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DRAFT

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

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Executive Summary

3 West of Scotland

3.1 Area overview

There is no area overview.

3.2 Cod in Subarea VIa

Cod in Division VIa is included in the EU long-term management plan for cod stocks and the fisheries exploiting those stocks (Council Regulation (EC) 1342/2008). A benchmark assessment was conducted in February 2012 (ICES 2012). In general the assessment carried out at the WG follows the procedure outlined in the stock annex developed at the benchmark. Any deviations are outlined in this section.

ICES advice applicable to 2012

ICES advises on the basis of the precautionary considerations that catches in 2012 should be reduced to the lowest possible level.

ICES advice applicable to 2013

ICES advises on the basis of the MSY approach that there should be no directed fisheries and that bycatch and discards should be minimized in 2013 and 2014.

3.2.1 General

Stock definition and the management unit

General information about the stock can be found in the stock annex and an overview of the fisheries West of Scotland can be found in Section 3.1. The assessment unit is VIa and up to 2011 a TAC was set for ICES Areas VIa and Vb (EC waters). For 2012 and 2013 the TAC has been set to zero but a bycatch of cod is allowed so long as it comprises no more than 1.5% of landings by live weight.

Management applicable to 2010 and 2011

The minimum landing size of cod in the human consumption fishery in this area is 35 cm. Before 2009 a TAC was set for ICES Subarea VI and EC and international waters of ICES Subareas XII and XIV and Subdivision Vb1. From 2009 a TAC advice for VIa and Vb1 has been given. As stated above from 2012 the TAC has been set to zero but a bycatch of cod is allowed so long as it comprises no more than 1.5% of landings by live weight.

TAC for 2012

Species: Cod *Gadus morhua*		Zone: VIa; EU and international waters of Vb east of 12° 00′ W (COD/5BE6A)
Belgium	0	
Germany	0	
France	0	
Ireland	0	
United Kingdom	0	
Union	0	
TAC	0 (1)	Analytical TAC

(1) By-catch of cod in the area covered by this TAC may be landed provided that it does not comprise more than 1,5 % of the live weight of the total catch retained on board per fishing trip.

TAC for 2013

Species: Cod *Gadus morhua*		Zone: VIa; EU and international waters of Vb east of 12° 00′ W (COD/5BE6A)
Belgium	0	
Germany	0	
France	0	
Ireland	0	
United Kingdom	0	
Union	0	
TAC	0 (1)	Analytical TAC

(1) By-catch of cod in the area covered by this TAC may be landed provided that it does not comprise more than 1,5 % of the live weight of the total catch retained on board per fishing trip.

Technical measures applicable to the West of Scotland, including those associated with the cod recovery plan in force up to 2008 (Council Regulation No. 423/2004), the cod long-term management plan in force from 2009 (Council Regulation No. 1342/2008) and the Restrictions on fishing for cod, haddock and whiting in ICES zone VI contained in Council Regulation No. 43/2009 (Annex III paragraph 6), are described in Section 3.1.

The fishery in 2012

Cod is believed to be no longer targeted in any fisheries now operating in ICES Division VIa. The table of official landings statistics is given in Table 3.2.1. This indicates landings in 2012 were comparable to those from 2011 (the most recent year with a non-zero TAC).

Because of restrictive TACs, seasonal/spatial closures of the fishery, and effort restrictions based on bycatch composition the probability of misreporting and underreporting of cod in the past is considered to have been high. From 2006 the Registration of Buyers and Sellers legislation in the UK and Sales Notes management system in Ireland are considered to have reduced to low levels under reporting (see Section 3.1) and Figure 3.2.1. Area misreporting, however, is believed to take place in the UK and

Figure 3.2.1 shows results compiled by Marine Scotland Compliance. Area misreporting will, for example, see cod caught in VIa declared as taken from the Faroe region or ICES Area IVa. The UK and Irish legislation introduced in 2006 is also believed responsible for a significant increase in discards starting in 2006. Since 2006, the estimated weight of discards has exceeded landings (Table 3.2.2), and discarding has taken place over an increased range of age groups (Tables 3.2.6 and 3.2.7 and Figure 3.2.7). Discard numbers as a percentage of catch numbers-at-age for 2006–2011 are shown in the following text table.

Numbers-at-age: discards as % of catch							
Age year	1	2	3	4	5	6	7+
2006	98.5%	32.7%	24.0%	7.2%	16.3%	32.7%	10.6%
2007	98.9%	88.8%	41.9%	50.7%	46.1%	43.8%	0.0%
2008	99.8%	74.8%	68.4%	3.2%	1.3%	0.0%	0.0%
2009	99.6%	92.3%	90.9%	61.5%	0.0%	70.8%	0.0%
2010	100%	90.0%	51.8%	16.0%	8.6%	0.0%	0.0%
2011	100%	96.3%	93.1%	55.3%	2.2%	11.7%	0.0%
2012	99.3%	98.5%	90.4%	49.5%	2.2%	0.0%	0.0%

The absolute level of numbers discarded from the 2005 year class at age 1 in 2006 through to age 4 in 2009 were high relative to the same age class from adjacent cohorts (Table 3.2.6). A similar pattern is evident for the 2008 year class, with numbers of fish discarded at age 3 exceptionally high in 2011. Increased discards from 2006 are considered an indicator of the combined effect of restrictive quotas and new regulation.

3.2.2 Data

An overview of the data provided and used by the WG is provided in the following text table.

	Commercial Data			
	Landings		Discards	
	No.-at-age	Wght.-at-age	No.-at-age	Wght.-at-age
Available	1978–2012 Ages : 1–7+	1978–2012 Ages : 1–7+	1978–2012 Ages : 1–7+	1978–2012 Ages : 1–7+
Used	1981–1990 & 2006–2012 Ages : 1–7+	1981–2012 Ages : 1–7+	1981–1990 & 2006–2012 Ages : 1–7+	1981–2012 Ages : 1–7+

From 1991 to 2005, only the age composition information from the commercial data was used in the assessment. This is because of concerns over bias in the data caused by under and misreporting. The problem of biased data is considered to have become serious from 1995. WKROUND 2012 considered that landings subject to underreporting could still be expected to yield unbiased age structures when sampled. Therefore, rather than exclude landings and discards data completely from 1995 it was agreed to make use of the information on age structure from the landings and discards data. The survey tuning data is then used to estimate a correction factor on overall catch amounts in these years. To allow the model an overlap with a period considered to contain relatively unbiased commercial data the 'age structure only' period was started in 1991.

	Survey Data					
	cpue at age					
	ScoGFS-WIBTS-Q1	ScoGFS-WIBTS-Q4	IreGFS	IRGFS-WIBTS-Q4	UKSGFS-WIBTS-Q1	UKSGFS-WIBTS-Q4
Available	1985–2010 Ages: 1–7	1996–2009 Ages: 0–8	1993–2002 Ages: 0–3	2003–2012 Ages: 0–3	2011–2013 Ages: 1–7	2011-2012 Ages: 0–8
Used	1985–2010 Ages: 1–6	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED

Catch data

Scottish landings (numbers-at-age) were adjusted for misreporting using

$$\hat{N}_{a,y} = N_{a,y} * \frac{L_y + Lm_y}{L_y},$$

where $N_{a,y}$ is number-at-age a in year y, Ly is total weight of landings in year y and Lm_y is weight of landings misreported in year y. The adjusted totals were then submitted to InterCatch and the aggregated international data compiled. In the 2012 assessment landings and discards were adjusted in the same way. It was agreed at this WG that only landings should be adjusted (on the grounds area misreporting would occur to avoid the need to discard). This is different to the dataset used at WGCSE 2012. Minor adjustments to the 2011 landings numbers were also adopted. The approach also differs to that adopted at WKROUND. There international landings totals were used for the Ly term and the adjustment for misreporting was applied to all fleets. WGCSE considered the change of approach necessary because the misreporting data only relates to Scottish fleet landings. Analysis of Irish fleet behaviour indicated little likelihood of misreporting and the type of fishing conducted by other fleets in the area was also thought to lead to little area misreporting.

Raised discard numbers-at-age are given in Table 3.2.6. Discard data including age distributions were supplied by Scotland and Ireland. Discard rates at age for the Irish fleet were considerably lower than those of the Scottish fleet. Observer coverage 2008–2012 (number of trips) is detailed in the following text table.

AREA VI					
	Scotland			Ireland	
Year	Other trawlers Mesh ≥100 mm	*Nephrops* trawlers Mesh 70–99 mm	Total	OTB trawlers	Total
2008	9	8	17		
2009	10	22	32		
2010	5	6	11	9	9
2011	8	7	15	?	?
2012	10	13	23		

Landings uploaded to InterCatch by metier and country are shown in Figure 3.2.2 and the discard totals of fleets sampled for discards in Figure 3.2.3. It can be seen that landings by Scottish trawl ≥100 mm dominate, and discards are also highest from this fleet. However the discard rate is higher from the Scottish trawl 70–100 mm fleet Figure 3.2.4. The Scottish trawl ≥100 mm fleet discard ratio was applied to all fleets with mesh ≥100 mm with no discard information on the grounds they are all offshore large mesh otter trawl fisheries. Trawl fleets with mesh 70–100 mm were assigned a discard ratio based on a weighted average of those from the Scottish *Nephrops* fleet and Irish vessels, (weighted by CATON). All other unsampled fleets received a weighted average discard rate derived from all sampled fleets. Age distributions were assigned within InterCatch on the same basis. The discard percentages assigned to fleets without discard estimates are shown in Figure 3.2.5. The final mix of numbers-at-age from sampled and unsampled landings and sampled and raised (unsampled) discards is given in Figure 3.2.6.

Annual mean weights-at-age in landings, discards and catch are given in Tables 3.2.5, 3.2.7 and 3.2.9. In years where landings and discards data are not used fully, weights-at-age for the stock are still required to obtain biomass estimates and so the full series of stock weights are used. Figure 3.2.7 shows the mean weights-at-age in the landings and discards. The figure indicates an increase in mean weight of landed fish at ages 2 and 3 in recent years. Mean weight-at-age of discarded fish at age 2 has increased in recent years. These results combined with the high discarding rates of recent years suggest increasing levels of high grading. By contrast there are indications mean weight-at-age at ages 5 and 6 are declining. An investigation of the mean weight-at-age of this stock could be valuable in advance of the next benchmark of this stock.

A plot of log catch curve gradient derived from commercial catch data (landings plus discards) is shown in Figure 3.2.8. The trend in gradients over time appear fairly consistent between the age ranges considered (2–5, 2–4 and 3–5) except for the most recent cohorts. The implication from the figure is of an increasing rate of mortality for cohorts spawned during the 1990s, a considerable reduction in mortality for the 2002, 2003 and 2004 cohorts, but a return to a higher mortality rate for the cohorts from 2005 onwards. The final value (estimated over age range 2–5) is comparable to those for cohorts from the start of the time-series through to the early 1990s.

Survey data

All available survey data are given in Table 3.2.3, with the data used in the assessment highlighted in bold. Survey descriptions are given in the stock annex.

For 2011 the rig and sampling design of the ScoGFS-WIBTS-Q1 survey was changed. A new groundgear was introduced broadly modelled around the rig used by Ireland for the IRGFS-WIBTS-Q4. The move to a more robust gear also allowed a move to a random stratified survey (which is again consistent with the IRGFS-WIBTS-Q4). It is hoped the greater compatibility between Scottish and Irish surveys will facilitate both being used to assess gadoids west of Scotland. WGCSE 2011 concluded the changes constituted a new abundance series. The ScoGFS-WIBTS-Q1 survey data therefore finishes in 2010. There are insufficient years of data from the new survey UKSGFS-WIBTS-Q1 to be used in the current assessment. The same changes to groundgear and survey design occurred for the ScoGFS-WIBTS-Q4 and the final year of data from the ScoGFS-WIBTS-Q4 series is 2009 (the survey did not take place in 2010).

The cpue by survey haul from 2010–2012 for the IRGFS-WIBTS-Q4 survey are shown in Figure 3.2.9, from 2011–2013 for the UKSGFS-WIBTS-Q1 survey (Figure 3.2.10) and from 2011–2012 for the UKSGFS-WIBTS-Q4 (Figure 3.2.11). The data from the Scottish surveys show cpue for ages 1+, that from the Irish survey a proxy for fish at ages 1+ (fish at lengths >23 cm).

All surveys show mostly zero returns over latitudes between 56 degrees N and 58.5 degrees N (although the IRGFS-WIBTS-Q4 survey only extends to 56.5 degrees N). This pattern has been consistent in surveys since 2007. The Scottish surveys have strongest cpue north of 58.5 degrees N. The Q1 surveys catch cod in the Clyde region and the Q4 surveys show relatively high cpue just north of Northern Ireland. From the IRGFS-WIBTS-Q4 survey there is also evidence of stronger abundance along the shelf edge in the southern part of Division VIa.

Figures 3.2.12 and 3.2.13 show the log mean standardised indices from the ScoGFS-WIBTS-Q1 survey by year and by cohort respectively. Figure 3.2.12 does not exhibit any exceptional year effects. Figure 3.2.13 shows the survey is able to track cohorts to some extent at younger ages.

Figure 3.2.14 shows log catch curves for the ScoGFS-WIBTS-Q1 survey. It shows a strong "hook" at the younger ages, with abundance at age two often higher than at age one. The index of the 2005 and 2008 year classes also increased from age 2 to age 3 and the survey's ability to track recent cohorts seems poor relative to the 1990s and early 2000s.

A plot of log catch curve gradient derived from the ScoGFS-WIBTS-Q1 data is shown in Figure 3.2.15. For cohorts after 1995 index values of zero have sometimes been recorded at age five. For the age ranges considered (2–5, 2–4 and 3–5) this means the slope has not always been fitted to data from all the ages indicated. There is little consistancy in results between age ranges chosen and this appears to worsen after the 1995 or 1996 cohort. The series for ages 2–5 seems more stable than the others in this later period although large variations in the final years occur over all age ranges. There is no evidence of a long-term trend in catch curve gradient. In contrast to the commercial data the result for the 2005 cohort shows a large decline in mortality rate on this cohort.

Figures 3.2.16 and 3.2.17 show the log mean standardised indices and log catch curves from the IRGFS-WIBTS-Q4. The log mean standardised indices plot suggests only ages 1 and 2 are tracked successfully down cohorts although the log catch curves appear reasonable over ages 1 to 3. There is no indication of large year classes recruited since 2010 (the last year of survey input to the assessment model). Figure 3.2.18 shows log catch curves from the UKSGFS-WIBTS-Q1. There are only three years of data and little indication to date of successful tracking of cohorts.

Overall, information on mortality trends from all survey-series (including the ScoGFS-WIBTS-Q1) appears weak.

Biological data

Values for natural mortality-at-age (previously 0.2 for all ages and years) have changed based on a new approach agreed at WKROUND 2012. Natural mortality-at-age (M) is assumed weight-dependent after Lorenzen (1996) with mortality assumed to be time invariant, M is calculated by finding the time-series means for stock weights-at-age before applying the Lorenzen parameters, i.e.

$$M_a = 3\overline{W}_a^{-0.29}$$

Where *Ma* is natural mortality-at-age *a*, $\overline{Wa}$ is the time averaged stock weight-at-age *a* (in grammes) and the numbers are the Lorenzen parameters for fish in natural ecosystems. Figure 3.2.19 shows the resulting M at age values used in the assessment and the values calculated in each year individually for comparison. The time averaged M at age values from the 2012 and this year's assessment are shown below.

Natural mortality (M) at age:

YEAR/AGE	1	2	3	4	5	6	7+
2012	0.528	0.386	0.305	0.261	0.236	0.222	0.210
2013	0.531	0.386	0.306	0.261	0.236	0.222	0.210

Proportion of fish mature-at-age are unchanged from the last meeting:

Age	1	2	3	4+
Proportion mature-at-age	0.0	0.52	0.86	1.0

The proportion of F and M acting before spawning is set to zero.

A study by the sea mammal research unit (SMRU) on seal predation has indicated that seal predation on cod probably constitutes significant natural mortality. A version of the TSA assessment model incorporating a seal predation model element was developed for WKROUND 2012. The specification of the seal feeding model is provided in the stock annex. Because only two years of seal consumption data are available WKROUND considered estimation of the seal feeding parameters likely to be highly uncertain and inclusion of seal predation in the model to be potentially adding little other than noise to the assessment. WKROUND 2012 concluded the final assessment of VIa cod should not include seal predation estimation but that a supplementary run including the seal feeding model should be run to test the sensitivity of the assessment to model specification. The latest estimates of grey seal population were taken from Thomas, 2011.

3.2.3 Historical stock development

This assessment uses a TSA run as outlined in the stock annex.

Model settings and input parameter settings for the final run are given in Table 3.2.10 and final parameter estimates from the TSA run are given in Table 3.2.11. Standardised prediction errors at age from the update assessment run (which can be interpreted as residuals) are shown in Figure 3.2.20 (landings), Figure 3.2.21 (discards) and Figure 3.2.22 (ScoGFS-WIBTS-Q1). Errors within ±2 are considered reasonable. A large prediction error is observed for discards at age 3 in 2011. Such a result can indicate a large departure from previous values because of sampling error, in which case that datapoint can be down-weighted. In this instance, however, a stronger 2008 year class combined with very low TAC provides supporting evidence for the rise in discards at age 3 in 2011 and WGCSE_12 agreed the datapoint should not be down-weighted.

Table 3.2.12 gives the TSA population numbers-at-age and Table 3.2.13 gives their associated standard errors. Estimated F at age is given in Table 3.2.14 and standard errors on the log of this mortality are given in Table 3.2.15. Full summary output is given in Table 3.2.16. A summary plot for this run is shown in Figure 3.2.23.

From Figure 3.2.23 there is a noticeable long-term downward trend in recruitment although the values for the 2005 and 2008 year classes are the highest since the 2001 year class. SSB falls to a time-series low in 2007. The estimates for 2012 and 2013 are the highest since 2006 but are little different to 2007 and the value is still well below B_{lim}. Mean F is above F_{lim}.

Retrospectives for the final assessment run are shown in Figure 3.2.24. This figure also shows lines at ±2 se (approximate 95% confidence limits) around the run using all years of data. Retrospective bias is small with respect to SSB although the run ending in 2003 has values above the upper confidence limit in its final two years. The runs ending in 2002 and 2003 also have final values for recruitment above the upper confidence limit but runs finishing in more recent years have trajectories for SSB and recruitment that remain close to that of the full assessment. For mean F all results sit within the confidence limits of this year's run but the confidence interval for mean F is wide, reflecting uncertainty in estimation of mean F when that estimation is based to a large extent on survey data (1991–2005) or the age structure of discards data (2006 onwards). Even so the figure also shows that the lower confidence limit stays above F_{lim} for the majority of years from the mid-1990s.

The TSA estimated stock–recruit relationship is shown in Figure 3.2.25. It includes the datapoint of the 1986 year class which from inspection of Figure 3.2.23 appears an outlier. The relatively high strength of the 2005 year class (considering the size of SSB) can also be seen.

The precautionary approach plot for this stock is given in Figure 3.2.26. It shows clearly how the stock has moved and remained in the zone indicating reduced reproductive capacity and unsustainable removals.

Comparison with last year's assessment

Recent assessments (to 2011) removed commercial data from 1995 onwards. The 2011 assessment was not accepted (because of change in survey indices-series) but assessments for several years showed a clear disparity between the estimated removals compared to the supplied commercial catch data. The 2012 assessment re-introduced landings and discards data from 2006 onwards. It adjusted Scottish landings and discards for estimates of misreporting. This year landings were adjusted for misreporting but discards were not on the assumption landings are most likely area misreported in order to avoid discards. Figure 3.2.27 shows the ratio between the estimated removals and observed catch from a) the 2010 assessment, b) 2012 assessment and c) this year's assessment. The pattern of increasing disparity between modelled removals and submitted data up to the mid-2000s is the same in all cases. Using the approach adopted this year the ratio between observed catch (reported and misreported landings plus reported discards) and model estimated removals are within 2 s.e. of unity for all years from 2006. When discards were adjusted for misreporting (Figure 3.2.27b) input catch was significantly greater than modelled catch.

Figure 3.2.28 shows a comparison of SSB, recruitment-at-age one and mean F estimates produced by final run assessments between this year's assessment and the previous four assessments. Compared to the 2012 assessment SSB in 2011 has been revised down from 3865 t to 2217 t while the estimate of mean F has increased from 0.95 to 1.02. The estimate of recruitment in 2011 is revised down from 3.29 million to 1.04 million. The estimate of SSB in 2012 from this year's assessment is 1835 t with an s.e. of 332 t. The short-term forecast from the 2012 assessment predicted SSB in 2012 at 3710 t or 71% more than the current estimate plus 2 s.e.

Comparison with supplementary (seal predation) assessment

Figure 3.2.29 shows the summary plot of the assessment run including seal predation. Visual inspection shows the trajectories of the metrics to be very similar to those from the final assessment. For comparison to the final assessment and that from 2012 the estimates of SSB in 2011 and 2012 from the model including seal predation are 3665 t and 2676 t.

3.2.4 Short-term stock projections

A short-term projection was made using WGFRANSW following the procedure outlined in the stock annex.

Estimating recruiting year-class abundance

The recruitment values (000 fish) used in the forecast are given in the following table:

Year	TSA	STF
2013	1739	1739
2014		2393 (GM 02–11)
2015		2393 (GM 02–11)

Three-year means of the F estimates were taken to represent *status quo* mortality. The cod long-term management plan introduced in 2009 (Council Regulation No. 1342/2008, article 6, paragraph 4), directs that forecasts "assume that in the year prior to the year of application of the TAC the stock is fished with an adjustment in fishing mortality equal to the reduction in maximum allowable fishing effort that applies in that year." At WGCSE 2010 and 2011 the F value was reduced by 25% for the intermediate year to reflect reductions in maximum allowed fishing effort (kWdays) or incorporation of vessels in schemes designed to achieve a 25% reduction in mortality. In 2012 and 2013 this was again done for 'Outlook table *A* Basis: Management plan assumption' where F in the advice year was again reduced by 25%. However *status quo* fishing mortality was used in the majority of projections. This is because analysis by STECF show that in past years effort (kWdays) for those fleet categories controlled under the cod management plan have reduced effort by amounts less than the annual reductions in overall effort allowance, (STECF 2011). There are also exemptions and special conditions allowing 'buy back' of fishing effort. The discard data made available to ICES and the assessment also indicate little or no trend in fishing mortality.

Input data to the short-term projection are shown in Table 3.2.17. Management options from the forecast are shown in Table 3.2.18 and detailed tables of catch numbers-at-age are shown in Table 3.2.19.

A plot of the short-term forecast is shown in Figure 3.2.30. Results from sensitivity analysis from this forecast are shown in Figure 3.2.31 and probability profiles in Figure 3.2.32.

From Table 3.2.18 it can be seen that an assumption of zero removals in 2014 gives an estimate of SSB in 2015 below B_{lim}.

3.2.5 MSY Explorations

Prior to 2010 ICES defined the following PA reference points:

Reference point	Technical basis
B_{pa} = 22 000 t	Previously set at 25 000 t, which was considered a level at which good recruitment is probable. This has since been reduced to 22 000 t due to an extended period of stock decline.
B_{lim} = 14 000 t	Smoothed estimate of B_{loss} (as estimated in 1998).
F_{pa} = 0.6	Consistent with B_{pa}.
F_{lim} = 0.8	F values above 0.8 led to stock decline in the early 1980s.

WKROUND 2012 concluded these reference points were still valid.

In 2010 WGCSE derived an F_{MSY} estimate using the srmsymc package. Mortalities from removals in the range 0.17 to 0.33 were concluded as consistent with F_{MSY}. A description of the runs performed is given in the stock annex. The current level of F is higher than the median F_{crash} value for all three stock–recruit relationships tested.

3.2.6 Management plans

Cod in VIa is included in Council Regulation No. 1342/2008 establishing a long-term plan for cod stocks and fisheries exploiting those stocks. The plan and its evaluation by ICES are discussed in Section 9.

3.2.7 Uncertainties and bias in assessment and forecast

Landings

Since the early 1990s the most significant problem with assessment of this stock is with commercial data. Incorrect reporting of landings -species, quantity and management area- is known to have occurred and directly affects the perception of the stock. Scottish landings (from 2006) are adjusted by estimates of misreporting. The misreporting estimates will have uncertainty associated with them.

Discards

The current assessment model removes discard information for the same years for which landings data is removed (although age composition data are included from both). Catch of this stock has been dominated by discards in recent years. Discard information is imprecise compared to landings data because of lower sampling coverage.

Surveys

The survey used for this assessment changed vessel and tow duration in 1999. Although a correction has been made based on comparative tows, there will be an additional variance associated with this correction factor which will affect the survey index. The spatial aggregation of the ScoGFS-WIBTS-Q1 survey (weighted arithmetic mean) can result in hauls catching large numbers of fish having a strong influence on index values (as was the case in 2008). This in turn has added noise to the indices leading to high prediction errors from TSA (residuals from other models) and downweighting of data points.

Biological factors

Assumptions on mean weight-at-length and mean maturity-at-age have remained unchanged for a long period. However, biological responses of cod in VIa as a localised species to high exploitation and low population numbers are so far unknown to the working group.

The contribution of seal predation to total cod mortality is likely to be significant and this may impair the ability of the cod stock to recover but data is limited. New weight dependent natural mortalities-at-age have been adopted to better take account of higher natural mortality at younger ages but it is not certain these values fully accommodate the possible large source of natural mortality from seals. Regular surveys giving estimates of consumption by seals would give greater confidence in natural mortality estimates.

Forecasts

Short-term forecasts are sensitive to the estimation of *status quo* mean fishing mortality. The WG considers mortality estimates arising from an assessment heavily based on discard data are poorly estimated and therefore noisy.

3.2.8 Recommendation for next Benchmark

problem	solution	expertise necessary[1]	suggested time
No survey data after 2010.	Inclusion of UKS-WIBTS-Q1 survey.	Scientists from MSS	This survey started in 2011. It is uncertain how many years of data will be sufficient before this survey can make a useful contribution to the assessment. In area VIa the cod index (from the previous survey design) was less precise than that for haddock. The haddock benchmark in 2014 will decide whether the new indices for that species are ready for use after four years of data. If so inclusion of the new indices for cod in the VIa cod assessment could be considered in 2015. If not then 2015 is probably too soon.
No survey data after 2010.	Combination of UKS-WIBTS-Q4 and IR-WIBTS-Q4	Scientists from MSS and MI	The new UKS-WIBTS-Q4 survey was conceived to be compatible for merging with the IR-WIBTS-Q4. This can be explored at a WGISDAA meeting in advance of the next cod VIa benchmark.
Possible trend in mean weights-at-age	Test whether smoothed trend departs from long-term average (F test)	Scientists from MSS	Close to next benchmark to allow use of as many years of data as possible.
Misreporting of landings; does not take account of fleet components.	Further analysis of misreporting data supplied by Scotland.	Scientists from MSS	?

[1] MSS = Marine Scotland Science; MI = Marine Institute Ireland.

3.2.9 Management considerations

The fishery is managed by a combination of landings limits, area closures, technical measures and effort restrictions. These do not seem to have been effective in controlling catches. Despite considerable reductions in fishing effort over the past decade, the stock structure is still truncated with few older fish present.

The fishing opportunities regulation has explicitly made the stock a bycatch species from 2012. Allowing landings up to a given percentage of the live weight of the total catch can cause a perverse incentive for vessels to increase catches of other species and does not inhibit the catch of cod.

Although the UK 'Buyers and Sellers' and Irish 'Sales Notes' legislation is considered to have reduced underreporting from 2006, discard data show increased discards at ages one and two and a change in discard practices such that fish are discarded at older ages. In 2008, Scotland introduced a voluntary programme known as "Conservation Credits", which involved seasonal closures, real-time closures (RTCs) and various selective gear options. This was designed to reduce mortality and discarding of cod. The number of RTCs west of Scotland and the % of all RTCs this represents are shown in the text table below.

year	2008	2009	2010	2011	2012
No RTC	4	17	27	4[a]	9
% of total	27%	12%	10%	2%	5%

[a] Three further RTCs straddled ICES Divisions VIa and IVa.

RTCs are determined by lpue, based on fine scale VMS data and daily logbook records and also by onboard inspections. The low number of RTCs west of Scotland results from few instances of high lpue in the area. Estimates of continuing high discard rates in Division VIa indicate the scheme has not been as effective as in the North Sea. Figure 3.2.33 highlights the problem from discards. In recent years mortality from landings is estimated to have decreased rapidly but over the same period mortality from discards has increased just as rapidly. This explains the relatively constant overall fishing mortality seen in Figure 3.2.23. It also needs to be remembered that mortality estimates arising from an assessment heavily based on survey and/or discard data are poorly estimated. In contrast, historical trends in spawning biomass and recruitment appear to be robust measures of stock dynamics.

Estimates of misreporting from Marine Scotland Compliance give area misreporting estimates considerably in excess of recent TACs. The assessment indicates the 2005 and 2008 year classes to be the biggest within the last decade. Both discards at higher ages and area misreporting reduce the potential for these year classes to contribute to increases in SSB. It is important good observer coverage is conducted in Division VIa to record discard trends in future.

Cod is taken in mixed demersal fisheries, and in Division VIa is now regarded as a bycatch species. To greatly reduce cod catch would likely result in having to greatly reduce harvesting of other stocks such as haddock, whiting and anglerfish. It is also important the bycatch from the *Nephrops* fleet is closely monitored (including discard observations). The STECF report (STECF 11) assessing effort and catch of fishing regimes subject to fishing effort limitations shows trawl gear vessels targeting finfish (TR1 gear) to take roughly 90–95% of cod catch and the *Nephrops* fleet (TR2 gear) to take 5–10% of cod catch in ICES Area VIa.

The EU cod long-term management plan, (Council Regulation No. 1342/2008) is complemented by a system of fishing effort limitation and in waters west of Scotland landings composition restrictions. For vessels of length 15 m and over operating west of a management line shown in Figure 3.2.34 effort is restricted to a lesser degree. Figure 3.2.34 also shows locations of fishing activity (2009 data) using TR1 gear (from VMS data) linked to cod landings. It can be seen a large proportion of the effort falls outside of the cod management area. In 2012 60% of cod landings from VIa by Scottish vessels came from west of the line. The landings composition restrictions do not restrict discards.

A report by the Sea Mammal Research unit (Hammond and Harris, 2006) gives estimates of cod consumed by grey seals to the west of Scotland. Although highly uncertain the estimates suggest predation mortality on cod is significant and this may impair the ability of the cod stock to recover, but data are limited. New weight dependent natural mortalities-at-age have been adopted to better take account of higher natural mortality at younger ages but it is not certain these values fully accommodate the possible large source of natural mortality from seals. Regular surveys giving estimates of consumption by seals would give greater confidence in natural mortality estimates.

Sources

Hammond, P. S., and Harris, R. N. 2006. Grey seal diet composition and prey consumption off western Scotland and Shetland. Final report to Scottish Executive Environment and Rural Affairs Department and Scottish Natural Heritage.

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Lorenzen K. 1996. The relationship between body weight and natural mortality in juvenile and adult fish: a comparison of natural ecosystems and aquaculture. Journal of Fish Biology 49, 627–647.

STECF. 2011. Scientific, Technical and Economic Committee for Fisheries. Evaluation of Fishing Effort Regimes Regarding Annexes IIA, IIB and IIC of TAC & Quota Regulations, Celtic Sea and Bay of Biscay (STECF-11–13).

Thomas, L. 2011. Estimating the size of the UK grey seal population between 1984 and 2010. SCOS Briefing Paper 11/02.

Table 3.2.1. Cod in Division VIa. Official catch statistics in 1985–2009, as reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Belgium	48	88	33	44	28	-	6	-	22	1	2	+	11	1	+	+	2	+
Denmark	-	-	4	1	3	2	2	3	2	+	4	2	-	-	+	-	-	-
Faroe Islands	-	-	-	11	26	-	-	-	-	-	-	-	-	-	-	-	-	-
France	7,411	5,096	5,044	7,669	3,640	2,220	2,503	1,957	3,047	2,488	2,533	2,253	956	714*	842*	236	391	208
Germany	66	53	12	25	281	586	60	5	94	100	18	63	5	6	8	6	4	+
Ireland	2,564	1,704	2,442	2,551	1,642	1,200	761	761	645	825	1,054	1,286	708	478	223	357	319	210
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-
Norway	204	174	77	186	207	150	40	171	72	51	61	137	36	36	79	114*	40*	88
Spain	28	-	-	-	85	-	-	-	-	-	16	+	6	42	45	14	3	11
UK (E., W., N.I.)	260	160	444	230	278	230	511	577	524	419	450	457	779	474	381	280	138	195
UK (Scotland)	8,032	4,251	11,143	8,465	9,236	7,389	6,751	5,543	6,069	5,247	5,522	5,382	4,489	3,919	2,711	2,057	1,544	1,519
UK																		
Total landings	18,613	11,526	19,199	19,182	15,426	11,777	10,634	9,017	10,475	9,131	9,660	9,580	6,992	5,671	4,289	2,767	2,439	2,231

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium								0	0	0
Denmark										
Faroe Islands		2	0	0.8	12	1		0.2	0	
France	172	91	107	100.7	92	82	74	60.3	46	4.21
Germany	+			2	2	1	0	0	0	0.04
Ireland	120	34	27.9	18	70	58.2	24.4	48.7	41.3	17.8
Netherlands	-						0		0	0
Norway	45	10	17	30	30	65	18	20.7	8.3	56.2
Spain	3									
UK (E., W., N.I.)	79	46	25		21	6	14			
UK (Scotland)	879	413	243		260	232				
UK				332.1			104	118.6	110	137.2
Total landings	1,298	596	419.9	483.6	487	445.2	234.4	248.5	205.6	215.5

*** Preliminary.**

Table 3.2.2. Cod in Division VIa. Landings, discards and catch (tonnes) estimates 1978–2012, as used by the WG. Values are totals for fish over the ages 1 to 7+. Values in brackets were used in 2011 assessment.

YEAR	LANDINGS		DISCARDS		CATCH	
	Unadjusted	**Adjusted for misreporting**	**Unadjusted**	**Adjusted for misreporting**	**Unadjusted**	**Adjusted for misreporting**
1978	13521		161		13682	
1979	16087		39		16126	
1980	17879		423		18302	
1981	23866		303		24169	
1982	21510		571		22081	
1983	21305		197		21502	
1984	21271		329		21600	
1985	18608		963		19571	
1986	11820		263		12083	
1987	18975		2388		21363	
1988	20413		368		20781	
1989	17171		2076		19247	
1990	12176		571		12747	
1991	10926		622		11548	
1992	9086		1779		10865	
1993	10315		139		10454	
1994	8929		661		9590	
1995	9438		141		9579	
1996	9425		63		9488	
1997	7033		499		7532	
1998	5714		538		6252	
1999	4201		69		4270	
2000	2977		821		3798	
2001	2347		92		2439	
2002	2242		480		2722	
2003	1241		34		1275	
2004	540		72		612	
2005	479		41		520	
2006	463	488	464	(504)	927	952(992)
2007	525	595	1879	(2363)	2404	2474(2958)
2008	451	682	695	(1363)	1146	1377(2045)
2009	222	408	945	(2538)	1167	1353(2946)
2010	239	559	785	(2881)	1024	1344(3440)
2011	206	454	1671	(5840)	1877	2124(6363)
2012	160	466	1166		1326	1632

Values for landings in 2011 adjusted from last year.

Table 3.2.3. Cod in Division VIa. Survey data made available to the WG. Data used in update run are highlighted in bold. For ScoGFS-WIBTS-Q1, numbers are standardised to catch-rate per 10 hours. Scottish surveys from 2011 were conducted according to a new design and using a new groundgear.

ScoGFS- WIBTS- Q1: Scottish west coast groundfish survey

1985	**2010**							
1	1	0	0.25					
1	7							
10	**1.5**	**23.7**	**8.6**	**13.6**	**3.9**	**2.5**	1.2	1985
10	**1.5**	**6.9**	**26.8**	**5.6**	**7.3**	**2.5**	1.9	1986
10	**57.4**	**16.2**	**15.3**	**22.8**	**3.0**	**2.8**	0.0	1987
10	**0.0**	**64.9**	**14.2**	**3.4**	**2.1**	**0.7**	0.2	1988
10	**4.5**	**7.2**	**45.1**	**8.6**	**1.9**	**0.5**	0.8	1989
10	**2.0**	**24.6**	**4.1**	**14.7**	**4.2**	**1.6**	0.8	1990
10	**4.8**	**5.4**	**17.4**	**5.2**	**13.4**	**2.8**	0.5	1991
10	**7.3**	**11.5**	**5.4**	**7.6**	**3.4**	**2.3**	0.5	1992
10	**1.7**	**38.2**	**12.7**	**1.7**	**1.4**	**1.1**	0.0	1993
10	**13.6**	**14.7**	**25.1**	**5.8**	**1.0**	**0.0**	0.0	1994
10	**6.4**	**23.8**	**14.0**	**16.5**	**1.2**	**1.9**	0.7	1995
10	**2.8**	**20.9**	**24.1**	**4.1**	**2.8**	**1.3**	0.0	1996
10	**11.1**	**7.7**	**11.6**	**7.9**	**4.2**	**4.7**	1.0	1997
10	**2.8**	**30.9**	**5.3**	**8.7**	**3.7**	**0.6**	2.0	1998
10	**1.5**	**8.2**	**8.2**	**1.4**	**3.2**	**0.5**	0.5	1999
10	**13.3**	**5.4**	**6.9**	**1.3**	**0.0**	**0.4**	0.0	2000
10	**2.7**	**18.4**	**5.7**	**13.2**	**19.5**	**1.1**	1.6	2001
10	**5.3**	**4.3**	**10.6**	**2.6**	**0.5**	**3.0**	0.0	2002
10	**2.7**	**16.7**	**2.0**	**4.7**	**1.8**	**0.7**	0.4	2003
10	**5.7**	**3.0**	**5.6**	**2.3**	**1.7**	**0.0**	0.0	2004
10	**1.3**	**1.5**	**1.2**	**0**	**0**	**0.4**	0	2005
10	**2.2**	**1.9**	**1.1**	**0.3**	**0**	**0**	0.3	2006
10	**2.1**	**18.8**	**3.4**	**1.2**	**0**	**0.6**	0	2007
10	**0.8**	**2.1**	**44.2**	**6.3**	**0.8**	**0**	0	2008
10	**1.8**	**2.6**	**2.3**	**0.4**	**0**	**0**	0	2009
10	**4.6**	**16.2**	**3.7**	**1.0**	**0.7**	**0**	0	2010

Table 3.2.3. cont. Cod in Division VIa. Survey data made available to the WG. Data used in update run are highlighted in bold. UKSGFS-WIBTS-Q1; numbers are standardised to catch-rate per ten hours.

2011	2013							
1	1	0	0.25					
1	7							
10	0.52	32.95	21.07	0.93	0.98	0.74	0	2011
10	13.99	27.3	22.72	4.58	3.50	2.20	4.20	2012
10	20.03	40.26	26.38	36.95	7.76	0.3	0	2013

Table 3.2.3. cont. Cod in Division VIa. Survey data made available to the WG. For IreGFS, effort is given as minutes towed, numbers are in units.

IreGFS	Irish groundfish survey			
1993	**2002**			
1	1	0.75	0.79	
0	3			
1849	0.0	312.0	49.0	13.0
1610	20.0	999.0	56.0	13.0
1826	78.0	169.0	142.0	69.0
1765	0.0	214.0	89.0	18.0
1581	6.0	565.0	31.0	10.0
1639	0.0	83.0	53.0	6.0
1564	0.0	24.0	14.0	3.0
1556	0.0	124.0	4.0	1.0
755	3.0	82.0	28.0	2.0
798	0.0	50.6	2.2	1.2

Table 3.2.3. cont. Cod in Division VIa. Survey data made available to the WG. For ScoGFS-WIBTS-Q4, numbers are standardised to catch-rate per 10 hours. "+" indicates value less than 0.5 after standardising. No survey was conducted in 2010. Scottish surveys from 2011 were conducted according to a new design and using a new groundgear.

ScoGFS-WIBTS-Q4: Quarter 4 Scottish ground fish survey

1996	2010									
1	1	0.75	1.00							
0	8									
10	0	1	14	5	3	1	0	0	0	1996
10	1	11	2	1	1	1	0	0	0	1997
10	+	15	9	1	0	0	0	0	0	1998
10	2	4	6	9	1	0	0	0	0	1999
10	0	16	3	0	0	0	0	0	0	2000
10	1	2	9	1	1	0	0	0	0	2001
10	1	10	3	7	1	0	0	0	0	2002
10	1	2	11	3	1	0	0	0	0	2003
10	0	5	4	0	+	0	0	0	0	2004
10	+	2	3	0	1	+	0	0	0	2005
10	0	17	6	1	1	0	0	0	0	2006
10	0	12.0	20.0	1.3	0.6	0	0.3	0	0	2007
10	2	8	5	7	1	0	0	0	0	2008
10	2	14	4	1	1	+	0	0	0	2009
10	na	na	na	na	na	na	na	na	na	2010

Table 3.2.3. cont. Cod in Division VIa. Survey data made available to the WG. Data used in update run are highlighted in bold. UKSGFS-WIBTS-Q4; numbers are standardised to catch-rate per ten hours.

2011	2012									
1	1	0.75	1.0							
0	8									
10	0.60	10.03	31.23	10.88	0.93	1.70	2.38	0	0	2011
10	0.75	19.78	7.12	15.43	13.60	1.02	0.68	0.34	0	2012

Table 3.2.3. cont. Cod in Division VIa. Survey data made available to the WG. For IRGFS-WIBTS-Q4, effort is given as minutes towed, numbers are in units.

IRGFS-WIBTS-Q4 Irish West Coast groundfish

2003	2012					
1	1	0.79	0.92			
0	4					
1127	0	10	11	0	0	2003
1200	0	24	10	1	0	2004
960	63	13	7	0	2	2005
1510	0	95	12	0	0	2006
1173	0	161	12	0	1	2007
1135	0	23	24	4	0	2008
1378	1	75	4	5	0	2009
1291	0	70	31	4	3	2010
1287	1	26	26	4	0	2011
1230	0	74	7	3	0	2012

Table 3.2.4. Cod in Division VIa. Landings at age (thousands).

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1966	384	2883	629	999	825	78	52
1967	261	2571	3705	670	442	264	67
1968	333	1364	3289	1838	215	171	151
1969	64	1974	1332	1943	759	149	170
1970	256	1176	1638	571	476	153	74
1971	254	1903	550	841	240	201	95
1972	735	2891	1591	409	501	108	110
1973	1015	1524	1442	583	161	193	104
1974	843	2318	778	1068	288	72	102
1975	1207	1898	1187	533	325	90	35
1976	970	3682	1467	638	256	215	56
1977	1265	1314	1639	624	269	87	79
1978	723	1761	999	695	286	97	75
1979	929	1612	2125	682	342	134	69
1980	1195	3294	2001	796	191	77	37
1981	461	7016	3220	904	182	29	20
1982	1827	1673	3206	1189	367	111	33
1983	2335	4515	1118	1400	468	148	60
1984	2143	2360	2564	448	555	185	59
1985	1355	5069	1269	1091	140	167	79
1986	792	1486	2055	411	191	40	30
1987	7873	4837	988	905	137	56	26
1988	1008	8336	2193	278	210	39	20
1989	2017	1082	3858	709	113	69	33
1990	513	4024	432	924	170	23	11
1991	1518	1728	1805	188	266	70	23
1992	1407	1868	575	720	69	58	24
1993	328	3596	1050	131	183	24	36
1994	942	1207	1545	280	56	51	20
1995	753	2750	700	630	70	15	11
1996	341	2331	1210	247	204	31	13
1997	1414	1067	989	281	66	62	7
1998	310	3318	293	174	57	16	9
1999	132	884	1047	64	48	24	9
2000	765	532	211	231	15	12	13
2001	96	1241	155	63	52	3	4
2002	337	340	522	41	13	14	4
2003	62	516	85	107	6	2	1
2004	44	92	85	11	26	2	1
2005	31	121	43	37	7	6	0.5
2006[1]	18	96	76	22	13	2	1

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
2007[1]	6	187	70	37	3	4	3
2008[1]	0.1	34	130	25	16	1	3
2009[1]	2	12	11	59	8	2	0.3
2010[1]	0	43	61	38	32	1	0.4
2011[1]	0	11	40	34	12	13	2
2012[1]	3	1	41	51	5	4	5

[1] Values include adjustment for misreporting.

Values for 2011 adjusted from last year.

Table 3.2.5. Cod in Division VIa. Mean weight-at-age in landings (kg).

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1966	0.730	1.466	3.474	5.240	4.868	8.711	9.250
1967	0.681	1.470	2.906	4.560	6.116	7.394	8.058
1968	0.745	1.776	2.766	4.721	6.304	7.510	8.278
1969	0.860	1.284	2.821	4.259	6.169	6.374	7.928
1970	0.595	0.955	2.533	4.678	6.016	7.120	8.190
1971	0.674	1.046	2.536	4.167	6.023	6.835	8.100
1972	0.609	1.192	2.586	4.417	6.226	7.585	8.538
1973	0.597	1.181	2.784	4.601	5.625	7.049	8.611
1974	0.611	1.103	2.834	4.750	6.144	7.729	9.339
1975	0.603	1.369	3.078	5.302	6.846	8.572	10.328
1976	0.616	1.397	3.161	5.005	6.290	8.017	9.001
1977	0.629	1.160	2.605	4.715	6.269	7.525	9.511
1978	0.630	1.373	3.389	5.262	7.096	8.686	9.857
1979	0.693	1.373	2.828	4.853	6.433	7.784	9.636
1980	0.624	1.375	3.002	5.277	7.422	8.251	9.331
1981	0.550	1.166	2.839	4.923	7.518	9.314	10.328
1982	0.692	1.468	2.737	4.749	6.113	7.227	9.856
1983	0.583	1.265	2.995	4.398	6.305	8.084	9.744
1984	0.735	1.402	3.168	5.375	6.601	8.606	10.350
1985	0.628	1.183	2.597	4.892	6.872	8.344	9.766
1986	0.710	1.211	2.785	4.655	6.336	8.283	9.441
1987	0.531	1.312	2.783	4.574	6.161	7.989	10.062
1988	0.806	1.182	2.886	5.145	6.993	8.204	9.803
1989	0.704	1.298	2.425	4.737	7.027	7.520	9.594
1990	0.613	1.275	2.815	4.314	7.021	9.027	11.671
1991	0.640	1.095	2.618	4.346	6.475	8.134	10.076
1992	0.686	1.293	2.607	4.268	6.190	7.844	10.598
1993	0.775	1.316	2.940	4.646	6.244	7.802	8.409
1994	0.644	1.292	2.899	4.710	6.389	8.423	8.409
1995	0.606	1.148	2.857	4.956	6.771	8.539	9.505
1996	0.667	1.221	2.738	5.056	6.892	8.088	10.759
1997	0.595	1.210	2.571	4.805	6.952	7.821	9.630
1998	0.605	1.061	2.264	4.506	6.104	8.017	9.612
1999	0.691	1.039	2.194	4.688	6.486	8.252	9.439
2000	0.689	1.261	2.457	4.126	6.666	7.917	8.392
2001	0.654	0.988	2.679	4.568	5.860	7.741	9.386
2002	0.668	1.140	2.330	4.841	6.175	7.192	9.548
2003	0.671	1.016	2.312	3.854	6.220	8.075	8.839
2004	0.609	1.027	2.194	4.396	6.003	8.258	9.678
2005	0.776	1.172	2.624	4.118	4.908	6.753	10.240
2006[1]	0.656	1.169	2.236	3.822	6.172	7.796	11.1

	AGE						
YEAR	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
2007[1]	0.476	0.976	2.512	4.285	6.491	7.733	8.81
2008[1]	0.557	1.183	2.992	4.826	6.33	7.957	8.471
2009[1]	0.988	1.961	3.132	4.759	5.904	8.171	8.646
2010[1]	n/a	1.521	2.671	3.977	5.269	6.144	7.974
2011[1]	n/a	1.434	3.2	4.057	5.832	6.525	9.891
2012[1]	0.66	1.737	2.797	4.833	6.876	7.296	7.52

[1] Values calculated after landings numbers-at-age adjusted for misreporting.

Values for 2011 adjusted from last year.

Table 3.2.6. Cod in Division VIa. Discard dataset from Scottish and Irish sampling programmes, ages 1–7, years 1978–2012. Data from 1978–2001 raised from Scottish sampling only; later data raised from Scottish sampling and Irish sampling when available (2004, 2005 and 2012 to date). Values for years 2006–2011 differ from 2012 assessment because landings and discards were adjusted for misreporting in 2012 but landings only in 2013.

DISCARDS AT AGE (THOUSANDS).

	AGE						
YEAR	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1978	412	26	0	0	0	0	0
1979	16	81	0	0	0	0	0
1980	1171	0	0	0	0	0	0
1981[1]	54	907	0	0	0	0	0
1982[1]	1808	8	0	0	0	0	0
1983[1]	843	25	0	0	0	0	0
1984[1]	1088	11	0	0	0	0	0
1985[1]	5188	114	0	0	0	0	0
1986[1]	970	14	0	0	0	0	0
1987[1]	14358	12	0	0	0	0	0
1988[1]	231	1059	2	0	0	0	0
1989[1]	6243	6	0	0	0	0	0
1990[1]	4181	41	0	0	0	0	0
1991[1]	2518	14	2	0	0	0	0
1992[1]	7385	143	3	0	0	0	0
1993[1]	279	84	1	0	0	0	0
1994[1]	2743	6	0	0	0	0	0
1995[1]	625	56	0	0	0	0	0
1996[1]	191	50	0	0	0	0	0
1997[1]	1521	34	0	0	0	0	0
1998[1]	790	972	0	0	0	0	0
1999[1]	230	5	0	0	0	0	0
2000[1]	2882	33	0	0	0	0	0
2001[1]	176	115	0	0	0	0	0
2002[1]	1051	199	0	0	0	0	0
2003[1]	69	26	1	0	0	0	0
2004	232	21	0	0	0	0	0
2005	108	20	0	0	0	0	0
2006	1210	47	24	2	3	1	1
2007	566	1489	50	38	3	3	0
2008	68	101	281	1	0.2	0	0
2009	605	150	109	94	0	5	0
2010	352	392	65	7	3	0	0
2011	316	281	535	42	0.3	2	0
2012	374	93	383	50	0.1	0	0

[1] **Values revised after 2012 benchmark because of new method for raising discards.**

Table 3.2.7. Cod in Division VIa. Discard dataset from Scottish and Irish sampling programmes, ages 1–7, years 1978–2006. Data from 1978–2001 raised from Scottish sampling only; later data raised from Scottish sampling and Irish sampling when available (2004, 2005 and 2012 to date). Values for years 2006–2011 differ from 2012 assessment because landings and discards were adjusted for misreporting in 2012 but landings only in 2013.

MEAN WEIGHT-AT-AGE IN DISCARDS (KG).

	AGE						
YEAR	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1978	0.37	0.321	0	0	0	0	0
1979	0.276	0.43	0	0	0	0	0
1980	0.361	0	0	0	0	0	0
1981	0.135	0.326	0	0	0	0	0
1982	0.314	0.392	0	0	0	0	0
1983	0.223	0.374	0	0	0	0	0
1984	0.298	0.435	0	0	0	0	0
1985	0.178	0.346	0	0	0	0	0
1986	0.267	0.305	0	0	0	0	0
1987	0.166	0.37	0	0	0	0	0
1988	0.296	0.283	0	0	0	0	0
1989	0.332	0.59	0	0	0	0	0
1990	0.132	0.454	0	0	0	0	0
1991	0.245	0.351	0	0	0	0	0
1992	0.22	1.03	2.382	0	0	0	0
1993	0.239	0.812	3.723	0	0	0	0
1994	0.24	0.365	0	0	0	0	0
1995	0.203	0.256	0	0	0	0	0
1996	0.226	0.389	0	0	0	0	0
1997	0.321	0.328	0	0	0	0	0
1998	0.23	0.367	0.59	0	0	0	0
1999	0.294	0.299	0	0	0	0	0
2000	0.28	0.421	0	0	0	0	0
2001	0.248	0.417	0	0	0	0	0
2002	0.263	1.021	0	0	0	0	0
2003	0.272	0.57	0.39	0	0	0	0
2004	0.258	0.581	0	0	0	0	0
2005	0.285	0.501	0	0	0	0	0
2006	0.259	1.291	2.649	3.499	6.24	5.581	11.122
2007	0.198	0.94	3.016	4.453	5.018	10.627	0
2008	0.22	0.976	2.046	4.047	7.937	0	0
2009	0.261	1.312	2.248	3.324	0	6.448	0
2010	0.253	1.312	2.268	3.218	3.245	0	0
2011	0.212	1.023	2.207	2.993	4.891	4.168	0
2012	0.151	1.197	2.18	3.222	8.537	0	0

Table 3.2.8. Cod in Division VIa. Total catch at age (thousands). Values for years 2006–2011 differ from 2012 assessment because landings and discards were adjusted for misreporting in 2012 but landings only in 2013.

	AGE						
YEAR	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1978	1135	1787	999	695	286	97	75
1979	945	1693	2125	682	342	134	69
1980	2366	3294	2001	796	191	77	37
1981[1]	515	7923	3220	904	182	29	20
1982[1]	3635	1681	3206	1189	367	111	33
1983[1]	3178	4540	1118	1400	468	148	60
1984[1]	3231	2371	2564	448	555	185	59
1985[1]	6543	5183	1269	1091	140	167	79
1986[1]	1762	1500	2055	411	191	40	30
1987[1]	22231	4849	988	905	137	56	26
1988[1]	1239	9395	2195	278	210	39	20
1989[1]	8260	1088	3858	709	113	69	33
1990[1]	4694	4065	432	924	170	23	11
1991[1]	4036	1742	1807	188	266	70	23
1992[1]	8792	2011	578	720	69	58	24
1993[1]	607	3680	1051	131	183	24	36
1994[1]	3685	1213	1545	280	56	51	20
1995[1]	1378	2806	700	630	70	15	11
1996[1]	532	2381	1210	247	204	31	13
1997[1]	2935	1101	989	281	66	62	7
1998[1]	1100	4290	293	174	57	16	9
1999[1]	362	889	1047	64	48	24	9
2000[1]	3647	565	211	231	15	12	13
2001[1]	272	1356	155	63	52	3	4
2002[1]	1388	539	522	41	13	14	4
2003[1]	131	542	86	107	6	2	1
2004	267	113	85	11	26	2	1
2005	139	141	43	37	7	6	0.5
2006[2]	1228	143	100	24	16	3	2
2007[2]	572	1676	120	75	6	7	3
2008[2]	68.1	135	411	26	16.2	1	3
2009[2]	607	162	120	153	8	7	0.3
2010[2]	352	435	126	45	35	1	0.4
2011[2]	316	292	575	76	12.3	15	2
2012[2]	377	94	424	101	5.1	4	5

[1] Values revised after 2012 benchmark because of new method for raising discards.

[2] Values include adjustment for misreporting of landings.

Table 3.2.9. Cod in Division VIa. Mean weight-at-age (kg) in total catch. Values for years 2006–2011 differ from 2012 assessment because landings and discards were adjusted for misreporting in 2012 but landings only in 2013.

	Age						
Year	1	2	3	4	5	6	7+
1978	0.389	0.946	3.389	5.262	7.096	8.686	9.857
1979	0.688	1.308	2.828	4.853	6.433	7.784	9.636
1980	0.440	1.375	3.002	5.277	7.422	8.251	9.331
1981[1]	0.50	1.070	2.839	4.923	7.518	9.314	10.328
1982[1]	0.504	1.463	2.737	4.749	6.113	7.227	9.856
1983[1]	0.488	1.260	2.995	4.398	6.305	8.084	9.744
1984[1]	0.588	1.398	3.168	5.375	6.601	8.606	10.350
1985[1]	0.271	1.165	2.597	4.892	6.872	8.344	9.766
1986[1]	0.466	1.203	2.785	4.655	6.336	8.283	9.441
1987[1]	0.295	1.310	2.783	4.574	6.161	7.989	10.062
1988[1]	0.711	1.081	2.883	5.145	6.993	8.204	9.803
1989[1]	0.423	1.294	2.425	4.737	7.027	7.520	9.594
1990[1]	0.185	1.267	2.815	4.314	7.021	9.027	11.671
1991[1]	0.394	1.089	2.615	4.346	6.475	8.134	10.076
1992[1]	0.295	1.274	2.606	4.268	6.190	7.844	10.598
1993[1]	0.529	1.304	2.941	4.646	6.244	7.802	8.409
1994[1]	0.343	1.287	2.899	4.710	6.389	8.423	8.409
1995[1]	0.423	1.130	2.857	4.956	6.771	8.539	9.505
1996[1]	0.509	1.204	2.738	5.056	6.892	8.088	10.759
1997[1]	0.453	1.183	2.571	4.805	6.952	7.821	9.630
1998[1]	0.336	0.904	2.264	4.506	6.104	8.017	9.612
1999[1]	0.439	1.035	2.194	4.688	6.486	8.252	9.439
2000[1]	0.366	1.212	2.457	4.126	6.666	7.917	8.392
2001[1]	0.391	0.940	2.679	4.568	5.860	7.741	9.386
2002[1]	0.361	1.096	2.330	4.841	6.175	7.192	9.548
2003[1]	0.461	0.995	2.290	3.854	6.220	8.075	8.839
2004	0.314	0.945	2.194	4.396	6.003	8.258	9.678
2005	0.395	1.078	2.624	4.118	4.908	6.753	10.240
2006[2]	0.265	1.209	2.335	3.799	6.183	7.071	11.103
2007[2]	0.201	0.944	2.723	4.37	5.813	9.001	8.81
2008[2]	0.22	1.028	2.345	4.801	6.351	7.957	8.471
2009[2]	0.264	1.362	2.329	3.876	5.904	6.951	8.646
2010[2]	0.253	1.332	2.462	3.856	5.095	6.144	7.974
2011[2]	0.212	1.038	2.276	3.469	5.812	6.248	9.891
2012[2]	0.154	1.205	2.239	4.036	6.913	7.296	7.52

[1] Values revised from 2012 benchmark because of new method for raising discards.

[2] Values calculated after landings numbers-at-age adjusted for misreporting.

Table 3.2.10. Cod in Division VIa. TSA parameter settings for the assessment run.

PARAMETER	SETTING	JUSTIFICATION
Age of full selection.	$a_m = 4$	Carried over from previous TSA. Based on inspection of XSA runs.
Multipliers on variance matrices of measurements.	$B_{landings}(a) = 2$ for ages 6, 7+ $B_{survey}(a) = 2$ for age 1, 5, 6	Allows extra measurement variability for poorly-sampled ages.
Multipliers on variances for fishing mortality estimates.	H(1) = 2	Allows for more variable fishing mortalities for age 1 fish.
Downweighting of particular data points.	Landings: Age 2 in 1987 age 6 in 1982 and 2009, age 7 in 1982,1983,1989. Discards: age 1 in 1988 and 1992, age 2 in 1988, 1992,1998,2002. Survey: age 2 in 2007 and 2010, age 3 in 2008 (large haul near 4W line), age 4 in 2001 and 2008, age 5 in 2001.	Large values indicated by exploratory prediction error plots. Downweighting in 2001 resulted from a single large haul, 24 fish >75 cm in 30 mins.
Discards	Discards are allowed to evolve over time constrained by a trend. Ages 1 to 4 are modelled independently. A step function is specified with the step occurring in 2006.	
Recruitment.	Modelled by a Ricker model, with numbers-at-age 1 assumed to be independent and normally distributed with mean $\eta_1 S \exp(-\eta_2 S)$, where S is the spawning–stock biomass at the start of the previous year. To allow recruitment variability to increase with mean recruitment, a constant coefficient of variation is assumed.	
Large year classes.	The 1986 year class was large, and recruitment at age 1 in 1987 is not well modelled by the Ricker recruitment model. Instead, N(1, 1987) is taken to be normally distributed with mean $5\eta_1 S \exp(-\eta_2 S)$. The factor of 5 was chosen by comparing maximum recruitment to median recruitment from 1966–1996 for VIa cod, haddock, and whiting in turn using previous XSA runs. The coefficient of variation is again assumed to be constant.	

Table 3.2.11. Cod in Division VIa. TSA parameter estimates for final assessment presented in 2012 and this year.

Parameter	Notation	Description	2012 WG	2013 WG
Initial fishing mortality	*F* (1, 1981)	Fishing mortality-at-age *a* in year *y*	0.3056	0.3268
	F (2, 1981)		0.6263	0.6068
	F (4, 1981)		0.9764	1.0206
Fishing mortality standard deviations	σ_F	Transitory changes in overall fishing mortality	0.0706	0.0871
	σ_U	Persistent changes in selection (age effect in F)	0.0334	0.0313
	σ_V	Transitory changes in the year effect in fishing mortality	0.1088	0.0818
	σ_Y	Persistent changes in the year effect in fishing mortality	0.0009	0.0015
Measurement CVs	$CV_{landings}$	CV of landings-at-age data	0.1295	0.1362
	$CV_{discards}$	CV of discards-at-age data	0.7262	0.6408
Recruitment	η_1	Ricker parameter (slope at the origin)	1.0053	0.8741
	η_2	Ricker parameter (curve dome occurs at $1/\eta_2$)	0.0139	0.0078
	cv_{rec}	Coefficient of variation of recruitment data	0.4779	0.4379
Discards	$\sigma_{logit\ p}$	Transitory trends in discarding	0.7079	0.7481
	$\sigma_{persistent}$	Persistent trends in discarding	0.3199	0.2674
	Step fn age 1	Amount by which discards increase in 2006	4.3109	4.1778
	Step fn age 2		6.1439	5.8499
	Step fn age 3		1.1598	0.9716
	Step fn age 4		0.3955	0.2067
Survey selectivities	Φ(1)	Survey selectivity-at-age *a*	0.5300	0.6121
	Φ(2)		2.5736	2.8330
	Φ(3)		6.4396	6.9089
	Φ(4)		10.8097	10.8994
	Φ(5)		14.9578	14.9577
	Φ(6)		21.8590	21.8356
Survey CVs	σ_{survey}	CV parameter controlling gamma type dispersion	0.2784	0.2402
	η_{survey}	CV parameter controlling poisson type dispersion	1.0606	1.1493
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability	Na	Na
	σ_β	Persistent changes in survey catchability	Na	Na

PARAMETER	*NOTATION*	DESCRIPTION	2012 WG	2013 WG
Misreporting		Transitory changes in misreporting	0.0	0.0
		Persistent changes in misreporting	0.1605	0.1569

Table 3.2.12. Cod in Division VIa. TSA population numbers-at-age (millions).

			Age				
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1978							
1979							
1980							
1981	11.498	19.468	6.949	1.873	0.332	0.051	0.042
1982	26.670	5.111	7.547	2.487	0.624	0.107	0.031
1983	14.680	12.290	2.173	2.803	0.840	0.211	0.047
1984	26.574	6.361	4.837	0.754	0.871	0.265	0.081
1985	12.684	12.027	2.401	1.571	0.219	0.240	0.101
1986	21.430	4.827	4.110	0.717	0.358	0.056	0.084
1987	53.594	9.790	1.948	1.441	0.224	0.114	0.046
1988	6.685	19.791	3.632	0.595	0.364	0.061	0.045
1989	23.191	2.863	6.599	1.116	0.178	0.104	0.031
1990	7.566	9.850	1.034	1.757	0.311	0.050	0.038
1991	12.291	3.328	3.611	0.358	0.532	0.100	0.029
1992	22.837	5.320	1.140	1.142	0.115	0.164	0.040
1993	8.875	10.249	1.961	0.348	0.326	0.035	0.065
1994	17.203	4.015	3.831	0.580	0.110	0.096	0.032
1995	14.060	7.791	1.541	1.270	0.168	0.034	0.039
1996	5.978	6.470	2.705	0.492	0.394	0.054	0.024
1997	21.951	2.725	2.086	0.743	0.143	0.115	0.023
1998	6.333	9.901	0.791	0.533	0.209	0.041	0.039
1999	4.687	2.844	2.937	0.200	0.149	0.065	0.025
2000	17.121	2.128	0.826	0.739	0.053	0.042	0.027
2001	3.747	7.321	0.652	0.227	0.201	0.015	0.020
2002	7.584	1.718	2.269	0.170	0.055	0.054	0.010
2003	1.658	3.165	0.495	0.573	0.040	0.013	0.014
2004	2.465	0.698	0.785	0.119	0.138	0.010	0.006
2005	1.628	1.071	0.187	0.183	0.033	0.030	0.003
2006	5.554	0.739	0.336	0.031	0.032	0.006	0.006
2007	1.758	2.567	0.252	0.097	0.007	0.009	0.004
2008	1.540	0.792	0.840	0.062	0.023	0.002	0.003
2009	3.103	0.721	0.261	0.230	0.015	0.006	0.001
2010	2.524	1.456	0.255	0.076	0.066	0.004	0.002
2011	1.036	1.206	0.531	0.072	0.022	0.021	0.002
2012	2.198	0.473	0.405	0.140	0.015	0.006	0.006
2013	1.739	1.027	0.167	0.114	0.039	0.005	0.003
GM(81–12)	7.296	3.548	1.350	0.421	0.122	0.037	0.018

***2013 values are TSA-derived projections of population numbers**

Table 3.2.13. Cod in Division VIa. Standard errors on TSA population numbers-at-age (millions).

			Age				
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1978							
1979							
1980							
1981	1.383	1.893	0.588	0.136	0.034	0.010	0.009
1982	2.236	0.307	0.656	0.198	0.048	0.015	0.005
1983	2.122	0.820	0.137	0.220	0.069	0.021	0.006
1984	1.860	0.612	0.334	0.051	0.075	0.030	0.009
1985	2.194	0.711	0.207	0.124	0.019	0.033	0.014
1986	2.253	0.540	0.306	0.062	0.041	0.008	0.014
1987	9.642	0.788	0.177	0.121	0.023	0.018	0.008
1988	1.283	2.917	0.246	0.055	0.043	0.010	0.008
1989	2.592	0.312	0.883	0.086	0.016	0.016	0.006
1990	1.856	0.845	0.098	0.230	0.030	0.007	0.006
1991	2.153	0.545	0.372	0.035	0.074	0.013	0.004
1992	2.156	0.653	0.169	0.130	0.013	0.027	0.006
1993	1.031	0.805	0.223	0.046	0.043	0.005	0.010
1994	2.364	0.364	0.352	0.072	0.014	0.016	0.005
1995	1.894	0.891	0.153	0.126	0.024	0.005	0.007
1996	1.291	0.692	0.344	0.054	0.045	0.009	0.004
1997	2.646	0.423	0.275	0.108	0.018	0.017	0.004
1998	1.473	1.028	0.147	0.085	0.034	0.007	0.008
1999	1.018	0.492	0.405	0.038	0.026	0.012	0.005
2000	2.268	0.330	0.144	0.114	0.011	0.009	0.005
2001	0.945	0.948	0.105	0.040	0.037	0.004	0.004
2002	1.657	0.316	0.326	0.031	0.013	0.014	0.003
2003	1.016	0.637	0.095	0.097	0.010	0.005	0.005
2004	1.170	0.308	0.207	0.026	0.032	0.004	0.003
2005	1.089	0.388	0.078	0.045	0.007	0.011	0.002
2006	1.171	0.285	0.085	0.012	0.009	0.002	0.003
2007	0.545	0.486	0.073	0.016	0.002	0.003	0.001
2008	0.564	0.208	0.140	0.012	0.004	0.001	0.001
2009	0.768	0.183	0.055	0.029	0.003	0.002	0.000
2010	0.598	0.317	0.053	0.012	0.007	0.001	0.000
2011	0.678	0.267	0.095	0.013	0.003	0.002	0.000
2012	0.851	0.322	0.097	0.028	0.004	0.001	0.001
2013	0.871	0.409	0.116	0.032	0.010	0.001	0.001
GM(81-12)	1.458	0.524	0.184	0.055	0.017	0.007	0.004

***2013 values are standard errors on TSA-derived projections of population numbers.**

Table 3.2.14. Cod in Division VIa. TSA estimates for mortality-at-age.

	Age						
Year	1	2	3	4	5	6	7
1978							
1979							
1980							
1981	0.243	0.569	0.727	0.818	0.901	0.905	0.900
1982	0.222	0.458	0.688	0.814	0.833	0.843	0.847
1983	0.319	0.542	0.742	0.904	0.913	0.931	0.936
1984	0.229	0.594	0.822	0.975	1.067	1.017	1.024
1985	0.432	0.693	0.912	1.225	1.134	1.198	1.188
1986	0.219	0.532	0.750	0.914	0.926	0.924	0.901
1987	0.407	0.606	0.882	1.114	1.072	1.071	1.069
1988	0.325	0.666	0.878	0.944	1.034	1.020	1.005
1989	0.326	0.642	0.971	1.025	1.047	1.067	1.049
1990	0.307	0.623	0.755	0.950	0.889	0.887	0.878
1991	0.314	0.686	0.852	0.875	0.952	0.969	0.983
1992	0.245	0.618	0.885	1.000	0.947	0.927	0.954
1993	0.252	0.601	0.921	0.899	0.997	0.961	0.945
1994	0.267	0.573	0.800	0.981	0.954	0.972	0.966
1995	0.243	0.671	0.841	0.915	0.914	0.922	0.908
1996	0.268	0.747	0.975	0.983	1.008	1.037	1.021
1997	0.264	0.810	1.034	1.005	1.013	1.038	1.005
1998	0.277	0.820	1.023	1.002	0.935	0.985	0.967
1999	0.267	0.828	1.062	1.041	1.030	1.009	1.023
2000	0.319	0.800	0.986	1.036	1.020	1.025	1.055
2001	0.255	0.778	1.016	1.094	1.059	1.012	1.009
2002	0.331	0.841	1.055	1.119	1.123	1.138	1.147
2003	0.281	0.883	1.063	1.109	1.088	1.107	1.104
2004	0.271	0.801	1.020	0.985	1.131	1.112	1.090
2005	0.265	0.765	1.111	1.188	1.225	1.163	1.135
2006	0.241	0.700	0.950	1.075	1.017	1.026	1.023
2007	0.265	0.738	1.054	1.154	1.156	1.150	1.145
2008	0.239	0.727	1.007	1.133	1.168	1.141	1.160
2009	0.228	0.657	0.933	0.994	1.008	1.044	1.007
2010	0.210	0.624	0.950	1.016	0.917	0.925	0.934
2011	0.251	0.711	1.038	1.235	1.103	1.101	1.143
2012	0.235	0.664	0.974	1.045	0.996	1.041	1.060
2013	0.239	0.683	0.991	1.063	1.063	1.063	1.063
GM(81-12)	0.271	0.679	0.920	1.012	1.014	1.017	1.014

***Estimates for 2013 are TSA projections.**

Table 3.2.15. Cod in Division VIa. Standard errors of TSA estimates for log mortality-at-age.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1981	0.031	0.053	0.065	0.072	0.095	0.099	0.098
1982	0.029	0.045	0.063	0.074	0.085	0.096	0.096
1983	0.043	0.053	0.067	0.082	0.094	0.101	0.107
1984	0.031	0.056	0.073	0.087	0.108	0.111	0.116
1985	0.060	0.069	0.086	0.114	0.120	0.134	0.137
1986	0.039	0.057	0.078	0.094	0.107	0.116	0.112
1987	0.066	0.069	0.083	0.104	0.113	0.119	0.124
1988	0.060	0.065	0.078	0.090	0.109	0.121	0.120
1989	0.055	0.063	0.091	0.094	0.110	0.118	0.122
1990	0.055	0.065	0.076	0.096	0.097	0.103	0.104
1991	0.058	0.073	0.088	0.092	0.108	0.115	0.121
1992	0.047	0.067	0.094	0.105	0.109	0.110	0.118
1993	0.047	0.066	0.095	0.097	0.114	0.118	0.114
1994	0.049	0.063	0.083	0.105	0.111	0.117	0.120
1995	0.046	0.072	0.087	0.095	0.104	0.111	0.109
1996	0.052	0.081	0.102	0.103	0.114	0.123	0.125
1997	0.050	0.087	0.107	0.109	0.118	0.125	0.125
1998	0.053	0.087	0.108	0.108	0.108	0.120	0.118
1999	0.052	0.089	0.110	0.114	0.120	0.122	0.128
2000	0.059	0.085	0.106	0.114	0.119	0.125	0.131
2001	0.049	0.083	0.107	0.119	0.123	0.124	0.124
2002	0.062	0.090	0.110	0.123	0.132	0.138	0.145
2003	0.054	0.095	0.112	0.120	0.127	0.136	0.135
2004	0.052	0.087	0.110	0.109	0.132	0.136	0.135
2005	0.053	0.095	0.133	0.134	0.146	0.143	0.145
2006	0.050	0.092	0.121	0.125	0.109	0.121	0.120
2007	0.055	0.098	0.134	0.129	0.125	0.134	0.139
2008	0.050	0.100	0.130	0.133	0.145	0.141	0.141
2009	0.048	0.092	0.123	0.113	0.111	0.125	0.124
2010	0.045	0.088	0.125	0.111	0.100	0.107	0.112
2011	0.054	0.102	0.136	0.137	0.125	0.129	0.144
2012	0.051	0.101	0.145	0.144	0.138	0.146	0.149
2013	0.054	0.108	0.153	0.153	0.153	0.153	0.153
GM(81-12)	0.049	0.076	0.098	0.106	0.114	0.121	0.123

***Estimates for 2013 are standard errors of TSA projections of log *F*.**

Table 3.2.16. Cod in Division VIa. TSA summary table. "Obs." denotes sum-of-products of numbers and mean weights-at-age, not reported caught, landed and discarded weight.

Year	Landings (000 tonnes)			Discards (000 tonnes)			Total catch (000 tonnes)			Mean F (2–5)		SSB (000 tonnes)		TSB (000 tonnes)		Recruitment at age 1 (millions)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1981	23.865	24.241	1.525	0.303	0.126	0.089	24.168	24.367	1.525	0.753	0.049	40.425	2.080	59.007	3.066	11.498	1.383
1982	21.511	21.272	1.351	0.571	0.574	0.241	22.082	21.846	1.333	0.698	0.045	38.353	2.016	58.275	2.643	26.670	2.236
1983	21.305	20.310	1.050	0.197	0.226	0.117	21.503	20.536	1.054	0.775	0.049	33.439	1.417	48.940	2.102	14.680	2.122
1984	21.272	20.023	1.076	0.329	0.607	0.248	21.601	20.631	1.049	0.865	0.054	30.726	1.355	52.759	2.074	26.574	1.860
1985	18.607	17.559	0.885	0.963	0.466	0.144	19.570	18.025	0.880	0.991	0.067	24.827	1.118	35.863	1.637	12.684	2.194
1986	11.820	11.763	0.787	0.263	0.599	0.191	12.083	12.363	0.815	0.780	0.061	19.728	1.010	34.107	1.676	21.430	2.253
1987	18.971	17.009	1.139	2.388	1.196	0.533	21.358	18.205	1.219	0.919	0.061	20.676	1.020	43.414	3.239	53.594	9.642
1988	20.413	19.190	1.723	0.368	0.237	0.111	20.781	19.428	1.732	0.880	0.056	26.670	1.870	43.155	3.500	6.685	1.283
1989	17.169	15.957	1.452	2.076	1.082	0.376	19.246	17.040	1.499	0.921	0.058	23.310	1.960	37.134	2.626	23.191	2.592
1990	12.175	12.386	0.886	0.571	0.146	0.059	12.746	12.532	0.895	0.805	0.058	19.647	1.354	27.440	1.838	7.566	1.856
1991	10.927	10.446	1.062	0.622	0.328	0.141	11.549	10.774	1.095	0.841	0.065	16.117	1.408	24.016	2.198	12.291	2.153
1992	9.086	8.958	0.976	1.779	0.674	0.211	10.865	9.632	1.009	0.863	0.068	13.375	1.282	23.773	2.009	22.837	2.156
1993	10.314	10.848	1.043	0.139	0.383	0.136	10.453	11.231	1.054	0.854	0.068	16.388	1.305	28.304	2.118	8.875	1.031
1994	8.928	10.397	1.011	0.661	0.533	0.178	9.588	10.930	1.048	0.827	0.066	16.750	1.356	26.691	2.121	17.203	2.364
1995	9.439	10.658	1.053	0.141	0.337	0.112	9.580	10.995	1.076	0.835	0.065	16.459	1.365	27.252	2.262	14.060	1.894
1996	9.427	11.089	1.146	0.063	0.199	0.071	9.489	11.288	1.164	0.928	0.072	16.315	1.478	24.130	2.266	5.978	1.291
1997	7.034	8.848	1.023	0.499	0.740	0.272	7.533	9.588	1.092	0.966	0.076	11.970	1.289	24.211	2.325	21.951	2.646
1998	5.714	8.592	0.991	0.538	0.225	0.092	6.252	8.817	1.010	0.945	0.074	10.579	1.111	17.251	1.806	6.333	1.473
1999	4.201	6.851	0.940	0.069	0.182	0.068	4.270	7.034	0.962	0.990	0.079	9.750	1.206	14.121	1.772	4.687	1.018
2000	2.977	5.551	0.738	0.821	0.664	0.230	3.798	6.215	0.792	0.960	0.077	7.051	0.932	14.835	1.681	17.121	2.268
2001	2.347	5.784	0.786	0.092	0.174	0.068	2.439	5.958	0.801	0.987	0.079	7.600	0.921	12.611	1.546	3.747	0.945
2002	2.243	5.501	0.799	0.480	0.264	0.114	2.722	5.765	0.832	1.035	0.083	7.174	0.968	11.558	1.565	7.584	1.657
2003	1.241	3.902	0.673	0.034	0.087	0.049	1.275	3.989	0.694	1.036	0.083	5.298	0.829	7.732	1.415	1.658	1.016
2004	0.540	2.256	0.543	0.072	0.096	0.052	0.612	2.352	0.571	0.984	0.080	3.315	0.739	4.647	1.150	2.465	1.170
2005	0.511	1.606	0.402	0.041	0.077	0.049	0.552	1.683	0.419	1.072	0.093	2.172	0.485	3.437	0.856	1.628	1.089
2006	0.488	0.416	0.069	0.465	0.943	0.215	0.954	1.359	0.252	0.935	0.075	1.570	0.280	3.579	0.558	5.554	1.171

Year	Landings (000 tonnes)			Discards (000 tonnes)			Total catch (000 tonnes)			Mean F (2–5)		SSB (000 tonnes)		TSB (000 tonnes)		Recruitment at age 1 (millions)	
	Obs.	**Pred.**	**SE**	**Obs.**	**Pred.**	**SE**	**Obs.**	**Pred.**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**	**Estimate**	**SE**
2007	0.595	0.513	0.070	1.880	1.388	0.277	2.474	1.901	0.296	1.026	0.081	2.430	0.325	4.043	0.556	1.758	0.545
2008	0.682	0.580	0.079	0.695	1.175	0.232	1.377	1.754	0.238	1.009	0.086	2.603	0.327	3.610	0.455	1.540	0.564
2009	0.408	0.446	0.050	0.945	1.005	0.176	1.353	1.451	0.181	0.898	0.071	2.061	0.225	3.436	0.409	3.103	0.768
2010	0.559	0.556	0.052	0.785	1.003	0.207	1.344	1.559	0.223	0.877	0.068	2.222	0.271	3.880	0.508	2.524	0.598
2011	0.454	0.436	0.043	1.670	1.184	0.212	2.124	1.620	0.217	1.022	0.080	2.217	0.260	3.207	0.427	1.036	0.678
2012	0.466	0.457	0.051	1.166	0.787	0.220	1.632	1.243	0.232	0.920	0.092	1.835	0.332	2.576	0.533	2.198	0.851
2013	NA	0.448	0.116	NA	0.773	0.258	NA	1.221	0.311	0.950	0.098	1.689	0.413	2.690	0.680	1.739	0.871
Min	0.408	0.416	0.043	0.034	0.077	0.049	0.552	1.243	0.181	0.698	0.045	1.570	0.225	2.576	0.409	1.036	0.545
GM	4.058	5.027	0.519	0.398	0.407	0.144	5.430	6.681	0.717	0.908	0.069	9.320	0.885	15.099	1.452	7.296	1.458
AM	8.615	9.200	0.796	0.678	0.553	0.172	9.293	9.753	0.852	0.912	0.070	14.158	1.059	22.781	1.717	11.584	1.774
Max	23.865	24.241	1.723	2.388	1.388	0.533	24.168	24.367	1.732	1.072	0.093	40.425	2.080	59.007	3.500	53.594	9.642

*** Estimates for 2013 are TSA projections.**

Table 3.2.17. Cod in Division VIa. Inputs to short-term predictions from TSA run. Mean weights assumed from final three years.

Table_____Cod,,,,VIa,,,

input data for catch forecast and linear sensitivity analysis

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	1739	0.50	WS1	0.21	0.24
N2	1027	0.40	WS2	1.19	0.12
N3	167	0.69	WS3	2.33	0.05
N4	114	0.28	WS4	3.79	0.08
N5	39	0.26	WS5	5.94	0.15
N6	5	0.33	WS6	6.56	0.10
N7	3	0.25	WS7	8.46	0.15
H.cons selectivity			Weight in the HC catch		
sH1	0.00	1.73	WH1	0.22	1.73
sH2	0.03	0.88	WH2	1.56	0.10
sH3	0.21	1.07	WH3	2.89	0.10
sH4	0.64	0.35	WH4	4.29	0.11
sH5	0.94	0.09	WH5	5.94	0.15
sH6	0.96	0.09	WH6	6.56	0.10
sH7	1.02	0.10	WH7	8.46	0.15
Discard selectivity			Weight in the discards		
sD1	0.23	1.73	WD1	0.20	0.25
sD2	0.62	0.88	WD2	1.18	0.12
sD3	0.76	1.07	WD3	2.22	0.02
sD4	0.43	0.35	WD4	3.14	0.04
sD5	0.04	0.09	WD5	0.00	0.00
sD6	0.04	0.09	WD6	0.00	0.00
sD7	0.00	0.10	WD7	0.00	0.00
Natural mortality			Proportion mature		
M1	0.53	0.10	MT1	0.00	0.10
M2	0.39	0.10	MT2	0.52	0.10
M3	0.31	0.10	MT3	0.86	0.10
M4	0.26	0.10	MT4	1.00	0.10

M5	0.24	0.10	MT5	1.00	0.00
M6	0.22	0.10	MT6	1.00	0.00
M7	0.21	0.10	MT7	1.00	0.00
Relative effort in HC fishery			Year effect for natural mortality		
HF13	1.00	0.05	K13	1.00	0.10
HF14	1.00	0.05	K14	1.00	0.10
HF15	1.00	0.05	K15	1.00	0.10
Recruitment in 2014 and 2015					
R14	2393	0.61			
R15	2393	0.61			

Proportion of F before spawning = .00

Proportion of M before spawning = .00

Stock numbers in 2013 are TSA survivors.,,,

Table 3.2.18. Cod in Division VIa. Results of short-term forecasts from TSA run. Management options.

Table_____.Cod,,,,VIa,,,

Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 2013	2014						
Mean F Ages								
H.cons 2 to 5	0.92	0.00	0.18	0.37	0.55	0.74	0.92	1.10
Effort relative to 2012								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	2.69	2.76	2.76	2.76	2.76	2.76	2.76	2.76
SSB at spawning time	1.69	1.68	1.68	1.68	1.68	1.68	1.68	1.68
Catch weight (,000t)								
H.cons	0.422	0.000	0.104	0.190	0.262	0.322	0.372	0.413
Discards	0.766	0.000	0.216	0.403	0.565	0.706	0.828	0.936
Total Catch	1.189	0.000	0.320	0.593	0.827	1.027	1.200	1.349
Biomass in year.... 2015								
Total 1 January		4.94	4.44	4.02	3.65	3.33	3.05	2.81
SSB at spawning time		3.46	3.02	2.65	2.33	2.06	1.82	1.62

	Year 2013	2014						
Effort relative to 2012								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.23	0.34	0.34	0.34	0.34	0.34	0.34	0.34
SSB at spawning time	0.23	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Catch weight								
H.cons	0.27	0.00	0.51	0.48	0.48	0.49	0.50	0.50
Discards	0.53	0.00	0.56	0.50	0.46	0.44	0.42	0.40
Biomass in year.... 2015								
Total 1 January		0.32	0.35	0.38	0.41	0.44	0.47	0.51
SSB at spawning time		0.34	0.38	0.42	0.46	0.50	0.55	0.60

Table 3.2.19. Cod in Division VIa. Results of short-term forecasts from TSA run. Detailed tables.

Table_____.Cod,,,,VIa,,

Detailed forecast tables.

Forecast for year 2013
F multiplier H.cons=1.00

Populations		Catch number		
Age	Stock No.	H.Cons	Discards	Total
1	1739	1	276	277
2	1027	21	396	417
3	167	20	72	91
4	114	40	27	68
5	39	21	1	22
6	5	3	0	3
7	3	2	0	2
Wt	3	0	1	1

Forecast for year 2014
F multiplier H.cons=1.00

Populations		Catch number		
Age	Stock No.	H.Cons	Discards	Total
1	2393	2	379	381
2	815	17	314	331
3	364	43	156	199
4	47	17	11	28
5	30	16	1	17
6	12	6	0	7
7	2	1	0	1
Wt	3	0	1	1

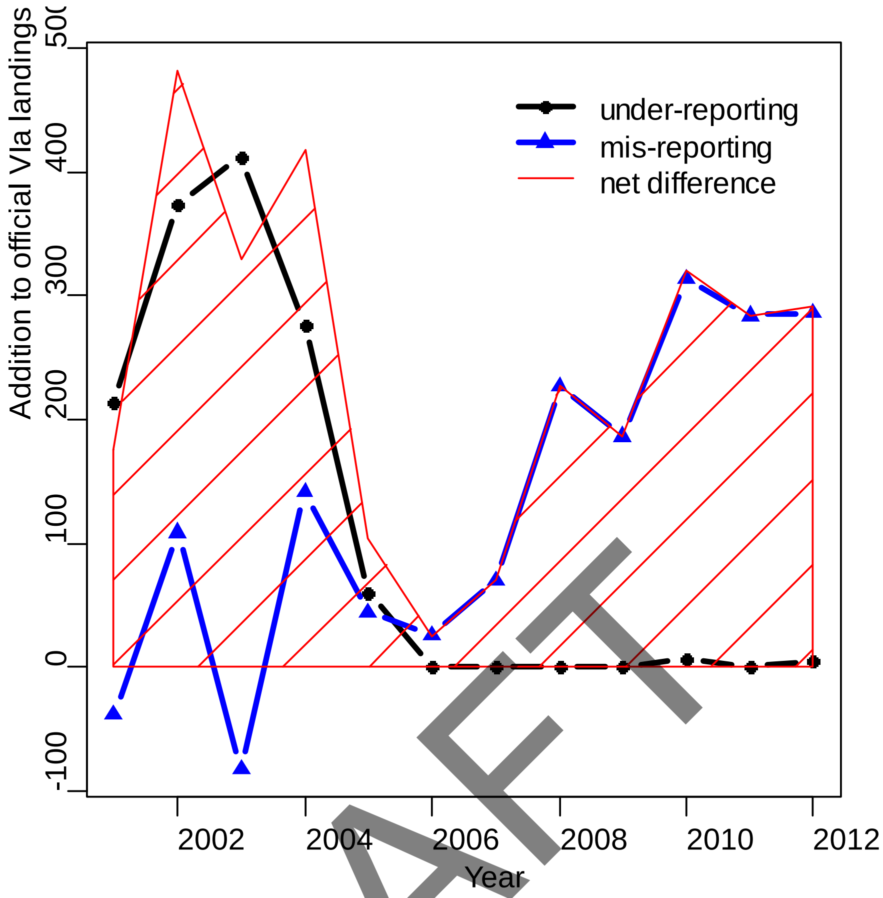

Figure 3.2.1. Cod in Division VIa. Estimates of underreporting and area misreporting of cod caught in ICES Division VIa by Scottish vessels. Negative values of area misreporting indicate a net balance of misreporting into Division VIa from other areas.

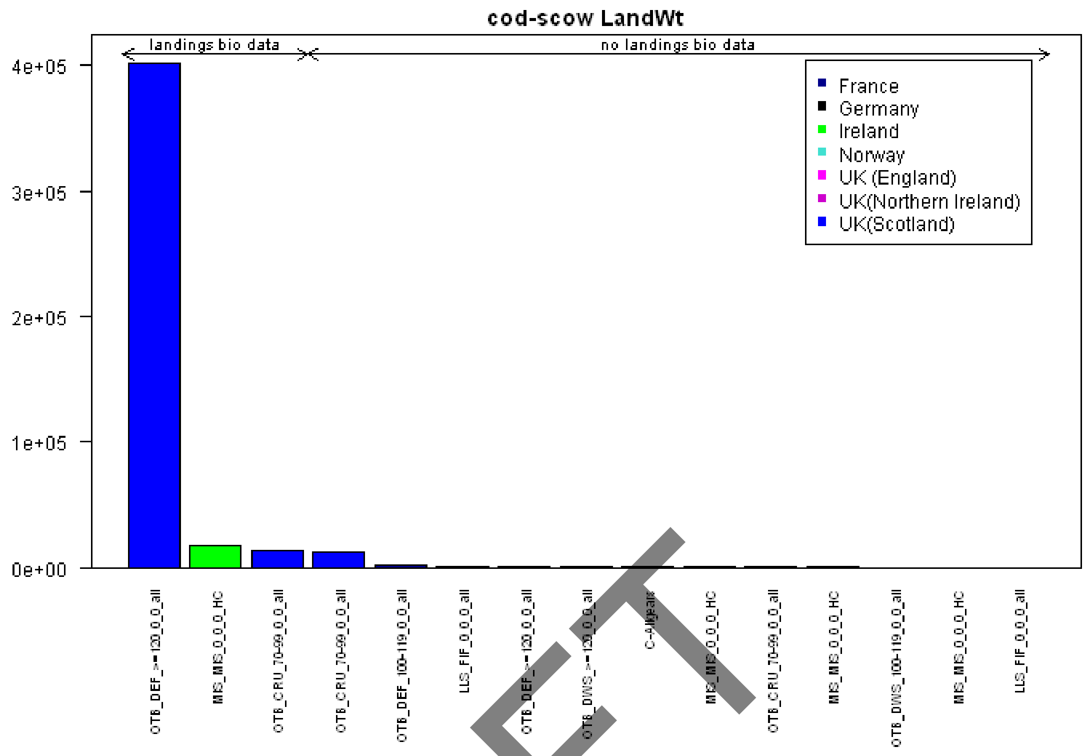

Figure 3.2.2. Cod in Division VIa. Amounts landed by metier (kg) in 2012 as entered into InterCatch.

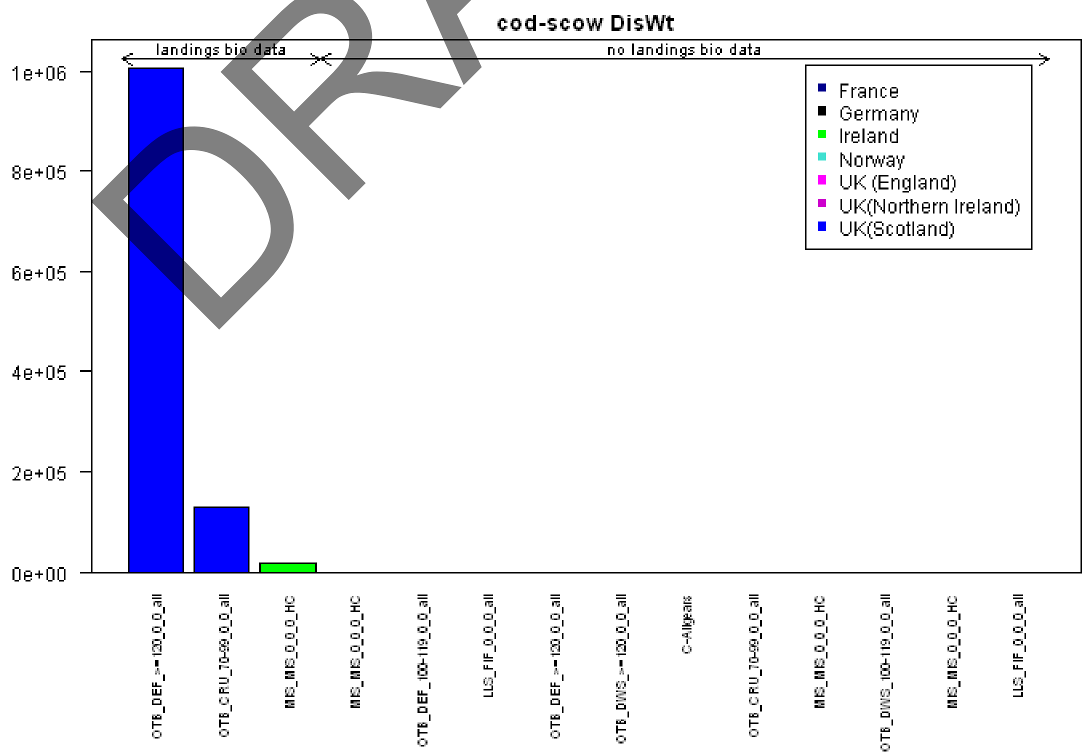

Figure 3.2.3. Cod in Division VIa. Amounts discarded by métier (kg) in 2012 as entered into InterCatch.

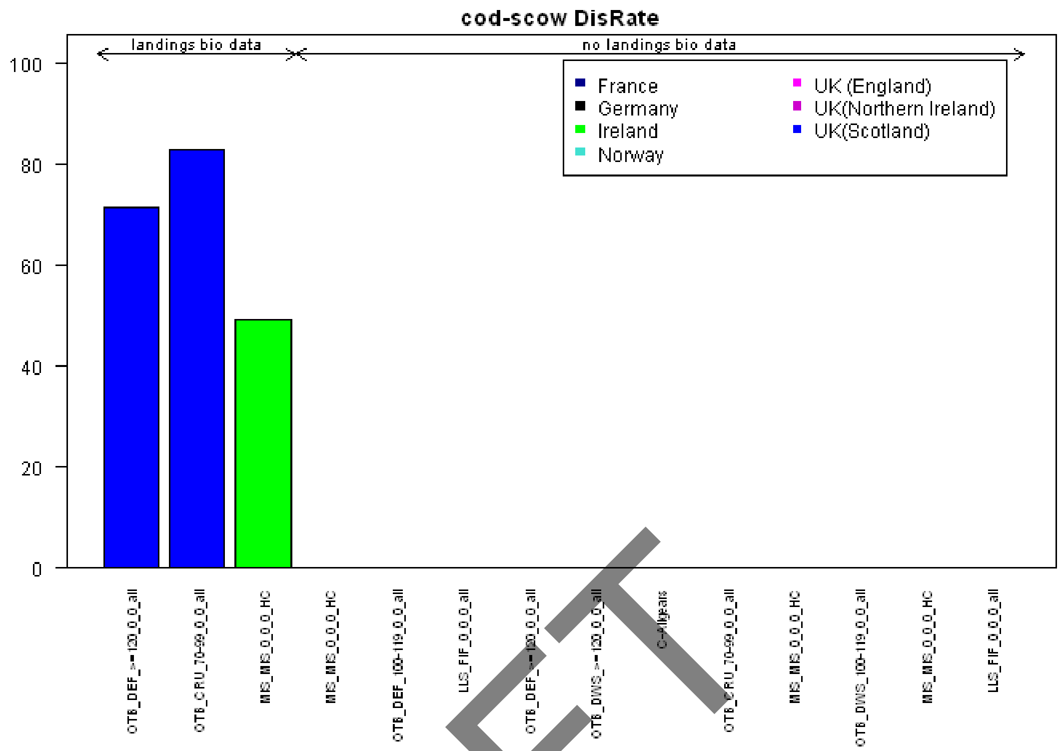

Figure 3.2.4. Cod in Division VIa. Discard rates before allocations within InterCatch.

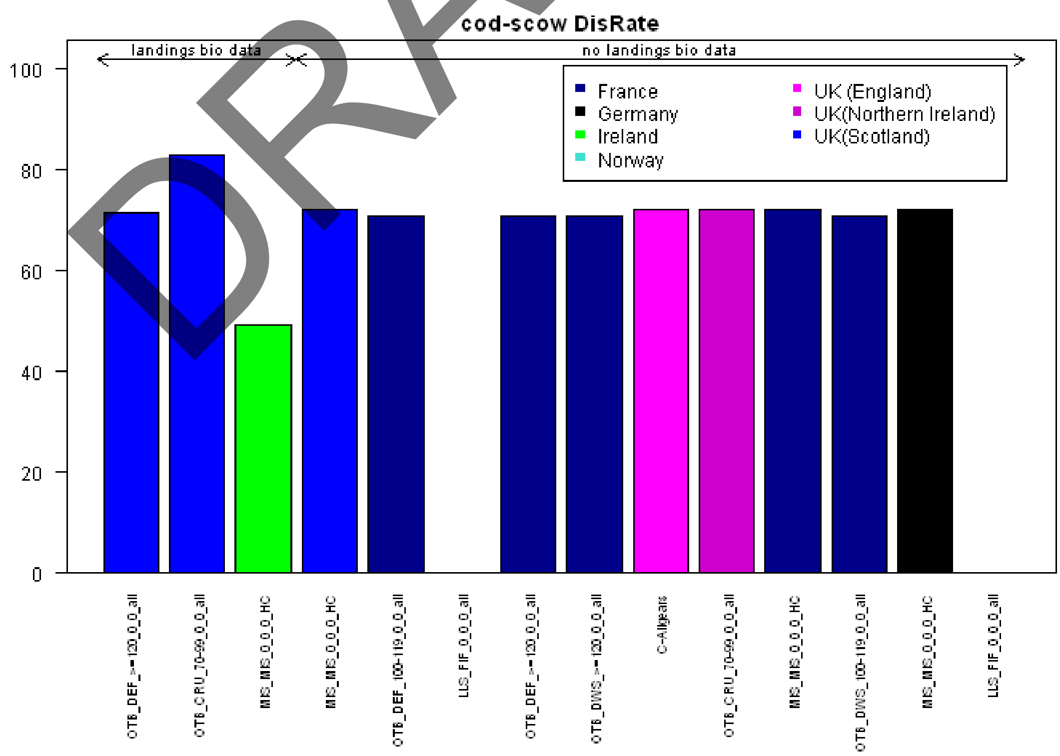

Figure 3.2.5. Cod in Division VIa. Discard rates for all fleets after allocations within InterCatch.

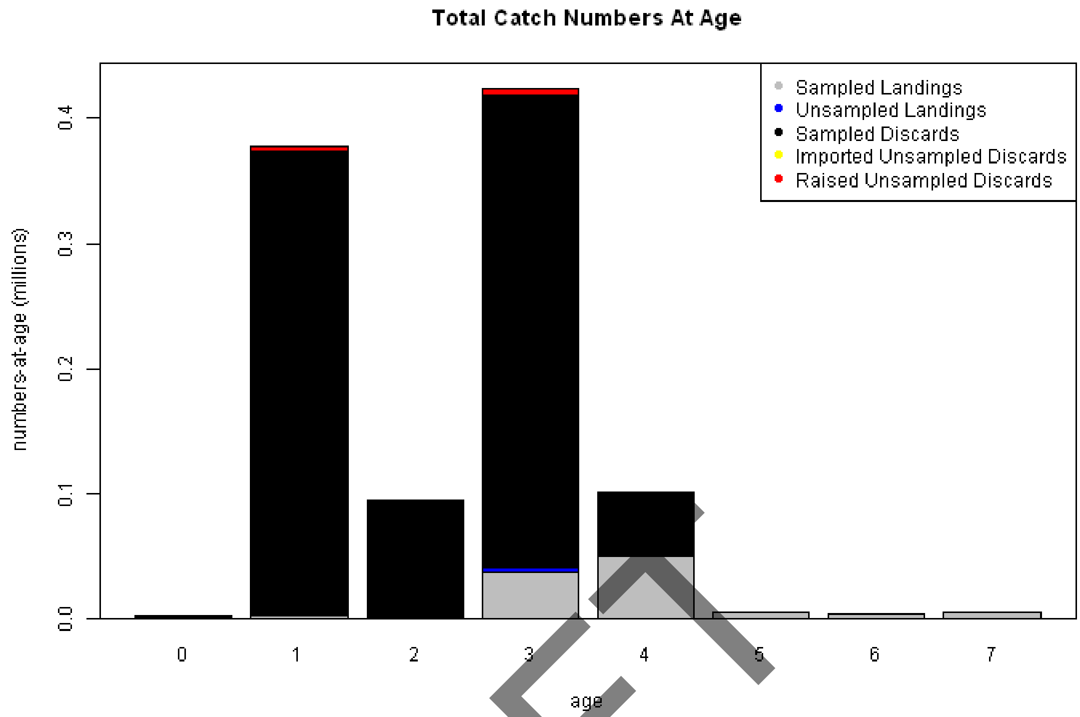

Figure 3.2.6. Cod in Division VIa. Number-at-age constituted by sampled and unsampled landings and sampled and raised (unsampled) discards after allocations within InterCatch.

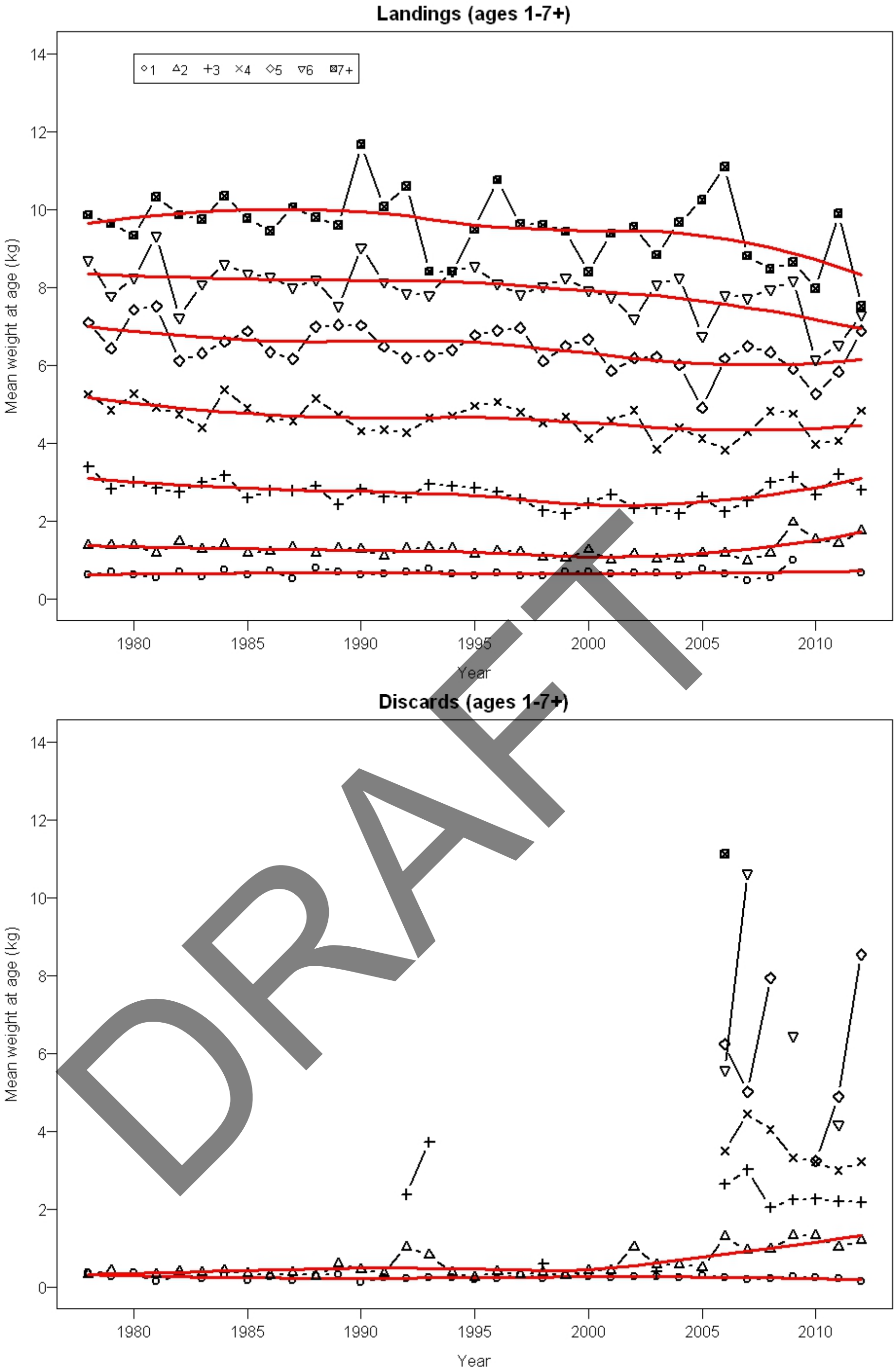

Figure 3.2.7. Cod in Division VIa. Mean weights-at-age in landings and discards. A loess smooth has been fitted to the data at each age, with a span including three quarters of the datapoints.

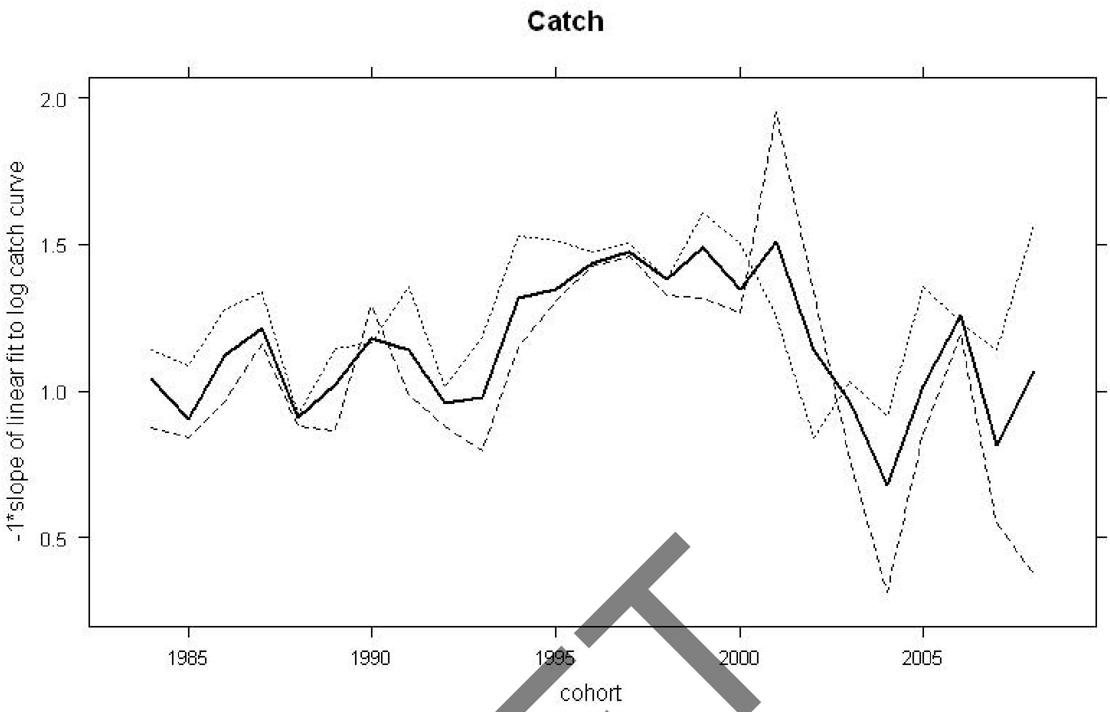

Figure 3.2.8. Cod in Division VIa. Log catch (landings + discards) curve gradient plot using WG commercial catch-at-age data. Solid line shows time-series of gradient of linear fit to curve over the age range 2–5, dashed line over the ages 2–4 and dotted line over the ages 3–5. An increasing value indicates increasing mortality.

2010 2011 2012

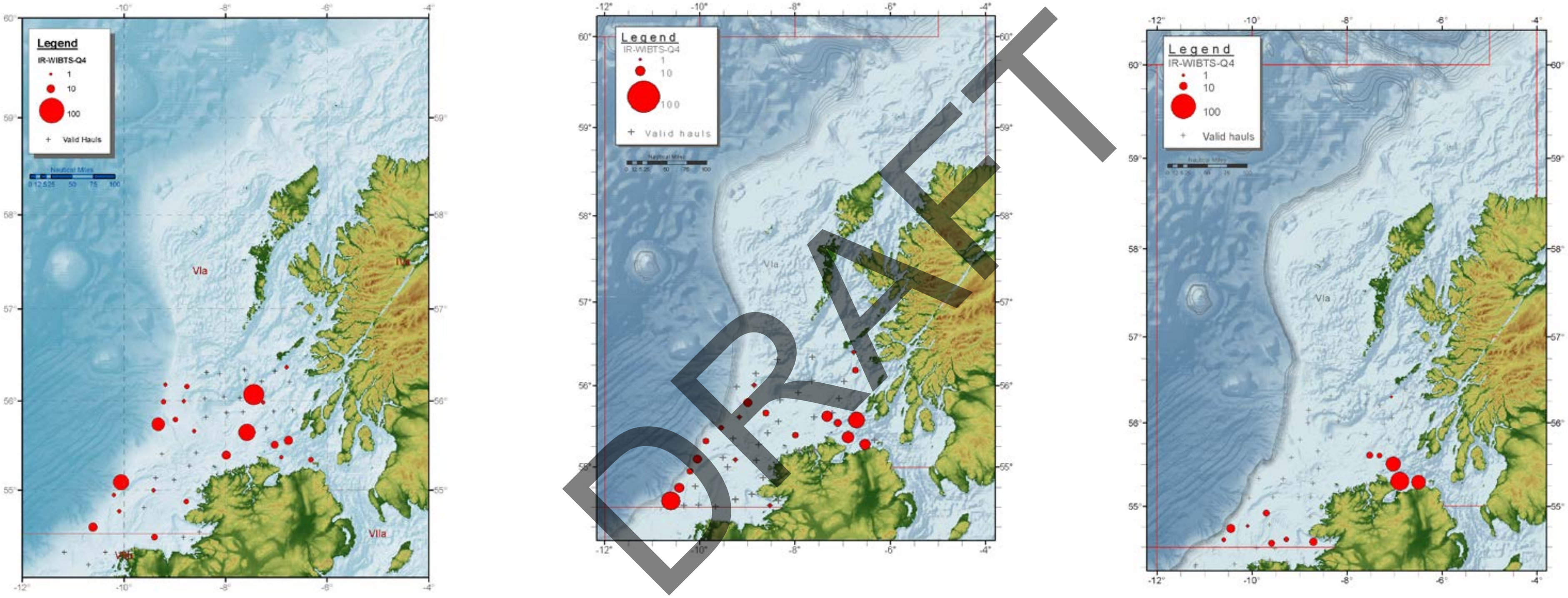

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Figure 3.2.9. Cod in Division VIa. Cpue numbers for fish aged at 1+ per haul resulting from quarter four Irish ground fish survey (IRGFS-WIBTS-Q4). Irish Survey values are for fish >23 cm in length (proxy for age 1+) and numbers are standardised to 60 minutes towing.

2011 2012 2013

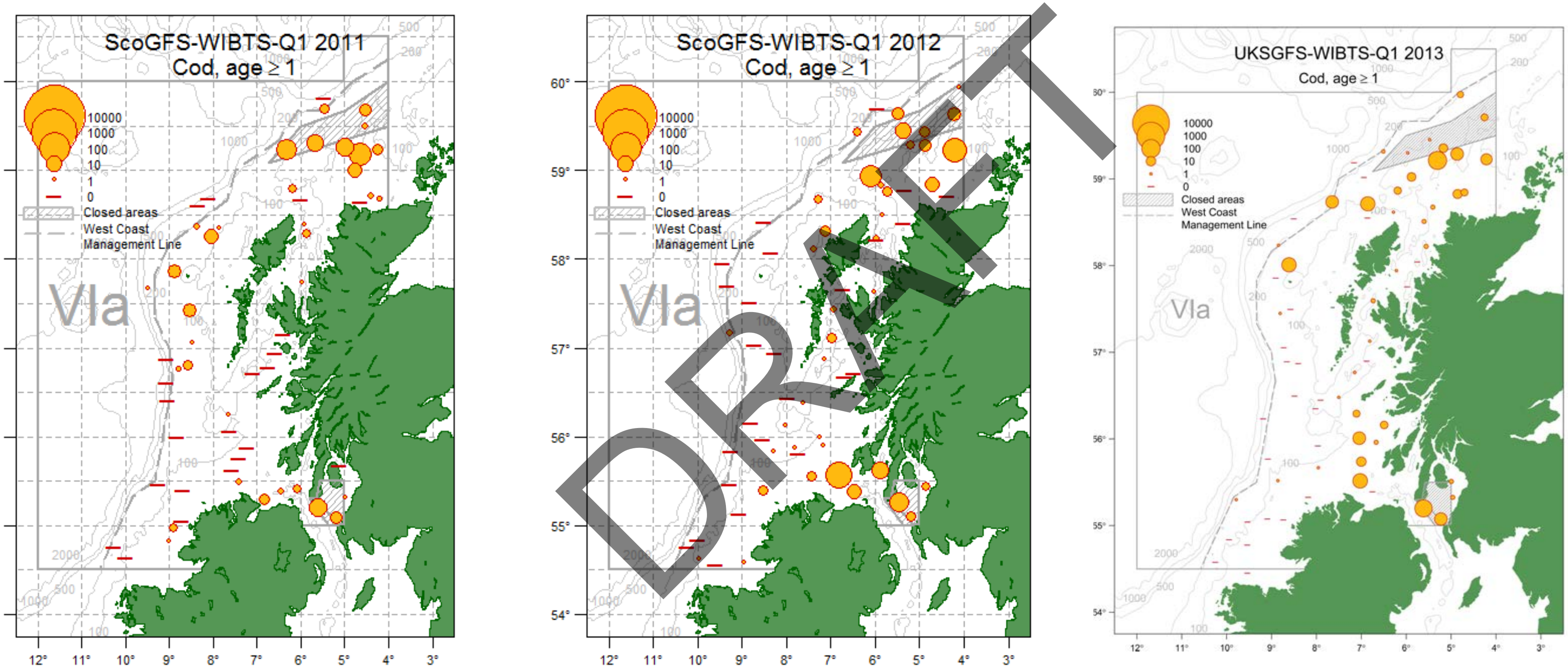


Figure 3.2.10. Cod in Division VIa. Cpue numbers for fish aged at 1+ per haul resulting from Scottish quarter one survey (UKSGFS-WIBTS-Q1). Numbers are standardised to 60 minutes towing.

Figure 3.2.11. Cod in Division VIa. Cpue numbers for fish aged at 1+ per tow resulting from Scottish quarter four survey (UKSGFS-WIBTS-Q4). Numbers are standardised to 60 minutes towing.

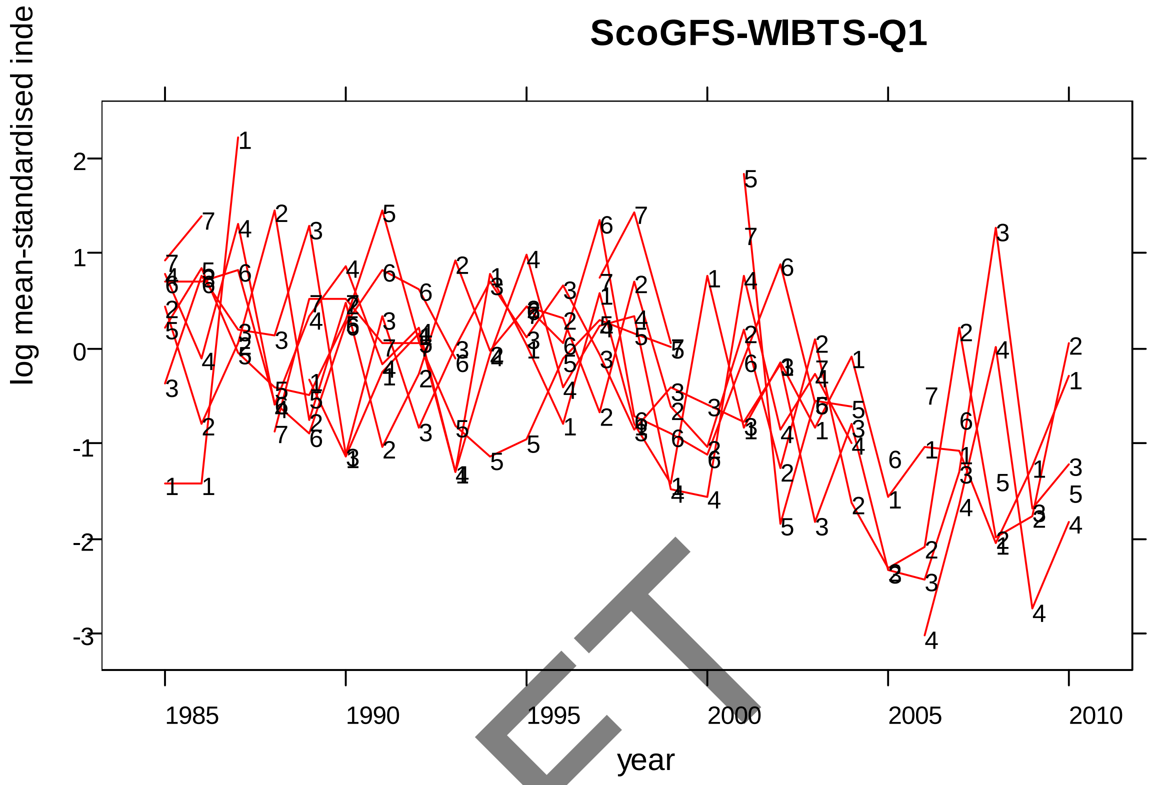


Figure 3.2.12. Cod in Division VIa. Log mean standardised index values -by year- from Scottish quarter one ground fish survey (ScoGFS-WIBTS-Q1); ages 1–6. Survey finished in 2010.

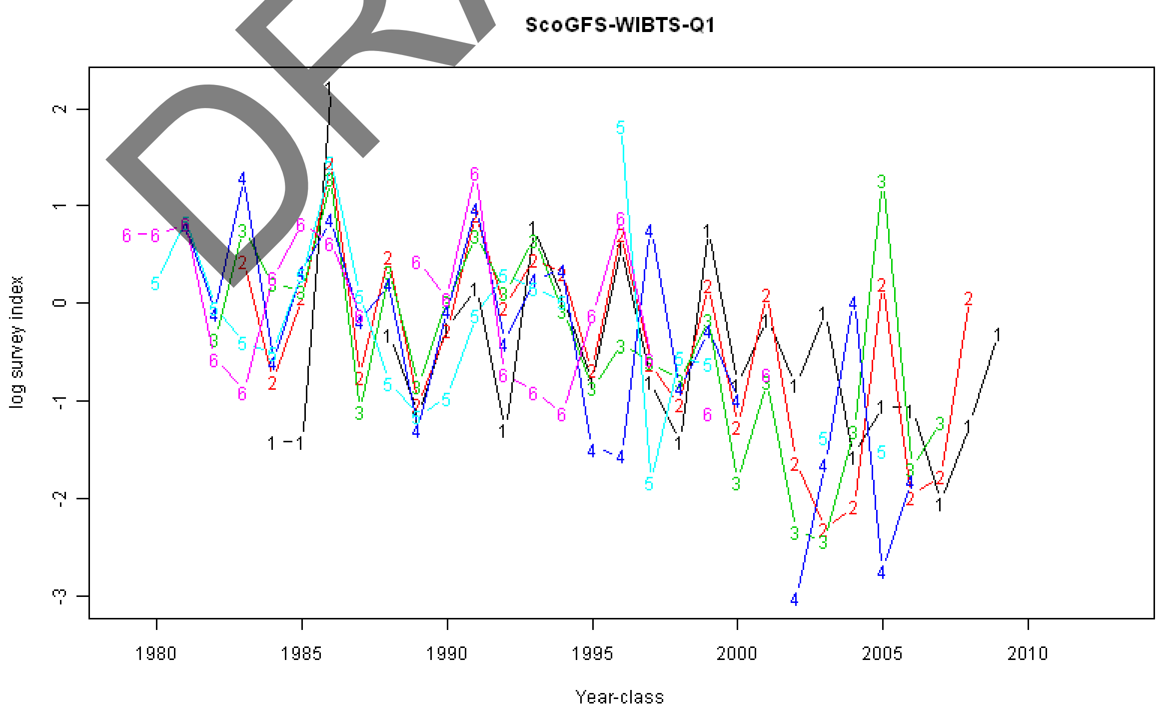


Figure 3.2.13. Cod in Division VIa. Log mean standardised index values -by cohort- from Scottish quarter one ground fish survey (ScoGFS-WIBTS-Q1); ages 1–6. Survey finished in 2010.

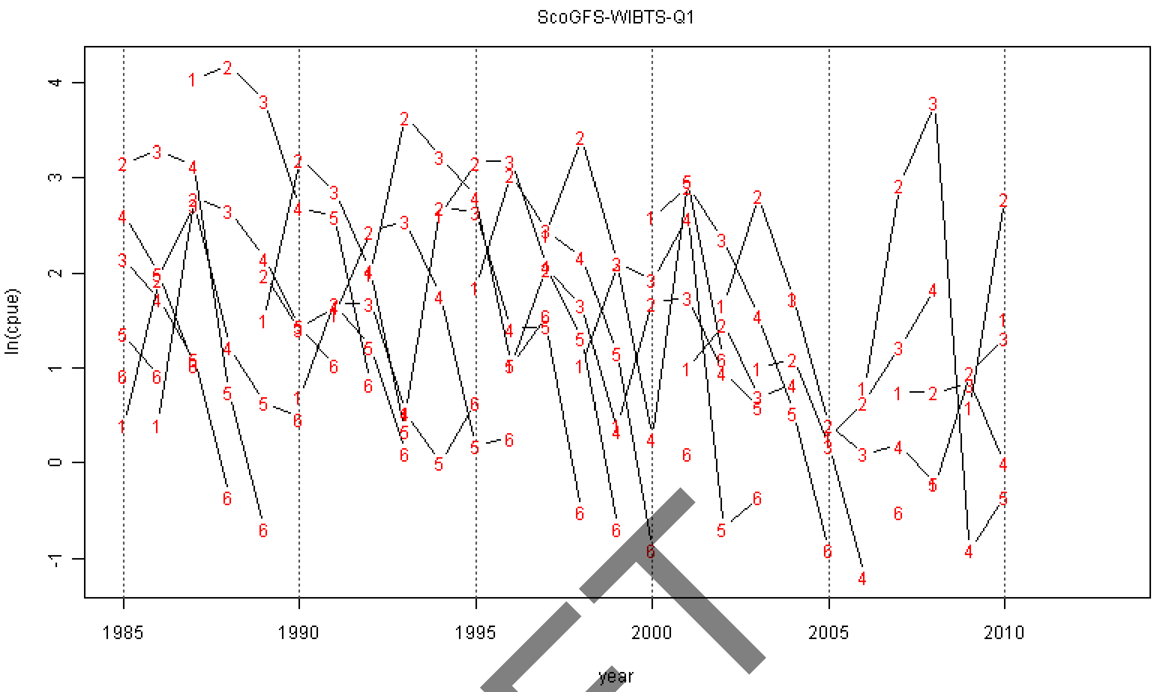


Figure 3.2.14. Cod in Division VIa. Log catch curves from Scottish quarter one ground fish survey (ScoGFS-WIBTS-Q1); ages 1–6. Survey finished in 2010.

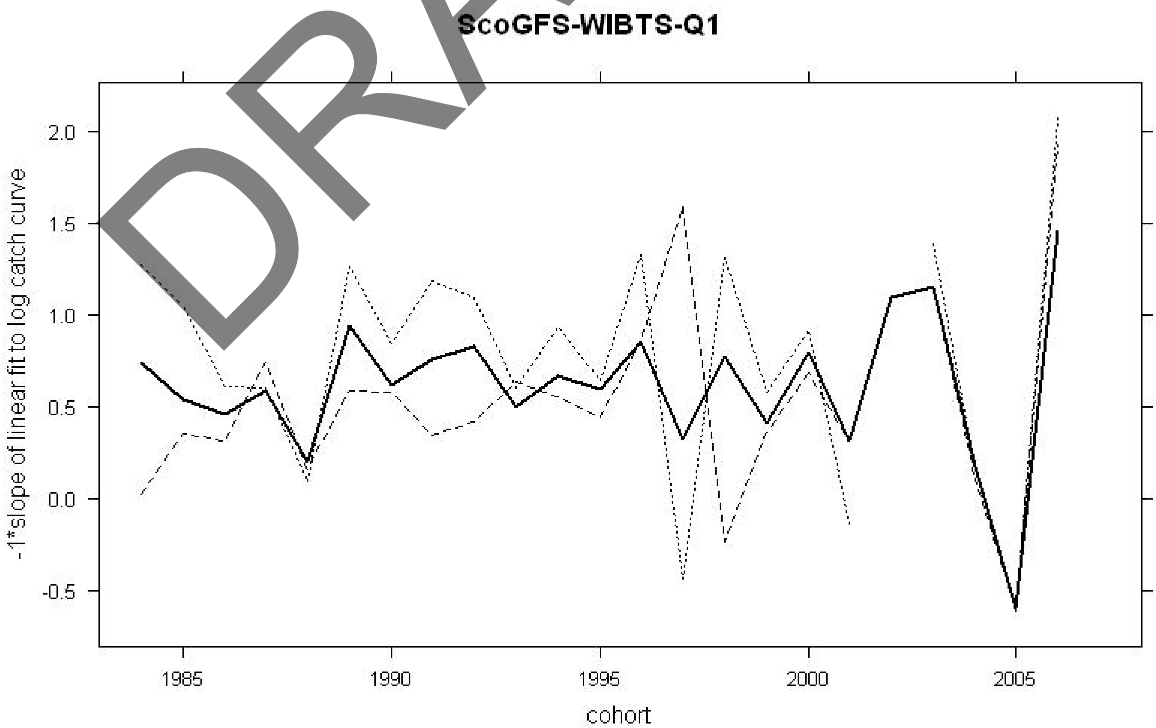


Figure 3.2.15. Cod in Division VIa. Log catch curve gradient plot using ScoGFS-WIBTS-Q1 index data. Solid line shows time-series of gradient of linear fit to curve over the age range 2–5, dashed line over the ages 2–4 and dotted line over the ages 3–5. An increasing value indicates increasing mortality. Last cohort shown was at age 5 in 2010, the last year of the ScoGFS-WIBTS-Q1 survey.

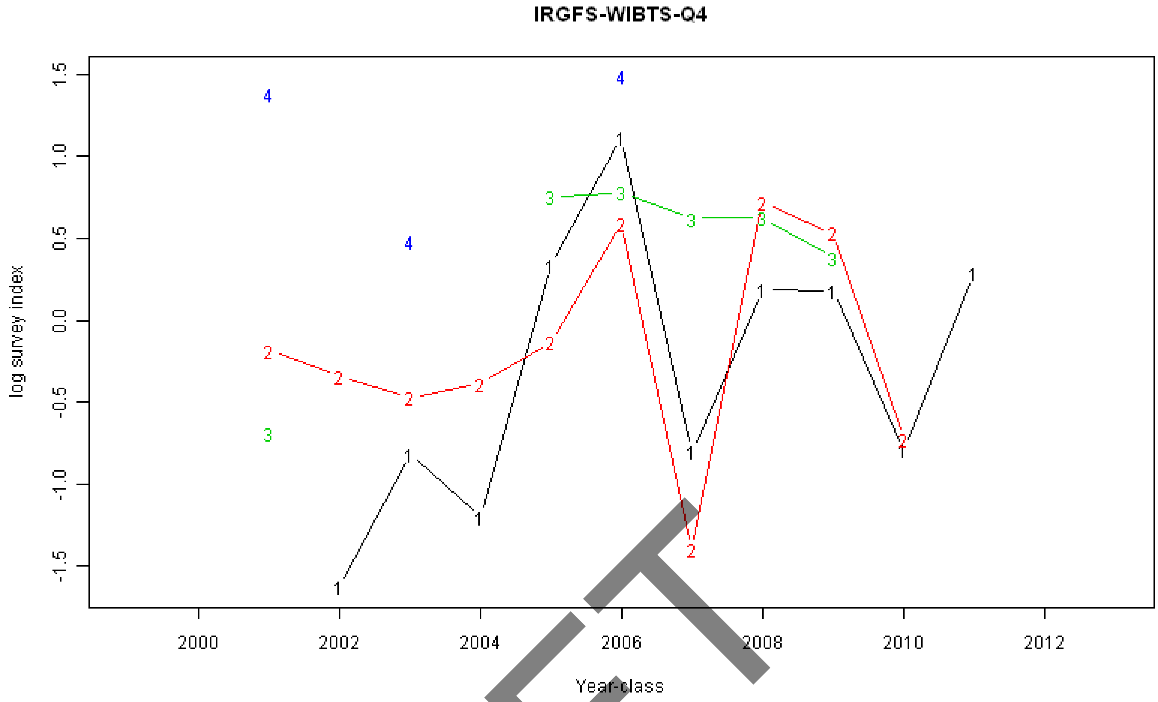


Figure 3.2.16. Cod in Division VIa. Log mean standardised index values -by cohort- from Irish quarter four ground fish survey (IRGFS-WIBTS-Q4); ages 1–4. Survey started in 2003.

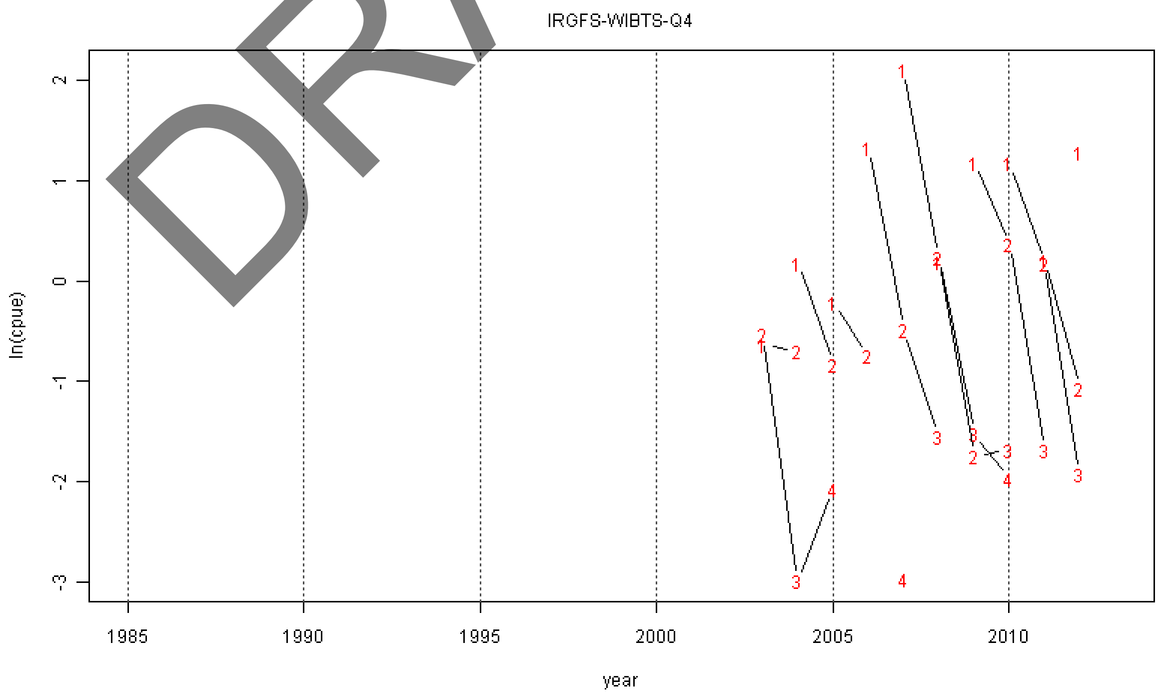


Figure 3.2.17. Cod in Division VIa. Log catch curves from Irish quarter four ground fish survey (IRGFS-WIBTS-Q4); ages 1–4. Survey started in 2003.

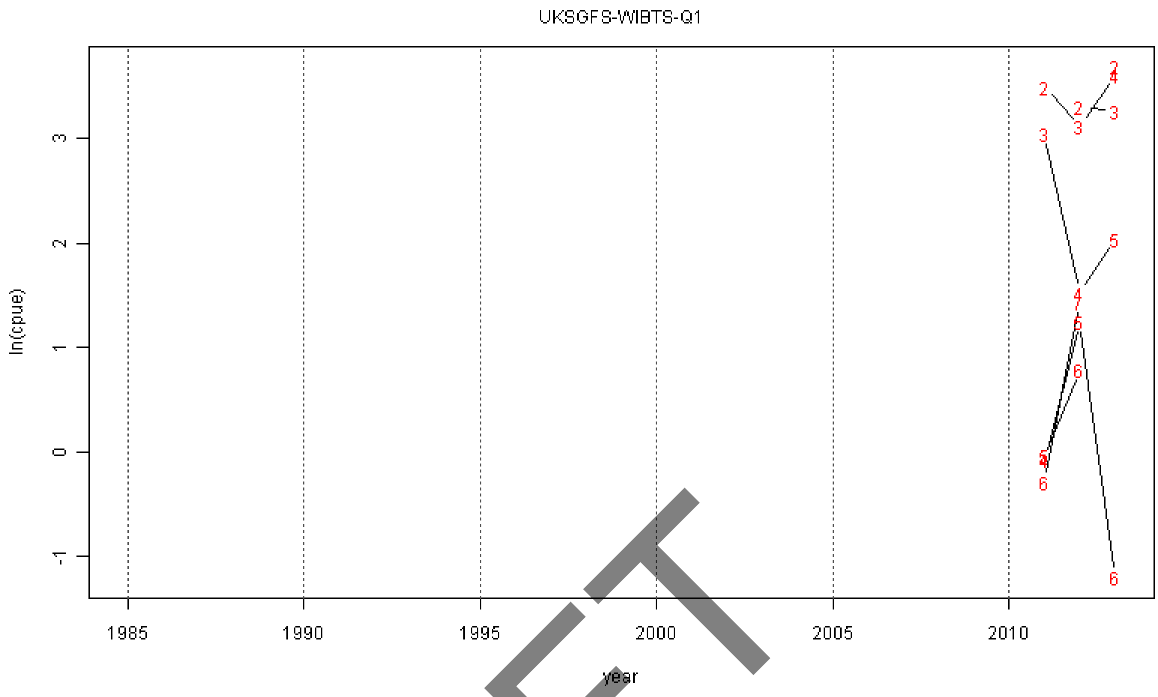


Figure 3.2.18. Cod in Division VIa. Log catch curves from new Scottish quarter one ground fish survey (UKS-IBTS_Q1); ages 2–7. Survey started in 2011.

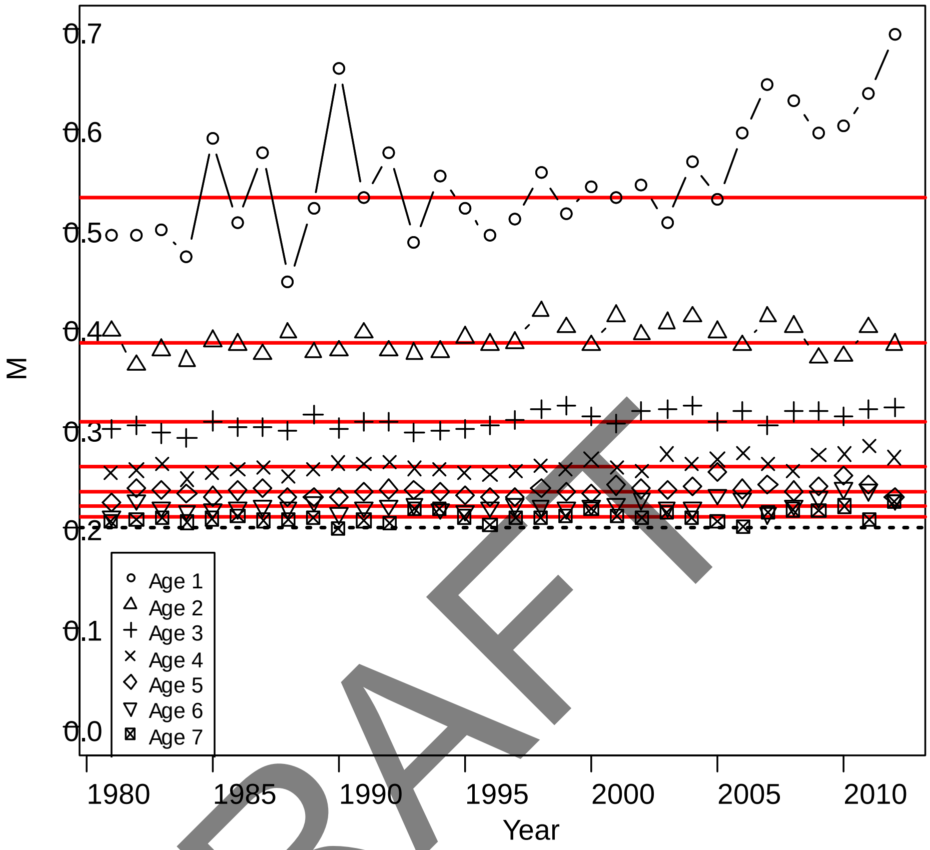


Figure 3.2.19. Cod in Division VIa. Natural mortality-at-age based on mean weight-at-age and mortality–weight relationship. Solid horizontal lines show the time averaged values at each age used in the assessment. Dotted horizontal line shows value of 0.2 previously used at all ages in all years.

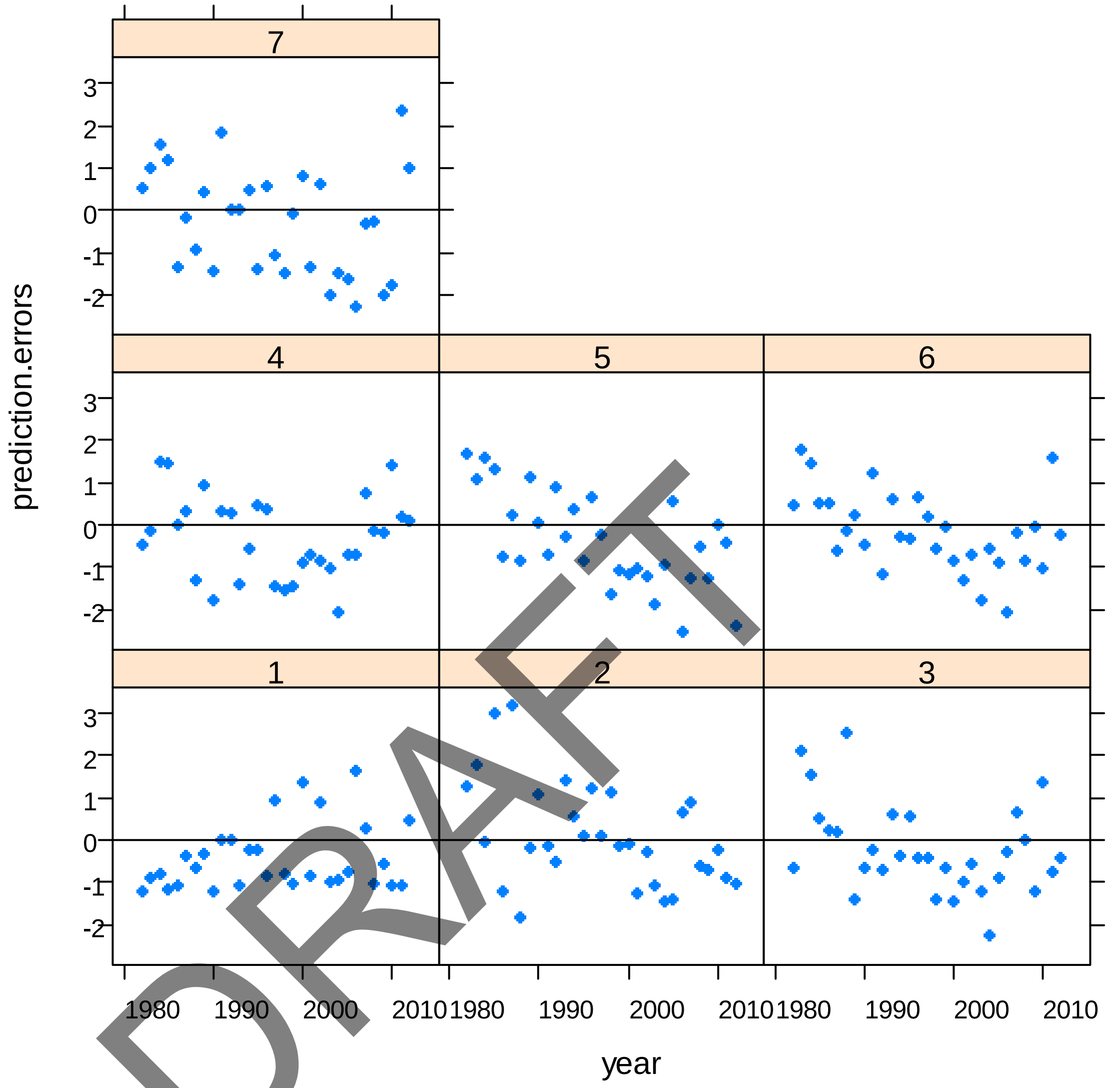


Figure 3.2.20. Cod in Division VIa. TSA final run. Standardised prediction errors at age plots for landings.

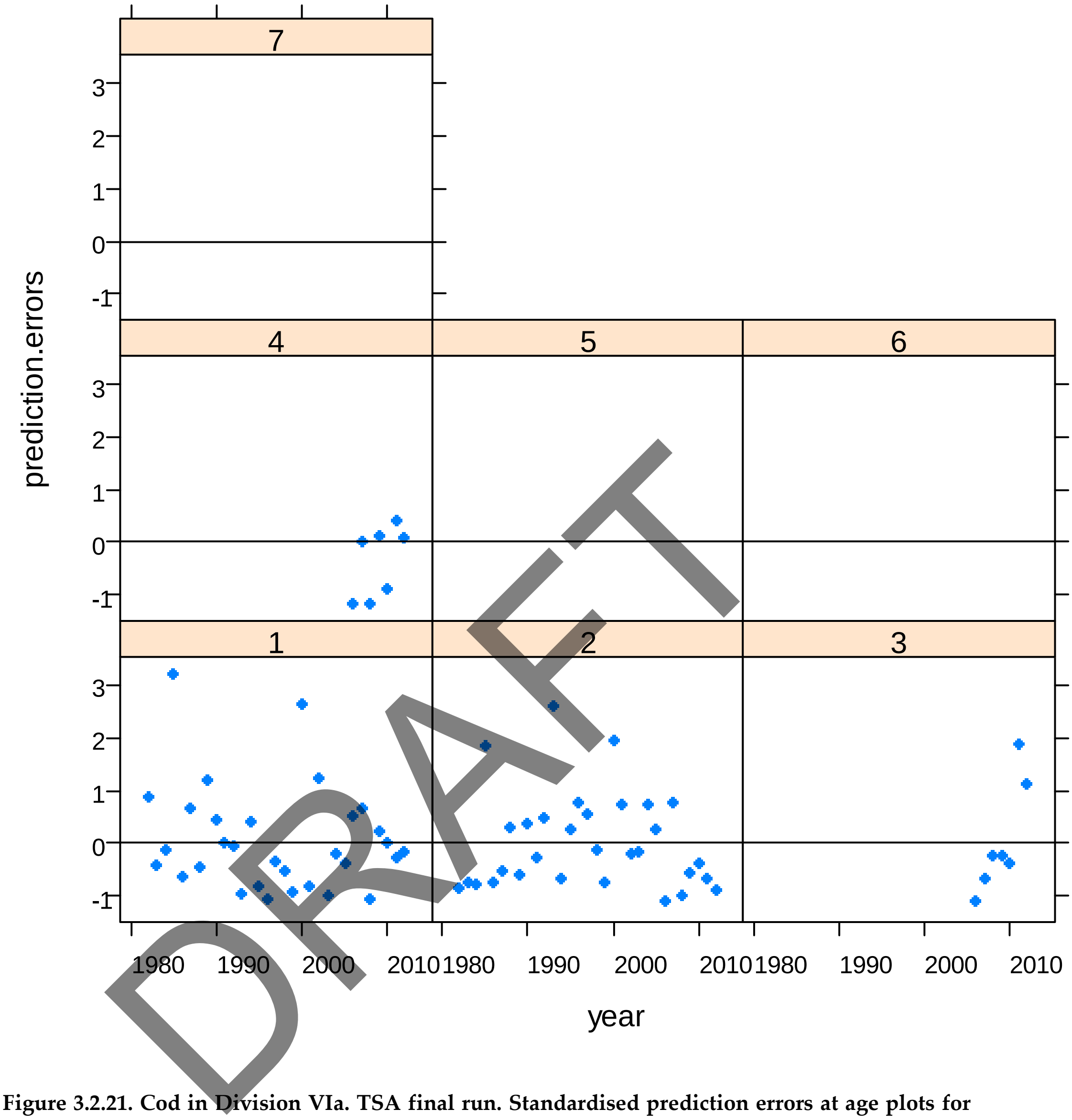


Figure 3.2.21. Cod in Division VIa. TSA final run. Standardised prediction errors at age plots for discards.

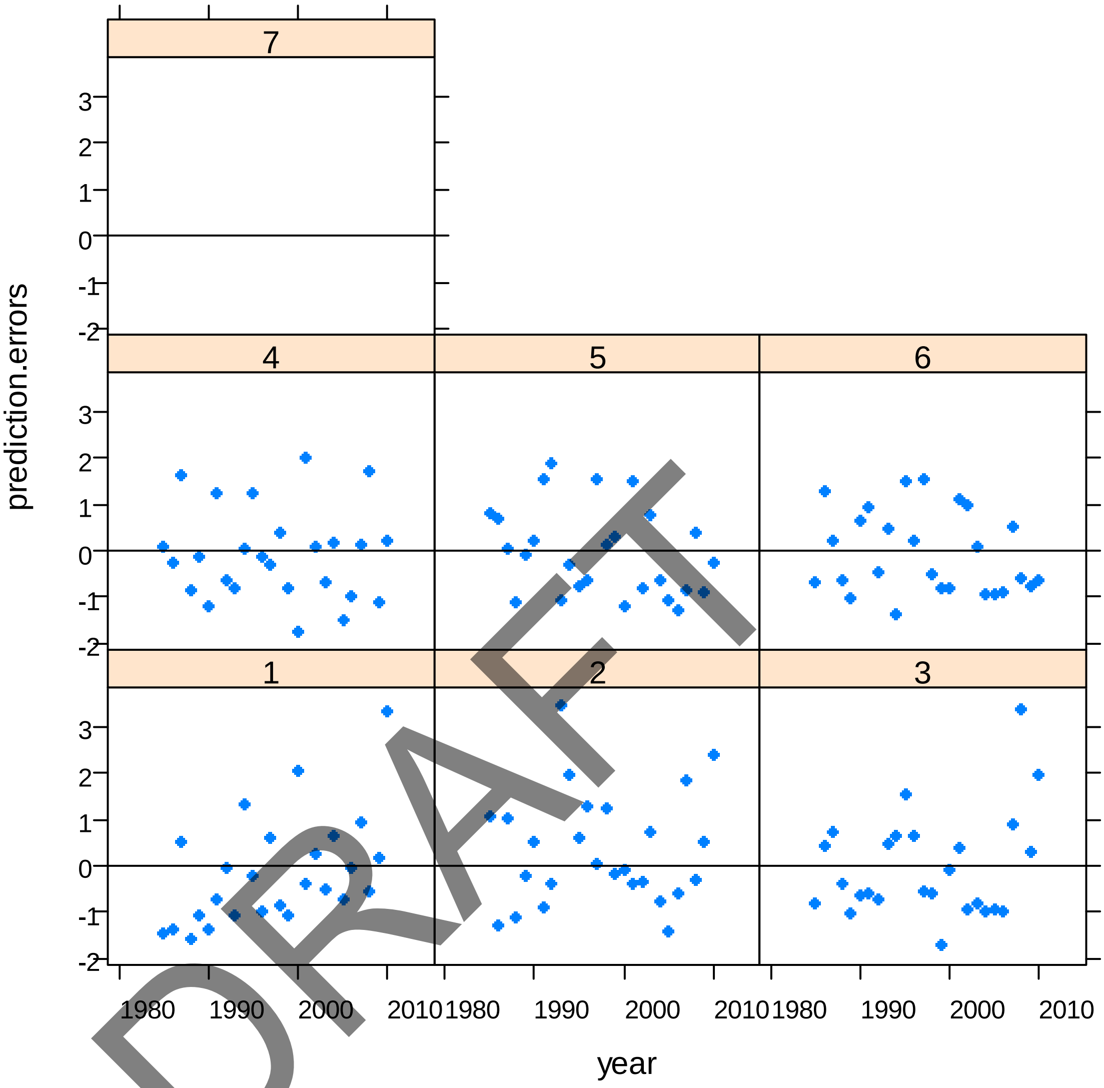


Figure 3.2.22. Cod in Division VIa. TSA run. Standardised prediction errors at age plots for ScoGFS-WIBTS-Q1.

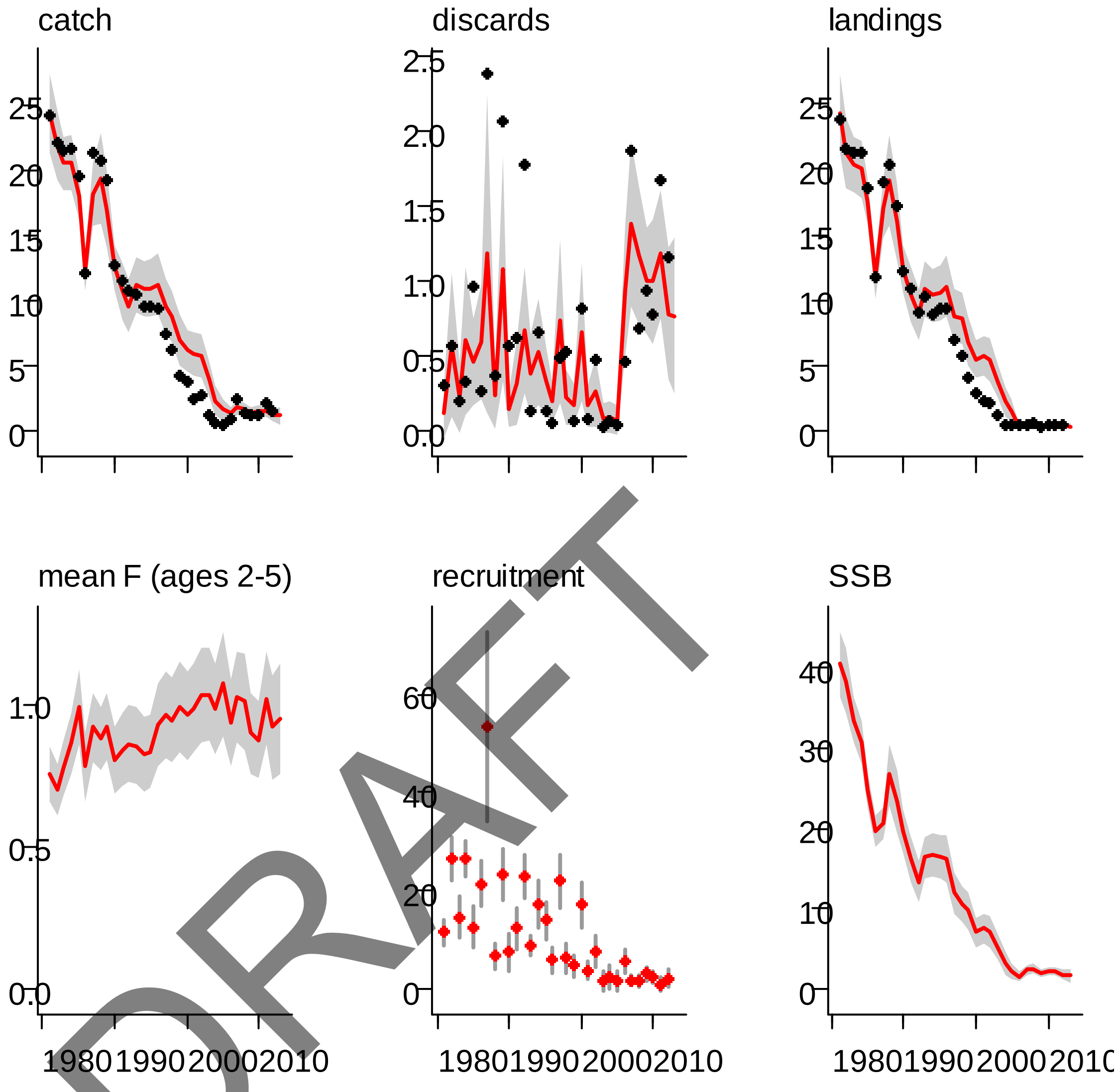


Figure 3.2.23. Cod in Division VIa. Summary plot of final TSA run.

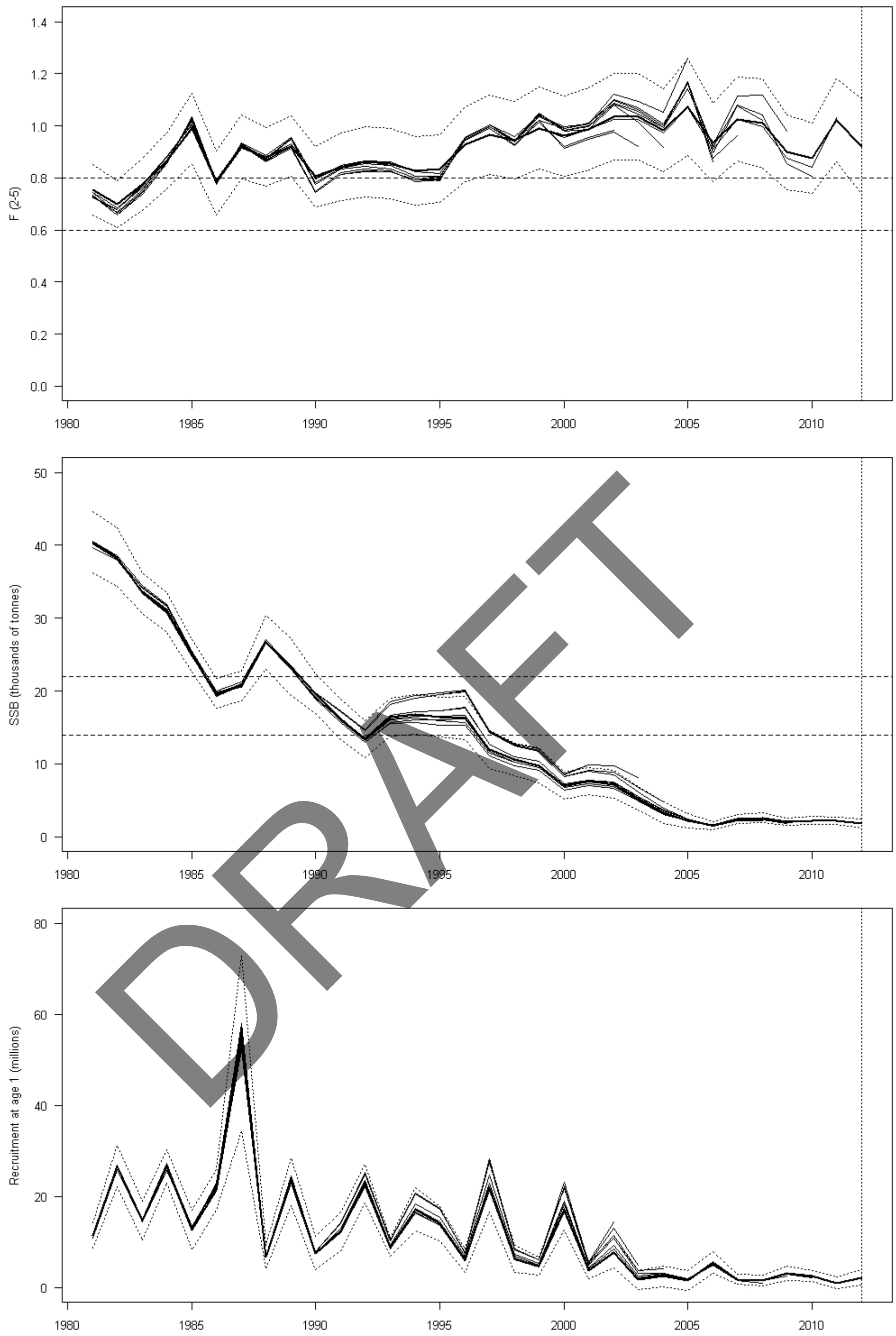


Figure 3.2.24. Cod in Division VIa. Retrospective plots of TSA run. Biological reference points are given by horizontal dashed lines. Confidence intervals for the run using all years of data are shown by dotted lines.

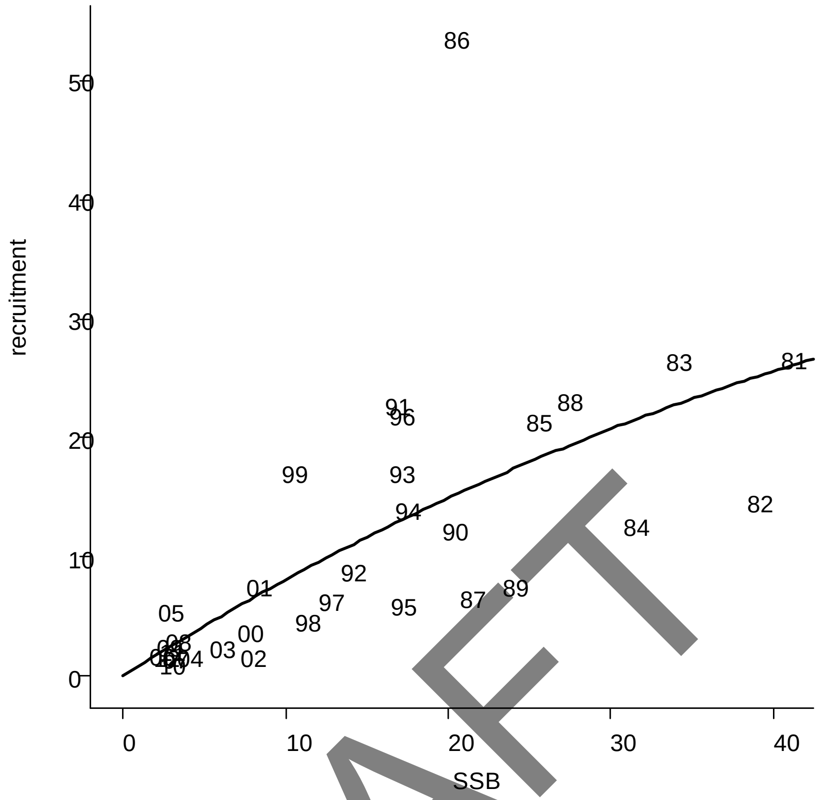


Figure 3.2.25. Cod in Division VIa. TSA final run. Stock–recruit relationship. Numbers indicate year class.

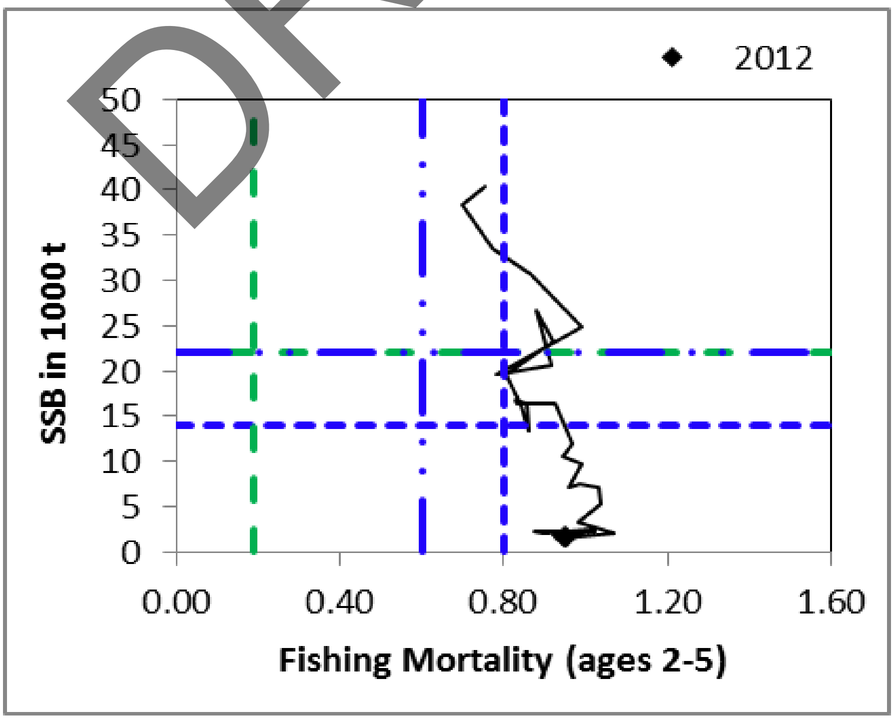
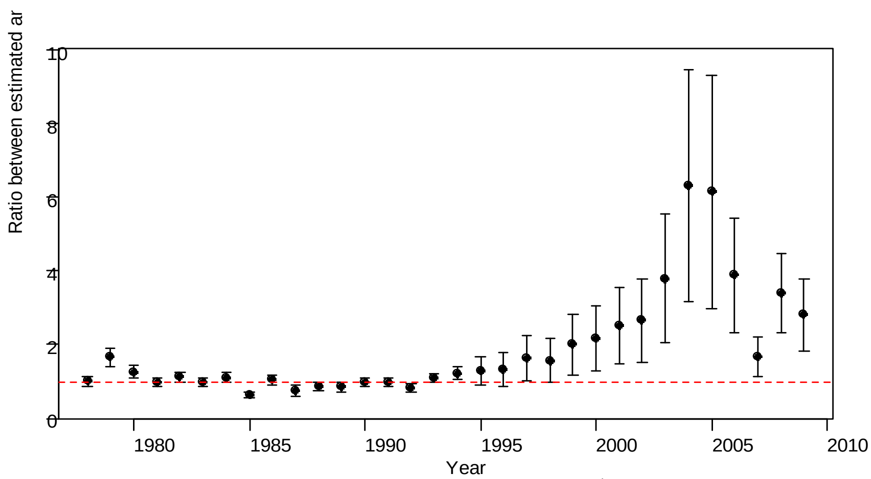
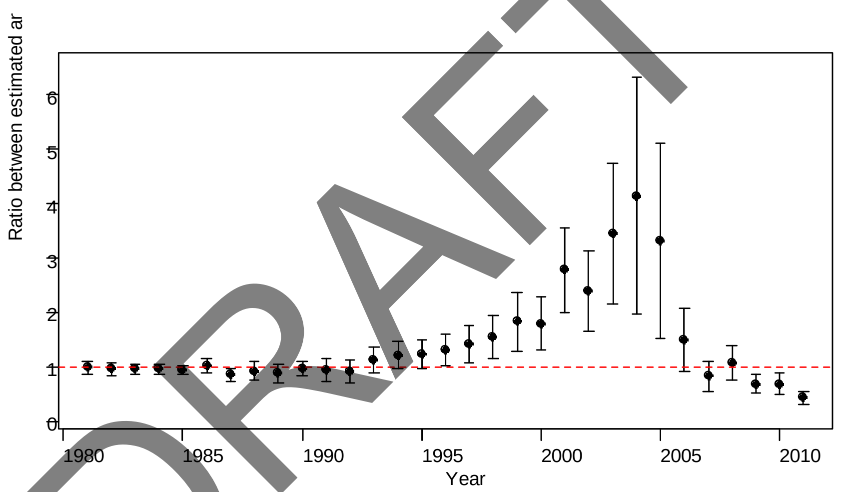


Figure 3.2.26. Cod in Division VIa. Precautionary approach plot.

a)



b)



c)

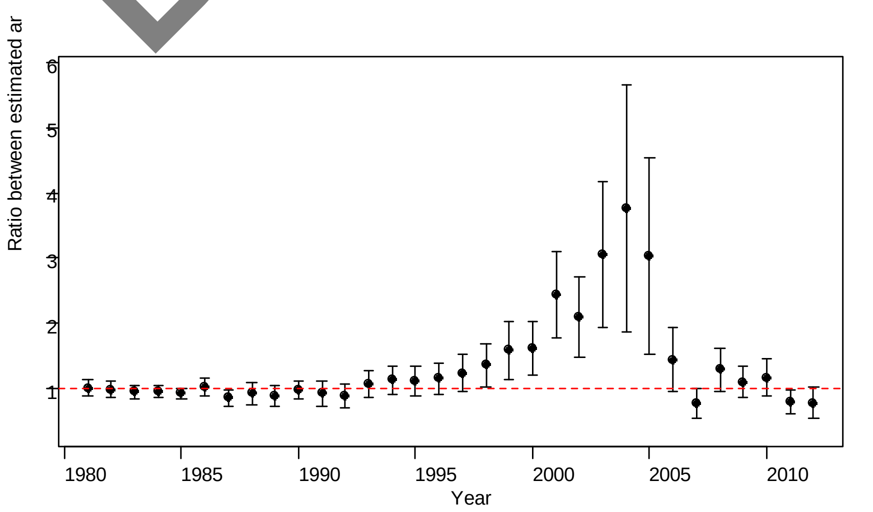


Figure 3.2.27. Cod in Division VIa. Ratio of estimated to observed catch using TSA, a) result from 2010 when catch was estimated using survey data for all years from 1995; b) 2012 assessment; c) 2013 assessment. Bars show ± 2 s.e.

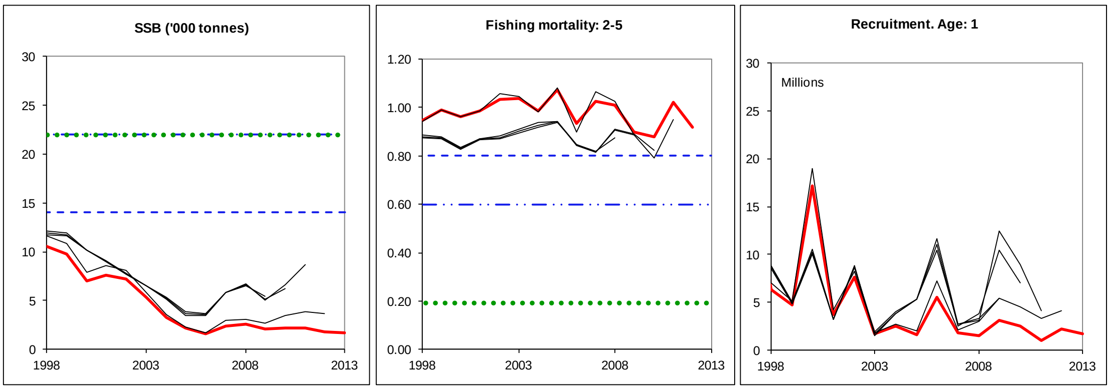


Figure 3.2.28. Cod in Division VIa. Comparison of SSB, mean F (2–5) estimates and recruitment-at-age one produced by final run assessments between this year's assessment and previous four assessments.

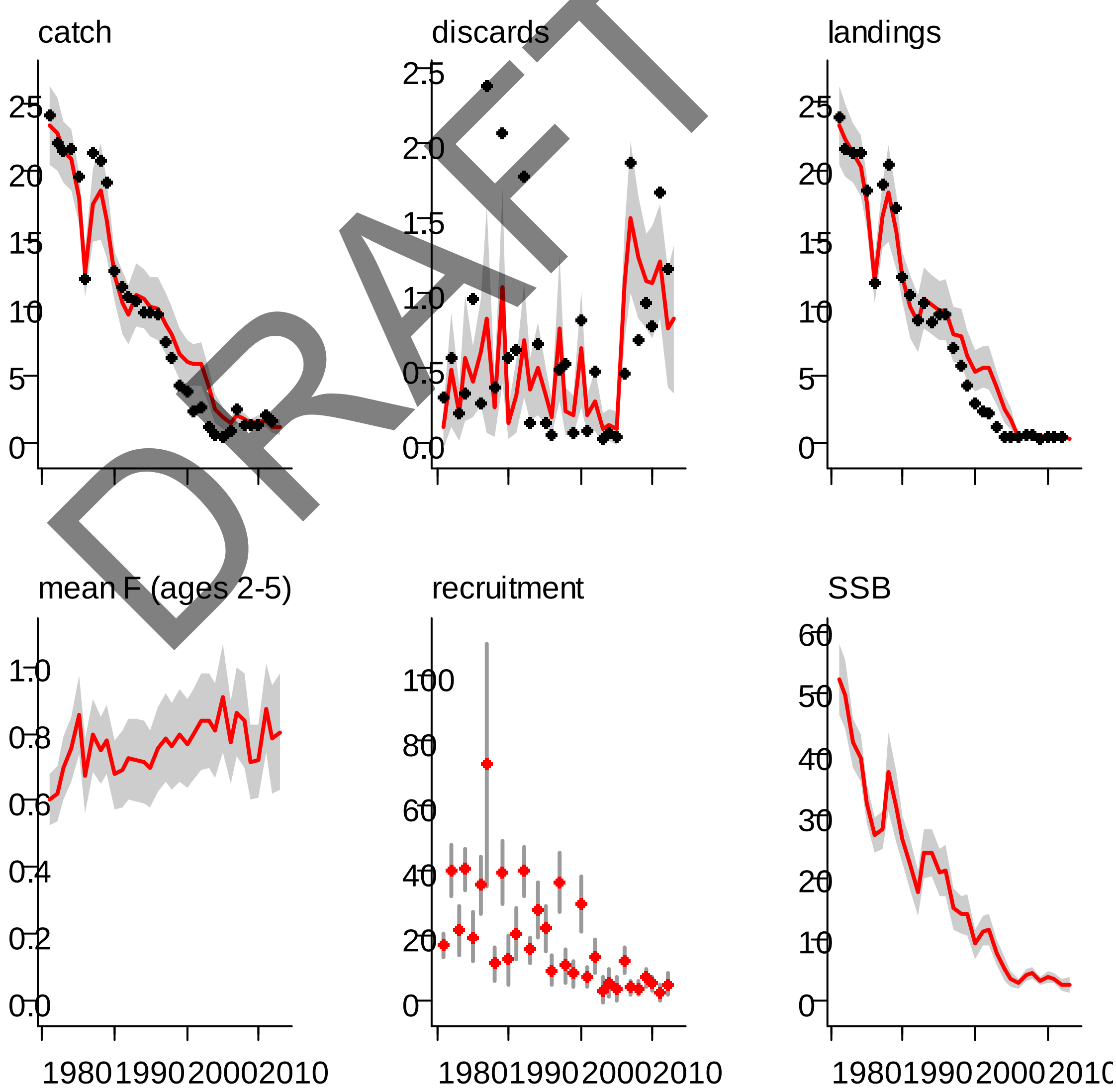


Figure 3.2.29. Cod in Division VIa. Summary plot of supplementary TSA run. Run includes a seal predation model within the assessment.

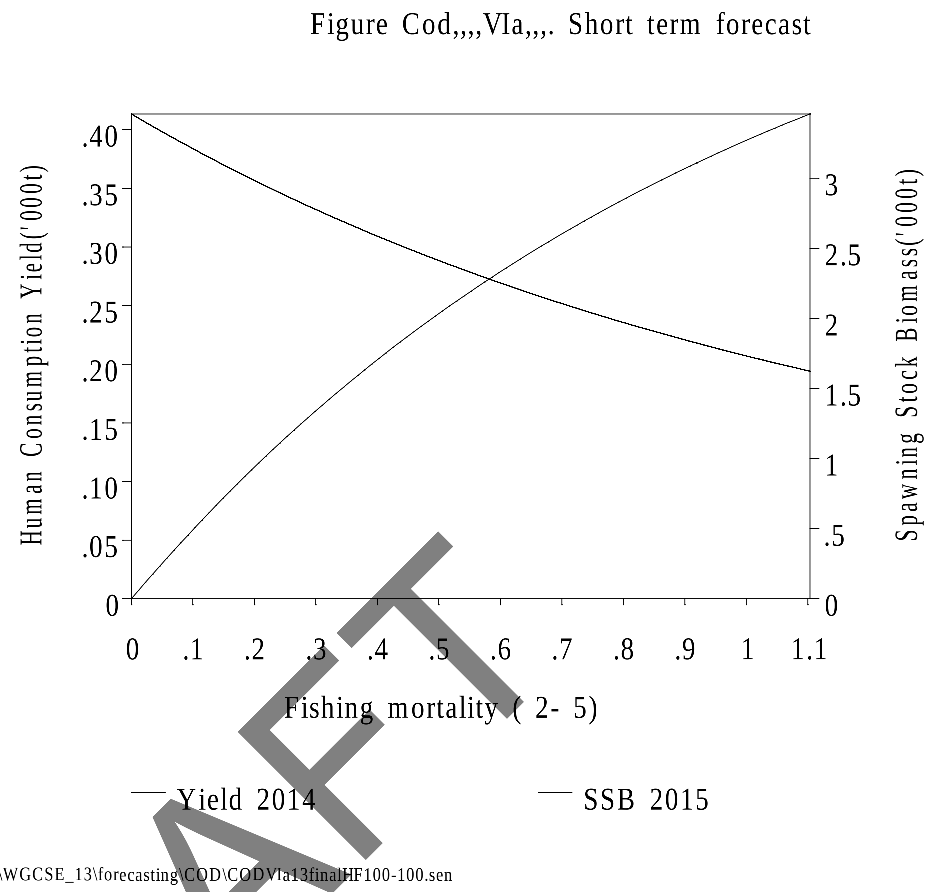


Figure 3.2.30. Cod in Division VIa. Short-term forecast.

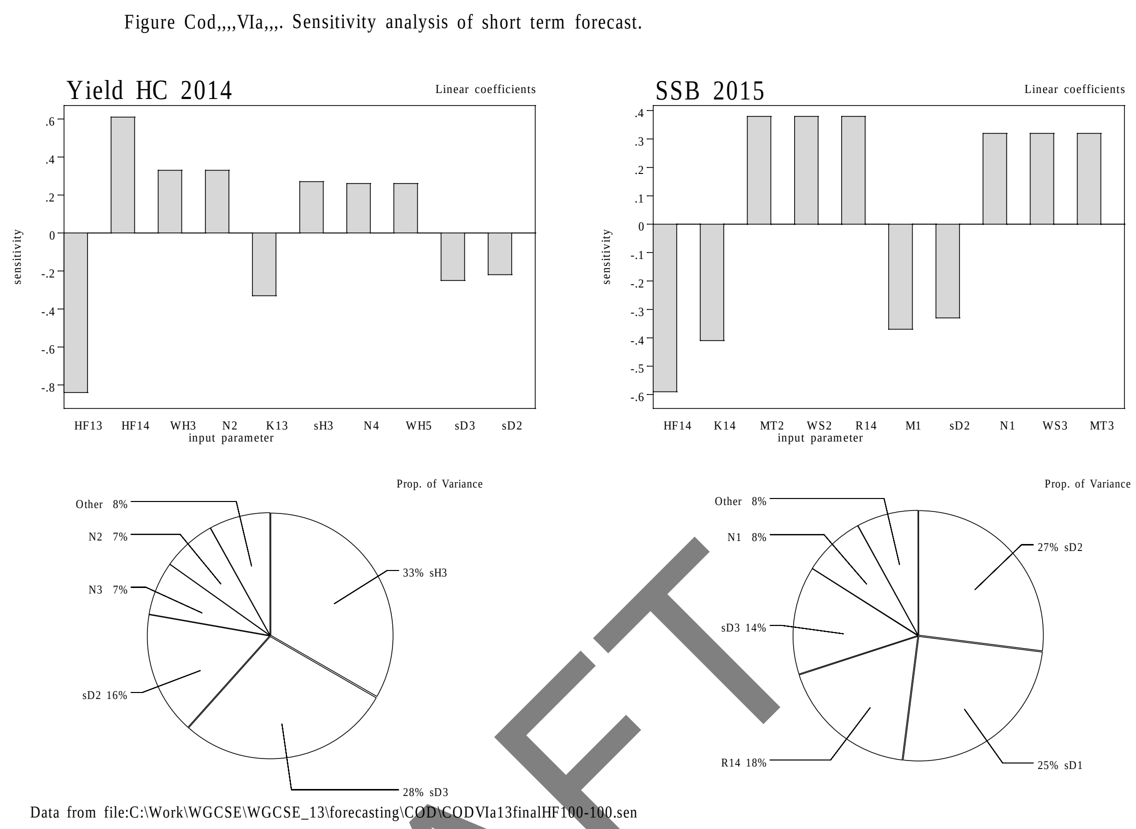


Figure 3.2.31. Cod in Division VIa. Sensitivity analysis of short-term forecast.

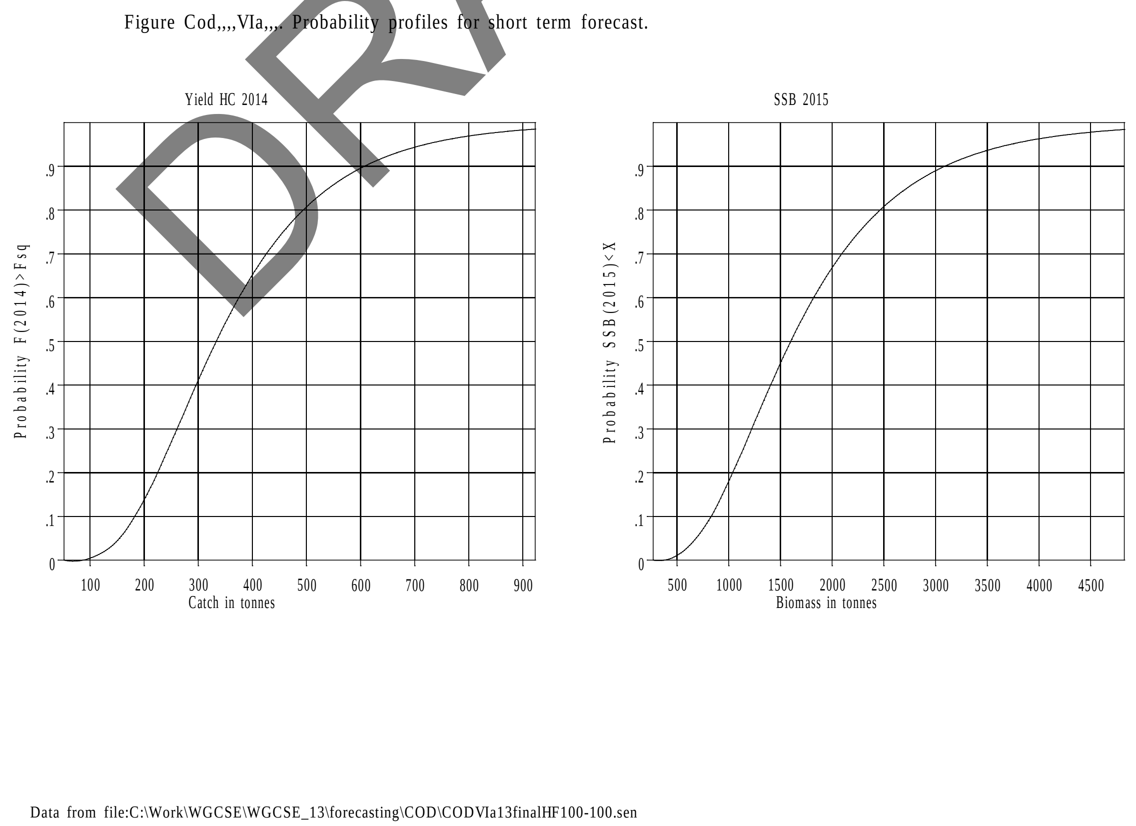


Figure 3.2.32. Cod in Division VIa. Probability profiles for short-term forecast.

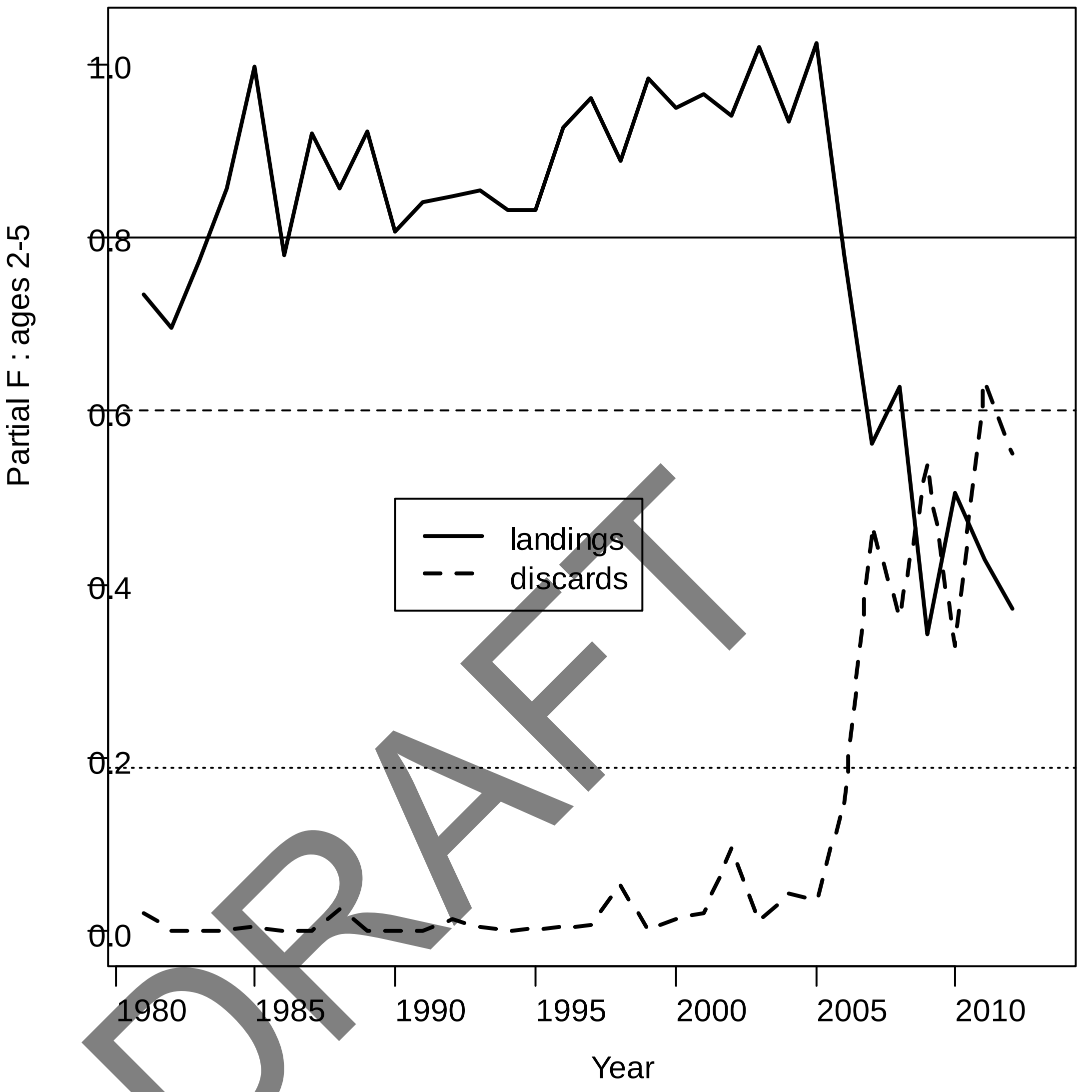


Figure 3.2.33. Cod in Division VIa. Partial mean F attributed to landings and discards. Horizontal lines represent F_{lim} (solid), F_{pa} (dashed) and F_{MSY} (dotted) values for the stock.

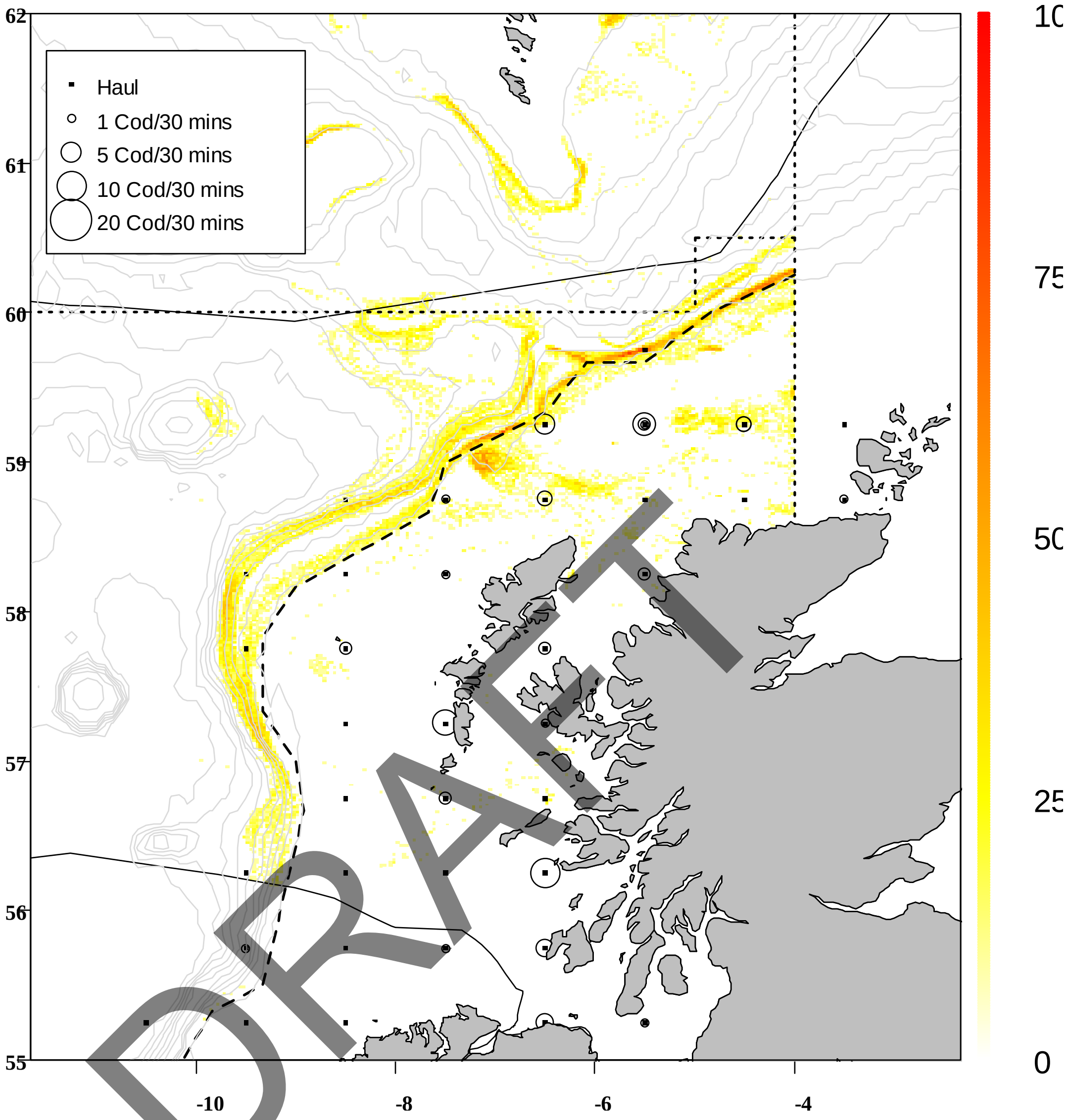


Figure 3.2.34. Scottish Q1 2010 Survey cpues of Cod plotted over Scottish (and other EU landing into Scotland) VMS data (2009 data) on fishing activity (annual VMS pings per square n.m.) associated with TR1 gear and trips with cod landings. Scottish survey results are centred on the statistical rectangle sampled. Dashed lines show ICES divisions, the broken line represents the cod management line and the solid line shows the limits of the UK EEZ, highlighting the extent of EU waters in Subdivision Vb. Depth contours are at 200 m intervals.

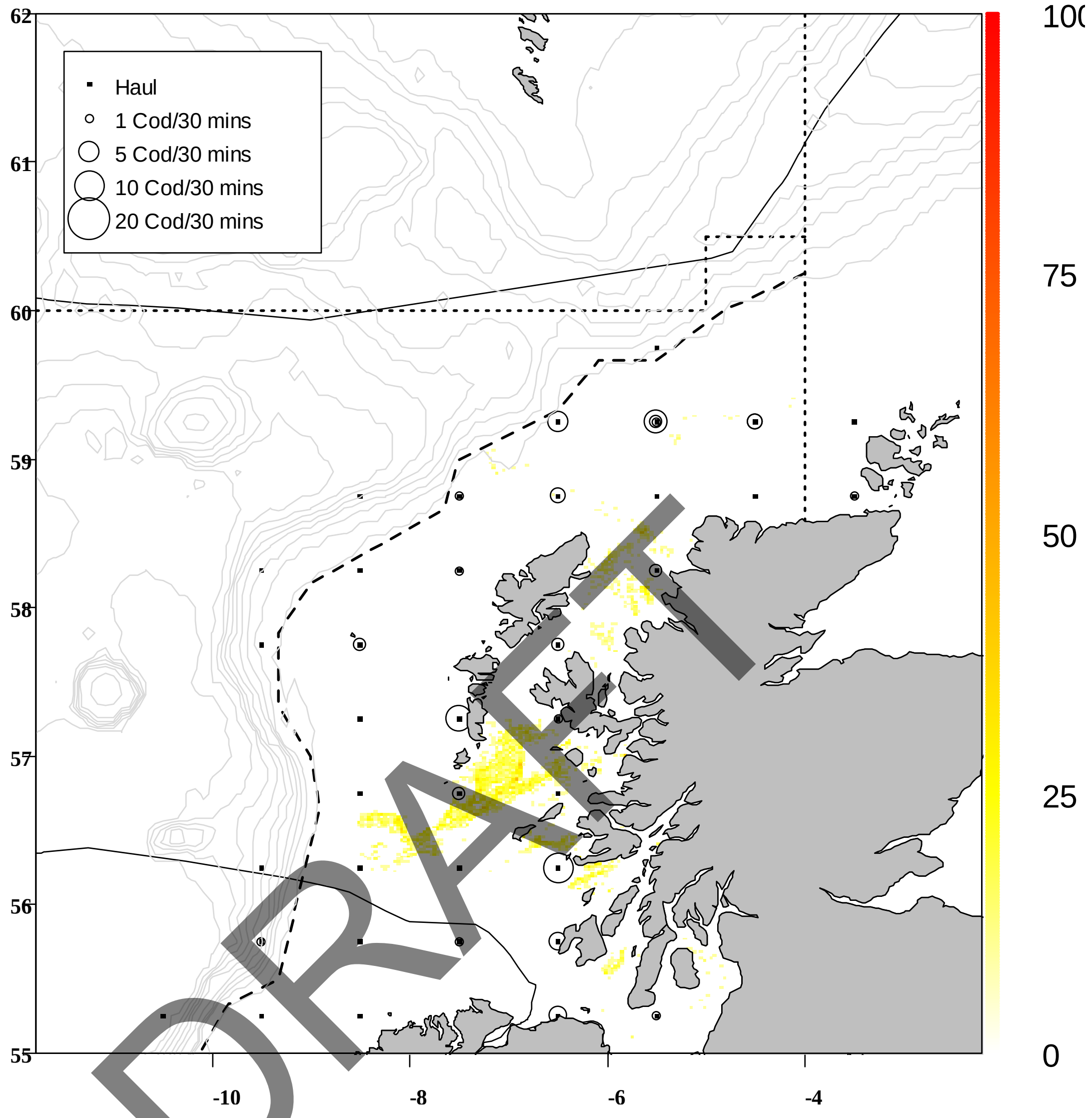


Figure 3.2.35. Scottish Q1 2010 Survey cpues of Cod plotted over Scottish (and other EU landing into Scotland) VMS data (2009 data) on fishing activity (annual VMS pings per square n.m.) associated with TR2 gear and trips with cod landings. Scottish survey results are centred on the statistical rectangle sampled. Dashed lines show ICES divisions, the broken line represents the cod management line and the solid line shows the limits of the UK EEZ, highlighting the extent of EU waters in Subdivision Vb. Depth contours are at 200 m intervals.

3.3 Haddock in Division VIa[1]

Type of assessment in 2013

The stock assessment of VIa haddock in 2013 is an update of last year's assessment using a TSA model. The model uses catch data from 1978 to 1994 and from 2006 to 2012. Two Scottish groundfish surveys are used for tuning: the ScoGFS-WIBTS Q1 (1985–2010) and ScoGFS-WIBTS Q4 (1996–2009). Due to changes in survey design, trawl ground gear and adjusted sweep lengths in waters >80 m, new data (2011 onwards) from these surveys was not used in the current assessment. See Section 3.3.2 for further explanation.

ICES advice applicable to 2012

MSY approach

Following the ICES MSY framework implies fishing mortality less than 0.3, resulting in human consumption landings of less than 10 200 t in 2012. This is expected to lead to an SSB of 40 700 t in 2013.

ICES advice applicable to 2013

MSY approach

Following the ICES MSY framework implies fishing mortality less than 0.25, resulting in human consumption landings of less than 3130 t in 2013. This is expected to lead to an SSB of 24 500 t in 2014.

3.3.1 General

Stock description and management units

A TAC relating to this stock is in place for EU and international waters of ICES management Areas Vb and VIa and the assessment is carried out using data from VIa. The basis for the stock assessment area is described in the stock annex.

The agreed minimum landing size for haddock in Division VIa is 30 cm. There is no formal management plan currently in place although one has been evaluated and considered precautionary by ICES. Further regulations implemented for the west of Scotland include technical measures associated with the cod recovery plan (EC regulation 1342/2008) and emergency measures introduced with EC regulation 43/2009. The EU Registration of Buyers and Sellers regulation has reduced bias in commercial landings data. The regulations are described in the overview section for this management area (Section 3.1).

The following table summarizes EC TACs applied for haddock in Division VIa during 2012.

[1] Corrected forecast results are available in Annex 5.

Species: Haddock *Melanogrammus aeglefinus*		Zone: EU and international waters of Vb and VIa (HAD/5BC6A.)
Belgium	7	
Germany	8	
France	332	
Ireland	985	
United Kingdom	4 683	
Union	6 015	
TAC	6 015	Analytical TAC

Values are in tonnes.

The following table summarizes EC TACs applied for haddock in Division VIa during 2013.

Species: Haddock *Melanogrammus aeglefinus*		Zone: EU and international waters of Vb and Via (HAD/5BC6A.)
Belgium	5	
Germany	6	
France	232	
Ireland	690	
United Kingdom	3 278	
Union	4 211	
TAC	4 211	Analytical TAC

Values are tonnes.

Fishery in 2012

Official (reported) landings for each country participating in the fishery are given in Table 3.3.1. Vessels operating in the fishery are mainly Scottish and Irish and the amount of quota allocated to different countries reflects this.

Uptake of quota is given here and is calculated from the official landings as a proportion of the EC allocated quota for each country. None of the countries used their entire quota, which led to a total uptake of ~83%. This uptake is in line with recent years values (e.g. ~79% in 2009, ~87% in 2011) where the odd value was 109% in 2010. Discards data that are reported are dealt with in the following section.

Country	TAC 2012	Official landings*	% uptake of quota
Belgium	7	0	0%
Germany	8	0.1	1%
France	232	31.8	9%
Ireland	690	845	86%
Norway	0	0.2	NA
Faroe Islands	0	0.3	NA
UK	3278	4122	88%
EC	4211	5000	83%

Values of TAC (Total Allowable Catch) and landings are in tonnes.

*** The official landings provided to the WG for 2012 are preliminary at time of writing in 2013.**

3.3.2 Data

An overview of the data that have been provided to the WG is given in Section 2, including sampling levels by country for this stock. The reliability of catch data for this stock was a concern for several years, due to issues such as misreporting or underreporting and associated unaccounted discarding. It became impossible to quantify the extent of unallocated removals, leading to the use at the 2006 meeting of a modified TSA assessment method which did not use catch data after 1994.

Recent changes in regulations and fleet behaviour have improved the quality of catch data, which is now thought to be more representative of the true catch. The UK Registration of Buyers and Sellers Regulations introduced in 2006 are likely to have reduced or largely eliminated underreported landings. Nevertheless, information from the Compliance section of Marine Scotland suggests that approximately 304 tonnes of haddock were suspected of misreported out of Area VIa in 2012 (~7% of the officially reported UK(Scotland) landings). At the same time 100 tonnes were suspected of misreported into Area VIa (~2% of the officially reported UK (Scotland) landings). The TAC in recent years (exception in 2010) was not restrictive. The values of misreporting are quite high and its inclusion on the assessment is a possibility that should be considered on next year benchmark.

Official landings as reported to ICES and estimated by the WG are provided in Table 3.3.1.

Catch-at-age data

Total catch-at-age data (landings and discards) are given in Table 3.3.2., while catch-at-age data and mean weights-at-age for each catch component (landings and discards) are given in Tables 3.3.3–3.3.7. The full available year and age range are given for completeness: however, it should be noted that commercial catch data before 1978 are not used in the assessment. The year of 1978 was the start year of the discard observer programme and for that reason data collected from that year onwards is reliable allowing the split of total catch into landings and discards.

Discards

WG estimates of discards are based on data collected in the Scottish and Irish discard observer programmes. Discards for the remaining fleets are raised by weighted average (Table 3.3.4.) using Scottish and Irish data. The 2012 discard data from Scotland and Ireland was raised based on respectively 23 and 14 sample observer trips, spread across 2012.

Biological

Weights-at-age

The estimated weights-at-age for the total catch in Division VIa are given in Table 3.3.5. These are calculated as weighted averages of the corresponding weights-at-age in landings and discards: the latter are given in Tables 3.3.6.and 3.3.7. Weights-at-age in the stock are assumed to be equal to the weights-at-age in the total catch, in the absence of a sufficiently long time-series of survey-based weight measurements. The weights-at-age time-series are also plotted in Figures 3.3.1–3.3.3. These show that weights-at-age in landings (and, by extension, catch and stock) for majority of ages have increased considerably in the last year. The mean weight for age 2 became the highest in the time series with 490 g. The exceptions to this increase are age 7 and plus group which had a decrease in weight. However, the older ages tend to be more variable as sampling tends to be smaller leading to increase in variation. Weights-at-age in discards are relatively constant and since 2010 the weight for all but one (age 2) ages is increasing. In 2011 there were no fish samples at age 1 in the Scottish and Irish landings, therefore it is more difficult to understand why there is a marked increase in weight for the age 2 in 2012. Also the age 1 discard samples show a decrease in weight in relation to the long-term average which is 142 grams; age 1 discarded fish weigh on average 91 grams based on Scottish data and 161 grams based on Irish data. According to Dickey-Collas *et al*., 2003, haddock tends to grow faster in the southern area of Division VIa, where the mean temperature is higher than in the West of Scotland (1°C less than the Irish Sea and 2°C less than the Celtic Sea) and where the Irish fishing vessels are most likely to operate. This might explain the differences between Scottish and Irish values but does not explain the difference with the long-term average.

Natural mortality and maturity

Natural mortality was assumed to be 0.2 for all ages and years, and maturity was assumed to be as follows:

Age	1	2	3+
Proportion mature	0.00	0.57	1.0

Proportions of F and M before spawning were both set to 0.0, in order to generate abundance (and hence SSB) estimates dated to January 1st.

Surveys

Research vessel surveys

Four research-vessel survey-series are available for the assessment of haddock in Division VIa as given in the following table:

Survey	Years available	Ages available	Ages used
ScoGFS-WIBTS Q1	1985–2010	1–8	1–7
ScoGFS-WIBTS Q4	1996–2009	0–7	1–7
IGFS-WIBTS-Q4	1993–2002	0–8	-
New IGFS-WIBTS-Q4	2003–2012	0–10	-

The reports of the 2006 meeting of the WG (WGNSDS 2006) and the 2007 meeting of the IBTS WG (IBTSWG 2007) explored available survey data in detail. Both ScoGFS-WIBTS-Q1 and Q4 were first accepted for use in the 2006 assessment, and this practice has been continued in subsequent years. The IGFS-WIBTS-Q4 series was not considered for further use due to problems with internal consistency (ICES-WGNSDS 2006). The new IGFS-WIBTS-Q4 series has nine years of data and can be considered for tuning purposes at the next benchmark assessment.

All survey-series available for tuning the assessment are given in Table 3.3.8; the data that were used in the final assessment are boxed. Plots of the spatial distribution of the ScoGFS-WIBTS-Q1 and Q4 survey mean catch rates per ICES statistical rectangle by age class are given in the stock annex.

Commercial catch-effort series

The available commercial effort and lpue data for this stock are indicated in the stock annex.

3.3.3 Historical stock development

The model used for this assessment is the state space model TSA, with data from two research vessel surveys (1985–2010) and with catch data included 1978–1994 and 2006–2012, corresponding to the time periods when catch data are thought to be reliable. The model is run using R. Outputs from the TSA assessment are shown in Figures 3.3.4–3.3.10 and Tables 3.3.10–3.3.14.

The reliability of landings data for haddock was a concern for several years and it was not possible to quantify the extent of unallocated removals. Therefore, at the 2006 meeting, it was decided to use a modified TSA assessment method that did not use catch data after 1994. This remained the accepted assessment method for the 2007–2009 meetings. In 2010, measurable improvements in the reliability of catch data (Section 3.3.2) made the WG question the continued discrepancy between the prediction of landings by the model and the reported catches after 2005. Furthermore, while the assessment was primarily survey based, the uncertainty around estimates of F was appreciable, and the estimate was not coming down in years when evidence of reduced effort indicated a probable reduction in F. Therefore the catch data, starting from 2006, were re-included in the 2010 assessment.

The re-inclusion of catch data has been implemented with TSA in other assessments for which this model is used. For example, catch data were re-included in the assessment of VIa cod at the 1997 meeting of the Working Group for the Assessment of Northern Shelf Demersal Stocks (WGNSDS, 1997). The catch data for cod were re-included in following assessments, but were removed again subsequently because of more recent concerns over reported landings for that stock. See Section 3.2.

Final update assessment

The assessment in 2013 was an update, including data indicated in the table below, which summarizes the data ranges used in recent assessments.

Data	2008 assessment	2009 assessment	2010 Assessment	2011 assessment	2012 assessment	2013 assessment
Catch data	Years: 1978–1994 Ages: 1–8+	Years: 1978–1994 Ages: 1–8+	Years: 1978–1994 and 2006–2009 Ages: 1–8+	Years: 1978–1994 and 2006–2010 Ages: 1–8+	Years: 1978–1994 and 2006–2011 Ages: 1–8+	Years: 1978–1994 and 2006–2012 Ages: 1–8+
Survey: ScoGFS Q1	Years: 1985–2008 Ages 1–7	Years: 1985–2009 Ages 1–7	Years: 1985–2010 Ages 1–7	Years: 1985–2010 Ages 1–7	Years: 1985–2010 Ages 1–7	Years: 1985–2010 Ages 1–7
Survey: ScoGFS Q4	Years: 1996–2007 Ages 1–7	Years: 1996–2008 Ages 1–7	Years: 1996–2009 Ages 1–7	Years: 1996–2009 Ages 1–7	Years: 1996–2009 Ages 1–7	Years: 1996–2009 Ages 1–7
Survey: IGFS	Not used	Not used	Not used	Not used	Not used	Not used

Table 3.3.9 shows the evolution of the corresponding TSA parameter estimates since 2003.

Standardized prediction errors from the assessment model are shown in Figures 3.3.5 (landings), 3.3.6 (discards), 3.3.7 (ScoGFS-WIBTS-Q1) and 3.3.8 (ScoGFS-WIBTS Q4). TSA is a state–space model, and these prediction errors are an analogous (but not completely equivalent) diagnostic tool to residuals of fits from other stock assessment models. The small, negative prediction errors for the landings and discards in the period 2006–2010 at various ages show that the model is predicting landings and discards to be slightly higher than observed data. Generally the prediction errors do not show a pattern persisting for longer than five years. The only cases where this occurs are for age 1 of the ScoGFS-WIBTS-Q1 index (Figure 3.3.7). The magnitude of these (age 1 ScoGFS) prediction errors is relatively small (ranging from -0.9 to -1.6). A similar, inconsequential, pattern is seen in the fit to the ScoGFS-WIBTS-Q4 index (Figure 3.3.8). None of the prediction errors are of a magnitude or show a pattern which would invalidate the model fit. Negative prediction errors in the survey indices at age 1 indicate lower than expected recruitments in recent years.

Previous assessments have applied a down-weighting to certain data points, based on the TSA prediction errors. High values of prediction errors do occur and the procedure to deal with these high values is to down-weight them in order to decrease the influence of these extreme values (an adjustment recommended in Fryer, 2001 that has been applied previously to several age/year data points). The down-weighted values are not changed in subsequent assessments and tend to only be revised at benchmarks.

There is a poor relationship between stock size (SSB) and recruitment for this stock, with large values for recruitment possible at small stock sizes and vice versa (Figure 3.3.9). The TSA stock–recruit plot is shown in Figure 3.3.9.

Estimated and observed discard rates (proportions-at-age) are shown in Figure 3.3.10. The discard model fits are good for the years when catch data are included (1978–1994 and 2006–2012) and also for the majority of the remaining years. The observed proportions deviate slightly in 2003–2005.

TSA estimates a discard ogive for every year. However, when there are no catch data, the estimated ogive will simply be some weighted average of the discard ogives in neighbouring years. So, when several years of catch data are omitted, the estimated discard ogives in this period will hardly change at all because there are no new data included. From 2006, when the catch data are re-included, the model is able to much better estimate the discard ogive (Figure 3.3.10). However, in the last couple of years the ogive has overestimated discards. This fact can be explained by the continuing decrease in F that is difficult for the model to keep up. Furthermore, in 2012 the quota increased by 300% making it unnecessary for most vessels to discard high numbers of haddock.

Retrospective analysis

Most retrospective bias in this stock assessment (see Figure 3.3.11) is thought to be caused by the mismatch between catch and survey data (WGMG 2007). As only survey data are used in the TSA model between 1995 and 2005, the retrospective pattern in F and SSB over the period of 1995–2005 is irregular.

Comparison with previous year's assessment

The 2012 VIa haddock assessment estimated F in 2011 at 0.22 and SSB (January 1st 2011) at 18 624 tonnes. The current assessment has revised these figures, to a fishing mortality of 0.18 in 2011 and an SSB (January 2011) as 24 350 tonnes (~30% increase). Recruitment in 2011 has been revised from ~50 million to ~17 million (~35% decrease).

The estimate of SSB in January 2012 from this assessment is 33 633 tonnes with a standard error of 8247 tonnes (~24%). Last year's assessment put this figure at 24 804 tonnes.

The current assessment's estimate of SSB (for January 2013) used in the forecast (output from MFDP1a, see Figure 3.3.17) is 30 365 tonnes. The short-term forecast from last year's assessment predicted SSB in 2013 to be at 25 098 tonnes. This is a difference of 5267 tonnes (~21% increase in the estimate).

State of the stock

The state of the stock is summarized in Figure 3.3.4 and Table 3.3.14.

The final estimates for the stock in 2012 are:

$F_{(2\text{-}6)}$ = 0.26

SSB = 30 365 t

Based on the most recent estimates of SSB in 2013 (30 365 tonnes > B_{pa}) ICES classifies the stock as being above trigger.

Based on the most recent estimate of fishing mortality in 2012 (0.26, <F_{pa}) ICES classifies the stock as being harvested sustainably.

Based on fishing mortality being estimated to be less that F_{MSY} and SSB greater than MSY $B_{trigger}$; In relation to the MSY reference points, ICES classifies the stock as being harvested appropriately.

Summaries from the final assessment, including, total removals, landings, discards, recruitment, mean F and SSB are given in Figure 3.3.4, while corresponding estimates and standard errors are presented in Tables 3.3.10 and 3.3.11 (population abundance), Tables 3.3.12 and 3.3.13 (fishing mortality), and Table 3.3.14 (stock summary). Mean $F_{2\text{–}6}$ is estimated to have risen to just above F_{PA} (0.5) during 2003–2007, subsequently falling below 0.5 in 2008, and remaining below F_{PA} since. A sequence of low recruitments led to a fall in SSB from the peak in 2003. The assessment estimates that SSB has been below B_{PA} since 2005, but in 2012 increased again to above B_{PA}.

Uncertainty in fitted and observed catches increases from 1995–2005 (Figure 3.3.4), which is the period when the landings and discards are excluded from the model and only the survey data are used for estimation. Catch data tend to have more precision than survey data and although both surveys used in the assessment track year-class strength well, the survey data are more "noisy" (show greater variability) than the catch data. Therefore, when the catch data is included in the later part of the time-series (2006–2012), the confidence intervals of the estimates are reduced.

The reported catch in 2012 is within the bounds of error of the estimated catch. Information from the Compliance section of Marine Scotland put estimates of misreporting out of and in to VIa at approximately ~404 tonnes in 2012 (table below). The misreporting seems to occur mainly between Areas VIa and IVa.

Recorded in	IVa (EU)	VIa (EU)
Suspected from	VIa (EU)	IVa (EU)
Tonnes	100	304

3.3.4 Short-term projections

Recruitment estimates

The TSA assessment model provides estimates of recruitment for the forecast years 2013 and 2014. Since 2011 these values are exclusively based on a Ricker stock–recruit model (Figure 3.3.9) as the time-series of the ScoGFS-WIBTS-Q1 survey ends in 2010. In 2011 it was decided by the WG to use a more conservative approach, as the relation between SSB and recruitment is quite poor. After a closer look at the recruitment values from both IGFS and the new ScoGFS-WIBTS-Q1 surveys, the preferred method to calculate recruitment forecasts was a geometric mean from the last eight years (2004–2011). The recruitment values used in the forecast are ~30.6 million for both 2013 and 2014.

TSA produces short-term forecasts as part of every standard model run. The model will also forecast fishing mortality rates. It does so by iterating forward the time-series model that had been fitted to historical data. These forecast mortalities therefore retain the time-series characteristics of the preceding data. Although the TSA estimates are likely to follow a pattern of damped oscillation towards an eventual steady state, the WG preferred to use standard tools (i.e. MFDP) as the basis for the forecast. The MFDP procedure is described below.

The time-series of fishing mortality-at-age estimates is shown in Figure 3.3.12, along with the mean F over ages 2–6. As with last year's assessment, a three year average fishing mortality selection pattern was used in the forecast. Figure 3.3.13 compares a simple three-year mean, the most recent estimate (2012), and TSA-generated selection patterns.

The forecasts presented in this section are forecasts of total removals, split subsequently into removals due to landings, discards and unallocated removals (other than those assumed to be due to current estimates of natural mortality) respectively. As highlighted previously, the assessment is survey-based from 1995 to 2005 and can only estimate total removals during this period. The difference between reported and estimated catches represents unallocated removals, reflecting our uncertainty in natural mortality and a certain amount of possible area-misreporting. In the period when the assessment is survey based only the estimated amount of unallocated removals is appreciable. The 1999 year class of haddock was strong, and survey estimates of that year class have contributed to high model estimates of the predicted catch between 2002 and 2005 (Figure 3.3.4).

In the past few years the level of discarding used in the forecast was the calculated mean of the last three years. However this year the 2012 ratio was applied. The reason behind this change was deduced from the latest figures in discards. The 2009 year class was estimated to be at appreciable numbers by the Scottish and Irish groundfish surveys, leading to an increase in discard numbers going from ~1800 to ~2800 tonnes in 2010. Since then the discards have fallen significantly to ~1500 tonnes in 2011 and to ~500 tonnes in 2012. This difference occurs mainly due to two factors. First, the 2009 year class moving into the fishery, hence not being discarded as heavily and secondly the increase in quota availability reducing the need to discard. It is not possible to know what the discarding practices will be in the immediate future, but these seem to be closely related with the quota availability, the price of the fish in the market, and the abundance at-age 1. The total catch for haddock is estimated to be ~5600 tonnes; of these ~10% are discards. Splitting discards by fleet shows that TR2 vessels are responsible for ~70% of all discards while landing only 550 tonnes, approximately ~10% of the total landings (5000 tonnes).

Nevertheless, taking a three year mean is still the most unbiased approach. For the short-term forecast, the assumption is that this input F remains constant.

Short-term projections are presented here for reference only; they are not considered reliable because recruitment of haddock is characterized by sporadic events. Therefore this year, following last year's suggestion of the WG; a geometric mean recruitment (2004–2011) was used for 2013–2015 estimates. This provides a very uncertain but precautionary estimate of the future recruitment. The time frame was chosen in order to include the eight most recent years. Table 3.3.18 summarises the outputs of the short-term forecast and each year class contribution for landings and SSB.

Short-term projections were performed using MFDP1a software.

Results of the forecast at *status quo* F are summarized in the following table:

Year	Removals (000 t)	SSB (000 t)
2013	6.7	30.4
2014	6.0	26.4
2015	-	27.8

At the *status quo* rate of removals, and given assumptions about growth and recruitment, the most recent estimate of SSB (2012) is greater than B_{lim} and is forecast to stay at the same levels for 2013 and 2014, primarily due to the estimated 2009 year class moving into the fishery.

3.3.5 MSY evaluations

No estimates of MSY reference points were presented at the WG this year.

Biological reference points

ICES has defined the following reference points for this stock.

Reference point	Technical basis
B_{pa} = 30 000 t	B_{lim}*1.4
B_{lim} = 22 000 t	Lowest observed SSB when reference point was establised (1998)
F_{pa} = 0.5	High probablity of avoiding SSB falling below B_{pa} in the long term
F_{lim}	Not defined

3.3.6 Management plans

There is a management plan evaluated by ICES as being precautionary, details of which can be found at:

http://www.ices.dk/committe/acom/comwork/report/2010/Special%20Requests/EC%20haddock%20management%20plan.pdf

However, this management plan is not yet implemented, waiting to be sign off by all parts.

3.3.7 Uncertainties and bias in assessment and forecast

Quality of the assessment

Landings and discards

Quotas for haddock in Division VIa appear to have started to become restrictive in or around 1995. Anecdotal evidence suggests that these and other restrictive management measures led to increasing unreliability of landings data from the commercial fleets prosecuting the fishery from 1995 to 2005. Therefore, the 2006 WG decided, that from that year onwards the stock should be assessed using a modified TSA model that did not include catch data from 1995 onwards, and thus modelled removals rather than catches. During the period when the catch data is not included (1994–2005) the discard ogives estimated by the model are weighted averages of those of neighbouring years. This results in little change in the estimated discard ogive in the years when the catch is excluded and an observable discrepancy between the model's discard ogive and the reported discards proportions in 2003–2005. In 2009 catch data from 2006 onwards were included again in the model; being 2006 the year in which the buyers and sellers registration was implemented increasing the reliability of the data.

Effort

In the 2010 assessment, catch data from 2006 onwards was reincorporated into the assessment as confidence levels rose due to the implementation of the UK Registration of Buyers and Sellers legislation. At the moment the assessment is driven by catch data, as there are only ScoGFS-WIBTS-Q4 survey data available up to 2009 and ScoGFS-WIBTS-Q1 survey data up to 2010.

Surveys

A survey-based assessment can only be as good as the surveys on which it is based. The Scottish groundfish survey-series appear to have good internal consistency and to track cohorts reasonably well, with the exception of a period during the mid-1990s. Concerns remain over the apparent differences in catchability of young fish between the Scottish and Irish components of IBTS (ICES-IBTSWG 2007). These concerns will extend in to the GFS WCIBTS Q1 as this survey adopted the same gear and design as the Irish. Any survey is likely to become less reliable when stock abundance declines, and this issue needs to be revisited in the near future for haddock and many other stocks.

This assessment is survey based for the years 1995–2005. Re-including catch data for 2006–2012 has resulted in narrower confidence intervals for estimates of F, SSB, and catch components (landings, discards and total removals). Some uncertainty remains over the unallocated component of removals and how this could be divided between removals caused by natural mortality and removals related to fishing (for example, escape mortality and area misreporting).

In 2011 the rigging and sampling design of the ScoGFS-WIBTS-Q1 and ScoGFS-WIBTS-Q4 surveys were changed and these data are not used in the assessment. A new groundgear capable of tackling challenging terrain was introduced broadly modelled around the rig used by Ireland for the IGFS-WIBTS-Q4. The move to a more robust groundgear allowed to move to a random stratified survey design (which is again consistent with the IRGFS-WIBTS-Q4). The previous repeat station survey format, consisting of the same series of survey trawl positions that are sampled at approximately the same temporal period every year, was considered to be prone to bias. It is hoped that the greater compatibility between Scottish and Irish surveys will facilitate the use of both surveys in the assessment of gadoids in the West of Scotland. New survey strata were designed using cluster analysis on aggregated data from the previous ScoGFS-WIBTS-Q1 data (1999–2010) as well as the data collected from a dedicated gadoid survey which took place during the first quarter of 2010. Species considered were cod, haddock, whiting, saithe and hake. Cluster analysis resulted in four specific clusters. Two additional strata were added; the Clyde area and the 'windsock' which is an area that has been designated as a recovery zone since 2002 and has therefore experienced no mobile gear exploitation during this time. Each individual polygon was treated as a separate stratum and the number of survey stations for each was allocated according to the polygon size and the variability of indices within each stratum. Strata were weighted by surface area to calculate the final indices. Due to vessel breakdown, the ScoGFS-WIBTS-Q4 survey did not take place in 2010. However, due to the re-inclusion of catch-at-age data this has less effect on the quality of the assessment than previously when the recent catch was excluded.

Weights-at-age

In previous years the mean weight-at-age has been calculated on the basis of a mix between a linear model for ages 3 to 8+ and a three year average for ages 1 and 2. In this year's assessment, a three year average was applied to all ages. This was thought to be a more conservative approach. The 2012 mean weights-at-age showed an increase of mean weight across most ages with age two recording the highest value in the entire series. This large increase in the mean weight heavily affected the linear model and for that reason a more conservative approach was sought. The forecast seems to be quite sensitive to variation in weight.

Model formulation

Models such as the modified TSA model, which is mainly based on survey data, are becoming the standard in several ICES assessments for which problems have existed with commercial catch data (see this report, and also WGNSSK 2006). Other examples include BADAPT and SURBA. While these types of models are essential in order to address data problems, it needs to be borne in mind that there are two main problems with such approaches. Firstly, survey data are based on far fewer samples and are therefore more variable than catch data. It is therefore likely that precision is sacrificed to reduce bias. Secondly, a survey-based assessment estimates removals from the stock and total mortality, rather than landings and fishing mortality, and is therefore more difficult to use as the basis of quota advice than corresponding catch-based approaches. Therefore, it was thought that the re-inclusion of catch data was appropriate. Investigations have indicated that this has been the case in the years 2006–2012.

Stock connectivity

There is uncertainty concerning the stock definition and hence the degree of connectivity between the VIa haddock stock and the North Sea haddock stock. Since these stocks are currently assessed separately, it is possible that the two stock assessments are both affected by uncertainties in catch data relating to area misreporting.

3.3.8 Recommendations for next benchmark

Some ways of addressing these issues are proposed here. All aspects are considered important and the proposed time frame would be to work on these in order to prepare for the next benchmark (2014).

Landings and discards

There should be a full analysis of the precision and bias of catch-at-age data. Although catch data between 2006–2012 are thought to represent a large proportion of the true catch, further analysis would help to put a clearer estimate on the uncertainty of this. Measures such as the UK Registration of Buyers and Sellers legislation seem to have greatly improved the reliability of commercial landings data for the last three years. Also, the landings misreporting: in, out and within Area VIa should be addressed in the next benchmark and their impact in the assessment should be determined. Marine Scotland-Compliance provides every year an estimation of the misreporting. The process of calculation should be investigated and considered for integration in the assessment.

Surveys

There are now nine years of data available from the IGFS-WIBTS-Q4 survey and the benchmark should evaluate its inclusion as a tuning survey. Also the new UKScoGFS-WIBTS Q1 will have reached four years by the next benchmark so a re-inclusion of this survey should be also investigated.

Weights-at-age

The growth characteristics of this haddock stock are very variable, and seem to be strongly driven by cohort effects rather than year effects: that is, early life-history events determine the subsequent growth potential of each cohort. Work is underway at Marine Scotland (Aberdeen) and elsewhere to develop improved models of growth, and it is hoped that these will improve stock forecasts in the future. Consideration of using stock weights from the survey, instead of the estimated weights-at-age could also be addressed at a benchmark assessment.

Other modelling

Growth modelling could help with forecasts of mean weights-at-age. Other assessment models could be considered where information from the age structure of the catch data could be incorporated in the assessment for the years where the catch data are currently excluded (1995–2005).

3.3.9 Management considerations

This stock is at a low level of biomass, but a good recruitment (age 1) in 2010 is moving into the population and is estimated to elevate the biomass to safer levels. An agreed long-term management plan, which takes into account the recruitment characteristics of this stock, has been evaluated by ICES in 2010 and is waiting to be signed off.

In recent years discard rates have been high, in 2010 they represented 51% of the total catch and in 2011 ~47%. In 2011 the majority of these discards ~80% (1156 tonnes) came from the *Nephrops* fishery that landed only 80 tonnes of the total landings (1713 tonnes). This illustrates the poor selectivity of the *Nephrops* fishery for young haddock. This year the discard values dropped considerably in the TR1 fleet but stayed at very high levels in the TR2 fleet, that was responsible for ~70% of all haddock discards. Any measures to reduce discarding and to improve the fishing pattern should be actively encouraged. Such measures should include the adoption of a sorting grid as well as appropriately located square mesh panels.

The expansion of the Catch Quota scheme in the North Sea from 17 vessels in 2010 to 23 vessels in 2011 and 2012 with growing potential, might “force” vessels to redirect their effort into VIa or VIb. Vessels participating within this scheme are not allowed to fish in the North Sea if they reach their annual cod quota, but as an alternative they can fish west of the 4 degree line.

3.3.10 References

Fryer R.J. 2001. TSA: is it the way? Annex of Report of the Working Group on Methods of Fish Stock Assessment, 2001.

Dickey-Collas, M., Armstrong, M.J., Officer, R.A., Wright, P.J., Brown, J., Dunn, M.R., Young, E.F. 2003. ' Growth and expansion of haddock (*Melanogrammus aeglefinus* L.) stocks to the west of the British Isles in the 1990's.' ICES Marine Science Symposia, 219, 271–282.

Table 3.3.1. Haddock in Division VIa. Nominal landings[2], as officially reported to ICES and estimated by the WG.

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	9	-	9	1	7	1	-	1	3	2	2	1
Denmark	+	+	+	+	1	-	1	1	-	-	-	-
Faroe Islands	13	-	1	-	-	-	-	-	-	-	-	-
France	1335	863	761	762	1132	753	671	455	270	394	-	282
Germany	-	-	1	2	9	19	14	2	1	1	2	1
Germany	4	15	-	-	-	-	-	-	-	-	-	-
Ireland	2171	773	710	700	911	746	1406	1399	1447	1352	1054	677
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-
Norway	74	46	12	72	40	7	13	16	21	28	18	70
Spain	-	-	-	-	-	-	1	-	-	2	4	+
UK – (E&W)[3]	235	164	137	132	155	254	322	448	493	458	315	199
UK - Scotland	19 940	10 964	8434	5263	10 423	7421	10 367	10 790	10 352	12 125	8630	5933
Un. Sov. Soc. Rep.	-	-	59	-	-	-	-	-	-	-	-	-
Total reported	23 781	12 825	10 124	6932	12 678	9201	12 795	13 112	12 587	14 362	10 025	7163
WG estimates	16 691	10 141	10 557	11 351	19 068	14 272	12 368	13 466	12 883	14 401	10 464	6958

1) Preliminary.

2) Includes Divisions Vb(EC) and VIb.

3) 1989–2005 N. Ireland included with England and Wales.

WG estimates refer to the sum-of-products of landings and weights-at-age provided to the WG, rather than the estimated removals produced in the final assessment.

Table 3.3.1. Continued. Haddock in Division VIa. Nominal landings[2], as officially reported to ICES and estimated by the WG.

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	2	-	-	<0.5	-	-	-	-	.	.	.	.
Denmark	-	-	<0.5	<0.5	-	-	.	.	.	.	.	.
Faroe Islands	-	-	-	4	-	1	2	<0.5	-	-	.	0.314
France	160	151	183	173	273	291	211	151	136	89	74.83	31.75
Germany	1	-	-	-	1	7	-	1	-	1		0.079
Germany, F.R.	.	.	.	.	.	.	.	.	.	.		.
Ireland	744	672	497	194	152	526	759	879	297	396	290.39	844.98
Netherlands	-	-	-	1	-	-	-	-	.	.		.
Norway	32	30	23	4	21	17	16	28	18	11	4.109	0.184
Spain	4	4	5	-	47	44	5	10	21	28		.
UK – (E&W)3	201	237	107	93	42	19	193	32	14	7		2.47
UK - Scotland	5886	5988	4582	2909	2025	4928	2587	1744	2366	2407	1373	4119.9
Un. Sov. Soc. Rep.	.	.	.	.	.	.	.	.	.	.		
Total reported	7030	7082	5397	3378	2561	5833	3773	2845	2852	2939	1743	5000
WG estimates	6762	7115	5337	3874	3792	6266	3777	2848	2851	3016	1737	5100

[1]) Preliminary.

[2]) Includes Divisions Vb(EC) and VIb.

[3]) 1989–2005 N. Ireland included with England and Wales.

WG estimates refer to the sum-of-products of landings and weights-at-age provided to the WG, rather than the estimated removals produced in the final assessment.

Table 3.3.2. Haddock in Division VIa. Total catch-at-age numbers (000s). Values used in the final assessment are boxed.

Year	0	1	2	3	4	5	6	7	8
1965	451	1059	1341	72461	6816	294	274	174	11
1966	5953	1595	529	1113	47431	1926	64	32	57
1967	40122	19185	19332	951	265	24979	400	9	14
1968	27	129418	38393	3079	356	681	14063	727	43
1969	2742	84	160706	10260	1434	268	379	4576	191
1970	17189	6317	519	95114	2770	173	89	145	585
1971	6604	71481	3915	3328	79966	545	127	7	20
1972	14215	20713	85141	2718	2336	53823	504	50	19
1973	19589	47387	16907	19477	258	1222	33193	150	32
1974	63698	68837	11562	10757	6317	83	447	11463	104
1975	6849	179349	34957	3339	3350	1882	95	98	3454
1976	4227	24337	72330	15224	1588	1491	868	21	7
1977	4552	13109	3468	35948	5705	680	495	308	28
1978	57	**15942**	**2095**	**971**	**24357**	**2938**	**351**	**247**	338
1979	5697	**70070**	**17282**	**1865**	**470**	**9863**	**833**	**114**	145
1980	13	**22729**	**21927**	**5636**	**922**	**143**	**3082**	**229**	22
1981	764	**251**	**83911**	**20697**	**1768**	**194**	**39**	**822**	39
1982	136	**15492**	**5019**	**73676**	**8167**	**898**	**108**	**272**	288
1983	2084	**14524**	**20233**	**6040**	**36122**	**3398**	**597**	**41**	194
1984	269	**98976**	**8626**	**12910**	**6242**	**22790**	**2449**	**371**	43
1985	155	**22820**	**78922**	**4667**	**4184**	**1789**	**11189**	**964**	84
1986	2979	**8127**	**11235**	**45367**	**1823**	**916**	**449**	**2611**	344
1987	1498	**89021**	**16824**	**10150**	**23857**	**1452**	**1116**	**642**	1818
1988	7582	**10007**	**58414**	**7598**	**4185**	**9255**	**428**	**235**	177
1989	3773	**5010**	**3420**	**25724**	**2755**	**1556**	**3634**	**255**	84
1990	437	**37247**	**5856**	**1884**	**12158**	**871**	**279**	**519**	48
1991	8921	**36924**	**21991**	**1259**	**834**	**5132**	**412**	**283**	410
1992	4332	**51840**	**18971**	**11331**	**565**	**236**	**1577**	**157**	37
1993	2196	**43659**	**60785**	**20763**	**4669**	**306**	**219**	**915**	70
1994	2843	**19484**	**32638**	**21527**	**5671**	**1579**	**76**	**175**	237
1995	7692	17580	15759	23599	6865	1472	387	34	111
1996	10249	33344	39812	6641	10225	3663	1007	324	23
1997	2984	23843	10507	21550	2178	2668	870	259	59
1998	2058	11421	18001	8032	15116	1352	1036	377	124
1999	6898	6179	18055	11569	3004	4919	579	452	96
2000	5709	50142	6642	8596	4213	1055	1104	205	133
2001	11818	11023	33496	2432	3666	1521	533	314	65
2002	1362	16427	12394	32248	833	714	549	238	144
2003	3861	6972	5592	6848	12830	222	209	70	34
2004	2727	15159	6506	2384	3839	6706	286	101	26
2005	3965	7190	6202	3700	2116	2669	2704	57	42
2006	817	**16031**	**4831**	**3844**	**3801**	**3109**	**2731**	**2750**	33
2007	257	**1777**	**15850**	**2897**	**1725**	**2428**	**811**	**904**	478
2008	1840	**2409**	**2330**	**4421**	**587**	**609**	**868**	**255**	185
2009	2021	**4999**	**434**	**429**	**6681**	**512**	**335**	**254**	79
2010	1373	**37370**	**1936**	**422**	**580**	**4633**	**258**	**158**	64
2011	63	**1721**	**6187**	**402**	**289**	**319**	**1625**	**88**	57
2012	28	**1756**	**256**	**7939**	**401**	**806**	**157**	**1912**	74

Table 3.3.2. Continued. Haddock in Division VIa. Total catch-at-age numbers (000s). Values used in the final assessment are boxed.

Year	9	10	11	12	13	14	15+	8+
1965	6	6	0	0	0	0	0	24
1966	0	0	0	0	0	0	0	57
1967	4	0	0	0	0	0	0	19
1968	9	0	0	0	0	0	0	52
1969	9	0	0	0	0	0	0	200
1970	13	2	0	0	0	0	0	600
1971	175	16	0	0	0	0	0	212
1972	0	67	0	0	0	0	0	86
1973	6	125	0	0	0	0	0	163
1974	34	31	0	1	4	0	0	174
1975	72	8	0	0	0	0	0	3534
1976	1103	4	0	5	0	0	0	1119
1977	11	259	5	0	0	0	0	304
1978	7	17	211	3	0	0	0	**575**
1979	28	3	1	42	1	0	0	**221**
1980	5	21	3	0	4	0	0	**54**
1981	14	2	2	1	0	1	0	**60**
1982	31	12	1	0	0	0	0	**332**
1983	195	40	15	0	0	0	0	**444**
1984	44	73	3	0	0	0	0	**162**
1985	4	8	56	4	0	0	1	**157**
1986	38	7	15	1	3	0	0	**409**
1987	326	20	15	9	3	12	0	**2203**
1988	935	45	3	1	3	2	0	**1167**
1989	87	437	56	1	1	0	0	**666**
1990	22	12	2	0	0	0	0	**85**
1991	24	11	5	6	0	0	1	**457**
1992	108	25	0	0	0	0	0	**169**
1993	107	44	25	1	2	0	0	**250**
1994	17	16	9	1	0	0	0	**279**
1995	90	2	0	0	0	0	0	203
1996	40	12	4	0	0	0	0	80
1997	1	7	1	0	0	0	0	67
1998	45	2	4	1	0	0	0	175
1999	12	2	1	2	1	0	0	115
2000	21	1	0	0	0	0	0	156
2001	25	11	0	3	0	0	0	104
2002	18	9	0	0	0	0	0	172
2003	12	10	0	0	0	0	0	56
2004	6	2	2	0	0	0	0	37
2005	5	1	1	0	0	0	0	48
2006	26	5	0	0	1	0	0	**65**
2007	6	0	0	0	0	0	0	**485**
2008	122	0	0	0	0	0	0	**307**
2009	41	32	0	0	0	0	0	**152**
2010	39	26	24	0	0	0	0	**153**
2011	0	0	0	0	0	0	0	**57**
2012	84	28	2	0	1	0	0	**188**

Table 3.3.3. Haddock in Division VIa. Landings-at-age numbers (000s). Values used in the final assessment are boxed.

Year	0	1	2	3	4	5	6	7	8
1965	0	33	463	60967	6753	294	274	174	11
1966	0	58	175	1082	46902	1926	64	32	57
1967	0	595	6136	782	262	24979	400	9	14
1968	0	3665	12439	2573	354	681	14063	727	43
1969	0	3	45819	8766	1423	268	379	4576	191
1970	0	169	170	78402	2747	173	89	145	585
1971	0	1925	1149	2665	78909	545	127	7	20
1972	0	576	26700	2225	2312	53823	504	50	19
1973	0	1252	5301	16109	256	1222	33193	150	32
1974	0	1706	3318	8625	6261	83	447	11463	104
1975	0	4629	10534	2735	3315	1882	95	98	3454
1976	0	745	22563	12358	1571	1491	868	21	7
1977	0	451	1317	29456	5645	680	495	308	28
1978	0	**1030**	**1006**	**813**	**23620**	**2912**	**344**	**247**	338
1979	0	**2068**	**10448**	**1761**	**468**	**9810**	**833**	**114**	145
1980	0	**2505**	**12871**	**5341**	**915**	**143**	**3082**	**229**	22
1981	0	**200**	**20553**	**15695**	**1768**	**194**	**39**	**822**	39
1982	0	**250**	**1342**	**46283**	**8004**	**898**	**108**	**272**	288
1983	0	**568**	**4917**	**4585**	**34659**	**3387**	**597**	**41**	194
1984	0	**3341**	**4386**	**10754**	**5959**	**20352**	**2449**	**371**	43
1985	0	**939**	**19434**	**4437**	**4112**	**1782**	**11031**	**964**	84
1986	0	**603**	**4812**	**26770**	**1823**	**916**	**449**	**2611**	344
1987	0	**4254**	**7388**	**9206**	**23551**	**1452**	**1116**	**642**	1818
1988	0	**847**	**20687**	**6873**	**4091**	**9205**	**428**	**235**	177
1989	0	**927**	**1414**	**18417**	**2744**	**1556**	**3633**	**255**	84
1990	0	**787**	**3198**	**1342**	**9450**	**848**	**279**	**519**	48
1991	0	**2145**	**10578**	**1217**	**834**	**5131**	**412**	**283**	410
1992	0	**691**	**10194**	**10010**	**553**	**236**	**1575**	**157**	37
1993	0	**745**	**15008**	**15975**	**4594**	**290**	**219**	**910**	70
1994	0	**1017**	**6326**	**15037**	**5240**	**1484**	**76**	**175**	237
1995	0	540	3669	12774	6483	1472	387	34	111
1996	0	437	9457	4968	8626	3622	1007	324	23
1997	0	883	2831	16921	2125	2638	870	259	59
1998	0	1345	7129	5675	13387	1352	1036	377	124
1999	0	346	5501	7159	2960	4864	493	452	96
2000	0	759	2507	5864	3841	1054	1090	205	133
2001	0	245	8535	1822	3523	1393	533	314	65
2002	0	177	1227	13557	691	707	549	199	144
2003	0	21	1029	2150	8809	221	206	69	34
2004	0	14	245	804	1819	4071	286	100	26
2005	0	7	287	792	1252	1212	2018	57	42
2006	0	**67**	**567**	**1513**	**2300**	**2504**	**2259**	**2192**	33
2007	0	**34**	**842**	**1121**	**1429**	**2394**	**778**	**855**	478
2008	0	**21**	**297**	**2718**	**546**	**584**	**752**	**254**	161
2009	0	**4**	**57**	**188**	**3929**	**487**	**287**	**208**	79
2010	0	**44**	**260**	**377**	**453**	**4250**	**234**	**158**	52
2011	0	**0**	**525**	**319**	**265**	**315**	**1613**	**88**	57
2012	0	**93**	**157**	**6622**	**400**	**804**	**157**	**1912**	74

Table 3.3.3. Continued. Haddock in Division VIa. Landings-at-age numbers (000s). Values used in the final assessment are boxed.

1965	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	**8+**
1966	6	6	0	0	0	0	0	24
1967	0	0	0	0	0	0	0	57
1968	4	0	0	0	0	0	0	19
1969	9	0	0	0	0	0	0	52
1970	9	0	0	0	0	0	0	200
1971	13	2	0	0	0	0	0	600
1972	175	16	0	0	0	0	0	212
1973	0	67	0	0	0	0	0	86
1974	6	125	0	0	0	0	0	163
1975	34	31	0	1	4	0	0	174
1976	72	8	0	0	0	0	0	3534
1977	1103	4	0	5	0	0	0	1119
1978	11	259	5	0	0	0	0	304
1979	7	17	211	3	0	0	0	**575**
1980	28	3	1	42	1	0	0	**221**
1981	5	21	3	0	4	0	0	**54**
1982	14	2	2	1	0	1	0	**60**
1983	31	12	1	0	0	0	0	**332**
1984	195	40	15	0	0	0	0	**444**
1985	44	73	3	0	0	0	0	**162**
1986	4	8	56	4	0	0	1	**157**
1987	38	7	15	1	3	0	0	**409**
1988	326	20	15	9	3	12	0	**2203**
1989	935	45	3	1	3	2	0	**1167**
1990	87	437	56	1	1	0	0	**666**
1991	22	12	2	0	0	0	0	**85**
1992	24	11	5	6	0	0	1	**457**
1993	108	25	0	0	0	0	0	**169**
1994	107	44	25	1	2	0	0	**250**
1995	17	16	9	1	0	0	0	**279**
1996	90	2	0	0	0	0	0	203
1997	40	12	4	0	0	0	0	80
1998	1	7	1	0	0	0	0	67
1999	45	2	4	1	0	0	0	175
2000	12	2	1	2	1	0	0	115
2001	21	1	0	0	0	0	0	156
2002	25	11	0	3	0	0	0	104
2003	18	9	0	0	0	0	0	172
2004	11	10	0	0	0	0	0	55
2005	6	2	2	0	0	0	0	37
2006	5	1	1	0	0	0	0	48
2007	26	5	0	0	1	0	0	65
2008	6	0	0	0	0	0	0	485
2009	122	0	0	0	0	0	0	283
2010	41	32	0	0	0	0	0	152
2011	39	26	24	0	0	0	0	140
2012	0	0	0	0	0	0	0	57
1965	84	28	2	0	1	0	0	188

Table 3.3.4. Haddock in Division VIa. Discards-at-age numbers (000s). Values used in the final assessment are boxed.

Year	0	1	2	3	4	5	6	7	8
1965	451	1026	877	11494	63	0	0	0	0
1966	5953	1537	354	31	529	0	0	0	0
1967	40122	18590	13196	169	3	0	0	0	0
1968	27	125753	25954	506	3	0	0	0	0
1969	2742	81	114887	1493	11	0	0	0	0
1970	17189	6148	348	16712	23	0	0	0	0
1971	6604	69556	2766	663	1057	0	0	0	0
1972	14215	20137	58442	494	24	0	0	0	0
1973	19589	46135	11607	3368	2	0	0	0	0
1974	63698	67131	8244	2132	56	0	0	0	0
1975	6849	174721	24423	604	35	0	0	0	0
1976	4227	23593	49767	2866	17	0	0	0	0
1977	4552	12658	2152	6492	59	0	0	0	0
1978	55	14911	1090	157	738	27	7	0	0
1979	5697	68002	6833	104	2	53	0	0	0
1980	13	20224	9057	295	7	0	0	0	0
1981	764	51	63359	5002	0	0	0	0	0
1982	136	15241	3678	27393	163	0	0	0	0
1983	2084	13957	15316	1456	1464	12	0	0	0
1984	269	95634	4240	2156	284	2438	0	0	0
1985	155	21882	59488	231	71	6	159	0	0
1986	2979	7524	6423	18597	0	0	0	0	0
1987	1498	84767	9436	944	306	0	0	0	0
1988	7582	9160	37727	725	95	49	0	0	0
1989	3773	4083	2007	7308	11	0	1	0	0
1990	437	36460	2658	542	2708	23	0	0	0
1991	8921	34779	11413	42	0	1	0	0	0
1992	4331	51148	8776	1322	12	0	2	0	0
1993	2196	42914	45777	4787	74	16	0	5	0
1994	2843	18467	26312	6490	432	94	0	0	0
1995	7692	17040	12090	10825	382	0	0	0	0
1996	10249	32907	30354	1674	1599	41	0	0	0
1997	2984	22961	7676	4629	53	30	0	0	0
1998	2058	10075	10872	2357	1728	0	0	0	0
1999	6898	5834	12554	4410	44	54	86	0	0
2000	5709	49383	4136	2731	372	1	14	0	0
2001	11818	10778	24961	611	143	128	0	0	0
2002	1362	16250	11168	18692	142	8	0	39	0
2003	3861	6951	4564	4697	4021	2	2	1	0
2004	2727	15146	6261	1580	2021	2635	0	1	0
2005	3965	7184	5915	2908	864	1457	686	0	1
2006	817	15964	4263	2331	1501	605	471	557	0
2007	257	1743	15008	1775	296	34	33	48	0
2008	1840	2388	2033	1703	41	25	116	1	24
2009	2021	4994	378	240	2752	25	48	46	0
2010	1373	37326	1676	45	127	382	24	0	13
2011	63	1721	5662	83	25	3	12	0	0
2012	28	1662	98	1316	1	2	0	0	0

Table 3.3.4. Continued. Haddock in Division VIa. Discards-at-age numbers (000s). Values used in the final assessment are boxed.

Year	9	10	11	12	13	14	15+	8+
1965	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	**0**
1979	0	0	0	0	0	0	0	**0**
1980	0	0	0	0	0	0	0	**0**
1981	0	0	0	0	0	0	0	**0**
1982	0	0	0	0	0	0	0	**0**
1983	0	0	0	0	0	0	0	**0**
1984	0	0	0	0	0	0	0	**0**
1985	0	0	0	0	0	0	0	**0**
1986	0	0	0	0	0	0	0	**0**
1987	0	0	0	0	0	0	0	**0**
1988	0	0	0	0	0	0	0	**0**
1989	0	0	0	0	0	0	0	**0**
1990	0	0	0	0	0	0	0	**0**
1991	0	0	0	0	0	0	0	**0**
1992	0	0	0	0	0	0	0	**0**
1993	0	0	0	0	0	0	0	**0**
1994	0	0	0	0	0	0	0	**0**
1995	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	1
2006	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	24
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	13
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0

Table 3.3.5. Haddock in Division VIa. Weights-at-age (kg) in total catch. Values used in the final assessment are boxed.

Year	0	1	2	3	4	5	6	7	8
1965	0.040	0.160	0.242	0.412	0.692	0.916	1.041	1.249	1.517
1966	0.040	0.162	0.251	0.555	0.572	1.041	1.125	1.325	1.522
1967	0.040	0.160	0.266	0.569	0.573	0.667	1.177	1.844	1.611
1968	0.040	0.159	0.264	0.567	0.823	0.731	0.811	1.430	1.903
1969	0.040	0.158	0.243	0.526	0.916	1.042	1.024	0.999	1.569
1970	0.040	0.161	0.230	0.368	0.812	1.283	1.262	1.043	1.342
1971	0.040	0.160	0.248	0.341	0.546	1.040	1.313	1.651	1.426
1972	0.040	0.160	0.249	0.380	0.530	0.546	0.984	1.499	1.538
1973	0.040	0.159	0.251	0.384	0.597	0.512	0.571	1.185	1.706
1974	0.040	0.159	0.248	0.368	0.527	0.764	0.685	0.798	1.142
1975	0.040	0.159	0.260	0.428	0.581	0.832	1.027	1.001	1.009
1976	0.040	0.159	0.256	0.459	0.592	0.831	1.095	1.585	1.084
1977	0.040	0.161	0.274	0.406	0.684	0.800	1.128	1.337	1.117
1978	0.068	**0.134**	**0.278**	**0.388**	**0.516**	**0.827**	**1.045**	**1.152**	1.399
1979	0.032	**0.182**	**0.325**	**0.457**	**0.730**	**0.777**	**1.040**	**1.491**	1.944
1980	0.077	**0.134**	**0.319**	**0.572**	**0.719**	**0.998**	**0.985**	**1.143**	1.565
1981	0.082	**0.252**	**0.245**	**0.467**	**0.887**	**0.975**	**1.376**	**1.294**	1.347
1982	0.038	**0.157**	**0.273**	**0.376**	**0.746**	**1.126**	**1.539**	**1.549**	1.514
1983	0.050	**0.178**	**0.282**	**0.461**	**0.557**	**1.002**	**1.370**	**1.716**	1.558
1984	0.059	**0.149**	**0.319**	**0.456**	**0.688**	**0.667**	**1.087**	**1.392**	2.075
1985	0.019	**0.138**	**0.268**	**0.486**	**0.636**	**0.802**	**0.868**	**1.272**	1.277
1986	0.064	**0.182**	**0.270**	**0.362**	**0.637**	**0.903**	**1.115**	**1.043**	1.418
1987	0.028	**0.168**	**0.270**	**0.418**	**0.566**	**0.880**	**1.105**	**1.250**	1.147
1988	0.085	**0.170**	**0.254**	**0.444**	**0.562**	**0.704**	**1.027**	**1.280**	1.279
1989	0.052	**0.226**	**0.301**	**0.402**	**0.625**	**0.749**	**0.894**	**1.115**	1.465
1990	0.073	**0.112**	**0.355**	**0.445**	**0.534**	**0.891**	**1.108**	**1.280**	1.823
1991	0.058	**0.184**	**0.297**	**0.547**	**0.618**	**0.678**	**0.931**	**1.053**	1.091
1992	0.050	**0.133**	**0.321**	**0.437**	**0.766**	**0.892**	**0.932**	**1.407**	1.493
1993	0.037	**0.108**	**0.277**	**0.458**	**0.650**	**0.861**	**0.898**	**1.022**	1.514
1994	0.031	**0.169**	**0.253**	**0.405**	**0.611**	**0.698**	**0.929**	**0.959**	0.909
1995	0.030	0.149	0.274	0.354	0.553	0.833	0.978	1.322	1.059
1996	0.047	0.128	0.243	0.404	0.462	0.645	0.750	0.754	1.122
1997	0.048	0.153	0.263	0.394	0.614	0.730	0.925	1.057	0.921
1998	0.089	0.164	0.283	0.382	0.502	0.689	0.802	0.951	1.006
1999	0.035	0.172	0.255	0.365	0.494	0.611	0.729	0.840	1.067
2000	0.053	0.127	0.270	0.361	0.447	0.572	0.719	0.840	0.749
2001	0.050	0.112	0.242	0.403	0.432	0.514	0.657	0.808	1.029
2002	0.048	0.118	0.208	0.307	0.521	0.606	0.632	0.636	0.810
2003	0.036	0.124	0.239	0.282	0.382	0.652	0.648	0.908	0.945
2004	0.033	0.112	0.189	0.290	0.313	0.373	0.541	0.715	0.782
2005	0.053	0.103	0.198	0.295	0.451	0.429	0.525	1.163	0.916
2006	0.024	**0.155**	**0.254**	**0.326**	**0.388**	**0.471**	**0.496**	**0.563**	1.242
2007	0.060	**0.115**	**0.219**	**0.331**	**0.404**	**0.456**	**0.550**	**0.593**	0.682
2008	0.022	**0.113**	**0.245**	**0.367**	**0.492**	**0.570**	**0.619**	**0.708**	0.770
2009	0.048	**0.135**	**0.266**	**0.357**	**0.410**	**0.570**	**0.633**	**0.630**	0.897
2010	0.000	**0.067**	**0.180**	**0.388**	**0.409**	**0.459**	**0.725**	**0.755**	0.852
2011	0.012	**0.054**	**0.259**	**0.357**	**0.509**	**0.476**	**0.617**	**0.818**	1.107
2012	0.031	**0.091**	**0.370**	**0.405**	**0.632**	**0.457**	**0.798**	**0.663**	0.791

Table 3.3.5. Continued. Haddock in Division VIa. Weights-at-age (kg) in total catch. Values used in the final assessment are boxed.

Year	9	10	11	12	13	14	15+	8+
1965	1.920	1.833	0.000	0.000	0.000	0.000	0.000	1.713
1966	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.522
1967	2.355	0.000	0.000	0.000	0.000	0.000	0.000	1.786
1968	2.516	0.000	0.000	0.000	0.000	0.000	0.000	2.005
1969	2.065	0.000	0.000	0.000	0.000	0.000	0.000	1.590
1970	1.791	1.213	0.000	0.000	0.000	0.000	0.000	1.352
1971	1.466	2.042	0.000	0.000	0.000	0.000	0.000	1.506
1972	0.000	1.551	0.000	0.000	0.000	0.000	0.000	1.548
1973	2.202	1.520	0.000	0.000	0.000	0.000	0.000	1.581
1974	1.319	1.229	0.000	0.833	0.890	0.000	0.000	1.183
1975	1.190	2.523	0.000	0.000	0.000	0.000	0.000	1.016
1976	1.243	1.806	0.000	1.679	0.000	0.000	0.000	1.246
1977	1.394	1.339	1.593	0.000	0.000	0.000	0.000	1.325
1978	2.126	1.376	1.208	1.627	0.000	0.000	0.000	**1.338**
1979	1.735	1.569	1.781	1.119	1.590	0.000	0.000	**1.754**
1980	1.632	1.879	2.862	0.000	1.482	0.000	0.000	**1.747**
1981	1.366	1.314	1.785	1.587	0.000	1.677	0.000	**1.379**
1982	1.738	2.068	1.543	0.000	0.000	0.000	0.000	**1.555**
1983	1.556	1.555	1.999	0.000	0.000	0.000	0.000	**1.572**
1984	1.882	1.417	1.864	0.000	0.000	0.000	0.000	**1.724**
1985	1.695	2.014	2.152	2.741	0.000	0.000	4.141	**1.694**
1986	1.517	1.832	1.925	1.504	2.635	0.000	0.000	**1.463**
1987	1.149	1.851	2.774	3.040	2.828	2.664	0.000	**1.182**
1988	0.879	1.618	0.990	3.424	3.994	4.150	0.000	**0.984**
1989	1.357	0.949	1.388	2.807	3.008	0.000	0.429	**1.110**
1990	1.682	2.288	1.964	2.506	0.000	0.000	0.000	**1.860**
1991	1.755	3.290	2.170	1.343	0.000	0.000	2.869	**1.201**
1992	1.564	2.180	0.000	0.000	0.000	0.000	0.000	**1.639**
1993	1.210	1.578	2.304	1.800	2.405	0.000	0.000	**1.483**
1994	1.243	1.319	1.961	2.430	0.000	0.000	0.000	**0.992**
1995	0.940	1.953	1.996	2.492	0.000	0.000	0.000	1.020
1996	1.163	1.046	1.141	0.000	3.167	0.000	0.000	1.137
1997	2.024	1.630	2.252	0.000	3.033	0.000	0.000	1.020
1998	1.064	2.488	2.585	3.322	2.591	0.000	0.000	1.077
1999	1.465	1.465	3.246	1.993	2.954	2.829	0.000	1.172
2000	1.186	1.262	0.000	2.168	0.000	0.000	0.000	0.813
2001	0.975	1.089	3.361	0.597	0.000	0.000	0.000	1.015
2002	1.995	0.916	0.000	2.698	0.000	0.000	0.000	0.939
2003	1.232	1.393	2.682	0.000	0.000	0.000	0.000	1.086
2004	0.853	1.396	3.976	0.000	0.000	0.000	0.000	0.988
2005	1.467	2.084	3.491	2.275	0.000	0.000	0.000	1.018
2006	1.182	1.682	2.675	0.000	3.889	5.471	0.000	**1.294**
2007	0.825	2.160	2.270	0.000	0.000	0.000	0.000	**0.685**
2008	0.911	2.494	2.109	0.000	0.000	0.000	0.000	**0.827**
2009	1.042	1.233	1.874	0.000	0.000	0.000	0.000	**1.008**
2010	0.852	0.734	1.141	0.000	0.000	0.000	0.000	**0.877**
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**1.107**
2012	0.709	0.811	0.876	2.524	2.610	0.000	0.000	**0.765**

Table 3.3.6. Haddock in Division VIa. Weights-at-age (kg) in landings. Values used in the final assessment are boxed.

Year	0	1	2	3	4	5	6	7	8
1965	0.000	0.273	0.295	0.440	0.695	0.916	1.041	1.249	1.517
1966	0.000	0.315	0.324	0.563	0.575	1.041	1.125	1.325	1.522
1967	0.000	0.285	0.374	0.635	0.576	0.667	1.177	1.844	1.611
1968	0.000	0.259	0.367	0.627	0.827	0.731	0.811	1.430	1.903
1969	0.000	0.199	0.314	0.570	0.921	1.042	1.024	0.999	1.569
1970	0.000	0.348	0.261	0.389	0.817	1.283	1.262	1.043	1.342
1971	0.000	0.295	0.328	0.360	0.549	1.040	1.313	1.651	1.426
1972	0.000	0.285	0.325	0.406	0.532	0.546	0.984	1.499	1.538
1973	0.000	0.259	0.329	0.408	0.599	0.512	0.571	1.185	1.706
1974	0.000	0.264	0.328	0.393	0.530	0.764	0.685	0.798	1.142
1975	0.000	0.277	0.365	0.465	0.585	0.832	1.027	1.001	1.009
1976	0.000	0.251	0.345	0.504	0.596	0.831	1.095	1.585	1.084
1977	0.000	0.307	0.370	0.437	0.689	0.800	1.128	1.337	1.117
1978	0.000	**0.257**	**0.353**	**0.419**	**0.524**	**0.832**	**1.060**	**1.152**	1.399
1979	0.000	**0.269**	**0.386**	**0.467**	**0.732**	**0.779**	**1.040**	**1.491**	1.944
1980	0.000	**0.251**	**0.373**	**0.587**	**0.722**	**0.998**	**0.985**	**1.143**	1.565
1981	0.000	**0.289**	**0.357**	**0.502**	**0.887**	**0.975**	**1.376**	**1.294**	1.347
1982	0.000	**0.285**	**0.369**	**0.452**	**0.754**	**1.126**	**1.539**	**1.549**	1.514
1983	0.000	**0.479**	**0.424**	**0.518**	**0.568**	**1.004**	**1.370**	**1.716**	1.558
1984	0.000	**0.273**	**0.388**	**0.486**	**0.705**	**0.713**	**1.087**	**1.392**	2.075
1985	0.000	**0.283**	**0.346**	**0.494**	**0.641**	**0.803**	**0.875**	**1.272**	1.277
1986	0.000	**0.294**	**0.373**	**0.440**	**0.637**	**0.903**	**1.115**	**1.043**	1.418
1987	0.000	**0.276**	**0.337**	**0.435**	**0.570**	**0.880**	**1.105**	**1.250**	1.147
1988	0.000	**0.310**	**0.338**	**0.462**	**0.567**	**0.706**	**1.027**	**1.280**	1.279
1989	0.000	**0.372**	**0.406**	**0.468**	**0.625**	**0.749**	**0.894**	**1.115**	1.462
1990	0.000	**0.335**	**0.443**	**0.532**	**0.618**	**0.908**	**1.108**	**1.280**	1.823
1991	0.000	**0.287**	**0.382**	**0.556**	**0.618**	**0.678**	**0.931**	**1.053**	1.091
1992	0.000	**0.310**	**0.384**	**0.461**	**0.777**	**0.892**	**0.932**	**1.407**	1.493
1993	0.000	**0.313**	**0.395**	**0.509**	**0.655**	**0.889**	**0.898**	**1.026**	1.514
1994	0.000	**0.280**	**0.352**	**0.454**	**0.633**	**0.723**	**0.929**	**0.959**	0.909
1995	0.000	0.293	0.375	0.415	0.567	0.833	0.978	1.322	1.059
1996	0.000	0.285	0.363	0.445	0.492	0.649	0.750	0.754	1.122
1997	0.000	0.275	0.365	0.425	0.621	0.735	0.925	1.057	0.921
1998	0.000	0.265	0.331	0.416	0.524	0.689	0.802	0.951	1.006
1999	0.000	0.313	0.353	0.420	0.496	0.614	0.820	0.840	1.067
2000	0.000	0.265	0.347	0.410	0.465	0.572	0.724	0.840	0.749
2001	0.000	0.243	0.332	0.457	0.439	0.538	0.657	0.808	1.029
2002	0.000	0.254	0.321	0.383	0.566	0.608	0.632	0.691	0.810
2003	0.000	0.240	0.311	0.389	0.428	0.654	0.651	0.917	0.946
2004	0.000	0.253	0.329	0.394	0.391	0.448	0.541	0.718	0.782
2005	0.000	0.270	0.358	0.415	0.542	0.596	0.594	1.167	0.921
2006	0.000	**0.291**	**0.348**	**0.392**	**0.437**	**0.508**	**0.527**	**0.621**	1.242
2007	0.000	**0.248**	**0.357**	**0.398**	**0.423**	**0.458**	**0.558**	**0.605**	0.682
2008	0.000	**0.275**	**0.378**	**0.418**	**0.505**	**0.578**	**0.666**	**0.709**	0.823
2009	0.000	**0.344**	**0.469**	**0.467**	**0.488**	**0.581**	**0.687**	**0.691**	0.897
2010	0.000	**0.280**	**0.338**	**0.406**	**0.438**	**0.471**	**0.764**	**0.755**	0.990
2011	0.000	**0.000**	**0.358**	**0.379**	**0.523**	**0.478**	**0.619**	**0.818**	1.107
2012	0.000	**0.260**	**0.490**	**0.429**	**0.633**	**0.457**	**0.798**	**0.663**	0.791

Table 3.3.6. Continued. Haddock in Division VIa. Weights-at-age (kg) in landings. Values used in the final assessment are boxed.

Year	9	10	11	12	13	14	15+	8+
1965	1.920	1.833	0.000	0.000	0.000	0.000	0.000	1.713
1966	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.522
1967	2.355	0.000	0.000	0.000	0.000	0.000	0.000	1.786
1968	2.516	0.000	0.000	0.000	0.000	0.000	0.000	2.005
1969	2.065	0.000	0.000	0.000	0.000	0.000	0.000	1.590
1970	1.791	1.213	0.000	0.000	0.000	0.000	0.000	1.352
1971	1.466	2.042	0.000	0.000	0.000	0.000	0.000	1.506
1972	0.000	1.551	0.000	0.000	0.000	0.000	0.000	1.548
1973	2.202	1.520	0.000	0.000	0.000	0.000	0.000	1.581
1974	1.319	1.229	0.000	0.833	0.890	0.000	0.000	1.183
1975	1.190	2.523	0.000	0.000	0.000	0.000	0.000	1.016
1976	1.243	1.806	0.000	1.679	0.000	0.000	0.000	1.246
1977	1.394	1.339	1.593	0.000	0.000	0.000	0.000	1.325
1978	2.126	1.376	1.208	1.627	0.000	0.000	0.000	**1.338**
1979	1.735	1.569	1.781	1.119	1.590	0.000	0.000	**1.754**
1980	1.632	1.879	2.862	0.000	1.482	0.000	0.000	**1.747**
1981	1.366	1.314	1.785	1.587	0.000	1.677	0.000	**1.379**
1982	1.738	2.068	1.543	0.000	0.000	0.000	0.000	**1.555**
1983	1.556	1.555	1.999	0.000	0.000	0.000	0.000	**1.572**
1984	1.882	1.417	1.864	0.000	0.000	0.000	0.000	**1.724**
1985	1.695	2.014	2.152	2.741	0.000	0.000	4.141	**1.694**
1986	1.517	1.832	1.925	1.504	2.635	0.000	0.000	**1.463**
1987	1.149	1.851	2.774	3.040	2.828	2.664	0.000	**1.182**
1988	0.879	1.618	0.990	3.424	3.994	4.150	0.000	**0.984**
1989	1.357	0.948	1.388	2.807	3.008	0.000	0.429	**1.109**
1990	1.682	2.288	1.964	2.506	0.000	0.000	0.000	**1.860**
1991	1.755	3.290	2.170	1.343	0.000	0.000	2.869	**1.201**
1992	1.564	2.180	0.000	0.000	0.000	0.000	0.000	**1.639**
1993	1.210	1.578	2.304	1.800	2.405	0.000	0.000	**1.483**
1994	1.243	1.319	1.961	2.430	0.000	0.000	0.000	**0.992**
1995	0.940	1.953	1.996	2.492	0.000	0.000	0.000	1.020
1996	1.163	1.046	1.141	0.000	3.167	0.000	0.000	1.137
1997	2.024	1.630	2.252	0.000	3.033	0.000	0.000	1.020
1998	1.064	2.488	2.585	3.322	2.591	0.000	0.000	1.077
1999	1.465	1.465	3.246	1.993	2.954	2.829	0.000	1.172
2000	1.186	1.262	0.000	2.168	0.000	0.000	0.000	0.813
2001	0.975	1.089	3.361	0.597	0.000	0.000	0.000	1.015
2002	1.995	0.916	0.000	2.698	0.000	0.000	0.000	0.939
2003	1.253	1.395	2.682	0.000	0.000	0.000	0.000	1.091
2004	0.853	1.396	3.976	0.000	0.000	0.000	0.000	0.988
2005	1.467	2.084	3.491	2.275	0.000	0.000	0.000	1.023
2006	1.182	1.682	2.675	0.000	3.889	5.471	0.000	**1.294**
2007	0.825	2.160	2.270	0.000	0.000	0.000	0.000	**0.685**
2008	0.911	2.494	2.109	2.966	0.000	0.000	0.000	**0.862**
2009	1.042	1.233	1.874	0.000	3.002	0.000	0.000	**1.011**
2010	0.852	0.734	1.141	0.000	0.000	0.000	0.000	**0.930**
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**1.107**
2012	0.710	0.811	0.876	2.524	2.610	0.000	0.000	**0.765**

Table 3.3.7. Haddock in Division VIa. Weights-at-age (kg) in discards. Values used in the final assessment are boxed.

Year	0	1	2	3	4	5	6	7	8
1965	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1966	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1967	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1968	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1969	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1970	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1971	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1972	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1973	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1974	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1975	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1976	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1977	0.040	0.156	0.215	0.265	0.279	0.000	0.000	0.000	0.000
1978	0.059	**0.125**	**0.208**	**0.231**	**0.259**	**0.265**	**0.308**	**0.000**	0.000
1979	0.032	**0.180**	**0.230**	**0.272**	**0.266**	**0.303**	**0.000**	**0.000**	0.000
1980	0.077	**0.120**	**0.243**	**0.287**	**0.334**	**0.000**	**0.000**	**0.000**	0.000
1981	0.082	**0.106**	**0.209**	**0.360**	**0.000**	**0.000**	**0.000**	**0.000**	0.000
1982	0.038	**0.155**	**0.238**	**0.247**	**0.363**	**0.000**	**0.000**	**0.000**	0.000
1983	0.050	**0.165**	**0.237**	**0.283**	**0.298**	**0.536**	**0.000**	**0.000**	0.000
1984	0.059	**0.145**	**0.248**	**0.303**	**0.331**	**0.278**	**0.000**	**0.000**	0.000
1985	0.019	**0.132**	**0.242**	**0.326**	**0.362**	**0.423**	**0.353**	**0.000**	0.000
1986	0.064	**0.173**	**0.193**	**0.248**	**0.000**	**0.000**	**0.000**	**0.000**	0.000
1987	0.028	**0.163**	**0.218**	**0.247**	**0.281**	**0.000**	**0.000**	**0.000**	0.000
1988	0.085	**0.157**	**0.208**	**0.279**	**0.331**	**0.341**	**0.000**	**0.000**	0.000
1989	0.052	**0.193**	**0.226**	**0.237**	**0.491**	**0.961**	**1.423**	**0.000**	2.572
1990	0.073	**0.108**	**0.250**	**0.228**	**0.242**	**0.268**	**0.000**	**0.000**	0.000
1991	0.058	**0.178**	**0.218**	**0.278**	**0.000**	**0.263**	**0.000**	**0.000**	0.000
1992	0.050	**0.130**	**0.247**	**0.258**	**0.242**	**0.000**	**0.947**	**0.000**	0.000
1993	0.037	**0.105**	**0.238**	**0.287**	**0.382**	**0.348**	**0.000**	**0.430**	0.000
1994	0.031	**0.163**	**0.229**	**0.291**	**0.337**	**0.304**	**0.000**	**0.000**	0.000
1995	0.030	0.144	0.243	0.281	0.310	0.000	0.000	0.000	0.000
1996	0.047	0.126	0.206	0.282	0.300	0.317	0.000	0.000	0.000
1997	0.048	0.148	0.226	0.283	0.340	0.317	0.000	0.000	0.000
1998	0.089	0.151	0.251	0.298	0.337	0.000	0.000	0.000	0.000
1999	0.035	0.163	0.213	0.276	0.318	0.311	0.206	0.000	0.000
2000	0.053	0.125	0.223	0.257	0.259	0.625	0.337	0.000	0.000
2001	0.050	0.109	0.211	0.243	0.254	0.245	0.000	0.000	0.000
2002	0.048	0.117	0.196	0.253	0.305	0.456	0.000	0.358	0.000
2003	0.036	0.123	0.223	0.233	0.282	0.462	0.439	0.496	0.591
2004	0.033	0.112	0.183	0.237	0.242	0.256	0.000	0.411	0.000
2005	0.053	**0.103**	**0.190**	**0.262**	**0.320**	**0.290**	**0.322**	**0.416**	0.493
2006	0.024	**0.154**	**0.241**	**0.284**	**0.313**	**0.318**	**0.348**	**0.336**	0.000
2007	0.060	**0.113**	**0.211**	**0.288**	**0.314**	**0.336**	**0.368**	**0.373**	0.000
2008	0.022	**0.112**	**0.226**	**0.287**	**0.322**	**0.389**	**0.312**	**0.458**	0.419
2009	0.048	**0.134**	**0.235**	**0.271**	**0.298**	**0.362**	**0.309**	**0.356**	0.000
2010	0.000	**0.067**	**0.156**	**0.240**	**0.307**	**0.320**	**0.345**	**0.000**	0.279
2011	0.012	**0.054**	**0.250**	**0.274**	**0.360**	**0.296**	**0.375**	**0.000**	0.000
2012	0.031	**0.082**	**0.177**	**0.285**	**0.391**	**0.331**	**0.739**	**0.577**	0.633

Table 3.3.7. Continued. Haddock in Division VIa. Weights-at-age (kg) in discards. Values used in the final assessment are boxed.

Year	9	10	11	12	13	14	15+	8+
1965	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1966	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1967	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1968	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1969	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1970	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1971	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1972	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1973	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1974	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1975	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1977	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1978	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1979	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1980	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1981	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1982	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1983	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1984	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1985	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1986	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1987	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1988	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1989	0.000	3.048	0.000	0.000	0.000	0.000	0.000	2.810
1990	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1991	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1992	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1993	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1994	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1997	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1998	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1999	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2003	0.432	0.689	0.000	0.000	0.000	0.000	0.000	0.493
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.493**
2006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.419**
2009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.279**
2011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
2012	0.488	0.316	0.000	0.000	0.000	0.000	0.000	**0.513**

Table 3.3.8. Haddock in Division VIa. Available research-vessels survey data. Values used in the final assessment are boxed.

ScoGFS Q1

Year	Age 1	2	3	4	5	6	7	8	Total
1985	1104	4085	68	80	141	388	27	1	5893
1986	753	1669	1877	17	14	47	90	5	4467
1987	5518	446	460	690	25	34	25	67	7198
1988	571	3610	303	112	246	10	4	8	4856
1989	178	488	1701	98	49	69	5	1	2588
1990	2577	87	54	296	26	6	36	3	3082
1991	1591	1763	92	25	184	9	4	15	3668
1992	3618	1193	321	12	13	28	6	1	5191
1993	5371	5922	675	167	0	2	18	2	12 155
1994	1151	2300	787	126	39	3	1	8	4407
1995	7112	1074	1697	485	65	30	10	4	10 473
1996	4401	3742	315	456	125	20	11	3	9070
1997	4262	2018	1915	147	151	53	2	1	8548
1998	5034	2720	616	562	40	64	19	7	9055
1999	941	2989	687	168	128	15	11	2	4939
2000	7936	553	440	97	13	20	1	3	9060
2001	3421	5762	143	146	34	16	6	1	9528
2002	2339	3246	5293	56	70	24	9	3	11 037
2003	2650	1696	1449	1874	23	34	18	4	7744
2004	1397	2765	869	1199	609	11	3	5	6853
2005	573	633	1402	351	512	402	5	3	3878
2006	633	892	539	397	156	170	51	2	2838
2007	99	2019	296	121	192	82	89	65	2898
2008	86	113	1094	98	84	71	13	15	1558
2009	42	113	147	1445	29	43	63	7	1882
2010	706	111	26	71	452	23	4	9	1393

Table 3.3.8. Continued. Haddock in Division VIa. Available research-vessels survey data. Values used in the final assessment are boxed.

ScoGFS Q4

	Age								
Year	0	1	2	3	4	5	6	7	Total
1996	2907	761	656	70	137	57	24	6	1711
1997	3713	1359	282	151	25	26	14	4	1861
1998	399	1640	486	148	137	17	33	5	2466
1999	4670	366	574	267	92	68	11	18	1396
2000	2959	4231	147	191	59	25	5	3	4661
2001	3083	2219	3563	48	138	22	12	2	6004
2002	2943	1709	1770	2841	34	50	24	8	6436
2003	293	2023	965	1470	639	28	17	3	5145
2004	542	574	1068	410	649	524	5	9	3239
2005	286	419	409	410	223	309	87	1	1858
2006	19	543	233	162	281	79	100	40	1438
2007	125	69	1392	109	128	90	48	45	1881
2008	14	117	78	835	74	94	63	29	1290
2009	335	68	161	343	551	44	35	26	1228

IreGFS

	Effort	Age									
Year	(minutes)	0	1	2	3	4	5	6	7	8	Total
1993	2130	143	2493	5691	1606	693	29	112	56	35	10 715
1994	1865	76	1237	3538	3303	367	187	13	18	66	8729
1995	2026	967	3104	1149	4152	1663	187	149	29	14	10 447
1996	2008	192	2536	3688	2155	627	254	126	45	24	9455
1997	1879	2900	8289	636	532	375	294	45	8	3	10 182
1998	1936	96	1098	1538	1353	192	84	75	15	49	4404
1999	1914	7985	1028	1967	1530	679	237	118	25	34	5618
2000	1878	1454	8865	569	691	484	183	32	30	0	10 854
2001	965	1951	2728	3548	136	187	151	36	4	0	6790
2002	796	6618	2541	2768	1788	67	90	32	5	2	7293

Table 3.3.8. Continued. Haddock in Division VIa. Available research-vessels survey data. Values used in the final assessment are boxed.

IGFS	Effort (minutes)	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Total
2003	1127	207	7588	2382	839	355	22	30	7	0	3	2	11435
2004	1200	86	2163	3322	1281	941	957	60	10	21	0	0	8841
2005	960	233	1160	767	778	315	87	3	0	0	1	0	3344
2006	1510	313	207	1027	381	1337	543	130	59	0	0	0	3997
2007	1173	320	979	1049	346	689	101	64	69	1	0	0	3619.539
2008	1135	76	2052	562	645	74	196	169	31	14	0	0	3817.856
2009	1378	744	535	919	309	328	76	187	61	6	0	0	3166.002
2010	1291	66	2997	213	348	123	237	48	70	57	0	3	4161.155
2011	1287	33	633	8951	121	726	70	193	20	30	13	1	10791.95
2012	1230	102	653	557	6973	264	155	85	69	7	3	0	8869.118

Table 3.3.9. Haddock in Division VIa. TSA parameter estimates from this year's assessment, along with those from previous assessments for comparison. * = fixed parameter.

Notation	Description	2006	2007	2008	2009	2010	2011	2012	2013
F (1, 1978)		0.23	0.25	0.40	0.40	0.43	0.4105	0.394	0.3947
F (2, 1978)	Fishing mortality at age a in year y	0.50	0.56	0.71	0.70	0.81	0.6707	0.7205	0.7278
F (4, 1978)		0.51	0.52	0.56	0.57	0.59	0.5971	0.5863	0.6132
Φ(1)		2.49	2.58	2.60	2.58	3.11	2.5	-	-
Φ(2)	ScoGFS Q1 survey selectivity at age a	2.55	3.01	3.07	3.01	3.34	2.86	-	-
Φ(4)		2.19	2.04	1.92	1.94	2.24	1.93	-	-
Φ(1)		1.99	1.62	1.77	1.75	2.24	2.09	-	-
Φ(2)	ScoGFS Q4 survey selectivity at age a	1.99	1.76	1.88	1.84	2.22	2.1	-	-
Φ(4)		2.25	2.39	2.61	2.64	3.44	2.76	-	-
σF	Transitory changes in overall F	0.10	0.12	0.20	0.20	0.19	0.076	0.1046	0.1053
σU	Persistent changes in selection (age effect in F)	0.00	0.09	0.03	0.03	0.05	0.08	0.0681	0.0534
σV	Transitory changes in the year effect in F	0.23	0.23	0.33	0.35	0.26	0.25	0.2475	0.3099
σY	Persistent changes in the year effect in F	0.09	0.07	0.00	0.00	0.15	0.17	0.1414	0.1497
σΩ1	Transitory changes in ScoGFS Q1 catchability	0.30	0.19	0.12	0.12	0.27	0.23	-	-
σβ1	Persistent changes in ScoGFS Q1 catchability	0.00*	0.00*	0.00*	0.00*	0.00*	0	-	-
σΩ2	Transitory changes in ScoGFS Q4 catchability		0.16	0.20	0.19	0.21	0.17	-	-
σβ2	Persistent changes in ScoGFS Q4 catchability		0.00*	0.00*	0.00*	0.00*	0	-	-
cv landings	Coefficent of variation of landings-at-age data	0.20	0.20	0.24	0.25	0.28	0.24	0.255	0.2881
cv discards	Coefficent of variation of discards-at-age data	0.42	0.41	0.54	0.54	0.59	0.51	0.5749	0.541
cv survey	Coefficent of variation of ScoGFS Q1 survey data	0.57	0.33	0.35	0.36	0.41	0.37	-	-
cv survey	Coefficent of variation of ScoGFS Q4 survey data	0.57	0.22	0.34	0.35	0.51	0.41	-	-
σP	Transitory changes in overall discard proportion	0.19	0.18	0.20	0.20	0.00	0.3	0.0001	7.00E-04

Notation	Description	2006	2007	2008	2009	2010	2011	2012	2013
σα1	Transitory changes in discard-ogive intercept	0.00	0.14	0.00	0.00	0.01	0	0	0.1016
σν1	Persistent changes in discard-ogive intercept	0.21	0.32	0.26	0.25	0.29	0.28	0.2594	0.2567
σα2	Transitory changes in discard-ogive slope	0.21	0.23	0.22	0.23	0.40	0.36	0.3868	0.4312
σν2	Persistent changes in discard-ogive slope	0.23	0.002	0.000	0.000	0.00	0	0.007	0.0488
θν1	Trend parameter for discard-ogive intercept	0.00*	0.00*	0.00*	0.00*	0.00*	0	0	0
θν2	Trend parameter for discard-ogive slope	0.00*	0.00*	0.00*	0.00*	0.00*	0	0	0
η1	Ricker parameter (slope at the origin)	9.73	9.06	11.35	11.08	9.62	10.84	10.0321	9.7144
η2	Ricker parameter (curve dome occurs at 1/η2)	0.29	0.30	0.35	0.35	0.39	0.36	0.3604	0.3612
cv rec	Coefficent of variation of recruitment curve	0.90	0.62	0.60	0.61	0.69	0.55	0.6636	0.6239

Table 3.3.10. Haddock in Division VIa. Estimates of population abundance (in thousands) from the final TSA run.

YEAR	1	2	3	4	5	6	7	8+
1978	70314	7928	2481	58006	4376	624	472	1034
1979	155234	42274	3777	1081	22689	1566	236	577
1980	484376	86547	17463	1461	381	7534	491	260
1981	62310	313240	43958	7150	575	158	3025	295
1982	70471	41731	185068	22408	3536	287	80	1654
1983	43395	47450	24509	99439	11651	1856	149	912
1984	317313	27969	25713	10846	44940	5256	821	480
1985	73664	195511	12081	9883	4614	19028	2175	536
1986	59337	42878	93287	4999	4052	2001	7846	1145
1987	266636	39071	23710	47570	2532	2074	1040	4601
1988	21313	147035	14845	8010	16171	830	677	1900
1989	16677	11204	62000	5371	2808	5712	299	921
1990	97374	8401	4406	23019	1892	940	1931	416
1991	125401	58659	3469	1795	9356	765	383	947
1992	176446	69745	24078	1225	672	3405	282	486
1993	175131	111289	33308	10147	531	296	1459	331
1994	56505	100701	40751	9388	2971	144	80	507
1995	200961	31998	47016	15505	3400	1135	56	222
1996	104512	119711	14693	19065	6019	1320	451	110
1997	120679	56555	49029	4999	6669	2017	451	193
1998	137487	67877	23563	16856	1764	2379	698	225
1999	32330	77781	28567	8347	5858	650	897	329
2000	496649	18072	32419	9980	3069	1988	238	446
2001	186538	246459	5912	8190	2594	847	478	177
2002	95903	113636	119366	2373	3166	1011	340	253
2003	116850	65209	68883	66338	1234	1644	539	315
2004	45952	75113	35882	34889	29829	557	739	388
2005	30673	29096	40777	17535	16474	13522	248	510
2006	94376	17756	13512	15562	6358	6126	4672	269
2007	18605	60605	8796	6322	6752	2711	2638	2082
2008	13036	11843	37222	4610	3266	3412	1391	2416
2009	12975	8796	7410	22949	2628	1895	1950	2190
2010	103714	8875	5758	4721	14232	1603	1162	2542
2011	17839	71666	5627	3609	2858	8552	972	2241
2012	71769	12868	50423	3792	2441	1927	5752	2172
2013	96926	50924	8567	31132	2401	1496	1225	4954

***Estimates for 2013 are TSA forecasts.**

Table 3.3.11. Haddock in Division VIa. Standard errors of estimates of population abundance (in thousands) from the final TSA run.

Year	1	2	3	4	5	6	7	8+
1978	8541	771	314	375	1208	216	124	324
1979	16386	4610	344	146	2058	568	109	176
1980	44364	9201	2391	171	66	1180	259	102
1981	7250	28459	5525	1227	94	37	661	149
1982	8419	4873	17767	2960	618	53	21	401
1983	6427	5577	2902	9352	1417	311	29	208
1984	35181	3573	2774	1178	3535	533	121	82
1985	8654	19843	1654	1329	477	2013	317	83
1986	6604	4842	9811	632	535	260	1171	195
1987	35835	4079	2749	4905	296	267	147	690
1988	4270	16773	1574	991	1804	116	122	324
1989	3938	1601	6994	629	371	763	53	169
1990	12071	1731	607	2960	253	167	378	94
1991	13540	7000	587	219	1092	101	71	176
1992	17706	6881	2847	188	75	450	45	86
1993	19337	10918	3065	1148	61	31	197	47
1994	11635	11542	4052	990	295	13	11	65
1995	28255	7077	7548	2838	649	205	10	45
1996	20450	19894	3536	3929	1355	304	103	27
1997	21965	11382	9445	1068	1243	437	105	45
1998	22190	11557	4308	3082	289	345	130	43
1999	9131	12634	4955	1393	1052	102	145	61
2000	98523	5213	6308	1956	539	439	48	91
2001	23567	47467	1659	1838	533	161	142	48
2002	14946	13479	20296	442	556	161	56	58
2003	15095	9915	8130	10643	210	274	86	54
2004	6802	10081	5487	4755	4760	102	140	70
2005	4327	4155	5972	2561	2179	2224	48	93
2006	7512	2305	1546	1872	752	775	847	51
2007	2676	4716	1271	731	856	375	424	438
2008	1988	1605	3261	631	398	484	228	422
2009	4121	1300	1024	2148	397	266	322	372
2010	19625	2992	907	762	1601	281	193	423
2011	20294	14471	2077	627	565	1273	205	411
2012	39733	15532	11005	1551	466	442	1028	443
2013	60694	29847	10719	8704	1108	383	347	1159

***Estimates for 2013 are TSA forecasts.**

Table 3.3.12. Haddock in Division VIa. Estimates of fishing mortality from the final TSA run.

Year	1	2	3	4	5	6	7	8+
1978	0.292913	0.439241	0.625964	0.743143	0.746619	0.732804	0.723761	0.728241
1979	0.384297	0.664983	0.741619	0.854137	0.880027	0.866437	0.872311	0.872095
1980	0.245111	0.480003	0.621767	0.704721	0.658602	0.682653	0.67797	0.671833
1981	0.205035	0.335857	0.46757	0.49328	0.491339	0.479775	0.494315	0.489262
1982	0.187882	0.318536	0.401741	0.460118	0.452648	0.458028	0.459032	0.450918
1983	0.272922	0.415654	0.420485	0.458038	0.477266	0.482189	0.48104	0.494411
1984	0.283933	0.598771	0.73317	0.64939	0.647606	0.676876	0.679106	0.669886
1985	0.340882	0.538199	0.672632	0.685044	0.635627	0.685865	0.663088	0.656665
1986	0.207086	0.395571	0.465345	0.465494	0.454791	0.441783	0.459429	0.461181
1987	0.395224	0.758317	0.885153	0.874009	0.912298	0.919505	0.897484	0.882555
1988	0.407488	0.663638	0.816609	0.847857	0.840407	0.818995	0.8219	0.830766
1989	0.409815	0.685866	0.787605	0.83337	0.871348	0.872713	0.865798	0.863802
1990	0.307806	0.661518	0.697722	0.690057	0.695036	0.681821	0.694081	0.693898
1991	0.371031	0.690207	0.822969	0.767609	0.809355	0.787785	0.807555	0.792157
1992	0.233835	0.484021	0.646355	0.625663	0.57434	0.607538	0.600738	0.592716
1993	0.34457	0.736408	0.992795	0.936751	0.903326	0.978115	0.940916	0.949318
1994	0.373592	0.547378	0.759043	0.814702	0.754809	0.745512	0.775197	0.76456
1995	0.319466	0.572528	0.703314	0.739748	0.742105	0.721423	0.728262	0.729514
1996	0.411755	0.692838	0.8781	0.849577	0.891625	0.87322	0.863968	0.870471
1997	0.389301	0.692443	0.874485	0.83781	0.791531	0.869003	0.846921	0.84235
1998	0.372052	0.670075	0.833393	0.862357	0.792367	0.772395	0.835052	0.817413
1999	0.377125	0.672925	0.852598	0.813632	0.867364	0.805555	0.80252	0.828132
2000	0.499681	0.924636	1.175831	1.156314	1.091508	1.21561	1.142531	1.153484
2001	0.285269	0.539321	0.748858	0.756282	0.729609	0.705706	0.761101	0.738638
2002	0.18611	0.298227	0.403871	0.453235	0.453537	0.427902	0.426213	0.439781
2003	0.241898	0.405372	0.469974	0.596892	0.601519	0.605425	0.598224	0.587775
2004	0.256955	0.411488	0.517177	0.545763	0.591125	0.60799	0.593883	0.587427
2005	0.366771	0.575009	0.753964	0.81846	0.792169	0.856015	0.84347	0.831579
2006	0.255705	0.479827	0.556702	0.628814	0.650235	0.640043	0.660403	0.636454
2007	0.241392	0.286649	0.445007	0.459939	0.479473	0.465549	0.468585	0.466275
2008	0.178645	0.269158	0.280152	0.358003	0.343464	0.357712	0.350955	0.351162
2009	0.153866	0.221679	0.242591	0.277632	0.292682	0.287792	0.289393	0.28533
2010	0.167471	0.258911	0.269871	0.301387	0.309293	0.30031	0.3039	0.302421
2011	0.115156	0.1475	0.191402	0.181548	0.195389	0.196341	0.192541	0.191576
2012	0.14311	0.206779	0.282203	0.256721	0.289751	0.253241	0.272099	0.263629
2013	0.148715	0.213994	0.269929	0.270401	0.270401	0.270401	0.270401	0.270401

***Estimates for 2013 are TSA forecasts.**

Table 3.3.13. Haddock in Division VIa. Standard errors of estimates of log fishing mortality from the final TSA run.

Year	1	2	3	4	5	6	7	8+
1978	0.223189	0.160186	0.162064	0.130787	0.140339	0.15094	0.15508	0.153389
1979	0.203036	0.146201	0.137237	0.13442	0.127199	0.14107	0.149851	0.148442
1980	0.232038	0.15928	0.161375	0.140449	0.149801	0.145584	0.158391	0.159365
1981	0.233526	0.171413	0.160279	0.15189	0.155887	0.162504	0.162748	0.167258
1982	0.224321	0.164271	0.155799	0.144849	0.148776	0.155173	0.163595	0.158237
1983	0.202904	0.148439	0.162333	0.135895	0.140192	0.147036	0.155635	0.152732
1984	0.242997	0.145423	0.134641	0.140084	0.133681	0.147984	0.154762	0.156253
1985	0.206136	0.145015	0.146954	0.133	0.137728	0.141772	0.152177	0.153798
1986	0.223568	0.15683	0.152686	0.146987	0.14851	0.15337	0.158848	0.161311
1987	0.209626	0.128167	0.130135	0.115981	0.121275	0.133177	0.142461	0.138621
1988	0.216681	0.141594	0.131558	0.123895	0.125543	0.138227	0.146337	0.144397
1989	0.223098	0.152289	0.141356	0.126722	0.13056	0.136191	0.149055	0.147681
1990	0.21368	0.150061	0.155341	0.138363	0.140079	0.146837	0.15311	0.155856
1991	0.205396	0.142353	0.148521	0.128211	0.12858	0.140233	0.148836	0.146949
1992	0.216002	0.149296	0.147314	0.13787	0.138546	0.145444	0.154685	0.154123
1993	0.20539	0.130158	0.119527	0.114683	0.117372	0.136512	0.139694	0.144482
1994	0.254678	0.210077	0.200619	0.183951	0.188133	0.196719	0.200238	0.199874
1995	0.365889	0.30671	0.295692	0.281661	0.283338	0.285729	0.288159	0.28816
1996	0.345344	0.277236	0.279254	0.261179	0.261653	0.26407	0.266273	0.26822
1997	0.32203	0.249156	0.235765	0.225041	0.225308	0.227892	0.232547	0.234817
1998	0.332755	0.256391	0.250588	0.231414	0.233268	0.235521	0.23855	0.241404
1999	0.341535	0.267079	0.259266	0.246353	0.244962	0.246661	0.248224	0.251634
2000	0.333509	0.254247	0.230406	0.225033	0.225513	0.227402	0.231426	0.233974
2001	0.346181	0.27034	0.262854	0.249225	0.250221	0.250454	0.25249	0.255479
2002	0.354853	0.280503	0.27834	0.259487	0.258236	0.258711	0.258785	0.263143
2003	0.351172	0.277097	0.265263	0.250378	0.250194	0.251721	0.253971	0.256478
2004	0.361873	0.284791	0.274815	0.265807	0.265044	0.266865	0.268252	0.27041
2005	0.325434	0.241618	0.212393	0.205158	0.205416	0.210342	0.215733	0.216142
2006	0.243825	0.165599	0.158809	0.13882	0.140108	0.144884	0.153428	0.157316
2007	0.24897	0.17843	0.17332	0.150289	0.150652	0.154537	0.162742	0.165209
2008	0.253566	0.192435	0.195287	0.164176	0.165006	0.166331	0.174941	0.176796
2009	0.25832	0.203836	0.209059	0.179135	0.179128	0.180516	0.187835	0.189654
2010	0.274026	0.227589	0.233844	0.203848	0.204192	0.205555	0.212475	0.212564
2011	0.305934	0.274141	0.273875	0.241391	0.239187	0.238299	0.246322	0.246062
2012	0.36756	0.329605	0.319452	0.286353	0.286501	0.280533	0.286666	0.287022
2013	0.512402	0.47089	0.469272	0.451922	0.451922	0.451922	0.451922	0.451922

***Estimates for 2013 are TSA forecasts.**

Table 3.3.14. Haddock in Division VIa. Stock summary from final TSA run. "Obs." denotes the SOP of numbers and mean weights-at-age, rather than the reported caught, landed and discarded yield. "Pred." are TSA estimates, and "SE" denotes standard errors. *Estimates for 2012 and 2013 are TSA projections.

YEAR	LANDINGS (TONNES)			DISCARDS (TONNES)			TOTAL CATCHES (TONNES)			MEAN F(2–6)		SSB (TONNES)		RECRUITMENT (000S AT AGE 1)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE
1978	17187	18278	1654	2318	2413	542	19505	20666	1841	0.658	0.068	38345	1173	70314	8541
1979	14837	15808	1661	13841	10353	2102	28678	26674	3015	0.801	0.074	30935	2227	155234	16386
1980	12759	13553	1727	4715	15846	3254	17474	31214	4491	0.630	0.068	35596	2799	484376	44364
1981	18233	19443	2803	15048	13725	2771	33281	33701	4733	0.454	0.054	75788	5162	62310	7250
1982	29635	28634	4356	10063	6614	1362	39698	33547	4455	0.418	0.047	99880	7335	70471	8419
1983	29411	28459	3607	6781	5067	984	36192	33503	3850	0.451	0.047	90250	5964	43395	6427
1984	30689	26725	2625	15666	12727	3023	46355	39736	4635	0.661	0.065	61897	3353	317313	35181
1985	24451	24330	2621	17385	14983	2833	41837	38819	4577	0.643	0.063	65862	4235	73664	8654
1986	19561	19634	2654	7153	4645	918	26714	23091	2942	0.445	0.049	59237	4361	59337	6604
1987	27012	29060	2895	16193	15256	3595	43205	44441	5151	0.870	0.072	54120	3685	266636	35835
1988	21153	21688	2430	9519	9707	2029	30672	31254	3833	0.798	0.072	47363	3328	21313	4270
1989	16691	19183	2606	2979	2953	718	19669	21495	2804	0.810	0.077	38785	3242	16677	3938
1990	10141	11030	1567	5381	3123	713	15522	13231	1797	0.685	0.072	21931	1991	97374	12071
1991	10557	9948	1127	8691	9800	1887	19248	20381	2637	0.776	0.074	21527	1639	125401	13540
1992	11351	9496	1179	9161	8978	1495	20513	19315	2304	0.588	0.060	29180	2057	176446	17706
1993	19068	17957	1849	16803	15807	2248	35871	33831	3144	0.909	0.076	42114	2680	175131	19337
1994	14272	11756	1709	11070	12519	2267	25342	24877	3028	0.724	0.119	39529	2984	56505	11635
1995	12368	13269	4097	8552	11739	3722	20920	24768	6947	0.696	0.186	34427	5045	200961	28255

Continued on next page.

Table 3.3.14. Continued. Haddock in Division VIa. Stock summary from final TSA run. "Obs." denotes the SOP of numbers and mean weights-at-age, rather than the reported caught, landed and discarded yield. "Pred." are TSA estimates, and "SE" denotes standard errors. *Estimates for 2013 are TSA projections.

YEAR	LANDINGS (TONNES)			DISCARDS (TONNES)			TOTAL CATCHES (TONNES)			MEAN F(2–6)		SSB (TONNES)		RECRUITMENT (000S AT AGE 1)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE
1996	13466	13433	4312	11351	14288	4218	24817	28176	7871	0.837	0.204	36682	5692	104512	20450
1997	12883	13952	4216	6461	12944	3736	19344	28007	6959	0.813	0.166	38315	5851	120679	21965
1998	14401	11111	3238	5535	13947	3929	19936	26183	6539	0.786	0.168	32425	4383	137487	22190
1999	10464	10057	3066	4856	9776	2843	15321	20848	5197	0.802	0.180	31073	4042	32330	9131
2000	6958	10964	3213	7893	26420	9130	14851	38063	10933	1.113	0.225	22701	3616	496649	98523
2001	6762	7277	2893	6626	22434	7110	13389	31482	9674	0.696	0.159	42348	7472	186538	23567
2002	7115	9344	3836	8862	10946	3457	15977	19849	5568	0.407	0.097	54470	7238	95903	14946
2003	5337	16523	5043	4101	10513	3163	9438	25764	6123	0.536	0.123	56375	5985	116850	15095
2004	3874	12727	3764	3705	7012	2133	7579	18494	4827	0.535	0.131	41707	4621	45952	6802
2005	3792	15857	3980	2902	6248	1854	6694	20816	4570	0.759	0.138	38188	4238	30673	4327
2006	6266	7213	997	4618	5725	1035	10884	12810	1558	0.591	0.062	22029	1528	94376	7512
2007	3777	4100	516	3968	3762	662	7745	7842	996	0.427	0.051	20583	1280	18605	2676
2008	2848	3847	504	1229	2258	510	4077	6388	913	0.322	0.044	24562	1716	13036	1988
2009	2851	3386	511	1643	1304	319	4494	4644	601	0.264	0.040	19522	1547	12975	4121
2010	3016	3318	425	2812	1444	321	5828	4845	622	0.288	0.052	15876	1681	103714	19625
2011	1737	2207	283	1540	2338	540	3277	4600	722	0.182	0.040	24350	3694	17839	20294
2012	5100	4817	649	529	2641	854	5629	8417	1601	0.258	0.069	33663	8247	30629	39733
2013	NA	5416	2224	NA	2979	1591	NA	9095	3817	0.259	0.113	34841	11751	30629	60694
Min	1737	2207	283	529	1304	319	3277	4600	601	0.182	0.040	15876	1173	12975	1988
GM	10012	11386	1935	5720	7151	1717	16309	19686	3212	0.562	0.083	37237	3399	74416	12983
AM	12858	13717	2412	7427	9257	2330	20285	23080	4035	0.608	0.094	41013	4107	115618	18946
Max	30689	29060	5043	17385	26420	9130	46355	44441	10933	1.113	0.225	99880	11751	496649	98523

Table 3.3.15. Haddock in Division VIa. Mean weights-at-age in total catches (or stock) and forecasted weights-at-age in 2012. Forecasts in this table are based on either of simple three year means or linear model projections.

		Age							
	Year	1	2	3	4	5	6	7	8+
	1999	0.172	0.255	0.365	0.494	0.611	0.729	0.840	1.172
	2000	0.127	0.270	0.361	0.447	0.572	0.719	0.840	0.813
	2001	0.112	0.242	0.403	0.432	0.514	0.657	0.808	1.015
	2002	0.118	0.208	0.307	0.521	0.606	0.632	0.636	0.939
	2003	0.124	0.239	0.282	0.382	0.652	0.648	0.908	1.086
	2004	0.112	0.189	0.290	0.313	0.373	0.541	0.715	0.988
	2005	0.103	0.198	0.295	0.451	0.429	0.525	1.163	1.018
	2006	0.155	0.254	0.326	0.388	0.471	0.496	0.563	1.294
	2007	0.115	0.219	0.331	0.404	0.456	0.550	0.593	0.685
	2008	0.113	0.245	0.367	0.492	0.570	0.619	0.708	0.827
	2009	0.135	0.266	0.357	0.410	0.570	0.633	0.630	1.008
	2010	0.067	0.180	0.388	0.409	0.459	0.725	0.755	0.877
	2011	0.054	0.259	0.357	0.509	0.476	0.617	0.818	1.107
	2012	0.091	0.370	0.405	0.632	0.457	0.798	0.663	0.765
arithmetic mean	2013	0.071	0.270	0.384	0.517	0.464	0.713	0.745	0.916
linear model	2013			0.5105	0.6978	0.628333	0.804571	0.76125	1.13569
	yr class in 2013	2012	2011	2010	2009	2008	2007	2006	2005
	CV	0.271	0.353	0.064	0.216	0.023	0.128	0.104	0.191

Table 3.3.16. Haddock in Division VIa. Inputs to short-term forecasts(.prd).

MFDP version 1a								
Run: R6_0_2								
Time and date: 14:50 21/06/2013								
Fbar age range: 2-6								
2013								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	30629	0.2	0	0	0	0.071	0.142	0.071
2	21759	0.2	0.57	0	0	0.27	0.204	0.27
3	8567	0.2	1	0	0	0.384	0.248	0.384
4	31132	0.2	1	0	0	0.517	0.247	0.517
5	2401	0.2	1	0	0	0.464	0.265	0.464
6	1496	0.2	1	0	0	0.713	0.25	0.713
7	1225	0.2	1	0	0	0.745	0.256	0.745
8	4954	0.2	1	0	0	0.916	0.253	0.916
2014								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	30629	0.2	0	0	0	0.071	0.142	0.071
2	.	0.2	0.57	0	0	0.27	0.204	0.27
3	.	0.2	1	0	0	0.384	0.248	0.384
4	.	0.2	1	0	0	0.517	0.247	0.517
5	.	0.2	1	0	0	0.464	0.265	0.464
6	.	0.2	1	0	0	0.713	0.25	0.713
7	.	0.2	1	0	0	0.745	0.256	0.745
8	.	0.2	1	0	0	0.916	0.253	0.916
2015								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	30629	0.2	0	0	0	0.071	0.142	0.071
2	.	0.2	0.57	0	0	0.27	0.204	0.27
3	.	0.2	1	0	0	0.384	0.248	0.384
4	.	0.2	1	0	0	0.517	0.247	0.517
5	.	0.2	1	0	0	0.464	0.265	0.464
6	.	0.2	1	0	0	0.713	0.25	0.713
7	.	0.2	1	0	0	0.745	0.256	0.745
8	.	0.2	1	0	0	0.916	0.253	0.916

Input units are thousands and kg - output in tonnes.

Table 3.3.17. Haddock in Division VIa. . Management options table (.prm).

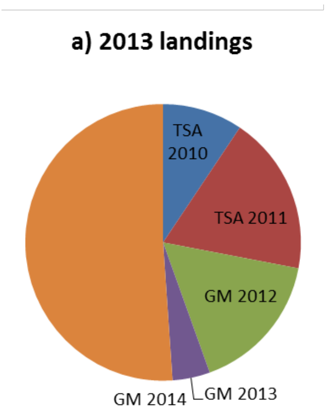
MFDP VERSION 1A						
Run: R6_0_2						
hadMFDP Index file 21/06/2013						
Time and date: 14:50 21/06/2013						
Fbar age range: 2-6						
2013						
Biomass	SSB	FMult	FBar	Landings		
35066	30365	1	0.2428	6673		
2014					2015	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
31078	26377	0	0	0	40216	35130
.	26377	0.1	0.0243	663	39363	34318
.	26377	0.2	0.0486	1310	38530	33525
.	26377	0.3	0.0728	1942	37716	32751
.	26377	0.4	0.0971	2560	36921	31995
.	26377	0.5	0.1214	3164	36144	31258
.	26377	0.6	0.1457	3753	35386	30537
.	26377	0.7	0.17	4329	34645	29834
.	26377	0.8	0.1942	4892	33921	29147
.	26377	0.9	0.2185	5441	33214	28477
.	26377	1	0.2428	5978	32523	27823
.	26377	1.1	0.2671	6503	31849	27184
.	26377	1.2	0.2914	7015	31190	26560
.	26377	1.3	0.3156	7516	30546	25950
.	26377	1.4	0.3399	8005	29917	25356
.	26377	1.5	0.3642	8483	29302	24775
.	26377	1.6	0.3885	8950	28702	24208
.	26377	1.7	0.4128	9407	28116	23654
.	26377	1.8	0.437	9852	27543	23114
.	26377	1.9	0.4613	10288	26983	22586
.	26377	2	0.4856	10714	26436	22070

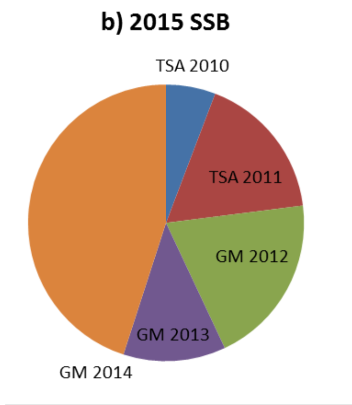
Input units are thousands and kg - output in tonnes.

Table 3.3.18. Haddock in Division VIa. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year.

LANDINGS YIELD				SSB			
	Years Predicted				Years Predicted		
Ages	2013	2014		Ages	2013	2014	2015
1	262	262		1	0	0	0
2	986	986		2	3349	3348	3348
3	658	1115		3	3290	5578	5578
4	3206	564		4	16095	2830	4799
5	236	1958		5	1114	9238	1624
6	215	216		6	1067	1075	8917
7	188	146		7	913	711	716
8	923	732		8	4538	3596	2840
TotWt	6674	5979		TotWt	30366	26376	27822
	09 cohort '13 cohort						
Year-class			2010	2011	2012	2013	2014
Recruits(thousands)			103714	17839	30629	30629	30629
Source			TSA	TSA	GM	GM	GM
Status Quo F:							
% in	2013 landings		9.9%	14.8%	3.9%	0.0%	
% in	2014 landings		9.4%	18.6%	16.5%	4.4%	0.0%
% in	2013 SSB		10.8%	11.0%	0.0%	0.0%	
% in	2014 SSB		10.7%	21.1%	12.7%	0.0%	0.0%
% in	2015 SSB		5.8%	17.2%	20.0%	12.0%	0.0%
GM: geometric mean recruitment							

Haddock in Via : Year-class % contribution to





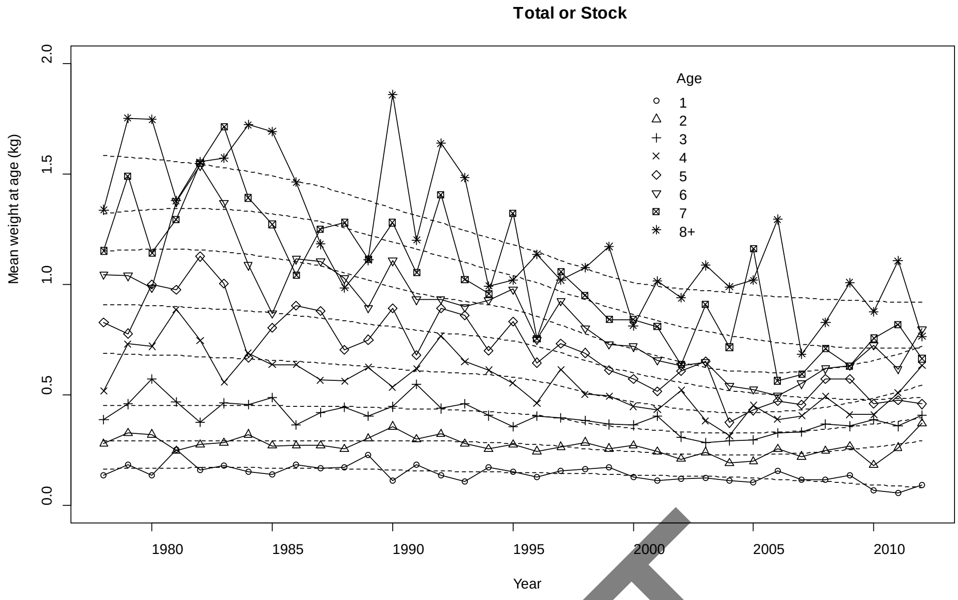


Figure 3.3.1. Haddock in Division VIa. Mean weights-at-age (kg) in total catch (also used for stock weights). Dotted lines show LOESS smoothers fitted through each time-series at age. For clarity, only ages 1–8+ are shown here.

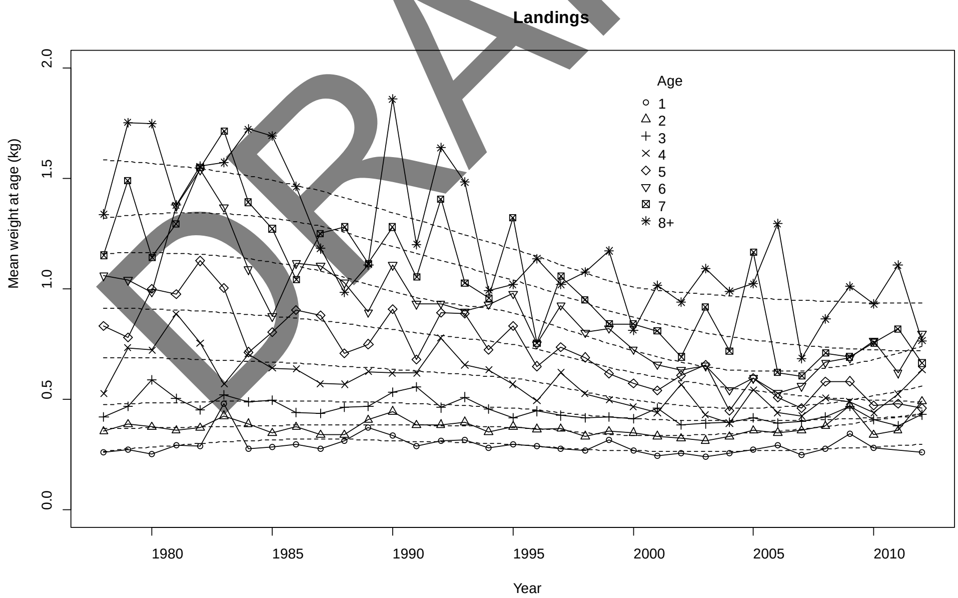


Figure 3.3.2. Haddock in Division VIa. Mean weights-at-age (kg) in landings. Dotted lines show LOESS smoothers fitted through each time-series at age. For clarity, only ages 1–8+ are shown here.

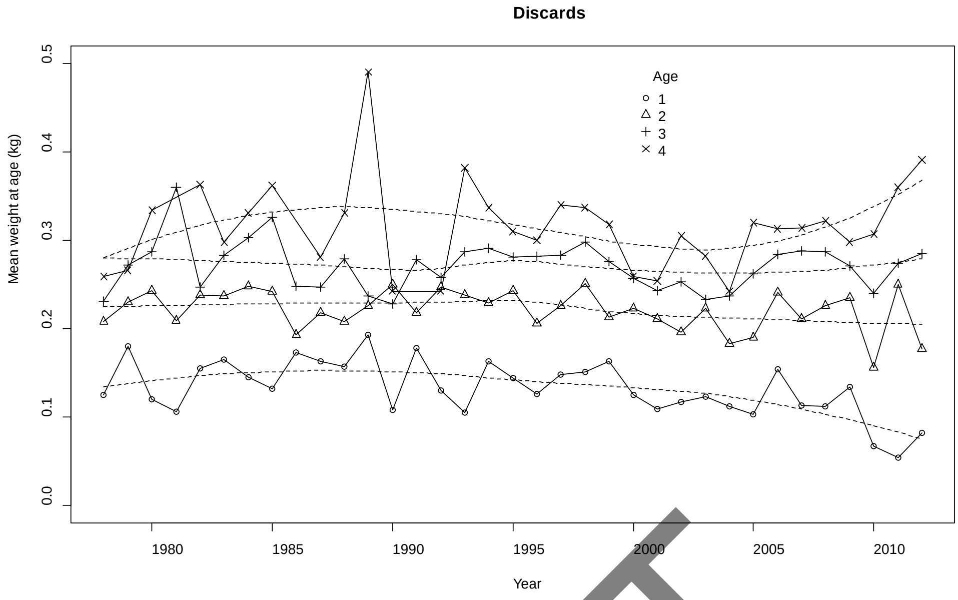


Figure 3.3.3. Haddock in Division VIa. Mean weights-at-age (kg) in discards. Dotted lines show LOESS smoothers fitted through each time-series at age. For clarity, only ages 1–4 are shown here.

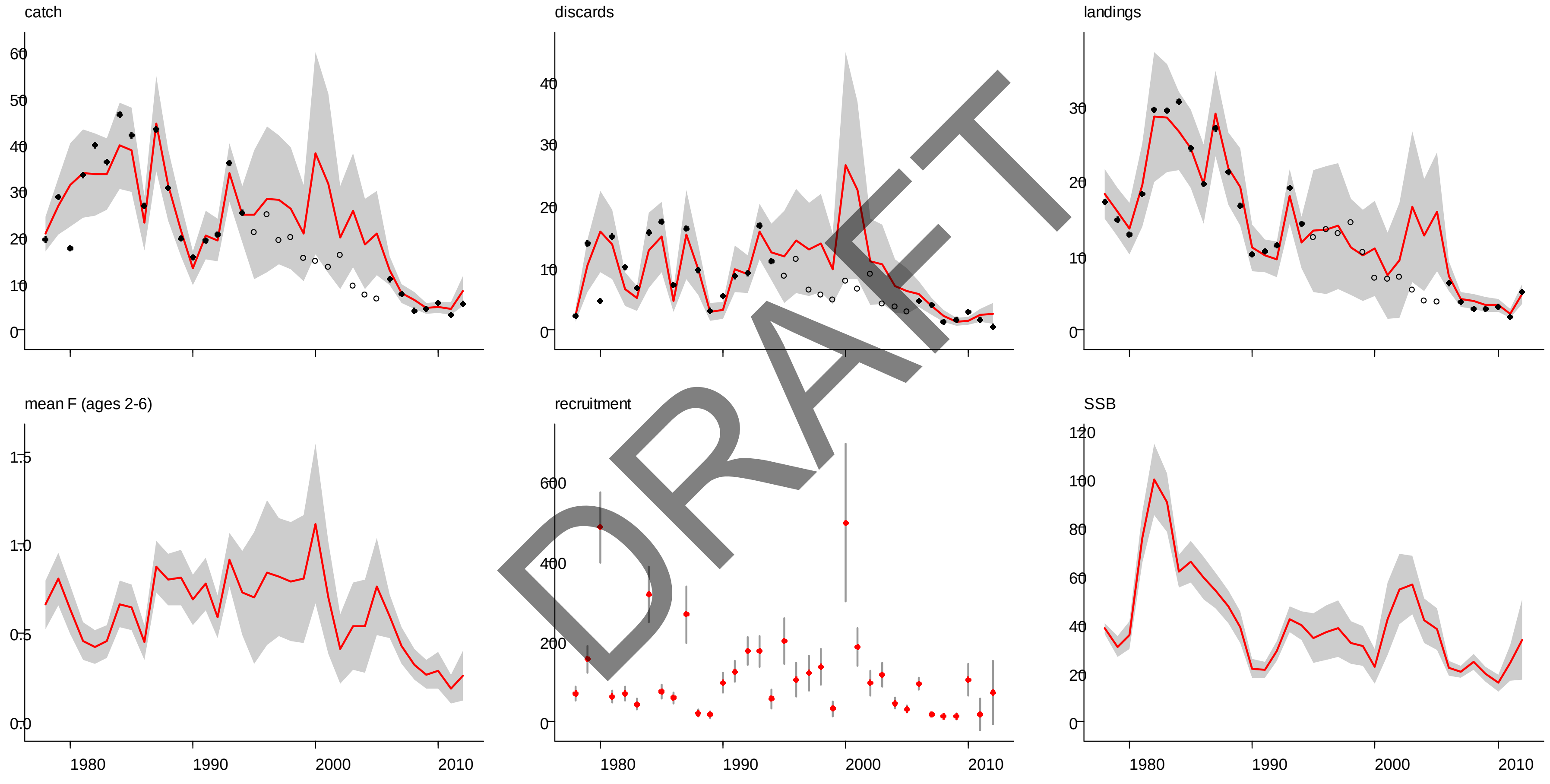


Figure 3.3.4. Haddock in Division VIa. TSA stock summaries from the final run with catch data included 1978–1994 and 2006–2012. Estimates are plotted with approximate pointwise 95% confidence bounds. Dots indicate observed values for catch, landings and discards. Values to the right of the vertical dashed line are forecasted by the model.

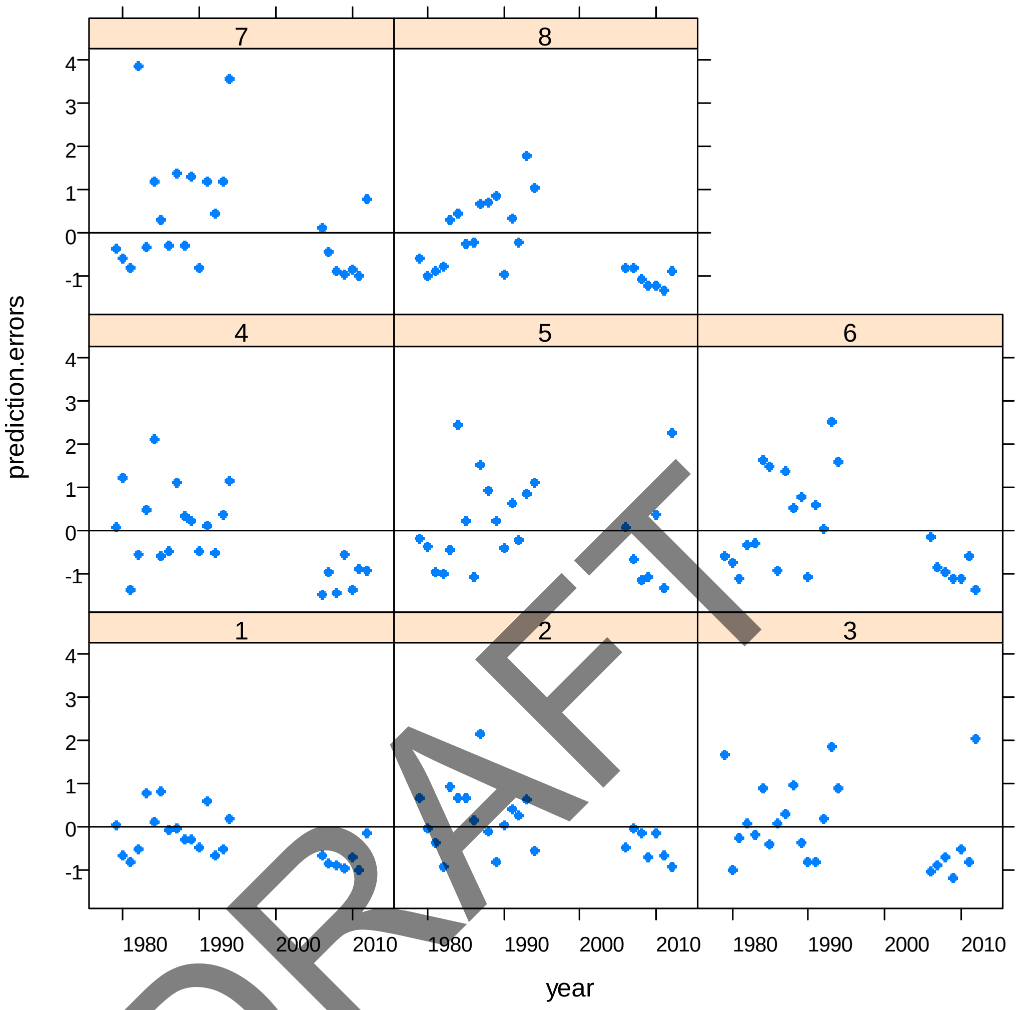


Figure 3.3.5. Haddock in Division VIa. Standardized landings prediction errors from the final TSA run.

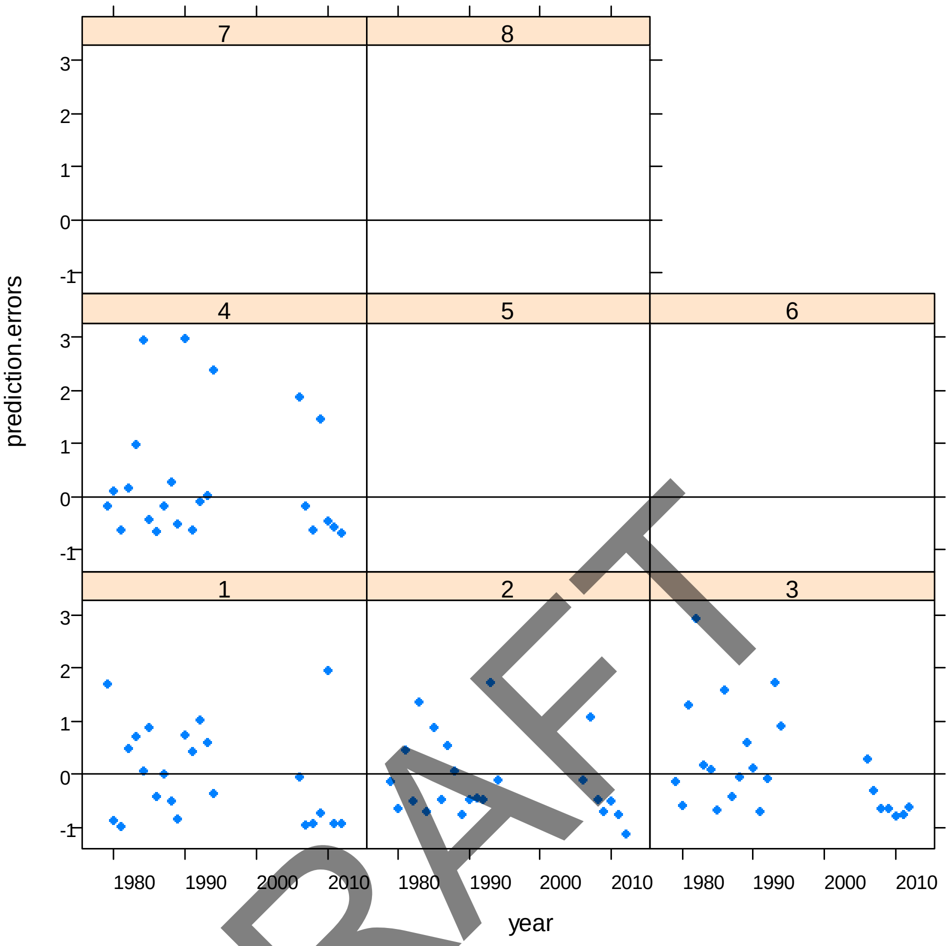


Figure 3.3.6. Haddock in Division VIa. Standardized discards prediction errors from the final TSA run.

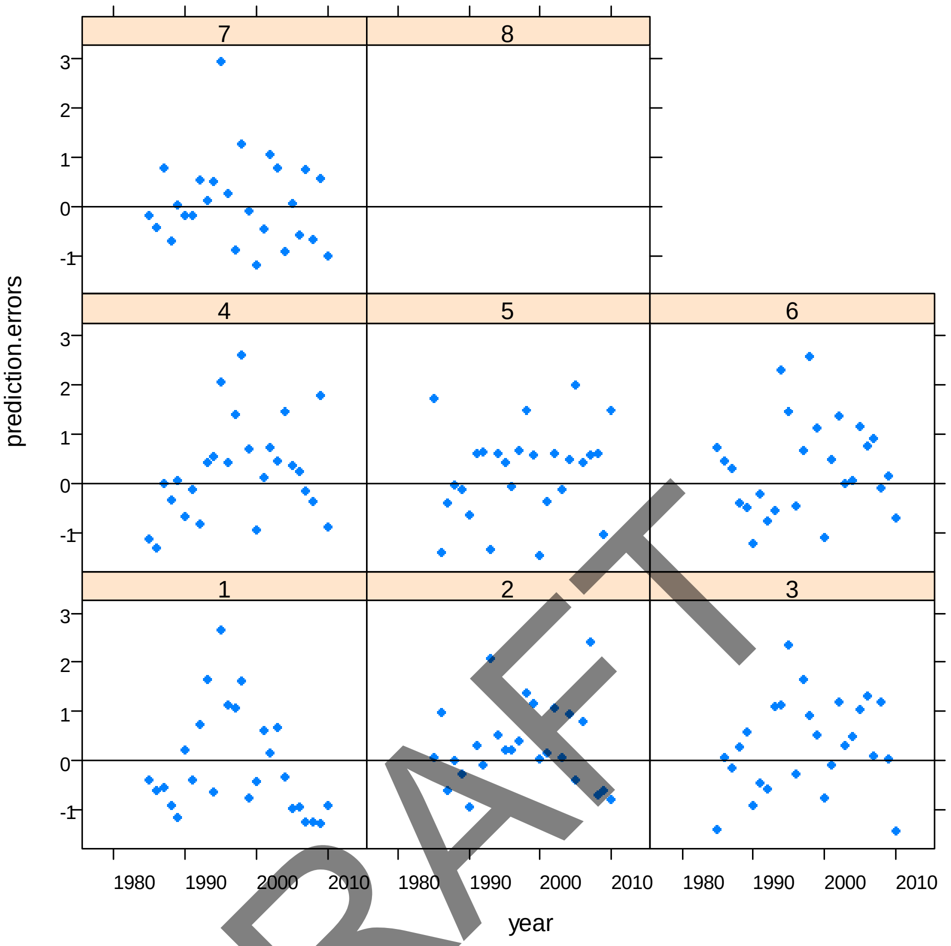


Figure 3.3.7. Haddock in Division VIa. Standardized ScoGFS Q1 prediction errors from the final TSA run.

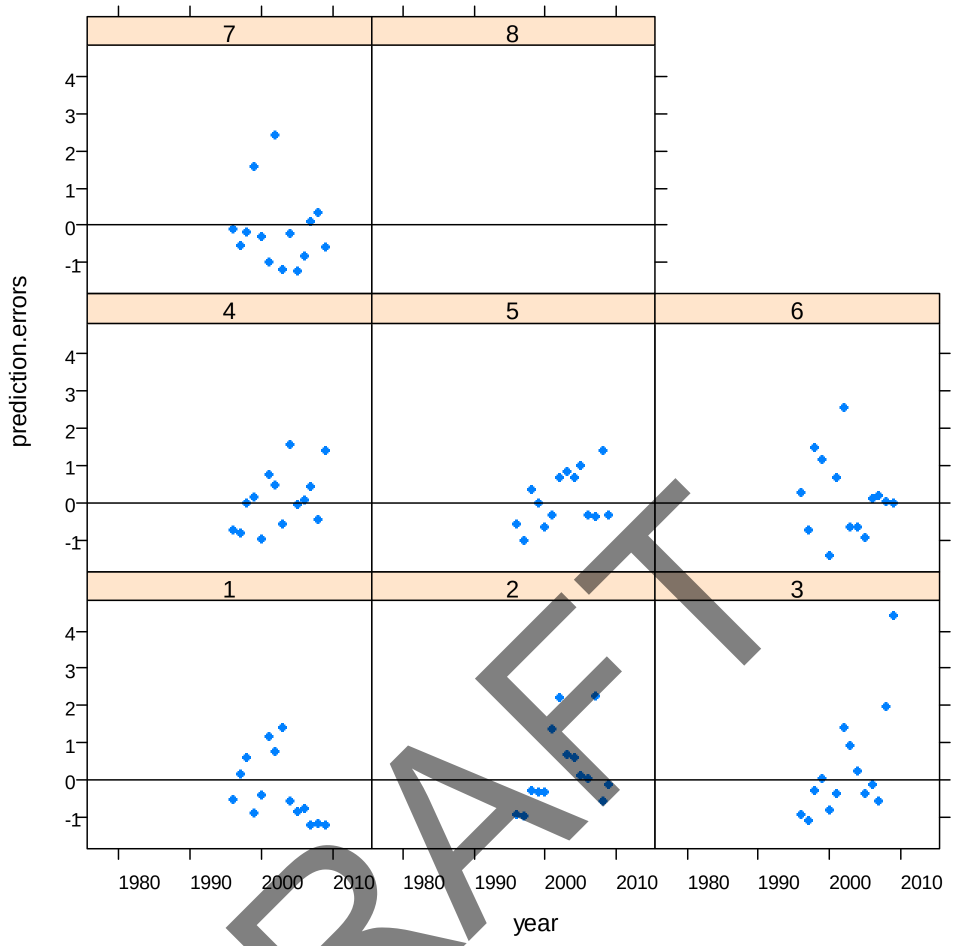
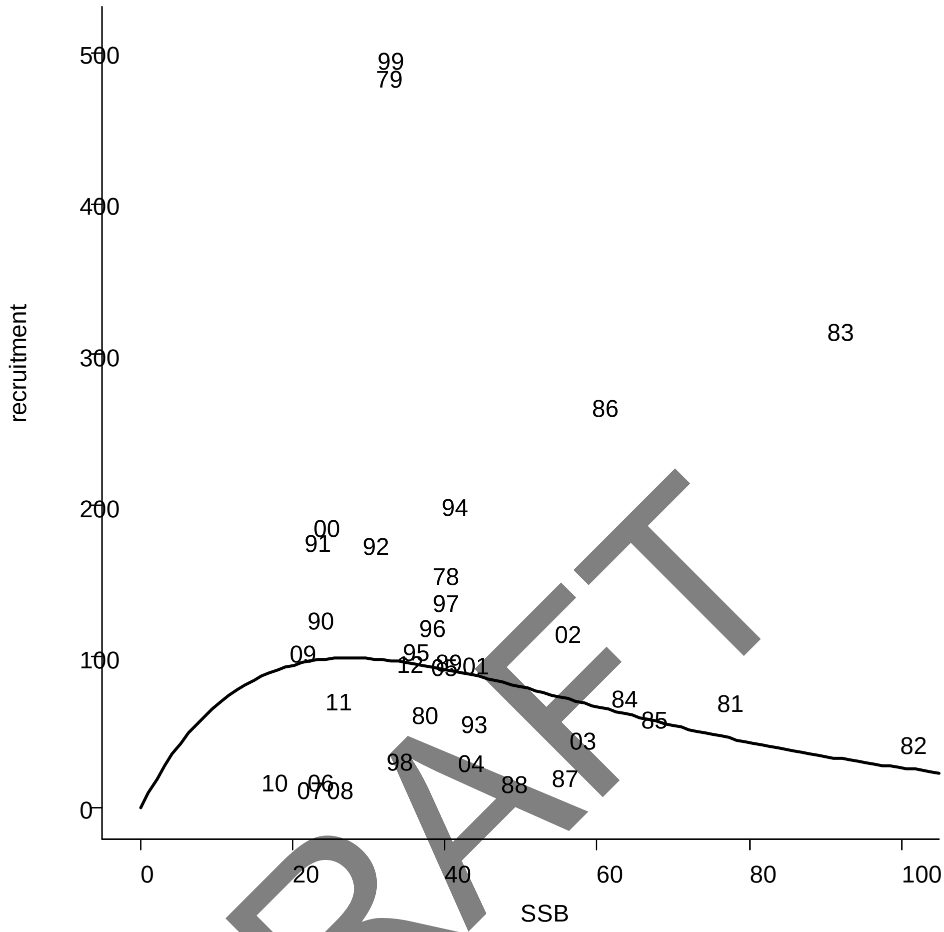


Figure 3.3.8. Haddock in Division VIa. Standardized ScoGFS Q4 prediction errors from the final TSA run.



DRAFT

Figure 3.3.9. Haddock in Division VIa. Stock–recruit plot from the final TSA run, points labelled as year classes.

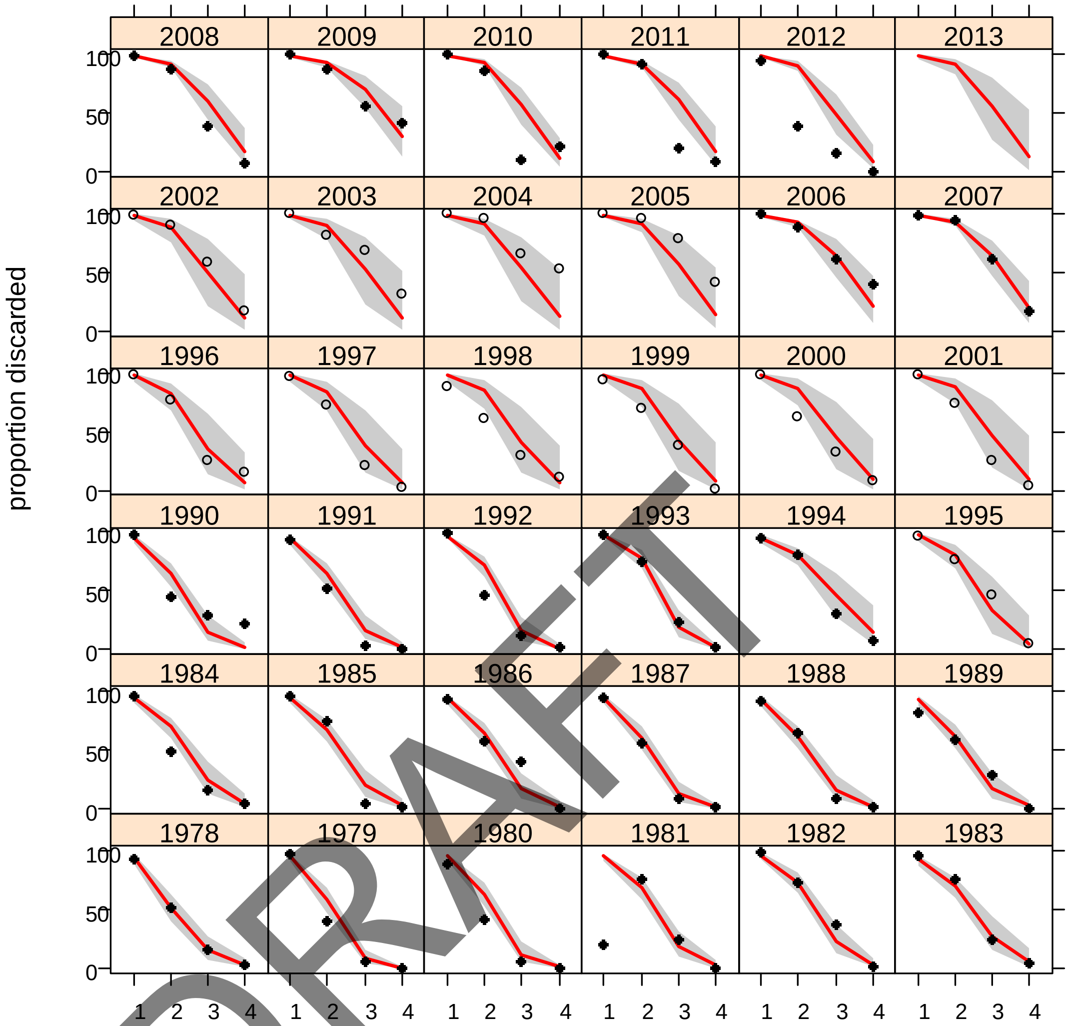


Figure 3.3.10. Haddock in Division VIa. Fitted (lines) and observed (dots) discard proportions-at-age from the final TSA run.

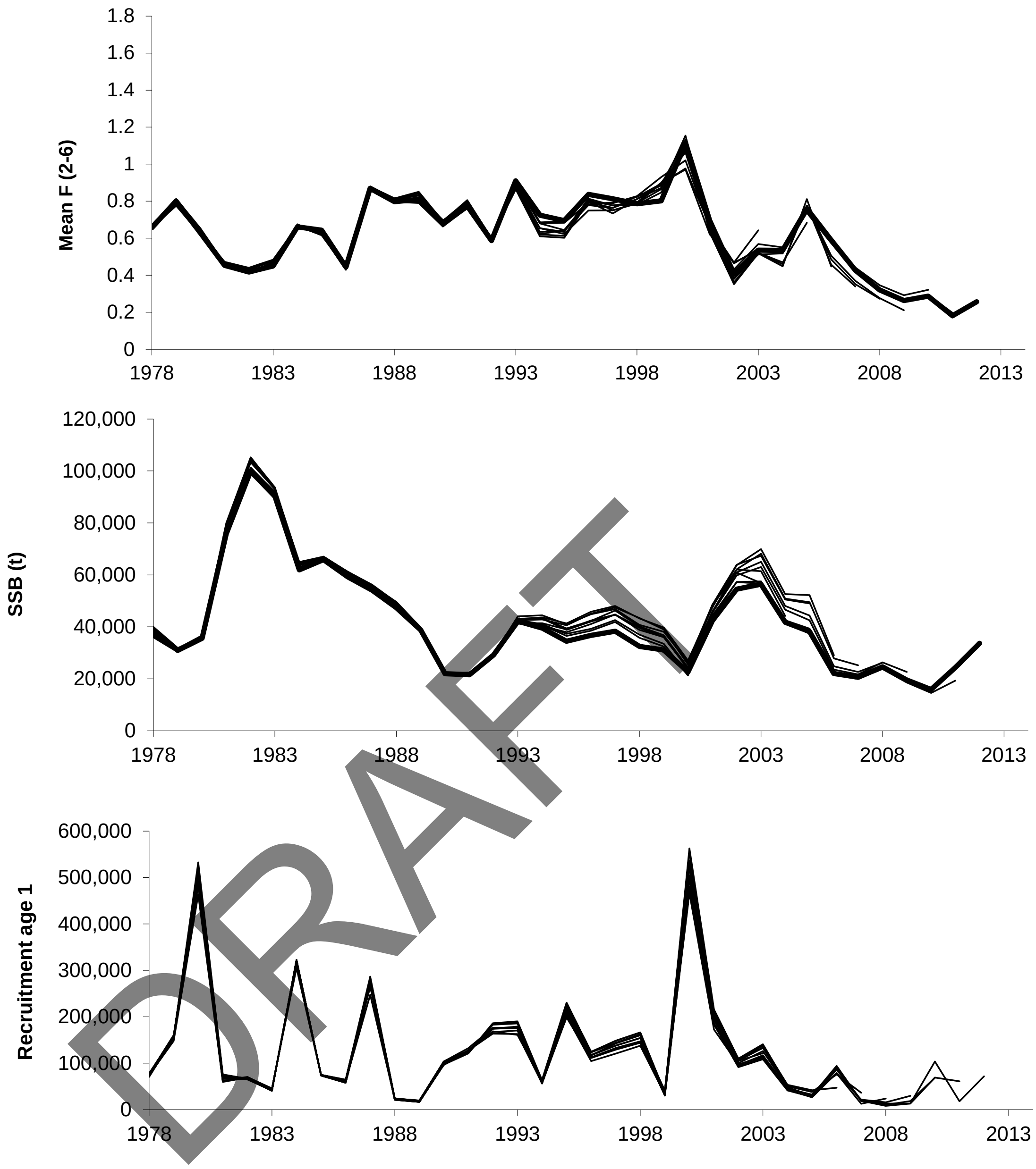


Figure 3.3.11. Haddock in Division VIa. Estimates of Mean F_{2-6}, SSB and recruitment from retrospective TSA runs.

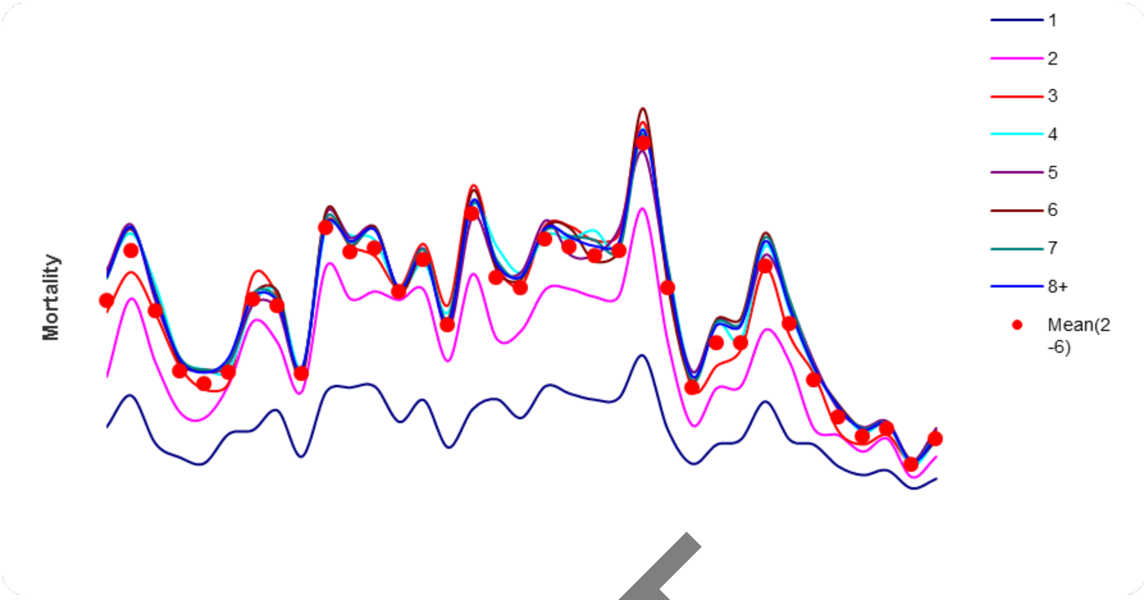


Figure 3.3.12. Haddock in Division VIa. Time-series of estimated fishing mortality-at-age, along with the mean over ages 2–6.

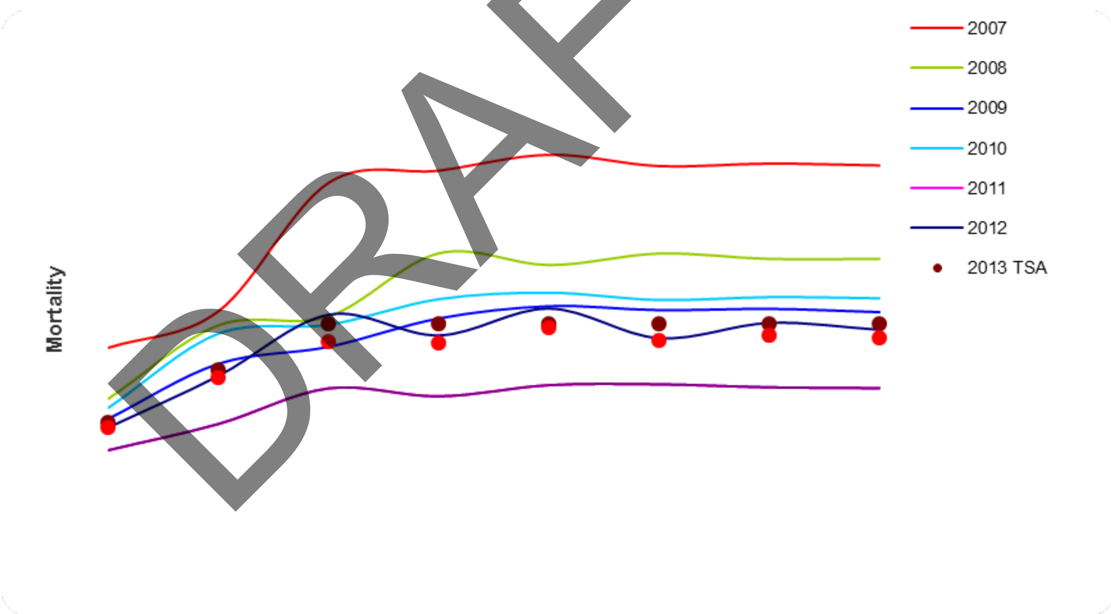


Figure 3.3.13. Haddock in Division VIa. Candidates for fishing mortality-at-age in short-term forecasts. Lines labelled 2007 to 2012 indicate the TSA estimates for those years. Points marked 2013 TSA show the TSA-generated forecast values from the final assessment.

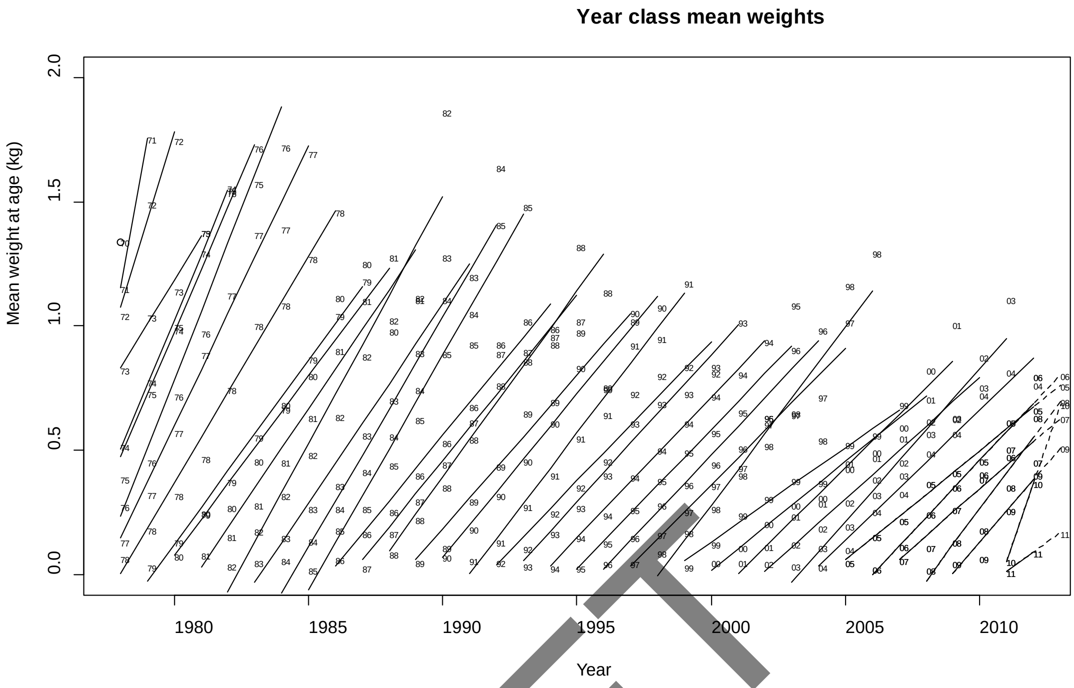


Figure 3.3.14. Haddock in Division VIa. Mean weights-at-age (kg) in total catch (or stock), tracked by year class with a linear model fit. Predicted weights in 2012 based on linear model fits indicated with the dotted lines.

3.4 Whiting in Division VIa

Type of assessment in 2013

As agreed at the 2011 meeting of ACOM, whiting in Division VIa was benchmarked in 2012. The benchmark assessment was conducted in February 2012 (ICES WKROUND, 2012). The agreed assessment follows the procedure outlined in the stock annex developed at the benchmark. The main method adopted in this year's assessment is Time Series Analysis (TSA) used with catch and survey data.

ICES advice applicable to 2012 and 2013

In 2006, the ICES Advice for 2007 in terms of single-stock exploitation boundaries was as follows:

Exploitation boundaries in relation to precautionary limits.

"Given that SSB is estimated at the lowest observed level and total mortality at the highest level over the time period, catches in 2007 should be reduced to the lowest possible level."

The Advice given since then has been the same (see table with the ICES Advice given in the years 2001–2013 below). Detailed advice given for 2013 taking into account MSY, PA and EU policy paper considerations was as follows:

MSY considerations

Biomass has declined to record low level in recent years. Exploitation status is unknown with regards to MSY levels. To allow the stock to rebuild, catches (half of which are discarded) should be reduced to the lowest possible level in 2013.

There are strong indications that TAC management control is not effective in limiting the catch.

PA considerations

Given that SSB is estimated at the lowest observed level and that recent recruitment (with the exception of the 2009 and 2011 year classes) has been weak, catches in 2013 should be reduced to the lowest possible level.

Policy paper

In the light of the EU policy paper on fisheries management (EC, 2010), catches should be reduced to the lowest possible level. This implies a 25% TAC decrease. The resulting TAC would be 230 t.

3.4.1 General

Stock description

General information is now located in the stock annex.

Management applicable to 2012 and 2013

The TAC for whiting is set for ICES Subareas VI, XII and XIV and EU and international waters of ICES Subdivision Vb, and for 2013 was as shown below:

Species:	Whiting *Merlangius merlangus*	Zone:	VI; EU and international waters of Vb; international waters of XII and XIV (WHG/56-14)
Germany	2		
France	36		
Ireland	87		
United Kingdom	167		
Union	292		
TAC	292		Analytical TAC

The following table summarises ICES advice and actual management applicable for whiting in Division VIa during 2001–2013:

Year	Single species exploitation (tonnes)	Basis for single species	TAC for Vb, VI, XII, XIV (tonnes)	% change in F associated with TAC[1]
2001	< 4200	Reduce F below F_{pa}	4000	-40%
2002	< 2000	SSB > B_{pa} in short term	3500	-40%
2003	-	SSB > B_{pa} in short term	2000	-60%
2004	-	SSB > B_{pa} in 2005	1600	(no assessment)
2005	-	-	1600	(assessment in relative trends only)
2006	-	-	1360	(assessment in relative trends only)
2007	0	Reduce catches to lowest possible level	1020	(assessment in relative trends only)
2008	0	Reduce catches to lowest possible level	765	(no assessment)
2009	0	Reduce catches to lowest possible level	574	(no assessment)
2010	0	Reduce catches to lowest possible level	431	(assessment in relative trends only)
2011	See scenarios	Reduce catches to lowest possible level	323	(assessment in relative trends only)
2012	0	Reduce catches to lowest possible level	307	
2013	0	Reduce catches to lowest possible level	292	

[1] Based on F-multipliers from forecast tables.

The minimum landing size for whiting in Division VIa is 27 cm.

Fishery in 2012

A description of the fisheries on the west of Scotland is given in Section 3.1.

Tables and figures of total effort to 2006 by the fleets operating in Division VIa can be found in Section 16 of the Report of WGNSDS 2007 (ICES-WGNSDS, 2007).

Anecdotal information from the fishing industry suggests that the number of vessels targeting whiting continues to be very low. However, the recent low TACs combined with increased interest in bigger whiting (driven by good prices) has resulted in an increasing uptake of the whiting quota. Quota uptake for UK vessels in 2011 was 43%, and the UK landings in 2012 exceeded the UK quota by 16%.

Total landings in 2012 were 300 t, up considerably from 2011 (Table 3.4.1). These are the third lowest recorded landings in the time-series. About a third was landed by Irish vessels and two thirds were landed by Scottish vessels.

The total estimated international catch of ages 1–7+ in 2012 was 1041 t of which approximately 729 t were discards (Table 3.4.2). Of the Scottish discards, 26 t were discarded by the TR1 fleet and 592 t were discarded by the TR2 (*Nephrops*) fleet. About 60 t of 0-group fish were recorded in the discards.

Mandatory introduction of larger square mesh panels for the TR2 (*Nephrops*) fleet in 2008 does not seem to have had much of an effect on the discards of whiting in Division VIa in 2012. In the TR1 fleet, discarding is expected to decline in subsequent years following the mandatory increase in mesh size to 120 mm in 2009. The discards in 2012 were lower than those in 2010, but higher than those in 2011, and they were among the average in the last decade. In terms of discard rate (discards as a proportion of catch), they were still among the highest in the time-series.

3.4.2 Data

Landings

Total landings, as officially reported to ICES in 1965–2012, are shown in Figure 3.4.1 and Table 3.4.2. There have been concerns that the quality of landings data is deteriorating, giving a possible reason for the different stock dynamics implied by the commercial fleet and the annual survey (ScoGFS-WIBTS-Q1) in recent years (see Section 5.1.6.1.3 in the 2005 WG Report; ICES-WGNSDS, 2005). Improved compliance measures and the introduction of UK and Irish legislation requiring registration of all fish buyers and sellers may mean that the reported landings from 2006 onwards are more representative of actual landings.

Landings uploaded to InterCatch by métier and country are shown in Figure 3.4.2. Age distributions were estimated from market samples. Annual numbers-at-age in the landings are given in Table 3.4.3. Annual mean weights-at-age in the landings are given in Table 3.4.6 and shown in Figure 3.4.3. These have been variable in recent years due to the variability associated with low sample sizes. Efforts to increase sampling in these fisheries are being pursued.

Discards

This year, WG estimates of discards are based on data collected in the Irish and Scottish discard programme (raised by weighted average to the level of the total international discards). Discard age compositions from Scottish and Irish samples have been applied to unsampled fleets. Discards uploaded to InterCatch by métier and country are shown in Figure 3.4.2.

To reduce bias and increase precision of discard estimates, previous estimates (ICES-WGCSE, 2011) for the years 1981–2003 were replaced by those provided by Millar and Fryer (2005). Such revisions are particularly important for the estimation of total catch for this stock which has very high discards across a wide age range.

Annual numbers-at-age in the discards are given in Table 3.4.4. Annual mean weights-at-age in the discards are given in Table 3.4.7 and shown in Figure 3.4.3.

Biological

Annual numbers-at-age in the total catch are given in Table 3.4.5. Annual mean weights-at-age in the total catch are given in Table 3.4.8. As in previous meetings, the catch mean weights-at-age were also used as stock mean weights-at-age (see stock annex).

An alternative to the assumption of constant natural mortality (previously 0.2 for all ages and years) was proposed this year linking *M* to fish weight. Thus, natural mortality (*M*) is assumed to vary and be dependent on fish weight (Lorenzen, 1996). *M* values are time-invariant and are calculated as:

$$M_a = 3.0\overline{W}_a^{-0.29}$$

where M_a is natural mortality-at-age a, $\overline{W}_a$ is the time averaged stock weight-at-age a (in g) and the numbers are the Lorenzen parameters for fish in natural ecosystems.

No changes to maturity data were considered this year. Maturity-at-age was assumed to be knife-edge, with the value 0 at age 1 and with 1 (full maturity) at age 2. That has been a source of criticism in previous assessments. However, recent research on gadoid maturity conducted by the UK gives no evidence for substantial change in whiting maturity since the 1950s, although there has been an increase in the incidence of precocious maturity-at-age 1, particularly in males, since 1998, in the Irish Sea. Also as in the 2007 assessment, the proportion mature before spawning and the proportion fished before spawning are both set to be zero.

Surveys

Six research vessel survey-series for whiting in VIa were available to the WG. In all surveys listed, the highest age represents a true age not a plus group.

- Scottish first-quarter west coast groundfish survey (ScoGFS-WIBTS-Q1): ages 1–7, years 1985–2010).
- Scottish fourth-quarter west coast groundfish survey (ScoGFS-WIBTS-Q4): ages 0–8, years 1996–2009).

The Q1 Scottish Groundfish survey was running in the period 1981–2010, and this was performed using a repeat station format with the GOV survey trawl together with the west coast groundgear rig, 'C'. Similarly the Q4 Scottish Groundfish survey was running in 1996–2009, once again using the GOV survey trawl with groundgear 'C' and the fixed station format. The Q4 survey was not carried out in 2010 due to an engine break down of the research vessel.

In 2011, the Q1 and Q4 Scottish Groundfish surveys were re-designed. The previous repeat station survey format consisting of the same series of survey trawl positions being sampled at approximately the same temporal period every year is considered a rather imprecise method for surveying both these subareas and as such a move towards some sort of random stratified survey design was judged necessary. The largest obstacle preventing an earlier move to a more randomised survey design was the lack of confidence in the 'C' rig to tackle the potentially hard substrates that a new randomised survey was likely to encounter. The first step in the process of modifying the survey design was therefore to design a new groundgear that would be capable of tackling such challenging terrain. The introduction of the new design initiated two time-series:

- Scottish first-quarter west coast groundfish survey (UKSGFS-WIBTS-Q1): ages 1–7, years 2011–2013).
- Scottish fourth-quarter west coast groundfish survey (UKSGFS-WIBTS-Q4): ages 0–8, year 2011–2012).

(see the distribution of whiting at-age in the Q1 and Q4 surveys in 2012 and 2013, Figure 3.4.4).

The Irish groundfish survey:

- Irish fourth-quarter west coast groundfish survey (IreGFS): ages 0–5, years 1993–2002.

was a comparatively short series. It was discontinued in 2003 and has been replaced by a new survey:

- Irish fourth-quarter west coast groundfish survey (IGFS-WIBTS-Q4): ages 0–6, years 2003–2012.

This survey uses the RV Celtic Explorer and is part of the IBTS coordinated western waters surveys. The vessel uses a GOV trawl, and the design is a depth stratified survey with randomised stations. Effort is recorded in terms of minutes towed. This survey was considered long enough to be used in the assessment of whiting in Division VIa, giving useful additional indications of year-class strength.

Further descriptions of these surveys can be found in ICES-IBTSWG (2011).

WKROUND 2012 decided to use three survey-series (ScoGFS-WIBTS-Q1, ScoGFS-WIBTS-Q4 and IGFS-WIBTS-Q4) in the tuning procedure in the final assessment. ICES will consider inclusion of the two new Scottish survey time-series to produce tuning indices through an inter-benchmark procedure when 4+ years of data have been gathered.

The survey indices are shown in Table 3.4.9 with data used in the final assessment highlighted in bold.

A comparison of scaled (standardised to z-scores) survey indices (from ScoGFS-WIBTS-Q1, ScoGFS-WIBTS-Q4 and IGFS-WIBTS-Q4) at age show similar trends, mainly for the two Scottish surveys, for most ages (up to age 5, Figure 3.4.5).

Log mean-standardised survey indices by year class and by year and scatterplots of indices within year classes are shown in Figures 3.4.6, 3.4.7, 3.4.8 and 3.4.9. The year-class plots for all three surveys are quite noisy and the ability of these surveys to reliably track year-class strength is generally poor. In addition, some of the correlations for the older ages in the ScoGFS-WIBTS-Q1 scatterplot are negative, while the equivalent plots of the Q4 surveys show very scattered datapoints. Age 0 in the Q4 surveys appears to be a particularly poor measure of year-class strength (little evidence of positive correlation) and is therefore excluded in further analysis of this survey. There are no marked year effects. The log catch curves for these surveys along with those for the catch are shown in Figure 3.4.10. The curves for both ScoGFS-WIBTS-Q1 and ScoGFS-WIBTS-Q4 are relatively linear and not very noisy, and show a fairly steep and consistent drop in abundance.

Commercial cpue

Four commercial catch-effort dataseries were available to the WG including:

- Scottish light trawlers (ScoLTR): ages 1–7, years 1965–2005;

- Scottish seiners (ScoSEI): ages 1–6, years 1965–2005;
- Scottish *Nephrops* trawlers (ScoNTR): ages 1–6, years 1965–2005;
- Irish Otter Trawlers (IreOTB); ages 1–7, years 1995–2005.

Given the problems with non-mandatory effort reporting in the UK (described further in the report of WGNSSK for 2000, ICES-WGNSSK 2001), these cpue series have not been used for a number of years and are not presented in the report. They are retained in the stock annex.

3.4.3 Historical stock development

The final assessment of whiting in VIa was conducted using a TSA model. The method was first developed by Gudmundsson (1994), and it was modified by Rob Fryer for the purpose of assessing time-series containing several years with survey data but no reliable catch data (Fryer, 2002). Subsequent enhancements to the method are detailed in Needle and Fryer (2002). The TSA model allows for years with missing catch or survey data.

Alternative exploratory assessments conducted using SURBA (Needle, 2003) and a Bayesian approach (Cook, 2012) were presented at the WKROUND benchmark in 2012, but were not further explored in this assessment. A SURBA analysis may again be conducted to explore the tuning indices for the two new Scottish surveys when sufficient data have been gathered.

Data screening and exploratory runs

Model used: TSA

Software used: NAG library (FORTRAN DLL) and functions in R.

Input data types and characteristics:

- Landings, ages 1–7+, years 1981–2012 (1995–2005 age structure only used);
- Discards, ages 1–7+, years 1981–2012 (1995–2005 age structure only used);
- ScoGFS-WIBTS-Q1, ages 1–6, years 1985–2010;
- ScoGFS-WIBTS-Q4, ages 1–6, years 1996–2009;
- IGFS-WIBTS-Q4, ages 1–4, years 2003–2006 and 2008–2012.

The main assessment was carried out using a TSA model with ScoGFS-WIBTS-Q1, ScoGFS-WIBTS-Q4 and IGFS-WIBTS-Q4. Natural mortality was assumed to vary with age being dependent on fish weight. No modification was made to account for misreporting (ICES-WKROUND, 2012). A “hockey-stick” model was employed to describe the stock–recruitment relationship. The proportion mature was knife-edge at age 2 (i.e. 0 at age 1, 1 at age 2 and above). Some extra variability in landings and discards was allowed for some ages. Also some points in the time-series that were identified as outliers were downweighted to improve the fit. One point in the IGFS-WIBTS-Q4 time-series (for 2007) was treated as an outlier and was excluded from the analysis. Methods of acquiring the input data are outlined in Section 3.4.2 and further details are given in the stock annex. Table 3.4.10 shows the TSA parameter settings for the assessment run.

The main diagnostics of the quality of the model fit was the value of the objective function (–2*log likelihood), prediction errors and a consideration of how well the model has replicated discard ratios in the input data.

Final assessment

The TSA run using the three surveys is presented as the final assessment run. Table 3.4.11 shows the TSA parameter estimates for the assessment.

Table 3.4.12 gives the TSA population numbers-at-age and Table 3.4.13 gives their associated standard errors. Estimated F at-age is given in Table 3.4.14 and standard errors on the log of this mortality are given in Table 3.4.15. Full summary output is given in Table 3.4.16.

Standardised prediction errors for landings and discards are given in Figure 3.4.11, and those for the three surveys in Figure 3.4.12. None of these are large enough to invalidate the model fit and there are no obvious time-trends in recent years.

Discards continue to account for a large proportion of the total catch, with the proportion discarded tending to level off in the recent years (Figure 3.4.13). The TSA stock–recruit plot is presented in Figure 3.4.14 and shows a rather good relationship, partly because the stock was driven to very low levels of SSB in the last decade.

TSA also estimated a large increase in catchability: this is plotted as the percentage change compared to the catchability at the start of each of the three surveys in Figure 3.4.15. The estimates are uncertain with relatively wide confidence intervals. The summary plots for the final assessment are shown in Figure 3.4.16.

The final estimates for the stock are:

$F_{(2–4)}$ in 2012 = 0.069

SSB in 2013 = 8526 t

Mean $F_{2\text{-}4}$ is estimated to have declined below F_{pa} (0.6) since 2002, but a sequence of low recruitments led to a fall in SSB in recent years. The 2009 year class is estimated as the strongest since 2000 and contributes towards a slight increase in SSB in 2013. The 2011 year class appears to be strong as well, but this will need to be verified in subsequent years.

Estimated and observed catches diverged considerably in the period where catches are thought to be unreliable due to black landings (1995–2005). Recent estimates of catch are almost the same as observed values. This could indicate a beneficial effect of management regulations and changes in fleet behaviour since 2006, and is supported by anecdotal information from the fishing industry.

Retrospectives for the final assessment run are shown in Figure 3.4.17. This figure also shows lines at ±2 se (approximate 95% confidence limits) around the run in the respective years. Retrospective bias is small with respect to SSB. With respect to mean F and recruitment, all results are within the confidence limits of this year's run. The confidence interval for mean F reflects uncertainty in estimation of mean F when that estimation is based to a large extent on survey data (1995–2005) or the age structure of discards data (2006 onwards).

3.4.4 Short-term projections

A short-term projection was made using WGFRANSW following the procedure outlined in the stock annex.

The recruitment value (in thousand fish) derived from TSA and used in the forecast for 2013 was 72 835. The value for 2014 and 2015 was taken as the geometric mean for 2003–2012 and was 31 222.

A three-year mean exploitation pattern rescaled to the final year F estimate was taken to represent *status quo* mortality.

Input data to the short-term projection is shown in Table 3.4.17. Management options from the forecast and detailed tables of catch numbers-at-age are shown in Table 3.4.18.

A plot of the short-term forecast is shown in Figure 3.4.18. Results from sensitivity analysis from this forecast are shown in Figure 3.4.19 and probability profiles in Figure 3.4.20.

3.4.5 MSY explorations

The WG explored, last year and this year, the use of the srmsymc package for defining MSY reference points. Estimates of F_{MSY} and potential proxies (e.g. F_{MAX}) were highly uncertain and parameter values were successfully estimated on only 50% of iterations for all three stock–recruit relationships (not shown in this report). The WG concluded that the data did not support the provision of estimates of F_{MSY}.

3.4.6 Biological reference points

ICES considers that B_{lim} is 16 000 t and B_{pa} be set at 22 000 t. ICES proposes that F_{lim} is 1.0 and F_{pa} be set at 0.6.

3.4.7 Management plans

There are no specific management objectives or a management plan for this stock, but a plan is under development.

3.4.8 Uncertainties and bias in the assessment and forecast

The most significant problem with assessment of this stock is with commercial data. Incorrect reporting of landings (species and quantity) is known to occur and directly affects the perception of the stock. TSA is explicitly designed to allow for omission in the catch data during this period (1995–2005 uses only age structure data from the catch) which is why it was used here as the final assessment.

The survey data and commercial catch data contain different signals concerning the stock. The data since the mid-1990s are sufficiently consistent to conduct a catch-at-age analysis tuned with survey data. However, due to the discrepancy present in the earlier period, the Working Group considers that it is not possible to evaluate the current state of the stock with reference to precautionary reference points. A similar problem has been present in the North Sea whiting stock (as reported by ICES-WGNSSK, 2010). Three potential sources of this discrepancy were identified for the North Sea stock, and they may apply to whiting in VIa as well: bias in catch estimates, changes in survey catchability or changes in natural mortality due to predation or regime shift (ICES WGNSSK, 2010).

Long-term information on the historical yield and catch composition indicates that the present stock size is low. The current assessment indicates that the stock is historically at a very low level. Total mortality has been declining over the past few years. The sum of the Scottish west coast groundfish survey indices (both in quarter one and quarter four) is also low, but shows a moderate increase from 2008 onwards. The persistence of this trend should be verified in subsequent assessments.

3.4.9 Recommendation for next benchmark

A landings and discards disaggregated assessment appeared to be a reliable basis for determining the status of the whiting stock in VIa. Given the new legislation on reporting landings, the quality of landings data is likely to continue to improve.

With regard to the assessment method, changes to the variance structures used in the model should be allowed if they improve model diagnostics (e.g. likelihood ratio tests, prediction error plots).

The potential for improvement in the quality of survey data needs to be investigated. The issue of changes in survey catchability needs to be addressed. The inclusion of the two new Scottish surveys in this assessment should also be considered once a sufficient time-series becomes available.

3.4.10 Management considerations

Recruitment during the 1990s appears to have been high while more recently, it has been below average. The 2009 year class is still estimated to be relatively strong, following low recruitment of 2006 to 2008 year classes. The 2011 year class appears to be moderately strong following historically low recruitment of 2010 year class.

Recent estimates of SSB remain at a low level, but the latest estimate for 2012 indicates a potential upturn, driven by the relatively large 2009 and 2011 year classes. Fishing mortality also remains low. The perception of the state of this stock (as estimated from this assessment) appears not to have changed much from last year.

Whiting are caught in mixed fisheries with cod and haddock in Division VIa. Management of whiting will be strongly linked to that for cod for which there is an ongoing recovery plan (EC, 2008). There have also been several technical conservation measures introduced in the VIa gadoid fishery in recent years including the mandatory increases in mesh size to 120 mm.

Whiting are caught mainly as a bycatch species and there are no targeted fisheries for this stock, making direct management difficult. Whiting are caught and heavily discarded in small meshed fisheries for *Nephrops*: in 2012 this fleet only discarded over 60% of the total catch (across all fleets) of 1041 t (almost 50% in 2011). Any management measures which may result in a shift of vessels to these smaller mesh sizes will therefore result in a worse exploitation pattern and higher discards. Measures to improve the selectivity of these fisheries, such as sorting grids and appropriately placed square mesh panels should be introduced if these discards are to be avoided.

3.4.11 References

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Table 3.4.1. Whiting in Division VIa. Nominal landings (in tonnes) as officially reported to ICES.

COUNTRY	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium	1	-	+	-	+	+	+	-	1	1	+	-	-	-	-	+	-	-	-	-	-	-	-	-
Denmark	1	+	3	1	1	+	+	+	+	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	1
France	199	180	352	105	149	191	362	202	108	82	300	48	52	21	11	6	9	7	1	3	1	3	4	+
Germany	+	+	+	1	1	+	-	+	-	-	+	-	-	-	-	-	-	+	1	-	-	-	-	-
Ireland	1,315	977	1,200	1,377	1,192	1,213	1,448	1,182	977	952	1,121	793	764	577	568	356	172	196	56	69	125	99	149	96
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Spain	-	-	-	-	-	-	1	-	1	2	+	-	2	-	-	-	-	-	-	-	-	-	-	-
UK (E, W & NI)	44	50	218	196	184	233	204	237	453	251	210	104	71	73	35	13	5	2	1	-	-	-	-	-
UK (Scot.)	6,109	4,819	5,135	4,330	5,224	4,149	4,263	5,021	4,638	3,369	3,046	2,258	1,654	1,064	751	444	103	178	424	-	-	-	-	-
UK (total)																				369	354	247	77	204
Total landings	7,669	6,026	6,908	6,010	6,751	5,786	6,278	6,642	6,178	4,657	4,677	3,203	2,543	1,735	1,365	819	289	383	484	441	482	349	230	300

*** Preliminary.**

Table 3.4.2. Whiting in Division VIa. Landings, discards and catch estimates 1978–2012, as used by the WG. Values are totals for fish over the ages 1 to 7+. Discard and catch values are revised 1978–2003 compared to previous assessments because of a revised method for raising discards.

YEAR	WEIGHT (TONNES)			NUMBERS (THOUSANDS)		
	Total	Human consumption	Discards	Total	Human consumption	Discards
1978	19346	14677	4669	85502	54369	31133
1979	20100	17081	3019	77484	61393	16091
1980	14598	12816	1782	54643	44562	10081
1981	14335	12203	2132	59247	46067	13180
1982	19356	13871	5485	84886	47883	37003
1983	22264	15970	6294	86244	49359	36885
1984	20475	16458	4017	89113	50218	38895
1985	17733	12893	4840	75192	43166	32026
1986	11123	8454	2669	49413	31273	18140
1987	23462	11544	11918	158176	41221	116955
1988	19484	11352	8132	109474	40681	68793
1989	13407	7531	5876	72364	26876	45488
1990	10173	5643	4530	51426	19201	32225
1991	11543	6660	4883	63767	25103	38664
1992	15253	6004	9249	93424	22266	71158
1993	11631	6872	4759	52365	23246	29119
1994	9356	5901	3455	44986	20060	24926
1995	11847	6076	5771	66432	18763	47669
1996	15096	7156	7940	81230	22329	58901
1997	11536	6285	5251	55724	19250	36474
1998	13847	4631	9216	88803	14387	74416
1999	8588	4613	3975	43219	15970	27249
2000	16295	3010	13285	176734	10118	166616
2001	6701	2438	4263	38114	8477	29637
2002	4560	1709	2851	28381	5765	22616
2003	2075	1356	719	10063	4124	5939
2004	3437	811	2626	21749	2571	19178
2005	1239	341	898	6154	1051	5103
2006	1326	380	946	12988	1049	11939
2007	849	484	365	4879	1145	3734
2008	617	443	174	3085	1232	1853
2009	905	488	417	18038	1115	16923
2010	1193	307	886	18391	601	17790
2011	569	230	339	4877	583	4294
2012	1041	313	729	9679	702	8977
Min	569	230	174	3085	583	1853
GM	6699	3384	2752	38856	10688	23205
AM	10725	6486	4239	57036	22176	34859
Max	23462	17081	13285	176734	61393	166616

Table 3.4.3. Whiting in Division VIa. Landings-at-age (thousands).

	Age						
Year	1	2	3	4	5	6	7+
1965	6938	6085	43530	4803	388	103	22
1966	1685	10544	2229	28185	1861	186	52
1967	5169	26023	10619	697	14574	789	143
1968	7265	16484	9239	3656	324	5036	368
1969	873	25174	8644	2566	1206	118	2333
1970	730	6423	28065	3241	670	214	550
1971	2387	8617	4122	34784	1338	240	223
1972	16777	12028	4013	1363	14796	793	148
1973	14078	36142	5592	1461	357	4292	310
1974	9083	51036	10049	1166	180	52	849
1975	14917	16778	36318	2819	281	57	245
1976	8500	46421	15757	17423	1508	66	57
1977	16120	13376	25144	3127	4719	292	24
1978	17670	18175	6682	9400	941	1433	68
1979	6334	34221	13282	3407	3488	276	384
1980	11650	11378	14860	4155	1244	1085	190
1981	3593	24395	11297	4611	1518	452	201
1982	2991	5783	29094	6821	2043	803	348
1983	3418	7094	8040	22757	6070	1439	540
1984	7209	12765	8221	4387	14825	1953	858
1985	4139	19520	8574	3351	1997	4764	822
1986	2674	14824	9770	2653	532	291	529
1987	6430	13935	13988	5442	837	330	259
1988	1842	20587	9638	6168	1949	290	207
1989	2529	5887	11889	4767	1266	468	71
1990	3203	8028	2393	4009	1326	204	37
1991	3294	8826	10046	1208	1391	286	51
1992	2695	9440	4473	4782	396	373	106
1993	1051	10179	6293	2673	2738	163	147
1994	909	4889	9158	3607	712	715	69
1995	215	4322	6516	5654	1397	376	282
1996	990	5410	7675	5052	2461	583	157
1997	877	3658	8514	4316	1441	338	106
1998	840	3504	4277	3698	1442	338	288
1999	1013	6131	4546	2040	1774	355	112
2000	484	2952	4211	1570	485	328	89
2001	461	3271	2630	1567	401	131	16
2002	62	1624	3018	799	227	23	13
2003	170	710	1111	1673	347	111	2
2004	54	724	543	521	622	78	29
2005	28	276	455	140	99	45	7
2006	82	139	369	260	61	113	24

	Age						
Year	1	2	3	4	5	6	7+
2007	187	168	255	326	132	27	50
2008	6	265	394	336	152	55	24
2009	59	216	254	430	100	44	13
2010	53	94	153	119	126	24	31
2011	0	310	133	82	28	17	12
2012	9	25	375	210	57	15	11

Table 3.4.4. Whiting in Division VIa. Discards-at-age (thousands). Previous discard estimates (ICES-WGCSE, 2011) for the years 1978–2003 were replaced by those estimated by Millar and Fryer (2005).

	Age						
Year	1	2	3	4	5	6	7+
1965	17205	4968	11437	531	14	2	0
1966	4322	8946	515	3317	79	3	0
1967	12237	20791	2674	84	629	12	1
1968	16394	12612	2137	377	13	82	3
1969	1983	20494	2093	292	51	2	26
1970	1776	6704	7494	382	33	4	0
1971	5505	6719	969	3906	57	4	1
1972	39192	8930	850	152	610	14	1
1973	30521	26995	1225	147	14	77	2
1974	23101	40590	2362	123	7	1	7
1975	37295	13541	8485	310	12	1	0
1976	24891	35812	3360	1940	63	1	0
1977	48148	8675	5432	301	212	5	0
1978	17886	12512	501	194	0	40	0
1979	2581	12099	1113	264	34	0	0
1980	2725	4889	2003	366	86	12	0
1981	1128	10415	1397	201	27	12	0
1982	19511	3421	12683	1197	187	4	0
1983	21690	6748	2909	5372	158	8	0
1984	34330	2400	909	371	811	73	1
1985	17615	9858	3273	672	205	363	40
1986	6159	9823	1962	185	1	0	10
1987	97611	17427	1763	154	0	0	0
1988	28057	38019	2239	467	11	0	0
1989	31079	5598	8570	223	13	5	0
1990	20952	11176	71	23	3	0	0
1991	23211	7540	7355	266	236	56	0
1992	50665	16729	2810	954	0	0	0
1993	14057	11139	2903	588	431	0	1
1994	12700	6859	3872	1152	189	150	4
1995	21974	21786	3416	484	7	1	1
1996	33621	18625	5086	1535	13	1	20
1997	22422	9632	3806	540	71	2	1
1998	53742	16058	3553	847	177	31	8
1999	7928	17097	1402	503	275	44	0
2000	158913	5254	2238	154	16	41	0
2001	5666	23084	715	172	0	0	0
2002	11055	8531	2428	415	175	9	3
2003	3770	1416	334	374	32	9	4
2004	14667	3557	536	305	107	4	2

	Age						
Year	1	2	3	4	5	6	7+
2005	2923	1578	534	37	19	7	4
2006	9784	852	1000	256	36	11	2
2007	995	1077	308	64	4	3	0
2008	806	638	142	162	51	41	0
2009	6926	112	72	49	16	3	0
2010	16005	1427	245	42	61	6	1
2011	2697	1410	172	12	3	0	0
2012	7837	434	576	106	21	2	0

Table 3.4.5. Whiting in Division VIa. Total catch-at-age (thousands).

	Age						
Year	1	2	3	4	5	6	7+
1965	24143	11054	54967	5334	402	105	22
1966	6007	19490	2744	31502	1940	189	53
1967	17406	46814	13293	781	15204	801	144
1968	23659	29096	11376	4034	337	5118	372
1969	2856	45668	10737	2858	1257	120	2358
1970	2506	13128	35559	3623	703	218	550
1971	7891	15336	5090	38690	1395	245	224
1972	55969	20958	4863	1514	15406	807	149
1973	44599	63137	6817	1608	371	4369	313
1974	32185	91625	12412	1289	188	53	856
1975	52213	30319	44804	3129	293	58	245
1976	33392	82233	19117	19363	1571	67	57
1977	64268	22051	30576	3428	4931	297	24
1978	35556	30687	7183	9594	941	1473	68
1979	8915	46320	14395	3671	3522	276	384
1980	14375	16267	16863	4521	1330	1097	190
1981	4721	34810	12694	4812	1545	464	201
1982	22502	9204	41777	8018	2230	807	348
1983	25108	13842	10949	28129	6228	1447	540
1984	41539	15165	9130	4758	15636	2026	859
1985	21754	29378	11847	4023	2202	5127	862
1986	8833	24647	11732	2838	533	291	539
1987	104041	31362	15751	5596	837	330	259
1988	29899	58606	11877	6635	1960	290	207
1989	33608	11485	20459	4990	1279	473	71
1990	24155	19204	2464	4032	1329	204	37
1991	26505	16366	17401	1474	1627	342	51
1992	53360	26169	7283	5736	396	373	106
1993	15108	21318	9196	3261	3169	163	148
1994	13609	11748	13030	4759	901	865	73
1995	22189	26108	9932	6138	1404	377	283
1996	34611	24035	12761	6587	2474	584	177
1997	23299	13290	12320	4856	1512	340	107
1998	54582	19562	7830	4545	1619	369	296
1999	8941	23228	5948	2543	2049	399	112
2000	159397	8206	6449	1724	501	369	89
2001	6127	26355	3345	1739	401	131	16
2002	11117	10155	5446	1214	402	32	16
2003	3940	2126	1445	2047	379	120	6
2004	14721	4281	1079	825	730	82	31
2005	2951	1854	988	178	118	53	11

	Age						
Year	1	2	3	4	5	6	7+
2006	9865	991	1369	516	97	124	26
2007	1182	1245	563	390	136	29	50
2008	812	903	536	498	203	96	24
2009	6985	328	325	478	116	47	13
2010	16058	1521	399	161	187	30	32
2011	2697	1720	305	93	32	17	12
2012	7846	460	952	316	78	16	11

Table 3.4.6. Whiting in Division VIa. Landings weight-at-age (kg).

	Age						
Year	1	2	3	4	5	6	7+
1965	0.218	0.249	0.308	0.452	1.208	0.72	0.778
1966	0.238	0.243	0.325	0.374	0.61	0.72	0.828
1967	0.204	0.24	0.319	0.424	0.412	0.639	0.821
1968	0.206	0.263	0.366	0.444	0.554	0.538	0.735
1969	0.178	0.223	0.335	0.5	0.57	0.649	0.63
1970	0.205	0.203	0.274	0.382	0.519	0.619	0.683
1971	0.209	0.247	0.276	0.316	0.426	0.551	0.712
1972	0.211	0.258	0.345	0.368	0.426	0.494	0.638
1973	0.196	0.235	0.362	0.479	0.485	0.532	0.666
1974	0.193	0.215	0.317	0.444	0.591	0.641	0.584
1975	0.209	0.245	0.305	0.471	0.651	0.615	0.717
1976	0.201	0.242	0.309	0.361	0.497	0.687	0.856
1977	0.2	0.244	0.296	0.392	0.431	0.629	0.819
1978	0.199	0.235	0.286	0.389	0.516	0.549	0.612
1979	0.218	0.232	0.306	0.404	0.536	0.678	0.693
1980	0.172	0.242	0.33	0.42	0.492	0.595	0.817
1981	0.192	0.228	0.289	0.382	0.409	0.409	0.547
1982	0.184	0.22	0.276	0.352	0.505	0.513	0.526
1983	0.216	0.249	0.28	0.34	0.409	0.494	0.51
1984	0.216	0.259	0.313	0.371	0.412	0.458	0.458
1985	0.185	0.238	0.306	0.402	0.43	0.461	0.538
1986	0.174	0.236	0.294	0.365	0.468	0.482	0.499
1987	0.188	0.237	0.304	0.373	0.511	0.52	0.576
1988	0.176	0.215	0.301	0.4	0.483	0.567	0.6
1989	0.171	0.22	0.279	0.348	0.459	0.425	0.555
1990	0.225	0.251	0.324	0.359	0.417	0.582	0.543
1991	0.199	0.22	0.291	0.354	0.391	0.442	0.761
1992	0.193	0.23	0.288	0.349	0.388	0.397	0.51
1993	0.186	0.242	0.314	0.361	0.412	0.452	0.474
1994	0.161	0.217	0.29	0.371	0.451	0.482	0.483
1995	0.19	0.225	0.296	0.381	0.469	0.473	0.528
1996	0.195	0.245	0.288	0.365	0.483	0.526	0.569
1997	0.198	0.245	0.297	0.384	0.522	0.629	0.661
1998	0.215	0.236	0.301	0.364	0.438	0.5	0.646
1999	0.181	0.225	0.28	0.365	0.44	0.524	0.594
2000	0.205	0.241	0.298	0.336	0.419	0.488	0.617
2001	0.173	0.234	0.303	0.37	0.395	0.376	0.595
2002	0.213	0.257	0.304	0.363	0.464	0.65	0.707
2003	0.228	0.264	0.309	0.362	0.374	0.436	0.717
2004	0.193	0.251	0.295	0.345	0.382	0.403	0.342
2005	0.189	0.261	0.313	0.378	0.44	0.482	0.356

	Age						
Year	1	2	3	4	5	6	7+
2006	0.221	0.292	0.319	0.394	0.455	0.528	0.567
2007	0.215	0.280	0.349	0.418	0.498	0.598	0.660
2008	0.274	0.245	0.322	0.384	0.514	0.530	0.653
2009	0.328	0.347	0.437	0.479	0.470	0.519	0.595
2010	0.288	0.402	0.456	0.567	0.652	0.619	0.613
2011	0.210	0.327	0.405	0.523	0.613	0.570	0.393
2012	0.295	0.304	0.387	0.508	0.615	0.705	0.493

Table 3.4.7. Whiting in Division VIa. Discard weight-at-age (kg).

	Age						
Year	1	2	3	4	5	6	7+
1965	0.122	0.177	0.213	0.249	0.287	0.303	0.287
1966	0.122	0.178	0.212	0.248	0.29	0.297	0.286
1967	0.122	0.178	0.213	0.248	0.29	0.295	0.289
1968	0.128	0.179	0.213	0.249	0.291	0.298	0.287
1969	0.121	0.178	0.214	0.249	0.29	0.295	0.285
1970	0.121	0.175	0.213	0.249	0.29	0.299	0.284
1971	0.12	0.177	0.211	0.248	0.29	0.299	0.284
1972	0.121	0.177	0.213	0.248	0.289	0.301	0.281
1973	0.123	0.176	0.215	0.252	0.288	0.301	0.285
1974	0.119	0.177	0.214	0.25	0.285	0.299	0.288
1975	0.119	0.176	0.213	0.25	0.286	0.301	0.278
1976	0.116	0.177	0.213	0.249	0.288	0.3	0.28
1977	0.118	0.177	0.214	0.249	0.289	0.299	0.282
1978	0.135	0.167	0.199	0.288	0.32	0.238	0
1979	0.173	0.188	0.208	0.215	0.281	0	0
1980	0.14	0.179	0.208	0.22	0.271	0.386	0
1981	0.108	0.16	0.195	0.298	0.286	0.295	0
1982	0.096	0.18	0.209	0.243	0.283	0.44	0
1983	0.141	0.186	0.228	0.237	0.267	0.267	0
1984	0.087	0.199	0.246	0.26	0.259	0.303	0.227
1985	0.102	0.191	0.237	0.286	0.326	0.312	0.316
1986	0.092	0.17	0.196	0.245	0.258	0.33	0.263
1987	0.085	0.182	0.233	0.249	0.225	0	0
1988	0.076	0.143	0.203	0.227	0.262	0	0
1989	0.099	0.177	0.205	0.209	0.294	0.305	0
1990	0.124	0.171	0.214	0.219	0.237	0.264	0
1991	0.085	0.169	0.205	0.223	0.226	0.281	0
1992	0.109	0.173	0.219	0.227	0	0	0
1993	0.118	0.197	0.225	0.242	0.256	0	0.436
1994	0.087	0.157	0.22	0.283	0.297	0.253	0.299
1995	0.075	0.154	0.189	0.246	0.278	0.597	0.493
1996	0.095	0.18	0.203	0.229	0.302	0.421	0.26
1997	0.112	0.182	0.221	0.235	0.243	0.422	0.819
1998	0.098	0.179	0.225	0.254	0.282	0.264	0.245
1999	0.077	0.168	0.217	0.205	0.266	0.268	0
2000	0.075	0.164	0.203	0.233	0.282	0.25	0
2001	0.094	0.154	0.196	0.203	0.381	0	0
2002	0.073	0.162	0.212	0.245	0.24	0.295	0.276
2003	0.077	0.177	0.231	0.242	0.213	0.3	0.278
2004	0.086	0.186	0.236	0.246	0.304	0.349	0.314
2005	0.088	0.149	0.223	0.214	0.315	0.292	0.373

	Age						
Year	1	2	3	4	5	6	7+
2006	0.046	0.197	0.235	0.295	0.322	0.518	0.362
2007	0.059	0.159	0.225	0.226	0.334	0.794	0.266
2008	0.075	0.211	0.286	0.301	0.397	0.222	0.304
2009	0.051	0.288	0.227	0.262	0.248	0.253	0
2010	0.038	0.124	0.269	0.375	0.376	0.401	0.964
2011	0.030	0.141	0.321	0.266	0.221	0	0
2012	0.057	0.151	0.292	0.355	0.349	0.414	0.907

Table 3.4.8. Whiting in Division VIa. Total catch weight-at-age (kg).

	Age						
Year	1	2	3	4	5	6	7+
1965	0.150	0.217	0.288	0.432	1.176	0.712	0.778
1966	0.155	0.213	0.304	0.361	0.597	0.713	0.812
1967	0.146	0.212	0.298	0.405	0.407	0.634	0.817
1968	0.152	0.227	0.337	0.426	0.544	0.534	0.729
1969	0.138	0.203	0.311	0.474	0.559	0.643	0.626
1970	0.145	0.189	0.261	0.368	0.508	0.613	0.683
1971	0.147	0.216	0.264	0.309	0.420	0.545	0.710
1972	0.148	0.223	0.322	0.356	0.421	0.491	0.636
1973	0.146	0.210	0.336	0.458	0.478	0.528	0.661
1974	0.140	0.198	0.297	0.425	0.576	0.635	0.582
1975	0.145	0.214	0.288	0.449	0.636	0.610	0.717
1976	0.138	0.214	0.292	0.350	0.489	0.681	0.856
1977	0.139	0.218	0.281	0.379	0.425	0.623	0.819
1978	0.160	0.210	0.276	0.387	0.516	0.545	0.612
1979	0.202	0.222	0.295	0.378	0.530	0.678	0.693
1980	0.167	0.220	0.308	0.393	0.467	0.594	0.817
1981	0.173	0.196	0.271	0.379	0.402	0.408	0.547
1982	0.109	0.202	0.252	0.336	0.499	0.513	0.526
1983	0.155	0.215	0.270	0.324	0.405	0.479	0.510
1984	0.099	0.245	0.305	0.358	0.397	0.454	0.456
1985	0.107	0.216	0.288	0.383	0.427	0.448	0.537
1986	0.109	0.198	0.274	0.360	0.465	0.481	0.474
1987	0.097	0.210	0.297	0.369	0.510	0.520	0.576
1988	0.080	0.164	0.281	0.392	0.477	0.567	0.600
1989	0.108	0.204	0.255	0.337	0.446	0.422	0.555
1990	0.140	0.217	0.295	0.342	0.405	0.575	0.543
1991	0.096	0.207	0.265	0.338	0.376	0.424	0.761
1992	0.114	0.195	0.265	0.329	0.388	0.397	0.510
1993	0.123	0.211	0.271	0.331	0.361	0.452	0.473
1994	0.089	0.170	0.258	0.344	0.419	0.448	0.473
1995	0.076	0.166	0.235	0.361	0.440	0.472	0.526
1996	0.098	0.198	0.257	0.336	0.482	0.526	0.537
1997	0.116	0.200	0.275	0.369	0.505	0.629	0.661
1998	0.101	0.197	0.274	0.341	0.420	0.469	0.573
1999	0.084	0.194	0.269	0.341	0.433	0.505	0.594
2000	0.076	0.199	0.277	0.329	0.415	0.477	0.617
2001	0.100	0.183	0.280	0.350	0.395	0.376	0.560
2002	0.074	0.194	0.270	0.346	0.385	0.541	0.728
2003	0.080	0.211	0.287	0.340	0.360	0.424	0.498
2004	0.086	0.197	0.266	0.308	0.371	0.400	0.340
2005	0.089	0.166	0.264	0.344	0.420	0.456	0.362

	Age						
Year	1	2	3	4	5	6	7+
2006	0.047	0.210	0.258	0.345	0.406	0.527	0.551
2007	0.084	0.175	0.281	0.387	0.494	0.616	0.659
2008	0.076	0.221	0.312	0.357	0.484	0.397	0.649
2009	0.053	0.327	0.391	0.457	0.440	0.500	0.595
2010	0.038	0.141	0.341	0.517	0.562	0.573	0.622
2011	0.030	0.174	0.358	0.491	0.571	0.570	0.393
2012	0.058	0.160	0.329	0.456	0.543	0.673	0.497

Table 3.4.9. Whiting in Division VIa. Survey data made available to the WG. Data used in the TSA run are highlighted in bold. For the Scottish surveys, numbers are standardised to catch-rate per ten hours. The Scottish surveys from 2011 have been conducted according to new design and groundgear.

	ScoGFS-WIBTS-Q1: Scottish Groundfish Survey – Effort in hours – Numbers-at-age							
	Effort	Age						
Year	(hours)	1	2	3	4	5	6	7
1985	10	**3140**	**1792**	**380**	**85**	**23**	**156**	18
1986	10	**1456**	**1525**	**403**	**68**	**10**	**9**	10
1987	10	**6938**	**1054**	**584**	**142**	**36**	**2**	1
1988	10	**567**	**3469**	**654**	**189**	**42**	**5**	1
1989	10	**910**	**505**	**586**	**237**	**48**	**3**	0
1990	10	**1818**	**571**	**122**	**216**	**61**	**4**	1
1991	10	**3203**	**276**	**299**	**22**	**39**	**9**	1
1992	10	**4777**	**1597**	**410**	**517**	**56**	**18**	0
1993	10	**5532**	**6829**	**644**	**91**	**30**	**11**	2
1994	10	**6614**	**2443**	**1487**	**174**	**56**	**15**	6
1995	10	**5598**	**2831**	**1160**	**370**	**70**	**17**	32
1996	10	**9385**	**2237**	**635**	**341**	**135**	**30**	4
1997	10	**5663**	**2444**	**1531**	**355**	**102**	**17**	4
1998	10	**9851**	**1352**	**294**	**195**	**50**	**14**	1
1999	10	**6125**	**4952**	**489**	**103**	**16**	**1**	0
2000	10	**12862**	**471**	**152**	**34**	**10**	**11**	0
2001	10	**4653**	**1955**	**242**	**41**	**8**	**1**	1
2002	10	**5542**	**1028**	**964**	**89**	**15**	**1**	1
2003	10	**6934**	**746**	**436**	**300**	**32**	**2**	4
2004	10	**5887**	**1566**	**189**	**131**	**44**	**9**	1
2005	10	**1308**	**723**	**183**	**35**	**8**	**11**	2
2006	10	**1441**	**466**	**282**	**77**	**0**	**3**	1
2007	10	**614**	**522**	**127**	**75**	**16**	**3**	2
2008	10	**593**	**127**	**77**	**26**	**8**	**3**	0
2009	10	**906**	**387**	**103**	**105**	**20**	**9**	7
2010	10	**3523**	**340**	**108**	**52**	**40**	**4**	3

	UKSGFS-WIBTS-Q1: Scottish Groundfish Survey – Effort in hours – Numbers-at-age							
	Effort	Age						
Year	(hours)	1	2	3	4	5	6	7
2011	10	222	1884	397	64	37	45	12
2012	10	3441	293	738	72	14	5	7
2013	10	552	1031	302	463	61	7	3

Table 3.4.9. (continued).

	IR-WCGFS : Irish West Coast GFS (VIa) - Effort in minutes - Numbers-at-age						
	Effort	Age					
Year	(min)	0	1	2	3	4	5
1993	2130	14403	32643	11419	1464	231	13
1994	1865	264	11969	4817	2812	78	57
1995	2026	34584	5609	6406	734	186	80
1996	2008	376	7457	3551	374	232	5
1997	1879	1550	13865	8207	1022	524	50
1998	1936	1829	4077	3361	663	121	5
1999	1914	3337	3059	1965	322	11	12
2000	1878	682	10102	2126	109	109	4
2001	965	1118	5201	2903	149	70	3
2002	796	594	8247	9348	820	280	0

	IRGFS-WIBTS-Q4: Irish groundfish survey - Effort in minutes - Numbers-at-age							
	Effort				Age			
Year	(min)	0	1	2	3	4	5	6
2003	1127	**1101**	**12886**	**2894**	**512**	**290**	102	1
2004	1200	**6924**	**3114**	**1312**	**104**	**35**	16	1
2005	960	**910**	**2228**	**1126**	**91**	**5**	4	0
2006	1510	**99**	**1055**	**921**	**214**	**27**	3	0
2007	1173	138	1989	2380	722	169	251	122
2008	1135	**24**	**4342**	**1328**	**573**	**243**	123	36
2009	1378	**16906**	**1430**	**989**	**325**	**68**	21	41
2010	1291	**108**	**9822**	**1510**	**382**	**121**	64	15
2011	1287	**453**	**4449**	**6042**	**683**	**290**	68	71
2012	1230	**264**	**6938**	**741**	**2014**	**501**	47	22

Table 3.4.9. (continued).

	SCOGFS-WIBTS-Q4: SCOTTISH GROUNDFISH SURVEY – EFFORT IN HOURS – NUMBERS-AT-AGE									
	Effort	Age								
Year	(hours)	0	1	2	3	4	5	6	7	8
1996	10	5154	1908	1116	570	188	51	6	1	0
1997	10	8001	2869	951	323	160	46	12	1	0
1998	10	1852	2713	1125	150	100	20	1	0	1
1999	10	8203	2338	582	141	33	24	1	1	0
2000	10	4434	4056	789	160	9	7	1	0	0
2001	10	9615	1957	1420	155	40	12	2	0	0
2002	10	14658	1591	621	479	30	9	5	0	0
2003	10	9932	3446	567	338	83	27	4	0	0
2004	10	5923	1758	940	83	57	62	1	0	0
2005	10	2297	308	318	76	9	4	1	1	0
2006	10	415	296	140	101	35	8	3	0	0
2007	10	1894	434	326	99	83	48	1	0	0
2008	10	2297	208	78	110	28	24	4	0	0
2009	10	4833	236	178	50	58	12	6	6	0
2010	10	NA	NA	NA	NA	NA	NA	NA	NA	NA

	UKSGFS-WIBTS-Q4: SCOTTISH GROUNDFISH SURVEY – EFFORT IN HOURS – NUMBERS-AT-AGE									
	Effort	Age								
Year	(hours)	0	1	2	3	4	5	6	7	8
2011	10	3644	119	2096	109	30	14	10	1	2011
2012	10	748	964	426	658	110	19	2	11	2012

Table 3.4.10. Whiting in Division VIa. TSA parameter settings for the assessment run.

Parameter	Setting	Justification
Age of full selection.	$a_m = 4$	Based on inspection of previous XSA and TSA runs.
Multipliers on variance matrices of measurements.	$B_{landings}(a) = 2$ for ages 1, 7+ $B_{discards}(a) = 2$ for age 5 $B_{ScoGFS\text{-}WIBTS\text{-}Q4}(a) = 2$ for age 6	Allows extra measurement variability for poorly-sampled ages.
Multipliers on variances for fishing mortality estimates.	$H(1) = 2$	Allows for more variable fishing mortalities for age 1 fish.
Downweighting of particular datapoints	Discards: cvmult = 3 for age 1 in 1981, age 1 in 1987, age 3 in 1991, age 1 in 2000 Surveys: *ScoGFS-WIBTS-Q1* cvmult = 3 for age 5 in 1992, age 2 in 1993, age 1 in 2000, age 2 in 2000 cvmult = 5 for age 4 in 1992 *ScoGFS-WIBTS-Q4* cvmult = 3 for age 4 in 2007, age 5 in 2007	Large values indicated by exploratory prediction error plots.
Discards	Discards are allowed to evolve over time constrained by a trend. Ages 1 to 5 are modelled independently.	
Recruitments	Modelled by a hockey-stick model, with numbers-at-age 1 assumed to be independent and normally distributed. To allow recruitment variability to increase with mean recruitment, a constant coefficient of variation is assumed.	

Table 3.4.11. Whiting in Division VIa. TSA parameter estimates for final assessment presented this year.

Parameter	Notation	Description	2012 WG	2013 WG
Initial fishing mortality	F (1, 1981)	Fishing mortality-at-age a in year y	0.1054	0.1097
	F (2, 1981)		0.1282	0.1296
	F (4, 1981)		0.3968	0.4211
Fishing mortality standard deviations	σ_F	Transitory changes in overall fishing mortality	0.0627	0.0635
	σ_U	Persistent changes in selection (age effect in F)	0.0935	0.0982
	σ_V	Transitory changes in the year effect in fishing mortality	0.0639	0.0847
	σ_Y	Persistent changes in the year effect in fishing mortality	0.2711	0.2632
Measurement CVs	$CV_{landings}$	CV of landings-at-age data	0.1879	0.2034
	$CV_{discards}$	CV of discards-at-age data	0.5909	0.6294
Recruitment		Hockey-stick parameter Recruitment value at change point	25.0080	24.5697
		Hockey-stick parameter SSB at change point	2.9943	2.8149
	CV_{rec}	Coefficient of variation of recruitment data	0.2845	0.2784
Discards	$\sigma_{logit\ p}$	Transitory trends in discarding	0.2903	0.0645
	$\sigma_{persistent}$	Persistent trends in discarding	0.2071	0.1658
Survey selectivities (ScoGFS-WIBTS-Q1)	$\Phi(1)$	Survey selectivity-at-age a	1.9864	1.9374
	$\Phi(2)$		1.8925	1.8726
	$\Phi(3)$		1.5958	1.5552
	$\Phi(4)$		1.4244	1.3986
	$\Phi(5)$		1.2418	1.1515
	$\Phi(6)$		0.9273	0.9357
	σ_{survey}	Standard error of survey data	0.4375	0.4077
	σ_η	???	0.0926	0.1212
Survey catchability standard deviations	σ_Ω	Transitory changes in survey catchability	0.0137	0.0436
	σ_β	Persistent changes in survey catchability	0.2253	0.1857
Survey selectivities (ScoGFS-WIBTS-Q4)	$\Phi(1)$	Survey selectivity-at-age a	4.2790	4.0764
	$\Phi(2)$		3.9478	3.7532
	$\Phi(3)$		3.2596	2.9920
	$\Phi(4)$		2.8881	2.6963
	$\Phi(5)$		3.7300	3.7804
	$\Phi(6)$		0.8531	0.9100
	σ_{survey}	Standard error of survey data	0.1678	0.1917
	σ_η	???	0.1601	0.1741

PARAMETER	NOTATION	DESCRIPTION	2012 WG	2013 WG
Survey catchability standard deviations	σ_{Ω}	Transitory changes in survey catchability	0.0762	0.0348
	σ_{β}	Persistent changes in survey catchability	0.1486	0.1742
Survey selectivities (IRGFS-WIBTS-Q4)	$\Phi(1)$		11.6395	11.6970
	$\Phi(2)$		11.0456	10.4560
	$\Phi(3)$		5.9686	5.9502
	$\Phi(4)$		5.5077	6.2116
	σ_{survey}	Standard error of survey data	0.0873	0.1272
	σ_{η}	???	0.3933	0.3747
Survey catchability standard deviations	σ_{Ω}	Transitory changes in survey catchability	0.3195	0.2318
	σ_{β}	Persistent changes in survey catchability	0.0554	0.0905
Misreporting		Transitory changes in misreporting	0.0	0.0436
		Persistent changes in misreporting	0.0	0.1822

Table 3.4.12. Whiting in Division VIa. TSA population numbers-at-age (thousands).

	AGE						
YEAR	1	2	3	4	5	6	7+
1981	206414	467298	83771	21077	6492	1850	984
1982	174046	83592	216735	37500	8651	2741	1222
1983	210909	69617	37768	93537	15302	3622	1686
1984	327863	79679	27373	13216	31249	5082	1813
1985	304197	116451	27275	8284	3619	8851	1981
1986	273178	110709	40100	7507	1862	795	2419
1987	377113	103453	41977	13837	2222	594	1010
1988	106461	136073	36514	13078	3665	612	453
1989	293930	36042	44517	11429	2872	839	251
1990	176271	108401	11819	13560	2889	704	273
1991	236177	65409	41479	4390	4283	936	330
1992	300362	87996	24345	14465	1406	1431	439
1993	236936	115126	34033	9177	5002	502	685
1994	238176	91887	44970	12520	2849	1579	394
1995	238992	93222	37644	16750	3932	934	641
1996	152370	94183	37046	13884	4788	1152	461
1997	146089	54246	35406	12260	3452	1174	407
1998	187902	49790	18249	10946	2883	820	392
1999	137011	61196	15090	5211	2647	648	283
2000	210729	40419	15765	3498	985	506	179
2001	93622	64752	11579	4254	653	197	132
2002	40120	28346	20046	3417	857	121	66
2003	59949	10330	9658	6782	943	248	54
2004	39870	15963	2695	3183	1541	232	75
2005	25464	11471	5066	834	846	388	83
2006	30905	8544	4653	2027	283	281	167
2007	20386	11129	3623	1989	744	106	171
2008	23103	7156	5020	1677	823	320	121
2009	29664	8484	3090	2317	679	346	188
2010	76846	11170	3837	1462	1032	313	252
2011	11820	30445	5357	1936	721	523	294
2012	36880	4792	14987	2808	1022	391	453
2013	72835	15347	2384	7904	1496	563	477
2014	77355	30083	7605	1257	4204	819	583
GM(81-12)	109136	42946	17951	6666	2129	686	353

***2013 and 2014 values are TSA-derived projections of population numbers.**

Table 3.4.13. Whiting in Division VIa. Standard errors on TSA population numbers-at-age (thousands).

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1981	47769	63023	11910	2604	837	283	317
1982	51621	17164	27665	5301	1128	406	212
1983	55201	18576	7149	12404	2303	554	275
1984	49319	15179	5563	2208	3950	866	309
1985	38750	15574	5003	1644	687	1607	460
1986	39480	12601	5602	1485	407	260	789
1987	49037	11668	4538	1730	402	136	339
1988	38341	16860	3965	1488	502	125	132
1989	43292	10864	6835	1523	552	194	80
1990	46737	13332	3009	2591	575	216	100
1991	44106	12586	4307	784	786	203	103
1992	47143	14962	4202	1570	227	275	102
1993	48508	17041	5967	1697	764	103	159
1994	49069	16140	7099	2418	676	358	111
1995	30202	12440	4861	2405	779	236	171
1996	24963	9684	4884	1994	890	314	161
1997	29939	8461	3697	1734	573	285	149
1998	36576	10632	3341	1488	581	214	146
1999	37556	13324	4126	1140	483	191	109
2000	45229	12073	4627	1169	257	126	72
2001	33088	16899	3769	1181	201	51	42
2002	26679	9237	5372	985	251	50	25
2003	26547	7310	2991	1850	257	72	22
2004	16811	7585	1691	926	479	78	29
2005	6907	3149	1332	254	139	114	30
2006	4903	1631	871	343	44	38	43
2007	5007	1608	577	335	121	18	31
2008	5033	1705	722	274	163	63	24
2009	5591	1739	692	348	134	83	44
2010	11992	2020	801	346	191	74	67
2011	6021	4907	920	402	178	107	75
2012	18633	2599	2570	510	231	105	107
2013	25147	7907	1312	1432	294	136	123
2014	30742	10720	3982	702	831	175	151
GM(81-12)	25184	8613	3296	1196	407	157	100

***2013 and 2014 values are standard errors on TSA-derived projections of population numbers.**

Table 3.4.14. Whiting in Division VIa. TSA estimates for mortality-at-age.

	Age						
Year	1	2	3	4	5	6	7+
1981	0.1004	0.1224	0.2250	0.3493	0.3516	0.3541	0.3521
1982	0.1114	0.1508	0.2634	0.3606	0.3620	0.3713	0.3671
1983	0.1700	0.2738	0.4678	0.5742	0.6164	0.6122	0.5985
1984	0.2384	0.4249	0.6120	0.7845	0.7961	0.7965	0.8013
1985	0.2243	0.4351	0.6839	0.9106	0.9338	0.9436	0.9227
1986	0.1742	0.3277	0.4962	0.6933	0.6758	0.6870	0.6906
1987	0.2176	0.3903	0.5896	0.8174	0.8268	0.8477	0.8300
1988	0.2618	0.4816	0.5962	1.0101	1.0045	0.9979	0.9985
1989	0.2333	0.4658	0.6181	0.8696	0.9081	0.9132	0.8975
1990	0.1946	0.3064	0.4450	0.6477	0.6562	0.6477	0.6475
1991	0.1895	0.3602	0.4318	0.6421	0.6485	0.6487	0.6424
1992	0.1633	0.3161	0.4162	0.5396	0.5573	0.5590	0.5590
1993	0.1669	0.3093	0.4354	0.6637	0.6830	0.6591	0.6604
1994	0.1609	0.2715	0.4151	0.6367	0.6280	0.6593	0.6347
1995	0.1727	0.2909	0.4243	0.6882	0.6829	0.6884	0.6869
1996	0.2493	0.3650	0.5281	0.8383	0.8553	0.8433	0.8377
1997	0.2851	0.4401	0.6025	0.8788	0.8886	0.8638	0.8757
1998	0.3238	0.4940	0.6586	0.8890	0.9512	0.9315	0.9385
1999	0.3923	0.6457	0.8012	1.1264	1.1676	1.1707	1.1572
2000	0.3782	0.5775	0.7505	1.1834	1.1499	1.2211	1.1869
2001	0.3573	0.4904	0.6276	1.0253	1.0785	1.0777	1.0480
2002	0.2760	0.3791	0.4545	0.7491	0.7456	0.7584	0.7580
2003	0.3017	0.3790	0.4356	0.8273	0.8191	0.8400	0.8134
2004	0.3100	0.3549	0.4261	0.7348	0.7647	0.7580	0.7546
2005	0.2738	0.2826	0.3594	0.5897	0.5724	0.5848	0.5848
2006	0.2590	0.2157	0.2778	0.4724	0.4697	0.4872	0.4724
2007	0.2427	0.1534	0.1930	0.3475	0.3423	0.3503	0.3485
2008	0.2219	0.1876	0.1946	0.3619	0.3557	0.3668	0.3583
2009	0.2034	0.1488	0.1655	0.2719	0.2683	0.2657	0.2673
2010	0.1288	0.0909	0.1041	0.1672	0.1686	0.1659	0.1665
2011	0.0895	0.0631	0.0660	0.0990	0.0993	0.0982	0.0994
2012	0.0779	0.0558	0.0589	0.0909	0.0866	0.0849	0.0862
2013	0.0828	0.0591	0.0626	0.0926	0.0926	0.0926	0.0926
2014	0.0858	0.0614	0.0650	0.0962	0.0962	0.0962	0.0962

***Estimates for 2013 and 2014 are TSA projections.**

Table 3.4.15. Whiting in Division VIa. Standard errors of TSA estimates for log mortality-at-age.

	Age						
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
1981	0.0213	0.0210	0.0384	0.0574	0.0578	0.0586	0.0593
1982	0.0277	0.0306	0.0530	0.0689	0.0695	0.0718	0.0719
1983	0.0486	0.0610	0.1070	0.1176	0.1270	0.1278	0.1262
1984	0.0660	0.0848	0.1164	0.1317	0.1342	0.1386	0.1409
1985	0.0638	0.0832	0.1259	0.1573	0.1623	0.1680	0.1663
1986	0.0537	0.0680	0.0955	0.1244	0.1212	0.1264	0.1280
1987	0.0687	0.0790	0.1083	0.1415	0.1437	0.1532	0.1501
1988	0.0842	0.1102	0.1214	0.1939	0.1935	0.1982	0.1991
1989	0.0768	0.1132	0.1356	0.1814	0.1899	0.1952	0.1930
1990	0.0651	0.0762	0.1023	0.1498	0.1526	0.1529	0.1535
1991	0.0625	0.0856	0.0960	0.1387	0.1397	0.1428	0.1427
1992	0.0585	0.0864	0.1094	0.1430	0.1488	0.1509	0.1512
1993	0.0580	0.0822	0.1051	0.1641	0.1696	0.1666	0.1671
1994	0.0550	0.0702	0.0960	0.1462	0.1451	0.1543	0.1494
1995	0.0544	0.0629	0.0779	0.1186	0.1199	0.1230	0.1236
1996	0.0796	0.0843	0.1005	0.1426	0.1473	0.1486	0.1493
1997	0.0956	0.1092	0.1188	0.1623	0.1656	0.1648	0.1683
1998	0.1064	0.1186	0.1213	0.1478	0.1601	0.1618	0.1645
1999	0.1304	0.1429	0.1381	0.1668	0.1733	0.1824	0.1824
2000	0.1237	0.1217	0.1221	0.1675	0.1635	0.1823	0.1793
2001	0.1191	0.1105	0.1123	0.1676	0.1791	0.1854	0.1808
2002	0.0920	0.0878	0.0856	0.1283	0.1291	0.1348	0.1356
2003	0.1006	0.0902	0.0846	0.1378	0.1400	0.1472	0.1438
2004	0.1059	0.0890	0.0911	0.1380	0.1443	0.1467	0.1470
2005	0.0953	0.0755	0.0829	0.1259	0.1220	0.1265	0.1273
2006	0.0844	0.0527	0.0547	0.0844	0.0850	0.0905	0.0882
2007	0.0805	0.0419	0.0442	0.0758	0.0754	0.0781	0.0777
2008	0.0737	0.0512	0.0446	0.0742	0.0733	0.0763	0.0752
2009	0.0679	0.0412	0.0380	0.0550	0.0546	0.0545	0.0555
2010	0.0452	0.0269	0.0261	0.0374	0.0377	0.0373	0.0379
2011	0.0314	0.0190	0.0165	0.0220	0.0221	0.0217	0.0224
2012	0.0293	0.0183	0.0156	0.0209	0.0199	0.0196	0.0201
2013	0.0401	0.0263	0.0253	0.0359	0.0359	0.0359	0.0359
2014	0.0474	0.0319	0.0318	0.0466	0.0466	0.0466	0.0466
GM(81-12)	0.0668	0.0662	0.0765	0.1078	0.1094	0.1123	0.1123

***Estimates for 2013 and 2014 are standard errors of TSA projections of log F.**

Table 3.4.16. Whiting in Division VIa. TSA summary table. "Obs." denotes sum-of-products of numbers and mean weights-at-age, not reported caught, landed and discarded weight. *Estimates for 2013 and 2014 are TSA projections.

YEAR	LANDINGS (TONNES)			DISCARDS (TONNES)			TOTAL CATCHES (TONNES)			MEAN F(2-4)		SSB (TONNES)		TSB (TONNES)		RECRUITMENT (000S AT AGE 1)	
	Obs.	Pred.	SE	Obs.	Pred.	SE	Obs.	Pred.	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1981	12194	10651	2721	2132	4863	2092	14325	15514	1767	0.232	0.034	132288	14975	167777	19069	206414	47769
1982	13880	13354	1818	5485	3996	1238	19366	17350	1971	0.258	0.044	91403	10355	110148	13360	174046	51621
1983	15962	17224	1839	6294	5259	1412	22257	22483	2490	0.439	0.083	64060	8678	95952	13705	210909	55201
1984	16459	15209	1472	4017	6315	1552	20476	21524	2352	0.607	0.089	48810	5632	84674	8617	327863	49319
1985	12879	11845	1290	4840	7214	1592	17719	19059	2071	0.677	0.098	43428	4731	79260	7471	304197	38750
1986	8458	7949	897	2669	4973	1111	11127	12922	1493	0.506	0.080	39479	4021	71392	7278	273178	39480
1987	11542	10106	989	11918	7136	1593	23460	17242	2017	0.599	0.092	40924	3634	75379	6704	377113	49037
1988	11349	10594	1033	8132	4853	1090	19481	15448	1549	0.696	0.122	40673	3902	49419	6023	106461	38341
1989	7523	7295	774	5876	5672	1325	13399	12967	1659	0.651	0.125	23929	3888	54620	7324	293930	43292
1990	5642	5628	621	4530	4744	1120	10172	10372	1363	0.466	0.096	32573	4253	56791	9527	176271	46737
1991	6658	5466	578	4883	4233	924	11541	9699	1209	0.478	0.093	27078	3584	50499	7098	236177	44106
1992	6005	5065	615	9249	5435	1242	15253	10500	1574	0.424	0.102	29488	4174	63501	8565	300362	47143
1993	6872	6248	674	4759	6253	1322	11631	12500	1598	0.469	0.105	40506	5659	69585	10299	236936	48508
1994	5901	5840	633	3455	4614	929	9356	10455	1211	0.441	0.092	35282	5295	57181	8609	238176	49069
1995	6078	6508	1087	5771	4659	1021	11849	11167	1816	0.468	0.070	34034	3571	52224	4761	238992	30202
1996	7158	7244	1356	7940	5996	1376	15098	13241	2396	0.577	0.090	35533	3331	50444	4750	152370	24963
1997	6290	6719	1139	5251	5758	1372	11542	12477	2188	0.640	0.110	27766	2938	44601	5478	146089	29939
1998	4627	4898	863	9216	6120	1515	13843	11019	2092	0.681	0.106	19900	3197	38653	6121	187902	36576
1999	4613	4324	951	3975	5681	1487	8588	10005	2196	0.858	0.118	18532	3761	30696	6491	137011	37556
2000	3011	3210	923	13285	5609	1595	16296	8820	2282	0.837	0.106	13822	3703	29710	6551	210729	45229
2001	2439	2775	793	4263	4392	1345	6702	7167	1988	0.714	0.105	15773	4034	25130	6908	93622	33088
2002	1767	2176	663	2851	1811	719	4618	3986	1302	0.528	0.081	11819	3174	14779	4827	40120	26679
2003	1355	1813	586	719	1535	709	2074	3347	1225	0.547	0.085	7714	2804	12721	4742	59949	26547
2004	811	1005	383	2159	1313	621	2970	2318	960	0.505	0.089	5532	2206	8976	3436	39870	16811
2005	341	640	173	629	744	258	970	1383	398	0.411	0.082	4088	841	6353	1301	25464	6907
2006	380	549	65	946	531	121	1326	1079	160	0.322	0.051	4051	588	5517	760	30905	4903
2007	427	440	47	317	390	91	745	830	116	0.231	0.045	4284	558	5989	907	20386	5007
2008	445	447	47	314	485	114	759	931	140	0.248	0.047	4353	721	6120	1047	23103	5033
2009	488	438	49	419	436	101	908	874	129	0.195	0.037	5622	1006	7204	1246	29664	5591
2010	307	340	39	893	353	88	1200	693	107	0.121	0.026	4558	830	7542	1228	76846	11992
2011	230	265	30	339	213	53	569	478	71	0.076	0.016	9007	1442	9361	1582	11820	6021
2012	313	296	39	727	216	69	1039	512	92	0.069	0.016	8028	1583	10139	2478	36880	18633
2013*	NA	396	125	NA	276	113	NA	672	219	0.071	0.027	8526	2423	11587	3102	72835	25147
2014*	NA	433	174	NA	367	174	NA	800	332	0.074	0.034	11125	3364	14377	4290	77355	30742
Min	230	265		314	213		569	478		0.069		4051	558	5517	760	11820	4903
GM	2940	3045		2728	2472		6054	5630		0.403		18937	2911	29776	4660	109136	25184
AM	5700	5518		4320	3806		10021	9324		0.468		28886	3846	45386	6196	156992	31877
Max	16459	17224		13285	7214		23460	22483		0.858		132288	14975	167777	19069	377113	55201

Table 3.4.17. Whiting in Division VIa. Inputs to short-term predictions from TSA run. Mean weights assumed from final three years.

```
Whiting VIa
 input data for catch forecast and linear sensitivity analysis

 Label     Value     CV     Label     Value     CV

 Number at age              Weight in the stock
 N1        72835   0.34     WS1        0.04   0.33
 N2        15347   0.52     WS2        0.16   0.10
 N3         2384   0.55     WS3        0.34   0.04
 N4         7904   0.18     WS4        0.49   0.06
 N5         1496   0.20     WS5        0.56   0.03
 N6          563   0.24     WS6        0.60   0.10
 N7          477   0.26     WS7        0.56   0.16

 H.cons selectivity         Weight in the HC catch
 sH1        0.00   1.13     WH1        0.26   0.18
 sH2        0.01   0.71     WH2        0.34   0.15
 sH3        0.02   0.25     WH3        0.42   0.09
 sH4        0.07   0.27     WH4        0.53   0.06
 sH5        0.07   0.29     WH5        0.63   0.04
 sH6        0.08   0.29     WH6        0.63   0.11
 sH7        0.07   0.23     WH7        0.50   0.22

 Discard selectivity        Weight in the discards
 sD1        0.08   1.13     WD1        0.04   0.33
 sD2        0.05   0.71     WD2        0.14   0.10
 sD3        0.04   0.25     WD3        0.29   0.09
 sD4        0.02   0.27     WD4        0.33   0.17
 sD5        0.02   0.29     WD5        0.32   0.26
 sD6        0.01   0.29     WD6        0.41   0.02
 sD7        0.00   0.23     WD7        0.94   0.04

 Natural mortality          Proportion mature
 M1         0.81   0.10     MT1        0.00   0.10
 M2         0.65   0.10     MT2        1.00   0.10
 M3         0.58   0.10     MT3        1.00   0.00
 M4         0.54   0.10     MT4        1.00   0.00
 M5         0.51   0.10     MT5        1.00   0.00
 M6         0.50   0.10     MT6        1.00   0.00
 M7         0.48   0.10     MT7        1.00   0.00

 Relative effort            Year effect for natural mortality
 in HC fishery
 HF13       1.00   0.05     K13        1.00   0.10
 HF14       1.00   0.05     K14        1.00   0.10
 HF15       1.00   0.05     K15        1.00   0.10

 Recruitment in 2014 and 2015
 R14       31222   0.58
 R15       31222   0.58

 Proportion of F before spawning = .00
 Proportion of M before spawning = .00

 Stock numbers in 2012 are TSA survivors.
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Table 3.4.18. Whiting in Division VIa. Results of short-term forecasts from TSA run. Management options and detailed tables.

Whiting VIa

Catch forecast output and estimates of coefficient of variation (CV) from linear analysis.

	Year 2013	2014						
Mean F Ages 2 to 4								
H.cons	0.07	0.00	0.01	0.03	0.04	0.05	0.07	0.08
Effort relative to 2012								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Biomass								
Total 1 January	11.6	12.5	12.5	12.5	12.5	12.5	12.5	12.5
SSB at spawning time	8.5	11.2	11.2	11.2	11.2	11.2	11.2	11.2
Catch weight (,000t)								
H.cons	0.339	0.000	0.065	0.128	0.191	0.253	0.314	0.374
Discards	0.300	0.000	0.062	0.123	0.183	0.243	0.302	0.361
Total Catch	0.639	0.000	0.126	0.251	0.375	0.496	0.616	0.735
Biomass in year.... 2015								
Total 1 January		13.41	13.25	13.10	12.94	12.79	12.64	12.49
SSB at spawning time		12.10	11.94	11.78	11.63	11.48	11.33	11.18

	Year 2013	2014						
Effort relative to 2012								
H.cons	1.00	0.00	0.20	0.40	0.60	0.80	1.00	1.20
Est. Coeff. of Variation								
Biomass								
Total 1 January	0.18	0.21	0.21	0.21	0.21	0.21	0.21	0.21
SSB at spawning time	0.18	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Catch weight								
H.cons	0.23	0.00	0.32	0.26	0.24	0.24	0.23	0.23
Discards	0.66	0.00	0.53	0.49	0.48	0.48	0.47	0.47
Biomass in year.... 2015								
Total 1 January		0.23	0.23	0.23	0.23	0.23	0.23	0.23
SSB at spawning time		0.24	0.24	0.24	0.24	0.25	0.25	0.25

Whiting VIa

Detailed forecast tables.

Forecast for year 2013
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Discards	Total
1	72835	0	3680	3680
2	15347	55	540	595
3	2384	42	62	104
4	7904	410	129	539
5	1496	79	24	102
6	563	34	4	39
7	477	27	0	27
Wt	12	0	0	1

Forecast for year 2014
F multiplier H.cons=1.00

Age	Populations: Stock No.	Catch number: H.Cons	Discards	Total
1	31222	0	1577	1577
2	30181	108	1063	1171
3	7606	135	196	331
4	1255	65	20	85
5	4193	220	66	286
6	818	50	6	56
7	586	33	0	33
Wt	12	0	0	1

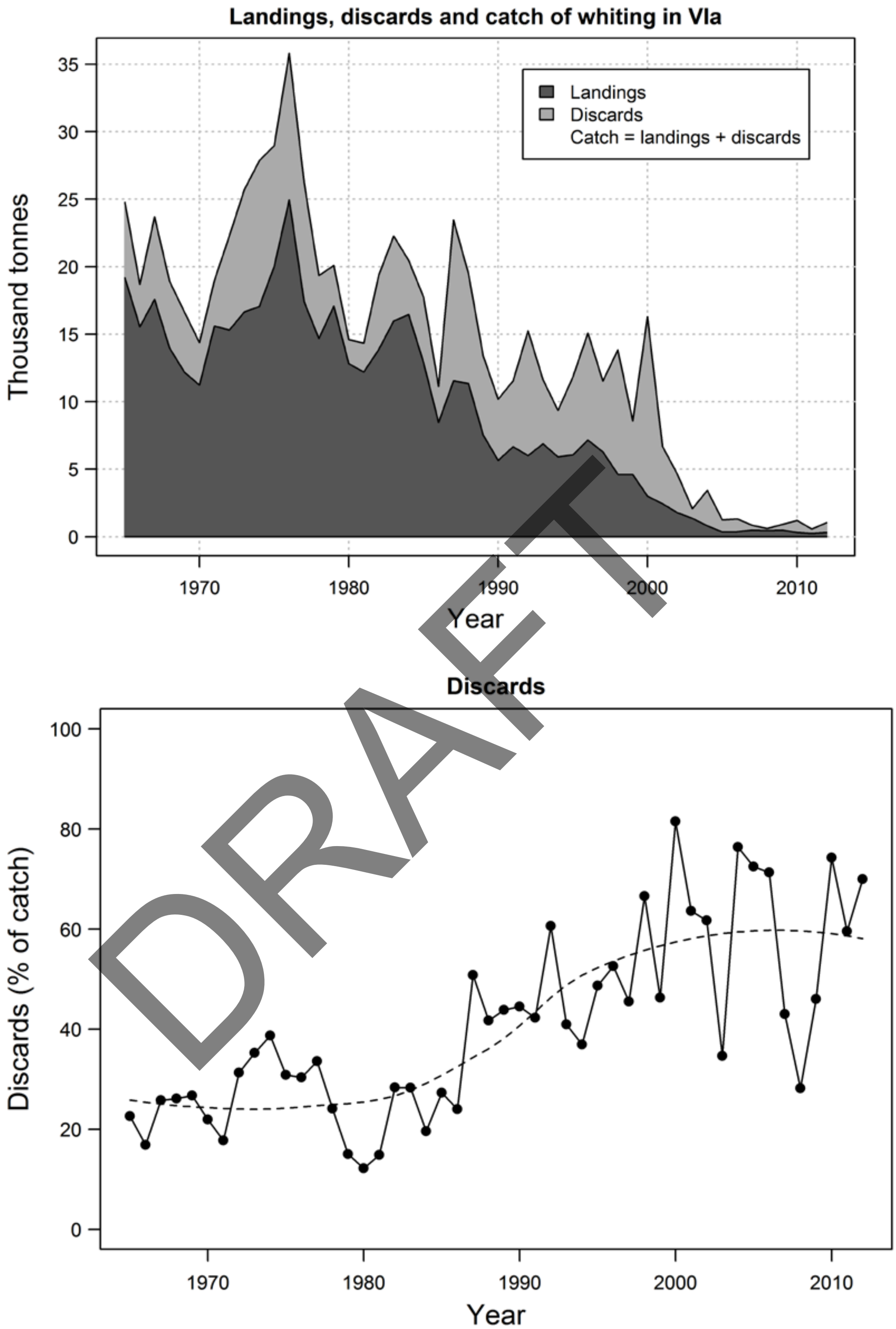


Figure 3.4.1. Whiting in Division VIa. Landings, discards and catch (in tonnes) as officially reported to ICES (upper panel) and discards (as % of catch, lower panel).

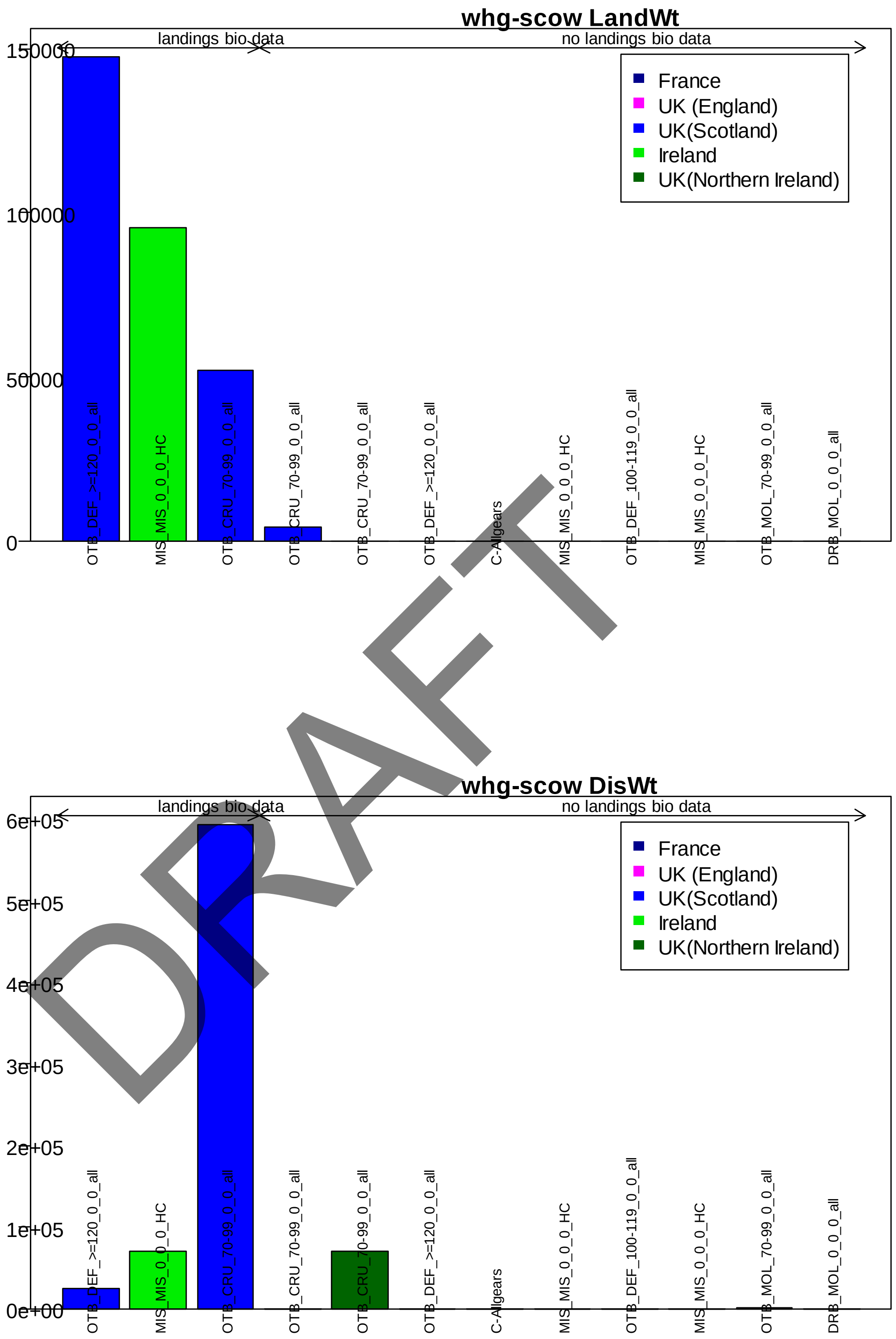
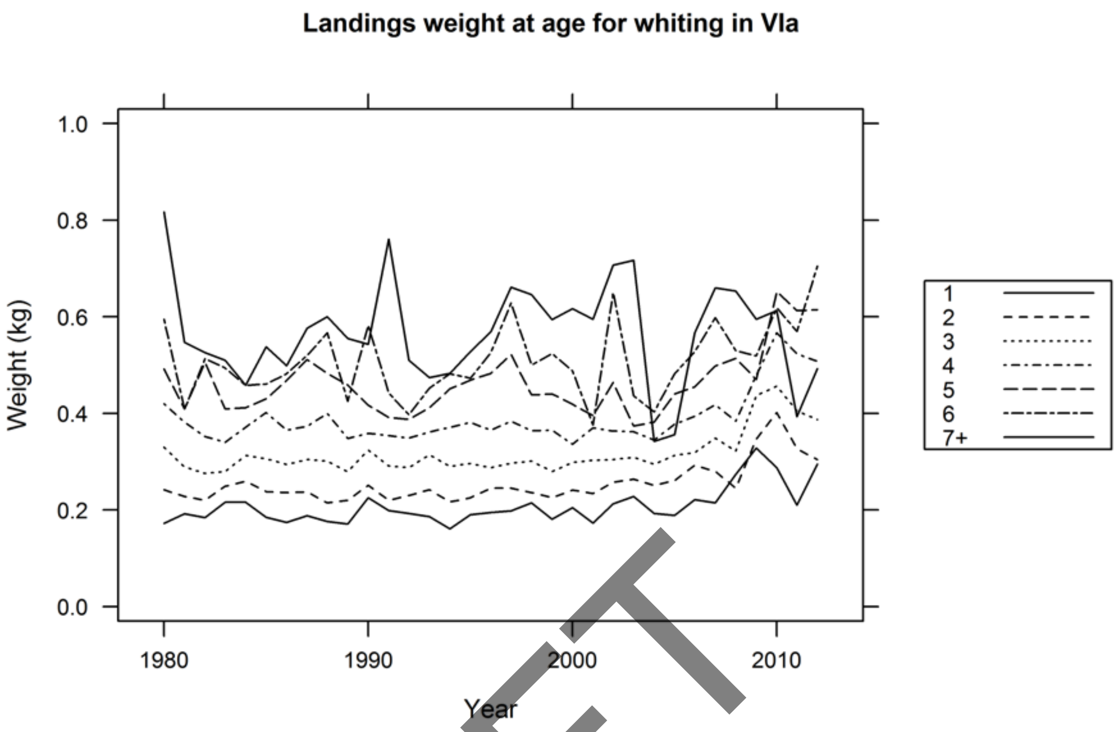


Figure 3.4.2. Whiting in Division VIa. Landings (upper panel) and discards (lower panel) by métier (kg) in 2012 as entered into InterCatch.



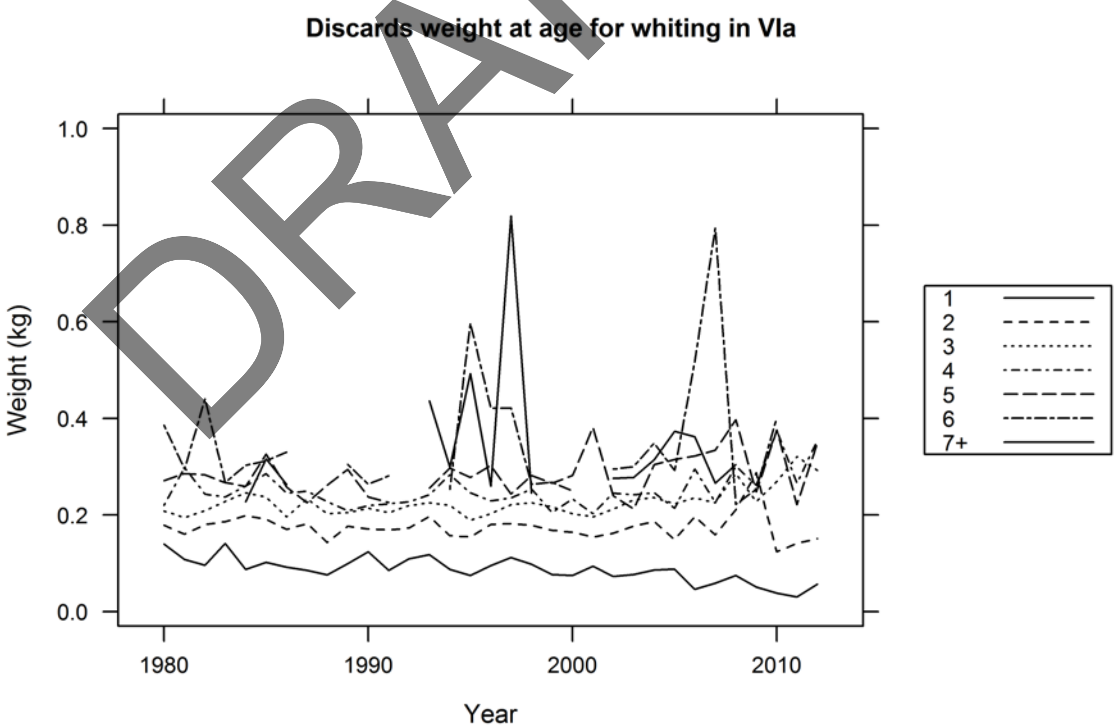


Figure 3.4.3. Whiting in Division VIa. Mean weight-at-age in the landings (upper panel) and discards (lower panel).

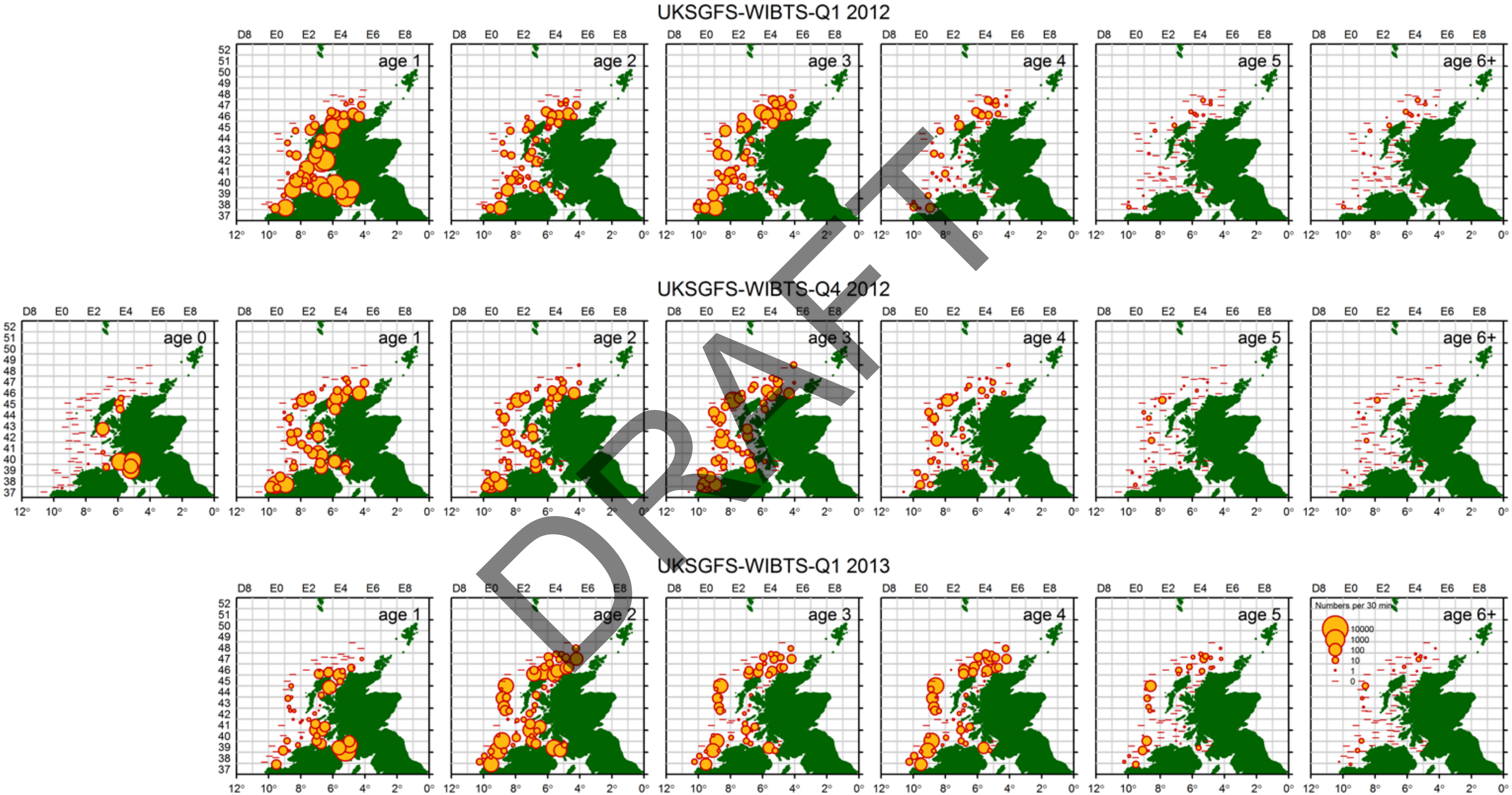


Figure 3.4.4. Whiting in Division VIa. Map of the west coast of Scotland showing the catch of whiting per unit of effort during the Scottish first quarter west coast groundfish survey (UKSGFS-WIBTS-Q1) in 2012 and 2013 (first and third row, respectively) and the 2012 Scottish fourth quarter groundfish survey (UKSGFS-WIBTS-Q4) in 2012 (second row). Each circle is centred on the sample location and the size of the circle is proportional to the log number density (n/30 min fished), according to the legend.

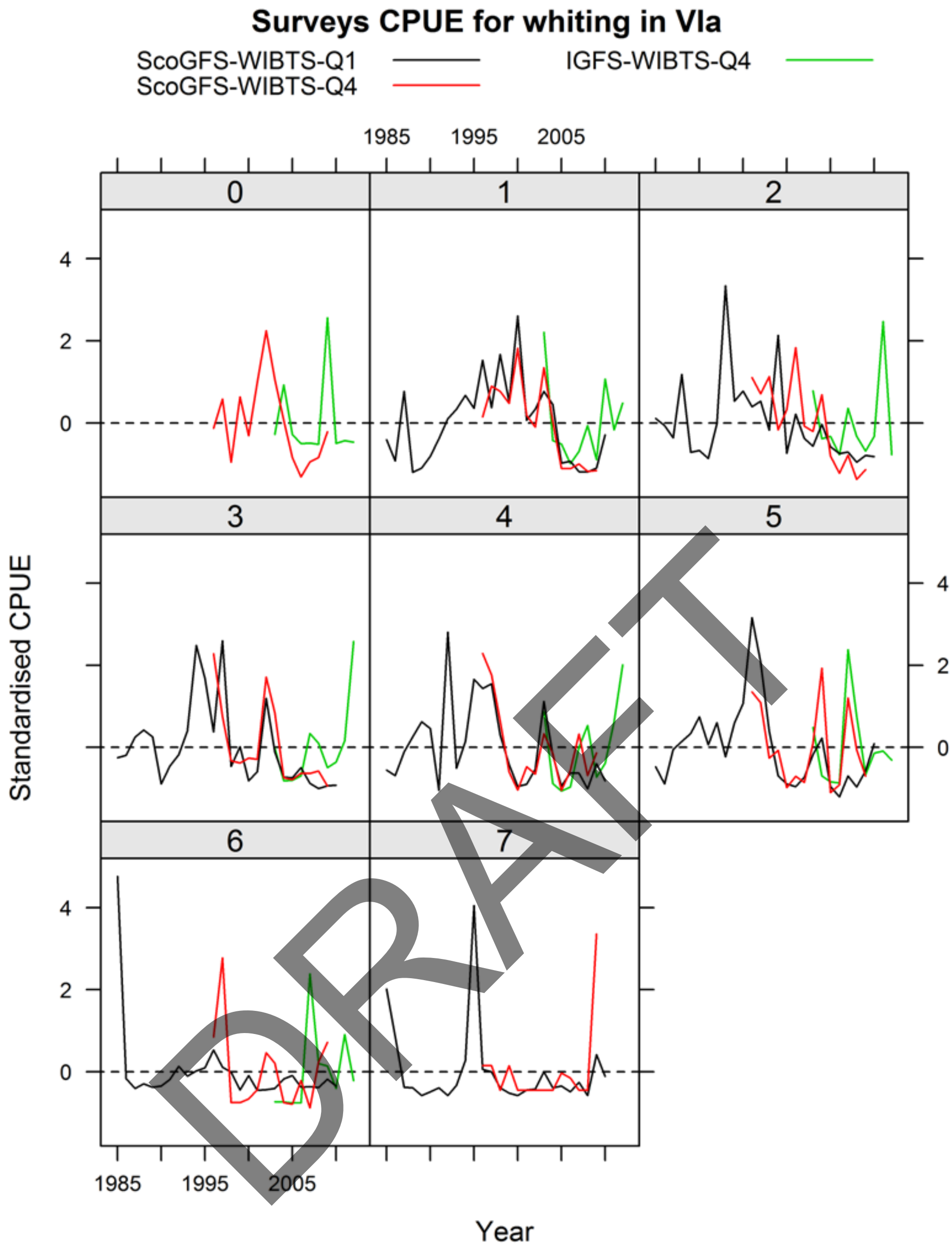


Figure 3.4.5. Whiting in Division VIa. Comparison of scaled survey indices from ScoGFS-WIBTS-Q1, ScoGFS-WIBTS-Q4 and IGFS-WIBTS-Q4.

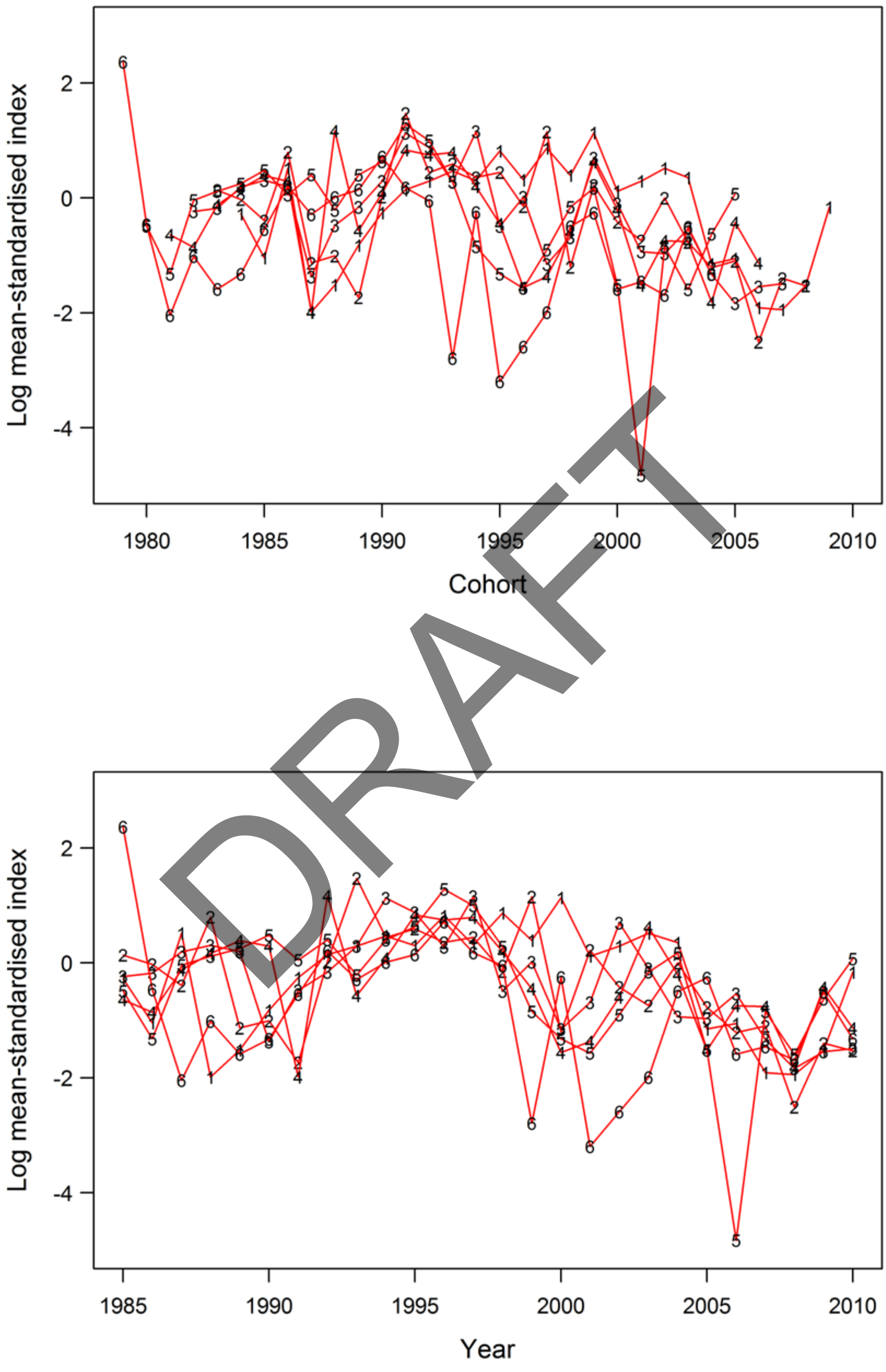


Figure 3.4.6. Whiting in Division VIa. Log mean standardised survey index for each age by cohort (upper panel) and year (lower panel) in ScoGFS-WIBTS-Q1.

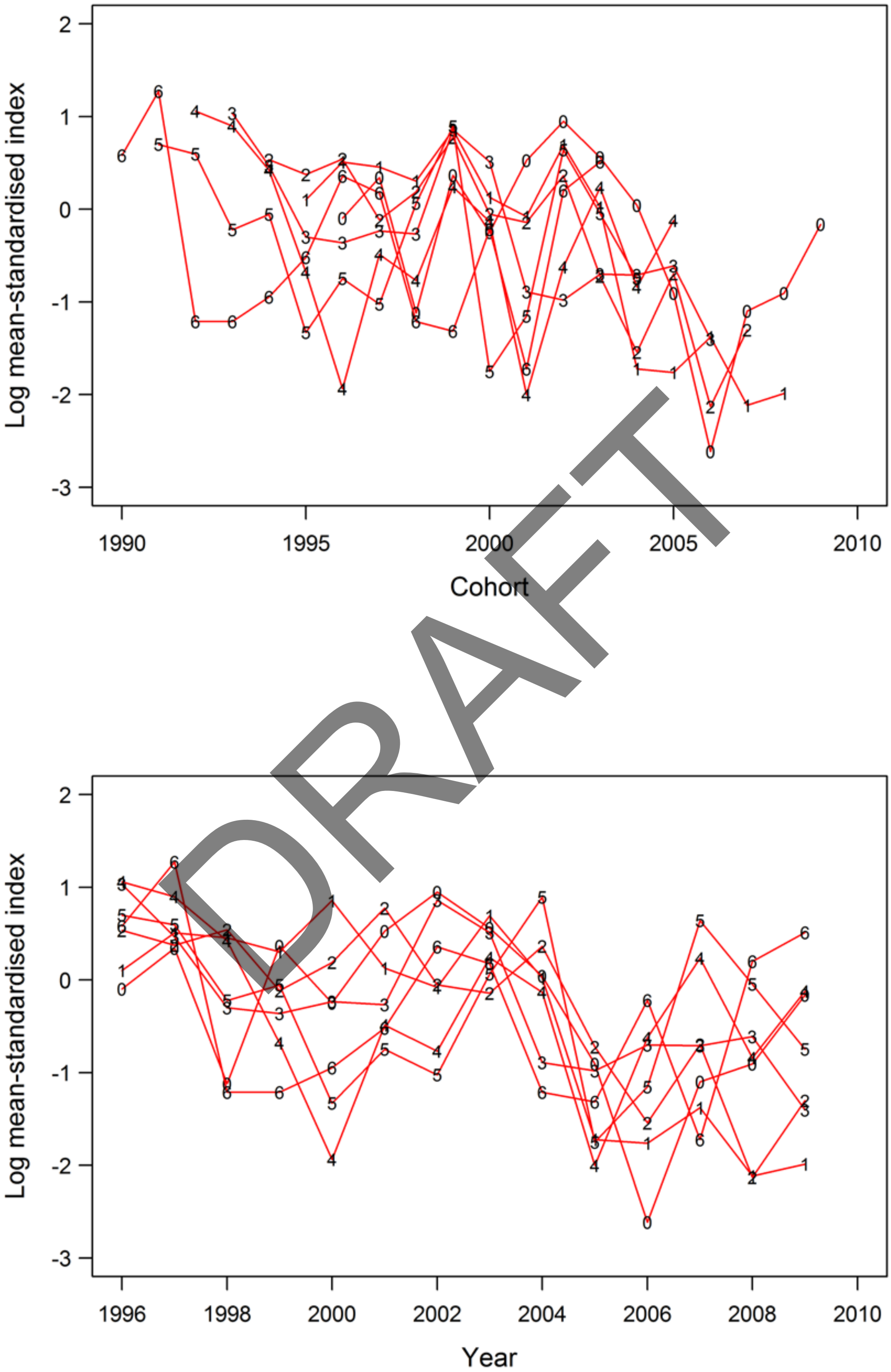
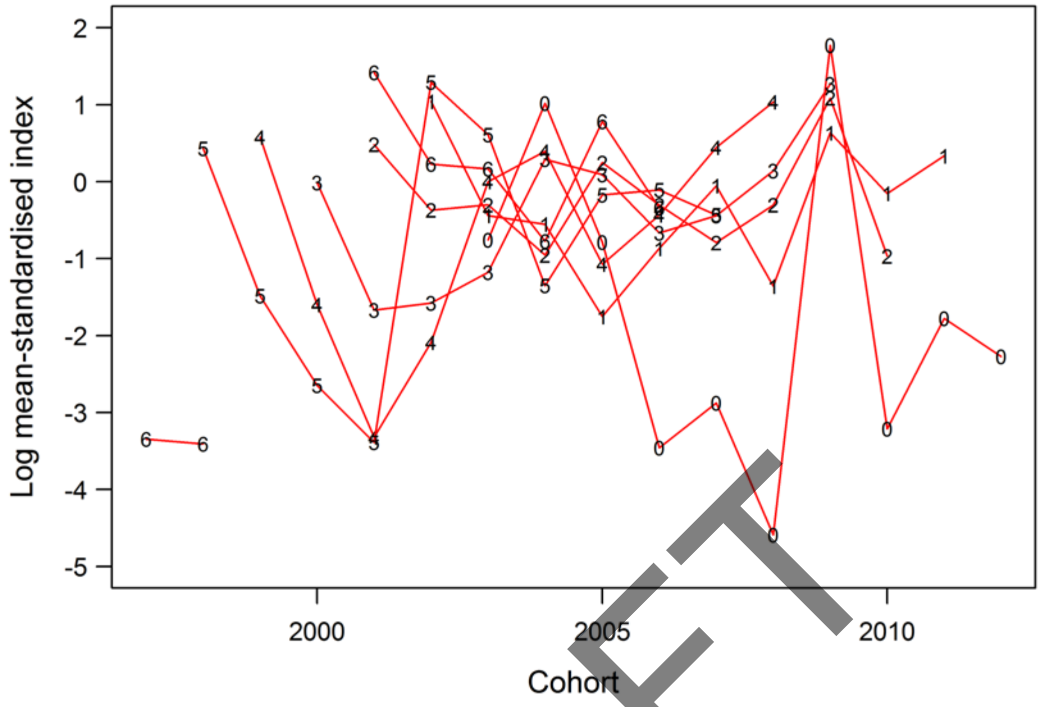


Figure 3.4.7. Whiting in Division VIa. Log mean standardised survey index for each age by cohort (upper panel) and year (lower panel) in ScoGFS-WIBTS-Q4.



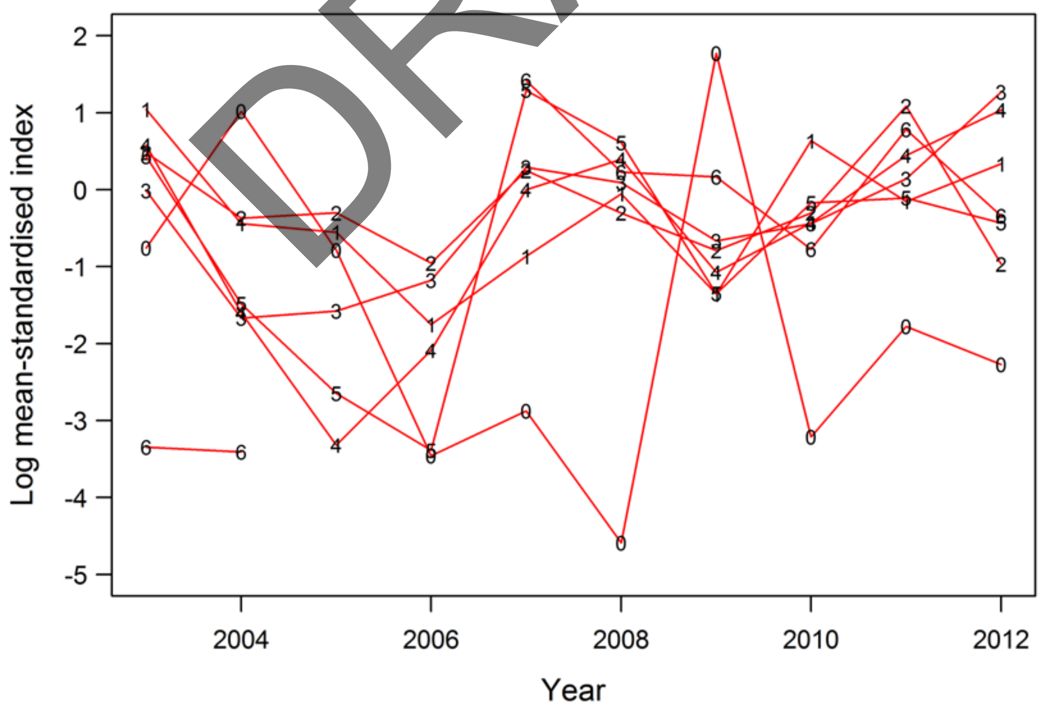


Figure 3.4.8. Whiting in Division VIa. Log mean standardised survey index for each age by cohort (upper panel) and year (lower panel) in IGFS-WIBTS-Q4.

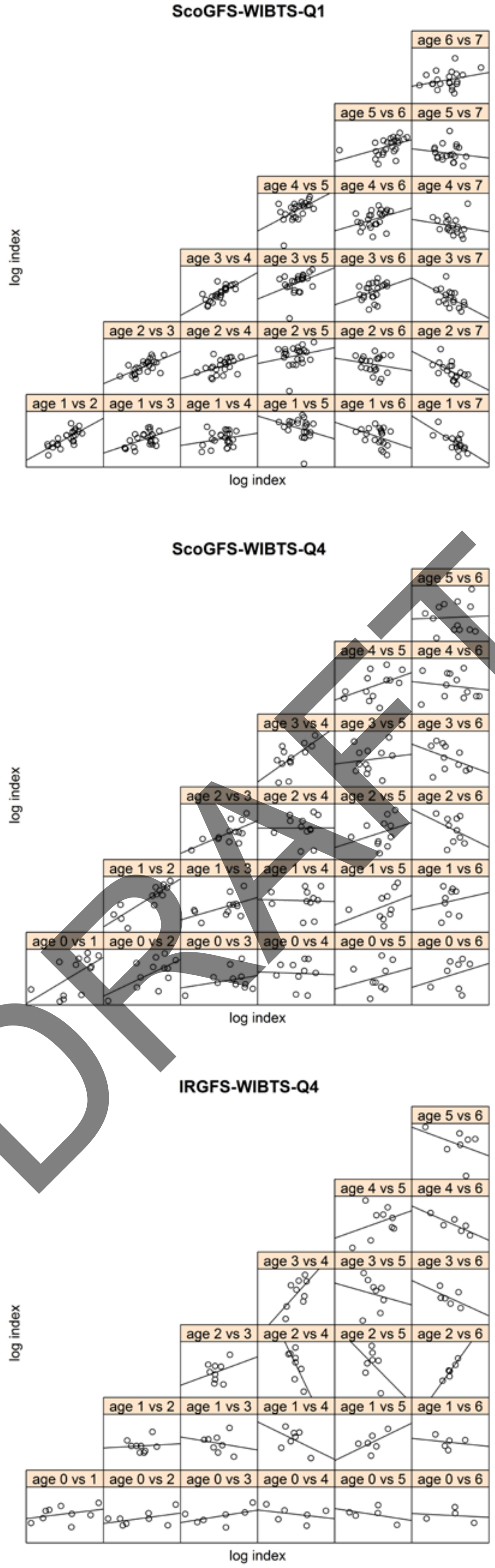


Figure 3.4.9. Whiting in Division VIa. Comparative scatterplots at-age for the Scottish groundfish surveys, ScoGFS-WIBTS-Q1 (top panel) and ScoGFS-WIBTS-Q4 (middle panel), and for the Irish survey, IGFS-WIBTS-Q4 (bottom panel).

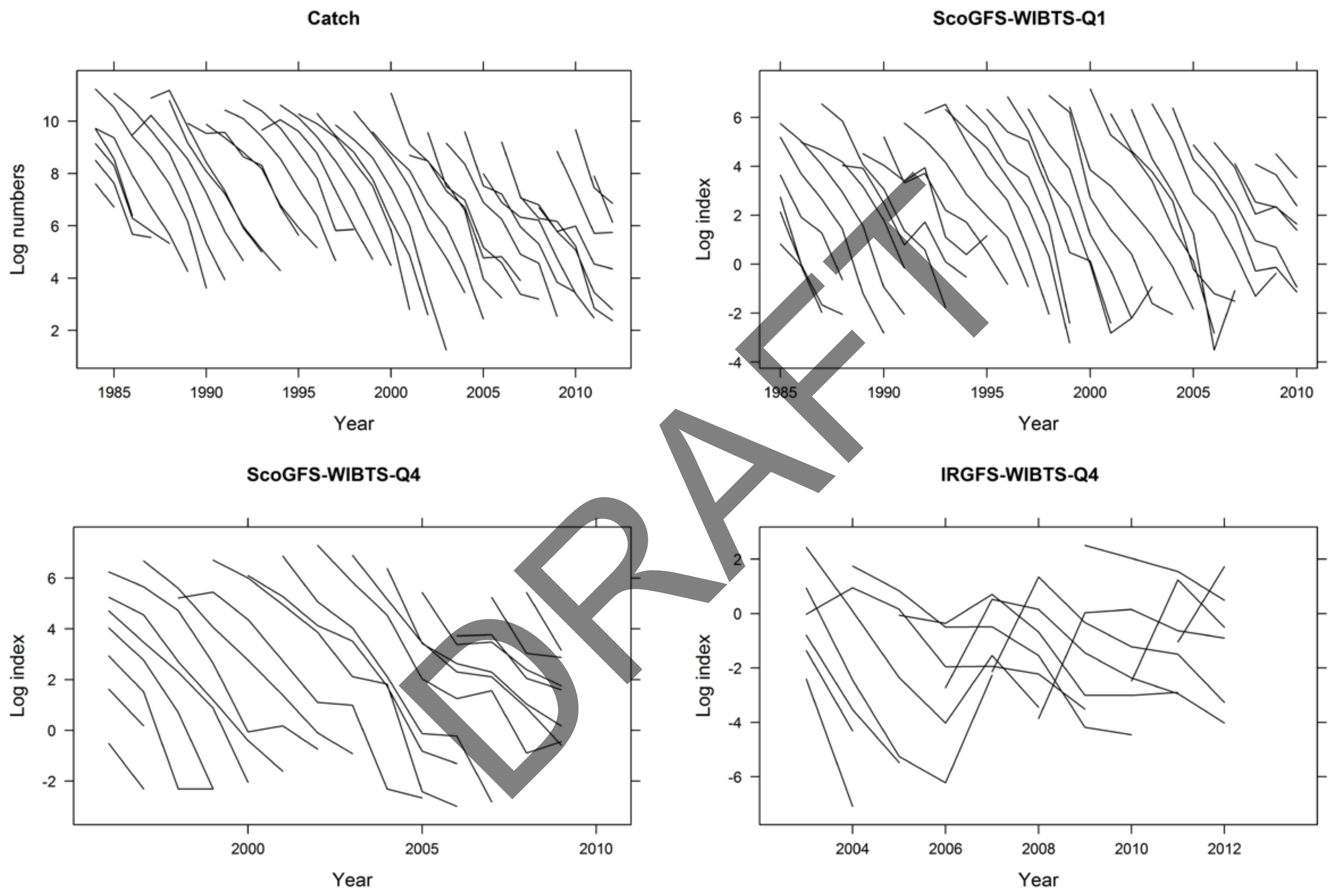


Figure 3.4.10. Whiting in Division VIa. Log catch curves from the catch (ages 1–7, upper left panel) and the two Scottish groundfish surveys, ScoGFS-WIBTS-Q1 (ages 1–7, upper right panel) and ScoGFS-WIBTS-Q4 (ages 0–7, lower left panel), and the Irish groundfish survey, IGFS-WIBTS-Q4 (ages 0–6, lower right panel).

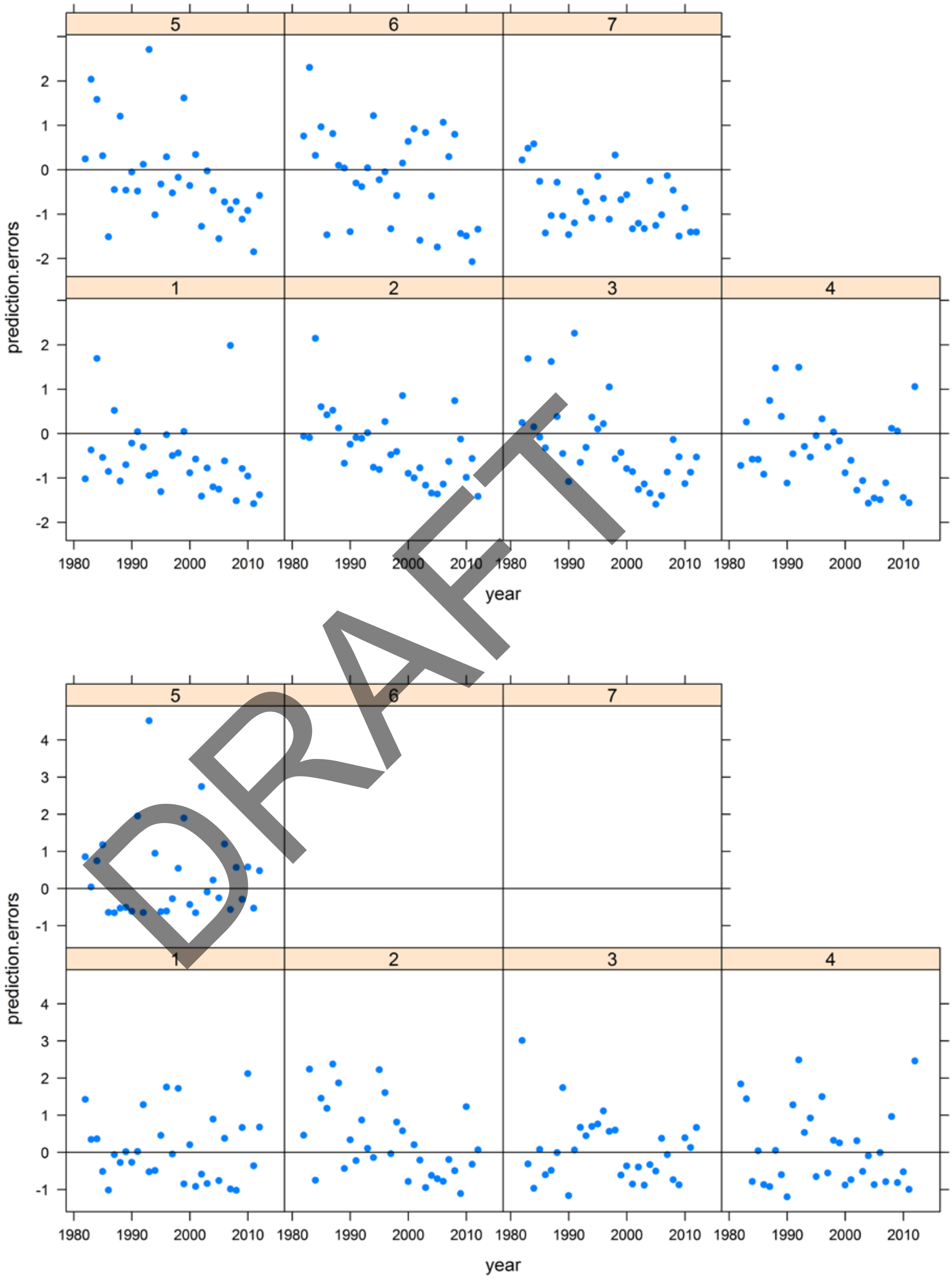


Figure 3.4.11. Whiting in Division VIa. Standardised landings (upper panel) and discards (lower panel) prediction errors from TSA.

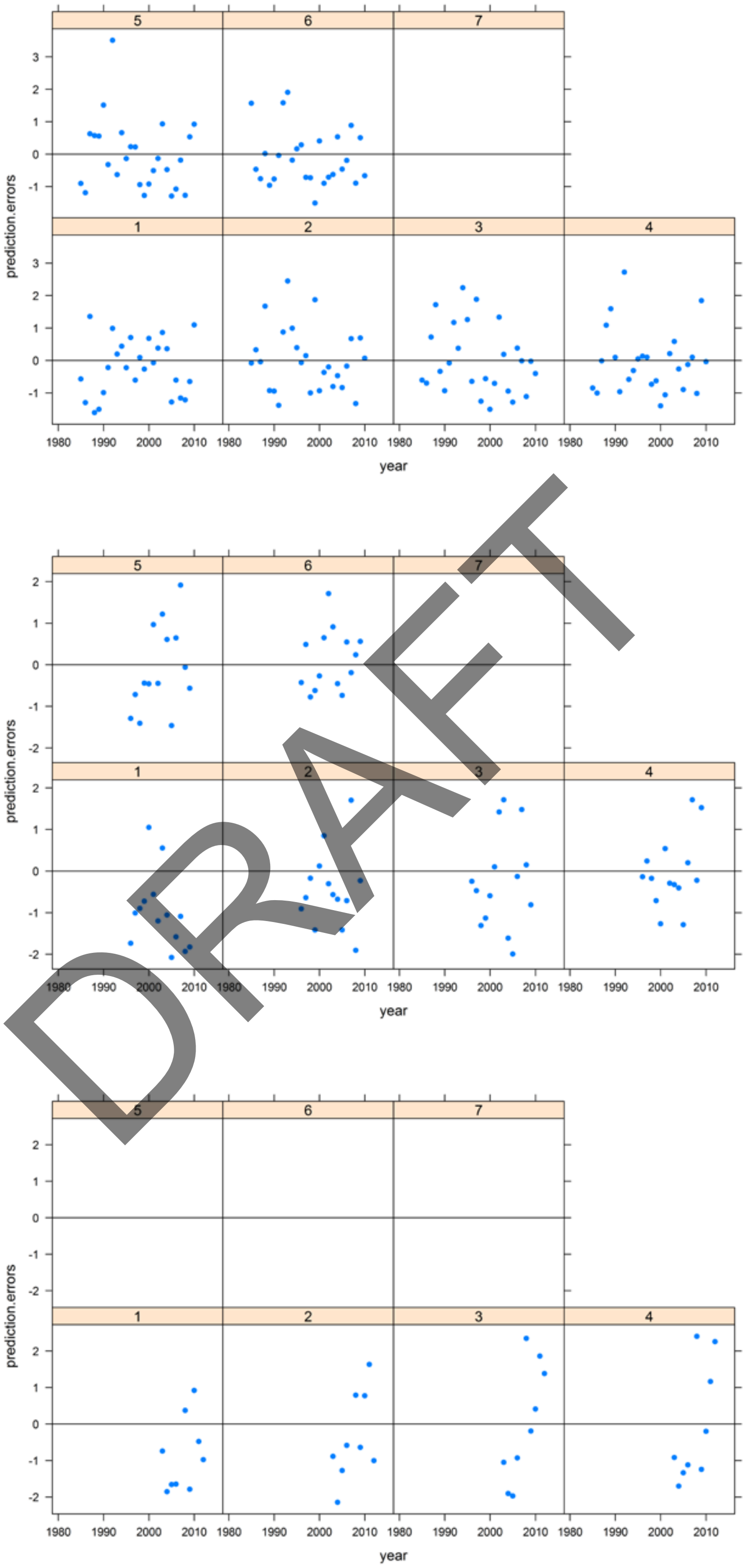


Figure 3.4.12. Whiting in Division VIa. Standardised survey errors from TSA in ScoGFS-WIBTS-Q1 (top panel), ScoGFS-WIBTS-Q4 (middle panel) and IGFS-WIBTS-Q4 (bottom panel).

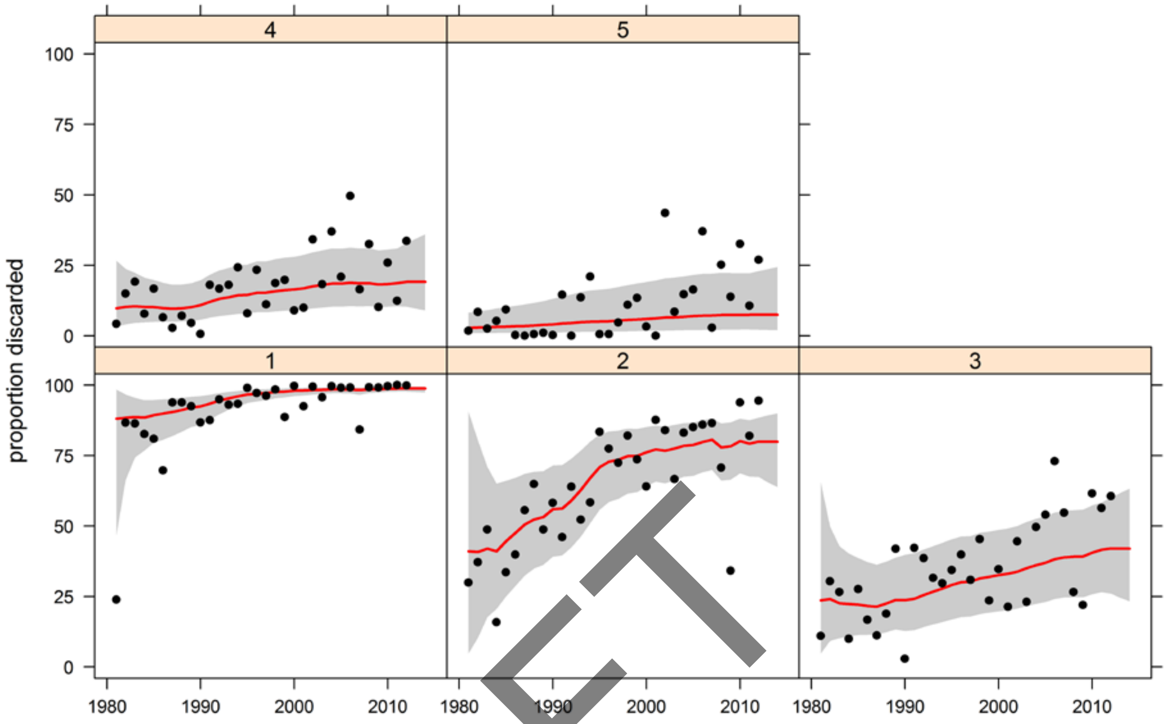


Figure 3.4.13. Whiting in Division VIa. Proportion discarded at-age.

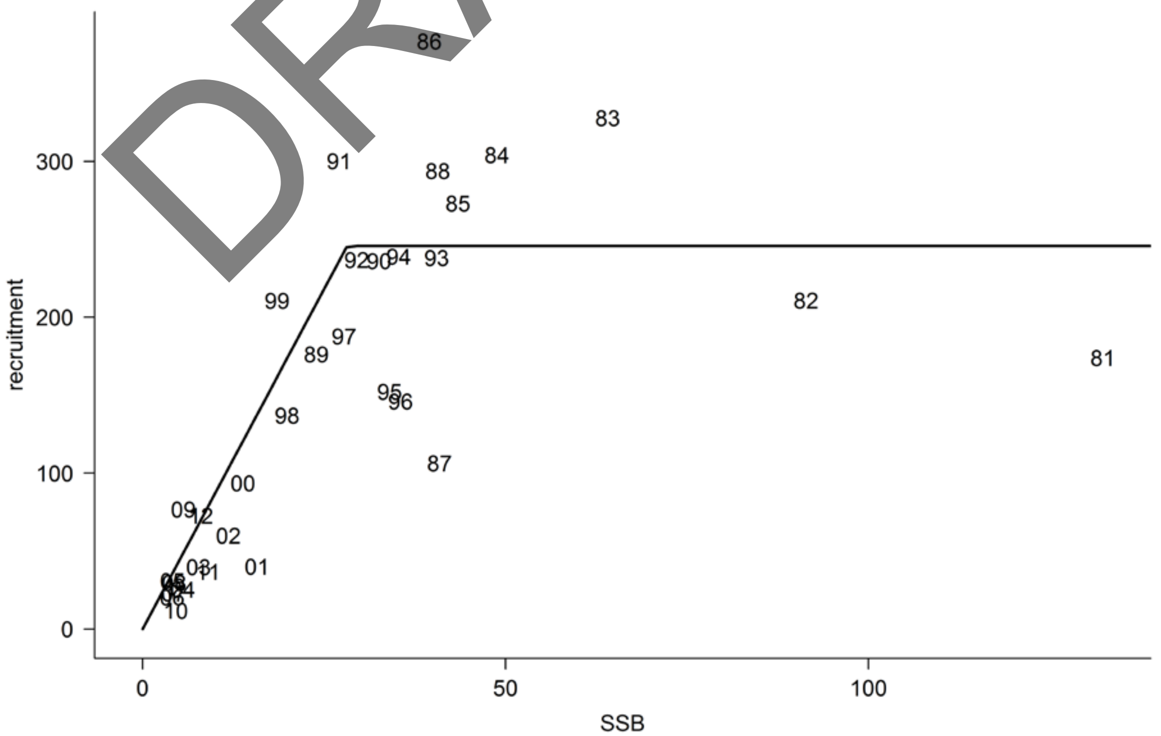


Figure 3.4.14. Whiting in Division VIa. Stock–recruitment relationship (recruitment in millions, SSB in thousand tonnes) from the final TSA run, with points labelled as year classes, and fitted with a "hockey-stick" model (solid line).

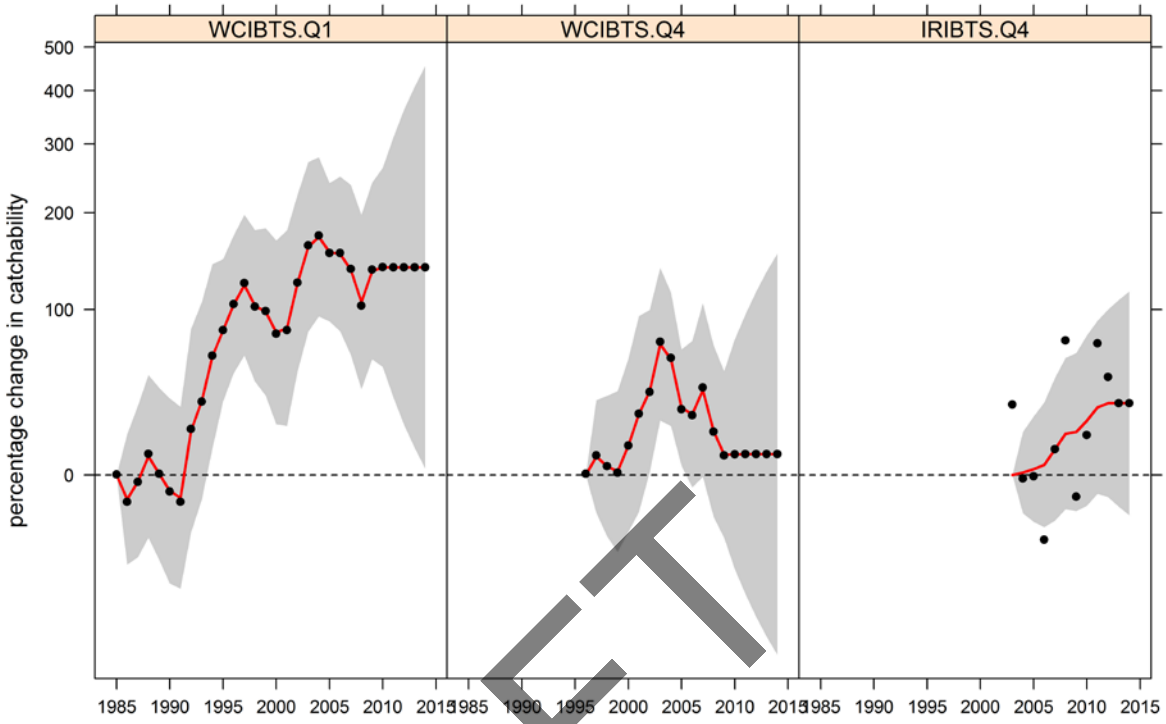


Figure 3.4.15. Whiting in Division VIa. Percentage change in catchability from the final TSA run. Transient changes (points) and the persistent change (solid line) with uncertainty bounds.

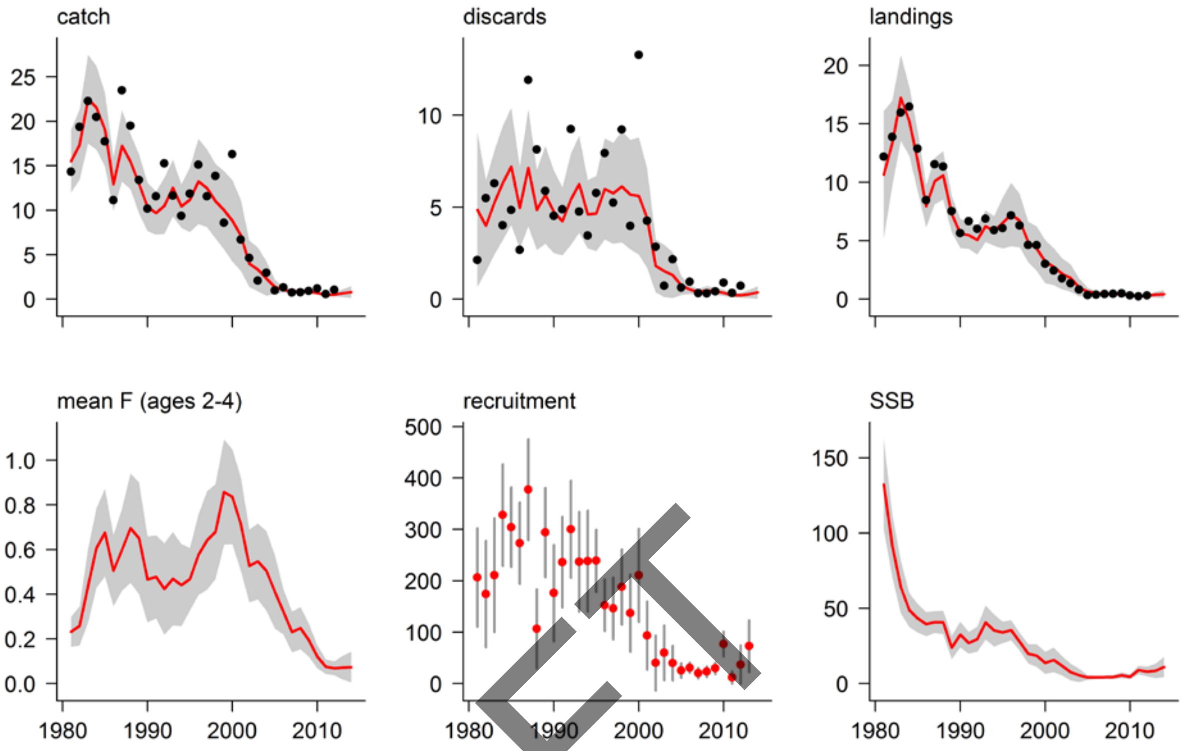


Figure 3.4.16. Whiting in Division VIa. TSA stock summaries from the final TSA run. Catch, landings, discards and SSB in tonnes, recruitment in thousands. Estimates are plotted with approximate pointwise 95% confidence bounds. Dots indicate observed values for catch, landings and discards.

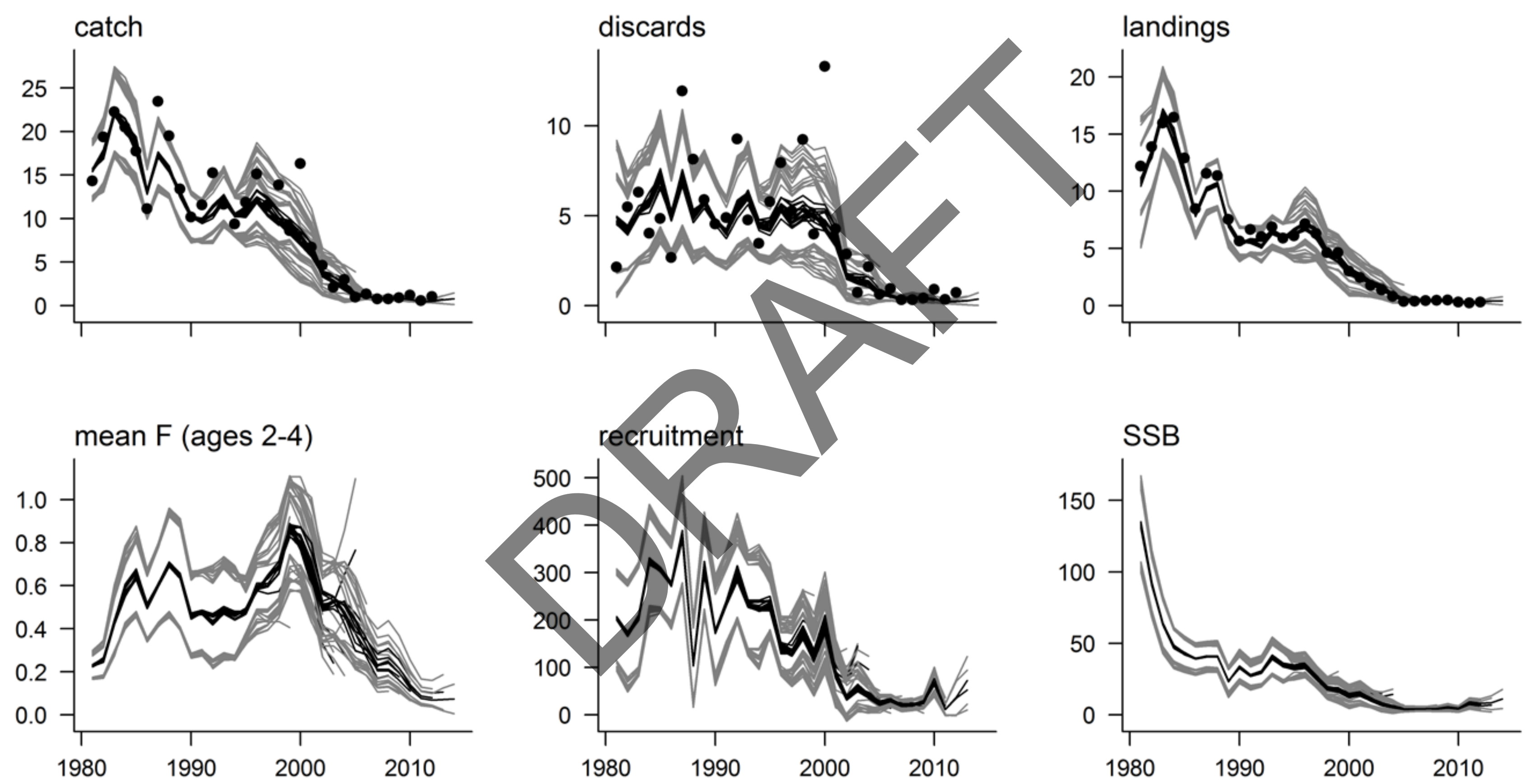


Figure 3.4.17. Whiting in Division VIa. Retrospective plots of TSA run. Catch, landings, discards and SSB in tonnes, recruitment in thousands. Black lines show estimates, grey lines show confidence intervals in the respective years.

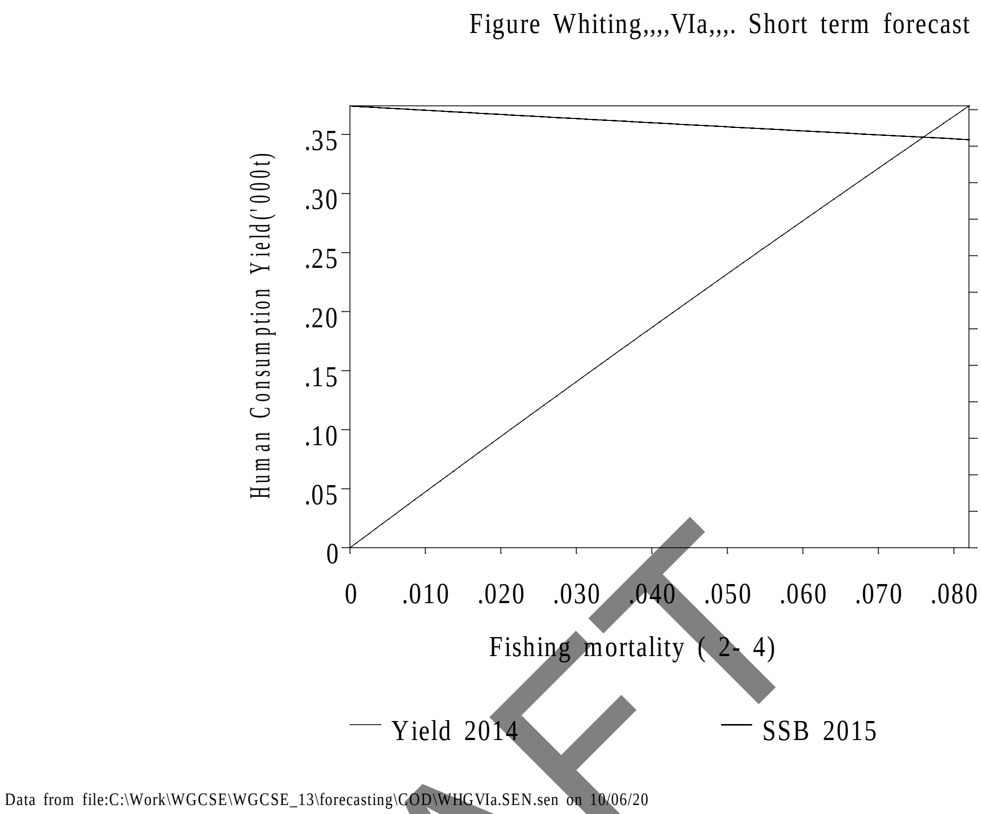


Figure 3.4.18. Whiting in Division VIa. Short-term forecast.

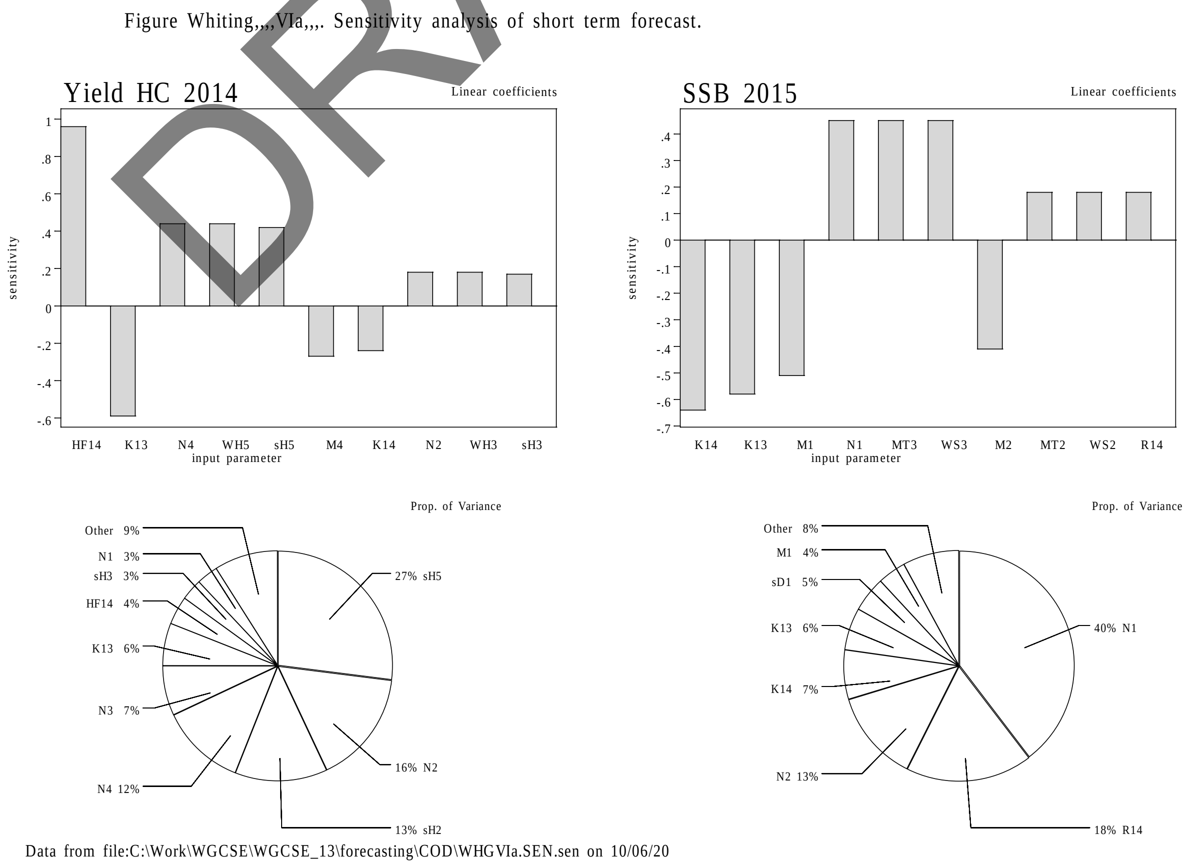


Figure 3.4.19. Whiting in Division VIa. Sensitivity analysis of short-term forecast.

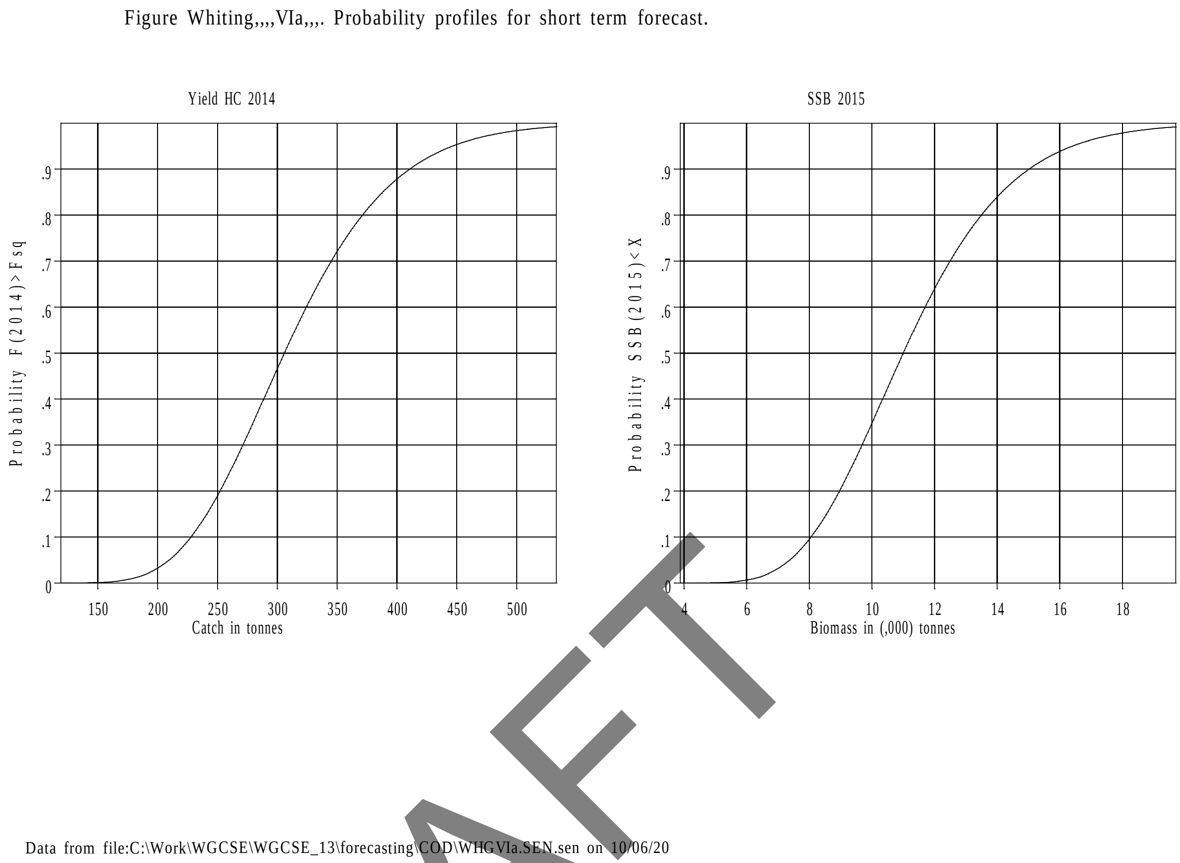


Figure 3.4.20. Whiting in Division VIa. Probability profiles for short-term forecast.

3.5 North Minch, FU11

Nephrops stocks have previously been identified by WGNEPH on the basis of population distribution, and defined as separate Functional Units. The Functional Units (FU) are defined by the groupings of ICES statistical rectangles given in Table 3.5.1 and illustrated in Figure 3.5.1. The Functional Unit is the level at which the WG collects fishery data (quantities landed and discarded, fishing effort, cpues and lpues, etc.) and length distributions, and at which it performs assessments.

There are three Functional Units in Division VIa, the level at which EU management of *Nephrops* currently takes place. Nominal landings as reported to ICES, along with WG estimates of landings are presented in Tables 3.5.2. (a), 3.5.2. (b) and 3.5.3.. Landings are also made from outside the Functional Units, from statistical rectangles where small pockets of suitable sediment exist, these are generally small amounts. There are no Functional Units in Division VIb and only very small quantities of *Nephrops* are landed.

Type of assessment in 2013

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG (WKNEPH, 2013) and described in Section 2.8.2.

3.5.1 Ecosystem aspects

The North Minch Functional Unit 11 is located at the northern end of the west coast of Scotland (Figure 3.5.1). Owing to its burrowing behaviour, the distribution of *Nephrops* is restricted to areas of mud, sandy mud and muddy sand. Within the North Minch Functional Unit these substrates are distributed according to prevailing hydrographic and bathymetric conditions. The area is characterised by numerous islands of varying size and sea lochs occur along the mainland coast. These topographical features create a diverse habitat with complex hydrography and a patchy distribution of soft sediments. The North Minch exhibits the most patchy ground amongst west coast FUs. Very soft sediments are found in the southeast while coarser sandy mud prevails to the north and west. Results from recent work on mapping the spatial extent of *Nephrops* habitat in the North Minch sea lochs indicate that the muddy habitat is only a very small proportion of the total *Nephrops* grounds. Figure 3.5.9 shows the distribution of sediment in the area.

3.5.2 The fishery in 2012

Information on developments in the fishery was provided by Marine Scotland staff including fishery officers and scientists sampling in the ports and on board vessels; some comments were also received from industry representatives.

The fishery in 2012 was described as being better than last year with a very good fishing season during spring/summer and high demand and good prices for *Nephrops*. In the first semester of 2012 there was a very significant increase in TR2 activity from visiting east coast vessels (mostly twin riggers) fishing for *Nephrops* in the North and South Minch. This included 48 vessels with no record of West coast of Scotland TR2 activity in 2010 and 2011. The reason for this increase is related with the poor fishery and low catch rates reported in the east coast grounds such as Fladen. This resulted in an overshoot of VIa TR2 effort experienced for quarters one and two in 2012. To address this and to keep the fishery open until the end of the year, an agreement was secured to implement temporary measures introduced in August 2012. These measures included a maximum of 15 days at sea per month for local boats and a prohibition of vessels from the east coast of Scotland to carry TR2 gear in ICES Division VIa.

The local fleet is mainly formed by smaller trawlers working 1–4 day trips from the main ports of Lochinver, Ullapool, Stornoway and Gairloch. The largest part of the North Minch fleets continued to be based at Stornoway, made up of mostly 15 m length vessels, both single-rigged and multi-rigged trawlers. The Barra fleet is more nomadic as the fishing grounds are more exposed which forces the fleet to find shelter on the east side of the North Minch. The Barra vessels are generally bigger than the Stornoway fleet, being all over 15 m in length. Vessels in North Minch have generally continued to fish with the same pattern, not changing the target species as mesh regulations impose that vessels with mesh <80 mm are not allowed to fish for squid in the area. Most trawlers were landing daily or every second day. Trawlers are still fishing with 80 mm mesh. In 2009, under the west coast emergency measures a square meshed panel of 120 mm was also required (Council Reg. (EU) 43/2009). Little if any marketable fish bycatch was landed by the boats fishing in the North Minch, this was confirmed during *Nephrops* discard trips on board North Minch boats. Estimates of discard rates of haddock and whiting remain high however.

Further general information on the fishery can be found in the stock annex.

3.5.3 ICES advice for 2012 and 2013

ICES advice applicable to 2012

"Following the ICES MSY framework implies the harvest ratio for the North Minch Functional Unit to be less than 12.5%, resulting in landings less than 3200 t in 2012."

ICES advice applicable to 2013

"Following the ICES MSY framework implies the harvest ratio for the North Minch functional unit to be less than 12.5%, resulting in landings no more than 4200 t in 2013."

3.5.4 Management applicable to 2012 and 2013

Management is at the ICES Subarea level as described at the beginning of Section 3.5. In 2012, ICES again reiterated its advice that *Nephrops* stocks should be managed at the FU level. The total TAC for 2013 in Subarea VI and international waters of Vb was 16 690 tonnes.

3.5.5 Assessment

Conclusions of the Review of the 2012 assessment

"*Overall, the assessment appears appropriate for the basis of management advice. However, the results of the short-term forecasts may be biased and need to be reanalyzed before being used for 2013 landings advice. It appears that the input parameters used to calculate the harvest ratios for the catch option table were not used in a consistent manner to the method in the annex, and the change was not justified. It is unclear if the method is similar to that of the previous assessment. The landings predictions for 2013 may be biased as a result. The RG feels that the catch option table should be recalculated using the method in the annex because, as the report states, "The method to derive landings for the catch options is sensitive to the* *input dead discard rate and mean weight in landings and this introduces uncertainties in the catch forecasts." The RG suggests that sensitivity analyses would help to quantify the effect of the decision on catch advice."*

The comments of the review group on the mismatch between the input parameters on the stock annex and the ones used in the 2012 assessment relate to the fact that the stock annex for FU 11 was not updated following the calculation of the F_{MSY} proxies at the 2010 WGCSE meeting. As it is stated in Section 3.5.7, the proxy harvest rate values remain preliminary and may be modified following further data exploration and analysis. The RG report contained some technical comments and attempts have been made to address these.

Approach in 2013

The assessment in 2013 is based on a combination of examining trends in fishery indicators and underwater TV using an extensive dataseries for the North Minch FU 11. The assessment of *Nephrops* and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG (WKNEPH 2009 and WKNEPH 2013) and is described in Section 2.8.2.

The provision of advice in 2013 follows the process defined by the benchmark WG and described in Section 3.5 and attempts to incorporate decisions taken at WKFRAME for the provision of MSY advice by ICES in 2010 (see Section 2.8.2.). The approach was developed based on intersessional work carried out by participants of the benchmark and involving collaboration between WGNSSK and WGCSE. Previous TV based assessments have derived predicted landings by applying a harvest rate approach to populations described in terms of length compositions from the trawl component of the fishery. Creel fishing is an important component of the North Minch fishery and landings from creel vessels have risen since the mid-1990s having been at a stable level since then. Given that creels operate across similar areas to those of the trawl fishery, the assessments from 2010 onwards were performed using combined length compositions from trawl and creels.

The accuracy of the currently used boundaries of what is considered *Nephrops* suitable habitat has been considered a source of uncertainty particularly in highly heterogeneous grounds such those on the west coast of Scotland and particularly in the North Minch where differences between fished area and surveyed area are likely to exist. Marine Scotland Science recent access to Vessel Monitoring System data (VMS) makes it possible to link geographical information on the positioning of vessels to landings data resulting in more detailed information on the spatial distribution of fishing effort in the *Nephrops* trawl fishery. In the 2011 assessment a VMS area (rather than the British Geological Survey sediment area estimate) was used for the first time to raise the burrow counts and produce an overall abundance estimate. Following the acceptance from the WG, this approach is being used again for the assessment in North Minch. At WKNEPH (2013) the total area of the ground was refined and estimated to be 2908 km^2. Further details are described in the Research Vessel Data section.

Data available

An overview of the data provided and used by the WG is shown in Section 2, Table 2.1.

Commercial catch and effort data

Official catch statistics (landings) reported to ICES are shown in Tables 3.5.2. (a) and 3.5.2. (b); these relate to the whole of VI of which the North Minch is a part. Landings by gear category for FU 11 provided through national laboratories are presented in Table 3.5.5. Landings from this fishery are usually only reported from Scotland but in 2012, 2 tonnes of *Nephrops* were reported from Ireland. A variety of gear types make landings of *Nephrops*. Total reported landings in 2012 were 3388 tonnes, consisting of 2852 tonnes landed by trawlers (84%) and 536 tonnes landed by creel vessels (16%).

Given the concerns about the previously (prior to 2010) presented Scottish effort data (due to non-mandatory recording of hours fished in recent years) and following recommendations made by the RG, effort data in terms of days absent were presented to the WG. Reported effort by all Scottish trawlers has shown a decreasing trend since 2000 (Figure 3.5.3) but in 2012 the effort increased by 20% and a large portion of this was applied in the first semester (see “The fishery in 2012” section above). Recently there was some concern about the method used to store effort data at the Marine Scotland Science internal database. This is related with how the effort is split by statistical rectangle when vessels fish over a wide area. This is more likely to affect North Sea than West coast FUs. However, given that a new effort data extraction became available from another database held in Edinburgh which is thought to be more reliable, these new data is being presented in Figure 3.5.3. Therefore, the effort and lpue time-series range (2000–2012) do not match with the more extensive year range available for landings. The new effort data does not change the lpue perception for the North Minch when compared with the data presented in previous years in the same period. The introduction of the “buyers and sellers” regulations in the UK in 2006 however, have led to increased reliability in the reported landings. Combined together, the increase in lpue in 2005 is probably reflecting the increase in reported landings rather than a change in stock abundance.

Males consistently make the largest contribution to the landings, although the sex ratio does seem to vary (54% males by number and 65% males by weight in 2012; Figure 3.5.4). This is likely to be due to the varying seasonal pattern in the fishery and associated relative catchability (due to different burrow emergence behaviour) of male and female *Nephrops.* This occurs because males are available throughout the year and the fishery is also prosecuted in all quarters. Females on the other hand are mainly taken in the summer when they emerge after egg hatching.

Discarding of undersized and unwanted *Nephrops* occurs in this fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 2000. Discarding rates in this FU averaged 14% by number in the last five years (Table 3.5.10). The mean weight in landings (Figure 3.5.6) for this FU decreased in 2012 following a decrease in the mean size of larger (>35 mm) animals, specially the males (Table 3.5.6, Figure 3.5.3). An increase in mean size of smaller (<35 mm) animals in 2010 may have contributed to the decrease in discard rate from 2010. Other factors related with market prices for *Nephrops* may also contribute for this trend. In 2012 the mean size of smaller animals increased slightly. It is likely that some *Nephrops* survive the discarding process, an estimate of 25% (Charuau *et al*., 1982; Sangster *et al*., 1997; Wileman *et al*., 1999) survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard survival rate for creel caught *Nephrops* have been shown to be high (WKNEPH, 2013) and a value of 100% is used. The discard rate adjusted for survivorship which is used in the provision of landings options for 2014 was 10% based on a three year average.

Length compositions

Length compositions of landings and discards are obtained during monthly market sampling and quarterly on-board observer sampling respectively. Quarterly landings and discards at length data were available from Scotland and these sampling levels are shown in Table 3.5.4. Although assessments based on detailed catch analysis are not presently possible, examination of length compositions can provide a preliminary indication of exploitation effects.

Figure 3.5.5 shows a series of annual length–frequency distributions for the period 1990 to 2012. Catch (removals) length compositions are shown for each sex along with the mean size for both. In both sexes the mean sizes have been fairly stable over time although in 2010 there is some evidence of a slight increase in the mean lengths. Examination of the tails of the distributions above 35 mm (the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) shows a relatively stable trend despite some evidence of a reduction in the relative numbers of larger males in 2012. The observation of relatively stable length compositions series is further confirmed in the series of mean sizes of larger *Nephrops* (>35 mm) in the landings (trawl only) shown in Figure 3.5.3 and Table 3.5.6. This parameter might be expected to reduce in size if overexploitation were taking place. The mean size of smaller animals (<35 mm) in the catch (and landings) is also relatively stable through time. The mean weight in the landings (Figure 3.5.6 and Table 3.5.9) shows a clear increase in 2008–2010 followed by a decrease in the last two years. These variations have a strong effect in the catch forecast and therefore it was considered more appropriate to use a full-time average, from 1999 (first year with creel and trawl length distributions combined) until 2012. This is further discussed under "quality of assessment and forecast".

InterCatch

Scottish data for 2012 were successfully uploaded into InterCatch prior the 2013 WG meeting according with the deadline proposed. Uploaded data was worked-up in InterCatch to generate 2012 raised international length–frequency distributions. Data exploration in InterCatch has previously shown that outputs of raised data were very close to those generated by the previous method applied internally with differences being <0.1%. As such, InterCatch length–frequency outputs have been used in the stock assessment since 2012.

Natural mortality, maturity-at-age and other biological parameters

Biological parameter values are included in the stock annex.

Research vessel data

Underwater TV surveys using a stratified random approach are available for this stock since 1994 (missing surveys in 1995 and 1997). Underwater television surveys of *Nephrops* burrow numbers and distributions, reduce the problems associated with traditional trawl surveys that arise from variability in burrow emergence of *Nephrops*. TV surveys are targeted at known areas of mud, sandy mud and muddy sand in which *Nephrops* construct burrows. Traditionally, because of the uncertainty in the sediment distribution in the North Minch, the area surveyed has been divided in four arbitrary rectangles roughly corresponding to discrete patches of mud and the burrow densities in the four rectangles raised to the total sediment area in the FU. The sediment distribution around UK is given by the British Geological Survey (BGS) and the estimated area for the North Minch is 1775 km². VMS plots (Figure 3.5.9) have shown fishing effort for trawlers (length >15 m) clearly extends outside of the present survey area for FU 11, which would imply an underestimate of the stock area. In the 2008 and 2009 TV surveys, a number of exploratory stations were surveyed on the basis of the newly available VMS data and burrows were identified confirming the presence of *Nephrops* outside the BGS sediment grounds. To account for this, the VMS area (based on 2007–2009 data) was used to generate the sampling stations for the 2010 and 2011 surveys and the burrow densities were raised accordingly. As more VMS data became available since 2009, in 2013 at the WKNEPH2013 (ICES, 2013) the sediment area of North Minch was recalculated and estimated to be 2908 km^2. This was based on the union of annual polygons produced from the VMS data which was shown to the best method to define the ground area in FU 11 as it includes the main fishing areas while it excludes some low intensity areas. The time series of previously estimated sediment and VMS abundances were scaled according with the new area/old area ratio (see the stock annex for more information). The VMS effort data by year in relation to the BGS sediment is shown in Figure 3.5.9. In 2012, 41 valid stations were used in the survey final analysis (Table 3.5.8).

Data analyses

Exploratory analyses of survey data

A re-working of the UWTV survey abundances for Division VIa were presented to the *Nephrops* benchmark workshop (WKNEPH) in 2009 (ICES, 2009) and further details of the technical changes to the camera can be found in the report of that workshop. The revised abundance estimates for FU 11 from 1999 onwards were presented for the first time at WGCSE 2009 and are slightly higher than the previous values due to the field of view being smaller than previously calculated.

Table 3.5.7 shows the basic analysis for the most recent TV survey conducted in FU 11. From 2010 onwards, a single strata based on VMS was applied do calculate the overall abundance. The area calculation method is based in the alpha convex-hull method to define and characterize the overall shape of a set of points and is described in the 2010 SGNEPS report (ICES, 2010). From the work presented at the 2012 SGNEPS meeting (ICES, 2012) it was decided by the group that a CV (relative standard error) of <20% was an acceptable precision level for UWTV survey estimates of abundance. The CV for the most recent TV survey (Table 3.5.7) is lower (10.1%) than the precision level agreed. Figure 3.5.7 shows the distribution of stations in recent TV surveys (2006–2012), with the size of the symbols reflecting the *Nephrops* burrow density. Table 3.5.8 and Figure 3.5.8 show the time-series estimated abundance for the TV surveys, with 95% confidence intervals on annual estimates. The use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009; ICES, 2013). A number of potential biases were highlighted including those due to edge effects, species burrow misidentification and burrow occupancy. The cumulative relative to absolute conversion factor estimated for FU11 was 1.33 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 33%.

FU	AREA	EDGE EFFECT	DETECTION RATE	SPECIES IDENTIFICATION	OCCUPANCY	CUMULATIVE ABSOLUTE CONVERSION FACTOR
11	North Minch	1.38	0.85	1.1	1	1.33

Final assessment

The underwater TV survey is presented as the best available information on the North Minch *Nephrops* stock. The surveys provide a fishery-independent estimate of *Nephrops* abundance. The details of the 2012 survey are shown in Table 3.5.7. At present it is not possible to extract any length or age structure information from the survey and therefore it only provides information on abundance over the area of the survey. The abundance in 2012 (891 million) shows a 48% decrease and is now close to the levels calculated for the 2007–2009 period.

3.5.6 Historic stock trends

The TV survey estimates of abundance for *Nephrops* in the North Minch suggest that historically the population increased until 2003 at which time it has fluctuated around the maximum value until 2006 when it declined for two years. More recently, the abundance increased to the levels of the early 2000s and decreased sharply again in 2012 by 48%. The bias adjusted abundance estimates are shown in Table 3.5.10. A new series with the VMS calculated abundance estimated for previous years was added to the table. In 2012, the stock is estimated to be at 891 million individuals (bias adjusted value). Table 3.5.10 also shows the estimated harvest ratios over this period. It is likely that prior to 2006, the estimated harvest ratios may not be representative of actual harvest ratios due to underreporting of landings.

3.5.7 MSY considerations

A number of potential F_{MSY} proxies are obtained from the per-recruit analysis for *Nephrops* and these are discussed further in Section 2.8.2 of this report. The analysis assumes the same input biological parameters as used at the benchmark meeting in 2013 and an exploitation and discard ogive for trawl and creel caught *Nephrops* generated in 2013 for the years 2009–2011. At WKNEPH 2013 the complete range of the per-recruit F_{MSY} proxies were recalculated and are given in the text table below. The process for choosing an appropriate F_{MSY} proxy is described in Section 2.8.3. All F_{MSY} proxy harvest rate values remain preliminary and may be modified following further data exploration and analysis.

For this FU, the absolute density observed on the UWTV survey is intermediate (based on the guideline categories suggested in Section 2.8.3) with an average of just over 0.55 m^{-2} suggesting the stock may have a medium productivity capability. Historical harvest ratios in this FU have been above that equivalent to fishing at F_{MAX} and landings have been relatively stable in the last thirty years. $F_{35\%SpR}$ (combined between sexes) is also estimated to be at F_{MAX}. For these reasons, the working group considered that **F35%SpR (combined between sexes) deliver high long-term yield with a low probability of recruitment overfishing and therefore is chosen as a proxy for F_{MSY}.**

			Fbar(20–40 mm)		HR (%)	SPR (%)		
		Fmult	M	F		M	F	T
$F_{0.1}$	M	0.21	0.134	0.060	6.9	39.9	65.9	49.0
	F	0.46	0.294	0.131	12.8	20.5	47.9	30.1
	T	0.24	0.153	0.068	7.7	36.2	63.0	45.5
F_{max}	M	0.38	0.243	0.108	11.1	24.6	52.4	34.3
	F	1.07	0.684	0.305	23.0	8.2	30.2	15.9
	T	0.48	0.307	0.137	13.2	19.7	46.9	29.2
$F_{35\%SpR}$	M	0.26	0.166	0.074	8.2	34.0	61.2	43.5
	F	0.84	0.537	0.240	19.6	10.8	34.8	19.2
	T	**0.37**	**0.237**	**0.106**	**10.9**	**25.2**	**53.0**	**34.9**

3.5.8 Landings forecasts

Landings prediction for 2014 based on principles established at the Benchmark Workshop WKNEPH (ICES, 2009) and using the revised approach based on various proxies for F_{MSY} (Dobby, 2009) outlined in the introductory Section 2 was made for the North Minch. These predictions were made on the basis of the 2012 UWTV survey and will be updated in October on the basis of the 2013 survey for the provision of advice.

The text table below shows landings predictions at various harvest ratios, including a selection of those equivalent to the per-recruit reference points discussed in Section 2 of this report. The harvest ratio in 2012 is calculated using input parameters agreed at WKNEPH (ICES, 2013). Inputs to the catch options table are the mean weight in landings (1999–2012), the average dead discard rate (2010–2012) and the cumulative absolute conversion factor for this FU. The landings prediction for 2014 at the F_{MSY} proxy harvest ratio is 2215 tonnes. The inputs to the landings forecast were as follows:

Survey Abundance (2012) = 891 million

Mean weight in landings (1999–2012) = 25.33 g

Dead discard rate (2010–2012) = 10.0%

Harvest ratio F (2012) = 17.9%

F_{MSY} = 10.9%

Cumulative absolute conversion factor= 1.33

	Harvest rate	Survey Index (adjusted)	Implied fishery	
			Retained number	Landings (tonnes)
$F_{MSY} = F_{35\%SpR(T)}$	10.9%	891	87	2215
$F_{0.1(T)}$	7.7%	891	62	1565
$F_{MAX\,(T)}$	13.2%	891	106	2682
F_{2012}	17.9%	891	144	3637

$F_{0.1(T)}$: Harvest ratio equivalent to fishing at a level associated with 10% of the slope at the origin on the combined sex YPR curve.

$F_{35\%SPR(T)}$: Harvest ratio equivalent to fishing at a rate which results in combined SPR equal to 35% of the unfished level.

$F_{max\,(T)}$: Harvest ratio equivalent to fishing at a rate which maximises the combined YPR.

A discussion of F_{MSY} reference points for *Nephrops* is provided in Section 2.

3.5.9 Biological reference points

Precautionary approach biological reference points have not been determined for *Nephrops* stocks. The $B_{trigger}$ point for this FU (bias adjusted lowest observed UWTV abundance corrected for the VMS area increase) is calculated as 541 million individuals.

3.5.10 Quality of assessment and forecast

The length and sex composition of the landings data is considered to be well sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in this fishery since 1990, and is considered to represent the fishery adequately. From 2010 combined trawl and creel length compositions are used to account for the fact that the creel fishery accounts for around 20% of the landings, increasingly operates over similar areas to trawling, and exhibits a length composition composed of larger animals.

There were concerns over the accuracy of historical landings and effort data prior to 2006 when Buyers and Sellers was introduced and the reliability began to improve. Because of this the final assessment adopted is independent of official statistics. Harvest ratios since 2006 are also considered more reliable due to more accurate landings data reported under new legislation. Incorporation of creel length compositions has also improved estimates of harvest ratios. Effort data from year 2000 extracted from another database was presented to the WG for the first time in 2012. This new effort data is considered to be more accurate and improved the estimates of lpue although it did not change its interpretation compared with what was presented in previous years.

Underwater TV surveys have been conducted for this stock since 1994, with a continual annual series available since 1998. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are relatively small for this functional unit. There is a gap of 18 months between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is rarely the case. The effect of this assumption on realised harvest rates has not been investigated.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. A three year average (2010–2012) of discard rate (adjusted to account for some survival of discarded animals) have been used in the calculation of catch options. The recent observed discard rate shows a decline in the last three years. This is discussed in Section 3.5.5 under "commercial catch and effort data". The cumulative absolute conversion factor estimates for FU 11 are largely based on expert opinion (See Stock

Annex). The precision of these bias corrections cannot yet be characterised. The method to derive landings for the catch options is sensitive to the input dead discard rate and mean weight in landings and this introduces uncertainties in the catch forecasts. Precision estimates are needed for these forecast inputs.

The stock area has been increased in 2011 and revised in 2013 (ICES, 2013) using integrated VMS-logbook data to more accurately estimate the spatial extent of *Nephrops* catches. Two other factors however, have the potential to increase the fished area further. Firstly, the inclusion of vessels smaller than 15 m would likely increase the fished area in some of the inshore locations and secondly, it is known that most of the sea lochs have areas of mud substrate and are typically fished by creel boats. In recent years, a number of TV surveys have taken place in the major North Minch sea lochs in an attempt to improve estimates of the ground area and *Nephrops* abundance. Work presented at the WKNEPH2013 (ICES, 2013) showed that the total area of the sea lochs is 105 km^2, which is considerably smaller than the offshore VMS area estimated to be 2908 km^2. Therefore, it is unlikely that the exclusion of these inshore areas from the survey have an impact in the mean densities and overall abundance of *Nephrops* in the North Minch.

3.5.11 Status of the stock

The evidence from the TV survey suggests that the abundance has decreased sharply (48%) in 2012 and is now at a similar level to that observed between 2007 and 2009. However there is no clear sign in the mean length information to suggest the recruitment has suffered. The calculated harvest ratio in 2012 (dead removals/TV abundance = 17.9%) is above the values associated with high long-term yield and low risk depletion (10.9%).

3.5.12 Management considerations

The WG, ACFM and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level and management at the Functional Unit level could provide the controls to ensure that catch opportunities and effort were compatible and in line with the scale of the resource.

Creel fishing takes place in this area but overall effort by this fleet in terms of creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the North Minch and STECF estimates that discards of whiting and haddock are high in VIa generally. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod under the Scottish Conservation Credits scheme and west coast emergency measures include the implementation of larger meshed square meshed panels (120 mm).

The implementation of buyers and sellers legislation in the UK in 2006 has improved the reliability of fishery statistics but the transition period was accompanied in some cases by large changes in landings which produce significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has built up, use of fishery catch and effort data in the assessment process should be avoided.

3.5.13 References

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Table 3.5.1. *Nephrops* Functional Units and descriptions by statistical rectangle.

Functional Unit	Stock	Division	ICES Rectangles
11	North Minch	VIa	44–46 E3–E4
12	South Minch	VIa	41–43 E2–E4
13	Clyde	VIa	39–40 E4–E5
14	Irish Sea East	VIIa	35–38E6; 38E5
15	Irish Sea West	VIIa	36E3; 35–37 E4–E5; 38E4

Table 3.5.2. (a). Nominal catch (tonnes) of *Nephrops* in Division VIa, 1980–2012, as officially reported to ICES.

	France	Ireland	Spain	UK-(Engl+Wales+N.Irl)	UK-Scotland	UK	TOTAL
1980	5	1	-	-	7,422	-	7,428
1981	5	26	-	-	9,519	-	9,550
1982	1	1	-	1	9,000	-	9,003
1983	1	1	-	11	10,706	-	10,719
1984	3	6	-	12	11,778	-	11,799
1985	1	1	28	9	12,449	-	12,488
1986	8	20	5	13	11,283	-	11,329
1987	6	128	11	15	11,203	-	11,363
1988	1	11	7	62	12,649	-	12,730
1989	-	9	2	25	10,949	-	10,985
1990	-	10	4	35	10,042	-	10,091
1991	-	1	-	37	10,458	-	10,496
1992	-	10	-	56	10,783	-	10,849
1993	-	7	-	191	11,178	-	11,376
1994	3	6	-	290	11,047	-	11,346
1995	4	9	3	346	12,527	-	12,889
1996	-	8	1	176	10,929	-	11,114
1997	-	5	15	133	11,104	-	11,257
1998	-	25	18	202	10,949	-	11,194
1999	-	136	40	256	11,078	-	11,510
2000	1	130	69	137	10,667	-	11,004
2001	9	115	30	139	10,568	-	10,861
2002	-	117	18	152	10,225	-	10,512
2003	-	145	12	81	10,450	-	10,688
2004	-	150	6	267	9,941	-	10,364
2005	-	153	17	153	7,616	-	7,939
2006	-	133	1	255	13,419	-	13,808
2007	-	155	-	2,088	14,120	-	16,363
2008	-	56	1	419	14,795	-	15,271
2009	-	53	-	1,226	11,462	-	12,741
2010	-	45	1	1,962	10,250	-	12,258
2011	35	76	0	-	-	12,934	13,045
2012*		29				14267	14296

***Figures are provisional.**

Table 3.5.2. (b) Nominal catch (tonnes) of *Nephrops* in Division VIb, 1980–2012, as officially reported to ICES. There are no Functional Units in ICES Division VIb but occasional small landings are made.

	France	Germany	Ireland	Spain	UK-(Engl+Wales+N.Irl)	UK-Scotland	TOTAL
1980	-	-	-	-	-	-	0
1981	-	-	-	-	-	-	0
1982	-	-	-	-	-	-	0
1983	-	-	-	-	-	-	0
1984	-	-	-	-	-	-	0
1985	-	-	-	-	-	-	0
1986	-	-	-	8	-	-	8
1987	-	-	-	18	11	-	29
1988	-	-	-	27	4	-	31
1989	-	-	-	14	-	-	14
1990	-	-	-	10	1	-	11
1991	-	-	-	30	-	-	30
1992	-	-	-	2	4	1	7
1993	-	-	-	2	6	9	17
1994	-	-	-	5	16	5	26
1995	1	-	-	2	26	1	30
1996	-	6	-	5	65	5	81
1997	-	-	1	3	88	23	115
1998	-	-	1	6	46	7	60
1999	-	-	-	5	2	5	12
2000	2	-	8	3	4	4	21
2001	1	-	1	14	2	7	25
2002	1	-	-	7	3	7	18
2003	-	-	1	5	6	18	30
2004	-	-	-	2	7	13	22
2005	3	-	1	1	5	7	17
2006	-	-	-	-	1	3	4
2007	-	-	-	2	3	-	5
2008	-	-	-	-	-	-	0
2009	-	-	-	-	-	-	0
2010	-	-	-	-	-	-	0
2011	-	-	-	-	-	-	0
2012*	-	-	-	-	-	-	0

*** Figures are provisional.**

Table 3.5.3. ***Nephrops*, Total *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles, 1981–2012.**

Year	FU11	FU12	FU13	Other	Total
1981	2861	3651	2968	39	9519
1982	2799	3552	2623	27	9001
1983	3196	3412	4077	34	10 719
1984	4144	4300	3310	36	11 790
1985	4061	4008	4285	104	12 458
1986	3382	3484	4341	89	11 296
1987	4083	3891	3007	257	11 238
1988	4035	4473	3665	529	12 702
1989	3205	4745	2812	212	10 974
1990	2544	4430	2912	182	10 068
1991	2792	4442	3038	255	10 527
1992	3560	4237	2805	248	10 849
1993	3192	4455	3342	344	11 332
1994	3616	4415	2629	441	11 101
1995	3656	4680	3989	460	12 785
1996	2871	3995	4060	239	11 165
1997	3046	4345	3618	243	11 252
1998	2441	3730	4843	157	11 171
1999	3257	4051	3752	438	11 498
2000	3246	3952	3419	421	11 038
2001	3259	3992	3182	420	10 853
2002	3440	3305	3383	397	10 525
2003	3268	3879	3171	433	10 751
2004	3135	3868	3025	403	10 431
2005	2984	3841	3423	254	10 502
2006	4160	4554	4778	241	13 733
2007	3968	5451	6495	420	16 334
2008	3799	5347	5997	128	15 271
2009	3497	4282	4777	185	12 741
2010	2263	3725	5701	569	12 258
2011	2696	3699	6431	219	13 045
2012*	3388	3889	6584	435	14 296

*** Provisional.**

Table 3.5.4. *Nephrops.* Sampling levels all FUs in VIa.

		2010		2011		2012	
FU		**N trips***	**N measured**	**N trips***	**N measured**	**N trips***	**N measured**
North Minch	Landings	38	23 570	64	39 356	54	34 205
	Discards	120	2364	28	2441	30	2536
South Minch	Landings	49	32 888	59	34 389	60	33 842
	Discards	28	1886	32	2258	15	1104
Clyde	Landings	42	33 054	39	30 664	26	22 412
	Discards	46	4691	46	4594	42	3723

***Number of trips expressed as number of hauls for discards.**

Table 3.5.5. *Nephrops*, North Minch (FU11), Nominal Landings of *Nephrops*, 1981–2012.

	UK Scotland				Other UK & Ireland	Total
	Nephrops trawl	Other trawl	Creel	Subtotal**		
1981	2320	170	371	2861	0	2861
1982	2323	105	371	2799	0	2799
1983	2784	95	317	3196	0	3196
1984	3449	161	534	4144	0	4144
1985	3236	117	708	4061	0	4061
1986	2642	203	537	3382	0	3382
1987	3458	143	482	4083	0	4083
1988	3449	149	437	4035	0	4035
1989	2603	112	490	3205	0	3205
1990	1941	134	469	2544	0	2544
1991	2228	125	439	2792	0	2792
1992	2978	150	432	3560	0	3560
1993	2699	85	408	3192	0	3192
1994	2916	246	454	3616	0	3616
1995	2940	184	532	3656	0	3656
1996	2355	147	369	2871	0	2871
1997	2553	102	391	3046	0	3046
1998	2023	67	351	2441	0	2441
1999	2791	56	410	3257	0	3257
2000	2695	28	523	3246	0	3246
2001	2651	41	567	3259	0	3259
2002	2775	79	586	3440	0	3440
2003	2607	44	617	3268	0	3268
2004	2400	25	710	3135	0	3135
2005	2267	18	699	2984	0	2984
2006	3446	17	697	4160	0	4160
2007	3362	16	590	3968	0	3968
2008	3230	12	557	3799	0	3799
2009	2858	26	613	3497	0	3497
2010	1717	6	540	2263	0	2263
2011	2110	16	570	2696	0	2696
2012*	2844	6	536	3386	2	3388

*** provisional.**

NA = not available.

Table 3.5.6. *Nephrops*, North Minch (FU 11): Mean sizes (CL mm) above and below 35 mm of male and female *Nephrops* in Scottish catches and landings, 1981–2012.

	Catches		Landings			
	< 35 mm CL		< 35 mm CL		> 35 mm CL	
Year	Males	Females	Males	Females	Males	Females
1981	30.2	29.3	30.6	30.2	39.2	37.6
1982	29.8	28.6	30.1	29.0	39.8	37.4
1983	29.0	27.6	29.1	27.5	40.0	37.8
1984	28.5	28.0	28.5	28.1	39.2	37.4
1985	27.9	27.5	27.9	27.5	40.0	37.5
1986	29.5	28.4	29.7	28.6	39.1	37.6
1987	29.6	29.0	29.9	29.6	39.8	37.9
1988	29.9	29.5	30.3	30.1	38.9	38.0
1989	29.0	29.0	29.2	29.2	40.1	38.9
1990	29.3	28.6	29.8	28.9	39.1	38.1
1991	30.3	29.1	30.6	29.5	39.4	39.1
1992	29.3	28.0	29.7	28.3	39.6	38.3
1993	29.4	27.9	29.5	28.0	38.7	38.3
1994	28.1	27.0	29.4	28.3	39.5	38.8
1995	27.7	27.7	28.6	29.0	40.0	38.2
1996	29.5	29.4	30.2	30.2	40.0	38.7
1997	29.1	28.4	29.9	28.8	39.4	38.0
1998	29.8	28.8	30.6	29.3	39.6	38.4
1999	28.9	28.2	30.1	29.1	39.4	37.5
2000	29.9	28.6	30.4	29.0	39.4	37.8
2001	29.4	28.1	30.3	28.8	39.8	38.2
2002	29.2	28.4	30.4	29.5	39.7	38.3
2003	29.0	28.3	30.3	29.6	39.2	37.8
2004	29.6	28.9	30.4	29.5	40.3	38.8
2005	28.4	27.8	30.1	30.0	39.4	37.8
2006	29.0	27.4	30.5	28.9	39.1	38.2
2007	30.0	28.3	30.0	28.2	40.3	38.7
2008	29.6	28.3	30.1	28.8	40.0	38.5
2009	28.6	27.0	29.9	28.0	40.8	39.3
2010	30.2	28.8	31.2	29.5	40.7	39.8
2011	28.6	28.3	29.7	29.4	41.2	39.3
2012*	29.8	28.5	30.6	29.1	39.7	38.9

***Provisional.**

NA = not available.

Table 3.5.7. ***Nephrops*****, North Minch (FU 11): Results of the 2012 TV survey.**

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance	Survey Precision Level (RSE)
2012 TV survey								
VMS	2908	41	0.41	0.07	891	14 538	1	
Total	2908	41			891	14 538	1	0.101

Table 3.5.8. ***Nephrops*****, North Minch (FU 11): Results of the 1994–2012 TV surveys (values adjusted for bias).**

Year	Number of valid stations	Mean density	Abundance (Sediment)	95% confidence interval (sediment)	Abundance (VMS)	95% confidence interval (VMS)
		burrows/m²	millions	millions	millions	millions
1994	41	0.38	500	74	820	-
1995			No survey			
1996	38	0.25	330	47	541	-
1997			No survey			
1998	38	0.41	547	77	898	-
1999	36	0.36	484	89	794	-
2000	39	0.53	711	82	1166	-
2001	56	0.50	666	81	1092	-
2002	37	0.61	815	91	1337	-
2003	41	0.80	1068	129	1751	-
2004	38	0.80	1068	107	1751	-
2005	41	0.70	939	100	1540	-
2006	30	0.81	1075	101	1762	-
2007	36	0.55	736	91	1206	-
2008	41	0.48	638	95	1047	-
2009	26	0.55	729	138	1195	-
2010	37	0.59	-	-	1293	231
2011	41	0.79	-	-	1726	226
2012	41	0.41	-	-	891	181

Table 3.5.9. *Nephrops* mean weight in the landings (FU 11–13).

Year	FU 11	FU 12	FU13 Firth of Clyde	FU13 Sound of Jura
1990	21.31	19.90	24.21	
1991	25.28	21.65	20.57	
1992	21.58	24.01	25.08	
1993	20.70	21.16	29.40	
1994	23.38	24.88	25.22	
1995	22.16	21.87	19.14	
1996	26.63	23.02	21.60	
1997	21.62	23.28	24.14	
1998	23.57	22.09	18.04	
1999*	22.7	25.14	16.88	
2000	24.19	27.3	19.82	
2001	25.33	23.79	19.45	
2002	25.93	26.83	16.3	
2003	26.03	27.86	19.16	
2004	25.16	27.37	18.81	16.90
2005	27.65	28.11	17.97	15.47
2006	24.52	26.24	19.28	15.05
2007	23.61	23.95	19.05	19.02
2008	23.81	23.84	16.42	21.60
2009	25.34	23.79	18.09	25.58
2010	29.33	25.79	21.16	17.13
2011	27.56	31.10	19.34	na
2012	23.43	29.17	21.83	na
Average**	25.33	26.45	20.78	21.44

***From 1999 onwards mean weights are shown for trawl and creels combined except for Sound of Jura where there are no creel sampling available.**

**** Average for North Minch and South Minch (1999–2010); Clyde (2010–2012); Sound of Jura (2008–2010).**

Table 3.5.10. ***Nephrops*, North Minch (FU 11): Adjusted TV survey abundance, landings, discard rate (proportion by number) and estimated harvest rate.**

Year	Landings in number (millions)	Discards in number (millions)	Removals in number (millions)**	Adjusted survey sediment (millions)	Adjusted survey VMS (millions)	Harvest ratio VMS*	Harvest ratio sediment	Landings (tonnes)	Discard (tonnes)	Discard rate	Dead discard rate***	Mean weight in landings (g)
1999	145	28	164	484	794	20.6	33.8	3257	275	16.4	12.8	22.7
2000	133	10	141	711	1166	12.1	19.9	3246	98	6.9	5.2	24.19
2001	130	17	141	666	1092	12.9	21.2	3259	161	11.7	9.1	25.33
2002	132	28	153	815	1337	11.4	18.7	3440	276	17.6	13.8	25.93
2003	127	30	148	1068	1751	8.4	13.8	3268	303	19.2	15.2	26.03
2004	123	18	136	1068	1751	7.8	12.7	3135	203	13.0	10.1	25.16
2005	108	51	144	939	1540	9.3	15.3	2984	514	32.0	26.1	27.65
2006	171	74	223	1074	1762	12.6	20.7	4160	762	30.3	24.6	24.52
2007	170	12	177	735	1206	14.7	24.1	3968	216	6.5	5.0	23.61
2008	162	19	173	638	1047	16.5	27.1	3799	198	10.5	8.1	23.81
2009	145	37	164	729	1195	13.7	22.5	3497	344	20.3	16.0	25.34
2010	77	11	85	-	1293	6.6	-	2263	121	12.4	9.6	29.33
2011	96	16	108	-	1726	6.3	-	2696	154	14.2	11.0	27.56
2012	145	20	159	-	891	17.9	-	3388	204	12.0	9.3	23.43
Average											10.0	25.33

***harvest rates previous to 2006 are unreliable.**

**** Removals numbers take the dead discard rate into account.**

***** Dead discard average: 2010–2012; Mean weight in landings average: 1999–2012.**

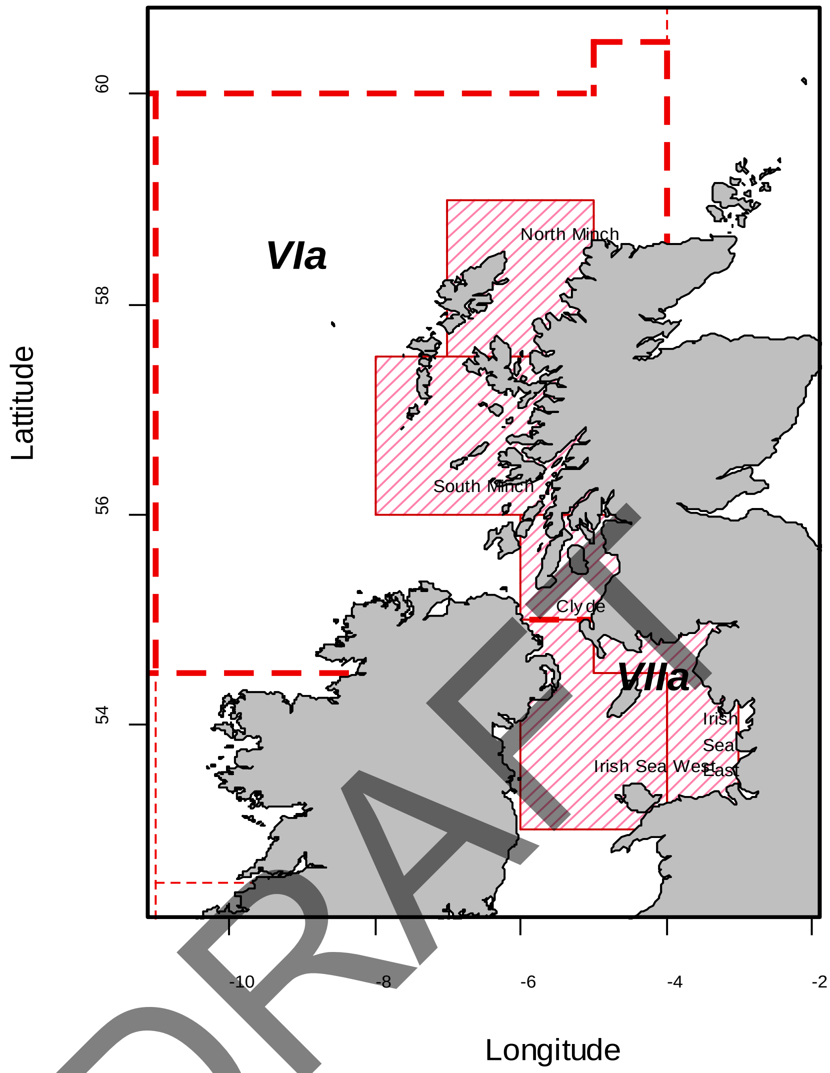

Figure 3.5.1. ***Nephrops*** **Functional Units in VIa and VIIa. North Minch (FU11), South Minch (FU12), Clyde (FU13), Irish Sea East (FU14) and Irish Sea West (FU15).**

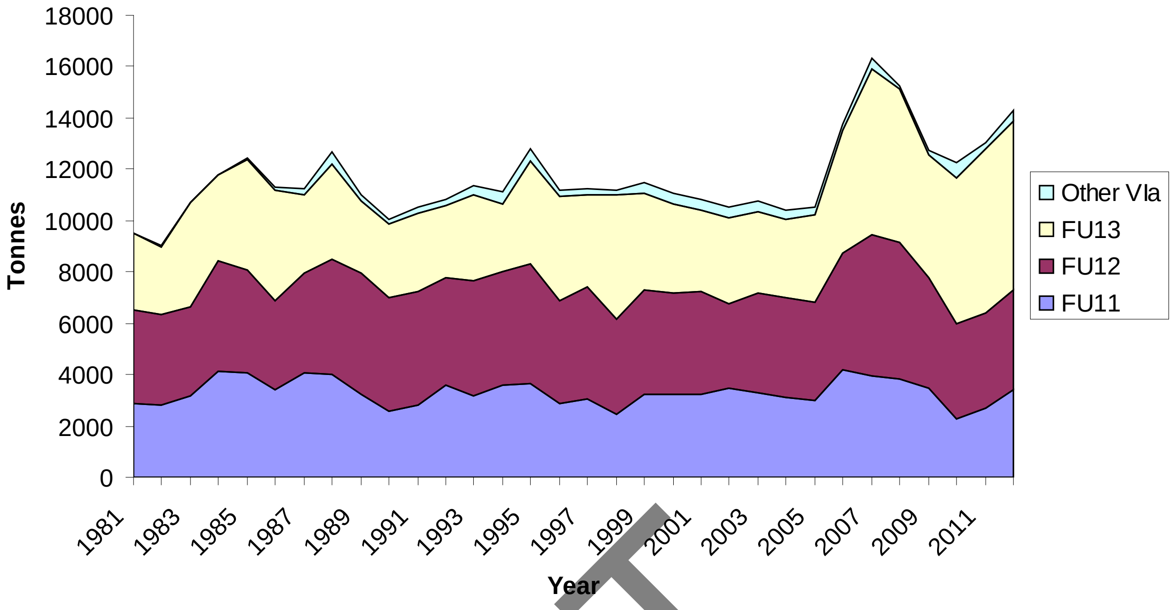

Figure 3.5.2. ***Nephrops*** **in Division VIa. Landing (thousands tonnes) by FU and other rectangles.**

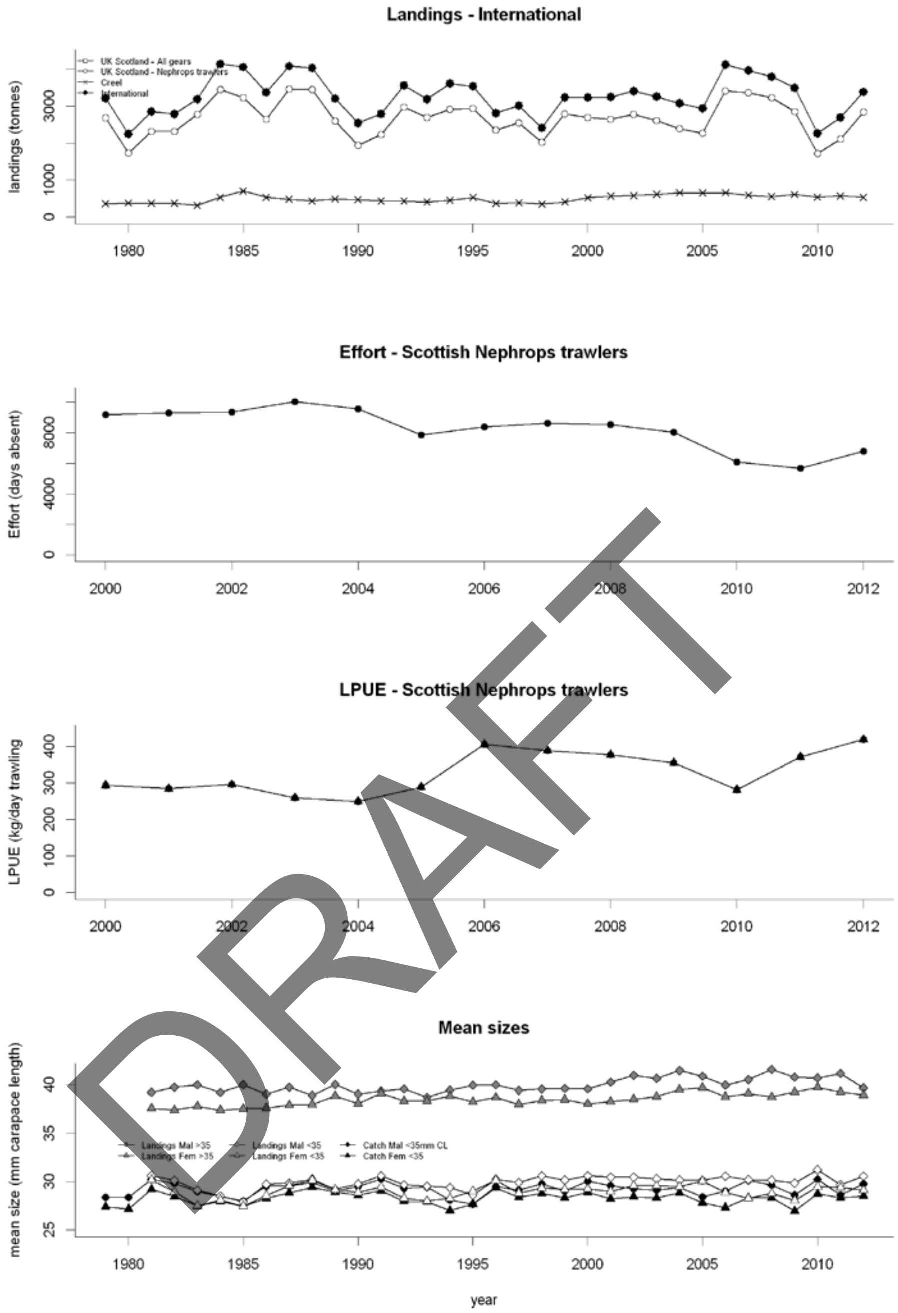

Figure 3.5.3. ***Nephrops*, North Minch (FU11). Long-term landings, effort, lpue and mean sizes. The interpretation of the lpue series is likely to be affected by the introduction of the "buyers and sellers" regulations in 2006.**

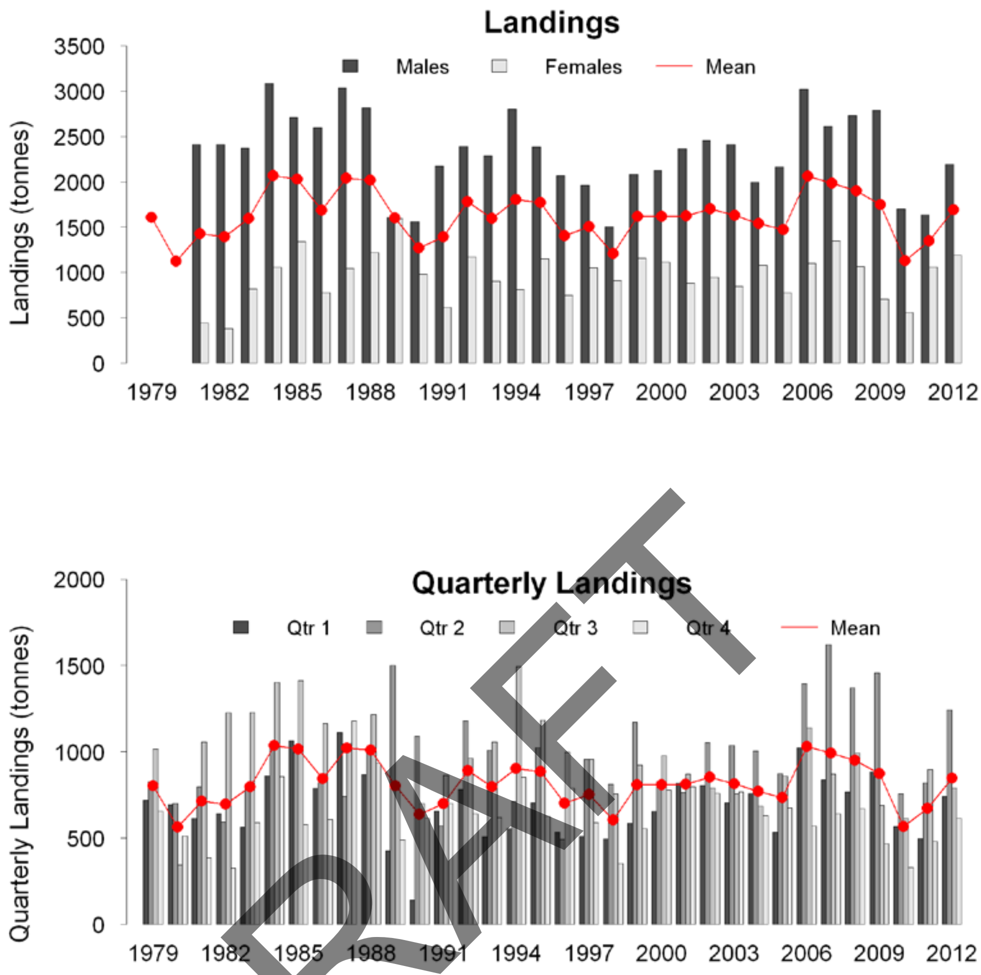

Figure 3.5.4. ***Nephrops*, North Minch (FU11), Landings by quarter and sex from Scottish trawlers.**

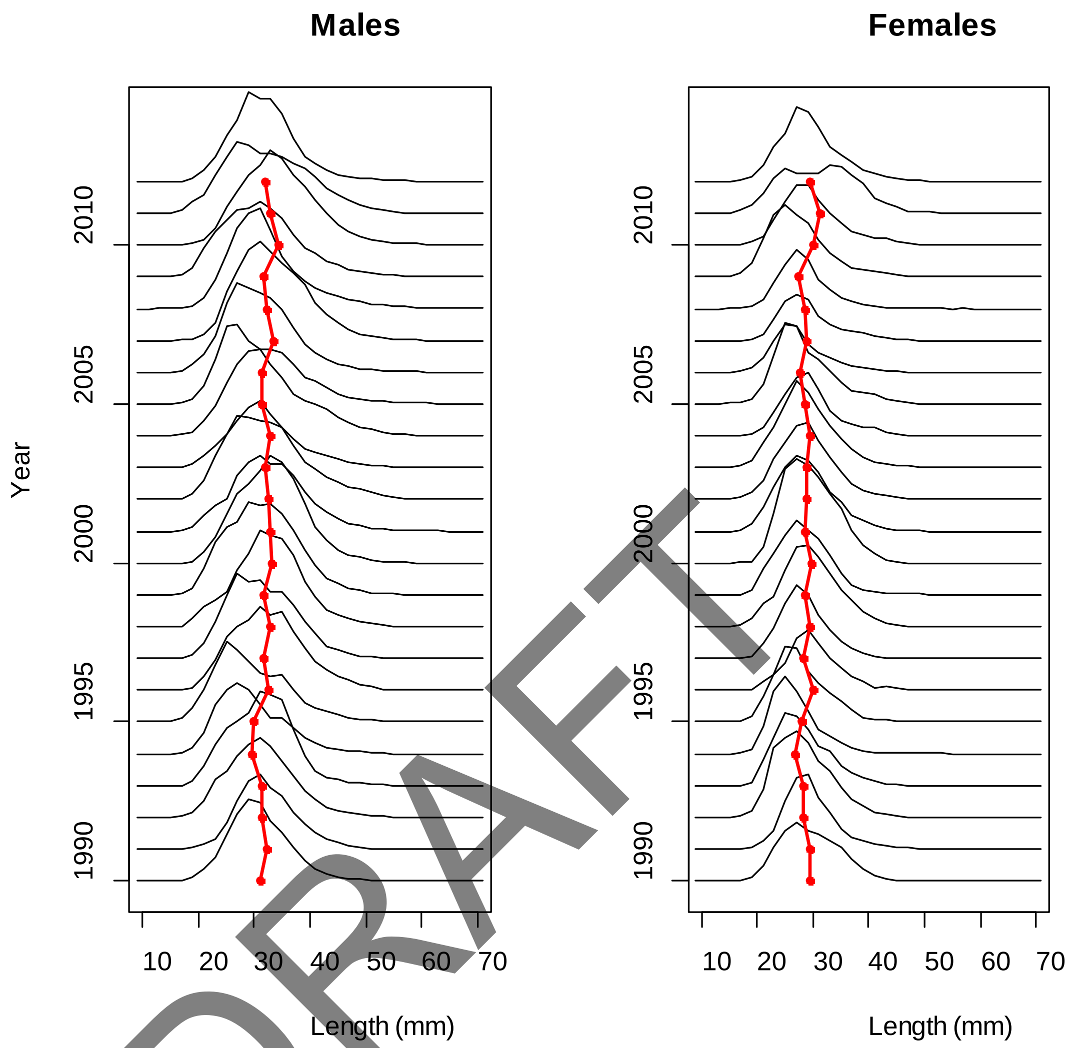

Figure 3.5.5. ***Nephrops*, North Minch (FU11), Catch length–frequency distribution and mean sizes (red line) for *Nephrops* in the North Minch, 1990–2012.**

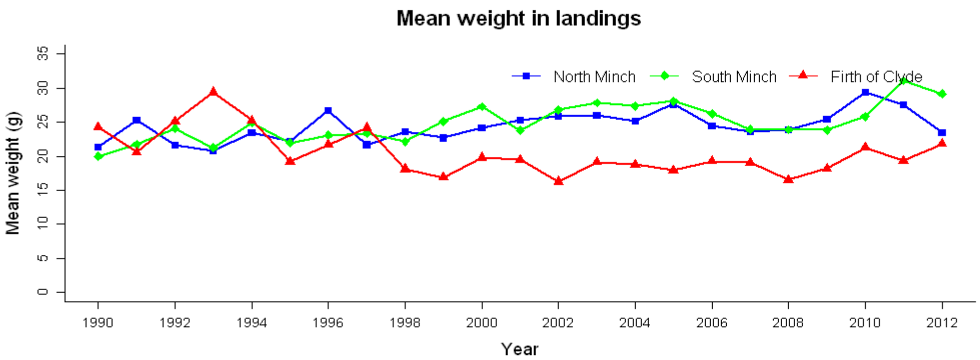

Figure 3.5.6. ***Nephrops*, (FU 11-North Minch, FU 12-South Minch and FU 13-Clyde), individual mean weight in the landings from 1990–2012 (from Scottish market sampling data).**

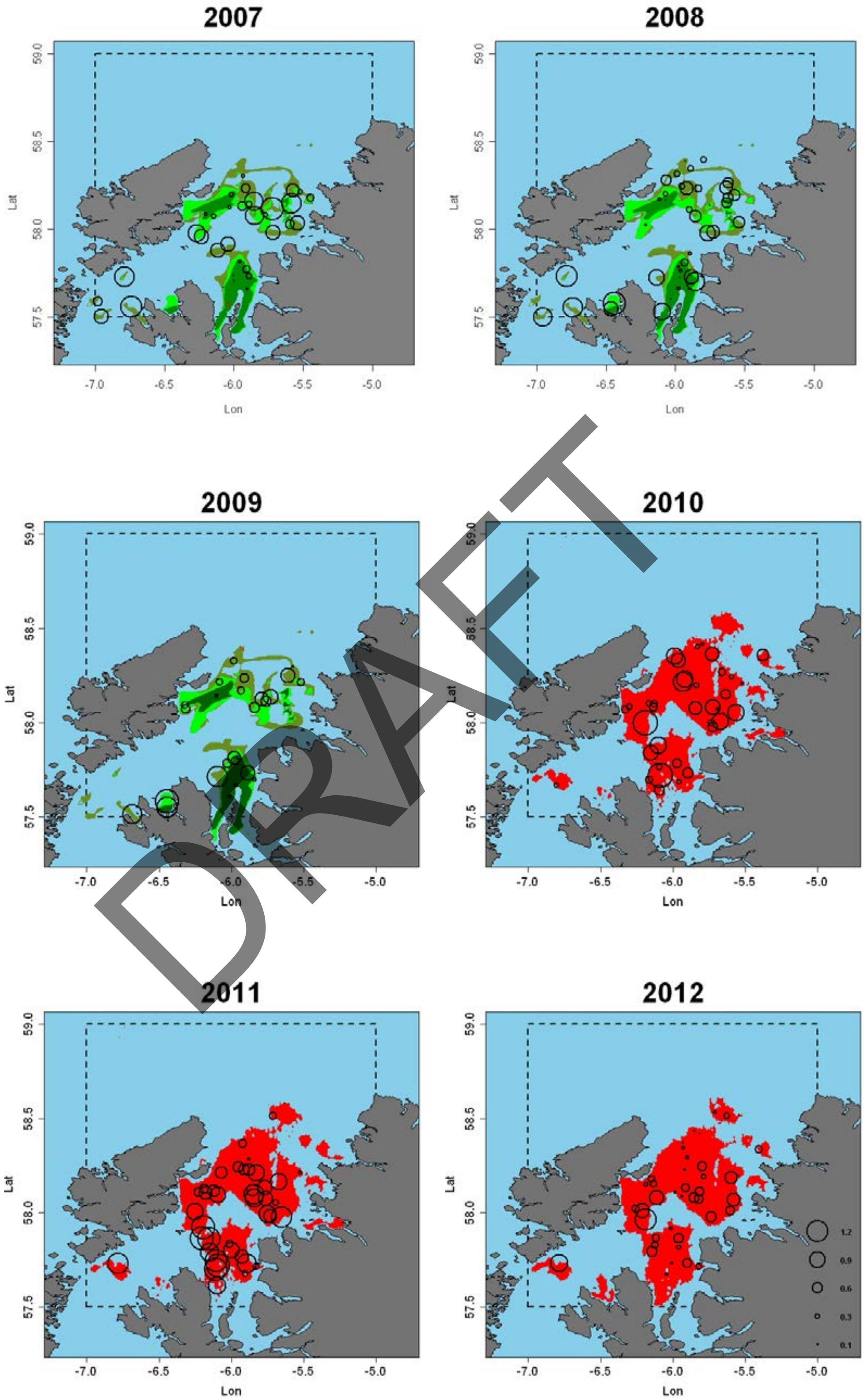

Figure 3.5.7. ***Nephrops*****, North Minch (FU11), TV survey station distribution and relative density (burrows/m²), 2007–2012. Shaded green and brown areas represent areas of suitable sediment for *Nephrops*. Bubbles in these figures are all scaled the same. Crosses represent zero observations.**

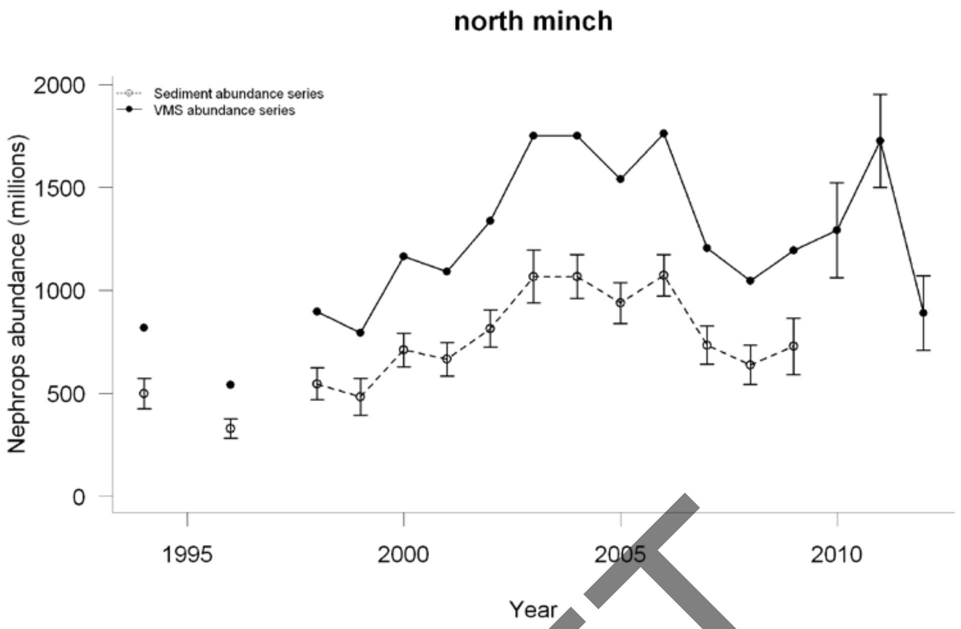

Figure 3.5.8. ***Nephrops*, North Minch (FU11), time-series of revised TV survey abundance estimates (adjusted for bias), with 95% confidence intervals, 1994–2012 (no survey in 1995 and 1997). The dashed and solid lines are the abundance estimated raised to the sediment area and VMS area, respectively.**

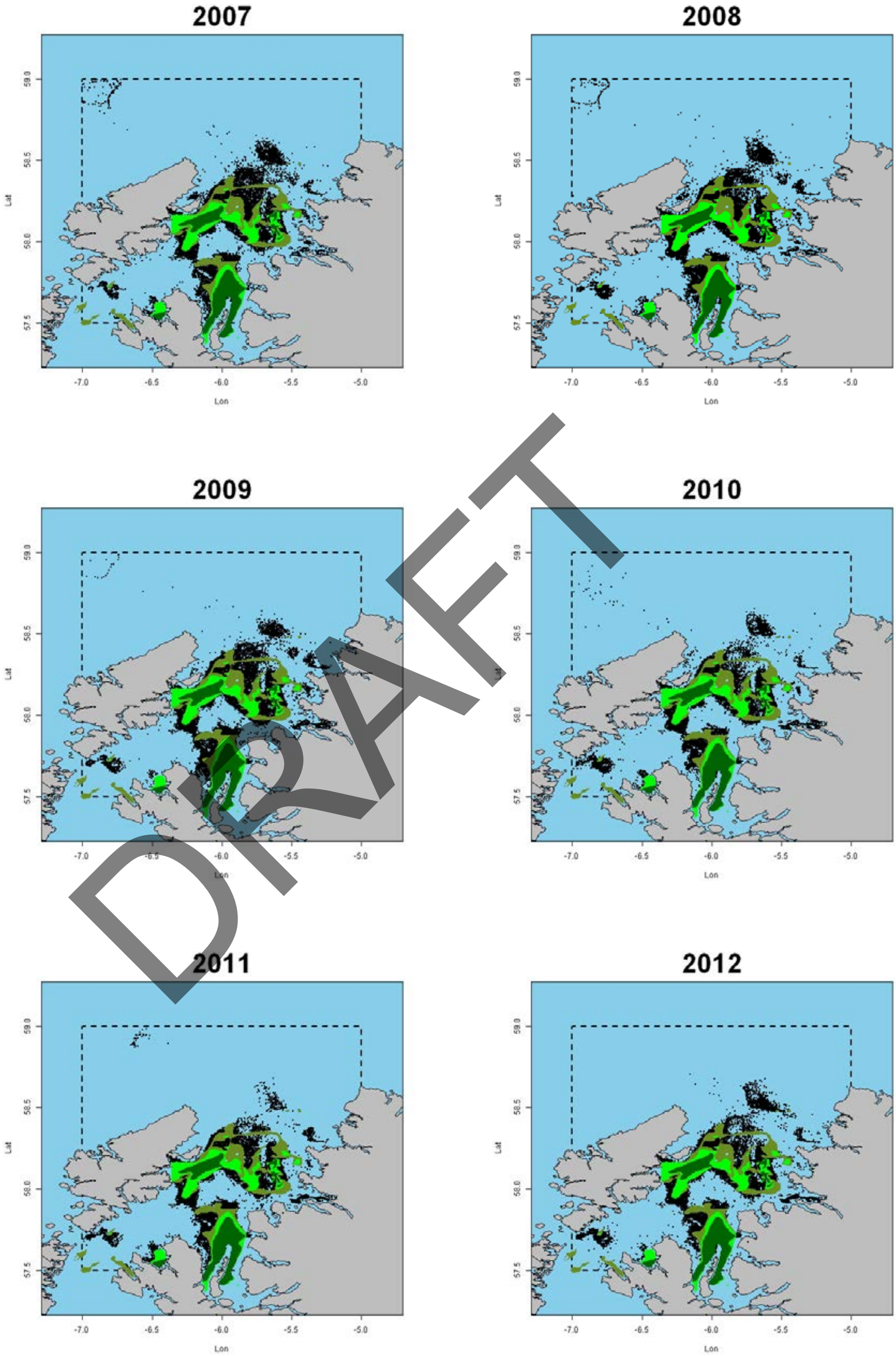

Figure 3.5.9. ***Nephrops*, North Minch (FU11), comparison of area of *Nephrops* ground defined by BGS sediment distribution (green shaded overlay) and by distribution of VMS pings (shown by black dots, underlay) recorded from *Nephrops* trawlers >15 m length for 2007–2012. VMS data filtered to exclude vessel speeds >4.5 knots.**

3.6 South Minch, FU12

Type of assessment in 2013

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG (WKNEPH, 2009, WKNEPH, 2013) and described in Section 2.

3.6.1 Ecosystem aspects

The South Minch Functional Unit 12 is located midway down the west coast of Scotland (Figure 3.5.1; see North Minch report, Section 3.5).

Owing to its burrowing behaviour, the distribution of *Nephrops* is restricted to areas of mud, sandy mud and muddy sand. Within the South Minch Functional Unit these substrates are distributed according to prevailing hydrographic and bathymetric conditions. The area is characterised by numerous islands of varying size and sea lochs occur along the mainland coast. These topographical features create a diverse habitat with complex hydrography and a patchy distribution of soft sediments. A more continuous extensive area of sediment suitable for *Nephrops* occurs further offshore to the southwest. Figure 3.6.6 shows the distribution of sediment in the area.

3.6.2 The fishery in 2012

Information on developments in the fishery was provided by Marine Scotland staff including fishery officers and scientists sampling in the ports and on board vessels; some comments were also received from industry representatives. In 2012 overall landings have remained at a similar level as the previous two years with good *Nephrops* prices. There has been some diversification in fishing in this area due to high prices for haddock that have been reported to be present in high numbers in the west coast of Scotland. In the first semester of 2012 there was a very significant increase in TR2 activity from visiting east coast vessels (mostly twin riggers) fishing for *Nephrops* in the North and South Minch. This included 48 vessels with no record of West coast of Scotland TR2 activity in 2010 and 2011. The reason for this increase is related with the poor fishery and low catch rates reported in the east coast grounds such as Fladen. This resulted in an overshoot of VIa TR2 effort experienced for quarters one and two in 2012. To address this and to keep the fishery open until the end of the year, an agreement was secured to implement temporary measures introduced in August 2012. These measures included a maximum of 15 days at sea per month for local boats and a prohibition of vessels from the east coast of Scotland to carry TR2 gear in ICES Division VIa.

Two distinct fleets continued to operate in the South Minch during 2012, landing into the two main ports of Oban and Mallaig. Inshore, a fleet of smaller vessels including creel boats operated throughout the year, whilst some larger twin riggers fish further offshore. Most of these boats are thought to fish for *Nephrops* at some time. The Mallaig local fleet tend to fish closer to shore in harder ground and land better quality *Nephrops* than visitor boats. Most boats landed once or twice per week. There are very few vessels (2–3) that landed on a daily basis. During the winter months, fishing activity is usually reduced in the South Minch due to the weather and small boats are often restricted to trawling in the sheltered sea-lochs.

There is increasing overlap of the areas exploited by trawl and creel fishing and this has led to some gear conflict issues. Boats on the west coast of Scotland are operating in accordance with the Scottish Conservation Credits Scheme and from 2009 have been required to fit 120 mm square meshed panels in accordance with the west coast emergency measures (Council Reg. (EU) 43/2009). Twin rig vessels tend to use a 200 mm square mesh panel (with a 100 mm codend), some of them slightly bigger than that. This means that they do not catch bulk quantities and this leads to prawns of better average size and quality.

There is very little fish bycatch landed; only 2–3 vessels do so owing to the restrictions on cod, haddock and whiting under the emergency measures. Estimates of discard rates of haddock and whiting remain high however.

3.6.3 ICES advice for 2012 and 2013

ICES advice applicable to 2012

"Following the ICES MSY framework implies the harvest ratio for the South Minch functional unit to be less than 12.3%, resulting in landings of less than 5500 t in 2012."

ICES advice applicable to 2013

"Following the ICES MSY approach implies the harvest ratio for the South Minch functional unit should be no more than 12.3%, resulting in landings of no more than 5800 t in 2013."

3.6.4 Management applicable to 2012 and 2013

Management is at the ICES subarea level as described at the beginning of Section 3.5 (North Minch report). In 2012, ICES again reiterated its advice that *Nephrops* stocks should be managed at the FU level.

3.6.5 Assessment

Conclusions of the Review of the 2012 assessment

"Overall, the assessment appears appropriate for the basis of management advice. The assessment results are consistent with previous updates, and the stock appears to be relatively stable with low fishing mortality. The RG agrees that the MSY proxy is a solid basis for setting management advice, but the results of the forecasts may be biased if discarding rates increase."

The RG report contained some technical comments and attempts have been made to address these.

Approach in 2013

As last year the assessment in 2012 is based on a combination of examining trends in fishery indicators and underwater TV using an extensive dataseries for the South Minch FU 12. The assessment of *Nephrops* through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG and described in the stock annex.

The provision of advice in 2013 develops the process defined by the benchmark WG. Section 2 outlines the WG approach to integrate WKFRAME recommendations in the provision of F_{MSY} proxies for *Nephrops*. The approach was developed based on intersessional work carried out by participants of the benchmark and involving collaboration between WGNSSK and WGCSE. Previous TV based assessments have derived predicted landings by applying a harvest rate approach to populations described in terms of length compositions from the trawl component of the fishery. Creel fishing is important in the South Minch and increasingly operates across similar areas to the trawl fishery. For this reason the assessment is performed using combined length compositions from these fisheries.

Data available

An overview of the data provided and used by the WG is shown in Table 2.1.

Commercial catch and effort data

Official catch statistics (landings) reported to ICES are shown in Table 3.5.2 (see North Minch report, Section 3.5). These relate to the whole of VIa of which the South Minch is a part. Landings for FU 12 provided through national laboratories are presented in Table 3.6.1, broken down by country and by gear type. Landings from this fishery are predominantly reported from Scotland, with low levels reported from the rest of the UK in the mid-1990s, and low levels more recently reported for Ireland. Total international reported landings in 2012 were 3889 tonnes, consisting of 3147 tonnes landed by trawlers and 742 tonnes landed by Scottish creel vessels. These estimates for total landings show a reduction from the high values in 2006 to 2008 to landings more typical of the late 1980s. The high landings of 2006–2008 are thought to have arisen through a combination of good recruitment in the mid-2000s recruiting to the fished population, increased catching opportunities and to the introduction of the "buyers and sellers" regulations in the UK in 2006 which have increased the reliability of landings information. Landings from creel vessels have remained stable at around 800 tonnes in the last ten years. Reported effort by all Scottish trawlers has shown a decreasing trend since 2003 (Figure 3.6.1) but in 2012 the effort increased by 16% and a large portion of this was applied in the first semester (see "The fishery in 2012" section above). Recently there was some concern about the method used to store effort data at the Marine Scotland Science internal database. This is related with how the effort is split by statistical rectangle when vessels fish over a wide area. This is more likely to affect North Sea than west coast FUs. However, given that a new effort data extraction became available from another database held in Edinburgh which is thought to be more reliable, these new data is being presented in Figure 3.6.1. Therefore, the effort and lpue time-series range (2000–2012) does not match with the more extensive year range available for landings. The new effort data does not change the lpue perception for the South Minch when compared with the data presented last year in the same period.

Sex ratio in the South Minch shows some variation but males consistently make the largest contribution to the annual landings (59% males by number and 69% males by weight in 2012) (Figure 3.6.2). This occurs because males are available throughout the year while females on the other hand are mainly taken in the summer when they emerge after egg hatching.

Discarding of undersized and unwanted *Nephrops* occurs in this fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 2000. Discarding rates in this FU have varied considerably over the last five years. The discard rate decreased from 25% to 8% in the 2008–2010 period (Table 3.6.5). This pattern is consistent with what was observed in the other FUs in Division VIa. The mean sizes in the length compositions of smaller individuals (<35 mm CL) increased in the last four years and may have contributed to the decrease in discard rate. Other factors related with market prices for *Nephrops* may also contribute for this trend. Studies (Charuau *et al*., 1982; Sangster *et al*., 1997; Wileman *et al*., 1999) suggest that some *Nephrops* survive the discarding process, an estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard survival rate for creel caught *Nephrops* have been shown to be high (WKNEPH, 2013) and a value of 100 % is used. The discard rate adjusted to account for some survival was estimated by taking a three year average 2010–2012 and amounts to 7%.According to the agreed benchmark protocol this 'dead discard' value is used in the provision of landings options for 2014.

Length compositions

Length compositions of landings and discards are obtained during monthly market sampling and quarterly on-board observer sampling respectively. Quarterly landings and discards-at-length data were available from Scotland and these sampling levels are shown in Table 3.5.4 (see North Minch report, Section 3.5). Length compositions for the creel fishery are available for landings only since the small numbers of discards survive well and are not considered to be removed from the population. Although assessments based on detailed catch analysis are not currently possible, examination of length compositions can provide a preliminary indication of exploitation effects.

Figure 3.6.3 shows a series of annual length–frequency distributions for the period 1990 to 2012. Catch (removals) length compositions are shown for each sex along with the mean size for both. Examination of the tails of the distributions above 35 mm (the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) shows some evidence of reductions in relative numbers of larger animals. This parameter might be expected to reduce in size if overexploitation were taking place. The mean sizes in the length compositions of smaller individuals (<35 mm CL) has increased consistently (Figure 3.6.1) indicating low recruitment in the last four years (Table 3.6.2). The mean weight in the landings (Figure 3.5.6; see North Minch report, Section 3.5; Table 3.6.5) shows a marked increase in the last three years. This has a strong effect in the catch forecast and therefore it was considered more appropriate to use a full time average, from 1999 (first year with creel and trawl length distributions combined) until 2012. This is further discussed under "quality of assessment and forecast".

InterCatch

Scottish data for 2012 were successfully uploaded into InterCatch prior the 2013 WG meeting according with the deadline proposed. Uploaded data was worked up in InterCatch to generate 2012 raised international length–frequency distributions. Data exploration in InterCatch has previously shown that outputs of raised data were very close to those generated by the previous method applied internally with differences being <0.1%. As such, InterCatch length–frequency outputs have been used in the stock assessment since 2012.

Natural mortality, maturity-at-size and other biological parameters

Biological parameter values are included in the stock annex.

Research vessel data

Underwater TV surveys using a stratified random approach are available for this stock since 1995. Underwater television surveys of *Nephrops* burrow number and distribution reduces the problems associated with traditional trawl surveys that arise from variability in burrow emergence of *Nephrops*. TV surveys are targeted at known areas of mud, sandy mud and muddy sand in which *Nephrops* construct burrows. South Minch VMS data linked to landings suggest no major differences between areas fished and the mud sediment (Figure 3.6.6). Consequently, the approach followed is different from that used for North Minch and the sediment area is used to raise the abundance estimate in South Minch. This issue is discussed further under quality of assessment. The numbers of valid stations used in the final analysis in each year are shown in Table 3.6.4. On average, 35 stations have been considered valid each year, and then raised to a stock area of 5072 km^2.). In 2012, 38 valid stations were used in the survey final analysis (Table 3.6.4).

Data analyses

Exploratory analyses of survey data

Full details of the UWTV approach can be found in the stock annex and the report of (WKNEPH) in 2009 (ICES, 2009). A reworking of the UWTV survey abundance-series for Division VIa was presented to the *Nephrops* benchmark workshop (WKNEPH) in 2009 (ICES, 2009) and further details of the technical changes to the camera can be found in the report of that workshop. The revised abundance estimates for FU 12 from 1999 onwards were presented for the first time at WGCSE 2009 and are slightly higher than the previous values due to the field of view being smaller than previously calculated.

Table 3.6.3 shows the basic analysis for the three most recent TV surveys conducted in FU 12. The table includes estimates of abundance and variability in each of the strata adopted in the stratified random approach. Results in 2012 show a much lower abundance in the sandy mud strata of the ground (0.27 in 2012 vs. 0.59 burrows/m^2 in 2010–2011). This is due to a decrease in the traditional high density area in the inshore area of the ground, between the southwest of the Isle of Skye and the Ardnamurchan peninsula. Densities are generally lower in the western parts of the area towards the Outer Hebrides (Figure 3.6.4). From the work presented at the 2012 SGNEPS meeting (ICES, 2012) it was decided by the group that a CV (relative standard error) of <20% was an acceptable precision level for UWTV survey estimates of abundance. CVs for the three most recent TV surveys (Table 3.6.3) are lower than the precision level agreed but higher than those estimates for FU 11 and FU 13. This is related to the high variance associated with the sandy mud strata and is further discussed in Section 3.6.10 (quality of assessment and forecast). Table 3.6.4 and Figure 3.6.5 show the time-series estimated abundance for the TV surveys, with 95% confidence intervals on annual estimates. The review of the use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009; ICES, 2013). A number of potential biases were highlighted including those due to edge effects, species burrow misidentification and burrow occupancy. The cumulative relative to absolute conversion factor estimated for FU 12 was 1.32 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 32%.

FU	Area	Edge effect	detection rate	species identification	Occupancy	Cumulative absolute conversion factor
12	South Minch	1.37	0.85	1.1	1	1.32

Final assessment

The underwater TV survey is presented as the best available information on the South Minch (FU 12) *Nephrops* stock. This survey provides a fishery-independent estimate of *Nephrops* abundance. The details of the 2012 survey are shown in Table 3.6.3 and compared with the 2010 and 2011 outcomes. At present it is not possible to extract any length or age structure information from the survey and therefore it only provides information on abundance over the area of the survey. The 2012 TV survey abundance estimate (919 million) has decreased by 53% compared to 2011 and is now the lowest point in the time series below the $B_{trigger}$ (2007 estimate).

The TV survey results reported here do not cover the sea loch areas adjacent to the main South Minch grounds and should therefore be considered underestimates of the overall abundance. The sea lochs support an unknown but significant part of both the trawl and creel fishery. This issue is discussed further under quality of assessment.

3.6.6 Historic stock trends

The TV survey estimates of abundance for *Nephrops* in the South Minch show that the population has fluctuated without obvious trend over the period of the survey (Figure 3.6.5). The recently observed abundance of 919 million individuals represents a 53% decline in relation to 2011. The bias adjusted abundance estimates from 1999–2012 are shown in Table 3.6.5. This table also shows the estimated harvest ratios over this period. The current harvest ratio has increased in relation to 2011 to 15.8%. It is likely that prior to 2006, the harvest ratios are underestimates of the actual harvest ratios due to under-reported landings.

3.6.7 MSY considerations

A number of potential F_{MSY} proxies are obtained from the per-recruit analysis for *Nephrops* and these are discussed further in Section 2 of this report. The analysis assumes the same input biological parameters as used at the benchmark meeting in 2009, and a recent exploitation pattern and discards ogive for trawl and creel caught *Nephrops* generated in 2010 for the years 2008–2009. The complete range of the per-recruit F_{MSY} proxies is given in the table below and the process for choosing an appropriate F_{MSY} proxy is described in Section 2. Note that all F_{MSY} proxy harvest rate values remain preliminary and may be modified following further data exploration and analysis.

For this FU, the absolute density observed in the UWTV survey-series is intermediate (average of just over 0.42 m^{-2}) suggesting the stock has moderate productivity. In addition, the fishery in this area has been in existence since the 1960s and the population has been studied numerous times (Afonso-Dias, 1998; Howard and Hall, 1983). Historical harvest ratios in this FU have been variable but generally around the $F_{35\%SpR}$.. **The WG concluded that combined sex $F_{35\%SpR}$ is an appropriate F_{proxy} for South Minch FU 12 *Nephrops*.** This is slightly below F_{MAX} in males and is predicted to result in about 27% SPR for males; in excess of the 20% considered precautionary lower bound outlined in Section 2.

		F_{BAR}(20–40 mm)				SPR (%)		
		F_{MULT}	M	F	HR (%)	M	F	T
$F_{0.1}$	M	0.22	0.13	0.06	7.8	40.9	60.8	48.5
	F	0.44	0.27	0.12	13.8	23.8	43.7	31.4
	T	0.25	0.15	0.07	8.7	37.4	57.7	45.2
F_{MAX}	M	0.42	0.25	0.12	13.3	24.8	44.8	32.5
	F	1.1	0.67	0.31	26.8	9.9	23.6	15.2
	T	0.54	0.33	0.15	16.1	19.8	38.7	27.1
$F_{35\%SpR}$	M	0.28	0.17	0.08	9.6	34.5	54.9	42.3
	F	0.64	0.39	0.18	18.3	16.9	34.8	23.8
	T	0.38	0.23	0.11	12.3	27.0	47.3	34.8

3.6.8 Landings forecasts

A landings prediction for 2014 was made for the South Minch (FU12) using the approach agreed at the Benchmark Workshop and outlined in Section 2. These predictions were made on the basis of the 2012 UWTV survey and will be updated in October on the basis of the 2013 survey for the provision of advice.

The text table below shows landings predictions at various harvest ratios, including a selection of those equivalent to the per-recruit reference points discussed in Section 2 of this report. The harvest ratio in 2012 is calculated by using input parameters agreed at WKNEPH (ICES 2009). Inputs to the catch options table are the mean weight in landings (1999–2012), the average dead discard rate (2010–2012) and the cumulative relative to absolute conversion factor for this FU. The landings prediction for 2014 at the F_{MSY} proxy harvest ratio for the South Minch (i.e. 12.3%) is 2785 tonnes. The UWTV abundance has fallen below the $B_{trigger}$ and so the harvest rate is reduced (UWTV 2012 abundance/MSY $B_{trigger}$ * F_{MSY}) to 11.1% with predicted landings of 2514 tonnes. The inputs to the landings forecast were as follows:

Survey Abundance (2012) = 919 million

Mean weight in landings (1999–2012) = 26.45 g

Dead discard rate (2010–2012) = 7.0%

Harvest ratio F (2012) = 15.8%

F_{MSY} = 12.3%

F_{MSY} (B_{trig}) = (UWTV 2012 abundance/MSY $B_{trigger}$ * F_{MSY}) = 11.1%

Cumulative relative to absolute conversion factor = 1.32

	Harvest rate	Survey Index (adjusted)	Implied fishery	
			Retained number	Landings (tonnes)
F_{MSY} (B_{trig})*	11.1%	919	95	2514
F_{MSY} = $F_{35\%SpR(T)}$	12.3%	919	105	2785
$F_{0.1(T)}$	8.7%	919	74	1970
F_{2012}	15.8%	919	135	3578
$F_{MAX (T)}$	16.1%	919	138	3646

***B trigger rule applies under MSY approach**

$F_{0.1(T)}$: Harvest ratio equivalent to fishing at a level associated with 10% of the slope at the origin on the combined sex YPR curve.

$F_{35\%SPR(T)}$: Harvest ratio equivalent to fishing at a rate which results in combined SPR equal to 35% of the unfished level.

$F_{MAX\ (T)}$: Harvest ratio equivalent to fishing at a rate which maximises the combined YPR.

A discussion of F_{MSY} reference points for *Nephrops* is provided in Section 2.

3.6.9 Biological reference points

Precautionary approach biological reference points have not been determined for *Nephrops* stocks. The $B_{trigger}$ point for this FU (bias adjusted lowest observed UWTV abundance) is calculated as 1016 million individuals.

3.6.10 Quality of assessment and forecast

The length and sex composition of the landings data is considered to be well sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in this fishery since 1990, and is considered to represent the trawl fishery adequately. Since 2010 this assessment combined trawl and creel length compositions. The creel fishery accounts for over 20% of the landings and increasingly operates over similar areas to trawling. The creel fishery exhibits a length composition composed of larger animals.

There are concerns over the accuracy of historical landings and effort data prior to 2006 when Buyers and Sellers legislation was introduced and the reliability began to improve. Because of this the final assessment adopted is independent of official statistics. Harvest ratios since 2006 are also considered more reliable due to more accurate landings data reported under new legislation. Incorporation of creel length compositions has also improved estimates of harvest ratios. Effort data from year 2000 extracted from another database was presented to the WG for the first time in 2012. This new effort data is considered to be more accurate and improved the estimates of lpue although it did not change its interpretation compared with what was presented in previous years.

Underwater TV surveys have been conducted for this stock every year since 1995. The number of valid stations in the survey has remained relatively stable throughout the time period. The UWTV-FU12 is targeted at known areas of mud, sandy mud and muddy sand within the South Minch. The variance of density estimates in the South Minch is relatively high, particularly in the sandy mud strata (e.g. 77% of total variance in 2011) which result in large confidence intervals and a greater uncertainty on the abundance estimates. This makes it difficult to determine which population changes are significant. There is a need to explore options to implement further stratification for the South Minch survey area. There is a gap of 18 months between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is impossible to test and is probably rarely the case. The effect of this assumption on realised harvest rates has not been investigated.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. A three year average (2010–2012) of discard rate (adjusted to account for some survival of discarded animals) has been used in the calculation of catch options. The observed discard rate in the last three years is lower than in previous years. This is discussed in Section 3.6.5 under "commercial catch and effort data". The cumulative relative to absolute conversion factor estimates for FU 12 are largely based on expert opinion (See stock annex). The precision of these bias corrections cannot yet be characterised. The method to derive landings for the catch options is sensitive to the input dead discard rate and mean weights in landings and this introduces uncertainties in the catch forecasts. Precision estimates are needed for these forecast inputs.

The overall area of the ground is estimated from the available BGS contoured sediment data and at present is considered to be a minimum estimate. Work is underway to improve the area estimation although the problem is less severe than in the North Minch. VMS data, recently made available and linked to landings (from queries of the Scottish FIN database) suggest no major differences between areas fished and the mud sediment maps. Figure 3.6.6 overlays the British Geological Survey based sediment distributions on the VMS based activity of >15 m trawlers. On the one hand there is some evidence of *Nephrops* fishing activity outside the contoured areas, but on the other hand, some of the sediment areas are apparently not fished. Two other factors however, are likely to increase the estimate of ground area available for *Nephrops* and *Nephrops* directed fishing. Firstly, the inclusion of vessels smaller than 15 m would likely increase the fished area in some of the inshore locations and secondly, it is known that most of the sea lochs have areas of mud substrate and are typically fished by creel boats. In recent years, limited TV surveys have taken place in some of the sea lochs and attempts are being made to utilise these data to improve estimates of mud area and *Nephrops* abundance in the South Minch.

3.6.11 Status of the stock

The UWTV survey indicates that the population declined from a record high in 2004 to a low point in 2007 (defined later as the $B_{trigger}$) but has increased to a level significantly above this again in 2010. In 2012 the abundance decreased markedly to 919 million individuals (53%) which is the record low of the time-series and below the $B_{trigger}$. The increasing mean sizes in the length compositions of catches (of individuals <35 mm CL) in the last four years indicates the recruitment in this stock has been low and the mean size (and weight) of individuals is increasing. This has led to lower discard rates compared with the values observed in the mid-2000s. The calculated harvest ratio in 2012 (dead removals/TV abundance) is above the values associated with high long-term yield and low risk depletion and the abundance has fallen below $B_{trigger}$.

3.6.12 Management considerations

The ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level. Management at the Functional Unit level could provide controls to ensure effort and catch were in line with resources available.

Creel fishing takes place in this area but overall effort in terms of creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the South Minch and STECF continues to estimate that discards of whiting and haddock are high in VIa generally. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod under the Scottish Conservation Credits scheme and the West of Scotland emergency measures (Council Reg. (EU) 43/2009) include the implementation of larger meshed square meshed panels (120 mm).

The implementation of buyers and sellers legislation in the UK in 2006 has improved the reliability of fishery statistics but the transition period was accompanied in some cases by large changes in landings which produce significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has built up, use of fishery catch and effort data in the assessment process should be avoided.

3.6.13 References

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Table 3.6.1. *Nephrops*, South Minch (FU12), Nominal Landings of *Nephrops*, 1981–2012, as officially reported.

YEAR	UK SCOTLAND				OTHER UK	IRELAND	TOTAL
	Nephrops trawl	Other trawl	Creel	Subtotal			
1981	2965	254	432	3651	0	0	3651
1982	2925	207	420	3552	0	0	3552
1983	2595	361	456	3412	0	0	3412
1984	3228	478	594	4300	0	0	4300
1985	3096	424	488	4008	0	0	4008
1986	2694	288	502	3484	0	0	3484
1987	2927	418	546	3891	0	0	3891
1988	3544	364	555	4463	10	0	4473
1989	3846	338	561	4745	0	0	4745
1990	3732	262	436	4430	0	0	4430
1991	3597	341	503	4441	1	0	4442
1992	3479	208	549	4236	1	0	4237
1993	3608	193	649	4450	5	0	4455
1994	3743	265	404	4412	3	0	4415
1995	3442	716	508	4666	14	0	4680
1996	3107	419	468	3994	1	0	3995
1997	3519	331	492	4342	3	1	4345
1998	2851	340	538	3729	0	0	3730
1999	3165	359	513	4037	0	14	4051
2000	2939	312	699	3950	0	2	3952
2001	2823	393	767	3983	0	9	3992
2002	2234	315	742	3291	0	14	3305
2003	2812	203	858	3873	0	6	3879
2004	2865	104	880	3849	0	19	3868
2005	2810	46	953	3809	1	31	3841
2006	3569	19	922	4510	9	35	4554
2007	4436	8	958	5402	19	30	5451
2008	4432	5	895	5332	2	13	5347
2009	3347	20	900	4267	4	11	4282
2010	2801	13	889	3703	16	6	3725
2011	2878	6	783	3667	23	9	3699
2012*	3102	20	742	3864	19	6	3889

*** provisional NA = not available.**

Table 3.6.2. *Nephrops*, South Minch (FU 12): Mean sizes (CL mm) above and below 35 mm of male and female *Nephrops* in Scottish catches and landings, 1981–2012.

	Catches		Landings			
	< 35 mm CL		< 35 mm CL		> 35 mm CL	
Year	Males	Females	Males	Females	Males	Females
1981	28.2	26.4	29.6	27.5	41.5	38.0
1982	27.8	27.1	28.7	28.8	41.7	41.3
1983	28.6	26.5	29.3	27.6	39.5	37.6
1984	27.9	26.3	28.4	27.0	39.8	38.0
1985	27.9	27.5	28.6	28.5	40.0	37.6
1986	28.4	27.9	29.3	28.9	39.5	37.3
1987	28.3	26.6	29.2	28.1	39.8	37.6
1988	29.3	27.7	30.4	29.7	39.5	38.6
1989	28.6	28.1	29.8	29.4	39.5	38.4
1990	28.0	27.5	29.3	29.0	39.4	38.5
1991	29.4	27.5	29.9	27.9	39.0	38.5
1992	29.6	28.6	31.0	29.8	39.5	38.0
1993	29.0	27.8	30.0	28.5	39.5	38.0
1994	29.8	28.0	30.8	29.2	39.3	38.1
1995	29.5	28.2	30.0	28.4	39.4	38.0
1996	28.9	28.5	30.4	29.8	39.9	38.1
1997	29.3	28.7	30.6	29.6	39.8	37.8
1998	28.6	27.6	30.4	28.7	39.1	38.0
1999	28.6	27.7	30.0	29.5	39.4	38.3
2000	28.9	28.3	30.9	30.0	39.7	38.5
2001	27.7	27.3	29.7	28.8	39.6	38.1
2002	29.1	27.8	30.4	29.0	39.5	38.8
2003	29.0	28.1	30.4	29.5	39.8	38.4
2004	28.8	28.1	30.1	29.8	39.5	38.8
2005	28.1	27.8	30.4	29.5	39.8	38.6
2006	29.2	28.0	30.5	28.8	39.5	38.1
2007	29.7	28.2	29.9	28.2	40.0	38.3
2008	28.6	27.5	29.4	28.5	39.6	38.1
2009	28.9	27.9	29.9	28.7	40.8	38.8
2010	29.4	28.7	30.1	29.0	41.9	39.6
2011	29.5	29.4	30.5	30.2	41.6	39.9
2012*	29.9	29.2	30.7	30.5	41.2	38.9

*** Provisional NA = not available.**

Table 3.6.3. ***Nephrops*** **South Minch (FU12). Results by stratum of the 2010–2012 TV surveys. Note that stratification was based on a series of sediment strata (M – Mud, SM – Sandy mud, MS – Muddy sand).**

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance	Survey Precision Level (RSE)
2010 TV Survey								
M	303	5	0.512	0.255	118	4682	0.024	
SM	2741	13	0.615	0.251	1278	144966	0.753	
MS	2028	16	0.443	0.167	680	42875	0.223	
Total	5072	34			2076	192523	1	0.152
2011 TV Survey								
M	303	3	0.707	0.476	162	14572	0.055	
SM	2741	16	0.564	0.431	1170	202305	0.766	
MS	2028	17	0.399	0.195	613	47094	0.178	
Total	5072	36			1945	263971	1	0.190
2012 TV Survey								
M	303	5	0.29	0.029	67	525	0.035	
SM	2741	17	0.275	0.022	570	9638	0.646	
MS	2028	16	0.184	0.019	282	4755	0.319	
Total	5072	38			919	14918	1	0.087

Table 3.6.4. ***Nephrops*****, South Minch (FU 12): Results of the 1995–2012 TV surveys. (values adjusted for bias).**

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1995	33	0.30	1152	251
1996	21	0.38	1473	530
1997	36	0.28	1086	185
1998	38	0.38	1452	232
1999	37	0.28	1086	260
2000	41	0.48	1854	348
2001	47	0.53	2037	459
2002	31	0.49	1899	567
2003	25	0.56	2157	756
2004	38	0.67	2558	473
2005	33	0.57	2208	740
2006	36	0.48	1845	598
2007	39	0.26	1016	155
2008	33	0.42	1608	415
2009	25	0.40	1542	634
2010	34	0.54	2076	665
2011	36	0.51	1945	779
2012	38	0.24	919	185

Table 3.6.5. ***Nephrops*****, South Minch (FU 12): Adjusted TV survey abundance, landings, discard rate proportion by number) and estimated harvest rate.**

Year	Landings in number (millions)	Discards in number (millions)	Removals in number (millions)**	Adjusted Survey (millions)	Harvest Ratio*	Landings (tonnes)	Discard (tonnes)	Discard rate	Dead discard rate	Mean weight in landings (g)
1999	154	28	178	1086	16.4	4051	196	15.4	12.0	25.14
2000	140	32	168	1854	9.0	3952	275	18.7	14.7	27.3
2001	160	62	215	2037	10.6	3992	562	27.9	22.5	23.79
2002	119	25	142	1899	7.5	3305	239	17.6	13.8	26.83
2003	139	38	167	2157	7.7	3879	380	21.3	16.9	27.86
2004	138	43	173	2558	6.8	3868	443	23.8	19.0	27.37
2005	135	49	173	2208	7.8	3841	447	26.5	21.2	28.11
2006	174	29	196	1845	10.6	4554	320	14.3	11.1	26.24
2007	227	65	277	1016	27.2	5451	896	22.4	17.8	23.95
2008	224	74	279	1608	17.3	5347	605	24.7	19.8	23.84
2009	179	25	199	1542	12.9	4282	215	12.5	9.6	23.79
2010	142	12	153	2076	7.4	3725	127	7.7	5.9	25.79
2011	118	11	126	1945	6.5	3699	92	8.2	6.3	31.10
2012	133	16	145	919	15.8	3889	145	10.8	8.3	29.17
Average***									7%	26.45

***harvest rates previous to 2006 are unreliable.**

**** Removals numbers take the dead discard rate into account.**

***** Dead discard average: 2010–2012; Mean weight in landings average: 1999–2012.**

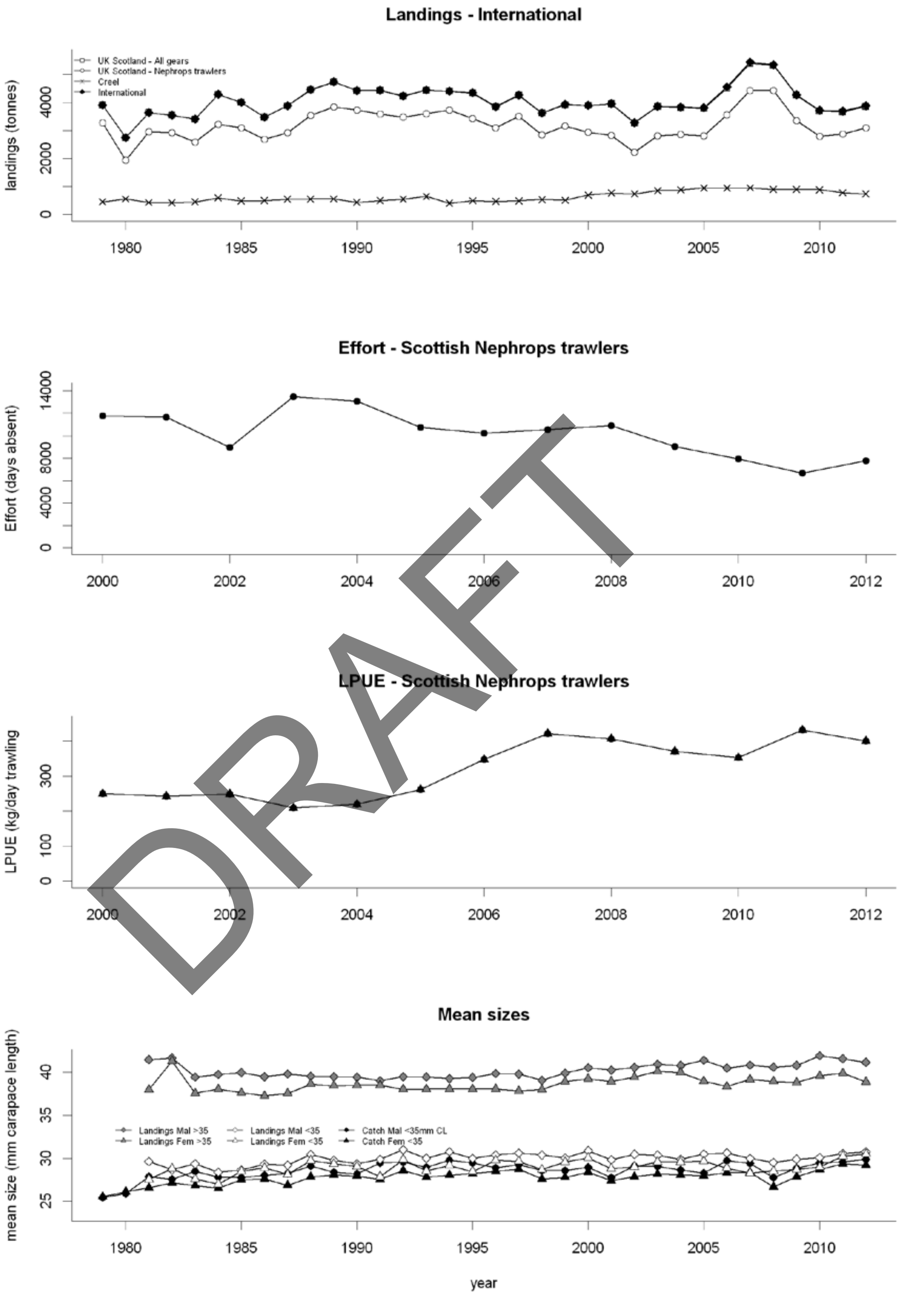
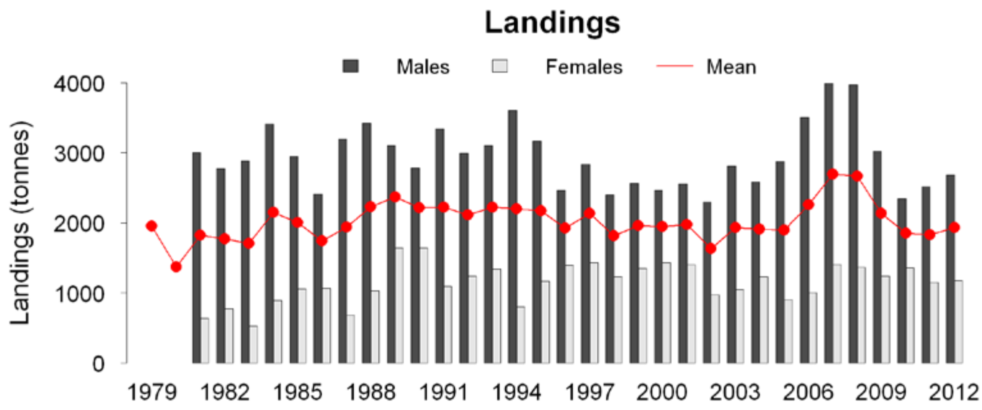


Figure 3.6.1. ***Nephrops,*** **South Minch (FU12). Long-term landings, effort, lpue and mean sizes. The interpretation of the lpue series is likely to be affected by the introduction of the "buyers and sellers" regulations in 2006.**



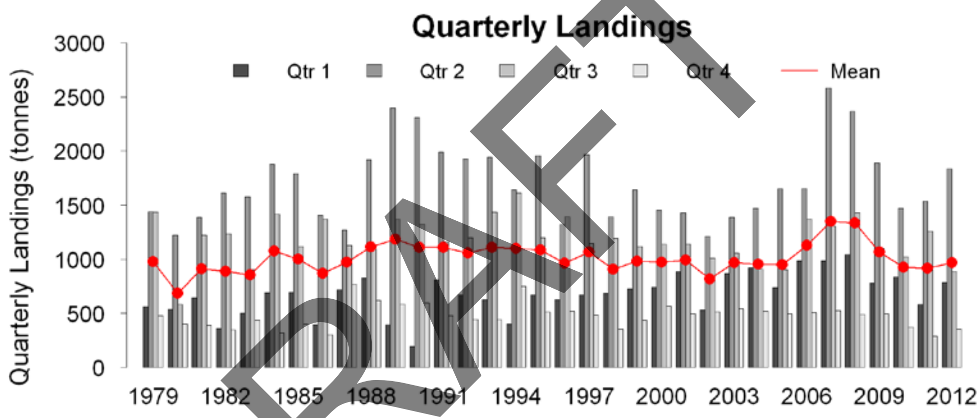


Figure 3.6.2. ***Nephrops,*** **South Minch (FU12). Landings by sex and quarter from Scottish trawlers.**

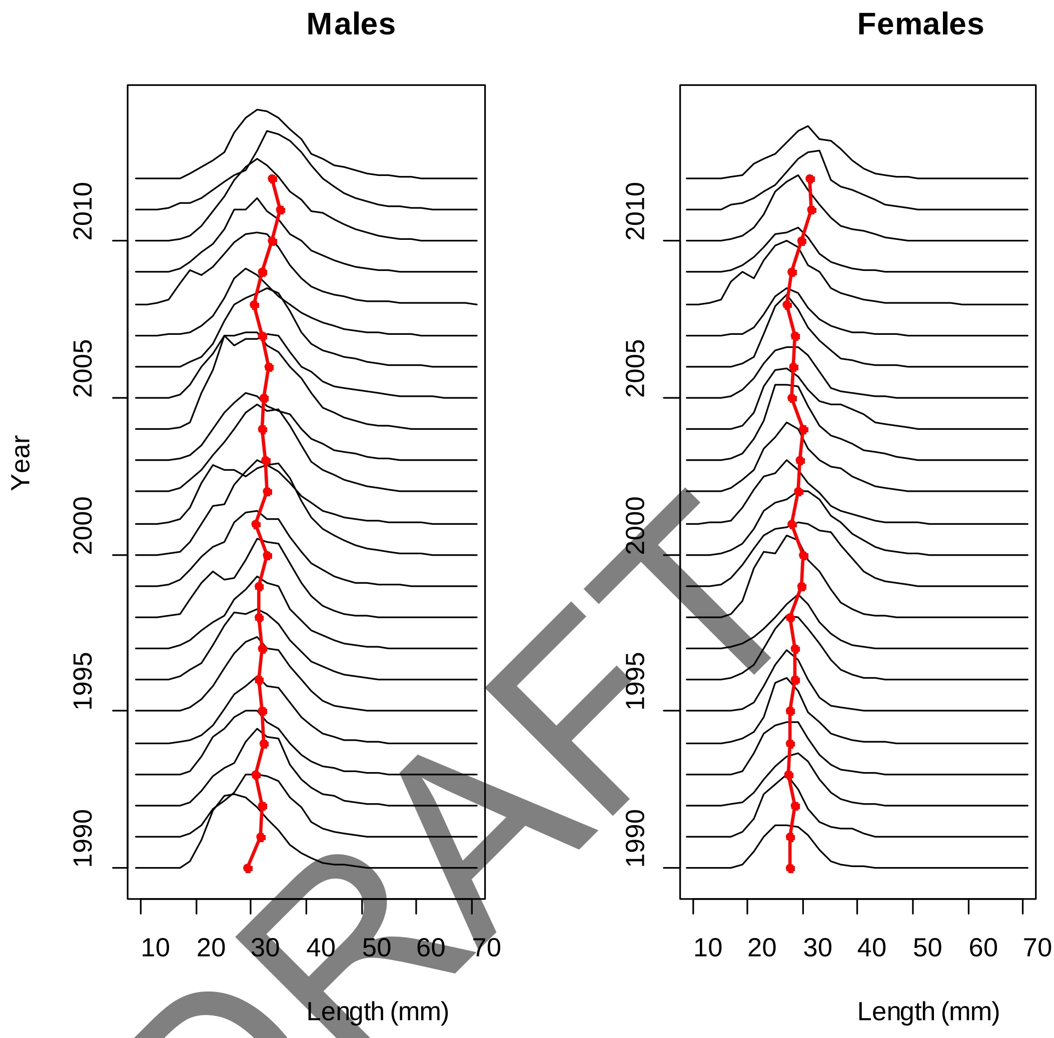


Figure 3.6.3. ***Nephrops*****. South Minch (FU12). Catch length–frequency distribution and mean sizes (red line) for *Nephrops* in the South Minch, 1990–2012.**

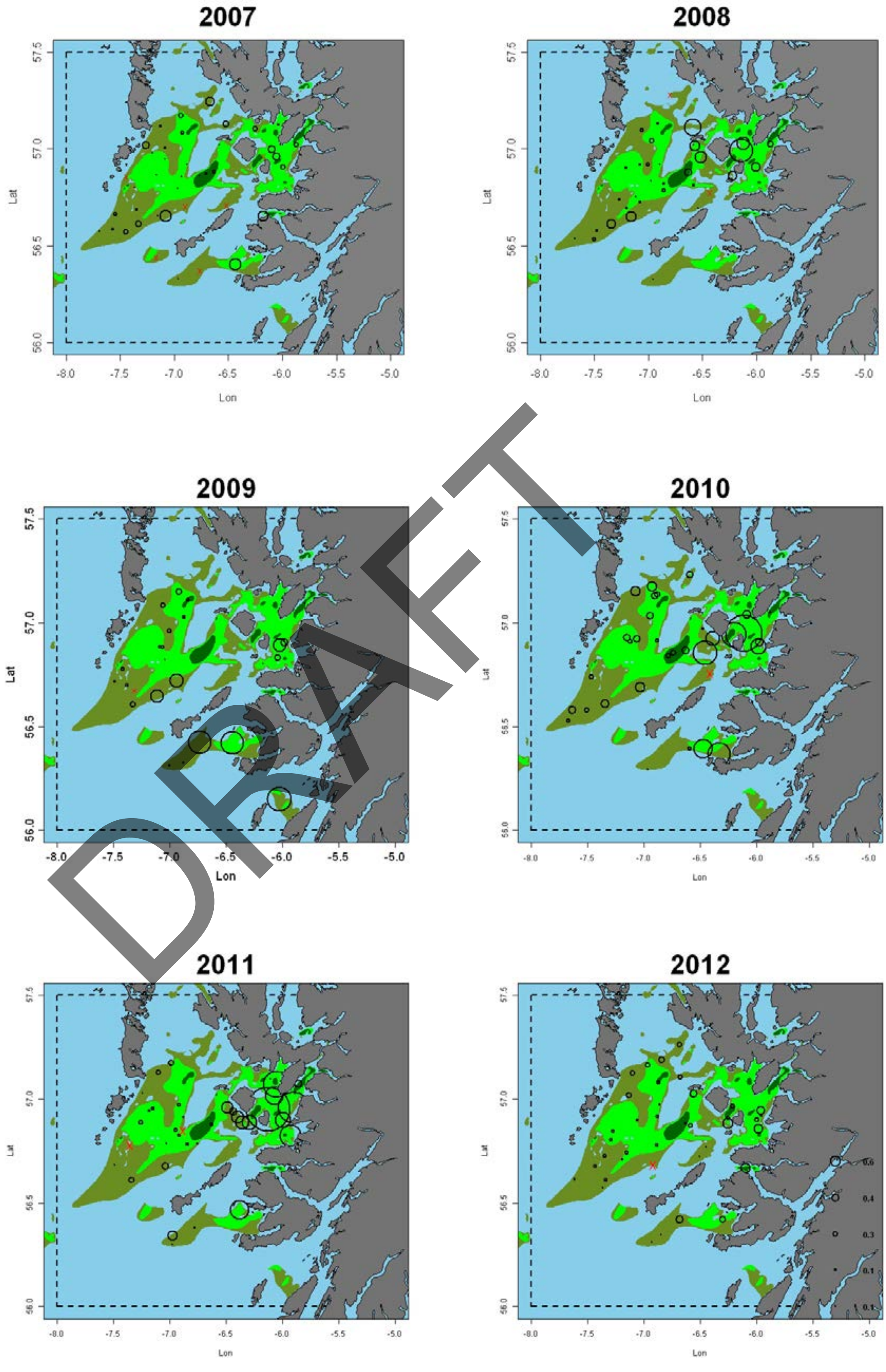


Figure 3.6.4. ***Nephrops*, South Minch (FU12), TV survey station distribution and relative density (burrows/m²), 2007–2012. Shaded green and brown areas represent areas of suitable sediment for *Nephrops*. Bubbles in this figure are all scaled the same. Red crosses represent zero observations.**

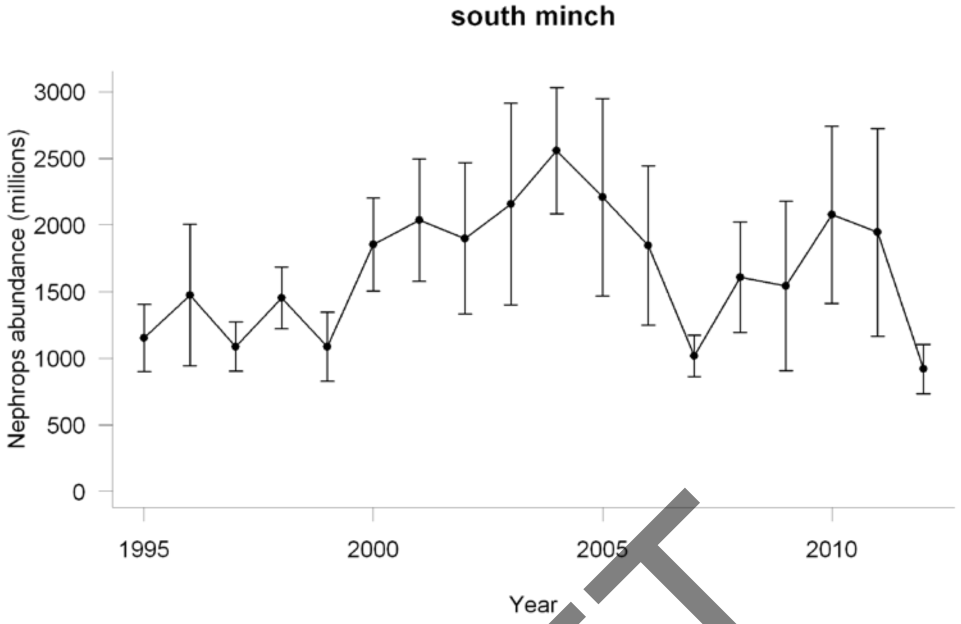


Figure 3.6.5. ***Nephrops*, South Minch (FU12), Time-series of revised TV survey abundance estimate (adjusted for bias), with 95% confidence intervals, 1995–2012.**

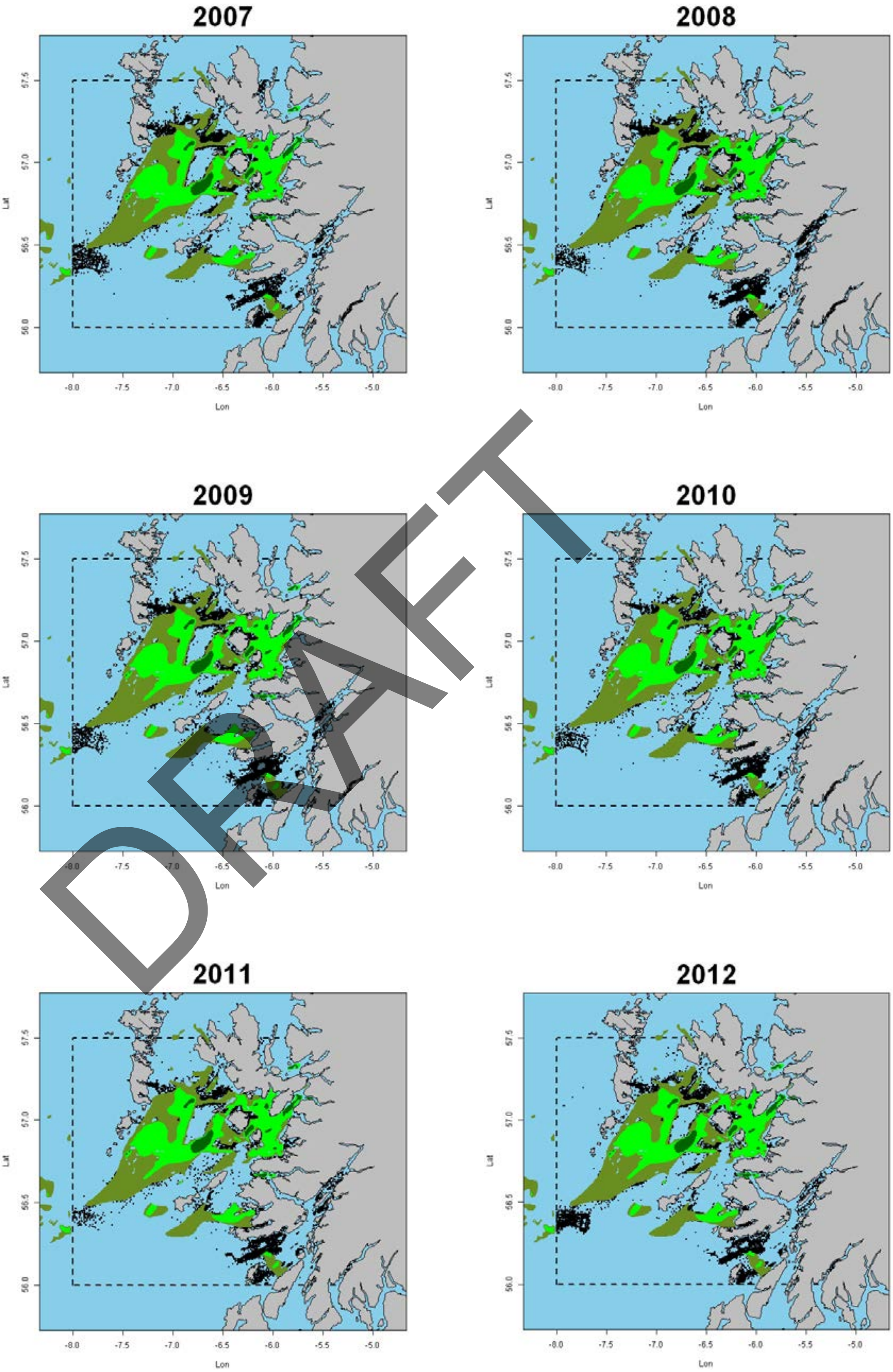


Figure 3.6.6. ***Nephrops*, South Minch (FU12), comparison of area of *Nephrops* ground defined by BGS sediment distribution (green shaded overlay) and by distribution of VMS pings (shown by black dots, underlay) recorded from *Nephrops* trawlers >15 m length for 2007–2012. VMS data filtered to exclude vessel speeds >4.5 knots.**

3.7 Clyde, FU13

Type of assessment in 2013

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG (WKNEPH, 2009, WKNEPH, 2013) and described in Section 2.

3.7.1 Ecosystem aspects

The Clyde FU comprises two distinct patches in the Firth of Clyde and the Sound of Jura, to the east and west of the Mull of Kintyre respectively. The hydrography of the two subareas differs with the Sound of Jura characterised by stronger tidal currents and the Firth of Clyde exhibiting features of a lower energy environment with a shallow entrance sill. Owing to its burrowing behaviour, the distribution of *Nephrops* is restricted to areas of mud, sandy mud and muddy sand. Within the two patches these substrates are distributed according to prevailing hydrographic and bathymetric conditions. The available area of suitable sediment is smaller in the Sound of Jura, occupying only the deepest parts of the Sound, while in the Firth of Clyde these sediments predominate. Figure 3.7.7 shows the distribution of sediment in the area.

3.7.2 The fishery in 2012

Information on developments in the fishery was provided by Marine Scotland staff including fishery officers and scientists sampling in the ports and on board vessels; some comments were also received from industry representatives.

The fishery in 2012 has been described as good with relatively high market prices and fairly stable fuel prices. The number of vessels fishing in the Clyde in 2012 was approximately 50 over ten meters vessels and 89 under 10 meters vessels. The resident fleet is composed of 14 vessels from Tarbert, ten vessels from Campbeltown four vessels from Carradale that operate predominantly *Nephrops* trawl and approximately 25 under 10 meters vessels working *Nephrops* creels. Fleet is made up of vessels from 5 metres to 24 metres with power up to 585 kw. The fleet has remained fairly static in size over the last few years. All vessels use 80 mm codends with 120 mm minimum square mesh panels, in accordance with west coast emergency measures conditions (Council Reg. (EU) 43/2009). The most significant landings came from the main Clyde landing ports of Troon, Girvan, Largs on the East side of the Clyde and Campbeltown, Tarbert, and Carradale on the west side of the Clyde. Almost all of the Clyde *Nephrops* fleet are day trippers.

A small number of boats did move to the North Minch and South Minch in the spring of 2012. There was a larger than usual fleet of Northern Irish vessels fishing in the Clyde from the early spring until effort controls were set in during the autumn (see the fishery topic in North Minch and South Minch report sections). These vessels mainly fished in the grounds south of Arran across to Ailsa Craig. Northern Ireland boats are reported to land more tails than local fleets.

Mobile gear is banned in the Inshore Clyde from Friday night to Sunday night as are vessels greater than 21 m in length. A number of creel boats operate in the Clyde, most of them with two crew members and operating around 1000 creels. Creeling activity now takes place quite widely in the northern parts of the Firth operating on some of the same grounds but often taking place during the weekend trawling ban.

Only about a third of creelers operated throughout the year, the rest prosecuted a summer fishery.

During the weekends, some of the larger boats fish in the Sound of Jura. There has been reports of good fishing in Sound of Jura however, the price of fuel means that it is not always worth the trip up for a weekend.

3.7.3 ICES advice for 2012 and 2013

ICES advice applicable to 2012

"Following the ICES MSY framework implies the harvest ratio for the Firth of Clyde subarea to be reduced to less than 16.4%, resulting in landings of less than 4000 t in 2012. Following the transition scheme towards the ICES MSY framework implies the harvest ratio for the Firth of Clyde should be reduced to less than 17.1% (0.6 x harvest ratio(F_{2010}) + 0.4 x harvest ratio(F_{MSY})), resulting in landings of less than 4200 t in 2012.

Following the ICES MSY framework implies the harvest ratio for the Sound of Jura subarea to be less than 14.5%, resulting in landings of less than 900 t in 2012. For the Sound of Jura no transition is needed as the harvest rate is already below the F_{MSY} proxy."

ICES advice applicable to 2013

"Following the ICES MSY framework implies the harvest ratio for the Firth of Clyde subarea to be reduced to less than 16.4%, resulting in landings of no more than 5600 t in 2013. As the current harvest ratio for 2011 (17.6%) is very close to the F_{MSY} proxy (16.4%), no transition stage was calculated.

Following the ICES MSY framework implies the harvest ratio for the Sound of Jura subarea to be less than 14.5%, resulting in landings of less than 800 t in 2013. For the Sound of Jura no transition is needed as the harvest rate is already below the F_{MSY} proxy."

3.7.4 Management applicable to 2012 and 2013

Management is at the ICES subarea level as described at the beginning of Section 3.5 (North Minch report). In 2012, ICES again reiterated its advice that *Nephrops* stocks should be managed at the FU level.

3.7.5 Assessment

Conclusions of the Review of the 2012 assessment

"Overall, the assessment appears appropriate for the basis of management advice. The assessment results are consistent with previous updates, and the stock appears to be stable or increasing in biomass. Harvest ratios have been reduced in recent years with transition to the F_{MSY} approach. Discarding has been historically high in FU13 and reasons for the decline in discards in 2010–2011 were not well documented. Similar to the 2011 RG conclusions, the RG notes that the catch forecast depends on the recent low discard rates continuing."

The RG report contained some technical comments and attempts have been made to address these.

Approach in 2013

The assessment in 2013 is based on a combination of examining trends in fishery indicators and underwater TV using an extensive dataseries for the Firth of Clyde component of FU 13. Following the 2010 assessment approach, the more limited UWTV data available for the Sound of Jura subarea was also used for providing advice. The assessment of *Nephrops* through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG and described in Section 2.

The provision of advice in 2013 develops the process defined by the benchmark WG described in Section 2 and attempts to incorporate decisions taken at WKFRAME for the provision of MSY advice by ICES in 2010. The approach was developed based on intersessional work carried out by participants of the benchmark and involving collaboration between WGNSSK and WGCSE.

Previous TV based assessments have derived predicted landings by applying a harvest rate approach to populations described in terms of length compositions from the trawl component of the fishery. In recent years, creel fishing has become more important in the Firth of Clyde and operates across similar areas to the trawl fishery. For this reason the assessment is performed using combined length compositions.

Data available

An overview of the data provided and used by the WG is shown in Table 2.1.

Commercial catch and effort data

Official catch statistics (landings) reported to ICES are shown in Table and Figure 3.7.1. These relate to the whole of VIa of which the Clyde FU is a part. Landings statistics for FU 13 provided through national laboratories are presented in Table 3.7.1, broken down by country and by gear type. Landings from this fishery are predominantly reported from Scotland, although the remainder of the UK also contributed about 13% in 2012; landings from Northern Ireland form the main part of this. Total international reported landings remained at the same level in 2012 and consisted of 6390 tonnes landed by trawlers and 194 tonnes landed by Scottish creel vessels. Creel landings have increased in the most recent years but remain at a low level compared to other gears and to the creel fisheries elsewhere on the west coast of Scotland.

Table 3.7.2 shows the split in landings between the two subareas comprising FU13. Most of the landings are presently taken from the Firth of Clyde subarea with less than 1% from the Sound of Jura. Earlier in the time-series the Sound of Jura contributed as much a 20%. The decline has occurred through a progressive reduction in fishing activity in the area. The main reason for this is probably related to the size composition in the population which is characterised by small *Nephrops* (Bailey and Chapman, 1983) whereas the market has increasingly favoured larger whole animals.

The introduction of the "buyers and sellers" regulation in the UK in 2006 has led to increased reliability in the reported landings. Uncertainties over the accuracy of the effort data emerged recently. In an attempt to improve reliability, effort from 2009 was extracted and expressed in terms of days fished (since the logbook field for hours is not mandatory). Preliminary examination of the effort series showed a marked discontinuity around 1995 with a large and inexplicable drop in effort in days. Further investigation revealed that at this time the process of recording days as effort in the split rectangle region of the Clyde changed. Given that a new effort data extraction became available from another database held in Edinburgh which is thought to be more reliable; these new data are presented in Figure 3.7.1. Therefore, the effort and lpue time-series range (2000–2012) does not match with the more extensive year range available for landings. Examination of these new effort series shows a fairly stable trend in effort since year 2000 whilst lpue has increased following the landings increase in the last decade.

Sex ratio in the Firth of Clyde shows some variation but males make the largest contribution to the annual landings (52% males by number and 64% males by weight in 2012). This occurs because males are available throughout the year and the fishery takes place in all quarters (Figure 3.7.2). Females on the other hand are mainly taken in the summer when they emerge after egg hatching.

Discarding of undersized and unwanted *Nephrops* occurs in the Firth of Clyde fishery, and quarterly discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 2000. Discarding rates have been high in this FU and average around 31% by number in this FU since 1999. From 2010, discard rates were estimated to be substantially lower than the average (Table 3.7.8). This pattern is consistent with what was observed in the other FUs in Division VIa. An increase in mean size of smaller (<35 mm) animals (Figure 3.7.1) from 2009 may have contributed to the decrease in discard rate. Other factors related with market prices for *Nephrops* may also contribute for this trend. Studies (Charuau *et al*., 1982; Sangster *et al*., 1997; Wileman *et al*., 1999) suggest that some *Nephrops* survive the discarding process, an estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard survival rate for creel caught *Nephrops* have been shown to be high (WKNEPH, 2013) and a value of 100% is used. The discard rate adjusted to account for some survival was estimated to be 20% (taking a three year average 2010–2012) and according to the agreed benchmark protocol this value is used in the provision of landings options for 2014.

Length compositions

Length compositions of landings and discards are obtained during monthly market sampling and quarterly on-board observer sampling respectively. Quarterly landings and discards-at-length data were available for the Firth of Clyde from Scotland and these sampling levels are shown in Table 3.5.4 (see North Minch report, Section 3.5). Length compositions for the creel fishery are of landings only since the small numbers of discards survive well and are not considered to be removed from the population. Sampling of length compositions in the Sound of Jura is more infrequent and only limited data are available. In 2011 and 2012 no samples were collected from Sound of Jura.

The long steaming to reach this ground combined with fuel costs make fishing trips to this component of FU 13 more infrequent despite anecdotal evidence of a good fishery in the area. Sampling at Clyde ports is opportunistic and two trips are usually carried out per quarter which means it is not always possible to sample Sound of Jura landings. It is envisaged that an agreement between Marine Scotland Science and Marine Scotland Compliance may improve *Nephrops* sampling at Sound of Jura through the collaboration of Compliance Officers in collecting scientific data at ports.

Although assessments based on detailed catch analysis are not presently considered advisable, examination of length compositions can provide a preliminary indication of exploitation effects. Figure 3.7.3 shows a series of annual Firth of Clyde length–frequency distributions for the period 1979 to 2012. Catch (removals) length compositions are shown for each sex along with the mean size for both. In both sexes the mean sizes have been fairly stable over time, although in 2010–2012 there is some evidence of a slight increase in the mean lengths. Examination of the tails of the distributions above 35 mm (the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) shows no evidence of reductions in relative numbers of larger animals. The observation of relatively stable length compositions is further confirmed in the series of mean sizes of larger *Nephrops* (>35 mm) in the landings shown in Figure 3.7.1 and Table 3.7.3. This parameter might be expected to reduce in size if overexploitation were taking place but there is no evidence of this. The mean size of smaller animals (<35 mm) in the catch (and landings) is also stable through time, although in 2010 the mean size of individuals in the landings and catch below 35 mm has increased slightly, which is in line with what was described in the previous years about trawlers tubing larger *Nephrops* and not landing as many small tails as before. Mean weight in the Firth of Clyde landings shows a small increase in relation to 2011 (Figure 3.5.6; see North Minch report, Section 3.5) and Table 3.7.8.

InterCatch

Scottish data for 2012 were successfully uploaded into InterCatch prior the 2013 WG meeting according with the deadline proposed. Uploaded data was worked-up in InterCatch to generate 2012 raised international length–frequency distributions. Data exploration in InterCatch has previously shown that outputs of raised data were very close to those generated by the previous method applied internally with differences being <0.1%. As such, InterCatch length–frequency outputs have been used in the stock assessment since 2012.

Natural mortality, maturity–at–size and other biological parameters

Biological parameter values are included in the stock annex.

Research vessel data

Underwater TV surveys are available for both sub areas since 1995 although the Sound of Jura has been sampled more infrequently. Underwater television surveys of *Nephrops* burrow number and distribution reduces the problems associated with traditional trawl surveys that arise from variability in burrow emergence of *Nephrops*. TV surveys are targeted at known areas of mud, sandy mud and muddy sand in which *Nephrops* construct burrows. Clyde VMS data linked to landings suggest no major differences between areas fished and the mud sediment. In fact, Figure 3.7.7 shows a closer VMS/sediment match in Clyde than South Minch. Therefore, the sediment area is used to raise the abundance estimate in Clyde. This issue is discussed further under quality of assessment.

The UWTV in the Firth of Clyde subarea is carried out using a stratified random approach. The numbers of valid stations used in the final analysis in each year are shown in Table 3.7.4. On average, 38 stations have been considered valid each year and then raised to the estimated ground area available for *Nephrops*; in total 2080 km^2 based on contoured superficial sediment information (British Geological Surveys). In 2012, 37 valid stations were used in the survey final analysis for the Firth of Clyde (Table 3.7.5) and twelve stations for the Sound of Jura (Table 3.7.7).

Data analyses

Exploratory analyses of survey data

Full details of the UWTV approach can be found in the stock annex and the report of (WKNEPH) in 2009 (ICES, 2009). A reworking of the UWTV survey abundance-series for Division VIa was presented to the *Nephrops* benchmark workshop (WKNEPH) in 2009 (ICES, 2009) and further details of the technical changes to the camera can be found in the report of that workshop. The revised abundance estimates for FU 13 from 1999 onwards were presented for the first time at WGCSE 2009 and are slightly higher than the previous values due to the field of view being smaller than previously calculated.

Table 3.7.4 shows the basic analysis for the most recent TV surveys conducted in the Firth of Clyde. The table includes estimates of abundance and variability in each of the strata adopted in the stratified random approach. The areas of all sediment types (mud, muddy sand and sandy mud) in this region are very similar and as such the number of stations surveyed in each sediment type is similar also. Basic analysis for the Sound of Jura is shown in Table 3.7.6. From the work presented at the 2012 SGNEPS meeting (ICES, 2012) it was decided by the group that a CV (relative standard error) of <20% was an acceptable precision level for UWTV survey estimates of abundance. CVs for the three most recent TV surveys in Firth of Clyde and Sound of Jura (Tables 3.7.4 and 3.7.6) are lower than the precision level agreed.

Figure 3.7.4 shows the distribution of stations in recent TV surveys (2007–2012) across FU13 (the two distinct subareas can be clearly seen) with the size of the symbols reflecting the *Nephrops* burrow density. Table 3.7.5 and Figure 3.7.5 show the time-series estimated abundance for the TV surveys in the Firth of Clyde, with 95% confidence intervals on annual estimates. Similar information for the Sound of Jura is shown in Table 3.7.7 and Figure 3.7.6. The most recent survey suggests continued higher density in the south part of the functional unit but lower than in previous years.

The use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009; ICES, 2013). A number of potential biases were highlighted including those due to edge effects, species burrow misidentification and burrow occupancy. The cumulative relative to absolute conversion factor estimated for the Firth of Clyde was 1.19 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 19%. A review of the Sound of Jura biases has not so far been carried out; biases are here assumed to be similar to the Firth of Clyde.

FU	Area	Edge effect	Detection rate	Species identification	Occupancy	Cumulative absolute conversion factor
13	Clyde	1.19	0.75	1.25	1	1.19

Final assessment

The underwater TV surveys are presented as the best available information on the stocks of *Nephrops* in the two subareas of FU13. The surveys provide fishery independent estimates of *Nephrops* abundance. The details of the 2012 Firth of Clyde survey are shown in Table 3.7.4 and compared with the 2010 and 2011 outcomes. The details of the 2012 Sound of Jura survey are shown in Table 3.7.6. At present it is not possible to extract any length or age-structure information from the survey and it therefore only provides information on abundance over the area of the survey. The 2012 TV survey abundance estimate in the Firth of Clyde (1421 million) represents a 34% decrease in abundance compared to 2011. The abundance is in line with the values recorded in the early 2000s. The 2012 TV abundance estimate in the Sound of Jura (371 million) increased 19% compared to the previous 2011 estimate remaining at the same range of values observed in the last decade.

The TV survey results reported here do not cover the sea loch areas adjacent to the main Firth of Clyde area and should therefore be considered underestimates of the overall biomass. This issue is discussed further under quality of assessment.

Historic stock trends

The TV survey estimates of abundance for *Nephrops* in the Firth of Clyde suggest that the population increased until the mid-2000s implying a sustained period of increased recruitment. Following this, abundance has declined and fluctuated around the values previously observed in the early 2000s. The absolute abundance estimates (bias adjusted) from 1999–2012 (the period over which the survey estimates have been revised) is shown in Table 3.7.8. The 2012 absolute stock estimate is 1421 million individuals. Table 3.7.8 also shows the estimated harvest ratios over this period. These range from 12–50% over this period. It is unlikely that prior to 2006, the estimated harvest ratios are representative of actual harvest ratios due to under-reporting of landings.

Results for the Sound Jura are sparse and are associated with large confidence intervals particularly in 2002 and 2006. Table 3.7.9 summarise the absolute abundance estimates of abundance and harvest rates where available. The 2012 stock estimate is 371 million individuals.

3.7.6 MSY considerations

A number of potential F_{MSY} proxies are obtained from the pre-recruit analysis for *Nephrops* and these are discussed further in Section 2 of this report. The analysis assumes the same input biological parameters as used at the benchmark meeting in 2009 and an exploitation and discard ogive for trawl and creel caught *Nephrops* generated in 2010 for the years 2008–2009. The complete range of the pre-recruit F_{MSY} proxies for the Firth of Clyde subarea is given in the table below and the process for choosing an appropriate F_{MSY} proxy is described in Section 2. Note that all F_{MSY} proxy harvest rate values remain preliminary and may be modified following further data exploration and analysis.

For the Firth of Clyde subarea of this FU, the absolute density observed on the UWTV survey is generally high (average of over 0.8 m^{-2} for entire series and around 1.0 m^{-2} for the last five years suggesting the stock has relatively high productivity. In addition, the fishery in this area has been in existence since the 1960s and the population and biological parameters have been studied numerous times (Bailey and Chapman, 1983; Tuck *et al*., 1997; Tuck *et al*., 1999). Historical harvest ratios in this FU have been generally high at or above F_{MAX}.. **An appropriate F_{MSY} proxy is considered therefore to be the total population F_{MAX} which is predicted to deliver an $F_{35\%SpR}$ of about 22% for males;** considered precautionary for this species (See Section 2).

		F_{BAR}(20–40 mm)				SPR (%)		
		F_{MULT}	M	F	HR (%)	M	F	T
$F_{0.1}$	M	0.17	0.15	0.06	8.7	40.2	66.8	49.1
	F	0.43	0.37	0.14	21.1	16.2	40.7	24.4
	T	0.19	0.16	0.06	9.7	36.9	64.0	45.9
F_{MAX}	M	0.27	0.23	0.09	13.6	27.0	54.4	36.2
	F	0.71	0.61	0.24	34.0	8.3	26.5	14.3
	T	0.33	0.28	0.11	16.4	21.9	48.6	30.8
$F_{35\%SpR}$	M	0.21	0.18	0.07	10.7	34.0	61.4	43.1
	F	0.53	0.46	0.18	25.7	12.4	34.6	19.8
	T	0.29	0.25	0.10	14.5	25.1	52.4	34.2

Yield per recruit analysis is not yet available for the Sound of Jura subarea of this FU and so proxies from the Firth of Clyde (shown in the table above) are used. The absolute density observed on the UWTV survey is generally high (average of about 0.9 m^{-2} over the time-series and around 1 m^{-2} over the last five years) suggesting the stock has relatively high productivity. A number of studies have investigated biology and the area is acknowledged as having high abundance for many years. However, the time-series of TV data is more fragmented and sampling is at a relatively low level; confidence intervals are larger. The fishery in this area has been in existence since the 1960s but in recent times has operated at a low level and harvest ratios in this FU have been low. **An appropriate F_{MSY} proxy is considered therefore to be the total population $F_{35\%SpR}$ which is predicted to deliver an $F_{35\%SpR}$ of about 25% for males;** above the level considered precautionary for this species (See Section 2).

3.7.7 Landings forecasts

A landings prediction for 2014 was made for the Firth of Clyde and Sound of Jura subareas of Clyde FU13 using the approach agreed at WKNEPH 2009 and outlined in the Section 2. These predictions were made on the basis of the 2012 UWTV survey and will be updated in October on the basis of the 2013 survey for the provision of advice.

The text table below shows landings predictions at various harvest ratios, including a selection of those equivalent to the pre-recruit reference points discussed in Section 2 of this report. The harvest ratio in 2012 is calculated using input parameters agreed at WKNEPH (ICES 2009). Inputs to the catch options table are the mean weight in landings (2010–2012), the average dead discard rate (2010–2012) and the cumulative relative to absolute conversion factor for this FU. The landings prediction for 2014 at the F_{MSY} proxy harvest ratio considered appropriate for the Firth of Clyde (i.e. 16.4%) is 4099 tonnes.

For the Sound of Jura subarea, the landings prediction for 2014 at the F_{MSY} proxy harvest ratio of 14.5% is 976 tonnes.

The inputs to the landings forecast for the Firth of Clyde and Sound of Jura were as follows: Firth of Clyde:

Survey Abundance (2012) = 1421 million

Mean weight in landings (2010–2012) = 20.78 g

Dead discard rate = 15.3%

Harvest ratio F (2012) = 26.0%

F_{MSY} = 16.4%

Cumulative relative to absolute conversion factor = 1.19

	Harvest rate	Survey Index (adjusted)	Implied fishery	
			Retained number	Landings (tonnes)
$F_{MSY} = F_{MAX\,(T)}$	16.4%	1421	197	4099
$F_{0.1(T)}$	9.7%	1421	117	2425
$F_{35\%SpR(T)}$	14.5%	1421	174	3625
F_{2012}	26.0%	1421	313	6499

Sound of Jura

Survey Abundance (2012) = 371 million

Mean weight in landings in Sound of Jura (2008–2010) = 21.44 g (2008–2010 used as no sampling available in 2012)

Dead discard rate = 15.3%

Harvest ratio F (2012) = 0.8%

F_{MSY} = 14.5%

Cumulative relative to absolute conversion factor = 1.19

	Harvest rate	Survey Index (adjusted)	Implied fishery	
			Retained number	Landings (tonnes)
$F_{MSY} = F_{35\%SpR(T)}$	14.5%	371	46	976
F_{2012}	0.8%	371	2.5	54
$F_{0.1(T)}$	9.7%	371	30	653
$F_{MAX\,(T)}$	16.4%	371	52	1104

$F_{0.1(T)}$: Harvest ratio equivalent to fishing at a level associated with 10% of the slope at the origin on the combined sex YPR curve.

$F_{35\%SPR(T)}$: Harvest ratio equivalent to fishing at a rate which results in combined SPR equal to 35% of the unfished level.

$F_{max\,(T)}$: Harvest ratio equivalent to fishing at a rate which maximises the combined YPR.

A discussion of F_{MSY} reference points for *Nephrops* is provided in Section 2.

3.7.8 Biological reference points

Precautionary approach biological reference points have not been determined for *Nephrops* stocks. The $B_{trigger}$ point for the Firth of Clyde (bias adjusted lowest observed UWTV abundance) is calculated as 579 million individuals. The $B_{trigger}$ point for the Sound of Jura has not been defined but is expected to be below 200 million individuals.

3.7.9 Quality of assessment and forecast

The length and sex composition of the landings data is considered to be well sampled. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in the Firth of Clyde subarea fishery since 1990, and is considered to represent the fishery adequately. Sampling in the Sound of Jura is sparser. There are concerns over the accuracy of historical landings and effort data and because of this the final assessment adopted is independent of official statistics. Harvest ratios since 2006 are also considered more reliable due to more accurate landings data reported under new legislation. Effort data from year 2000 extracted from another database was presented to the WG for the first time in 2012. This new effort data is considered to be more accurate and improved the estimates of lpue.

Underwater TV surveys have been conducted for this stock every year since 1995. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are stable throughout the series and relatively low compared with other FUs in VIa. There has typically been a gap of 18 months between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is rarely the case. The effect of this assumption on realised harvest rates has not been investigated.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. A three year average (2010–2012) of discard rate (adjusted to account for some survival of discarded animals) has been used in the calculation of catch options. The recent observed discard rate shows a decline in the last three years compared to previous years. This is discussed in Section 3.7.5 under "commercial catch and effort data". Firth of Clyde discard rates and F_{MSY} proxy calculations were applied to the Sound of Jura in the absence of estimates for this subarea. The cumulative relative to absolute conversion factor estimates for FU 13 Clyde and Jura component is largely based on expert opinion (See Stock Annex). The precision of these bias corrections cannot yet be characterised. The method to derive landings for the catch options is sensitive to the input dead discard rate and mean weight in landings and this introduces uncertainties in the catch forecasts. Precision estimates are needed for these forecast inputs.

The overall area of the ground is estimated from the available BGS contoured sediment data and at present is considered to be a minimum estimate. VMS data, recently made available and linked to landings (from queries of the Scottish FIN database) suggest no major differences between areas fished and the mud sediment maps. Figure 3.7.7 overlays the British Geological Survey based sediment distributions on the VMS based activity of >15 m trawlers. On the one hand there is some evidence of *Nephrops* fishing activity outside the contoured areas, but also some of the sediment areas are apparently not fished. The inclusion of vessels smaller than 15 m would likely increase the fished area in some of the inshore locations while in the Clyde the non-estimated sea loch areas are relatively small.

3.7.10 Status of the stock

The evidence from the TV survey suggests that the abundance has decreased by 34% in 2012 and is now at a similar level to that observed between 2007 and 2010. The calculated harvest ratio in 2012 (dead removals/TV abundance) is above the values associated with high long-term yield and low risk depletion.

3.7.11 Management considerations

The ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES Division level. Management at the Functional Unit level could provide controls to ensure effort and catch were in line with resources available. In this FU the two subareas imply that additional controls may be required to ensure that the landings taken in each subarea are in line with the landings advice.

Creel fishing takes place in part of this area although the relative scale of the fishery is smaller than in the Minches. Overall effort in terms of creel numbers is not known and measures to control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the Firth of Clyde and STECF estimates that discards of whiting and haddock are generally high in VIa. It is important that efforts are made to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce the discards and unwanted bycatches of cod under the Scottish Conservation credits scheme and west coast emergency measures include the implementation of larger meshed square meshed panels (120 mm). A seasonal closure (early spring) in the southwest part of the Firth of Clyde is in place to protect spawning cod although *Nephrops* vessels are derogated to fish in those parts where mud sediments are distributed.

The implementation of buyers and sellers legislation in the UK in 2006 has improved the reliability of fishery statistics but the transition period was accompanied in some cases by large changes in landings which produce significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has built up, use of fishery catch and effort data in the assessment process should be avoided.

3.7.12 Other *Nephrops* populations within Division VIa

Nephrops fisheries also take place outside the Functional Units in Subdivision VIa, although they represent a low proportion of the reported landings (Table 3.5.3; see North Minch report, Section 3.5). Over the time-series, average landings have been just over 250 t and in recent ten years just over 300 t. An allowance for this activity is required in the final landings advice for 2014. The main areas of activity are the Stanton Bank (to the west of the South Minch) and areas of suitable sediment along the shelf edge and slope to the west of the Hebrides.

3.7.13 Stanton Bank

Underwater TV surveys were not conducted in Stanton Bank.

3.7.14 Shelf edge west of Scotland

Marine Scotland Science has taken the opportunity of using the Scotia deep-water surveys conducted in 2000, 2002 and 2004 to conduct preliminary underwater TV work on the *Nephrops* populations along the shelf edge. These TV runs are carried out during the night (when the vessel is not required for fishing). It is hoped that this can continue as an annual survey.

To date, successful survey runs have been conducted to a depth of 635 m, observing *Nephrops* burrows at a range of locations along the shelf edge and slope. Observed densities have been very low (average 0.04 m^{-2}) compared to shelf stocks on the west coast and in the North Sea (typically 0.2–0.9 m^{-2}), although the animals on the shelf edge are considerably larger than those found on the shelf. Forecasts of landings based on TV surveys were not attempted for this area.

3.7.15 References

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Table 3.7.1. *Nephrops*, Clyde (FU13), Nominal Landings of *Nephrops*, 1981–2012, as officially reported.

YEAR	UK SCOTLAND				OTHER UK	TOTAL**
	Nephrops trawl	Other trawl	Creel	Subtotal		
1981	2498	404	66	2968	0	2968
1982	2373	171	79	2623	0	2623
1983	3890	120	53	4063	14	4077
1984	3069	154	77	3300	10	3310
1985	3921	293	64	4278	7	4285
1986	4074	175	79	4328	13	4341
1987	2859	80	65	3004	3	3007
1988	3507	108	43	3658	7	3665
1989	2577	184	35	2796	16	2812
1990	2732	122	24	2878	34	2912
1991	2845	145	25	3015	23	3038
1992	2532	246	10	2788	17	2805
1993	3199	110	5	3314	28	3342
1994	2503	49	28	2580	49	2629
1995	3767	132	26	3925	64	3989
1996	3880	111	27	4018	42	4060
1997	3486	44	25	3555	63	3618
1998	4539	81	40	4660	183	4843
1999	3475	29	38	3542	210	3752
2000	3143	63	76	3282	137	3419
2001	2889	67	94	3050	132	3182
2002	3074	53	105	3232	151	3383
2003	2954	20	117	3091	80	3171
2004	2659	18	90	2767	258	3025
2005	3166	14	95	3275	148	3423
2006	4446	0	0	4534	244	4778
2007	6129	0	0	6129	366	6495
2008	5382	2	197	5581	416	5997
2009	4305	0	189	4494	283	4777
2010	5050	0	186	5236	465	5701
2011	5672	0	219	5891	540	6431
2012*	5523	4	194	5721	863	6584

*** provisional ** Total also includes Rep. of Ireland**

Table 3.7.2. ***Nephrops*****, Clyde (FU13), Nominal Landings of** ***Nephrops*****, in each of the subareas (Firth of Clyde and Sound of Jura 1981–2012), as officially reported.**

YEAR	UK		
	Firth of Clyde	Sound of Jura	All subareas
1981			2968
1982			2623
1983			4077
1984			3310
1985			4285
1986			4341
1987			3007
1988			3665
1989			2812
1990			2912
1991			3038
1992			2805
1993	2766	576	3342
1994	2094	535	2629
1995	3690	299	3989
1996	3673	387	4060
1997	3132	486	3618
1998	4372	471	4843
1999	3424	328	3752
2000	3230	189	3419
2001	2980	202	3182
2002	3349	34	3383
2003	3153	18	3171
2004	2975	50	3025
2005	3387	36	3423
2006	4717	61	4778
2007	6397	98	6495
2008	5919	78	5997
2009	4686	91	4777
2010	5643	58	5701
2011	6362	69	6431
2012*	6532	52	6584

*** Provisional.**

Table 3.7.3. *Nephrops*, Clyde (FU 13): Firth of Clyde subarea. Mean sizes (CL mm) above and below 35 mm of male and female *Nephrops* in Scottish trawl catches and landings, 1981–2012.

	Catches		Landings			
	< 35 mm CL		< 35 mm CL		> 35 mm CL	
Year	Males	Females	Males	Females	Males	Females
1981	28.4	27.3	30.2	29.3	40.3	39.3
1982	28.2	26.4	29.9	29.0	39.9	40.1
1983	27.9	26.7	29.3	28.5	40.8	39.5
1984	27.0	25.9	28.0	26.8	40.9	39.6
1985	27.1	26.1	28.1	27.2	39.8	39.3
1986	27.1	26.0	27.9	27.1	40.5	39.0
1987	28.5	26.5	29.6	28.3	39.4	40.0
1988	28.1	27.0	30.6	29.5	41.2	40.1
1989	26.9	26.9	30.2	30.0	41.6	39.8
1990	27.4	26.2	30.4	29.5	40.1	39.8
1991	28.6	27.1	29.2	28.2	39.3	40.3
1992	29.6	28.8	30.1	29.2	39.9	41.1
1993	29.6	29.7	31.4	30.9	40.4	39.9
1994	26.4	27.0	29.4	29.4	40.8	39.2
1995	27.2	25.8	28.7	27.6	40.3	39.8
1996	28.8	28.0	30.0	29.1	38.6	40.4
1997	27.9	26.9	30.0	29.2	40.0	40.3
1998	25.9	25.2	28.4	27.9	38.9	39.1
1999	26.5	25.3	28.5	27.3	39.0	39.5
2000	28.3	27.7	29.3	28.6	38.7	39.1
2001	27.4	26.8	29.5	28.7	39.0	39.6
2002	27.5	25.6	28.4	26.4	39.0	39.4
2003	27.2	25.9	29.1	27.9	39.2	38.6
2004	27.1	26.5	28.4	27.6	39.2	39.5
2005	28.0	26.7	29.2	27.9	38.7	38.1
2006	28.7	27.1	29.0	27.3	40.0	38.7
2007	27.0	26.7	29.1	29.2	39.1	38.6
2008	27.2	25.2	28.6	26.6	39.1	38.2
2009	26.9	25.3	29.3	26.4	39.4	39.0
2010	29.0	27.9	29.8	28.7	39.9	38.2
2011	27.9	27.4	29.2	28.5	39.9	38.7
2012*	29.0	28.1	29.9	28.8	39.5	38.5

*** Provisional.**

Table 3.7.4. *Nephrops,* Clyde (FU 13): Firth of Clyde subarea. Results by stratum of the 2010–2012 TV surveys. Note that stratification was based on a series of sediment strata (M – Mud, SM – Sandy mud, MS – Muddy sand).

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance	Survey Precision Level (RSE)
2010 TV survey								
M	717	13	1.106	0.22	666	8712	0.23	
SM	699	15	1.23	0.516	722	16800	0.444	
MS	665	9	0.648	0.251	362	12324	0.326	
Total	2081	37			1750	37836	1	0.092
2011 TV survey								
M	717	13	1.286	0.141	775	5561	0.168	
SM	699	14	1.494	0.233	877	8127	0.246	
MS	665	13	0.918	0.569	513	19325	0.585	
Total	2081	40			2165	33013	1	0.071
2012 TV survey								
M	717	12	0.695	0.063	419	2494	0.137	
SM	699	13	0.987	0.18	579	6744	0.37	
MS	665	11	0.758	0.224	423	8992	0.493	
Total	2081	37			1421	18230	1	0.079

Table 3.7.5. ***Nephrops*****, Clyde (FU 13): Firth of Clyde subarea. Results of the 1995–2012 TV surveys (values adjusted for bias).**

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1995	29	0.33	579	176
1996	38	0.54	935	242
1997	31	0.68	1198	262
1998	38	0.72	1262	213
1999	39	0.53	930	289
2000	40	0.81	1411	246
2001	39	0.85	1486	268
2002	36	0.90	1571	288
2003	37	1.04	1817	292
2004	32	1.13	1970	367
2005	44	1.12	1959	287
2006	43	1.05	1851	257
2007	40	0.71	1233	218
2008	38	1.01	1769	291
2009	39	0.86	1499	210
2010	37	1.00	1750	327
2011	40	1.24	2165	305
2012	37	0.81	1421	227

Table 3.7.6. *Nephrops,* Clyde (FU 13): Sound of Jura subarea. Results by stratum of the 2010–2012 TV surveys. Note that stratification was based on a series of sediment strata.

Stratum	Area (km²)	Number of Stations	Mean burrow density (no./m²)	Observed variance	Abundance (millions)	Stratum variance	Proportion of total variance	Survey Precision Level (RSE)
2010 TV survey								
M	90	2	1.305	<0.01	98	0.2	<0.01	
SM	150	5	1.066	0.039	134	173	0.332	
MS	142	5	1.202	0.086	144	349	0.668	
Total	382	12			376	522	1	0.057
2011 TV survey								
M	90	2	0.76	0.024	57	98	0.052	
SM	150	5	0.948	0.147	120	661	0.352	
MS	142	5	1.13	0.277	135	1118	0.596	
Total	382	12			312	1877	1	0.124
2012 TV survey								
M	90	3	0.91	0.03	69	81	0.062	
SM	150	6	1.13	0.011	142	42	0.031	
MS	142	3	1.337	0.178	160	1197	0.907	
Total	382	12			371	1320	1	0.059

Table 3.7.7. *Nephrops*, Clyde (FU 13): Sound of Jura subarea. Results of the 1995–2012 TV surveys (values adjusted for bias).

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1995	7	0.50	160	58
1996	10	0.53	171	26
1997	no surveys			
1998				
1999				
2000				
2001	13	0.85	272	76
2002	9	1.24	398	167
2003	12	0.81	260	68
2004	no survey			
2005	11	0.94	303	84
2006	10	1.34	430	134
2007	10	0.80	255	58
2008	no survey			
2009	12	0.78	251	68
2010	12	1.17	376	38
2011	12	0.97	312	73
2012	12	1.16	371	61

Table 3.7.8. *Nephrops*, Clyde (FU 13): Firth of Clyde subarea. Adjusted TV survey abundance, landings, discard rate (proportion by number) and estimated harvest rate.

Year	Landings in number (millions)	Discards in number (millions)	Removals in number (millions)**	Adjusted Survey (millions)	Harvest Ratio*	Landings (tonnes)	Discard (tonnes)	Discard rate	Dead discard rate	Mean weight in landings (g)
1999	189	79	267	930	28.7	3424	481	29.6	24.0	16.88
2000	154	43	197	1411	14.0	3230	418	21.8	17.3	19.82
2001	141	71	211	1486	14.2	2980	584	33.5	27.4	19.45
2002	193	47	243	1571	15.4	3349	379	19.4	15.3	16.3
2003	161	130	264	1817	14.5	3153	1209	44.7	37.8	19.16
2004	143	152	284	1970	14.4	2975	1298	51.5	44.4	18.81
2005	179	66	240	1959	12.3	3387	580	26.9	21.6	17.97
2006	234	52	286	1851	15.4	4717	487	18.3	14.3	19.28
2007	323	357	614	1233	49.8	6397	2372	52.5	45.3	19.05
2008	332	192	513	1769	29.0	5919	1329	36.6	30.2	16.42
2009	236	152	382	1499	25.5	4686	1248	39.1	32.5	18.09
2010	236	48	306	1750	17.5	5643	460	16.8	13.1	21.16
2011	326	73	380	2165	17.6	6431	556	18.2	14.3	19.34
2012	300	92	369	1421	26.0	6584	1046	23.4	18.6	21.83
Average 2010-2012									15.33	20.78

*** Harvest rates previous to 2006 are unreliable.**

**** Removals numbers take the dead discard rate into account.**

Table 3.7.9. *Nephrops*, Clyde (FU 13): Sound of Jura subarea. Adjusted TV survey abundance, landings, discard rate (proportion by number) and estimated harvest rate.

Year	Removals in number (millions)	Adjusted Survey (millions)	Harvest ratio	Landings (tonnes)	Discard Rate*	Dead discard Rate*	Mean weight in landings (g)
2005	2.9	303	1.0	36	26.9	21.6	15.47
2006	4.7	430	1.1	61	18.3	14.3	15.05
2007	9.4	255	3.7	98	52.5	45.3	19.02
2008	5.1	NA	NA	78	36.6	30.2	21.60
2009	5.0	251	2.0	91	39.1	32.5	25.58
2010	3.9	376	1.0	58	16.8	13.1	17.13
2011	3.6**	312	1.2	69	18.2	14.3	na
2012	2.3**	371	0.8	52	23.4	18.6	na
Average 2010-2012						15.33	21.44**

*** Discard rates assumed to be the same as in the Firth of Clyde.**

**** Average mean weight in landings and Removals number calculated from years 2008–2010 as there were no samples in 2011 and 2012.**

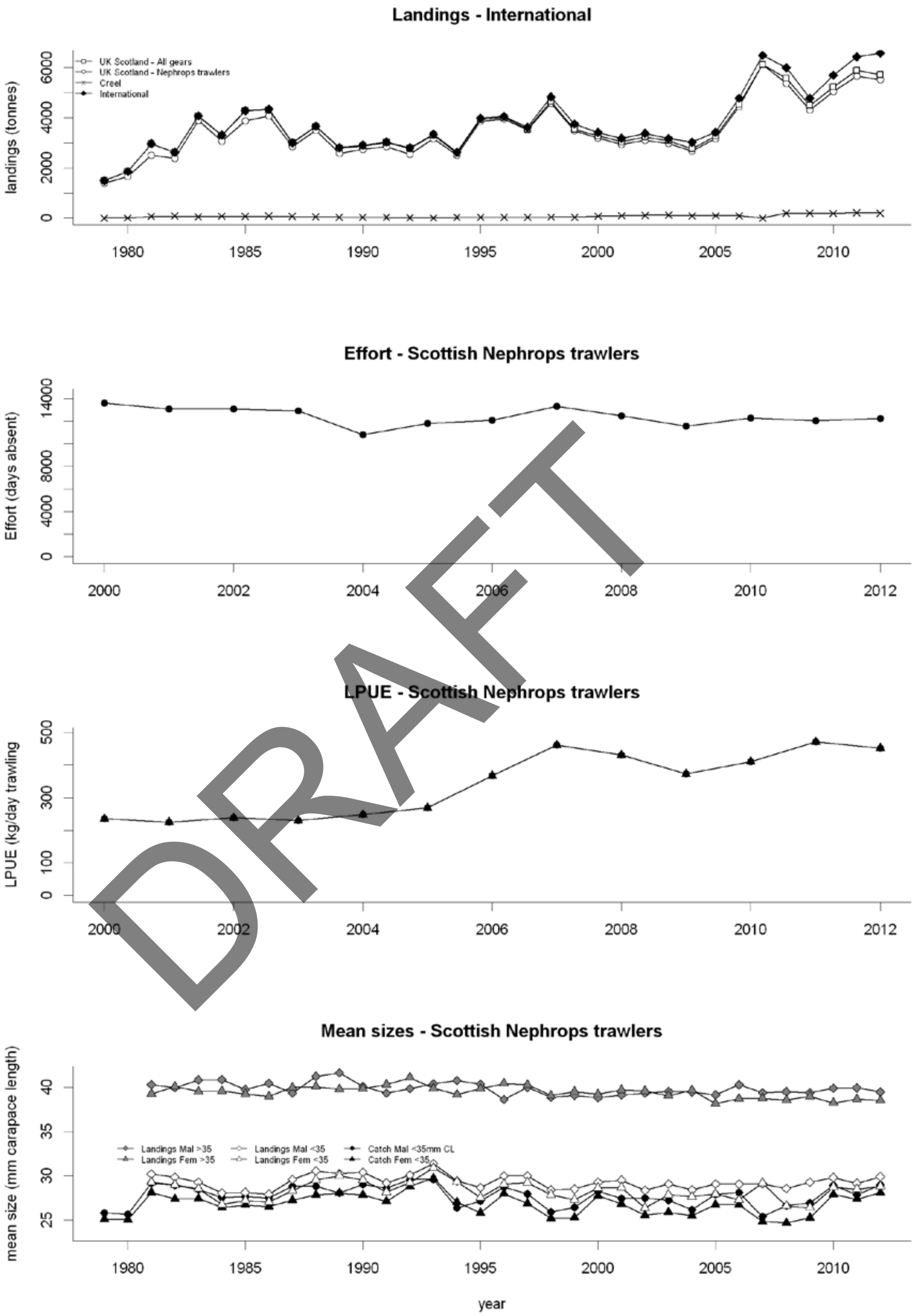
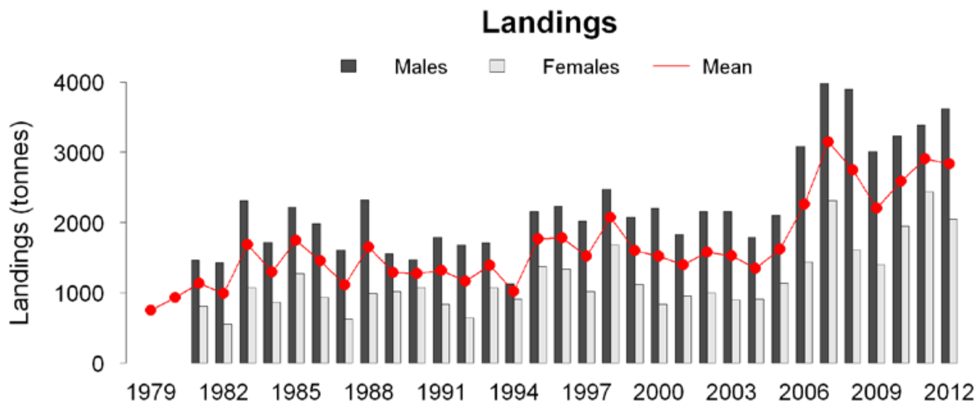


Figure 3.7.1. ***Nephrops*, Clyde (FU13), Firth of Clyde subarea. Long-term landings, effort, lpue and mean sizes. The interpretation of the lpue series is likely to be affected by the introduction of the "buyers and sellers" regulations in 2006.**



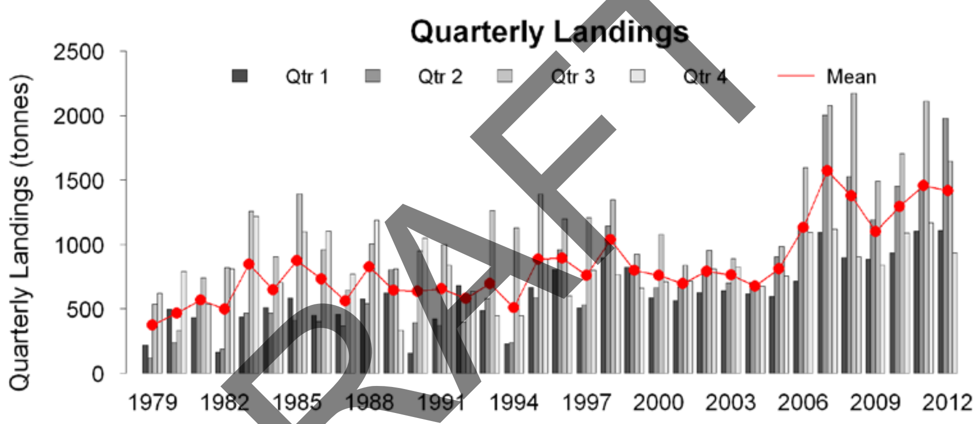


Figure 3.7.2. ***Nephrops*, Clyde (FU13), Firth of Clyde subarea. Landings by quarter and sex from Scottish trawlers.**

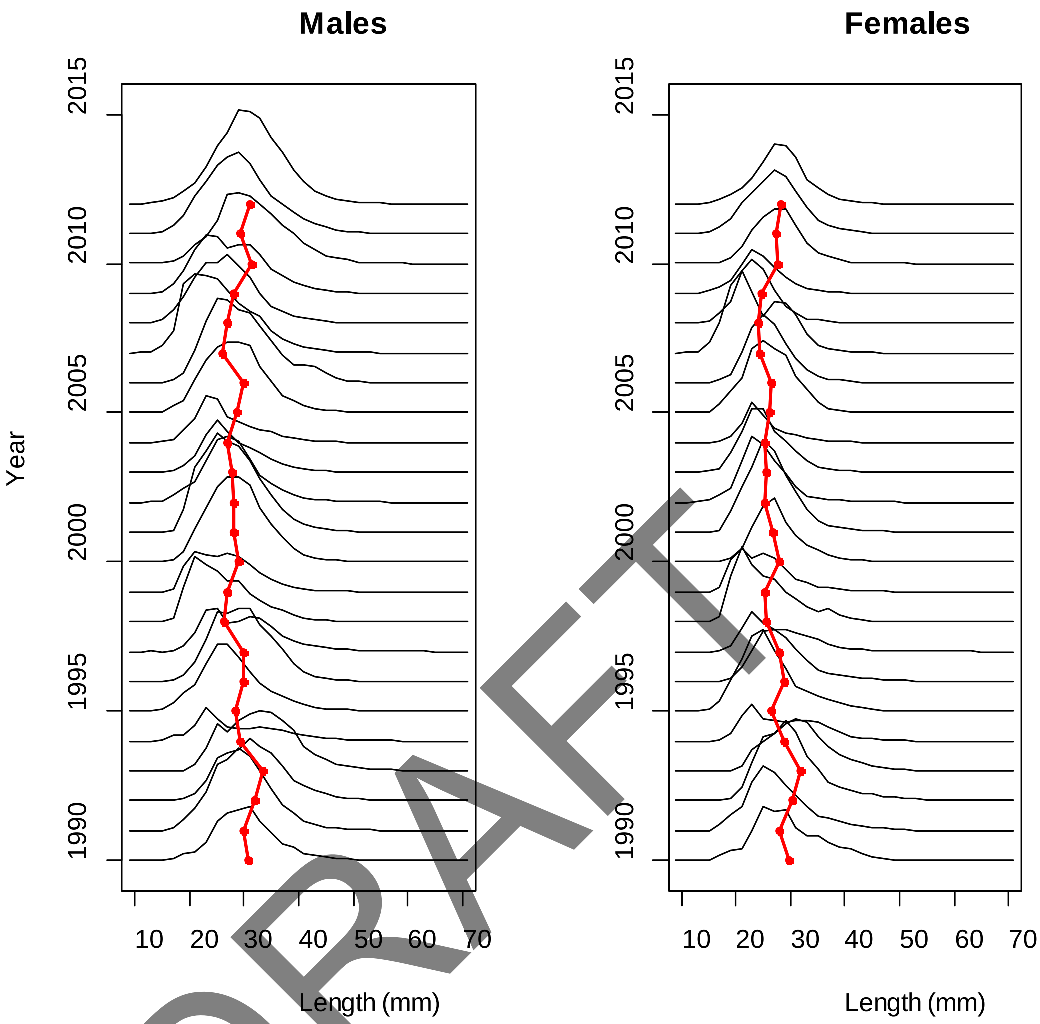


Figure 3.7.3. ***Nephrops*, Clyde (FU13). Catch length–frequency distribution and mean sizes (red line) for *Nephrops* in the Firth of Clyde, 1990–2012.**

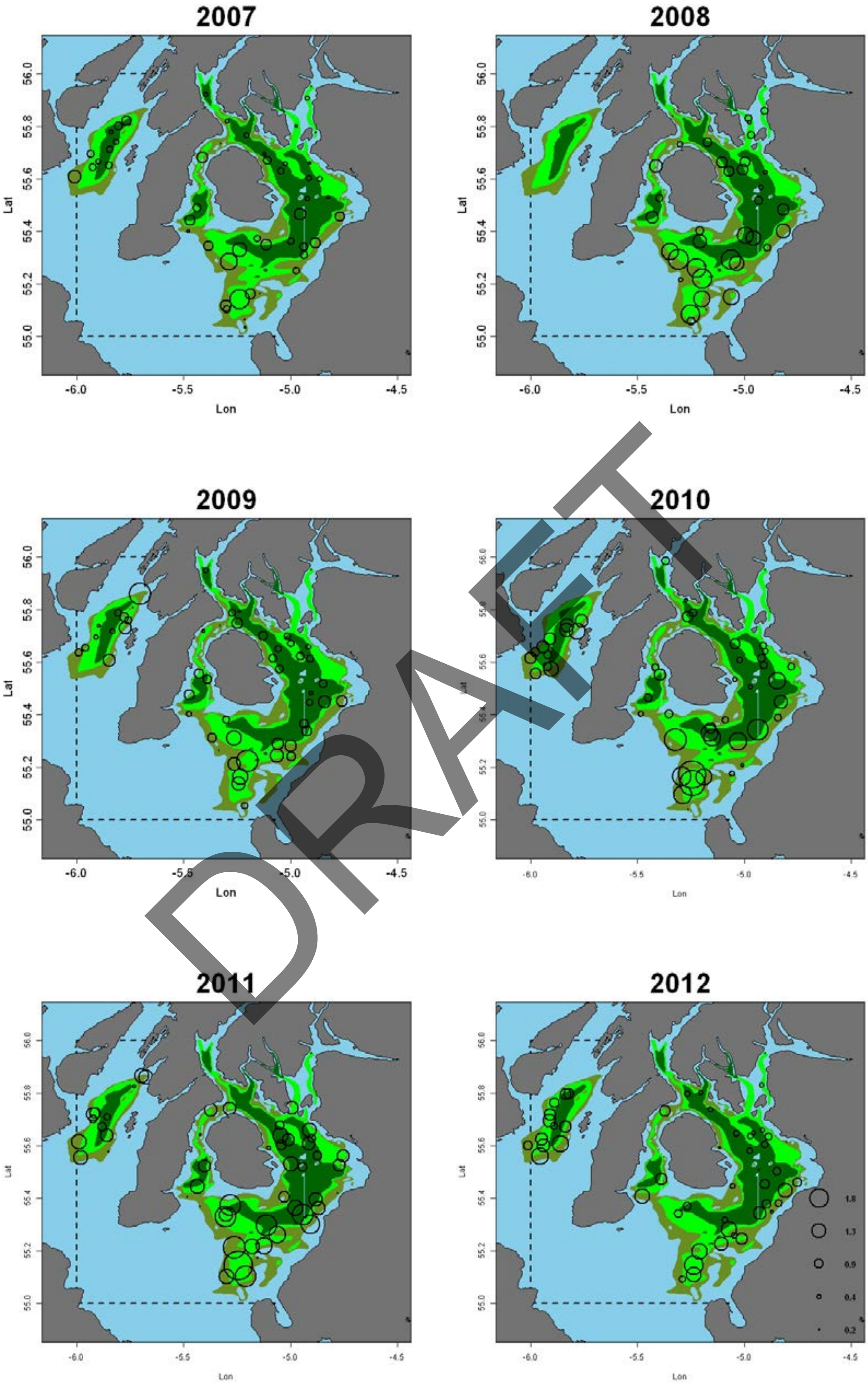


Figure 3.7.4. ***Nephrops*, Clyde (FU13), TV survey station distribution and relative density (burrows/m^2) for Firth of Clyde and Sound of Jura subareas, 2007–2012. Sound of Jura located to the east. Shaded green and brown areas represent areas of suitable sediment for *Nephrops*. Bubbles scaled the same. Red crosses represent zero observations.**

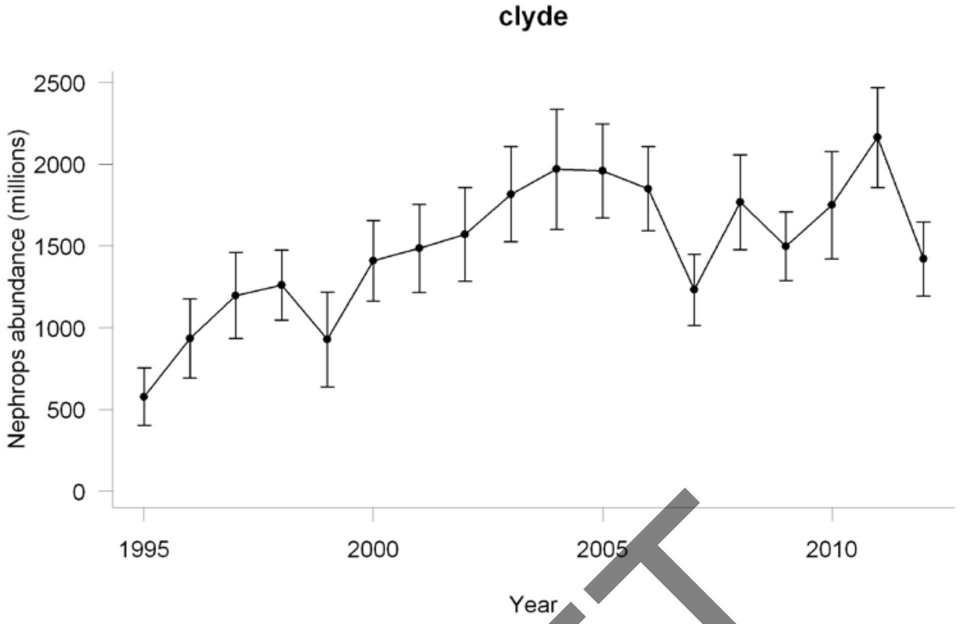


Figure 3.7.5. ***Nephrops*****, Clyde (FU13): Firth of Clyde subarea. Time-series of revised TV survey abundance estimates (adjusted for bias), with 95% confidence intervals, 1995–2012.**

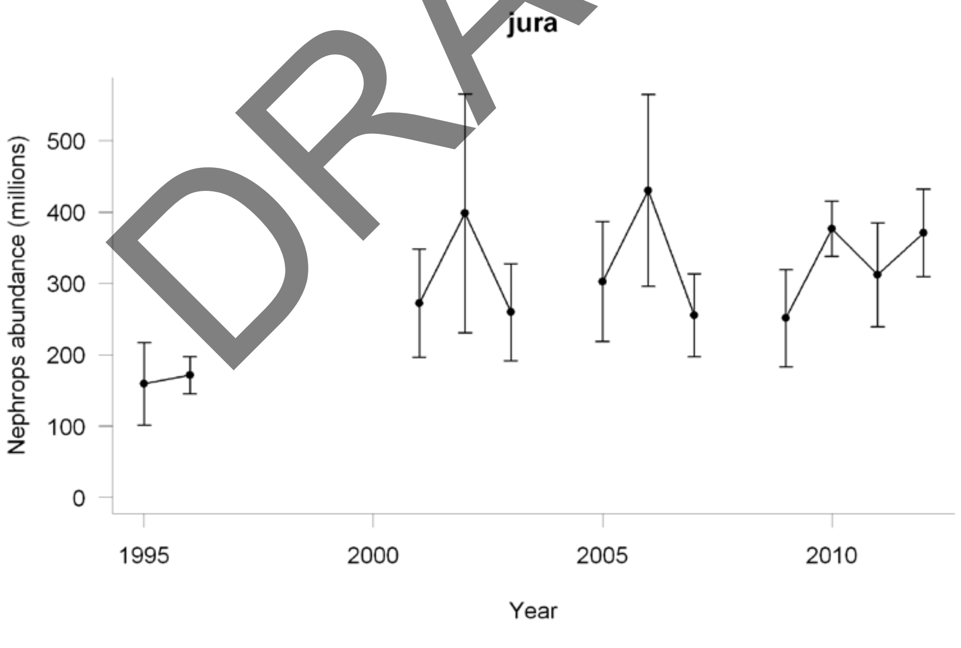


Figure 3.7.6. ***Nephrops*****, Clyde (FU13): Sound of Jura subarea, Time-series of TV survey abundance estimates (adjusted for bias) with 95% confidence intervals, 1995–2012.**

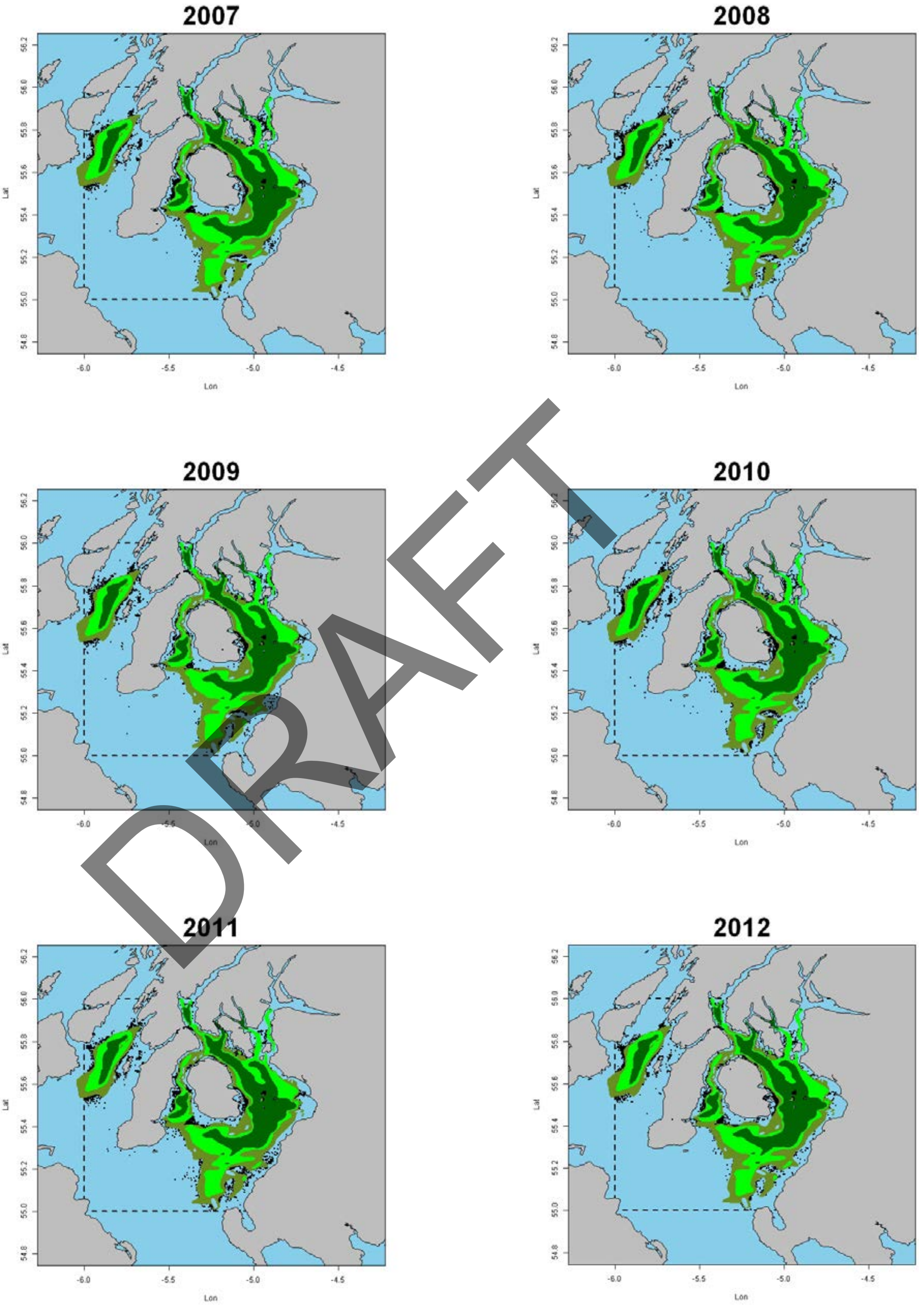


Figure 3.7.7. ***Nephrops*****, Clyde (FU13), comparison of area of** ***Nephrops*** **ground defined by BGS sediment distribution (green shaded overlay) and by distribution of VMS pings (shown by black dots, underlay) recorded from** ***Nephrops*** **trawlers >15 m length for 2007–2012. VMS data filtered to exclude vessel speeds >4.5 knots.**

4.2 Cod in Division VIb

Type of assessment in 2013

No assessment was performed in 2013.

ICES advice applicable in 2013

In 2012, ICES provided biennial advice for 2013 and 2014.

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 70 tonnes.

2012 was the first year that ICES provided quantitative advice for data-limited stocks (see Quality considerations).

No analytical assessment is available for this stock. The main cause of this is lack of data. Therefore, fishing possibilities cannot be projected.

ICES approach to data-limited stocks

For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock.

For this stock, ICES advises that catches should decrease by 20% of the average landings in the three years prior to the most recent fishing year. This corresponds to catches of no more than 70 t.

Management applicable in 2013

The TAC for cod is set for ICES Subdivision VIb and EU and international waters of ICES Subdivision Vb. For 2013 the TAC for these areas was as shown below:

Species:	Cod *Gadus morhua*	Zone:	VIb; EU and international waters of Vb west of 12° 00′ W and of XII and XIV (COD/5W6-14)
Belgium	0		
Germany	1		
France	12		
Ireland	16		
United Kingdom	45		
Union	74		
TAC	74		Precautionary TAC

Data

Officially reported catches are shown in Table 4.2.1 and Figure 4.2.1. Lpue results from the Irish and Scottish otter-trawl fleet are presented in Figures 4.2.2 and 4.2.3.

Target DLS category

In 2012, advice was provided using the DL approach for category 6.2.0; stocks with negligible landings and stocks caught in minor amounts as bycatch with no indication of F in relation to reference points and no marked positive trends in stock indicators. WKLIFE suggested a target category of 4 for this stock. Given the potential unreliability of landings data and lack of sampled data, WGCSE considers that cod in VIb remain a category 6 stock.

Table 4.2.1. Cod in Division VIb (Rockall). Official catch statistics.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Faroe Islands	18	-	1	-	31	5	-	-	-	1	-	-
France	9	17	5	7	2	-	-	-	-	-	-	-
Germany	-	3	-	-	3	-	-	126	2	-	-	-
Ireland	-	-	-	-	-	-	400	236	235	472	280	477
Norway	373	202	95	130	195	148	119	312	199	199	120	92
Portugal	-	-	-	-	-	-	-	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	-	-	-	-
Spain	241	1200	1219	808	1345	-	64	70	-	-	-	2
UK (E. & W. & N.I.)	161	114	93	69	56	131	8	23	26	103	25	90
UK (Scotland)	221	437	187	284	254	265	758	829	714	322	236	370
Total	1023	1973	1600	1298	1886	549	1349	1596	1176	1097	661	1031

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Faroe Islands	-	-	-	-	n/a	n/a	n/a				
France	-	-	-	-	+	+*	1			0.08	
Germany	10	22	3	11	1	-	-				
Ireland	436	153	227	148	119	40	18	11	7	12	22.7
Norway	91	55*	51*	85*	152*	89	28	25	23	7	7
Portugal	-	5	-	-	-	-	-				
Russia	-	-	-	-	7	26	-				
Spain	5	1	6	4	3	1		6			
UK(E.&W. & N.I.)	23	20	32	22	4	2	2	3			
UK (Scotland)	210	706	341	389	286	176	67	57	45	43	
UK											28.7
Total	775	962	660	659	572	334	115	102	75	62	58.4

Country	2007	2008	2009	2010	2011	2012*
Faroe Islands	-		3	5	0	+
France	-					+
Germany	-					
Ireland	24	41	20	6	12	1
Norway	12	12	25	27	49	20
Portugal	-					
Russia	-		1			
Spain	-					
UK (E.&W. & N.I.)						
UK (Scotland)	26	41	48			
UK				23	37	11
Total	62	94	97	61	98	32

*** Preliminary**

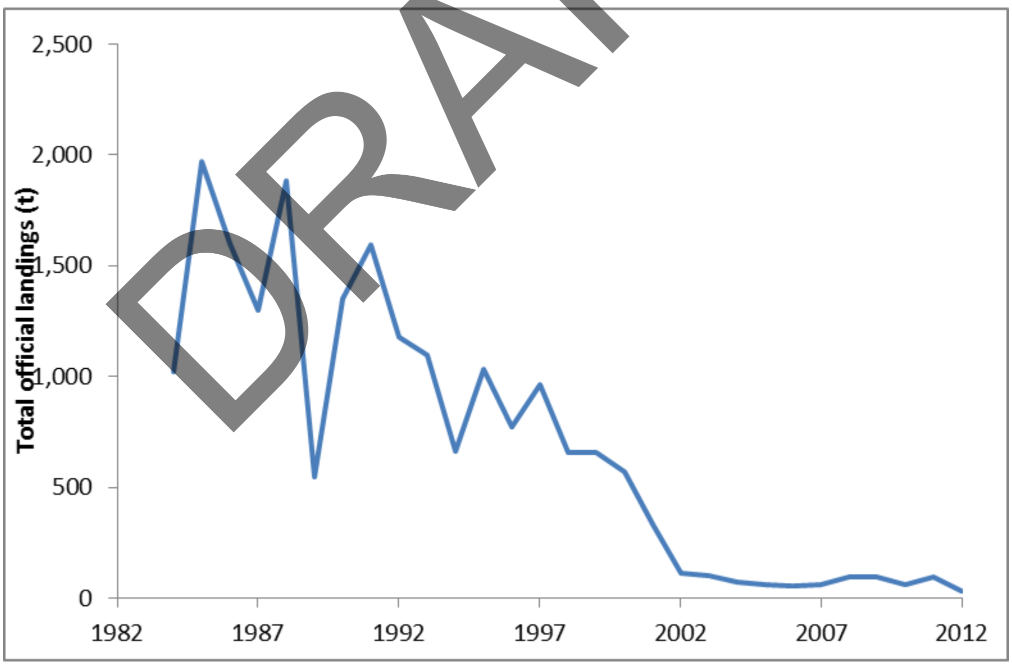


Figure 4.2.1. Cod in Division VIb. Total of official catch (all nations combined), 1984–2012. Values for 2012 are provisional.

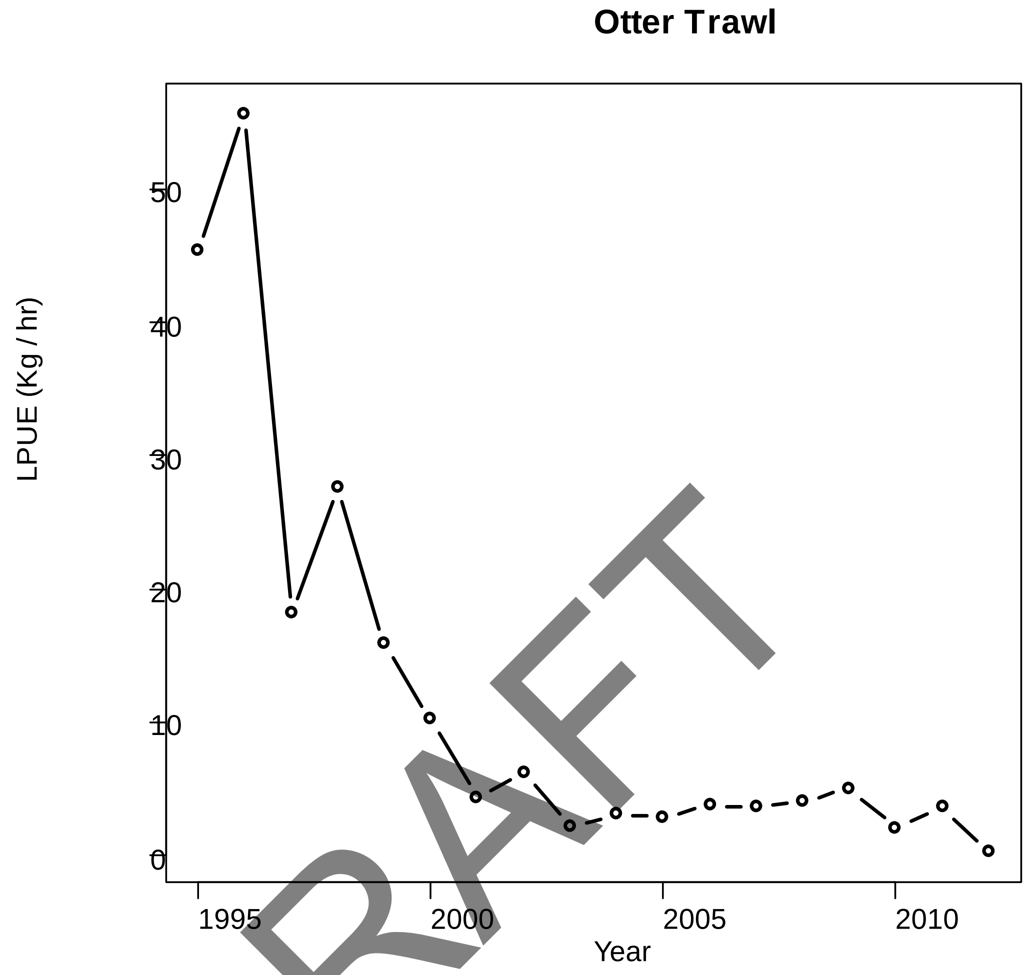


Figure 4.2.2. Cod in Division VIb. Lpue (kg/hr) from Irish Otter-trawl fleet, 1995–2012.

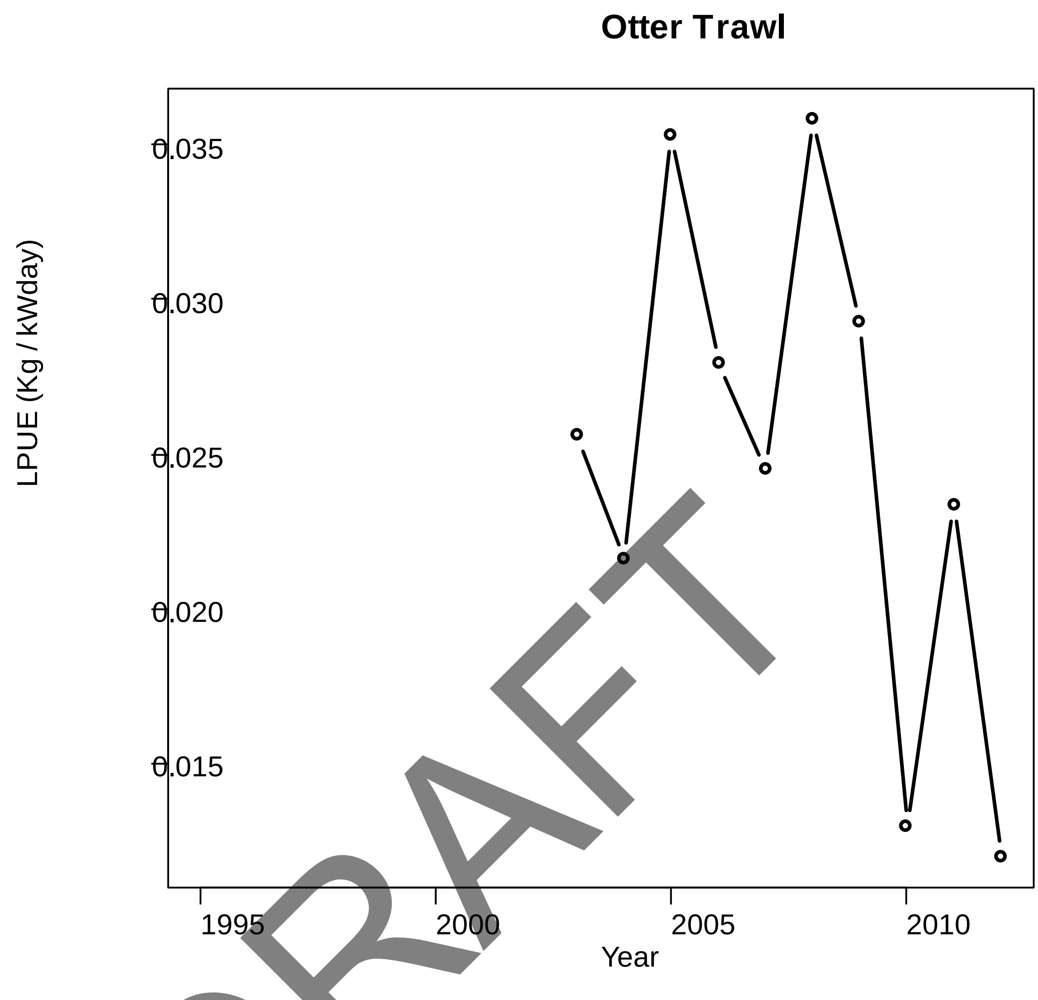


Figure 4.2.3. Cod in Division VIb. Lpue (Kg/kWday) from Scottish Otter trawl fleet, 2003–2012.

4.4 Whiting in Subarea VIb

Type of assessment in 2013

No assessment was performed in 2013.

ICES advice applicable in 2013

In 2012, ICES provided biennial advice for 2013 and 2014.

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 11 tonnes.

This is the first year that ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

No analytical assessment is available for this stock. The main cause of this is lack of data. Therefore, fishing possibilities cannot be projected.

ICES approach to data-limited stocks

For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock.

For this stock, ICES advises that catches should decrease by 20% in relation to the last three years average landing (14 t), corresponding to catches of no more than 11 t.

4.4.1 General

Stock description

There is an absence of information on whiting stock structure in this region and whiting caught at Rockall may potentially be part of the adjacent VIa stock.

Management applicable in 2013

The TAC for whiting is set for ICES Subareas VI, XII and XIV and EU and international waters of ICES Subdivision Vb, and for 2012 was as shown below:

Species:	Whiting *Merlangius merlangus*	Zone:	VI; EU and international waters of Vb; international waters of XII and XIV (WHG/56-14)
Germany	2		
France	36		
Ireland	87		
United Kingdom	167		
Union	292		
TAC	292		Analytical TAC

The fishery in 2012

No specific information is available for 2012. Whiting at Rockall are taken as a bycatch in fisheries for other species such as haddock and anglerfish.

4.4.2 Data

Only official landings data are available for whiting in VIb. These are shown by nation in Table 4.4.1 and Figure 4.4.1. Reported landings are currently negligible (1 tonne in 2012). In the past official landings have shown very high inter-annual variation and it is not known whether these are a true reflection of removals.

Survey catch rates of whiting at Rockall are extremely low and are therefore unlikely to provide a reliable index of abundance.

Catches of whiting (both survey and commercial) are too low to support the collection of the necessary information for an assessment of stock status.

4.4.3 Target category

In 2012, advice was provided using the DL approach for category 6.2.0; stocks with negligible landings stocks and stocks caught in minor amounts as bycatch with no indication of F in relation to reference points and no marked positive trends in stock indicators. WKLIFE suggested a target category of 4 for this stock. Given the comments in Section 4.4.2 regarding the potential unreliability of landings data and lack of sampled data, WGCSE considers that whiting in VIb remain a category 6 stock.

4.4.4 Management considerations

The TAC is for the combined Area VIa and VIb and therefore cannot be effective in limiting catches in Rockall.

Table 4.4.1. Whiting in VIb. Nominal landings (t) of Whiting in Division VIb, 1989–2012, as officially reported to ICES.

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Faroe Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	-	-	-	-	32	10	4	23	3	1	-	-	10		2	3	3	104	16	23	4	2	3	-
Spain	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
UK (E.& W, NI)	16	6	1	5	10	2	5	26	49	20	+	+	-	-	-	-	-	-	-	-	-	-	-	-
UK (Scotland)	18	482	459	283	86	68	53	36	65	23	44	58	4	7	11	1	1	1	1	8	12	16		
UK (all)																							6	1
Total	34	488	460	288	128	80	62	85	117	44	44	58	14	7	13	4	4	105	17	31	16	18	9	1

*** Preliminary.**

1989–2009 N. Ireland included with England and Wales.

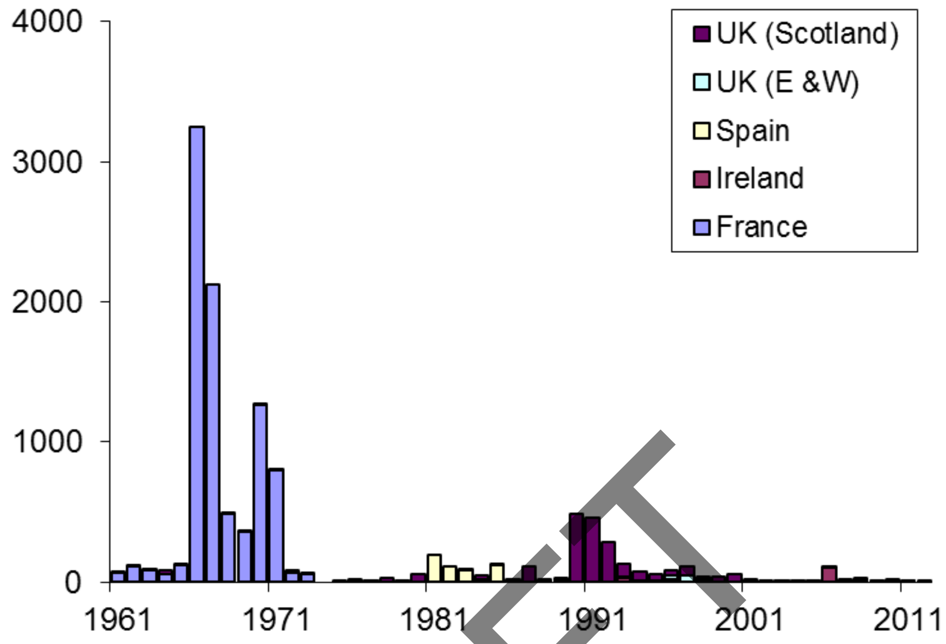


Figure 4.4.1. Whiting in Subarea VIb. Official landings of whiting in VIb by nation (tonnes).

5.1 Northern Shelf overview

Description of fisheries

UK (Scottish) vessels account for most of the reported anglerfish landings from the Northern Shelf area, taking approximately 65% of the landings overall, 70% in the North Sea and 50% of the landings in the West Coast in 2012. French vessels take approximately 40% of the West Coast landings. The Danish and Norwegian fleets are the next most important exploiters of this stock in the North Sea, taking 15% and 10% respectively while Irish vessels take approximately 10% of the landings from the West of Scotland. A description of the fisheries can be found in the stock annex.

5.2 Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Division IIIa, Subarea IV and VI

The WGNSDS considered the stock structure of anglerfish on a wider European scale in 2004, and found no conclusive evidence to indicate an extension of the stock area northwards to include Division IIa. In 2013, Division IIa was removed from WGCSE ToR.

Assessment in 2013

There has been no assessment of the anglerfish stock on the northern shelf since 2003. ACFM review groups highlighted the generally poor data for this stock and the need to continue with the recently instigated data collection schemes (both survey and commercial data) in order to obtain time-series of sufficient length. Since 2005, an annual science- industry partnership survey has been conducted by the Scottish, and in some years, Irish institutes: updates to these survey data are presented this year, along with updates to catch and effort data where available.

ICES advice applicable to 2012 and 2013

ICES advice for 2012

ICES advises on the basis of precautionary considerations that catches in 2012 should be reduced.

ICES advice for 2013

Based on the ICES approach to data-limited stocks, ICES advises that catches in 2012 should be reduced by 20% in relation to the average of the last three years. Due to uncertainty in the landings data, ICES is not able to quantify the resulting catch.

This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

ICES advises that the management area should be consistent with the assessment area.

5.2.1 General

Stock description and management units

In this section, the anglerfish stock on the Northern Shelf is considered to occur in Division IIIa (Skagerrak and Kattegat), Subarea IV (the North Sea) and Subarea VI

(West of Scotland plus Rockall). Anglerfish in the North Sea and Skagerrak/Kattegat were considered by this Working Group for the first time in 1999.

Management of Northern Shelf anglerfish is based on separate TACs for the North Sea area and West of Scotland area. The following Table summarises ICES advice and actual management applicable for Northern Shelf anglerfish during 2003–2013.

			West of Scotland			North Sea		
Year	Single stock exploitation boundary	Basis	TAC[4)]	% change in F associated with TAC	WG landings	TAC[5)]	% change in F associated with TAC	WG landings
2003	<6700[1)]	Reduce F below F_{pa}	3180	49% reduction	4126	7000	49% reduction	8268
2004	<8800[2)]	Reduce F below F_{pa} [2)]	3180	48% reduction	3296	7000	48% reduction	9027
2005	-	No effort increase[2)]	4686	-	n/a	10 314	-	n/a
2006	-	No effort increase[2)]	4686	-	n/a	10 314	-	n/a
2007	-	No effort increase[2)]	5155	-	n/a	11 345	-	n/a
2008	-	No effort increase[3)]	5155	-		11 345	-	
2009	-	No effort increase[3)]	5567	-		11 345	-	
2010	-	No effort increase[3)]	5567	-		11 345	-	
2011	-	Decrease effort	5456	-		9643	-	
2012	-	Reduce catches	5183	-		9161	-	
2013		DLS approach[3)]	4924			8703		

All values in tonnes.

[1)] Advice for Division IIIa, Subarea IV and Subarea VIa combined.

[2)] Advice for Division IIIa, Subarea IV and Subarea VI combined.

[3)] Advice for Division IIa, Division IIIa, Subarea IV and Subarea VI combined.

[4)] TAC applies to Vb(EC), VI, XII and XIV.

[5)] TAC applies to IIa & IV (EC)

Although there is no minimum landing size for this species, there is an EU minimum weight of 500 g for marketing purposes (EC Regulation 2406/96).

An additional quota of 1500 t was also available for EU vessels fishing in the Norwegian zone of Subarea IV in 2011–2013.

The fishery in 2012

A description of the fisheries on the northern shelf is given in the stock annex.

The official landings by area are given in Table 5.2.1 and the breakdown by country in Tables 5.2.2–5.2.4. In 2012, total [officially reported] landings (11 389 t) were 16% lower than in 2011 (13 576 t). Total officially reported landings of anglerfish from the

Northern Shelf are shown in Figure 5.2.1. During the 1970s landings were fairly stable at around 9000 t, but from about 1983 they increased steadily to a peak of over 35 000 t in 1996, and then declined rapidly during the following six years. However, any subsequent declines in reported landings may have been due to restrictive TACs and are not necessarily representative of actual landings. The overall trend in landings is driven by the landings from the Northern North Sea and West of Scotland. Together these two areas account on average for approximately 85% of the total landings over 1973–2012.

Uptake of EC quota in 2012, based on the officially reported landings was as follows:

	TAC	LANDINGS	UPTAKE	TAC	TAC	TAC	LANDINGS	UPTAKE
	VI	VI	(%)	IV	IIa & IV	IIa & IV	IIa & IV	(%)
				(Norwegian)		(total)	(total)	
Belgium	186	0	0	45	324	369	131	36
Denmark				1152	714	1866	1122	60
Estonia								
Faroes		5						
France	2412	1622	67		66	66	17	26
Germany	213	149	70	18	349	367		0
Ireland	518	325	63					
Netherlands	179	0	0	16	245	261	59	23
Norway		1					495	
Portugal								
Russia								
Spain	199		0					
Sweden					8	8	15	188
UK (total)	1595	2085	131	269	7455	7724	5046	65
Total	5302	4187	79	1500	9643	10 661	6885	65

[1]TAC applies to VI, Vb(EC), and international waters of XII and XIV.

[2]Norwegian waters.

Catches in Division IIIa are not regulated: Table 5.2.4 shows the official landings which came to a total of 466 t in 2012, similar to 2011.

5.2.2 Data

Landings (Tables 5.2.1–5.2.4)

The TACs for both the West of Scotland and North Sea areas were reduced substantially in 2003 and 2004, and at previous WGs it has been highlighted that these reductions would likely imply an increased incentive to misreport landings and increase discarding unless fishing effort was reduced accordingly (Section 6.4.6, ICES WGNSDS 2003). Anecdotal information from the fishery in 2003 to 2005 appeared to suggest that the TACs were particularly restrictive in these years. The official statistics for these years are, therefore, likely to be particularly unrepresentative of actual landings. The introduction of UK & Irish legislation requiring registration of all fish buyers and sellers (See Section 1.7) may mean that the total reported landings from 2006 onwards are more representative of actual total landings in the UK & Ireland.

In the meantime, collation of an international landings-at-age dataset is being hampered by the different approaches to age determination by the institutes which could provide these data. Several countries use the illicia to age, whilst others use otoliths. An anglerfish ageing exchange was held in 2011 and found little agreement between methods or readers. Collation of an international landings-at-length dataset will be initiated in 2013.

The absence of a TAC for Subarea IV prior to 1999 means that before 1999, landings in excess of the TAC in other areas were likely to be misreported into the North Sea. In 1999, a precautionary TAC was introduced for North Sea anglerfish, but unfortunately for current and future reporting purposes, the TAC was set in accord with recent catch levels from the North Sea which includes a substantial amount misreported from Subarea VI. The area misreporting practices have thus become institutionalised and the statistical rectangles immediately east of the 4˚W boundary (E6 squares) have accounted for a disproportionate part of the combined VIa/North Sea catches of anglerfish. The Working Group historically (prior to 2005) provided estimates of the actual Division VIa landings by adjusting the reported data for Division VIa to include a proportion of the landings declared from Division IVa in the E6 ICES statistical rectangles. This adjustment has been adapted to include landings declared from the whole of Area VI. Details of how the correction has been applied are given in the Stock Annex. Scottish officially reported landings adjusted for area misreporting are shown along with landings from England & Wales, Ireland, Denmark, France and Norway in Figure 5.2.2. Due to a lack of landings data provided to the Working Group by some of the major nations exploiting the fishery, WG estimates of the actual Division VIa and IVa landings have not been calculated for recent years (2005–2011). However, during the benchmark at WKROUND 2013, it was agreed that landings are now likely to be more accurate for two reasons, firstly the unrestrictive TAC, and secondly the offshore gillnet fishery for anglerfish historically conducted by Spanish flagged vessels and thought to under-report landings, is now much reduced.

The corrected spatial distribution of anglerfish landings shows a typical pattern, with most landings being taken from the area around Shetland and also the area to the west of Scotland close to the shelf edge. Some landings, associated with the *Nephrops* fishery, are taken from the Fladen ground in the middle of the northern North Sea. A substantial amount of landings were taken from Rockall. The spatial distribution of Danish landings shows the typical pattern of higher landings around the Norwegian deeps. The Irish fishery in 2012 landed principally from the west coast of Ireland and in the south of Division VIa, but with substantial landings from Rockall.

Consideration should be given in future to examining the distribution of landings combined with vessel monitoring system (VMS) data, perhaps using a kilowatt fishing hours metric to produce spatial distributions of lpue.

Commercial catch–effort data

Trends in nominal international fishing effort in Skagerrak, North Sea & Eastern Channel and West of Scotland collated by STECF Evaluation of Fishing Effort Regimes in European Waters - Part 2 (STECF-12-16) are shown in Figure 5.2.3. These show a substantial decline in effort of the main gears this fishery (TR). A change in this overall trend is not anticipated with the introduction of 2012 data.

Scotland

Effort data in terms of kw.days are available from official logbooks and these data are presented by gear in the report of WGNSDS 2007. However, given the uncertainties associated with the official landings from the recent past, no attempt has been made to use these data to calculate an lpue series and they have not been updated this year.

Attempts have recently been made to obtain more reliable data on catch and effort from the Scottish anglerfish fishery but were discontinued in 2009 due to falling participation levels.

Ireland

Trends in official landings, effort in hours fished) from the Irish otter trawl fleets (OTB) operating in Division VIa and VIb for 2007–2011 are shown in Table 5.2.5 and Figure 5.2.4. This fleet is responsible for the majority of the landings from the south of Division VIa. Landings and effort data from the other fleets (1995–2006) are available in the stock annex. The Irish lpues from logbooks are shown in Figure 5.2.4. The time-series show increasing trends in (particularly) Division VIa in recent years. However, it is not clear whether such trends are indicative of stock trends as such increases in lpue could also be due to changes in targeting behaviour due to reductions in fishing opportunities for other species and changes in reporting practices.

Denmark

Danish logbook data for anglerfish landings and corresponding effort by main fishery in the North Sea and IIIA for 2001–2011 are given in Tables 5.2.6 and 5.2.7. Figure 5.2.5 shows the fluctuations in lpue for anglerfish in mixed demersal fisheries (targeting roundfish, anglerfish, *Nephrops*) in the northeastern North Sea) and the shrimp (*Pandalus*) fishery (small-meshed). The lpue series for the mixed demersal trawl fisheries in the North Sea represents the fisheries where most anglerfish is taken (Table 5.2.6). On the other hand, the lpue series for shrimp trawl represents a ‘bycatch lpue’ and may be a better indicator of stock fluctuations. Note the upwards trend, especially from 2003 to 2004 for both series. Since 2006 the trends of the two series have differed, although there has been a decline in both series from 2010 to 2011. There was a decline in overall (nominal) effort in 2010 compared to the previous two years but this has increased again in 2011 (Table 5.2.7).

The decline in effort (measured in days) reflects the development in the Danish mixed fishery taking anglerfish in recent years, where there have been TAC constraints on the Danish fishery in the Norwegian EEZ which was not in evidence in earlier years. In 2008–2009 around 30 vessels were engaged in this fishery, but in 2010 only ten vessels participated. Several factors are causing this reduction in number of vessels (and therefore also fishing trips): TACs in the Norwegian EEZ (1152 t in 2011 and 2012), increasing fuel prices and also the system of vessel ITQs used in the national management of the Danish fishery. Restrictive bycatch rules in the Norwegian zone have probably also influenced the decline in number of vessels.

Due to increasing fishing power of the vessels effective effort is probably greater than indicated by the nominal effort.

Norway

Available logbook data from Norwegian trawlers have been examined for the possibility of establishing a cpue time-series for anglerfish. However, several problems were encountered in the dataset, and it is still considered insufficient for providing any reliable information on trends in stock abundance.

Six gillnetters have been included in a self-sampling scheme established along the Norwegian coast within IVa and IIIa. Detailed information about effort and catch will be provided through this scheme, and will potentially be valuable in future assessments of anglerfish in this area.

Other countries

No effort data were available for the Spanish and French fleets operating in Subarea VI.

Research vessel surveys

The Sco-IV-VI-AMISS-Q2 survey is described in the stock annexe. This is a targeted anglerfish survey using commercial gear, covering Subareas IV and VI.

The 2012 survey took place in April and May: the sample locations (n = 169) are illustrated in Figure 5.2.6 as the number density (number per square kilometre) and Figure 5.2.7 as the weight density (kilograms per square kilometre) of anglerfish. The highest densities of anglerfish occurred close to the 200 m contour in the northern and western areas, including the northwestern North Sea. The highest densities were found on the eastern Rockall plateau. The abundance and biomass estimates from the survey are presented in Table 5.2.8. The total estimate for the Northern Shelf in 2012 was 36 325 t. The 95% confidence limit estimates for this estimate were between 29 569 and 43 081 t, and the relative standard error 9.3%.

Estimates of biomass from the survey in ICES Area IV (15 106 t) were smaller than those in Area VI (21 218 t). In the North Sea (ICES Division IV), the time-series estimates for anglerfish age 1 and older, indicate a decline in numbers since 2007 (Figure 5.2.7). However, estimates at Rockall (ICES Division VIb) are more stable over the seven year time-series. Numbers in the west of Scotland (ICES Division VIa), declined since 2005. The biomass estimates show a decrease in the North Sea since 2008, a possible slight increase at Rockall and a slight decline in the west of Scotland (Figure 5.2.6).

The time-series of numbers-at-age are shown in Figure 5.2.8. A large year class from 2004 or 2005 can be approximately tracked through the cohorts, with high numbers of ages 2 and 3 in 2006, age 4 in 2007, age 5 in 2007 * 2008, and ages 6 in 2008. Since this large year class, numbers of fish age 2–6 have declined. However, over the course of the time-series, ages 1 and 7 have remained relatively constant, whilst ages 8 and above appear to have increased slightly. Anglerfish mature at ages 5 or 6, so the SSB is slightly increasing since 2005.

The estimates of abundance of anglerfish from the surveys are in line with previous attempts to quantify their abundance (ICES 2004): the last assessment estimated the total stock biomass to be just under 37 000 t in 2002. There are still several factors which make the survey estimates likely to be underestimates or minimum estimates. Firstly, although experiments have been carried out to estimate escapes from under the footrope, and a model applied to account for this component of catchability, the estimates of younger anglerfish (ages 0–4) still look to be underestimated (Figure 5.2.8). This could be due to either a net selectivity issue, or an availability [to the trawl] issue, as it is known that younger fish occur in shallower water (Hislop *et al.*, 2001), or both. Methods to compensate for these additional catchability and availability factors are being considered by developing a survey based assessment model.

Secondly, the area considered is not complete. Quite a large part of ICES Area IV is not surveyed (Figure 5.2.5). The problem is being tackled by an examination of data from the International Bottom Trawl survey. If a relationship can be found between the IBTS survey data and the data from the anglerfish survey where they overlap, then abundance estimates in the southern North Sea could be derived by interpolation where there is only IBTS data. These methods are currently under development (see ICES WKAGME 2009).

5.2.3 Historical stock development

There has been no assessment of this stock since the length-based assessment presented in ICES (2004). This indicated a total stock size of approximately 36 590 t in 2002.

The estimates of abundance of anglerfish from the surveys from 2005–2012 are in line with these previous attempts to quantify their abundance. There are still several factors which make the survey estimates likely to be underestimates or minimum estimates (see above).

5.2.4 Short-term projections

In the absence of an age based assessment, there are no short-term projections for this stock.

5.2.5 Biological reference points

Precautionary approach reference points

	Type	Value	Technical basis
Precautionary approach	B_{lim}	Not defined	There is currently no biological basis for defining B_{lim}
	B_{pa}	Not defined	
	F_{lim}	Not defined	There is currently no biological basis for defining F_{lim}
	F_{pa}	0.30	$F_{35\%SPR}$ = 0.30. This fishing mortality corresponds to 35% of the unfished SSB/R. It is considered to be an approximation of F_{MSY}.
Targets	F_y	Not defined	

(unchanged since 1998).

Yield-per-recruit analysis

Previous attempts to determine suitable harvesting rates, based on a yield per recruit analysis, estimated F_{MAX} to be 0.19 (ICES 2004). The aforementioned southern stock has recently been benchmarked and an F_{MAX} of 0.28 was used there (ICES 2012a).

5.2.6 Management plans

There is no management plan for this stock.

5.2.7 Uncertainties and bias in assessment and forecast

This WG has previously attempted assessments of the anglerfish stock(s) within its remit using a number of different approaches. As yet none have proved entirely satisfactory. The catch-at-length analysis used in previous years appears to have addressed a number of the suspected problems with the data due to the rapid development of the fishery, and has also provided a satisfactory fit to the catch-at-length distribution data. However, since 2003, the WG has been unable to present an analytic assessment due to the lack of reliable fishery and insufficient survey information, and in addition it is not known to what extent the dynamic pool assumptions of the traditional assessment model are valid for anglerfish. A catch-at-age model has been presented to two benchmark working groups (WKFLAT 2012 and WKROUND 2013) but has not yet been accepted due to concerns over age-reading.

Commercial data

For a number of years the WG has expressed concerns over the quality of the commercial catch-at-length data because of:

- Accuracy of landings statistics due to species and area misreporting.
- Lack of information on total catch and catch composition of gillnetters operating on the continental slope to the northwest of the British Isles (See the stock annex for further details of this fishery).

It is now thought that the introduction of legislation on buyers and sellers registration in the UK and Ireland since 2006 and unrestrictive TACs in recent years mean that reported landings for these two countries are now accurate. There is also now thought to have been a reduction in the offshore gillnetters removing this problem also. Thus the WG now considers the landings data to be reliable.

Survey data

In addition to obtaining estimates of abundance from swept area methods and a time-series of data for use in survey based assessments, a visual count method has been developed at Marine Scotland Science to provide alternative estimates of anglerfish density in areas where trawling is prohibited (at Rockall for example). These estimates have been included in the survey estimates, but account for only about 1% of the total biomass. It is also anticipated that the new Scottish–Irish science/industry survey will provide further useful information on the biology and stock structure of anglerfish. So far, a total of 48 live anglerfish have been tagged with data storage tags (DSTs) on the Marine Scotland Science surveys which if and when recovered will provide information on the vertical migration, depth distribution and temperature regime of individuals. So far two tags have been returned from fish tagged in 2005: these data are currently being analysed. Tagging carried out on the Irish survey (800 ribbon tags) should also provide information on movement of anglerfish.

In 2006, 2007 and 2009 Ireland extended the survey area to include the more southerly regions of the Northern Shelf stock of anglerfish area not covered by the Scottish survey. This larger survey area was also covered in 2011 and 2012 by the Scottish survey. However the participation of other nations in a collaborative survey to include coverage of waters in the east and south of the North Sea would be invaluable.

Biological information

Knowledge of the biology of anglerfish is improving. Some of the basic biological parameters used in the assessments, such as mean weight-at-age in the stock, are now becoming available from the industry science surveys. Difficulties still remain in finding mature females. However, recent studies by Laurenson *et al*. (2005; 2008) carried out whilst observing the fishery, have obtained similar growth parameters and maturity ogives to those previously used. A further discussion of the biology can be found in the stock annex.

In addition, ageing has not been validated and should still be regarded as uncertain. An ageing exchange was carried out in 2011 and found little agreement between methods or readers using the same method.

Stock structure

Currently, anglerfish on the Northern Shelf are split into Subarea VI (including Vb(EC), XII and XIV) and the North Sea (& IIa (EC)) for management purposes. However, genetic studies have found no evidence of separate stocks over these two regions (including Rockall) and particle-tracking studies have indicated interchange of larvae between the two areas (Hislop *et al*., 2001). So, at previous WGs, assessments have been made for the whole Northern Shelf area combined. In fact, both microsatellite DNA analysis (O'Sullivan *et al*., 2005) and particle tracking studies carried out as part of EC 98/096 (Anon, 2001) also suggested that anglerfish from further south (Subarea VII) could also be part of the same stock.

5.2.8 Recommendations for next Benchmark

This stock was benchmarked in February 2013 at WKROUND. The meeting recommended a lot of work to be carried out before the next benchmark. WGCSE prioritised the following tasks:

- Compile historical catch-at-length time data.
- Compile survey-based stock numbers-at-length data.
- Investigate growth models appropriate for anglerfish IV & VI.
- Assess within reader variability for otolith readers used on the SCO-AMISS-IV-VI-Q2 survey.
- Investigate a *Nephrops*-like harvest-ratio approach.
- Investigate length-based stock assessment using, for example, the SS3 approach applied to southern anglerfish stocks.
- Investigate an age-aggregated production/depletion model.
- Determine the best way to incorporate *Lophius budegassa* into assessment and advice.
- Develop the "q1" assessment model (WKROUND 2013) and test sensitivities as described in WKROUND 2013.

5.2.9 Management considerations

In a previous "Policy Statement" Communication, the European Commission set out its approach to setting TACs where "the state of the stock is not known precisely and STECF advises on an appropriate catch level". These were designated "Category 6" stocks. In such cases the Commission proposed simple rules to adjust the TAC based on comparisons between average catch rates (catch per unit of effort, cpue) in the time-series. In relation to this, the European Commission's STECF had considered use of stock biomass to be a more appropriate indicator of reproductive potential as it is less sensitive to fluctuations in numbers of small, immature fish.

However, in 2011 the commission changed their approach (Council Regulation (EU) No 298/2011), initially suggesting that "When scientific advice on overfishing is unavailable..." as would be the case for anglerfish, "...a reduction of 25% in the TAC and/or in the fishing effort levels should be proposed...". This approach was dropped in advance of the council decisions to set the TAC.

ICES then developed the Data-Limited Stocks approach, for which anglerfish is a category 3 data-limited stock, described in ICES (2013), and in the stock annex: This applies an uncertainty cap and precautionary buffer to a survey adjusted *status quo* catch.

A comparison of mean biomass estimates from the SCO-IV-VI-AMISS-Q2 surveys (Table 5.2.9) shows that the mean biomass in Areas IV and VI combined has decreased by 22% from 2008–2010 to 2011–2012. Application of the uncertainty cap leads to a reduction in the average of the previous three years landings by 20%. However, the clear decrease in international effort by the main fisheries in the stock area since 2003, indicate that a precautionary buffer should not be applied.

Area flexibility is also an issue which can be considered in the light of the survey data. The TACs in Subareas IV (including Norwegian waters) and VI in 2011 were 10 611 t and 5183 t respectively, which is a 67:33% split. However, the stock is fairly continuously and evenly distributed across the two areas (Figures 5.2.1.4 and 5.2.1.5). Over the course of the surveys the IV:VI split has fluctuated around 50:50 (49:51% in 2005; 54:46% in 2006; 57:43% in 2007; 55:45% in 2008; 47:53% in 2009; 52:48% in 2010; 45:55% in 2011; and 42:58% in 2012). Care should be taken in the interpretation of these splits, because the North Sea is only partially surveyed: however, the area covered does encompass most of the distribution of anglerfish.

Whatever action is taken, it should be noted that it cannot be taken without some risk to the long-term sustainability of the stock given the uncertainties about its long-term exploitation. Ideally, the management of the fishery should be based on a specific plan, or harvest control rule, after an evaluation of various stakeholder-led suggestions of alternative options. This still needs to be pursued in consultation with stakeholders such as the North Western Waters Regional Advisory Council. The survey data need to be subjected to some form of stock assessment to take into account the low numbers of younger fish and in particular the likely number of recruits. Some form of management evaluation can then be implemented to develop a more specific and sustainable harvesting regime. The outcome of this exercise will almost certainly result in a change to the way the stock is managed in forthcoming years.

5.2.10 References

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Table 5.2.1. Anglerfish on the Northern Shelf (IIIa, IV & VI). Total official landings by area (tonnes).

Year	IIIa	IVa	IVb	IVc	VIa	VIb	IV	VI	Total
1973	140	2085	575	41	9221	127	2701	9348	12189
1974	202	2737	1171	39	3217	435	3947	3652	7801
1975	291	2887	1864	59	3122	76	4810	3198	8299
1976	641	3624	1252	49	3383	72	4925	3455	9021
1977	643	3264	1278	54	3457	78	4596	3535	8774
1978	509	3111	1260	72	3117	103	4443	3220	8172
1979	687	2972	1578	112	2745	29	4662	2774	8123
1980	652	3450	1374	175	2634	200	4999	2834	8485
1981	549	2472	752	132	1387	331	3356	1718	5623
1982	529	2214	654	99	3154	454	2967	3608	7104
1983	506	2465	1540	181	3417	433	4186	3850	8542
1984	568	3874	1803	188	3935	707	5865	4642	11075
1985	578	4569	1798	77	4043	1013	6444	5056	12078
1986	524	5594	1762	47	3090	1326	7403	4416	12343
1987	589	7705	1768	66	3955	1294	9539	5249	15377
1988	347	7737	2061	95	6003	1730	9893	7733	17973
1989	334	7868	2121	86	5729	313	10075	6042	16451
1990	570	8387	2177	34	5615	822	10598	6437	17605
1991	595	9235	2522	26	5061	923	11783	5984	18362
1992	938	10209	3053	39	5479	1089	13301	6568	20807
1993	843	12309	3144	66	5553	681	15519	6234	22596
1994	811	14505	3445	210	5273	777	18160	6050	25021
1995	823	17891	2627	402	6354	830	20920	7184	28927
1996	702	25176	1847	304	6408	602	27327	7010	35039
1997	776	23425	2172	160	5330	899	25757	6229	32762
1998	626	16857	2088	78	4506	900	19023	5406	25055
1999	660	13326	1517	24	4284	1401	14867	5685	21212
2000	602	12338	1617	31	3311	1074	13986	4385	18973
2001	621	12861	1832	21	2660	1309	14714	3969	19304
2002	667	11048	1244	21	2280	718	12313	2998	15978
2003	478	8523	847	20	2493	643	9390	3136	13004
2004	519	8987	851	15	2453	671	9853	3124	13496
2005	458	8424	688	5	3019	958	9117	3977	13552
2006	423	10338	685	3	2785	916	11026	3701	15150
2007	433	10632	749	4	3352	1260	11385	4612	16430
2008	486	11038	769	5	3373	1630	11812	5003	17300
2009	479	10096	658	8	3029	2119	10757	5148	16389
2010	477	6979	619	11	3187	1423	7609	4610	12696
2011	432	7760	773	9	2724	1878	8542	4602	13576
2012	466	6176	705	4	2682	1356	6885	4038	11389
Min	140	2085	575	3	1387	29	2701	1718	5623
Max	938	25176	3445	402	9221	2119	27327	9348	35039
Average	554	8629	1531	77	3921	840	10236	4760	15551

Table 5.2.2. Anglerfish in Subarea VI. Nominal landings (t) as officially reported to ICES.

Division VIa (West of Scotland)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium	3	2	9	6	5	-	5	2	-	-	+	+	-	+	-	-	-	-	-	-		
Denmark	1	3	4	5	10	4	1	2	1	+	+	-	+	+	-	-	-	-	-	-		
Estonia																						
Faroe Is.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	3	2	1	2	4	1	+
France	1,910	2,308	2,467	2,382	2,648	2,899	2,058	1,634	1,814	1,132	943	739	1,212	1,191	1,392	1,314	1763	1746	1555	1,160	1,021	1,166
Germany	1	2	60	67	77	35	72	137	50	39	11	3	27	39	39	1	-	54	79	79	59	
Ireland	250	403	428	303	720	717	625	749	617	515	475	304	322	219	356	392	470	295	328	510	488	325
Netherlands	-	-	-	-	-	-	27	1	-	-	-	-	-	-	-	-	-	-	-	-	0	0
Norway	6	14	8	6	4	4	1	3	1	3	2	1	+	+	1	1	1	2	-	1	1	1
Russia																						
Spain	7	11	8	1	37	33	63	86	53	82	70	101	196	110	82	76	3	174	189	-	138	
UK(E,W&NI)	270	351	223	370	320	201	156	119	60	44	40	32	31	30	20	24	42	5	12	393		
UK(Scot.)	2,613	2,385	2,346	2,133	2533	2,515	2,322	1,773	1,688	1,496	1,119	1,100	705	862	1,127	974	1,071	1096	864	1040		
UK (total)																			876	1,021	1,016	1,190
Total	5,061	5,479	5,553	5,273	6,354	6,408	5,330	4,506	4,284	3,311	2,660	2,280	2,493	2,453	3,019	2,785	3,352	3,373	3,029	3,187	2,724	2,682
Unallocated	296	2,638	3,816	2,766	5,112	11,148	7,506	5,234	3,799	3,114	2,068	1,882	985	1,938								72
As used by WG	5,357	8,117	9,369	8,039	11,466	17,556	12,836	9,740	8,083	6,425	4,728	4,162	3,478	4,391							2,724	2,754

***Preliminary.**

Table 5.2.2 contd. Anglerfish in Subarea VI. Nominal landings (t) as officially reported to ICES.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium																						
Denmark																						
Estonia	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-		-			
Faroe Is.	-	2	-	-	-	15	4	2	2	-	1	-	-	-	-	-	-	1	4	8	+	5
France	-	-	29	-	-	-	1	1	-	48	192	43	191	175	293	224	327	327	637	23	515	456
Germany	-	-	103	73	83	78	177	132	144	119	67	35	64	66	77	72	222	0	132	87	90	
Ireland	272	417	96	135	133	90	139	130	75	81	134	51	26	13	35	53	70	76	91	107	108	-
Norway	18	10	17	24	14	11	4	6	5	11	5	3	6	5	4	6	7	5	9	12	7	0
Portugal	-	-	-	-	-	-	-	+	429	20	18	8	4	19	63	-	-	-	-			
Russia	-	-	-	-	-	-	-	-	-	-	1	-	-	2	4	1	1	35	-			
Spain	333	263	178	214	296	196	171	252	291	149	327	128	59	43	34	36	12	85	57		29	
UK(E,W&NI)	99	173	76	50	105	144	247	188	111	272	197	133	133	54	93	46	146	5	48	15		
UK(Scot)	201	224	182	281	199	68	156	189	344	374	367	317	160	294	355	478	475	1096	1141	1171		
UK (total)																			1189	1192	1129	895
Total	923	1089	681	777	830	602	899	900	1401	1074	1309	718	643	671	958	916	1260	1629.6	2119	1423	1878	1356
Unallocated									-9	17	-178	-47	145	121								32
As used by WG	923	1,089	681	777	830	602	899	900	1392	1091	1131	671	788	792								1388

Division VIb (Rockall)

***Preliminary.**

Table 5.2.2 contd. Anglerfish in Subarea VI. Nominal landings (t) as officially reported to ICES.

Subarea VI (West of Scotland and Rockall)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium	3	2	9	6	5	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	1	3	4	5	10	4	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Faroe Is.	0	2	0	0	0	15	4	2	2	0	1	0	0	2	2	3	2	2	6	12	1	5
France	1910	2308	2496	2382	2648	2899	2059	1635	1814	1180	1135	782	1403	1366	1685	1538	2090	2073	2192	1183	1536	1622
Germany	1	2	163	140	160	113	249	269	194	158	78	38	91	105	116	73	222	54	211	166	149	0
Ireland	522	820	524	438	853	807	764	879	692	596	609	355	348	232	391	445	540	370.6	419	617	596	325
Netherlands																						
Norway	18	10	17	24	14	11	31	7	5	11	5	3	6	5	4	6	7	5	9	12	7	0
Portugal	6	14	8	6	4	4	1	3	430	23	20	9	4	19	64	1	1	2	0	1	1	1
Russia	0	0	0	0	0	0	0	0	0	0	1	0	0	2	4	1	1	35	0	0	0	0
Spain	340	274	186	215	333	229	234	338	344	231	397	229	255	153	116	112	15	259	246	0	167	0
Sweden																						
UK(E,W&NI)	369	524	299	420	425	345	403	307	171	316	237	165	164	84	113	70	188	10	60	408	0	0
UK(Scot)	2814	2609	2528	2414	2732	2583	2478	1962	2032	1870	1486	1417	865	1156	1482	1452	1546	2192	2005	2211	0	0
UK (total)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2065	2213	2145	2085
Total	5984	6568	6234	6050	7184	7010	6229	5406	5685	4385	3969	2998	3136	3124	3977	3701	4612	5002.6	5148	4610	4602	4038
Unallocated	296	2638	3816	2766	5112	11148	7506	5234	3790	3131	1890	1835	1130	2059								104
As used by WG	923	1,089	681	777	830	602	899	10640	9475	7516	5859	4833	4266	5183								4142

***Preliminary.**

Table 5.2.3. Nominal landings (t) of Anglerfish in the North Sea, as officially reported to ICES.

Northern North Sea (IVa)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium	2	9	3	3	2	8	4	1	5	12	-	8	1	-	-	-	-	-	-			
Denmark	1,245	1265	946	1,157	732	1,239	1,155	1,024	1,128	1,087	1,289	1,308	1,523	1,538	1,379	1,311	961	1,071	1,134	1	841	821
Faroes	1	-	10	18	20	-	15	10	6	-	2	+	3	11	22	2	+	-	4		0	0
France	124	151	69	28	18	7	7	3	18	8	9	8	8	8	4	7	13	13	48	6	12	14
Germany	71	68	100	84	613	292	601	873	454	182	95	95	65	20	84	173	186	344	216	124	46	
Ireland																					0	0
Netherlands	23	44	78	38	13	25	12	-	15	12	3	8	9	38	13	14	14	12	5	8	5	5
Norway	587	635	1,224	1,318	657	821	672	954	1,219	1,182	1,212	928	769	999	880	1,005	831	860	859	735	494	480
Sweden	14	7	7	7	2	1	2	8	8	78	44	56	8	6	5	5	20	67	-	4	9	7
UK(E, W&NI)	129	143	160	169	176	439	2,174	668	781	218	183	98	104	83	34	99	303	13	320	371		
UK (Scotland)	7,039	7,887	9,712	11,683	15,658	22,344	18,783	13,319	9,710	9,559	10,024	8,539	6,033	6,284	6,003	7,722	8,304	8,658	7,510	5730		
UK (total)																			7,830	6101	6353	4849
Total	9,235	10,209	12,309	14,505	17,891	25,176	23,425	16,860	13,344	12,338	12,861	11,048	8,523	8,987	8,424	10,338	10,632	11,038	10,096	6,979	7,760	6,176

***Preliminary.**

Table 5.2.3 continued. Nominal landings (t) of Anglerfish in the North Sea, as officially reported to ICES.

Central North Sea (IVb)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium	357	538	558	713	579	287	336	371	270	449	579	435	180	260	207	138	179	181	134	124	111	129
Denmark	345	421	347	350	295	225	334	432	368	260	251	255	191	274	237	276	173	237	248	194	286	301
Faroes	-	-	2	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	0	
France	-	1	-	2	-	-	-	-	-	-	-	-	-	+	-	-	-	-	9	6	4	+
Germany	4	2	13	15	10	9	18	19	9	14	9	17	11	11	9	14	12	22	17	21	17	
Ireland													1	-	-	-	-	-	-	-		
Netherlands	285	356	467	510	335	159	237	223	141	141	123	62	42	25	31	33	61	58	36	46	53	59
Norway	17	4	3	11	15	29	6	13	17	9	15	10	12	22	16	14	24	15	21	10	11	14
Sweden				3	2	1	3	3	4	3	2	9	2	1	4	4	6	9	-	5	7	7
UK(E, W&NI)	669	998	1,285	1,277	919	662	664	603	364	423	475	236	167	120	96	108	122	105	85	88		
UK (Scotland)	845	733	469	564	472	475	574	424	344	318	378	210	241	138	88	98	172	142	103	125		
UK (total)																			193	213	284	195
Total	2,522	3,053	3,144	3,445	2,627	1,847	2,172	2,088	1,517	1,617	1,832	1,244	847	851	688	685	749	769	653	619	773	705

*** Preliminary**

Table 5.2.3 continued. Nominal landings (t) of Anglerfish in the North Sea as officially reported to ICES.

Southern North Sea (IVc)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium	13	12	34	37	26	28	17	17	11	15	15	16	9	5	4	3	3	4	6	7	6	2
Denmark	2	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	-		-	-	0	0
Faroes																						
France	-	-	-	-	-	-	-	10	-	+	-	+	-	-	-	-	-	+	-	1	1	+
Germany	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-	-	-		
Ireland																						
Netherlands	5	10	14	20	15	17	11	15	10	15	6	5	1	-	1	-	1	1	-	2	1	1
Norway	-	-	-	-	+	-	-	-	+	-	+	-	-	-	-	-	-	-	1	-		
Sweden																						
UK(E&W&NI)	6	17	18	136	361	256	131	36	3	1	-	-	10	3	-	-	-	-	1	1		
UK (Scotland)	-	-	-	17	-	3	1	+	+	+	-	-	-	7	-	-	-	-	-	-		
UK (Total)																		+	1	1	1	+
Total	26	39	66	210	402	304	160	78	24	31	21	21	20	15	5	3	4	5	8	12	9	4

*** Preliminary.**

Table 5.2.3 continued. Nominal landings (t) of Anglerfish in the North Sea as officially reported to ICES.

Total North Sea

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium	372	559	595	753	607	323	357	389	286	476	594	459	190	265	211	141	182	184.6	140	131	117	131
Denmark	1592	1686	1293	1507	1027	1464	1489	1456	1496	1347	1540	1563	1714	1812	1616	1587	1134	1308	1382	195	1127	1122
Estonia																						
Faroes	1	0	12	18	20	0	15	10	6	0	2	10	3	11	22	2	0	0	4	0	0	0
France	124	152	69	30	18	7	7	13	18	8	9	8	8	8	4	7	13	13	57	13	17	14
Germany	75	70	113	99	623	301	619	892	463	196	104	112	76	31	93	187	198	366	233	145	63	0
Ireland	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Netherlands	313	410	559	568	363	201	260	238	166	168	132	75	52	63	45	47	76	71	41	56	59	65
Norway	604	639	1227	1329	672	850	678	967	1236	1191	1227	938	781	1021	896	1019	855	875	881	745	505	494
Portugal																						
Russia																						
Spain																						
Sweden	14	7	7	10	4	2	5	11	12	81	46	65	10	7	9	9	26	76	0	9	16	14
UK(E&W&NI)	804	1158	1463	1582	1456	1357	2969	1307	1148	642	658	334	281	206	130	207	425	118	406	460	0	0
UK (Scotland)	7884	8620	10181	12264	16130	22822	19358	13743	10054	9877	10402	8749	6274	6429	6091	7820	8476	8800	7613	5855	0	0
UK (Total)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8024	6315	6638	5044
Total	11783	13301	15519	18160	20920	27327	25757	19026	14885	13986	14714	12313	9390	9853	9117	11026	11385	5	10757	7609	8542	6884

***Preliminary.**

Table 5.2.4. Nominal landings (t) of Anglerfish in Division IIIa, as officially reported to ICES.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Belgium	15	48	34	21	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Denmark	493	658	565	459	312	367	550	415	362	377	375	369	215	311	274	227	255	287	344	270	251	308
France	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Germany	-	-	1	-	-	1	1	1	2	1	-	1	-	1	1	2	1	1	1	1	2	0
Netherlands							-	-	-	-	-	.	3	4	4	3	1	3	-	5	0	0
Norway	64	170	154	263	440	309	186	177	260	197	200	242	189	130	100	137	132	144	134	158	153	115
Sweden	23	62	89	68	36	25	39	33	36	27	46	55	71	73	79	54	44	51	…	43	26	43
Total	595	938	843	811	823	702	776	626	660	602	621	667	478	519	458	423	433	486	479	477	432	466

***Preliminary.**

Table 5.2.5. Anglerfish in Subarea VI. Landings, effort and lpue from the Irish OTB fleet.

Year	Hours (VIa)	Kw.Days (VIa)	Hours VIb)	kw.Days (VIb)	Landings (VIa)	Landings (VIb)	LPUE (VIa_Hours)	LPUE (VIa kw.days)	LPUE (VIb_Hours)	LPUE (VIb kw.days)
1995	56863	1408312	9029	599053	655	114	11.52	0.47	12.63	0.019
1996	60960	1388902	7219	469212	624	74	10.24	0.45	10.25	0.022
1997	63159	1462368	7169	377836	587	93	9.29	0.40	12.97	0.025
1998	57398	1343782	7337	403310	558	99	9.72	0.42	13.49	0.024
1999	54075	1348480	8680	437920	449	64	8.30	0.33	7.37	0.019
2000	52847	1325585	9883	613229	410	62	7.76	0.31	6.27	0.013
2001	47224	1320179	7232	593467	315	93	6.67	0.24	12.86	0.011
2002	35016	1007965	2626	217918	276	41	7.88	0.27	15.61	0.036
2003	39211	1536279	4543	478464	314	26	8.01	0.20	5.72	0.017
2004	35217	1279049	2234	205349	210	13	5.96	0.16	5.82	0.029
2005	30748	1075974	3844	216991	351	35	11.42	0.33	9.11	0.053
2006	28014	1031169	5903	464965	386	53	13.78	0.37	8.98	0.030
2007	25373	911973	6589	548392	467	69	18.41	0.51	10.47	0.034
2008	17327	630615	9740	n/a	295	78	17.03	0.47	8.01	n/a
2009	17108	567289	4354	n/a	332	91	19	n/a	20.90	n/a
2010	24870	825760	3280	n/a	525	107	21	n/a	32.53	n/a
2011	15199	n/a	2495	n/a	487	105	32	n/a	42.22	n/a

Landings in tonnes

Lpue estimates on '000 hours fished or '000 kw.days

Table 5.2.6. Total Danish Anglerfish landings (tonnes) by fishery (from logbook data).

Year			North Sea	tons			North Sea			IIIA	tons			IIIA	Grand Total
	Beam trawl	Demersal trawl	Industrial trawl	Lobster trawl	Other gear	Shrimp trawl	total	Beam trawl	Demersal trawl	Industrial trawl	Lobster trawl	Other gear	Shrimp trawl	total	(Tons)
1993	45	621	346	94	96	90	1293	12	262	9	163	83	34	564	1857
1994	59	827	196	285	93	60	1520	51	201	5	108	61	23	449	1969
1995	57	344	127	254	78	168	1027	82	97	1	62	48	21	312	1339
1996	17	762	130	282	42	234	1467	70	125	2	90	40	40	368	1834
1997	58	1148	105	57	33	89	1489	137	183	8	139	59	24	550	2040
1998	118	1036	96	41	62	102	1456	86	167	2	89	58	13	415	1871
1999	98	1127	86	39	69	77	1496	41	121	1	105	82	12	362	1858
2000	88	1066	68	16	52	56	1347	47	117	0	140	61	13	377	1724
2001	18	1343	67	7	53	52	1540	18	86	4	211	45	11	375	1915
2002	59	1268	53	86	42	54	1562	41	116	1	161	35	15	369	1931
2003	40	1515	30	59	28	42	1714	4	27	1	144	31	8	215	1929

Year			North Sea	tons			North Sea			IIIA	tons			IIIA	Grand Total
	Beam trawl	**Demersal trawl**	**Industrial trawl**	**Lobster trawl**	**Other gear**	**Shrimp trawl**	**total**	**Beam trawl**	**Demersal trawl**	**Industrial trawl**	**Lobster trawl**	**Other gear**	**Shrimp trawl**	**total**	**(Tons)**
2004	45	1524	42	67	83	48	1809	13	39	0	20	231	7	310	2119
2005	48	1423	26	97	15	16	1625	5	84	0	136	39	8	274	1898
2006	8	1454	10	96	9	9	1587	1	107	0	105	10	3	227	1814
2007	24	1020	10	67	10	2	1134	10	124	0	97	14	9	255	1389
2008	33	1162	1	86	18	8	1308	8	91	0	145	27	17	287	1595
2009	19	1186	0	133	35	8	1382	3	77	1	225	17	20	344	1725
2010	12	1242	0	45	34	4	1337	3	66	0	175	18	9	270	1607
2011	19	959	0	47	98	4	1127	1	30	0	194	17	10	251	1378

Tables 5.2.7. Total Danish effort (days fishing) by fishery (from logbook data).

Year			North Sea	days			North Sea			IIIA	days			IIIA	Grand Total
	Beam trawl	Demersal trawl	Industrial trawl	Lobster trawl	Other gear	Shrimp trawl	total	Beam trawl	Demersal trawl	Industrial trawl	Lobster trawl	Other gear	Shrimp trawl	total	(days)
1993	292	3370	4414	968	1286	1534	11864	228	2914	81	3452	651	928	8253	20117
1994	356	3694	1963	2423	971	831	10239	595	2267	42	1991	618	616	6129	16369
1995	360	1882	1896	2254	948	2526	9866	617	1586	23	1288	391	594	4499	14365
1996	110	2869	1597	2027	394	2364	9360	739	1267	29	1767	424	820	5046	14407
1997	221	4707	1562	729	461	1415	9096	980	1820	106	2207	526	468	6108	15204
1998	413	4482	1321	379	549	1702	8845	665	1447	14	1455	390	262	4234	13079
1999	523	5056	1069	409	648	1214	8919	475	1463	23	2305	621	237	5123	14042
2000	787	6297	808	285	699	1095	9970	568	1332	6	3007	438	314	5664	15634
2001	250	8165	1039	182	789	1122	11548	361	1047	42	3940	431	291	6111	17659
2002	536	7412	1155	740	689	1011	11544	432	1277	22	3115	370	253	5468	17012
2003	447	7952	530	714	306	814	10763	78	409	9	2436	301	192	3424	14187
2004	419	6210	517	356	623	592	8717	191	235	5	226	3195	154	4006	12723

Year	North Sea days						North Sea total	IIIA days						IIIA total	Grand Total (days)
	Beam trawl	Demersal trawl	Industrial trawl	Lobster trawl	Other gear	Shrimp trawl		Beam trawl	Demersal trawl	Industrial trawl	Lobster trawl	Other gear	Shrimp trawl		
2005	404	6123	242	440	180	259	7649	123	695	4	2359	513	205	3899	11548
2006	96	5912	125	543	174	154	7003	54	675	2	1758	124	65	2679	9682
2007	194	3808	106	362	107	36	4613	164	882		1475	135	214	2870	7482
2008	191	3985	38	469	189	104	4977	63	855	1	2517	230	492	4158	9136
2009	175	3936	11	362	338	136	4959	45	817	15	3015	177	579	4648	9607
2010	116	3468	0	255	428	126	4393	24	649	1	2772	198	374	4018	8411
2011	139	3380	2	273	970	143	4908	18	357		2957	222	458	4013	8921

Table 5.2.8. Abundance (millions of individuals - age 1 and older) and biomass (thousands of tonnes - age 1 and older) estimates from the 2005–2011 anglerfish surveys (SCO-IV-VI-AMISS-Q2) by ICES subareas and Divisions.

	Abundance (millions)							
ICES subarea/division	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Subarea IV (partial)	11.168	12.844	15.304	12.613	8.279	7.366	5.150	5.432
Division VIa	10.866	10.459	7.956	7.718	5.144	5.161	6.057	4.961
Division VIb	1.800	3.174	4.000	3.952	3.688	3.131	3.669	5.135
Subarea VI	12.666	13.633	11.956	11.670	8.832	8.292	9.725	10.096
Northern Shelf (partial)	**23.833**	**26.477**	**27.261**	**24.283**	**17.111**	**15.658**	**14.875**	**15.528**

	Biomass (thousand tonnes)							
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Subarea IV (partial)	18.642	21.921	28.534	29.721	17.058	21.944	14.949	15.106
Division VIa	14.096	12.175	11.072	14.383	8.150	11.590	9.330	9.213
Division VIb	5.879	6.889	10.786	9.442	12.852	8.745	8.974	12.005
Subarea VI	19.975	19.064	21.858	23.825	21.002	20.334	18.305	21.218
Northern Shelf (partial)	**38.617**	**40.985**	**50.392**	**53.546**	**38.060**	**42.279**	**33.254**	**36.325**

Table 5.2.9. Percentage change in mean stock biomass from 2008–2010 to 2011–2012 in ICES Areas IV, VI and the two combined.

Region	2008-2010	2011-2012	%change
			Biomass
IV	22,907	15,027	-34.40
VI	21,720	19,762	-9.02
IV & VI	44,628	34,789	-22.05

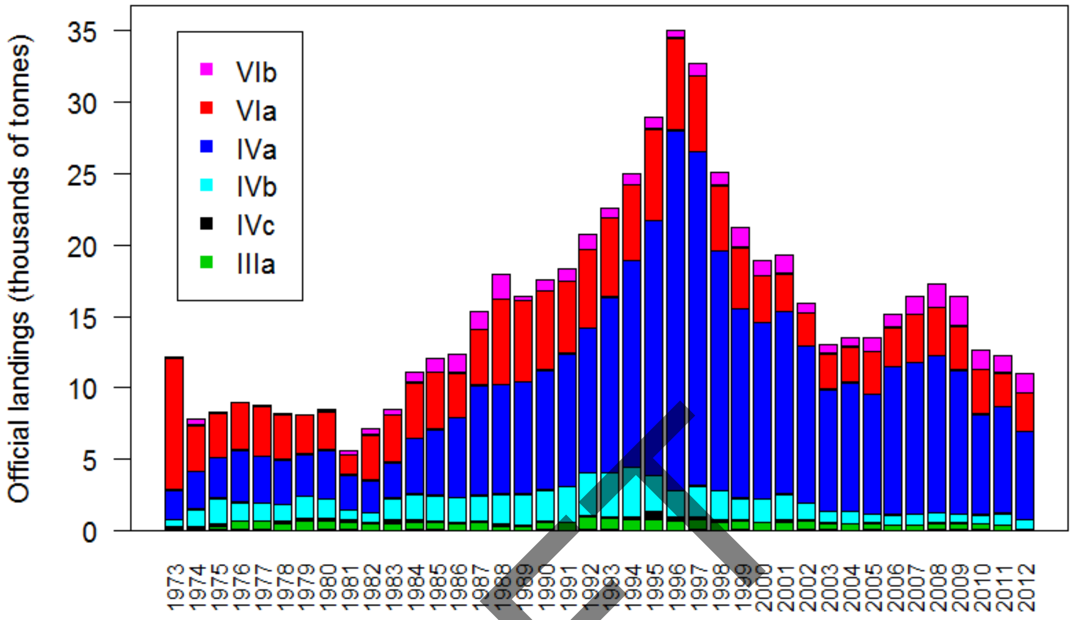


Figure 5.2.1. Northern Shelf anglerfish. Officially reported landings by ICES area.

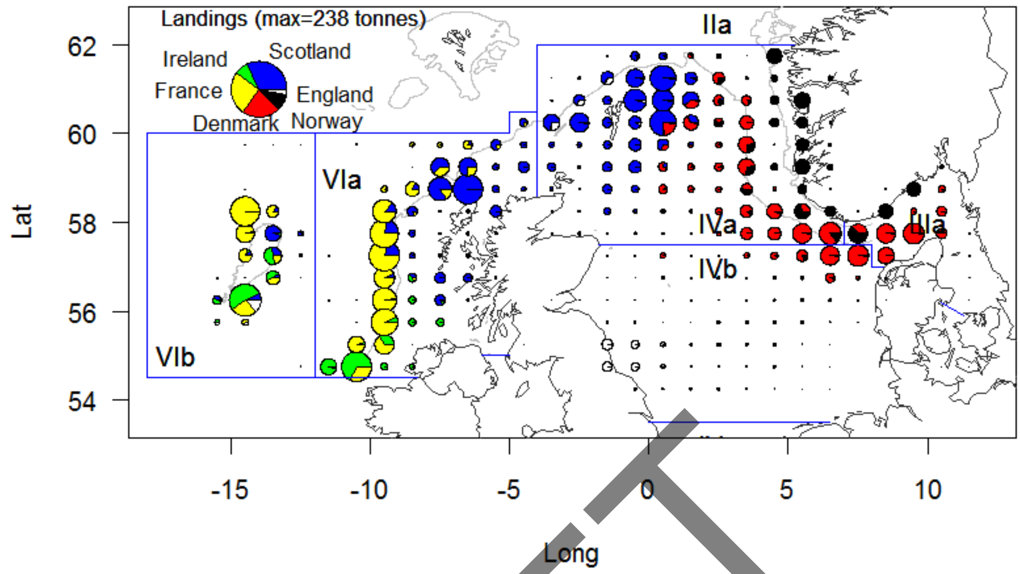


Figure 5.2.2 Map of the European Northern Shelf showing the distribution of reported landings of anglerfish for 2012 from Scotland, Ireland, France, Denmark, and Norway. The circles are centred on each ICES rectangle and segmented according to the landings of each country according to the legend. The legend is divided according to the total reported landings of each country. The area of each circle is proportional to the landings in tonnes relative to the maximum as indicated. The Scottish data have been corrected according to certain assumptions about area misreporting (see stock annex).

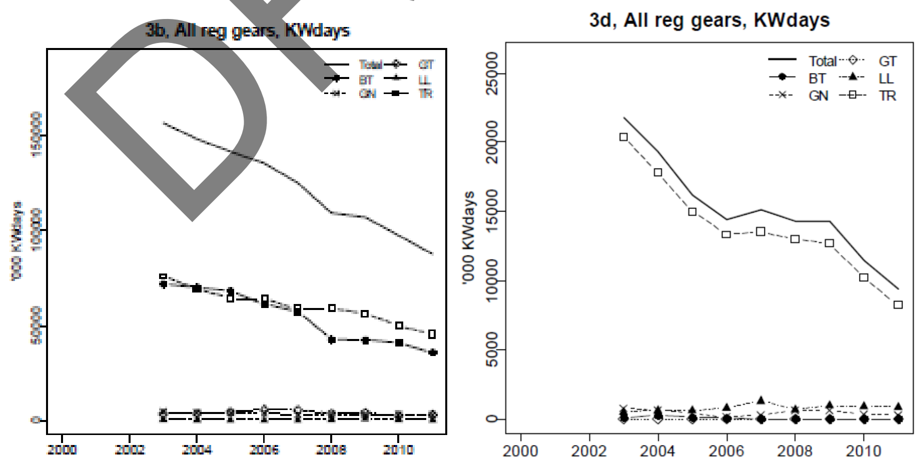


Figure 5.2.3. Trends in nominal international fishing effort in Skagerrak, North Sea & Eastern Channel (left) and West of Scotland (right) collated by STECF Evaluation of Fishing Effort Regimes in European Waters - Part 2 (STECF-12-16).

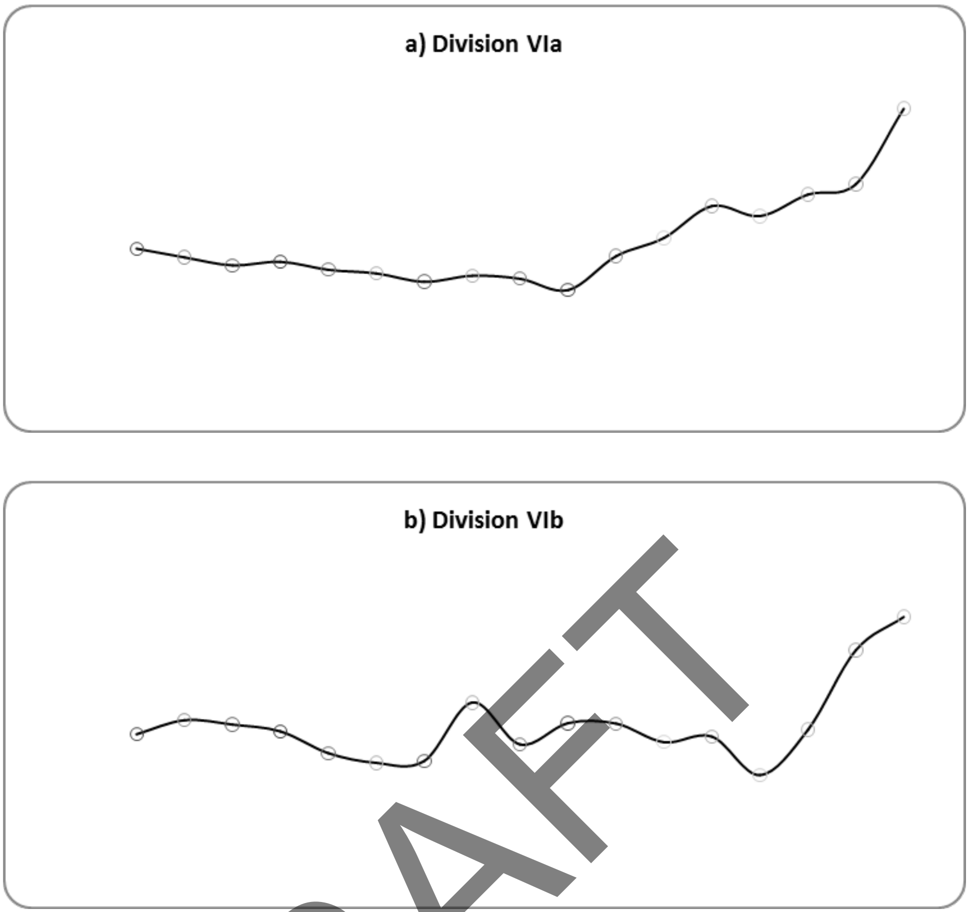


Figure 5.2.4. Lpue for the Irish otter trawl fleet with effort in hours fished for a) Division VIa, and b) Division VIb.

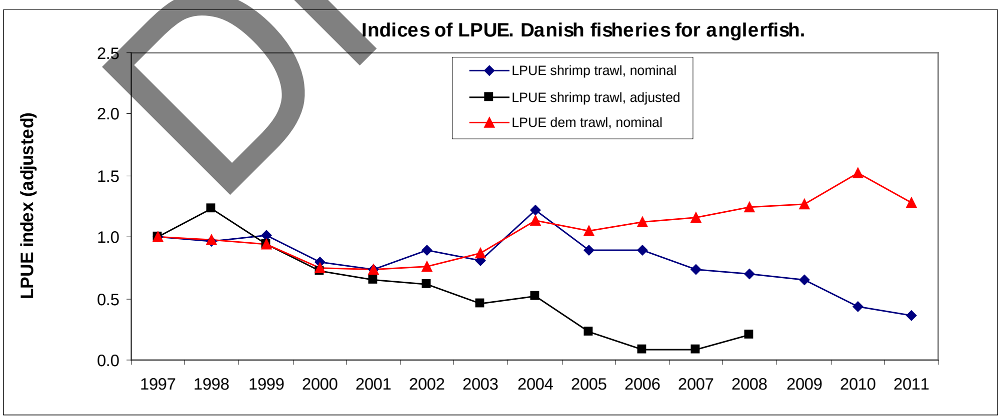


Figure 5.2.5. Anglerfish in the North Sea & Division IIIa. Danish lpue by demersal trawl and shrimp trawl, relative to 1997. Based on nominal logbook records.

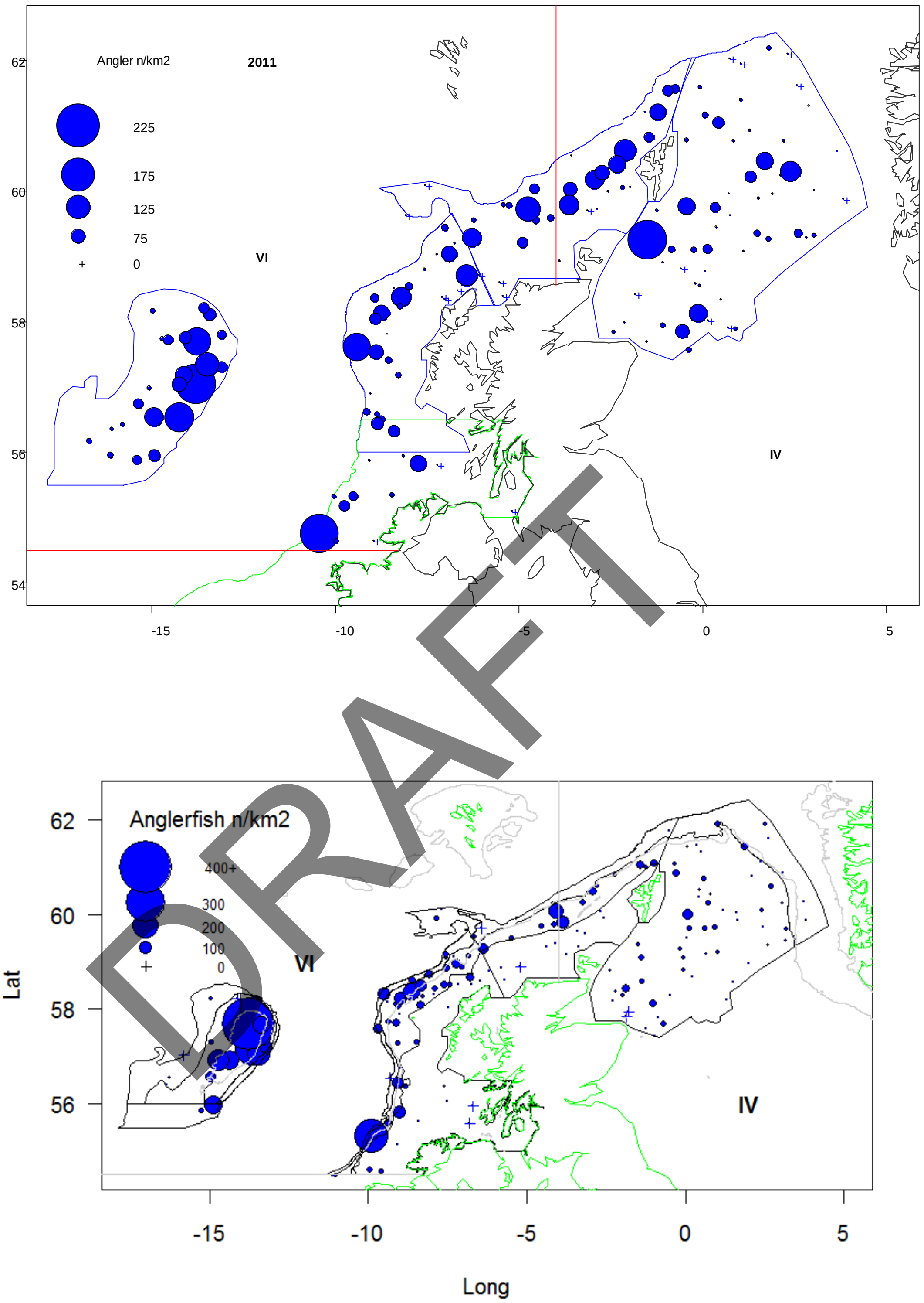


Figure 5.2.6. Map of the northern continental shelf around Scotland showing the number density of anglerfish during the 2012 surveys. Each circle is centred on the sample location and circle size is proportional to the number density in n/km² according to the legend (top left). Trawl densities in this figure account for herding but not footrope escapes. The grey lines separate the ICES sub-areas indicated by roman numerals: IV (east) and VI (west).

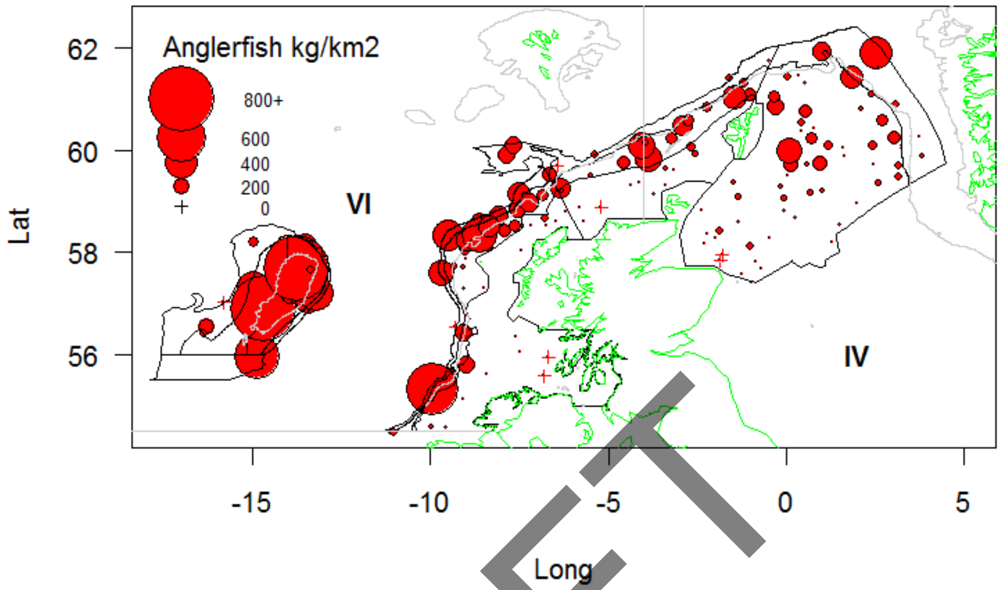


Figure 5.2.7. Map of the northern continental shelf around Scotland showing the weight density of anglerfish during the 2012 anglerfish survey. Each circle is centred on the sample location and circle size is proportional to weight density in kg/km² according to the legend. Trawl densities in this figure account for herding but not footrope escapes. The grey lines separate the ICES subareas indicated by roman numerals: IV (east) and VI (west).

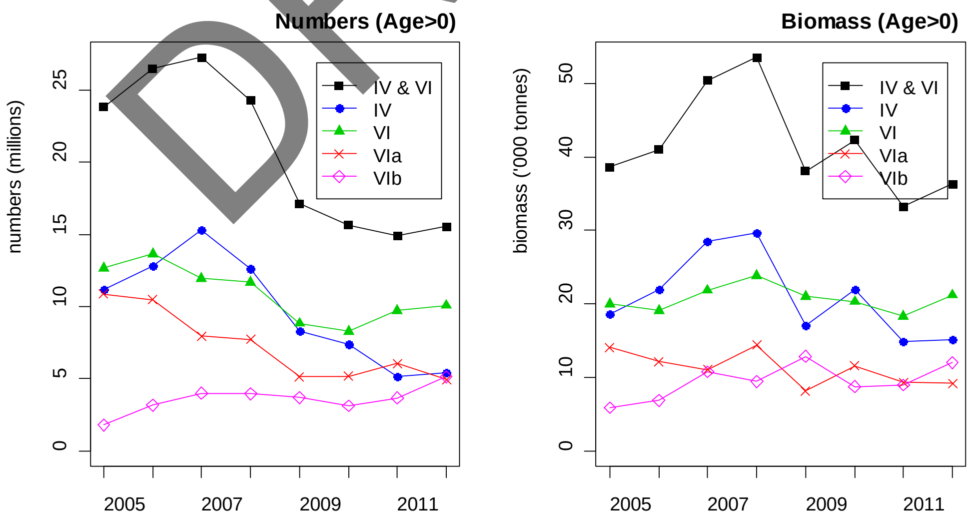


Figure 5.2.8. Estimates of total abundance (left) and biomass (right) of anglerfish for the Northern shelf (black filled squares). Estimates are also provided for ICES Subarea IV (blue filled squares), ICES Subarea VI (green filled triangles), Division VIa (red crosses) and Division VIb (pink open triangles).

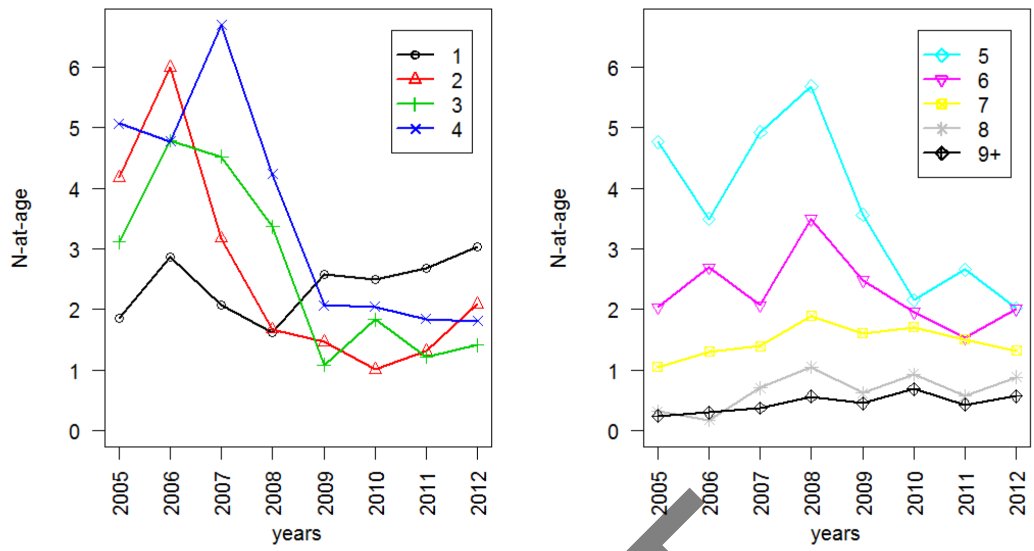


Figure 5.2.9. Estimates of total abundance-at-age for each of the anglerfish surveys 2005–2012. The abundance at different ages is shown as different lines on the graphs (black – age 1, red – age 2, green –age 3, blue – age 4, etc.) according to the legends.

5.3 Megrim in IVa and VIa (Northern North Sea and West of Scotland) and Megrim in VIb (Rockall)

Based on the recommendation of WGNSDS (2008), in addition to megrim in VI, WGCSE now also considers megrim in IVa and IIa. Spatial data from both the commercial fishery (using VMS and catches by statistical rectangle) and from fishery independent surveys provide little evidence to support the view that megrim in VIa and IVa are indeed separate stocks. Based on the recommendations from WKFLAT (2011), megrim in VIa and IVa are considered a single unit stock and assessed accordingly. Megrim in VIb is considered a separate stock unit for assessment purposes.

5.3.1 Megrim in IVa and VIa (Northern North Sea and West of Scotland)

Type of assessment in 2013

Due to ageing issues with megrim in VIa and IVa associated with low sampling size and depth dependent growth issues, a surplus production process model is used (Schaefer, 1954) following on from the exploratory Bayesian state space biomass dynamic model presented at WKFLAT(2011) and WGCSE (2011), the assessment method was subject to inter-benchmark in 2012 (IBP-MEG 2012).

The model describes the current exploitation of megrim relative to F_{MSY} and stock biomass relative to B_{MSY}. The biomass dynamics are given by a difference form of a Schaefer biomass dynamic model:

$$B_t = B_{t-1} + rB_{t-1}\left(1 - \frac{B_{t-1}}{K}\right) - C_{t-1}$$

where B_t is the biomass at time t, r is the intrinsic rate of population growth, K is the carrying capacity, and C_t is the catch, assumed known exactly. To assist the estimation the biomass is scaled by the carrying capacity, denoting the scaled biomass $P_t = B_t/K$. Lognormal error structure is assumed giving the scaled biomass dynamics (process) model:

$$P_t = \left(P_{t-1} + rP_{t-1}(1 - P_{t-1}) - \frac{C_{t-1}}{K}\right) e^{u_t}$$

where the logarithm of process deviations are assumed normal $u_t \sim N(0, \sigma_u^2)$; σ_u^2 is the process error variance.

The starting year biomass is given by $B_{1985} = aK$, where a is the proportion of the carrying capacity in 1980.The biomass dynamics process is related to the observations on the indices through the measurement error equation:

$$I_{j,t} = q_j P_t K e^{\varepsilon_{j,t}}$$

where $I_{j,t}$ is the value of abundance index j in year t, q_j is index-specific catchability, $B_t = P_t K$, and the measurement errors are assumed lognormally distributed with $\varepsilon_t \sim N(0, \sigma_{\varepsilon,j}^2)$; $\sigma_{\varepsilon,j}^2$ is the index-specific measurement error variance.

ICES advice applicable to 2012

ICES advises that effort should be consistent with no increase in catches.

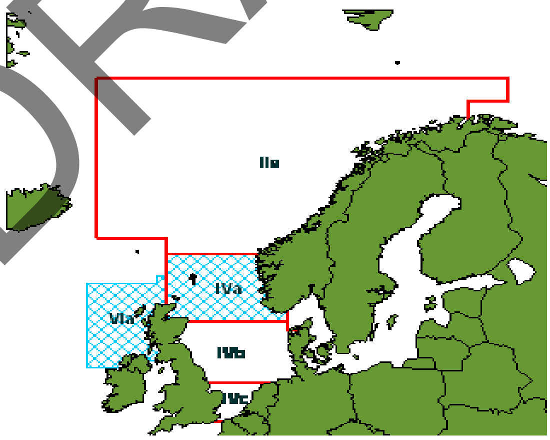
ICES advice applicable to 2013

ICES advises on the basis of the MSY approach that landings in 2013 and 2014 should be no more than 4700 t.

5.3.1.1 General

Stock description and management units

Megrim stock structure is uncertain and historically the working group has considered megrim populations in VIa and VIb as separate stocks. The review group questioned the basis for this in 2004. Data collected during an EC study contract (98/096) on the 'Distribution and biology of anglerfish and megrim in the waters to the west of Scotland' showed significantly different growth parameters and significant population structure difference between megrim sampled in VIa and VIb (Anon, 2001). Spawning fish occur in both areas but whether these populations are reproductively isolated is not clear. As noted by WGNSDS (2008), megrim in IVa has historically not been considered by ICES and WGNSDS (2008). Since 2009 data from IV and IIa are included in this report, but international catch and weight-at-age data for IV prior 2006 was not available to the working group or WKFLAT (2011). Given that there is little evidence to suggest that megrim in VIa and IVa are separate stocks, based on a visual inspection of the spatial distribution of commercial landings and fishery independent survey data, WKFLAT (2011) concluded that megrim in VIa and IVa should be considered as a single stock. This has subsequently been supported through recent genetic studies (MacDonald and Prieto, 2012) indicating that there is one stock consisting of Divisions IVa (northern North Sea) and VIa (West of Scotland) and another separate stock in Division VIb (Rockall). As a consequence, the assessment area is now incompatible with the management area.



Management area (red boxes) and assessment area (blue hatched boxes)

Species: Megrims *Lepidorhombus* spp.		Zone: EU waters of IIa and IV (LEZ/2AC4-C)
Belgium	6	
Denmark	5	
Germany	5	
France	32	
The Netherlands	25	
United Kingdom	1 864	
Union	1 937	
TAC	1 937	Analytical TAC

Species: Megrims *Lepidorhombus* spp.		Zone: EU and international waters of Vb; VI; international waters of XII and XIV (LEZ/56-14)
Spain	385	
France	1 501	
Ireland	439	
United Kingdom	1 062	
Union	3 387	
TAC	3 387	Analytical TAC

2012 TAC for VI, EC waters of Vb and international waters of XII and XIV

COUNTRY	TAC	WG LANDINGS[2]	% TAC UPTAKE[1]
Spain	385	204	53%
France	1501	140	9%
Ireland	439	334	76%
UK	1062	678	64%
EU	3387	1356	40%
TAC	3387		

[1] **post regulation quota swaps have not been taken into account.**

[2] **Provisional figures.**

The uptake of the TAC for ICES Division VI and EU waters of Vb was 40% in 2012. Uptake varied considerably between countries. France, which holds much of the quota allocation, utilised only 9% of its allocation. This pattern is typical. It should be noted that no landings data were made available to the working group by Spain therefore the uptake during 2010 will be higher, while historically Spanish uptake has been low, this has increased in recent years.

In ICES Area IV and IIa, 77% of the TAC was used in 2011. The majority of available TAC is allocated to the UK.

2011 TAC for EC IV and IIa

	TAC	WG LANDINGS[1]	% TAC UPTAKE
Belgium	6	0	3%
Denmark	5	36	720%
Germany	5	4	80%
France	30	5	17%
Netherlands	24	16	67%
UK	1775	1397	79%
EC	1845	1458	79%

[1] **post regulation quota swaps have not been taken into account.**

Fishery in 2013

The introduction of the Cod Long-Term Management Plan (EC Regulation 1342/2008) and additional emergency measures applicable to VIa in 2009 (EC Regulation 43/2009, annex III 6) has impacted on the amount of effort deployed and increased the gear selectivity pattern of the main otter trawl fleets. Figure 5.3.1 shows the effort pattern for the main fleets catching megrim in VIa. Additionally, EC regulation 43/2009 has effectively prohibited the use of mesh sizes <120 mm for vessels targeting fish, which had been used particularly by the Irish fleet up to that point, the resultant rapid decline in effort for this category (IRE TR2) can be seen in Figure 5.3.1 Much of the effort has been transferred into the TR1 fleet. Effort associated with the French fleet has continued to decline while the substantial declines seen in the Scottish TR1 fleets (120 mm mesh) appears to have stabilized at levels well below the earlier part of the time-series. The increase in mesh size (from 100 to 120 mm) has also impacted on the retention length of megrim, increasing L50 from 28 cm to 42 cm, an increase of almost 50%.

Fishing effort in IVa (Figure 5.3.2) for the main Scottish otter fleets (TR1 and TR2) have stabilized since the large total effort reductions observed between 2000 and 2003.

An overview of the data provided and used by the WG is provided in Table 2.1.

Landings

Official landings data for each country together with working group best estimates of landings from VIa are shown in Table 5.3.1 and for IVa in Table 5.3.2. The distributions of landings by statistical rectangle for 2012 in VIa, IVa and VIb are shown in Figure 5.3.3. Note that this does not include French and Spanish data. The WG best estimates of landings are those supplied by stock coordinators of the various countries and differ from the official statistics in some years. These were supplied for VIa by Ireland, France and UK in 2011 and by UK for Division IVa. Landings have increased in recent years and are more in line with historical trends.

Catches of megrim comprise two species, *Lepidorhombus whiffiagonis* and *L. boscii*. Information available to the Working Group indicates that *L. boscii*, are a negligible proportion of the Scottish and Irish megrim catch (Kunzlik *et al*., 1995; Anon, 2001). It is not clear to the WG whether landings of other countries are accurately partitioned by megrim species. Megrim are caught in association with anglerfish by some fleets and are area-misreported along with anglerfish. Previously, the reported Division VIa landings have been adjusted to the Working Groups estimate of catch by including landings declared from Subarea IVa in the ICES statistical rectangles immediately east of the 4 degree W line (see anglerfish stock annex for a detailed methodology). Area-misreporting peaked in 1996 and 1997 when around 50% of the estimated working group landings for Division VIa were area-misreported. The correction process has not been conducted for the past two years. There are indications that more recently the process has reversed. Laurenson and MacDonald (2008) note that in more recent years that megrim TAC in the North Sea has become more restrictive and anecdotal evidence suggest that megrim catches from IVa are misreported as coming from Division VIa. Therefore, because of conflicting information on the potential direction of area-misreporting, megrim landings at a statistical rectangle level has not been adjusted. However, the decision to consider megrim in VIa and IVa as single unit stock negates this problem. However, it is unknown whether misreporting from Division VIb is an issue.

Discards

Raised discard data were made available by Scotland (VIa and IVa) and Ireland (VIa). Scottish data give a discard rate (by weight) of 5% and 31% for IVa and VIa respectively. Un-raised discard data was provided by France. Irish discards were 3% by weight. Discards were estimated to be 15% by weight for the stock area in 2012.

Laurenson and MacDonlad (2008) note that while discarding of megrim below minimum landing size is low (<1%), discarding of legal sized fish was much higher at 22% over the six observed trips. This is attributed to low market price for small grades and bruised fish, resulting in high grading of catches on length/quality reasons to maximise the value of a restrictive quota. Other studies (BIM, unpublished data) show that high grading of damaged fish is in the range of 10 to 15% of the marketable megrim catch. A historic time-series of discards for all areas and fleets in not available and in general, discard data for this stock is very sparse and intermittent. As catch weights are required for the model, sensitivity runs contrasting runs using landings data only and runs with different historic levels of discards (fixed 15% discard rate over time-series and linear decline from 30 to 15%) have been undertaken (see Section 5.3.1.3).

Surveys

Indices from six fishery-independent surveys are used in the assessment. These comprise of the Scottish North Sea IBTS survey (IBTSWG, 2011), Scottish quarter 1 (ScoGFS-WIBTS-Q1) and quarter 4 (ScoGFS-WIBTS-Q4) West of Scotland survey and the Scottish (SAMISS-Q2) and Irish (IAMISS-Q2) dedicated anglerfish survey which provides estimates of absolute biomass and abundance (see Reid *et al*., 2007 for further details), however the survey also catches significant quantities of megrim, but as there are no estimates of catchability, for the purposes of this work, the indices are treated in a relative sense.

NUMBER	SURVEY	NATIONALITY	AREA	TIME SERIES	DEPTH RANGE(M)
1	Sco-IBTS-Q3	Scotland	IVa	1987–2011	<400 m
2	Sco-IBTS-Q1	Scotland	IVa	1987–2011	<400 m
3	ScoGFS-WIBTS-Q1	Scotland	VIa	1986–2010	40–400
4	ScoGFS-WIBTS-Q4	Scotland	VIa	1986–2010	50–300
5	SAMISS-Q2	Scotland	VIa*/IVa	2005–2011	50–1050
6	IAMISS-Q2	Ireland	VIa*	2005–2011	50–850

The surveys adequately cover the distribution of the stock. The start positions from all six surveys with the distribution of reported megrim landings by statistical rectangle (VIa and IVa) and VMS data associated with megrim landings (VIa only) for 2009 (last year of complete landings data attributed to ICES rectangles) is shown in Figure 5.3.4.

The anglerfish surveys cover a depth range of up to 1050 m (SAMISS-Q2/IAMISS-Q2) while the Sco-WIBTS surveys are distributed to depths of 400 m. In 2011 both the groundgear and the survey design associated with the ScoGFS-WIBTS Q1 and Q4 surveys were changed. Rather than relying on fixed trawling locations moved to a new random-stratified survey design with trawl locations randomly distributed within 10 *a priori* sampling strata. While there were rationale reasons for these changes, it has resulted in a breach in the time-series and it will not be possible to use these indices until a reasonable time-series, ca. five years, has been built up. The indices from the six surveys, together with commercial landings are given in Table 5.3.3.

5.3.1.2 Estimation of survey cpue indices

International Bottom Trawl Surveys (IBTS)

IBTS survey data from Scottish groundfish survey data (surveys 1–4 shown above) are available for quarters 1 and 4 in ICES Area VIa and quarters 1 and 3 in ICES Area IVa north. The survey design is based on ICES statistical rectangles. One tow is selected per rectangle based on a library of clean tows. The tow location is largely the same every year and as such the design may be considered fixed station although minor changes to tow locations can occur.

Catch weights are not routinely collected on all IBTS surveys so the length data was converted to weight using the length–weight relationship

$$W = 0.0047L^{3.13} \qquad [1]$$

where W is the weight in grams and L is the length in centimetres. This relationship was estimated using all available megrim length–weight measurements from the dedicated monkfish survey. The weights were then raised by the numbers at length per tow and summed to provide a catch in kilograms per tow. This was divided by the duration of the tow in decimal hours to provide a cpue measured in units of kg.hr-1.

The data from all four surveys exhibit a relatively large proportion of zeros; therefore the delta method of Stefánsson (1996) was used to extract indices. This method (delta-gamma model) comprises fitting two generalized linear models. The first model (binomial GLM) is used to obtain the proportion of non-zero tows and is fit to the data coded as 1 or 0 if the tow contained a positive or zero cpue, respectively. The second model is fit to the positive only cpue data using a gamma or lognormal GLM.

The data are modelled at the level of the station (largely synonymous with tow for a quarterly fixed-station survey design). The binomial data were modelled as follows:

$$\ln\left(\frac{p_{st}}{1-p_{st}}\right) = \alpha_1 + \delta_{1,s} + \gamma_{1,t} \qquad (2)$$

where p_{st} is the probability of non-empty tow at station s in year t - note the logit link function; $\delta_{1,s}$ is the station (ICES rectangle) effect (number subscript used to differentiate from parameters of the second GLM below); stratum effects (strata defined as sampling areas 40—48 for VIa surveys and roundfish areas in IVa) were included as alternatives to the more spatially resolved station effects or potentially modelled in a nested hierarchy (not considered further here); and $\gamma_{1,t}$ is the year effect. Additional covariates such as depth could also be included here. The predominantly best fitting model by survey (lowest AIC) of those considered (from a single overall mean; yearly effects only; stratum effects only; station effects only and various combinations) was that given in Equation 2, i.e., including year and station effects. Quarter 4 in VIa differed in that year was not significant (proportion of non-zero tows constant across time).

Positive cpue observations were modelled using a gamma-distributed GLM with a log link. The linear predictor given by

$$\ln(\mu_{st}) = \alpha_2 + \delta_{2,s} + \gamma_{2,t} \qquad (3)$$

where μ_{st} is the mean positive cpue at station s in year t - note the log link function; $\delta_{2,s}$ is the station effect; again, stratum effects were included as alternatives to the more spatially resolved station effects; and $\gamma_{2,t}$ is the year effect. The best fitting model was that given in Equation 3. Model diagnostics including Q-Q plots of the residuals indicated the suitability of the gamma distribution; although the percentage of the deviance explained was only 42% (VIa Q1), indicating substantial unexplained variability in the data.

The estimated probability of a non-zero tow and the mean of the positive tows were combined to produce the mean estimated cpue per station by year:

$$\widehat{CPUE}_{st} = \hat{p}_{st}\hat{\mu}_{st} \qquad (4)$$

These values are combined across stations within strata by the taking the average of the station-level estimates by stratum. Similarly, the overall mean is then taken as the average of the stratum-level means (Stefánsson, 1996).

Anglerfish survey indices

Scottish (SAMISS) and Irish (IAMISS) dedicated anglerfish surveys (surveys 5–6 shown above) have been undertaken in VIa and IVa (SAMISS only) since 2005. The survey design is stratified based on expected densities of anglerfish (not megrim), within each strata, the location of individual tows are randomly selected. The modelling approach of Stefánsson, (1996) is mainly applicable to a fixed station design and therefore for the anglerfish indices we used the weighted cpue estimates and allow the observation error to be estimated within the model. The anglerfish survey provides absolute estimates of abundance and biomass. The average fish density at age a in stratum s, ρ_{as}, is estimated from the weighted mean of fish densities corrected for the catchability of each trawl, as follows:

$$\hat{\rho}_{as} = \sum_{i \in s} w_i \left\{ \sum_{l \in a} \frac{n_{lai}}{v_{1i} \hat{Q}_{li}} \right\} = \sum_{i \in s} w_i \left\{ \sum_{l \in a} \frac{n_{lai}}{\hat{e}_l (v_{1i} + v_{2i} \hat{h})} \right\}$$

where:

n_{lai} is the number of fish of age *a* and length *l* caught in trawl *i*,

$$w_i = \frac{v_{1i} + v_{2i}}{\sum_i (v_{1i} + v_{2i})},$$

v_{1i} is the area swept by gear in trawl *i* (the area swept by the wing),

v_{2i} is the sweep area of gear in trawl *i* i.e. the area swept by the door minus that swept by the wing,

$\hat{Q}_{li} = \hat{e}_l + \hat{e}_l \hat{h} \frac{v_{2i}}{v_{1i}}$ is the catchability estimate for a fish of length *l* in trawl *i*, following the definition by Somerton *et al*. (2007),

$\hat{e}_l$ is the estimated footrope selectivity at length *l*, is the proportion of fish of length *l* originally in the area swept by the wing which are caught by the net and do not escape under the footrope,

$\hat{h}$ is the estimated herding coefficient. ($\hat{h}$=0.017).

It should be noted that the methods outlined above were specifically designed for anglerfish. The most significant issue for megrim is that as there is no estimates of footrope selectivity, $\hat{e}_l$ is assumed to be 1. While this is not an issue when the survey indices are treated in a relative sense as presented here for megrim, Fernandes (2010) does use this approach to provide a raised absolute biomass based but notes that due to the full retention assumption for groundgear selectivity, the estimates are considered as a minimum estimate.

Cpue trends and length analysis of survey data

The modelled cpue trends from indicate that the Sco-WIBTS-Q3 and Sco-WIBTS-Q1 surveys appear to show an increase in cpue earlier when compared to the other surveys (Figure 5.3.5).

The results from mixture distribution model (Figure 5.3.6) shows that there is clear bimodal and multimodal distribution in some of the survey data. In particular the IBTS surveys (Sco-WIBTS Q1/Q4 and Sco-IBTS Q1 /Q3) in some years show discrete modes around 20 cm. This may offer up the possibility to use survey data as a means to estimate the strength of incoming year classes before they enter the fishery and could therefore be used as the basis for estimating future catch options. Further work is proposed. In contrast, the SAMISS and IAMISS surveys do not appear to catch these smaller length classes, although the component model does indicate some catch, this is probably due to the larger trawl and cod-end mesh size used in these surveys (100 mm).

Commercial cpue

Logarithmic lpues for Scottish, French and Irish vessels split by mesh bands corresponding to gear groups TR1 (>100 mm) and TR2 (>70–100 mm) as defined by 1342/2008 are available for, VIa (Ireland, France, Scotland) and IVa (Scotland) based on data presented to SGMOS 09-05 (Part 2). These are presented in Figure 5.3.7 (IVa/VIa). Between 2005 and 2010, both the commercial lpues and the survey cpues trends are reasonable consistent across fleets with all showing generally positive increases. It should be noted that the IRE TR2 fleet has been discontinued due to the prohibition of mesh sizes <120 mm for vessels targeting fish (EC regulation 43/2008).

Since 2007, the lpues for both the SCO TR1 and FR TR1 fleets show a dramatic increase as has the IRE TR1 since 2008 in VIa. These signals give a much stronger positive signal than the survey-series during this period. It is not possible to determine how much this could be attributed to changes in megrim abundances or changes in targeting behaviour, but there is anecdotal information from the fishery that indicate changes in targeting behaviour. Over the period, there have been reduced fishing opportunities for other species (e.g. cod) and reduced effort allocations inside the West of Scotland management line, particularly affecting Scottish and Irish vessels; this may have resulted in increased targeting of anglerfish and megrim to the west of the management line, where effort opportunities are far less constrained.

5.3.1.3 Stock assessment

The input data for the stock assessment is given in Table 5.3.3. This comprises of a time-series from all six surveys and landings data presented to the working group.

International landings data collated by the ICES Working Group on the Celtic Seas Eco-region (WGCSE) is used as an estimate of catch. However, discarding is a feature of the key fisheries but note that discard data is not available for the entire time-series. The availability or raised discard data is highly variable across fleets and areas and prior to 2000, discard data from VIa and VIb was combined into a single VI estimate.

To assess the sensitivity of the model outputs to this assumption, two alternative model runs with (i) a fixed 20% discard proportion over the full landings time-series and (ii) a linear decline in proportion from 30% at the start of the time-series to 15% at the end (see discards section). It is probable that the proportion of megrim discarded in IVa has declined since 2000 and in VIa since 2009 the mesh size in the North Sea increased from 100 to 110 mm and was further increased to 120 mm in 2001, while in Division VIa, the mesh size was increased from 100 to 120 mm in 2009. It is therefore likely that the discarding profiles have probably changed significantly in line with these mesh size increases.

Previous runs have shown that the inclusion of discard data has some impact on the output.

Parameter	Landings only	Fixed 15%	Slope 30–15%	%diff. 15%	% diff. Slope
r.hat	0.59	0.61	0.62	3%	5%
K.hat	32996	35760	38536	8%	14%
MSY	4539	5147	5645	12%	20%
F_{MSY}	0.29	0.30	0.31	3%	5%
B_{MSY}	16498	17880	19268	8%	14%
B_{2011}	26762	28697	30617	7%	13%
F_{2010}	0.15	0.14	0.13	-8%	-18%
B_{lim}	4949	5364	5780	8%	14%
B_{trig}	8249	8940	9634	8%	14%

Effectively, the inclusion of discard information into the catch introduces more fish into the system back in time. As a result the carrying capacity (K) is scaled upwards by 8% and 14% for the fixed 15% discard and linear decline from 30–15% respectively. This impacts on all the biomass estimates and biomass reference points. The impact on *r* less pronounced (3 and 5%) and as a consequence there is less impact on the F_{MSY} (F_{MSY} = r/2). Despite increase in catch final year estimate of fishing mortality (F_{2010}) revised downwards. IBP-MEG (2012) concluded that in the absence of a historic time-series of discard data, the assumption of a linear decline is appropriate given the technical changes in the fishery. In future discard estimates from national observer programmes will be used.

2013 Final run

The survey cpue indices and landings data used are provided in Table 5.3.3 and model priors are presented in Table 5.3.4. The final run assumed a linear decline in discards from 30 to 15% over time. There is no deviation from the agreed stock annex.

Figure 5.3.8 shows the trends in landings of VIa and IVa (solid line) with an overall catch estimate (dashed line) and estimated trends in total biomass and exploitation rate (upper panels). Trends in annual cpue estimates from all the surveys used in the surplus production model are shown. The solid line is the modelled cpue trend across all surveys. A plot contrasting the prior and posterior assumed and estimated if given in Figure 5.3.9.

It is noted that the modelled cpue trend tends to deviate in recent years from the raw cpues for the SCO Q1 IVa and SCO Q3 IVa surveys. This can be seen more clearly in the survey residuals plot in Figure 5.3.10 with a sequence of positive residuals from 2005 onwards. This is a consequence of the low interannual variation in cpue from the monk VIa (SAMISSQ2/IAMISSQ2) and monk IVa(SAMISSQ2) surveys and the in comparison to the mush higher interannual variation seen in the other 'IBTS' surveys. As a result the model places more weighting on the two 'monk' surveys. As a sensitivity analysis, a run excluding the Sco-IBTS-Q3 survey was undertaken. This had the result of greatly expanding the credible intervals on both biomass and harvest ratio estimates. This resulted in unrealistic estimates of fishing mortality and biomass being obtained when the SCO-NSIBTS Q3 and Q1 surveys were reduced indicating that in spite of the apparent trends in residuals they continue to provide important information to the assessment model. Similarly, a run was undertaken excluding the two monk surveys to assess whether they are having a strong influence over the model given their low residuals. This again resulted in increasing the credible intervals but with limited impact on the underlying trend in the model. A slight increase in both K and r was noted when the last five years of data were omitted from the SAMISS Q2 series.

The model output in terms of current stock status and exploitation relative to biomass and mortality reference levels are presented in Table 5.3.5. The MSY is estimated at 5565 tonnes and fishing mortality in 2011 was estimated at 0.13, considerably lower than F_{MSY} (0.32). The trends in F and biomass over the full time-series are shown in Figure 5.3.11 and tabulated together with the ratio of B/B_{MSY} and F/F_{MSY} in Table 5.3.6.

Comparion with last year's assessment: The results are presented in terms of the estimated B/B_{MSY} and F/F_{MSY} inferences (Figure 5.3.12).

In age-disaggregated models, biomass and fishing mortality trajectories would be expected to converge back in time as cohorts become exhausted and estimates of catch-at-age become more precise. Such patterns should not be expected with surplus production methods as the *K* and *r* estimates can vary according to the potential contrast that additional years of data offer as such, with between year variation in *K* and *r*, the entire times-series is recalculated.

5.3.1.4 Historical stock development

State of the stock

The biomass dynamic model estimates that over the available time-series that the stock has been only moderately exploited with fishing mortality being below F_{MSY} for almost the entire time-series. Stock biomass is estimated to be well above B_{MSY}.

5.3.1.5 Short-term projections

The assessment method outputs a range of management objectives, including the yield at F_{MSY}, F_{2011}, B_{MSY}, $B_{MSY\ trigger}$ (50% B_{MSY}) and B_{lim} (30% B_{MSY}). However, as there is no recruitment estimate for megrim it is not possible to construct a traditional style catch forecast for management purposes but catch advice is based on fishing at F_{MSY} with associated biomass projections.

Following the ICES MSY approach implies a fishing mortality at F_{MSY} = 0.33, resulting in catches of no more than 7000 tonnes in 2014. If discard rates do not change from the average of the last three years, this implies landings of no more than 5950 tonnes. The probability of the biomass falling below MSY $B_{trigger}$ is 1%. Catch options ranging from 3000 tonnes to 7000 tonnes are presented in Table 5.3.7.

5.3.1.6 Biological reference points

Precautionary approach reference points

F_{MSY}, B_{MSY} and the yield at MSY are all directly estimated in the model. It should be noted that these will vary when new survey and catch information is added. $B_{trigger}$ and B_{lim} are defined as 50%B_{MSY} and 30%B_{MSY} respectively. F_{lim} is defined as 1.7F_{MSY} and is the F that drives the stock to B_{lim} assuming B_{lim}=30%B_{MSY}. The derivation is given below:

$P=rB(1-B/K)$

The surplus productivity associated with *Blim* is:

$Plim=rBlim(1-Blim/K)$

The corresponding *F* is:

$Flim=rBlim(1-Blim/K)/Blim = r(1-Blim/K)$

$Blim=0.3Bmsy = 0.3K/2$

$Flim = r(1-0.3K/(2K)) = r(1-0.3/2) =0.85r$

$Fmsy=r/2$, let x denote the proportionality between *Fmsy* and *Flim*

$xFmsy=Flim$

$x(r/2)=0.85r$

$x=2*0.85$

$x=1.7$

Yield-per-recruit analysis

It was not possible to define $F_{0.1}$ and F_{MAX} values for this stock due to the lack of international catch-at-age data and recent changes in fleet selectivity due to likely changes in targeting behaviour and recent changes in mesh selectivity, which, if fully implemented, will result in a significant change in age selectivity in the fishery.

5.3.1.7 Uncertainties and bias in assessment and forecast

The age-aggregated biomass dynamic model provides estimates of total fishing mortality. Biomass estimates are influenced by one of surveys (IAMISS/SAMISS VIa), although the trends in biomass are consistent with the other surveys used in the assessment and indicator trends in commercial cpue indices.

5.3.1.8 Recommendation for next benchmark

This stock was recently subject to an inter-benchmark (IBP-MEG, 2012). Due to incomplete age data, particularly for IVa, a Bayesian state–space surplus production model has been used. Further work is proposed to investigate the utility of the survey data as an estimate of recruitment.

5.3.1.9 Management considerations

The TAC in VI has not been fully utilised. However, the uptake rate is country specific, with full uptake being reported by some member states. Partial quota by individual member states may be an artefact of reduction in effort rather than reflective of a reduction in biomass. The TAC and assessment area are incompatible. There are two separate TAC areas covering ICES Areas VI and IV whereas the assessment covers

ICES Divisions VIa, and IVa combined. Due consideration of the inconsistency between management and assessment area is required when setting fishing opportunities for this stock and the separate VIb Rockall stock. ICES (2013) have advised the EC that the TAC areas should be consistent with the assessment area and that ICES has no basis on how to split the catch advice so that it is consistent with the TAC areas.

5.3.1.10 References

Kunzlik, P. A., A. W. Newton and A. W. Jermyn. 1995. Exploitation of monks (*Lophius* spp.) and megrims (*Lepidorhombus* spp.) by Scottish fishermen in ICES Division VIa (west of Scotland). Final report EU FAR contract MA-2-520.

Laurenson, C. and MacDonald, P. 2008. Collection of fisheries and biological data on megrim in ICES Subarea IVa. Scottish Industry Science Partnership Report No 05/08.

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Stefánsson, G. 1996. Analysis of groundfish survey abundance data: combining the GLM and delta approaches. *ICES Journal of Marine Science*, 53, 577—588.

5.3.2 Megrim in VIb

Type of assessment in 2011

Based on the recommendation of WGNSDS (2008), in addition to megrim in VI, WGCSE now also considers megrim in IVa and IIa. Spatial data from both the commercial fishery (using VMS and catches by statistical rectangle) and from fishery-independent surveys provide little evidence to support the view that megrim in VIa and IVa are indeed separate stocks. Based on the recommendations from WKFLAT (2011) Megrim in VIb is considered a separate stock unit for assessment purposes.

The stock was benchmarked in 2011 (WKFLAT, 2011) and an exploration of landings numbers-at-age for VIa only was undertaken. However, due to lack of specific ageing data from VIb, precludes the development of an age-based assessment.

The current assessment is based on survey trends in relative biomass from the ISP-Anglerfish survey conducted annually in VIa, IVa and VIb.

ICES advice applicable to 2012

ICES advises that effort should be consistent with no increase in catches.

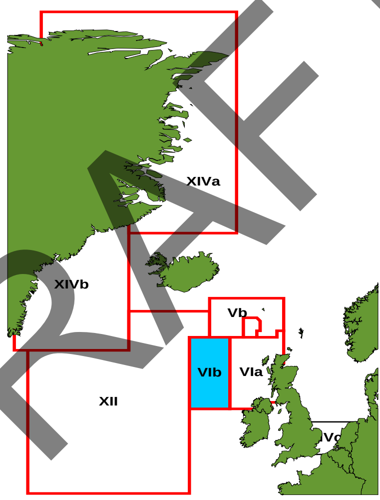
ICES advice applicable to 2013

ICES advises on the basis of precautionary considerations that there should be no increase in catch.

5.3.2.1 General

Stock description and management units

Megrim stock structure is uncertain and historically the working group has considered megrim populations in VIa and VIb as separate stocks. The review group questioned the basis for this in 2004. Data collected during an EC study contract (98/096) on the 'Distribution and biology of anglerfish and megrim in the waters to the west of Scotland' showed significantly different growth parameters and significant population structure difference between megrim sampled in VIa and VIb (Anon, 2001). Spawning fish occur in both areas but whether these populations are reproductively isolated is not clear. WKFLAT (2011) concluded that megrim in VIb should be considered as a single stock. As a consequence, the assessment area is now incompatible with the management area.



Management area (red box) and assessment area (blue hatched area)

Species: Megrims *Lepidorhombus* spp.		**Zone:** VI; EU and international waters of Vb; international waters of XII and XIV (LEZ/561214)
Spain	385	
France	1 501	
Ireland	439	
United Kingdom	1 062	
EU	3 387	
TAC	3 387	Analytical TAC

Fishery in 2011

Following the increases in Irish effort in Subdivision VIb from 2004–2008, effort in 2012 (the last available year) has declined significantly (Figure 5.3.14) while Scottish effort has increased. Based on landings data presented to the working group, only 50% of the overall TAC for VI, EC waters of Vb and international waters of XII and

XIV was taken. It should be noted that no landings data were made available to the working group by Spain therefore the uptake during 2010 will be higher, while historically, France only utilizes ~10% of its available quota, Spanish uptake has been ~80%.

2012 TAC for VI, EC waters of Vb and international waters of XII and XIV

Country	TAC	WG Landings[2]	% TAC Uptake[1]
Spain	385	204	53%
France	1501	140	9%
Ireland	439	334	76%
UK	1062	678	64%
EU	3387	1356	40%
TAC	3387		

***nr not reported to the Working Group, 2011=2010 for assessment purpose.**

[1] post regulation quota swaps have not been taken into account.

[2] Provisional figures.

5.3.2.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

As part of the 2011 benchmark, landings-at-age data were compiled from 1990 to 2010. However, there is very sparse age data available from VIb and prior to 2002 age a common Subarea VI ALK was applied to megrim from VIa and VIb. Commencing in 2012, area-specific age data will be gathered during the Anglerfish survey.

Landings

Official landings data for each country together with Working Group best estimates of landings from VIb are shown in Table 5.3.5. The distributions of landings by statistical rectangle in 2011 in VIa, IVa and VIb is shown in Figure 5.3.3. The WG best estimates of landings are those supplied by stock coordinators of the various countries and differ from the official statistics in some years. These were supplied for VIb by Ireland and Scotland in 2011.

Catches of megrim comprise two species, *Lepidorhombus whiffiagonis* and *L. boscii*. Information available to the working group indicates that *L. boscii*, are a negligible proportion of the Scottish and Irish megrim catch (Kunzlik *et al*., 1995; Anon, 2001). It is not clear to the WG whether landings of other countries are accurately partitioned by megrim species. Megrim are caught in association with anglerfish by some fleets and are area-misreported along with anglerfish. However, it is unknown whether misreporting from Division VIb is an issue.

Discards

Discard data was available from Ireland and Scotland.

Surveys

In 2005, Scotland initiated a new industry–science partnership survey to provide an absolute abundance estimate for anglerfish (see Section 5.2). Seven years of survey data is available and these cover the main distribution of the anglerfish fishery. The survey is also considered to have greater spatial coverage for megrim and as such is recommended by WKAGME (2008) as the main source of data of megrim relative biomass for all megrim stocks the Northern Shelf. Currently, seven years of data are available (2005–2011).

The sample locations and the density of megrim are illustrated in Figure 5.3.15 as numbers (number per square kilometre) and in Figure 5.3.16, as weight (kilograms per square kilometre). The highest densities of megrim occurred close to the 200 m contour in the northern and western areas, and on the eastern slopes of the Rockall plateau; high densities were also present in the northern North Sea. Prior to 2011, survey indices for VI and IV (partial) were presented. However, based on the recommendations of WKFLAT (2011), the megrim in VIb is considered as a separate stock. The survey index for VIb is presented in Figure 5.3.17 and Table 5.3.8.

Abundance and biomass in VIb and from 2005 to 2010 has increased considerably (Table 5.3.4) but has shown a marked decline in 2011 (Figure 5.3.11). It is unclear whether this is a year effect in the survey or an actual decline in biomass. The recent harvest ratios have been very low and the yield in 2011 is estimated to be <200 tonnes. Additionally, the trend in commercial lpue (IRE OTB) has been increasing over recent years (Figure 5.3.18). Under the WKLIFE categorisation procedure, VIb megrim falls under category 4. The average biomass and abundance from the last two years of survey data are contrasted with the average of the preceding three years (EU Survey HCR from 2010). This shows that the biomass has declined by 7% and abundance has increased by 4% (Table 5.3.9).

The area stratified survey provides a minimum estimate of absolute biomass as the survey catches are raised based on swept area raised and weighted by area (Table 5.3.7). The survey assumes that all megrim in the trawl path are retained e.g. q=1. Assuming full retention is overly optimistic therefore providing a minimum estimate of stock biomass. However, the biomass dynamic model used for VIa/IVa megrim assessment provides megrim catchability estimates for SAIMISS-Q2/IAMISS-Q2 VIa and IVa surveys (q5 and q6 in figure 5.3.9). These are estimated to be in the region of 0.2–0.3. Using the upper q estimate of 0.3 in combination to scale the survey biomass estimate to provide an absolute biomass estimate, and catch estimate (with assumed discard profiles) have been used to provide a broad estimate of the relative harvest ratio of megrim in VIa (Table 5.3.10). This shows that the harvest ratio for megrim to be in the range 3 to 21% over the time-series and this has been very low in recent years typically less than 6%.

Commercial cpue

Logarithmic lpues for Irish OTB vessels are available for VIb. These are presented in Figure 5.3.18. The commercial data does not follow the trends observed in the survey time-series and the commercial lpues between the commercial fleet and the survey is somewhat contradictory. Care should be taken in interpreting the commercial lpues given possible shifts in targeting behaviour and the conflicting signal between the two fleets in recent years.

5.3.2.3 Historical stock development

No analytical assessment has been agreed for this stock since 1999.

State of the stock

The state of the stock is unknown.

5.3.2.4 Short-term projections

There is no accepted analytical assessment for this stock.

5.3.2.5 Biological reference points

Precautionary approach reference points

No precautionary reference points have been defined for this stock.

Yield-per-recruit analysis

It was not possible to define $F_{0.1}$ and F_{max} values for this stock due to the lack of international catch-at-age data and recent changes in fleet selectivity due to likely changes in targeting behaviour and recent changes in mesh selectivity, which, if fully implemented, will result in a significant change in age selectivity of the gear.

5.3.2.6 Uncertainties and bias in assessment and forecast

There is no accepted analytical assessment for this stock.

5.3.2.7 Recommendation for next benchmark

This stock was recently subject to benchmark. Due to lack of age data specific to megrim in VIb, it was not possible to undertake any exploratory age based assessments. Age data will be gathered during the surveys from 2012 onwards. Intersessional work on a Bayesian state–space surplus production model is continuing.

5.3.2.8 Management considerations

The TAC in VI has not been fully utilised. However, the uptake rate is country specific, with full uptake being reported by some member states. Partial quota by individual member states may be an artefact of reduction in effort rather than reflective of a reduction in biomass. The TAC and assessment area are incompatible.

5.3.2.9 References

Kunzlik, P. A., A. W. Newton and A. W. Jermyn. 1995. Exploitation of monks (*Lophius* spp.) and megrims (*Lepidorhombus* spp.) by Scottish fishermen in ICES Division VIa (west of Scotland). Final report EU FAR contract MA-2-520.

Laurenson, C. and MacDonald, P. 2008. Collection of fisheries and biological data on megrim in ICES Subarea IVa. Scottish Industry Science Partnership Report No 05/08.

Table 5.3.1. Megrim in Subarea VIa. Nominal catch (t) of Megrim West of Scotland, as officially reported to ICES and WG best estimates of landings. *Unallocated landings in 2011 relates to lack of Spanish landings data for 2011. 2011 landings assumed to be equal to 2010 levels for purpose of assessment.

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	455	504	517	408	618	462	192	172	0	135	252	79	92	50	48	53	104	92	134	270	139	140
Ireland	260	317	329	304	535	460	438	433	438	417	509	280	344	278	156	221	191	172	188	318	226	214
Netherlands	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	48	25	7	1	24	22	87	111	83	98	92	89	98	45	69	52	5	149	112	288	227	189
UK - Eng+Wales+N.Irl.	167	392	298	327	322	156	123	65	42	20	7	14	13	17	10	0	8	6				
UK – Scotland	1223	887	896	866	952	944	954	841	831	754	770	643	558	469	269	336	658	868	953			
UK																				822	705	589
Offical Total	2154	2125	2047	1907	2451	2044	1795	1622	1394	1424	1630	1105	1105	859	552	662	966	1287	1387	1698	1070	1132
Unallocated	278	424	674	786	1047	2010	1477	1083	1254	823	843	723	537	469	9	213	n/a	8	0	0	288*	0
As used by WG	2432	2549	2721	2693	3498	4054	3272	2705	2648	2247	2473	1828	1642	1328	561	875	1301	1545	1387	1698	1358	1132
Area Mispreported landings	338	466	735	871	1126	2062	1556	1156	1066	868	829	731	544	421	n/a	212	478	250	0	0	0	0

Table 5.3.2. Megrim in Subarea IV and IIa. Nominal catch (t) of Megrim North Sea, as officially reported to ICES and WG best estimates of landings.

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	3	2	7	2	7	5	3	5	4	10	2	5	3	-	-	2	6	3	1.6		1.6	0.2
Denmark	1	4	6	1	2	7	5	18	21	29	52	8	11	7	1	6	11	31		22	25	36
France	-	36	25	27	24	14	16	14	.	7	5	6	11	9	3	4	18	21		5	6	5
Germany	6	3	4	1	2	1	2	4	1	3	1	-	2	2	4	7	16	5	4		5	4
Germany, Fed. Rep. of	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.					
Ireland	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	.				-	–
Netherlands	28	27	30	28	26	9	20	30	26	20	11	9	7	11	19	22	20	3	2	1	16	16
Norway	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	<0.5	<0.5	1	1	4		2	1	0.6
Spain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.					
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
UK - Eng+Wales+N.Irl.	9	47	8	19	44	4	3	5	4	2	2	3	1	1	1	9	17					
UK - England & Wales	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6			1367	
UK - N. Ireland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.					
UK - Scotland	1169	1372	1736	2000	2193	3221	3091	2628	2121	2044	1854	1675	1235	1130	958	1340	1436	1526				
UK																			1476	1469		1397
Official total	1216	1491	1816	2078	2298	3261	3140	2704	2177	2115	1927	1706	1271	1160	986	1391	1525	1599	1484	1499	1421	1459
As used by WG	878	1025	1081	1207	1172	1199	1584	1548	1111	1247	1098	975	727	739	n/a	1179	1047	1349	1484	1499	1421	1459
Area Mispreported landings	338	466	735	871	1126	2062	1556	1156	1066	868	829	731	544	421	n/a	212	478	250	0	0	0	0

Table 5.3.3. Time-series of survey indices and landings of megrim in ICES Area VIa and Division IV as used in the 2012 surplus production model.

Year	ScoGFS-WIBTS-Q1	ScoGFS-WIBTS-Q4	Sco-IBTS-Q1	Sco-IBTS-Q3	SAMISS-Q2/ IAMISS-Q2	SAMISS-Q2	VIa & IVa landings
1985	NA	NA	NA	NA	NA	NA	4499
1986	2.022041	NA	NA	NA	NA	NA	2858
1987	1.438229	NA	0.15231	0.538613	NA	NA	4614
1988	2.433792	NA	0.85134	0.352888	NA	NA	5212
1989	1.372235	NA	1.349909	0.478759	NA	NA	3451
1990	1.172838	1.421119	0.321947	0.241552	NA	NA	3047
1991	0.993033	0.816731	0.489991	0.390778	NA	NA	3310
1992	0.86039	1.872102	0.513651	0.27403	NA	NA	3574
1993	1.091872	1.529652	0.879519	0.317033	NA	NA	3802
1994	1.633247	5.962035	0.00751	0.267762	NA	NA	3900
1995	1.626724	2.06466	0	0.386454	NA	NA	4670
1996	1.994012	1.589756	0.174242	0.559735	NA	NA	5253
1997	1.236186	1.08362	0.366326	0.438556	NA	NA	4856
1998	1.257126	2.50406	0.585829	0.480087	NA	NA	4253
1999	1.572227	2.486679	0.685998	0.35149	NA	NA	3759
2000	1.774741	2.746517	0.782337	0.387239	NA	NA	3494
2001	1.571553	2.001607	0.167189	0.135261	NA	NA	3571
2002	1.32686	1.882926	0.943994	0.695834	NA	NA	2803
2003	1.365124	1.534736	0.417331	0.428694	NA	NA	2369
2004	1.396114	1.436756	0.144181	0.432644	NA	NA	2067
2005	0.768293	1.24548	0.345727	0.861051	2847.751	4612.849	1527
2006	0.946288	1.429524	0.415692	1.144823	3049.429	3464.123	2054
2007	0.952731	1.496073	0.751438	1.393703	3304.689	6940.738	2348
2008	1.281508	1.235648	1.264974	1.396733	3653.99	8023.604	2894
2009	1.956423	1.689299	1.813651	0.985541	4560.281	6297.433	2759
2010	1.233817	NA	1.212913	1.568344	4115.859	7502.313	2909
2011	NA	NA	1.400436	1.594589	3732.823	5128.571	2708
2012	NA	NA	3.164756	1.773914	6339.286	5483.529	2618

Table 5.3.4. *Lepidorhombus whiffiagonis* in ICES Areas VIa and IVa. Prior distributions on parameters.

PARAMETER	SYMBOL	PRIOR DISTRIBUTION	NOTES
Intrinsic rate of population growth	r	Uniform(0.001,2.0)	
Carrying capacity	K	$\mathrm{Uniform}(\ln(\max(C)), \ln(10 \times \sum_{t=1985}^{2010} C_t)$	From the maximum catch to ten times the cumulative catch across all years assuming uniform distribution on the logarithmic scale
Catchabilities	$\log(q_j)$	Uniform(−11.0, 0.0)	Uniformly distributed on log-scale. See catchability sensitivity in section 2.2.3.1
Process error variance	$1/\sigma_u^2$	Gamma(shape = 0.001,rate = 0.001)	Gamma distributed on inverse variance (precision) scale
Measurement error variances	$1/\sigma_{\varepsilon,j}^2$	Gamma(shape = 0.001,rate = 0.001)	Gamma distributed on inverse variance (precision) scale
Proportion of *K* in 1985	a	Uniform(0.01, 2.0)	

Table 5.3.5. Estimates of Estimates of MSY, F_{MSY}, B_{MSY}, B_{2012}, F_{2011}, with reference points of $B_{trigger}$ (50% B_{MSY}) and B_{lim} (30% B_{MSY}).

PARAMETER	ESTIMATE
r.hat	0.67
K.hat	39346
MSY	6037
F_{MSY}	0.33
B_{MSY}	19673
B_{2013}	36243
F_{2012}	0.09
B_{lim}	5902
B_{trig}	9837

Table 5.3.6. Time-series of biomass and fishing mortality estimates and ratios of B/B$_{MSY}$ and F/F$_{MSY}$.

YEAR	B/BMSY	F/FMSY	BIOMASS	MEAN F
1985	2.28	0.63	42636	0.20
1986	1.71	0.46	31951	0.14
1987	1.50	0.85	27994	0.26
1988	1.74	0.87	32388	0.27
1989	1.26	0.72	23463	0.22
1990	1.07	0.73	19866	0.22
1991	0.95	0.89	17638	0.27
1992	0.96	0.94	17942	0.29
1993	1.11	0.87	20625	0.26
1994	1.45	0.70	26947	0.21
1995	1.47	0.84	27259	0.25
1996	1.50	0.94	27856	0.28
1997	1.19	1.04	22222	0.32
1998	1.26	0.84	23474	0.26
1999	1.41	0.66	26224	0.20
2000	1.53	0.57	28333	0.17
2001	1.35	0.64	25072	0.19
2002	1.27	0.52	23641	0.16
2003	1.21	0.45	22541	0.13
2004	1.17	0.40	21664	0.12
2005	0.94	0.34	17533	0.10
2006	1.01	0.44	18754	0.13
2007	1.11	0.46	20747	0.14
2008	1.27	0.51	23548	0.15
2009	1.54	0.42	28542	0.13
2010	1.38	0.51	25740	0.16
2011	1.32	0.44	24541	0.14
2012	1.95	0.31	36243	0.09

Table 5.3.7. Risk of stock falling below biomass reference points and fishing mortality exceeding F_{lim} based on a range of potential catch options for 2013.

Rationale	Catch (2014)	Landings (2014)[1)]	Discards (2014)[1)]	Basis	Fishing mortality (F_{2014}/F_{MSY})	Stock size (B_{2015}/B_{MSY})	Probability* of $Biomass_{2015}$ falling below MSY $B_{trigger}$	Probability* of $Biomass_{2015}$ falling below B_{lim}
MSY approach	7000	5950	1050	F_{MSY} (= 0.33)	1.0	1.32	1%	0%
Zero catch	0	0	0	F = 0			0%	0%
Other options	6076	5164	911	Long-term MSY	0.86	1.42	1%	0%
	6000	5100	900	0.36	0.85	1.41	1%	0%
	5000	4250	750	0.21	0.65	1.53	1%	0%
	4000	3400	600	0.16	0.48	1.59	1%	0%

Table 5.3.8. Survey index for VIb megrim from the SAMISSQ2 survey.

Year	Abundance (millions)	Biomass (tonnes)
2005	1.14	679
2006	3.488	910
2007	4.813	1289
2008	6.545	1728
2009	6.622	1507
2010	9.221	1911
2011	3.231	885
2012	16.725	4321

Table 5.3.9. Changes in relative megrim abundance and biomass from Scottish-Irish anglerfish surveys based on percentage changes in mean abundance and biomass from the first three years of the survey relative to the mean of the last two years.

	Biomass		Abundance		Percentage Change	
Trend mean (2008/2010)/(2011–2012)	Mean 07-09	Mean 10/11	Mean 08-09	Mean 10/11	Biomass	Abundance
VIb	7.5	10.0	1715	2603	34%	52%

Table 5.3.10. Estimates of VIb (Roackall) megrim biomass from Scottish-Irish anglerfish surveys.

Year	Survey Biomass	Survey q	Raised Biomass	Landings	Catch	Harvest Ratio
2005	679	0.3	2263	382	469	21%
2006	910	0.3	3033	344	419	14%
2007	1289	0.3	4297	106	128	3%
2008	1728	0.3	5760	294	353	6%
2009	1507	0.3	5023	226	270	5%
2010	1911	0.3	6370	139	165	3%
2011	885	0.3	2950	138	162	5%
2012	4321	0.3	14403	209	245	1%

Table 5.3.5 Megrim in Subarea VIb. Nominal catch (t) of Megrim Rockall, as officially reported to ICES and WG best estimates of landings.

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
France	-	-	-	-	-	-	-	-	.	4	<0.5	<0.5	-	-	-	-	-					
Ireland	240	139	128	176	117	124	141	218	127	167	176	87	83	43	68	95	87	68	48	47	72	120
Spain	587	683	594	574	520	515	628	549	404	427	370	120	93	71	88	59	19	84	0	0	17	15
UK - Eng+Wales+N.Irl.	14	53	56	38	27	92	76	116	57	57	42	41	74	42	19	9	.					
UK - England & Wales	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.	1				
UK - Scotland	204	198	147	258	152	112	164	208	278	309	236	207	382	372	207	181	.	141	178			
UK																				92	66	89
Offical Total	1045	1073	925	1046	816	843	1009	1091	866	964	824	455	632	528	382	344	106	294	226	139	155	224
Unallocated																						
As used by WG	1045	1073	925	1046	816	843	1009	1091	866	964	824	455	632	528	382	344	106	294	226	139	155	224

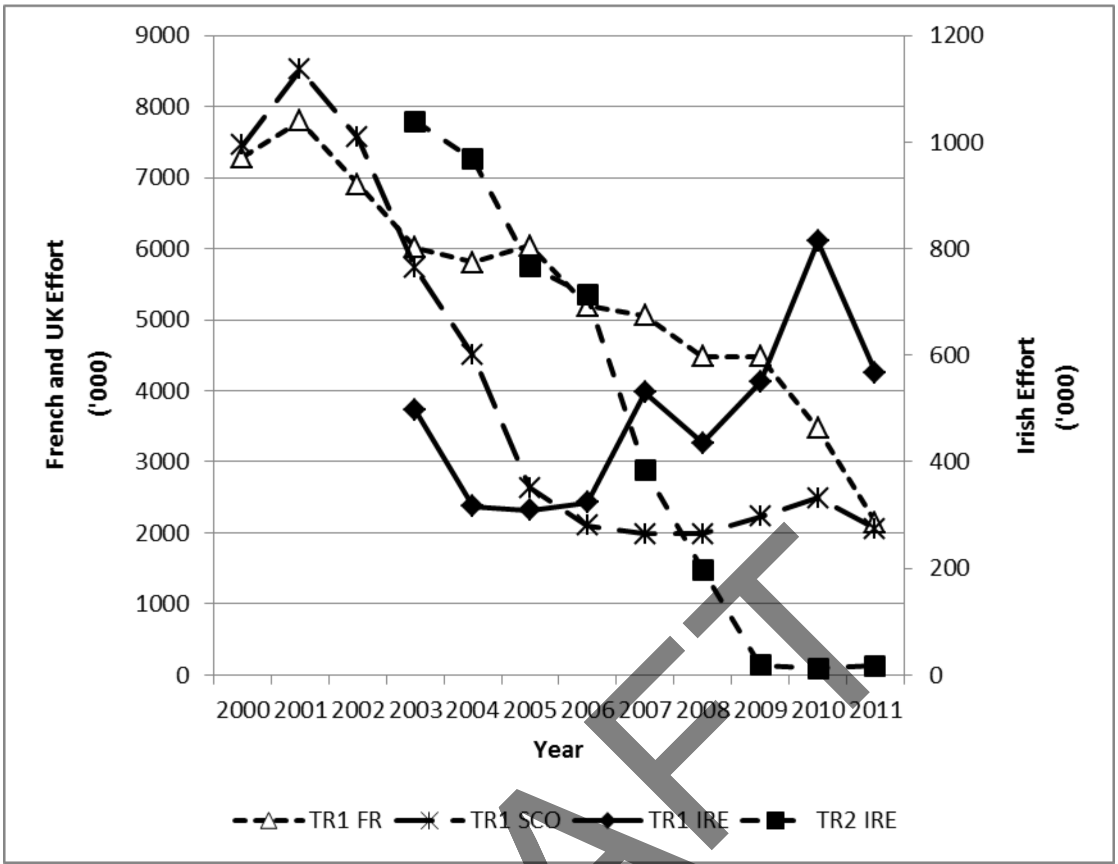


Figure 5.3.1. Scottish TR1, French TR1, Irish TR1 and TR2 effort in ICES Division VIa expressed in kw.days.

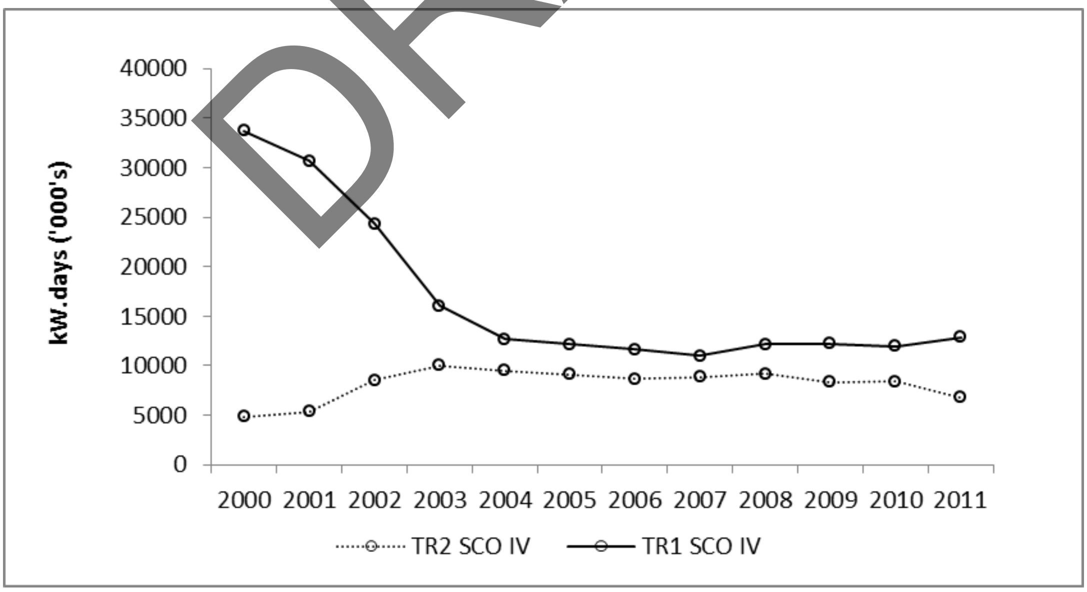


Figure 5.3.2. Scottish TR1 and TR2 effort in ICES Division IVa expressed in kw.days.

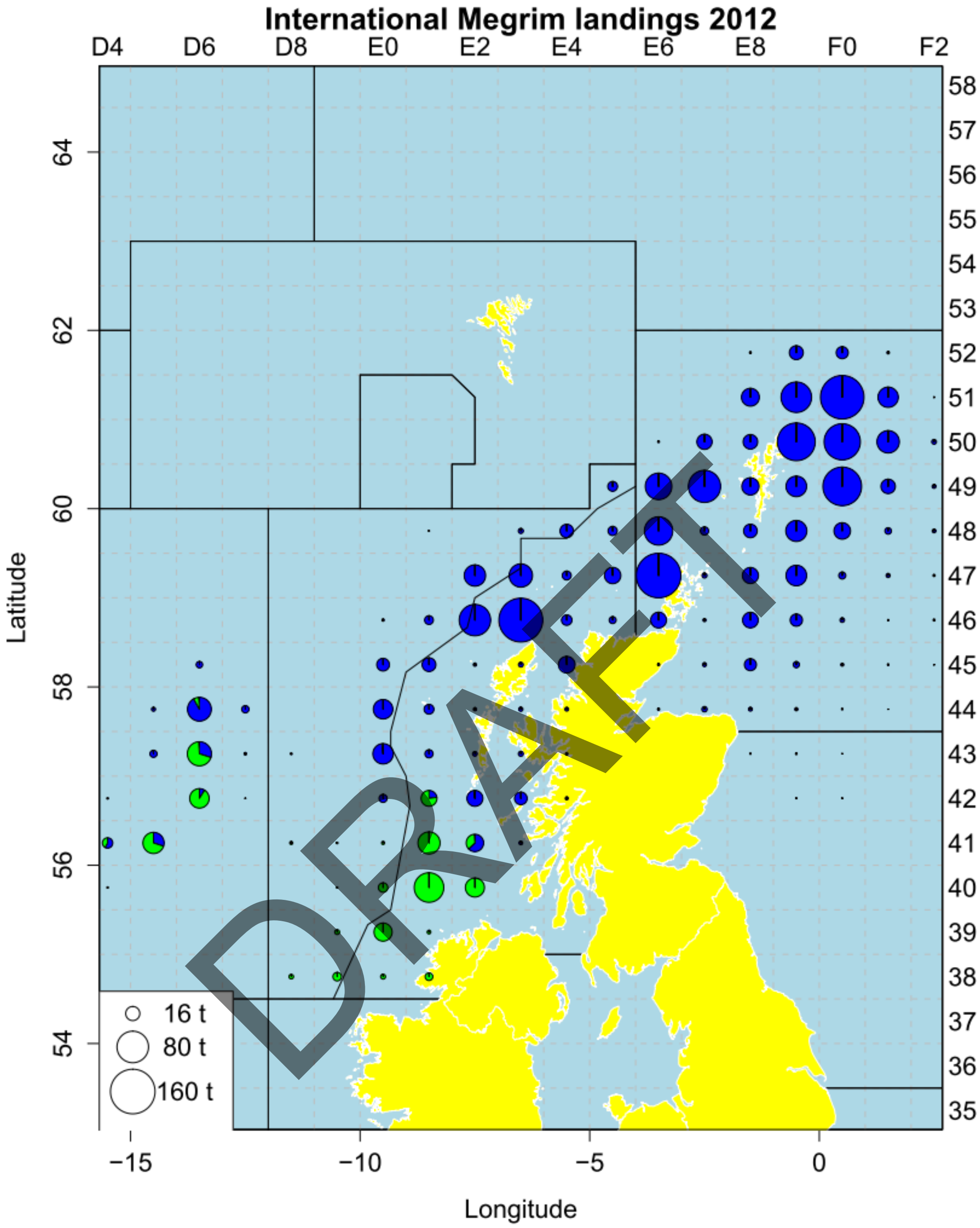


Figure 5.3.3. International megrim landing by ICES statistical rectangle for ICES Divisions VIa, VIb and IVa for 2012 for Ireland (green) and Scotland (blue) only.

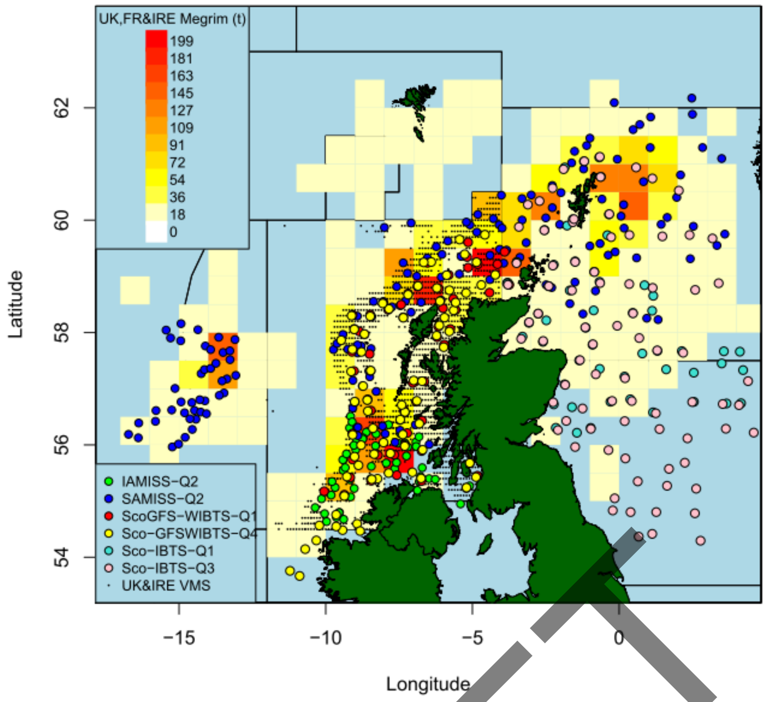


Figure 5.3.4. Distribution of individual haul start positions for all 6 surveys overlaid on landings by statistical rectangle for VIa, IV and VIb. VMS distribution of UK and Ireland activity in VIa is also shown.

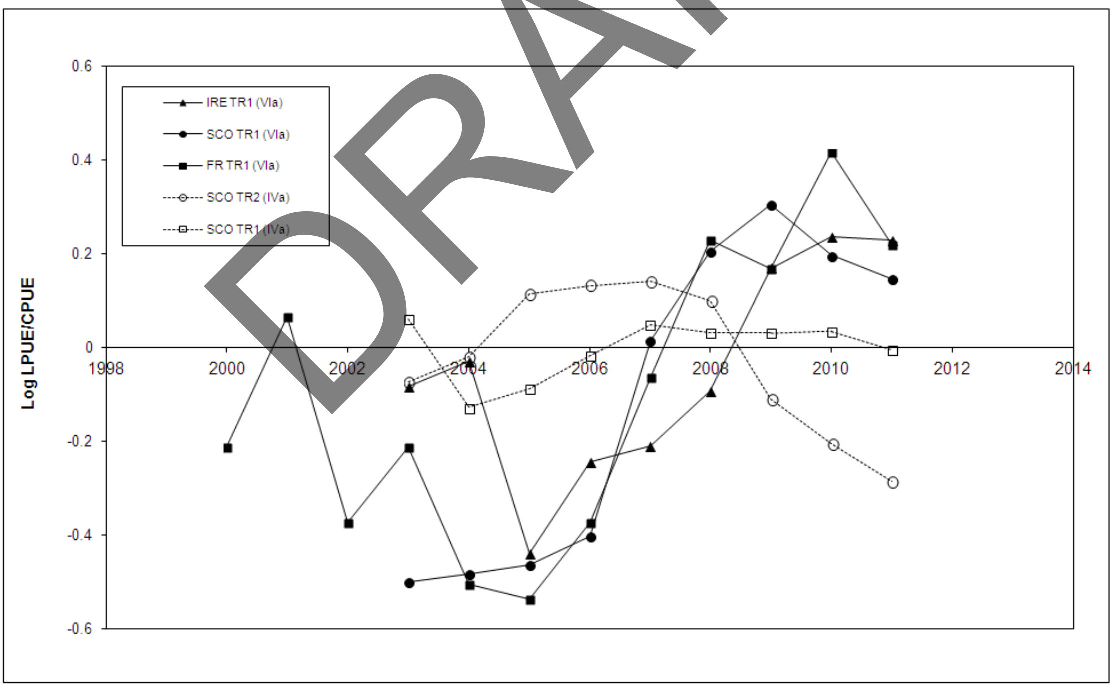


Figure 5.3.7. Standardised commercial log lpue for Megrim in VIa and IVa.

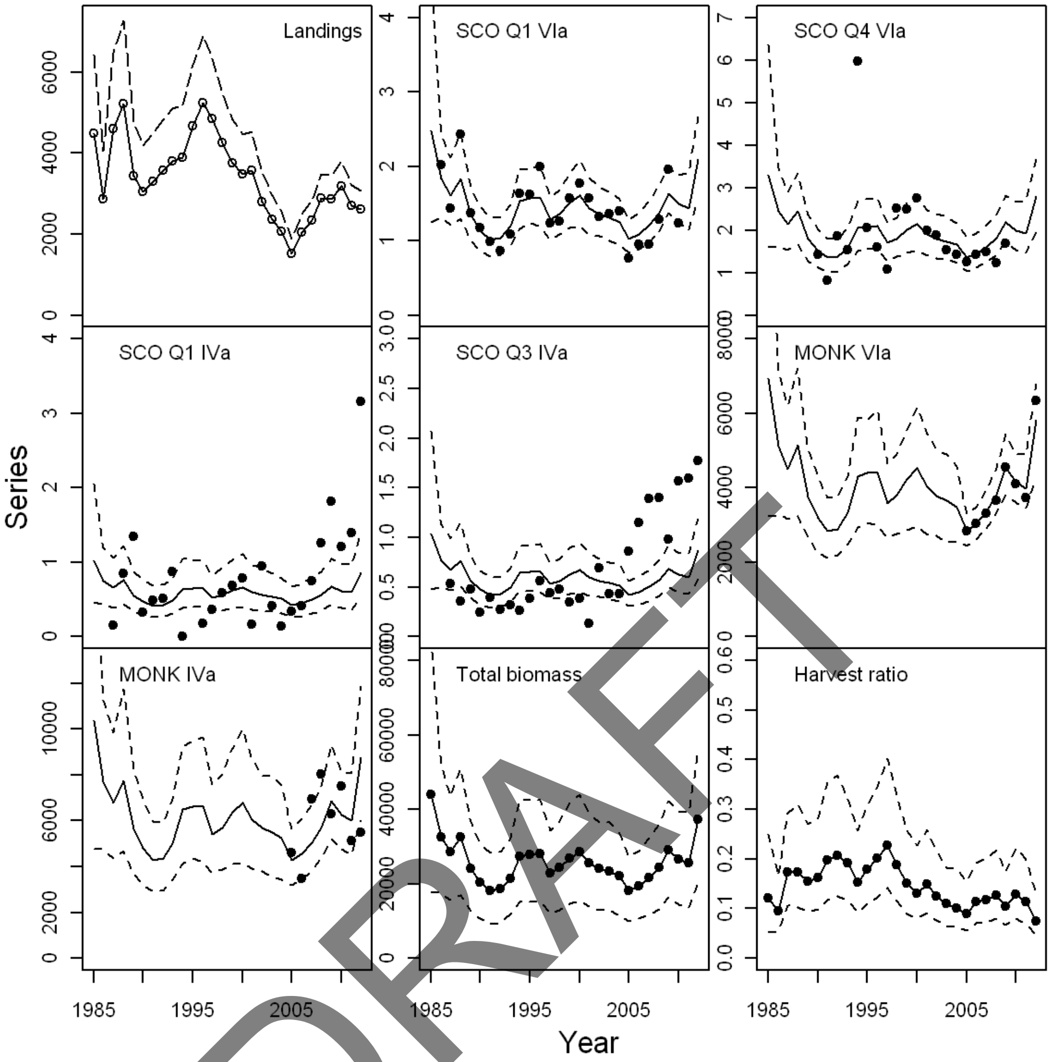


Figure 5.3.8. Trends in landings of VIa and IVa (solid line) with catch estimate (dashed line) assuming a linear decline in discards from 30 to 15% over the time-series, estimated trends in total biomass and exploitation rate. Trends in annual cpue from the NS-IBTS, W-IBTS and IRE-IV.VI.-AMISS-Q2 and SCO-IV.VI.AMISS-Q2 surveys used in the surplus production model. The solid line is the modelled cpue trend across all surveys.

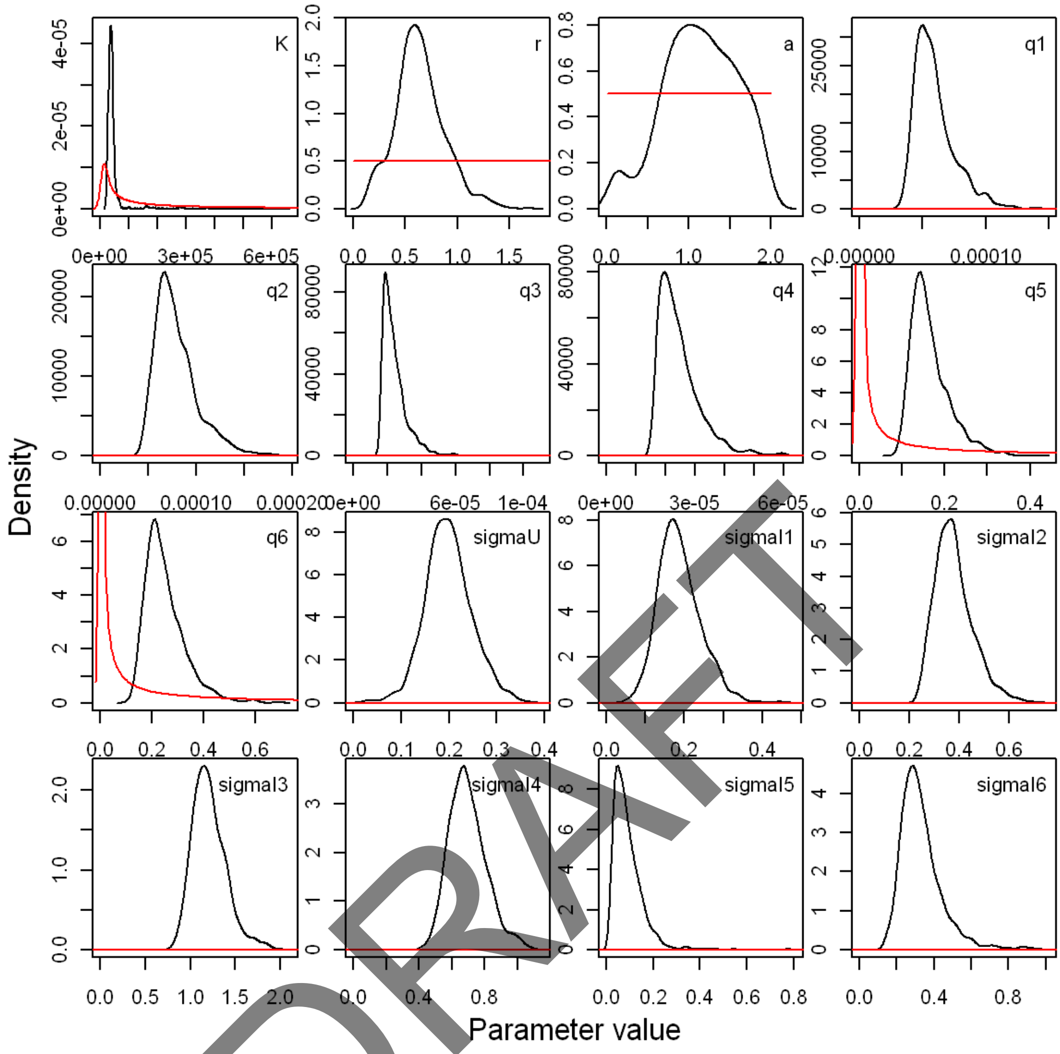


Figure 5.3.9. Prior and posterior distributions assumed and estimated.

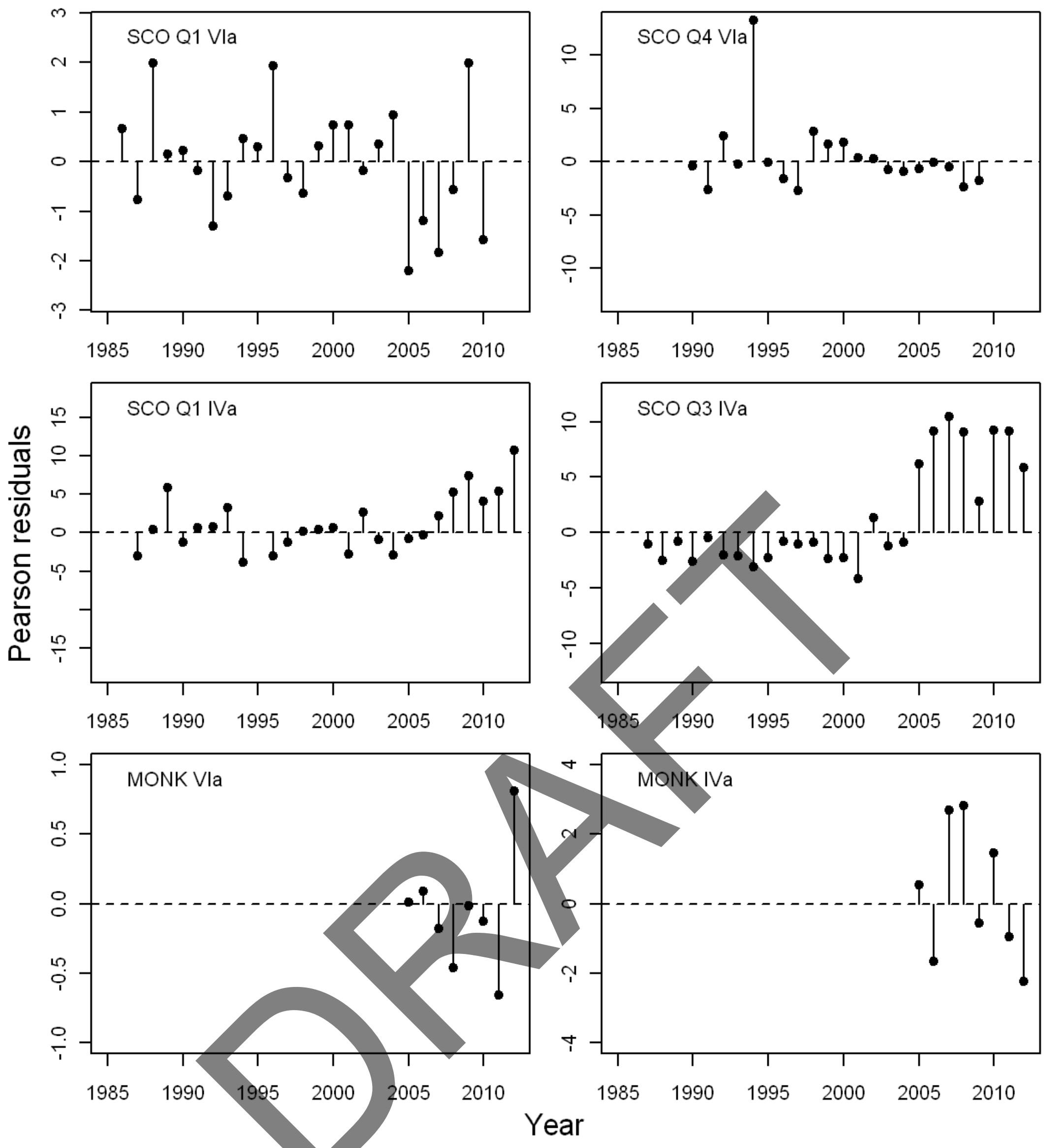
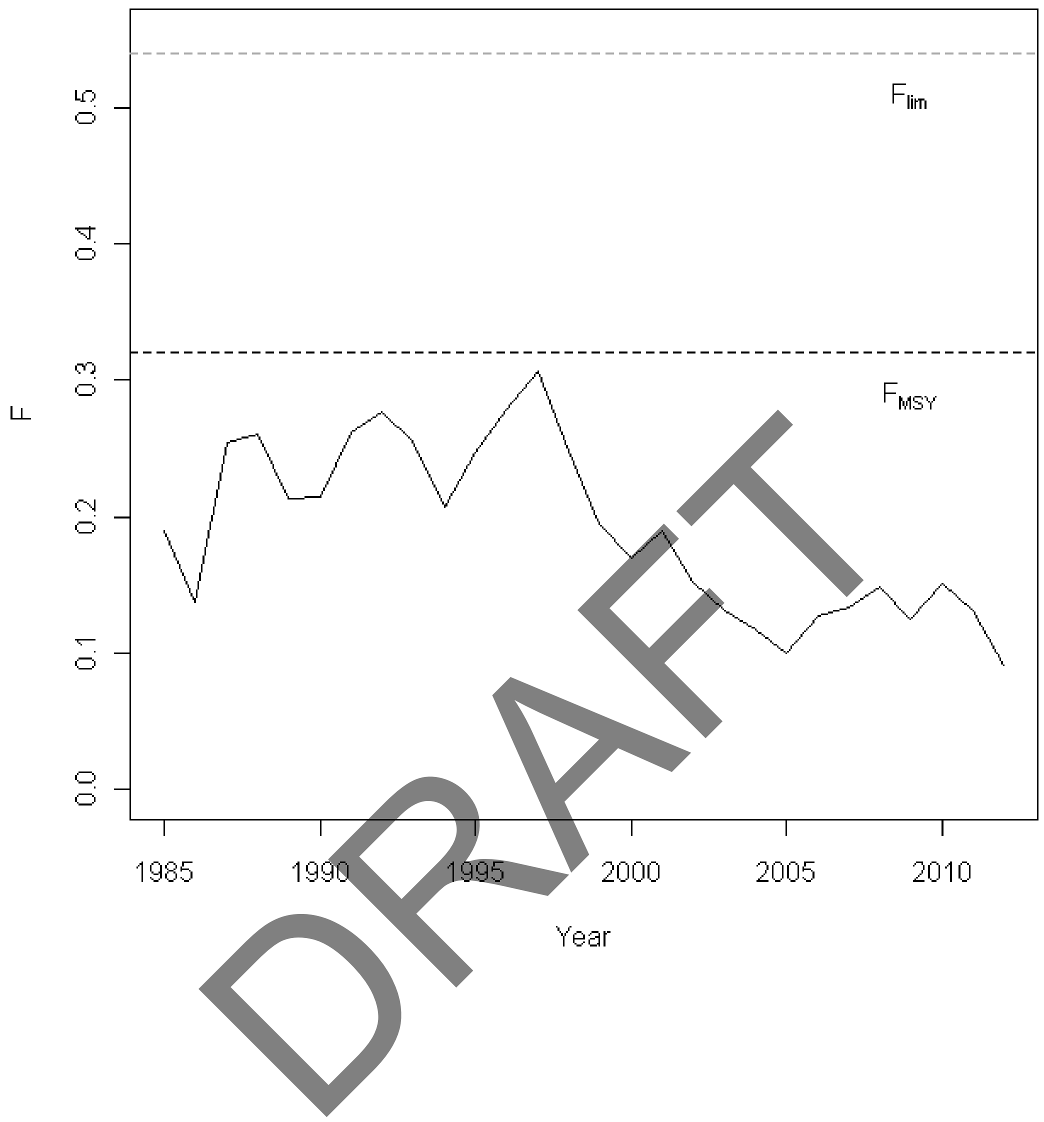


Figure 5.3.10. Pearson residuals for the six survey indices.



F
0.0
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F_lim
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1985
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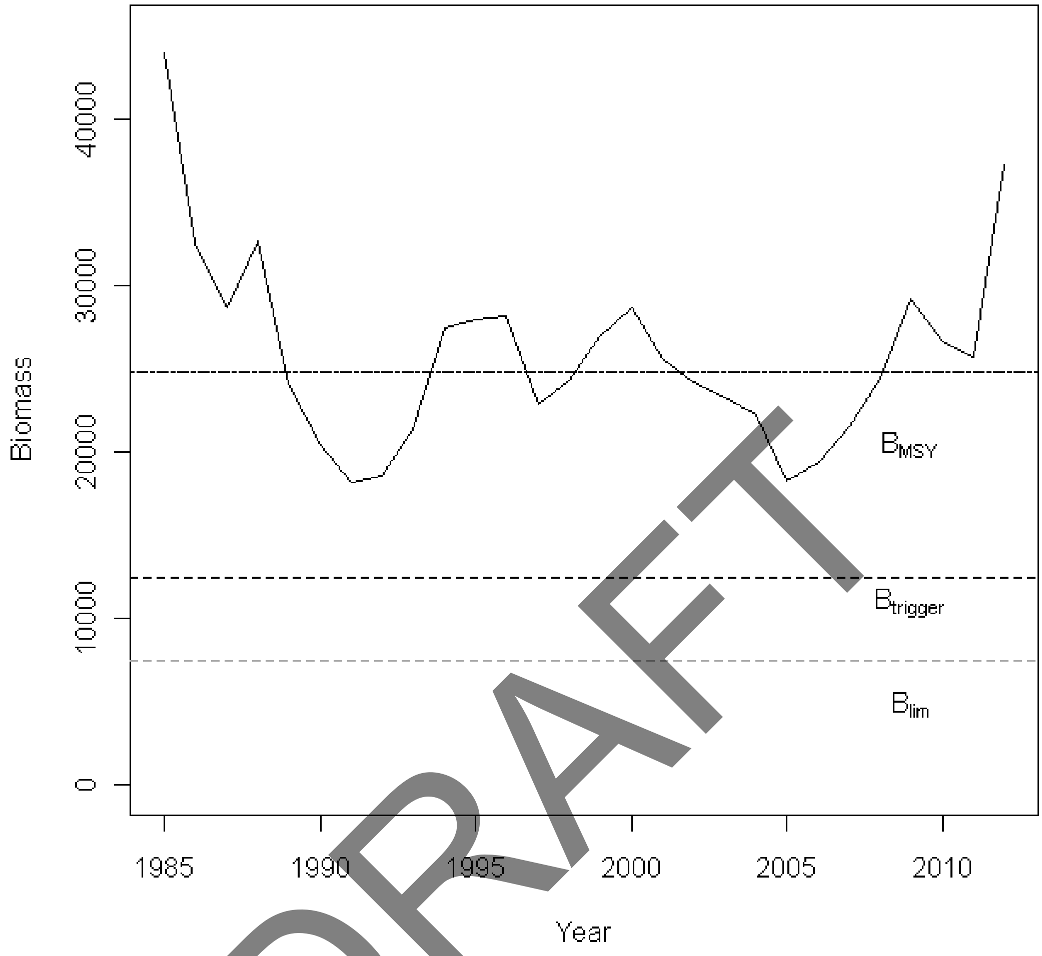

Figure 5.3.11. Trends in fishing mortality (upper panel) and biomass (lower panel) relative to fishing mortality and biomass reference points.

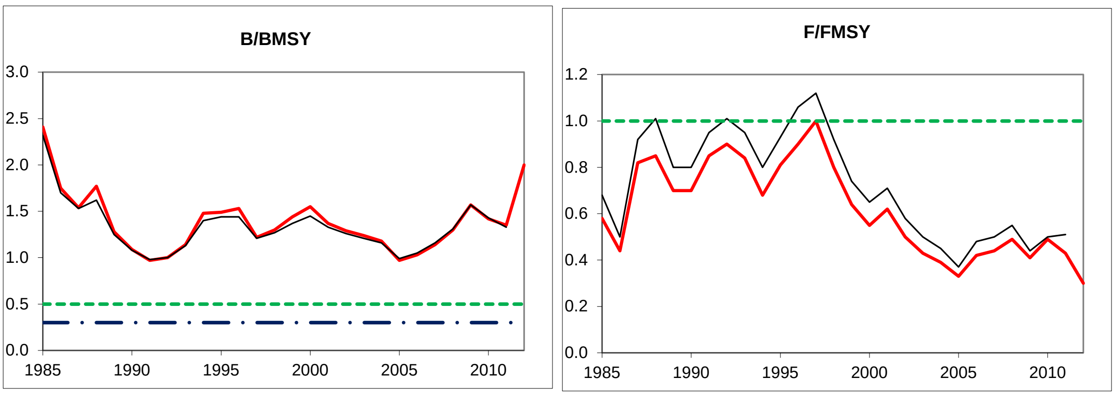

Figure 5.3.12. Comparison with previous assessments.

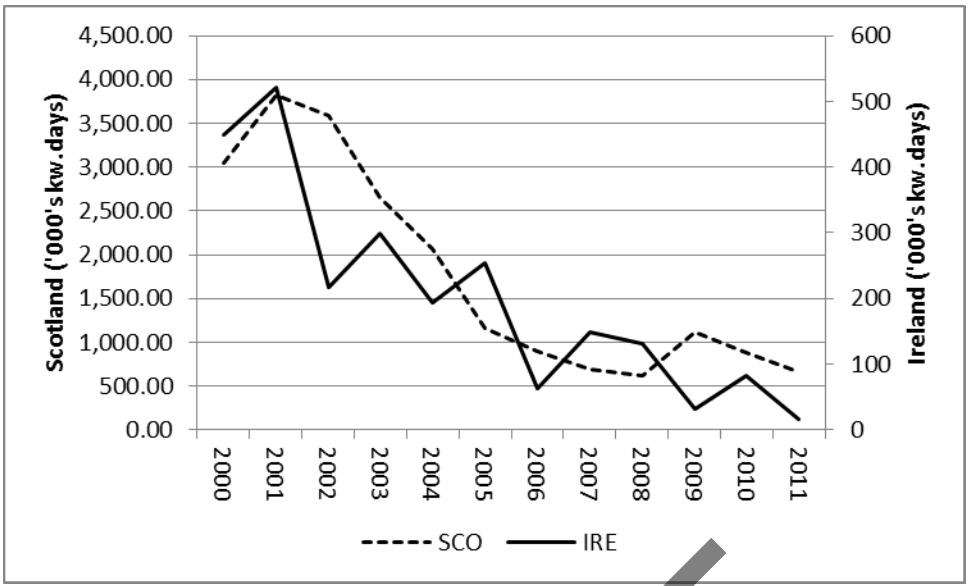

Figure 5.3.14. Time-series of Irish and Scottish effort in ICES Subdivision VIb

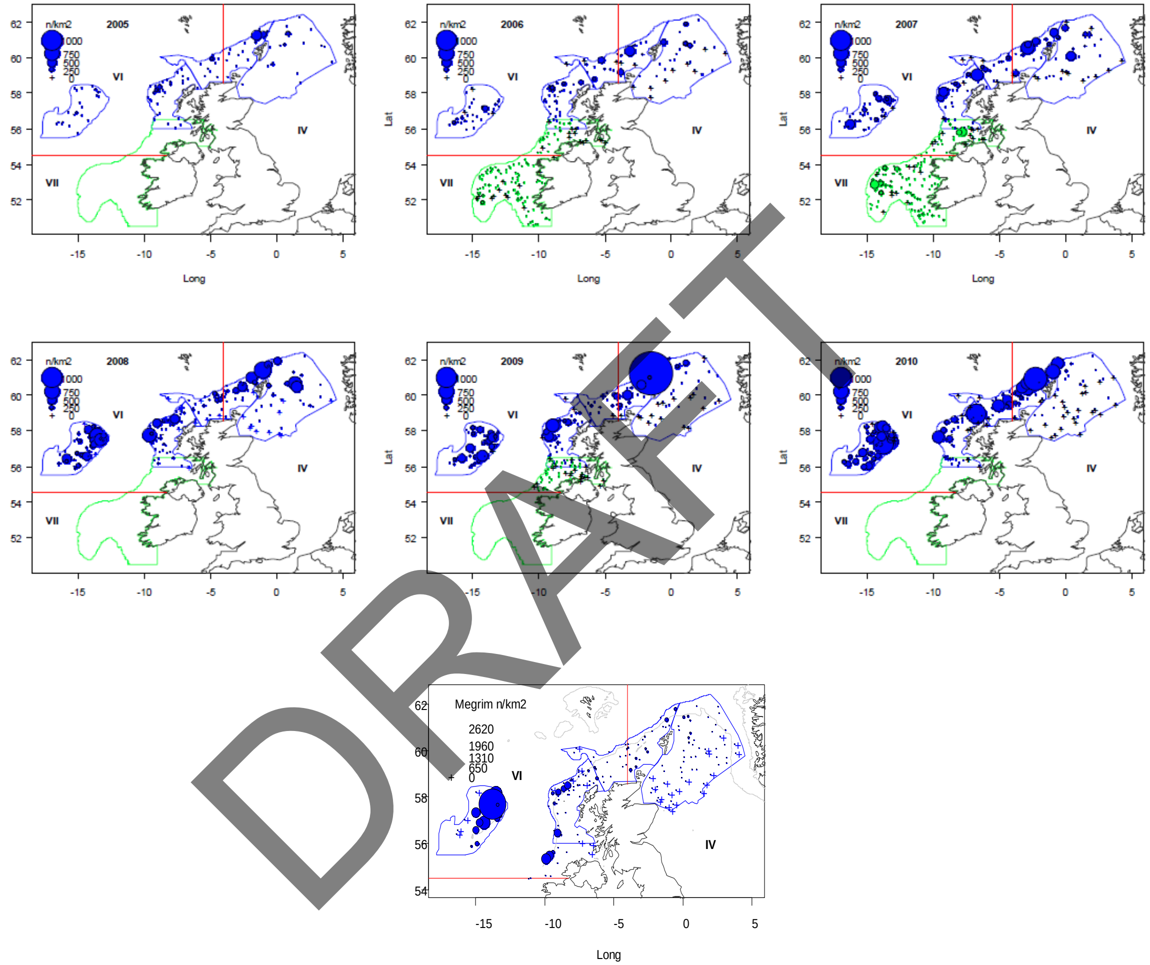

Figure 5.3.15. Maps of the northern continental shelf around the British Isles showing the number density of megrim caught during the anglerfish surveys 2005–2012. Each circle (blue for Scottish surveys; green for Irish surveys) is centred on the sample location and the size of the circle is proportional to the number density in n/km² according to the legend (top left). The red lines indicate the position of the borders between the main ICES subareas (labelled with Roman numerals).

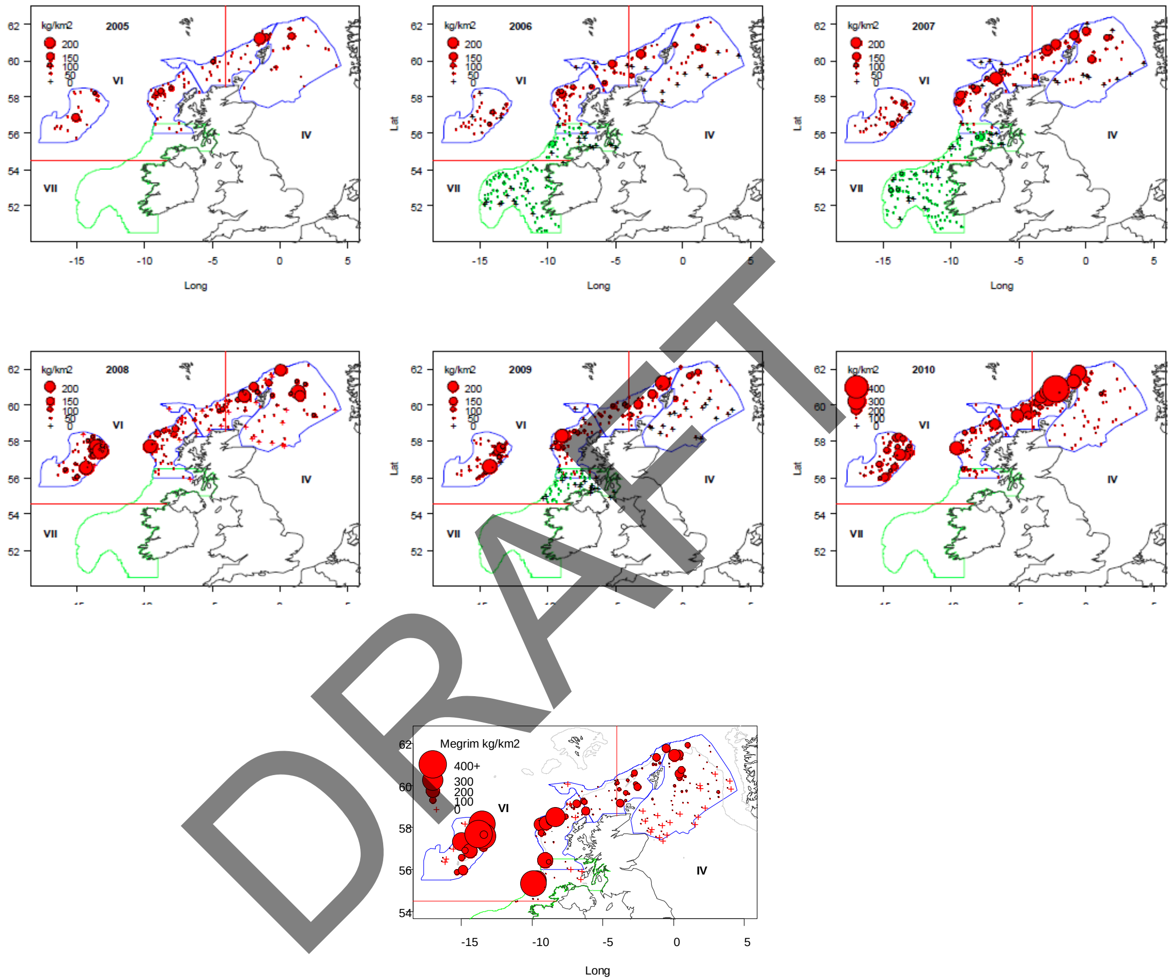

Figure 5.3.16. Maps of the northern continental shelf around the British Isles showing the weight density of megrim during the anglerfish surveys 2005–2010. Each circle (blue for Scottish surveys; green for Irish surveys) is centred on the sample location and the size of the circle is proportional to the weight density in kg/km² according to the legend (top left). The red lines indicate the position of the borders between the main ICES subareas (labelled with Roman numerals).

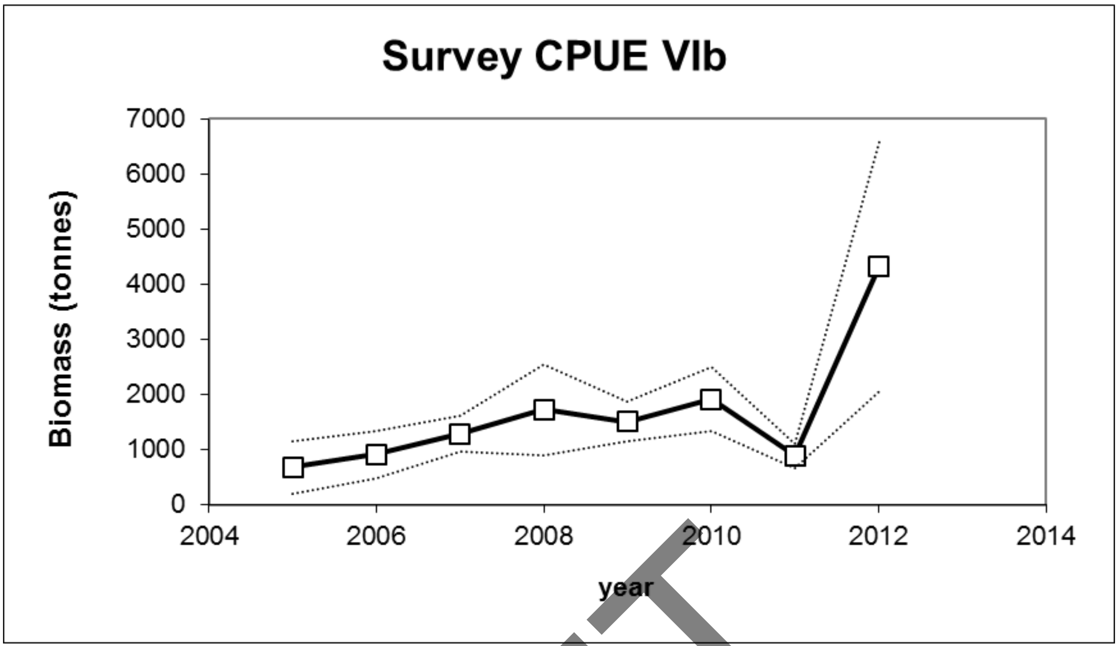

Figure 5.3.17. Change in megrim biomass in ICES Division VIb from the 2005–2012 anglerfish (SAMISSQ2) survey.

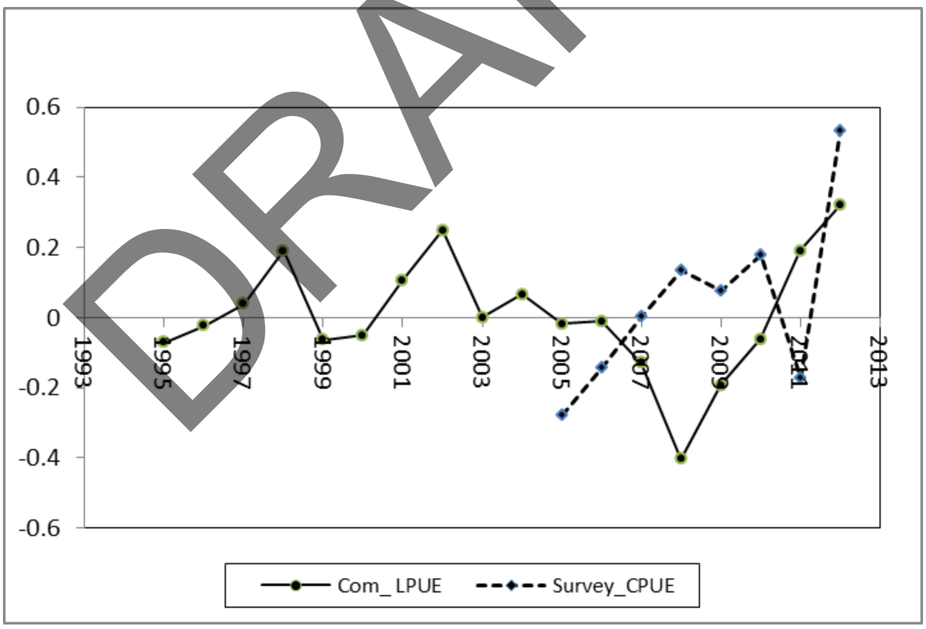

Figure 5.3.18. Change in commercial Log lpue and survey cpue for VIb megrim.

6.1 Irish Sea overview

There is no overview.

6.2 Cod in VIIa

Type of assessment

This is an update assessment of the benchmark model fitted at ICES WKROUND2 (2012) and WGCSE 2012. At the ICES WKROUND2 it was agreed that:

1) The assessment model should be the state–space model SAM as estimates of unallocated mortality are more robust when fitted to noisy survey data and the model allows the fitting of an SSB index time-series which is currently available for VIIa cod. In order to fit the model age 0 (no catches) was removed from the assessment and a 1–6+ age range applied.

2) New survey-series should be included within the assessment; the SSB index from the IS-AEPM survey, and two UK Fisheries partnership surveys (UK-FSP) conducted by commercial fishers in Western and Eastern Irish Sea with observation and analysis of the data conducted by Cefas (www.cefas.co.uk/fsp).

3) Although there is evidence for increased maturity within the stock at age 2 in recent years and historic problems with weights-at-age resulting in SOP bias, these represent only minor refinements to the model estimates which are heavily dependent on the estimation of unallocated mortality. Research effort should be concentrated on determining the reasons for the current high mortality rates on the stock.

4) The model agreed by WKROUND2 is considered work in progress rather than a final model structure. As such it should be used to give advice on the status of the stock and total mortality rate but the actual causes of that high mortality rate are still undetermined.

ICES advice applicable to 2012

"ICES has evaluated the long-term management plan and found it not precautionary. … Given the low SSB and low recruitment it is not possible to identify any non-zero catch which would be compatible with the MSY transition scheme. This implies no targeted fishing should take place on cod in Division VIIa. Bycatches including discards of cod in all fisheries in VIIa should be reduced to the lowest possible level."

ICES advice applicable to 2013

"ICES has evaluated the long-term management plan and found it not precautionary..... Given the low SSB and low recruitment it is not possible to identify any non-zero catch which would be compatible with the MSY transition scheme. This implies no targeted fishing should take place on cod in Division VIIa. Bycatches including discards of cod in all fisheries in Division VIIa should be reduced to the lowest possible level and uptake of further technical measures to reduce discards."

6.2.1 General

Stock description and management units

The stock and the management unit are both ICES Division VIIa (Irish Sea).

Management applicable to 2012 and 2013

TACs and quotas set for 2012

Zone VIIa (COD/07A)	Analytical TAC	Weight tonnes
	Belgium	5
	France	14
	Ireland	251
	The Netherlands	1
	United Kingdom	109
	EU	380
	TAC	380

TACs and quotas set for 2013

Zone VIIa (COD/07A)	Analytical TAC	Weight tonnes
	Belgium	4
	France	10
	Ireland	188
	The Netherlands	1
	United Kingdom	82
	EU	285
	TAC	285

Management of cod is by TAC, days-at-sea limits and technical measures. Technical regulations in force in the Irish Sea, including those associated with the cod recovery plan since 2000, are described in Section 6.1.

Fishery in 2012

Landings of cod in 2012 (Table 6.2.1) were the lowest recorded, continuing the downward trend in recorded landings in recent years following restrictions on the fishery. The total uptake of quota was only 52%, however this is not reflected across all the national uptake figures with the UK (109/109 Landings/TAC) reaching the quota, and Belgium (23/5) trading in quota to be able to exceed the national allocation, while Ireland (63/251) and France (1/11) having low uptake. Northern Ireland landed approximately 50% of the cod (Table 6.2.2), with the majority taken by whitefish otter trawlers and *Nephrops* trawlers. The percentages landed into southern Ireland have increased from 13% in 2008 to 43% in 2011; in 2012, Ireland landed the 32% of the cod total landings, with Belgium and UK (England and Wales) at roughly 12% and 7% respectively. Irish landings over that last few years have been adjusted downwards to take account of catches taken in the Celtic Sea off SE Ireland. In 2012 130 tonnes of cod landings reported as taken in VIIa were reallocated.

A cod sentinel fishery campaign has been carried out in the northwestern Irish Sea in the period 21 August–07 September 2012. This sentinel fishery has provided essential information for our understanding of Irish Sea cod stocks as there is no longer a directed commercial fishery, representing a valuable opportunity to collect biological information from the stock and improve the input data used in the assessment.

Three fishing vessels using semi-pelagic gear took part in the summer sentinel fishery. The fishery operated as it would in normal commercial operation. No restrictions were imposed in terms of haul duration, number of hauls or area fished within the Irish Sea. The vessels were restricted by the available quota and each vessel was allocated 10 t from the 2012 TAC for Irish Sea stock. The fishery operated under a 100% observer coverage condition and coordinated sampling at the ports when the fish were landed. The vessels were exempt from the current effort regulations enforced in the Irish Sea (ICES Division VIIa), while taking part in the fishery with observers onboard. The sampling of catches was conducted using the standard methods employed by AFBI observers during the routine observer programme of the Northern Ireland fleet. Data on species composition and abundance (number of specimens and total weight) of both the retained and discarded fractions were collected. Sampling effort did concentrate on cod, but the entire catch was sorted by species that was split into proportions retained and discarded. A known fraction was measured and then raised to the total catch to determine the total number and size distribution for each species.

A total of 38 hauls were conducted (Figure 6.2.1). A total of 29 species were caught with a total estimated weight of 37 t for the 38 hauls sampled. The total discards for all species made up less than 11% of the total catch by weight (mostly spurdogs and whiting for which there are no or little quotas) (Figure 6.2.2). Cod was the only species that was caught in all hauls and almost all cod caught were landed (<0.5% of cod were discarded). Cod dominated the catch. Retained cod comprised 75% of the total catch by weight (Figure 6.2.2) and more than 80% of the total landings, indicating a well-targeted fishery.

Catch rates for cod ranged 30–133 kg/h (mean 69 kg/h) in term of biomass (Figure 6.2.3) and 6–36 no./h (mean 16 no./h) for density. Traditionally, one box (50–60 kg) of cod per hour was considered a good catch rate by the semi-pelagic fishermen in the Irish Sea. The average catch rate during the sentinel fishery was higher than one box per hour and also the catch rates for a significant amount of the observed hauls (nearly 70%). Much higher catch rates of more than two boxes per hour were also observed for 13% of the hauls. The highest catch rates were found in two distinct areas of concentration.

Catch rates observed during the UK-FSP surveys, which have been conducted annually since 2004 in the western Irish Sea using semi-pelagic gear survey on commercial vessels, were comparable to those observed in the sentinel fishery only in the early part of the time-series.

A total of 4000 cod were measured and 869 aged during an intense sampling programme. Cod range in length from 20–102 cm with a mean length of 70.5 cm. The frequency distribution shows that almost all the cod (98%) were in the 50–90 cm length range. The age ranged between 1–7 years, with three year-olds dominating and comprising nearly 50% of the cod caught (Figure 6.2.4). A large proportion of the cod (30%) was two year-old cod at which age the majority of the fish have not yet contributed to the spawning–stock biomass (Armstrong *et al*., 2004). Less than six out of each 100 cod caught were older than four years.

All sources of information on age composition in the stock, from the fishery as well as surveys using research vessels and chartered commercial vessels, shows a paucity of cod older than four years of age in the Irish Sea. The proportion-at-age from the data collected during the sentinel fishery supports this steep age profile. A comparison with the FSP survey that was conducted earlier in 2012, also using semi-pelagic commercial gear, shows very similar age profiles and length–frequency distributions. The steep age profile indicates a continued very high total mortality rate.

6.2.2 Data

Fishery landings

The input data on fishery landings and age compositions are split into four periods (Figure 6.2.6):

1) 1968–1990. Landings in this period, provided to ICES by stock coordinators from all countries, are assumed to be un-biased and are used directly as the input data to stock assessments.

2) 1991–1999. TAC reductions in this period caused substantial misreporting of cod landings into several major ports in one country, mainly species misreporting. Landings into these ports were estimated based on observations of cod landings by different fleet sectors during regular port visits. For other national landings, the WG figures provided to ICES stock coordinators were used.

3) 2000–2005. Cod recovery measures were considered to have caused significant problems with estimation of landings. The ICES WG landings data provided by stock coordinators for all countries are considered uncertain and estimated within an assessment model. Observations of misreported landings were available for 2000, 2001, 2002 and 2005. However, they have generally not been used to correct the reported landings but have been used to evaluate model estimates in those years.

4) 2006–2012. The introduction of the UK buyers and sellers legislation is considered to have reduced the bias in the landings data but the level to which this has occurred is unknown. Consequently comparisons were made between the fit of the model to recorded landings under an assumption of bias and unbiased information.

In addition to the above Irish landings of cod reported from ICES rectangles immediately north of the Irish Sea/Celtic Sea boundary (ICES rectangles 33E2 and 33E3) have been reallocated into the Celtic Sea as they represent a combination of inaccurate area reporting and catches of cod considered by ICES to be part of the Celtic Sea stock (ICES, 2009). The amount of Irish landings transferred from VIIa to VIIe–k by year is shown below:

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Tonnes	108	54	103	527	558	193	143	147	130

The higher level in 2007 and 2008 was a consequence of limited quota in VIIe–k and available quota in VIIa. Since 2009 more restrictive monthly quotas have been set for VIIa during periods of high cod abundance close to the VIIa–VIIg boundary.

The total landed weight, annual numbers-at-age landed and the mean weights-at-age in the landings by age class are given in Tables 6.2.3 and 6.2.4 and Figure 6.2.5. There are no long-term trends in catch weights-at-age from 1982 onwards. Weights-at-age prior to 1982 are fixed at constant values lower than estimated for subsequent years, leading to sum-of-products errors, and weights-at-ages 6+ are becoming noisy for the last few years (Figure 6.2.14). Given these problems, and the likelihood of further deterioration in the quality of the data on older aged fish, WGCSE and WKROUND2 considered that future revision of historical catch-at-age data and associated weights is considered appropriate.

However, WKROUND2 established that revising the weight-at-age would only represent only minor refinements to the model estimates of mortality and SSB trends and the reference point which are dependent on them compared to the sensitivities associated with the estimation of unallocated mortality. Consequently the revision of the weights-at-age should be conducted following the determination of the reasons for the current high mortality rates on the stock.

Total mortality rates for the stock have been high throughout the time period for which information is available. Even when the stock was considered abundant and recruitment levels supported high levels of catch the gradient of the catch curve was in the range 0.8–1.0. Year classes rapidly disappeared from the commercial landings data. The increase in the negative slope indicates that total "mortality" rates have increased over time and now are double that recorded in the historic data during the period when the stock was abundant. There is currently no evidence from the age compositions from surveys or commercial fishery operations of any improvement in age structure that would result from a reduction in total mortality.

Discards data

No discards data are currently included in the assessment. Suitable discards estimates are not available prior to the mid-1990s and are not complete for many subsequent years. Available data indicates that discarding was historically mainly a function of MLS (35 cm) and therefore mainly restricted to catches of <= 1-gp cod.

EU countries are now required under the EU Data Collection Framework to collect data on discards of cod and other species. Consequently at WKROUND 2012 collation of recent discard information provided by Member States for the stock was carried out as a scoping exercise ready for future modelling and the provision of advice.

Up to 2003, estimates of discards are available only from limited observer schemes and a self-sampling scheme. Observer data are collected using standard at-sea sampling schemes. Results have been reported to ICES. Discards data (numbers-at-age and/or length frequencies) are have been supplied for VIIa cod by Ireland, UK(Northern Ireland) and UK(E&W) and Belgium. The data were supplied raised to the appropriate fleet/métier level by the member states (Figures 6.2.7–6.2.9).

Raising to total national discards

Ireland: Length frequencies from Irish (Marine Institute) observer trips in specified fleet métiers are raised to the trip level, averaged across trips during each year (not by quarter) then multiplied by the annual number of trips per year in the Irish fleet in VIIa to give raised annual LFDs for discards. An age–length key from discards trips is then applied to give annual discards by age class and métier.

Northern Ireland self-sampling scheme: The quantity of cod discarded from the UK (NI) *Nephrops* fishery from 1996 to 2002 was estimated on a quarterly basis from samples of discards and total catch provided by skippers. The discards samples contain the heads of *Nephrops* tailed at sea. Using a length–weight relationship, the live weight of *Nephrops* that would have been landed as tails only is calculated from the carapace lengths of the discarded heads. The number of cod in the discard samples is summed over all samples in a quarter and expressed as a ratio of the summed live weight of *Nephrops* in the discard samples (i.e. those represented as heads only in the samples). The reported live weight of *Nephrops* landed as tails only is then used to estimate the quantity of cod discarded using the cod:*Nephrops* ratio in the discard samples. The length frequency of cod in the discard samples is then raised to the fleet estimate. Age data have not been collected; however the discards are mainly of small cod that can be allocated to ages 0 and 1 based directly on their length. Roughly 40 discard samples were collected annually.

Northern Ireland observer trips: Length frequencies from NI (AFBI) observer trips in specified fleet métiers are raised to the trip level, summed across trips during each year or by quarter then raised to the annual number of trips per year in the NI fleet in VIIa to give raised annual LFDs for discards. An age–length key from discards trips is then applied to give annual discards by age class and métier.

UK(E&W) observer trips: Trips are arranged on vessels selected using a vessel randomisation scheme. Discard numbers are raised to sampled hauls then to the trip. The trip-raised length frequencies from Cefas observer trips in specified fleet métiers are then raised to the trip level, summed across trips during each quarter. Sampled quarters are then raised to total discards by quarter from the landings to discards ratios at age. As recorded in the data sent annually to ICES catches and discards of cod within the Irish Sea by UK(E&W) vessels have been extremely low for a number of years. For instance in 2010, 63 hours fishing were observed distributed across quarters 1–4 with three cod caught and one discarded in quarter 1 (six hours trawling), 21 caught and 20 discarded in quarter 2 (32 hours) and 0 (zero) cod caught and discarded in quarters 3 (twelve hours) and 4 (13 hours).

Belgium observer trips: Several Belgian métiers are operating in the Irish Sea. The beam-trawl fleet targeting sole and plaice (TBB_DEF_70-99_0_0) is the most important fleet, but, it should be noted that the OTB_DEF_70-99_0_0 métier (otter trawls) is becoming more important each year. Part of the landings and effort that could not be allocated to the main métiers, are referred to as: 'no allocated métier'. Since the observers only collect information from the commercial beam trawlers, the data can only be raised to the TBB_DEF_70-99_0_0 fleet and not to all Belgian métiers operating in the Irish Sea. In order to find the most suitable raising procedure for the Belgian discard (and landing) data, the tools developed by the COST project were used. Having considered the different raising procedures, raising by hauls was found to be the most appropriate method for the Belgian cod VIIa data. The results of the raising procedure were scaled relative to the official landings. The time stratification for the Belgian data is by year, as sampling was insufficient to provide quarterly figures. It should be noted that due to the lack of Belgian individual length–weight information, the length–weight keys used in the analyses, are based on Irish sampling data. Note also that the Belgian minimum landing size has changed a couple of times over the last years, which is reflected in the differences in length frequency distributions between years of the retained and discarded part of the catch.

- From the beginning of 2004 until the 30th of June 2008: 40 cm;
- From the 1st of July 2008 until 30th of September 2011: 50 cm;
- From the 1st of October 2011 up to today: 35 cm.

Raising to total international discards

National, raised to fleet discard numbers-at-age from Ireland, Belgium, UK(E&W) and NI were added to give the international numbers (with no additional weighting).

The data represents the main fleets discarding cod, i.e. *Nephrops* and beam trawlers. Table 6.2.5 presents the raised discard numbers-at-age for the years 2007–2011, the years for which common raised discard datasets are available, the associated reported landings numbers-at-age and the proportion discarded at age.

Total raised discarding has been 100% at age 0 in all years. At age 1 the discarding rate is high and has been relatively constant at around 77%. At older ages discarding has been very low until 2010 during which it has increased at all ages but particularly at age 1 indicating highgrading. Discards data for 2012 showed a drastic increase of discard rates also at ages older than 2 (Figures 6.2.8–6.2.9).

The current discard information is considered representative of the information for the main fleets highlighting strong differences between national, quarterly and potentially regional discard rates as the national fleets tend to fish differing areas with differing gears.

The time-series are still too short to include the data within an assessment and at the youngest ages discard raising still needs some development, however that also applies to landings numbers-at-age, which have deteriorated significantly in quality in recent years in terms of sampling levels due to low levels of landings.

Impact of discards on the assessment

Historical F and recruitment for 1-gp cod will be underestimated by the assessment which does not include discards but there will not any impact on the estimated average fishing mortality used to monitor the stock and estimated dynamics of the SSB. The increase in discarding at older ages observed in 2010 and, in particular, in 2012 is likely to result in an underestimate of the mortality rate at those ages.

Biological data

Natural mortality

The current assessment uses constant values of M=0.2 (all ages).

Maturity

Maturity-at-age has been considered constant in all years within the assessment at the values listed in the text table below.

Age	0	1	2	3+
Proportion Mature (1968–1995)	0	0	0.38	1
Proportion Mature (2001–to present)	0	0	0.65	1

However, Armstrong *et al*. (2004) and Nash *et al*. (2010) have shown that maturity at age 2 has increased during the late 1990s. WKROUND2 evaluated the time-series of maturity information as estimated from the Northern Ireland first quarter groundfish survey (NIGFS-WIBTS-Q1) by Armstrong *et al*. (2004) using a weighted average plotted with the raw average from the full time-series of data. The survey data indicates that the proportion mature at age 2 increased between 1995 to around 2003 from levels close to that of the WG historic estimate of 38% to 65% and has subsequently remained stable at that proportion. Changing the maturity at age 2 in the most recent years increases the estimated spawning biomass but does not change the conclusions that would be drawn from the assessment fit in that spawning biomass is well below historic values and the PA reference thresholds. WKROUND2 therefore recommended that:

1) The time-series of the proportion mature at age 2 be changed to reflect the increased proportion mature at that age.
2) That the average value from 2000 is used for the recent time period and that the transition from the historic value of 0.38, developed at WKROUND2, be adopted for the period between 1996 and 2000.
3) The biomass thresholds for the stock will be unaffected by the change to recent maturity proportions however care will need to be taken in the choice of maturity values to use when estimating F_{MSY}.

Survey data used in assessment

Six research vessel survey series for cod in VIIa have been used by WGCSE previously for the assessment of the stock until 2011. In 2012 three additional surveys became available, two fisheries science partnership surveys (UK-FSP, Western and Eastern Irish Sea) and an egg production biomass estimate from the UK IS-AEPM survey. The year ranges for each survey are presented below. The time-series of catch per unit of effort for each series are presented in Table 6.2.6.

Survey	Ages	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
NIGFS-WIBTS-Q1	1 - 5																						
ScoGFS-WIBTS-Q1	1 - 5																						
ScoGFS-WIBTS-Q4	1 - 2																						
NIGFS-WIBTS-Q4	1 - 3																						
UK-FSPw	1 - 5																						
UK-FSPe	1 - 5																						
UK(E&W)-BTS-Q3	(0) 1																						
NIMIK	(0) 1																						
IS-AEPM	SSB index																						

WKROUND2 evaluated the consistency of the survey data between and within series and the fit of the SAM model to each survey. The group concluded that the older ages in the autumn surveys did not represent the dynamics of those ages in the population due, most likely, to changes in the spatial distribution of the stock during the summer and autumn. Consequently the group recommended using all of the available surveys, which cover the time period when catch data is suspected to have been biased, and the following age ranges from each survey and this has been carried out in the update assessment.

Survey	Ages	Years				
NIGFS-WIBTS-Q1	1–5	1993	2013			
ScoGFS-WIBTS-Q1	1–5	1996	2006			
ScoGFS-WIBTS-Q4	1–2	1997	2007			
NIGFS-WIBTS-Q4	1–3	1992	2012			
UK-FSPw	1–5	2005	2013			
UK-FSPe	1–5	2005	2013			
UK(E&W)-BTS-Q3 age 0 brought forward to age 1	1 (0)	1994 (1993)	2013 (2012)			
NIMIK age 0 brought forward to age 1	1 (0)	1995 (1994)	2013 (2012)			
IS-AEPM	SSB index	1995	2000	2006	2008	2010

Internal consistency of survey data

The survey data during spring each year are of critical importance for the fit of the assessment models as noted by WGCSE previously and evaluated by WKROUND2. The data for all surveys were screened by WKROUND2 and due to the number of plots produced the exercise is not repeated in this report this year.

Following WKROUND2 three new updates of survey data were available in 2013, the Northern Ireland groundfish survey NIGFS-WIBTS-Q1, and the two March FSP surveys (UK-FSP in the Eastern and Western Irish Sea, respectively). The survey data were compared internally and between surveys for consistency with no outliers and therefore the most recent data were used in the fit of the assessment model.

Commercial cpue

Commercial cpue data are available for this stock but are not currently used in the assessment.

Other relevant data

Indices of abundance from the UK Fisheries Science Partnership (UK-FSP) are now used in the update assessment following their inclusion in the model fit by WKROUND2 the most recent results are described with Armstrong *et al*. (WD 7 to WKROUND2). The series of cod SSB estimates from applications of the annual egg production method, using gene probes to identify early-stage cod eggs, were presented for 2010 in Armstrong *e al.* (WKROUND2 WD 8). The final estimates for 2010 were 1097 t (RSE 17%) in the western Irish Sea, 522 t (RSE 13%) in the eastern Irish Sea and 1619 t (RSE 16%) for the whole Irish Sea. The time-series was reviewed at WKROUND2 and included in the assessment as a relative index of SSB abundance.

6.2.3 Historical stock development

Deviations from Stock Annex

The assessment does not deviate from the procedure developed at WKROUND2 and is described in the report of that meeting which has been developed into the stock Annex.

Software used and model options chosen

The SAM method, software version FLSAM, was used to allow estimation of removals bias from 2000 onwards and to allow inclusion of the SSB index from the IS-AEPM survey.

Model settings for the update assessment are given in Table 6.2.7. SAM can use survey data for the year after the last year of catch data, and in this assessment the survey indices for NIGFS-WIBTS-Q1 and UK-FSP (Eastern and Western Irish Sea) in 2013 are used.

Input data types and characteristics

New data added to the update SAM assessment are the fishery landings data for 2012, the NIGFS-WIBTS-Q1 survey data and UK-FSP (Eastern and Western Irish Sea) for 2013 and the NIGFS-WIBTS-Q4, and NIMIK and UK(E&W)-BTS-Q3 0-gp indices for 2012 (series brought forward to provide indices of age 1).

The update SAM assessment follows the same procedure as in the WKROUND2 and WGCSE 2012 assessments by including the sample-based estimates of landings at three major ports from 1991–2002 and 2005 while estimating removals in excess of the assumed natural mortality rate in 2003, 2004 and 2006–2012. The sample based estimates of landings for 2000–2002 and 2005 had previously been used to provide a comparison with the model estimates of removals.

Data screening

Screening of input catch and survey data is described in Section 6.2.2.

Final update assessment: diagnostics

The diagnostics of the update SAM run are given in Figure 6.2.10–6.2.28.

Figure 6.2.10 presents the estimated catchability parameters at age for the time series of six of the surveys used in the assessment. The noise in the estimates increases with age such that at oldest ages of the NIGFS-WIBTS-Q1 survey; the UK-FSP west and east can be estimated as a single parameter for each survey as there is no significant difference between each age. Both the NIGFS-WIBTS-Q1 survey and the UK- FSP east are dome shaped, catching fewer older fish whereas the historic Scottish surveys and the western UK-FSP survey have increasing catchability with age.

Figure 6.2.15 presents the SAM estimated fishing mortality-at-age, with age 5=age 6. "Fishing mortality" is estimated to have increased until ~2000 and decreased subsequently, but is still at high levels. As noted previously the model allocates mortality that is not the input base level of natural mortality to fishing mortality therefore the unallocated mortality could be discarding (although unlikely given the observed estimates) the additional natural mortality. Tagging studies reported in WKROUND2 indicate that emigration is an unlikely source of the rapid decline in the cohorts.

Figure 6.2.16 presents the estimated catch and catchability variances at age. As is usual with the SAM model, the fit to the catch-at-age data is closest as selectivity is allowed to vary in time; there is increasing variance at the youngest and oldest ages.

Figure 6.2.18 presents the selectivity-at-age of the fishery in five year blocks.

Figures 6.2.19a–f present the residuals of the fit of the time-series model to the catch data for each age. The fitted values track the trends in the observations well in the early years in which there is no calibration information, with no strong pattern in the residuals. After the introduction of the tuning data the residuals are increasingly noisy especially during the period when the scale parameters are estimated.

The diagnostics for the Northern Ireland groundfish March survey (NIGFS-WIBTS-Q1) are presented in Figure 6.2.20. The fit to the survey still has some pattern in the early years but is much improved over a fit without estimation of catch bias in recent years. Similarly a transition from negative to positive residuals which is apparent when no bias is fitted in the model is also reduced by the estimation of bias in the Scottish quarter 1 groundfish survey, which also spans this period (Figure 6.2.21). Fits of the model to the Scottish groundfish (ScoGFS-WIBTS-Q4), the Northern Ireland groundfish October survey (NIGFS-WIBTS-Q4), UK-FSP west and east, UK(E&w)–BTS-Q3, NIMIK and the SSB index from IS-AEPM survey data are presented in Figures 6.2.22–6.2.28. As with the fit of the model to the survey data at WKROUND2, there are no apparent anomalies in the fits to the survey data that would indicate a systematic problem with the model estimates.

Final update assessment: long-term trends

Figure 6.2.31 presents the SAM estimated spawning–stock biomass, average F (ages 2–4) and recruitment. The population numbers and F-at-age from the update SAM assessment are given in Tables 6.2.8 and 6.2.9, and the summary data are given in Table 6.2.10.

SSB is estimated to be very low but has shown a small increase after two improved but still low recruitments and a slight reduction in mortality rates. SSB is well below historic and reference levels following the recent protracted period of low recruitments and fishing/total mortality is estimated to be very high.

Comparison with previous assessments

The current assessment is a direct update of the model fitted at the WGCSE 2012. The current assessment is consistent with that assessment (Figure 6.2.32), with recruitment and SSB still at very low levels, although a slight increase in SSB likely due to the 2009 year class, and fishing mortality still at high level.

There is a large divergence between model estimates of removals for 2011 and 2012 and the reported landings. Increased discarding of older fish (>age2) in 2012 may explain this for 2012 as discards are not included in the model, driving also the 2011 estimate.

In the view of these considerations, it is suggested to use the recruitment index that will be obtained from the analysis of 2013 data as a stock size indicator. A full assessment of this stock will be carried out only if the recruitment index will be higher than a defined value that is considered to be able to produce a significant increase in SSB in the future years.

The state of the stock

The spawning–stock biomass has declined ten-fold since the late 1980s and is suffering reduced reproductive capacity (SSB < B_{lim} of 6000 t).

The fishing mortality estimates since 1988 have remained above the F_{lim} value of F=1.0 and the stock has therefore been harvested unsustainably over this period.

Fishing mortality throughout the assessment period has been well above the candidate reference points associated with high long-term yields and a low risk of depleting the productive potential of the stock. There are indications that the total mortality rate on the stock is declining; however it is still well above the rate at which the stock will recover to historic levels of biomass at the current low recruitment abundance.

Recruitment has been below average for the past eighteen years. The 2002 to 2008 year classes were amongst the smallest on record but there has been a slight improvement subsequently. The 2009 year class increased recruitment compared the recent period of low recruitment, but is still well below the long-term average. The 2011 year class is, unfortunately, estimated to be at the low levels recorded from 2002–2008.

6.2.4 Short-term predictions

Due to the inability to identify the source of the bias in removals estimates from the assessment, and the relationship between future TAC and total removals, detailed short-term catch forecasts are not provided for this stock.

6.2.5 Medium-term projections and MSY evaluation

F_{MSY} Evaluations

A full F_{MSY} evaluation was carried out at WGCSE in 2010 and the suggested level of F_{MSY} for this stock was Fs within the range of 0.25 to 0.54. No further work was carried out this year.

6.2.6 Biological reference points

The current precautionary reference points for Irish Sea cod are given below they are unchanged since 1998:

B_{lim}	6000 t
B_{pa}	10 000 t
F_{lim}	1.00
F_{pa}	0.72

6.2.7 Management plans

The Irish Sea cod management plan, as described in Council Regulation (EC) 1342/2008 was evaluated independently by ICES in 2009 using the approach adopted in AGCREMP 2008 and found to be not consistent with the ICES Precautionary Approach (WGCSE 2009).

The long-term target for the management plan is a fishing mortality of 0.4, based on the EU-Norway negotiated target for North Sea cod. This target is within F_{msy} range for Irish Sea cod, and well below the current estimates of total removals mortality in excess of M=0.2.

6.2.8 Uncertainties and bias in assessment and forecast

Landings data

The quality of the commercial landings and catch-at-age data for this stock deteriorated in the 1990s following reductions in the TAC without associated control of fishing effort. The Working Group has, since the 1990s, attempted to overcome this problem by incorporating sample-based estimates of landings from three major ports in the WG landings figures. The data for this method have become more limited since 2003, and the WG uses modelling approaches to estimate subsequent removals for 2003, 2004 and 2006 onwards. The unaccounted removals figures given by models could potentially include components due to increased natural mortality and discarding as well as misreported landings or catches from the stock taken outside VIIa.

Discarding

Discarding has historically been mainly at age 1, and the omission of estimates of discards at that age will result in under-estimation of historical F and recruitment at age 1. However, this will not bias the management metrics as this age is not included in the fishing mortality average and is immature and therefore does not alter the perception of spawning biomass trends.

Strict controls on catch reporting following the introduction of the Registration of Fish Buyers and Sellers regulations has resulted in documented increases in discarding of cod above the MLS off the west of Scotland and in the Celtic Sea (see Sections

3.2 and 7.2). Observer data provided no evidence for this in the Irish Sea in 2008–2009, but the 2010 and in particular the 2012 Irish and Northern Irish data do show shifts towards the discarding of high amounts of older fish.

Compliance with catch composition rules for some fleets, especially for those targeting *Nephrops*, could also result in increased discarding of cod. Implementation of unbiased sampling schemes to estimate discarding with adequate precision is likely to be of increasing importance for this stock to prevent further deterioration in fishery catch data.

Surveys

The Irish Sea has relatively good survey coverage. The surveys in general give consistent signals of fish abundance-at-age. All surveys catching adult cod indicate a severe depletion of the SSB during a run of very poor recruitment from 2002, with only one reasonable recruitment observed in 2010.

The UK Fisheries Science Partnership surveys (UK-FSP) of the Irish Sea cod spawning grounds in spring 2005–2013 (now included in the assessment), carried out using commercial trawlers, indicated a widespread distribution of cod mostly at low density but with some localized aggregations. The time-series of SSB indices shows an upward trend similar to that shown by NIGFS-WIBTS-Q1 pointing to some recovery following the maturation of the 2009 year class. As with all survey and catch data information there is a highly truncated age composition of cod in the UK-FSP surveys supporting the ICES assessment in indicating continuing high mortality rates.

Estimates of cod SSB from applications of the annual egg production method are below B_{lim} and show a similar trend in SSB to the assessment.

Model formulation

The SAM estimates of removals bias vary around relatively high values of 2.0–3.0 despite more accurate catch reporting. WKROUND2 examined the potential for unaccounted losses from other sources including fishery catches taken outside VIIa during seasonal migrations, a gradual shift in distribution to areas beyond VIIa, but could find no supporting evidence for this.

The estimates of bias could also be influenced by any remaining non-randomness of survey catchability, but this would have had to have occurred across several independent surveys consistently in time.

There is currently limited evidence from surveys and fishery age compositions of a reduction in mortality rates resulting from the current management measures. However the models estimates continue to indicate relatively large unaccounted-for removal of fish from the stock, but unfortunately there is currently very little direct evidence to evaluate the potential source(s) of this and how much is due to fishing in VIIa or elsewhere.

Stock structure and migrations

The VIIa commercial fishery for cod extends into the North Channel, particularly for vessels using mid-water trawls. It is not clear if the cod in this region belong to the Irish Sea stock, the nearby Clyde stock which exhibits dense aggregations of adult fish during spring in the area covered by the Clyde closure, or to other VIa cod populations. Incorrect allocation of catches to stocks could lead to biases in the assessments.

Bendall *et al*. (2009) presented the results of a series of tagging studies of the cod stocks in ICES Divisions VIa, VIIa and VIIe–k. The study analysed conventional returns and data storage tag point location estimates to determine the movement within and between cod stocks during the year and consequently the potential exchange of fish between them.

Although there is evidence for limited seasonal migrations into neighbouring regions, most fish will stay within their management area. There is no significant long-term emigration from VIIa into the adjacent northern (VIa) and southern (VIIe–k) management units that would indicate that the areas should be considered together.

The seasonal migrations can be used to explain the underlying stock dynamics that have led to the selection of only the youngest survey ages from the autumn groundfish surveys in the VIIa cod assessment model calibration by the ICES WGCSE working group. Bendall *et al*. (2009) showed that during the first two quarters of the year the adult cod are distributed throughout the western Irish Sea (in quarter 2 two cod moved south into the VIIg but returned later). Later in the year in quarters 3 and 4 the cod have a very restricted distribution, confined to deeper waters in the northern and southern channels. If the survey station distributions do not cover the deeper water this could explain the lack of consistency in the catch rates of the surveys in autumn.

Tagging of cod off Greencastle on the north coast of Ireland (O'Cuaig and Officer, 2007), and more limited tagging on UK Fisheries Science Partnership (UK-FSP) surveys (Armstrong *et al*., WD2 to WGNSDS 2007), have demonstrated movements of cod between Division VIa and VIIa. Most recaptures in VIIa from cod tagged in VIa have come from the North Channel and in or near the deep basin in the western Irish Sea that is a southward extension of the North Channel. The research surveys used for tuning the VIIa cod assessment cover only the western and eastern Irish Sea, and do not extend into the deeper water of the North Channel, where large catches of cod were made by mid-water trawlers in the 1980s and 1990s.

Historical tagging studies have also shown more limited movements of cod between spawning components in the western and eastern Irish Sea, for which the migrations tend to be in a north-south direction. STECF Subgroup SGRST (2005, Appendix 4) concluded that management of the Irish Sea stock on the basis of substock assessment regions would be difficult in practice, particularly the separation of catches when the stock units are mixed. Further tagging and genetics studies are required to investigate stock structure, seasonal movements and mixing in VIIa and neighbouring areas.

The WKROUND2 concluded from these studies that:

1) The present evidence does not call for radical changes in the current assessment units. Most fish can be expected to remain within their respective area.
2) Seasonal migrations, sometimes leading outside the area, may affect catchability in surveys. In particular, surveys in quarters 3 and 4 in Division VIIa may not pick up all ages properly as established by WGCSE.
3) Within VIIa, the population of cod is likely to consist of several partly isolated substocks. The opportunity for exchange may be variable, but in general, one cannot expect a depleted substock to be repopulated from neighbouring areas.

4) For management, this implies that in addition to maintaining the current stocks at a productive level, care needs to be taken to avoid depletion of local stock components.

6.2.9 Recommendations for next benchmark assessment

WKROUND2 concluded that:

- The status of the assessment of Irish Sea cod is considered to be “work in progress”.
  - The current assessment structure which includes the estimation of unallocated mortality in the most recent period is considered suited to the provision of advice on the status of the biomass and the total mortality rate for the Irish sea cod.
  - The fishing mortality rate in recent years is uncertain, but total mortality remains very high; a conclusion that is independent of the model assumptions.
  - Spawning–stock biomass has declined tenfold since the late 1980s and has been considered to be well below B_{lim} at reduced reproductive capacity since the mid-1990s. With the exception of the 2009 year class, recruitment has been low for the last nine years.
  - The model estimates of total removals continue to vary around two to three times the reported landings, despite more accurate catch reporting and lack of evidence for significant highgrading of cod until 2010.
- Discard estimates are not currently integrated into the assessment but sampling by observers indicates that in 2010 and 2012 discarding occurred also at older ages.
  - It is recommended that the work to collate and provide discard estimates for each year should be continued and the data be used to partition the estimated mortality rates into landings discards and unallocated within a forecast in order to provide management advice on the order of their magnitude and the impact on the stock.
- Tagging studies have indicated that migration from the stock is not occurring at a rate that would lead to it being misinterpreted as unallocated mortality. The tagging studies have revealed that the aggregating behaviour of cod it is resulting in high cod density even at low abundance which can result in high catches in localised areas and low levels of fishing effort causing high mortality on the stock.
  - Short-term migrations of cod out of and back into the Irish Sea in the north Channel is indicated by the studies and consequently the impact of catches taken in these areas, assuming all are from the Irish sea stock, should be investigated in a sensitivity analysis.
- There are model assumption and data issues that require investigation and which should be included within the final assessment when the unallocated mortality issue has been resolved and reference point values re-estimated.
  - Natural mortality-at-age; in the future assessments the Lorenzen natural mortality should be used, constant in time.

- The proportion mature at age 2 should be re-estimated from survey data and used within the assessment and estimation of reference levels.

6.2.10 Management considerations

A number of emergency and cod recovery plan measures have been introduced since 2000 to conserve Irish Sea cod. These include a spawning closure since 2000 and effort control since 2003. There have also been several vessel decommissioning schemes. As it has not been possible to provide analytical catch forecasts in recent years, the TAC has been reduced by 15–20% annually since 2006 and by 25% since 2009. These measures may have prevented a further increase in fishing mortality of cod and may have resulted in some reduction in fishing mortality. However, the current assessment does not provide sufficiently robust estimates of fishing mortality to allow the possible changes to be determined.

Although recent recruitment patterns appear well estimated in the assessment, the problem of inaccurate landings and discards estimates makes it difficult to estimate the absolute value and recent trends in fishing mortality. However, all sources of information on age composition in the stock, from the fishery as well as surveys using research vessels and chartered commercial vessels, indicates a continued paucity of cod older than four years of age in the Irish Sea indicating a continued very high mortality rate. Possible causes of this include:

- TACs have not restricted catches as intended. Substantial underreporting of landings is known to have occurred since the 1990s, although there is some indication that this is reduced since 2006. However the assessment continues to indicate a large unaccounted removal of fish. The relative contribution of fishing to this has not been identified;
- The effort reductions have not been sufficient, although considerable effort reductions have been observed in some fleets (particularly vessels using >100 mm mesh);
- Cod continues to be taken in mixed demersal fisheries (particularly for *Nephrops*);
- Time and area closures have not been sufficient to lead to rebuilding of this stock;
- Other non-fishery causes, such as increased natural mortality, have increased over time.

It is difficult to reconcile the large apparent mortality rate and unaccounted removals in recent years with the reduction in fishing effort by whitefish trawlers (shown by STECF Subgroup STECF (2011) the very low abundance of cod, and the evidence for more accurate catch reporting since the introduction of the Registration of Buyers and Sellers.

The scientific evaluation of the revised cod Management Plan (Council Regulation (EC) 1342/2008) indicates that it may not be sufficiently precautionary to allow rebuilding of the Irish Sea cod stock to a level where it can regain historical productivity by 2015 (see WGCSE 2009 Report, Section 9.2). The probability of recovery of the cod stock will be increased by measures to eliminate discards of cod which historically have mainly comprised undersized fish.

A closure of the western Irish Sea spawning grounds for cod from mid-February to end of April has been in place since 2000, with an extension to the eastern Irish Sea in

2000. The closure was reviewed in 2007 by STECF SGMOS-07-03. On the basis of the information available, SGMOS-07-03 was unable to determine the extent to which the closure has reduced fishing mortality to a lower value than would otherwise have occurred, through protection of adult cod during spawning or influencing changes in fishing effort in the different fleets. SGMOS advised that a comprehensive evaluation of how fleet activities have been affected by the closure and other regulations and factors is required to evaluate the cod closure.

Estimates of spawning–stock biomass of cod in 2010 based on the annual egg production and estimates of fecundity and sex ratio give SSB below B_{lim} and indicate declines in SSB in recent years.

6.2.11 References

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Table 6.2.1. Nominal landings (t) of COD in Division VIIa as officially reported to ICES, and figures used by ICES.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011[1]	2012
Belgium	142	183	316	150	60	283	318	183	104	115	60	67	26	19	21	36	23
France	148	268	269	n/a	53	74	116	151	29	35	18[2]	17[2]	3	12	1	3	1
Ireland	2,476	1,492	1,739	966	455	751	1,111	594	380	220	275	608	618[2]	323[2]	289	275	193
Netherlands	25	29	20	5	1	-	-	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-
UK (England, Wales & NI)	2,359	2,370	2,517	1,665	799	885	1,134	505	646	594	5892	423	5432	3872	282	169	109
UK (Isle of Man)	27	19	34	9	11	1	7	7	5	n/a	n/a	n/a	22	12	1	1	<1
UK (Scotland)	126	80	67	80	38	32	29	23	15	3	6	2	12	12	-	-	-
Total	5,303	4,441	4,962	2,875	1,417	2,026	2,715	1,477	1,179	967	948	1,117	1224	754	594	485	326
Unallocated	-339	1,418	356	1,909	-143	226	-20	-192	-107	-57	-108	-415	-563	-286	-130	-117	-128
Total as used by WG	4964[3]	5859[3]	5318[3]	4784[3]	1274[4]	2252[4]	2695[4]	1285[4]	1072[4]	910[4]	840[4]	702[4]	661[4]	468[4]	464[4]	368	198

[1]Preliminary. [2]Revised. n/a = not available [3] includes sample-based estimates of landings into three ports [4] based on official data only.

Table 6.2.2. Cod in VIIa. Working Group figures for annual landings by country since 2000.

(a) WG Landings (tonnes)

Year	NI	E & W	Scotland	Ireland	France	Belgium	Isle of Man	Netherlands	Total	TAC	% uptake
2000	638	156	39	321	52	56	11	0	1273	2100	61
2001	697	209	32	645	361	300	8	0	2251	2100	107
2002	983	171	39	953	251	294	1	2	2695	3200	84
2003	381	118	32	415	145	187	7	0	1285	1950	66
2004	539	103	15	271	37	103	5	0	1072	2150	50
2005	523	72	4	168	31	108	3	0	910	2150	42
2006	552	32	6	172	17	59	3	0	840	1828	46
2007	396	27	2	191	18	66	2	0	702	1462	48
2008	523	22	1	85	3	27	1	0	662	1199	55
2009	375	15	0	55	3	19	1	0	468	899	52
2010	274	17	0	151	1	21	1	0	465	674	69
2011	152	17	0	160	3	36	1	0	368	506	73
2012	98	14	0	63	0	23	0	0	198	380	52

2009	UK	Ireland	France	Belgium	Netherlands	Total
Landings	391	55	3	19	0	498
TAC	259	592	33	12	3	899
% uptake	151%	9%	9%	160%	0%	

2010	UK	Ireland	France	Belgium	Netherlands	Total
Landings	292	151	1	21	0	465
TAC	194	444	25	9	2	674
% uptake	150%	34%	4%	233%	0%	

2011	UK	Ireland	France	Belgium	Netherlands	Total
Landings	170	160	3	36	0	369
TAC	146	333	19	7	2	506
% uptake	117%	48%	16%	533%	0%	

2012	UK	Ireland	France	Belgium	Netherlands	Total
Landings	112	63	0	23	0	198
TAC	109	251	14	5	1	380
% uptake	103%	25%	0%	460%	0%	

(b) Percentage of annual total

Year	NI	E & W	Scotland	Ireland	France	Belgium	Isle of Man	Netherlands	Total
2000	50.1	12.3	3.0	25.2	4.1	4.4	0.9	0.0	100
2001	31.0	9.3	1.4	28.6	16.1	13.3	0.4	0.0	100
2002	36.5	6.4	1.5	35.4	9.3	10.9	0.0	0.1	100
2003	29.7	9.2	2.5	32.3	11.3	14.6	0.6	0.0	100
2004	50.3	9.6	1.4	25.2	3.5	9.6	0.4	0.0	100
2005	57.5	7.9	0.5	18.5	3.5	11.8	0.3	0.0	100
2006	65.7	3.8	0.7	20.4	2.0	7.1	0.3	0.0	100
2007	56.5	3.8	0.3	27.2	2.5	9.5	0.3	0.0	100
2008	78.9	3.4	0.2	12.8	0.5	4.0	0.2	0.0	100
2009	80.1	3.1	0.0	11.7	0.6	4.1	0.3	0.0	100
2010	41.3	4.6	0.0	43.5	0.8	9.8	0.2	0.0	100
2011	41.3	4.6	0.0	43.5	0.8	9.8	0.3	0.0	100
2012	49.5	7.1	0.0	31.8	0.0	11.6	0.0	0.0	100

Table 6.2.3. Cod in VIIa. Landings numbers-at-age used in the update SAM assessment.

Catch numbers at age Numbers *10**-3

Age\Year	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	364	882	1717	2739	789	2263	530	1699	1135	816	687	1762	2533	1299	345
2	1563	1481	1385	2022	3267	1091	3559	642	3007	511	1092	1288	2797	3635	2284
3	1003	1050	352	904	824	1783	557	1407	363	1233	310	608	729	1448	1455
4	456	269	204	144	250	430	494	294	500	163	311	127	243	244	557
5	177	186	163	67	58	173	131	249	61	218	39	164	49	99	102
+ gp	30	113	71	51	59	81	74	117	104	71	65	71	55	47	79
TOTALNUM	3593	3981	3492	5927	5247	5821	5345	4408	5170	3012	2504	4020	6406	6772	4822
TONSLAND	8541	7991	6426	9246	9243	11819	10251	9863	10247	8054	6271	8371	10776	14907	13381
SOP COF %	87	81	94	97	86	91	86	93	97	99	113	113	102	108	99

Age\Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	814	1577	1218	974	4323	2792	582	710	1973	1375	223	749	498	318	523
2	932	1195	2105	2248	1793	4734	2163	1075	1408	1243	2907	569	1283	1113	1149
3	751	439	703	699	841	702	1886	545	442	664	403	848	180	700	501
4	499	240	158	203	252	263	231	372	127	132	119	68	163	38	213
5	154	161	84	64	75	71	86	70	98	42	16	20	7	39	17
+ gp	46	75	77	65	43	38	37	30	22	49	13	10	6	6	16
TOTALNUM	3196	3687	4345	4253	7327	8600	4985	2802	4070	3505	3681	2264	2137	2214	2418
TONSLAND	10015	8383	10483	9852	12894	14168	12751	7379	7095	7735	7555	5402	4587	4964	5859
SOP COF %	98	101	101	100	100	100	100	100	100	100	100	100	100	100	100

Age\Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	204	70	289	338	196	45	68	42	14	49	14	20	40	11	4
2	1926	843	176	841	564	439	101	224	142	205	166	53	128	105	35
3	335	871	107	53	405	93	158	62	112	56	87	66	15	36	32
4	80	66	50	13	7	35	21	33	16	11	9	17	7	2	4
5	28	21	4	9	2	1	6	5	8	1	3	3	2	1	0
+ gp	8	7	1	2	3	0	3	1	3	0	0	0	1	1	0
TOTALNUM	2581	1877	627	1256	1177	613	357	367	296	322	279	159	192	155	74
TONSLAND	5318	4784	1274	2252	2695	1285	1072	910	840	702	662	466	464	368	198
SOP COF %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 6.2.4. Cod in VIIa. Mean weights-at-age in the landings (used for stock and catch).

Catch and stock w eights at age (kg)

Age\Year	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	1.01
2	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.52
3	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.49
4	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.57
5	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	6.19	7.59
+ gp	6.86	7.26	7.17	7.12	7.28	7.16	7.34	7.05	7.13	7.63	7.19	7.48	6.87	7.55	9.11
SOPCOFAC	0.8734	0.8126	0.9407	0.9683	0.8622	0.9114	0.8575	0.9261	0.9706	0.9855	1.1287	1.1266	1.023	1.0757	0.9916

Age\Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	1.00	0.68	0.78	0.81	0.71	0.61	0.94	0.84	0.86	0.81	0.85	0.80	0.90	0.98	0.85
2	1.84	1.81	2.02	1.83	2.16	1.56	1.85	1.94	1.64	1.96	1.71	1.92	1.84	1.63	1.94
3	3.99	3.81	4.24	3.86	3.91	3.76	3.22	3.57	3.54	3.99	3.67	3.61	4.00	3.26	3.62
4	5.96	5.87	5.83	5.86	6.41	5.67	5.41	5.28	5.42	5.98	5.68	6.08	5.79	5.30	5.29
5	7.97	7.48	7.50	7.39	7.82	8.02	6.57	7.53	6.39	6.92	7.37	7.68	8.45	7.72	6.12
+ gp	9.97	10.05	9.04	8.78	10.32	9.88	9.47	9.40	9.11	8.67	10.17	8.57	9.14	9.79	9.40
SOPCOFAC	0.9833	1.0131	1.0051	1.0018	1.0014	1.0003	0.9972	0.9971	1.0013	1.004	0.9986	0.9993	1.0001	0.9987	0.9996

Age\Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	0.93	0.85	0.85	0.99	0.94	1.21	1.11	0.91	0.83	0.83	0.89	1.10	1.26	0.95	0.93
2	1.65	1.62	1.99	1.82	1.84	1.66	2.20	1.94	1.84	1.85	1.59	2.01	2.29	1.88	1.88
3	3.73	3.18	3.57	4.15	3.44	3.29	3.63	3.51	3.67	3.78	3.54	3.46	3.93	3.75	3.37
4	5.37	5.51	5.14	5.61	5.73	5.43	6.51	5.32	4.71	5.35	6.00	5.31	6.34	5.54	5.34
5	7.03	7.52	7.15	7.33	7.71	10.20	7.64	7.74	6.39	7.99	7.57	7.10	7.33	6.75	7.60
+ gp	9.35	10.25	8.39	8.39	10.01	11.09	8.61	8.89	7.84	10.04	9.46	6.82	9.64	9.04	8.56
SOPCOFAC	1.0004	1.0003	1.0004	1.0027	0.9979	0.9955	0.9969	0.9971	1.002	1.0051	1.0001	0.9951	0.9988	0.9989	0.9988

Table 6.2.5. Cod in VIIa. Estimates of numbers discarded and the discarded proportion during 2007–2012. Data are total numbers ('000 fish) discarded at-age, estimated from numbers per sampled trip raised to total fishing effort by each country supplying data (UK, Ireland and Belgium). Discards are not currently used in the assessment due to the short time-series available.

Discards	0	1	2	3	4	5
2007	16	167	4.6	0	0	0
2008	5.5	63.4	3.4	0	0	0
2009	329.3	39.8	4.4	0.1	0	0
2010	48.7	180	60.3	1.4	0.5	0.1
2011	9.7	42.7	0.9	0	0	0
2012	7.5	79.9	100.2	112.9	5.9	0.2

Landings	0	1	2	3	4	5
2007	0	49	205	56	11	0.5
2008	0	13.7	165.7	87.1	9.4	2.7
2009	0	19.7	53.2	65.5	16.9	2.9
2010	0	40.2	127.6	15	7.4	1.5
2011	0	109	105.1	35.8	1.7	1.0
2012	0	3.6	35.3	31.5	3.6	0.1

Proportion	0	1	2	3	4	5
2007	1	0.773	0.022	0.000	0.000	0.000
2008	1	0.822	0.020	0.000	0.000	0.000
2009	1	0.669	0.076	0.002	0.000	0.000
2010	1	0.817	0.321	0.085	0.063	0.063
2011	1	0.282	0.008	0.000	0.000	0.000
2012	1	0.957	0.740	0.782	0.623	0.697

Table 6.2.6. Cod in Division VIIa: Survey catch numbers-at-age and annual effort multiplier. Numbers in bold are used in the assessment model fit.

Northern Ireland groundfish survey March

Year	Effort/Age	1	2	3	4	5	6
1993	1	**138.121**	**648.763**	**44.599**	**10.421**	**1.417**	2.769
1994	1	**1380.438**	**109.71**	**120.271**	**8.45**	**1.367**	0
1995	1	**700.728**	**386.153**	**20.039**	**10.779**	**0**	0.994
1996	1	**1106.129**	**329.282**	**111.668**	**1.394**	**8.808**	0
1997	1	**537.298**	**415.843**	**66.723**	**21.392**	**1.394**	0
1998	1	**169.385**	**769.234**	**56.874**	**11.984**	**0**	0
1999	1	**49.499**	**253.08**	**241.874**	**15.286**	**2.787**	0
2000	1	**629.595**	**101.053**	**34.576**	**33.014**	**0**	2.258
2001	1	**406.682**	**561.441**	**18.438**	**5.775**	**4.042**	0
2002	1	**662.163**	**253.311**	**333.543**	**0**	**0**	1.129
2003	1	**73.865**	**1079.204**	**104.05**	**32.702**	**3.652**	3.049
2004	1	**216.956**	**171.956**	**88.622**	**5.375**	**4.381**	0
2005	1	**63.533**	**225.07**	**29.407**	**27.963**	**18.27**	0
2006	1	**169.989**	**130.752**	**58.304**	**2.523**	**0**	0
2007	1	**164.351**	**124.393**	**30.601**	**5.148**	**0**	0
2008	1	**40.658**	**217.151**	**13.018**	**5.172**	**4.178**	0.994
2009	1	**144**	**59**	**33**	**9**	**0**	0
2010	1	**1022.117**	**208.961**	**14.656**	**2.258**	**0**	0
2011	1	**353.981**	**414.689**	**46.006**	**2.258**	**2.01**	0
2012	1	**161.898**	**222.819**	**99.271**	**14.250**	**0**	0
2013	1	**276.592**	**213.675**	**60.082**	**1.491**	**15.547**	0

Scottish groundfish survey quarter 1

Year	Effort/Age	1	2	3	4	5
1996	1	**3**	**31**	**44**	**7**	**9**
1997	1	**22**	**29**	**15**	**13**	**2**
1998	1	**5**	**81**	**27**	**5**	**1**
1999	1	**7**	**33**	**93**	**15**	**5**
2000	1	**51**	**6**	**11**	**16**	**0**
2001	1	**28**	**56**	**1**	**1**	**4**
2002	1	**13**	**18**	**37**	**1**	**1**
2003	1	**8**	**69**	**18**	**9**	**0**
2004	1	**8**	**11**	**49**	**0**	**3**
2005	1	**1**	**25**	**8**	**9**	**1**
2006	1	**2**	**5**	**11**	**0**	**2**

Table 6.2.6. (cont.) Cod in Division VIIa: Survey catch numbers-at-age and annual effort multiplier. Numbers in bold are used in the assessment model fit.

Scottish groundfish survey quarter 4						
Year	Effort/Age	0	**1**	**2**	3	4
1997	1	3	**28**	**19**	1	2
1998	1	0	**8**	**42**	5	0
1999	1	164	**2**	**24**	6	2
2000	1	24	**136**	**4**	0	0
2001	1	0	**0**	**7**	0	0
2002	1	0	**18**	**15**	9	0
2003	1	2	**0**	**27**	0	0
2004	1	2	**12**	**5**	5	0
2005	1	3	**8**	**25**	2	0

Northern Ireland groundfish survey October						
Year	Effort/Age	0	1	2	3	4
1992	1	57.9	**1109.37**	**50.06**	**47.6**	8.64
1993	1	780.82	**553.23**	**146.44**	**0.76**	0
1994	1	1996.19	**1672.49**	**25.44**	**10.44**	0
1995	1	788.56	**1206.8**	**33.32**	**0**	0
1996	1	1481.33	**486.65**	**50.15**	**6.54**	0
1997	1	420.45	**1322.2**	**97.19**	**0**	0
1998	1	36.98	**376.51**	**163.9**	**5.72**	0
1999	1	2022.49	**58.47**	**32.48**	**9.49**	0
2000	1	724.17	**301.64**	**2.03**	**0**	0
2001	1	841.1	**506.79**	**109.91**	**0**	0
2002	1	89.68	**487.89**	**37.68**	**12.53**	0
2003	1	275.94	**161.45**	**29.4**	**0**	0
2004	1	443.71	**578.97**	**23.71**	**0**	0
2005	1	824.45	**706.13**	**107.72**	**17.28**	2.89
2006	1	117.02	**130.2**	**1.47**	**6.58**	0
2007	1	6.78	**86.99**	**0**	**2.98**	0
2008	1	19	**17**	**17**	**0**	0
2009	1	535.61	**213.62**	**6.1**	**0**	0
2010	1	277.95	**171.8**	**2.98**	**0**	0
2011	1	8.362	**92.480**	**53.862**	**3.049**	3.049
2012	1	190.718	**107.046**	**1.694**	**6.369**	2.981

Table 6.2.6. (cont.) Cod in Division VIIa: Survey catch numbers-at-age and annual effort multiplier. Numbers in bold are used in the assessment model fit.

UK(E&W) Fisheries science partnership survey (west).

Year	Effort/Age	1	2	3	4	5	6
2005	1	**0**	**0.427**	**1.409**	**0.99**	**0.084**	0.025
2006	1	**0.003**	**0.536**	**2.815**	**0.427**	**0.104**	0.01
2007	1	**0.008**	**0.611**	**1.322**	**0.585**	**0.055**	0.058
2008	1	**0.003**	**0.221**	**0.824**	**0.147**	**0.084**	0.02
2009	1	**0.009**	**0.171**	**1.152**	**0.377**	**0.099**	0.018
2010	1	**0**	**0.735**	**0.452**	**0.467**	**0.13**	0.023
2011	1	**0**	**0.407**	**1.681**	**0.144**	**0.095**	0.039
2012	1	**0**	**0.364**	**2.300**	**0.803**	**0.072**	0.021
2013	1	**0**	**0.844**	**1.883**	**1.348**	**0.370**	0.057

UK(E&W) Fisheries science partnership survey (east).

Year	Effort/Age	1	2	3	4	5	6	7
2005	1	**0.06**	**4.02**	**0.25**	**0.38**	**0.004**	0.01	0
2006	1	**0.83**	**0.77**	**0.67**	**0.007**	**0.042**	0	0.001
2007	1	**0.59**	**1.43**	**0.09**	**0.08**	**0**	0	0
2008	1	**0.01**	**1.8**	**0.32**	**0.02**	**0.03**	0.003	0.01
2009	1	**0.5**	**0.36**	**0.21**	**0.09**	**0.01**	0.004	0
2010	1	**0.97**	**0.65**	**0.03**	**0.04**	**0.01**	0	0
2011	1	**0.46**	**1.57**	**0.06**	**0**	**0**	0	0
2012	1	**0.358**	**1.135**	**0.333**	**0.022**	**0**	0	0
2013	1	**3.564**	**1.118**	**0.410**	**0.086**	**0.003**	0	0

Table 6.2.6. (cont.) Cod in Division VIIa: Survey catch numbers-at-age and annual effort multiplier. Numbers in bold are used in the assessment model fit. The indices are treated as 1-gp and forward shifted to allow use in SAM model as age 1+.

UK(E&W) September beam-trawl survey

Year	Effort/Age	0
1993	1	**22**
1994	1	**30**
1995	1	**40**
1996	1	**29**
1997	1	**32**
1998	1	**2**
1999	1	**49**
2000	1	**37**
2001	1	**24**
2002	1	**7**
2003	1	**9**
2004	1	**22**
2005	1	**42**
2006	1	**6**
2007	1	**4**
2008	1	**7**
2009	1	**6**
2010	1	**4**
2011	1	**9**
2012	1	**37**

Northern Ireland Methot Isaacs–Kidd Survey

Year	Effort/Age	0
1994	1	**57.4**
1995	1	**6.9**
1996	1	**66.3**
1997	1	**5.7**
1998	1	**0.1**
1999	1	**26.2**
2000	1	**6.1**
2001	1	**9.6**
2002	1	**3.4**
2003	1	**3.2**
2004	1	**25.8**
2005	1	**11.4**
2006	1	**9**
2007	1	**0**
2008	1	**0.8**
2009	1	**23.6**
2010	1	**5.7**
2011	1	**1.4**
2012	1	**10.6**

Table 6.2.7. SAM model configuration file settings for update run in 2012. Same settings as WKROUND 2012 settings.

```
# Auto generated file
# Datetime : 2013-05-12 16:59:50

# Min, max age represented internally in model
 1 6
# Max age considered a plus group? (0 = No, 1= Yes)
 1

# Coupling of fishing mortality STATES (ctrl@states)
 # 1 2 3 4 5 6 #
   1 2 3 4 5 5 # catch
   0 0 0 0 0 0 # NIGfsMar
   0 0 0 0 0 0 # ScoGfsQ1
   0 0 0 0 0 0 # ScoGfsQ4
   0 0 0 0 0 0 # NIGfsOct
   0 0 0 0 0 0 # UKFspW
   0 0 0 0 0 0 # UKFspE
   0 0 0 0 0 0 # EngBtsSep
   0 0 0 0 0 0 # NIMikNet
   0 0 0 0 0 0 # EggSurvey

# Coupling of catchability PARAMETERS (ctrl@catchabilities)
 # 1  2  3  4  5  6 #
   0  0  0  0  0  0 # catch
   1  2  3  4  4  0 # NIGfsMar
   5  6  7  8  9  0 # ScoGfsQ1
  10 11  0  0  0  0 # ScoGfsQ4
  12 13 13  0  0  0 # NIGfsOct
  14 15 16 17 17  0 # UKFspW
  18 19 20 20 20  0 # UKFspE
  21  0  0  0  0  0 # EngBtsSep
  22  0  0  0  0  0 # NIMikNet
   0  0  0  0  0  0 # EggSurvey
```

Table 6.2.7 (cont.) SAM model configuration file settings for update run in 2012. Same settings as WKROUND 2012 settings.

```
# Coupling of power law model EXPONENTS (ctrl@power.law.exps)
 # 1 2 3 4 5 6 #
   0 0 0 0 0 0 # catch
   0 0 0 0 0 0 # NIGfsMar
   0 0 0 0 0 0 # ScoGfsQ1
   0 0 0 0 0 0 # ScoGfsQ4
   0 0 0 0 0 0 # NIGfsOct
   0 0 0 0 0 0 # UKFspW
   0 0 0 0 0 0 # UKFspE
   0 0 0 0 0 0 # EngBtsSep
   0 0 0 0 0 0 # NIMikNet
   0 0 0 0 0 0 # EggSurvey

# Coupling of fishing mortality RW VARIANCES (ctrl@f.vars)
 # 1 2 3 4 5 6 #
   1 1 1 1 1 1 # catch
   0 0 0 0 0 0 # NIGfsMar
   0 0 0 0 0 0 # ScoGfsQ1
   0 0 0 0 0 0 # ScoGfsQ4
   0 0 0 0 0 0 # NIGfsOct
   0 0 0 0 0 0 # UKFspW
   0 0 0 0 0 0 # UKFspE
   0 0 0 0 0 0 # EngBtsSep
   0 0 0 0 0 0 # NIMikNet
   0 0 0 0 0 0 # EggSurvey

# Coupling of log N RW VARIANCES (ctrl@logN.vars)
   1 1 1 1 1 1
```

Table 6.2.7 (cont.) SAM model configuration file settings for update run in 2012. Same settings as WKROUND 2012 settings.

```
# Coupling of OBSERVATION VARIANCES (ctrl@obs.vars)
 # 1  2  3  4  5 6 #
   1  1  1  1  1 1 # catch
   2  3  3  4  4 0 # NIGfsMar
   5  6  6  7  7 0 # ScoGfsQ1
   8  9  0  0  0 0 # ScoGfsQ4
  10 11 11  0  0 0 # NIGfsOct
  12 13 13 14 14 0 # UKFspW
  15 16 16 17 17 0 # UKFspE
  18  0  0  0  0 0 # EngBtsSep
  19  0  0  0  0 0 # NIMikNet
   0  0  0  0  0 0 # EggSurvey

# Stock recruitment model code (0=RW, 1=Ricker, 2=BH, ... more
in time
 0
# Years in which catch data are to be scaled by an estimated
parameter (mainly cod related)
 9

# Years
 2003 2004 2006 2007 2008 2009 2010 2011 2012

#Ages
  1  1  1  1  1  1
  2  2  2  2  2  2
  3  3  3  3  3  3
  4  4  4  4  4  4
  5  5  5  5  5  5
  6  6  6  6  6  6
  7  7  7  7  7  7
  8  8  8  8  8  8
  9  9  9  9  9  9

# Fbar range
 2 4

# Checksums to ensure correct reading of input data
 123456 123456
```

Table 6.2.8. Estimated fishing mortalities.

Year/Age	1	2	3	4	5	6
1968	0.22	0.70	0.87	0.75	0.81	0.81
1969	0.23	0.71	0.87	0.75	0.82	0.82
1970	0.24	0.69	0.85	0.76	0.82	0.82
1971	0.24	0.69	0.85	0.76	0.80	0.80
1972	0.24	0.69	0.84	0.77	0.80	0.80
1973	0.25	0.68	0.84	0.79	0.82	0.82
1974	0.25	0.69	0.83	0.80	0.82	0.82
1975	0.25	0.68	0.84	0.82	0.83	0.83
1976	0.26	0.69	0.84	0.83	0.83	0.83
1977	0.25	0.69	0.85	0.84	0.84	0.84
1978	0.25	0.69	0.86	0.84	0.84	0.84
1979	0.25	0.71	0.87	0.85	0.86	0.86
1980	0.25	0.73	0.88	0.86	0.87	0.87
1981	0.25	0.75	0.90	0.88	0.89	0.89
1982	0.24	0.77	0.92	0.90	0.91	0.91
1983	0.25	0.79	0.94	0.92	0.92	0.92
1984	0.26	0.81	0.97	0.94	0.94	0.94
1985	0.26	0.84	1.00	0.96	0.96	0.96
1986	0.26	0.86	1.03	1.00	0.99	0.99
1987	0.27	0.89	1.07	1.03	1.02	1.02
1988	0.27	0.92	1.13	1.08	1.05	1.05
1989	0.26	0.95	1.19	1.12	1.09	1.09
1990	0.25	0.97	1.25	1.17	1.12	1.12
1991	0.25	1.00	1.32	1.23	1.14	1.14
1992	0.24	1.04	1.39	1.31	1.17	1.17
1993	0.22	1.06	1.48	1.36	1.18	1.18
1994	0.21	1.07	1.50	1.40	1.20	1.20
1995	0.20	1.06	1.52	1.40	1.21	1.21
1996	0.19	1.05	1.55	1.42	1.26	1.26
1997	0.18	1.04	1.59	1.48	1.33	1.33
1998	0.17	1.03	1.61	1.49	1.38	1.38
1999	0.16	1.02	1.63	1.50	1.39	1.39
2000	0.15	0.99	1.62	1.47	1.31	1.31
2001	0.15	0.95	1.57	1.45	1.30	1.30
2002	0.14	0.92	1.52	1.43	1.29	1.29
2003	0.13	0.89	1.51	1.48	1.24	1.24
2004	0.12	0.86	1.48	1.49	1.30	1.30
2005	0.11	0.83	1.45	1.48	1.28	1.28
2006	0.10	0.86	1.47	1.50	1.34	1.34
2007	0.10	0.88	1.49	1.45	1.29	1.29
2008	0.10	0.88	1.50	1.41	1.24	1.24
2009	0.10	0.88	1.48	1.38	1.19	1.19
2010	0.09	0.88	1.46	1.35	1.14	1.14
2011	0.09	0.87	1.44	1.32	1.13	1.13
2012	0.09	0.88	1.45	1.30	1.10	1.10

Table 6.2.9. Estimated stock numbers (Thousands).

Year/Age	1	2	3	4	5	6
1968	3029	3598	1840	915	379	59
1969	4697	2444	1611	612	338	188
1970	6738	3249	797	445	268	151
1971	9247	4384	1585	297	151	121
1972	5649	6922	1785	583	123	118
1973	7612	2814	3140	761	287	126
1974	4072	6532	1158	1070	281	151
1975	6264	1784	2720	464	437	194
1976	4517	5400	730	987	136	212
1977	4256	1592	2196	276	374	129
1978	4570	2597	633	686	86	152
1979	7727	2933	1170	240	272	110
1980	9257	5765	1306	462	91	117
1981	5969	6840	2581	463	187	83
1982	3130	4126	2657	934	171	119
1983	4203	1975	1412	888	294	88
1984	6106	2633	795	445	290	130
1985	6162	3878	1131	282	150	139
1986	6323	4118	1291	362	103	105
1987	11762	3567	1440	408	122	70
1988	8414	8160	1208	434	121	61
1989	4041	3912	2739	361	131	57
1990	4127	2132	950	630	104	49
1991	5517	2622	674	214	166	38
1992	4823	2192	898	159	57	64
1993	1940	3600	427	159	27	24
1994	3345	810	1002	82	29	14
1995	3019	2059	213	217	14	10
1996	2471	1689	810	55	58	8
1997	2969	1693	504	188	17	21
1998	1382	3139	454	95	28	10
1999	620	1123	1110	83	22	8
2000	2074	312	189	112	9	3
2001	2173	1691	72	20	17	3
2002	1895	1100	764	14	3	4
2003	1000	2200	397	124	5	1
2004	1008	473	518	54	16	4
2005	619	785	152	74	9	2
2006	506	417	299	25	12	5
2007	692	595	155	42	3	2
2008	339	559	174	24	8	1
2009	644	208	181	40	7	2
2010	1057	575	60	31	8	2
2011	739	914	215	11	7	4
2012	720	646	423	61	3	2

Table 6.2.10. Estimated recruitment (age 1), total stock biomass (TBS), spawning–stock biomass (SSB), and average fishing mortality for ages 2 to 4 (F24).

Year	Recruits	Low	High	TSB	Low	High	SSB	Low	High	$F_{2\text{-}4}$	Low	High	Reported Landings	WG estimates	Model estimates
1968	3029	1828	5019	21358	16572	27527	15808	11920	20966	0.78	0.63	0.96	8541		
1969	4697	3004	7344	18860	15045	23643	13479	10406	17461	0.78	0.64	0.95	7991		
1970	6738	4349	10439	17165	13613	21643	9711	7640	12343	0.77	0.64	0.93	6426		
1971	9247	5944	14387	21508	16805	27528	11355	8692	14834	0.77	0.64	0.92	9246		
1972	5649	3660	8719	25463	19629	33033	14892	11495	19294	0.76	0.64	0.91	9234		
1973	7612	4935	11741	26318	20689	33478	18788	14064	25100	0.77	0.65	0.91	11819		
1974	4072	2634	6298	25463	19883	32610	16269	12774	20720	0.77	0.65	0.92	10251		
1975	6264	4075	9629	22270	17573	28222	16622	12518	22072	0.78	0.66	0.92	9863		
1976	4517	2953	6911	21519	16812	27544	13207	10321	16900	0.79	0.67	0.93	10247		
1977	4256	2781	6512	17254	13563	21950	13019	9766	17357	0.79	0.67	0.93	8054		
1978	4570	2972	7027	14328	11391	18024	8869	6898	11403	0.80	0.68	0.94	6271		
1979	7727	5058	11804	17211	13736	21566	9478	7408	12126	0.81	0.69	0.95	8371		
1980	9257	6021	14231	23295	18161	29880	11707	9120	15026	0.83	0.70	0.97	10776		
1981	5969	3912	9106	27723	21489	35764	17050	12973	22408	0.85	0.72	0.99	14907		
1982	3130	1997	4905	26291	20867	33126	19231	14707	25148	0.87	0.74	1.01	13381		
1983	4203	2749	6425	21980	17745	27226	15523	12073	19959	0.88	0.76	1.03	10015		
1984	6106	3998	9328	18039	14636	22234	10933	8721	13705	0.90	0.78	1.05	8383		
1985	6162	4040	9397	21459	16998	27091	11796	9254	15036	0.93	0.80	1.08	10483		
1986	6323	4135	9670	21442	16972	27089	11648	9082	14939	0.96	0.83	1.11	9852		
1987	11762	7523	18390	25978	20538	32859	12850	9995	16520	1.00	0.87	1.15	12894		
1988	8414	5427	13043	26450	20326	34419	13413	10486	17158	1.04	0.90	1.20	14168		
1989	4041	2630	6208	23202	18152	29657	14921	11137	19990	1.09	0.95	1.25	12751		
1990	4127	2701	6304	15562	12488	19393	9532	7437	12217	1.13	0.99	1.30	7379		
1991	5517	3531	8619	13994	11065	17699	6584	5215	8312	1.18	1.03	1.36	6714	7095	
1992	4823	3183	7308	13683	10831	17285	7113	5478	9237	1.25	1.09	1.43	7173	7735	
1993	1940	1300	2895	10720	8323	13809	5255	4157	6643	1.30	1.13	1.49	5727	7555	
1994	3345	2274	4922	8691	6913	10928	5051	3759	6786	1.32	1.16	1.51	4187	5402	
1995	3019	2067	4411	8825	7044	11057	3759	2988	4728	1.32	1.16	1.51	3721	4587	
1996	2471	1692	3610	8631	7012	10623	4502	3530	5742	1.34	1.18	1.52	3622	4964	
1997	2969	2049	4304	8926	7277	10949	4530	3639	5639	1.37	1.20	1.56	4360	5859	
1998	1382	950	2008	8955	7107	11285	5029	4015	6299	1.37	1.20	1.57	4418	5310	
1999	620	414	928	6578	5184	8347	5214	3969	6850	1.39	1.21	1.59	2975	4784	
2000	2074	1404	3064	3725	2967	4677	1708	1357	2149	1.36	1.19	1.56	1274	2179	
2001	2173	1479	3191	5795	4461	7527	2567	1904	3460	1.32	1.16	1.51	2252	3598	
2002	1895	1299	2763	6576	5202	8313	4087	3074	5432	1.29	1.13	1.47	2695	4431	
2003	1000	681	1470	6910	5457	8750	4421	3460	5650	1.29	1.13	1.48	1285		3590
2004	1008	689	1474	4544	3643	5667	3061	2357	3974	1.27	1.11	1.46	1072		2365
2005	619	415	924	3103	2482	3880	2006	1601	2514	1.25	1.09	1.44	910	1646	
2006	506	329	777	2517	2022	3133	1829	1442	2320	1.28	1.11	1.47	840		1391
2007	692	469	1022	2525	2024	3150	1565	1245	1967	1.27	1.11	1.47	702		1251
2008	339	227	508	2013	1609	2519	1400	1107	1772	1.26	1.09	1.46	662		1091
2009	644	429	968	2027	1621	2535	1171	928	1478	1.25	1.08	1.45	466		920
2010	1057	693	1611	3164	2424	4129	1371	1054	1783	1.23	1.05	1.43	464		1171
2011	739	485	1128	3370	2626	4327	2068	1596	2678	1.21	1.03	1.43	365		1637
2012	720	461	1123	3673	2902	4649	2578	1994	3335	1.21	1.01	1.45	198		1960
2013							2429	1766	3341						

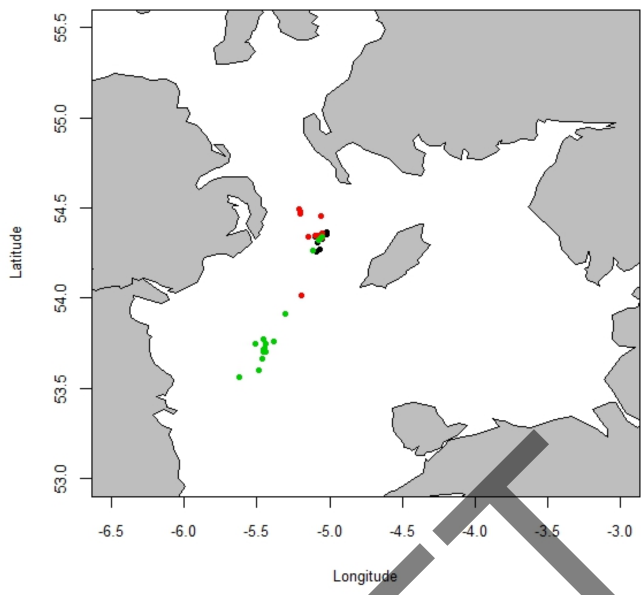


Figure 6.2.1. Cod Sentinel Fishery: Map showing the positions of 38 hauls carried out during the sentinel fishery 2012. Different colours represent the haul distribution of each participating vessels.

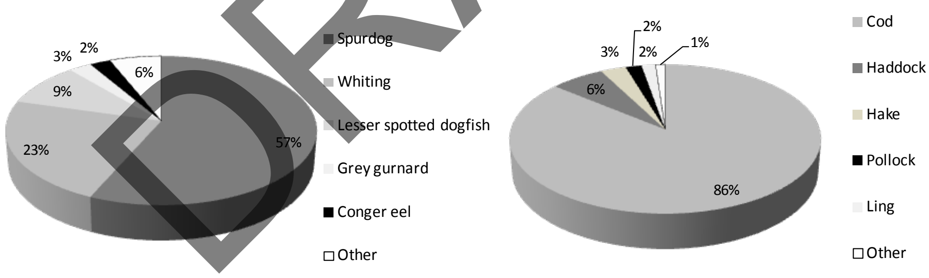


Figure 6.2.2. Cod Sentinel Fishery: Species composition of discarded and retained catches from the sentinel fishery, expressed as a percentage of total weight (total discard rate 11% by weight).

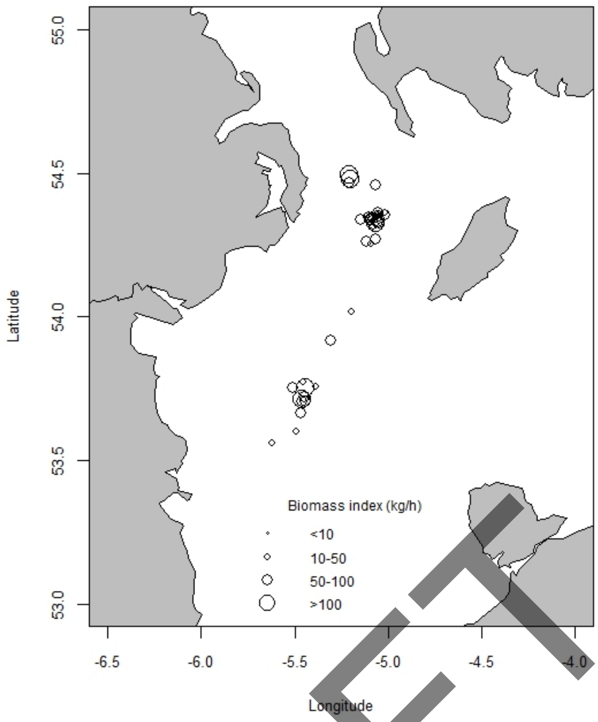


Figure 6.2.3. Cod Sentinel Fishery: Spatial distribution of cod in terms of biomass (kg/h) obtained from the 38 hauls observed during the sentinel fishery 2012.

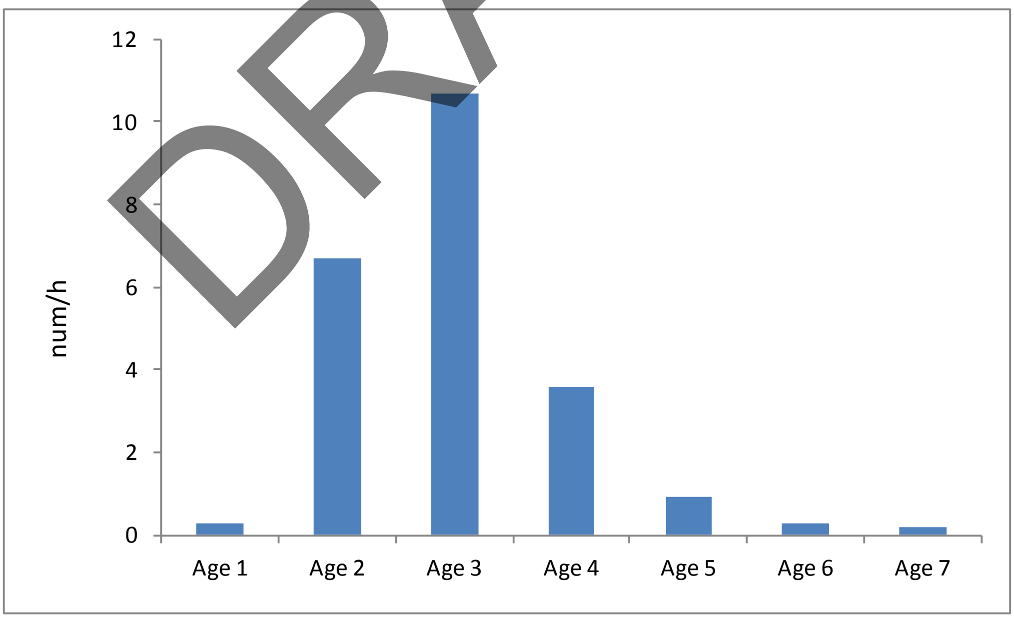


Figure 6.2.4. Cod Sentinel Fishery: Catch rates of cod by age class from the cod sentinel fishery 2012.

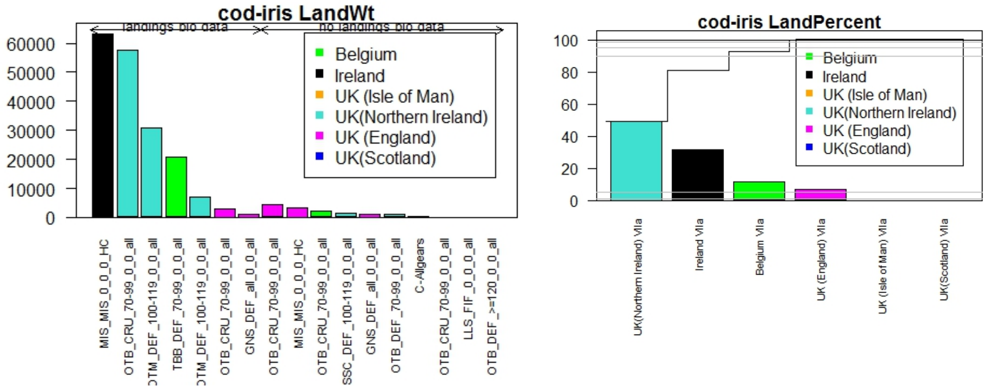


Figure 6.2.5. Cod in VIIa. Landings data as provided to WGCSE2013.

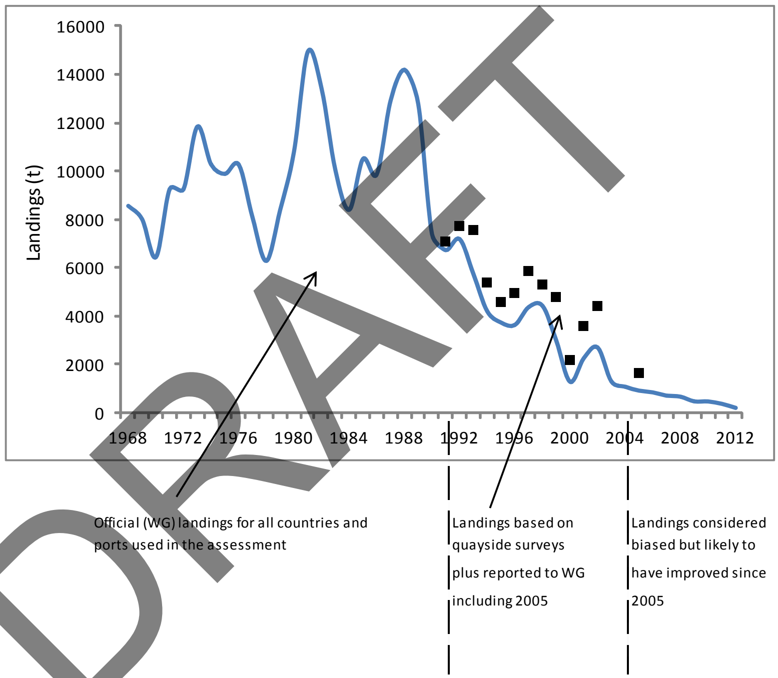


Figure 6.2.6. Cod in VIIa. Landings data time series used in the SAM assessment.

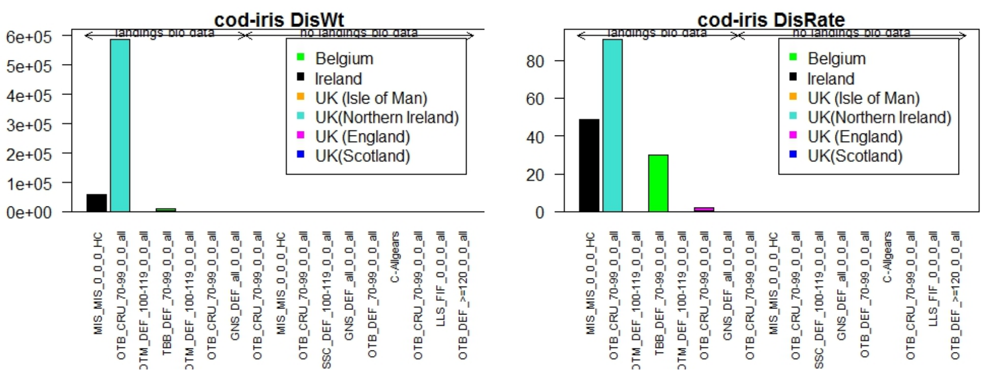


Figure 6.2.7. Cod in VIIa. Biomass discarded (kg) in 2012 (left panel); discard rate (%) (right panel). Discards are not currently used in the assessment due to the short time-series available.

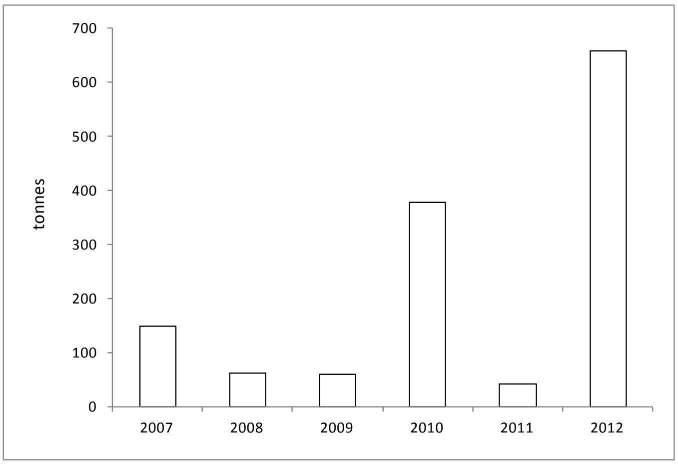


Figure 6.2.8. Cod in VIIa. Biomass discarded during 2007–2012, estimated from numbers per sampled trip raised to total fishing effort by each country supplying data (UK, Ireland and Belgium).

Figure 6.2.9. Cod in VIIa. Discarded proportion by age and by year during 2007–2012.

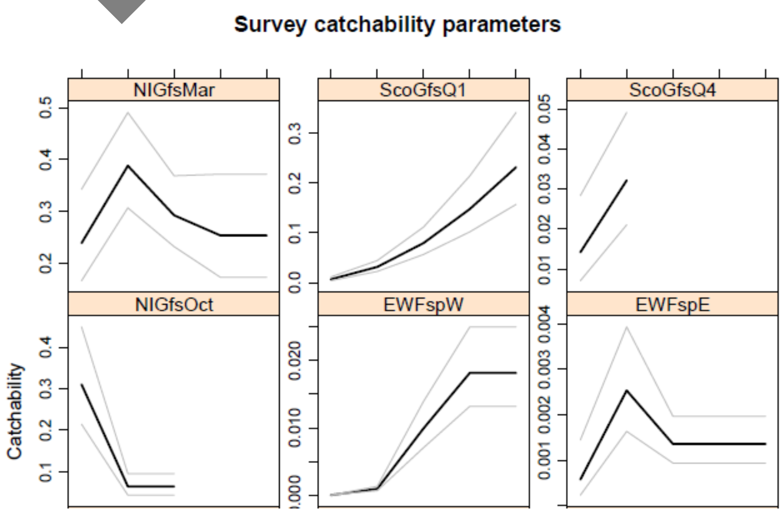


Figure 6.2.10. Cod in ICES Division VIIa: SAM estimated survey catchability-at-age.

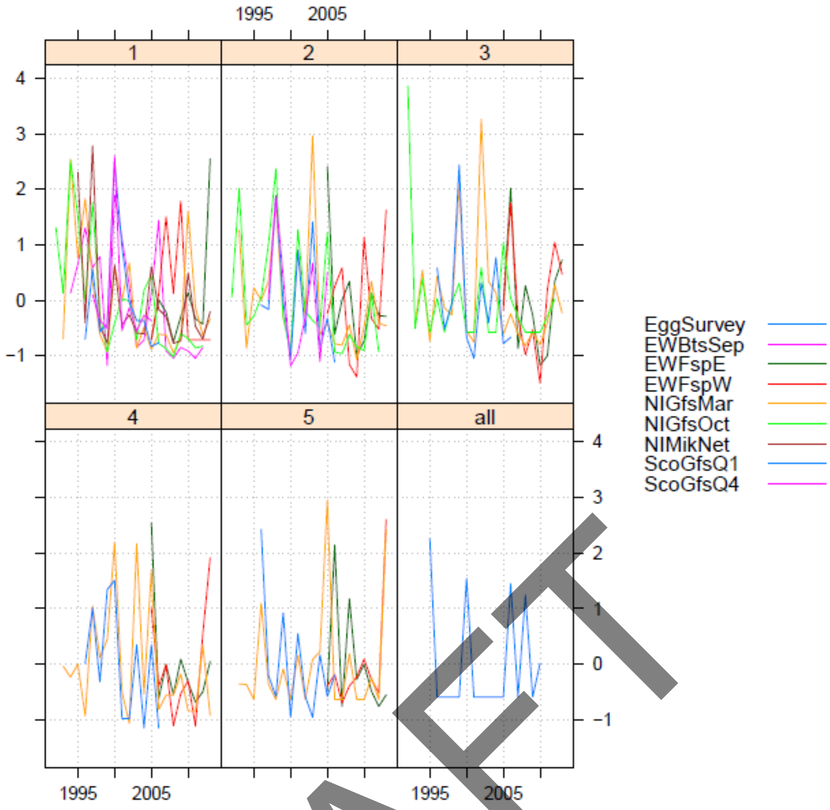


Figure 6.2.11. Cod in VIIa. Standardized catch rates by age from the nine surveys used in the SAM assessment model.

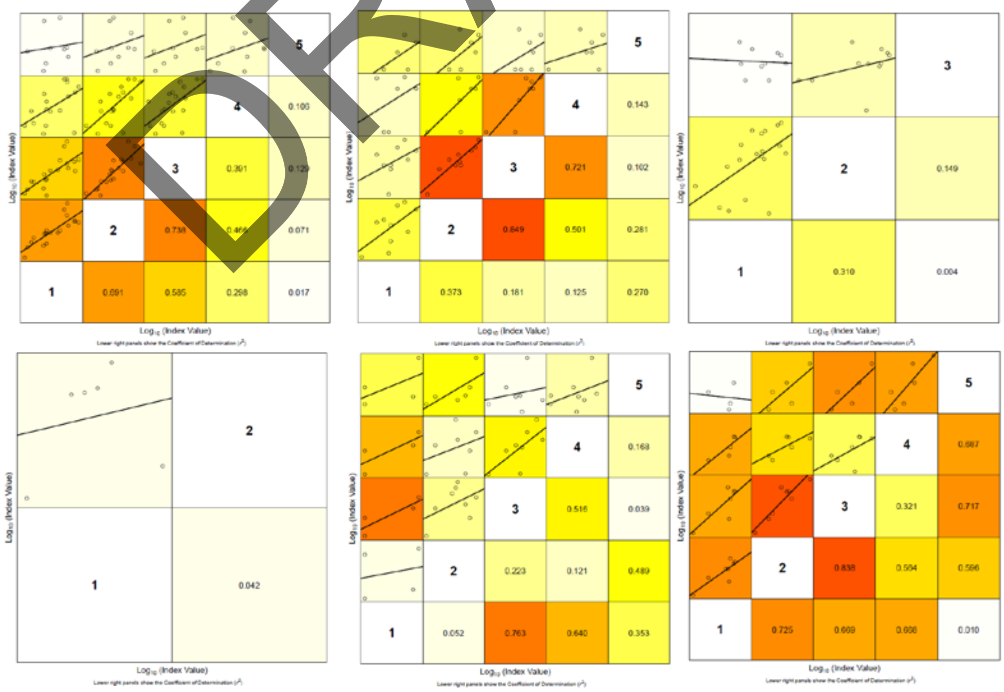


Figure 6.2.12. Cod in VIIa. Internal consistency for six of the nine surveys used in the SAM assessment: clockwise from top left: NIGFS-WIBTS-Q1, ScoGFS-WIBTS-Q1, NIGFS-WIBTS-Q4, UK-FSP Eastern Irish Sea, UK_FSP Western Irish Sea, ScoGFS-WIBTS-Q4.

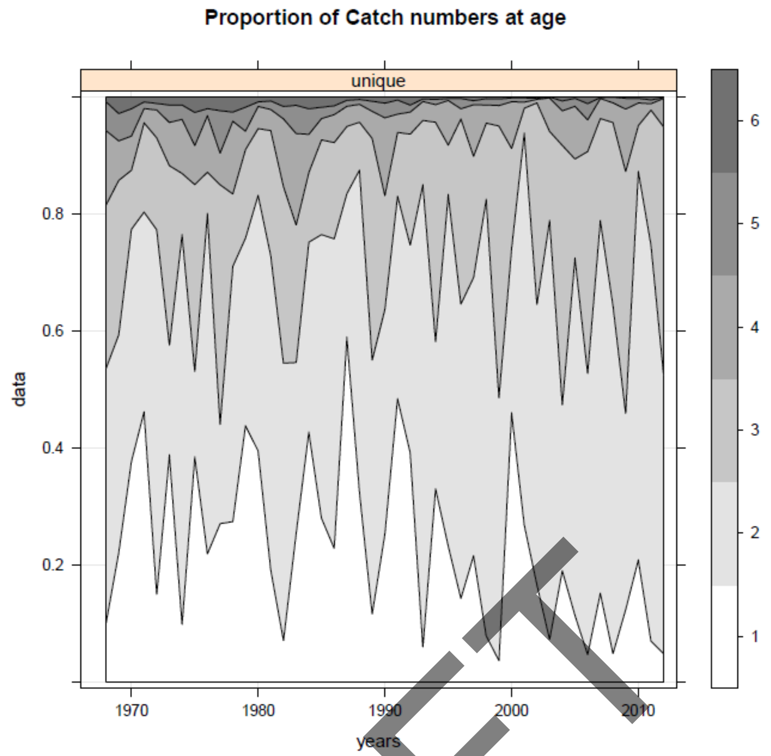


Figure 6.2.13. Cod in VIIa. Proportion of catch numbers-at-age.

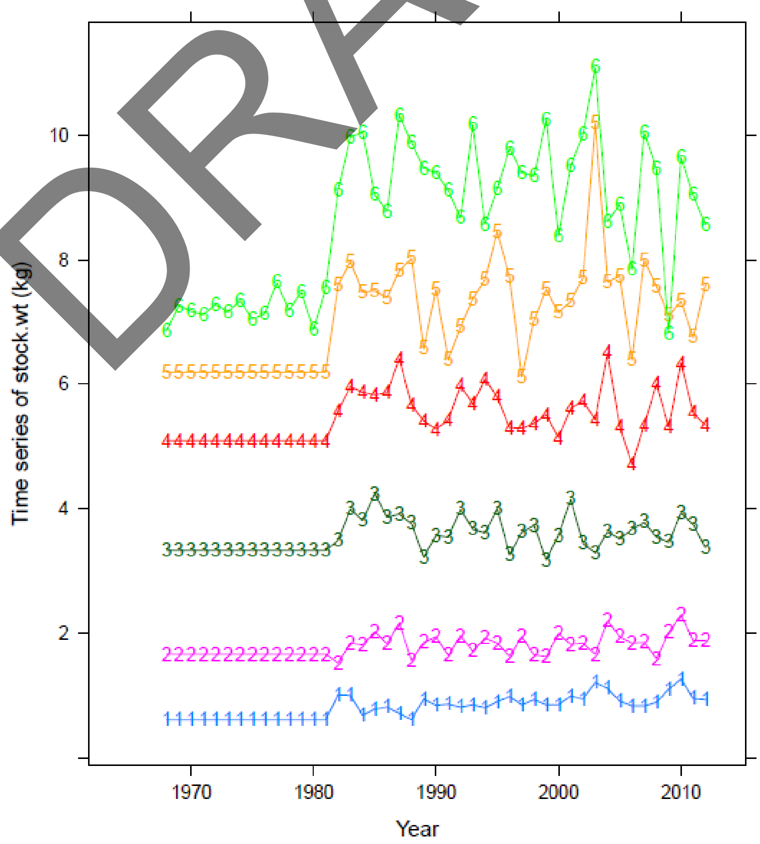


Figure 6.2.14. Cod in VIIa. Catch weights-at-age (same as stock weights).

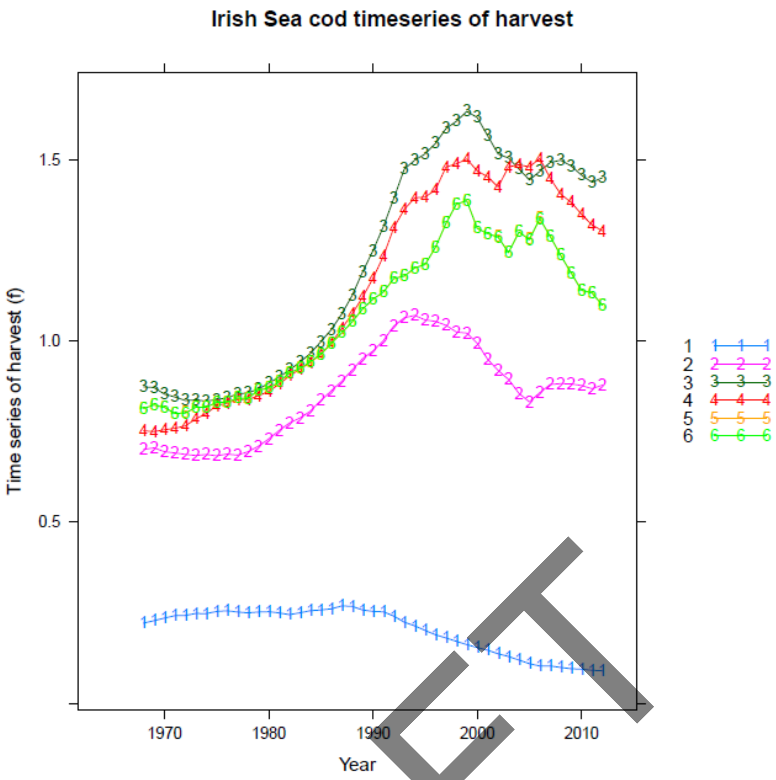


Figure 6.2.15. Cod in ICES Division VIIa: SAM estimated fishing mortality-at–age (age5 = age6).

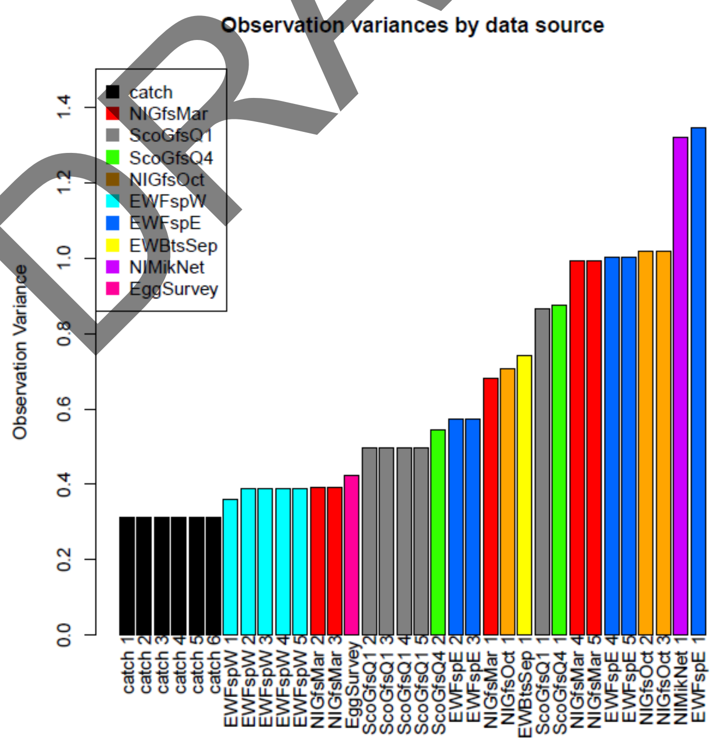


Figure 6.2.16. Cod in ICES Division VIIa: SAM estimated paired parameter variance at age.

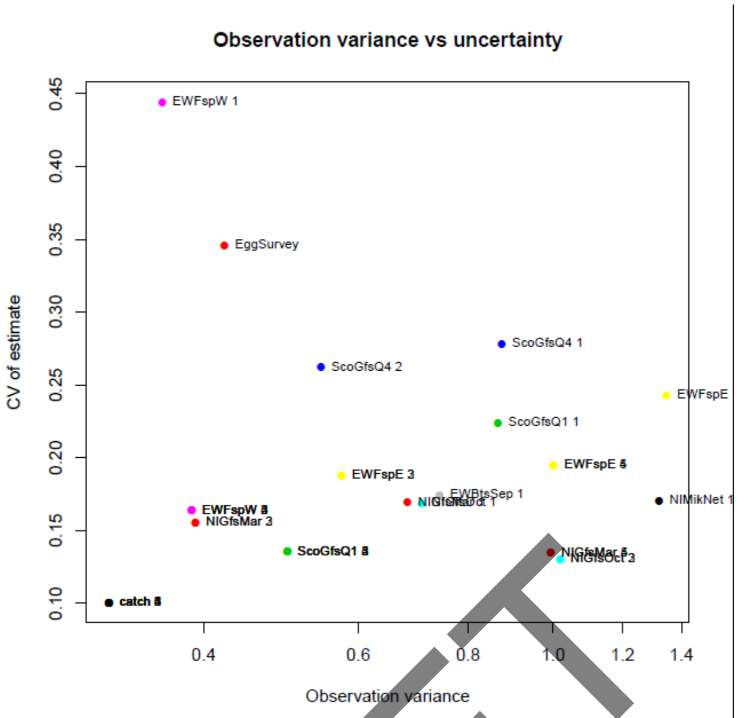


Figure 6.2.17. Cod in ICES Division VIIa: observation variance against uncertainty.

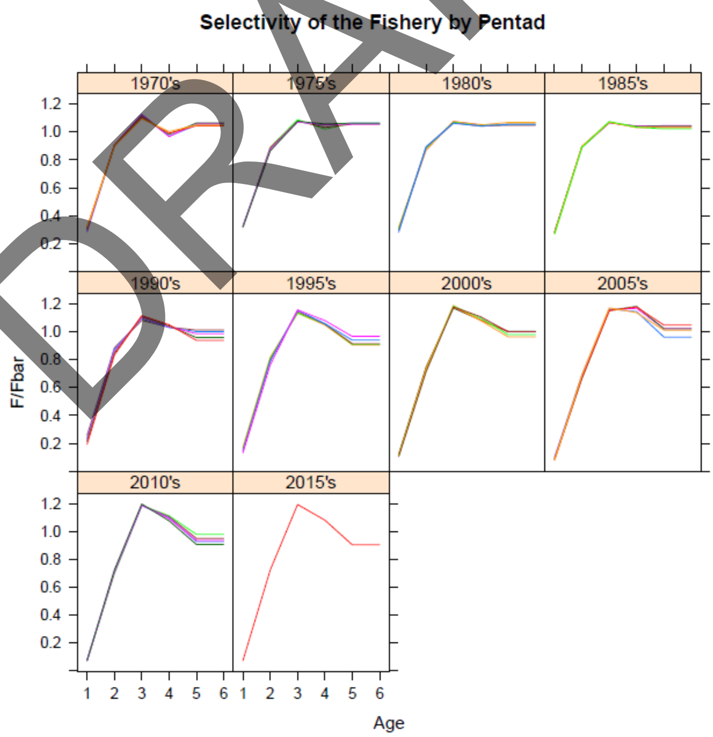


Figure 6.2.18. Cod in ICES Division VIIa: SAM estimated fishery selectivity-at-age.

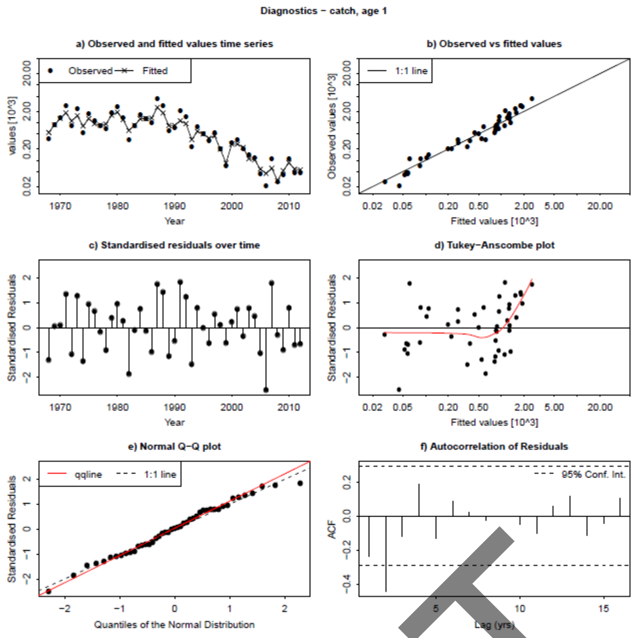


Figure 6.2.19a. Cod in ICES Division VIIa: SAM estimated catch residuals for age 1.

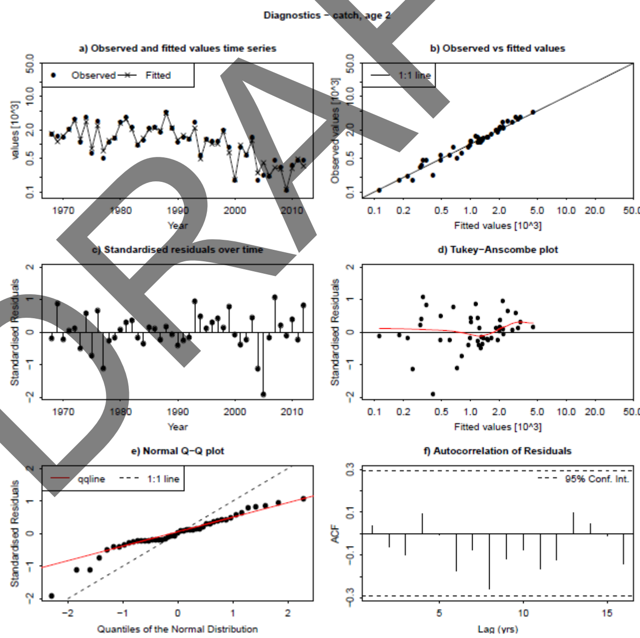
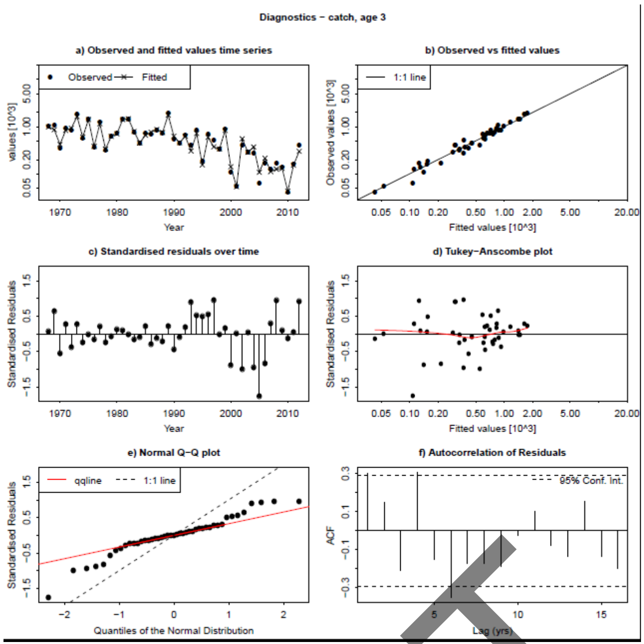
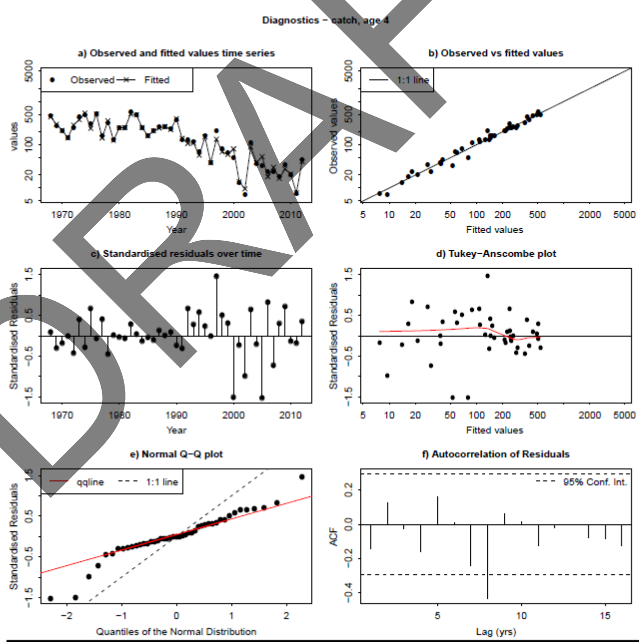


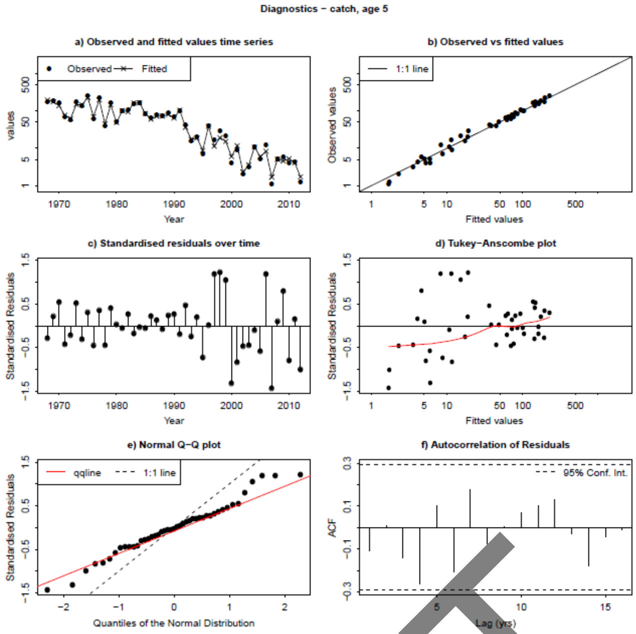
Figure 6.2.19b. Cod in ICES Division VIIa: SAM estimated catch residuals for age 2.



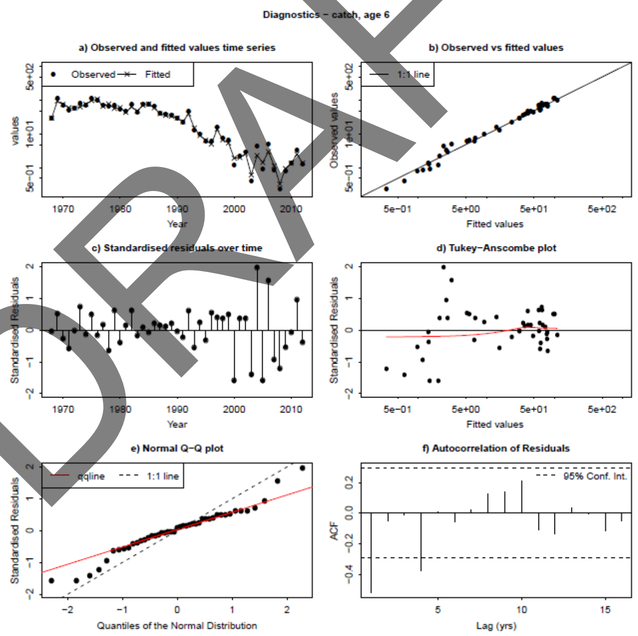
Figures 6.2.19c. Cod in ICES Division VIIa: SAM estimated catch residuals for age 3.



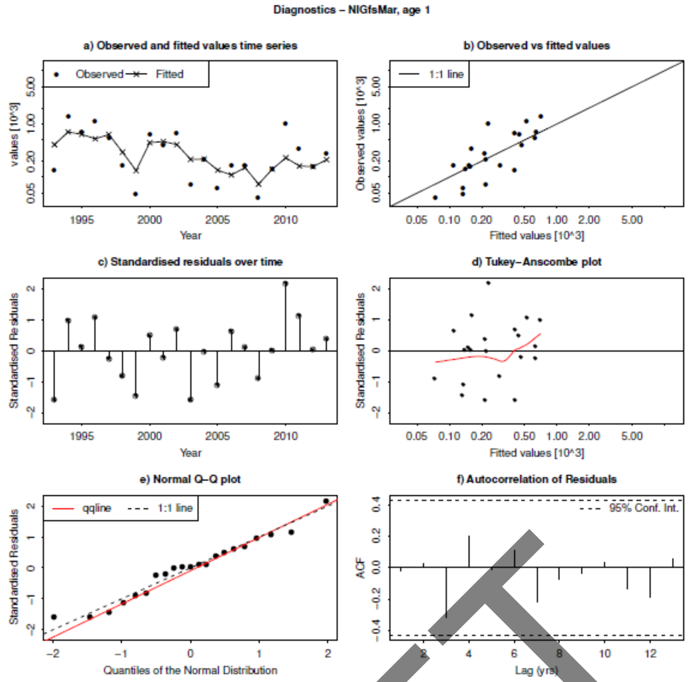
Figures 6.2.19d. Cod in ICES Division VIIa: SAM estimated catch residuals for age 4.



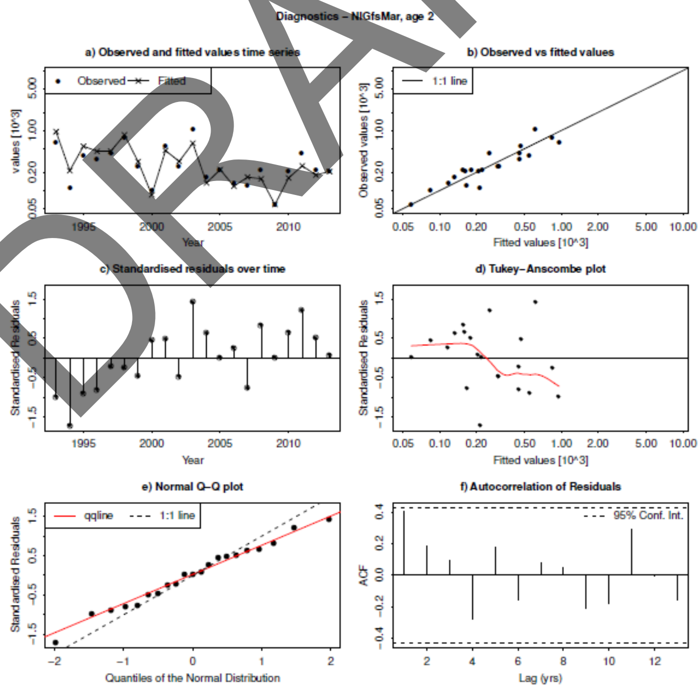
Figures 6.2.19e. Cod in ICES Division VIIa: SAM estimated catch residuals for age 5.



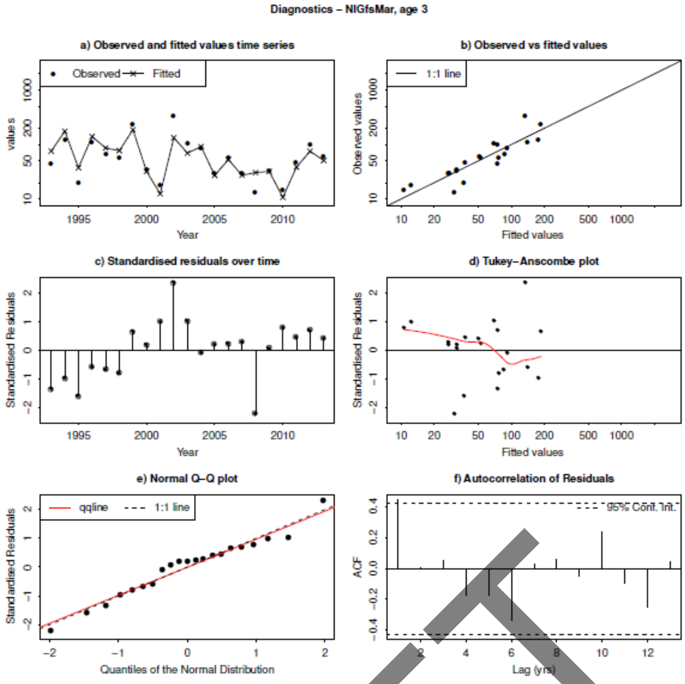
Figures 6.2.19f. Cod in ICES Division VIIa: SAM estimated catch residuals for age 6+.



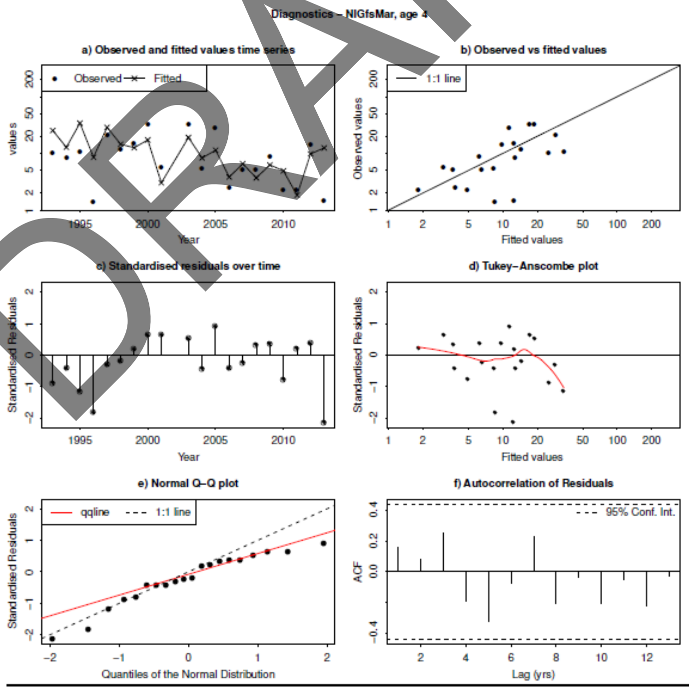
Figures 6.2.20a. Cod in ICES Division VIIa: SAM estimated NIGFS-WIBTS-Q1 survey index residuals for age 1.



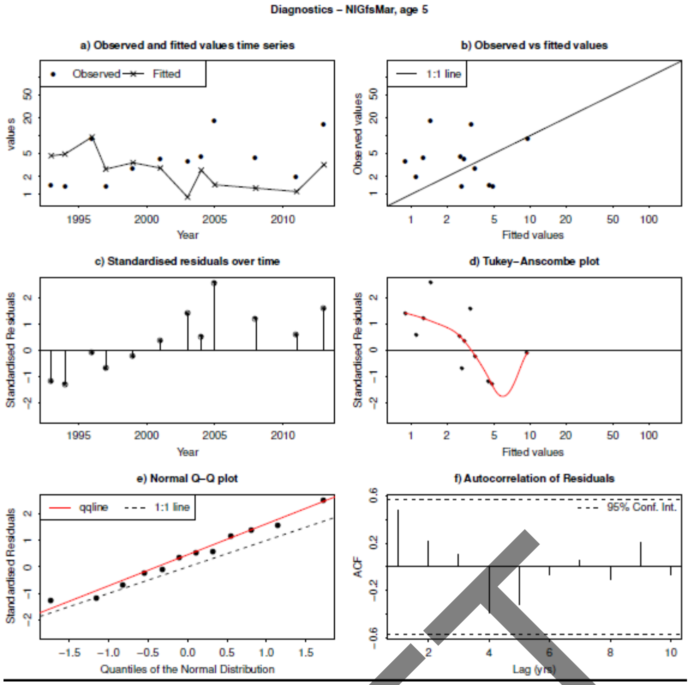
Figures 6.2.20b. Cod in ICES Division VIIa: SAM estimated NIGFS-WIBTS-Q1 survey index residuals for age 2.



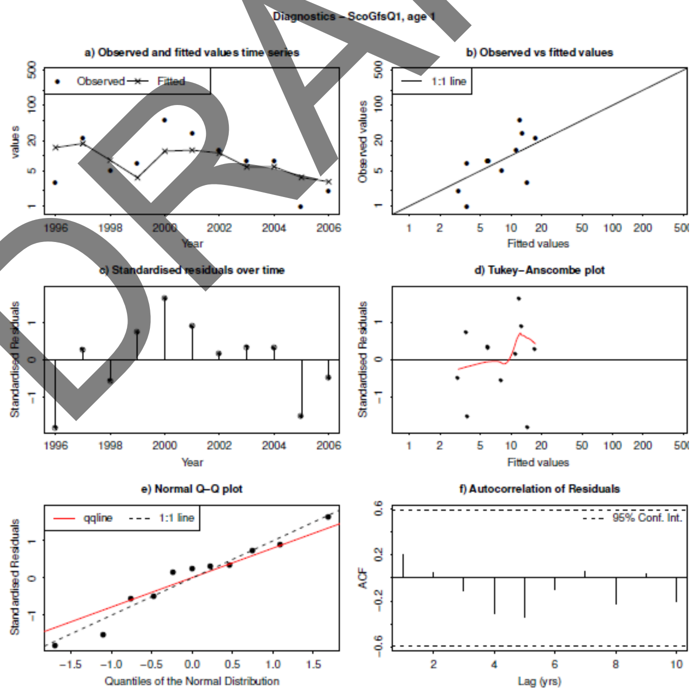
Figures 6.2.20c. Cod in ICES Division VIIa: SAM estimated NIGFS-WIBTS-Q1 survey index residuals for age 3.



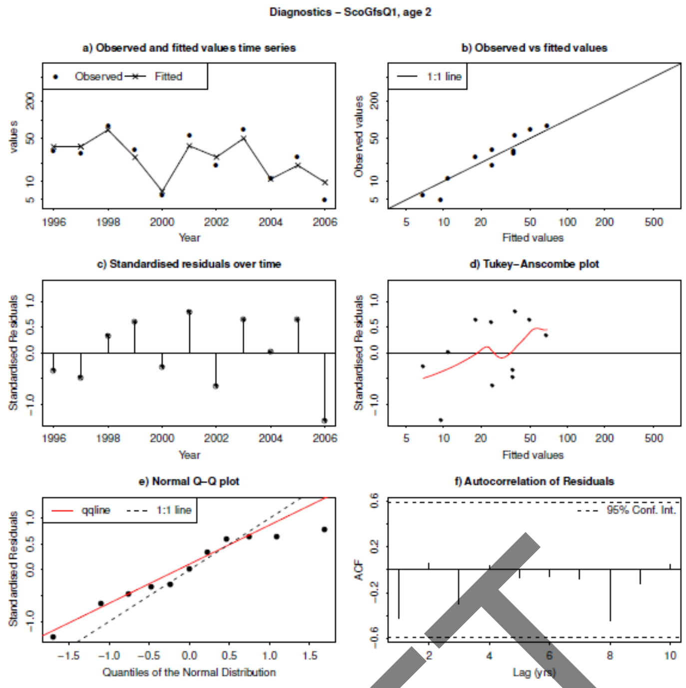
Figures 6.2.20d. Cod in ICES Division VIIa: SAM estimated NIGFS-WIBTS-Q1 survey index residuals for age 4.



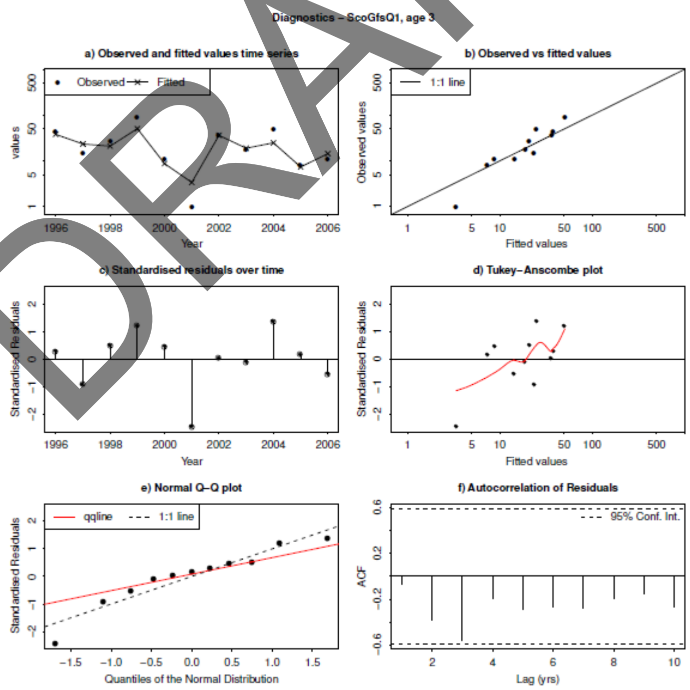
Figures 6.2.20e. Cod in ICES Division VIIa: SAM estimated NIGFS-WIBTS-Q1 survey index residuals for age 5.



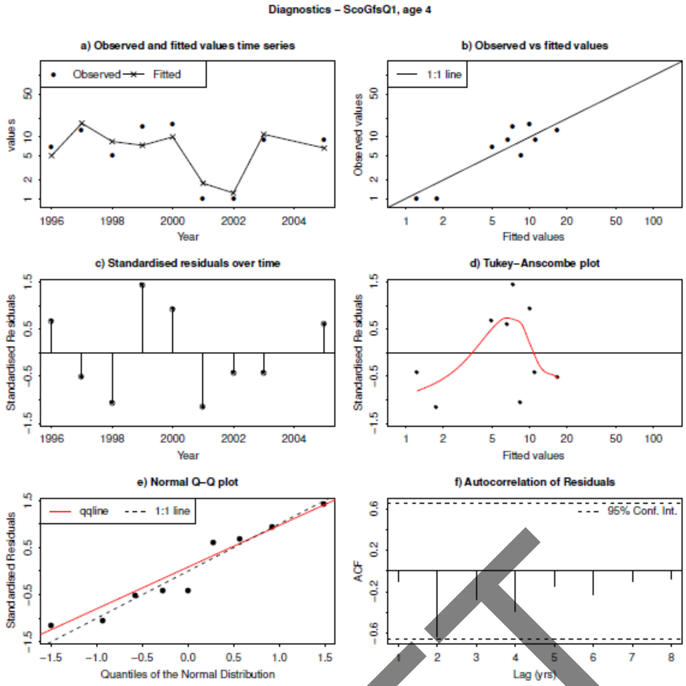
Figures 6.2.21a. Cod in ICES Division VIIa: SAM estimated SCOGFS-WIBTS-Q1 survey index residuals for age 1.



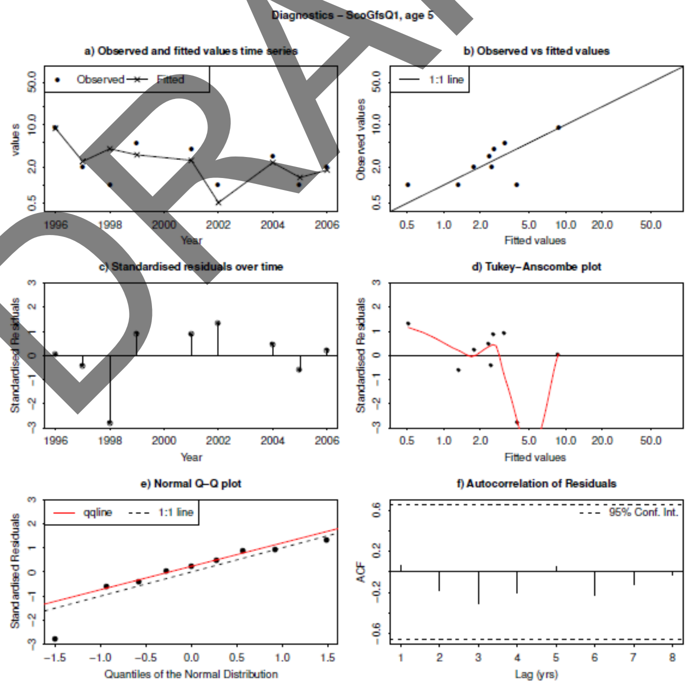
Figures 6.2.21b. Cod in ICES Division VIIa: SAM estimated SCOGFS-WIBTS-Q1 survey index residuals for age 2.



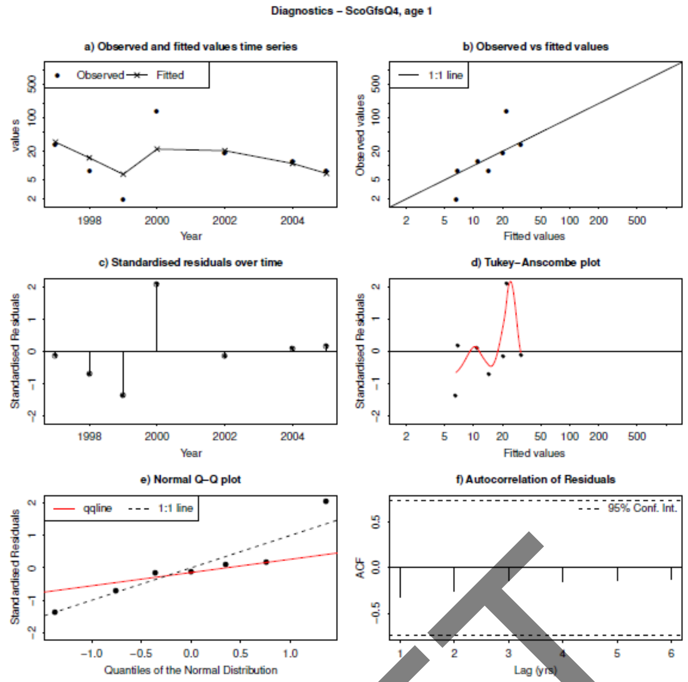
Figures 6.2.21c. Cod in ICES Division VIIa: SAM estimated SCOGFS-WIBTS-Q1 survey index residuals for age 3.



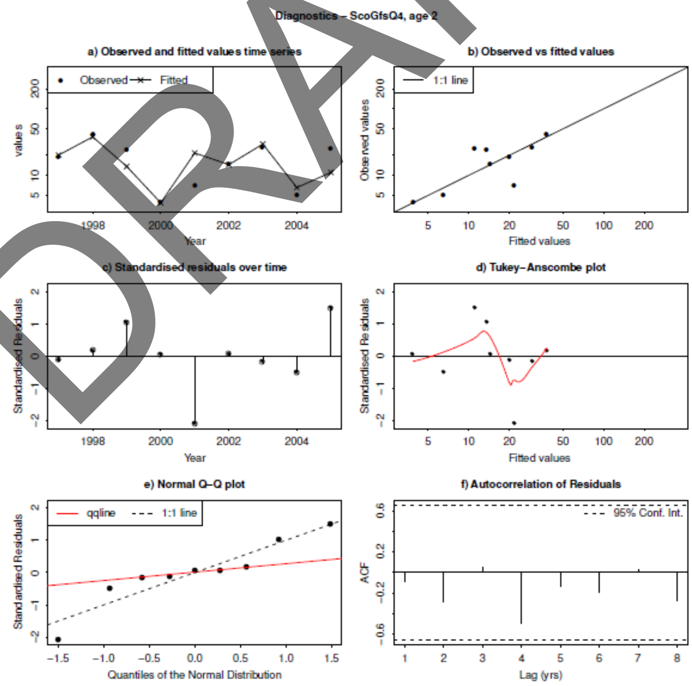
Figures 6.2.21d. Cod in ICES Division VIIa: SAM estimated SCOGFS-WIBTS-Q1 survey index residuals for age 4.



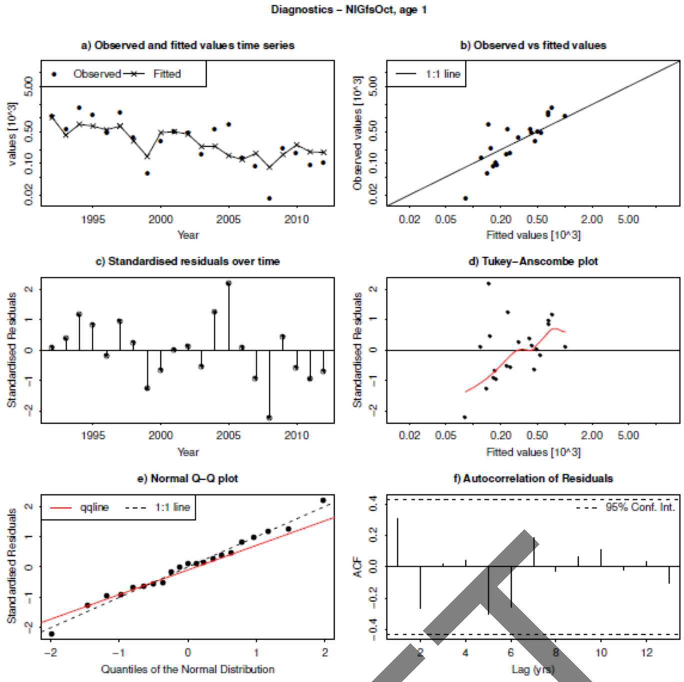
Figures 6.2.21e. Cod in ICES Division VIIa: SAM estimated SCOGFS-WIBTS-Q1 survey index residuals for age 5.



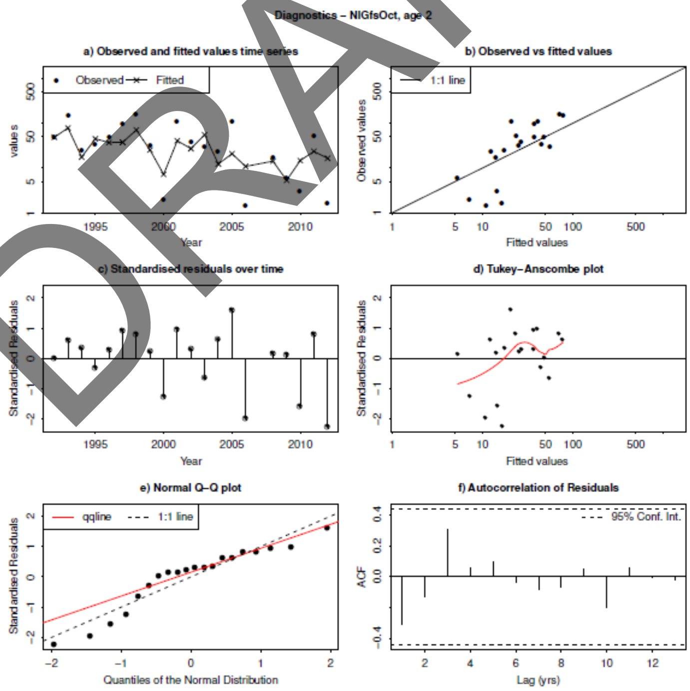
Figures 6.2.22a. Cod in ICES Division VIIa: SAM estimated SCOGFS-WIBTS-Q4 survey index residuals for age 1.



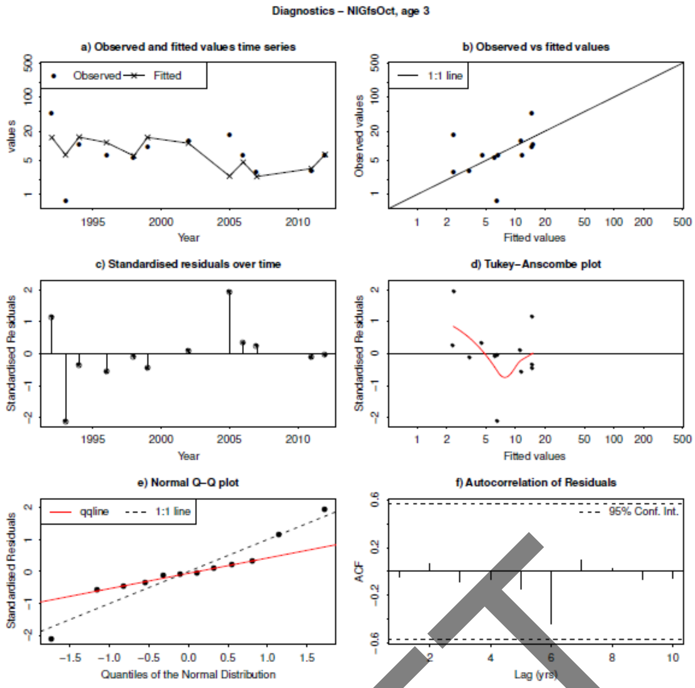
Figures 6.2.22b. Cod in ICES Division VIIa: SAM estimated SCOGFS-WIBTS-Q4 survey index residuals for age 2.



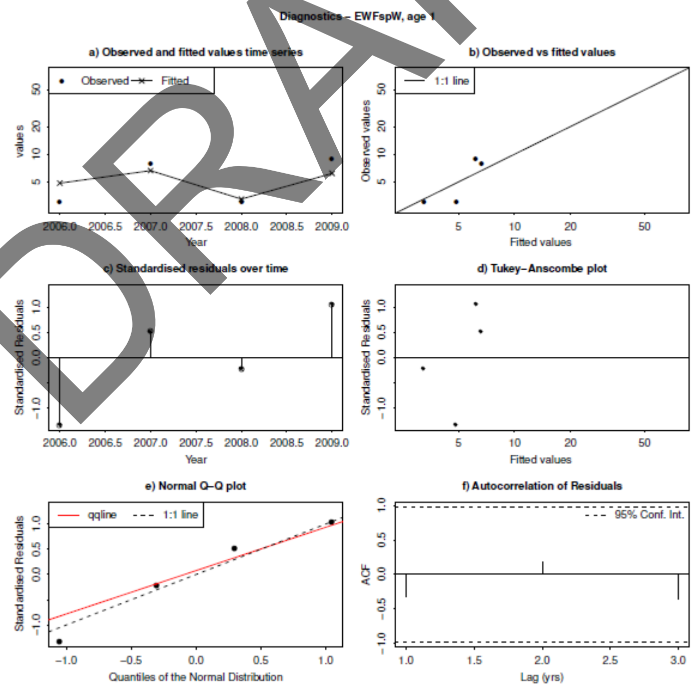
Figures 6.2.23a. Cod in ICES Division VIIa: SAM estimated NIGFS-WIBTS-Q4survey index residuals for age 1.



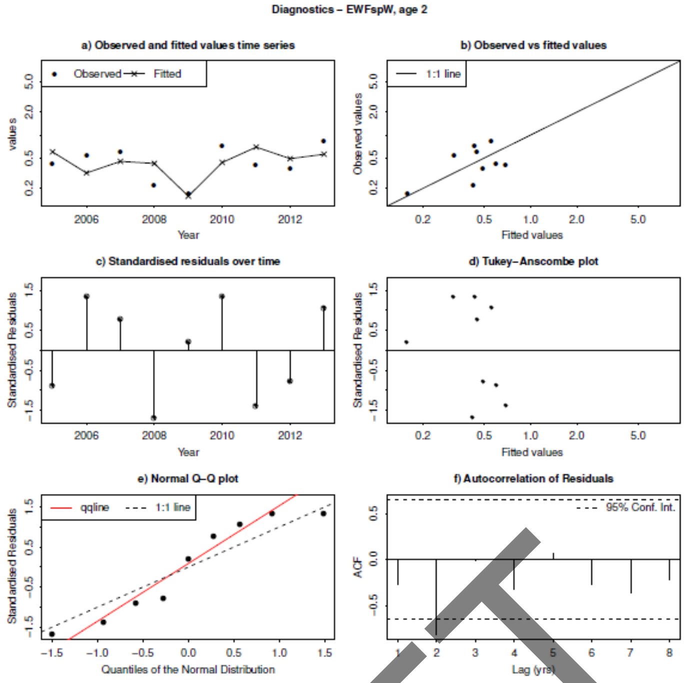
Figures 6.2.23b. Cod in ICES Division VIIa: SAM estimated NIGFS-WIBTS-Q4survey index residuals for age 2.



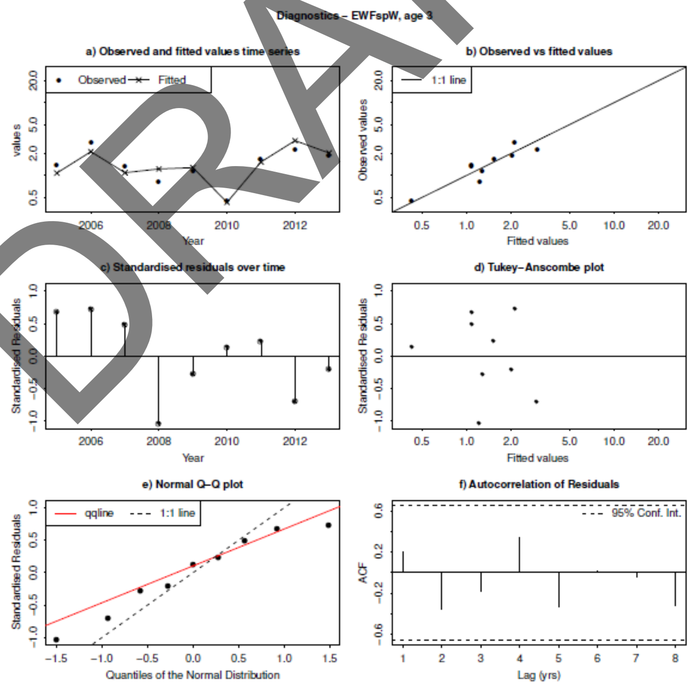
Figures 6.2.23c. Cod in ICES Division VIIa: SAM estimated NIGFS-WIBTS-Q4 survey index residuals for age 3.



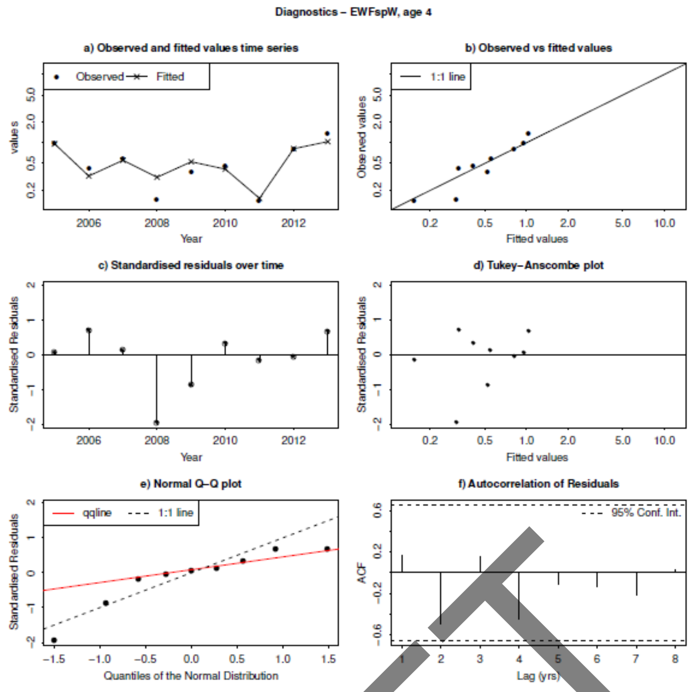
Figures 6.2.24a. Cod in ICES Division VIIa: SAM estimated UK-FSP west survey index residuals for age 1.



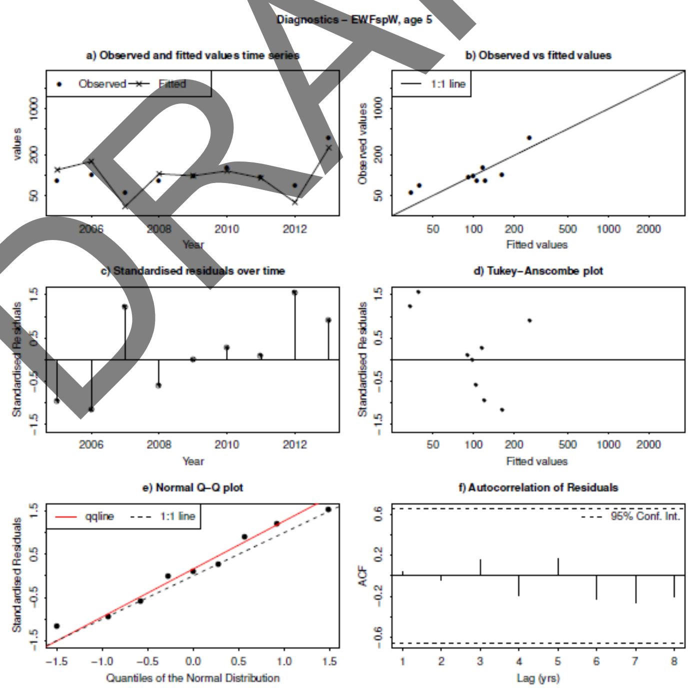
Figures 6.2.24b. Cod in ICES Division VIIa: SAM estimated UK-FSP west survey index residuals for age 2.



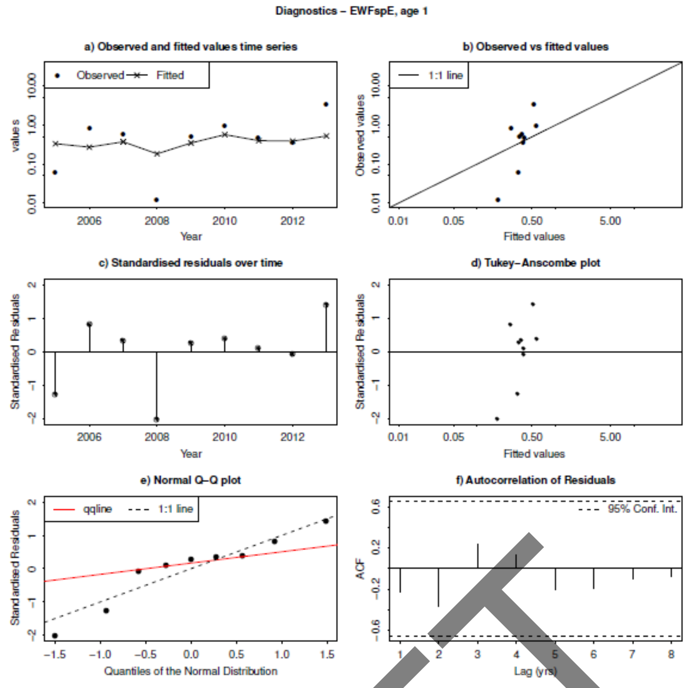
Figures 6.2.24c. Cod in ICES Division VIIa: SAM estimated UK-FSP west survey index residuals for age 3.



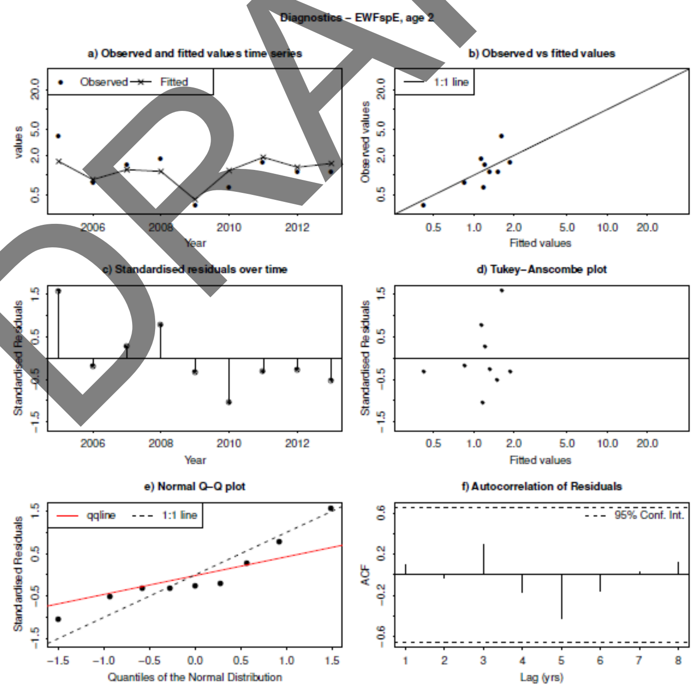
Figures 6.2.24d. Cod in ICES Division VIIa: SAM estimated UK-FSP west survey index residuals for age 4.



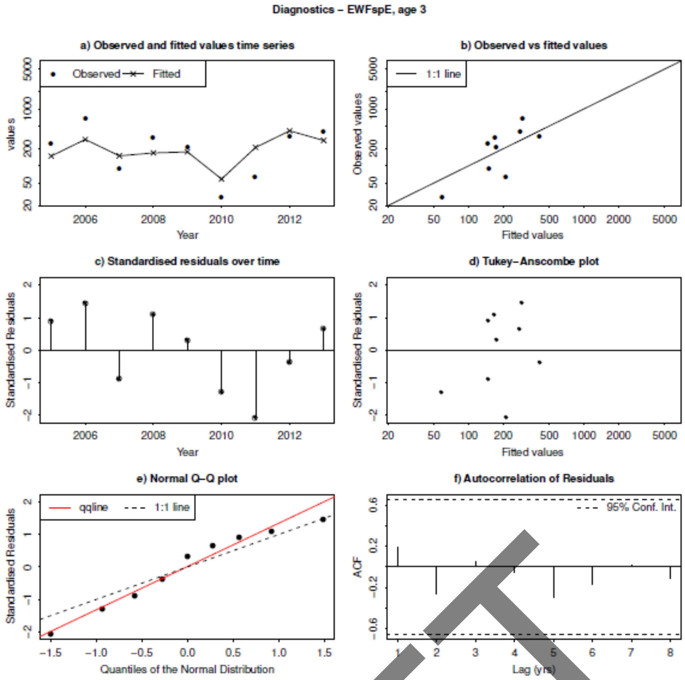
Figures 6.2.24e. Cod in ICES Division VIIa: SAM estimated UK-FSP west survey index residuals for age 5.



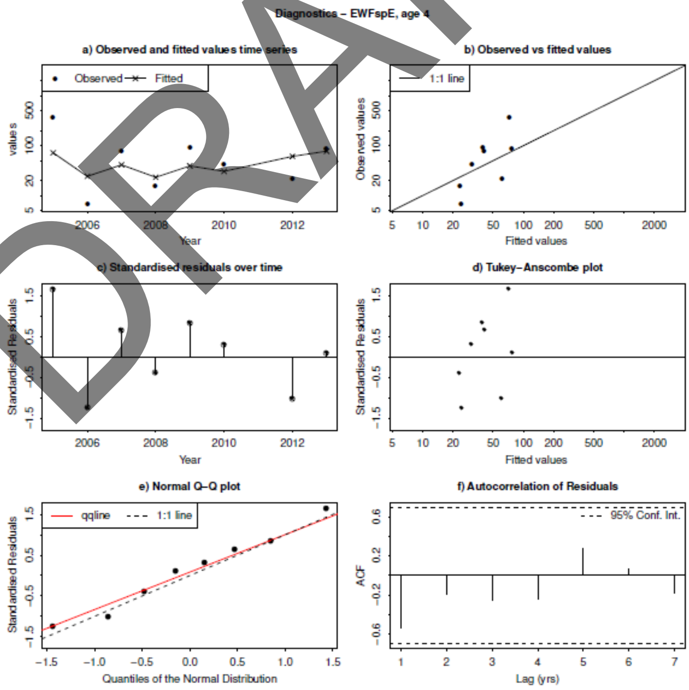
Figures 6.2.25a. Cod in ICES Division VIIa: SAM estimated UK-FSP east survey index residuals for age 1.



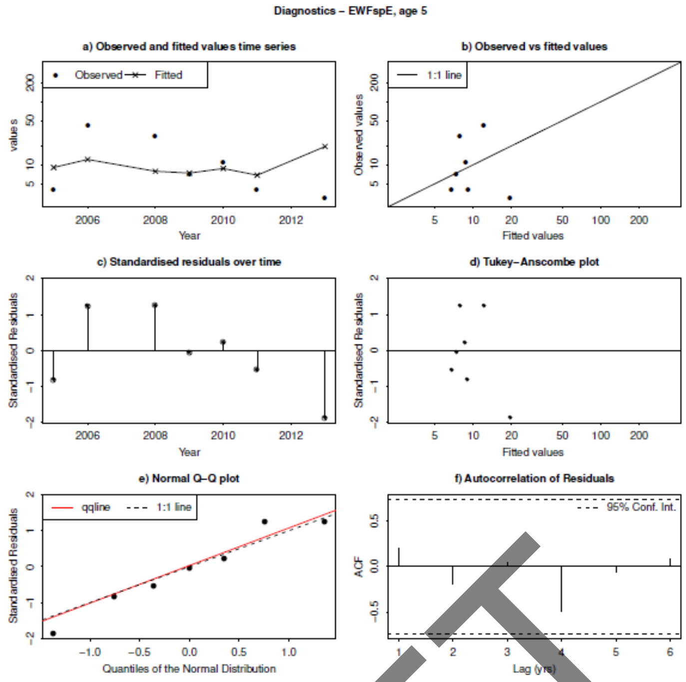
Figures 6.2.25b. Cod in ICES Division VIIa: SAM estimated UK-FSP east survey index residuals for age 2.



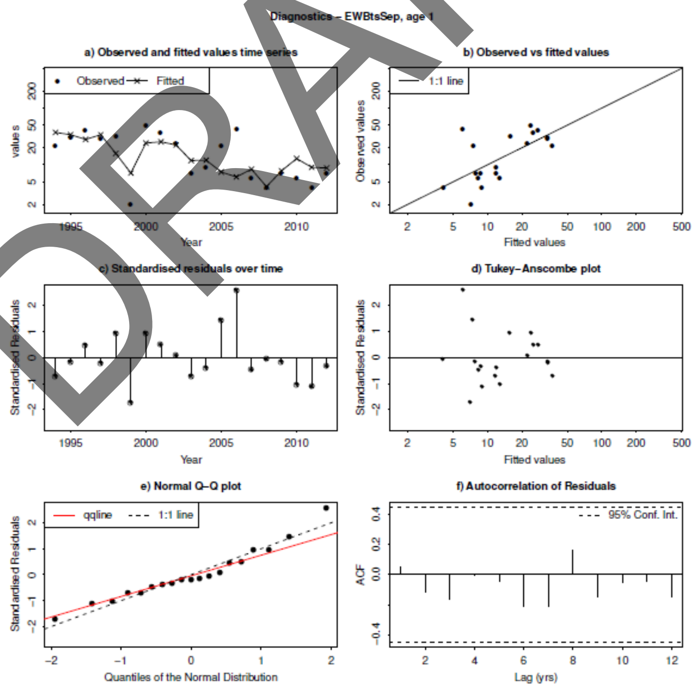
Figures 6.2.25c. Cod in ICES Division VIIa: SAM estimated UK-FSP east survey index residuals for age 3.



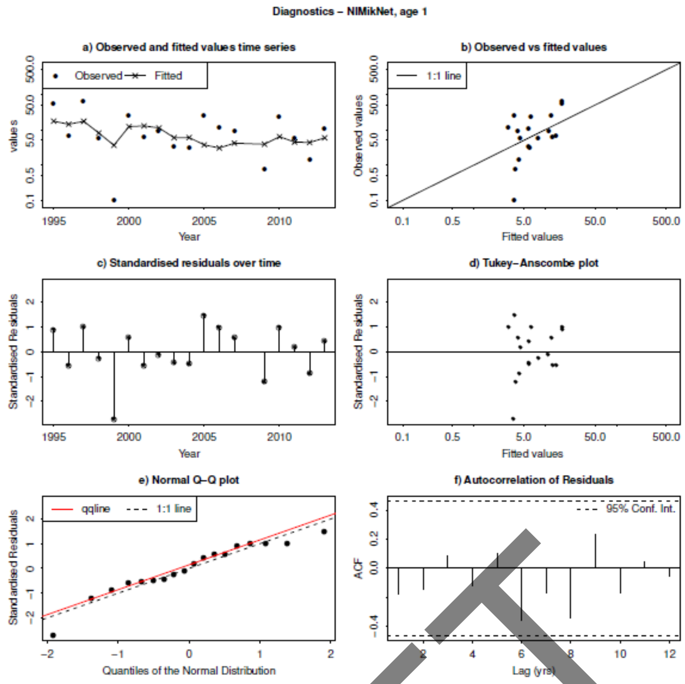
Figures 6.2.25d. Cod in ICES Division VIIa: SAM estimated UK-FSP east survey index residuals for age 4.



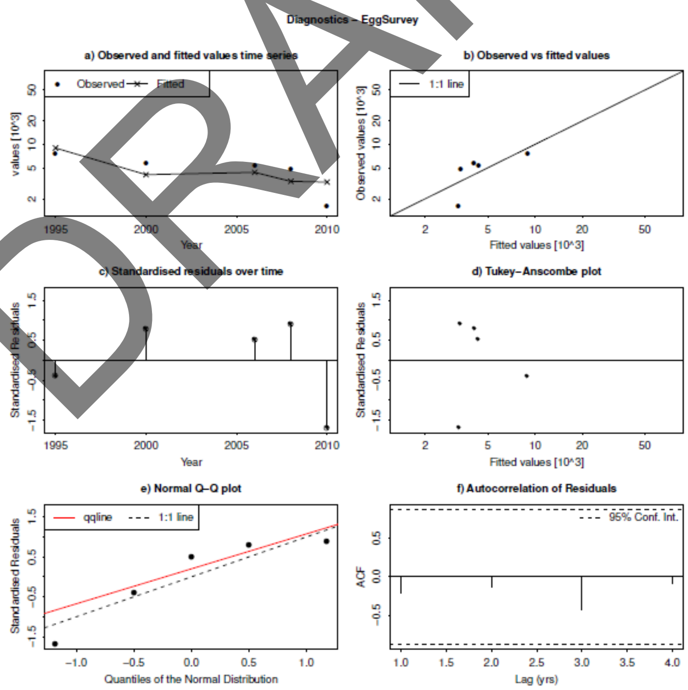
Figures 6.2.25e. Cod in ICES Division VIIa: SAM estimated UK-FSP east survey index residuals for age 5.



Figures 6.2.26. Cod in ICES Division VIIa: SAM Run 3 estimated UK(E&W)-BTS-Q3 survey index residuals for age 1 (age 0 moved forward 1 year).



Figures 6.2.27. Cod in ICES Division VIIa: SAM estimated NIMIK survey index residuals for age 1 (age 0 moved forward 1 year).



Figures 6.2.28. Cod in ICES Division VIIa: SAM estimated IS-AEPM survey biomass index residuals.

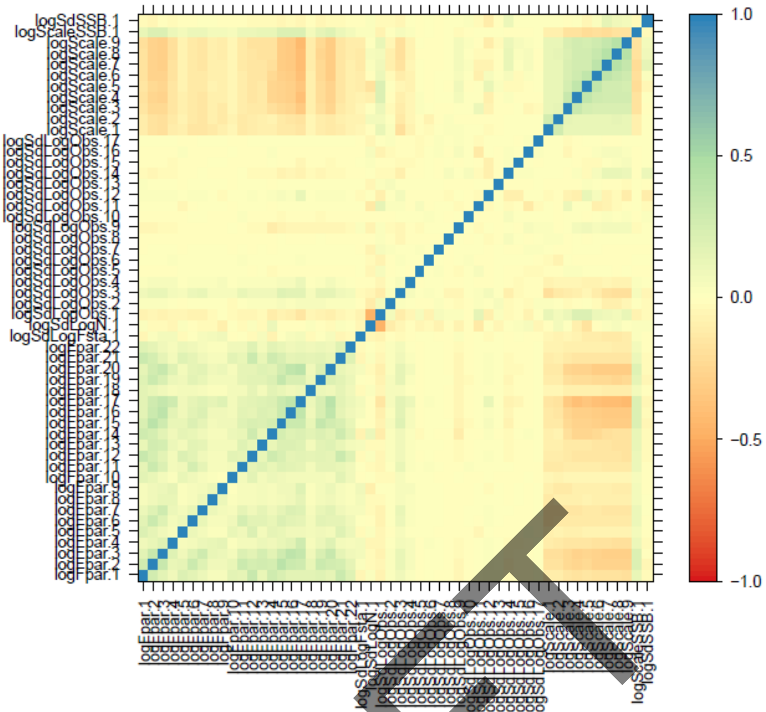


Figure 6.2.29. Cod in ICES Division VIIa: SAM model estimates of correlation among parameters.

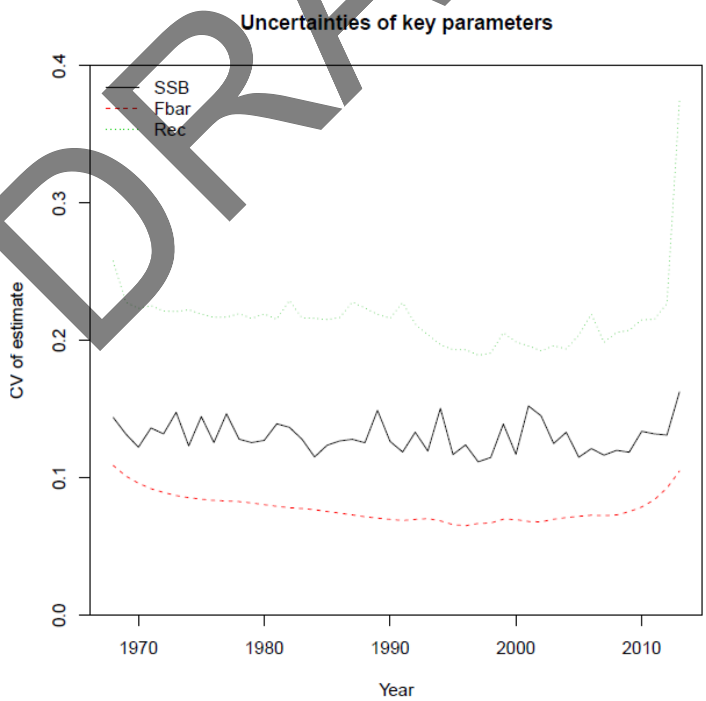


Figure 6.2.30. Cod in ICES Division VIIa: SAM model estimates of uncertainties of the spawning–stock biomass (SSB), fishing mortality (F_{bar}) and recruitment (Rec).

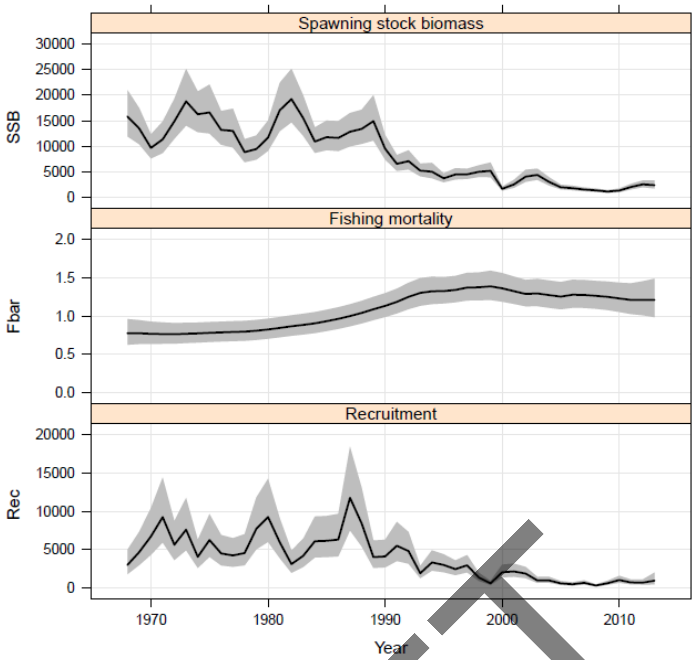


Figure 6.2.31. Cod in ICES Division VIIa: SAM model estimates of spawning–stock biomass, fishing mortality and recruitment.

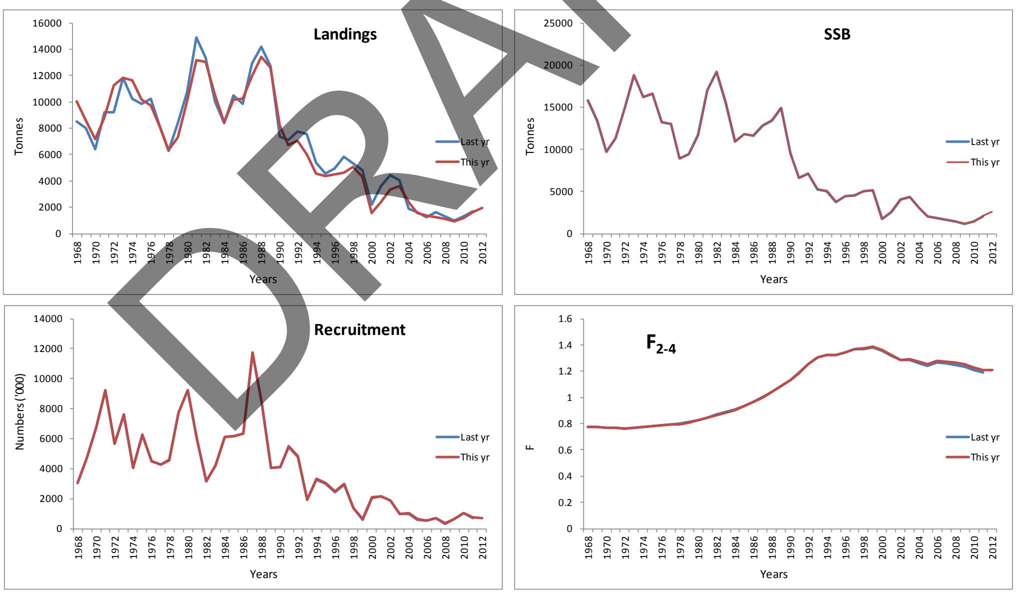


Figure 6.2.32. Cod in ICES Division VIIa: Comparison between the results of the assessment carried out at WGCSE 2012 and that performed at WGCSE 2013.

6.3 Haddock in Division VIIa

Type of assessment

The Working Group performed benchmark in 2013 (WKROUND2013). The primary concern was the lack of reliable catch-at-age data for recent years and discards not being included in the assessment. During the benchmark, significant progress was made to address these deficiencies, but no alternative assessment method were proposed that appropriately address the uncertainty in the mortality estimates for the stock (consistent trend in mortality despite the large expansion of the stock and subsequent fishing effort reduction). The stock was assessed using SURBA-R and is indicative of trends only.

ICES advice applicable to 2012

ICES advises based on precautionary considerations, that catches in 2012 should be reduced, and uptake of further technical measures to reduce discards.

Precautionary considerations

The exploitation status is unknown and SSB is fluctuating widely considering the full time-series. Therefore catches should be reduced.

Management by TAC is inappropriate for this stock because landings, but not catches, are controlled. Management measures should be introduced in the Irish Sea to reduce discarding of small haddock in order to maximize their contribution to future yield and SSB.

ICES advice applicable to 2013

This was the first year that ICES provided quantitative advice for data-limited stocks.

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 710 tonnes and further technical measures should be introduced to reduce discards.

ICES approach to data-limited stocks

For data-limited stocks for which a biomass index is available, ICES uses a harvest control rule based on index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the biomass is estimated to have decreased by 18% in 2008–2010 (average of the three years) and 2011–2012 (average of the two years). This implies a decrease of catches of 18% in relation to the average landings of the last three years, corresponding to catches of no more than 710 t. Considering that SSB has increased very significantly from the early 1990s and that the effort in the main fisheries has decreased, no additional precautionary reduction is needed.

6.3.1 General

Stock descriptions and management units

The stock and management units are both ICES Division VIIa (Irish Sea).

Management applicable to 2012 and 2013

Management measures include TAC and effort restrictions as well as technical measures. Due to the bycatch of cod in the haddock fishery, the regulations affecting Irish Sea haddock remain linked to those implemented under the cod recovery plan.

TAC regulations for 2012 and 2013 are given below:

2012

Species: Haddock *Melanogrammus aeglefinus*		Zone: VIIa (HAD/07A.)
Belgium	20	
France	91	
Ireland	542	
United Kingdom	598	
Union	1 251	
TAC	1 251	Analytical TAC

2013

Species: Haddock *Melanogrammus aeglefinus*		Zone: VIIa (HAD/07A.)
Belgium	19	
France	86	
Ireland	515	
United Kingdom	569	
Union	1 189	
TAC	1 189	Analytical TAC

The minimum landing size for haddock in the Irish Sea is 30 cm.

Fishery in 2012

The characteristics of the fishery are described in the stock annex. An overview of the fisheries in the Irish Sea is given in Section 6.1.

The fishery in 2012 was prosecuted by the same fleets and gears as in recent years, with directed fishing prevented inside the cod closure in spring. The targeted whitefish fishery that developed during the 1990 using semi-pelagic trawls, continued to decline during 2012. There are now less than four whitefish directed boats operating a seasonal fishery only. Whitefish directed effort is now low and dependent on available cod quota. A large proportion of the TAC is taken as bycatch in the *Nephrops* fishery.

The reported uptake of TAC has been poor since 2004, with the exception of 2007. The estimated percentage uptake of UK, Irish and Belgium vessels in 2012 were 40% (estimated 237 t of 598 t quota), 17% (90 t of 542 t) and 65% (13 t of 20 t), respectively. The French fleet had <3% uptake of the TAC. These figures have been corrected for area misreporting, but quota swaps have, however, not been taken into account.

Table 6.3.1 gives nominal landings of haddock from the Irish Sea (Division VIIa) as reported by each country to ICES since 1984.

6.3.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1. The landings of the fleets sampled by quarter comprise 51% of the international total in 2012. No sampling information is available for some of the smaller fleets contributing to the international landings.

Landings

Table 6.3.2 gives the long-term trend of nominal landings of haddock from the Irish Sea (Division VIIa) as reported to ICES since 1972, together with Working Group estimates. The 1993–2005 WG estimates (excl. 2003) include sampled-based estimates of landings into a number of Irish Sea ports. Sampled-based evidence suggests that WG estimates are similar to reported landings since 2006. Following the benchmark (WKROUND 2013) the landings have been revised since 1993 and exclude landings from the southern rectangles in the Irish Sea as they not are believed to be part of this stock.

The methods for estimating quantities and composition of haddock landings from VIIa, used in previous years, are described in the stock annex (Annex 6.3). The series of numbers-at-age in the international commercial landings is given in Table 6.3.3. Sampling levels were not considered adequate to derive catch age compositions in 2003. The time-series mean weight-at-age in the landings is given Table 6.3.4.

Discards

The series of the Irish and Northern Irish discard data, raised to the number of trips, were updated. Discard numbers-at-age for the different sampled fleets are given in Table 6.3.5. The proportions of discards-by-age for the different sampled fleets are given in Table 6.3.6. Issues relating to the reliability of the data were addressed at the benchmark assessment for this stock (WKROUND 2013).

Methods for estimating quantities and composition of discards from UK (NI) and Irish *Nephrops* trawlers are described in the stock annex (Annex 6.3). Sampling levels have increased in recent years. The very large estimates of discarding for *Nephrops* fleets observed by previous WG are still evident. A time-series of discard numbers-at-age was constructed at the benchmark, but this still need some refinement in terms of the raising methodology used. Discard rates are very variable between fleets. Discard estimates since 2010 were nevertheless calculated, including raising the estimates to unsampled fleets. Estimates were:

Year	Total Discard estimate (t)
2010	383
2011	307
2012	718

Using preliminary total estimates of discard numbers-at-age for the fleet and the stock weights indicate that total tonnage of discards from the fleet could be 250–750 t per year since 2008. This equates to discard rates of 20–50% in weight for the fleet. Discarding of adult age 2+ fish (spawning–stock biomass) are considerably lower at 70–170 t, highlighting the majority of discarding is at juvenile ages.

Biological data

The derivation of biological parameters and variables is described in the stock annex Natural mortality-at-age was calculated using the methods proposed by Lorenzen (1996) at WKROUND (2013). The proportions mature-at-age were also recalculated at the benchmark based mean proportion observed during the NIGFS-WIBTS-Q1 survey. Maturity-at-age is considered 0 at age 1, 0.72 at age 2, .97 at age 3 and fully mature at age 4+.

There is evidence of a decline in mean length of adult haddock over time (Figure 6.3.1), which needs to be reflected in the stock weights-at-age. Since 2001 the WG calculated stock weights by fitting a von Bertalanffy growth curve to all available survey estimates of mean length-at-age in March, described in the stock annex 6.3. The procedure was updated this year using NIGFS-WIBTS-Q1 and quarter one commercial landings data for 2011. The time-series of length–weight parameters indicate a reduction in expected weight-at-length since 1996 (see stock annex for historical data):

	Length–weight parameters		Expected weight–at–length	
Year	A	B	30 cm	40 cm
2006	0.00506	3.165	239	595
2007	0.00469	3.194	244	612
2008	0.00523	3.159	242	601
2009	0.00431	3.224	249	629
2010	0.00413	3.238	250	635
2011	0.00457	3.207	250	629
2012	0.00499	3.174	243	606
2013	0.00451	3.208	247	622

The following parameter estimates were obtained (last year's estimates in parentheses):

Mean LI_{yc} = 80.0 cm (78.2); K = 0.186 (0. 194); t_0 = -0.453 (-0.437)

Year-class effects giving estimates of asymptotic length relative to the mean were as follows (2011 and 2012 data were combined as there is only one observation for the 2012 year class):

Year class	Effect	Year class	Effect
1990	1.222	2001	0.992
1991	1.161	2002	0.955
1992	1.093	2003	0.899
1993	1.103	2004	0.828
1994	1.120	2005	0.841
1995	1.093	2006	0.846
1996	1.005	2007	0.867
1997	0.981	2008	0.903
1998	0.993	2009	0.886
1999	0.947	2010	0.905
2000	0.965	2011/2012	0.947

The year-class effects show a smooth decline from the mid-1990s coincident with the rapid growth of the stock and may represent density-dependent growth effects, although other environmental factors may contribute. The close fit of the model to observed length-at-age data is shown by year class in Figure 6.3.1. The resultant stock weights-at-age are given in Table 6.3.7. The weight-at-age in the stock shows a very clear decreasing trend over time, stabilizing in more recent years.

Surveys

The survey data considered in the assessment for this stock are given in Table 6.3.8. Survey-series for haddock available to the Working Group are described in the stock annex for 7a haddock. The following age-structured abundance indices were used in the assessment:

- UK (NI) groundfish survey (NIGFS) in March (age classes 1 to 5, years 1992–2013). Acronym NIGFS-WIBTS-Q1.

Additional age-structured abundance indices, that provided auxiliary information, are available from the following sources:

- UK (NI) groundfish survey (NIGFS) in October (age classes 0 to 3; years 1991 to 2012). Acronym NIGFS-WIBTS-Q4.
- UK (NI) Methot–Isaacs–Kidd (MIK) net survey in June (age 0; years 1994–2012).
- UK Fishery Science Partnership (FSP) Irish Sea roundfish survey, 2004–2013 (www.cefas.co.uk/fsp).
- UK Irish Sea Annual Egg Production Method survey (AEPM), 2006–2010 (see WGCSE 2011 for details).

The relative abundance indices are plotted against time in Figure 6.3.2. Surveys give similar signals for all ages (0–4). The two 0-group indices indicate decreased recruitment since 2010, with only the 2009 recruitment above average since 2007. Strong year classes were evident for all age groups in all surveys, indicating that the different surveys were capturing the prominent year-class signals in this stock (Figure 6.3.3). The strength of the 2012 year class is uncertain with the 0-gp and 1-gp survey indices giving inconsistent recruitment signals (Figure 6.3.3). Correlation between survey indices by age is positive for all surveys and show high consistency within each fleet, but patchy consistency between the fleets (Stock Annex 6.3). The indices from the UK FSP survey in the western Irish Sea also show similar year-class signals to the other survey-series, but are noisy with obvious year effects (Figure 6.3.2). Haddock SSB estimates derived from an annual egg production method in the Irish Sea show a similar trends as the SURBA estimates from NIGFS-WIBTS-Q1 data (Figure 6.3.4), where SSB decreased substantially in 2010 from the high 2006–2008 levels. The international landings-at-age (excl. 2003) show similar patterns of year-class variation to the surveys (Figure 6.3.2), giving confidence in the combined ability of the surveys to track year classes through time. The signal from the landings-at-age data is, however, much reduced since 2004.

The empirical trend in SSB from both the NIGFS series show the growth in SSB in the mid-1990s, a decline to 2000 and a subsequent variable trend (Figure 6.3.5). In recent years, both surveys show a decreasing trend in SSB from 2007–2010 (diverging considerably in 2008) and an increasing trend in the last three years.

Commercial cpue

Commercial cpue data are available for this stock but are not currently used in the assessment.

6.3.3 Historical stock development

Deviation from stock annex

The assessment presented is the single fleet SURBA analysis, using only the NIGFS-WIBTS-Q1 survey. The assessment does not deviate from the procedure described in the stock annex.

SURBA-R0 was used for the assessment and model settings (similar to last year's assessment) are given below:

	WGCSE 2013
Year range:	1992–2013
Age range:	1–5
Catchability:	1.0 at all ages
Age weighting	1.0 at all ages
Smoothing (Lambda):	1.0
Cohort weighting:	not applied
Reference age	2
Survey used	NIGFS-WIBTS-Q1

Data screening

Screening of internal and between survey consistency is described in Section 6.3.2.

Final update assessment

SURBA model residuals (log-population indices) for the NIGFS-WIBTS-Q1 survey show noisy residuals (Figure 6.3.6). Residuals show some evidence of year effects in older ages in some years. The age 2 residual pattern from the NIGFS-WIBTS-Q1 survey continue to show a better pattern than the other ages. The NIGFS-WIBTS-Q1 survey model show no obvious retrospective patters in SSB (Figure 6.3.6). There large retrospective patterns in mortality estimates, highlighting the difficulty in estimating mortality for this stock.

The trends in Z, SSB and recruitment for the assessment using the NIGFS-WIBTS-Q1 survey data, and the model residuals are given in Figures 6.3.7 and 6.3.8. The SURBA fitted numbers-at-age and total mortality-at-age given in Table 6.3.9. The SURBA index of Z generally follows the much noisier empirical estimates. The index of total mortality appears relatively stable. Both the empirical and SURBA estimates of SSB give a similar increasing trend from 2005–2008 followed by in decrease in 2009–2010, SSB has increased since 2011 following the stronger 2009–2010 recruitment. The recruitment estimates at age 1 indicate an average recruitment in 2012, following three years of above average recruitment. The strength of the 2012 year class is uncertain with conflicting survey indices (Figure 6.3.3), with the survey used in the assessment estimating recruitment to be higher than the 0-gp survey indices. In general, the SURBA results capture similar year-class dynamics than observed from the raw survey indices (Figure 6.3.2).

Comparison with previous assessments

The perception of the stock has not changed since last year's assessment. Figure 6.3.9 compares the relative trends between the SURBA fitted estimates from this year's to last year's assessment. There is a slight difference in the SSB values due to the change in the maturity-at-age profile. The most recent SSB estimate indicates that the stock has increased following increased recruitment in 2009–2011. The relative SSB estimate for 2013 is above the series average.

The assessment methodology was the same as last year, but the version of SURBA was updated at the benchmark from SURBA 3.0 to using SURBA-R. A change has been made to the estimation algorithm, with a different uncertainty method (SURBA 3.0 = delta method, SURBAR = bootstrap), and it results in slightly different results for Z.

State of the stock

Stock trends indicate an increase in SSB over the time-series. SSB trend is declining since 2008, but is showing an increase in the last three years. The stock is characterized by highly variable recruitment. The model indicates above average recruitment for the 2009–2011 year class after below average recruitment for the 2007 and 2008 year classes. Recruitment in 2012 is uncertain due to conflicting survey indices. Total mortality remains stable.

WKLIFE explorations

WKLIFE classified this stock into category 3.2.0; stocks for which survey based analyses or indices indicate trends. The survey data show very coherent year-class signals and appear to give a very clear picture of the development of the stock. The SSB indices appear to respond dynamically to the very variable recruitment, as would be expected given the steep age profile in the surveys. Mortality indices are stable, but absolute scale of fishing mortality is unknown. Applying catch option rule proposed for this stock category the last two years is 17% higher than the SSB in the three years previous to that.

Given the uncertainty in mortality estimates discussed above and conflicting signals of possible levels of mortality (steep age profile vs. proportion of catch to egg production SSB estimates), it is difficult to access the current level of exploitation in relation to reference points.

DCAC

Depletion corrected average catch, DCAC, is available in the NOAA toolbox (http://nft.nefsc.noaa.gov/DCAC.html). It is a "simple formula for estimating sustainable yields in data-poor situations" as stated in the original article on this model (MacCall, 2009). The formula is an extension of the potential yield formula, and it provides useful estimates of sustainable yield for data-poor fisheries on long-lived species. Wetzel and Punt (2011) simulation tested a number of methods used to set harvest levels for data-poor and data-limited stocks, including DCAC, and found that DCAC was fairly robust to mis-specification of M and F_{MSY}/M, but not to mis-specification of depletion ($=B_{current}/B_{virgin}$). They found that harvest levels set by DCAC were no longer conservative and led to overfishing when an overly optimistic depletion levels were assumed. So caution is needed when setting values for depletion in the application of DCAC.

WGCSE carried out a number of explorations with DCAC, although the method is probably inappropriate for such a dynamic stock. The model was insensitive to F_{MSY}/M values (ranging from 0.8–1.5, the later in associated with F_{MSY} estimates of other haddock stock of around 0.3) and a high depletion ratio of 0.5 (given the historic abundance trends of haddock in the Irish Sea and current SSB estimates being around the time-series average). The B_{MSY}/B_0 was taken to be 0.4 in line with the recommendations. The average DCAC was 1200–1350 t, which is around current TAC levels.

6.3.4 Short-term projections

No short-term forecast has been performed for this stock. This year the WG projected the SSB for 2014 using the 2013 survey information. Since maturity for the stock is considered 0 below age 2, all the age classes that will comprise the 2014 SSB are already represented by the 2013 quarter one survey index. SSB for 2014 was projected using an average of the last three years total mortality from the SURBA model, a three year average of stock weights (2011–2013) and ten year geometric mean recruitment.

The projected SSB trend is illustrated in Figure 6.3.10, indicating a small decrease in SSB compared to 2013. SURBA fitted recruitment estimates are also compared to recruitment from the 0-gp indices (NIGF-WIBTS-Q4 and NIMIK), indicating that the model estimates might overestimate the strength of the 2010 and 2011 year classes, but the relative strengths of these year classes have been confirmed by subsequent surveys.

6.3.5 MSY evaluations

MSY evaluations have been performed by the 2010 Working Group and these have not been updated. The MSY evaluations were performed on a very limited dataset. Input data were taken from the last accepted catch-at-age assessment in 2002 from the ICES network (similar input data to the yield-per-recruit analysis presented in Table 6.3.11). The analysis was performed using the srmsymc ADMB package. The evaluation was based on this historical catch-at-age data, including the underlying problems with the accuracy of the data.

The three stock–recruit relationships fitted by srmsymc are illustrated in Figure 6.3.11. The high uncertainty around these fits reflects the shortage of information within the limited dataseries to inform any stock–recruit relationship. The data are very noisy with relatively high rejection rates for the Ricker and Beverton–Holt models. Mathematically there is very little to distinguish between the three models, based on the AIC values that indicate equal fits (Table 6.3.10). F reference points are poorly defined with wide distributions and very high levels of uncertainty (cv values are high for all three models). F_{MSY} values falls within the range of F_{crash} in all cases (Table 6.3.10).

Stock–recruit relationships are generally poorly defined for haddock stocks. These models assume a positive relationship between spawning–stock size and recruitment. However, haddock is characterized by sporadic high recruitment even at low spawning–stock levels making any relationship difficult to define. Recent trends within the Irish Sea haddock stock showed that an increase in spawning–stock biomass depends on these impulses of high recruitment, i.e. recruit–stock. Density-dependent growth is also evident by year class, which will have an effect on the overall yield of large year classes. This all makes an evaluation for the stock at equilibrium very difficult.

The Working Group is thus unable to provide absolute values for F_{MSY} or F_{MSY} proxies, as there are insufficient data to derive absolute estimates of F_{MSY} with any degree of precision.

There are some additional considerations in relations to exploitation levels to maximize long-term yield, which might indicate that current F might be above F_{MSY}:

- The stock has a high growth rate with considerable growth potential. Estimates of 0-gp and 1-gp discards are high, thus any improvement in the selectivity pattern would result in increased future yield.
- The age structure is narrow and is not recovering despite a significant decrease in overall effort from the midwater pelagic fleet.

6.3.6 Biological reference points

Precautionary approach reference points

There is currently no biological basis for defining appropriate reference points, in view of the rapid expansion of the stock size over a short period (ACFM, October 2002). ACFM (2007) proposed that F_{PA} be set at 0.5 by association with other haddock stocks, however, the Working Group no longer considers an F_{PA} value determined in association with other haddock stocks as appropriate. The absolute level of F in this stock at present is poorly known.

Yield and biomass-per-recruit

Yield-per-recruit (YPR) and SSB per recruit (SPR) for the Irish Sea stock were calculated by the 2004 WGNSDS, conditional on the exploitation pattern for landings in 2000–2002 given for ages 0 to 5+ by XSA, using MFYPR software. Long-term (1993–2003) catch weights and stock weights-at-age were used. Input data are given in Table 6.3.11, and the summary output is given in Table 6.3.12. The YPR and SPR curves are plotted in Figure 6.3.12. The deterministic output from this model is, however, highly uncertain. Figure 6.3.12 illustrates the uncertainty in the yield-per-recruit curve. Any estimate from the analysis is highly uncertain (high cv values in Table 6.3.10) implying poorly defined F reference point as well as the absolute level of yield. The main problem with the historical yield-per-recruit analysis is the absence of discard fishing mortality and should be addressed at the next benchmark.

6.3.7 Management plans

There is no specific management plan for haddock in the Irish Sea. Due to the bycatch of cod in the haddock fishery, the regulations affecting Irish Sea haddock remain linked to those implemented under the cod management plan (Council Regulation (EC) 1342/2008).

6.3.8 Uncertainties and bias in assessment and forecast

This assessment is based on survey trends only as recent levels of catch are uncertain. After a period of poor sampling of landings for length and age, the sampling levels and coverage since 2007 are adequate to allow compilation of catch-at-age data. Discard sampling levels also increased significantly in the last three years. The highly variable and very large estimates of discarding for this fleet observed by previous WG are still evident. Historical landings data for this stock are uncertain, but sample-based estimates of landings suggest that the accuracy of officially reported landings has improved substantially since 2006.

The narrow age range in the haddock stock and the resulting small numbers caught at older ages in the surveys restricted the number of age classes that could be used in the model. This and the differences in catchability-at-age between surveys make the total mortality difficult to estimate. The survey data used in the assessment are quite consistent both internally and between fleets, probably due to the very large data contrast between year-class strengths as well as the restricted distribution of the stock. The recruitment pattern for this stock since the early 1990s is relatively well established and can be tracked fairly consistently through both the surveys and commercial catches. Hence it can be established with some confidence how, qualitatively, the catch and stock is likely to be impacted in the short term by recent year classes.

Knowledge of basic biology of Irish Sea haddock is expanding through data on growth, maturity and distribution obtained during trawl surveys. Patterns of movement within the Irish Sea and between the Irish Sea and surrounding areas are poorly understood, and it is assumed that the Irish Sea stock is essentially self-sustaining at present. Trends in length and weight-at-age in the stock over time are apparent and reduced growth appears to have coincided with the growth of the stock. This may represent density-dependent growth effects (although other environmental factors may contribute) that will affect any forecast and lead to overoptimistic forecast estimates unless correctly predicted.

The projected survey estimate of biomass should only be used for interpreting trends rather than a relative estimate. F/Z is poorly estimated and currently unknown. The problem is with using Z-M as a proxy for F in the SURBA-based assessment, when total mortality from the model is poorly defined. The SURBA Z-values are only a relative measure and do not mean anything unless the catchability-at-age in the survey(s) are quantified. The SURBA Z-values cannot be taken as an absolute, which makes effort based management very difficult, especially measured against a non-stock specific reference point. A horizontal line can be drawn through the Z time series (Figure 6.3.6) that lies fully with the confidence interval for all but the first two years, indicating that the survey data don’t show any significant evidence of changes in mortality. This is over a time period when the stock expanded significantly in the early part, to a dramatic reduction in fishing effort in the latter part.

The Annual Egg Production (AEMP) survey estimates of haddock SSB confirm the trend in SSB from the assessment. The absolute estimates in 2006 and 2008 (8.8 kt and 9.4 with CV of 32% and 24%, respectively) are very large compared to the WG landings of 650 and 870 t for these years. Even when discard estimates at age 2+ are taken into account the total catch estimates are ~1000–1200 t (from raised discard estimates by fleet Table 6.3.5 and stock weights) during this period. This would imply a much lower mortality than given by the age profile in the groundfish surveys (which indicate Z of around 1.5). There is, however, no evidence from any fishery data for an age composition that would reflect low mortality. The AEMP estimate for 2010 is in contrast to the 2006 and 2008 estimates, substantially lower at 870 t (CV of 26%) corresponding to landing of 940 t and catch estimates of ~1100 t.

The perception of the stock from this year’s assessment does not differ qualitatively from that obtained last year.

6.3.9 Recommendations for next benchmark assessment

The primary concern for this stock is that recent catch-at-age data (landings ad discards) are considered inaccurate to form the basis for a traditional analytical assessment based on catch-at-age data. This has been attributed to poor sampling information, which has improved in the last two years. This has largely been addressed at the benchmark in 2013 where an international catch-at-age matrix was constructed. A full analytical assessment was not possible due to the uncertainty in the mortality estimates for the stock. This needs further investigation and possibly dealt with through choice of assessment methods.

6.3.10 Management considerations

Following decades of very low recruitment and biomass as indicated by very low fishery catches, this stock grew substantially in the 1990s following sudden pulses of recruitment, and has gone from a minor bycatch species to one of the most economically valuable target species in the Irish Sea. Since the mid-1990s the haddock population in the Irish Sea is experiencing one of the largest and most sustained period of growth. The recruitment signals are clearly revealed by surveys, but the steep age profile in the catches and the resultant dependence of the fishery on highly variable recent year classes means that catch and SSB forecasts will be uncertain. The prevention of directed fishing for haddock during the cod closures in 2000–2013, other than during limited fishing experiments, should have curtailed the directed fisheries on mature haddock that occur in spring. EU has adopted a long-term plan for cod stocks and the fisheries exploiting those stocks (Council Regulation (EC) 1342/2008). The long-term management plan for cod implemented in the Irish Sea from 2008 will affect catches of species caught in related fisheries, including haddock.

Sampling schemes since the 1990s have shown high rates of discarding of haddock less than three years old and variable discarding of 3-year-olds in fisheries using 70–89 mm mesh nets. Samples from whitefish vessels since the introduction of 100+ mm mesh and other recent technical measures are too few to form a basis for evaluation of discards in that fleet.

ICES notes that there have been a number of industry and national initiatives to reduce discarding associated with *Nephrops* fisheries. A conditional national licence has been introduced by Ireland since March 2012, making the use of grids or separator panels mandatory for all TR2 boats fishing in the Irish Sea. Around 55% of the Irish vessels use separator trawls and while 45% have opted to use Swedish grids to reduce bycatch. Grids have been shown to reduce catches of <25 cm haddock to negligible levels. Since October 2012, all TR2 vessels in the UK(Northern Ireland) fleet are required to use a highly selective fishing gear to reduce overall discarding of fish. The expected reduction of haddock discards cannot be quantified at present and it is important that the effectiveness of these devices and their impact on discards and landings are monitored and evaluated.

Current TAC management measures are not responsive enough considering the dynamic nature of changes in stock abundance. Under the assumption of constant effort, the increase in abundance from 2005–2008, created increased catch opportunities. During this period the TAC remained relatively constant and resulted in increased discarding of older fish (particularly in 2007). The TAC for 2009 was increased based on the increasing trend of stock abundance, despite evidence of weaker recruitment and possible decreasing abundance.

Landings data have not been used in the assessment. Landings data for this stock are uncertain because of species misreporting, which has been estimated from quayside observations in one country only. The landings since 1993 have been revised and exclude landings from the southern rectangles in the Irish Sea as they not are believed to be part of this stock. Restrictive quotas for some countries caused extensive misreporting during the 1990s prior to the introduction of a separate TAC allocation for the Irish Sea. Estimates of misreporting have been included in the estimates of landings, except for 2003. The recent implementation of buyers and sellers legislation has improved the quality of the landings data since 2006. However, with the sharp decline in whitefish directed effort in the Irish Sea, sampling opportunities for haddock from landings, are not likely to improve.

The SSB indices appear to respond dynamically to the very variable recruitment, as would be expected given the steep age profile in the surveys. Stock trends indicate an increase in SSB over the time-series followed by a decrease since 2008 due to some below-average year classes. The rapid decline in Surba SSB index from 2009 to 2010 is also reflected in the AEPM egg survey biomass estimates, indicating that year classes are depleted very rapidly. However the catches in 2006 and 2008 were quite small relative to the AEPM SSB estimates, suggesting low mortality. This conundrum (continuing apparent very steep age profile despite large reductions in whitefish fishing effort) is the same as with cod and whiting.

Table 6.3.1. Nominal landings (t) of HADDOCK in Division VIIa, 1984–2012, as officially reported to ICES. (Working Group figures are given in Table 6.3.2)

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	3	4	5	10	12	4	4	1	8	18
France	38	31	39	50	47	n/a	n/a	n/a	73	41
Ireland	199	341	275	797	363	215	80	254	251	252
Netherlands	-	-	-	-	-	-	-	-	-	-
UK(E&W)[1]	29	28	22	41	74	252	177	204	244	260
UK (Isle of Man)	2	5	4	3	3	3	5	14	13	19
UK (N. Ireland)	38	215	358	230	196	…	…	…	…	…
UK (Scotland)	78	104	23	156	52	86	316	143	114	140
Total	387	728	726	1,287	747	560	582	616	703	730

Country	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Belgium	22	32	34	55	104	53	22	68	44	20
France	22	58	105	74	86	n/a	49	184	72	146
Ireland	246	320	798	1,005	1,699	759	1,238	652	401	229
Netherlands	-	-	1	14	10	5	2	-	-	-
UK(E&W)[1]	301	294	463	717	1,023	1,479	1,061	1,238	551	248
UK (Isle of Man)	24	27	38	9	13	7	19	1	-	-
UK (N. Ireland)	…	…	…	…	…	…	…	…	…	…
UK (Scotland)	66	110	14	51	80	67	56	86	47	31
Total	681	841	1,453	1,925	3,015	2,370	2,447	2,229	1,115	674

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	15	22	23	30	15	7	9	16	13*
France	20	36	20	11	6	3	2	8	3*
Ireland	296	139	184	477	319	388	333	434	561*
Netherlands	-	-		-	-	-	-	-	-
UK (England & Wales)[1]	421	344	419	559	521	446	593	355	236*
UK (Isle of Man)	-	-	-	-	1	1	-	-	<1*
UK (N. Ireland)	…	…	…	…	…	…	…	…	...
UK (Scotland)	9	6	9	1	17	1	2		
United Kingdom									236*
Total	761	547	655	1078	879	846	939	813	813*

***Preliminary.**

[1]1989–2011 Northern Ireland included with England and Wales.

n/a = not available.

Table 6.3.2. Haddock in VIIa. Total international landings of haddock from the Irish Sea, 1972–2012, as officially reported to ICES. Working Group figures, assuming 1972–1992 official landings to be correct, are also given. The 1993–2005 WG estimates include sampled-based estimates of landings at a number of Irish Sea ports. Sample-based evidence confirms more accurate catch reporting since 2006. Landings in tonnes live weight. Since 1993 the landings have been corrected to exclude catches from the southernmost rectangles, which are not considered part of this stock.

Year	Official landings	WG landings
1972	2204	2204
1973	2169	2169
1974	683	683
1975	276	276
1976	345	345
1977	188	188
1978	131	131
1979	146	146
1980	418	418
1981	445	445
1982	303	303
1983	299	299
1984	387	387
1985	728	728
1986	726	726
1987	1287	1287
1988	747	747
1989	560	560
1990	582	582
1991	616	616
1992	703	656
1993	730	813
1994	681	1042
1995	841	1736
1996	1453	2981
1997	1925	3547
1998	3015	4874
1999	2370	4095
2000	2447	1357
2001	2229	2246
2002	1115	1817
2003	674	659
2004	761	1217
2005	547	666
2006	655	633
2007	1078	886
2008	879	786
2009	846	581
2010	939	679
2011	813	446
2012	n/a	343

Table 6.3.3. Haddock in VIIa: Catch numbers-at-age (=landings number-at-age; no discard data included).

TABLE 1 LANDINGS NUMBERS AT AGE					NUMBERS*10**-3																
	YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
	AGE																				
0		0	0	0	0	0	0	924	1	0	0	n/a	0	0	0	0	0	0	0	0	0
1		94	30	1329	108	1272	601	287	548	13	290	n/a	72	69	13	23	129	33	18	44	9
2		1250	123	1310	4568	693	8353	916	575	2741	697	n/a	220	473	519	911	336	451	430	550	232
3		18	861	106	727	2387	252	4773	438	1074	2036	n/a	753	226	519	495	718	549	409	148	170
4		1	3	220	16	201	488	25	457	30	142	n/a	46	193	63	60	242	121	309	97	27
	+gp	1	2	5	30	16	42	57	418	89	18	n/a	78	34	51	47	36	36	59	52	28
0	TOTALNUM	1364	1019	2970	5449	4569	9736	6982	2437	3947	3183	n/a	1169	995	1165	1536	1461	1190	1225	891	466
	TONSLAND	813	1042	1736	2981	3547	4874	4095	1357	2246	1817	659	1217	666	633	886	786	581	679	446	343
	SOPCOF %	100	100	100	100	95	100	100	97	100	100	n/a	100	99	100	100	100	100	100	100	100

Table 6.3.4. Haddock in VIIa: catch weights-at-age (=landings weight-at-age; no discard data included).

CATCH WEIGHTS AT AGE (KG)																					
	YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
	AGE																				
0		0	0	0	0	0	0	0.013	0.135	0	0	NA	0	0	0	0	0	0	0	0	0
1		0.351	0.346	0.361	0.346	0.348	0.235	0.189	0.26	0.405	0.244	NA	0.438	0.299	0.309	0.246	0.278	0.291	0.315	0.233	0.362
2		0.596	0.56	0.545	0.474	0.592	0.428	0.399	0.372	0.46	0.339	NA	0.612	0.381	0.397	0.441	0.387	0.388	0.362	0.411	0.477
3		1.688	1.103	0.898	0.917	1.002	1.066	0.726	0.46	0.734	0.644	NA	1.055	0.642	0.498	0.659	0.538	0.468	0.499	0.673	0.809
4		2.52	2.73	1.983	2.034	1.349	1.63	1.951	0.984	1.317	1.165	NA	1.566	1.342	0.949	1.082	0.763	0.793	0.747	0.588	1.383
	+gp	2.52	2.522	2.178	2.682	1.955	2.27	2.646	0.836	1.714	1.811	NA	2.376	1.797	2.027	1.853	1.368	1.195	1.405	1.003	2.143
0	SOPCOFAC	0.9995	1.0008	1.0007	1.0029	0.9465	0.9958	0.9996	0.9675	1.0002	0.9991										

Table 6.3.5. Haddock in VIIa: Estimates of Irish Sea haddock discards 1995–2011. Data are numbers ('000 fish) discarded by the fleet, estimated from numbers per sampled trip raised to total fishing effort by each fleet, for the range of quarters indicated. Tables (b) and (d) represent estimates from limited observer sampling of N.Ireland vessels also included within the self-sampling estimates for N.Ireland trawlers catching *Nephrops* (Table (a)). Table (f) is the total for sampled fleets and quarters, excluding missing quarters or fleets. Table (e) is the revised figures supplied to the 2005 WG.

a) Self sampling scheme: N.Ireland single trawl Nephrops vessels. Estimates are extrapolated to all N.Ireland vessels catching *Nephrops* (single and twin trawl)

	1996 Q1-4	**1997 Q1-4**	**1998 Q1-4**	**1999 Q1-4**	**2000 Q1-4**	**2001 Q1-4**	**2002 Q1-4**	**2003 Q1**	**2004**	**2005**	**2006**	**2007**	**2008 Q2-4**	**2009 Q1-4**	**2010 Q1-4**	**2011 Q1-4**
Age	43 trips	39 trips	48 trips	39 trips	44 trips	43 trips	35 trips	8 trips					114	136	100	86
0	4485	100	1552	1274	110	1083	851	0	n/a	n/a	n/a	n/a	1312	7058	3830	5393
1	229	1209	318	342	2384	140	1073	62	n/a	n/a	n/a	n/a	601	1015	2219	5389
2	179	88	210	69	253	199	37	28	n/a	n/a	n/a	n/a	156	651	83	1162
3	0	0	0	0	0	0	11	0	n/a	n/a	n/a	n/a	5	253	11	16

(b) Observer scheme: N.Ireland vessels catching *Nephrops* (single trawl only) (*not raised to fleet level – no. of fish)

	1999 Q3-4	**2000 Q1-3**	**2001 Q1**	**2006 Q3-4***	**2007 Q1-4**	**2008 Q1-4**	**2009 Q1-4**	**2010 Q1-4**	**2011 Q1-4**
Age	4 trips	6 trips	1 trip	9 trips	29 trips	55 trips	30 trips	36 trips	24 trips
0	2185	210	0	8391	901	625	1609	924	909
1	22	280	1677	809	1553	295	284	763	448
2	0	57	1593	60	681	124	101	16	77
3	0	0	0	15	74	16	23	1	1
4	0	0	0	0	0	1	0	0	0

(c) Observer scheme: N.Ireland midwater trawl

	1997 Q2-4	**1998 Q1-3**	**1999 Q3-4**	**2000 Q1**	**2001 Q1**	**2008 Q4**	**2009 Q2**	**2010 Q1,2,4**	**2011**
Age	n/a	n/a	5 trips	4 trips	2 trips	1 trip	1 trip	3 trip	0 trips
0	0	0	68	0	0	0	0	0	
1	178	316	96	20	0.4	7	1	33	
2	19	1342	35	83	19	15	39	28	
3	4	0	2	5	0	2	19	4	

(d) Observer scheme: N.Ireland twin trawl (*not raised to fleet level – no. of fish)

	1997 Q2-4	**1998 Q1-3**	**1999 Q4**	**2000 Q1-4**	**2001 Q1**	**2006 Q3-4***	**2007 Q1-4**	**2008 Q1-4**	**2009 Q1-4**	**2010 Q1-4**	**2011 Q1-4**
Age	n/a	n/a	1 trips	10 trips	2 trips	2 trip	14 trips	16 trips	18 trips	21 trips	14 trips
0	34	4	26	10	0	363	369	676	3219	493	157
1	284	205	3	13	3	59	275	183	315	1849	298
2	6	382	0	10	19	9	77	70	600	277	197
3	0.5	0	0	0	0	0	9	6	200	39	3
4	0	0	0	0	0	0	0	0	1	3	1

Table 6.3.5. (Cont) Haddock in VIIa: Estimates of Irish Sea haddock discards 1995–2011.

(e) Observer scheme: Republic of Ireland otter trawlers

	1996 Q1-4	1997 Q1-4	1998 Q1-4	1999 Q1-4	2000 Q1-4	2001 Q1-4	2002 Q1-4	2003 Q1-4	2004 Q1-4	2005 Q1-4	2006 Q1-4	2007 Q1-4	2008 Q1-4	2009 Q1-4	2010 Q1-4	2011 Q1-4
Age	8 trips	8 trips	7 trips	4 trips	10 trips	2 trips	1 trip	9 trips	11 trips	8 trips	5 trips	16 trips	18 trips	18 trips	4 trips	6 trips
0	3808	165	565	87	182	5349	47	1169	5663	776	3966	1122	322	5759	233	885
1	713	11396	1973	58	2193	7354	31	1747	6566	2350	10140	8735	1226	5654	374	647
2	297	303	3564	59	580	140	0	1178	2301	996	3856	3995	783	334	105	311
3	0	0	0	0	0	15	0	10	225	120	132	435	44	72	57	3
4	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0

(f) Observer scheme: Republic of Ireland GEAR TECH otter trawlers (using grids)

	2010	2011
Age	9 trips	4 trips
0	43	256
1	125	67
2	43	11
3	26	0
4	1	0

(g) Total for sampled fleets and quarters: NI self sampling scheme (a); NI midwater trawl (c); ROI otter trawl (e)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010
Age	51 trips	n/a	n/a	48 trips	58 trips	47 trips	36 trips	17 trips	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
0	8293	265	2117	1429	292	47	36	17	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1	942	12783	2607	496	4597	6432	898	1169	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2	476	410	5116	163	916	7494	1104	1809	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
3	0	4	0	2	5	358	37	1206	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4	0	0	0	0	0	15	11	10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 6.3.6. Haddock in VIIa: Proportion by number-at-age discarded by sampled fleets.

		Proportion discarded			
Fleet	Period	age 0	age 1	age 2	age 3
Midwater trawl	Q2-Q4 1997		0.93	0.37	0.02
Midwater trawl	Q1-Q3 1998		0.99	0.16	0.00
Midwater trawl	Q3-Q4 1999	1.00	0.79	0.31	0.00
Midwater trawl	Q1 2000		1.00	0.44	0.04
Midwater trawl	Q1 2001		1.00	0.30	
Midwater trawl	Q4 2008	1.00	0.97	0.90	0.30
Midwater trawl	Q2 2009		-	0.44	0.14
Midwater trawl	Q1-2,4 2010	1.00	0.92	0.22	0.03
Single *Nephrops*	Q3-Q4 1999	1.00	0.94		
Single *Nephrops*	Q1-Q3 2000	1.00	0.97	0.45	
Single *Nephrops*	Q1 2001		1.00	0.49	
Single *Nephrops*	Q3-Q4 2006	1.00	1.00	0.96	0.50
Single *Nephrops*	Q1-Q4 2007	1.00	1.00	0.94	0.79
Single *Nephrops*	Q1-Q4 2008	1.00	0.99	0.78	0.18
Single *Nephrops*	Q1-Q4 2009	1.00	1.00	0.88	0.46
Single *Nephrops*	Q1-Q4 2010	1.00	1.00	0.96	0.68
Single *Nephrops*	Q1-Q4 2011	1.00	1.00	0.94	0.21
Twin trawl	Q2-Q4 1997	1.00	1.00	0.61	0.04
Twin trawl	Q1-Q3 1998	1.00	1.00	0.76	0.00
Twin trawl	Q4 1999	1.00	1.00		
Twin trawl	Q1 – Q4 2000	1.00	0.96	0.28	
Twin trawl	Q1 2001		1.00	0.12	
Twin trawl	Q3-Q4 2006	1.00	1.00	0.81	0.00
Twin trawl	Q1-Q4 2007	1.00	1.00	0.91	0.63
Twin trawl	Q1-Q4 2008	1.00	0.95	0.50	0.05
Twin trawl	Q1-Q4 2009	1.00	0.99	0.95	0.75
Twin trawl	Q1-Q4 2010	1.00	1.00	0.85	0.42
Twin trawl	Q1-Q4 2011	1.00	1.00	0.80	0.08
OTB	Q1-Q4 2007	1.00	1.00	0.93	0.65
OTB	Q1-Q4 2008	1.00	0.97	0.90	0.17
OTB	Q1-Q4 2009	1.00	1.00	0.62	0.24
OTB	Q1-Q4 2010	1.00	0.99	0.59	0.29
OTB	Q1-Q4 2011	1.00	0.99	0.63	0.03

Table 6.3.7. Haddock in VIIa: stock weights-at-age.

	YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	AGE																					
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1		0.098	0.086	0.088	0.085	0.072	0.061	0.059	0.049	0.053	0.057	0.051	0.042	0.032	0.034	0.035	0.038	0.043	0.041	0.044	0.051	0.045
2		0.428	0.344	0.353	0.366	0.362	0.257	0.229	0.232	0.204	0.218	0.233	0.201	0.168	0.13	0.139	0.141	0.155	0.178	0.167	0.175	0.205
3		1.07	0.977	0.791	0.792	0.87	0.746	0.565	0.511	0.548	0.473	0.486	0.512	0.459	0.381	0.301	0.312	0.328	0.358	0.407	0.371	0.405
4		1.788	2.035	1.708	1.315	1.429	1.381	1.285	0.961	0.924	0.973	0.793	0.81	0.899	0.796	0.678	0.514	0.562	0.578	0.62	0.682	0.659
	+gp	2.584	3.055	7.148	10.696	10.022	8.243	7.968	7.873	7.728	6.853	5.55	4.983	4.993	4.887	5.205	4.823	4.33	3.719	3.322	3.331	3.691

Table 6.3.8. Haddock in VIIa: Available tuning data (file name: h7ani.tun).

```
IRISH SEA haddock,2013 WG,ANON,COMBSEX,TUNING DATA(effort, nos at age)
104
NIGFS-WIBTS-Q1
1992 2013
1 1 0.21 0.25
1 5
       1   1525    23     0     0   0  0
       1    139   569    31     0   0  0
       1    644    58   183     0   0  0
       1  24823   437     0    43   0  0
       1   1065  3743    67     3   1  0
       1  25118   474  1457    44   0  2
       1   3913  8694    70   105   1  0
       1   6058   680  2072    16  11  0
       1  14028  1853    64   147   2  3
       1   3277  6990   770    40  20  0
       1  28755   842  1059    78   1  0
       1   6966 14162   341   356  26  0
       1  19945  2379  2206    45  35  0
       1  24488  6454   406   234  13  2
       1  13444 12721  2194    91  33  0
       1  20918 11325  3661   240  16 11
       1   7480 12009  2559   495  48  0
       1   9345  3888  2877   163  37  5
       1  17058  1765   524   239  26  1
       1  17278  5543   299    67  46  4
       1  13509  5266  1095    38   6  7
       1   8245  5202   751   119  11  9
NIGFS-WIBTS-Q4
1991 2012
1 1 0.83  0.88
0 3
        1   15780      70      0       0  0  0  0
        1     124     784    151       0  0  0  0
        1    4462     101    375       3  0  0  0
        1   56683    1137     12      79  0  0  1
        1    1661   10153     74       0  5  0  0
        1  143300    1167   1480      13  0  0  0
        1   16400   39680    174      98  1  0  0
        1   41820    1243   3778      22  3  4  0
        1   80674    2835     71     145  0  1  0
        1    6545    8598    763      31 39  0  0
        1   75017    2003   2742     311  0 20  0
        1   15116   10501     86     365  0  0  0
        1   53922    7125   3008      59 79  0  0
        1   70337   14413   1261     649  0  0  0
        1   47030   12962   1743      59  8  0  0
        1   35748   10788   3607     392 52  0  0
        1    9654    9804   4050    1057 41  0  0
        1    9037    4880   2242     277 24  0  0
        1   45869    4269    951     459 29 12  3
        1   22538    8433    587     197 85  0  3
        1   20678    4234   1086     140 49 16  5
       1   10673    8042   1549    193 0   0  0
NIMIK
1994 2012
1 1 0.38 0.47
0 0
        1     47000
        1      1700
        1     47800
        1     14500
        1      2500
        1     15400
        1      1700
        1     17100
        1      1200
        1      4250
        1     25970
        1      8250
        1     40240
        1      3820
        1      6638
```

```
        1     18540
        1      4532
        1      6606
       1      9818
SGFS Spring
1997  2006
1 1 0.15 0.21
1 5
       1   6581    65   213     9   2   0
       1    564   472     4     9   0   0
       1    246    21   137     2   1   0
       1    819   338     8    15   0   0
       1     62   299    71     6   5   1
       1    944    72   111    16   0   0
       1    318  1420     7    16   3   0
       1   1591   242   355     0   3   0
       1    514   371    41    40   0   0
       1     97   252    91     0   3   0
```

Table 6.3.9. Haddock in VIIa: SURBA-R fitted numbers-at-age, total mortality-at-age, SSB and Z using the NIGFS-WIBTS-Q1 survey data.

Numbers-at-age						Total mortality-at-age				
	Age					**Age**				
Year	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
1992	0.205	0.007	0.001	0	0	0.088	0.113	0.179	0.165	0.165
1993	0.031	0.188	0.006	0.001	0	0.648	0.831	1.319	1.22	1.22
1994	0.322	0.016	0.082	0.002	0	1.066	1.367	2.17	2.007	2.007
1995	4.118	0.111	0.004	0.009	0	0.964	1.235	1.961	1.813	1.813
1996	0.438	1.571	0.032	0.001	0.002	0.665	0.852	1.352	1.251	1.251
1997	10.167	0.225	0.67	0.008	0	1.192	1.528	2.424	2.242	2.242
1998	0.756	3.088	0.049	0.059	0.001	1.141	1.463	2.322	2.147	2.147
1999	3.036	0.241	0.715	0.005	0.007	1.143	1.466	2.326	2.152	2.152
2000	5.615	0.968	0.056	0.07	0.001	1.01	1.295	2.055	1.9	1.9
2001	1.184	2.045	0.265	0.007	0.01	1.059	1.357	2.154	1.992	1.992
2002	7.508	0.411	0.526	0.031	0.001	0.783	1.004	1.594	1.474	1.474
2003	2.266	3.43	0.15	0.107	0.007	0.924	1.185	1.88	1.739	1.739
2004	7.207	0.899	1.049	0.023	0.019	1.06	1.358	2.156	1.994	1.994
2005	10.173	2.498	0.231	0.121	0.003	0.973	1.247	1.979	1.831	1.831
2006	6.905	3.845	0.718	0.032	0.019	0.882	1.131	1.795	1.66	1.66
2007	11.374	2.858	1.241	0.119	0.006	0.927	1.188	1.886	1.744	1.744
2008	3.128	4.502	0.871	0.188	0.021	1.099	1.409	2.237	2.069	2.069
2009	2.455	1.042	1.1	0.093	0.024	1.109	1.422	2.256	2.087	2.087
2010	5.908	0.81	0.251	0.115	0.012	1.095	1.404	2.229	2.061	2.061
2011	5.225	1.976	0.199	0.027	0.015	1.115	1.429	2.269	2.098	2.098
2012	5.077	1.713	0.473	0.021	0.003	1.02	1.308	2.076	1.92	1.92
2013	2.914	1.83	0.463	0.059	0.003	1.077	1.381	2.191	2.026	2.026

Stock summary						
Year	**Recruits (age 1)**	**log SE (rec)**	**SSB**	**TSB**	**Z(2–3)**	**SE (Z)**
1992	0.205	0.003	0.004	0.025	0.146	0.013
1993	0.031	0	0.066	0.092	1.075	0.01
1994	0.322	0.004	0.085	0.117	1.768	0.01
1995	4.118	0.052	0.048	0.421	1.598	0.01
1996	0.438	0.005	0.443	0.642	1.102	0.01
1997	10.167	0.126	0.636	1.409	1.976	0.01
1998	0.756	0.009	0.691	0.96	1.892	0.01
1999	3.036	0.038	0.453	0.659	1.896	0.01
2000	5.615	0.064	0.257	0.596	1.675	0.01
2001	1.184	0.015	0.465	0.649	1.756	0.01
2002	7.508	0.089	0.337	0.798	1.299	0.01
2003	2.266	0.028	0.741	1.083	1.532	0.01
2004	7.207	0.086	0.692	1.062	1.757	0.01
2005	10.173	0.121	0.518	0.964	1.613	0.01
2006	6.905	0.084	0.677	1.06	1.463	0.01
2007	11.374	0.129	0.737	1.258	1.537	0.01
2008	3.128	0.039	0.839	1.144	1.823	0.01
2009	2.455	0.031	0.539	0.701	1.839	0.01
2010	5.908	0.081	0.268	0.553	1.817	0.011
2011	5.225	0.071	0.346	0.671	1.849	0.01
2012	5.077	0.08	0.403	0.751	1.692	0.011
2013	2.914	0.066	0.494	0.736	1.786	0.006

Table 6.3.10. Haddock VIIa: Estimates of biomass and fishing mortality reference levels derived from the fit of three stock–recruit relationships and the yield per recruit F_{MSY} proxies.

Stock name
Had-7a
Sen filename
had-7a.sen
pf, pm
0 0
Number of iterations
1000
Simulate variation in Biological parameters
TRUE
SR relationship constrained
TRUE

Ricker
767/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	1.45	0.46	4629	2523	1.15	0.30	4.04	0.00022	34.25
Mean	1.36	0.55	7784	4833	1.70	0.44	8.15	0.00033	
5%ile	0.44	0.21	1594	1414	0.74	0.07	2.29	5.00E-05	
25%ile	0.72	0.33	2507	2195	1.07	0.24	3.65	0.00018	
50%ile	1.07	0.47	3441	2778	1.42	0.42	5.49	0.00031	
75%ile	1.68	0.65	5575	3732	2.02	0.60	8.96	0.00044	
95%ile	3.36	1.22	17254	8047	3.43	0.93	21.81	0.0007	
CV	0.67	0.62	4.86	5.25	0.61	0.61	1.13	0.61	

Beverton-Holt
813/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	2.80	0.29	7030	2580	0.44	0.80	7964	1111	34.12
Mean	1.15	0.20	58936	9346	0.45	1.31	41130	22121	
5%ile	0.31	0.07	2363	848	0.05	0.63	3484	153	
25%ile	0.51	0.14	4913	1657	0.22	0.89	5903	1014	
50%ile	0.82	0.19	9186	2574	0.38	1.12	9186	2705	
75%ile	1.46	0.25	19246	4389	0.59	1.45	16093	6579	
95%ile	3.15	0.36	129006	17393	1.00	2.31	70557	40158	
CV	0.82	0.43	7.6	8.4	1.27	0.80	11.25	13.45	

Smooth hockeystick
918/1000 Iterations resulted in feasible parameter estimates

	Fcrash	Fmsy	Bmsy	MSY	ADMB Alpha	ADMB Beta	Unscaled Alpha	Unscaled Beta	AIC
Deterministic	0.87	0.41	5359	2661	0.49	0.92	1.27	2727	34.55
Mean	0.90	0.38	10384	3359	0.60	0.99	1.56	2941	
5%ile	0.33	0.14	2439	1534	0.30	0.49	0.78	1439	
25%ile	0.50	0.28	3943	2304	0.43	0.66	1.13	1960	
50%ile	0.69	0.37	5546	3010	0.56	0.95	1.45	2797	
75%ile	1.04	0.47	8645	4073	0.71	1.30	1.85	3830	
95%ile	2.05	0.66	22638	6218	1.06	1.64	2.76	4840	
CV	0.77	0.42	2.44	0.48	0.41	0.38	0.41	0.38	

Per recruit

	F35	F40	F01	Fmax	Bmsypr	MSYpr	Fpa	Flim
Deterministic	0.24	0.20	0.20	0.41	0.77	0.38	0	0
Mean	0.20	0.17	0.18	0.39	1.20	0.39		
5%ile	0.05	0.04	0.05	0.15	0.39	0.28		
25%ile	0.15	0.12	0.14	0.29	0.55	0.34		
50%ile	0.20	0.17	0.19	0.38	0.71	0.38		
75%ile	0.26	0.22	0.23	0.48	0.97	0.44		
95%ile	0.34	0.29	0.29	0.67	2.20	0.55		
CV	0.44	0.43	0.39	0.43	2.06	0.22		

Table 6.3.11. Haddock in VIIa: Input for yield/Recruit.

MFYPR version 2a
Run: Had7a_2004WG_yield
Had7a_2004WG_yieldMFYPR Index file 11/05/2004
Time and date: 10:55 13/05/2004
Fbar age range: 2-4

Age	M	Mat	PF	PM	SWt	Sel	CWt
0	0.2	0	0	0	0.000	0.000	0.000
1	0.2	0	0	0	0.061	0.140	0.322
2	0.2	1	0	0	0.302	0.544	0.492
3	0.2	1	0	0	0.754	1.118	0.967
4	0.2	1	0	0	1.377	1.057	1.814
5	0.2	1	0	0	2.259	1.057	2.308

Weights in kilograms

Table 6.3.12. Haddock in VIIa: Yield per recruit output table.

MFYPR version 2a
Run: Had7a_2004WG_yield
Time and date: 10:55 13/05/2004
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	5.5167	5.8695	3.6979	5.8200	3.6979	5.8200
0.1000	0.0906	0.2211	0.3492	4.4167	3.5229	2.5980	3.4733	2.5980	3.4733
0.2000	0.1813	0.3298	0.4658	3.8781	2.4296	2.0593	2.3801	2.0593	2.3801
0.3000	0.2719	0.3951	0.5037	3.5564	1.8139	1.7377	1.7644	1.7377	1.7644
0.4000	0.3626	0.4390	0.5098	3.3412	1.4279	1.5225	1.3783	1.5225	1.3783
0.5000	0.4532	0.4709	0.5022	3.1861	1.1681	1.3674	1.1186	1.3674	1.1186
0.6000	0.5439	0.4952	0.4888	3.0683	0.9843	1.2496	0.9347	1.2496	0.9347
0.7000	0.6345	0.5146	0.4735	2.9752	0.8490	1.1564	0.7995	1.1564	0.7995
0.8000	0.7252	0.5305	0.4580	2.8993	0.7464	1.0805	0.6969	1.0805	0.6969
0.9000	0.8158	0.5438	0.4431	2.8358	0.6666	1.0171	0.6170	1.0171	0.6170
1.0000	0.9065	0.5552	0.4293	2.7818	0.6030	0.9631	0.5535	0.9631	0.5535
1.1000	0.9971	0.5651	0.4167	2.7350	0.5515	0.9163	0.5019	0.9163	0.5019
1.2000	1.0878	0.5739	0.4052	2.6939	0.5090	0.8751	0.4594	0.8751	0.4594
1.3000	1.1784	0.5817	0.3947	2.6573	0.4733	0.8386	0.4238	0.8386	0.4238
1.4000	1.2691	0.5887	0.3853	2.6245	0.4431	0.8057	0.3936	0.8057	0.3936
1.5000	1.3597	0.5951	0.3768	2.5947	0.4172	0.7760	0.3676	0.7760	0.3676
1.6000	1.4503	0.6009	0.3692	2.5676	0.3946	0.7489	0.3451	0.7489	0.3451
1.7000	1.5410	0.6063	0.3622	2.5427	0.3749	0.7240	0.3253	0.7240	0.3253
1.8000	1.6316	0.6113	0.3559	2.5197	0.3574	0.7010	0.3079	0.7010	0.3079
1.9000	1.7223	0.6159	0.3501	2.4983	0.3418	0.6796	0.2923	0.6796	0.2923
2.0000	1.8129	0.6202	0.3449	2.4784	0.3278	0.6597	0.2783	0.6597	0.2783

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.9065
FMax	0.3811	0.3455
F0.1	0.2074	0.188
F35%SPR	0.2494	0.2261

Weights in kilograms

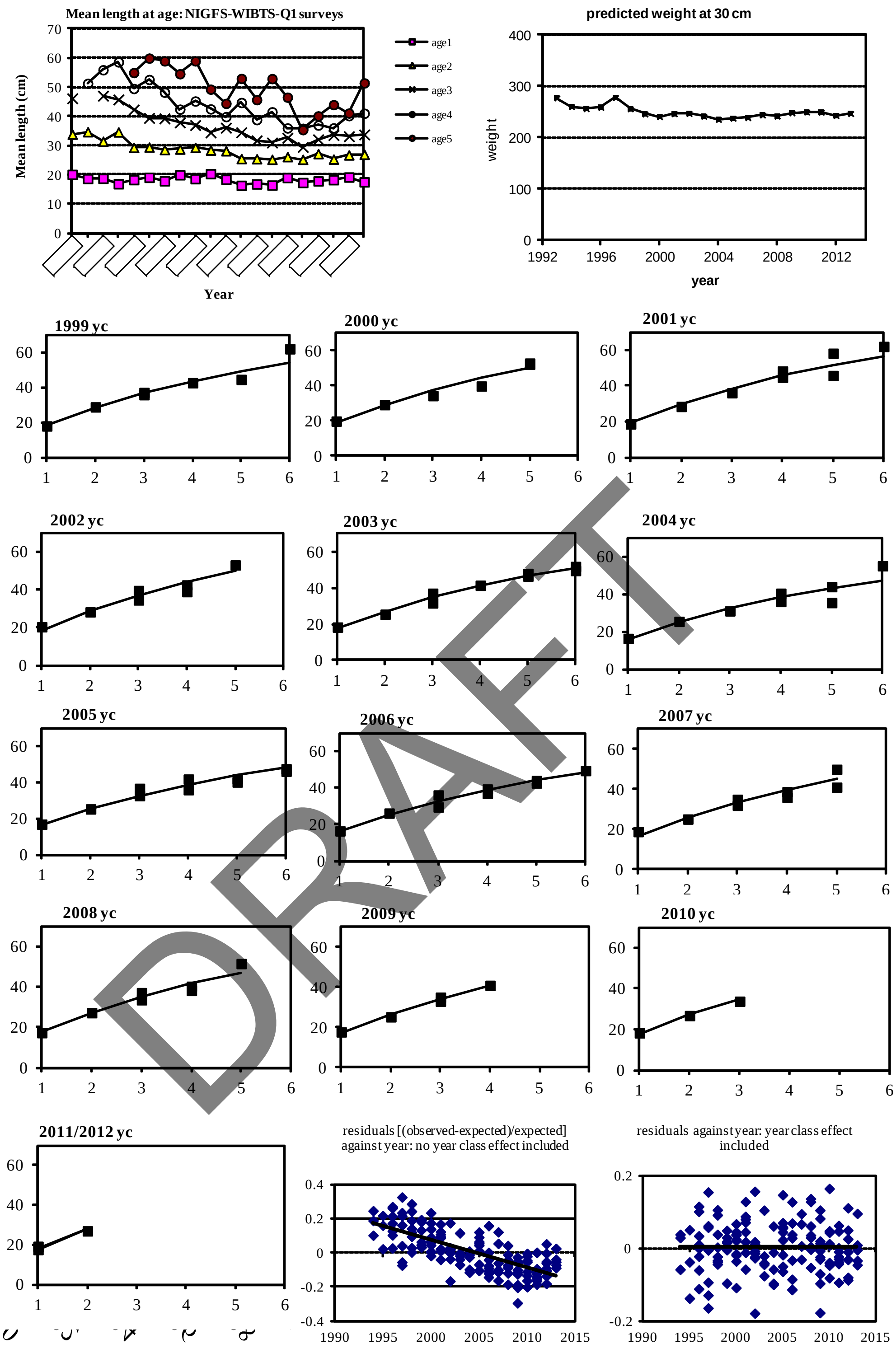


Figure 6.3.1. Haddock in VIIa: Growth of haddock in the Irish Sea. Top two panels: mean length-at-age in UK(NI) groundfish surveys in March (NIGFS-WIBTS-Q1), by year and age, and expected mean weight-at-length based on length–weight parameters from each survey. Lower panels: mean length-at-age from March surveys, and from Quarter 1 commercial landings at age 3 and over, by year class. Lines are von Bertalanffy model fits with year-class effect included. Model residuals are shown for the fit without year-class effects, and for the fit with year class effects.

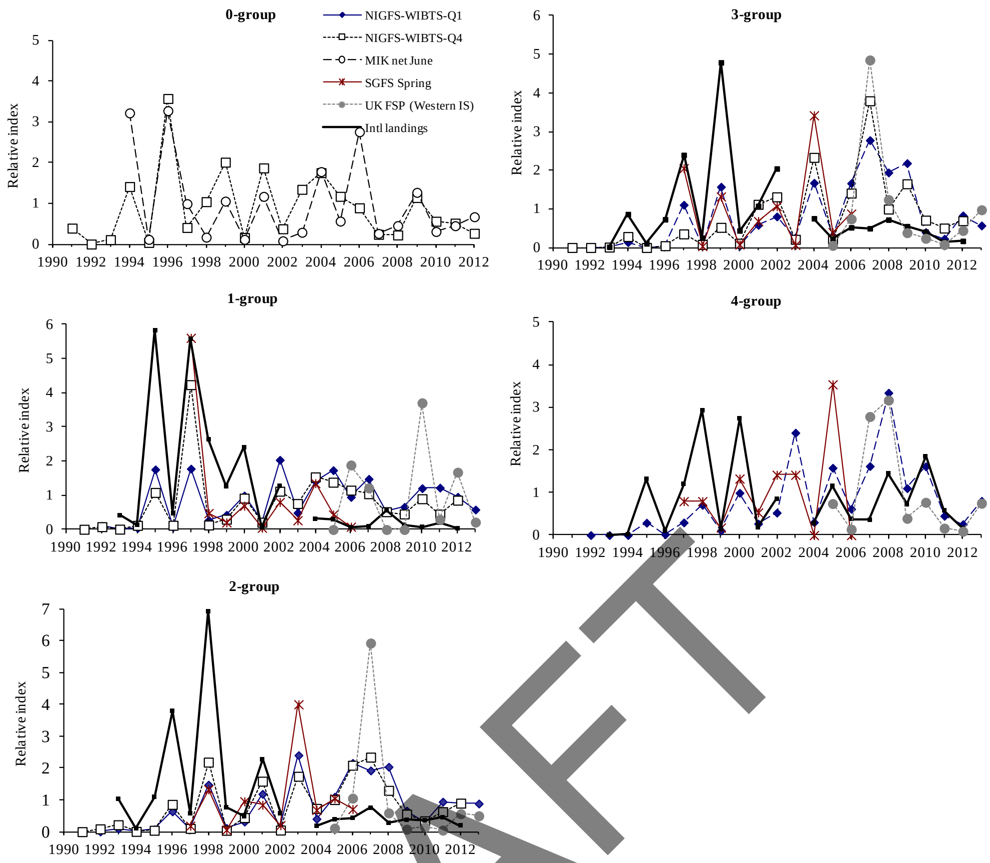


Figure 6.3.2. Haddock in VIIa: Trends in raw survey indices compared with international landings, by age class and year. All values are standardised to the mean for years common to all series in each plot (except for short FSP series).

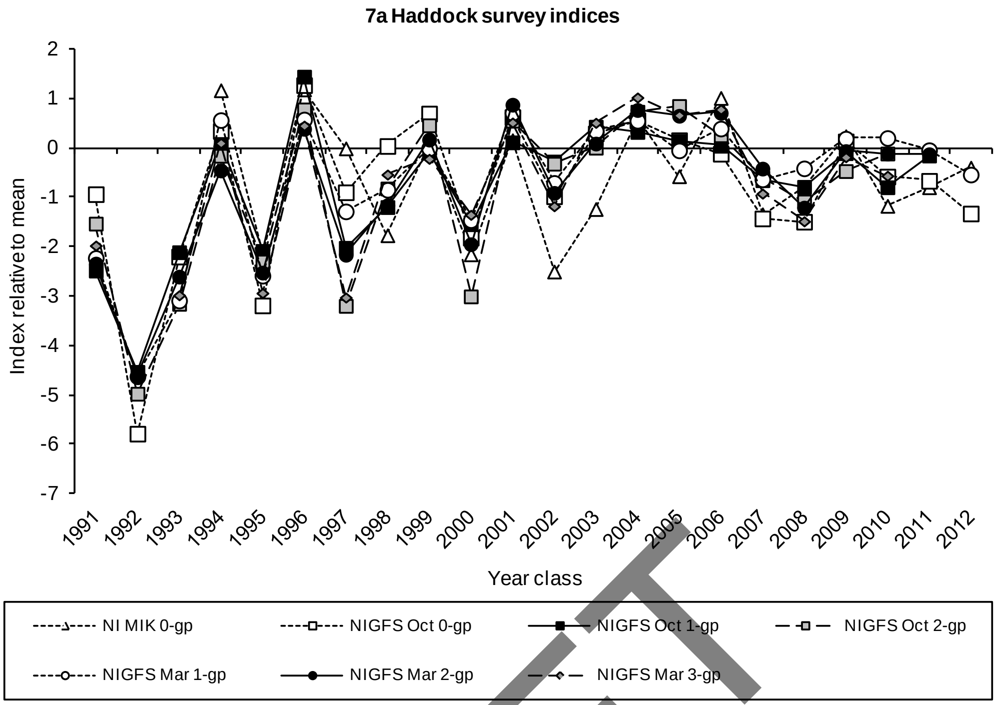


Figure 6.3.3. Haddock in VIIa: Time-series plots of the logarithms of survey indices at age by year class, after standardising by dividing by the series mean for years from 1991. Data have only been illustrated for the most abundant ages for comparison of year-class signals.

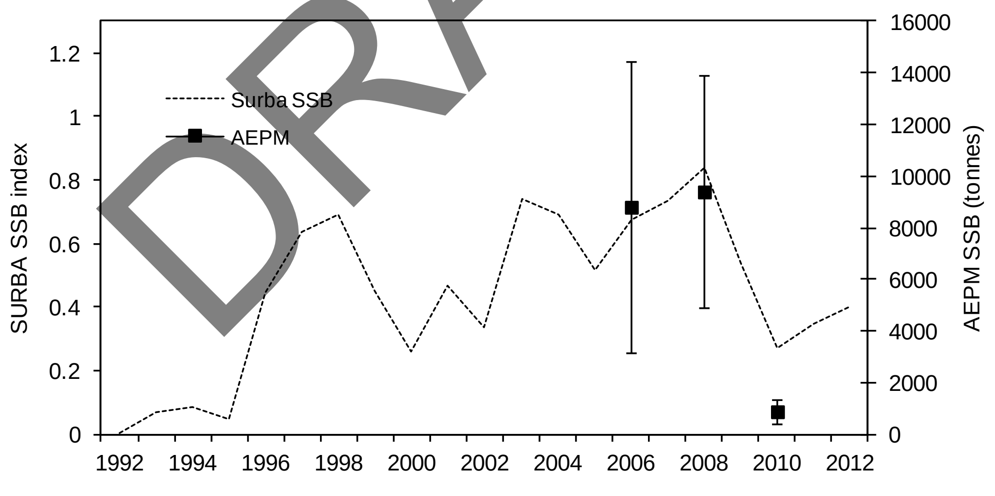


Figure 6.3.4. Haddock in VIIa: Comparison in the relative trends of SSB form 2013 SURBA run and the Irish Sea annual egg production method survey estimates of SSB (+ 2 SE).

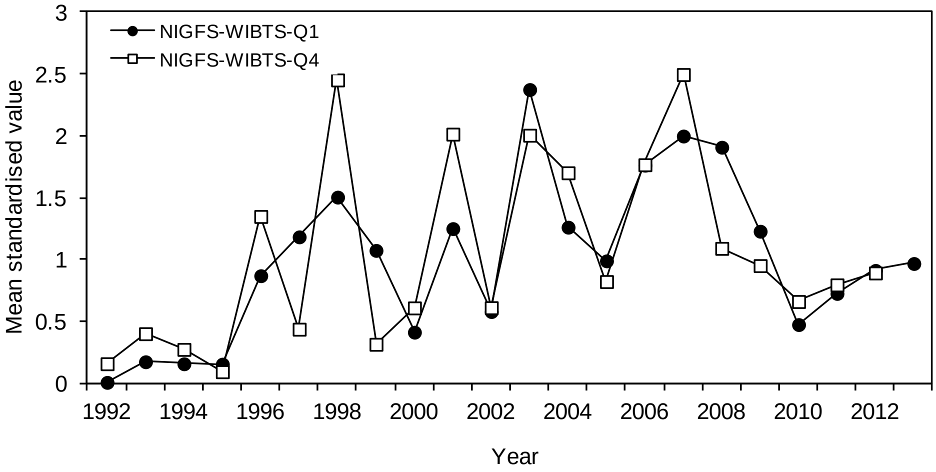


Figure 6.3.5. Haddock in VIIa: Mean Standardised empirical SSB indices from the NIGFS-WIBTS-Q1 and NIGFS- WIBTS-Q4 surveys, based on raw indices up to age 6.

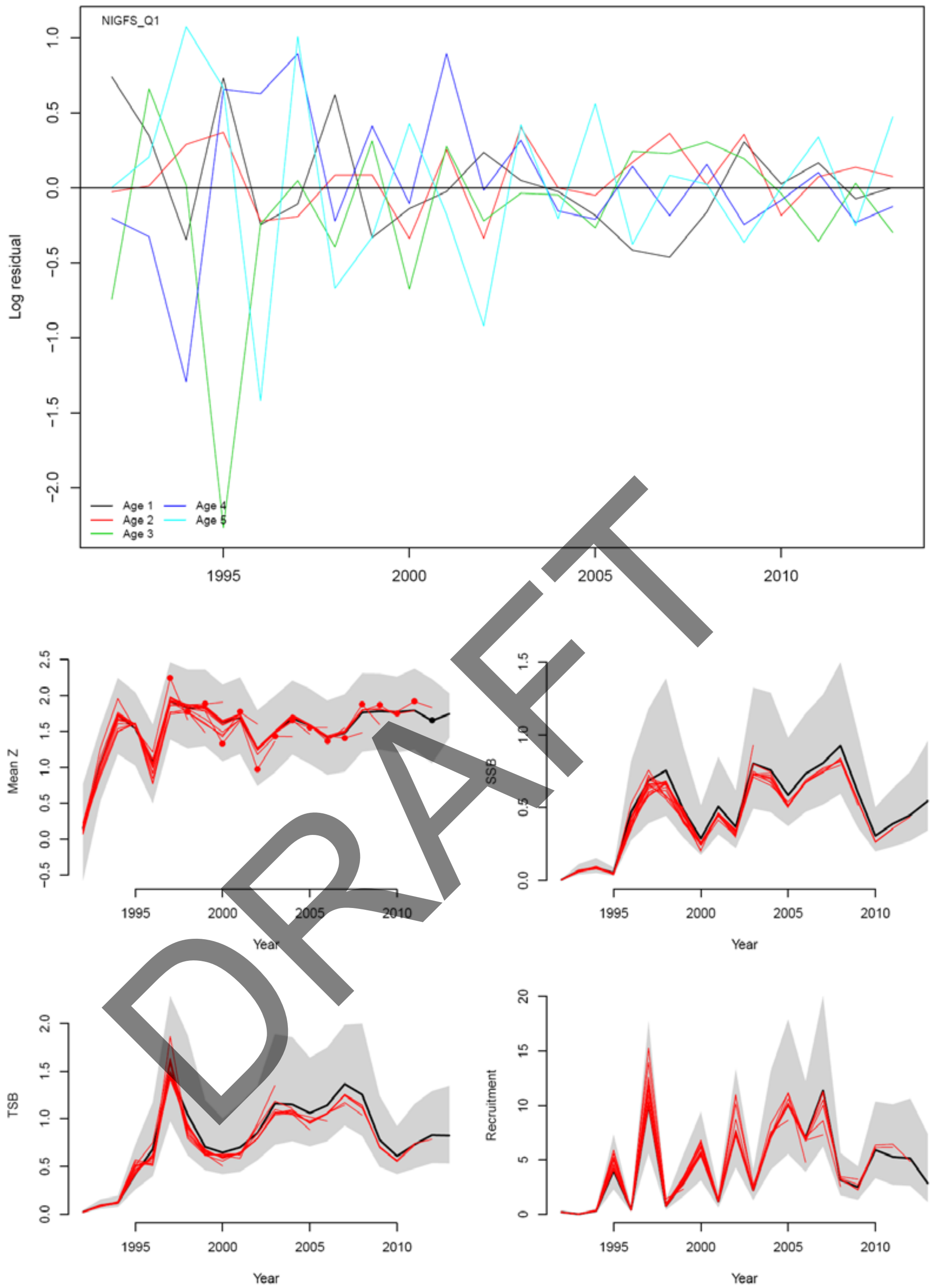


Figure 6.3.6. Haddock VIIa: SURBA-R Residuals at age (top panel) and retrospective plots (bottom panel) for the NIGFS-WIBTS-Q1 survey.

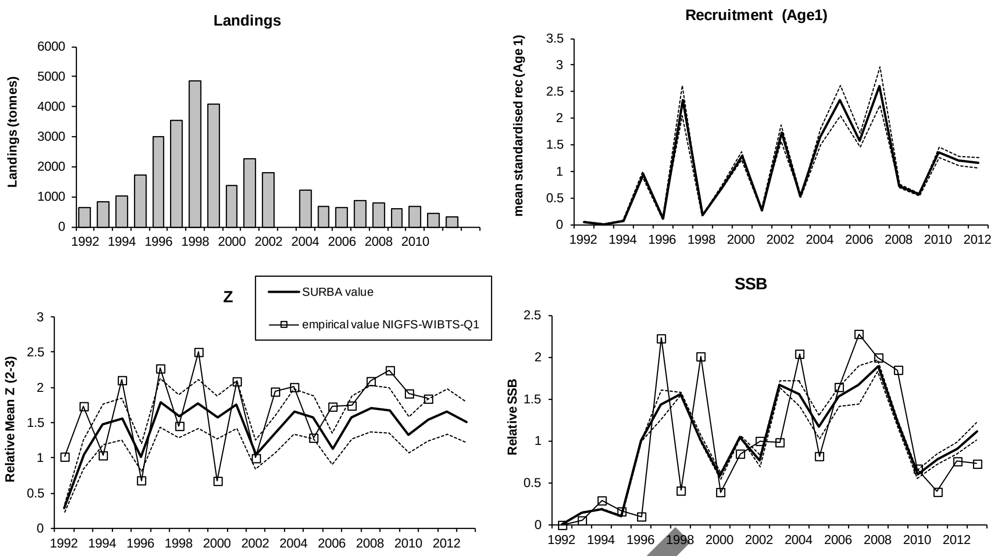


Figure 6.3.7. Haddock VIIa: Summary plots of landings and results of final SURBA-R run using the NIGFS-WIBTS-Q1 survey data. Dotted lines are +/- 1SE. Empirical estimates of SSB and Z given by SURBA from the raw survey data are also shown.

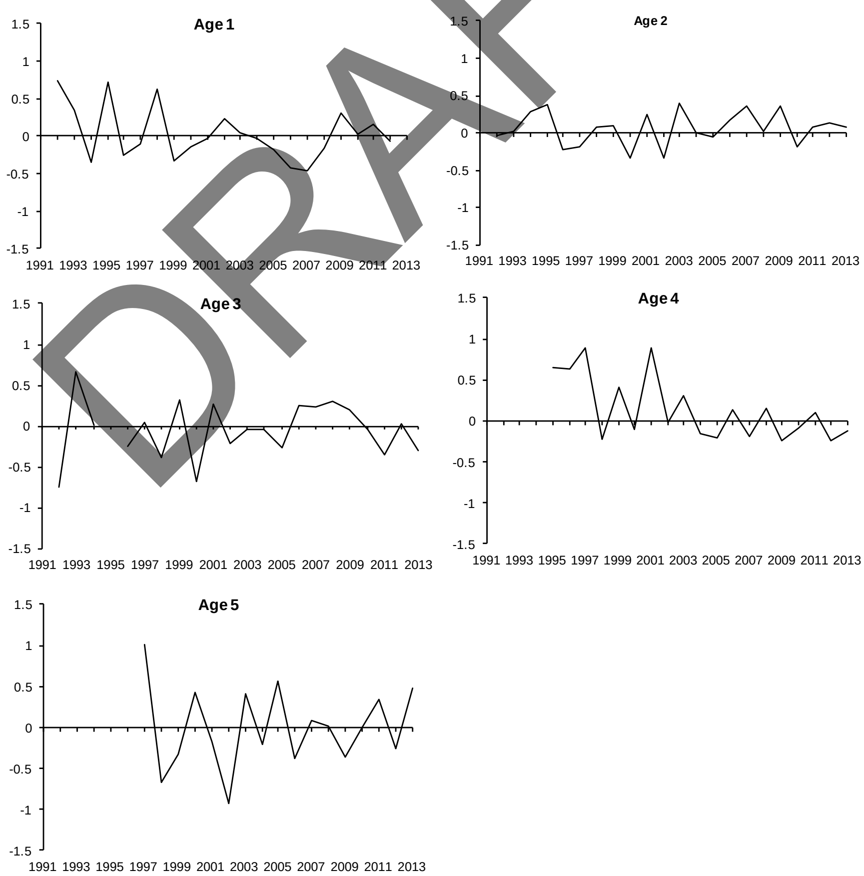


Figure 6.3.8. Haddock VIIa: SURBA-R Residuals at age for final run using the NIGFS-WIBTS-Q1 survey data.

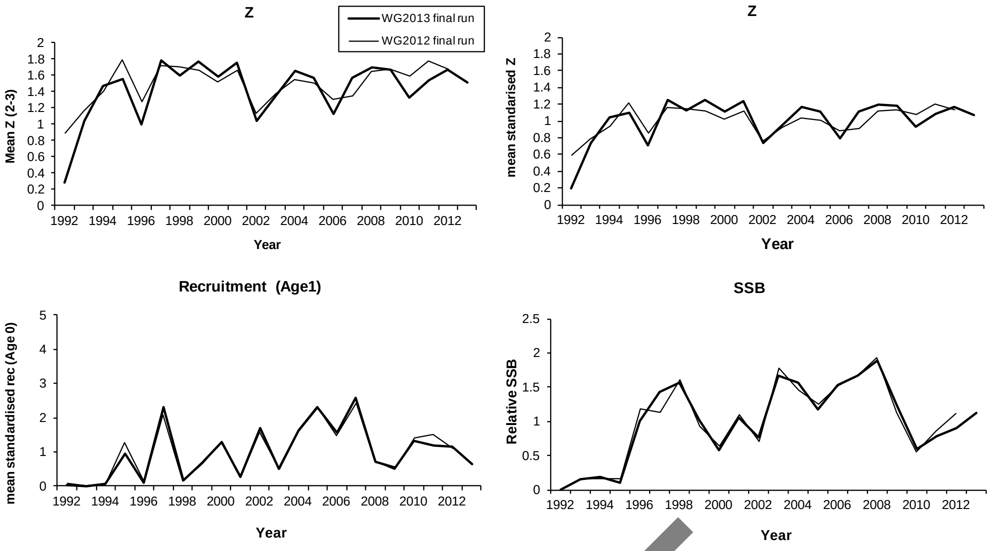


Figure 6.3.9. Haddock VIIa: Trends in SSB, recruitment and Z(2–3) from the 2012 and 2013 SURBA. SSB and recruitment are standardised to the mean for years common to all series (1992–2012) in each plot.

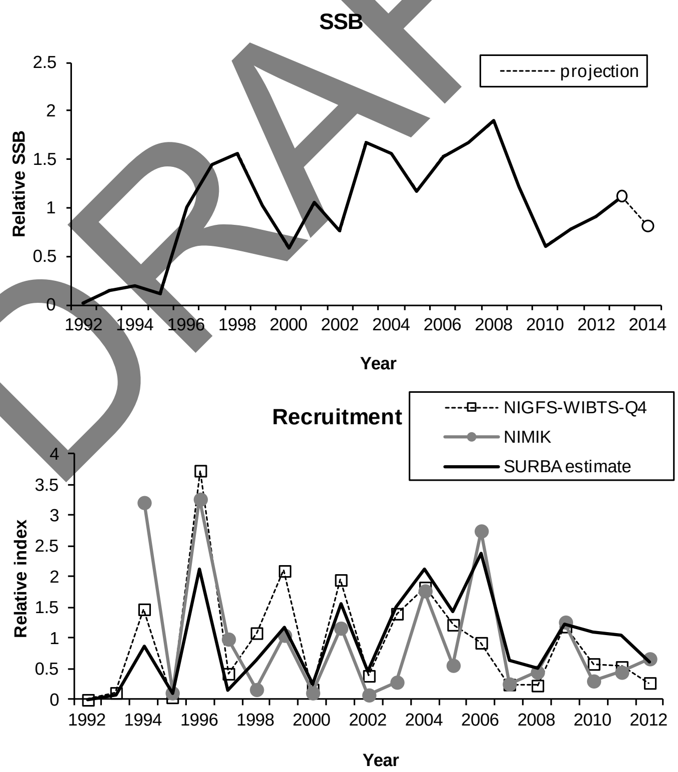


Figure 6.3.10. Haddock VIIa: Trend in SSB form 2013 SURBA projected to 2014 compared to the Irish Sea annual egg production method survey estimates of SSB (+ 2 SE) (top panel) and SURBA estimate of recruitment compared to available 0-gp indices (bottom panel). SSB and recruitment are standardised to the mean for years common to all series (1994–2013) in each plot.

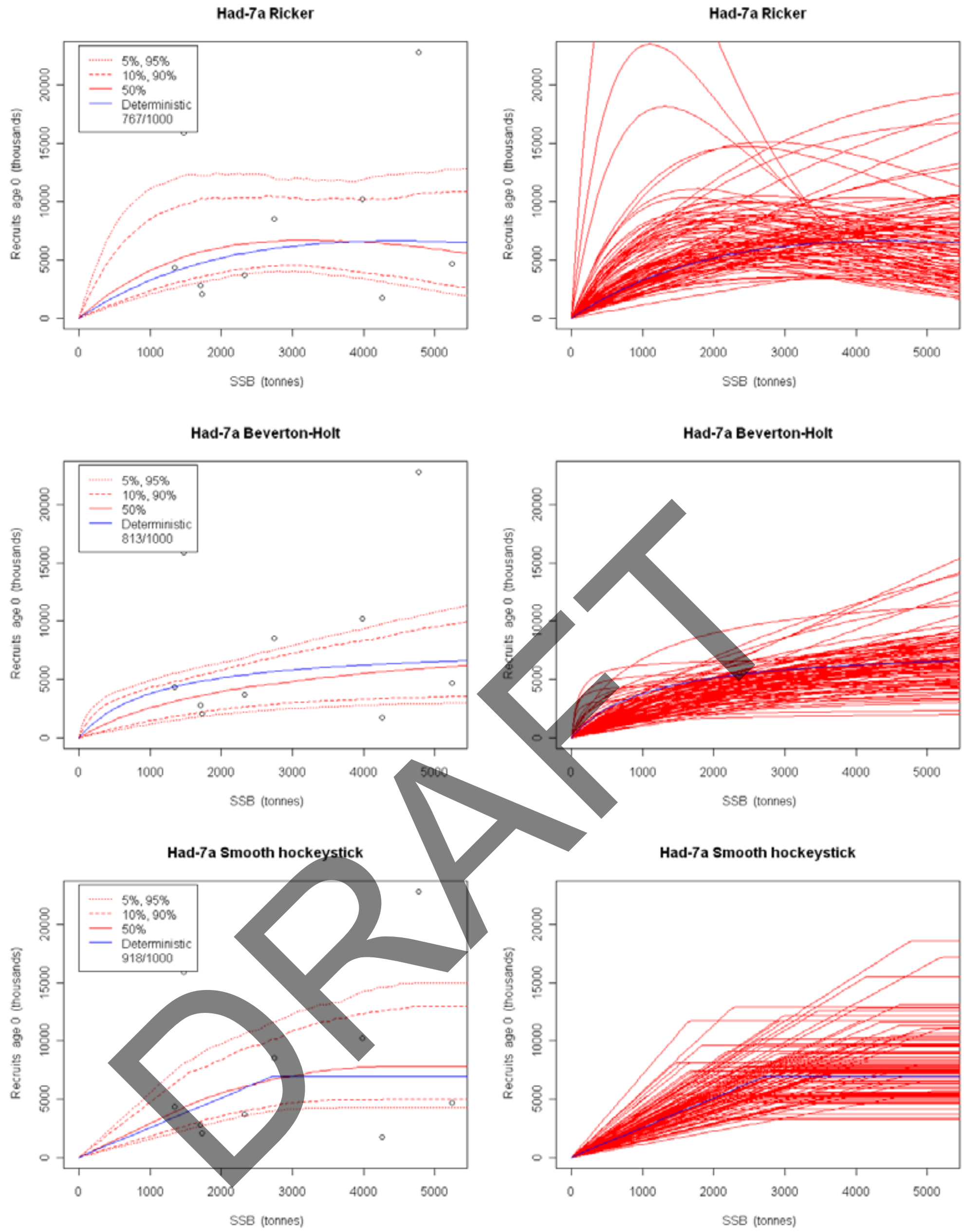


Figure 6.3.10. Haddock VIIa: MSY fitted stock and recruitment relationships. Left hand panels: blue line indicates the deterministic estimate; red line median and percentiles of curves with converged estimates of F_{MSY}. Right hand panels: curves plotted from the first 100 MCMC re-samples with converged F_{MSY} estimates. The legends for each recruitment model show the number of converged values of F_{MSY} from the 1000 re-samples.

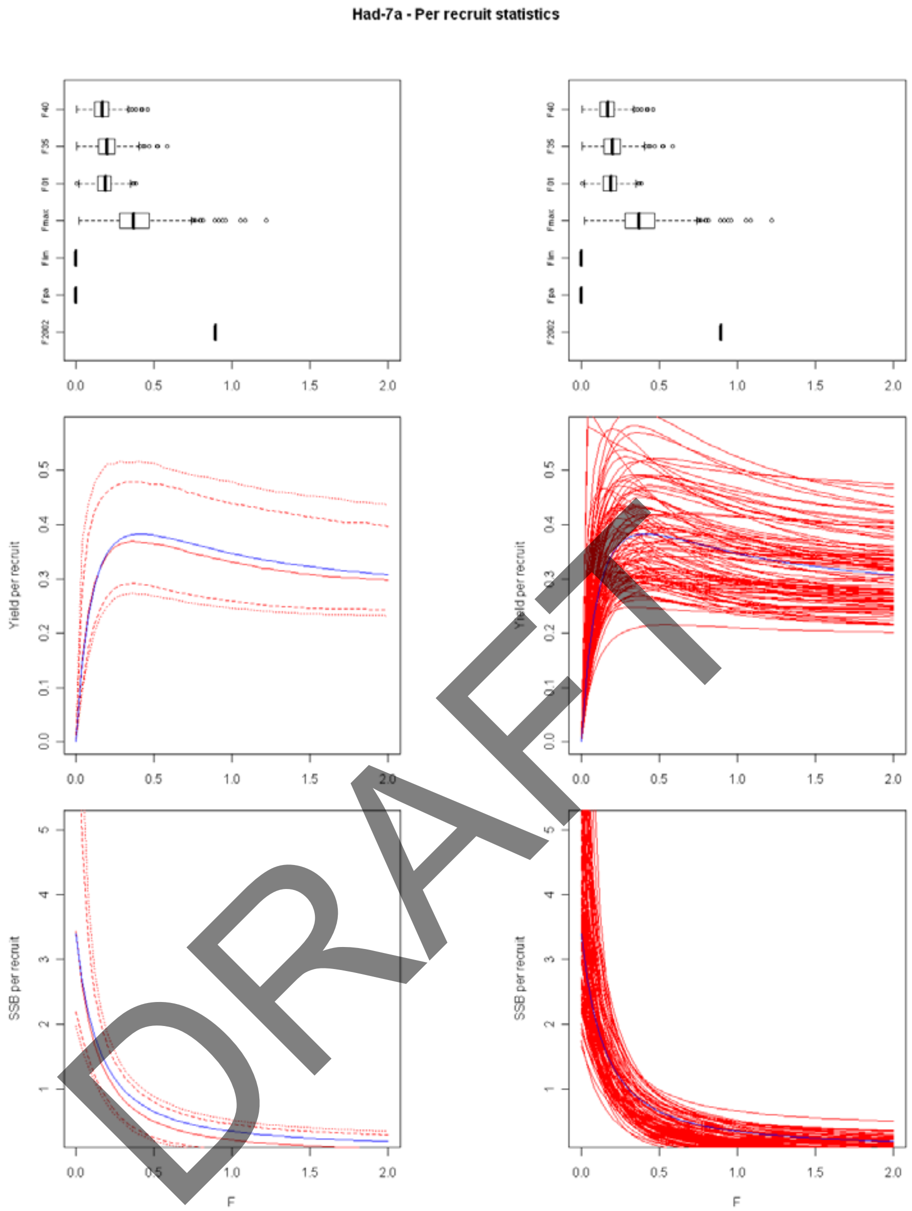
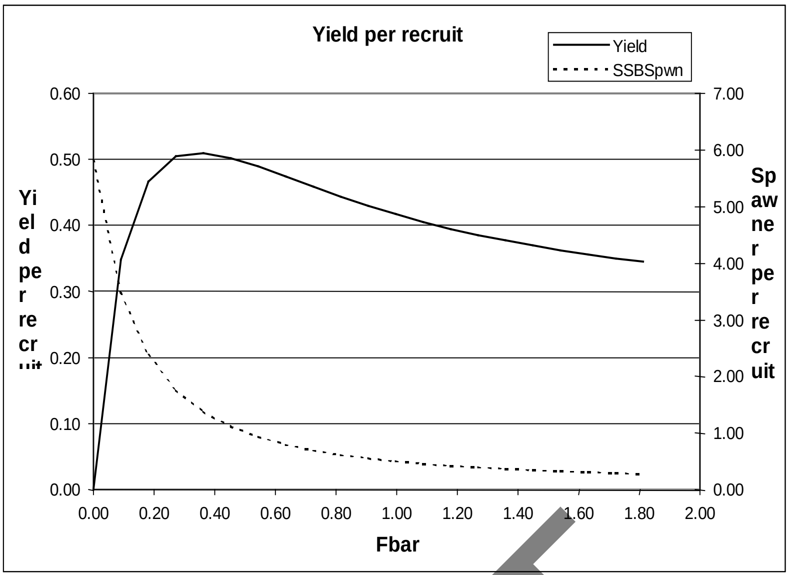


Figure 6.3.11. Haddock VIIa: Fitted yield per recruit F reference points, yield per recruit and SSB per recruit against fishing mortality with confidence intervals estimated by parametric re-sampling of the selection, weight-at-age, natural mortality and maturity estimates and their c.v. Left hand panels: blue line indicates the deterministic estimate, red lines the median and percentiles. Right hand panels: the first 100 re-samples.



MFYPR version 2a
Run: Had7a_2004WG_yield
Time and date: 10:55 13/05/2004

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.9065
FMax	0.3811	0.3455
F0.1	0.2074	0.1880
F35%SPR	0.2494	0.2261

Weights in kilograms

Figure 6.3.12. Haddock VIIa: Yield per recruit based on analysis carried out in 2004.

6.4 *Nephrops* in Division VIIa (Irish Sea East, FU14)

Type of assessment in 2013

UWTV survey data are used to calculate a fishery independent absolute abundance estimate for 2012 and catch options following the process defined by WKNEPH (2009). Also an update of trends in total landings, lpue, size composition, and biological data from the commercial fisheries is given for this FU. The stock annex was also updated for this stock.

The 2012 RG report contained minor technical comments and attempts have been made to address these in the present report.

ICES advice applicable to 2012

The advice was for using the MSY approach which implies the harvest ratio for the east Irish sea FU to be less than 9.8%, resulting in landings of less than 960 t in 2012.

ICES advice applicable to 2013

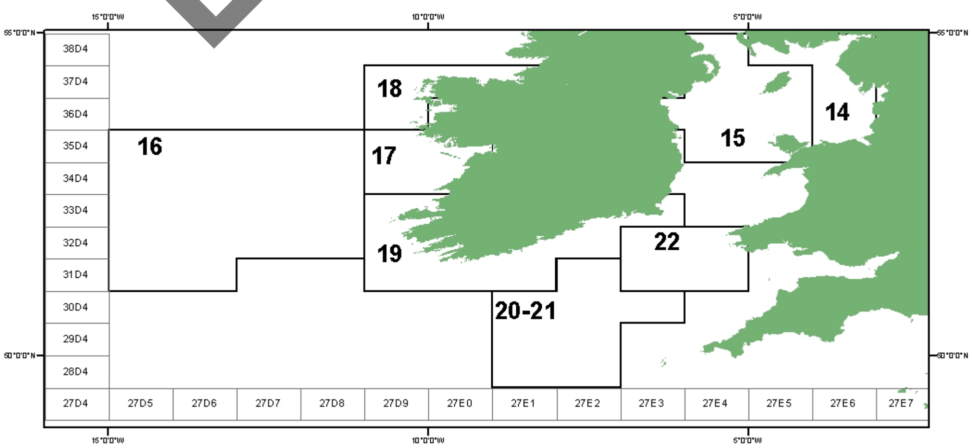
Following the ICES MSY approach implies the harvest ratio to be no more than 9.8%, resulting in landings of 880 t.

6.4.1 General

Stock description and management units

The Irish Sea East *Nephrops* stock (FU14) is in ICES Subarea VII which includes the Irish Sea West (FU15) stock; the Porcupine Bank (FU16); Aran Grounds (FU17); northwest Irish Coast (FU18), southeast and southwest Irish Coast (FU19); and the Labadie, Jones and Cockburn bank (FU20–21) and Smalls Ground (FU22). The TAC is set for the whole of Subarea VII which does not correspond to the areas occupied by these stocks.

Nephrops Functional Units in Subarea VII:



Management applicable in 2012 and 2013

The TAC is currently set for the whole Area VII. The TAC for 2013 was 23 065 t, a 5.7% increase on the 21 759 quota for 2011. The TAC area includes a number of *Nephrops* stocks showing different levels of exploitation. A single TAC covering a number of distinct stocks allows the possibility of unrestricted catches being taken from a heavily exploited stock when advice suggests they should be limited.

Details of all regulations including effort controls in place are provided in the stock annex.

The fishery

Between 1999 and 2003 the number of vessels fishing for *Nephrops* in FU14 declined by 40% to a fleet of around 50 vessels. This was largely due to the reduction in the number of visiting UK vessels and the decommissioning of part of the Northern Ireland and local English fleets. Since then, the number of vessels fishing the area has returned to and settled at around 70 vessels over the last four years mainly from Northern Ireland. Currently, just under 30 of these vessels, between 9 and 21 m in length, have their 'home' ports in Whitehaven, Maryport and Fleetwood, England. The rest of the fleet is generally made up of larger vessels from Northern Ireland, where the main port of landings is Kilkeel.

In 2012 the main fleets targeting *Nephrops* include directed single-rig and twin-rig otter trawlers operating out of ports in UK (NI), UK (E&W) and Ireland.

Whitehaven (England) has always been the main fishing port, contributing usually in between 70% to 80% of the total landings (1999–2009), but in these last two years landings have dropped in this port to 60% in 2010 and 58% in 2011. Parallel the two second main ports, Kilkeel (Northern Ireland) and Maryport (England), had an increase in the landings for 2010 and 2011. This shift has been mainly created by the Northern Ireland vessels that for 2010 and 2011 have landed around 43% in Kilkeel. Fleetwood, that usually accounted with an average of 10% of the landings in the past ten years, in 2011 drop to less than 1%. Over half of the Northern Irish and a few of the English vessels use twin trawls and between 2006 and 2012 these account for 30% to 40% of the *Nephrops* landings. The Northern Irish twin riggers can extend their trips to multiday trips (up to four days at sea). Local single rig vessels are restricted to day trips being very much controlled by weather and tides.

During the years 2010 and 2011, the Walney (UK) Offshore Windfarms Ltd. has constructed the Walney 1 and Walney 2 offshore wind farms, located approximately 15 km off Walney Island, Cumbria, in the Irish Sea (Figure 6.4.6.). Those started operating at the beginning of 2012, these two offshore wind farms were the world's largest offshore wind farms ever installed with a total capacity of 367.2 MW. The wind farm location site covers an area of what is acknowledged to be extremely good trawling ground for both *Nephrops* and whitefish. In the past this area has been fished by vessels from Fleetwood, Cumbrian ports and Northern Ireland, but during the windfarm construction this area was interdicted to fishing. Nowadays, there is an exclusion zone around each wind turbine, but fishing is now allowed in the overall area.

The next years will be crucial to understand how fishermen will work this ground and evaluate the financial impact of the windfarms in the *Nephrops* fishery in the eastern Irish Sea. VMS activity will be monitored to evaluate the total fishing ground being used. If changes occur this will imply modifications to the total area used in the geo-statistical model to estimate the total abundance of *Nephrops* in this ground.

6.4.2 Data available

In 2012 the UWTV *Nephrops* survey for the eastern Irish Sea was successfully completed providing abundance estimates for 2012. The time-series of abundance estimates goes from 2007 to 2012.

Landings and lpue series were updated by country.

Biological sampling levels were considered insufficient to derive catch and discard length frequencies for this year. As a result none of the length derived metrics have been up-dated for 2012.

InterCatch

Data for 2012 were successfully uploaded into InterCatch prior the 2013 WG meeting. Uploaded data was worked-up in InterCatch to generate 2012 raised international length–frequency distributions, although it was considered insufficient to derive catch and discard length frequencies for 2012.

Landings

Official landings as reported to ICES from FU14 are presented in Table 6.4.1 and were updated for 2012 data.

Historically there are reported landings since 1973 for this functional unit with a minimum and maximum of 178.7 t (in 1974) and 960.5 t (in 1978), respectively. Between 1987 and 2006 landings from FU14 appeared relatively stable fluctuating around a long-term average of about 550 t (Figure 6.4.1 and Table 6.4.1). Landings in 2012 (530 t) were 5.5% down on the 2011 level and around 45% down on the peak of 2007 (959 t). The introduction of the buyers and sellers legislation in 2006 by the UK precludes direct comparison with previous years as reported levels are considered to have significantly improved.

Over the last ten years (2003–2012) UK vessels have landed, on average, 92% of the reported annual international landings. Irish vessels increased their share of the landings to 35% in 2002 but it has declined since then. In 2012 the Republic of Ireland fleet accounted for 10% of the total landings (Table 6.4.2).

Length composition

Not updated in 2012 due to insufficient sampling levels.

Quarterly length compositions of landings, catch and discards were available from the UK England and Wales for most of the period 1992–2009. In 2010 the *Nephrops* catch sampling programme crashed and no samples of length were provided and only five samples were made as part of the English discard observer programme for this year. In 2011 there was an attempt to reinstate the *Nephrops* catch sampling programme but it wasn't very successful. This sampling programme was usually completed with the cooperation of the North Eastern Sea Fisheries Committee but due to transition to NW Inshore Fisheries and Conservation Authority (IFCA) in 2011 the entire financial system changed making difficult the payment to skippers. Thus, for 2011 only two samples were collected from this catch sampling programme. Also the collection of these samples was very restricted to weather conditions and the operation of the patrol vessel that faced severe technical problems over the past years. Efforts have been made in 2012 to re-establish the sampling programme and also one discard observer is now covering this part of the coast. Five catch samples were collected in 2012. Next year more people and financial support will be directed to this area and sampling intensity will be expected to increase.

Since 2009 sampling was considered insufficient to derive catch and discard length frequencies. As a result none of the length derived metrics have been updated for the last three years.

Historical trends in length distributions are shown in Figure 6.4.5. Discard rates (Table 6.4.7) have been estimated from the same figures and have declined in the terminal six years from 24% to 4% of total catch by weight and 43% and 8% by number. Females generally have a higher discard rate because they are generally smaller. The sharp decline in the discard rate from 2008 to 2009 particularly for males might suggest a change in discard practice but the shift to the right for the catch distribution in 2009 and the minimum observed size suggests something else. This could be partly a sampling artefact. Only ten observer trips were carried out in 2009, around a third of the number carried out in 2008. These observer trips have been the only source for catch and discard data in recent years. The landings were still well sampled so these concerns are only limited to defining the discarded component of the catch in 2009.

A summary of the historical mean size information is provided in Table 6.4.5. The mean sizes in the catch and landings appear relatively stable. The mean size in the landings remains relatively stable. Due to poor sampling mean size in the landings as not been updated since 2009. The increasing lpue of the <35 mm CL categories and decline in mean size of the landings (Figures 6.4.1 and 6.4.3) and the increase in the range of sizes in the catch (Figure 6.4.5) up to 2007 could be indicative of good recruitment. This is supported by the local enforcement agency who noted an increase in the proportion of tails landed in 2007. In 2009 the same agency remarked on improved catches of good sized prawns and better fishing than had been seen for some time.

Commercial cpue

A 10% TAC increase in 2006 followed by a 17% increase in 2007 coupled with the implementation in the UK of buyers and sellers regulations effective from and throughout 2006, has improved the accuracy of reported landings information. This appears to have reduced the reasons to misreport, despite the declines in TAC from 2009 to 2011 in Area VII the legislation provides the quality control. The introduction of the buyers and sellers legislation for 2006 complicates the interpretation of any prior trends. Landings do not appear to have exceeded the advised TAC for this Functional Unit. UK *Nephrops* directed effort fluctuated around a downward trend starting in 1978 (Figure 6.4.1.). After a period of relative stability between 2002 and 2007 effort started declining, to the lowest value 2011 since 1974. Quarterly effort plots show a predominance of effort in the 2nd and 3rd quarters (Figure 6.4.2).

The UK lpue series is based on a combination of directed *Nephrops* voyages by English and Welsh (E&W) vessels landing to Fleetwood and Whitehaven, where the mesh size is 70–99 mm and where the weight of *Nephrops* landed is more than 25% of the total landing; and all trips by visiting Northern Irish (NI) vessels which target *Nephrops* (Table 6.4.4). The lpue trends of the E&W fleet compared to the NI fleet are broadly similar in their inter-annual trends although there are several step-changes in absolute level (Figure 6.4.1). There is little correspondence between the lpue of the Republic of Ireland vessels and the UK (Table 6.4.4) except that the Northern Irish vessels are now reporting lpues at generally the same level as the Republic of Ireland vessels.

Lpue between gear-types for targeted trips (Figure 6.4.4) also shows divergence in the trends. English twin trawls underwent a gradual decline in lpue between 1997 and 2006 before rising sharply whilst the single trawls fluctuated without trend. Northern Irish lpues were similar in magnitude between 1994 and 2003 and have recently diverged. Northern Irish lpue is generally higher than English lpue. The step change in lpue around the time of the introduction of buyers and sellers legislation in 2006 is considered to be driven by a change in reporting levels more than a change in biological productivity (Figure 6.4.1).

Historically, male *Nephrops* have predominated in the landings and the annual proportion of females appears highly dependent on the fishing effort in the third quarter (Figure 6.4.2) but due to the low sampling levels in 2010, 2011 and 2012 these data have not been updated. Lpues for males and females <35 mm CL (Figure 6.4.3) appear to exhibit the same general trends. Minima in 2003 were followed by upward trends to the highest values in both series in 2007. They have both since declined but still remain above any other values in the series. The lpue of the larger males (>35 mm, the length beyond which the effects of recruitment pulses and discarding are considered to be negligible) has been increasing since 2002 and continues to rise. The quarterly pattern of availability to the fishery of females >35 mm, means that meaningful statistics for this portion of the population are highly dependent upon the level of fishing and the sampling effort deployed in the 3rd quarter.

Surveys

In August of 2007–2012 the UK and the Republic of Ireland carries out an underwater TV survey of the *Nephrops* grounds in the eastern Irish Sea. The survey is of a fixed grid design and is carried out using the same protocols used in UWTV surveys in the western Irish Sea. This survey was not reviewed at WKNEPH 2009 or at WKNEPH 2013 but the protocols and standardised process has been adopted (see updated stock annex). The survey area is shown in Figure 6.4.6 giving the survey stations. The boundary used to define the ground limits for absolute abundance runs close to the outer survey stations.

As described in previous reports, the limited number of stations available on the 2007 survey and the poor quality of the data processed preclude its use in formal assessment. The subsequent surveys were far more successful. A new camera and sledge improved the resolution of the footage captured and the sea conditions were far better so the quality of the video data collected was much improved, thus the valid surveys dataseries started in 2008.

Due to the construction of the Walney Offshore wind farm in the southern part of the ground, in 2010 and 2011 some stations were abandoned. VMS data indicated vessels were avoiding that part of the ground while the wind farm was in construction and fishing was not allowed around the construction side. In 2012 most of the southern stations were surveyed.

In 2011 three new exploratory stations were added (Figure 6.4.6.) due to some VMS activity in that part of the ground. Although, those stations were very close to zero burrows counts and were not included in the calculations of the main area abundance.

In 2012 another station was added in the eastern part of the ground, but no *Nephrops* burrows were observed in this station.

6.4.3 Data analyses

Exploratory analyses of survey data

The use of the UWTV surveys for the provision of *Nephrops* management advice was extensively reviewed by WKNEPH (2009). A number of potential factors were highlighted including those due to edge effects; species burrow misidentification and burrow occupancy. Using the same process adopted at WKNEPH, a cumulative absolute conversion factor for this FU was predicted to be 1.2 for FU14 (see stock annex) which means the TV survey is likely to overestimate *Nephrops* abundance by 20%. The burrow abundances shown in Table 6.4.6 and Figure 6.4.7 have been adjusted using this conversion factor since 2008.

Time period	Edge effect	Detection rate	Species identification	Occupancy	Cumulative Absolute Conversion Factor
<= 2012	1.3	0.75	1.15	1	1.2

Since the WG 2011 the TV abundance estimate is calculated using a geostatistical approach (see stock annex), as opposed to the approach used before which calculated the mean density of non-zero counts which was raised to the total fished area. The former approach ignored the spatial distribution of the counts and was highly sensitive to the total area used for raising. The geostatistical procedure takes the spatial position of the burrow density estimates and fits a semi-variogram model to describe the how variance changes with distance. The results of this model are then used in a Krigging process to produce a 3D surface of burrow density on a 500 m*500 m grid, bounded by a polygon defined by the outermost survey stations. The area within the polygon is 1032.75 km^2. Additionally the Wigtown Bay area (small ground on the top of the grid, see Figure 6.4.6) is included. The Wigtown Bay area is 1.9% of the area of the main patch, so the survey abundance number is simply inflated by that proportion. This will provide a most accurate unbiased estimate. Uncertainty estimation of the overall abundance estimate is performed by bootstrapping the counts (resampling with replacement), re-fitting the semi-variogram and re-estimating the surface.

The algorithm used to determine the distance towed on each station changed in the WG of 2011. In 2012 there was an historical revision of burrow density estimates from the TV survey (2008–2011 series) (see stock annex).

The surveys show a clear spatial distribution pattern, with highest densities in the central north of the patch and variable in the area further south. The grounds are fairly well delineated by consistently low density ground to the northeast and west (Figure 6.4.7). After some reasonable stable years, in 2012, the *Nephrops* abundance increased to 652.7 million, by 51% compared with the 2011 abundance (431 million). However, the confidence intervals are high and there is an overlap of the confidence intervals of 2011 and 2012 (Table 6.4.6.). In the 2012 the highest density is distributed in the central part of the ground. The time-series of abundance estimates is too short for any meaningful comparison with lpue trends.

From the work presented at the 2012 SGNEPS meeting (ICES, 2012) it was decided by the group that a CV (relative standard error) of <20% was an acceptable precision level for UWTV survey estimates of abundance. CV calculated for 2012 was of 9.8% and therefore lower than the precision level agreed.

Short-term projections

A landings prediction for 2014 was made for FU14 using the approach agreed at the benchmark workshop (WKNEPH, 2009). Due to the poor sampling levels in 2010–2012 (and to a lesser extent 2009) the Length Cohort Analysis (LCA) presented in WG 2010 (using lengths 2006–2008) continues to be used as the basis for determining Harvest Rates as proxies for F_{MSY}.

The text table below shows landings predicted for 2014 at a range of harvest ratios including those equivalent to fishing at F_{MSY} proxies for the fishery as well as $F_{current}$. Only the Harvest Rates associated with the males and combined sex F_{MSY} proxies are identified in the table as they are considered more appropriate for this stock (see below). The inputs to the landings forecast were as follows for a discard survival rate of 0% (Table 6.4.7):

			Implied fishery	
	Harvest Rate	**Adjusted Survey (millions)**	**Retained number (Millions)**	**Landings (tonnes)**
$F_{sq\_2010-2012}$	5.56%	652.7	26.1	755
$F_{0.1Male}$	9.62%	652.7	45.3	1308
FMSY = $F_{0.1Combined}$	9.80%	652.7	46.1	1333
$F_{35\%Male}$	12.50%	652.7	58.8	1700
$F_{35\%Spr\ Combined}$	13.00%	652.7	61.2	1768
$F_{maxMale}$	15.79%	652.7	74.3	2147
$F_{max\ Combined}$	16.40%	652.7	77.2	2230

Survey Abundance (Millions)	652.7	UWTV Survey 2012
Cumulative absolute conversion factor	1.2	As per WKNEPH 2009 (See annex)
Mean weight in landings (kg)	0.0289	Sampling 2006–2008
Dead discard rate	27.9%	Sampling 2006–2008
Prop of removals retained by the fishery	0.721	Sampling 2006–2008

6.4.4 MSY explorations

The results of the Length Cohort Analysis model (outputs calculated at WGCSE 2010) in the text table below show the F multipliers required to achieve the potential F_{MSY} proxies, the harvest rates that correspond to those multipliers and the resulting level of spawner per recruit as a percentage of the virgin level.

		Fbar 20-40 mm		Harvest Rates	SPR	
		Female	**Male**		**Female**	**Male**
F0.1	Combined	0.10	0.14	9.8%	44.6%	42.6%
	Female	0.11	0.15	10.2%	43.5%	41.4%
	Male	0.10	0.14	9.6%	45.3%	43.3%
F35%Spr	Combined	0.14	0.20	13.0%	35.9%	33.4%
	Female	0.15	0.21	13.5%	34.7%	32.2%
	Male	0.14	0.19	12.5%	37.1%	34.6%
Fmax	Combined	0.20	0.28	16.4%	28.9%	26.2%
	Female	0.21	0.30	17.4%	27.3%	24.5%
	Male	0.19	0.26	15.8%	30.0%	27.2%

- Compared to other *Nephrops* fisheries in ICES Area VII the absolute population density of this stock is relatively low.
- The area covered by this fishery is relatively small and the confidence intervals for the abundance estimate are large for a geostatistical survey due to the sample density (Figure 6.4.8). The differences in the spatial distribution (Figure 6.4.7) suggest some degree of variation between years.
- The perception in the Irish Sea is that the growth rates in the eastern Irish Sea are similar to those in the western Irish Sea but the mean sizes (CLmm) in each fishery are markedly different, with the eastern Irish Sea *Nephrops* being the larger.
- This fishery is highly seasonal, in effect a spring to summer fishery, where the landings are predominantly male. Landings are around 60% male by weight and have ranged from 55 to 75% over the last ten years.
- The annual variability of lpue for the smaller component of the catch, plus the recent lack of recruit signals in the length frequencies suggest that recruitment to this fishery, though apparently high in 2007, is quite variable.
- Current Harvest Ratio for 2012 was estimated at 3.80%and the F_{sq} (2010–2012) at around 5.56% both are below the F_{MSY} proxy.

Only the combined sex and male options and the F_{MSY} are considered here to limit the potential of over-fishing the males to meet a female MSY, in a seasonal male dominant fishery.

According to the guidelines Section 2.2, the limited time-series in the abundance indices, the poor biological sampling since 2009, the uncertainties about the stability of the stock over the reference period and uncertainties about the variability in recruitment might suggest that $F_{0.1}$ should be used as a proxy.

6.4.5 Biological reference points

Biological reference points have not been updated since 2010 as the current sampling levels are considered too low for reliable length–frequency determination. MSY $B_{trigger}$ is not defined for this stock as the time-series of abundance estimates is too short.

6.4.6 Management plans

A number of cod recovery measures have been introduced since 2000 to promote recovery of Irish Sea cod stocks. These include a closure of the western Irish Sea cod spawning grounds from mid-February to end of April since 2000, with a later extension to the eastern Irish Sea. Despite a partial derogation for *Nephrops* vessels during the closed period the distribution of effort on *Nephrops* has been affected by this management plan. There have also been various decommissioning schemes to reduce fishing effort. A 25% effort reduction on cod is in hand along with technical measures to reduce cod bycatch.

6.4.7 Uncertainties and bias in assessment and forecast

There are several key uncertainties and bias sources in the method proposed (these are discussed further in WKNEPH 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that is more accurate but no more precise (WKNEPH 2009).

The cumulative absolute conversion factor estimates for FU14 are largely based on expert opinion. However these were based on experience on other grounds and relatively limited experience on these grounds which would make this less reliable. The precision of these cannot yet be characterised. Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates.

The effect of this assumption on realised harvest rates has not been investigated but remains a key uncertainty.

6.4.8 Quality of assessment

The length composition and sex ratio of catches have generally been well sampled until 2009 by E&W. However the variability in the discard rate and discard selectivity within this fishery would suggest that sampling needs to be carried out at a high level to improve on discard estimates.

The quality of landings data has improved in the last four years but because of concerns over the accuracy of earlier years; this limits the period we can be confident about trends in lpue and landings.

Underwater TV surveys have been conducted annually for this stock since 2007. The quality of the data from the first survey and the limited number of valid stations in the survey limits the number of useable surveys to 2008–2012.

The revised algorithm used to derive distance covered by the sledge is considered as significantly more robust than the previous algorithm.

The abundance estimations were improved for the dataseries when recalculated using a more accurate field of view (0.75 m).

6.4.9 Recommendation for next benchmark

A future benchmark was not set up for this stock, but it is recommended in the next few years.

Full review of the biological parameters is required and exploration of new databases that might provide complementary biological data to be combined with the existent data is also required.

6.4.10 Management considerations

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES division level. Management at the Functional Unit level could confer controls to ensure effort and catch were in line with the scale of the resource.

In view of uncertainties about historical catch statistics interpretation of trends in lpue prior to 2006 should be treated with caution. Recent catch, effort and historical trends in size still offer some reference to the status of the stock. The reliability of landings statistics has improved and effort appears to be decreasing since 2008 probably as a result in the decrease in number of vessels directed to targeting *Nephrops*. There are no explicit recruitment indices.

The new UWTV survey data allows for the provision of catch options and also to adopt the MSY approach. The UWTV surveys are conducted annually and a benchmarked process has been adopted. In the past this stock has only been assessed biannually. These data provide the opportunity to reassess this stock more reliably on an annual basis.

6.4.11 References

ICES. 2012. Report of the Study Group on Nephrops Surveys (SGNEPS), 6–8 March 2012, Acona, Italy. ICES CM 2012/SSGESST:19. 36 pp.

Table 6.4.1. Irish Sea: Landings (tonnes) by FU, 2000–2011. 2012* refers to preliminary landings data. In 2012 landings outside FU for Area VIIa were not provided, only available for the entire Area VII.

Year	FU14	FU15	Other	Total
2000	567	8370	1	8938
2001	532	7441	3	7976
2002	577	6793	1	7371
2003	376	7052	3	7431
2004	472	7267	25	7764
2005	570	6554	103	7227
2006	628	7561	52	8241
2007	959	8491	83	9533
2008	676	1050	122	11306
2009	708	9198	57	9963
2010	582	8963	23.1	9568
2011	561	10162	61	10784
2012 *	530	10527	-	11057

Table 6.4.2. Irish Sea East (FU14): Landings (tonnes) by country, 2000–2012.

Year	Rep. Of Ireland	UK	Other Countries	Total
2000	114	451	2	567
2001	26	506	0	532
2002	203	373	1	577
2003	69	306	1	376
2004	62	409	1	472
2005	34	536	0	570
2006	34	594	0	628
2007	86	873	0	959
2008	29	652	0	681
2009	16	692	0	708
2010	45	538	0	583
2011	31	530	0	561
2012	53	478	0	530

Table 6.4.3. Irish Sea East (FU14): Effort ('000 hours trawling) and lpue (kg/hour trawling) of *Nephrops* directed voyages by UK trawlers, 2000–2012.

Year	Effort	LPUE
2000	10.4	19.5
2001	10.1	17.9
2002	8.1	20.3
2003	6.9	15.9
2004	6.7	20.4
2005	6.6	20.1
2006	7.4	21.4
2007	6.3	24.0
2008	6.1	26.8
2009	5.6	25.8
2010	5.8	27.9
2011	5.78	27.36
2012	4.62	25.15

Table 6.4.4. Irish Sea East (FU14): Effort ('000 hours trawling) and lpue (kg/hour trawling) of *Nephrops* directed voyages by Republic of Ireland trawlers, 2000–2012.

Year	Effort	LPUE
2000	2.5	43.6
2001	0.5	43.9
2002	3.3	57.1
2003	1.1	37.6
2004	1.4	39.7
2005	0.8	40.6
2006	0.7	53.7
2007	1.7	49.3
2008	0.6	41.6
2009	0.4	40.1
2010	0.7	60.5
2011	0.5	66.6
2012	0.9	59.7

Table 6.4.5. Irish Sea East (FU14): Mean sizes (mm CL) of male and female *Nephrops* from UK vessels landing in England and Wales, 2000–2009. Not updated since 2009 due to insufficient sampling levels.

	Catch		Landings	
Year	Males	Females	Males	Females
2000	29.2	28.3	33.7	32.3
2001	31.6	29.2	34.2	32.5
2002	32	29.2	35.1	32
2003	36.4	30.7	38.4	34.5
2004	32.2	29.4	35.2	33.1
2005	32.8	29.9	34.6	32.3
2006	33.8	31.4	36.1	32.6
2007	31.7	30	33.5	32.1
2008	33	30	34	31.4
2009	34.5	31.3	34.6	31.8

Table 6.4.6. Irish Sea East (FU14): Results from NI/ROI/E&W collaborative UWTV surveys of *Nephrops* grounds in 2007–2012. Abundance is adjusted by using a cumulative absolute conversion factor of 1.2, also includes the Wigtown Bay area (1.9% of the main area).

Year	No stations	Mean station density (no./m²)	Mean Krigged density (no./m²)	Adjusted Abundance (millions) including Wigtown Bay	95% CI	Landings	Removals (millions)	Harvest Rate
2007				Unreliable data				
2008	32	0.34	0.38	407.6	63.0	676	32.4	7.96%
2009	32	0.28	0.33	350.0	76.0	707	33.9	9.69%
2010	26	0.33	0.4	422.0	103.0	582	27.9	6.62%
2011	26	0.36	0.41	431.0	109.0	561	26.9	6.25%
2012	26	0.48	0.62	652.7	114.1	530	25.4	3.90%

Table 6.4.7. Irish Sea East (FU14): Catch option table inputs. Data used for 2013 catch prediction are shaded. Mean weight in landings (2006–2008) = 28.9 g; Discard rate based on sampling (2006–2008) = 27.9%.

Year	Landings in Number (millions)	Discards in Numbers (millions)	Removals in Number (millions)	Prop Removals Retained	Adjusted Survey (millions)	Harvest Ratio (%)	Landings (t)	Discards (t)	Dead discard rate	Mean Weight in landings (gr)
2003	9.6	8.7	18.4	0.52			376.7	151	0.48	39.2
2004	14.9	11.3	26.2	0.57			472.2	150	0.43	31.6
2005	18.5	8.6	27.1	0.68			569.7	128	0.32	30.7
2006	19.8	6.9	26.7	0.74			627.3	111	0.26	31.6
2007	34.1	13.7	47.8	0.71			958.5	178	0.29	28.1
2008	24.2	9.8	34.0	0.71	407.6	8	676.0	138	0.29	27.9
2009	22.5	1.8	24.3	0.92	350.0	9.7	694.5	33	0.08	30.9
2010					422.0	6.6	582			
2011					431.0	6.2	561			
2012					652.7	3.9	530			

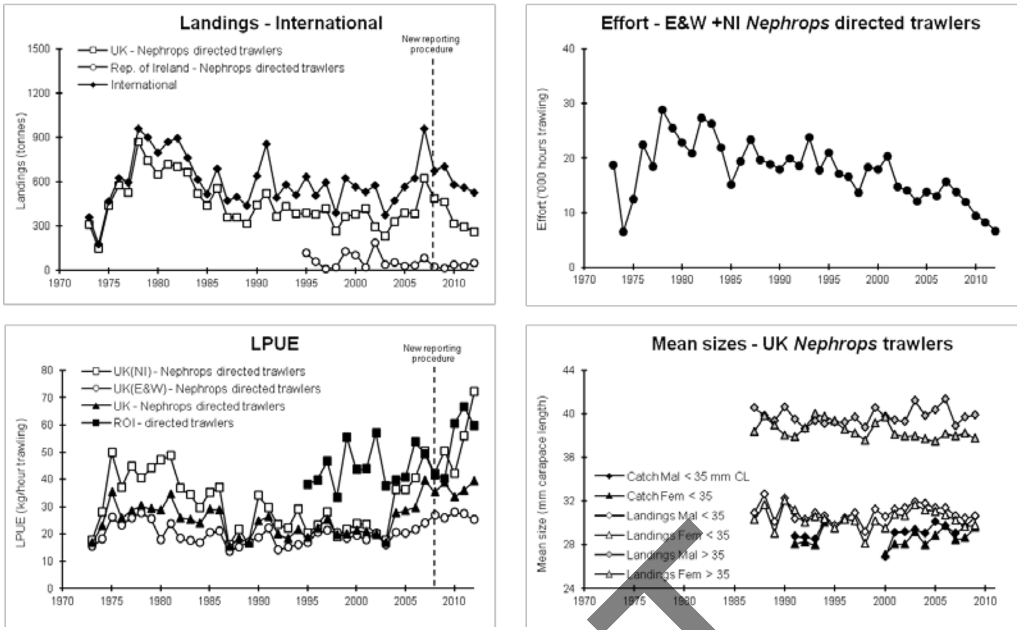


Figure 6.4.1. Irish Sea East (FU 14): Long-term trends in landings, effort, lpues and mean sizes of *Nephrops*. Note that mean sizes were not updated since 2009 due to insufficient sampling levels. The introduction of the buyers and sellers legislation in 2006 by the UK precludes direct comparison with previous years as reported levels are considered to have significantly improved.

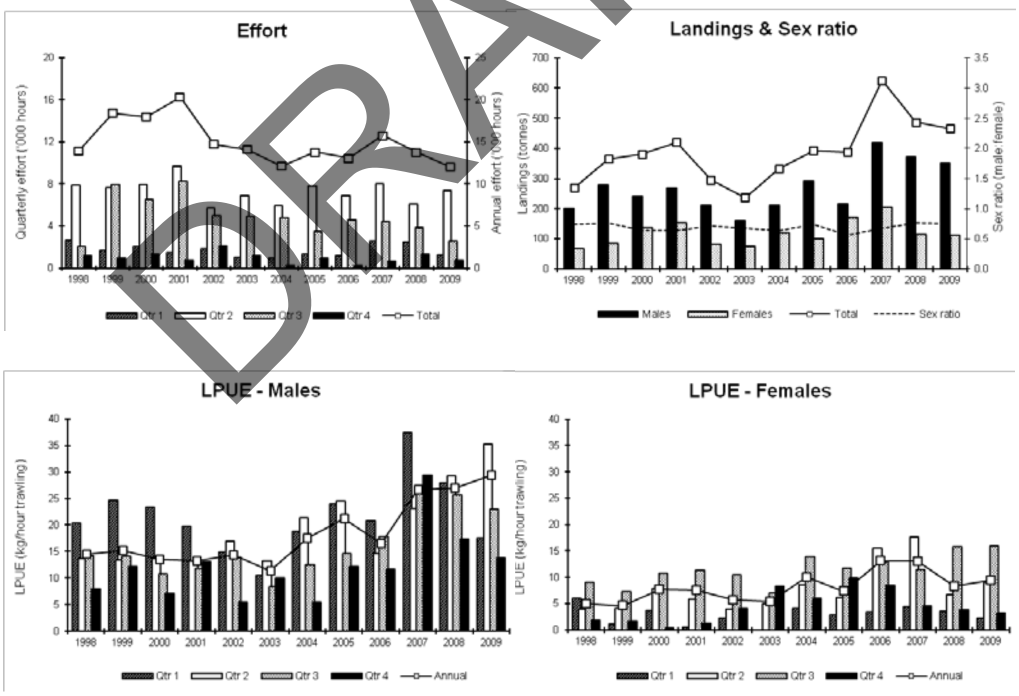


Figure 6.4.2. Irish Sea East (FU 14): Landings, effort and lpues by quarter and sex from UK *Nephrops* directed trawlers. Not updated since 2009 due to insufficient sampling levels. The introduction of the buyers and sellers legislation in 2006 by the UK precludes direct comparison with previous years as reported levels are considered to have significantly improved.

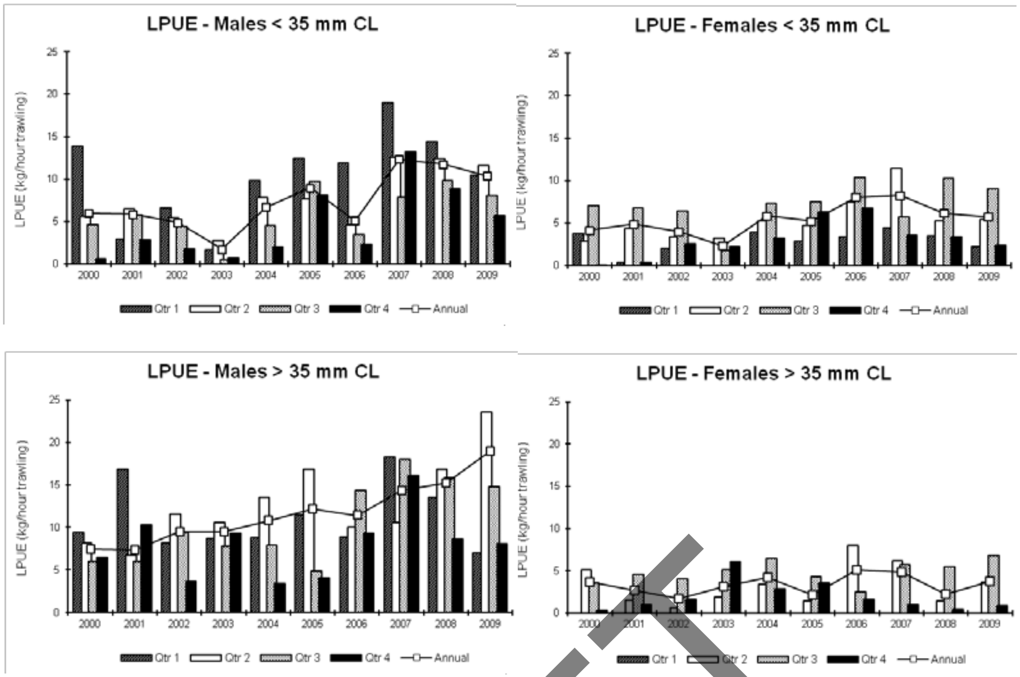


Figure 6.4.3. Irish Sea East (FU 14): lpues by sex and quarter for selected size groups, UK *Nephrops* directed trawlers. Not updated since 2009 due to insufficient sampling levels. The introduction of the buyers and sellers legislation in 2006 by the UK precludes direct comparison with previous years as reported levels are considered to have significantly improved.

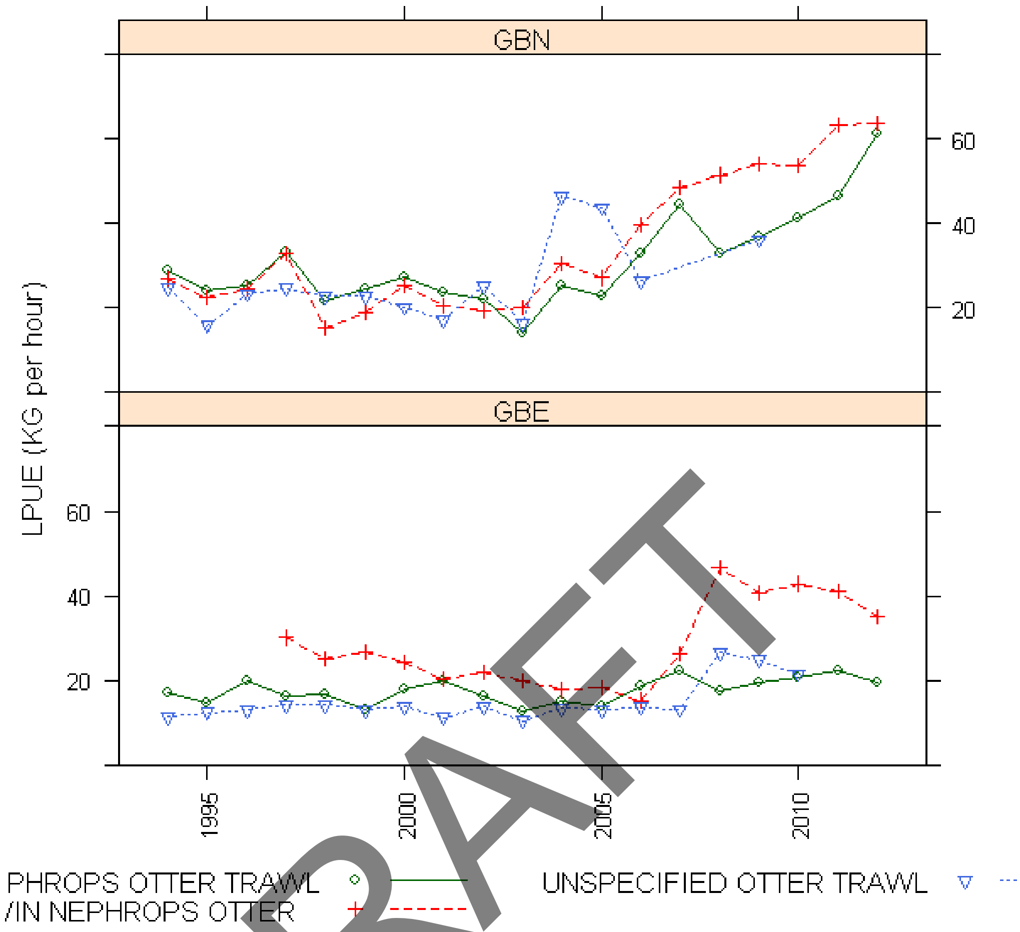


Figure 6.4.4. Lpue (Kg per hour) by gear type for English (GBE) and Northern Irish (GBN) vessels targeting *Nephrops* (>25% *Nephrops* in landings, using towed gears 70–99 mm mesh). Single rigs represented with a continuous green line; Twin rigs represented with a dashed red line; Unspecified rigs represented with a dotted blue line.

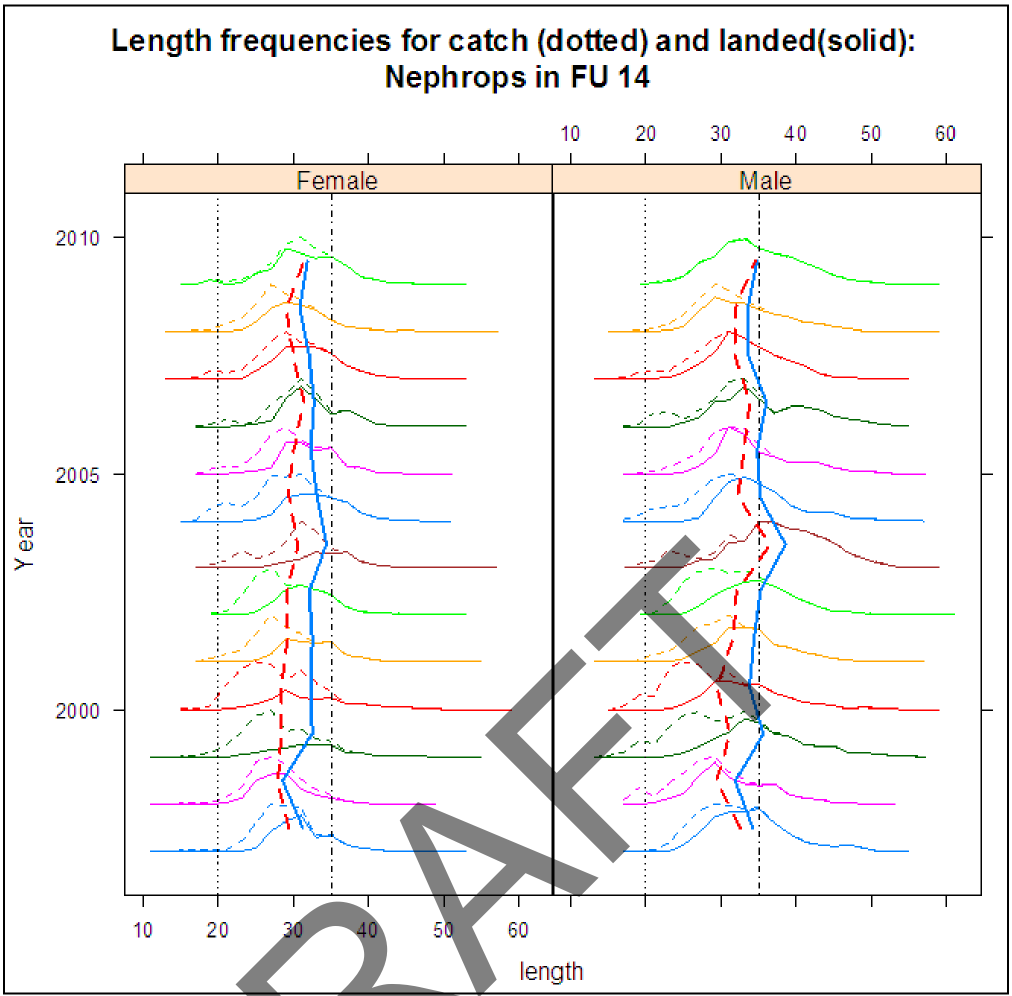


Figure 6.4.5. Irish Sea East (14): Length–frequency distributions of male and female landings and catch, 1997–2009. Figure shows a vertical display of MLS (20 mm CL) and 35 mm CL levels. Not updated since 2009 due to insufficient sampling levels.

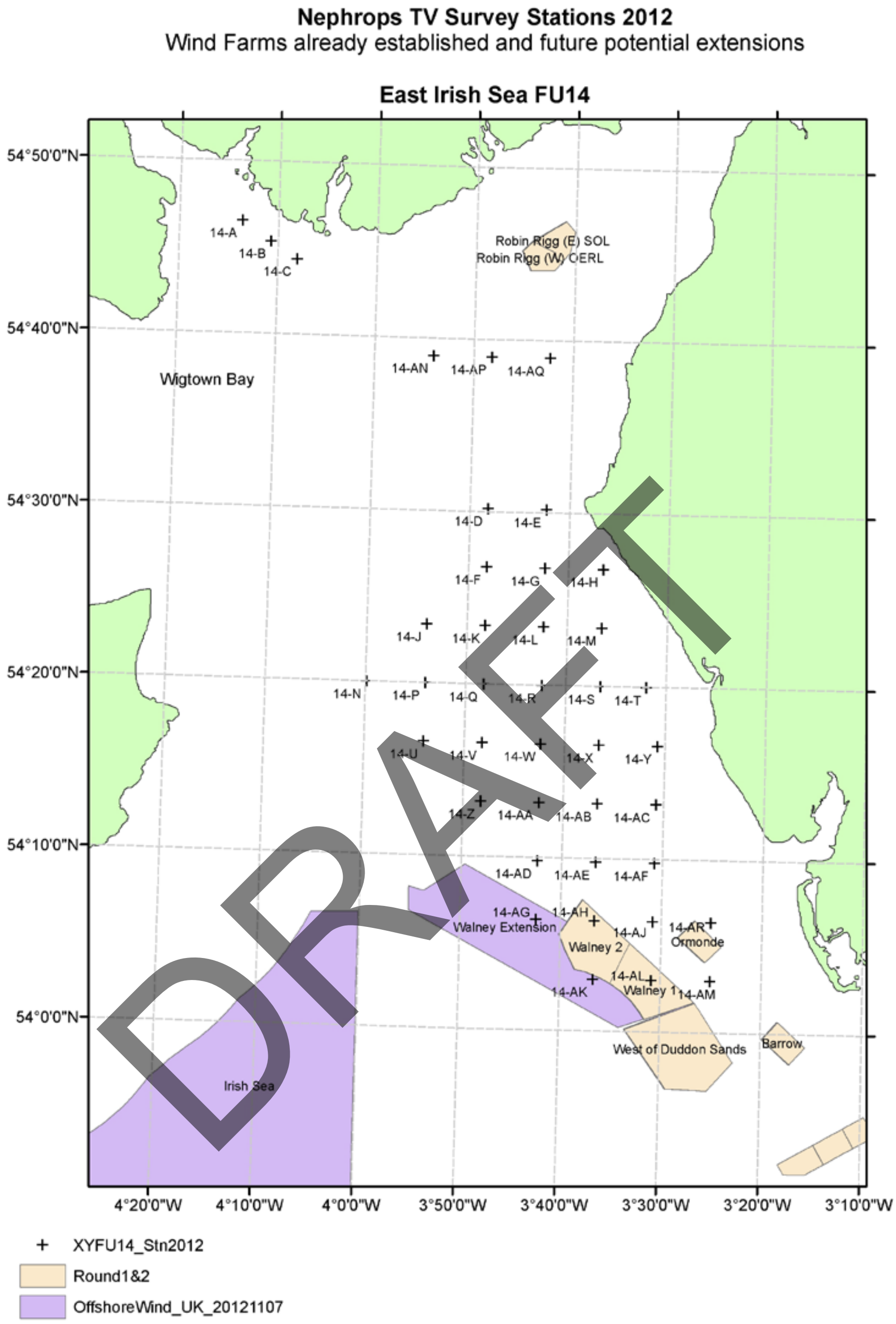


Figure 6.4.6. Irish Sea East (FU14): UWTV Survey stations, showing the Wigtown Bay area and the wind farm extensions (cream colour – already operating; purple – waiting for approval). In 2011 three new exploratory stations were added, but not included in the analysis. In 2012 stn 14-AR was added.

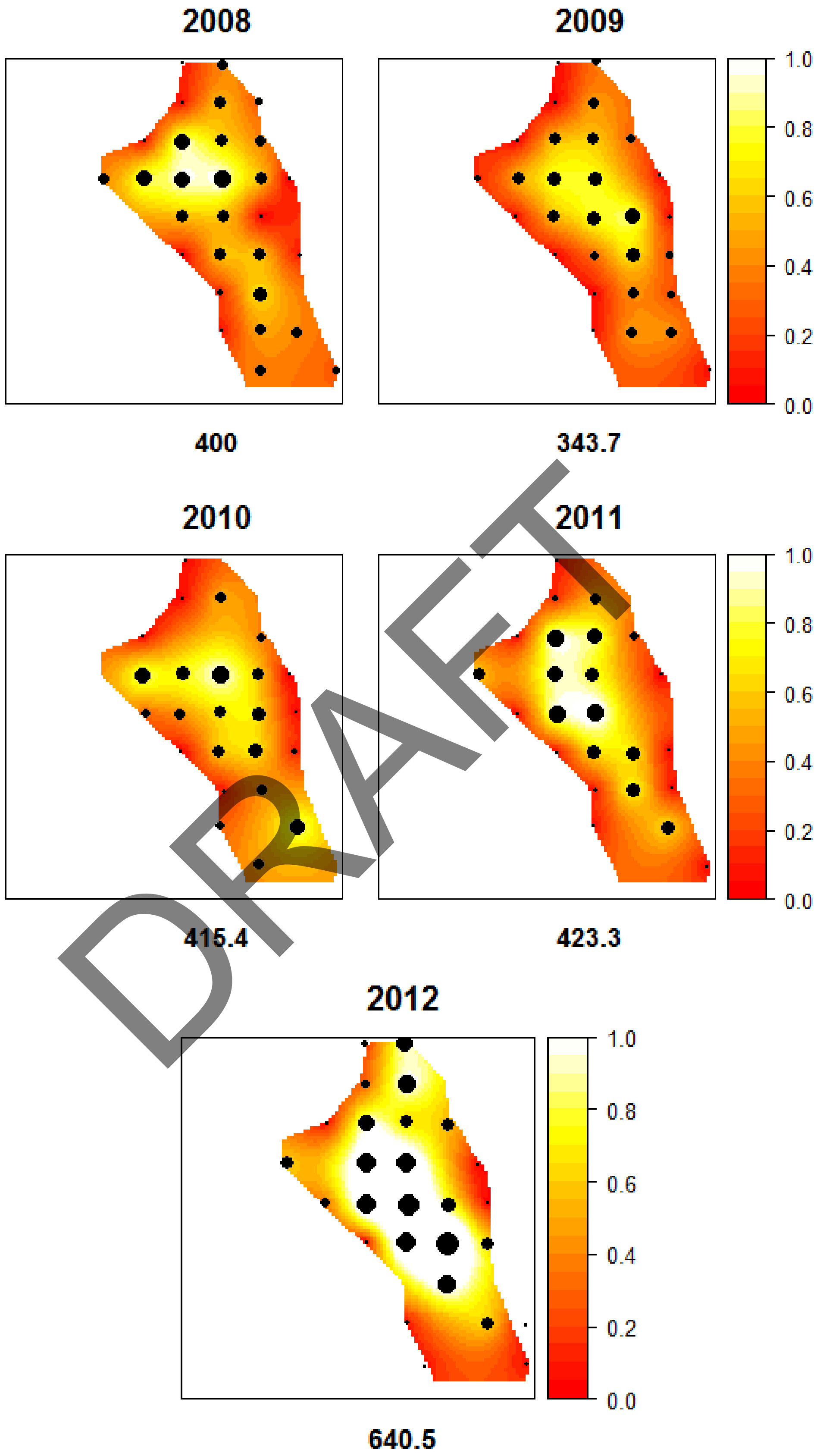


Figure 6.4.7. Irish Sea East (FU14): Burrow density estimates from the UWTV Survey 2008–2012. Abundance estimates given at the bottom of each plot are adjusted with the cumulative absolute conversion factor (but does not contain the additional 1.9% for Wigtown Bay). Area of ground = 1032.75 Km². CV 2012 = 9.8%.

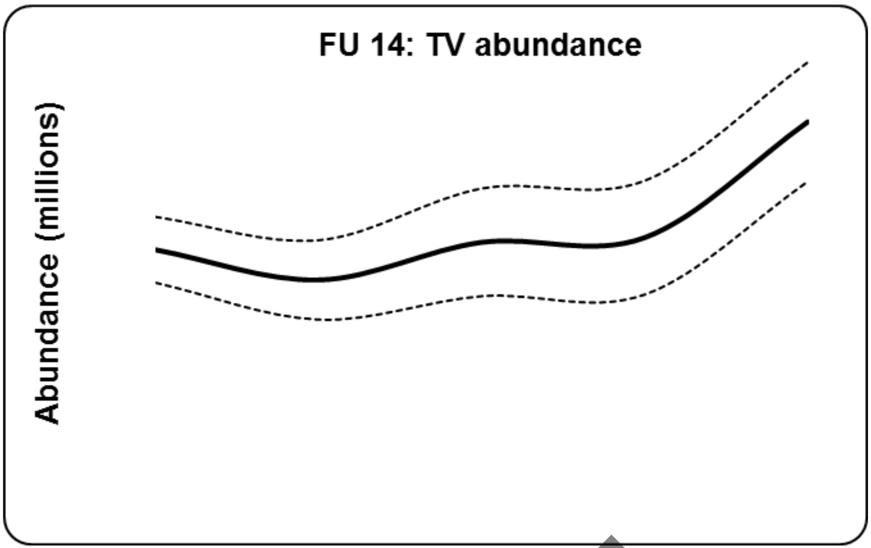


Figure 6.4.8. Irish Sea East (FU14): Burrow density estimates from the UWTV Survey 2008–2012.

6.6 Whiting in VIIa

2012 Assessment and advice

For whiting in VIIa, in 2012 ICES provided biennial advice for 2013 and 2014 stating that catches should be reduced to lowest possible levels and that effective technical measures are introduce to reduce discards which contribute to >95% of the total catch (discards >1400 t; landings ~50 t in 2012). There is no basis to reopen advice as discards remain very high. It is proposed that the rate and level of discards are used as a potential indicator for reopening the advice.

For WGCSE (2013) the data tables have been updated. In addition and in common with Irish Sea Cod and Haddock, all landings associated with ICES rectangles 33E2 and 33E3 have been reassigned to the VIIe–k whiting stock. The working group landings estimates for 2012 have been adjusted accordingly. Note that none of the SURBA runs have been updated or figures.

Type of assessment

In 2012, a single fleet SURBA runs were carried out for two of the main surveys assessing this stock, the NIGFS-WIBTS-Q1 and NIGFS-WIBTS-Q4 surveys to provide trends in the stock. Overall it is clear that the stock is in a state of decline. Landings have decreased, and have been at low levels in recent years (≤200 t). The survey results indicate a decline in SSB to low levels in recent years. Total mortality has been variable over the time-series.

ICES advice applicable to 2012

In the advice for 2012, the stock status was presented as follows:

Fishing mortality	2007	2008	2009
F_{MSY}	Unknown	Unknown	Unknown
F_{PA}/F_{lim}	Unknown	Unknown	Unknown
Spawning–Stock Biomass (SSB)	2008	2009	2010
MSY $B_{trigger}$	Unknown	Unknown	Unknown
B_{PA}/B_{lim}	Unknown	Unknown	Unknown

MSY approach

SSB has declined to a very low level. The underlying data do not support the provision of estimates of F_{MSY}. However it is likely that current F is above F_{MSY}. Therefore, catches (mainly discards) of whiting should be reduced.

Management by TAC is inappropriate for this stock because landings, but not catches, are controlled. Further management measures should be introduced in the Irish Sea to reduce discarding of small whiting in order to maximize their contribution to future yield and SSB.

PA considerations

ICES considers that catches should be reduced to the lowest possible levels in 2011.

ICES advice applicable to 2013 and 2014

ICES advises on the basis of precautionary considerations that catches should be reduced to the lowest possible levels and that effective technical should be implemented to reduce discards.

In the advice for 2012, the stock status was presented as follows:

F (Fishing Mortality)		
	2009–2011	
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown
Qualitative evaluation	✗	Above poss. reference points

SSB (Spawning–Stock Biomass)		
	2009–2011	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	✗	Below poss. reference points

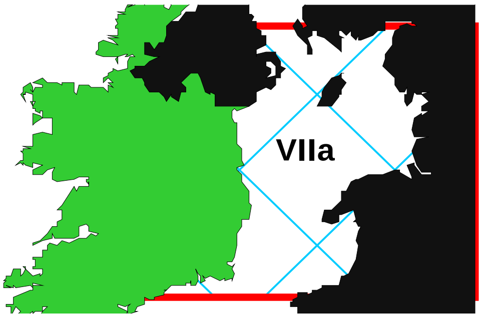
F (Fishing Mortality)		
	2009–2011	
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown
Qualitative evaluation	✗	Above poss. reference points

SSB (Spawning–Stock Biomass)		
	2009–2011	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	✗	Below poss. reference points

6.6.1 General

Stock description and management units

The stock and the management unit are both ICES Division VIIa (Irish Sea).



Red Box-TAC/Management Area
Blue Shading– Assessment Area

Management applicable to 2011 and 2012

The minimum landing size of whiting is 27 cm. The 2013 TAC for whiting VIIa has been reduced from 89 t to 84 t. This TAC has not been considered restrictive, with officially reported VIIa landings totalling 71 t in 2011.

TAC 2012

Species: Whiting *Merlangius merlangus*		Zone: VIIa (WHG/07A.)
Belgium	0	
France	3	
Ireland	52	
The Netherlands	0	
United Kingdom	34	
Union	89	
TAC	89	Analytical TAC

TAC 2013

Species: Whiting *Merlangius merlangus*		Zone: VIIa (WHG/07A.)
Belgium	0	
France	3	
Ireland	49	
The Netherlands	0	
United Kingdom	32	
Union	84	
TAC	84	Analytical TAC

Fishery in 2012

ICES officially reported landings for Division VIIa and landings as used by the Working Group are given in Table 6.6.1. In recent years the values provided to the WG are very similar to officially reported landings. In 2012 international landings provided to the Working Group (73 t) were very similar to the 2011landings of 74 t.

The Irish Sea whiting stock is primarily caught by otter trawlers and to a lesser extent, Scottish seines, beam trawls and gillnets. Otter trawlers utilize two main mesh size ranges, 70–89 mm and 100–119 mm. Effort of trawlers utilizing the larger mesh range, traditionally targeting whitefish (cod, haddock, whiting), has seen a large declined since 2003, partially as a result of effort management restrictions. The smaller range however has remained relatively stable. The primary target species of this smaller mesh range is *Nephrops* from which whiting is discarded at a high rate.

The closure of the western Irish Sea to whitefish fishing from mid-February to the end of April, designed to protect cod, was continued in 2011 but is unlikely to have affected whiting catches which are mainly bycatch in the derogated *Nephrops* fishery. *Nephrops* vessels can obtain a derogation to fish in certain sections of the closed area, providing they fit separator panels to their nets to allow escape of cod and other fish. The Irish and UK NI *Nephrops* fishery shows a peak in activity in summer months, after the reopening of the Irish Sea codbox.

Since late 2009, a number of Irish vessels operating within the Irish Sea *Nephrops* fishery incorporated a Swedish grid into otter trawls, as part of the cod long-term management plan. The use of species selective gears to mitigate effort restrictions to avoid effort limits has increased steadily since 2009. A conditional national licence has been introduced by Ireland since March 2012, making the use of grids or separator panels mandatory for all TR2 boats fishing in the Irish Sea. Around 55% of the Irish vessels use separator trawls and while 45% have opted to use Swedish grids to reduce bycatch. Since October 2012, all TR2 vessels in the UK(Northern Ireland) fleet are required to use a highly selective fishing gear. In the Irish Sea these currently include Seltra 300 mm box trawl, 270 mm diamond mesh panel Seltra box trawl and 300 mm square mesh panel. All these gears are being developed with the aim of achieving exemption from the cod recovery plan under Article 11 (less than 1.5% cod catch).

In recent years, Irish East Coast *Nephrops* vessels have moved away from their traditional Irish Sea grounds to the Smalls grounds (FU22; VIIg), which is not controlled by effort limitation and generally better prices are obtained for their catch.

During 2008 Ireland introduced a further decommissioning scheme with the aim of removing 11 140 GT from the fleet register. This was targeted at vessels over ten years and >18 m. Of the decommissioned vessels 29 operated within the Irish Sea, primarily targeting *Nephrops* landing into east, and to a lesser extent south coast ports.

6.6.2 Data

An overview of the data provided and used by the WG is shown in Table 2.1 in the WGCSE Report.

For WGCSE (2013) all data has been updated but no assessment (SURBA) runs have been performed this should be undertaken during WGCSE (2014) if considered appropriate. Where figures require updating the figure label has the following "To be updated at WCCSE (2014)".

Fishery landings

Table 6.6.1 gives the nominal landings of VIIa whiting as reported by each country to ICES. The officially reported landings have declined since 1996. Landings remained at a very low level in 2012. Working Group estimates of catch available since 1980 are illustrated in Figure 6.6.1 and indicate the declining trend since the start of the time-series. No revisions were made to last year's Working Group estimate of landings. Discard estimates from the IR-OTB fleet are available since 2003 and from the NI *Nephrops* fishery since 2009 are also presented in Table 6.6.1 but are imprecise.

In common with VIIa cod and haddock, this year whiting landings associated with ICES rectangles 33E2, 33E3 and 33E4 have been reassigned to the VIIe–k whiting stock.

There is evidence that officially reported landings of whiting in the past (especially around the mid-1990s) have been inaccurate due to misreporting. Landings data have previously been partially corrected for by using sample-based estimates of landings at a number of Irish Sea ports. Due to the low level of landings recently, this has not been carried out since 2003.

The introduction of UK and Irish legislation requiring registration of fish buyers and sellers may mean that the reported landings from 2006 onwards are more representative of actual landings.

Sampling and raising methods previously used are described in the stock annex for VIIa whiting. Methods for estimating quantities and composition of landings are described in the stock annex (Section B1.1).

Landings, discards and total catch numbers and weights-at-age for the period 1980 to 2002 as estimated by WGNSDS 2002 are given in Tables 6.6.3 to 6.6.8. The proportion of the total catch comprising of discards from the *Nephrops* fleets increased over time for ages 1 and above (Table 6.6.9), although this will also reflect trends in catch of vessels not sampled for discards. While the proportion of discarded fish has increased it is largely due to the decline in abundance of marketable sized whiting (>27 cm) and the total volume over time has declined as shown in Table 6.6.10. Mean weights-at-age for landings and discards are presented in Figure 6.6.3.

Since 2003 it has not been possible to construct catch numbers-at-age for this stock. This is due to a number of factors including low levels of landings, leading to low sampling levels, in addition to restricted access to some ports in some years.

Discards data

Discarding of whiting is high within the Irish Sea. The onboard observer trips carried out in 2011 by UK(E&W), UK (NI) and Ireland, showed negligible fish were retained on board, while high numbers of small fish were discarded. Raised discards from the main national fleets landing whiting show greater than 1400 t in weight, were discarded in 2012. This focused on the two youngest ages, and to a lesser extent age 2. In some years up to age 4 fish are discarded. The following discard data were available for this stock:

- Discard numbers-at-age from 1980–2002 estimated from the NI *Nephrops* fishery and raised to the International Fleet (from the NI self-sampling scheme).
- Discard numbers-at-age from the Irish Otter Trawl Fleet from 1996–2012, including length–frequency data. Note the data in 2010 is not thought to be fully representative of discarding in the Irish Sea for the Irish OTB fleet as there were only four trips sampled.
- Discard Length Frequencies for the UK (E and W) fleet, 2004–2012, raised to trip.
- Discard numbers-at-age for the NI fleet for 1997–2001, and 2006, 2007, 2009 and 2010, raised to trip, including length–frequency data from the NI observer scheme.

Methods for estimating quantities and composition of discards from UK (NI) and Irish *Nephrops* trawlers are described in the stock annex Section B.1.2. Irish otter trawl fleet discard estimates (1996–2010) raised according to the methods described in Borges *et al.* (2005) were available to the Working Group (Table 6.6.11).

Numbers-at-age and mean weights-at-age for the Irish otter-trawl fleet are also presented in Figure 6.6.4.

The length–frequency of discards of national sampled fleets in 2011 is given in Figure 6.6.5. There appears to be a distinct bimodal distribution in the length frequencies in the Northern Irish fleet indicating tracking of the year classes.

Biological data

The derivation of these parameters and variables is described in the stock annex 6.6.

Survey data used in assessment

Table 6.6.2 describes the survey data made available to the Working Group.

Figure 6.6.2 provides a comparison of mean catch weights of whiting from the eastern and western Irish Sea for NIGFS-WIBTS-Q1 surveys from 1992 to March 2011 indicating low level catch rates since 2003. The decline in catch rates for the eastern Irish Sea since 2003 has been evaluated by the working group but no apparent reasons for this decline were evident.

WGNSDS 2006 also provides information on the distribution of whiting less than MLS in the Irish Sea up to 2006.

Survey-series for whiting provided to the Working Group are further described in the stock annex for VIIa whiting (Section B.3).

Commercial cpue

Commercial catch and effort-series data available to the Working Group are described in the stock annex for VIIa whiting (Section B.4). Although effort data were provided for the UK(E&W) and Ireland, it was decided not to include this data in the Report as it was considered not to be indicative of lpue trends due to the low levels of landings and changes in discard practices.

6.6.3 Historical stock development

No assessment was carried out for this stock in 2011. The last assessment for this stock was a survey based assessment in 2007.

Catch-at-age data was not updated and commercial catch data was not explored in 2011.

Data screening

The general methodology is outlined in Section 2.

Final update assessment

Note that these runs have not been updated since WGCSE (2011). It is intended that these and other data will be updated on a biannual basis.

Single fleet survey based runs were carried out on the NIGFS-Mar and NIGFS-Oct surveys using SURBA (version 2.2). Default values were used for both catchability and smoothing settings.

Log-mean standardised indices and scatter plots of log-index at age for the NIGFS-WIBTS-Q1 survey are presented in Figures 6.6.6(a) and 6.6.7(a), respectively. Both plots indicate poor internal consistency within the survey. The survey appears to track the 1991 year class but examination of the internal consistency via the scatter-plots indicates poor correlation between age classes. Corresponding figures for the NIGFS-Oct are plotted in Figures 6.6.6(b) and 6.6.7(b). There is some indication of tracking for the 1991, 1994 and 1995 year class but scatterplots at-age are noisy and do not show strong positive correlations.

Catch curves for the NIGFS-Mar and NIGFS-Oct survey are plotted in Figures 6.6.8(a) and (b). Both surveys show a steep decline in log-numbers-at-age over time.

Empirical SSB estimates are presented in Figure 6.6.9 for the NIGFS-WIBTS-Q1 and the NIGFS-WIBTS-Q4 surveys. The NIGFS-WIBTS-Q1 survey shows a slightly increased SSB levels in the terminal year whilst the NIGFS-WIBTS-Q4 survey shows a decline in the terminal year. Overall SSB is still at low levels compared to earlier on in the time-series.

Figure 6.6.10 shows the residual plots by age for the NIGFS-WIBTS-Q1 survey, the model fits well for age one but for older ages residuals are quite noisy, especially in the latter part of the time-series. Stock summary for the NIGFS-WIBTS-Q1 survey is shown in Figure 6.6.11. The temporal F trend is variable in later years. There are no extreme age or cohort effects. The plot of empirical SSB with model fit (bottom, centre) shows good fit for most years. Figure 6.6.12 shows the retrospective summary plot for the NIGFS-WIBTS-Q1 survey. SSB is declining since 2002 and shows a further decline in 2012. It is still at comparatively low levels and there is no apparent retrospective pattern. F shows an increasing trend over the time-series, although it appears to have declined since 2008. Recruitment is also variable and shows a declining trend in recent years. There is no strong retrospective pattern for recruitment and the previously seen noisy periods between 1995–2000 and 2004–2008 seem to have improved with the inclusion of the 2012 data.

Residual plots by age for the NIGFS-WIBTS-Q4 survey are shown in Figure 6.6.13. Residuals are quite noisy for all ages apart from age 0. Figure 6.6.14 shows the stock summary plot for the NIGFS-WIBTS-Q4 survey. The temporal F trend is variable throughout the time-series. There appears to be an age effect for age 3 for this survey but no strong cohort effects. The plot of empirical SSB versus model estimates shows improved fit for the latter part of the time-series. Retrospective patterns for the summary plots (Figure 6.6.15) show a variable F trend over the time-series, with a decline in 2009. SSB has been declining since 2003 and shows an increase in 2010. Recruitment shows a slight increase in 2011. No strong retrospective bias is evident in F, SSB or recruitment.

The state of the stock

The decline in fishery landings to under 1000 t since 2000 has been interpreted in all assessment models as a collapse in biomass, despite the absence of an analytical assessment. Generally, trends in biomass have been declining in recent years. Recruitment also appears to have declined recently. However the long-term trends of recruitment for this stock are difficult to interpret given the uncertainty in discard estimates for younger ages.

6.6.4 Short-term predictions

No short-term forecast was carried out for this stock.

6.6.5 Medium-term projection

There is no analytical assessment for this stock.

6.6.6 Maximum sustainable yield evaluation

High discarding, low landings and poor sampling has led to uncertain catch data in recent years. This data does not support the evaluation or estimation of F_{MSY}. However, it is likely that recent F is above F_{MSY} at the current selection pattern.

6.6.7 Biological reference points

Precautionary approach reference points

Precautionary reference points for this stock have remained unchanged since 1998.

6.6.8 Management plans

No management plan has been agreed or proposed.

6.6.9 Uncertainties and bias in assessment and forecast

There is no analytical assessment for this stock.

6.6.10 Recommendations for next benchmark assessment

Before a benchmark can be recommended, it is first necessary to construct international catch numbers/weights-at-length and age for the main fleets engaged in the fishery since 2003. Effort data for the main fleets engaged in whiting VIIa fisheries are required to provide a time-series of trends in commercial lpue. None of these issues will be resolved in the short term and a benchmark assessment of this stock in the near future is unlikely.

6.6.11 Management considerations

Technical measures applied to this stock include a minimum landing size (≥27 cm) and minimum mesh sizes applicable to the mixed demersal fisheries. These measures are set depending on areas and years by several regulations.

Whiting are caught within a number of different fisheries as a non-target species, primarily within demersal otter trawl fisheries. Significant decline of the mixed gadoid directed fishery has occurred within the Irish Sea to minimal levels. Bycatches also occur within flatfish and ray beam-trawl fisheries.

Management by TAC is inappropriate for this stock because landings, but not catches, are controlled. Discarding of this stock is a major consideration and efforts should be made to reduce catches of undersized fish through technical considerations. Since late 2009, a number of Irish vessels operating within the Irish Sea *Nephrops* fishery incorporated a Swedish grid into otter trawls, as part of the cod long-term management plan.

Effort limitations are in force within the Irish Sea as a result of the cod long-term management plan. Although vessels catching whiting will be affected by this regulation at present it is not believed that the effort limitations will prove beneficial to the whiting stock.

Whiting has a low market value, which is likely to contribute to discarding rates.

Table 6.6.1. Nominal catch (t) of Whiting in Division VIIa, 1988–2012, as officially reported to ICES and Working Group.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	90	92	142	53	78	50	80	92	80	47	52
France	1,063	533	528	611	509	255	163	169	78	86	81
Ireland	4,394	3,871	2,000	2,200	2,100	1,440	1,418	1,840	1,773	1,119	1,260
Netherlands									17	14	7
UK(Engl. & Wales)[a]	1,202	6,652	5,202	4,250	4,089	3,859	3,724	3,125	3,557	3,152	1,900
Spain											
UK (Isle of Man)	15	26	75	74	44	55	44	41	28	24	33
UK (N.Ireland)	4,621										
UK (Scotland)	107	154	236	223	274	318	208	198	48	30	22
UK											
Total human consumption	11,492	11,328	8,183	7,411	7,094	5,977	5,637	5,465	5,581	4,472	3,355
Estimated Nephrops fishery discards used by the WG[b]	1,611	2,103	2,444	2,598	4,203	2,707	1,173	2,151	3,631	1,928	1,304
Estimated Discards from IR-OTB fleet[c]											
Estimated Discards from NI Nephrops fishery[d]											
Working Group Estimate of Landings	10245	11305	8212	7348	8588	6523	6763	4893	4335	2277	2229
Working Group Estimates	11,856	13,408	10,656	9,946	12,791	9,230	7,936	7,044	7,966	4,205	3,533

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Belgium	46	30	27	22	13	11	10	4.2	3	2	2
France	150	59	25	33	29	8	13	3.7	3	2	
Ireland	509	353	482	347	265	96	94	55.3	187	68	78
Netherlands	6	1									
UK(Engl. & Wales)[a]	1,229	670	506	284	130	82	47	21.7	3	11	20
Spain					85						
UK (Isle of Man)	5	2	1	1	1	1			1	1	
UK (N.Ireland)											
UK (Scotland)	44	15	25	27	31	6	<0.5	<0.5	<0.5		
UK											
Total human consumption	1,989	1,130	1,066	714	554	204	164	84.9	197	84	100
Estimated Nephrops fishery discards used by the WG[b]	1,092	2,118	1,012	740	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Estimated Discards from IR-OTB fleet[c]					524	680	201	223	1545	585	892
Estimated Discards from NI Nephrops fishery[d]											1019
Working Group Estimate of Landings	1670	762	733	747	676	184	158	86	196	81	102
Working Group Estimates	2,762	2,880	1,745	1,487	1200	864	359	309	1740	666	2013

Country	2010	2011	2012*
Belgium	5	4	5
France	3	3	1
Ireland	97	97	57
Netherlands			
UK(Engl. & Wales)[a]	16	16	
Spain			
UK (Isle of Man)	<0.5	<0.5	
UK (N.Ireland)			
UK (Scotland)			
UK			11
Total human consumption	121	120	74
Estimated Nephrops fishery discards used by the WG[b]			
Estimated Discards from IR-OTB fleet[c]	330	269	531
Estimated Discards from NI Nephrops fishery[d]	704	903	922
Working Group Estimate of Landings	121	74	52
Working Group Estimates	1,154	1,246	1,527

[a] 1989-onwards Northern Ireland included with England and Wales.
[b] Based on UK(N.Ireland) and Ireland data.
[c] Based on data from Ireland.
[d] Based on data from Northern Ireland.
[*] Preliminary (and rounded).

Table 6.6.2. Whiting in VIIa. Survey data available to WGCSE 2013. Updated Survey Titles highlighted in bold.

NIGFS-WIBTS-Q4: Northern Ireland October Groundfish Survey - Irish Sea West - Nos. per 3 nm

1994	2012						
1	1 0.83	0.88					
0	5						
1	5903	1278	55	48.1	2.7	0.2	1994
1	4660	962	130	10.0	4.7	1.5	1995
1	5933	792	117	20.0	1.7	0.5	1996
1	8722	628	125	10.0	4.9	0.2	1997
1	8199	708	134	16.0	0.7	0.0	1998
1	7481	360	44	4.0	1.4	0.0	1999
1	4037	593	32	2.0	2.1	0.3	2000
1	15262	761	205	16.0	0.1	0.0	2001
1	7229	1712	114	11.7	0.9	0.5	2002
1	8487	1600	469	19.1	1.2	0.1	2003
1	11446	1119	124	12.0	0.0	0.0	2004
1	5433	299	54	7.2	0.5	0.0	2005
1	4625	173	22	4.7	0.5	0.0	2006
1	5932	1491	125	4.2	0.2	0.0	2007
1	13253	2814	294	10.0	0.0	0.0	2008
1	5927	555	117	14.5	1.9	0.1	2009
1	5532	542	87	4.1	0.2	0.0	2010
1	7827	712	205	17.9	5.8	0.0	2011
1	2611	740	140	14.0	2.6	0.0	2012

NIGFS-WIBTS-Q1: Northern Ireland March Groundfish Survey - Irish Sea West - Nos. per 3 nm

1994	2013					
1	1 0.21	0.25				
0	4					
1	4307	73	121	6	0	1994
1	3604	988	53	30	1	1995
1	2323	587	188	11	15	1996
1	3250	447	52	14	1	1997
1	3857	535	71	9	3	1998
1	2373	228	39	7	2	1999
1	4037	231	23	3	0	2000
1	1998	631	30	2	1	2001
1	3580	163	36	3	0	2002
1	2952	812	25	6	1	2003
1	3568	174	36	1	0	2004
1	1219	97	6	1	0	2005
1	1266	150	12	0	0	2006
1	1825	190	10	1	0	2007
1	1254	290	17	1	0	2008
1	1941	227	10	1	0	2009
1	1485	297	20	1	0	2010
1	818	211	32	1	0	2011
1	2054	148	18	4	0	2012
1	1077	585	21	2	0	2013

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2012.

NIGFS-WIBTS-Q4-EAST: Northern Ireland October Groundfish Survey - Irish Sea East - Nos. per 3 nm

1994	2012						
1	1 0.83	0.88					
0	5						
1	749	472	179	165.0	29.0	3.0	1994
1	2515	259	178	41.0	47.0	9.0	1995
1	1005	517	127	64.0	15.0	10.0	1996
1	640	668	682	88.0	26.0	6.0	1997
1	1446	277	178	95.0	11.0	4.0	1998
1	2287	1388	260	102.0	79.0	3.0	1999
1	1972	1288	216	26.0	22.0	9.0	2000
1	2998	691	300	35.0	7.0	5.0	2001
1	1296	1285	349	76.0	8.5	2.0	2002
1	3783	1939	1104	155.4	25.0	3.2	2003
1	1820	521	347	109.1	7.7	1.7	2004
1	1247	865	296	17.5	1.9	0.6	2005
1	2304	150	52	9.0	2.1	0.0	2006
1	1094	827	165	18.4	2.9	3.1	2007
1	2329	873	81	1.3	0.2	0.0	2008
1	641	675	48	4.4	1.1	0.0	2009
1	807	260	326	9.1	1.4	0.3	2010
1	1638	230	47	18.2	2.8	1.1	2011
1	695	370	154	15.2	6.6	0.3	2012

NIGFS-WIBTS-Q1-EAST: Northern Ireland March Groundfish Survey - Irish Sea East - Nos. per 3 nm

1993	2013					
1	1 0.21	0.25				
1	5					
1	611	290	390	47	12.0	1994
1	448	522	142	109	25.0	1995
1	1094	221	203	40	44.0	1996
1	561	1054	91	33	2.0	1997
1	409	903	522	32	11.0	1998
1	1023	407	135	52	6.0	1999
1	1481	524	229	35	4.0	2000
1	631	739	162	15	9.0	2001
1	869	1043	243	54	13.1	2002
1	1118	1328	178	24	5.7	2003
1	1026	302	69	4	1.6	2004
1	499	129	41	12	3.9	2005
1	964	323	39	10	0.7	2006
1	623	120	11	3	0	2007
1	669	417	51	3	0	2008
1	956	313	47	2	0	2009
1	671	357	24	2	2	2010
1	530	164	33	4	1	2011
1	703	418	43	6	1	2012
1	545	734	78	4	1	2013

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2012.

UK (E&W)-BTS-Q3: Corystes Irish Sea Beam Trawl Survey (Sept) - Prime stations only - Effort and numbers at age (per km towed)

1988	2011		
1	1 0.75	0.79	
0	1		
1	326	134	1988
1	226	66	1989
1	316	242	1990
1	494	74	1991
1	451	596	1992
1	297	197	1993
1	196	133	1994
1	1952	74	1995
1	172	207	1996
1	406	277	1997
1	905	186	1998
1	581	153	1999
1	321	139	2000
1	596	197	2001
1	283	103	2002
1	520	184	2003
1	908	339	2004
1	845	293	2005
1	1019	222	2006
1	369	90	2007
1	826	85	2008
1	397	385	2009
1	206	31	2010
1	540	347	2011

NIGFS-WIBTS-Q4-EAST & WEST: Northern Ireland October Groundfish Survey - Irish Sea East & West - Nos. per 3 nm

1992	2011						
1	1 0.83	0.88					
0	5						
1	1454	995	96	26.0	4.0	0.0	1992
1	1554	425	300	27.0	2.0	0.1	1993
1	2450	686	133	123.0	20.0	2.0	1994
1	3199	483	163	30.9	33.6	6.9	1995
1	2628	605	124	50.0	10.8	6.8	1996
1	3219	655	504	63.0	19.0	4.0	1997
1	3601	414	164	70.0	7.9	3.0	1998
1	3945	1060	191	70.0	54.1	1.7	1999
1	2631	1066	158	18.0	15.8	6.1	2000
1	6911	713	270	29.0	4.7	3.1	2001
1	3189	1421	274	55.4	6.1	1.5	2002
1	5284	1831	901	111.9	17.4	2.2	2003
1	4892	712	276	78.1	5.3	1.2	2004
1	2583	684	219	14.2	1.5	0.4	2005
1	3045	157	43	7.6	1.6	0.0	2006
1	2638	1039	153	13.8	2.0	2.1	2007
1	5815	1492	149	4.1	0.1	0.0	2008
1	2328	637	70	7.6	1.3	0.0	2009
1	2315	350	250	7.5	1.0	0.2	2010
1	3613	384	97	18.1	3.8	0.7	2011

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2012.

NIGFS-WIBTS-Q1-EAST & WEST: Northern Ireland March Groundfish Survey- Irish Sea East & West - Nos. per 3 nm

1992	2012						
1	1 0.21	0.25					
1	5						
1	1477	456	94	29	5.0	0.0	1992
1	667	655	67	9	2.0	0.5	1993
1	1790	221	304	34	8.0	5.0	1994
1	1696	698	116	85	17.0	3.0	1995
1	1478	280	160	28	32.0	5.6	1996
1	1419	860	79	27	1.7	4.3	1997
1	1730	767	196	12	3.3	0.1	1998
1	1453	350	104	38	5.0	1.0	1999
1	2297	431	163	25	2.7	0.0	2000
1	1067	704	120	11	7	1.6	2001
1	1734	762	177	38	9	0.3	2002
1	1703	1163	129	18	4	0.0	2003
1	1837	261	59	3	1	0.1	2004
1	729	119	30	9	3	0.3	2005
1	1054	274	31	7	1	0.1	2006
1	1007	142	11	2	0.1	0.0	2007
1	856	376	40	3	0.2	0.0	2008
1	1270	285	35	1	0.1	0.1	2009
1	931	338	23	2	1.5	0.0	2010
1	622	179	33	3	0.4	0.0	2011
1	1134	331	35	5	0.8	0.0	2012

NIMIK : Northern Ireland MIK Net Survey

1994	2011	
1	1 0.46	0.50
0	0	
1	778	1994
1	225	1995
1	397	1996
1	205	1997
1	59	1998
1	91	1999
1	40	2000
1	167	2001
1	19	2002
1	148	2003
1	101	2004
1	135	2005
1	118	2006
1	82	2007
1	99	2008
1	173	2009
1	78	2010
1	122.2	2011

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2012.

ScoGFS-WIBTS-Q1: Scottish groundfish survey in Spring

1996 2006

1 1 0.15 0.21

1 8

1	11610	4051	1898	362	229	59	3	4	1996
1	16322	16200	2953	964	250	105	39	1	1997
1	22145	8187	3817	137	110	0	5	0	1998
1	19815	6642	1706	282	11	0	27	0	1999
1	13019	1662	169	71	36	6	0	0	2000
1	9419	4541	407	40	2	0	0	0	2001
1	15605	3060	430	34	1	0	0	0	2002
1	14798	5404	375	45	0	4	0	0	2003
1	9199	2219	583	27	1	0	0	0	2004
1	3783	899	200	56	3	0	0	0	2005
1	7317	1040	319	32	2	0	0	0	2006

ScoGFS-WIBTS-Q4: Scottish groundfish survey

1995 2005

1 1 0.83 0.91

0 6

1

1	30094	8827	2530	435	215	4	0	1997
1	18457	7166	1291	37	35	26	0	1998
1	73309	7357	2166	263	219	0	6	1999
1	16862	8677	503	242	25	12	0	2000
1	0	140	133	13	0	0	0	2001
1	30324	16655	1435	224	2	28	0	2002
1	26671	7170	1138	69	0	0	0	2003
1	42435	19333	3321	319	3	0	0	2004
1	16510	3382	97	4	2	3	0	2005

IR-ISCSGFS : Irish Sea Celtic Sea GFS 4th Qtr - Effort min. towed - No. at age

1997 2002

1 1 0.8 0.9

0 5

540	1566	3330	793	154	23	12	1997
1020	48396	6534	2249	170	15	0	1998
1170	208494	3302	624	24	28	2	1999
1128	97502	4402	25	1	0	0	2000
1221	28881	29577	3123	177	1	0	2001
1035	12112	10237	1497	225	33	5	2002

IR-Q4 IBTS: IRISH GFS RV Celtic Explorer: NUMBERS AT AGE

2003 2004

1 1 0.89 0.91

0 5

1	72340	19658	13391	1617	605	0	2003
1	75196	14563	1293	147	5	2	2004

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2012.

IR-OTB : Irish Otter trawl - Effort in h - VIIa Whiting numbers at age - Year

1995	2002						
1	1 0	1					
1	6						
80314	6	437	206	261	21	1	1995
64824	64	682	1528	266	71	4	1996
92178	3	368	494	418	55	19	1997
93533	20	395	838	117	27	30	1998
110275	34	398	531	130	19	3	1999
82690	40	192	155	58	8	0	2000
77541	13	397	444	42	22	3	2001
77863	21	173	383	88	8	8	2002

UKNI-Pelagic trawl : Northern Ireland Midwater trawlers - Effort in h - No per h fished

1993	2002					
1	1 0	1				
2	6					
74014	3174	1060	172	29.5	4.8	1993
73778	1706	4340	574	72.8	16.2	1994
52773	1997	416	719	37.9	7.2	1995
53083	1432	2276	361	327.4	41.8	1996
55863	1241	660	549	12.3	17.5	1997
61153	438	423	98	45.8	2.7	1998
72859	162	185	57	13.5	11.6	1999
46412	67	53	11	7.9	1.1	2000
50302	7	4	2	0.5	0.2	2001
57754	189	316	90	11	15	2002

UKNI-Otter trawl : Northern Ireland single-rig otter trawlers - Effort in h - No per h fished - includes discards

1993	2002							
1	1 0	1						
0	6							
195323	10308	9217	21444	2791	261	28	2	1993
191705	3172	11286	3957	9723	747	75	16	1994
161025	5228	10692	8874	987	1312	17	1	1995
154418	8663	20784	6748	4623	551	460	56	1996
165612	4344	12001	5864	1292	528	7	7	1997
149088	5869	11381	2368	1135	200	50	1	1998
146990	14625	3517	1202	344	59	12	8	1999
130117	4403	12613	3082	520	61	14	8	2000
131418	10658	6663	1833	228	64	13	10	2001
108616	4601	8586	1068	265	44	3	2	2002

Table 6.6.2 (cont'd). Whiting in VIIa. Survey data available to WGCSE 2012.

UKE&W-Otter trawl : England/Wales Otter Trawl

1981	2000						
1	1 0	1					
2	6						
107	906	766	162	103	4	1981	
127	1984	893	340	67	49	1982	
88	685	1065	227	67	21	1983	
103	1395	439	475	80	29	1984	
103	2077	889	148	125	25	1985	
90	2246	1006	158	20	17	1986	
131	2206	1505	316	58	5	1987	
132	1885	827	161	30	6	1988	
140	1344	1201	234	40	10	1989	
117	2076	671	222	35	14	1990	
107	2374	793	165	48	5	1991	
97	2072	1020	177	42	3	1992	
79	784	654	157	31	5	1993	
43	110	454	91	15	3	1994	
43	460	188	375	7	1	1995	Revised at NSWG 1997
42	260	604	102	90	10	1996	
40	331	211	155	7	1	1997	
37	311	355	81	28	1	1998	
23	194	175	46	11	8	1999	
27	186	134	47	36	4	2000	

Table 6.6.3. VIIa whiting International numbers-at-age ('000) for human consumption, 1980–2002 (partially corrected for misreporting). Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	0	0	41	0	0	0	0	0	0	0
1	14520	11203	5427	4886	18254	15540	6306	10149	6983	11645
2	21811	29011	18098	9943	12683	35324	16839	21563	25768	14029
3	6468	16004	19340	9100	5257	8687	10809	6968	6989	13011
4	2548	2596	6108	4530	2571	996	1877	1943	1513	3645
5	350	821	813	1165	1045	675	285	242	396	490
6+	621	339	400	321	402	372	270	111	197	177

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0	102	0	38	0	0	129	0	0	1
1	9502	7426	8380	2742	3245	1124	1652	610	329	341
2	17604	18406	21907	21468	6983	10095	6162	4239	3287	2806
3	4734	5829	7959	7327	18509	3020	7432	2567	4727	2607
4	1477	993	1374	932	1801	4444	1263	1795	888	741
5	318	311	462	135	208	233	1082	87	261	160
6+	128	84	93	27	50	21	135	79	95	119

Age	2000	2001	2002
0	0	0	0
1	319	111	67
2	1364	1189	748
3	1002	1006	1480
4	299	171	376
5	115	53	48
6+	15	20	41

Table 6.6.4. VIIa whiting International discard numbers-at-age ('000), 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	12786	9865	4047	23847	26394	12380	28364	16594	6922	17247
1	32318	24935	8489	7328	33900	26461	21111	40598	17958	20701
2	6888	9162	560	2036	1568	1859	1464	1875	1940	2476
3	65	162	19	9	11	9	33	0	0	26
4	26	26	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6+	0	0	0	0	0	0	0	0	0	0

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	4216	20349	1497	12639	3731	7118	12732	8163	6096	20851
1	31810	29334	61451	13979	12063	17613	39647	25497	27131	7677
2	3353	3823	10404	17707	1812	7015	8168	5352	2293	2117
3	72	146	97	426	1702	492	1976	689	550	228
4	0	1	0	5	29	234	81	141	44	34
5	0	0	0	0	0	0	0	0	0	2
6+	0	0	0	0	0	0	0	0	0	2

Age	2000	2001	2002
0	7321	16940	8538
1	38922	12631	13412
2	4395	3150	1588
3	564	102	231
4	55	10	33
5	1	0	0
6+	10	0	1

Table 6.6.5. VIIa whiting International catch numbers-at-age ('000) combined landings and discards, 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	12786	9865	4088	23847	26394	12380	28364	16594	6922	17247
1	46838	36138	13916	12214	52154	42001	27417	50747	24941	32346
2	28699	38173	18658	11979	14251	37183	18303	23438	27708	16505
3	6533	16166	19359	9109	5268	8696	10842	6968	6989	13037
4	2574	2622	6108	4530	2571	996	1877	1943	1513	3645
5	350	821	813	1165	1045	675	285	242	396	490
6+	621	339	400	321	402	372	270	111	197	177

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	4216	20451	1497	12677	3731	7118	12861	8163	6096	20852
1	41312	36760	69831	16721	15308	18737	41299	26107	27460	8018
2	20957	22229	32311	39175	8795	17110	14330	9591	5580	4923
3	4806	5975	8056	7753	20211	3512	9408	3256	5277	2835
4	1477	994	1374	937	1830	4678	1344	1936	932	776
5	318	311	462	135	208	233	1082	87	261	161
6+	128	84	93	27	50	21	135	79	95	121

Age	2000	2001	2002
0	7321	16940	8538
1	39242	12742	13479
2	5758	4338	2336
3	1566	1108	1711
4	354	181	409
5	115	53	48
6+	25	20	42

Table 6.6.6. VIIa whiting International landings mean weight-at-age (kg), 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	0.133	0.133	0.133	0	0.144	0	0.134	0	0	0
1	0.216	0.216	0.216	0.215	0.208	0.174	0.184	0.173	0.152	0.197
2	0.269	0.269	0.269	0.279	0.257	0.250	0.225	0.223	0.214	0.209
3	0.365	0.365	0.365	0.397	0.403	0.333	0.342	0.363	0.330	0.269
4	0.533	0.533	0.533	0.491	0.550	0.478	0.512	0.535	0.547	0.433
5	0.630	0.630	0.630	0.605	0.699	0.567	0.709	0.720	0.763	0.680
6+	0.772	0.888	0.736	0.655	0.745	0.642	0.940	0.933	1.005	1.079

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0	0.115	0	0.117	0	0	0	0	0	0.120
1	0.198	0.172	0.160	0.151	0.169	0.188	0.196	0.171	0.169	0.166
2	0.220	0.210	0.198	0.186	0.198	0.219	0.217	0.219	0.202	0.218
3	0.313	0.266	0.274	0.233	0.227	0.273	0.244	0.244	0.240	0.255
4	0.436	0.352	0.361	0.332	0.304	0.334	0.288	0.296	0.274	0.328
5	0.676	0.453	0.513	0.454	0.378	0.551	0.365	0.396	0.350	0.352
6+	0.800	0.692	1.007	0.892	0.496	1.320	0.415	0.537	0.421	0.328

Age	2000	2001	2002
0	0.064	0	0
1	0.179	0.182	0.145
2	0.216	0.250	0.214
3	0.269	0.319	0.273
4	0.317	0.346	0.356
5	0.347	0.538	0.449
6+	0.412	0.337	0.428

Table 6.6.7. VIIa whiting International discard mean weight-at-age (kg), 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	0.034	0.034	0.029	0.033	0.024	0.022	0.023	0.024	0.021	0.026
1	0.062	0.062	0.072	0.101	0.075	0.080	0.058	0.078	0.069	0.063
2	0.125	0.125	0.125	0.147	0.130	0.137	0.126	0.157	0.114	0.105
3	0.230	0.230	0.141	0.245	0	0	0.155	0	0.449	0.091
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6+	0	0	0	0	0	0	0	0	0	0

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.034	0.030	0.014	0.029	0.029	0.031	0.026	0.026	0.017	0.028
1	0.060	0.051	0.050	0.050	0.048	0.055	0.051	0.041	0.034	0.038
2	0.113	0.115	0.110	0.089	0.123	0.120	0.111	0.101	0.090	0.086
3	0.115	0.130	0.137	0.143	0.154	0.153	0.161	0.141	0.130	0.147
4	0	0	0	0.175	0.149	0.179	0.186	0.170	0.145	0.237
5	0	0	0	0	0	0	0	0	0	0.218
6+	0	0	0	0	0	0	0	0	0	0.174

Age	2000	2001	2002
0	0.024	0.017	0.016
1	0.036	0.034	0.033
2	0.100	0.088	0.082
3	0.128	0.119	0.127
4	0.150	0.194	0.141
5	0.213	0	0
6+	0.152	0	0.213

Table 6.6.8. VIIa whiting International catch mean weight-at-age (kg) combined landings and discard, 1980–2002. Estimates have not been possible since 2003 due to low landings and resulting poor sampling.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	0.034	0.040	0.031	0.033	0.032	0.021	0.025	0.024	0.021	0.026
1	0.110	0.118	0.135	0.146	0.125	0.107	0.100	0.101	0.088	0.111
2	0.235	0.240	0.265	0.256	0.244	0.245	0.217	0.217	0.201	0.193
3	0.363	0.364	0.365	0.397	0.403	0.333	0.342	0.363	0.330	0.269
4	0.529	0.529	0.533	0.491	0.550	0.478	0.512	0.535	0.547	0.433
5	0.630	0.630	0.630	0.605	0.700	0.567	0.709	0.720	0.763	0.680
6+	0.772	0.888	0.736	0.655	0.745	0.642	0.940	0.933	1.005	1.079

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.036	0.031	0.014	0.029	0.030	0.031	0.027	0.026	0.017	0.028
1	0.094	0.077	0.063	0.067	0.074	0.063	0.057	0.044	0.035	0.044
2	0.204	0.194	0.170	0.142	0.183	0.179	0.159	0.153	0.156	0.161
3	0.310	0.263	0.272	0.228	0.221	0.257	0.230	0.222	0.228	0.246
4	0.436	0.352	0.361	0.331	0.301	0.326	0.284	0.287	0.268	0.324
5	0.676	0.453	0.513	0.454	0.378	0.551	0.364	0.396	0.350	0.351
6+	0.800	0.692	1.007	0.892	0.496	1.320	0.715	0.679	0.421	0.325

Age	2000	2001	2002
0	0.024	0.017	0.016
1	0.038	0.036	0.033
2	0.127	0.132	0.124
3	0.218	0.301	0.253
4	0.291	0.338	0.339
5	0.347	0.538	0.449
6+	0.310	0.337	0.425

Table 6.6.9. VIIa whiting estimates of discard numbers-at-age from the *Nephrops* fleet as a proportion of total International numbers-at-age.

Age	0	1	2	3	4	5
1981	1.000	0.690	0.240	0.010	0.010	0
1982	0.990	0.610	0.030	0.001	0	0
1983	1.000	0.600	0.170	0.001	0	0
1984	1.000	0.650	0.110	0.002	0	0
1985	1.000	0.630	0.050	0.001	0	0
1986	1.000	0.770	0.080	0.003	0	0
1987	1.000	0.800	0.080	0	0	0
1988	1.000	0.720	0.070	0	0	0
1989	1.000	0.640	0.150	0.002	0	0
1990	1.000	0.770	0.160	0.015	0	0
1991	0.995	0.798	0.172	0.024	0.001	0
1992	1.000	0.880	0.322	0.012	0	0
1993	0.997	0.836	0.452	0.055	0.005	0
1994	1.000	0.788	0.206	0.084	0.016	0
1995	1.000	0.940	0.410	0.140	0.050	0
1996	0.990	0.960	0.570	0.210	0.060	0
1997	1.000	0.977	0.558	0.212	0.073	0
1998	1.000	0.988	0.411	0.104	0.047	0
1999	1.000	0.957	0.430	0.081	0.044	0.009
2000	1.000	0.992	0.763	0.360	0.154	0.005
2001	1.000	0.991	0.726	0.092	0.055	0
2002	1.000	0.995	0.680	0.135	0.081	0.000
Mean 81-02	0.999	0.817	0.311	0.070	0.027	0.001

Table 6.6.10. VIIa whiting estimated landed and discarded catch (t). Data partially corrected for misreporting.

	Catch (t)	
Year	Landed	Discarded
1980	13461	3324
1981	17646	2960
1982	17304	808
1983	10525	1820
1984	11802	3433
1985	15582	2654
1986	10300	2115
1987	10519	3899
1988	10245	1611
1989	11305	2103
1990	8212	2444
1991	7348	2598
1992	8588	4203
1993	6523	2707
1994	6763	1173
1995	4893	2151
1996	4335	3631
1997	2277	1928
1998	2229	1304
1999	1670	1092
2000	762	2118
2001	733	1012
2002	747	740
2003	401	n/a
Mean:	7990	2253

Table 6.6.11. VIIa whiting discard numbers- and mean weights-at-age from the Irish otter board trawl fleet 1996–2011. To be updated at WGCSE (2014).

Age	1996 Numbers ('000)	1996 Weight (kg)	1997 Numbers ('000)	1997 Weight (kg)	1998 Numbers ('000)	1998 Weight (kg)	1999 Numbers ('000)	1999 Weight (kg)	2000 Numbers ('000)	2000 Weight (kg)	2001 Numbers ('000)	2001 Weight (kg)	2002 Numbers ('000)	2002 Weight (kg)
0	5631.20	0.015	4110.63	0.027	5073.57	0.027	187.26	0.036	7850.12	0.033	20981.54	0.016	29017.16	0.021
1	5925.33	0.035	8361.19	0.044	5939.53	0.064	276.50	0.102	3098.24	0.047	8883.11	0.054	12097.93	0.033
2	1802.90	0.111	3243.45	0.120	3826.20	0.107	150.99	0.174	137.80	0.153	1413.48	0.126	576.17	0.112
3	144.34	0.217	696.18	0.200	440.05	0.185	43.70	0.235	30.31	0.229	479.38	0.133	152.95	0.105
4	6.02	0.206	68.71	0.241	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
5	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	22.95	0.136	17.66	0.123
6	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
7	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
8	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
9	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
10+	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total weight (t)		520.8		1024.1		1010.3		71.6		434.3		1054.5		1100.9

Sampling Information	1996	1997	1998	1999	2000	2001	2002
Number of Trips	8	8	7	4	10	2	1
Number of Hauls	48	44	58	40	111	34	7

Age	2004 Numbers ('000)	2004 Weight (kg)	2005 Numbers ('000)	2005 Weight (kg)	2006 Numbers ('000)	2006 Weight (kg)	2007 Numbers ('000)	2007 Weight (kg)	2008 Numbers ('000)	2008 Weight (kg)	2009 Numbers ('000)	2009 Weight (kg)	2010 Numbers ('000)	2010 Weight (kg)
0	17091.56	0.018	442.07	0.010	1534.97	0.016	5138.89	0.043	4585.77	0.025	13319.29	0.028	1406.81	0.016
1	7347.29	0.034	2531.84	0.035	1483.43	0.060	23000.16	0.038	7879.78	0.040	12913.10	0.036	4513.61	0.038
2	731.35	0.101	783.68	0.091	621.58	0.133	3282.67	0.095	1485.70	0.093	712.51	0.081	1383.11	0.084
3	142.50	0.165	129.28	0.159	99.02	0.218	916.09	0.145	161.03	0.119	2.60	0.175	129.68	0.133
4	96.30	0.218	40.12	0.154	16.82	0.312	10.96	0.276	13.46	0.130	0.89	0.257	5.41	0.163
5	0.00	0.000	24.48	0.371	0.00	0.000	1.92	0.304	0.00	0.000	0.00	0.000	0.47	0.167
6	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
7	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
8	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
9	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
10+	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
Total weight (t)		680.3		201.3		223.2		1544.7		585.3		892.3		329.8

Sampling Information	2004	2005	2006	2007	2008	2009	2010
Number of Trips	11	8	5	15	18	12	4
Number of Hauls	122	96	56	90	91	55	29

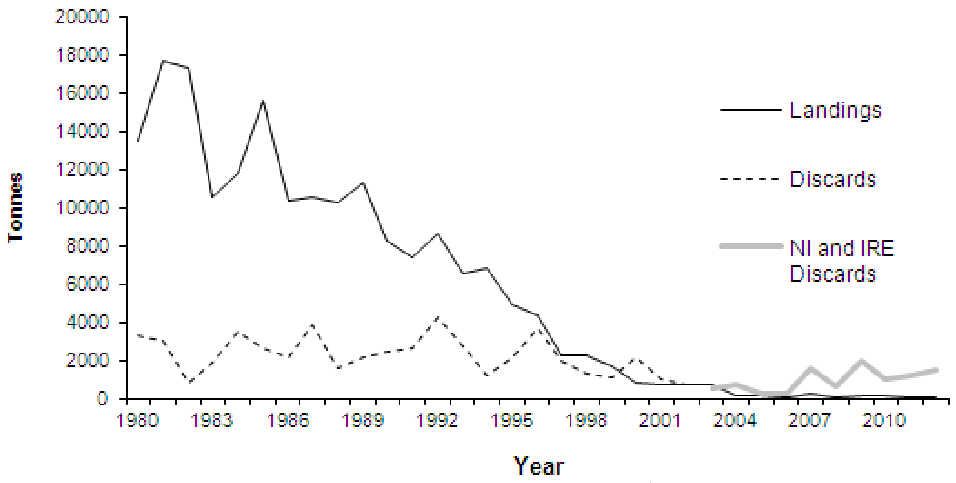


Figure 6.6.1. Whiting VIIa. Working group estimates of International Landings 1980–2012 and Discards 1980–2002. Between 2003–2008 only partial estimates discards were available. Since 2009–2011 discard estimates are for the main Irish and NI fleets.

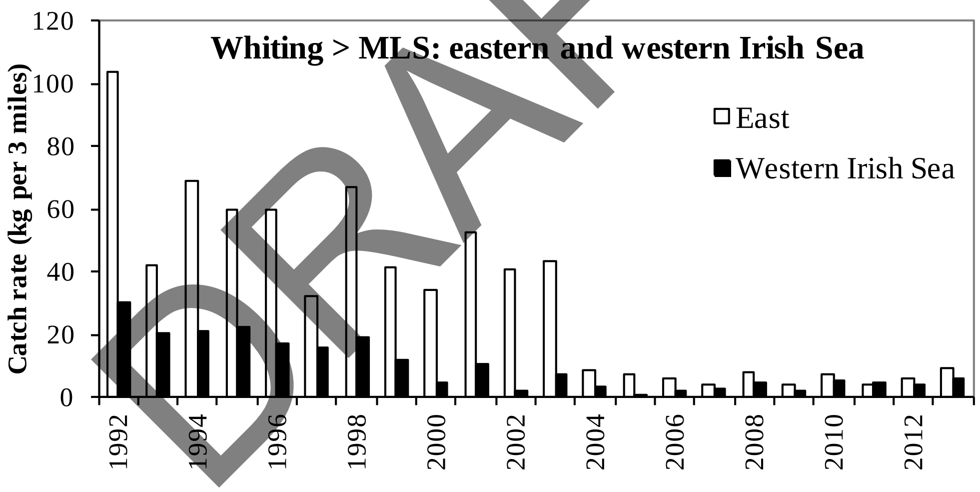
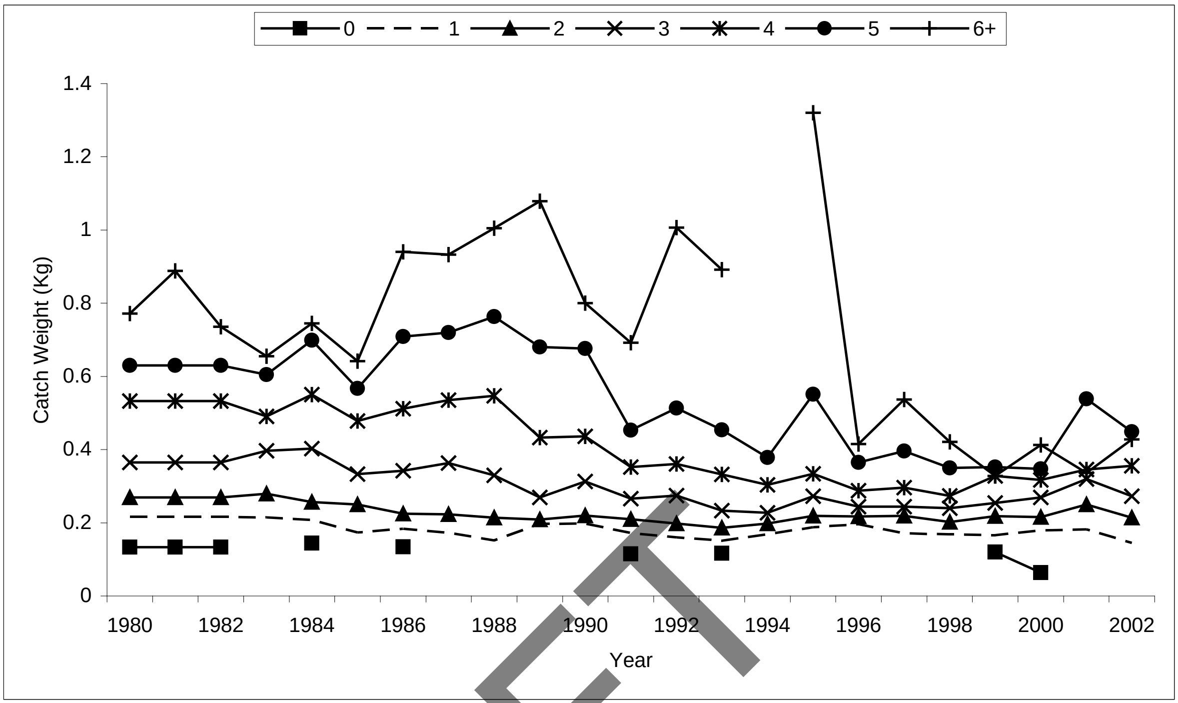


Figure 6.6.2. Eastern and western VIIa whiting mean catch rates in kg per 3-mile tow, for fish at and above the minimum landing size (27 cm) for NIGFS-WIBTS-Q1 survey in March 1992–2013.

a)



b)

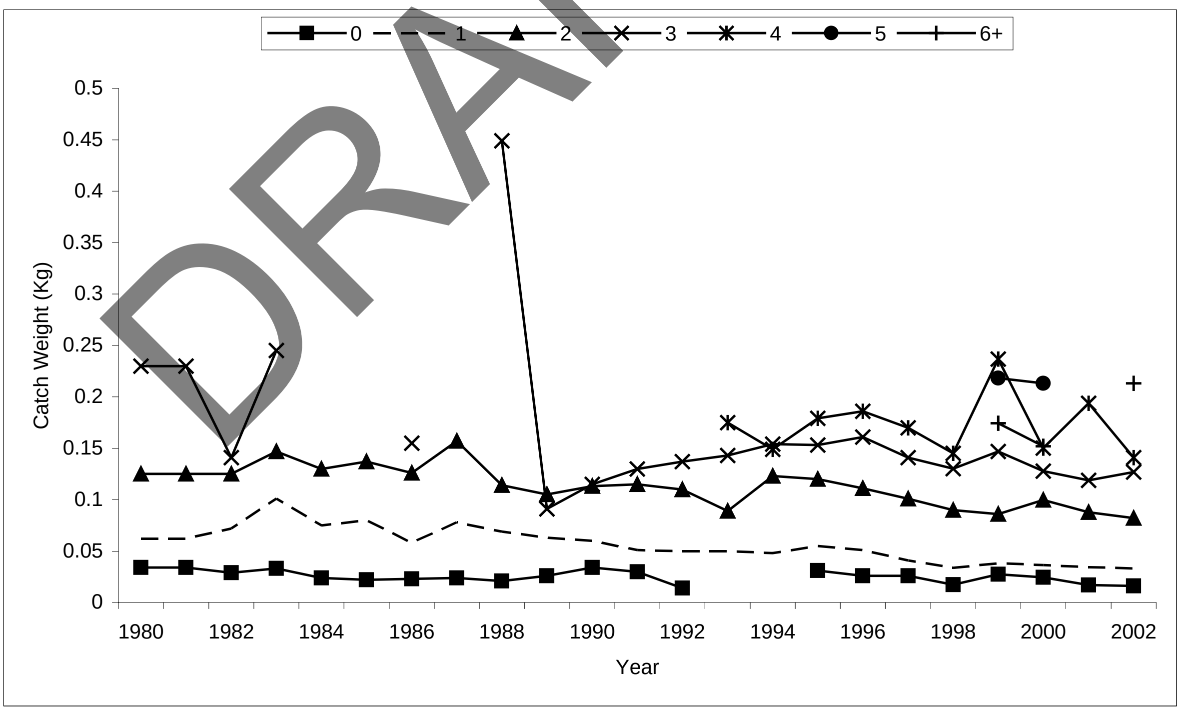


Figure 6.6.3. VIIa whiting International mean weights-at-age in (a) landings (Human Consumption Fishery) and (b) discards, 1980–2002.

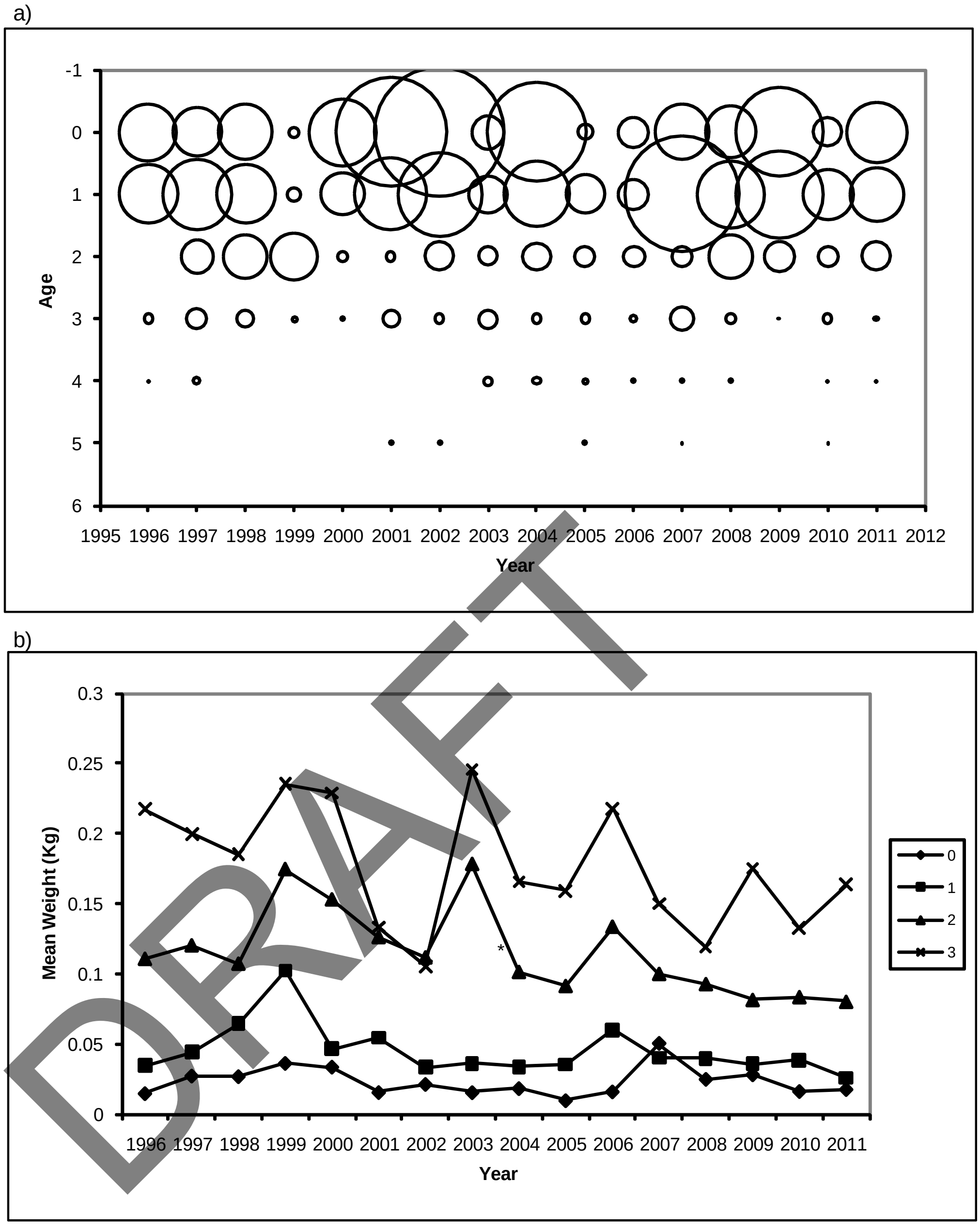


Figure 6.6.4. VIIa whiting discard information for the Irish commercial otter board trawl fleet (a) numbers-at-age and (b) mean weights-at-age, 1996–2011. NB To be updated at WGCSE (2014).

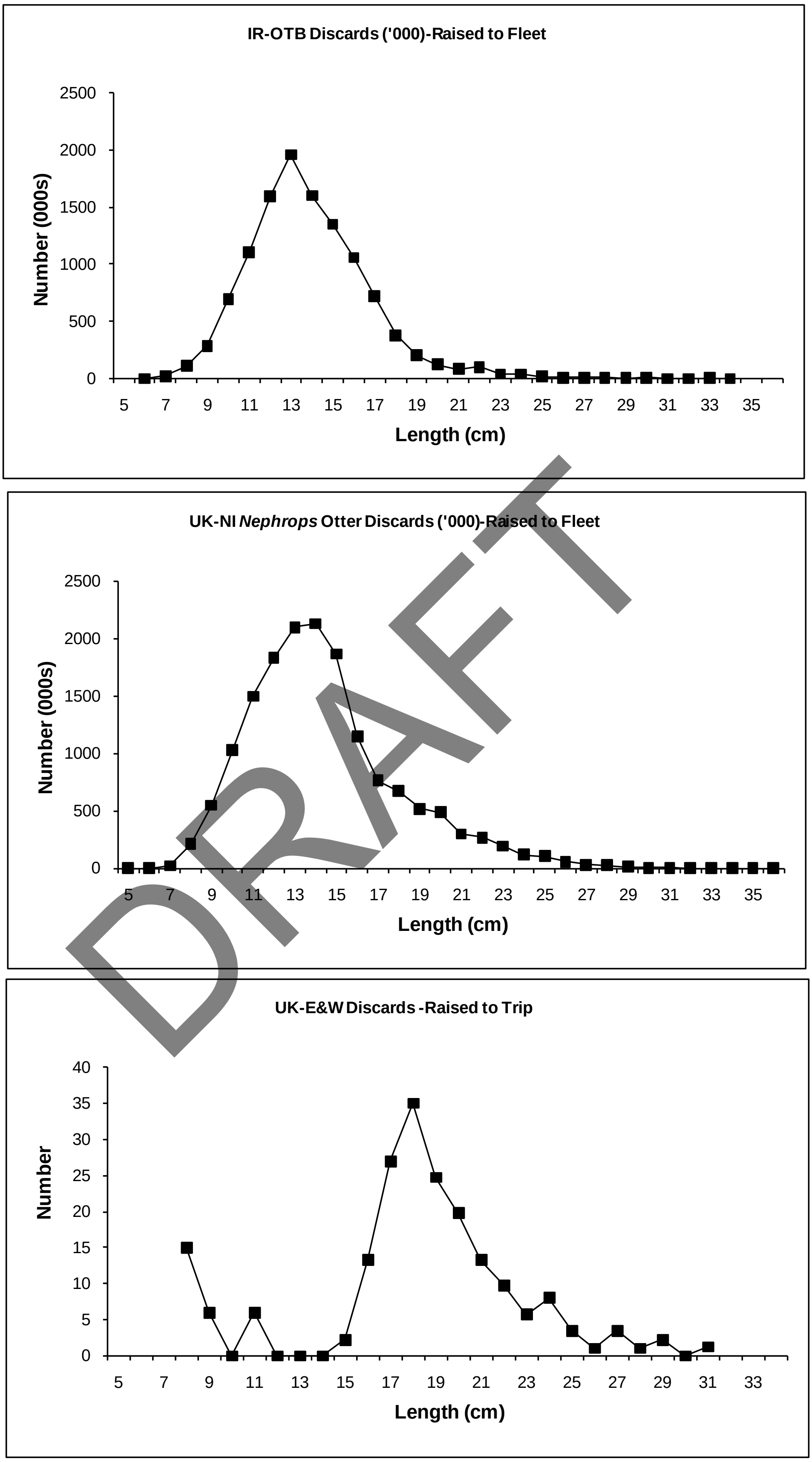
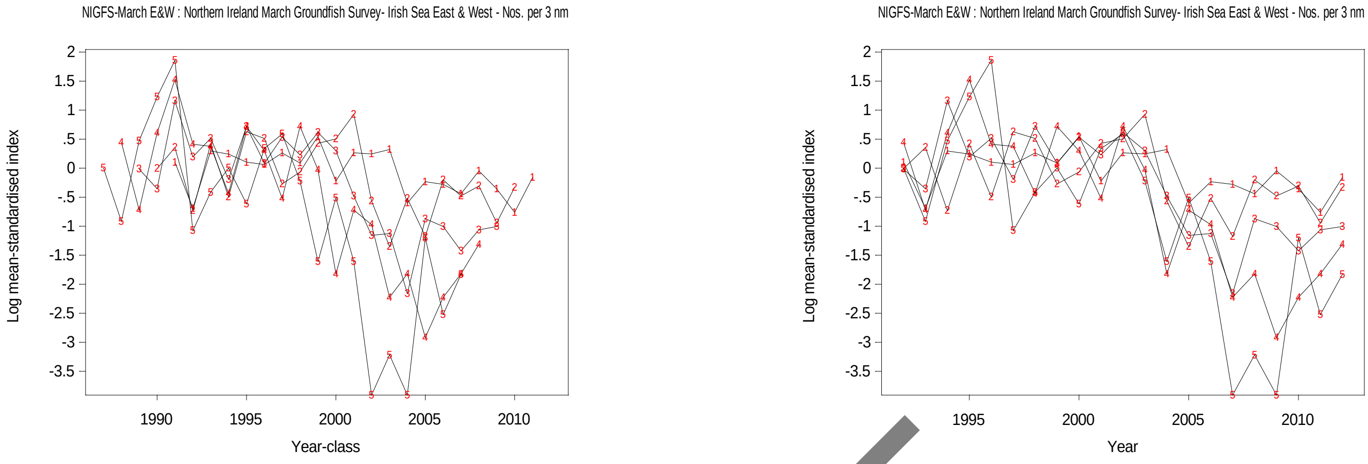


Figure 6.6.5. VIIa Whiting discard length–frequency by national fleets in 2011. Note due to low levels of retained catch, and hence low sampling, this data is not presented. NB To be updated at WGCSE (2014).

A)



B)

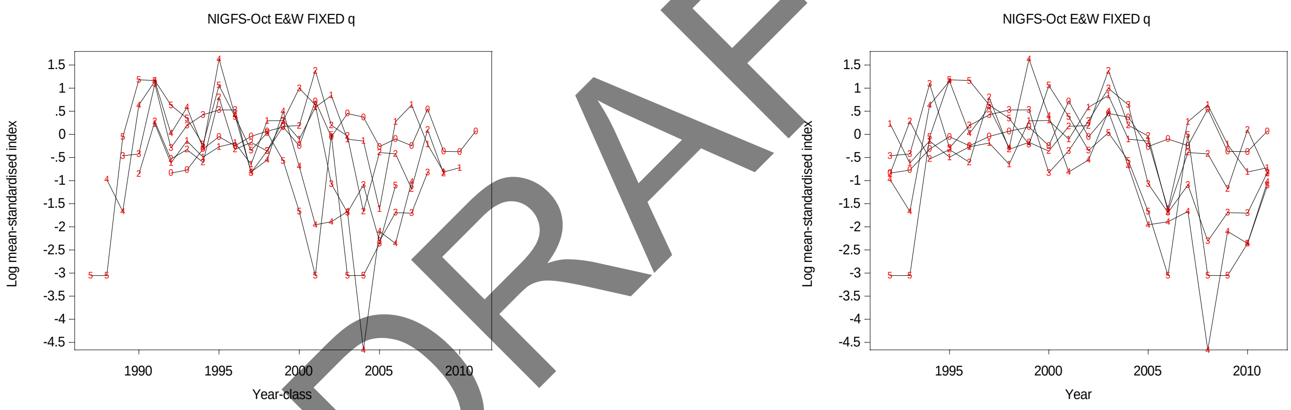
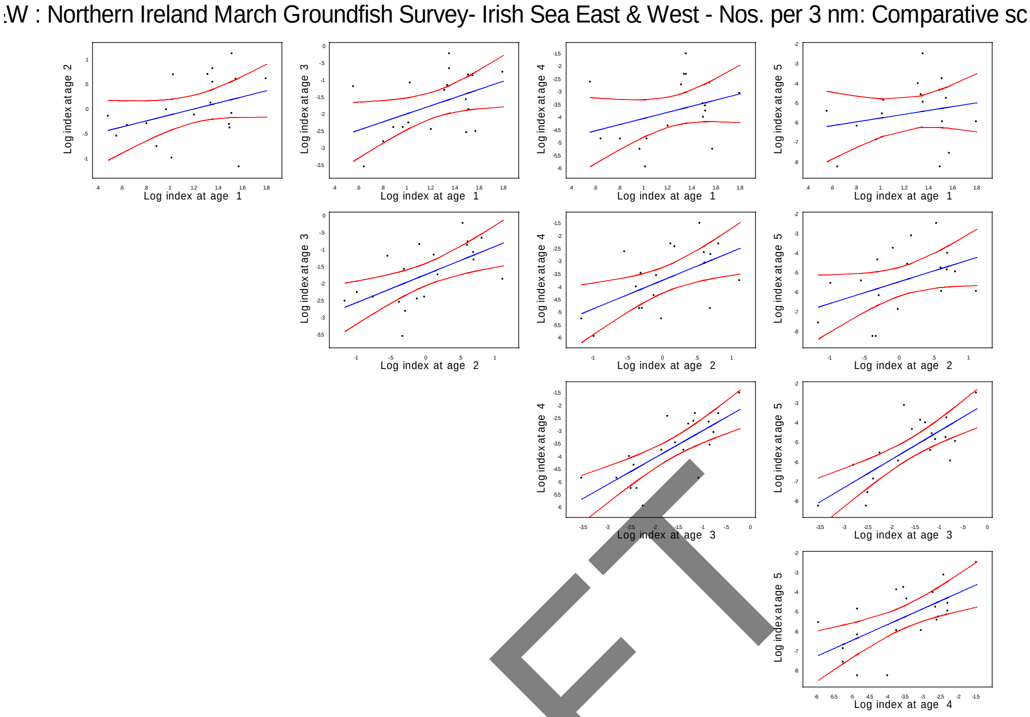


Figure 6.6.6. Log Mean Standardized Indices for (a) NIGFS-WIBTS-Q1 and (b) NIGFS-WIBTS-Q4 by year class and year. To be updated at WGCSE (2014).

a)



b)

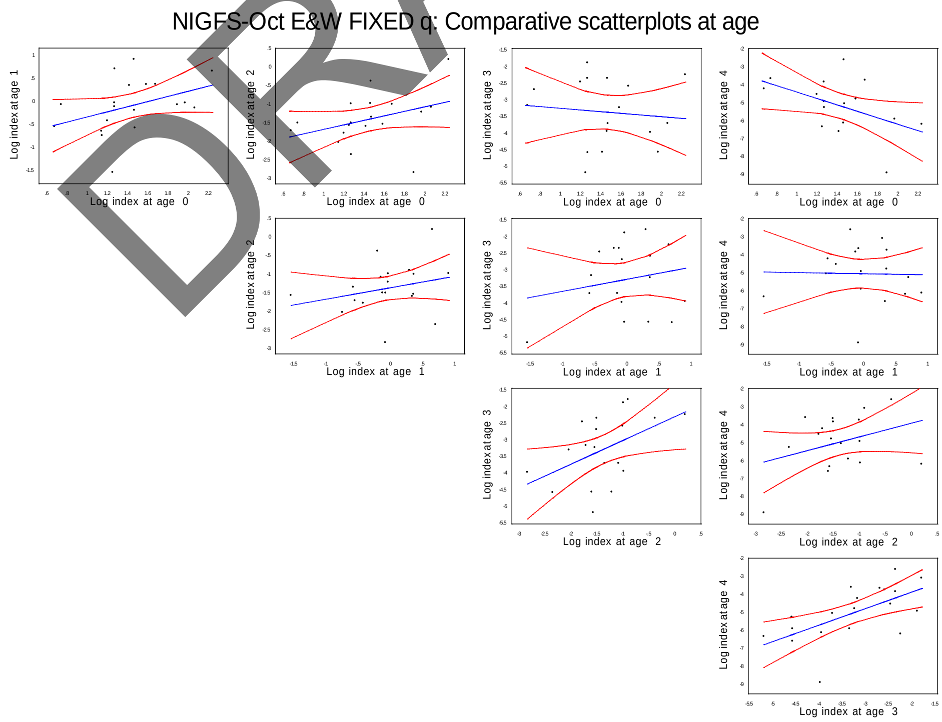
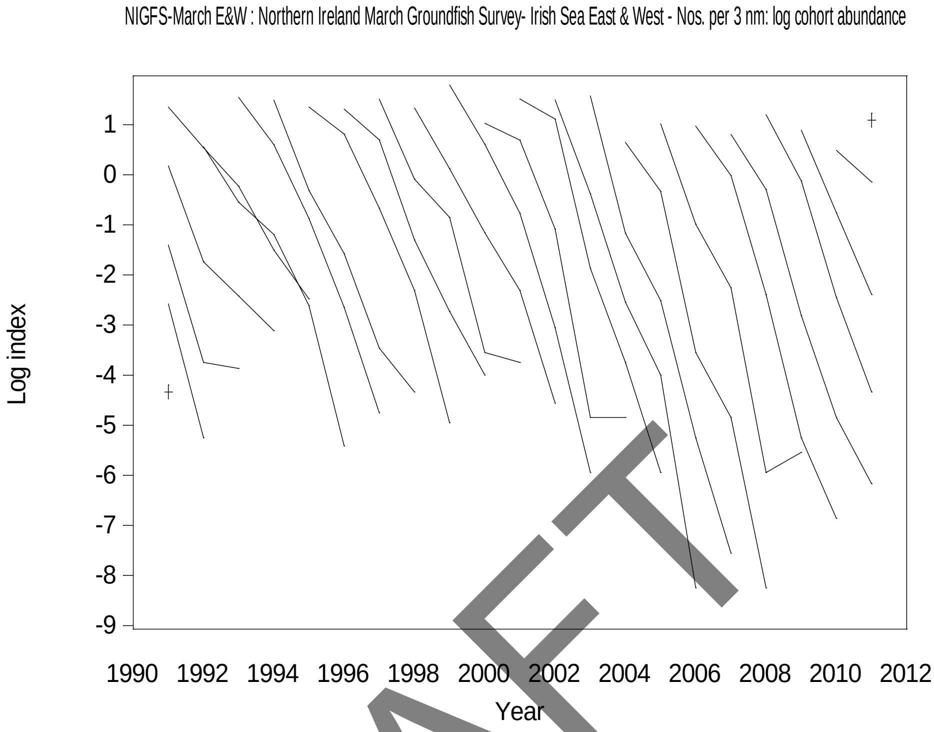


Figure 6.6.7. Scatter Plots of Log index-at-age for the NIGFS-WIBTS-Q1 (a) and NIGFS-WIBTS-Q4 (b) surveys. To be updated at WGCSE (2014).

a)



b)

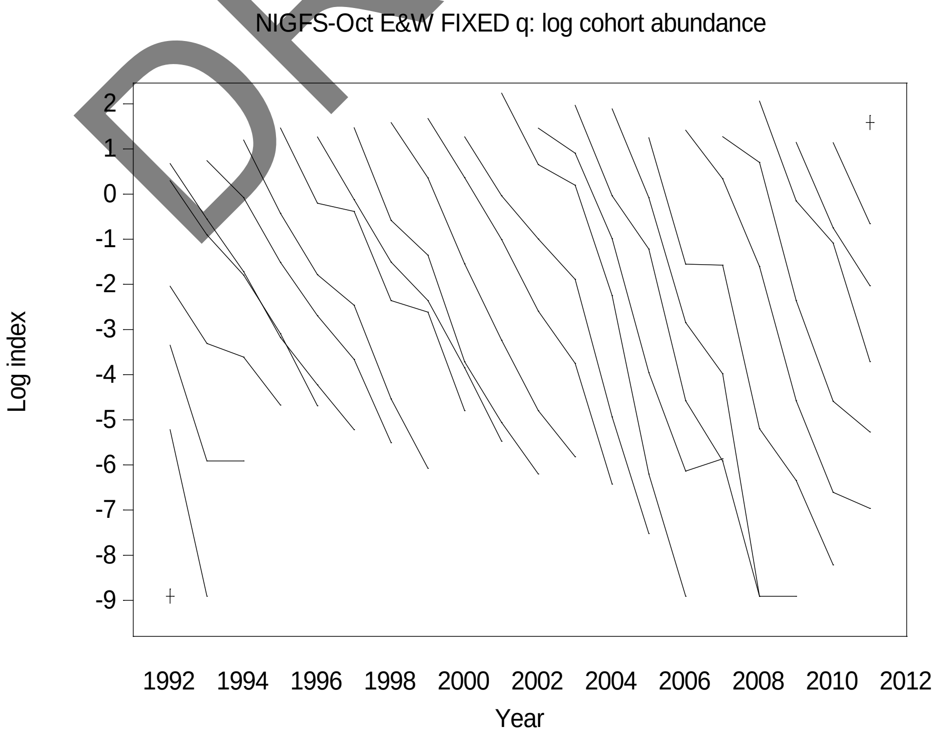
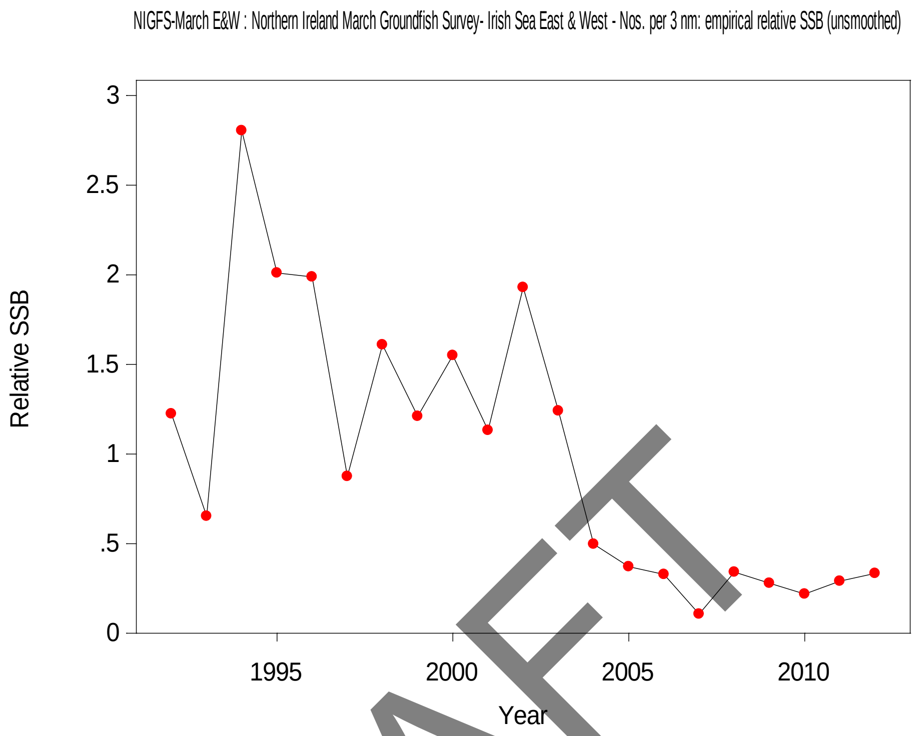


Figure 6.6.8. Catch Curves for NIGFS-WIBTS-Q1 (a) and NIGFS-WIBTS-Q4 (b) surveys. To be updated at WGCSE (2014).

a)



b)

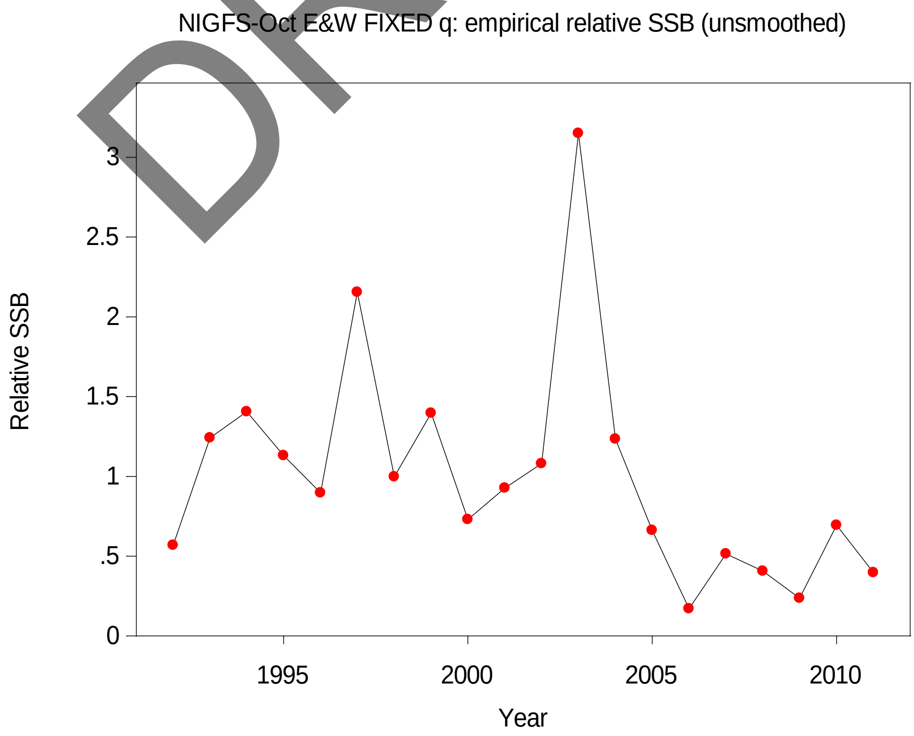


Figure 6.6.9. Empirical Estimates of SSB for NIGFS-WIBTS-Q1 (a) and NIGFS-WIBTS-Q4 (b) surveys. To be updated at WGCSE (2014).

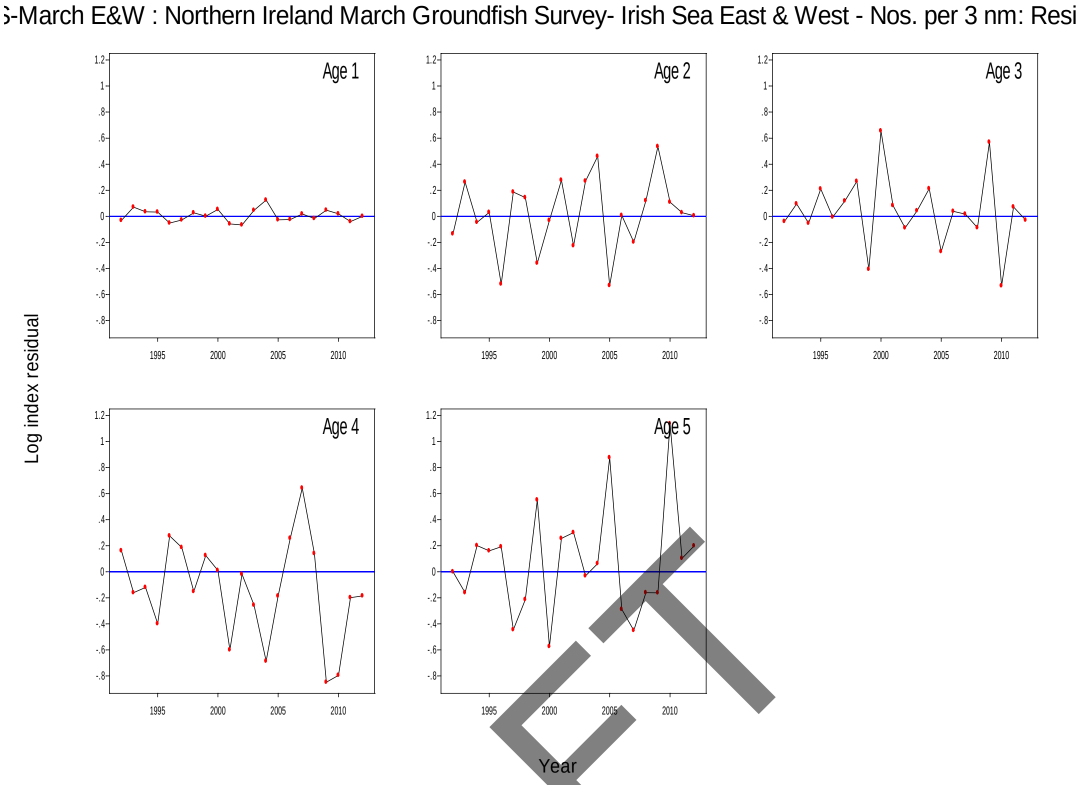


Figure 6.6.10. Residual Plots by Age of the NIGFS-WIBTS-Q1 survey. To be updated at WGCSE (2014).

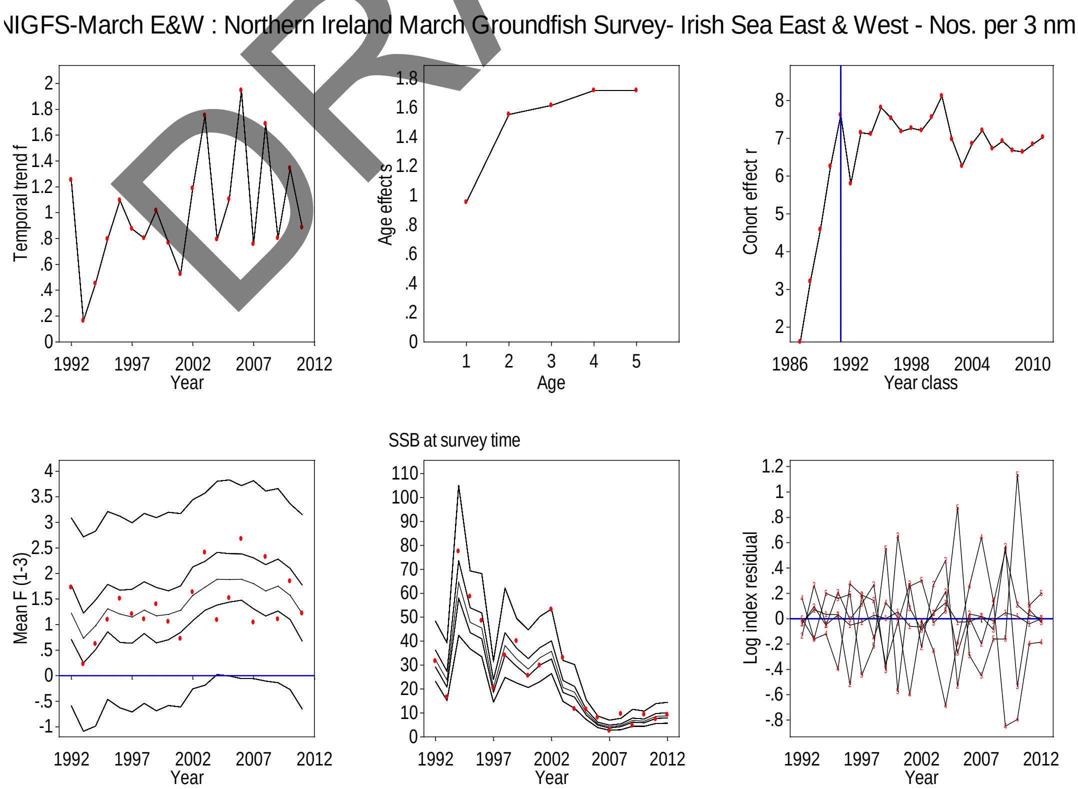


Figure 6.6.11. Stock Summary of the SURBA model fit for the NIGFS-WIBTS-Q1 survey. Empirical SSB (red dots) with model estimates of SSB (black line) are shown in bottom centre panel. To be updated at WGCSE (2014).

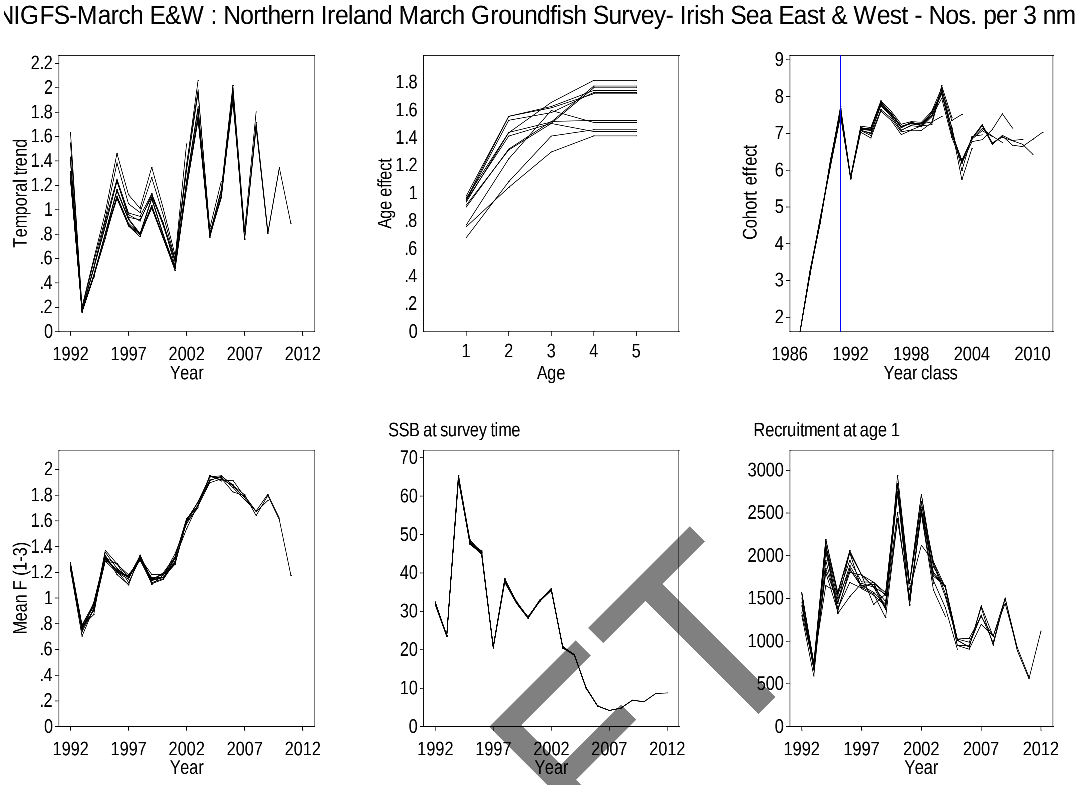


Figure 6.6.12. Retrospective pattern of Single fleet SURBA run for NIGFS-WIBTS-Q1 survey. To be updated at WGCSE (2014).

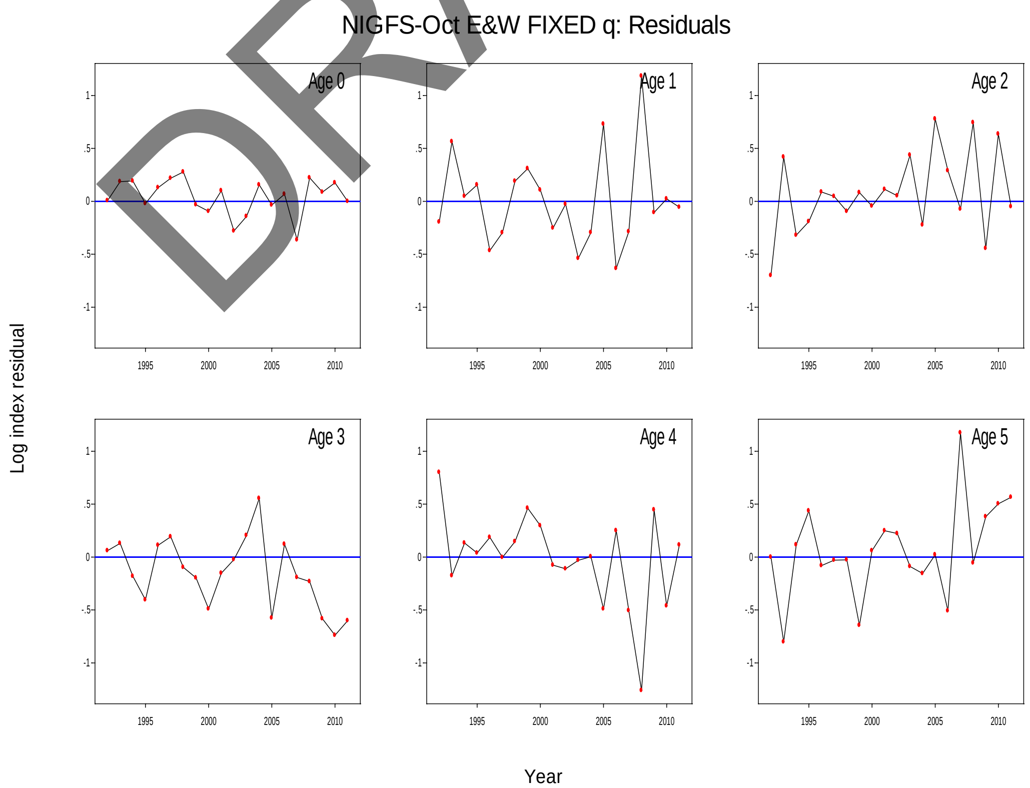


Figure 6.6.13. Residual Plots by Age of the NIGFS-WIBTS-Q4 survey. To be updated at WGCSE (2014). To be updated at WGCSE (2014).

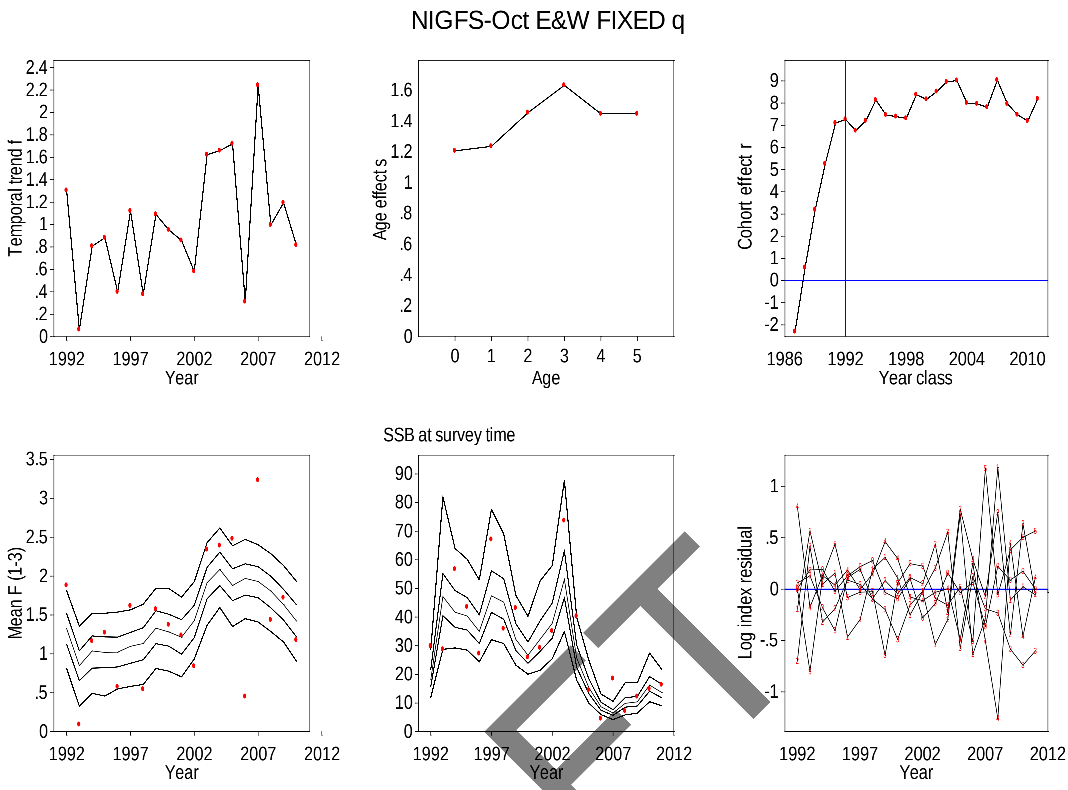


Figure 6.6.14. Stock Summary of the SURBA model fit for the NIGFS-WIBTS-Q4 survey. Empirical SSB (red dots) with model estimates of SSB (black line) are shown in bottom centre panel. To be updated at WGCSE (2014).

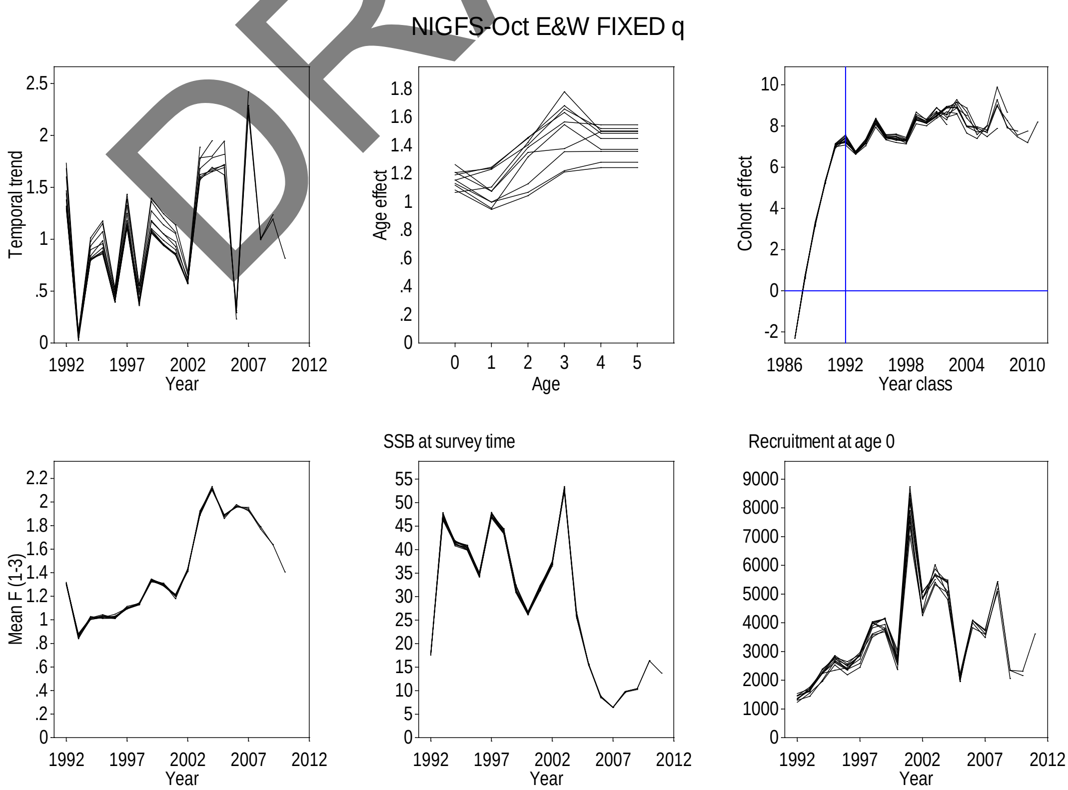


Figure 6.6.15. Retrospective pattern of Single fleet SURBA run for NIGFS-WIBTS-Q4 survey. To be updated at WGCSE (2014).

6.7 Plaice in Division VIIa (Irish Sea)

Type of assessment in 2013

Update of the analytic assessment used to derive relative trends. ICES WKFLAT (2011) benchmarked this assessment and included estimates of discards-at-age from 2004 into the catch matrix. However, due to the short time-series of discard data available considerable uncertainty exists regarding the historical levels of discarding. This uncertainty translates into uncertain stock size and unknown exploitation status, therefore the assessment is indicative of trends only.

ICES advice applicable to 2012

Effort should be consistent with no increase in catches.

ICES advice applicable to 2013

Effort should be consistent with no increase in catches.

6.7.1 General

Stock description and management units

The stock assessment area and the management unit are both Division VIIa (Irish Sea).

Management applicable in 2012 and 2013

Management of plaice in Division VIIa is by TAC and there is a minimum landing size (MLS) of 27 cm in force. The agreed TACs and associated implications for plaice in Division VIIa are detailed in the tables below.

2012

Species:	Plaice *Pleuronectes platessa*	Zone:	VIIa (PLE/07A.)
Belgium	42		
France	18		
Ireland	1 063		
The Netherlands	13		
United Kingdom	491		
EU	1 627		
TAC	1 627		Analytical TAC

2013

Species:	Plaice *Pleuronectes platessa*	Zone:	VIIa (PLE/07A.)
Belgium	83	Precautionary TAC	
France	36		
Ireland	651		
The Netherlands	25		
United Kingdom	832		
Union	1 627		
TAC	1 627		

The fishery in 2012

National landings data reported to ICES and Working Group estimates of total landings are given in Table 6.7.2.1.

The TAC in 2012 was 1627 tonnes and the working group estimate of landings in 2012 was 496 tonnes, which is a 16% decrease in landings comparable to 2011 and only 30% of the TAC in 2012. This shortfall in estimated landings relative to the TAC has occurred in previous years, increasing steadily from 7% of the TAC in 2003 to a peak shortfall of 70% in 2008, 2009 and 2012. It seems unlikely that the poor uptake of the quota is a consequence of an inability to catch sufficient quantities of plaice greater than the MLS; rather the shortfall in the uptake of the TAC is likely due to limited consumer demand and poor value of the catch.

Landings (based on working group estimates) by the Belgian, UK (E&W), NI, and Irish fleets comprised approximately 48%, 22%, 9% and 21% respectively of total landings in 2012. The landings of plaice are mainly split between beam trawlers (54%; primarily Belgian vessels then Irish vessels) targeting sole, and otter trawlers (39%; UK and Irish vessels). Historically, otter trawling was dominated by UK vessels fishing for whitefish, but in recent years many vessels have switched to target *Nephrops* (Figure 6.7.2.1). Otter trawlers from Ireland and N. Ireland typically target *Nephrops* in the western Irish Sea.

High levels of discarding are known to occur in all fisheries that catch plaice in the Irish Sea (see Figures 6.7.2.3 to 6.7.2.5).

A general description of the fishery can be found in the stock annex (Annex 6.7) and also in 'Other Relevant Data' section below. For general mixed fisheries advice applicable to this stock and other species taken in the same fisheries, see Section 6.1.

6.7.2 Data

Landings

National landings data reported to ICES and Working Group estimates of total landings are given in Table 6.7.2.1. Landed numbers-at-age for the younger ages (ages 2 to 4) have declined more rapidly over the last two decades than landings of older fish (Figure 6.7.2.2), despite the fact that high numbers of younger fish are caught by the beam-trawl survey, suggesting that the selection pattern and/or discarding behaviour of the fleets has changed over time. The procedures used to determine the total international landings figures are documented in the stock annex. The landings-at-age matrix alone is not representative of the true catch (Figure 6.7.2.2).

Discards

Prior to 2010, indications were that discard rates, although variable, were substantial. During WKFLAT 2011, discard data from the countries participating in the fishery was raised and collated to the total international level for the years 2004 – 2010 (Table 6.7.2.1). Discard information was available for Belgium, Ireland, N. Ireland and UK(E+W).

Routine discard sampling has been conducted by the UK(E&W) since 2002 and by Ireland since 1993. Northern Ireland has collected data from 1996 (but not between 2003 and 2005), and by Belgium since 2003. Length distributions (LD) of landed and discarded fish estimates are presented for UK(E&W) (Figure 6.7.2.3), Irish (Figure 6.7.2.4) and Belgian fleets (Figure 6.7.2.5). While, the discarding pattern is dominated by discarding of small fish (below MLS) in some years the Irish and Belgian fleets have discarded a small number of fish of a much greater size (e.g. 2004). Both, the UK(E&W) and Belgian observer data indicate overall mean (2004–2010) lengths of discarded and retained plaice at 23 cm and 30 cm respectively. However, the UK(E&W) data show that the mean length of discarded fish between 2007 and 2009 was 1 cm below the overall mean. Although variable, the Irish annual discard sampling LDs indicate that the overall mean (2004–2010) length of fish discarded is 19 cm, while the mean length of the retained component is 33 cm. However, in 2010, the mean length of both discarded and retained fish in the Irish data was ~3 cm greater (22 cm and 35 cm).

The UK estimates were raised to incorporate equivalent levels of discards for Ireland and N. Ireland on the basis of similar gear types and given the limitations of their data. A raising factor based on tonnages landed for these countries was calculated and applied to the UK(E+W) estimates of discard numbers. Finally, these estimates were added to those calculated for Belgium to give estimates of total international discard numbers-at-age. The total estimates (Table 6.7.2.1) confirm the perception of the significant level of discarding; discards were therefore included within the assessment for the first time in the 2010 assessment. WG estimates of the combined, raised, level of discards are available from 2004 and they have shown a general increase in time to levels higher than landings since 2006 (Figure 6.7.2.8). However, discarding in 2011 dropped markedly to the level of the landings. The beam trawl survey (UK(E&W)-BTS-Q3) shows the strong 2006 year class at ages 1, 2 and 3 (Figure 6.7.2.2) and this cohort is present in the discard data at ages 2–4 before entering the landings at age 5 in 2011.

There is a considerable historic time period for which no international raised discards are available. Work is ongoing on the issue of raising additional samples from Irish and N. Irish observer programmes.

Biological

Landings numbers-at-age are given in Table 6.7.2.5 and plotted in Figure 6.7.2.2. Weights-at-age in the landings and stock are given in Table 6.7.2.6 and since 1995 are no longer altered by fitting a quadratic model. The stock weights are taken as the landings weights. However, prior to 1995 the data have not yet been revised to remove the quadratic smoother. Discard weights-at-age are given in Table 6.7.2.7 and modified weights-at-age in the stock in Table 6.7.2.8. The history of the derivation of the landings weights and stock weights used in this assessment is described in the stock annex.

Mean weight-at-age in the landings and survey data indicate declines in both sexes throughout the Irish Sea since 1993 so that plaice at ages ≤4 are typically below MLS (see stock annex, Figure A2).

Surveys

All available tuning data are shown in Tables 6.7.2.3 and 6.7.2.4. Due to inconsistencies in the available commercial tuning fleets, Irish Sea plaice assessments since 2004 have only included the UK (E&W) beam trawl survey (UK (E&W)-BTS-Q3) and the two NIGFS-WIBTS spawning biomass indices based on ground fish surveys (NIGFS-WIBTS-Q1 and NIGFS-WIBTS-Q4). For more information see WGNSDS 2004. The UK (E&W)-BTS-Q3 index was revised by WKFLAT 2011 to include stations in the western Irish Sea and in St George's Channel.

Inspection of UK (E&W)-BTS-Q3 mean standardised cpue plots (Figures 6.7.2.6) indicates that the survey has fair internal consistency and also suggests increasing abundance of plaice of both sexes in the eastern Irish Sea (ISE and ISN). In the western Irish Sea the cohort strength was high during 1995–2002 and fell thereafter. For the entire Irish Sea, the biomass index of age 1–4 fish calculated from the UK (E&W)-BTS-Q3 also indicates an upwards trend since 1993 with a small decrease in 2010 and 2011, which is due to the trends in biomass in the eastern Irish Sea (Figure 6.7.2.9). Although the UK (E&W)-BTS-Q3 and the NIGFS-WIBTS surveys show similar increases in biomass between 1993 and 2003, low biomass values were recorded between 2004 and 2007 in the autumn index of the NIGFS-WIBTS surveys and between 2004 and 2009 in the spring index. Nevertheless, the autumn (Q4) index has been at high levels since 2009 and the spring (Q1) index since 2010.

The NIGFS-WIBTS survey strata can be disaggregated into eastern (Strata 4–7) and western (Strata 1–3) subareas, where the subareas are divided by the deep trench that runs roughly north–south to the west of the Isle of Man (Figure 6.7.2.7, Table 6.7.2.3). The notable difference in mean biomass between spring and autumn in the western area (Strata 1–3) suggests either that spawning fish migrate into the area during spring or that catchability of plaice increases during spawning.

The SSB of plaice in the Irish Sea is also independently estimated using the Annual Egg Production Method (AEPM, Figure 6.7.2.2):

Year	SSB (tonnes)
1995	9081
2000	13 303
2006	14 417
2008	14 352
2010	15 071

The results confirm that plaice in the Irish Sea is lightly exploited. Splitting the SSB estimates from the AEPM into eastern and western Irish Sea areas also indicates that the perceived increase in plaice biomass is due to increased production in the eastern Irish Sea only (For more details see stock annex).

In summary, the UK (E&W)-BTS-Q3 in September, the NIGFS-WIBTS-Q4 index in October (but not NIGFS-WIBTS-Q1 March), and the AEPM indicate a sustained increase in biomass in the eastern Irish Sea, but this rise does not appear to extend across the deep channel to plaice in the western Irish Sea (Figure 6.7.2.9).

Commercial cpue

All available tuning data are shown in Table 6.7.2.4. Age based tuning data available for this assessment comprise three commercial fleets; the UK(E&W) otter trawl fleet (UK(E&W)OTB, from 2008), the UK(E&W) beam trawl fleet (UK(E&W)BT, from 1989) and the Irish otter trawl fleet (IR-OTB, from 1995). Due to inconsistencies in the available tuning fleets, Irish Sea plaice assessments since 2004 have omitted these indices. For more information see WGNSDS 2004. The effort and catch by these commercial fleets has been very low in recent years and the cpue data is no longer considered informative.

Other relevant data

Table 6.7.2.2 and Figure 6.7.2.1 show that effort levels have decreased between 2008 and 2009 for all fleets. Both the UK otter and beam trawl fleets are close to their lowest recorded effort levels in time-series extending back to 1972 and 1978 respectively. Effort by UK *Nephrops* trawlers has increased since 2006 and this fleet is now the dominant UK fleet in terms of hours fished in VIIa. Belgian vessels operating in Division VII typically move in and out of the Irish Sea, depending on the season, from specifically the Bristol Channel and Celtic Sea, the Bay of Biscay and the southern North Sea.

In 2012, landings by the Belgian fleet decreased by 94 tonnes relative to 2011 landings, and landings by Ireland decreased by 12 tonnes. Landings by UK(E&W, including NI) increased by 9 tonnes.

6.7.3 Historical stock development

Model: Aarts and Poos (AP)

Software: R version 2.10.1 (2009-12-14) with additional packages (version in parenthesis):

FLCore (3.0); stats4 (2.10.1); grid (2.10.1); splines (2.10.1); boot (1.2-4); mvtnorm (0.9-9); MASS (7.2-46).

Model options chosen

Settings for this update stock assessment are given in the table below. The update AP assessment follows the same procedure as in the WKFLAT 2011 benchmark assessment as described in the stock annex. WKFLAT (2011) agreed that the model that will be used as a temporary basis for the assessment and provision of advice for the Irish Sea plaice. This was selected on the basis that it was the only model available to WKFLAT which reconstructs the historic discarding rates (derived from the survey dataseries). Although a good start, the AP model is not considered the definitive assessment tool for Irish Sea plaice but a temporary solution to the fitting of datasets which include recent discards estimates but for which historic discard information is not available. The model reconstructs historic discard rates using a time variant spline. Given that the spline extrapolates beyond the range of the recent data to which it is fitted, it can potentially result in spurious estimates of historic discarding, which may change markedly as new discard data is added to the short time-series. In addition, it is highly likely that the discard patterns currently observed differ from those that would have been observed historically as a result of substantial changes in the composition of the gear types that have been used to prosecute the fisheries in which plaice is caught. A model which incorporates estimates of historic discards that are derived from the proportional allocation of the effort deployed by the dominant gear types is considered more appropriate in the long term.

Input data types and characteristics

New data added to the update AP assessment are the fishery landings data for 2012; discard estimates for 2012 and survey data for 2012 for the following surveys: UK (E&W)-BTS-Q3, NIGFS-WIBTS-Q4, and 2013 for NIGFS-WIBTS-Q1.

Data screening

Data was screened as described in the stock annex.

Final update assessment

The assessment settings are shown in the following table, with changes to the previous year's settings highlighted in bold. Historic settings are given in the stock annex. Final model parameters and diagnostics are shown in Table 6.7.3.1.

Assessment year		2011	2012	2013
Assessment model		AP	AP	AP
Tuning fleets	UK (E&W)-BTS-Q3	Series omitted	Series omitted	Series omitted
	Extended UK (E&W)-BTS-Q3	1993–2010, ages 1–6	1993–**2011**, ages 1–6	1993–**2012**, ages 1–6
	UK(E&W) BTS Mar	Survey omitted	Survey omitted	Survey omitted
	UK(E&W) OTB	Series omitted	Series omitted	Series omitted
	UK(E&W) BT	Series omitted	Series omitted	Series omitted
	IR-OTB	Series omitted	Series omitted	Series omitted
	NIGFS-WIBTS-Q1	1993–2010	1993–**2011**	1993–**2013**
	NIGFS-WIBTS-Q4	1993–2010	1993–**2011**	1993–**2012**
Time series weights		n/a	n/a	n/a
Num yrs for separable		n/a	n/a	n/a
Reference age		n/a	n/a	n/a
Terminal S		n/a	n/a	n/a
Catchability model fitted		n/a	n/a	n/a
SRR fitted		n/a	n/a	n/a
Selectivity model		Linear Time Varying Spline at age (TVS)	Linear Time Varying Spline at age (TVS)	Linear Time Varying Spline at age (TVS)
Discard fraction		Polynomial Time Varying Spline at age (PTVS)	Polynomial Time Varying Spline at age (PTVS)	Polynomial Time Varying Spline at age (PTVS)
Landings num at age, range:		1–9+	1–9+	1–9+
Discards N at age, yrs, ages:		2004–2010, ages 1–5	2004–**2011**, ages 1–5	2004–**2012**, ages 1–5

The estimated selectivity patterns split into the landed and discarded components is shown in Figure 6.7.2.10; the landings selectivity is initially flat topped (indicating that older age fish are selected) but becomes dome shaped gradually during the 2000s and falls over time to very low values relative to the discard pattern which expands to the older aged fish during the 2000s (Figure 6.7.2.11). The catchability of the UK(E&W)-BTS-Q3 survey is elevated for ages 1 and 2 and reflects the nature of the survey, which was designed as a recruit index (Figure 6.7.2.11). Diagnostic output from the AP model is printed in Table 6.7.3.1. A year effect in 2004 is present in the UK(E&W)–BTS-Q3 residuals (Figure 6.7.2.13). Although, the estimated recruitments from the AP model largely follow the UK (E&W)–BTS-Q3 numbers at age 1 there is some mismatch for the early years (1993–1994, Figure 6.7.2.14), which is a result of uncertain historic discards. A pattern of negative residuals between 2004 and 2009 is present in the residuals of the NIGFS-WIBTS due to large fluctuations in the SSB indices, which are due potentially to variable catchability of the survey (Figure 6.7.2.15).

In the catch residuals (Figure 6.7.2.16), negative values are apparent in all ages in the discard matrix for 2011 and 2012 (the model overestimates discards greatly in this year), and there is an underestimate of the large peak of discards in 2010.

The estimated SSB from the AP model shows an increasing trend until 2003, after which time the SSB stabilises and this is largely in agreement with independent SSB estimates from the Annual Egg Production Method (AEPM, Figure 6.7.2.17). While this SSB pattern agrees well with the survey data used in the assessment between 1993 and 2003 (NIGFS-WIBTS-Q1 and –Q4; UK (E&W)-BTS-Q3, Figure 6.7.2.17), notable differences exist, particularly the low values of the groundfish survey indices (NIGFS-WIBTS-Q1 and –Q4) during 2006–2008. The low UK (E&W)-BTS-Q3 biomass estimate in 2010–2011 partly reflects the limited age range of plaice selected (1 to 4); however, this survey does appear to show a potential decline in both sexes.

Estimates of numbers-at-age in the landings, discards and population, and fishing mortality numbers-at-age are given in Tables 6.7.3.2–6.7.3.5. A summary plot for the final update AP assessment is shown in Figure 6.7.2.18 and bootstrapped time-series estimates for F, SSB and recruitment are given in Table 6.7.3.6.

No retrospective analysis can be performed for this assessment due to limited discard data. A general trend of increasing SSB and decreasing fishing mortality during the 1990s to stable levels is evident.

Comparison with previous assessments

Comparisons between this year's and previous years' AP assessment and the previous ICA assessment are shown in Figure 6.7.2.19. The three AP assessments models perform similarly in terms of temporal trends in SSB, recruitment (other than the initial year) and F_{BAR} during the 1990s. However, in the previous ICA assessment the F and SSB did not stabilise from 2003 due to the lack of discard information.

State of the stock

Trends in F_{BAR}, SSB, recruitment and landings, for the full time-series, are shown in Table 6.7.3.6 and Figure 6.7.2.18. The updated assessment estimates that fishing mortality declined from high levels in the early 1990s to very low levels since 2000, while SSB increased between 1995 and 2005 and has been stable thereafter, with a slight decrease in 2012. The estimate of F in the final two years is overestimated due to the poor fit of the model to the discard data in 2010–2012. Estimated recruitments are highly variable but stable since 2000. Landings have decreased to low levels, and discards are at a high level: the proportion by weight of the catch discarded has increased markedly between 2004 and 2010 (Figure 6.7.2.18). However, the observer data indicate relatively lower discards in 2011 and 2012 although discards still exceed the landings.

6.7.4 Short-term projections

There are no short-term projections for this stock.

6.7.5 Medium-term projections

There are no medium-term projections for this stock.

6.7.6 MSY explorations

There are no MSY explorations for this stock.

6.7.7 Biological reference points

Precautionary approach reference points

There have been no biological reference points determined for this stock since discards have been included in the assessment. Previously reference points were proposed by the 1998 working group as below:

F_{lim}	No proposal
F_{pa}	0.45 (on the basis of F_{med} and long-term considerations)
B_{lim}	No proposal
B_{pa}	3100 t (on the basis of B_{loss} and evidence of high recruitments at low SSBs)

Yield per Recruit analysis

There are no yield per recruit analyses for this stock.

6.7.8 Management plans

There are no management plans for this stock.

6.7.9 Uncertainties and bias in assessment and forecast

Although, WKFLAT 2011 revised the UK (E&W)-BTS-Q3, there is still some disagreement between this survey and the NIGFS-WIBTS indices. Further work should focus on improving the NIGFS-WIBTS to take into account spatial and temporal change in the maturity ogive and length–weight relationships.

There is evidence of a decline in weight-at-age from the raw commercial landings data and survey data. The UK (E&W)-BTS-Q3 survey data also indicate declines in length-at-age and maturity-at-age.

There are no raised estimates of discard levels for the period prior to 2004. The uncertainty in the discard data requires evaluation.

The model has a substantial sensitivity to new data, for example the new data added in 2012 caused the model to fail to converge, and to change the historical trends of recruitment from decreasing to increasing. The model assumes that discarding only occurs at ages 1–5, whereas discards-at-age data indicate significant numbers of discards up to age 8.

6.7.10 Recommendations for next benchmark

Further work on the discard raising procedures is required and bootstrap estimates of variability need to be developed. Historic data collected by N. Ireland require further evaluation. The length distribution in the discard data are much more reliable than the age information and given the biological changes observed in the stock (see Section 6.7.9) a length based model would be more appropriate.

There is evidence of substantial substock structure and, if the catch data can be partitioned, then exploratory assessments for the eastern and western subareas would merit further study.

Annual maturity ogives should be determined from survey data and incorporated into the procedure for calculating the NIGFS-WIBTS indices.

Commercial indices and their horse-power (HP) corrections for the older ages should be reanalysed. Inclusion of the historic UK (E&W)-BTS-Q1 data may benefit the assessment in the historic period.

Ecosystem information ought to be explored.

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting
2011	VIIa Plaice	Weights and lengths-at-age show trends in recent years. Maturity ogives appear to have changed The NIGFS-WIBTS indices require recalculation Variability in discards should be quantified A length-based model with separate sexes should be developed. Catches by fleets should be included separately. Spatial structure in the stock should be reflected in the model.	2013	Expert group members.

6.7.11 Management considerations

The high level of discarding in this fishery indicates a mismatch between the minimum landing size and the mesh size of the gear being used. Any measures that effect a reduction in discards will result in increased future yield. However, the market demand for plaice is poor and small plaice are particularly undesirable. Strong year effects are seen in the discard data and these are likely due to spatial structure in the stock. Spatial management of fleets in the Irish Sea may reduce the discarding of plaice.

Whilst the precise levels of F_{BAR} and SSB are considered to be poorly estimated, the overall state of the stock is consistently estimated to have low fishing mortality and high spawning biomass. Therefore the stock is considered to be within safe biological limits.

Due to the uncertainty in the assessment the working group does not provide a short-term forecast.

Discarding has increased throughout the period in which data are available, while landings of plaice have decreased, even though the TAC is not restrictive. Effort has decreased in fisheries targeting plaice (including UK(E&W) and Belgian beam-trawl fisheries and UK(E&W) and Irish otter-trawl fisheries targeting demersal fish). In contrast, effort by the UK(E&W) *Nephrops* fleet has increased. However, this is still small in comparison to effort by the Irish *Nephrops* fleet. The main *Nephrops* grounds are located in the western Irish Sea, where relatively small plaice are found. Technical measures to mitigate discarding by all *Nephrops* fleets could include the use of sorting grids: gear selectivity trials and monitoring from four Irish *Nephrops* trawlers using grids since 2009 indicate a potential reduction in fish discarding by 75% (BIM, 2009).

6.7.12 Sources

Aarts, G., and Poos, J.J. 2009. Comprehensive discard reconstruction and abundance estimation using flexible selectivity functions. ICES Journal of Marine Science, 66: 763–771.

BIM. 2009. Summary report of Gear Trials to Support Ireland's Submission under Articles 11 & 13 of Reg. 1342/2008. *Nephrops* Fisheries VIIa & VIIb–k. Project 09.SM.T1.01. Bord Iascaigh Mhara (BIM) May 2009.

ICES. 2011. Report of the Benchmark Workshop on Flatfish (WKFLAT), 1–8 February 2011, Copenhagen, Denmark. ICES CM 2011/ACOM:39.

Table 6.7.2.1. Nominal landings of Plaice in Division VIIa as officially reported to ICES.

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012[1]
Belgium	321	128	332	327	344	459	327	275	325	482	636	628	431	566	343	194	157	197	138	332	236
France	42	19	13	10	11	8	8	5	14	9	8	7	2	9	2	2	2	0.4	0.2	0.28	0.08
Ireland	1,355	654	547	557	538	543	730	541	420	378	370	490	328	272	179	194	102	73	89	118	106
Netherlands	-	-	-	-	69	110	27	30	47	-	-	-	-	-	-	-	-	-	-	-	-
UK (Eng.&Wales)[2]	1,381	1,119	1,082	1,050	878	798	679	687	610	607	569	409	369	422	413	412	300	185	148	145	154
UK (Isle of Man)	24	13	14	20	16	11	14	5	6	1	1	1	0	0	0	0	1	…	0.5	0.25	0.11
UK (Scotland)	70	72	63	60	18	25	18	23	21	11	7	9	4	1	0	0	1	2	3	0	0
Total	3,193	2,005	2,051	2,024	1,874	1,954	1,803	1,566	1,443	1,488	1,591	1,544	1,134	1,270	937	802	562	457	379	594	496
Discards	-	-	-	-	-	-	-	-	-	-	-	-	628	1210	1254	1743	1270	1131	2560	604	911
Unallocated	74	-9	15	-150	-167	-83	-38	34	-72	-15	32	15	9	11	-5	3	1	2	0	0	0
Total figures used by the Working Group for stock assessment	3,267	1,996	2,066	1,874	1,707	1,871	1,765	1,600	1,371	1,473	1,623	1,559	1,771	2,491	2,186	2,548	1,833	1,591	2,938	1,198	1,406

[1] **Provisional.**

[2] **Northern Ireland included with England and Wales.**

{UK (Total) excludes Isle of Man data}.

Table 6.7.2.2. Irish Sea plaice: English standardised lpue and effort, Belgian beam trawl lpue and effort and Irish otter trawl lpue and effort series.

Year	CPUE			LPUE					Effort ('000hrs)					
	UK(E&W) Beam trawl survey[4]			English[1]		Belgian[3]	Irish[7]		English			Belgian[5]	Irish	
	March	September Prime only	September Extended	Otter Trawl	Beam Trawl	Beam Trawl	Otter Trawl	Beam Trawl	Otter[2] Trawl	Beam[2] Trawl	Nephrops Trawl	Beam Trawl	Otter Trawl	Beam Trawl
1972				6.96		9.8			128.4			6.8		
1973				6.33		9.0			147.6			16.5		
1974				7.45		10.4			115.2			14.2		
1975				7.71		10.7			130.7			16.2		
1976				5.03		5.8			122.3			15.1		
1977				4.82		5.3			101.9			13.4		
1978				6.77	4.88	6.9			89.1	0.9		12.0		
1979				7.18	15.23	8.0			89.9	1.7		13.7		
1980				8.24	8.98	8.6			107.0	4.3		20.8		
1981				6.87	4.91	7.1			107.1	6.4		26.7		
1982				4.92	1.77	4.4			127.2	5.5		21.3		
1983				5.32	3.08	7.8			88.1	2.8		18.5		
1984				7.77	6.98	6.8			103.1	4.1		13.6		
1985				9.97	25.70	8.8			102.9	7.4		21.9		
1986				9.27	4.21	8.7			90.3	17.0		38.3		
1987				7.20	3.57	8.2			130.6	22.0		43.2		
1988		392		5.02	3.05	6.3			132.0	18.6		32.7		
1989		253		5.51	13.59	6.2			139.5	25.3		36.7		
1990		239		5.93	12.02	7.2			117.1	31.0		38.3		
1991		157		4.79	10.56	7.5			107.3	25.8		15.4		
1992		188		4.20	9.99	11.9			96.8	23.4		23.0		
1993	91	235	152	3.97	9.50	5.0			78.9	21.5		24.4		
1994	128	225	137	4.90	7.79	9.2			43.0	20.1	0.0	31.6		
1995	134	169	111	5.08	7.69	9.5	3.2	17.0	43.1	20.9	0.0	27.1	80.3	8.6
1996	-[6]	210	113	5.37	12.96	11.8	4.1	18.9	42.2	13.3	0.0	22.2	64.8	6.3
1997	147	262	153	5.25	7.66	13.9	3.1	13.7	39.9	10.8	0.0	29.3	92.2	9.0
1998	113	249	148	5.00	5.66	12.3	3.7	22.2	36.9	10.4	0.0	23.8	93.5	11.6
1999	-[6]	264	155	5.38	7.76	7.1	2.3	23.2	22.9	11.0	0.0	37.2	110.3	14.7
2000	-[6]	357	170	5.02	13.04	7.8	2.0	13.8	27.0	6.3	0.0	27.0	82.7	11.4
2001		281	151	3.35	8.33	9.2	2.5	10.8	33.0	12.5	0.0	41.9	77.5	13.1
2002		340	199	5.66	5.46	7.4	2.8	7.9	24.8	8.0	0.0	52.5	77.9	17.7
2003		503	245	2.60	3.76	7.5	4.1	9.5	23.9	14.0	0.0	48.7	73.8	18.7
2004		540	248	3.17	4.20	11.2	2.1	8.6	23.5	7.4	0.0	36.1	72.5	14.2
2005		367	176	4.85	4.67	12.8	2.0	8.0	16.7	11.6	1.0	42.1	68.3	14.7
2006		356	164	6.50	2.19	10.8	1.37	6.3	5.2	4.6	10.9	28.9	64.9	11.9
2007		432	187	17.94	4.22	6.9	1.20	6.1	4.4	3.2	12.6	23.8	73.2	14.0
2008		416	186	9.03	4.47	9.5	0.90	5.2	2.7	1.3	11.5	12.4	58.8	9.5
2009		467	196	6.46	1.21	10.1	1.03	3.8	1.5	0.46	10.0	14.7	41.5	7.6
2010		400	156	11.55	14.39	7.9	0.98	4.5	1.0	0.19	9.2	15.2	45.8	9.4
2011		417	155	4.35	11.95	17.3	1.17	5.5	0.69	1.56	11.7	16.4	54.5	8.1
2012		460	190	1.86	10.30	14.39	1.00	4.9	0.24	0.85	12.08	14.95	58.2	7.2

1 Whole weight (kg) per corrected hour fished, weighted by area
2 Corrected for fishing power (GRT)
3 Kg/hr
4 Kg/100km. Sept Prime: ISS/ISN Traditional Prime Stations Only. Sept Extended: ISS/ISN/ISW/SGC All Stations.
5 Corrected for fishing power (HP) [data for 1999-2010, replaced at 2011WG following recalculation at WKFLAT 2011].
6 Carhelmar survey, Kg/100km not available
7 All years updated in 2007 due to slight historical differences

Fishing power corrections are detailed in Appendix 2 of the 2000 working group report

Table 6.7.2.3. Irish Sea plaice: NIGFS-WIBTS-Q1 and Q4 indices of relative biomass trends by region.

NIGFS-WIBTS-Q1	Estimated mean abundance			Estimated standard error		
Mar (Spring)	Combined	West	East	Combined	West	East
Year	Str1-7	Str1-3	Str4-7	Str1-7	Str1-3	Str4-7
1992	9.59	6.40	10.54	4.39	2.13	5.66
1993	13.27	21.40	10.85	2.22	5.56	2.36
1994	10.09	5.38	11.50	2.56	1.83	3.27
1995	7.59	6.56	7.89	1.39	1.66	1.74
1996	7.96	14.41	6.04	1.68	5.94	1.28
1997	13.73	15.80	13.11	3.99	6.78	4.76
1998	12.50	19.61	10.38	3.62	10.88	3.39
1999	9.37	19.10	6.46	2.34	7.42	2.09
2000	15.79	35.36	9.96	5.40	22.56	1.97
2001	13.52	23.78	10.46	2.11	6.21	2.02
2002	13.36	25.65	9.70	3.24	8.93	3.25
2003	26.79	55.52	18.23	8.36	32.38	4.95
2004	10.55	8.60	11.13	4.77	5.23	7.58
2005	15.86	27.20	12.48	3.54	8.59	3.82
2006	9.57	16.33	7.55	1.80	6.15	1.45
2007	8.73	21.76	4.84	1.81	7.00	1.06
2008	6.33	9.26	5.46	0.90	5.71	1.01
2009	11.00	17.85	8.96	1.89	4.61	2.03
2010	22.67	16.49	24.51	3.80	4.49	4.75
2011	23.68	32.44	21.06	4.60	8.37	5.42
2012	17.87	30.15	14.21	3.12	10.89	2.42
2013	28.15	43.20	23.66	5.73	12.53	6.44
NIGFS-WIBTS-Q4	Estimated mean abundance			Estimated standard error		
Oct (Autumn)	Combined	West	East	Combined	West	East
Year	Str1-7	Str1-3	Str4-7	Str1-7	Str1-3	Str4-7
1991	0.81	3.38	0.04	0.39	1.71	0.03
1992	4.83	2.76	5.45	0.85	1.26	1.04
1993	4.64	2.91	5.16	0.95	1.18	1.18
1994	9.20	8.65	9.36	2.27	3.74	2.72
1995	4.77	8.31	3.72	1.28	3.52	1.29
1996	8.69	9.95	8.32	2.15	5.67	2.22
1997	8.22	7.67	8.38	2.18	2.80	2.71
1998	5.39	4.21	5.74	1.45	2.39	1.75
1999	6.90	4.91	7.50	2.29	3.12	2.82
2000	10.50	2.84	12.78	6.42	1.16	8.33
2001	13.93	4.03	16.88	6.45	1.96	8.35
2002	9.98	6.63	10.98	3.80	3.45	4.82
2003	18.65	10.09	21.20	5.41	4.87	6.87
2004	8.49	2.52	10.28	1.90	1.10	2.44
2005	11.58	3.88	13.88	4.39	2.39	5.66
2006	7.20	2.59	8.57	1.98	1.47	2.53
2007	8.48	6.09	9.19	1.69	2.55	2.05
2008	11.28	4.66	13.26	3.06	2.50	3.91
2009	14.83	5.36	17.66	3.25	3.71	4.07
2010	17.61	7.50	20.63	5.40	5.72	6.80
2011	17.54	6.94	20.70	5.32	3.07	6.84
2012	18.96	20.29	18.56	4.90	11.61	5.33

Table 6.7.2.4. Irish Sea plaice: tuning fleet data available. Figures shown in bold are those used in the assessment.

Tuning index of the extended UK (E&W)-BTS-Q3 survey (extended area). Effort (km towed) and numbers-at-age.

year	distance towed (kms)	0	1	2	3	4	5	6	7	8	9+
1993	292.77	58	**1358**	**1179**	**265**	**126**	**7**	**14**	37	1	10
1994	281.66	162	**1162**	**699**	**401**	**90**	**24**	**15**	6	19	14
1995	281.66	316	**1566**	**553**	**237**	**117**	**24**	**16**	8	0	22
1996	277.95	78	**1611**	**604**	**146**	**53**	**55**	**20**	1	0	4
1997	281.66	449	**1539**	**820**	**356**	**78**	**45**	**47**	21	0	8
1998	281.66	158	**1269**	**1201**	**307**	**114**	**59**	**24**	20	1	4
1999	277.95	726	**1102**	**1086**	**553**	**190**	**81**	**31**	30	0	0
2000	281.66	442	**2462**	**788**	**415**	**313**	**133**	**50**	41	3	3
2001	281.66	235	**1686**	**1020**	**314**	**168**	**153**	**30**	21	2	0
2002	281.66	111	**1819**	**1392**	**639**	**247**	**150**	**147**	29	5	0
2003	277.95	934	**1701**	**1625**	**726**	**440**	**162**	**149**	72	0	10
2004	281.66	306	**2273**	**1510**	**1111**	**530**	**324**	**59**	78	4	8
2005	281.66	584	**1058**	**1337**	**558**	**400**	**227**	**144**	38	25	0
2006	281.66	1004	**1411**	**972**	**693**	**309**	**223**	**101**	56	5	16
2007	281.66	475	**2244**	**1258**	**467**	**337**	**182**	**71**	83	38	0
2008	270.54	503	**1266**	**1544**	**548**	**312**	**99**	**55**	40	0	0
2009	281.66	345	**1335**	**957**	**930**	**278**	**185**	**179**	46	37	0
2010	277.95	560	**1730**	**1199**	**568**	**401**	**183**	**152**	104	78	12
2011	281.66	289	**1896**	**1206**	**493**	**283**	**304**	**137**	77	105	44
2012	281.66	396	**1835**	**1794**	**483**	**289**	**134**	**149**	82	62	94

Biomass tuning indices from the NIGFS-WIBTS: DARDS is the Q1 spring index and DARDA the Q4 autumn index

Irish Sea Plaice biomass indices.

2 21 2

Year	DARDS	DARDA
1992	**9.59**	**4.83**
1993	**13.27**	**4.64**
1994	**10.09**	**9.2**
1995	**7.59**	**4.77**
1996	**7.96**	**8.69**
1997	**13.73**	**8.22**
1998	**12.5**	**5.39**
1999	**9.37**	**6.9**
2000	**15.79**	**10.5**
2001	**13.52**	**13.93**
2002	**13.36**	**9.98**
2003	**26.79**	**18.65**
2004	**10.55**	**8.49**
2005	**15.86**	**11.58**
2006	**9.57**	**7.2**
2007	**8.73**	**8.48**
2008	**6.33**	**11.28**
2009	**11**	**14.83**
2010	**22.67**	**17.61**
2011	**23.68**	**17.54**
2012	**17.87**	**18.96**
2013	**28.15**	

UK BT SURVEY (Sept-Trad) - Prime stations only

1989 2012

1 1 0.75 0.85

1 8

129.710 309 441 530 77 13 44 3 0

128.969 1688 405 176 90 54 30 3 1

123.780 591 481 68 47 4 4 24 3

129.525 1043 470 267 23 19 14 14 3

131.192 1106 812 136 101 16 8 21 4

124.892 815 608 307 68 33 12 17 8

126.004 1283 387 179 84 16 18 0 1

126.004 1701 601 124 74 49 9 11 1

126.004 1363 668 322 65 50 23 8 7

126.004 1167 767 212 95 34 23 14 3

126.004 1189 965 344 113 38 17 7 7

126.004 2112 659 298 141 73 22 7 3

126.004 1468 663 218 130 89 28 10 7

126.004 1734 1615 647 243 79 51 16 17

126.004 1480 1842 827 296 122 62 39 10

126.004 1816 1187 1184 404 261 57 57 14

122.298 869 1295 666 499 297 111 17 17

126.004 1120 840 722 411 178 83 59 16

126.004 2667 1255 525 417 196 95 45 37

122.298 1293 1893 628 339 243 76 55 33

126.004 1460 1083 1225 310 189 251 65 31

126.004 1806 1407 670 505 185 173 100 60

122.298 2213 1432 663 315 347 122 101 87

122.298 1964 1796 660 319 156 148 137 84

UK(E+W)TRAWL FLEET (calculated using ABBT age compositions)

1987 2012

1 1 0 1

1 14

130.597 24.4 1475.8 1434.6 1593.3 409.0 291.2 31.4 46.8 16.9 24.2 11.2 1.4 3.2 3.6

131.950 22.0 1374.8 1421.0 455.0 295.5 142.5 78.9 8.1 28.9 6.7 9.6 3.5 4.1 1.1

139.521 10.6 771.5 2102.0 801.1 235.2 99.8 48.0 37.6 13.7 11.0 6.3 6.7 3.2 1.7

117.058 8.2 501.0 1094.3 983.9 217.0 82.8 60.0 17.5 15.9 4.5 3.2 6.7 3.0 2.2

107.288 94.3 949.9 451.3 419.5 245.0 99.7 35.2 38.7 12.1 11.1 0.6 3.6 1.8 1.5

96.802 80.8 851.1 907.2 181.3 114.6 82.4 28.6 8.3 17.8 7.3 5.4 0.4 1.3 0.8

78.945 12.9 387.7 519.1 367.7 63.5 55.7 69.5 21.8 5.2 10.7 2.6 1.1 0.0 0.2

42.995 38.8 408.3 534.9 142.5 92.5 18.2 12.3 15.9 7.3 1.8 1.3 2.2 0.5 0.0

43.146 7.3 350.1 512.5 255.7 88.9 46.1 10.9 4.8 8.3 2.4 1.7 0.7 0.2 0.2

42.239 10.9 326.5 280.3 198.7 80.5 32.9 15.3 4.8 2.0 10.0 2.1 0.7 0.6 0.1

39.886 11.2 250.6 214.7 125.2 74.2 37.5 12.8 12.4 1.8 0.8 1.4 0.4 0.2 0.7

36.902 1.6 202.7 318.6 105.3 40.6 37.6 16.5 9.8 4.5 0.5 0.5 1.0 0.3 0.2

22.903 17.6 139.2 200.5 120.0 35.0 14.0 9.0 5.4 1.6 0.8 0.2 0.1 0.1 0.0

26.967 0.0 107.1 233.3 185.0 95.5 18.5 14.4 9.8 5.9 2.7 2.1 0.9 0.4 .01

32.964 5.5 65.9 130.4 124.0 108.7 53.2 17.4 10.6 7.1 3.0 0.5 0.7 0.1 0.1

24.762 0.5 78.6 175.8 95.3 58.6 33.0 23.8 3.3 2.5 1.4 0.4 0.4 0.0 0.1

23.851 0.0 34.1 79.6 88.7 35.6 16.1 12.3 7.4 2.3 0.4 0.3 0.2 0.0 0.2

23.456 1.5 34.8 149.1 103.1 60.6 27.0 8.7 5.8 4.3 1.2 0.7 0.2 0.1 0.0

16.683 0.0 32.6 52.6 108.1 95.1 40.0 17.8 7.5 5.4 1.7 1.3 0.6 0.2 0.1

5.218 0.8 15.1 46.9 34.8 55.1 23.4 13.9 4.9 2.6 1.9 0.7 0.6 0.1 0.0

4.404 0.0 2.5 33.7 94.5 58.4 50.4 17.3 16.7 2.2 1.5 0.5 0.3 0.1 0.0

2.710 0.1 5.8 27.8 37.9 40.9 23.9 15.4 7.3 2.9 1.1 0.5 0.2 0.1 0.0

1.535 0.0 0.2 4.1 8.7 7.4 6.6 3.1 2.0 0.8 0.5 0.1 0.1 0.0 0.0

1.424 0.0 0.1 1.6 7.5 7.4 4.5 3.4 1.9 1.3 0.5 0.4 0.2 0.0 0.0

0.686 0.0 0.1 0.8 0.8 1.4 0.7 0.3 0.2 0.1 0.1 0.1 0.0 0.0 0.0

0.240 0.0 0.0 0.3 0.3 0.3 0.6 0.4 0.3 0.1 0.1 0.1 0.0 0.0 0.0

UK(E+W)BEAM TRAWL FLEET

1987 2012

1 1 0 1

1 14

21.997 0.0 1.1 27.1 113.1 36.0 31.3 2.9 6.7 1.9 3.1 0.6 0.1 0.2 0.1

18.564 0.0 2.0 48.0 23.7 24.4 13.2 8.5 1.4 2.6 1.6 1.5 0.6 0.8 0.3

25.291 3.1 132.8 297.5 163.4 52.6 42.4 25.1 16.1 4.3 5.3 3.3 5.7 2.6 1.1

31.003 2.2 136.2 391.9 361.1 78.2 30.2 17.2 8.4 3.6 1.5 1.9 3.8 1.4 0.5

25.838 17.3 282.5 182.9 174.5 91.8 35.9 11.2 11.8 3.5 4.7 0.2 1.0 0.6 0.3

23.399 3.9 141.5 335.6 79.6 64.6 45.5 18.6 8.0 12.2 7.1 4.0 0.2 0.7 1.0

21.503 0.6 73.4 112.8 95.2 23.3 24.2 32.0 11.8 4.5 7.1 2.2 1.2 0.0 0.4

20.145 13.4 151.8 186.1 39.9 26.0 6.8 6.6 7.8 3.5 1.2 0.9 1.2 0.2 0.0

20.932 5.2 183.4 229.1 100.6 33.1 16.1 3.9 1.7 3.3 1.0 0.9 0.5 0.1 0.2

13.320 13.4 144.0 111.4 75.3 30.8 11.0 5.9 2.1 1.2 2.7 0.5 0.2 0.4 0.3

10.760 0.9 98.6 69.5 39.0 30.2 13.5 3.7 3.2 0.5 0.4 0.3 0.2 0.1 0.1

10.386 0.3 63.5 103.7 32.6 12.0 9.7 6.3 2.7 1.8 0.3 0.2 0.5 0.2 0.0

11.016 4.8 51.3 124.4 80.4 24.4 12.5 10.5 5.6 0.9 0.8 0.2 0.2 0.2 0.1

6.275 0.0 25.2 61.4 46.6 27.9 7.3 6.5 4.5 1.9 0.7 0.7 0.7 0.1 0.1

12.495 1.5 20.6 47.5 56.6 42.7 20.8 7.0 4.5 2.5 1.2 0.4 0.1 0.1 0.0

8.017 0.0 11.5 33.1 21.0 18.8 14.9 8.0 2.3 1.3 1.4 0.4 0.4 0.0 0.0

13.996 0.0 11.4 45.5 47.7 20.9 10.0 8.7 5.4 1.7 0.3 0.0 0.3 0.0 0.1

7.396 0.2 18.0 29.4 11.7 11.9 5.1 1.7 1.4 1.0 0.3 0.2 0.1 0.0 0.0

11.406 0.1 6.5 11.0 24.0 20.7 9.2 3.4 1.6 1.3 0.4 0.4 0.1 0.1 0.0

4.649 0.2 2.7 8.1 4.9 8.2 3.8 2.6 0.9 0.6 0.5 0.2 0.2 0.1 0.0

3.197 0.0 0.2 3.2 7.2 4.5 5.3 1.8 1.3 0.3 0.3 0.1 0.1 0.0 0.0

1.300 0.0 0.0 1.4 3.5 3.9 2.1 1.7 0.8 0.3 0.1 0.1 0.0 0.0 0.0

0.462* 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

0.186* 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

1.564 0.0 0.7 5.8 6.8 13.7 8.0 4.3 2.8 1.1 1.0 0.5 0.4 0.2 0.0

0.850* 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

*No UK(E&W) beam trawl sampling occurred in 2010, 2011 and 2012

UK BT SURVEY (March) - Prime stations only

1993 1999

1 1 0.15 0.25

1 8

126.931 480 662 141 71 12 8 11 3

115.442 361 662 370 98 47 5 7 10

126.189 859 647 340 120 29 28 0 10

134.343 1559 908 295 98 49 16 8 1

121.742 967 905 351 63 39 31 10 13

130.081 648 957 217 82 24 23 12 1

130.822 570 770 389 98 26 11 9 6

IR-JPS : Irish Juvenile Plaice Survey 2nd Qtr - Effort min. towed - Plaice No. at age

1991 2004

1 1 0.37 0.43

1 7

555 185 206 60 21 9 1 1

570 1785 268 48 16 7 2 2

600 643 630 189 45 8 21 3

585 614 254 196 33 8 2 0

570 840 321 110 86 18 5 2

675 752 221 134 39 57 7 0

675 665 303 105 41 22 17 5

675 311 466 191 48 11 7 4

660 0 0 0 0 0 0 0

645 805 342 72 61 32 9 2

675 743 739 213 88 43 14 5

660 273 145 40 2 1 1 0

660 346 322 152 78 20 9 7

660 1046 501 171 86 50 10 6

Table 6.7.2.5. Irish Sea plaice: Landings number-at-age 1 to 15+ (thousands), where rows are years 1964–2010 and columns are ages 1 to 15+.

IRISH SEA PLAICE
1 2
1964 2012
1 15
1

0	997	1911	1680	446	851	480	140	26	15 5	30	2	1	1	10
28	141	3155	2841	1115	555	309	300	17	20	5	2	1	1	1
0	120	4303	3605	2182	620	588	386	181	13	20	7	7	3	6
0	164	1477	5593	4217	995	642	267	210	176	86	35	5	6	1
0	171	1961	3410	4641	161	319	113	135	24	17	3	4	1	1
59	430	2317	2932	2080	222	779	184	58	100	80	22	9	4	1
9	803	2278	2179	1877	102	899	239	64	29	52	51	20	3	2
0	427	3392	3882	1683	137	491	497	244	60	65	36	11	9	1
0	142	3254	5136	1461	752	555	627	353	169	55	40	38	19	12
0	925	4091	5233	2682	642	345	238	183	238	129	40	14	11	17
7	120	2530	2694	2125	104	191	139	56	47	95	40	5	5	5
18	137	4313	1902	1158	933	152	119	81	94	47	72	18	16	4
23	255	4333	2425	902	563	391	198	59	79	47	22	58	11	5
565	412	2767	2470	839	236	150	112	63	21	15	8	8	10	3
22	306	5169	1535	542	202	98	54	52	43	10	9	4	4	2
12	338	5679	1835	363	187	109	61	68	68	17	5	6	4	6
3	278	6738	2560	646	312	125	64	24	54	16	13	7	5	5
22	174	5939	2984	837	222	105	53	52	41	28	35	13	3	11
27	715	3288	3082	1358	330	137	69	44	36	11	15	11	14	13
51	292	2494	3211	1521	648	211	110	53	30	13	15	9	11	11
41	315	5179	1182	1054	459	299	113	60	13	22	15	10	6	13
4	235	6152	3301	614	429	262	181	78	36	21	8	7	3	6
31	165	5280	2942	1287	344	371	112	92	54	24	9	5	3	9
62	371	5317	5252	1341	107	123	121	75	74	25	8	10	12	13
46	292	5040	2552	1400	750	316	84	112	44	41	28	38	21	37
24	173	5945	2671	854	436	214	153	56	47	26	38	18	7	19
15	101	2715	2935	1132	465	259	98	51	22	15	15	9	6	7
180	200	1506	1929	1205	465	182	122	49	34	5	6	3	3	4
151	195	3209	1435	1358	903	388	118	74	44	27	15	9	3	4
28	910	1649	1357	474	556	377	179	42	50	16	8	2	3	2
97	114	2173	1309	644	318	245	134	86	18	6	9	6	1	3
21.	960.	1702.	1935.	764.1	318.	137.	70	46.	22.	8.9	4.5	0.8	0.	2.9
37	855.	1345.	1196.	943.4	370	128.	43.9	25.	36.	14	7	4.8	1.	2.5
27.	829.	1589.	1513.	1002.	482.	285.	139.	42.	52.	12.	6.7	1.3	2.	0.8
5.5	691.	1739.	1024.	611.6	475.	403	176.	91.	51.	24.	17.	19.	2.	1.3
68.	802.	1504.	1293.	695.5	280.	196.	117	68.	43.	5.6	4.3	1.2	0.	1
0	450	1174.	1283.	685.5	211.	219.	101.	55.	19.	13.	7.1	2.4	1.	2
13.	374.	1138.	1083	767	408.	178.	90.3	45.	17.	6.3	2.4	3.7	0.	0.4
1.1	205.	939.8	1481.	842.2	538.	317.	95.9	48.	17.	4.4	3.1	0.3	0.	0.3
0	285.	1030.	1314.	706.7	415	252.	127.	48.	22.	12.	7.4	1	2.	0.2
7.5	198.	966.8	1104.	705	246.	114.	87.7	74.	10.	10.	1.1	1	0.	0.3
6.4	228.	708.4	1177.	889.5	461.	204	91.8	54.	36.	11.	11.	4.4	1.	0.8
4.5	180.	619.8	550.2	684	346.	220	86.9	53.	46.	20.	6.5	1.8	1.	1.1
0	64.2	350.5	859.9	506.6	401.	150.	114.	27	14.	5	2.9	0.5	0.	0.0
0.6	98.5	385.5	388.6	409.3	214.	141.	61	36.	9.2	6.9	3.3	0.8	1.	0
0	12.6	204.3	373.9	351.2	272.	116.	73.3	26	12.	3.6	2	0.9	1.	0.7
0	7.2	74.3	269.8	305.6	192.	159.	57.3	31.	13.	8.3	3.3	1	0.	0.5
2	53	199	357	483	305	194	101	43	27	10	6	3	0	1
0	8	149	288	295	358	211	119	48	24	16	9	4	0	2

Table 6.7.2.6. Irish Sea plaice: Landings weight-at-age 1 to 15+ (kg) (unsmoothed from 1995, bold).

Plaice in VIIa
1 3
1964 2012
1 15
1

0.024	0.109	0.226	0.348	0.412	0.545	0.767	0.981	1.085	0.540	1.311	0.991	1.508	1.544	1.630
0.023	0.105	0.213	0.327	0.480	0.587	0.641	0.680	0.769	1.152	1.128	0.948	1.442	1.477	1.558
0.019	0.087	0.177	0.266	0.366	0.480	0.643	0.652	0.881	0.947	1.036	1.038	1.204	1.233	1.301
0.018	0.082	0.169	0.251	0.336	0.464	0.482	0.716	0.747	0.660	0.758	0.509	1.125	1.152	1.216
0.018	0.083	0.168	0.263	0.360	0.458	0.541	0.732	0.838	0.921	0.982	0.862	1.146	1.174	1.238
0.019	0.084	0.170	0.261	0.355	0.485	0.593	0.742	0.841	0.719	0.701	1.062	1.157	1.185	1.250
0.019	0.087	0.175	0.272	0.365	0.472	0.599	0.647	0.854	0.891	0.848	0.594	1.201	1.231	1.298
0.018	0.082	0.164	0.249	0.346	0.442	0.550	0.709	0.625	0.821	0.708	1.044	1.126	1.153	1.217
0.020	0.091	0.186	0.280	0.379	0.504	0.678	0.672	0.902	1.031	1.103	1.168	1.258	1.288	1.359
0.019	0.085	0.173	0.267	0.363	0.445	0.596	0.655	0.748	0.866	0.895	0.840	1.176	1.204	1.271
0.021	0.094	0.192	0.282	0.390	0.468	0.634	0.798	0.906	1.014	1.070	1.018	1.295	1.326	1.399
0.024	0.109	0.218	0.336	0.463	0.582	0.695	0.873	1.078	1.127	1.311	1.317	1.497	1.533	1.617
0.020	0.090	0.181	0.272	0.368	0.475	0.548	0.679	0.757	0.812	0.808	0.974	1.237	1.267	1.337
0.020	0.089	0.179	0.286	0.375	0.461	0.550	0.696	0.794	0.978	0.914	1.065	1.222	1.252	1.321
0.024	0.106	0.213	0.330	0.457	0.602	0.668	0.859	0.977	1.011	1.220	1.286	1.462	1.497	1.580
0.023	0.104	0.208	0.317	0.481	0.599	0.733	0.862	0.941	0.935	1.230	1.190	1.436	1.471	1.552
0.022	0.099	0.201	0.307	0.422	0.474	0.623	0.833	0.983	1.032	1.215	1.232	1.370	1.403	1.480
0.023	0.103	0.210	0.318	0.446	0.537	0.630	0.814	1.030	0.777	1.231	1.268	1.280	1.452	1.532
0.020	0.090	0.209	0.309	0.408	0.478	0.568	0.658	0.747	0.847	0.946	1.046	1.146	1.255	1.365
0.019	0.087	0.213	0.300	0.348	0.397	0.455	0.523	0.590	0.677	0.765	0.861	0.968	1.094	1.239
0.020	0.100	0.230	0.350	0.430	0.520	0.610	0.710	0.820	0.930	1.040	1.170	1.330	1.530	1.790
0.020	0.100	0.240	0.360	0.430	0.510	0.590	0.680	0.790	0.890	1.000	1.130	1.290	1.490	1.750
0.020	0.120	0.260	0.380	0.440	0.520	0.610	0.720	0.830	0.960	1.120	1.260	1.410	1.560	1.720
0.020	0.100	0.240	0.345	0.405	0.480	0.560	0.660	0.770	0.885	1.010	1.150	1.290	1.440	1.610
0.245	0.258	0.288	0.335	0.401	0.484	0.585	0.704	0.841	0.995	1.168	1.358	1.565	1.791	2.034
0.206	0.249	0.296	0.347	0.402	0.460	0.522	0.588	0.658	0.732	0.809	0.890	0.975	1.064	1.156
0.173	0.229	0.286	0.346	0.408	0.471	0.537	0.604	0.674	0.745	0.818	0.894	0.971	1.050	1.132
0.241	0.256	0.280	0.312	0.353	0.403	0.462	0.529	0.605	0.689	0.782	0.884	0.994	1.114	1.241
0.147	0.193	0.245	0.305	0.372	0.445	0.525	0.612	0.706	0.807	0.914	1.029	1.150	1.278	1.413
0.259	0.263	0.280	0.308	0.350	0.404	0.470	0.549	0.641	0.745	0.862	0.991	1.132	1.287	1.453
0.133	0.180	0.236	0.302	0.376	0.459	0.551	0.652	0.762	0.882	1.010	1.147	1.293	1.449	1.613
0.189	**0.224**	**0.262**	**0.329**	**0.353**	**0.406**	**0.461**	**0.619**	**0.682**	**0.734**	**0.851**	**1.020**	**1.101**	**1.077**	**1.468**
0.204	**0.223**	**0.270**	**0.333**	**0.398**	**0.493**	**0.584**	**0.712**	**0.748**	**0.712**	**1.204**	**1.272**	**1.306**	**1.770**	**1.186**
0.205	**0.233**	**0.241**	**0.286**	**0.354**	**0.410**	**0.510**	**0.513**	**0.709**	**0.610**	**0.976**	**1.389**	**1.288**	**1.027**	**1.162**
0.185	**0.226**	**0.249**	**0.316**	**0.353**	**0.410**	**0.468**	**0.506**	**0.647**	**0.784**	**0.861**	**1.105**	**0.888**	**1.629**	**1.302**
0.205	**0.236**	**0.250**	**0.300**	**0.375**	**0.457**	**0.483**	**0.556**	**0.632**	**0.602**	**1.187**	**1.011**	**1.130**	**1.159**	**1.280**
0.000	**0.259**	**0.270**	**0.307**	**0.337**	**0.429**	**0.437**	**0.492**	**0.580**	**0.796**	**1.007**	**1.030**	**1.408**	**1.221**	**1.314**
0.232	**0.233**	**0.271**	**0.334**	**0.396**	**0.439**	**0.571**	**0.666**	**0.785**	**0.934**	**1.155**	**1.228**	**1.024**	**0.945**	**1.505**
0.228	**0.271**	**0.267**	**0.308**	**0.386**	**0.476**	**0.518**	**0.585**	**0.730**	**0.838**	**1.014**	**0.944**	**1.206**	**1.488**	**1.196**
0.000	**0.235**	**0.289**	**0.335**	**0.383**	**0.458**	**0.567**	**0.566**	**0.779**	**0.912**	**0.861**	**0.675**	**0.797**	**1.313**	**1.304**
0.214	**0.239**	**0.258**	**0.297**	**0.347**	**0.416**	**0.543**	**0.544**	**0.515**	**0.760**	**0.751**	**0.817**	**1.693**	**2.000**	**2.327**
0.235	**0.245**	**0.265**	**0.292**	**0.322**	**0.394**	**0.441**	**0.536**	**0.648**	**0.691**	**0.678**	**0.913**	**0.974**	**0.807**	**0.982**
0.200	**0.256**	**0.265**	**0.282**	**0.321**	**0.378**	**0.425**	**0.462**	**0.553**	**0.611**	**0.732**	**0.838**	**1.415**	**1.139**	**1.277**
0.000	**0.280**	**0.266**	**0.281**	**0.320**	**0.371**	**0.416**	**0.411**	**0.621**	**0.530**	**0.900**	**0.846**	**0.976**	**0.878**	**1.016**
0.246	**0.228**	**0.257**	**0.281**	**0.311**	**0.364**	**0.431**	**0.445**	**0.570**	**0.700**	**0.833**	**1.122**	**0.430**	**1.320**	**0.000**
0.000	**0.257**	**0.256**	**0.265**	**0.305**	**0.330**	**0.395**	**0.467**	**0.465**	**0.537**	**0.571**	**0.591**	**0.760**	**0.576**	**0.475**
0.000	**0.260**	**0.265**	**0.282**	**0.301**	**0.356**	**0.392**	**0.460**	**0.481**	**0.530**	**0.560**	**0.508**	**0.882**	**1.908**	**1.037**
0.236	**0.251**	**0.257**	**0.283**	**0.298**	**0.354**	**0.404**	**0.459**	**0.565**	**0.554**	**0.628**	**0.531**	**0.644**	**0.986**	**0.997**
0.118	**0.259**	**0.255**	**0.283**	**0.301**	**0.321**	**0.349**	**0.414**	**0.449**	**0.434**	**0.529**	**0.371**	**0.655**	**0.828**	**0.452**

Table 6.7.2.7. Plaice VIIa: weight-at-age in the discards (unsmoothed).

IRISH SEA PLAICE, COMBSEX, PLUSGROUP, Discard weights-at-age (age 0 exc, 9+ set to 0).
1 3 2004 2012
1 8
1

0.057	0.115	0.145	0.164	0.211	0.29	0.238	0.21
0.099	0.117	0.134	0.179	0.178	0.277	0.644	0.356
0.141	0.113	0.141	0.145	0.162	0.21	0.274	0.077
0.044	0.081	0.113	0.14	0.15	0.205	0.219	0.243
0.096	0.097	0.116	0.135	0.151	0.173	0.217	0.17
0.033	0.08	0.119	0.147	0.165	0.196	0.232	0.276
0.083	0.101	0.138	0.183	0.201	0.14	0.194	0.225
0.077	0.098	0.116	0.141	0.157	0.168	0.164	0.176
0.042	0.092	0.125	0.153	0.187	0.162	0.149	0.161

Table 6.7.2.8. Irish Sea plaice: New stock weights-at-age modified to include discard element (kg) (unsmoothed from 1995, bold).

IRISH SEA PLAICE, COMBSEX, PLUSGROUP, NEW stock weights (modified to inc disc element)
1 4
2004 2012 (not smoothed)
1 8
1

0.090	0.148	0.179	0.228	0.323	0.416	0.543	0.544	0.515	0.760	0.751
	0.817	1.693	2.000	2.327						
0.103	0.126	0.161	0.237	0.234	0.394	0.441	0.536	0.648	0.691	0.678
	0.913	0.974	0.807	0.982						
0.141	0.122	0.162	0.175	0.256	0.378	0.425	0.462	0.553	0.611	0.732
	0.838	1.415	1.139	1.277						
0.044	0.084	0.123	0.167	0.209	0.371	0.416	0.411	0.621	0.530	0.900
	0.846	0.976	0.878	1.016						
0.096	0.100	0.132	0.167	0.204	0.364	0.431	0.445	0.570	0.700	0.833
	1.122	0.430	1.320	0.000						
0.033	0.081	0.125	0.173	0.213	0.330	0.395	0.467	0.465	0.537	0.571
	0.591	0.760	0.576	0.475						
0.083	0.101	0.140	0.191	0.210	0.356	0.392	0.460	0.481	0.530	0.560
	0.509	0.882	1.908	1.040						
0.078	0.104	0.137	0.182	0.221	0.354	0.404	0.459	0.565	0.554	0.628
	0.531	0.644	0.986	0.997						
0.042	0.092	0.133	0.182	0.266	0.321	0.349	0.414	0.449	0.434	0.529
	0.371	0.655	0.828	0.452						

Table 6.7.3.1. Irish Sea plaice: Final AP output and diagnostics. note: (1) model takes log(Ftrend #) as input; (2) The log.recruitments 1–8 merely provide initial cohorts for each entry in the numbers-at-age matrix.

Age range for fishery selectivity:	1 to 8
Age range for discard fraction:	1 to 5
Age range for UK-BTS:	1 to 6

Tue May 14 11:33:08 2013	
SEL_MODEL	TV
DISC_MODEL	PTVS
INCL_EGG	FALSE
INCL_RELBIO	TRUE
INCL_PLUSGROUP_NIGFS	TRUE
EST_SD_BIO	TRUE
firstoptMETHOD	SANN
mainMETHOD	BFGS
BFGS_MAXIT	800
BFGS_RELTOL	1.00E-20
n.tries for uncertainty	1000
eigenvalues Hessian positive?	FALSE
negative log.likelihood	114.3935968
negative log.likelihood Landings	2.059401367
negative log.likelihood Discards	48.74612755
negative log.likelihood UK-BTS	-2.438968412
negative log.likelihood NI-GFSs	66.02703627
AIC	390.7871935
Nparameters	81
Nobservations	368
Final parameter values	
Ftrend 1	0.737479
Ftrend 2	0.680758
Ftrend 3	0.562274
Ftrend 4	0.377829
Ftrend 5	0.459386
Ftrend 6	0.35994
Ftrend 7	0.234305
Ftrend 8	0.194211
Ftrend 9	0.184653
Ftrend 10	0.174307
Ftrend 11	0.156334
Ftrend 12	0.116667
Ftrend 13	0.147104
Ftrend 14	0.113115

Ftrend 15	0.125402
Ftrend 16	0.103478
Ftrend 17	0.096925
Ftrend 18	0.104284
Ftrend 19	0.221525
sel.C 1	-2.34656
sel.C 2	18.20064
sel.C 3	-10.275
sel.C 4	2.569851
sel.C 5	0.078792
sel.C 6	0.95303
sel.C 7	-0.65677
sel.C 8	-0.06997
logrecruitment 1	18.83716
logrecruitment 2	17.51861
logrecruitment 3	16.09643
logrecruitment 4	14.19515
logrecruitment 5	13.06908
logrecruitment 6	11.74075
logrecruitment 7	10.7975
logrecruitment 8	10.29811
logrecruitment 9	10.08301
logrecruitment 10	10.13463
logrecruitment 11	10.3918
logrecruitment 12	10.46522
logrecruitment 13	10.24655
logrecruitment 14	10.19468
logrecruitment 15	10.54777
logrecruitment 16	10.52794
logrecruitment 17	10.62917
logrecruitment 18	10.37009
logrecruitment 19	10.62786
logrecruitment 20	10.32099
logrecruitment 21	10.42467
logrecruitment 22	10.62926
logrecruitment 23	10.19293
logrecruitment 24	10.29799
Logrecruitment 25	10.52787
Logrecruitment 26	10.59647
Catchability 1	-8.559
sel.U 1	5.394388
sel.U 2	-1.28747
sel.U 3	-0.22861
sel.U 4	-1.0508
b1	5.209377
b2	0.664839

b3	-0.43368
b4	-0.56489
b5	0.284779
b6	0.053928
b7	0.102998
b8	0.123254
b9	0.003464
b10	0.031687
b11	0.016017
b12	0.012685
sds.land1	-2.16988
sds.land2	-1.6609
sds.land3	3.086217
sds.disc1	-0.33636
sds.disc2	-0.47606
sds.disc3	0.538566
sds.tun1	-2.14355
sds.tun2	2.04155
sds.tun3	-0.22384
sds.biotun1	0.820665
sds.biotun2	-1.18947

Table 6.7.3.2. Irish Sea plaice: Estimated landed numbers-at-age (thousands).

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	46	29	22	23	20	11	7	6	4	4	2	1	1	1	1	0	0	0	0	0
2	1430	958	722	674	984	871	571	390	491	432	365	171	228	119	87	58	25	18	26	17
3	1764	2262	1532	1196	1599	1636	1646	1043	971	1341	1071	780	692	587	357	261	232	102	151	117
4	1318	1478	1840	1224	1338	1222	1448	1255	1107	1122	1331	911	1236	682	812	408	414	349	338	274
5	495	652	748	925	896	681	610	689	878	849	687	688	854	677	503	470	327	276	525	279
6	508	269	347	359	635	407	283	286	374	530	374	259	477	339	371	222	245	167	353	401
7	352	249	139	161	251	313	183	145	172	266	253	156	197	197	186	155	100	120	153	176
8	179	180	141	67	124	141	160	111	106	127	154	139	166	112	156	118	108	78	181	138
9+	123	129	87	91	118	208	125	101	76	74	94	98	121	131	50	58	46	58	90	103

Table 6.7.3.3. Irish Sea plaice: Estimated discarded numbers-at-age (thousands).

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	3728	2447	2001	2348	2274	1385	970	1012	916	967	649	590	526	517	526	267	283	332	702	625
2	21396	12265	8183	6990	9660	8371	5563	3979	5437	5366	5252	2961	4881	3290	3178	2901	1792	1856	4116	4238
3	6575	7075	4150	2896	3576	3483	3447	2216	2162	3231	2880	2418	2550	2657	2050	1961	2352	1435	3070	3542
4	1925	1926	2187	1355	1411	1254	1476	1299	1190	1278	1642	1244	1910	1219	1713	1038	1297	1379	1717	1833
5	520	632	677	792	736	543	478	539	693	685	573	603	794	678	549	566	441	420	920	567
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6.7.3.4. Irish Sea plaice: Estimated population numbers-at-age (thousands).

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	40386	31526	32601	41522	44827	36370	34070	48303	47347	51716	39914	52131	37714	42760	49469	32359	36897	45848	51296	47066
2	49720	32271	25633	27012	34596	37600	30944	29299	41884	41126	44954	34788	45680	32953	37438	43380	28448	32458	40352	44835
3	18149	22755	16246	14391	16769	20705	24676	21686	21881	31577	31027	34592	27909	35712	26022	30134	35692	23522	27026	31895
4	7062	8300	11444	9086	8926	10021	13560	17104	16171	16464	23709	23805	27674	21705	28624	20817	24637	29227	19417	20942
5	2267	3232	4176	6377	5639	5340	6565	9282	12770	12184	12348	18234	19087	21587	17463	23013	17103	20242	24296	15289
6	1693	1061	1664	2368	4045	3472	3587	4800	7078	9849	9365	9766	14958	15378	17871	14500	19436	14446	17298	20189
7	1203	1025	689	1150	1763	2991	2696	2915	3989	5926	8237	7953	8419	12818	13320	15502	12651	17008	12656	15009
8	610	737	675	481	869	1328	2358	2219	2449	3376	5006	7068	6907	7282	11184	11639	13603	11126	14972	11081
9+	420	529	417	650	829	1958	1837	2033	1755	1974	3074	4999	5036	8508	3585	5718	5860	8203	7428	8323

Table 6.7.3.5. Irish Sea plaice: Estimated fishing mortality-at-age.

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	0.104	0.087	0.068	0.062	0.056	0.042	0.031	0.023	0.021	0.02	0.017	0.012	0.015	0.013	0.011	0.009	0.008	0.008	0.015	0.014
2	0.662	0.566	0.457	0.357	0.393	0.301	0.236	0.172	0.162	0.162	0.142	0.1	0.126	0.116	0.097	0.075	0.07	0.063	0.115	0.106
3	0.662	0.567	0.461	0.358	0.395	0.303	0.247	0.173	0.164	0.167	0.145	0.103	0.131	0.101	0.103	0.081	0.08	0.072	0.135	0.13
4	0.662	0.567	0.465	0.357	0.394	0.303	0.259	0.172	0.163	0.168	0.143	0.101	0.128	0.097	0.098	0.076	0.076	0.065	0.119	0.113
5	0.639	0.544	0.447	0.335	0.365	0.278	0.193	0.151	0.14	0.143	0.115	0.078	0.096	0.069	0.066	0.049	0.049	0.037	0.065	0.06
6	0.382	0.311	0.25	0.175	0.182	0.133	0.087	0.065	0.058	0.059	0.043	0.028	0.034	0.024	0.022	0.016	0.013	0.012	0.022	0.021
7	0.37	0.297	0.24	0.161	0.164	0.118	0.075	0.054	0.047	0.049	0.033	0.021	0.025	0.016	0.015	0.011	0.008	0.007	0.013	0.013
8	0.37	0.298	0.25	0.161	0.164	0.119	0.075	0.054	0.047	0.041	0.033	0.021	0.026	0.016	0.015	0.011	0.008	0.007	0.013	0.013
9+	0.37	0.298	0.25	0.161	0.164	0.119	0.075	0.054	0.047	0.041	0.033	0.021	0.026	0.016	0.015	0.011	0.008	0.007	0.013	0.013

Table 6.7.3.6. Irish Sea plaice: Update AP stock summary. Uncertainty analysis: modelled median values from 1000 bootstrap simulations (50th percentile) with 5th (lower) and 95th (upper) percentiles indicating the 90% CI for: spawning–stock biomass (SSB, tonnes), mean fishing mortality (F) for ages 3–6, discard tonnage (D) and recruitment (R, 000s).

Year	SSB (t) lower	SSB (t) med	SSB (t) upper	F lower	F med	F upper	D (t) lower	D (t) med	D (t) upper	R (000s) lower	R (000s) med	R (000s) upper
1993	5019	8733	16807	0.474	0.575	0.711	1741	3527	7092	26895	40308	63186
1994	5042	8213	14568	0.402	0.495	0.605	1600	2810	4937	21784	31349	47853
1995	5206	8117	14049	0.314	0.404	0.511	1257	2070	3431	22577	32921	47508
1996	5755	9157	15787	0.232	0.301	0.391	1061	1706	2659	29180	41533	59756
1997	6161	9847	16317	0.246	0.328	0.432	1376	2104	3142	30588	45175	65106
1998	7799	12870	21412	0.177	0.251	0.347	1239	1840	2631	25377	36401	53165
1999	8644	14678	24359	0.131	0.193	0.282	1004	1506	2239	23442	34235	49765
2000	9566	16656	27805	0.095	0.139	0.204	800	1143	1623	33268	48592	70942
2001	11861	20632	34302	0.089	0.131	0.192	932	1315	1819	33075	47357	69136
2002	14079	24320	39747	0.087	0.134	0.201	1065	1464	2033	36020	52516	75268
2003	17278	29792	48841	0.073	0.109	0.166	1031	1415	1928	27973	40230	57732
2004	16879	29503	48789	0.051	0.077	0.117	781	1055	1371	36987	52508	75789
2005	17549	29862	48746	0.063	0.097	0.148	1096	1431	1833	26097	38108	54951
2006	19227	32379	52877	0.047	0.071	0.110	831	1096	1414	29093	43088	62942
2007	17183	28584	46418	0.046	0.072	0.113	648	826	1050	33819	49478	72885
2008	18973	31268	50448	0.036	0.055	0.090	603	758	958	22520	32428	47212
2009	18537	30390	48857	0.033	0.054	0.089	547	684	866	25925	37118	53792
2010	19614	32123	51007	0.028	0.046	0.080	578	739	986	31258	46132	68400
2011	20248	33328	52635	0.050	0.085	0.152	914	1201	1624	35331	50968	76327
2012	18225	30241	48162	0.043	0.079	0.149	889	1233	1731	31101	46679	70968

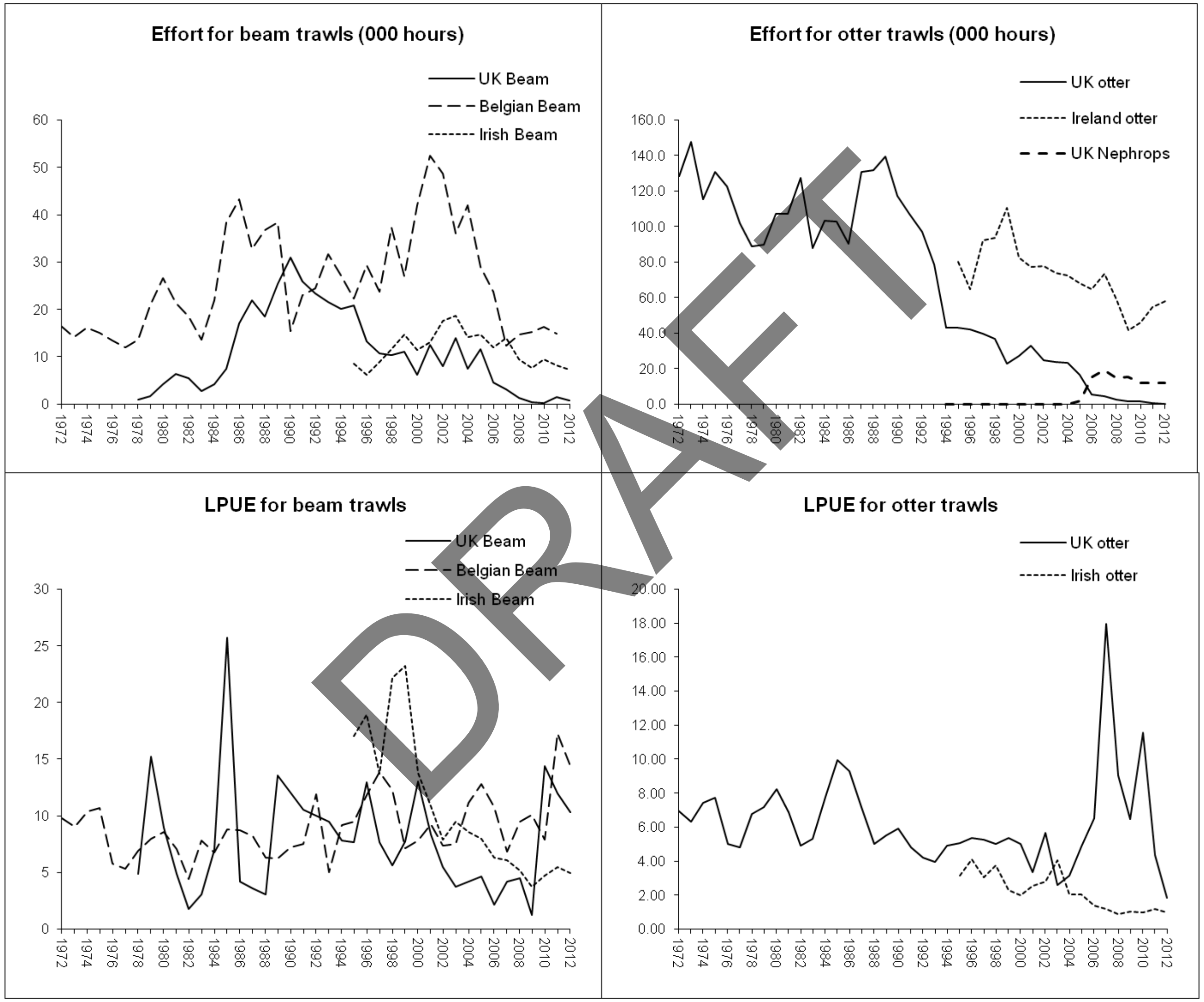


Figure 6.7.2.1. Irish Sea plaice: Effort and lpue for commercial fleets (note addition of effort by UK *Nephrops* trawlers).

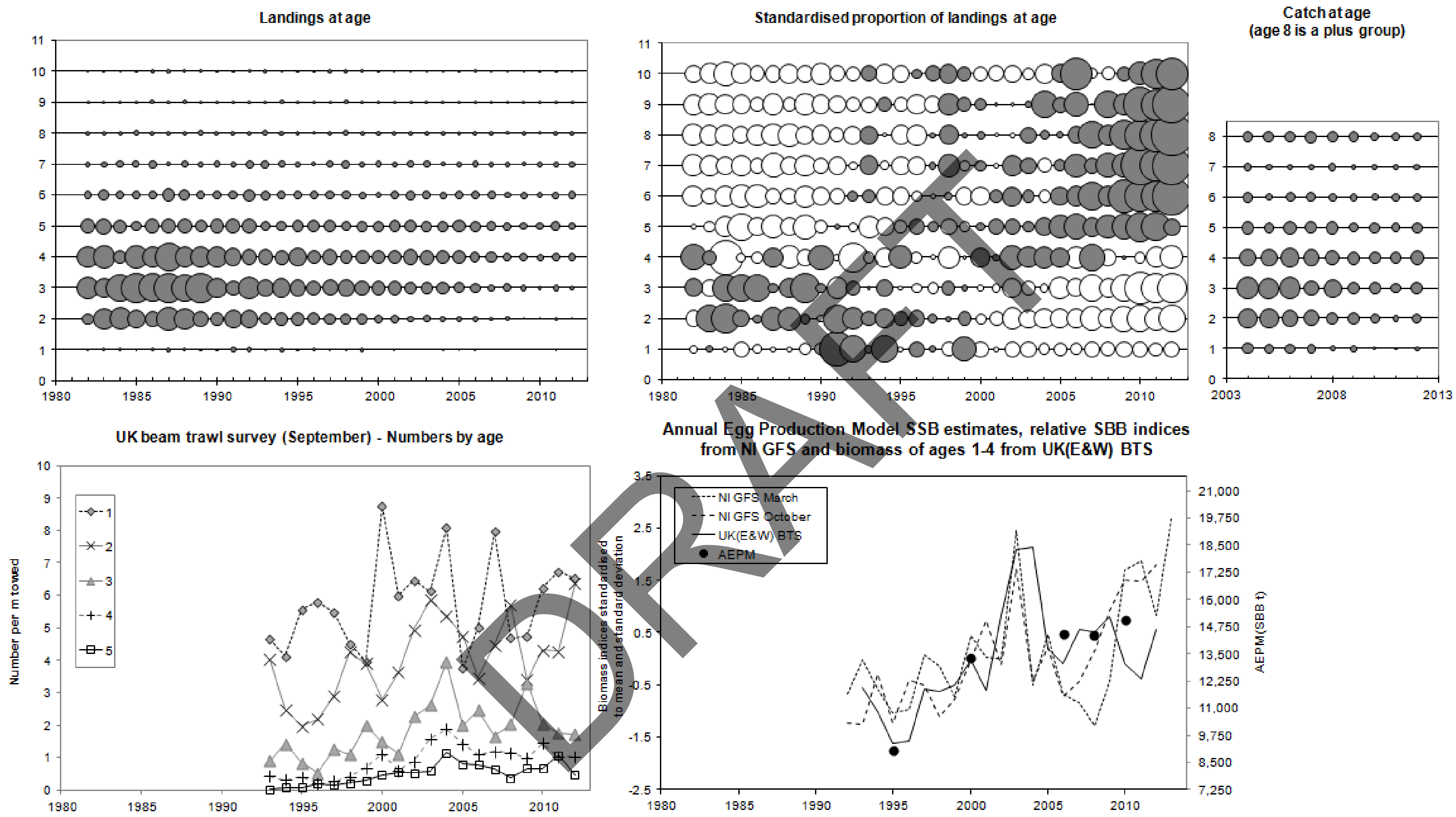


Figure 6.7.2.2. Catch and survey data: raw landings-at-age data (top left), mean standardised proportion-at-age (top centre, grey bubbles are positive values and white bubbles are negative); raw catch-at-age data (discards plus landings, top right); UK(E&W)-BTS-Q3 (extended area) cpue (bottom left); standardised indices of SBB (bottom right) derived from NIGFS-WIBTS and also shown biomass of ages 1–4 from UK(E&W)-BTS-Q3 (extended area) and the SSB estimates from the Annual Egg Production Methods (circles, bottom right). Mean standardised proportion-at-age = [(proportion-at-age in year) – mean(proportion-at-age over all years)] / STDEV(proportion-at-age over all years).

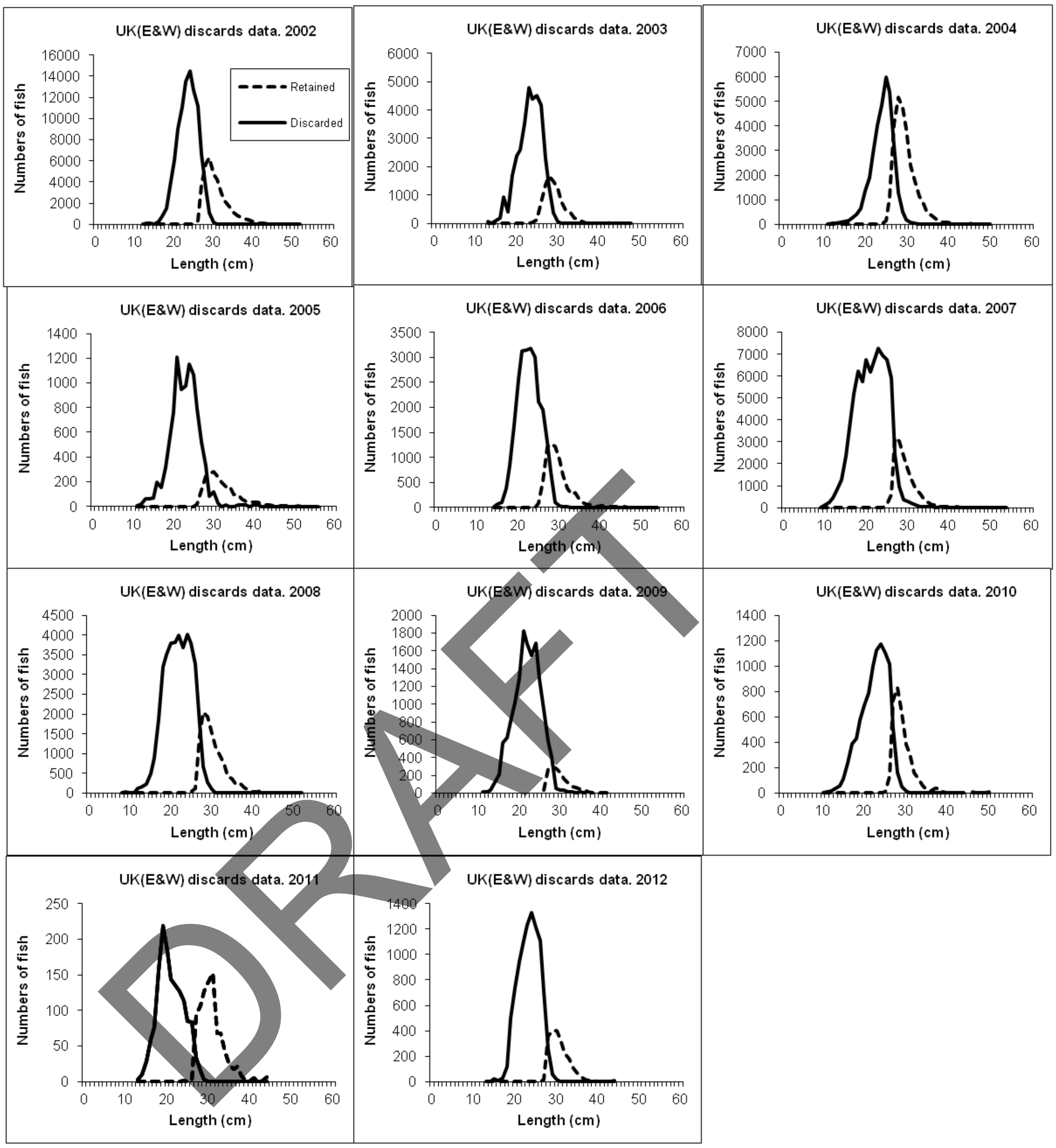


Figure 6.7.2.3. Length distributions of discarded and retained catches from UK(E&W).

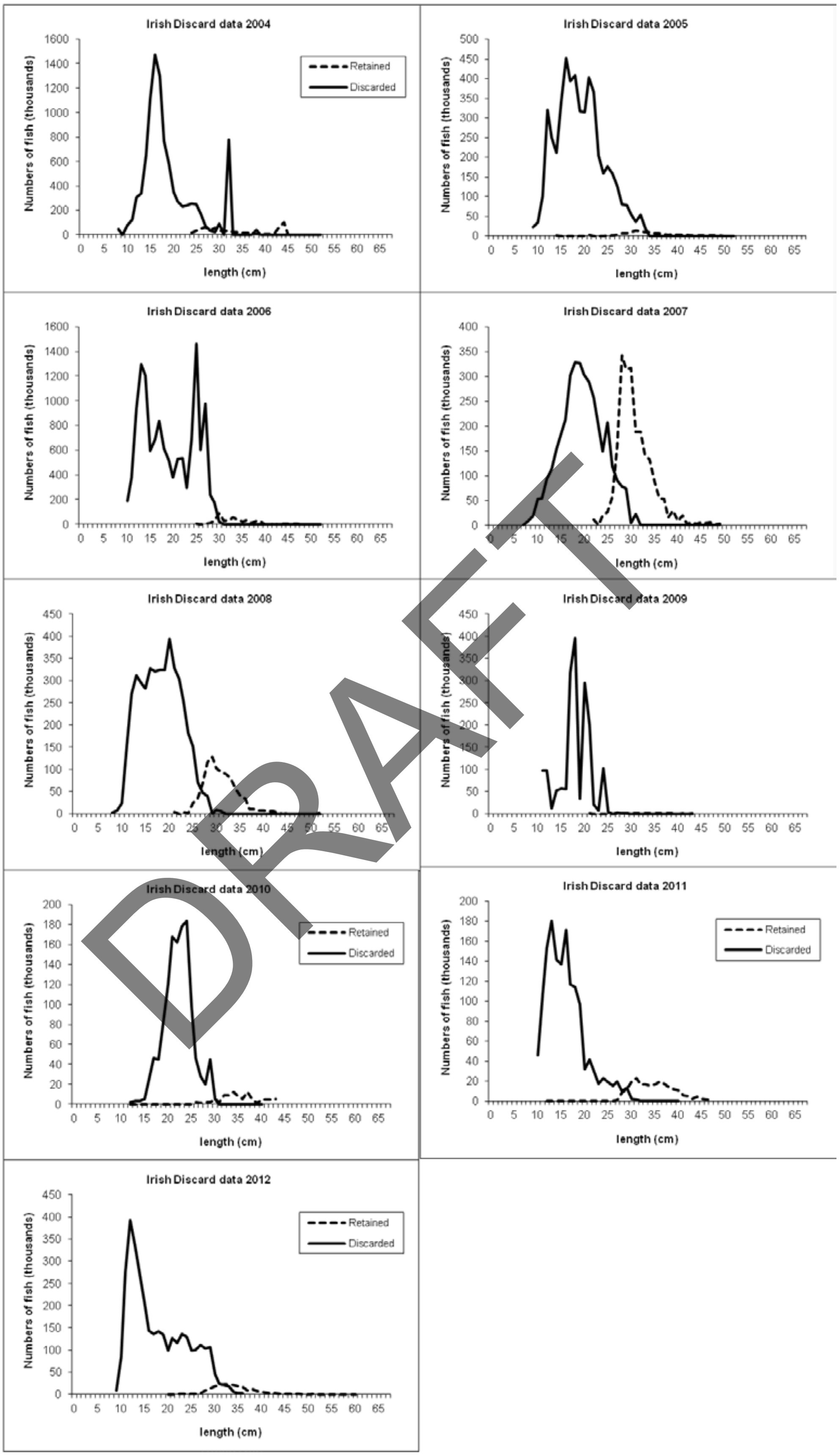


Figure 6.7.2.4. Length distributions of discarded and retained catches from Ireland.

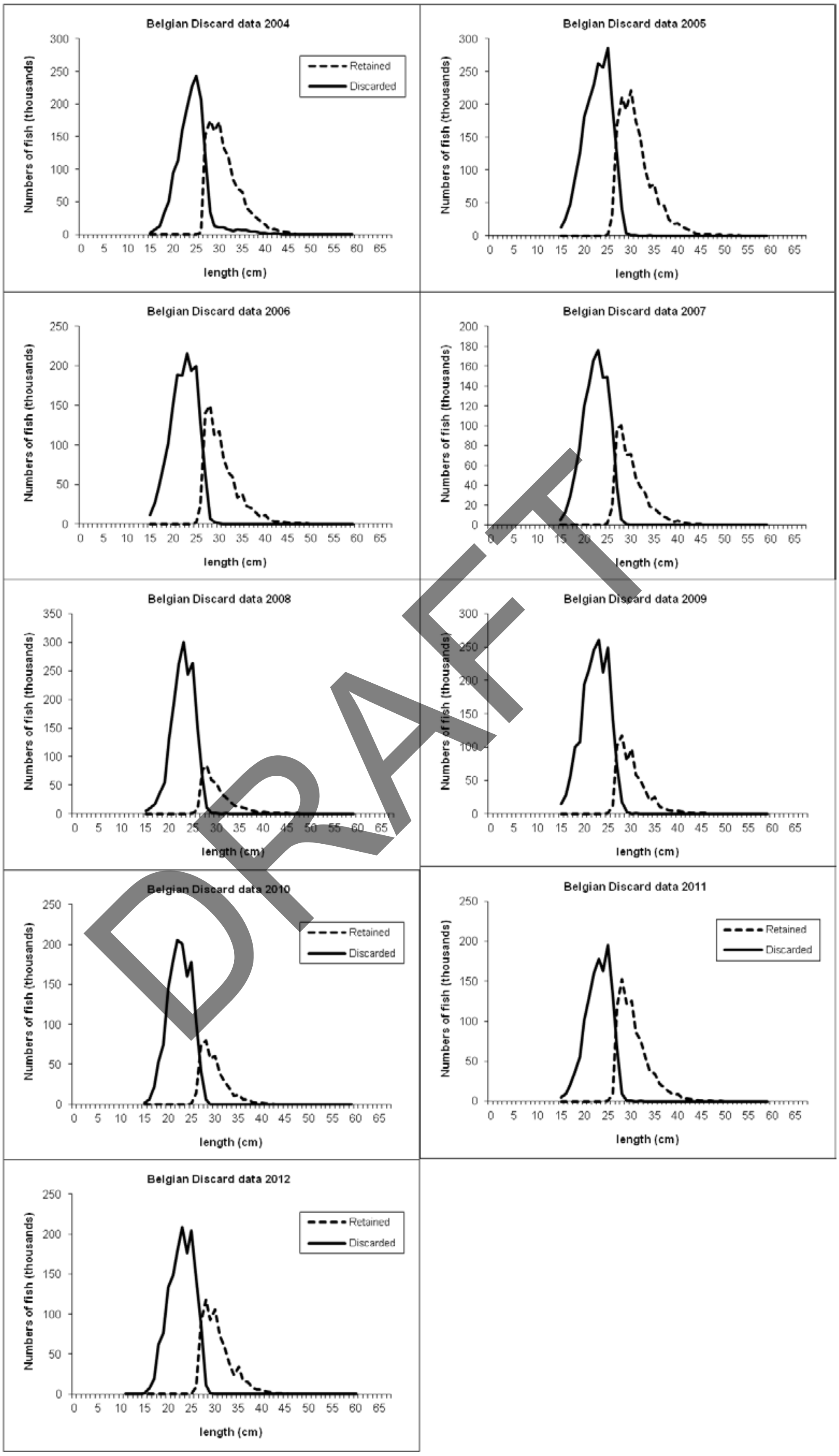


Figure 6.7.2.5. Length distributions of discarded and retained catches from Belgium.

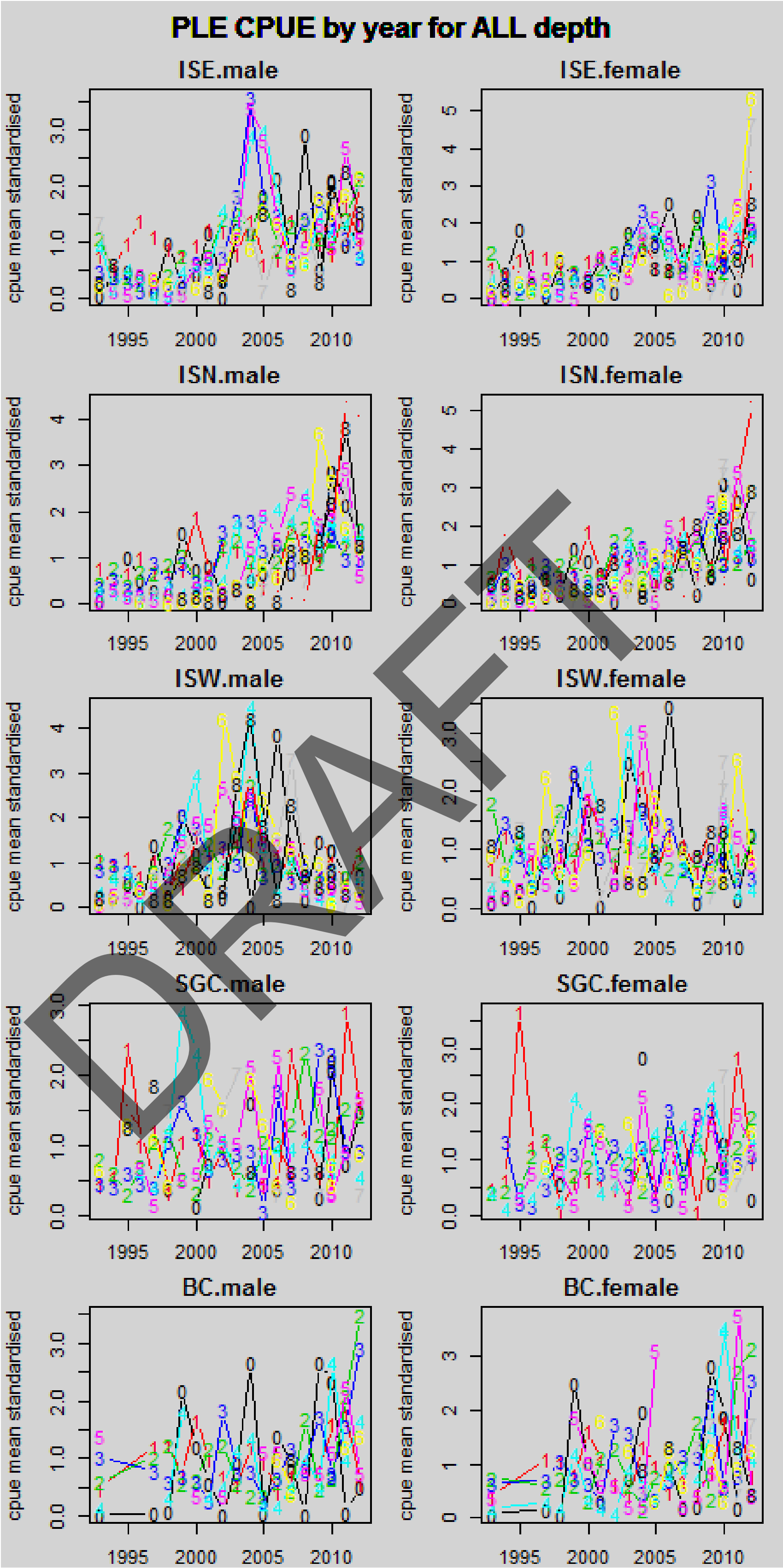


Figure 6.7.2.6. UK (E&W)-BTS-Q3 mean standardised cpue by age by year. Mean standardised by age = cpue age i / mean(cpue age i over all years). Regions are: ISE – Irish Sea East, ISN -Irish Sea North, ISW – Irish Sea West, SGC – St George's Channel, BC – Bristol Channel.

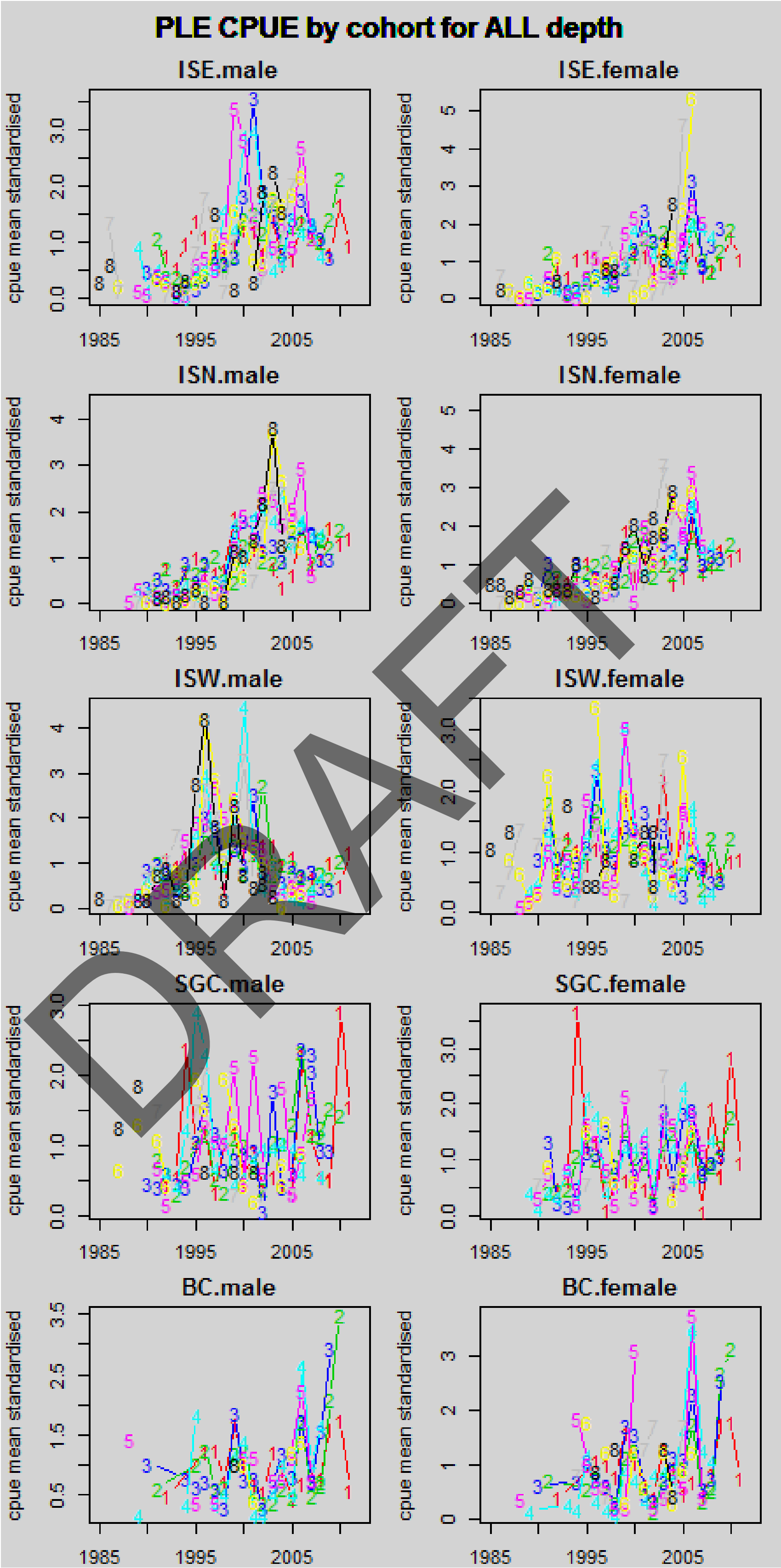


Figure 6.7.2.6. UK (E&W)-BTS-Q3 mean standardised cpue by age by year class. Mean standardised by age = cpue age i / mean (cpue age i over all years). Regions as in Figure 6.7.2.6.

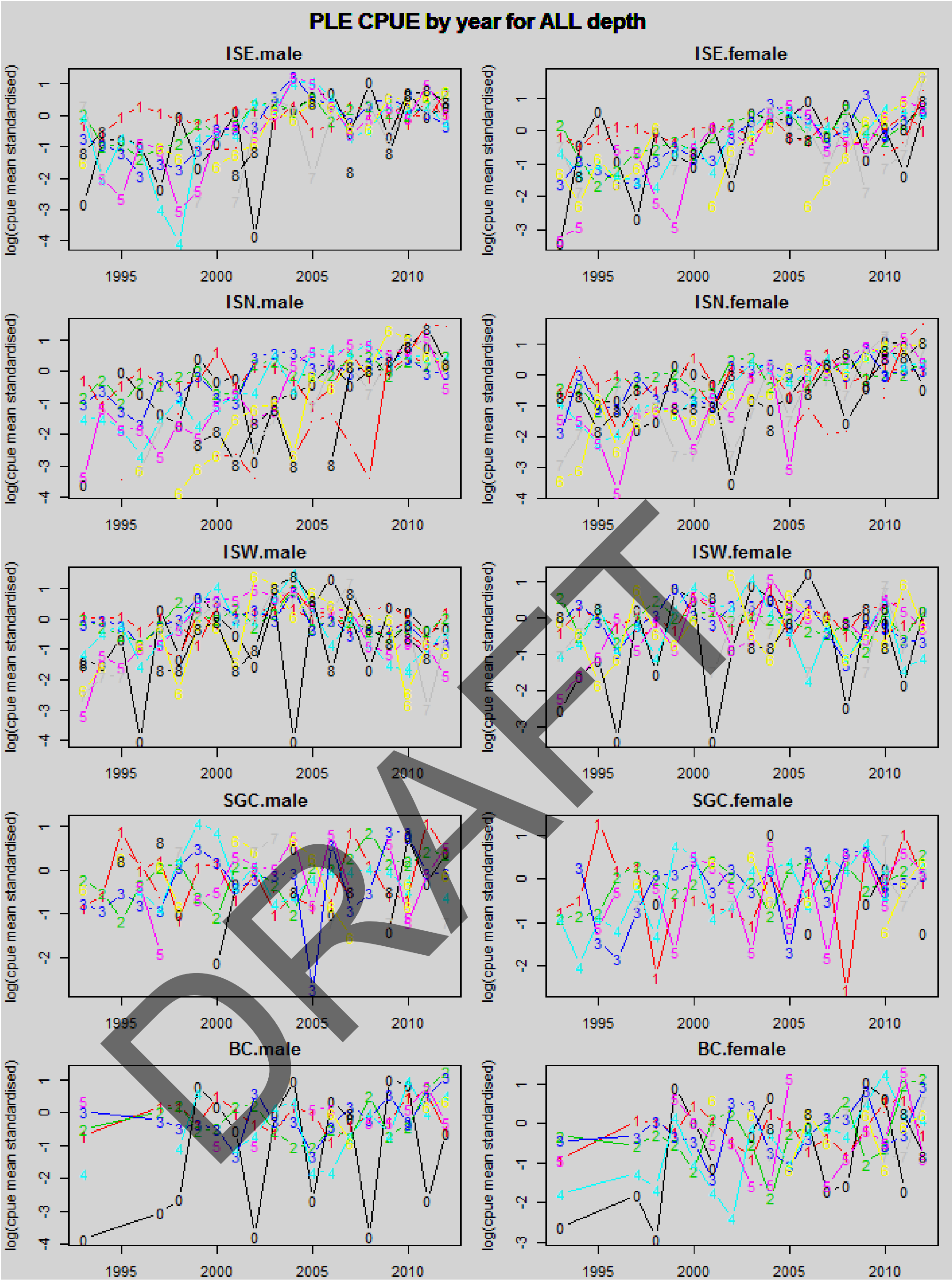


Figure 6.7.2.6 cont. log(mean standardised cpue) by age for UK (E&W)-BTS-Q3 by year. Mean standardised by age = cpue age i / mean (cpue age i over all years). Regions as in Figure 6.7.2.6.

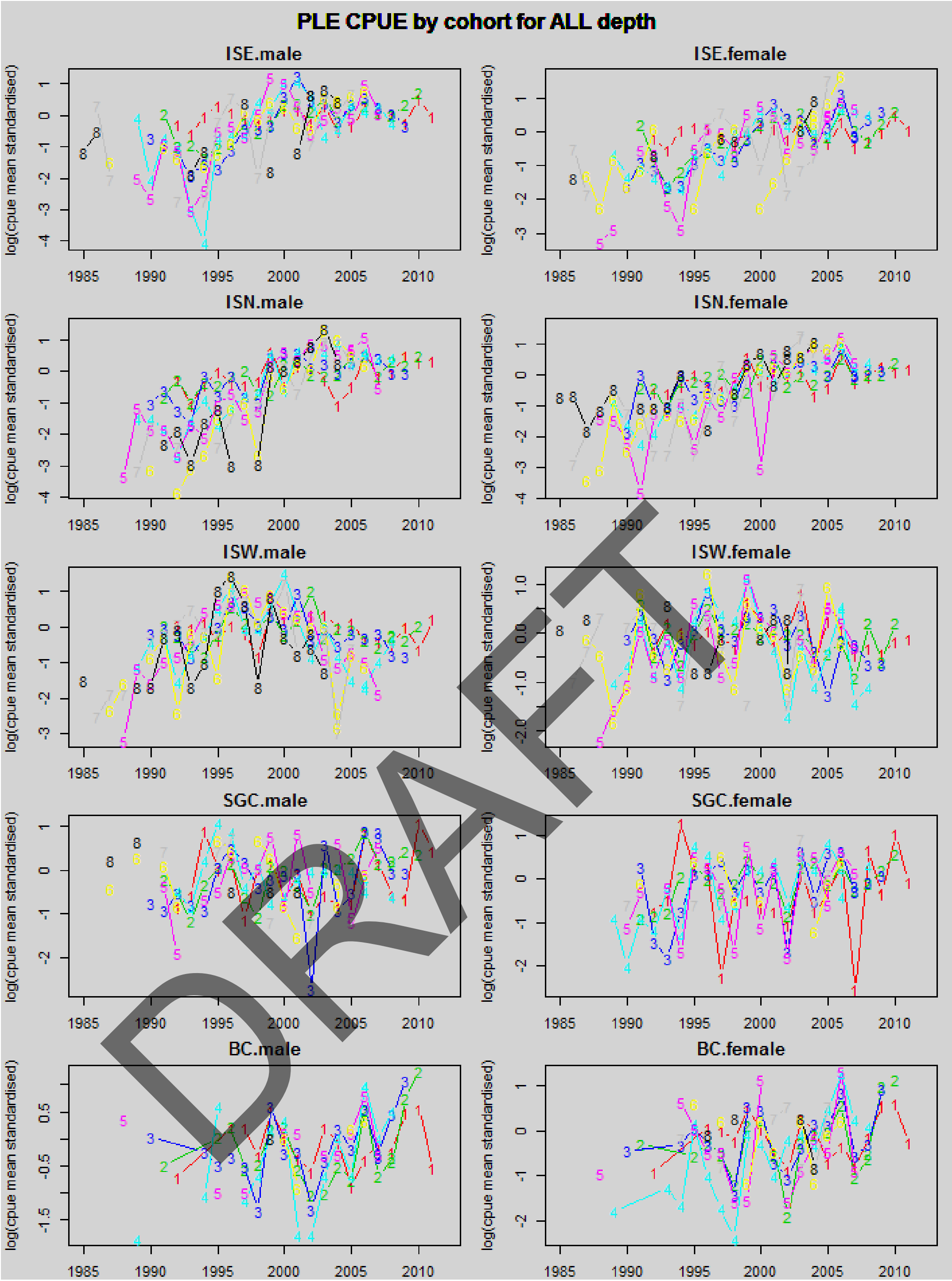


Figure 6.7.2.6 cont. log(mean standardised cpue) by age for UK (E&W)-BTS-Q3 by year class. Mean standardised by age = cpue age i / mean (cpue age i over all years). Regions as in Figure 6.7.2.6.

Figure 6.7.2.7. Northern Irish groundfish survey SSB indices split into spring (left hand panels) and autumn (right hand panels) sampling by western strata (1–3), eastern strata (4–7) and total survey area (strata 1–7) with confidence intervals (± 1 standard error, vertical lines) and mean biomass (kg/3 miles, dashed horizontal lines) for periods identified by statistical breakpoint analysis (see WGCSE 2010). Note the different scale on the y-axis in the top-left panel.

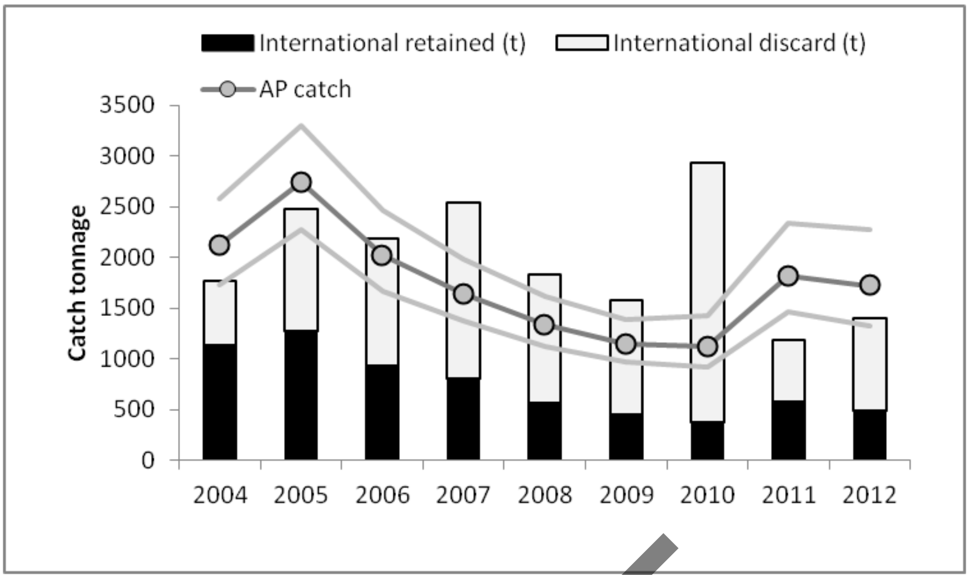


Figure 6.7.2.8. Plaice in VIIa: WG raised international catch tonnage vs. AP model estimates with uncertainty bounds.

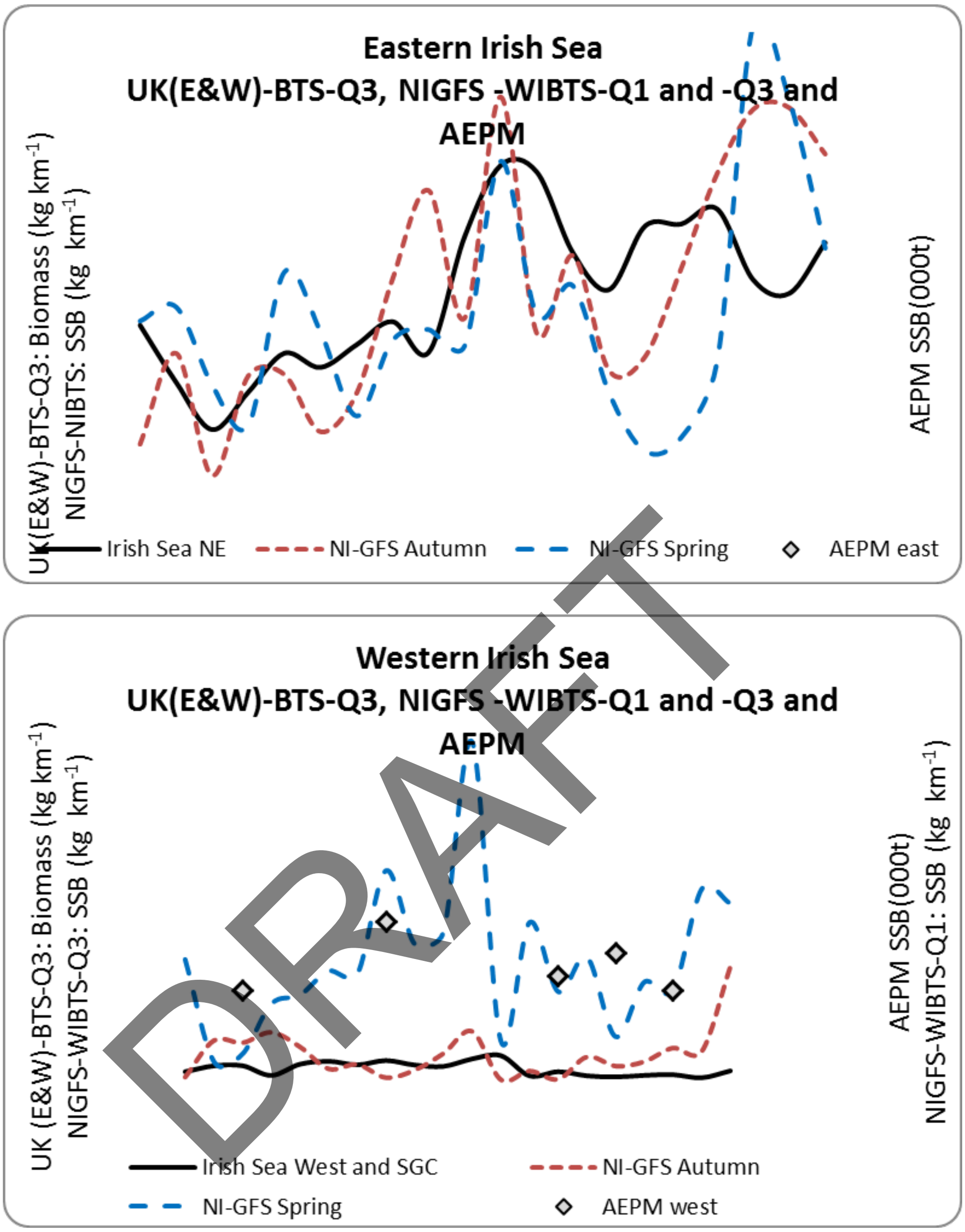


Figure 6.7.2.9. Trends in biomass indices (kg per km towed) from the UK (E&W)-BTS-Q3 (black line) and the NIGFS-WIBTS-Q1 and -Q3 (blue and red dashed lines respectively) in the eastern Irish Sea (top) and the western and southern Irish Sea (bottom). Also shown (grey diamonds, right axis) are the estimates of SSB from the Annual Egg Production Method (AEPM) from Armstrong *et al*. (2011).

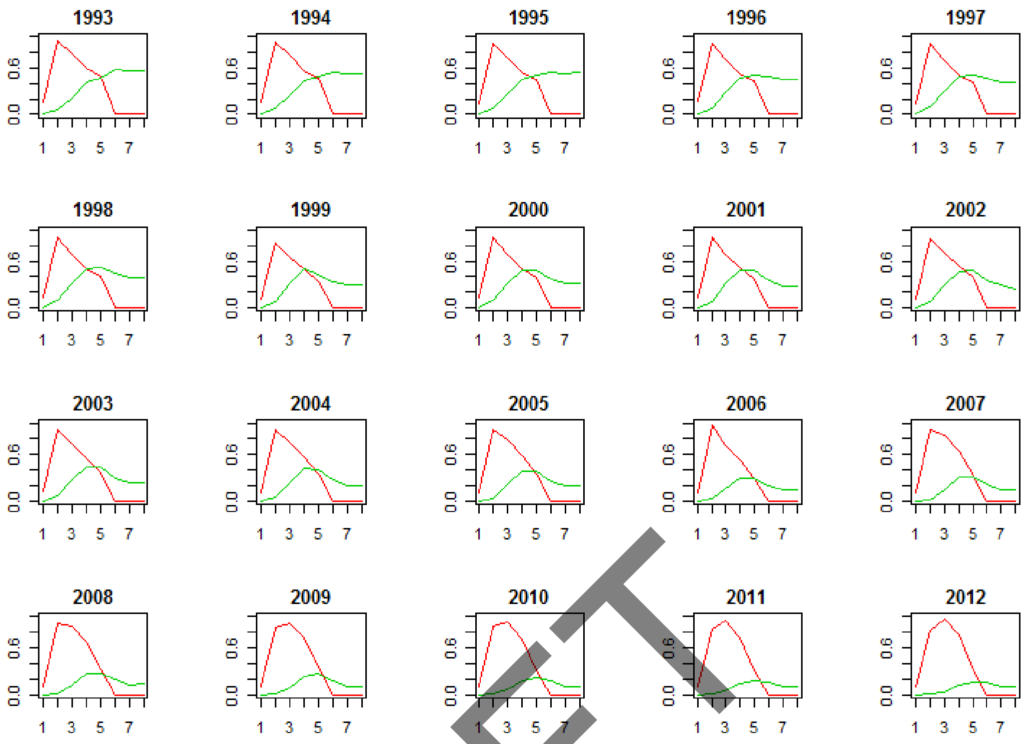


Figure 6.7.2.10. Selectivity of the fishery split into the landed (green) and discarded (red) components as estimated by the AP model, where the x-axis shows age and the y-axis gives the fishing mortality-at-age scaled so that the maximum value is 1 and split by the proportion of fish (by number) discarded and landed-at-age.

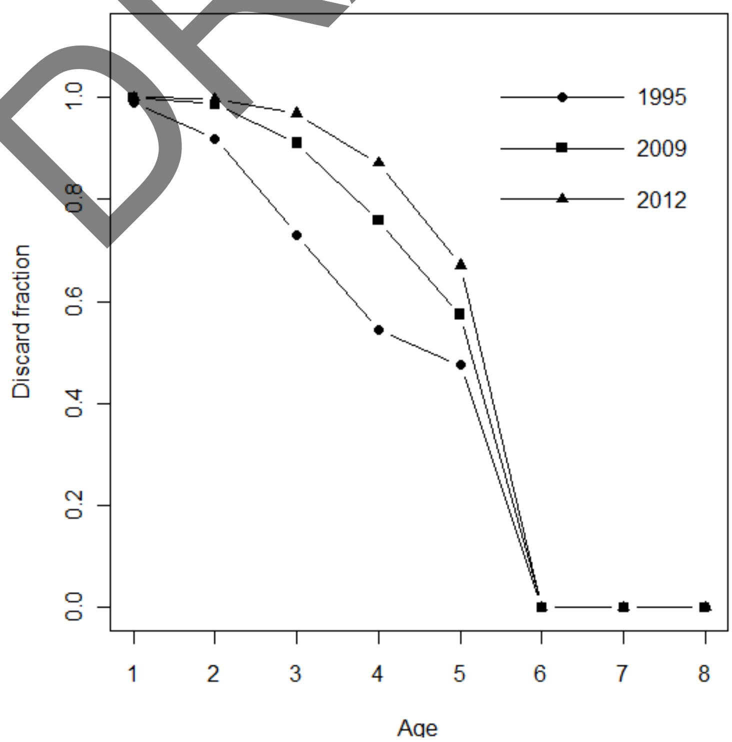


Figure 6.7.2.11. Change in the discard fraction at age over time as estimated by the AP model.

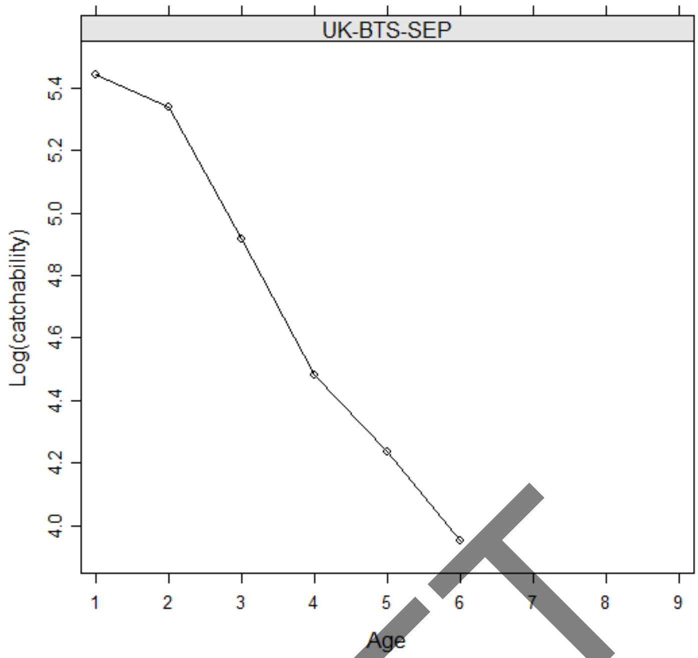


Figure 6.7.2.12. Log catchability for the UK (E&W)-BTS-Q3 extended index as estimated by the AP model.

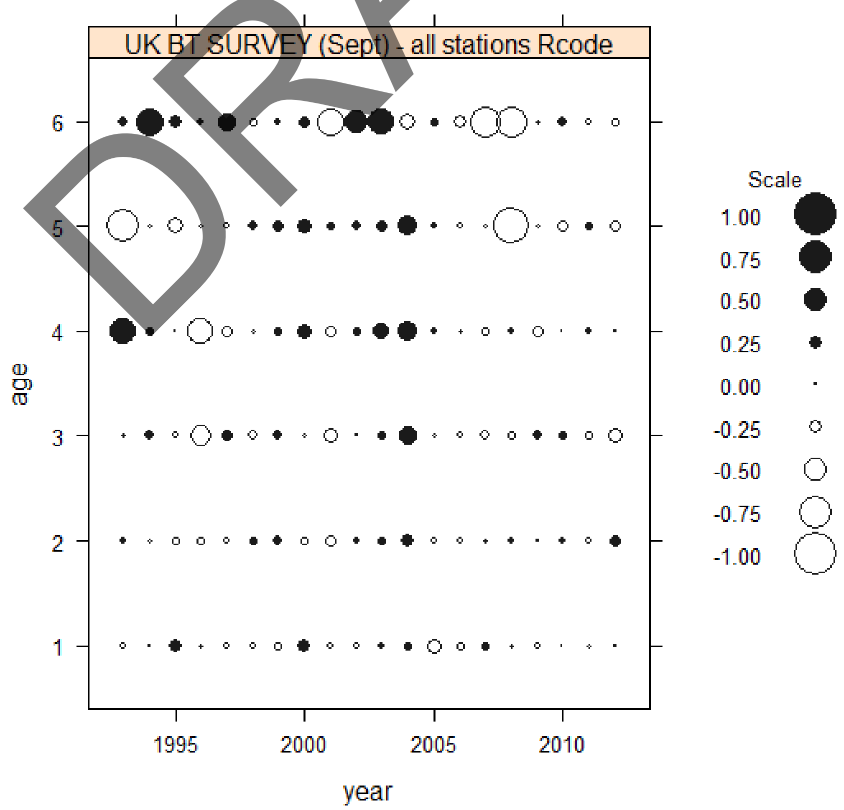


Figure 6.7.2.13. Residual plot (left) for the UK (E&W)-BTS-Q3extended area index. Bubbles are log(observed) – log(expected). Expected values were estimated by the AP model.

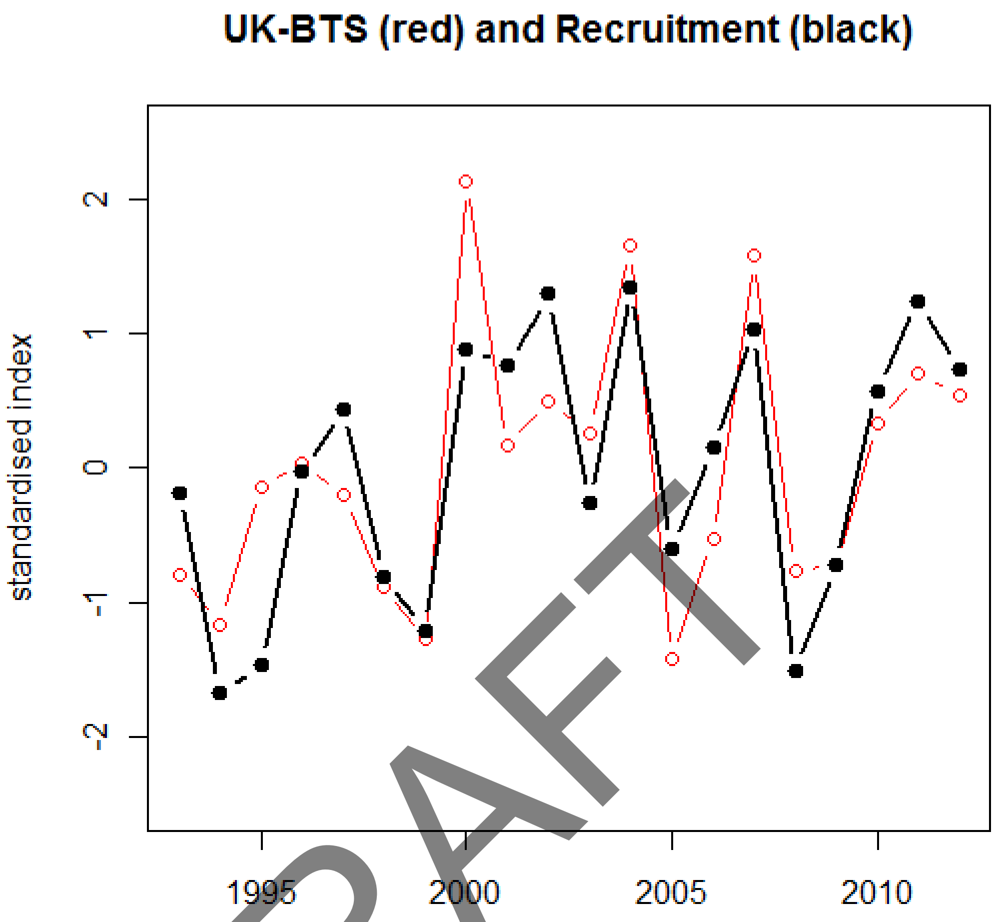


Figure 6.7.2.14. Age 1 index from the UK (E&W)-BTS-Q3 extended area index (red and crosses) and recruitment (black and circles) estimated by the AP model.

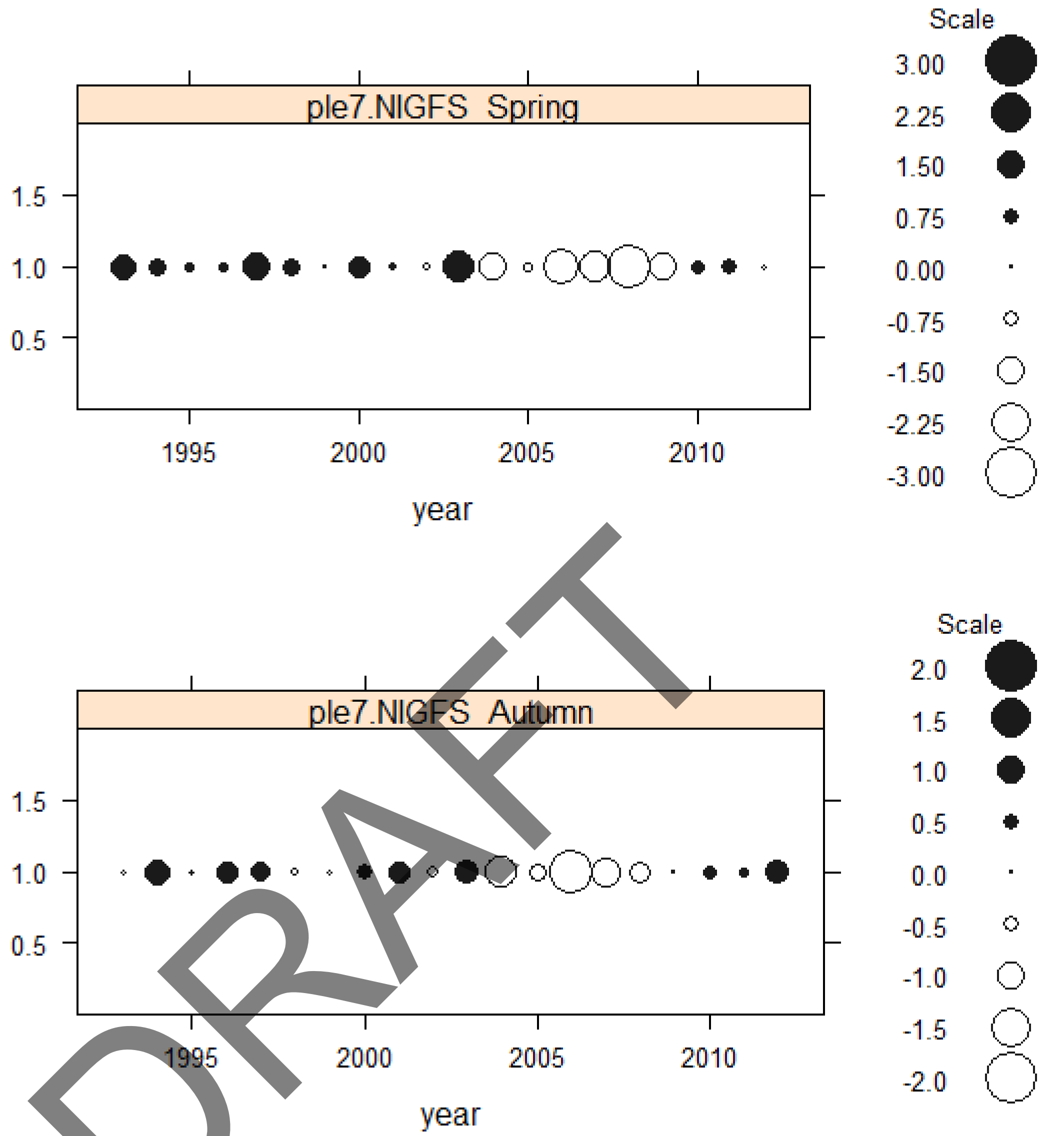


Figure 6.7.2.15. Residual plots for the NIGFS-WIBTS-Q1 (top) and –Q4 (bottom). Bubbles are (observed mean standardised SSB) – (expected mean standardised SSB). Expected values were estimated by the AP model.

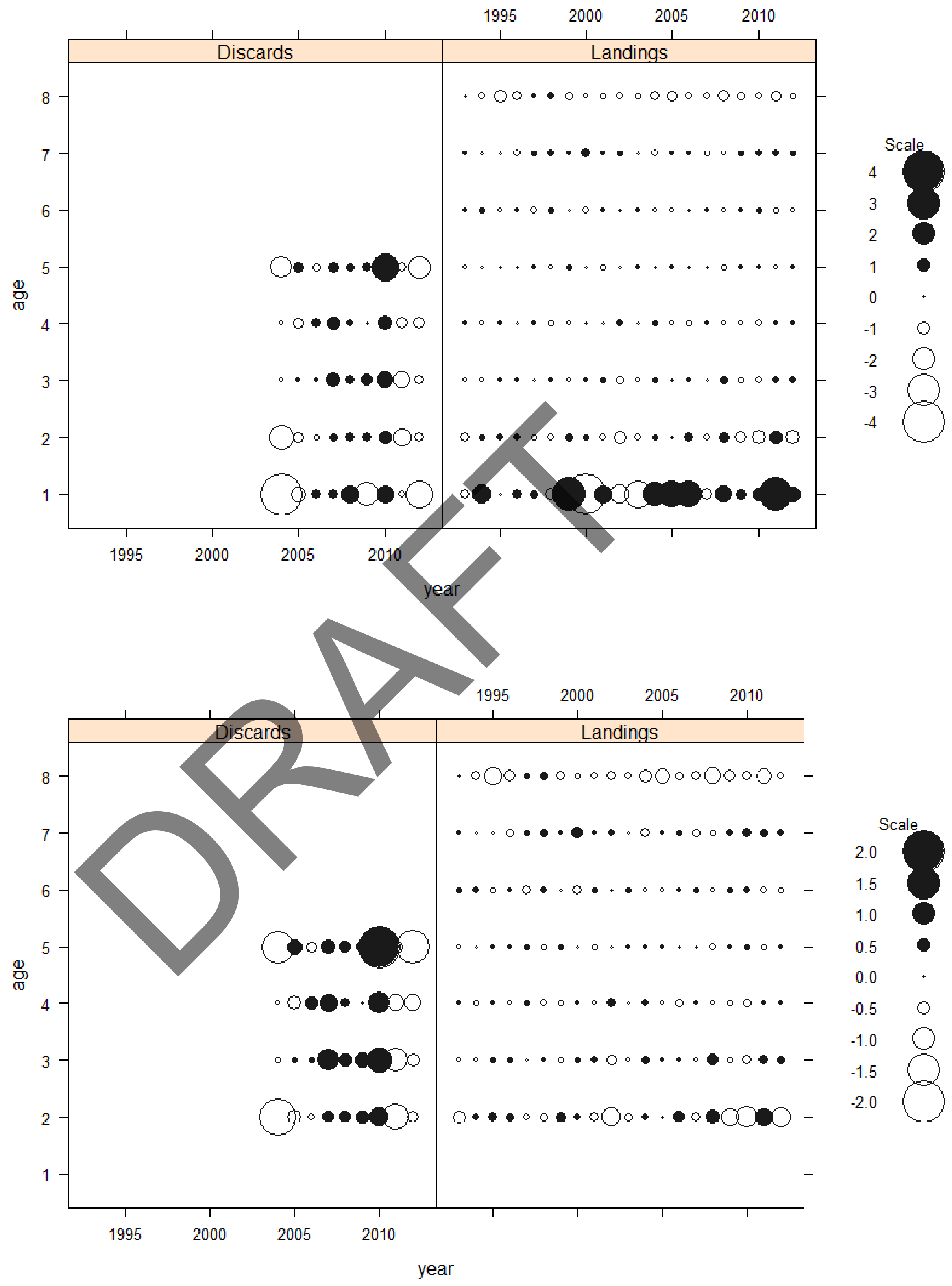


Figure 6.7.2.16. Residual plots for discards (left) and landings (right) with (bottom) and without (top) bubbles drawn for age 1. Bubbles are log(observed) – log(expected). Expected values were estimated by the AP model.

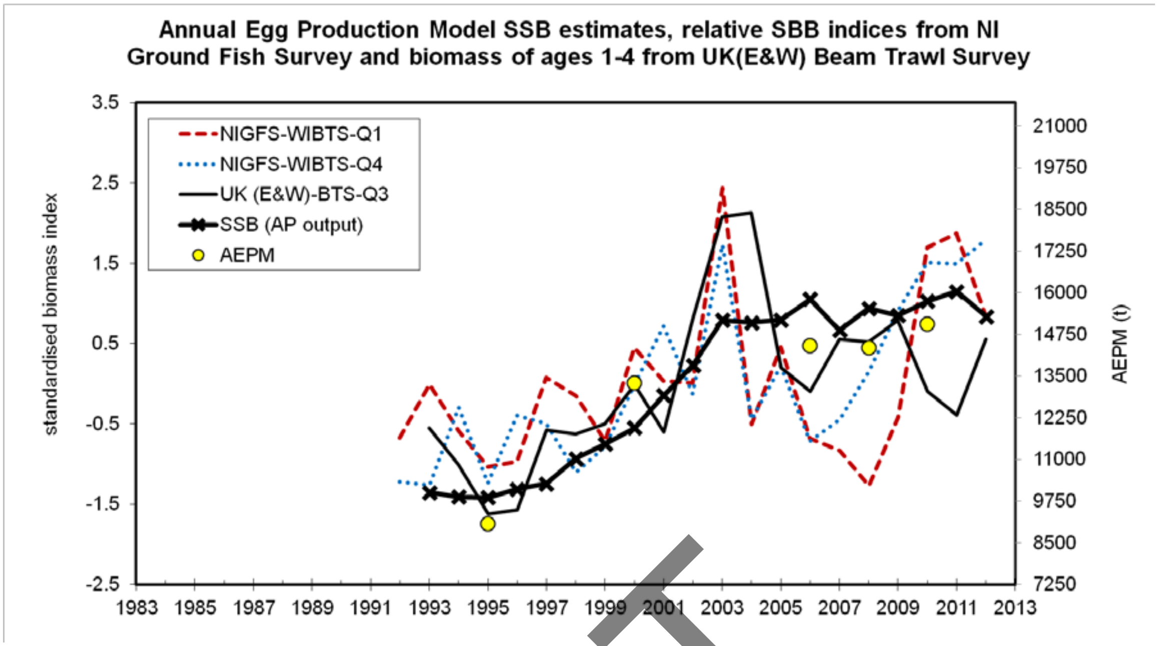


Figure 6.7.2.17. AP model estimates of mean standardised SSB (black line) overlain with standardised NI-GFS in spring (blue) and autumn (green) relative SSB indices, standardised (minus mean and divide by standard deviation) biomass (ages 1–4) from the UK(E&W)-BTS (grey line) and AEPM SSB index (circles, right axis).

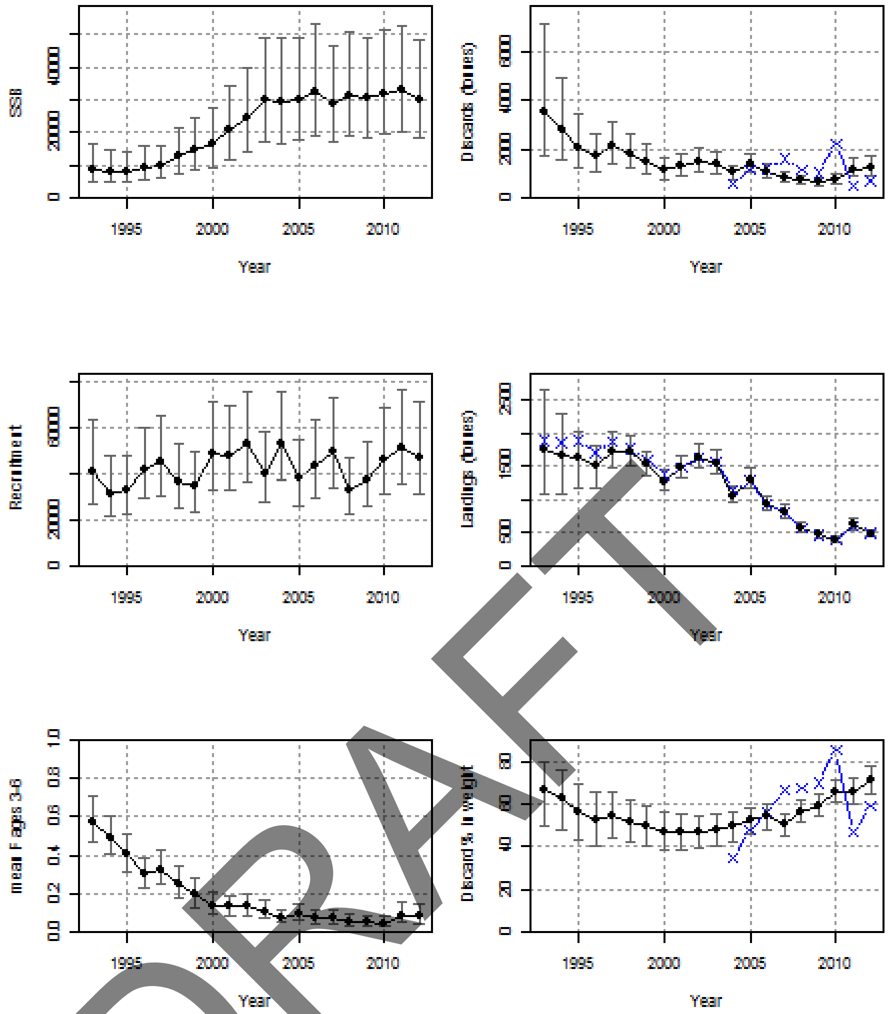


Figure 6.7.2.18. Modelled SSB (tonnes, top left), recruitment (thousands, centre left), F_{BAR} (ages 3–6, bottom left) discard tonnage (top right), landed tonnage (centre right) and % discarded by weight (bottom right). Modelled using the AP model. Raw data shown in blue with crosses. Error bars indicate 5th–95th percentiles.

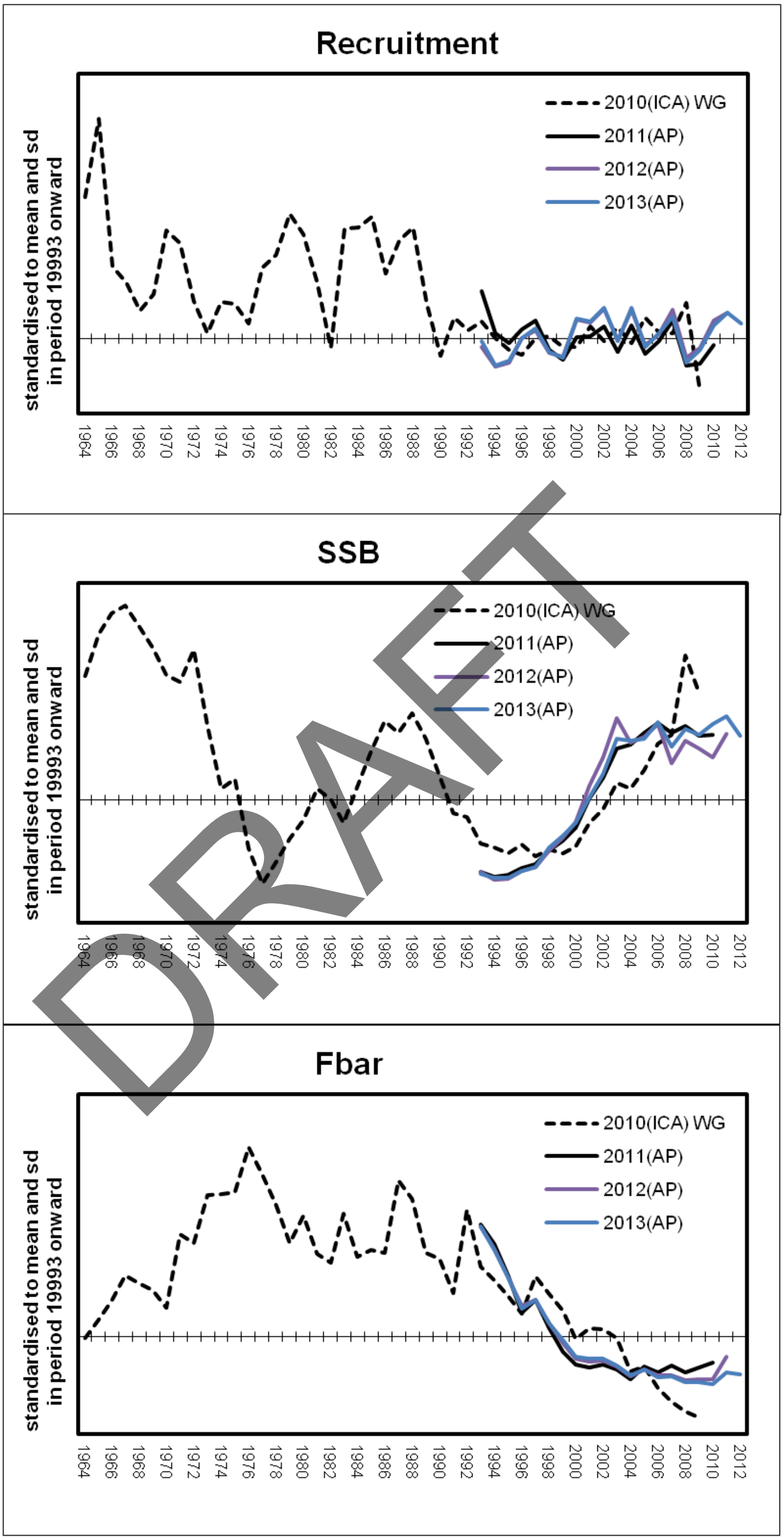


Figure 6.7.2.19. Comparison of recruitment (age 1), SSB and FBAR (ages 3–6) between 2010 (WGCSE 2010, ICA model, dashed lines) and WGCSE 'AP model' assessments in 2011 (black) and 2013 (blue).

6.8 Sole in Division VIIa (Irish Sea)

Type of assessment in 2013

This assessment is an update assessment.

ICES advice applicable to 2012

In 2012 the stock status was presented as follows:

F (Fishing Mortality)				
	2008	2009	**2010**	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✓	✗	✓	Harvested sustainably

SSB (Spawning–Stock Biomass)				
	2009	2010	**2011**	
MSY ($B_{trigger}$)	✗	✗	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	✗	✗	✗	Reduced reproductive capacity

ICES advice applicable to 2012

MSY approach

Following the ICES MSY framework implies fishing mortality to be reduced to 0.07 (56% lower than FMSY because SSB is 56% below MSY $B_{trigger}$), resulting in landings of less than 80 t in 2012. This is expected to lead to a SSB of 1520 t in 2013.

Following the transition scheme towards the ICES MSY framework implies fishing mortality of 0.19 for 2012. This results in landings of 200 t in 2012. This is expected to lead to an SSB of 1390 in 2013.

PA approach

Given the low SSB and low recruitment since 2000, it is not possible to identify any non-zero catch which would be compatible with the precautionary approach.

ICES advice applicable to 2013

In 2013 the stock status was presented as follows:

F (Fishing Mortality)				
	2009	2010	2011	
MSY (F_{MSY})				Above target
Precautionary approach (F_{pa},F_{lim})				Increased risk

SSB (Spawning–Stock Biomass)				
	2010	2011	2012	
MSY ($B_{trigger}$)				Below trigger
Precautionary approach (B_{pa},B_{lim})				Reduced reproductive capacity

ICES advice applicable to 2013

MSY approach

Following the ICES MSY framework implies fishing mortality to be reduced to 0.06 (63% lower than F_{MSY} because SSB is 64% below MSY $B_{trigger}$), resulting in landings of less than 60 t in 2013. This is expected to lead to a SSB of 1500 t in 2014.

Following the transition scheme towards the ICES MSY framework implies fishing mortality of 0.14 for 2012. This results in landings of 140 t in 2013. This is expected to lead to an SSB of 1400 in 2014.

Considering the low SSB and low recruitment since 2000, it is not possible to identify any non-zero catch which would be compatible with the MSY approach.

Comments made by the Review Group (RGCS)

1) The RG agrees with the WG conclusion that discards appear to be a small portion of the recent catch (0–8%). However, the RG recommends that discards should be considered for inclusion in the assessment, particularly if they increase due to TAC restrictions.

As the TAC continues to decline, discarding of sole in the Irish Sea could become more substantial. Therefore it is important that the discard fraction of the catch is monitored through the sea sampling programme. However, the opportunities to take onboard samples could become scarce when the TAC is further decreasing.

2) The long-term projection method specified in the stock annex is a yield- and spawning biomass-per-recruit analysis (MFYPR). However, the RG notes that the stock–recruit relationship is informative (Figure 6.8.10) and recommends that the stock–recruit relationship used to derive F_{MSY} should be considered for evaluating rebuilding plans.

The comment of the RG to take account of the information from the stock–recruitment plot for evaluating management plans is a good suggestion.

3) The legend for Figure 6.8.9 should define 'X' in the Y-axis label ('Probability of SSB(2014)<X'). Presumably this is MSY $B_{trigger}$.

The X in the Y-axis label of Figure 6.8.9 is not referring to MSY $B_{trigger}$ but to the values on the X-axis. It should be interpreted as the probability that the SSB in 2015 (Y-axis) is lower than 400 t, 600 t, ..., 1600 t (X-axis), e.g. for this year's assessment there is a 20% probability that the SSB in 2015 is lower than 800 t. The following note is been added to the legend of the figure: "Note that X is referring to the values on the X-axis."

6.8.1 General

Stock description and management units.

The sole fisheries in the Irish Sea are managed by TAC (see text tables below) and technical measures, with the assessment area corresponding to the stock area. Technical measures in force are minimum mesh sizes and minimum landing size (24 cm). In addition beam trawlers, fishing with mesh sizes equal to or greater than 80 mm, are obliged to have 180 mm mesh sizes in the entire upper half of the anterior part of their net. More details can be found in Council Regulation (EC) N°254/2002 and the stock annex.

Since 2000, a spawning closure for cod has been in force. During the first year of the regulation the closure covered the western and eastern Irish Sea. Since then, closure has been mainly in the western part whereas the sole fishery takes place mainly in the eastern part of the Irish Sea (Liverpool Bay and Cardigan Bay). No direct impact on the sole stock is expected from this closure.

For 2009 Council Regulation (EC) N°43/2009 allocates different amounts of Kw*days by Member State and area to different effort groups of vessels depending on gear and mesh size. The areas are Kattegat, part of IIIa not covered by Skaggerak and Kattegat, ICES Zone IV, EC waters of ICES Zone IIa, ICES Zone VIId, ICES Zone VIIa, ICES Zone VIa and EC waters of ICES Zone Vb. The grouping of fishing gear concerned are: bottom trawls, Danish seines and similar gear, excluding beam trawls of mesh size: TR1 (≥100 mm)–TR2 (≥70 and <100 mm)–TR3 (≥16 and <32 mm); Beam trawl of mesh size: BT1 (≥120 mm)–BT2 (≥ 80 and <120 mm); gillnets excluding trammelnets: GN1; trammelnets: GT1 and longlines: LL1.

For 2010–2012, Council Regulation (EC) N°53/2010, Council Regulation (EC) N°57/2011 and Council Regulation (EC) N°43/2012 were updates of the Council Regulation (EC) N°43/2009 with new allocations, based on the same effort groups of vessels and areas as stipulated in Council Regulation (EC) N°43/2009. (See Section 1.2.1 for complete list).

Management applicable to 2012 and 2013

TAC 2012

Species: Common sole *Solea solea*		Zone: VIIa (SOL/07A.)
Belgium	131	
France	2	
Ireland	67	
The Netherlands	41	
United Kingdom	59	
Union	300	
TAC	300	Analytical TAC

TAC 2013

Species: Common sole *Solea solea*		Zone: VIIa (SOL/07A.)
Belgium	36	
France	0	
Ireland	58	
The Netherlands	11	
United Kingdom	35	
Union	140	
TAC	140	Analytical TAC Article 3 of Regulation (EC) No 847/96 shall not apply. Article 4 of Regulation (EC) No 847/96 shall not apply.

Fishery in 2012

A full description of the fishery is provided in the stock annex, Section A2.

The Working Group estimated the total international landings at 294 t in 2012 (Table 6.8.1), which is about 2% below the 2012 TAC (300 t) and 5% above last year's forecast of 279 t.

The main countries fishing for Irish Sea sole are Belgium, Ireland and UK (England & Wales).

The Belgian beam trawl effort has declined since 2002, however for the last five years it remains stable at around the lowest level in the time-series. After a peak in 2003, the Irish beam trawl effort has shown a declining trend that has stabilized in the most recent years. After the historically lowest value reported in 2009, the Irish otter trawl effort has increased since 2010. Since the beginning of the nineties the UK beam trawl effort has continued to decline.

Landings

An overview of the landings data provided and used by the WG is shown in Table 6.8.1. The landings reached a level of 2800 t in the mid-1980s due to good recruitments in 1982–1984, but then subsequently dropped to a lowest of 818 t in 2000 (Table 6.8.12). After a small increase to 1090 t in the beginning of the 2000s, the landings have fallen to under 350 t in the last five years.

The WG estimated the total international landings at 294 t in 2012 (Table 6.8.1), of which 75% (222 t) was landed by Belgium, 17% (51 t) by Ireland, 5% (14 t) by the UK (England & Wales) and the remainder by Northern Ireland, Scotland, Isle of Man and France. These landing figures are about the lowest in the time-series, corresponding to an international uptake of 98% of the agreed TAC in 2012 (300 t).

There is no accurate information on the level of misreporting, but given the partial uptake (50–98%) of the agreed TAC in recent years, misreporting is not considered a problem for this stock (Table 6.8.1).

Data

Quarterly age compositions for 2012 were available from the countries that take the major part of the international landings (97%) (Belgium, UK (E&W) and Ireland). The raw age data were combined for the three countries without weighting. The combined ALK was applied to the raised length distribution of the national catches to obtain a combined age distribution. This distribution was applied to the landings from France, Northern Ireland, Isle of Man and Scotland to obtain the catch numbers-at-age for 2012 (Table 6.8.2). Annual length distributions of the three major countries involved are given in Table 6.8.3.

Catch weights-at-age for 2011 were taken from the combined age–weight key (Table 6.8.4).

Stock weights-at-age for 2011 were derived from the mean catch weights by cohort interpolation to the first of January (Rivard weight calculator) (Table 6.8.5).

Further details on raising methods are given in the stock annex.

As last year, the combined age data (calculated outside InterCatch) as well as the landings from Northern Ireland, Scotland, Isle of Man and France were uploaded to InterCatch. It should be noted that the international age distribution is uploaded as "BE" as no international country code is available in InterCatch at present. Moreover, the landings of Northern Ireland, Scotland and Isle of Man are aggregated as "UK" as for the moment no country code is available for those countries in InterCatch.

Discards

The available discard data indicate that discarding is not a major problem in the Irish Sea sole fishery. Discard rates (Table 6.8.6) in the various fisheries targeting sole are generally less than 8% in weight (and often even smaller than 2%). For 2012 discard rates from the beam trawl fleets are 5% for Belgium and 0.4% for Ireland. The discard rates for the Irish fleets were derived from the Irish length distributions and the Irish length–weight relationship.

Length distributions of retained and discarded catches of sole for 2012 from samples taken onboard Belgian beam trawl vessels are given in Figure 6.8.1. It should be noted that the number of sampled trips is low.

Biological

Natural mortality, maturity and proportions of natural mortality and fishing mortality before spawning were set as in previous years, details of which can be found in the stock annex Section B2.

Surveys

Lpue and effort series were available from the UK (E&W) September beam-trawl survey (UK(E&W)-BTS-Q3) (1988–2012) and the UK (E&W) March beam-trawl survey (UK(E&W)-BTS-Q1) (1993–1998) (Tables 6.8.7 and Figure 6.8.2c). From 2006 until 2010 the two UK beam-trawl surveys have been used as tuning indices in the Irish Sea sole assessments. Following the outcome of WKFLAT 2011, the March survey (UK(E&W)-BTS-Q1) was omitted from the following assessments. Over the first half of the time-series, lpue from the UK(E&W)-BTS-Q3 fluctuated between 90 and 200 kg/100 km fished. Since 2000 it has dropped gradually to the lowest value in 2012 (27 kg/100 km fished).

Detailed information on the survey protocols and area coverage can be found in the stock annex.

Commercial lpue

Commercial lpue and effort data were available for Belgian beam trawlers, UK (E&W) beam and otter trawlers and Irish otter and beam trawlers.

Trends in lpue and effort are given in Table 6.8.7 and Figure 6.8.2–3.

Effort from both Belgian and UK commercial beam trawl fleets increased from the early seventies until the beginning of the nineties. Since then UK beam-trawl effort has shown a continuing declining trend. In contrast, the Belgian beam-trawl effort has shown a fluctuating pattern. After the decline in the early nineties, it reached its highest level in 2002 and decreased again afterwards. For the five most recent years, it remained at around the lowest level in the time-series. The effort of the Irish beam trawlers shows a slow decline since 2003 back to the levels of the mid-nineties. In 2008 all beam-trawl fleets showed a substantial reduction in effort compared to 2007. The effort from the UK otter trawlers remained stable until the beginning of the nineties. Since then the UK otter-trawl effort has continuously declined and is now at the lowest level in 2012. The Irish otter trawlers have also shown a striking reduction in effort since 1999. However, since 2010 it has increased slightly.

Lpue for both UK and Belgian beam trawlers was at a high level in the late seventies and early eighties but since early 2000s, lpue for these fleets has fluctuated at a lower level. Since 2007–2008 there has been a small increase in lpue. However, in 2011 the UK beam-trawl lpue has dropped to a remarkable low level in the time-series and remains at around the same level in 2012 (5.2 kg/hour fished in 2012). The Belgian beam trawlers on the other hand hold on to a higher lpue value (18.3 kg/hour fished in 2012) for the last five years. As the Belgian beam-trawl fleet operates also in the Cardigan Bay and southwestern Irish Sea, an overflow from the Celtic Sea (VIIfg) could perhaps explain a part of this discrepancy in lpue. However, tagging studies have shown low rates of movement of sole between the Irish Sea, Celtic Sea and the surrounding assessment areas (Horwood, 1993; Williams, 1965).

Irish beam-trawl lpue shows a diminishing trend over the whole time-series. However, in 2012 it has increased slightly. The lpue of UK and Irish otter trawlers shows a decline over the whole time-series.

Historical stock development

In 2010, the Irish Sea sole assessment was based on XSA with two survey tuning indices (UK(E&W)-BTS-Q3 and UK(E&W)-BTS-Q1 (Table 6.8.8). The UK(E&W)-BTS-Q1 indices only provides information for years 1993 up to 1999 and therefore no longer contributes to the final survivor estimates. At WKFLAT 2011, the exclusion of the UK(E&W)-BTS-Q1 from the assessment was investigated and it was found that there was little effect on the catchability residuals and the retrospective pattern showed a slight improvement. WKFLAT 2011 therefore decided to omit this survey from the assessment.

6.8.2 Stock assessment

Data screening

The age range for the analysis was 2–8+.

A preliminary inspection of the quality of international catch-at-age data was carried out using separable VPA with a reference age of 4, terminal F=0.5 and terminal S=0.8. The log-catch ratios for the fully recruited ages (4–7) did not show any patterns or large residuals. The results of exploratory XSA runs, which are not included in this report, are available in ICES files.

The screening of the tuning indices (UK(E&W)-BTS-Q3) showed good cohort tracking and consistency between ages for year-class strength. The plots with log standardised indices, which are not included in this report, are available in ICES files.

Final update assessment

The model settings for the final assessment are summarized below.

Assmnt Year	2010	2011–2013
Assmnt Model	XSA	XSA
Fleets		
Bel Beam Trwl	omitted	omitted
UK Trawl	omitted	omitted
UK Sept BTS	1988–2009 2–7	1988–2012 2–7
UK Mar BTS	1993–1999 2–7	omitted
Time Ser. Wts	linear 20 yrs	no taper weighting
Power Model	none	none
Q plateau	7	4
Shk se	1.5	1.5
Shk age-yr	5 yrs 3 ages	5 yrs 3 ages
Pop Shk se	0.3	0.3
Prior Wting	none	none
Plusgroup	8	8
FBAR	4–7	4–7

The final XSA output is given in Table 6.8.9 (diagnostics), Table 6.8.10 (fishing mortalities) and Table 6.8.11 (stock numbers). Log catchability residuals for the final assessment are given in Figure 6.8.4. A summary of the XSA results is given in Table

6.8.12 and trends in yield, fishing mortality, recruitment and spawning–stock biomass are shown in Figure 6.8.5. Retrospective patterns for the final run are shown in Figure 6.8.6.

Adding the 2012 data to the time-series did not cause any additional anomalies compared to last year. The log catchability residual pattern showed no trends and no year effects for the UK(E&W)-BTS-Q3 fleet.

The survivor estimates and fishing mortality estimates are almost entirely determined by the UK(E&W)-BTS-Q3 survey as it gets a high weighting (>96%) at all ages.

This assessment shows no retrospective bias in recruitment, whereas for the fishing mortality and SSB, there is a tendency in the last years to respectively slightly underestimate and overestimate them.

Comparison with previous assessments

A comparison of the estimates of this year's assessment with last year's is given in Figure 6.8.7.

Trends in fishing mortality, SSB and recruitment are very similar. In last year's assessment, F and SSB for 2011 were estimated to be 0.32 and 1137 t respectively; this year's estimates for 2011 are 0.34 and 1095 t, an upward revision of 6% for F and a downward revision of 4% for SSB. The estimated recruitment by XSA in 2011 (541 thousand fish) was revised upward by 3% in 2012 (559 thousand fish).

State of the stock

Estimated trends of Irish Sea sole landings, SSB, fishing mortality and recruitment are presented in Table 6.8.12 and Figure 6.8.5. Since the late eighties the landings of Irish Sea sole have been declining to the lowest level of the time-series (275 t) in 2010, followed by a small increase in 2011 (330 t) and a decrease in 2012 (294 t). SSB has been at a higher level until the late eighties. Since then SSB has been fluctuating around B_{PA} and since 2005 it dropped below B_{lim}. In 2011 SSB declined to the lowest estimate of the time-series (1095 t). In 2012 SSB is still around the lowest level (1126 t). High fishing mortalities were observed during the late eighties until the mid-nineties. Thereafter fishing mortality declined to a level fluctuating around F_{lim} and since 2007 to around F_{PA}. The decline in F is supported by a reduction in effort observed for the Belgian beam trawlers, UK (E&W) beam and otter trawlers and Irish otter trawlers. Since 2001 recruitment has been well below the mean (6033 thousand fish) and the 2011 recruitment (year class 2009) is estimated to be the lowest in the time-series (559 thousand fish). The 2012 recruitment (year class 2010) is estimated to be slightly higher (744 thousand fish).

6.8.3 Short-term projections

Estimating year-class abundance

The 2010 year class is now estimated at 744 thousand fish at age 2, which is 73% lower than the RCT3-value (2748 thousand fish) used in last year's forecast. The current estimate of the 2010 year class is solely coming from the UK(E&W)-BTS-Q3 and this survey has the second lowest abundance for age 2 in the time-series in 2012 (49 in 2012 and 35 in 2011).

The 2011 year class (age 2 in 2013) was estimated using RCT3 (input in Table 6.8.13, output in Table 6.8.14). The RCT3 estimate (1388 thousand fish) was used as it incorporates additional information of age 1 fish from the UK(E&W)-BTS-Q3 survey that is not included in the XSA.

The short term GM (2003–2011, 1900 thousand fish) recruitment was assumed for the 2012 and subsequent year classes.

The working group estimates of year-class strength used for prediction can be summarised as follows:

YEAR CLASS	XSA	GM 70–08	GM 03–11	RCT3
2010 (age 3 in 2013)	**657**	4448	-	-
2011 (age 2 in 2013)	-	4931	-	**1388**
2012 & 2013 (recruits)	-	4931	**1900**	-

The input for the short-term catch predictions and sensitivity analysis is given in Table 6.8.15. Selectivity was calculated as the mean of 2010–2012. Catch and stock weights-at-age were also averages for the years 2010–2012. Population numbers at the start of 2013 for ages 3 and older were taken from the XSA output.

The short-term management option table is given in Table 6.8.16, a detailed output is presented in Table 6.8.17. A short-term forecast plot is shown in Figure 6.8.8.

The working group decided to use a TAC constraint for the intermediate year (2013) as a *status quo* fishing mortality gives much higher landings (250 t) in the intermediate year than the agreed TAC (140 t). At the end of 2012 additional quota regulations were imposed by the Flemish government for the Belgian sole fishery in the Irish Sea. After a national closure of the Irish Sea in January 2013, only twelve vessels (of which eleven beam trawlers) were admitted in the Irish Sea, from February until the end of August 2013. The uptake of each vessel is limited and is in line with the Belgian quota for 2013. At the beginning of May about 40% of the Belgian quota had been taken. Furthermore, there is no longer a directed fisheries by the Irish fleet. Because of the decrease in fishing opportunities by the main countries fishing for Irish Sea sole, it seemed reasonable that the landings in 2013 would be in line with the agreed TAC of 140 t, rather than the 250 t from a *status quo* assumption.

Assuming a TAC constraint for 2013 of 140 t, implies a fishing mortality in 2013 of 0.16. The assumed catch using a *status quo* fishing mortality in 2014 is 268 t. This results in a SSB of 1048 t in 2014 and 1365 t in 2015.

Assuming a TAC constraint for 2013 and a *status quo* F in 2014, the proportional contributions of recent year classes to the predicted landings and SSB are given in Table 6.8.18. Given the low stock size, predictions become more dependent on the assumed incoming recruitment. The RCT3 value and the assumed GM recruitment accounts for about 21% and 3% respectively of the landings in 2014 and about 18% and 32% respectively of the 2015 SSB.

Results of a sensitivity analysis are presented in Figure 6.8.9 (probability profiles). The approximate 90% confidence intervals of the expected status quo yield in 2014 are 145 t and 365 t. There is 100% probability that at current fishing mortality SSB will fall below B_{lim} (2200 t in 2015).

6.8.4 MSY explorations

Investigations for possible F_{MSY} candidates for this stock were carried out at WGCSE 2010. ACOM adopted an F_{MSY} value of 0.16, based on stochastic simulations using a

Ricker model (PLOTMSY program). $B_{trigger}$ was set to the B_{PA} value of 3100 t. No further work was carried out this year.

6.8.5 Biological reference points

Precautionary approach reference points

Biological reference points are:

B_{lim} = 2200 t	Basis: **B_{lim}**=**B_{loss}**	Changed in ACFM 2007 (from 2800 to 2200 t). The lowest observed spawning stock, followed by an increase in SSB.
B_{pa} = 3100 t	Basis: **B_{pa}** ~ **B_{lim}** * 1.4	Changed in ACFM 2007 (from 3800 to 3100 t).
F_{lim}=0.4	Basis: **F_{lim}**=**F_{loss}**	Although poorly defined, based that there is evidence that fishing mortality in excess of 0.4 has led to a general stock decline and is only sustainable during periods of above average recruitment.
F_{pa}=0.3	Basis: **F_{pa}** be set at 0.30	This F is considered to have a high probability of avoiding **F_{lim}**.
F_{max}=0.60 (2012WG)		Using MFDP program and PLOTMSY program
F_{MSY}=0.16		Using PLOTMSY program

Yield per Recruit analysis

Yield-per-recruit results, long-term yield and SSB, conditional on the present exploitation pattern and assuming *status quo* F in 2012, are given in Table 6.8.19 and Figure 6.8.8. Current fishing mortality (0.30) is well above F_{MSY} (0.16). F_{max} is calculated by this year's assessment to 0.60, but was considered to be not well defined given flat yield per recruit curve.

6.8.6 Management plans

No management plan is currently in place for Irish Sea sole.

6.8.7 Uncertainties and bias in assessment and forecast

Sampling

The major fleets fishing for Irish Sea sole are sampled. Sampling is considered to be at a reasonable level. Under the DCF there is an initiative to co-ordinate sampling across the three countries involved in the fishery. One of the problems in this assessment may well be the quality of historic catch-at-age data (before the introduction of the combined age distribution in 2000).

Landings

There is no reliable information on the accuracy of the landing statistics. Nevertheless, the total TAC uptake since 2005 was only in the range of 50–98%. In this context, misreporting is not considered to be a major problem in recent years.

Discards

The absence of discard data is unlikely to affect the quality of the assessment as information from recent years indicates that discarding ranges by weight vary between 0 and 8%.

Effort

There are no indications of Irish Sea sole fisheries misreporting effort. Effort in beam-trawl fisheries that target sole has declined substantially in the last few years.

Surveys

The UK(E&W)-BTS-Q3 survey appears to track year-class strength well. As previously investigated, this tuning fleet is also consistent in estimating year-class strength of the same year class at different ages. Therefore the Working Group had confidence in using the UK(E&W)-BTS-Q3 survey as the only tuning fleet. The bias problem in the assessment may be the result of the precise survey and less precise catch-at-age data.

Model formulation

At present XSA is used to assess Irish Sea sole. In the WG of 2007 the model settings were changed which had a considerable impact on the estimates of SSB and fishing mortality. Due to these major revisions, ACFM changed the biomass reference points at its meeting of 2007. In the next two update assessments (2008–2009) no major changes were apparent. In the assessment of 2011, the settings were changed according to the outcome of the WKFLAT 2011. The following assessments were update assessments.

6.8.8 Recommendations for next benchmark

The assessment diagnostics indicate a good correlation between the catch data and the survey tuning-series. Therefore, at present there are no recommendations for a next benchmark. However, because of the mismatch between the perception of the Belgian fishermen and the assessment results, a proposal for setting up an action plan has been submitted to the EU. The WG agrees that it is reasonable to wait for the outcome of this action plan before proposing potential benchmark recommendations.

6.8.9 Management considerations

There is a stock–recruitment relationship for this stock and evidence of reduced recruitment at low levels of SSB. However, the recruitment for higher levels of SSB is less well defined (Figure 6.8.10).

SSB in 2012 is estimated to be well below B_{lim}. Recruitment at age 2 has been well below average since 2001, and in 2011 is estimated to be the lowest in the time-series. XSA indicates that fishing mortality has fallen over the last couple of years (as did effort for most fleets fishing for Irish Sea sole), and is now at F_{PA}.

It is not possible for the stock to reach B_{PA} in one year. A management plan for effort reduction that can be phased in over a number of years and implemented in conjunction with technical conservation measures should be considered.

Given the successive recent low recruitment, predictions become more dependent on the assumed incoming recruitment and 32% of the predicted SSB in 2015 is based on that assumption. The short-term GM (03–11) recruitment used for year classes 2012 and 2013 is a more realistic assumption given the consecutive low recruitments in recent years.

Sole is caught in a mixed fishery with other flatfish as well as gadoids. Information from observer trips indicates that discarding of sole is relatively low.

6.8.10 Ecosystem considerations

Sole and plaice are primarily targeted by beam-trawl fisheries. Beam trawling is known to have an impact on the benthic communities, although less so on soft substrates and in areas which have been historically exploited by this fishing method. Some beam trawlers are using benthic drop-out panels that release about 75% of benthic invertebrates from the catches. Full square mesh codends are being tested in order to reduce the capture of benthos further and improve the selection profile of gadoids (Connolly, P.L. *et al*., 2009).

A complete ecosystem overview can be found in the stock annex Section A.3.

6.8.11 References

Connolly, P.L., Kelly, E., Dransfeld, L., Slattery, N., Paramor, O.A.L., and Frid, C.L.J. 2009. MEFEPO North Western Waters Atlas. Marine Institute.

Horwood, J. W. 1993a. The Bristol Channel Sole (*Solea solea* (L.)): A Fisheries Case Study. Advances in Marine Biology, 29: 215–367.

Williams, T. 1965. Movements of tagged soles in the Irish Sea and Bristol Channel. ICES CM 1965, Near Northern Seas Committee, No. 87 (mimeo).

Table 6.8.1. Sole in VIIa. Nominal landings (tonnes) as officially reported by ICES, and working group estimates of the landings. Last year's landings are preliminary.

Year	Belgium	France	Ireland	Netherlands	UK (E+W)	UK (Isle of Man)	UK (N. Ireland)[1]	UK (Scotland)	Officially reported	Unallocated	Total used by WG	TAC
1973	793	12	27	281	258	-	46	11	1428	0	1428	
1974	664	54	28	320	218	-	23	-	1307	0	1307	
1975	805	59	24	234	281	-	24	15	1442	-1	1441	
1976	674	72	74	381	195	-	49	18	1463	0	1463	
1977	566	39	84	227	160	-	49	21	1146	1	1147	
1978	453	65	127	177	189	-	57	30	1098	8	1106	
1979	779	48	134	247	290	-	47	42	1587	27	1614	
1980	1002	41	229	169	367	-	44	68	1920	21	1941	
1981	884	13	167	186	311	-	41	45	1647	20	1667	
1982	669	9	161	138	277	-	31	44	1329	9	1338	
1983	544	3	203	224	219	-	33	29	1255	-86	1169	
1984	425	10	187	113	230	-	38	17	1020	38	1058	
1985	589	9	180	546	269	-	36	28	1657	-511	1146	
1986	930	17	235	-	637	1	50	46	1916	79	1995	
1987	987	5	312	-	599	3	72	63	2041	767	2808	2100
1988	915	11	366	-	507	1	47	38	1885	114	1999	1750
1989	1010	5	155	-	613	2	.	38	1823	10	1833	1480
1990	786	2	170	-	569	10	.	39	1576	7	1583	1500
1991	371	3	198	-	581	44	.	26	1223	-11	1212	1500
1992	531	11	164	-	477	14	.	37	1234	25	1259	1350
1993	495	8	98	-	338	4	.	28	971	52	1023	1000
1994	706	7	226	-	409	5	.	14	1367	7	1374	1500
1995	675	5	176	-	424	12	.	8	1300	-34	1266	1300
1996	533	5	133	149	194	4	.	5	1023	-21	1002	1000
1997	570	3	130	123	189	5	.	7	1027	-24	1003	1000
1998	525	3	134	60	161	3	.	9	895	16	911	900
1999	469	<1	120	46	165	1	.	8	810	53	863	900
2000	493	3	135	60	133	1	.	8	833	-15	818	1080
2001	674	4	135	-	195	+	.	4	1012	41	1053	1100
2002	817	4	96	-	165	+	.	3	1085	5	1090	1100

Year	Belgium	France	Ireland	Netherlands	UK (E+W)	UK (Isle of Man)	UK (N. Ireland)[1]	UK (Scotland)	Officially reported	Unallocated	Total used by WG	TAC
2003	687	4	103	-	217	+	.	3	1014	0	1014	1010
2004	527	1	77	-	106	+	.	1	712	-3	709	800
2005	662	3	85	-	103	+	.	1	854	1	855	960
2006	419	1	85	-	69	+	.	2	576	-7	569	960
2007	305	1	115	-	66	<1	.	4	491	1	492	820
2008	216	1	66	-	37	n/a	.	n/a	320	12	332	669
2009	257	n/a	47	-	19	1	.	1	325	0	325	502
2010	217	<1	47	-	12	<1	.	n/a	277	0	277	402
2011	250	<1	48	-	31	<1	.	n/a	330	0	330	390
2012	222	<1	51	-	21	<1	-	n/a	294	0	294	300

[1] 1989 onwards: N. Ireland included with England & Wales.

Table 6.8.2 - Sole in VIIa. Catch numbers at age (in thousands)

Age/Year	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**
2	29	113	31	368	25	262	29	221	65
3	895	434	673	363	891	733	375	416	958
4	1009	2097	730	2195	576	2386	1332	1292	649
5	467	1130	1537	557	1713	539	2330	774	1009
6	1457	232	537	815	383	842	247	1066	442
7	289	878	172	267	422	157	544	150	638
+gp	2537	1887	1500	1143	971	1006	739	648	587
TOTALNUM	6683	6771	5180	5708	4981	5925	5596	4567	4348
TONSLAND	1785	1882	1450	1428	1307	1441	1463	1147	1106
SOPCOF %	100	100	100	100	100	100	100	100	100

Age/Year	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
2	108	187	70	8	37	651	154	141	189
3	1027	939	580	346	165	786	1601	3336	3348
4	3433	1968	1668	1241	998	380	1086	3467	4105
5	829	3055	1480	1298	758	610	343	961	3185
6	637	521	1640	711	757	343	334	235	844
7	326	512	114	641	416	424	164	277	307
+gp	620	1145	865	397	709	557	739	848	808
TOTALNUM	6980	8327	6417	4642	3840	3751	4421	9265	12786
TONSLAND	1614	1941	1667	1338	1169	1058	1146	1995	2808
SOPCOF %	100	100	100	100	100	100	100	100	100

Age/Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
2	32	179	564	1317	363	83	122	132	60
3	444	771	1185	1270	2433	543	1342	920	469
4	4752	775	986	841	918	1966	1069	1444	1188
5	2102	3978	598	300	556	559	1578	737	741
6	1310	1178	2319	226	190	251	394	1010	430
7	203	552	592	1173	156	199	133	179	509
+gp	516	255	466	459	929	686	524	350	347
TOTALNUM	9359	7688	6710	5586	5545	4287	5162	4772	3744
TONSLAND	1999	1833	1583	1212	1259	1023	1374	1266	1002
SOPCOF %	100	100	100	100	100	100	100	100	100

Age/Year	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2	789	167	301	178	240	148	436	295	536
3	713	1728	1069	908	1438	927	824	850	1052
4	474	466	1258	909	822	1618	965	337	626
5	710	256	297	601	717	738	794	363	271
6	408	315	115	150	511	573	302	300	314
7	258	191	136	55	80	253	217	137	279
+gp	531	423	232	258	272	216	344	178	368
TOTALNUM	3883	3546	3408	3059	4080	4473	3882	2460	3446
TONSLAND	1003	911	863	818	1053	1090	1014	709	855
SOPCOF %	100	100	100	100	100	100	100	101	100

Age/Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
2	111	171	99	92	22	17	17
3	666	356	354	414	336	225	146
4	645	348	191	333	233	401	307
5	202	243	196	146	177	176	271
6	112	86	157	132	65	97	114
7	150	41	56	127	72	54	51
+gp	377	298	210	162	158	122	114
TOTALNUM	2263	1543	1263	1406	1063	1092	1020
TONSLAND	569	492	332	325	277	330	294
SOPCOF %	101	100	100	100	100	100	100

Table 6.8.3 - Sole in VIIa. Annual lenght distributions by country (2012)

Length (cm)	UK (England & Wales) All gears	Belgium All gears	Ireland All gears
20			
21			
22	143		
23	143	6732	88
24	856	81473	177
25	2427	109898	442
26	4140	82639	1327
27	6852	102422	2124
28	4140	99077	3451
29	3854	66915	5929
30	3854	79886	5486
31	2569	51858	8141
32	2141	43614	9203
33	2427	32887	8937
34	1713	17727	9822
35	1142	19901	10884
36	856	13662	9203
37	1142	13924	7344
38	856	6530	6637
39	1142	4415	5575
40	999	3944	3274
41	571	2339	3274
42	428	1630	2124
43	143	931	1416
44	143	734	1416
45	0	71	796
46	285	112	708
47		82	354
48			88
49			0
50			0
51			0
52			0
53			0
54			0
55			0
56			0
57			88
58			
59			
60			
Total	42966	843403	108308

Table 6.8.4 - Sole in VIIa. Catch weights at age (kg)

Age/Year	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**
2	0.13	0.152	0.126	0.151	0.138	0.13	0.12	0.085	0.093
3	0.153	0.178	0.164	0.178	0.174	0.172	0.161	0.146	0.147
4	0.178	0.204	0.201	0.204	0.209	0.21	0.2	0.202	0.197
5	0.204	0.23	0.237	0.23	0.241	0.244	0.239	0.251	0.243
6	0.232	0.257	0.272	0.256	0.272	0.275	0.276	0.293	0.286
7	0.26	0.284	0.306	0.283	0.301	0.303	0.313	0.33	0.326
+gp	0.3769	0.4194	0.4169	0.3918	0.3956	0.3671	0.4574	0.387	0.4294
SOPCOF %	1	0.9997	1.0004	0.9999	1	0.9999	0.9996	0.9996	0.9997

Age/Year	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
2	0.134	0.146	0.162	0.112	0.189	0.191	0.144	0.122	0.135
3	0.165	0.169	0.183	0.171	0.212	0.225	0.189	0.164	0.164
4	0.199	0.193	0.207	0.225	0.238	0.257	0.231	0.203	0.196
5	0.234	0.219	0.234	0.275	0.266	0.288	0.272	0.241	0.231
6	0.271	0.247	0.264	0.321	0.298	0.318	0.31	0.277	0.268
7	0.311	0.275	0.296	0.362	0.332	0.347	0.346	0.311	0.308
+gp	0.4507	0.3801	0.452	0.4564	0.4577	0.4085	0.4296	0.4071	0.4615
SOPCOF %	0.9997	1.0007	1.0002	1.0002	0.9997	0.9998	0.9994	0.9994	0.9998

Age/Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
2	0.111	0.125	0.135	0.133	0.149	0.102	0.175	0.129	0.156
3	0.147	0.163	0.162	0.172	0.177	0.156	0.198	0.182	0.193
4	0.183	0.201	0.192	0.208	0.207	0.205	0.227	0.232	0.228
5	0.218	0.237	0.227	0.241	0.239	0.248	0.261	0.277	0.263
6	0.252	0.271	0.265	0.272	0.274	0.285	0.301	0.318	0.296
7	0.286	0.304	0.307	0.3	0.31	0.318	0.346	0.356	0.327
+gp	0.4188	0.3887	0.414	0.3452	0.3788	0.3701	0.5093	0.4507	0.4104
SOPCOF %	0.999	1.0001	1.0004	0.9995	0.9992	0.9994	1.0007	0.9998	1.0003

Age/Year	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2	0.154	0.187	0.179	0.14	0.175	0.162	0.16	0.17	0.16
3	0.197	0.209	0.217	0.189	0.18	0.172	0.187	0.219	0.203
4	0.237	0.234	0.252	0.25	0.271	0.211	0.247	0.289	0.256
5	0.275	0.263	0.285	0.311	0.293	0.283	0.294	0.338	0.286
6	0.311	0.295	0.314	0.368	0.326	0.328	0.342	0.371	0.312
7	0.345	0.331	0.341	0.428	0.42	0.333	0.326	0.383	0.326
+gp	0.4068	0.4399	0.3992	0.5042	0.438	0.3746	0.415	0.4436	0.3515
SOPCOF %	1.0015	1	1.0005	0.9981	1	1.003	1.0015	1.0141	0.9996

Age/Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
2	0.179	0.172	0.148	0.141	0.166	0.215	0.187
3	0.194	0.224	0.189	0.195	0.193	0.213	0.22
4	0.224	0.296	0.248	0.229	0.266	0.276	0.26
5	0.297	0.36	0.279	0.279	0.285	0.362	0.31
6	0.293	0.38	0.291	0.277	0.321	0.413	0.33
7	0.318	0.429	0.386	0.261	0.308	0.368	0.367
+gp	0.3494	0.4785	0.3919	0.2767	0.3353	0.3635	0.3335
SOPCOF %	1.0057	0.9989	0.9963	0.9993	1.0002	0.9992	1.0018

Table 6.8.5 - Sole in VIIa. Stock weights at age (kg)

Age/Year	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**
2	0.13	0.152	0.126	0.151	0.138	0.13	0.12	0.085	0.093
3	0.153	0.178	0.164	0.178	0.174	0.172	0.161	0.146	0.147
4	0.178	0.204	0.201	0.204	0.209	0.21	0.2	0.202	0.197
5	0.204	0.23	0.237	0.23	0.241	0.244	0.239	0.251	0.243
6	0.232	0.257	0.272	0.256	0.272	0.275	0.276	0.293	0.286
7	0.26	0.284	0.306	0.283	0.301	0.303	0.313	0.33	0.326
+gp	0.377	0.419	0.417	0.392	0.396	0.367	0.457	0.387	0.429

Age/Year	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
2	0.134	0.146	0.162	0.112	0.189	0.191	0.144	0.122	0.135
3	0.165	0.169	0.183	0.171	0.212	0.225	0.189	0.164	0.164
4	0.199	0.193	0.207	0.225	0.238	0.257	0.231	0.203	0.196
5	0.234	0.219	0.234	0.275	0.266	0.288	0.272	0.241	0.231
6	0.271	0.247	0.264	0.321	0.298	0.318	0.31	0.277	0.268
7	0.311	0.275	0.296	0.362	0.332	0.347	0.346	0.311	0.308
+gp	0.451	0.380	0.452	0.456	0.458	0.409	0.430	0.407	0.462

Age/Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
2	0.111	0.125	0.135	0.133	0.149	0.102	0.175	0.129	0.156
3	0.147	0.163	0.162	0.172	0.177	0.156	0.198	0.182	0.193
4	0.183	0.201	0.192	0.208	0.207	0.205	0.227	0.232	0.228
5	0.218	0.237	0.227	0.241	0.239	0.248	0.261	0.277	0.263
6	0.252	0.271	0.265	0.272	0.274	0.285	0.301	0.318	0.296
7	0.286	0.304	0.307	0.3	0.31	0.318	0.346	0.356	0.327
+gp	0.419	0.389	0.414	0.345	0.379	0.370	0.509	0.451	0.410

Age/Year	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
2	0.154	0.187	0.179	0.124	0.151	0.145	0.144	0.15	0.144
3	0.197	0.209	0.217	0.158	0.159	0.174	0.174	0.187	0.186
4	0.237	0.234	0.252	0.23	0.226	0.195	0.207	0.232	0.237
5	0.275	0.263	0.285	0.303	0.271	0.277	0.249	0.289	0.288
6	0.311	0.295	0.314	0.345	0.318	0.31	0.311	0.331	0.325
7	0.345	0.331	0.341	0.41	0.393	0.33	0.327	0.362	0.348
+gp	0.407	0.440	0.399	0.530	0.450	0.397	0.383	0.419	0.383

Age/Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
2	0.152	0.156	0.134	0.129	0.158	0.167	0.156
3	0.177	0.2	0.181	0.17	0.165	0.188	0.218
4	0.213	0.24	0.236	0.208	0.228	0.231	0.235
5	0.276	0.284	0.288	0.263	0.256	0.31	0.293
6	0.289	0.336	0.324	0.278	0.3	0.343	0.346
7	0.315	0.354	0.383	0.276	0.292	0.344	0.389
+gp	0.348	0.419	0.424	0.319	0.305	0.340	0.344

Table 6.8.6. Sole in VIIa. Discard rates for the main fleets operational in the Irish Sea (Belgian , UK and Irish beam trawl, UK otter trawl, UK and Irish *Nephrops* trawl).

Country	Gear	Landings (t)	Ratio discarded/ catch	years	Landings (t) 2010	Ratio discarded/ catch 2010	Landings (t) 2011	Ratio discarded/ catch 2011	Landings (t) 2012	Ratio discarded/ catch 2012
BEL	TBB	716	0.05	2007–2009	209	0.04	249.911	0.04	221.693	0.05
UK	TBB	284	0.08	2002, 2005–2007	1.721	na	13.662	na	7.278	na
	OTB	61	0.05	2002–2009	1.071	0.00	2.866	0.02	0.485	0.00
	TWIN OTB	4	0.01	2003, 2004,2007	0.014	na	0.050	na	0.00	0.00
	NEPH OTB	25	0.08	2003, 2006–2009	3.329	0.05	5.201	0.00	4.582	0.00
	TWIN NEPH	6	0.02	2002, 2003,2008	0.501	na	0.414	na	0.392	na
	other	na	na	Na	0.741	na	0.821	na	1.229	0.00
IRL	TBB	427	0.02	2003–2009	38.3	0.05	32.712	0.003	38.790	0.004
	NEPH OTB	16	0.56*	2003–2009	9.0	0.29*	15.697	0.00	8.162	0.093

*** It should be noted that the 56% discard rate for the year range 2003–2009, 29% discard rate for 2010 and 9,3% discard rate for 2012 of the Irish *Nephrops* fleet only accounts for respectively 0.4%, 3.3% and 2,8% of the total international landings.**

Table 6.8.7 - Sole in VIIa. Effort and LPUE series.

	LPUE							Effort				
	Belgium [1]	UK(E&W) [3]		UK [5]		Ireland		Belgium [2]	UK(E&W) [4]		Ireland [6]	
	beam	beam	otter	beam survey		otter	beam	beam	beam	otter	otter	beam
Year	Whole year	Whole year	Whole year	Sept	March	Whole year	Whole year	Whole year	Whole year	Whole year	Whole Year	Whole Year
1972	-	-	1.06	-	-	-	-	-	-	128.4	-	-
1973	-	-	1.06	-	-	-	-	-	-	147.6	-	-
1974	-	-	1.09	-	-	-	-	-	-	115.2	-	-
1975	21.4	-	1.39	-	-	-	-	28.4	-	130.7	-	-
1976	23.1	-	0.94	-	-	-	-	24.9	-	122.3	-	-
1977	19.8	-	0.80	-	-	-	-	22.1	-	101.9	-	-
1978	18.1	34.32	1.04	-	-	-	-	17.5	0.9	89.1	-	-
1979	33.4	32.01	1.43	-	-	-	-	20.4	1.7	89.9	-	-
1980	28.2	31.70	1.01	-	-	-	-	32.0	4.3	107.0	-	-
1981	22.2	21.32	0.75	-	-	-	-	36.5	6.4	107.1	-	-
1982	22.0	29.94	0.53	-	-	-	-	26.5	5.5	127.2	-	-
1983	13.9	37.31	0.57	-	-	-	-	28.7	2.8	88.1	-	-
1984	22.5	16.24	0.71	-	-	-	-	17.5	4.1	103.1	-	-
1985	20.6	17.34	0.56	-	-	-	-	27.0	7.4	102.9	-	-
1986	19.1	19.23	0.84	-	-	-	-	44.5	17.0	90.3	-	-
1987	17.7	14.82	0.77	-	-	-	-	51.6	22.0	130.6	-	-
1988	21.3	11.81	0.46	158.7	-	-	-	38.2	18.6	132.0	-	-
1989	21.9	9.17	0.70	145.9	-	-	-	42.2	25.3	139.5	-	-
1990	17.5	9.52	0.61	190.1	-	-	-	42.4	31.0	117.1	-	-
1991	18.7	10.43	1.12	170.5	-	-	-	17.1	25.8	107.3	-	-
1992	19.2	9.50	1.02	158.3	-	-	-	25.1	23.4	96.8	-	-
1993	20.0	7.60	0.54	97.3	104.7	-	-	23.9	21.5	78.9	-	-
1994	19.1	11.76	0.74	107.7	91.9		-	32.5	20.1	43.0	-	-
1995	18.1	14.96	0.95	89.5	79.3	0.38	12.69	28.6	20.9	43.1	80.3	8.64
1996	17.7	9.44	0.53	86.8	-	0.25	14.94	23.2	13.3	42.2	64.8	6.26
1997	16.6	10.49	0.73	151.2	63.3	0.23	8.53	30.7	10.8	39.9	92.2	9.86
1998	19.0	8.42	0.48	140.8	89.3	0.38	7.77	24.7	10.4	36.9	93.5	11.58
1999	19.5	9.94	0.60	107.3	-	0.29	9.22	22.7	11.0	22.9	110.3	14.67
2000	15.5	12.90	0.44	122.6	-	0.29	8.49	26.0	6.3	27.0	82.7	11.42
2001	15.0	11.72	0.15	96.9	-	0.38	7.86	36.8	12.5	32.8	77.5	13.13
2002	15.0	16.73	1.48	76.0	-	0.32	4.67	47.0	8.0	24.8	77.9	17.67
2003	14.8	13.20	0.15	88.6	-	0.34	4.20	43.6	14.0	23.9	73.9	18.70
2004	15.4	13.86	0.17	98.9	-	0.14	4.31	32.0	7.4	23.5	72.5	14.19
2005	16.7	9.14	0.19	48.9	-	0.16	4.70	37.5	11.4	16.7	68.3	14.67
2006	15.2	7.83	0.52	52.6	-	0.16	6.00	24.6	4.65	5.22	66.2	12.22
2007	13.7	16.38	0.42	53.0	-	0.37	6.37	19.4	3.2	4.40	74.1	14.18
2008	19.5	15.25	0.30	50.7	-	0.20	6.08	9.6	1.3	2.71	58.8	9.54
2009	20.2	18.88	0.22	45.8	-	0.28	4.53	11.1	0.46	1.54	42.8	7.59
2010	18.0	13.90	0.46	27.8	-	0.19	4.09	11.1	0.19	1.42	45.8	9.42
2011	17.6	4.45	0.18	37.0	-	0.30	4.13	12.5	1.56	0.69	54.5	8.12
2012*	18.3	5.22	0.12	26.5	-	0.14	5.41	11.2	0.85	0.24	58.3	7.17

All LPUE values in Kg/hr except UK beam survey (Kg/100 km)

[1] Kg/000'hr

[2] 000' hours fishing

[3] Kg/000'hr fished (GRT corrected > 40' vessels)

[4] 000'hours fished (GRT corrected > 40' vessels)

[5] Kg/100km fished

[6] 000'hours

* Provisional

Table 6.8.8 - Sole in VIIa. Tuning series (values in bold are used in the assessment)

BE-CBT		Belgium Commercial Beam trawl (Effort = Corrected formula)										
	1975	2005										
	1	1	0	1								
	4	14										
12.3		1045	275	393	69	105	94	61	72	11	15	64
11.8		568	1066	80	263	64	58	35	5	56	5	5
10.7		434	307	509	76	93	45	23	20	2	35	32
9.9		169	304	155	258	41	90	12	29	12	7	17
11.2		1455	510	323	193	162	37	36	9	41	0	0
16.7		958	1644	296	268	247	210	30	64	31	14	7
22.6		909	721	998	62	92	44	161	13	92	10	8
19.5		451	608	378	394	52	64	11	29	24	5	0
20.5		259	310	394	238	216	44	38	28	49	3	26
12		107	204	143	188	91	121	2	1	4	14	0
19.6		606	171	186	99	150	125	83	27	13	4	23
38		1531	468	138	135	90	104	69	69	20	8	21
43.2		1527	881	297	167	69	39	54	59	40	13	9
30.5		2027	1012	480	21	33	37	34	42	35	0	7
34		376	2423	751	250	59	15	9	2	14	0	1
36.1		307	223	1263	276	142	13	9	11	11	8	5
13.8		253	78	60	588	115	40	16	1	1	11	3
23.9		298	330	68	40	203	93	36	12	0	0	0
24.5		862	253	149	89	79	160	66	77	0	0	0
31		680	786	164	103	39	117	58	19	15	0	7
26.2		729	366	410	52	27	6	28	15	6	11	3
21.6		537	334	241	219	53	13	11	14	9	7	2
28.5		270	376	180	162	134	28	27	15	9	8	1
23.3		248	146	142	89	73	62	20	20	9	10	3
21.7		693	199	65	50	37	21	17	9	6	4	6
18.6		685	220	107	31	15	33	13	7	9	0.6	8
30.5		600	284	248	39	35	44	33	1	3	0.2	4
38.6		1138	814	349	109	30	9	2	1	1	1	0
24.45		724	436	196	84	20	7	2	1	0	2	1
25.58		313	197	159	47	12	11	6	3	0	0	0
32.15		505	342	156	71	87	9	7	1	13	2	1

UK(E&W)-BTS-Q3			September beam trawl survey							
	1988	2012								
	1	1	0.75	0.85						
	1	9								
100.062		118	**196**	**180**	**410**	**76**	**40**	**4**	0	4
129.71		218	**304**	**180**	**74**	**284**	**56**	**32**	8	6
128.969		1712	**534**	**122**	**42**	**88**	**194**	**40**	20	6
123.78		148	**1286**	**122**	**26**	**16**	**14**	**55**	19	7
129.525		220	**309**	**657**	**142**	**34**	**22**	**7**	75	17
131.192		83	**330**	**143**	**211**	**40**	**17**	**7**	16	36
124.892		60	**408**	**203**	**73**	**132**	**49**	**11**	13	6
126.004		246	**154**	**253**	**110**	**30**	**67**	**12**	5	5
126.004		886	**126**	**32**	**76**	**46**	**23**	**31**	8	2
126.004		1158	**577**	**72**	**24**	**55**	**27**	**16**	30	7
126.004		539	**716**	**292**	**18**	**6**	**24**	**23**	5	18
126.004		385	**293**	**255**	**203**	**29**	**8**	**26**	5	6
126.004		354	**464**	**147**	**219**	**91**	**13**	**2**	13	6
126.004		91	**284**	**192**	**65**	**96**	**64**	**6**	3	12
126.004		205	**61**	**121**	**126**	**42**	**79**	**49**	2	1
126.004		242	**210**	**51**	**97**	**81**	**40**	**43**	26	1
126.004		406	**240**	**119**	**27**	**77**	**45**	**41**	17	19
122.298		53	**165**	**69**	**25**	**13**	**35**	**25**	4	6
126.004		107	**110**	**90**	**45**	**36**	**9**	**16**	15	10
126.004		125	**93**	**49**	**57**	**41**	**11**	**4**	6	12
122.298		126	**125**	**60**	**21**	**43**	**23**	**6**	2	9
126.004		57	**150**	**68**	**39**	**23**	**30**	**12**	7	1
126.004		25	**59**	**73**	**37**	**16**	**5**	**10**	9	3
122.298		89	**35**	**62**	**68**	**35**	**12**	**4**	13	6
122.298		21	**49**	**17**	**46**	**29**	**12**	**9**	2	6

Table 6.8.8 - Sole in VIIa. Continued (values in bold are used in the assessment)

UK(E&W)-BTS-Q1			March beam trawl survey											
	1993	1999												
	1	1	0.15	0.25										
	1	9												
126.931		18	337	147	332	73	15	17	10	41				
115.442		8	354	208	69	151	51	14	11	9				
126.189		24	96	186	140	30	104	27	10	8				
134.343		651	114	49	110	78	32	54	10	12				
121.742		130	417	33	17	69	23	11	46	17				
130.081		47	421	330	39	19	48	27	12	37				
130.822		45	227	284	177	14	4	34	12	7				
UK(E&W)-CBT			UK Commercial Beam trawl											
	1991	2012												
	1	1	0	1										
	2	14												
25.838		267	426	212	84	58	218	53	34	4	1	2	1	0
23.399		36	460	176	68	37	32	121	34	38	3	1	0	0
21.503		11	74	355	98	36	48	25	34	13	22	5	2	4
20.145		24	228	150	234	87	17	25	19	42	10	17	1	0
20.392		47	239	231	130	199	55	11	22	5	34	10	11	3
13.32		0	13	109	98	49	100	37	9	8	6	14	8	3
10.76		0	111	50	81	58	24	46	34	12	12	0	8	1
10.386		43	219	40	28	49	31	12	22	11	9	2	1	0
11.016		53	115	134	12	15	25	10	9	14	9	0	1	2
6.275		16	90	84	82	9	6	10	5	5	7	2	1	1
12.495		33	184	100	145	107	12	4	17	12	10	6	4	2
8.017		4	63	152	50	79	47	5	4	6	3	1	1	1
13.996		28	63	178	149	78	52	72	7	5	8	3	7	14
7.396		54	61	29	43	25	12	10	5	1	1	4	0	1
11.406		10	81	44	16	45	37	17	10	17	3	0	3	3
4.649		7	28	33	11	5	10	12	7	9	5	2	0	1
3.197		22	20	34	17	6	1	7	7	6	3	2	1	1
1.302		1	11	5	7	12	1	2	4	3	4	0	3	1
0.462		0	0	0	0	0	0	0	0	0	0	0	0	0
0.186		0	0	0	0	0	0	0	0	0	0	0	0	0
1.564		0	3	6	3	3	1	1	1	0	0	0	0	0
0.849		0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6.8.8 - Sole in VIIa. Continued (values in bold are used in the assessment)

UK(E&W)-C0T UK Commercial Otter trawl

	1991	2012											
	1	1	0	1									
	2	14											
107.3		265	155	63	29	19	71	20	11	2	0	1	1	1
96.8		16	224	69	22	16	10	36	10	10	1	0	0	0
78.9		9	27	77	19	3	7	4	5	1	2	0	0	0
43		4	66	34	50	20	3	4	4	7	1	2	0	0
43.1		17	50	34	15	24	7	1	2	0	2	1	1	0
42.2		2	5	18	12	7	12	4	1	1	1	1	1	1
39.9		14	15	7	14	9	3	7	3	1	1	0	1	0
36.9		5	24	5	3	5	3	2	2	1	1	0	0	0
22.8		5	15	12	2	0	2	1	1	1	1	0	0	0
27		2	12	9	8	1	0	1	1	0	0	0	0	0
32.9		3	10	6	8	5	0	0	0	0	0	0	0	0
24.8		0	8	16	3	5	3	1	0	1	0	0	0	0
23.9		1	2	6	4	2	1	2	0	0	0	0	0	0
23.5		3	5	3	4	3	2	1	1	0	0	0	0	0
16.7		2	4	2	1	2	2	1	1	1	0	0	0	0
5.2		1	2	4	1	1	1	1	1	1	1	0	0	0
4.4		1	1	2	2	0	0	1	1	1	0	0	0	0
2.7		0	1	1	1	1	0	0	0	0	0	0	0	0
1.54		0	0	0.2	0.3	0.1	0.2	0.2	0	0	0.1	0	0	0
1.42		0	0.1	0.2	0.3	0.1	0.1	0.2	0.1	0	0.1	0.1	0.1	0
0.686		0	0.1	0.1	0	0	0	0	0	0	0	0	0	0
0.241		0	0	0	0	0	0	0	0	0	0	0	0	0

IR-COT Irish Commercial Otter trawl

	1995	2005								
	1	1	0	1						
	2	10								
70682		6.8	17.7	25.5	9.2	25.8	3.6	0.8	1.5	1.9	1995
58166		0	5.7	12.9	12.7	4.7	4.7	2.2	0.2	0	1996
75029		27.8	10.2	4.1	9.2	6.4	3.5	3.9	1	0.2	1997
81073		5.5	40.7	14.7	6.6	12.3	5.4	2.7	4.1	1	1998
93221		26.6	36.8	30.9	5.1	3.8	5.3	2.4	0.5	1.2	1999
64320		1.6	13.2	13.4	11	3.4	1.1	1	0.4	0	2000
77541		0.2	6.1	18.6	18.6	10.8	2.1	4.1	1.3	0.3	2001
39996		20.3	20	30.2	16.4	8.2	2.9	2.4	1.4	0.5	2002
73854		0.9	35.9	21.7	9.8	3.3	0.5	0.8	0.2	0.2	2003
72507		9	15.1	4.1	3.2	1.9	1.6	0.3	0.2	0.1	2004
##										
31142		4	1.7	1.6	1.6	0.6	0.1	0	0	0	2005
##										

Please note the 2005 data is based only on Q3 and Q4 data and has not been raised to annual effort.
It should not be included as part of this time series.

Table 6.8.9 - Sole in VIIa. Diagnostics

Lowestoft VPA Version 3.1

22/04/2013 11:06

Extended Survivors Analysis

IRISH SEA SOLE 2013 WG COMBSEX PLUSGROUP.

CPUE data from file SOL7ATUN.TXT

Catch data for 43 years. 1970 to 2012. Ages 2 to 8.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
UK (E&W)-BTS-Q3	1988	2012	2	7	0.75	0.85

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 4

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 22 iterations

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
2	0.162	0.088	0.207	0.091	0.102	0.057	0.041	0.015	0.032	0.024
3	0.579	0.478	0.453	0.379	0.415	0.282	0.319	0.185	0.191	0.376
4	0.479	0.438	0.691	0.491	0.309	0.364	0.413	0.266	0.311	0.381
5	0.455	0.295	0.669	0.438	0.307	0.256	0.463	0.357	0.293	0.318
6	0.294	0.275	0.397	0.571	0.3	0.296	0.244	0.342	0.301	0.28
7	0.161	0.188	0.394	0.297	0.373	0.29	0.368	0.183	0.469	0.228

1

XSA population numbers (Thousands)

YEAR \ AGE	2	3	4	5	6	7
2003	3.06E+03	1.97E+03	2.67E+03	2.28E+03	1.25E+03	1.53E+03
2004	3.67E+03	2.35E+03	1.00E+03	1.50E+03	1.31E+03	8.40E+02
2005	3.02E+03	3.04E+03	1.32E+03	5.84E+02	1.01E+03	9.00E+02
2006	1.33E+03	2.22E+03	1.75E+03	5.98E+02	2.71E+02	6.13E+02
2007	1.86E+03	1.10E+03	1.38E+03	9.67E+02	3.49E+02	1.38E+02
2008	1.87E+03	1.52E+03	6.59E+02	9.13E+02	6.44E+02	2.34E+02
2009	2.41E+03	1.60E+03	1.04E+03	4.14E+02	6.40E+02	4.33E+02
2010	1.53E+03	2.09E+03	1.05E+03	6.20E+02	2.36E+02	4.54E+02
2011	5.59E+02	1.36E+03	1.58E+03	7.28E+02	3.92E+02	1.52E+02
2012	7.44E+02	4.90E+02	1.02E+03	1.04E+03	4.91E+02	2.63E+02

Estimated population abundance at 1st Jan 2013

0.00E+00	6.57E+02	3.04E+02	6.31E+02	6.87E+02	3.36E+02

Taper weighted geometric mean of the VPA populations:

4.49E+03	4.11E+03	3.11E+03	1.92E+03	1.14E+03	6.65E+02

Standard error of the weighted Log(VPA populations) :

0.8069	0.7755	0.7677	0.7737	0.7901	0.7893

1

Log catchability residuals.

Fleet : UK (E&W)-BTS-Q3

Age	1988	1989	1990	1991	1992
2	0.05	0.03	0.41	0.51	-0.05
3	0.59	0.37	-0.12	-0.3	0.47
4	0.04	0.11	-0.21	-0.89	0.48
5	-0.35	0.01	1	-0.59	0.01
6	-0.21	-0.22	0.31	-0.17	0.18
7	-0.11	0.08	0.17	-0.21	-0.19

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2	-0.27	0.16	0.19	-0.27	0.09	0.44	-0.15	0.01	-0.04	-0.89
3	-0.27	-0.05	0.29	-0.67	-0.07	0.1	-0.01	-0.22	-0.22	-0.23
4	-0.06	-0.25	0.08	-0.21	-0.12	-0.73	0.34	0.35	-0.46	0.1
5	-0.29	0.06	-0.55	-0.2	0.05	-0.72	0.36	-0.11	-0.12	-0.38
6	-0.06	0.54	-0.01	-0.16	-0.15	-0.28	0.37	0.17	-0.08	0.08
7	-0.12	0.17	-0.36	-0.17	0.25	0.19	0.18	-0.14	-0.03	-0.03

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
2	0.15	0.05	-0.01	0.28	-0.21	0.07	-0.04	-0.54	-0.01	0.03
3	-0.17	0.42	-0.37	0.12	0.24	0.05	0.12	-0.19	0.12	-0.01
4	0.27	-0.06	-0.18	-0.06	0.27	0.08	0.25	0.07	0.34	0.44
5	0.23	0.47	-0.04	0.74	0.29	0.38	0.68	-0.17	0.43	-0.1
6	0	0.05	0.19	0.26	-0.01	0.14	0.34	-0.38	-0.01	-0.26
7	-0.24	0.33	-0.04	-0.21	-0.04	-0.2	-0.09	-0.47	-0.03	0.04

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7
Mean Log q	-7.4573	-7.7801	-7.9595	-7.9595	-7.9595	-7.9595
S.E(Log q)	0.2966	0.2931	0.3395	0.432	0.2328	0.2008

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.89	1.595	7.53	0.9	25	0.26	-7.46
3	0.98	0.18	7.78	0.85	25	0.29	-7.78
4	0.99	0.088	7.96	0.83	25	0.34	-7.96
5	1.16	-1.29	8.02	0.73	25	0.49	-7.91
6	1.02	-0.289	7.95	0.93	25	0.24	-7.93
7	0.99	0.283	7.99	0.95	25	0.2	-8.01
1							

Terminal year survivor and F summaries :

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2010

Fleet	Esti Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK (E&W)-BTS-Q3	677	0.302	0	0	1	0.96	0.024
F shrinkage mean	318	1.5				0.04	0.05

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
657	0.3	0.15	2	0.51	0.024

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2009

Fleet	Esti Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK (E&W)-BTS-Q3	301	0.213	0.004	0.02	2	0.971	0.379
F shrinkage mean	432	1.5				0.029	0.279

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
304	0.21	0.04	3	0.206	0.376

1

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2008

Fleet	Esti Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK (E&W)-BTS-Q3	628	0.182	0.287	1.57	3	0.976	0.382
F shrinkage mean	738	1.5				0.024	0.333

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
631	0.18	0.23	4	1.277	0.381

Age 5 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 2007

Fleet	Esti Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK (E&W)-BTS-Q3	689	0.171	0.117	0.68	4	0.976	0.318
F shrinkage mean	645	1.5				0.024	0.336

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
687	0.17	0.1	5	0.583	0.318

1

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 2006

Fleet	Esti Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK (E&W)-BTS-Q3	337	0.157	0.117	0.74	5	0.98	0.279
F shrinkage mean	313	1.5				0.02	0.297

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
336	0.16	0.1	6	0.659	0.28

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 4

Year class = 2005

Fleet	Esti Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
UK (E&W)-BTS-Q3	191	0.151	0.051	0.34	6	0.982	0.227
F shrinkage mean	125	1.5				0.018	0.327

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
189	0.15	0.05	7	0.344	0.228

1
1

Table 6.8.10 - Sole in VIIa. Fishing mortality

Age/Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
2	0.0083	0.0117	0.0103	0.0299	0.0045	0.0421	0.0079	0.0148	0.0076	0.0129	0.0395
3	0.1196	0.148	0.0809	0.1436	0.0847	0.1575	0.0704	0.135	0.0743	0.1427	0.1333
4	0.2956	0.3988	0.3518	0.3621	0.3157	0.3032	0.4193	0.3256	0.2867	0.3646	0.3927
5	0.4445	0.5545	0.5058	0.4394	0.4722	0.4844	0.4817	0.4072	0.4037	0.6324	0.5668
6	0.4292	0.3671	0.493	0.4873	0.5435	0.3973	0.3793	0.3752	0.3816	0.4262	0.9485
7	0.3909	0.4416	0.4517	0.431	0.4453	0.3962	0.4281	0.3704	0.3583	0.476	0.6387
+gp	0.3909	0.4416	0.4517	0.431	0.4453	0.3962	0.4281	0.3704	0.3583	0.476	0.6387
FBAR 4-7	0.39	0.4405	0.4506	0.43	0.4442	0.3953	0.4271	0.3696	0.3576	0.4748	0.6367

Age/Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2	0.0165	0.0034	0.007	0.045	0.01	0.0062	0.0588	0.0096	0.0437	0.1116	0.1146
3	0.1487	0.0951	0.0811	0.1804	0.1337	0.2738	0.1785	0.1712	0.2966	0.3958	0.3478
4	0.3285	0.4766	0.3828	0.2422	0.3595	0.4191	0.5593	0.3662	0.4466	0.6696	0.4795
5	0.5105	0.4072	0.5313	0.3784	0.3193	0.5499	0.752	0.5519	0.5261	0.6541	0.3865
6	0.6023	0.4364	0.3914	0.4317	0.3262	0.3353	1.2434	0.7126	0.6091	0.5906	0.4872
7	0.4821	0.4415	0.4366	0.3518	0.3359	0.4362	0.8558	1.0667	0.6616	0.6271	0.598
+gp	0.4821	0.4415	0.4366	0.3518	0.3359	0.4362	0.8558	1.0667	0.6616	0.6271	0.598
FBAR 4-7	0.4808	0.4404	0.4355	0.351	0.3352	0.4351	0.8526	0.6743	0.5609	0.6354	0.4878

Age/Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2	0.0795	0.0141	0.0245	0.0715	0.0254	0.1025	0.0253	0.0612	0.027	0.0566	0.069
3	0.2848	0.1472	0.2923	0.2314	0.3439	0.4128	0.3028	0.1999	0.2361	0.2805	0.2856
4	0.404	0.3485	0.423	0.517	0.4646	0.6132	0.4606	0.3348	0.2332	0.3099	0.5153
5	0.5969	0.4079	0.4618	0.5129	0.4843	0.4952	0.7036	0.5311	0.2357	0.26	0.447
6	0.4009	0.5232	0.4982	0.5365	0.5658	0.4767	0.3772	0.7071	0.4963	0.2873	0.3041
7	0.6519	0.846	0.5151	0.3919	0.5032	0.7023	0.3798	0.2467	0.784	0.4761	0.2011
+gp	0.6519	0.846	0.5151	0.3919	0.5032	0.7023	0.3798	0.2467	0.784	0.4761	0.2011
FBAR 4-7	0.5134	0.5314	0.4745	0.4896	0.5045	0.5719	0.4803	0.4549	0.4373	0.3333	0.3669

Age/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	FBAR 10-12
2	0.1624	0.0884	0.2067	0.0915	0.1019	0.0574	0.0409	0.0152	0.0325	0.0243	0.024
3	0.5789	0.478	0.4529	0.3789	0.4149	0.2817	0.3186	0.1847	0.1906	0.3759	0.2504
4	0.4785	0.4375	0.6908	0.4913	0.3093	0.3637	0.4128	0.2658	0.3113	0.3806	0.3192
5	0.4551	0.2945	0.6691	0.4384	0.3067	0.2557	0.463	0.357	0.2932	0.3185	0.3229
6	0.2942	0.2753	0.3967	0.5709	0.2997	0.2961	0.2444	0.3421	0.3009	0.2796	0.3075
7	0.161	0.1881	0.3942	0.2971	0.3732	0.2896	0.3684	0.1826	0.4692	0.2282	0.2933
+gp	0.161	0.1881	0.3942	0.2971	0.3732	0.2896	0.3684	0.1826	0.4692	0.2282	
FBAR 4-7	0.3472	0.2989	0.5377	0.4494	0.3222	0.3013	0.3721	0.2869	0.3437	0.3017	

Table 6.8.11 - Sole in VIIa. Stock numbers at age (start of year, in thousands)

Age/Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
2	3695	10178	3186	13136	5872	6681	3857	15773	9042	8854	5074	4505	2469
3	8349	3316	9102	2853	11536	5289	5796	3463	14062	8120	7908	4413	4009
4	4145	6703	2587	7596	2237	9590	4089	4888	2737	11813	6370	6263	3441
5	1368	2791	4071	1647	4785	1476	6408	2432	3194	1859	7423	3892	4080
6	4389	794	1450	2221	960	2700	823	3582	1465	1930	894	3811	2114
7	939	2586	498	802	1235	505	1642	509	2227	905	1140	313	1888
+gp	8212	5534	4321	3418	2829	3221	2222	2193	2042	1713	2536	2367	1165
TOTAL	31098	31901	25215	31672	29452	29462	24836	32841	34769	35194	31345	25563	19166

Age/Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2	5570	15547	16341	23939	3477	3523	4400	5615	12790	4992	6240	5302	2011
3	2226	5005	13448	14640	21527	2967	3158	3811	4544	10320	4171	5567	4682
4	3299	1857	3781	10646	10073	16293	2262	2124	2321	2904	7024	3258	3761
5	1933	2035	1319	2388	6335	5210	10223	1309	984	1300	1754	4485	1931
6	2457	1028	1262	867	1247	2702	2715	5466	616	605	648	1056	2557
7	1236	1503	604	824	561	325	1199	1336	2740	342	366	347	580
+gp	2098	1968	2714	2512	1466	820	551	1046	1066	2027	1254	1362	1131
TOTAL	18820	28945	39470	55815	44686	31840	24507	20707	25061	22491	21457	21377	16653

Age/Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2	2513	8514	7030	5332	7017	4587	2334	3057	3666	3017	1335	1855	1867
3	1694	2216	6954	6202	4539	6180	3923	1971	2352	3037	2220	1102	1516
4	3361	1087	1327	4648	4595	3243	4224	2668	1000	1319	1747	1375	659
5	2029	1911	533	758	3009	3293	2152	2283	1496	584	598	967	913
6	1046	1131	1054	238	403	2151	2297	1246	1310	1008	271	349	644
7	1353	538	635	654	106	222	1460	1534	840	900	613	138	234
+gp	918	1100	1402	1113	496	752	1244	2427	1089	1183	1537	1002	876
TOTAL	12915	16497	18935	18945	20164	20428	17635	15185	11752	11048	8321	6789	6708

Age/Year	2009	2010	2011	2012	2013	GMST 70-**	AMST 70-**
2	2412	1530	559	744	0	4931	6296
3	1595	2095	1363	490	657	4448	5656
4	1035	1050	1576	1020	304	3253	4278
5	414	620	728	1045	631	1993	2639
6	640	236	392	491	687	1193	1570
7	433	454	152	263	336	705	909
+gp	551	993	341	586	611		
TOTAL	7080	6977	5112	4638	3227		

Table 6.8.12 - Sole in VIIa. Summary

	RECRUITS Age 2	TOTALBIO	TOTSPBIC	LANDING	YIELD/SSB	FBAR 4- 7
1970	3695	7133	6437	1785	0.2773	0.39
1971	10178	7406	6222	1882	0.3025	0.4405
1972	3186	5727	5010	1450	0.2894	0.4506
1973	13136	6554	5123	1428	0.2787	0.43
1974	5872	6190	5068	1307	0.2579	0.4442
1975	6681	6230	5360	1441	0.2688	0.3953
1976	3857	5503	4890	1463	0.2992	0.4271
1977	15773	5510	4491	1147	0.2554	0.3696
1978	9042	6245	5093	1106	0.2172	0.3576
1979	8854	6889	5685	1614	0.2839	0.4748
1980	5074	6431	5514	1941	0.352	0.6367
1981	4505	5913	5169	1667	0.3225	0.4808
1982	2469	4752	4336	1338	0.3086	0.4404
1983	5570	4927	4104	1169	0.2849	0.4355
1984	15547	6812	4618	1058	0.2291	0.351
1985	16341	7893	5664	1146	0.2023	0.3352
1986	23939	9577	6994	1995	0.2853	0.4351
1987	3477	8621	7218	2808	0.389	0.8526
1988	3523	6062	5581	1999	0.3582	0.6743
1989	4400	5256	4704	1833	0.3897	0.5609
1990	5615	4372	3705	1583	0.4273	0.6354
1991	12790	4560	3260	1212	0.3718	0.4878
1992	4992	4522	3507	1259	0.359	0.5134
1993	6240	3927	3292	1023	0.3107	0.5314
1994	5302	5072	4131	1374	0.3326	0.4745
1995	2011	4048	3604	1266	0.3513	0.4896
1996	2513	3148	2776	1002	0.3609	0.5045
1997	8514	3516	2558	1003	0.3921	0.5719
1998	7030	4357	3108	911	0.2931	0.4803
1999	5332	4430	3408	863	0.2532	0.4549
2000	7017	4001	3204	818	0.2553	0.4373
2001	4587	4410	3656	1053	0.288	0.3333
2002	2334	4129	3685	1090	0.2958	0.3669
2003	3057	3722	3322	1014	0.3052	0.3472
2004	3666	2848	2364	709	0.2999	0.2989
2005	3017	2574	2128	855	0.4017	0.5377
2006	1335	1940	1686	569	0.3375	0.4494
2007	1855	1701	1442	492	0.3411	0.3222
2008	1867	1613	1368	332	0.2426	0.3013
2009	2412	1380	1099	325	0.2956	0.3721
2010	1530	1491	1231	277	0.2251	0.2869
2011	559	1242	1095	330	0.3015	0.3437
2012	744	1242	1126	294	0.2611	0.3017
2013	1388 [1]	1141 [2]	961 [2]			0.1629 [3]
Arith. Mean	6033	4741	3908	1191	0.3059	0.4471
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

[1] RCT3

[2] Forecast

[3] F corresponding to a TAC constraint in 2013

Table 6.8.13 – Sole in VIIa. Input to RCT3

XSA = XSA estimates at age 2
S2= abundance indices at age 2 from UK(E&W)-BTS-Q3
S1= abundance indices at age 1 from UK(E&W)-BTS-Q3
Irish Sea sole recruits - age 2

2	40	2	
1972	5872	-11	-11
1973	6681	-11	-11
1974	3857	-11	-11
1975	15773	-11	-11
1976	9042	-11	-11
1977	8854	-11	-11
1978	5074	-11	-11
1979	4505	-11	-11
1980	2469	-11	-11
1981	5570	-11	-11
1982	15547	-11	-11
1983	16341	-11	-11
1984	23939	-11	-11
1985	3477	-11	-11
1986	3523	196	-11
1987	4400	304	118
1988	5615	534	218
1989	12790	1286	1712
1990	4992	309	148
1991	6240	330	220
1992	5302	408	83
1993	2011	154	60
1994	2513	126	246
1995	8514	577	886
1996	7030	716	1158
1997	5332	293	539
1998	7017	464	385
1999	4587	284	354
2000	2334	61	91
2001	3057	210	205
2002	3666	240	242
2003	3017	165	406
2004	1335	110	53
2005	1855	93	107
2006	1867	125	125
2007	2412	150	126
2008	1530	59	57
2009	-11	35	25
2010	-11	49	89
2011	-11	-11	21

S2
S1

Table 6.8.14 - Sole in VIIa.

Analysis by RCT3 ver3.1 of data from file :

sole7a.txt

Irish Sea sole recruits - age 2

Data for 2 surveys over 40 years : 1972 - 2011

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 2010

	I-----------Regression----------				I	-----------Prediction---------			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
S2	.82	3.76	.22	.880	23	3.91	6.96	.259	.716
S1	.79	4.00	.47	.637	22	4.50	7.55	.510	.185
						VPA Mean =	8.48	.700	.099

Yearclass = 2011

	I-----------Regression----------				I	-----------Prediction---------			I
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
S2									
S1	.79	4.00	.47	.637	22	3.09	6.44	.561	.609
						VPA Mean =	8.48	.700	.391

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
2010	1360	7.22	.22	.34	2.34		
2011	1388	7.24	.44	1.00	5.17		

Table 6.8.15 - Sole in VIIa
Input for catch forecast and Fmsy analysis

Input: TAC constraint for 2013 (140 t)
Catch and stock weights are mean 10-12
Recruits age 2 in 2014 and 15 GM (03-11)

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N2	1388	1.00	WS2	0.160	0.04
N3	657	0.30	WS3	0.190	0.14
N4	304	0.21	WS4	0.231	0.02
N5	631	0.23	WS5	0.286	0.10
N6	687	0.17	WS6	0.330	0.08
N7	336	0.16	WS7	0.342	0.14
N8	611	0.15	WS8	0.330	0.07
H.cons selectivity			Weight in the HC catch		
sH2	0.024	0.36	WH2	0.189	0.13
sH3	0.250	0.43	WH3	0.209	0.07
sH4	0.319	0.18	WH4	0.267	0.03
sH5	0.323	0.10	WH5	0.319	0.12
sH6	0.308	0.10	WH6	0.355	0.14
sH7	0.293	0.53	WH7	0.348	0.10
sH8	0.293	0.53	WH8	0.344	0.05
Natural mortality			Proportion mature		
M2	0.1	0.1	MT2	0.38	0.1
M3	0.1	0.1	MT3	0.71	0.1
M4	0.1	0.1	MT4	0.97	0.1
M5	0.1	0.1	MT5	0.98	0.1
M6	0.1	0.1	MT6	1	0
M7	0.1	0.1	MT7	1	0
M8	0.1	0.1	MT8	1	0
Relative effort in HC fihery			Year effect for natural mortality		
HF13	1	0.1	K13	1	0.1
HF14	1	0.1	K14	1	0.1
HF15	1	0.1	K15	1	0.1
Recruitment in 2014 and 2015					
R14	1900	0.62			
R15	1900	0.62			

Table 6.8.16 Sole in VIIa - Management option table

MFDP version 1a
Run: S7A
IRISH SEA SOLE,2013 WG
Time and date: 12:09 10/05/2013
Fbar age range: 4-7

2013 Biomass	SSB	FMult	FBar	Landings
1141	961	0.5243	0.1629	140

2014 Biomass	SSB	FMult	FBar	Landings	2015 Biomass	SSB
1310	1048	0.0000	0.0000	0	1622	1328
.	1048	0.1000	0.0311	30	1593	1299
.	1048	0.2000	0.0622	60	1565	1271
.	1048	0.3000	0.0932	88	1537	1244
.	1048	0.4000	0.1243	116	1511	1218
.	1048	0.5000	0.1554	143	1485	1193
.	1048	0.6000	0.1865	170	1459	1168
.	1048	0.7000	0.2175	195	1435	1144
.	1048	0.8000	0.2486	220	1411	1121
.	1048	0.9000	0.2797	244	1388	1098
.	1048	1.0000	0.3108	268	1365	1076
.	1048	1.1000	0.3418	291	1343	1054
.	1048	1.2000	0.3729	313	1322	1033
.	1048	1.3000	0.4040	335	1301	1013
.	1048	1.4000	0.4351	356	1281	994
.	1048	1.5000	0.4661	376	1262	974
.	1048	1.6000	0.4972	396	1243	956
.	1048	1.7000	0.5283	416	1224	938
.	1048	1.8000	0.5594	434	1206	920
.	1048	1.9000	0.5904	453	1189	903
.	1048	2.0000	0.6215	471	1172	886

Input units are thousands and kg - output in tonnes

Fmult corresponding to Fpa = 0.966						
.	1048	0.966	0.3002	260	1373	1083
Fmult corresponding to FMSY = 0.515						
.	1048	0.515	0.16	147	1481	1189
Fmult corresponding to FHCR-MSY = 0.174						
.	1048	0.174	0.0541	52	1572	1279
Fmult corresponding to FHCR-MSY transition = 0.324						
.	1048	0.324	0.1007	95	1531	1238

Bpa = 3100 t

Table 6.8.17 Sole in VIIa. Detailed results

MFDP version 1a
Run: S7A
Time and date: 12:09 10/05/2013
Fbar age range: 4-7

Year: 2013		F multiplier: 0.5243		Fbar:	0.1629				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0126	17	3	1388	223	527	85	527	85
3	0.1313	77	16	657	125	466	89	466	89
4	0.1674	45	12	304	70	295	68	295	68
5	0.1693	94	30	631	181	618	177	618	177
6	0.1612	97	35	687	226	687	226	687	226
7	0.1538	46	16	336	115	336	115	336	115
8	0.1538	83	29	611	201	611	201	611	201
Total		458	140	4614	1141	3541	961	3541	961

Year: 2014		F multiplier: 1		Fbar:	0.3108				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0240	43	8	1900	305	722	116	722	116
3	0.2504	262	55	1240	236	881	168	881	168
4	0.3192	136	36	521	121	506	117	506	117
5	0.3229	61	20	233	67	228	65	228	65
6	0.3075	122	43	482	159	482	159	482	159
7	0.2933	128	45	529	181	529	181	529	181
8	0.2933	178	61	735	242	735	242	735	242
Total		930	268	5640	1310	4082	1048	4082	1048

Year: 2015		F multiplier: 1		Fbar:	0.3108				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0240	43	8	1900	305	722	116	722	116
3	0.2504	355	74	1678	319	1192	227	1192	227
4	0.3192	228	61	874	202	847	196	847	196
5	0.3229	90	29	343	98	336	96	336	96
6	0.3075	39	14	152	50	152	50	152	50
7	0.2933	78	27	321	110	321	110	321	110
8	0.2933	207	71	853	281	853	281	853	281
Total		1039	284	6121	1365	4423	1076	4423	1076

Input units are thousands and kg - output in tonnes

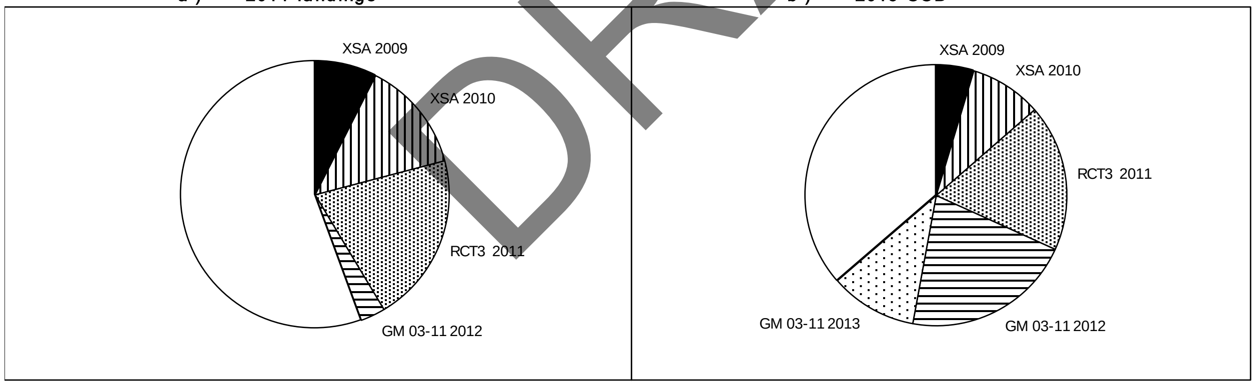
Table 6.8.18 **Sole VIIa**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			2009	2010	2011	2012	2013	
Stock No. (thousands) of 2 year-olds			559	744	1388	1900	1900	
Source			XSA	XSA	RCT3	GM 03-11	GM 03-11	
Status Quo F:								
% in	2013	landings	8.5	11.3	2.1	-	-	78.0
% in	2014	landings	7.5	13.4	20.5	3.0	-	55.6
								100.0
% in	2013	SSB	7.1	9.3	8.8	-	-	74.8
% in	2014	SSB	6.2	11.2	16.0	11.1	-	55.5
% in	2015	SSB	4.6	8.9	18.2	21.1	10.8	36.3

GM : geometric mean recruitment

Sole VIIa : Year-class % contribution to

a) 2014 landings **b) 2015 SSB**



XSA	XSA	RCT3	GM 03-11	GM 03-11
2009	2010	2011	2012	2013

Table 6.8.19 - Sole in VIIa Yield per recruit summary table

MFYPR version 2a
Run: S7A
Time and date: 12:14 10/05/2013
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	10.5083	3.0637	9.5866	2.9045	9.5866	2.9045
0.1000	0.0311	0.2078	0.0662	8.4324	2.3828	7.5128	2.2240	7.5128	2.2240
0.2000	0.0622	0.3385	0.1060	7.1277	1.9561	6.2102	1.7978	6.2102	1.7978
0.3000	0.0932	0.4282	0.1321	6.2328	1.6644	5.3173	1.5066	5.3173	1.5066
0.4000	0.1243	0.4936	0.1500	5.5816	1.4529	4.6680	1.2956	4.6680	1.2956
0.5000	0.1554	0.5433	0.1627	5.0868	1.2930	4.1751	1.1361	4.1751	1.1361
0.6000	0.1865	0.5823	0.1720	4.6985	1.1681	3.7886	1.0117	3.7886	1.0117
0.7000	0.2175	0.6138	0.1789	4.3858	1.0680	3.4777	0.9120	3.4777	0.9120
0.8000	0.2486	0.6397	0.1840	4.1287	0.9862	3.2223	0.8306	3.2223	0.8306
0.9000	0.2797	0.6614	0.1879	3.9137	0.9182	3.0090	0.7630	3.0090	0.7630
1.0000	0.3108	0.6799	0.1909	3.7313	0.8609	2.8282	0.7061	2.8282	0.7061
1.1000	0.3418	0.6958	0.1931	3.5746	0.8120	2.6732	0.6575	2.6732	0.6575
1.2000	0.3729	0.7096	0.1948	3.4386	0.7698	2.5387	0.6157	2.5387	0.6157
1.3000	0.4040	0.7217	0.1960	3.3195	0.7331	2.4211	0.5793	2.4211	0.5793
1.4000	0.4351	0.7324	0.1969	3.2143	0.7009	2.3174	0.5475	2.3174	0.5475
1.5000	0.4661	0.7419	0.1976	3.1207	0.6725	2.2252	0.5194	2.2252	0.5194
1.6000	0.4972	0.7505	0.1980	3.0369	0.6472	2.1428	0.4944	2.1428	0.4944
1.7000	0.5283	0.7583	0.1982	2.9614	0.6246	2.0687	0.4722	2.0687	0.4722
1.8000	0.5594	0.7653	0.1984	2.8931	0.6043	2.0017	0.4522	2.0017	0.4522
1.9000	0.5904	0.7717	0.1984	2.8309	0.5860	1.9408	0.4341	1.9408	0.4341
2.0000	0.6215	0.7776	0.1983	2.7741	0.5694	1.8853	0.4178	1.8853	0.4178

Reference poin	F multiplier	Absolute F
Fbar(4-7)	1.0000	0.3108
FMax	1.8571	0.5771
F0.1	0.5696	0.177
F35%SPR	0.5956	0.1851

Figure 6.8.1a - Sole VIIa - BE Length distributions of discarded and retained fish from discard sampling studi

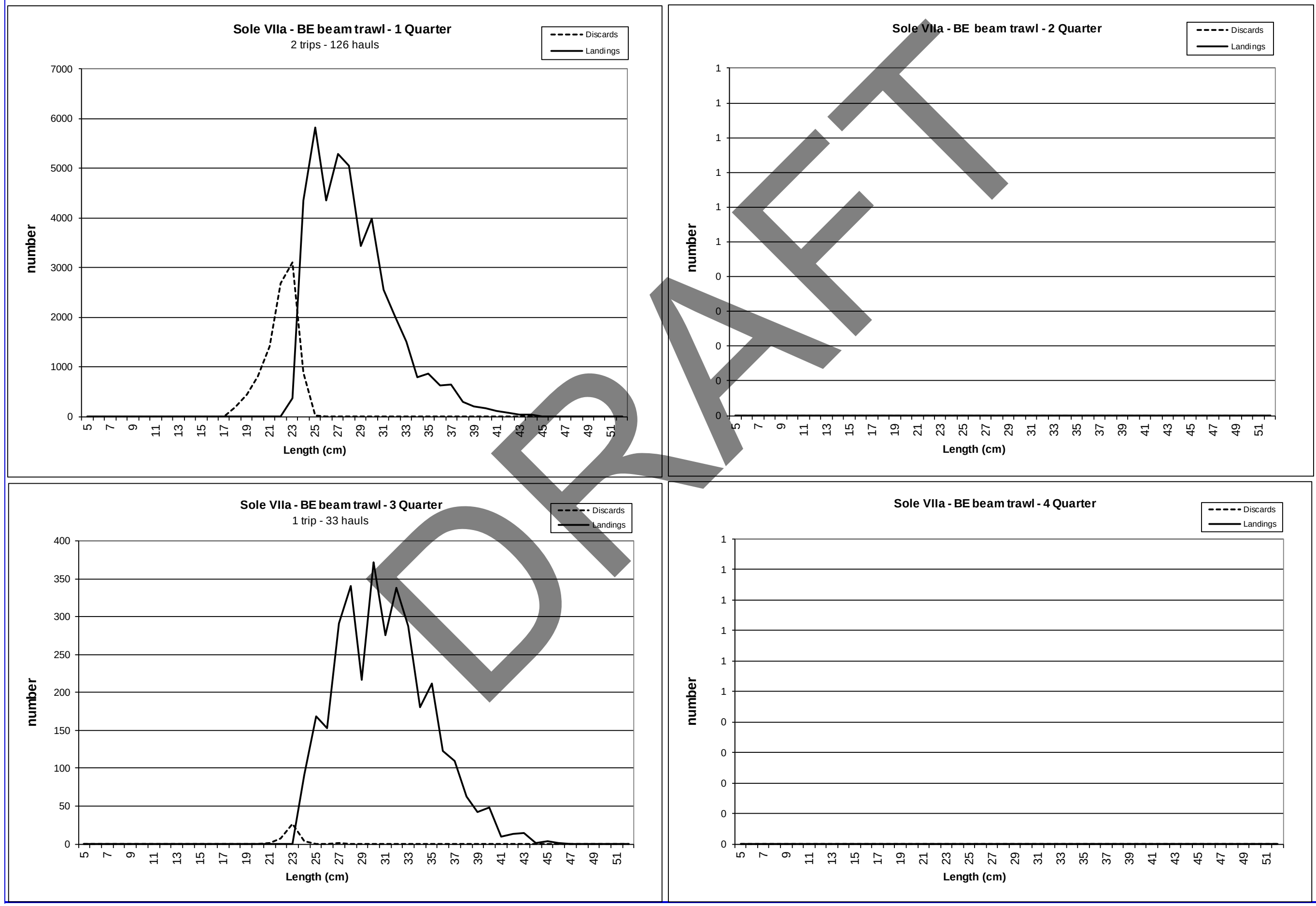


Figure 6.8.2a Sole in VIIa. Effort series

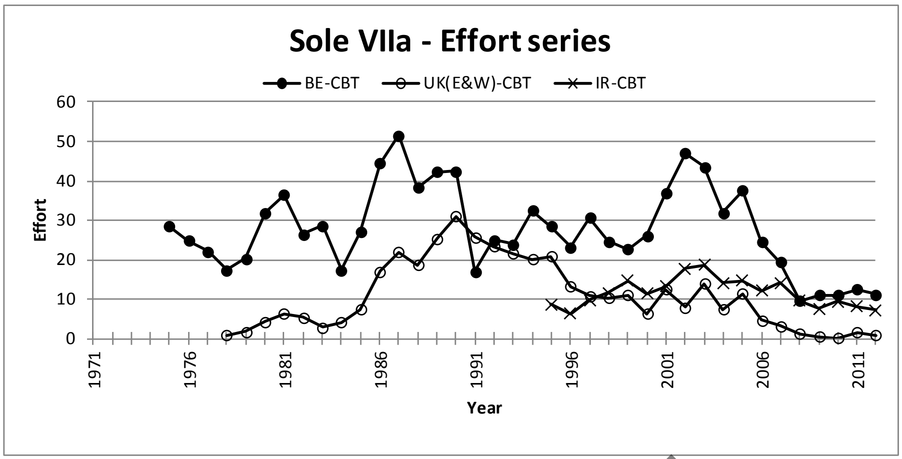


Figure 6.8.2b Sole in VIIa. Relative effort series

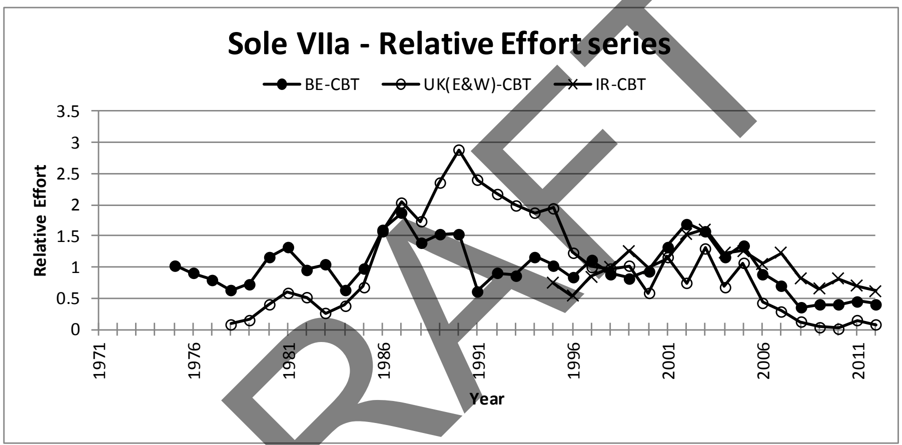


Figure 6.8.2c Sole in VIIa. Relative LPUE series

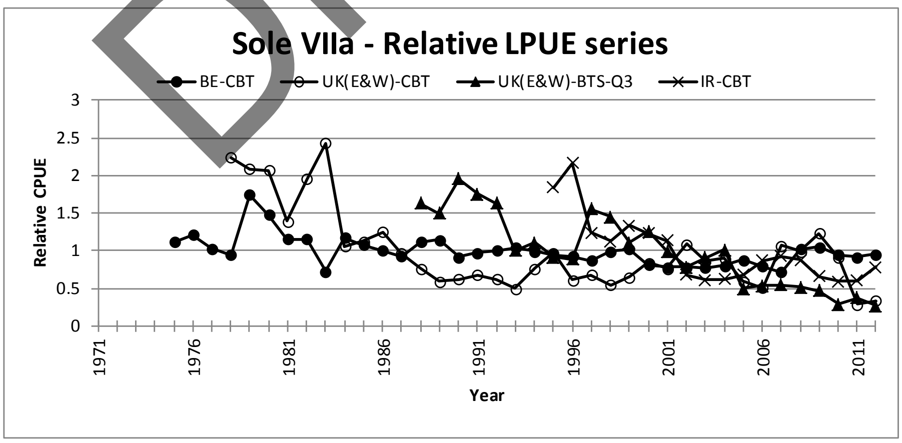


Figure 6.8.3a Sole in VIIa. Effort series

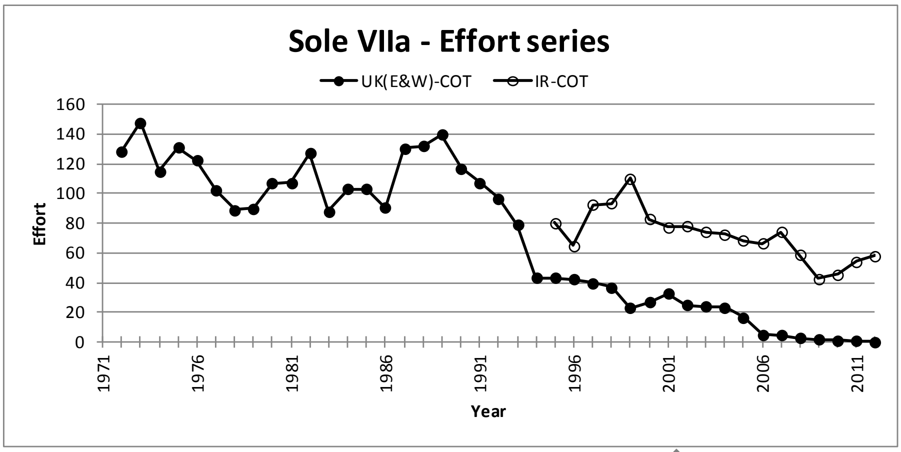


Figure 6.8.3b Sole in VIIa. Relative effort series

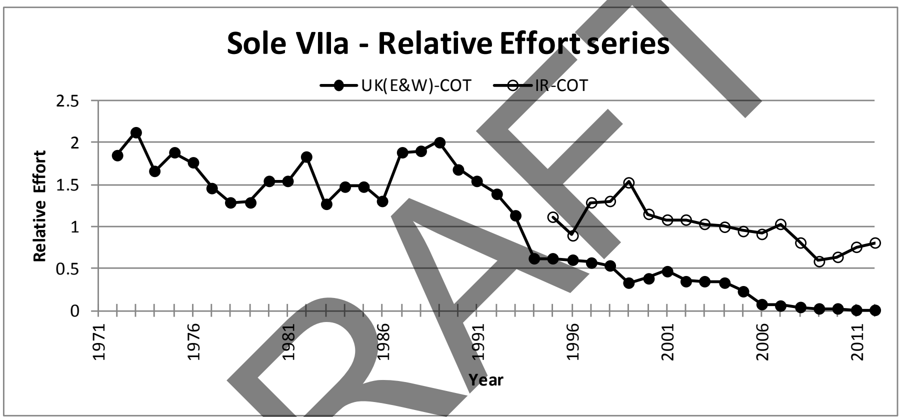


Figure 6.8.3c Sole in VIIa. Relative LPUE series

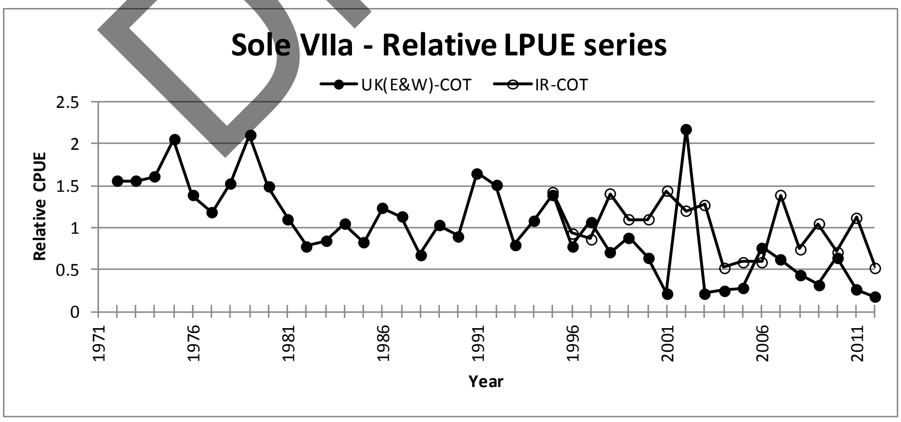
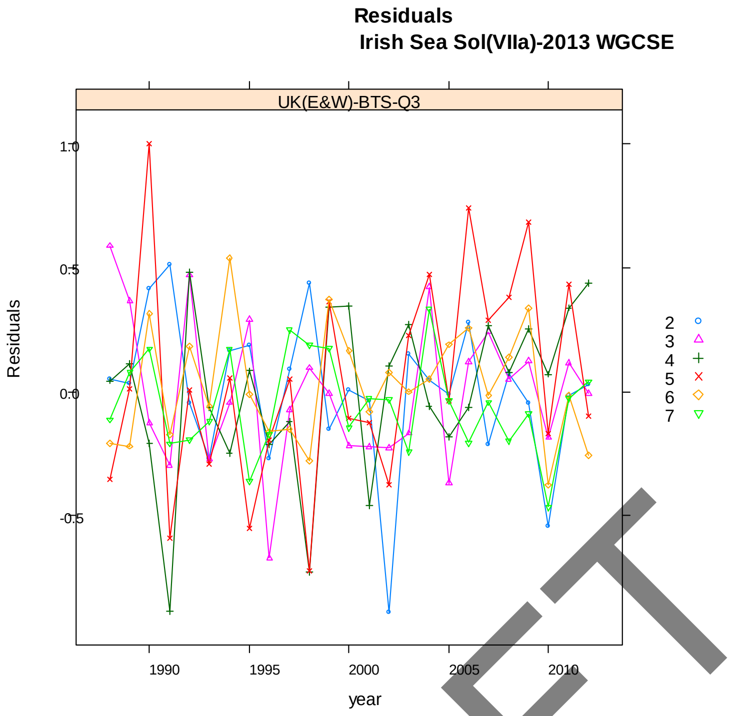


Figure 6.8.4 - VIIa SOLE LOG CATCHABILITY RESIDUAL PLOTS - Final XSA



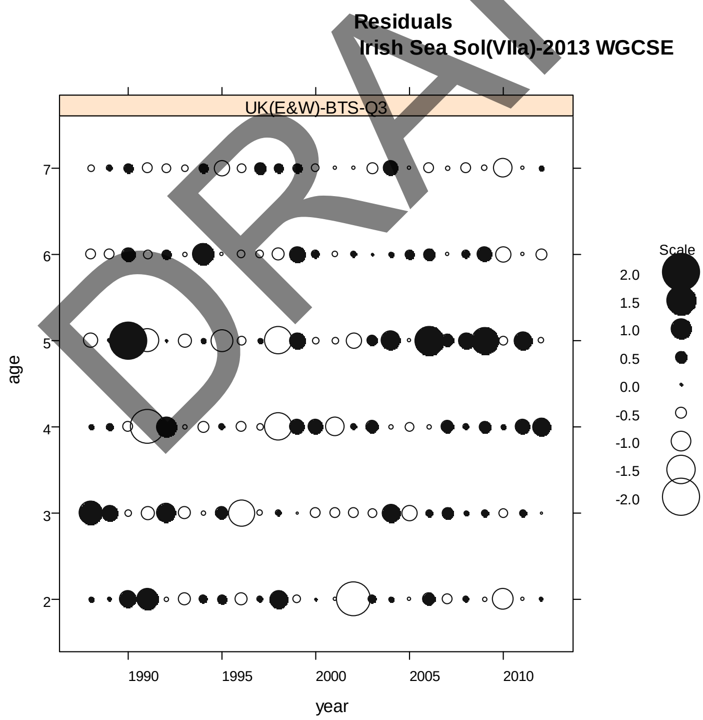
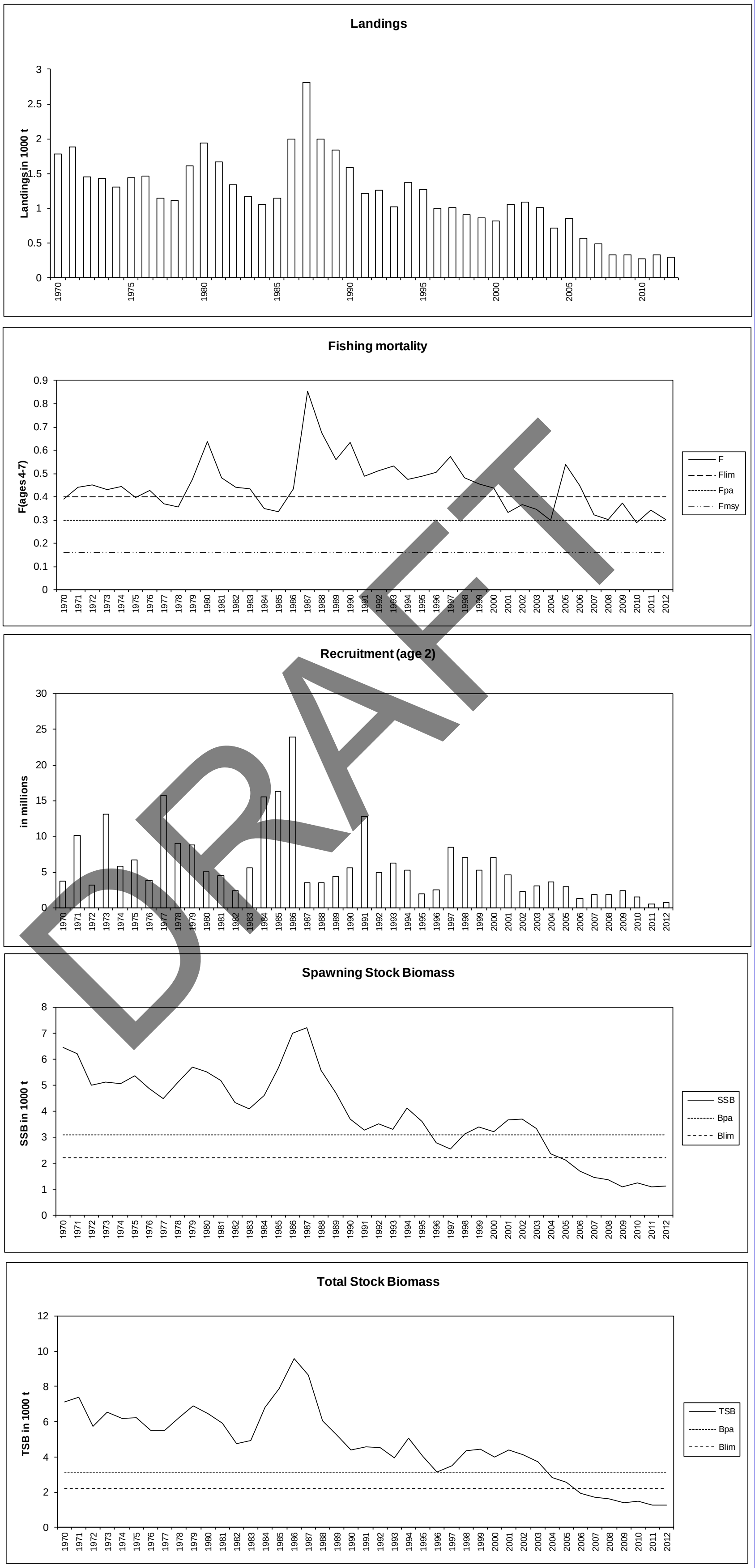


Figure 6.8.5 Sole in VIIa. Summary plots



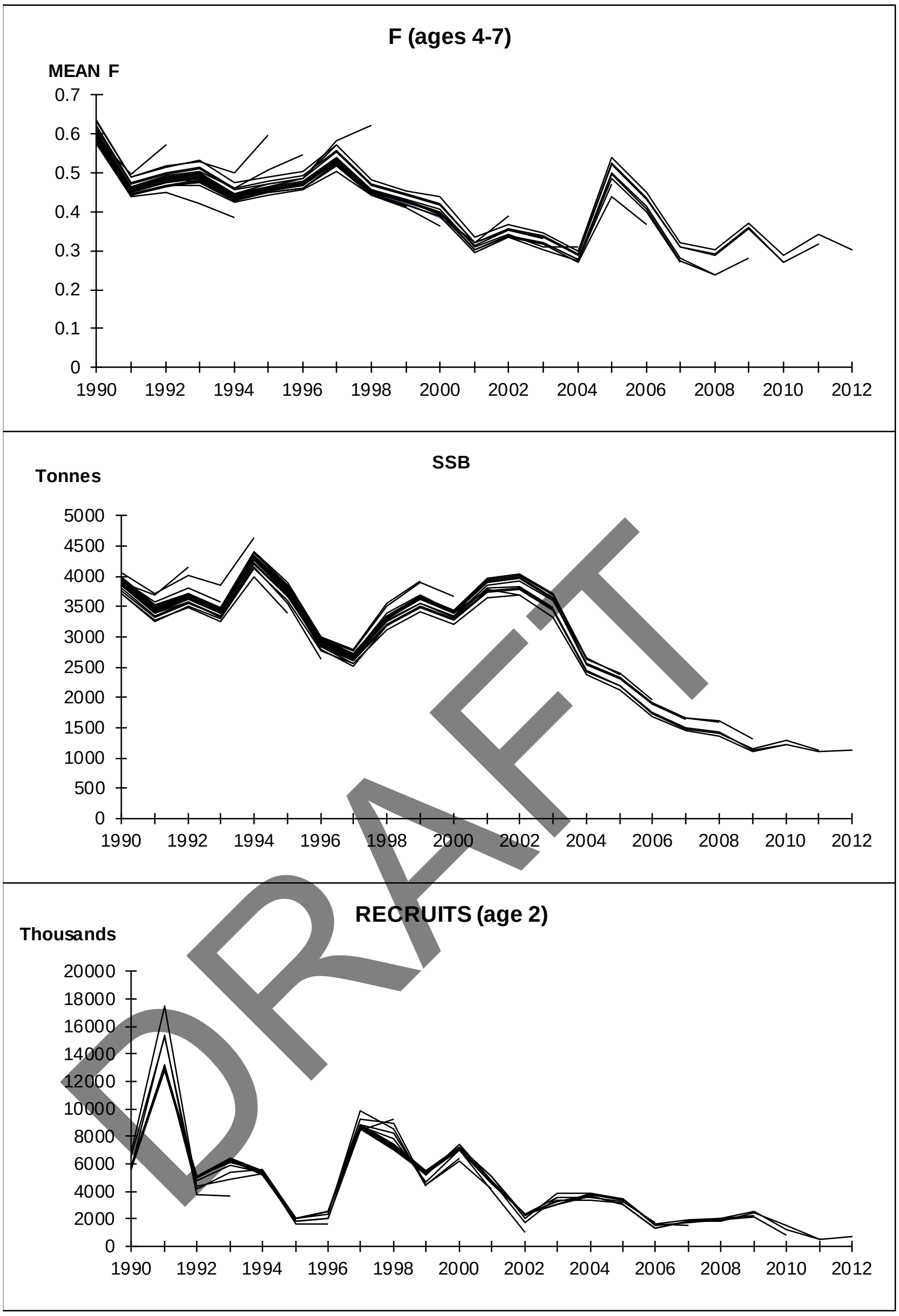
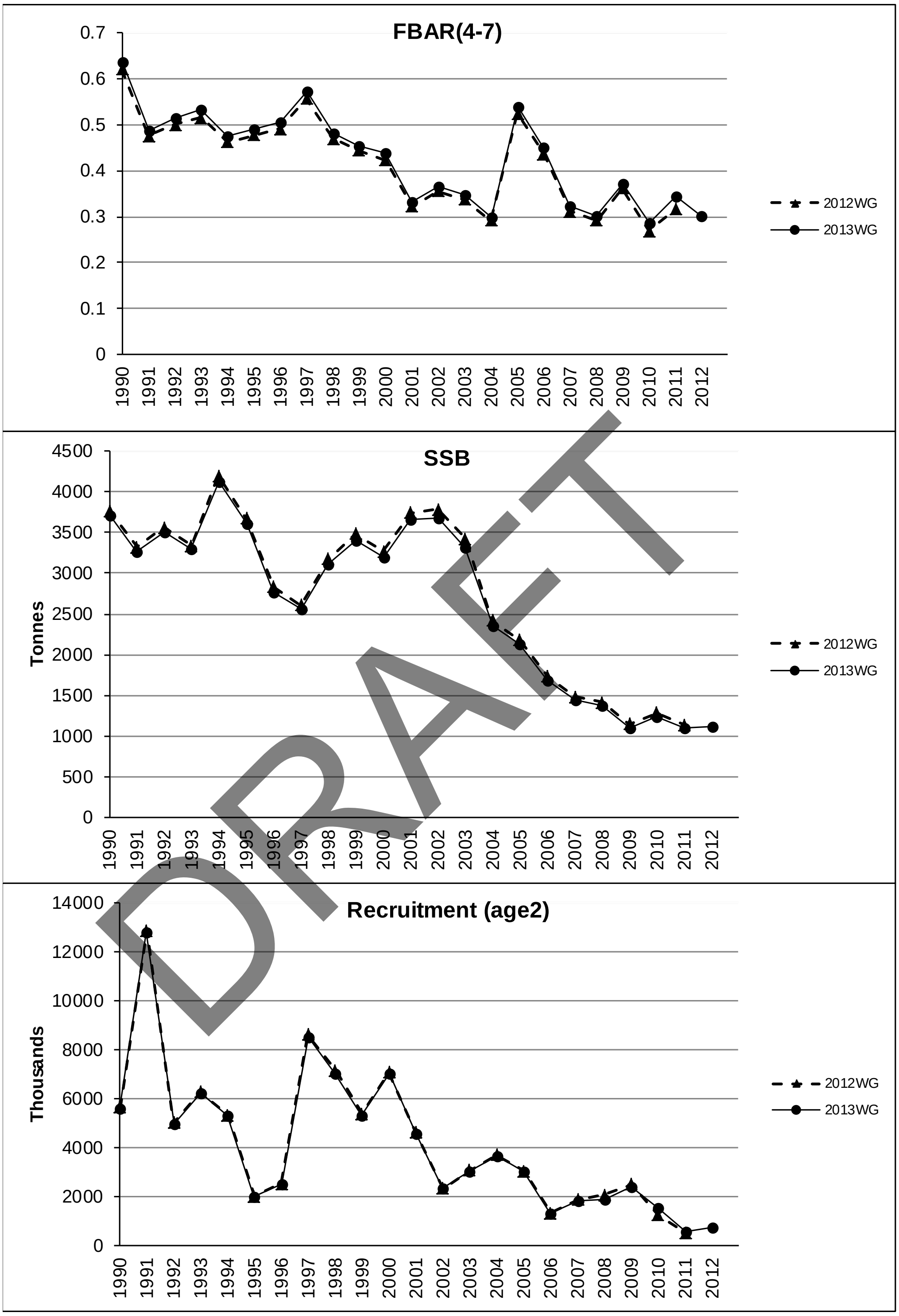


Figure 6.8.6. Sole VIIa retrospective XSA analyses (shrinkage SE=1.5).

Figure 6.8.7 - Sole VIIa comparison with last year's assessment



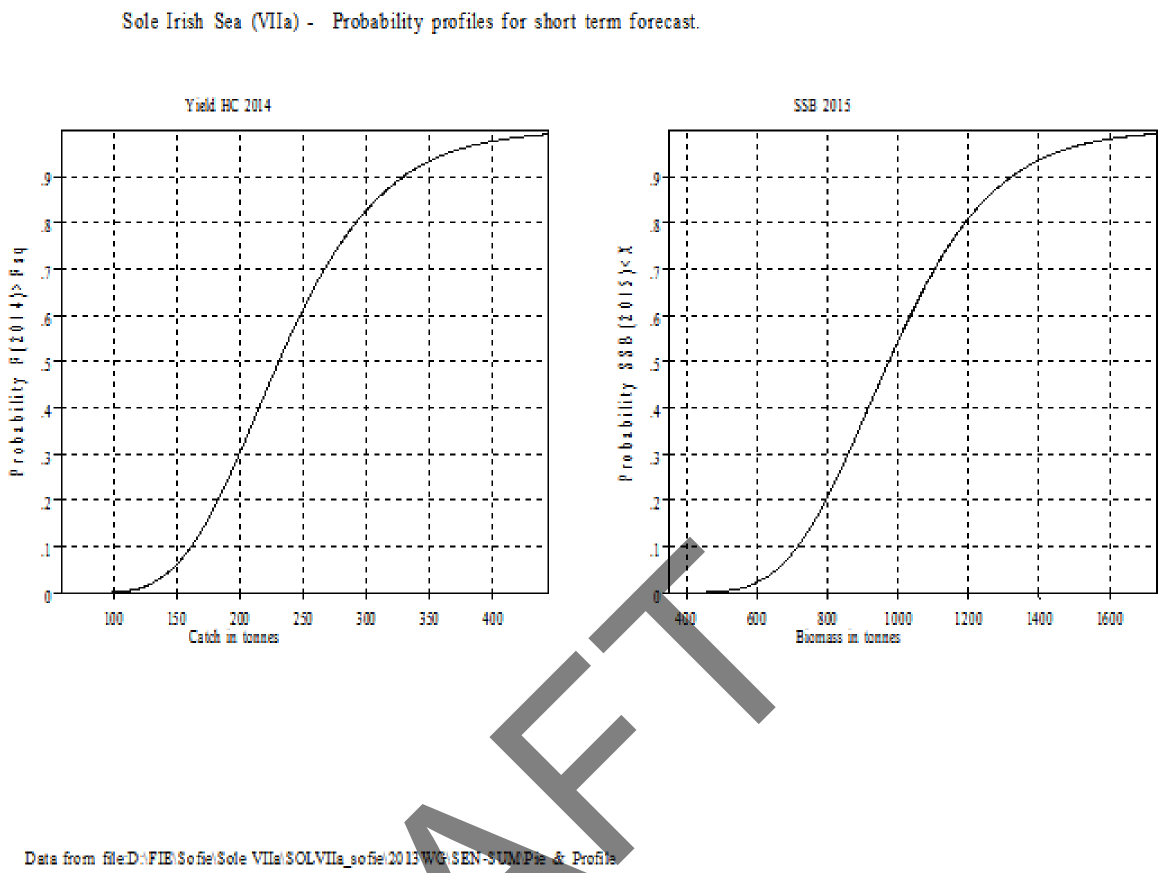


Figure 6.8.9. Sole VIIa-probability profiles for short-term forecast. Note that X is referring to the values on the X-axis.

7.1 Celtic Sea overview

There is no overview.

7.2 Cod in Division VIIe-k (Celtic Sea)

Type of assessment in 2013

Full analytical assessment

This stock has been benchmarked at WKROUND in February 2012. While XSA was kept as the assessment model, substantial changes have been done to time-series and parameters:

- A reduction in the number of tuning indices leading to keeping only one commercial index and one combined survey index as tuning fleets;
- The combination of FR-IBTS Q4 and IR-GFS Q4 into one single survey index;
- The use of a French commercial indices based on otter trawler catching more than 40% of gadoids per trip;
- The use of mortality-at-age rather than M=0.2;
- The assumption that full selectivity occurs at age 3 rather than age 5.

At the end of the benchmark, the new assessment method was considered suitable to carry out a full analytical assessment including forecasts.

ICES advice applicable to 2012

"The strong 2009 year class is expected to bring the SSB above $MSY_{Btrigger}$. Based on the MSY framework, ICES advises that F in 2012 be set at F_{MSY}=0.40, resulting in landings of 10 000 t in 2012."

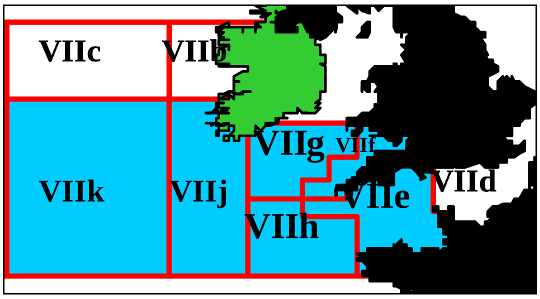
ICES advice applicable to 2013

"ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 10 200 t."

7.2.1 General

Stock description and management units

The 2013 TAC was set for ICES Areas VIIb–c, VIIe–k, VIII, IX, X, and CECAF 34.1.1(1), excluding VIId. This is more representative of the stock area than in previous years as the cod population in VIId is more relevant to the North Sea population. However, landings from VIIbc are not included in the assessment area (see Section 7.3 for these).



Red Boxes-TAC/Management Areas.Blue Shading-Assessment Area.

Management applicable in 2012 and 2013

TAC 2012 (Council regulation 43/2012)

Species: Cod *Gadus morhua*		Zone: VIIb, VIIc, VIIe-k, VIII, IX and X; EU waters of CECAF 34.1.1 (COD/7XAD34)
Belgium	449	
France	7 357	
Ireland	1 459	
The Netherlands	1	
United Kingdom	793	
Union	10 059	
TAC	10 059	Analytical TAC Article 11 of this Regulation applies.

TAC 2013 (Council regulation 608/2012)

Species: Cod *Gadus morhua*		Zone: VIIb, VIIc, VIIe-k, VIII, IX and X; EU waters of CECAF 34.1.1 (COD/7XAD34)
Belgium	456	Analytical TAC
France	7 459	Article 11 of this Regulation applies.
Ireland	1 479	
The Netherlands	2	
United Kingdom	804	
Union	10 200	
TAC	10 200	

Fishery in 2012

Landings data used by the WG are shown in Table 7.2.1. No revision was required.

The 2011 landings were substantially higher than those from 2009 and 2010 which were around 3200 t and were about 60% of the average of the time-series (7700 t). Landings in 2011 (4737 t) are the highest since 2007 because of the strong recruitment of year class 2009 which subsequently led to an increase of TAC to 5379 t during the autumn 2011 and a further increase of the TAC in 2012 at 10 059 t. In 2012, landings were 7693 t.

The contribution of landings by country remained unchanged in 2012. France accounts for 67% of the international landings followed by Ireland (20%), United Kingdom (9%) Belgium (4%). The quotas were not entirely taken (73% uptake). France has taken 70% of its quota, Ireland 105%, UK 88% and Belgium 65%. The low uptake rate for France is the consequence of the combination of the mixed nature of its fisheries and the restricted TAC on haddock.

There is no information on the absolute level of misreporting for this stock but there is evidence that misreporting has increased from 2002 when quotas became restrictive with a maximum in 2008. Misreporting has decreased since then. Irish landings data in some years have been corrected for area misreporting into the southern rectangles of VIIa. In 2012, misreporting was not estimated due to various changes on how the data were provided to the WG but is assumed to be lower than the previous year due to a higher TAC. These misreporting estimates are summarized in the table below.

Year	2004	2005	2006	2007	2008	2009	2010	2011
Mis alloc (t)	108	54	103	527	558	193	143	147

Last year, the WG observed highgrading in 2011 occurring in all countries because of the strong recruitment of the 2009 year class and a limiting TAC leading to an exceptionally high level of discards above the MLS (35 cm). Based on the information from sampling at sea on all fleets, it appeared that more than 70% in weight of the "non-landed" fraction of the catch was over the official MLS for the main métiers. The remaining 30% are mainly age 1 cods (year class 2010) caught by Irish trawlers. It was estimated that 2524 t of cod were discarded which would imply that highgrading accounted for around 1766 t.

The level of highgrading was different per country and métier which makes it difficult to provide accurate estimates of its magnitude. The proportion of highgraded fish among the discards was 60% for Ireland and France, 90% for UK and 100% for Belgium (because of its higher MLS at 50 cm).

Highgrading over the last decade was taken account of in the assessment when the absolute magnitude of this phenomenon was considered important. The procedure explaining how the WG has treated highgrading information before this year is in the stock annex appended to this report.

In 2012, the amount of discards and highgraded fish were lower than the year before due to a higher TAC but above-MLS fish still represent almost all the discarded length classes. This is related to the still relatively abundant 2009 and 2010 year classes and relatively low recruitment of year class 2011. As less small fish are caught and discarded, the proportion of bigger fish discarded is naturally higher.

The times-series of estimates of highgrading is summarized in the table below:

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
HG (t)	210	148	74	432	592	322	25	7	1766	905

Both assumed Irish area misreporting and French high grading estimates since 2003 in percentages of the landings are summarized in the table below:

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
%	3	7	4	14	23	22	7	5	26	5

Fishery-science partnerships

French self-sampling programme

The French self-sampling program is voluntary under the auspices of the main Fishermen's Organization P.M.A (Pêcheurs de Manche et Atlantique). In 2009, six otter trawlers participated, providing data for métiers targeting either gadoids (OTB or OTTPD), *Nephrops* (OTTLN) or benthic species such as monkfish, megrim, rays, john dory (OTB or OTTPB). In 2010, four otter trawlers participated. In 2011 and 2012, three otter trawlers have participated.

Table Legend: No of sampling trips/hauls/samples.

Gear Code	Q1	Q2	Q3	Q4	Total	Métier	2011
OTBPB	14	17	19	4	54	BENTH= OTBPB+OTTPB	
OTBPD	6	8	5	1	20	GADI= OTBPD+OTTPD	
OTCRU		5	2	1	8	NEPH= OTTLN	
Total	20	30	26	6	82		

Gear code	Q1	Q2	Q3	Q4	Total	Métier
2011						
OTDEF	20	25	24	5	74	Otter trawl targeting gadoids
OTCRU		5	2	1	8	Otter trawl targeting nephrops
Total	20	30	26	6	82	

Retained and discarded parts of the catch have been scrutinized in each haul sampled. Overall 17 215 cod have been measured in 2009, 15 310 belonging to the retained part and 1905 to the discarded part. In 2010, 12 381 cod have been measured, 9709 in the retained part and 2672 in the discarded part of the catch. In 2011, 36 234 cod have been measured with 35 570 in the retained part and 664 in the discarded part of the catch. The participating vessels have not exhibited highgrading practice (Figure 7.2.1). This figure is contrary to the perception of strong highgrading occurring in all fleets but may more reflect the habits of those participating vessels rather than the whole picture of the fleet behaviour.

Since 2010, these sampling data are provided by the Professional Organization (P.M.A) and stored in a database currently located at Ifremer/Lorient. Motivation of the crew or the vessel owners could become a problem in future. The reasons are that 1) the effort required of the industry to provide more biological data is not linked with incentives in setting TAC and quotas, 2) since 2009 there has been a pragmatic link between the quota set and change in fleet effort by metier, or even decommissioning, which led to an under-consumption of the agreed quota. In addition, the reduction of scientific staff to manage or deal with the data flows from the industry adds additional problems to have the information made available in time for the working group.

In 2012, data from the French self-sampling programme were not available at the time of the working group, due to compatibility constraints between the software used to collect the data and the new Ifremer database (SIH) therefore only data from the at-sea observer programme (obsmer) were included in the assessment.

Ireland–UK tagging programme in the Irish and Celtic Seas and Irish industry–science partnership quarter 1 cod survey

A tagging programme on both nursery areas and spawning aggregations of cod in the Irish and Celtic Seas, involving conventional (plastic) tags and sophisticated electronic data storage tags, was initiated in 2007. The main objectives were to examine the movements of cod in relation to closed areas and in respect to stock mixing; to determine fine-scale movements and behaviour of cod during spawning; to examine vertical distribution (in relation to catchability) and thermal experiences (in relation to gonad development). Detailed results were presented to the ICES ASC in 2009 (Bendall *et al*., 2009) and are summarized in the WGCSE 2012 report. No additional information was presented to the group this year.

In recognition of ICES advice (ICES, 2009), the Marine Institute and the Federation of Irish Fishermen, in 2010 initiated an annual Q1 fishery-independent survey for Celtic Sea Cod (See WGCSE 2012 for complementary information and Figure 7.2.1). No updated information was presented to the group this year and no further survey is planned.

Landings

Figure 7.2.3 shows the annual length structure of the landings per métier and country. Figure 7.2.4 shows the evolution of the age structure of the landings.

It is noticeable that this stock has always been composed of a few age classes. The catch number-at-age table (Table 7.2.2) shows the catch was mainly composed of age 2 over the period 2005–2008. In 2009 the proportion of 2 year old fish is comparatively low and ages 3, 4, and 5 are higher than those observed since 2005. In 2010 year lass 2009 (age 1) represents 40% of the total number of landed fishes. This is the strongest recruitment since 2000. Age 2 represented 30% of the total number of landed fishes for the same year. In 2011, year class 2009 represents 63% of the fish caught and year class 2010 only 30% of the catch. Logically in 2012, Age 3 (corresponding to year class 2009) represents 63% of the total number of landed fished, followed by age 2 and 4 which account for 23 and 10 % of the total number of landed fished respectively. Contribution of age 1 accounts for less than 2% of the fish in number which is likely a consequence of a low recruitment event in 2012.

Discards

Figure 7.2.3a–d shows the length structure of landings and discards per métier and country. The majority of the cod discarded results from the highgrading behaviour occurring for all countries while discarding of undersized individuals is low for all fleets. The landings/discards pattern is known to be strongly variable between fleets and years. In 2009, age 1 individuals (30–45cm) were mainly discarded. In 2010, most of them were landed. In 2011, ages 1 and 2 represents respectively 51% and 46% of the total discards in numbers for all fleets (Table 7.2.3). This relates well to the good recruitments of year class 2009 and 2010.

Discards were also available from Belgium. For these fleets, the modal distribution of discards was around 30cm. Due to the MLS being set at 50 cm for Belgium, discards occur well above 35 cm while relatively low in numbers. Belgian MLS switched back to 35 cm on the 1st of October 2011.

Due to the low TAC relative to the high magnitude of recruitment in 2009 and 2010, all countries had unusually high discards rates in 2011, generally 70% by weight was made up of fish above the MLS.

In 2012, the discard rate was back to the usual proportion for this stock (around 10%). Discard rate is known to vary between country and TAC constraint. It is quite low for France and Belgium in 2012 (5 and 7% respectively) due to non-restrictive TAC for cod. Discard rate is higher in Ireland (18%) and United Kingdom (31%).

The estimates of the discarded weight for 2012 were the following:

Country	Landings (t)	Discards (t)	Catch (t)	Discard rate %
France	5166	273	5439	5
Ireland	1536	345	1881	18
United Kingdom	701	312	1013	31
Belgium	290	21	311	7
Other	0	unknown	unknown	n/a
Total	7693	951	8644	11

There are uncertainties in the actual level of discards as all metiers are likely to exhibit different discarding patterns. For example for France, the observer at sea programme indicates that the discard rates for OTCRU and OTDEF métier in 2011 were both at very low levels (1 to 11% per quarter) while all the other métiers had a discard rate of 46%. It appears that fleets targeting gadoids were likely to keep older fish and discard younger individuals (e.g. Irish discards) while the other métiers tended to highgrade more maybe because they are less prone to target gadoids or because the fish caught despite its size was not marketable.

Despite low amount of discards this year, most lengths are above the 35 cm MLS and therefore highgraded fishes are the main component of the discards in both number (70–100%) and weight (89–100%):

	% of highgrading in discards	
Country	**in number of fish**	**in weight**
France	80.9	97.3
Ireland	71.0	89.6
United Kingdom	93.5–99.7	99.9
Belgium	77.2	89.0

Those numbers are the consequence of both the good recruitment of year classes 2009 and 2010 and also the lack of small individuals from year class 2011. Overall, the discard weights are low this year.

Biological

Catch in numbers-at-age, catch and stock weights are given respectively in Tables 7.2.2, 7.2.3, 7.2.4 and 7.2.5. The final year estimates are consistent with the recent historical values.

Percentage of F before spawning and maturity ogive have been scrutinized during the 2012 WKROUND benchmark and have remained unchanged since then.

Values for natural mortality-at-age (previously 0.2 for all ages and years) have changed based on a new approach agreed at WKROUND 2012. Natural mortality-at-age (M) is assumed weight-dependent after Lorenzen (1996) with mortality assumed to be time invariant.

Other parameters remained unchanged and are described in the stock annex. Celtic Sea cod are very fast growing and early maturing compared with more northern cod stocks.

Surveys

Table 7.2.6 presents the survey dataseries. Two ongoing surveys, both part of the DCF, IBTS Q4 (FR-EVHOE & IR-GFS7gj combined) were used to assess this stock. In order to overcome the difficulty of constructing survey-series with generally low number of cod, WKROUND 2012 tested and agreed on a combination of the two surveys into a single abundance index. Surba is no longer used to assess this stock since the last benchmark. Both surveys reflect the strong 2009 and 2010 year class. French survey (FR-EVOHOE) generally picks up older fish in central and southern Celtic Sea whereas the Irish survey provides more juvenile information from VIIg and along the Irish coast.

Commercial cpue

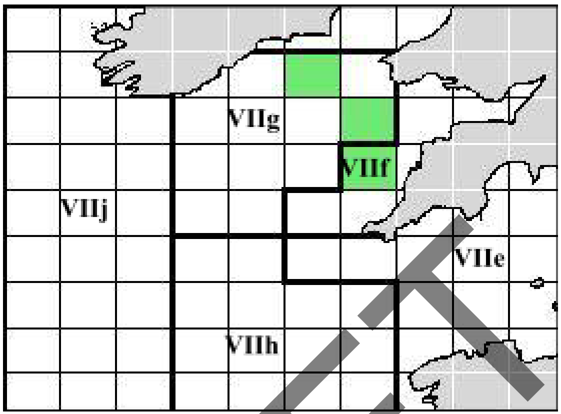
Table 7.2.7 show the series of landings, fishing effort and lpue dataseries for four French fleets (a), eight Irish fleets (b) and three UK fleets (c). Figure 7.2.5 (a,b,c,d) shows their trends.

A new French OTDEF demersal fleet tuning-series has been introduced during WKROUND 2012. This series is based on landings and effort data from French OTDEF vessels with 40% of the landed weight per trip of gadoids. Because of the strong recruitment of cod for 2009 and 2010, this limit of 40% has proven not reliable this year as more vessels were included which led to a suspicious increase of effort of 170%. During the WG, four indicators were used to evaluate the true relative difference in effort between 2011 and 2010, i.e. number of trips and number of days at sea in the Area VIIe–k by French trawlers and then in a restricted area including only those ICES rectangles were at least 1 ton of cod was fished during the two years (to exclude flatfish trawling areas in VIIe that could bias the estimates). The four indicators were extremely consistent giving values between -3% to +1%. The highest value (+1%) was retained for correcting the 2011 effort figure of the tuning-series. In 2012, this situation occurred again because of the high landings of haddock therefore the calculation of French OTDEF demersal fleet tuning-series was carried out by aggregating the effort of the vessel ids which reached the 40% threshold in 2009 and 2010 as these years were considered to be "normal" years for gadoids.

A general decrease in the lpue trend is observed in almost all series between 1990 and 2004, where the TAC began to be constraining. From that point, the lpues seemed to stabilize, or even to increase if highgrading is taken into account. In 2011, the strong recruitment of year class 2009 has resulted in an increase of lpue for all fleets between 2010 and 2012.

Different features are observed in the effort time-series. The métiers showing the highest levels of cod directed effort have decreased significantly in the last 5–10 years. Irish otter trawlers show an increasing trend over the period, the majority of this effort being directed towards *Nephrops*. French metiers might have had higher effort possibly because of bigger TAC on cod but the change in calculation for the last two years is somehow interfering with any assumption on recent trends in the fishery.

A special effort was made during the 2009 WG to combine international landings and effort datasets and produce historical distribution maps. These maps are respectively composed of France, UK, Ireland and Belgium landings (Figure 7.2.6), France and Ireland effort (Figure 7.2.7) and France and Ireland lpue (Figure 7.2.8). The data are not corrected for misreporting or highgrading. The main conclusion from these maps is the shrinking of the geographical area of the stock over the years. This is particularly visible in the distribution of the landings (Figure 7.2.6). The perceived decrease of landings over time is to be regarded with caution given the recent levels of misreporting and highgrading. The rectangles temporarily closed (30E4, 31E4 and 32E3) since 2005 were clearly among the most important in terms of lpue.



Green: Trevose closed areas.

7.2.2 Stock assessment

Model used: XSA.

The assessment was benchmarked in 2012 at WKROUND and the assessment procedure agreed during the WK was followed (see stock annex)

The following parameters were applied for all runs:

		WG 2012	WG 2013
Catch data range		1971–2011	1971–2012
Age range		1–7+	1–7+
Commercial tuning series			
	FR-OTDEF Q2-Q4 VIIek Age 1–6	2000–2011	2000–2012
Scientific Surveys			
	Combined FR IBTS Q4 - IR GFS Q4	2003–2011	2003–2012
	Age 0–4		
Taper		No	No
Age s catch dep. Stock size		None	None
q plateau		3	3
F shrinkage se		1	1
Year range		5	5
age range		3	3
age range of mean F		2–5	2–5

The tuning indices used are in Table 7.2.8.

Exploratory XSA

The XSA settings developed by the WKROUND 2012 included tuning information at age 0 from the survey. However, because no catch-at-age 0 was included in the catch numbers-at-age, this information was not included in the assessment. WGCSE 2013 removed age 0 from the procedure, with no effect on the assessment.

The mean weight of the catch-at-age provided by France was lower than the values observed by other countries as well as the mean of the time-series. Given those results and the importance of this parameter in the assessment, the group decided to modify weights that were unrealistically low. For French data, mean weight of the catch were replaced by mean weight of the stock for age 4 to 8 in quarter 2 and age 4 in quarter 3. The problem was identified to be related some errors in the French Age–Length Key. Those numbers will be revised before next working group.

Final XSA

In contrast to 2011, in 2012 the length frequency and amount of discards were back to the normal situation of the time-series: around 10% of catches in weight. In line with the benchmark conclusions, discards were not included in the assessment this year.

Diagnostics tables are in Tables 7.2.9. Output Tables are 7.2.10–7.2.12. Residuals (Figure 7.2.9) and diagnostics do not highlight any problem regarding the input data and model fit.

Summary plots (Figure 7.2.10–7.2.11) show that fishing mortality has decreased since 2005 (0.95) and in 2011 and 2012 is close to 0.40 which is the F_{MAX} value and F_{MSY} candidate. Given that the shape of the yield per recruit curve for this stock has a large plateau, and considering the uncertainties this year on effort and level of discards, it is impossible to estimate whether fishing mortality is actually slightly above or below the F_{MSY} threshold. But the decrease of fishing mortality is both the consequence of the good recruitment of year classes 2009 and 2010 and a decreasing trend in fishing effort in the major fleets exploiting this stock.

Recruitment in 2012 was estimated to be 736 thousands individuals. This is much less than in 2011 (re estimated this year at 5244 thousands individual) and well below the average of the times-series (6428 thousands individuals). This is consistent with the observations made during both French and Irish surveys where very few Age 0 fish were observed.

As a result of the strong 2009 year class, SSB is still increasing and currently at around 20 858 t in 2012. This is twice the level of the long-term average (11 089 t). SSB in 2012 is the highest value since 1989. Based on survivors estimates from XSA, SSB reaches a value of 21 632 tonnes in 2013.

The assessment does not exhibit suspicious retrospective patterns (Figure 7.2.11). Fishing mortality does not show any particular trend of over or underestimation. Recruits are slightly overestimated some years as well as SSB but the magnitude of this is low in both cases.

7.2.3 Short-term projections

The short-term prognosis was carried out with MFDP.

The exploitation pattern used was the mean F-at-age over the period 2010–2012, with F_{BAR} age range set from 2 to 3. The weights used for prediction were the average over the last three years. No TAC constraint was applied this year. Input to the short-term predictions is presented in Table 7.2.13 and results in Table 7.2.14.

The assumption of recruitment was the geometric mean of the time-series minus the last two years. This implies a recruitment for 2013–2015 of 4830 thousands individuals. SSB in 2013 is estimated to be 21 632 t.

Projection for 2013 implies that landings will be 8398 t and F_{2013} equal to 0.426. The assumed GM recruitment will account for about 23% of the landings in 2014 and 35% of the SSB in 2015.

This will result in a spawning–stock biomass of 17 206 tonnes in 2014 which is above $B_{MSYtrigger}$ (10 300 t) (Table 7.2.15).

7.2.4 Medium-term projection

No medium-term projections were carried out.

7.2.5 Biological reference points

Because the natural mortality-at-age has been changed during the WKROUND 2012 from constant to age dependent, biological reference points were revised during the WGCSE 2013 using the MSYPlot software provided by the Cefas.

Looking at the data and the results of the MSYplot program, the yield per recruit approach was preferred rather that the Ricker, Beverton–Holt or hockey stick stock–recruitment relationships. Indeed, no obvious stock–recruitment relationship appears in the Figure 7.2.12.

In a first attempt, input data were set according to the assessment and forecast procedure. This preliminary run set the F_{MAX} at 0.32.

Results for the Yield per recruit estimates where F and weight estimates are equal to the mean of the last three year are summarized below:

	F20	F25	F30	F35	F40	F01	F_{MAX}	B_{MSYPR}	MSY_{PR}
Deterministic	0.382	0.309	0.255	0.213	0.179	0.177	0.301	6.639	2.008
Mean	0.376	0.304	0.250	0.209	0.176	0.188	0.318	5.823	1.995
5%ile	0.292	0.231	0.189	0.154	0.128	0.117	0.224	4.132	1.695
25%ile	0.336	0.270	0.221	0.183	0.153	0.146	0.267	4.951	1.864
50%ile	0.374	0.301	0.248	0.206	0.173	0.175	0.303	5.773	1.995
75%ile	0.409	0.333	0.276	0.231	0.196	0.220	0.358	6.582	2.118
95%ile	0.470	0.383	0.321	0.271	0.232	0.300	0.459	7.784	2.306
CV	0.148	0.157	0.166	0.176	0.186	0.307	0.231	0.198	0.095
N	1000	1000	1000	1000	1000	1000	1000	1000	1000

However, because of the changes in F across years the group recommended to calculate the mean F and weights using the average of the time-series between 2000 and 2010, instead of the mean of the last three years. The resulting estimates of F_{MAX} = 0.42. In the light of these results, the group decided to keep the F_{MAX} as it was before and equal to 0.4. Therefore, estimates of B_{pa}, B_{lim}, F_{MSY} and MSY $B_{trigger}$ are also unchanged.

The results for the Yield per recruit estimates where F and weight estimates are equal to the mean of the time-series between 2000 and 2010 are summarized below:

	F20	F25	F30	F35	F40	F01	FMAX	BMSYPR	MSYPR
Deterministic	0.434	0.353	0.293	0.246	0.208	0.236	0.413	5.301	2.053
Mean	0.430	0.348	0.288	0.242	0.204	0.241	0.423	4.760	2.058
5%ile	0.340	0.276	0.229	0.192	0.162	0.186	0.331	3.516	1.834
25%ile	0.385	0.313	0.260	0.218	0.184	0.213	0.376	4.145	1.963
50%ile	0.424	0.343	0.283	0.238	0.201	0.235	0.416	4.699	2.051
75%ile	0.467	0.377	0.313	0.263	0.222	0.266	0.460	5.316	2.146
95%ile	0.544	0.438	0.362	0.302	0.255	0.313	0.539	6.194	2.308
CV	0.145	0.142	0.141	0.141	0.141	0.168	0.152	0.176	0.069
N	1000	1000	1000	1000	1000	1000	1000	1000	1000

However, further investigations using simulations (e.g. risk assessment) are required by the group, especially because the level of catch at F_{MSY}(F_{MAX}) appears quite high compared to the SSB.

The advice and forecasts are based on the following reference points:

	Type	Value	Technical basis
MSY	MSY $B_{trigger}$	10 300t	Provisionally set at B_{pa}.
Approach	F_{MSY}	0.40	Provisional proxy based on F_{MAX} (ICES, 2011).
	B_{lim}	7300t	B_{lim} = B_{loss} (B76), the lowest observed spawning–stock biomass.
Precautionary	B_{pa}	10 300t	B_{pa} = B_{lim} * 1.4. Biomass above this value affords a high probability of maintaining SSB above B_{lim}, taking into account the variability in the stock dynamics and the uncertainty in assessments.
Approach	F_{lim}		Undefined.
	F_{pa}		Undefined

Yield and spawning biomass per Recruit F-reference points (2012):

	Fish Mort	Yield/R	SSB/R
	Ages 2–5		
Average last three years	0.54	1.40	2.67
F_{MAX}	0.37	1.45	4.03
$F_{0.1}$	0.20	1.33	6.79
F_{MED}	0.74	1.32	1.85

7.2.6 Management plans

A long-term management plan has been under discussion for this stock and an effort based management system in the Celtic Sea (VIIfg) is being discussed by member states and the EC.

7.2.7 Uncertainties and bias in assessment and forecast

The major sources of uncertainties were discard estimates (including highgrading) and misreporting. These problems occurred in 2003 and subsequent years, when quotas became increasingly restrictive. The magnitude of highgrading and misreporting has decreased since 2008. Estimates of highgrading and discards have been high in 2011 and were included in this assessment. In line with the benchmark conclusions, discards were not included in the assessment this year because the magnitude was back to the mean level for the time-series.

Landings have been revised to include catches from the southern part of the Irish Sea as they are believed to be part of this stock. Lpue for the French demersal fleet have been revised and are available from 2000.

Effort estimation in the main commercial tuning-series is currently based on a catch proportion threshold of 40% of gadoids per trip. With the recent strong recruitment the number of trips qualifying has increased dramatically despite no apparent change in behaviour of the fleet. The WG made the most appropriate adjustment to the effort estimate, but results are sensitive to this adjustment. The effort calculation in the main commercial tuning-series was modified in 2012 and 2013 to account for the strong recruitment. The value of effort in 2012 was computed using the vessels ID identified as targeting mainly gadoids in 2009 and 2010.

7.2.8 Management considerations

This stock was considered to have contracted significantly according to the international landings and lpue distribution maps. However, it can extend substantially when recruitment is strong as seen with the 2009 year class when the FR-IBTS Q4 EVHOE survey started to catch cod in the southern part of the Bay of Biscay in 2010. This stock has had a very truncated age structure with age 2 fish having been the most numerous in landings over many years. The historical dynamics of Celtic Sea cod have been "recruitment driven," i.e. the stock increased in the past in response to good recruitments and decreased rapidly during times of poor recruitment. Recruitment before 2009 was poor. The 2009 and 2010 year classes have been strong. Fishing mortality should be reduced in the longer term to maximize the contributions of recruitment to future SSB and yield and will result in reduced risk to the stock.

Cod in Divisions VIIe–k are caught in a range of fisheries including gadoid trawlers, *Nephrops* trawlers, otter trawlers, beam trawlers, and gillnetters. Other commercial species that are caught by these fisheries include haddock, whiting, *Nephrops*, plaice, sole, anglerfish, hake, megrim, and elasmobranchs.

Over the last decade, there have been indications of underreporting of cod landings in some fleets. The introduction of the buyers and sellers legislation in the UK and Ireland may have reduced this, but may also have increased discards. Measures aimed at reducing discarding and improving the fishing pattern should be encouraged. These might include spatial and temporal changes in fishing practices or technical measures. These measures would need to be evaluated in the context of other species caught in mixed fisheries. Technical mesh size regulation was introduced 14th August 2012 (EC Regulation 737/2012). For both French and Irish fleets, the technical measures were in practice implemented earlier in the year by the national administrations. The effect on Cod has not been scrutinized yet.

The exclusion of ICES Division VIId in the TAC area since 2009 makes the management area more in line with the boundaries of the stock as the stock in VIId is considered as an extension of the cod population in the North Sea.

Since 2005, ICES rectangles 30E4, 31E4, and 32E3 have been closed during the first quarter (Council Regulations 27/2005, 51/2006, and 41/2007, 40/2008 and 43/2009) with the objective of reducing fishing mortality on cod. At an annual resolution, maps of international effort distribution do not show evidence that this closure has redistributed effort of otter trawlers to other areas.

There have been major changes in fleet dynamics over the period of the assessment. Effort in the French otter trawlers has been declining since 1999 and a decommissioning plan has occurred in 2008 and a new plan is ongoing since 2009. A consequence of the Trevose closure is that a part of the effort displayed by the French otter trawlers in the three rectangles before or after the closure has been reported to the allowed area where the catch of mixed species (mainly gadoids) is still profitable, particularly in the rectangles neighbouring the closed area (rectangles 32E4, 32E2, 31E2, 31E3, 30E3, 29E3, 29E4) or in a more distant and still shallower rectangle 31E1. Another part of the effort is displayed in the rectangles 29E1, 28E1, meaning that this effort is then targeting *Nephrops*, monkfish, megrim, *Nephrops* and elasmobranchs. Overall, a part of the French bottom trawlers has not changed their activity with the closed period and continue to target gadoid fish in the neighbouring rectangles of the closed area. Another part of them target benthic species (anglerfish, megrim and john dory) in more distant rectangles 28E1, 29E1.

Irish otter trawl effort in VIIg,j has been stable over the last six years. During this period there has been a fleet modernisation and several decommissioning schemes in Ireland both within the national whitefish fleet and beam trawl fleet.

7.2.9 References

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Table 7.2.1.Nominal landings of Cod in Divisions VII e–k used by the Working Group.

Year	Belgium	France	Ireland	UK	Others	Total	Highgrading and discards estimates	Total catch estimates
1971						5782		
1972						4737		
1973						4015		
1974						2898		
1975						3993		
1976						4818		
1977						3058		
1978						3647		
1979						4650		
1980						7243		
1981						10596		
1982						8766		
1983						9641		
1984						6631		
1985						8317		
1986						10475		
1987						10228		
1988	554	13863	1480	1292	2	17191		
1989	910	15801	1860	1223	15	19809		
1990	621	9383	1241	1346	158	12749		
1991	303	6260	1659	1094	20	9336		
1992	195	7120	1212	1207	13	9747		
1993	391	8317	766	945	6	10425		
1994	398	7692	1616	906	8	10620		
1995	400	8321	1946	1034	8	11709		
1996	552	8981	1982	1166	0	12680		
1997	694	8662	1513	1166	0	12035		
1998	528	8096	1718	1089	0	11431		

Year	Belgium	France	Ireland	UK	Others	Total	Highgrading and discards estimates	Total catch estimates
1999	326	5488	1883	897	0	8594		
2000	208	4281	1302	744	0	6535		
2001	347	6033	1091	838	0	8309		
2002	555	7368	694	618	0	9235		
2003	136	5222	517	346	0	6221	210	6431
2004	153	2425	663	282	0	3523	148	3671
2005	186	1623	870	309	0	2988	74	3062
2006	103	1896	959	368	0	3326	432	3758
2007	108	2509	1210	412	0	4239	592	4831
2008	65	2064	1221	289	0	3639	322	3961
2009	49	2080	870	264	0	3263	25	3288
2010	51	1853	1034	289	2	3229	7	3236
2011	124	3171	1011	414	17	4737	2524	7261
2012	290	5166	1536	701	0	7693	951	8644

*** Provisional.**

Scaled landings 1971–1987 (SSDS WG 1999).

Table 7.2.2. Cod in Divisions VIIe–k. Landings number-at-age (note: 2011 values represents actual catch).

YEAR	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8	AGE 9	AGE 10
1971	725	461	557	96	35	17	5	5	1	0
1972	4	774	110	205	45	26	11	5	1	0
1973	332	239	346	60	74	17	6	4	1	0
1974	1	224	40	118	38	37	18	4	14	0
1975	673	136	185	61	105	20	20	12	1	0
1976	51	1456	61	107	11	22	2	4	1	0
1977	25	416	236	15	60	2	2	5	10	0
1978	197	497	129	116	20	34	6	8	4	2
1979	438	357	263	68	104	19	24	5	2	1
1980	609	1213	285	175	52	55	14	0	0	0
1981	315	3086	811	153	41	20	10	2	0	0
1982	76	1157	888	169	36	19	4	1	0	0
1983	1285	529	540	424	77	21	5	5	1	0
1984	737	1210	134	97	94	22	3	2	0	0
1985	726	1245	465	61	40	47	12	2	1	0
1986	651	1303	673	254	30	31	17	0	0	0
1987	2741	946	448	250	62	20	11	4	0	0
1988	1830	5443	320	133	46	21	4	2	2	0
1989	666	2639	2483	149	77	18	8	2	1	0
1990	360	846	1006	663	79	21	8	6	2	0
1991	1377	1034	229	330	203	48	11	3	0	0
1992	1434	2601	329	64	70	53	16	1	0	0
1993	274	2371	928	79	24	19	14	2	0	0
1994	1340	692	1199	258	27	10	11	6	0	0
1995	823	3320	310	284	73	13	2	3	0	0
1996	617	2248	1199	134	95	43	3	1	0	0
1997	1184	1870	951	297	48	22	6	0	0	0
1998	639	2545	641	254	99	36	6	2	0	0
1999	496	1141	756	158	59	36	9	5	0	0
2000	1693	464	419	169	44	17	12	2	0	0
2001	1091	2373	136	98	70	19	12	6	1	0
2002	210	2069	883	64	33	12	6	4	1	0
2003	103	556	827	217	15	9	6	1	0	0
2004	341	298	175	168	59	8	4	3	0	0
2005	295	664	138	52	45	11	2	0	0	0
2006	368	994	249	25	14	13	4	1	0	0
2007	491	1245	409	60	9	4	3	1	0	0
2008	123	769	312	101	24	4	3	1	0	0
2009	161	281	324	96	37	10	2	0	0	0
2010	532	434	122	91	42	9	2	0	0	0
2011	1516	3158	232	52	32	9	2	0	0	0
2012	35	489	1346	219	26	14	4	0	3	0

Table 7.2.3.Cod in Divisions VIIe–k. Landings, Discards and Catch number-at-age.

AGE	LANDINGS		DISCARDS		SOP CORR. LANDINGS		SOP CORR. CATCH	
	Numbers	Weight-at-age	Numbers	Weight-at-age	Numbers	Weight-at-age	Numbers	Weight-at-age
0	0	0.000	13	0.080	0	0.000	23	0.080
1	31746	1.094	18689	0.765	35105	1.093	68270	0.934
2	459241	1.697	95334	0.952	488668	1.712	657844	1.517
3	1286306	3.487	106250	3.271	1346127	3.510	1534673	3.480
4	213858	7.082	9205	5.001	218888	7.077	235222	6.933
5	25145	10.198	456	9.512	26163	10.196	26972	10.176
6	13918	12.253	11	9.841	14498	12.232	14518	12.229
7	3912	14.137	1717	11.548	4216	14.106	7264	13.033
8	431	13.973	8	14.359	455	13.929	469	13.942
9	2502	11.219	1151	11.162	2823	11.214	4865	11.192
10	130	16.253	3	17.667	137	16.248	143	16.307
Lan/Dis/Catch	Reported	SOP	Reported	SOP	Reported	SOP	Reported	SOP
(tons)	7693	7332	951	536	7693	7692	8644	8643

Table 7.2.4.Cod in Divisions VIIe–k. Catch weight-at-age.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1971	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1972	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1973	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1974	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1975	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1976	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1977	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1978	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1979	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1980	0.908	2.193	4.831	7.464	9.669	11.784	13.862	15.494	16.195	16.315
1981	0.945	1.549	4.385	7.565	9.06	12.75	13.822	19.232	19.232	19.232
1982	0.945	2.242	4.474	7.797	10.25	12.465	15.074	16.908	18.538	20.949
1983	0.979	2.525	4.961	7.457	9.965	12.01	14.767	17.643	19.131	19.131
1984	0.981	2.645	5.284	7.828	9.758	11.672	14.548	16.527	16.527	16.527
1985	1.001	2.637	5.521	8.082	10.407	11.469	13.448	16.658	20.853	20.853
1986	1.054	2.554	5.398	7.44	10.782	12.396	13.558	13.558	13.558	13.558
1987	0.909	2.504	5.264	8.089	10.447	13.574	15.029	16.229	16.229	16.229
1988	0.906	2.187	5.318	7.997	10.649	12.486	13.805	14.285	16.592	16.592
1989	0.844	2.013	4.706	7.638	9.438	12.917	12.479	15.407	16.683	16.683
1990	0.88	2.3	4.624	7.188	9.045	11.713	13.769	16.786	13.081	13.081
1991	0.905	2.135	4.987	6.738	8.865	10.809	13.768	15.478	15.478	15.478
1992	0.815	1.916	4.916	7.359	9.744	11.498	12.474	15.117	15.117	15.117
1993	0.871	2.043	4.508	6.866	8.431	10.942	12.147	13.646	16.53	16.53
1994	0.874	2	4.492	7.926	10.092	12.212	13.072	15.865	15.865	15.865
1995	0.806	1.973	4.589	7.56	9.75	11.152	13.983	14.147	14.147	14.147
1996	0.787	1.877	4.639	6.997	9.854	11.407	13.04	10.363	10.363	10.363
1997	0.771	2.039	4.516	7.389	9.719	11.82	14.367	13.687	13.687	13.687
1998	0.853	1.896	4.461	6.881	9.329	11.216	13.904	14.573	17.161	14.02
1999	0.993	2.098	4.495	7.326	8.945	11.255	13.877	15.988	15.988	17.159
2000	0.863	2.541	4.629	7.042	9.502	10.66	11.746	14.476	14.72	14.72
2001	0.794	2.029	5.112	7.858	9.832	11.423	13.206	14.879	16.311	16.311
2002	0.757	1.88	4.728	6.764	9.36	10.774	12.876	13.463	13.719	14.3
2003	0.889	1.844	4.274	6.667	9.506	11.064	12.04	12.762	11.139	11.139
2004	0.884	2.177	4.543	7.073	9.435	10.802	11.985	14.115	14.115	12.468
2005	0.776	2.118	3.907	6.168	9.194	11.544	10.037	12.657	13.835	13.835
2006	0.789	1.793	4.716	7.404	9.186	11.646	12.313	12.699	12.699	12.699

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
2007	0.772	1.657	4.276	7.463	9.697	11.863	12.441	13.953	15.046	15.046
2008	0.847	1.804	4.541	7.164	9.229	11.095	13.47	12.807	15.178	16.086
2009	0.923	2.384	4.248	6.721	8.895	10.584	10.342	10.497	16.169	14.56
2010	0.853	2.226	4.789	7.285	9.975	11.948	12.188	14.489	15.119	15.119
2011	0.532	1.449	4.551	7.745	9.524	10.597	12.749	10.595	10.595	10.595
2012	1.093	1.712	3.51	7.077	10.196	12.232	14.106	13.929	11.214	16.248

Table 7.2.5. Cod in Divisions VIIe–k. Stock weight-at-age = 1st quarter values.

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
1971	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1972	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1973	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1974	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1975	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1976	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1977	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1978	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1979	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1980	0.662	1.709	4.444	7.321	9.529	11.605	13.513	15.327	15.744	15.744
1981	0.46	1.549	2.284	7.806	10.544	11.439	14.464	15.354	15.354	15.354
1982	0.704	1.488	3.876	7.407	9.624	12.316	15.032	18.569	18.569	18.569
1983	0.446	1.945	4.467	7.353	9.752	11.223	15.908	18.089	21.977	21.977
1984	0.512	1.951	4.928	7.433	9.552	12.18	14.181	16.733	16.733	16.733
1985	0.581	2.07	5.333	8.376	10.851	11.585	14.247	16.399	20.853	20.853
1986	0.528	1.902	5.286	7.382	10.689	12.393	14.482	14.482	14.482	14.482
1987	0.522	1.947	4.877	7.946	10.308	14.419	15.171	16.201	16.201	16.201
1988	0.906	1.621	4.887	7.777	10.302	11.786	12.416	13.889	15.119	15.119
1989	0.844	1.463	4.514	7.615	9.438	12.692	12.788	17.794	17.794	17.794
1990	0.613	1.774	4.39	7.186	8.486	10.703	13.305	16.987	13.081	13.081
1991	0.539	1.538	4.791	6.524	8.631	10.672	13.512	14.898	14.898	14.898
1992	0.663	1.318	4.6	6.558	9.342	11.285	12.322	14.77	14.77	14.77
1993	0.703	1.385	4.278	6.574	8.066	10.815	11.945	13.421	16.53	16.53
1994	0.605	1.754	4.189	7.72	9.722	12.101	12.844	15.859	15.859	15.859
1995	0.612	1.444	4.346	7.452	9.14	10.646	13.908	14.147	14.147	14.147
1996	0.673	1.283	4.471	6.747	9.877	11.424	12.848	12.848	12.848	12.848
1997	0.47	1.41	4.079	7.112	9.044	11.156	13.73	13.623	13.623	13.623
1998	0.421	1.314	4.34	6.676	9.303	11.172	12.369	14.205	17.161	14.02
1999	0.778	1.542	4.252	7.126	8.7	11.142	13.978	17.463	17.159	17.159
2000	0.561	1.696	4.223	6.627	9.326	10.505	11.115	13.566	13.566	13.566
2001	0.63	1.455	4.904	7.872	10.192	11.613	13.174	14.715	16.311	16.311
2002	0.352	1.257	4.452	7.046	9.4	10.614	12.637	14.949	14.949	14.949
2003	0.482	1.327	4.111	6.601	9.183	10.635	12.047	15.832	15.832	15.832

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
2004	0.591	1.258	4.053	6.759	9.372	10.158	11.68	13.85	13.85	13.85
2005	0.588	1.688	4.075	5.945	9.018	11.333	11.487	13.772	13.772	13.772
2006	0.703	1.216	4.233	6.819	8.895	11.487	11.411	12.703	12.703	12.703
2007	0.722	1.399	3.794	6.99	9.809	12.273	15.042	14.465	14.795	14.795
2008	0.869	1.449	4.188	6.896	8.881	11.543	13.624	10.045	13.763	13.763
2009	0.938	1.629	3.865	6.557	8.985	10.567	12.981	12.981	12.981	12.981
2010	0.819	1.424	4.373	6.984	9.891	11.663	12.575	13.085	13.085	13.085
2011	0.374	1.214	4.198	7.239	9.404	11.039	12.785	12.785	12.785	12.785
2012	1.005	1.224	3.534	7.333	10.404	11.702	13.727	12.663	16.045	16.174

Table 7.2.6. Cod in DivisionsVIIe–k. Time-series of survey indices scrutinized at WGCSE.

IR - GFS : Irish Groundfish Survey (IBTS 4th Qtr) - VIIg Cod number-at-age (Effort Standardised to 1hr)									
2003	2012								
1	1	0.79	0.92						
0	7								
1	0.0	0.4	0.7	0.7	0.3	0.0	0.0	0.0	2003
1	0.4	1.0	0.4	0.1	0.1	0.1	0.0	0.0	2004
1	0.1	2.0	0.6	0.1	0.0	0.0	0.0	0.0	2005
1	0.1	2.2	0.6	0.1	0.0	0.0	0.1	0.0	2006
1	0.0	2.6	0.8	0.4	0.1	0.0	0.0	0.0	2007
1	0.0	0.5	1.3	0.3	0.1	0.0	0.0	0.0	2008
1	0.2	1.9	0.2	0.3	0.1	0.0	0.0	0.0	2009
1	0.0	12.4	1.2	0.0	0.0	0.0	0.0	0.0	2010
1	0.0	6.5	5.9	0.3	0.0	0.0	0.0	0.0	2011
1	0.0	0.8	2.5	1.3	0.4	0.0	0.0	0.0	2012

IR - GFS : Irish Groundfish Survey (IBTS 4th Qtr) - VIIj Cod number at age (Effort Standardised to 1hr)									
2003	2011								
1	1	0.79	0.92						
0	7								
1	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0	2003
1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2004
1	0.0	1.8	0.0	0.1	0.0	0.0	0.0	0.0	2005
1	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	2006
1	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	2007
1	0.0	0.1	0.3	0.1	0.0	0.0	0.0	0.0	2008
1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2009
1	0.2	3.5	0.2	0.0	0.1	0.0	0.0	0.0	2010
1	0.0	0.9	1.8	0.1	0.1	0.0	0.0	0.0	2011
1	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	2012

FR-EVHOE Groundfish Oct-Nov survey in VIIf,g,h,j, numbers per 30 mn

1997	2012						
1	1	0.75	1				
1	6						
1	0.213	0.095	0.246	0.117	0.048	0	1997
1	0.212	0.52	0.207	0.045	0.045	0	1998
1	0.155	0.184	0.283	0.015	0.03	0.015	1999
1	1.046	0.041	0.118	0.064	0.013	0	2000
1	0.716	0.18	0.029	0.038	0.018	0.007	2001
1	0.033	0.313	0.148	0	0.015	0	2002
1	0.052	0.041	0.142	0.061	0.008	0	2003
1	0.066	0.144	0.072	0.122	0.046	0	2004
1	0.255	0.12	0.055	0	0.026	0	2005
1	0.125	0.139	0	0.048	0.045	0	2006
1	0.321	0.206	0.117	0.033	0	0	2007
1	0.217	0.141	0.117	0.096	0	0	2008
1	0.237	0.092	0.132	0.078	0	0.023	2009
1	1.805	0.21	0.028	0.094	0	0	2010
1	0.792	1.119	0.095	0.031	0.011	0	2011
1	0.063	0.416	0.529	0.025	0	0	2012

Table 7.2.7a. Cod in Divisions VIIe–k. Time-series of landings, effort, lpue and highgrading for the French gadoid, *Nephrops*, otter trawlers fleet (time-series discontinued in 2009), OT-DEF fleets (2000–ongoing –tuning fleet used in the assessment).

	France											
	Fr gadoid trawlers VIIfgh			Fr *Nephrops* trawlers VIIfgh			Fr Otter trawlers VIIe–k			Fr Otter trawlers VII e		
Year	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue
1978	Q2+Q3+Q4 for			Q2+Q3+Q4 for								
1979	consistency with			consistency with			includes Fr gadoid trawlers and					
1980	box closure			box closure			Fr Nephrops trawlers					
1981	during Q1 2005			during Q1 2005								
1982	and Feb–March 2006 to 2008			and Feb–March 2006 to 2008								
1983	1453	75.0	19.4	630	190.5	3.3	5443	904.3	6.0	472	210.6	2.2
1984	2002	60.6	33.1	671	170.5	3.9	4881	654.9	7.5	189	118.4	1.6
1985	1667	73.4	22.7	1023	150.7	6.8	6262	847.6	7.4	351	154.1	2.3
1986	2086	85.3	24.5	774	132.6	5.8	8046	932.0	8.6	431	220.4	2.0
1987	2804	107.8	26.0	778	145.7	5.3	8215	886.0	9.3	835	167.6	5.0
1988	6243	184.4	33.9	1726	144.1	12.0	13739	963.6	14.3	1320	199.4	6.6
1989	5171	166.3	31.1	1496	157.7	9.5	15715	1066.0	14.7	983	217.4	4.5
1990	3045	155.2	19.6	1138	206.3	5.5	9018	1073.3	8.4	383	198.6	1.9
1991	2096	127.1	16.5	690	186.2	3.7	5878	1013.2	5.8	335	177.7	1.9
1992	2304	133.0	17.3	1223	226.2	5.4	6709	1060.6	6.3	325	179.1	1.8
1993	2566	155.5	16.5	1236	205.3	6.0	8302	1095.6	7.6	295	238.4	1.2
1994	1725	121.8	14.2	1245	225.1	5.5	7353	959.7	7.7	306	185.1	1.7
1995	2598	128.2	20.3	1606	200.5	8.0	8248	1010.8	8.2	520	215.2	2.4
1996	2455	123.0	20.0	1450	181.6	8.0	8667	954.6	9.1	460	188.5	2.4
1997	2830	168.2	16.8	1246	152.6	8.2	8307	1057.5	7.9	584	258.3	2.3
1998	1707	139.3	12.3	805	111.1	7.2	5765	743.383*	7.76*	150*	28.2*	5.33*
1999	1271	138.8	9.2	546	114.6	4.8	5445	1047.3	5.2	647	298.4	2.2
2000	938	115.3	8.1	711	125.3	5.7	4254	1051.9	4.0	542	312.5	1.7
2001	1911	138.5	13.8	916	141.7	6.5	5957	1010.4	5.9	584	281.3	2.1
2002	2412	121.8	19.8	1083	147.6	7.3	7389	974.8	7.6	654	317.4	2.1
2003	1110	92.0	12.1	972	169.9	5.7	5157	1025.7	5.0	619	366.2	1.7
2004	469	83.1	5.6	462	128.2	3.6	2379	952.1	2.4	193	353.6	0.5
2005	483	79.1	6.1	343	113.3	3.0	1577	874.2	1.7	239	333.9	0.7
2006	430	55.6	7.7	376	108.3	3.5	1834	866.8	2.1	359	334.8	1.1
2007	678	63.4	10.7	509	85.1	6.0	2438	805.7	3.0	445	311.5	1.4
2008	496	54.0	9.2	445	78.1	5.7	1958	655.3	3.0	399	242.5	1.6
2009 2010	Incomplete datasets/not usable											

Units: landings in Tonnes live weight, Effort in 000s hours fished, lpue in Kg/hour fished.

	Fr gadoid trawlers VIIfgh			Fr *Nephrops* trawlers VIIfgh			Fr Otter trawlers VIIe-k		
	Landings	**Effort**	**lpue**	**Landings**	**Effort**	**lpue**	**Landings**	**Effort**	**lpue**
FR- High-grading input									
2003	1155	92.0	12.6	1011	169.9	6.0	5367	1025.7	5.2
2004	498	83.1	6.0	491	128.2	3.8	2527	952.1	2.7
2005	506	79.1	6.4	359	113.3	3.2	1651	874.2	1.9
2006	548	55.6	9.8	465	108.3	4.3	2229	866.8	2.6
2007	886	63.4	14.0	630	85.1	7.4	2995	805.7	3.7
2008	591	54.0	11.0	534	78.1	6.8	2284	655.3	3.5
2009 2010	Incomplete datasets/not usable								

	French OTDEF fleets VIIe-k Q2-Q4 (2000-ongoing)		
Year	**Effort**	**Landings**	**lpue**
2000	217 480	1 360 798	6.3
2001	223 428	2 297 415	10.3
2002	191 161	2 521 943	13.2
2003	184 878	1 594 331	8.6
2004	164 607	693 554	4.2
2005	132 472	589 933	4.5
2006	117 259	571 192	4.9
2007	115 878	816 211	7.0
2008	113 485	652 236	5.7
2009	113 348	550 406	4.9
2010	100 332	635 002	6.3
2011	101 251	925 373	9.1
2012	124 404	2 518 810	20.2

Table 7.2.7b. Cod in DivisionsVIIe–k. Time-series of landings, effort and lpue for the Irish fleets. Units: landings in tonnes live weight, Effort in 000s hours fished, lpue in Kg/hour fished.

	IRELAND			IRELAND			IRELAND			IRELAND		
	Ir OttertrawlersVIIj			Ir BeamtrawlersVIIj			Ir Scottish seinersVIIj			Ir GillnetVIIj		
	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue
1995	338.5	93.7	3.6	0.1	0.2	0.2	75.5	5.3	14.4	179.6	21.3	8.4
1996	326.4	70.2	4.6	8.7	1.5	5.9	124.5	8.2	15.3	65.0	5.2	12.4
1997	352.8	83.2	4.2	3.4	1.8	1.9	115.8	10.7	10.8	45.5	8.3	5.5
1998	262.3	89.6	2.9	19.2	5.2	3.7	103.4	6.6	15.6	59.1	16.0	3.7
1999	76.7	40.6	1.9	27.6	7.4	3.7	9.6	1.4	6.8	25.0	8.7	2.9
2000	95.5	64.6	1.5	21.2	6.9	3.1	23.7	3.5	6.8	14.0	7.2	2.0
2001	140.4	67.7	2.1	10.4	3.0	3.5	28.0	4.4	6.3	12.7	6.6	1.9
2002	150.1	90.4	1.7	5.4	3.1	1.7	24.7	8.9	2.8	12.3	8.1	1.5
2003	78.5	111.3	0.7	8.8	9.0	1.0	14.7	9.2	1.6	6.2	11.1	0.6
2004	36.1	92.0	0.4	2.5	2.2	1.2	11.6	9.2	1.3	4.2	6.1	0.7
2005	40.6	73.9	0.5	4.7	2.4	1.9	17.8	6.1	2.9	3.3	6.3	0.5
2006	42.7	65.9	0.6	2.0	1.5	1.3	15.6	5.3	2.9	7.2	7.3	1.0
2007	39.0	80.5	0.5	7.8	2.4	3.3	9.8	3.5	2.8	6.5	10.5	0.6
2008	33.5	66.5	0.5	2.6	1.1	2.3	9.5	2.8	3.3	6.5	7.9	0.8
2009	26.6	73.1	0.4	4.7	2.8	1.7	8.9	3.3	2.7	8.0	10.9	0.7
2010	52.5	85.5	0.6	1.7	1.0	1.7	17.0	4.4	3.9	8.4	9.4	0.9
2011	57.7	62.6	0.9	1.7	0.6	2.7	21.6	4.6	4.7	16.8	8.0	2.1
2012	62.6	65.5	1.0	0.4	0.3	1.5	29.8	5.4	5.6	25.1	8.2	3.0

	IRELAND			IRELAND			IRELAND			IRELAND		
	Ir OttertrawlersVIIg			Ir BeamtrawlersVIIg			Ir Scottish seinersVIIg			Ir GillnetVIIg		
	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue	Landings	Effort	lpue
1995	429.9	63.6	6.8	85.8	20.8	4.1	111.3	6.4	17.3	114.9	6.3425	18.1
1996	569.3	60.0	9.5	112.6	26.8	4.2	164.9	9.7	16.9	338.8	6.2245	54.4
1997	401.9	65.1	6.2	131.6	28.3	4.7	215.2	16.1	13.3	52.8	1.9	27.7
1998	450.6	72.3	6.2	166.9	35.3	4.7	264.1	14.9	17.7	87.3	3.5	24.8
1999	300.9	51.7	5.8	190.6	40.9	4.7	64.6	8.0	8.1	211.9	8.3795	25.3
2000	279.4	60.6	4.6	180.7	37.0	4.9	106.0	9.9	10.7	157.0	10.1420	15.48
2001	339.5	69.4	4.9	96.6	39.7	2.4	111.1	16.3	6.8	108.0	8.7678	12.3
2002	213.0	77.7	2.7	57.9	31.6	1.8	70.8	20.9	3.4	34.7	7.7	4.5
2003	167.4	86.8	1.9	57.1	49.3	1.2	38.1	20.9	1.8	31.3	11.1	2.82
2004	190.2	97.0	2.0	74.3	54.9	1.4	54.9	19.4	2.8	62.0	13.5	4.59
2005	294.9	124.4	2.4	118.7	49.7	2.4	66.1	14.8	4.5	77.7	10.9	7.14
2006	390.0	119.2	3.3	128.6	60.5	2.1	91.0	14.8	6.2	63.7	7.8	8.1
2007	323.0	136.5	2.4	96.2	55.9	1.8	58.5	15.8	3.7	85.4	9.4	9.1
2008	349.9	125.8	2.8	85.4	37.2	2.3	55.6	11.7	4.8	88.0	14.1	6.24
2009	405.9	137.1	3.0	74.4	38.0	2.0	34.6	8.2	4.2	81.1	13.8	5.86
2010	524.8	140.8	3.7	94.7	40.2	2.4	54.3	9.7	5.6	76.0	14.0	5.42
2011	438.4	120.1	3.7	82.5	35.3	2.3	60.1	14.6	4.1	76.6	11.4	6.75
2012	775.6	126.2	6.1	161.9	40.3	4.0	114.6	14.4	8.0	129.1	15.4	8.4

Table 7.2.7c. Cod in Divisions VIIe–k. Time-series of landings, effort and lpue for the UK fleets. Units: landings in tonnes live weight, Effort in 000s hours fished, lpue in Kg/hour fished.

	UNITED KINGDOM (ENGLAND + WALES)								
	UK OTTER TRAWLERS VIIE–K			UK BEAM TRAWLERS VIIE–K			UKOTTERTRAWLERS VIIE		
YEAR	LANDINGS	EFFORT	LPUE	LANDINGS	EFFORT	LPUE	LANDINGS	EFFORT	LPUE
1972	355.1	117.1	3.0				80.4	64.6	1.2
1973	222.7	118.5	1.9				57.6	69.5	0.8
1974	191.5	91.6	2.1				55.1	50.1	1.1
1975	136.0	100.3	1.4				38.2	54.7	0.7
1976	96.6	88.2	1.1				31.7	56.1	0.6
1977	118.6	88.5	1.3				78.3	55.4	1.4
1978	116.3	83.2	1.4	6.4	24.7	0.3	70.2	48.8	1.4
1979	130.0	73.5	1.8	13.8	44.0	0.3	73.7	49.9	1.5
1980	227.6	85.6	2.7	38.8	76.7	0.5	83.6	50.0	1.7
1981	323.6	104.3	3.1	62.9	87.6	0.7	76.0	46.9	1.6
1982	361.9	104.7	3.5	84.4	115.0	0.7	65.2	38.5	1.7
1983	163.3	82.1	2.0	84.0	135.3	0.6	73.1	52.6	1.4
1984	236.9	86.7	2.7	128.6	131.5	1.0	76.8	52.9	1.5
1985	249.4	90.3	2.8	145.1	152.5	1.0	64.1	57.7	1.1
1986	233.2	84.7	2.8	163.7	135.7	1.2	80.2	49.5	1.6
1987	221.4	84.3	2.6	246.4	177.1	1.4	95.7	45.1	2.1
1988	270.1	89.1	3.0	248.2	194.9	1.3	155.3	53.4	2.9
1989	186.2	84.1	2.2	230.4	198.2	1.2	105.0	54.7	1.9
1990	314.4	99.5	3.2	307.3	207.6	1.5	128.0	53.1	2.4
1991	242.7	76.7	3.2	257.6	203.2	1.3	83.6	40.8	2.0
1992	232.1	86.4	2.7	256.0	196.1	1.3	80.6	39.9	2.0
1993	181.1	61.9	2.9	220.4	208.4	1.1	42.7	39.2	1.1
1994	78.7	53.7	1.5	173.9	220.0	0.8	41.4	38.8	1.1
1995	114.9	52.3	2.2	238.8	243.1	1.0	55.0	35.5	1.5
1996	119.9	60.5	2.0	303.1	260.8	1.2	59.2	30.5	1.9
1997	148.8	66.7	2.2	299.2	264.8	1.1	79.2	33.3	2.4
1998	119.2	62.1	1.9	265.1	254.6	1.0	62.3	29.8	2.1
1999	90.4	98.4	0.9	256.7	251.4	1.0	46.5	27.5	1.7
2000	110.6	104.1	1.1	187.3	259.0	0.7	52.4	30.5	1.7
2001	109.5	85.3	1.3	256.2	272.7	0.9	59.0	31.9	1.8
2002	79.7	82.7	1.0	129.9	249.5	0.5	33.9	28.3	1.2
2003	58.0	72.3	0.8	103.0	282.1	0.4	23.9	25.1	1.0
2004	44.0	75.7	0.6	96.0	273.9	0.4	15.0	25.6	0.6
2005	41.0	76.4	0.5	102.0	270.3	0.4	17.2	21.1	0.8
2006	55.2	83.3	0.7	90.9	252.0	0.4	13.5	21.1	0.6
2007	49.5	87.6	0.6	110.9	239.9	0.5	21.5	22.4	1.0
2008	49.2	71.2	0.7	70.9	216.9	0.3	24.2	19.9	1.2
2009	27.5	73.8	0.4	67.1	190.9	0.4	12.5	21.4	0.6
2010	31.0	77.6	0.4	65.3	195.9	0.3	15.2	26.1	0.6

	UNITED KINGDOM (ENGLAND + WALES)								
	UK OTTER TRAWLERS VIIE–K			UK BEAM TRAWLERS VIIE–K			UKOTTERTRAWLERS VIIE		
YEAR	LANDINGS	EFFORT	LPUE	LANDINGS	EFFORT	LPUE	LANDINGS	EFFORT	LPUE
2011	47.6	66.9	0.7	98.7	231.1	0.4	25.8	25.2	1.0
2012	62.61	56.772	1.1	77.86	172.52	0.5	27.809	25.64	1.1

Units:landings in Tonnes live weight, Effort in 000s hours fished, lpue in Kg/hour fished.

Table 7.2.8. Cod in Divisions VIIe–k. Tuning indices used for exploratory XSA.

Cod in Divisions VIIe–k, tuning fleets,WGCSE10

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FR-OTDEF Q2+3+4 trawlers in VIIe–k

2000	2012									
1	1	0.25	1							
1	10									
217479	200742	93804	59384	35784	11253	5683	3988	545	356	0
223427	119879	383175	45401	44844	34907	11427	5256	2109	0	0
191161	188306	472476	144332	38748	16046	9760	4317	4212	252	0
184878	22380	134512	138065	59698	7928	7313	4455	847	424	0
164606	12412	54908	41644	21032	13420	1720	208	0	0	208
132472	13489	132632	10525	6207	8814	2861	367	54	237	0
117259	24447	148506	27730	3716	1912	1282	845	0	0	0
115878	265362	409573	76766	13367	2099	684	818	235	60	0
113485	77385	252690	44372	16057	4178	624	236	447	0	8
113348	106600	58211	46807	14017	5042	1939	894	353	0	19
100332	206831	103580	15881	8766	4600	678	102	0	17	0
101251	6870	1145981	92577	22801	17131	3074	551	0	0	0
124404	2709	108920	463339	109825	12257	6173	1939	176	1329	0

IR-GFS FR-EVHOE Q4 combined indices

2003	2012						
1	1	0.79	0.92				
0	6						
1	0.0	9.9	13.8	14.4	3.6	0.0	0.0
1	3.0	18.7	7.7	3.5	4.8	2.3	0.0
1	1.3	48.3	5.8	2.9	0.0	0.0	0.0
1	1.0	31.6	15.2	2.5	0.0	0.0	0.5
1	0.0	55.0	16.8	7.4	1.5	0.0	0.0
1	0.0	19.0	23.4	6.4	3.2	0.0	0.0
1	1.1	45.8	5.5	6.9	2.7	0.0	0.3
1	2.1	254.8	26.9	2.6	2.7	4.4	0.0
1	0.0	69.8	16.1	7.1	2.8	1.1	0.1
1	0.0	10.7	43.2	30.2	6.4	2.0	0.0

Table 7.2.9. Cod in Divisions VIIe–k. Final XSA.diagnostics.

Lowestoft VPA Version 3.1
15/05/2013 14:54
Extended Survivors Analysis
Cod in Divisions VIIe–k,WKROUND2012,index file
CPUE data from file fleets-xsa-final.txt
Catch data for 42 years. 1971 to 2012.Ages 1 to 7.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FR-OTDEF Q2+3+4 traw,	2000,	2012,	1,	6,	.250,	1.000
IR-GFS FR-EVHOE Q4 c,	2003,	2012,	0,	6,	.790,	.920

Time-series weights :
Tapered time weighting not applied
Catchabilityanalysis:
Catchability independent of stock size for all ages
Catchability independent of age for ages >= 3

Terminal population estimation:
Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.
S.E. of the mean to which the estimates are shrunk = 1.000
Minimum standard error for population
estimates derived from each fleet = .300
Prior weighting not applied
Tuning converged after 24 iterations

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Fishing mortalities

Age,	2003,	2004,	2005,	2006,	2007,	2008,	2009,	2010,	2011,	2012
1,	.108,	.162,	.096,	.109,	.175,	.100,	.057,	.040,	.467,	.063
2,	.870,	.714,	.759,	.747,	.927,	.626,	.469,	.281,	.471,	.354
3,	1.215,	.944,	1.125,	.907,	1.019,	.767,	.719,	.451,	.278,	.444
4,	1.026,	1.024,	.971,	.696,	.643,	.873,	.639,	.500,	.391,	.515
5,	.541,	.993,	.965,	.847,	.633,	.629,	1.081,	.707,	.350,	.371
6,	.264,	.667,	.516,	.908,	.662,	.690,	.623,	.922,	.328,	.265

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
2003	1.30E+03	1.15E+03	1.37E+03	3.87E+02	4.06E+01	4.36E+01
2004	2.94E+03	7.02E+02	3.34E+02	3.00E+02	1.06E+02	1.85E+01
2005	4.17E+03	1.50E+03	2.38E+02	9.58E+01	8.23E+01	3.07E+01
2006	4.61E+03	2.27E+03	4.86E+02	5.70E+01	2.77E+01	2.45E+01
2007	3.95E+03	2.48E+03	7.45E+02	1.45E+02	2.17E+01	9.28E+00
2008	1.67E+03	1.99E+03	6.78E+02	1.98E+02	5.82E+01	9.01E+00
2009	3.76E+03	9.03E+02	7.36E+02	2.33E+02	6.34E+01	2.42E+01
2010	1.76E+04	2.13E+03	3.91E+02	2.65E+02	9.38E+01	1.68E+01
2011	5.25E+03	1.01E+04	1.11E+03	1.84E+02	1.23E+02	3.61E+01
2012	7.38E+02	1.97E+03	4.37E+03	6.22E+02	9.49E+01	6.75E+01

Estimated population abundance at 1st Jan 2013

	0.00E+00	4.15E+02	9.59E+02	2.07E+03	2.84E+02	5.12E+01

Taper weighted geometric mean of the VPA populations:

	4.63E+03	2.47E+03	8.88E+02	2.97E+02	1.09E+02	4.39E+01

Standard error of the weighted Log(VPA populations):

	.8167	.7547	.7337	.6226	.6222	.6632

1

Log catchability residuals.

Fleet : FR-OTDEF Q2+3+4 traw

Age	2000	2001	2002
1	.04	-.35	1.63
2	-.33	-.52	-.02
3	-.43	.00	.01
4	-.40	.31	1.06
5	-.49	.50	.27
6	.02	.23	.07

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	.04	-1.21	-1.30	-.68	1.91	1.52	1.00	.24	-1.72	-1.13
2	.14	-.23	.13	-.05	.99	.57	-.19	-.47	.48	-.51
3	.20	.38	-.34	-.09	.58	.00	-.05	-.53	.07	.20
4	.50	-.17	-.07	-.10	.23	.26	-.17	-.73	.52	.74
5	.44	.39	.42	.04	.26	-.02	.35	-.23	.60	.33
6	.12	-.12	.01	-.21	.00	-.03	.08	-.31	.08	-.09

Mean log catchability and standard error of ages with catchability independent of year-class strength and constant w.r.t. time

Age ,	1,	2,	3,	4,	5,	6
Mean Log q,	-8.9480,	-6.7707,	-6.8182,	-6.8182,	-6.8182,	-6.8182,
S.E(Log q),	1.2140,	.4588,	.3117,	.5142,	.3857,	.1441,

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Regs.e,	Mean Q
1,	1.08,	-.175,	9.01,	.31,	13,	1.37,	-8.95,
2,	.88,	.790,	6.88,	.79,	13,	.41,	-6.77,
3,	.89,	1.134,	6.79,	.90,	13,	.27,	-6.82,
4,	.98,	.094,	6.64,	.64,	13,	.50,	-6.67,
5,	.98,	.130,	6.55,	.79,	13,	.32,	-6.60,
6,	.92,	1.508,	6.54,	.97,	13,	.13,	-6.83,

1

Fleet : IR-GFS FR-EVHOE Q4 c

Age ,	2003,	2004,	2005,	2006,	2007,	2008,	2009,	2010,	2011,	2012
1 ,	-.37,	-.51,	.04,	-.47,	.29,	.03,	.05,	.22,	.49,	.24
2 ,	.66,	.43,	-.57,	-.03,	.13,	.43,	-.36,	.20,	-1.70,	.82
3 ,	.59,	.35,	.66,	-.39,	.36,	.10,	.05,	-.52,	-.71,	-.49
4 ,	.27,	.82,	99.99,	99.99,	.06,	.69,	.17,	-.08,	.23,	-.06
5 ,	99.99,	1.07,	99.99,	99.99,	99.99,	99.99,	99.99,	1.60,	-.36,	.51
6 ,	99.99,	99.99,	99.99,	.93,	99.99,	99.99,	.19,	99.99,	-1.56,	99.99

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age ,	1,	2,	3,	4,	5,	6
Mean Log q,	-3.9773,	-4.0217,	-3.8461,	-3.8461,	-3.8461,	-3.8461,
S.E(Log q),	.3424,	.7374,	.4968,	.4335,	1.1708,	1.2933,

Regression statistics:

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Regs.e	Mean Q
1,	.93,	.574,	4.28,	.89,	10,	.33,	-3.98,
2,	2.87,	-2.370,	-2.53,	.17,	10,	1.72,	-4.02,
3,	1.28,	-1.094,	3.09,	.66,	10,	.63,	-3.85,
4,	1.13,	-.411,	3.32,	.61,	8,	.40,	-3.58,
5,	-.24,	-1.745,	5.00,	.50,	4,	.15,	-3.14,
6,	-.23,	-3.046,	3.17,	.86,	3,	.13,	-4.00,

1

Terminal year survivor and F summaries:

Age 1Catchability constant w.r.t. time and dependent on age
Year class = 2011

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FR-OTDEF Q2+3+4 traw,	134.,	1.260,	.000,	.00,	1,	.067,	.184
IR-GFS FR-EVHOE Q4 c,	525.,	.359,	.000,	.00,	1,	.821,	.050
F shrinkage mean ,	146.,	1.00,,,,				.113,	.171

Weighted prediction:

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
415.,	.33,	.37,	3,	1.129,	.063

Age 2Catchability constant w.r.t. time and dependent on age
Year class = 2010

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FR-OTDEF Q2+3+4 traw,	521.,	.449,	.332,	.74,	2,	.377,	.577
IR-GFS FR-EVHOE Q4 c,	1705.,	.333,	.141,	.42,	2,	.512,	.214
F shrinkage mean ,	537.,	1.00,,,,				.112,	.564

Weighted prediction:

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
959.,	.26,	.32,	5,	1.202,	.354

Age 3Catchability constant w.r.t. time and dependent on age
Year class = 2009

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FR-OTDEF Q2+3+4 traw,	2700.,	.267,	.081,	.30,	3,	.537,	.356
IR-GFS FR-EVHOE Q4 c,	1572.,	.285,	.427,	1.50,	3,	.397,	.551

F shrinkage mean , 1246., 1.00,,,, .066, .656

Weighted prediction:

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2070.,	.19,	.20,	7,	1.026,	.444

Age 4Catchability constant w.r.t. time and age (fixed at the value for age) 3
Year class = 2008

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FR-OTDEF Q2+3+4 traw,	335.,	.239,	.245,	1.02,	4,	.487,	.452
IR-GFS FR-EVHOE Q4 c,	246.,	.245,	.179,	.73,	4,	.453,	.576

F shrinkage mean , 224., 1.00,,,, .060, .617

Weighted prediction:

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
284.,	.17,	.14,	9,	.817,	.515

Age 5Catchability constant w.r.t. time and age (fixed at the value for age) 3
Year class = 2007

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FR-OTDEF Q2+3+4 traw,	55.,	.224,	.223,	.99,	5,	.606,	.348
IR-GFS FR-EVHOE Q4 c,	52.,	.260,	.162,	.62,	5,	.332,	.368

F shrinkage mean , 23., 1.00,,,, .062, .688

Weighted prediction:

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
51.,	.17,	.14,	11,	.820,	.371

Age 6Catchability constant w.r.t. time and age (fixed at the value for age) 3
Year class = 2006

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FR-OTDEF Q2+3+4 traw,	43.,	.200,	.170,	.85,	6,	.783,	.256
IR-GFS FR-EVHOE Q4 c,	41.,	.288,	.100,	.35,	5,	.165,	.264

F shrinkage mean , 22., 1.00,,,, .052, .447

Weighted prediction:

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
41.,	.17,	.11,	12,	.660,	.265

Table 7.2.10. Cod in Divisions VIIe–k. Final XSA.Fishing mortality-at-age.

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE											
1	0.2183	0.0056	0.1656	0.0015	0.1559	0.0337	0.0113	0.0975	0.0894	0.0666	0.0824
2	0.6839	0.5183	0.7318	0.209	0.3674	0.8366	0.5702	0.4326	0.3401	0.5141	0.78
3	0.6335	0.3972	0.5532	0.2912	0.3129	0.3267	0.3521	0.4058	0.5122	0.6024	0.991
4	0.5485	0.5681	0.4373	0.4088	1.1602	0.3327	0.1353	0.3234	0.4328	0.8985	0.8938
5	0.3581	0.5857	0.4422	0.5971	0.8714	0.716	0.3376	0.2876	0.5853	0.7681	0.5825
6	0.5182	0.5219	0.4819	0.4361	0.7909	0.4625	0.2768	0.3415	0.5149	0.7652	0.8325
+gp	0.5182	0.5219	0.4819	0.4361	0.7909	0.4625	0.2768	0.3415	0.5149	0.7652	0.8325
0 FBAR 2–5	0.556	0.5173	0.5411	0.3765	0.678	0.553	0.3488	0.3624	0.4676	0.6958	0.8118

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE											
1	0.0475	0.2743	0.1535	0.173	0.1828	0.1499	0.2141	0.2676	0.1221	0.1702	0.1717
2	0.673	0.7465	0.619	0.5713	0.747	0.6025	0.6901	0.7646	0.9293	0.8653	0.7859
3	0.6457	0.9862	0.4998	0.6179	0.8743	0.7645	0.4964	1.0063	0.948	0.8688	0.948
4	0.6351	0.8604	0.5144	0.4993	0.9728	1.1753	0.6048	0.5085	0.9601	1.1727	0.7239
5	0.5796	0.7406	0.4966	0.4447	0.5315	0.7336	0.7619	0.9745	0.6066	1.0183	0.9479
6	0.6267	0.8732	0.5083	0.5256	0.8024	0.9025	0.6276	0.84	0.8486	1.0338	0.8843
+gp	0.6267	0.8732	0.5083	0.5256	0.8024	0.9025	0.6276	0.84	0.8486	1.0338	0.8843
0 FBAR 2–5	0.6333	0.8334	0.5325	0.5333	0.7814	0.8189	0.6383	0.8135	0.861	0.9813	0.8514

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE											
1	0.1004	0.1348	0.1162	0.113	0.1651	0.1783	0.3158	0.2289	0.1732	0.1322	0.1076
2	0.6558	0.5348	0.8099	0.739	0.8273	0.9141	0.779	0.7753	0.8205	0.8141	0.87
3	0.907	1.0662	0.5857	0.9958	1.0427	0.9608	0.9709	0.9313	0.6547	1.0852	1.2147
4	0.7042	0.7915	0.9182	0.6132	0.8279	1.0594	0.7545	0.67	0.652	0.866	1.0257
5	0.7249	0.6018	0.5833	1.054	0.4982	0.8118	0.8361	0.521	0.7166	0.5121	0.5411
6	0.788	0.8299	0.7036	0.899	0.7991	0.9564	0.8645	0.6518	0.4705	0.2591	0.2638
+gp	0.788	0.8299	0.7036	0.899	0.7991	0.9564	0.8645	0.6518	0.4705	0.2591	0.2638
0 FBAR 2–5	0.748	0.7486	0.7243	0.8505	0.799	0.9365	0.8351	0.7244	0.711	0.8194	0.9129

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	FBAR	
AGE											
1	0.1621	0.0958	0.1089	0.175	0.1003	0.0568	0.0399	0.4667	0.0633	0.1899	
2	0.7139	0.7591	0.7466	0.9269	0.6256	0.4687	0.2808	0.4705	0.3536	0.3683	
3	0.9438	1.1245	0.9072	1.019	0.7666	0.7187	0.4514	0.2778	0.4437	0.391	
4	1.0243	0.9707	0.6962	0.6426	0.8728	0.6391	0.4998	0.3914	0.515	0.4687	
5	0.9933	0.9648	0.8472	0.6326	0.6287	1.081	0.7066	0.3498	0.371	0.4758	
6	0.6669	0.5157	0.9076	0.6621	0.6904	0.6229	0.9219	0.3282	0.2651	0.5051	
+gp	0.6669	0.5157	0.9076	0.6621	0.6904	0.6229	0.9219	0.3282	0.2651		
0 FBAR 2–5	0.9188	0.9548	0.7993	0.8053	0.7234	0.7269	0.4847	0.3724	0.4208		

Table 7.2.11. Cod in Divisions VIIe–k.Final XSA.Stock numbers-at-age.

YEAR	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE											
1	4774	929	2810	888	6021	1986	2871	2738	6619	12215	5145
2	1119	2300	554	1427	532	3088	1151	1701	1489	3627	6849
3	1382	391	948	184	802	255	926	450	764	733	1501
4	260	541	194	402	102	432	136	480	221	338	296
5	132	115	234	96	204	24	237	91	266	110	105
6	47	72	50	118	41	67	9	132	53	116	40
+gp	30	46	32	112	66	21	78	76	88	29	23
TOTAL	7744	4394	4822	3228	7768	5873	5406	5669	9499	17168	13960

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE											
1	2115	6918	6690	5904	5034	25442	12267	3664	4047	11364	11740
2	2839	1209	3151	3439	2976	2513	13126	5935	1680	2146	5744
3	2173	1003	397	1174	1344	976	952	4556	1912	459	625
4	411	841	276	178	467	414	335	428	1229	547	142
5	93	167	272	126	82	135	98	140	197	360	129
6	46	41	62	129	63	38	51	36	41	84	101
+gp	12	21	14	41	34	28	19	21	31	24	32
TOTAL	7689	10198	10861	10990	10001	29545	26847	14780	9136	14983	18514

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE											
1	3705	13727	9694	7462	10049	5055	2366	10689	8860	2191	1304
2	5926	2008	7189	5173	3994	5106	2535	1034	5095	4465	1150
3	1812	2129	814	2214	1710	1209	1417	805	330	1552	1369
4	179	540	541	334	603	445	341	396	234	126	387
5	53	68	187	165	138	201	118	123	155	93	41
6	39	20	29	81	45	66	70	40	57	59	44
+gp	32	33	11	7	12	14	27	32	56	53	34
TOTAL	11745	18524	18465	15436	16552	12095	6873	13119	14787	8540	4328

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AGE										
1	2944	4171	4608	3951	1665	3763	17563	5252	738	0
2	702	1500	2271	2477	1988	903	2131	10114	1974	415
3	334	238	486	745	678	736	391	1114	4373	959
4	300	96	57	145	198	233	265	184	622	2070
5	106	82	28	22	58	63	94	123	95	284
6	18	31	24	9	9	24	17	36	68	51
+gp	16	5	9	9	9	5	4	8	33	62

TOTAL	4420	6124	7484	7357	4605	5727	20464	16829	7902	3841

YEAR	GMST	AMST
AGE	71-**	71-**
1	4830	6399
2	2396	3106
3	848	1072
4	295	352
5	110	130
6	44	53
+gp		
TOTAL		

Table 7.2.12 Cod in Divisions VIIe–k. Final XSA Summary table.

	RECRUITMENT	SSB	CATCH	LANDINGS	TSB	FBAR2-5	Y/SSB
1971	4774	10100	5782	5782	15358	0.556	0.57
1972	929	9314	4737	4737	12830	0.517	0.51
1973	2810	8625	4015	4015	11710	0.541	0.47
1974	888	8330	2898	2898	10719	0.377	0.35
1975	6021	7518	3993	3993	12574	0.678	0.53
1976	1986	7307	4818	4818	12209	0.553	0.66
1977	2871	8839	3059	3059	12543	0.349	0.35
1978	2738	9688	3647	3647	13780	0.362	0.38
1979	6619	9835	4650	4650	16323	0.468	0.47
1980	12215	10329	7243	7243	22794	0.696	0.7
1981	5145	11177	10597	10597	20623	0.812	0.95
1982	2115	13451	8766	8766	18826	0.633	0.65
1983	6918	13004	9641	9641	18539	0.833	0.74
1984	6690	9568	6631	6631	17142	0.532	0.69
1985	5904	13082	8317	8317	21773	0.533	0.64
1986	5034	13752	10475	10475	21028	0.781	0.76
1987	25442	11472	10228	10228	28586	0.819	0.89
1988	12267	16629	17191	17191	41509	0.638	1.03
1989	3664	26382	19809	19809	37673	0.813	0.75
1990	4047	19240	12749	12749	25249	0.861	0.66
1991	11364	10845	9336	9336	19520	0.981	0.86
1992	11740	9073	9747	9747	21914	0.851	1.07
1993	3705	12278	10425	10425	20979	0.748	0.85
1994	13727	14367	10620	10620	26271	0.749	0.74
1995	9694	13044	11709	11709	26052	0.724	0.9
1996	7462	15953	12681	12681	26467	0.851	0.79
1997	10048	14173	12035	12035	23538	0.799	0.85
1998	5054	12733	11431	11431	19842	0.937	0.9
1999	2366	11234	8594	8594	16411	0.835	0.77
2000	10687	8011	6536	6536	15701	0.725	0.82
2001	8858	9022	8308	8308	19462	0.712	0.92
2002	2190	11257	9236	9236	16410	0.82	0.82
2003	1304	9117	6420	6420	11586	0.915	0.7
2004	2944	4776	3672	3672	7371	0.922	0.77
2005	4171	3502	3062	3062	7665	0.958	0.87
2006	4610	3857	3776	3776	9077	0.8	0.98
2007	3952	5214	4830	4830	10620	0.806	0.93
2008	1657	5603	3961	3961	9266	0.724	0.71
2009	3758	5354	3292	3292	10248	0.727	0.61

	RECRUITMENT	SSB	CATCH	LANDINGS	TSB	FBAR2-5	Y/SSB
2010	17553	5551	3229	3229	22124	0.484	0.58
2011	5244	11726	7261	7261	21871	0.374	0.62
2012	736	20858	7692	7692	25394	0.424	0.37
2013	4830*	21632					
Average	6203	11089	7788	7788	18561	0.696	0.72

Table 7.2.13. Cod in Divisions VIIe–k. Short-term forecast input table.

2013								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4830	0.51	0	0	0	0.733	0.190	0.826
2	415	0.37	0.39	0	0	1.287	0.368	1.796
3	959	0.30	0.87	0	0	4.035	0.391	4.283
4	2070	0.27	0.93	0	0	7.185	0.469	7.369
5	284	0.25	1	0	0	9.900	0.476	9.898
6	51	0.23	1	0	0	11.468	0.505	11.592
7	62	0.22	1	0	0	13.360	0.505	12.601
2014								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4830	0.51	0	0	0	0.733	0.190	0.826
2	.	0.37	0.39	0	0	1.287	0.368	1.796
3	.	0.30	0.87	0	0	4.035	0.391	4.283
4	.	0.27	0.93	0	0	7.185	0.469	7.369
5	.	0.25	1	0	0	9.900	0.476	9.898
6	.	0.23	1	0	0	11.468	0.505	11.592
7	.	0.22	1	0	0	13.360	0.505	12.601
2015								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4830	0.51	0	0	0	0.733	0.190	0.826
2	.	0.37	0.39	0	0	1.287	0.368	1.796
3	.	0.30	0.87	0	0	4.035	0.391	4.283
4	.	0.27	0.93	0	0	7.185	0.469	7.369
5	.	0.25	1	0	0	9.900	0.476	9.898
6	.	0.23	1	0	0	11.468	0.505	11.592
7	.	0.22	1	0	0	13.360	0.505	12.601

Table 7.2.14. Cod in Divisions VIIe–k.Short-term forecast. Single option output table.

Year:	2013	F multiplier:	1	Fbar:	0.426				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.19	659	545	4830	3539	0	0	0	0
2	0.3683	108	194	415	534	162	208	162	208
3	0.391	270	1158	959	3870	834	3367	834	3367
4	0.4687	686	5057	2070	14874	1925	13832	1925	13832
5	0.4758	96	952	284	2812	284	2812	284	2812
6	0.5051	18	211	51	585	51	585	51	585
7	0.5051	22	281	62	828	62	828	62	828
Total		1861	8398	8671	27041	3318	21632	3318	21632

Year:	2014	F multiplier:	1	Fbar:	0.426				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.19	659	545	4830	3539	0	0	0	0
2	0.3683	624	1120	2394	3082	934	1202	934	1202
3	0.391	56	240	199	802	173	698	173	698
4	0.4687	159	1169	479	3439	445	3198	445	3198
5	0.4758	335	3319	990	9799	990	9799	990	9799
6	0.5051	49	571	138	1581	138	1581	138	1581
7	0.5051	20	247	54	728	54	728	54	728
Total		1902	7211	9083	22970	2734	17206	2734	17206

Year:	2015	F multiplier:	1	Fbar:	0.426				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.19	659	545	4830	3539	0	0	0	0
2	0.3683	624	1120	2394	3082	934	1202	934	1202
3	0.391	323	1384	1146	4626	997	4024	997	4024
4	0.4687	33	242	99	713	92	663	92	663
5	0.4758	78	767	229	2266	229	2266	229	2266
6	0.5051	172	1989	480	5510	480	5510	480	5510
7	0.5051	33	419	92	1234	92	1234	92	1234
Total		1922	6466	9271	20968	2825	14899	2825	14899

Input units are thousands and kg - output in tonnes.

Table 7.2.15. Cod in Divisions VIIe–k. Short-term forecast. Management options output.

2013				
Biomass	SSB	FMult	FBar	Landings
27041	21632	1	0.426	8398

2014					2015	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
22970	17206	0	0	0	29537	22782
.	17206	0.1	0.0426	863	28506	21828
.	17206	0.2	0.0852	1691	27518	20916
.	17206	0.3	0.1278	2486	26572	20043
.	17206	0.4	0.1704	3247	25666	19207
.	17206	0.5	0.213	3978	24797	18408
.	17206	0.6	0.2556	4679	23965	17643
.	17206	0.7	0.2982	5352	23167	16911
.	17206	0.8	0.3408	5997	22403	16211
.	17206	0.9	0.3834	6616	21671	15540
.	17206	1	0.426	7211	20968	14899
.	17206	1.1	0.4685	7782	20295	14284
.	17206	1.2	0.5111	8330	19650	13697
.	17206	1.3	0.5537	8856	19031	13134
.	17206	1.4	0.5963	9361	18438	12595
.	17206	1.5	0.6389	9847	17869	12080
.	17206	1.6	0.6815	10313	17324	11586
.	17206	1.7	0.7241	10761	16801	11114
.	17206	1.8	0.7667	11191	16299	10661
.	17206	1.9	0.8093	11605	15818	10228
.	17206	2	0.8519	12002	15356	9813

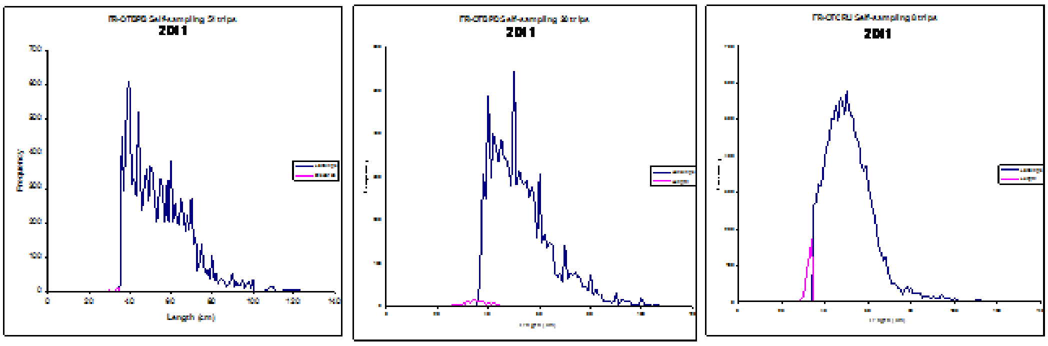


Figure 7.2.1. Annual length compositions of sampling and discards from the French self-sampling programme for 2011.

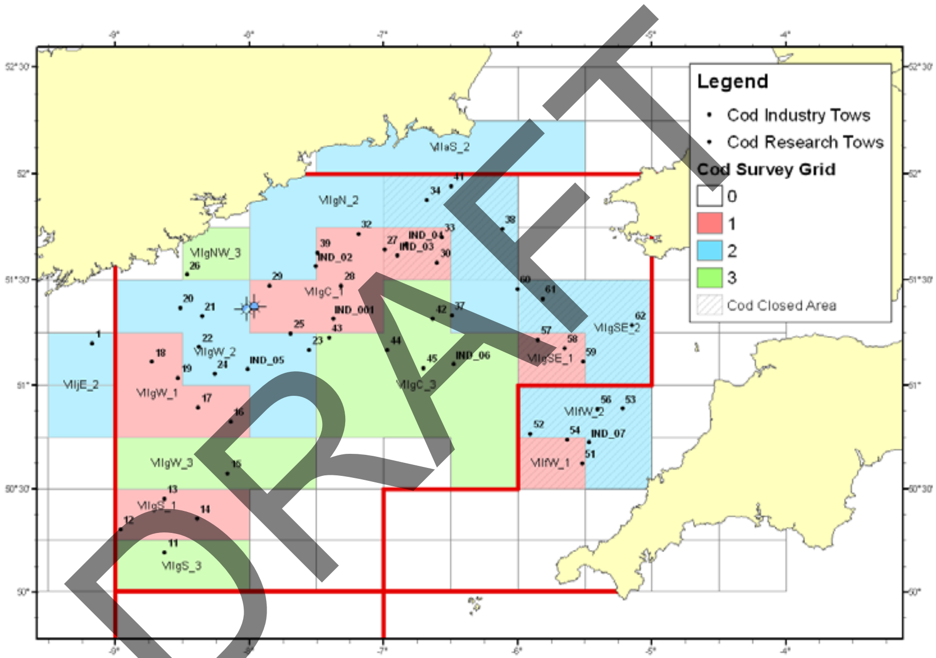


Figure 7.2.2. Irish industry and science survey. Map of sampled stations.

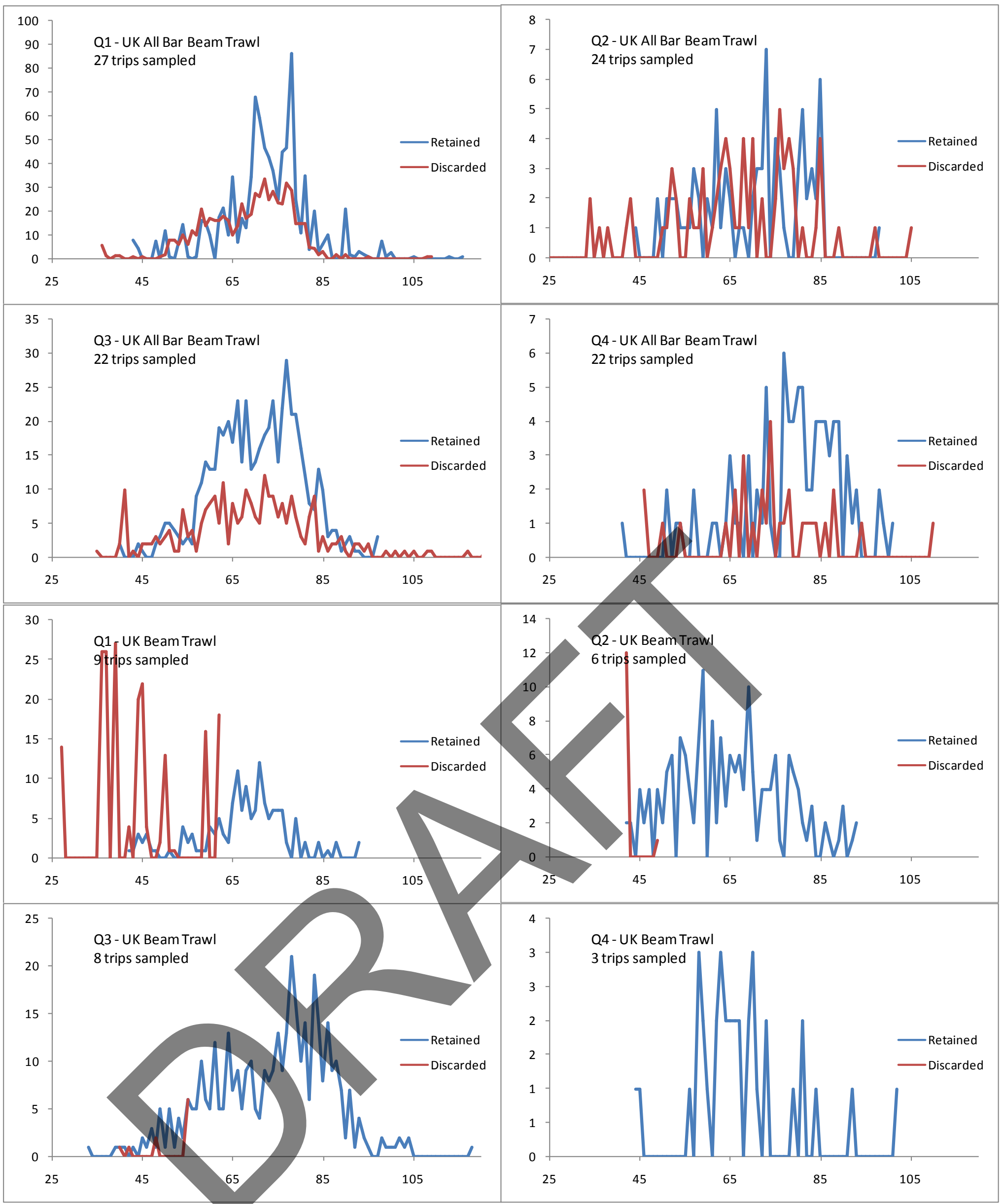


Figure 7.2.3a. Cod in Divisions VIIe–k. 2012 Quarterly length compositions of UK landings and discards from hauls sampled.

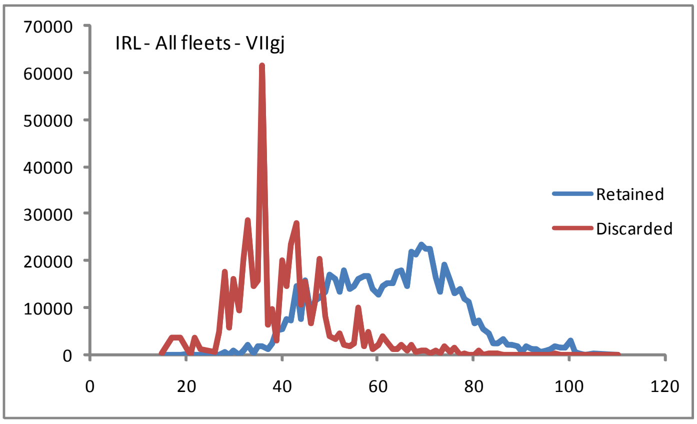


Figure 7.2.3b. Cod in Divisions VIIe–k. 2012 Annual length compositions of Irish landings and discards raised using effort ratio.

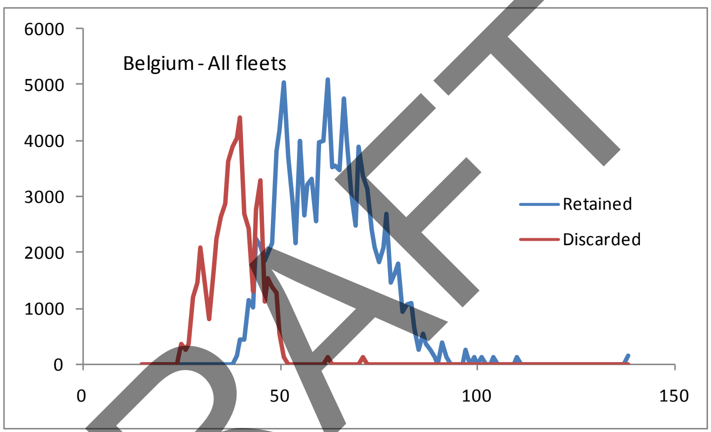


Figure 7.2.3c. Cod in Divisions VIIe–k. 2012 Annual length compositions of Belgian landings and discards from observers at sea.

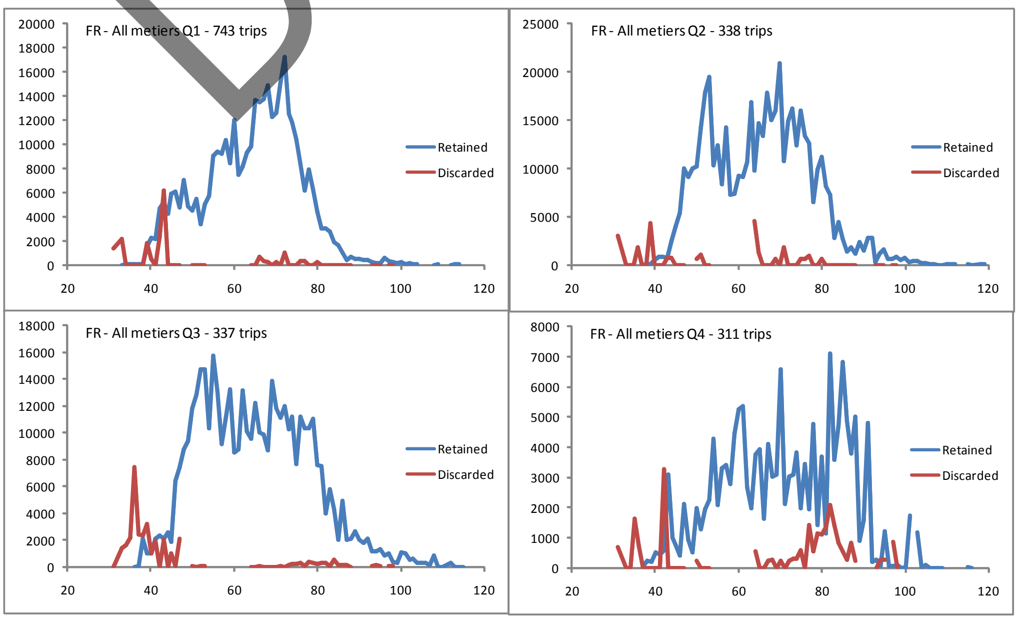


Figure 7.2.3d. Cod in Divisions VIIe–k. 2012 Annual length composition of French landings and discards available from hauls sampled by observers at sea.

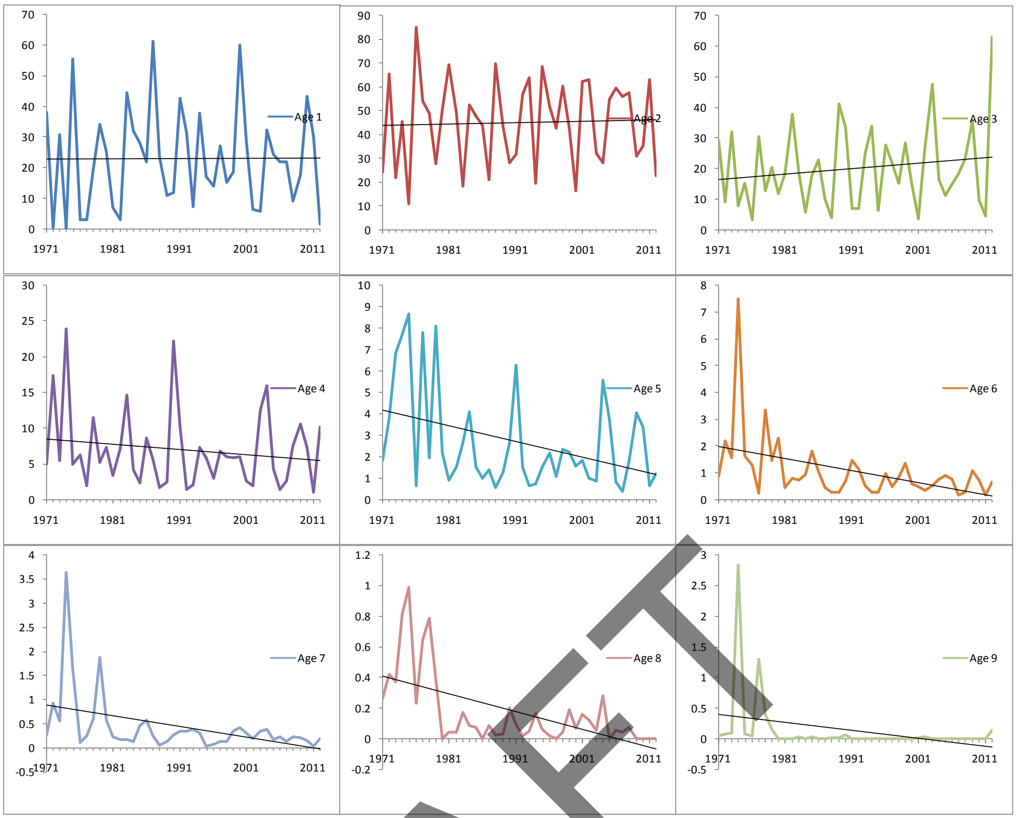
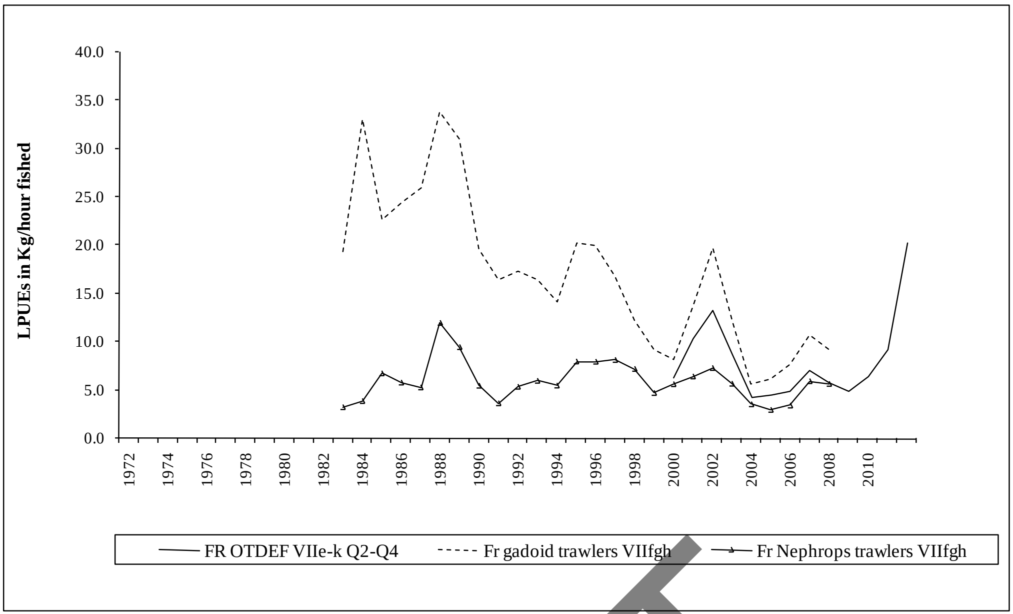


Figure 7.2.4.Cod in Divisions VIIe–k. Percentage of landings accounted for by each age class in Celtic Sea cod over the time-series.



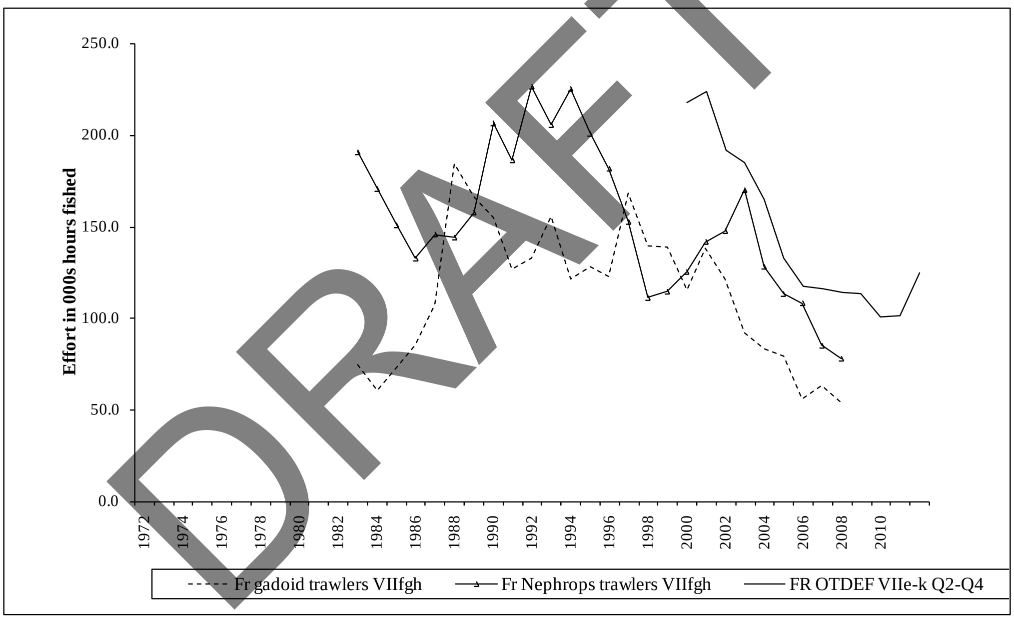
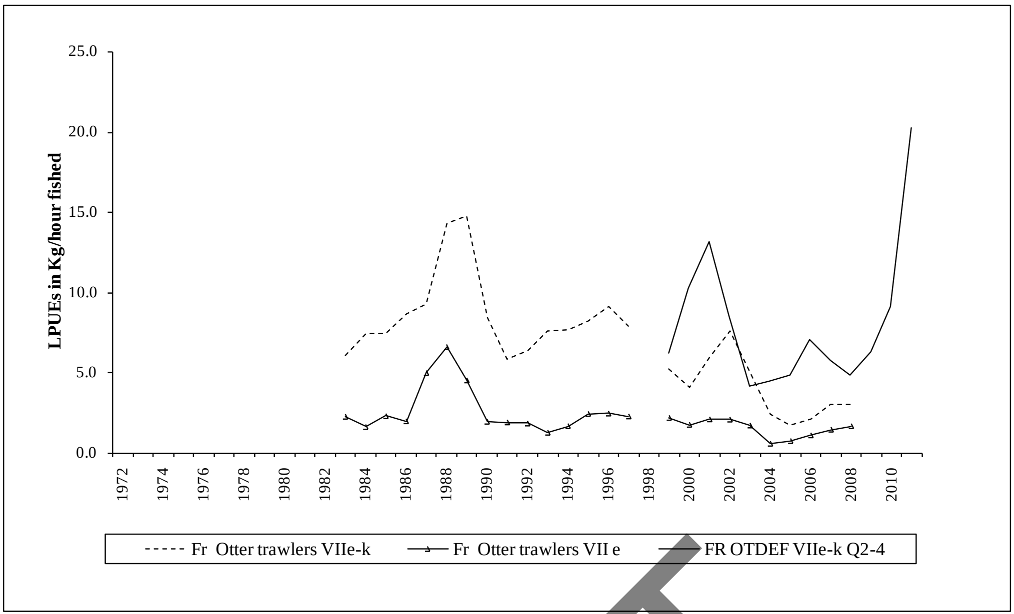


Figure 7.2.5a. Cod in Divisions VIIe–k. Trends of lpues and effort. French Gadoid trawlers and French *Nephrops* trawlers in VIIfgh.



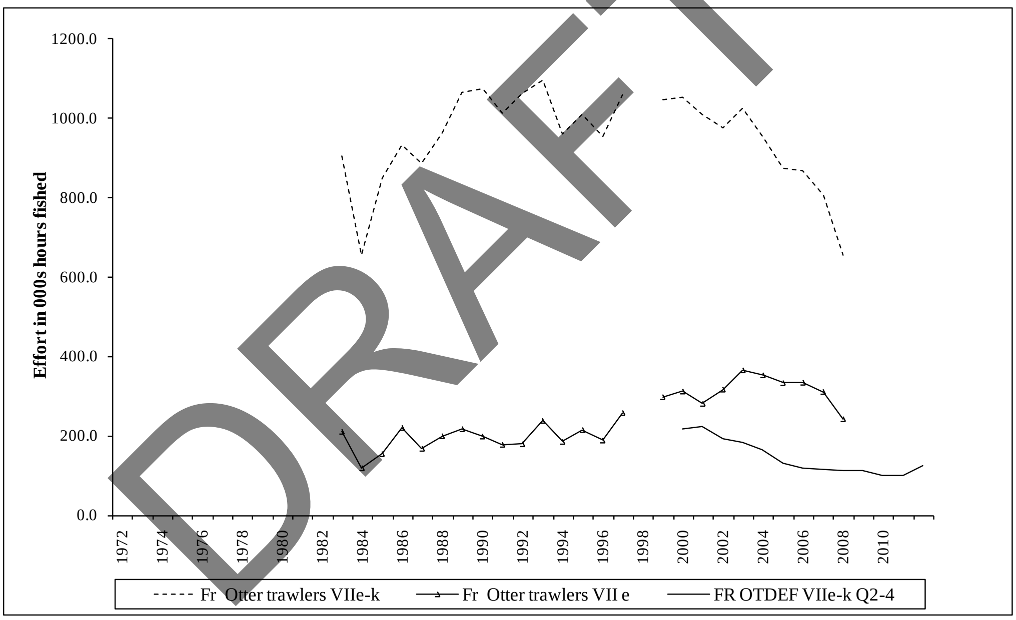
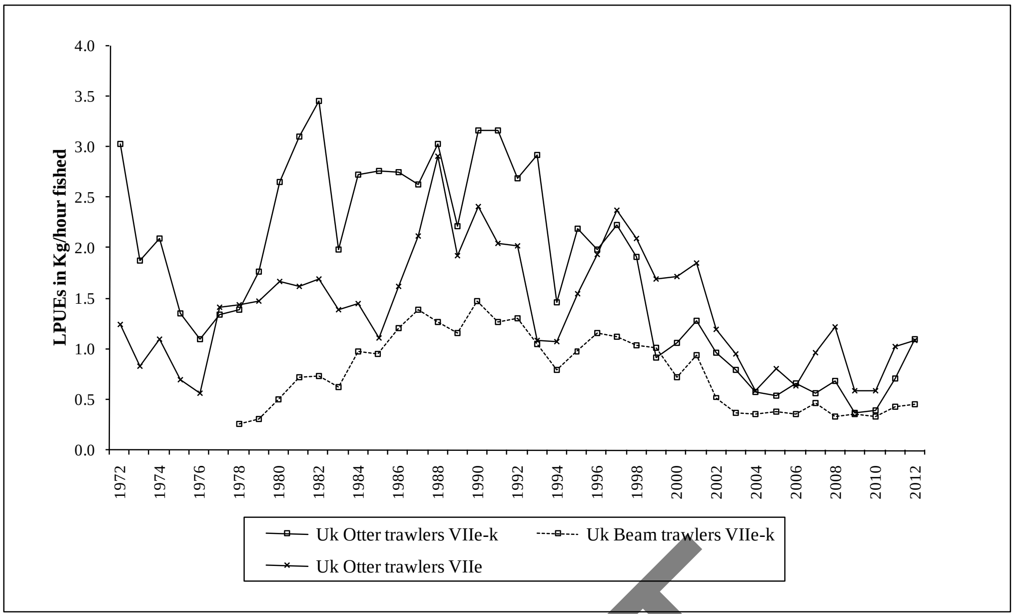


Figure 7.2.5b. Continued. Cod in Divisions VIIe–k. Trends of lpues and effort. French otter trawlers in VIIe–k (including Gadoid trawlers and *Nephrops* trawlers in VIIfgh) and French otter trawlers in VIIe.



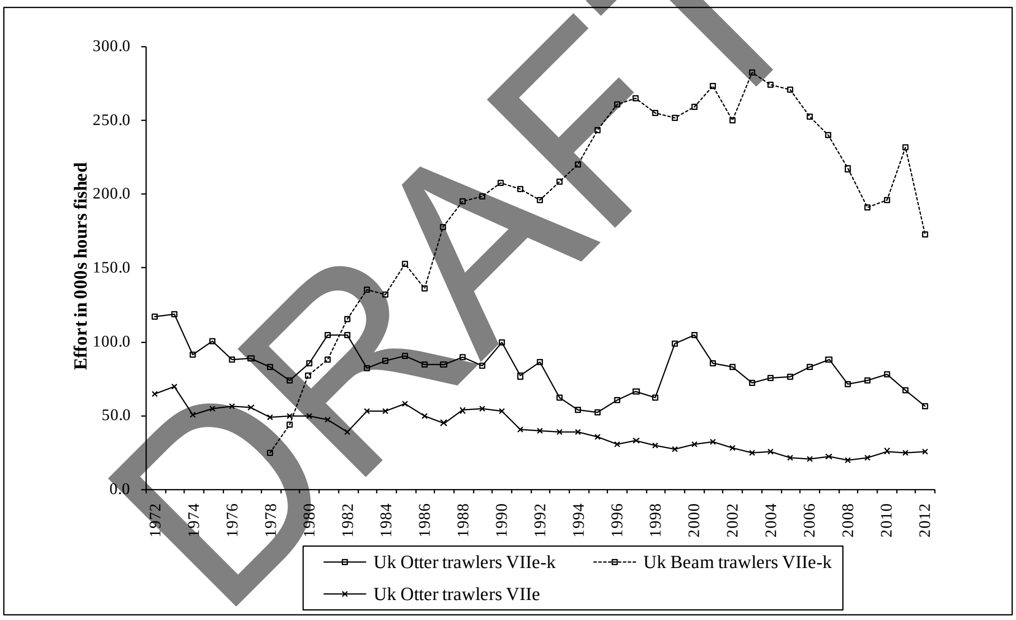


Figure 7.2.5c. Continued. Cod in Divisions VIIe–k. Trends of lpues and effort. UK otter trawlers in VIIe–k and VIIe, UK beam trawlers in VIIe–k.

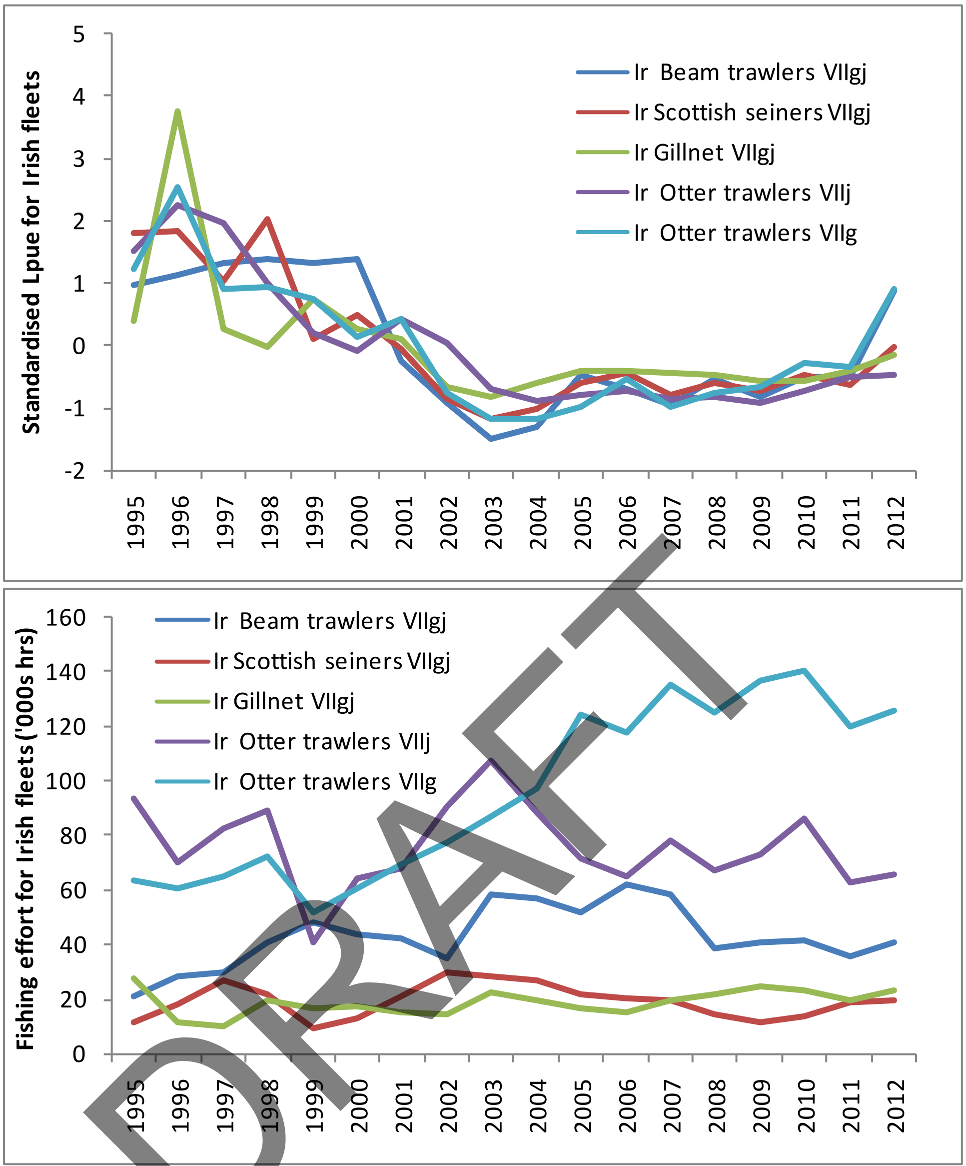


Figure 7.2.5d. Cod in Divisions VIIe–k. Trends of lpues and effort in VIIg and VIIj. Irish otter trawlers, Irish beam trawlers, Irish Scottish seiners.

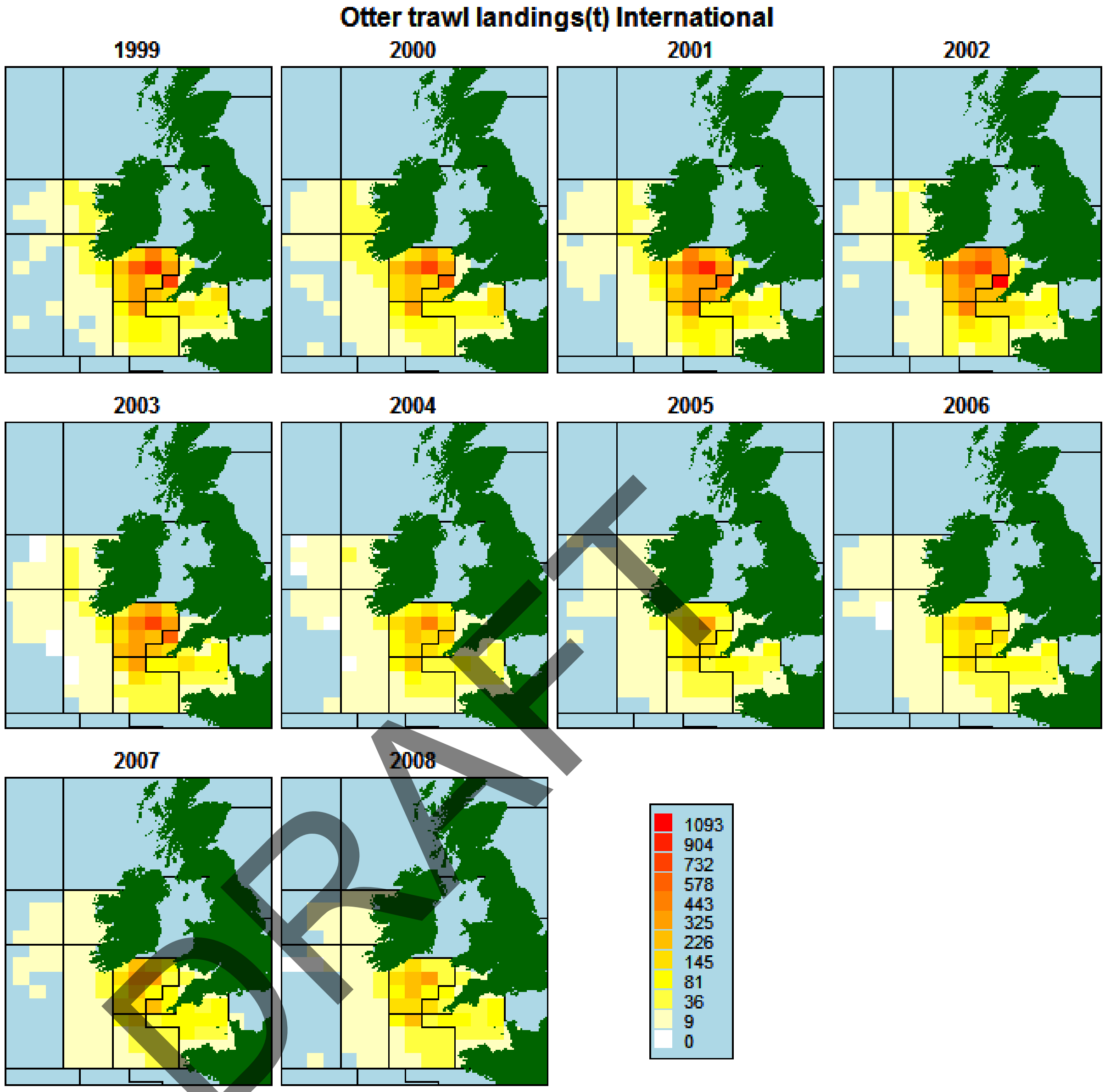


Figure 7.2.6. Cod in VII e–k. Distribution of landings by otter trawlers in the TAC area.

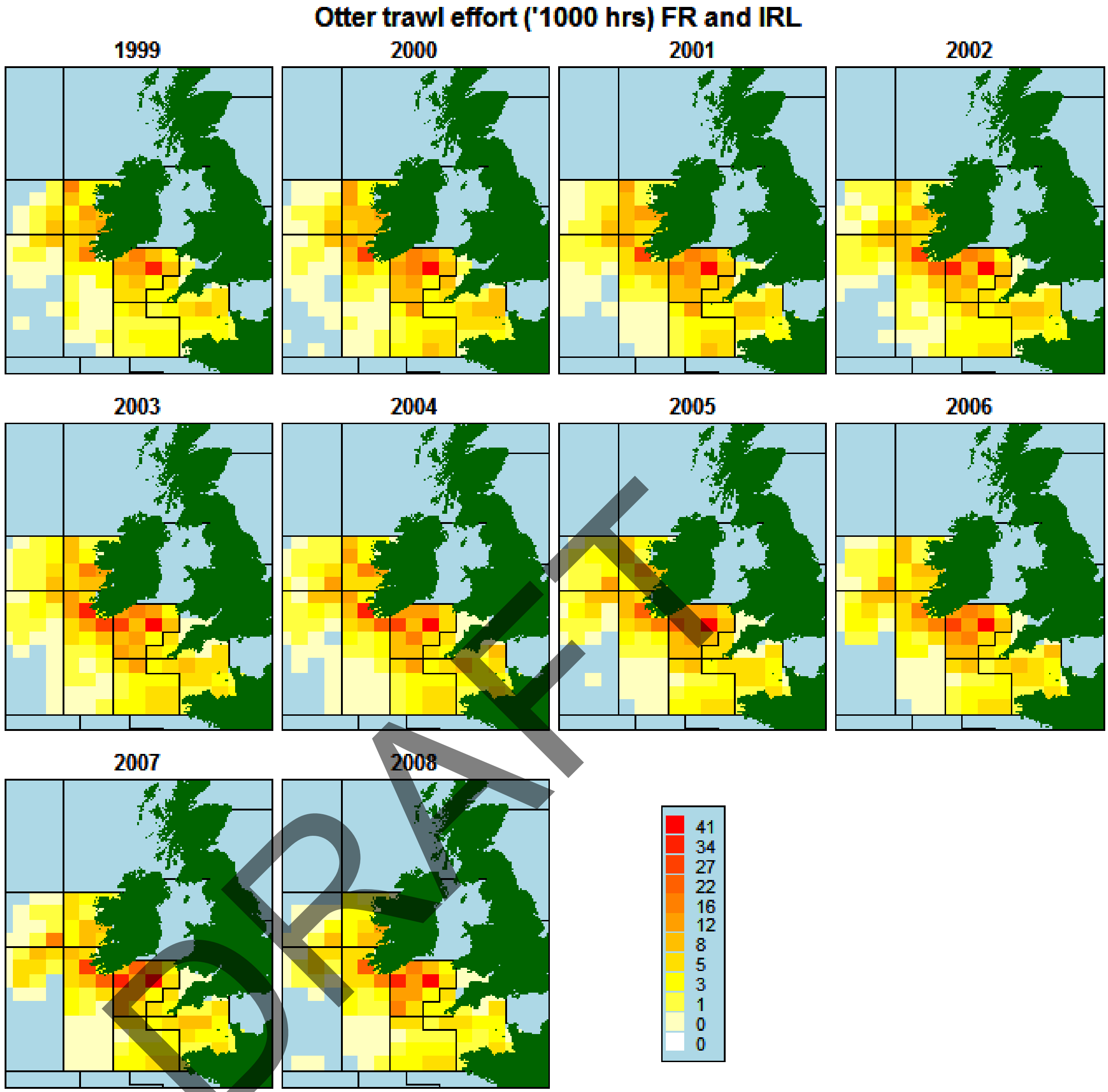


Figure 7.2.7. Cod in VII e–k. Distribution of effort by French and Irish otter trawlers in the TAC area.

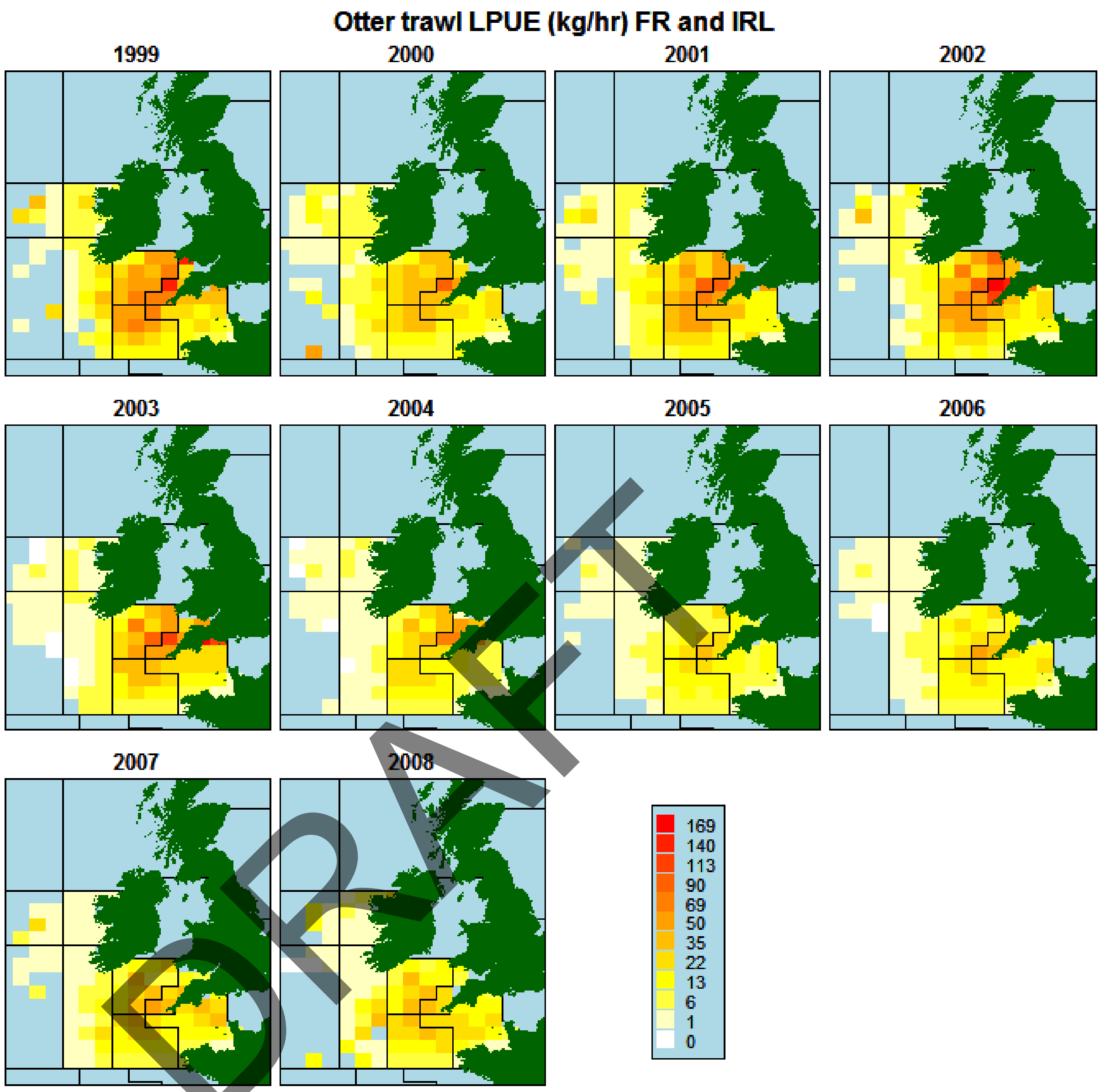


Figure 7.2.8. Cod in VII e–k. Distribution of lpues by French and Irish otter trawlers in the TAC area.

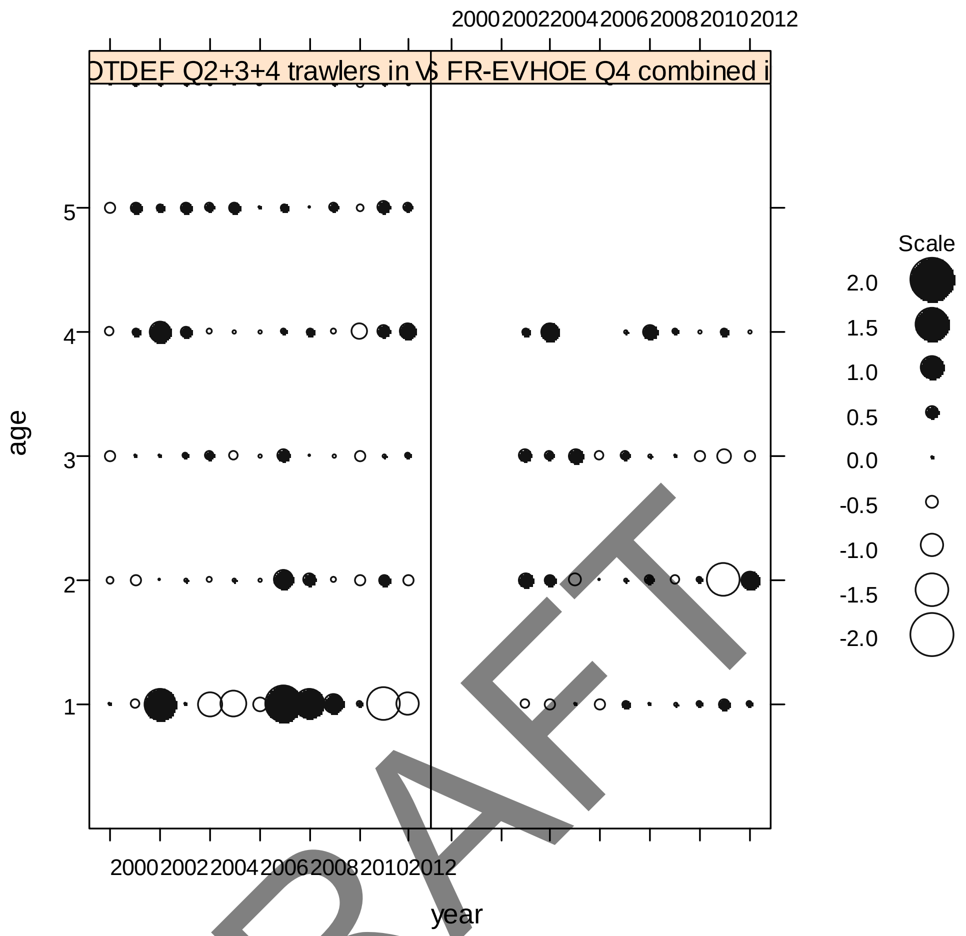


Figure 7.2.9. Celtic Sea cod in Division VIIe–k. Final XSA. Residuals (Left Panel: French OTDEF dermersal tuning fleet, Right Panel: Combined survey indices.

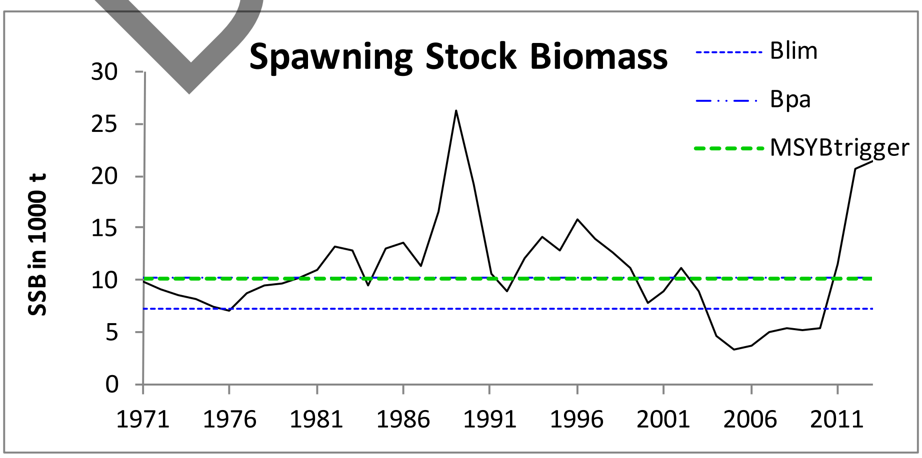


Figure 7.2.10. Celtic Sea cod in Division VIIe–k. Final XSA. Summary plots.

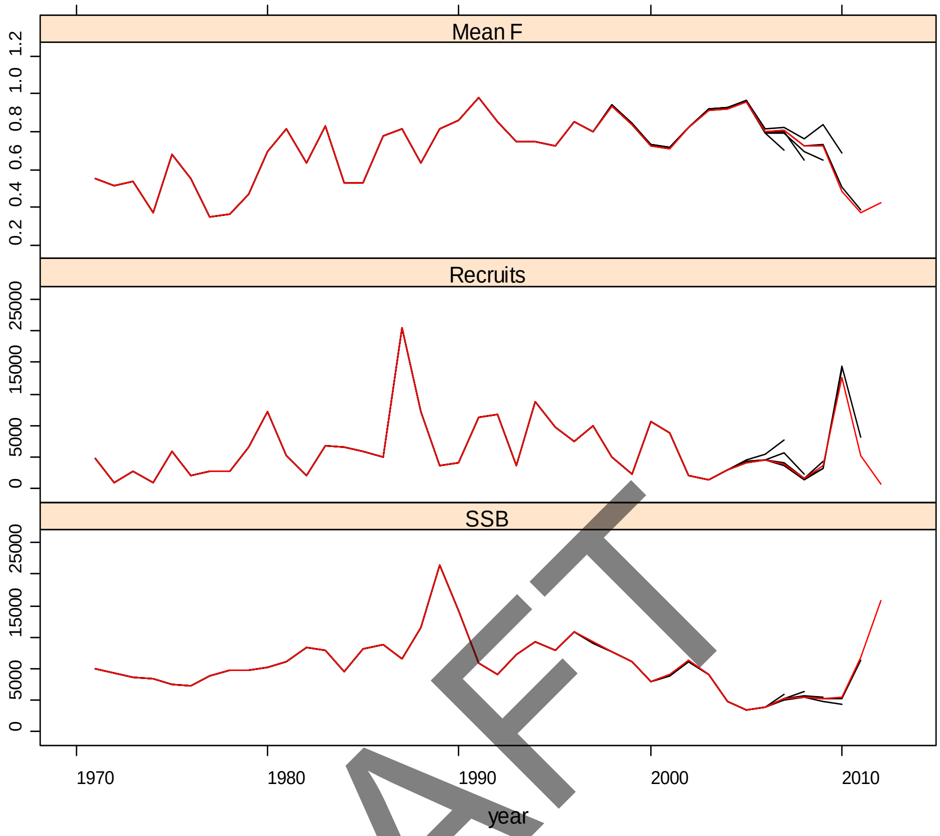


Figure 7.2.11. Celtic Sea cod in Division VIIe–k. Final XSA. Summary plots and retrospective plots.

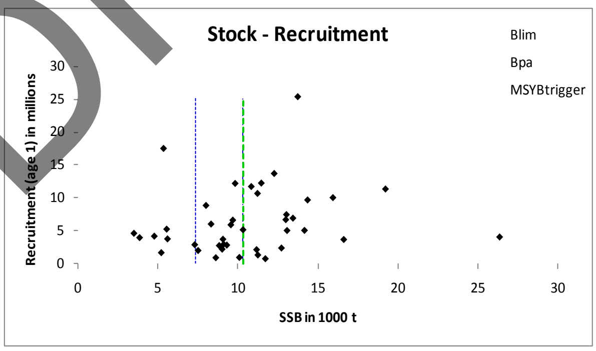


Figure 7.2.12. Cod in Divisions VIIe–k (Celtic Sea cod). Stock–recruitment plot (left).

7.3 Cod in Divisions VIIb, c

Type of assessment: No assessment

The nominal landings are given in Table 7.3.1.

Table 7.3.1. Landings (t) of cod in Division VIIb,c for 1995–2012 as officially reported to ICES.

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003
France	91	115	71	44	...[1]	46	38	54	33
Germany	-	-	3	-	-	-	-	-	
Ireland	282	353	177	234	154	141	107	59	59
Netherlands	-	-	-	-	-	-	+	-	1
Norway	3	1	6		11	+	1	5	
Spain	6	3		6	2	3	1	1	
UK(E/W/NI)	25	35	37	25	4	4	2	1	8
UK(Scotland)	66	12	7	9	1	-		1	1
UK									
Total	**473**	**519**	**301**	**318**	**172**	**194**	**150**	**122**	**102**

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012
France	13	13	10	18	14	5	17	697*	48
Germany									
Ireland	60	32	16	11	18	29	37	36	39
Netherlands									
Norway			1	1					1
Spain									
UK(E/W/NI)		0	1	2	1		1		1
UK(Scotland)	10		0						
UK									
Total	**83**	**45**	**28**	**32**	**33**	**34**	**55**	**36**	**89**

*** Official french landings in 2011 are probably incorrect, last year the preliminary 2011 landings for France were 42 t.**

7.4 Haddock in Divisions VIIb,c,e–k

Type of assessment in 2013

Update.

ICES advice applicable to 2012

"Abundance of haddock is increasing due to a large recruiting year class, but exploitation status is unknown; therefore, ICES advises no increase in catch and technical measures to mitigate the increased discarding of the recruiting year class.

Standard short-term projections imply a TAC increase of around 300% for 2012 compared to 2011, under *status quo* F, although the precision is expected to be poor. Discarding rates will be high unless technical measures are implemented in 2011. During 2011 new data from surveys and the industry will be coming in that will improve the estimate of the year-class strength, and this may allow changes in management in 2012."

ICES advice applicable to 2013

"ICES advises on the basis of the MSY transition that landings should be no more than 9500 tonnes. Technical measures should be introduced to reduce discard rates in fisheries catching haddock."

7.4.1 General

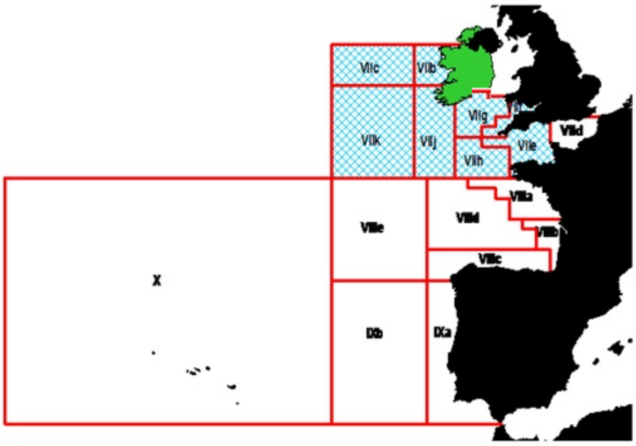
Stock description and management units

The basis for the stock assessment Area VIIb,c,e–k is described in detail in the stock annex. Landings from VIId are insignificant and this division is not included in the assessment area but because this was not obvious from the stock name, this has now been changed from "Haddock in VIIb–k" to "Haddock in VIIb,c,e–k".

More importantly, Irish landings from rectangles 33E2 and 33E3 have now been added to the stock assessment area. Landings from these rectangles were removed from the VIIa stock area following the benchmark of had-7a at WKROUND 2013. WKROUND found that landings from these rectangles had increased substantially in recent years and that geographically this fishery is contiguous with the fishery in VIIg and quite separate from the haddock fishery in VIIa. These landings have been added to VIIg for the years 2003–2012 and the landings numbers-at-age have been adjusted. Before 2007 landings from these rectangles were <0.5% of the total landings in VIIbc,e–k, between 2007 and 2012 they contributed around 3% of the total landings (Table 7.4.1a).

Figure 7.4.1 shows the distribution of international haddock landings in the stock area for 2011 (2012 data not yet available). It is clear from the figure that the stock extends into Area VIII and it could be argued that landings from VIII should be included in the stock area. In recent years these landings varied between 20 and 300 t which is up to 4% of the total landings in the stock area.

The TAC for haddock is set for the combined Areas VIIb–k, VIII, IX and X and EU waters of CECAF 34.1.1. This does not correspond to the stock assessment area (VIIb–k).



Red Boxes-TAC/Management Areas Blue Shading– Assessment Area.

Management applicable to 2012 and 2013.

TAC table 2012

Species: Haddock *Melanogrammus aeglefinus*		**Zone:** VIIb-k, VIII, IX and X; EU waters of CECAF 34.1.1 (HAD/7X7A34)
Belgium	185	
France	11 096	
Ireland	3 699	
United Kingdom	1 665	
Union	16 645	
TAC	16 645	Analytical TAC Article 11 of this Regulation applies.

TAC table 2013

Species: Haddock *Melanogrammus aeglefinus*		**Zone:** VIIb-k, VIII, IX and X; EU waters of CECAF 34.1.1 (HAD/7X7A34)
Belgium	157 (1)	
France	9 432 (1)	
Ireland	3 144 (1)	
United Kingdom	1 415 (1)	
Union	14 148 (1)	
TAC	14 148	Analytical TAC Article 11 of this Regulation applies.

(1) In addition to this quota, a Member State may grant to vessels flying its flag and participating in trials on fully documented fisheries an additional allocation within an overall limit of 5 % of the quota allocated to that Member State, pursuant to Article 7 of this Regulation.

Since 2009, a separate TAC is set for VIIa haddock; previously a separate allocation for VIIa existed within the TAC for VII, VIII, IX and X.

Article 11 refers to the closure of the porcupine bank from 1 May to 31 July.

During the 2011 December fisheries council meeting, Ireland, UK and France agreed to introduce additional technical measures to reduce the high levels of gadoids discards recently observed in the Celtic Seas. In consultation with national governments and the NWWRAC it was agreed to introduce the mandatory use of a 110 mm square mesh panel in /*Nephrops* /trawls and a 100 mm panel in gadoid fisheries. While the regulation was not introduced until 14th August 2012 (EC Regulation 737/2012), it is understood that for both French and Irish fleets, the technical measures were in practice introduced much earlier in the year by the national administrations. Following the outcome of the 2012 December Fisheries council, member states committed to an evaluation of the effectiveness of the technical measures and to introduce additional measures if required (see STECF PLEN-13-01). The EC is in the process of collating information from member states to allow STECF to undertake and evaluation of the technical measures at the 2013 winter plenary meeting.

The fishery

The official landings reported to ICES and Working Group estimates of the landings and discards are given in Table 7.4.1a. This year there is a considerable difference between the official landings for Ireland (3307 t) and the WG landings (4513 t) which may be the consequence of data issues relating to the introduction of electronic logbooks. The WG is confident that the WG estimates are more accurate than the official landings. The historic landings are also shown in Figure 7.4.2. The UK provided minor revisions to the landings figures for 2011.

Before 2002, the TAC was well in excess of the landings in the TAC area (Table 7.4.1a). Between 1999 and 2003 the TAC was sequentially reduced and appeared to become restrictive for France in 2003–2004 and Ireland in 2002–2003 and perhaps after (Table 7.4.1b and Figure 7.4.2b). (WGSSDS05 provided some qualitative evidence that misreporting was now a problem). During 2005–2008 the TAC was between 11 520 t and 11 579 t and the international landings in the TAC area were less than 70% of the TAC. In 2009 and 2010 the total landings were still below the TAC but the quota appeared to become restrictive again for Ireland and Belgium. Since 2011 the TAC has been close to the total landings and can be assumed to be restrictive for all countries.

Figure 7.4.2a gives a long-term overview of the landings of haddock. The time-series is characterized by a number of peaks with rapid increases in the landings, mostly followed by rapid decreases in landings within a few years, suggesting the fishery was taking advantage of sporadic events of very high recruitment. During the 1960s and 1970s three such peaks in landings occurred where the landings increased from less than 4000 t to 10 000 t or more. During the 1980s and early 1990s, landings were relatively stable around 2000–4000 t. During the mid-1990s the haddock landings increased again to over 10 000 t, mirroring increased landings in the Irish Sea in that period. Since the late 1990s the landings have varied between 7000 and 10 000 t and in 2012 the landings were the highest on record at more than 18 500 t.

The discard estimate for 2010 was the highest on record at 16 547 tonnes (Table 7.4.1a), this was mainly a consequence of the 2009 cohort entering the fishery.

Table 7.4.2 and Figure 7.4.3 show that commercial lpue has shown an increasing trend in recent years in all available fleets suggesting improved availability of haddock. Effort in the French fleet has declined considerably since the early 2000s as the result of a decommissioning scheme. French data for 2012–2013 are omitted; due to the increased availability of cod, many trips were classified as OT_DEF that would not have been classified in this métier before, this resulted in unrepresentative lpue data. This figure is presented for auxiliary information only; these fleets are not used directly in the assessment.

Comments from the industry

The French industry states that their fishing opportunities have been reduced by 27% from 2012 to 2013 (taking into account inter-annual flexibility and penalties). The very large 2009 cohort is still being caught in high numbers and the high abundance of haddock causes high levels of discarding of mature fish. The French fishing industry is disappointed that fishing opportunities have reduced so much despite their voluntary acceptance of the use of square mesh panels before these became compulsory. The fishermen state that the square mesh panels are very efficient in reducing catches of small fish. It should be noted, however, that there are very few small gadoids available due to poor recent recruitment which makes it difficult to evaluate the efficacy of the square mesh panels.

The perception of the Irish industry is similar: haddock are very abundant and restrictive quota lead to discarding of marketable fish.

7.4.2 Data

Numbers-at-length

Discard and retained catch length distributions for 2012 are shown in Figure 7.4.4. Significant numbers of discarded fish were above the MLS, which is likely to be the result of restrictive quota.

Figure 7.4.5 shows the available time-series of catch (discards and retained catch) length distributions. The Irish fleet in VIIb generally catches smaller fish than the other fleets although the retained catches appear similar to the Irish VIIgj fleets. The French fleets tend to catch fewer small fish and to discard larger fish than the Irish fleets in many years. Figure 7.4.6 shows the time-series of discard ogives. Discarding of fish over the minimum landing size of 30 cm has occurred in all years although nearly all fish >35 cm were landed up to 2010. In 2011–2012 significant proportions of fish >35 cm have been discarded, presumably in response to restrictive quota.

Landings and discard numbers-at-age

Landings numbers-at-age are given in Table 7.4.3a, discard numbers-at-age are given in Table 7.4.3b and catch numbers-at-age in 7.4.3c. Despite uncertainty about the quality of the discard data, it is possible to track strong year classes in both the discards and the landings-at-age matrices. Discards account for a large proportion of the catch numbers up to age 3. Figure 7.4.7 shows the proportions-at-age that are discarded; over the last 10 years 96% of 1-year-olds, 74% of 2-year-olds and 28% of 3-year-olds have been discarded. By number, 79% of the total catch was discarded (48% by weight; average last ten years). There is a trend for increasing proportions of 2 and 3-year-olds to be discarded, in the mid-nineties around half of the 2-year-olds were discarded and around 10% of 3-year-olds while in recent years around 80% of 2-year-olds and 30% of 3-year-olds were being discarded.

Catch and stock weights-at-age are given in the ASAP input file (Table 7.4.4). Figure 7.4.8a shows the raw stock weights-at-age which are fairly noisy. A 3-year running average was applied to the stock weights used in the assessment (Figure 7.4.8b).

Biological

The assumptions of natural mortality and maturity are described in the stock annex. The maturity ogive used in the assessment is knife-edged at age 2. Recent Irish maturity data from 2004–2012 (WD 01) suggested a similar maturity ogive for females but also indicated that a significant number of males mature before the age of two.

Surveys and commercial tuning fleets

The available surveys and commercial tuning fleets are described in detail in the stock annex. One survey index is used in the assessment: the FR-IRL-IBTS index, which is a combined index from the French EVHOE Q4 WIBTS and Irish IGFS Q4 WIBTS surveys. Additionally one commercial tuning fleet is used: the IR-GAD index, which is the Irish gadoid fleet in selected rectangles of VIIgj. The index data are given in the ASAP input file (Table 7.4.4). The standardised indices are given by year in Figure 7.4.9a and by cohort in Figure 7.4.9b. Figure 7.4.10 shows the scatter plot matrices of the log indices. These plots suggest that the internal consistency of the indices is reasonable. The IR-GAD index (Figure 7.4.9.a) shows an increasing trend over time, mainly as a result of the relatively strong 2002 and 2008 cohorts.

7.4.3 Historical stock development

Model used: ASAP; (XSA is also used for quality control purposes)

Software used: ASAP V2.0.21 NOAA Fisheries toolbox (http://nft.nefsc.noaa.gov)

VPA95 (http://www.ices.dk/datacentre/software.asp)

FLR with R version 2.8.1 with packages FLCore 2.2, FLAssess 2.0.1, FLXSA 2.0 and FLEDA 2.0 (http://cran.r-project.org; http://flr-project.org)

Data screening

The general approach to data screening and analysis was followed in addition to the data exploration tools available in the FLR package FLEDA. The results of the data screening are available in the folder 'Data\Stock\had-7bce–k\DataScreening' on SharePoint.

Final update assessment

The final assessment was run with the same settings as established by WKROUND 2012 and described in the stock annex. Discards were included in the landings and not supplied separately to the model.

Figure 7.4.11 shows the residuals of that catch proportions-at-age. For age classes where discards dominate, the residuals are relatively large. There is no obvious pattern in the younger ages but the residuals in the older ages at the start of the time-series are mostly positive. The observed and predicted catches are shown in Figure 7.4.12. The predicted catches were slightly lower than observed in 2007–2009 years while they were generally higher than observed from 2002–2006.

The residuals of the index proportions-at-age are shown in Figure 7.4.13a. . The 2009 year class consistently has positive residuals in the survey index, indicating that the model does not 'believe' that this cohort is as strong as the index suggests. However, Figure 7.4.13b shows that the difference between observed and predicted values for this cohort are minor. The observed and predicted index cpue values are shown in Figure 7.4.14. The model closely follows both indices.

The selectivity of the catch data was freely estimated for ages 1 and 2 by the model. For the other ages, selectivity was fixed. Table 7.4.5 shows the model estimates for ages 1 and 2. Selectivity of the FR-IR-IBTS index was fixed at 1 for all ages that were included and selectivity of the IRL-GAD index was freely estimated for age 3 and fixed at one for older ages. (Discards are not included in this commercial fleet therefore selectivity was not assumed to be the same of that of the catch data).

Figure 7.4.15 shows the retrospective analysis. The predicted catch shows no retrospective pattern, neither does the recruitment estimate. However, the SSB had a tendency to be revised upwards as another year of data was added during 2006–2009. F has often been overestimated and revised downwards with the addition of another year. The survey index only started in 2003 and it appears that the retrospective patterns have reduced as this time-series is getting longer.

Comparison with previous assessments

The stock was benchmarked in 2012, resulting in revised discard estimates and a new assessment method (ASAP). Figure 7.4.16 shows the comparison of the current ASAP assessment with last year's ASAP and with previous XSA assessments. The addition of an additional year of data did not noticeably change the estimates of SSB, recruitment and F. The ASAP assessments produce very similar SSB estimates to the historic XSA and while F_{BAR} estimates are similar from the late 1990s onwards, they are quite different at the start of the time-series. Note that the F_{BAR} range previous to the benchmark was over ages 2–5, this has been changed to 3–5. The perception of the trend in recruitment is unaffected but the new method estimates the absolute level of recruitment to be much higher. This is mainly due to a change in the assumed natural mortality, which mainly affects the youngest ages.

State of the stock

Table 7.4.6 shows the estimated fishing mortality-at-age and Table 7.4.7 shows the stock numbers-at-age. The stock summary is given in Table 7.4.8 and Figure 7.4.17. An XSA was run in parallel to the ASAP assessment to monitor the performance of both methods. The XSA results are in general agreement with the ASAP results with the exception of F_{BAR} estimates at the start of the time-series. The catch has increased dramatically in the last few years which has resulted in increased discards. The SSB peaked in 2011 as the very strong 2009 year class matured. However since 2009 recruitment has been below-average so it is expected that the stock will decline rapidly as the 2009 year class is fished out. Fishing mortality shows a stable trend but appears to have increased in 2012 and is well above any F_{MSY} reference point that might be considered for this stock. Recruitment in 2012 was the lowest on record.

7.4.4 Short-term projections

Because recruitment of haddock is characterised by sporadic events, the use of geometric mean recruitment (1993–2010) for 2013–2015 provides a very uncertain estimate of future recruitment. However, the short-term predictions are expected to give a reliable estimate of SSB in 2013 and 2014, (but not in 2015 when the 2013 cohort will mature).

Short-term projections were performed using MFDP1a software. Landings and discard numbers and weights were supplied separately. Recruitment for 2013–2015 was estimated at 290 479 (GM 93–10; thousands). Three year averages were used for F and weights-at-age. Input data for the short-term forecast are given in Table 7.4.9. Table

7.4.10 give the management options. Estimates of the relative contribution of recent year classes to the 2014 landings and 2015 SSB are shown in Table 7.4.11. The high recruitment in 2009 still accounts for 63% of the projected landings in 2013 but only 3% of the SSB in 2014. The GM recruitment assumption contributes very heavily to the 2015 SSB estimate (64%); this is because the GM is considerably higher than recruitment of the 2011 and 2012 cohorts. At GM recruitment and *status quo* F, SSB will remain well above $B_{TRIGGER}$ However if 2013 recruitment is as low as 2012 (the lowest observed), SSB will fall below $B_{TRIGGER}$.

7.4.5 MSY evaluation

No stock–recruitment relationship can be defined for this stock due to the erratic nature of recruitment. Figure 7.4.18 shows the yield-per recruit analysis. If one assumes recruitment to be independent of stock size (flat line) then $F_{MSY} = F_{MAX} = 0.30$. This estimate has changed slightly from the estimate of WGCSE 2012 of 0.28.

7.4.6 Biological reference points

WKROUND (2012) stated that the only biomass reference point that can be suggested is an SSB of 7500 tonnes, which is one of the lowest in the time-series. The current SSB is 50 000 t but it is expected to decrease rapidly.

7.4.7 Management plans

No management plan for VIIb,c,e–k haddock has been agreed or proposed.

7.4.8 Uncertainties and bias in assessment and forecast

Landings

Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches, although the assessment is contingent on the accuracy of the landings statistics.

Discards

Irish discards have been monitored since 1995. The number of trips sampled has varied considerably over time (between three and 59 trips per year). Sample numbers were particularly low in 1995, 1999–2002 and 2006. During the remaining years, the number of sampled trips was considered sufficient to give reliable estimates of discards.

French discard data exist from 2004 onwards but the data are not considered to be reliable before 2008. The time-series of French discards was reconstructed by assuming that 90% of one-year olds, 50% of two-year olds and 10% of three year olds were discarded throughout the time-series. These proportions were estimated from the available discard and retained catch data provided by France. Because French discards are estimated to account for 80–86% of the international discards (by weight; 2008–2012), there is considerable uncertainty around the historic discard estimates. However WKROUND (2012) concluded that the ASAP assessment is relatively insensitive to the discard estimates.

Although historic discard estimates are considered to be more reliable, the problem remains that the number of discard trips is very small compared to the total number of trips. The level of uncertainty due to the small sample sizes is likely to be high but the cost of increasing discard coverage would be considerable.

Selectivity

As a consequence of the introduction of grids and square-mesh panels in the Celtic Sea, the selectivity of the fleet is expected to change. The regulations were introduced in the second half of 2012 but a preliminary investigation by Ifremer (France) and the Marine Institute (Ireland) did not provide strong evidence of a change in selectivity in the second semester of 2012. Future assessments will probably need to introduce a second selectivity block and any information on the change of selectivity in the fishery will be helpful.

Surveys

The combined French/Irish survey has nearly full spatial coverage of the assessment area. The survey has good internal consistency. The commercial tuning fleet only covers a small part of the stock area but it is necessary to include this fleet due to the short time-series of the survey.

Forecast

The forecasted landings in 2014 are mainly based on the 2009 year class (63% contribution). Recruitment in 2009 was estimated with a relatively low CV of 11% and it shows no retrospective pattern, suggesting that the size of this year class is well estimated. The GM recruitment assumption does not contribute much to the forecasted landings in 2014 (1% contribution); however the 2015 SSB estimate is highly dependent on the GM recruitment assumption (64% contribution). Therefore the 2015 SSB forecast is very uncertain.

7.4.9 Recommendation for next benchmark

Review Group comments

General comments of the review group have been addressed by clarifying the relevant sections of the report.

The review group suggested reducing the plus group because the stock weights in the older ages are erratic. However, because these age classes contribute very little to the SSB but do have information about relative year-class strength, the WGCSE proposes to leave the plus group unchanged.

Recommendations for future work

It would be desirable to include discard separately in the assessment model in order to specify a lower precision for the discard numbers-at-age than for the landings numbers-at-age. However WKROUND (2012) concluded that this resulted in undesirable residual patterns. The benchmark workshop did not have sufficient time to fully evaluate this problem.

7.4.10 Management considerations

Due to erratic recruitment, only a flat stock–recruit relationship can be assumed, in which case $F_{MSY} = F_{MAX}$. Current F is above F_{MAX}. B_{LOSS} has been proposed as MSY $B_{trigger}$. Current SSB is more than six times as high as B_{LOSS}. Future catches and SSB will be highly dependent on the strength of incoming year classes and their discard mortality. The stock should be managed by ensuring that fishing effort is not allowed to increase and technical measures should be in place to reduce discards.

Management by TAC is inappropriate for this stock because landings, but not catches, are controlled. Haddock are caught in a mixed fishery so TAC management can lead to discarding of over-quota fish in addition to already considerable discarding of undersized fish.

Discarding is a serious problem for this stock; over the last ten years 79% of the catch (in numbers) has been discarded (48% by weight). The TAC appears to have been restrictive since 2011 and significant numbers of fish over the MLS were being discarded (Figure 7.4.6).

Technical measures have been introduced to reduce discards of undersize gadoids (110 mm square mesh panel in the *Nephrops* fisheries and 100 mm in the gadoid fisheries). It is not clear whether this is sufficient to reduce discard mortality of future cohorts but recent recruitment has been very low so presently much of the discards are above the MLS. It is important that technical measures are fully implemented and their effectiveness in reducing discards and impact on commercial catches are monitored and evaluated.

Table 7.4.1. (a) Haddock in VIIb–k official landings, the landings used by the working group, the landings from rectangles 33E2 and 33E3 that were included in the WG landings, and the TAC (tonnes). (b) The landings used by the working group, disaggregated by country and the quota (tonnes).

(a)	Official landings						Un-	Used by WG			33E2 +	TAC
Year	BEL	FRA	IRL	UK	Others	Total	allocated	Landings	Discards	Catch	33E3	VII - X
1993	51	1839	1262	256	0	3408	-60	3348	1208	4557		
1994	123	2788	908	240	17	4076	55	4131	1886	6017		
1995	189	2964	966	266	83	4468	2	4470	2218	6688		6000
1996	133	4527	1468	439	86	6653	103	6756	4309	11064		14000
1997	246	6581	2789	569	85	10270	557	10827	2883	13710		14000
1998	142	3674	2788	444	312	7360	308	7668	934	8603		20000
1999	51	2725	2034	278	159	5247	-365	4882	586	5468		22000
2000	90	3088	3066	289	123	6656	755	7411	2503	9913		16600
2001	165	4842	3608	422	665	9702	-1070	8632	3418	12050		12000
2002	132	4348	2188	315	106	7089	-686	6403	7073	13476		9300
2003	118	5781	1867	393	82	8241	-31	8210	9456	17666	64	8185
2004	136	6130	1715	313	159	8453	181	8634	6750	15384	53	9600
2005	167	4174	2037	292	197	6867	-277	6590	5191	11781	35	11520
2006	99	3190	1875	274	209	5647	-239	5408	2484	7893	26	11520
2007	119	4142	1930	386	52	6629	103	6732	2739	9471	222	11520
2008	108	3639	1800	566	121	6234	1100	7334	11187	18521	194	11579
2009	131	5429	2983	716	48	9307	254	9561	9080	18641	285	11579[2]
2010	170	6240	2609	853	128	10000	135	10135	16547	26682	267	11579[2]
2011	211	8070	3322	1658	129	13390	-492	12898	14378	27276	374	13316[2]
2012[1]	232	11793	3307	1901	62	17294	1206	18501	10191	28691	473	16645[2]

[1] preliminary data

[2] Applies to VIIb-k, VIII, IX and X

(b)	Landings used by WG (Quota in brackets)					
Year	Belgium	France	Ireland	UK	Others	Total
2002	134 (103)	3878 (6200)	2070 (2067)	301 (930)	21	6403 (9300)
2003	116 (91)	5960 (5456)	1731 (1819)	362 (819)	41	8210 (8185)
2004	137 (107)	6336 (6400)	1785 (2133)	303 (960)	73	8634 (9600)
2005	165 (128)	4096 (7680)	2026 (2560)	282 (1152)	20	6590 (11520)
2006	98 (128)	3151 (7680)	1883 (2560)	262 (1152)	14	5408 (11520)
2007	118 (128)	4073 (7680)	2135 (2560)	383 (1152)	23	6732 (11520)
2008	109 (129)	4587 (7719)	2032 (2573)	545 (1158)	61	7334 (11579)
2009	131 (129)	5455 (7719)	3271 (2573)	703 (1158)	2	9561 (11579)
2010	170 (129)	6267 (7719)	2876 (2573)	789 (1158)	33	10135 (11579)
2011	212 (148)	7365 (8877)	3697 (2959)	1511 (1332)	113	12898 (13316)
2012	232 (185)	11793 (11096)	4513 (3699)	1610 (1665)	353	18501 (16645)

Table 7.4.2. Lpue (kg/hour fishing) of haddock and effort (hours fishing x 1000) for Irish Otter trawls in VIIbc, VIIfgh and VIIjk, the French demersal fleet in VIIbc–ek and effort only for the trawl fleets (excl beam trawls) in VIIe–k.

	IRL OTB VIIbc		IRL OTB VIIfgh		IRL OTB VIIjk		FR OTB_DEF VIIbk		UK Trawl VIIe-k
	LPUE	Effort	LPUE	Effort	LPUE	Effort	LPUE	Effort	Effort
1983									82
1984									87
1985									90
1986									85
1987									84
1988									89
1989									84
1990									99
1991									77
1992									86
1993									62
1994									54
1995	5.77	78	1.48	64	2.20	106			300
1996	4.16	47	5.35	60	3.24	73			240
1997	4.36	63	5.83	65	8.23	92			287
1998	5.71	79	4.09	72	5.88	99			312
1999	5.27	77	2.35	51	3.53	52			279
2000	4.73	74	10.43	61	4.25	72	6.90	321	632
2001	4.30	78	8.69	69	7.41	81	10.99	342	656
2002	2.81	63	3.22	79	5.50	108	10.96	295	627
2003	2.09	81	3.26	87	3.88	123	15.28	267	630
2004	2.51	82	3.49	97	3.35	108	19.91	223	587
2005	2.45	69	4.53	127	3.69	93	14.84	178	543
2006	2.56	60	4.19	119	3.58	89	11.01	170	521
2007	3.31	60	4.01	136	3.65	103	15.17	163	551
2008	4.36	48	4.56	127	4.58	84	19.54	149	479
2009	5.47	48	9.25	141	7.04	82	22.61	153	499
2010	4.36	54	7.33	144	5.09	101	30.82	134	511
2011	6.39	40	10.51	129	4.86	84			320
2012	4.95	37	13.27	127	6.39	75			296

Table 7.4.3. VIIb–k haddock Landings numbers-at-age (a) and discard numbers-at-age (b).

a) Landings Numbers at Age

Year	0	1	2	3	4	5	6	7	8	9	10
1993	0	491	3291	948	810	255	129	129	42	3	0
1994	0	1277	5223	674	302	94	24	35	14	1	0
1995	0	4275	1622	1327	270	245	46	0	0	0	0
1996	0	3693	15998	818	313	93	32	10	4	3	2
1997	0	1353	9645	5553	716	354	139	144	59	48	2
1998	0	162	3077	7154	1395	298	173	84	41	9	9
1999	0	468	643	1438	2382	302	18	19	3	3	0
2000	0	2171	2961	775	733	1235	203	34	21	7	0
2001	0	3998	8036	1053	282	295	298	51	29	7	0
2002	0	872	4216	3354	760	39	88	73	19	5	2
2003	0	694	8733	2138	1204	113	43	48	41	10	0
2004	0	125	5900	4566	887	575	50	12	16	3	0
2005	0	784	840	4191	1897	438	114	4	13	3	0
2006	0	833	3330	1437	2119	377	64	7	0	0	0
2007	0	695	6371	2666	526	851	154	29	3	2	0
2008	0	1581	3976	4380	961	227	368	67	11	1	0
2009	0	788	6964	3385	1934	486	142	109	25	2	0
2010	0	1284	4730	5998	891	490	158	66	53	6	1
2011	0	172	11248	3360	3237	606	200	54	26	12	4
2012	0	62	794	18780	2369	1310	209	58	35	10	7

b) Discard Numbers at Age

Year	0	1	2	3	4	5	6	7	8	9	10
1993	0	7617	2816	160	6	0	0	0	0	0	0
1994	0	15120	3069	170	5	0	0	0	0	0	0
1995	0	32830	1977	91	4	0	0	0	0	0	0
1996	0	20734	8976	187	9	0	0	0	0	0	0
1997	0	12613	10022	493	5	0	0	0	0	0	0
1998	0	3580	2348	445	5	0	0	0	0	0	0
1999	0	3742	1562	100	10	0	0	0	0	0	0
2000	0	29015	2521	64	3	0	0	0	0	0	0
2001	0	25234	6772	219	2	0	0	0	0	0	0
2002	0	21624	20729	249	7	0	0	0	0	0	0
2003	0	52412	11075	352	8	0	0	0	0	0	0
2004	0	11733	21598	1395	61	0	0	0	0	0	0
2005	0	15904	10766	4315	149	0	0	0	0	0	0
2006	0	9377	4130	381	33	0	0	0	0	0	0
2007	0	6387	7066	662	34	0	0	0	0	0	0
2008	0	48764	15658	5492	330	0	0	0	0	0	0
2009	0	23561	27015	873	581	0	0	0	0	0	0
2010	0	98400	23292	2133	131	0	0	0	0	0	0
2011	0	16081	47971	1831	665	0	0	0	0	0	0
2012	0	7056	22315	12250	115	0	0	0	0	0	0

c) Catch Numbers at Age

Year	0	1	2	3	4	5	6	7	8	9	10
1993	0	8107	6107	1108	816	255	129	129	42	3	0
1994	0	16396	8292	844	307	94	24	35	14	1	0
1995	0	37105	3599	1419	273	245	46	0	0	0	0
1996	0	24428	24973	1005	321	93	32	10	4	3	2
1997	0	13965	19667	6046	722	354	139	144	59	48	2
1998	0	3742	5424	7599	1400	298	173	84	41	9	9
1999	0	4210	2205	1538	2392	302	18	19	3	3	0
2000	0	31186	5482	839	735	1235	203	34	21	7	0
2001	0	29232	14808	1272	283	295	298	51	29	7	0
2002	0	22496	24945	3603	766	39	88	73	19	5	2
2003	0	53106	19808	2490	1213	113	43	48	41	10	0
2004	0	11858	27497	5961	948	575	50	12	16	3	0
2005	0	16688	11606	8507	2047	438	114	4	13	3	0
2006	0	10210	7461	1818	2153	377	64	7	0	0	0
2007	0	7082	13437	3329	560	851	154	29	3	2	0
2008	0	50345	19634	9872	1291	227	368	67	11	1	0
2009	0	24350	33978	4258	2514	486	142	109	25	2	0
2010	0	99684	28022	8132	1022	490	158	66	53	6	1
2011	0	16253	59218	5191	3902	606	200	54	26	12	4
2012	0	7118	23109	31030	2484	1310	209	58	35	10	7

Table 7.4.4. Input data to ASAP.

```
# ASAP VERSION 2.0
# Had7bc-ek
#
# ASAP GUI - 15 JAN 2008
#
# Number of Years
20
# First Year
1993
# Number of Ages
9
# Number of Fleets
1
# Number of Selectivity Blocks (sum over all fleets)
1
# Number of Available Indices
2
# Fleet Names
#$LAND+DIS
# Index Names
#$FR-IRL-IBTS
#$IR-GAD
#
# Natural Mortality Rate Matrix
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
0.99  0.72  0.60  0.50  0.43  0.40  0.37  0.36  0.34
# Fecundity Option
```

```
0
# Fraction of year that elapses prior to SSB calculation (0=Jan-1)
0
# Maturity Matrix
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
0.0  0.0  1.0  1.0  1.0  1.0  1.0  1.0  1.0
# Weight at Age for Catch Matrix
0.000  0.090  0.257  0.524  0.848  1.402  1.693  2.130  2.573
0.000  0.100  0.358  0.614  0.987  1.456  1.745  2.014  2.536
0.000  0.089  0.388  0.875  1.321  1.188  1.746  0.000  0.000
0.000  0.130  0.275  0.576  0.799  1.181  1.369  1.828  1.827
0.000  0.097  0.305  0.743  1.205  1.362  1.268  1.412  1.176
0.000  0.103  0.295  0.610  0.938  0.958  1.089  1.293  1.455
0.000  0.128  0.297  0.847  1.072  1.186  1.223  0.908  1.708
0.000  0.091  0.451  1.189  1.463  1.719  1.627  1.163  1.459
0.000  0.119  0.378  0.963  1.857  1.783  1.705  2.297  1.612
0.000  0.095  0.294  0.790  1.026  1.732  1.671  1.504  1.571
0.000  0.133  0.353  0.803  1.240  1.445  1.816  1.705  1.707
0.000  0.136  0.284  0.654  1.144  1.381  1.857  1.815  2.067
0.000  0.136  0.211  0.498  0.976  1.256  1.946  2.667  1.949
0.000  0.162  0.347  0.501  0.929  1.487  2.120  2.621  4.022
0.000  0.168  0.340  0.566  0.856  1.203  1.643  1.503  2.830
0.000  0.129  0.287  0.460  0.738  1.164  1.284  1.689  1.916
0.000  0.118  0.291  0.618  0.846  1.313  1.554  1.657  2.453
0.000  0.114  0.268  0.653  1.072  1.756  1.861  1.747  1.680
0.000  0.155  0.278  0.590  0.928  1.627  2.122  1.899  1.477
0.000  0.127  0.248  0.544  1.042  1.446  2.041  2.322  2.234

# Weight-at-Age for Spawning—Stock Biomass Matrix
```

```
0.041  0.093  0.277  0.641  0.824  1.804  2.089  2.407  3.869
0.042  0.093  0.290  0.756  1.138  2.360  2.163  2.407  3.869
0.045  0.102  0.295  0.715  1.232  2.174  1.972  1.981  2.304
0.046  0.100  0.313  0.719  1.246  2.046  1.773  1.656  1.833
0.043  0.098  0.287  0.579  0.904  1.145  1.263  1.631  1.975
0.037  0.096  0.274  0.655  0.870  1.005  1.017  1.252  1.732
0.028  0.102  0.264  0.790  0.962  1.149  1.205  1.349  1.787
0.027  0.108  0.303  0.926  1.326  1.548  1.605  1.647  1.585
0.022  0.101  0.310  0.922  1.329  1.633  1.672  1.765  1.619
0.021  0.109  0.309  0.838  1.398  1.676  1.887  1.719  1.597
0.023  0.119  0.275  0.725  1.194  1.605  1.936  1.381  1.603
0.032  0.133  0.248  0.621  1.212  1.666  2.306  1.962  1.920
0.037  0.139  0.251  0.522  1.061  1.595  2.165  2.411  2.672
0.043  0.148  0.264  0.488  0.922  1.421  2.069  2.536  3.338
0.041  0.145  0.282  0.481  0.800  1.317  1.768  2.165  3.280
0.048  0.135  0.267  0.505  0.758  1.148  1.607  1.832  3.057
0.048  0.119  0.252  0.522  0.802  1.251  1.516  1.772  2.476
0.041  0.128  0.256  0.550  0.860  1.330  1.730  2.038  2.296
0.043  0.130  0.251  0.520  0.913  1.439  1.897  2.275  2.117
0.038  0.139  0.254  0.488  0.900  1.386  2.063  2.585  2.213
# Weight at Age for Jan-1 Biomass Matrix
0.041  0.093  0.277  0.641  0.824  1.804  2.089  2.407  3.869
0.042  0.093  0.290  0.756  1.138  2.360  2.163  2.407  3.869
0.045  0.102  0.295  0.715  1.232  2.174  1.972  1.981  2.304
0.046  0.100  0.313  0.719  1.246  2.046  1.773  1.656  1.833
0.043  0.098  0.287  0.579  0.904  1.145  1.263  1.631  1.975
0.037  0.096  0.274  0.655  0.870  1.005  1.017  1.252  1.732
0.028  0.102  0.264  0.790  0.962  1.149  1.205  1.349  1.787
0.027  0.108  0.303  0.926  1.326  1.548  1.605  1.647  1.585
0.022  0.101  0.310  0.922  1.329  1.633  1.672  1.765  1.619
0.021  0.109  0.309  0.838  1.398  1.676  1.887  1.719  1.597
0.023  0.119  0.275  0.725  1.194  1.605  1.936  1.381  1.603
0.032  0.133  0.248  0.621  1.212  1.666  2.306  1.962  1.920
0.037  0.139  0.251  0.522  1.061  1.595  2.165  2.411  2.672
0.043  0.148  0.264  0.488  0.922  1.421  2.069  2.536  3.338
0.041  0.145  0.282  0.481  0.800  1.317  1.768  2.165  3.280
0.048  0.135  0.267  0.505  0.758  1.148  1.607  1.832  3.057
0.048  0.119  0.252  0.522  0.802  1.251  1.516  1.772  2.476
0.041  0.128  0.256  0.550  0.860  1.330  1.730  2.038  2.296
0.043  0.130  0.251  0.520  0.913  1.439  1.897  2.275  2.117
0.038  0.139  0.254  0.488  0.900  1.386  2.063  2.585  2.213
# Selectivity Blocks (fleet outer loop, year inner loop)
# Sel block for fleet 1
1
1
1
```

```
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
# Selectivity Options for each block 1=by age, 2=logisitic, 3=double logistic
1
# Selectivity initial guess, phase, lambda, and CV
# (have to enter values for nages + 6 parameters for each block)
# Sel Block 1
0            -1           0            1
0.5          1            0            1
1            1            0            1
1            -1           0            1
1            -1           0            1
1            -1           0            1
1            -1           0            1
1            -1           0            1
1            -1           0            1
1            1            0            1
1            1            0            1
1            1            0            1
1            1            0            1
1            1            0            1
1            1            0            1
# Selectivity Start Age by fleet
1
# Selectivity End Age by fleet
9
# Age range for average F
4  6
# Average F report option (1=unweighted, 2=Nweighted, 3=Bweighted)
1
# Use likelihood constants? (1=yes)
```

```
1
# Release Mortality by fleet
1
# Fleet 1 Catch at Age - Last Column is Total Weight
0	8107	6107	1108	816	255	129	129	42	4557
0	16396	8292	844	307	94	24	35	14	6017
0	37105	3599	1419	273	245	46	0	0	6688
0	24428	24973	1005	321	93	32	10	4	11064
0	13965	19667	6046	722	354	139	144	59	13710
0	3742	5424	7599	1400	298	173	84	41	8603
0	4210	2205	1538	2392	302	18	19	3	5468
0	31186	5482	839	735	1235	203	34	21	9913
0	29232	14808	1272	283	295	298	51	29	12050
0	22496	24945	3603	766	39	88	73	19	13476
0	53106	19808	2490	1213	113	43	48	41	17666
0	11858	27497	5961	948	575	50	12	16	15384
0	16688	11606	8507	2047	438	114	4	13	11781
0	10210	7461	1818	2153	377	64	7	0	7893
0	7082	13437	3329	560	851	154	29	3	9471
0	50345	19634	9872	1291	227	368	67	11	18521
0	24350	33978	4258	2514	486	142	109	25	18641
0	99684	28022	8132	1022	490	158	66	53	26682
0	16253	59218	5191	3902	606	200	54	26	27276
0	7118	23109	31030	2484	1310	209	58	35	28691
# Fleet 1 Discards at Age - Last Column is Total Weight
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
# Fleet 1 Release Proportion at Age
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
```

```
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
# Index Units
2  2
# Index Month
11  7
# Index Selectivity Choice
-1  -1
# Index Selectivity Option for each Index 1=by age, 2=logisitic, 3=double lo-
gistic
1  1
# Index Start Age
1  4
# Index End Age
6  8
# Use Index? 1=yes
1  1
# Index Selectivity initial guess, phase, lambda, and CV
# (have to enter values for nages + 6 parameters for each block)
# Index-1
1         1         1         0.0001
1         -1        0         1
1         -1        0         1
1         -1        0         1
1         -1        0         1
1         -1        0         1
-1        -1        0         1
-1        -1        0         1
-1        -1        0         1
1         1         0         1
1         1         0         1
```

0	-1	0	1
0.001	-1	0	1
1	1	0	1
1	1	0	1

Index-2

-1	-1	0	1
-1	-1	0	1
-1	-1	0	1
0.8	1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
1	-1	0	1
-1	-1	0	1
1	1	0	1
1	1	0	1
3	-1	0	1
1	-1	0	1
8	-1	0	1
1	-1	0	1

Index Data - Year, Index Value, CV, proportions at age and input effective sample size (only used if estimating parameters)

Index-1

1993	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0
2003	707.4	0.2	157	508.3	32.6	7.1	2.4	0.1	0	0	0	40
2004	517.7	0.2	385.7	49.1	70.9	7.9	2.7	1.4	0	0	0	40
2005	310.7	0.2	193.5	85.7	9.9	19.4	1.9	0.3	0	0	0	40
2006	176.9	0.2	110.2	39.7	19	4.5	3.2	0.4	0	0	0	40
2007	670.6	0.2	610.8	38.6	9.9	5.8	2.8	2.7	0	0	0	40
2008	424	0.2	271.5	143.3	5.6	1.6	1.3	0.7	0	0	0	40
2009	1562.4	0.2	1428.4	67.1	62	2.1	1.9	0.8	0	0	0	40
2010	823.4	0.2	89.7	686	33	13.6	0.4	0.8	0	0	0	40
2011	317.8	0.2	69.2	45.3	193.9	7.2	2.1	0.2	0	0	0	40
2012	113.9	0.2	21.4	23.2	13.4	52.4	2.2	1.3	0	0	0	40

Index-2

1993	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0
1995	0.826	0.3	0	0	0	0.7510	0.0600	0.0150	0	0	0	40
1996	1.031	0.3	0	0	0	0.6750	0.2260	0.0960	0.0350	0	0	40

```
1997   3.578    0.3    0   0   0   3.0860    0.3390   0.1150   0.0190   0.0190   0   40
1998   6.695    0.3    0   0   0   5.8110    0.8240   0.0330   0.0080   0.0180   0   40
1999   3.047    0.3    0   0   0   1.1470    1.7350   0.1490   0.0050   0.0110   0   40
2000   4.103    0.3    0   0   0   1.6180    1.0770   1.2040   0.2040   0        0   40
2001   3.47     0.3    0   0   0   2.9260    0.2930   0.1480   0.0930   0.0090   0   40
2002   3.996    0.3    0   0   0   3.6570    0.2660   0.0200   0.0210   0.0340   0   40
2003   2.058    0.3    0   0   0   1.2560    0.6980   0.0810   0.0090   0.0140   0   40
2004   4.586    0.3    0   0   0   3.3630    0.8560   0.3500   0.0100   0.0070   0   40
2005   7.06     0.3    0   0   0   4.6750    2.0710   0.2660   0.0470   0        0   40
2006   7.004    0.3    0   0   0   2.9530    3.4970   0.4800   0.0620   0.0120   0   40
2007   4.683    0.3    0   0   0   2.6510    0.6710   1.2130   0.1360   0.0120   0   40
2008   5.441    0.3    0   0   0   3.5340    1.1620   0.2560   0.4010   0.0870   0   40
2009   5.846    0.3    0   0   0   2.9390    1.8140   0.5660   0.3050   0.2220   0   40
2010   9.904    0.3    0   0   0   8.2360    0.9570   0.5030   0.1530   0.0560   0   40
2011   9.565    0.3    0   0   0   3.9250    4.5770   0.7020   0.3000   0.0600   0   40
2012   17.757   0.3    0   0   0   13.8430   1.7480   1.7890   0.2850   0.0920   0   40
# Phase Control Data
# Phase for F mult in 1st Year
1
# Phase for F mult Deviations
2
# Phase for Recruitment Deviations
3
# Phase for N in 1st Year
1
# Phase for Catchability in 1st Year
3
# Phase for Catchability Deviations
-5
# Phase for Stock Recruitment Relationship
1
# Phase for Steepness
-5
# Recruitment CV by Year
1
1
1
1
1
1
1
1
1
1
1
1
1
```

```
1
1
1
1
1
1
1
#Lambda for Each Index
1  1
# Lambda for Total Catch in Weight by Fleet
1
# Lambda for Total Discards at Age by Fleet
1
# Catch Total CV by Year and Fleet
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.300
0.200
0.200
0.200
0.200
0.200
# Discard Total CV by Year and Fleet
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
```

```
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
# Input Effective Sample Size for Catch at Age by Year & Fleet
25
25
25
25
25
25
25
25
25
50
50
50
50
50
50
50
50
50
50
50
# Input Effective Sample Size for Discards at Age by Year & Fleet
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
```

```
0
0
0
0
0
# Lambda for F mult in first year by fleet
0
# CV for F mult in first year by fleet
0.5
# Lambda for F mult Deviations by Fleet
0
# CV for F mult deviations by Fleet
0.5
# Lambda for N in 1st Year Deviations
0
# CV for N in 1st Year Deviations
1
# Lambda for Recruitment Deviations
0
# Lambda for Catchability in first year by index
0  0
# CV for Catchability in first year by index
1  1
# Lambda for Catchability Deviations by Index
0  0
# CV for Catchability Deviations by Index
1  1
# Lambda for Deviation from Initial Steepness
0
# CV for Deviation from Initial Steepness
1
# Lambda for Deviation from Initial unexploited Stock Size
0
# CV for Deviation from Initial unexploited Stock Size
1
# NAA for Year 1
100  90  80  70  60  50  40  30  20
# F mult in 1st year by Fleet
0.7
# Catchability in 1st year by index
1  1
# Initial unexploited Stock Size
1000
# Initial Steepness
1
# Maximum F
```

```
2.5
# Ignore Guesses
0
# Projection Control Data
# Do Projections? (1=yes, 0=no), still need to enter values even if not doing projections
0
# Fleet Directed Flag
1
# Final Year of Projections
2013
# Year Projected Recruits, What Projected, Target, non- directed F mult
2013    -1    4    0    1
# MCMC info
# doMCMC (1=yes)
0
# MCMCnyear option (0=use final year values of NAA, 1=use final year + 1 values of NAA)
0
# MCMCnboot
1000
# MCMCnthin
200
# MCMCseed
1415963
# R in agepro.bsn file (enter 0 to use NAA, 1 to use stock-recruit relation-ship, 2 to used geometric mean of previous years)
0
# Starting year for calculation of R
1993
# Starting year for calculation of R
2005
# Test Value
-23456
#####
# ---- FINIS ----
```

Table 7.4.5. Selectivity of the catches and indices. Catch selectivity was fixed at zero for age 0 and at one for ages 3–8; it was freely estimated for ages 1–2. Catch selectivity was the same for all years. For the FR_IR_IBTS survey the selectivity was fixed at 1 for all ages and for the IR_GAD commercial fleet selectivity was freely estimated for age 3 and fixed at 1 for the older ages.

Age	Catch	FR-IRL-IBTS	IRL-GAD
0	0	1	-
1	0.39	1	-
2	0.99	1	-
3	1	1	0.79
4	1	1	1
5	1	1	1
6	1	-	1
7	1	-	1
8+	1	-	-

Table 7.4.6. Haddock VIIb–k. Fishing mortality (F) at age.

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Fbar3-5
1993	0.00	0.44	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14
1994	0.00	0.44	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12
1995	0.00	0.36	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
1996	0.00	0.33	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
1997	0.00	0.28	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
1998	0.00	0.30	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
1999	0.00	0.22	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
2000	0.00	0.27	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
2001	0.00	0.27	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
2002	0.00	0.51	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
2003	0.00	0.26	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
2004	0.00	0.31	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
2005	0.00	0.32	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
2006	0.00	0.21	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
2007	0.00	0.17	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
2008	0.00	0.30	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
2009	0.00	0.24	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
2010	0.00	0.25	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
2011	0.00	0.22	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
2012	0.00	0.36	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Fbar	0.00	0.30	0.78	0.78	0.78	0.78	0.78	0.78	0.78	

Table 7.4.7. Haddock VIIb–k. Stock numbers-at-age (start of year) ('1000).

Year	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
1993	105044	49306	12051	2779	780	247	253	220	68
1994	364916	39032	15422	2123	541	163	53	56	65
1995	502667	135594	12289	2763	420	115	36	12	28
1996	139106	186779	46277	2709	673	110	31	10	11
1997	69534	51688	65128	10778	697	186	31	9	6
1998	144567	25837	19007	17389	3180	221	61	10	5
1999	391231	53718	9284	4782	4835	948	68	19	5
2000	377376	145372	21024	2909	1656	1796	363	27	10
2001	424171	140224	54049	5774	883	539	602	125	13
2002	746077	157612	51976	14728	1739	285	179	207	48
2003	202417	277225	46202	7750	2427	307	52	34	48
2004	259653	75214	104598	13178	2443	821	107	19	30
2005	247711	96481	26886	25966	3615	719	249	33	16
2006	182215	92044	33974	6422	6854	1024	210	75	15
2007	663176	67707	36403	10937	2285	2615	402	85	37
2008	341849	246421	27929	13056	4335	971	1146	182	56
2009	1556140	127023	89342	7190	3715	1323	305	371	78
2010	205776	578226	48839	26747	2379	1318	484	115	172
2011	77212	76462	218346	13959	8449	806	460	174	105
2012	23796	28690	29882	68167	4816	3127	307	181	112
2013	0	8842	9724	6469	16310	1236	827	84	81

Table 7.4.8. Stock Summary for haddock in VIIb–k. Weights in tonnes, recruitment-at-age 0 in thousands.

Year	Landings	Discards	Catch	Predicted Catch	TSB	SSB	CV	Fbar 3–5	CV	Recruits age 0	CV
1993	3348	1208	4557	4857	16421	7529	18%	1.136	28%	105044	22%
1994	4131	1886	6017	5338	26534	7578	18%	1.119	22%	364916	19%
1995	4470	2218	6688	6429	42977	6526	22%	0.912	25%	502667	16%
1996	6756	4309	11064	11844	42664	17587	25%	0.857	25%	139106	20%
1997	10827	2883	13710	12661	33897	25842	23%	0.721	23%	69534	22%
1998	7668	934	8603	9030	27499	19670	20%	0.78	24%	144567	20%
1999	4882	586	5468	5575	28521	12087	19%	0.56	28%	391231	18%
2000	7411	2503	9913	9926	40572	14683	16%	0.692	26%	377376	21%
2001	8632	3418	12050	14825	48877	25382	16%	0.7	29%	424171	18%
2002	6403	7073	13476	22148	64929	32082	17%	1.303	22%	746077	14%
2003	8210	9456	17666	15976	59586	21940	18%	0.654	25%	202417	16%
2004	8634	6750	15384	20467	57105	38793	17%	0.793	23%	259653	14%
2005	6590	5191	11781	13482	48522	25946	21%	0.832	22%	247711	13%
2006	5408	2484	7893	9804	42008	20550	17%	0.533	28%	182215	15%
2007	6732	2739	9471	7993	58823	21815	15%	0.425	25%	663176	11%
2008	7334	11187	18521	14573	70472	20796	16%	0.757	17%	341849	14%
2009	9561	9080	18641	15406	122027	32216	15%	0.606	18%	1556140	11%
2010	10135	16547	26682	24849	114928	32478	14%	0.652	18%	205776	18%
2011	12898	14378	27276	28593	85690	72429	14%	0.564	18%	77212	24%
2012	18501	10191	28691	28237	55765	50873	12%	0.93	22%	23796	40%
Mean 09-11								0.715			
GM 93-010										290479	

Table 7.4.9. Input values for short-term forecast (.prd).

MFDP VERSION 1A						
Run: mfdp						
Time and date: 16:16 11/05/2013						
Fbar age range (Total) : 5-5						
Fbar age range Fleet 1 : 5-5						
2013						
Age	N	M	Mat	PF	PM	SWt
0	290479	0.99	0	0	0	4.07E-02
1	8842	0.72	0	0	0	0.132333
2	9724	0.6	1	0	0	0.253667
3	6469	0.5	1	0	0	0.519333
4	16310	0.43	1	0	0	0.891
5	1236	0.4	1	0	0	1.385
6	827	0.37	1	0	0	1.896667
7	84	0.36	1	0	0	2.299333
8	81	0.34	1	0	0	2.146333
CATCH						
Age	Sel	CWt	DSel	DCWt		
0	0	0	0	4.27E-02		
1	2.92E-03	0.386333	0.275749	0.129667		
2	8.30E-02	0.535667	0.632291	0.226		
3	0.469607	0.727667	0.2457	0.329667		
4	0.641084	1.094667	0.07425	0.394333		
5	0.715333	1.609667	0	0		
6	0.715333	2.008	0	0		
7	0.715333	1.989333	0	0		
8	0.715333	1.797	0	0		
2014						
Age	N	M	Mat	PF	PM	SWt
0	290479	0.99	0	0	0	4.07E-02
1	.	0.72	0	0	0	0.132333
2	.	0.6	1	0	0	0.253667
3	.	0.5	1	0	0	0.519333
4	.	0.43	1	0	0	0.891
5	.	0.4	1	0	0	1.385
6	.	0.37	1	0	0	1.896667
7	.	0.36	1	0	0	2.299333
8	.	0.34	1	0	0	2.146333

CATCH						
Age	Sel	CWt	DSel	DCWt		
0	0	0	0	4.27E-02		
1	2.92E-03	0.386333	0.275749	0.129667		
2	8.30E-02	0.535667	0.632291	0.226		
3	0.469607	0.727667	0.2457	0.329667		
4	0.641084	1.094667	0.07425	0.394333		
5	0.715333	1.609667	0	0		
6	0.715333	2.008	0	0		
7	0.715333	1.989333	0	0		
8	0.715333	1.797	0	0		
2015						
Age	N	M	Mat	PF	PM	SWt
0	290479	0.99	0	0	0	4.07E-02
1	.	0.72	0	0	0	0.132333
2	.	0.6	1	0	0	0.253667
3	.	0.5	1	0	0	0.519333
4	.	0.43	1	0	0	0.891
5	.	0.4	1	0	0	1.385
6	.	0.37	1	0	0	1.896667
7	.	0.36	1	0	0	2.299333
8	.	0.34	1	0	0	2.146333
CATCH						
Age	Sel	CWt	DSel	DCWt		
0	0	0	0	4.27E-02		
1	2.92E-03	0.386333	0.275749	0.129667		
2	8.30E-02	0.535667	0.632291	0.226		
3	0.469607	0.727667	0.2457	0.329667		
4	0.641084	1.094667	0.07425	0.394333		
5	0.715333	1.609667	0	0		
6	0.715333	2.008	0	0		
7	0.715333	1.989333	0	0		
8	0.715333	1.797	0	0		
Input units are thousands and kg - output in tonnes						

Table 7.4.10. Management options table (.prm).

MFDP version 1a								
Run: mfdp2								
Time and date: 18:49 14/05/2013								
Fbar age range (Total) : 3-5								
Fbar age range Fleet 1 : 3-5								
2013								
		"CATCH"	Landings		Discards			
Biomass	SSB	FMult	FBar	Yield	FBar	Yield		
36989	24006	1	0.6087	10061	0.1066	1560		
2014							2015	
		"CATCH"	Landings		Discards			
Biomass	SSB	FMult	FBar	Yield	FBar	Yield	Biomass	SSB
38706	12610	0	0	0	0	0	51236	25140
.	12610	0.1	0.0609	755	0.0107	326	50054	23958
.	12610	0.2	0.1217	1461	0.0213	642	48939	22843
.	12610	0.3	0.1826	2122	0.032	949	47886	21789
.	12610	0.4	0.2435	2742	0.0427	1246	46891	20795
.	12610	0.5	0.3043	3322	0.0533	1535	45951	19854
.	12610	0.6	0.3652	3866	0.064	1815	45062	18966
.	12610	0.7	0.4261	4375	0.0747	2087	44221	18125
.	12610	0.8	0.4869	4852	0.0853	2350	43425	17329
.	12610	0.9	0.5478	5300	0.096	2607	42672	16576
.	12610	1	0.6087	5720	0.1066	2856	41959	15863
.	12610	1.1	0.6695	6113	0.1173	3097	41283	15187
.	12610	1.2	0.7304	6483	0.128	3332	40642	14546
.	12610	1.3	0.7913	6829	0.1386	3561	40034	13938
.	12610	1.4	0.8521	7155	0.1493	3783	39458	13361
.	12610	1.5	0.913	7460	0.16	3999	38910	12814
.	12610	1.6	0.9739	7747	0.1706	4209	38390	12294
.	12610	1.7	1.0347	8017	0.1813	4414	37896	11800
.	12610	1.8	1.0956	8270	0.192	4613	37426	11330
.	12610	1.9	1.1565	8508	0.2026	4806	36979	10883
.	12610	2	1.2173	8732	0.2133	4995	36554	10458

Table 7.4.11. Haddock VIIbc–ek. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Landings yield		
	Years Predicted	
Ages	2013	2014
0	0	0
1	6	77
2	241	81
3	1279	516
4	6814	802
5	858	3601
6	725	355
7	73	244
8	64	45
Tot Wt	10060	5721

SSB			
	Years Predicted		
Ages	2013	2014	2015
0	0	0	0
1	0	0	0
2	2467	826	10086
3	3360	1355	454
4	14532	1710	690
5	1712	7186	845
6	1569	768	3226
7	193	642	315
8	174	122	247
Tot Wt	24007	12609	15863

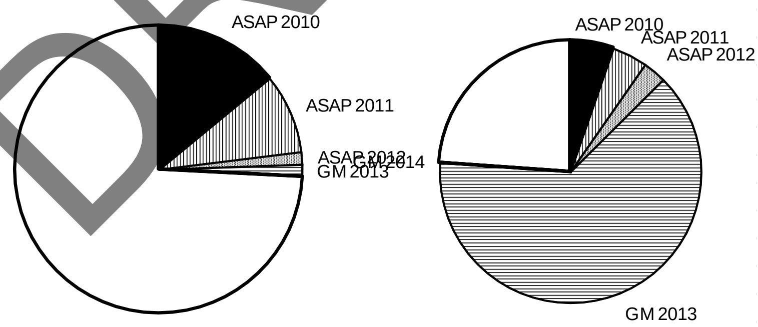
'09 coho '13 cohort

Year-class			2010	2011	2012	2013	2014
Recruits (thousands)			205776	77212	23796	290479	290479
Source			ASAP	ASAP	ASAP	GM	GM
Status Quo F:							
% in	2013	landings	12.7%	2.4%	0.1%	0.0%	-
% in	2014	landings	14.0%	9.0%	1.4%	1.3%	0.0%
% in	2013	SSB	14.0%	10.3%	0.0%	0.0%	-
% in	2014	SSB	13.6%	10.7%	6.6%	0.0%	0.0%
% in	2015	SSB	5.3%	4.3%	2.9%	63.6%	0.0%

GM : geometric mean recruitment

Haddock in VIIbc-ek : Year-class % contribution to

a) 2014 landings b) 2015 SSB



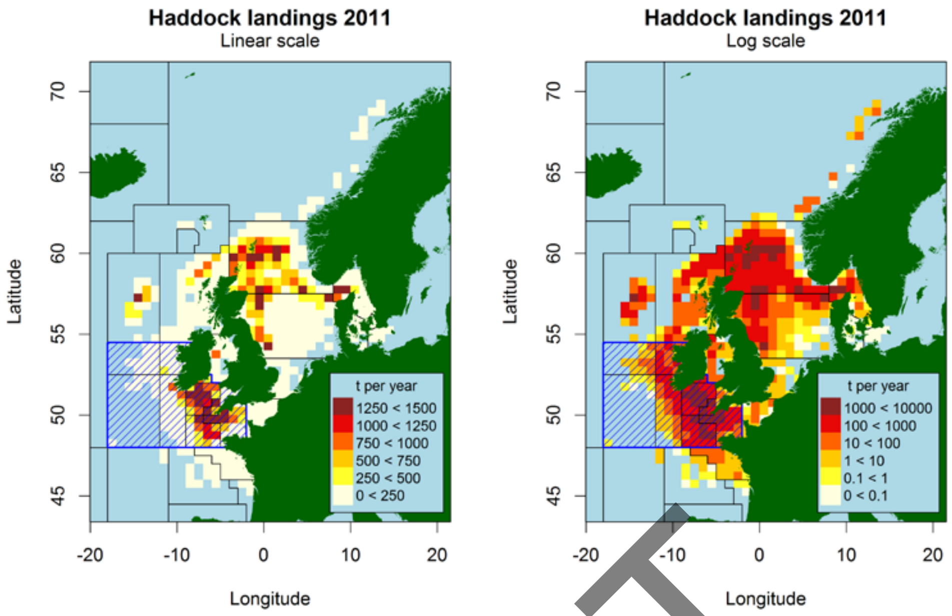


Figure 7.4.1. International haddock landings by ICES rectangle (all gears; 2011; data from STECF). The blue area indicates the assessment area. The figure on the left shows the landings on a linear scale, the figure on the right has a log scale.

a) b)

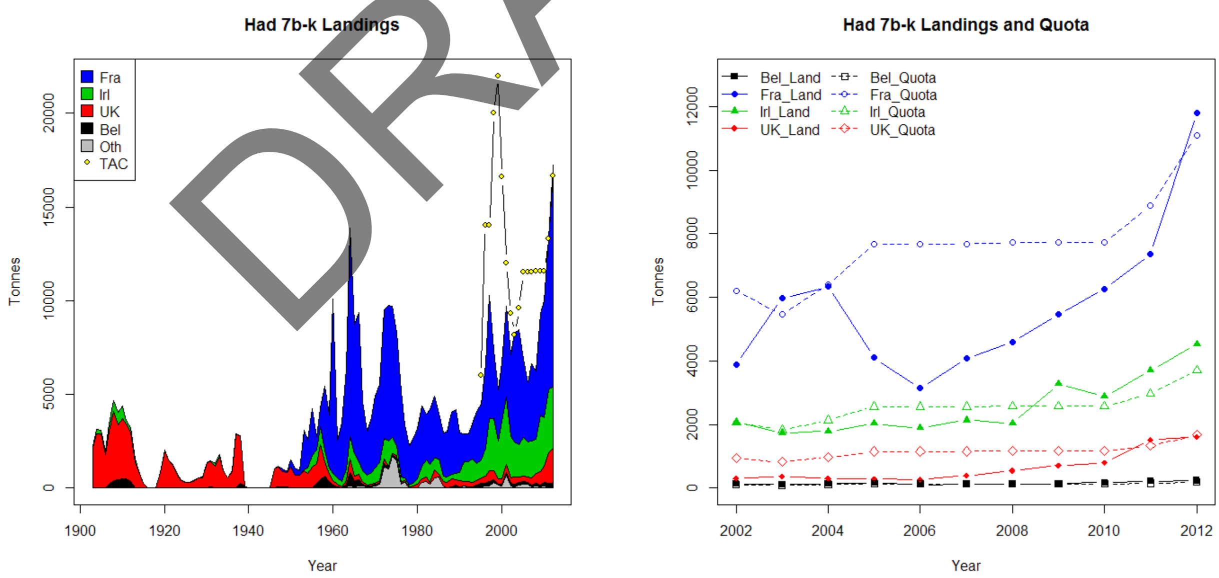


Figure 7.4.2. a) Official Ices landings and TAC of haddock in VIIb–k. b) Recent working group landings and quota by country.

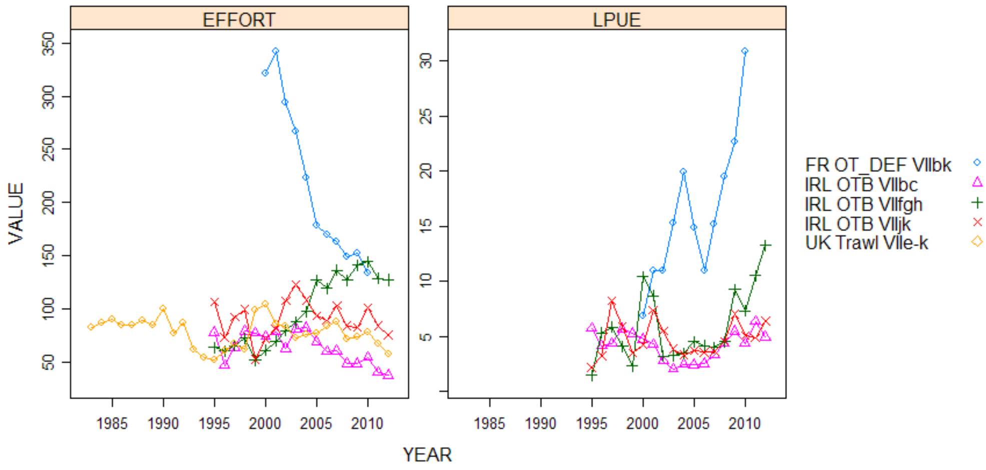


Figure 7.4.3. Effort ('1000h) of the Irish Otter trawl fleets, the French demersal otter trawl fleet and for UK trawl fleet and lpue (kg/h) for the Irish and French fleets.

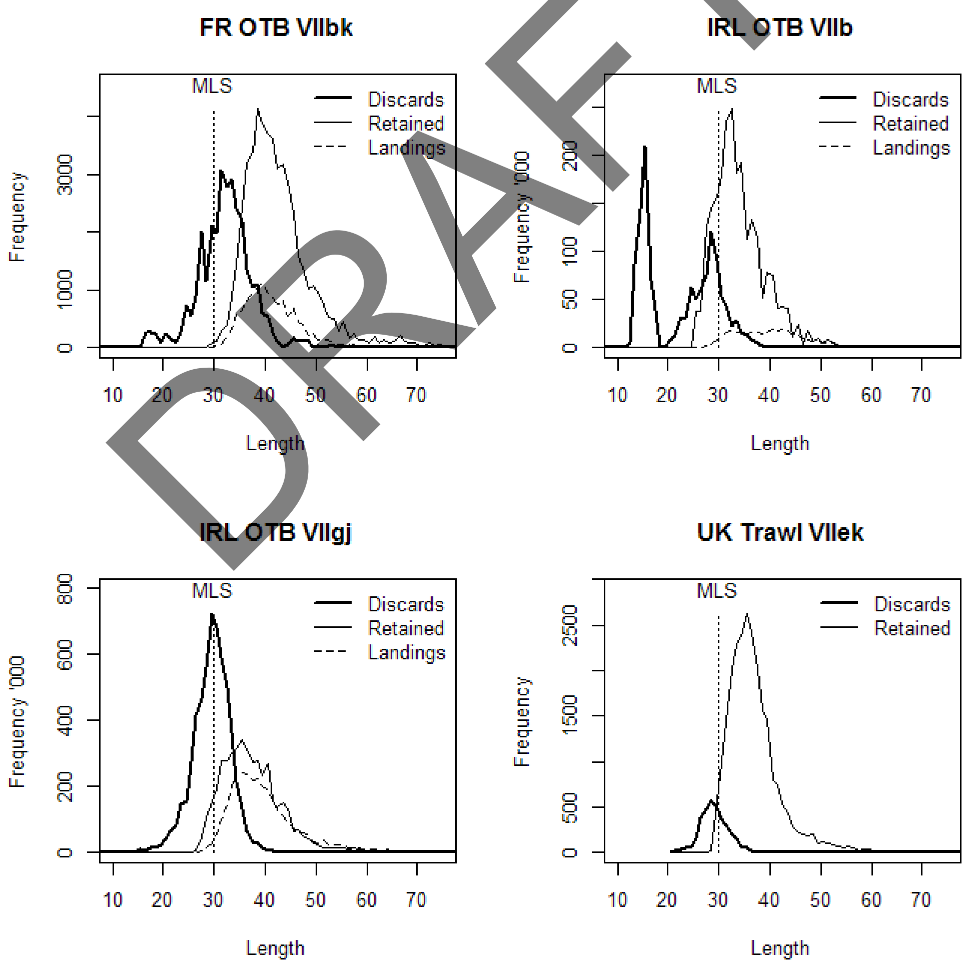


Figure 7.4.4. Length distributions of discards and the retained catch of haddock in VIIb–k in 2010. FR OTB is the French otter trawl fleet (demersal fish and *Nephrops* combined); IRL OTB is the Irish otter trawl fleet; UK trawl consists of all UK trawls except beam trawls. Irish and French data were raised to total numbers, the raised length distributions of the landings (from port sampling) is given for comparison.

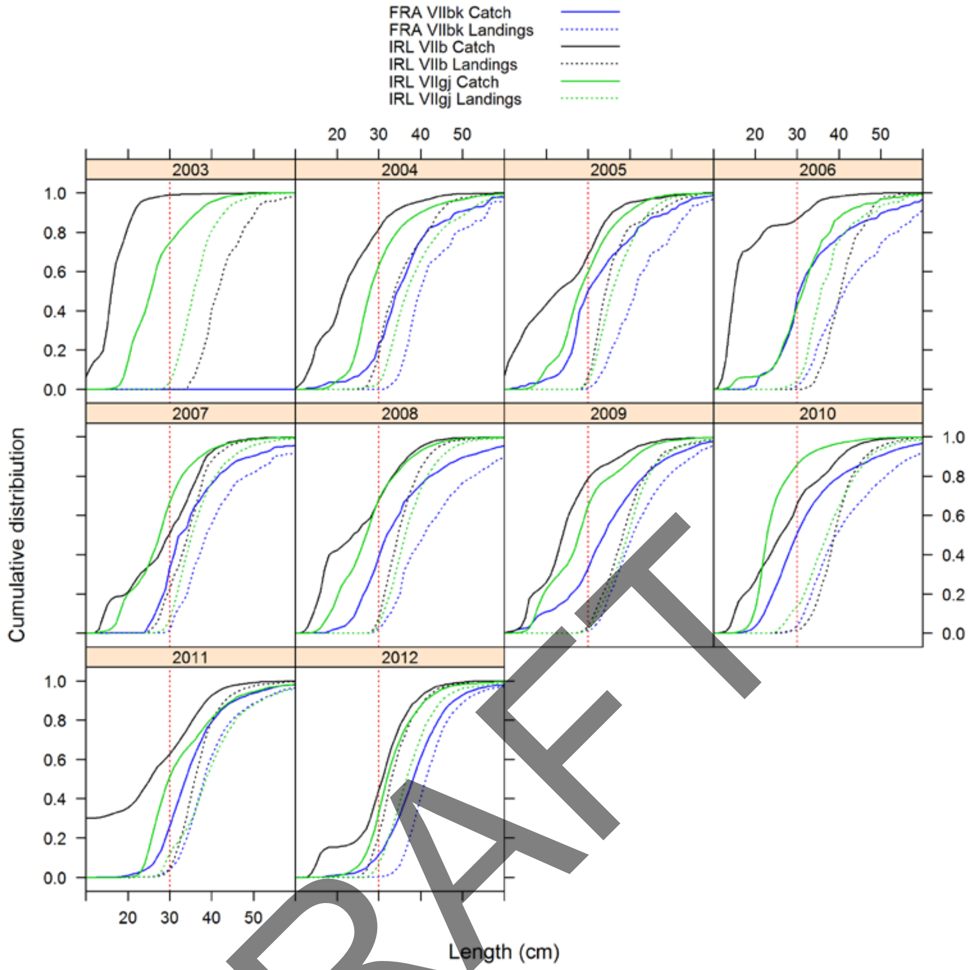


Figure7.4.5. Time-series of the cumulative length distributions of total catch and the retained catch of haddock in VIIb–k. The minimum landing size (30 cm) is indicated by the dotted red line.

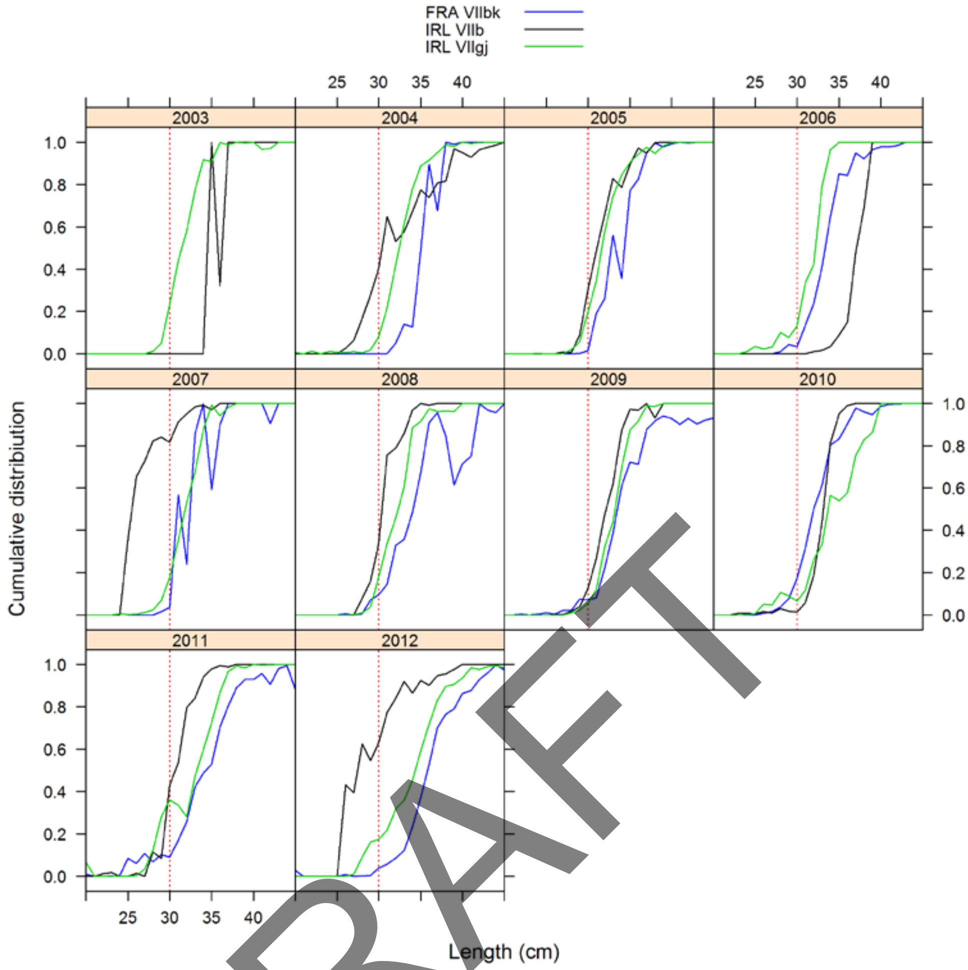


Figure7.4.6.Time-series of the discard ogives of haddock in VIIbc–ek. The minimum landing size (30 cm) is indicated by the dotted red line.

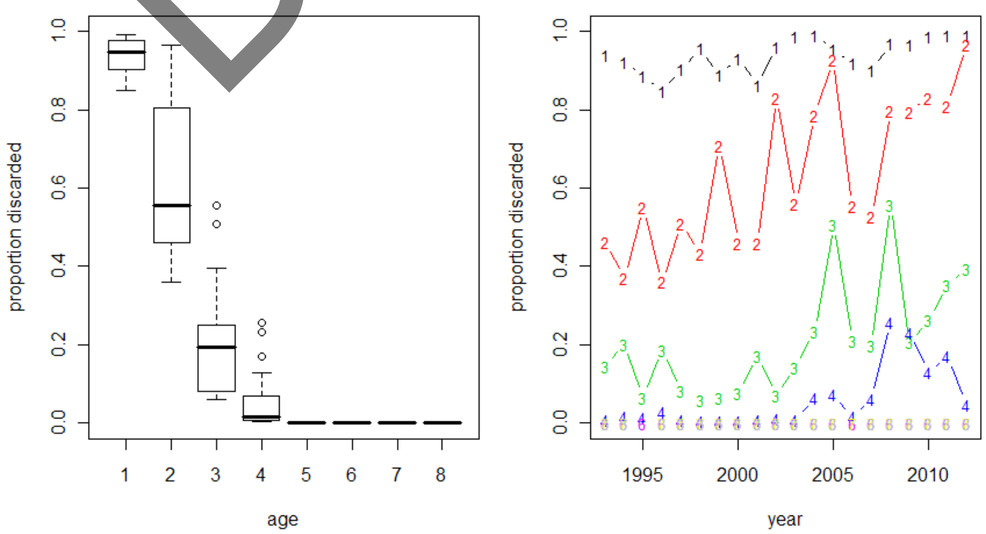


Figure7.4.7. Proportion of discards of haddock in VIIbc–ek by age (left) and year (right).

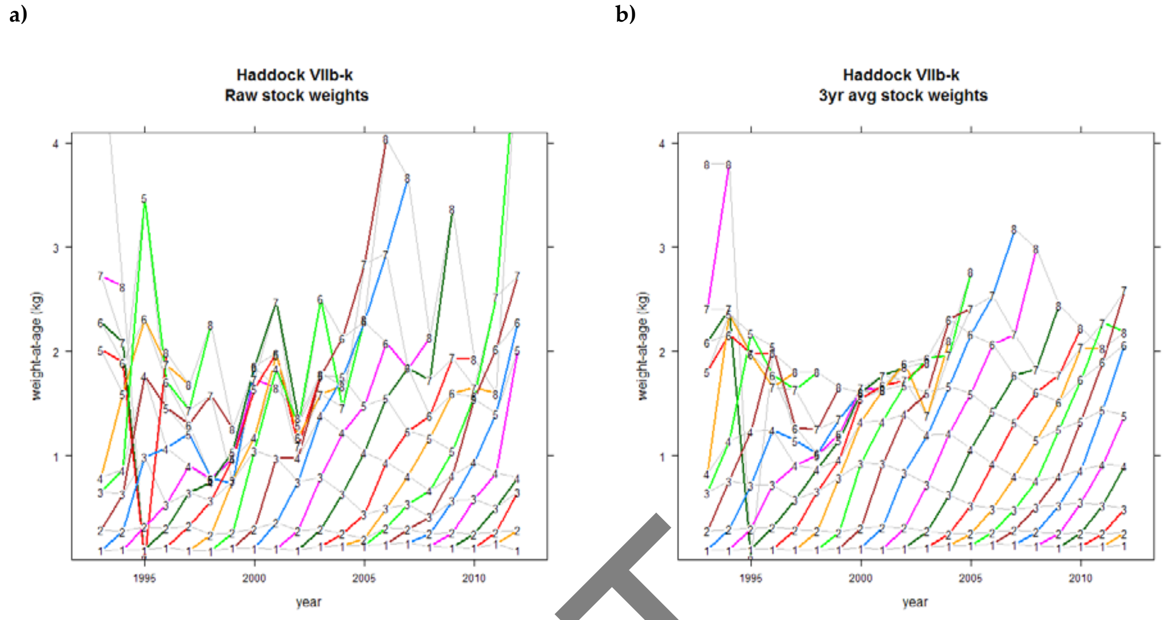
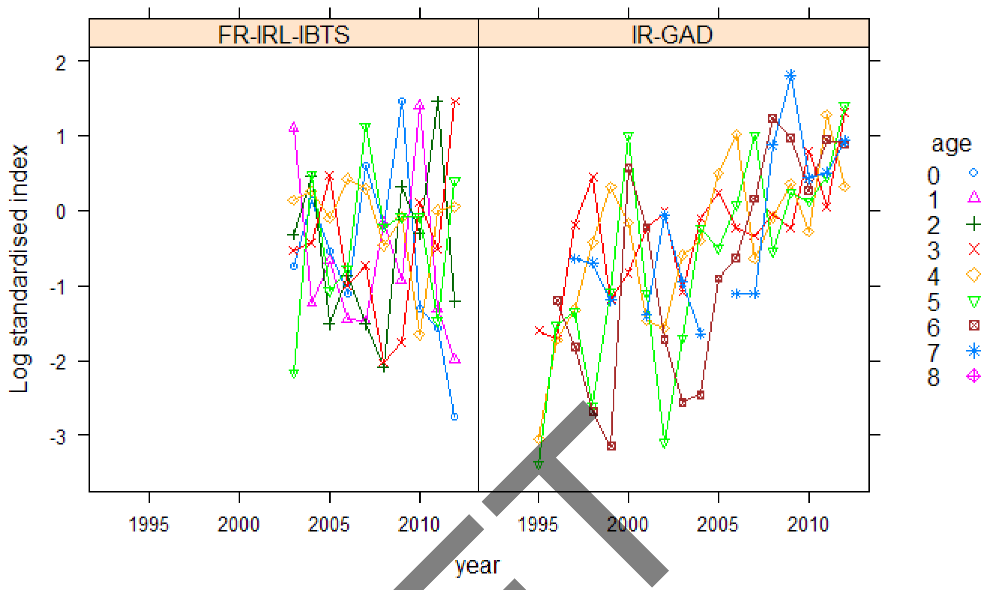


Figure7.4.8. Raw stock weights-at-age (a) and the three-year running average stock weights (b).

a)



b)

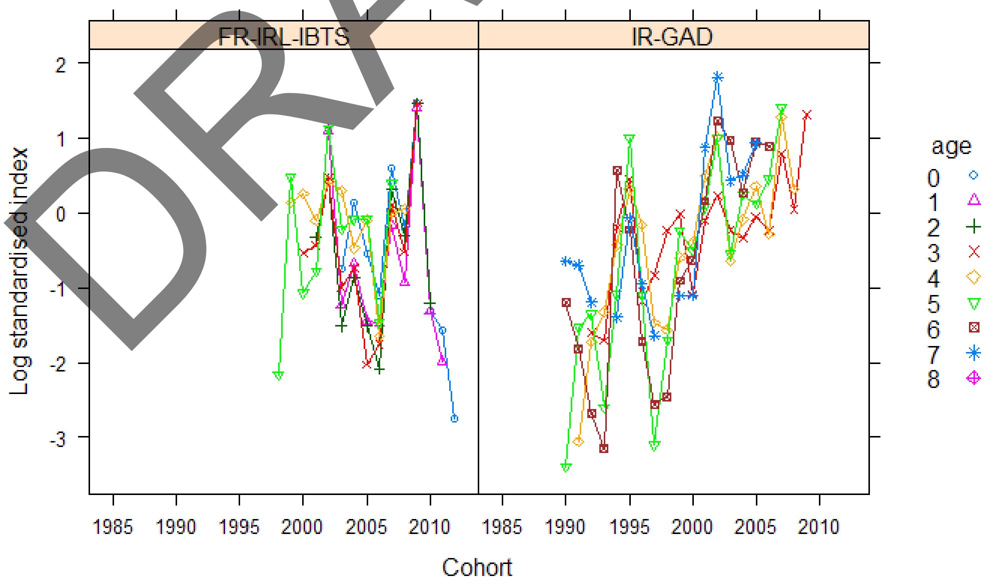


Figure 7.4.9. Log standardised indices of tuning fleets by year (a) and cohort (b).The FR-IRL-IBTS survey is the combined French EVHOE Q4 WIBTS and Irish IGFS Q4 WIBTS survey. The IR-GAD commercial tuning fleet is the Irish gadoid fleet in VIIgj.

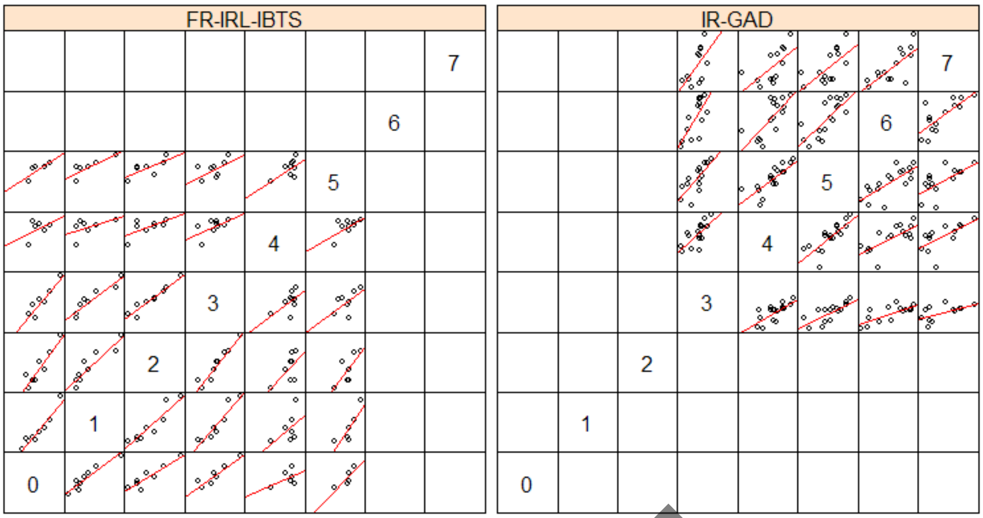


Figure 7.4.10. Scatterplot matrix of log indices of cohorts at different ages.

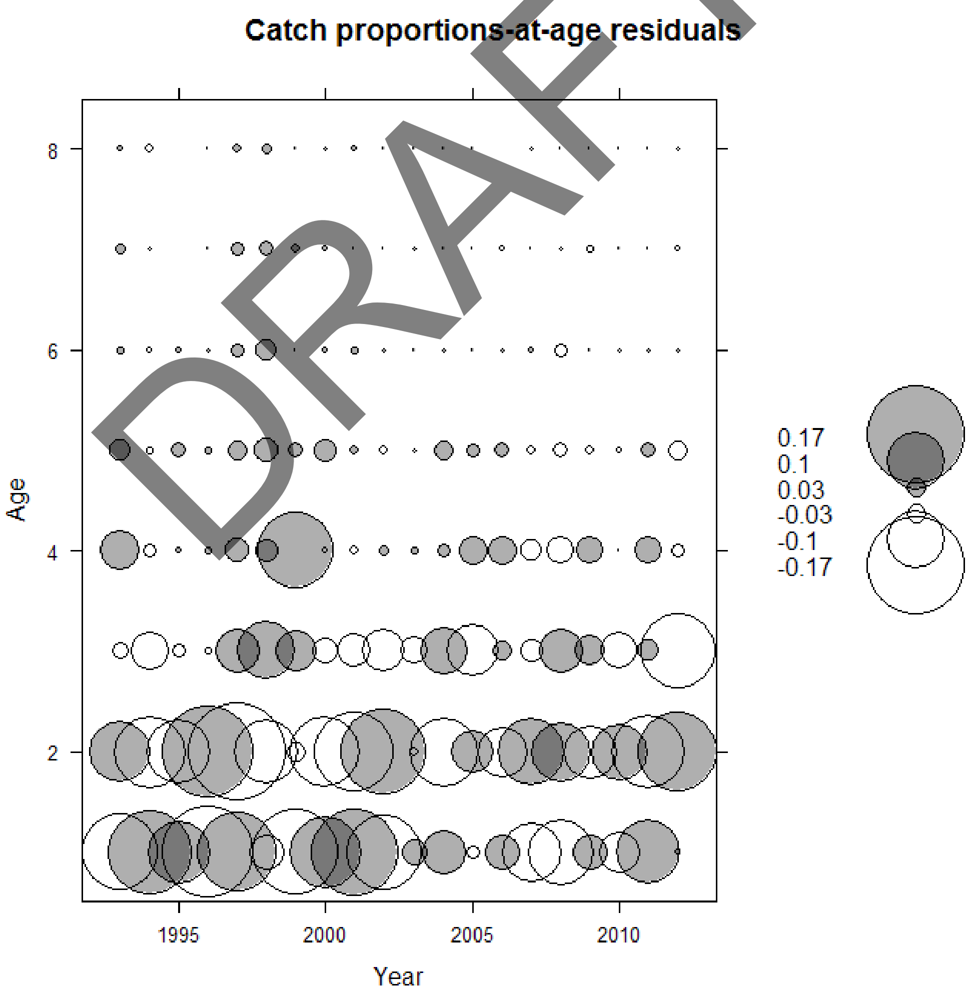


Figure 7.4.11. Catch proportions-at-age residuals (observed-predicted).

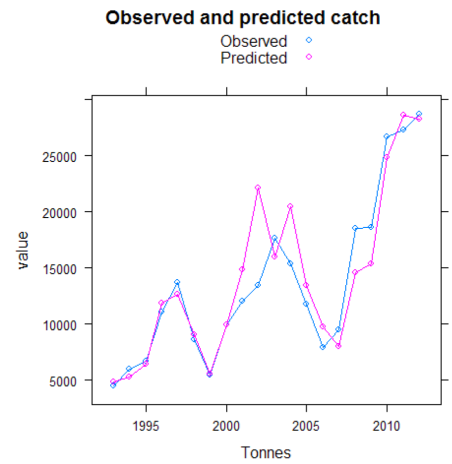


Figure 7.4.12. Observed and predicted catches (discards were included in the landings data).

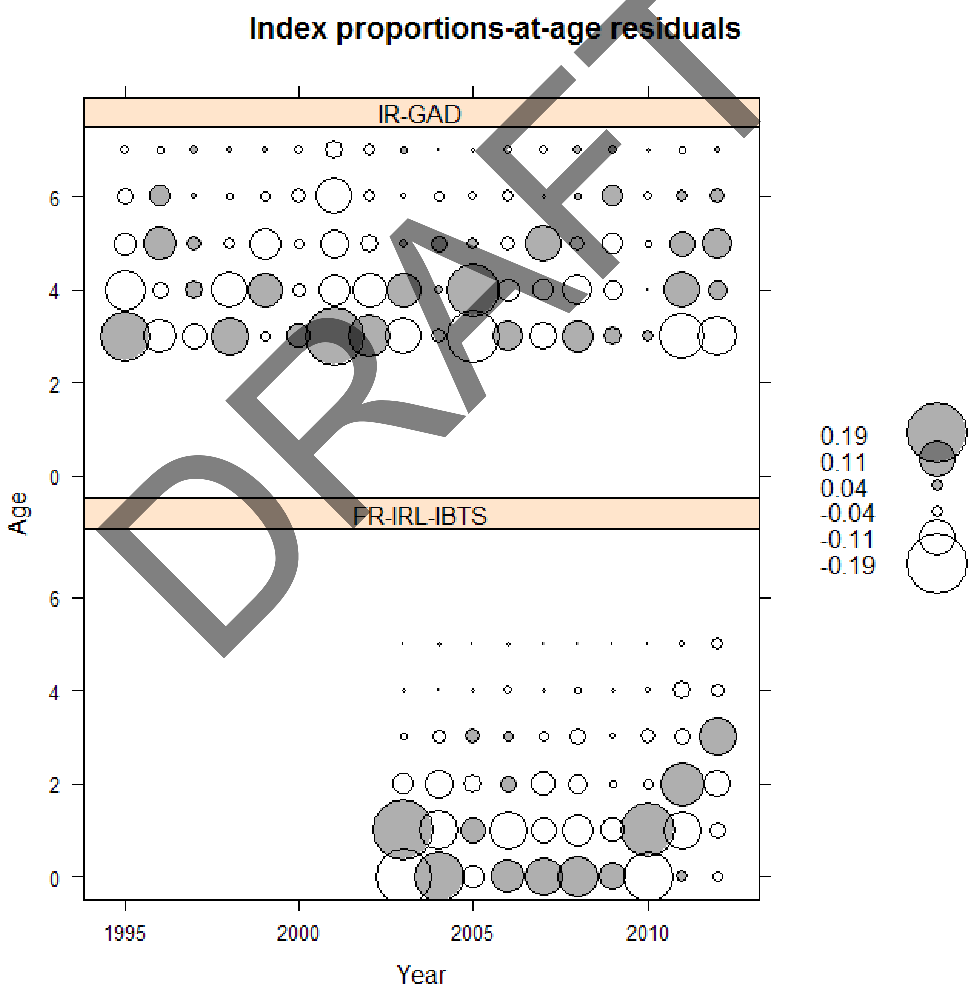


Figure 7.4.13a. Index proportions-at-age residuals (observed – predicted).

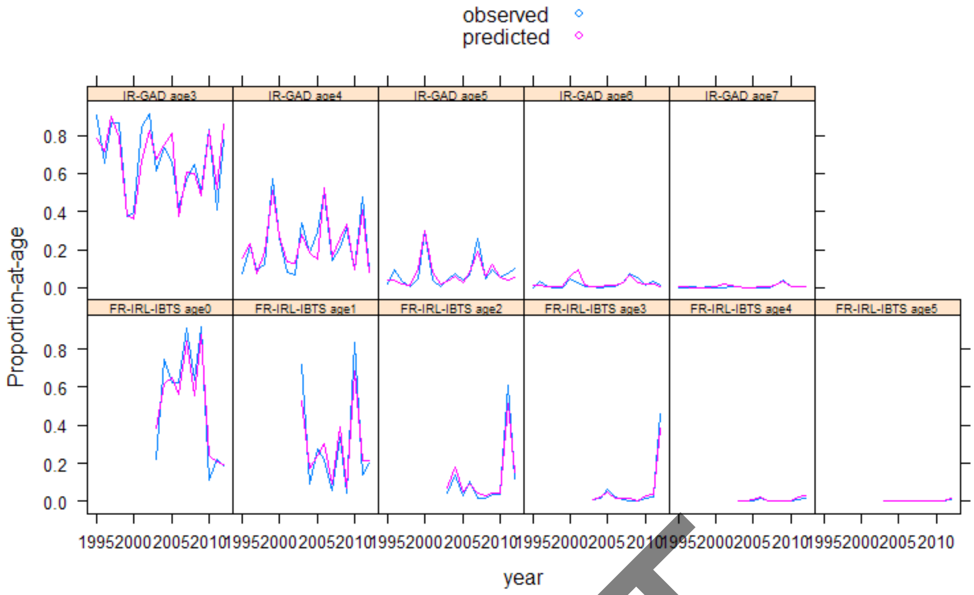


Figure 7.4.13b. Index proportions-at-age observed and predicted values

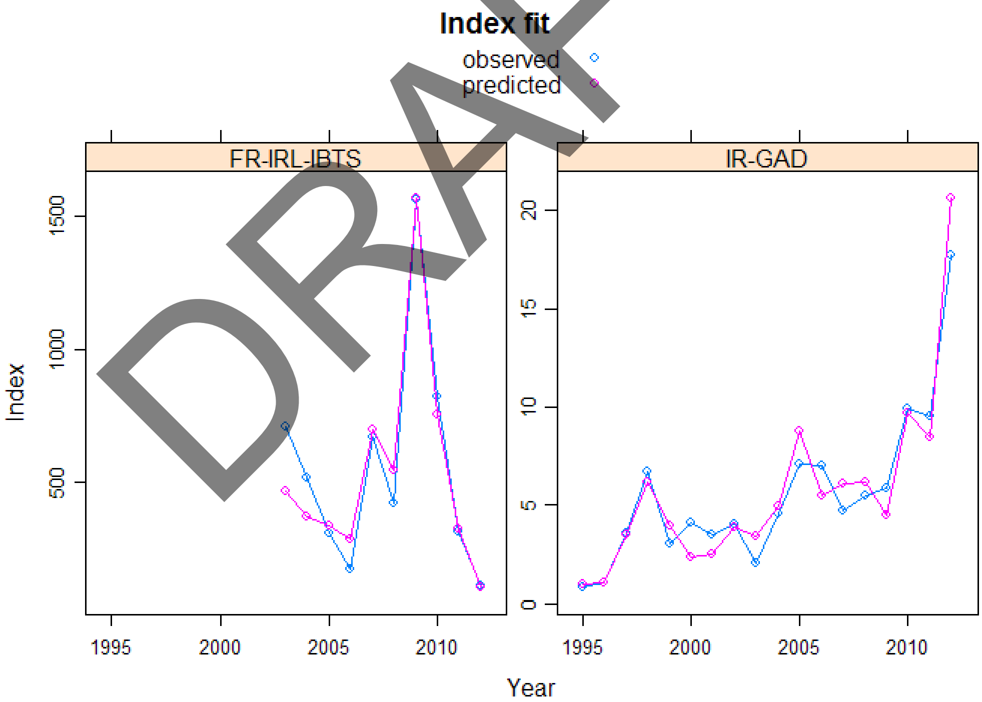


Figure 7.4.14. Observed and predicted index cpue.

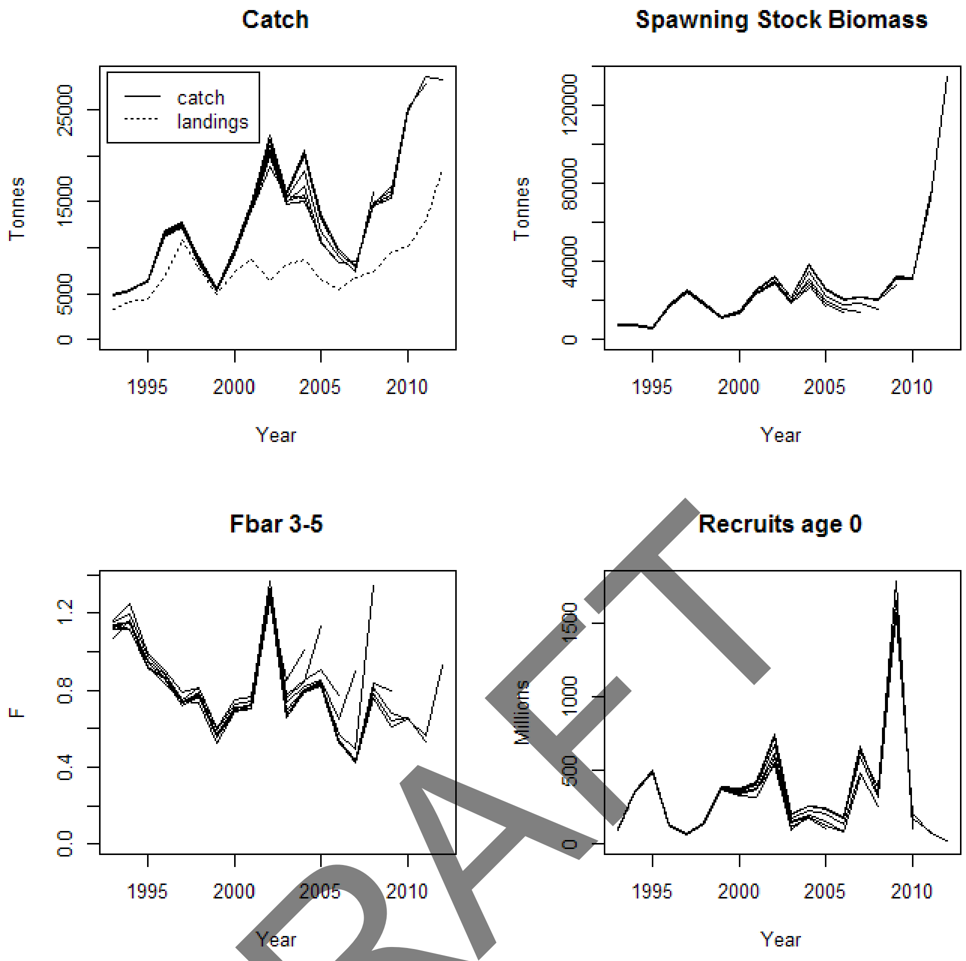


Figure 7.4.15. Retrospective analysis of the final ASAP run. Note that the survey index only started in 2003.

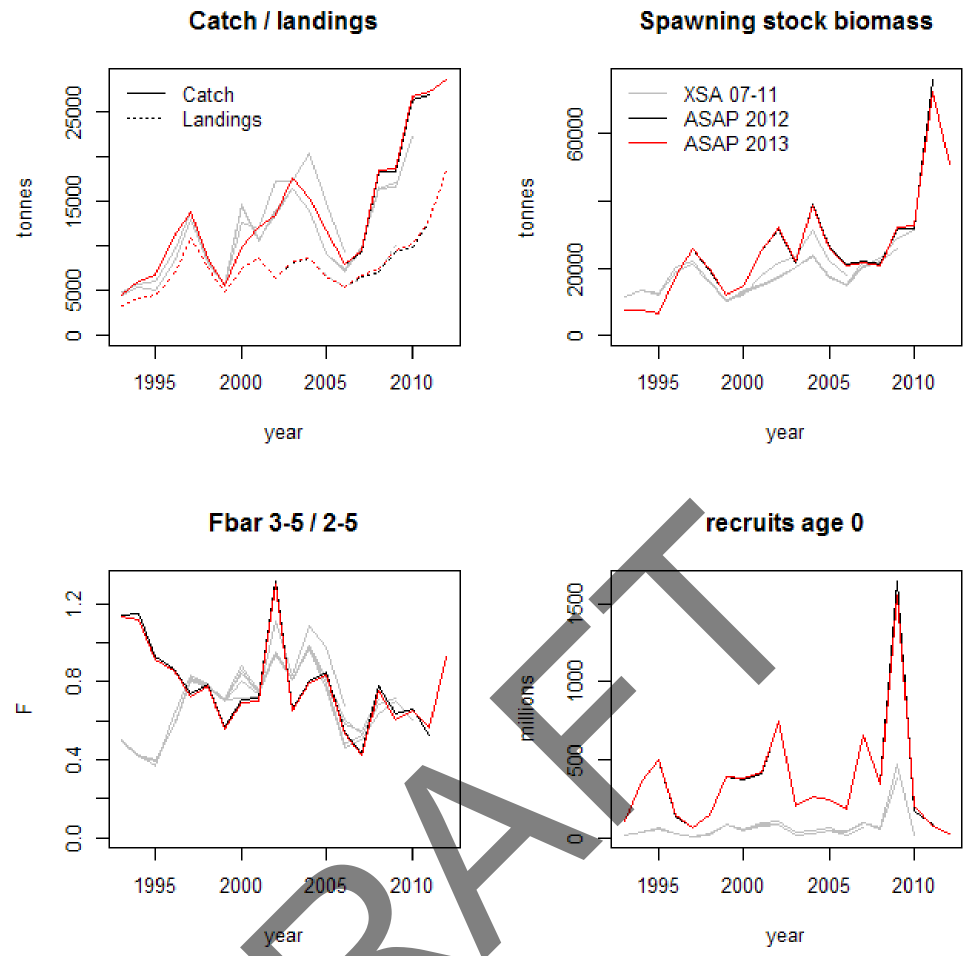


Figure 7.4.16. Comparison of the 2012 ASAP assessment (red) with historic assessments (ASAP in black; XSA in grey). The FBAR range was 3–5 for the ASAP assessments and 2–5 for the XSAs. The natural mortality assumption for the ASAP is much higher for young ages than the assumed M for the historic XSAs.

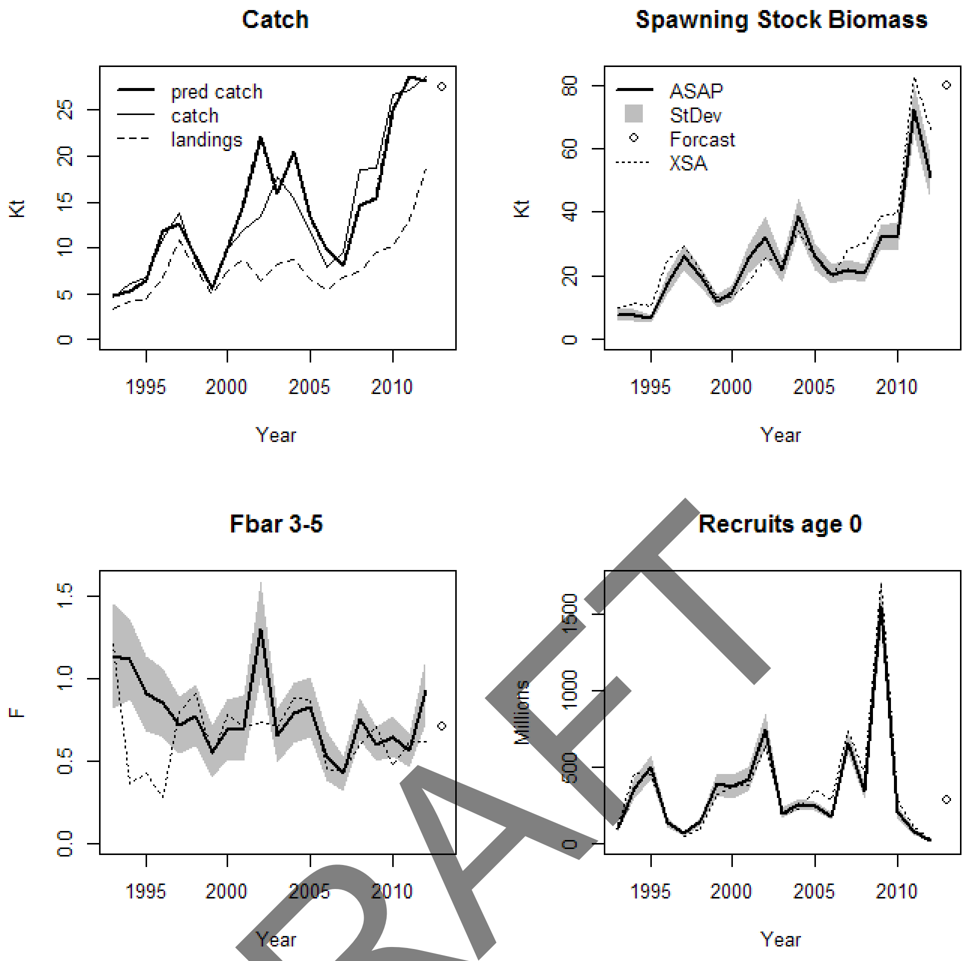


Figure 7.4.17. Stock summary plot. The thick black line represents the ASAP assessment standard deviations from ASAP are shaded grey. The forecast/ assumed values for 2012 are given by open circles. The thick black line in the catch plot represents the predicted catch from ASAP. The dotted line in the SSSB, FBAR and recruitment plots represents the XSA assessment with the same input data.

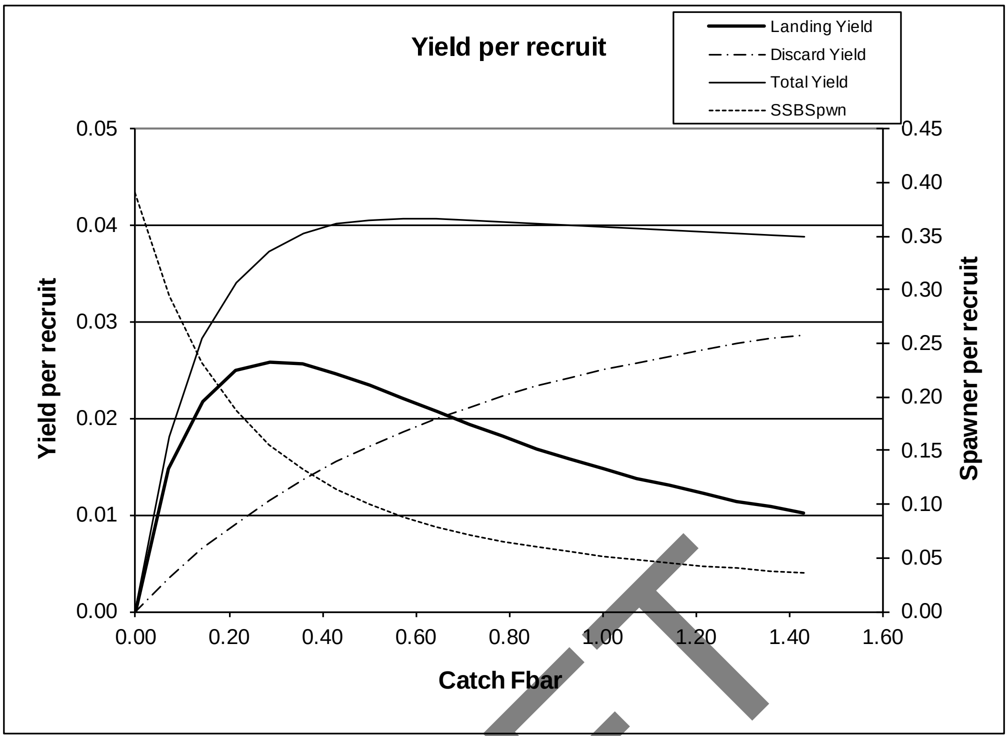


Figure 7.4.18. Yield-per-recruit analysis. F_{MAX} of the landings is 0.30 and $F_{0.1}$ of the landings is 0.21.

7.5 *Nephrops* in Division VIIb (Aran Grounds, FU17)

Type of assessment in 2013

UWTV based assessment using WK*NEPH* 2009 protocol as described in the stock annex. This year long-term reference points have been examined for this stock. Further description on the background is presented in Section 7.5.2.

ICES advice applicable to 2012

"ICES advises on the basis of the MSY approach that landings in 2012 should be no more than 1100 t."

ICES advice applicable to 2013 (June)

"ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 890 tonnes."

ICES advice applicable to 2013 (November)

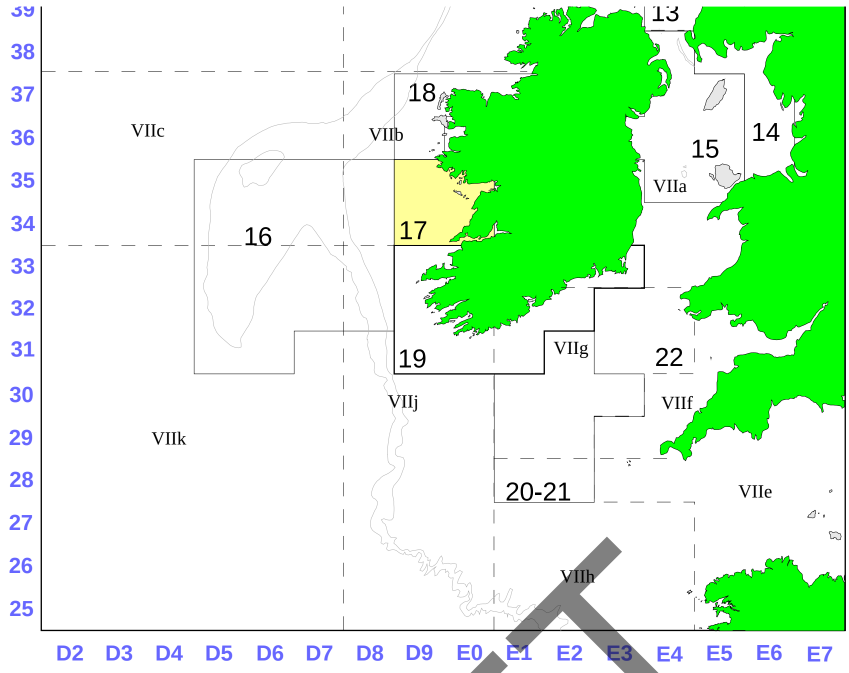
The advice was updated in November 2012 to take account of the most recent UWTV survey information.

"ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 590 *tonnes."*

7.5.1 General

Stock description and management units

The Aran Grounds *Nephrops* stock (FU17) covers ICES rectangles 34–35 D9–E0 within VIIb. This stock is included as part of the TAC Area VII *Nephrops* which includes the following stocks: Irish Sea East and West (FU14, FU15), Porcupine Bank (FU16), northwestern Irish Coast (FU18), southeastern and southwestern Irish Coast (FU19) and the Celtic Sea (FU20–22).



The TAC is set for Subarea VII which does not correspond to the stock area (FU 17 is shaded light yellow). There is no evidence that the individual functional units belong to the same stock. The 2013 TAC is 23 065 t, an increase of about 6 %compared to 2012 TAC. No FU17 specific restrictions in TAC apply thus, up to 100% of the Area VII TAC could, in theory be taken within FU17.

Management applicable to 2012 and 2013

COUNCIL REGULATION (EU) No 43/2012 of 17 January 2012 fixing for 2012 the fishing opportunities available to EU vessels for certain fish stocks and groups of fish stocks which are not subject to international negotiations or agreements.

TAC in 2012

Species: Norway lobster *Nephrops norvegicus*		Zone: VII (NEP/07.)
Spain	1 306 (1)	
France	5 291 (1)	
Ireland	8 025 (1)	
United Kingdom	7 137 (1)	
Union	21 759 (1)	
TAC	21 759 (1)	Analytical TAC Article 11 of this Regulation applies.

(1) Special condition: of which no more than the following quotas may be taken in VII (Porcupine Bank – Unit 16) (NEP/*07U16):

Spain	380
France	238
Ireland	457
United Kingdom	185
Union	1 260

COUNCIL REGULATION (EU) No 39/2013 of 21 January 2013 fixing for 2013 the fishing opportunities available to EU vessels for certain fish stocks and groups of fish stocks which are not subject to international negotiations or agreements.

TAC in 2013

Species: Norway lobster *Nephrops norvegicus*		Zone: VII (NEP/07.)
Spain	1 384 (1)	
France	5 609 (1)	
Ireland	8 506 (1)	
United Kingdom	7 566 (1)	
Union	23 065 (1)	
TAC	23 065 (1)	Analytical TAC Article 11 of this Regulation applies.

(1) Special condition: of which no more than the following quotas may be taken in Functional Unit 16 of ICES Subarea VII (NEP/*07U16):

Spain	543
France	340
Ireland	653
United Kingdom	264
Union	1 800

The MLS implemented by EC is set at 25 mm CL i.e. 8.5 cm total length and this regulation is applied by the Irish and UK fleets whereas a more restrictive regulation adopted by the French Producers' Organisations (35 mm CL i.e. 11.5 cm total length) is applied by the French trawlers.

Ecosystem aspects

This section is detailed in stock annex.

Fishery description

Since 1996 the Republic of Ireland fleet had over 99% of the landings from this FU. A description of the fleet is given in the Stock Annex. 53 Irish trawlers reported landings from this FU in 2012. This is about a 47% increase compared with the number of vessels reporting in 2009. In addition, 27 of these vessels reported landings in excess of 10 t. The majority of these vessels are based in the port of Ros-a-Mhíl. Recently vessels from the ports of Clogherhead and Dunmore-East also fish the Aran grounds in peak times of the early summer and also the winter months Vessel lengths range from 13 to 38 m and engine power ranges from 120–870 kW (See stock annex). The majority of vessels are in the 20–25 m length range and make fishing trips between 3-7 days in duration. The majority of the landings are made with 80 mm mesh.

The majority of the landings come from the grounds to the west and southwest of the Aran Islands known as the 'back of the Aran ground' (See stock annex). The fishery on the Aran Grounds operates throughout the year, weather permitting with a seasonal trend (Figure A.2.5).

Fishery in 2012

The 2012 landings increased by about 90 % from those made in 2011 and amounted to 1135 t In recent years several newer vessels specializing in *Nephrops* fishing have participated periodically in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. There has been a trend for Irish vessels to switch to multi (quad) rig trawls. Provisional data suggests a ~30% increase in *Nephrops* catch rates and a reduction in fish bycatch of ~30% due to the lower headline height.

7.5.2 Data

Sampling of landings and discards resumed in 2008 after a break of two years (2006–2007) in the sampling programme. This break was due to non-cooperation with sampling by the fishing industry. Sampling levels in 2012 were good and are detailed in Section 2 (Table 2.1). Historical data availability and quality is reported in the stock annex (Section B).

Landings

The reported landings time-series is shown in Figure 7.5.1 and Table 7.5.1. The reported Irish landings from FU17 have fluctuated around 800 t in the recent years. There are concerns about the accuracy of reported landings statistics for *Nephrops* by Irish vessels due to restrictive quotas and various misreporting practices. The introduction of sales notes and increased control and enforcement since 2007 should improve the accuracy of reported landings data. In 2012 landings have increased by about 90%. 27 vessels reported landings from FU17 and these accounted for 90% of the landings.

Commercial cpue

Effort data for this FU is available from 1995 for the Irish otter trawl *Nephrops* directed fleet. In 2012 this fleet accounted for ~95% of the landings compared with an average of 70% over the time period. These data have not been standardized to take into account vessel or efficiency changes during the time period. Effort shows a declining trend since late 1990s and in 2012 effort increased and is just below the recent series average (Table 7.5.2.). Landings per unit of effort (lpues) increased in the mid-2000s and has remained at a high level since then. Lpue in 2012 was the highest observed in the time-series at 70 kg/hr (Figure 7.5.2).

Discarding

Before 2001 there was no discard sampling and it was reported that *Nephrops* discarding in this fishery was relatively low. Since 2001 discard rates have been estimated using unsorted catch and discards sampling (as described in the stock annex). Discard rates range between 7–30% of total catch by weight and 12–40% of total catch by number (Table 7.5.3). Discard rate of females tends to be higher due to the smaller average size and market reasons. There is no information on discard survival rate in this fishery (10% is assumed). No estimates of discards were available in 2006 and 2007 due to the non-cooperation of the fishing industry with sampling programmes. The 2012 discard rate is the lowest in the series.

Discarding by the *Nephrops* trawl fleet is around 47% of the total catch by weight (Table 7.5.4). The main discards are small whole *Nephrops*. The main fish species discarded are dogfish, haddock, whiting and megrim (Anon, 2011).

Biological sampling

The Irish sampling programme resumed in 2008 and since then coverage and intensity has been very good. The mean size of whole *Nephrops* (>35 mm) in Irish landings has remained stable between 1995 and 2000 for both sexes (Figure 7.5.3 and Table 7.5.5.). The mean size of *Nephrops* in the catch has remained relatively stable since 2001.

The sex ratio in the landings has fluctuated with a slight male bias in most years (Figure 7.5.4). The proportion of males was higher in 2009 due an increased proportion of the landings taken in autumn. Conversely in 2011 the majority of the landings were made in Q2 when the catches are dominated by female *Nephrops* (see Fishery in 2009 WGCSE Report 2010).

There is no change to other biological parameters as described in the stock annex.

Abundance indices from UWTV surveys

WK*NEPH* 2009 concluded that this survey could be used as an absolute index of abundance for this stock provided the bias (see text table below) was taken into account (ICES, 2009). These bias sources are not easily estimated and are largely based on expert opinion. In the Aran Grounds the largest source of perceived bias is the "edge effect". The bias correction factor is in line with other stocks with similar density e.g. FU11 = 1.33 and FU12 = 1.32 (ICES, 2009).

FU	Area	Edge effect	detection rate	species identification	Occupancy	Cumulative bias
17	Aran	1.35	0.9	1.05	1	1.3

SGNEPS 2012 recommended that a CV (or relative standard error) of <20% is an acceptable precision level for UWTV survey estimates of abundance. This allowed sampling intensity to be reduced from around 75 stations in the past to 31 on the Aran grounds in 2012 which allowed survey coverage of other FUs. A randomised isometric grid design was employed with UWTV stations at 3.5 nmi (6.5 km) intervals, whereas previously a 2.25 nmi square grid was used. The 2012 krigged burrow abundance estimate declined by 34% relative to 2011 with a CV (or relative standard error) of 5%.

The blanked krigged contour plot and posted point density data are shown in Figure 7.5.5. The krigged contours correspond very well to the observed data. In general the densities are higher towards the western side of the ground and there is a notable trend towards lower densities to the east. Densities and abundance have fluctuated considerably in the time-series (e.g. 0.4–1.4 burrows/m^2). The mean density in 2012 is approximately 35% decrease on 2011 and is the lowest observed during the the time-series.

The summary statistics from this geostatistical analysis are given in Table 7.5.6 and plotted in Figure 7.5.6. The statistical analysis follows these steps documented in WD 22 (Annex 3, Working Document 22): annual variograms were used to create krigged grid files and the resulting cross-validation data were plotted. If the results looked reasonable then surface plots of the grids were made using a standardised scale. The final part of the process was to limit the calculation to a fixed ground boundary using a blanking file. The resulting blanked grid was used to estimate the mean, variance, standard deviation, coefficient of variation, domain area and total burrow abundance estimate.

The 2012 estimate of 325 million burrows are the lowest observed, but the estimates have fluctuated widely since the survey commenced with a declining trend in the recent years. The estimation variance of the survey as calculated by EVA is very low (CVs in the order <5%).

Raised abundance estimates are presented for the first time for the smaller Slyne Head and Galway Bay grounds (Table 7.5.7; Figure 7.5.6.). The spatial extent of these grounds has been estimated (See Lordan *et al.*, WD22). The abundance estimates are the product of the mean density and ground area. The sample variances, standard errors, t-values and 95% CI were calculated for each ground. The size and contribution to landings of these grounds is small relative to the Aran grounds on average 10%. This has not been taken into account in the overall abundance estimate or catch options.

7.5.3 Assessment

Summary of Review Group comments on the 2012 assessment

The assessment was carried out in accordance with the description in the stock annex. The assessment approach used by WGCSE 2010 was said to be consistent with that set out in the stock annex and WK*NEPH* (2009). The stock annex was very clear and contained good information on ecosystem consideration.

Discard estimates are included in the assessment since 2001 with the exception of 2006–2007 when there was no sampling of landings and discards.

Technical comments

The RG report contained some technical comments and attempts have been made to address these.

Conclusions

The RG agrees that the FU17 *Nephrops* stock appears to be in 'acceptable' shape. However, uncertainty exists in MSY proxy values and in harvest rate estimates due to the possibility of misreporting in the fishery. The RG suggests that the *status quo* F (7.7%) should be maintained indicating 2013 landings of 653.7 t. Due to the observed 30% decline in burrow density since 2010, this stock should be closely monitored. Future reductions in catch and a re-evaluation of reference points may be warranted if the stock decline continues. Additionally, the RG suggests that FU-specific TACs be enacted, as opposed to division based management, for *Nephrops* in order to avoid sudden displacement of effort from year to year.

Comparison with previous assessments

The assessment is based on the same methods and similar data as used in 2012. The stock size is estimated to have decreased and harvest ratio has increased to highest observed in the series.

State of the stock

UWTV abundance estimates suggest that the stock size has fluctuated widely with a declining trend and the 2012 estimate is lowest observed and below the average of the series (geomean: 693 million). Table 7.5.8 summarizes recent harvest ratios for the stock along with other stock parameters. Figure 7.5.7 is the stock summary plot for FU17. There is no clear sign in the mean length information to suggest the recruitment has declined. The harvest ratio in 2012 is the highest in the series and above the $F_{MSYproxy}$.

7.5.4 Short-term projections

Catch option table inputs and historical estimates of mean weight in landings and harvest ratios are presented in Table 7.5.8. A three year average (2010–2012) of mean weight in landings and proportion of removals retained was used. The decline in mean weight and increase in proportions of removal retained in 2011 was confirmed from the sampling programme due to an influx of vessels which tend to "tail"[1] more of their catch in 2011. Since 2002 mean weight in the landings has varied between 18–27 g. The estimate harvest ratio has also varied a lot, 3–19% with 2012 being the highest observed.

A prediction of landings for 2014 was made for the Aran Grounds Functional Unit using the approach agreed procedure proposed at WK*NEPH* 2009 and outlined in the stock annex. Table 7.5.9 shows landings predictions at various harvest ratios, including those equivalent to fishing within the range of $F_{0.1}$ to F_{max}. The F_{2012} (mean F 2010–2012) for the Aran grounds is estimated above the $F_{msy\ proxy}$ proposed by ICES.

7.5.5 MSY explorations

As discussed previously no new MSY explorations were carried out at WGCSE this year. The results of the final SCA model carried in 2011 are given in the text table below. The F multipliers required to achieve the potential F_{MSY} proxies, the harvest

[1] This is a labour intensive process whereby the head and thorax of the *Nephrops* are removed and only the tail is retained for landing. Vessel which tail extensively tend to land more of the smaller *Nephrops* caught.

rates that correspond to those multipliers and the resulting level of spawner per recruit as a percentage of the virgin level.

		F_{BAR} 20–40mm		Harvest Rate	% Virgin Spawner per Recruit	
		Female	Male		Female	Male
$F_{0.1}$	Comb	0.06	0.17	7.2%	64.3%	39.4%
$F_{0.1}$	Female	0.11	0.31	9.1%	49.7%	25.4%
$F_{0.1}$	Male	0.05	0.14	6.4%	68.8%	44.8%
F_{35}	Comb	0.12	0.34	10.5%	47.0%	23.2%
$F_{35\%}$	Female	0.55	0.19	12.8%	34.9%	15.0%
$F_{35\%}$	Male	0.07	0.21	8.4%	60.0%	34.8%
F_{MAX}	Comb	0.12	0.34	11.1%	47.0%	23.2%
F_{MAX}	Female	0.56	0.19	13.0%	34.5%	14.8%
F_{MAX}	Male	0.09	0.26	9.8%	54.1%	29.2%

This fishery is highly seasonal (see Annex), but the timing of the fishery has varied somewhat in recent years. This coupled with limited time-series of survey data and biological knowledge of the stock suggests that a risk adverse harvest rate would be appropriate.

Compared to other *Nephrops* fisheries in ICES area the absolute population density of this stock is relatively high Figure 7.5.7. This implies that sperm limitation if males are overfished is not likely to be a significant problem. The combined sex $F_{35\%\ SPR}$ would result in >20% males SPR and 47% female SPR. **The WGCSE and RGCSE 2010 concluded that a combined sex $F_{35\%}$ was a suitable $F_{MSY\ proxy}$ for this stock. This corresponds to a harvest rate of 10.5%.**

7.5.6 Biological reference points

Precautionary reference points have not been defined for *Nephrops* stocks. Given the short time-series of UWTV survey data it is not possible to define an appropriate $B_{trigger}$. The combined sex $F_{35\%}$ SPR is proposed by the WG as proxy for F_{MSY}.

7.5.7 Management strategies

As yet there are no explicit management strategies for this stock but there have been some discussions among the fishing industry and scientists about developing a long-term plan for the management of the Aran fishery. Sustainable utilization of the *Nephrops* stock will form the cornerstone of any management strategy for this fishery.

7.5.8 Uncertainties and bias in assessment and forecast

The SCA and YPR analysis carried out by WGCSE 2010 was based on 2008 and 2009 sampling. The fit to the SCA model was problematic, as discussed above, so harvest proxies are likely to be uncertain. The harvest ratio for the combined sex $F_{35\%}$ appears to be conservative relative to other stocks with similar burrow densities as noted by RGCSE 2010.

There are several key uncertainties and bias sources in the method proposed (these are discussed further in WK*NEPH* 2009 (ICES, 2009)). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009 (ICES, 2007, 2008, 2009). These recommendations have been retrospectively applied to historical survey estimates this year (Section 5.1) and these are now considered final. Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (ICES, 2009). The survey estimates themselves are likely to be fairly precisely estimated given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU17 are largely based on expert opinion. The precision of these cannot yet be characterized. Ultimately there still remains a degree of subjectivity in the production of UWTV indices.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. These parameters are quite variable (Table 7.5.8). In future years the uncertainty in these key parameters should be estimated.

Landings data are assumed to be accurate. Since 2007 the introduction of "buyers and sellers legislation" in Ireland is thought to have improved the accuracy of the reported landings.

Finally, the catch options developed do not take into account *Nephrops* abundance outside the current domain area or on the Slyne or Galway Bay Grounds. This is likely to cause a small (<10%) underestimate in the catch options for FU17 as a whole.

7.5.9 Recommendation for next benchmark

This stock was benchmarked in 2009. WK*NEPH* 2009 suggested several areas to be addressed before the next Benchmark. For this stock the inputs to the SCA analysis need further investigation given that growth and natural mortality parameters are assumed from the Irish Sea and the fit to the SCA analysis might be improved. Also investigations to define an appropriate $B_{trigger}$ for this stock also needs analysis. The next benchmark should also look at integrating UWTV estimates for Galway Bay and Slyne head *Nephrops* as well as the accuracy of the ground boundary for the main Aran ground. WGCSE recommend that these issues could be addressed through and inter-benchmark process.

7.5.10 Management considerations

The trends from the fishery (landings, effort,lpue, mean size, etc.) appear to be relatively stable. Lpues have been relatively high in the last five years. Conversely, the UWTV abundance and mean density estimates show large fluctuations in burrow abundance and harvest rates. This suggests that the *Nephrops* population at current exploitation and recruitment rates is rather dynamic. The generally low apparent harvest rate (12% average) appears to have little impact on observed stock fluctuations. A new survey point should be available after July 2013 which will provide a more up to date prognosis of stock status. The use of the most up to date survey information should be considered for this stock.

In recent years several newer vessels specializing in *Nephrops* fishing have participated in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. Since the introduction of effort management associated with the cod long-term plan (EC 1342/2008) there have been concerns that effort could be displaced towards the Aran and other *Nephrops* grounds where effort control has not been put in place. This has not happened to date and the 2011 effort was the lowest in the time-series. There has been a trend for Irish vessels to switch to multi (quad) rig trawls. Provisional data suggests a ~30% increase in *Nephrops* catch rates and a reduction in fish bycatch of ~30% due to the lower headline height.

The *Nephrops* trawl fleet operating in VIIb discards around 47% by weight (Table 7.5.4.). Small whole *Nephrops* are the main species comprising the discards. The main fish species discarded are haddock, hake, whiting, megrim and dogfish (Anon, 2011).

7.5.11 References

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Table 7.5.1. ***Nephrops*** **in FU17 (Aran Grounds). Landings in tonnes by country.**

Year	France	Rep. of Ireland	UK	Total
1974	477			477
1975	822			822
1976	131			131
1977	272			272
1978	481			481
1979	452			452
1980	442			442
1981	414			414
1982	210			210
1983	131			131
1984	324			324
1985	207			207
1986	147		1	148
1987	62		0	62
1988	14	814		828
1989	27	317	3	347
1990	30	489		519
1991	11	399		410
1992	11	361	2	374
1993	11	361	0	372
1994	18	707	4	729
1995	91	774	2	867
1996	2	519	7	528
1997	2	839	0	841
1998	9	1401	0	1410
1999	0	1140	0	1140
2000	1	879	0	880
2001	1	912	0	913
2002	2	1152	0	1154
2003	0	933	0	933
2004	0	525	0	525
2005	0	778	0	778
2006	0	637	0	637
2007	0	913	0	913
2008	0	1050	7	1057
2009	0	625	0	625
2010	0	991	9	1000
2011	0	600	0	600
2012	0	1135	0	1135

Table 7.5.2. ***Nephrops*** **in FU 17 (Aran Grounds). Irish effort and lpue for** ***Nephrops*** **directed fleet.**

	Irish *Nephrops* Directed Fleet		
Year	Effort ('000 Hrs)	Landings (tonnes)	Lpue (kg/hr)
1995	15.3	530	34.6
1996	9.1	311	34.1
1997	15.8	478	30.3
1998	21.9	926	42.3
1999	19.5	743	38
2000	17.1	547	31.9
2001	18.7	600	32.1
2002	18.6	861	46.4
2003	19.9	732	36.8
2004	12.9	381	29.5
2005	14.9	729	45.8
2006	10.8	559	51.8
2007	13.6	815	59.9
2008	16.7	963	57.8
2009	10.6	561	52.8
2010	16.2	875	54
2011	8.1	418	51.5
2012	13.4	946	70.6

Table 7.5.3. *Nephrops* in FU17 (Aran Grounds). Landings and discard weight and numbers by year and sex.

	Female		Male		Both sexes
Year	Landings (t)	Discards (t)	Landings (t)	Discards (t)	% Discard
2001	312	109	601	138	21%
2002	423	96	729	99	14%
2003	237	89	688	98	17%
2004	267	71	259	45	18%
2005	323	106	441	86	20%
2006					
2007			No Sampling		
2008	324	160	726	98	20%
2009	90	130	534	134	30%
2010	404	125	587	73	17%
2011	323	51	277	31	12%
2012	522	43	612	43	7%

	Female Numbers '000s		Male Numbers '000s		Both sexes
Year	Landings	Discards	Landings	Discards	% Discard
2001	18,665	12,161	29,949	13,250	34%
2002	23,105	9,374	31,256	8,326	25%
2003	14,530	9,577	29,538	8,744	29%
2004	16,109	7,068	12,930	4,282	28%
2005	20,280	11,383	21,828	8,967	33%
2006					
2007			No Sampling		
2008	15,697	13,223	31,184	8,350	32%
2009	3,084	7,485	20,421	8,218	40%
2010	16,741	7,928	23,858	5,288	25%
2011	16,805	4,726	13,962	2,965	20%
2012	27,914	3,982	27,706	3,604	12%

Table 7.5.4. *Nephrops* in FU17 (Aran Grounds). Composition of discards by the *Nephrops* trawl fleet in VIIb.

Species	Discards	Landings	Catch
Hake	426.57	35.44	462.01
Lesser Spotted Dogfish	249.48		249.48
Others	654.55	103.93	758.48
Haddock	518.7	84.19	602.89
Megrim	328.32	211.96	540.28
Angler-piscatorius		19.3	19.3
Mackerel	120.94		120.94
Angler-budegassa		54.77	54.77
Black Sole		52.66	52.66
Dab	107.35		107.35
Dogfish	703.46		703.46
Grey Gurnard	260.07		260.07
Nephrops	1329.158	5316.63	6645.788
Turbot		23.64	23.64
Whiting	402.47	66.09	468.56
Witch	170.68	18.34	189.02
Sum of all species	5271.748	5986.95	11258.7
Percentage of Catch	47%	53%	

Table 7.5.5. *Nephrops* in FU17 (Aran Grounds). Mean size trends for catches and whole landings by sex.

	Catches		Catches		Whole Landings			
	<35 mm CL		>35 mm CL		<35 mm CL		>35 mm CL	
Year	Males	Females	Males	Females	Males	Females	Males	Females
1995	na	na	na	na	32.0	31.8	38.3	37.0
1996	na	na	na	na	31.1	32.1	37.8	37.4
1997	na	na	na	na	31.9	32.0	37.8	37.4
1998	na	na	na	na	31.3	31.7	38.0	37.2
1999	na	na	na	na	31.3	32.3	38.0	37.1
2000	na	na	na	na	32.0	31.4	38.4	36.3
2001	28.9	27.5	38.0	37.3	na	na	na	na
2002	30.7	29.1	38.2	37.2	na	na	na	na
2003	30.5	27.4	38.2	38.0	na	na	na	na
2004	29.3	28.3	37.3	37.5	na	na	na	na
2005	28.9	27.7	37.8	37.2	na	na	na	na
2006	No Sampling							
2007								
2008	27.4	29.7	36.8	37.8	na	na	na	na
2009	30.3	28.4	38.0	37.1	na	na	na	na
2010	30.2	29.6	38.7	37.3	na	na	na	na
2011	28.6	28.3	38.4	37.0	na	na	na	na
2012	29.4	29.5	37.9	36.9	na	na	na	na

Table 7.5.6. *Nephrops* in FU17 (Aran Grounds). Results summary table for geostatistical analysis of UWTV survey.

Ground	Year	Number of stations	Mean Density (burrows/m2)	Area Surveyed (m2)	Domain Area (km²)	Burrow Count	Geostatistical Abundance Estimate adjusted (millions burrows)	CV on Burrow estimate
Aran Grounds	2002	49	0.84	8,316	943	7,036	629	4%
	2003	41	1.01	7,937	943	9,814	761	5%
	2004	64	1.43	7,561	943	10,687	1075	3%
	2005	70	1.09	8,701	936	8,774	818	3%
	2006	67	0.64	10,934	932	6,928	474	3%
	2007	71	0.93	11,252	942	10,272	697	3%
	2008	63	0.56	13,075	906	7,617	412	3%
	2009	82	0.73	10,900	940	6,585	552	2%
	2010	91	0.85	11,441	937	8,091	636	2%
	2011	76	0.67	11,645	909	7,365	491	3%
	2012	31	0.44	3,031	942	1,271	325	5%

Table 7.5.7. *Nephrops* in FU17 (Galway Bay and Slyne Head). Results summary table for analysis of UWTV survey.

Ground	Year	Number of stations	Mean Density (burrows/m²)	Area Surveyed (m²)	Domain Area (km²)	Burrow Count	Raised Abundance Estimate (millions burrows)	CV on Burrow estimate
Galway Bay	2002	7	1.58	1,299	74	2,017	114.98	9%
	2003	3	1.60	591	74	941	117.87	11%
	2004	9	0.73	2,312	74	1,625	52.07	19%
	2005	4	1.67	661	74	1,107	124.11	6%
	2006	3	0.98	540	74	522	74.01	16%
	2007	5	1.14	890	74	992	82.57	9%
	2008	10	0.42	1,907	74	859	33.37	23%
	2009	8	0.93	1,207	74	1,116	68.46	6%
	2010	10	1.61	1,284	74	1,757	101.39	9%
	2011	10	0.51	1,355	74	745	40.73	25%
	2012	4	0.84	460	74	374	60.12	16%

Ground	Year	Number of stations	Mean Density (burrows/m²)	Area Surveyed (m²)	Domain Area (km²)	Burrow Count	Raised Abundance Estimate (millions burrows)	CV on Burrow estimate
Slyne Head	2002	5	0.85	1,216	39	1,027	33.21	10%
	2003	0	-	-	39	-	-	-
	2004	3	0.68	827	39	531	25.22	23%
	2005	3	0.55	531	39	294	21.77	6%
	2006	3	0.41	526	39	210	15.65	28%
	2007	4	0.63	838	39	547	25.54	24%
	2008	0	-	-	39	-	-	-
	2009	6	0.40	531	39	144	10.66	22%
	2010	9	0.74	1,117	39	928	32.66	20%
	2011	7	0.66	1,166	39	785	26.45	11%
	2012	3	0.68	405	39	275	26.69	3%

***random stratified estimates are given for the Slyne Head and Galway Bay grounds.**

Table 7.5.8. ***Nephrops*** **in FU17 (Aran Grounds). Forecast inputs (bold) and historical estimates of mean weight in landings and harvest ratio. Removals estimated in years with no sampling (shaded) using ratio of removals to landings in adjacent years.**

Year	Landings in Number (millions)	Discards in Number (millions)	Removals in Number (millions)	Prop Removals Retained	Adjusted Survey (millions)	Harvest Ratio	Landings (t)	Discards (t)	Mean Weight in landings (gr)
2001	48.7	25.4	71.6	0.68			912		
2002	54.5	17.7	70.4	0.77	629	11.2%	1,152	192	21.2
2003	44.1	18.3	60.6	0.73	761	8.0%	933	183	21.2
2004	29	11.4	39.3	0.74	1075	3.7%	525	112	18.1
2005	42.4	19.7	60.1	0.7	818	7.4%	778	182	18.4
2006	na	na	49.5	na	474	10.4%	636	na	na
2007	na	na	57.3	na	697	8.2%	913	na	na
2008	46.9	21.6	66.3	0.71	412	16.1%	1,050	245	22.4
2009	23.5	15.7	37.6	0.62	552	6.8%	625	256	26.6
2010	41	13.3	53	0.77	636	8.3%	1,000	194	24.4
2011	30.8	7.7	37.7	0.82	491	7.7%	600	83	19.5
2012	55.6	7.6	62.4	0.89	**325**	19.2%	1135	85	20.4
Avg 10-12				**0.83**					**21.4**

na= not available due to non-cooperation with sampling programmes.

Shading indicates removal estimated based on combined 2005 and 2008 numbers-at-length scaled appropriately to landings in 2006 and 2007. The commensurate harvest ratio estimate is also shaded.

Table 7.5.9. *Nephrops* in FU 17 (Aran Grounds). Catch option table for 2014.

			Implied fishery	
	Harvest rate	Survey Index (millions)	Retained number (millions)	Landings (tonnes)
MSY approach	10.50%	325	28	605.445
F_{2012}	19.20%	325	52	1107.067
$F_{0.1\ Combined}$	7.20%	325	19	415.162
$F_{max\ Combined}$	11.10%	325	30	640.042
	0%	325	0	0.000
	2%	325	5	115.323
	4%	325	11	230.646
	6%	325	16	345.969
	8%	325	22	461.292
	10%	325	27	576.615
	12%	325	32	691.937
				Basis
Landings Mean Weight (Kg)		0.0214		Sampling 2010–2012
Survey Overestimate Bias		1.3		WKNEPH 2009
Survey Numbers (Millions)		325		UWTV Survey 2012
Prop. Retained by the Fishery		0.83		Sampling 2010–2012

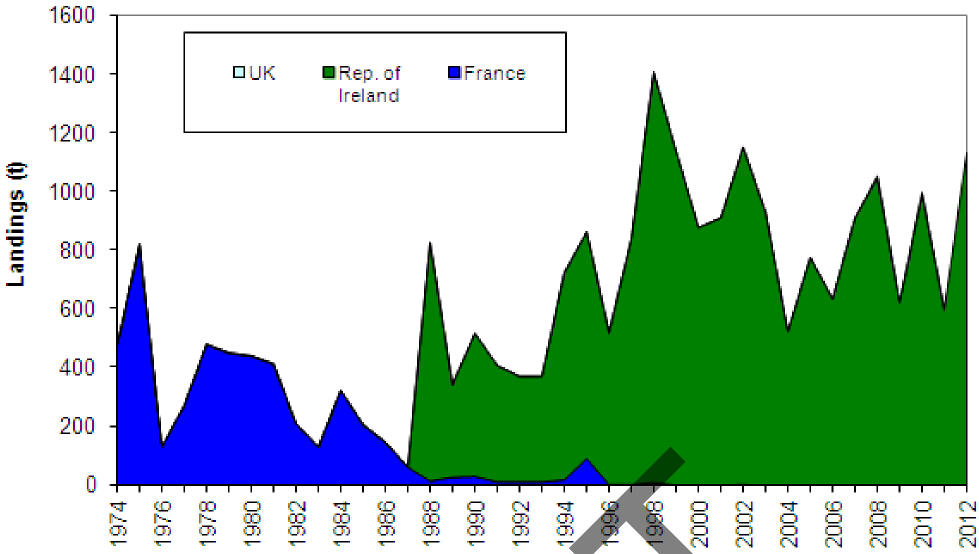


Figure 7.5.1. *Nephrops* in FU17 (Aran Grounds). Landings in tonnes by country.

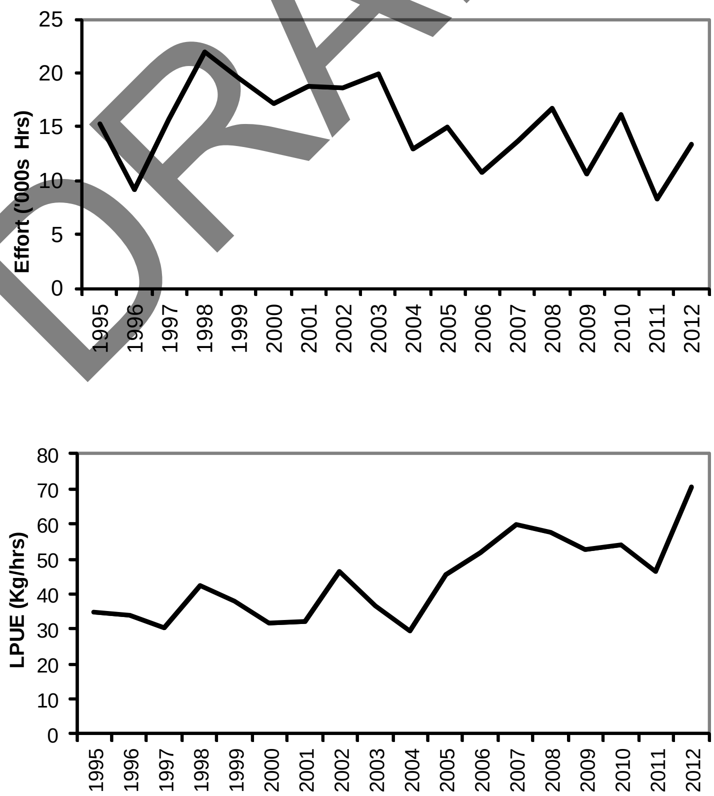


Figure 7.5.2. *Nephrops* FU17 Aran Grounds. Irish effort and lpue for *Nephrops* directed fleet.

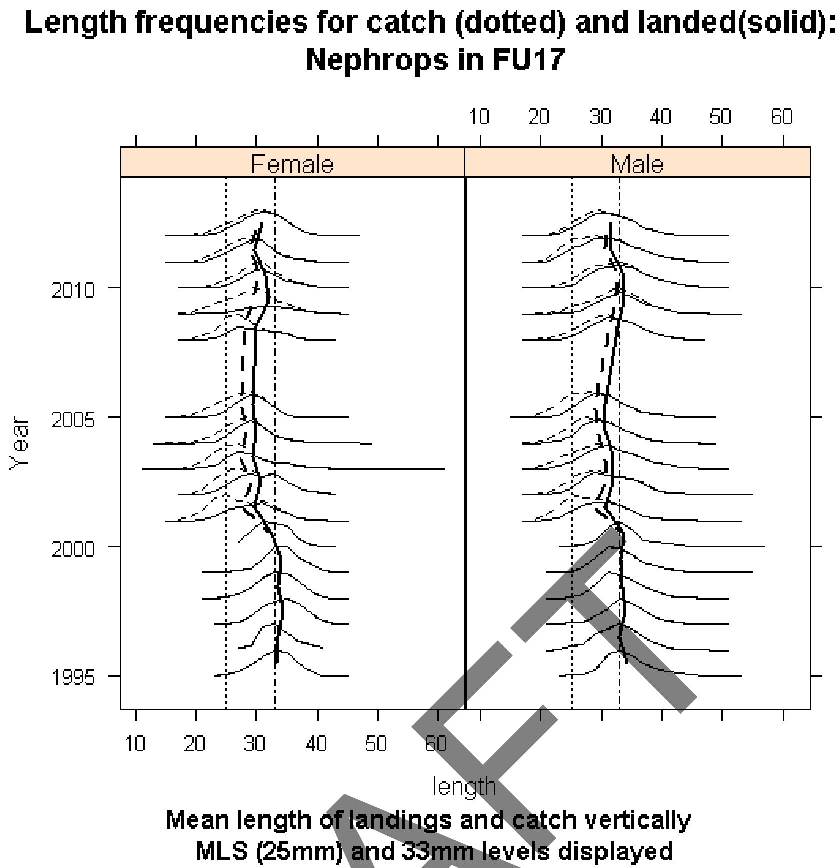


Figure 7.5.3. ***Nephrops*** **FU17 Aran Grounds. Length distributions in the catches 2001–2005, 2008–2012.**

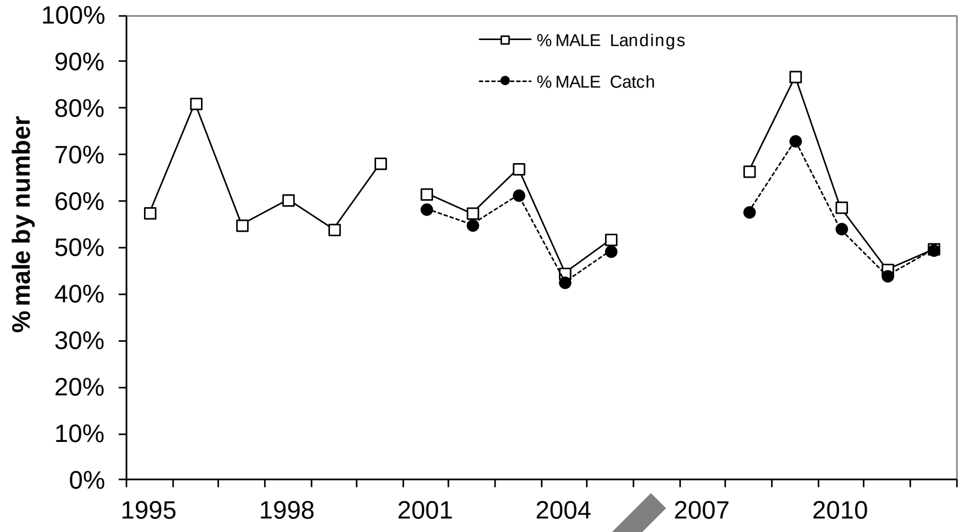


Figure 7.5.4. ***Nephrops*** **FU17 (Aran Grounds). Sex ratio of whole landings (1995–2000), landings (2001–2012) and catch (2001–2012).**

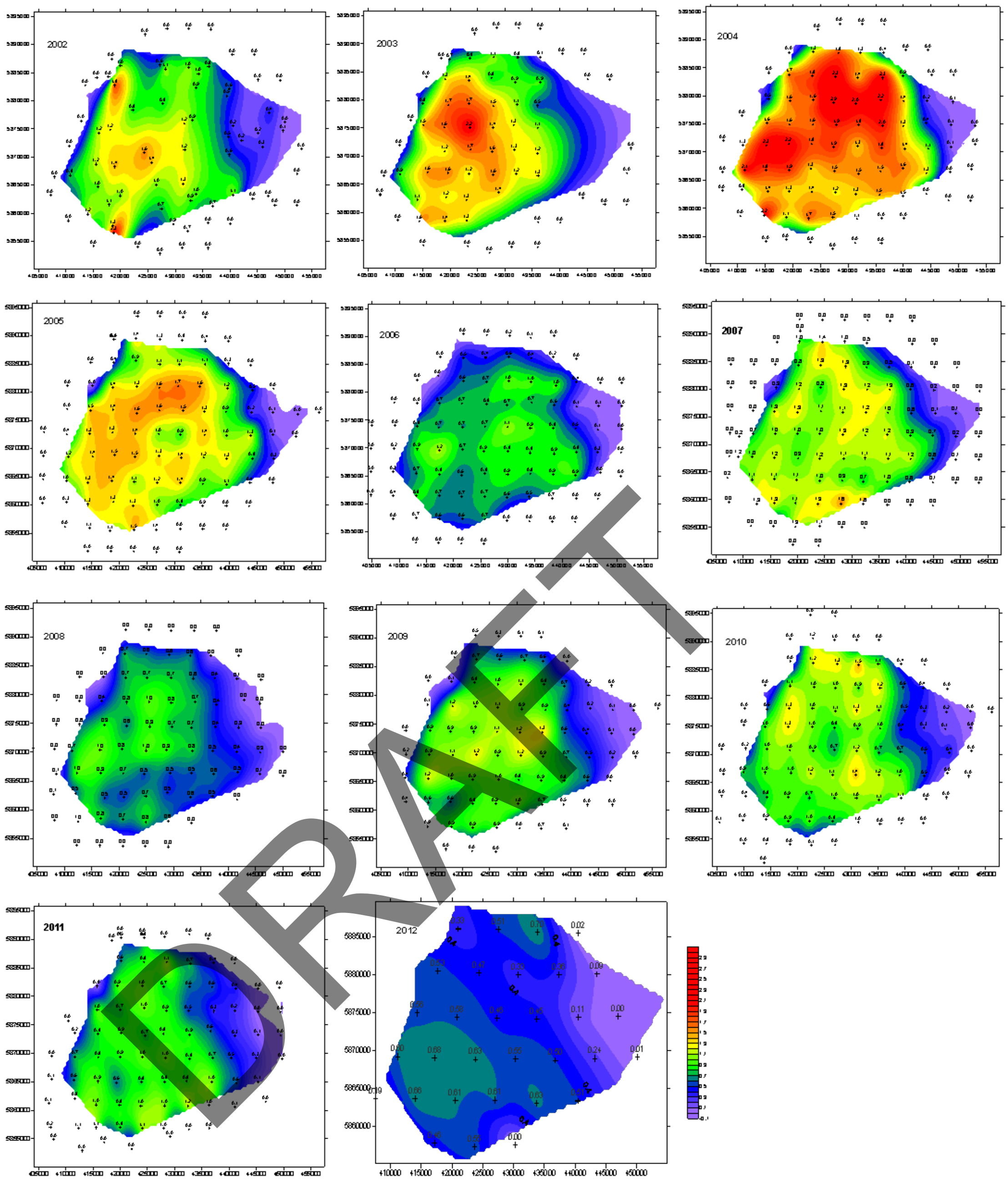


Figure 7.5.5. ***Nephrops*** **in FU17 (Aran Grounds). Contour plots of the krigged density estimates for the Aran Ground UWTV surveys from 2002–2012.**

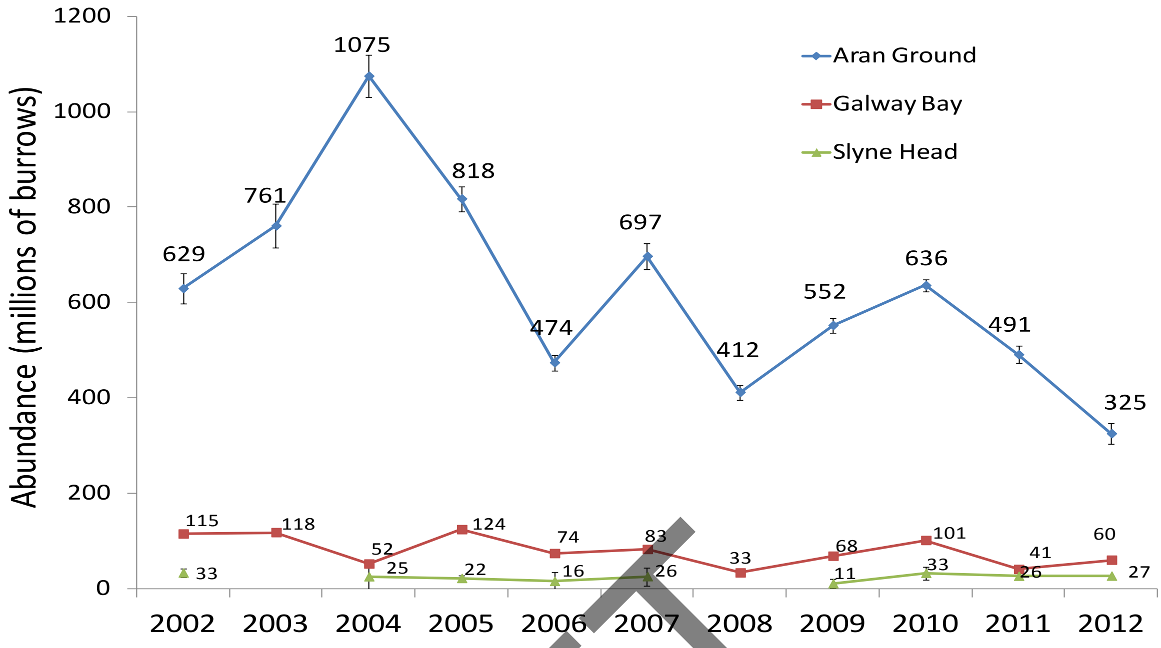


Figure 7.5.6. ***Nephrops*** **FU17 Aran Grounds.** ***Nephrops*** **burrow estimates in FU17 Aran, Galway Bay and Slyne Head grounds 2002–2012.**

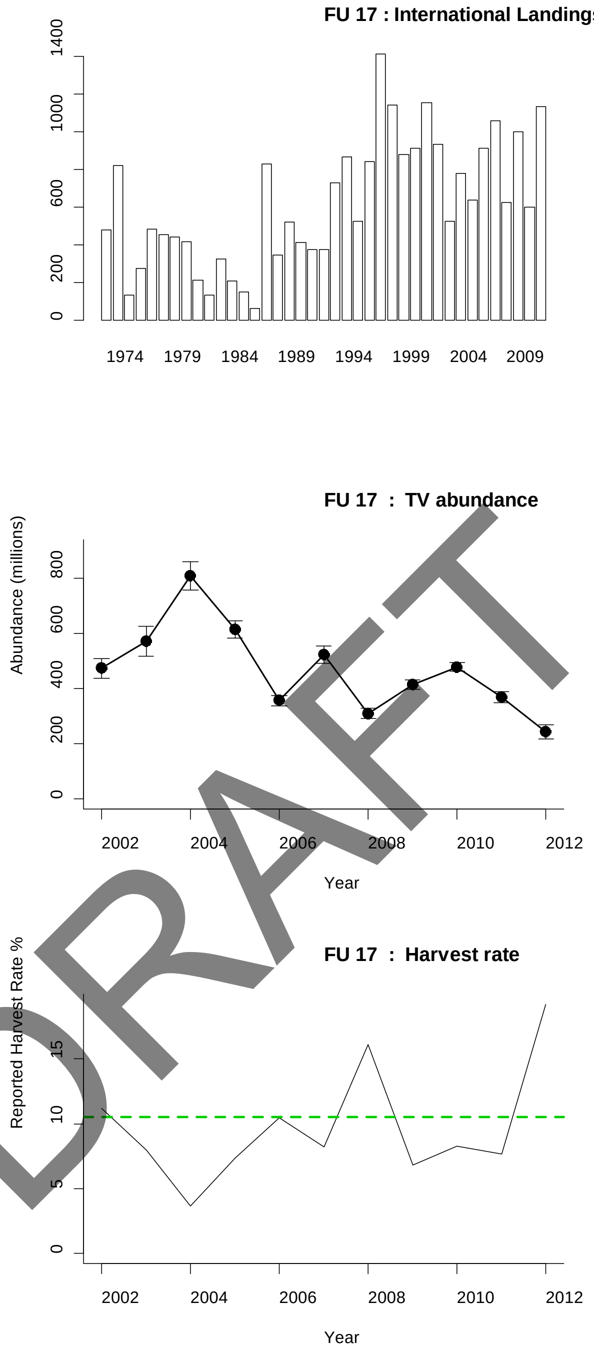


Figure 7.5.7. *Nephrops* FU17 Aran Grounds. Stock Summary plots: Landings (tonnes), UWTV abundance (millions) and Harvest Ratio (% dead removed/UWTV abundance).

7.7 *Nephrops* in Division VIIfg (Smalls Grounds, FU22)

Type of assessment in 2013

UWTV based assessment using WK*NEPH* 2009 protocol as described in the stock annex.

ICES applicable to 2012

ICES advises on the basis of the MSY approach that landings from FU22 in 2012 should be no more than 2300 t.

ICES advice applicable to 2013 (June)

ICES advises on the basis of the MSY approach that landings from FU22 in 2013 should be no more than 2600 tonnes.

ICES advice applicable to 2013 (November)

The advice was updated in November 2012 to take account of the most recent UWTV survey information.

ICES advises on the basis of the MSY approach that landings from FU 22 in 2013 should be no more than 3100 tonnes.

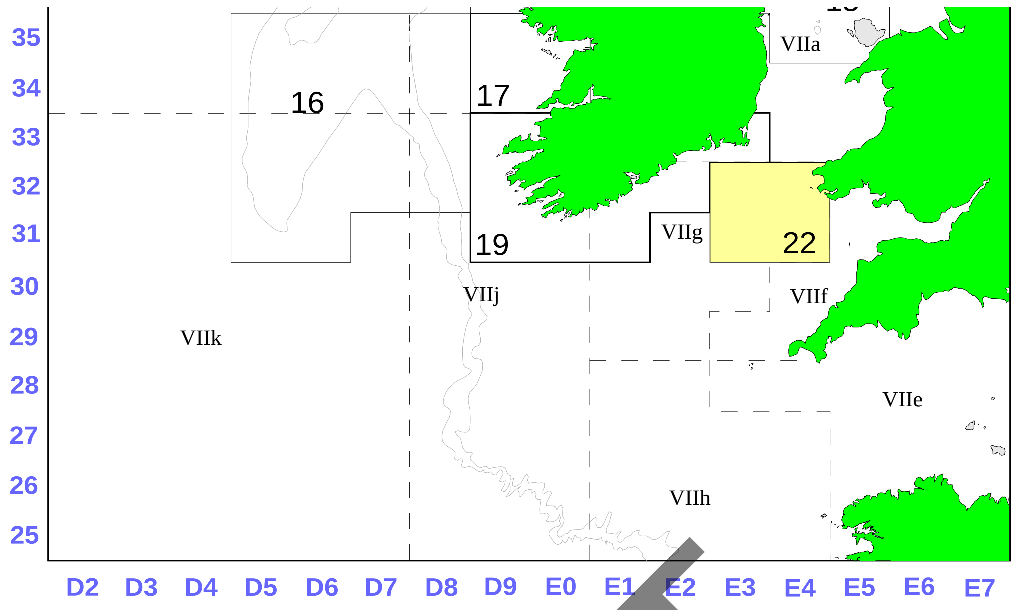
7.7.1 General

Stock description and management units

The Smalls *Nephrops* stock (FU22) covers ICES rectangles 31–32E3, 31–32E4 within VIIfg. It is included in the whole ICES Area VII together with Irish Sea East and West [FU14, FU15], Porcupine Bank [FU16], Aran Grounds [FU17], northwest Irish Coast [FU18], southeast and southwest Irish Coast [FU19], NW Labadie, Baltimore and Galley [FU20–21], Jones and Cockburn [FU21].

Historically FU20–22 has covered an amalgamation of several spatially distinct mud patches; FU 20 NW Labadie, Baltimore and Galley, FU 21 Jones and Cockburn and FU22 the Smalls. There is no evidence that the whole exploited area belongs to the same stock or that there are several patches linked in meta-population sense. WGCSE 2013 recommends that FU20–22 should be split into FU20–21 and FU22 for the purposes of assessment and advice provision.

The TAC is set for Subarea VII which does not correspond to the stock area (FU 22 is shaded light yellow). There is no evidence that the individual functional units belong to the same stock. The 2013 TAC is 23 065 t, an increase of about 6%compared to 2012 TAC. No FU22 specific restrictions in TAC apply thus, up to 100% of the Area VII TAC could, in theory be taken within FU22.



Management applicable in 2012 and 2013

TAC in 2012

Species: Norway lobster *Nephrops norvegicus*		**Zone:** VII (NEP/07.)
Spain	1 306 (1)	
France	5 291 (1)	
Ireland	8 025 (1)	
United Kingdom	7 137 (1)	
Union	21 759 (1)	
TAC	21 759 (1)	Analytical TAC Article 11 of this Regulation applies.

(1) Special condition: of which no more than the following quotas may be taken in VII (Porcupine Bank – Unit 16) (NEP/*07U16):

Spain	380
France	238
Ireland	457
United Kingdom	185
Union	1 260

Council Regulation (EU) No 43/2012 of 17 January 2012 fixing for 2012 the fishing opportunities available to EU vessels for certain fish stocks and groups of fish stocks which are not subject to international negotiations or agreements.

TAC in 2013

Species:	Norway lobster *Nephrops norvegicus*	Zone:	VII (NEP/07.)
Spain	1 384 ([1])		
France	5 609 ([1])		
Ireland	8 506 ([1])		
United Kingdom	7 566 ([1])		
Union	23 065 ([1])		
TAC	23 065 ([1])		Analytical TAC Article 11 of this Regulation applies.

([1]) Special condition: of which no more than the following quotas may be taken in Functional Unit 16 of ICES Subarea VII (NEP/*07U16):

Spain	543
France	340
Ireland	653
United Kingdom	264
Union	1 800

COUNCIL REGULATION (EU) No 39/2013 of 21 January 2013 fixing for 2013 the fishing opportunities available to EU vessels for certain fish stocks and groups of fish stocks which are not subject to international negotiations or agreements.

The MLS implemented by EC is set at 25 mm CL i.e. 8.5 cm total length and this regulation is applied by the Irish and UK fleets whereas a more restrictive regulation adopted by the French Producers' Organisations (35 mm CL i.e. 11.5 cm total length) was applied by the French trawlers for a long period. In application of the Council Regulation (EC) N° 1459/1999, June 24th 1999, modifying the regulation (EC) N° 850/98 of the Council for the conservation of fishery resources through technical measures for the protection of juveniles, the French minimum mesh size of codend was set at 100 mm in January 2000 whereas the Irish mesh size was maintained at 80 mm.

Ecosystem aspects

This section is detailed in stock annex.

Fishery description

Ireland, France and the UK are the main countries involved in the FU22 *Nephrops* fishery. In the early 2000s the Republic of Ireland fleet had on average over 70% of the landings and this has increased to over 90% from this FU in recent times. A description of this fleet is given in the stock annex. Irish landings from this FU come mainly from ICES statistical rectangle 31E3. The fishery on the Smalls Grounds operates throughout the year, weather permitting with a seasonal trend.

French trawlers targeting *Nephrops* in the Celtic Sea operate mainly in the FU20–21 component of the stock, thus the contribution of the FU22 (Smalls grounds) became minor during recent years: in 2000, 1186 t coming from FU22 were landed by French vessels (in a total of 2848 t for the whole Celtic Sea) whereas in 2012 only 65 t were harvested in the same area (in a total of 519 t for the whole Celtic Sea). 80–90% of the FU22 French landings come for the ICES statistical rectangle 31E3.

Fishery in 2012

In 2012, 78 Irish vessels reported landings from FU22. Of these, 47 vessels reported landings in excess of 10 t accounting for 96% of the total Irish landings. Vessels >18 m account for 93% of the landings in 2012. In recent years several newer vessels specializing in *Nephrops* fishing have participated periodically in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. In 2012, 29 French trawlers reported landings for FU22.Among them, twelve vessels provided production exceeding 1 t for around of 94% of the total French landings coming from this area (61 t in a total of 65 t).

The French minimum mesh size of codend was set at 100 mm in January 2000 whereas the Irish mesh size was maintained at 80 mm.

7.7.2 Data

A dedicated sampling of landings and discards began in 2003 by Ireland. Sampling levels in 2012 were good and are detailed in Section 2 (Table 2.1).

Landings

The reported landings time-series by country is shown in Figure 7.7.1 and Table 7.7.1. The reported Irish landings from FU22 have increased since 2000 to the present fluctuating around 1800 t recently. French landings have gradually decreased since the early 2000s to the present to the second lowest level (65 t). Reported landings from the UK have fluctuated with no obvious trend.

Commercial cpue

Effort data for this FU is available from 1995 for the Irish otter trawl *Nephrops* directed fleet. In 2012 this fleet accounted for ~95% of the landings compared with an average of 70% over the time period. These data have not been standardized to take into account vessel or efficiency changes during the time period. Effort shows an increasing trend since the early 2000s and the 2012 effort is above the series average (Table 7.7.2.). Landings per unit of effort (lpues) increased since the early 2000s with a slight decrease in the mid-2000s and has remained at a high level since then. Lpue in 2012 is the highest at 61 kg/hr (Figure 7.7.2).

Effort data for France is not available for FU22 and is only available for the combined area FU20–22.

Discarding

Since 2003 discard rates have been estimated using unsorted catch and discards sampling. This involves unsorted catch and discard samples being provided by vessels or collected by observers at sea on discard trips. The catch sample is partitioned into landings and discards using an onboard discard selection ogive derived for the discard samples. Sampling effort is stratified monthly, but quarterly aggregations are used to derive length distributions and selection ogives. The length–weight regression parameters given in the stock annex are used to calculate sampled weights and appropriate quarterly raising factors. The sampling intensity and coverage has varied over the time-series, but in recent years has been good. The quality of the sampling has not yet been qualitatively assessed in terms of precision and accuracy.

Discard rates range between 6–34% of total catch by weight and 10–48% of total catch by number (Table 7.7.3). Discard rate of females tends to be higher due to the smaller average size and market reasons. There is no information on discard survival rate in this fishery (25% is assumed according with Charuau *et al*., 1982). Highest discard rates were observed in 2007 as a result of the recruitment into the fishery in 2006.

Discarding by the Irish *Nephrops* trawl fleet is around 38% of the total catch by weight (Table 7.7.4). The main discards are small whole *Nephrops*. The main fish species discarded are whiting, haddock, and dogfish (Anon, 2011).

Biological sampling

The Irish sampling programme started in 2003 and since then coverage and intensity has been very good covering the seasonal trend of the fishery. The mean size of *Nephrops* in Irish landings has remained stable for both sexes. The mean size of *Nephrops* in the catch has remained relatively stable since 2005 (Figure 7.7.3 and Table 7.7.5).

The sex ratio in the landings is strongly male biased in most years (Figure 7.7.4).

Surveys

Abundance indices from UWTV surveys

WK*NEPH* 2009 concluded that UWTV surveys could be used as an absolute index of abundance for *Nephrops* stocks provided the various biases (see text table below) were taken into account (ICES, 2009). This direct use of the survey is in lieu of alternative assessment approaches. These bias sources are not easily estimated and are largely based on expert opinion. In the FU22 Smalls grounds the largest source of perceived bias is the "edge effect". The bias correction factor is in line with other stocks with similar density e.g. FU11 = 1.33 and FU12 = 1.32 (ICES, 2009).

FU	Area	Edge effect	detection rate	species identification	Occupancy	Cumulative bias
22	Smalls	1.35	0.9	1.05	1	1.3

SGNEPS 2012 (ICES, 2012) recommended that a CV (or relative standard error) of <20% is an acceptable precision level for UWTV survey estimates of abundance. This allowed sampling intensity to be reduced from around 90 stations in the past to 47 on the Smalls grounds in 2012 which allowed survey coverage of other FUs. A randomised isometric grid design was employed with UWTV stations at 5.5 nmi intervals, whereas previously a 3.0 nmi square grid was used. The 2012 krigged burrow abundance estimate increased by about 19% relative to 2011 with a CV (or relative standard error) of 8%.

The blanked krigged contour plot and posted point density data are shown in Figure 7.7.5. The krigged contours correspond very well to the observed data. In general the densities are higher in the central area of the ground with a localised hotspot centrally and also in the southwestern leg. Densities and abundance have remained stable in the time-series with the exception of the first year which was the highest in the series. The mean density in 2012 is approximately 19% increase on 2011 and is similar to that observed at the start of the series. The summary statistics from this geostatistical analysis are given in Table 7.7.6 and plotted in Figure 7.7.6. The statistical analysis follows these steps documented in WD 24 (Doyle *et al*., Annex 3): annual variograms were used to create krigged grid files and the resulting cross-validation data were plotted. If the results looked reasonable then surface plots of the grids were made using a standardised scale. The final part of the process was to limit the calculation to a fixed ground boundary using a blanking file. The resulting blanked grid was used to estimate the mean, variance, standard deviation, coefficient of variation, domain area and total burrow abundance estimate.

The 2012 estimate of 1498 million burrows are the second highest observed, and the estimates have remained fairly stable since the survey commenced except in the first year which was the highest level (1503 million burrows). The estimation variance of the survey as calculated by EVA is very low (CVs in the order <8%).

Groundfish survey data

The Irish groundfish survey (IGFS-WIBTS-Q4) has been carried out since 2003.This provides information on length–frequency compositions, mean size in the catches, cpue of *Nephrops* in FU22. . The mean size of the catches is stable over the time-series except in 2006 and 2008 which signals recruitment into the fishery in 2006 and 2007 (Figure 7.7.7.).This signal of recruitment was also picked up during the 2006 UWTV survey (WD24). This survey provides a useful indicator of recruitment in this FU.

7.7.3 Assessment

Summary of Review Group comments on the 2012 assessment

The RG report contained some technical comments and attempts have been made to address these in terms of data presentation. Also this stock is due to be benchmarked in 2014, which will address those issues raised by the RG.

Conclusions

The UWTV method used to assess FU22 appears to be appropriate as the basis of management advice. Catch limits based on the ICES MSY framework seem suitable for management.

Comparison with previous assessments

The assessment is based on the same methods and similar data as used in 2012. The stock size is estimated to have increased and harvest ratio has decreased based on the UWTV survey.

This year WGCSE decided to use a series average (2003–2012) for mean weight to account for the variability in the mean weights linked to recent recruitment. For proportion removals retained recent three year average was used as is standard procedure.

State of the stock

UWTV abundance estimates suggest that the stock size is stable and the 2012 estimate (1498 million) is above the average of the series (geomean [2006–2012]: 1238 million). Table 7.7.7 summarizes recent harvest ratios for the stock along with other stock parameters. Figure 7.7.9 is the stock summary plot for FU22. Recent harvest rates have fluctuated due to recruitment pulses into the fishery in 2006 and 2010 and landings have fluctuated around 2300 t.

7.7.4 MSY explorations

No new MSY explorations were carried out at WGCSE this year for FU22 Smalls. The results of the final SCA model carried out at WGCSE 2011 are given in the text table below. The F multipliers required to achieve the potential F_{MSY} proxies, the harvest rates that correspond to those multipliers and the resulting level of spawner per recruit as a percentage of the virgin level.

		F_{BAR} 20–40 mm		Harvest	SPR	
		Female	Male	Rates	Female	Male
$F_{0.1}$	Combined	0.08	0.15	7.5%	57.2%	37.9%
	Female	0.13	0.26	10.9%	45.2%	25.5%
	Male	0.06	0.13	6.5%	61.5%	42.8%
$F_{35\%SPR}$	Combined	0.13	0.26	10.9%	45.2%	25.5%
	Female	0.22	0.43	15.3%	34.1%	15.9%
	Male	0.09	0.18	8.4%	53.5%	33.9%
F_{MAX}	Combined	0.15	0.31	12.3%	41.2%	21.8%
	Female	0.28	0.56	17.7%	29.5%	12.6%
	Male	0.13	0.26	10.9%	45.2%	25.5%

WGCSE took into account the following considerations based on the check list presented in Section 2.2:

- Compared to other *Nephrops* fisheries in the ICES area the population density of FU22 is the moderate ~0.5/m². These moderate densities have been fairly consistent throughout time and space (Figure 7.7.5) with the exception of 2006 when strong recruitment was observed. The time-series of UWTV estimates is short.
- The biological parameters in the Celtic Sea are rather old indicating slightly faster growth in males than in other areas. Natural mortality estimates are assumed in line with other stocks.
- Fishery operates throughout the year but there has been some variability in the seasonality depending on *Nephrops* emergence.
- The observed harvest rate has fluctuated over the time series but is relatively stable over the most recent years.
- Overall the indicators suggest that the adult stock has been relatively stable or increasing for more than a decade.

WGCSE 2011 concluded that the default proxy of combined sex $F_{35\%Spr}$ is appropriate as an $F_{MSY\ proxy}$. This corresponds to a harvest rate of 10.9%, this is in line with several other stocks in the remit of this WG. Fishing at the combined sex $F_{35\%Spr}$ is predicted to keep the SPR for both sexes >25% and should deliver long-term yield with a low probability of recruitment over-fishing. No $B_{trigger}$ can be proposed given the shortness of the UWTV series although other indicators suggest that the stock is currently at a high level relative to the past.

7.7.5 Short-term projections

Catch option table inputs and historical estimates of mean weight in landings and harvest ratios are presented in Table 7.7.7. Since 2003 mean weight in the landings has varied between 18–26 gr (Figure 7.7.8.). WG decided to use the series average (2003–2012) of mean weight in landings to account for this variability. Three year average (2010–2012) of proportion of removals retained was used as is standard for other *Nephrops* stocks. The estimate harvest ratio has also varied a lot, 5–24% with

2007 being the highest observed. This is a result of recruitment into the fishery in 2006 and 2007.

A prediction of landings for 2013 was made for FU22 using the approach agreed procedure proposed at WK*NEPH* 2009 and outlined in the stock annex. Table 7.7.8 shows landings predictions at various harvest ratios, including those equivalent to fishing within the range of $F_{0.1}$ to F_{max}. The F_{2012} (mean F 2010–2012) for FU22 is estimated below the $F_{msy\ proxy}$ proposed by ICES.

7.7.6 Biological reference points

Given the short time-series of FU22 UWTV survey data it is not possible to define an appropriate $B_{trigger}$. The combined sex $F_{35\%}$ SPR is proposed by the WG as proxy for F_{MSY}.

7.7.7 Management plans

There are several key uncertainties and bias sources in the method used here (these are discussed further in WK*NEPH* 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009). Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates (Marrs *et al.*, 1996). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that is more accurate, although no more precise (WK*NEPH* 2009). The survey estimates themselves are very precisely estimated (CVs 2–8%) given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU22 are largely based on expert opinion. The precision of these bias corrections cannot yet be characterised, but is likely to be lower than that observed in the survey.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. For FU22 deterministic estimates of the mean weight in the landings and discard rates for 2003–2012 are used by the WG to account for the variability in these over time. This variability has occurred when large recruitments are observed in the stock as was the case in 2006 and 2007.

There is a gap of 16 months between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is rarely the case. The effect of this assumption on realised harvest rates has not been investigated, but remains a key uncertainty.

The quality of landings data is thought to be good and sampling and discard estimates have improved over the time-series.

7.7.8 Recommendation for next benchmark

This stock has not been formally benchmarked by ICES although the approach used has. WGCSE recommends that this stock be inter-benchmarked in 2014. As part of that process the historical time-series of landings and effort by rectangle should be disaggregated. Historical sampling and groundfish survey data in this FU should also be disaggregated as far as possible back in time and investigated for useful trends and signals. The inputs to the SCA analysis also need further investigation given that growth and natural mortality parameters could be updated.

7.7.9 Management considerations

The trends from the fishery (landings, effort lpue, mean size, etc.) appear to be relatively stable. The UWTV abundance and mean density estimates show some fluctuations in burrow abundance although it is stable over the time-series. There are fluctuations in the harvest rates which are related to the signals of recruitment into the fishery in 2006 and 2007 picked up by the UWTV and IGFS-WIBTS-Q4. Recent harvest rates for the FU22 Smalls suggest the stock is exploited below F_{MSY}. A new survey point should be available after July 2013 which will provide a more up to date prognosis of stock status. The use of the most up to date survey information should be considered for this stock.

In recent years several newer vessels specializing in *Nephrops* fishing have participated in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. Since the introduction of effort management associated with the cod long-term plan (EC 1342/2008) there have been concerns that effort could be displaced towards the Smalls and other *Nephrops* grounds where effort control has not been put in place. This has not happened to date and the 2012 effort was just below the recent average in the time-series.

In 2012 several vessels have switched to quad rig gear and the effect of this has yet to be taken into account.

These fisheries also have differences in non-*Nephrops* bycatch composition. Cod, whiting and to a lesser extent haddock are the main bycatch species (Davie and Lordan, 2011).

7.7.10 References

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Table 7.7.1. *Nephrops* in FU22 (Smalls Grounds). Landings in tonnes by country.

	FU 22 Landings (t)			
Year	**France**	**Rep. of Ireland**	**UK**	**Total**
1999	1,027	741	20	1,788
2000	1,186	1,687	34	2,907
2001	876	2,054	5	2,935
2002	595	1,392	3	1,990
2003	799	1,241	10	2,050
2004	465	1,330	33	1,827
2005	494	1,931	0	2,425
2006	302	1,398	52	1,752
2007	218	2,614	48	2,881
2008	312	2,474	328	3,114
2009	235	1,642	368	2,245
2010	136	2,220	351	2,708
2011	54	1,548	15	1,617
2012	65	2,509	59	2,633

Table 7.7.2. *Nephrops* in FU22 (Smalls Grounds). Effort and lpue data for the Irish otter trawl *Nephrops* directed fleet.

Year	Effort ('000 Hrs)	Landings (tonnes)	LPUE (kg/hr)
1995	25.0	1,217	48.61
1996	18.7	871	46.58
1997	21.8	1,052	48.22
1998	24.8	1,330	53.55
1999	13.9	616	44.32
2000	26.0	1,318	50.63
2001	34.2	1,912	55.96
2002	27.3	1,284	46.98
2003	28.3	973	34.36
2004	28.3	975	34.45
2005	43.5	1,875	43.10
2006	35.6	1,373	38.62
2007	48.1	2,663	55.36
2008	41.2	2,495	60.54
2009	29.1	1,579	54.28
2010	39.9	2,184	54.77
2011	29.9	1,486	49.71
2012	35.3	2,176	61.66

Table 7.7.3. ***Nephrops*** **in FU22 (Smalls Grounds). Landings and discards weight and numbers by year and sex.**

	FEMALE		MALE		BOTH SEXES
Year	Landings (t)	Discards (t)	Landings (t)	Discards (t)	% Discard
2003	504	193	886	170	21%
2004	803	60	796	44	6%
2005	1,075	692	1,289	428	32%
2006	758	307	1,080	300	25%
2007	1,041	903	2,137	738	34%
2008	976	448	2,408	358	19%
2009	645	200	2,181	249	14%
2010	1,066	245	2,015	191	12%
2011	402	34	1,129	78	7%
2012	645	114	1,864	130	9%
	Female Numbers '000s		Male Numbers '000s		Both sexes
Year	Landings	Discards	Landings	Discards	% Discard
2003	29,116	20,427	35,772	16,335	36%
2004	35,081	4,417	27,612	3,047	11%
2005	56,023	55,037	55,817	33,507	44%
2006	48,589	30,199	53,375	27,165	36%
2007	74,047	98,994	107,834	66,434	48%
2008	54,518	39,354	88,841	26,430	31%
2009	38,239	19,316	78,474	19,796	25%
2010	60,796	17,201	79,957	13,571	18%
2011	19,377	2,003	38,878	4,288	10%
2012	38,211	11,779	79,779	11,088	16%

Table 7.7.4. *Nephrops* in FU22 (Smalls Grounds). Composition of discards by the *Nephrops* trawl fleet in VIIfgh.

Species	Discards	Landings	Catch
Hake	478.89		478.89
Cod		1764.49	1764.49
Lesser Spotted Dogfish	567.21		567.21
Pollack		1273.64	1273.64
Others	2695.52	661.67	3357.19
Haddock	1202.19	268.51	1470.7
Ling		331.9	331.9
Megrim	469.97	734.71	1204.68
Angler-piscatorius		979.7	979.7
Blue Whiting	433.56		433.56
Dogfish	1409.3		1409.3
Grey Gurnard	895.18		895.18
Long Rough Dab	361.25		361.25
Poor Cod	1107.05		1107.05
Thornback Ray		195.62	195.62
Whiting	4025.81	745.33	4771.14
Witch		311.48	311.48
Nephrops	5874.665	23498.66	29373.33
Sum of all species	19520.6	30765.71	50286.31
Percentage of Catch	38.82%	61.18%	

Table 7.7.5. *Nephrops* in FU22 (Smalls Grounds). Mean sizes (carapace length, CL in mm) trends for catches, landings and discards by sex.

	FU22 Smalls					
Year	Catches		Landings		Discards	
	Females	Males	Females	Males	Females	Males
2005	30.2	30.6	32.3	33.1	28.1	27.7
2006	29.7	30.7	31.3	32.7	27.2	27.6
2007	26.0	29.6	28.2	30.5	24.4	25.8
2008	28.7	32.5	30.6	33.7	26.2	27.2
2009	28.3	31.6	29.9	32.8	25.4	26.6
2010	29.8	31.9	30.4	32.7	27.9	27.5
2011	31.4	33.5	32.0	34.3	28.0	29.7
2012	28.6	31.2	29.8	31.9	24.7	26.0

Table 7.7.6. *Nephrops* in FU22 (Smalls Grounds). Results summary table for geostatistical analysis of UWTV survey.

Ground	Year	Number of stations	Mean Density (burrows/m²)	Area Surveyed (m²)	Domain Area (km²)	Burrow Count	Geostatistical Abundance Estimate adjusted (millions burrows)	CV on Burrow estimate
Smalls	2006	100	0.63	15,413	2962	10,498	1503	2%
	2007	107	0.48	15,588	2955	8,571	1136	6%
	2008	76	0.47	14,503	2698	9,411	1114	6%
	2009	67	0.47	9,994	2824	6,362	1093	5%
	2010	90	0.49	15,153	2861	8,195	1141	4%
	2011	107	0.53	15,485	2881	8,191	1256	3%
	2012	47	0.63	6,448	2934	4,327	1498	8%

Table 7.7.7. *Nephrops* in FU22 (Smalls Grounds). Short-term catch option prediction inputs (Bold) and recent estimates of mean weight in landings and harvest ratio (shaded cells indicates inputs to catch option calculations).

Year	Landings in Number (millions) scaled	Discards in Number (millions) scaled	Removals in Number (millions) 25% discard survival	Prop Removals Retained	Adjusted Survey (millions)	Harvest Ratio	FU 22 Landings (t)	FU 22 Discards (t)	Mean Weight in landings (gr)
2003	95.71	54.22	136.37	0.7	Na		2,050	535	21.4
2004	71.65	8.53	78.05	0.92	Na		1,828	76	25.5
2005	114.71	90.81	182.82	0.63	Na		2,425	647	21.1
2006	97.18	54.67	138.19	0.7	1503	9.2%	1,752	593	18
2007	164.78	149.88	277.19	0.59	1136	24.4%	2,880	1513	17.5
2008	131.90	60.52	177.30	0.74	1114	15.9%	3,114	764	23.6
2009	92.75	31.08	116.06	0.8	1093	10.6%	2,245	589	24.2
2010	129.70	28.36	150.97	0.86	1141	13.2%	2,840	439	21.9
2011	61.55	6.65	66.54	0.93	1256	5.3%	1,617	144	26.3
2012	123.82	24.00	141.82	0.87	**1498**	9.5%	2,633	256	21.3
			Avg 10–12	**0.89**			Avg 03–12		**22.08**

Table 7.7.8. *Nephrops* in FU22 (Smalls Grounds). Short-term forecast management option table giving catch options for 2014.

			IMPLIED FISHERY	
	Harvest rate	Adjusted Survey (millions)	Retained number (millions)	Landings (tonnes)
MSY approach	10.9%	1,498	144	3,178.14
F_{2012}	9.5%	1,498	126	2,773.16
F0.1 Combined	7.5%	1,498	99	2,182.22
Fmax Combined	12.3%	1,498	163	3,594.08
	0%	1,498	0	-
	2%	1,498	27	585.83
	4%	1,498	53	1,171.66
	6%	1,498	80	1,757.49
	8%	1,498	106	2,343.33
	10%	1,498	133	2,929.16
	12%	1,498	159	3,514.99
				Basis
Landings Mean Weight (gr)		022.08		Sampling 2003–2012
Survey Overestimate Bias		1.3		WGCSE 2011
Survey Numbers (Millions)		1498		UWTV Survey 2012
Prop. Retained by the Fishery		0.89		Sampling 2010–2012

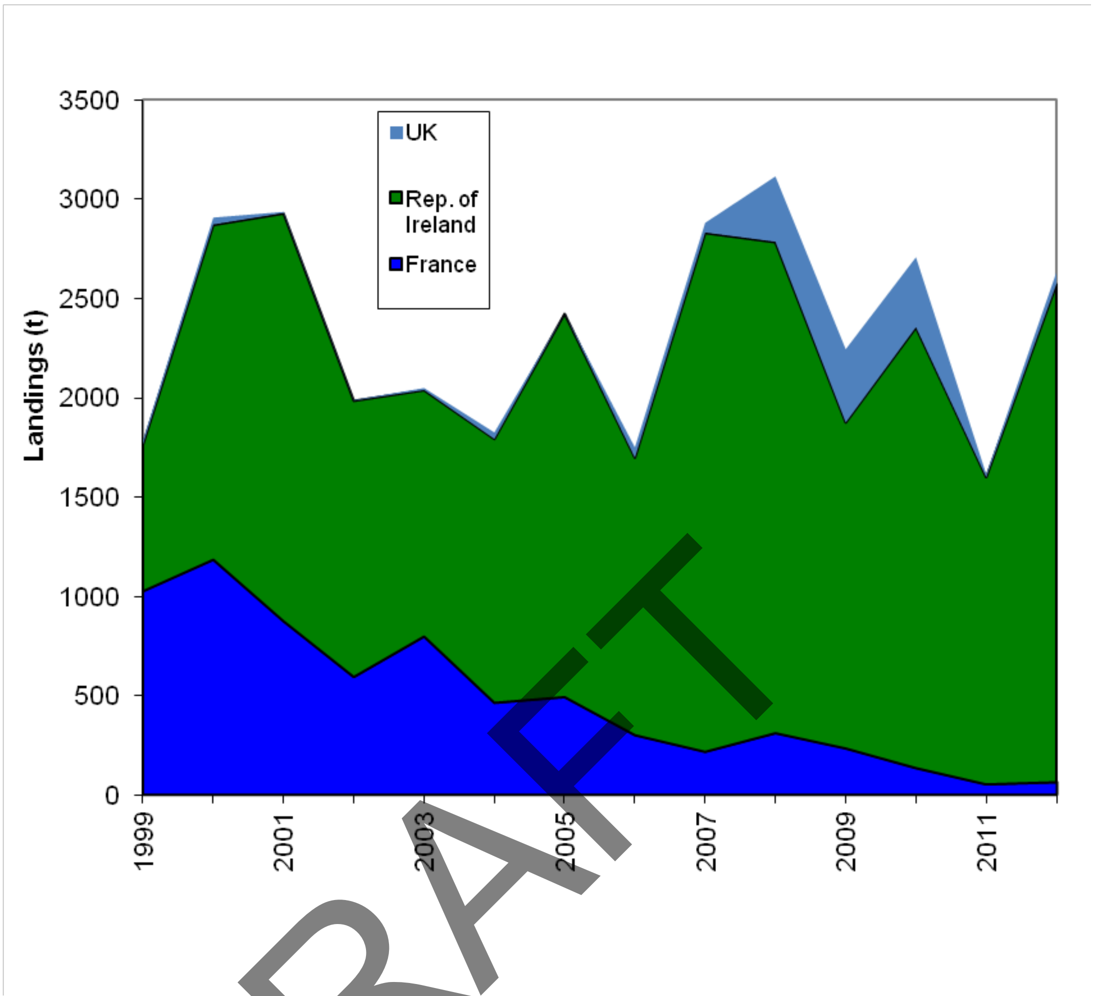


Figure 7.7.1. *Nephrops* in FU22 (Smalls Grounds). Landings in tonnes by country.

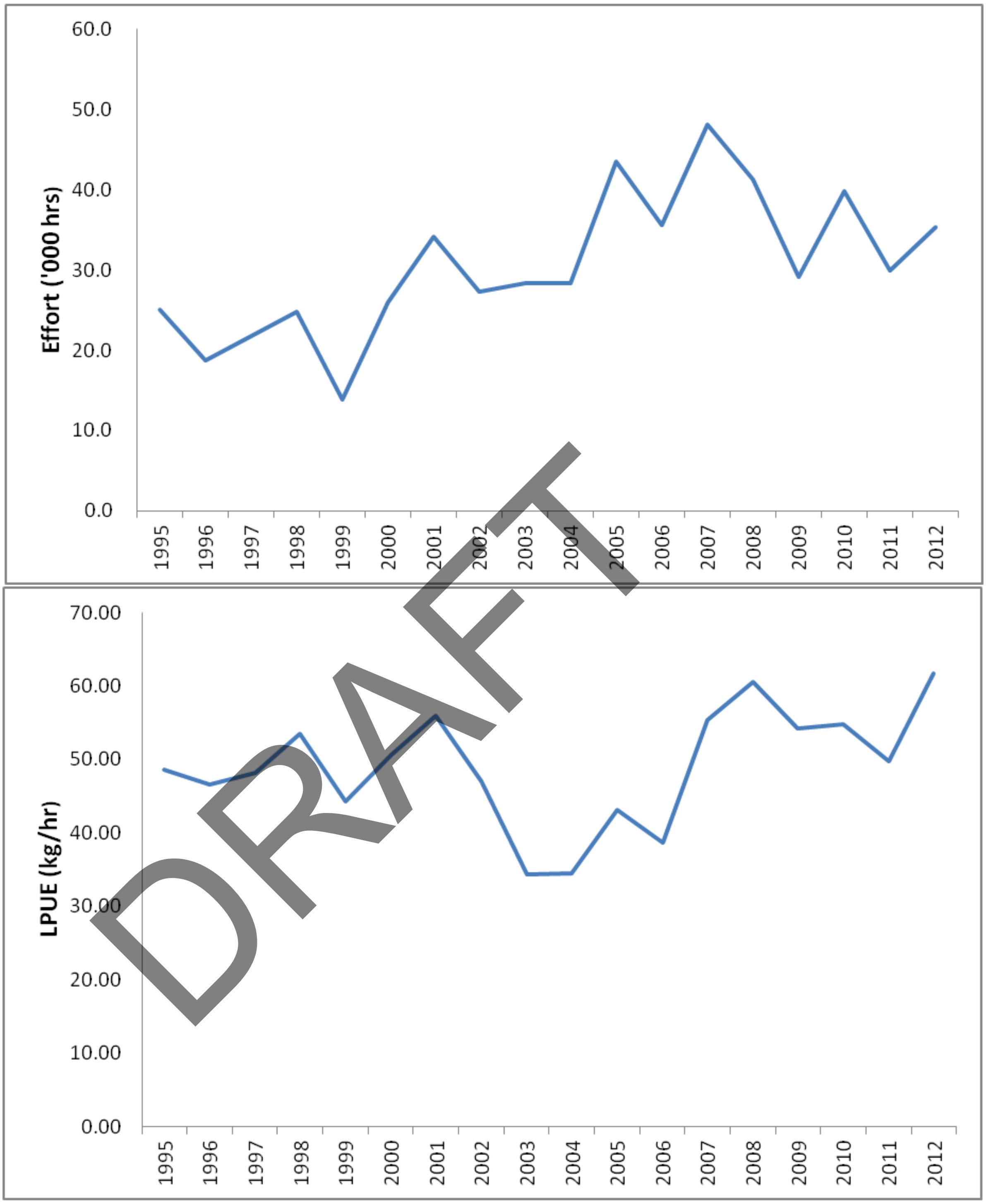


Figure 7.7.2. ***Nephrops*** **in FU22 (Smalls Grounds). Fishing effort and lpue series for for the Irish otter trawl** ***Nephrops*** **directed fleet (30% of** ***Nephrops*** **weight in total landings).**

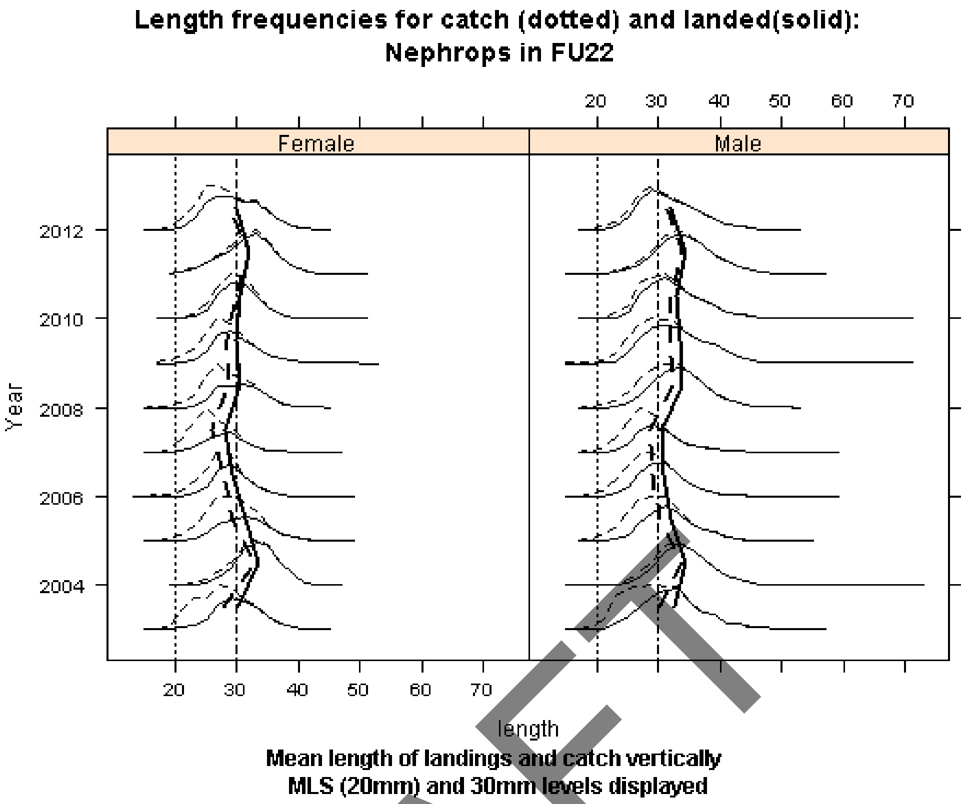


Figure 7.7.3. ***Nephrops*** **in FU22 (Smalls Grounds). Mean size trends for catches and whole landings by sex 2003–2012.**

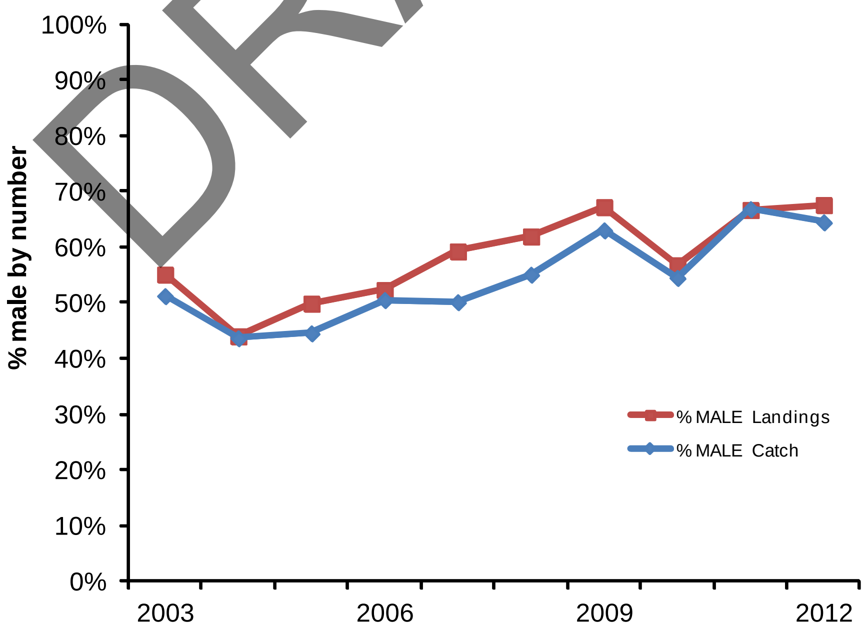


Figure 7.7.4. ***Nephrops*** **in FU22 (Smalls Grounds). Sex ratio of landings (2003–2012) and catch (2003–2012).**

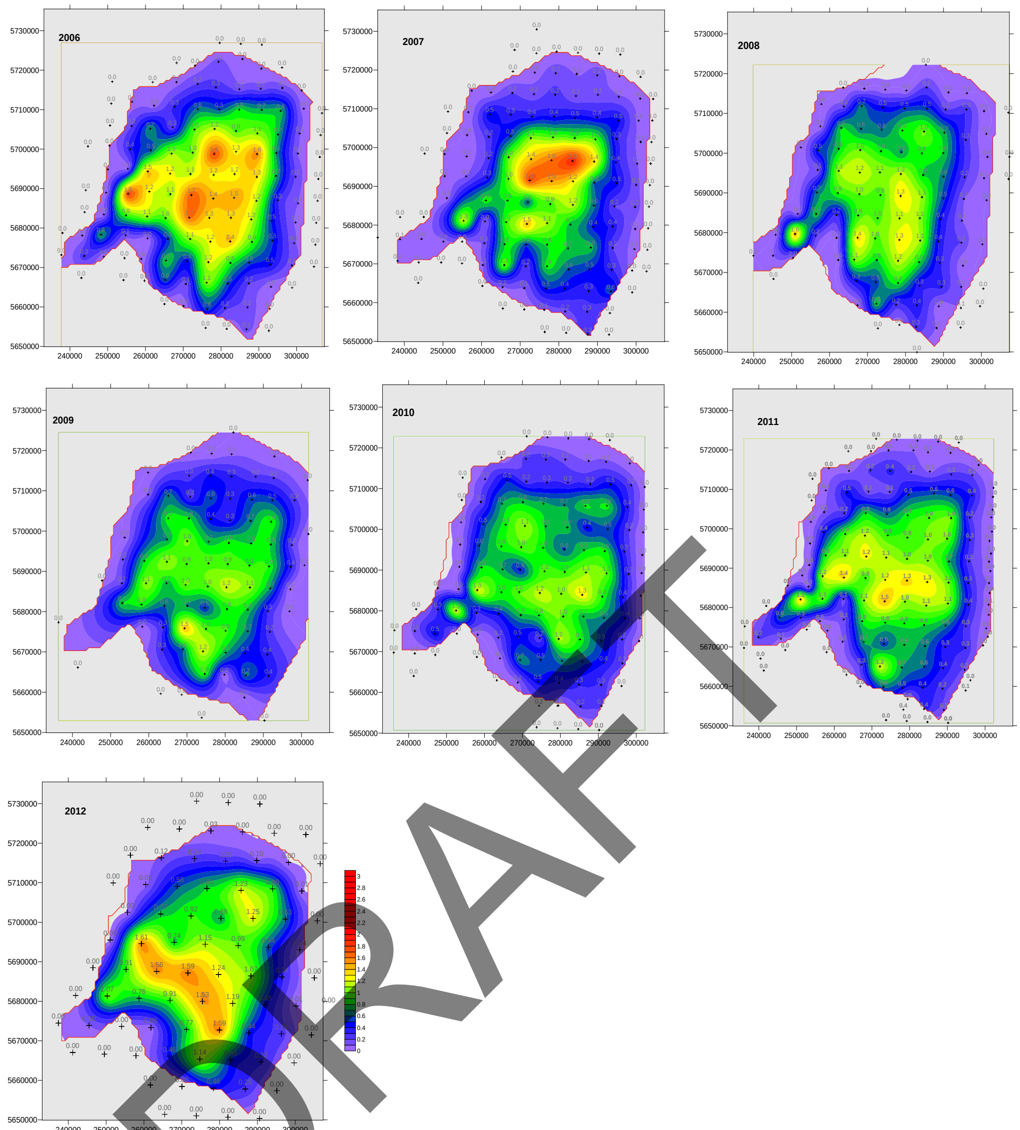


Figure 7.7.5. ***Nephrops*** **in FU22 (Smalls Grounds). Contour plots of the krigged density estimates for the UWTV surveys from 2006–2012.**

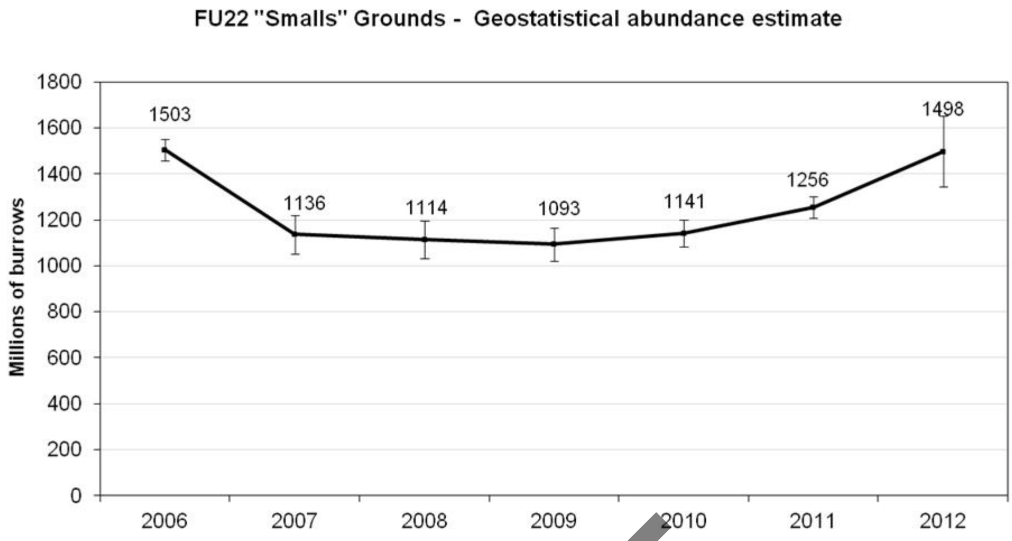


Figure 7.7.6. ***Nephrops*** **in FU22 (Smalls Grounds). Abundance estimates for the UWTV surveys from 2006–2012.**

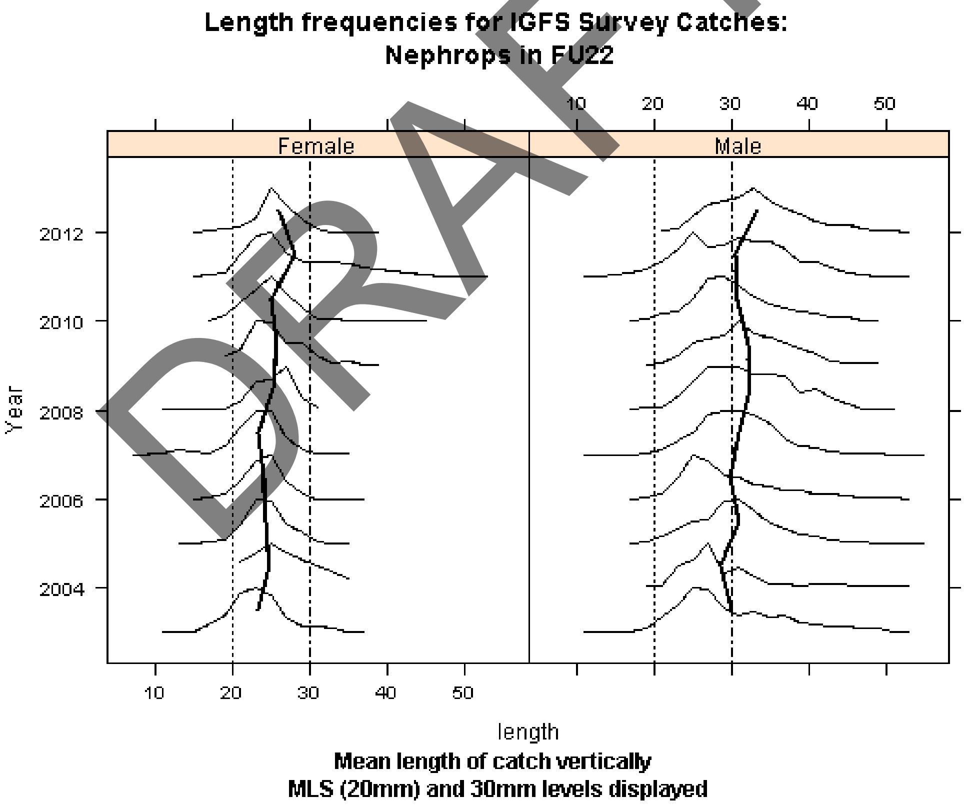


Figure 7.7.7. ***Nephrops*** **in FU22 (Smalls Grounds). Mean size trends for catches by sex from Irish Groundfish Survey 2003–2012.**

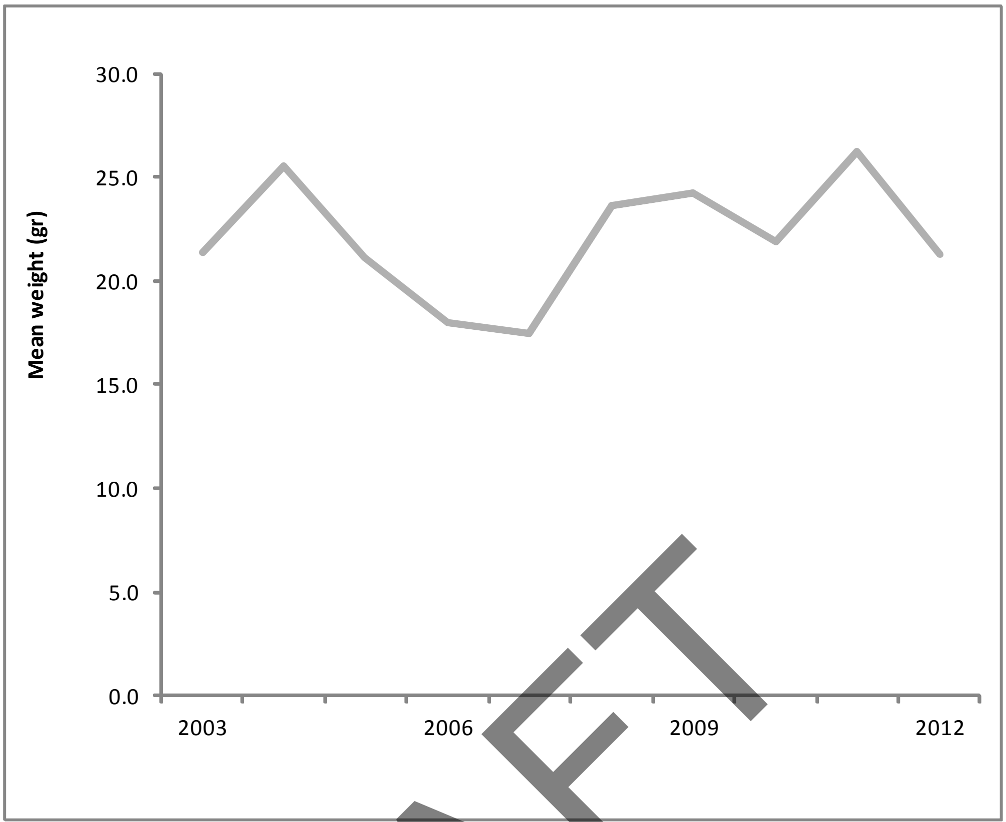
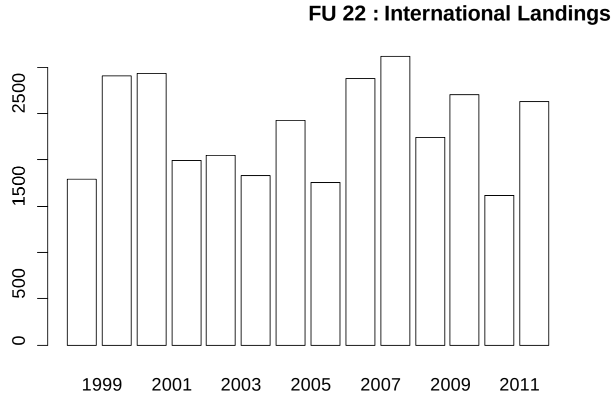
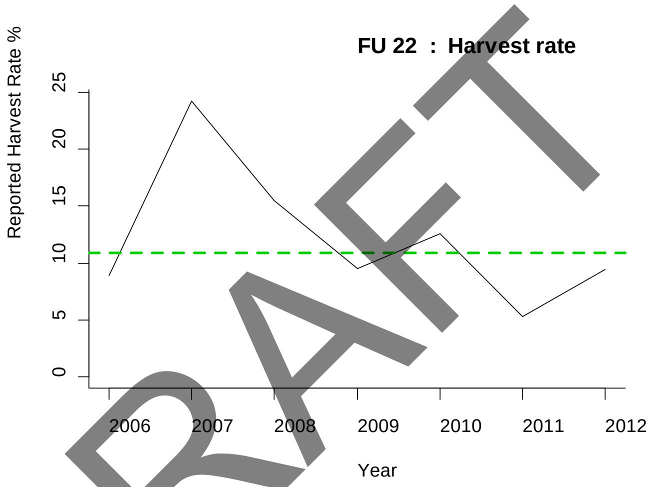


Figure 7.7.8. *Nephrops* in FU22 (Smalls Grounds). Mean weight in the landings 2003–2012.





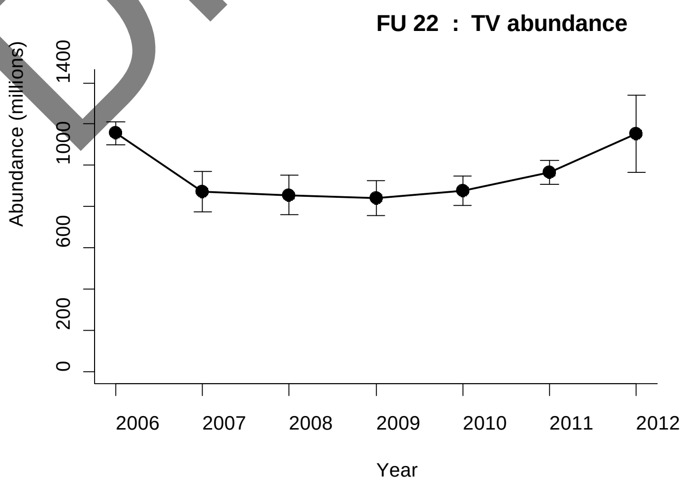


Figure 7.7.9. ***Nephrops*** **in FU22 (Smalls Grounds). Stock Summary plots: Landings (tonnes), UWTV abundance (millions), Harvest Ratio (% dead removed/UWTV abundance) and LFDs for landings by sex.**

7.8 *Nephrops* in Divisions VIIjg (South and SW Ireland, FU19)

Type of assessment in 2013

UWTV based assessment using WK*NEPH* 2009 protocol as described in the stock annex. Further description on the background is presented in Section 7.8.2.

ICES advice applicable to 2012

"ICES advises on the basis of the precautionary considerations that catches in 2012 should be reduced.

To protect the stock in this functional unit, management should be implemented at the functional unit level."

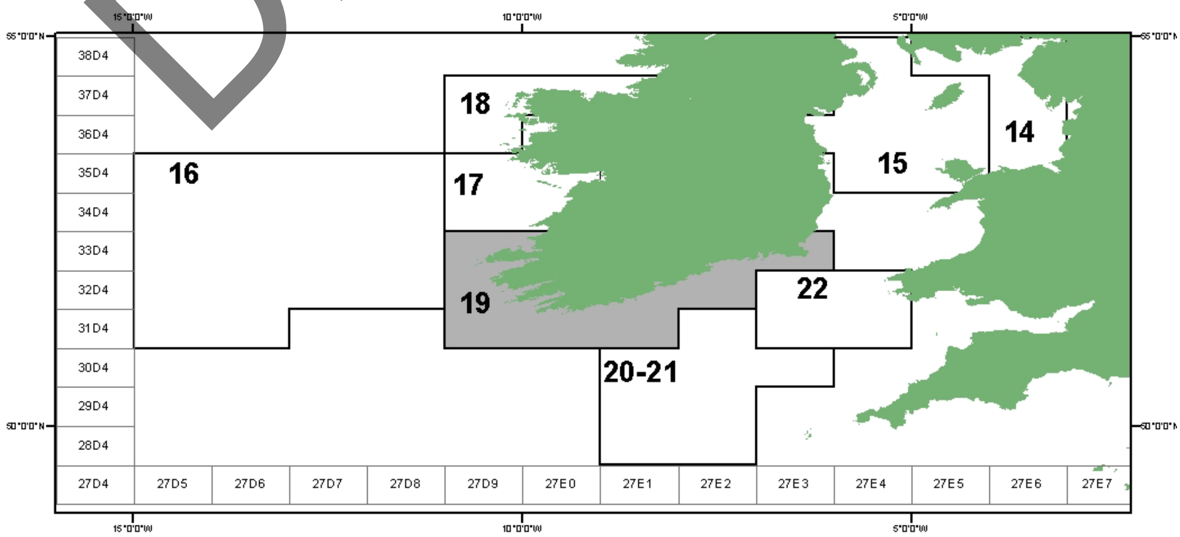
ICES advice applicable to 2013

"ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 820 t."

7.8.1 General

Stock description and management units

In FU19 *Nephrops* are caught on a large number of spatially discrete small inshore grounds and on some larger grounds further offshore Figure 7.8.1. Of these the 'Galley ground 4' and around Cork channels appear to be the most important (see Figure 7.8.7). The TAC is set for Subarea VII which does not correspond to the stock area (FU 19 is shaded).There is no evidence that the individual functional units belong to the same stock. The 2013 TAC is 23 065 t an increase of about 6% compared with the 2012 TAC. No FU19 specific restrictions in TAC apply thus, up to 100% of the Area VII TAC could, in theory be taken within FU19.



A map of the spatial distribution of FU19 is given in the Figure 7.8.1 and includes *Nephrops* within the following ICES statistical rectangles; 31–33 D9–E0; 31E1; 32E1–E2; 33E2–E3.

Management applicable to 2012 and 2013

TAC in 2012

COUNCIL REGULATION (EU) No 43/2012 of 17 January 2012 fixing for 2012 the fishing opportunities available to EU vessels for certain fish stocks and groups of fish stocks which are not subject to international negotiations or agreements.

Species: Norway lobster *Nephrops norvegicus*		**Zone:** VII (NEP/07.)
Spain	1 306 ([1])	
France	5 291 ([1])	
Ireland	8 025 ([1])	
United Kingdom	7 137 ([1])	
Union	21 759 ([1])	
TAC	21 759 ([1])	Analytical TAC Article 11 of this Regulation applies.

([1]) Special condition: of which no more than the following quotas may be taken in VII (Porcupine Bank – Unit 16) (NEP/*07U16):

Spain	380
France	238
Ireland	457
United Kingdom	185
Union	1 260

COUNCIL REGULATION (EU) No 39/2013 of 21 January 2013 fixing for 2013 the fishing opportunities available to EU vessels for certain fish stocks and groups of fish stocks which are not subject to international negotiations or agreements.

TAC in 2013

Species: Norway lobster *Nephrops norvegicus*		**Zone:** VII (NEP/07.)
Spain	1 384 ([1])	
France	5 609 ([1])	
Ireland	8 506 ([1])	
United Kingdom	7 566 ([1])	
Union	23 065 ([1])	
TAC	23 065 ([1])	Analytical TAC Article 11 of this Regulation applies.

([1]) Special condition: of which no more than the following quotas may be taken in Functional Unit 16 of ICES Subarea VII (NEP/*07U16):

Spain	543
France	340
Ireland	653
United Kingdom	264
Union	1 800

The MLS implemented by EC is set at 25 mm CL i.e. 8.5 cm total length and this regulation is applied by the Irish and UK fleets whereas a more restrictive regulation adopted by the French Producers' Organisations (35 mm CL i.e. 11.5 cm total length) is applied by the French trawlers.

Ecosystem aspects

This section is detailed in stock annex.

Fishery description

A description of the fleet is given in the stock annex. For the Irish fleet vessels <18 metre total length operate out of many local ports and fish the inshore *Nephrops* patches in periods of good emergence and weather. Irish vessels >18 m tend to fish the offshore *Nephrops* patches and target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. The minimum mesh size in use is 80 mm.French trawlers harvesting *Nephrops* on this area fish also in the Celtic Sea (FU22 and FU20–21) and switch to the FU19 according to meteorological conditions. They have used mesh size 100 mm for codend since January 2000 (in order to not be constrained by bycatch composition) and they apply MLS of 11.5 cm (i.e. 35 mm CL) adopted by French Producers' Organizations larger than the European one (8.5 cm i.e. 25 mm CL).

Fishery in 2012

The number of Irish vessels reporting landings in this area has increased from 28 in 2000 to 101 in 2012. Of these, 30 vessels (<18 m) reported landings in excess of 10 t and these vessels accounted for 72% of the total landings. There has been a trend for Irish vessels (>18 m) to switch to multi (quad) rig trawls. Provisional data suggests a ~30% increase in *Nephrops* catch rates and a reduction in fish bycatch of ~30% due to the lower headline height.

The number of French vessels reporting landings in FU19 has decreased from 35 vessels in 2005 to eleven vessels in 2012 and only one of these vessels reported landings in excess of 5 tonnes.

7.8.2 Data

The sampling levels for this FU are given in Section 2 (Table 2.1).

Landings

Landings data for FU19 are summarized in Table 7.8.1. The Republic of Ireland, France and the UK report landings for FU19. The Republic of Ireland landings have fluctuated considerably throughout the time-series, with a marked dip in 1994 (Figure 7.8.2). The highest landings in the time-series were observed in 2002–2004 (>1000 t). Landings in 2005 and 2006 have been below average for the series. In 2012 landings increased by approximately 30% for the Irish fleet and were below the series average. Landings by the French fleet have fluctuated with a declining trend throughout the time-series from the highest value in 1989 of 245 t to 11 t in 2012. Landings from the UK are minor.

Disaggregated effort and lpue data are available for the Irish *Nephrops* directed fleet in FU19 from 1995–2012 for all vessels and vessels >18 metres total length. (Table 7.8.2; Figure 7.8.3). The lpue and effort-series is based on the same criteria for FU15, 16 ,17, 22 and 20–21 (30% landings threshold) and will be contingent on the accuracy of landings data reported in logbooks. The long-term trend in lpues for all vessels and vessels >18 m are stable over the dataseries. For vessels >18 m recent effort (since early 2000s) has fluctuated with a decreasing trend and lpue with an increasing trend (33 kg/hr in 2012). This can be explained by fleet mobility where vessels target *Nephrops* in this area in periods of good emergence.

A time-series of landings by all FUs in ICES Subarea VII together with the overall TAC is shown in Table 7.8.10. (Note that national quotas for Ireland and the UK are restrictive in most of the recent years).

Discarding

In 2002 a new catch self-sampling programme was put in place in Ireland. This involves unsorted catch and discard samples being provided by vessels or collected by observers at sea on discard trips. The catch sample is partitioned into landings and discards using an onboard discard selection ogives derived for the discard samples. Sampling effort is stratified monthly but quarterly aggregations are used to derive length distributions and selection ogives. The length–weight regression parameters given in the stock annex are used to calculate sampled weights and appropriate quarterly raising factors. The sampling intensity and coverage has varied over the time-series (stock annex.). Sampling of the discards has proven difficult in recent years due to logistics. The quality of the sampling has not yet been qualitatively assessed in terms of precision and accuracy.

Discarding of other species by the *Nephrops* trawl fleet is around 47% of the total catch by weight. The main discards are small whole *Nephrops*. The main fish species discarded are dogfish, haddock, whiting and megrim (Anon, 2011).

Biological sampling

Length–frequency data of the landings were collected on a regular basis 2002 to 2012. Spatial and temporal coverage is problematic with landings from FU19 coming from several discrete grounds (Figure 7.8.6). Discard samples are difficult to obtain due to the spatial coverage of the grounds.

The mean size in the catches of males varies from 30 to 36 mm CL, and for females between 27 and 33 mm CL (Table 7.8.3; Figure 7.8.4). There is a slight increase in mean size for both sexes in 2012.

There is no change to other biological parameters as described in the stock annex.

Abundance indices from UWTV surveys

The methods used during the survey were similar to those employed for UWTV surveys of *Nephrops* stocks around Ireland and elsewhere and are documented by WKNEPHTV (ICES, 2007). The 2006–2012 UWTV stations in FU19 were randomly picked from within polygons defined using integrated VMS data to determine the extent of the *Nephrops* patches (using methods described in Gerritsen and Lordan, 2011). Only around 40% of the total landings are made by vessels with VMS so the area estimates are likely to be underestimates of the total spatial extent of *Nephrops* in this area. The discrete grounds have been named as: Bantry Bay, Galley Ground 1–4, Cork Channels and Helvick 1–3 and are shown in Figure 7.8.6. The estimation of the areas within FU19 was calculated based on VMS derived polygons using ArcGIS10 (Table 7.8.4). In terms of area the Galley Grounds (1–4) account for 60% of the total grounds in FU19 and Galley Ground 4 is the largest of these representing 39% of the total area (Table 7.8.5).

A number of factors are suspected to contribute bias to UWTV surveys. In order to use the survey abundance estimate as absolute it is necessary to correct for these potential biases. The bias estimates are based on simulation models, preliminary experimentation and expert opinion. Previously a bias correction factor has not been estimated for FU19 but WD 09 offers a basis to estimate this as follows: The burrow systems are estimated to be of moderate size ~40 cm for most of the area. A field of view (FOV) of ~75 cm on the UWTV survey has been confirmed for most stations using sledge mounted lasers. There may be some random noise in the FOV due to sinking and jumping in poor weather, but this is normally not a major problem in FU19. The FOV is smaller than that used for Scottish stocks (FOV ~1 m) resulting an edge effect bias correction factor of around 1.25 based on the findings of Campbell *et al.* (2009). Burrow system detection rates are thought to be relatively high (0.9). Visibility is generally good; most systems have multiple entrances and are fairly evenly spaced making detection easier. There are some other burrowing macrobenthic species present in FU19 and misidentification is assumed to be in the order of 1.15. Fishing activity in FU19 is intensive and unoccupied burrows are likely to be filled in quickly due to a combination of fishing and hydrodynamic sediment disturbance. As for most other areas the assumption is that all the burrows counted are occupied by a single *Nephrops*.

The cumulative biases associated with the estimates of *Nephrops* abundance for FU19 are:

FU	Area	Edge effect	detection rate	species identification	Occupancy	Cumulative bias
19	South and SW Coast	1.25	0.9	1.15	1	1.3

The 2012 Galley ground 2 mean density is similar to that observed in 2011 at 0.76 (no./m²). Helvick 1 and 2 grounds mean densities have increased in 2012. The mean density observed for the other grounds (Bantry Bay, Cork Channels, Helvick 3, Galley Grounds 2 and 3) have decreased from that observed in 2011. Galley Grounds 1 was not surveyed due to logistics. Galley Grounds 4 was surveyed in 2012 and the 2012 abundance estimate is 0.48 (no./m²). This ground had last been surveyed in 2006 and the abundance estimate was 0.27 no./m²).

Raised abundance estimates for the discrete grounds are presented in Table 7.8.6. The abundance estimation is the product of the mean density and ground area. The sample variances, standard errors, t-values and 95% CI were calculated for each ground. Two raising options were explored by WGCSE 2012 to calculate the total abundance given that Galley 1 was not surveyed in 2012. Option one was to raise the average density for all patches surveyed in 2012 to the total area estimated for FU19. This resulted in an abundance estimate (bias adjusted) of 550 million individuals. A more conservative alternative was to assume that the densities on Galley 1 were at the same density as observed in 2011. This gives a total abundance estimate (bias adjusted) of 498 million. The WGCSE deemed it more appropriate to include the 2011 mean density estimate for Galley ground 1 for the FU19 2012 abundance estimate (498 million burrows).

Information from Irish Groundfish survey

Length–frequency data of the *Nephrops* catches on the Irish groundfish survey (IGFS-WIBTS-Q4) from 2003–2012 are available (Table 7.8.7; Figure 7.8.5). These data were investigated at this WG for trends in indicators such as mean size and were compared with commercial data. The mean size of males and females in from the survey was fairly stable over time at 33 mm for males and 25 mm for females. There are some difference with the commercial data due to differences in catchability and selectivity between the commercial fishery and the survey not to mention the spatial coverage differences.

7.8.3 Assessment

The WGCSE 2013 carried out an UWTV based assessment for this stock. The methods used were very much in line with WK*NEPH* (2009) and the approach taken for other *Nephrops* stocks in VI and VII by WGCSE.

Summary of Review Group comments on the 2012 assessment

The RG report contained some technical comments and attempts have been made to address these in terms of data presentation. Also this stock is due to be inter-benchmarked in 2014, which will address those issues raised by the RG in terms of the methodology when mean density of patches within the FU are not surveyed.

Technical comments

The WG states that more work is needed to develop life-history parameters that are specific to the FU 19 *Nephrops* stock and to establish FMSY proxies. The RG agrees with this suggestion and encourages future research and sampling programmes that will better characterize the biological structure and catch of *Nephrops* in this area. The 2013 benchmark will provide a good opportunity to accomplish this task.

The WG notes that the current survey footprint may underestimate the extent of the *Nephrops* stock. The video survey areas are based on VMS observations of fishing locations. However, roughly 50% of the vessels in the *Nephrops* fleet do not have VMS. The RG encourages the WG to cooperate with *Nephrops* fishermen to determine if the current survey footprint is missing any of the major fishing grounds for this stock.

Conclusions

The assessment appears appropriate for the basis of management advice. The assessment was performed as prescribed in the stock annex. Based on recent trends in landings and lpue, and the estimated 2011 harvest rate (7%), the RG agrees with the WG that the biomass of the stock appears to be stable. Additionally, the MSY proxy appears to be a solid basis for prescribing future management advice. As the UWTV survey is continued in FU 19, it may become possible to estimate biomass reference points for this stock, and to assess stock status with more certainty.

Comparison with previous assessments

The assessment is based on the same methods and similar data as used in 2012. For Galley ground 1 (which was not surveyed in 2012 due to logistics), the 2011 mean density estimate for this mud patch was used in the overall abundance estimate for 2012. The stock size is estimated to have decreased and harvest ratio has increased based on the UWTV survey.

State of the stock

UWTV abundance estimates suggest that the stock size has decreased by about 11% compared to that in 2011.Table 7.8.9 summarizes recent harvest ratios for the stock along with other stock parameters.

7.8.4 MSY explorations

No new MSY explorations were carried out at WGCSE this year. The results of the final SCA model carried out at WGCSE 2012 are given in the text table below. The F multipliers required to achieve the potential F_{MSY} proxies, the harvest rates that correspond to those multipliers and the resulting level of spawner per recruit as a percentage of the virgin level.

The length–frequency distributions reference period 2009–2011 were used as input to the SCA model. The length distributions in the reference period were relatively stable. Other SCA inputs such as growth parameters and discard survival were all taken from the stock annex.

The L_{50} for female maturity was estimated at 26 mm and was based on Irish sampling in FU19. Figure 7.8.8 shows the estimated YPR and SPR curves. The SCA model fit to both landings and discards of both sexes is fairly good. The YPR plot indicates a more domed YPR for females than males. The results of the model in the table below show the F multipliers required to achieve the potential F_{MSY} proxies; the harvest rates that correspond to those multipliers and the resulting level of spawner-per-recruit as a percentage of the virgin level. The estimated harvest rates are very close to those estimated for several other stocks in VI and VII.

		Fmult	Fbar 20–40mm		Harvest Rate %	% Virgin Spawner per Recruit		
			Male	Female		Male	Female	Comb
$F_{0.1}$	Male	0.2	0.13	0.04	6.5	42.57	72.19	53.38
$F_{0.1}$	Female	0.55	0.36	0.11	14.2	18.97	49.02	29.94
$F_{0.1}$	Comb	0.24	0.16	0.05	7.5	37.60	68.41	48.85
F_{max}	Male	0.36	0.24	0.07	10.4	27.48	59.20	39.06
F_{max}	Female	1.04	0.68	0.21	21.9	10.54	34.63	19.33
F_{max}	Comb	0.47	0.31	0.10	12.7	21.85	52.80	33.15
$F_{35\%SpR}$	Male	0.27	0.18	0.06	8.3	34.51	65.83	45.94
$F_{35\%SpR}$	Female	1.03	0.68	0.21	21.8	10.63	34.83	19.46
$F_{35\%SpR}$	Comb	0.44	0.29	0.09	12.1	23.16	54.40	34.56

WGCSE took into account the following considerations when proposing a suitable F_{MSY} proxy:

- Compared to other *Nephrops* fisheries in the ICES area the population density of FU19 appears to be moderate ~0.5/m². In 2011 Galley ground 4 was not surveyed and the 2006 mean density for this ground has been used.
- There is one year of UWTV survey data available (2011) for this FU.
- The biological parameters are assumed in line with other Celtic Sea stock but probably vary significantly between areas with different density levels. Natural mortality estimates are assumed in line with other stocks.
- Fishery operates throughout the year but there has been some variability of the seasonality depending on *Nephrops* emergence.

- The time-series of mean size in the landings/catches is very short and quite noisy. The mean size in survey catches is also short but covers only a few of the patches regularly and the survey only operates in quarter 4.
- Area estimates are likely to be conservative estimates of the stock distribution. Around 50% of the landings are made by vessels <18 metres which do not currently have VMS.
- Mean weights have been variable over the available time-series but this is likely to be a result of the variability in sampling of the discrete patches.
- Sampling and discard estimates have been improving over the time-series.

The WG concluded default proxy of combined sex $F_{0.1}$ is appropriate as an $F_{MSY\ proxy}$. This corresponds to an interim harvest rate of 7.5%, which is in line with several other stocks in the remit of this WG. Fishing at the combined sex $F_{0.1}$ is predicted to keep the SPR for both sexes >53% and should deliver long-term yield with a low probability of recruitment overfishing. No $B_{trigger}$ can be proposed given the shortness of the UWTV series. Given that the stock in recent years has been at a relatively moderate level (as evidenced in the lpue series) it is likely to be above $B_{trigger}$.

7.8.5 Short-term projections

Projections are carried out for FU19 component using the method agreed at WK*NEPH* 2009 and applied for all other stocks with UWTV estimates in VI and VII by WGCSE.

Catch option for 2014 at various harvest rations were calculated using the approach agreed at the Benchmark Workshop (WK*NEPH*, 2009). Catch options are calculated by applying a bias correction factor (1.3) to the UWTV survey estimate, using three year mean weight in the landings, three year mean proportions of the catch retained and harvest ratios at different reference points from a SCA analysis to calculate landings options.

The inputs to the catch option table are given in Table 7.8.8. Table 7.8.9 shows landings predicted at a range of harvest ratios including those equivalent to fishing at F_{MSY} proxies for the fishery as well as $F_{current} = F_{2012}$. Only the Harvest Rates associated with the combined sex F_{MSY} proxies are identified in the table as they are considered more appropriate to this stock. As for other *Nephrops* stocks the F_{MSY} proxy harvest rate values are considered preliminary and may be modified following further data exploration and analysis.

7.8.6 Biological reference points

There are no biological reference points for FU19 *Nephrops* stock. Given the short time-series of UWTV survey data it is not possible to define an appropriate $B_{trigger}$. The combined sex $F_{0.1}$ is proposed by the WG as proxy for F_{MSY}.

7.8.7 Management plans

No specific management plan exists for this stock.

7.8.8 Uncertainties and bias in assessment and forecast

There are several key uncertainties and bias sources in the method used here (these are discussed further in WK*NEPH* 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008;

SGNEPS 2009). Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates (Marrs *et al.*, 1996). Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that is more accurate, although no more precise (WK*NEPH*, 2009). Different densities are apparent on the various different grounds within this FU. For the 2012 survey the number of observations on each individual patch is relatively low making the relative standard error (RSE) estimates not that relevant. Aggregating all areas together gives a mean burrow density of -0.43 with a RSE of around 10% which is below the 20% threshold recommended by SGNEPS 2012. The cumulative bias estimates for FU19 are largely based on expert opinion. The precision of these bias corrections cannot yet be characterized, but is likely to be lower than that observed in the survey.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. For FU19 deterministic estimates of the mean weight in the landings and discard rates for 2010–2012 are used although there is some variability of these over time.

There is a lag between the survey and the start of the year for which the assessment is used to set management levels. It is assumed that the stock is in equilibrium during this period (i.e. recruitment and growth balance mortality) although this is rarely the case. The effect of this assumption on realized harvest rates has not been investigated, but remains a key uncertainty.

The quality of landings data is thought to be good and sampling and discard estimates have improved over the time-series.

7.8.9 Recommendations for next benchmark

This stock has not been formally benchmarked by ICES although the approach used has. WGCSE recommends that this stock be inter-benchmarked in 2014. For this stock the inputs to the SCA analysis could warrant further investigation. The growth and natural mortality parameters used here were assumed in line with the Celtic Sea. The utility of the Irish groundfish survey and other survey information also could be developed further. The spatial extent of the *Nephrops* grounds also requires further investigation as the current area estimates are likely to be under estimates of the total extent of *Nephrops* in this area.

7.8.10 Management considerations

The trends from the fishery (landings, effort, lpue, mean size, etc.) appear to be relatively stable. Lpues have been moderate in the last three years. The UWTV abundance and mean density estimates vary between the discrete patches and population dynamics between these are not fully understood. A new survey point should be available by September 2013 which will provide a more up to date prognosis of stock status. The use of the most up to date survey information should be considered for this stock.

In recent years several newer vessels specializing in *Nephrops* fishing have participated in this fishery. These vessels target *Nephrops* on several other grounds within the TAC area and move around to optimize catch rates. Since the introduction of effort management associated with the cod long-term plan (EC 1342/2008) there have been concerns that effort will be displaced towards FU19 and other *Nephrops* grounds where effort control has not been put in place.

Nephrops fisheries in this area are fairly mixed also catching megrim, anglerfish and other demersal species. There are also some catches of hake, and in the offshore parts of the area. The *Nephrops* grounds in FU19 coincide with an important nursery area for juvenile hake and anglerfish among other species (ICES, 2009).

7.8.11 FU18

The spatial distribution of FU18 includes *Nephrops* within the following ICES statistical rectangles; 37E0–E1; 36–37D9.

Data available

For FU18 landings information from 1993 was available to the WG only (Table 7.8.1). The Republic of Ireland has taken 100% of the landings for the last seven years. The highest reported landings were in 1994 with 124 t; landings in recent years have been minor (28 t in 2012). This FU will be monitored to see if any fishery develops.

7.8.12 References

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Table 7.8.1. ***Nephrops*** **in FU18 and FU19 (NW, SW and SE Ireland). Landings in tonnes by country and Functional Unit.**

YEAR	FU 18			FU 19			
	Rep. of Ireland	UK	Total	France	Rep. of Ireland	UK	Total
1989		0		245	652	2	899
1990		0		181	569	4	754
1991		0		212	860	5	1077
1992		0		233	640	15	888
1993	9	1	10	229	672	4	905
1994	124	2	126	216	153	21	390
1995	24	0	24	175	507	12	695
1996	46	1	46	145	736	7	888
1997	13	0	13	93	656	7	756
1998	77	1	78	92	733	2	827
1999	15	0	16	77	499	3	579
2000	9	0	9	144	541	11	696
2001	2	0	2	111	702	2	815
2002	14	0	14	188	1130	0	1318
2003	16	0	16	165	1075	0	1239
2004	22	0	22	76	997	1	1074
2005	15	0	15	62	648	2	711
2006	14	0	14	65	675	1	741
2007	3	0	3	63	894	0	957
2008	1	0	1	46	805	15	866
2009	14	0	14	55	764	15	833
2010	7	0	7	14	694	13	722
2011	13	0	13	23	585	1	608
2012	28	0	28	11	758	1	770

Table 7.8.2. ***Nephrops*** **in FU19 (SW and SE Ireland). Irish** ***Nephrops*** **directed effort (in hours) and lpue, 1993–2012.**

YEAR	IRISH FLEET – *NEPHROPS* TRAWLERS (>30% LANDINGS WEIGHT)					
	All Vessels			**Vessels >18 m**		
	Effort hrs	**Landings Tonnes**	**LPUE Kg/hr**	**Effort hrs >18 m**	**Landings Tonnes**	**LPUE >18 m Kg/hr**
1995	9.1	206	22.5	3.8	121	32.2
1996	9.3	220	23.7	2.5	86	33.7
1997	9.6	248	25.8	2.4	101	42.1
1998	15.8	386	24.5	4.9	188	38.1
1999	13.3	206	15.4	1.9	47	25.3
2000	9.3	178	19.1	3.1	86	27.7
2001	9.7	309	31.8	3.6	130	35.9
2002	25.6	764	29.9	12.9	434	33.5
2003	28.9	621	21.5	14.5	363	25.1
2004	26.6	529	19.9	13.7	311	22.7
2005	23.8	455	19.1	9.4	218	23.3
2006	24.3	460	19.0	7.7	187	24.2
2007	30.4	665	21.9	10.2	263	25.9
2008	25.1	573	22.8	9.5	315	33.1
2009	22.8	527	23.1	8.4	243	28.9
2010	23.6	467	19.7	3.8	114	30.2
2011	18.7	315	16.8	5.2	167	32.3
2012	22.7	411	18.1	1.7	59	33.8

Table 7.8.3. ***Nephrops*** **in FU19 (SW and SE Ireland). Mean time-series for catches and landings, 1995–2012.**

Year	Catches		Landings			
			<35 mm CL		>35 mm CL	
	Males	Females	Males	Females	Males	Females
1995	na	na	na	na	na	na
1996	34.5	31.3	31.1	29.7	38.7	38.8
1997	34.6	32.9	31.2	30.9	39.8	38.4
1998	na	na	na	na	na	na
1999	38.5	35.4	31.8	31.2	41.3	39.1
2000	na	na	na	na	na	na
2001	na	na	na	na	na	na
2002	30.4	28.8	29.7	28.8	39.9	40.5
2003	33.1	29.4	31.1	30.0	38.4	38.0
2004	32.8	28.8	32.0	30.2	39.8	37.7
2005	31.3	27.5	29.1	26.9	38.4	37.0
2006	34.4	31.7	31.4	30.4	38.9	37.7
2007	35.6	33.2	32.4	31.7	39.1	38.2
2008	36.2	33.1	32.5	31.6	38.9	38.1
2009	33.9	29.2	31.2	29.8	39.3	37.4
2010	32.7	29.2	29.4	28.2	39.4	37.3
2011	30.4	28.5	28.9	27.5	38.9	36.9
2012	31.3	28.4	30.5	29.3	38.4	38.0

na = not available.

Table 7.8.4. *Nephrops* in FU19 (SW and SE Ireland). Area estimates of *Nephrops* grounds based on integrated VMS data using ArcGIS10.

FU	Ground	Eckert VI (world) (km2)	Irish National Grid (km2)	Cylindrical Equal Area (km2)	Average(km2)
19	Helvick 1	38.52	38.58	38.58	38.56
19	Helvick 2	31.44	31.48	31.49	31.47
19	Helvick 3	12.65	12.67	12.67	12.66
19	Helvick 1-3	82.61	82.72	82.74	82.69
19	Bantry Bay	90.92	91.08	90.72	90.91
19	Galley Grounds 1	61.81	61.91	61.91	61.88
19	Galley Grounds 2	77.88	77.99	77.99	77.95
19	Galley Grounds 3	202.56	202.85	202.85	202.75
19	Galley Grounds 4	651.79	652.61	652.61	652.33
19	Galley Grounds 1-4	994.04	995.35	995.35	994.91
19	Cork Channels	484.28	484.93	485.02	484.75

Table 7.8.5. *Nephrops* in FU19 (SW and SE Ireland). Percentage area contribution of the various *Nephrops* grounds.

% Area composition of *Nephrops* grounds in FU19		
Ground	**Area km²**	**%**
Bantry	90.91	5%
Cork Channels	484.75	29%
Galley Grounds 1	61.88	4%
Galley Grounds 2	77.95	5%
Galley Grounds 3	202.75	12%
Galley Grounds 4	652.33	39%
Helvick 1	38.56	2%
Helvick 2	31.47	2%
Helvick 3	12.66	1%
Total	1653.26	

Table 7.8.6. *Nephrops* in FU19 (SW and SE Ireland). Results summary table for statistical analysis of UWTV survey.

Year	Ground	Area Surveyed (m²)	Area Estimates (km²)	Burrow count	Mean Density (burrow/ m²)	95%CI	CViid (Relative SE)	Domain Area (km²)	Raised abundance estimate (million burrows)
2006	Bantry	-	90.91	-	-	-	-	-	
	Cork Channels	-	484.75	-	-	-	-	-	
	Galley Grounds 1	-	61.88	-	-	-	-	-	
	Galley Grounds 2	-	77.95	-	-	-	-	-	
	Galley Grounds 3	-	202.75	-	-	-	-	-	
	Galley Grounds 4	927.53	652.33	293	0.27	0.25	0.36	652.33	134.79
	Helvick 1	-	38.56	-	-	-	-	-	
	Helvick 2	-	31.47	-	-	-	-	-	
	Helvick 3	-	12.66	-	-	-	-	-	
2011	Bantry	740.51	90.91	334	0.43	0.37	0.31	90.91	29.87
	Cork Channels	1645.84	484.75	768	0.45	0.26	0.26	484.75	168.18
	Galley Grounds 1	386.74	61.88	248	0.67	1.33	0.46	61.88	32.11
	Galley Grounds 2	447.43	77.95	352	0.76	1.40	0.42	77.95	45.86
	Galley Grounds 3	615.26	202.75	472	0.75	0.46	0.19	202.75	117.41
	Galley Grounds 4	-	652.33	-	-	-	-	652.33	
	Helvick 1	436.96	38.56	341	0.78	0.05	0.01	38.56	23.17
	Helvick 2	314.97	31.47	84	0.22	0.89	0.96	31.47	5.22
	Helvick 3	242.76	12.66	18	0.06	0.82	1.00	12.66	0.63
2012	Bantry	130.28	90.91	21	0.16	-	-	90.91	11.27
	Cork Channels	1091.79	484.75	322	0.29	0.17	0.25	484.75	109.16
	Galley Grounds 1	-	61.88	-	-	-	-	61.88	
	Galley Grounds 2	601.67	77.95	473	0.76	0.25	0.10	77.95	45.81
	Galley Grounds 3	87.53	202.75	19	0.22	-	-	202.75	33.85
	Galley Grounds 4	2620.13	652.33	1192	0.48	0.11	0.10	652.33	242.62
	Helvick 1	340.76	38.56	132	0.38	0.44	0.27	38.56	11.41
	Helvick 2	373.12	31.47	108	0.28	1.06	0.88	31.47	6.78
	Helvick 3	364.94	12.66	196	0.50	1.37	0.63	12.66	4.90
2011*	FU19	4830.46	1,653.26	2616	0.51	0.14	0.13	1653.26	654
2011**	FU19								557
2012[1]	FU19	5610.22	1,653.26	2463	0.43	0.09	0.10	1653.26	550
2012[2]	FU19								498

2011* Abundance estimate does not include 2006 Galley ground 4
2011** Abundance estimate includes 2006 Galley Ground 4 estimate
2012[1] Abundance estimate does not include 2011 Galley ground 1
2012[2] Abundance estimate includes 2011 Galley Ground 1 estimate

Table 7.8.7. *Nephrops* in FU19 (SW and SE Ireland). Mean weights and mean size from IGFS survey (2003–2012) sampling in FU19.

Year	Mean Size in catch (CL mm)	Mean Size >25 mm (CL mm)	Mean Weight in catch (g)	Mean Weight >25 mm (g)	Number of samples	Numbers in samples
2003	31.41	33.16	20.37	24.25	11	1121
2004	25.88	28.17	10.94	14.37	3	562
2005	28.82	30.54	15.46	18.62	5	515
2006	30.28	32.22	18.11	22.09	4	237
2007	32.3	32.3	22.27	22.27	4	91
2008	29.82	30.72	17.25	18.97	15	845
2009	32.31	33	22.29	23.85	9	285
2010	28.85	30.27	15.51	18.1	13	1379
2011	29.76	30.71	17.14	18.96	21	4020
2012	32.30	32.83	22.28	23.47	11	327
Average(03–12)	30.17	31.39	18.16	20.50	10	938

Table 7.8.8. *Nephrops* in FU19 (SW and SE Ireland).). Forecast inputs (bold) and historical estimates of mean weight in landings and harvest ratio.

Year	Landings in Number (millions)	Discards in Number (millions)	Removals in Number (millions)	Prop Removals Retained	Adjusted Survey (millions)	Harvest Ratio	Landings (t)	Discards (t)	Mean Weight in landings (gr)
2006	25.1	2.5	27.3	0.92			741	41	29.5
2007	29.9	1.5	31.3	0.96			957	27	32
2008	26.6	1.4	27.8	0.96			866	23	32.6
2009	30.1	6.9	36.3	0.83			833	87	27.7
2010	27.3	9	35.4	0.77			722	106	26.4
2011	27.4	12.6	38.8	0.71	557	7.00%	608	137	22.2
2012	33.54	14.28	46.39	0.72	**498**	9.3%	770	149	23.0
Avg 10–12				**0.73**					**23.84**

Table 7.8.9. *Nephrops* FU19 (SW and SE Ireland). Catch option table for 2014.

			Implied fishery	
	Harvest rate	**Survey Index (millions)**	**Retained number (millions)**	**Landings (tonnes)**
MSY framework	7.5%	498	27	653.68
F_{2012}	7.0%	498	25	606.32
$F_{0.1\ Combined}$	7.5%	498	27	653.68
$F_{35\%SpR}$	12.1%	498	44	1,054.61
$F_{max\ Combined}$	12.7%	498	46	1,106.91
	0%	498	0	-
	2%	498	7	174.32
	4%	498	15	348.63
	6%	498	22	522.95
	8%	498	29	697.26
	10%	498	37	871.58
	12%	498	44	1,045.90
				Basis
Landings Mean Weight (Kg)	0.024		Sampling 2010–2012	
Survey Overestimate Bias	1.3		WGCSE 2012	
Survey Numbers (Millions)*	498		UWTV Survey 2012	
Prop. Retained by the Fishery	0.73		Sampling 2010–2012	

Table 7.8.10. ***Nephrops*** **in VII summary table of landings by Function Unit and outside FU for TAC Area VII.**

Year	FU 14 Irish Sea East	FU 15 Irish Sea West	FU 16 Porcupine Bank	FU 17 Aran Grounds	FU 18 Ireland NorthWest Coast	FU 19 Ireland SouthWest and SouthEast coast	FU 20–21 Labadie, Jones, Cockburn	FU 22 Smalls Grounds	FUs 20+21+22 All Celtic Sea FUs combined	Other statistical rectangles Outside FUs	Total Landings ICES Subarea VII	TAC for VII
1978	961	7,296	1,744	481						249	10,730	
1979	900	8,948	2,269	452						237	12,807	
1980	730	4,578	2,925	442						205	8,880	
1981	829	7,249	3,381	414						382	12,255	
1982	869	9,315	4,289	210						234	14,917	
1983	763	9,448	3,426	131					3,667	174	17,609	
1984	602	7,760	3,571	324					3,653	187	16,097	
1985	498	6,901	3,919	207					3,599	194	15,317	
1986	671	9,978	2,591	147					2,638	113	16,138	
1987	449	9,753	2,499	62					3,409	107	16,279	24,700
1988	462	8,586	2,375	828					3,165	140	15,557	24,700
1989	401	8,128	2,115	344		899			4,005	134	16,026	26,000
1990	563	8,300	1,895	519		754			4,290	102	16,423	26,000
1991	747	9,554	1,640	410		1,077			3,295	169	16,892	26,000
1992	427	7,541	2,015	372		888			4,165	409	15,816	20,000
1993	515	8,102	1,857	372	10	905			4,648	455	16,863	20,000
1994	447	7,606	2,512	729	126	390			5,143	570	17,523	20,000
1995	584	7,796	2,936	866	26	695			5,505	397	18,805	23,000
1996	475	7,247	2,230	525	46	888			4,828	623	16,862	23,000
1997	566	9,971	2,409	841	15	756			4,240	340	19,138	23,000

Year	FU 14 Irish Sea East	FU 15 Irish Sea West	FU 16 Porcupine Bank	FU 17 Aran Grounds	FU 18 Ireland NorthWest Coast	FU 19 Ireland SouthWest and SouthEast coast	FU 20–21 Labadie, Jones, Cockburn	FU 22 Smalls Grounds	FUs 20+21+22 All Celtic Sea FUs combined	Other statistical rectangles Outside FUs	Total Landings ICES Subarea VII	TAC for VII
1998	388	9,128	2,155	1,410	78	827			3,925	514	18,426	23,000
1999	624	10,786	2,289	1,140	16	579	1,152	1,788		322	18,699	23,000
2000	567	8,370	911	880	9	696	1,778	2,907		243	16,365	21,000
2001	532	7,441	1,222	913	2	815	1,833	2,935		368	16,064	18,900
2002	577	6,793	1,327	1,154	14	1,318	2,674	1,990		243	16,099	17,790
2003	376	7,052	907	933	16	1,239	2,953	2,050		186	15,712	17,790
2004	472	7,266	1,525	525	22	1,074	2,443	1,827		161	15,314	17,450
2005	570	6,529	2,312	778	15	711	2,469	2,425		180	16,042	19,544
2006	628	7,535	2,120	637	14	741	2,523	1,752		270	16,210	21,498
2007	959	8,424	2,186	1,096	3	957	2,419	2,881		206	19,130	25,153
2008	726	10,482	1,000	1,057	1	841	2,980	3,114		322	20,430	25,153
2009	693	9,166	825	625	10	833	3,145	2,245		107	17,619	24,650
2010	583	8,929	917	1,000	7	722	1,793	2,708		359	17,018	22,432
2011	561	10,159	1187	600	13	608	1,237	1,617		109	16,091	21,759
2012	530	10,527	1260	1,135	28	770	1,189	2,633		237	18,308	23,605
Average	607	8,361	2,135	645	24	833	2,185	2,348	4,011	264		

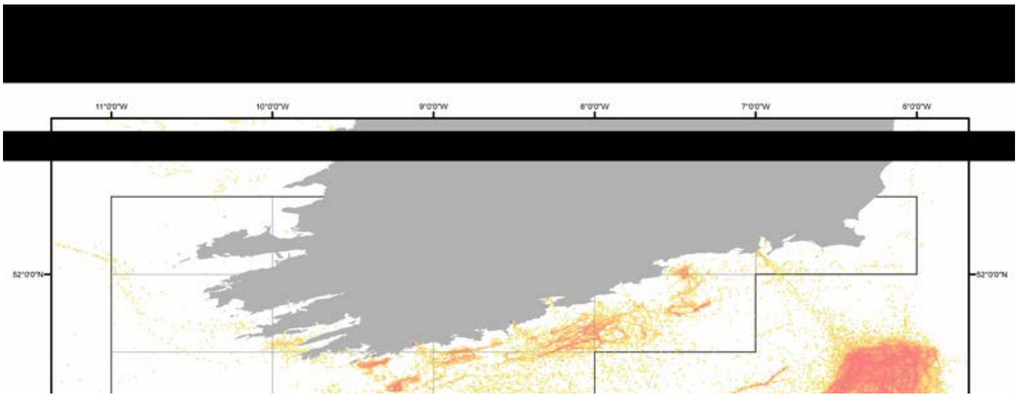

Figure 7.8.1. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). The spatial distribution of the fishery of the Irish Fishery from VMS data (2005–2008).**

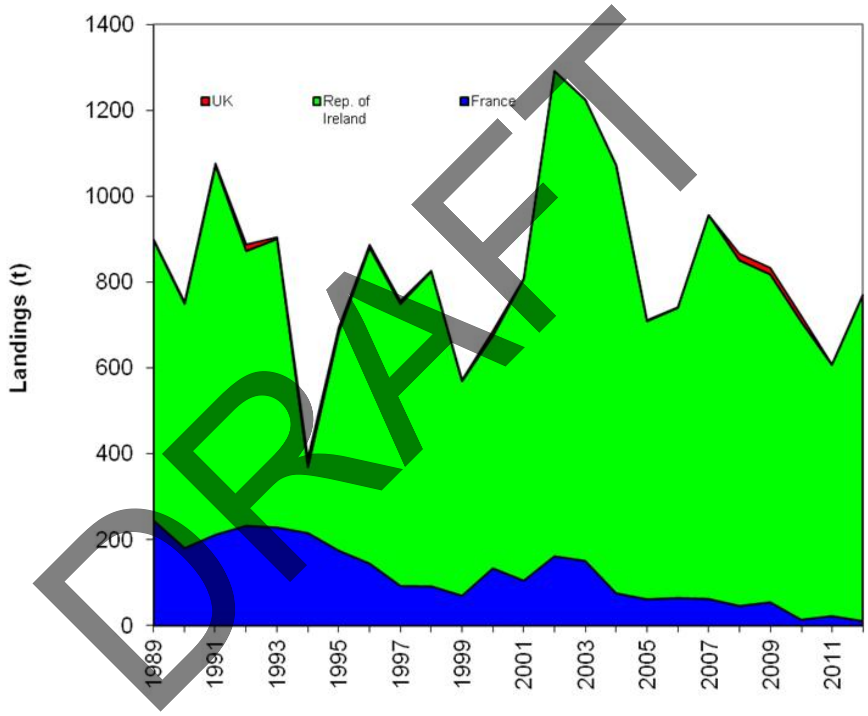

Figure 7.8.2. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Landings in tonnes by country.**

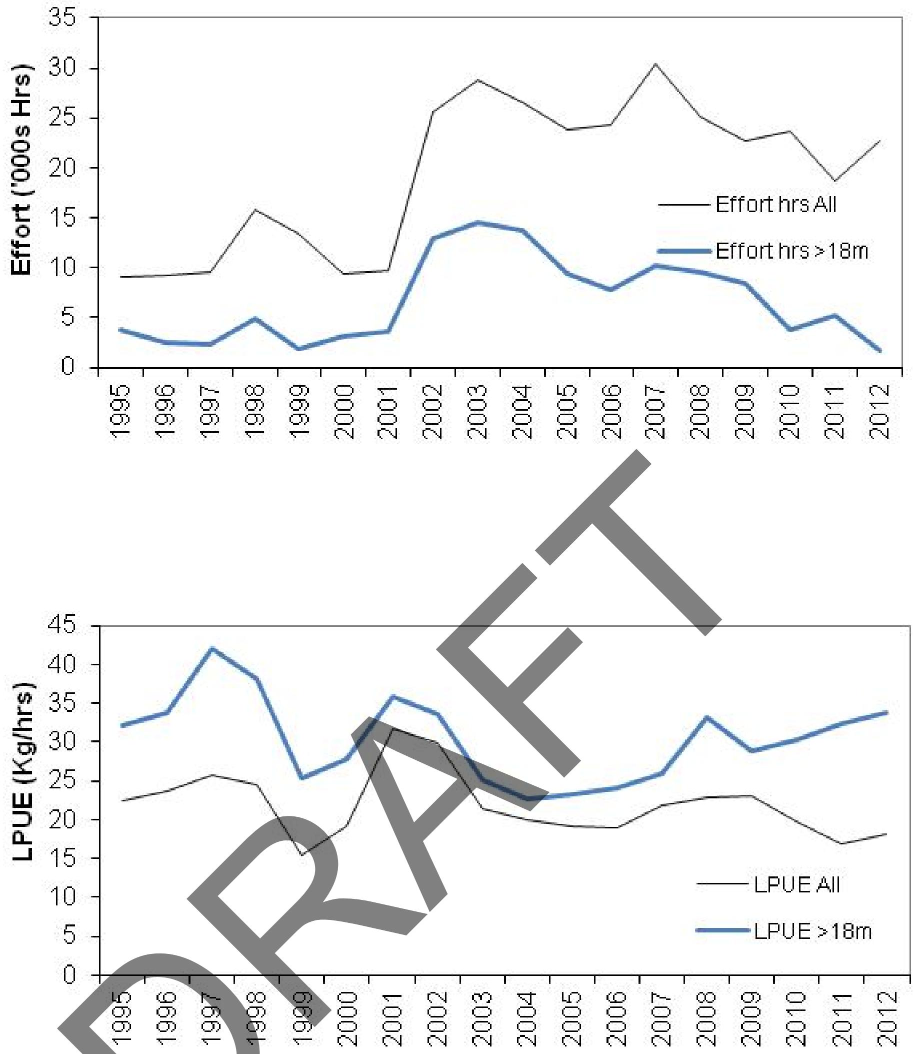

Figure 7.8.3. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Trawl effort for Irish OTB vessels where >30% of landed weight was** ***Nephrops*****.**

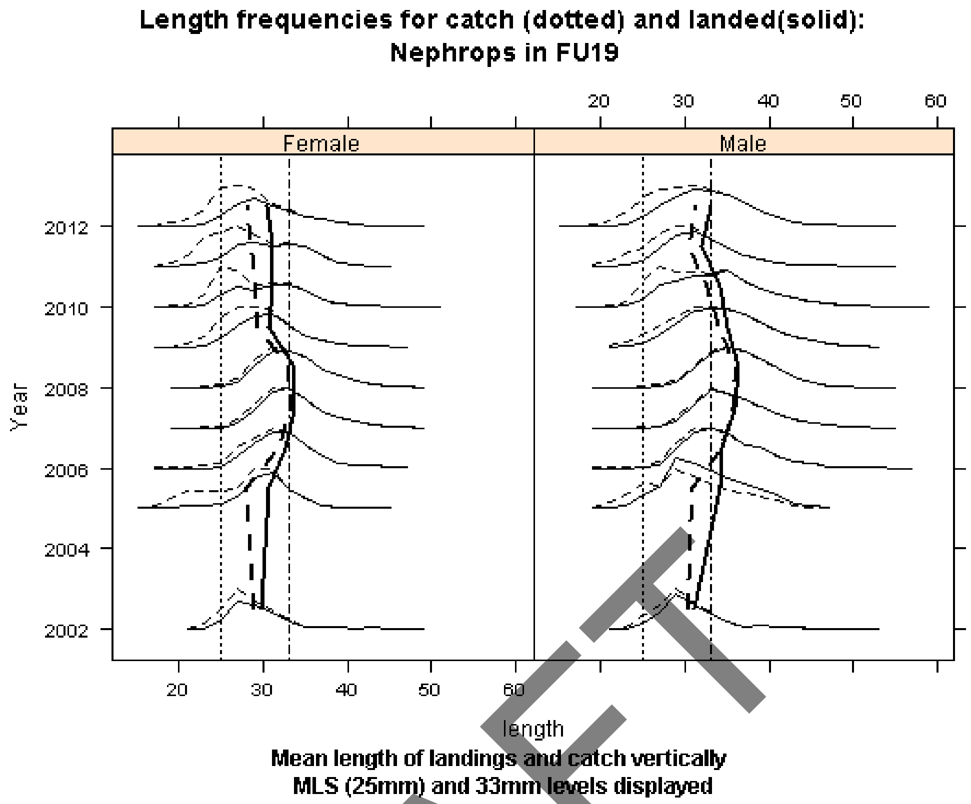

Figure 7.8.4. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Mean size trends for catches and whole landings by sex 2002–2012.**

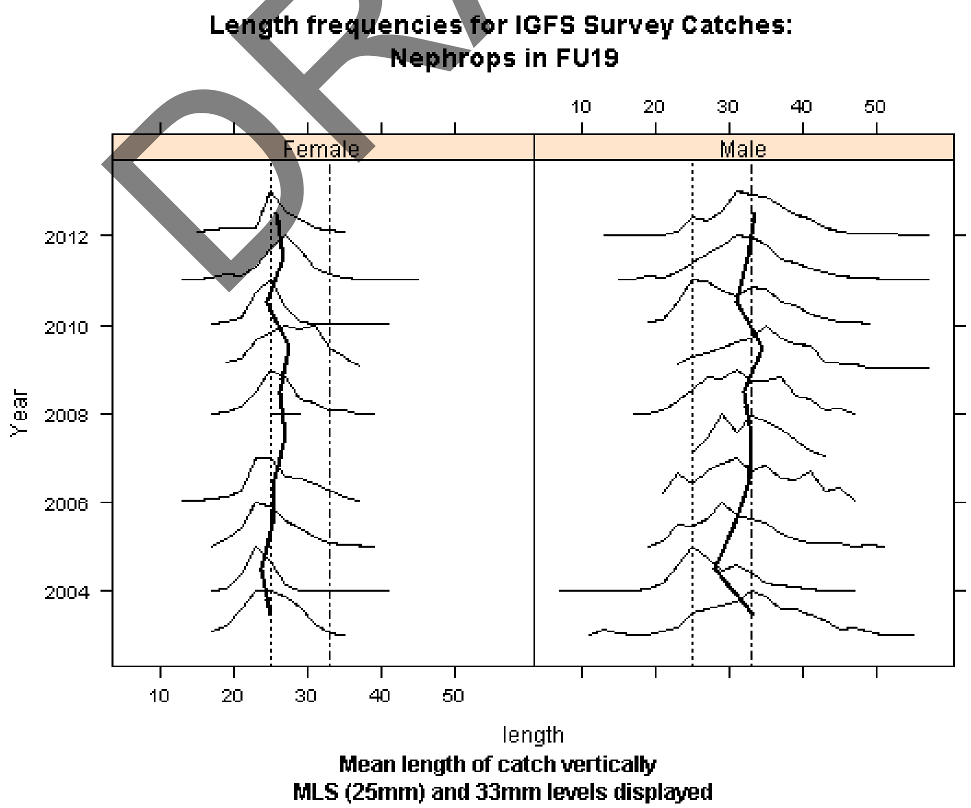

Figure 7.8.5. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Mean size trends for catches by sex from Irish Groundfish Survey 2003–2012.**

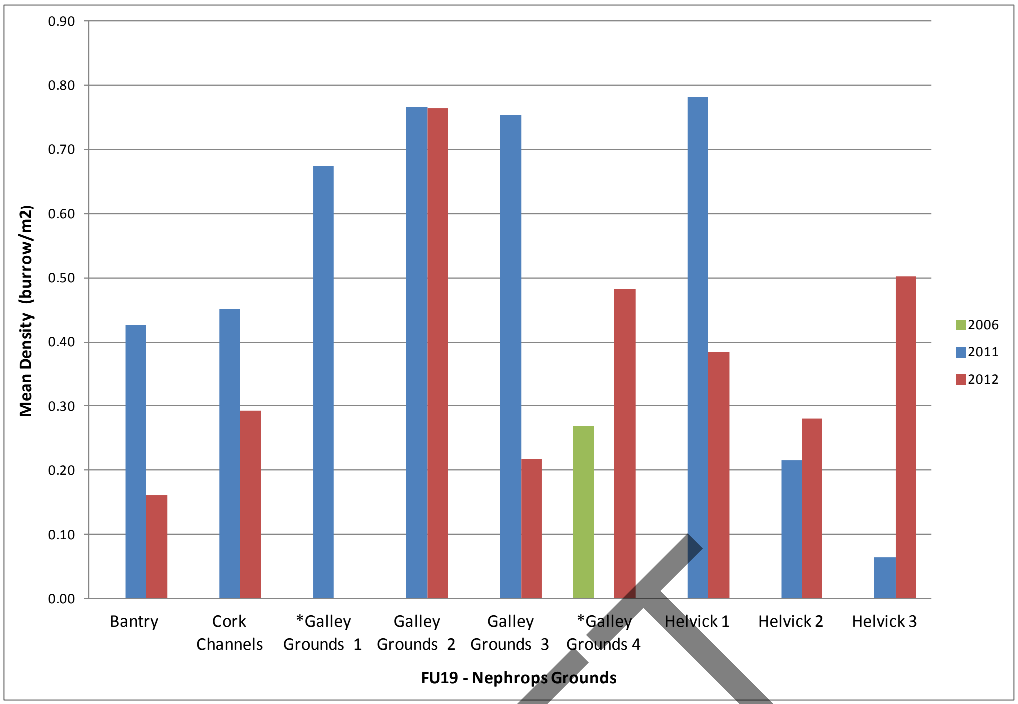

Figure 7.8.5. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Mean density estimates for the various** ***Nephrops*** **grounds in FU19 from UWTV survey 2006–2012.**

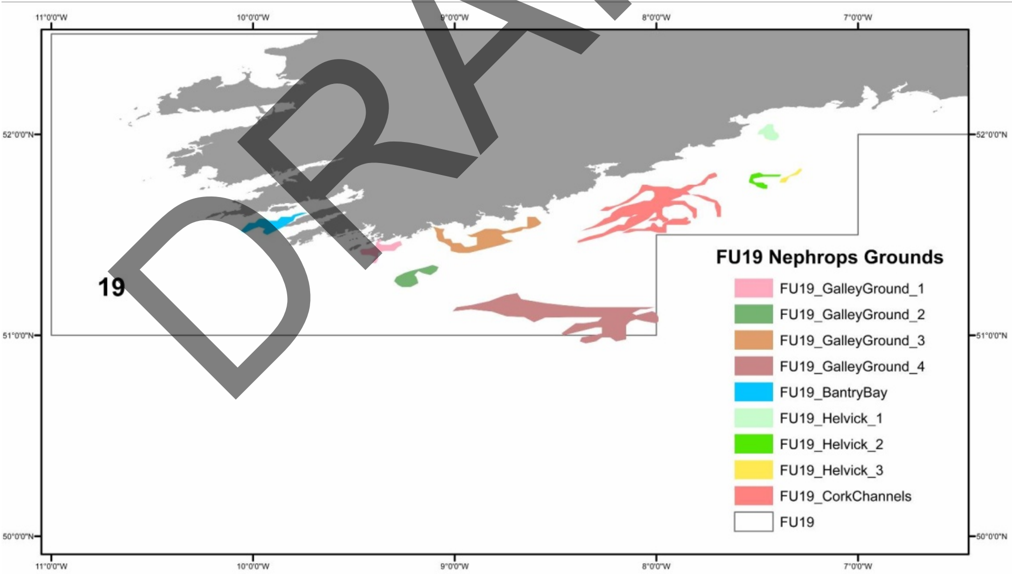

Figure 7.8.6. ***Nephrops*** **in FU19 (Ireland SW and SE Coast). Discrete** ***Nephrops*** **grounds in FU19.**

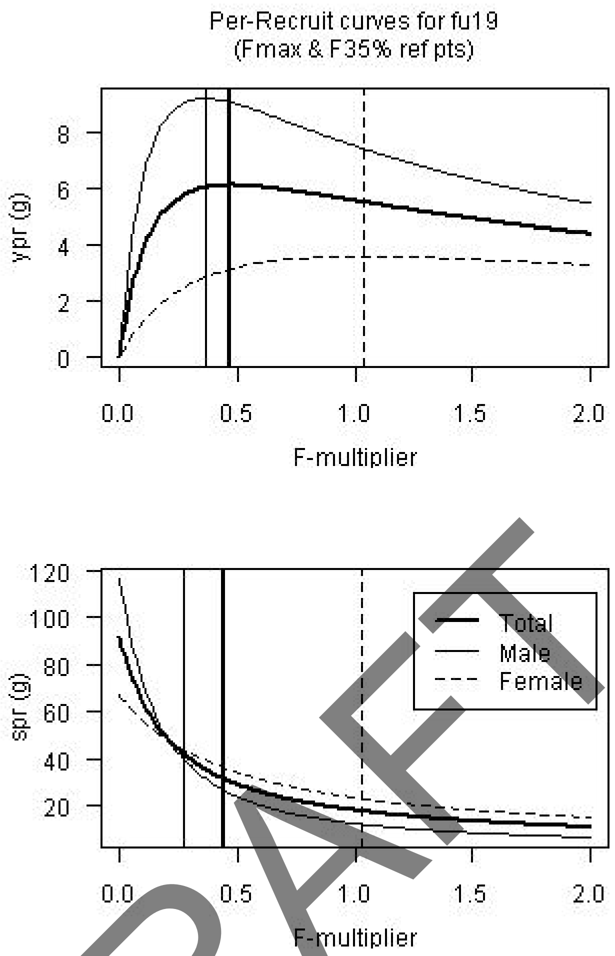

Figure 7.8.7. *Nephrops* in FU19 (Ireland SW and SE Coast). Separable Cohort Analysis model fit. Solid lines are for males, dashed lines are females. The top panel gives the yield-per-recruit against fishing mortality, the thick solid line gives the combined value and vertical lines represent F_{max} for the three curves. The bottom panel gives the spawner per recruit against fishing mortality.

7.9 Plaice in West of Ireland Division VII b, c

Type of assessment in 2012

No assessment was performed.

7.9.1 General

Stock Identity

Plaice in VIIb are mainly caught by Irish vessels on sandy grounds in coastal areas. Plaice catches in VIIc are negligible. There are two distinct areas in which plaice are caught by Irish vessels in VIIb: an area to the west of the Aran Islands and an area in the north of VIIb which extends into VIa (the Stags and Broadhaven Ground). During 1995–2000 a large proportion of the VIIbc plaice landings were taken from the Stags Grounds (Rectangles 37D8, 37D9, 37E0 and 37E1). The landings and lpue in this area have dropped sharply since 2000, in line with a general decrease of lpue in Division VIa. Plaice in this area appear to be more linked with VIa than populations further south. The landings and lpue on the Aran grounds appear to have been more or less stable since the start of the logbooks' time-series in 1995 (WD 1, WGCSE 2009). It is not known how much exchange there is between plaice on the Aran grounds and those on the Stags ground. The commercial lpue time-series may not be reflective of overall stock abundance due to changing fishing practices.

7.9.2 Data

The nominal landings are given in Table 7.9.1.

7.9.3 Historical stock development

No analytical assessment was performed but following recommendations from WGLIFE a Depletion-Corrected Average Catch (DCAC; MacCall, 2009) analysis was performed. Because the value of the depletion delta parameter is unknown, a range of values were used (10%, 50% and 90%; delta is the difference in biomass in the first year and biomass in the last year as a proportion of the virgin biomass (unfished vulnerable abundance). Also, because average catch is analysed, the year-range chosen can have a large influence on the results. Two year ranges were tested: 1950–present (the time period after WWII when the stock was heavily exploited) and 1995–present (the time period when the landings showed a declining trend). All other settings are based on default values and recommendations from MacCall (2009). Table 7.9.2 shows the input and output values. The year-range has a major influence on the estimated depletion-corrected average catch.

The most conservative estimate of DCAC (27.9 tonnes) is around the same level as recent landings. But landings have been much higher for many years over the full time-series since 1908 (Table 7.9.1).

7.9.4 Reference

MacCall, AD. 2009. Depletion-corrected average catch: a simple formula fro estimating sustainable yields in data-poor situations. ICES J Mar Sci 66:10 p. 2267–2271.

Table 7.9.1. Landings of plaice in VIIbc as officially reported to ICES.

Year	BEL	FRA	UK	IRL	OTH	TOT	Year	BEL	FRA	UK	IRL	OTH	TOT	Unalloc	WG est
1908	0	0	0	135	0	135	1961	0	182	0	30	0	212		
1909	0	0	0	49	0	49	1962	0	239	0	42	0	281		
1910	0	0	0	36	0	36	1963	0	471	2	67	0	540		
1911	0	0	2	54	0	56	1964	0	427	2	66	0	495		
1912	0	0	1	40	0	41	1965	0	417	2	99	0	518		
1913	0	0	0	54	0	54	1966	0	0	1	127	0	128		
1914	0	0	0	85	0	85	1967	0	182	2	112	0	296		
1915	0	0	1	23	0	24	1968	0	403	0	89	0	492		
1916	0	0	0	22	0	22	1969	0	281	2	99	0	382		
1917	0	0	0	36	0	36	1970	0	124	0	110	0	234		
1918	0	0	0	29	0	29	1971	0	0	1	89	0	90		
1919	0	0	1	32	0	33	1972	0	110	0	124	0	234		
1920	0	0	25	15	0	40	1973	0	60	1	124	0	185		
1921	0	0	9	34	0	43	1974	0	45	1	106	0	152		
1922	0	0	1	37	0	38	1975	0	10	0	153	0	163		
1923	0	0	1	30	0	31	1976	0	9	0	133	0	142		
1924	0	0	4	166	0	170	1977	0	4	0	135	0	139		
1925	0	0	5	28	0	33	1978	0	16	0	122	0	138		
1926	0	13	10	42	0	65	1979	0	6	0	117	2	125		
1927	0	126	14	45	0	185	1980	0	12	0	142	65	219		
1928	0	40	7	35	0	82	1981	0	9	4	135	58	206		
1929	0	262	25	31	0	318	1982	0	8	4	122	22	156		
1930	0	96	6	44	0	146	1983	0	37	0	108	7	152		
1931	0	238	8	58	0	304	1984	0	2	6	110	0	118		
1932	0	411	19	76	0	506	1985	0	10	7	150	0	167		
1933	0	595	29	29	0	653	1986	0	11	5	114	0	130		
1934	0	406	31	33	0	470	1987	0	13	1	153	0	167		
1935	0	249	18	33	0	300	1988	0	9	2	157	0	168		
1936	0	265	47	37	0	349	1989	0	1	14	159	0	174		
1937	0	242	59	25	0	326	1990	0	11	92	130	0	233		
1938	0	359	25	20	0	404	1991	0	9	3	179	0	191		
1939	0	0	0	24	0	24	1992	0	3	9	180	0	192		
1940	0	0	0	47	0	47	1993	0	2	3	191	0	196		
1941	0	0	0	43	0	43	1994	0	1	5	200	0	206		
1942	0	0	0	41	0	41	1995	0	5	2	239	0	246		
1943	0	0	0	29	0	29	1996	0	1	2	248	0	251	-11	240
1944	0	0	0	42	0	42	1997	0	3	0	206	0	209	4	213
1945	0	0	0	30	0	30	1998	0	0	1	160	0	161	22	183
1946	0	0	5	32	0	37	1999	0	0	2	157	0	159	13	172
1947	5	0	9	36	0	50	2000	0	31	0	99	0	130	-22	108
1948	0	0	8	47	0	55	2001	0	8	0	70	0	78	9	87
1949	0	0	20	63	0	83	2002	0	17	2	51	0	70	1	71

Year	BEL	FRA	UK	IRL	OTH	TOT	Year	BEL	FRA	UK	IRL	OTH	TOT	Unalloc	WG est
1950	0	289	16	42	0	347	2003	0	7	0	56	2	65	7	72
1951	0	100	12	31	0	143	2004	0	14	0	39	1	54	1	55
1952	0	120	18	46	0	184	2005	0	12	0	25	0	37	1	38
1953	0	340	8	48	0	396	2006	0	11	0	20	1	32	-2	30
1954	0	273	5	72	0	350	2007	0	12	0	23	0	35	-1	34
1955	0	111	3	96	0	210	2008	0	9	0	21	1	31	4	35
1956	0	174	1	64	0	239	2009	0	7	0	45	0	52	1	53
1957	0	80	1	60	0	141	2010	0	6	0	27	0	33	0	33
1958	0	204	0	71	0	275	2011	0	2	0	16	0	18	-2	16
1959	0	392	5	54	0	451	2012	0	9	0	20	0	29		
1960	0	197	3	46	0	246									

Table 7.9.2. Settings and results from DCAC.

Year range	sumCatch (landings)	CV	Nyears	M	StDev	Fmsy/M	StDev1	Bmsy/B0	StDev2	Delta	StDev2	Avg Catch	Avg DCAC
1950–2012	12 293	0.2	63	0.12	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.1	0.1 (bounded 1–0)	195.1	179.1
1950–2012	12 293	0.2	63	0.12	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.5	0.1 (bounded 1–0)	195.1	135.1
1950–2012	12 293	0.2	63	0.12	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.9	0.1 (bounded 1–0)	195.1	110.7
1995–2012	1690	0.2	18	0.12	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.1	0.1 (bounded 1–0)	93.9	74.5
1995–2012	1690	0.2	18	0.12	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.5	0.1 (bounded 1–0)	93.9	39.6
1995–2012	1690	0.2	18	0.12	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.9	0.1 (bounded 1–0)	93.9	27.9

[1] **Assuming lognormal distribution.**

[2] **Assuming bounded (1-0) beta distribution.**

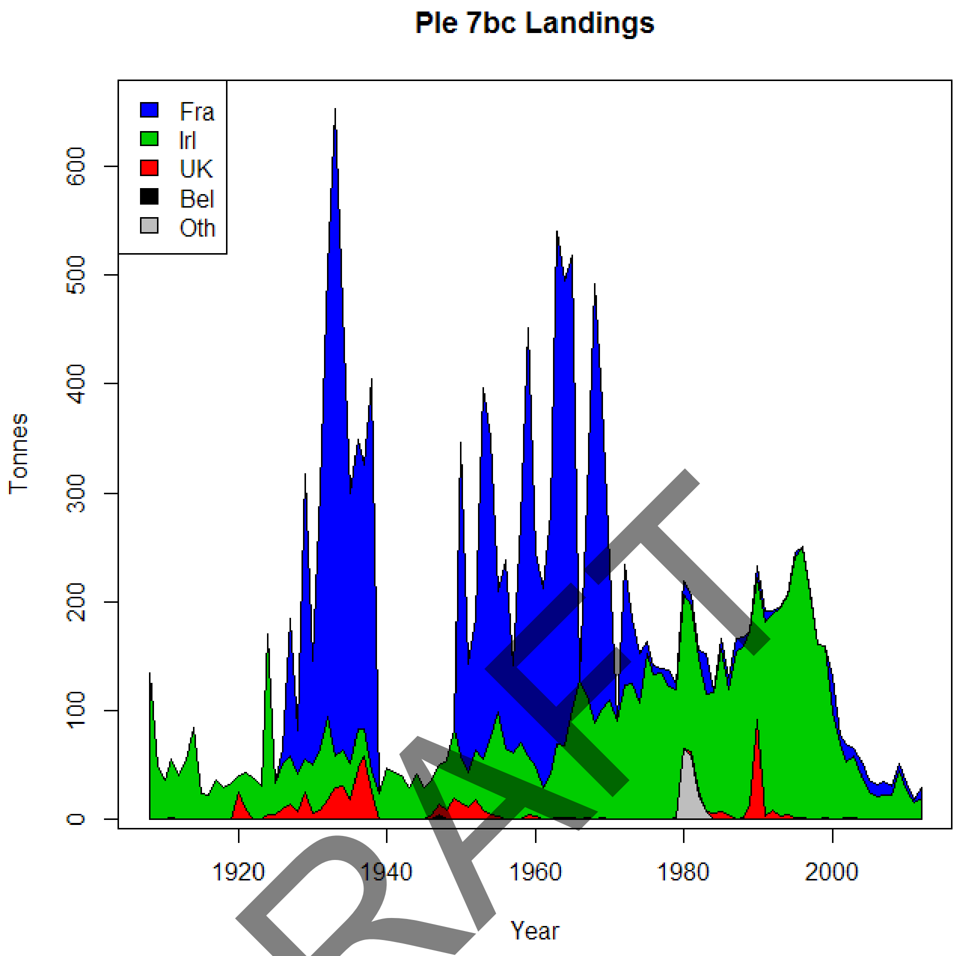

Figure 7.9.1. Landings of plaice in VIIbc as officially reported to ICES.

7.10 Plaice in Divisions VIIf,g (Celtic Sea)

Type of assessment in 2013

No assessment is presented for this stock given that the "preferred" Aarts and Poos (2009) model failed to converge and other model variants could not provide realistic representations of observed landings and discards in 2012 (Figure S.1. in the supplementary information located on the WGCSE 2013 SharePoint site). Instead, the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) was used to infer trends in recruitment, stock size (spawning–stock biomass) and fishing mortality.

ICES advice applicable to 2012

No reliable forecast can be presented for this stock given that the assessment is only indicative of trends and the absolute level of stock size remains uncertain.

The stock is considered to be below any possible reference points, while the exploitation rate is deemed too high to improve this and thus above possible reference points. Therefore, catches of plaice should be reduced and measures to reduce discarding should be introduced.

ICES advice applicable to 2013

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 1608 tonnes. If discard rates remain unchanged from the average of the last three years, this implies landings of no more than 519 tonnes. Discards exceed landings by a factor of more than ×2 and technical measures should be introduced to reduce discard rates.

7.10.1 General

Stock description and management units

A TAC is allocated to ICES Areas VIIf&g which corresponds to the stock area.

Management applicable to 2012 and 2013

TACs and quotas set for 2012 (source COUNCIL REGULATION (EU) No 43/2012.)

Species: Plaice *Pleuronectes platessa,* Zone: VIIf and VIIg (PLE/7FG.)

Belgium	46
France	83
Ireland	197
United Kingdom	43
Total EU	369
Total TAC	369

TACs and quotas set for 2013 (source COUNCIL REGULATION (EU) No 39/2013).

Species: Plaice *Pleuronectes platessa,* Zone: VIIf and VIIg (PLE/7FG.)

Belgium	46
France	83
Ireland	197
United Kingdom	43
Total EU	369
Total TAC	369

Fishery in 2012

The main fishery is concentrated on the Trevose Head ground off the north Cornish coast and around Land's End. Despite plaice being harvested throughout the year, the bulk of landings are taken in March, following the peak of spawning with a second peak in September. The fisheries harvesting plaice in the Celtic Sea primarily involve vessels from Belgium, France, England and Wales. In 2012 Belgium reported 45% of the landings, France 28%, Ireland 17% and the UK 10%. The percentage contribution of individual countries to total landings is similar to 2011, with only France and Belgium increasing and decreasing their percentage contribution by 5%, respectively. The Working Group estimated that total international landings for 2012 were 443 t, ~17% above the TAC of 369 t.

Discards are a significant component of catch (~68%), with the available time-series extending from 2004 to 2012. Discards have exceeded landings since 2006, and the proportion that discards contribute to total catch has continued to increase in recent years.

7.10.2 Data

Landings

National landings data and estimates of total landings used by the Working Group are given in Table 7.10.1.

Discards

Prior to 2010 indications were that discard rates, although variable, were substantial in some fleets/periods. At the ICES WKFLAT (2011) benchmark meeting, discard data from countries participating in the fishery was raised and collated to the total international level for first time, a process that will be continued annually.

Discard information was available for Belgium, Ireland and the UK(E&W). The UK discard estimates were raised to incorporate equivalent levels of discards for the unsampled countries of France and Northern Ireland (on the basis of similar gear types). A raising factor based on tonnages landed for these countries was calculated and applied to the UK(E&W) estimates of discard numbers. Finally, these estimates were added to those calculated for Belgium and Ireland to give total international discard numbers-at-age estimates. The total estimates (Table 7.10.1) confirm the perception that there is a significant level of discarding; discards have therefore been included within the assessment since 2011. Working Group estimates of the combined, raised, level of discards are available from 2004, they have shown a steady increase over time to levels higher than landings since 2006; in 2007 a substantial increase occurred in the discarding by all fleets followed by a return to the previously lower levels - until 2011 when at 1107 t, discards were again more than double landings and this trend has continued in 2012 with discards of 947 t. Data from national discard sampling programmes in 2012 are summarised in Figures 7.10.3a and b. The contribution of sampled and unsampled landings and discards to final assessment catch numbers-at-age in 2012 are presented in Figure 7.10.5.

Biological information

Following minor revisions to discard data for previous years, the international age compositions and landings and discard weights-at-age have been amended.

Quarterly age compositions for 2012 were available for Ireland and the UK(E&W), while annual age-compositions for 2012 were only available for Belgium. Collectively, these international age-compositions accounted for approximately 72% of total landings. French age-composition data disaggregated by fleet was unavailable to the Working Group, as had been the case in previous years. Methods for the derivation of international catch numbers-at-age are fully described in the stock annex.

International landings and discard numbers-at-age in years for which both were available (2004–2012) are compared in Figure 7.10.4. In recent years, discards considerably exceed landing numbers at the majority of ages.

Landings weight-at-age

Historically, landings weights-at-age were constructed by fitting a quadratic smoother through the aggregated catch weights for each year. WKFLAT (2011) decided not to continue this approach, following concerns raised by WGCSE that poor fits of the quadratic smoothing curve were resulting in the youngest ages being estimated to have heavier weights than adjacent older ages. WKFLAT (2011) rejected the use of the polynomial smoother for weights-at-age and suggested that raw landings weights are used in future. Raw data back to 1995 was obtained by WKFLAT (2011) and used to update the catch weights and stock weights files (Table 7.10.6).

Discard weight-at-age

Raw discard weight-at-age data was available for the UK(E&W), Belgium and Ireland in 2012. Previously, Irish discard data was available but not used in the assessment and Belgian weight-at-age data was derived using estimates of total catch biomass and total numbers-at-age. In this year's assessment, UK weight-at-age data was derived from data collated for each year from 2002 onwards and Belgian weight-at-age data was derived from data collated for each year from 2004 onwards. Prior to 2012, the UK(E&W) estimates of discard weights-at-age were used to derive the Northern Irish and the Irish discard component. The three national weight-at-age matrices were averaged to formulate total international estimates by weighting the individual weights-at-age for each year by the catch numbers-at-age from the three countries for each year and age (Tables 7.10.7 and 7.10.8).

Stock weight-at-age

Where discard estimates were available from 2004 onwards, a revised set of stock weights-at-age were calculated. The stock weights were derived from the total international landings weights-at-age and the discard weights-at-age averaged by numbers-at-age from the respective data sets. Prior to 2004, a revised set of stock weights-at-age based on international landings data was produced. These new values were based on collected weight data with a SOP correction (Table 7.10.9).

Numbers- and weights-at-age for landings, discards and the stock used in the assessment are presented in Tables 7.10.5–7.10.9. The separable assessment model fitted to estimate discards and landings mortality does not handle zero values efficiently (log zero), therefore zero numbers-at-age 1 were replaced by the value 1. This replacement affected age 1 for discards and landings. Sensitivity to the replacement value used will be explored as the model is developed.

Natural mortality and maturity

Estimates of natural mortality (0.12 for all years and all ages from tagging studies) were based on the value estimated for Irish Sea plaice. The maturity ogive is based on UK(E&W) VIIfg survey data for March 1993 and March 1994 (Pawson and Harley, 1997). This maturity ogive was produced in 1997 and applied to all years in the assessment.

Age	1	2	3	4	5+
Maturity	0	0.26	0.52	0.86	1.00

Surveys

Indices of abundance from the UK(E&W)-BTS-Q3 beam trawl survey in VIIf and the Irish Celtic Explorer IBTS survey (IGFS-WIBTS-Q4) are presented in Table 7.10.10. The UK(E&W)-BTS-Q3 data indicate relatively strong 1994 and 1999 year classes. There is an indication at age 1 of a stronger year class entering the fishery but survey data at this age can exhibit substantial noise. The IGFS-WIBTS-Q4 data indicates that 2008–2011 are all strong year classes; the UK(E&W)-BTS-Q3 suggests that the 2009 and 2010 are strong but the 2008 and 2011 year-classes are average.

The Irish Celtic Explorer IBTS survey (IGFS-WIBTS-Q4) time-series started in 2003, but is not yet included in the assessment. WKFLAT (2011) noted that year effects in the survey catch rates dominate the abundance indices; year class and catch curve plots illustrated that the consistency of plaice year-class abundance estimates between ages is relatively poor (Figure 7.10.6). The survey was not fitted during preliminary runs of the assessment model in 2013, but will be monitored for inclusion as the time-series progresses.

Figure 7.10.7 presents the log UK (BTS-Q3) catch per unit of effort (cpue) indices by year and year class, the log catch curves for each cohort and the gradient of the catch curves used as an indication of total mortality trends. The plots illustrate the historical consistency of year-class estimates from the survey, with less agreement in more recent years.

Commercial landings per unit of effort

Commercial tuning indices of abundance from the UK(E&W) beam trawl and otter trawl data are presented in Table 7.10.11. Figure 7.10.8a, b presents the log commercial cpue indices by year and year class, the log catch curves for each cohort and the gradient of the catch curves used as an indication of total mortality trends. The plots illustrate the historical consistency of year-class estimates from the commercial data throughout the time-series for the beam trawls with noise resulting from two major year effects in the otter-trawl data (2005 and 2009).

Effort, landings per unit of effort (lpue) and cpue data were available for the UK(E&W) beam-trawl, the UK(E&W) otter-trawl, the Irish otter-trawl, beam-trawl and seine fleets, the Belgian beam-trawl and the UK September beam-trawl survey (Tables 7.10.2, 3, 4 and Figures 7.10.1, 7.10.2). Commercial lpue data illustrate a general pattern of steep decline since the high levels in the early 1990s, followed by a further more gradual decline in the late 1990s. Since 2000, lpue has been relatively stable at a low level with small and short-term increases for beam trawlers fishing in VIIf and for otter trawlers and Irish seine vessels in VIIg east. Overall, the lpue rates remain at a relatively low level compared to historic catch rates.

UK(E&W) beam trawl effort levels have declined in Divisions VIIf and VIIg from the high levels observed from 1999 to 2001. Since 2008, UK(E&W) beam trawl effort levels have remained relatively stable. UK(E&W) otter-trawl effort levels in Divisions VIIf and VIIg have shown a general decline since 1990, increased in VIIf after 2000 and have been relatively stable since 2003.

Irish otter-trawl effort levels have steadily increased since 1999, while beam-trawl effort levels have shown a less-pronounced increase over the time-series prior to 2008, with a decrease in 2008 and 2009. The Irish seine fleet effort levels have shown a weak downward trend since 2003.

Other relevant data

Except for rectangle closures, there were no early closures of the fishery for plaice in 2012. There is relatively little information regarding the level of landings misreporting for this stock, although it is not considered to be a major problem. Reports from industry suggest that the main issues affecting the fishery in VIIf&g are displacement of effort due to the rectangle closures and the restrictions on the use of 80 mm mesh west of 7°W.

7.10.3 Stock assessment

Section 1.4.1 outlines the general approach adopted at this year's Working Group meeting.

Assessment model

WKFLAT (2011) agreed that the AP model (Aarts and Poos, 2009) will be used as the temporary basis for the assessment and the provision of advice for Celtic Sea plaice. The AP model was selected on the basis that it was the only model available to WKFLAT which reconstructs historic discarding rates (derived from the survey data series).

WKFLAT (2011) concluded that:

1) Due to the change in estimated fishing mortality when discards are included within the model fit, that discards should be retained within the assessment model structure.
2) Given that the time-series of discard data to which the model variants are fitted is short and that, consequently, there are likely to be changes in the management estimates as discard data are added in subsequent years, no definitive model structure can be recommended at this stage in the development process.
3) The most flexible of the model variants, TVS_PTVS, should be used as the basis for advice; in terms of relative changes in estimated total fishing mortality and biomass.
4) The other two model variants which provide similar structures should continue to be fitted at the Working Group to provide sensitivity comparisons.
5) As the dataseries are extended, a final model selection can be then determined.

Comparative model runs

For each of the three AP model variants (TI_PTVS, TI_TVS and TV_PTVS), Figure 7.10.9a presents the estimated time-series of SSB, recruitment, fishing mortality, total discard and landings weight as well as the proportion of discards by weight. Output from the three AP model variants was unrealistic in 2012, underestimating landings by more than 26% and overestimating discards by more than 46%, thereby resulting in a substantial increase in fishing mortality in the final year. Figure 7.10.9b presents the estimated selection pattern at-age for landings and discards scaled to the highest value from the TV_PTVS AP model variant. The estimated selection pattern at-age for landings and discards indicated that more than 90% of individuals at age 2 were discarded.

The TV_PTVS AP model variant preferred by WKFLAT (2011) encountered convergence issues and failed to provide realistic representations of empirical observations in 2012. Consequently, WGCSE 2013 decided to avoid the use of the "preferred" TV_PTVS AP model variant and instead focus on assessing the stock using trends derived from the fishery-independent UK(E&W) beam trawl survey (UK(E&W)-BTS-Q3). Trends derived from the UK(E&W) beam-trawl survey were selected for the basis of advice given that this survey most appropriately covered the spatial extent of the stock and well represented the mean age (2–5) landed in the fishery. In contrast, trends from the Irish Celtic Explorer IBTS survey (IGFS-WIBTS-Q4) were not selected for the basis of advice given that this survey lacked the spatial coverage of the stock and as noted by WKFLAT (2011) year effects in the survey catch rates dominate the abundance indices.

The table below compares the log likelihood, significance, number of observations and the Akaike Information Criteria (AIC) of the fit for each model variant.

SELECTION	DISCARDS	- LOG.LIKELIHOOD	AIC	N_PARAM	N_OBS
TI	PTVS	263.81	721.62	97	552
TI	TVS	261.88	701.76	89	552
TV	PTVS	260.35	706.69	93	552

The settings and data for the model fits were set out as follows:

ASSESSMENT YEAR		2012
Assessment model		AP
Catch data		Including discards 1990–2012
Tuning fleets	UK(E&W)-BTS-Q3	1990–2012 ages 1–5
	UK commercial beam trawl	1990–2012 ages 4–8
	UK commercial otter trawl	1990–2012 ages 4–8
	IGFS-WIBTS-Q4	Series omitted
Selectivity model		Linear Time Varying Spline at-age (TV)
Discard fraction		Polynomial Time Varying Spline at age (PTVS)
Landings number-at-age, range		1–9+
Discards number-at-age, year range, age range		2004–2012, ages 1–7

Final assessment

WGCSE 2013 decided to provide advice on the basis of trends derived from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) rather than consider the output from the three AP model variants which exhibited convergence issues and provided unrealistic representations of empirical observations in 2012. Recruitment at age 1 from the UK(E&W) beam-trawl survey was taken from the standardised cpue index. Spawning–stock biomass and fishing mortality derived from the UK(E&W) beam-trawl survey were calculated as follows:

$$ssb_y = \sum_a (\mu_{a,y} \cdot sw_{a,y} \cdot mat_{a,y})$$

Where μ is the standardised cpue, sw the stock weight and mat the maturity for age a in year y.

$$F_{a,y} = \ln(\mu_{a,y}) - \ln(\mu_{a+1,y+1}) - nm$$

Where μ is the standardised cpue and nm is the natural mortality for age a in year y.

Figure 7.10.10 presents the negative gradient (slope) of the log cpue index-at-age and mean total mortality (Z_{BAR}) for the UK(E&W) Beam Trawl Survey (UK(E&W)-BTS-Q3), the UK Commercial Beam Trawl and the UK(E&W) Commercial Otter Trawl. In contrast to the output from the three AP model variants, the trends in Z_{BAR} reveal that fishing mortality has been relatively stable between 1990 and 2012.

Figure 7.10.11 presents the estimated time-series of recruitment-at-age 1 from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3). Recruitment has varied without trend from 1994 to 2012, with relatively minor fluctuations around the mean.

Figure 7.10.12 presents the estimated time-series of relative spawning–stock biomass for the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) from 1990 to 2012. Spawning–stock biomass decreased sharply from 1990 to 1994, followed by a relatively stable period from 1996 to 2004, after which spawning–stock biomass trends generally increased. Historically, spawning–stock biomass has fluctuated around the mean and therefore an extended time-series is required to validate the apparent decline in spawning–stock biomass between 2011 and 2012.

Figure 7.10.13 presents mean fishing mortality (F_{BAR}) at-ages 2–5 from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3). Mean fishing mortality varied without trend between 1990 and 2004, followed by a stepped decrease to lower levels commensurate with the recent increase in spawning–stock biomass.

Tables 7.10.12, 7.10.13 and 7.10.14 present the standardised cpue index, total fishing mortality-at-age and biomass-at-age derived from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) respectively.

State of the stock

WKFLAT (2011) concluded that estimates from the TV_PTVS AP model variant should be used as the basis for advice only in terms of relative changes in estimated total fishing mortality and biomass, until the discard time-series is longer and a definitive model structure can be recommended. Nevertheless, the "preferred" TV_PTVS AP model variant exhibited inadequate predictive performance, failing to replicate observed levels of landings and discards in 2012.

Based on information derived from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3), recruitment has varied without trend and appears not to have been impaired by observed levels of spawning–stock biomass over the time-series. Mean spawning–stock biomass increased by ~50% in the last two years (2011–2012) compared to the three previous years (2008–2010). Fishing mortality has remained at relatively low level since 2005 commensurate with the increase in spawning–stock biomass during the same period.

7.10.4 Short-term projections

No short-term projections are presented for this stock. Catches are dominated by discards (~2× landings) which will remain at similar levels to previous years if recruitment continues to vary without trend as indicated by the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3).

7.10.5 Maximum Sustainable Yield evaluation

On the basis of the revision of the assessment data structures and procedure, no MSY reference points are recommended for this stock. MSY reference points will be generated when the assessment procedure is developed further.

7.10.6 Precautionary approach reference points

On the basis of the revision of the assessment data structures and procedure, no precautionary reference levels are suggested at this stage in the assessment.

7.10.7 Management plans

There is no management plan for Celtic Sea plaice.

7.10.8 Uncertainties in assessment and forecast

Sampling

Sampling levels of landed catch in recent years are sufficient to support current assessment approaches, and associated CVs of some national catch-at-age datasets are available in the stock annex. The sampling levels for those countries supplying information are given in Section 2.1.2.

Discards

Estimates of discarding are now included in the assessment. The composition of the fleets and the gear types employed in the fishery have fluctuated over time, consequently it is likely that the discard rates observed in the fishery now are not applicable to periods earlier in the time-series and this variability in fleet operations has been incorporated within the assessment model estimation. From 2003 onwards, discard sampling for Ireland, Belgium, France and the UK(E&W) has been improved under the Data Collection Regulation. Nevertheless, only discard data from the UK, Ireland and Belgium was available in a suitable format required to raise the data to international level. Discarding remains too high (~×2 landings) in this fishery, thereby compromising the effectiveness of quota management.

Consistency

Advice for this stock was provided on the basis of trends derived from the fishery-independent UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) rather than considering output from the AP model used in the previous assessment. The underlying rationale for altering the assessment methodology has been provided in Section 7.10.3. The consequence of changing the basis of advice is that it is no longer possible to assess fishing mortality trends with respect to F reference points. Although it is likely that fishing mortality levels are still above possible F reference points as advised last year, there is no longer any objective method to evaluate this and the discrepancy in the advisory framework between data-limited categories 3.2 and 3.11 means that this year's advice is for an increase in catches, as opposed to decrease in catches advised last year, despite similar trends in spawning–stock biomass.

Mortality estimates (F and Z) derived from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) are dependent on the size selectivity of the fishing gear employed. Given that the UK(E&W) beam trawl survey operates 4 m beam gear with a 75 mm codend and a 40 mm liner to primarily target juvenile fish, selectivity is highest for the youngest ages and this selectivity bias can impact the perceived mortality signal. Nevertheless, the mesh size employed by the UK(E&W) beam-trawl survey has remained constant over time indicating a relatively consistent size selectivity from which to infer trends in mortality. Consequently, estimated trends in mortality derived from the UK(E&W) beam-trawl survey are likely to be reasonably well determined even if the absolute values remain uncertain.

Alterations to the assessment methodology have changed the perception of stock size. Figure 7.10.14 presents a comparison of mean standardised spawning–stock biomass estimates from the fit of the "preferred" TV_PTVS AP model variant in 2012 and derived from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) in 2013. Some disparity exists in spawning–stock biomass estimates prior to 2003, but both indicators reveal a general increase in spawning–stock biomass from 2004 onwards. Trends from the UK(E&W) beam-trawl survey reveal that mean spawning–stock biomass has increased by ~50% in the last two years (2011–2012) compared to the three previous years (2008–2010). Consequently, spawning–stock biomass estimates have been revised upwards in the most recent years, in contrast to the downward trajectory identified in the previous assessment.

Figure 7.10.15 compares mean standardised spawning–stock biomass estimates from the XSA landings only based assessment model in 2011, the fit of the "preferred" TV_PTVS AP model variant in 2012 and the UK(E&W) beam-trawl survey in 2013. Although spawning–stock biomass levels in recent years are comparable with estimates from the landings only XSA assessment model and the TV_PTVS AP model variant, there is historically a striking difference with the UK(E&W) beam-trawl survey estimating considerably lower (~47%) biomass between 1993 and 1995. Despite variability in biomass estimates, similar trends from the TV_PTVS AP model variant and the landings only XSA assessment from 1997 onwards indicate that differences in survey biomass estimates between 1993 and 1995 are not solely driven by the inclusion/exclusion of discards in the assessment model. Differences in spawning–stock biomass estimates during this period warrant further investigation.

Misreporting

Misreporting has been considered a potential problem for this stock in earlier years. However, misreporting of catches across ICES divisions is thought to be minor.

7.10.9 Management considerations

Based on trends from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3), the spawning–stock biomass of this stock is estimated to have increased since 2004. Increases in spawning–stock biomass are commensurate with a stepped decrease in mean fishing mortality to lower levels in recent years. Fishing mortality is estimated to have decreased in the most recent assessment and is likely to be at a magnitude that would lead to increasing levels of biomass and yield.

High levels of discarding in this fishery indicate that there is a mismatch between the mesh size employed in the fishery and the size of the fish landed at the market. Increases in the mesh size employed in this fishery would result in lower levels of fishing mortality, thereby reducing levels of discarding and ultimately increasing yield from the fishery. The results of studies presented to the 2004 Southern Shelf Working Group (ICES WGSSDS, 2004) indicate that this would also benefit the sole VIIf,g stock without decreasing sole landings in the long term. More recently, discarding is occurring at increasingly older ages suggesting that other market incentives are impacting fishers' harvesting behaviour. The mean length of discarded plaice from the UK(E&W) and the Irish discard sampling programmes in the last two years (2011–2012) is 5% and 12% higher, respectively, than the mean of the three previous years (2008–2010). This increase in the mean length of discarded plaice indicates that a higher proportion of older individuals are being discarded than in previous years.

Regulations and their effects

Technical measures in force for this stock are minimum mesh sizes, minimum landing size and restricted areas for certain classes of vessels. Technical regulations regarding allowable mesh sizes for specific target species and associated minimum landing sizes came into force on 1 January 2000 (Section 2.1). The minimum landing size for plaice in Divisions VIIf,g is currently 27 cm. Current mesh regulations have been ineffective at minimising discard rates.

Since 2005, ICES rectangles 30E4, 31E4, and 32E3 have been closed during the first quarter with the intention of reducing fishing mortality on cod. There is evidence that this closure has redistributed effort to other areas. Many vessels (particularly beam trawlers from the UK and Belgium) harvested close to the borders of the closed rectangles during the closure, and harvested intensively inside the rectangles when they were re-opened. Information from the UK shows that plaice can be caught in areas outside of the closed area with the same catch rates. Fishing mortality has decreased since 2005, and the closure may have been one of the contributing factors.

7.10.10 References

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Table 7.10.1. Plaice in Divisions VIIf&g: Nominal landings (tonnes) reported to ICES and total landings used by the working group.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Belgium	214	196	171	372	365	341	314	283	357	665
UK (Engl. & Wales)	150	152	176	227	251	196	279	366	466	529
France	365	527	467	706	697	568	532	558	493	878
Ireland	28	0	49	61	64	198	48	72	91	302
N. Ireland										
Netherlands										9
Scotland	0	0	0	7	0	0	0	0	0	1
Total reported	757	875	863	1373	1377	1303	1173	1279	1407	2384
Discards	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unallocated	0	0	0	0	0	0	-27	-69	345	-693
Landings used by WG	757	875	863	1373	1377	1303	1146	1210	1752	1691
Catch as used by WG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Belgium	581	617	843	794	836	371	542	350	346	410
UK (Engl. & Wales)	496	629	471	497	392	302	290	251	284	239
France	708	721	1089	767	444	504	373	298	254	246
Ireland	127	226	180	160	155	180	89	82	70	83
N. Ireland		1								
Scotland				1		5	9	1	2	
Total reported	1912	2194	2583	2219	1827	1362	1303	982	956	978
Discards	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Unallocated	-11	-78	-432	-137	-326	-174	-189	88	72	-26
Landings used by WG	1901	2116	2151	2082	1501	1188	1114	1070	1028	952
Catch as used by WG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Belgium	594	540	371	224	241	248	221	212	168	172
UK (Engl. & Wales)	258	176	170	134	136	105	127	87	55	88
France	329	298		287	262	186	165	145	132	106
Ireland	78	135	115	76	45	79	51	45	44	48
Total reported	1259	1149	656	721	684	618	564	489	399	414
Discards	N/A	N/A	N/A	N/A	N/A	N/A	N/A	274	321	453
Unallocated	-42	-82	312	-3	30	24	30	21	-13	-10
Landings used by WG	1217	1067	968	718	714	642	594	510	386	404
Catch as used by WG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	784	707	857

	2007	2008	2009	2010	2011	2012
Belgium	194	187	216	188	210	204
UK (Engl. & Wales)	61	63	55	54	45	44
France	104	62	N/A	136	100	125
Ireland	58	63	63	63	67	76
Total reported	417	375	N/A	442	422	450
Discards	1288	583	608	670	1107	947
Unallocated	-7	62	N/A	-9	-1	-7
Landings used by WG	410	437	463	433	421	443
Catch as used by WG	1698	1020	1071	1103	1528	1390

Table 7.10.2. Plaice in Divisions VIIf&g: lpue, cpue and effort for UK(E&W) fleets.

	LANDINGS PER UNIT EFFORT (LPUE)						LANDINGS/EFFORT DATA				ADDITIONAL EFFORT DATA						CATCH PER UNIT EFFORT (CPUE)		
	RECT. GROUP VIIf (grp 1)		RECT. GROUP VIIg EAST (grp 2)		RECT. GROUP VIIg WEST (grp 3)		RECT GROUP VIIf (grp1)				VIIg (East)		VIIg (West)		VIIfg		UK(E&W) BEAM TRAWL SURVEY		
							Otter trawl catch		Beam trawl catch		Otter	Beam	Otter	Beam	Otter	Beam	Beam trawl survey catch, effort and CPUE		
YEAR	TRAWL	BEAM TRAWL	TRAWL	BEAM TRAWL	TRAWL	BEAM TRAWL	tonnes	000s hr fished	tonnes	000s hr fished	000s hr fished	000s hr fished	000s hr fished	000s hr fished	000s hr fished	000s hr fished	Catch tonnes	000s hr fished	CPUE kg/hr
1972	7.70		4.97		1.15		361.82	45.72			6.01		0.74		52.46				
1973	7.54		2.75		0.00		353.95	45.28			3.59		0.05		48.92				
1974	4.99		1.22		0.00		198.12	38.94			2.03		0.00		40.97				
1975	4.88		4.07		0.75		173.01	33.53			10.35		0.04		43.91				
1976	4.54		2.70		2.13		112.09	25.61			5.21		0.04		30.86				
1977	4.06		1.76		0.00		102.81	27.16			5.36		0.04		32.56				
1978	4.19	3.06	2.24	0.00	0.00	0.00	117.74	27.08	7.58	2.50	6.73	0.00	0.00	0.00	33.82	2.50			
1979	5.31	3.62	3.34	2.19	0.00	0.00	125.81	23.84	6.30	1.96	4.54	0.13	0.00	0.00	28.39	2.09			
1980	5.91	4.27	4.03	7.15	2.46	0.00	162.29	26.43	17.65	4.31	2.67	0.10	0.60	0.00	29.71	4.40			
1981	5.36	3.50	3.20	3.13	1.05	5.23	126.27	24.10	23.72	6.24	7.78	0.78	4.78	0.10	36.66	7.12			
1982	4.82	5.10	1.14	6.73	0.06	5.57	92.65	19.20	55.42	9.95	7.50	1.86	2.56	0.58	29.26	12.39			
1983	6.05	3.92	2.66	5.24	0.00	4.88	108.76	17.61	47.72	12.35	5.33	6.82	0.00	0.80	22.94	19.97			
1984	6.15	6.41	4.90	7.49	0.00	4.14	160.64	23.16	99.01	13.55	4.35	4.31	0.00	2.06	27.51	19.91			
1985	6.98	6.38	5.09	8.05	2.61	7.10	188.06	25.24	146.73	18.69	5.72	5.14	0.57	1.41	31.52	25.25			
1986	6.62	5.22	4.28	10.62	1.44	11.31	142.84	21.18	90.44	20.72	7.72	4.31	0.82	0.68	29.71	25.71			
1987	6.60	4.32	6.46	10.79	0.86	10.66	199.03	24.43	145.37	38.76	9.87	4.83	0.83	0.92	35.13	44.52			
1988	10.04	8.53	7.32	9.95	1.97	14.42	205.56	20.09	204.58	25.62	9.96	2.18	0.43	0.88	30.47	28.68	0.04	0.36	7.03
1989	7.40	5.63	6.36	9.67	4.35	16.42	130.67	17.61	96.05	20.26	8.13	3.72	0.25	0.26	25.99	24.24	0.06	0.35	10.00
1990	4.16	3.93	2.43	6.80	2.70	5.34	97.82	22.56	157.15	30.77	10.55	4.89	0.45	4.32	33.56	39.98	0.10	0.59	10.07
1991	2.87	3.58	2.22	2.83	1.17	2.94	56.52	18.57	193.27	40.81	6.25	12.39	0.91	2.52	25.73	55.72	0.14	0.99	8.73
1992	2.78	2.26	2.32	2.54	1.68	2.08	44.82	16.00	91.34	35.78	5.22	16.61	8.42	2.59	29.64	54.97	0.13	1.00	7.84
1993	2.72	2.84	1.43	2.28	1.77	1.41	38.14	13.79	107.43	39.64	4.43	18.44	0.94	2.73	19.16	60.82	0.08	1.33	3.77
1994	2.71	2.47	2.18	3.07	0.83	4.14	23.36	9.48	84.97	37.03	3.05	9.48	0.24	1.94	12.75	48.44	0.06	1.14	3.01
1995	2.93	2.66	2.23	3.34	3.35	2.22	26.38	8.46	96.28	37.59	2.61	11.60	0.46	2.16	11.53	51.35	0.07	1.07	3.85
1996	2.63	2.05	1.91	1.84	0.38	0.77	23.60	8.67	81.18	39.78	4.60	8.70	1.68	3.91	14.95	52.39	0.12	0.96	7.37
1997	2.41	1.90	1.89	2.33	1.30	0.48	20.47	8.14	83.68	43.00	5.18	12.67	1.90	2.56	15.22	58.23	0.09	1.12	4.78
1998	1.59	1.54	1.24	0.93	0.33	0.69	10.94	7.13	85.06	47.84	5.09	10.45	1.55	2.81	13.77	61.09	0.10	1.16	5.29
1999	2.59	1.63	1.99	0.67	0.35	0.68	11.99	5.69	85.44	50.87	1.97	26.00	3.86	5.47	11.52	82.34	0.08	0.95	4.89
2000	2.29	1.00	3.10	0.68	0.19	0.60	10.98	4.05	53.46	51.19	0.26	17.53	2.34	3.36	8.96	72.09	0.09	0.96	5.63
2001	2.25	1.07	2.53	0.87	0.32	0.68	9.78	4.42	53.31	49.32	2.71	19.95	2.68	1.55	9.82	70.81	0.09	0.96	5.69
2002	1.31	1.14	3.70	1.49	0.54	0.27	6.81	6.10	37.93	37.53	1.54	6.19	2.49	0.93	10.12	44.65	0.09	0.96	5.73
2003	1.67	1.17	0.82	1.25	0.29	0.09	15.83	9.94	47.73	40.71	0.55	11.87	1.73	2.40	12.22	54.98	0.08	0.96	4.80
2004	1.28	1.16	0.93	0.51	0.18	0.22	12.44	9.42	40.06	32.37	3.03	14.25	2.03	2.42	14.48	49.04	0.06	0.92	4.16
2005	0.81	0.75	0.13	0.51	0.01	0.07	9.50	12.09	22.25	27.73	0.30	9.57	2.35	1.67	14.73	38.97	0.07	0.96	4.56
2006	1.53	0.88	0.47	0.91	0.05	0.03	19.78	12.97	13.99	18.57	0.31	10.48	3.47	1.16	16.75	30.19	0.07	0.96	4.29
2007	1.07	1.95	1.45	0.85	0.10	0.56	11.85	10.66	18.10	15.37	0.41	9.79	3.49	0.19	14.57	22.35	0.08	0.96	4.75
2008	1.27	2.95	1.69	0.80	0.01	0.10	13.21	10.13	18.80	13.83	1.58	3.84	3.65	0.08	15.36	17.76	0.09	0.96	5.88
2009	1.02	1.39	0.81	1.07	0.09	0.09	8.23	8.97	24.31	12.31	3.43	3.54	4.38	0.71	16.78	16.56	0.09	0.96	5.87
2010	1.03	1.86	0.98	1.10	0.02	0.07	7.65	7.67	19.63	14.44	1.19	4.47	7.43	1.62	16.28	20.53	0.11	0.97	7.11
2011	0.78	1.90	0.43	1.05	0.14	0.05	6.22	7.44	18.79	13.79	0.10	2.92	5.38	1.80	12.92	18.51	0.15	0.96	9.67
2012	0.79	1.44	0.17	0.67	0.04	0.15	6.00	7.71	10.69	12.39	1.77	1.92	5.16	0.11	14.64	14.41	0.17	0.95	10.97

Table 7.10.3. Plaice in Divisions VIIf&g: lpue and effort for Belgian fleets in VIIf&g.

		BELGIAN BEAM TRAWL VIIFG	
Year	**Landings (t)**	**Effort (000 hr)**	**lpue (kg/h)**
1996	356.89	53.27	6.70
1997	474.71	57.36	8.28
1998	443.38	57.79	7.67
1999	410.22	55.11	7.44
2000	230.63	51.34	4.49
2001	274.84	54.90	5.01
2002	259.80	49.60	5.24
2003	215.95	62.73	3.44
2004	207.27	78.73	2.63
2005	153.73	64.50	2.38
2006	134.44	50.28	2.67
2007	139.39	45.72	3.05
2008	106.29	28.71	3.70
2009	140.76	30.84	4.56
2010	127.15	32.74	3.88
2011	159.03	41.41	3.84
2012	165.75	56.90	2.91

Table 7.10.4. Plaice in Divisions VIIf&g: lpue and effort for Irish otter trawl, beam and seine fleets in VIIg.

	IR-OTB-7G			IR-SCC-7G		
Year	Landings (t)	Effort (000 hr)	lpue (kg/h)	Landings (t)	Effort (000 hr)	lpue (kg/h)
1995	94.23	63.56	1.48	9.55	6.43	1.49
1996	133.66	60.04	2.23	14.20	9.73	1.46
1997	119.84	65.10	1.84	38.79	16.13	2.40
1998	96.72	72.30	1.34	21.38	14.94	1.43
1999	60.05	51.66	1.16	10.40	8.01	1.30
2000	28.78	60.60	0.47	11.40	9.90	1.15
2001	23.82	69.43	0.34	10.93	16.33	0.67
2002	42.30	77.69	0.54	16.42	20.86	0.79
2003	26.35	86.79	0.30	13.80	20.91	0.66
2004	26.62	96.99	0.27	5.04	19.38	0.26
2005	22.78	124.40	0.18	6.47	14.81	0.44
2006	25.17	119.23	0.21	5.10	14.79	0.34
2007	30.99	136.52	0.23	4.76	15.82	0.30
2008	39.17	125.81	0.31	8.38	11.65	0.72
2009	43.81	137.11	0.32	7.98	8.19	0.98
2010	44.29	140.65	0.31	10.71	9.69	1.11
2011	44.68	120.33	0.37	11.12	11.01	1.01
2012	43.21	121.08	0.36	18.41	14.15	1.30

	IR-TBB-7G		
Year	Landings (t)	Effort (000 hr)	lpue (kg/h)
1995	37.92	20.78	1.83
1996	53.02	26.76	1.98
1997	94.59	28.25	3.35
1998	122.13	35.25	3.46
1999	25.80	40.87	0.63
2000	12.62	37.03	0.34
2001	4.80	39.71	0.12
2002	7.08	31.62	0.22
2003	9.37	49.26	0.19
2004	6.17	54.86	0.11
2005	9.49	49.65	0.19
2006	14.46	60.48	0.24
2007	21.18	55.86	0.38
2008	14.18	37.22	0.38
2009	6.96	37.96	0.18
2010	6.56	40.22	0.16
2011	6.71	35.33	0.19
2012	33.63	40.33	0.83

Table 7.10.5. Plaice in Divisions VIIf&g: Landings numbers-at-age.

Landings numbers-at-age Numbers*10**-3

AGE\YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0	0	0	0	0	0	0	0	0	0
2	989	851	877	1921	822	300	750	704	1461	703
3	426	903	673	1207	2111	1180	560	918	2503	2595
4	411	291	638	658	681	955	827	343	393	1332
5	105	136	72	146	109	443	372	373	102	156
6	72	76	70	21	54	86	92	209	177	59
7	37	47	34	16	53	51	44	70	62	48
8	59	23	8	16	11	14	27	41	25	32
+gp	75	98	46	32	44	60	23	42	38	24
TOTALNUM	2175	2426	2419	4018	3886	3090	2696	2701	4762	4950

AGE\YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0	0	0	0	0	0	25	100	43	0
2	434	967	797	164	279	800	1019	428	488	812
3	1883	2099	3550	2078	1072	526	1179	936	572	734
4	1812	1568	1807	2427	1193	357	284	730	743	515
5	772	612	741	655	578	471	139	164	334	219
6	156	413	160	242	179	275	185	117	117	137
7	22	65	98	86	94	80	115	86	57	59
8	125	16	24	70	78	21	62	92	48	37
+gp	76	73	23	46	79	96	59	65	132	96
TOTALNUM	5281	5814	7201	5769	3553	2627	3066	2716	2534	2609

AGE\YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	8	17	22	19	75	3	15	6	24	12
2	420	426	243	320	651	170	239	126	201	331
3	1318	921	982	606	371	661	571	578	327	458
4	929	849	802	482	323	543	465	428	265	140
5	272	287	372	203	199	183	150	261	134	134
6	121	96	116	145	108	113	85	46	73	76
7	60	82	45	53	62	65	34	27	24	50
8	20	39	27	22	23	24	26	15	14	12
+gp	82	56	69	32	28	28	24	17	16	15
TOTALNUM	3231	2773	2678	1881	1838	1789	1608	1504	1078	1229

AGE\YEAR	2007	2008	2009	2010	2011	2012
1	8	15	2	3	1	3
2	130	270	127	135	135	196
3	513	341	626	223	326	528
4	340	443	345	430	208	277
5	104	145	273	191	248	155
6	76	47	68	152	130	155
7	46	29	20	44	69	64
8	26	11	10	8	28	32
+gp	13	15	12	8	17	23
TOTALNUM	1257	1315	1485	1187	1161	1433

Table 7.10.6. Plaice in Divisions VIIf&g: Landings weights-at-age.

Landings weights-at-age (kg)

AGE\YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0.078	0.194	0.076	0.118	0.185	0.151	0.178	0.276	0.135	0.000
2	0.205	0.258	0.203	0.238	0.255	0.245	0.274	0.324	0.251	0.160
3	0.323	0.323	0.325	0.354	0.330	0.339	0.369	0.384	0.363	0.301
4	0.430	0.389	0.440	0.467	0.412	0.433	0.464	0.455	0.470	0.434
5	0.528	0.457	0.550	0.576	0.500	0.526	0.559	0.538	0.572	0.559
6	0.615	0.525	0.652	0.682	0.595	0.620	0.654	0.633	0.670	0.677
7	0.693	0.595	0.749	0.784	0.695	0.714	0.749	0.739	0.763	0.787
8	0.760	0.666	0.839	0.882	0.802	0.808	0.844	0.857	0.851	0.889
+gp	0.8762	0.8435	1.0653	1.1812	1.1824	1.0948	1.1579	1.2661	1.0036	1.1033
SOPCOFAC	1.0052	1.0262	1.0225	1.0135	1.0042	1.0125	0.9995	1.0000	1.0047	0.9997

AGE\YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.129	0.260	0.102	0.240	0.200	0.148	0.171	0.236	0.219	0.000
2	0.208	0.288	0.176	0.270	0.260	0.257	0.263	0.296	0.254	0.247
3	0.288	0.325	0.255	0.309	0.327	0.362	0.314	0.308	0.304	0.295
4	0.368	0.370	0.337	0.358	0.400	0.464	0.405	0.397	0.364	0.349
5	0.449	0.423	0.423	0.416	0.481	0.563	0.500	0.455	0.485	0.512
6	0.530	0.484	0.514	0.483	0.567	0.658	0.598	0.598	0.603	0.553
7	0.612	0.554	0.608	0.560	0.661	0.750	0.643	0.801	0.714	0.523
8	0.694	0.633	0.706	0.646	0.761	0.839	0.728	0.728	0.752	0.947
+gp	0.8632	0.8887	0.9932	0.9097	1.0465	1.0399	0.9886	0.9585	1.0655	1.0667
SOPCOFAC	1.0034	1.0024	1.0006	1.0009	1.0113	1.0022	0.9997	1.0001	1.0004	0.9998

AGE\YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.249	0.213	0.213	0.245	0.268	0.246	0.205	0.221	0.237	0.238
2	0.291	0.256	0.268	0.260	0.305	0.284	0.295	0.258	0.260	0.246
3	0.304	0.317	0.278	0.302	0.340	0.281	0.321	0.287	0.295	0.291
4	0.357	0.380	0.332	0.370	0.398	0.343	0.353	0.330	0.356	0.339
5	0.466	0.463	0.440	0.479	0.466	0.433	0.439	0.382	0.425	0.385
6	0.663	0.604	0.538	0.539	0.556	0.484	0.502	0.514	0.525	0.513
7	0.745	0.661	0.618	0.672	0.675	0.541	0.651	0.649	0.631	0.549
8	0.877	0.690	0.839	0.875	0.695	0.859	0.681	0.750	0.714	0.638
+gp	1.1007	1.1886	1.1906	1.2018	1.0905	1.1262	1.0389	0.9919	1.0163	0.8369
SOPCOFAC	1.0002	1.0009	1.0000	1.0007	1.0007	1.0004	0.9994	1.0007	1.0011	1.0008

AGE\YEAR	2007	2008	2009	2010	2011	2012
1	0.278	0.260	0.279	0.233	0.228	0.194
2	0.271	0.273	0.267	0.292	0.242	0.190
3	0.277	0.298	0.275	0.331	0.283	0.260
4	0.303	0.329	0.329	0.328	0.335	0.304
5	0.389	0.386	0.376	0.376	0.378	0.345
6	0.457	0.433	0.469	0.458	0.465	0.421
7	0.537	0.511	0.499	0.598	0.600	0.492
8	0.547	0.719	0.605	0.469	0.690	0.574
+gp	0.9862	0.9042	0.7197	1.0433	1.1810	0.6662
SOPCOFAC	1.0005	1.0001	0.9993	1.0002	1.0000	0.9992

Table 7.10.7. Plaice in Divisions VIIf&g: Discard numbers-at-age.

Discard numbers-at-age Numbers*10**-3

AGE\YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	0	0	0	455	572	542	1829	73	671	385	960	450
2	0	0	0	360	1211	2584	3331	3595	985	2719	2656	2340
3	0	0	0	641	441	750	3408	632	2041	1017	1429	2051
4	0	0	0	171	118	74	814	393	761	550	1019	688
5	0	0	0	68	41	47	81	69	399	345	501	192
6	0	0	0	3	12	12	32	4	44	54	45	106
7	0	0	0	4	4	1	11	1	4	8	99	121
8	0	0	0	1	22	1	9	1	5	0	56	32
+gp	0	0	0	0	0	0	0	0	0	0	0	11
TOTALNUM	0	0	0	1703	2421	4011	9515	4768	4910	5078	6765	5991
TONSLAND	0	0	0	274	321	453	1288	583	608	670	1107	943
SOPCOF %	0	0	0	100	100	100	100	100	100	100	100	100

Table 7.10.8. Plaice in Divisions VIIf&g: Discard weights-at-age.

Discard weights-at-age (kg)

AGE\YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	0	0	0	0.123	0.095	0.064	0.088	0.092	0.088	0.085	0.118	0.090
2	0	0	0	0.152	0.127	0.107	0.126	0.11	0.127	0.125	0.148	0.135
3	0	0	0	0.177	0.154	0.154	0.159	0.154	0.127	0.143	0.173	0.165
4	0	0	0	0.194	0.188	0.176	0.163	0.172	0.127	0.149	0.168	0.196
5	0	0	0	0.212	0.202	0.201	0.204	0.211	0.143	0.163	0.225	0.242
6	0	0	0	0.337	0.344	0.242	0.249	0.282	0.194	0.189	0.304	0.285
7	0	0	0	0.23	0.403	0.395	0.368	0.365	0.2	0.445	0.339	0.218
8	0	0	0	0.455	0.419	0.349	0.425	0.283	0.257	0.523	0.389	0.318
+gp	0	0	0	0	0	0	0	0	0	0	0	0

Table 7.10.9. Plaice in Divisions VIIf&g: Stock weights-at-age.

Stock weights-at-age (kg)

AGE\YEAR	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0.112	0.086	0.107	0.109	0.082	0.096	0.103	0.256	0.075	0.000
2	0.216	0.170	0.212	0.217	0.167	0.192	0.206	0.298	0.193	0.087
3	0.315	0.252	0.313	0.322	0.257	0.288	0.307	0.352	0.307	0.232
4	0.406	0.334	0.412	0.426	0.350	0.383	0.408	0.418	0.417	0.369
5	0.492	0.414	0.507	0.528	0.447	0.479	0.507	0.495	0.521	0.498
6	0.570	0.493	0.599	0.628	0.548	0.574	0.606	0.584	0.621	0.619
7	0.642	0.570	0.689	0.727	0.653	0.668	0.704	0.685	0.717	0.733
8	0.707	0.646	0.775	0.823	0.762	0.763	0.801	0.797	0.808	0.839
+gp	0.839	0.822	1.015	1.132	1.129	1.049	1.114	1.190	0.965	1.064

AGE\YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0.089	0.249	0.066	0.228	0.173	0.092	0.171	0.236	0.219	0.000
2	0.168	0.273	0.139	0.254	0.229	0.203	0.263	0.296	0.254	0.247
3	0.248	0.305	0.215	0.288	0.293	0.310	0.314	0.308	0.304	0.295
4	0.328	0.346	0.295	0.332	0.363	0.414	0.405	0.397	0.364	0.349
5	0.408	0.395	0.380	0.386	0.440	0.514	0.500	0.455	0.485	0.512
6	0.489	0.453	0.468	0.448	0.523	0.611	0.598	0.598	0.603	0.553
7	0.571	0.518	0.560	0.520	0.613	0.705	0.643	0.801	0.714	0.523
8	0.653	0.593	0.657	0.602	0.710	0.795	0.728	0.728	0.752	0.947
+gp	0.822	0.837	0.938	0.854	0.987	1.000	0.989	0.959	1.066	1.067

AGE\YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0.249	0.213	0.213	0.245	0.268	0.246	0.205	0.221	0.237	0.238
2	0.291	0.256	0.268	0.260	0.305	0.284	0.295	0.258	0.260	0.246
3	0.304	0.317	0.278	0.302	0.340	0.281	0.321	0.287	0.295	0.291
4	0.357	0.380	0.332	0.370	0.398	0.343	0.353	0.330	0.356	0.339
5	0.466	0.463	0.440	0.479	0.466	0.433	0.439	0.382	0.425	0.385
6	0.663	0.604	0.538	0.539	0.556	0.484	0.502	0.514	0.525	0.513
7	0.745	0.661	0.618	0.672	0.675	0.541	0.651	0.649	0.631	0.549
8	0.877	0.690	0.839	0.875	0.695	0.859	0.681	0.750	0.714	0.638
+gp	1.101	1.189	1.191	1.202	1.091	1.126	1.039	0.992	1.016	0.837

AGE\YEAR	2007	2008	2009	2010	2011	2012
1	0.278	0.260	0.279	0.233	0.228	0.194
2	0.271	0.273	0.267	0.292	0.242	0.190
3	0.277	0.298	0.275	0.331	0.283	0.260
4	0.303	0.329	0.329	0.328	0.335	0.304
5	0.389	0.386	0.376	0.376	0.378	0.345
6	0.457	0.433	0.469	0.458	0.465	0.421
7	0.537	0.511	0.499	0.598	0.600	0.492
8	0.547	0.719	0.605	0.469	0.690	0.574
+gp	0.986	0.904	0.720	1.043	1.181	0.666

Table 7.10.10. Plaice in Divisions VIIf&g: Survey abundance indices (values normally used in the assessment highlighted in bold).

IRGFS							
2003	2012						
1	1	0.79	0.92				
1	7						
832	0	45	84	37	8	3	1
980	2	6	31	51	20	13	1
845	39	63	83	19	9	3	3
1046	3	105	80	22	18	11	12
1168	2	51	166	68	22	9	8
1139	7	113	106	72	19	8	5
1018	213	199	548	247	100	21	16
1381	233	871	304	479	197	84	23
1392	250	1150	701	195	210	84	107
1470	358	992	901	277	50	49	71

E+W BT Survey					
1990	2012				
1	1	0.75	0.85		
1	6				
69.86	161	215	64	15	6
123.41	841	33	65	21	12
125.08	487	307	13	5	15
127.67	120	107	44	2	5
120.82	127	40	20	11	1
114.9	275	103	19	3	8
118.6	265	342	37	1	3
114.9	259	117	40	5	2
114.9	272	144	54	10	2
118.6	181	94	34	23	8
118.6	403	75	37	8	7
118.6	251	185	19	10	5
118.6	162	208	95	7	7
118.6	117	95	72	26	3
114.9	297	38	31	15	3
118.6	228	89	25	10	13
118.6	102	121	41	11	2
118.6	178	109	56	18	2
118.6	167	257	57	19	6
118.6	192	66	93	25	13
118.6	393	105	31	47	8
118.6	433	353	63	24	27
118.6	173	506	116	29	12

Table 7.10.11. Plaice in Divisions VIIf&g: Commercial tuning data available to the working group (values normally used in the assessment highlighted in bold).

UK (E+W) BEAM TRAWL VIIF					
1990	**2012**				
1	**1**	**0**	**1**		
4	**8**				
30.8	**159.5**	**46.3**	**26.6**	**11.0**	**9.2**
40.8	**141.5**	**87.1**	**29.0**	**15.1**	**14.1**
35.8	**32.0**	**46.7**	**27.4**	**7.5**	**2.3**
39.6	**25.0**	**15.5**	**24.6**	**15.1**	**7.3**
37.0	**49.1**	**9.2**	**9.1**	**7.6**	**9.8**
37.6	**39.5**	**29.7**	**9.9**	**5.8**	**6.4**
39.8	**13.6**	**13.6**	**12.8**	**3.8**	**4.4**
43.0	**23.7**	**8.4**	**6.7**	**4.5**	**0.7**
47.8	**63.1**	**17.5**	**3.6**	**4.3**	**2.7**
50.8	**52.5**	**25.8**	**7.7**	**2.4**	**1.9**
51.2	**26.9**	**17.8**	**12.7**	**4.9**	**1.8**
49.3	**27.5**	**17.7**	**10.1**	**5.9**	**2.4**
37.5	**16.5**	**7.6**	**7.2**	**3.7**	**2.0**
40.7	**33.8**	**9.9**	**4.9**	**3.4**	**2.4**
32.4	**25.8**	**17.5**	**3.4**	**2.5**	**2.0**
27.7	**12.7**	**7.5**	**5.0**	**1.9**	**1.1**
18.6	**4.5**	**4.4**	**3.0**	**1.6**	**0.4**
15.4	**12.0**	**3.2**	**2.0**	**1.4**	**0.6**
13.8	**17.5**	**5.0**	**1.9**	**1.3**	**0.9**
12.2	**11.8**	**8.2**	**2.4**	**0.8**	**0.4**
14.4	**18.6**	**7.2**	**5.9**	**1.7**	**0.1**
13.8	**7.3**	**8.7**	**3.1**	**2.6**	**0.8**
12.4	**7.0**	**3.4**	**2.7**	**1.3**	**0.6**

UK (E+W) OTTER TRAWL VIIF					
1989	2012				
1	1	0	1		
4	8				
17.6	62.0	23.1	7.4	5.1	0.4
22.6	129.1	34.2	13.3	4.1	4.4
18.6	78.8	36.9	16.5	4.4	5.0
16	12.5	18.5	8.5	1.4	0.4
13.8	8.8	3.9	6.3	4.1	2.7
9.5	15.1	2.7	3.1	1.4	1.7
8.5	14.5	5.5	1.6	0.8	0.7
8.7	4.3	3.4	2.5	1.0	1.1
8.1	5.5	1.2	0.7	0.4	0.1
7.1	8.6	2.0	0.5	0.7	0.2
5.7	7.9	3.8	0.9	0.2	0.1
4.1	6.5	2.5	1.3	0.4	0.1
4.4	4.0	2.4	1.3	0.6	0.2
6.1	2.9	1.5	1.1	0.5	0.2
9.9	9.3	2.1	1.3	0.9	0.6
9.4	10.4	5.8	0.9	0.5	0.3
12.1	5.5	2.8	1.5	0.5	0.3
13	6.8	6.4	4.5	2.3	0.6
10.6	7.4	2.2	1.4	1.0	0.5
10.1	8.2	2.4	1.6	1.1	0.6
9	7.3	2.3	0.9	0.5	0.3
7.7	4.4	2.9	0.7	0.3	0.2
7.4	5.9	2.3	1.8	0.4	0.0
7.7	0.8	1.1	0.6	0.4	0.3

Table 7.10.12. Plaice in Divisions VIIf&g: cpue index from the UK (E&W) Beam Trawl Survey.

cpue

AGE\YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	2.305	6.815	3.894	1.020	1.071	2.394	2.235	2.254	2.368	1.526	3.398	2.117	1.366	0.987	2.585	1.923	0.860	1.501	1.408	1.619	3.318	3.651	1.459
2	3.078	0.267	2.454	0.902	0.319	0.897	2.884	1.018	1.253	0.793	0.632	1.560	1.754	0.801	0.331	0.750	1.020	0.919	2.167	0.557	0.885	2.977	4.267
3	0.916	0.527	0.104	0.363	0.155	0.165	0.312	0.348	0.470	0.287	0.312	0.160	0.801	0.607	0.270	0.211	0.346	0.472	0.481	0.784	0.264	0.531	0.978
4	0.215	0.170	0.040	0.017	0.082	0.026	0.008	0.044	0.087	0.194	0.067	0.084	0.059	0.219	0.131	0.084	0.093	0.152	0.160	0.211	0.399	0.202	0.245
5	0.086	0.097	0.120	0.042	0.008	0.070	0.025	0.017	0.017	0.067	0.059	0.042	0.059	0.025	0.026	0.110	0.017	0.017	0.051	0.110	0.067	0.228	0.101
6	0.010	0.024	0.016	0.010	0.010	0.017	0.008	0.017	0.009	0.010	0.010	0.034	0.017	0.017	0.009	0.025	0.093	0.025	0.008	0.042	0.043	0.152	0.152

Table 7.10.13. Plaice in Divisions VIIf&g: Total fishing mortality-at-age derived from the UK (E&W) Beam Trawl Survey.

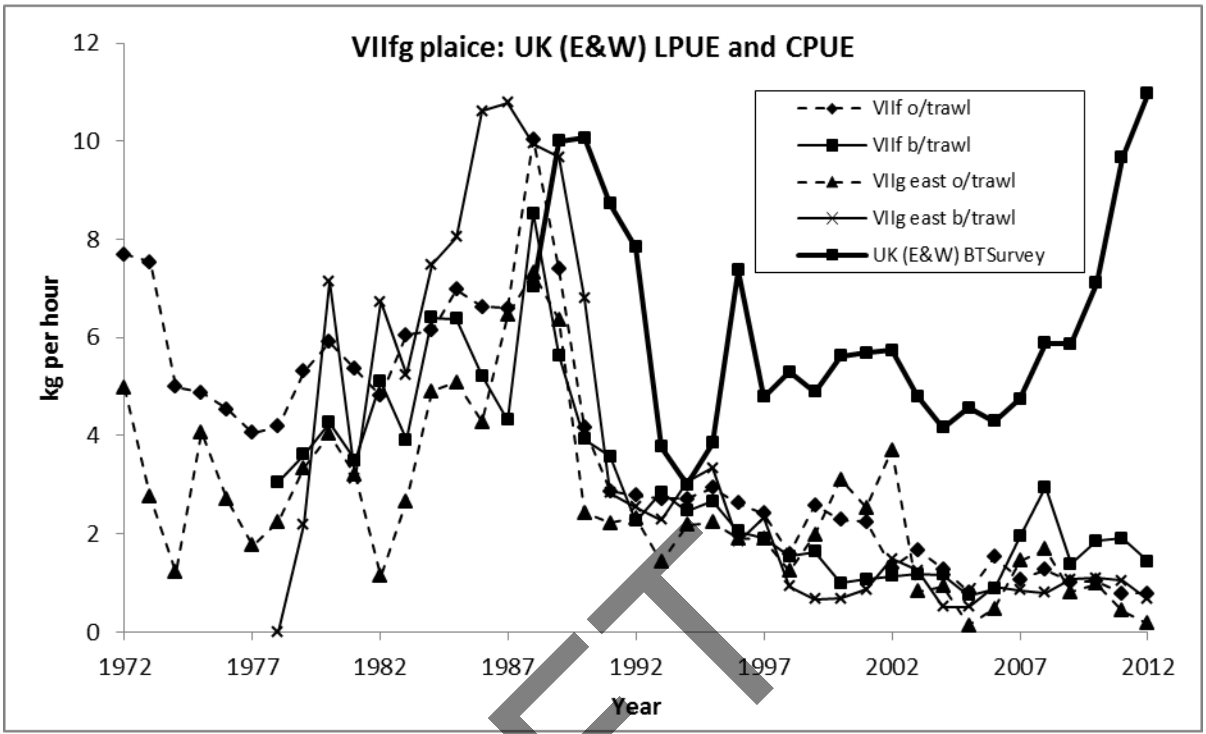
Total Fishing mortality-at-age

AGE\YEAR	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
1	0.816	0.324	0.515	0.385	-0.043	-0.201	0.222	0.135	0.355	0.263	0.218	-0.038	0.112	0.354	0.417	0.155	-0.149	-0.279	0.283	0.142	-0.073	-0.188
2	0.646	0.289	0.710	0.645	0.166	0.339	0.798	0.216	0.520	0.285	0.477	0.169	0.341	0.352	0.076	0.216	0.215	0.161	0.322	0.204	0.102	0.363
3	0.611	1.000	0.667	0.526	0.655	1.194	0.731	0.482	0.264	0.512	0.450	0.313	0.443	0.546	0.387	0.236	0.237	0.350	0.238	0.173	-0.004	0.216
4	0.226	0.031	-0.141	0.207	-0.051	-0.103	-0.447	0.293	-0.007	0.397	0.083	0.033	0.253	0.805	-0.044	0.574	0.618	0.354	0.043	0.378	0.123	0.181
5	0.434	0.663	0.959	0.503	-0.447	0.822	0.047	0.156	0.110	0.706	0.119	0.273	0.420	0.324	-0.103	-0.047	-0.287	0.207	-0.036	0.288	-0.476	0.056
FBAR 2-5	0.479	0.496	0.549	0.470	0.081	0.563	0.282	0.287	0.222	0.475	0.282	0.197	0.364	0.507	0.079	0.245	0.196	0.268	0.142	0.261	-0.064	0.204

Table 7.10.14. Plaice in Divisions VIIf&g: Biomass-at-age derived from the UK(E&W) Beam Trawl Survey.

Biomass-at-age (kg per km)

AGE\YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.216	0.018	0.164	0.062	0.025	0.059	0.185	0.077	0.083	0.055	0.043	0.124	0.130	0.061	0.022	0.051	0.065	0.065	0.154	0.039	0.067	0.187	0.154
3	0.147	0.090	0.020	0.059	0.025	0.026	0.048	0.055	0.077	0.041	0.049	0.028	0.117	0.101	0.040	0.032	0.052	0.068	0.075	0.112	0.045	0.078	0.094
4	0.066	0.058	0.016	0.006	0.028	0.008	0.002	0.014	0.028	0.055	0.021	0.029	0.017	0.066	0.037	0.026	0.027	0.040	0.045	0.060	0.113	0.058	0.048
5	0.036	0.047	0.068	0.021	0.004	0.034	0.013	0.008	0.008	0.029	0.028	0.020	0.026	0.011	0.010	0.047	0.007	0.007	0.020	0.041	0.025	0.086	0.029
6	0.005	0.014	0.011	0.006	0.006	0.010	0.004	0.011	0.005	0.005	0.005	0.019	0.008	0.009	0.005	0.013	0.048	0.011	0.003	0.020	0.020	0.071	0.056
SSB	0.470	0.226	0.278	0.154	0.087	0.138	0.253	0.165	0.203	0.187	0.147	0.219	0.298	0.249	0.114	0.169	0.199	0.190	0.297	0.272	0.270	0.481	0.380



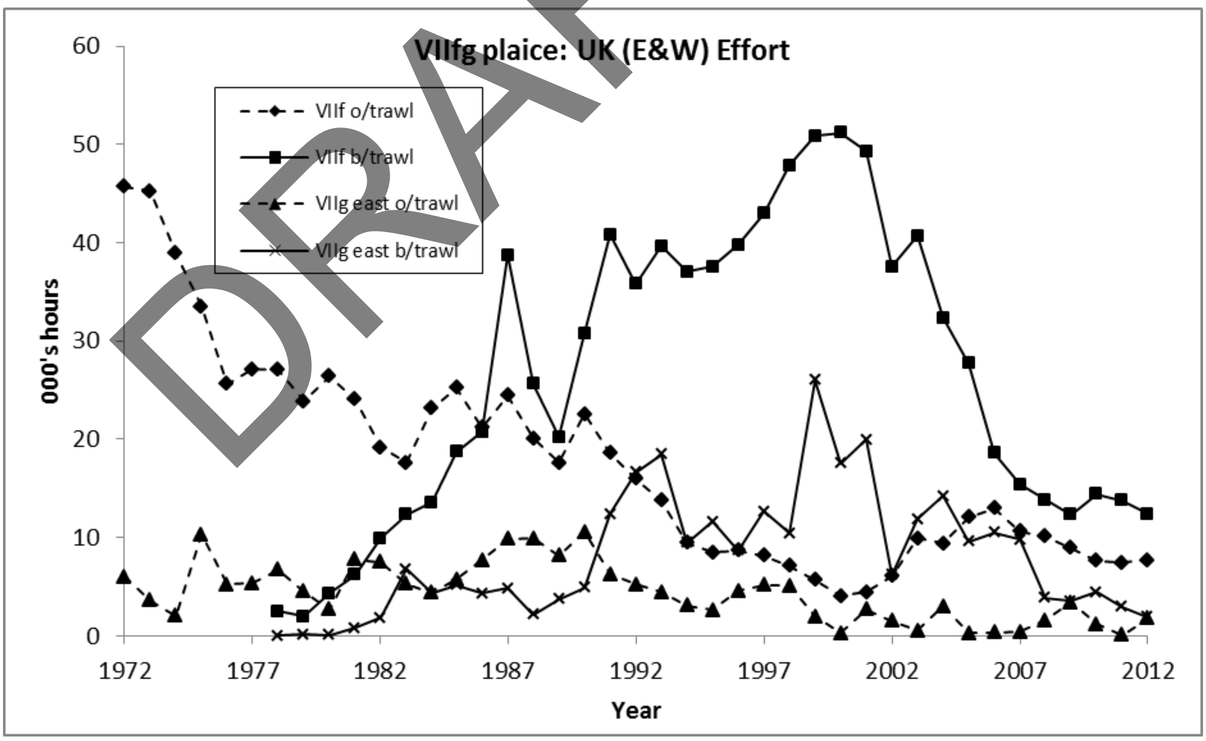


Figure 7.10.1. Plaice in Division VIIf&g: UK(E&W) lpue, cpue and effort by fleet.

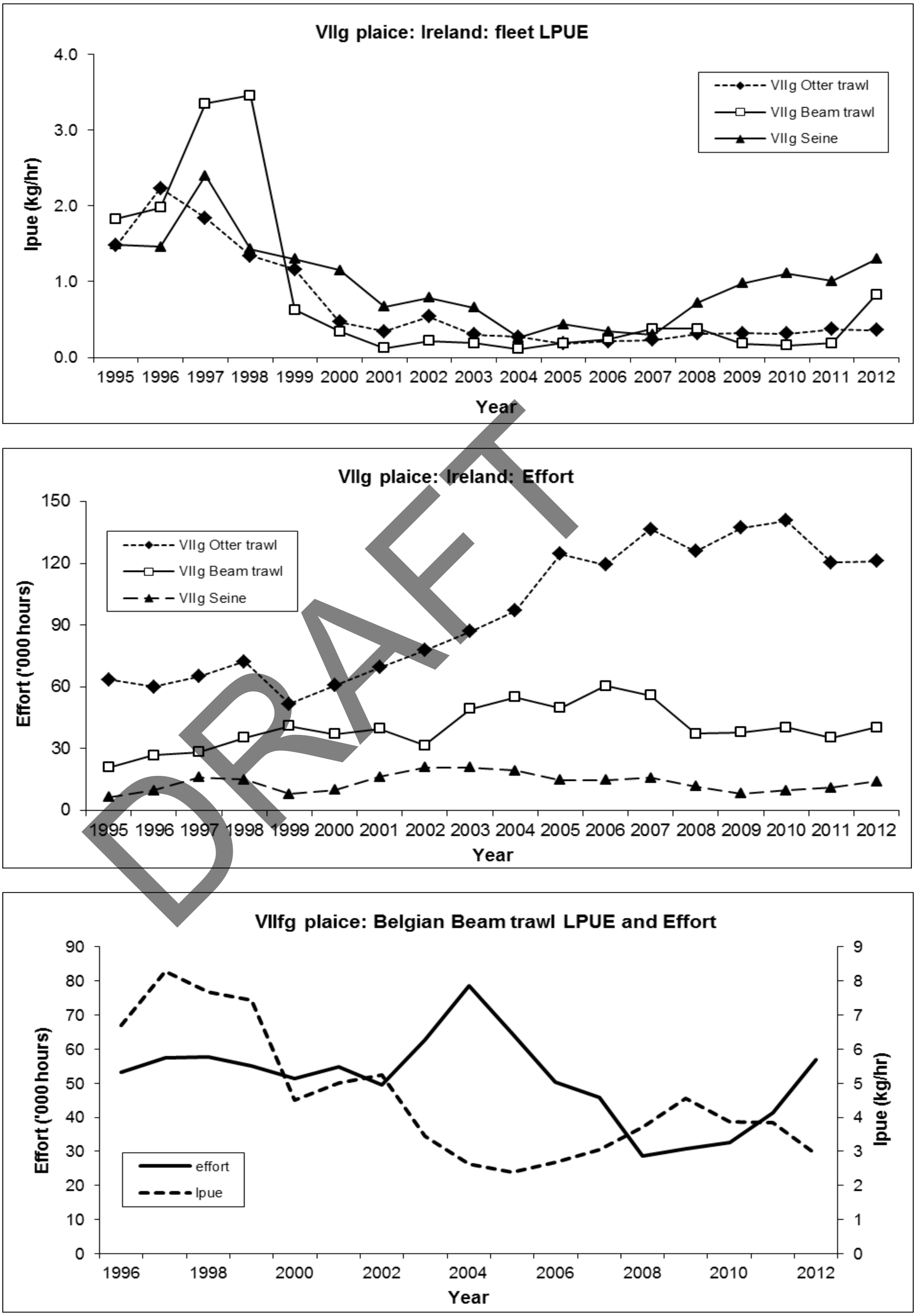


Figure 7.10.2. Plaice in Division VIIf&g: Ireland and Belgium lpue and effort by fleet.

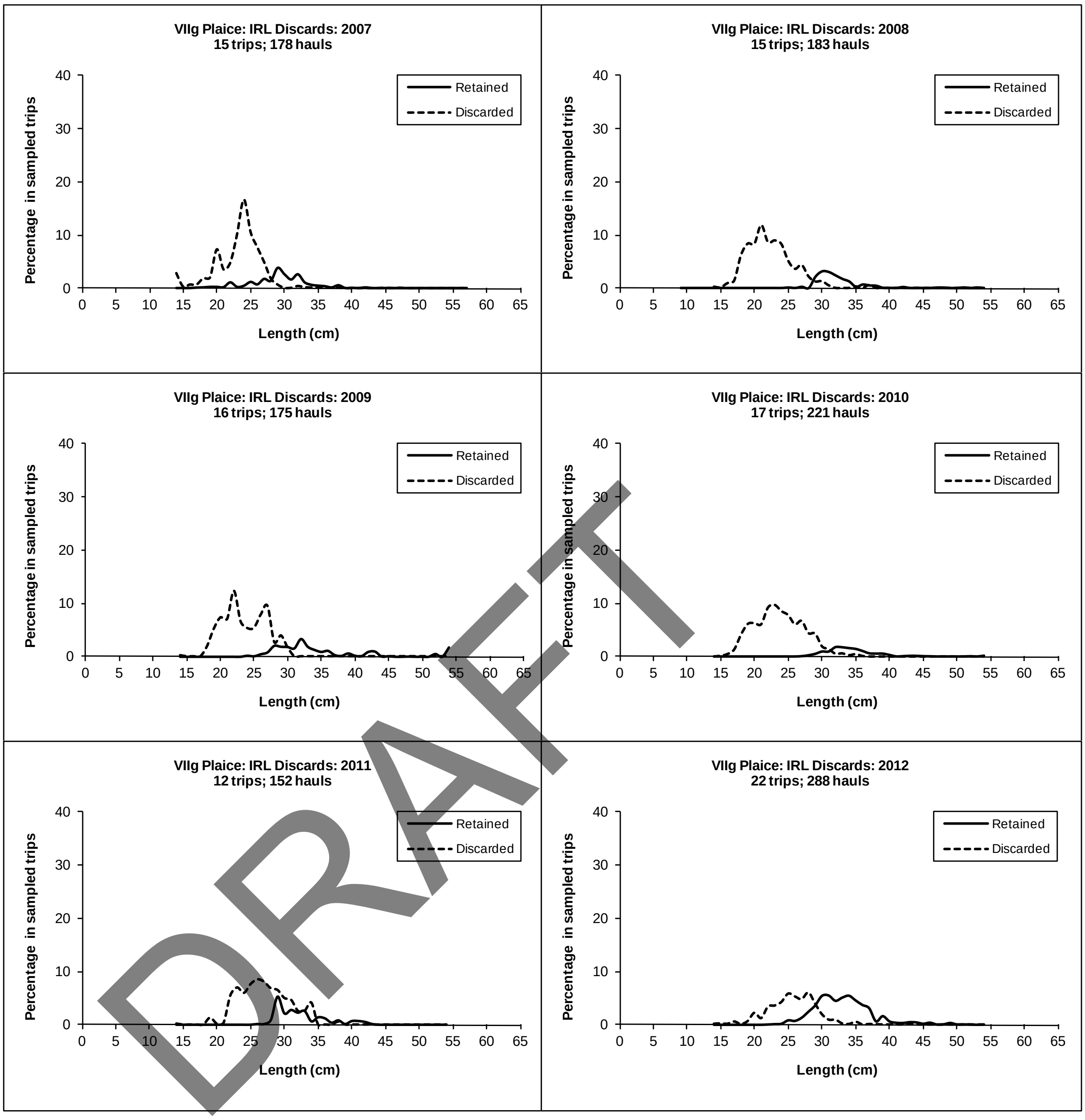


Figure 7.10.3a. Plaice in Division VIIf&g: Ireland otter trawl discard sampling results from 2007 to 2012, raised to sampled trips.

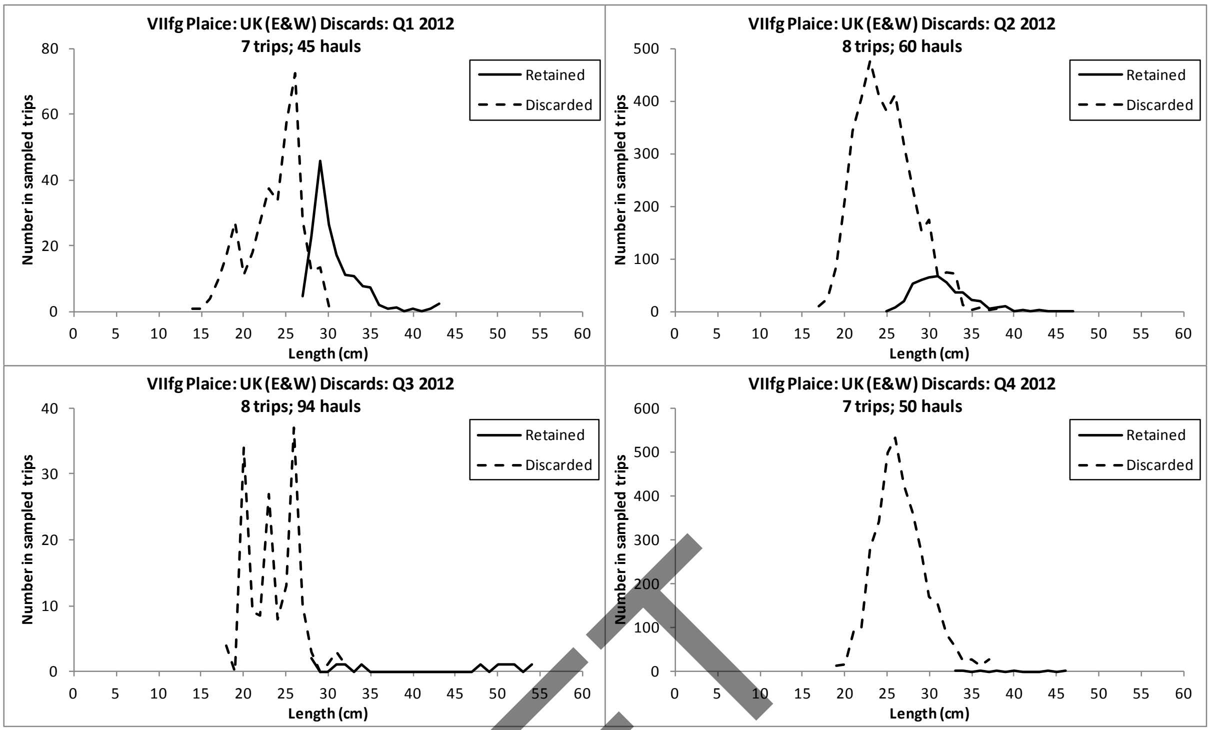


Figure 7.10.3b. Plaice in Division VIIf&g: UK(E&W) discard sampling results in 2012, raised to sampled trips. All gears, bar beam.

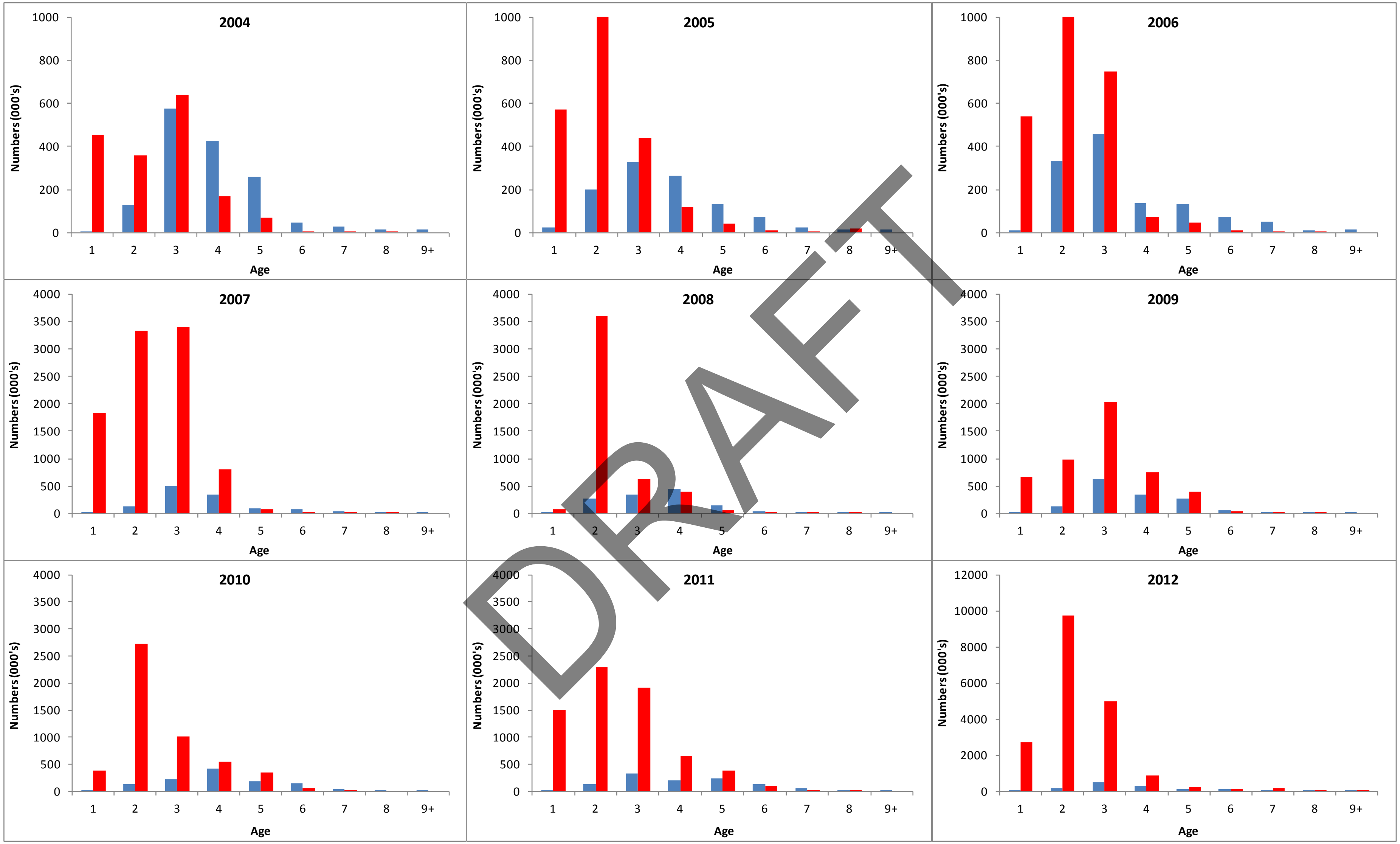


Figure 7.10.4. Plaice in Division VIIf&g: Age composition of International landings and discards from 2004 to 2012. Blue and red bars indicate landings and discards, respectively.

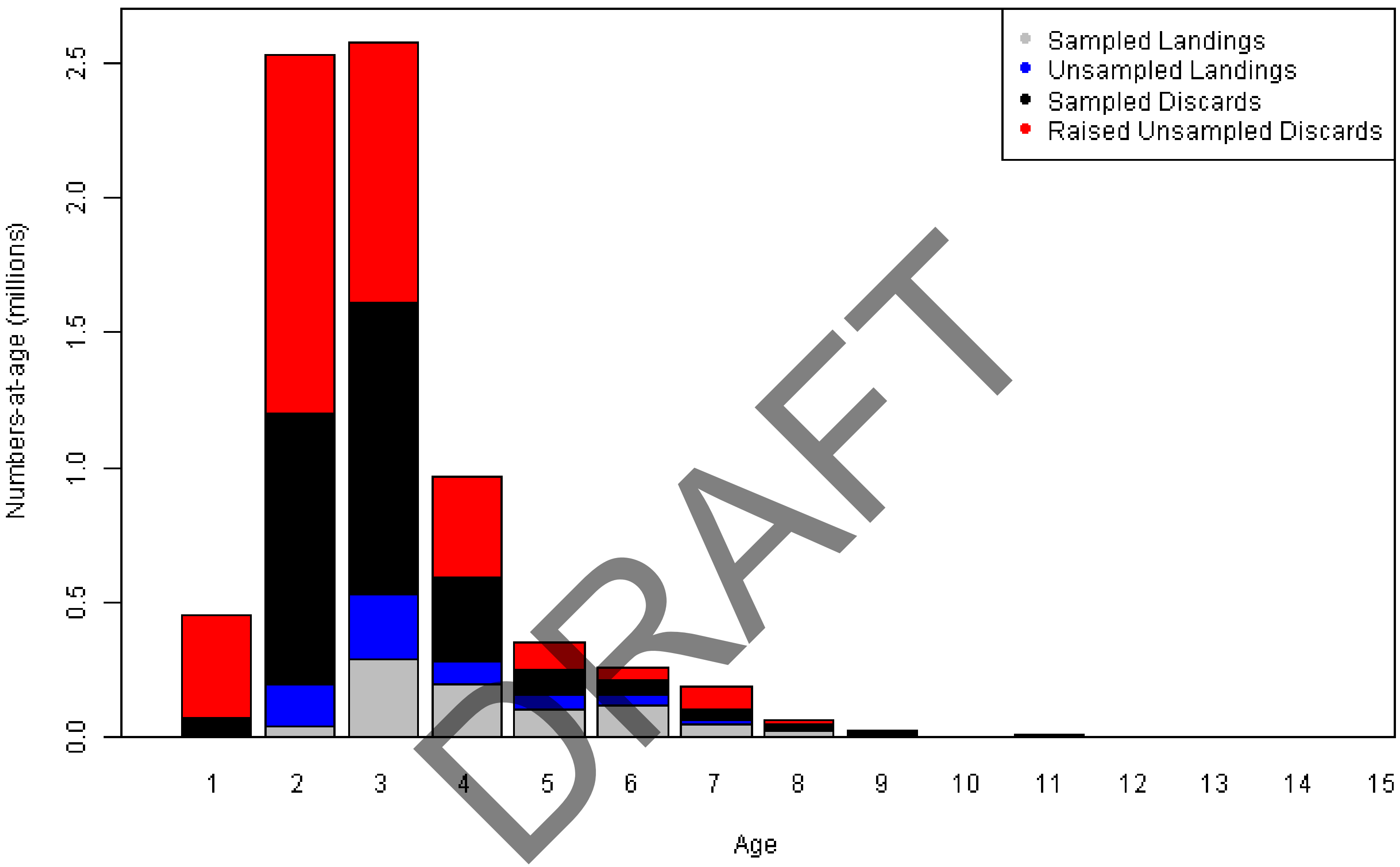


Figure 7.10.5. Plaice in Division VIIf&g: Contribution of sampled and unsampled landings and discards to final assessment catch numbers-at-age in 2012.

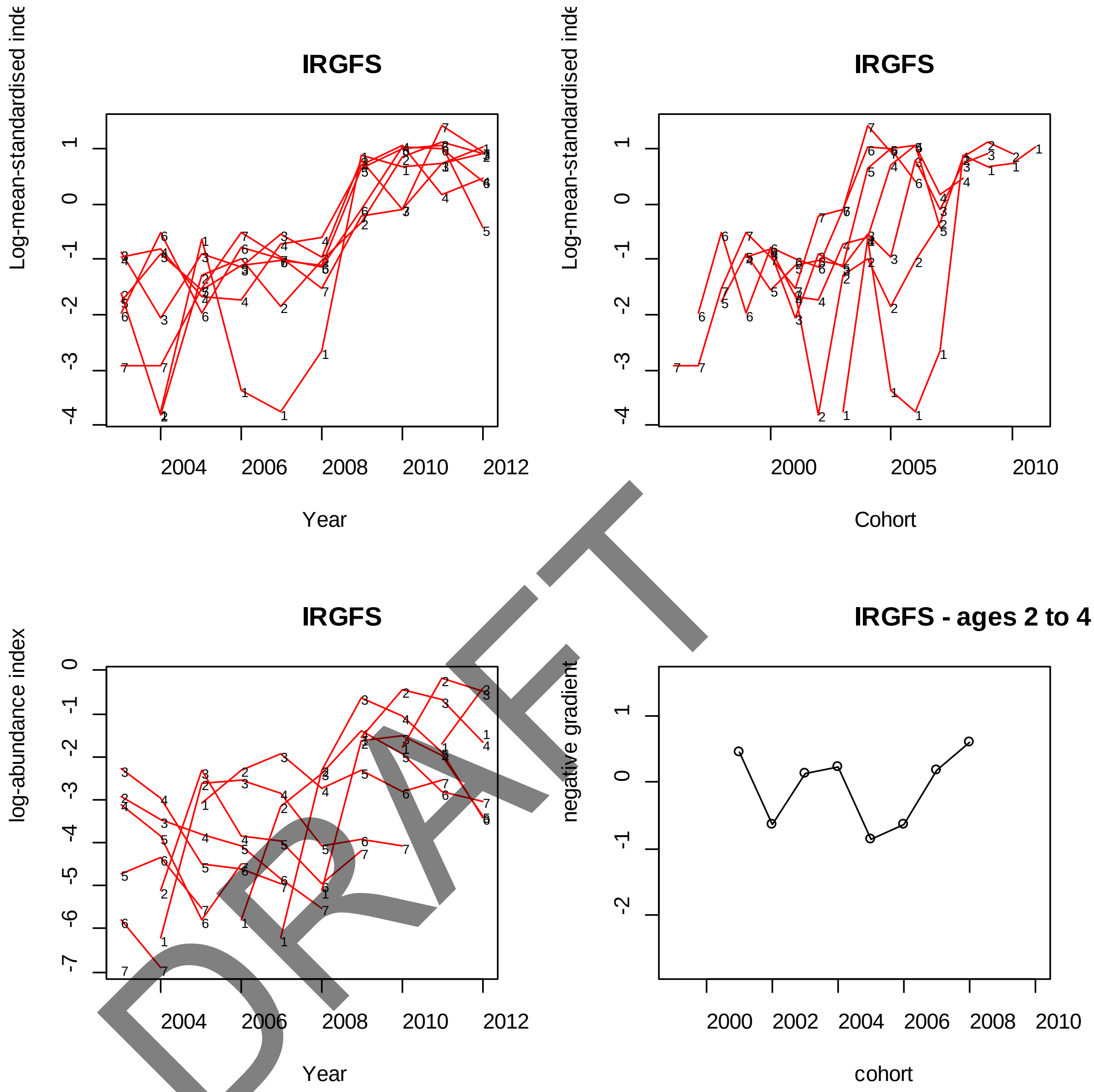


Figure 7.10.6. Plaice in Division VIIf&g: Irish Celtic Explorer IBTS survey (IGFS-WIBTS-Q4) log cpue by year and year class (top row), with log catch curves and the negative slope of the catch curves (~Z; bottom row).

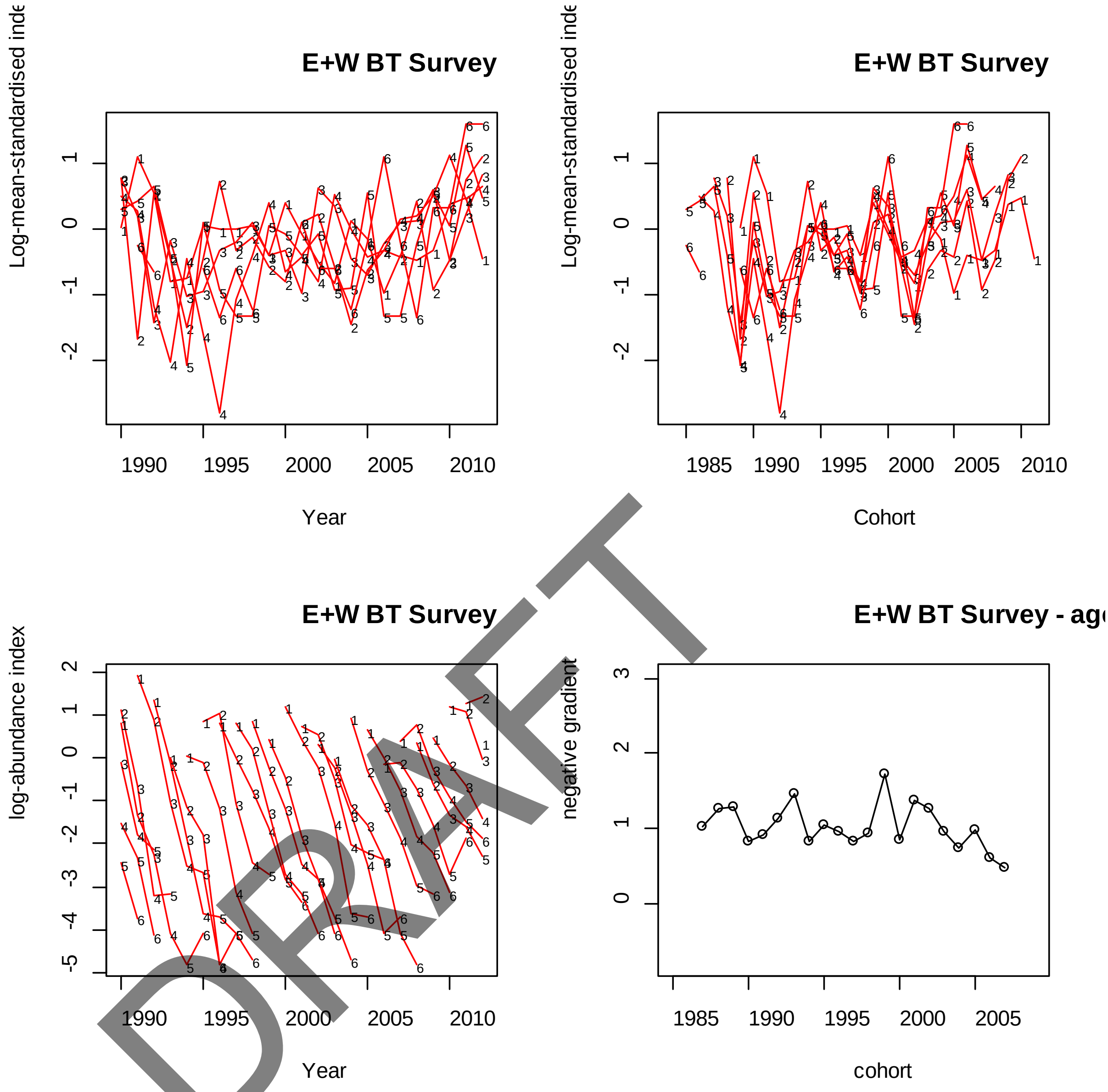


Figure 7.10.7. Plaice in Division VIIf&g: UK Beam trawl survey (UK(E&W)-BTS-Q3) log cpue by year, year class, log catch curves and the negative slope of the catch curves (~Z).

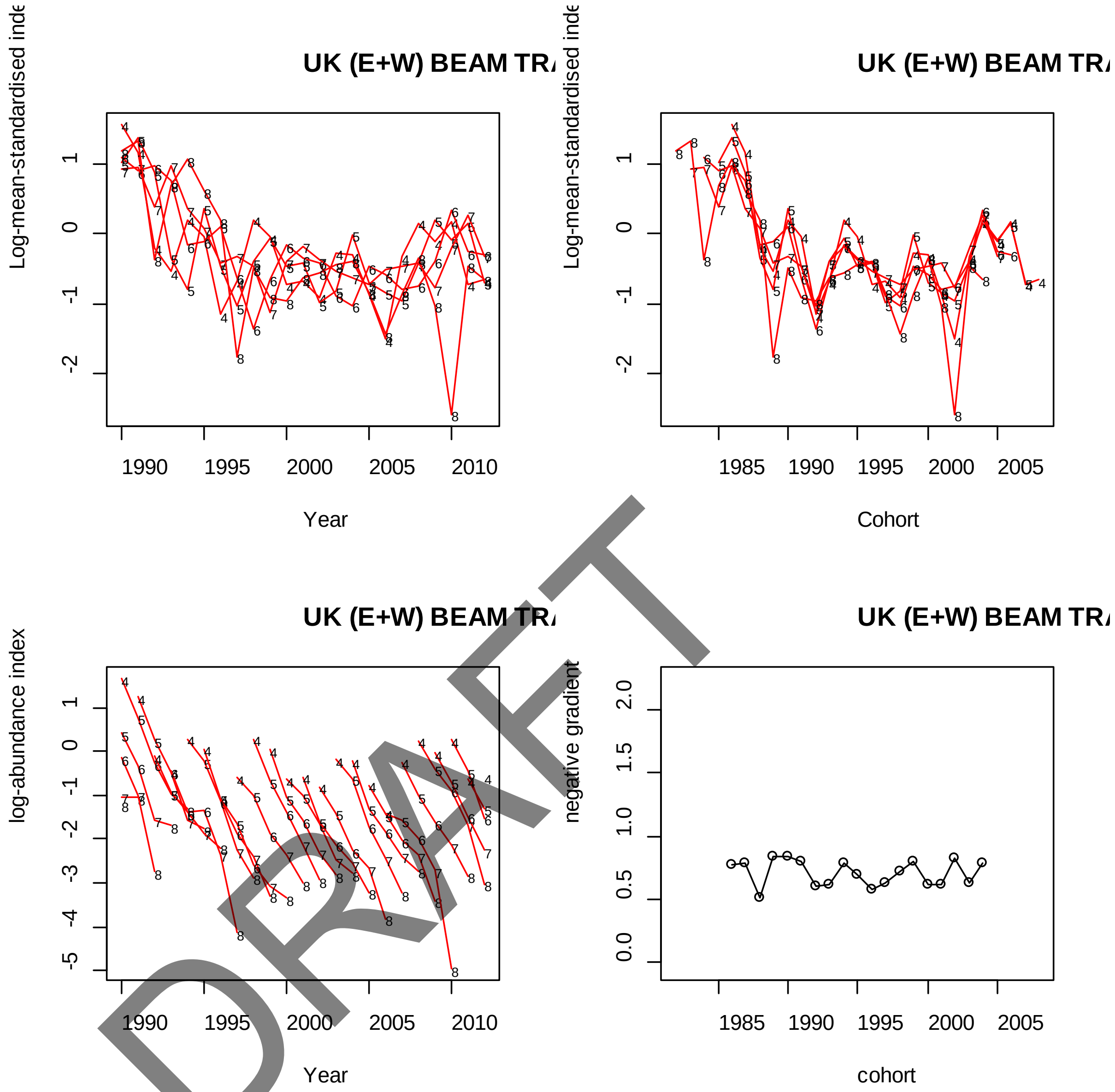


Figure 7.10.8a. Plaice in Division VIIf&g: UK (E&W) Beam trawl fleet log cpue by year, year class, log catch curves and the negative slope of the catch curves (~Z).

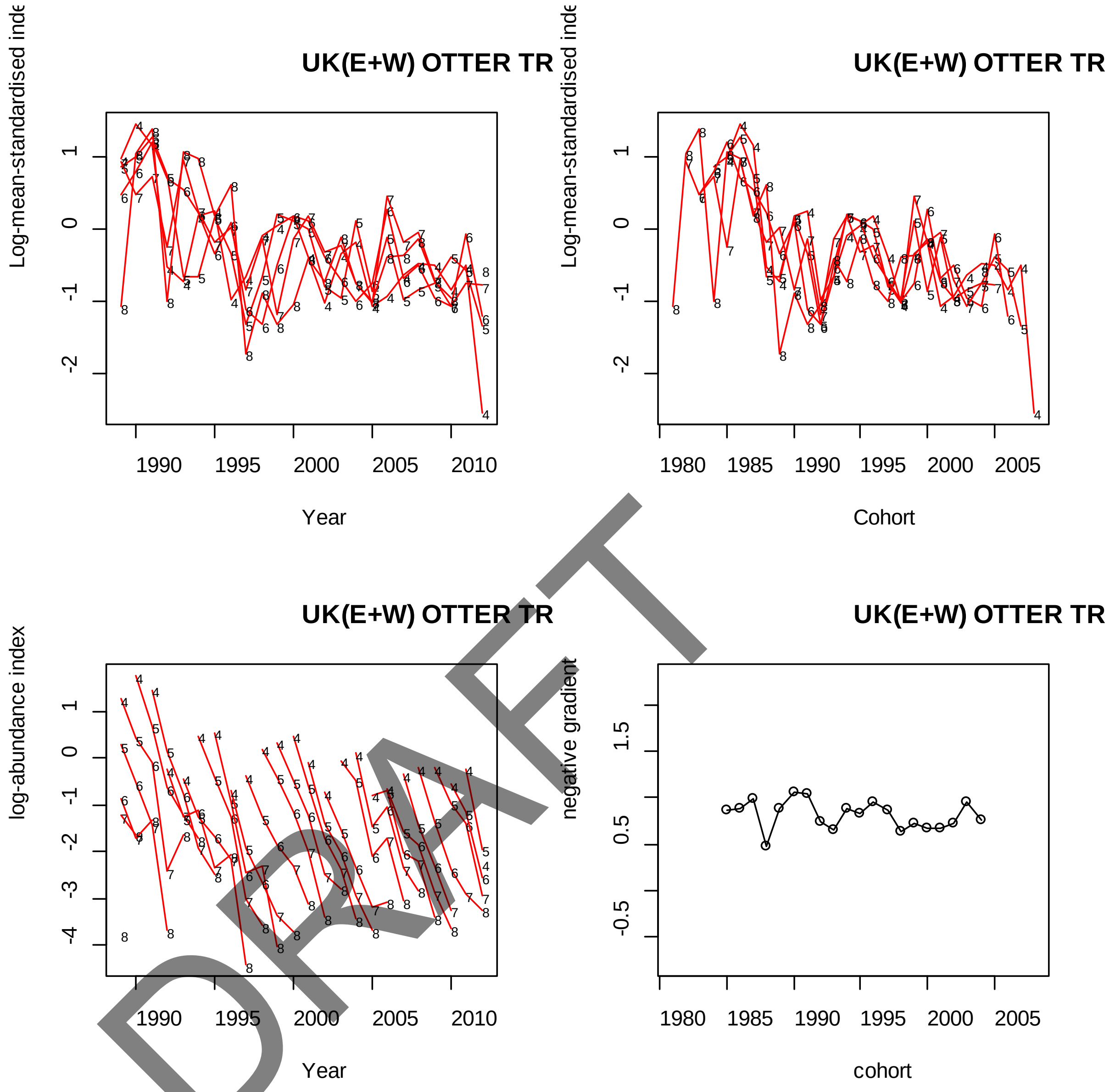


Figure 7.10.8b. Plaice in Division VIIf&g: UK (E&W) Otter trawl fleet log cpue by year, year class, log catch curves and the negative slope of the catch curves (~Z).

Figure 7.10.9a. Plaice in Division VIIf&g: Estimated time-series of total discard weight, discard percentage in weight (DiscardsPCT), average fishing mortality at ages 3–6 (Fbar), total landings weight, recruitment and spawning–stock biomass for the fits of the three AP model variants (TV_PTVS, TI_TVS and TI_PTVS). Note that empirical observations for total discard weight and total landings weight are illustrated by black dots.

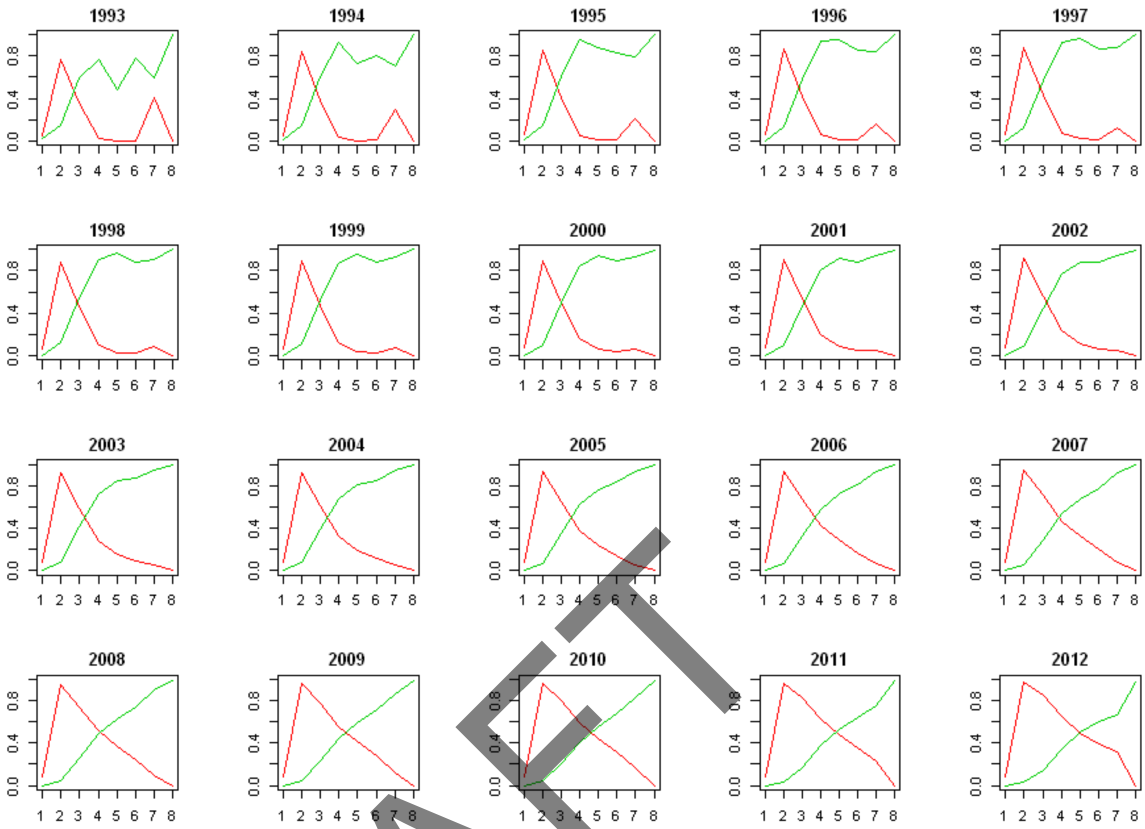


Figure 7.10.9b. Plaice in Division VIIf&g: Estimated selection pattern at-age for landings (green) and discards (red) scaled to the highest value (1.0 for the TV_PTVS model). The TV_PTVS model fits a time variant selection pattern to the landings and a polynomial time variant spline for the discard selection.

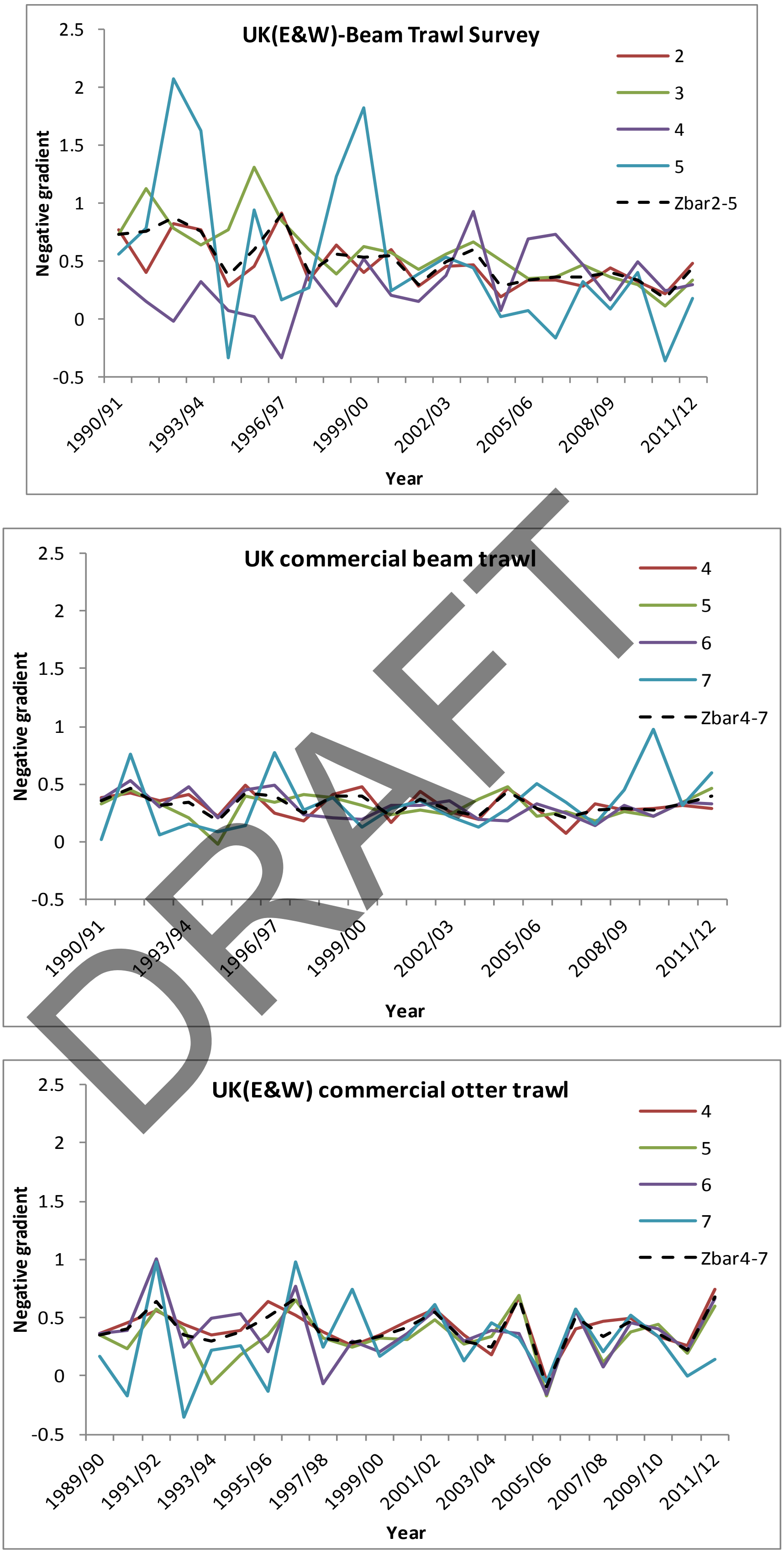


Figure 7.10.10. Plaice in Division VIIf&g: Negative gradient (slope) of the log cpue index-at-age and mean total mortality (Z_{BAR}) for the UK(E&W) beam-trawl survey, the UK commercial beam trawl and the UK(E&W) commercial otter trawl.

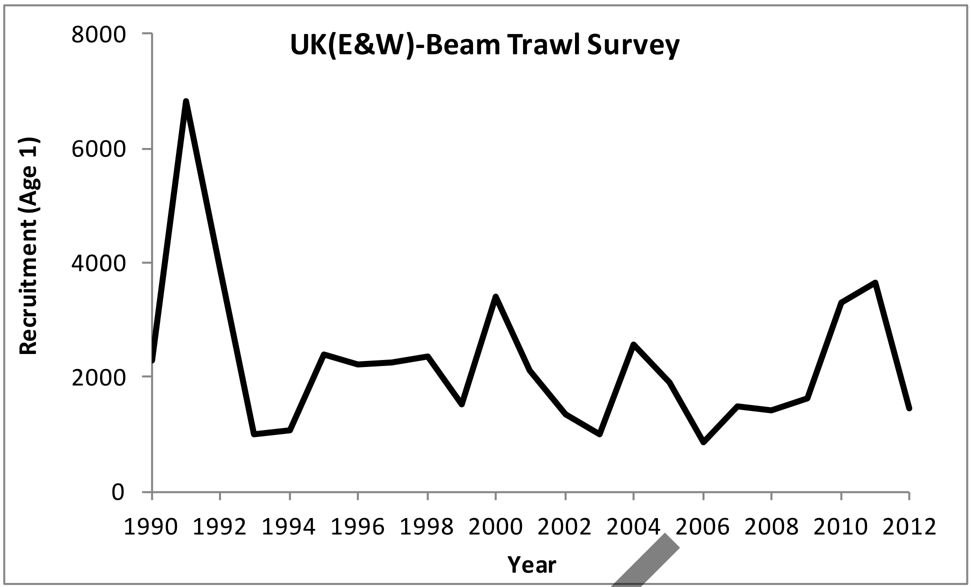


Figure 7.10.11. Plaice in Division VIIf&g: Time-series of recruitment for the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) from 1990 to 2012.

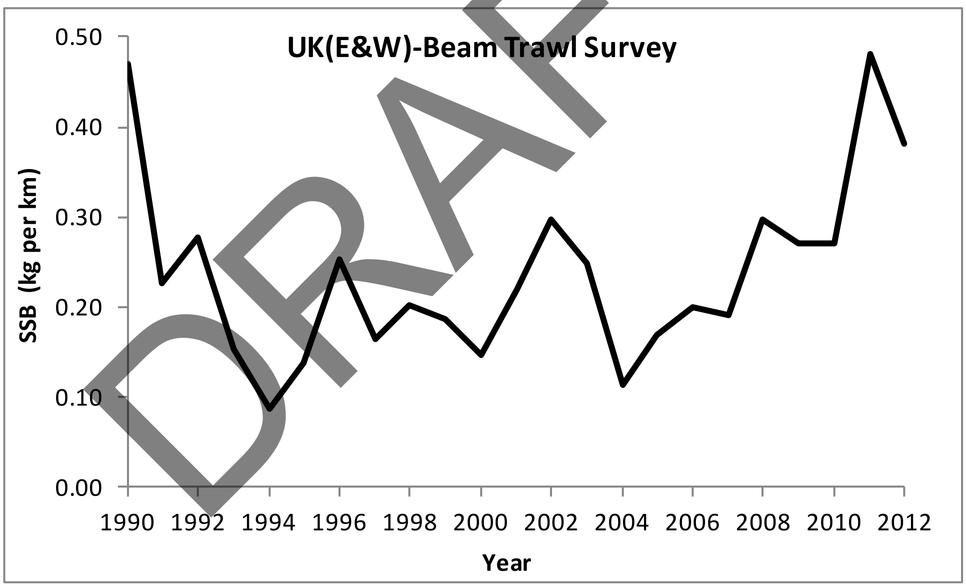


Figure 7.10.12. Plaice in Division VIIf&g: Time-series of spawning–stock biomass for the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) from 1990 to 2012.

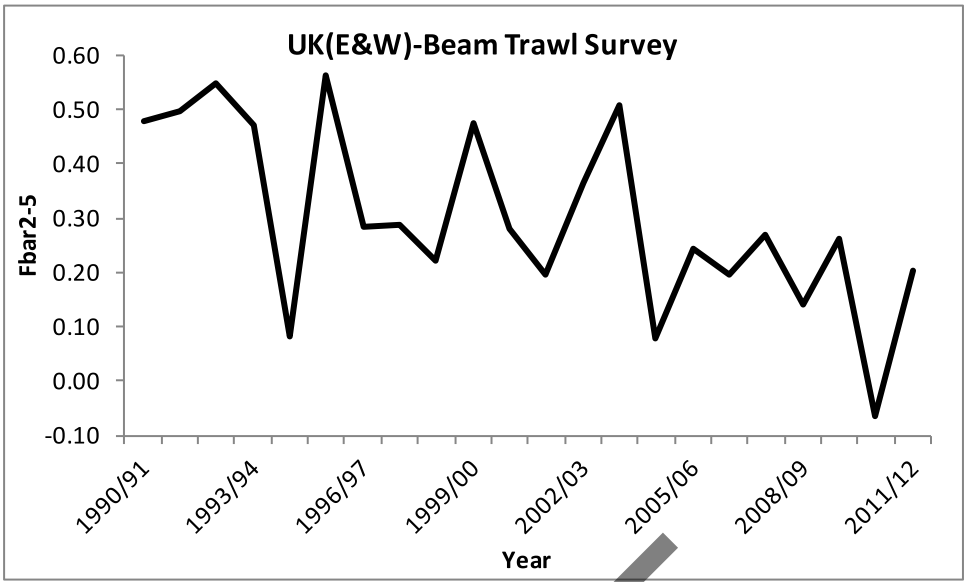


Figure 7.10.13. Plaice in Division VIIf&g: The time-series of mean fishing mortality at ages 2–5 for the UK(E&W) Beam Trawl Survey (UK(E&W)-BTS-Q3) from 1990 to 2012.

Figure 7.10.14. Plaice in Division VIIf&g: The time-series of mean standardised spawning–stock biomass estimates from the fit of the "preferred" TV_PTVS AP model variant in 2012 (red line; median value) and derived from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) in 2013 (black line).

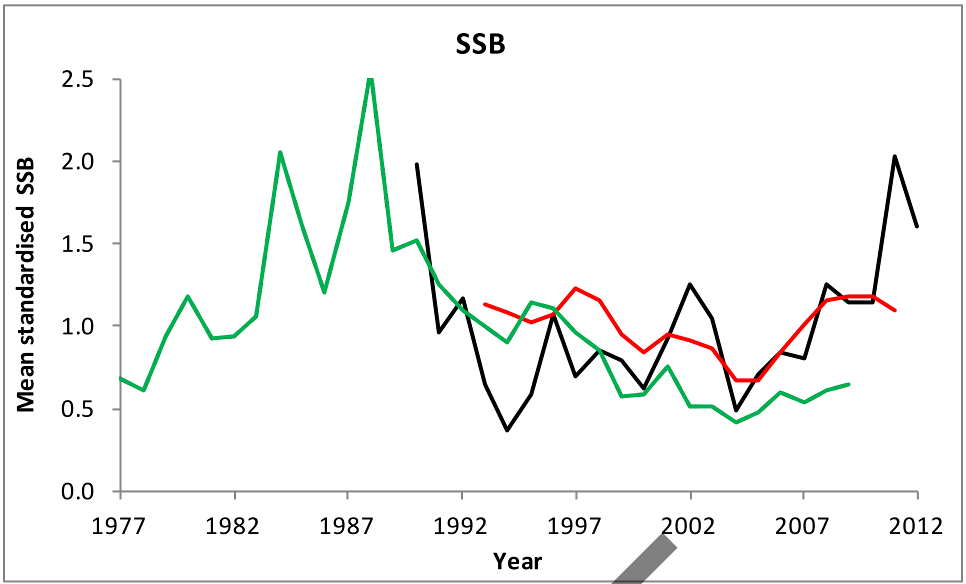


Figure 7.10.15. Plaice in Division VIIf&g: The time-series of mean standardised spawning–stock biomass estimates from the XSA landings only based assessment in 2011 (green line; median value), the fit of the "preferred" TV_PTVS AP model variant in 2012 (red line; median value) and derived from the UK(E&W) beam-trawl survey (UK(E&W)-BTS-Q3) in 2013 (black line).

7.11 Plaice in the southwest of Ireland (ICES Divisions VIIh–k)

Type of assessment in 2013

A separable VPA assessment was performed for the VIIjk component of the landings.

ICES advice applicable to 2013

"Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 100 tonnes, and bycatch and discards should be reduced.

This is the first year that ICES is providing quantitative advice for data-limited stocks."

7.11.1 General

Stock description and management units

Plaice in VIIj are mainly caught by Irish vessels on sandy grounds off the southwest of Ireland. Plaice catches in VIIk are negligible. VIIh is also considered part of the stock for assessment purposes but there is no evidence to suggest that this is actually the same stock (Figure 7.11.1). Irish VMS and logbook data indicate that the VIIj landings occur close to shore and this species is a small component (up to 5%) of the landings in a mixed fishery. (Figure 7.11.2).

The TAC is set for Divisions VIIh,j and k. However, because no age-disaggregated data are available for VIIh, the assessment is performed for VIIjk only.

Species: Plaice *Pleuronectes platessa*		**Zone:** VIIh, VIIj and VIIk (PLE/7HJK.)
Belgium	9	
France	18	
Ireland	61	
The Netherlands	35	
United Kingdom	18	
Union	141	
TAC	141	Analytical TAC Article 11 of this Regulation applies.

Article 11 refers to the closure of the Porcupine bank in May and July.

7.11.2 Data

The nominal landings are given in Table 7.11.1. Because age data were only available for Irish landings (which were mainly from VIIjk) the remainder of Section 7.11 concerns VIIjk only.

Table 7.11.2 gives the landings in VIIjk. Ireland has taken around 80–90% of the landings throughout the time-series.

The effort in the rectangles where the vast majority of the landings were taken (31–33D9 and 31E0) has remained relatively stable over time but the lpue has declined from around 3 kg/h in 1999 to just over 1 kg/h in 2003 and has remained constant since (Figure 7.11.3). This may indicate a decline in the stock or it could signify a change in the behaviour or the fleet.

Discard and retained catch numbers for the Irish OTB fleet in 2012 are shown by length and age in Figure 7.11.4. Significant numbers of plaice were discarded up to around 30 cm. A large proportion of fish at age 4 and even age 5 were discarded. No time-series of discards is currently available and discard numbers are not included in the assessment. In 2012 a significant part of the catches in VIIjk were discarded: 42% by numbers and 30% by weight.

Landings numbers-at-age are given in Table 7.11.3 and Figure 7.11.5. Figure 7.11.6 shows a bubble plot of the standardised landings proportions-at-age. There is very little contrast in the numbers-at-age matrix. Figure 7.11.7 shows the catch curves and the log-catch ratios. The figure suggests that plaice are fully recruited to the fishery by age 4 and the selection pattern appears to be flat after this age.

Figure 7.11.8 gives the stock weights (which are the same as the landings weights).

Data quality

The age data for 1995 were considered insufficient and for this year the combined age data for 1993–1996 were used. Sampling appears to be sufficient to establish landings numbers-at-age. The lack of cohort tracking in the numbers-at-age matrix is most likely due to an absence of very strong or weak cohorts, rather than poor sampling or ageing.

7.11.3 Historical stock development

Target category: 3.2.0.

Indicator to trigger update assessment: Increase in effort targeting plaice.

Model used: separable VPA

Software used: FLR with R version 2.15.3 and packages FLCore 2.5.0; FLEDA 2.5 and FLAssess 2.5.0

Because plaice in VIIh were not sampled, it would not be appropriate to raise the data to all landings in VIIhjk. Instead, the official International landings figures for VIIjk only were used to raise the age distributions (Table 7.11.2).

No suitable tuning fleets were available; the Irish Groundfish Survey (IGFS Q4 WIBTS) does not use gear that is suitable for quantifying flatfish abundance and the commercial lpue could change as a result of changes in behaviour of the fishery which only has a minor bycatch of plaice.

Exploratory assessment

Several exploratory assessments were carried out by means of a separable VPA. The initial runs explored the year and age range to be used in the separable and the choices of reference age, final F and S. The results of these are available on the ICES SharePoint site of WGCSE 2013 under data for this stock.

Final assessment

The results of the final separable assessment are given in Table 7.11.5. Age classes 4 to 8+ were included in the model. Younger ages were omitted because significant discarding is expected to take place at these ages. A terminal S of 1.0 was used because the catch curves and catch ratio plots suggest a flat selection pattern after age 4. A terminal F was of 0.5 chosen because effort has been fairly constant in recent years so one would not expect a strong trend in F in those years. The separable model was applied to the last six years only because the fishery appeared to have remained stable in this period. The estimated stock numbers, F, selection pattern and catch residuals are given in Table 7.11.5. The residual pattern is shown in Figure 7.11.9 and doesn't show any trends. The time-series of F-at-age is shown in Figure 7.11.10. The pattern in F for the period over which the VPA was applied is somewhat noisy.

State of the stock

The summary table with a time-series of landings, recruitment, SSB and F is given in Table 7.11.6 and Figure 7.11.11. Recruitment in the last ten years appears to be stable but lower than at the start of the time-series. The SSB has declined from around 400 tonnes to less than 100 t in 2005 but appears to be increasing in recent years. F appears to have come down from around 0.8 during 1993–2007 to 0.5 in recent years.

The sensitivity of the assessment to the parameter settings was investigated by comparing the results of a range of settings (Figure 7.11.11). Applying the separable model over the full time-series did not significantly change the trends compared to applying the separable model only over the last six years. The step-change in F after 2007 was not affected by applying the separable model over all years. Changing the terminal F to 0.7 resulted in an upwards trend in recent years, while reducing the terminal F to 0.3 resulted in a downward trend, neither of these scenarios are likely because effort in the fishery has remained relatively constant. The trends in SSB and recruitment were not strongly affected by the choice of terminal F. Including ages 2–8 resulted in very similar results to including ages 4–8 but due to uncertainty about discard patterns in the past the WG decided that it was best to omit the younger ages. Including ages 4–10 resulted in noisier F trends but otherwise similar results.

Short-term projections

Recruitment appears to have been quite stable since 2003. Before that, recruitment might have been higher or the discard rate could have been lower. There are some indications that discard patterns may have been different in that period because relatively small plaice were more marketable. For this reason the recruitment assumption for the short-term forecast was the geometric mean for 2003–2010 (159 t; omitting the last two years). Three-year averages were used for F and weights-at-age. The input data for the forecast is given in Table 7.11.7 and the management options are given in Table 7.11.8. Estimates of the relative contribution of recent cohorts are shown in Table 7.11.9. More than half of the 2014 landings and around a third of the 2015 SSB depends on the GM recruitment assumption.

MSY evaluation

A yield-per-recruit was performed with MFDP; the results are shown in Figure 7.11.12. Current F_{BAR} of 0.52 is above a poorly defined F_{MAX} value of 0.43. $F_{0.1}$ and $F_{35\%SPR}$ are at 0.16 and 0.18 respectively. The analysis was applied on the landings data only. If discarding in this stock is reduced, the ypr pattern will change.

Biological reference points

No reference points are defined for this stock. F_{MAX} is estimated at 0.43.

Uncertainties and bias in the assessment and forecast

The assessment is performed only on the VIIjk part of the stock area.

The trends are generally in line with lpue trends from the Irish OTB fishery in the rectangles where the majority of the catches are taken (Figure 7.11.3).

Discards in this stock may be considerable but are not presently included in the model because this might introduce more noise in the catch numbers-at-age matrix. The discarding pattern is assumed to be unchanged. The model appears to be reasonably robust to the absence of discards although removing the younger ages from the model would make the short-term forecast more reliant on assumed recruitment (at age 4).

Recommendations for the next benchmark

This stock is not due to be benchmarked; however WKFLAT 2014 will evaluate the inclusion of VIIh sole into sol-celt. The situation with sole is very similar to that of plaice and the two stock areas could be changed in tandem.

Management considerations

The stock area includes VIIh, however the landings in VIIjk are taken in the northeast of VIIj which is around 250 km away from the north of VIIh where most of the VIIh landings are taken. It is more likely that the VIIh plaice are part of the VIIe or VIIf stock.

The catches are taken in a mixed fisheries and should be managed as such. Constraining the landings by TAC will not constrain the catches. Because plaice are caught in spatially distinct areas, restricting effort in these areas will be more effective than limiting landings. Additionally, management should focus on reducing discards. The recently introduced square mesh panels will have no effect on catches of undersize plaice. An increase in mesh size could improve selection but this will also affect the catches of marketable fish (e.g. STECF PLEN 03-12).

Table 7.11.1. Plaice in Divisions VII h–k (Southwest Ireland). Nominal landings (t), 1987–2011, as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995
Belgium*	250	245	403	301	252	246	344	197	235
Denmark	1	1	1	-	-	-	-	-	-
France	85	135	229	77	173	90	64	48	60
Ireland	300	369	454	338	478	477	383	271	321
Netherlands	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-
UK - Eng+Wales+N	.	.	73	88	287	264	218	258	282
UK - England & Wa	246	433	.	.	.	.	.	.	.
UK - Scotland	-	1	-	1	1	6	7	1	4
Total	882	1184	1160	805	1191	1083	1016	775	902
Unallocated							-361	-198	-360
WG estimate							655	577	542

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004
Belgium*	304	442	335	45	4	27	69	20	67
Denmark	-	-	-	-	-	-	-	-	-
France	48	69	49	.	54	50	45	32	32
Ireland	305	344	286	299	200	160	155	127	91
Netherlands	52	-	13	1	2	-	-	-	-
Spain	-	-	-	1	5	3	2	6	6
UK - Eng+Wales+N	154	138	106	82	75	73	59	56	36
UK - England & Wa	.	.	.	.	.	.	.	.	.
UK - Scotland	1	1	1	1	1	-	-	-	-
Total	864	994	790	428	341	313	330	241	232
Unallocated	-411	-349	-346	-22	-42	-52	-17	-24	-11
WG estimate	453	645	444	406	299	261	313	217	221

Country	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	32	22	7	25	1		4	1
Denmark								
France	20	37	30	12	44	55	54	62
Ireland	90	65	72	72	71	66	73	99
Netherlands	.							
Spain	.	1	13	1				
UK - Eng+Wales+N	28	18	20	12	32	35	44	38
UK - England & Wa	.							
UK - Scotland	.							
Total	170	143	142	122	148	156	175	200
Unallocated	-6	4	-22	13	1	-1	-55	
WG estimate	164	147	120	135	148	155	120	

* Belgian Landings up to 1998 include VIIg

Table 7.11.2. Official landings of plaice in divisions VIIj and VIIk only. * Preliminary data.

Year	Bel	Fra	Irl	Esp	UK	Total
1993	.	8	383	-	46	437
1994	.	6	251	-	60	317
1995	.	12	317	-	90	419
1996	.	3	295	-	38	336
1997	.	6	337	-	32	375
1998	.	8	282	-	16	306
1999	42	0	296	<0.5	15	353
2000	4	16	195	5	9	229
2001	-	16	157	3	6	182
2002	14	21	155	2	5	197
2003	4	7	125	6	9	151
2004	<0.5	5	87	6	6	104
2005	-	4	88	-	2	94
2006	-	6	63	1	1	71
2007	-	9	72	11	2	94
2008	-	5	72	1	1	79
2009	-	7	71	-	2	79
2010	-	11	66	-	1	78
2011	-	10	67	-	2	79
2012*	-	17	94		2	113

Table 7.11.3. Landings numbers-at-age for plaice in VIIjk.

	1	2	3	4	5	6	7	8	9	10	11	12+
1993	0	93	624	479	115	45	23	10	6	2	0	1
1994	68	104	340	260	82	45	18	8	5	2	1	0
1995	10	207	633	348	107	36	16	7	5	1	2	0
1996	1	77	314	228	127	37	23	5	3	0	0	0
1997	0	166	277	268	119	42	19	4	0	0	0	9
1998	0	46	355	164	103	38	26	10	4	3	0	0
1999	11	143	312	201	65	37	18	11	9	2	2	8
2000	2	74	161	190	64	36	7	5	3	2	0	2
2001	1	55	165	146	47	6	22	2	7	0	0	0
2002	0	54	155	172	54	42	44	12	4	2	0	1
2003	0	74	166	65	29	6	15	10	1	2	1	0
2004	7	31	121	91	27	12	2	2	4	1	1	0
2005	1	25	71	77	48	22	13	4	0	1	0	1
2006	0	17	41	53	38	12	7	1	1	0	2	0
2007	0	47	136	61	22	17	4	2	0	0	0	0
2008	1	55	106	70	21	5	2	1	0	0	0	0
2009	0	13	112	78	30	11	5	0	1	0	0	0
2010	1	56	42	60	43	18	4	2	1	1	0	0
2011	0	19	83	54	36	22	11	4	1	0	0	0
2012	0	13	129	104	38	30	13	7	2	1	0	2

Table 7.11.4. Weight-at-age for plaice in VIIjk.

	1	2	3	4	5	6	7	8	9	10	11	12+
1993		0.196	0.256	0.306	0.417	0.582	0.751	0.939	1.151	1.532		1.983
1994	0.046	0.222	0.302	0.368	0.460	0.563	0.708	0.873	1.029	1.311	1.374	
1995	0.100	0.228	0.272	0.325	0.391	0.521	0.651	0.840	0.817	1.536	1.540	
1996	0.029	0.298	0.379	0.432	0.463	0.512	0.529	0.493	0.398	2.324		
1997	1.112	0.295	0.339	0.430	0.483	0.654	0.807	0.937				1.319
1998		0.249	0.308	0.419	0.529	0.690	0.779	0.757	0.941	1.192	2.201	
1999	0.218	0.289	0.354	0.417	0.596	0.627	0.840	0.882	1.170	1.729	2.120	1.136
2000	0.120	0.273	0.348	0.420	0.486	0.609	0.807	1.107	1.439	1.080		1.393
2001	0.215	0.243	0.325	0.405	0.537	0.644	0.800	0.550	1.115			
2002		0.211	0.296	0.328	0.415	0.498	0.567	0.701	1.014	1.098		1.533
2003		0.274	0.358	0.402	0.482	0.575	0.734	0.876	1.041	1.875	1.259	
2004	0.129	0.259	0.310	0.341	0.448	0.550	0.631	0.637	0.900	1.139	1.326	1.807
2005	0.170	0.238	0.276	0.324	0.381	0.459	0.731	0.949		1.223	1.535	1.992
2006		0.272	0.319	0.370	0.438	0.519	0.794	0.895	0.791	0.395	1.878	
2007		0.239	0.281	0.354	0.433	0.482	0.573	0.727	1.394	0.837	1.266	
2008	0.293	0.239	0.282	0.336	0.358	0.529	0.754	0.399	1.100	1.554		
2009		0.224	0.255	0.335	0.403	0.462	0.520		1.080		1.393	1.138
2010	0.217	0.257	0.310	0.342	0.369	0.462	0.563	0.739	0.735	0.718	2.512	
2011	0.286	0.257	0.282	0.321	0.355	0.407	0.626	0.625	0.507	0.841	0.963	1.133
2012		0.244	0.284	0.312	0.364	0.429	0.465	0.562	0.701	0.512		1.326

Table 7.11.5. Separable VPA stock numbers, F, selection and residuals for plaice in VIIjk.

StockN	4	5	6	7	8
1993	725	211	87	43	36
1994	521	197	79	35	31
1995	664	219	98	28	26
1996	475	264	95	53	19
1997	475	208	116	49	34
1998	360	171	74	63	43
1999	390	166	56	30	53
2000	346	158	87	15	26
2001	230	130	81	44	20
2002	258	68	71	66	27
2003	146	69	10	24	25
2004	180	68	34	3	15
2005	163	74	36	19	8
2006	98	72	21	11	8
2007	132	47	23	7	3
2008	177	48	16	7	1
2009	210	103	27	9	1
2010	196	119	57	15	3
2011	168	116	68	32	4
2012	280	100	67	39	8
2013	-	151	53	34	26
F	4	5	6	7	8
1993	1.18	0.86	0.78	0.82	0.82
1994	0.75	0.58	0.93	0.79	0.79
1995	0.80	0.72	0.50	0.91	0.91
1996	0.71	0.71	0.53	0.63	0.63
1997	0.90	0.92	0.49	0.54	0.54
1998	0.65	1.00	0.79	0.56	0.56
1999	0.78	0.53	1.20	1.02	1.02
2000	0.86	0.55	0.56	0.62	0.62
2001	1.10	0.48	0.08	0.73	0.73
2002	1.19	1.80	0.97	1.19	1.19
2003	0.64	0.58	0.98	1.05	1.05
2004	0.77	0.53	0.45	0.78	0.78
2005	0.69	1.13	1.08	1.15	1.15
2006	0.83	0.81	0.95	1.02	1.02
2007	0.90	0.94	0.99	0.90	0.90
2008	0.42	0.44	0.46	0.42	0.42
2009	0.45	0.48	0.50	0.45	0.45
2010	0.41	0.43	0.45	0.41	0.41
2011	0.40	0.42	0.44	0.40	0.40
2012	0.50	0.52	0.55	0.50	0.50

StockN	4	5	6	7	8
Selection	4	5	6	7	8
	0.91	0.95	1.00	0.91	0.91
Residuals	4	5	6	7	8
2007	-13.90	-5.37	3.65	0.00	1.82
2008	12.59	4.34	-0.95	-0.51	1.24
2009	5.95	-6.57	0.56	1.54	1.06
2010	-2.69	3.82	-1.33	-0.38	3.19
2011	1.42	-1.98	-0.82	0.71	4.55
2012	0.00	-1.02	2.79	-1.84	8.54

Table 7.11.6. Summary table for ple 7jk. Landings in tonnes (7jk only). Recruitment (age 4) in thousands. SSB in tonnes. F_{BAR} ages 3–8.

YEAR	LAND	RECRUIT	SSB	FBAR
1993	437	725	401	0.94
1994	317	521	356	0.75
1995	419	664	366	0.67
1996	336	475	387	0.65
1997	375	475	432	0.77
1998	306	360	359	0.81
1999	353	390	361	0.84
2000	229	346	301	0.66
2001	182	230	256	0.55
2002	197	258	197	1.32
2003	151	146	134	0.73
2004	104	180	118	0.58
2005	94	163	113	0.97
2006	71	98	92	0.86
2007	94	132	78	0.94
2008	79	177	83	0.44
2009	79	210	121	0.48
2010	78	196	138	0.43
2011	79	168	138	0.42
2012	113	280	165	0.53
GM '03-10: 159			AVG'10-12: 0.46	

Table 7.11.7. Input to short term forecast (.prd)

MFDP version 1a								
Run: mfdp								
Time and date: 10:03 13/05/2013								
Fbar age range: 4-6								
2013								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
4	159	0.12	0.86	0	0	0.325	0.4368	0.325
5	150.7181	0.12	1	0	0	0.362667	0.458513	0.362667
6	52.52268	0.12	1	0	0	0.432667	0.480704	0.432667
7	34.46204	0.12	1	0	0	0.551333	0.4368	0.551333
8	25.55218	0.12	1	0	0	0.723616	0.4368	0.723616
2014								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
4	159	0.12	0.86	0	0	0.325	0.4368	0.325
5	.	0.12	1	0	0	0.362667	0.458513	0.362667
6	.	0.12	1	0	0	0.432667	0.480704	0.432667
7	.	0.12	1	0	0	0.551333	0.4368	0.551333
8	.	0.12	1	0	0	0.723616	0.4368	0.723616
2015								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
4	159	0.12	0.86	0	0	0.325	0.4368	0.325
5	.	0.12	1	0	0	0.362667	0.458513	0.362667
6	.	0.12	1	0	0	0.432667	0.480704	0.432667
7	.	0.12	1	0	0	0.551333	0.4368	0.551333
8	.	0.12	1	0	0	0.723616	0.4368	0.723616

Input units are thousands and kg - output in tonnes.

Table 7.11.8. Management options table (.prm).

MFDP VERSION 1A						
Run: mfdp						
PLE7jk	WGCSE	COMBSEX	PLUSGROUP			
Time and date: 10:03 13/05/2013						
Fbar age range: 4-6						
2013						
Biomass	SSB	FMult	FBar	Landings		
167	159	1	0.4587	57		
2014					2015	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
162	155	0	0	0	220	212
.	155	0.1	0.0459	7	212	205
.	155	0.2	0.0917	13	205	198
.	155	0.3	0.1376	19	198	191
.	155	0.4	0.1835	25	192	185
.	155	0.5	0.2293	31	186	178
.	155	0.6	0.2752	36	180	173
.	155	0.7	0.3211	41	174	167
.	155	0.8	0.3669	46	169	161
.	155	0.9	0.4128	51	164	156
.	155	1	0.4587	56	159	151
.	155	1.1	0.5045	60	154	147
.	155	1.2	0.5504	64	149	142
.	155	1.3	0.5963	68	145	138
.	155	1.4	0.6421	72	141	134
.	155	1.5	0.688	76	137	130
.	155	1.6	0.7339	79	133	126
.	155	1.7	0.7797	82	130	122
.	155	1.8	0.8256	86	126	119
.	155	1.9	0.8715	89	123	116
.	155	2	0.9173	92	120	112

Input units are thousands and kg - output in tonnes.

Table 7.11.9. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Landings yield

Ages	2013	2014
	Years Predicted	
4	17	17
5	19	12
6	8	13
7	6	5
8	6	8
Tot Wt	56	55

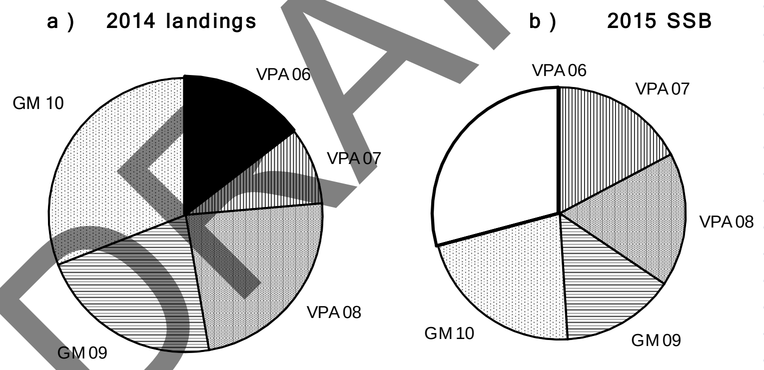
SSB

Ages	2013	2014	2015
	Years Predicted		
4	44	44	44
5	55	33	33
6	23	37	22
7	19	16	26
8	18	25	26
Tot Wt	159	155	151

Year-class			2006	2007	2008	2009	2010
Recruits (thousands)			196	168	280	159	159
Source			VPA	VPA	VPA	GM	GM
Status Quo F:							
% in	2013	landings	10.7%	14.3%	33.9%	30.4%	-
% in	2014	landings	14.5%	9.1%	23.6%	21.8%	30.9%
% in	2013	SSB	11.9%	14.5%	34.6%	27.7%	-
% in	2014	SSB	16.1%	10.3%	23.9%	21.3%	28.4%
% in	2015	SSB	0.0%	17.2%	17.2%	14.6%	21.9%

GM : geometric mean recruitment

Plaice in VIIjk : Year-class % contribution to



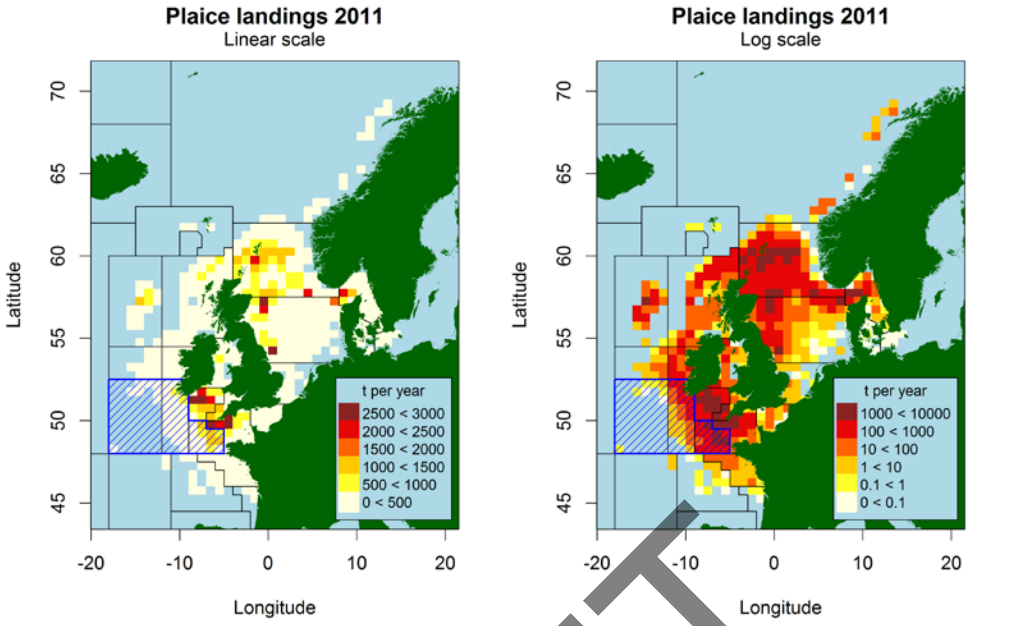


Figure 7.11.1. The spatial distribution of International landings of Plaice (all gears combined). The assessment area is outlined in blue. Data from STECF.

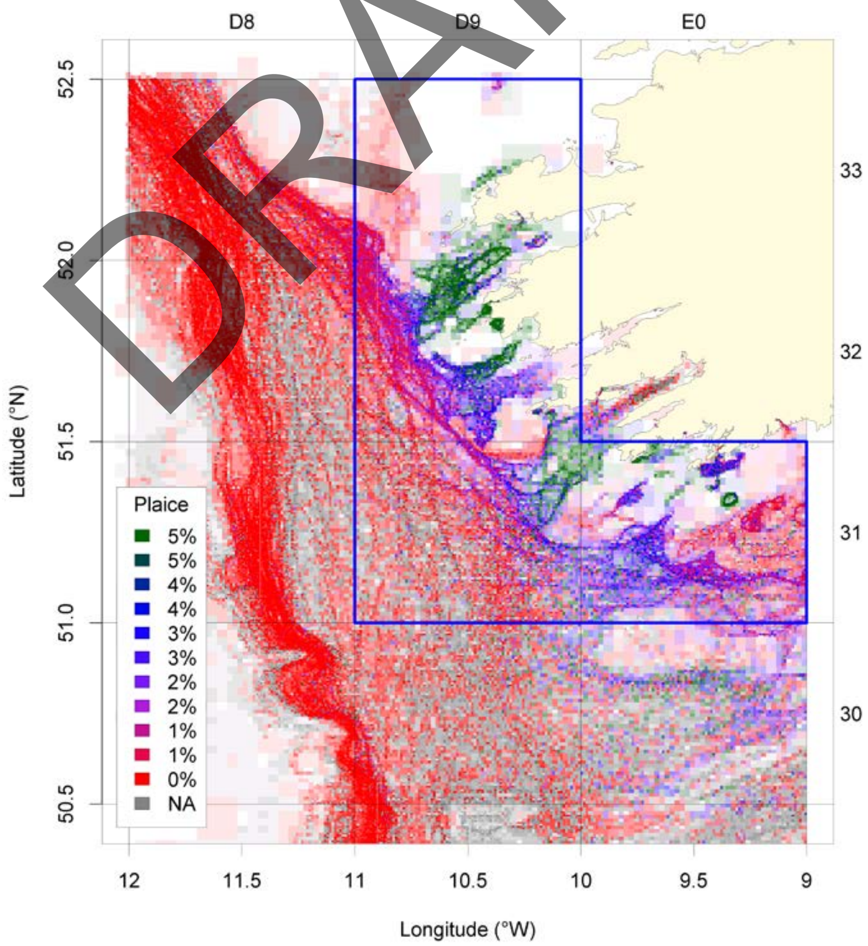


Figure 7.11.2. The proportion of plaice in Irish OTB catches in VIIj. The rectangles in blue were used to plot an lpue time-series.

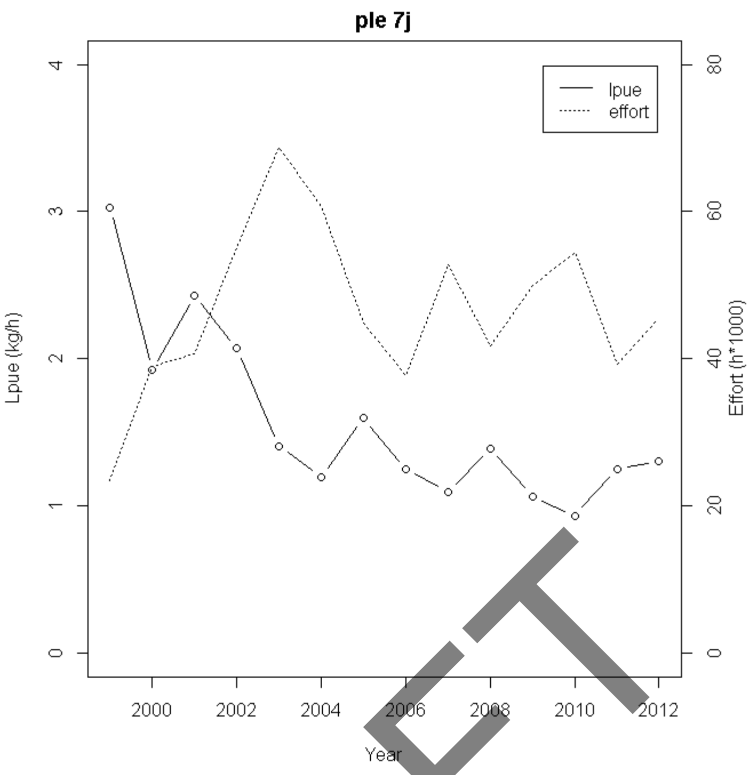


Figure 7.11.3. Irish OTB effort and plaice landings from rectangles 31–33D9 and 31E0.

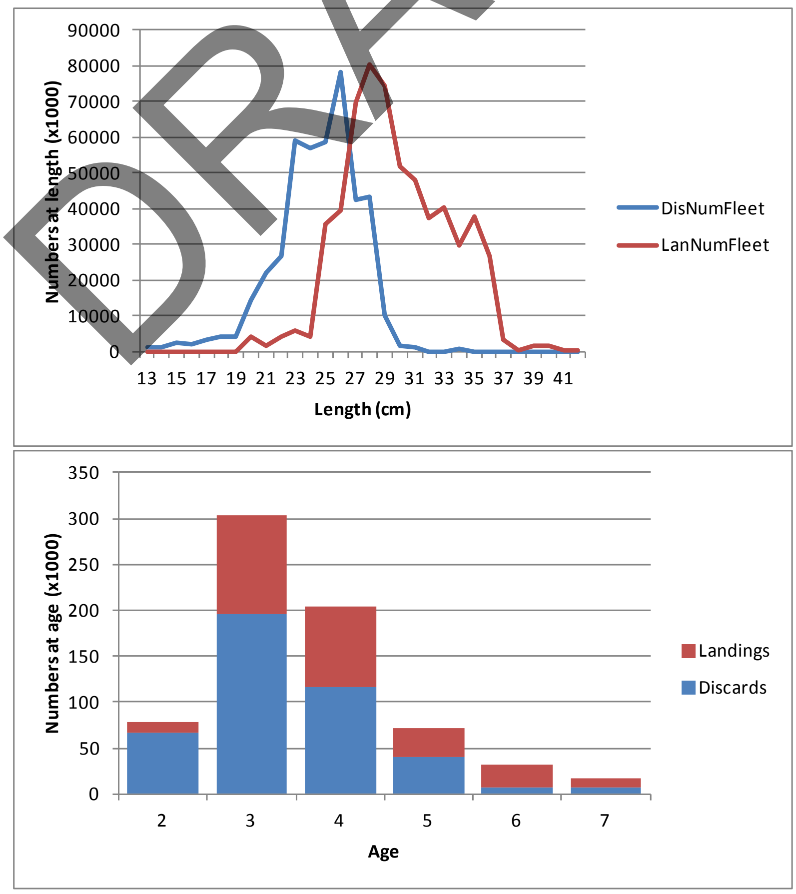


Figure 7.11.4. Irish OTB discards in 7j during 2012. Numbers raised to fleet level using fishing effort (hours fished).

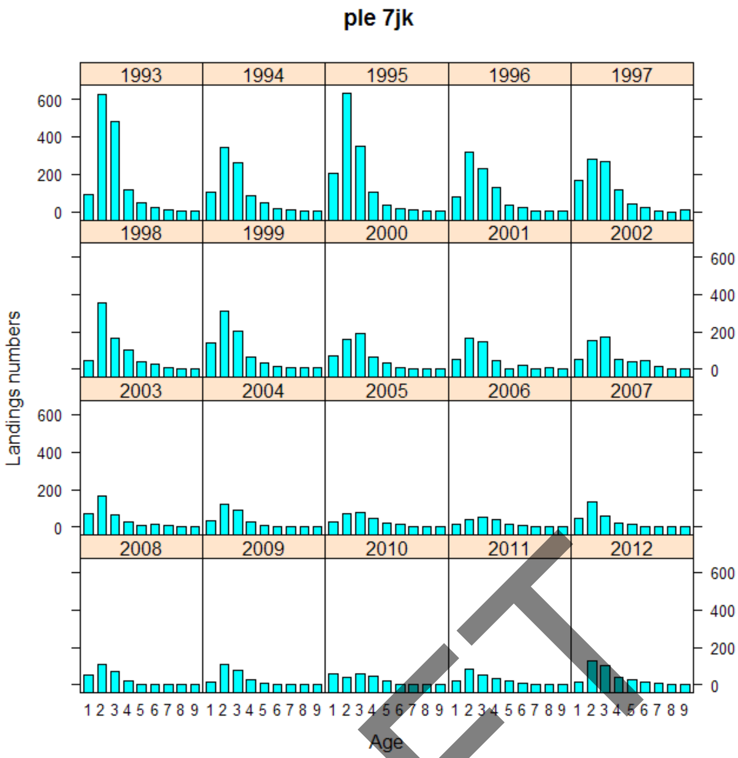


Figure 7.11.5. Age distribution of plaice in VIIjk between 1993 and 2011. All gears and quarters combined. The age data for 1995 were considered insufficient and for this year the combined age data for 1993–1996 were used.

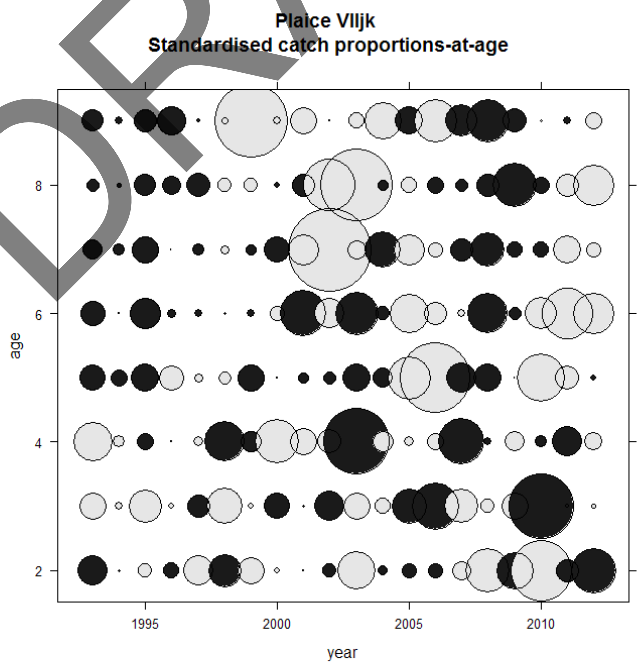


Figure 7.11.6. Standardised catch proportions-at-age for plaice in VIIjk. Grey bubbles represent higher than average catch-at-age and black bubbles represent lower than average catch-at-age.

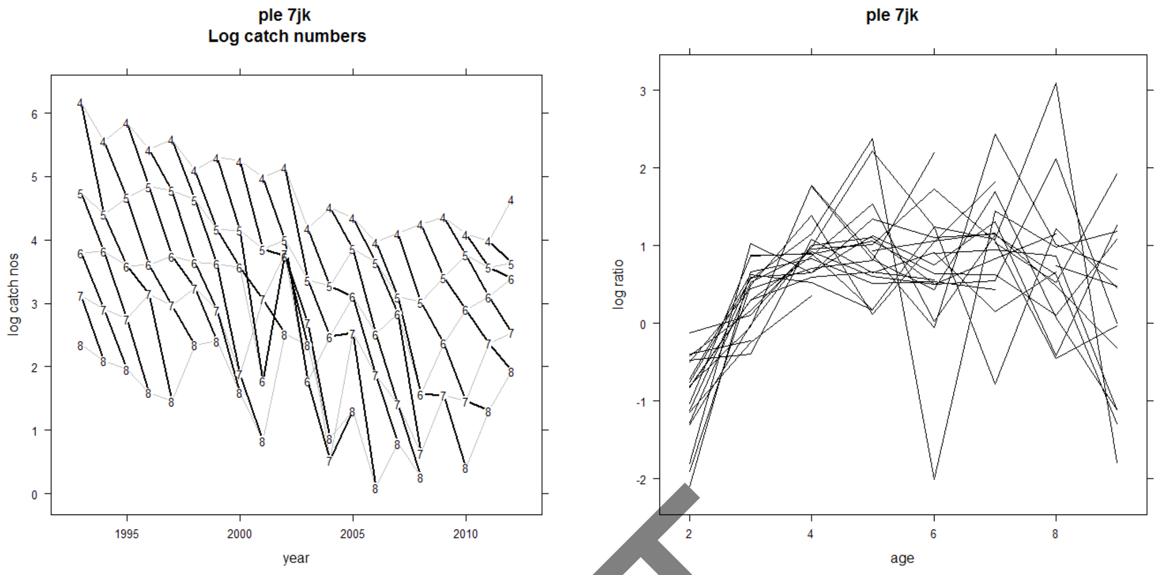


Figure 7.11.7. Catch curves (ages 4–8) and log catch ratios of plaice in 7jk.

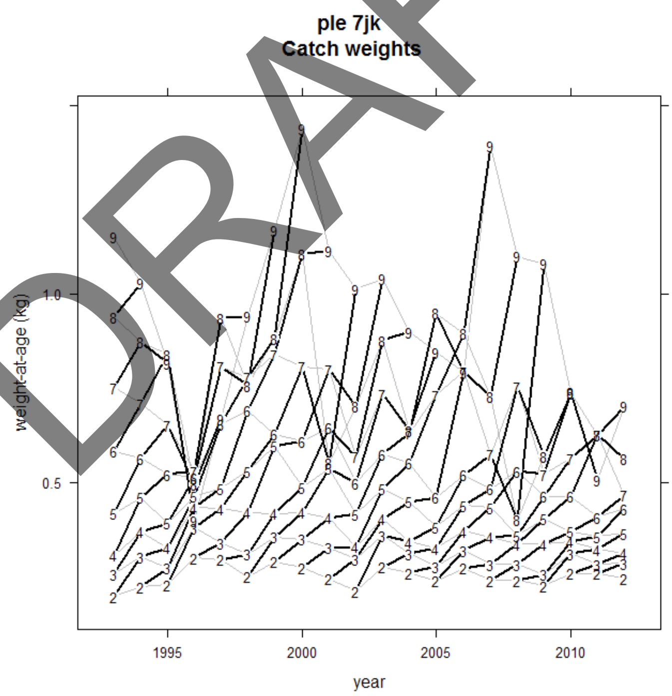


Figure 7.11.8. Catch weights (= stock weights) of ple7jk.

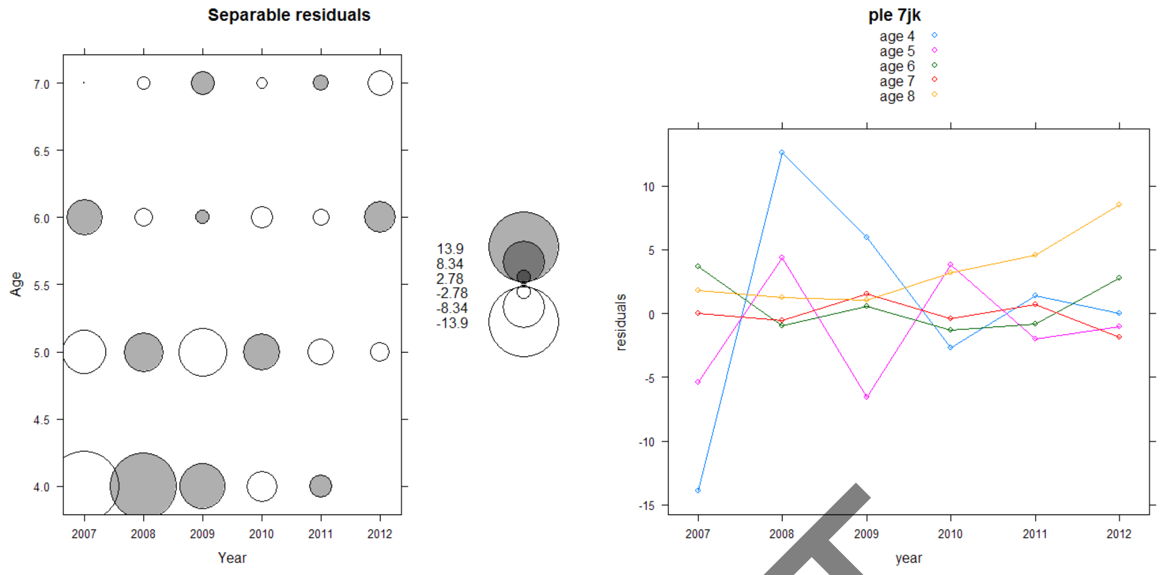


Figure 7.11.9. Catch residuals of the final separable model.

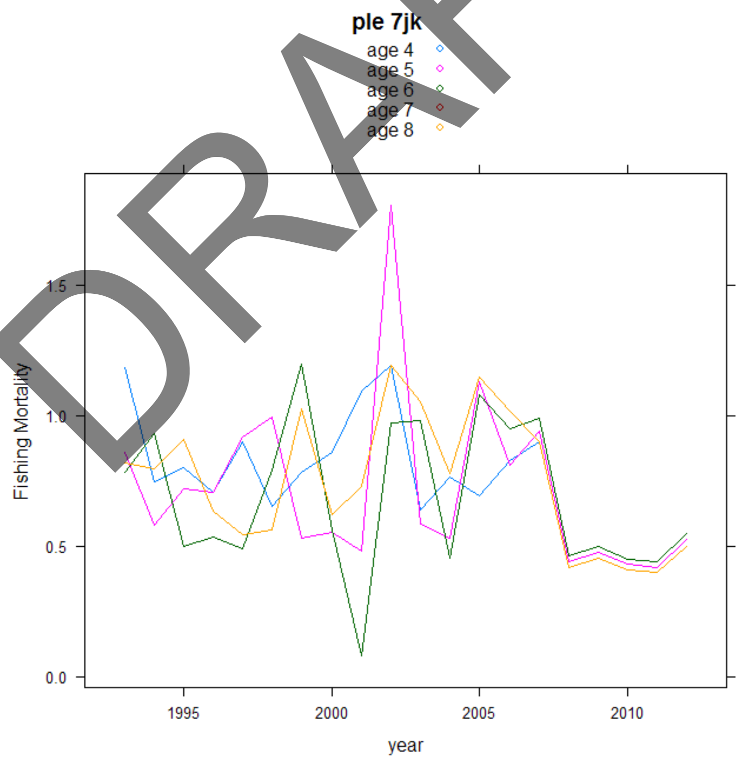


Figure 7.11.10. F at age for the separable model.

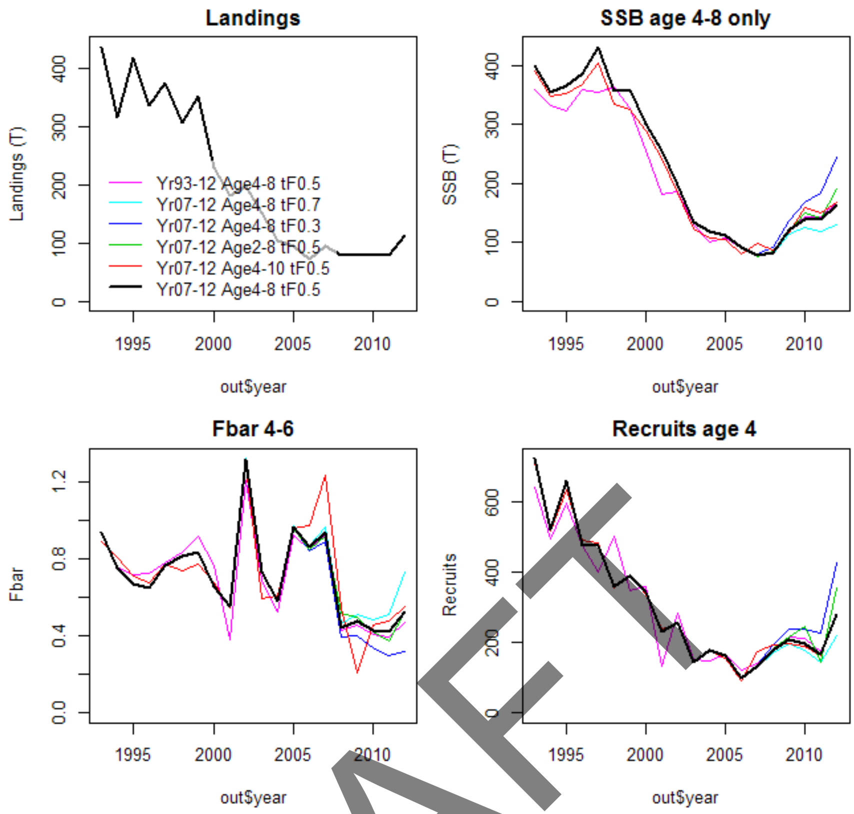


Figure 7.11.11. Summary plot of the final separable model (black lines) and sensitivity analysis of the model. The parameters that were varied were the year range for the separable model (Yr; full time-series or last six years only); the age range (Age; 4–8, 2–8 or 4–10) and the terminal F (tF; 0.3, 0.5 or 0.7).

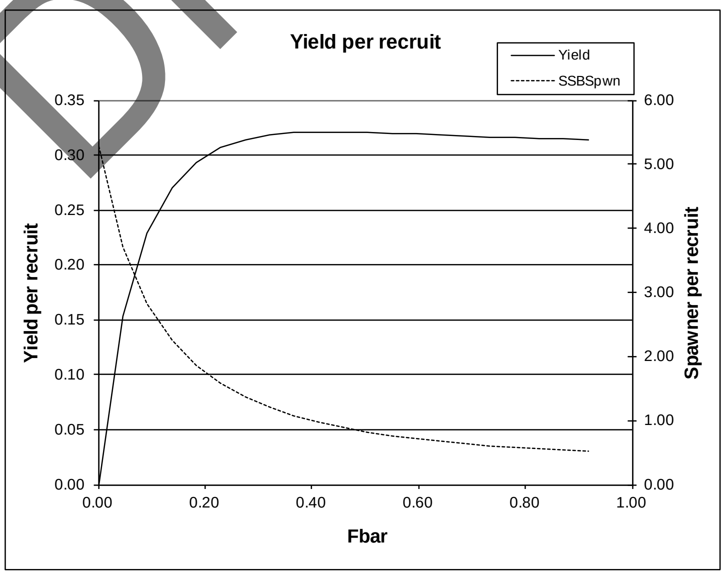


Figure 7.11.12. PleVIIjk Yield-Per-Recruit analysis. F_{MAX} is estimated to be 0.43 and $F_{0.1}$ 0.16 and $F_{35\%SPR}$ is 0.18.

7.12 Sole in West of Ireland Division VIIb, c

Type of assessment in 2013

No assessment was performed.

7.12.1 General

Stock Identity

Sole in VIIb are mainly caught by Irish vessels on sandy grounds in coastal areas. Sole catches in VIIc are negligible. In VIIb there are two distinct areas where sole are caught: an area to the west of the Aran Islands and an area in the north of VIIb which extends into VIa (the Stags and Broadhaven Ground). The landings and lpue of sole in VIIbc appear to have been more or less stable since the start of the logbooks time-series in 1995 (WD1, WGCSE 2009; Figure 7.12.2.). It is not known how much exchange there is between sole on the Aran Grounds and those on the Stags Ground.

7.12.2 Data

The nominal landings are given in Table 7.12.1. The time-series of official landings is presented in Figure 7.12.1.

The time-series of otter trawl landings effort and lpue since 1995 are shown in Figure 7.12.2. Lpue has remained stable over the time-series.

7.12.3 Historical stock development

No analytical assessment was performed but following recommendations from WGLIFE a Depletion-Corrected Average Catch (DCAC; MacCall, 2009) analysis was performed. Because the value of the depletion delta parameter is unknown, a range of values were used (10%, 50% and 90%; delta is the difference in biomass in the first year and biomass in the last year as a proportion of the virgin biomass (unfished vulnerable abundance). Also, because average catch is analysed, the year-range chosen can have a large influence on the results. Two year ranges were tested: 1950–present (the time period after WWII when the stock was heavily exploited) and 1995–present (the time period when the landings showed a declining trend). All other settings are based on default values and recommendations from MacCall (2009). Table 7.9.2 shows the input and output values. The year range has a major influence on the estimated depletion-corrected average catch.

The most conservative estimate of DCAC for the long time-series (35 tonnes) is similar to recent landings.

The limited information available (lpue and DCAC indicate that this stock may be harvested sustainably).

7.12.4 Reference

MacCall, AD. 2009. Depletion-corrected average catch: a simple formula for estimating sustainable yields in data-poor situations. ICES J Mar Sci 66:10 p. 2267–2271.

Table 7.12.1. Landings of Sole in VIIbc as officially reported to ICES.

YEAR	BEL	FRA	UK	IRL	OTH	TOT	YEAR	BEL	FRA	UK	IRL	OTH	TOT	UNALLOC	WG EST
1908	0	0	1	37	0	38	1961	0	110	1	12	0	123		
1909	0	0	0	32	0	32	1962	0	100	0	8	0	108		
1910	0	0	0	28	0	28	1963	0	172	0	19	0	191		
1911	0	0	1	22	0	23	1964	0	159	1	24	0	184		
1912	0	0	1	22	0	23	1965	0	95	5	24	0	124		
1913	0	0	1	25	0	26	1966	0	0	1	11	0	12		
1914	0	0	1	43	0	44	1967	0	78	0	11	0	89		
1915	0	0	1	12	0	13	1968	0	121	0	8	0	129		
1916	0	0	0	14	0	14	1969	0	86	1	9	0	96		
1917	0	0	0	6	0	6	1970	0	3	0	8	0	11		
1918	0	0	0	7	0	7	1971	0	0	2	5	0	7		
1919	0	0	0	6	0	6	1972	0	4	0	13	0	17		
1920	0	0	9	5	0	14	1973	0	0	0	12	0	12		
1921	0	0	10	9	0	19	1974	0	25	0	12	0	37		
1922	0	0	4	9	0	13	1975	0	7	0	19	0	26		
1923	0	0	2	10	0	12	1976	0	6	0	44	0	50		
1924	0	0	15	64	0	79	1977	0	3	0	14	0	17		
1925	0	0	11	18	0	29	1978	0	3	0	16	0	19		
1926	0	7	10	18	0	35	1979	0	6	0	13	0	19		
1927	0	47	11	19	0	77	1980	0	9	0	24	0	33		
1928	0	49	8	16	0	73	1981	0	6	0	47	0	53		
1929	0	74	11	18	0	103	1982	0	5	1	55	0	61		
1930	0	52	5	22	0	79	1983	0	9	0	40	0	49		
1931	0	82	9	29	0	120	1984	0	3	0	17	0	20		
1932	0	122	10	27	0	159	1985	0	6	0	44	0	50		
1933	0	411	10	10	0	431	1986	0	8	0	29	0	37		
1934	0	217	10	13	0	240	1987	0	2	0	39	0	41		
1935	0	40	7	11	0	58	1988	0	2	1	34	0	37		
1936	0	43	20	9	0	72	1989	0	0	0	38	0	38		
1937	0	32	25	14	0	71	1990	0	0	0	41	0	41		
1938	0	44	21	7	0	72	1991	0	5	0	46	0	51		
1939	0	0	0	13	0	13	1992	0	2	0	43	0	45		
1940	0	0	0	19	0	19	1993	0	1	0	59	0	60	0	60
1941	0	0	0	14	0	14	1994	0	1	0	60	0	61	9	70
1942	0	0	0	8	0	8	1995	0	2	0	59	0	61	-2	59
1943	0	0	0	11	0	11	1996	0	2	0	52	0	54	3	57
1944	0	0	0	16	0	16	1997	0	3	1	51	0	55	0	55
1945	0	0	0	20	0	20	1998	0	0	0	49	0	49	17	66
1946	0	0	12	10	0	22	1999	0	0	0	68	0	68	4	72
1947	15	0	6	8	0	29	2000	0	12	0	65	0	77	-9	68
1948	0	0	11	14	0	25	2001	0	7	0	53	0	60	0	60
1949	0	41	12	12	0	65	2002	0	14	0	50	0	64	-3	61

Year	BEL	FRA	UK	IRL	OTH	TOT	Year	BEL	FRA	UK	IRL	OTH	TOT	Unalloc	WG est
1950	0	24	9	6	0	39	2003	0	19	0	50	0	69	-5	64
1951	0	27	7	6	0	40	2004	0	18	0	49	0	67	2	69
1952	0	40	2	6	0	48	2005	0	7	0	38	0	45	-1	44
1953	0	99	2	4	0	105	2006	0	12	0	31	0	43	0	43
1954	0	116	1	7	0	124	2007	0	7	0	34	0	41	1	42
1955	0	66	1	9	0	76	2008	0	6	0	31	0	37	3	40
1956	0	161	1	6	0	168	2009	0	5	0	46	0	51	0	51
1957	0	94	1	4	0	99	2010	0	8	0	35	0	43	0	43
1958	0	163	2	6	0	171	2011	0	4	0	22	0	26	-5	22
1959	0	327	1	8	0	336	2012	0	7	0	38	0	45		
1960	0	80	1	9	0	90									

Table 7.9.2. Settings and results from DCAC.

Year range	sumCatch (landings)	CV	Nyears	M	StDev	Fmsy/M	StDev[1]	Bmsy/B0	StDev[2]	Delta	StDev[2]	Avg Catch	Avg DCAC
1950–2012	4199	0.2	63	0.1	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.1	0.1 (bounded 1–0)	66.7	60.3
1950–2012	4199	0.2	63	0.1	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.5	0.1 (bounded 1–0)	66.7	43.7
1950–2012	4199	0.2	63	0.1	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.9	0.1 (bounded 1–0)	66.7	35.1
1995–2012	955	0.2	18	0.1	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.1	0.1 (bounded 1–0)	53.1	40.8
1995–2012	955	0.2	18	0.1	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.5	0.1 (bounded 1–0)	53.1	20.3
1995–2012	955	0.2	18	0.1	0.5	0.8	0.2 (lognormal)	0.25	0.1 (bounded 1–0)	0.9	0.1 (bounded 1–0)	53.1	14.0

[1] Assuming lognormal distribution.

[2] Assuming bounded (1-0) beta distribution.

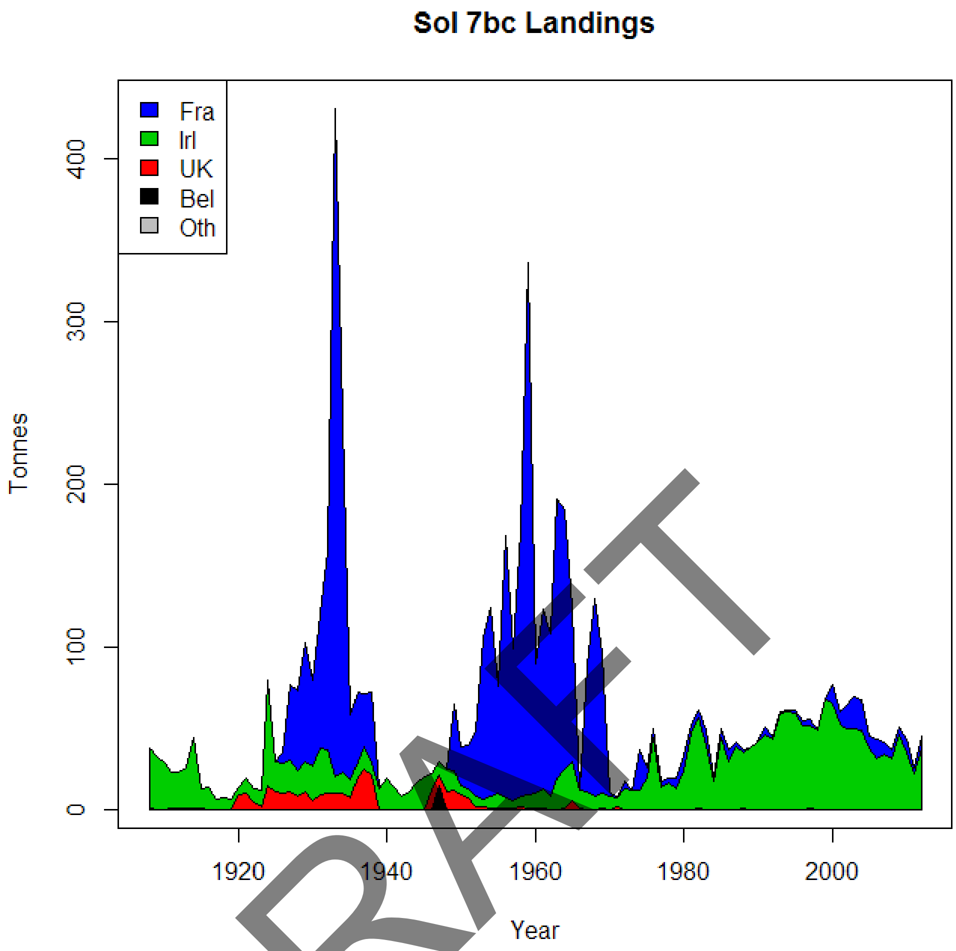


Figure 7.12.1. Landings of Sole in VIIbc as officially reported to ICES.

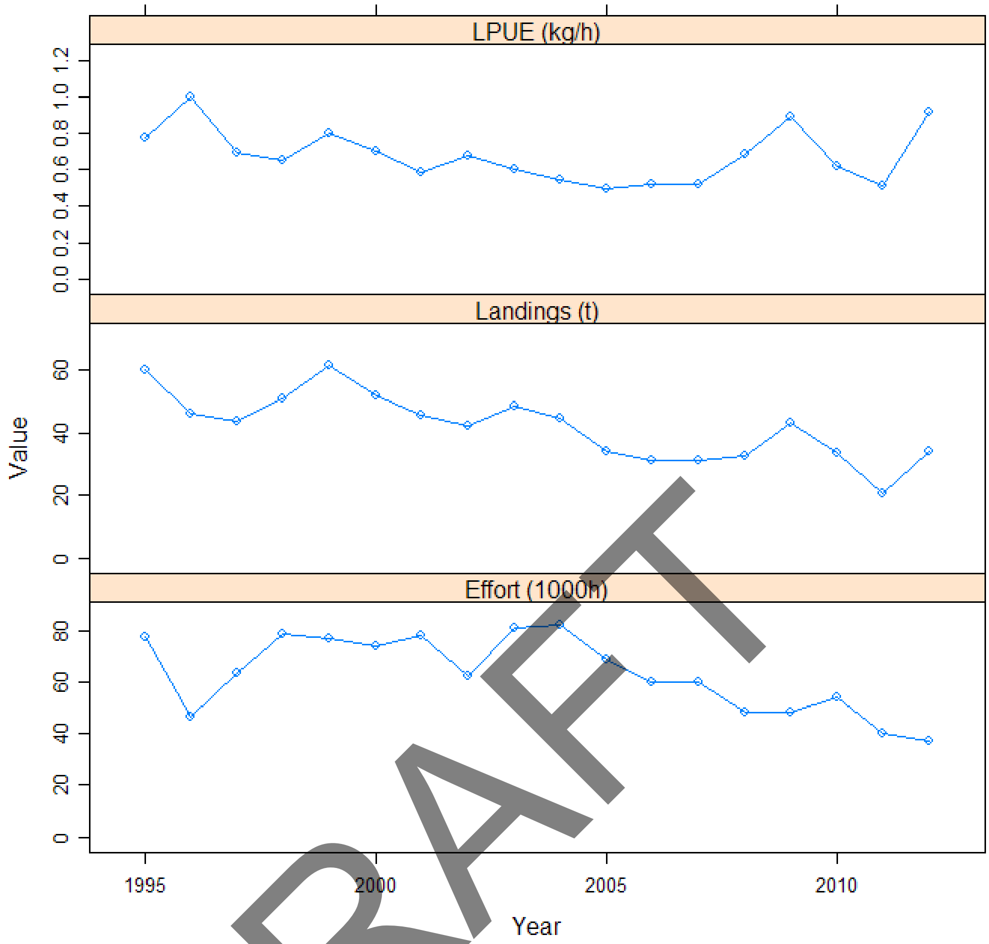


Figure 7.12.2. Sole in VIIbc Irish otter trawl landings effort and lpue since 1995.

7.13 Sole in Divisions VIIfg

Type of assessment in 2013: Update

ICES advice applicable to 2012

In the advice for 2012, the stock status was presented as follows:

F (Fishing Mortality)				
	2008	2009	2010	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{PA},F_{lim})	✓	✓	✓	Harvest sustainably

SSB (Spawning–Stock Biomass)				
	2009	2010	2011	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{PA},B_{lim})	✓	✓	✓	Full reproductive capacity

MSY approach

Following the ICES MSY framework implies fishing mortality to be 0.31, resulting in landings of 1060 t in 2012. This is expected to lead to an SSB of 3600 t in 2013.

PA approach

The fishing mortality in 2012 should be no more than F_{PA} corresponding to landings of less than 1230 t in 2012. This is expected to keep SSB above B_{PA} in 2013.

ICES advice applicable to 2013

In the advice for 2013, the stock status was presented as follows:

F (Fishing Mortality)				
	2009	2010	2011	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{PA},F_{lim})	✓	✓	✓	Harvest sustainably

SSB (Spawning–Stock Biomass)				
	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{PA},B_{lim})	✓	✓	✓	Full reproductive capacity

MSY approach

Following the ICES MSY framework implies fishing mortality to be 0.31, resulting in landings of 1100 t in 2013. This is expected to lead to an SSB of 4000 t in 2014.

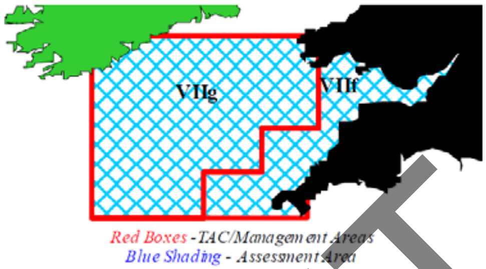
Precautionary approach

The fishing mortality in 2013 should be no more than F_{PA} corresponding to landings of less than 1300 t in 2013. This is expected to keep SSB above B_{PA} in 2014.

Technical comments made by the Review Group (RGCS)

Apart from some typo errors in last year's report,, there were no comments from the Review group.

Stock description and management units



A TAC is in place for ICES Divisions VIIfg. These divisions do correspond to the stock area. The basis for the stock assessment Area VIIfg is described in detail in the stock annex.

Management applicable to 2011 and 2012

Management of sole in VIIfg is by TAC and technical measures. The agreed TACs in 2011 and 2012 are presented in the text tables below. Technical measures in force for this stock are minimum mesh sizes and minimum landing size (24 cm). National regulations also restricted areas for certain types of vessels.

2012 TAC

Species: Common sole *Solea solea*		Zone: VIIf and VIIg (SOL/7FG.)
Belgium	663	
France	66	
Ireland	33	
United Kingdom	298	
Union	1 060	
TAC	1 060	Analytical TAC

2013 TAC

Species: Common sole *Solea solea*		Zone: VIIf and VIIg (SOL/7FG.)
Belgium	688	
France	69	
Ireland	34	
United Kingdom	309	
Union	1 100	
TAC	1 100	Analytical TAC

Three rectangles in the Celtic Sea (30E4, 31E4 and 32E3) were closed during the first quarter of 2005, and in February–March each year from 2006 until 2012. A derogation has permitted beam trawlers to fish there in March 2005. The effects of this closure have been discussed in WGSSDS and ACFM 2007. No new information was available at the time of the update working group.

Fishery in 2012

The Working Group estimated the total international landings at 1096 t in 2012 (Table 7.13.1), which is 3% above the 2012 TAC (1060 t) and 9% higher than last year's forecast of 1010 t.

Early in the time-series officially reported landings included Divisions VIIg–k for some countries and their total was higher than the WG estimate. Since 1999 official landings correspond to Divisions VIIfg, and the total is lower than the working group estimate. During the period 2002–2004 the difference between the two estimates was substantial. This was mainly due to area misreporting, which was taken into account in the working group estimates.

7.13.1 Data

Landings

There were no revisions to the 2011 landings data provided last year by Belgian, France, Ireland and UK.

Annual length compositions for 2011 are given by fleet in Table 7.13.2. Length distributions of the total Belgian and UK(E&W) landings for the last fourteen years are plotted in Figure 7.13.1. Belgian land a greater proportion of small fish compared to the UK(England & Wales).

Belgium, France, Ireland and UK have provided data this year under the ICES InterCatch format on a métier basis. Quarterly data for 2012 were available for landing numbers and weight-at-age, for most of the Belgian, Irish and UK fleets. These comprise 90% of the international landings. Allocation has been made as follows: two groups of métiers with age distributions were set up, e.g. All-OTB métiers and a group of all available métiers with age distributions (Overall). The OTB métiers without age distributions (5% of overall landings) were allocated with the group All-OTB and the rest of the métiers without age distributions (also 5% of overall landings) were allocated to the group Overall.

Catch weights-at-age were calculated, weighted by national catch numbers-at-age, and then quadratically smoothed in year (using age = 1.5, 2.5, etc.) and SOP-corrected. For 2012, the quadratic fit used was:

$$W(t) = 0.0832 + (0.0334*(AGE)) - (0.0003*(AGE)^2) \qquad R2 = 0.97$$

Further details on raising procedures are given in the stock annex.

Stock weights-at-age were the first quarter catch weights smoothed by fitting a quadratic fit:

$$W(t) = 0.0379 + (0.0495*(AGE)) - (0.0006*(AGE)^2) \qquad R2 = 0.92$$

Catch numbers-at-age are given in Table 7.13.3, and weights-at-age in the catch and the stock are given in Tables 7.13.4–7.13.5. Age compositions over the last 14 years are plotted in Figure 7.13.2. The standardised catch proportion-at-age is presented in Figure 7.13.3.

Sampling levels for those countries providing age compositions are given in Table 2.1.

Discards

The available discard data indicate that discarding of sole is usually minor. In 2007, 2008, 2009, 2010, 2011 and 2012, discarding of sole in the UK fleet was estimated at about 3%, 1%, 6%, 9%, 9% and 6% respectively in numbers. Discard rates of sole in the Belgian beam trawl fleet were available to the working group for 2004–2005 and 2008–2012 accounting for about 2%–5% of the total sole catches in weight. The length distributions of retained and discarded catches of sole from the Belgium beam-trawl fleet in Area VIIf and VIIg separately for 2012 are presented in Figures 7.13.4a. The UK length distributions for 2012 from samples of UK gear except beam trawls and beam trawls are given in Figure 7.13.4b. The Irish length distributions from the otter-trawl fleet for 2012 are shown in Figure 7.13.4c. It should be noted that the Irish otter-trawl landings only amount to less than 1% of the total international landings.

Biological

Natural mortality was assumed to be 0.1 for all ages and years. The maturity ogive is based on samples taken during the UK(E&W) beam-trawl survey of March 1993 and 1994 and is applied to all years of the assessment.

The proportion of M and F before spawning was set to zero.

Surveys

Standardised abundance indices for the UK beam-trawl survey (UK(E&W)-BTS-Q3)) are shown in Table 7.13.6 and Figure 7.13.5. Abundance-at-age 0 is highly variable and not used further on. The UK-survey appears to track the stronger year classes reasonably well from most of the ages. The internal consistency plot indicates also a reasonable fit for most of the age range (Figure 7.13.6).

Commercial lpue

Available estimates of effort and lpue are presented in Tables 7.13.7–7.13.8 and Figure 7.13.7.

Belgian beam-trawl (BE-CTB) effort was at highest levels in 2003–2005. During these years effort shifted from the Eastern English Channel (VIId) to the Celtic Sea because of days at sea limitations in the former area. In 2006, these restrictions had been lifted and effort decreased substantially to about half of the values observed in the early 2000s. The sharp effort reduction in 2008 may be a combined result of the unrestricted effort regime in VIId and the high fuel prices. The increase in the last two years is due to the good opportunities of sole catches in the Celtic sea taken by the mobile Belgian fleet. Lpue peaked in 2002. After a sharp decline to its record low in 2004, lpue has been increasing gradually. The 2012 value show an 18% drop from the second highest estimate of the time-series.

The effort from the UK(E&W) beam trawl fleet (UK(E&W)-CBT) has declined sharply since the early 2000s to a record low in 2009 and stayed at that level since. Lpue in the 1990s and 2000s was stable, but at lower levels compared to the period before. In 2007, lpue increased considerably and gave a similar value for 2008. In 2009, there was a decrease to a level just above the mean of the time-series, followed by similar values for 2010, 2011 and 2012.

Irish effort and lpue data are also presented. The main target species in the Irish fisheries are megrim, anglerfish, etc. The vessels usually operate on fishing grounds in the western Celtic Sea with lower sole densities.

The internal consistency plots for the main two commercial lpue series, used in the assessment (UK(E&W)-CBT and BEL-CBT), show high consistencies for the entire age range (Figure 7.13.8–7.13.9).

Other relevant data

Reports from UK industry suggest that the main issues affecting the fishery in VIIfg were displacement of effort due to the rectangle closures and the restrictions on the use of 80 mm mesh west of 7°W (Trebilcock and Rozarieux, 2009).

No additional information was received from the Belgian, French and Irish industries.

7.13.2 Stock assessment

The method used to assess Celtic Sea sole is XSA, using one survey and two commercial tuning-series (Table 7.13.9). It should be noted that the year range of the Belgian commercial beam-trawl tuning fleet only covers 1971 up to 2003 (see also Section 7.13.8 recommendation for next benchmark). Table 7.13.9 also includes tuning indices of the Irish ground fish survey (IGFS-IBTS_Q4) and the commercial UK otter-trawl fleet (UK(E&W)-COT) which are not used in this assessment.

Data screening

Adding the 2012 data to the time-series did not cause any additional anomalies compared to previous years. The "single fleet runs", "separable VPA", etc. are not presented in this report, but are available in the 'Exploratory runs folder'. This folder also contains a comparison plot of SSB, R and F of last year's final assessment and this year's assessment. The trends were very similar for both assessments.

The catchability residuals for the final XSA are shown in Figure 7.13.10 and the XSA tuning diagnostics are given in Table 7.13.10. There may be some indications of a decreasing trend in the UK beam-trawl fleet (UK-CBT) with predominantly positive residuals since 2007. The UK beam-trawl survey (UK(E&W)-BTS-Q3) show a similar trend over the same time-series with predominantly negative residuals, indicating a possible conflicting signal between these two fleets (see also Section 7.13.9. recommendation for next benchmark). It should be noted however that the positive residuals appear mostly in the older ages. Single fleet runs (ICES files) show no apparent trends in catchability residuals for the survey but may indicate a trend in the UK beam-trawl fleet since 2007. A comparison of estimates of fishing morality and SSB for the single tuning fleets and the final XSA indicate a lower F for the commercial fleet and a higher F for the survey. The SSB estimates from the commercial fleet are higher than the final XSA, but the survey gives almost identical values for the last five years. The working group was not able to explain the reason for these discrepancies and proposed that this will be investigated further in the future (e.g. benchmark in 2014). It should however be noted that this has been mentioned by previously working groups and review groups, but due to restrictions of financial and human resources, this has not been addressed yet.

In this year's assessment the estimates for the recruiting year class 2011 were estimated solely by the UK beam-trawl survey UK(E&W)-BTS-Q3) (Figure 7.13.11). The survivor estimates of the two prominent fleets (the UK(E&W)-BTS-Q3 survey and the UK(E&W)-CBT commercial fleet) which have at least 96% of the weighting for all the ages, differ remarkably from each other for ages 3, 6 and 7. However, it should be noted that the UK beam-trawl survey is rather consistent in the predicted year-class strengths at different ages (see detailed diagnostics in ICES files), where the UK commercial beam-trawl fleet has a higher variability in estimates of year-class strength at different ages. The working group was not able to clarify that particular issue. The different estimates from the two fleets do only generate a small retrospective bias and therefore probably balance off each other in the assessment. The working group also assumed that the Trevose closure, a change in special distribution of the UK beam-trawl fleet and the ending of the Belgian tuning-series in 2003, may have an influence on the divergence in survivor estimates from both dominant tuning fleets.

The working group notes however, from the detailed diagnostics (ICES files) that the estimated survivors of the 2006 year class at age 6 in 2012 by the UK(E&W)-BTS-Q3 survey differ substantially from the estimates for the same year class at other ages (around four times lower in 2012). The working group concluded that the resulting F for that age in 2012 may be estimated too high and therefore also F(4–8) in 2012.

F shrinkage gets low weights for all ages (<4%). The weighting of the survey decreases for the older ages as the commercial UK(E&W)-CBT fleet is given more weight (Figure 7.13.11).

Final update assessment

The final settings used in this year's assessment (and since 2006) are as detailed below:

	2013 assessment		
Fleets	Years	Ages	α–β
BEL-CBT commercial	1971–2003	2–9	0–1
UK-CBT commercial	1991–2012	2–9	0–1
UK(E&W)-BTS-Q3 survey	1988–2012	1–9	0.75–0.85
-First data year	1971		
-Last data year	2012		
-First age -Last age	1 10+		
Time-series weights	None		
-Model	Mean q model all ages		
-Q plateau set at age	7		
-Survivors estimates shrunk towards mean F	5 years / 5 ages		
-s.e. of the means	1.5		
-Min s.e. for pop. Estimates	0.3		
-Prior weighting	None		
Fbar (4–8)			

Retrospective patterns for the final run are shown in Figure 7.13.12. There is a tendency in the last three years to underestimated fishing mortality and overestimated SSB.

The final XSA output is given in Table 7.13.11 (fishing mortalities) and Table 7.13.12 (stock numbers). A summary of the XSA results is given in Table 7.13.13 and trends in yield, fishing mortality, recruitment and spawning stock biomass are shown in Figure 7.13.13.

Comparison with previous assessment

With the addition of the 2012 data, estimates of fishing mortality and SSB for the most recent years were revised slightly. For example, last year fishing mortality and SSB in 2011 were estimated to be 0.24 and 3898 t. In this year's assessment, the 2011 estimates have been revised upwards by 10% (fishing mortality) and downwards by 3% (SSB). The estimated recruitment by XSA in 2011 (year class 2010) was revised downward by 41% in this year's assessment.

State of the stock

Trends in landings, SSB, F(4–8) and recruitment are presented Table 7.13.13 and Figure 7.13.13.

During the eighties fishing mortality increased for this stock. In the following decades fishing mortality fluctuated around this higher level. However fishing mortality has decreased since the late 1990s and is estimated to be below F_{MSY} (0.31) from 2005 until 2011. Fishing mortality in 2012 is estimated to be 0.45 but that value may be a too high estimate (see Section 7.13.2).

Recruitment has fluctuated around 5 million recruits with occasional strong year classes. The 1998 year class is estimated to be the strongest in the time-series and the 2007 year class to be the second highest for this stock. The 2009 year class is by far the lowest in the time-series. The incoming recruitment (year class 2011) is estimated to be above average.

SSB has declined almost continuously from the highest value of 8000 t in 1971 to the lowest observed in the time-series in 1998. The exceptional year class of 1998 has increased SSB to above the long-term average. The good recruitment in 2008 and above average recruitment in 2009 and 2012 is predicted to keep SSB well above B_{PA}/$B_{trigger}$.

7.13.3 Short-term projections

The 2010 year class in 2011 was estimated to be below average at around 4.1 million fish at age 1. The XSA survivor estimate for this year class was used for further prediction.

The 2011 year class in 2012 was estimated by XSA to be above average with 7.3 million one year olds. The estimates solely coming from the UK(E&W)-BTS-Q3 survey. The XSA survivor estimates for this year class were used for further prediction.

The long-term $GM_{71\text{-}10}$ recruitment (4.8 million) was assumed for the 2012 and subsequent year classes.

The working group estimates of year-class strength used for prediction can be summarised as follows:

Year class	At age in 2013	XSA	GM	Source
2010	3	3230		XSA
2011	2	6640		XSA
2012	1	-	4848	GM 1971–2010
2013 & 2014	recruits	-	4848	GM 1971–2010

Population numbers at the start of 2013, estimated for ages 2 and older, were taken from the XSA output.

Fishing mortality was set as the mean over the last three years. F in 2012 is probably an over estimation (see Section 7.13.2). Weights-at-age in the catch and in the stock are averages for the years 2009–2012. Input to the short-term predictions and the sensitivity analysis are shown in Table 7.13.14. Results are presented in Table 7.13.15 (management options) and Table 7.13.16 (detailed output).

Assuming *status quo* F, implies a catch in 2013 of 986 t (the agreed TAC is 1100 t) and a catch of 1004 t in 2014. Assuming *status quo* F will result in a SSB of 3285 t in 2014 and 3382 t in 2015.

Assuming *status quo* F, the proportional contributions of recent year classes to the predicted landings and SSB are given in Table 7.13.17. The assumed GM recruitment accounts for about 4% of the landings in 2014 and about 13% of the 2015 SSB.

Results of a sensitivity analysis are presented in Figure 7.13.14 (probability profiles). The approximate 90% confidence intervals of the expected *status quo* yield in 2014 are 700 t and 1400 t. There is less than 5% probability that at current fishing mortality SSB will fall below the B_{pa} $B_{trigger}$ of 2200 t in 2015.

There are no known specific environmental drivers known for this stock.

7.13.4 MSY explorations

Yield-per-recruit results, long-term yield and SSB, conditional on the present exploitation pattern and assuming *status quo* F in 2013, are given in Table 7.13.18 and Figure 7.13.15. F_{MAX} is estimated to be 0.39. It should be noted that F_{MAX} is poorly defined. Long-term yield and SSB (using GM recruitment and F_{sq}) are estimated to be 925 t and 3100 t respectively.

Investigations for possible F_{MSY} candidates for this stock were done in 2010 WGCSE. ACOM adopted an F_{MSY} value of 0.31, based on stochastic simulations using a "Ricker" model (PLOTMSY program). $B_{trigger}$ was set to the B_{PA} value of 2200 t.

7.13.5 Biological reference points

The working group's current approach to reference points is outlined in Section 1.4.4. Current biological reference points are given in the text table below:

Reference points	ACFM 98 onwards
F_{MSY}	0.31 (stochastic simulations using Ricker,WG2010)
F_{lim}	0.52 (based on F_{loss}, WG1998)
F_{PA}	0.37 (F_{lim} x 0.72)
B_{lim}	Not defined
B_{PA}	2200 t (based on B_{loss} (1991), WG1998)
$B_{trigger}$	B_{PA}

7.13.6 Management plans

There are no explicit management plans for Celtic Sea sole.

In 2006, the working group presented results from a series of medium-term scenarios, carried out in conjunction with VIIfg plaice, to simulate some possible management plans for the two stocks Results indicated that an F in the range 0.27 to 0.49 in the long-term would maintain yield at or above 95% of that given by F_{MAX}, whilst posing a low probability (<5%) of SSB falling below B_{lim}. Three year average exploitation patterns were calculated and are given in Figure 7.13.16. The results suggest that the results of the analysis carried out in 2006 can probably still be used. The results of the F_{MSY} analysis, carried out during the 2010 Working group also confirm that a fishing mortality of 0.31 could be a candidate for a long-term management objective for sole in VIIfg, although other species caught in the fishery should also be considered.

7.13.7 Uncertainties and bias in assessment and forecast

Sampling

The major fleets fishing for VIIfg sole are sampled (approximately 95% of the total landings). Sampling is considered to be at a reasonable level (Table 2.1). However the assessment is likely to improve if a combined ALK is used to obtain the age composition (see Section 7.13.8).

Discards

Discard estimates, which are low (Figure 7.13.4a–c) are not included in the assessment.

Surveys

The UK(E&W)-BTS-Q3 survey, which is solely responsible for the recruiting estimates, has been able to track year-class strength at ages greater than 0 rather well in the past. However, the strong year classes have been revised downward in previous assessments and therefore estimates of very strong year classes may cause bias in the forecast. This year's assessment estimates the incoming recruitment (year class 2011) above average in the time-series and therefore there may be a slight concern regarding an overly optimistic forecast.

Consistency

The assessment provided by the WG is highly consistent with last year's assessment with similar trends in fishing mortality, SSB and recruitment. There is only a slight retrospective pattern in the last few years, indicating that there is no major concern about the uncertainty in the assessment and the forecast.

Misreporting

Area misreporting is known to have been considerable over the period 2002–2004. This was due to a combination of the good 1998 year class still being an important part of the catch composition and more restrictive TACs. The area misreporting has been corrected for the years 2002–2006 (method explained in the report of WGSSDS 2007). Since 2007 the area misreporting that could be estimated was negligible.

7.13.8 Recommendation for next benchmark

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting
2013	VIIf,g sole	The use of a combined ALK from Belgium, UK(E&W) and Ireland instead of the use of separate ALK's by county at the moment. A need to update the Belgian commercial tuning-series. The Belgian beam trawl tuning-series is only used up to 2003, mainly because the estimation of the corresponding lpue series could not be calculated correctly. At the 2009 WKFLAT a possible way of calculating Belgian beam trawl lpue for Division VIId was proposed, using a more realistic horsepower correction method. The proposed method could be investigated, not only for the Belgian beam trawl lpue but also for the UK beam trawl lpue in Division VIIfg, which are the two commercial fleets used in this assessment. Investigate the reason for the conflicting signals in the assessment diagnostics between the commercial UK(E&W)-CBT fleet and the UK(E&W)-BTS-Q3 survey (possible differences in spatial distributions, etc.). Investigate if commercial tuning fleets should still be used in future assessments of sole in VIIfg. Investigate the spatial distribution of the major Celtic sea fleets and possible impacts of the Trevose closure. Investigate if the Irish ground fish survey (IGFS-IBTS_Q4) can be incorporated in the assessment. Investigate possible inclusion of ICES subdivision VIIh in the Celtic Sea sole assessment.	2014	Expertise on commercial lpue dataseries correction

7.13.9 Management considerations

There is no apparent stock–recruitment relationship for this stock and no evidence of reduced recruitment at low levels of SSB (Figure 7.13.17).

SSB has declined almost continuously from the highest value of 8000 t in 1971 to the lowest observed in the time-series in 1998. The exceptional year class of 1998 has increased SSB to above the long-term average. The good recruitment in 2008 and above average recruitment in 2009 and 2012 is predicted to keep SSB well above B_{PA}/$B_{trigger}$.

The Celtic Sea is an area without days at sea limitations for demersal fisheries. In this context and given that many demersal vessels are very mobile, changes in effort measures in areas other than the Celtic Sea, can influence the effort regime in the Celtic Sea (cfr. increased effort in Celtic Sea for Belgian beamers during 2004–2005 when days at sea limitations were in place for the Eastern English Channel).

7.13.10 Ecosystem considerations

Sole and plaice are predominantly caught by beam-trawl fisheries. Beam trawling is known to have an impact on the benthic communities, although less so on soft substrates and in areas which have been historically exploited by this fishing method. Benthic drop-out panels have been shown to release around 75% of benthic invertebrates from the catches. Information from the UK industry (Trebilcock and Rozarieux, 2009) suggests that uptake in 2008 was minimal.

7.13.11 References

Trebilcock P. and N. de Rozarieux. 2009. National Federation Fishermen's Organisation Annual Fisheries Reports. Cornish Fish Producers Organisation / Seafood Cornwall Training Ltd, March 2009.

ICES. 2009. Report of the Benchmark and Data Compilation Workshop for Flatfish (WKFLAT 2009), 6–13 February 2009, Copenhagen, Denmark. ICES CM 2009/ACOM:31. 192 pp.

Table 7.13.1 - Celtic Sea Sole (ICES Divisions VIIfg). Official Nominal landings and data used by the Working Group (t)

Year	Belgium	Denmark	France	Ireland	UK(E.&W,NI.)	UK(Scotland)	Netherlands	Total-Official	Unallocated	Used by WG	TAC
1986	1039 *	2	146	188	611	-	3	1989	-389	1600	
1987	701 *	-	117	9	437	-	-	1264	-42	1222	1600
1988	705 *	-	110	72	317	-	-	1204	-58	1146	1100
1989	684 *	-	87	18	203	-	-	992	0	992	1000
1990	716 *	-	130	40	353	0	-	1239	-50	1189	1200
1991	982 *	-	80	32	402	0	-	1496	-389	1107	1200
1992	543 *	-	141	45	325	6	-	1060	-79	981	1200
1993	575 *	-	108	51	285	11	-	1030	-102	928	1100
1994	619 *	-	90	37	264	8	-	1018	-9	1009	1100
1995	763 *	-	88	20	294	-	-	1165	-8	1157	1100
1996	695 *	-	102	19	265	0	-	1081	-86	995	1000
1997	660 *	-	99	28	251	0	-	1038	-111	927	900
1998	675 *	-	98	42	198	-	-	1013	-138	875	850
1999	604	-	61	51	231	0	-	947	65	1012	960
2000	694	-	74	29	243	-	-	1040	51	1091	1160
2001	720	-	77	35	288	-	-	1120	48	1168	1020
2002	703	-	65	32	318	+	-	1118	227	1345	1070
2003	715	-	124	26	342	+	-	1207	185	1392	1240
2004	735	-	79	33	283	-	-	1130	119	1249	1050
2005	645	-	101	34	217	-	-	997	47	1044	1000
2006	576	-	75	38	232	-	-	921	25	946	950
2007	582	-	85	32	244	-	-	943	2	945	890
2008	466	-	68	28	218	-	-	780	20	800	964
2009	513	-	74	26	194	-	-	807	-2	805	993
2010	620	-	45	27	179	-	-	871	5	876	993
2010	766	-	50	30	168	-	-	1013	16	1029	1241
2012 [1]	827	-	48	33	170	-	-	1078	18	1096	1060

1 Preliminar

* including VIIg-k

Table 7.13.2 - Sole in VIIfg. Annual length distributions by fleet

Length (cm)	UK (England & Wales) Beam trawl	Belgium All gears	Ireland* All gears
17			
18			
19			
20			
21			
22		168	44
23	728	4539	0
24	2793	113984	182
25	8425	260919	607
26	20156	303117	1518
27	28888	363808	2375
28	37459	324300	3919
29	45525	271847	4292
30	46499	267140	6030
31	44583	222756	7098
32	40482	213510	6817
33	37558	152651	6407
34	27887	102384	5546
35	21113	83555	4333
36	16199	55479	3887
37	12703	37154	2759
38	8849	26731	2545
39	8863	17484	1537
40	4460	14458	1057
41	3922	11096	1025
42	3926	6893	1044
43	2845	6557	605
44	2175	3194	1139
45	1785	2354	428
46	548	672	562
47	279	504	266
48	100	672	45
49	43	168	143
50	223	168	164
51	26		24
52	13		
53			
54			
55			
56			
57			
58			
59			
60			
Total	429057	2868262	66398

* Distributions from sample only

Table 7.13.3 - Sole in VIIfg. Catch numbers at age (in thousands)

Run title : CELTIC SEA SOLE - 2013WG
At 6/05/2013 14:47

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1971	1972
AGE		
1	0	0
2	386	541
3	270	902
4	1341	314
5	625	670
6	433	329
7	537	213
8	763	232
9	376	314
+gp	1220	730
0 TOTALNUM	5951	4245
TONSLAND	1861	1278
SOPCOF %	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	364	155	119	312	314	318	328	657	602	342
3	1882	438	287	834	438	741	560	972	675	831
4	748	863	336	560	349	339	747	876	792	309
5	305	411	638	611	271	154	208	584	399	467
6	352	209	304	559	244	159	154	180	377	280
7	119	239	110	261	404	99	197	62	150	207
8	110	97	102	131	120	198	124	96	120	92
9	116	109	67	197	28	71	153	100	94	111
+gp	644	541	372	463	365	174	169	352	380	326
0 TOTALNUM	4640	3062	2335	3928	2533	2253	2640	3879	3589	2965
TONSLAND	1391	1105	919	1350	961	780	954	1314	1212	1128
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	647	672	196	494	318	526	479	277	1458	433
3	1078	846	1473	1296	957	464	1164	994	690	1700
4	729	606	766	1173	797	879	601	1176	658	644
5	284	542	565	526	577	441	621	399	496	409
6	349	184	296	358	273	387	237	452	151	253
7	225	277	100	193	205	127	188	138	156	61
8	192	106	140	87	100	78	82	115	55	59
9	52	47	73	103	61	67	24	50	46	28
+gp	320	274	240	328	179	268	102	129	162	89
0 TOTALNUM	3876	3554	3849	4558	3467	3237	3498	3730	3872	3676
TONSLAND	1373	1266	1328	1600	1222	1146	992	1189	1107	981
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	354	295	129	177	245	197	608	1721	704	29
3	863	790	1156	1035	890	932	1718	1480	1918	1465
4	1104	739	1098	904	599	724	834	683	860	2202
5	332	864	420	424	400	297	282	241	436	660
6	186	283	483	229	252	171	143	60	242	249
7	161	149	133	192	127	108	80	56	65	95
8	63	65	112	57	126	51	31	43	39	54
9	83	42	65	43	45	52	23	19	26	36
+gp	99	146	109	106	106	87	44	51	81	51
0 TOTALNUM	3245	3373	3705	3167	2790	2619	3763	4354	4371	4841
TONSLAND	928	1009	1157	995	927	875	1012	1091	1168	1345
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
AGE										
1	0	0	0	0	0	0	0	0	0	0
2	119	425	271	685	335	211	612	273	93	159
3	697	1721	855	1330	865	447	468	1278	758	230
4	1134	792	837	715	743	552	430	722	1079	1032
5	1860	794	473	576	474	558	349	337	297	1327
6	402	721	398	163	325	274	295	250	204	363
7	223	114	348	148	157	196	175	159	145	205
8	80	60	48	178	145	75	104	115	99	136
9	26	34	41	44	184	108	44	64	49	89
+gp	75	49	43	51	70	171	194	114	149	242
0 TOTALNUM	4616	4710	3314	3890	3298	2592	2671	3312	2873	3783
TONSLAND	1392	1249	1044	946	945	800	805	876	1029	1096
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 7.13.4 - Sole in VIIfg. Catch weights at age (kg)

Run title : CELTIC SEA SOLE - 2013WG
At 6/05/2013 14:47

Table 2 Catch weights at age (kg)

	YEAR	1971	1972
	AGE		
	1	0.039	0.106
	2	0.106	0.147
	3	0.167	0.186
	4	0.222	0.226
	5	0.272	0.264
	6	0.315	0.302
	7	0.352	0.34
	8	0.383	0.376
	9	0.408	0.413
	+gp	0.4397	0.5384
0	SOPCOFAC	0.9999	1.0009

Table 2 Catch weights at age (kg)

	YEAR	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
	AGE										
	1	0.081	0.063	0.046	0.114	0.098	0.068	0.023	0.048	0.078	0.061
	2	0.143	0.137	0.132	0.167	0.169	0.154	0.132	0.144	0.154	0.156
	3	0.202	0.205	0.212	0.218	0.235	0.234	0.232	0.234	0.225	0.243
	4	0.258	0.27	0.286	0.268	0.297	0.309	0.321	0.316	0.292	0.324
	5	0.311	0.329	0.355	0.316	0.355	0.378	0.401	0.392	0.355	0.397
	6	0.361	0.385	0.417	0.363	0.409	0.441	0.471	0.461	0.414	0.462
	7	0.408	0.436	0.473	0.409	0.46	0.499	0.531	0.523	0.469	0.521
	8	0.452	0.483	0.523	0.453	0.506	0.551	0.581	0.579	0.519	0.572
	9	0.493	0.525	0.567	0.496	0.548	0.598	0.622	0.627	0.565	0.617
	+gp	0.6021	0.6239	0.6715	0.6649	0.6681	0.7196	0.6636	0.7202	0.6654	0.7043
0	SOPCOFAC	1.0005	0.9995	0.9999	0.9988	0.9996	0.9979	1.0011	0.9992	0.9999	0.9994

Table 2 Catch weights at age (kg)

	YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
	AGE										
	1	0.085	0.019	0.089	0.046	0.048	0.074	0.013	0.049	0.054	0.073
	2	0.173	0.131	0.17	0.144	0.146	0.157	0.109	0.134	0.15	0.147
	3	0.255	0.235	0.246	0.236	0.236	0.235	0.198	0.214	0.239	0.216
	4	0.33	0.33	0.317	0.321	0.32	0.309	0.28	0.291	0.32	0.281
	5	0.398	0.416	0.383	0.4	0.396	0.378	0.355	0.363	0.393	0.342
	6	0.459	0.494	0.444	0.471	0.466	0.442	0.424	0.43	0.459	0.398
	7	0.514	0.562	0.5	0.536	0.528	0.502	0.487	0.494	0.516	0.451
	8	0.561	0.622	0.552	0.594	0.584	0.557	0.543	0.553	0.566	0.499
	9	0.602	0.673	0.598	0.645	0.632	0.608	0.592	0.609	0.608	0.543
	+gp	0.6786	0.7716	0.7026	0.7479	0.7404	0.7385	0.6909	0.7474	0.674	0.6402
0	SOPCOFAC	1.0004	0.9985	1.0016	1.0004	1.001	0.9993	0.9993	0.9993	0.9998	0.9995

Table 2 Catch weights at age (kg)

	YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	AGE										
	1	0.057	0.081	0.068	0.027	0.074	0.079	0.015	0.078	0.066	0.054
	2	0.134	0.151	0.147	0.124	0.156	0.163	0.122	0.166	0.148	0.13
	3	0.207	0.216	0.22	0.214	0.234	0.244	0.222	0.248	0.225	0.202
	4	0.275	0.276	0.288	0.296	0.307	0.32	0.315	0.322	0.296	0.271
	5	0.338	0.331	0.351	0.372	0.376	0.393	0.4	0.39	0.363	0.336
	6	0.396	0.38	0.409	0.439	0.44	0.462	0.478	0.451	0.425	0.399
	7	0.45	0.425	0.462	0.5	0.5	0.528	0.549	0.506	0.482	0.457
	8	0.5	0.465	0.51	0.552	0.555	0.589	0.613	0.553	0.533	0.513
	9	0.545	0.5	0.553	0.598	0.605	0.647	0.67	0.594	0.579	0.564
	+gp	0.6445	0.5626	0.6429	0.6773	0.7071	0.7809	0.7655	0.6649	0.6773	0.7045
0	SOPCOFAC	0.9994	0.9996	0.9982	1.0008	0.9997	0.9994	1.0005	1	0.9954	1.0001

Table 2 Catch weights at age (kg)

	YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
	AGE										
	1	0.123	0.066	0.068	0.085	0.075	0.098	0.132	0.092	0.14	0.134
	2	0.171	0.13	0.145	0.139	0.139	0.155	0.178	0.146	0.204	0.169
	3	0.218	0.194	0.219	0.192	0.2	0.209	0.225	0.199	0.266	0.204
	4	0.266	0.256	0.288	0.245	0.258	0.26	0.271	0.25	0.325	0.24
	5	0.313	0.317	0.354	0.297	0.313	0.31	0.317	0.3	0.382	0.276
	6	0.361	0.377	0.415	0.349	0.365	0.356	0.362	0.349	0.437	0.313
	7	0.408	0.435	0.473	0.4	0.414	0.401	0.408	0.396	0.489	0.351
	8	0.454	0.493	0.528	0.451	0.46	0.443	0.453	0.441	0.539	0.389
	9	0.501	0.549	0.578	0.501	0.503	0.482	0.498	0.486	0.586	0.428
	+gp	0.6379	0.7217	0.6918	0.6177	0.6087	0.5448	0.6024	0.5939	0.6856	0.5507
0	SOPCOFAC	1.0019	1.0003	1.0004	0.9992	0.9999	1.0035	0.9994	1.0005	1	0.9986

Table 7.13.5 - Sole in VIIfg. Stock weights at age (kg)

Run title : CELTIC SEA SOLE - 2013WG
At 6/05/2013 14:47

Table 3 Stock weights at age (kg)

YEAR	1971	1972
AGE		
1	0.09	0.09
2	0.076	0.113
3	0.136	0.157
4	0.19	0.222
5	0.239	0.298
6	0.406	0.351
7	0.472	0.352
8	0.389	0.593
9	0.346	0.417
+gp	0.5826	0.6005

Table 3 Stock weights at age (kg)

YEAR	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
AGE										
1	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2	0.113	0.113	0.113	0.113	0.145	0.113	0.113	0.113	0.113	0.113
3	0.142	0.159	0.141	0.16	0.174	0.167	0.163	0.157	0.159	0.164
4	0.203	0.221	0.215	0.21	0.236	0.257	0.255	0.238	0.232	0.255
5	0.263	0.305	0.295	0.269	0.366	0.36	0.392	0.354	0.306	0.356
6	0.334	0.45	0.353	0.354	0.392	0.413	0.437	0.394	0.385	0.487
7	0.322	0.448	0.593	0.432	0.454	0.521	0.485	0.622	0.462	0.543
8	0.4	0.464	0.423	0.462	0.505	0.508	0.595	0.556	0.551	0.61
9	0.539	0.624	0.465	0.425	0.907	0.56	0.657	0.704	0.737	0.766
+gp	0.5822	0.6707	0.7112	0.728	0.7006	0.7826	0.6963	0.7714	0.6627	0.8561

Table 3 Stock weights at age (kg)

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE										
1	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2	0.113	0.118	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113
3	0.175	0.173	0.175	0.18	0.153	0.158	0.152	0.164	0.179	0.184
4	0.262	0.274	0.268	0.273	0.242	0.233	0.227	0.247	0.23	0.265
5	0.37	0.429	0.472	0.398	0.361	0.363	0.308	0.369	0.356	0.388
6	0.488	0.517	0.433	0.462	0.473	0.466	0.465	0.476	0.536	0.498
7	0.633	0.641	0.462	0.546	0.468	0.687	0.546	0.523	0.376	0.751
8	0.606	0.613	0.48	0.636	0.587	0.687	0.526	0.753	0.859	0.754
9	0.464	0.836	0.944	0.89	0.82	0.676	0.542	0.847	0.735	0.475
+gp	0.823	0.9784	0.7983	0.8435	0.8378	0.818	0.7522	0.9732	0.6789	0.8963

Table 3 Stock weights at age (kg)

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE										
1	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2	0.148	0.113	0.113	0.104	0.113	0.113	0.11	0.062	0.113	0.113
3	0.196	0.135	0.143	0.186	0.178	0.195	0.204	0.169	0.187	0.189
4	0.267	0.227	0.233	0.284	0.276	0.282	0.317	0.306	0.312	0.289
5	0.392	0.329	0.335	0.387	0.386	0.371	0.433	0.434	0.434	0.403
6	0.47	0.43	0.441	0.486	0.495	0.454	0.541	0.534	0.538	0.512
7	0.492	0.521	0.54	0.573	0.598	0.529	0.635	0.603	0.619	0.609
8	0.576	0.599	0.629	0.647	0.689	0.593	0.712	0.648	0.68	0.691
9	0.636	0.661	0.705	0.708	0.766	0.644	0.772	0.677	0.725	0.757
+gp	0.7272	0.7572	0.8447	0.808	0.8923	0.7318	0.8525	0.707	0.7835	0.873

Table 3 Stock weights at age (kg)

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
AGE										
1	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
2	0.158	0.116	0.149	0.143	0.117	0.151	0.147	0.142	0.175	0.158
3	0.205	0.176	0.213	0.188	0.177	0.2	0.21	0.21	0.215	0.204
4	0.258	0.248	0.275	0.235	0.236	0.249	0.271	0.274	0.257	0.249
5	0.317	0.329	0.337	0.284	0.294	0.298	0.33	0.333	0.3	0.292
6	0.381	0.415	0.399	0.334	0.35	0.349	0.386	0.388	0.344	0.334
7	0.449	0.502	0.459	0.386	0.406	0.4	0.439	0.438	0.389	0.375
8	0.521	0.587	0.52	0.441	0.46	0.453	0.491	0.484	0.436	0.415
9	0.594	0.667	0.579	0.496	0.513	0.506	0.54	0.526	0.483	0.454
+gp	0.8113	0.869	0.7401	0.6414	0.6622	0.6027	0.6414	0.6088	0.6022	0.5631

Table 7.13.6 - Sole in VIIfg. Indices of abundance (No/100km) for UK(E&W)-BTS-Q3) survey

	0	1	2	3	4	5	6	7	8	9
1988	30	81	326	49	19	5	0	0	0	0
1989	144	222	331	176	20	15	7	4	2	2
1990	30	385	313	50	16	4	7	3	0	0
1991	32	241	517	67	17	15	4	0	2	2
1992	4	394	260	139	30	18	10	1	2	1
1993	3	169	320	43	19	1	2	2	1	1
1994	1	333	387	99	14	7	7	0	0	2
1995	27	124	222	52	11	6	12	1	1	1
1996	3	150	211	54	23	6	2	3	1	2
1997	32	433	180	18	11	12	4	3	5	0
1998	90	770	411	50	9	7	4	2	1	5
1999	24	2464	250	32	14	5	4	4	1	0
2000	13	916	1356	31	22	5	0	2	1	1
2001	22	379	599	259	20	7	5	2	0	2
2002	8	663	238	127	102	12	6	2	3	0
2003	12	392	530	47	26	47	8	3	3	0
2004	55	750	377	87	13	19	37	4	2	0
2005	37	343	225	32	14	6	4	14	1	2
2006	11	273	201	39	13	7	0	2	10	0
2007	91	357	108	43	14	11	6	3	3	12
2008	5	1039	104	13	15	6	8	3	3	4
2009	1	509	318	24	6	8	3	2	2	2
2010	16	85	471	122	17	2	6	7	3	1
2011	18	503	52	138	69	7	2	6	3	0
2012	13	542	231	7	53	24	1	1	1	2
Geomean	15	370	282	53	19	8	1	0.3	0.1	0.0
Mean	29	501	342	72	23	11	6	3	2	2

Table 7.13.7 - Sole in VIIfg. Indices of effort.

	England & Wales		Belgium		Ireland		
Year	Otter trawl	Beam trawl[1]	Beam trawl[2]	Beam trawl[4]	Otter trawl[3]	Scottish seine[4]	Beam trawl[4]
1971			11.06				
1972	45.72		8.44				
1973	45.28		17.39				
1974	38.94		18.83				
1975	33.53		16.38				
1976	25.61		28.07				
1977	27.16		24.11				
1978	27.08	2.50	18.09				
1979	23.84	1.96	18.90				
1980	26.43	4.31	29.02				
1981	24.10	6.24	35.39				
1982	19.20	9.95	28.77				
1983	17.61	12.35	34.95				
1984	23.16	13.55	33.48				
1985	25.24	18.70	40.49				
1986	21.18	20.72	52.46				
1987	24.43	38.76	37.26				
1988	20.09	25.62	42.92				
1989	17.61	20.26	53.58				
1990	22.56	30.77	40.27				
1991	18.57	40.81	18.05				
1992	16.00	35.78	25.47				
1993	13.79	39.64	31.27				
1994	9.48	37.03	38.35				
1995	8.46	37.59	47.81		63.56	6.43	20.78
1996	8.67	39.78	47.63	53.27	60.22	9.73	26.76
1997	8.14	43.00	51.98	57.36	65.10	16.13	28.36
1998	7.13	47.84	52.11	57.79	72.30	14.94	35.37
1999	5.69	50.87	55.03	55.11	51.66	8.01	41.09
2000	4.05	51.19	56.05	51.34	60.60	9.90	37.11
2001	4.42	49.32	52.06	54.90	69.43	16.33	39.71
2002	6.10	37.53	43.24	49.60	79.63	20.86	31.62
2003	9.94	40.71	42.81	62.73	86.87	20.91	49.42
2004	9.42	32.37		78.73	97.11	19.38	57.72
2005	12.09	27.73		64.50	126.19	14.81	51.76
2006	12.97	18.57		50.28	120.10	14.79	63.22
2007	10.66	15.37		45.72	137.13	15.82	56.63
2008	10.13	13.83		28.71	126.40	11.65	38.68
2009	8.97	12.31		30.85	137.61	8.19	39.13
2010	7.67	14.44		32.22	140.82	9.69	40.98
2011	7.44	13.79		39.58	120.14	14.62	35.33
2012	7.71	12.39		56.02	121.10	14.12	40.33

[1]Division VIIf only - Fishing hours (x10^3) corrected for fishing power
[2]Fishing hours (x 10^3) corrected for fishing power using P = 0.000204 BHP^1.23
[3]Division VIIg only - Fishing hours (x10^3)
[4]Fishing hours (x10^3)

Table 7.13.8 - Sole in VIIfg. LPUE

	UK	England & Wales			Belgium		Ireland		
	BT Survey[4]	Otter trawl[1]	Otter trawl[1]	Beam trawl[1]	Beam trawl[2]	Beam trawl[5]	Otter trawl[5]	Scottish sein[5]	Beam trawl[5]
Year	Division VIIfg	Division VIIf	Division VIIg[3]	Division VIIf	Division VIIfg	Division VIIfg	Division VIIg	Division VIIg	Division VIIg
1971	-			-	47.92				
1972	-	2.42	2.11	-	37.06				
1973	-	2.45	0.98	-	39.47				
1974	-	2.10	1.83	-	37.81				
1975	-	1.82	1.79	-	31.41				
1976	-	2.02	1.30	-	30.50				
1977	-	1.84	1.21	-	27.90				
1978	-	1.82	1.17	13.99	23.35				
1979	-	1.80	1.15	14.83	33.19				
1980	-	1.86	1.55	18.99	29.73				
1981	-	1.45	0.60	13.58	24.03				
1982	-	1.73	0.56	11.79	25.93				
1983	-	2.22	1.14	13.50	22.18				
1984	-	1.53	1.70	13.59	20.78				
1985	-	1.55	1.55	12.52	17.94				
1986	-	1.38	0.99	10.94	17.83				
1987	-	0.94	1.15	7.31	17.32				
1988	71.14	0.62	0.27	4.39	15.29				
1989	135.18	0.99	0.87	5.38	11.33				
1990	90.67	0.76	0.67	5.98	15.64				
1991	122.88	0.69	0.85	4.80	24.24				
1992	115.79	1.00	1.25	4.14	18.57				
1993	75.42	0.55	0.25	4.80	15.21				
1994	107.77	0.90	0.27	4.26	13.94				
1995	72.50	0.96	0.87	4.52	13.62		0.40	0.62	0.81
1996	70.15	0.66	0.52	3.94	11.27	11.45	0.73	0.05	0.88
1997	81.66	0.86	0.52	3.28	9.96	9.68	0.42	0.23	1.16
1998	135.41	0.60	0.40	2.67	10.12	9.64	0.48	0.11	1.13
1999	168.46	0.91	0.74	3.21	11.26	12.14	0.17	0.09	0.50
2000	236.43	0.49	1.85	3.36	11.90	13.77	0.19	0.05	0.26
2001	154.79	1.14	2.13	4.02	13.25	13.60	0.27	0.55	0.15
2002	118.11	0.78	3.60	5.64	18.71	17.80	0.42	0.29	0.14
2003	123.93	0.57	0.00	5.23	19.48	11.40	0.12	0.03	0.20
2004	149.65	0.60	0.19	5.75		9.17	0.18	0.02	0.20
2005	76.26	0.76	0.26	4.94		9.78	0.14	0.00	0.29
2006	68.96	1.16	0.60	5.97		10.70	0.11	0.05	0.29
2007	80.95	0.78	1.00	9.87		11.74	0.13	0.02	0.21
2008	115.96	0.82	0.86	9.46		14.51	0.12	0.02	0.31
2009	89.80	0.94	0.46	6.37		12.90	0.10	0.00	0.29
2010	109.55	1.01	0.63	5.92		16.00	0.13	0.01	0.21
2011	99.47	1.47	0.31	6.72		16.14	0.19	0.02	0.20
2012	101.45	1.69	0.53	6.54		13.21	0.14	0.01	0.48

[1]Kg/hr corrected for GRT.
[2]Kg/hr corrected for fishing power using P = 0.000204 BHP^1.23
[3]Division VIIg (East).
[4]Kg/100km
[5]Kg/hour

Table 7.13.9 - Sole in VIIfg. Tuning series

Indices in bold are used in the assessment

BE-CBT **Belgium Beam trawl (Effort = Corrected formula)**

1971 2003
1 1 0 1
2 14

11.06	111	77	384	179	124	154	218	108	32	107	76	21	40
8.44	132	220	76	163	80	52	57	76	39	23	14	38	14
17.39	179	926	368	150	173	58	54	57	108	32	23	21	45
18.83	102	287	565	270	136	156	64	79	90	75	38	39	37
16.38	69	167	195	370	176	64	59	39	33	29	37	18	23
28.07	199	533	357	391	357	167	84	125	40	17	21	51	35
24.11	220	307	244	190	170	283	84	20	35	39	36	18	52
18.09	173	403	185	84	86	54	108	38	11	21	61	8	9
18.9	222	379	506	141	104	133	84	103	35	12	16	4	6
29.02	438	647	583	389	119	45	63	66	92	22	25	16	10
35.39	429	481	565	286	268	107	86	67	86	74	33	13	13
28.77	245	594	221	334	200	148	66	80	54	19	41	16	25
34.95	363	605	409	159	196	127	108	29	44	32	15	12	12
33.48	372	467	334	300	102	153	59	26	26	16	24	19	18
40.49	52	909	471	372	208	75	104	46	68	15	29	16	10
52.46	377	900	823	359	230	140	49	58	65	29	50	6	9
37.23	247	664	438	344	191	119	47	29	20	4	14	2	16
42.92	362	293	603	250	197	77	51	36	26	19	19	13	16
53.58	244	680	428	471	179	145	62	13	24	10	19	3	17
40.27	231	742	663	181	240	70	59	17	26	12	2	4	12
18.05	1028	380	225	131	29	26	9	7	13	8	4	1	2
25.47	327	1062	376	210	98	14	14	7	9	5	0	0.3	2
31.27	296	615	629	161	81	75	38	36	19	4	2	1	1
38.35	205	524	523	530	176	71	20	15	16	11	6	5	7
47.81	77	827	838	277	250	78	48	21	17	8	1	5	2
47.63	104	737	579	258	130	88	29	17	9	12	3	3	0
51.98	193	661	377	241	143	74	55	23	16	18	7	3	2
52.11	166	771	608	188	100	84	33	25	21	8	6	10	7
55.03	493	1286	622	189	66	36	11	14	5	3	1	3	0
56.05	1509	1174	435	124	20	16	14	6	2	9	3	1	1
52.06	621	1445	710	307	174	38	16	11	11	6	17	1	1
43.24	0	1292	1704	570	163	56	27	15	1	1	1	4	0.6
42.81	16	538	929	1273	315	160	50	19	12	2	7	1	3

UK(E&W)-CBT **UK(E+W) VIIf Beam trawl**

1991 2012
1 1 0 1
1 14

40.81	0	52	98	189	171	60	67	23	20	16	13	5	4	4
35.78	0	18	220	103	83	69	22	21	10	13	5	3	1	1
39.64	1.9	6	83	198	77	50	41	11	24	9	5	4	3	4
37.03	0	23	80	59	116	36	31	19	11	15	8	5	5	4
37.59	0	16	87	73	56	105	24	30	23	8	8	4	5	3
39.78	0.2	22	96	128	70	45	53	15	13	12	4	9	5	2
43	0	10	60	86	69	53	27	39	11	11	5	5	3	2
47.84	0	13	101	73	77	50	17	13	20	7	6	4	2	1
50.87	0.4	31	204	107	52	50	28	13	6	10	4	2	1	0
51.19	0.1	72	152	150	75	27	28	20	9	4	8	3	2	2
49.32	0	37	272	99	89	48	19	17	11	9	3	7	1	2
37.53	0	11	149	375	90	63	28	18	14	9	6	4	4	1
40.71	0.1	18	101	176	369	77	45	18	6	7	3	4	1	2
32.37	0	19	91	65	114	180	34	27	15	7	3	5	1	1
27.73	0	27	78	126	55	60	115	15	14	4	5	2	2	1
18.57	0	16	86	94	103	32	39	69	13	8	4	2	2	1
15.37	0.9	18	77	89	77	82	32	41	76	8	8	4	2	3
13.83	0	12	76	100	67	52	54	19	32	42	10	5	2	3
12.31	0	23	54	72	72	63	27	29	12	12	29	4	3	1
14.44	0	2	98	65	48	46	34	19	18	5	5	13	1	1
13.79	0.4	7	57	125	41	34	22	19	12	12	4	7	16	1
13.39	0	3	14	82	105	26	18	16	9	7	6	1	3	3

Table 7.13.9 - Sole in VIIfg. Tuning series - continued

Indices in bold are used in the assessment

UK(E&W)-BTS-Q3 **UK(E+W) VIIf Corystes (automated indices since 1995)**

	1988	**2012**									
	1	**1**	**0.75**	**0.85**							
	0	**9**									
74.120		22	**60**	**242**	**36**	**14**	**4**	**0**	**0**	**0**	**0**
91.909		132	**204**	**304**	**162**	**18**	**14**	**6**	**4**	**2**	**2**
69.858		21	**269**	**219**	**35**	**11**	**3**	**5**	**2**	**0**	**0**
123.410		40	**297**	**638**	**83**	**21**	**18**	**5**	**0**	**3**	**2**
125.078		5	**493**	**325**	**174**	**37**	**23**	**12**	**1**	**2**	**1**
127.672		6	**207**	**436**	**52**	**28**	**3**	**2**	**2**	**1**	**1**
120.816		1	**424**	**430**	**133**	**23**	**11**	**9**	**0**	**0**	**3**
114.886		31	**142**	**255**	**60**	**13**	**7**	**14**	**1**	**1**	**1**
118.592		3	**178**	**251**	**64**	**27**	**7**	**3**	**4**	**1**	**3**
114.886		37	**498**	**207**	**21**	**13**	**14**	**5**	**3**	**6**	**0**
114.886		104	**885**	**472**	**57**	**11**	**9**	**5**	**2**	**1**	**5**
118.592		29	**2922**	**297**	**38**	**16**	**7**	**4**	**5**	**1**	**0**
118.592		16	**1086**	**1608**	**37**	**26**	**6**	**0**	**2**	**1**	**1**
118.592		26	**449**	**711**	**307**	**23**	**9**	**6**	**2**	**0**	**2**
118.592		9	**786**	**283**	**151**	**121**	**14**	**7**	**2**	**3**	**0**
118.592		14	**465**	**628**	**55**	**30**	**56**	**9**	**3**	**3**	**0**
114.886		63	**862**	**434**	**99**	**15**	**22**	**42**	**4**	**3**	**0**
118.592		44	**407**	**267**	**38**	**16**	**7**	**5**	**17**	**1**	**2**
118.592		13	**324**	**238**	**47**	**16**	**8**	**0**	**2**	**12**	**0**
118.592		104	**424**	**128**	**51**	**16**	**13**	**7**	**3**	**4**	**14**
118.592		6	**1232**	**124**	**15**	**18**	**7**	**9**	**4**	**3**	**5**
118.592		1	**604**	**377**	**29**	**8**	**10**	**4**	**3**	**3**	**2**
118.592		19	**101**	**558**	**144**	**20**	**2**	**7**	**9**	**4**	**2**
118.592		22	**596**	**62**	**163**	**82**	**8**	**2**	**7**	**3**	**0**
118.592		16	**643**	**274**	**9**	**63**	**28**	**1**	**1**	**1**	**3**

IR - GFS : Irish Groundfish Survey (IBTS 4th Qtr) - VIIb Sole number at age (Interim indices for new Celtic Explorer series)

	2003	2012									
	1	1	0.79	0.92							
	1	10									
832		1.0	5.2	1.1	3.2	3.0	4.1	4.0	0.0	1.0	0.0
980		1.0	8.0	6.0	5.0	1.0	2.0	1.0	0.0	0.0	1.0
845		0.0	0.0	6.0	2.0	4.0	2.0	2.0	0.0	0.0	0.0
1046		0.0	0.0	4.0	4.0	6.0	4.0	1.0	0.0	0.0	0.0
1168		0.0	2.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0
1139		2.0	9.0	7.0	3.0	2.0	0.0	2.0	0.0	1.0	0.0
1018		0.0	15.0	3.0	4.0	1.0	1.0	2.0	1.0	0.0	2.0
1381		0.0	12.0	24.7	9.1	8.2	1.0	3.0	3.9	0.0	2.1
1392		2.0	0.0	20.1	8.0	6.1	3.1	0.0	1.0	1.0	3.7
1470		0.0	7.0	3.0	3.0	3.0	1.0	0.0	0.0	0.0	0.0

UK (E+W) TRAWL 107F. (Processed as unsexed - from 2001WG)

1991		2012									
1		1	0	1							
1		10									
18.57		0	1.7	6.4	13	11.2	3.5	3.3	1.1	0.8	0.8
16.00		0	8.4	29.4	10.4	6.9	5.9	1.5	1.8	0.8	0.9
13.79		0.1	0.8	3.7	10.2	3.8	2	1.4	0.3	0.6	0.2
9.48		0	1.7	4.3	2.5	4.9	1.7	1.5	1.1	0.6	0.7
8.46		0	2.3	12	5.3	2.5	4.5	0.9	1.2	0.7	0.2
8.67		0.1	2.8	4.3	4.9	2.4	1.4	1.4	0.3	0.5	0.2
8.14		0	2	8	6.8	4.1	2.1	0.7	1.2	0.4	0.3
7.13		0	2	4	2.7	2.1	1.3	0.4	0.3	0.5	0.1
5.69		0.1	8.5	12.4	3.5	1.5	1.2	0.8	0.4	0.1	0.3
4.05		0	0.9	1.8	1.6	0.7	0.2	0.2	0.2	0.1	0
4.42		0	1.5	10.1	2.3	1.7	0.6	0.3	0.2	0.2	0.1
6.10		0	0.5	4.8	8.2	1.8	1	0.3	0.2	0.2	0.1
9.94		0.1	1.6	2.8	3.3	6.7	1	0.7	0.3	0.1	0.1
9.42		0	1	4.8	2.9	3.3	4.9	0.9	0.6	0.4	0.2
12.09		0	2.6	4.9	6.1	2.3	2.6	4.9	0.7	0.7	0.2
12.97		0	0.4	7.1	7.7	9.5	3	3.9	6.9	1.3	0.9
10.66		0	0.5	2.6	3.5	3.2	3.2	1.2	1.5	2.6	0.3
10.13		0	0.4	3.5	**5**	3.8	2.9	2.7	0.9	1.6	2.2
9.00		0	0	0	0	0	0	0	0	0	0
7.70		0	0.2	5.3	3.7	2.3	2.1	1.1	0.8	0.9	0.2
7.4		0	0.7	5.7	8.6	3.2	3.2	2.4	1.3	1.2	0.9
7.7		0	3.8	2.9	9.6	10	3.4	2.5	1.5	1.3	0.8

Table 7.13.10 - Sole VIIfg - XSA diagnostics

Lowestoft VPA Version 3.1

6/05/2013 14:46

Extended Survivors Analysis

CELTIC SEA SOLE

CPUE data from file S7FGTUN.TXT

Catch data for 42 years. 1971 to 2012. Ages 1 to 10.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
BE-CBT	1971	2012	2	9	0	1
UK(E&W)-CBT	1991	2012	2	9	0	1
UK(E&W)-BTS-Q3	1988	2012	1	9	0.75	0.85

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 50 iterations

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	0	0	0	0	0	0	0	0	0	0
2	0.021	0.1	0.055	0.174	0.123	0.069	0.075	0.046	0.091	0.046
3	0.245	0.405	0.266	0.37	0.309	0.214	0.192	0.197	0.157	0.303
4	0.374	0.428	0.313	0.33	0.324	0.295	0.292	0.447	0.228	0.295
5	0.488	0.432	0.434	0.327	0.338	0.382	0.274	0.348	0.296	0.427
6	0.671	0.314	0.355	0.232	0.276	0.297	0.317	0.286	0.327	0.625
7	0.597	0.356	0.219	0.193	0.326	0.238	0.28	0.251	0.239	0.561
8	0.541	0.278	0.222	0.149	0.262	0.227	0.172	0.267	0.219	0.328
9	0.499	0.411	0.277	0.29	0.203	0.283	0.181	0.136	0.156	0.278

1

XSA population numbers (Thousands)

YEAR \ AGE	1	2	3	4	5	6	7	8	9
2003	5.20E+03	6.13E+03	3.38E+03	3.82E+03	5.07E+03	8.65E+02	5.22E+02	2.01E+02	6.96E+01
2004	5.83E+03	4.70E+03	5.43E+03	2.39E+03	2.38E+03	2.81E+03	4.00E+02	2.60E+02	1.06E+02
2005	4.98E+03	5.28E+03	3.85E+03	3.28E+03	1.41E+03	1.40E+03	1.86E+03	2.54E+02	1.78E+02
2006	3.37E+03	4.50E+03	4.52E+03	2.67E+03	2.17E+03	8.27E+02	8.87E+02	1.35E+03	1.84E+02
2007	3.69E+03	3.05E+03	3.42E+03	2.82E+03	1.74E+03	1.42E+03	5.93E+02	6.62E+02	1.05E+03
2008	9.88E+03	3.34E+03	2.44E+03	2.27E+03	1.85E+03	1.12E+03	9.72E+02	3.88E+02	4.61E+02
2009	7.03E+03	8.94E+03	2.82E+03	1.78E+03	1.53E+03	1.14E+03	7.54E+02	6.93E+02	2.79E+02
2010	1.24E+03	6.36E+03	7.50E+03	2.11E+03	1.20E+03	1.06E+03	7.53E+02	5.16E+02	5.28E+02
2011	4.13E+03	1.12E+03	5.50E+03	5.57E+03	1.22E+03	7.69E+02	7.17E+02	5.30E+02	3.57E+02
2012	7.34E+03	3.74E+03	9.24E+02	4.25E+03	4.02E+03	8.21E+02	5.02E+02	5.11E+02	3.85E+02

Estimated population abundance at 1st Jan 2013

0.00E+00	6.64E+03	3.23E+03	6.17E+02	2.87E+03	2.37E+03	3.98E+02	2.59E+02	3.33E+02

Taper weighted geometric mean of the VPA populations:

4.88E+03	4.39E+03	3.57E+03	2.48E+03	1.50E+03	8.87E+02	5.51E+02	3.57E+02	2.31E+02

Standard error of the weighted Log(VPA populations) :

0.4101	0.4058	0.4128	0.3796	0.4334	0.4724	0.5826	0.7643	0.9402

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Log catchability residuals.

Fleet : BE-CBT

Age	1971	1972
1	No data for this fleet at this age	
2	0.23	0.13
3	-0.48	0.18
4	0.26	-0.16
5	0.32	0.14
6	0.13	0.3
7	0.5	-0.01
8	0.32	0.21
9	0.02	-0.1

Age	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	No data for this fleet at this age									
2	0.54	0.11	-0.15	0.55	0.21	0.38	0.41	1.18	0.54	0.22
3	0.38	-0.1	-0.34	0.4	0.15	0.08	0.08	0.05	0.22	0.12
4	0.13	-0.05	-0.31	-0.01	-0.02	0.07	0.41	0.27	-0.09	-0.15
5	0.19	0.14	0	0.26	-0.08	-0.46	0.13	0.21	-0.14	0.05
6	-0.09	0.5	0.27	-0.18	0.08	-0.21	0.05	-0.04	0.21	0.21
7	-0.3	0.12	0.37	0.15	0.19	-0.38	0.63	-0.87	0.17	0.41
8	-0.42	-0.01	-0.45	0.57	-0.02	-0.17	0.3	-0.16	-0.14	0.36
9	-0.18	0.15	-0.1	0.07	-0.27	-0.23	0.02	-0.01	0.08	0.42

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	No data for this fleet at this age									
2	0.45	0.17	-1.66	-0.09	0.42	0.05	-0.31	0.09	1.61	0.79
3	-0.02	-0.19	-0.06	0.01	-0.16	-0.54	-0.48	0.18	0.42	0.43
4	-0.25	-0.34	-0.12	-0.09	0	-0.19	-0.15	0.13	0.08	0.31
5	-0.24	0.02	0.12	-0.04	0	-0.05	-0.11	-0.04	0	0.24
6	-0.18	-0.1	0.07	0.11	0.38	-0.03	0.09	0.22	-0.35	0.02
7	0.14	0.22	-0.06	0.05	0.68	0.02	0.18	0.2	-0.45	-0.85
8	0.5	-0.08	0.19	-0.27	-0.13	0.57	0.17	0.24	-0.41	-0.96
9	-0.22	-0.29	-0.06	-0.08	0.16	0.04	-0.31	-0.16	-0.42	-0.47

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	No data for this fleet at this age									
2	0.41	-0.16	-1.11	-0.77	-0.44	-0.91	0.03	0.26	0.08	99.99
3	0.29	-0.2	0.1	0.25	0.07	0	0.2	-0.03	-0.71	0.04
4	-0.03	0.23	0.42	0.19	-0.08	0.45	0.1	-0.55	-0.17	-0.2
5	-0.18	0.2	0.05	0.04	0.02	-0.07	0.05	-0.92	-0.3	0.39
6	-0.34	0.36	-0.02	0.04	0.21	-0.09	-0.47	-1.6	0.07	-0.2
7	0.23	-0.08	0.1	-0.32	0.22	0.66	-0.45	-1.28	-0.39	-0.22
8	0.44	-0.74	-0.02	-0.26	-0.25	0.17	-0.64	-0.82	-0.74	0.01
9	0.29	-0.02	-0.29	-0.32	0.08	-0.41	-0.08	-0.61	-0.39	-0.02

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	No data for this fleet at this age									
2	-3.27	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	-0.32	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	-0.06	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	0.06	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	0.57	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	0.46	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	0.22	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	0.3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-6.3721	-5.1048	-4.8858	-4.9157	-4.9804	-5.0678	-5.0678	-5.0678
S.E(Log q)	0.8638	0.2856	0.2321	0.2418	0.3726	0.45	0.4186	0.258

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	0.97	0.072	6.44	0.15	32	0.85	-6.37
3	1.06	-0.417	4.91	0.58	33	0.31	-5.1
4	1.07	-0.603	4.68	0.71	33	0.25	-4.89
5	0.85	1.932	5.28	0.84	33	0.2	-4.92
6	0.76	2.38	5.39	0.76	33	0.27	-4.98
7	0.82	1.746	5.28	0.74	33	0.36	-5.07
8	0.9	1.298	5.21	0.83	33	0.36	-5.14
9	0.92	2.017	5.18	0.96	33	0.21	-5.17
1							

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Fleet : UK(E&W)-CBT

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.39	0.13
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.01	0.28
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.49	0.08
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.5	0.02
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.35	0.12
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.35	-0.06
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.39	-0.22
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.49	0.23

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	No data for this fleet at this age									
2	-1.14	0.27	0.13	0.43	-0.63	-0.78	-0.08	-0.12	-0.1	-0.46
3	-0.19	-0.28	-0.14	0.16	-0.37	-0.18	0.2	-0.22	-0.56	-0.21
4	-0.03	-0.51	-0.39	0.25	0.03	-0.18	-0.19	-0.13	-0.69	-0.18
5	-0.11	-0.24	-0.26	-0.03	0.01	0.18	-0.11	-0.28	-0.44	-0.26
6	-0.26	-0.4	0.14	-0.05	0.2	0.1	0.12	-0.42	-0.37	-0.21
7	0.06	-0.19	-0.16	0.01	0.08	-0.17	0.06	0.05	-0.36	-0.1
8	-0.36	-0.08	0.43	-0.07	0.28	0	0.28	0.25	0.05	0.42
9	0.33	0.38	0.72	0.27	0.21	0.14	-0.17	0.57	0.34	0.73

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	No data for this fleet at this age									
2	-0.53	0.06	0.43	0.52	1.2	0.78	0.56	-1.71	1.35	-0.7
3	-0.18	-0.45	-0.17	0.21	0.54	0.93	0.55	0.01	-0.2	0.28
4	-0.27	-0.55	-0.1	0.22	0.3	0.72	0.75	0.4	0.02	-0.07
5	-0.08	-0.31	-0.35	0.2	0.33	0.25	0.58	0.29	0.14	-0.02
6	0.01	-0.26	-0.48	-0.24	0.37	0.27	0.56	0.16	0.23	0.07
7	-0.08	0.02	-0.21	-0.16	0.3	0.39	0.09	0.15	-0.2	0.13
8	-0.07	0.18	-0.25	-0.03	0.41	0.26	0.19	-0.05	-0.05	-0.11
9	-0.13	0.56	0.06	0.36	0.53	0.64	0.22	-0.19	-0.15	-0.42

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-8.9504	-6.8699	-6.2841	-5.9652	-5.7716	-5.744	-5.744	-5.744
S.E(Log q)	0.7342	0.3603	0.3834	0.28	0.2912	0.1922	0.2504	0.4155

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	2.12	-1.713	9.55	0.1	22	1.49	-8.95
3	1.44	-2.059	6.27	0.52	22	0.48	-6.87
4	1.2	-0.844	5.97	0.47	22	0.46	-6.28
5	1.01	-0.056	5.96	0.76	22	0.29	-5.97
6	0.97	0.205	5.79	0.77	22	0.29	-5.77
7	0.94	0.829	5.76	0.92	22	0.18	-5.74
8	1.04	-0.468	5.66	0.89	22	0.25	-5.66
9	1.07	-0.744	5.52	0.85	22	0.35	-5.48
1							

Fleet : UK(E&W)-BTS-Q3

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	99.99	99.99	99.99	99.99	99.99	-1.41	-0.21	-0.5	-0.25	0.18
2	99.99	99.99	99.99	99.99	99.99	0.02	0.29	0.4	0.16	0.12
3	99.99	99.99	99.99	99.99	99.99	0.31	1.07	0.12	0.49	0.57
4	99.99	99.99	99.99	99.99	99.99	-0.17	0.51	-0.12	0.13	0.75
5	99.99	99.99	99.99	99.99	99.99	-0.15	0.4	-0.07	0.67	1
6	99.99	99.99	99.99	99.99	99.99	99.99	0.61	0.3	0.4	0.76
7	99.99	99.99	99.99	99.99	99.99	99.99	0.54	0.61	99.99	-0.67
8	99.99	99.99	99.99	99.99	99.99	99.99	0.69	99.99	1.04	-0.1
9	99.99	99.99	99.99	99.99	99.99	99.99	1.74	99.99	0.88	0.44

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	-0.7	0.33	-0.68	-0.69	0.07	0.51	0.79	0.46	0.21	0.28
2	0.31	0.34	0.1	0.1	-0.26	0.24	-0.33	0.5	0.31	-0.06
3	-0.05	0.8	0.17	0.49	-0.6	0.15	-0.49	-0.68	0.41	0.4
4	-0.22	0.34	-0.18	0.64	0.16	0.1	0.08	0.21	-0.09	0.46
5	-1.04	-0.24	0.08	0.13	1	0.69	0.6	-0.19	-0.12	0.26
6	-1.05	0.72	0.71	-0.17	0.61	0.59	0.41	99.99	0.34	0.05
7	-0.32	99.99	-0.63	0.15	0.77	0.72	1.29	0.32	0.28	-0.13
8	-0.13	99.99	-0.22	-0.08	1.26	0.39	0.68	0.26	99.99	1.3
9	-0.18	1.76	0.34	1.53	99.99	1.66	99.99	1.37	1.58	99.99

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	0.02	0.55	-0.07	0.09	0.27	0.35	-0.02	-0.07	0.5	0
2	0.26	0.25	-0.41	-0.28	-0.55	-0.71	-0.58	0.13	-0.29	-0.05
3	-0.12	0.15	-0.61	-0.47	-0.16	-1.12	-0.63	0	0.41	-0.59
4	-0.19	-0.34	-0.71	-0.49	-0.55	-0.24	-0.81	0.06	0.32	0.38
5	0.48	0.29	-0.36	-0.75	-0.03	-0.68	-0.22	-1.53	-0.2	-0.03
6	0.5	0.61	-0.82	99.99	-0.56	-0.05	-0.87	-0.25	-1.16	-1.68
7	-0.03	0.37	0.14	-1.28	-0.37	-0.65	-0.65	0.43	0.22	-1.11
8	0.88	0.45	-0.7	0.05	-0.24	-0.02	-0.65	0.01	-0.34	-1.32
9	99.99	99.99	0.39	99.99	0.5	0.36	-0.14	-0.81	99.99	0.02

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6	7	8	9
Mean Log q	-7.1304	-7.2212	-8.4942	-9.0565	-9.2908	-9.2289	-9.3518	-9.3518	-9.3518
S.E(Log q)	0.4965	0.3368	0.539	0.4064	0.5995	0.721	0.6491	0.6852	1.0925

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.75	1.614	7.48	0.64	25	0.36	-7.13
2	0.84	1.305	7.41	0.75	25	0.28	-7.22
3	0.73	1.663	8.42	0.62	25	0.38	-8.49
4	1.02	-0.102	9.08	0.49	25	0.42	-9.06
5	1.16	-0.545	9.62	0.33	25	0.71	-9.29
6	1.48	-0.976	10.45	0.17	22	1.07	-9.23
7	1.83	-2.025	12.05	0.23	22	1.11	-9.35
8	1.94	-2.595	12.57	0.29	21	1.14	-9.2
9	2.74	-3.509	14.74	0.23	16	1.66	-8.64
1							

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2011

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BE-CBT	1	0	0	0	0	0	0
UK(E&W)-CBT	1	0	0	0	0	0	0
UK(E&W)-BTS-Q3	6640	0.506	0	0	1	1	0
F shrinkage mean 0		1.5				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6640	0.51	0	1	0	0

1

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2010

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BE-CBT	1	0	0	0	0	0	0
UK(E&W)-CBT	1605	0.751	0	0	1	0.121	0.09
UK(E&W)-BTS-Q3	3651	0.284	0.255	0.9	2	0.847	0.041
F shrinkage mean	1796	1.5				0.032	0.081

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3230	0.26	0.21	4	0.821	0.046

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2009

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BE-CBT	1	0	0	0	0	0	0
UK(E&W)-CBT	990	0.331	0.41	1.24	2	0.371	0.2
UK(E&W)-BTS-Q3	454	0.253	0.126	0.5	3	0.604	0.393
F shrinkage mean	916	1.5				0.025	0.214

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
617	0.2	0.21	6	1.065	0.303

1

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2008

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BE-CBT	1	0	0	0	0	0	0
UK(E&W)-CBT	2140	0.254	0.341	1.34	3	0.424	0.378
UK(E&W)-BTS-Q3	3588	0.217	0.094	0.43	4	0.558	0.242
F shrinkage mean	2624	1.5				0.018	0.318

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2865	0.16	0.16	8	0.971	0.295

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BE-CBT	1	0	0	0	0	0	0
UK(E&W)-CBT	2428	0.197	0.071	0.36	4	0.557	0.419
UK(E&W)-BTS-Q3	2274	0.207	0.191	0.92	5	0.426	0.442
F shrinkage mean	3248	1.5				0.017	0.328

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2373	0.14	0.09	10	0.633	0.427

1

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 2006

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BE-CBT	1	0	0	0	0	0	0
UK(E&W)-CBT	485	0.172	0.094	0.54	5	0.662	0.537
UK(E&W)-BTS-Q3	246	0.21	0.272	1.3	6	0.317	0.876
F shrinkage mean	982	1.5				0.021	0.301

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
398	0.14	0.15	12	1.126	0.625

Table 7.13.10 - Sole VIIfg - XSA diagnostics - continued

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BE-CBT	1	0	0	0	0	0	0
UK(E&W)-CBT	356	0.155	0.119	0.77	6	0.709	0.437
UK(E&W)-BTS-Q3	107	0.212	0.175	0.83	7	0.273	1.039
F shrinkage mean	636	1.5				0.018	0.267

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
259	0.13	0.18	14	1.384	0.561

1
Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BE-CBT	1	0	0	0	0	0	0
UK(E&W)-CBT	369	0.141	0.131	0.93	7	0.748	0.3
UK(E&W)-BTS-Q3	235	0.214	0.181	0.85	8	0.239	0.438
F shrinkage mean	501	1.5				0.013	0.23

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
333	0.12	0.11	16	0.9	0.328

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 2003

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
BE-CBT	1	0	0	0	0	0	0
UK(E&W)-CBT	287	0.14	0.115	0.82	8	0.771	0.259
UK(E&W)-BTS-Q3	203	0.226	0.155	0.68	9	0.215	0.348
F shrinkage mean	150	1.5				0.014	0.449

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
264	0.12	0.09	18	0.747	0.278

Table 7.13.11 - Sole in VIIfg. Fishing mortality

Run title : CELTIC SEA SOLE - 2013WG
At 6/05/2013 14:47

	1971	1972
1	0.0000	0.0000
2	0.0826	0.0677
3	0.1456	0.2515
4	0.3798	0.2250
5	0.3894	0.2945
6	0.3044	0.3243
7	0.4009	0.2149
8	0.3351	0.2685
9	0.2486	0.1997
+gp	0.2486	0.1997
FBAR 4-8	0.3619	0.2654

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000
2	0.1042	0.0547	0.0415	0.1301	0.0729	0.0831	0.0719	0.2434	0.1466	0.085
3	0.3137	0.1579	0.1222	0.3978	0.2428	0.2196	0.1847	0.2800	0.3753	0.276
4	0.3038	0.2067	0.1567	0.3288	0.2561	0.2680	0.3196	0.4317	0.3439	0.262
5	0.3159	0.2428	0.2078	0.4169	0.2334	0.1535	0.2337	0.3935	0.3172	0.311
6	0.2217	0.3303	0.2545	0.2532	0.2592	0.1869	0.2026	0.2900	0.4216	0.342
7	0.1662	0.2061	0.2584	0.3216	0.2615	0.1423	0.3304	0.1053	0.3708	0.383
8	0.1472	0.1778	0.1142	0.4911	0.2141	0.1766	0.2379	0.2369	0.2711	0.363
9	0.1865	0.1907	0.1608	0.2988	0.1623	0.1697	0.1803	0.2736	0.3414	0.383
+gp	0.1865	0.1907	0.1608	0.2988	0.1623	0.1697	0.1803	0.2736	0.3414	0.383
FBAR 4-8	0.2310	0.2328	0.1983	0.3623	0.2449	0.1855	0.2648	0.2915	0.3449	0.332

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1670	0.1221	0.0496	0.1070	0.1244	0.1126	0.1323	0.0905	0.2193	0.1277
3	0.3714	0.3047	0.3777	0.4649	0.2769	0.2404	0.3446	0.3923	0.3023	0.3798
4	0.3675	0.3277	0.4408	0.5174	0.5146	0.3913	0.4927	0.6151	0.4330	0.4527
5	0.3625	0.4540	0.5102	0.5454	0.4595	0.5302	0.4682	0.6296	0.5044	0.4656
6	0.3589	0.3753	0.4260	0.6276	0.5380	0.5663	0.5368	0.6546	0.4569	0.4617
7	0.4491	0.4760	0.3195	0.4824	0.8041	0.4562	0.5259	0.6110	0.4348	0.2992
8	0.6511	0.3497	0.4162	0.4494	0.4385	0.7324	0.5319	0.6307	0.4637	0.2583
9	0.3192	0.2853	0.3837	0.5443	0.5792	0.5234	0.4577	0.6410	0.4919	0.4033
+gp	0.3192	0.2853	0.3837	0.5443	0.5792	0.5234	0.4577	0.6410	0.4919	0.4033
FBAR 4-8	0.4378	0.3966	0.4226	0.5244	0.5509	0.5353	0.5111	0.6282	0.4586	0.3875

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0969	0.0806	0.0450	0.0640	0.0729	0.0427	0.1192	0.1416	0.1099	0.0081
3	0.3566	0.2888	0.4518	0.5237	0.4580	0.3825	0.5462	0.4162	0.2075	0.3108
4	0.4028	0.5200	0.7222	0.6805	0.5802	0.7386	0.6177	0.3847	0.4027	0.3461
5	0.3949	0.5603	0.5593	0.6014	0.6476	0.5638	0.6358	0.3187	0.4019	0.5458
6	0.3539	0.6091	0.6239	0.6007	0.7802	0.5628	0.5158	0.2344	0.5389	0.3743
7	0.5323	0.4714	0.5721	0.4789	0.7026	0.8206	0.4953	0.3455	0.3801	0.3708
8	0.5076	0.3762	0.6938	0.4552	0.5898	0.6019	0.5166	0.4793	0.3822	0.5526
9	0.6130	0.6680	0.7029	0.5532	0.6991	0.4565	0.5302	0.6127	0.5293	0.6440
+gp	0.6130	0.6680	0.7029	0.5532	0.6991	0.4565	0.5302	0.6127	0.5293	0.6440
FBAR 4-8	0.4383	0.5074	0.6343	0.5633	0.6601	0.6575	0.5562	0.3525	0.4211	0.4379

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	FBAR 10-12
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0206	0.0998	0.0555	0.1742	0.1227	0.0687	0.0747	0.0462	0.0914	0.0458	0.0611
3	0.2446	0.4051	0.2657	0.3702	0.3088	0.2139	0.1917	0.1973	0.1567	0.3033	0.2191
4	0.3737	0.4277	0.3125	0.3303	0.3237	0.2945	0.2924	0.4467	0.2275	0.2946	0.3229
5	0.4878	0.4318	0.4343	0.3272	0.3380	0.3817	0.2735	0.3484	0.2957	0.4266	0.3569
6	0.6708	0.3138	0.3555	0.2321	0.2762	0.2969	0.3169	0.2864	0.3269	0.6252	0.4128
7	0.5966	0.3560	0.2190	0.1929	0.3259	0.2383	0.2798	0.2511	0.2390	0.5612	0.3504
8	0.5408	0.2779	0.2219	0.1489	0.2618	0.2274	0.1717	0.2671	0.2187	0.3283	0.2714
9	0.4985	0.4109	0.2769	0.2899	0.2027	0.2828	0.1810	0.1363	0.1557	0.2782	0.1901
+gp	0.4985	0.4109	0.2769	0.2899	0.2027	0.2828	0.1810	0.1363	0.1557	0.2782	
FBAR 4-8	0.5339	0.3614	0.3086	0.2463	0.3051	0.2878	0.2669	0.3200	0.2616	0.4472	

Table 4.3.12 - Sole in VIIfg. Stock numbers at age (start of year, in thousand)

Run title : CELTIC SEA SOLE - 2013WG
At 6/05/2013 14:47

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	9602	4273	3385	3401	2972	5192	4634	5491	3533	5130	4859
2	5119	8688	3866	3063	3078	2689	4698	4193	4969	3197	4642
3	2095	4265	7347	3152	2624	2672	2136	3952	3492	4184	2268
4	4461	1638	3001	4857	2435	2101	1624	1516	2871	2627	2861
5	2037	2761	1184	2004	3574	1884	1369	1137	1049	1887	1543
6	1735	1249	1861	781	1422	2627	1124	981	883	752	1152
7	1709	1158	817	1349	508	998	1846	785	736	652	509
8	2817	1036	845	626	993	355	655	1286	616	479	531
9	1796	1823	717	660	474	802	197	478	975	439	342
+gp	5813	4230	3970	3269	2628	1879	2557	1170	1075	1542	1377
TOTAL	37184	31121	26993	23162	20709	21198	20838	20988	20198	20888	20084

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	4887	6793	4703	5655	3157	5738	4490	3718	8602	4197	4455
2	4396	4422	6147	4256	5117	2857	5192	4062	3364	7784	3798
3	3628	3653	3386	4922	3664	4160	2283	4198	3220	2780	5656
4	1410	2492	2280	2259	3053	2083	2854	1624	2691	1968	1859
5	1836	982	1561	1486	1315	1646	1127	1746	898	1316	1155
6	1017	1217	618	897	807	690	941	600	989	433	719
7	684	654	769	384	530	390	364	483	317	465	248
8	318	422	378	432	253	296	158	209	258	156	272
9	367	200	199	241	258	146	173	69	111	124	89
+gp	1073	1227	1157	789	817	426	688	291	285	436	281
TOTAL	19614	22061	21198	21322	18972	18432	18269	16999	20736	19660	18533

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	4426	3410	3316	4050	5470	6288	15144	7860	4158	6773
2	4031	4005	3085	3000	3664	4950	5690	13703	7112	3762
3	3025	3311	3343	2669	2546	3083	4291	4570	10762	5765
4	3501	1916	2244	1925	1430	1458	1903	2249	2727	7913
5	1070	2117	1031	986	882	725	630	928	1385	1650
6	656	652	1094	533	489	418	373	302	611	838
7	410	417	321	530	265	203	215	202	216	322
8	166	218	235	164	297	119	81	119	129	134
9	190	91	135	106	94	149	59	44	67	80
+gp	226	313	226	261	220	248	112	116	206	112
TOTAL	17701	16449	15030	14225	15359	17639	28497	30091	27372	27350

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	GMST 71-10	AMST 71-10
1	5198	5835	4977	3370	3690	9876	7030	1237	4130	7338	0*	4848	5274
2	6129	4704	5280	4503	3049	3339	8936	6361	1119	3737	6640	4556	4872
3	3377	5432	3852	4519	3423	2440	2820	7504	5496	924	3230	3653	3912
4	3823	2393	3278	2672	2824	2275	1783	2107	5574	4252	617	2401	2575
5	5065	2380	1411	2170	1737	1849	1533	1204	1220	4017	2865	1466	1606
6	865	2814	1399	827	1416	1121	1142	1055	769	821	2373	892	1002
7	522	400	1860	887	593	972	754	753	717	502	398	548	655
8	201	260	254	1352	662	388	693	516	530	511	259	350	484
9	70	106	178	184	1054	461	279	528	357	385	333	225	364
+gp	200	152	186	212	400	728	1229	939	1084	1045	980		
TOTAL	25449	24476	22675	20697	18849	23448	26200	22203	20996	23532	17695		

* Replaced with GM (71-10) (=4848)

Table 7.13.13 - Sole in VIIfg. Summary

Run title : CELTIC SEA SOLE - 2013WG
At 6/05/2013 14:47

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4- 8
1971	9602	9487	8020	1861	0.2320	0.3619
1972	4273	7983	6325	1278	0.2020	0.2654
1973	3385	6626	5292	1391	0.2628	0.2310
1974	3401	6688	5668	1105	0.1950	0.2328
1975	2972	5876	5022	919	0.1830	0.1983
1976	5192	5380	4353	1350	0.3101	0.3623
1977	4634	5933	4670	961	0.2058	0.2449
1978	5491	5077	3757	780	0.2076	0.1855
1979	3533	5090	3880	954	0.2459	0.2648
1980	5130	5239	4017	1314	0.3271	0.2915
1981	4859	4594	3418	1212	0.3546	0.3449
1982	4887	4804	3554	1128	0.3174	0.3322
1983	6793	5133	3654	1373	0.3757	0.4378
1984	4703	5371	3914	1266	0.3235	0.3966
1985	5655	4789	3306	1328	0.4017	0.4226
1986	3157	4621	3366	1600	0.4753	0.5244
1987	5738	3733	2517	1222	0.4856	0.5509
1988	4490	3902	2707	1146	0.4233	0.5353
1989	3718	3247	2111	992	0.4698	0.5111
1990	8602	3881	2403	1189	0.4947	0.6282
1991	4197	3605	2133	1107	0.5190	0.4586
1992	4455	3855	2445	981	0.4012	0.3875
1993	4426	3833	2475	928	0.3749	0.4383
1994	3410	3263	2255	1009	0.4475	0.5074
1995	3316	3083	2152	1157	0.5376	0.6343
1996	4050	3057	2077	995	0.4789	0.5633
1997	5470	2969	1817	927	0.5103	0.6601
1998	6288	3051	1619	875	0.5404	0.6575
1999	15144	4277	1816	1012	0.5571	0.5562
2000	7860	3892	1938	1091	0.5629	0.3525
2001	4158	5402	3116	1168	0.3749	0.4211
2002	6773	5952	4090	1345	0.3288	0.4379
2003	5198	5593	3761	1392	0.3701	0.5339
2004	5835	5128	3521	1249	0.3548	0.3614
2005	4977	5217	3524	1044	0.2963	0.3086
2006	3370	4484	3071	946	0.3080	0.2463
2007	3690	4319	3256	945	0.2902	0.3051
2008	9876	4626	2956	800	0.2706	0.2878
2009	7030	5579	3423	805	0.2352	0.2669
2010	1237	5407	3575	876	0.2451	0.3200
2011	4130	5148	3778	1029	0.2723	0.2616
2012	7338	5109	3686	1096	0.2973	0.4472
2013	4848 [1]	5069 [2]	3319 [2]			0.3429 [3]
Arith. Mean	5296	4864	3439	1123	0.3587	0.3985
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

[1] Geometric mean 1971-2010

[2] From forecast

[3] Mean $F_{(2010\text{-}2012)}$

Table 7.13.14 - Sole in VIIfg
Input for catch forecast and Fmsy analysis

Input: F mean 10-12 not rescaled to F2012
Catch and stock weights are mean 10-12
Recruits age 1 in 2013,14 and 15 GM (71-10)

Label	Value	CV	Label	Value	CV
Number at age			Weight in the stock		
N1	4848	0.43	WS1	0.090	0.00
N2	6640	0.51	WS2	0.158	0.10
N3	3230	0.26	WS3	0.210	0.03
N4	617	0.21	WS4	0.260	0.05
N5	2865	0.16	WS5	0.308	0.07
N6	2373	0.14	WS6	0.355	0.08
N7	398	0.15	WS7	0.401	0.08
N8	259	0.18	WS8	0.445	0.08
N9	333	0.12	WS9	0.488	0.07
N10	980	0.12	WS10	0.591	0.04
H.cons selectivity			Weight in the HC catch		
sH1	0.0000	0.00	WH1	0.122	0.21
sH2	0.0611	0.43	WH2	0.173	0.17
sH3	0.2191	0.35	WH3	0.223	0.17
sH4	0.3229	0.35	WH4	0.272	0.17
sH5	0.3569	0.18	WH5	0.319	0.17
sH6	0.4128	0.45	WH6	0.366	0.17
sH7	0.3504	0.52	WH7	0.412	0.17
sH8	0.2714	0.20	WH8	0.456	0.17
sH9	0.1901	0.40	WH9	0.500	0.16
sH10	0.1901	0.40	WH10	0.610	0.11
Natural mortality			Proportion mature		
M1	0.1	0.1	MT1	0	0
M2	0.1	0.1	MT2	0.14	0.1
M3	0.1	0.1	MT3	0.45	0.1
M4	0.1	0.1	MT4	0.88	0.1
M5	0.1	0.1	MT5	0.98	0.1
M6	0.1	0.1	MT6	1	0
M7	0.1	0.1	MT7	1	0
M8	0.1	0.1	MT8	1	0
M9	0.1	0.1	MT9	1	0
M10	0.1	0.1	MT10	1	0
Relative effort in HC fihery			Year effect for natural mortality		
HF13	1	0.1	K13	1	0.1
HF14	1	0.1	K14	1	0.1
HF15	1	0.1	K15	1	0.1
Recruitment in 2013 and 2014					
R14	4848	0.43			
R15	4848	0.43			

Table 7.13.15 Sole in VIIfg - Management option table

MFDP version 1a
Run: Sol7FG_fin
Sole in VIId
Time and date: 19:52 10/05/2013
Fbar age range: 4-8

2013 Biomass	SSB	FMult	FBar	Landings
5069	3319	1.0000	0.3429	986

2014 Biomass	SSB	FMult	FBar	Landings	2015 Biomass	SSB
5046	3285	0.0000	0.0000	0	6041	4377
.	3285	0.1000	0.0343	114	5920	4263
.	3285	0.2000	0.0686	225	5804	4153
.	3285	0.3000	0.1029	332	5690	4046
.	3285	0.4000	0.1372	437	5580	3942
.	3285	0.5000	0.1714	538	5474	3842
.	3285	0.6000	0.2057	637	5370	3744
.	3285	0.7000	0.2400	733	5269	3650
.	3285	0.8000	0.2743	826	5171	3558
.	3285	0.9000	0.3086	916	5076	3469
.	3285	1.0000	0.3429	1004	4984	3382
.	3285	1.1000	0.3772	1089	4895	3298
.	3285	1.2000	0.4115	1172	4808	3217
.	3285	1.3000	0.4458	1253	4723	3138
.	3285	1.4000	0.4801	1331	4641	3061
.	3285	1.5000	0.5143	1407	4561	2987
.	3285	1.6000	0.5486	1482	4483	2914
.	3285	1.7000	0.5829	1554	4408	2844
.	3285	1.8000	0.6172	1624	4335	2776
.	3285	1.9000	0.6515	1692	4263	2710
.	3285	2.0000	0.6858	1758	4194	2645

Input units are thousands and kg - output in tonnes

Fmult corresponding to Fpa = 1.08

.	3285	1.08	0.3703	1072	4912	3315

Fmult corresponding to Ftransition = 0.91

.	3285	0.91	0.312	925	5067	3460

Fmult corresponding to Fmsy = 0.90

.	3285	0.904	0.31	920	5073	3465

Bpa = 2 200 t

Table 7.13.16 - Sole in VIIfg. Detailed results

MFDP version 1a
Run: Sol7FG_fin
Time and date: 19:52 10/05/2013
Fbar age range: 4-8

Year: **2013** F multiplier: 1 Fbar: 0.343

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.000	0	0	4848	436	0	0	0	0
2	0.061	375	65	6640	1051	930	147	930	147
3	0.219	606	135	3230	677	1454	305	1454	305
4	0.323	162	44	617	160	543	141	543	141
5	0.357	821	262	2865	883	2808	866	2808	866
6	0.413	766	281	2373	843	2373	843	2373	843
7	0.350	112	46	398	159	398	159	398	159
8	0.271	59	27	259	115	259	115	259	115
9	0.190	55	27	333	162	333	162	333	162
10	0.190	162	99	980	580	980	580	980	580
Total		3118	986	22543	5069	10077	3319	10077	3319

Year: **2014** F multiplier: 1 Fbar: 0.343

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.000	0	0	4848	436	0	0	0	0
2	0.061	248	43	4387	695	614	97	614	97
3	0.219	1060	236	5652	1185	2543	533	2543	533
4	0.323	618	168	2348	610	2066	537	2066	537
5	0.357	116	37	404	125	396	122	396	122
6	0.413	586	215	1814	645	1814	645	1814	645
7	0.350	401	165	1421	569	1421	569	1421	569
8	0.271	58	26	254	113	254	113	254	113
9	0.190	29	15	179	87	179	87	179	87
10	0.190	162	99	982	581	982	581	982	581
Total		3278	1004	22288	5046	10269	3285	10269	3285

Year: **2015** F multiplier: 1 Fbar: 0.343

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.000	0	0	4848	436	0	0	0	0
2	0.061	248	43	4387	695	614	97	614	97
3	0.219	700	156	3734	783	1680	352	1680	352
4	0.323	1082	294	4108	1068	3615	940	3615	940
5	0.357	441	141	1538	474	1507	465	1507	465
6	0.413	83	30	256	91	256	91	256	91
7	0.350	307	126	1086	435	1086	435	1086	435
8	0.271	205	94	906	403	906	403	906	403
9	0.190	29	14	175	85	175	85	175	85
10	0.190	143	87	869	514	869	514	869	514
Total		3237	986	21906	4984	10708	3382	10708	3382

Input units are thousands and kg - output in tonnes

Table 7.13.17 **Sole VIIf,g**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2009	2010	2011	2012	2013
Stock No. (thousands) of 1 year-olds	1237	4130	7338	4848	4848
Source	XSA	XSA	XSA	GM71-10	GM71-10
Status Quo F:					
% in 2013 landings	4.5	13.7	6.6	0.0	-
% in 2014 landings	3.7	16.7	23.5	4.3	0.0
% in 2013 SSB	4.2	9.2	4.4	0.0	-
% in 2014 SSB	3.7	16.4	16.2	3.0	0.0
% in 2015 SSB	2.7	13.7	27.8	10.4	2.9

GM : geometric mean recruitment

Sole VIIf,g : Year-class % contribution to

a) 2014 landings **b) 2015 SSB**

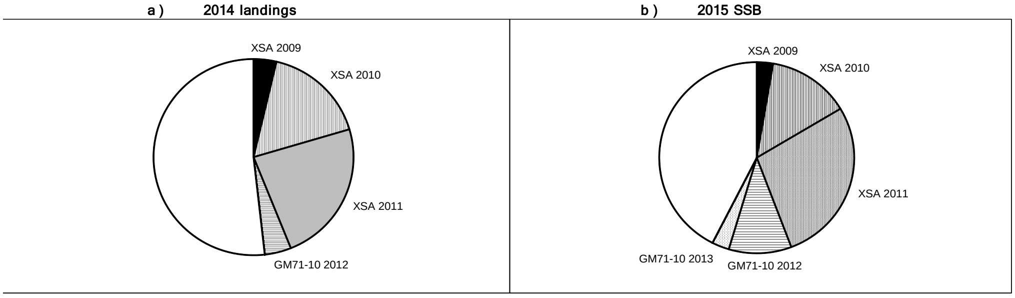


Table 7.13.18 - Sole in VIIfg Yield per recruit summary table

MFYPR version 2a
Run: Sol7FG_yield_fin
Time and date: 11:27 11/05/2013
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	10.5083	4.2062	8.1776	3.8713	8.1776	3.8713
0.1000	0.0343	0.1712	0.0715	8.7980	3.2610	6.4732	2.9276	6.4732	2.9276
0.2000	0.0686	0.2896	0.1154	7.6165	2.6215	5.2976	2.2895	5.2976	2.2895
0.3000	0.1029	0.3751	0.1432	6.7632	2.1699	4.4500	1.8393	4.4500	1.8393
0.4000	0.1372	0.4391	0.1610	6.1255	1.8403	3.8179	1.5111	3.8179	1.5111
0.5000	0.1714	0.4883	0.1726	5.6354	1.5934	3.3333	1.2655	3.3333	1.2655
0.6000	0.2057	0.5270	0.1802	5.2500	1.4043	2.9532	1.0776	2.9532	1.0776
0.7000	0.2400	0.5581	0.1850	4.9409	1.2567	2.6494	0.9313	2.6494	0.9313
0.8000	0.2743	0.5836	0.1880	4.6886	1.1396	2.4023	0.8154	2.4023	0.8154
0.9000	0.3086	0.6047	0.1898	4.4797	1.0452	2.1985	0.7223	2.1985	0.7223
1.0000	0.3429	0.6224	0.1908	4.3042	0.9683	2.0279	0.6465	2.0279	0.6465
1.1000	0.3772	0.6375	0.1912	4.1550	0.9046	1.8836	0.5841	1.8836	0.5841
1.2000	0.4115	0.6505	0.1912	4.0267	0.8515	1.7601	0.5320	1.7601	0.5320
1.3000	0.4458	0.6618	0.1909	3.9153	0.8065	1.6534	0.4882	1.6534	0.4882
1.4000	0.4801	0.6718	0.1905	3.8177	0.7682	1.5603	0.4509	1.5603	0.4509
1.5000	0.5143	0.6806	0.1900	3.7313	0.7352	1.4785	0.4190	1.4785	0.4190
1.6000	0.5486	0.6884	0.1894	3.6544	0.7065	1.4060	0.3913	1.4060	0.3913
1.7000	0.5829	0.6955	0.1887	3.5854	0.6813	1.3414	0.3672	1.3414	0.3672
1.8000	0.6172	0.7019	0.1880	3.5231	0.6592	1.2833	0.3460	1.2833	0.3460
1.9000	0.6515	0.7077	0.1873	3.4664	0.6394	1.2309	0.3273	1.2309	0.3273
2.0000	0.6858	0.7130	0.1867	3.4147	0.6218	1.1833	0.3106	1.1833	0.3106

Reference point	F multiplier	Absolute F
Fbar(4-8)	1.0000	0.3429
FMax	1.1506	0.3945
F0.1	0.5033	0.1726
F35%SPR	0.4603	0.1578

Figure 7.13.1 - Sole in VIIfg. Dotted lines give the length distributions of UK (England and Wales) landings; solid lines of Belgian landings

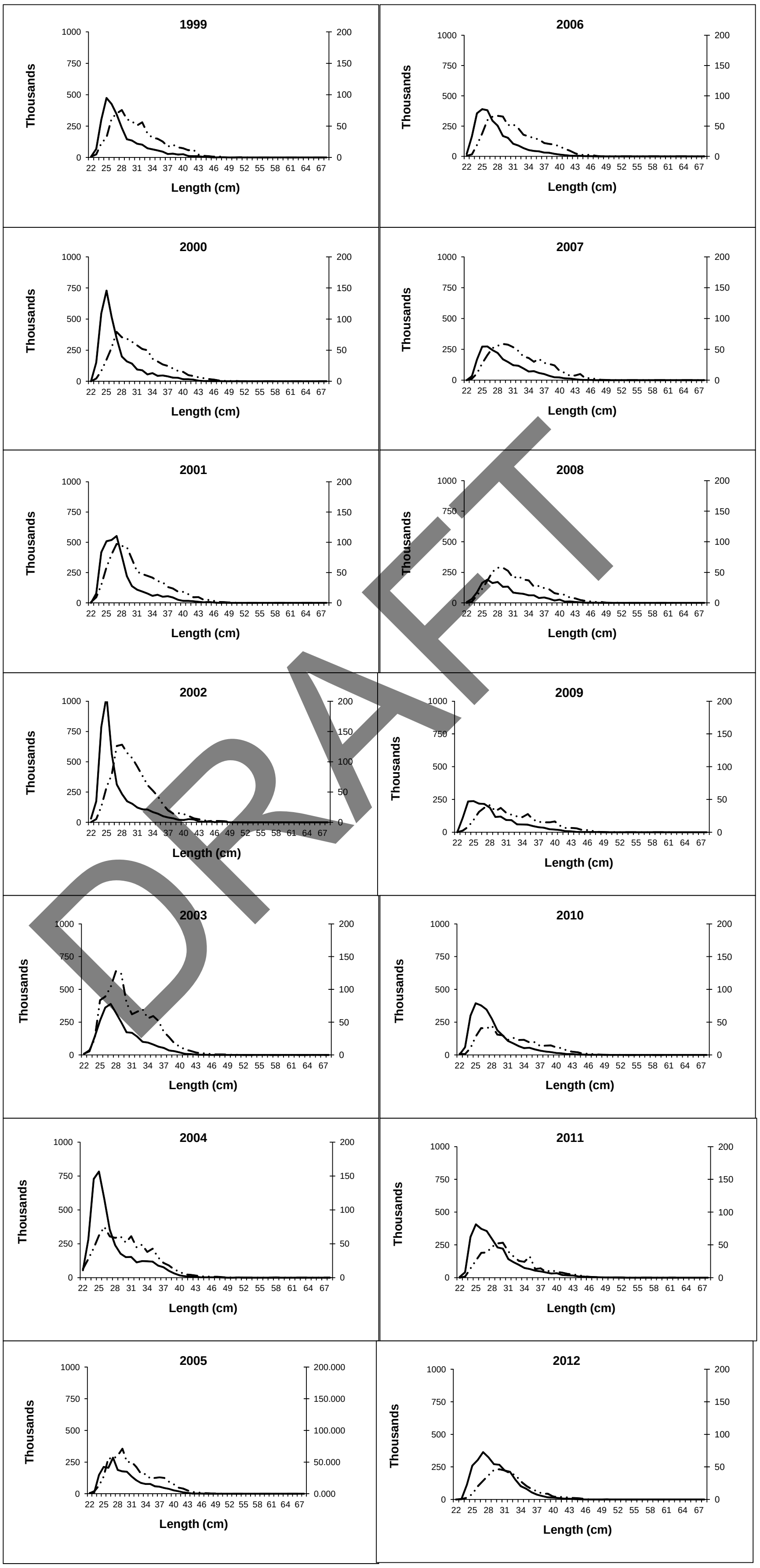


Figure 7.13.2 - Sole in VIIfg. Age composition of landings

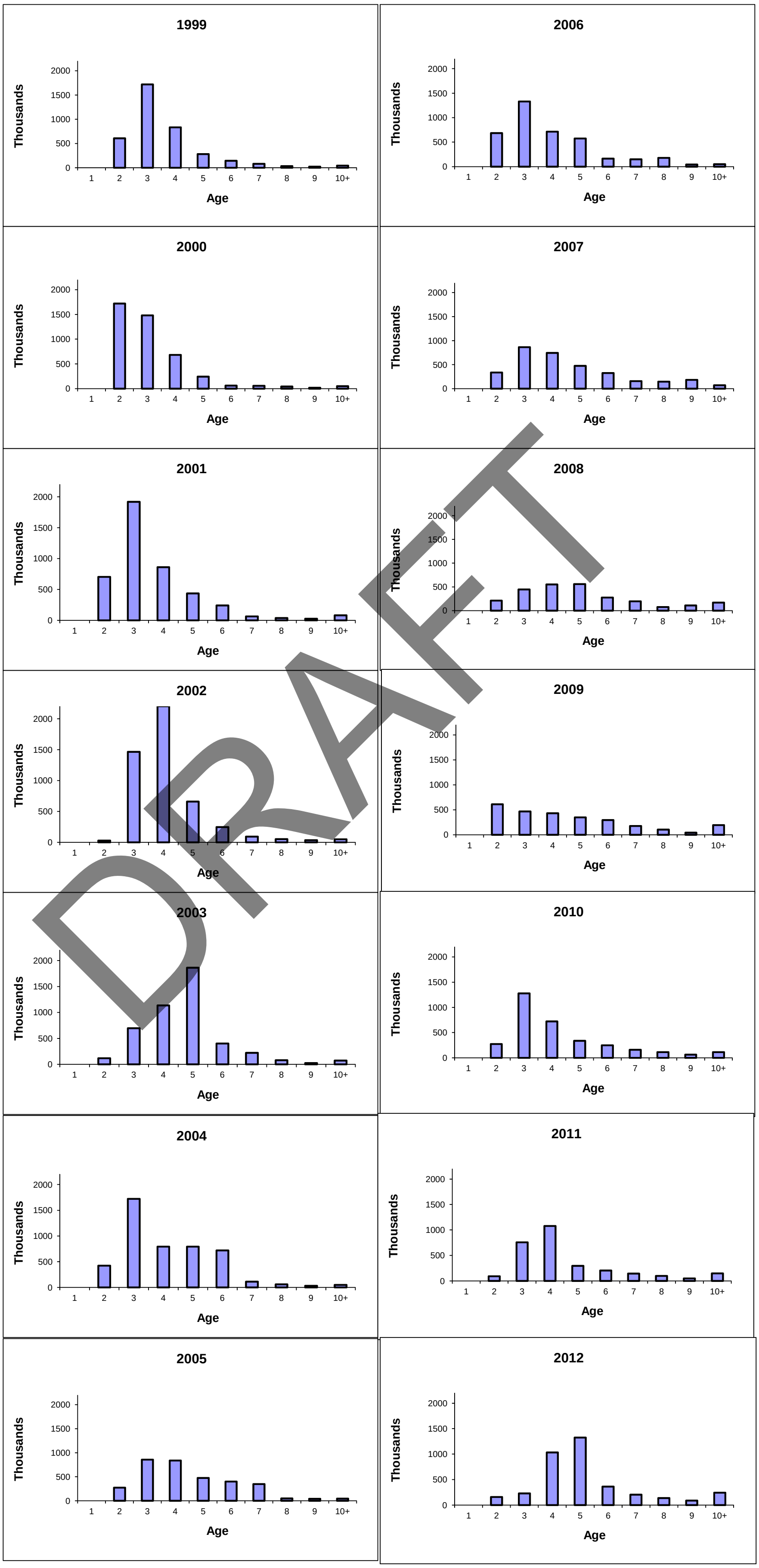


Figure 7.13.3 - Sole VIIfg - Standardized catch proportion

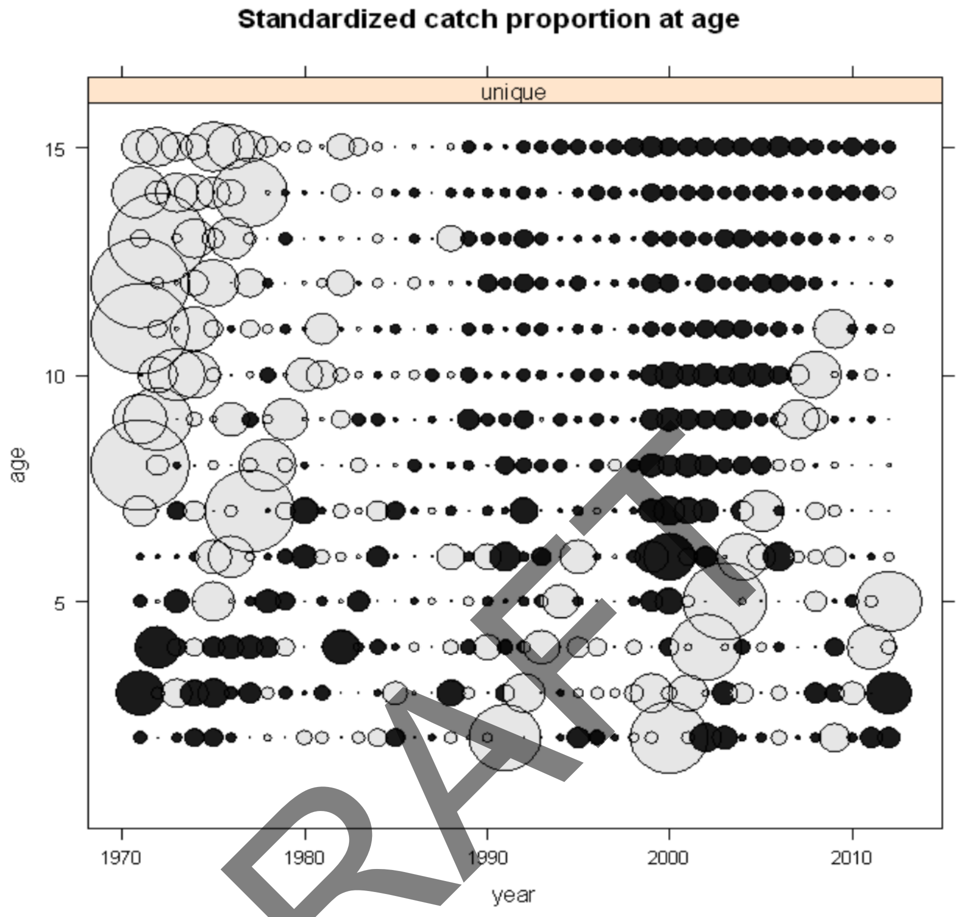


Figure 7.13.4a - Sole VIIf - BE Length distributions of discarded and retained fish from discard sampling studies

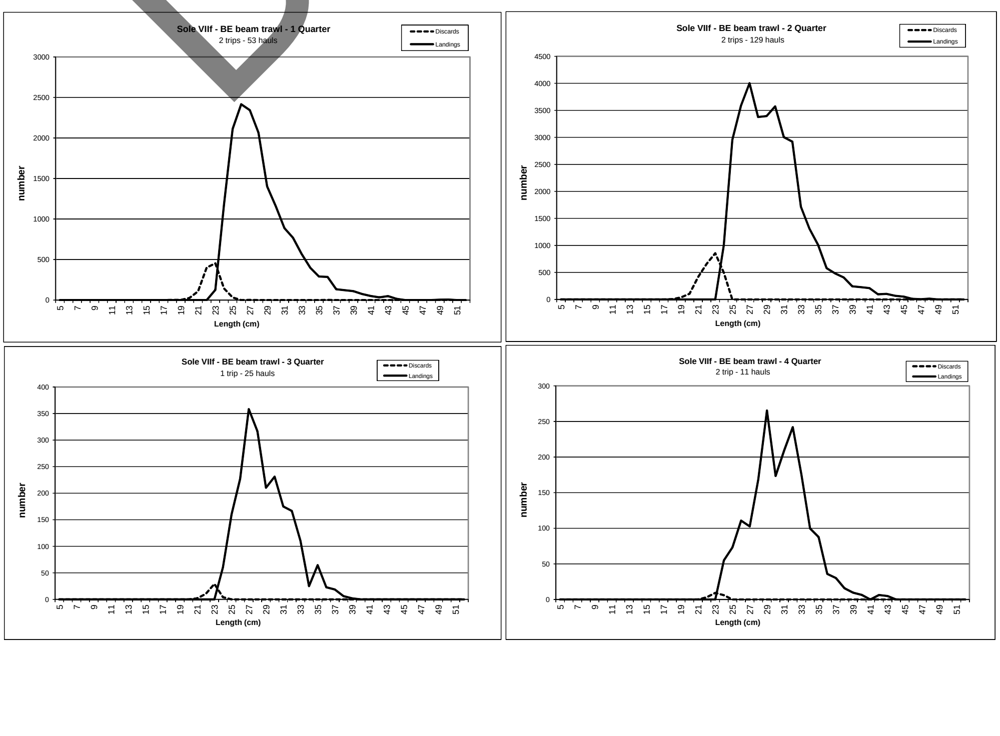


Figure 7.13.4a -continued - Sole VIIg - BE Length distributions of discarded and retained fish from discard sampling studies

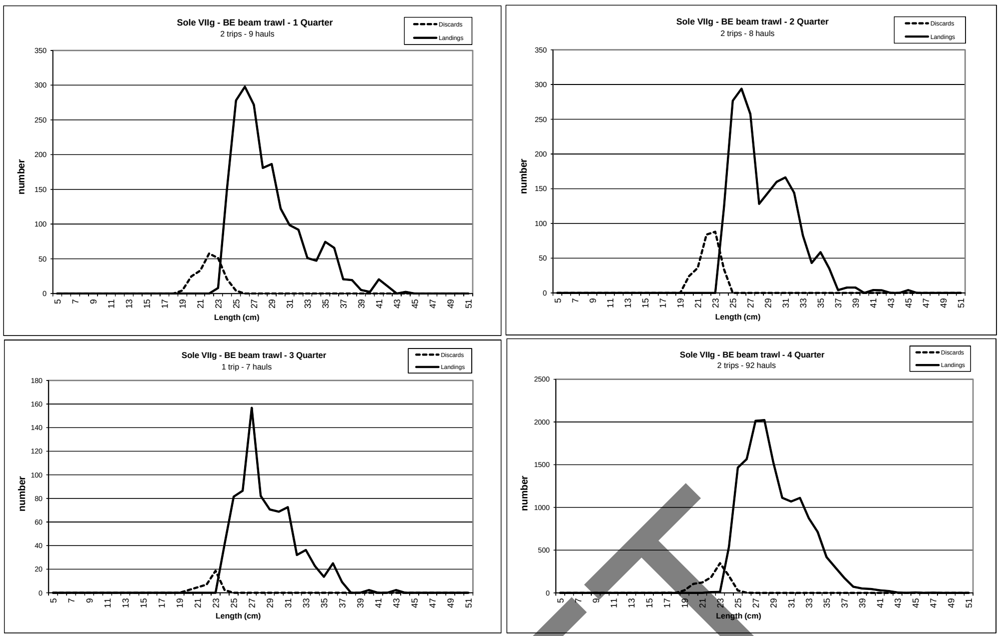


Figure 7.13.4b - Sole VIIfg - UK (E+W) Length distributions of discarded and retained fish from discard sampling studies

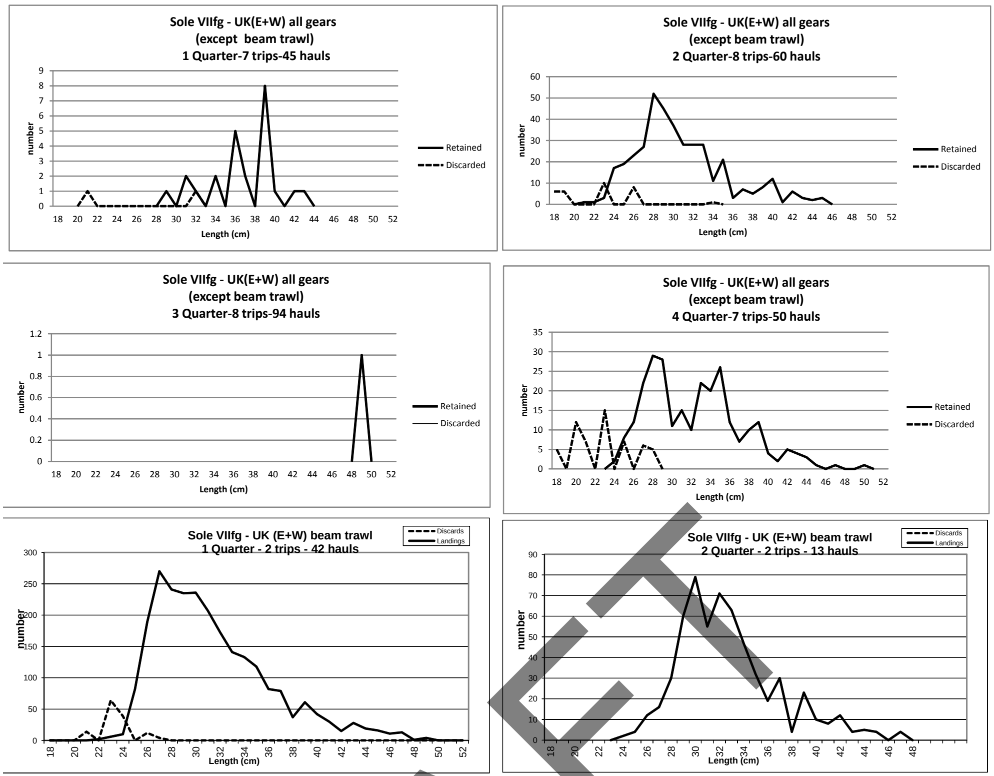


Figure 7.13.4c - Sole VIIfg - IRL Length distributions of discarded and retained fish from discard sampling studies

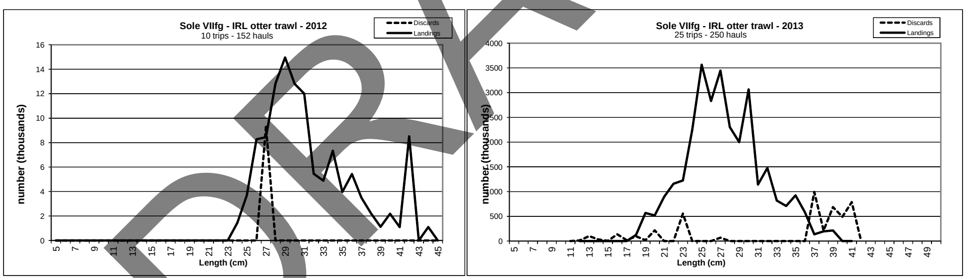
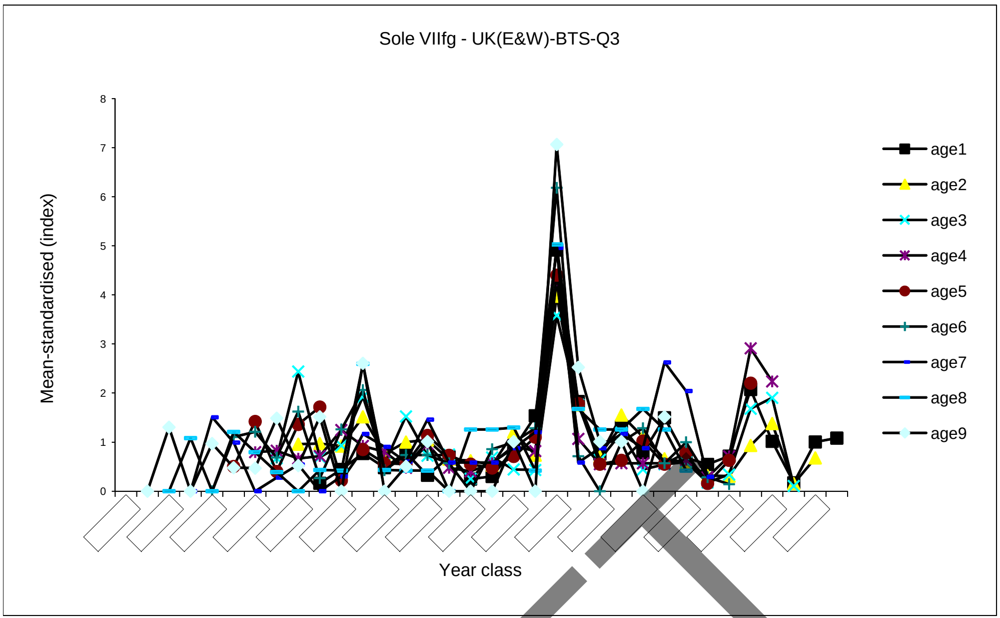


Figure 7.13.5 - Sole VIIfg - Mean-standardised index of UK(E&W) VIIfg Corystes survey



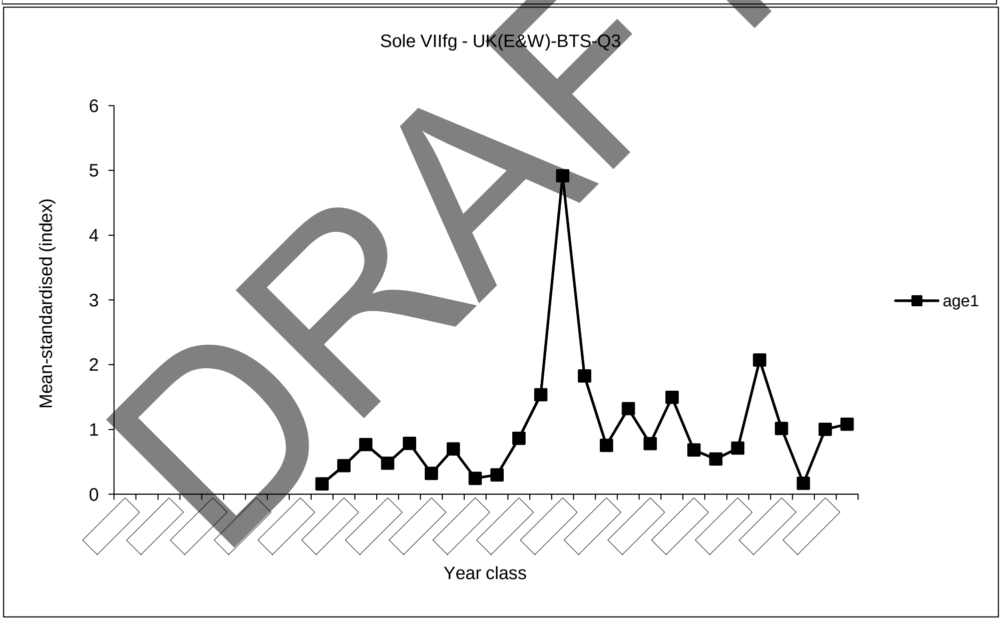


Figure 7.13.6 - Sole in VIIfg - Consistency plot UK(E&W)-BTS-Q3 survey

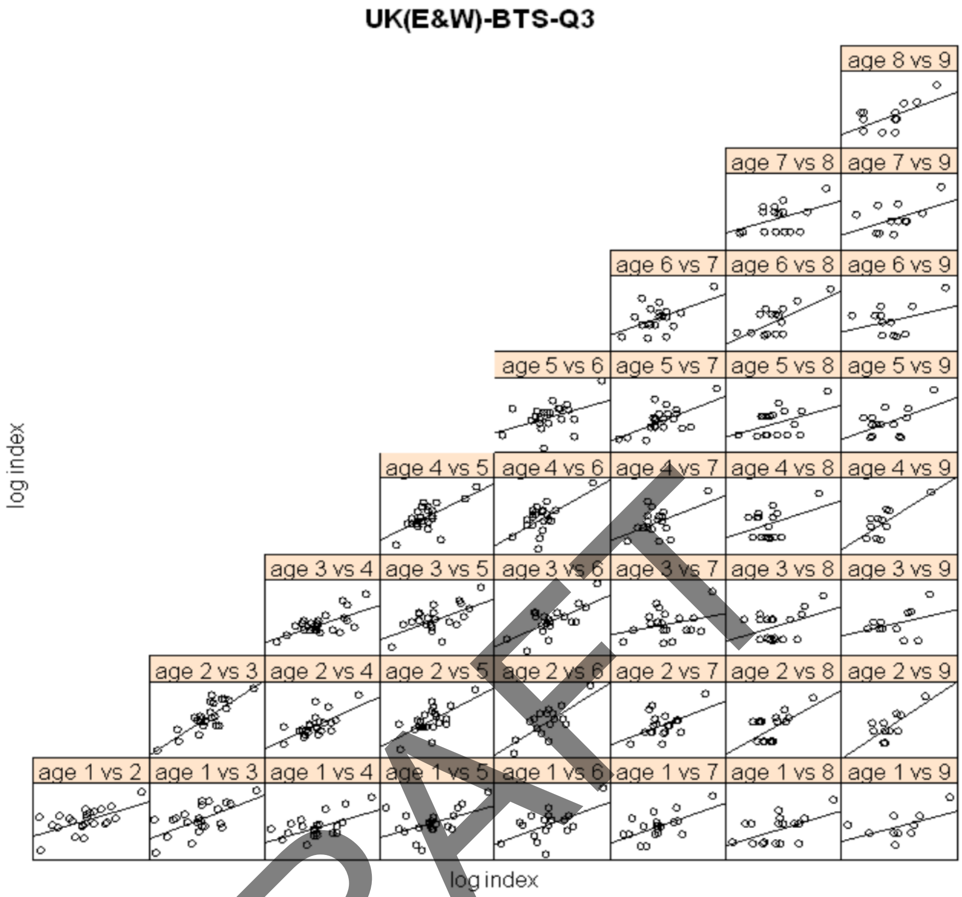


Figure 7.13.7 - Sole in VIIfg. Effort (in thousand hours, GRT corrected in case of E&W beam trawl fleet) and LPUE (in kg/hour; or in kg/100km in case of UK(BTS-3Q) survey) for three beam trawl fleets and one survey.

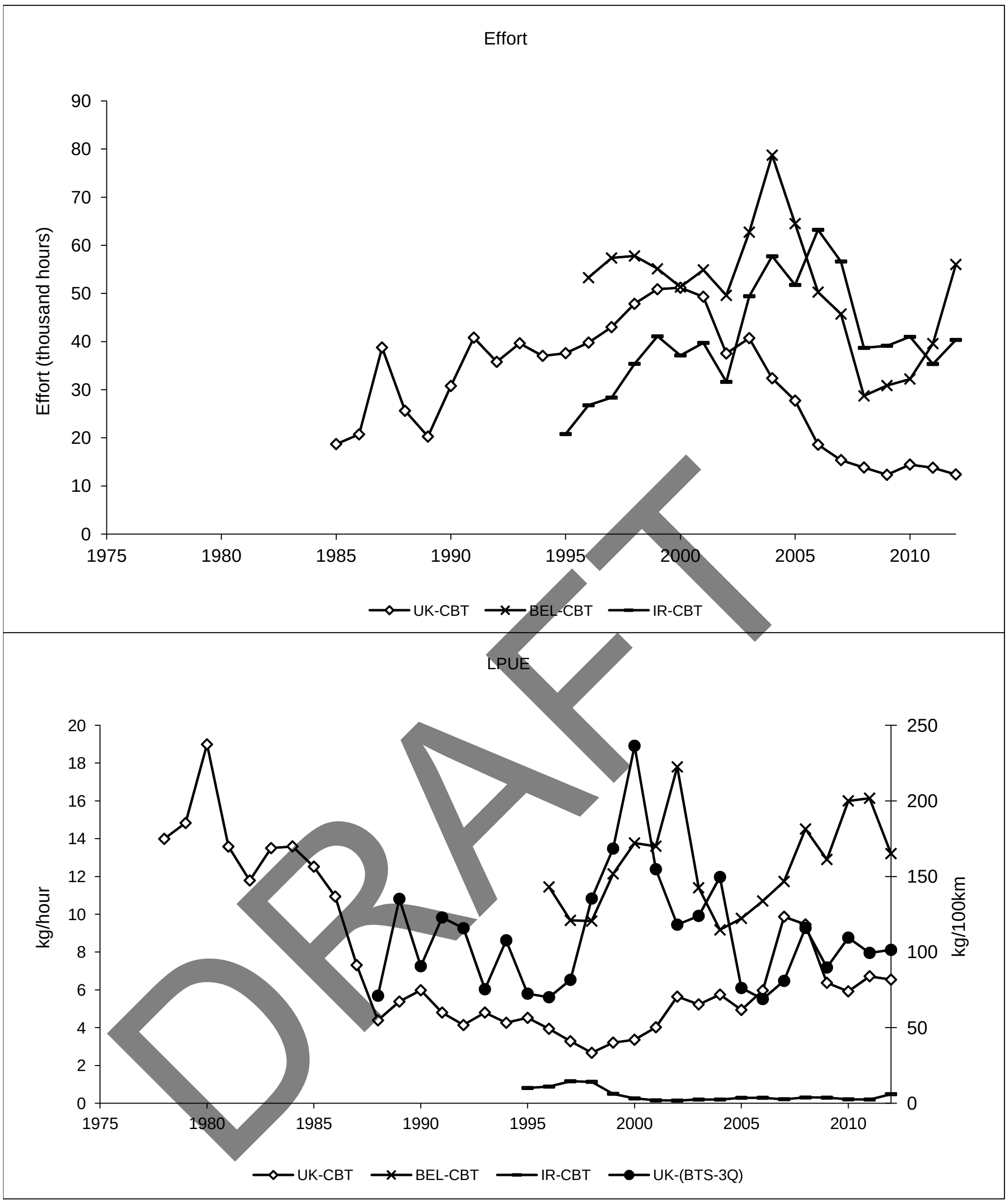


Figure 7.13.8 - Sole in VIIfg - Consistency plot Uk(E&W) beam trawl

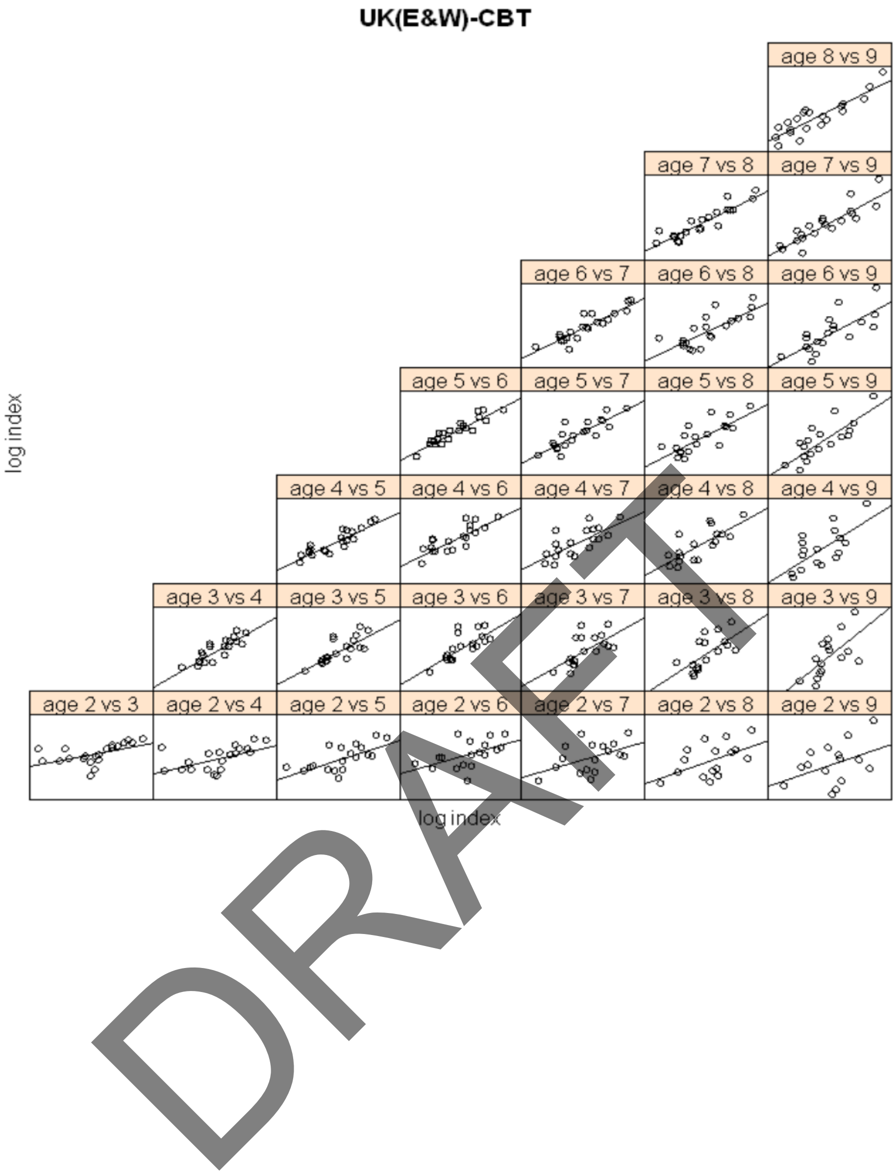


Figure 7.13.9 - Sole in VIIfg - Consistency plot Belgian beam trawl

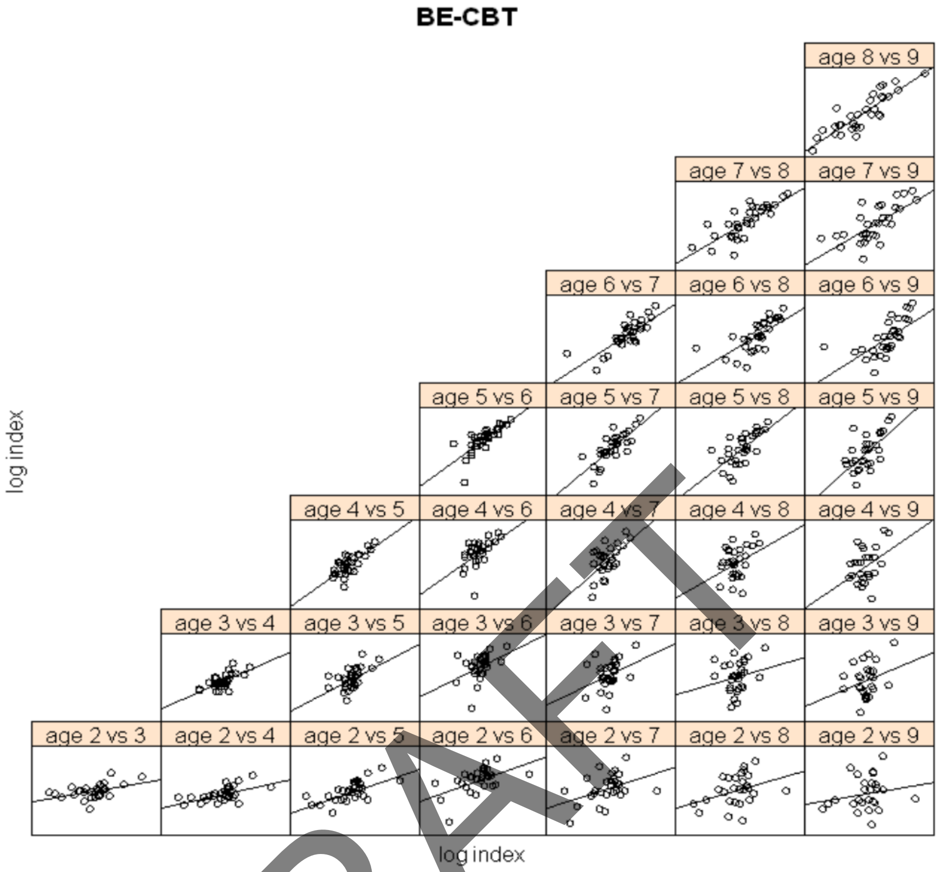
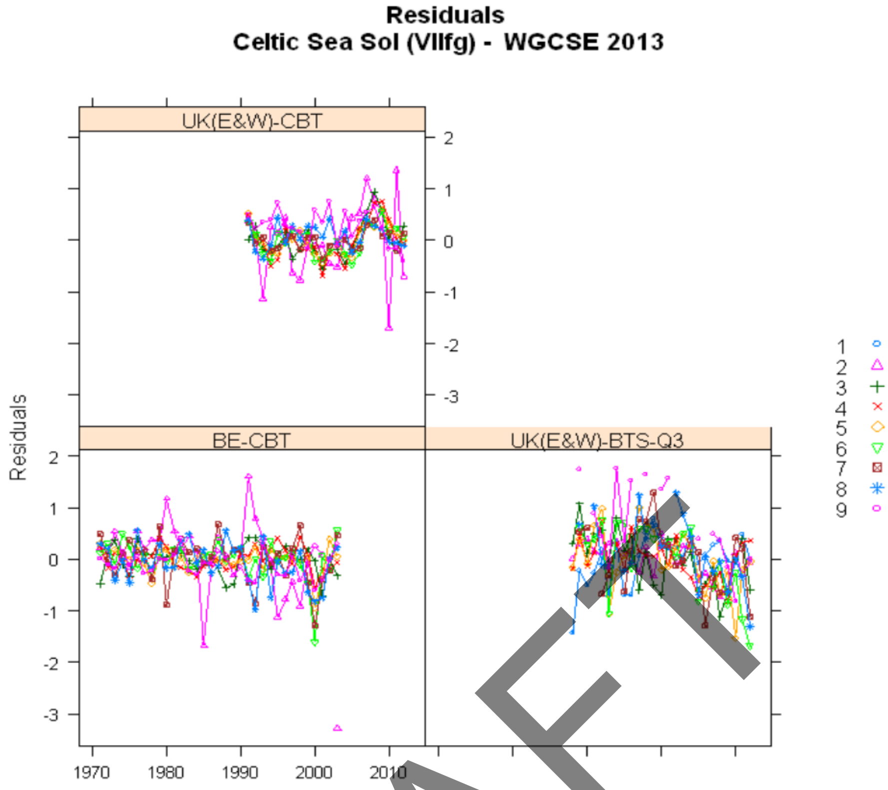


Figure 7.13.10 - Sole in VIIfg. Catchability residuals for final XSA run



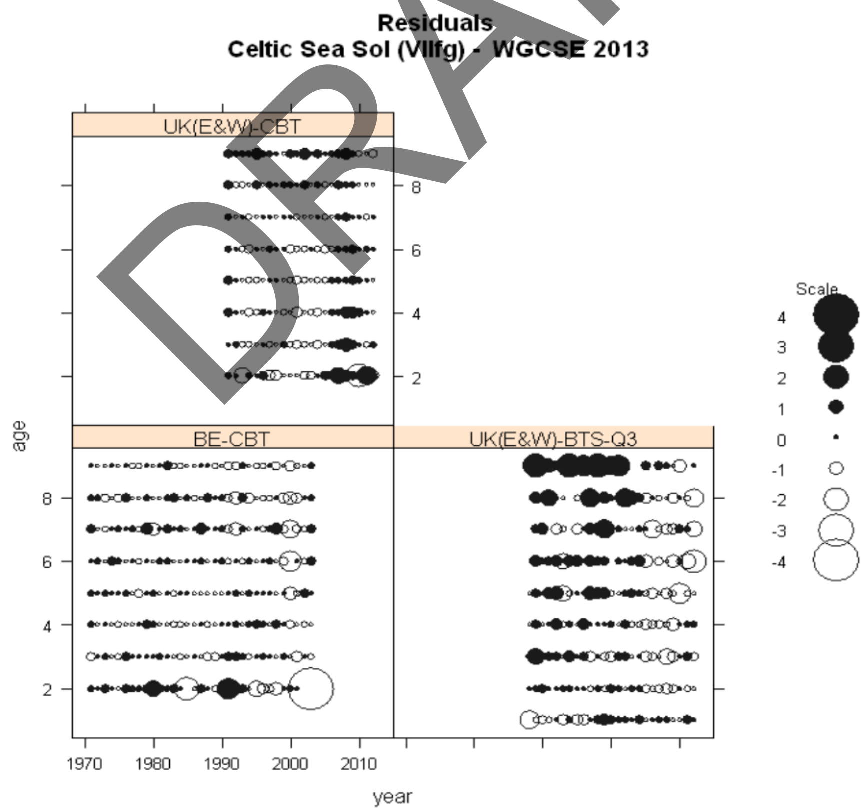


Figure 7.13.11 - Sole in VIIfg. Estimates of survivors from different fleets and shrinkage, as well as their different weighting in the final XSA-run

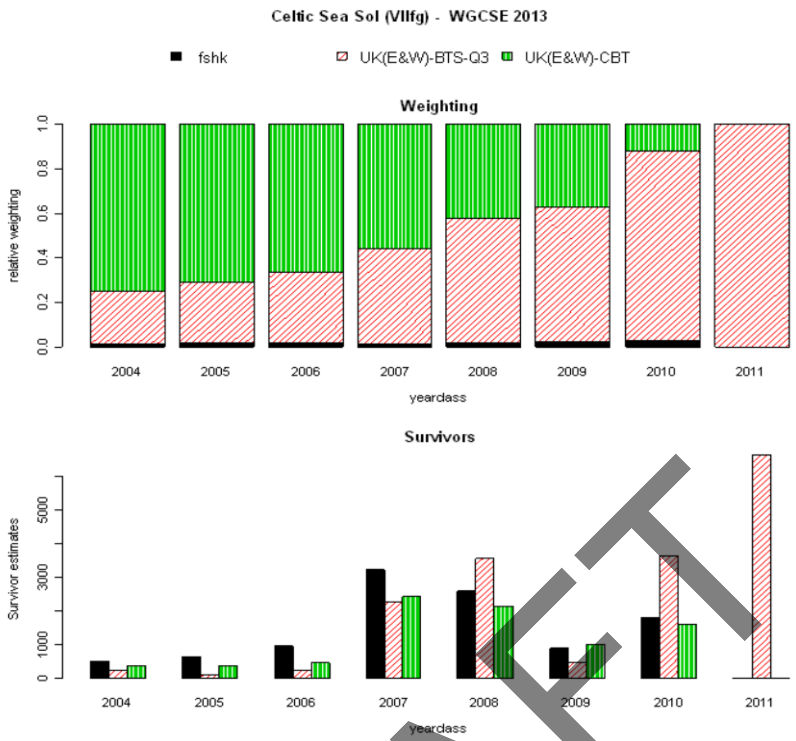


Figure 7.13.12 - Sole VIIf,g retrospective XSA analysys (shinkage SE=1.5)

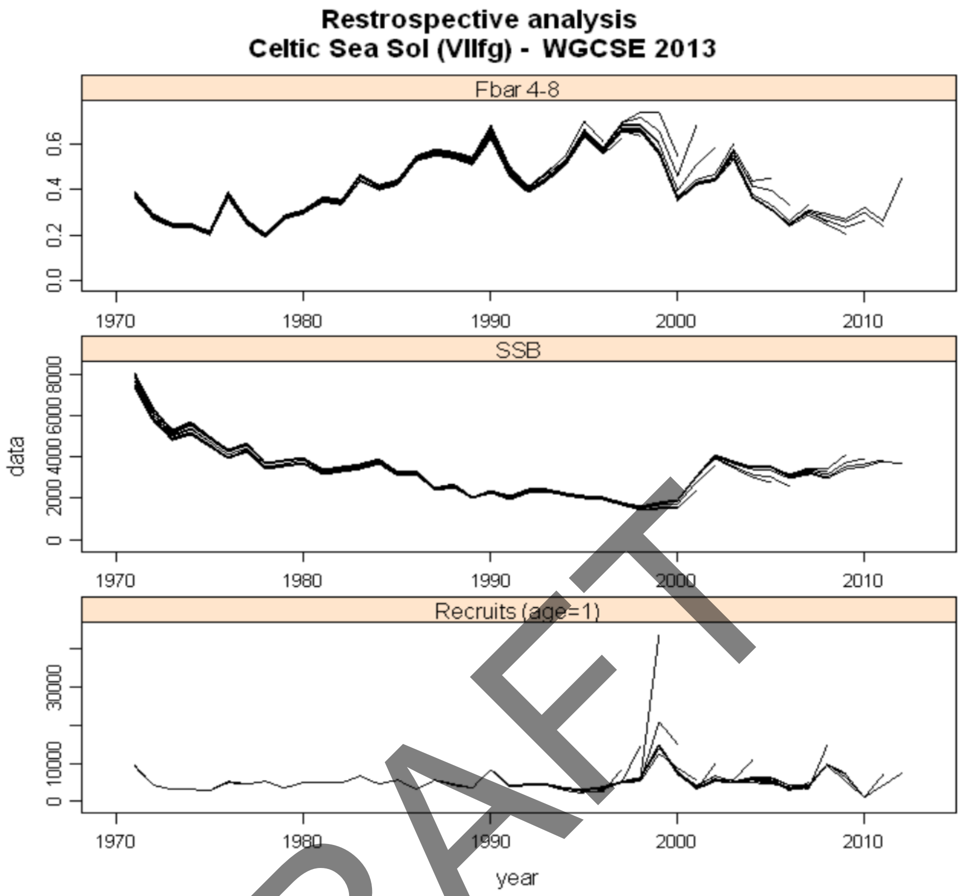
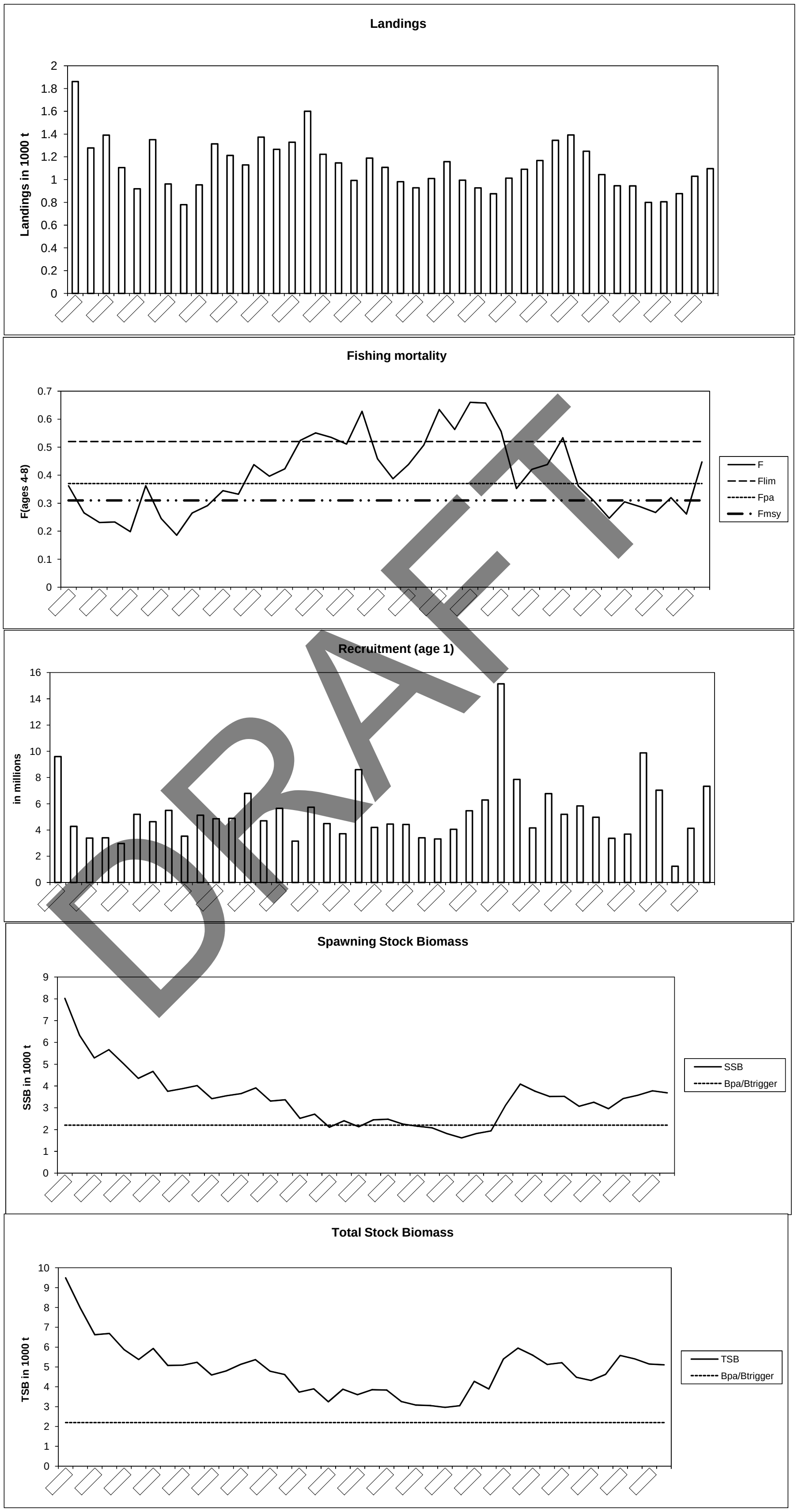


Figure 7.13.13 Sole in VIIfg. Summary plots



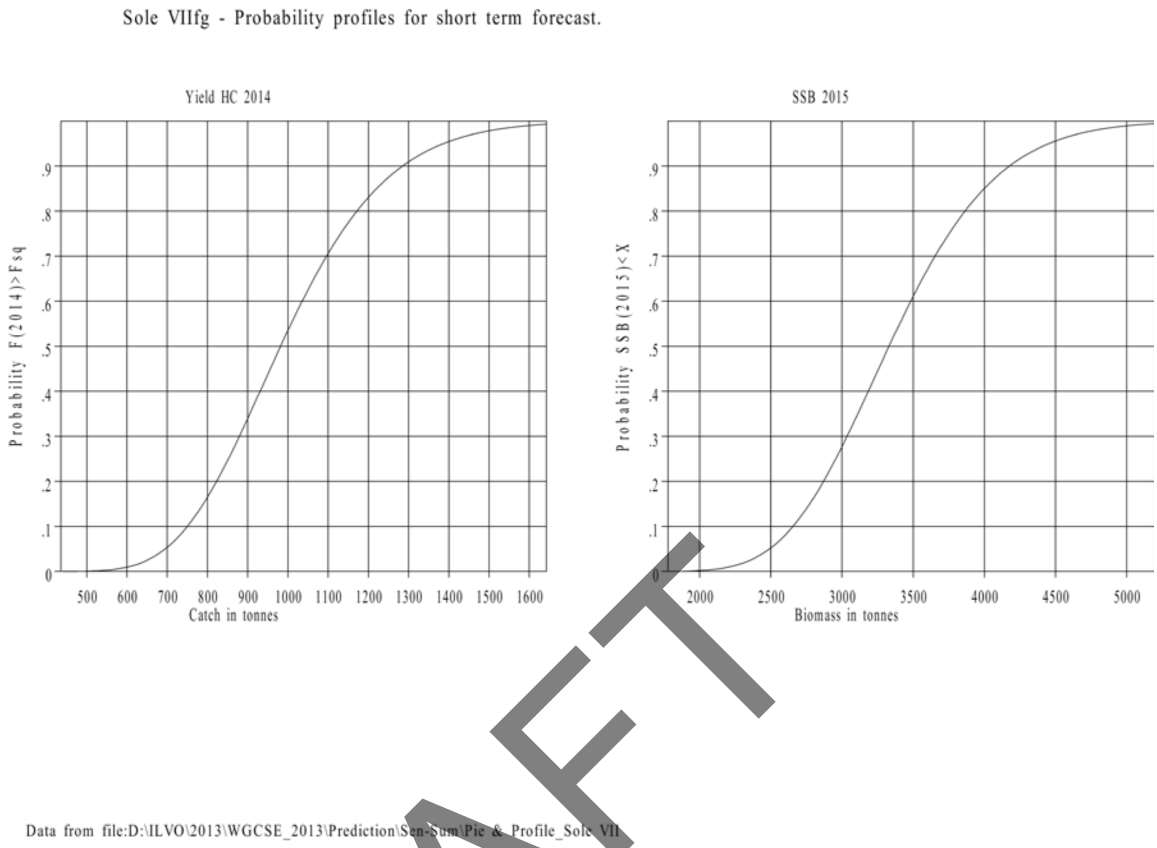
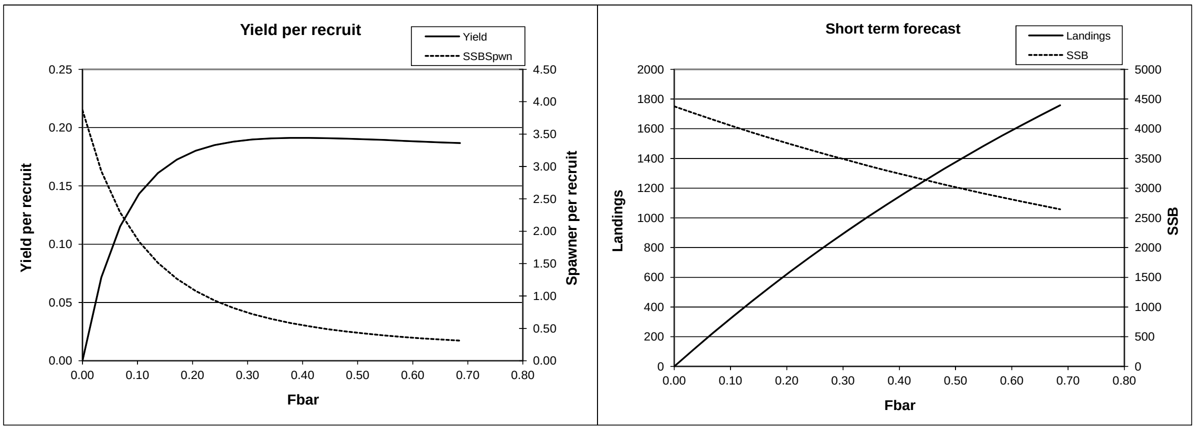


Figure 7.13.14. Sole VIIfg Probability profiles for short-term forecast.

Figure 7.13.15 - Sole in VIIfg Yield per recruit and short term forecast plots



MFYPR version 2a
Run: Sol7FG_yield_fin
Time and date: 11:27 11/05/2013

Reference point	F multiplier	Absolute F
Fbar(4-8)	1.0000	0.3429
FMax	1.1506	0.3945
F0.1	0.5033	0.1726
F35%SPR	0.4603	0.1578

MFDP version 1a
Run: Sol7FG_fin
Sole in VIId
Time and date: 19:52 10/05/2013
Fbar age range: 4-8

Input units are thousands and kg - output in tonnes

Figure 7.13.16 - Sole in VIIfg. Three year average exploitation pattern, standardised to Fbar (4-8)

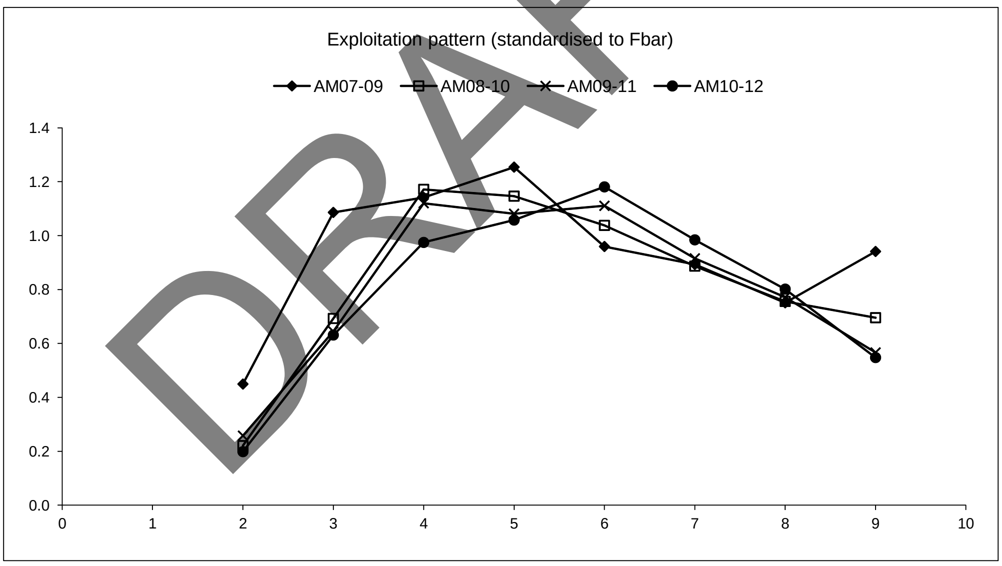
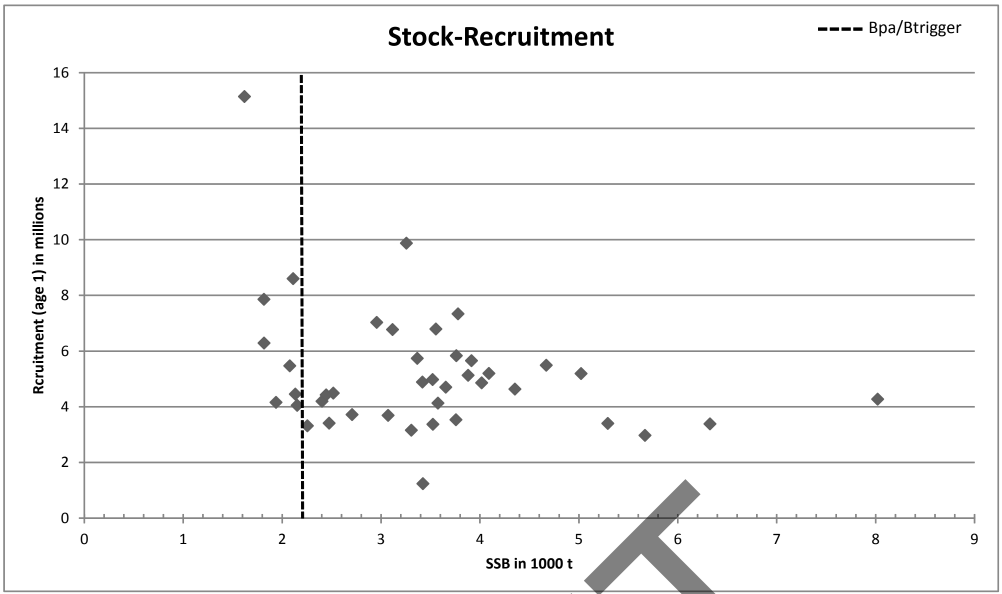


Figure 7.13.17 - Sole VIIfg - Stock/recruiment plot



7.14 Sole in the Southwest of Ireland (ICES Divisions VIIh–k)

Type of assessment in 2013

A separable VPA assessment was performed for the VIIjk component of the landings.

ICES advice applicable to 2013

"Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 200 t.

Management of sole should take into account the advice for reduced bycatches and discards of plaice in this management area.

This is the first year ICES is providing quantitative advice for data-limited stocks."

7.14.1 General

Stock description and management units

Sole in VIIj are mainly caught by Irish vessels on sandy grounds off the southwest of Ireland. Catches in VIIk are negligible. VIIh is also considered part of the stock for assessment purposes but there is no evidence to suggest that this is actually the same stock (Figure 7.14.1). Irish VMS and logbook data indicate that the VIIj landings occur close to shore and this species is a small (but valuable) component (up to 5%) of the landings in a mixed fishery. (Figure 7.14.2).

The TAC is set for Divisions VIIh,j and k. However, because no age-disaggregated data are available for VIIh, the assessment is performed for VIIjk only.

Species:	Common sole *Solea solea*	Zone:	VIIh, VIIj and VIIk (SOL/7HJK.)
Belgium	33		
France	67		
Ireland	181		
The Netherlands	54		
United Kingdom	67		
Union	402		
TAC	402		Analytical TAC Article 11 of this Regulation applies.

Article 11 refers to the closure of the Porcupine bank in May and July.

Data

The nominal landings are given in Table 7.14.1. Because age data were only available for Irish landings (which were mainly from VIIjk) the remainder of Section 7.14 concerns VIIjk only.

Table 7.14.2 gives the landings in VIIjk. Generally Ireland has taken around 90% of the landings although in some years Belgium took around 30% of the landings.

The effort and lpue in the rectangles where the vast majority of the landings were taken (31-33D9 and 31E0) have remained relatively stable over time (Figure 7.14.3).

Discarding of sole in VIIjk is not considered to be a problem. In 2012 less than 1% of the catch was discarded (Figure 7.14.4).

Landings numbers-at-age are given in Table 7.14.3 and Figure 7.14.5. Figure 7.14.6 shows a bubble plot of the standardised landings proportions-at-age. The numbers-at-age matrix shows quite good cohort tracking, suggesting that ageing is accurate and that recruitment is variable. Figure 7.14.7 shows the catch curves and the log-catch ratios. The figure suggests that sole are fully recruited to the fishery by age 5 and the selection pattern appears to be flat after this age.

Figure 7.14.8 gives the stock weights (which are the same as the landings weights).

Data quality

Sampling appears to be sufficient to establish landings numbers-at-age.

Historical stock development

Target category: 3.1.0

Indicator to trigger update assessment: Increase in effort targeting sole.

Model used: separable VPA

Software used: FLR with R version 2.15.3 and packages FLCore 2.5.0; FLEDA 2.5 and FLAssess 2.5.0

Because sole in VIIh were not sampled, it would not be appropriate to raise the data to all landings in VIIhjk. Instead, the official International landings figures for VIIjk only were used to raise the age distributions (Table 7.14.2).

No suitable tuning fleets were available; the Irish Groundfish Survey (IGFS Q4 WI-BTS) does not use gear that is suitable for quantifying flatfish abundance and the commercial lpue could change as a result of changes in behaviour of the fishery which only has a minor bycatch of sole.

Exploratory assessment

Several exploratory assessments were carried out by means of a separable VPA. The initial runs explored the age range to be used in the separable and the choices of reference age, final F and S. The results of these are available on the ICES SharePoint site of WGCSE 2013 under data for this stock.

Final assessment

The results of the final separable assessment are given in Table 7.14.5. Age classes 2 to 10+ were included in the model. A terminal S of 1.0 was used because the catch curves and catch ratio plots suggest a flat selection pattern after age 5. A terminal F of 0.15 was chosen because effort has been fairly constant in recent years so one would not expect a strong trend in F in those years. The separable model was applied to the last ten years only because the fishery appeared to have remained stable in this period. The residual pattern resulting from fitting the separable model over the full time-series, suggested a possible change in selection around 2003. The estimated stock numbers, F, selection pattern and catch residuals are given in Table 7.14.5. The residual pattern of the final run is shown in Figure 7.14.7 there is a suggestion of 'blocks' of year and age groups with positive or negative residuals but this pattern persisted with a range of model settings. The patterns did not persist for more than three years. The time-series of F-at-age is shown in Figure 7.14.8. The fishing mortality in 1999 is very high and might indicate problems with the data. The F pattern in the period 1999–2003 was quite noisy.

State of the stock

The summary table with a time-series of landings, recruitment, SSB and F is given in Table 7.14.6 and Figure 7.14.10. Recruitment appears to be stable over the time-series. The SSB has declined from >800 tonnes around 400 t in 2004–2006 but appears to be increasing again in recent years. F appears to stable around 0.15–0.20 in recent years.

The sensitivity of the assessment to the parameter settings was investigated by comparing the results of a range of settings (Figure 7.14.10). Applying the separable model over the full time-series resulted in quite a different perception of SSB. It is probably not appropriate to assume that selection has remained unchanged over the full time-series. The recent trends in SSB were reasonably sensitive to the terminal F however the trend in F appeared to be quite robust to the model settings. Including ages 4–8 resulted in very similar results (except for recruitment which was now at age 4). Including ages 2–15 resulted in a flatter SSB trend.

7.14.2 Short-term projections

Recruitment appears to have been quite stable throughout the time-series. Therefore the recruitment assumption for the short-term forecast was the geometric mean for 1993–2010 (619 t; omitting the last two years). Three year averages were used for F and weights-at-age. The input data for the forecast is given in Table 7.14.7 and the management options are given in 7.12.8. Estimates of the relative contribution of recent cohorts are shown in 7.12.9. GM recruitment assumption does not contribute much to the 2014 landings or the 2015 SSB.

7.14.3 MSY evaluation

A yield-per-recruit was performed with MFDP; the results are shown in Figure 7.14.10. F_{MAX} is poorly defined around 0.39 $F_{0.1}$ and $F_{35\%SPR}$ are at 0.12 and 0.15 respectively. Current F (0.13) is well below F_{MAX} and close to $F_{0.1}$ and $F_{35\%SPR}$.

7.14.4 Biological reference points

No reference points are defined for this stock. WKFRAME (2011) performed a meta-analysis on sole MSY reference points and concluded that for most stocks an F target (ages 3–8) of 0.25 is a good choice.

Uncertainties and bias in the assessment and forecast

The assessment is carried out on the VIIjk part of the stock area only.

There is sufficient contrast in the landings-at-age matrix to inform the model. However there may be some data issues between 1999 and 2003 which result in erratic F estimates. The trend in SSB is broadly in line with lpue trends from the Irish OTB fishery in the rectangles where the majority of the catches are taken (Figure 7.14.3).

Recommendations for the next benchmark

This stock is not due to be benchmarked; however WKFLAT 2014 will evaluate the inclusion of VIIh sole into sol-celt.

7.14.5 Management considerations

The stock area includes VIIh, however the landings in VIIjk are taken in the northeast of VIIj which is around 250 km away from the north of VIIh where most of the VIIh landings are taken. It is more likely that the VIIh sole are part of the VIIe or VIIf stock.

The catches are taken in a mixed fisheries and should be managed as such. Constraining the landings by TAC will not constrain the catches. Because sole are caught in spatially distinct areas, restricting effort in these areas will be more effective than limiting landings. The catches are taken in a mixed fisheries and should be managed as such. Constraining the landings by TAC will not constrain the catches.

Table 7.14.1. Sole in Divisions VII h–k (Southwest Ireland). Nominal landings (t), 1987–2011, as officially reported to ICES.

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Belgium	406	369	210	638	519	290	384	522	576	471
Denmark	-	-	-	-	-	-		-	-	-
France	390	143	207	19	103	23	29	27	107	104
Ireland	108	116	97	152	126	73	109	162	195	172
Netherlands	4	15	2	33	140	60	-	-		
Spain	190	153	152	131	26	1	8	2		
UK - Eng+Wales+N.	.	.	.	.	.	.	.	.	.	.
UK - England & Wal	6	5	24	11	12	11	18	42	83	108
UK - Scotland	-	-	-	-	-	-	-	-	-	-
Total	1104	801	692	984	926	458	548	755	961	855

Country	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Belgium	411	474	318	442	271	254	252	353	358	312
Denmark	-	-	-	-	-	-	-	-	-	-
France	176	120	25	38	44	53	84	66	55	43
Ireland	176	156	201	188	168	182	206	266	306	255
Netherlands	51	194	280	3		-	-	-	-	-
Spain	38					-	-	-	-	-
UK - Eng+Wales+N.	.	.	.	.	.	.	177	144	234	215
UK - England & Wal	129	151	200	261	193	166	.	.	.	.
UK - Scotland	-	-	-	-	-	-	-	-	-	2
Total	981	1095	1024	932	676	655	719	829	953	827

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Belgium	317	338	433	375	368	346	101	8	13	154
Denmark	-	-	-	-	-	-	-	-	-	-
France	44	42	47	50	58	74	.	79	103	108
Ireland	237	184	243	183	203	221	207	111	125	130
Netherlands	-	-	-	70	-	7	1	10	-	-
Spain	-	-	-	-	-	-	-	-	-	1
UK - Eng+Wales+N.	209	172	192	148	113	111	97	95	111	124
UK - England & Wal	.	.	.	.	.	.	.	.	.	.
UK - Scotland	5	2	-	-	-	-	-	-	-	-
Total	812	738	915	826	742	759	406	303	352	517
Unallocated				-383	-178	-336	-25	26	-27	-87
WG estimate				443	564	423	381	329	325	430

Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	170	157	90	36	31	10	11	20	10	17
Denmark	-	-								
France	133	103	93	92	78	57	79	87	90	85
Ireland	105	111	98	63	78	72	60	71	64	85
Netherlands	-	-		1						
Spain	-	-	2							
UK - Eng+Wales+N.	78	79	112	87	91	80	58	51	54	46
UK - England & Wal	.	.								
UK - Scotland	-	-								
Total	486	450	395	279	278	219	208	229	218	233

Table 7.14.2. Official landings of sole in divisions VIIj and VIIk only. * Preliminary data.

Year	Belgium	France	Ireland	Spain	UK	Total
1993	-	1	237	.	8	246
1994	-	0	176	.	2	178
1995	-	3	232	.	6	241
1996	-	2	163	.	1	166
1997	-	2	187	.	2	191
1998	-	9	208	.	2	219
1999	96	0	199	.	1	296
2000	8	6	103	.	0	117
2001	7	13	114	.	0	134
2002	69	23	121	.	0	213
2003	48	20	82	.	0	150
2004	2	7	78	.	0	87
2005	-	7	70	<0.5	0	77
2006	-	11	49	-	1	61
2007	-	9	74	.	0	83
2008	-	8	69	-	0	77
2009	0	9	60	-	0	69
2010	0	14	68	-	0	82
2011	0	23	63	-	0	86
2012*	0	11	83	-	0	94

Table 7.14.3. Landings numbers-at-age for sole in VIIjk.

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1993	33	218	224	77	56	57	32	21	12	11	5	5	5	8	1
1994	23	117	130	69	41	22	19	11	12	13	11	4	3	11	12
1995	0	279	81	174	117	51	15	15	4	22	8	8	2	2	2
1996	12	46	116	80	53	54	31	8	5	6	10	3	5	6	21
1997	39	161	84	110	43	41	38	16	1	0	4	3	3	2	11
1998	23	137	113	59	93	40	43	34	9	5	3	5	3	0	30
1999	51	179	218	187	67	77	30	28	19	2	11	1	0	1	18
2000	39	96	83	42	29	16	21	11	17	8	3	0	2	0	3
2001	65	115	53	49	38	22	22	14	9	4	2	5	3	2	3
2002	13	139	183	66	38	39	15	8	24	8	21	5	6	3	22
2003	2	54	93	128	76	45	18	4	5	9	14	0	3	1	5
2004	7	18	92	48	36	19	14	6	8	1	7	1	4	3	12
2005	9	34	47	65	17	38	21	9	4	4	0	4	4	3	7
2006	13	29	30	28	38	18	16	11	6	4	1	1	1	1	9
2007	1	44	36	30	44	42	21	16	10	4	4	1	3	1	3
2008	1	25	90	43	21	20	25	11	8	5	3	3	2	1	4
2009	0	15	38	76	31	17	17	16	6	6	6	1	1	0	3
2010	5	48	50	54	47	14	9	9	9	6	7	3	3	0	5
2011	1	24	65	46	33	33	14	8	8	8	7	4	2	1	8
2012	1	11	48	71	34	31	26	10	9	7	8	6	3	3	7

Table 7.14.4. Weight-at-age for sole in VIIjk.

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+
1993	0.154	0.221	0.275	0.342	0.412	0.455	0.511	0.496	0.628	0.567	0.762	0.499	0.505	0.777	0.154
1994	0.143	0.233	0.278	0.346	0.421	0.453	0.514	0.552	0.610	0.632	0.632	0.583	0.660	0.845	0.143
1995	0.000	0.194	0.322	0.362	0.338	0.370	0.493	0.452	0.722	0.579	0.401	0.297	0.836	0.350	0.000
1996	0.138	0.169	0.230	0.307	0.435	0.421	0.505	0.587	0.613	0.712	0.755	0.643	0.765	0.723	0.138
1997	0.133	0.200	0.281	0.334	0.409	0.526	0.618	0.592	0.679	0.000	0.691	0.848	0.889	0.695	0.133
1998	0.136	0.223	0.281	0.357	0.379	0.448	0.515	0.554	0.455	0.647	0.497	0.641	0.659	0.000	0.136
1999	0.152	0.192	0.308	0.345	0.400	0.426	0.461	0.575	0.578	0.657	0.449	0.896	0.000	0.832	0.152
2000	0.180	0.210	0.255	0.396	0.416	0.472	0.503	0.489	0.506	0.452	0.555	0.000	0.525	0.000	0.180
2001	0.164	0.228	0.295	0.337	0.394	0.481	0.548	0.530	0.587	0.795	0.542	0.740	0.967	0.867	0.164
2002	0.203	0.198	0.254	0.305	0.469	0.490	0.473	0.654	0.730	0.721	0.626	0.616	1.150	0.643	0.203
2003	0.168	0.191	0.296	0.323	0.329	0.378	0.371	0.575	0.499	0.548	0.477	0.000	0.446	0.779	0.168
2004	0.094	0.199	0.197	0.293	0.313	0.353	0.287	0.584	0.636	0.499	0.595	0.499	0.845	0.457	0.094
2005	0.131	0.168	0.198	0.249	0.383	0.313	0.340	0.446	0.525	0.468	0.000	0.489	0.393	0.437	0.131
2006	0.160	0.180	0.205	0.257	0.298	0.354	0.354	0.377	0.456	0.377	0.612	0.438	0.568	0.508	0.160
2007	0.154	0.208	0.268	0.282	0.329	0.341	0.378	0.395	0.449	0.376	0.418	0.554	0.494	0.594	0.154
2008	0.144	0.204	0.236	0.278	0.305	0.339	0.339	0.395	0.389	0.445	0.560	0.450	0.512	0.457	0.144
2009	0.123	0.196	0.234	0.265	0.268	0.318	0.386	0.420	0.393	0.417	0.368	0.476	0.828	0.000	0.123
2010	0.177	0.197	0.247	0.304	0.331	0.364	0.371	0.400	0.440	0.427	0.512	0.423	0.541	0.503	0.177
2011	0.186	0.207	0.236	0.260	0.298	0.340	0.420	0.479	0.469	0.523	0.580	0.600	0.597	0.485	0.186
2012	0.191	0.216	0.254	0.294	0.320	0.362	0.404	0.423	0.459	0.483	0.461	0.517	0.584	0.681	0.191

Table 7.14.5. Separable VPA stock numbers, F, selection and residuals for sole in VIIjk.

StockN	2	3	4	5	6	7	8	9	10
1993	699	992	788	377	143	166	84	116	262
1994	1146	601	691	500	268	77	97	46	279
1995	453	1014	432	501	387	204	48	69	221
1996	741	410	653	315	289	240	136	29	202
1997	751	659	328	481	208	211	165	93	149
1998	670	642	443	217	331	148	152	114	180
1999	644	583	451	294	141	212	96	97	182
2000	879	534	358	202	90	64	119	58	176
2001	612	758	393	245	143	54	43	87	171
2002	447	492	577	305	175	94	27	18	194
2003	373	661	365	403	214	113	47	11	28
2004	401	334	513	228	224	122	63	26	25
2005	502	360	276	374	156	155	83	42	17
2006	1044	451	300	205	262	110	108	58	13
2007	527	941	389	241	159	204	85	83	15
2008	487	475	810	312	187	124	158	66	14
2009	534	439	410	656	244	147	97	123	12
2010	800	482	381	336	521	195	117	77	19
2011	253	721	413	303	256	400	149	88	21
2012	212	228	623	335	238	202	314	116	23
2013	-	191	197	503	261	186	158	243	109

F	2	3	4	5	6	7	8	9	10
1993	0.05	0.26	0.35	0.24	0.52	0.44	0.50	0.21	0.21
1994	0.02	0.23	0.22	0.16	0.17	0.37	0.23	0.29	0.29
1995	0.00	0.34	0.22	0.45	0.38	0.30	0.39	0.26	0.26
1996	0.02	0.12	0.21	0.31	0.21	0.27	0.28	0.34	0.34
1997	0.06	0.30	0.31	0.27	0.24	0.23	0.27	0.19	0.19
1998	0.04	0.25	0.31	0.33	0.35	0.33	0.35	0.38	0.38
1999	0.09	0.39	0.70	1.09	0.69	0.48	0.40	0.36	0.36
2000	0.05	0.21	0.28	0.24	0.41	0.30	0.20	0.22	0.22
2001	0.12	0.17	0.15	0.24	0.32	0.57	0.76	0.19	0.19
2002	0.03	0.35	0.41	0.26	0.26	0.56	0.85	0.65	0.65
2003	0.01	0.15	0.37	0.49	0.47	0.48	0.51	0.49	0.49
2004	0.01	0.09	0.22	0.28	0.27	0.28	0.29	0.28	0.28
2005	0.01	0.08	0.20	0.26	0.25	0.26	0.27	0.26	0.26
2006	0.00	0.05	0.12	0.16	0.15	0.16	0.16	0.16	0.16
2007	0.00	0.05	0.12	0.16	0.15	0.16	0.16	0.16	0.16
2008	0.00	0.05	0.11	0.14	0.14	0.14	0.15	0.14	0.14
2009	0.00	0.04	0.10	0.13	0.13	0.13	0.14	0.13	0.13
2010	0.00	0.05	0.13	0.17	0.16	0.17	0.18	0.17	0.17
2011	0.00	0.05	0.11	0.14	0.14	0.14	0.15	0.14	0.14
2012	0.00	0.05	0.11	0.15	0.14	0.15	0.16	0.15	0.15

Selection	2	3	4	5	6	7	8	9	10
	0.02	0.32	0.76	1.00	0.96	0.99	1.04	1.00	1.00

Residuals	2	3	4	5	6	7	8	9	10
2003	-1.98	-36.71	-15.35	-20.13	-0.02	3.67	0.46	0.00	
2004	4.52	-8.91	-2.26	-5.65	-14.27	-9.62	-1.56	-0.15	
2005	6.56	7.02	0.26	-16.24	-15.37	5.01	2.08	0.21	
2006	9.21	8.26	-2.42	-0.70	3.02	2.74	0.21	2.88	
2007	-0.71	0.49	-5.93	-3.18	23.29	14.36	8.30	4.39	
2008	-0.35	4.32	8.86	2.48	-1.58	4.48	3.95	2.08	
2009	-1.24	-2.31	1.19	-0.38	3.87	-0.21	4.80	1.51	
2010	1.99	24.21	5.07	3.67	-27.81	-15.32	-9.34	-2.38	
2011	-0.09	-5.96	24.83	8.17	1.77	-17.35	-5.95	-2.73	
2012	0.00	1.28	-16.07	26.33	3.23	4.32	-16.89	-5.62	

Table 7.14.6. Summary table for sol 7jk. Catch/landings in tonnes (7jk only). Recruitment (age 2) in thousands. SSB in tonnes.

YEAR	CATCH	LAND	RECRUIT	SSB	FBAR 3–8
1993	246	246	699	833	0.39
1994	178	178	1146	833	0.23
1995	241	241	453	773	0.35
1996	166	166	741	726	0.23
1997	191	191	751	794	0.27
1998	219	219	670	723	0.32
1999	296	296	644	647	0.62
2000	117	117	879	479	0.27
2001	134	134	612	543	0.37
2002	213	213	447	577	0.45
2003	150	150	373	440	0.41
2004	87	87	401	353	0.24
2005	77	77	502	341	0.22
2006	61	61	1044	350	0.13
2007	83	83	527	452	0.13
2008	77	77	487	492	0.12
2009	69	69	534	509	0.11
2010	82	82	800	572	0.14
2011	86	86	253	565	0.12
2012	94	94	212	601	0.13
	GM 93-10		619		

Table 7.14.7. Input to short-term forecast (.prd).

MFDP version 1a								
Run: mfdp								
Time and date: 15:47 14/05/2013								
Fbar age range: 3-8								
2013								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
2	619	0.1	0.14	0	0	0.184667	0.003574	0.184667
3	191.1887	0.1	0.45	0	0	0.206667	0.049103	0.206667
4	196.6517	0.1	0.88	0	0	0.245667	0.117654	0.245667
5	502.972	0.1	0.98	0	0	0.286	0.154264	0.286
6	260.9604	0.1	1	0	0	0.316333	0.147988	0.316333
7	186.3343	0.1	1	0	0	0.355333	0.15322	0.355333
8	157.7291	0.1	1	0	0	0.398333	0.160516	0.398333
9	243.3658	0.1	1	0	0	0.434	0.154264	0.434
10	108.5674	0.1	1	0	0	0.512678	0.154264	0.512678
2014								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
2	619	0.1	0.14	0	0	0.184667	0.003574	0.184667
3	.	0.1	0.45	0	0	0.206667	0.049103	0.206667
4	.	0.1	0.88	0	0	0.245667	0.117654	0.245667
5	.	0.1	0.98	0	0	0.286	0.154264	0.286
6	.	0.1	1	0	0	0.316333	0.147988	0.316333
7	.	0.1	1	0	0	0.355333	0.15322	0.355333
8	.	0.1	1	0	0	0.398333	0.160516	0.398333
9	.	0.1	1	0	0	0.434	0.154264	0.434
10	.	0.1	1	0	0	0.512678	0.154264	0.512678
2015								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
2	619	0.1	0.14	0	0	0.184667	0.003574	0.184667
3	.	0.1	0.45	0	0	0.206667	0.049103	0.206667
4	.	0.1	0.88	0	0	0.245667	0.117654	0.245667
5	.	0.1	0.98	0	0	0.286	0.154264	0.286
6	.	0.1	1	0	0	0.316333	0.147988	0.316333
7	.	0.1	1	0	0	0.355333	0.15322	0.355333
8	.	0.1	1	0	0	0.398333	0.160516	0.398333
9	.	0.1	1	0	0	0.434	0.154264	0.434
10	.	0.1	1	0	0	0.512678	0.154264	0.512678

Input units are thousands and kg - output in tonnes.

Table 7.14.8. Management options table (.prm).

MFDP VERSION 1A						
Run: mfdp						
SOL7jk, WGCSE, COMBSEX, PLUSGROUP						
Time and date: 15:47 14/05/2013						
Fbar age range: 3-8						
2013						
Biomass	SSB	FMult	FBar	Landings		
719	590	1	0.1305	78		
2014					2015	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
761	594	0	0	0	881	703
.	594	0.1	0.013	8	872	695
.	594	0.2	0.0261	16	864	686
.	594	0.3	0.0391	24	855	678
.	594	0.4	0.0522	32	847	670
.	594	0.5	0.0652	40	839	662
.	594	0.6	0.0783	47	831	654
.	594	0.7	0.0913	55	824	647
.	594	0.8	0.1044	62	816	639
.	594	0.9	0.1174	69	808	632
.	594	1	0.1305	76	801	624
.	594	1.1	0.1435	84	793	617
.	594	1.2	0.1565	90	786	610
.	594	1.3	0.1696	97	779	603
.	594	1.4	0.1826	104	772	596
.	594	1.5	0.1957	111	765	589
.	594	1.6	0.2087	117	758	582
.	594	1.7	0.2218	124	751	575
.	594	1.8	0.2348	130	745	569
.	594	1.9	0.2479	137	738	562
.	594	2	0.2609	143	732	556

Input units are thousands and kg - output in tonnes.

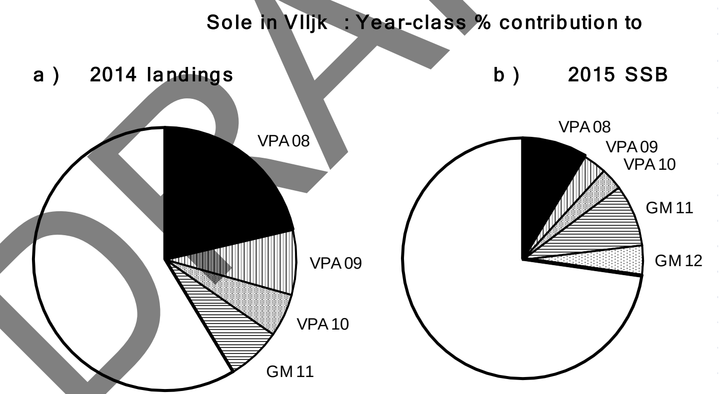
Table 7.14.9. Stock numbers of recruits and their source for recent year classes used in predictions and the relative (%) contributions to landings and SSB (by weight) of these year classes.

Landings yield		
	Years Predicted	
Ages	2013	2014
2	0	0
3	2	5
4	5	4
5	20	6
6	11	16
7	9	10
8	9	8
9	14	7
10	8	19
Tot Wt	78	75

SSB			
	Years Predicted		
Ages	2013	2014	2015
2	16	16	16
3	18	52	52
4	43	36	104
5	141	44	37
6	83	123	39
7	66	72	108
8	63	58	63
9	106	53	48
10	56	140	157
Tot Wt	592	594	1248

Year-class			2008	2009	2010	2011	2012
Recruits (thousands)			800	253	212	619	619
Source			VPA	VPA	VPA	GM	GM
Status Quo F:							
% in	2013	landings	25.6%	6.4%	2.6%	0.0%	-
% in	2014	landings	21.3%	8.0%	5.3%	6.7%	0.0%
% in	2013	SSB	23.8%	7.3%	3.0%	2.7%	-
% in	2014	SSB	20.7%	7.4%	6.1%	8.8%	2.7%
% in	2015	SSB	8.7%	3.1%	3.0%	8.3%	4.2%

GM : geometric mean recruitment



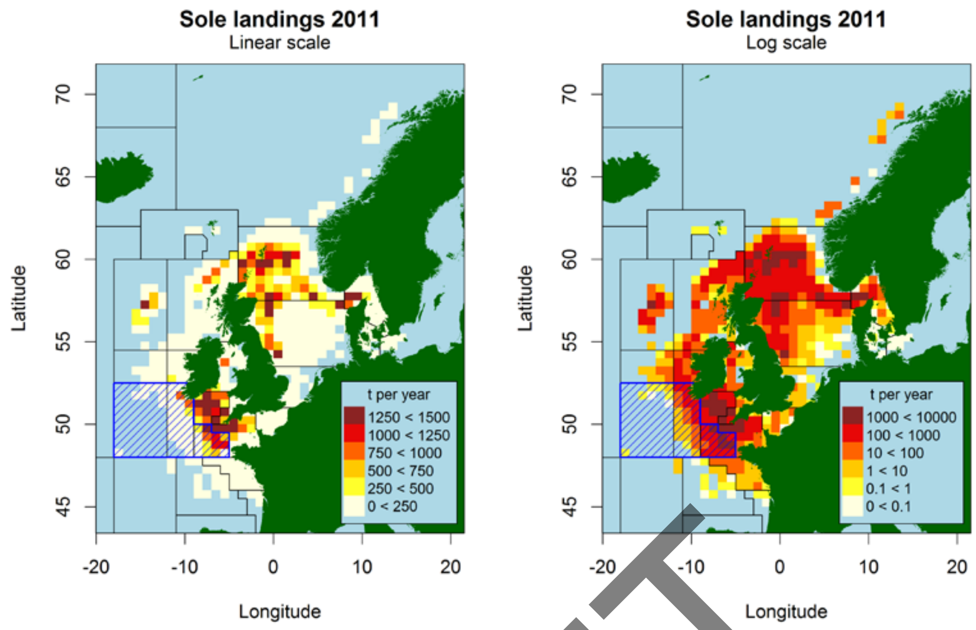


Figure 7.14.1. The spatial distribution of International landings of Sole (all gears combined). The assessment area is outlined in blue. Data from STECF.

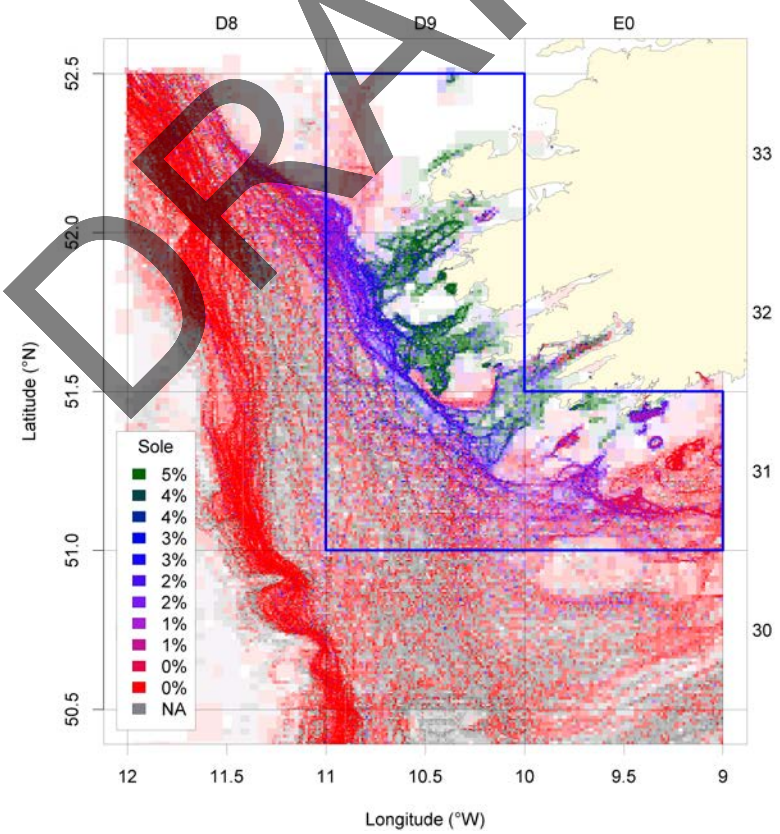


Figure 7.14.2. The proportion of sole in Irish OTB catches in VIIj. The rectangles in blue were used to plot an lpue time-series.

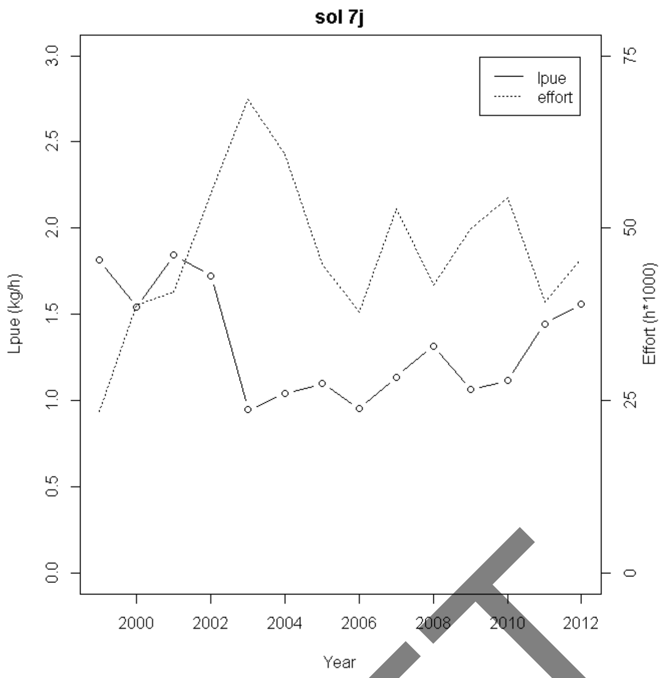


Figure 7.14.3. Irish OTB effort and sole landings from rectangles 31–33D9 and 31E0.

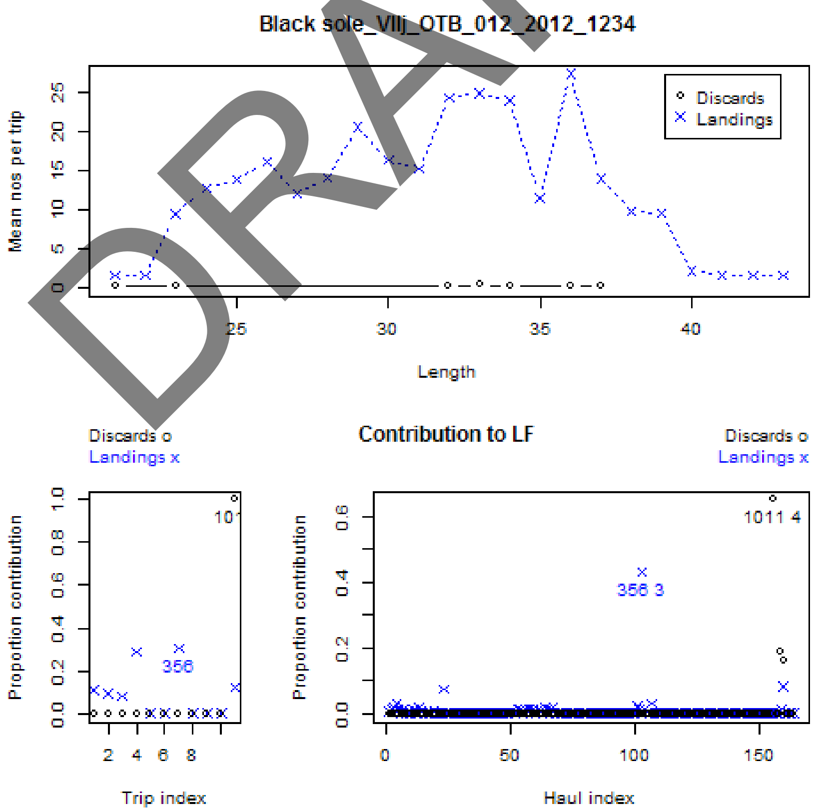


Figure 7.14.4. Irish OTB discards in 7j during 2012. Numbers raised to fleet level using fishing effort (hours fished). Discards were only observed on a single trip, landings were observed on six out of eleven trips but nearly half of the observed landings were from a single haul (haul 3 on trip 356).

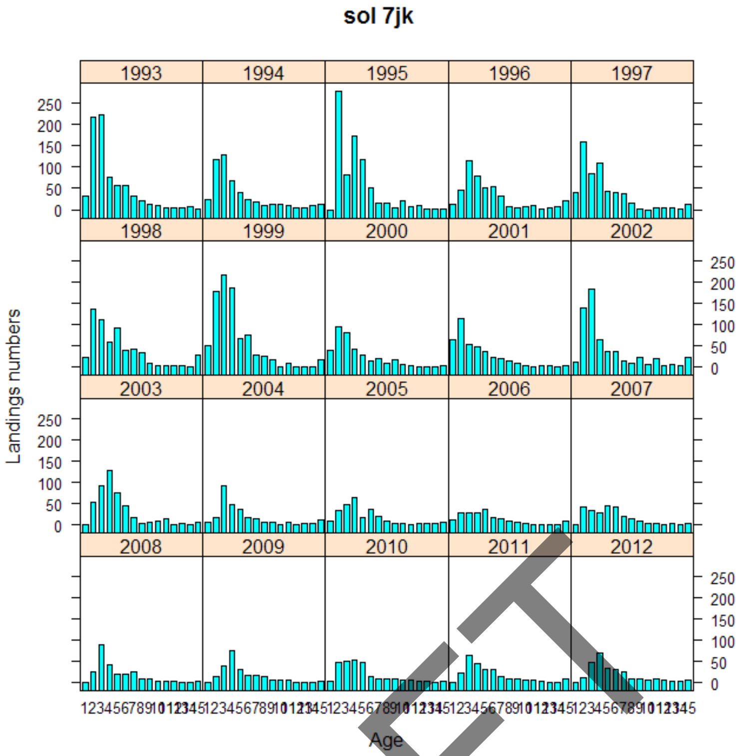


Figure 7.14.5. Age distribution of sole in VIIjk between 1993 and 2012. All gears and quarters combined.

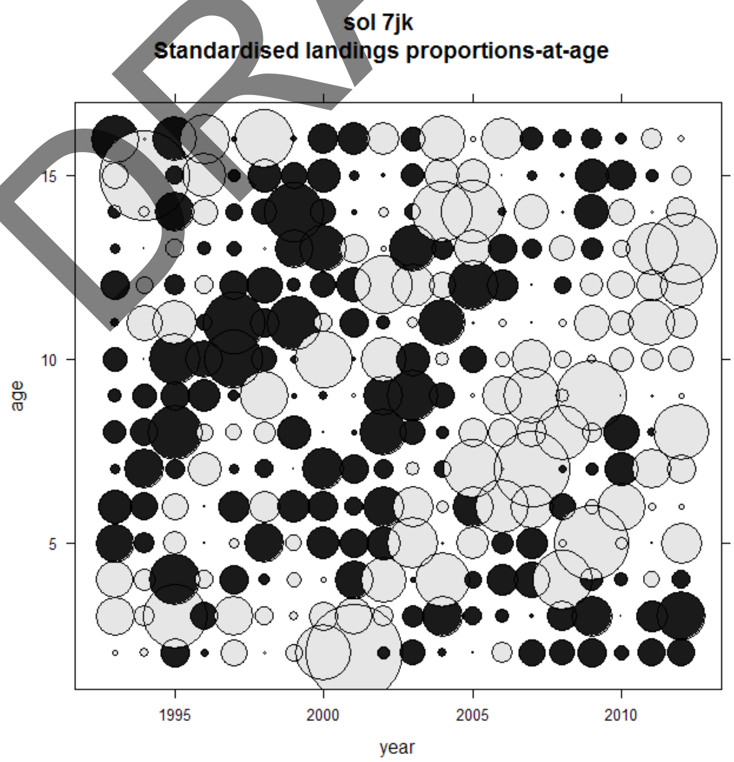


Figure 7.14.6. Standardised catch proportions-at-age for sole in VIIjk. Grey bubbles represent higher than average catch-at-age and black bubbles represent lower than average catch-at-age.

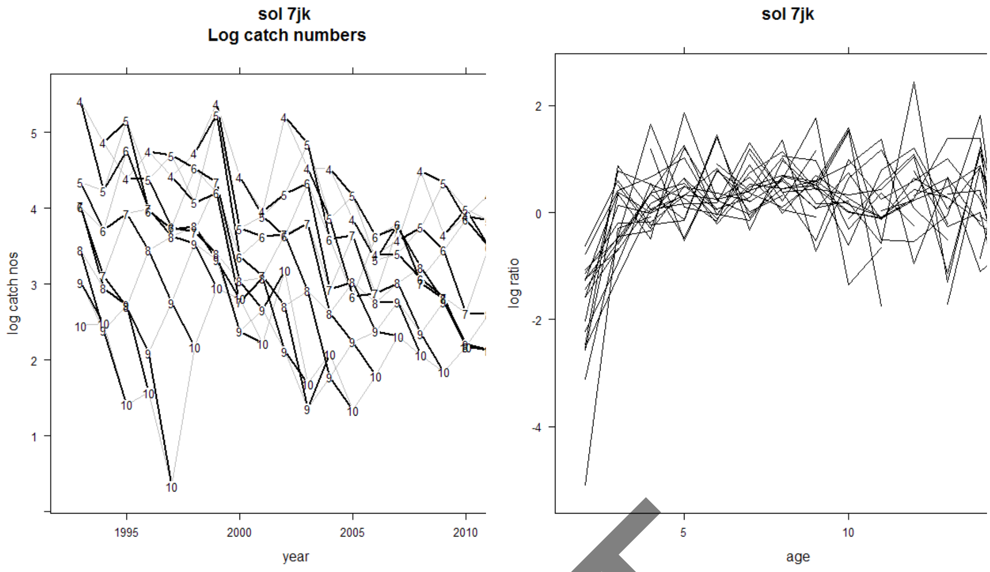


Figure 7.14.4. Catch curves (ages 4–8) and log catch ratios of sole in 7jk.

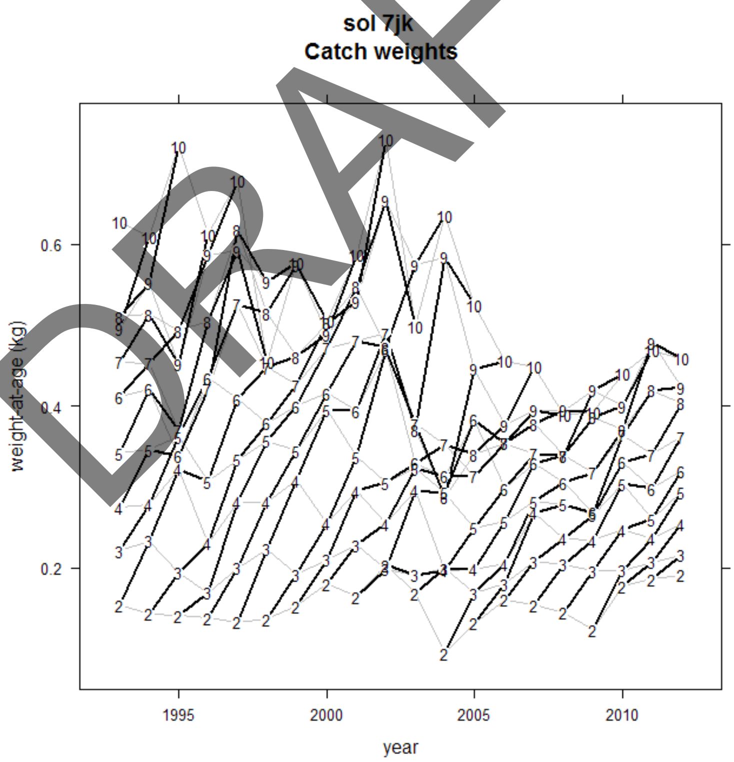


Figure 7.14.6. Catch weights / stock weights of sol7jk.

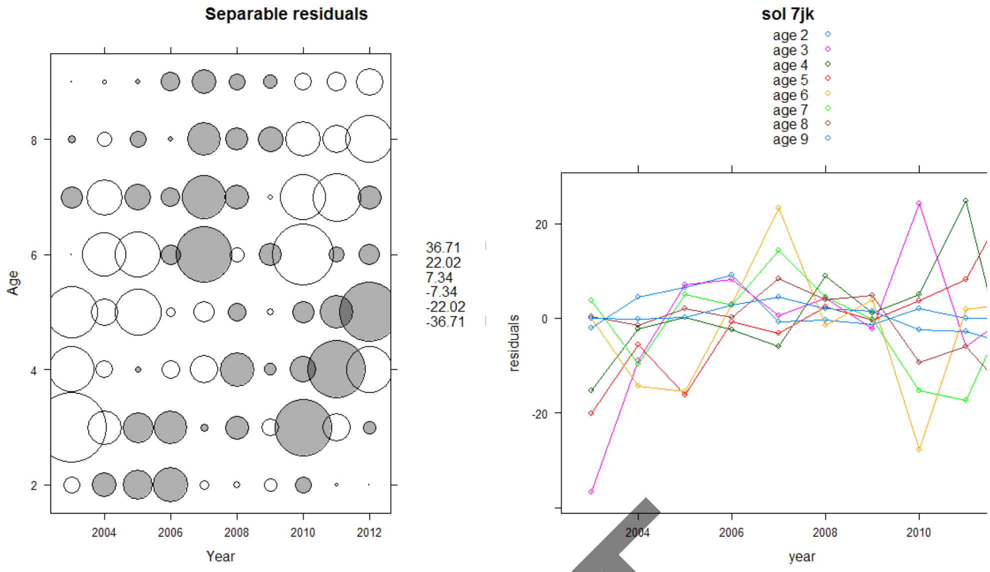


Figure 7.14.7. Catch residuals of the final separable model.

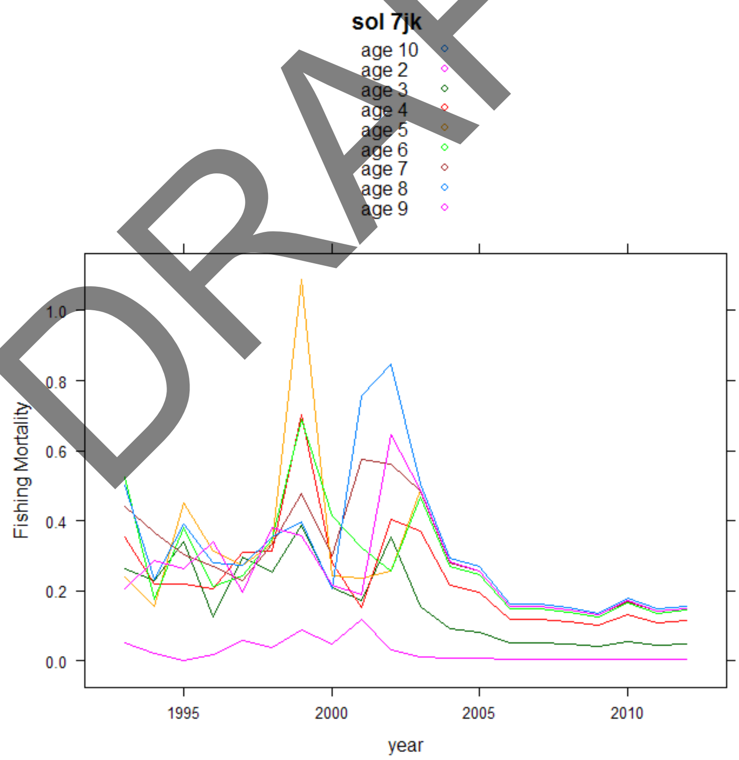


Figure 7.14.8. F-at-age for the separable model.

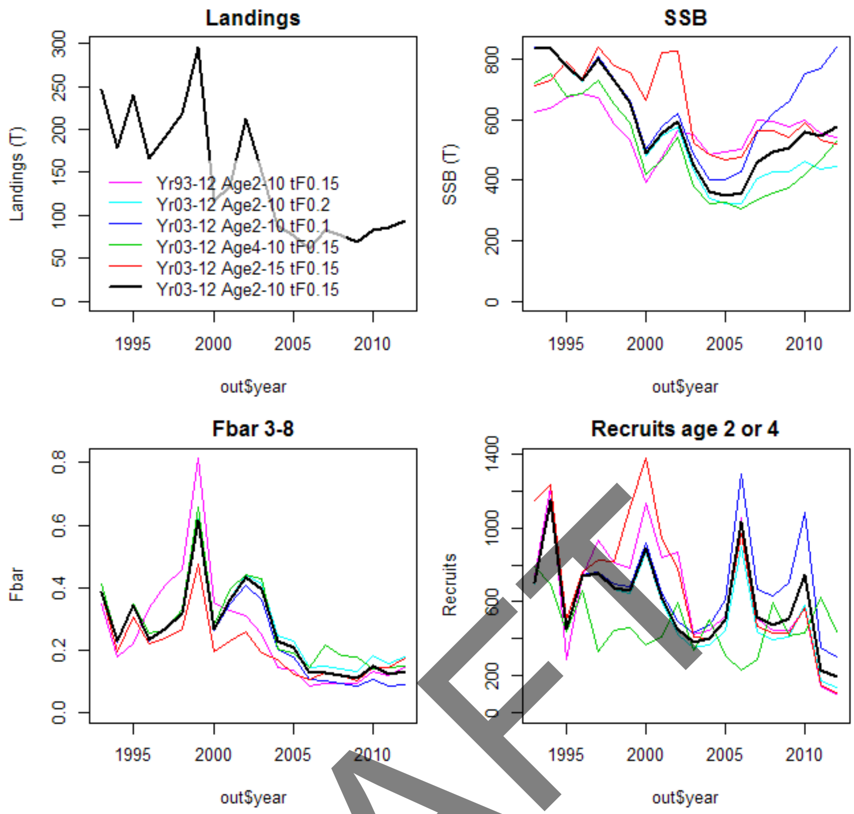


Figure 7.14.9. Summary plot of the final separable model (black lines) and sensitivity analysis of the model. The parameters that were varied were the year range for the separable model (Yr; full time-series or last ten years only); the age range (Age; 4–8, 2–8 or 4–10) and the terminal F (tF; 0.1, 1.5 or 0.2).

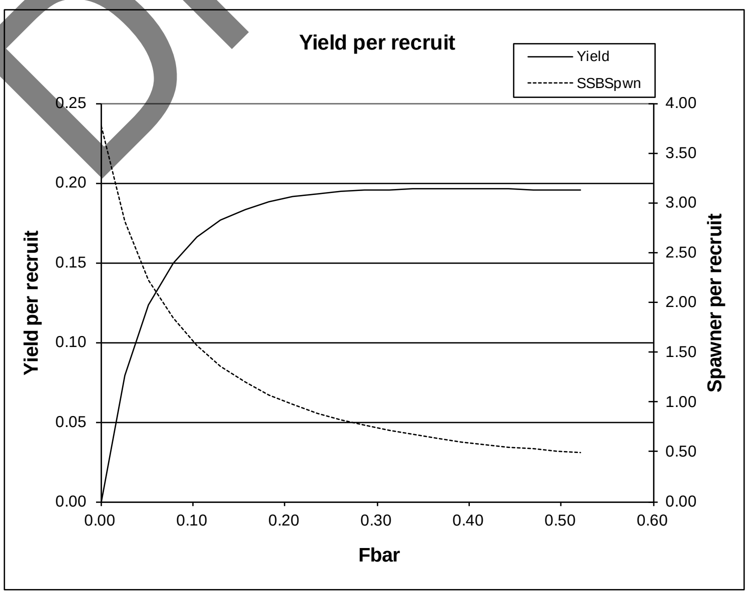


Figure 7.14.10. Sole VIIjk Yield-Per-Recruit analysis. F_{MAX} is estimated to be 0.37 and $F_{0.1}$ 0.12 and $F_{35\%SPR}$ is 0.14.

7.15 Whiting in Division VIIe–k

Type of assessment in 2012

Last year WGCSE proposed a full analytical assessment (XSA) tuned with two surveys and forecast (MFDP) for this stock. Previously the assessment had been used as indicative of trends but not considered suitable for forecast. However, stock assessments in recent years have been extremely consistent in terms of trends and levels. The issue in the recent past had been the accuracy of forecasts from the assessment due to retrospective reductions in recruit estimates. This is no longer a major concern and WGCSE concluded that the assessment and forecast were a suitable basis for management advice.

ICES advice applicable to 2012

Precautionary considerations

The SSB estimates show an increase since 2007 and the exploitation status is unknown. Therefore, catches should not be allowed to increase.

Management by TAC is inappropriate for this stock because landings, but not catches, are controlled. Recruitment in 2008 and 2009 appears to be above average. Catches and SSB may increase in 2012 if effort remains constant. Technical measures to minimise discards should be considered with urgency

ICES advice applicable to 2013

Precautionary considerations

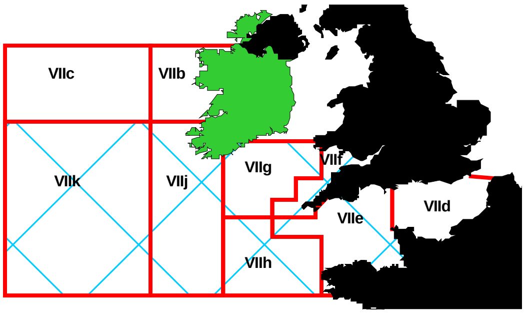
The SSB estimates continue to show an increase since 2007, but the exploitation status is unknown. Therefore catches should not be allowed to increase.

Management by TAC is inappropriate for this stock because landings and not catches are controlled. Recruitment in 2008 and 2009 appears to be above average. Catches and SSB may increase again in 2013 if effort remains constant. Technical measures to minimise discards have now been introduced and should be evaluated.

7.15.1 General

Stock description and management units

The TAC for whiting is set for Divisions VIIb–h and VIIk. However VIIj has been omitted from the area for the last three years. The assessment area does not correspond to the TAC area. Whiting in VIIb,c are not assessed and whiting in VIId are included in the WGNSSK assessment of the North Sea stock. Any management measures implemented for this stock should be consistent with the assessment area.



Red Boxes-TAC/Management Areas Blue Shading– Assessment Area.

The 2013 TAC for whiting VIIb–h and k has been increased from 19 053 t (2012) to 24 500 (2013). This TAC has not been considered restrictive, with officially reported VIIe–k landings totalling 10 136 t in 2012. However, the aggregated reported landings for VIIb-k inclusive was 14 454 in 2012, 76% of the TAC. Landings for the full VIIe-k TAC area in 2010 and 2011 were 103% and 90% respectively of the TAC in each year, and therefore the TAC may be considered limiting in some years. The assessment is based on landings only, as reported in logbooks, and does not include discards. The introduction of buyers and sellers legislation in 2007 should improve landings statistics, but has not been analysed as yet.

TAC in 2013

Species: Whiting *Merlangius merlangus*		Zone: VIIb, VIIc, VIId, VIIe, VIIf, VIIg, VIIh, VIIj and VIIk (WHG/7X7A-C)
Belgium	239	
France	14 700	
Ireland	6 812	
The Netherlands	120	
United Kingdom	2 629	
Union	24 500	
TAC	24 500	Analytical TAC Article 11 of this Regulation applies.

Fishery in 2012

ICES officially reported landings for Divisions VIIe–k and landings as used by the Working Group are given in Table 7.15.1. ICES Official landings in 2011 increased by ~1084 t, largely as a result of revisions from Ireland and France ranging between 342–689 tonnes respectively. The 2012 reported landings are 160 t higher than those used by WGCSE in 2013, primarily due to 135 t of landings from the Netherlands being reported to ICES, but not included in InterCatch during the assessment.

The VIIe–k whiting stock is primarily targeted by otter trawlers and to a lesser extent Scottish seines and beam trawls. Otter trawlers utilize two mesh size ranges of 70–99 mm and 100–119 mm. Effort of trawlers utilizing these two mesh size ranges has remained relatively stable within the Celtic Sea as a whole. However, decommissioning and re-targeting within the French otter-trawl fleet has seen a decline over the last decade in landings and effort in VIIf&g. Although landings for the French OTB fleet report a moderate increase in the last two years, reliable effort data has not been available since 2009 and therefore lpue is also unknown for this component.

The vessels utilizing these mesh ranges have different species selectivity patterns. Several main species groups are targeted by otter trawlers catching whiting, as part of a targeted mixed gadoid fishery and as bycatch within the *Nephrops* and hake, anglerfish, and megrim fisheries. Beam trawlers operate to the eastern side of the assessment area, VIIe–h where small quantities of whiting are taken as a bycatch species in flatfish, anglerfish, and ray target fisheries. The spatial distributions of landings by Irish and UK fleets in 2011 are given in Figure 7.15.1. Irish catches are primarily from within VIIg particularly within 32E2 and 31E3. Landings also emanate, to a lesser extent from VIIj. In previous years French landings have exhibited similar spatial and temporal focus around 31E3. No French spatial data were available for 2011. The majority of UK landings are from otter trawlers in VIIe, and focused within 29E5 and 29E6.

7.15.2 Data

An overview of the data provided and used by the WG is provided in Table 2.1.

Landings

National landings and numbers-at-age data were aggregated for the Area VIIe–k following methodology described in the stock annex. The landings data were available this year through InterCatch already raised to VIIe–k. The sample length distributions within each quarter were assumed to be representative of the landings of each métier. National sampling levels for the landings are presented in Table 2.1.

The length compositions from various fleets for 2012 are displayed in Table 7.15.2 and Figure 7.15.2. The landings length distributions of the Irish, UK and French otter-trawl fleets, which account for the majority of the landings, are similar, averaging around 37 cm. Scottish seine fleets land a wider distribution reaching sizes over 50 cm, averaging from 37 cm to 44 cm in length.

The international catch numbers-at-age are given in Table 7.15.3 and Figure 7.15.3. It is possible to track strong year classes in the landings-at-age matrices. The age distribution has remained similar over time, with the exception of periods where strong year classes pass through older ages. Older ages (3+) were slightly higher in the 2012 landings than in the preceding two years, but ages 1 and 2 were approximately 75% down on the same period. Age group 0 was included in the assessment data to allow inclusion of 0-group indices in the XSA, although landings at this age are not recorded in most years. Very small landings of 0-group whiting were not included in the catch-at-age data-file to avoid spurious F-shrinkage effects at this age. Mean weights-at-age in the catch and stock (Tables 7.15.4 and 7.15.5) were derived as per the methodology described in the stock annex. The stock weights are shown in Figure 7.15.4. There is some variability of stock weights particularly at older ages. Mean weight-at-age appears to have declined during the period of high SSB between 1994–1997. There is some indication of an increasing trend in weights for ages 6 and 7 over the last three years.

Discards

Discard data are available from the Irish fishery since 1994 (ICES: SGDBI, 2002), from French sampling in 1991, 1997, and 2005–2012, and for the UK (E&W) fisheries from 2001–2012. Availability and quality of effort data from France, however, has been variable since 2008. Discard data are not used in the assessment as the data that is available does not cover the full time-series of landings-at-age-data, and historically sampled fleets may not be representative of the main fleets involved in the fishery. Furthermore, there is a need to examine and agree the best raising practice for the various fleets. Discard rates are substantial (>50% by fleet/quarter) and variable. It is not clear if current sampling intensity will obtain precise enough annual estimates to support an assessment method where catch numbers are assumed to be exact as in XSA.

A summary of the 2012discarding rates is presented in Table 7.15.6. Discarding is presented here raised to the landings, unlike previous years where sampling ratios only were presented for France and the UK. Discarded whiting length distributions from 2012 Irish and French otter trawlers, and all UK gears were made available to the WG (Figure 7.15.5). The available data indicate that discarding occurs well above the 27 cm MLS with fish being discarded above 50 cm in some fleets. The discard L_{50}'s for most countries/fleets is around 28 cm, down from about 30 cm.

Age compositions for Irish discard data were provided for otter trawlers in VIIg and VIIj for 2006–2012 indicating discarding from age 0 up to age 8 in some years. Substantial discarding of ages 1–3 occurs for most years (Figure 7.15.6). Discard numbers-at-age have not yet been calculated for other fleets.

Biological

Mean stock weights- and numbers-at-age data were calculated following the methodology described in the stock annex.

Natural mortality was assumed to be 0.2 over all age groups and years.

Available data on maturity-at-age are described in the stock annex. Since 2006 the knife-edge maturity ogive has been replaced with indices calculated based on data from the UK WCGFS but a fixed vector is still used. Recent maturity sampling by Ireland and the UK on dedicated surveys confirms the use of this ogive but is insufficient to provide annual data.

Age	0	1	2	3	4	5+
Maturity	0	0.39	0.90	0.99	0.99	1.00

The proportions of F and M before spawning were both set to zero to reflect the SSB calculation date of January 1st.

Surveys

A time-series of available standardized survey abundance indices for ages 0–3 are given in Table 7.15.7. Further details of these surveys are given in WGSSDS 2008 Table 1.3.3 and described in the stock annex. Figure 7.15.9 shows standardized and log standardized abundance indices by age (0–7) for the three surveys used in the assessment by year class. The strong 1999 year class is evident in all surveys. The complete time-series and ages available from these surveys are given in the tuning fleet information available to the Working Group (Table 7.15.8). The internal consistency of the commercial and survey tuning fleets was examined using pairwise scatterplots of log numbers-at-age, bearing in mind that the correlations may be impacted by changes in fishing mortality. Plots for the two tuning fleets and three surveys included in the assessment are provided in Figure 7.15.7–8. Year effects were examined with mean log standardized plots of indices by age and year (Figure 7.15.9a). Cohort tracking was examined with mean log standardized plots of indices by age and cohort (Figure 7.15.9b).

The EVHOE-WIBTS-Q4 survey log index scatterplots display a reasonably positive correlation between adjacent ages. The mean log standardized indices by year display a year effect in 2006 and by cohort demonstrates good tracking of stronger year classes. The UK-WCGFS Q1 is now terminated, but shows reasonably good consistency between years in the log-index scatterplots and reasonably consistent cohort tracking with minor evidence of year effects. There is some suggestion of a trend over time (Figure 7.15.9). Log-indices for the Irish VIIg swept-area survey reveal some positive correlation for younger ages. The mean log standardized index by year demonstrated some slight year effect in 2003 which was the first year of the new series.

Commercial lpue

Estimates of commercial lpue, from 1995 to 2012, were available for the Irish otter trawl, Scottish seine, and beam-trawl fleets operating in Divisions VIIg and VIIj (Table 7.15.9 and Figure 7.15.11). Provisional French fleet data for 2012 has also been provided based on a new effort time-series since 2011, but appear variable so have not been included in the figure as yet. The effort-series is raw effort in hours uncorrected for changes in vessel power or changes in species targeting (i.e. métier compositions). Increased Irish VIIg otter-trawl landings and lpue occurred 2005–2007, returning to prior levels in 2008. This increase coincides with the 1999 year class passing through the fishery. Effort for this fleet has steadily increased since 1999 with landings and lpue tracking each other and rising since 2008. The more recent elevated effort has been associated with fleet displacement due to restrictive management in other areas, particularly VIa and VIIa. The VIIj otter trawl fleet landings, effort, and lpue show similar levels since 2005, although marginal increases to those of 2008–2009 are observed. In the earlier part of the time-series lpue for the IR-7G-SSC and IR-7J-SSC showed declining tends. Since 2006/2007 lpue has increased. Landings by these two fleets however are low. Effort and lpue data for the Irish beam trawls (TBB) operating in VIIg and VIIj are also included in Table 7.15.9 but is not plotted as landings, effort and lpue are minimal.

Estimates of commercial lpue, up to 2008 were available for French gadoid trawlers and French *Nephrops* trawlers operating in Divisions VIIf,g (Table 7.15.9 and Figure 7.15.10). Fishing effort in the FR-GADOID fleet has been declining since 1989, while the effort in the FR-*NEPHROPS* has declined since 1992. The FR-GADOID fleet's lpue increased to high levels in 1994 and 1995 but declined since. Sharp increases in lpue for the French gadoid fleet occurred in both 1998 and 2005, since which lpue has declined. Lpue for the FR-*NEPHROPS* fleet peaked in the mid-to-late 1990s, having declined since to levels similar to the early 1980s. Landings, effort and lpue for both these fleets currently demonstrate the lowest levels within the time-series. Limited lpue data from France are available for Divisions VIIj–k, but they are not considered representative. The commercial tuning fleets available to the assessment are given in Table 7.15.8.

Abundance indices-at-age were available for three commercial fleets, the French gadoid, and *Nephrops* fleets, and the Irish otter trawl fleet. As with the surveys, cohort tracking (Figure 7.15.7) was examined. The French commercial *Nephrops* index demonstrates very good internal consistency. The French gadoid fleet shows good consistency, although consistency at age 3 is slightly poorer. The IR-OT-7g&j previously used in the assessment was not considered as a consequence of poor cohort tracking and *a priori* concerns about changes in targeting practice and fishing power following recent fleet changes since 2002.

7.15.3 Historical stock development

An XSA assessment was carried out for this stock applying the same settings as last year's update assessment, with the addition of 2012 data. The settings previously used and applied this year are detailed within the stock annex.

Data screening

The general methodology is outlined in Section 2. Preliminary investigations were carried out using FLR under R version 2.4.1. The packages FLCore 1.4–3, FLAssess 1.4.1, FLXSA 1.4–2 and FLEDA 1.4–2 were used.

Final update assessment

The final assessment was carried out using the Lowestoft VPA suite. The assessment uses the same settings as last year (detailed below), with the exception of the French commercial tuning fleets which were not updated since 2009due to data non-availability. The tuning data available, and the subset used in the assessment, are given in Table 7.15.8.

		2012	2013
Catch date range:	Years	1982–2011	1982–2013
	Ages	0–7+	0–7+
Fbar Age Range:		2–5	2–5
Assessment Method:		XSA	XSA
Commercial Tuning Fleets:			
FR-Gadoid Late	Yrs	1993–2008	1993–2008
	Ages	3–6	3–6
FR-Nephrops	Yrs	1993–2008	1993–2008
	Ages	3–6	3–6
Survey Tuning-series:			
FR-EVHOE	Yrs	1997–2011	1997–2012
	Ages	0–4	0–4
UK-WCGFS	Yrs	1987–2001	1987–2001
	Ages	1–6	1–6
IR-IGFS Swept-area	Yrs	1999–2011	1999–2012
	Ages	0–6	0–6
Time taper:		No	No
Q plateau age:		5	5
F shrinkage S.E:		1.0	1.0
	Num yrs	5	5
	Num ages	3	3
Fleet S.E:		0.5	0.5

The full XSA diagnostics are given in Table 7.15.10. The assessment is now dominated by the survivor estimates given by the two surveys (only the 2005 cohort has some commercial tuning data contributing to the estimates). The surveys are very consistent in their estimates of the 2010 and 2006 cohorts. There is some divergence in the estimates for the 2012, 2011, 2009, 2008 and 2007 cohorts but on the whole the estimates are reasonably consistent given that whiting are prone to year effects in survey catches. Where there is divergence the final estimates are fairly evenly weighted, Figure 7.15.12 shows the scaled weights received by each fleet in the assessment.

The log-catchability residuals from the XSA fit are plotted for each tuning-series in Figure 7.15.13. The residual patterns for the two surveys do not show any trends. Some year effects are apparent 1998, 2003, 2004 and 2006 for EVHOE and 2007 for IR-GFS-7G-SweptArea. In the past the commercial fleets showed waves in the residual patterns thought to be associated with changing targeting practices by the commercial fleet. This will have little impact on the current assessment. The main discrepancy between the surveys in the estimation of the 2007 year class is also apparent in the residuals.

The retrospective pattern is shown in Figure 7.15.14. There is no apparent retrospective bias in F or SSB and the estimates and trends are very consistent from year to year. In the past the main rational for not accepting this assessment as a Category 1 (i.e. full assessment and forecast) was the problem forecasting landings and SSB in the short term due to retrospective bias on the estimates of recruitment. This recruitment bias is a consequence of the non-inclusion of discards in the assessment and was particularly severe when stronger year classes entered the fishery.

Estimates of fishing mortality and stock numbers from the final XSA are given in Tables 7.15.11 and 7.15.12. Fishing mortality for nearly all ages has dropped consistently and significantly since 2010. There is an increase in relative F at age 6 and a slight decline at age 4 which is in the F_{BAR} range. This is something that should be fixed at the next benchmark but it is not significant enough to be a major concern now. These are summarized in Table 7.15.13 and Figure 7.15.14. The assessment this year reveals a slight decrease in fishing mortality. Recruitment of 2012 is well below the time-series average.

Comparison with previous assessments

The assessment settings used are in accordance with the stock annex and have remained unchanged since 2007. Since 2009, consistent updated French commercial tuning fleets have not available. There was a major correction to the 2010 index for the IR-IGFS Swept area. Revisions to landings and landings numbers-at-age have been included for 2011. The corrected assessment was very consistent with the 2011 update however.

State of the stock

Trends in landings, F(2–5), SSB, and recruitment are presented in Table 7.15.13 and Figure 7.15.15. SSB displays peak biomass in the mid-1990s following a series of good recruitment in preceding years.

SSB then shows a declining trend up to 2007. Since then SSB has increased rapidly and is now close to the highest levels observed. The 2012 estimate of 65.4 kt is well above B_{PA} (21 000 t). Fishing mortality (F_{BAR}) has declined since 2007 and is now at the lowest level ever observed for this stock. There has been two above average recruitments (2008 and 2009) entering the fishery and SSB.

There is no apparent relationship between SSB and recruitment (Figure 7.15.16) nor is there evidence of reduced recruitment at the levels of SSB seen over the time-series.

7.15.4 Short-term projections

As previously discussed there were problems forecasting out of this assessment in the past due to strong retrospective revision in recruitment. This is not a problem in the current assessment. The update assessment and retrospective pattern are very consistent therefore. WGCSE preformed short-term projections this year.

The short-term projection settings were as described in the stock annex with the following exceptions. The GM period was 1982–2010 (-2 years instead of -1). The XSA estimate of the 2012 year class (23 m) was used in the forecast instead of GM (68 m). Both surveys have a very low index for the 2012 year class and although the historical performance of the terminal recruit estimation in this assessment is poor it is likely that the 2012 year class is weak (this has little impact on the 2014 landings prediction, see Table 7.15.14).

The input values for the catch forecast (using the MFDP software) are given in Table 7.15.15. The F-at-age values used were calculated as the mean of the XSA values from 2010–2012, unscaled. Catch and stock weights-at-age were also the mean of the period 2010–2012. Stock numbers-at-age in 2012 for ages 0 and older were obtained from the XSA. SSB values are calculated for 1 January.

Table 7.15.14 gives the management option table from the *F_{MSY} transition* catch prediction, and short-term results are shown in Figure 7.15.17. Assuming *F_{MSY} transition* F (F_{MSY} = 0.36) implies landings of 18.4 kt in 2013 and 15.6 kt in 2014. The TAC for 2013 is likely to be somewhat restrictive (the total TAC is 25.5 kt given recent landings from VIId are in the order of 6 kt).

The detailed output for the F_{trans} forecast by age group is given in Table 7.15.16, and the estimated contributions of recent year classes to the predicted catches and SSBs are given in Table 7.15.17. The assumptions of $GM_{1982-2010}$ recruitment for 2013 and 2014 and the XSA estimate of recruitment in 2012 are predicted to contribute <3% to the landings in 2014 and 48% to SSB in 2015.

7.15.5 Biological reference points

Precautionary approach to reference points

The Working Groups current approach to reference points is outlined in Section 2. A summary of reference point proposals to date and their technical basis is given in the stock annex. The reference points were not re-examined in this update assessment, those currently adopted and their basis are as follows:

F_{LIM}	No Proposal
F_{PA}	No Proposal
B_{LIM}	15 000 t (B_{LIM} = B_{LOSS} 1983, ACFM1998)
B_{PA}	21 000 t (B_{PA} = B_{LOSS} 1983 x 1.4)

MSY reference points

WGCSE carried out some MSY evaluations in 2012 using the srmsymc program. This program uses fishing mortality-at-age (average of the most recent three year), catch and stock weights (three year averages), maturity and natural mortality-at-age together with their CVs in a stochastic framework to estimate proxies for the fishing mortality biomass and landings at maximum sustainable yield.

The lack of a stock–recruit relationship is something that was previously mentioned for this stock. Less than 50% of the S–R realisations for the various models (Beverton and Holt, Ricker and Hockey Stick) fitted the data in 'srmsymc' and the results of srmsymc were deemed uninformative by WGCSE 2012. The results are available on the ICES SharePoint in the data folder for this stock.

Yield-per-recruit analysis

Results for deterministic yield and SSB per recruit (using program MFYPR), conditional on the recent exploitation pattern, are given Figure 7.15.17. F_{MAX} is not well determined due to the very flat-topped nature of the Y/R curve. $F_{0.1}$ was better determined but was considered to be too low as an interim MSY proxy for a fairly productive stock such as Celtic Sea whiting. WGCSE 2012 concluded that $F_{35\%SPR}$ was a more appropriate F_{MSY} candidate in the short term. This reference point has been used for many other moderately productive gadoid stocks worldwide. This is obviously something that will need to be revisited if selection in the fishery improves or if an assessment including discards is performed in the future.

7.15.6 Management plans

No management plan has been agreed or proposed.

7.15.7 Uncertainties and bias in assessment and forecast

Sampling

The sampling levels for those countries supplying data for 2012 are given in Table 2.1. Sampling levels of the landed catch for recent years are considered to be sufficient to support current assessment approaches. Sampling levels were not available by fishery/métier and the WG was therefore unable to evaluate whether or not current sampling levels are sufficient to support fishery/métier disaggregated assessment approaches.

Ageing

The strong recent cohorts passing through the fishery indicates that age estimation is consistent throughout the age range used in the assessment, although some underestimation does occur at older ages.

Discards

Discarding is a major feature of most fisheries catching whiting in the Celtic Sea. The non-inclusion of discard data in the assessment is a major source of uncertainty and may explain a large proportion of the retrospective bias problems and changing catchabilities in commercial fleets observed throughout the assessment period. The sampling of discards has improved since the implementation of the DCF sampling programmes, although a time-series of raised discard estimates together with metrics on their precision and accuracy are not available for all the main fleets in the fishery.

Surveys

The surveys for whiting are prone to year effects and there are some indications of a 2011 year effect in the EVHOE index. This will have some impact on recent survivor estimates since it receives roughly 30–40% of the scaled weights. Having said that, the estimates are reasonably consistent with the IR-IGFS Swept-area index for most year classes.

Misreporting

The level of misreporting of this stock is not known and underreporting has previously been considered unlikely to have been a significant source of unaccounted mortality of whiting in the assessment because the TAC has been in excess of recent landings.

7.15.8 Recommendation for next benchmark

The 2013 assessment was accepted by WGCSE as a basis to provided management advice and a short-term forecast. Nevertheless several short-comings still exist with the current assessment and a benchmark assessment of whiting is necessary in the near future. This would only be possible if significant progress can be made with the estimation of discards for the main fleets involved in the fishery.

The loss of the commercial tuning information may be consistent with recent ICES trends to remove commercial information from assessments. However in this stock there is little reason to believe that misreporting may have been an issue. Moreover the available survey information is only useful at younger ages and prone to year effects likely due to spatial distribution differences. Re-establishment of some form of tuning information at the older ages should be implemented at the next benchmark meeting to stabilize the assessment.

A better methodology of deriving stock weights is necessary in order to avoid the problem of declining weight-at-age at age 8 and 9 which is required to estimate the weight of the currently moderate +gp.

Problem: The primary uncertainty of this assessment is underestimation of mortality. Currently the assessment is based on landings only. Discarding is a major feature of most fisheries catching whiting in this stock area. Mortality may therefore be grossly underestimated in younger ages. This could explain some of the retrospective bias problems and changing catchabilities in commercial fleets observed throughout the assessment period.

Solution: The available discard data has improved in the most recent years since the implementation of the DCR sampling programmes. Raw data are available for the main fleets, operating within VIIe–k. Work is now required to raise and compile a complete time-series of discard data. Assessment model and settings then need to be reviewed to ensure optimum performance.

Year of last benchmark: No benchmark assessment of this species has been carried out.

Expertise required: Expertise in discard raising and uncertainty methods, in addition to expertise in assessment methods permitting inclusion of discard data.

A further matter for consideration is the improvement of commercial tuning fleets by selection of vessel subsets with consistent spatial and temporal effort and catch composition over the majority of the time-series, moving towards the métier based approach. This would require a detailed analysis of vessel behaviour.

Currently, there are two IBTS surveys (French and Irish) covering the Celtic Sea provided to the working group. Although these surveys normally catch large quantities of whiting they seem prone to year effects as has been observed for this species in other areas (e.g. Irish Sea, North Sea). Survivor estimates are generally fairly consistent for the surveys when used independently. A detailed evaluation of the survey data and the potential for integration of the indices would be beneficial before the next benchmark.

7.15.9 Management considerations

Catches and SSB in VIIe–k whiting fluctuate considerably depending on year-class strength. The 2008 and 2009 year classes are above average, and will be contributing to catches and SSB in the short term but the upturn in catches and SSB is likely to be short lived as the 2011 and 2012 year classes appear to be quite weak.

Discarding of this stock for different fleets is substantial and highly variable depending on gear and year-class strength. High levels of discarding for a species like whiting reduce the longer term yields one might expect from the stock so efforts to improve selection and reduce discards in the mixed fishery should be encouraged. ICES notes that the recently supported introduction of square mesh panels in all trawl fisheries operating in ICES Divisions VIIfg is now in place. It is important that these measures are fully implemented and their effectiveness in reducing discards and the impact on commercial catches is monitored and evaluated. Further gear modifications to increase the likelihood of small whiting passing through the gear, such as introduction of larger minimum mesh sizes, separator panels, or grids may be needed.

Whiting are caught in directed gadoid trips and as part of mixed fisheries throughout the Celtic Sea, as well as bycatch within *Nephrops* fisheries. Discard rates are high as a consequence of the low market value of the species, particularly at smaller sizes. Highgrading above the MLS to some extent is also prevalent in most fisheries.

From the 1 February to the 31 March fishing activity has been prohibited within ICES rectangles: 30E4, 31E4, 32E3 (excluding within six nautical miles from the baseline) annually since 2005 to protect the cod stock.

There have been major changes in fleet dynamics over the period of the assessment. Effort in the French gadoid fleet has been declining since 1999, but recent data gaps prevent current status to be evaluated with certainty. Irish otter trawl effort in VIIg,j has been stable over the last four years, but risen recently somewhat. During this period there has been a fleet modernisation and several decommissioning schemes in Ireland both within the national whitefish fleet and beam trawl fleet. The most recent round of decommissioning occurred in 2008 and 2009 removed 40 vessels which had operated within the Celtic Sea in 2007–2008. The decommissioned vessels accounted for 15–16% of whiting landings from the stock area in 2007 and 2008. The majority of these vessels primarily landed *Nephrops* or a combination of Hake, monkfish and megrim. Only eight vessels primarily landed whitefish (cod, haddock and whiting). A French decommissioning scheme was implemented in 2008 and 2009. A reduction in the French fleet operating in VIIe–k was expected as a result and appears to be occurring.

Table 7.15.1. Whiting in Divisions VIIe–k. Nominal Landings (t) as reported to ICES, and total landings as used by the Working Group.

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	130	158	160	107	112	159	295	317	304	111	145	228	205	268	449
Denmark															
France	7,572	4,024	7,819	7,763	9,773	10,947	19,771	19,348	10,006	9,620	11,285	13,535	13,400	9,936	11,370
Germany										14					
Ireland	1,511	1,227	2,241	1,309	1,518	2,036	1,651	1,764	1,403	1,875	3,630	5,053	6,077	6,115	6,893
Netherlands		398		124										8	
Spain													4	31	24
UK (E/W/NI)	1,192	986	751	910	1,098	1,632	1,326	1,829	2,023	1,393	1,776	1,624	1,803	1,724	1,742
UK(Scotland)						1	33	32	20	41	16	23	23	34	42
United Kingdom															
Channel Islands			2	2	2								1	1	
Total	10,405	6,793	10,973	10,215	12,503	14,775	23,076	23,290	13,756	13,054	16,852	20,463	21,513	18,116	20,520
Unallocated	1,376	3,192	-135	-263	149	353	-6,535	-9,184	-248	-690	-532	-429	1,165	144	12
Total as used by Working Group	11,781	9,985	10,838	9,952	12,652	15,128	16,541	14,106	13,508	12,364	16,320	20,034	22,678	18,260	20,532

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	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012a
Belgium	479	448	194	171	149	149	129	180	218	128	127	87	101	100	167
Denmark															
France	11,711	16,418[b]	9,077	7,203	7,435	7,435	5,897	4,811	5,784	4,649	3,543	2,739	3,397	4,079	3,629
Germany															
Ireland	5,226	5,807	4,795	5,008	5,332	5,332	4,093	4,215	5,709	4,521	4,764	2,704	4,187	4,547	5,455
Netherlands	1			5	4	4	9	18	60	40	64	24	76	166	135
Spain	53	21	11	9	12	12	-	76	56	70	21	1	6	7	
UK (E/W/NI)	1,706	1,344	1,249	943	843	843	758	586	471	402	569	764	757		
UK(Scotland)	68	3	2	11	12	12	5	7	-	6	4	63	35		
United Kingdom														739	749
Channel Islands	3	2	3	3	1	1	4	0	0	0	1	-	4	1	1
Total	19,247	24,043	15,331	13,353	13,788	13,788	10,895	9,893	12,298	9,816	9,093	6,382	8,563		10,136
Unallocated	-2	-4,128	-466	-583	-642	-3,205	-942	2,137	-2,765	-869	-3,356	-674	-139		-160
Total as used by Working Group	19,245	19,915	14,865	12,770	13,146	10,583	9,954	12,030	9,533	8,948	5,737	5,708	8,424	9,639	9,976

[a]: Preliminary.

[b]: Preliminary, Reported as VIIb–k.

Table 7.15.2. Whiting in Divisions VIIe–k. Raised length distributions for 2012 by country and fleet (Numbers in '000s).

Length	France	UK (E+W)		Ireland			
(cm)	All Gears	Beam trawl	All gears (exc beam)	Scottish Seine	Otter trawl Demersal	Otter trawl Nephrops	Gillnet
	VII e–k	VIIe–k	VIIe–k	VIIe–k	VIIe–k	VIIe–k	VIIe–k
19							
20							
21							
22	0.4				0.9		
23	0.0				1.1		
24	0.0				10.8		0.3
25	0.0				28.2		1.0
26	0.4	0.0	6.6		34.1		
27	3.4	0.0	12.4	1.9	50.7		0.3
28	7.8	0.7	32.8		64.7		0.3
29	7.9	1.6	38.7	1.6	82.9		1.6
30	26.8	2.3	66.5	19.9	109.9		2.3
31	65.3	3.6	75.9	48.0	173.8		4.6
32	97.6	5.2	90.6	83.7	247.5		5.2
33	160.3	4.9	99.3	125.6	314.5	0.2	7.2
34	235.2	6.1	125.5	130.1	346.8	0.4	5.6
35	305.7	4.7	134.9	218.2	405.3	1.2	3.9
36	306.4	6.4	117.0	209.3	402.5	1.4	4.3
37	354.0	6.7	90.5	221.4	392.6	3.4	4.3
38	339.5	5.1	77.5	225.0	373.7	3.4	4.6
39	306.2	10.6	65.3	239.6	339.8	5.2	3.6
40	326.1	5.6	67.1	219.6	304.0	3.0	5.2
41	262.4	4.9	61.0	190.7	319.0	4.0	3.6
42	273.4	3.3	32.8	210.3	234.4	7.6	5.2
43	214.4	4.3	28.3	173.4	198.9	4.2	4.9
44	212.9	3.2	28.1	168.3	189.7	4.2	3.6
45	246.8	2.9	23.2	140.0	142.8	3.6	2.6
46	202.5	1.4	20.4	158.2	126.9	2.6	3.3
47	169.6	1.2	18.8	173.6	94.8	1.8	3.9
48	152.1	0.8	14.2	146.9	89.6	4.0	3.9
49	141.6	1.1	10.6	115.8	60.0	2.4	2.0
50	156.2	1.2	13.0	89.1	47.8	1.2	4.3
51	112.0	0.7	9.8	82.7	46.2	3.0	4.3
52	87.4	0.5	6.3	83.6	23.1	1.8	2.6

Length	France	UK (E+W)		Ireland			
(cm)	All Gears	Beam trawl	All gears (exc beam)	Scottish Seine	Otter trawl Demersal	Otter trawl Nephrops	Gillnet
	VII e–k	VIIe–k	VIIe–k	VIIe–k	VIIe–k	VIIe–k	VIIe–k
53	46.4	0.2	7.9	57.8	19.1	1.6	2.6
54	77.3	0.2	7.4	39.9	18.1	1.6	2.3
55	35.1	0.4	5.1	40.1	10.7	2.4	3.6
56	23.1	0.1	3.4	39.2	8.8	0.6	2.6
57	40.8	0.1	1.9	21.4	6.5	2.4	0.7
58	19.8	0.3	3.1	18.6	0.5	2.0	2.0
59	8.7	0.4	1.2	7.6	1.4	0.6	1.0
60	5.0	0.0	1.1	6.1	1.0		0.7
61	3.1	0.0	0.2	10.0	1.8	1.2	
62	0.6	0.0	0.8			1.0	0.3
63	0.1	0.0	0.8	3.6		0.6	
64	2.7	0.0	0.7	1.9		0.4	0.3
65	0.0						0.0
66	0.6			0.7		0.8	
67	0.0						
68	0.0						
69	0.1						
Total N.	**5037.7**	**90.9**	**1400.5**	**3723.4**	**5324.7**	**73.9**	**114.8**
Total (t)	**3628.7**	**46.9**	**628.0**	**2534.6**	**2722.1**	**65.0**	**83.6**

Table 7.15.3. Whiting in Divisions VIIe–k. Landings numbers-at-age ('000), examples of strong year classes are highlighted.

Age	0	1	2	3	4	5	6	7+
1982	0	2624	12523	9862	4564	880	41	23
1983	0	5867	9981	9059	3393	1319	195	10
1984	0	2854	18645	4697	1815	618	128	28
1985	0	3698	15538	8005	1380	289	96	33
1986	0	3769	15157	6465	2091	553	60	45
1987	0	5977	19376	8825	2467	587	112	60
1988	0	2315	26780	11400	1962	409	70	21
1989	0	602	17057	24243	3459	339	63	25
1990	0	3270	9249	19509	8654	749	62	21
1991	0	8339	11997	5578	11742	2700	143	3
1992	0	4964	20513	9198	1420	1275	435	39
1993	0	2304	22277	17939	2829	526	382	172
1994	0	1272	14110	25384	6165	1019	135	177
1995	0	540	15062	21854	14142	2242	310	92
1996	0	1345	7473	17783	12850	5486	775	114
1997	0	609	4451	11734	21209	7322	2787	720
1998	0	1182	6680	10938	12758	13240	2865	882
1999	0	4163	10223	12444	8406	8733	6479	1188
2000	0	3575	9357	10328	5468	2351	1993	1845
2001	0	336	11648	11076	5135	2061	745	275
2002	0	1067	5962	19658	5732	1064	274	63
2003	0	462	3599	8264	11530	1675	264	20
2004	0	1209	4141	5963	6755	5978	496	69
2005	0	768	6169	8141	5008	4551	3456	147
2006	0	1366	6342	7631	3672	1767	1148	581
2007	0	988	5598	8479	4984	1535	412	226
2008	0	1269	3710	5948	2923	700	173	31
2009	0	341	4194	5693	2768	695	165	36
2010	0	530	3258	8335	4247	1273	217	117
2011	0	943	4766	5964	4830	1463	369	85
2012	0	86	1050	7623	5159	1692	499	110

Table 7.15.4. Whiting in Divisions VIIe–k. Landings weights-at-age (kg).

Age	0	1	2	3	4	5	6	7+
1982	0.000	0.245	0.279	0.395	0.557	0.646	1.193	1.593
1983	0.000	0.273	0.328	0.441	0.545	0.678	0.731	1.652
1984	0.000	0.227	0.286	0.457	0.656	0.807	1.060	1.514
1985	0.000	0.233	0.335	0.433	0.631	1.008	1.157	0.980
1986	0.000	0.198	0.277	0.493	0.585	0.781	1.469	1.680
1987	0.000	0.222	0.284	0.398	0.658	0.877	0.897	0.990
1988	0.000	0.224	0.303	0.416	0.628	0.977	1.322	1.374
1989	0.000	0.201	0.281	0.376	0.593	0.980	1.444	1.877
1990	0.000	0.226	0.260	0.328	0.452	0.722	1.083	1.721
1991	0.000	0.220	0.291	0.355	0.395	0.534	0.834	1.695
1992	0.000	0.208	0.289	0.388	0.472	0.623	0.739	1.084
1993	0.086	0.205	0.286	0.379	0.589	0.831	0.963	1.360
1994	0.000	0.249	0.300	0.404	0.637	0.915	0.982	1.222
1995	0.090	0.202	0.275	0.382	0.527	0.844	1.124	1.197
1996	0.000	0.229	0.266	0.346	0.460	0.598	0.616	1.058
1997	0.000	0.196	0.277	0.329	0.406	0.536	0.714	1.005
1998	0.000	0.188	0.270	0.333	0.396	0.452	0.567	0.896
1999	0.000	0.222	0.298	0.352	0.426	0.441	0.497	0.633
2000	0.101	0.250	0.326	0.419	0.510	0.573	0.585	0.597
2001	0.000	0.265	0.286	0.393	0.521	0.624	0.761	0.820
2002	0.082	0.217	0.293	0.363	0.519	0.682	0.810	1.022
2003	0.000	0.211	0.281	0.369	0.447	0.603	0.831	1.149
2004	0.086	0.218	0.303	0.376	0.433	0.492	0.523	0.754
2005	0.101	0.246	0.318	0.396	0.506	0.509	0.487	0.595
2006	0.112	0.232	0.299	0.414	0.545	0.585	0.586	0.707
2007	0.000	0.206	0.290	0.389	0.492	0.603	0.564	0.673
2008	0.116	0.235	0.291	0.378	0.512	0.617	0.754	1.124
2009	0.000	0.245	0.322	0.405	0.504	0.592	0.669	0.902
2010	0.000	0.267	0.348	0.441	0.560	0.638	0.777	0.726
2011	0.000	0.267	0.313	0.468	0.605	0.793	0.945	1.213
2012	0.000	0.219	0.346	0.506	0.656	0.808	0.970	1.103

Table 7.15.5. Whiting in Divisions VIIe–k. Stock weights-at-age (kg).

Age	0	1	2	3	4	5	6	7	8	9	10
1982	0	0.157	0.270	0.345	0.474	0.607	0.843	1.403	1.255	0.688	0.688
1983	0	0.167	0.276	0.363	0.498	0.632	0.826	1.313	1.256	0.732	0.732
1984	0	0.192	0.282	0.371	0.521	0.709	0.847	1.188	1.270	0.723	0.723
1985	0	0.179	0.272	0.389	0.534	0.738	1.030	1.187	1.382	1.046	0.957
1986	0	0.183	0.259	0.370	0.543	0.756	1.020	1.223	1.513	1.145	0.98
1987	0	0.171	0.253	0.367	0.533	0.752	1.059	1.261	1.474	1.585	0.864
1988	0	0.186	0.252	0.342	0.531	0.784	1.050	1.322	1.685	1.465	0.768
1989	0	0.173	0.249	0.331	0.477	0.760	1.114	1.439	1.643	1.853	0.599
1990	0	0.166	0.247	0.317	0.427	0.651	1.007	1.524	1.461	1.465	0.842
1991	0	0.151	0.248	0.317	0.396	0.553	0.815	1.310	1.154	1.032	0.929
1992	0	0.174	0.253	0.327	0.421	0.551	0.736	1.133	1.105	0.866	1.216
1993	0	0.166	0.251	0.340	0.470	0.637	0.779	1.034	1.337	0.954	1.126
1994	0	0.175	0.254	0.340	0.487	0.715	0.906	1.077	1.258	1.405	1.158
1995	0	0.108	0.259	0.346	0.476	0.711	0.861	0.994	1.047	1.341	1.044
1996	0	0.135	0.256	0.328	0.430	0.626	0.820	0.942	0.990	1.107	1.035
1997	0	0.110	0.245	0.307	0.396	0.525	0.645	0.830	1.123	0.912	0.912
1998	0	0.148	0.238	0.293	0.378	0.453	0.585	0.747	1.043	0.968	0.968
1999	0	0.112	0.245	0.324	0.419	0.491	0.518	0.677	0.779	0.725	0.725
2000	0	0.144	0.253	0.357	0.465	0.556	0.611	0.711	0.685	0.895	0.895
2001	0	0.182	0.259	0.370	0.490	0.612	0.676	0.802	0.649	0.995	0.995
2002	0	0.193	0.248	0.361	0.480	0.627	0.795	1.009	0.850	1.062	1.062
2003	0	0.187	0.244	0.332	0.439	0.560	0.693	0.886	1.202	0.875	1.127
2004	0	0.167	0.253	0.333	0.449	0.541	0.652	0.892	1.380	1.38	1.38
2005	0	0.163	0.256	0.346	0.484	0.535	0.582	0.765	1.431	1.431	1.431
2006	0	0.177	0.280	0.390	0.553	0.624	0.647	0.832	0.990	0.799	0.799
2007	0	0.204	0.285	0.403	0.566	0.666	0.727	0.951	0.811	0.633	0.633
2008	0	0.227	0.298	0.397	0.549	0.659	0.714	0.920	0.527	0.467	0.467
2009	0	0.220	0.286	0.380	0.525	0.631	0.723	0.981	0.540	0.54	0.54
2010	0	0.286	0.307	0.417	0.537	0.637	0.748	0.706	0.941	0.883	0.883
2011	0	0.246	0.268	0.441	0.598	0.78	1.059	1.066	1.579	1.579	1.579
2012	0	0.246	0.267	0.481	0.63	0.838	1.037	1.248	1.456	1.456	1.456

Table 7.15.6. Whiting in Divisions VIIe–k. Summary of discard data in 2011 provided to the Working Group.

Country	Year	Fleet	Landings Tonnes	Discards Tonnes	Proportion %
France	2012	MISC	987	880	
France	2012	OT_DEF	2642	750	
		Total	**3629**	**1630**	**31%**
UK*	2012	Beam Trawl	22	25	
UK*	2012	Others	405	223	
		Total	**427**	**247**	**37%**
Ireland	2012	Otter Trawls	2960	1729	
	2012	Seiners	579	11	
		Total	**3539**	**1741**	**33%**

* UK discard sampling raised to landings

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Table 7.15.7. Whiting in Divisions VIIe–k. Standardized survey abundance indices of age groups 0–3.

Survey	UK-WCGFS			UK-BCCSBTS-S		FR-EVHOE				IR-GFS-7g&j				IR-GFS-7g-Swept-area			
Units	No. per min			No. per km towed		No. per 30 min haul				No. per 30 min haul				No. per 10 kmsq			
Year	1-gp	2-gp	3-gp	0-gp	1-gp	0-gp	1-gp	2-gp	3-gp	0-gp	1-gp	2-gp	3-gp	0-gp	1-gp	2-gp	3-gp
1987	0.36	1.61	0.16														
1988	0.24	0.23	0.06	0.1	0.9												
1989	0.25	0.73	0.49	0.9	1.1												
1990	0.02	0.06	0.25	5.2	0.5												
1991	0.21	0.01	0.01	4.4	1.4												
1992	1.31	0.53	0.11	6.7	1.3												
1993	4.88	0.92	0.27	10.0	1.7												
1994	8.99	1.33	0.92	2.7	1.5												
1995	0.59	5.52	1.43	2.3	1.5												
1996	0.52	1.51	1.39	4.6	1.5												
1997	0.73	0.56	0.18	10.7	0.5	31	24	9	8.5								
1998	1.19	0.77	0.53	5.3	0.5	48	15	7.9	1.2								
1999	0.84	0.50	0.15	15.1	1.0	261	62	18	5.1					24175	7307	1881	633
2000	14.91	0.93	0.29	1.2	3.1	31	77	23	2.9					6077	15 835	3116	190
2001	2.49	1.35	0.24	1.7	0.5	23	35	49	8					4650	2836	13871	1849
2002	3.35	1.80	3.04	5.3	0.3	39	15	11	10					2468	3664	1719	1252
2003	3.20	2.51	2.48	3.9	0.1	47	58	27	20	127	88	38	11	6061	2219	1027	413
2004	2.00	1.80	0.99	10.3	0.1	28	108	31	14	295	95	48	10	9778	3444	655	321
2005	Survey discontinued			6.4	0.0	44	16	5	2	83	106	29	10	1146	3177	1573	422
2006				4.3	0.3	15	10	3	1	373	161	50	10	15260	5883	2175	707
2007				7.7	0.7	178	46	4	1	332	218	47	7	9951	8081	2718	455
2008				25.1	0.7	365	45	10	3	402	140	44	11	16344	5554	2238	475
2009				6.7	0.6	30	68	31	6	346	289	65	17	11053	10 819	2154	589
2010				2.0	0.3	27	36	24	11	85	317	128	27	2105	10 592	5924	1016
2011				13	57	100	55	13	57	282	177	182	41	2357	8164	7044	2090
2012				14	13	9	10	14	13	129	130	77	75	3550	3748	4089	3708

Table 7.15.8. Whiting in Divisions VIIe–k. Available commercial and survey tuning-series, ages and years used in the assessment are highlighted in bold.

Whiting in the Celtic Sea VIIe-k Tuning data WGCSE 2013 (D. Stokes 09/05/2012)114

FR-GADOID-Early: French Gadoid trawlers (FU5) - Effort, No. of whiting/age/1000 hours fished, Year, Live weight (t)

1983	1992									
1	1	0	1							
1	11									
1000	18325	41531	38575	15377	6184	886	51	0	0	0
	0	#1983	5742t							
1000	13779	97659	25223	9993	3362	688	82	46	22	0
	0	#1984	4598t							
1000	14948	75447	37539	6687	1506	540	189	9	0	0
	0	#1985	4514t							
1000	13417	66679	29328	9073	2310	266	183	20	3	2
	0	#1986	5049t							
1000	25446	79928	33683	10141	2358	518	161	30	36	0
	0	#1987	6859t							
1000	6738	71192	30313	5029	1040	184	45	4	2	0
	0	#1988	7921t							
1000	1539	41365	58078	7808	843	161	30	12	0	0
	0	#1989	8974t							
1000	10547	29023	60936	24967	2297	148	49	18	2	0
	0	#1990	7897t							
1000	31392	41485	18143	40085	8616	352	15	0	0	0
	0	#1991	7525t							
1000	15843	65677	28694	4589	4435	1226	132	0	0	0
	0	#1992	6460t							

FR-GADOID-late: French Gadoid trawlers (FU5) - Effort, No. of whiting/age/1000 hours fished, Year, Live weight (t)

1993	2008									
1	1	0	1							
1	11									
1000	4736	57675	**35630**	**5286**	**825**	**883**	469	40	20	6
	0	#1993	7815t							
1000	448	26922	**65786**	**18395**	**2948**	**289**	454	125	80	0
	0	#1994	9236t							
1000	86	10737	**43840**	**34895**	**7662**	**1360**	248	0	28	32
	0	#1995	9186t							
1000	8	2509	**34872**	**31293**	**13650**	**1708**	328	32	31	29
	0	#1996	6028t							
1000	0	3641	**17743**	**45915**	**14168**	**4338**	721	63	12	0
	0	#1997	7218t							

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1000	3827 0	17367 #1998	**32394** 7674t	**25399**	**30762**	**21832**	3285	631	186	0
1000	3457 0	15689 #1999	**29265** 9102t	**22945**	**27790**	**19723**	2967	570	168	0
1000	4987 0	23934 #2000	**29232** 6053t	**15124**	**6851**	**7110**	5976	1306	132	10
1000	213 0	23745 #2001	**25724** 4624t	**9253**	**3440**	**1465**	593	539	114	57
1000	405 0	9574 #2002	**48049** 4799t	**13052**	**2399**	**816**	136	59	27	25
1000	13 3	2004 #2003	**15027** 2975t	**33581**	**3776**	**542**	94	48	67	13
1000	238 0	4747 #2004	**10190** 2589t	**18892**	**20570**	**1688**	269	17	0	0
1000	278 0	11772 #2005	**23815** 3659t	**15806**	**17601**	**15832**	418	54	0	0
1000	295 0	16943 #2006	**35200** 2795t	**15517**	**7869**	**5396**	2180	142	6	0
1000	369 0	13147 #2007	**23994** 1898t	**12964**	**2496**	**461**	400	460	53	0
1000	257 0	8841 #2008	**14651** 1133t	**10665**	**2942**	**586**	50	65	0	0

FR-NEPHROPS-Early: French Nephrops trawlers (FU8) - Effort, No. whiting/age/1000 hours fished, Year, Live weight (t)

1987 1992

1 1 0 1

1 11

1000	917 0	3681 #1987	2247 588t	761	176	23	18	2	6	0
1000	632 0	7960 #1988	3610 844t	918	165	39	11	0	0	0
1000	131 0	4874 #1989	6866 891t	1294	128	31	5	1	0	0
1000	321 0	1139 #1990	3596 671t	2297	279	27	8	5	0	0
1000	1048 0	2312 #1991	982 527t	1745	498	33	6	0	0	0
1000	1542 0	6078 #1992	3348 1153t	478	571	171	14	0	0	0

FR-NEPHROPS-Late: French Nephrops trawlers (FU8) - Effort, No. whiting/age/1000 hours fished, Year, Live weight (t)

1993 2008

1 1 0 1

1 11

1000	766 0	6928 #1993	**5695** 1356t	**1001**	**163**	**86**	74	1	2	0

1000	184 0	6145 #1994	**8313** 1565t	**1840**	**214**	**17**	16	5	2	0
1000	29 0	2217 #1995	**7580** 1446t	**4802**	**697**	**91**	20	0	3	3
1000	2 0	979 #1996	**5599** 1230t	**4992**	**2359**	**305**	55	4	1	7
1000	0 0	737 #1997	**3511** 1393t	**10406**	**4124**	**1231**	275	23	1	0
1000	58 0	1042 #1998	**2567** 881t	**4299**	**5925**	**1236**	239	46	2	0
1000	1253 0	4408 #1999	**4764** 1190t	**3762**	**3867**	**3563**	575	136	8	0
1000	277 0	2381 #2000	**3085** 869t	**2213**	**923**	**836**	959	232	23	0
1000	104 0	2948 #2001	**3131** 548t	**1531**	**557**	**213**	106	95	36	8
1000	27 0	747 #2002	**4007** 550t	**1455**	**462**	**170**	69	13	14	7
1000	5 2	311 #2003	**1708** 543t	**3944**	**574**	**95**	27	7	1	0
1000	47 0	748 #2004	**1090** 435t	**2045**	**2726**	**233**	49	6	0	0
1000	104 0	1285 #2005	**1926** 378t	**1133**	**1266**	**1283**	54	2	0	0
1000	46 0	802 #2006	**1299** 174t	**591**	**299**	**187**	101	12	0	0
1000	138 0	981 #2007	**1159** 96t	**604**	**137**	**26**	19	16	5	0
1000	41 0	506 #2008	**565** 54t	**408**	**96**	**19**	7	2	0	0

FR-EVHOE: Thalassa Survey - No. whiting at age/30 min, Year

1997	2012									
1	1	0.75	1							
0	8									
1	**30.82**	**23.85**	**8.93**	**8.47**	10.38	1.93	0.24	0.00	0.00	#1997
1	**48.10**	**15.15**	**7.88**	**1.23**	1.67	0.55	0.18	0.02	0.00	#1998
1	**260.66**	**62.15**	**17.64**	**5.09**	1.92	1.67	1.18	0.15	0.13	#1999
1	**30.62**	**76.50**	**23.18**	**2.85**	1.17	0.33	0.18	0.50	0.06	#2000
1	**22.77**	**35.46**	**48.80**	**8.12**	0.79	0.14	0.11	0.02	0.04	#2001
1	**38.50**	**15.33**	**11.00**	**9.58**	0.82	0.00	0.00	0.00	0.00	#2002
1	**46.62**	**58.30**	**27.11**	**19.94**	14.74	0.05	0.01	0.00	0.00	#2003
1	**28.23**	**108.11**	**31.11**	**14.36**	6.98	3.98	0.00	0.00	0.00	#2004
1	**44.14**	**15.85**	**5.19**	**1.89**	1.15	0.63	0.16	0.00	0.00	#2005
1	**14.60**	**9.53**	**3.45**	**1.18**	0.30	0.03	0.00	0.01	0.00	#2006
1	**178.39**	**46.30**	**4.34**	**0.68**	0.36	0.07	0.00	0.00	0.01	#2007
1	**364.99**	**44.55**	**10.17**	**3.27**	1.43	0.14	0.00	0.00	0.03	#2008
1	**29.93**	**68.10**	**30.54**	**6.47**	1.34	0.02	0.01	0.00	0.00	#2009
1	**26.91**	**36.04**	**24.03**	**10.89**	2.95	0.71	0.01	0.00	0.00	#2010
1	12.56	56.97	100.08	55.40	11.87	2.95	0.01	0.00	0.00	#2011
1	14.29	12.50	8.72	10.14	4.61	0.75	0.11	0.00	0.06	#2012

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```
UK-WCGFS:UK (E+W) PHHT Groundfish Survey in VIIf&g - Effort mins towed, no.s at-age,
Year, Vessel (final survey in 2004)

1987    2004
1       1       0.15    0.25
1       7
```

360	129	580	57	8	6	4	1	#1987	Cirolana
540	129	125	31	3	3	0	0	#1988	Cirolana
540	137	393	267	21	4	2	0	#1989	Cirolana
540	11	31	137	55	9	1	0	#1990	Cirolana
482	99	6	3	11	9	1	0	#1991	Cirolana
840	1097	441	94	28	22	6	1	#1992	Cirolana
840	4101	772	229	29	4	8	3	#1993	Cirolana
535	4809	713	490	70	17	1	3	#1994	Cirolana
1320	777.4	7282.9	1891.2	595	82.2	18.6	11.3	#1995	Cirolana
1475	773	2225	2050	391	148	11	2	#1996	Corystes
1519	1113	852	280	646	226	60	5	#1997	Cirolana
900	1071.5	691.5	477	343.3	104.8	13.3	12.5	#1998	Cirolana
900	760.2	453.9	139.4	52.1	47.8	90.2	30.5	#1999	Cirolana
1038	15471.8	962.8	296.4	118.9	47.2	51	50.6	#2000	Cirolana
880	2195.3	1186.5	206.8	35.4	2	7.6	1	#2001	Cirolana
762	2551.5	1368.9	2313.6	155.9	75.7	1.2	4.4	#2002	Cirolana
863	2765.7	2169.9	2138.8	1665.8	157.9	0	0	#2003	Cirolana
860	1716.8	1548.2	852.1	203.6	184.3	2	0	#2004	Cefas Endeavour

UK BT SURVEY : (Sept) - Prime stations only (VIIf) Effort (km towed), numbers-at-age per Km towed

1988	2012			
1	1	0.75	0.85	
0	1			
74.12	6	66	#1988	Tows 15 minute duration - raised here to 30 minutes
91.91	80	104	#1989	Tows 15 minute duration - raised here to 30 minutes
69.86	363	37	#1990	
123.41	540	175	#1991	
125.08	839	164	#1992	
127.67	1279	213	#1993	
120.82	330	182	#1994	
104.14	240	154	#1995	
122.11	557	188	#1996	
115.63	1238	56	#1997	
104.7	553	49	#1998	
117.11	1770	116	#1999	
105.99	128	333	#2000	
118.22	204	56	#2001	
113.03	602	36	#2002	
111.92	442	6	#2003	
101.92	1053	6	#2004	
119.11	760	5	#2005	
120.56	520	31	#2006	
118.59	910	81	#2007	
119.33	2994	81	#2008	
123.22	826	72	#2009	
116.92	232	35	#2010	
118.22	256	18	#2011	
119.33	507	8	#2012	

IR-GFS-7G Swept-area : Swept-area Method - Effort in kmsq

1999	2012									
1	1	0.75	0.92							
0	8									
10.0	**24175**	**7307**	**1881**	**633**	**292**	**110**	**85**	40	0	#1999
10.0	**6077**	**15835**	**3116**	**190**	**35**	**27**	**8**	0	0	#2000
10.0	**4650**	**2836**	**13871**	**1849**	**222**	**18**	**22**	6	0	#2001
10.0	**2468**	**3664**	**1719**	**1252**	**127**	**3**	**9**	0	0	#2002
10.0	**6061**	**2219**	**1027**	**413**	**0**	**10**	**0**	0	0	#2003 *age 4 replaced with zero,was 22
10.0	**9778**	**3444**	**655**	**321**	**147**	**123**	**1**	0	0	#2004
10.0	**1146**	**3177**	**1573**	**422**	**169**	**104**	**163**	0	0	#2005 *revised 2009
10.0	**15260**	**5883**	**2175**	**707**	**68**	**0**	**28**	0	0	#2006 *revised 2009

10.0 **9951** **8081** **2718** **455** **83** **23** **4** 0 3 #2007*revised 2009

10.0 **16344** **5554** **2238** **475** **65** **2** **0** 0 0 #2008

10.0 **11053** **10819** **2154** **589** **110** **25** **0** 3 0 #2009

10.0 **2817** **30977** **784** **172** **11** **2** **0** 0 0 #2010 *revised 2012

10.0 2357 8164 7044 2090 412 28 20 0 0 #2011

10.0 3550 3748 4089 3708 517 103 18 0 0 #2012

IR-7G&J-OT : Irish Otter Trawl Fleet (Areas VIIg&j) - Effort in hours, no.s @ age, Year, Live weight (t), LPUE (kg/h)

1995 2012

1 1 0 1

1 4

157085 679 2281 1889 1333 # #1995

130257 164 1549 1889 905 # #1996

148276 170 756 1488 1247 # #1997

161909 180 933 980 736 # #1998

92195 388 960 962 449 # #1999

125229 619 1042 808 500 228 103 65 2000 1506.6t 12.03

137086 91 2224 1538 1046 412 125 48 2001 2227.9t 16.25

168134 291 1140 2615 613 86 13 6 2002 1761.4t 10.48

198059 147 878 1640 1195 155 8 0 2003 1544.6t 7.80

188948 132 628 1763 1002 428 42 2 2004 2243.9t 11.88

198315 385 2630 3154 1377 1341 751 33 2005 3730.4t 18.81

185083 201 2243 2511 1282 473 332 171 2006 3008.2t 16.25

217009 252 1797 3564 2503 655 153 92 2007 3597.2t 16.58

192317 194 1225 1182 726 180 54 7 2008 1269.3t 6.60

209568 218 1155 1755 699 287 77 17 2009 1576.6t 7.52

225900 140 1374 2356 1472 414 97 12 2010 2631.5t 11.65

182782 0 470 1928 1585 510 136 20 2011 2507.2t

181562 0 342 2205 1875 474 109 22 2012 2600t 14.32

13.72IR-ISCSGFS : Irish Sea Celtic Sea GFS (VIIg) - Whiting #/30 min towed (Prime stations only)

1997 2002

1 1 0.8 0.9

0 5

1 21 38 70 223 113 23 #1997

1 1605 1430 300 79 135 16 #1998

1 6389 507 120 38 17 6.3 #1999

1 6062 687 104 4.2 0.2 0.1 #2000

1 1661 1549 838 8.8 0.4 0.5 #2001

1 312 298 102 77 9.1 0.2 #2002

IR-WCGFS : Irish Autumn WCGFS (VIIj) - Effort min. towed, #@ age, Yr

1993 2002

1 1 0.75 0.79

0 6

323	372	912	1529	1722	352	0	0	#1993
673	11235	123	304	344	25	0	0	#1994
651	15564	1736	229	285	29	0	0	#1995
671	406	618	189	42	59	0	0	#1996
1232	478	171	345	59	22	21	12	#1997
1310	2384	758	159	34	65	7	2	#1998
1281	23133	3013	175	45	12	2	2	#1999
1190	203	2445	664	44	6	0	0	#2000
595	218	1253	1709	169	12	2	0	#2001
606	3239	4489	1538	438	61	5	1	#2002

IR-GFS-7G : Irish Groundfish Survey in VIIg (IBTS 4th Qtr) - Whiting no. @ age (Interim indices: New Celtic Explorer series)

2003 2012

1 1 0.79 0.92

0 6

832	6598	2571	1189	466	23	11	0	#2003
980	12662	4470	853	417	191	159	2	#2004
845	4078	4776	1745	483	178	107	182	#2005
1046	22967	8854	3273	1064	102	0	43	#2006
1168	16479	13382	4501	754	138	38	13	#2007
1139	23296	7916	3190	677	93	3	0	#2008
1018	14872	14558	2898	793	148	34	0	#2009
1381	3390	17059	9541	1636	247	29	15	#2010
1392	4189	14509	12519	3714	732	50	36	#2011
1470	6407	6764	7381	6692	934	186	32	#2012

IR-GFS-7J : Irish Groundfish Survey in VIIj (IBTS 4th Qtr) - Whiting no. @ age (Interim indices: New Celtic Explorer series)

2003 2012

1 1 0.79 0.92

0 6

780	227	2121	883	146	67	3	0	#2003
720	3864	1230	1675	155	27	6	4	#2004
881	455	1001	234	121	17	4	9	#2005
901	727	1141	403	31	15	3	3	#2006
874	5221	582	144	35	8	4	0	#2007
873	2468	1631	625	239	42	3	7	#2008
747	4501	3513	908	193	47	10	0	#2009
1021	2275	7315	1173	538	50	23	0	#2010
1052	18217	765	1341	155	21	9	2	#2011
1021	4304	1790	205	447	29	0	2	#2012

IR-GFS-7G&J : Irish Groundfish Survey in VIIg&j (IBTS 4th Qtr) - Whiting no. @ age (Interim indices: New Celtic Explorer series)

2003 2012

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1	1	0.79	0.92					
0	6							
1612	6836	4714	2064	582	96	12	0	#2003
1700	16710	5405	2733	570	170	115	10	#2004
1726	4761	6085	1655	573	142	75	101	#2005
1947	24194	10418	3250	637	100	3	25	#2006
2042	22609	14869	3182	508	82	39	10	#2007
2012	26990	9362	2957	734	135	6	8	#2008
1765	20379	17026	3845	989	196	41	0	#2009
2402	6783	25405	10268	2134	303	52	19	#2010
2444	22971	14390	14842	3328	641	52	35	#2011
2491	10681	10763	6398	6242	837	163	30	#2012

Table 7.15.9. Whiting in Divisions VIIe–k. Landings (t), lpue of French and Irish fleets, and Effort ('000 h) of French, Irish and UK fleets.

	FR-Gadoid			FR-*Nephrops*			IR-OTB-7G			IR-OTB-7J				
	VII fg French			VII fg French			Irish otter trawlers			Irish otter trawlers			UK (E&W) in VIIe-k	
	gadoid trawlers			*Nephrops* trawlers			VIIg			VIIj			Beam	Otter
Year	Landings	Effort[4]	Lpue[3]	Landings	Effort[4]	Lpue[3]	Landings	Effort[4]	Lpue[3]	Landings	Effort[4]	Lpue[3]	Effort[4]	Effort[4]
1983	5,742	109	53	470	207	2							135	82
1984	4,598	84	55	340	173	2							131	87
1985	4,514	89	51	651	185	4							152	90
1986	5,049	116	44	374	146	3							136	85
1987	6,859	137	50	588	177	3							177	84
1988	7,921	200	40	844	156	5							195	89
1989	8,974	231	39	891	159	6							198	84
1990	7,897	188	42	671	196	3							208	99
1991	7,525	167	45	527	187	3							203	77
1992	6,460	173	37	1,153	234	5							196	86
1993	7,815	201	39	1,356	223	6							208	62
1994	9,236	171	54	1,565	223	7							220	54
1995	9,186	171	54	1,446	202	7	829	64	13	1,305	94	14	243	52
1996	6,028	152	40	1,230	179	7	906	60	15	803	70	11	261	61
1997	7,218	195	37	1,393	149	9	1,066	65	16	783	83	9	265	67
1998	9,102	172	53	881	125	7	813	72	11	545	90	6	255	62
1999	9,102	191	48	1,190	130	9	946	52	18	247	41	6	251	98
2000	6,053	157	38	869	161	5	990	61	16	517	65	8	259	104

2001	4,624	174	27	548	137	4	1,286	69	19	942	68	14	273	85
2002	4,841	165	29	550	142	4	1,004	78	13	758	90	8	249	83
2003	2,975	125	24	543	161	3	1,051	87	12	494	111	4	282	72
2004	2,589	107	24	435	127	3	1,932	97	20	312	92	3	274	76
2005	3,787	93	41	378	114	3	3,445	124	28	285	74	4	270	76
2006	2,795	75	37	175	107	2	2,757	119	23	251	66	4	252	83
2007	1,898	80	24	96	75	1	3,324	137	24	273	80	3	240	88
2008	1,133	62	18	54	70	1	1,037	126	8	233	67	4	217	71
2009	Not available			Not available			1,283	137	9	294	73	4	191	74
2010	Not available			Not available			2,208	141	16	424	85	5	196	78
2011	628			26			24	1	0	1	2,214	120	18	293
2012*	2,515										2,180	121	18	421

	IR-SSC-7J Irish Scottish Seiners			IR-SSC-7G Irish Scottish Seiners			IR-TBB-7J Irish Beam Trawls			IR-TBB-7G Irish Beam Trawls		
Year	Landings	Effort[4]	Lpue[3]	Landings	Effort[4]	Lpue[3]	Landings	Effort[4]	Lpue[3]	Landings	Effort[4]	Lpue[3]
1995	1,008	5	192	1,123	6	175	0	0	1	63	21	3
1996	1,100	8	135	1,534	10	158	5	1	3	33	27	1
1997	806	11	75	2,654	16	165	3	2	2	44	28	2
1998	467	7	71	2,502	15	167	5	5	1	46	35	1
1999	77	1	55	1,378	8	172	8	7	1	47	41	1
2000	187	3	54	1,187	10	120	8	7	1	64	37	2
2001	236	4	53	1,005	16	62	6	3	2	79	40	2
2002	409	9	46	1,971	21	94	6	3	2	60	32	2
2003	371	9	41	1,560	21	75	13	9	1	55	49	1
2004	314	9	34	1,038	19	54	1	2	1	33	55	1

2005	253	6	41	1,004	15	68	1	2	1	24	50	0
2006	192	5	36	912	15	62	1	2	0	19	60	0
2007	205	4	58	825	16	52	0	2	0	25	56	0
2008	225	3	79	741	12	64	0	1	0	4	37	0
2009	347	3	104	734	8	90	0	3	0	2	38	0
2010	533	4	122	1,035	10	107	0	1	0	4	40	0
2011	368	5	80	1,212	11	110	0	1	0.5	14	35	0.4
2012*	724	5	136	1,804	14	128	0	0	0.1	12	40	0.3

[1] = Lpue calculated as landings in kg/h fishing, power corrected.

[2] = Effort in hours fishing, power corrected.

[3] = Lpue calculated as landings in kg/h fishing.

[4] = Effort in 000 hours fishing.

*** Provisional.**

Table 7.15.10. Whiting in Divisions VIIe–k. XSA Diagnostics.

LOWESTOFT VPA VERSION 3.1

14/05/2013 13:56

Extended Survivors Analysis

"Whiting in the Celtic Sea (VIIe-k) WGCSE 2013 COMBSEX (Updated by DS 08/05/20

CPUE data from file whg7ektutrimed.txt

Catch data for 31 years. 1982 to 2012. Ages 0 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
"FR-GADOID-late: Fre	1993	2012	3	6	0	1
"FR-NEPHROPS-Late: F	1993	2012	3	6	0	1
"FR-EVHOE: Thalassa	1997	2012	0	4	0.75	1
"UK-WCGFS: UK (E+W)	1987	2012	1	6	0.15	0.25
"IR-GFS-7G-SweptArea	1999	2012	0	6	0.75	0.92

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 5

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.000

Minimum standard error for population
estimates derived from each fleet = .500

Prior weighting not applied

Tuning converged after 36 iterations

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1										
Regression weights										
	1	1	1	1	1	1	1	1	1	1
Fishing mortalities										
Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	0	0	0	0	0	0	0	0	0	0
1	0.016	0.039	0.026	0.05	0.034	0.028	0.005	0.007	0.028	0.006
2	0.173	0.197	0.283	0.314	0.296	0.174	0.144	0.059	0.084	0.039
3	0.382	0.482	0.742	0.68	0.922	0.592	0.515	0.381	0.147	0.188
4	0.597	0.625	1.01	0.931	1.503	1.016	0.762	0.779	0.398	0.184
5	1.035	0.727	1.252	1.397	1.535	0.916	0.772	0.803	0.686	0.235
6	1.011	1.069	1.407	1.469	2.015	0.695	0.481	0.549	0.573	0.528
7	0.687	0.817	1.177	1.003	1.629	0.91	0.996	0.928	0.431	0.331
1										
XSA population numbers (Thousands)										

AGE								
YEAR	0	1	2	3	4	5	6	7
2003	4.29E+04	3.17E+04	2.50E+04	2.88E+04	2.84E+04	2.87E+03	4.59E+02	4.45E+01
2004	3.98E+04	3.52E+04	2.56E+04	1.72E+04	1.61E+04	1.28E+04	8.35E+02	1.37E+02
2005	3.79E+04	3.26E+04	2.77E+04	1.72E+04	8.70E+03	7.04E+03	5.06E+03	2.35E+02
2006	3.97E+04	3.10E+04	2.60E+04	1.71E+04	6.70E+03	2.59E+03	1.65E+03	1.01E+03
2007	6.29E+04	3.25E+04	2.42E+04	1.56E+04	7.08E+03	2.16E+03	5.25E+02	3.11E+02
2008	9.34E+04	5.15E+04	2.57E+04	1.47E+04	5.06E+03	1.29E+03	3.82E+02	5.73E+01
2009	9.80E+04	7.65E+04	4.10E+04	1.77E+04	6.67E+03	1.50E+03	4.23E+02	1.56E+02
2010	4.67E+04	8.02E+04	6.23E+04	2.91E+04	8.67E+03	2.55E+03	5.68E+02	2.14E+02
2011	2.07E+04	3.82E+04	6.52E+04	4.81E+04	1.63E+04	3.26E+03	9.35E+02	2.69E+02
2012	2.28E+04	1.69E+04	3.04E+04	4.91E+04	3.40E+04	8.94E+03	1.34E+03	4.31E+02
Estimated population abundance at 1st Jan 2013								
	0.00E+00	1.87E+04	1.38E+04	2.40E+04	3.33E+04	2.31E+04	5.79E+03	6.49E+02
Taper weighted geometric mean of the VPA populations:								
	6.36E+04	5.28E+04	4.24E+04	2.45E+04	9.25E+03	2.57E+03	5.92E+02	1.47E+02
Standard error of the weighted Log(VPA populations) :								

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	0.5539	0.5322	0.4991	0.6244	0.8574	1.0717	1.3131	1.4889		
1										
Log catchability residuals.										
Fleet : "FR-GADOID-late: Fre										
Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.18	0.09	-0.33	-1	-1.06	0.18	0.33	0.51	0.2	-0.11
4	-0.34	-0.01	-0.22	-0.45	-0.65	-0.55	0.31	0.26	0.05	0.06
5	-0.64	-0.07	-0.18	-0.45	-0.56	-0.41	0.49	0.25	0.12	-0.05
6	-0.46	-0.7	0.15	-0.91	-0.61	0.89	0.26	0.84	0.4	0.73
Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.65	-0.48	0.49	0.86	0.67	0.09	99.99	99.99	99.99	99.99

4	-0.24	-0.23	0.36	0.58	0.56	0.51	99.99	99.99	99.99	99.99
5	-0.14	-0.06	0.59	0.84	-0.08	0.36	99.99	99.99	99.99	99.99
6	-0.25	0.31	0.87	0.94	-0.19	-0.12	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6
Mean Log q	-6.6348	-6.1305	-5.941	-5.941
S.E(Log q)	0.5651	0.4011	0.4209	0.634

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q

3	2.52	-2.984	1.05	0.22	16	1.15	-6.63
4	1.73	-4.539	3.68	0.74	16	0.46	-6.13
5	1.07	-0.605	5.76	0.83	16	0.46	-5.94
6	0.86	1.114	5.99	0.83	16	0.53	-5.81
1							

Fleet : "FR-NEPHROPS-Late: F

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.65	0.32	0.22	-0.53	-0.38	-0.05	0.82	0.57	0.4	-0.29
4	0.2	-0.11	0	-0.07	0.08	-0.11	0.71	0.55	0.46	0.08
5	-0.08	-0.51	-0.4	-0.03	0.38	0.12	0.69	0.42	0.48	0.48
6	-0.61	-1.36	-0.37	-0.45	0.3	0.19	0.73	0.88	0.65	1.34

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	No data for this fleet at this age									

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1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.52	-0.41	0.27	-0.14	-0.06	-0.86	99.99	99.99	99.99	99.99
4	-0.17	-0.24	-0.06	-0.48	-0.3	-0.54	99.99	99.99	99.99	99.99
5	0.16	0.09	0.14	-0.25	-0.8	-0.88	99.99	99.99	99.99	99.99
6	0.18	0.5	0.54	-0.24	-0.88	-1.37	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	3	4	5	6
Mean Log q	-8.9352	-8.3409	-8.1194	-8.1194
S.E(Log q)	0.483	0.3468	0.4653	0.7958

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1	-0.012	8.93	0.59	16	0.5	-8.94
4	0.97	0.23	8.37	0.83	16	0.35	-8.34
5	0.83	1.792	8.17	0.89	16	0.36	-8.12
6	0.77	1.8	7.9	0.81	16	0.57	-8.12
1							

Fleet : "FR-EVHOE: Thalassa

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	99.99	99.99	99.99	99.99	-0.43	-0.13	0.9	-0.54	-0.35	0.17
1	99.99	99.99	99.99	99.99	-0.46	-0.88	0.44	-0.06	-0.15	-0.48
2	99.99	99.99	99.99	99.99	-0.67	-0.66	0.31	0.44	0.36	-0.46
3	99.99	99.99	99.99	99.99	-0.42	-1.61	0.17	-0.22	0.6	-0.26
4	99.99	99.99	99.99	99.99	-0.14	-1.23	0.08	-0.08	-0.06	-0.49
5	No data for this fleet at this age									
6	No data for this fleet at this age									

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	0.26	-0.17	0.33	-0.82	1.22	1.54	-1.01	-0.37	-0.32	-0.29
1	0.84	1.37	-0.48	-0.92	0.6	0.09	0.1	-0.58	0.64	-0.08
2	0.96	1.1	-0.7	-1.02	-0.73	-0.05	0.56	-0.17	1.23	-0.49
3	1.05	1.32	-0.48	-1	-1.24	0.1	0.53	0.43	1.35	-0.33
4	0.96	0.81	-0.05	-1.2	-0.57	0.72	0.16	0.7	1.13	-0.74
5	No data for this fleet at this age									
6	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	0	1	2	3	4
Mean Log q	-6.9111	-6.9476	-7.4595	-7.8162	-7.8298
S.E(Log q)	0.7091	0.6443	0.7208	0.868	0.7297

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Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	0.66	1.429	8.24	0.56	16	0.45	-6.91
1	1.2	-0.426	6.22	0.25	16	0.79	-6.95
2	0.67	1.009	8.48	0.4	16	0.48	-7.46
3	0.84	0.369	8.18	0.28	16	0.75	-7.82
4	1.07	-0.232	7.72	0.45	16	0.81	-7.83
1							

Fleet : "UK-WCGFS: UK (E+W)

Age	1987	1988	1989	1990	1991	1992
0	No data for this fleet at this age					
1	-1.23	-1.42	-0.2	-3.21	-1.59	-0.14
2	1.33	-1.29	0.03	-1.3	-3.29	-0.24
3	0.57	-0.87	0.39	-0.23	-2.42	-0.13
4	0.08	-1.08	0.17	0.06	-1.41	0.55

5	1.07	0.26	0.79	0.64	-0.51	0.26				
6	2.2	99.99	1.47	1.43	0	-0.06				

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	No data for this fleet at this age									
1	1.3	1.63	-0.49	-0.1	0.31	0.82	0.34	2.54	1.45	99.99
2	-0.16	0.3	1.42	0.72	0.27	0.66	0.3	0.81	0.45	99.99
3	-0.01	0.55	1.01	0.6	-0.82	0.81	-0.23	0.57	0.21	99.99
4	-0.1	0.34	0.73	0.12	0.01	0.57	-0.45	0.61	-0.2	99.99
5	-0.54	0.66	0.31	-0.07	0.16	-0.71	-0.61	0.43	-2.12	99.99
6	0.3	-0.43	0.88	-1	-0.07	-1.15	0.18	0.96	0.32	99.99

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	No data for this fleet at this age									
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

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Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	1	2	3	4	5	6
Mean Log q	-11.3403	-11.385	-11.576	-11.6728	-11.4713	-11.4713
S.E(Log q)	1.4755	1.1992	0.8699	0.6039	0.8004	1.0191

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.62	0.771	11.28	0.24	15	0.92	-11.34
2	0.55	1.282	11.19	0.39	15	0.65	-11.38
3	0.58	2.216	11.05	0.68	15	0.45	-11.58

4	0.89	0.676	11.42	0.76	15	0.55	-11.67
5	1.34	-1.567	12.64	0.62	15	1.02	-11.47
6	1.6	-2.677	13.76	0.62	14	1.25	-11.11
1							

Fleet : "IR-GFS-7G-SweptArea

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
0	99.99	99.99	99.99	99.99	99.99	99.99	0.46	-0.22	-0.01	-0.64
1	99.99	99.99	99.99	99.99	99.99	99.99	0.1	0.16	-0.88	-0.12
2	99.99	99.99	99.99	99.99	99.99	99.99	-0.2	0.17	0.84	-0.58
3	99.99	99.99	99.99	99.99	99.99	99.99	0.04	-0.98	1.07	-0.34
4	99.99	99.99	99.99	99.99	99.99	99.99	0.57	-1.21	1.04	0.02
5	99.99	99.99	99.99	99.99	99.99	99.99	0.52	0.19	0.65	-1.28
6	99.99	99.99	99.99	99.99	99.99	99.99	0.28	-0.21	2.1	2.03

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0	0.16	0.71	-1.39	1.16	0.27	0.37	-0.07	-0.99	-0.06	0.25
1	-0.64	-0.28	-0.3	0.39	0.65	-0.19	0.06	-0.01	0.49	0.55
2	-0.58	-1.03	-0.16	0.25	0.53	0.17	-0.36	0.16	0.31	0.49

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3	-0.86	-0.52	-0.03	0.44	0.3	0.12	0.09	0.03	0.05	0.6
4	99.99	-0.66	0.41	-0.3	0.32	0	0.04	0.13	0.17	-0.53
5	-0.66	0.1	0.97	99.99	0.87	-1.57	0.69	-0.14	-0.04	-0.31
6	99.99	-1.7	1.88	1.29	0.94	99.99	99.99	0.45	0.77	0.21

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	0	1	2	3	4	5	6
Mean Log q	-4.2485	-4.1472	-4.6029	-5.1972	-5.6473	-6.2762	-6.2762
S.E(Log q)	0.6623	0.4426	0.5114	0.5489	0.5774	0.7931	1.3577

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	0.85	0.499	5.25	0.47	14	0.58	-4.25
1	1.21	-0.652	2.8	0.45	14	0.55	-4.15
2	0.67	1.429	6.53	0.61	14	0.33	-4.6
3	1.01	-0.019	5.16	0.4	14	0.58	-5.2
4	1.45	-0.934	4.05	0.28	13	0.84	-5.65
5	0.73	1.279	6.79	0.68	13	0.57	-6.28
6	1.1	-0.254	5.38	0.41	11	1.3	-5.54
1							

Terminal year survivor and F summaries :

Age 0 Catchability constant w.r.t. time and dependent on age

Year class = 2012

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
"FR-GADOID-late: Fre	1	0	0	0	0	0	0
"FR-NEPHROPS-Late: F	1	0	0	0	0	0	0
"FR-EVHOE: Thalassa	13983	0.731	0	0	1	0.468	0
"UK-WCGFS: UK (E+W)	1	0	0	0	0	0	0
"IR-GFS-7G-SweptArea	24042	0.686	0	0	1	0.532	0

F shrinkage mean	0	1				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
18655	0.5	0.27	2	0.541	0

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2011

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
"FR-GADOID-late: Fre	1	0	0	0	0	0	0
"FR-NEPHROPS-Late: F	1	0	0	0	0	0	0
"FR-EVHOE: Thalassa	11390	0.492	0.118	0.24	2	0.367	0.007
"UK-WCGFS: UK (E+W)	1	0	0	0	0	0	0
"IR-GFS-7G-SweptArea	19346	0.404	0.29	0.72	2	0.544	0.004
F shrinkage mean	3793	1				0.089	0.02

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
13772	0.3	0.27	5	0.906	0.006

1

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2010

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
"FR-GADOID-late: Fre	1	0	0	0	0	0	0
"FR-NEPHROPS-Late: F	1	0	0	0	0	0	0
"FR-EVHOE: Thalassa	23331	0.41	0.368	0.9	3	0.356	0.04
"UK-WCGFS: UK (E+W)	1	0	0	0	0	0	0
"IR-GFS-7G-SweptArea	28441	0.321	0.431	1.34	3	0.581	0.033
F shrinkage mean	5790	1				0.063	0.152

Weighted prediction :

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Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
23963	0.25	0.28	7	1.137	0.039

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2009

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
"FR-GADOID-late: Fre	1	0	0	0	0	0	0
"FR-NEPHROPS-Late: F	1	0	0	0	0	0	0
"FR-EVHOE: Thalassa	27468	0.373	0.491	1.32	4	0.337	0.224
"UK-WCGFS: UK (E+W)	1	0	0	0	0	0	0
"IR-GFS-7G-SweptArea	41740	0.28	0.151	0.54	4	0.602	0.153
F shrinkage mean	10226	1				0.061	0.516

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
33284	0.22	0.23	9	1.045	0.188

1

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2008

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
"FR-GADOID-late: Fre	1	0	0	0	0	0	0
"FR-NEPHROPS-Late: F	1	0	0	0	0	0	0
"FR-EVHOE: Thalassa	31724	0.335	0.436	1.3	5	0.346	0.137
"UK-WCGFS: UK (E+W)	1	0	0	0	0	0	0
"IR-GFS-7G-SweptArea	23084	0.254	0.144	0.57	5	0.6	0.184
F shrinkage mean	3192	1				0.054	0.901

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
23148	0.2	0.24	11	1.202	0.184

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
"FR-GADOID-late: Fre	1	0	0	0	0	0	0
"FR-NEPHROPS-Late: F	1	0	0	0	0	0	0
"FR-EVHOE: Thalassa	11956	0.344	0.22	0.64	5	0.294	0.12
"UK-WCGFS: UK (E+W)	1	0	0	0	0	0	0
"IR-GFS-7G-SweptArea	5344	0.258	0.101	0.39	6	0.615	0.252
F shrinkage mean	961	1				0.091	0.953

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5791	0.21	0.23	12	1.092	0.235

1

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2006

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
"FR-GADOID-late: Fre	1	0	0	0	0	0	0
"FR-NEPHROPS-Late: F	1	0	0	0	0	0	0
"FR-EVHOE: Thalassa	853	0.351	0.277	0.79	5	0.197	0.425
"UK-WCGFS: UK (E+W)	1	0	0	0	0	0	0
"IR-GFS-7G-SweptArea	827	0.321	0.132	0.41	7	0.536	0.436
F shrinkage mean	325	1				0.266	0.872

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
649	0.32	0.17	13	0.529	0.528

Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2005

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Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
"FR-GADOID-late: Fre	278	0.583	0	0	1	0.047	0.306
"FR-NEPHROPS-Late: F	107	0.5	0	0	1	0.064	0.657
"FR-EVHOE: Thalassa	216	0.364	0.245	0.67	5	0.14	0.379
"UK-WCGFS: UK (E+W)	1	0	0	0	0	0	0
"IR-GFS-7G-SweptArea	292	0.348	0.205	0.59	7	0.404	0.294
F shrinkage mean	266	1				0.344	0.317

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
254	0.38	0.12	15	0.314	0.331

Table 7.15.11. Whiting in Divisions VIIe–k. Fishing mortality (F)-at-age. F_{bar} range is 2–5.

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	0.1364	0.08	0.0973	0.0737	0.0624	0.0299	0.0246	0.0837	0.1074	0.0421
2	0.7386	0.838	0.8063	0.7165	0.6547	0.4344	0.3195	0.6298	0.4963	0.4167
3	1.4101	0.9895	1.1643	0.9943	1.3656	1.0919	0.9203	0.7464	1.0389	0.9206
4	1.4617	1.4178	0.9325	1.2143	1.5782	1.5722	1.3233	1.0741	1.69	0.8388
5	1.8707	1.3359	0.9374	1.4032	1.6712	1.5087	1.6378	1.3049	1.326	0.8823
6	1.634	1.0529	0.7591	0.5007	1.4229	0.9915	1.086	2.5988	0.9854	0.7859
7	1.6781	1.2848	0.8857	1.0515	1.5784	1.2774	1.3453	1.6044	1.3305	0.8192
0 FBAR 2- 5	1.3703	1.1453	0.9601	1.0821	1.3174	1.1518	1.0502	0.9388	1.1378	0.7646
YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	0.0221	0.0091	0.0071	0.0297	0.0143	0.0286	0.0901	0.0388	0.0073	0.0379
2	0.2684	0.1828	0.1421	0.1282	0.1299	0.2151	0.3659	0.2993	0.1714	0.1719
3	0.8035	0.5595	0.4772	0.2487	0.3042	0.5386	0.7899	0.7879	0.7023	0.4869
4	0.8383	0.7291	0.7139	0.5784	0.5299	0.639	1.108	1.0378	1.3019	1.032
5	0.9021	0.8613	0.6476	0.6806	0.7876	0.7609	1.3781	1.1804	1.8281	1.1311
6	0.7305	0.6147	0.7086	0.4855	0.9289	0.8501	1.1439	1.7552	2.0644	1.8834
7	0.8599	0.9391	1.2268	0.6221	1.2353	0.8967	1.1351	1.3627	1.6416	1.2401
0 FBAR 2- 5	0.7031	0.5832	0.4952	0.409	0.4379	0.5384	0.9105	0.8264	1.0009	0.7055

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	FBAR **-**
AGE											
0	0	0	0	0	0	0	0	0	0	0	0
1	0.0162	0.0388	0.0264	0.0499	0.0341	0.0276	0.0046	0.0073	0.0277	0.0056	0.0135
2	0.1732	0.1973	0.2827	0.314	0.2958	0.1735	0.1438	0.0594	0.0842	0.0389	0.0608
3	0.3821	0.4824	0.7417	0.6805	0.9223	0.5919	0.5149	0.3808	0.1474	0.1883	0.2388
4	0.5966	0.6248	1.0103	0.9307	1.5033	1.0158	0.7619	0.7786	0.3979	0.1837	0.4534
5	1.035	0.7272	1.2523	1.397	1.5345	0.9158	0.7724	0.8027	0.6858	0.2346	0.5744
6	1.011	1.0686	1.4068	1.4686	2.015	0.695	0.481	0.5488	0.5734	0.5284	0.5502
7	0.6874	0.8167	1.1774	1.0025	1.6289	0.9099	0.9962	0.9277	0.4306	0.3312	0.5631
0 FBAR 2- 5	0.5467	0.5079	0.8218	0.8306	1.064	0.6743	0.5482	0.5054	0.3288	0.1614	

Table 7.15.12. Whiting in Divisions VIIe–k. Stock number-at-age (‘000).

	YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
	AGE										
0		50135	53843	71585	133370	105949	33446	54976	110493	162714	142343
1		50839	41047	44083	58609	109194	86743	27383	45011	90464	133219
2		21123	36315	31024	32746	44575	83992	68925	21875	33893	66521
3		13245	8263	12861	11341	13095	18963	44535	40997	9541	16894
4		4882	2647	2515	3287	3435	2736	5210	14526	15913	2764
5		1723	927	525	810	799	580	465	1136	4063	2404
6		268	217	199	168	163	123	105	74	252	883
7		14	43	62	76	84	32	37	29	5	77
0	TOTAL	142228	143301	162855	240407	277293	226616	201637	234141	316844	365104

	YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	AGE										
0		189188	103136	62050	57721	56598	65253	126729	62684	38752	38755
1		116540	154894	84440	50802	47258	46338	53425	103757	51321	31728
2		104579	93330	125666	68645	40376	38141	36869	39974	81714	41714
3		35901	65465	63645	89258	49440	29030	25183	20936	24261	56362
4		5509	13162	30630	32334	56987	29861	13870	9358	7796	9841
5		978	1950	5198	12281	14846	27467	12904	3750	2714	1736
6		814	325	675	2227	5091	5529	10508	2663	943	357
7		330	321	144	272	1122	1646	1935	2741	377	98
0	TOTAL	453840	432583	372447	313540	271718	243265	281422	245862	207878	180592

	YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	GMST 82-**	AMST 82-**
	AGE													
0		42935	39838	37885	39735	62861	93413	97998	46667	20661	22786	0	68473	77350
1		31730	35152	32617	31018	32532	51466	76480	80234	38208	16916	18655	55511	63001
2		25011	25560	27686	26009	24159	25741	40989	62330	65210	30428	13772	42259	48259
3		28758	17221	17180	17085	15556	14715	17718	29065	48087	49077	23963	23327	28392
4		28358	16068	8704	6700	7084	5064	6665	8668	16261	33974	33284	8671	12473
5		2871	12785	7043	2595	2163	1290	1501	2547	3258	8943	23148	2440	4529
6		459	835	5058	1648	525	382	423	568	935	1344	5791	566	1433
7		44	137	235	1014	311	57	156	214	269	431	649	138	402
0	TOTAL	160166	147595	136408	125804	145191	192128	241930	230293	192888	163899	119261		

Table 7.15.13. Whiting in Divisions VIIe–k. Summary table.

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFAC	F_{BAR} 2–5
	Age 0						
1982	62095	22699	19049	11225	0.5893	0.9997	1.0651
1983	50135	22903	17064	11781	0.6904	1.0007	1.3703
1984	53843	23436	17566	9985	0.5684	0.9991	1.1453
1985	71585	23341	17620	10838	0.6151	1	0.9601
1986	133370	26068	18617	9952	0.5346	1.0001	1.0821
1987	105949	37501	24905	12652	0.508	1.001	1.3174
1988	33446	45864	33826	15128	0.4472	1	1.1518
1989	54976	39627	34852	16541	0.4746	0.9994	1.0502
1990	110493	32950	27657	14106	0.51	1.0005	0.9388
1991	162714	33844	24579	13508	0.5496	0.9998	1.1378
1992	142343	48784	32886	12364	0.376	1.0005	0.7646
1993	189188	61884	47335	16320	0.3448	0.9983	0.7031
1994	103136	81600	62387	20034	0.3211	1.001	0.5832
1995	62050	83702	74406	22678	0.3048	1.0123	0.4952
1996	57721	77474	71093	18260	0.2568	1.0012	0.409
1997	56598	65067	60514	20532	0.3393	1.0034	0.4379
1998	65253	52981	47657	19245	0.4038	1.0066	0.5384
1999	126729	42416	37685	19915	0.5285	1.0081	0.9105
2000	62684	43092	32716	14865	0.4544	1.013	0.8264
2001	38752	46792	38696	12770	0.33	1.0194	1.0009

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFAC	F_{BAR} 2–5
2002	38755	43158	38120	13146	0.3449	1.0034	0.7055
2003	42935	36061	31604	10583	0.3349	1.0017	0.5467
2004	39838	32919	28555	9953	0.3486	1.0015	0.5079
2005	37885	29537	25472	12030	0.4723	1.0029	0.8218
2006	39735	26789	22589	9533	0.422	1.0044	0.8306
2007	62861	26092	21220	8947	0.4216	1.0067	1.064
2008	93413	29238	21234	5737	0.2702	1.003	0.6743
2009	97998	44546	30896	6386	0.2067	0.9995	0.5482
2010	46667	61451	45268	8442	0.1865	1.0065	0.5054
2011	20661	61679	53881	9077	0.1685	1.0009	0.3288
2012	22786	69362	65411	9976	0.1525	1.0396	0.1614
Arith.							
Mean	73761	44286	36302	13113	.4024	.7930	
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)			

Table 7.15.14. Whiting in Divisions VIIe–k. Management options table.

MFDP VERSION 1A						
Run: WHG7ek_fin						
"Whiting in the Celtic Sea (VIIe-k), WGCSE 2013, COMBSEX (Updated by DS 08/05/2013)"						
Time and date: 13:35 14/05/2013						
Fbar age range: 2-5						
2013						
Biomass	SSB	FMult	FBar	Landings		
62524	58883	1	0.3319	18392		
2014					2015	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
58784	49354	0	0	0	72286	62023
.	49354	0.1	0.0332	1802	70334	60075
.	49354	0.2	0.0664	3517	68480	58223
.	49354	0.3	0.0996	5151	66716	56463
.	49354	0.4	0.1327	6707	65040	54790
.	49354	0.5	0.1659	8189	63445	53198
.	49354	0.6	0.1991	9601	61928	51685

.	49354	0.7	0.2323	10947	60485	50245
.	49354	0.8	0.2655	12229	59113	48875
.	49354	0.9	0.2987	13452	57806	47572
.	49354	1	0.3319	14618	56563	46331
.	49354	1.1	0.365	15730	55379	45151
.	49354	1.2	0.3982	16791	54253	44027
.	49354	1.3	0.4314	17803	53180	42957
.	49354	1.4	0.4646	18769	52158	41938
.	49354	1.5	0.4978	19690	51184	40967
.	49354	1.6	0.531	20571	50257	40043
.	49354	1.7	0.5642	21411	49373	39162
.	49354	1.8	0.5973	22214	48530	38322
.	49354	1.9	0.6305	22981	47727	37522
.	49354	2	0.6637	23714	46961	36758

Input units are thousands and kg - output in tonnes.

Table 7.15.15. Whiting in Divisions VIIe–k. Input values for the catch forecast.

MFDP version 1a								
Run: WHG7ek_fin								
Time and date: 13:35 14/05/2013								
Fbar age range: 2-5								
2013								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	68473	0.2	0	0	0	0	0	0
1	18655	0.2	0.39	0	0	0.259333	1.35E-02	0.251
2	13772	0.2	0.9	0	0	0.280667	6.08E-02	0.335667
3	23963	0.2	0.99	0	0	0.446333	0.238833	0.471667
4	33284	0.2	0.99	0	0	0.588333	0.4534	0.607
5	23148	0.2	1	0	0	0.751667	0.574367	0.746333
6	5791	0.2	1	0	0	0.948	0.5502	0.897333
7	649	0.2	1	0	0	1.006667	0.563167	1.014
2014								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	68473	0.2	0	0	0	0	0	0
1	.	0.2	0.39	0	0	0.259333	1.35E-02	0.251
2	.	0.2	0.9	0	0	0.280667	6.08E-02	0.335667

3	.	0.2	0.99	0	0	0.446333	0.238833	0.471667
4	.	0.2	0.99	0	0	0.588333	0.4534	0.607
5	.	0.2	1	0	0	0.751667	0.574367	0.746333
6	.	0.2	1	0	0	0.948	0.5502	0.897333
7	.	0.2	1	0	0	1.006667	0.563167	1.014
2015								
Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	68473	0.2	0	0	0	0	0	0
1	.	0.2	0.39	0	0	0.259333	1.35E-02	0.251
2	.	0.2	0.9	0	0	0.280667	6.08E-02	0.335667
3	.	0.2	0.99	0	0	0.446333	0.238833	0.471667
4	.	0.2	0.99	0	0	0.588333	0.4534	0.607
5	.	0.2	1	0	0	0.751667	0.574367	0.746333
6	.	0.2	1	0	0	0.948	0.5502	0.897333
7	.	0.2	1	0	0	1.006667	0.563167	1.014

Input units are thousands and kg - output in tonnes.

Table 7.15.16. Whiting in Divisions VIIe–k. The detailed output for the *status quo* F forecast by age group.

MFDP version 1a									
Run: WHG7ek_fin									
Time and date: 13:35 14/05/2013									
Fbar age range: 2-5									
Year:	2013	F multiplier:	1	Fbar:	0.3319				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	68473	0	0	0	0	0
1	0.0135	227	57	18655	4838	7275	1887	7275	1887
2	0.0608	737	248	13772	3865	12395	3479	12395	3479
3	0.2388	4633	2185	23963	10695	23723	10589	23723	10589
4	0.4534	11080	6725	33284	19582	32951	19386	32951	19386
5	0.5744	9254	6907	23148	17400	23148	17400	23148	17400
6	0.5502	2241	2011	5791	5490	5791	5490	5791	5490
7	0.5632	256	259	649	653	649	653	649	653
Total		28429	18392	187735	62524	105933	58883	105933	58883
Year:	2014	F multiplier:	1	Fbar:	0.3319				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	68473	0	0	0	0	0
1	0.0135	683	171	56061	14538	21864	5670	21864	5670
2	0.0608	807	271	15068	4229	13561	3806	13561	3806
3	0.2388	2051	967	10610	4736	10504	4688	10504	4688

4	0.4534	5143	3122	15451	9090	15297	8999	15297	8999
5	0.5744	6923	5167	17317	13016	17317	13016	17317	13016
6	0.5502	4130	3706	10671	10116	10671	10116	10671	10116
7	0.5632	1197	1213	3037	3058	3037	3058	3037	3058
Total		20934	14618	196689	58784	92251	49354	92251	49354
Year:	2015	F multiplier:	1	Fbar:	0.3319				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	68473	0	0	0	0	0
1	0.0135	683	171	56061	14538	21864	5670	21864	5670
2	0.0608	2425	814	45282	12709	40754	11438	40754	11438
3	0.2388	2244	1059	11609	5181	11493	5129	11493	5129
4	0.4534	2277	1382	6841	4025	6773	3985	6773	3985
5	0.5744	3214	2399	8039	6042	8039	6042	8039	6042
6	0.5502	3090	2773	7983	7568	7983	7568	7983	7568
7	0.5632	2543	2579	6456	6499	6456	6499	6456	6499
Total		16476	11176	210743	56563	103360	46331	103360	46331

Table 7.15.17. Whiting in Divisions VIIe–k. Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes.

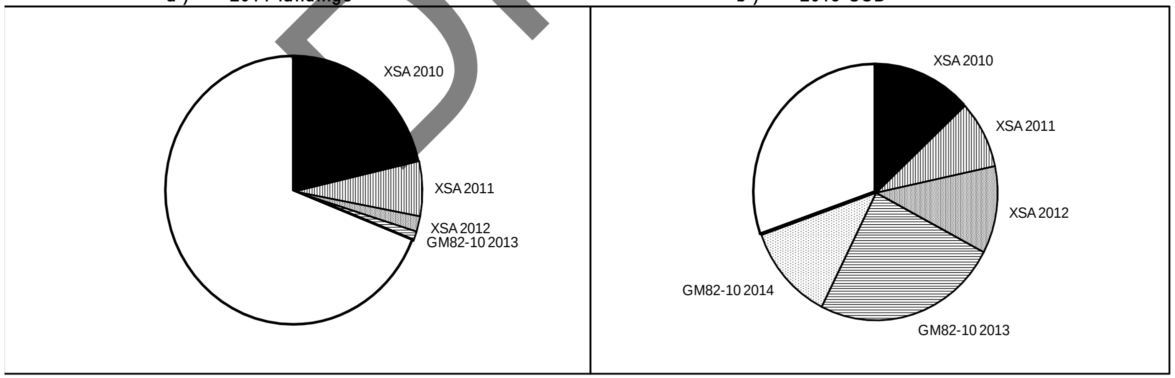
Table 5.4.6 Whiting VIIe-k
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			2010	2011	2012	2013	2014
Stock No. (thousands) of 0 year-olds			46667	20661	22786	68473	68473
Source			XSA	XSA	XSA	GM82-10	GM82-10
Status Quo F:							
% in	2013	landings	11.9	1.3	0.3	0.0	-
% in	2014		21.4	6.6	1.9	1.2	0.0
% in	2013	SSB	18.0	5.9	3.2	0.0	-
% in	2014	SSB	18.2	9.5	7.7	11.5	0.0
% in	2015	SSB	13.0	8.6	11.1	24.7	12.2

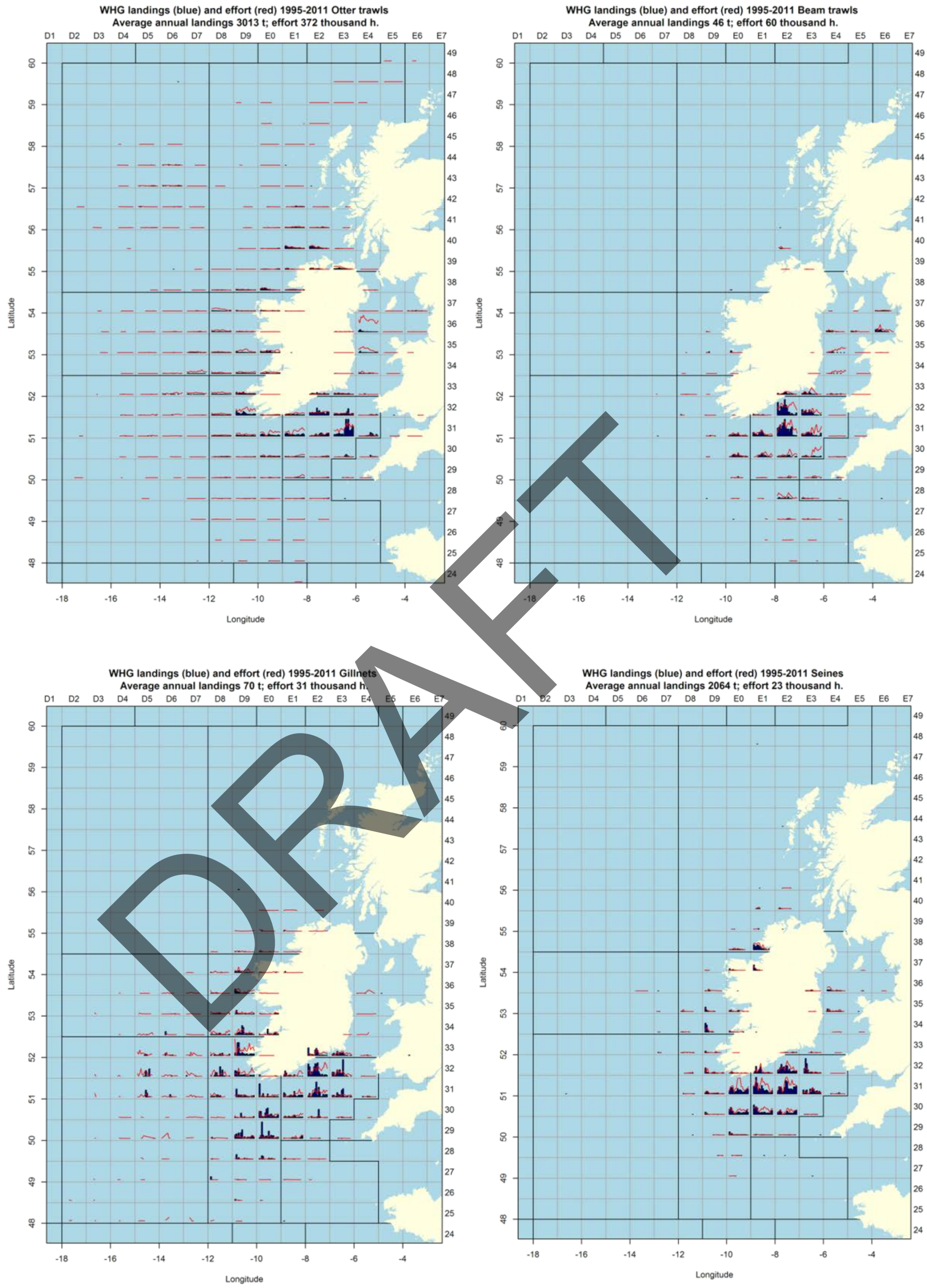
GM : geometric mean recruitment

Whiting VIIe-k : Year-class % contribution to

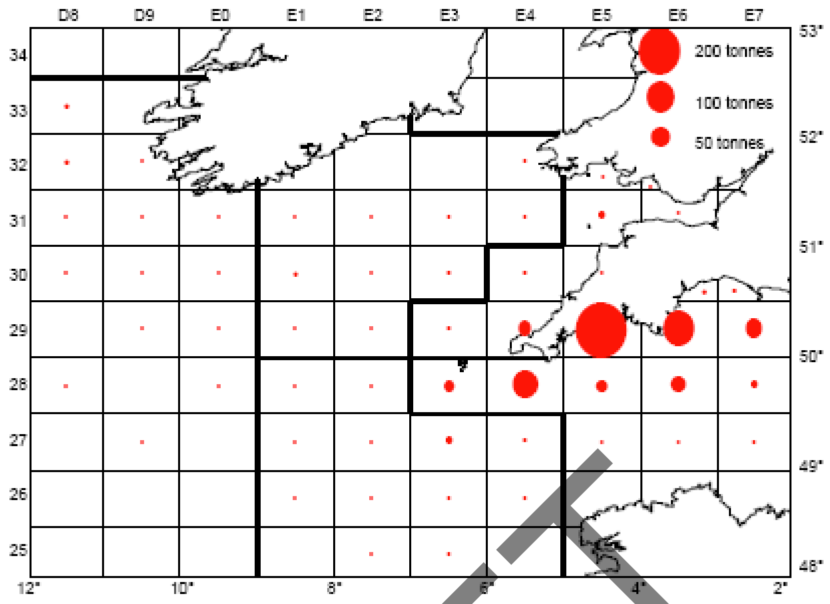
a) 2014 landings b) 2015 SSB



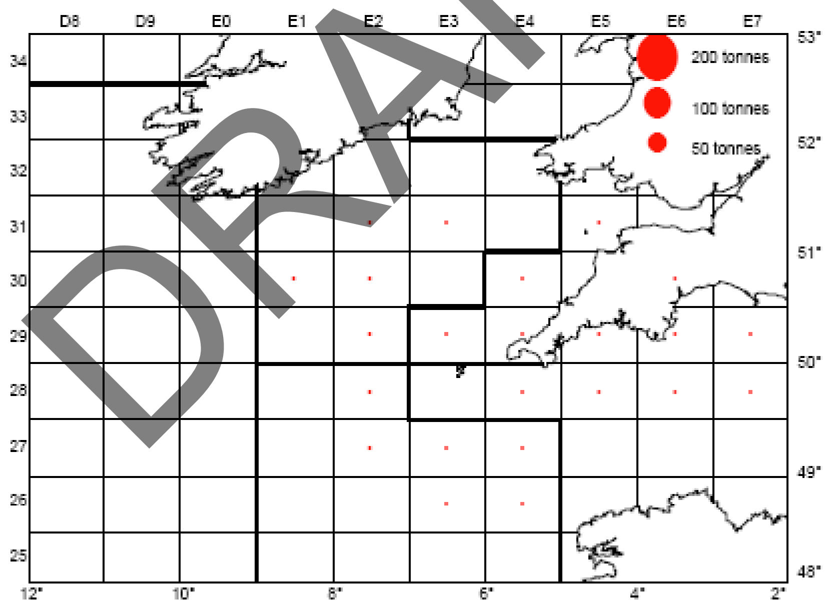
Irish landings for the main gear types by quarter in 2011.



UK (E&W) whiting landings for all gears 2011.



Total UK (E+W) Landings 688.70 tonnes.



Total UK Landings by Samples Vessels 2.82 tonnes.

Figure 7.15.1. Whiting in VIIe–k (Celtic Sea). The spatial and temporal distribution of UK landings data in 2011 available to the WG.

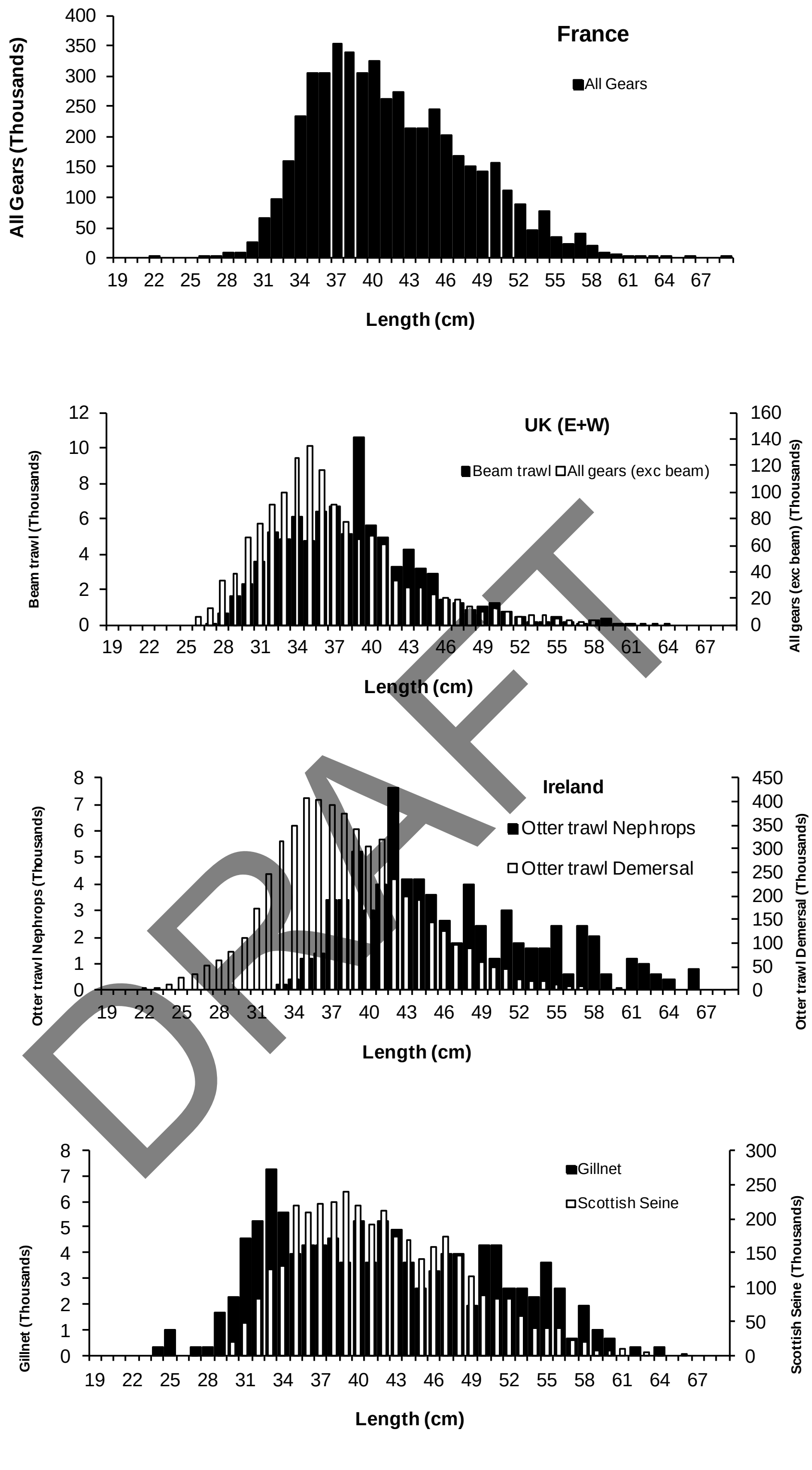


Figure 7.15.2. Whiting in VIIe–k (Celtic Sea). 2011 length compositions (raised numbers) of French, UK and Irish fleets.

(a)

(b)

7.15.3. Whiting in VIIe–k (Celtic Sea). Annual landings age composition (a) and standardized catch proportions-at-age (b).

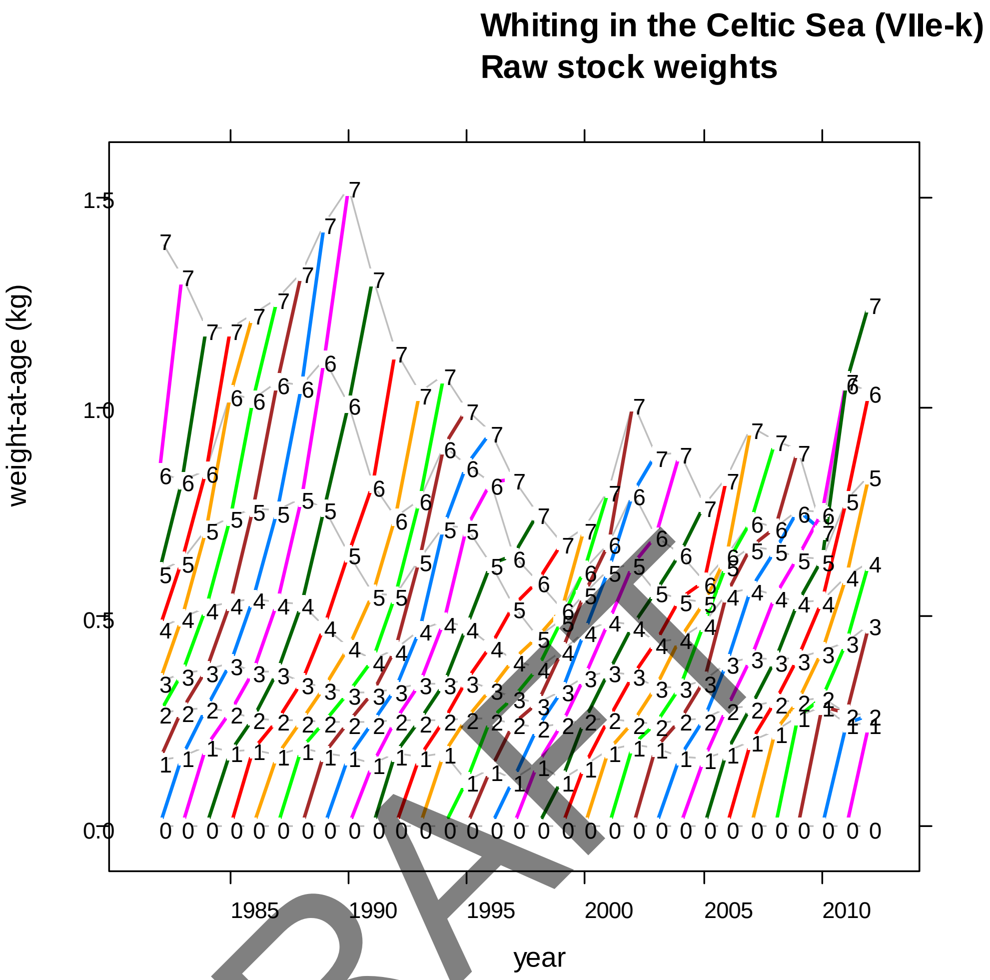


Figure 7.15.4. Whiting in VIIe–k (Celtic Sea). Stock weights-at-age.

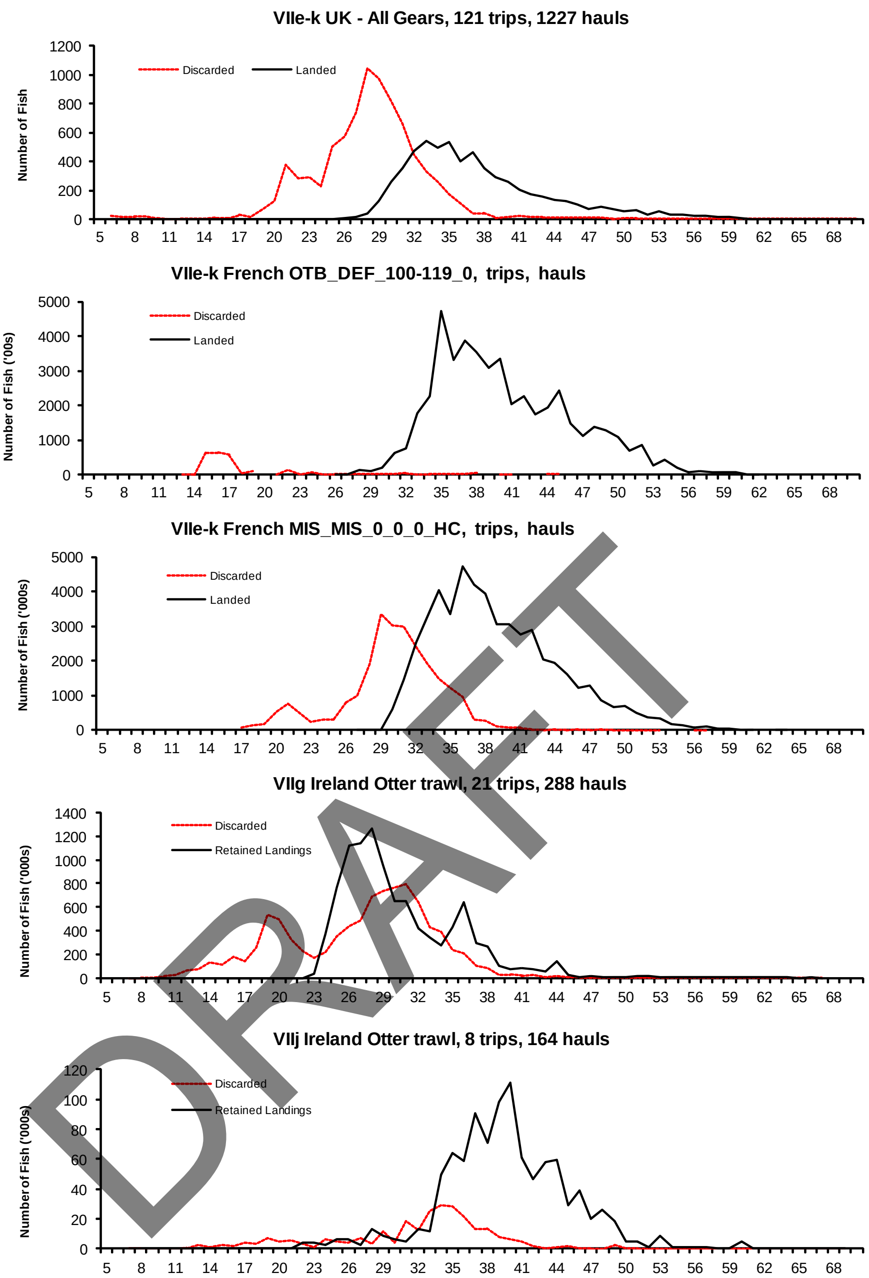


Figure 7.15.5. Whiting in VIIe–k (Celtic Sea). 2012 Annual length compositions of Irish, UK and French discards. Numbers are raised to the sampled catch for the UK and France, and are raised by trip to the fleet for Ireland.

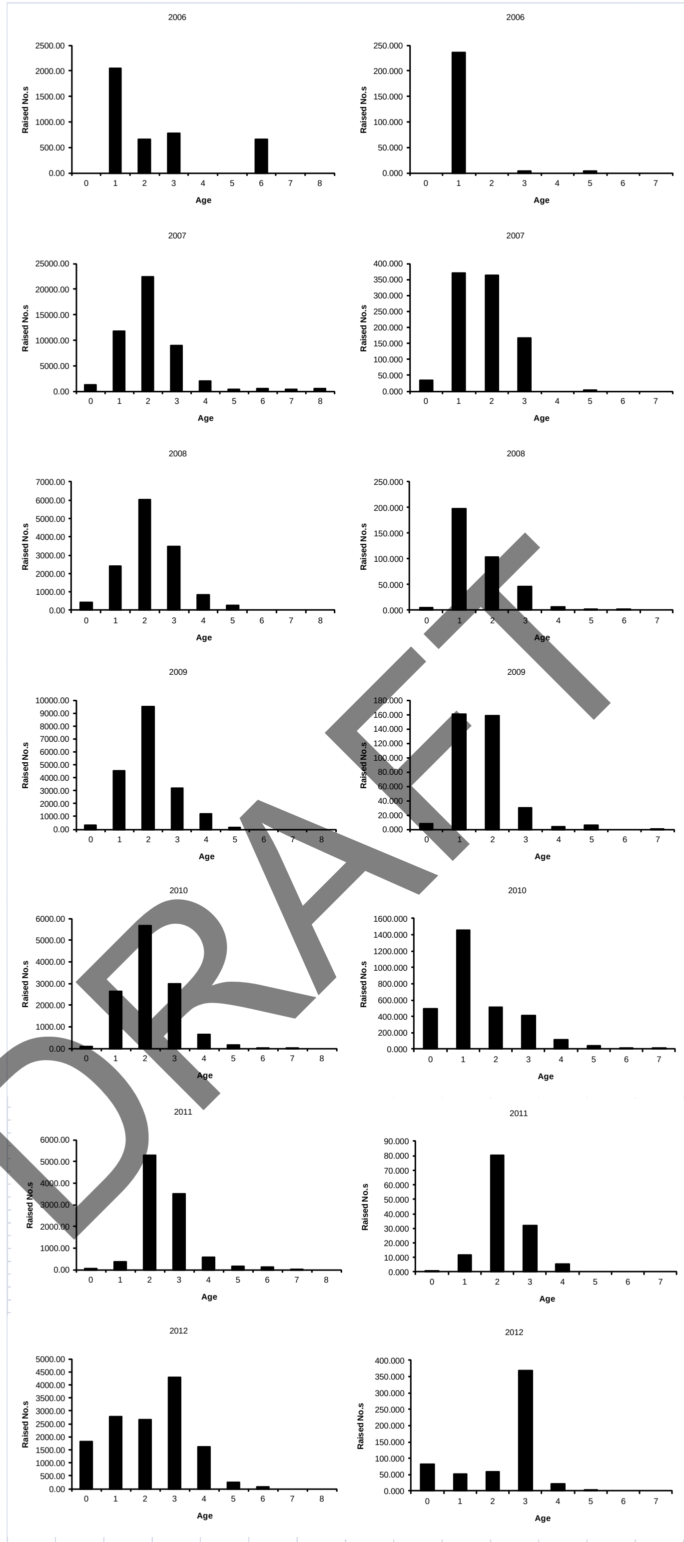
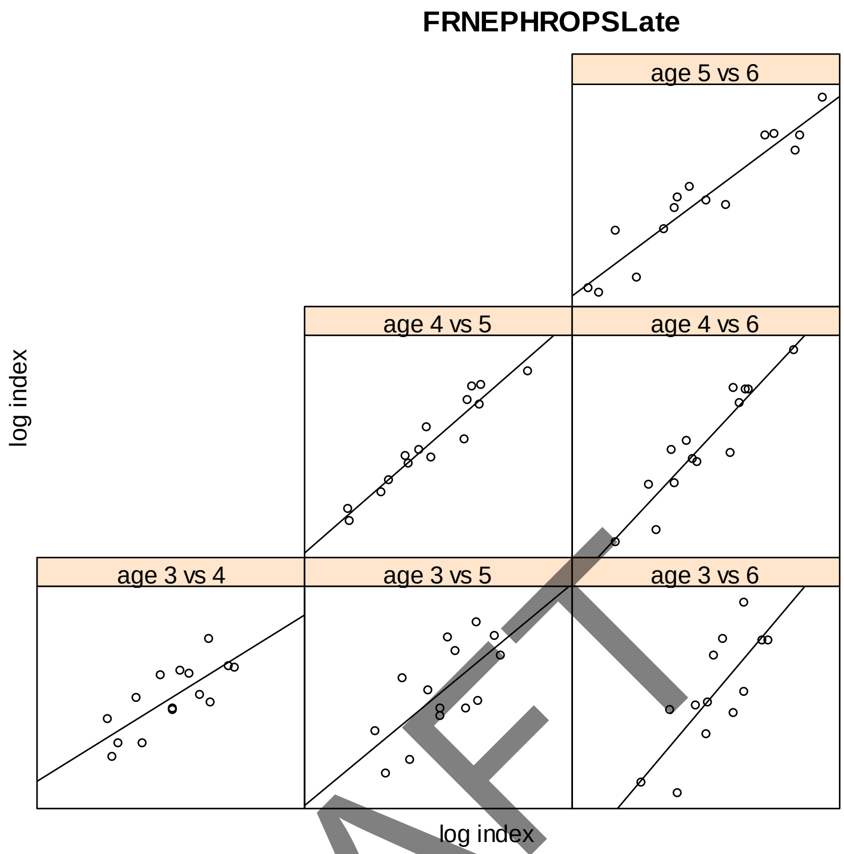


Figure 7.15.6. Whiting in VIIe–k (Celtic Sea). Age Composition of Discards from Irish otter-board trawlers 2006–2012 in VIIg (left) and VIIj (right).



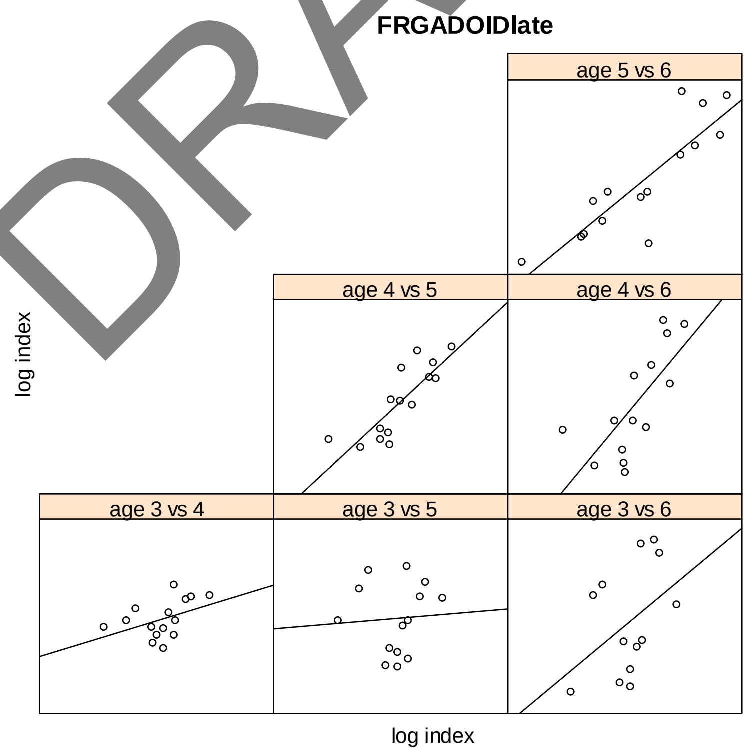
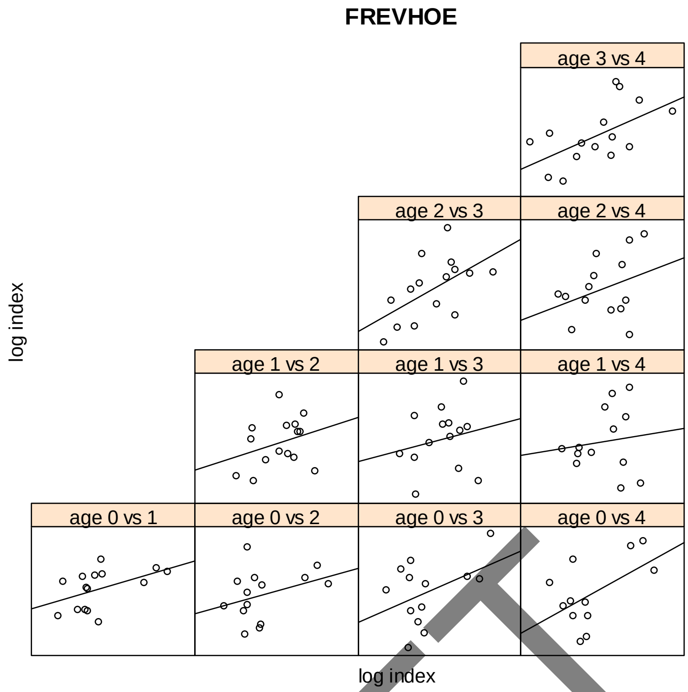


Figure 7.15.7. Whiting in VIIe–k (Celtic Sea). Pairwise scatterplots for the log numbers-at-age for the main commercial fleets.



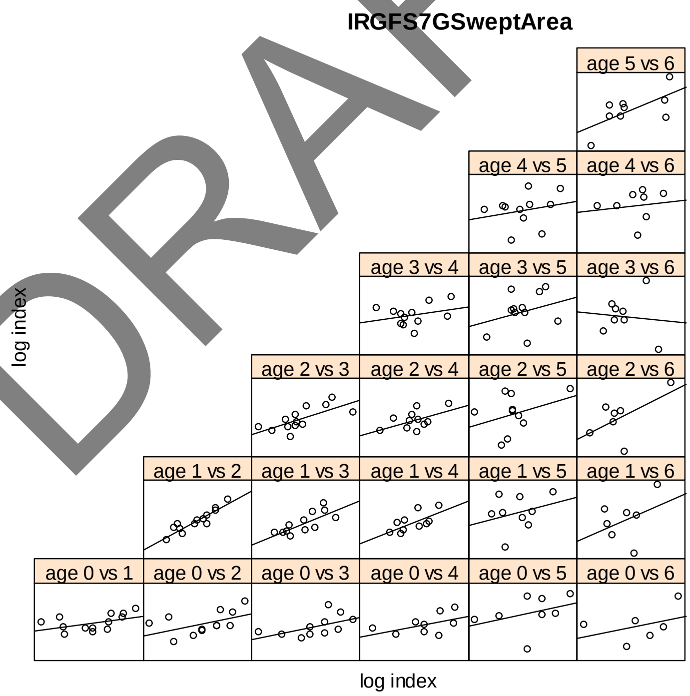
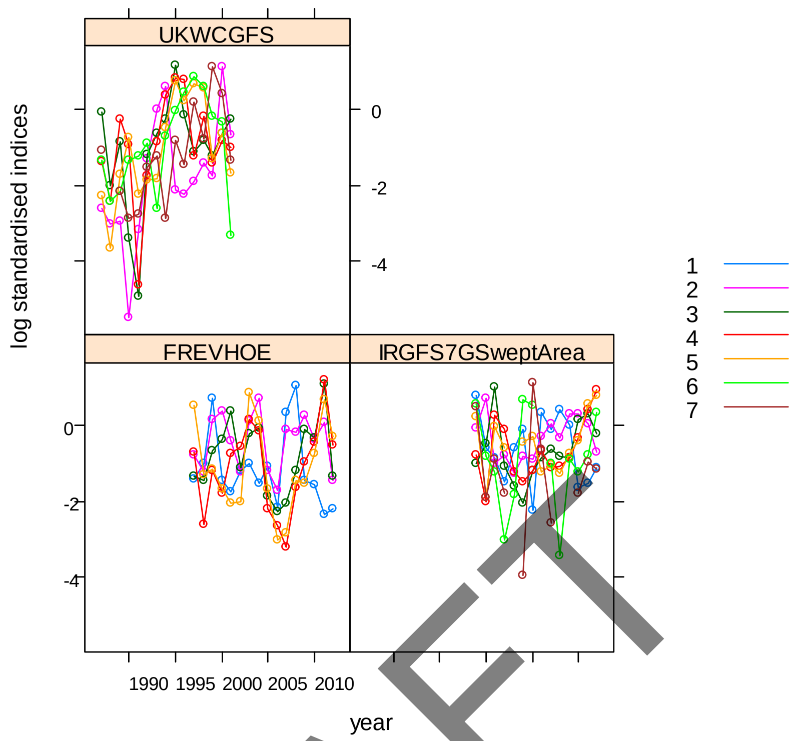


Figure 7.15.8. Whiting in VIIe–k (Celtic Sea). Pairwise scatterplots for the log numbers-at-age for the survey tuning fleets to examine internal constancy of the indices.



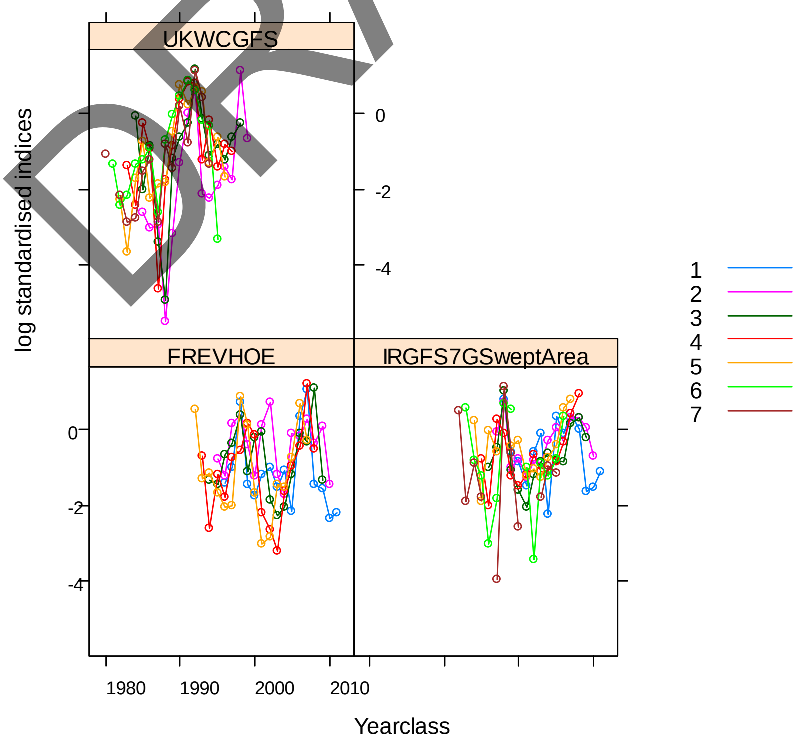


Figure 7.15.9. Whiting in VIIe–k (Celtic Sea). Mean log standardized plots of indices by (a) age and year, and (b) age and cohort.

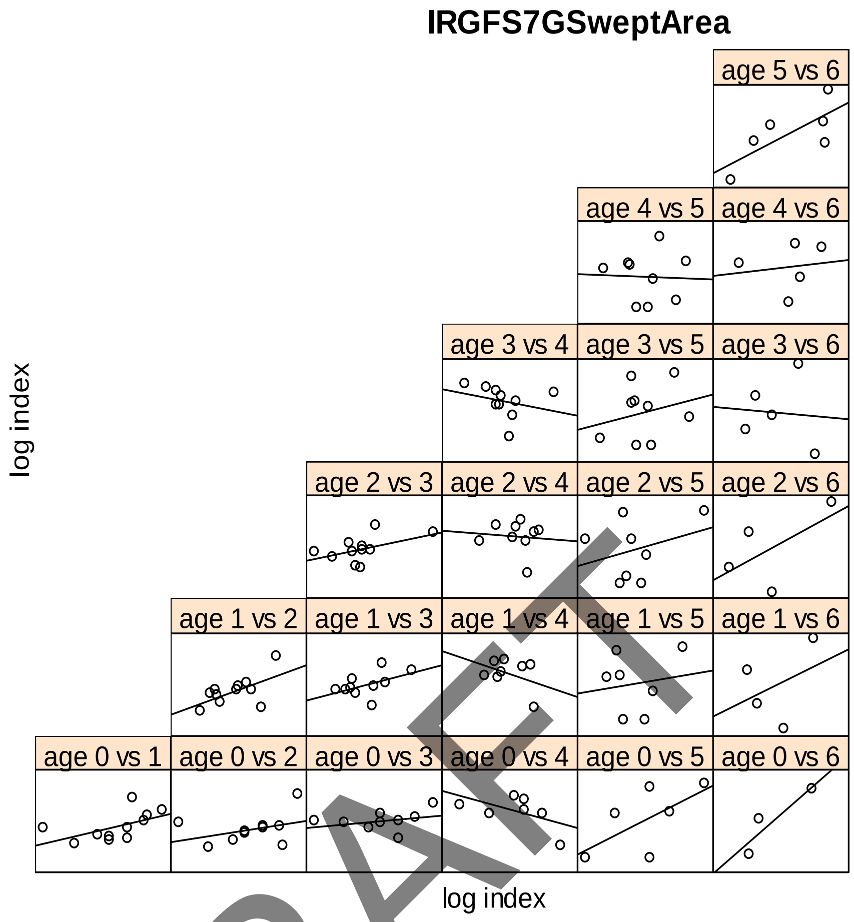


Figure 7.15.10. Whiting in VIIe–k (Celtic Sea). (a) standardized and (b) log standardized plots of survey indices used within the assessment for younger ages (0–2) by cohort.

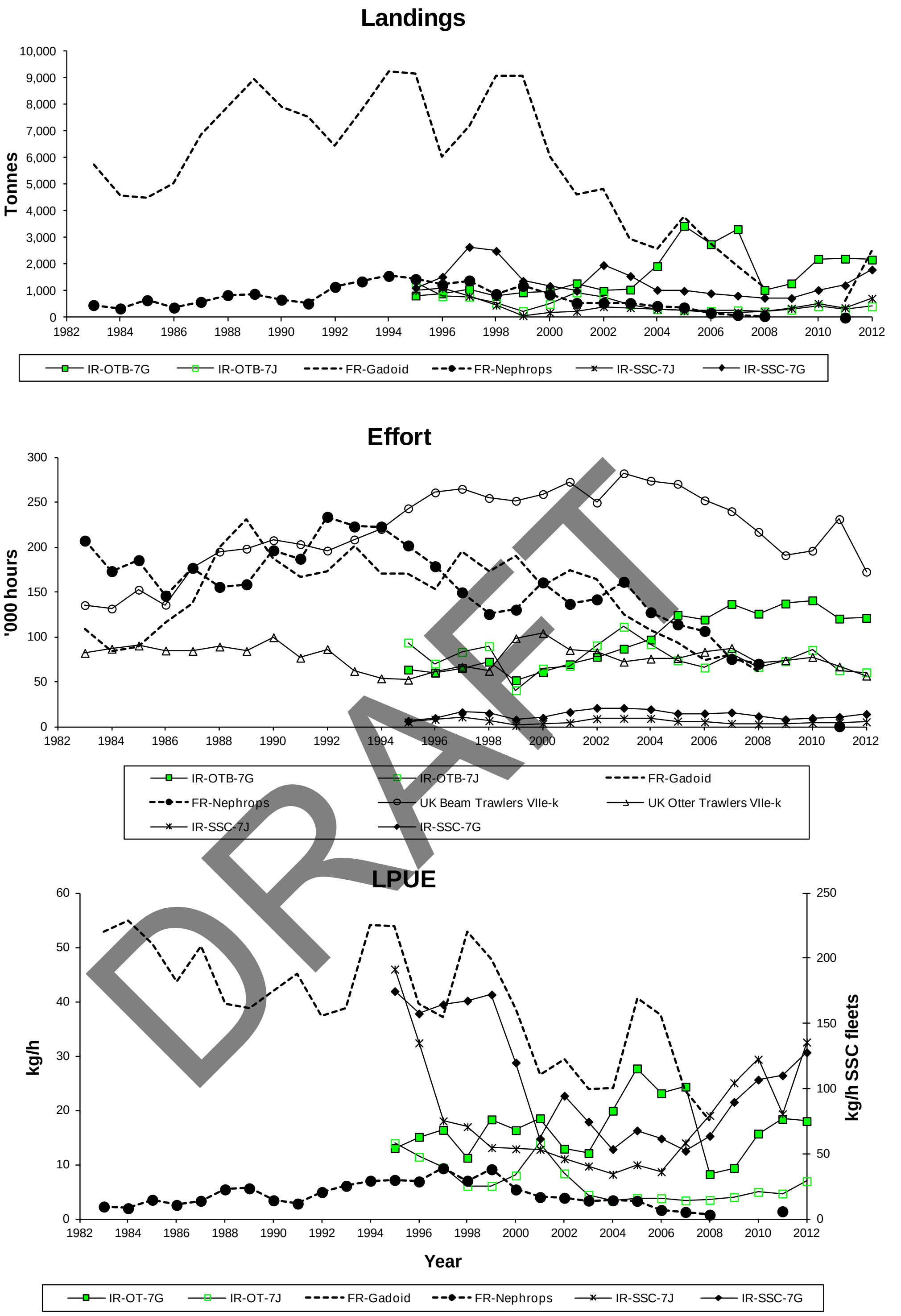


Figure 7.15.11. Whiting in VIIe–k (Celtic Sea). Landings, Effort and Landings per Unit of Effort (lpue) for some fleets landing whiting. For the UK fleets Effort is GRT corrected.

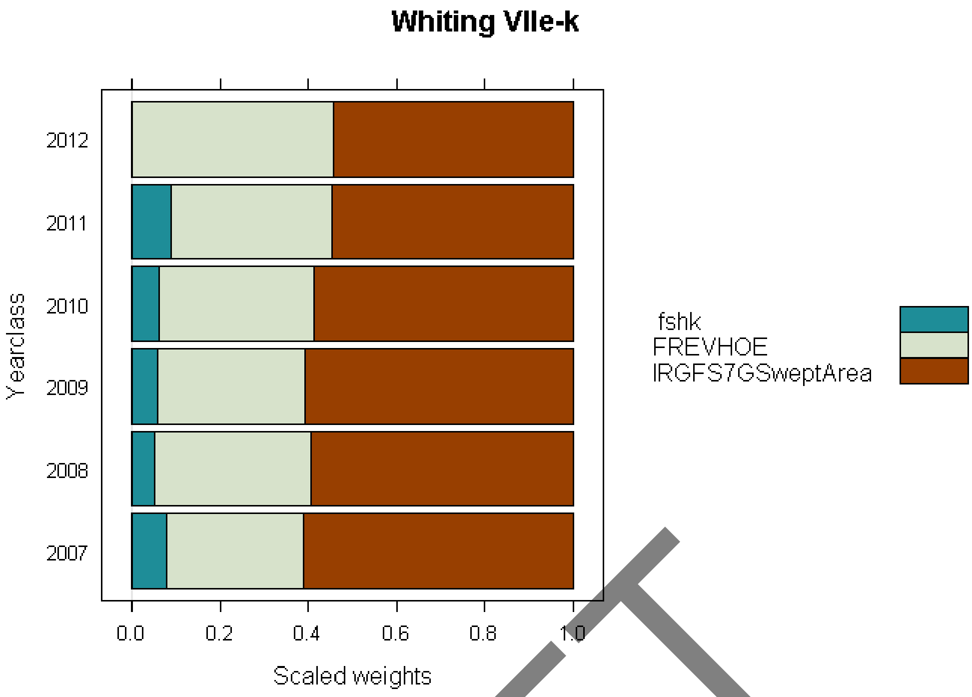


Figure 7.15.12. Whiting in VIIe–k (Celtic Sea). The survivor estimate weightings given by all fleets.

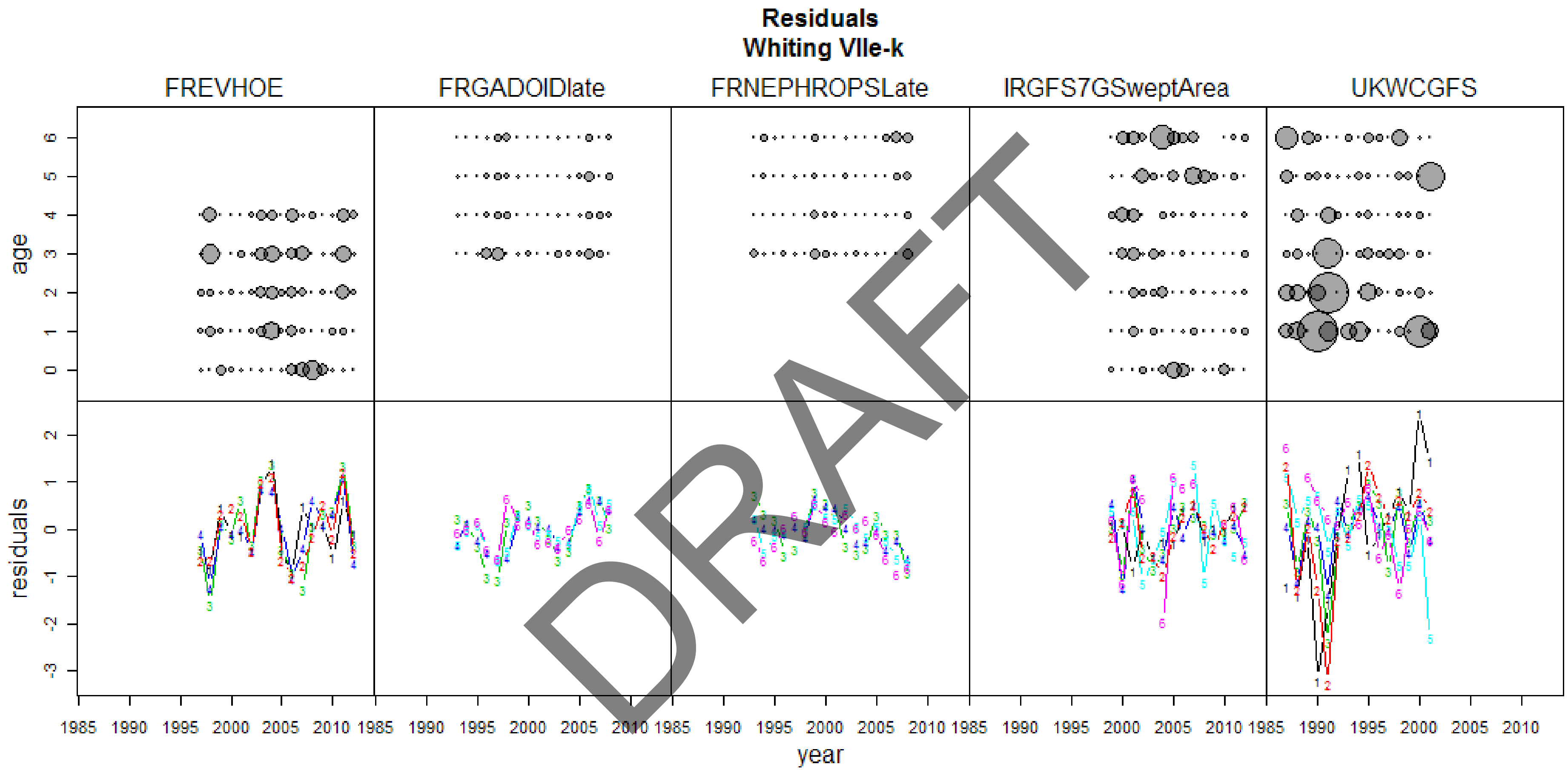


Figure 7.15.13. Whiting in VIIe–k (Celtic Sea). Log fleet catchability residuals bubble plots (above) and line plots (below).

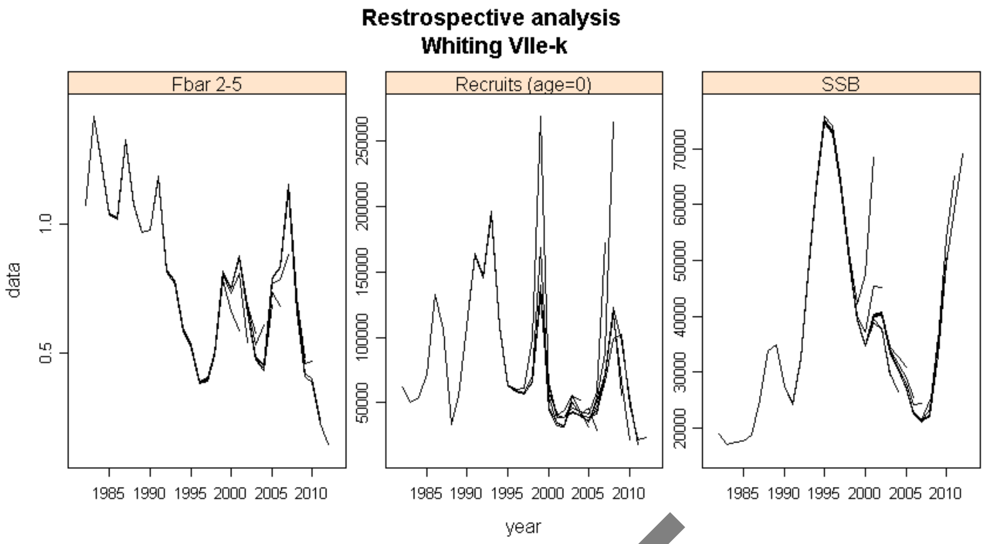


Figure 7.15.14. Whiting in VIIe–k (Celtic Sea). Retrospective analysis.

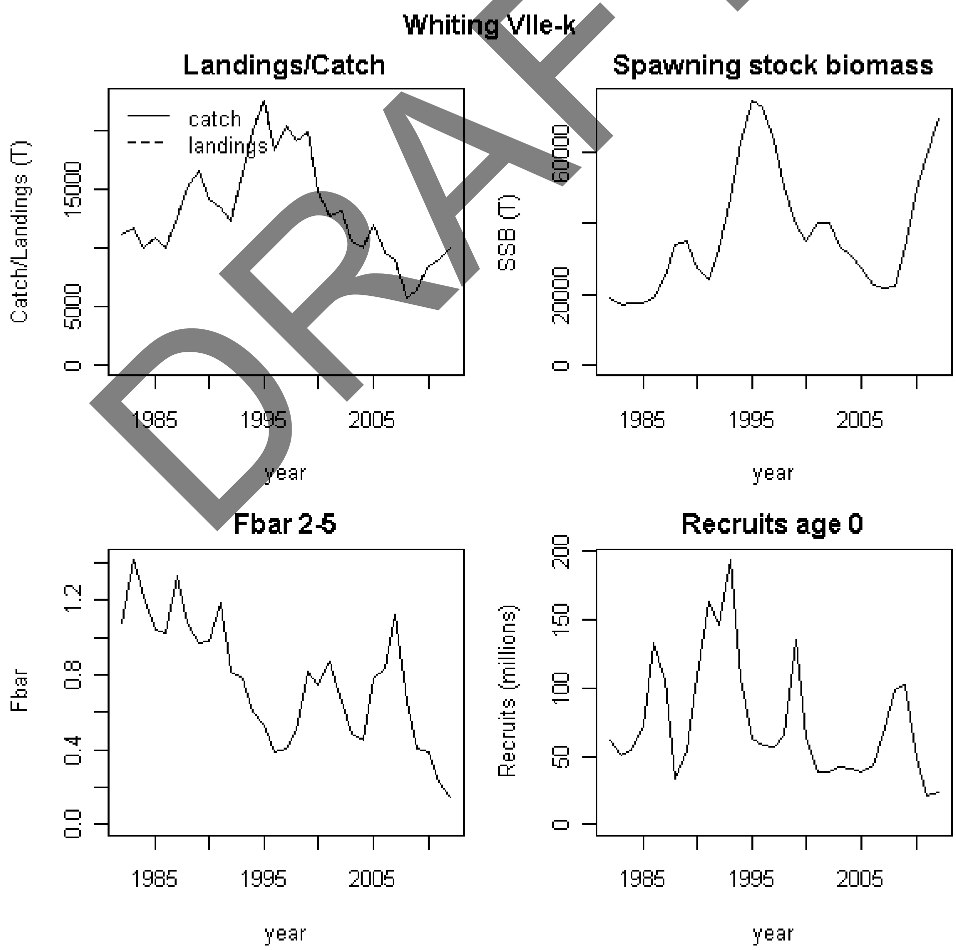


Figure 7.15.15. Whiting in VIIe–k (Celtic Sea). Stock summary.

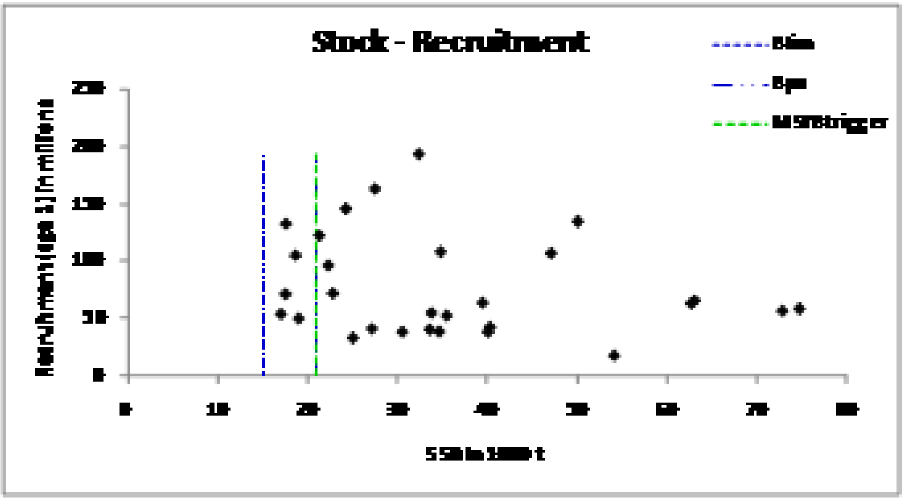
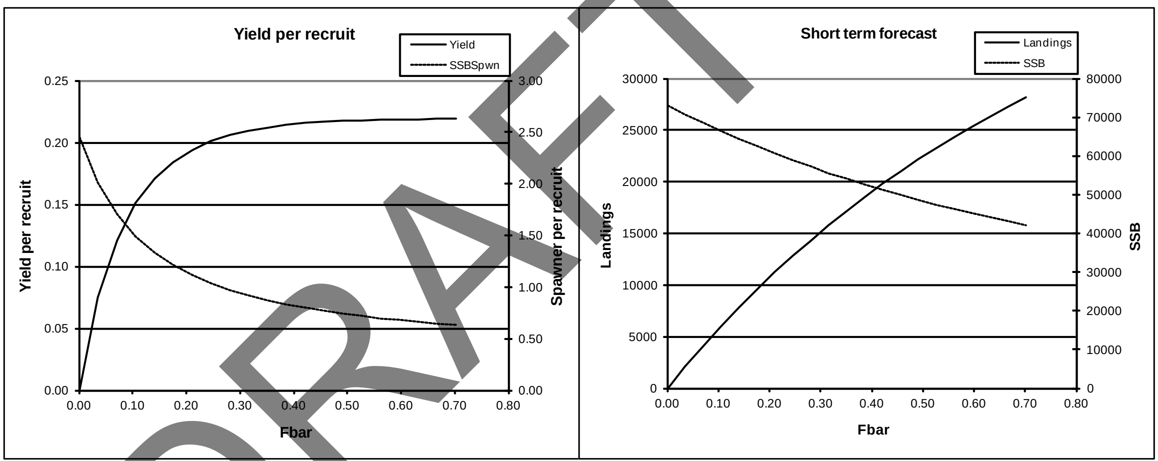


Figure 7.15.16. Whiting in VIIe–k (Celtic Sea). Stock–recruitment relationship.



MFYPR version 2a
Run: WHG_7ek
Time and date: 13:11 15/05/2012

Reference point	F multiplier	Absolute F
Fbar(2-5)	1.0000	0.3511
FMax	2.0169	0.7080
F0.1	0.5445	0.1912
F35%SPR	1.0294	0.3614

Weights in kilograms

MFDP version 1a
Run: WHG_7ek
WHG7ekMFDP Index file 14/05/2012
Time and date: 12:43 15/05/2012
Fbar age range: 2-5

Input units are thousands and kg - output in tonnes

Figure 7.15.17. Whiting in VIIe–k (Celtic Sea). Short-term predictions from the forecast.

7.16 Whiting in Divisions VIIb, c

Type of assessment

No assessment.

The nominal landings are given in Table 7.16.1.

Table 7.16.1. Nominal Landings (t) of Whiting in Division VIIb,c for 1995–2012.

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012a
France	57	76	65	37*	…1*	107	114	111	92	59	102	62	32	26	32	67	44	82
Ireland	1,894	1,233	403	323	206	563	357	386	423	135	65	49	100	76.0	94	144	205	384
Netherlands	-	-	-	-	-	-	2	-	3	-	2	-	-	-	-	-	-	-
Spain	+	+	-	27	1	4	-	6	-	31	18	19	1	4	-	4	-	-
UK(E/W/NI)	24	96	75	49	10	6	5	4	5	1	11	5	1	1	2	-	-	1
UK(Scotland)	71	17	4	27	-	19	1	+	-	-	-	-	-	-	-	-	-	-
Total	2,046	1,422	547	463	217	699	479	507	523	226	198	135	134	107	128	215	249	467

*** See VIIg–k.**

[a] Provisional.

8.2 Plaice in the Western Channel (ICES Divisions VIIe)

Type of assessment in 2013

Update assessment with no changes to the assessment settings as agreed at the Benchmark assessment meeting (WKFlat 2010) held in February 2010.

ICES advice applicable to 2012

Following the ICES MSY framework implies fishing mortality to be reduced to 0.19 (at F_{MSY} as SSB in 2012 is above MSY $B_{trigger}$), resulting in landings of 840 t in 2012. This is expected to lead to an SSB of 4620 t in 2013.

Following the transition scheme towards the ICES MSY framework implies fishing mortality of 0.35 for 2012. This results in landings of 1440 t in 2012. This is expected to lead to an SSB of 4030 t in 2013.

	F (Fishing Mortality)			
	2008	2009	**2010**	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

	SSB (Spawning Stock Biomass)			
	2009	2010	**2011**	
MSY ($B_{trigger}$)	✗	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

ICES advice applicable to 2013

Following the ICES MSY framework implies fishing mortality to be reduced to 0.24 (at F_{MSY} as SSB in 2013 is above MSY $B_{trigger}$), resulting in landings of 1400 t in 2013. This is expected to lead to an SSB of 6700 t in 2014.

Following the transition scheme towards the ICES MSY framework implies fishing mortality of 0.36 for 2013. This results in landings of 2100 t in 2013. This is expected to lead to an SSB of 6000 t in 2014.

Stock status

	F (Fishing Mortality)			
	2009	2010	**2011**	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

	SSB (Spawning Stock Biomass)			
	2010	2011	**2012**	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

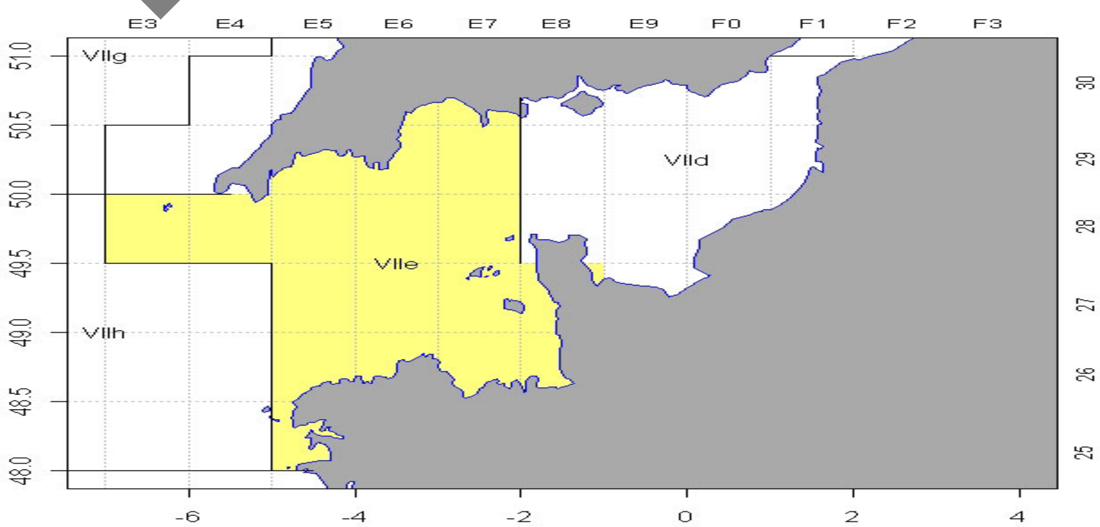
Technical comments made by the Review Group (RGCS)

The Review Group in 2012 made only one technical comment on this stock within Annex 4 'Technical minutes. This report state that 'Page 4 of the report cites Table 2.1, but no table exists'. This table does exist and can be found in WGCSE 2012 report Section 2 'Data and Methods; Subsection 2.2 'Biological Sampling'.

8.2.1 General

Stock description and management units

The management area for this stock is strictly that for ICES Area VIIe called the Western English Channel. The TAC area does not correspond to the stock area as it includes the larger component of VIId (Eastern English Channel). However, as determined by WKFlat 2010, a significant proportion of the catches of the VIIe stock are taken in the adjacent area during the time of spawning. Plaice is not the target species in VIIe, and it is generally caught as a bycatch by the sole directed fleets.



TAC Area = VIId+e; Assessment Area = VIIe

Management applicable to 2012 and 2013

There are technical measures in operation including a minimum 80 mm mesh size and a MLS (27 cm) for this species.

The TAC and the national quotas by country for 2012

Species:	Plaice *Pleuronectes platessa*	Zone:	VIId and VIIe (PLE/7DE.)
Belgium	828		
France	2 761		
United Kingdom	1 473		
Union	5 062		
TAC	5 062		Analytical TAC

In addition, Annex IIc, restricts the number of days-at-sea to 164 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional twelve days for the UK beam-trawl fleet due to a reduction in capacity of the fleet.

The TAC and the national quotas by country for 2013

Species:	Plaice *Pleuronectes platessa*	Zone:	VIId and VIIe (PLE/7DE.)
Belgium	1 047 (1)		
France	3 491 (1)		
United Kingdom	1 862 (1)		
Union	6 400		
TAC	6 400		Analytical TAC

(1) In addition to this quota, a Member State may grant to vessels flying its flag and participating in trials on fully documented fisheries an additional allocation within an overall limit of 1 % of the quota allocated to that Member State, pursuant to Article 7 of this Regulation.

In addition, Annex IIc, restricts the number of days-at-sea to 164 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional twelve days for the UK beam-trawl fleet due to a reduction in capacity of the fleet.

The fishery in 2012

A full description of the fishery is provided in the stock annex, Section A2.

In the western English Channel plaice are taken mainly as a bycatch in beam trawls directed at sole and anglerfish. In 2012, the UK beam trawl fleet took around 47% of the total landing of this stock with the UK otter-trawl fleet taking around 23%. The remainder of the landings are taken by the France (around 16%) mostly taken by otter trawlers and Belgium (around 10%) taken mostly by beam trawlers.

UK otter-trawl effort in 2012 has remained at the level observed in the previous two years and these years followed a steady decline since 2001. The UK beam-trawl effort (GRT corrected) in 2012 has decreased slightly since 2011 but remains close to the series high levels observed over the period 2003–2008 (Figure 8.2.1).

This stock is the smaller of the two stocks that make up the larger TAC Area of VIId,e. The landings from this stock amounted to around 27% of the TAC in 2012 and around 28% of the TAC in 2011.

Landings

National landings data reported to ICES, and estimates of total landings used by the Working Group, are given in Table 8.2.1. Total international reported landings in 2012 were 1338 t with Working Group estimates of VIIe plaice landings 2% higher at 1365 t. The Working Group estimate of the 2011 landings was revised upwards due to minor revisions to the landings by UK (E&W), UK(Jersey) and UK(Guernsey). These combined additional landings totalled around 2 t making the revised total international landings in 2011 to be 1334 t.

Landings increased to levels of 2600 t during the latter half of the 1980s due to a series of good recruitments in 1986–1988, but subsequently dropped to levels fluctuating around 1200 t. The last few years had seen landings fall to under 1000 t, but this trend has been reversed in the past three years with increases leading to landings of over 1300 t since 2011. Unallocated landings in recent years, are generally the additional French landings derived from sales note information.

In addition to the estimated 2012 landings for VIIe, an extra 155 tonnes was added from the VIId plaice stock representing an adjustment for migration of 15% of quarter 1 between the two stocks. This process was agreed at the benchmark assessment meeting in February 2010 and the method is documented in the stock annex. A reciprocal correction was made to the VIId stock at WGNSSK 2013.

Data

Sampling levels for this stock are detailed in WGCSE 2013 report Section 2 ‘Data and Methods; Subsection 2.2 ‘Biological Sampling’.

Annual length compositions of the 2012 UK(E&W) landings (three fleets) and France (three fleets) are provided (Table 8.2.3). Length distributions of total UK(E&W) landings from 2003 to 2012 as used by the WG are illustrated in Figure 8.2.3.

This year, all nations provided data disaggregated by both métier and quarter and this was all uploaded into InterCatch. Quarterly age compositions for landings in 2012 were available from UK(E&W) only and was provided for four métiers. These data accounted for almost 70% of the total reported international landings. Additional quarter landings data (only) was available by quarter/métier for Belgium, France, UK(E+W), UK(Guernsey), UK(Jersey) and UK(Scotland). These datasets were aggregated to an International age structure using the ICES InterCatch software.

Country	Fleet	Quarterly data provision	
		Age structure	**Tonnage only**
BELGIUM	TBB_DEF_70-99_0_0_all	-	Q1, Q2, Q3, Q4
BELGIUM	MIS_MIS_0_0_0	-	Q1, Q2, Q3, Q4
BELGIUM	OTB_CRU_70-99_0_0_all	-	Q2, Q3, Q4
FRANCE	GTR_DEF_>=220_0_0_all	-	Q1, Q2, Q3, Q4
FRANCE	GTR_DEF_120-219_0_0_all	-	Q1, Q2, Q3, Q4
FRANCE	MIS_MIS_0_0_0	-	Q1, Q2, Q3, Q4
FRANCE	OTB_DEF_100-119_0_0_all	-	Q1, Q2, Q3, Q4
FRANCE	OTB_DEF_70-99_0_0_all	-	Q1, Q2, Q3, Q4
FRANCE	OTB_MOL_70-99_0_0_all	-	Q1, Q2, Q3, Q4
FRANCE	OTB_MOL_100-119_0_0_all	-	Q1, Q4
UK (ENGLAND & WALES)	TBB_DEF_70-99_0_0_all	Q1, Q2, Q3, Q4	-
UK (ENGLAND & WALES)	GNS_DEF_all_0_0_all	Q1, Q3, Q4	Q2
UK (ENGLAND & WALES)	LLS_FIF_0_0_0_all	-	Q1, Q2, Q3, Q4
UK (ENGLAND & WALES)	MIS_MIS_0_0_0_HC	-	Q1, Q2, Q3, Q4
UK (ENGLAND & WALES)	OTB_DEF_>=120_0_0_all	Q3	Q1, Q2, Q4
UK (ENGLAND & WALES)	OTB_CRU_70-99_0_0_all	Q1, Q2, Q3, Q4	-
UK (ENGLAND & WALES)	GTR_DEF_all_0_0_all	-	Q1, Q2, Q3
UK (ENGLAND & WALES)	TBB_DEF_70-99_0_0_all_FDF	-	Q1, Q2, Q3, Q4
UK (GUERNSEY)	ALL FLEETS	-	Q1, Q2, Q3, Q4
UK (JERSEY)	ALL FLEETS	-	Q1, Q2, Q3, Q4
UK (SCOTLAND)	SSC_DEF_70-99_0_0_all	-	Q1
VIId MIGRATION (INT)	ALL FLEETS	ANNUAL	-

An additional age composition representing the migration adjustment (15% of quarter 1 landings for VIId) for the combined nations of UK(E&W), Belgium, France and the Netherlands was supplied by the WGNSSK coordinator for the VIId plaice stock.

The method for the derivation of the international catch numbers and the calculation of the catch and stock weights-at-age are fully described in the stock annex, Section B1. Catch numbers-at-age landed annually (including the migration element) are given in Table 8.2.4 and plotted for 2003 to 2012 in Figure 8.2.4. Catch and stock weights-at-age are given in Tables 8.2.5 and 8.2.6.

Catch weights are plotted as mid-year values; stock weights are interpolated back (in year) to January 1st, as standard for this stock. The standard settings used for natural mortality and the proportions of F and M before spawning were used (see stock annex). This is consistent with the procedures developed and agreed at the benchmark workshop held in February 2010.

Discards

Discards estimates, from the UK(E&W) and French discard sampling programme, are available for the period 2002–2012 (Annual Data Files on ICES network) and indicate that discarding appears to be higher in quarters 1 and 2 in this fishery, but is still low compared to other plaice stocks. In addition to these data, Belgian quarterly discard length frequency data is available for 2010–2012 and these data show similar discarding ratios to both the UK and France. Quarterly profiles of numbers landed and discarded-at-length by country and fleet in 2012, are given in Figure 8.2.2. This does not include discarding estimates for the Q1 migrants exploited in VIId. The latter estimates are thought to be minor as only mature plaice are thought to migrate.

Quarterly discard tonnages and age structures were available for 2012 for UK(E+W) but these were not included in the assessment in line with the agreed assessment methodology for this stock. However, inspection of these data indicate that for the UK(E+W) beam-trawl and trawl fleets in 2012, that discarding is in the order of 20% of the catch.

Biological

The natural mortality and the maturity ogives used were as in previous assessments and described in the stock annex.

Surveys

There are currently two surveys that provide abundance estimates to the Working Group. The UK(E&W) commercial beam-trawl survey (UK-WEC-BTS) has used the FV Carhelmar for most survey years with the exception being 2002 and 2004, when the RV Corystes was used instead. Detailed information on the survey protocols and area cover age can be found in the stock annex.

Table 8.2.7 gives abundance indices as numbers caught per 100 km for age groups 1 to 9 as obtained by UK-WEC-BTS. Strong and weak year classes have been well tracked by this survey in the past (Figure 8.2.6). This survey's takes place in the north of VIIe and its cpue shows a similar trend to that of the commercial beam-trawl fleet lpue in the same area with both showing an increase in recent years. This difference is likely due to the inclusion of non-recruited year classes in the survey catches that do not appear in the commercial catches. Recent year's had seen a large increase in this survey's cpue as a result of large catch numbers of the last two year classes and this is a clear indication of recently improved recruitments entering the fishery. However, the survey's cpue has fallen in 2012 mainly as a result of the low numbers caught at age 1. The log cpue of the survey index indicates a total mortality of roughly 0.4 over the time-series as shown in Figure 8.2.6b.

Since 2003 the UK Fisheries Science Partnership (FSP: Cefas-UK industry cooperative project) has been conducting a survey using commercial vessels with scientific observers and following a standard grid of stations extending from the Scilly Isles to Lyme Bay (FSP-7e UK). This survey covers a substantially larger area than the UK-WEC-BTS survey and is thought to be more representative of the stock in UK waters. This dataset was first included in the 2007 assessment, and the exploratory analysis can be seen in that report (ICES, 2007; Section 3.2.5). There have been a number of vessel changes, gear changes and temporal variations in this survey-series, but overall the survey has performed well in tracking year classes.

The FSP-7e survey shows a similar recent trend in cpue to that of the UK-WEC-BTS survey although the small fall in cpue observed in the BTS in 2012 is not seen with the FSP survey.

Commercial fleet effort and lpue

The UK cpue data shows the individual fleets that make up the composite of all otter trawl and all beam-trawl fleets that are used in the commercial tuning datasets. Trends in commercial lpue and effort are given in Table 8.2.2 and Figure 8.2.1. More detailed information on the distribution of effort by area and trends in the fishery can be found in the stock annex. Lpue in the north of VIIe for both commercial beam and otter trawlers reached a peak in 1988–1990, fell sharply to 1995 and has since fluctuated at a low level.

Commercial beam-trawl lpue in the south and west of VIIe show a general decline from 1990 to 2008 followed by a small upturn in the last few years. Commercial otter-trawler lpue in the western sector shows a slow declining trend since 1997 followed by a small upturn over the last five years. In the southern sector, commercial otter-trawl lpue shows greater variation throughout the time-series than that observed in the western sector but historically at much higher levels.

Effort (fishing power corrected, using GRT) by UK(E&W) beam trawlers shows an increasing trend between 1992 and 2003, then remaining stable at this high level until 2008 (Figure 8.2.1). In 2009 effort fell dramatically back to the levels observed in 2000, but increases in the most recent years has seen effort levels restored to the high levels observed in the mid-noughties. In contrast, effort by otter trawlers continues to decline slowly from the highest values shown at the beginning of the time-series. However commercial otter-trawl effort now shows a small increase in years 2009–2012 but effort remains at a low level.

8.2.2 Stock assessment

Catch-at-age analysis

WGCSE report Section 1 outlines the general approach adopted at this year's working group meeting, and the specific approach for this stock is given in the stock annex. All relevant tuning and XSA outputs not included in this report are available in the 'Exploratory runs' folder. The details of the previous assessment approaches for this stock can be found in the stock annex.

Data screening

The age range for the analysis was 1–10+, as standard.

As this was again an update assessment, full data screening, tuning data and exploratory XSA trials were not carried out. For catch data screening, a separable VPA was carried out using the standard setting as detailed in the stock annex. The results (Figure 8.2.5.cont.) show no anomalies in recent years, and high residuals on the youngest age as previously observed.

Tuning information available consisted of same five fleets as last year: three UK commercial series, UK otter historic, UK otter trawl, UK beam trawl; and two UK survey-series: UK-WEC-BTS, and FSP-7e (UK(E+W)). These are presented in Table 8.2.8. The figures in bold indicate the data used for the final run.

Details of the derivation of the tuning fleets are presented in the stock annex.

Tuning indices were examined for inconsistencies using SURBA version 3.0. Log(cpue) plots plotted by year class and by year (Figure 8.2.6). All five of the tuning indices indicate highly consistent year-class estimates, and plots of index by year do not indicate substantial year effects in the tuning data. The FSP-7e UK(E&W) data for 2008 continue to be excluded from the assessment. Inclusion of these data at the WGCSE 2009 led to the final estimates of each year class for this fleet being reduced significantly from the previous year's estimate at all ages and given that this fleet's estimates received heavy weighting in the final estimates or survivors, these data were excluded from the final assessment. The cause of this year effect remains unclear. There were a number of changes to the survey in 2008, but these mostly affected the eastern part of the survey, whereas the greatest change in abundance was noted in the western survey and these changes continued in 2009.

Final update assessment

The settings used for the final run are shown in the table. The full assessment history is given in the stock annex.

		2011 XSA	2012 XSA	2013 XSA
Catch-at-age data		1980–2010, 1–10+ add catch from 7d	1980–2011, 1–10+ add catch from 7d	1980–2012, 1–10+ add catch from 7d
Fleets	UK-WECBTS – Survey	1986–2010, 1–8	1986–2011, 1–8	1986–2012, 1–8
	UK WECOT – Commercial	1988–2010, 3–9	1988–2011, 3–9	1988–2012, 3–9
	UK WECOT– Commercial historic	1980–1987, 2–9	1980–1987, 2–9	1980–1987, 2–9
	UK WECBT – Commercial	1989–2010, 3–9	1989–2011, 3–9	1989–2012, 3–9
	FSP-7e (UK E+W)	2003–2010, 2–8 (exc. 08)	2003–2011, 2–8 (exc. 08)	2003–2012, 2–8 (exc. 08)
Taper		No	No	No
Taper range		-	-	-
Ages catch dep. Stock size		None	None	None
q plateau		7	7	7
F shrinkage se		2.5	2.5	2.5
year range		5	5	5
age range		4	4	4
Fleet SE threshold		0.5	0.5	0.5
Prior weighting		-	-	-
Plus group		10	10	10
F Bar Range		F(3–6)	F(3–6)	F(3–6)

The diagnostics for the final XSA run are shown in Table 8.2.9 and the catchability residuals are plotted in Figure 8.2.5. Some weak trends/patterns can be seen in the commercial beam-trawl and otter-trawl fleet (UK-WECB; UK-WECOT) residuals. However, an increasing trend is being seen in the commercial beam-trawl fleet in the most recent three years, with larger negative residuals observed at the youngest ages (3–6). This is likely to be as a result of the movement of commercial beam-trawl effort away from the inshore grounds where the younger age groups tend to be located.

The UK beam-trawl survey (UK-WEC-BTS) shows a distinct change in the last few years with a trend in larger positive residuals being seen. This may well also be explained by the shift in commercial beam-trawl effort away from the inshore survey area in Lyme Bay to areas further south. In addition, a year effect can be seen in the survey results for 2002 and 2004 and this is probably associated with the use of a Research Vessel rather than the chartered commercial vessel in those years.

Estimates for the youngest age are almost entirely determined by the UK-WEC-BTS survey and this fleet gets more weight than the other fleets up to age 5. The FSP-7e UK survey provides >25% of the weight for all ages up to age 8. The commercial fleets provide around 50% of the weight of ages 5 and older. The contribution of F-shrinkage is minor for all ages. Fishing mortalities and population numbers estimated from the final run are given in Tables 8.2.10 and 8.2.11, and the assessment summary table is shown in Table 8.2.12. The 2008–2010 above average year classes have led to a further increase in SSB in 2012. Landings in 2012 have remained level with the previous year. There has been a small decline in F in 2012 compared to 2011.

A retrospective analysis (Figure 8.2.7) was run without the short FSP-7e UK(E&W) tuning-series due to the shortness of the time-series. Last year, the 2010 year class was estimated to be the highest in the time-series and despite being heavily downgraded in this year's assessment, it is still in excess of the long-term average (80-11) by more than 25%. The 2011 year class is estimated to be the smallest in the time-series but this estimate is solely based on the UK-WEC-BTS survey but this estimate has low precision in in the assessment.

This assessment shows no retrospective bias in either SSB or F estimation.

Comparison with previous assessments

Fishing mortality is estimated to have remained relatively stable in 2011 at 0.40 and SSB is estimated to have increased to 3388 t. Last year, fishing mortality and SSB in 2011 were estimated to be 0.43 and 3271 t; this year's estimates for 2011 are 0.42 and 2906 t; a small downward revision of 2% in F and a downward revision of 12% in SSB due to the re-estimation of the 2010 cohort.

State of the stock

A summary of the final assessment is given in Table 8.2.12 and Figure 8.2.8. Spawning–stock biomass (SSB) was stable during the period 1981–1987, peaked above 5000 t during 1988–1990 following good recruitments in the mid-1980s, and then decreased to around 2400 t in 1995–1996. Since then SSB increased following the good 1996 year class but subsequently declined steadily to the lowest level in the time-series of around 1650 t in 2008. Above average recruitments in the 2008–2010 year classes and a reduction in fishing mortality has led to an increase in the SSB estimate for 2012 to around 3400 t.

Fishing mortality showed a gradually increasing trend up until the early 2000s, spiking briefly in 2007 and 2008. Following a large fall in F in 2009, this assessment shows a general decline to around 0.40 in 2012; the lowest level observed over the time-series 1980–2012. Recent changes in F have been evidenced by corresponding changes in the effort observed for the UK beam-trawl fleet and the F for sole, the target species for this fishery.

Two periods of below average recruitments in the period 1989–1994 and from 1998–2006 contributed to the decrease in yield and SSB seen in 2008. This assessment now estimates that three year classes have been above the long-term GM80-10 (6114) since 2008.

8.2.3 Short-term projections

At this year's working group the short-term forecast was run as per the procedure as detailed in the stock annex.

Estimating year-class abundance

The 2011 year class is estimated to be the lowest value in the time-series at around 1.2 million with 91% of the weight coming from the UK-WEC-BTS. However, given that other year classes have been significantly revised at this age in following assessments, the working group considered this estimate to be highly uncertain and replaced it with the GM recruitment (GM80-10) of 6.1 million. At last year's working group, a similar decision was taken with the high estimate on the 2010 year class (23.3 million) and in this year's assessment this is estimated to be considerably lower at 8.7 million, still above the GM(80-09) value used in last year's forecast.

Working group estimates of year-class strength used for prediction can be summarised as follows:

Recruitment at-age 1:

Year class	Thousands	Basis	Surveys	Commercial	Shrinkage
2009	11 820	XSA	65%	34%	1%
2010	8690	XSA	98%	0%	2%
2011	6114	GM (80-10)	-	-	-
2012	6114	GM (80-10)	-	-	-
2013	6114	GM (80-10)	-	-	-

The input values for the catch forecast (using the MFDP software) are given in Table 8.2.13. The F at-age values used were calculated as the mean of the XSA values from 2010–2012 scaled to the final year. Catch and stock weights-at-age used were also the mean of the period 2010–2012. Stock numbers-at-age in 2013 for ages 3 and older were obtained from the XSA, with the values for age 2 being set at 5423, the GM(80-10) less a reduction for natural mortality (0.12). Recruitment for 2013 onwards are taken to be 6114, the GM (80-10).

Table 8.2.14 gives the management option table from the *status quo* catch prediction and short-term results are shown in Figure 8.2.9.

Assuming *status quo* F (Fsq = 0.48) implies landings of 2100 t in 2013 and 2054 t in 2014. (The TAC for 2013 is 6400 t. for VIId,e combined). SSB is predicted to rise from 4615 t in 2013 to 4855 t in 2014 before falling again to 4755 t in 2015. Uncertainties in these results are discussed in Section 8.2.7.

The detailed output for the *status quo* F forecast by age group is given in Table 8.2.15, and the estimated contributions of recent year classes to the predicted catches and SSBs are given in Table 8.2.16. The assumptions of GM1980-10 recruitment are predicted to contribute 25% to the landings in 2014 and 39% to SSB in 2015.

The stock and recruitment scatter plot is given in Figure 8.2.10.

8.2.4 F_{MSY} evaluation

A full F_{MSY} evaluation was carried out at WGCSE in 2010 and the suggested level of F_{MSY} for this stock was F's within the range of 0.14 and 0.31 with the provisional proxy of 0.19 being agreed by analogy with the plaice in the Celtic sea. Given that the assessment for the latter stock was rejected by WKFlat 2011 and that this stock suffers from greater levels of discarding than the Western Channel stock, the provision of a more appropriate F_{MSY} were examined at the WGCSE in 2012. A full F_{MSY} evaluation was again carried out and the Working Group agreed that the most appropriate F_{MSY} value was one based on F_{MAX} 2012 as this has been consistently determined to be around the same level in the past three years. Therefore, the suggested level of F_{MSY} for this stock was 0.24. Stockastic stock simulations presented as WD7 to the 2012 working group indicate that this equilibrium value is sustainable given the selectivity pattern and the present auto-correlated recruitment pattern.

The WGCSE 2012 Working Group agreed that the appropriate value for $B_{Trigger}$ would be 1650 t. This is the lowest level of SSB observed over the time-series (1980–2011) and this level of SSB has been seen to produce excellent numbers of recruits in subsequent years.

8.2.5 Biological reference points

	TYPE	*VALUE*	*TECHNICAL BASIS*
MSY Approach	MSY $B_{trigger}$	1650 t	Preliminary based on lowest SSB (in converged part of XSA) from which the stock has recovered
	F_{MSY}	0.24	F_{MAX} (2012)
Precautionary Approach	B_{lim}	Not defined.	
	B_{pa}	Not defined.	
	F_{lim}	Not defined.	
	F_{pa}	Not defined.	

The PA reference points from the advice sheet in 2011 at the recommendation of the Celtic Sea Review Group due to them being regarded as unreliable. The basis for this is documented in the WGCSE 2012 report.

Yield-per-recruit analysis

Results for the deterministic yield and SSB per recruit (using program MFYPR), conditional on the recent exploitation pattern, are given in Table 8.2.17 and Figure 8.2.9. F_{MAX} is given by a reference F of 0.22, around 56% of Fsq. Long-term yield and SSB (at Fsq and assuming GM80-10 recruitment = 6,114 million) are given as 1780 t and 4120 t respectively.

8.2.6 Management plans

There is no management plan in place for this stock.

8.2.7 Uncertainties and bias in assessment and forecast

The assessment model changes introduced by WKFlat 2010 added new uncertainties into a portion of the data (~10%). The spawning migration correction assumes that a constant 15% of quarter 1 catches in VIId to originate from VIIe, based on historical tagging information. This proportion makes no provision for changes in the relative sizes of the two populations. In addition, this correction utilises the age structure of the VIId catches, representing a mix of age structure from VIIe, VIId and portions of the Area IV populations migrating into VIId for spawning. At present, both stocks are increasing suggesting that the ratio may stay constant for the time being.

There is a heavy reliance on the age composition data derived from UK(E&W) sample data. Around 30% of the landings for this stock are taken by countries that do not provide age-based data and this situation is improved only slightly once the migration correction data from VIId is added. Survivor estimates for ages 1 and 2 almost entirely come from the UK survey data and some consideration should be given to using age 2 data from the commercial tuning fleets.

UK and Belgian and French discard data provided this year continue to support previous WG conclusions that discard levels are low in the second half of the year, and overall that discarding for this stock is variable but low compared to other plaice stocks. As the time-series of data expands, the WG will be able to better determine how to include this data in the assessment appropriately.

The assessments ability to accurately estimate age 1 recruits depends heavily upon the Carhelmar UK beam-trawl survey which is not particularly consistent at catching fish of this age. The working group has considered these values too uncertain for use in the short-term forecast opting instead to use GM recruitment. Recent large recruit estimates (2009/2010 year classes) have subsequently been confirmed to be above average in the following year by both the Carhelmar survey and the FSP-7e survey at-age 2. However, this year's 2012 recruits estimate (based purely on the Carhelmar survey are 1 catches) is now also being estimated as being the smallest year class in the time-series.

It should be noted that the area of coverage of the UK-WEC-BTS survey (Lyme Bay), is no longer commercially fished on the same scale as in previous years. According to VMS data, the UK commercial beam-trawl fleet effort has moved further south and this could be what is driving the higher survey residuals in the last few years in the assessment diagnostics.

8.2.8 Recommendation for next benchmark

A benchmark assessment was carried out for this stock in February 2010 but any future benchmark assessment will need to consider the following issues.

- Both the UK-WEC_BTS and the FSP-7e UK(E&W) surveys are spatially restricted to the same area as the commercial tuning fleets and little information exists on stock dynamics on the French coast. Inclusion of the UK Q1 South West Beam Trawl Survey index (Q1SWBeam) should be considered the next time this stock has a benchmark assessment as this survey covers the entire ICES Division of VIIe.
- It is likely that the survey time-series UK-WEC-BTS will be terminated after 2013 and the likely effect of this loss on the assessment and forecast will need to be investigated. This may be investigated in an inter-benchmark process or may be done as part of a wider examination at a full benchmark.

- Re-investigate the assumption of 15% migration.
- Investigate the addition of age composition information from the French and Belgian fleets. These fleets collectively account for 30% of the total landings of this stock. In particular, inclusion of French data would add information on the stock dynamics on the French coast.
- Inclusion of discard estimates in the assessment once an adequate time-series of data is available. Discarding estimates would ideally include the time-series of French discard data that has been collected but not currently been made available along with the UK data already made available.

8.2.9 Management considerations

The stock unit (Division VIIe) does not correspond with the management unit (Divisions VIId and VIIe). This hampers effective management of plaice in the western English Channel, but because components of the VIIe stock are also taken during spawning time in Area VIId, some provision must be made in management to accommodate effective management of both plaice stocks.

Plaice are taken as a bycatch in the beam-trawl fishery targeting a mixed species fishery including sole, monk and cuttlefish, and as part of a mixed demersal fishery by otter trawlers. The restrictions under the management plan for sole VIIe appear to have benefited the plaice stock.

The assessment is now able to accurately estimate recent trends in F and historical trends are estimated with some certainty. Fishing mortality is estimated to be well above F_{MAX} but is falling in the most recent years.

Table 8.2.1 Plaice in VIIe. Nominal landings (t) in Division VIIe, as used by Working Group.

Year	Belgium	Denmark	Netherlands	France	UK (E &W) inc. CI's.	Others	Total reported	Unallocated[1]	Total	VIIe stock caught in VIId[4]	As used by WG
1976	5	-	-	323	312	-	640	-	640	-	640
1977	3	-	-	336	363	-	702	-	702	-	702
1978	3	-	-	314	467	-	784	-	784	-	784
1979	2	-	-	458	515	-	975	2	977	-	977
1980	23	-	-	325	609	9	966	113	1079	136	1215
1981	27	-	-	537	953	-	1517	-16	1501	245	1746
1982	81	-	-	363	1109	-	1553	135	1688	250	1938
1983	20	-	-	371	1195	-	1586	-91	1495	259	1754
1984	24	-	-	278	1144	-	1446	101	1547	266	1813
1985	39	-	-	197	1122	-	1358	83	1441	310	1751
1986	26	-	-	276	1389	-	[1] 1691	119	1810	351	2161
1987	68	-	-	435	1419	-	1922	36	1958	430	2388
1988	90	-	-	584	1654	-	2328	130	2458	536	2994
1989	89	-	-	448 [1]	1712	-	2250	108	2358	450	2808
1990	82	2	-	N/A [2]	1891	2	1979	614	2593	465	3058
1991	57	-	-	251 [1]	1326	-	1635	213	1848	402	2250
1992	25	-	-	419	1110	14	1568	56	1624	326	1950
1993	56	-	-	284	1080	24	1444	-27	1417	274	1691
1994	10	-	-	277	998	-	1285	-129	1156	315	1471
1995	13	-	-	288	857	-	1158	-127	1031	264	1295
1996	4	-	-	279	855	-	1138	-94	1044	277	1321
1997	6	-	-	329	1038	1	1374	-51	1323	331	1654
1998	22	-	-	327	892	1	1242	-111	1131	299	1430
1999	12	-	-	194 [1]	947	-	1154	117	1271	345	1616
2000	4	-	-	360	926	+	1290	-9	1281	397	1678
2001	12	-	-	303	797	-	1112	-6	1106	273	1379
2002	27	-	-	242	978	+	1247	10	1257	351	1608
2003	39	-	-	216	985	-	1240	-22	1218	260	1478
2004	46	-	-	184	912	-	1142	12	1154	248	1402
2005	48	-	-	198	887	-	1133	66	1199	171	1370
2006	52	-	-	223	966	-	1241	72	1313	153	1466
2007	84	-	-	202	679	-	965	38	1003	181	1184
2008	66	-	-	148	677	-	891	83	974	170	1144
2009	53	-	2	193	724	5	978	-55	923	142	1065
2010	51	-	2	220	838	2	1113	-21	1092	149	1241
2011	141	-	3	259	927	-	1330	4	1334	173	1507
2012	131	-	2	224	981	-	1338	27	1365	155	1520

[1]Estimated by the Working Group

[2]Divisions VIId,e = 4,739 t.

[3]Included in Division VIId

[4]Migration correction (15% of VIId Qtr 1) added to stock.

Table 8.2.2 Division VIIe PLAICE effort and LPUE and CPUE data.
The UK (E&W) data are for vessels > 12m and are corrected for fishing power (based on GRT). All effort data are in fishing hours, LPUE data are kg/hr for commercial fleets, CPUE in kg/10 km towed for Carhelmar beam survey and Kg/hour/ Metre beam length for FSP survey .

Year	(LPUE) (kg/hr).						Effort (000 hours)		Landings (tonnes)		(CPUE) (kg/10 km)	(CPUE) (Kg h^{-1} m^{-1} beam)
	West Sector		North Sector		South Sector						Carhelmar Survey (UK-WEC-BTS)	FSP survey (FSP-7e)
	Otter	Beam	Otter	Beam	Otter	Beam	Otter	Beam	Otter	Beam		
1972	2.31	-	4.50	-	0.00	-	64.60	-	194.36	-	-	-
1973	2.25	-	3.85	-	0.00	-	69.54	-	200.45	-	-	-
1974	1.65	-	3.47	-	2.94	-	50.09	-	121.03	-	-	-
1975	1.78	-	3.53	-	2.54	-	54.69	-	132.95	-	-	-
1976	1.89	-	3.62	-	4.14	-	56.13	-	144.56	-	-	-
1977	1.37	-	3.10	-	4.96	-	55.40	-	117.72	-	-	-
1978	1.61	5.41	3.63	10.35	4.24	11.84	48.80	22.09	114.02	204.69	-	-
1979	1.84	4.16	4.58	7.37	1.64	6.58	49.92	39.38	142.52	233.81	-	-
1980	2.02	3.15	5.82	6.06	0.67	6.45	49.95	62.16	150.69	335.16	-	-
1981	2.61	4.44	10.98	8.35	7.30	8.33	46.88	65.29	257.28	471.20	-	-
1982	3.28	4.43	10.77	9.23	0.00	7.69	38.51	81.59	249.60	611.52	-	-
1983	2.57	2.76	11.03	9.64	8.10	5.71	52.59	103.07	303.04	612.16	-	-
1984	2.95	4.08	10.92	10.38	2.43	7.80	52.89	87.63	281.94	575.22	-	-
1985	2.60	3.79	8.81	9.00	0.09	6.38	57.69	92.19	255.86	540.61	15.21	-
1986	3.25	6.30	10.94	12.21	10.17	6.85	49.52	76.33	315.08	602.07	16.46	-
1987	3.56	5.37	11.02	9.69	3.63	7.45	45.11	87.05	329.97	672.81	20.59	-
1988	3.90	3.50	15.38	6.51	5.04	4.85	53.40	103.36	433.20	564.72	25.34	-
1989	2.69	6.50	10.87	14.25	1.42	6.88	54.71	109.95	315.73	900.19	14.80	-
1990	2.95	6.52	7.77	15.64	3.55	10.17	53.05	100.95	268.81	990.05	11.60	-
1991	2.80	6.16	5.08	13.24	0.41	7.47	40.79	83.57	152.93	721.46	8.72	-
1992	1.92	6.30	3.51	10.61	3.06	9.69	39.91	80.87	105.41	695.70	7.45	-
1993	1.39	6.14	3.03	11.04	5.46	7.17	39.17	83.92	81.77	655.48	6.16	-
1994	1.46	4.62	2.48	9.17	2.11	6.47	38.77	100.42	63.67	650.99	5.70	-
1995	1.61	4.60	1.99	6.29	2.36	5.40	35.45	100.80	60.20	531.06	5.13	-
1996	2.00	3.09	2.49	6.66	11.62	4.39	30.54	116.45	64.83	482.18	5.97	-
1997	2.69	3.50	3.08	7.16	1.56	5.58	33.28	108.39	99.05	561.74	9.82	-
1998	1.65	2.97	4.13	6.10	1.85	3.03	29.80	111.17	73.30	459.22	8.74	-
1999	1.39	3.49	3.60	8.55	1.11	4.59	27.52	103.56	59.67	576.76	8.42	-
2000	0.81	2.98	4.00	6.63	1.25	3.72	30.49	118.83	61.82	541.33	11.31	-
2001	0.89	2.30	3.03	5.45	3.14	3.61	31.90	143.27	48.82	527.38	10.56	-
2002	0.90	2.90	4.18	6.52	0.56	3.45	28.35	139.83	57.44	651.04	8.05	-
2003	0.96	3.26	2.10	8.18	0.50	2.89	25.06	159.95	36.88	743.07	7.96	0.47
2004	0.88	3.38	2.01	6.16	0.19	2.80	25.58	158.68	37.98	701.17	4.53	0.58
2005	0.88	2.62	2.13	8.20	3.48	2.75	21.13	157.81	29.44	691.27	7.02	0.47
2006	0.96	2.68	3.41	6.97	1.71	2.50	21.06	161.44	28.57	665.16	7.47	0.47
2007	0.68	1.71	1.95	4.55	1.31	2.13	22.35	158.01	27.27	472.27	7.94	0.29
2008	0.94	1.83	2.07	4.88	0.71	2.06	19.86	158.50	25.72	465.09	8.18	0.24
2009	1.26	2.62	2.23	7.58	1.78	3.48	21.41	122.53	32.45	521.17	12.85	0.44
2010	1.68	2.64	2.71	8.55	0.45	3.50	26.06	128.45	52.41	549.64	21.63	0.71
2011	1.88	2.53	5.24	6.75	1.28	2.93	25.16	150.79	53.91	564.92	24.74	0.76
2012	2.07	3.77	3.69	5.74	5.16	2.79	25.64	149.23	59.08	546.37	23.91	0.83

Table 8.2.3. Plaice in VIIe. Annual length distribution by fleet (2012)

	UK (England & Wales)			France		
Length (cm)	Beam trawl	Dredge	All gears (excl. beam+dredge)	Nets	Trawl	Other
23					197	
24	128		385		143	
25	1066		734	92	0	
26	13439		5258	0	655	
27	51297		23612	135	5616	
28	74222		65846	92	27257	3042
29	103789		106896	743	15063	3667
30	136385	112	127020	179	25962	5087
31	157022	445	156448	1473	26083	7449
32	127299	822	132033	1764	16793	4509
33	135706	1382	107725	4258	36652	3265
34	109838	1317	74979	1448	24271	4019
35	93286	683	63712	1628	25833	5247
36	72163	1409	48381	1948	17691	2807
37	61216	410	29517	1742	19199	3147
38	46287	677	17288	1260	13755	3310
39	47058	1269	13128	973	9965	1007
40	28916	265	7383	1081	12437	2565
41	33864	112	5880	922	6510	1875
42	20189	429	4728	649	6236	601
43	19934	62	3881	634	4220	0
44	17662	112	2418	336	2679	768
45	12555	0	1259	399	2118	1972
46	14415	160	1807	271	1092	2217
47	10067	110	631	1109	0	1531
48	6292	0	1258	94	2639	1097
49	5175	0	390	271	1337	335
50	4764	0	365	135	551	1300
51	3515	48	89	43	423	1300
52	2412	0	826	263	0	1300
53	3080	48	30	0	1111	601
54	1813		87	246	550	0
55	762		317	184	340	0
56	1329		199	491	144	0
57	1682		0	0	356	168
58	626		60	222	407	0
59	580		0	135	197	433
60	393		0	1433	0	0
61	474		251	0	0	930
62	163		0	92	0	
63	38		25	442	0	
64	0		0	43	144	
65	0		0	0		
66	32		25	0		
67				0		
68				92		
Total	1420934	9874	1004870	27323	308626	65550

Table 8.2.4 Plaice in VIIe. Catch numbers-at-age.

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1980	1981	1982
AGE			
1	19	41	72
2	814	723	310
3	800	2268	2131
4	252	591	1420
5	230	120	263
6	62	103	89
7	63	21	83
8	23	47	17
9	13	19	28
+gp	138	95	122
TOTALNUM	2415	4027	4534
TONSLAND	1215	1746	1938
SOPCOF %	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE										
1	3	77	3	10	74	12	10	57	41	90
2	790	970	727	1025	1258	1932	352	391	691	841
3	893	1864	1605	2532	2303	5179	2960	3408	1352	1430
4	1702	702	1399	963	1407	1160	3014	2757	1943	760
5	593	531	157	488	657	464	843	1222	973	654
6	104	197	255	116	233	155	274	272	528	452
7	41	92	142	129	90	116	121	135	106	264
8	50	30	28	68	52	40	97	80	46	72
9	2	33	16	29	45	25	32	57	33	33
+gp	100	51	52	62	52	53	101	73	51	50
TOTALNUM	4276	4546	4383	5421	6170	9136	7805	8451	5764	4646
TONSLAND	1754	1813	1751	2161	2388	2994	2808	3058	2250	1950
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE										
1	36	84	6	15	7	7	19	46	6	188
2	844	409	421	1160	963	636	678	399	585	1400
3	1488	1707	818	774	2443	1732	2480	1331	946	1251
4	650	878	986	403	486	1158	1219	2069	795	597
5	266	256	269	392	185	159	414	496	950	428
6	272	111	120	127	155	66	94	181	145	511
7	219	119	58	60	80	61	38	38	79	116
8	171	83	84	41	34	23	40	14	19	49
9	40	86	69	48	18	21	17	22	12	13
+gp	86	65	90	107	101	63	46	52	37	42
TOTALNUM	4071	3797	2920	3127	4472	3926	5046	4648	3574	4595
TONSLAND	1691	1471	1295	1321	1654	1430	1616	1678	1379	1608
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 1 Catch numbers at age Numbers*10**-3

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
AGE										
1	23	21	22	18	3	5	5	18	11	0
2	1004	600	831	1089	428	1015	742	854	1257	307
3	1208	1644	1034	1448	1168	781	1359	1035	1531	2064
4	622	600	858	543	723	563	295	768	750	1117
5	207	349	282	388	287	252	147	205	292	324
6	172	102	146	121	196	107	76	109	78	192
7	224	75	52	60	70	83	30	41	50	73
8	54	96	50	29	30	32	21	15	27	40
9	41	44	53	22	10	15	7	19	11	15
+gp	39	38	44	45	49	28	16	25	20	21
TOTALNUM	3594	3569	3372	3764	2962	2882	2698	3089	4027	4153
TONSLAND	1478	1402	1370	1466	1184	1144	1065	1241	1507	1520
SOPCOF %	100	100	100	100	100	100	100	100	100	100

Table 8.2.5 Plaice in VIIe. Catch weights-at-age.

Table 2 Catch weights at age (kg)

YEAR	1980	1981	1982
AGE			
1	0.248	0.144	0.186
2	0.337	0.268	0.273
3	0.428	0.389	0.360
4	0.519	0.507	0.447
5	0.612	0.622	0.532
6	0.706	0.733	0.619
7	0.801	0.841	0.702
8	0.898	0.946	0.786
9	0.996	1.047	0.869
+gp	1.404	1.387	1.217
SOPCOFAC	0.9999	1.0007	0.9999

Table 2 Catch weights at age (kg)

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE										
1	0.106	0.136	0.098	0.171	0.252	0.134	0.156	0.236	0.194	0.242
2	0.221	0.238	0.214	0.257	0.288	0.215	0.217	0.267	0.245	0.282
3	0.330	0.343	0.328	0.346	0.337	0.303	0.285	0.308	0.306	0.335
4	0.432	0.447	0.437	0.438	0.403	0.399	0.360	0.359	0.377	0.401
5	0.529	0.550	0.543	0.533	0.480	0.504	0.440	0.421	0.456	0.481
6	0.617	0.654	0.644	0.632	0.572	0.618	0.528	0.493	0.545	0.574
7	0.699	0.757	0.743	0.734	0.679	0.740	0.622	0.577	0.643	0.680
8	0.775	0.861	0.837	0.840	0.799	0.870	0.723	0.670	0.750	0.799
9	0.844	0.965	0.928	0.950	0.933	1.009	0.830	0.775	0.866	0.933
+gp	1.027	1.390	1.253	1.427	1.388	1.357	1.122	1.078	1.221	1.317
SOPCOFAC	1.0003	1.0000	0.9996	0.9993	0.9997	0.9991	1.0001	0.9996	1.0004	0.9996

Table 2 Catch weights at age (kg)

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE										
1	0.212	0.201	0.213	0.173	0.188	0.179	0.107	0.117	0.167	0.193
2	0.269	0.258	0.281	0.266	0.259	0.239	0.196	0.204	0.231	0.246
3	0.332	0.322	0.353	0.360	0.334	0.294	0.282	0.290	0.305	0.306
4	0.405	0.391	0.429	0.455	0.412	0.411	0.364	0.375	0.384	0.372
5	0.484	0.464	0.507	0.551	0.494	0.526	0.444	0.459	0.468	0.446
6	0.571	0.543	0.588	0.647	0.580	0.638	0.521	0.542	0.558	0.525
7	0.667	0.628	0.674	0.743	0.669	0.747	0.596	0.624	0.654	0.612
8	0.769	0.717	0.763	0.840	0.762	0.853	0.667	0.705	0.754	0.706
9	0.880	0.812	0.855	0.938	0.860	0.958	0.735	0.784	0.861	0.806
+gp	1.202	1.117	1.055	1.170	1.110	1.274	0.950	1.029	1.272	1.137
SOPCOFAC	1.0000	1.0002	0.9998	1.0006	0.9992	1.0004	1.0000	0.9997	1.0001	0.9998

Table 2 Catch weights at age (kg)

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
AGE										
1	0.147	0.254	0.226	0.206	0.186	0.208	0.098	0.180	0.120	0.118
2	0.250	0.293	0.287	0.276	0.259	0.279	0.239	0.268	0.234	0.210
3	0.352	0.342	0.354	0.352	0.334	0.356	0.376	0.361	0.348	0.302
4	0.450	0.400	0.426	0.434	0.412	0.438	0.507	0.458	0.464	0.396
5	0.548	0.468	0.504	0.521	0.493	0.526	0.634	0.560	0.581	0.490
6	0.641	0.545	0.586	0.614	0.577	0.619	0.757	0.666	0.700	0.586
7	0.734	0.632	0.674	0.712	0.663	0.718	0.874	0.776	0.819	0.682
8	0.822	0.728	0.766	0.814	0.752	0.822	0.987	0.891	0.940	0.780
9	0.910	0.833	0.864	0.923	0.844	0.932	1.096	1.011	1.061	0.878
+gp	1.231	1.189	1.106	1.165	1.095	1.270	1.336	1.262	1.367	1.147
SOPCOFAC	1.0003	1.0005	1.0002	1.0003	1.0001	1.0002	1.0000	1.0003	1.0004	1.0003

Table 8.2.6 Plaice in VIIe. Stock weights-at-age.

Table 3 Stock weights at age (kg)

YEAR	1980	1981	1982
AGE			
1	0.114	0.126	0.108
2	0.227	0.250	0.214
3	0.338	0.373	0.318
4	0.447	0.492	0.419
5	0.554	0.609	0.517
6	0.660	0.725	0.615
7	0.764	0.838	0.710
8	0.867	0.949	0.802
9	0.967	1.057	0.893
+gp	1.351	1.435	1.255

Table 3 Stock weights at age (kg)

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE										
1	0.116	0.111	0.112	0.096	0.068	0.103	0.138	0.236	0.182	0.235
2	0.228	0.222	0.222	0.195	0.145	0.184	0.200	0.262	0.232	0.269
3	0.335	0.334	0.331	0.297	0.232	0.275	0.270	0.300	0.292	0.317
4	0.436	0.446	0.438	0.401	0.326	0.373	0.347	0.349	0.362	0.378
5	0.532	0.560	0.543	0.507	0.429	0.481	0.431	0.408	0.442	0.454
6	0.623	0.673	0.647	0.615	0.539	0.598	0.522	0.479	0.531	0.543
7	0.710	0.788	0.749	0.727	0.659	0.723	0.620	0.561	0.631	0.646
8	0.791	0.903	0.849	0.840	0.788	0.858	0.725	0.654	0.740	0.763
9	0.867	1.018	0.948	0.955	0.924	1.002	0.837	0.758	0.858	0.893
+gp	1.094	1.498	1.329	1.442	1.347	1.363	1.143	1.064	1.223	1.274

Table 3 Stock weights at age (kg)

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE										
1	0.188	0.188	0.191	0.134	0.171	0.169	0.069	0.082	0.139	0.180
2	0.241	0.248	0.262	0.233	0.248	0.225	0.171	0.181	0.204	0.233
3	0.302	0.314	0.336	0.333	0.329	0.254	0.270	0.279	0.277	0.293
4	0.371	0.385	0.413	0.434	0.414	0.382	0.365	0.376	0.356	0.360
5	0.447	0.462	0.495	0.535	0.503	0.507	0.457	0.472	0.441	0.435
6	0.531	0.545	0.580	0.637	0.596	0.629	0.545	0.567	0.531	0.516
7	0.623	0.633	0.668	0.739	0.694	0.749	0.631	0.660	0.627	0.605
8	0.723	0.728	0.760	0.842	0.795	0.866	0.712	0.752	0.729	0.701
9	0.830	0.828	0.856	0.945	0.901	0.980	0.791	0.842	0.836	0.805
+gp	1.145	1.150	1.064	1.191	1.176	1.326	1.040	1.122	1.253	1.148

Table 3 Stock weights at age (kg)

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
AGE										
1	0.100	0.246	0.205	0.177	0.156	0.175	0.026	0.138	0.064	0.072
2	0.211	0.282	0.266	0.248	0.229	0.243	0.169	0.224	0.177	0.164
3	0.319	0.327	0.334	0.323	0.305	0.317	0.308	0.314	0.291	0.256
4	0.425	0.383	0.406	0.405	0.385	0.396	0.442	0.409	0.406	0.349
5	0.529	0.448	0.484	0.492	0.467	0.481	0.571	0.508	0.523	0.443
6	0.630	0.523	0.567	0.584	0.551	0.572	0.696	0.612	0.640	0.538
7	0.728	0.608	0.656	0.682	0.639	0.668	0.816	0.721	0.759	0.634
8	0.824	0.702	0.749	0.786	0.730	0.769	0.931	0.833	0.879	0.731
9	0.918	0.807	0.849	0.895	0.823	0.876	1.042	0.950	1.000	0.829
+gp	1.263	1.160	1.095	1.139	1.078	1.207	1.288	1.197	1.123	0.927

Table 8.2.7 UK-WEC-BTS effort standardised plaice abundance indices

age year	0	1	2	3	4	5	6	7	8	9	10+
1985	0.00	82.16	75.37	72.36	113.06	20.35	15.83	8.29	0.75	0.00	2.26
1986	0.00	61.62	86.67	168.60	64.33	23.70	2.71	12.19	1.35	0.00	1.35
1987	0.74	398.98	110.17	104.21	54.34	27.54	21.59	10.42	5.95	5.95	2.98
1988	0.00	108.40	289.33	265.15	75.65	17.16	8.58	7.80	3.12	4.68	3.12
1989	0.00	18.71	42.26	169.63	113.49	13.88	6.64	8.45	4.83	3.62	10.87
1990	0.00	14.23	21.63	125.24	49.53	42.70	1.14	3.42	0.57	3.42	3.98
1991	1.16	12.81	15.73	36.70	46.02	36.11	23.88	5.24	0.00	0.58	1.75
1992	0.00	77.31	22.38	36.62	12.21	20.35	10.17	8.65	1.53	2.54	2.03
1993	0.00	11.10	37.00	31.71	12.69	6.87	13.21	6.87	5.81	1.06	1.06
1994	0.00	16.52	15.54	47.60	14.57	4.86	0.97	4.37	6.31	3.89	0.97
1995	0.00	26.72	24.58	24.04	25.65	6.41	2.14	2.67	3.21	0.53	2.14
1996	0.54	17.90	57.49	16.27	9.22	13.56	2.71	0.54	1.63	3.80	4.34
1997	0.00	28.69	66.04	106.63	12.99	3.25	6.50	3.79	0.54	0.54	3.79
1998	0.00	43.67	67.39	67.39	45.83	4.85	3.23	3.77	2.16	0.00	1.62
1999	0.53	20.22	23.42	96.86	28.21	15.97	1.60	1.06	3.19	2.13	1.06
2000	0.00	26.57	34.79	69.51	99.00	21.13	12.30	0.60	1.11	0.00	2.77
2001	11.52	17.91	35.78	28.65	62.57	54.75	13.79	7.08	0.00	1.69	2.81
2002	0.00	76.78	56.50	48.17	12.91	13.06	22.18	2.97	1.11	0.00	1.11
2003	0.00	15.82	75.35	32.84	27.52	2.47	9.91	14.86	3.96	0.00	1.10
2004	0.00	6.71	19.82	35.67	14.03	6.10	1.83	0.61	6.10	0.00	2.44
2005	0.80	16.31	40.42	48.71	37.42	6.90	1.71	1.43	2.81	1.18	1.47
2006	0.00	29.77	55.43	55.78	16.45	16.89	1.44	2.06	0.00	2.44	1.08
2007	0.00	20.44	50.35	66.58	18.67	14.93	3.31	3.04	0.28	1.38	2.21
2008	0.00	8.54	83.46	38.71	17.67	6.87	4.48	5.44	2.00	0.57	1.72
2009	1.74	9.40	90.88	124.18	16.93	8.50	6.36	4.65	2.68	0.58	1.45
2010	7.78	102.40	194.97	124.64	62.66	17.25	8.36	9.17	0.56	1.85	2.22
2011	0.00	118.05	328.50	199.49	53.58	31.14	4.97	4.69	1.70	0.57	3.69
2012	0.00	9.04	131.03	321.33	104.73	26.28	24.56	10.76	3.38	2.78	3.83

Table 8.2.8 Plaice in VIIe. Tuning fleet data available (data in bold have been used for tuning)

W.CHANNEL PLAICE 2013 WGCSE									
105									
UK-WEC-BTS									
1986	**2012**								
1	**1**	**0.75**	**0.8**						
1	**8**								
147.68	**91**	**128**	**249**	**95**	**35**	**4**	**18**	**2**	0
134.34	**536**	**148**	**140**	**73**	**37**	**29**	**14**	**8**	8
128.23	**139**	**371**	**340**	**97**	**22**	**11**	**10**	**4**	6
165.66	**31**	**70**	**281**	**188**	**23**	**11**	**14**	**8**	6
175.66	**25**	**38**	**220**	**87**	**75**	**2**	**6**	**1**	6
171.68	**22**	**27**	**63**	**79**	**62**	**41**	**9**	**0**	1
196.6	**152**	**44**	**72**	**24**	**40**	**20**	**17**	**3**	5
189.19	**21**	**70**	**60**	**24**	**13**	**25**	**13**	**11**	2
205.87	**34**	**32**	**98**	**30**	**10**	**2**	**9**	**13**	8
187.15	**50**	**46**	**45**	**48**	**12**	**4**	**5**	**6**	1
184.37	**33**	**106**	**30**	**17**	**25**	**5**	**1**	**3**	7
184.74	**53**	**122**	**197**	**24**	**6**	**12**	**7**	**1**	1
185.49	**81**	**125**	**125**	**85**	**9**	**6**	**7**	**4**	0
187.89	**38**	**44**	**182**	**53**	**30**	**3**	**2**	**6**	4
180.37	**48**	**63**	**125**	**179**	**38**	**22**	**1**	**2**	0
177.98	**32**	**64**	**51**	**111**	**97**	**25**	**13**	**0**	3
179.74	**138**	**102**	**87**	**23**	**23**	**40**	**5**	**2**	0
182.24	**29**	**137**	**60**	**50**	**5**	**18**	**27**	**7**	0
163.99	**11**	**33**	**59**	**23**	**10**	**3**	**1**	**10**	0
186.6	**30**	**75**	**91**	**70**	**13**	**3**	**3**	**5**	2
184.74	**55**	**102**	**103**	**30**	**31**	**3**	**4**	**0**	5
181.02	**37**	**91**	**121**	**34**	**27**	**6**	**6**	**1**	3
174.66	**15**	**146**	**68**	**31**	**12**	**8**	**10**	**4**	1
172.05	**16**	**156**	**214**	**29**	**15**	**11**	**8**	**5**	1
179.93	**184**	**351**	**224**	**113**	**31**	**15**	**16**	**1**	3
176.18	**208**	**579**	**351**	**94**	**55**	**9**	**8**	**3**	1
179.7	**16**	**235**	**577**	**188**	**47**	**44**	**19**	**6**	5
UK-WECOT									
1988	**2012**								
1	**1**	**0**	**1**						
3	**9**								
53.402	**754.5**	**116.9**	**51.5**	**15.1**	**10**	**3.4**	**1.9**		
54.707	**494**	**359.7**	**77**	**26.5**	**7**	**5.9**	**0.8**		
53.05	**347.1**	**265.9**	**85.3**	**18.4**	**11.3**	**6**	**2.8**		
40.789	**89.5**	**134.9**	**64.8**	**30.3**	**6.3**	**2.7**	**1.9**		
39.909	**71.7**	**46.3**	**40.1**	**25.5**	**12.9**	**3.9**	**1.3**		
39.24	**76.1**	**33.1**	**12**	**12.2**	**9.8**	**7.7**	**1.7**		
38.768	**86.1**	**37.1**	**9.8**	**3.5**	**4.4**	**2.4**	**2.7**		
35.453	**47.8**	**48.8**	**10.8**	**5.7**	**1.3**	**2.7**	**2.2**		
30.541	**39.8**	**16.3**	**14.5**	**4**	**2**	**1**	**1.2**		
33.281	**180.1**	**14.6**	**5.5**	**4.3**	**1.6**	**0.6**	**0.3**		
29.802	**96.2**	**61.3**	**6.4**	**2.4**	**1.6**	**0.4**	**0.5**		
27.516	**90.1**	**34.6**	**14.3**	**2.8**	**1.1**	**0.9**	**0.3**		
30.493	**49.6**	**64.4**	**13.3**	**6.5**	**1.3**	**0.5**	**0.8**		
31.9	**31.3**	**29.3**	**31.5**	**4.4**	**2.6**	**0.5**	**0.3**		
28.346	**57.1**	**17.9**	**12.6**	**15.6**	**3.3**	**1.4**	**0.5**		
25.06	**33.2**	**15.8**	**5.1**	**3.5**	**4.3**	**1.2**	**0.6**		
25.584	**50.7**	**18.2**	**10.5**	**2.8**	**1.4**	**2.1**	**1.1**		
21.129	**24.1**	**17.6**	**5.7**	**2.6**	**0.8**	**0.8**	**0.8**		
21.058	**32.4**	**9.9**	**6.5**	**1.9**	**1**	**0.4**	**0.3**		
22.347	**36.6**	**18.6**	**5.3**	**2.8**	**1**	**0.3**	**0.1**		
19.855	**19.2**	**12.2**	**5.4**	**1.9**	**1.2**	**0.6**	**0.3**		
21.412	**43.7**	**8.6**	**3.5**	**1.8**	**0.7**	**0.5**	**0.1**		
26.062	**49**	**36.6**	**7.7**	**3**	**1.1**	**0.4**	**0.3**		
25.161	**66.4**	**28.6**	**6.8**	**1.4**	**0.9**	**0.4**	**0.1**		
25.640	**88.3**	**39.8**	**10.1**	**6.1**	**2**	**1.1**	**0.2**		

Table 8.2.8 (Cont.) Plaice in VIIe. Tuning fleet data available (data in bold have been used for tuning)

UK-WECBT									
1989	**2012**								
1	**1**	**0**	**1**						
3	**9**								
109.947	**922.6**	**784.7**	**210.1**	**96.9**	**48.9**	**35.2**	**7.5**		
100.947	**1053.9**	**826.9**	**326.5**	**77.2**	**54.4**	**23.5**	**13.1**		
83.574	**365.7**	**641.3**	**355.6**	**159.9**	**35.7**	**11.3**	**8.1**		
80.865	**465.5**	**308**	**293.7**	**172**	**89.2**	**25.9**	**9.7**		
83.918	**543.6**	**248.2**	**102.7**	**114.7**	**89.6**	**66.6**	**14.3**		
100.415	**659**	**312.7**	**104.4**	**43.1**	**53.3**	**34.7**	**38**		
100.797	**285.7**	**343.6**	**101.6**	**51.4**	**18.9**	**34.3**	**33.5**		
116.446	**221.8**	**115**	**126.4**	**41.1**	**21.5**	**12.6**	**19.2**		
108.388	**683.6**	**76.7**	**43.9**	**46.9**	**20.7**	**9.6**	**5.4**		
111.171	**413.3**	**297.9**	**48.6**	**26.1**	**26.7**	**8.8**	**8.8**		
103.555	**747.8**	**274.5**	**135.3**	**40**	**14.4**	**16**	**8**		
118.833	**388.4**	**529.8**	**111.8**	**54.7**	**11**	**5.4**	**6.8**		
143.272	**248.7**	**283.6**	**393.2**	**61**	**35**	**7.4**	**4**		
139.832	**497.3**	**164.6**	**148.5**	**197.6**	**46.8**	**19.2**	**4.5**		
159.894	**495.5**	**260.2**	**95**	**81.9**	**116.1**	**26.8**	**22.9**		
158.681	**690**	**299.6**	**168.3**	**49.9**	**40.1**	**51.6**	**24.9**		
157.812	**464.1**	**355.3**	**136.4**	**71.6**	**24.9**	**23**	**27.3**		
161.44	**599**	**202.1**	**159.3**	**52.5**	**27.5**	**11.2**	**8.3**		
158.005	**416.7**	**246.1**	**100.2**	**67.6**	**27.3**	**13.2**	**4.3**		
158.501	**261.7**	**187.1**	**94.7**	**41.4**	**25.5**	**14.1**	**6.3**		
122.528	**617.7**	**135.5**	**63.3**	**34.8**	**11.4**	**10.4**	**4**		
128.448	**388.1**	**291**	**89.4**	**50.2**	**19.3**	**7.3**	**9**		
150.79	**474.5**	**276.6**	**112.6**	**36.9**	**26.9**	**13.3**	**6.7**		
149.232	**557.2**	**289.9**	**116.2**	**82.9**	**39**	**16.9**	**10.1**		
UK-WECOT (historic)									
1976	**1987**								
1	**1**	**0**	**1**						
2	**9**								
22.771	**13.7**	**80.4**	**20.2**	**14.2**	**7.5**	**7.7**	**4.8**	**1.8**	
21.194	**60.1**	**29.4**	**25.8**	**8.1**	**4.8**	**3**	**4.5**	**1.4**	
16.823	**18.8**	**71.1**	**8**	**10.6**	**3.8**	**2.3**	**2**	**1.6**	
16.981	**42.5**	**57.1**	**44.5**	**5.7**	**6.1**	**2.9**	**1.9**	**1.2**	
13.647	**53.1**	**50.8**	**14.7**	**13.4**	**4**	**4.2**	**1.4**	**1**	
15.172	**76.6**	**216.2**	**44.4**	**11**	**10.3**	**1.8**	**5**	**1.6**	
14.422	**27**	**169.1**	**111.9**	**19.5**	**7.1**	**7.3**	**1.1**	**2.6**	
19.117	**103.7**	**102.2**	**173.4**	**75.3**	**12.4**	**4.8**	**5.5**	**0.3**	
15.8	**100.5**	**155**	**49.7**	**40.6**	**16.3**	**7.7**	**2.2**	**3.2**	
17.545	**60.5**	**129.6**	**102.4**	**12.9**	**21.2**	**13.4**	**2.1**	**0.4**	
20.758	**108.3**	**254.8**	**77.8**	**44.1**	**8.2**	**12.9**	**7.4**	**3.3**	
17.995	**116.3**	**208.7**	**124.7**	**62.2**	**22**	**5.6**	**4.2**	**4.1**	
UK(E+W) FSP									
2003	**2012**								
1	**1**	**0.75**	**0.8**						
2	**8**								
1	**0.295**	**0.320**	**0.159**	**0.061**	**0.047**	**0.090**	**0.038**	0.025	
1	**0.288**	**0.567**	**0.220**	**0.130**	**0.022**	**0.038**	**0.047**	0.019	
1	**0.296**	**0.362**	**0.235**	**0.086**	**0.044**	**0.010**	**0.016**	0.032	
1	**0.492**	**0.375**	**0.175**	**0.097**	**0.036**	**0.027**	**0.006**	0.008	
1	**0.132**	**0.294**	**0.139**	**0.068**	**0.034**	**0.010**	**0.006**	0.005	
-9	-9	-9	-9	-9	-9	-9	-9	-9	
1	**0.362**	**0.373**	**0.153**	**0.049**	**0.028**	**0.019**	**0.006**	0.003	
1	**0.711**	**0.567**	**0.436**	**0.046**	**0.034**	**0.014**	**0.010**	0.003	
1	**0.953**	**1.206**	**0.304**	**0.146**	**0.017**	**0.012**	**0.016**	0.002	
1	**0.331**	**1.084**	**0.576**	**0.154**	**0.141**	**0.01**	**0.019**	0.011	

Table 8.2.9. Plaice in VIIe Diagnostics.

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Lowestoft VPA Version 3.1

   9/05/2013   8:17

 Extended Survivors Analysis

 W.CHANNEL PLAICE 2013 WGCSE

 CPUE data from file c:\vpa\PLE7ETU5.dat

 Catch data for  33 years. 1980 to 2012. Ages  1 to  10.

      Fleet,            First, Last, First, Last, Alpha,  Beta
                    ,    year, year,  age ,  age
 UK-WEC-BTS          ,   1986, 2012,   1,     8,   .750,   .800
 UK WECOT            ,   1988, 2012,   3,     9,   .000,  1.000
 UK WECBT            ,   1989, 2012,   3,     9,   .000,  1.000
 UK WECOT historic   ,   1980, 2012,   2,     9,   .000,  1.000
 FSP-7e   UK(E+W)    ,   2003, 2012,   2,     8,   .750,   .800


 Time series weights :

      Tapered time weighting not applied


 Catchability analysis :

      Catchability independent of stock size for all ages

      Catchability independent of age for ages >=    7


 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final   5 years or the   4 oldest ages.

      S.E. of the mean to which the estimates  are shrunk =   2.500

      Minimum standard error for population
      estimates derived from each fleet =    .500

      Prior weighting not applied


 Tuning converged after   27 iterations



 Regression weights
       , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000
```

Fishing mortalities

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	.006	.005	.005	.007	.000	.001	.001	.002	.001	.000
2	.219	.209	.228	.339	.199	.230	.195	.144	.136	.043
3	.615	.602	.600	.698	.670	.605	.496	.412	.377	.316
4	.593	.647	.665	.667	.840	.731	.438	.526	.540	.473
5	.600	.718	.656	.657	.832	.730	.380	.562	.352	.428
6	.594	.614	.686	.594	.751	.793	.453	.494	.393	.374
7	.593	.505	.660	.610	.750	.763	.473	.434	.399	.712
8	.417	.495	.689	.897	.647	.867	.389	.428	.524	.577
9	.814	.640	.505	.678	.766	.703	.448	.667	.594	.536

XSA population numbers (Thousands)

	AGE								
YEAR	1	2	3	4	5	6	7	8	9
2003	3.84E+03	5.42E+03	2.79E+03	1.48E+03	4.86E+02	4.08E+02	5.31E+02	1.69E+02	7.90E+01
2004	4.91E+03	3.38E+03	3.86E+03	1.34E+03	7.24E+02	2.37E+02	2.00E+02	2.60E+02	9.90E+01
2005	4.56E+03	4.33E+03	2.44E+03	1.88E+03	6.21E+02	3.13E+02	1.14E+02	1.07E+02	1.41E+02
2006	2.85E+03	4.02E+03	3.06E+03	1.19E+03	8.55E+02	2.86E+02	1.40E+02	5.21E+01	4.76E+01
2007	5.91E+03	2.51E+03	2.54E+03	1.35E+03	5.40E+02	3.93E+02	1.40E+02	6.74E+01	1.88E+01
2008	5.03E+03	5.24E+03	1.83E+03	1.15E+03	5.17E+02	2.08E+02	1.65E+02	5.87E+01	3.13E+01
2009	7.61E+03	4.45E+03	3.69E+03	8.84E+02	4.92E+02	2.21E+02	8.36E+01	6.81E+01	2.19E+01
2010	1.18E+04	6.74E+03	3.25E+03	1.99E+03	5.06E+02	2.98E+02	1.25E+02	4.62E+01	4.09E+01
2011	8.69E+03	1.05E+04	5.17E+03	1.91E+03	1.05E+03	2.56E+02	1.61E+02	7.16E+01	2.67E+01
2012	1.17E+03	7.70E+03	8.10E+03	3.15E+03	9.87E+02	6.52E+02	1.53E+02	9.60E+01	3.76E+01

Table 8.2.9. Plaice in VIIe Diagnostics (continued).

Estimated population abundance at 1st Jan 2013

,	0.00E+00,	1.04E+03,	6.54E+03,	5.24E+03,	1.74E+03,	5.71E+02,	3.98E+02,	6.66E+01,	4.78E+01,

Taper weighted geometric mean of the VPA populations:

,	5.88E+03,	5.50E+03,	4.00E+03,	1.94E+03,	8.57E+02,	4.03E+02,	2.07E+02,	1.09E+02,	5.64E+01,

Standard error of the weighted Log(VPA populations) :

,	.5368,	.4587,	.4954,	.5473,	.5350,	.5716,	.6055,	.6452,	.7394,

Log catchability residuals.

Fleet : UK-WEC-BTS

Age ,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992
1 ,	99.99,	99.99,	99.99,	-.34,	1.76,	.77,	-.14,	-.48,	-.71,	.95
2 ,	99.99,	99.99,	99.99,	.08,	-.44,	.82,	-.89,	-.66,	-.98,	-.74
3 ,	99.99,	99.99,	99.99,	.53,	-.01,	.17,	-.07,	-.04,	-.35,	-.28
4 ,	99.99,	99.99,	99.99,	.36,	.22,	.30,	.09,	-.51,	-.16,	-.59
5 ,	99.99,	99.99,	99.99,	.11,	.45,	-.13,	-.44,	-.04,	.05,	-.08
6 ,	99.99,	99.99,	99.99,	-.66,	.78,	.06,	-.19,	-2.01,	.20,	-.33
7 ,	99.99,	99.99,	99.99,	.73,	.99,	-.11,	.24,	-.50,	-.28,	-.61
8 ,	99.99,	99.99,	99.99,	-.98,	.57,	.41,	.01,	-1.78,	99.99,	-.94
9 ,	No data for this fleet at this age									

Age ,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002
1 ,	-.21,	.14,	-.37,	-.65,	-.61,	.53,	.19,	.20,	-.34,	.95
2 ,	-.40,	-.48,	-.06,	-.21,	.04,	-.45,	-.71,	.10,	-.12,	.36
3 ,	-.59,	-.37,	-.23,	-.72,	.27,	-.24,	-.49,	.09,	-.35,	-.05
4 ,	-.53,	-.47,	-.15,	-.39,	-.11,	.28,	-.32,	.22,	.68,	-.31
5 ,	-.27,	-.65,	-.41,	.15,	-.50,	-.27,	.11,	.29,	.45,	.01
6 ,	.34,	-1.36,	-.59,	-.38,	.34,	.38,	-.44,	.72,	.64,	.51
7 ,	-.44,	-.57,	-.08,	-1.68,	.42,	.02,	-.39,	-1.19,	.41,	-.75
8 ,	-.41,	-.02,	-.29,	.23,	-.99,	.50,	.47,	.24,	99.99,	-.90
9 ,	No data for this fleet at this age									

Age ,	2003,	2004,	2005,	2006,	2007,	2008,	2009,	2010,	2011,	2012
1 ,	-.15,	-1.26,	-.31,	.78,	-.33,	-1.04,	-1.37,	.58,	1.03,	.45
2 ,	.35,	-.50,	-.04,	.44,	.70,	.50,	.72,	1.03,	1.11,	.42
3 ,	-.34,	-.59,	.17,	.16,	.50,	.24,	.61,	.68,	.66,	.64
4 ,	.10,	-.43,	.23,	-.15,	.00,	.02,	.00,	.57,	.46,	.59
5 ,	-.97,	-.48,	-.24,	.32,	.80,	-.01,	.00,	.80,	.50,	.44
6 ,	.69,	-.44,	-.79,	-.76,	-.25,	.74,	.76,	.75,	.34,	.95
7 ,	.47,	-1.81,	-.16,	-.11,	.43,	.82,	1.07,	1.29,	.33,	1.47
8 ,	.12,	.22,	.44,	99.99,	-.71,	1.02,	.74,	-.50,	.26,	.68
9 ,	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	1,	2,	3,	4,	5,	6,	7,	8
Mean Log q,	-9.8442,	-8.9738,	-8.1330,	-8.1352,	-8.2551,	-8.4597,	-8.1007,	-8.1007,
S.E(Log q),	.7552,	.5951,	.4190,	.3698,	.4295,	.7342,	.8217,	.6989,

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
1,	.90,	.412,	9.73,	.41,	27,	.69,	-9.84,
2,	.86,	.645,	8.92,	.47,	27,	.52,	-8.97,
3,	.86,	1.052,	8.15,	.69,	27,	.36,	-8.13,
4,	.85,	1.358,	8.05,	.76,	27,	.31,	-8.14,
5,	.84,	1.242,	8.02,	.71,	27,	.36,	-8.26,
6,	.92,	.357,	8.25,	.42,	27,	.68,	-8.46,
7,	1.30,	-.839,	8.91,	.24,	27,	1.07,	-8.10,
8,	1.52,	-1.538,	9.91,	.29,	24,	1.03,	-8.17,

Table 8.2.9. Plaice in VIIe Diagnostics (continued).

Fleet : UK WECOT

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	99.99	99.99	99.99	99.99	99.99	.61	.41	.35	.18	.03
4	99.99	99.99	99.99	99.99	99.99	.11	.54	.47	.45	.32
5	99.99	99.99	99.99	99.99	99.99	.43	.63	.10	.34	.32
6	99.99	99.99	99.99	99.99	99.99	.13	.60	.22	.17	.32
7	99.99	99.99	99.99	99.99	99.99	.14	.00	.63	.16	.06
8	99.99	99.99	99.99	99.99	99.99	.46	.14	.51	.07	.25
9	99.99	99.99	99.99	99.99	99.99	-.10	-.25	.09	.28	-.12

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-.04	-.08	.23	.13	.61	.11	-.46	-.28	-.35	.13
4	.04	.05	.19	.05	-.23	.45	-.15	-.31	-.22	-.06
5	.03	-.18	-.03	.18	-.10	.05	.10	-.19	-.14	.03
6	.03	-.31	.24	.01	-.17	.12	.20	.09	-.50	.20
7	.18	-.26	-.44	.14	-.09	-.27	.23	.17	-.13	.01
8	.14	-.66	-.09	.18	-.49	-.63	-.18	-.02	-.20	-.07
9	.03	-.30	-.13	-.12	-.21	.24	-.17	.22	.07	.58

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-.21	-.14	-.23	-.11	.12	-.10	-.11	-.10	-.24	-.45
4	-.36	-.11	-.29	-.40	.12	-.07	-.36	.11	-.05	-.27
5	-.16	.20	-.09	-.28	-.01	.13	-.49	.16	-.75	-.28
6	-.17	.14	.01	-.25	-.17	.21	-.12	-.09	-.71	-.20
7	-.09	-.29	-.03	-.03	-.03	.12	.05	-.11	-.55	.42
8	-.30	-.15	.05	.17	-.55	.50	-.12	-.13	-.49	.23
9	-.05	.23	-.31	-.13	-.32	.36	-.56	-.19	-.86	-.55

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	-7.0998	-7.0666	-7.2842	-7.4770	-7.6165	-7.6165	-7.6165
S.E(Log q)	.2903	.2821	.2904	.2776	.2532	.3403	.3312

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	.88	1.240	7.24	.82	25	.25	-7.10
4	.80	2.621	7.16	.89	25	.20	-7.07
5	.87	1.489	7.21	.84	25	.25	-7.28
6	.88	1.468	7.30	.86	25	.24	-7.48
7	.97	.413	7.54	.86	25	.25	-7.62
8	.95	.493	7.53	.81	25	.32	-7.67
9	.95	.559	7.53	.85	25	.31	-7.71

Table 8.2.9. Plaice in VIIe Diagnostics (continued).

```
Fleet : UK WECBT

 Age  ,  1983,  1984,  1985,  1986,  1987,  1988,  1989,  1990,  1991,  1992
    1 , No data for this fleet at this age
    2 , No data for this fleet at this age
    3 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.25,   .23,   .29,   .60
    4 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.11,   .23,   .57,   .78
    5 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.01,  -.15,   .38,   .66
    6 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .08,  -.11,   .00,   .40
    7 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.01,   .30,  -.08,   .03
    8 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.03,  -.02,  -.47,   .18
    9 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .03,  -.27,  -.24,  -.07


 Age  ,  1993,  1994,  1995,  1996,  1997,  1998,  1999,  2000,  2001,  2002
    1 , No data for this fleet at this age
    2 , No data for this fleet at this age
    3 ,   .58,   .42,   .39,  -.08,   .17,  -.34,  -.25,  -.17,  -.37,   .11
    4 ,   .57,   .50,   .37,  -.06,  -.48,  -.02,  -.14,  -.29,  -.18,  -.16
    5 ,   .47,   .29,   .22,   .07,  -.15,  -.18,   .08,  -.36,  -.06,  -.04
    6 ,   .38,   .13,   .27,  -.13,  -.08,   .06,   .41,  -.26,  -.50,   .02
    7 ,   .37,   .03,  -.06,  -.08,   .03,  -.03,   .23,  -.31,  -.28,  -.19
    8 ,   .28,  -.20,   .15,   .12,  -.15,  -.11,   .11,  -.25,  -.27,  -.30
    9 ,   .14,   .14,   .29,   .06,   .24,   .53,   .53,  -.25,  -.10,  -.07


 Age  ,  2003,  2004,  2005,  2006,  2007,  2008,  2009,  2010,  2011,  2012
    1 , No data for this fleet at this age
    2 , No data for this fleet at this age
    3 ,   .06,   .06,   .13,   .18,   .01,  -.15,   .21,  -.21,  -.65,  -.96
    4 ,  -.14,   .14,  -.02,  -.15,   .02,  -.15,  -.08,  -.14,  -.30,  -.77
    5 ,  -.03,   .20,   .12,  -.06,   .03,  -.03,  -.28,   .07,  -.68,  -.54
    6 ,   .01,   .07,   .19,  -.09,  -.07,   .09,  -.03,   .01,  -.35,  -.48
    7 ,   .10,  -.02,   .15,  -.01,   .07,  -.16,  -.16,  -.09,  -.20,   .38
    8 ,  -.30,  -.03,   .14,   .21,   .03,   .32,  -.08,  -.08,  -.03,  -.05
    9 ,   .48,   .27,  -.04,  -.10,   .23,   .08,   .12,   .36,   .30,   .35



Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time


   Age ,          3,          4,          5,          6,          7,          8,          9
Mean Log q,  -6.5129,   -6.3395,   -6.3392,   -6.3523,   -6.3610,   -6.3610,   -6.3610,
S.E(Log q),    .3697,     .3544,     .2990,     .2416,     .1853,     .2042,     .2712,



Regression statistics :


Ages with q independent of year class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 3,    1.39,   -1.802,      5.85,     .49,     24,     .49,   -6.51,
 4,    1.00,     .008,      6.34,     .71,     24,     .36,   -6.34,
 5,     .97,     .237,      6.35,     .79,     24,     .30,   -6.34,
 6,    1.01,    -.142,      6.36,     .85,     24,     .25,   -6.35,
 7,     .93,    1.175,      6.29,     .93,     24,     .17,   -6.36,
 8,     .98,     .378,      6.36,     .92,     24,     .20,   -6.40,
 9,    1.07,    -.979,      6.39,     .89,     24,     .26,   -6.24,
```

Table 8.2.9. Plaice in VIIe Diagnostics (continued).

Fleet : UK WECOT historic

Age	1980	1981	1982
1	No data for this fleet at this age		
2	-.16	.08	-.06
3	-.25	.26	.02
4	-.37	-.02	.22
5	-.35	-.03	.05
6	.38	-.12	.29
7	-.41	.14	-.02
8	-.39	.16	.54
9	.00	.23	.11

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	No data for this fleet at this age									
2	.25	.54	-.30	.09	-.44	99.99	99.99	99.99	99.99	99.99
3	.08	-.06	-.18	.12	.03	99.99	99.99	99.99	99.99	99.99
4	.35	.11	-.05	-.40	.17	99.99	99.99	99.99	99.99	99.99
5	.50	.08	-.50	-.18	.42	99.99	99.99	99.99	99.99	99.99
6	.00	-.08	.11	-.53	-.05	99.99	99.99	99.99	99.99	99.99
7	.18	.22	.12	.03	-.26	99.99	99.99	99.99	99.99	99.99
8	-.05	.34	-.57	-.02	-.35	99.99	99.99	99.99	99.99	99.99
9	-.24	.17	-.41	.30	.19	99.99	99.99	99.99	99.99	99.99

Age	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
8	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
9	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-7.2665	-5.9579	-5.8018	-5.9613	-6.0613	-5.9718	-5.9718	-5.9718
S.E(Log q)	.3116	.1647	.2706	.3451	.2789	.2253	.3837	.2532

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	1.43	-1.132	6.58	.54	8	.44	-7.27
3	.83	1.325	6.37	.91	8	.13	-5.96
4	.79	1.603	6.19	.91	8	.19	-5.80
5	.73	1.535	6.18	.84	8	.23	-5.96
6	1.32	-1.432	6.10	.77	8	.34	-6.06
7	1.11	-.718	6.05	.87	8	.26	-5.97
8	1.47	-1.553	6.68	.65	8	.51	-6.01
9	.81	2.993	5.52	.98	8	.14	-5.93

Table 8.2.9. Plaice in VIIe Diagnostics (continued).

```
Fleet : FSP-7e   UK(E+W)

 Age  ,  2003,  2004,  2005,  2006,  2007,  2008,  2009,  2010,  2011,  2012
    1 , No data for this fleet at this age
    2 ,  -.29,   .15,  -.05,   .62,  -.34, 99.99,   .09,   .32,   .16,  -.66
    3 ,  -.13,   .11,   .12,   .00,  -.08, 99.99,  -.35,   .13,   .40,  -.21
    4 ,  -.33,   .13,  -.12,   .04,  -.19, 99.99,   .02,   .32,   .02,   .11
    5 ,   .00,   .45,   .15,  -.05,   .19, 99.99,  -.40,  -.35,  -.08,   .09
    6 ,   .04,  -.16,   .31,   .13,  -.13, 99.99,   .03,  -.05,  -.67,   .50
    7 ,   .37,   .42,  -.23,   .51,  -.37, 99.99,   .57,  -.16,  -.60,  -.49
    8 ,   .51,   .36,   .32,   .22,  -.23, 99.99,  -.44,   .49,   .59,   .51
    9 , No data for this fleet at this age



Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time


   Age ,         2,          3,          4,          5,          6,          7,          8
Mean Log q,   -9.2680,   -8.3752,   -8.2518,   -8.4294,   -8.5551,   -8.4998,   -8.4998,
S.E(Log q),     .3828,     .2198,     .1925,     .2642,     .3259,     .4644,     .4526,



Regression statistics :


Ages with q independent of year class strength and constant w.r.t. time.

Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 2,    1.04,    -.112,      9.30,     .55,      9,     .42,   -9.27,
 3,    1.02,    -.100,      8.38,     .74,      9,     .24,   -8.38,
 4,     .89,     .652,      8.15,     .83,      9,     .18,   -8.25,
 5,     .80,     .806,      8.04,     .70,      9,     .22,   -8.43,
 6,     .64,    1.884,      7.55,     .80,      9,     .18,   -8.56,
 7,     .88,     .398,      8.09,     .62,      9,     .43,   -8.50,
 8,     .86,     .720,      7.70,     .78,      9,     .32,   -8.24,
```

Table 8.2.9. Plaice in VIIe Diagnostics (continued).

Terminal year survivor and F summaries :

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2011

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
UK-WEC-BTS ,	1634.,	.769,	.000,	.00,	1,	.914,	.000
UK WECOT ,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK WECBT ,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK WECOT historic ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FSP-7e UK(E+W) ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	9.,	2.50,,,,				.086,	.001

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1042.,	.74,	1.53,	2,	2.080,	.000

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2010

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
UK-WEC-BTS ,	12588.,	.476,	.299,	.63,	2,	.514,	.023
UK WECOT ,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK WECBT ,	1.,	.000,	.000,	.00,	0,	.000,	.000
UK WECOT historic ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FSP-7e UK(E+W) ,	3380.,	.500,	.000,	.00,	1,	.466,	.082
F shrinkage mean ,	1452.,	2.50,,,,				.019,	.181

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
6538.,	.34,	.41,	4,	1.213,	.043

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2009

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
UK-WEC-BTS ,	11307.,	.346,	.158,	.46,	3,	.333,	.159
UK WECOT ,	3330.,	.500,	.000,	.00,	1,	.170,	.460
UK WECBT ,	2007.,	.500,	.000,	.00,	1,	.170,	.677
UK WECOT historic ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FSP-7e UK(E+W) ,	5063.,	.354,	.184,	.52,	2,	.318,	.325
F shrinkage mean ,	2890.,	2.50,,,,				.009,	.514

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
5239.,	.20,	.24,	8,	1.210,	.316

Table 8.2.9. Plaice in VIIe Diagnostics (continued).

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2008

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK-WEC-BTS	,	2792.,	.291,	.381,	1.31,	4,	.291,	.320
UK WECOT	,	1346.,	.360,	.011,	.03,	2,	.209,	.578
UK WECBT	,	845.,	.360,	.056,	.16,	2,	.209,	.809
UK WECOT historic	,	1.,	.000,	.000,	.00,	0,	.000,	.000
FSP-7e UK(E+W)	,	2228.,	.296,	.092,	.31,	3,	.283,	.387
F shrinkage mean	,	1230.,	2.50,,,,				.008,	.618

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1739.,	.16,	.18,	12,	1.089,	.473

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2007

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK-WEC-BTS	,	875.,	.273,	.189,	.69,	5,	.270,	.299
UK WECOT	,	478.,	.310,	.076,	.24,	3,	.229,	.493
UK WECBT	,	380.,	.310,	.101,	.33,	3,	.229,	.589
UK WECOT historic	,	1.,	.000,	.000,	.00,	0,	.000,	.000
FSP-7e UK(E+W)	,	617.,	.276,	.023,	.08,	4,	.266,	.401
F shrinkage mean	,	393.,	2.50,,,,				.007,	.574

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
571.,	.15,	.10,	16,	.672,	.428

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 2006

Fleet,		Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
UK-WEC-BTS	,	722.,	.271,	.117,	.43,	6,	.222,	.223
UK WECOT	,	295.,	.277,	.181,	.65,	4,	.257,	.478
UK WECBT	,	266.,	.277,	.161,	.58,	4,	.257,	.519
UK WECOT historic	,	1.,	.000,	.000,	.00,	0,	.000,	.000
FSP-7e UK(E+W)	,	489.,	.277,	.179,	.64,	4,	.257,	.315
F shrinkage mean	,	230.,	2.50,,,,				.006,	.580

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
398.,	.14,	.12,	19,	.837,	.374

Table 8.2.9. Plaice in VIIe Diagnostics (continued).

```
Age  7   Catchability constant w.r.t. time and dependent on age

Year class = 2005

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
    ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
UK-WEC-BTS          ,       132.,   .289,       .208,    .72,   7,  .173,     .422
UK WECOT            ,        64.,   .266,       .239,    .90,   5,  .273,     .733
UK WECBT            ,        70.,   .266,       .152,    .57,   5,  .273,     .687
UK WECOT historic   ,         1.,   .000,       .000,    .00,   0,  .000,     .000
FSP-7e   UK(E+W)    ,        42.,   .268,       .099,    .37,   5,  .271,     .971

  F shrinkage mean  ,        91.,   2.50,,,,                        .009,     .567

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
       67.,       .14,      .11,   23,    .826,   .712


Age  8   Catchability constant w.r.t. time and age (fixed at the value for age)  7

Year class = 2004

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
    ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
UK-WEC-BTS          ,        72.,   .314,       .116,    .37,   8,  .159,     .417
UK WECOT            ,        42.,   .256,       .150,    .59,   6,  .281,     .632
UK WECBT            ,        43.,   .256,       .043,    .17,   6,  .281,     .627
UK WECOT historic   ,         1.,   .000,       .000,    .00,   0,  .000,     .000
FSP-7e   UK(E+W)    ,        48.,   .263,       .215,    .82,   6,  .271,     .577

  F shrinkage mean  ,        48.,   2.50,,,,                        .008,     .574

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
       48.,       .14,      .07,   27,    .554,   .577


Age  9   Catchability constant w.r.t. time and age (fixed at the value for age)  7

Year class = 2003

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
    ,                  Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
UK-WEC-BTS          ,        30.,   .345,       .186,    .54,   8,  .108,     .379
UK WECOT            ,        13.,   .260,       .093,    .36,   7,  .347,     .708
UK WECBT            ,        22.,   .260,       .081,    .31,   7,  .347,     .488
UK WECOT historic   ,         1.,   .000,       .000,    .00,   0,  .000,     .000
FSP-7e   UK(E+W)    ,        24.,   .285,       .156,    .55,   6,  .189,     .452

  F shrinkage mean  ,        20.,   2.50,,,,                        .010,     .525

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
       20.,       .15,      .08,   29,    .524,   .536
```

Table 8.2.10 Plaice in VIIe. Fishing mortality-at-age.

Run title : W.CHANNEL PLAICE 2013 WGCSE

At 9/05/2013 11:51

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1980	1981	1982
AGE			
1	0.0024	0.0121	0.0098
2	0.1242	0.1087	0.1093
3	0.4331	0.5369	0.4807
4	0.492	0.6001	0.6969
5	0.4286	0.4158	0.5312
6	0.731	0.3155	0.5657
7	0.3474	0.5135	0.4095
8	0.3924	0.4299	0.9902
9	0.4661	0.5781	0.4399
+gp	0.4661	0.5781	0.4399
FBAR 3- 6	0.5212	0.4671	0.5686

Table 8 Fishing mortality (F) at age

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE										
1	0.0005	0.0097	0.0004	0.0006	0.0055	0.0012	0.0024	0.0127	0.008	0.0154
2	0.1305	0.1835	0.1091	0.1506	0.0881	0.1774	0.0413	0.1114	0.1916	0.2068
3	0.4692	0.4637	0.4713	0.603	0.5304	0.5578	0.4084	0.6167	0.6153	0.6795
4	0.8113	0.7562	0.6912	0.5227	0.7309	0.5065	0.6736	0.7542	0.795	0.7742
5	0.643	0.5796	0.3356	0.4969	0.7504	0.5111	0.7775	0.579	0.5939	0.6172
6	0.3744	0.4115	0.5529	0.4048	0.425	0.3539	0.5892	0.5581	0.4812	0.5539
7	0.5067	0.6089	0.5345	0.5485	0.5739	0.3531	0.4683	0.5892	0.3978	0.4293
8	0.4199	0.775	0.3438	0.4776	0.4018	0.4927	0.5119	0.5825	0.3641	0.4718
9	0.2955	0.4925	1.181	0.6225	0.6151	0.3131	0.8388	0.5829	0.47	0.4401
+gp	0.2955	0.4925	1.181	0.6225	0.6151	0.3131	0.8388	0.5829	0.47	0.4401
FBAR 3- 6	0.5745	0.5528	0.5127	0.5069	0.6092	0.4823	0.6121	0.627	0.6213	0.6562

Table 8 Fishing mortality (F) at age

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE										
1	0.0134	0.0299	0.0008	0.0022	0.0007	0.0014	0.0059	0.0109	0.0012	0.0321
2	0.1788	0.1894	0.1877	0.1905	0.1765	0.0719	0.1663	0.1491	0.1688	0.3869
3	0.6134	0.5917	0.6359	0.5586	0.6893	0.4967	0.3975	0.5118	0.5617	0.5867
4	0.6905	0.8276	0.746	0.68	0.7543	0.7559	0.7148	0.6144	0.5982	0.7685
5	0.6183	0.5823	0.5893	0.6857	0.6998	0.536	0.6079	0.6514	0.5789	0.687
6	0.5117	0.5131	0.5408	0.5556	0.5789	0.5242	0.6373	0.5316	0.3613	0.6456
7	0.5184	0.4013	0.5071	0.5225	0.7523	0.4312	0.5985	0.5238	0.4222	0.4978
8	0.4943	0.3414	0.4954	0.7462	0.5828	0.4545	0.5058	0.4226	0.4837	0.4614
9	0.4668	0.4532	0.4835	0.5343	0.8136	0.7901	0.6543	0.509	0.6511	0.6303
+gp	0.4668	0.4532	0.4835	0.5343	0.8136	0.7901	0.6543	0.509	0.6511	0.6303
FBAR 3- 6	0.6085	0.6287	0.628	0.62	0.6806	0.5782	0.5894	0.5773	0.525	0.6719

Table 8 Fishing mortality (F) at age

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	FBAR 10-12
AGE											
1	0.0064	0.0046	0.0052	0.0069	0.0004	0.0011	0.0007	0.0017	0.0013	0	0.001
2	0.219	0.2087	0.2277	0.3391	0.1994	0.2302	0.1947	0.1444	0.1364	0.0432	0.108
3	0.6153	0.6017	0.5995	0.6979	0.6702	0.6054	0.4957	0.4123	0.3772	0.3156	0.3683
4	0.593	0.647	0.6652	0.6666	0.84	0.7315	0.4381	0.5257	0.5397	0.473	0.5128
5	0.6005	0.7178	0.656	0.6571	0.8324	0.7303	0.3803	0.5616	0.3517	0.4281	0.4472
6	0.5937	0.6135	0.6855	0.5936	0.7508	0.7928	0.4535	0.4938	0.3935	0.3743	0.4205
7	0.5927	0.505	0.6599	0.6105	0.7499	0.7634	0.4731	0.4341	0.3993	0.7125	0.5153
8	0.4173	0.4953	0.6894	0.8966	0.6475	0.867	0.3891	0.4278	0.5237	0.5768	0.5095
9	0.8141	0.6403	0.5053	0.6785	0.766	0.7027	0.4481	0.6674	0.5938	0.5364	0.5992
+gp	0.8141	0.6403	0.5053	0.6785	0.766	0.7027	0.4481	0.6674	0.5938	0.5364	
FBAR 3- 6	0.6006	0.645	0.6516	0.6538	0.7733	0.715	0.4419	0.4983	0.4155	0.3978	

Table 8.2.11 Plaice in VIIe. Stock numbers-at-age.

Run title : W.CHANNEL PLAICE 2013 WGCSE

At 9/05/2013 11:51

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1980	1981	1982
AGE			
1	8422	3633	7803
2	7399	7451	3183
3	2418	5796	5928
4	689	1391	3005
5	699	374	677
6	128	404	219
7	228	55	261
8	76	143	29
9	38	45	82
+gp	391	229	361
TOTAL	20488	19520	21549

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE										
1	6932	8500	8783	17866	14310	10427	4449	4802	5432	6266
2	6853	6145	7466	7787	15836	12622	9236	3937	4205	4779
3	2531	5334	4536	5937	5941	12861	9375	7861	3123	3079
4	3251	1404	2976	2511	2881	3100	6530	5527	3763	1497
5	1327	1281	585	1322	1321	1230	1657	2953	2306	1507
6	353	619	636	371	713	553	655	675	1468	1129
7	110	215	364	325	219	414	344	322	343	805
8	154	59	104	189	166	110	258	191	158	204
9	10	90	24	65	104	99	59	137	95	98
+gp	412	137	78	140	119	209	187	173	145	148
TOTAL	21933	23784	25552	36514	41611	41624	32751	26578	21037	19512

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AGE										
1	2873	3033	8017	7140	10976	5305	3471	4554	5230	6308
2	5472	2514	2611	7105	6318	9729	4698	3060	3995	4633
3	3447	4059	1845	1919	5209	4697	8029	3528	2338	2993
4	1384	1655	1992	866	974	2319	2535	4786	1876	1183
5	612	615	642	838	389	406	966	1100	2296	915
6	721	293	305	316	374	172	211	466	509	1141
7	576	383	155	157	161	186	90	99	243	314
8	465	304	228	83	83	67	107	44	52	141
9	113	251	192	123	35	41	38	57	26	28
+gp	242	188	247	274	191	121	100	138	82	94
TOTAL	15905	13296	16233	18821	24710	23041	20246	17832	16647	17752

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	GMST 80-10	AMST 80-10
AGE													
1	3839	4909	4556	2852	5911	5028	7605	11820	8690	1175	0	6114	6808
2	5418	3383	4334	4020	2512	5240	4455	6740	10466	7697	1042	5326	5908
3	2791	3861	2435	3061	2540	1825	3692	3252	5174	8099	6538	3877	4395
4	1476	1338	1876	1186	1351	1153	884	1995	1910	3147	5239	1910	2237
5	486	724	621	855	540	517	492	506	1046	987	1739	848	992
6	408	237	313	286	393	208	221	298	256	652	571	403	477
7	531	200	114	140	140	165	84	125	161	153	398	211	254
8	169	260	107	52	67	59	68	46	72	96	67	111	137
9	79	99	141	48	19	31	22	41	27	38	48	59	75
+gp	74	85	116	96	96	59	47	54	46	54	47		
TOTAL	15272	15095	14613	12597	13570	14286	17569	24876	27848	22099	15689		

Table 8.2.12 Plaice in VIIe. Summary

Run title : W.CHANNEL PLAICE 2013 WGCSE

At 9/05/2013 11:51

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 3- 6
1980	8422	5042	2404	1215	0.5056	0.5212
1981	3633	6245	3276	1746	0.5331	0.4671
1982	7803	5888	3460	1938	0.5602	0.5686
1983	6932	6217	3651	1754	0.4805	0.5745
1984	8500	6369	3473	1813	0.5219	0.5528
1985	8783	6663	3549	1751	0.4932	0.5127
1986	17866	7562	3735	2161	0.5786	0.5069
1987	14310	7070	3605	2388	0.6625	0.6092
1988	10427	9789	5137	2994	0.5828	0.4823
1989	4449	8978	5465	2808	0.5139	0.6121
1990	4802	8574	5276	3058	0.5797	0.6270
1991	5432	6629	4290	2250	0.5244	0.6213
1992	6266	6549	3578	1950	0.5450	0.6562
1993	2873	5136	3048	1691	0.5548	0.6085
1994	3033	4437	2705	1471	0.5438	0.6287
1995	8017	4856	2405	1295	0.5382	0.6280
1996	7140	4905	2364	1321	0.5590	0.6200
1997	10976	6413	2497	1654	0.6623	0.6806
1998	5305	5876	2663	1430	0.5370	0.5782
1999	3471	4960	2956	1616	0.5469	0.5894
2000	4554	4796	3288	1678	0.5103	0.5773
2001	5230	4455	2720	1379	0.5070	0.5250
2002	6308	4925	2510	1608	0.6406	0.6719
2003	3839	4251	2506	1478	0.5898	0.6006
2004	4909	4867	2276	1402	0.6161	0.6450
2005	4556	4541	2257	1370	0.6070	0.6516
2006	2852	3847	2063	1466	0.7106	0.6538
2007	5911	3519	1726	1184	0.6860	0.7733
2008	5028	3810	1646	1144	0.6948	0.7150
2009	7605	3128	1773	1065	0.6007	0.4419
2010	11820	5649	2296	1241	0.5405	0.4983
2011	8690	5665	2906	1507	0.5185	0.4155
2012	6114*	5555	3388	1520	0.4487	0.3978
Arith. Mean	6694	5672	3057	1707	0.5665	0.5822
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

* GM80-10 recruitment (replaced 1175)

Table 8.2.13 VIIe plaice : Catch forecast input data

MFDP version 1a
Run: p7e2013
Time and date: 09:59 11/05/2013
Fbar age range: 3-6

2013

Age	*N*	*M*	*Mat*	*PF*	*PM*	*SWt*	*Sel*	*CWt*
1	6114	0.12	0	0	0	0.091	0.001	0.139
2	5423	0.12	0.26	0	0	0.188	0.098	0.237
3	6538	0.12	0.52	0	0	0.287	0.335	0.337
4	5239	0.12	0.86	0	0	0.388	0.467	0.439
5	1739	0.12	1	0	0	0.491	0.407	0.544
6	571	0.12	1	0	0	0.597	0.383	0.651
7	398	0.12	1	0	0	0.705	0.469	0.759
8	67	0.12	1	0	0	0.814	0.463	0.870
9	48	0.12	1	0	0	0.926	0.545	0.983
10	47	0.12	1	0	0	1.082	0.545	1.259

2014

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	6114	0.12	0	0	0	0.091	0.001	0.139
2	.	0.12	0.26	0	0	0.188	0.098	0.237
3	.	0.12	0.52	0	0	0.287	0.335	0.337
4	.	0.12	0.86	0	0	0.388	0.467	0.439
5	.	0.12	1	0	0	0.491	0.407	0.544
6	.	0.12	1	0	0	0.597	0.383	0.651
7	.	0.12	1	0	0	0.705	0.469	0.759
8	.	0.12	1	0	0	0.814	0.463	0.870
9	.	0.12	1	0	0	0.926	0.545	0.983
10	.	*0.12*	*1*	*0*	*0*	*1.082*	*0.545*	*1.259*

2015

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	6114	0.12	0	0	0	0.091	0.001	0.139
2	.	0.12	0.26	0	0	0.188	0.098	0.237
3	.	0.12	0.52	0	0	0.287	0.335	0.337
4	.	0.12	0.86	0	0	0.388	0.467	0.439
5	.	0.12	1	0	0	0.491	0.407	0.544
6	.	0.12	1	0	0	0.597	0.383	0.651
7	.	0.12	1	0	0	0.705	0.469	0.759
8	.	0.12	1	0	0	0.814	0.463	0.870
9	.	0.12	1	0	0	0.926	0.545	0.983
10	.	0.12	1	0	0	1.082	0.545	1.259

Input units are thousands and kg - output in tonnes

Table 8.2.14 VIIe plaice : management option table - status quo forecast

MFDP version 1a
Run: p7e2013
W.CHANNEL PLAICE 2013 WGCSE forecast inputs
Time and date: 09:59 11/05/2013
Fbar age range: 3-6

2013 Biomass	SSB	FMult	FBar	Landings
7114	4615	1.0000	0.3978	2100

2014 Biomass	SSB	FMult	FBar	Landings	2015 Biomass	SSB
6995	4855	0.0000	0.0000	0	8964	6778
.	4855	0.1000	0.0398	243	8709	6536
.	4855	0.2000	0.0796	478	8464	6305
.	4855	0.3000	0.1193	703	8229	6082
.	4855	0.4000	0.1591	919	8002	5868
.	4855	0.5000	0.1989	1127	7785	5663
.	4855	0.6000	0.2387	1327	7576	5467
.	4855	0.7000	0.2784	1520	7375	5278
.	4855	0.8000	0.3182	1705	7182	5096
.	4855	0.9000	0.3580	1883	6997	4922
.	4855	1.0000	0.3978	2054	6818	4755
.	4855	1.1000	0.4375	2219	6647	4594
.	4855	1.2000	0.4773	2378	6482	4440
.	4855	1.3000	0.5171	2531	6323	4291
.	4855	1.4000	0.5569	2678	6170	4149
.	4855	1.5000	0.5966	2819	6024	4012
.	4855	1.6000	0.6364	2955	5882	3881
.	4855	1.7000	0.6762	3086	5746	3755
.	4855	1.8000	0.7160	3213	5616	3633
.	4855	1.9000	0.7557	3334	5490	3517
.	4855	2.0000	0.7955	3451	5369	3405

Input units are thousands and kg - output in tonnes

Table 8.2.15 **VIIe plaice : forecast detailed results - status quo projection**

MFDP version 1a
Run: p7e2013
Time and date: 09:59 11/05/2013
Fbar age range: 3-6

Year:	2013	F multiplier:	1	Fbar:	0.3978				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0009	5	1	6114	558	0	0	0	0
2	0.0983	479	114	5423	1021	1410	266	1410	266
3	0.3351	1760	593	6538	1876	3400	976	3400	976
4	0.4665	1849	812	5239	2033	4506	1748	4506	1748
5	0.4068	550	299	1739	854	1739	854	1739	854
6	0.3826	172	112	571	341	571	341	571	341
7	0.4688	141	107	398	280	398	280	398	280
8	0.4635	24	20	67	55	67	55	67	55
9	0.5451	19	19	48	44	48	44	48	44
10	0.5451	19	24	47	51	47	51	47	51
Total		5017	2100	26184	7114	12185	4615	12185	4615

Year:	2014	F multiplier:	1	Fbar:	0.3978				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0009	5	1	6114	558	0	0	0	0
2	0.0983	478	113	5418	1020	1409	265	1409	265
3	0.3351	1174	396	4360	1251	2267	651	2267	651
4	0.4665	1464	643	4148	1609	3567	1384	3567	1384
5	0.4068	922	501	2914	1432	2914	1432	2914	1432
6	0.3826	309	201	1027	613	1027	613	1027	613
7	0.4688	122	93	345	243	345	243	345	243
8	0.4635	78	68	221	180	221	180	221	180
9	0.5451	15	15	37	35	37	35	37	35
10	0.5451	19	24	49	53	49	53	49	53
Total		4586	2054	24633	6995	11836	4855	11836	4855

Year:	2015	F multiplier:	1	Fbar:	0.3978				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0009	5	1	6114	558	0	0	0	0
2	0.0983	478	113	5418	1020	1409	265	1409	265
3	0.3351	1173	395	4355	1250	2265	650	2265	650
4	0.4665	976	429	2766	1073	2378	923	2378	923
5	0.4068	730	397	2307	1134	2307	1134	2307	1134
6	0.3826	517	337	1721	1027	1721	1027	1721	1027
7	0.4688	220	167	621	438	621	438	621	438
8	0.4635	67	59	192	156	192	156	192	156
9	0.5451	49	48	123	114	123	114	123	114
10	0.5451	18	22	44	48	44	48	44	48
Total		4233	1968	23661	6818	11060	4755	11060	4755

Input units are thousands and kg - output in tonnes

Table 8.2.16 Plaice in VIIe
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			2009	2010	2011	2012	2013
Stock No. (thousands) of 1 year-olds			11820	8690	6114	6114	6114
Source			XSA	XSA	GM80-10	GM80-10	GM80-10
Status Quo F:							
% in	2013	landings	38.6	28.2	5.4	0.0	-
% in	2014		24.4	31.3	19.3	5.5	0.0
% in	2013	SSB	37.9	21.1	5.8	0.0	-
% in	2014	SSB	29.5	28.5	13.4	5.5	0.0
% in	2015	SSB	21.6	23.8	19.4	13.7	5.6

GM : geometric mean recruitment

Plaice in VIIe : Year-class % contribution to

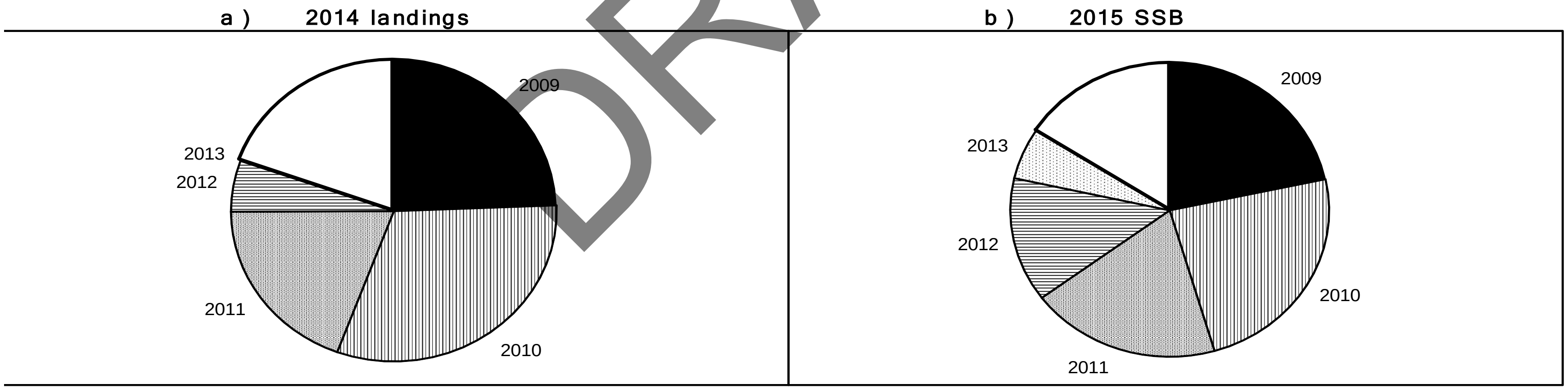


Table 8.2.17 VIIe plaice : Yield per recruit

MFYPR version 2a
Run: P7E2013
Time and date: 11:44 11/05/2013
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	8.8433	5.6860	6.7118	5.3248	6.7118	5.3248
0.1000	0.0398	0.2241	0.1835	6.9792	3.8242	4.8556	3.4657	4.8556	3.4657
0.2000	0.0796	0.3453	0.2555	5.9715	2.8697	3.8555	2.5138	3.8555	2.5138
0.3000	0.1193	0.4225	0.2860	5.3309	2.2960	3.2225	1.9426	3.2225	1.9426
0.4000	0.1591	0.4766	0.2986	4.8831	1.9168	2.7820	1.5659	2.7820	1.5659
0.5000	0.1989	0.5169	0.3026	4.5500	1.6497	2.4560	1.3012	2.4560	1.3012
0.6000	0.2387	0.5482	0.3025	4.2911	1.4527	2.2041	1.1066	2.2041	1.1066
0.7000	0.2784	0.5734	0.3004	4.0833	1.3023	2.0031	0.9583	2.0031	0.9583
0.8000	0.3182	0.5942	0.2974	3.9124	1.1841	1.8388	0.8424	1.8388	0.8424
0.9000	0.3580	0.6117	0.2941	3.7692	1.0892	1.7020	0.7496	1.7020	0.7496
1.0000	0.3978	0.6266	0.2907	3.6471	1.0116	1.5862	0.6741	1.5862	0.6741
1.1000	0.4375	0.6395	0.2873	3.5417	0.9470	1.4869	0.6116	1.4869	0.6116
1.2000	0.4773	0.6508	0.2842	3.4498	0.8927	1.4010	0.5592	1.4010	0.5592
1.3000	0.5171	0.6607	0.2812	3.3688	0.8463	1.3258	0.5147	1.3258	0.5147
1.4000	0.5569	0.6696	0.2784	3.2969	0.8064	1.2596	0.4767	1.2596	0.4767
1.5000	0.5966	0.6776	0.2758	3.2326	0.7717	1.2008	0.4438	1.2008	0.4438
1.6000	0.6364	0.6848	0.2734	3.1746	0.7413	1.1483	0.4152	1.1483	0.4152
1.7000	0.6762	0.6913	0.2712	3.1222	0.7145	1.1012	0.3901	1.1012	0.3901
1.8000	0.7160	0.6972	0.2691	3.0744	0.6906	1.0586	0.3679	1.0586	0.3679
1.9000	0.7557	0.7027	0.2671	3.0307	0.6693	1.0200	0.3482	1.0200	0.3482
2.0000	0.7955	0.7077	0.2653	2.9906	0.6501	0.9848	0.3306	0.9848	0.3306

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.3978
FMax	0.5440	0.2164
F0.1	0.2504	0.0996
F35%SPR	0.318	0.1265

Weights in kilograms

Figure 8.2.1 VIIe plaice: UK(E&W) commercial fleet LPUE and effort; and survey CPUE

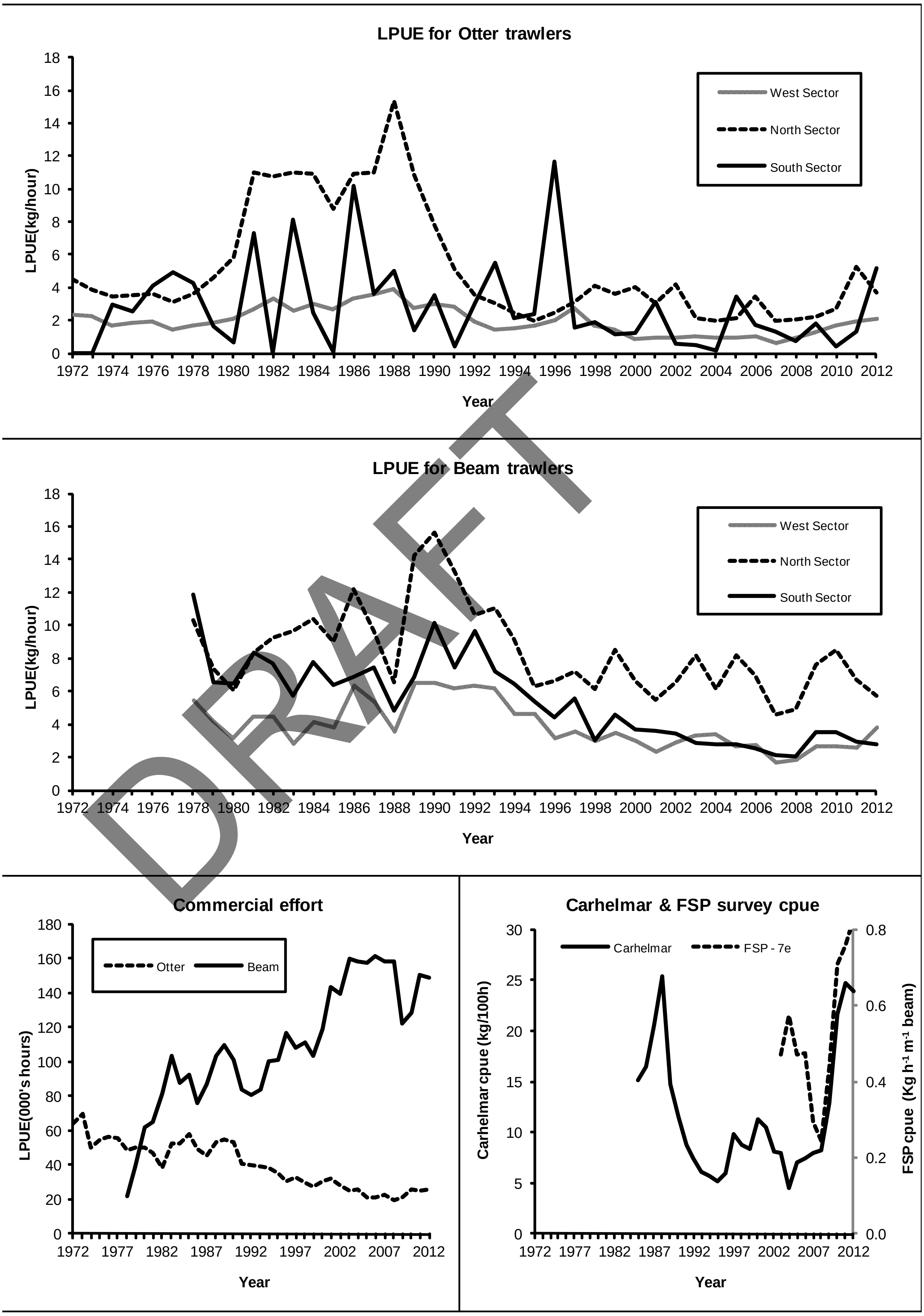


Figure 8.2.2 (cont.) Plaice VIIe Discards - UK by Quarter (2012)

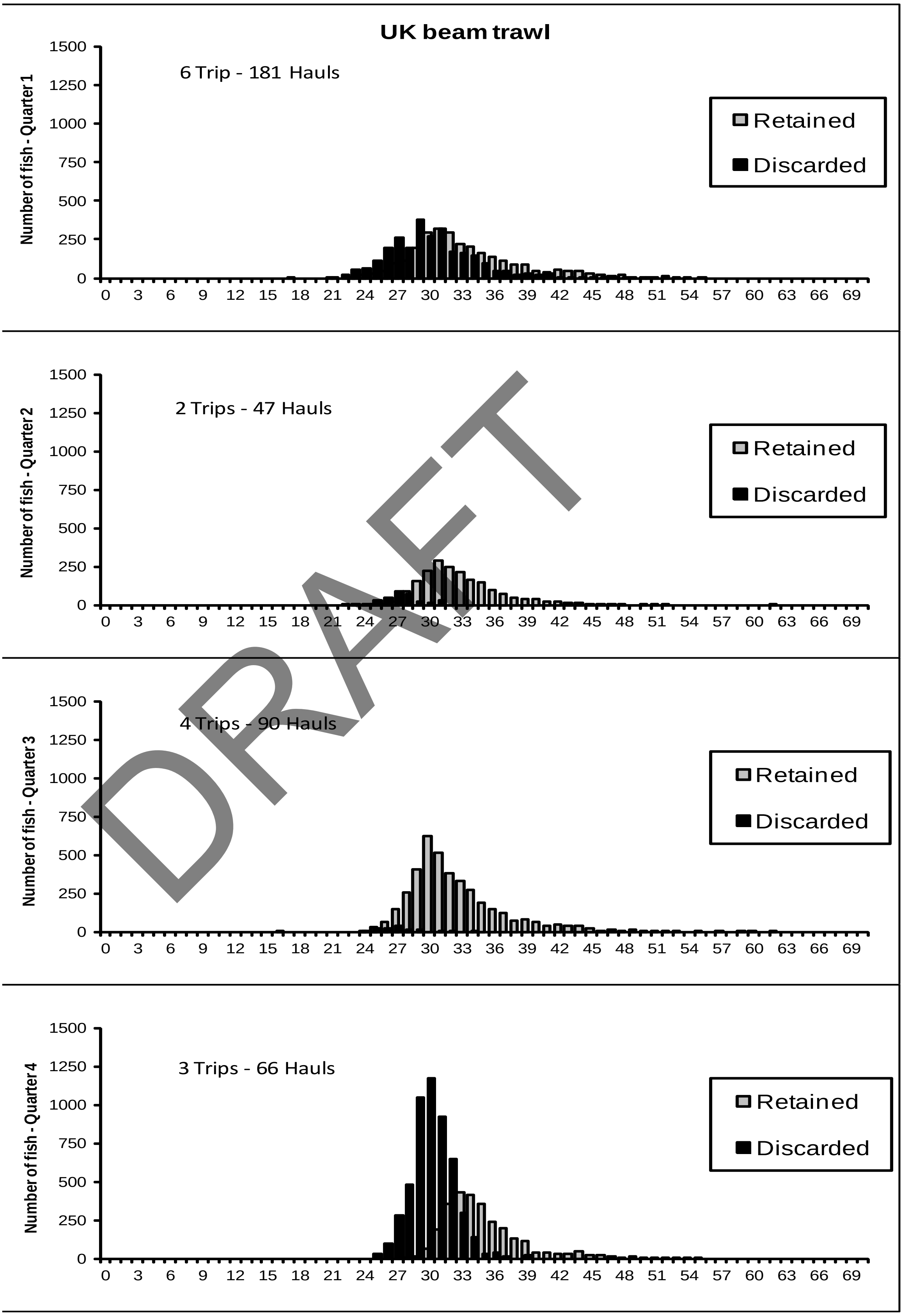


Figure 8.2.2 (cont.) Plaice VIIe Discards - UK by Quarter (2012)

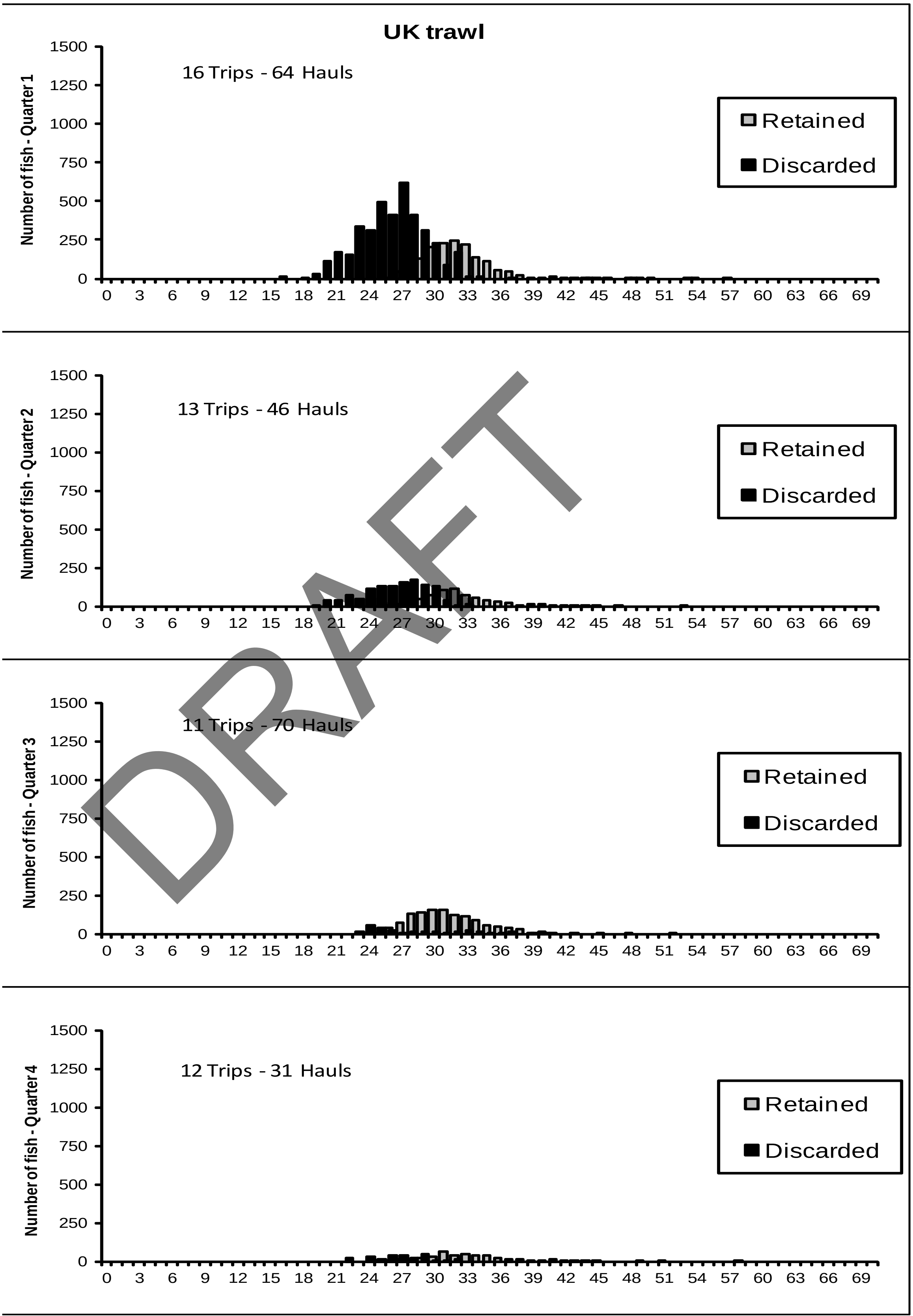


Figure 8.2.2 (cont.) Plaice VIIe Discards - French Trawl by Quarter (2012)

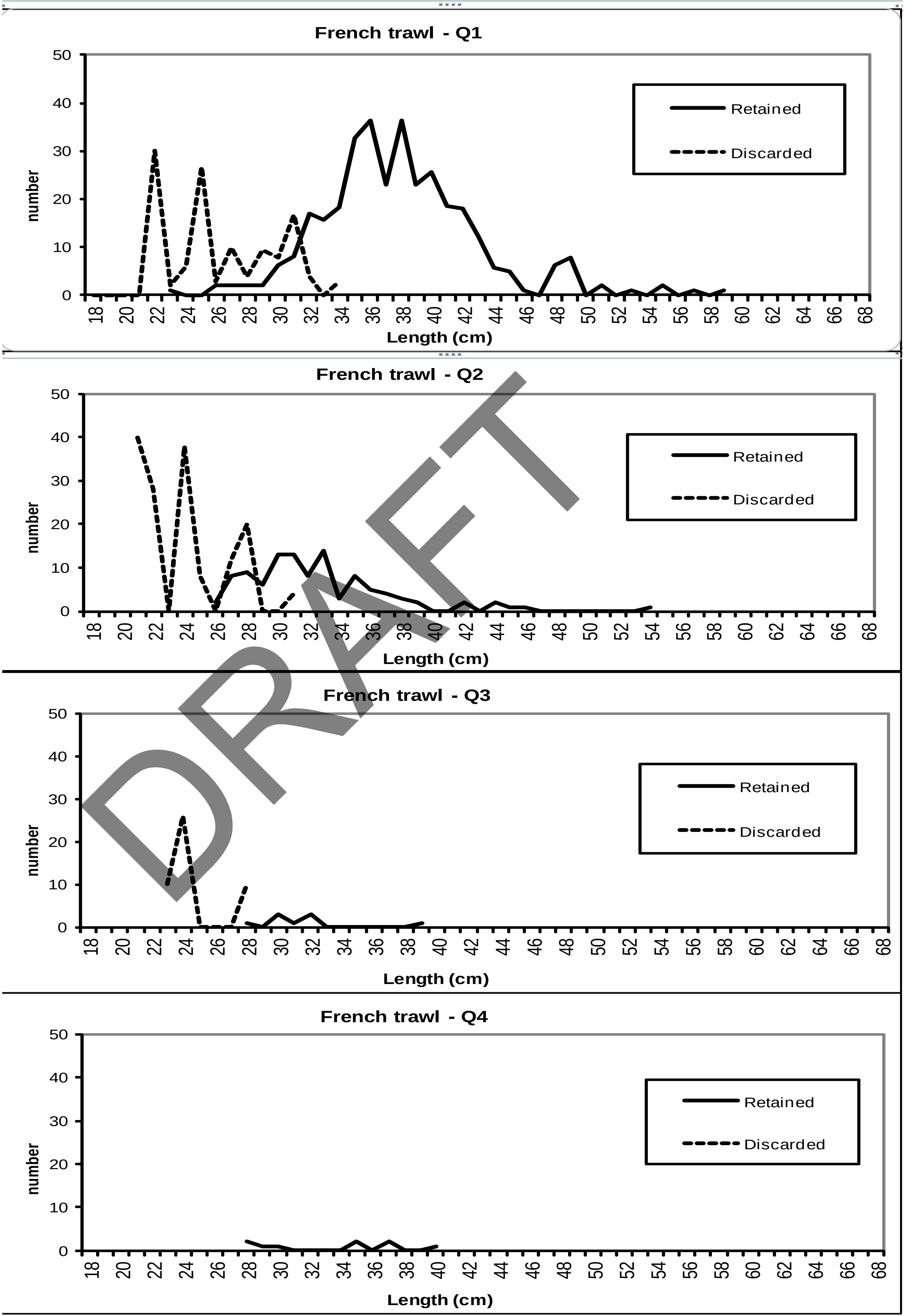


Figure 8.2.2 (cont.) Plaice VIIe Discards - French Nets by Quarter (2012)

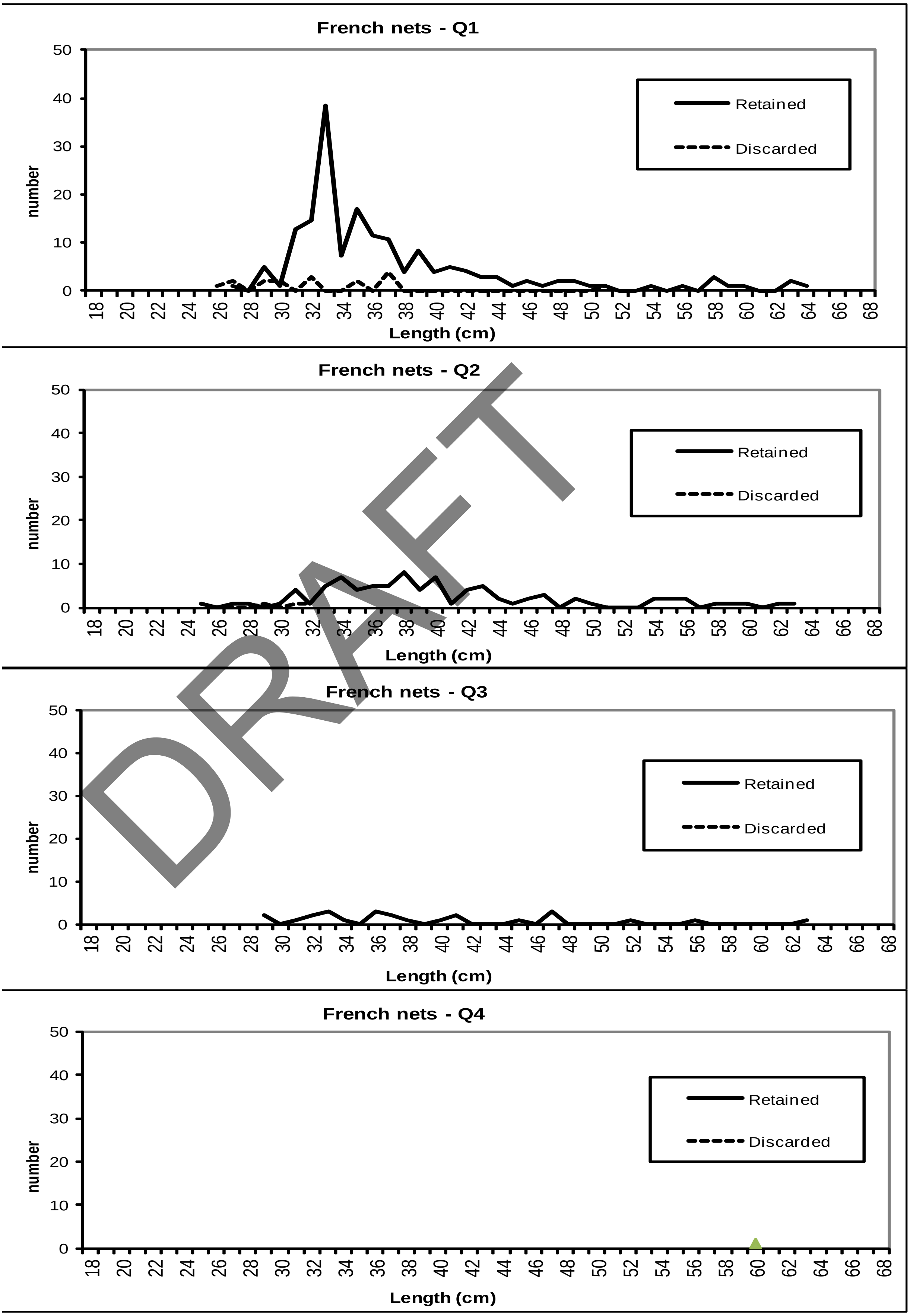


Figure 8.2.2 (cont.) Plaice VIIe Discards - French Other by Quarter (2012)

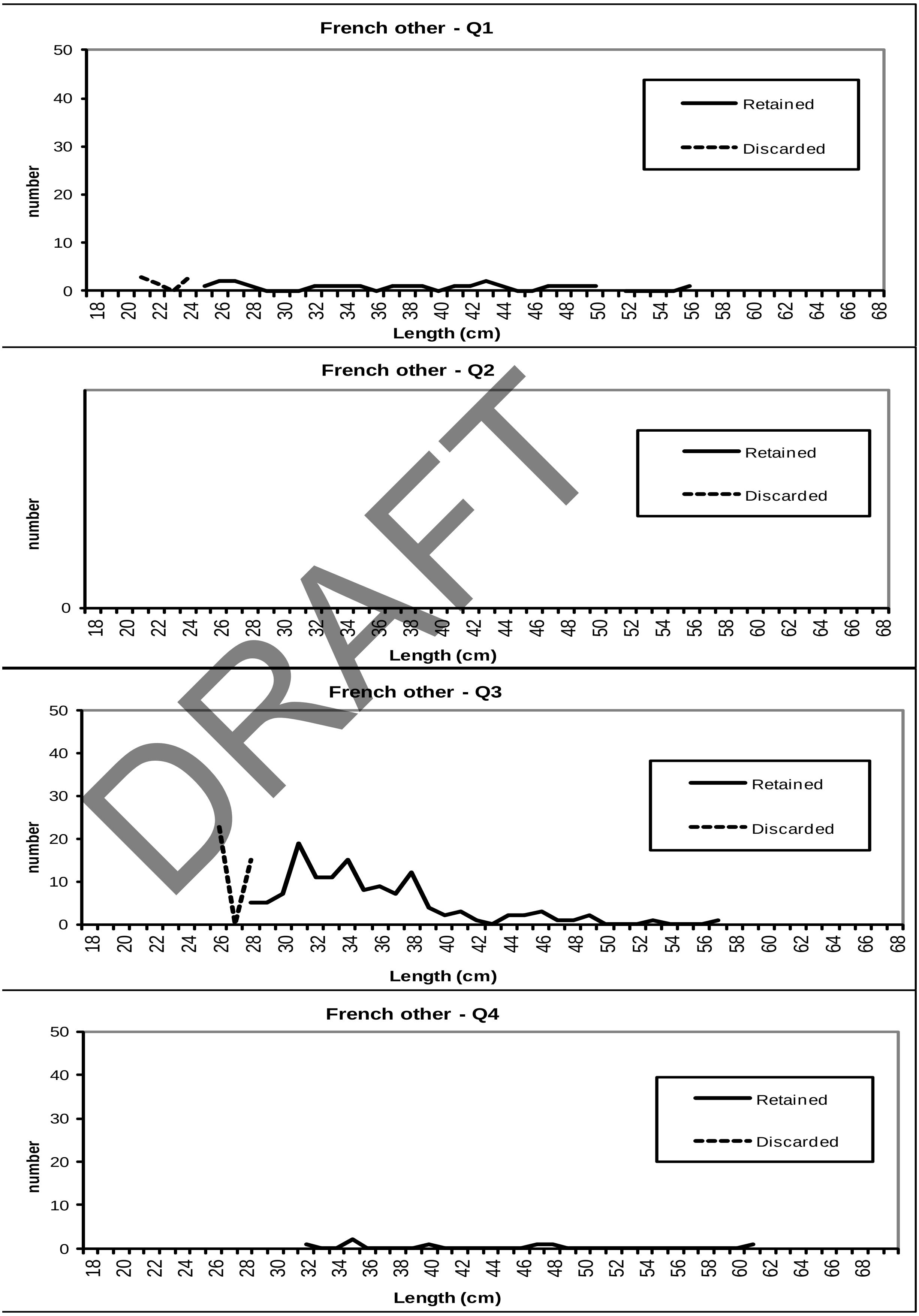


Figure 8.2.2 (cont.) Plaice VIIe Discards - Belgium by Quarter (2012)

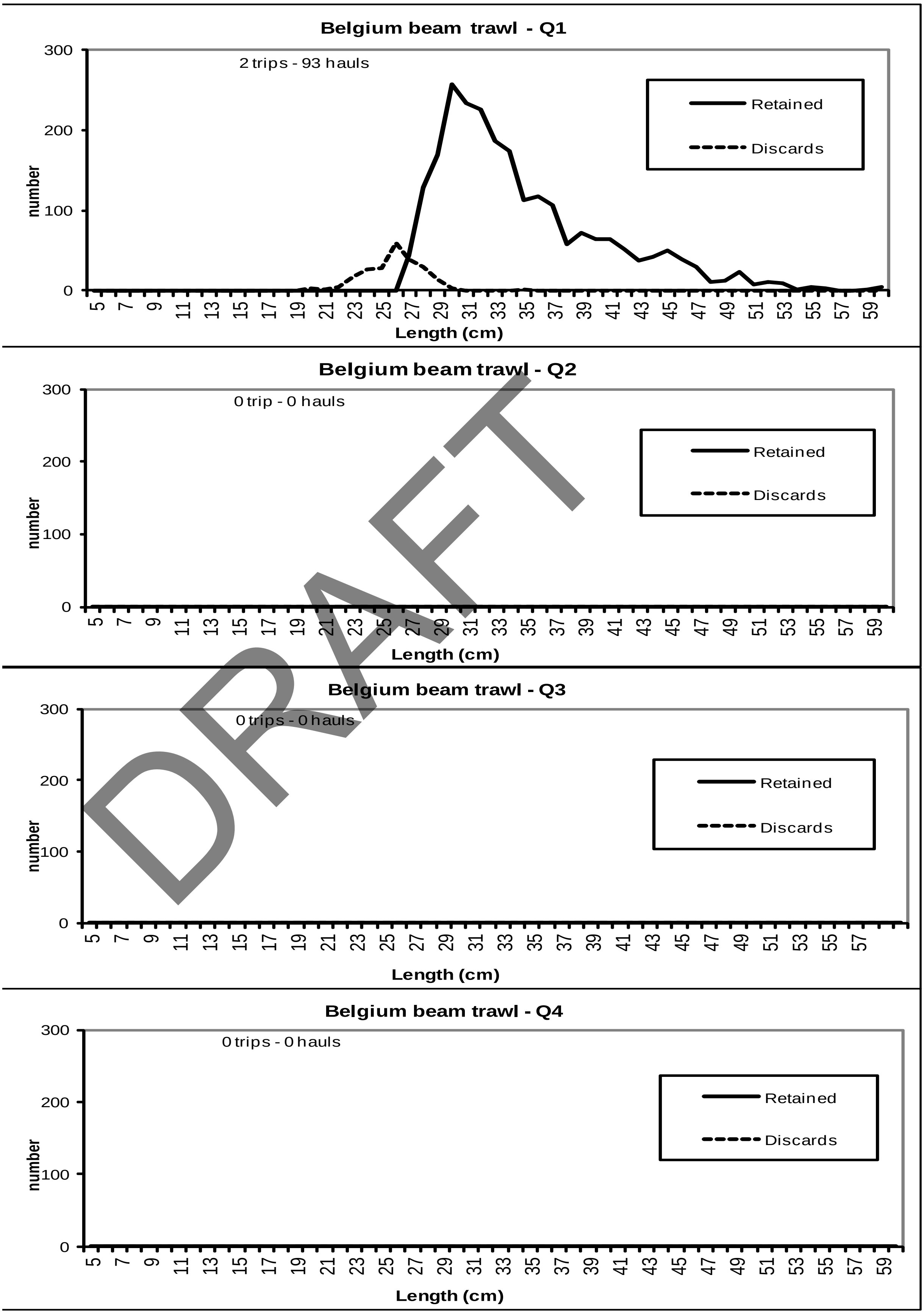


Figure 8.2.3 : Plaice in Division VIIe Length distributions of UK (England & Wales) landings from 2003 to 2012

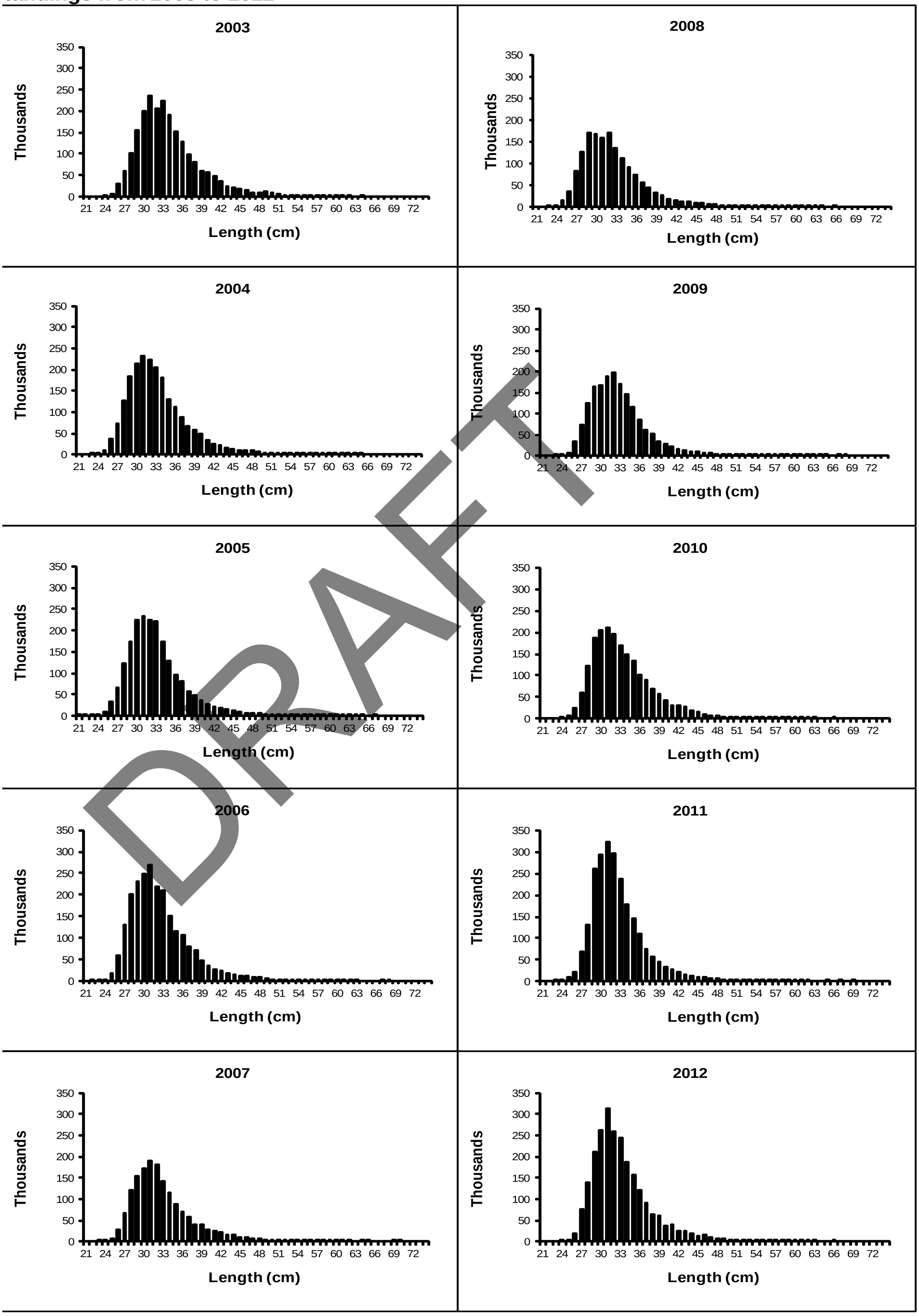


Figure 8.2.4 : Plaice in Division VIIe Age composition of international landings 2003-2012

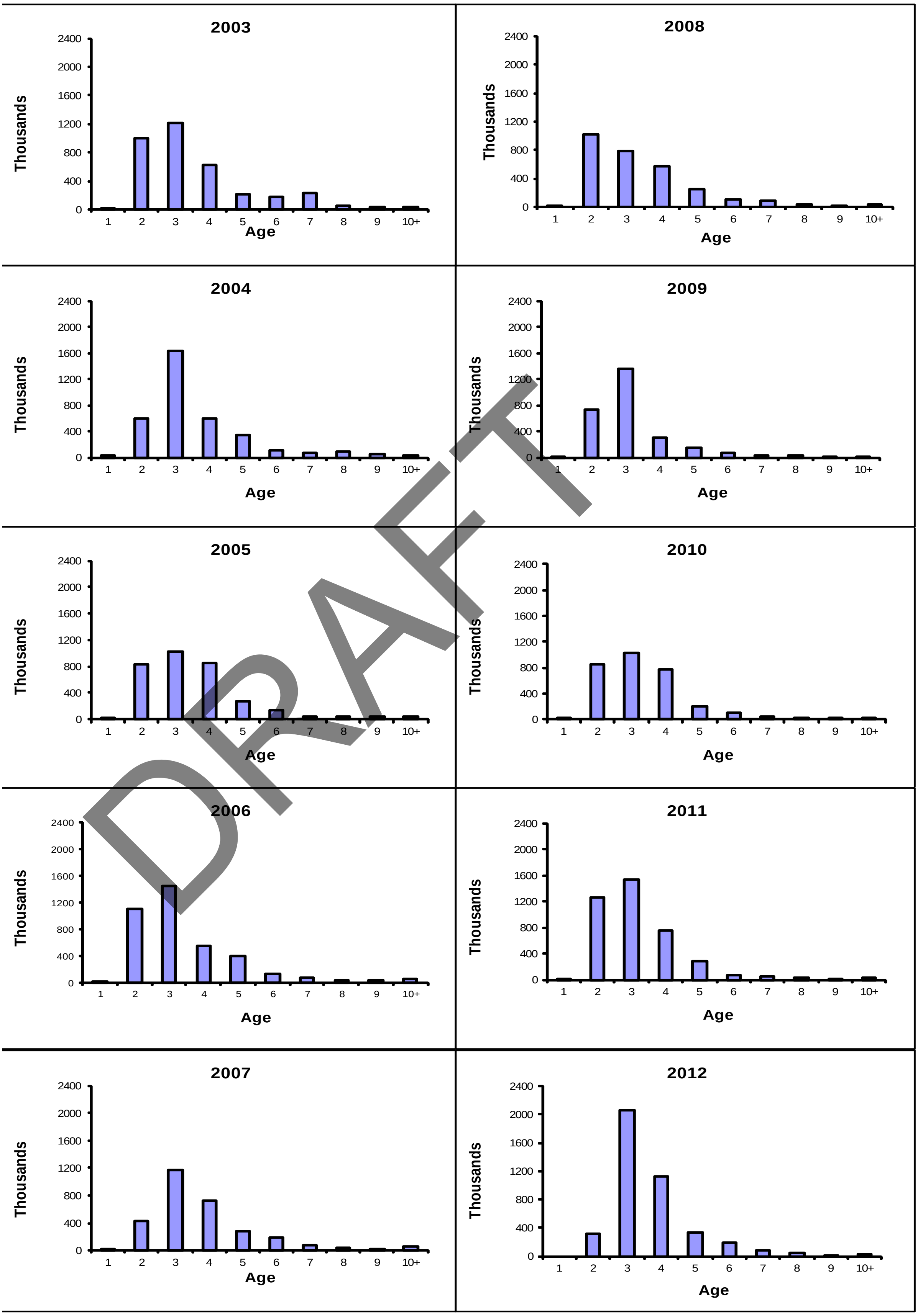


Figure 8.2.5 VIIe Plaice fleet log catchability residuals from the final run

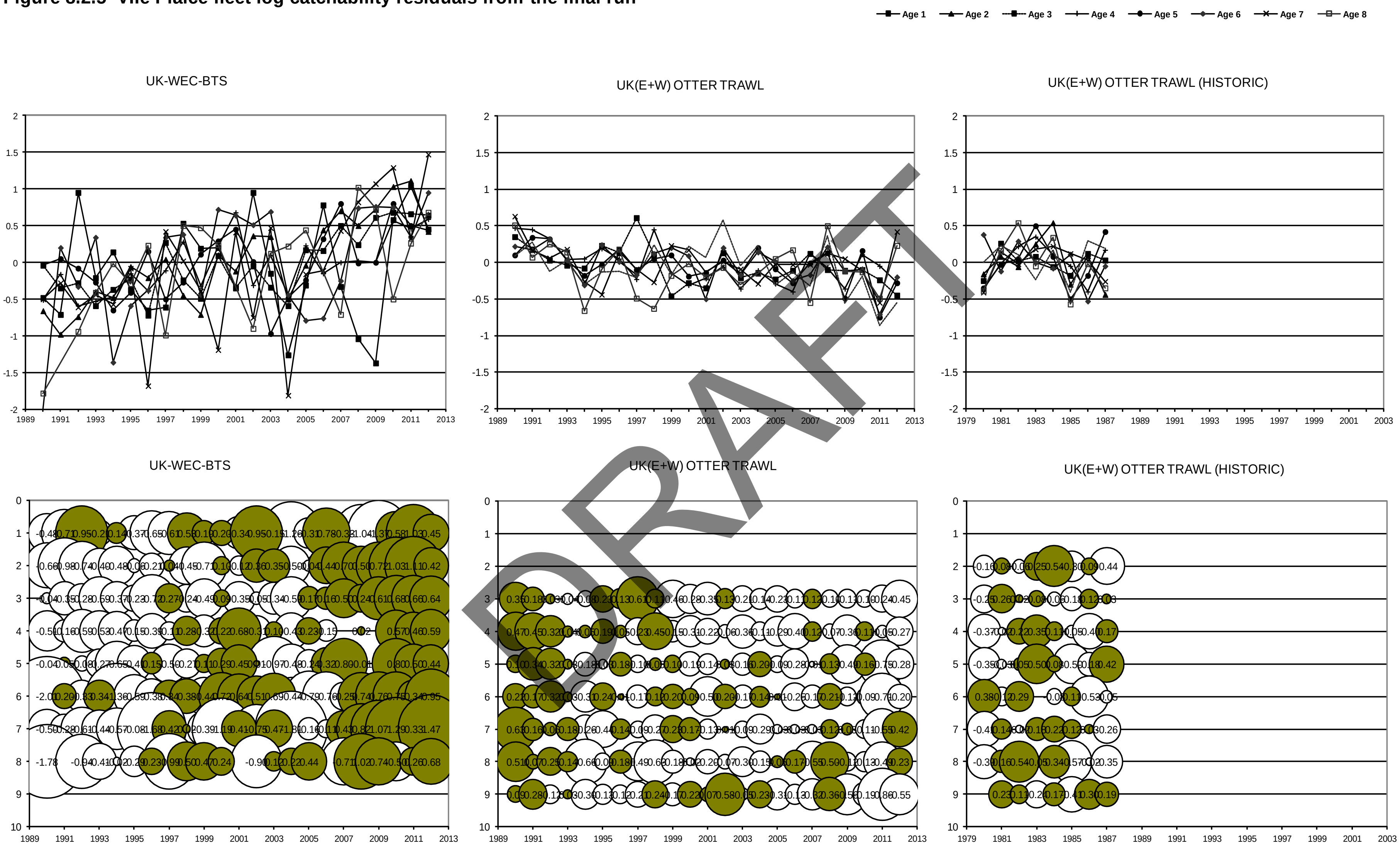


Figure 8.2.5 (cont.) VIIe Plaice fleet log catchability residuals from the final run

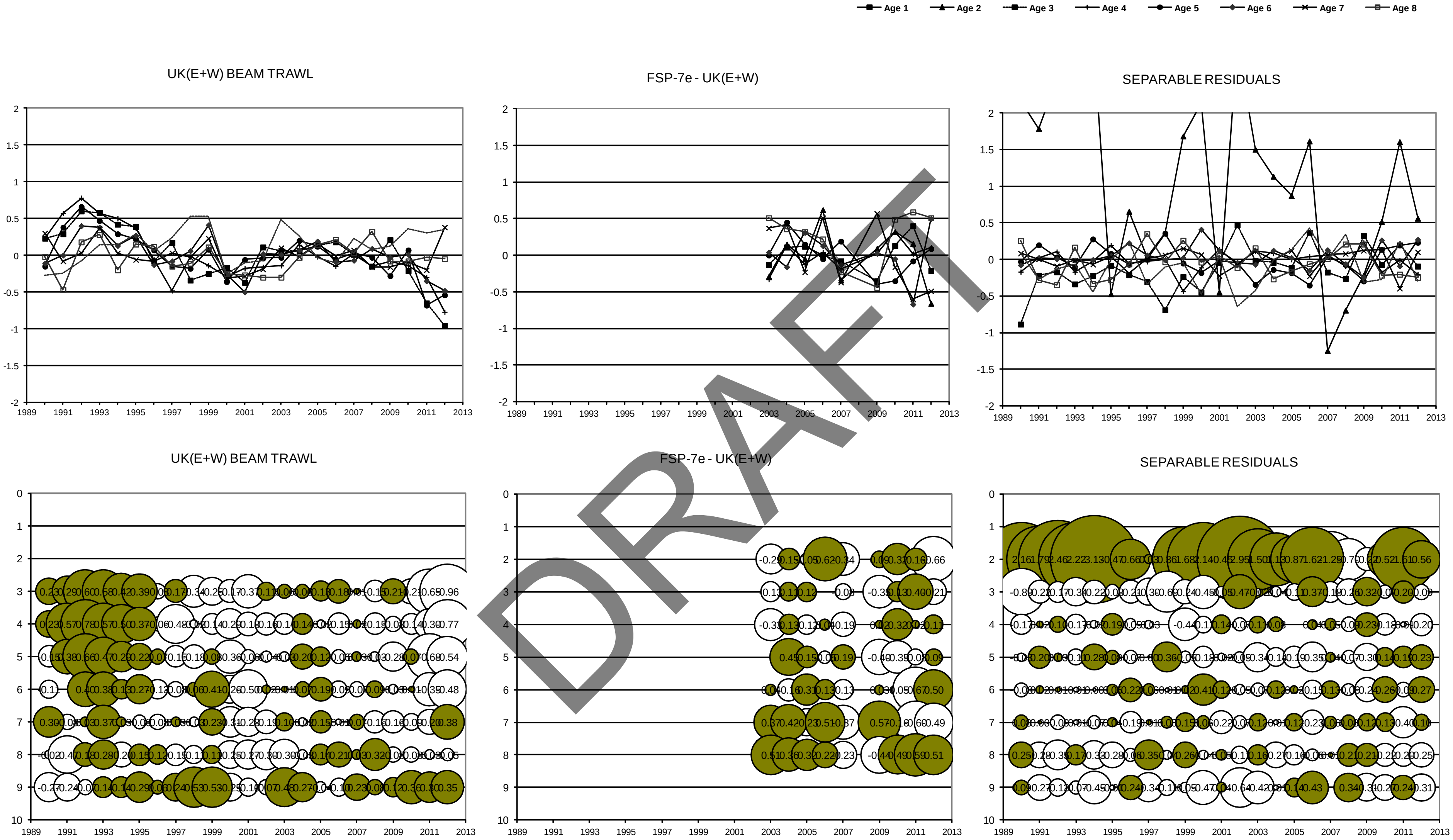
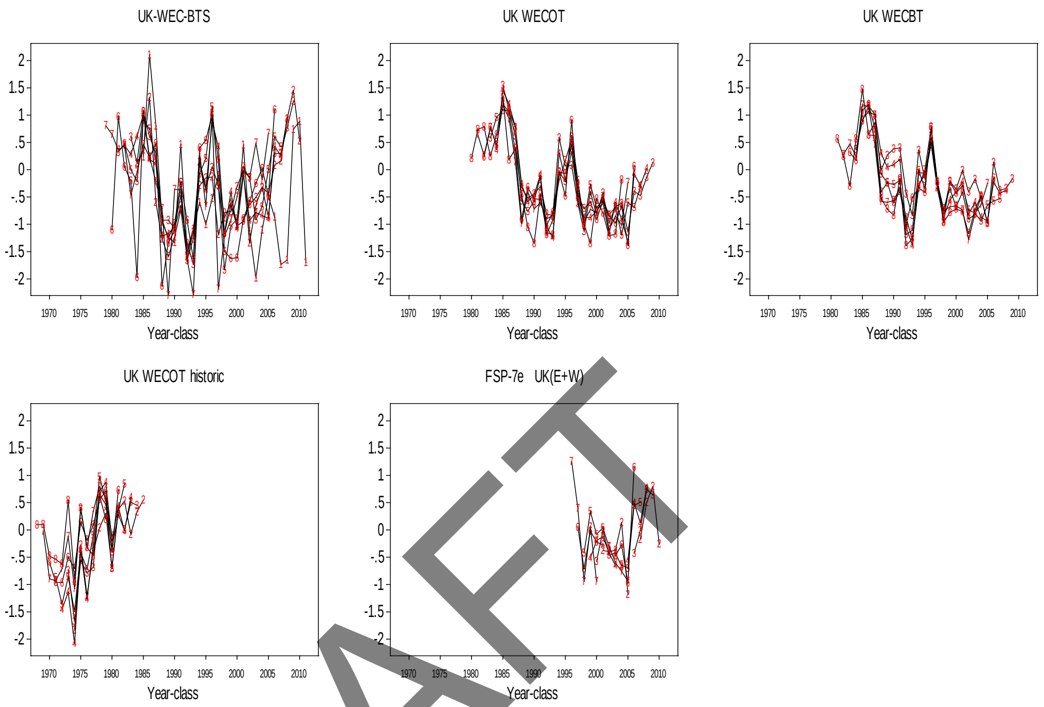


Figure 8.2.6 VIIe Plaice – Surba results

Tuning fleets by year-class



Tuning fleets by year

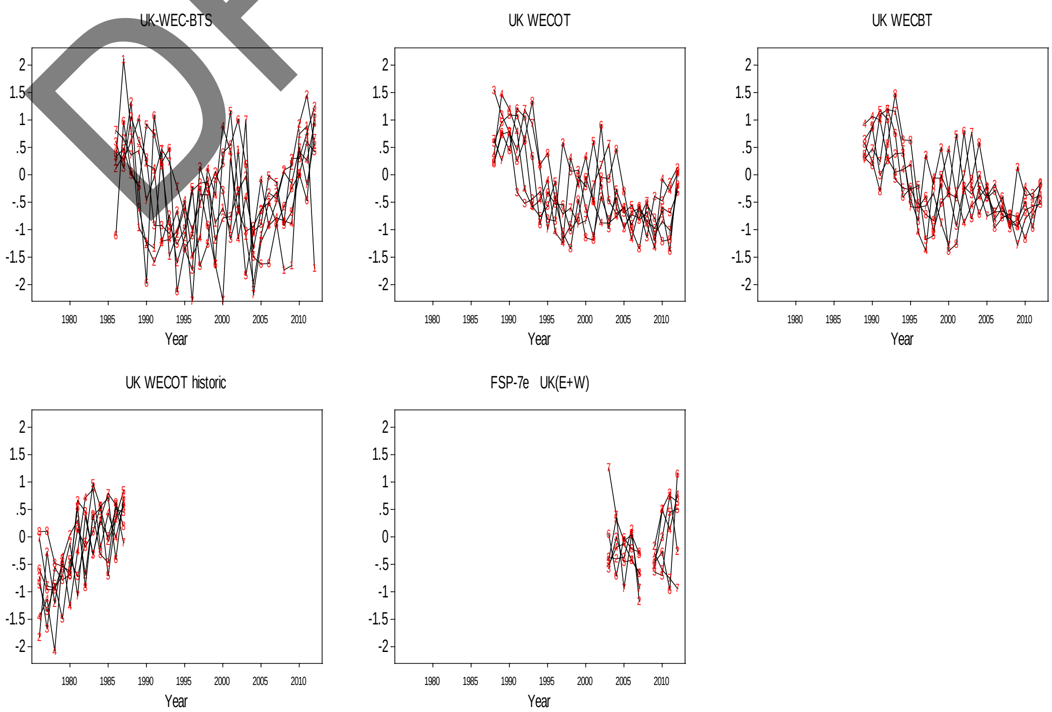


Figure 8.2.6b: Log CPUE plots by cohort for the UK-WEC-BTS by cohort indicating a roughly stable total mortality rate of around 0.4 for the time-series.

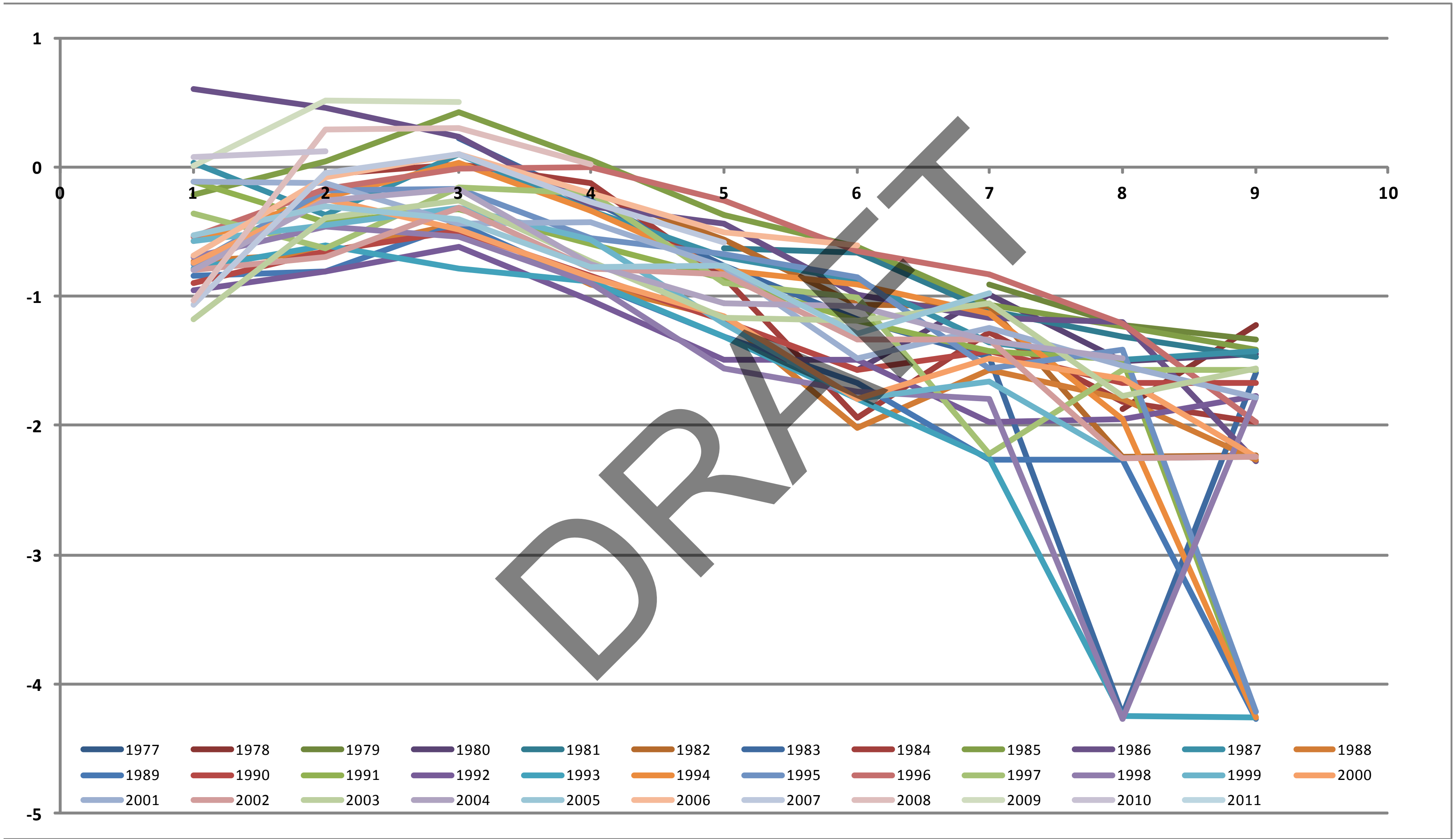
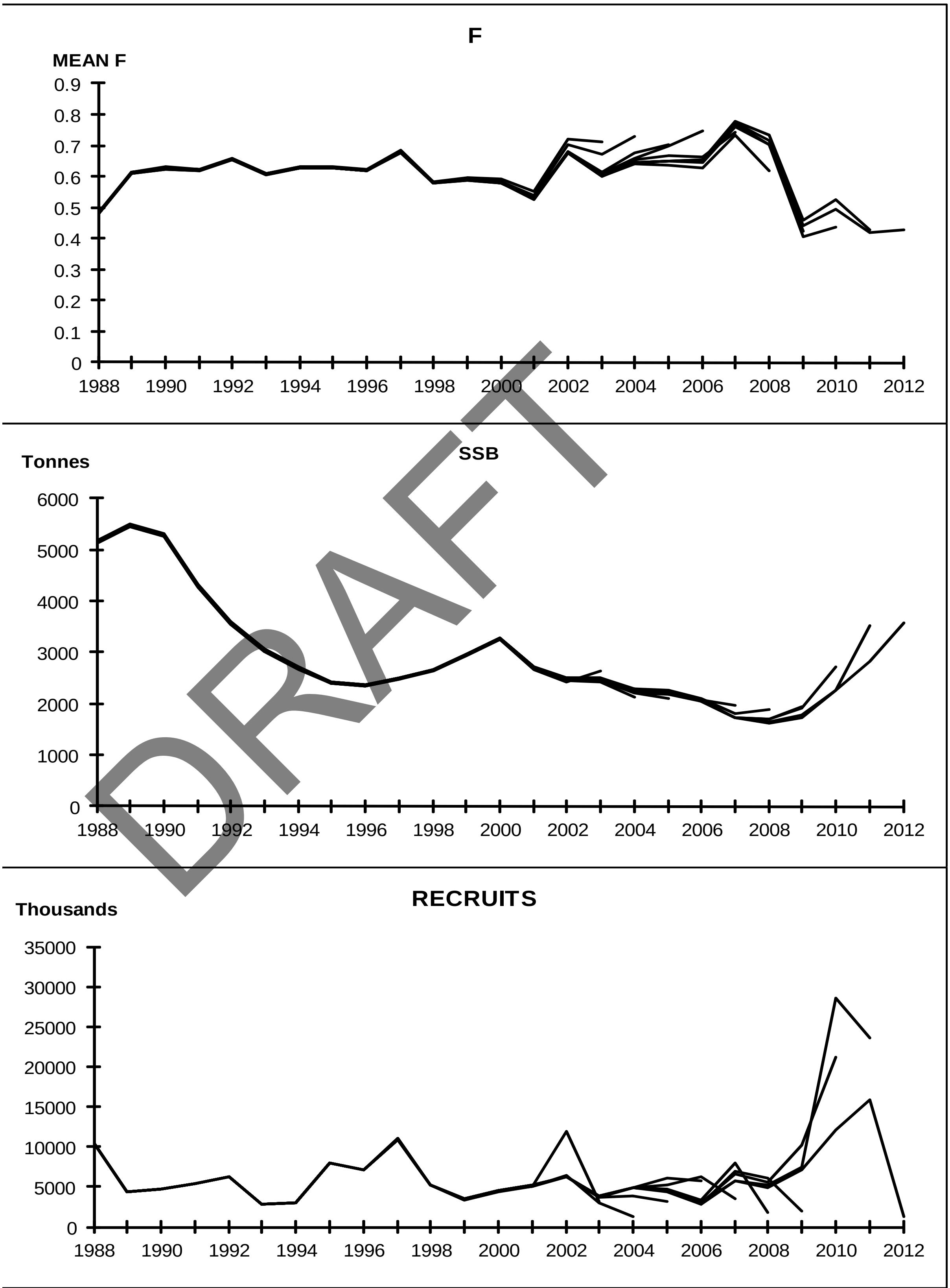


Figure 8.2.7 VIIe Plaice: Retrospective XSA results
(Shrinkage SE=2.5)



Note: the retrospective analysis was run without the short FSP survey

Figure 8.2.8 **Plaice in Division VIIe (Western Channel)**

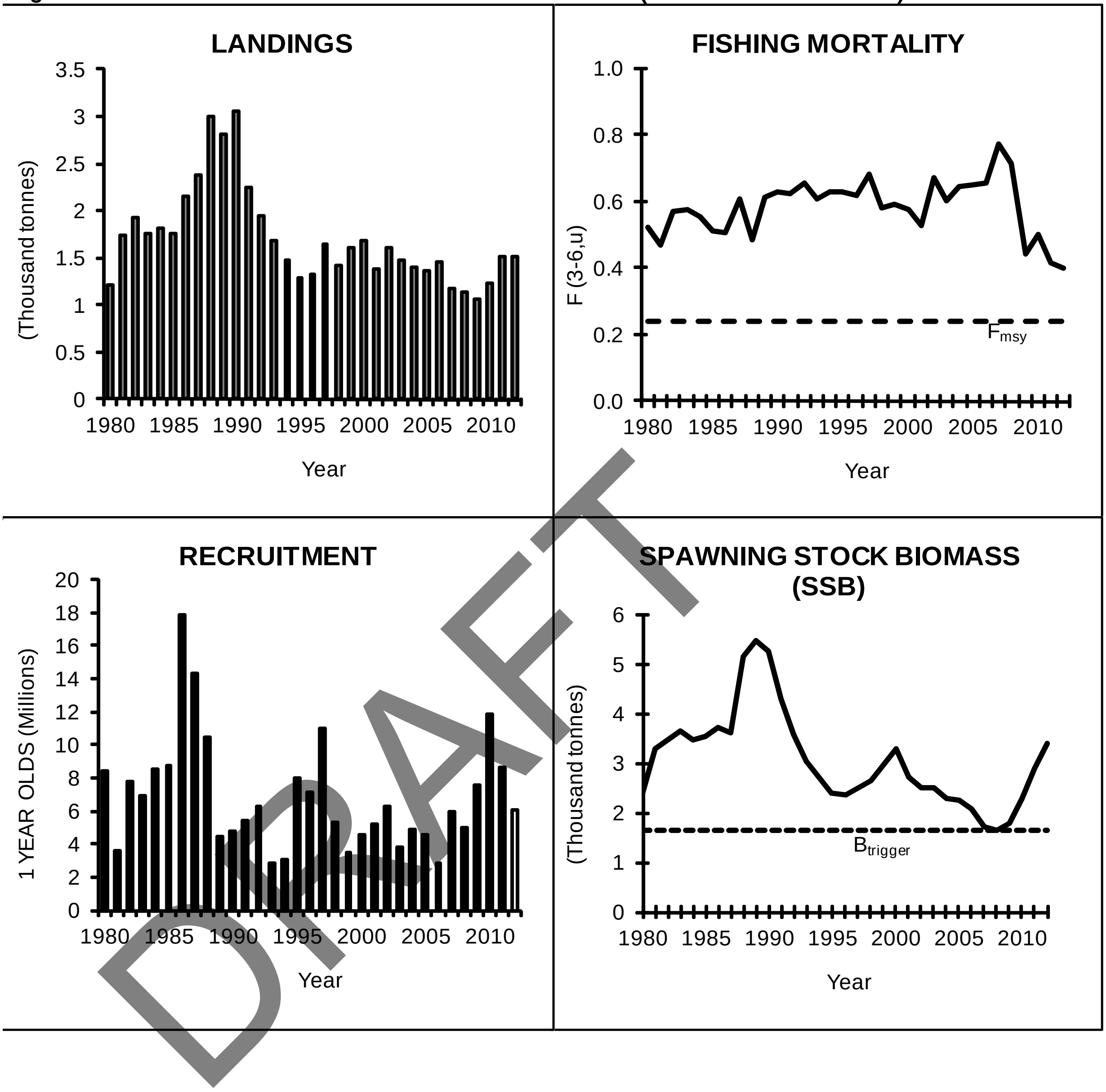
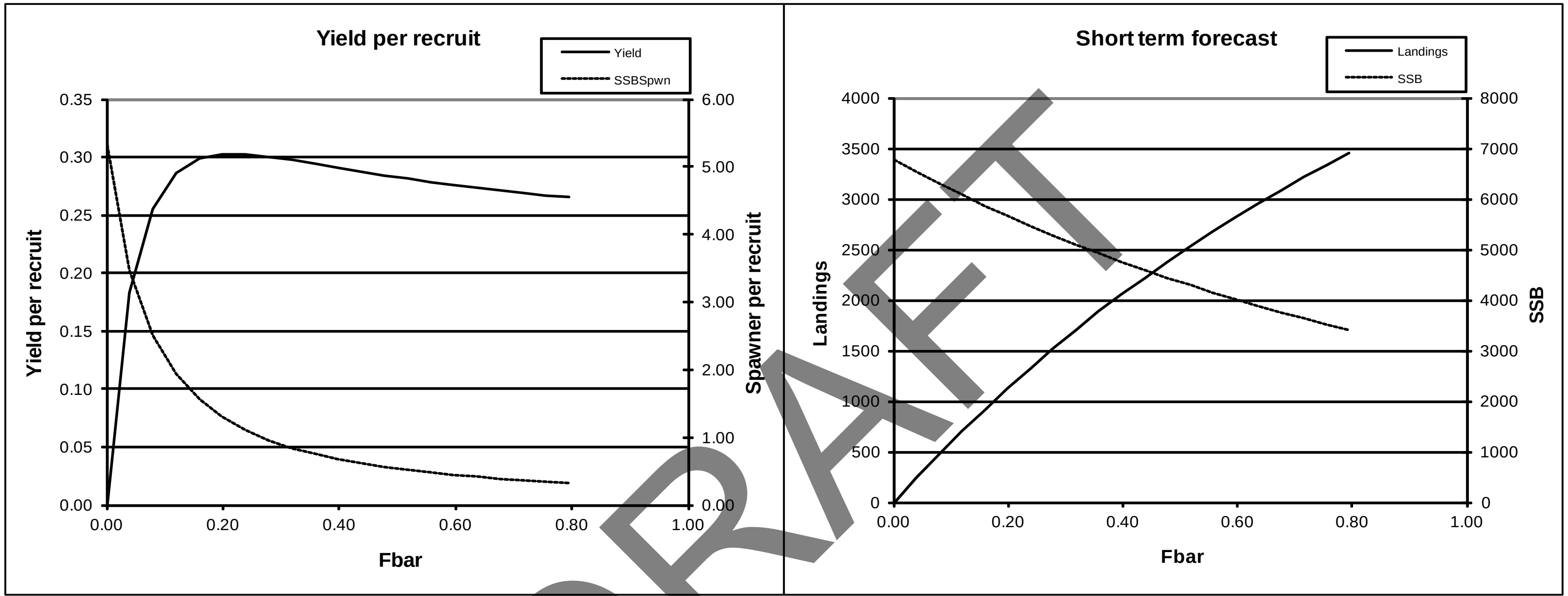


Figure 8.2.9 VIIe Plaice : Yield per recruit and short term forecast results



MFYPR version 2a
Run: P7E2013
Time and date: 11:44 11/05/2013

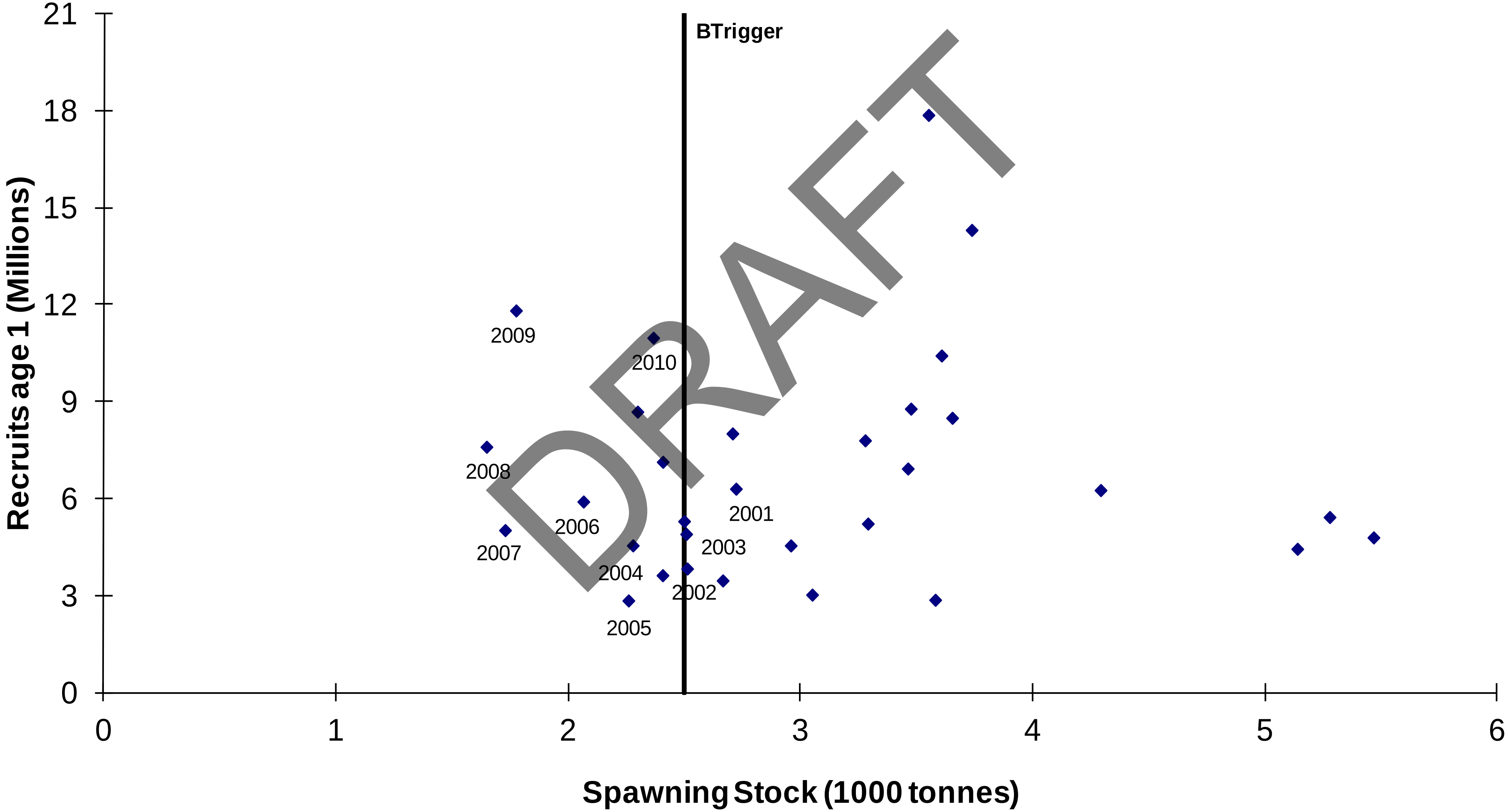
Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.3978
FMax	0.5440	0.2164
F0.1	0.2504	0.0996
F35%SPR	0.3180	0.1265

Weights in kilograms

MFDP version 1a
Run: p7e2013
W.CHANNEL PLAICE 2013 WGCSE forecast inputs
Time and date: 09:59 11/05/2013
Fbar age range: 3-6

Input units are thousands and kg - output in tonnes

Figure 8.2.10 Plaice in VIIe. Stock-Recruitment



8.3 Sole in Division VIIe

Type of assessment in 2012

This stock was placed on the observational list in 2004 and has been subject to a full assessment in subsequent years. A management plan for this stock was agreed in May 2007 (Council Regulation (EC) No 509/2007). Since 2009 the stock has been exploited below F_{MSY} resulting in a recovery of the biomass to levels well above $B_{MSYtrigger}$.

WGCSE followed the procedure prescribed by the 2012 benchmark process to conduct an update assessment.

ICES advice applicable to 2012

F (Fishing Mortality)				
	2008	2009	2010	
MSY (F_{MSY})	✗	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

SSB (Spawning Stock Biomass)				
	2009	2010	2011	
MSY ($B_{trigger}$)	✗	✗	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

Management plan

Council Regulation (EC) No. 509/2007 establishes a multiannual plan for the sustainable exploitation of Division VIIe sole. Years 2007–2009 were deemed a recovery plan, with subsequent years being deemed a management plan. For 2010, 2011, and 2012 the TAC shall be set at the highest value resulting from either a 15% reduction in F compared to average F (2007–2009) or an F of 0.27, with a maximum TAC variation of no more than 15%.

Following the agreed management plan implies an F for 2011 of 0.27 (F_{MP}, the management plan long-term target), suggesting a TAC of 777 t in 2012 which is less than the 15% TAC increase cap in the plan. This is expected to lead to a SSB increase of 5% in 2013. This plan has not been evaluated by ICES.

MSY approach

Following the ICES MSY framework implies fishing mortality to be at 0.26 (6% lower than F_{MSY} because SSB is 6% below MSY $B_{trigger}$). This implies landings of less than 740 t in 2012.

ICES advice applicable to 2013

Stock status:

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

SSB (Spawning Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity

MSY approach

ICES advises on the basis of the MSY framework that landings in 2013 should be less than 960 tonnes.

Management plan

Council Regulation (EC) No. 509/2007 establishes a multiannual plan for the sustainable exploitation of sole in Division VIIe. The years 2007–2009 were deemed a recovery plan, with subsequent years being deemed a management plan.

Following the agreed management plan implies an F for 2013 of 0.27 (F_{MP}, the management plan long-term target), suggesting a TAC of 958 t in 2013 which is greater than the 15% TAC increase cap in the plan. Consequently the management plan implies a TAC for 2013 of 894 t (F = 0.25). Fishing at this level is expected to lead to an SSB increase of 2% in 2014. ICES has not evaluated this management plan.

Technical consideration

General comments

Data inputs and assessment methods are consistent with the stock annex.

The RG agrees with the way that tuning indices were treated. Nevertheless, the RG is concerned about the time trend in the residuals: the early UK-CBT and the late UK-CBT show a strong decreasing trend and a dome-shaped trend, respectively. Although the value of the residuals is relatively small, the trend is problematic. The RG suggests that the WG perform an exploratory run that does not include the UK-CBT index.

WKFLAT 2012 discussed these issues at length as well as conducting the requested exploratory analysis and reported to the need for the inclusion of this fleet in the assessment (in its absence there is currently insufficient information on the older ages to run the assessment which will instead inappropriately use shrinkage to estimate a large proportion of the SSB). The development of the new survey-series will alleviate this problem in time, but currently the number of parameters required to estimate q's precludes sensible assessment results in the absence of this fleet. The residual trends are consistent with the changes in the spatial distribution of the fleet as described in the report and the WG would be more concerned with an assessment where trends in residuals were absent from this fleet.

The RG agrees that discard data should be more widely collected. Additionally, a sensitivity analysis that includes an approximate discard percentage, which is added to the landings, should be provided to help guide management advice and better estimate total fishing mortality.

As in previous assessments the WG commented that sole discards in this fishery are minor. Adding an approximate percentage to the landings is inappropriate, as these will be assumed to have the same age compositions as the catch which is certainly not the case. In 2012 estimates of discard rates are less than 1.2% in number and around 0.5 % in weight. Discarding of under sized sole was 0.07% in numbers and negligible by weight.

Minor retrospective patterns exist for SSB and F, but are generally not very large. However, there has been a severe overestimation of recruitment in the last two years of the retrospective analysis.

The overestimation in recruitment is not a retrospective bias, i.e. not systematic. It is known that the abundance estimates of age 1 sole are highly variable and come from a single source of information. It is however possible to distinguish strong and weak year classes, which is why it is used in the assessment. However, it is not used in the forecast for this very reason, instead using geometric mean recruitment excluding the last two years are used to replace the XSA estimate. There is therefore no concern with respect to the management advice.

8.3.1 General

Stock description and management units

The TAC is specified for ICES Area VIIe consistent with the assessment area.

Official national landings data as reported to ICES and the landings estimates as used by the working group are given in Table 8.3.1.

Official landings in 2012 were 854 t, a 10% overshoot of the TAC. WG landings indicated total international landings were 871 t in 2012, 12% above the TAC. A UK single area licence scheme introduced at the end of 2008 stopped the previous practice of misreporting; previous UK landings estimates have been corrected for area misreporting to ICES Division VIId which brought UK landings into line with the national quota. Previously landings had been stable at around 1000 t over the previous five years, with the UK taking about 65% of the TAC and France reporting the majority of the remainder. The proportion of French landings has increased in recent years.

Management applicable to 2012 and 2013

2012 (Council Regulation (EC) No43/2012)

Species: Common sole *Solea solea*		Zone: VIIe (SOL/07E.)
Belgium	27 (1)	
France	293 (1)	
United Kingdom	457 (1)	
Union	777	
TAC	777	Analytical TAC

(1) In addition to this quota, a Member State may grant to vessels flying its flag participating in trials on fully documented fisheries additional allocation within an overall limit of 5 % of the quota allocated to that Member State, under the conditions set out in Article 7 of this Regulation.

In addition to this quota, a Member State may grant to vessels participating in trials on fully documented fisheries additional allocation within an overall limit of an additional 5% of the quota allocated to that Member State, under the conditions set out in Article 7 of this Regulation.

In addition, Annex IIc, restricts the number of days at sea to 164 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional twelve days for the UK beam-trawl fleet due to a reduction in capacity of the fleet. In November 2008 the UK introduced a single area licence scheme to eliminate the opportunity for UK vessels to misreport catches to Area VIId.

2013 (Council Regulation (EC) No39/2013)

Species: Common sole *Solea solea*		Zone: VIIe (SOL/07E.)
Belgium	32 (1)	Analytical TAC
France	337 (1)	
United Kingdom	525 (1)	
Union	894	
TAC	894	

(1) In addition to this quota, a Member State may grant to vessels flying its flag and participating in trials on fully documented fisheries an additional allocation within an overall limit of 5 % of the quota allocated to that Member State, pursuant to Article 7 of this Regulation.

In addition to this quota, a Member State may grant to vessels participating in trials on fully documented fisheries additional allocation within an overall limit of an additional 5% of the quota allocated to that Member State, under the conditions set out in Article 7 of this Regulation.

In addition, Annex IIc, restricts the number of days at sea to 164 for beam trawlers of mesh size equal to or greater than 80 mm, and for static nets including gillnets, trammelnets and tanglenets, with mesh size less than 220 mm, with an additional twelve days for the UK beam-trawl fleet due to a reduction in capacity of the fleet.

8.3.2 Data

Landings

Levels of landings have been above or near 1000 t for this stock for most of the time-series, but have dropped significantly since 2009 to a level closer to 700 t. With increasing quotas the landings have been rising since then to 871 t in 2012 (Table 8.3.1). There were no revisions to 2011 landings data used by the WG.

Data

Total international catch numbers-at-age (Table 8.3.2, Figure 8.3.1), catch weights and stock weights-at-age (Table 8.3.3, 8.3.4, Figure 8.3.2) as used in the assessment were derived mostly by the procedure described in the Annex, except in 2009–2012 where some UK age information was used to supplement sparse French age information at larger lengths. The differences in the length distributions between the different fleets are shown in Table 8.3.5.

Sampling levels are detailed in InterCatch.

Discards

Discard data suggests that discarding in 2012 is very again minor in this stock (Figure 8.3.3a–e) for all fleets (UK, French and Belgian fleets), although occasional trips may show some discarding of undersized sole.

More generally discarding by number in the towed gears using 80 mm mesh sizes, which are responsible for the large majority of the landings is very small by number (<5%) and small (5–10%) for the much smaller gillnet fishery. Other spatially or temporally restricted métiers have shown higher values of discarding (10–40% averaged over years) but have limited effort and hence contribute only a very small percentage to the landings (<5%). The selectivities of the gears used to target sole in the UK is highly selective for fish above the MLS, and only a few sporadic cases of highgrading (included in the numbers above) have been observed.

No discard information is included in this assessment as currently it is not possible to provide this information for the entire time-series but given the minor scale of the problem it is unlikely to have any impact on the perception of the stock.

Biological

Natural mortality and maturity were used as in previous assessments and described in the stock annex. The review group suggested developing temporally variable maturity data for this stock. However, the surveys, usually used for such estimates due to the much better quality control on staging individuals, occur in September. This time of year has been determined to be unreliable for estimating maturity for this species as gonadal development has not commenced. A new quarter 1 survey may provide better data which will be considered at the next benchmark meeting.

Survey indices

Aggregated cpue has substantially increased from the low point of the time-series observed in 2005 to the highest values in 2010. There appears to have been a slight decline since then due to below average 2009 and 2010 year classes. (Figure 8.3.4, Table 8.3.6).

The abundance for the UK-WEC- BTS survey carried out on the chartered beam trawler *FV Carhelmar* is given in Table 8.3.7 and shown in Figures 8.3.5 and 8.3.6, plotted by cohort and by years. The figures show few clear year effects and good year-class tracking for the survey at all ages until about the mid-1990s. Since then, the estimate of year-class strength at age 1 and at ages greater than 7 has deteriorated slightly. This may partly be associated with the change of vessel that occurred in 2002 and 2004 (*RV Corystes* used), but it seems likely this is not the only cause and weather may play a part in the catchability. Notable differences between the commercial and survey tuning-series are the 1998 year class. This is well represented in the commercial data, but much less clearly so in the survey data. This YC was also seen to be very strong in the VIIf&g stock and may represent some overspill of recruitment from that stock in the adjacent western part of VIIe, not covered by the survey. The 2001YC is also well defined and estimated to be above average in the survey and implied to be strong particularly at the older ages, but lacking in the commercial data.

The UK fisheries science partnership (FSP) again conducted a survey, now in its 10th year (only nine years used for sole due to data issues), of sole and plaice abundance in the Western Channel. The results indicate that sole continue to be wide spread in the area and that a large number of cohorts contribute to the stock. The working group has reported on this survey on several occasions and the information is now included in the assessment following the benchmark in 2012.

The Q1SWBeam survey

This is the first consideration in an assessment of the new survey-series starting in 2006. Important considerations for WKFLAT were that it is based on a stratified random survey approach and covers the entire region of the management area and some adjacent waters which may not fully conform to the delineation. The survey shows strong gradients in species composition within the Western Channel (justifying the stratification approach), although there is some indication that more appropriate post stratification could potentially provide an increase in precision of single-species abundance estimates.

Given sampling effort, fundamentally this survey is more variable than fixed stations survey designs of equal effort, but also inherently is less biased when there are potential changes in the distribution of the species within the area. Although estimates of survey variance of the limited dataseries are available, these are unlikely to reflect the full range of the variance that would be encountered in a longer time-series as variance estimates are unlikely to have reached their asymptote, particularly since the range of SSBs observed by the survey is very restricted.

The survey-series was started in 2006 and surveys have been conducted consistently since then. To include as much information as is available at the time of the assessment working group the survey that is conducted in the first quarter has been shifted to back by one year and one age. This practical, because it adds further available information on the abundance of recruitment into the assessment, particularly important since there is uncertainty regarding the estimation of recruits from the UK-BTS which otherwise is the sole source of information of this parameter. The benefits of shifting the series were thought to out-weight the potential error that may be introduced by this procedure if the seasonal pattern of true F were to change in future.

Age information provides estimates of abundance for all ages in the assessment, despite the fact that the survey only catches between 250 and 300 sole in a given year. Theoretically this removes the necessity of retaining the commercial lpue (at age) series required as the UK-BTS survey does not cover the full age range in the assessment. Internal consistency estimation is very difficult given the short time-series, and relatively small contrast in cohort strength observed (based on other series). Despite this reasonable cohort tracking is apparent and the signal matches the cohort signal from other survey-series, particularly the FSP survey.

Commercial fleets effort and lpue

Effort for both UK over and under 24 m beam trawlers in hours fished increased until 2000 when it levelled off until 2006 (Figure 8.3.4, Table 8.3.6). Since then >24 m boats have declined in favour of smaller boats due to a combination of the UK decommissioning scheme and the substantial increases in fuel costs, making the larger boats commercially unviable. The decline of the larger boats has resulted in a resurgence of the use of less than 24 m vessels. Given the licence transfer rules currently in force in the UK restructuring of the fleets will lead to a 10% decrease in the kW day capacity of replaced vessels not withstanding any latent capacity 2012 data indicates stable effort compared to 2011 but this must be weighed up against a decrease in cpue due to a further offshore migration with the assessment indicating that F has remained relatively stable. Otter trawl effort (UK-COT) has been in continual decline since the early 1970s and is currently around the series minimum (shown 1988 onwards in Figure 8.3.4 and Table 8.3.6) at values roughly a third of those seen in the 1970s. Gross registered tonnage corrected effort used in the assessment also shown in Figure 8.3.4 shows a strong decline in effort in the main fleet exploiting the stock in 2009 as vessels moved out of the area as a result of the UK single area licensing scheme (Figure 8.3.4, Table 8.3.7).

Otter-trawl effort, as used in the tuning information has been declining steadily since the late 1990s and is now at historically low levels, but takes only a small proportion of the landings.

Lpue for both over and under 24 m beam trawlers has declined steadily since 1988. Cpue from the survey appears to show a comparable trend over the period 1998–2005, but over the entire an increasing trend is implied, with the last five datapoints being the highest in the series. It is however representative only of the younger ages in the fishery (1 to ~6) and only a proportion of the stock.

Age-disaggregated commercial abundance indices used in the assessment are the commercial beam-trawl fleet (UK-CBT) and the otter-trawl fleet (UK-COT) are given in Table 8.3.7, and plotted log converted by cohort and year in Figures 8.3.5 and 8.3.6. The UK-CBT shows very good year class tracking indicated by the consistent estimation of strong and weak year classes at different ages, and demonstrates a decline in the abundance-at-age from 1975 to 1990, after which the observed decline continues but at a much smaller rate. This series has now been split in 2002, the year when area misreporting was officially recognised as a problem and a response by enforcement caused a change in the behaviour of the fleet. There is little indication of year effects in this time-series. The UK-COT fleet also shows good year class tracking over the middle of the time period and also gives some indication of a decline in lpue in the early 1980 although this is much less clear than in the beam-trawl fleet. This is likely in part caused by the strong year effect seen for this fleet in 1991 and to a lesser degree in 2004. The causes of this are not clear from anecdotal evidence, but sampling for the fleet is now at relatively low levels, due to the small size of the fleet and landings. In 2013 the review group commented on the use of commercial tuning data which appears to show undesirable trends. The reasons for using this data were justified by WKFLAT2012 and these reasons still apply. However, it is likely that in 2014 the UK-BTS survey will no longer be available at which point a benchmark process will be necessary. At this point the need to continue including the commercial tuning information should be re-examined.

Information from the fishing industry

No comments were received in 2013 regarding the assessment or management of this stock beyond the information from the UK fisheries science partnership already formally included in the assessment process.

8.3.3 Stock assessment

Model used: XSA assessment as described in the Annex by WKFLAT 2012

Software used: FLR – FLXSA (FLCore 1.4-3 - "Golden Jackal" ; R 2.4.1)

Model Options chosen: Data used were as in previous years although some alterations to the French age compositions were necessary due to a lack of age information in Q1 and Q4 as well as the higher ages.

Input data types and characteristics: catch numbers-at-age without discards, five tuning fleets, three surveys, three current commercial lpue series (the previously used beam-trawl fleet having been split into an early and a late part).

Data screening

Data screening of the catch-at-age, weights, tuning information and ancillary qualitative information was carried out by the procedures set out in the annex.

Single fleet XSA's for the current tuning fleets (see annex for procedures) were run. Residuals for all single fleet runs were generally small (Figure 8.3.7). Residuals of the single fleet runs indicated a small but persistent decreasing trend for the CBT fleet, two large negative residuals in the COT fleet in 1992 and 2003–2004 and more variable, but largely unbiased residuals for the UK-WEC-BTS. The characteristics of the individual tuning fleets are consistent with those shown previously in the screening of the tuning fleet data and hence suggest that all tuning fleets are largely consistent with the available landings data.

Summary plots of the single fleet runs are shown in Figure 8.3.8 indicate F, SSB and recruitment estimates are consistent between the fleets overall. The recent estimates of F are similar between the otter trawlers (UK-OTB) and the survey (UK-WEC-BTS), with SSB trends differing only because of a difference in the perception of recent recruitment not yet seen in the commercial fleet which uses ages ≥3. UK-CBT provides the highest F estimates and a commensurate lower SSB estimate and like the UK-OTB fleet misses recent recruitment values because it uses the same age range.

Final update assessment

The WG fitted the XSA model as developed by WKFLAT 2012 and the addition of the 2012 data had no major consequences on the diagnostics or the interpretation of the assessment. Settings used are shown in the text table below, with previous settings having been included in the stock annex at the benchmark.

Figures 8.3.9–8.3.11 show the residual plots from the final fitted model, a comparison with the 2012 assessment and the respective XSA survivor weightings. XSA diagnostic tables, fishing mortality-at-age, and stock number-at-age for the final assessment are shown in Tables 3.8.8–3.8.10.

A five year retrospective analysis was run (Figure 8.3.12), which still shows some retrospective bias in the earlier period, but confirms that the more recent period is more stable with respect to F and SSB trends. Some of the retrospective bias still observed in the assessment is undoubtedly due to the loss of influence of the FSP and Q1SWBeam survey indices which are too short for an unbiased retrospective analysis.

	2013WG
Assmnt Age Range	1–12+
Fbar Age Range	F(3–9)
Assmnt Method	XSA
Tuning Fleets	
Q1SWBeam (offset by 1y 1a)	2006–2013 2–12
UK-FSP	2004–2012 2–11
UK combined beam Ages (early)	1988–2002 3–11
UK combined beam Ages (late)	2003–2012 3–11
UK otter trawl Ages	1988–2012 3–11
UK BTS yrs Ages	1988–2012 1–9
Time taper	No
Power model ages	No
P shrinkage	No
Q plateau age	6
F shrinkage S.E	0.5
Num yrs	3
Num ages	5
Fleet S.E.	0.6

State of the stock

Stock trends are shown in Table 8.3.11 and plotted in Figure 8.3.10.

SSB is estimated to have increased from 1970 to 1980 following successive strong recruitments. Subsequently it has declined until 1993 after which it remained stable until 2009 since when there has been an increase in the most recent time in response to the reduction in F. In 2012 SSB is estimated to be 3488 t.

The base level of recruitment has remained stable during the whole time-series in the range 4–5 million recruits. The main development has been a reduction in recruitment variability since 1991 with none of the substantial year classes that maintained a higher level of biomass during the early period.

Fishing mortality was stable at a low level until 1977 after which it increased sharply until 1982, remained relatively constant but fluctuating (peaking briefly in 1989–1990). F then decreased slightly in 2008 and then abruptly to a below 0.25 and has remained around that level F in 2012 was estimated to be 0.246.

Information that is consistent with the decrease in fishing mortality in the most recent year is provided by the decline in UK effort (Figure 8.3.4) and landings. International landings are around the TAC, but variable year to year. Slight increases in recent effort have not had the commensurate effect on F because of a spatial shift in the distribution of the feet to areas of lower sole cpue in order to take advantage of other fishing opportunities.

The age structure of the VIIe sole stock continues to be more extended than other sole stocks in European waters, implying low mortality rates, with the plus group (at age 12) containing a high proportion of the catches and including some individual of ages 33–38 in recent years.

8.3.4 Short-term projections

Last year the WG assumed that the TAC might be observed as the opportunities for the UK beam-trawl fleet to area misreport had been eliminated but this year saw another overshoot of the TAC for different reasons. Reported landings and WG estimates are now tending around the TAC estimate, but French landings are still subject to a lag between reaching the TAC and closure of the fishery so that an F_{sq} interim year assumption remains prudent. F estimates 2010–2012 indicate a slight increase through this is more likely linked to the small but remaining retrospective pattern so that average $F_{10\text{-}12}$ rescaled to F_{2012} is considered appropriate for the forecast as per the stock annex. The mean catch and stock weights-at-age 10–12 were also used.

Estimating year-class abundance

As implemented previously, the geometric mean recruitment over the entire time-series (69-10) was used as there is no evidence of a significant relationship between SSB and subsequent recruitment over the range of SSB values observed in the assessment.

Year class	Thousands	Basis	Surveys	Commercial	Shrinkage
2010	3931	XSA	77%	-	23%
2011	4345	GM (69-10)			
2012	4345	GM (69-10)			
2013	4345	GM (69-10)			

Complete input data for the short-term forecast is shown in Table 8.3.12, and resulting forecast estimates landings in 2013 to be 877, 17 t less than the TAC (Table 8.3.13).

SSB estimated at 3517 t in 2013 will fall to 3345 t in 2014 at the current level of F assuming GM (69-10) recruitment for the 2012 year class the estimate of which is considered uncertain as in previous years (XSA estimate = 1535). This procedure should be reinvestigated at the next benchmark to examine if the addition of the new survey series has not improved the precision of this estimate.

The proportions that the 2010–2014 year classes will contribute to the landings in 2012, and to the SSB in 2013, are given in Table 8.3.14. 16% of the landings for 2014 and 32% of the SSB for 2014 rely on year classes for which GM recruitment has been assumed. The 2011 year class that has been replaced with GM (69-10) contributes to 1.9% of the landings in 2013 and 9.9% of the SSB in 2014.

A full management options table is provided in Table 8.3.15. The management plan for this stock requires exploitation at F_{MSY}=0.27 leading to a projected yield of 911 t in 2014.

8.3.5 Biological reference points

The most recent reference points for this stock were developed by WKFLAT2012 and are shown in the text table below. No F based limit reference points were proposed as the management plan provides an F-target of F=0.27 and given the SSB limits only small deviations of F from this target are to be expected. There is only very small risk to the stock at these levels of exploitation under current stock dynamics and assessment uncertainty.

	TYPE	VALUE	TECHNICAL BASIS
Precautionary approach	B_{lim}	1300 t	WKFRAME 2 metaanalysis (ICES, 2011)
	B_{pa}	1800 t	WKFRAME 2 metaanalysis (ICES, 2011)
	F_{lim}	Undefined	
	F_{pa}	Undefined	
MSY approach	F_{MSY}	0.27	Based on a suitably defined F_{max} and stochastic LT simulations
	MSY $B_{trigger}$	2800 t	Based on the lower 95% confidence limits of exploitation at F_{max} from LT simulations.

8.3.6 MSY evaluation

The WG did not conduct any further MSY evaluations given the repeat of the evaluation at WKFLAT 2012 and little or no change in the selection pattern given by the current assessment.

8.3.7 Management plan

The commission implemented a management plan for the recovery of the stock early in 2007 (Council Regulation (EC) No 509/2007). ICES evaluated the management plan and concluded that:

The long-term management target (F=0.27) is precautionary in the sense that it ensures that there is a less than 5% chance of SSB declining below previously observed levels, as well as maintaining yield within 10% of MSY (*WGCSE note: long-term yield at F_{MAX}*) (WG 2005, WG 2006). ICES has again failed to evaluate the management plan in 2012 as in previous years, so continues to provide advice on the basis of the F_{MSY} framework, although in 2013 the recommended yields are identical.

8.3.8 Uncertainties in assessment and forecast

The methodology provided is as robust as possible as assessed by WKFLAT 2012 at present does not appear to currently suffer from a serious retrospective pattern, though the effect is beginning to become visible again as the trimmed commercial fleet is increasing in length, as predicted by WKFLAT 2012. The short-term forecast is relatively insensitive to such problems and management targets and limits are sufficiently removed from the current state so that the risk to the stock is small.

In addition the short-term forecast suffers from two specific uncertainties the size of which cannot quantitatively determined by the assessment. The first is the likely F in 2013. For this WG there is little difference between the Fsq forcast and one assuming a catch constraint in line with the quota (17 t) and with the constraint of the management plan in relation to a maximum increase in TAC there is no difference in the likely TAC for 2013. The other uncertainty relates to the size of the 2011 year class estimated to be weak in the assessment, however this has not been seen to be reliable in recent times (irrespective of whether this value was low or high) so that this value has been replaced with $GM_{(69\text{-}10)}$ potentially overestimating the yield in 2013 and SSB in 2014. The choice of options means that the uncertainties are opposing, but does suggest that uncertainties in the estimates are larger than those suggested by the assessment and forecast. In addition the management plan simulations have shown that management is robust to the uncertainty introduced by this procedure.

Discarding

Despite the small scale of discarding in this fishery a time-series of available discard information raised to the fleet level should be developed in order to be able to deal with potential future discard issues effectively as a time-series. However the EU is hoping to implement a 100% landings obligation in the area in 2016 so this issue appears to be less urgent now.

Surveys

The assessment methodology includes three surveys. The Q1SWBeam survey added to the assessment in 2012 covers the entire management area for this. It also provides fisheries-independent tuning information for the entire age range used in the assessment so that the assessment now relies much less on the commercial tuning information and is less susceptible to localised exploitation by the fishery. However, there is still some uncertainty with respect to the precision of this information particularly now where the time-series is still short. Consequently commercial tuning information is still used in the assessment to maintain the balance between accuracy and precision required by management. Survey information for the recruiting year class remains variable, but is not used in the forecast for this reason.

Sampling

Age and length sampling for this stock is mostly adequate. Age data from the largest two sectors prosecuting this fishery (UK and France, together about 95% of landings) are included in the assessment. French age data in 2009-12 were insufficient at older ages to raise the length compositions, so that UK data was used to cover the larger fish.

Consistency

The assessment provided by the WG is highly consistent with the previous assessment conducted in 2012. Fs in 2008 to 2011 have been revised downwards by 3, 5, 7, and 10% respectively with SSB estimates revised up wards by 2, 4, 6, and 8%.

Misreporting

Area misreporting, mainly to Area VIId had declined to low levels in recent years, through a combination of enforcement and a substantial increase in the TAC in 2005. There have also been some attempts to prosecute UK fishermen for misreporting to Area VIIh, although to date none of those prosecutions have been successful for lack of legally acceptable evidence.

Levels of under-reporting are thought to have been serious in the early 1980s prior to the shift to area misreporting. Although it is clear that levels of under-reporting are also much lower now, no quantitative information is available on the size of the problem.

Landings of the UK beam-trawl fleet, historically the main contributors to area misreporting, in 2009–2011 were in line with the TAC, suggesting improved compliance. The decrease in landings is also consistent with a reduction in effort by the main fleet and a reduction in F observed in the plaice VIIe stock, a major bycatch of the sole fishery.

8.3.9 Recommendation for the next benchmark

Year	Candidate Stock	Supporting Justification	Suggested time	Indicate expertise necessary at benchmark meeting.
2012	VIIe Sole	It is likely that the longest survey time-series for this assessment will no longer be available after 2014, and an interim benchmark process should be conducted to determine the likely effects of the loss of information. WKFLAT also asked the review group to re-examine the appropriateness of the shrinkage value used once it was possible to run an appropriate retrospective analysis. The WG did so this year, but felt it would be better to make such changes in conjunction with the above examination.		

8.3.10 Management considerations

Effort restrictions have not been sufficient to ensure an observable decrease in F in recent years. Decommissioning in the UK fleet in 2007–2008 did not reduce fleet capacity sufficiently. UK single area licensing appear to have been effective since 2009 and resulted in the UK fleet utilising fishing opportunities in other ICES divisions so that effective effort and F in Division VIIe dropped markedly. A catch quota scheme based on an assumed 30% discarding by weight is currently running in the UK for beam trawlers. This value is well in excess of the likely discarding in the fleet which was less than 2% by weight. Consequently as this concession continues to be granted to boats participating in the fishery this will lead to additional mortality.

Plaice are taken as a bycatch in this fishery, so that management advice for sole must also take into account the advice for plaice. The effort reductions in 2009 have also positively impacted the plaice stock with a sizeable reduction in F indicated for that stock also. Angler fish, cuttle fish, and lemon sole are also important bycatches in this fishery. The UK beam-trawl fleet has recently started to land sizeable quantities of gurnards for human consumption.

8.3.11 Ecosystem considerations

Beam trawling, especially using chain-mat gear, is known to have a significant impact on the benthic communities, although less so on soft substrates and in areas which have been historically exploited by this fishing method. Discard rates of non-commercial species and commercial species of unmarketable size are substantial, but total discards are lower compared to some other gears due to the relatively small area swept by the gear.

8.3.12 Regulations and their effects

Management of this stock is mainly by TAC. In 2005 effort restrictions were implemented for beam trawlers and entangling gears targeting sole this fishery to enforce the TAC and improve data quality. To date the latter restrictions have not been limiting in this fishery, in part due to the large numbers of days available, but also because in the UK fleet there appears to remain some latent effort/overcapacity in the beam-trawl fleet despite decommissioning. WKFLAT 2012 observed a change in the distribution of the fleet due to multispecies considerations (foregoing higher cpue for sole in favour of taking a larger proportion of other available resources). Under the current pattern of exploitation effort restrictions are commensurate with the TAC as indicated by the negligible contribution of highgrading to the total mortality. However if the availability of other resources such as monk fish, scallops, cuttle fish and lemon sole were to decrease, then economics may drive the fishery back to areas of higher sole cpue in which case current effort restrictions may not be sufficient to ensure an appropriate relationship between TAC and effort restrictions.

In November 2008 the UK introduced a single area licensing scheme for beam trawlers, which is thought to be highly effective in eliminating the current practice of area misreporting by this fleet, but will have had little effect on the fishery in 2008. UK landings and effort data indicate that the measure has been effective since 2009.

Mesh restrictions for towed gears are set to 80 mm codends, which correspond well with the minimum landing size of sole at 24 cm. Consequently there is little discarding of sole in this fishery this view has not changed in spite of the more restrictive TAC on the UK beam-trawl fleet.

8.3.13 Changes in fishing technology and fishing patterns

The UK industry has applied for MSC certification in 2009 commensurate with which it has started to adopt larger codend meshes and square mesh panels to limit the impact on benthic ecosystems. However these changes appear to minimally affect the catch rates of sole, nor is the degree of uptake of these measures in the fleet clear. Changes in fishing pattern to make the most of available opportunities for other species in this multispecies fishery have changed fleet behaviour. To date the evidence suggests that these effects are more substantial than those associated with changes in the fishing gear, but both will need to be monitored in the future.

8.3.14 Changes in the environment

WGRED 2008 overall indicated that there were no consistent environmental drivers altering the ecosystem in Celtic Sea Area, although it did provide some more detailed description of the environmental changes occurring in the system, including climate change, NAO and changes in plankton productivity and species composition.

The winter NAO experienced a strong negative phase in the 1960s, becoming more positive in the 1980s and early 1990s. It remained mainly negative from 1996 to 2004, but became positive in 2005 (6.7 mbar).

Although the assessment only goes back to 1969, relative year class for sole VIIe from catches indicates some very strong recruitment for example in 1963, following which recruitment appears to have declined coinciding with the strong negative phase of the NAO. Positive NAOs in the 1980s and 1990s coincide with some of the highest recruitments seen in the assessment, which have declined since then along with NAO values. Since 2005 the NAO again shows more favourable conditions although this has not immediately resulted in returns very large year classes, there is some evidence that recruitment is higher now, but more consistent so that we aren't seeing the extreme recruitments seen earlier in the time-series.

Table 8.3.1 Sole VIIE Nominal landings (t) as used by the WG

Year	Belgium	Denmark	France	Netherlands	Ireland	Jersey	Guernsey	UK E W NI	UK other	Unallocated	Total
1974			323							104	427
1975	3		271				2	215			491
1976	4		352				1	259			616
1977	3		331					272			606
1978	4		384					453		20	861
1979	1		515				2	663			1181
1980	45		447		13		1	763			1269
1981	16		415	1			4	784		-5	1215
1982	98		321				15	1013		-1	1446
1983	47		405	3		2	16	1025			1498
1984	48		421			9	14	878			1370
1985	58		130			9	8	894		310	1409
1986	62		467			3	6	831		50	1419
1987	48		432			1	5	626		168	1280
1988	67		98			0	4	780		495	1444
1989	69		112	6			3	610		590	1390
1990	41	0	81			1	3	632		556	1315
1991	35		325					477		15	852
1992	41		267				2	457	9	119	895
1993	59		236			1		479	18	111	904
1994	33		257					546		-38	800
1995	21		294			1	2	562		-24	856
1996	8		297					428		91	833
1997	13		348		1	13	13	470		91	949
1998	40		343			17	3	369		108	880
1999	13					18	3	375		548	957
2000	4		241			22	5	386		256	914
2001	19		224			20	5	382		419	1069
2002	33		198			15	5	289		566	1106
2003	1		363		1	15	5	235		458	1078
2004	7		302			7	6	172		581	1075
2005	26		406			17	5	505		80	1039
2006	32		357			4	4	568	0	56	1022
2007	34		384		2	2		525	4	64	1015
2008	28		312		0	2	6	464		96	908
2009	17		386			1	3	374	3	83	701
2010	17		375			2	3	361	2	62	698
2011	22		401			2	4	422		50	801
2012	37		325		0		2	490		-17	871

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's

Age	1969	1970	1971	1972	1973	1974
1	0	0	0	0	0	0
2	89	53	51	146	71	45
3	322	232	200	412	396	349
4	80	322	246	167	433	220
5	148	90	198	115	89	178
6	210	83	65	112	99	71
7	21	112	80	14	120	80
8	50	13	156	25	17	43
9	26	35	10	134	52	32
10	20	52	35	38	30	24
11	9	22	54	54	4	55
+gp	63	113	113	106	136	106
Total	1037	1127	1207	1323	1446	1202
Landings	353	391	432	437	459	427

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1	0	0	0	0	0	0	0	0	0	0
2	82	167	426	250	227	175	245	128	91	333
3	567	419	318	1123	803	559	806	1451	753	663
4	170	472	384	347	811	497	651	916	1573	826
5	199	161	206	214	250	630	467	553	583	758
6	115	135	102	189	229	126	389	352	351	325
7	28	92	70	103	174	183	179	240	267	204
8	53	46	74	72	103	140	126	136	294	129
9	26	58	10	77	90	65	76	113	119	152
10	22	51	24	38	104	56	58	81	73	54
11	24	14	32	27	28	130	55	61	37	28
+gp	171	213	159	203	290	342	211	294	262	255
Total	1456	1830	1804	2644	3108	2902	3262	4324	4401	3727
Landings	491	616	606	861	1181	1269	1215	1446	1498	1370

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1	0	0	0	0	0	0	0	0	0	0
2	287	246	487	443	390	341	450	316	209	97
3	1700	1618	808	1438	871	902	415	1434	704	657
4	756	971	1090	596	1233	581	482	417	1107	558
5	469	421	427	728	497	553	289	297	350	558
6	585	321	204	374	509	244	220	115	219	112
7	179	336	224	153	225	264	93	112	151	106
8	97	84	229	162	110	143	111	61	78	49
9	103	75	47	109	107	103	68	74	60	57
10	85	90	50	39	113	75	37	26	56	44
11	29	74	41	50	48	85	31	23	31	50
+gp	125	127	162	171	214	235	145	90	79	99
Total	4414	4363	3770	4262	4316	3525	2341	2964	3045	2388
Landings	1409	1419	1280	1444	1390	1315	852	895	904	800

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	0	0	0	0	0	0	0	0	0	0
2	95	365	216	265	280	307	145	332	598	398
3	308	445	831	606	915	599	1401	1251	835	1080
4	629	364	724	536	500	751	531	843	953	448
5	427	298	325	336	398	367	497	387	645	445
6	411	235	180	209	255	229	268	322	130	526
7	131	257	194	151	114	107	178	129	74	164
8	101	68	173	80	103	53	100	105	50	116
9	61	61	44	127	54	68	55	94	58	61
10	33	49	20	35	107	51	43	33	63	54
11	18	37	40	34	25	88	42	18	14	35
+gp	142	143	88	162	123	91	159	85	61	85
Total	2356	2321	2835	2543	2874	2710	3419	3599	3482	3412
Landings	856	833	949	880	957	914	1069	1106	1078	1075

Table 8.3.2 Sole VIIE Catch Numbers at Age in 000's continued

Age	2005	2006	2007	2008	2009	2010	2011	2012	geom mean 10-12	arith mean 10-12
1	0	0	0	0	0	0	0	0	0.00	0.00
2	258	500	201	281	166	68	91	37	61.39	65.57
3	468	786	852	752	540	348	499	270	360.60	372.40
4	834	472	755	678	385	394	476	561	472.31	477.21
5	449	606	293	376	333	329	405	409	379.07	380.93
6	366	250	362	163	202	204	233	352	255.78	262.95
7	293	224	179	184	66	127	156	226	165.18	170.01
8	113	185	130	105	74	49	80	131	80.06	86.65
9	80	85	110	71	37	71	39	67	56.99	58.93
10	45	56	55	67	50	20	34	41	30.51	31.75
11	24	31	27	39	35	34	28	38	32.95	33.20
+gp	96	87	99	89	65	78	93	121	95.66	97.21
Total	3027	3282	3062	2805	1955	1723	2136	2252	2023.53	2036.81
Landings	1039	1023	1015	908	701	698	801	871	786.75	790.00

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs

Age	1969	1970	1971	1972	1973
1	0.000	0.000	0.113	0.000	0.000
2	0.188	0.187	0.151	0.194	0.203
3	0.245	0.223	0.222	0.227	0.224
4	0.332	0.294	0.296	0.272	0.262
5	0.329	0.314	0.367	0.369	0.310
6	0.367	0.354	0.350	0.408	0.381
7	0.522	0.434	0.359	0.458	0.414
8	0.455	0.498	0.431	0.495	0.459
9	0.463	0.442	0.455	0.402	0.466
10	0.606	0.512	0.476	0.454	0.537
11	0.647	0.528	0.388	0.508	0.654
+gp	0.660	0.593	0.653	0.600	0.561

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.144	0.142	0.139	0.118	0.000	0.000	0.000	0.000	0.120	0.000
2	0.183	0.181	0.170	0.197	0.180	0.187	0.189	0.174	0.213	0.188
3	0.224	0.214	0.217	0.248	0.241	0.237	0.254	0.226	0.208	0.251
4	0.281	0.299	0.286	0.302	0.303	0.327	0.343	0.322	0.276	0.272
5	0.379	0.358	0.323	0.356	0.390	0.423	0.389	0.382	0.345	0.307
6	0.434	0.403	0.390	0.399	0.439	0.460	0.525	0.478	0.424	0.390
7	0.372	0.435	0.454	0.502	0.377	0.468	0.560	0.515	0.495	0.419
8	0.464	0.497	0.413	0.463	0.486	0.477	0.609	0.534	0.507	0.475
9	0.475	0.591	0.475	0.517	0.489	0.565	0.646	0.599	0.520	0.532
10	0.487	0.651	0.478	0.484	0.488	0.522	0.655	0.620	0.523	0.610
11	0.474	0.535	0.583	0.552	0.540	0.569	0.600	0.710	0.561	0.553
+gp	0.731	0.676	0.628	0.681	0.670	0.725	0.783	0.661	0.659	0.667

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	0.088	0.000	0.106	0.098	0.091	0.110	0.158	0.105	0.088	0.000
2	0.209	0.162	0.174	0.174	0.170	0.167	0.216	0.182	0.166	0.146
3	0.242	0.225	0.237	0.245	0.244	0.222	0.270	0.255	0.238	0.209
4	0.304	0.296	0.297	0.310	0.312	0.275	0.322	0.323	0.305	0.268
5	0.379	0.358	0.354	0.370	0.375	0.326	0.370	0.386	0.366	0.324
6	0.389	0.389	0.407	0.425	0.432	0.375	0.416	0.445	0.423	0.376
7	0.478	0.469	0.456	0.474	0.484	0.422	0.458	0.499	0.474	0.425
8	0.539	0.520	0.502	0.518	0.531	0.467	0.498	0.549	0.520	0.470
9	0.559	0.531	0.544	0.557	0.572	0.510	0.534	0.594	0.561	0.513
10	0.601	0.519	0.583	0.590	0.608	0.551	0.567	0.634	0.597	0.551
11	0.722	0.584	0.618	0.618	0.639	0.590	0.597	0.669	0.627	0.587
+gp	0.639	0.817	0.703	0.665	0.694	0.692	0.664	0.742	0.684	0.672

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	0.122	0.133	0.164	0.000	0.000	0.158	0.141	0.000	0.123	0.101
2	0.183	0.192	0.214	0.186	0.191	0.208	0.201	0.203	0.181	0.173
3	0.241	0.248	0.262	0.244	0.247	0.257	0.257	0.245	0.236	0.241
4	0.295	0.301	0.308	0.300	0.300	0.303	0.309	0.287	0.290	0.306
5	0.347	0.351	0.354	0.354	0.350	0.347	0.357	0.326	0.342	0.367
6	0.396	0.397	0.399	0.406	0.397	0.389	0.400	0.365	0.391	0.425
7	0.442	0.441	0.442	0.455	0.441	0.429	0.440	0.402	0.439	0.479
8	0.484	0.481	0.484	0.503	0.482	0.467	0.475	0.438	0.485	0.530
9	0.524	0.518	0.524	0.548	0.520	0.502	0.507	0.472	0.529	0.577
10	0.561	0.552	0.564	0.592	0.555	0.535	0.534	0.505	0.570	0.620
11	0.595	0.583	0.602	0.633	0.586	0.566	0.557	0.537	0.610	0.660
+gp	0.671	0.652	0.695	0.734	0.661	0.636	0.645	0.615	0.705	0.746

Table 8.3.3 Sole VIIE Catch Weights at Age in kgs continued

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	mean 10-12
1	0.122	0.123	0.106	0.117	0.147	0.094	0.000	0.000	0.000	0.000
2	0.176	0.180	0.168	0.183	0.197	0.176	0.169	0.200	0.152	0.174
3	0.230	0.235	0.226	0.244	0.245	0.252	0.258	0.261	0.233	0.251
4	0.282	0.289	0.280	0.299	0.292	0.322	0.339	0.319	0.305	0.321
5	0.334	0.342	0.331	0.350	0.337	0.385	0.412	0.375	0.369	0.385
6	0.385	0.393	0.378	0.395	0.382	0.443	0.476	0.428	0.425	0.443
7	0.435	0.443	0.421	0.436	0.425	0.494	0.532	0.480	0.471	0.494
8	0.485	0.492	0.461	0.471	0.468	0.540	0.580	0.528	0.510	0.539
9	0.533	0.539	0.497	0.501	0.509	0.579	0.619	0.575	0.539	0.578
10	0.581	0.585	0.529	0.526	0.549	0.612	0.650	0.618	0.561	0.610
11	0.628	0.629	0.558	0.546	0.588	0.639	0.673	0.660	0.574	0.636
+gp	0.756	0.746	0.667	0.616	0.652	0.702	0.699	0.750	0.647	0.699

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs

Age	1969	1970	1971	1972	1973
1	0.040	0.045	0.030	0.055	0.035
2	0.125	0.120	0.090	0.130	0.105
3	0.200	0.195	0.170	0.200	0.170
4	0.270	0.255	0.240	0.265	0.235
5	0.330	0.305	0.295	0.325	0.290
6	0.380	0.355	0.345	0.380	0.340
7	0.425	0.395	0.390	0.420	0.390
8	0.460	0.430	0.420	0.460	0.435
9	0.490	0.465	0.445	0.490	0.475
10	0.520	0.490	0.470	0.520	0.510
11	0.550	0.510	0.490	0.540	0.540
+gp	0.609	0.541	0.544	0.558	0.585

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.040	0.071	0.095	0.086	0.090	0.064	0.052	0.038	0.038	0.040
2	0.125	0.144	0.146	0.156	0.156	0.141	0.125	0.119	0.117	0.120
3	0.200	0.221	0.198	0.221	0.217	0.216	0.206	0.197	0.195	0.195
4	0.265	0.267	0.247	0.278	0.276	0.287	0.288	0.276	0.265	0.250
5	0.320	0.327	0.294	0.332	0.330	0.352	0.360	0.358	0.335	0.307
6	0.370	0.385	0.338	0.382	0.380	0.414	0.436	0.427	0.398	0.365
7	0.410	0.435	0.380	0.425	0.425	0.463	0.513	0.490	0.455	0.420
8	0.455	0.479	0.417	0.462	0.463	0.502	0.575	0.543	0.506	0.475
9	0.490	0.516	0.456	0.497	0.498	0.539	0.620	0.582	0.536	0.520
10	0.515	0.545	0.491	0.527	0.526	0.574	0.650	0.616	0.562	0.570
11	0.530	0.569	0.523	0.553	0.555	0.608	0.674	0.645	0.585	0.615
+gp	0.571	0.628	0.595	0.629	0.630	0.719	0.714	0.699	0.632	0.709

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	0.032	0.095	0.071	0.058	0.050	0.081	0.128	0.065	0.048	0.000
2	0.108	0.150	0.140	0.137	0.131	0.139	0.187	0.144	0.128	0.114
3	0.192	0.204	0.206	0.210	0.208	0.195	0.243	0.219	0.202	0.178
4	0.268	0.258	0.268	0.278	0.278	0.249	0.296	0.290	0.272	0.239
5	0.339	0.311	0.326	0.341	0.344	0.300	0.346	0.355	0.336	0.296
6	0.400	0.364	0.381	0.398	0.404	0.350	0.393	0.416	0.395	0.350
7	0.453	0.416	0.432	0.450	0.459	0.398	0.437	0.473	0.449	0.401
8	0.501	0.468	0.480	0.497	0.508	0.444	0.478	0.524	0.498	0.448
9	0.545	0.520	0.524	0.538	0.552	0.488	0.516	0.572	0.542	0.492
10	0.577	0.571	0.564	0.574	0.591	0.531	0.551	0.614	0.580	0.532
11	0.607	0.621	0.601	0.605	0.624	0.571	0.583	0.652	0.613	0.570
+gp	0.696	0.790	0.691	0.659	0.687	0.675	0.654	0.731	0.677	0.659

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	0.091	0.103	0.139	0.000	0.000	0.132	0.110	0.000	0.094	0.063
2	0.153	0.163	0.189	0.156	0.162	0.183	0.172	0.181	0.152	0.137
3	0.212	0.221	0.238	0.215	0.220	0.233	0.230	0.224	0.209	0.207
4	0.268	0.275	0.285	0.272	0.274	0.280	0.284	0.266	0.263	0.274
5	0.322	0.326	0.331	0.327	0.325	0.326	0.333	0.307	0.316	0.337
6	0.372	0.374	0.376	0.380	0.374	0.369	0.379	0.346	0.367	0.396
7	0.419	0.419	0.420	0.431	0.419	0.410	0.421	0.384	0.415	0.452
8	0.463	0.461	0.463	0.480	0.462	0.448	0.458	0.420	0.462	0.505
9	0.505	0.500	0.504	0.526	0.501	0.485	0.492	0.455	0.507	0.554
10	0.543	0.536	0.544	0.570	0.537	0.519	0.521	0.489	0.550	0.599
11	0.578	0.568	0.583	0.612	0.571	0.551	0.546	0.521	0.591	0.641
+gp	0.659	0.641	0.677	0.717	0.650	0.624	0.643	0.602	0.688	0.732

Table 8.3.4 Sole VIIE Stock Weights at Age in kgs continued

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	mean 10-12
1	0.095	0.094	0.074	0.083	0.122	0.051	0.000	0.000	0.000	0.000
2	0.149	0.152	0.138	0.151	0.172	0.136	0.121	0.169	0.108	0.133
3	0.203	0.208	0.197	0.214	0.221	0.215	0.215	0.231	0.194	0.213
4	0.256	0.263	0.254	0.272	0.268	0.287	0.300	0.290	0.270	0.287
5	0.308	0.316	0.306	0.325	0.315	0.354	0.376	0.347	0.338	0.354
6	0.360	0.368	0.355	0.373	0.360	0.415	0.445	0.402	0.398	0.415
7	0.410	0.419	0.400	0.416	0.404	0.469	0.505	0.454	0.449	0.469
8	0.460	0.468	0.442	0.454	0.447	0.518	0.557	0.504	0.492	0.518
9	0.509	0.516	0.479	0.486	0.489	0.560	0.600	0.552	0.526	0.559
10	0.557	0.562	0.514	0.514	0.529	0.596	0.636	0.597	0.551	0.595
11	0.605	0.607	0.544	0.536	0.569	0.626	0.663	0.639	0.568	0.623
+gp	0.734	0.726	0.661	0.614	0.640	0.698	0.696	0.738	0.648	0.694

Table 8.3.5 Sole VIIE Landings Length Frequency Distributions

Length	UK BeamTrawl	UK other	French Nets	French Trawl
14	0	0	87	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	321
19	0	0	0	0
20	0	0	0	167
21	0	0	175	0
22	71	0	262	925
23	309	135	561	416
24	1807	59	343	29053
25	5873	2526	725	27065
26	15539	6646	1505	46375
27	31957	9396	2523	79136
28	58102	12060	5293	70754
29	74957	12454	7649	71753
30	85858	10093	7424	54011
31	95063	9074	10345	53454
32	90490	10561	9272	52191
33	73280	10634	8848	41861
34	70018	13513	9205	44822
35	67837	9824	5207	22374
36	56662	11645	8826	22173
37	50387	6760	2418	27943
38	35766	7274	2632	20013
39	34430	3902	6175	8945
40	21879	13044	3583	10385
41	17297	7584	4478	15600
42	13758	6058	3207	7317
43	9317	1334	3801	5078
44	6952	722	2671	1962
45	4657	2293	2787	607
46	2347	2012	887	1192
47	1432	485	915	4301
48	1035	957	482	353
49	451	145	180	1992
50	408	179	480	321
51	142	90	572	0
52	30	42	43	0
53	33	42	0	0
54	50	0	178	0
55	0	0	264	0
56	15	42	43	0
57	0	0	0	0
58	0	0	0	0
59	0	0	0	0
60	0	0	0	0
61	0	0	0	0
62	0	0	618	0
Total	928209	171585	114664	722860

Table 8.3.1 Sole VIIE Nominal landings (t) as used by the WG

Year	Belgium	Denmark	France	Netherlands	Ireland	Jersey	Guernsey	UK E W NI	UK other	Unallocated	Total
1974			323							104	427
1975	3		271				2	215			491
1976	4		352				1	259			616
1977	3		331					272			606
1978	4		384					453		20	861
1979	1		515				2	663			1181
1980	45		447		13		1	763			1269
1981	16		415	1			4	784		-5	1215
1982	98		321				15	1013		-1	1446
1983	47		405	3		2	16	1025			1498
1984	48		421			9	14	878			1370
1985	58		130			9	8	894		310	1409
1986	62		467			3	6	831		50	1419
1987	48		432			1	5	626		168	1280
1988	67		98			0	4	780		495	1444
1989	69		112	6			3	610		590	1390
1990	41	0	81			1	3	632		556	1315
1991	35		325					477		15	852
1992	41		267				2	457	9	119	895
1993	59		236			1		479	18	111	904
1994	33		257					546		-38	800
1995	21		294			1	2	562		-24	856
1996	8		297					428		91	833
1997	13		348		1	13	13	470		91	949
1998	40		343			17	3	369		108	880
1999	13					18	3	375		548	957
2000	4		241			22	5	386		256	914
2001	19		224			20	5	382		419	1069
2002	33		198			15	5	289		566	1106
2003	1		363		1	15	5	235		458	1078
2004	7		302			7	6	172		581	1075
2005	26		406			17	5	505		80	1039
2006	32		357			4	4	568	0	56	1022
2007	34		384		2	2		525	4	64	1015
2008	28		312		0	2	6	464		96	908
2009	17		386			1	3	374	3	83	701
2010	17		375			2	3	361	2	62	698
2011	22		401			2	4	422		50	801
2012	37		325		0		2	490		-17	871

Table 8.3.6 Sole VIIE landings, effort & mean standardised CPUE data

Year	Effort BT u24 000s h	Effort BT o24 000s h	Landings BT u24 t	Landings BT o24 t	Survey CPUE kg 100km	BTu24 LPUE kg hour	BTo24 LPUE kg hour	Survey CPUE MS	BTu24 LPUE MS	BTo24 LPUE MS
1988	46.33	60.90	332.79	441.99	74.24	7.18	7.26	1.20	1.58	2.09
1989	35.29	86.80	200.99	520.43	69.36	5.70	6.00	1.12	1.25	1.72
1990	36.35	78.51	238.56	474.06	43.72	6.56	6.04	0.71	1.44	1.74
1991	27.93	64.94	165.12	296.01	72.58	5.91	4.56	1.18	1.30	1.31
1992	29.47	61.95	169.31	291.50	78.13	5.74	4.70	1.27	1.26	1.35
1993	31.08	65.31	199.90	281.75	49.63	6.43	4.31	0.80	1.41	1.24
1994	34.77	73.47	189.29	317.87	40.66	5.44	4.33	0.66	1.20	1.24
1995	31.30	76.80	158.01	328.93	37.78	5.05	4.28	0.61	1.11	1.23
1996	33.16	94.91	164.71	300.93	48.72	4.97	3.17	0.79	1.09	0.91
1997	34.15	88.68	192.26	332.09	63.11	5.63	3.74	1.02	1.24	1.08
1998	43.41	83.09	186.94	306.70	65.83	4.31	3.69	1.07	0.95	1.06
1999	42.82	73.17	185.15	271.41	54.50	4.32	3.71	0.88	0.95	1.07
2000	49.07	79.58	202.29	250.02	51.94	4.12	3.14	0.84	0.91	0.90
2001	65.65	92.42	302.55	300.74	74.67	4.61	3.25	1.21	1.01	0.94
2002	61.55	92.19	293.79	298.56	43.18	4.77	3.24	0.70	1.05	0.93
2003	67.25	107.01	277.64	329.50	50.28	4.13	3.08	0.81	0.91	0.89
2004	56.25	108.64	206.17	239.23	57.99	3.67	2.20	0.94	0.80	0.63
2005	51.49	107.66	198.42	255.15	35.67	3.85	2.37	0.58	0.85	0.68
2006	50.87	110.87	225.31	238.63	49.10	4.43	2.15	0.80	0.97	0.62
2007	65.32	94.07	237.46	213.78	62.91	3.64	2.27	1.02	0.80	0.65
2008	76.21	83.37	222.79	170.25	73.55	2.92	2.04	1.19	0.64	0.59
2009	63.66	58.99	184.35	115.31	77.38	2.90	1.95	1.25	0.64	0.56
2010	74.52	54.00	202.08	93.77	99.20	2.71	1.74	1.61	0.60	0.50
2011	100.70	49.71	257.40	90.10	89.40	2.56	1.81	1.45	0.56	0.52
2012	113.89	35.38	262.36	67.24	79.05	2.30	1.90	1.28	0.51	0.55

Table 8.3.7 Tuning information as used in the assessment

```
W CHANNEL SOLE 2012 WGCSE, 1-14, SEXES COMBINED,
106
UK-CBT-early
1988 2002
1 1 0 1
3 14
107.23 747.49 382.4  497.05 225.59  71.83  70.57 66.73 14.92 24.57 15.09 31.15  7.87
122.09 480.71 603.07 295.68 344.28 124.29  52.66 52.11 48.82 30.47 18.98 21.01 12.79
114.86 478.16 361.27 271.68 174.70 170.90  65.40 49.23 31.81 27.42 14.67 24.04 12.60
 92.87 229.74 240.99 186.87 121.76  52.87  67.89 37.54 17.79 12.29 22.67  5.38  9.83
 91.43 773.74 216.51 152.49  57.61  60.04  28.95 41.72 10.80  7.61  7.45  7.99  7.08
 96.39 382.12 602.61 186.88 114.16  81.18  41.21 31.94 31.52 15.68  4.58 11.85  8.02
108.24 443.52 361.70 347.10  69.39  62.83  30.89 34.86 26.44 29.61 14.09 10.91  5.74
108.10 173.64 357.84 240.49 233.61  71.61  56.73 33.47 18.33 10.07 22.33  9.28  6.44
128.07 239.43 194.61 165.43 133.04 143.67  38.10 34.80 27.59 20.80 22.58 20.66  8.37
122.83 474.85 387.28 181.39  95.01 104.45  92.27 23.00 10.67 21.69  8.71 10.14  7.52
126.50 352.44 311.69 194.66 115.68  83.44  44.32 66.82 18.37 18.30 15.18 16.05  7.08
115.99 471.41 244.17 181.40 114.13  48.08  45.38 23.67 47.22 10.45 17.65  5.01  5.30
128.65 308.67 374.19 177.98 110.37  53.08  26.86 31.31 23.64 41.62  4.51  6.91  2.95
158.07 832.95 295.63 281.48 143.95  95.75  53.72 28.03 23.25 22.22 25.86  9.65  7.28
153.74 775.07 469.78 172.07 172.99  77.14  54.40 23.91 10.98 12.98  7.28 13.62  6.31
UK-CBT-late
2003 2012
1 1 0 1
3 14
174.26 425.77 550.11 423.34  69.80  59.67  33.48 43.96 21.73  7.15  6.69 10.92  9.19
164.89 494.01 207.46 180.26 253.67  38.28  50.45 25.25 20.16 14.39  7.15  3.98  6.39
159.15 223.71 346.97 141.36 165.05 140.46  29.15 34.66 23.97 15.14  8.83  6.32  5.14
161.74 380.29 188.15 245.65  86.37 109.33 107.95 37.56 20.86 13.81 13.74  6.74  3.01
159.39 488.97 280.33 113.45 110.97  58.13  66.53 55.17 16.44 11.91 11.16  9.05  8.76
159.57 314.87 306.44 135.02  72.71  70.10  45.39 42.38 38.92 15.58 12.62  4.60  6.40
122.65 190.42 183.01 153.14  89.78  26.07  27.96 13.26 16.14 12.94  4.86  3.75  1.92
128.52  80.65 180.67 158.21 101.65  52.18  25.40 22.65  8.29 16.83 25.49  7.46  3.90
150.41 241.99 147.50 185.30 120.55  81.07  35.30 15.67 20.10 10.75 14.01  8.20  2.08
149.27 106.64 254.62 114.54 118.37  75.51  54.60 25.11 14.79 12.42  7.15 10.17  9.04
UK-COT
1988 2012
1 1 0 1
3 14
53402 33.38 16.95 20.78  9.30 2.75 2.75 1.98 0.38 0.82 0.43 0.93 0.27
54707 16.22 19.72  9.91 12.63 5.08 2.60 2.54 2.16 1.51 1.20 1.07 0.70
53050 19.09 13.10  9.60  6.35 5.76 2.17 1.91 1.16 0.94 0.65 1.00 0.53
40789 10.04  7.04  4.12  2.46 0.96 1.44 0.42 0.41 0.24 0.27 0.08 0.18
39909 26.15  5.98  3.59  1.19 1.14 0.48 0.65 0.17 0.09 0.07 0.17 0.10
39240 12.22 17.24  5.29  3.38 2.44 1.24 0.98 0.90 0.55 0.13 0.32 0.29
38768 12.67 11.69 12.60  2.55 2.65 1.25 1.38 1.05 1.20 0.63 0.46 0.27
35453  5.26  9.75  6.34  6.18 1.89 1.49 0.91 0.52 0.25 0.59 0.32 0.18
30541  9.46  6.52  4.36  3.14 3.53 0.95 0.75 0.67 0.45 0.44 0.42 0.18
33281 15.05  8.74  4.75  2.81 2.88 2.52 0.62 0.28 0.43 0.31 0.26 0.27
29802  8.50  7.38  4.14  2.42 1.49 0.90 1.43 0.31 0.43 0.37 0.34 0.12
27516 11.35  5.73  4.83  2.84 1.42 1.44 0.72 1.47 0.38 0.56 0.19 0.19
30493  6.40  8.07  3.87  2.53 1.19 0.57 0.77 0.59 0.95 0.09 0.20 0.05
31900 17.90  5.23  4.93  2.67 1.99 1.11 0.70 0.51 0.50 0.65 0.24 0.22
28346  9.77  6.05  2.36  2.64 1.26 0.81 0.33 0.20 0.24 0.17 0.27 0.10
25060  4.49  5.72  4.67  1.01 0.83 0.47 0.52 0.26 0.12 0.15 0.22 0.17
25584  5.98  2.55  2.20  3.21 0.45 0.57 0.29 0.24 0.18 0.13 0.07 0.09
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21129  6.34  9.41  3.47  4.07 3.39 0.73 0.89 0.57 0.45 0.25 0.19 0.14
21058  6.85  3.24  4.08  1.34 1.61 1.73 0.59 0.30 0.20 0.19 0.12 0.05
22347  9.16  5.35  2.26  2.28 1.17 1.39 1.11 0.35 0.21 0.23 0.20 0.20
19855  5.58  4.81  2.06  1.14 1.17 0.74 0.74 0.70 0.31 0.23 0.11 0.10
21412  7.94  5.45  3.91  2.16 0.64 0.82 0.39 0.52 0.44 0.18 0.12 0.08
26062  2.70  5.84  4.73  3.14 1.63 0.81 0.73 0.30 0.59 0.83 0.28 0.16
25161  6.46  3.29  3.86  2.44 1.62 0.58 0.31 0.37 0.19 0.36 0.18 0.06
25640  3.81  8.24  3.57  3.65 2.07 1.58 0.74 0.44 0.41 0.30 0.39 0.32
UK-WEC-BTS
1988 2012
1 1 0.75 0.8
1 9
128.2  2  39 129  52 75 22  0 12  3
165.7  5  56 120 107 34 40 17  5  7
175.7 23  52  76  31 24  7 15  3  6
171.7 11 231  79  51 23 21  5 17  4
196.6  5 140 316  44 36 12  7  5 11
189.2  5  54 115 105 14 10  9  3  3
205.9  6  47 106  62 44  5  5  2  3
187.2 14  37  44  42 26 31  4  5  5
184.4 28 112  67  25 32 20 17  3  2
184.7 11 130 126  43 14 16 13 14  5
185.5 11 141 114  76 22 10 14  6  8
187.9 11  97 128  47 23  8  4  4  4
180.4 12 136  70  52 23 16  5  3  5
178.0  9 197 162  52 31 12 12  4  1
180.0  6  37 113  48 27  6  3  2  0
170.7 23 158  57  50 19  4  4  6  1
164.9 16 110 120  24 15 10 16  9  4
186.6  8 110  39  53 12 12  6  2  4
184.7  5 120  95  26 37 10  7  9  0
181.0  7 188 135  50 11 23  3  3  1
174.7 10  85 158  77 40  2 14  3  6
172.0 11 104 126  96 49 13 13 12  1
179.9 20 175 154  84 59 31 20  7 12
176.2  9 156 231  62 39 25 24  8  2
179.7  3  47 162 125 40 27 13  3  6
Q1SWBeam-offset
2005 2012
1 1 0.95 1
1 14
1  94001 113998  62225 103018 48544 54439 56793 22432 27006 35279  3988 12146  3120 10522
1  92172 239570 101387  18155 62736 16883 23594 32739 20652 29497  1810  6856  9460  4558
1 101385 185010 151595  78338 60931 20751 51105 43538 33596 16775 11018 15347 10556  4558
1  27993 154131 110973  80631 44529 15942 21406  6701 29431 40894  5123  3291  1832  4750
1 157202 171595 174803  87035 64353 51894 15281 16685 10263  8762 13813  5350  4657  4373
1  85753 159546 110635  83064 37066 23554 31016 15019  3677  8563  7567  2159  2773   867
1  17757 150426 166151  66950 53531 62480 30847 20671   918  9631 15150  1802  6735   717
1  31496  91692 135576 125773 76255 55079 56086 43514 31270  8292 30422  4899 20834  4815


FSP-UK
2004 2012
1 1 0.7 0.75
2 11
1  0.130 0.663 0.288 0.337 0.115 0.027 0.087 0.027 0.008 0.012
1  0.102 0.208 0.269 0.119 0.159 0.134 0.036 0.032 0.014 0.018
1  0.146 0.335 0.152 0.202 0.09  0.107 0.117 0.025 0.021 0.017
```

1	0.150	0.496	0.203	0.067	0.1	0.051	0.057	0.087	0.018	0.014
1	0.150	0.264	0.205	0.1	0.041	0.027	0.014	0.029	0.03	0.002
1	0.094	0.246	0.227	0.127	0.052	0.032	0.025	0.03	0.025	0.022
1	0.104	0.201	0.227	0.157	0.092	0.034	0.035	0.037	0.024	0.028
1	0.026	0.231	0.259	0.173	0.142	0.069	0.031	0.012	0.01	0.011
1	0.065	0.335	0.399	0.165	0.109	0.034	0.038	0.027	0.006	0.008

Updated sk 09/05/13

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics
FLR XSA Diagnostics 2013-05-11 09:32:15

CPUE data from index.final
Catch data for 44 years. 1969 to 2012. Ages 1 to 12.

fleet	first age	last age	first year	last year	alpha	beta
UK-CBT-early	3	11	1988	2002	0	1
UK-CBT-late	3	11	2003	2012	0	1
UK-COT	3	11	1988	2012	0	1
UK-WEC-BTS	1	9	1988	2012	0.75	0.8
Q1SWBeam-offset	1	11	2005	2012	0.95	1
FSP-UK	2	11	2004	2012	0.7	0.75

Time series weights :
Tapered time weighting not applied

Catchability analysis :
Catchability independent of size for all ages
Catchability independent of age for ages >5

Terminal population estimation :
Survivor estimates shrunk towards the mean F
of the final 3 years or
the 5 oldest ages.
S.E. of the mean to which the estimates are shrunk = 0.5
min. S.E. for population estimates derived from each fleet = 0.6

Regression weights
Year

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	1	1	1	1	1	1	1	1	1

Estimated population abundance at 1st Jan 2013
Age

1	2	3	4	5	6	7	8	9	10	11	12
0	1389	1497	2137	2372	957	933	671	457	234	97	104

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for UK-CBT-early

Fleet q-residuals

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
3	0.338	0.233	0.303	-0.007	0.271	0.107	0.262	-0.376	-0.609	0.095	-0.120	-0.018	-0.304	-0.154	-0.021
4	0.258	0.359	0.283	0.082	0.108	0.177	0.108	0.277	-0.314	0.087	-0.156	-0.229	-0.133	-0.384	-0.523
5	0.322	0.356	0.237	0.265	0.027	0.346	-0.118	0.096	-0.235	0.061	-0.204	-0.221	-0.256	-0.176	-0.498
6	0.400	0.387	0.527	0.245	-0.473	0.185	-0.259	-0.071	-0.161	-0.284	0.162	-0.156	-0.324	-0.127	-0.052
7	-0.139	0.196	0.238	-0.007	-0.046	0.169	-0.123	0.156	-0.361	0.082	-0.033	-0.124	-0.637	-0.240	-0.260
8	-0.044	-0.150	0.156	-0.081	-0.247	-0.118	-0.563	0.181	-0.215	-0.416	-0.382	-0.093	-0.377	-0.482	-0.326
9	-0.078	0.005	0.383	0.332	-0.242	0.184	-0.039	-0.177	-0.023	-0.296	-0.425	-0.584	-0.079	-0.086	-0.814
10	-0.643	-0.096	0.104	0.139	-0.504	-0.273	0.350	-0.336	-0.158	-0.802	-0.153	-0.311	-0.316	-0.065	-0.439
11	-0.010	0.367	-0.049	-0.132	-0.250	0.198	-0.123	-0.177	0.003	0.088	0.087	-0.189	-0.099	-0.117	-0.152

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11
MeanLogq	-6.6286	-6.419	-6.3849	-6.4567	-6.4567	-6.4567	-6.4567	-6.4567	-6.4567
S.ELogq	0.2759	0.272	0.2664	0.3	0.2366	0.2186	0.319	0.3027	0.1648

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for UK-CBT-late

Fleet q-residuals

Age	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
3	0.462	0.329	0.229	0.323	0.506	0.128	-0.145	-0.841	-0.299	-0.692
4	0.465	-0.096	0.149	0.164	0.184	0.149	-0.117	-0.256	-0.381	-0.262
5	0.311	-0.191	-0.051	0.243	0.127	-0.102	0.074	-0.043	-0.111	-0.257
6	-0.422	0.308	0.184	-0.062	0.005	0.166	0.173	-0.045	-0.145	-0.162
7	-0.184	-0.631	0.209	0.191	0.041	0.036	-0.220	-0.062	-0.123	-0.267
8	-0.214	0.032	-0.457	0.358	0.115	0.303	-0.234	0.010	-0.285	-0.188
9	0.409	-0.116	0.118	0.224	0.106	0.018	-0.245	-0.148	-0.317	-0.296
10	0.181	0.124	0.268	0.044	-0.105	0.129	-0.366	-0.470	-0.085	0.006
11	0.169	0.420	0.326	0.125	-0.081	0.371	-0.388	-0.066	-0.037	-0.219

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11
MeanLogq	-7.4201	-7.1309	-7.1001	-7.1183	-7.1183	-7.1183	-7.1183	-7.1183	-7.1183
S.ELogq	0.4769	0.2632	0.1847	0.2153	0.2478	0.2643	0.2404	0.2368	0.2661

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for UK-COT

Fleet q-residuals

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
3	0.440	0.160	0.368	0.199	0.226	0.076	0.246	-0.244	0.107	0.462	0.115	0.208	-0.227	0.119	-0.190	-0.429	-0.499	0.407	0.067	0.215	-0.099	0.145	-0.920	-0.413	-0.540
4	0.415	0.317	0.315	-0.052	-0.077	0.098	0.279	0.365	0.300	0.178	0.122	0.033	0.046	-0.243	-0.609	-0.298	-0.768	0.425	0.005	0.054	-0.057	-0.021	-0.228	-0.533	-0.067
5	0.456	0.374	0.277	-0.116	-0.282	0.291	0.204	0.186	0.173	0.335	0.002	0.203	-0.034	-0.009	-0.485	-0.361	-0.837	0.157	0.080	0.072	-0.304	0.047	-0.061	-0.299	-0.068
6	0.485	0.461	0.562	-0.257	-0.947	0.140	0.040	-0.012	0.102	0.078	0.317	0.166	-0.083	0.062	0.033	-0.803	-0.283	0.415	-0.275	-0.001	0.009	0.107	-0.012	-0.342	0.036
7	-0.127	0.378	0.197	-0.616	-0.604	0.140	0.315	0.213	-0.057	0.373	-0.036	0.370	-0.419	0.063	-0.107	-0.605	-1.296	0.420	-0.073	0.015	-0.058	-0.267	-0.017	-0.334	-0.187
8	-0.016	0.221	0.099	-0.535	-0.941	-0.147	-0.167	0.233	0.104	-0.134	-0.257	0.472	-0.213	-0.184	-0.266	-0.625	-0.673	-0.210	0.178	0.127	0.186	-0.103	0.075	-0.691	-0.054
9	-0.322	0.363	0.483	-0.761	-0.998	0.175	0.335	-0.090	0.150	-0.027	-0.247	-0.061	0.232	0.401	-0.830	-0.174	-0.804	0.390	0.024	0.080	-0.031	-0.111	-0.072	-0.538	-0.144
10	-1.039	0.165	0.141	-0.232	-1.250	-0.354	0.727	-0.207	0.134	-0.560	-0.212	0.235	0.010	0.292	-0.177	-0.391	-0.528	0.463	-0.244	-0.075	0.109	-0.141	-0.279	-0.378	0.168
11	-0.136	0.741	-0.073	-0.669	-1.282	0.323	0.274	-0.181	0.180	0.050	0.358	0.512	0.138	0.265	0.125	-0.064	-0.183	0.744	-0.156	-0.240	0.453	-0.109	0.094	-0.370	0.047

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11
MeanLogq	-16.0499	-15.9028	-15.9038	-15.9411	-15.9411	-15.9411	-15.9411	-15.9411	-15.9411
S.ELogq	0.3503	0.3146	0.2999	0.3541	0.3985	0.3398	0.4127	0.4309	0.429

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for UK-WEC-BTS

Fleet q-residuals

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1	-1.184	-0.253	0.295	0.170	-0.617	-0.209	-0.479	0.302	1.181	-0.042	0.194	-0.446	-0.128	-0.055	-0.824	1.218	0.545	-0.406	-0.728	-0.388	0.251	0.004	0.972	0.773	-0.147
2	-0.511	-0.397	-0.244	0.299	0.268	-0.527	-0.398	-0.922	0.095	0.389	0.174	0.046	-0.231	0.326	-0.959	0.215	0.559	0.023	0.026	0.581	-0.178	0.272	0.358	0.692	0.044
3	0.232	0.365	-0.131	0.090	0.412	0.023	-0.017	-0.533	-0.482	0.167	0.158	-0.003	-0.339	-0.107	-0.294	-0.509	-0.074	-0.679	-0.192	0.096	0.347	0.079	0.434	0.458	0.496
4	0.404	0.719	-0.263	0.227	0.058	0.073	0.006	-0.077	-0.432	-0.181	0.354	-0.053	-0.120	0.067	-0.669	-0.295	-0.674	-0.280	-0.330	-0.040	0.277	0.456	0.195	0.174	0.403
5	0.849	0.525	0.025	0.136	0.396	-0.303	-0.262	-0.084	0.336	-0.303	-0.191	-0.179	-0.050	0.105	0.086	-0.912	-0.823	-0.785	0.117	-0.446	0.462	0.438	0.469	0.014	0.379
6	0.780	0.815	-0.226	0.733	0.004	-0.060	-0.711	0.202	0.428	0.368	0.218	-0.432	0.257	0.152	-0.683	-1.112	-0.714	-0.396	-0.146	0.530	-1.318	0.080	0.588	0.281	0.363
7	NA	0.788	0.245	-0.145	-0.125	0.154	-0.462	-0.409	-0.026	0.467	0.663	-0.218	-0.515	0.433	-0.812	-0.725	0.685	-0.906	-0.495	-0.827	0.538	0.903	0.811	0.659	-0.031
8	0.876	0.052	-0.452	0.744	0.060	-0.578	-1.139	0.070	-0.276	0.120	0.067	-0.132	-0.067	-0.353	-0.927	0.235	0.500	-1.103	-0.066	-0.929	-0.284	0.741	0.542	0.230	-1.106
9	-0.524	0.571	0.783	0.349	0.477	0.006	-0.296	0.209	-0.381	0.611	-0.098	-0.016	0.630	-0.642	NA	-1.173	0.225	-0.003	NA	-1.848	0.135	-1.006	1.061	-0.372	0.256

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9
MeanLogq	-11.2044	-8.7242	-8.3152	-8.6055	-8.8442	-9.1885	-9.1885	-9.1885	-9.1885
S.ELogq	0.6093	0.4382	0.3359	0.3461	0.4444	0.5783	0.5848	0.5935	0.6805

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for Q1SWBeam-offset

Fleet q-residuals

Age	2005	2006	2007	2008	2009	2010	2011	2012
1	0.028	0.146	0.225	-0.815	0.553	0.361	-0.635	0.137
2	-0.419	0.239	0.053	-0.125	0.211	-0.259	0.113	0.188
3	-0.266	-0.186	0.133	-0.124	0.257	-0.008	-0.005	0.199
4	0.235	-0.844	0.240	0.102	0.092	-0.040	0.025	0.191
5	0.022	0.049	0.644	-0.100	0.007	-0.660	-0.347	0.385
6	0.323	-0.423	-0.381	-0.102	0.574	-0.546	0.318	0.238
7	0.546	-0.087	1.198	0.105	0.161	0.399	0.032	0.587
8	0.516	0.417	0.910	-0.327	0.169	0.448	0.301	0.716
9	1.112	0.905	0.831	0.842	0.423	-0.964	-2.027	1.055
10	1.888	1.666	1.190	1.384	-0.056	0.504	0.292	0.606
11	0.211	-0.647	1.051	0.578	0.584	0.093	1.479	1.837

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11
MeanLogq	2.9821	3.9242	3.9455	3.7727	3.982	3.8305	3.8305	3.8305	3.8305	3.8305	3.8305
S.ELogq	0.4774	0.2423	0.1868	0.3552	0.4021	0.418	0.4144	0.3719	1.1458	0.6967	0.7976

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

XSA fleet diagnostics for FSP-UK

Fleet q-residuals

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012
2	0.546	-0.106	0.156	0.273	0.271	0.037	-0.249	-1.208	0.280
3	0.548	0.032	0.095	0.404	-0.168	-0.292	-0.293	-0.556	0.230
4	0.306	-0.041	0.038	-0.057	-0.194	-0.142	-0.224	0.165	0.148
5	0.607	-0.056	0.238	-0.233	-0.249	-0.248	-0.145	-0.110	0.197
6	-0.192	0.393	0.245	0.170	-0.159	-0.407	-0.149	0.172	-0.072
7	-0.709	0.406	0.427	0.177	-0.667	-0.066	-0.485	-0.131	-0.899
8	0.851	-0.006	0.695	0.193	-0.608	-0.395	0.327	-0.261	-0.395
9	0.218	0.282	0.087	0.795	-0.144	0.525	0.359	-0.427	-0.068
10	-0.501	-0.031	0.319	0.246	0.094	0.024	0.578	-0.634	-0.716
11	0.562	0.730	0.593	0.308	-1.398	0.088	0.437	0.166	-0.489

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11
MeanLogq	-10.3587	-9.0495	-8.9216	-8.9833	-9.0942	-9.0942	-9.0942	-9.0942	-9.0942	-9.0942
S.ELogq	0.5102	0.3593	0.1793	0.291	0.2569	0.4962	0.5103	0.3681	0.4515	0.6712

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2011 at terminal Age 1

Source	Age 1
fshk	1
	0.0000
FSP-UK	1
	0.0000
Q1SWBeam-offset	1592
	2.7778
UK-CBT-late	1
	0.0000
UK-COT	1
	0.0000
UK-WEC-BTS	1199
	2.5900

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	NaN	NA	NA	NA	0	NA	0.000
FSP-UK	NaN	NA	NA	NA	0	NA	0.000
Q1SWBeam-offset	1592	0.600	Inf	Inf	1	0.517	0.000
UK-CBT-late	NaN	NA	NA	NA	0	NA	0.000
UK-COT	NaN	NA	NA	NA	0	NA	0.000
UK-WEC-BTS	1199	0.621	NaN	NaN	1	0.483	0.000

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
1389	0.432	0.142	2	Var Ratio	0.000

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2010 at terminal Age 2

Source	Age 1	Age 2
fshk	1	998
	0.0000	4.0000
FSP-UK	1	1981
	0.0000	2.7138
Q1SWBeam-offset	794	1806
	2.7138	2.7138
UK-CBT-late	1	1
	0.0000	0.0000
UK-COT	1	1
	0.0000	0.0000
UK-WEC-BTS	3243	1565
	2.5303	2.7138

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	998	0.494	NaN	NaN	1	0.230	0.035
FSP-UK	1981	0.600	NaN	NaN	1	0.156	0.018
Q1SWBeam-offset	1197	0.424	0.411	0.969	2	0.312	0.029
UK-CBT-late	NaN	NA	NA	NA	0	NA	0.000
UK-COT	NaN	NA	NA	NA	0	NA	0.000
UK-WEC-BTS	2224	0.432	0.364	0.844	2	0.302	0.016

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
1497	0.237	0.222	6	Var Ratio	0.023

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2009 at terminal Age 3

Source	Age 1	Age 2	Age 3
fshk	1	1	1539
	0.0000	0.0000	4.0000
FSP-UK	1	639	2690
	0.0000	2.4010	2.4799
Q1SWBeam-offset	3068	2393	2608
	2.4010	2.4010	2.4799
UK-CBT-late	1	1	1070
	0.0000	0.0000	2.4799
UK-COT	1	1	1245
	0.0000	0.0000	2.4799
UK-WEC-BTS	5650	4270	3511
	2.2387	2.4010	2.4799

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	1539	0.472	NaN	NaN	1	0.142	0.154
FSP-UK	1326	0.424	0.719	1.694	2	0.173	0.177
Q1SWBeam-offset	2675	0.346	0.072	0.209	3	0.258	0.092
UK-CBT-late	1070	0.600	NaN	NaN	1	0.088	0.215
UK-COT	1245	0.600	Inf	Inf	1	0.088	0.187
UK-WEC-BTS	4355	0.350	0.137	0.391	3	0.252	0.057

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
2137	0.177	0.185	11	Var Ratio	0.113

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2008 at terminal Age 4

Source	Age 1	Age 2	Age 3	Age 4
fshk	1	1	1	2303
	0.0000	0.0000	0.0000	4.0000
FSP-UK	1	1849	1361	2750
	0.0000	1.9444	1.9753	2.2676
Q1SWBeam-offset	4121	1830	2360	2870
	1.9444	1.9444	1.9753	2.2676
UK-CBT-late	1	1	1759	1826
	0.0000	0.0000	1.9753	2.2676
UK-COT	1	1	1569	2218
	0.0000	0.0000	1.9753	2.2676
UK-WEC-BTS	2382	3394	3750	3549
	1.8130	1.9444	1.9753	2.2676

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	2303	0.452	NaN	NaN	1	0.115	0.208
FSP-UK	1939	0.347	0.207	0.595	3	0.178	0.243
Q1SWBeam-offset	2680	0.301	0.168	0.558	4	0.234	0.181
UK-CBT-late	1794	0.425	0.019	0.044	2	0.122	0.260
UK-COT	1888	0.425	0.173	0.406	2	0.122	0.248
UK-WEC-BTS	3251	0.303	0.099	0.328	4	0.230	0.152

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
2372	0.147	0.071	16	Var Ratio	0.203

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2007 at terminal Age 5

Source	Age 1	Age 2	Age 3	Age 4	Age 5
fshk	1	1	1	1	1496
	0.0000	0.0000	0.0000	0.0000	4.0000
FSP-UK	1	993	714	1129	1165
	0.0000	1.2398	1.3114	1.5137	1.9748
Q1SWBeam-offset	423	1181	949	981	1406
	1.2398	1.2398	1.3114	1.5137	1.9748
UK-CBT-late	1	1	413	654	740
	0.0000	0.0000	1.3114	1.5137	1.9748
UK-COT	1	1	381	562	894
	0.0000	0.0000	1.3114	1.5137	1.9748
UK-WEC-BTS	1230	1256	1477	1139	1398
	1.1560	1.2398	1.3114	1.5137	1.9748

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	1496	0.422	NaN	NaN	1	0.117	0.231
FSP-UK	1006	0.305	0.109	0.358	4	0.177	0.326
Q1SWBeam-offset	962	0.273	0.201	0.735	5	0.213	0.339
UK-CBT-late	607	0.352	0.171	0.487	3	0.141	0.494
UK-COT	612	0.352	0.248	0.704	3	0.141	0.490
UK-WEC-BTS	1301	0.275	0.047	0.171	5	0.211	0.261

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
957	0.13	0.097	21	Var Ratio	0.340

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2006 at terminal Age 6

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
fshk	1	1	1	1	1	1329
	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
FSP-UK	1	1224	697	746	836	868
	0.0000	1.0437	1.1249	1.3477	1.6039	2.0448
Q1SWBeam-offset	1168	823	1207	897	659	1183
	1.0437	1.0437	1.1249	1.3477	1.6039	2.0448
UK-CBT-late	1	1	807	722	835	793
	0.0000	0.0000	1.1249	1.3477	1.6039	2.0448
UK-COT	1	1	1078	742	691	967
	0.0000	0.0000	1.1249	1.3477	1.6039	2.0448
UK-WEC-BTS	633	781	1010	1133	946	1342
	0.9732	1.0437	1.1249	1.3477	1.6039	2.0448

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	1329	0.429	NaN	NaN	1	0.101	0.224
FSP-UK	849	0.277	0.085	0.307	5	0.180	0.331
Q1SWBeam-offset	964	0.253	0.104	0.411	6	0.206	0.297
UK-CBT-late	790	0.307	0.030	0.097	4	0.154	0.352
UK-COT	852	0.307	0.102	0.331	4	0.154	0.330
UK-WEC-BTS	999	0.255	0.107	0.422	6	0.205	0.288

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
933	0.12	0.057	26	Var Ratio	0.306

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2005 at terminal Age 7

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
fshk	1	1	1	1	1	1	888
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
FSP-UK	1	881	567	582	580	796	273
	0.0000	0.8430	0.8896	1.1539	1.3872	1.7144	2.1027
Q1SWBeam-offset	776	707	592	735	347	922	1206
	0.8430	0.8430	0.8896	1.1539	1.3872	1.7144	2.0630
UK-CBT-late	1	1	762	597	642	580	514
	0.0000	0.0000	0.8896	1.1539	1.3872	1.7144	2.1027
UK-COT	1	1	607	656	631	476	556
	0.0000	0.0000	0.8896	1.1539	1.3872	1.7144	2.1027
UK-WEC-BTS	324	1199	949	1058	1071	888	650
	0.7860	0.8430	0.8896	1.1539	1.3872	1.7144	2.1027

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	888	0.435	NaN	NaN	1	0.090	0.217
FSP-UK	532	0.258	0.190	0.735	6	0.182	0.339
Q1SWBeam-offset	751	0.241	0.163	0.677	7	0.201	0.252
UK-CBT-late	593	0.280	0.061	0.219	5	0.163	0.309
UK-COT	570	0.280	0.058	0.208	5	0.163	0.320
UK-WEC-BTS	823	0.242	0.145	0.599	7	0.200	0.232

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
671	0.112	0.062	31	Var Ratio	0.278

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2004 at terminal Age 8

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8
fshk	1	1	1	1	1	1	1	542
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
FSP-UK	1	535	685	377	357	394	401	308
	0.0000	0.5536	0.6246	0.8237	1.1442	1.4508	1.7726	2.1825
Q1SWBeam-offset	470	581	522	506	460	265	472	936
	0.5536	0.5536	0.6246	0.8237	1.1442	1.4508	1.7392	2.1825
UK-CBT-late	1	1	758	531	492	437	404	379
	0.0000	0.0000	0.6246	0.8237	1.1442	1.4508	1.7726	2.1825
UK-COT	1	1	567	432	479	452	327	433
	0.0000	0.0000	0.6246	0.8237	1.1442	1.4508	1.7726	2.1825
UK-WEC-BTS	305	469	504	604	708	823	884	151
	0.5162	0.5536	0.6246	0.8237	1.1442	1.4508	1.7726	2.0473

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	542	0.443	NaN	NaN	1	0.086	0.207
FSP-UK	388	0.250	0.087	0.347	7	0.184	0.278
Q1SWBeam-offset	519	0.238	0.152	0.637	8	0.195	0.215
UK-CBT-late	448	0.264	0.085	0.321	6	0.172	0.245
UK-COT	425	0.264	0.070	0.265	6	0.172	0.257
UK-WEC-BTS	476	0.239	0.257	1.075	8	0.192	0.232

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
457	0.109	0.056	36	Var Ratio	0.241

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2003 at terminal Age 9

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9
fshk	1	1	1	1	1	1	1	1	233
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
FSP-UK	1	211	258	221	183	156	144	181	219
	0.0000	0.3585	0.3843	0.5071	0.7677	1.0700	1.3977	1.7756	2.1846
Q1SWBeam-offset	1	154	195	298	212	416	349	317	673
	0.0000	0.3585	0.3843	0.5071	0.7677	1.0700	1.3713	1.7756	0.5003
UK-CBT-late	1	1	324	282	212	279	220	176	174
	0.0000	0.0000	0.3843	0.5071	0.7677	1.0700	1.3977	1.7756	2.1846
UK-COT	1	1	251	247	173	261	230	117	203
	0.0000	0.0000	0.3843	0.5071	0.7677	1.0700	1.3977	1.7756	2.1846
UK-WEC-BTS	404	240	193	225	372	254	527	295	303
	0.3343	0.3585	0.3843	0.5071	0.7677	1.0700	1.3977	1.6656	1.6201

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	233	0.443	NaN	NaN	1	0.092	0.241
FSP-UK	186	0.248	0.064	0.260	8	0.194	0.293
Q1SWBeam-offset	318	0.259	0.129	0.497	8	0.155	0.182
UK-CBT-late	209	0.257	0.083	0.323	7	0.186	0.265
UK-COT	192	0.257	0.116	0.450	7	0.186	0.286
UK-WEC-BTS	318	0.244	0.100	0.410	9	0.187	0.182

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
234	0.111	0.041	40	Var Ratio	0.240

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2002 at terminal Age 10

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10
fshk	1	1	1	1	1	1	1	1	1	185
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
FSP-UK	1	167	100	101	77	83	91	135	63	47
	0.0000	0.2316	0.2712	0.3488	0.5120	0.7536	1.0615	1.2995	1.5929	1.9880
Q1SWBeam-offset	1	1	74	42	185	88	114	152	13	178
	0.0000	0.0000	0.2712	0.3488	0.5120	0.7536	1.0415	1.2995	0.3648	0.4289
UK-CBT-late	1	1	122	114	110	115	78	98	71	98
	0.0000	0.0000	0.2712	0.3488	0.5120	0.7536	1.0615	1.2995	1.5929	1.9880
UK-COT	1	1	146	98	104	98	74	105	57	115
	0.0000	0.0000	0.2712	0.3488	0.5120	0.7536	1.0615	1.2995	1.5929	1.9880
UK-WEC-BTS	328	170	49	70	62	26	239	167	67	1
	0.2159	0.2316	0.2712	0.3488	0.5120	0.7536	1.0615	1.2189	1.1813	0.0000

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	185	0.423	NaN	NaN	1	0.104	0.189
FSP-UK	77	0.240	0.134	0.557	9	0.209	0.404
Q1SWBeam-offset	100	0.274	0.263	0.959	8	0.130	0.325
UK-CBT-late	92	0.246	0.067	0.270	8	0.203	0.348
UK-COT	90	0.246	0.105	0.428	8	0.203	0.354
UK-WEC-BTS	98	0.248	0.269	1.086	9	0.150	0.331

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
97	0.11	0.091	43	Var Ratio	0.334

Table 8.3.8 Sole VIIE XSA detailed survivor diagnostics continued

Year Class 2001 at terminal Age 11

Source	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
fshk	1	1	1	1	1	1	1	1	1	1	111
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.0000
FSP-UK	1	1	180	100	132	123	53	70	149	55	64
	0.0000	0.0000	0.1629	0.2201	0.3144	0.4793	0.7331	1.0433	1.2862	1.7043	1.4397
Q1SWBeam-offset	1	1	1	132	109	71	116	123	40	139	654
	0.0000	0.0000	0.0000	0.2201	0.3144	0.4793	0.7193	1.0433	0.2945	0.3677	0.5915
UK-CBT-late	1	1	145	121	133	105	108	82	90	96	84
	0.0000	0.0000	0.1629	0.2201	0.3144	0.4793	0.7331	1.0433	1.2862	1.7043	2.0632
UK-COT	1	1	63	159	113	104	98	94	97	71	109
	0.0000	0.0000	0.1629	0.2201	0.3144	0.4793	0.7331	1.0433	1.2862	1.7043	2.0632
UK-WEC-BTS	46	129	97	79	117	177	178	218	301	1	1
	0.1343	0.1441	0.1629	0.2201	0.3144	0.4793	0.7331	0.9787	0.9538	0.0000	0.0000

Source	Survivors	int s.e.	ext s.e.	Var Ratio	N	Scaled W	F est.
fshk	111	0.431	NaN	NaN	1	0.113	0.280
FSP-UK	80	0.251	0.144	0.574	9	0.208	0.373
Q1SWBeam-offset	135	0.306	0.276	0.903	8	0.113	0.236
UK-CBT-late	94	0.247	0.049	0.197	9	0.225	0.325
UK-COT	95	0.247	0.066	0.268	9	0.225	0.322
UK-WEC-BTS	181	0.262	0.159	0.606	9	0.116	0.182

term. Surv.	int s.e.	ext s.e.	N	Var. Ratio	F
104	0.116	0.047	45	Var Ratio	0.297

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's

Age	1969	1970	1971	1972	1973	1974	1975
1	1481	4212	2830	2493	3425	3268	3069
2	1871	1340	3812	2560	2256	3099	2957
3	2375	1608	1162	3401	2178	1973	2762
4	624	1843	1235	860	2686	1594	1454
5	964	489	1361	883	619	2018	1233
6	1511	731	357	1043	689	476	1657
7	159	1167	582	262	837	530	363
8	506	124	949	451	223	643	404
9	571	411	100	711	384	186	541
10	261	493	339	81	516	299	138
11	90	217	396	274	37	439	247
+gp	635	1121	819	541	1218	846	1748
Total	11048	13757	13941	13560	15069	15372	16572

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's continued

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	7197	5107	4779	5132	8843	5114	4133	6516	7676	4162
2	2777	6512	4621	4325	4644	8002	4627	3739	5896	6946
3	2597	2353	5487	3943	3697	4035	7007	4066	3297	5017
4	1960	1951	1827	3897	2804	2813	2885	4960	2963	2353
5	1154	1324	1400	1323	2754	2064	1926	1738	2992	1895
6	926	891	1002	1063	960	1893	1424	1216	1019	1987
7	1390	709	708	727	745	749	1343	954	767	613
8	302	1170	576	543	493	500	508	987	609	500
9	315	229	988	453	393	313	332	330	613	428
10	465	230	198	821	324	294	211	193	186	410
11	104	372	185	143	644	240	211	114	106	117
+gp	1590	1855	1376	1482	1687	923	1018	808	945	506
Total	20777	22703	23148	23850	27987	26940	25625	25622	27068	24932

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's continued

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	6359	4128	4046	3086	7737	4290	3740	2585	3735	4391
2	3766	5754	3736	3661	2792	7001	3881	3384	2339	3380
3	6012	3173	4743	2959	2942	2202	5907	3212	2863	2024
4	2923	3901	2102	2924	1849	1804	1598	3981	2237	1966
5	1410	1721	2492	1335	1473	1120	1173	1049	2548	1493
6	1269	876	1151	1563	736	807	738	779	616	1775
7	1241	842	598	685	930	434	521	559	496	451
8	385	804	549	396	406	590	304	364	362	348
9	360	268	509	343	253	231	429	217	255	280
10	289	254	198	357	209	132	145	318	140	176
11	291	176	182	142	216	118	84	106	234	84
+gp	498	695	623	636	594	556	327	269	459	647
Total	24802	22592	20930	18088	20137	19284	18847	16823	16284	17015

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's continued

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	3699	4930	3875	7257	6001	4241	6028	3164	4466	5108
2	3973	3347	4461	3506	6566	5430	3837	5455	2863	4041
3	2968	3248	2823	3784	2906	5649	4775	3156	4367	2213
4	1538	2262	2148	1978	2554	2060	3779	3130	2061	2924
5	1180	1045	1358	1433	1314	1597	1359	2618	1926	1439
6	945	785	636	909	918	840	972	861	1756	1319
7	1215	631	539	377	580	613	506	573	655	1088
8	284	855	387	344	232	423	386	335	448	437
9	220	192	609	274	214	160	287	249	256	295
10	195	141	132	430	196	129	92	170	170	174
11	128	130	108	86	287	129	76	52	94	102
+gp	500	285	506	427	298	484	351	233	227	404
Total	16845	17851	17583	20806	22067	21754	22447	19997	19289	19544

Table 8.3.9 Sole VIIE Stock Numbers at Age in 000's continued

Age	2006	2007	2008	2009	2010	2011	2012	2013 survivors	geom mean 06-12	arith mean 06-12
1	4450	4524	3534	5055	3338	1872	4345[a]	0	3202	3472
2	4622	4026	4093	3198	4574	3020	1694	3931	3440	3604
3	3411	3706	3452	3436	2736	4074	2646	1497	3317	3352
4	1556	2339	2543	2408	2595	2145	3211	2137	2352	2400
5	1852	959	1398	1657	1813	1973	1487	2372	1554	1591
6	874	1099	590	908	1182	1327	1400	957	1018	1054
7	846	553	650	379	629	875	979	933	672	702
8	706	553	330	413	280	448	643	671	459	482
9	287	463	377	199	303	207	329	457	298	309
10	191	179	315	273	145	207	150	234	201	208
11	115	120	109	220	199	112	155	97	142	147
+gp	320	442	247	407	463	368	491	434	382	391
Total	19231	18964	17638	18553	18256	16627	14721			

[a] XSA estimate (1535) replaced with GM recruitment69-10

Table 8.3.10 Sole VIIE Fishing Mortality at Age

Age	1969	1970	1971	1972	1973
1	0.000	0.000	0.000	0.000	0.000
2	0.051	0.043	0.014	0.062	0.034
3	0.154	0.164	0.200	0.136	0.212
4	0.144	0.203	0.235	0.229	0.186
5	0.177	0.214	0.166	0.148	0.164
6	0.158	0.127	0.212	0.120	0.163
7	0.151	0.107	0.156	0.059	0.163
8	0.109	0.115	0.189	0.059	0.081
9	0.048	0.093	0.109	0.220	0.152
10	0.084	0.118	0.114	0.691	0.063
11	0.110	0.112	0.156	0.231	0.125
+gp	0.110	0.112	0.156	0.231	0.125
Fbar$_{3-9}$	0.134	0.146	0.181	0.139	0.160

Table 8.3.10 Sole VIIE Fishing Mortality at Age continued

Age	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.015	0.030	0.065	0.071	0.059	0.057	0.040	0.033	0.029	0.026
3	0.206	0.243	0.186	0.153	0.242	0.241	0.173	0.236	0.246	0.216
4	0.157	0.131	0.292	0.232	0.222	0.247	0.206	0.279	0.406	0.406
5	0.097	0.186	0.159	0.178	0.175	0.221	0.275	0.272	0.360	0.434
6	0.171	0.076	0.167	0.129	0.221	0.256	0.148	0.243	0.301	0.361
7	0.172	0.083	0.072	0.109	0.166	0.289	0.298	0.289	0.208	0.349
8	0.072	0.148	0.176	0.069	0.141	0.223	0.355	0.309	0.331	0.376
9	0.199	0.051	0.217	0.048	0.085	0.234	0.190	0.293	0.442	0.475
10	0.090	0.182	0.123	0.115	0.227	0.143	0.200	0.233	0.513	0.504
11	0.141	0.108	0.151	0.094	0.168	0.230	0.239	0.274	0.360	0.414
+gp	0.141	0.108	0.151	0.094	0.168	0.230	0.239	0.274	0.360	0.414
Fbar$_{3-9}$	0.153	0.131	0.181	0.131	0.179	0.244	0.235	0.274	0.328	0.374

Table 8.3.10 Sole VIIE Fishing Mortality at Age continued

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.061	0.044	0.071	0.093	0.133	0.119	0.138	0.070	0.089	0.067
3	0.238	0.440	0.333	0.312	0.384	0.370	0.389	0.221	0.295	0.262
4	0.347	0.412	0.430	0.348	0.354	0.586	0.401	0.330	0.321	0.346
5	0.309	0.301	0.376	0.303	0.367	0.496	0.502	0.317	0.309	0.433
6	0.408	0.370	0.309	0.281	0.418	0.419	0.428	0.338	0.179	0.351
7	0.328	0.366	0.335	0.327	0.314	0.424	0.355	0.256	0.257	0.335
8	0.253	0.229	0.260	0.356	0.370	0.345	0.461	0.220	0.237	0.256
9	0.302	0.291	0.249	0.204	0.255	0.397	0.554	0.369	0.200	0.341
10	0.366	0.244	0.396	0.232	0.231	0.404	0.472	0.349	0.208	0.205
11	0.332	0.301	0.311	0.281	0.339	0.434	0.533	0.320	0.339	0.365
+gp	0.332	0.301	0.311	0.281	0.339	0.434	0.533	0.320	0.339	0.365
Fbar$_{3\text{-}9}$	0.312	0.344	0.327	0.304	0.352	0.434	0.442	0.293	0.257	0.332

Table 8.3.10 Sole VIIE Fishing Mortality at Age continued

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.045	0.030	0.102	0.070	0.065	0.088	0.050	0.028	0.095	0.122
3	0.276	0.175	0.171	0.313	0.256	0.293	0.244	0.302	0.322	0.326
4	0.304	0.410	0.286	0.410	0.304	0.309	0.370	0.316	0.267	0.386
5	0.261	0.358	0.308	0.396	0.302	0.345	0.348	0.396	0.356	0.300
6	0.212	0.279	0.303	0.276	0.424	0.350	0.304	0.408	0.428	0.173
7	0.254	0.363	0.251	0.391	0.349	0.384	0.216	0.363	0.312	0.147
8	0.155	0.362	0.290	0.239	0.245	0.376	0.273	0.288	0.338	0.169
9	0.270	0.260	0.346	0.273	0.248	0.233	0.405	0.450	0.421	0.281
10	0.404	0.217	0.306	0.165	0.325	0.304	0.318	0.431	0.465	0.494
11	0.255	0.261	0.356	0.391	0.409	0.359	0.386	0.422	0.295	0.324
+gp	0.255	0.261	0.356	0.391	0.409	0.359	0.386	0.422	0.295	0.324
Fbar$_{3\text{-}9}$	0.248	0.315	0.279	0.328	0.304	0.327	0.309	0.360	0.349	0.255

Table 8.3.10 Sole VIIE Fishing Mortality at Age continued

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	mean $F_{10\text{-}12}$
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.158	0.069	0.121	0.054	0.075	0.056	0.016	0.032	0.023	0.024
3	0.301	0.252	0.277	0.277	0.260	0.181	0.143	0.138	0.113	0.132
4	0.259	0.357	0.384	0.415	0.329	0.184	0.174	0.266	0.203	0.214
5	0.278	0.398	0.422	0.387	0.332	0.237	0.212	0.243	0.341	0.265
6	0.378	0.344	0.358	0.425	0.343	0.267	0.200	0.204	0.306	0.237
7	0.306	0.333	0.326	0.416	0.353	0.202	0.239	0.208	0.278	0.242
8	0.318	0.318	0.322	0.284	0.406	0.209	0.204	0.207	0.241	0.217
9	0.287	0.336	0.373	0.287	0.222	0.219	0.281	0.222	0.240	0.248
10	0.409	0.316	0.367	0.394	0.255	0.214	0.161	0.191	0.335	0.229
11	0.500	0.287	0.335	0.267	0.476	0.184	0.195	0.308	0.297	0.267
+gp	0.500	0.287	0.335	0.267	0.476	0.184	0.195	0.308	0.297	0.267
$Fbar_{3\text{-}9}$	0.304	0.334	0.352	0.356	0.321	0.214	0.208	0.213	0.246	0.222

Table 8.3.11 Sole VIIE Summary Table

Year	Recruits[000']	TSB[t]	SSB[t]	Landings[t]	Yield//SSB	FBar3-9
1969	1480	2980	2432	352.72	0.15	0.134
1970	4212	3206	2646	389.61	0.15	0.146
1971	2829	2915	2383	431.92	0.18	0.181
1972	2493	3218	2388	436.55	0.18	0.139
1973	3425	3373	2767	458.25	0.17	0.160
1974	3267	3628	2883	426.52	0.15	0.153
1975	3068	4627	3652	500.63	0.14	0.131
1976	7197	4765	3385	614.25	0.18	0.181
1977	5106	5746	4074	604.58	0.15	0.131
1978	4779	5822	4047	868.31	0.21	0.179
1979	5132	6290	4825	1170.17	0.24	0.244
1980	8843	6777	5282	1268.10	0.24	0.235
1981	5114	6066	4508	1217.81	0.27	0.274
1982	4132	5972	4493	1437.95	0.32	0.328
1983	6515	5513	4271	1503.84	0.35	0.374
1984	7676	5546	4289	1362.66	0.32	0.312
1985	4161	5797	3858	1400.09	0.36	0.344
1986	6359	5535	3845	1418.02	0.37	0.327
1987	4128	5347	3921	1279.28	0.33	0.304
1988	4046	5078	3825	1443.13	0.38	0.352
1989	3086	4327	3227	1389.36	0.43	0.434
1990	7737	4934	3025	1306.25	0.43	0.442
1991	4289	4236	2754	852.20	0.31	0.293
1992	3739	3964	2641	895.68	0.34	0.257
1993	2584	3393	2626	903.83	0.34	0.332
1994	3734	3971	2901	800.26	0.28	0.248
1995	4390	4188	2941	855.85	0.29	0.315
1996	3699	4428	2819	833.38	0.30	0.279
1997	4929	3623	2709	949.66	0.35	0.328
1998	3874	3783	2740	880.05	0.32	0.304
1999	7256	4816	2746	955.93	0.35	0.327
2000	6000	4875	2780	911.73	0.33	0.309
2001	4240	4484	2867	1068.62	0.37	0.360
2002	6028	4798	3053	1105.32	0.36	0.349
2003	3164	4553	3231	1078.12	0.33	0.255
2004	4466	4413	3059	1073.92	0.35	0.304
2005	5107	4529	3166	1036.77	0.33	0.334
2006	4449	4071	2765	1015.53	0.37	0.352
2007	4523	4268	2851	1014.65	0.36	0.356
2008	3534	4213	2666	908.12	0.34	0.321
2009	5054	4174	3041	700.48	0.23	0.214
2010	3337	4329	3422	698.15	0.20	0.208
2011	1871	4495	3450	801.28	0.23	0.213
2012	4345[a]	4041	3488	871.97	0.25	0.246

[a] replaced XSA estimate (1535) with GM recruitment69-10

Table 8.3.12 Sole VIIE Short-term Forcast Input Table

2013

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4345	0.10	0.00	0.00	0.00	0.000	0.000	0.000
2	3931	0.10	0.14	0.00	0.00	0.133	0.026	0.174
3	1497	0.10	0.45	0.00	0.00	0.213	0.146	0.251
4	2137	0.10	0.88	0.00	0.00	0.287	0.238	0.321
5	2372	0.10	0.98	0.00	0.00	0.354	0.294	0.385
6	957	0.10	1.00	0.00	0.00	0.415	0.263	0.443
7	933	0.10	1.00	0.00	0.00	0.469	0.268	0.494
8	671	0.10	1.00	0.00	0.00	0.518	0.241	0.539
9	457	0.10	1.00	0.00	0.00	0.559	0.275	0.578
10	234	0.10	1.00	0.00	0.00	0.595	0.254	0.610
11	97	0.10	1.00	0.00	0.00	0.623	0.296	0.636
12	434	0.10	1.00	0.00	0.00	0.694	0.296	0.699

2014

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4345	0.10	0.00	0.00	0.00	0.000	0.000	0.000
2		0.10	0.14	0.00	0.00	0.133	0.026	0.174
3		0.10	0.45	0.00	0.00	0.213	0.146	0.251
4		0.10	0.88	0.00	0.00	0.287	0.238	0.321
5		0.10	0.98	0.00	0.00	0.354	0.294	0.385
6		0.10	1.00	0.00	0.00	0.415	0.263	0.443
7		0.10	1.00	0.00	0.00	0.469	0.268	0.494
8		0.10	1.00	0.00	0.00	0.518	0.241	0.539
9		0.10	1.00	0.00	0.00	0.559	0.275	0.578
10		0.10	1.00	0.00	0.00	0.595	0.254	0.610
11		0.10	1.00	0.00	0.00	0.623	0.296	0.636
12		0.10	1.00	0.00	0.00	0.694	0.296	0.699

2015

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	4345	0.10	0.00	0.00	0.00	0.000	0.000	0.000
2		0.10	0.14	0.00	0.00	0.133	0.026	0.174
3		0.10	0.45	0.00	0.00	0.213	0.146	0.251
4		0.10	0.88	0.00	0.00	0.287	0.238	0.321
5		0.10	0.98	0.00	0.00	0.354	0.294	0.385
6		0.10	1.00	0.00	0.00	0.415	0.263	0.443
7		0.10	1.00	0.00	0.00	0.469	0.268	0.494
8		0.10	1.00	0.00	0.00	0.518	0.241	0.539
9		0.10	1.00	0.00	0.00	0.559	0.275	0.578
10		0.10	1.00	0.00	0.00	0.595	0.254	0.610
11		0.10	1.00	0.00	0.00	0.623	0.296	0.636
12		0.10	1.00	0.00	0.00	0.694	0.296	0.699

Table 8.3.13 Sole VIIE Single Option Output

Year=2013 F / F10-12= 1.108 Fbar= 0.246

Age	F	Catch No	Yield	Stock No	Biomass	SS No	SSB
1	0.000	0	0	4345	0	0	0
2	0.026	97	17	3931	522	550	73
3	0.146	194	49	1497	319	674	144
4	0.238	431	138	2137	613	1881	539
5	0.294	576	222	2372	839	2324	822
6	0.263	211	93	957	397	957	397
7	0.268	209	103	933	438	933	438
8	0.241	137	74	671	347	671	347
9	0.275	105	61	457	256	457	256
10	0.254	50	31	234	139	234	139
11	0.296	24	15	97	60	97	60
12	0.296	106	74	434	301	434	301
Total		2140	877	18066	4232	9213	3517

Year=2014 F / F10-12= 1.108 Fbar= 0.246

Age	F	Catch No	Yield	Stock No	Biomass	SS No	SSB
1	0.000	0	0	4345	0	0	0
2	0.026	97	17	3931	522	550	73
3	0.146	448	112	3465	739	1559	333
4	0.238	236	76	1171	336	1030	295
5	0.294	371	143	1525	539	1495	529
6	0.263	352	156	1599	664	1599	664
7	0.268	149	74	666	312	666	312
8	0.241	132	71	646	334	646	334
9	0.275	109	63	477	267	477	267
10	0.254	67	41	314	187	314	187
11	0.296	40	26	165	103	165	103
12	0.296	87	61	358	248	358	248
Total		2090	839	18661	4251	8859	3345

Year=2015 F / F10-12= 1.108 Fbar= 0.246

Age	F	Catch No	Yield	Stock No	Biomass	SS No	SSB
1	0.000	0	0	4345	0	0	0
2	0.026	97	17	3931	522	550	73
3	0.146	448	112	3465	739	1559	333
4	0.238	546	175	2709	777	2384	683
5	0.294	203	78	835	295	819	290
6	0.263	227	100	1028	427	1028	427
7	0.268	250	123	1113	522	1113	522
8	0.241	94	51	461	239	461	239
9	0.275	105	61	459	257	459	257
10	0.254	70	43	328	195	328	195
11	0.296	54	34	221	138	221	138
12	0.296	86	60	352	244	352	244
Total		2180	855	19247	4354	9274	3400

input units are in 000's and kg, output in t

Table 8.3.14 Sole VIIE Contributions and Source of Cohort for Short-term Forecast

YC	Source	Yield2013	Yield2014	SSB2013	SSB2014	SSB2015
2010	XSA	5.5	9	4.1	8.8	8.5
2011	GM 69-10	1.9	13.4	2.1	9.9	20.1
2012	GM 69-10		2		2.2	9.8
2013	GM 69-10					2.1
2014	GM 69-10					

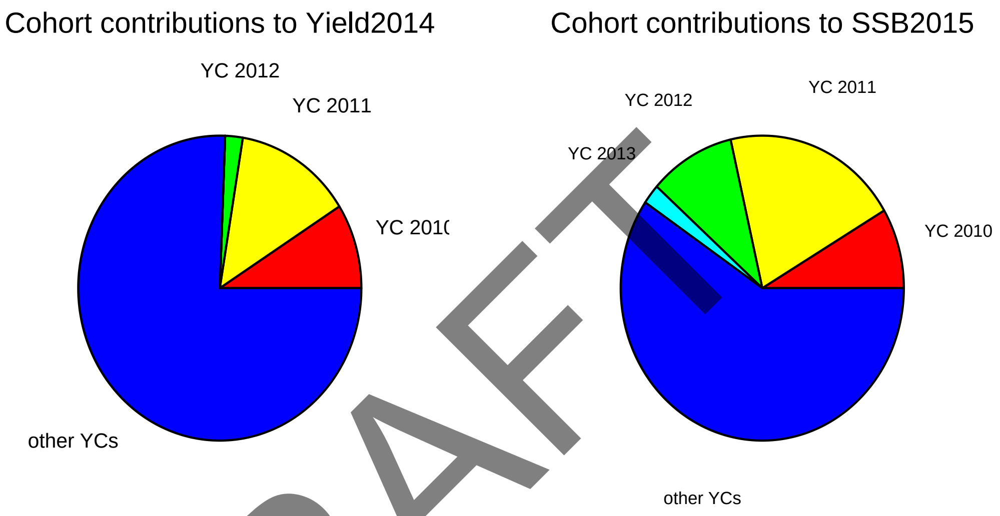


Table 8.3.15 Sole VIIE Management Options Output

SSB 2014	TSB 2014	F-mult	F	basis	Yield 2014	SSB 2015	TSB 2015	%SSB-Change	%TAC-Change
3345	4251	0.0	0.000	F2013	0	4225	5206	26	-100
3345	4251	0.1	0.025	F2013	93	4133	5111	24	-90
3345	4251	0.2	0.049	F2013	185	4043	5018	21	-79
3345	4251	0.3	0.074	F2013	274	3955	4928	18	-69
3345	4251	0.4	0.098	F2013	360	3870	4840	16	-60
3345	4251	0.5	0.123	F2013	445	3786	4754	13	-50
3345	4251	0.6	0.148	F2013	528	3705	4670	11	-41
3345	4251	0.7	0.172	F2013	609	3626	4588	8	-32
3345	4251	0.8	0.197	F2013	687	3549	4508	6	-23
3345	4251	0.9	0.222	F2013	764	3473	4430	4	-15
3345	4251	1.0	0.246	F2013	839	3400	4354	2	-6
3345	4251	1.097561	0.270	F2013	911	3330	4281	0	2
3345	4251	1.1	0.271	F2013	913	3328	4280	0	2
3345	4251	1.2	0.295	F2013	984	3258	4207	-3	10
3345	4251	1.3	0.320	F2013	1054	3190	4136	-5	18
3345	4251	1.4	0.345	F2013	1122	3123	4067	-7	26
3345	4251	1.5	0.369	F2013	1189	3058	4000	-9	33
3345	4251	1.6	0.394	F2013	1254	2995	3934	-10	40
3345	4251	1.7	0.419	F2013	1317	2933	3870	-12	47
3345	4251	1.8	0.443	F2013	1379	2873	3807	-14	54
3345	4251	1.9	0.468	F2013	1440	2814	3746	-16	61
3345	4251	2.0	0.492	F2013	1499	2756	3686	-18	68
3345	4251	1.097561	0.270	Fmsy	911	3330	4281	0	2
3345	4251	1.097561	0.270	Fmp F	911	3330	4281	0	2

Figure 8.3.1 Sole VIIE International Landings Age Compositions

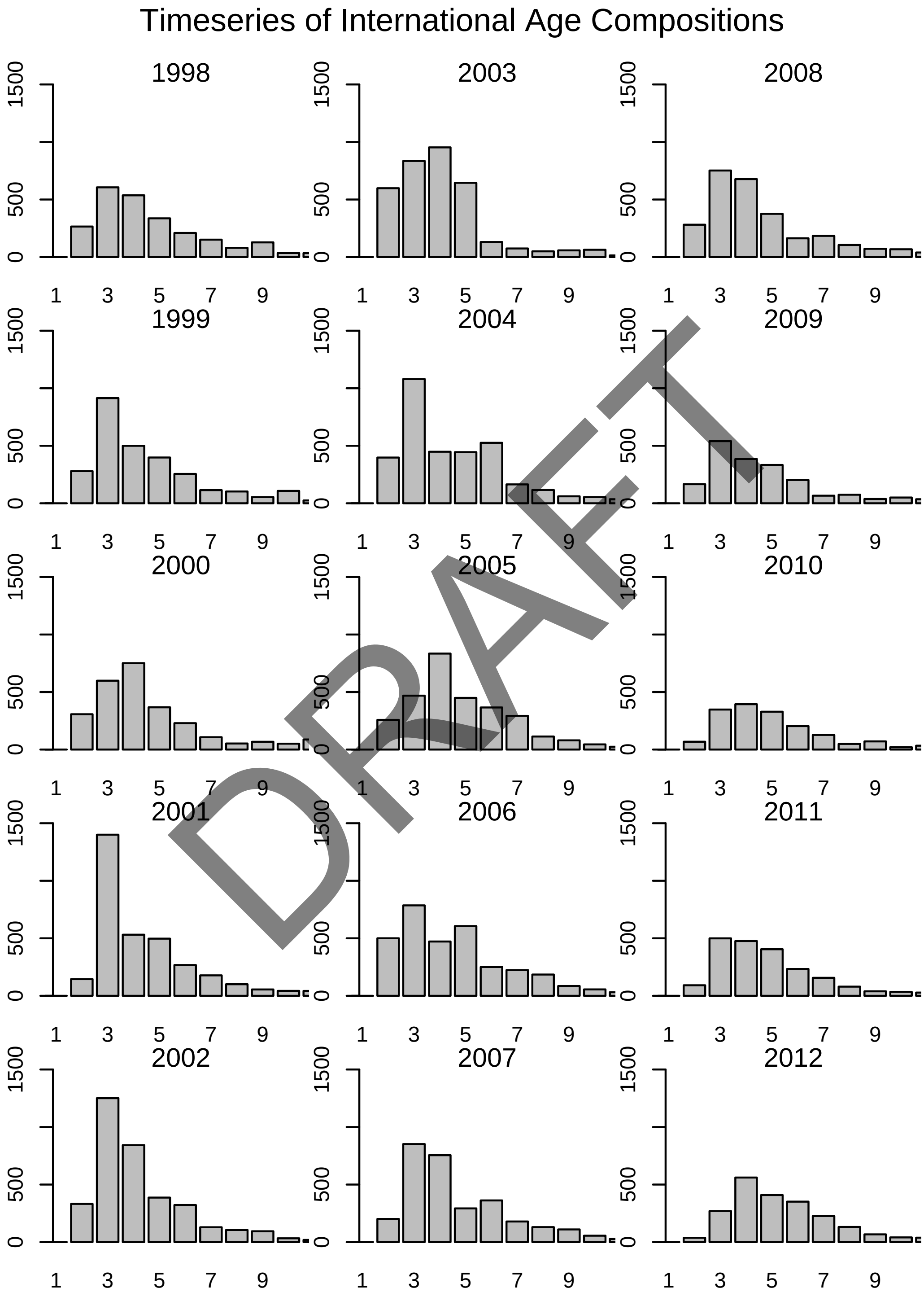


Figure 8.3.2 Sole VIIE Catch and Stock Weights at Age

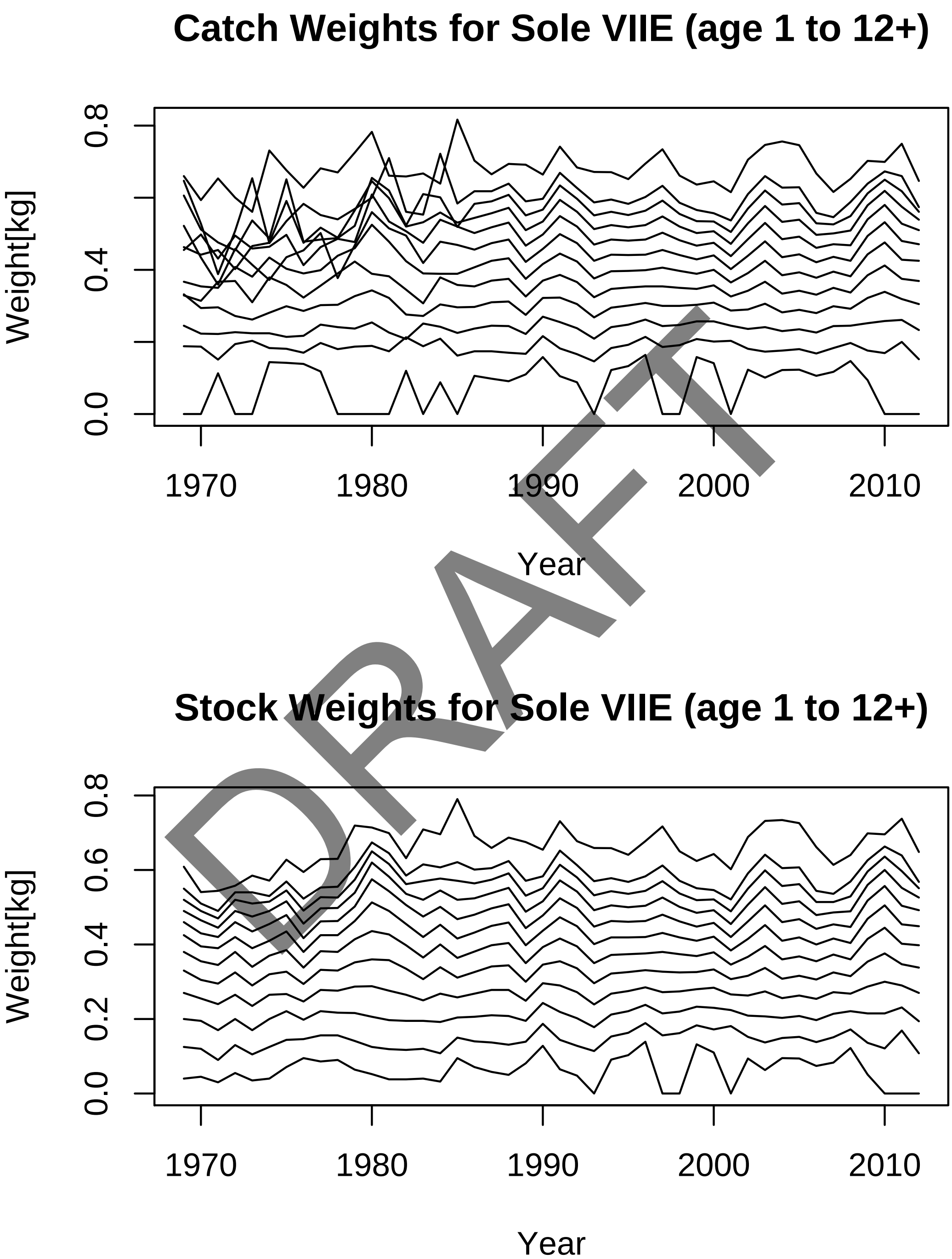


Figure 8.3.3a Sole VIIE Discards by Quarter, Fleet

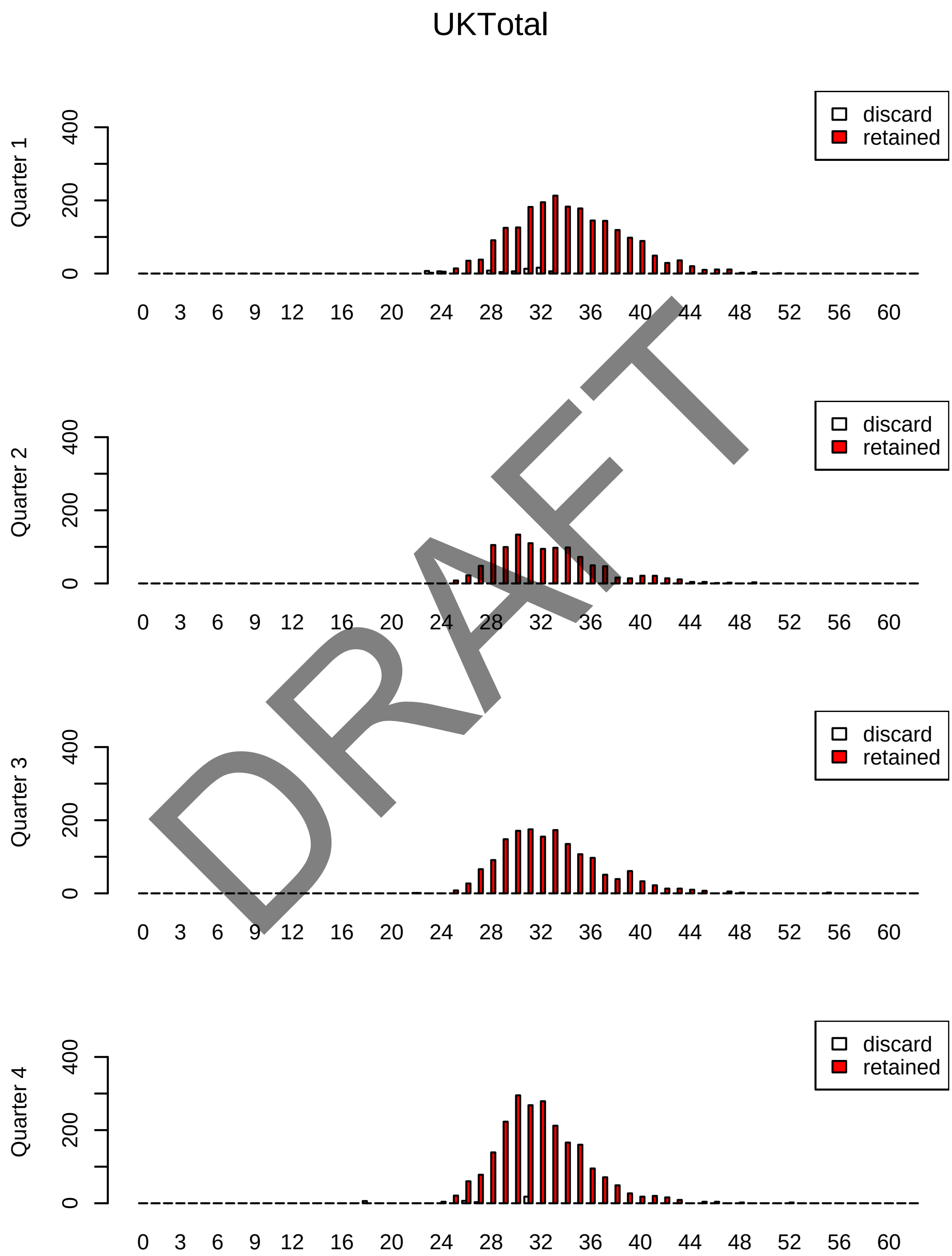


Figure 8.3.3b Sole VIIE Discards by Quarter, Fleet continued

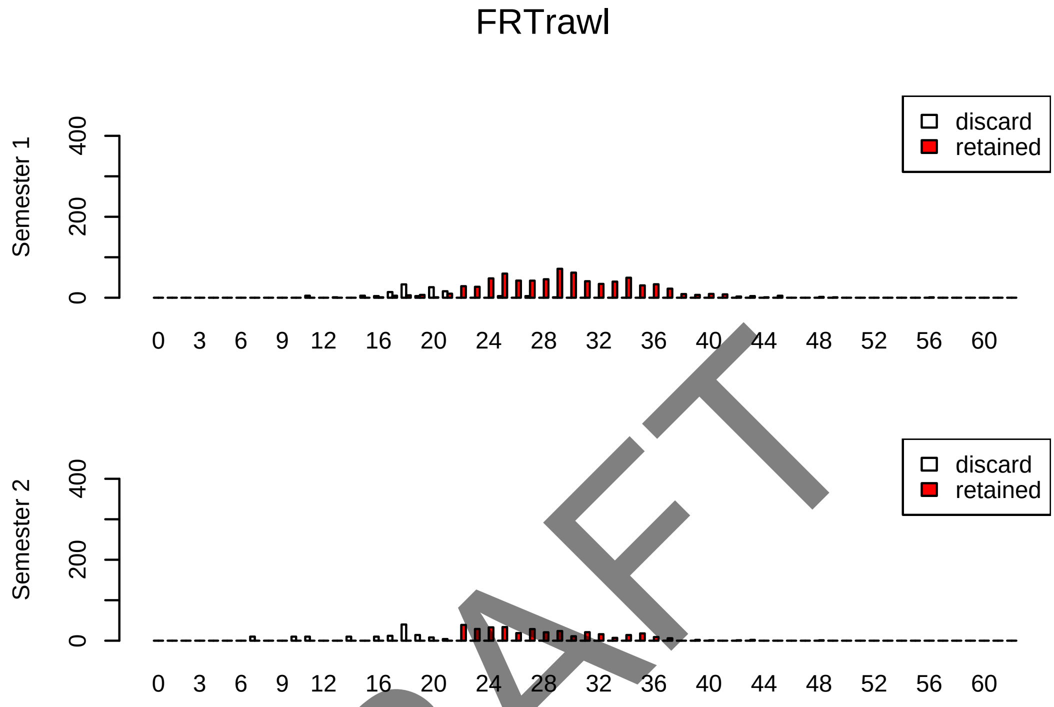


Figure 8.3.3c Sole VIIE Discards by Quarter, Fleet continued

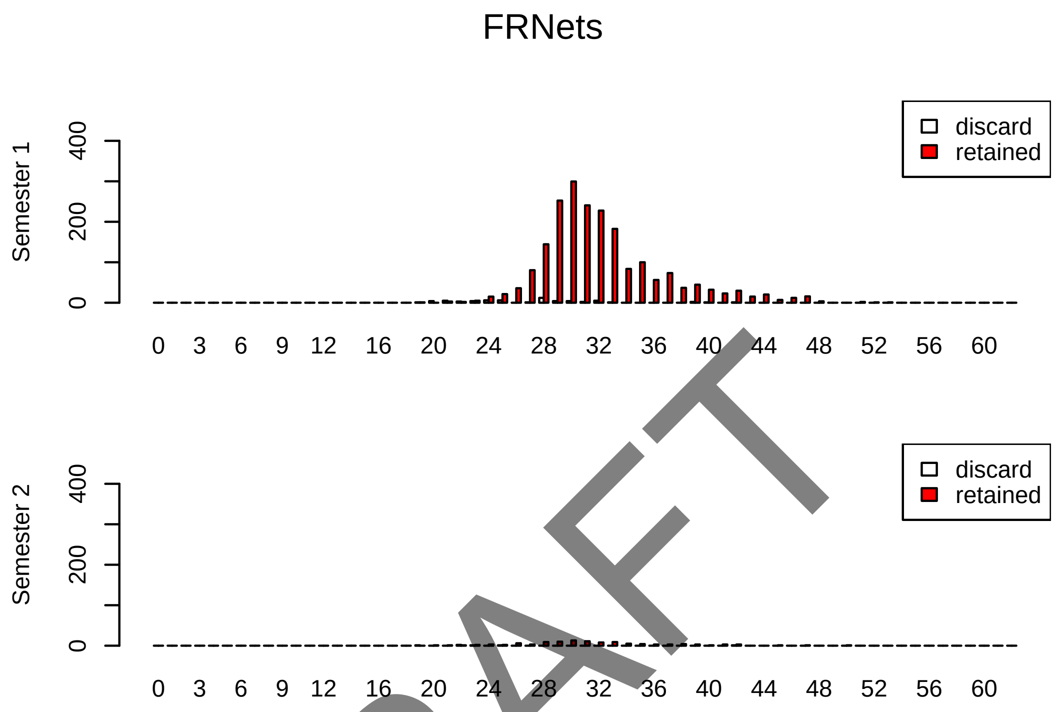


Figure 8.3.3d Sole VIIE Discards by Quarter, Fleet continued

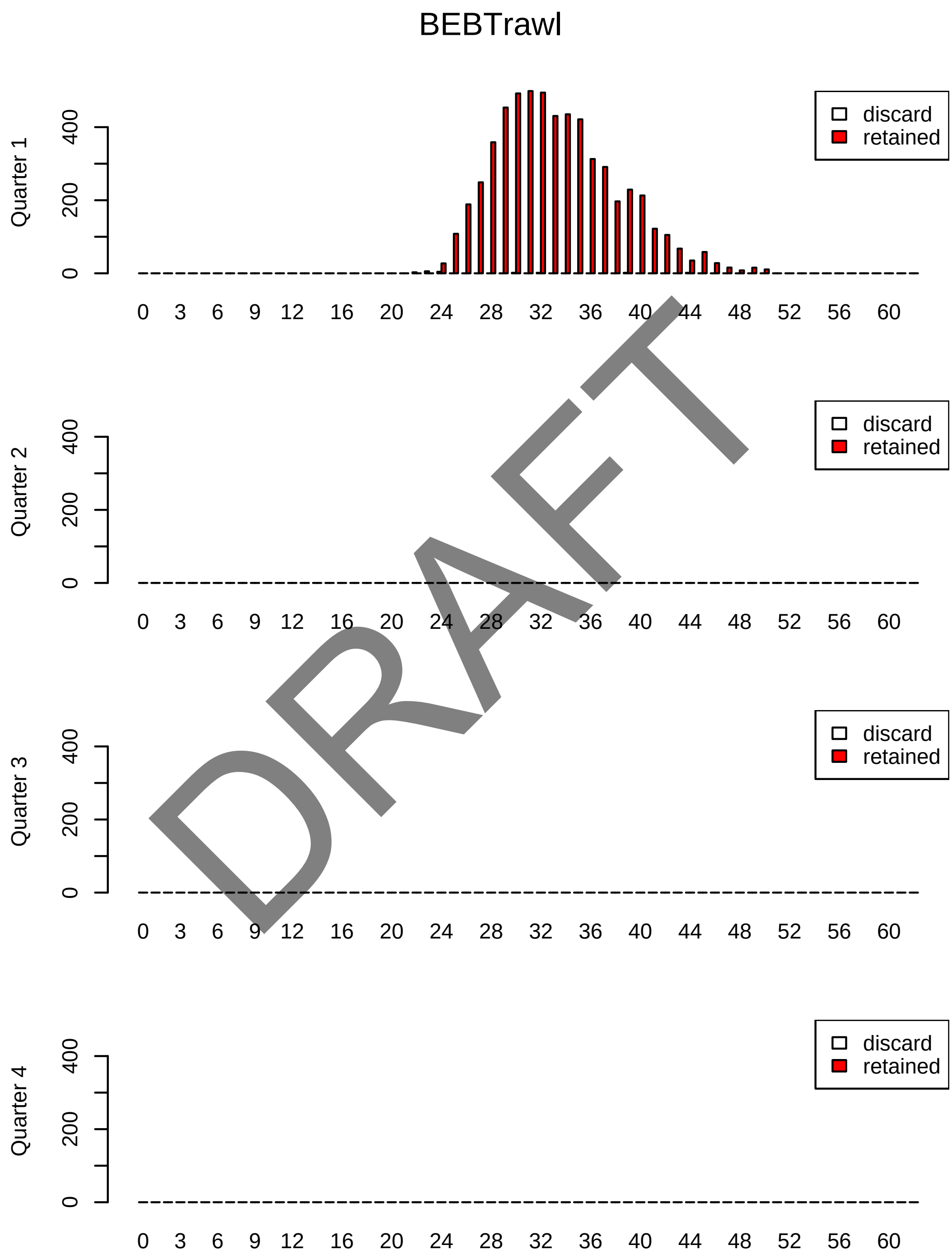


Figure 8.3.4 Sole VIIE LPUE and effort. The recent decline in LPUE for the commercial series is known in part to be due to a spatial shift in the fleet

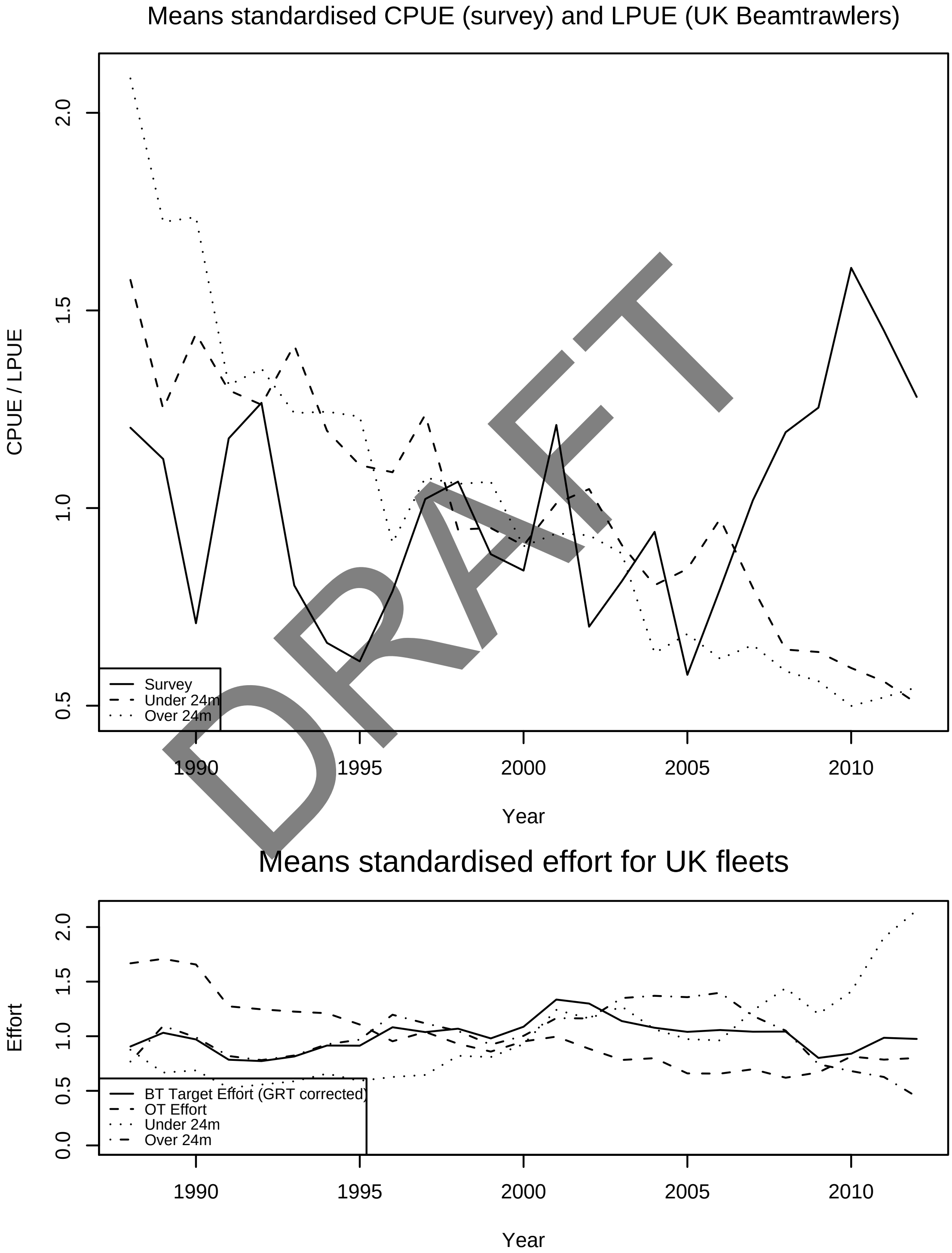


Figure 8.3.5 Sole VIIE Log CPUE by Yearclass

note the cohorts differ on the x-axes due to the differences in the length and age range of the tuning series

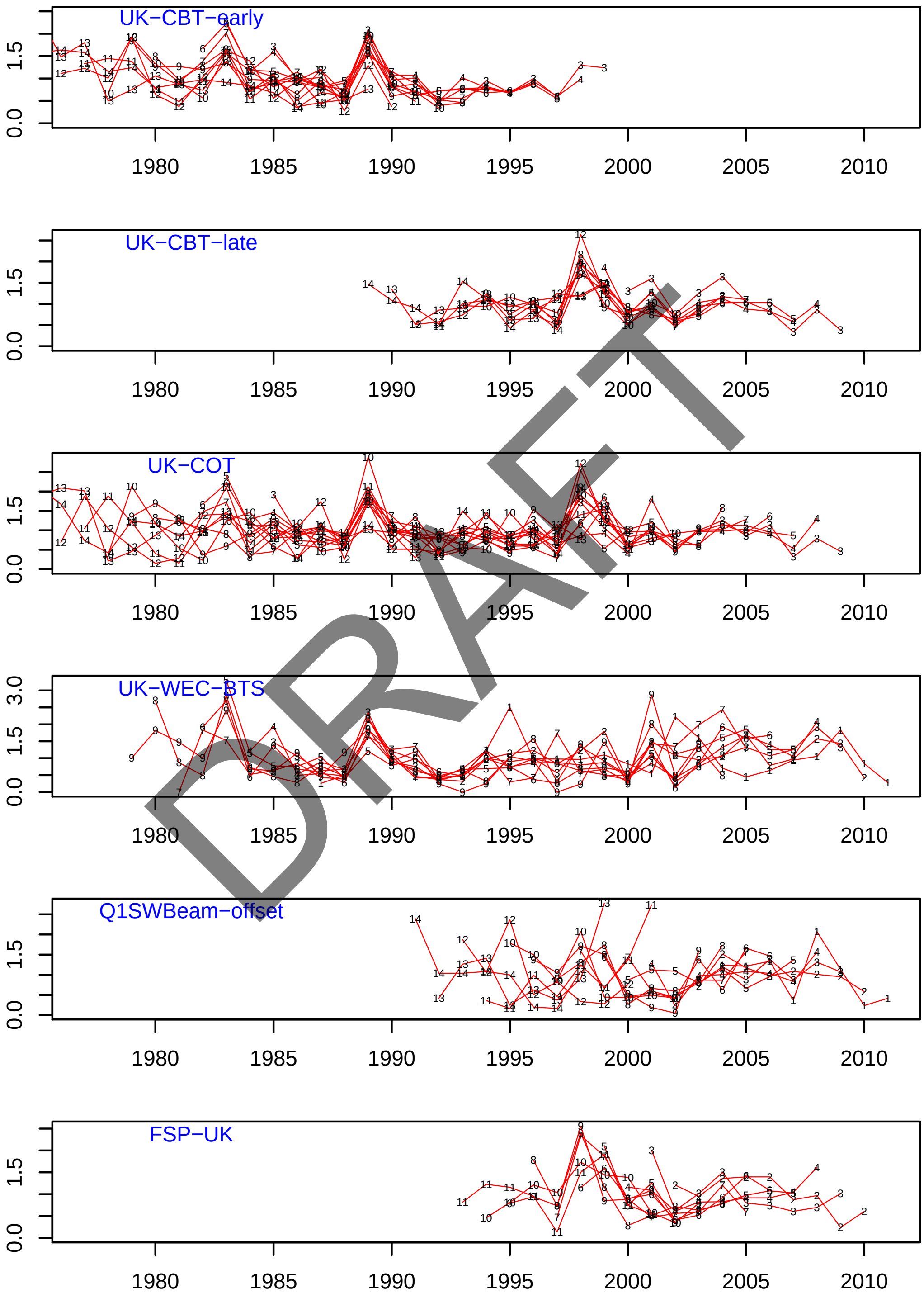


Figure 8.3.6 Sole VIIE Log CPUE by Year

note the cohorts differ on the x-axes due to the differences in the length and age range of the tuning series

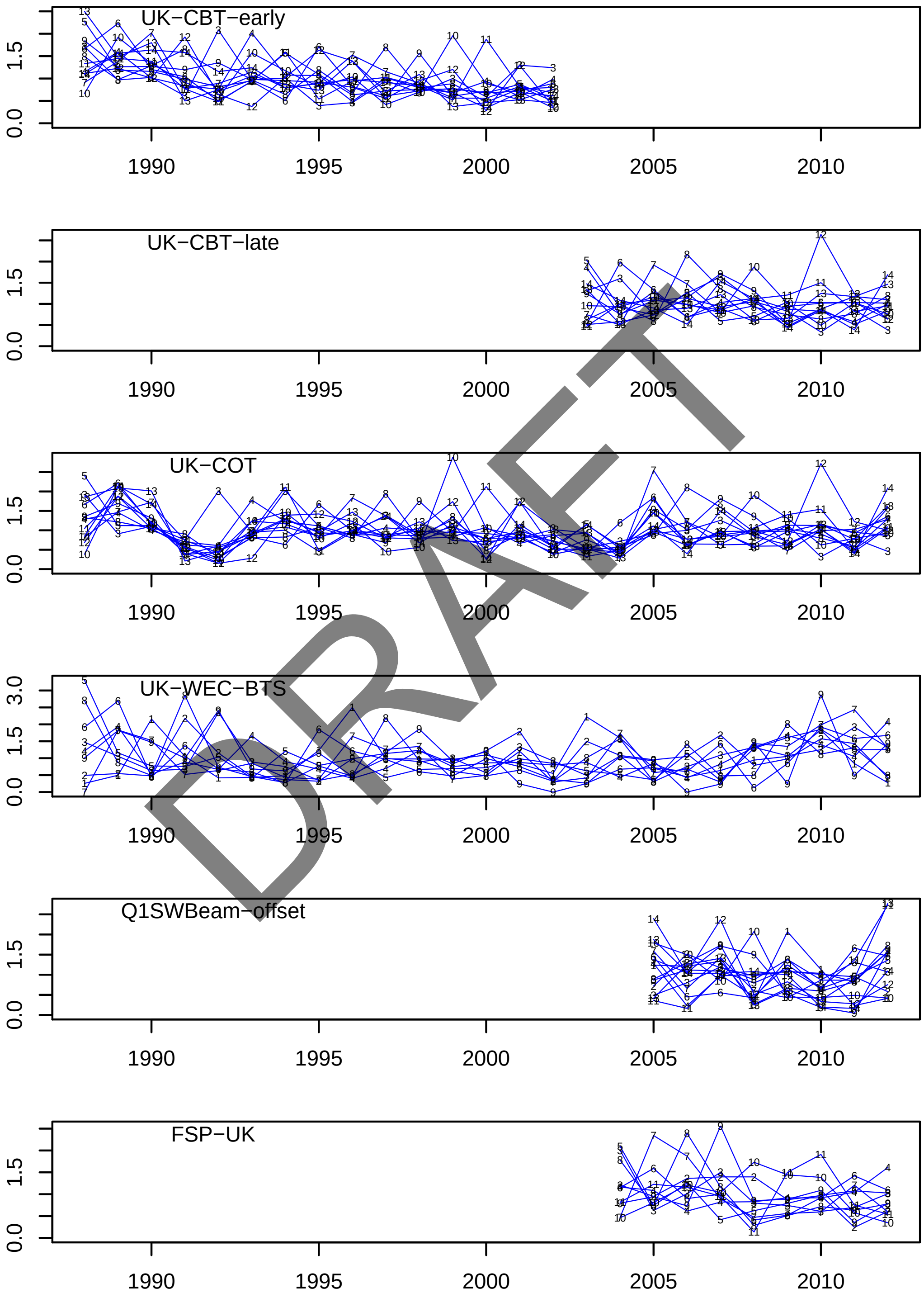


Figure 8.3.7 Sole VIIE Single Fleet log catchability Residuals

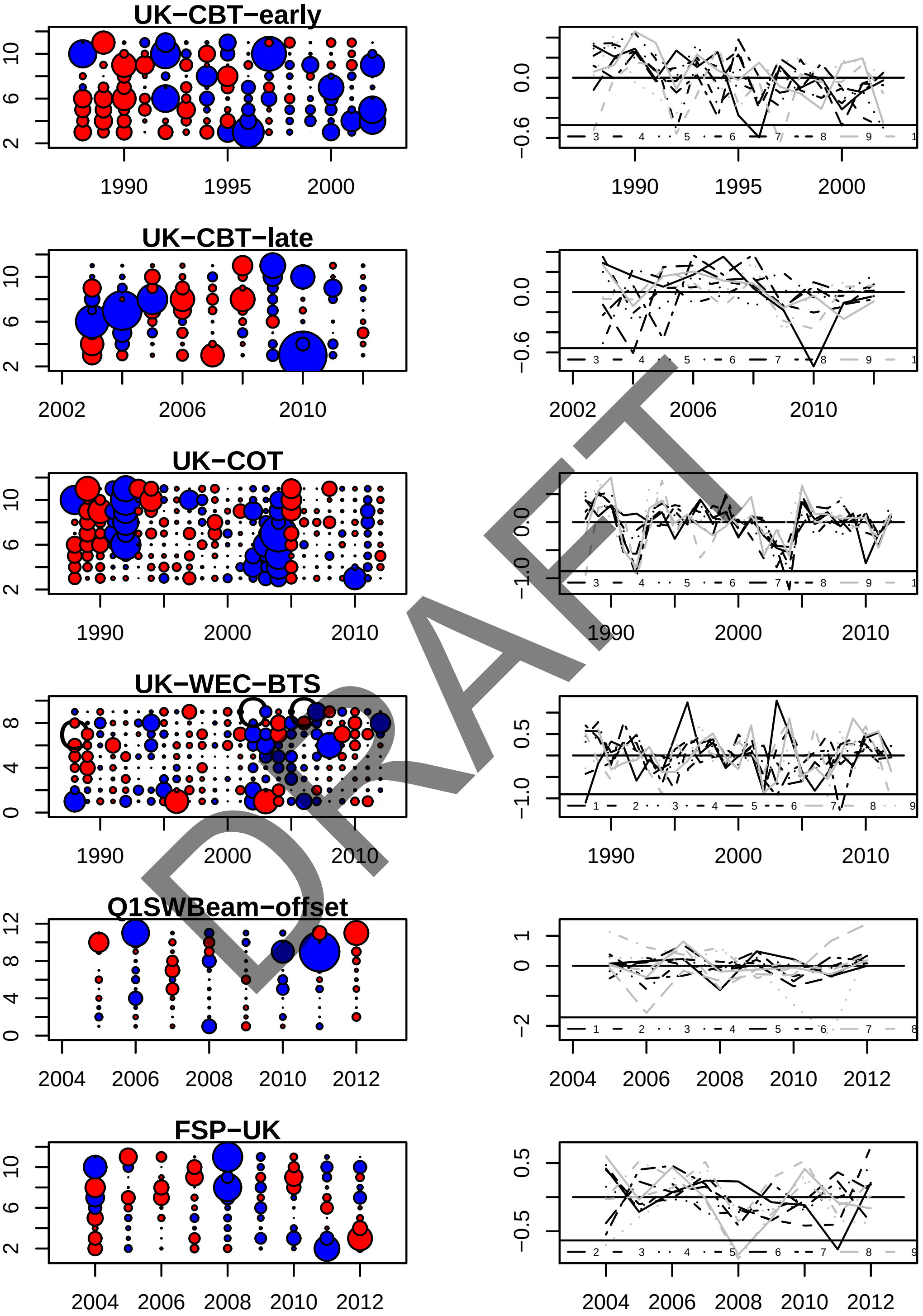


Figure 8.3.8 Sole VIIE Single Fleet Summary

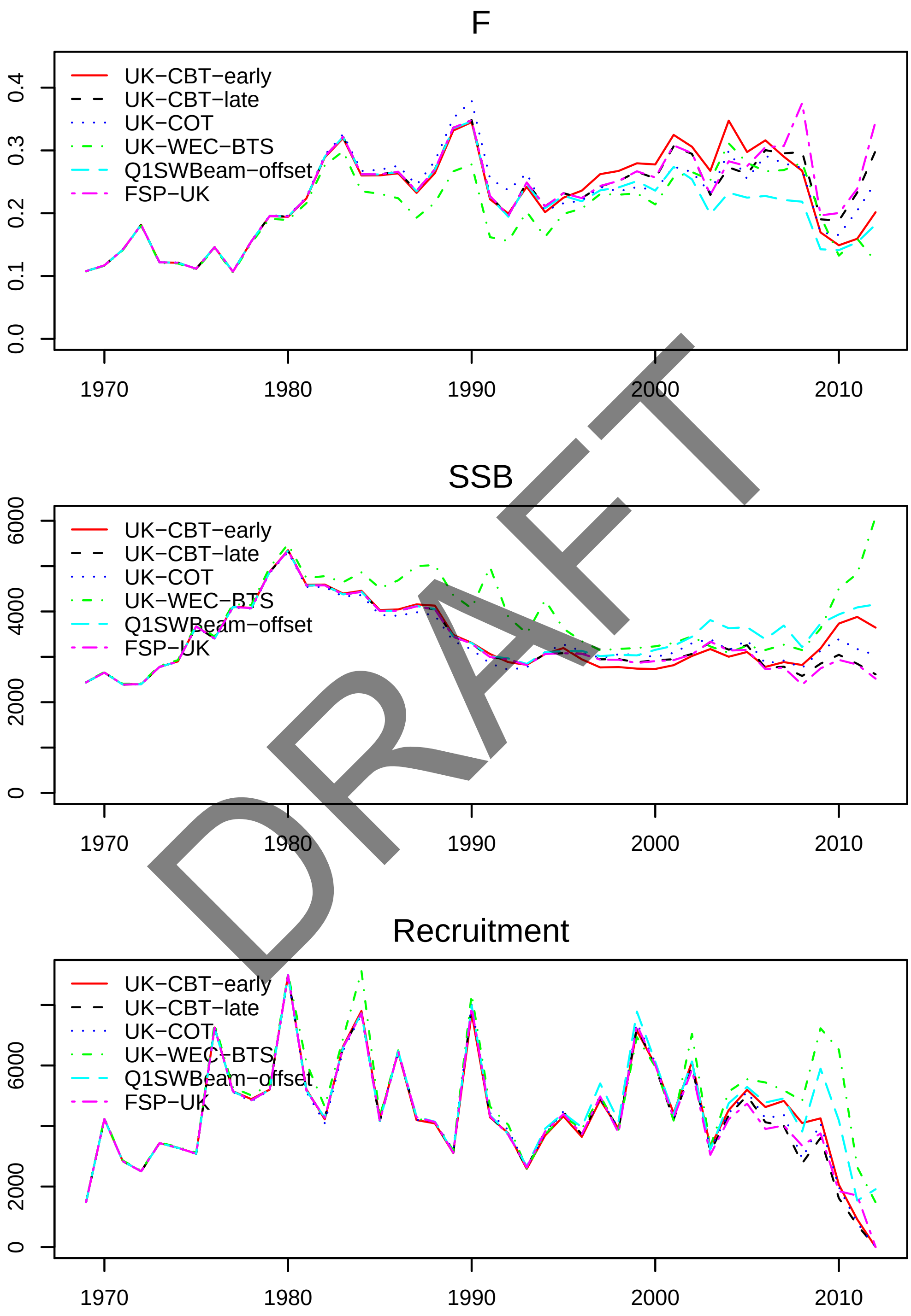


Figure 8.3.9 Sole VIIE Final XSA Fleet log catchability Residuals

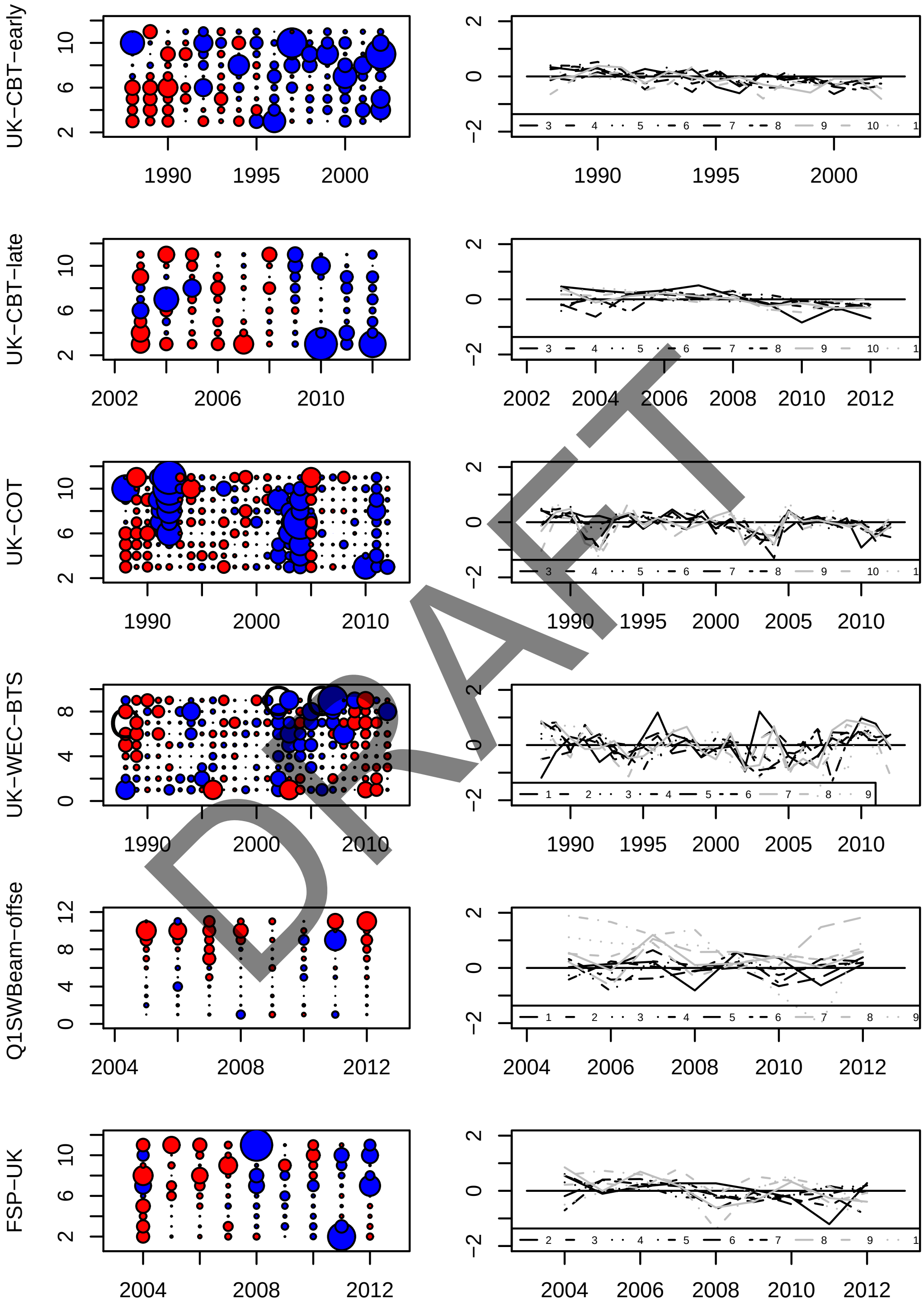


Figure 8.3.10 Sole VIIE Final XSA and previous XSAs

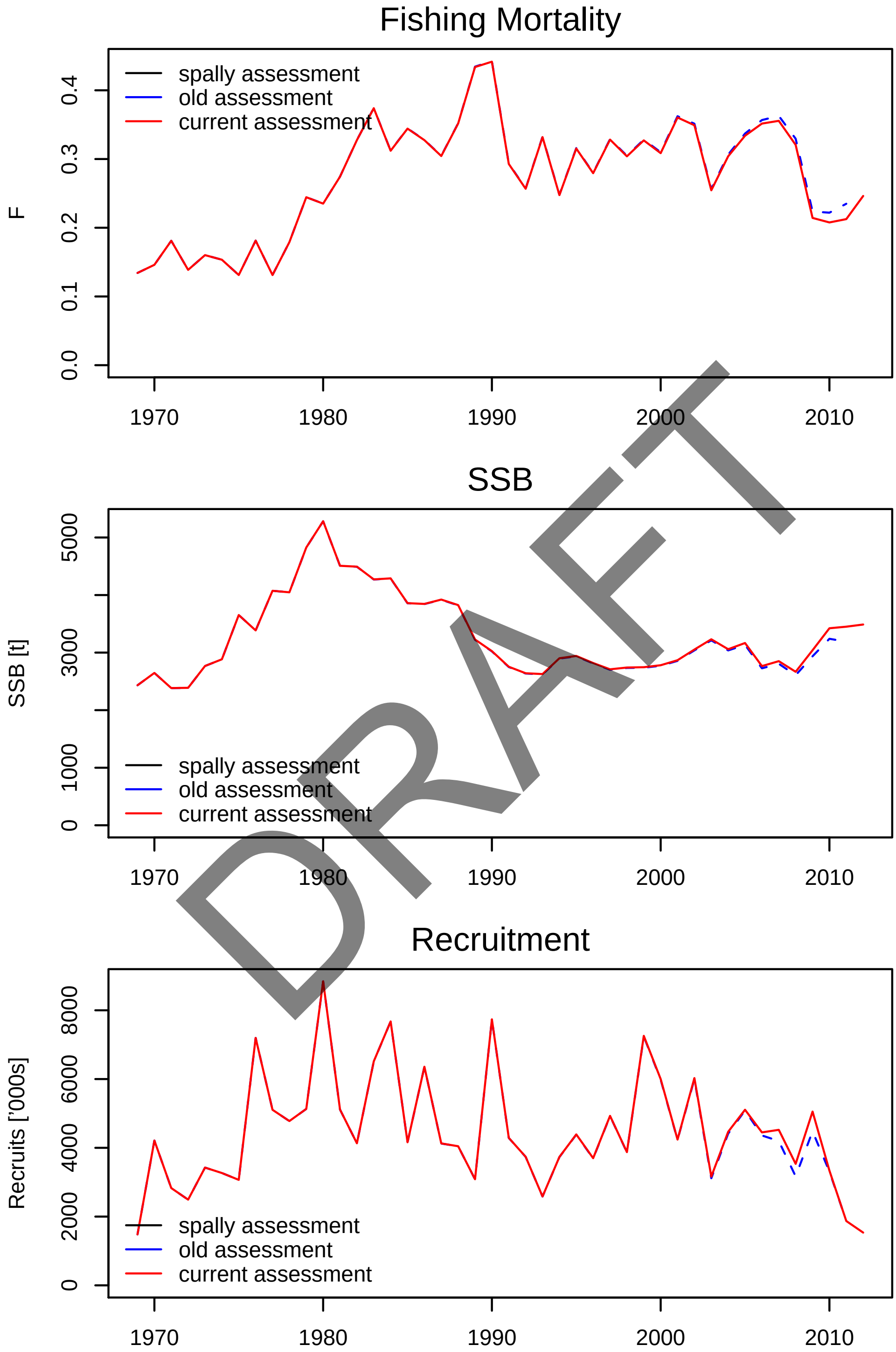


Figure 8.3.11 Sole VIIE Final and previous Assessment weights

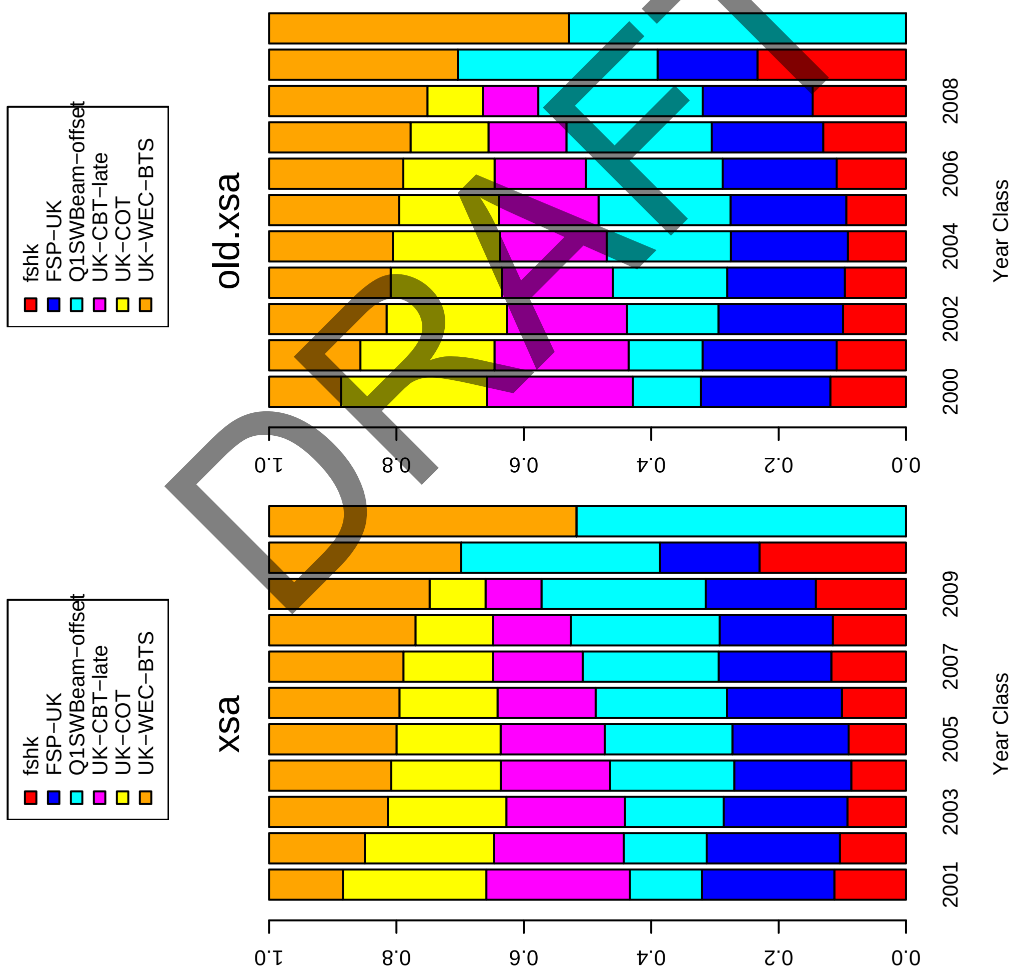
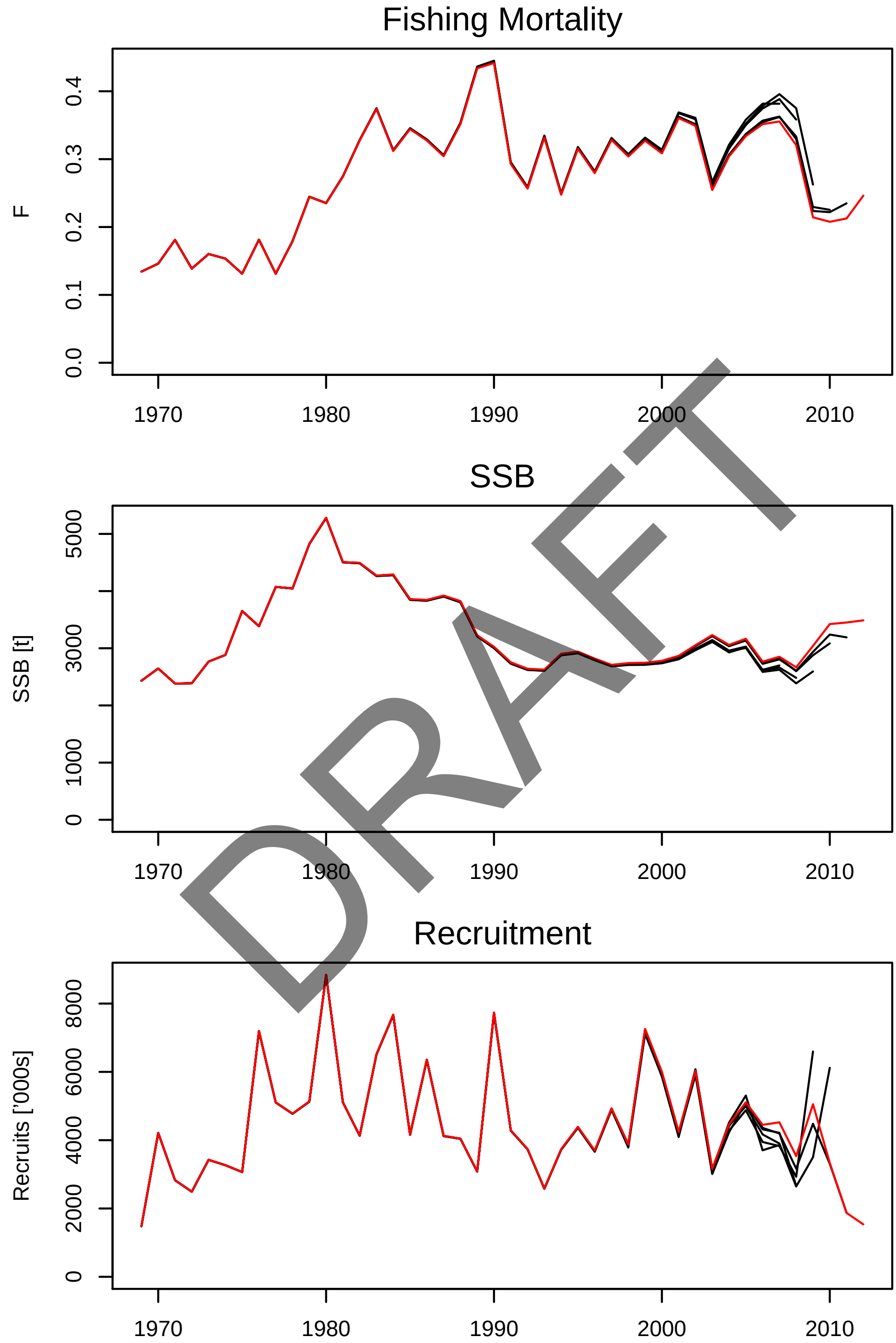


Figure 8.3.12 Sole VIIE XSA Retrospective Plots



9.2 Pollack in the Celtic Seas (ICES Subareas VI and VII)

Type of assessment in 2013

Pollack in the Celtic Sea and West of Scotland (Subareas VI and VII) is considered as data-limited stock, classified by ICES WKLIFE II (ICES CM2012/ACOM:79) as category 4 stock. DCAC (Depletion-Corrected Average Catch) method is used to assess this stock.

ICES advice applicable to 2013

In 2012, ICES analysed data for pollack in the Celtic Sea and West of Scotland for the first time. The advice, based on precautionary considerations, was: *"Catches should be no more than 1% more than recent catch (last three years), and should not exceed 4200 tons in 2013."* This advice was given for two years (2013 and 2014), but following the report of WKLIFE II has to be re-examined in 2013.

9.2.1 General

Stock Identity

This section is not dedicated to a 'stock', it relates to a species in a wider region where data is available. The stock structure of pollack populations in this ecoregion is not clear. ICES does not necessarily advocate that VI and VII constitutes a management unit for pollack, and further work is required. More information can be found in WGNEW (ICES 2012).

Management applicable to 2013

The TAC for Pollack is set for ICES Subareas VI and VII separately, and for 2013 as follows:

TAC	316

Species:	Pollack *Pollachius pollachius*	Zone:	VI; EU and international waters of Vb; international waters of XII and XIV (POL/56-14)
Spain	6	Precautionary TAC	
France	190		
Ireland	56		
United Kingdom	145		
Union	397		
TAC	397		

Species:	Pollack *Pollachius pollachius*	Zone:	VII (POL/07.)
Belgium	420	Precautionary TAC Article 11of this Regulation applies.	
Spain	25		
France	9 667		
Ireland	1 030		
United Kingdom	2 353		
Union	13 495		
TAC	13 495		

The article 11 referred to for the Subarea VII prohibits to fish or retain on board pollack, amongst other species, in the Porcupine Bank during the period from 1 May to 31 July 2012.

Annex III to Council Regulation (EC) No 43/2009 (2), as amended by Regulation (EC) No 1288/2009 (3), and Regulation (EU) No 579/2011 of the European Parliament and of the Council (4), establishes within ICES Division VI a zone in which fishing activities are prohibited. These regulations essentially make directed fisheries for pollock in the West of Scotland illegal.

Technical comments made by the Review Group (RGCS 2011)

The RG (ICES 2011, Annex IV) would have liked to see the following data in order to advise on future directions for supporting ICES advice on pollack in western waters:

- Full description of the fisheries taking pollack, directed and as bycatch, including historical reported landings by gear type/mesh band; spatial distribution (landings by rectangle);
- Mixed fishery information; i.e. associations with other species such as ling, conger eel and saithe;

- Available fishery length compositions by gear/area;
- Discard rates and discard size compositions where available;
- Documented (referenced) information on size and maturity-at-age.

There are no data allowing an assessment of stock trends, and very little useful information other than long-term landings trends which may reflect development of the fisheries rather than stock trends.

Biology

0-group pollack are found in shallow coastal waters and may therefore be protected from fisheries in the early life stages. Pollack is benthopelagic, found mostly close to the shore over hard bottom. It usually occurs at 40–100 m depth but is found down to 200 m. A maximum size of 130 cm, a maximum weight of 18.1 kg and a maximum age of 15 years are reported. Growth is thus fairly rapid, approaching 10 cm per year. There is a migration from the coast to deeper waters as it grows. Maturity occurs at approximately three years and spawning occurs mainly in the first half of the year, at about 100 m depth, but a lack of knowledge still remains.

The fisheries

Since ten years official landings are approximately 4000 tons (Figure 9.2.1). In 2012, 99% of the landings originated from the Subarea VII, especially in ICES Division VIIe (Figure 9.2.2). UK, France and Ireland together comprised 99% of the official landings (Figure 9.2.3). Most Pollack in the Celtic Sea ecoregions is caught by trawls (especially as bycatches), gillnets and trolling lines, and other gears come to complement the landings, such as seine nets or beam trawls (Figure 9.2.4). The overall gear contribution is unknown due to the lack of complete statistics. Pollack is also an important species for recreational fishing, but no data is available.

Surveys

Pollack may be caught by bottom-trawl surveys such IGFS-WIBTS-Q4 (Figure 9.2.5) and EVHOE-WIBTS-Q4. Abundance indexes estimated by IGFS-WIBTS-Q4 are erratic (Figure 9.2.6), and the too low number of individuals caught by EVHOE-WIBTS-Q4 is not sufficient to estimate any trend of abundance indexes.

9.2.2 Data

Landings

The nominal landings are given in Tables 9.2.1 and 9.2.2 for ICES Subarea VI and VII respectively.

The French fishing locations for pollack (Figure 9.2.7) shows a predominance of ICES Division VIIe and inshore areas, although on board observations on fishing trips over the period 2004–2011 indicates that fishing pollack may sporadically occur offshore.

9.2.3 MSY explorations

As long as the stock units are not well defined, it will not be possible to estimate MSY reference points. This stock has been categorized by WKLIFE (ICES, 2012) as category 4 data-limited and in this situation it was suggested to run a DCAC (Depleted-Corrected Adjusted Catch) method to estimate a yield likely to be sustainable (MacCall, 2009). WKLIFE II (ICES, 2012) recommended that “the DCAC method should be re-examined in 2013 due to the *slow up–fast down* nature of the method”.

The inputs to the DCAC method are further detailed:

<u>Sum of catch</u>: The period over which the catches is summed is 1986–2012, i.e. 27 years, as 1986 is the year where Ireland recomposed a time-series of landings after 13 years of missing declaration. In Subarea VI, the landings by Spain were removed as they appear only over the period 1981–1988. In Subarea VII, the French landings in 1999 are missing and are replaced by the mean of the previous and following year. The value used is 143 056 tons for Subarea VII and 6453 tons for Subarea VI.

<u>Natural mortality</u>: set to 0.2 arbitrarily. The standard deviation and distribution are set at 0.4 and lognormal, after a series of trial settings (Figure 9.2.8).

<u>F_{MSY} to M</u>: MacCall (2009) proposes a value of 0.6 for vulnerable stocks. Values of 0.6, 0.8 and 1.0 are used in order to test the sensitivity of the outputs.

<u>B_{MSY} to B_0</u>: 0.5 will be used in line with a value proposed by MacCall (2009).

<u>Depletion delta</u>: is the fractional reduction in biomass from the beginning to the end of the time-series, relative to unfished biomass. A value of 0.5 is commonly used, whereas a value of 0 means that the biomass is unchanged and a value of 1 means that the stock is totally depleted. For Subarea VI, values of 0.8 and 0.9, for Subarea VII, values of 0.5, 0.6 and 0.7 will be used.

The results are as below:

		F_{MSY} TO M				F_{MSY} TO M		
	Subarea VI	0.6	0.8	1.0	Subarea VII	0.6	0.8	1.0
Depl. delta	0.8	152	167	177	0.5	3902	4166	4345
	0.9	146	161	172	0.6	3712	3999	4197
					0.7	3387	3707	3933
Average		162 tonnes			Average	3928 tonnes		

The DCAC (Depletion-Corrected Average Catch) outputs (table above and Figure 9.2.9) suggest that yield in Subarea VI could be increased up to 162 tons (same result as in 2012 computations). The possibility to increase the catch is supported by evidence of very low effort on targeting this species due to restrictive regulations for inshore fisheries in the area. In Subarea VII, the range of sustainable yield estimated by DCAC averaged 3928 tons (4000 tons in 2012). This is supported by the observation than landings for the last 20 years have been around that level without any signs of decline (the lower 1999 yield being the consequence of a problem in the French database). The re-examination in 2013 conducts to similar results than last year.

9.2.4 Uncertainties in assessment and forecast

As last year, the weakness of the DCAC analysis resides in the non-inclusion of the significant removals from the recreational fisheries. If managers want to actively manage pollock fisheries in VI and VII then better data on recreational fisheries will be needed. From preliminary data it seems likely that catches in recreational fisheries are of a similar order of magnitude to, or larger than, commercial landings.

Progress in the qualification of the status of pollack in the Celtic Seas can be made by processing all the data available through the EU fisheries monitoring programs in place in all EU Member States since 2002 (EU, 2010). This can only be achieved if experts are formally designated as stock coordinator and stock assessor in order to take the leadership on the needed analysis.

As already pointed out by the ICES RGCS in 2011 (see Section 9.2.1), more information is needed on:

- stock identity of pollack within the ICES area;
- details of the fisheries (more spatial detail in landings data; especially for the earlier years in the time-series, landings by gear, length compositions, discards);
- life-history/biological parameters (all 2013 and early 2014 surveys and commercial sampling): in order to complete biological knowledge and to estimate length-based reference points such as recommended by ICES WKLIFE II (2012), more data is needed to complete age–length relationships and age and length at first maturity. More fish, especially juveniles under 30 cm and old individuals, must be collected and otoliths read;
- recreational fisheries (catch and effort statistics).

9.2.5 Ecosystem considerations

No information.

9.2.6 Management considerations

TAC for Subarea VII includes ICES Division VIId, which is not in the remit of the Celtic Sea ecoregion. TAC set for both Subarea VI and VII are not in line with the current estimates of catches and estimated sustainable yields, and therefore are not constraining.

9.2.7 References

EU. 2010. Commission Decision (EU) No 2010/93/EU of 18 December 2009 adopting a multiannual Community programme for the collection, management and use of data in the fisheries sector for the period 2011–2013. Official Journal of the European Union, L 41/8.

ICES. 2011. Report of the Working Group for Celtic Seas Ecoregion (WGCSE). ICES CM 2011/ACOM:12. 1572 pp.

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ICES. 2012. Report of The Workshop to Finalize the ICES Data-limited Stock (DLS) Methodologies Documentation in an Operational Form for the 2013 Advice Season and to make Recommendations on Target Categories for Data-limited Stocks (WKLIFE II), 20–22 November 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:79. 46 pp.

MacCall, A. D. 2009. Depletion-corrected average catch: a simple formula for estimating sustainable yields in data-poor situations. – ICES Journal of Marine Science, 66: 2267–2271.

Table 9.2.1. Landings of pollack in Subarea VI as officially reported to ICES.

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Belgium	1	-	-	-	-	-	-	-	-	1
Denmark	-	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-	-	23	6
Ireland	-	-	-	-	-	-	-	-	-	-
Netherlands	-	-	1	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-	-
Sweden	-	-	-	-	-	-	-	-	-	-
UK	295	484	503	422	452	566	528	547	710	607
Subarea VI	296	484	504	422	452	566	528	547	733	614

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Belgium	15	1	2	6	1	1	2	1	5	1
Denmark	-	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	-	-	-
Germany	-	1	8	2	1	1	-	1	2	4
Ireland	-	125	197	204	130	402	200	263	214	282
Netherlands	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	148	-
Portugal	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-	-
Sweden	-	-	-	-	-	-	-	1106	1012	1224
UK	441	259	235	320	368	496	428	413	500	667
Subarea VI	456	386	442	532	500	900	630	1784	1881	2178

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Belgium	2	1	1	2	6	<0.5	7	-	-	-
Denmark	-	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	196	196	310
Germany	1	5	1	-	-	1	-	-	-	-
Ireland	398	75	127	-	-	-	-	-	-	-
Netherlands	-	-	-	-	3	1	1	1	-	-
Norway	-	-	-	-	-	4	-	2	4	-
Portugal	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-	-
Sweden	756	750	779	-	-	-	-	-	-	-
UK	447	256	317	503	359	393	519	493	553	350
Subarea VI	1604	1087	1225	505	368	399	527	692	753	660

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Belgium	-	-	-	-	-	<0.5	-	-	-	-
Denmark	-	-	<0.5	-	-	-	-	<0.5	<0.5	<0.5
France	36	342	272	331	212	224	145	108	128	111
Germany	-	-	-	-	-	1	-	-	-	1
Ireland	-	-	-	-	-	-	223	103	163	103
Netherlands	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	-	-	-
Spain	-	55	95	86	222	283	2217	860	1925	-
Sweden	-	-	-	-	-	-	-	-	-	-
UK	233	185	103	148	194	328	187	259	221	179
Subarea VI	269	582	470	565	628	836	2772	1330	2437	394

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Belgium	-	-	-	-	-	-	-	-	-	-
Denmark	-	-	<0.5	-	-	-	<0.5	-	-	-
France	76	31	21	39	34	64	29	14	21	-
Germany	-	-	-	-	-	3	-	1	-	-
Ireland	150	145	23	12	26	83	97	69	60	73
Netherlands	-	-	-	-	-	-	-	-	-	-
Norway	1	-	-	-	-	-	1	2	-	3
Portugal	-	-	-	-	-	-	-	-	<0.5	-
Spain	-	4	-	-	-	-	-	-	-	-
Sweden	-	-	-	-	-	-	-	-	-	-
UK	192	189	203	273	276	354	210	162	147	136
Subarea VI	419	369	247	324	336	504	337	248	228	212

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Belgium	-	-	-	<0.5	<0.5	-	-	-	-	-
Denmark	-	-	-	-	-	-	-	-	-	-
France	11	8	9	3	2	23	3	10	8	6
Germany	2	-	-	-	-	-	-	-	-	-
Ireland	62	108	26	88	68	28	25	21	21	5
Netherlands	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	1	1	-	-	6	1	-
Portugal	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	4	-	-	-
Sweden	-	-	-	-	-	-	-	-	-	-
UK	116	101	96	111	65	16	5	21	23	25
Subarea VI	191	217	131	203	136	67	37	58	53	36

	2010	2011	2012
Belgium	-	2	-
Denmark	-	-	-
France	4	3	2
Germany	-	-	-
Ireland	34	8	10
Netherlands	-	-	-
Norway	<0.5	-	-
Portugal	-	-	-
Spain	-	-	-
Sweden	-	-	-
UK	39	34	33
Subarea VI	78	47	45

Table 9.2.2. Landings of pollack in Subarea VII as officially reported to ICES.

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Belgium	93	74	80	34	17	38	67	219	342	158
Denmark	-	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	-	-	-
Germany	-	2	10	-	4	-	1	6	17	32
Ireland	-	-	-	-	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-	-
UK	375	380	336	252	365	247	155	367	233	251
Subarea VII	468	456	426	286	386	285	223	592	592	441

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Belgium	317	268	367	95	299	362	456	417	214	142
Denmark	-	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	-	-	-	-	-
Germany	-	-	1	-	-	-	-	-	-	-
Ireland	-	360	369	411	342	335	438	474	508	794
Netherlands	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-	-
UK	267	210	170	176	194	231	175	202	167	161
Subarea VII	584	838	907	682	835	928	1069	1093	889	1097

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Belgium	165	114	142	89	299	295	339	157	186	151
Denmark	-	-	-	-	-	-	-	1	21	18
France	-	-	-	-	-	-	-	3569	5496	5119
Germany	1	-	-	-	-	-	-	-	14	76
Ireland	724	673	1073	-	-	-	-	-	-	-
Netherlands	-	-	-	3	13	17	4	1	8	1
Norway	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	-	-
UK	120	116	123	127	223	290	421	465	515	696
Subarea VII	1010	903	1338	219	535	602	764	4193	6240	6061

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Belgium	237	244	154	167	207	269	241	149	191	145
Denmark	7	-	-	-	-	-	-	-	-	-
France	5242	5814	4253	6214	3927	3741	4574	5213	5211	3893
Germany	-	-	-	-	-	-	-	-	-	-
Ireland	-	-	-	-	-	-	1335	848	1066	994
Netherlands	1	3	-	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-
Spain	1	23	32	26	486	20	17	19	22	18
UK	769	780	1022	1045	1100	1022	1795	2010	1740	1487
Subarea VII	6257	6864	5461	7452	5720	5052	7962	8239	8230	6537

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Belgium	133	76	62	55	94	88	94	99	92	86
Denmark	-	-	-	-	-	2	-	-	-	-
France	4831	3211	2849	2325	2621	2315	2684	2443	2375	-
Germany	-	-	-	-	-	-	-	-	-	-
Ireland	1066	1045	1014	1137	921	1107	1190	984	886	976
Netherlands	-	-	-	-	-	-	6	4	1	-
Norway	-	-	-	-	-	-	-	<0.5	-	3
Spain	26	22	19	7	8	4	5	7	11	19
UK	1914	1962	1889	2135	2391	2168	2519	2540	2347	1703
Subarea VII	7970	6316	5833	5659	6035	5684	6498	6077	5712	2787

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Belgium	71	100	117	113	104	98	79	91	76	42
Denmark	-	-	-	-	-	-	-	-	-	-
France	2422	2515	2481	2284	1914	2198	2213	1970	1579	1641
Germany	-	-	-	-	-	-	-	-	-	-
Ireland	1069	1274	1308	1151	1049	728	809	782	738	828
Netherlands	-	-	-	-	1	1	1	3	1	4
Norway	-	-	-	-	-	-	-	-	-	-
Spain	5	9	17	12	13	16	28	1	14	3
UK	1810	1987	1999	1788	1705	1684	1531	1764	1453	1545
Subarea VII	5377	5885	5922	5348	4786	4725	4661	4611	3861	4063

	2010	2011	2012
Belgium	35	25	42
Denmark	-	-	-
France	1709	1415	1421
Germany	-	-	-
Ireland	935	911	1132
Netherlands	2	-	-
Norway	-	-	-
Spain	-	-	-
UK	1384	1814	1836
Subarea VII	4065	4165	4432

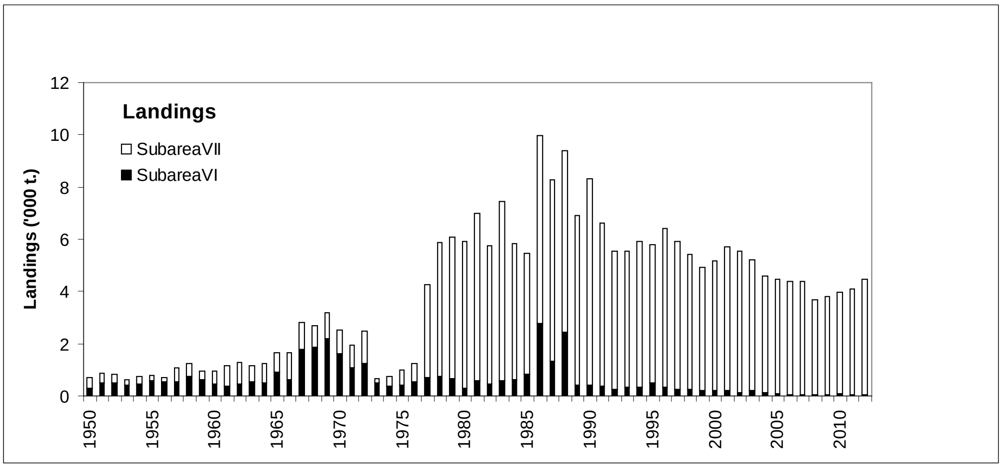

Figure 9.2.1. Pollack landings in the Celtic Seas.

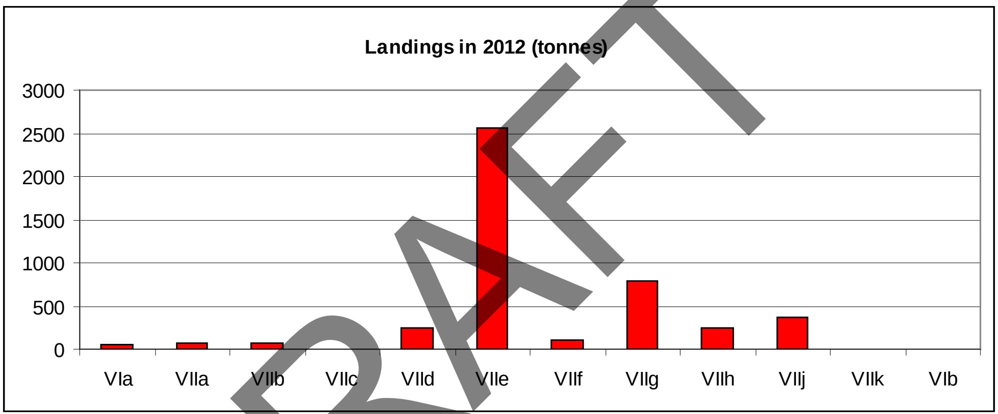

Figure 9.2.2. Pollack landings in 2012 in the Celtic Seas.

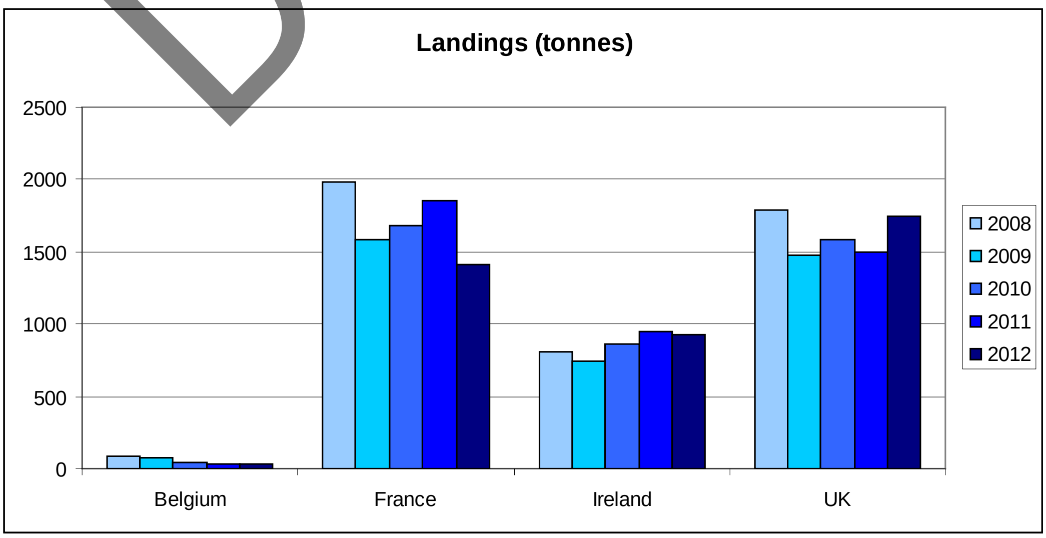

Figure 9.2.3. Contributions of different countries in Pollack landings in the Celtic Seas.

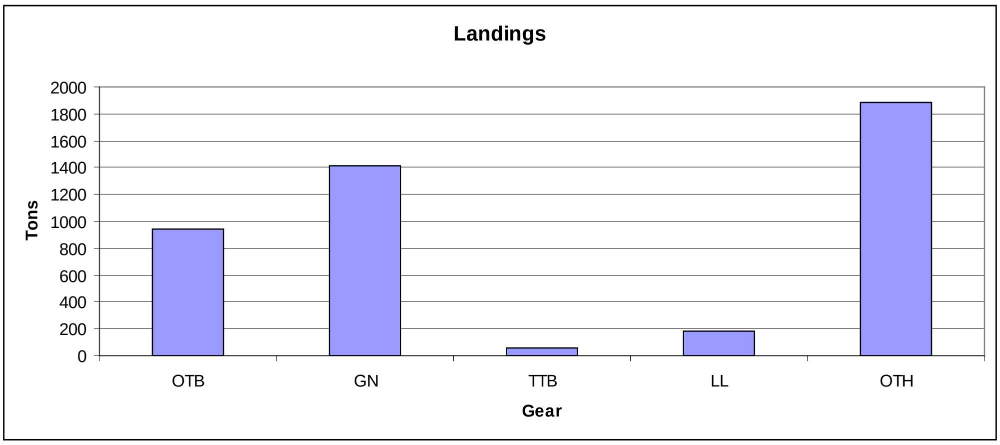

Figure 9.2.4. Pollack in the Celtic Seas. Catches per gear in 2012 (all countries).

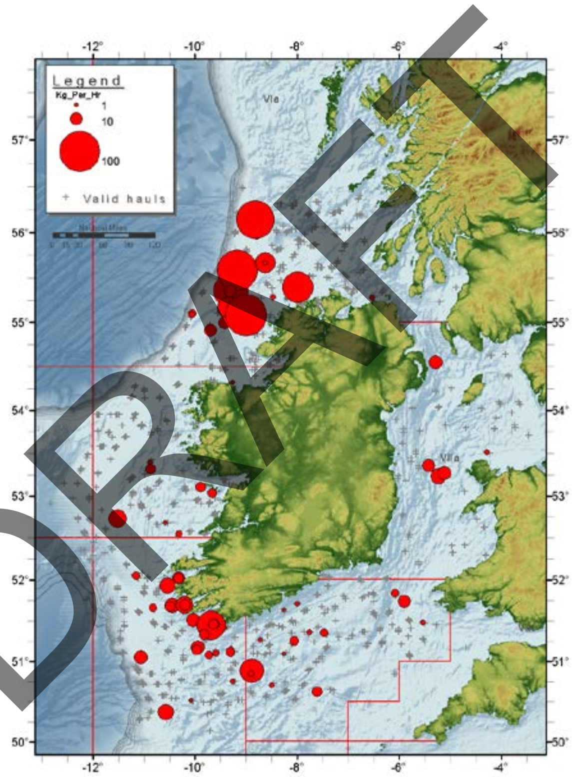

Figure 9.2.5. Pollack in the Celtic Seas. Distribution of catches from IGFS-WIBTS-Q4 (2011).

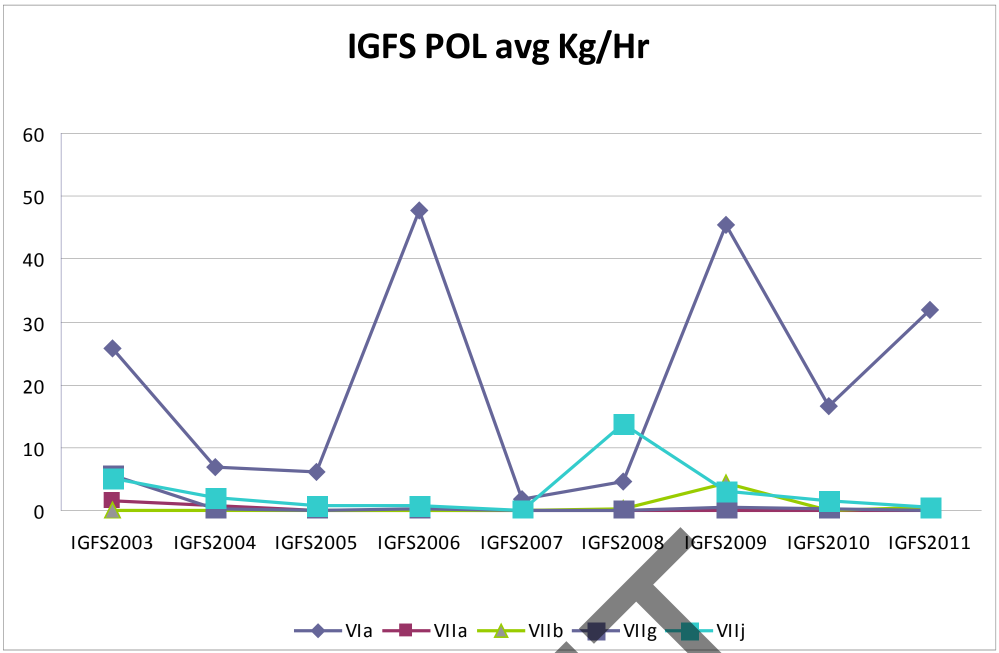

Figure 9.2.6. Pollack in the Celtic Seas. Abundance indexes from IGFS-WIBTS-Q4.

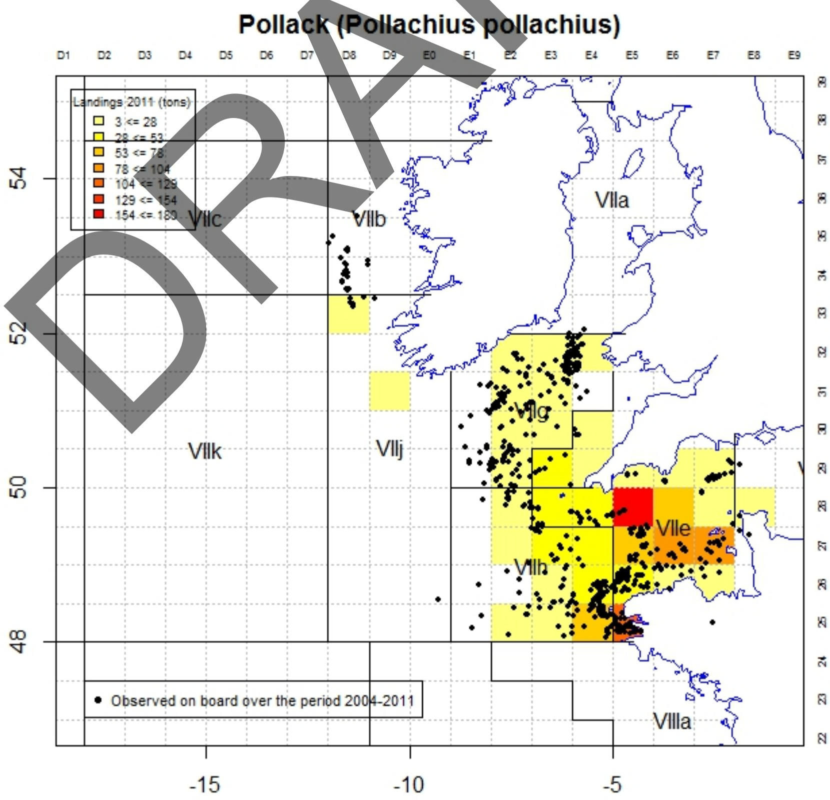

Figure 9.2.7. Pollack in the Celtic Seas. Distribution of catches in the French landings 2011 and in trips observed at sea (over the period 2004–2011).

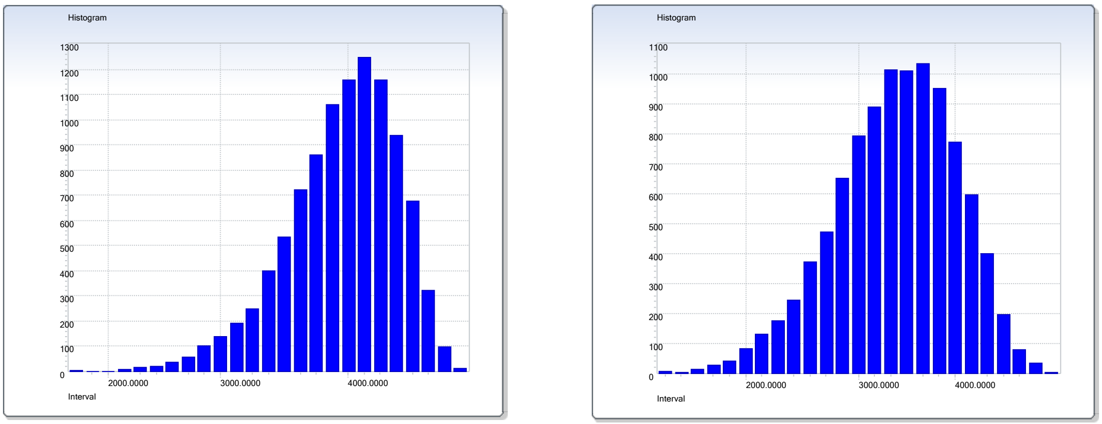

Figure 9.2.8. Pollack in the Celtic Seas, Subarea VII. Distribution of the DCAC mean sustainable catches. Left: M=0.2 (lognormal distribution, CV=0.4), F_{MSY}/M (normal distribution, value=0.8, CV=0.2), B_{MSY}/B_0 (value=0.5, CV=0.1), Depleted delta (normal distribution, value=0.6, CV=0.1). Right: M=0.2 (lognormal distribution, CV=0.4), F_{MSY}/M (lognormal distribution, value=0.6, CV=0.1), B_{MSY}/B_0 (value=0.5, CV=0.1), Depleted delta (value=0.8, CV=0.1,).

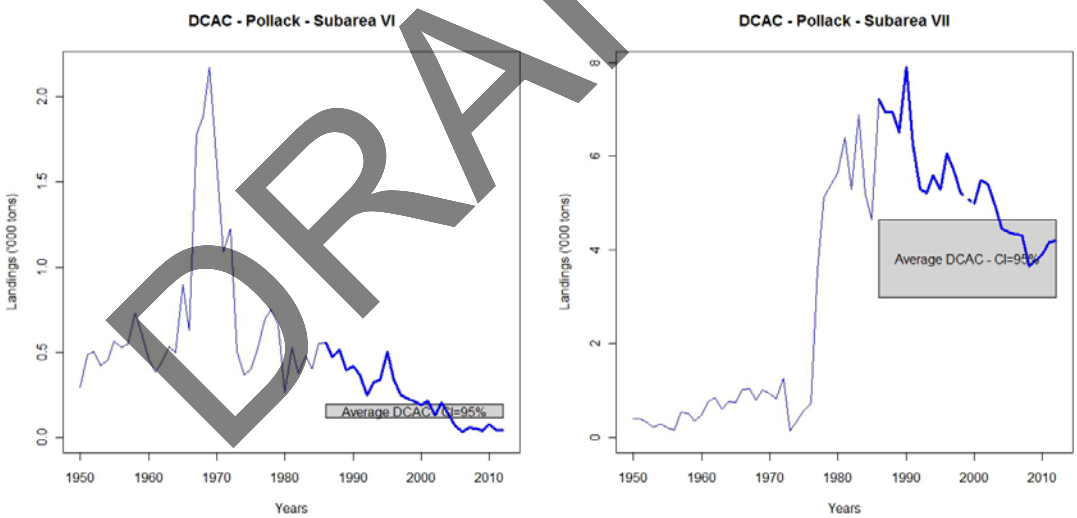

Figure 9.2.9. Pollack in the Celtic Seas. Results of DCAC for Subarea VI (left panel) and Subarea VII (right panel).

9.3 Grey gurnard in the Celtic Seas (ICES Subareas VI and VIIac and VIIe–k)

Type of assessment in 2013

No assessment.

ICES advice applicable to 2013

In 2011, the advice for grey gurnard was based on the precautionary approach and was given for the Northeast Atlantic as a whole. In 2012 the advice is based on the ICES approach to data-limited stocks and this biennial advice is given for three separate ecoregions: Bay of Biscay and Atlantic Iberian waters, North Sea, and Celtic Seas.

ICES advises on the ICES approach to data-limited stocks, implying that catches in 2013 should be reduced by 20% in relation to the average catch of the last three years. Because the data for catches of grey gurnard are considered highly unreliable, ICES is not in a position to quantify the result.

9.3.1 General

Stock identity

WGNEW 2012 concluded that in the absence of specific information on stock structure, the ICES ecoregions are chosen as minimum level of disaggregation for the definition of stock units. This is an interim solution until more information is available on stock. ICES does not necessarily advocate that VI and VII constitutes a management unit for grey gurnard, and further work is required. More information can be found in WGNEW (ICES 2012).

The fisheries

Grey gurnard is a bycatch species in demersal fisheries mainly by trawlers. Catches are largely discarded.

9.3.2 Data

Landings

The nominal landings are given in Table 9.3.1 for ICES Subarea VI and VII respectively. In the past, gurnards were often landed in one generic category of "gurnards". Catch statistics are incomplete for several years: some countries reporting no landings at all, other countries reporting exceptionally high landings. Because the species is largely discarded, landing data will not reflect the actual catches, and only DCF programme by observation at sea could provide with an accurate estimate of catches.

More information on UK (England and Wales) and Russian fishery in 2012 can be found in WD08, WD25 (WGCSE 2013).

Surveys

The EVHOE-WIBTS-Q4IBTS survey in Celtic Sea VIIfghj can be used as a good indicator of abundance of grey gurnard only in this area. The availably of the time-series of abundance from the UK (Scotland), France, Spain, Russia, Ireland and Northern Ireland surveys should provide with indications of trend in the northern and central parts of the ecoregion (VIa, VIb, VIIa, VIIb,c).

In recent years, was already collected and published a great volume of information on the biology and distribution of grey gurnard at Rockall based on survey and observers trips (Vinnichenko *et al*., 2003; Vinnichenko *et al*., 2005; Khlivnoy, 2005).

9.3.3 Ecosystem considerations

No information.

9.3.4 Uncertainties in the assessment

The two priority sources of information for this species are (i) the sampling information from onboard sampling programmes and (ii) the demersal surveys. This is of primary priority since this species is known to be heavily discarded and captured in abundance by the surveys. Information from Russian surveys at Rockall VIb (2000–2003, 2005, 2010) are also available and should be taken into account in further analysis. Progress on processing all this information can only be achieved if experts are formally designated as stock coordinator and stock assessor in order to take the leadership on the needed analysis.

9.3.5 References

ICES. 2012. Report of the Working Group on Assessment of New MoU Species (WGNEW).

Vinnichenko V. I., Khlivnoy V. N. and Newton A. 2003. Peculiarities of distribution of grey gurnard Eutrigla gurnardus at Rockall area. Working Document for Working Group on the Assessment of Northern Shelf Demersal Stocks, ICES, 2003, 12 p.

Vinnichenko V. I., Khlivnoy V. N., Timoshenko N. M. and Newton A. 2005. The Distribution of Grey Gurnard *Eutrigla gurnardus* Linnaeus (Scorpaeniformes, Triglidae) in the Rockall Area. Journal of Ichthyology, Vol. 45, No. 2, pp. 165–174.

Khlivnoy V. N. 2005. Life history and seasonal migrations of main commercial Rockall fish species. In: Proceedings of the International Conference of RAS “Fish behaviour”. M. Borok (ed.). Aquaros, p. 530–536.

Table 9.3.1. Landings of Grey grunard in Subarea VI and VII (excl. VIId) as officially reported to ICES.

	Belgium	Denmark	France	Ireland	Nether-lands	Russian Fed.	UK
1950	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0
1978	0	0	206	0	0	0	0
1979	0	0	165	0	0	0	0
1980	0	0	155	0	0	0	0
1981	0	0	0	0	0	0	0
1982	0	0	407	0	0	0	0
1983	0	0	271	0	0	0	0
1984	0	0	157	0	0	0	2
1985	35	0	130	0	0	0	2
1986	0	0	280	0	0	0	0
1987	37	0	216	0	0	0	0
1988	30	0	211	0	0	0	21
1989	34	0	646	0	0	0	0
1990	18	0	538	16	0	0	0

	Belgium	Denmark	France	Ireland	Nether-lands	Russian Fed.	UK
1991	17	0	298	15	0	0	4
1992	13	0	123	17	0	0	0
1993	11	0	113	10	0	0	1
1994	11	0	107	0	0	0	2
1995	7	0	101	0	0	0	0
1996	6	0	117	0	0	0	2
1997	8	0	61	0	0	0	2
1998	13	0	59	38	0	0	0
1999	11	0	0	0	0	0	0
2000	13	0	109	0	7	26081	0
2001	3	0	116	0	0	3155	13
2002	7	0	81	0	0	60	11
2003	3	0	66	0	1	263	0
2004	5	0	61	0	7	1401	0
2005	9	0	59	0	8	2456	0
2006	4	0	28	0	10	138	6
2007	4	0	24	0	1	0	4
2008	7	0	1	0	3	0	1
2009	11	0	33	0	1	0	8
2010	14	0	45	0	5	0	12
2011	17	0	42	0	3	1	19
2012	23		57		2	92	101

10 Sea bass 47

10.1 Sea bass in IVbc and VIIa,d–h (North Sea, Channel, Celtic Sea and Irish Sea)

Type of assessment

This is an update assessment using the implementation of the Stock Synthesis (SS3; Methot 2000, 2011) model developed at IBP-NEW (2012). This approach was adopted primarily for its highly flexible statistical model framework allowing the building of simple to complex models using a mix of data compositions available. The model is written in ADMB (www.admb-project.org), is forward simulating and available at the NOAA toolbox: http://nft.nefsc.noaa.gov/SS3.html. IBP-NEW developed two basic implementations of SS3, with the same specifications where possible:

1) An age and length model, including age compositions for the four UK fleets and combined length compositions for the French fleets.
2) Length only model, including only the length composition data for all UK and French fishery fleets (French sampling for age does not cover all areas and years).

Both models include the survey data as age-based indices. Landings for other countries (Netherlands; Belgium) were assumed to have the same fishery selectivity characteristics as the French fleets.

A wide range of sensitivity runs of the length-based model were carried out at IBP-NEW, including incorporation of limited data on UK and French discards, different assumptions regarding M and growth, and different model settings. WGCSE 2013 provides results of both model formulations using the model structure and settings recommended by IBP-NEW.

Insufficient data were available to IBP-NEW on recreational harvests for inclusion in the assessment, although available estimates indicate that recreational fisheries could account for as much as 20% of the fishing mortality. Given the exclusion of recreational catches, which will affect accuracy of absolute forecasts, IBP-NEW recommended continued use of Stock Synthesis for provision of **trends-based** advice by WGNEW, and that procedures for carrying out trends-only projections should be developed at WGNEW 2013. (The assessment since moved to WGCSE).

ICES advice applicable to 2012

Currently there is no TAC for this species and it is not clear whether there should be one or several management units. There is insufficient information to evaluate the status of the European seabass in the Northeast Atlantic area. Therefore, based on precautionary considerations, ICES advises that catches should not be allowed to increase in 2012.

ICES reiterates its previous recommendation that implementation of 'input' controls (preferably through technical measures aimed at protecting juvenile fish, in conjunction with entry limitations into the offshore fishery in particular) should be promoted *(ICES, 2004).*

ICES advice applicable to 2013

"ICES advises on the basis of the approach to data-limited stocks that commercial catches should be no more than 6000 tonnes. ICES recommends that implementation of 'input' con-

trols should be promoted. This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations)."

10.1.1 General

Stock description and management units

At IBP-NEW (2012), it was agreed that sea bass in the North Sea (IVb&c) and in the Irish Sea, Channel and Celtic Sea (VIIa,d,e,f,g&h) would be treated as a functional stock unit as there is no clear basis from fishery data, tagging and genetics studies to subdivide the populations in the Irish Sea, Celtic Sea, Channel and North Sea into independent stock units. Supporting information can be found in the IBP-NEW report.

Management applicable to 2012 and 2013

Sea bass are not subject to EU TACs and quotas. Commercial vessels catching bass within cod recovery zones are subject to days-at-sea limits according to gear, mesh and species composition. Under EU regulation, the minimum landing size (MLS) of bass in the Northeast Atlantic is 36 cm total length, and there is effectively a banned range for enmeshing nets of 70–89 mm stretched mesh in Regions 1 and 2 of Community waters[1]. A variety of national restrictions on commercial bass fishing are also in place. These include:

- A landings limit of 5 t/boat/week for French and UK trawlers landing bass (which is not based on a biological point of reference). In France from 2012, following the implementation of a national licensing system for commercial gears targeting sea bass, the landings limits have slightly changed (depending on season and gear)[2];
- Closure of 37 bass nursery areas in England and Wales to specified fishing methods;
- UK regional byelaws in Cornwall and South Wales stipulating a 37.5 cm MLS;
- A minimum gillnet mesh size of 100 mm in South Wales;
- A variety of control measures in Ireland that effectively ban commercial fishing for bass in Irish waters; plus MLS of 40 cm;
- A licensing system from 2012 in France for commercial gears targeting sea bass.

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[1] Region 1: All waters which lie to the north and west of a line running from a point at latitude 48 ºN, longitude 18 °W; thence due north to latitude 60 °N; thence due east to longitude 5 °W; thence due north to latitude 60 °30'N; thence due east to longitude 4 °W; thence due north to latitude 64 °N; thence due east to the coast of Norway.

Region 2: All waters situated north of latitude 48 °N, but excluding the waters in Region 1 and ICES Divisions IIIb, IIIc and IIId.

[2] http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000026844700&dateTexte=&categorieLien=id

- Voluntary closed season from February to mid-March for longline and handline bass fisheries in Brittany.

Depending on country, measures affecting recreational fisheries include minimum landing sizes, restrictions on sale of catch, bag limits (Ireland), and gear restrictions (France; Netherlands).

Fishery in 2012

Landings data used by the WG are given in Table 10.1.1 and Fig. 10.1.1. Fishery landings increased in all areas in the 1990s and early 2000s, with the greatest relative increase observed in the North Sea (Figure 10.1.1b), but have stabilised since the mid-2000s. The landings of 4060 t in 2012 were similar to recent years. France continued to take the bulk of the landings of this stock (Figure 10.1.1c). The largest individual fishery for bass in 2012 continued to be offshore pelagic/ midwater pair trawling (mainly France but some UK vessels), taking 30% of the total international landings (Table 10.1.2). This fishery is mainly in the English Channel and Celtic Sea (Figures 10.1.2 and 10.1.3). French and UK bottom trawls took around 20% of the landings. Fixed gears continued to be relatively more important in the UK (68% of UK landings) than in France (17%) in 2012 (see also Figures10.1.2 and 10.1.3)). Lines represented 12% of landings in 2012.

The bulk of the French commercial landings is taken by relatively few vessels: in 2012 43% of the French landings were made by approximately 40 pelagic (pair) trawlers which target the species in offshore areas during December to April when sea bass are aggregating to spawn. These pelagic trawlers have shifted their activities from the Bay of Biscay to the Channel from the mid-2000s, causing an increased fishing effort on adult bass in this area. Almost 20% of the French landings were made by a large fleet of artisanal liners, handliners and (to a lesser extent) netters mainly targeting sea bass on inshore feeding grounds after the spawning season. Although around 30% of the French landings in 2012 were made by bottom trawlers, these vessels usually are not targeting sea bass. It has to be noted that some French vessels using Danish seines appeared in the offshore fisheries since 2009. Their catches are low but have increased from 27 t in 2009 to 112 t in 2012.

The market value of sea bass in France depends greatly on how it is caught, giving added value to certain métiers (Drogou *et al*., 2011; ICES WGNEW 2010). In 2009, the mean first-sale value of sea bass for pelagic trawlers was around €6/Kg and around €15/Kg for liners and handliners, reflecting differences in catch volume and fish condition.

10.1.2 Data

Commercial landings data

Landings series for use in the assessment are given in Table 10.1.3 and Figure 10.1.1c and are based on census data (EU logbooks and/or sales slips). The UK trawl, midwater trawl, nets and line fleets, and the French fleets, have length composition data allowing separate modelling of fishery selectivity patterns. All other fleets are combined in a single gear grouping. The landings data are derived from two sources:

1) Official statistics recorded in the ICES official landings database since around the mid-1970s (data from 1985 are used in the assessment).

2) French landings for 1999–2012 from a separate analysis by Ifremer of logbook and auction data.

The official landings data for sea bass available to WGCSE are subject to several uncertainties that can affect the accuracy of assessments:

- Incomplete reporting of landings in the 1970s and early 1980s when the fisheries were developing (the assessment uses only data from 1985 onwards);
- Reporting of official French data by port rather than fishing ground before 2000. (The best landings estimates are from auctions for this period. During WGCSE, no fishing grounds could be identified for these landings);
- Poor reporting accuracy for small vessels that do not supply EU logbooks.

From 1999 onwards, Ifremer has provided revised French landings from a separate analysis of logbook and auction data which allocates landings correctly by fishing ground. To generate a consistent series of French landings from 1985 onwards for the Area IV and VII assessment, IBPNew 2012 adjusted pre-1999 official landings from the ICES database by the average of the Ifremer correction factors by area from 1999–2010:

- IVbc and VIId: 1.04; VIIeh: 1.6; VIIafg: 0.62.

The accuracy of UK landings statistics is expected to have improved since the introduction of the Registration of Buyers and Sellers regulations in 2005[3] , particularly for small vessels that do not have to supply EU logbooks.

The UK(England) has previously carried out independent surveys to estimate historical landings data for sea bass, particularly for smaller vessels not supplying EU logbooks. A voluntary logbook scheme was carried out in conjunction with a biennial census of vessels catching sea bass. The census covers different segments of coast in different years (Pickett, 1990). The landings tables in earlier ACOM advice included "unallocated" landings which were the difference between the voluntary logbook estimates and the official UK statistics in each ICES area.

A review of the Cefas logbook scheme in 2012 (Armstrong and Walmsley, 2012a) showed that the previous estimates included recreational charter boats. After removal of these landings, the Cefas logbook estimates for nets and lines still showed substantial differences with official estimates, even for recent years when the Registration of Buyers and Sellers has vastly improved recording of landings by 10 m and under vessels. Coverage of trawls has been too low to provide estimates. The review concluded that the survey is sensibly spread over a range of vessel types and gears, but is over-stratified and has insufficient (and declining) coverage of the many survey strata while using *ad hoc*, judgment-based vessel selection schemes rather than randomized selection. However, the official UK data on sea bass for 10 m and under vessels up to 2005 are also of poor quality and subject to potentially large bias (most likely underestimation). Neither data source for UK 10 m and under vessels is con-

[3] http://www.legislation.gov.uk/uksi/2005/1605/contents/made

sidered reliable historically, but. ICES WGNEW (ICES, 2008) previously found that the stock trends from a statistical assessment model using UK sea bass data (Pawson *et al*., 2007) were relatively insensitive to the choice of these two catch histories. Given the small contribution of UK under-10 m fleets to total bass-47 landings, the official statistics have been retained in the current assessment.

Length compositions: commercial landings

Length and age compositions of sea bass landings, in a form suitable for inclusion in assessments, were available from sampling in the UK and France. Sampling design is described in the stock annex.

Sampling rates

UK Sampling rates for length compositions have been very variable between area, gear and year strata (Tables 10.1.4 and 10.1.5). Most strata have some sampling coverage with the exception of midwater pair trawls which have had zero or very low coverage in many years despite large catches. Although separate ALKs are derived by the UK for the five areas, the same ALK is applied to all gear groups meaning that the age composition estimates for the different gears are not independent. Annual sampling rates for age compositions, by area are given in Table 10.1.5.

Sampling of sea bass in France has also been very variable between areas and gears (Table 10.1.6). There has been a general increase in numbers of trips sampled for length since 2009.

Numbers of sampled trips for UK trawls, midwater trawls, nets and lines, and French all-gears, were used by IBP-NEW as proxies for effective sample size for initial runs, prior to re-adjustment according to model estimates of effective sample size.

Length composition estimates for landings

Tables 10.1.7–10.1.10 give fleet-raised length compositions for UK gears, and Table 10.1.11 gives length compositions for all French gears combined.

Age composition estimates for landings

Fleet-raised age compositions were obtained for UK fleets from 1985 onwards by application of quarterly age–length keys developed for the Areas IVbc, VIId, VIIe and h, and VIIa,f,g. The annual age compositions are given in Tables 10.1.12–10.1.15, and the corresponding mean weights-at-age are in Tables 10.1.16–10.1.19. The UK updated the IBP-NEW landings-at-age series to include 2011 data, but could not complete all scale readings in time to provide 2012 data. Hence the length and age assessment model include UK length compositions for 2012, but age compositions from 1985–2011.

Although France has age compositions for their fishery in VIIe,h from 2000 onwards (presented in IBP-NEW 2012), they could only supply age composition data for the whole stock area for 2011 and 2012 (Table 10.1.11). The French age compositions for 2011 are very similar to the UK midwater pair trawl age compositions that year.

Commercial discards

Data sources for discards estimates, and sampling design, are described in the stock annex.

Discarding of sea bass by commercial fisheries can occur where fishing takes place in areas with bass smaller than the minimum landing size (36 cm in most European countries), and where mesh sizes <100 mm are in use. Estimates were provided to WGCSE from sampling in UK and France.

For UK fleets, sample numbers by gear type and area are highest for otter trawls and nets (Table 10.1.20), but of these, a variable and often small number of trips have bass catches. Very little discards sampling has taken place on offshore UK pair trawlers, however as this fishery targets mature bass, discarding is expected to be low, as observed in the French offshore pelagic fishery where discard rates are 1% or less (Table 10.1.23). No trips were undertaken on UK vessels using lines, which are a significant component of the UK bass fishery. Hooking related mortality will occur in discarded line-caught bass, which could be around 20% depending on handling conditions (see recreational fishery section).

Estimates of annual numbers and weight of sea bass discarded by UK fleets, and numbers of samples, are given for trawls and gillnets in ICES Divisions IVvc, VIId, VIIeh and VIIafg combined in Tables 10.1.21 and 10.1.22. Generally the highest discard rates were for trawlers using 80–89 mm mesh in the eastern Channel (VIId) and southern North Sea. Overall, annual trawl discard rates (by weight) ranged from 7–23% during 2002–2011 (average 13% for the better-sampled 2006–2011 period). Discard rates of gillnetters were very low in most sampled years (0–33%; average 2.5% by weight for 2006–2011; 33% figure appears an outlier). Beam trawl catches and discards of sea bass are minor.

Numbers of fishing trips sampled on French vessels in 2009–2012, and discard estimates by fleet, are given in Table 10.1.23. Discard rates were low in general. As with UK fleets, bottom trawlers had the highest discard rate, similar to the UK figures. Length compositions of French discards are very variable (Table 10.1.24), probably reflecting a low and patchy occurrence of discarding in sampled vessels.

The total amount of discards estimated for sampled fleets in 2009–2012 range up to around 200 t, which represents only around 5% of the total international catch. Addition of discards estimates from non-sampled fleets would increase this. Most discards are fish below the MLS of 36 cm, and mostly from otter trawlers using 80–99 mm mesh in areas such inshore regions of the English Channel where juvenile bass are most common.

Discards estimates for UK and France are from vessel selections that for some areas and gears include relatively limited numbers of observed trips where sea bass is caught and discarded. Precision is therefore very low at current sampling rates. Sampling rates for under-10 m vessels, which take the bulk of the UK sea bass catch, has historically been low or absent, and line gears have not been sampled. There is therefore a large potential for bias in the discards estimates.

Recreational catches

Recreational marine fishery surveys in Europe are still at an early stage in development (ICES, WGRFS 2012). Methods are described in the stock annex.

France

A survey of recreational fishers, focusing mainly on bass, was conducted between 2009 and 2011. Estimates of sea bass catches were obtained from a panel of 121 recreational fishermen recruited during a random digit dialling screening survey of 15 000 households in the targeted districts. The estimated recreational catch of bass in the

Bay of Biscay and in the Channel was 3170 t of which 2350 t was kept and 830 t released (Table 10.1.25). The estimates for Area IV and VII were 940 t kept and 332 t released.

The precision of the combined Biscay and Channel estimate was relatively low (CV =-26%; note that the figure of 51% given in IBPNEW 2012 was incorrect). This gives mean and 95% confidence intervals of 3170 t [1554 t; 4786 t] for the whole Area IV, VII and VIII. Increasing the panel from 121 to 210 fishermen would be expected to improve precision to 20% and increasing this panel to 500 would improve precision to 13%.

The main gears used, in order of total catch, were fishing rod with artificial lure, fishing rod with bait, handline, longline, net and spear fishing. Approximately 80% of the recreational catch was taken by sea angling (rod and line or handline).

Taking into account a potential hooking mortality of 20%, the estimate of annual French recreational fishery removals from Areas IV and VII in 2009–2011 is increased to just over 1000 t.

A new survey was conducted from July 2011 to December 2012, based on a similar methodology to the previous study (not only on sea bass this time, but also on other marine species including crustaceans and cephalopods). A random digit dialling screening survey of 16 130 households led to the recruitment of a panel of 183 fishermen to keep logbooks. In parallel, 151 fishermen were recruited on site by the association Promopeche, and 30 more via the sea bass fishermen panel set up in 2009. This resulted in 364 panel members keeping logbooks describing their catches (species, weight, size, etc.). The focus of the survey on sea bass shows that in Atlantic (Bay of Biscay and Channel), the estimated recreational catch of bass in 2012 was 3922 t of which 3146 t was kept and 776 t released. At this time results have to be considered as provisional, (results split between Bay and Biscay and Channel are not available yet with relative standard error).

UK (E&W)

A new survey programme based on a statistically sound survey design commenced in 2012 to estimate fishing effort, catches (kept and released) and fish sizes for shore based and boat angling in England. The survey does not cover other forms of recreational fishing. Results will be available late 2013.

Netherlands

A recent survey investigated the amount of sea bass caught by recreational fishers (van der Hammen and de Graaf, 2012; ICES, 2012) from March 2010 to February 2011. Estimates of sea bass catches were obtained from a panel of 1043 recreational fishermen recruited during a telephone survey of 109 293 people. Revised estimates were provided to WGCSE 2013. The catch weights are estimated with a limited amount of length–frequency data, and are therefore less reliable than the estimates in numbers (and may also be adjusted if more data is available). For the same reason, there are no 'returned' estimates by weight (yet).

The estimated total recreational catch of sea bass was 366 000 fish (RSE 30%), of which 234 000 were retained, equivalent to 128 t (Table 10.1.25). These results are mainly applicable to Subarea IV.

Total recreational catch

The recent estimates of total recreational removals of sea bass for France and Netherlands in Areas IV and VII amount to over 1000 t, and if UK removals are intermediate between the French and Dutch values, it is likely that around 20% of annual fishery removals are attributable to recreational fishing. This represents a significant missing catch from the assessment, and the impact of this (particularly any trends in recreational catches) on the assessment is unknown.

Biological data

This section provides biological parameters of growth, maturity and natural mortality required for stock assessment of sea bass. Further information can be found in the stock annex and detailed methods and results are given in IBP-NEW 2012 working documents by Armstrong (2012) and Armstrong and Walmsley (2012b,c).

Growth parameters

Growth parameters, standard deviations of length-at-age distributions, and an age error vector are required for the Stock Synthesis model.

Growth of sea bass in ICES Areas IV and VII were investigated using data from more than 90 000 sea bass sampled by Cefas since 1985. The samples are from fishery catches around England and Wales as well as from trawls surveys of young bass in the Solent and Thames estuary. The inshore surveys are mainly young sea bass up to 3–5 years of age, whereas the fishery samples include fish up to 28 years of age. Wide variations in year-class strength result in equally wide variations in numbers of fish sampled per year class, with similar year-class signals appearing all around the UK coast.

The sampled sea bass showed sexual dimorphism of growth from about seven years of age onwards (Figure 10.1.4). Samples of fish became increasingly dominated by females from around 12 years of age (i.e. in the plus-group of the age based assessment).

Combined-sex mean lengths-at-age have not shown any trends over time (Figure 10.1.5). Length-at-age is also very similar in strong and weak year classes (Armstrong and Walmsley, 2012b). Hence data have been combined over the full series to estimate growth parameters.

Growth curves fitted to combined data over areas and years, and by area, are plotted in Figure 10.1.6. The fit to young bass is improved in IVbc and VIId due to inclusion of many fish of 0–5 years of age from inshore surveys. Ages are referred to 1 January, according to month of capture.

Von Bertalanffy model parameters were estimated by area using an absolute error model minimizing ∑(obs-exp)^2) in lengths-at-age:

Area	IVbc	VIId	VIIe	VIIafg	All areas
Linf (cm)	82.98	87.22	92.27	81.87	84.55
K	0.1104	0.09298	0.07697	0.09246	0.09699
t0 (years)	-0.608	-0.592	-1.693	-1.066	-0.730

The "all areas" VBGF parameters are used in the Stock Synthesis model.

Standard deviations of length-at-age

As expected, the standard deviation of length-at-age increased with length, and the trend could be described by the linear model SD = 0.1166 * age + 3.5609 (Figure 10.1.6). The regression estimates of SD by age class are input to the assessment model to generate length-at-age distributions.

Age error parameters for Stock Synthesis

Inclusion of age error parameters in the Stock Synthesis model (CV's for ageing error by age class) were derived from results of the ICES sea bass scale exchange in 2002 (Mahé *et al*., 2012). CVs of 12% at age were specified as increasing values per age class to give a standard error of ~1 year per age class. These are used in the SS3 observation submodel to derive expected values for observed data on age distributions.

Weight-at-length

Weights were derived from total lengths according to the following relationship derived from UK sampling:

W(kg) = 0.00001296 L(cm)^2.969

Maturity-at-length

In the Stock Synthesis length-based and age/length based models, maturity is modelled as a function of length. As the critical variable for management is reproductive potential of the stock, female maturity ogives are used rather than a combined-sex ogive.

Methods and results of estimating proportion mature-at-length for female sea bass, based on UK sampling from the 1980s up to 2003, are described in the stock annex, IBP-NEW 2012 and Armstrong and Walmsley (2012c). These include fish analysed by Pawson and Pickett (1996) to provide estimates of size-at-maturity that have been widely cited since then, and additional samples collected in more recent years. Sample numbers are relatively small.

Maturity was modelled using a binomial error structure and logit link function, fitted in R to individual observations. The logistic model describing proportion mature by 1-cm length class *L* was formulated as:

$$\text{Pmat}(L) = 1/(1+e^{-(a+bL)})$$

defined by the parameters slope *b* and length intecept *a*. These parameters were estimated separately for females and males. This can also be expressed as:

$$\text{Pmat}(L) = 1/(1+e^{-b(L+c)}) \text{ where } c = a/b$$

Stock Synthesis uses the second formulation, and the parameters required are the slope (b = 0.3335: entered as a negative value) and the length inflection, which is the estimated length at 50% maturity ($L^{50\%}$ = 40.65 cm).

The fitted female ogive proposed by IBPNEW 2012 for the update assessments is plotted in Figure 10.1.7 along with the equivalent ogive for males. The parameters of the model are summarized below:

	(A) females	(b) males
Intercept (a)	-13.556	-16.851
Slope (b)	0.3335	0.4861
c (=a/b)	-40.6488	-34.6652
L25%	37.35	32.41
L50%	40.65	34.67
L75%	43.95	36.93

The logistic model for females and males is:

Pmat(L) = 1/(1+e-0.3335(L-40.649)) (females)
Pmat(L) = 1/(1+e-0.4861(L-34.665)) (males)

The maturation range for females during 1982–2003 occurred at ages 4 to 7, and for males at ages 3–6, as shown by the proportion mature at-age in the same samples used for estimation of length-based maturity ogives (see stock annex).

More recent sampling indicates the possibility that sea bass may be maturing at a smaller size and younger age than previously. Samples collected in the southern North Sea from 2005 to 2011 by the Netherlands (Quirijns and Bierman, 2012) indicate 50% maturity in female sea bass at age 4. This is substantially lower than the age at 50% maturity of six years in the Cefas 1982–2003 samples, and closer to an ogive fitted using UK data including a large sample collected in 2009 (see stock annex), for which L50 was around 35 cm (~four years old). This may confirm that sea bass could now be maturing earlier than in the 1980s–early 2000s, at least for the North Sea. A clearer indication of maturity patterns will require a sampling programme and data collection method that ensures representative sampling of mature and immature bass across the geographic range of the population, using a robust, validated marker for maturity.

Natural mortality

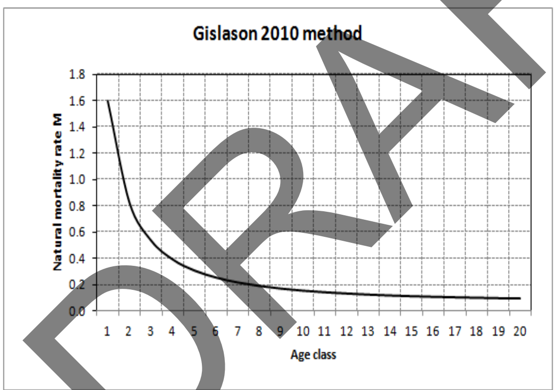
A variety of methods are given in the literature relating natural mortality rate M to life-history parameters such as von Bertalanffy growth parameters k and Linf (asymptotic length), length or age at 50% maturity and apparent longevity particularly in an unexploited or very lightly exploited population. The method of Gislason *et al*. (2010) generates age-varying M values. These methods were applied to the following sea bass life-history parameters by Armstrong (2012):

LIFE-HISTORY PARAMETERS	
VBGF K (combined-sex)	0.097
VBGF Linf (combined-sex)	84.55
VBGF to (combined-sex)	-0.73
Age at 50% maturity females (L50% converted to age)	6
Age at 50% maturity males (L50% converted to age)	4
Max age (combined-sex)	28
Length at 50% mat females	40.65
Length at 50% mat males	34.67

The probability of encountering very old bass is partly a function of the interaction of year-class strength and sampling rates, as well as mortality, however the occurrence of sea bass to almost 30 years of age suggests low rates of mortality. The observed maximum age of 28 years in sea bass samples in the UK was recorded in the early 1980s, following a period of relatively low fishery landings. Age compositions of recreational fishery caught bass in southern Ireland, presented by stakeholders at IBPNEW 2012, also show ages up to 26 years. This stock has been subject to a commercial fishery ban for many years.

Inferences on natural mortality rates are given below:

Source	Formulation	Combined sex M		
Hoenig 1983	variety of taxa ln(M) = 1.44-0.982*ln(tmax);	0.160		
	teleosts ln(M) = 1.46-1.01*ln(tmax)	**0.149**		
Alverson and Carney 1975	M = 3k/(exp(0.38*tmax*k)-1)	**0.161**		
Pauly 1980	M=exp(-0.0152+0.6543*ln(k)-0.279*ln(Linf,cm)+0.4634*lnT(oC))	0.196	temperature C	12
		0.211		14
		0.224		16
Ralston 1987	M=0.0189+2.06*k	**0.219**		
Beverton 1992	M=3k/(exp(*am* *k)-1) am = age at 50% maturity	0.369	female *am* ; comb sex k	
		0.614	male *am* , comb sex k	
Jensen (1997)	M=1.5K	**0.146**		
Gislason 2010	M = exp(0.55-1.61*Ln(L) + 1.44* Ln (Linf)+ Ln(K))			



Age class	Length	M
1	13.1	1.599
2	19.7	0.827
3	25.7	0.539
4	31.1	0.395
5	36.1	0.312
6	40.5	0.258
7	44.6	0.221
8	48.3	0.195
9	51.6	0.175
10	54.7	0.159
11	57.5	0.147
12	60.0	0.138
13	62.2	0.130
14	64.3	0.123
15	66.2	0.117
16	67.9	0.113
17	69.4	0.109
18	70.8	0.105
19	72.1	0.102
20	73.2	0.100

The inferred values of M, with the exception of the Beverton method, are in the range 0.15–0.22. The average of the Gislason estimates for ages 3–20 is 0.19. IBPNEW 2012 investigated sensitivity of the assessment to a baseline M=0.2 value and to other values of constant M and to the Gislason values, which acted mainly to rescale population and F values without markedly altering the stock trends. The value M=0.2 is adopted by WGCSE 2013.

Hooking mortality, and mortality of discarded bass from commercial vessels

The US National Marine Fisheries Service has in the past used an average hooking mortality of 9% for striped bass, estimated by Diodati and Richards, 1996. Striped bass are very similar to European sea bass in terms of morphology, habitats and angling methods. A literature review of hooking mortality for a range of species compiled by the Massachusetts Division of Marine Fisheries included a total of 40 different experiments by 16 different authors where striped bass hooking mortality was estimated over two or more days (Gary A. Nelson, Massachusetts Division of Marine Fisheries, pers. comm.) The mean hooking mortality rate was 0.19 (standard deviation 0.19). Direct experiments are needed on European sea bass to estimate hooking mortality for conditions and angling methods typical of European fisheries.

A fraction of sea bass discarded from commercial line vessels and netters may survive depending on the extent of injury or stress. This will affect the calculation of fishing mortality reference points that are conditional on selectivity patterns. Trawl-caught undersized bass are less likely to survive. Unfortunately no estimates of survival rates of commercial bass discards are available.

Survey data used in assessment

UK Solent and Thames prerecruit surveys

The UK has conducted prerecruit trawl surveys in the Solent and the Thames Estuary since 1981 and 1997 respectively. These surveys all ended in 2009 although the Solent survey was repeated as a one-off survey in autumn 2011 to help provide recruitment indices for the sea bass benchmark assessment. The location of the surveys, tow positions and methods are described in the stock annex. Both surveys use a high headline sea bass trawl, although in the Thames it is deployed as a twin rig and in the Solent as a single rig.

Abundance indices for ages 2–4 in the Solent and ages 0–3 in the Thames have large interannual variability (Tables 10.1.26 and 10.1.27; Figures 10.1.8 and 10.1.10). Strong year classes are apparent in 1989, 1995 and 1997, but in the last decade, year-class strength has been less variable, a pattern also seen in the commercial fishery. The survey indicates a general trend of increasing recruitment since the early 1990s. The most recent Solent survey in 2011 indicates very weak 2008 and 2009 year classes.

Some year-effects (where all or most age classes show a reduced or elevated index in a year) are evident in 2007 in the Solent September survey and in 1996 and 2003–2007 in the May–July survey (Figure 10.1.8). Year-class effects are not consistent across the survey and age range, and this is also shown by low correlation coefficients in the internal consistency plots (index for age *i*, year *y* plotted against age *i*-1, *y*-1; Figure 10.1.9).

The Thames survey shows fewer year effects and better internal consistency than the Solent survey (Figures 10.1.10 and 10.1.11). The overall trend is closer to the Solent September survey than to the Solent May–July survey, showing a trend of increasing recruitment in the 1990s although with a dip in the mid-1990s.

Other 0-gp & 1-gp surveys

Several series of 0-gp and 1-gp indices such as estuarine seine-net surveys are given in the stock annex, but were not used by IBPNEW to develop the bass assessment model. Further analyses of these data are warranted for future benchmark assessments.

Commercial cpue

IBPNEW 2012 evaluated a range of commercial fishery lpue series for French and UK fleets operating in Areas IV and VII, including the lpue trends for participants in the Cefas voluntary logbook scheme. The series are described in the stock annex and the UK data are examined in detail in Armstrong and Maxwell (2012). Commercial fishery lpue was estimated after exclusion of gear types contributing zero or negligible landings of sea bass, and exclusion of ICES rectangles with zero or very low sea bass landings over 1985–2011.

UK vessels of 10 m and under, for which historical landings data are very uncertain, were found to have a wide range of lpue trends depending on gear and area fished, often showing a very steep increase since the mid-2000s. This may be partly a consequence of more accurate reporting caused by the Registration of Buyers and Sellers regulations after its introduction in 2005, but may also represent a bias caused by increased targeting of sea bass by vessels with insufficient quotas for other stocks or trying to develop track record. With some exceptions (e.g. trawlers in VIId), UK >10 m vessels tended to show different lpue trends to 10 m and under vessels. Relative trends of sea bass lpue for 70–99 mm mesh UK otter trawls (1985–2011) and French otter trawlers (2000–2010) operating in IVbc,VIId, VIIeh and VIIafg show a general trend of increase in the 1980s and 1990s, followed by a levelling off and a decline after 2009 (Figure 10.1.12). The trends for >10m UK and French trawlers in IV and VIId and in VIIe closely match the trend total stock biomass estimates from the final Stock Synthesis assessment (Figure 10.1.12) whereas the UK trawlers in VIIa,f, and g have much lower lpue in the early part of the time-series. These results indicate a potential for development of fishery lpue series for inclusion in future development of SS3 for sea bass, using a more statistical approach to develop standardised series.

Other relevant data

None.

10.1.3 Historical stock development

Deviations from stock annex

The assessment follows the procedure developed at IBPNEW 2012 and described the report of that meeting and the stock annex. The following changes to model settings were made at WGCSE, as well as some revisions to input data:

- Treatment of recruitment from 2010–2012 as forecasts, as there are no survey data to estimate recruitment after 2009 (IBPNEW included estimation of 2010 recruitment, the last year with catch data, though no survey data were available to tune the estimates);
- Fixing the first year for main recruitment deviations in the “burn-in” period to 1965 (IBPNEW fixed it at 1980, which would only cover year classes associated with ages 1–5 in the first year of the model. A sufficiently long burn-in period is standard practice in US implementations of SS3. WGCSE evaluated effects of different burn-in periods;
- Exclusion of UK midwater trawl length or age compositions prior to 1996 when the fishery developed. These data are based on few samples and show some anomalous distributions. The fishery landings are negligible part of the international landings during 1985–1995 and removal of the data has little effect on the assessment but introduces unnecessary noise in the fitting procedure;
- Use of length compositions for UK midwater trawls in both the age–length and length models from 1996 onwards. The supplied age compositions generated selectivity curves for this fleet with anomalously high age at 50% selection, and require investigation. The length compositions generated selectivity curves closer to what may be expected, though the SS3 stock trends were very similar using lengths or ages.

These changes were considered justifiable by WGCSE, given that the modelling framework and all other parameters remained as described in the stock annex.

As at IBPNEW, WGCSE presents the results as a trends-based assessment, using both the length based and the age–length models for investigating trends in biomass, recruitment and fishing mortality.

Software used and model options chosen

Model used: Stock Synthesis 3 (SS3) (Methot, 2010)

Software used: Stock synthesis v3.23b (Methot, 2011)

The development of a sea bass assessment model by IBPNEW 2012 was built on experiences from application of the statistical, fleet-based separable model published by Pawson *et al*. (2007a) and updated by ICES WGNEW (Kupschus *et al*., 2008). This was fitted only using UK age compositions for trawls, midwater trawls, nets and lines, separately for Areas IVbc, VIId, VIIeh and VIIafg, and was intended mainly to estimate fleet selection patterns. Although it excluded any tuning data, the recruitment-series for each sea area closely resembled the Solent survey indices and to an extent the shorter Thames series, and was able to provide coherent selection patterns by fleet.

The IBPNEW 2012 benchmark assessment required a modelling framework capable of handling a mixture of age and length data for fisheries, including data for French fleets that had length composition data but no age composition data, and for which the length data were available only since the 2000s. The Stock Synthesis (SS) assessment model was chosen, primarily for its highly flexible statistical model framework allowing the building of simple to complex models using a mix of data compositions available. The model is written in ADMB (www.admb-project.org), is forward simulating and available at the NOAA toolbox: http://nft.nefsc.noaa.gov/SS3.html. For European sea bass a range of assessment models was built using Stock Synthesis 3 (SS3) version 3.29b to integrate the mix of fisheries and survey data available (fleet-based landings; landings age or length compositions, ages-based survey indices for young bass) and biological information on growth rates and maturity.

Two basic model structures were explored at IBPNEW 2012, with the same specifications where possible:

- Age and length model; including age compositions for the four UK fleets and combined length compositions for the French fleets;
- Length only model; including only the length composition data for all fishery fleets.

Exploratory runs at WGCSE showed that the updated age composition data for the UK midwater trawlers generated anomalous length-based selection curves, whereas inclusion of these data as length frequencies resulted in a selection pattern consistent with the length frequency. Pending future investigation of the age data for this fleet, the SS3 runs proceeded using the length compositions for this fleet in both the age & length and the length based models.

Model structure and input data / parameters

The different dataseries, and their temporal coverage, are shown graphically in Figures 10.1.13 and 10.1.14 for the length based and age–length model formulations.

Model structure

- Temporal unit: annual based data (landings, survey indices, age frequency and length frequency);
- Spatial structure: One area;
- Sex: Both sexes combined.

Fleet definition

Six fleets were defined: 1. UK bottom trawls, 2. UK midwater pair trawls; 3. UK fixed and driftnets; 4. UK lines; 5. French fleets (combined); 6. Other (other countries and other UK fleets combined).

Although landings for French fleets were available by métier for all areas, age composition data for 2000–2010 were available only for one area (VIIe,h), hence all gears were combined. Moreover, during 1985–2000 the catch statistics are poorly reported and French auction data don't differentiate catches of the north component of the Bay of Biscay.

Landed catches

Annual landings in tonnes from 1985 to 2012 for the six fleets from ICES Subdivisions IVb and c, VIIa, d–h were used in the assessment. French data are as provided by Ifremer.

Abundance indices

Ten independent abundance index series were defined, each being a single age group (up to four years old) from one of the three available trawl surveys. They are treated as ten independent surveys (following a recommendation from R. Methot) to circumvent difficulties in estimating selectivity parameters for each survey series comprising only 3–4 young age groups, although this approach loses covariance information due to year-effects in each survey.

- Spring Solent survey in ICES Subdivision VIId covering ages 2 to 4 for years 1985 to 2009;
- Autumn Solent survey in ICES Subdivision VIId covering ages 2 to 4 for years 1986 to 2009;
- Autumn/Winter Thames survey ICES Subdivision IVc covering ages 0 to 3 for years 1997 to 2009.

Fishery landings age composition data for age-length model

Age bins for this model were set at 0 to 11 with a plus group for ages 12 and over, because historical UK data had been compiled that way. (Future assessments should use more ages.) Age compositions for UK trawlers, netters and liners for 1985–2011 were expressed as fleet-raised numbers-at-age, although they are treated as relative compositions in SS3.

As UK age data for 2012 were not available in time for WGCSE, the length compositions for the three fleets in 2012 were included in the model.

Length composition data for age-length and length only model

The length bin was set from 4 to 100 cm by 2 cm intervals. Length compositions for the following fishing fleets were used:

- UK otter trawl, nets and lines (three fleets): 1985 to 2012 data were used in the length only model, and 2012 data in the age model;
- UK midwater pair trawls: 1996–2011 data were included in both the age & length and the length models. Sampling of midwater pair trawl landings has been low and patchy over time, and some years have no samples. Some of the midwater trawl data during the 1985–1995 period, before the fishery became established (see Figure 10.1.2), were from very small sample sizes and exhibited unusual length and age compositions. All length and age data for this fleet during 1985–1995 were excluded from the model. This is a change from the IBPNEW approach, but results in <1% change to annual SSB estimates.
- French all fleets combined: 2000 to 2012 data were used in both the age–length and length only model.

Model assumptions and parameters

The following text table summarises key model assumptions and parameters developed by IBPNEW for sea bass in IV and VII. Other parameter values and input data characteristics are defined in the SS3 control file BassIVVII.ctl, the forecast file Forecast.SS and the data file BassIVVII.dat. Changes from IBPNEW settings are indicated.

Characteristic	Settings
Starting year	1985
Ending year	2012 (IBPNEW: 2010)
Equilibrium catch for starting year	Mean landings by fleet: 1980–1984
Number of areas	1
Number of seasons	1
Number of fishing fleets	6
Number of surveys (recruit surveys)	3 surveys, modelled as 10 single-age fleets at ages 0–4
Individual growth	von Bertalanffy, parameters fixed, combined sex
Number of estimated parameters	62 (includes additional years and main recruit deviations back to 1965)
Population characteristics	
Maximum age	30
Genders	1
Population length bins	4–100, 2 cm bins
Ages for summary total biomass	0–12+
Data characteristics	
Data length bins (for length structured fleets)	14–94, 2 cm bins
Data age bins (for age structured fleets)	0–12+
Minimum age for growth model	0 [age 2 for age–length model]
Maximum age for growth model	30
Maturity	Logistic 2-parameter – females; L50 = 40.65cm
Fishery characteristics	
Fishery timing	-1 (whole year)
Fishing mortality method	Hybrid
Maximum F	2.9

Characteristic	Settings
Fleet 1: UK Trawl selectivity	Asymptotic
Fleet 2: UK Midwater trawl selectivity	Asymptotic
Fleet 3: UK Nets selectivity	Asymptotic (dome shaped forsensitivity run)
Fleet 4: UK Lines selectivity	Asymptotic
Fleet 5: Combined French fleet selectivity	Asymptotic
Survey characteristics	
Solent spring survey timing (yr)	0.42
Solent autumn survey timing (yr)	0.83
Thames survey timing (yr)	0.75
Catchabilities (all surveys)	Analytical solution
Survey selectivities	[all survey data entered as single ages; sel = 1]
Fixed biological characteristics	
Natural mortality	0.2
Beverton–Holt steepness	0.999
Recruitment variability (σR)	0.9
Weight–length coefficient	0.00001296
Weight–length exponent	2.969
Maturity inflection (L50%)	40.649 cm
Maturity slope	-0.33349
Length-at-age Amin	5.78 cm
Length-at-Amax	80.26 cm
von Bertalanffy k	0.09699
von Bertalanffy Linf	84.55 cm
von Bertalanffy t0	-0.730 yr
Std. Deviation length-at-age (cm)	SD = 0.1166 * age + 3.5609
Other model settings	
First year for main recruitment deviations for burn-in period	1965 (IBPNEW: 1980)

Data screening

Landings age composition data were evaluated at IBPNEW for internal consistency (year-class tracking) and any unusual features, and were considered suitable for inclusion in the model.

Year- and age-effects in the Solent and Thames surveys were investigated and discussed above with reference to Figures 10.1.8–10.1.11.

Final update assessment: diagnostics

The likelihood components (log L * Lambda) for the final length based and age–length based SS3 updates are given below:

	Length model	Age-length model
No. parameters	62	62
Total likelihood	1267	775
Landings	1.25E-07	1.25E-07
Initial equilibrium catch	0.233	0.0476
Survey indices	192	206
Length compositions	1047	287
Age compositions		258
Recruitment	28	22.9
Parm_priors	0.0387	0.0058
Parm_softbounds	0.0052	0.0077

Both models estimate the same parameters, but differ in the fitting of length compositions for UK fleets in one model, and age compositions in the other. As expected, the main contributor to total likelihood is the fishery composition data and the survey indices. Diagnostics of the two models are described below.

Fishery selection curves

Fishery selection curves from the update length-based and age& length model are given in Figure 10.1.15 b,c in comparison with the curves from the IBPNEW 2012 length based runs excluding and including discard data for UK trawls (Figure 10.1.15a, d). The updated length based assessment results in slightly altered selection curves for UK lines and midwater trawls. The age & length model generates steeper curves for UK trawls and nets than given by the length only model.

A run carried out at IBPNEW with trawl discards included, resulted in a substantial shift in the trawl selection curves towards smaller sizes well below the MLS of 36 cm (Figure 10.1.15d). In general, the fishery selection curves lie to the left of the female maturity ogive, explaining the substantial captures of fish that have not yet spawned for the first time.

Observed and fitted length and age compositions

Figures 10.1.16–10.1.20 show the observed and fitted length and age compositions for each fleet, and Figure 10.1.21 shows the results integrated over the full time-series. In general, the fits for UK fleets were poorest for the early part of the time-series, suggesting an effect of smaller numbers of samples and possibly a more *ad hoc* approach to data collection, as this species was not subject to any analytical assessments at that time. Fits to UK trawl and net data suggest that selectivity may decline beyond a certain length, as would be expected for gillnets and for trawling close inshore near nursery areas; and also indicated by the earlier assessments carried out on UK data by WGNEW. Future benchmark assessments should consider other forms of selectivity curves where this is supported by observations.

Observed and fitted survey indices

The model fit to the Solent survey in spring was generally poor, with only the major signals reflected in both, and with strong trends in residuals (Figure 10.1.22). A much better fit was apparent for the Solent autumn survey (Figure 10.1.22). As reported by IBPNEW 2012, the Thames survey was also poorly fitted (Figure 10.1.23). This survey gives low recruitment indices for 1998 and earlier year classes which does not match the Solent survey series or the SS3 estimates, and probably is more indicative of lower recruitment strength in the North Sea prior to the expansion of sea bass in that area.

Sensitivity of model to length of pre-1985 burn in period

The age& length model generates a higher biomass estimate for 1985 and lower estimate for 2012 compared with the length based model, and indicates larger estimates of F for recent years (Figure 10.1.24). During the pre-1985 burn-in period, annual landings by fleet were assumed to be equivalent to the 1980–1984 average from the ICES landings data base. Going further back in time to 1975 or earlier, official landings reports for sea bass are likely to become increasingly unreliable and incomplete. Extending the pre-1985 burn-in period from 1975 (ten years) to 1965 (20 years) lowers the 1985 SSB estimates slightly and increases the 2012 estimates, and reduces the F estimates. Recruitment trends are similar in the two models, the length based model giving noisier estimates with larger standard errors, and the extended burn-in period resulting in larger recruitment estimates in recent years.

The ability of the length based model to track year classes was largely dependent on the signals in the age-based survey indices. Scrutiny of raw UK sample age compositions out to 28 years of age (see Figure 10.1.26) showed that the age and length model correctly picked up a distinct 1976 year class in the burn-in period that was incorrectly assigned by the length model in the absence of any survey tuning data for those years.

In general, both models were lacking in accurate data on early landings and catch compositions by fleet, particularly age compositions extending out to the oldest ages, and this results in an uncertainty regarding the initial population abundance and subsequent depletion.

Retrospective analyses

With the exception of the SS3 run ending in 2011, the age and length model exhibited relatively small retrospective adjustments to SSB and F estimates (Figure 10.1.25). Estimates of recent recruitment were however very inconsistent, probably reflecting the reduction in survey information in recent years. The length based model had poorer retrospective performance (also noted by IBPNEW), but also had wider confidence limits for recent SSB and recruitment estimates.

Supporting evidence for trends in biomass and F

A potential problem is that the age-based model currently has UK age compositions only to a true age of eleven, well below the known maximum age of sea bass, whilst the ability of length-based models to detect changes in relative abundance of the oldest ages is also limited. Supporting evidence that the model is representing true changes in the population was sought from three sources:

- Incidence of sea bass at ages older than 15 or 20 years in historical data sets;
- Log catch ratios in the UK fleet age composition data;
- Fishery lpue data.

Incidence of bass older than 15 or 20 years

Figure 10.1.26a shows the number of Area IV and VII sea bass in UK age samples since 1985, out to the oldest age recorded (28). The recruitment signals given by the SS3 assessment are clearly apparent in this dataset. In Figure 10.1.26b, the numbers of sea bass aged 15 and older, or aged 20 and older are expressed as a percentage of the total number at age 8 and above (fish at age 8 can be considered as fully selected). From the early 1990s, these percentages decline at a similar rate to the equivalent percentage in the SS3 population estimates, also shown in the Figure. Although age composition data for French fleets is available for the full age range, the series commences only in 2000. However, the percentage of fish at ages 15 or 20 and older is also low (Figure 10.1.26b). The expected percentages for a population at equilibrium at the proposed f reference point Fspr35% are also plotted in Figure 10.1.26b. Prior to the mid-1990s, the percentages of fish of 15+ and 20+ in the population and sample collections were above Fspr35%, suggesting accumulation of older fish from earlier low mortality period, but the percentages have subsequently fallen well below the expectation at Fspr35%, consistent with the SS3 estimates of F increasing well above this reference point over time.

Log catch ratios in UK fishery age compositions

Log catch ratios (Ln ($C_{a,y}/C_{a+1/Y+1}$); proxy for F) for ages 6 and over in the UK nets and lines fishery vary without trend overt the 1985–2011 period, but increase over this period in UK trawls (Figure 10.1.26c).

Fishery lpue

Fishery lpue data for sea bass are very variable and there are historical inaccuracies in recording of sea bass landings, particularly for small vessels that have not been required to submit EU logbooks. For larger vessels using trawls in ICES rectangles where bass catches are recorded, there is evidence for low catch rates in the 1980s, and an increase in lpue coincident with the increase in total stock biomass shown by the SS3 model, and also a flattening off or even decline in lpue in recent years (Figure 10.1.12). This is most apparent for fleets operating in the North Sea and Channel; the trends for trawlers in VIIa and f,g,h are different during much of the 1980s and 1990s.

There is therefore some ancillary evidence to support the trends given by the SS3 model. There is however a strong need for relative abundance indices to be included in the SS3 model to help fix the trends in abundance of older bass, or fishing effort series that can help fix the trends in F.

Final update assessment: long-term trends

The Working Group noted that the age & length SS3 model provided additional information on year-class signals present in the raised fleet age compositions, leading to more precise historical recruitment estimates. However, the data are currently available with a plus group of 12+, losing important information on mortality at older ages. The length model allows fitting over the full age range in each fleet, though becomes more dependent on the surveys to tune recruitment estimates. However, the general trends from both models are similar (Figure 10. 1.27).

The population numbers and F-at-age from the update assessment using the age and length model are given in Tables 10.1.28 and 10.1.29, and the summary data are given in Table 10.1.30 and are plotted in Figure 10.1.27.

Comparison with previous assessments

There is no previous assessment other than the findings of IBPNEW which were not used as the basis for any advice. The general trends from the present assessment are based on inclusion of two additional years of data and changes to the handling of UK midwater trawl data and the length of the burn-in period. However the general retrospective patterns are similar, qualitatively, to the IBPNEW results.

The state of the stock

The spawning–stock biomass and recruitment at the beginning of the assessment time-series are uncertain due to the impact of different assumptions concerning catches and recruitment in the pre-1985 model burn-in period. The following comments on the state of the stock are conditional on the models that are presented.

The spawning–stock biomass declined in the 1980s due to a period of poor recruitment, but a very strong 1989 year class and some subsequent strong year classes in the 1990s led to a period of increasing SSB which also coincided with expansion of the stock in the North Sea. The enhanced productivity and geographic range of the stock at this time also coincided with a period of elevated sea temperatures. Declining recruitment since the mid-2000s, combined with a trend of increasing fishing mortality, appears to be causing a reduction in total stock biomass and spawning–stock biomass.

10.1.4 Short-term predictions

Due to the large uncertainties in recent recruitment (the most recent year class with survey tuning data was 2009), it is not possible to develop a short term prediction. If recruitment continues at or below the estimates for the 2008 and 2009 year classes, there is a high likelihood that the biomass of sea bass will continue to decline in the short term although the rate of decline cannot be predicted accurately.

There is some limited information (Longley *et al.*, 2012; presented at IBPNEW 2012) that 1-gp bass in the Solent area (the location of the main survey tuning-series for the SS3 assessment) may have been at lower abundance in spring 2010 and 2011 than in 2009, coincident with reducing sea temperature in the preceding winter. IBPNEW also presented seasonal sea temperatures from the Thames estuary showing that years with winter temperatures below 5°C coincided with very low Thames survey indices of recruitment, and that such conditions have been apparent each year from 2008 to 2011. The winter of 2012/2013 has also been one of the coldest on record in the UK. Cold winters are considered to cause elevated mortality in 0-gp and 1-gp sea bass in UK estuaries. (See also Management Considerations Section 10.1.10 and Figure 10.1.30 for long-term trends in bass recruitment and sea temperatures). Anecdotal information from UK recreational fishermen is that small sea bass have become very scarce in recent years, suggesting poor recruitment.

10.1.5 Medium-term projections and MSY evaluation

No medium-term projections were carried out because of lack of estimates of recent recruitment after the 2009 year class.

F_{MSY} evaluations

A full F_{MSY} evaluation based on stock–recruit dynamics was not possible as there is no SSB signal in recruitment deviations (Figure 10.1.28a). All recruitment values could be considered as fluctuating widely around the asymptote of a Beverton–Holt SRR.

10.1.6 Biological reference points

There are no existing biological reference points for sea bass. Yield-per-recruit (YPR) and spawning–stock biomass per recruit (SPR) reference points were generated conditional on the selectivity and weights-at-age estimated for each fleet in the age and length SS3 model, and the product of weight-at-age and maturity given by SS3. Inputs are given in Table 10.1.31 and results in Table 10.1.32 and Figure 10.1.28b). Reference point estimates are:

	TYPE	VALUE	TECHNICAL BASIS
Precautionary approach	B_{lim}	Undefined	
	B_{pa}	Undefined	
	F_{lim}	Undefined	
	F_{pa}	Undefined	
MSY approach	F_{MSY}	0.17	Based on F giving SSB per recruit 35% of value at zero F
	$MSY_{btrigger}$	Undefined	

The equivalent F value for F0.1 is 0.18. F_{max} is not definable.

Based on UK sampling in the 1980s and 1990s, 50% of female sea bass were mature at six years of age (Figure 10.1.29). Currently, 50% selection in the total international landings occurs at age five (Figure 10.1.29), and the selection value for the fishery including discards (mainly bottom trawls) will be lower. Hence there is substantial catch of fish that have not yet spawned for the first time, increasing vulnerability of the spawning stock to depletion through exploitation. Taking the relatively slow growth rate into account (von Bertalanffy k ~ 0.1), a conservative $F_{spr35\%}$ value may be most appropriate for this stock.

Some recent data from the Netherlands indicate a lower age at 50% maturity of around four years in the southern North Sea (Quirijns and Bierman, 2012), and a small number of fishery samples from UK vessels in 2009 indicated a similar value. However, without adequate and representative sampling of the population throughout the range of the stock, it is not known if this represents a fundamental shift in productivity of the stock. The Fspr35% value obtained by shifting the maturity ogive to give 50% maturity at age 4 is 0.24.

10.1.7 Management plans

There are no existing management plans for European sea bass.

10.1.8 Uncertainties and bias in assessment and forecast

Landings data

The historical fishery catch data are subject to several biases. From 1999 to 2010, French landings data from the ICES commercial landings database are replaced by more accurate figures from a separate analysis of logbook and auction data. From 2011 onwards, the official and scientific French landings use the same analysis of logbook and auction data and VMS data. Prior to 1999 official French landings figures have had to be redistributed between ICES areas according to the average spatial pattern observed from 1999 onwards.

Historical landings of small-scale national fisheries not supplying EU logbooks are known to be inaccurate. WGNEW has in the past run the previous ADMB bass model (applied to UK data only) with and without additional landings estimated from a separate Cefas logbook scheme, and found this had relatively little impact on stock trends.

Discard rates are low in most fisheries other than trawls. Estimates of discards are available only from the early 2000s, but do not cover all fisheries, are imprecise, and are not included in the assessment.

Recent recreational fishery surveys conducted under the DCF indicate that recreational removals could account for as much as 20% of the total fishery removals from Areas IV and VII. This is not accounted for in the assessment, and represents a bias in historical removals particularly in view of any trends in recreational catches and releases.

Discarding

Discarding of sea bass < MLS of 36 cm occurs mainly in bottom-trawl fisheries, particularly in the eastern Channel where important nursery areas for sea bass occur (e.g. the Solent area). Estimates of UK and French discards for trawlers in IV and VII available to WGCSE were between 100 and 200 t in recent years, compared with total international landings of around 4000 t.

Discarding is much less apparent in net fisheries using 90 mm + meshes, and in the offshore pelagic fisheries which mainly target mature fish. IBPNEW 2012 carried out a SS3 run including discards estimates and associated length composition data for UK trawls and nets in 2002–2010 (all areas combined) and French trawls (2009 and 2010), but found this had negligible effect on SSB and F trends but added noise to recruitment estimates. The lack of discards estimates in the model is therefore unlikely to have a major effect on the relative stock trends and estimates of F for ages 5 and over.

Surveys

The surveys included in the assessment contain only fish up to four years of age. This is a major drawback for an assessment with a broad age profile in the catches. Although strong year-class signals are apparent in the surveys, the SS3 model fits most closely to the UK Solent trawl survey, and fits poorly to the Solent spring and to the Thames survey. The Thames survey may provide year-class signals representing recruitment patterns in the North Sea, an area that experienced an expanding bass stock during the 1990s. The SS3 model has poor precision in estimating recruitment at age 0, with major annual revisions of previous estimates as new data are added. This partly is due to the termination of all the surveys after 2009, and the re-instatement of the Solent autumn survey for only one subsequent year (2011).

Termination of the UK juvenile bass surveys between 2009 and 2011 has meant there is no information available on recent year classes after 2009, and recent year classes up to 2009 are poorly estimated. Stock projections are therefore not possible, and the lack of survey data will progressively degrade the ability to detect recent changes in abundance unless other equivalent dataseries can be developed.

Model formulation

The current formulation of the model has been useful for exploring the information content of the available data, but is likely to be over complex given the data limitations and could potentially become unstable as new data are added (note the large change in perception of F and SSB with 2011 as terminal year in the retrospective analysis).

The longer term population trends are affected by choices and inputs related to the pre-1985 burn-in period, particularly given the format of the age data inputs with a 12+ group, which limits the information available for establishing pre-1985 recruitment deviations. Knowledge of pre-1985 fishery removals is also poor.

Stock structure and migrations

The assessment treats all sea bass in IVb,c and VIIa,d–h as a single biological stock. Although there can be extensive migrations, for example between the North Sea and the Channel, there is also strong site fidelity (Pawson *et al.*, 2008) resulting in a high proportion of tagged fish being recaptured at the same coastal location, even in subsequent years after migrations to offshore spawning sites. Immature sea bass may remain close inshore, and exploitation of young fish in coastal waters (< 6 n.miles offshore) may be predominantly by inshore fleets of that country. Mature fish originating from coastal waters of the UK, France or Netherlands or other countries may become increasingly vulnerable to offshore pelagic pair trawlers fishing mainly on mature fish during December to April. These spatial, ontogenetic patterns may lead to complex responses of length and age compositions to previous fishery catches of each country and fleet. This could potentially be addressed using spatial structuring in Stock Synthesis, but the data demands would increase substantially.

10.1.9 Recommendations for next benchmark assessment

An inter-benchmark meeting is needed in 2014 to review data inputs and implementation of the Stock Synthesis model, with a particular focus on improving the robustness of the model for providing management advice.

The intersessional work plan for the inter-benchmark is likely to include the following tasks:

- Source and review information on historical catches and develop plausible scenarios including over the 20+ year burn-in period for the assessment;
- Review the derivation and quality of historical fishery length/age composition data;
- Expand UK fishery age compositions to all true ages;
- Rationalise the fleet definitions, and reduce to the minimum sufficient to provide robust SS3 stock trends;
- Source and evaluate candidate lpue or effort series for tuning abundance or fishing mortality on older ages;
- Collate and evaluate other survey data on bass abundance that could be incorporated in the model;
- Determine the most robust approach to incorporating mean length-at-age and length-at-age distributions in SS3;
- Investigate potential biases in using combined-sex growth parameters;
- Further explore the sensitivity of the assessment to decisions on model structure and inputs;
- Consider if simpler assessment approaches area warranted;

There are a number of key gaps in data and understanding that need to be addressed through future research (some of which are being addressed in national research programmes). The following advice builds on the recommendations given by IBPNew 2012:

- Relative abundance indices are needed for adult sea bass, or development of fishing effort-series that are strongly correlated with fishing mortality;
- Recruitment indices are needed covering the main nursery areas over the full geographic range of the stock, including in France. The termination of the UK sea bass surveys in 2011, particularly the autumn Solent survey, will seriously impact the ability to continue an analytical assessment of this stock unless other time-series become available. WGCSE strongly advises the re-instatement of this survey, and the development of similar inshore surveys of young bass in France;
- Further research is needed to better understand the spatial dynamics of sea bass (mixing between ICES areas; effects of site fidelity on fishery impacts; spawning site–recruitment ground linkages; environmental influences);
- Studies are needed to investigate the accuracy/bias in ageing, and errors due to age-sampling schemes historically;
- Continued estimation of recreational catches is needed across the stock range, and information to evaluate historical trends in recreational effort and catches would be beneficial for interpreting changes in age–length compositions over time.

10.1.10 Management considerations

Sea bass are characterised by slow growth and late maturity, which imply the need for comparatively low rates of fishing mortality to avoid excessive depletion of spawning potential in each year class. In addition, sea bass in Areas IV and VII have experienced a period of enhanced recruitment with intermittent strong year classes between 1989 and the mid-2000s, coinciding with a period of oceanic warming which is known to be conducive to growth and survival of 0-gp and 1-gp bass in estuarine nursery areas. Sea temperature data from coastal stations along the UK coast show an extended period of colder winter sea temperatures from the late 1970s to the late 1980s at coastal stations along the south coast of England[4], where many bass nursery areas are located (Figure 10.1.30). The SS3 assessment model update indicates that recruitment was below average for much of this period. A sharp increase in temperatures from 1988–1990 coincided with a very strong 1989 year class, and several above-average year classes were formed from then until the mid-2000s while sea temperatures remained relatively high. Very warm conditions in 2007 and 2008 do not appear to have produced year classes as strong as previously, though the recent estimates of recruitment from the assessment are imprecise and some of the Thames and Solent survey data indicate a greater abundance of the 2007 year class. Sea temperatures have declined in the last few years, and recruitment has also declined. The winter of 2012/2013 has been exceptionally cold and this may also impact bass survival in nursery areas. Note that environmental conditions affecting survival of bass in

[4] http://www.cefas.defra.gov.uk/our-science/observing-and-modelling/monitoring-programmes/sea-temperature-and-salinity-trends.aspx

French or other non-UK nursery areas will also affect overall recruitment, but may differ from those in UK nursery areas in any year.

A combination of continued fishing mortality rates well above the F_{msy} proxy and an extended period of below-average recruitment could lead to continuing decline in spawning–stock biomass and loss of older fish, and cause increasing dependence of egg production on younger and less fecund fish. A reduction in fishing mortality on sea bass is needed to prevent SSB declining to such an extent that the stock's ability to produce strong recruitment in more favourable environmental conditions is impaired.

ICES advice in previous years has recommended that "implementation of 'input' controls (preferably through technical measures aimed at protecting juvenile fish, in conjunction with entry limitations into the offshore fishery in particular) should be promoted" (ICES, 2004), and that "any consideration of catch limitation (output control) would need to take into account that sea bass are a bycatch in mixed fisheries to a various extent, depending on gear and country; this incites discarding and should be avoided". Data available to WGCSE indicate that discarding is mainly an issue with otter trawlers using 80–90 mm mesh in or near areas where juvenile bass are most abundant, for example in coastal waters off the eastern Channel. However, even without discards included in the assessment, the length at 50% selection in the fisheries is at a younger age than the age at 50% maturity. Improvements to fishery selectivity to successfully achieve a large reduction in fishing mortality on pre-spawning fish without increasing discarding would require changes to gear designs which could have a strong spatial management component.

ICES has also previously advised that "Management of sea bass fisheries needs to take into account the distinctive characteristics and economic value of the different fisheries. Sea bass is of high social and economic value to the large inshore artisanal fleets and to sea angling and other recreational fishing that contribute substantially to local economies". Data from France indicate that the first-sale value of the high-volume and lower quality catches of sea bass caught by pelagic trawlers targeting offshore spawning fish during December to March has been up to three times lower per kg than for smaller volume sales of higher-quality fish for artisanal metiers fishing inshore (Drogou *et al*., 2011). The effects of targeting of offshore spawning aggregations of sea bass in the English Channel and Celtic Sea are poorly understood, particularly how the fishing effort is distributed in relation to mixing of fish from different nursery grounds or summer feeding grounds in the UK, France and other countries, given the strong site fidelity of sea bass.

The importance of sea bass to recreational fisheries, artisanal and other inshore commercial fisheries and large-scale offshore fisheries in different regions means that resource sharing is an important management consideration that has implications for the type of scientific evidence needed. Recent estimates of recreational fishery harvests of sea bass from surveys in France and the Netherlands, together with potential values for the UK, indicate that recreational harvests could be as much as 20% of total fishery removals. This is not included in the assessment. Many anglers practice catch-and-release, but the selectivity pattern of this fishery is not established and it is not clear how the inclusion of recreational catches in the assessment would scale either biomass or fishing mortality.

The current stock structure assumptions are pragmatic, and need further evaluation. The sea bass population in coastal waters of the Republic of Ireland is currently considered as a separate stock, although it extends into at least one of the ICES divisions defining the IVbc and VIIa,d–h stock. Further studies are needed to determine if the sea bass in Irish coastal waters are indeed functionally separate, or if they also mix with the other stock during spawning time and contribute to commercial catches on the offshore spawning grounds.

As bass is, at present, a non-TAC species, there is potential for displacement of fishing effort from other species with limiting quotas. The effort of the pelagic fisheries during winter and spring can shift between the Bay of Biscay and the English Channel and approaches, and there is evidence for such a shift to the Channel in recent years which is likely to have increased the fishing mortality on sea bass in Area VII.

10.1.11 References

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Table 10.1.1. Bass-47: Annual landings from IVb,c and VIId,e–h.

	Belgium	Denmark	France[1]	UK	Netherlands	Channel Is.	Total	Total WG figures[2]
1985	0	0	620	105	0	18	743	1076
1986	0	0	841	124	0	15	980	1315
1987	0	0	1226	123	0	14	1363	1979
1988	0	18	714	173	8	12	925	1238
1989	0	2	675	191	2	48	918	1161
1990	0	0	609	189	0	25	823	1033
1991	0	0	726	239	0	16	981	1225
1992	0	0	721	148	0	36	905	1184
1993	0	1	718	230	0	45	994	1251
1994	0	0	593	535	0	49	1177	1370
1995	0	1	801	707	0	69	1578	1777
1996	0	1	1703	562	8	56	2330	3023
1997	0	1	1429	560	1	74	2065	2620
1998	0	2	1363	487	48	79	1979	2388
1999	0	1	0	684	32	108	825	2665
2000	0	5	1522	406	60	130	2123	2397
2001	0	2	1619	458	77	80	2236	2482
2002	0	1	1580	627	96	73	2377	2628
2003	154	1	1903	586	163	84	2891	3445
2004	159	1	1883	617	191	159	3010	3730
2005	206	1	1937	512	327	220	3203	4392
2006	211	2	2116	574	308	193	3404	4522
2007	178	1	2074	713	376	160	3502	4213
2008	188	0	1506	791	380	143	3008	4244
2009	173	0	2905	697	395	103	4273	4013
2010	215	4	3441	736	399	144	4939	4758
2011	152	2	2526	795	395	0	3870	3870
2012	149	3	2492	885	372	46	3946	4060

Source: Official Catch Statistics 1950–2010 dataset 2011 and 1992–2011 dataset 2013, ICES, Copenhagen.

[1] Landings for 2000–2010 supplied to IBP-NEW by Ifremer.

[2] Includes adjustments to pre-2000 French statistics in line with ratio of Ifremer to official figures in later years.

Table 10.1.2. Bass-47: Percentage of total annual landings by country and gear.

Country/gear	2011	2012
UK trawl	4	4
UK midwater trawl	3	1
UK Nets	9	10
UK lines	4	5
UK other	1	2
France purse seine	0	1
France bottom trawl	21	20
France pelagic trawl	30	28
France Danish seine	1	3
France nets	3	4
France handlines	6	5
France longlines	3	2
France others	1	2
Other countries all gears	14	14

Table 10.1.3. Bass-47: Landings for the country / fleet components included separately in the assessment model.

	UK trawl	UK midwater trawl	UK Nets	UK lines	France all	Other	Total
1985	15	1	30	15	870	146	1076
1986	21	2	61	34	1180	17	1315
1987	45	0	55	18	1840	21	1979
1988	70	8	64	30	1028	39	1238
1989	91	9	61	29	917	53	1161
1990	75	23	47	14	849	25	1033
1991	49	14	113	61	971	17	1225
1992	51	8	64	24	1001	37	1184
1993	95	1	65	62	979	48	1251
1994	140	0	229	155	786	60	1370
1995	179	1	262	169	1057	110	1777
1996	144	87	186	129	2395	82	3023
1997	159	71	195	120	1984	91	2620
1998	157	85	108	121	1773	143	2388
1999	150	220	136	148	1843	168	2665
2000	156	52	103	53	1806	227	2397
2001	161	95	121	58	1883	162	2482
2002	187	109	233	75	1824	199	2628
2003	230	127	146	65	2471	407	3445
2004	202	131	206	72	2604	515	3730
2005	164	78	172	59	3161	757	4392
2006	201	33	198	107	3259	724	4522
2007	202	64	239	167	2770	772	4213
2008	231	20	322	162	2750	760	4244
2009	185	11	312	146	2649	709	4013
2010	155	42	299	180	3236	845	4758
2011	141	98	327	143	2526	635	3870
2012	163	49	408	184	2606	650	4060

Table 10.1.4. Bass-47: Sampling of commercial fishery landings by area in the UK (England and Wales) for length compositions – by gear groups included in the assessment model.

	TRAWL		MIDWATER		GILL/DRIFT NETS		LINES		ALL OTHER GEARS		ALL GEARS COMBINED	
	No. Samples	No. Lengths	No. Samples	No. Lengths	No. Samples	No. Lengths	No. Samples	No. Lengths	No. Samples	No. Lengths	No. Samples	No. Lengths
1985	17	232	2	43	15	181	19	285	6	16	59	757
1986	30	2620	0	0	18	1132	31	894	4	119	83	4765
1987	69	1360	1	589	44	1321	69	557	1	7	184	3834
1988	33	1360	0	0	42	3081	53	1365	0	0	128	5806
1989	48	772	1	832	48	1867	26	310	1	42	124	3823
1990	52	967	0	0	11	456	22	260	0	0	85	1683
1991	35	817	0	0	31	2073	53	963	2	41	121	3894
1992	19	460	0	0	30	1468	111	2077	8	32	168	4037
1993	68	1394	0	0	94	1686	123	1426	18	74	303	4580
1994	136	4721	0	0	159	5264	155	3783	17	228	467	13996
1995	84	2315	1	19	151	6324	107	1493	21	611	364	10762
1996	59	1857	1	214	115	3526	106	1790	18	177	299	7564
1997	70	2779	0	0	105	2747	137	2072	8	127	320	7725
1998	47	1592	0	0	86	2268	111	2820	5	23	249	6703
1999	53	1388	4	114	79	3622	149	3793	9	94	294	9011
2000	49	2078	0	0	118	7945	65	1967	1	2	233	11992
2001	69	2518	0	0	97	4000	114	2935	1	57	281	9510
2002	62	2315	0	0	253	8027	146	3031	1	3	462	13376
2003	56	1680	1	102	230	6629	91	3166	2	29	380	11606
2004	23	918	0	0	28	1672	40	986	4	16	95	3592
2005	37	2585	2	299	34	1179	25	921	0	0	98	4984
2006	20	967	1	100	48	1305	71	1054	0	0	140	3426
2007	25	963	4	489	43	1887	31	1088	0	0	103	4427
2008	40	3033	9	1302	64	3458	33	1527	1	3	147	9323
2009	13	807	5	509	100	3247	18	915	1	4	137	5482
2010	32	1367	3	376	69	2523	39	927	0	0	143	5193
2011	62	1981	4	463	41	1433	55	2250	0	0	162	6127
2012	57	891	1	199	61	2986	95	2052	1	15	215	6143

(note: numbers of samples for midwater pair trawlers may be underestimated).

Table 10.1.5. Bass-47: Sampling of commercial fishery landings by area in the UK (England and Wales). Scale reading for bass sampled in 2012 could not be completed in time for WGCSE 2013.

	North Sea IV				Eastern Channel VIId				Western Channel VIIe,h				Irish & Celtic Seas VIIafg			
	No. length samples	No. lengths	No. age samples	No. ages	No. length samples	No. lengths	No. age samples	No. ages	No. length samples	No. lengths	No. age samples	No. ages	No. length samples	No. lengths	No. age samples	No. ages
1985	15	161	37	219	4	232	22	311	20	234	17	159	20	130	63	330
1986	8	51	11	108	28	555	43	546	29	3884	15	94	18	275	30	269
1987	45	227	54	373	19	336	28	412	99	2923	58	336	21	348	38	240
1988	37	469	30	203	18	929	25	466	30	2414	24	329	43	1994	50	466
1989	36	466	89	490	11	306	49	534	19	2008	146	403	58	1043	85	451
1990	19	138	80	412	11	250	63	813	11	524	200	710	44	771	47	196
1991	19	139	114	635	44	566	113	1036	14	2019	223	866	44	1170	130	935
1992	50	336	107	480	44	2280	211	2286	42	812	175	638	32	609	71	633
1993	53	309	88	381	122	1935	188	2213	67	1455	259	1189	61	881	125	901
1994	71	1561	106	1092	219	6244	252	4146	107	3149	175	961	70	3042	46	515
1995	60	636	49	279	149	4376	133	1897	77	2138	102	595	78	3612	55	969
1996	22	179	44	101	125	2454	133	1783	72	2508	68	1170	80	2423	94	952
1997	90	221	116	284	96	3118	110	2217	46	1351	55	1262	88	3035	55	993
1998	51	668	94	634	64	2455	71	1198	61	1420	71	905	73	2160	103	764
1999	75	1081	134	529	88	3098	70	1071	68	2712	117	1305	63	2120	102	493
2000	33	663	139	464	85	4467	89	1410	49	4845	213	2228	66	2017	213	758
2001	39	1118	102	915	73	2515	85	1982	69	3498	179	1396	100	2379	294	1353
2002	181	3019	219	1917	101	3788	118	2528	86	3460	80	722	94	3109	112	743
2003	167	3122	133	762	80	2825	92	1190	76	3261	123	1109	57	2398	57	867
2004	13	184	24	114	37	1545	38	517	28	1195	30	552	17	668	11	167
2005	18	476	55	476	14	657	29	247	37	2445	84	707	29	1406	39	361
2006	46	831	35	298	15	546	27	208	53	1180	59	549	26	869	13	317
2007	20	730	17	258	18	391	49	437	31	1834	129	862	34	1472	45	396
2008	19	970	14	640	52	2330	78	890	39	3089	66	1128	37	2934	33	595
2009	8	1105	6	680	84	1789	97	1175	34	2061	88	1513	11	527	21	217
2010	30	740	28	501	50	1578	45	756	46	2324	48	822	17	551	11	161
2011	22	944	16	314	34	1275	25	648	85	2986	56	1377	21	922	11	216
2012	50	1314			32	1015			115	3206			18	608		

Table 10.1.6. Bass-47: Sampling of commercial fishery landings by area in France, giving numbers of fishing trips sampled, number of fish measured, and the total landings.

	lines			nets			bottom trawl		
	No. trips	No. fish	Landings	No. trips	No. fish	Landings	No. trips	No. fish	Landings
2000	53	1613	305	2	72	108	2	196	692
2001	101	2659	375	1	5	110	0	0	713
2002	79	2076	349	0	0	128	4	710	911
2003	78	1732	438	1	4	152	8	998	1087
2004	78	1748	381	6	84	150	12	887	1236
2005	34	949	439	4	110	148	14	689	1239
2006	73	1719	554	11	291	140	11	1240	1110
2007	69	2235	560	28	641	158	11	588	1187
2008	41	1280	425	25	496	128	18	1927	1145
2009	33	1339	251	25	159	94	93	1468	1052
2010	10	334	278	49	615	160	64	626	819
2011	17	540	359	156	278	129	151	1955	791
2012	10	681	295	60	408	142	87	1204	824

	pelagic trawl			Danish seine			Other gears		
	No. trips	No. fish	Landings	No. trips	No. fish	Landings	No. trips	No. fish	Landings
2000	2	629	681	0	0	0	0	0	20
2001	0	0	659	0	0	0	0	0	27
2002	3	680	415	0	0	0	0	0	22
2003	4	753	773	0	0	0	0	0	23
2004	6	938	820	0	0	0	0	0	17
2005	11	1239	1319	0	0	0	0	0	17
2006	16	2597	1420	0	0	0	0	0	35
2007	8	1800	841	0	0	0	0	0	24
2008	8	1065	1012	0	0	0	0	0	40
2009	55	899	1098	0	0	27	0	0	127
2010	28	1299	1828	0	0	61	2	2	90
2011	30	2309	1142	2	6	43	36	292	62
2012	9	1649	1143	6	370	112	7	154	91

Table 10.1.7. Bass-47: Numbers-at-length in UK(England and Wales) commercial bottom trawl landings.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
14	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	190	38	0	0	0	0	0	0	0	0	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	791	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	94	0	1475	0	0	0	0	0	254	0	0	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0
30	197	187	3999	7324	11007	0	0	0	6874	2667	17	0	0	0	90	0	0	9	0	0	14	0	0	0	0	0	0	0
32	251	867	11667	6332	7671	0	0	265	134	11651	268	0	14	163	358	16	2294	431	2805	293	135	488	95	441	0	0	0	0
34	143	1844	7273	10751	15454	149	3722	3174	6652	15319	10505	2479	1390	1851	14382	3690	8781	21126	4655	6168	5395	18858	1381	12788	1493	36	2033	23801
36	698	644	7009	33766	16665	1555	11514	12967	52808	63365	57902	14707	13477	20198	44533	35051	42989	52051	32226	41260	84310	61243	37687	92875	67892	22963	39998	69255
38	1596	655	5620	6084	1652	1784	4124	12334	23270	48945	49460	19542	17833	29438	36412	41684	38535	45195	38162	44158	44631	48143	52961	67562	54537	19472	25365	63016
40	1751	1162	7868	6013	2428	2526	1069	3468	15664	28299	34525	32730	22319	28036	28390	34199	27421	25631	36068	47811	21754	46033	35515	44034	32017	46007	30731	49797
42	743	823	2737	3525	7320	2717	1020	5489	7955	19210	20818	29259	23549	26780	21252	18893	20506	15544	25956	38242	19644	27775	32373	29526	13142	17733	26053	27993
44	1639	997	2194	8547	3591	6782	978	1634	4381	6185	16978	19223	24054	19399	16017	12025	11267	16232	19359	26077	11678	21820	36152	19911	16447	34654	12320	5106
46	1429	1639	935	1086	5113	8132	838	7557	3560	2706	8521	10004	17243	17973	9567	8805	10375	9530	14708	20962	12235	13312	25470	19321	1964	29784	9392	7216
48	1862	1057	1224	1868	4491	5944	1059	1025	2953	2036	16163	4077	12344	11013	6651	2898	5416	9786	14643	7665	7722	10089	7764	7719	15876	3332	9648	2177
50	1195	1240	427	750	3080	6097	839	2730	1870	1940	3217	2235	9586	10369	4219	8635	5620	7417	13025	7486	4192	10375	6626	7602	3436	2843	5162	932
52	415	1761	360	489	2700	4396	687	597	1075	1513	4011	3679	5936	4320	3703	5229	3257	3883	9001	4993	2649	4052	4346	5087	6612	2954	4431	3105
54	460	1491	544	1013	2788	2586	847	594	1197	678	4820	8279	3040	2707	3160	5506	5939	4904	5901	1564	2113	2138	1232	4261	6156	1555	2408	440
56	305	307	615	601	2525	2131	4159	514	806	1188	680	778	3449	1970	1215	3477	1862	3588	5757	781	1931	1649	882	2606	0	1143	1339	366
58	291	467	591	3228	2221	859	3378	509	1596	187	198	2703	1022	893	1756	2007	1917	3201	3403	512	1853	553	1476	615	3108	958	1468	220
60	152	496	817	609	2928	1994	982	428	969	350	687	2703	1300	521	653	1114	2010	1942	2451	286	1027	0	809	649	0	584	707	115
62	75	848	1696	154	1930	1634	857	414	242	1037	662	480	287	671	1539	957	1364	1206	1598	462	893	150	377	438	0	345	644	52
64	38	148	246	221	1230	1172	148	93	196	335	404	495	403	271	145	111	1060	1206	2784	759	406	150	284	246	2979	193	372	209
66	192	34	568	197	750	316	1365	404	233	221	320	318	1014	111	197	342	1252	522	1197	737	265	1728	122	177	0	144	259	52
68	75	237	192	1645	1194	773	272	224	313	926	210	378	629	347	128	350	32	1577	606	249	233	0	190	198	129	15	119	136
70	0	126	27	19	375	415	697	206	192	907	809	553	303	435	113	40	59	487	156	431	233	0	0	157	0	57	71	0
72	141	6	27	211	341	116	243	1073	134	98	389	173	402	111	85	8	39	47	1194	349	119	0	1147	144	198	93	136	42
74	0	4	525	158	86	353	89	54	221	34	186	87	54	111	28	8	9	96	157	185	38	0	47	0	0	87	0	42
76	0	0	188	0	49	168	111	0	516	68	36	29	500	0	57	151	776	109	156	0	48	0	0	13	1818	0	109	0
78	53	96	0	22	0	0	176	0	82	101	0	29	40	0	0	374	4	19	304	83	0	0	0	99	0	7	101	0
80	0	2	0	0	62	144	5	92	0	73	0	29	0	0	45	0	0	67	0	0	0	0	0	18	0	0	0	0
82	0	0	173	0	0	164	0	56	0	96	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84	0	0	0	0	0	0	0	0	41	0	0	14	7	27	0	0	0	0	118	0	0	0	0	0	0	0	0	0
86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10.1.8. Bass-47: Numbers-at-length in UK(England and Wales) midwater pair trawl landings.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	7	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	32	0	0	0	0	0
34	1	0	0	0	0	0	0	0	0	0	0	0	0	15	327	21	6	0	6346	559	0	0	63	38	0	633	0	199
36	4	0	0	76	0	0	0	0	0	8	418	60	0	139	1226	179	649	59	9189	2933	197	49	548	155	90	2147	293	2998
38	0	0	0	228	0	0	0	0	0	36	334	4942	0	4328	4529	754	1879	82	15903	6482	897	344	1509	624	268	3259	1045	2585
40	0	0	0	301	0	0	0	0	0	47	334	11074	0	7698	5998	1872	5466	624	22015	12788	3609	884	3586	1145	774	5121	4271	4525
42	0	0	0	882	14	0	0	96	0	29	418	20192	0	3775	13429	2068	5641	2048	15838	12911	7921	1081	4517	1262	1144	5036	4582	5530
44	0	0	0	1103	36	0	1219	32	0	6	84	14350	0	8722	17317	2544	9138	6767	14252	8843	10546	983	8634	1282	1812	3218	11310	5027
46	0	0	0	594	91	0	5919	446	0	1	0	12533	0	14010	19789	2801	8733	13119	9104	14530	12622	295	7245	1158	1304	3657	8588	7011
48	0	0	0	515	72	0	7260	223	0	0	0	10412	0	8272	15367	3193	7364	4288	6254	18163	12021	442	6637	1520	927	2542	9652	4504
50	1	0	8	443	29	0	4718	478	0	0	0	5550	0	9187	14103	2431	7054	8350	5105	20224	7371	246	3559	1382	1084	962	9609	4018
52	0	0	33	367	109	0	2020	1116	0	0	0	3274	0	2066	14349	2262	4774	6873	3219	4185	3641	197	4199	1347	572	1850	7336	4003
54	0	0	117	149	354	0	2298	670	0	0	0	417	0	6405	9289	2199	3737	3134	2069	9728	2790	246	2825	1390	255	1217	3924	1501
56	0	0	66	145	419	0	0	2423	0	0	0	980	0	464	11435	3199	3858	3562	1421	300	1561	49	1549	832	111	755	3130	1587
58	0	0	91	76	715	0	0	925	0	0	0	596	0	721	9379	2323	2755	4863	886	1100	1762	49	1059	817	205	1023	2508	586
60	264	0	75	76	547	0	0	351	0	0	0	98	0	966	4407	1452	2639	3079	736	1249	907	49	1055	515	93	384	2382	643
62	0	0	42	0	752	0	157	255	0	0	0	204	0	213	2987	1193	2416	2185	912	1249	565	0	639	418	107	180	1785	71
64	0	0	50	76	948	0	627	0	0	0	0	196	0	420	982	812	1617	1563	351	591	355	0	256	264	44	178	925	57
66	0	0	42	228	368	0	157	0	0	0	0	588	0	377	1096	443	588	1832	351	707	355	0	256	138	46	197	934	43
68	0	0	16	152	251	0	0	0	0	0	0	490	0	44	1314	279	761	1052	324	291	105	0	193	86	23	100	312	71
70	0	0	25	76	149	0	783	0	0	0	0	98	0	126	940	248	211	934	0	358	118	0	97	19	23	50	293	100
72	0	0	8	76	124	0	313	0	0	0	0	0	0	257	237	195	349	339	0	174	25	0	63	11	4	17	0	43
74	0	0	8	0	0	0	157	0	0	0	0	98	0	251	430	63	79	161	88	58	53	0	128	8	4	33	0	43
76	0	0	8	0	7	0	157	0	0	0	0	0	0	126	0	42	41	126	40	58	25	0	32	11	12	0	0	28
78	0	0	0	0	19	0	0	0	0	0	0	98	0	0	237	11	6	12	40	0	0	0	32	2	4	0	0	57
80	0	0	8	0	46	0	157	0	0	0	0	0	0	251	474	21	22	12	40	0	0	0	0	2	0	17	0	0
82	0	0	0	0	0	0	0	0	0	0	0	0	0	126	27	11	0	0	0	0	0	0	0	8	0	0	0	0
84	0	0	0	0	0	0	0	0	0	0	0	0	0	126	0	11	6	0	0	0	0	0	0	0	0	0	0	0
86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10.1.9. Bass-47: Numbers-at-length in UK(England and Wales) commercial drift & fixed net landings.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	147	0	0	0	0	0	0	0	0	0	0
18	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	0	0	0	0	0	0	0	0	0	0
24	78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	98	0	0	0	0	0	0	0	0	0	0
26	0	2415	0	0	0	0	0	0	0	32	0	0	0	0	0	0	6	25	0	0	0	0	0	0	0	0	0	0
28	86	1650	0	0	0	0	0	0	38	0	0	0	0	0	0	0	11	492	16	0	0	0	0	0	0	0	0	0
30	990	356	1541	0	27	0	48	0	479	39	0	0	0	177	0	0	6	664	22	45	0	0	0	0	0	0	0	0
32	5748	4301	12152	242	222	0	144	29	937	302	1223	290	0	603	45	0	70	691	69	377	356	1642	358	0	139	38	73	2002
34	11714	6123	12467	2322	1138	42	2827	5399	3449	6323	5513	2927	1158	3656	555	950	2968	14821	2424	1248	4113	3468	2274	2020	1464	2934	1449	10957
36	6675	3523	14192	3079	3168	1472	20728	17298	22574	60914	37572	20578	10245	10898	16572	11547	11698	46122	20460	14942	19954	33593	19623	90341	36417	52791	3876	51362
38	2523	5511	5180	6613	6181	2453	12085	14706	19001	60147	54304	32564	18627	11937	30551	21957	13076	61892	33530	32690	27594	43063	24668	87191	51471	42283	20014	61687
40	1246	6472	5167	4708	6026	2374	8810	10733	10080	40016	60955	43127	17369	14152	31046	23554	18004	51858	28900	42818	26602	45006	32733	64540	58481	49349	20293	51467
42	1239	4530	2644	6854	6813	1149	4296	6922	5051	22912	48248	41294	19401	12124	24577	19892	17592	30438	20287	39071	25408	26377	25913	48241	39225	35056	35168	36055
44	408	2070	2285	6575	7396	2279	4146	3832	3837	11802	30044	27829	17048	9970	12220	14592	10052	17408	10830	34593	24577	15171	26087	25958	31884	26174	35173	21096
46	700	1502	1702	3980	8579	6295	3918	235	1045	6647	14463	16833	23494	8019	8559	9384	5959	12685	7235	23784	16229	12940	15212	15834	22006	17861	45664	14721
48	804	958	903	2236	5437	1209	4686	982	1349	5083	5414	5372	23479	6111	5711	4446	3645	7699	4752	10010	12758	9911	11873	7740	14568	10389	20508	14560
50	755	3052	1065	972	4152	3697	4012	2081	671	2933	2247	2825	10849	5622	4310	1719	4310	5001	3817	5381	7988	4470	5774	6448	11743	8424	20399	16611
52	582	1293	1170	2326	1155	2770	3305	1046	449	2683	1300	1027	7192	4718	2411	1131	3371	3957	4827	3384	4518	3405	11580	6408	9093	5258	13022	16703
54	457	198	795	668	1225	2673	3765	1381	659	3319	1640	546	4759	3297	2431	766	3025	3044	3412	1237	3786	2434	6411	3839	6531	4835	10157	14006
56	902	1226	473	403	792	1065	4311	1138	711	2319	1020	415	2340	2172	1499	353	3001	2492	2189	524	941	2150	3825	3150	6744	5430	4591	10526
58	415	1888	329	135	354	444	1323	644	722	3447	832	340	1235	1936	1054	439	2381	1496	1618	646	230	1070	6842	2096	3666	3628	5186	9539
60	626	1071	1160	1374	254	989	2421	585	458	3349	1227	506	1544	850	890	322	2180	932	1674	306	296	2911	1412	858	2126	3373	2674	6473
62	415	690	846	20	327	308	1234	647	581	1707	2761	226	454	409	182	282	2129	1244	984	639	228	302	3287	1004	626	2456	4580	4839
64	158	204	281	1103	212	405	346	187	243	1414	1346	102	227	649	285	87	1252	636	590	439	356	918	3866	1030	1505	2604	1880	2964
66	128	157	835	675	307	680	773	0	492	1564	1469	398	263	310	173	155	379	641	401	128	26	844	332	621	87	2273	732	2233
68	0	2003	0	916	258	0	1153	9	84	950	3200	166	1609	97	168	59	468	357	130	123	0	324	285	661	335	1124	1868	2510
70	128	114	423	578	66	0	1650	18	97	795	144	190	1117	211	140	31	39	262	173	86	0	139	98	82	887	935	941	971
72	128	1124	220	634	93	38	1194	554	210	699	801	117	538	88	42	13	0	21	156	147	0	0	181	0	985	847	553	780
74	128	0	72	463	0	0	0	618	133	250	140	1037	27	80	111	49	139	25	17	0	0	162	272	0	303	231	1200	453
76	0	235	0	240	0	0	581	0	229	188	108	359	73	71	22	7	139	99	62	195	0	23	133	0	0	283	183	468
78	0	0	0	196	39	0	0	0	0	144	0	36	23	0	0	26	0	40	17	0	0	0	98	502	98	367	0	390
80	0	0	0	216	0	0	0	0	26	199	54	36	0	0	0	13	71	0	0	0	0	23	0	0	98	326	0	0
82	0	0	0	23	0	0	118	0	0	72	0	0	21	0	0	0	15	0	0	0	0	23	245	0	0	231	0	0
84	0	0	0	14	0	0	0	0	269	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	116	0	0
86	0	0	0	0	0	556	0	0	0	0	0	0	0	0	22	7	0	0	0	0	0	0	0	0	0	0	0	0
88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	156	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10.1.10. Bass-47: Numbers-at-length in UK(England and Wales) commercial line fishery landings.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	9	0	62	72	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	69	9	0	248	72	161	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	97	0	0	0	0	0	138	4	0	124	0	322	2553	44	0	0	0	0	0	0	0	0	0	0	0	0	0
26	1145	37	34	0	0	0	0	0	13	0	124	0	161	4350	21	0	0	0	0	0	0	0	0	0	0	0	0	0
28	2728	448	135	39	0	0	0	0	145	0	62	0	559	3597	30	0	0	0	0	0	0	0	0	0	0	0	0	0
30	3579	1477	227	450	586	0	76	0	817	23	124	0	345	4547	102	37	0	0	29	0	0	0	0	0	0	0	0	0
32	2409	2847	535	2468	1339	0	76	5	926	1389	186	0	1086	2686	210	6	0	47	29	37	0	24	0	0	0	0	11	0
34	130	2251	768	2865	11170	14	932	783	2142	11362	2995	1712	1643	626	787	45	104	699	230	28	47	0	963	269	66	0	162	457
36	386	2407	946	2698	11396	281	2209	3933	6563	34454	12260	6841	4739	7472	10077	3079	2174	3153	4239	1671	988	2440	4371	3459	7335	2131	2097	3756
38	1990	1887	975	1776	2121	522	2718	3378	4602	29677	24330	7559	5634	8330	13554	4139	2423	3715	6933	4247	5048	5155	12330	10075	12560	14767	7180	9787
40	577	2064	1407	2062	778	587	1527	2381	3403	18974	26672	12834	7023	10945	16212	5170	3494	3803	8074	6458	5044	6467	12839	14098	10727	27646	9888	9986
42	148	1242	567	2153	420	1028	1355	1427	2946	12046	19426	19139	7807	9001	11960	4709	5084	4828	7067	6300	4188	7523	12000	15542	16134	27622	12046	10519
44	757	1180	937	1436	389	1076	1961	761	2024	7888	10907	17158	8723	7821	7843	4205	4709	6394	5885	5264	4661	8305	10773	16095	13699	37215	9845	10129
46	1193	1245	249	1206	51	1065	3132	704	1710	6617	6735	9209	9734	8007	7861	3358	4128	6817	4274	5021	3393	5660	9217	10718	9840	22528	10140	11391
48	410	1648	432	1019	158	1136	3015	585	1516	4447	4631	7425	8804	7351	6367	2002	2743	5261	4450	3944	2167	4782	10576	8984	8040	9312	9720	6963
50	512	1689	408	598	62	731	2816	459	820	1796	2938	4137	7862	5775	6213	2177	2364	3767	3478	4112	2117	6520	7521	6192	6884	6149	8908	12333
52	359	1444	625	769	31	794	2116	736	1310	1809	2865	2952	5641	5608	6796	1842	1680	2537	2728	3182	1590	3482	4482	11863	5205	3116	6056	8326
54	501	1530	919	489	507	574	1505	562	997	1954	2668	2491	3621	3617	4672	1553	1598	2463	1491	2978	1705	3632	5279	6434	4062	2650	6053	8767
56	213	965	605	781	994	389	906	487	1754	1437	1495	2251	2802	2932	3954	1283	1846	2346	1471	2104	1381	3625	4234	3168	4270	1941	3877	10368
58	202	660	468	681	507	171	1021	586	1587	2582	1733	1092	1552	2197	3746	1850	1750	1719	916	1015	1215	3307	3319	3096	1786	1480	2760	5010
60	104	487	395	750	115	290	1075	282	1880	2591	2024	895	1259	1541	2409	1207	1727	1310	857	1007	2304	1321	4184	2827	3259	1531	2208	3979
62	193	517	188	647	586	174	730	248	1140	1544	2531	1296	951	1118	2068	938	1554	795	588	1541	926	1530	3721	2113	2421	461	2172	1477
64	120	696	101	399	69	130	847	189	1114	1688	2128	836	880	954	1211	637	778	777	579	810	650	1931	1867	2097	1314	693	2111	1975
66	148	222	80	429	545	202	1274	354	1101	1505	2187	1499	764	741	1082	261	667	672	300	759	64	559	2960	261	927	494	1374	2507
68	55	273	102	250	497	126	876	152	747	1222	1755	567	1054	764	914	384	158	407	204	472	247	287	1087	436	718	278	563	848
70	110	171	404	258	21	69	910	153	476	379	1249	834	711	258	899	90	143	346	129	90	414	617	1097	274	586	548	452	312
72	0	112	50	137	487	0	707	149	509	690	1878	593	464	441	541	132	126	261	56	285	139	274	0	528	132	305	267	598
74	10	112	204	51	10	69	708	199	544	165	963	385	362	320	488	130	101	265	107	74	558	61	660	509	453	205	226	123
76	75	37	45	27	38	49	271	95	464	318	438	405	588	277	212	21	27	99	10	11	526	720	425	0	255	51	206	665
78	30	0	128	56	0	9	242	87	120	764	96	167	289	180	130	0	17	113	40	97	0	115	0	0	66	0	131	12
80	0	0	18	23	0	0	105	32	124	543	235	254	87	169	0	51	41	47	0	0	108	19	0	172	0	51	92	0
82	0	0	28	77	0	9	111	12	25	64	210	0	99	133	74	0	27	19	0	0	0	743	21	0	0	26	62	0
84	0	0	38	0	0	0	0	31	0	12	0	0	0	0	53	0	0	0	0	0	0	0	21	0	0	0	0	0
86	0	0	7	0	0	0	0	10	30	0	0	0	0	0	53	0	13	0	0	0	0	0	21	0	0	0	0	0
88	0	0	4	0	0	0	0	0	9	0	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
94	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10.1.11. Bass-47: Numbers-at-length in French commercial all-gears fishery landings. Numbers-at-age for 2011 and 2012 also shown.

Length	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
20	0	0	0	0	0	0	0	0	0	0	717	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	3455	0	0	0	0	0	292	0	0	1219
30	0	0	1015	13054	14	0	15689	0	0	473	0	0	0
32	0	0	0	58717	13057	9903	32459	181	8250	2239	9811	1976	1583
34	9931	17962	12469	105655	78811	29872	179130	4715	28986	10714	28290	13885	6518
36	34932	19809	38249	125326	127801	97890	285704	39335	229758	124925	169311	57121	85760
38	85866	68920	46427	180475	124051	128022	217657	102714	263071	211881	177571	87842	172510
40	126730	76594	62503	119495	227214	231750	178250	146272	266408	225545	182105	128838	140273
42	102836	98008	82461	145456	282390	266905	196868	145122	237160	193030	283064	187586	147895
44	80478	109595	91064	104545	243107	344681	289998	164011	270810	222613	251956	201447	162333
46	93344	106857	86723	130023	188494	270532	285451	130859	228996	238849	230227	199487	180752
48	80934	77694	62163	115806	126685	239265	263272	100043	142650	155222	188149	194697	158490
50	55399	57055	55905	91915	72581	169478	200874	99210	112385	159658	186310	145447	130759
52	52948	51658	46180	93878	82331	115269	119836	75929	74336	114530	109212	124239	107214
54	42094	36737	35998	48742	50633	62106	99509	74405	66260	84649	120550	92526	90638
56	26460	35839	26001	60839	60284	67741	99674	55147	48853	96257	71590	72471	78934
58	27357	22762	19019	31614	31334	61132	54522	46087	39689	51578	62211	46869	54869
60	23581	25834	14210	33688	19126	43591	45908	28056	29840	36547	31544	31690	35387
62	14295	18773	11129	30691	23996	35774	23763	23057	28335	57472	19076	19998	33085
64	18044	13532	16771	18823	14799	25788	20607	18091	14420	24016	62005	17624	17714
66	10773	11068	11011	13230	10650	12456	14969	8715	12694	21415	26388	14720	15170
68	9903	9120	5447	7960	8569	13360	13976	8793	9039	27466	9340	7906	9374
70	5709	11771	4795	5374	4880	8908	9653	4835	6821	20198	8541	6114	8114
72	5721	5733	4559	5617	2974	8053	4521	2707	4714	12083	29128	2082	4147
74	2345	5345	1825	3275	2675	9811	3424	1962	1623	7551	1884	1163	2313
76	2595	2782	1260	1356	2567	5020	2883	1010	1257	979	2114	1096	1540
78	2102	1691	357	297	548	2378	731	399	534	1765	182	476	1134
80	888	583	155	783	425	1365	201	158	261	264	5525	148	282
82	1021	296	109	112	149	107	261	37	8	1004	6097	104	451
84	548	204	0	148	295	0	30	59	0	0	863	0	29
86	123	0	0	0	0	0	0	0	0	0	0	0	27
88	0	61	0	0	149	0	0	0	0	0	1207	0	0
90	0	0	0	0	0	0	0	0	0	0	0	0	0

age	**2011**	**2012**
2	0	0
3	10278	0
4	22466	9069
5	97784	63620
6	243099	295169
7	352223	318365
8	287145	299993
9	342936	280064
10	117832	195991
11	89100	89619
12	32938	50894
13	26515	23430
14	13885	8213
15	4983	3128
16	254	604
17	0	246
18	0	0
19	0	0
20	0	0

Table 10.1.12. Bass-47: Numbers-at-age in UK(England and Wales) commercial bottom trawl landings.

	2	3	4	5	6	7	8	9	10	11	12+
1985	0	287	1293	1086	3706	511	1348	3229	777	327	1073
1986	0	148	3252	1518	564	1783	376	1357	4410	588	1954
1987	0	310	15549	24 366	7432	755	1397	171	389	2385	4073
1988	0	2121	21091	45 329	16 656	4207	633	972	382	272	4082
1989	31571	4227	253	3149	16 208	14 914	5497	2380	2618	1296	15 857
1990	0	1168	1710	490	5457	18 337	12 730	3409	957	671	6114
1991	0	395	19 332	1603	1026	4673	7296	6319	2641	255	7304
1992	0	5069	23 603	14 242	890	784	1502	4121	2462	617	3181
1993	0	388	54 411	51 055	15 243	619	479	1504	3609	2356	2978
1994	0	870	8544	162 828	19 532	6238	454	96	574	2084	3175
1995	0	1172	9460	27 105	156 779	12 200	4157	363	148	174	3755
1996	0	1069	8540	9137	21 032	73 642	5257	2309	123	210	2859
1997	0	628	3868	33 195	23 358	21 429	68 762	4077	1507	193	3474
1998	0	293	19 558	25 217	49 977	16 706	9559	24 529	1229	435	1214
1999	87	95	49 306	78 844	20 591	18 237	5558	3755	11 342	746	1088
2000	0	5914	1774	89 986	44 508	8323	8476	3937	4496	7421	1427
2001	223	5076	56 358	12 240	75 098	19 158	5183	6093	2645	3693	7783
2002	0	4024	19 643	115 378	9264	42 010	10 107	4698	4631	1516	9587
2003	0	4340	46 788	37 874	92 709	6457	33 695	11 045	3886	2590	7771
2004	0	1206	15 540	117 370	48 769	57 111	1397	6183	2870	1286	2129
2005	0	5502	52 720	34 696	51 453	20 353	21 054	2501	5981	995	3104
2006	0	14221	76 405	73 547	30 341	34 725	12 905	17 101	1378	1711	2378
2007	0	356	22 195	106 103	57 214	21 354	16 876	6169	4095	1180	2172
2008	0	3755	48 903	128 086	69 039	26 740	9710	8683	3039	3190	1210
2009	0	596	19 294	51 618	55 675	18 733	4898	4312	1221	836	2189
2010	0	125	14 082	48 534	43 724	31 336	9107	2444	1118	1154	1025
2011	0	510	16 450	59 635	37 244	25 419	13 797	7153	2126	1904	2148

Table 10.1.13. Bass-47: Numbers-at-age in UK(England and Wales) midwater pair trawl landings (blank rows: no data).

	2	3	4	5	6	7	8	9	10	11	12+
1985	0	0	0	1	0	1	0	2	2	2	139
1986											
1987	0	0	0	0	9	6	40	7	36	224	270
1988	0	0	0	93	986	757	295	443	42	52	480
1989	0	0	0	0	45	279	252	227	440	191	3432
1990											
1991	0	0	218	218	604	1463	8618	9256	3027	0	2446
1992	0	0	0	230	114	190	513	2163	2759	521	474
1993											
1994	0	5	118	3	0	0	0	0	0	0	0
1995	0	14	83	206	1052	39	6	0	0	0	0
1996	0	0	289	795	3889	71 623	5580	1647	21	333	2017
1997											
1998	0	1	250	6228	12 334	8916	8479	26 206	2624	360	1802
1999	0	1	3362	20 818	17 214	30 944	15 780	20 556	48 999	4968	6126
2000	0	15	60	2475	7585	3270	4496	1459	2829	7075	1363
2001	0	0	176	884	19 449	19 953	6925	5181	3072	2797	11 351
2002	0	2	33	2126	1410	21 521	8661	5626	5342	402	13 768
2003	0	0	1783	6787	28 352	6022	32 115	8271	2768	2867	4832
2004	0	7	1254	12 498	14 367	48 093	3198	20 688	8007	353	4014
2005	0	0	121	2225	16 210	15 231	18 417	2018	5483	0	2717
2006											
2007	0	0	659	4305	12 038	9214	11 686	4780	3249	1079	1703
2008	0	53	517	1726	3699	2017	1626	1801	881	1120	870
2009	0	0	101	713	2441	2915	946	881	189	334	396
2010	0	8	34	1670	5318	7922	6403	4560	386	3631	1305
2011	0	0	255	4400	10234	13642	15910	13643	4424	4233	6151

Table 10.1.14. Bass-47: Numbers-at-age in UK(England and Wales) commercial drift & fixed net landings.

	2	3	4	5	6	7	8	9	10	11	12+
1985	0	9811	14 260	2238	2386	266	1239	3869	984	1419	1625
1986	0	11 414	17 736	17 701	3055	5888	225	1720	5459	973	7180
1987	0	80	14 010	31 300	5771	1209	1180	464	307	3398	4867
1988	0	0	1014	13 111	27 458	8792	1359	1469	491	271	6345
1989	776	931	657	4500	30 311	14 080	4654	1181	916	644	4421
1990	0	1553	350	2550	11 257	9958	6352	1025	669	513	2263
1991	0	13 454	27 470	1777	780	4610	14 517	12 946	5597	417	12 567
1992	0	11 880	39 087	28 086	557	293	1323	2322	3481	892	2553
1993	0	249	33 556	23 265	8571	785	235	521	1684	1911	3376
1994	2	536	23 374	218 682	21 583	9588	649	186	1719	4110	8698
1995	0	4414	27 219	56 712	198 292	6913	3121	330	280	761	10 328
1996	0	10 341	35 627	22 971	35 303	94 961	3581	1637	121	168	4207
1997	0	3413	4655	26 323	22 234	18 279	89 438	4590	2622	637	4294
1998	0	812	26 100	25 713	22 604	9368	6255	17 912	1613	440	945
1999	22	0	32 221	68 971	24 360	11 944	4617	2946	8479	513	1105
2000	0	4311	1056	74 273	34 286	5098	4421	1706	1096	2462	613
2001	119	5817	41 752	5048	45 307	13 320	3280	4011	2701	3335	6748
2002	0	8232	26 242	184 854	9582	36 220	8612	4206	5137	1711	10 391
2003	0	6197	54 798	31 410	52 011	2051	6685	2451	979	663	1860
2004	0	2638	21 733	114 580	40 057	49 459	2478	7541	2252	668	2261
2005	0	6544	38 905	45 783	79 590	17 947	12 836	706	2230	630	438
2006	0	10 936	76 519	75 401	27 189	18 909	4174	5644	543	1772	1995
2007	0	648	10 516	78 809	46 186	26 953	20 987	7769	10 923	10 536	5064
2008	0	6471	70 258	188 626	82 455	25 664	12 098	10 169	5942	3371	2971
2009	0	1502	40 301	100 073	116 153	43 938	13 247	6957	6745	5719	3375
2010	0	190	59 198	95 332	63 986	39 511	17 872	8819	5622	4702	8223
2011	0	342	12 143	66 368	56 101	46 559	41 309	25 283	8439	9554	12 039

Table 10.1.15. Bass-47: Numbers-at-age in UK(England and Wales) commercial line fishery landings.

	2	3	4	5	6	7	8	9	10	11	12+
1985	0	9010	9328	2534	3970	628	374	1629	415	250	715
1986	0	582	8254	3211	862	2259	347	717	5215	956	4312
1987	0	114	1341	3945	1899	515	532	411	499	1670	2592
1988	0	23	1691	13 184	4620	2264	554	1040	213	473	5369
1989	0	0	594	3259	4691	588	332	90	187	61	1788
1990	0	162	41	62	556	1892	1457	563	248	244	1975
1991	0	189	9627	513	303	1104	5934	5390	2191	69	14 784
1992	0	1897	6707	4759	285	212	453	1158	1658	591	2160
1993	0	133	9857	11 515	7486	674	336	940	3949	3375	7208
1994	0	78	4408	134 792	20 138	9624	740	188	1778	4772	8066
1995	0	218	8496	27 340	107 376	6146	4312	315	601	561	14 097
1996	0	235	10 225	14 007	16 001	59 837	4704	4426	145	425	8142
1997	0	550	3458	18 947	13 622	9287	60 554	3012	1447	676	3944
1998	0	2238	10 256	11 796	19 658	8170	6474	26 381	2834	993	5515
1999	17	274	29 278	41 760	13 664	13 780	5215	4917	16 776	1728	5481
2000	0	457	315	21 530	13 759	2856	3327	1469	1173	4492	1218
2001	42	776	7822	1442	18 150	7307	2043	3590	1598	1793	4719
2002	0	766	2806	15 076	2882	17 448	7789	2552	5003	1331	5648
2003	0	67	6087	6840	21 909	1840	8945	2891	1274	842	3133
2004	0	302	1875	14 520	8427	17 393	2101	6511	3381	1061	5459
2005	0	186	1435	4590	14 704	5224	7489	547	5636	1807	2247
2006	0	33	17 749	39 493	14 001	22 796	5742	10 879	1267	2603	3043
2007	0	17	6545	31 560	28 334	14 600	17 960	8547	10 950	5194	9134
2008	0	197	4979	27 228	41 880	21 466	12 180	12 468	5414	4904	6960
2009	0	296	8188	20 393	35 010	25 405	11 337	8797	4557	4318	6460
2010	0	592	5097	33 008	39 662	28 691	11 487	3772	1742	2158	1437
2011	0	8	5377	11 941	25 507	19 964	17 263	13 498	5129	6282	8295

Table 10.1.16. Bass-47: Weights-at-age (kg) in UK(England and Wales) commercial bottom trawl landings.

	2	3	4	5	6	7	8	9	10	11	12+
1985	0.000	0.408	0.610	0.711	0.861	0.952	1.121	1.360	1.501	1.826	3.043
1986	0.000	0.368	0.509	0.791	0.927	1.065	1.325	1.304	1.752	2.031	2.875
1987	0.000	0.312	0.429	0.626	0.896	1.117	1.323	1.743	2.133	2.332	3.400
1988	0.000	0.358	0.449	0.584	0.885	1.148	1.488	1.666	1.847	2.056	2.842
1989	0.463	0.508	0.953	0.550	0.768	1.167	1.360	1.563	1.874	1.885	2.658
1990	0.000	0.580	0.731	0.994	1.062	1.263	1.588	1.849	2.015	2.447	3.208
1991	0.000	0.623	0.650	0.779	0.866	1.172	1.609	2.020	2.295	2.683	3.499
1992	0.000	0.601	0.646	0.881	1.122	1.422	1.387	1.558	1.977	2.330	3.896
1993	0.000	0.608	0.587	0.719	1.015	1.263	1.579	1.557	1.942	2.258	3.648
1994	0.000	0.425	0.592	0.650	0.966	1.325	1.686	1.649	2.077	2.521	3.534
1995	0.000	0.567	0.614	0.729	0.843	1.254	1.442	1.804	2.793	2.219	3.174
1996	0.000	0.575	0.652	0.729	0.858	1.146	1.759	2.067	2.235	2.720	3.492
1997	0.000	0.601	0.656	0.736	0.866	1.016	1.256	1.792	2.349	2.555	3.573
1998	0.000	0.625	0.658	0.764	0.891	1.056	1.231	1.493	1.905	2.875	3.698
1999	0.439	0.361	0.639	0.740	0.922	1.064	1.305	1.603	1.844	2.289	3.509
2000	0.000	0.647	0.660	0.718	0.925	1.243	1.492	1.684	1.943	2.115	3.819
2001	0.651	0.601	0.637	0.657	0.838	1.142	1.477	1.687	2.119	2.278	2.769
2002	0.000	0.610	0.625	0.673	0.882	1.125	1.520	1.739	1.909	2.190	2.863
2003	0.000	0.605	0.666	0.738	0.893	1.193	1.430	1.749	1.989	2.185	3.206
2004	0.000	0.691	0.722	0.741	0.911	1.055	1.432	1.585	2.681	1.992	3.383
2005	0.000	0.623	0.622	0.723	0.867	1.037	1.278	1.313	2.184	2.158	2.954
2006	0.000	0.567	0.646	0.738	0.912	1.028	1.270	1.427	1.673	2.091	3.088
2007	0.000	0.640	0.602	0.696	0.865	0.992	1.101	1.382	1.647	1.794	3.551
2008	0.000	0.523	0.574	0.625	0.804	1.031	1.207	1.410	1.621	1.652	3.132
2009	0.000	0.603	0.595	0.650	0.776	1.064	1.414	1.670	1.981	2.249	3.559
2010	0.000	0.697	0.586	0.656	0.785	0.933	1.144	1.492	1.891	1.946	2.503
2011	0.000	0.620	0.627	0.627	0.756	0.961	1.189	1.456	1.840	2.057	2.727

Table 10.1.17. Bass-47: Weights-at-age (kg) in UK(England and Wales) midwater pair trawl landings (blank rows: no data).

	2	3	4	5	6	7	8	9	10	11	12+
1985	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.538
1986											
1987	0.000	0.000	0.000	0.000	1.805	1.927	1.994	2.361	2.225	2.222	3.245
1988	0.000	0.000	0.000	0.661	1.007	1.067	1.475	1.556	1.363	1.554	3.233
1989	0.000	0.000	0.000	0.000	1.458	1.596	1.920	2.038	2.433	2.657	3.052
1990											
1991	0.000	0.000	1.211	1.211	1.271	1.251	1.348	1.544	1.510	0.000	4.046
1992	0.000	0.000	0.000	1.191	1.276	1.317	1.770	1.922	2.092	2.143	2.418
1993											
1994	0.000	0.611	0.685	0.847	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1995	0.000	0.584	0.617	0.663	0.793	0.890	0.814	0.000	0.000	0.000	0.000
1996	0.000	0.000	0.797	0.771	0.850	1.085	1.417	1.686	2.915	2.102	3.418
1997											
1998	0.000	0.000	0.664	0.937	0.937	1.067	1.309	1.559	1.571	2.593	4.575
1999	0.000	0.000	0.804	0.947	1.116	1.188	1.443	1.727	1.970	2.283	3.802
2000	0.000	0.697	1.157	0.847	1.153	1.360	1.585	2.025	2.192	2.418	3.486
2001	0.000	0.000	0.838	0.943	0.996	1.273	1.57	1.717	1.912	2.503	2.689
2002	0.000	0.693	0.753	1.078	1.133	1.230	1.623	1.826	2.195	2.336	2.803
2003	0.000	0.000	0.631	0.740	0.976	1.061	1.326	1.603	2.027	2.284	3.030
2004	0.000	0.547	0.699	0.867	0.957	1.203	1.431	1.684	2.112	2.536	3.228
2005	0.000	0.000	0.714	0.937	1.060	1.161	1.413	1.582	2.204	0.000	2.722
2006											
2007	0.000	0.000	0.846	0.769	0.920	1.123	1.266	1.483	1.812	2.081	2.770
2008	0.000	0.612	0.653	0.769	1.026	1.208	1.478	1.614	1.987	2.031	2.796
2009	0.000	0.000	0.825	0.791	0.890	1.097	1.285	1.432	1.629	2.407	2.153
2010	0.000	0.602	0.646	0.780	0.885	0.987	1.289	1.416	1.217	2.077	2.771
2011	0.000	0.000	0.740	0.879	0.901	1.060	1.217	1.479	1.711	1.915	2.369

Table 10.1.18. Bass-47: Weights-at-age (kg) in UK(England and Wales) commercial drift & fixed net landings.

	2	3	4	5	6	7	8	9	10	11	12+
1985	0.000	0.349	0.521	0.758	0.884	0.999	1.187	1.643	1.736	2.260	2.930
1986	0.000	0.477	0.634	0.834	1.012	1.147	1.164	1.376	1.911	3.663	2.098
1987	0.000	0.428	0.482	0.650	0.974	1.328	1.544	2.094	2.254	2.296	3.328
1988	0.000	0.000	0.686	0.670	0.930	1.165	1.555	1.559	1.776	1.704	3.397
1989	0.574	0.613	0.637	0.644	0.796	1.124	1.263	1.371	1.615	1.962	2.721
1990	0.000	0.656	0.785	0.744	0.789	1.273	1.498	1.884	1.787	1.941	3.125
1991	0.000	0.675	0.652	0.990	0.950	1.289	1.626	2.078	2.257	2.092	3.779
1992	0.000	0.585	0.683	0.789	1.068	1.560	1.590	1.801	2.031	2.173	3.544
1993	0.000	0.588	0.641	0.765	1.033	1.406	1.959	1.679	2.279	2.638	3.701
1994	0.219	0.578	0.635	0.708	0.980	1.354	1.673	1.712	2.077	2.369	3.687
1995	0.000	0.523	0.668	0.816	0.854	1.189	1.504	2.114	2.848	2.537	3.323
1996	0.000	0.651	0.663	0.719	0.880	1.017	1.436	1.985	1.888	2.345	4.020
1997	0.000	0.679	0.739	0.765	0.900	1.061	1.348	1.743	2.687	2.196	3.680
1998	0.000	0.645	0.673	0.702	0.951	1.194	1.470	1.715	2.363	3.023	3.516
1999	0.439	0.000	0.722	0.817	0.885	1.089	1.440	1.839	1.964	2.320	3.905
2000	0.000	0.713	0.766	0.763	0.922	1.081	1.235	1.500	1.636	2.339	3.701
2001	0.625	0.643	0.652	0.723	0.885	1.135	1.443	1.730	2.163	2.396	2.839
2002	0.000	0.626	0.667	0.690	0.884	1.054	1.410	1.584	1.827	1.878	2.560
2003	0.000	0.686	0.731	0.767	0.847	1.087	1.418	1.888	2.227	2.240	2.859
2004	0.000	0.717	0.819	0.800	0.938	1.099	1.415	1.556	2.070	2.325	3.348
2005	0.000	0.690	0.662	0.843	0.992	1.194	1.260	1.480	1.795	2.229	2.452
2006	0.000	0.617	0.689	0.753	0.944	1.173	1.385	2.022	2.086	2.462	3.351
2007	0.000	0.557	0.620	0.712	0.895	1.242	1.296	1.454	1.991	2.453	2.916
2008	0.000	0.529	0.576	0.650	0.840	1.034	1.235	1.675	1.838	2.057	3.226
2009	0.000	0.635	0.634	0.732	0.870	1.113	1.417	1.687	1.743	2.026	2.492
2010	0.000	0.661	0.601	0.717	0.880	1.121	1.436	1.850	2.467	2.625	3.019
2011	0.000	0.646	0.743	0.838	0.953	1.100	1.274	1.508	1.763	2.012	2.713

Table 10.1.19. Bass-47: Weights-at-age (kg) in UK(England and Wales) commercial line fishery landings.

	2	3	4	5	6	7	8	9	10	11	12+
1985	0.000	0.306	0.387	0.535	0.726	0.780	1.207	1.426	1.814	2.035	3.082
1986	0.000	0.401	0.497	0.792	0.988	1.191	1.367	1.458	1.681	1.757	2.998
1987	0.000	0.275	0.433	0.664	0.960	1.431	1.475	1.721	2.054	2.139	3.541
1988	0.000	0.409	0.425	0.538	0.937	1.241	1.476	1.718	1.664	1.868	3.050
1989	0.000	0.000	0.468	0.522	0.623	1.178	2.092	2.495	2.535	2.570	3.284
1990	0.000	0.674	0.737	0.845	1.005	1.206	1.565	1.876	2.116	2.202	3.539
1991	0.000	0.628	0.659	0.960	0.978	1.278	1.631	2.221	2.406	2.331	4.031
1992	0.000	0.553	0.678	0.900	1.209	1.614	1.671	1.905	2.193	2.599	4.120
1993	0.000	0.393	0.626	0.820	1.181	1.578	1.864	1.865	2.254	2.557	3.799
1994	0.000	0.648	0.538	0.669	0.974	1.313	1.734	1.701	2.102	2.400	3.468
1995	0.000	0.515	0.645	0.710	0.863	1.350	1.789	1.917	2.625	2.675	3.636
1996	0.000	0.573	0.593	0.665	0.864	1.107	1.615	2.224	1.850	3.092	3.883
1997	0.000	0.490	0.602	0.707	0.877	1.027	1.281	1.748	2.333	2.564	3.634
1998	0.000	0.314	0.670	0.839	1.005	1.205	1.430	1.809	2.348	3.331	4.024
1999	0.439	0.355	0.684	0.849	1.062	1.226	1.518	1.833	2.114	2.416	3.762
2000	0.000	0.645	0.648	0.776	1.001	1.246	1.482	1.862	2.155	2.488	3.473
2001	0.701	0.652	0.686	0.779	0.983	1.259	1.524	1.849	2.106	2.359	3.057
2002	0.000	0.633	0.648	0.785	1.106	1.188	1.647	1.774	2.160	2.302	3.321
2003	0.000	0.589	0.680	0.782	0.944	1.213	1.487	1.777	1.994	2.318	3.068
2004	0.000	0.646	0.719	0.787	1.030	1.217	1.585	1.824	2.148	2.473	3.101
2005	0.000	0.702	0.663	0.800	1.005	1.348	1.458	1.263	2.473	3.821	3.099
2006	0.000	0.582	0.812	0.821	0.957	1.015	1.286	1.624	2.227	2.775	3.523
2007	0.000	0.639	0.634	0.737	0.881	1.070	1.324	1.672	1.996	2.305	2.949
2008	0.000	0.584	0.633	0.724	0.919	1.154	1.344	1.548	1.859	1.917	2.905
2009	0.000	0.582	0.607	0.727	0.867	1.109	1.440	1.653	1.971	2.026	2.693
2010	0.000	0.789	0.743	0.845	0.933	1.047	1.287	1.740	2.029	2.262	2.847
2011	0.000	0.619	0.620	0.754	0.840	1.017	1.337	1.512	1.894	2.035	2.766

Table 10.1.20. Discards sampling rates for UK (England & Wales): nos. observed trips by year compared with total number of fleet trips. Trips with bass catch are given.

	Total number of fishing trips						Number of discard trips sampled						Number of sampled trips with bass					
	Trawl	Midwater	Nets	Lines	Other	Total	Trawl	Midwater	Nets	Lines	Other	Total	Trawl	Midwater	Nets	Lines	Other	Total
IVbc																		
2002	13580	176	1929	535	6599	22819	25	0	0	0	2	27	3	0	0	0	0	3
2003	13230	158	1099	534	7457	22478	37	0	0	1	0	38	5	0	0	0	0	5
2004	10961	267	1200	805	6835	20068	65	0	4	0	0	69	8	0	0	0	0	8
2005	11475	279	1730	905	6893	21282	32	1	2	0	0	35	4	0	0	0	0	4
2006	13559	188	4360	608	8910	27625	42	0	25	0	0	67	6	0	8	0	0	14
2007	14636	119	4422	1130	8956	29263	85	0	44	1	1	131	12	0	12	0	0	24
2008	12702	60	5340	1383	8783	28268	56	0	16	2	0	74	11	0	10	0	0	21
2009	14498	187	5224	1073	22917	43899	54	0	25	0	1	80	8	0	7	0	0	15
2010	12809	182	5838	1308	21306	41443	49	0	17	0	1	67	13	0	6	0	0	19
2011	13162	252	6821	685	24678	45598	47	0	15	0	0	62	4	0	5	0	0	9
VIId																		
2002	2601	19	746	341	3068	6775	1	0	0	0	0	1	1	0	0	0	0	1
2003	3160	37	744	496	2821	7258	3	0	0	0	3	6	2	0	0	0	0	2
2004	2641	33	725	366	2800	6565	9	0	2	0	2	13	6	0	0	0	0	6
2005	1947	25	531	387	3616	6506	5	1	0	0	0	6	5	1	0	0	0	6
2006	2969	20	6237	909	6326	16461	4	0	0	0	0	4	4	0	0	0	0	4
2007	3683	27	13778	1417	10169	29074	3	0	26	0	0	29	1	0	2	0	0	3
2008	3756	14	14772	1060	10106	29708	2	0	6	0	0	8	2	0	4	0	0	6
2009	3448	20	16935	1388	13049	34840	8	0	6	0	0	14	7	0	2	0	0	9
2010	3257	15	16189	1519	16301	37281	12	0	2	0	0	14	5	0	0	0	0	5
2011	3038	21	16929	1168	16085	37241	10	0	14	0	1	25	4	0	3	0	0	7
VIIeh																		
2002	10698	523	2582	1083	6225	21111	19	0	1	0	1	21	7	0	0	0	0	7
2003	10451	581	2150	783	5906	19871	42	1	6	0	15	64	19	1	1	0	0	21
2004	10640	474	2264	736	5989	20103	64	1	11	1	13	90	31	0	1	0	0	32
2005	9681	284	2516	936	6590	20007	48	1	2	0	4	55	21	1	0	0	0	22
2006	11789	314	4710	2093	9262	28168	74	2	5	0	0	81	30	1	2	0	0	33
2007	12950	572	6929	3082	10567	34100	129	1	21	0	0	151	59	1	2	0	0	62
2008	11902	564	7967	3325	10287	34045	107	0	14	0	0	121	45	0	3	0	0	48
2009	11012	512	8504	4950	15005	39983	73	0	17	0	0	90	30	0	0	0	0	30
2010	11240	472	7850	6234	16781	42577	59	0	31	0	0	90	17	0	3	0	0	20
2011	9953	476	9079	6403	18145	44057	63	0	21	0	1	85	13	0	0	0	0	13
VIIafg																		
2002	12816	1209	1230	825	2558	18638	13	0	6	0	3	22	1	0	1	0	0	2
2003	14242	1227	784	159	2658	19070	26	0	13	0	2	41	8	0	1	0	0	9
2004	13669	771	1051	1248	2808	19547	34	0	7	0	1	42	10	0	0	0	0	10
2005	13505	518	990	1408	2870	19291	14	0	3	0	0	17	2	0	1	0	0	3
2006	12825	477	2285	2298	6479	24364	19	0	7	0	1	27	5	0	0	0	0	5
2007	12799	237	2760	3778	7352	26926	52	0	14	0	0	66	11	0	0	0	0	11
2008	13293	338	3613	3903	8653	29800	58	0	17	0	0	75	15	0	2	0	0	17
2009	12498	265	4042	5043	13467	35315	31	0	16	0	0	47	16	0	1	0	0	17
2010	10854	239	3262	5169	14810	34334	26	0	11	0	0	37	9	0	1	0	0	10
2011	10533	123	3850	5916	16887	37309	26	0	26	0	0	52	7	0	2	0	0	9

Table 10.1.21. Estimated annual numbers and weight of sea bass discarded by UK otter trawl fleets in Areas IV, VIId, VIIeh and VIIafg, with numbers of sampled trips shown.

Length cm	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
8	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	4263
12	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	566	0
16	0	0	0	0	0	0	0	1126	0	0
18	0	0	0	0	0	0	0	3378	0	0
20	0	0	47	0	0	0	0	22 522	0	0
22	0	0	0	0	0	0	0	14 639	0	0
24	0	0	1458	0	0	8715	0	8170	2613	0
26	8808	488	896	0	3459	30 748	0	3909	21 429	0
28	0	1464	9635	539	8663	29 619	32 284	1069	33 462	1888
30	11 329	191	35 720	12 716	19 868	38 240	2597	4690	16 089	3219
32	30 192	18 820	65 321	1790	13 405	14 249	27 549	8474	37 627	4150
34	5665	13 693	29 528	3092	16 776	10 432	3034	8842	21 639	10 810
36	0	4453	1477	0	1520	242	50	20	675	0
38	0	0	0	0	0	0	0	0	0	1001
40	0	0	78	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	37	0	0	0
56	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0
Total Nos	55 994	39 110	144 160	18 137	63 691	132 245	65 550	76 839	134 101	25 330
Tonnes	21.4	17.9	58.5	6.8	25.0	41.7	23.2	17.2	47.4	9.5
% discarded by weight	10	7	22	4	11	17	9	8	23	6
No. samples	58	108	172	99	139	269	223	166	146	146

Table 10.1.22. Estimated annual numbers and weight of sea bass discarded by UK gillnet fleets in Areas IV, VIId, VIIeh and VIIafg, with numbers of sampled trips shown.

Length cm	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
8	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	1859	0	0	0	0	0
22	0	0	0	0	1859	0	0	340	8150	0
24	0	0	0	0	0	254	0	0	0	0
26	0	0	0	0	0	0	0	340	0	0
28	0	0	0	0	7435	127	0	0	0	0
30	0	0	0	0	3718	286	0	0	0	0
32	0	0	0	0	7435	381	0	340	0	0
34	0	0	0	0	1859	1016	4444	0	0	32 632
36	0	0	0	0	1859	127	0	340	0	0
38	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	3722	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0
54	0	0	0	44973	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	1859	0	0	0	0	0
60	0	0	0	0	0	0	202	0	0	0
62	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0
Total Nos	0	0	0	44 973	31 604	2192	4646	1360	8150	32 632
Tonnes	0.00	0.00	0.00	85.6	18.4	0.9	2.7	0.5	1.2	16.2
% discarded by weight	0.0	0.0	0.0	33	8.5	0.4	0.8	0.1	0.4	4.7
No. samples	7	19	24	7	37	105	53	64	61	76

Table 10.1.23. Number of fishing trips sampled for retained and discarded weight of sea bass on French vessels using different gear types: 2009–2012.

		No. samples	Weight of discards (t) estimated	Total weight landings (t)	%Discarded
2009	Bottom trawl	54	121	1027	11.8%
	Longline	17	1	71	1.4%
	Nets	41	1	94	1.1%
	pelagic trawl	23	16	1098	1.5%
2010	Bottom trawl	45	143	797	17.9%
	Nets	25	0	159	0.0%
	pelagic trawl	20	12	1824	0.7%
2011	Bottom trawl	123	8	791	1.0%
	Danish seine	2	NA	43	NA
	Nets	150	0	129	0.2%
	Other	24	NA	57	NA
	longline	4	0	117	0.1%
	pelagic trawl	23	6	1142	0.5%
	Purse seine	6	NA	6	NA
2012	Bottom trawl	54	115	824	14.0%
provisional	Danish seine	6	NA	112	NA
	longlines	7	0	83	0.3%
	nets	31	7	142	5.0%
	Pelagic trawl	6	3	1143	0.2%

Table 10.1.24. Estimated numbers of bass discarded by sampled French fleets, by length class, in 2011 and 2012 (see Table 7 for sample numbers).

	2011				2012				
length (cm)	bottom trawl	longlines	nets	pelagic trawl	bottom trawl	longlines	nets	pelagic trawl	purse seine
10	0	0	0	0	11 994	0	0	0	0
11	0	0	0	0	5122	0	0	0	0
12	0	0	0	0	3535	0	0	0	0
13	0	0	0	0	2224	0	0	0	0
14	0	0	0	0	1427	0	0	0	0
15	0	0	0	0	571	0	0	0	0
16	0	0	0	0	1141	0	0	0	0
17	0	0	0	0	143	0	0	0	0
18	0	0	0	0	143	0	0	0	0
19	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0
21	530	0	0	0	0	0	0	0	0
22	795	0	0	0	0	0	0	0	0
23	2121	0	0	0	0	0	0	0	0
24	4773	0	0	0	0	0	0	0	0
25	1856	0	0	0	143	0	0	0	0
26	1061	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0
30	1791	0	0	0	12 658	0	537	0	0
31	0	0	0	54	40 742	0	0	0	0
32	5375	0	0	0	140 244	715	1100	0	0
33	2221	0	0	300	68 412	0	1100	522	10
34	5276	0	0	942	48 324	0	1100	1198	24
35	1779	810	0	1007	24 092	0	1100	2529	0
36	0	0	0	2944	0	0	0	1088	28
37	0	0	0	2559	0	0	0	322	19
38	0	0	0	1563	0	0	0	214	52
39	0	0	0	599	0	0	0	0	55
40	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	107	0
42	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0
44	0	0	0	300	0	0	0	0	0
45	0	145	0	0	0	0	1612	0	0
46	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	537	0	0
48	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	1100	0	0

Table 10.1.25. Bass-47: Estimates of recreational fishery removals.

a) France (catches by weight, in tonnes).

	Total	RSE	kept	released	hooking mortality for releases	total removed	Release rate (by weight)
2009/11	1272	>26%[1]	940	332	20%	1006	26%
2011/12							

[1]**RSE was 26% for area VII and VIII combined; area VII represented 40% of total.**

(~80% by weight in 2009/2011 was recreational sea angling).

b) Netherlands: March 2010–February 2011 (catches by number and weight).

	Total	RSE	kept	released	hooking mortality for releases	total removed	Release rate (by number)
By number	366 000	30%	234 000	131 000	20%	260 000	36%
By weight	n/a	n/a	128 t	n/a		>128 t	

(98% by weight is recreational sea angling).

Table 10.1.26. Sea bass in the Northeast Atlantic. Abundance indices from the UK(England) trawl surveys of juvenile bass in the Solent (VIId) in May–July and September (nos. per ten minute tow).

	May–July			September		
Year	age 2	age 3	age 4	age 2	age 3	age 4
1981	0.00	0.30	0.25			
1982	0.51	2.17	0.16	3.25	10.10	0.38
1983				9.87	0.91	1.88
1984	0.95	2.66	0.43	1.38	0.65	0.09
1985	0.00	10.33	2.56			
1986				0.27	4.26	1.31
1987	0.00	0.42	3.18	0.05	0.28	2.27
1988	0.00	0.02	0.47			
1989				6.68	0.37	0.00
1990	2.84	2.48	0.00	2.81	1.15	0.02
1991	5.78	0.62	0.09	3.08	0.21	0.03
1992	0.11	7.04	0.35	0.95	18.59	0.16
1993	0.05	7.33	14.02	6.65	3.59	4.39
1994	0.04	1.63	1.14	3.33	1.84	0.29
1995	0.05	1.57	0.97	4.83	4.69	0.72
1996	1.43	4.09	3.36	5.52	0.43	0.11
1997	0.27	1.94	0.11	33.62	4.52	0.06
1998	0.00	6.75	5.79	1.22	5.50	0.61
1999	0.61	0.95	12.30	19.37	0.67	0.87
2000	0.49	37.03	1.06	9.06	16.94	0.16
2001	1.71	6.33	3.43	34.42	3.92	1.57
2002	0.63	1.62	0.29	7.42	3.87	0.40
2003	0.06	0.32	0.38	8.37	4.60	0.59
2004	0.17	0.28	0.16			
2005	0.05	0.42	0.35	13.12	7.98	0.84
2006	0.44	2.47	1.03	9.51	9.21	1.02
2007	0.33	0.50	0.50	3.42	1.78	0.30
2008				18.52	6.66	0.34
2009	0.72	1.03	0.13	13.25	6.25	0.33
2010						
2011				2.25	1.39	0.42

Table 10.1.27. Sea bass in the Northeast Atlantic. Abundance indices from the UK(England) trawl surveys of juvenile sea bass in the Thames Estuary (IVc) in November (nos. per ten minute tow).

Year	age 0	age 1	age 2	age 3
1997	7.737	0	0.048	0.41
1998				
1999	19.54	6.033	0.764	0
2000	4.015	14.74	0.832	0.089
2001	121.5	11.47	5.108	0.171
2002	469	20.71	2.716	1.093
2003	225.6	35.76	4.429	0.159
2004	238.92	44.99	7.32	1.03
2005	37.04	14.49	6.86	0.75
2006	245.54	11.26	3.46	0.94
2007				
2008	107.55	50.69	1.86	0.2
2009	95.43	7.79	13.59	0.91

Table 10.1.28. Sea bass 47: population numbers-at-age from final age and length model ('000).

YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12+
1985	135	1244	5522	4791	1674	452	560	291	375	1086	304	241	1074
1986	540	110	1018	4520	3902	1334	349	419	213	271	780	218	937
1987	3231	442	90	834	3674	3080	1007	253	296	148	187	535	788
1988	3659	2646	362	74	675	2839	2216	679	163	186	92	115	810
1989	29577	2996	2166	296	60	531	2132	1596	476	113	127	62	626
1990	6538	24216	2453	1773	241	47	399	1535	1118	328	77	86	466
1991	5987	5353	19826	2008	1440	189	35	287	1074	770	224	52	373
1992	8290	4902	4383	16226	1626	1116	137	24	189	691	489	141	267
1993	4056	6787	4013	3587	13137	1258	806	93	16	120	435	305	253
1994	10583	3321	5557	3285	2909	10257	927	565	63	11	79	284	363
1995	16414	8664	2719	4548	2667	2288	7707	670	398	44	7	54	441
1996	1760	13439	7094	2226	3691	2091	1708	5514	466	272	30	5	333
1997	17682	1441	11003	5805	1798	2827	1478	1123	3453	284	163	18	199
1998	9035	14477	1180	9004	4694	1383	2019	989	719	2153	174	99	131
1999	19161	7397	11852	965	7289	3628	997	1367	641	455	1343	108	142
2000	9494	15688	6056	9700	781	5607	2584	662	866	395	275	807	149
2001	12948	7773	12844	4957	7853	604	4054	1759	433	552	248	172	595
2002	16323	10601	6364	10512	4014	6082	438	2767	1153	277	349	156	479
2003	15815	13364	8679	5209	8509	3106	4405	299	1817	740	176	220	397
2004	12157	12948	10942	7103	4208	6510	2190	2887	186	1101	441	104	362
2005	10696	9954	10601	8954	5733	3207	4553	1418	1775	111	645	256	269
2006	10168	8757	8149	8674	7210	4314	2177	2818	824	994	61	350	283
2007	7390	8325	7169	6668	6976	5392	2891	1323	1602	451	532	32	332
2008	5909	6050	6816	5866	5368	5246	3659	1790	769	898	247	289	196
2009	7270	4838	4953	5577	4720	4028	3548	2257	1038	430	492	134	261
2010	*7164*	5952	3961	4053	4489	3550	2738	2206	1321	586	238	270	215
2011	*7163*	5865	4873	3240	3248	3297	2285	1567	1165	666	288	115	233
2012	*7162*	5865	4802	3987	2599	2397	2148	1333	848	604	337	144	172

[1] Nos. at age 0 from 2010 on = SS3 predictions.

Table 10.1.29. Sea bass 47: total fishing mortality-at-age from final age and length model.

YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12+
1985	0.000	0.000	0.000	0.005	0.027	0.061	0.091	0.112	0.124	0.131	0.135	0.136	0.138
1986	0.000	0.000	0.000	0.007	0.036	0.081	0.121	0.148	0.164	0.173	0.178	0.180	0.183
1987	0.000	0.000	0.000	0.011	0.058	0.129	0.193	0.237	0.263	0.277	0.285	0.288	0.292
1988	0.000	0.000	0.000	0.008	0.039	0.086	0.128	0.156	0.173	0.182	0.186	0.189	0.191
1989	0.000	0.000	0.000	0.008	0.040	0.087	0.128	0.156	0.173	0.181	0.186	0.188	0.191
1990	0.000	0.000	0.000	0.008	0.040	0.087	0.129	0.157	0.173	0.182	0.187	0.189	0.192
1991	0.000	0.000	0.000	0.011	0.055	0.121	0.179	0.218	0.241	0.253	0.260	0.263	0.267
1992	0.000	0.000	0.000	0.011	0.057	0.125	0.185	0.226	0.251	0.264	0.271	0.274	0.278
1993	0.000	0.000	0.000	0.009	0.047	0.105	0.155	0.190	0.210	0.221	0.227	0.230	0.233
1994	0.000	0.000	0.000	0.008	0.040	0.086	0.125	0.151	0.167	0.175	0.179	0.182	0.184
1995	0.000	0.000	0.000	0.009	0.043	0.093	0.135	0.163	0.179	0.188	0.193	0.195	0.198
1996	0.000	0.000	0.000	0.013	0.067	0.147	0.219	0.268	0.297	0.313	0.321	0.326	0.330
1997	0.000	0.000	0.000	0.012	0.062	0.136	0.202	0.246	0.273	0.287	0.294	0.298	0.302
1998	0.000	0.000	0.000	0.011	0.058	0.128	0.190	0.233	0.258	0.272	0.279	0.283	0.287
1999	0.000	0.000	0.000	0.012	0.062	0.139	0.209	0.257	0.286	0.301	0.310	0.314	0.319
2000	0.000	0.000	0.000	0.011	0.056	0.124	0.185	0.225	0.250	0.263	0.270	0.273	0.277
2001	0.000	0.000	0.000	0.011	0.056	0.123	0.182	0.223	0.247	0.260	0.267	0.270	0.274
2002	0.000	0.000	0.000	0.011	0.056	0.123	0.181	0.220	0.244	0.256	0.263	0.266	0.270
2003	0.000	0.000	0.000	0.013	0.068	0.150	0.223	0.272	0.301	0.317	0.326	0.330	0.335
2004	0.000	0.000	0.001	0.014	0.071	0.158	0.234	0.286	0.317	0.334	0.343	0.347	0.352
2005	0.000	0.000	0.001	0.017	0.084	0.188	0.280	0.343	0.380	0.400	0.411	0.416	0.422
2006	0.000	0.000	0.001	0.018	0.090	0.200	0.298	0.365	0.404	0.426	0.437	0.443	0.449
2007	0.000	0.000	0.001	0.017	0.085	0.188	0.280	0.342	0.379	0.399	0.410	0.415	0.421
2008	0.000	0.000	0.001	0.017	0.087	0.191	0.283	0.345	0.381	0.401	0.412	0.417	0.423
2009	0.000	0.000	0.001	0.017	0.085	0.186	0.275	0.336	0.371	0.390	0.401	0.406	0.411
2010	0.000	0.000	0.001	0.022	0.109	0.240	0.358	0.438	0.485	0.511	0.525	0.532	0.539
2011	0.000	0.000	0.001	0.021	0.104	0.228	0.339	0.414	0.458	0.482	0.495	0.502	0.508

Table 10.1.30. Sea bass 47: Stock summary table from SS3 age and length model.

YEAR	RECRUITS (AGE 0)	SE (REC)	SSB	SE(SSB)	TSB	F(5–11)	LANDINGS
1985	116	29	9882	631	12335	0.09	1076
1986	477	101	8758	568	11586	0.13	1315
1987	2949	374	7980	508	10616	0.21	1979
1988	3458	404	7034	461	9040	0.14	1238
1989	27913	1273	6633	439	8189	0.14	1161
1990	6252	500	5983	426	7804	0.15	1033
1991	5142	428	5236	410	8445	0.21	1225
1992	7471	526	4348	382	9261	0.22	1184
1993	4289	384	4588	332	10419	0.18	1251
1994	10925	669	5873	284	11650	0.15	1370
1995	16253	847	7457	272	12662	0.17	1777
1996	1774	231	8459	281	13363	0.28	3023
1997	17482	940	7992	292	13042	0.26	2620
1998	9079	697	7542	300	12990	0.25	2388
1999	17835	1009	7606	299	13486	0.27	2665
2000	9185	708	7657	302	13967	0.23	2397
2001	12222	819	8130	314	14956	0.23	2482
2002	16459	1014	8645	325	15927	0.22	2628
2003	15407	1060	9415	331	16912	0.27	3445
2004	11407	983	9746	330	17393	0.29	3730
2005	9447	1007	9824	333	17691	0.35	4392
2006	8679	1227	9438	343	17326	0.37	4522
2007	6285	1208	9158	370	16668	0.35	4213
2008	4588	1353	9189	432	15982	0.35	4244
2009	5160	2002	8979	532	14823	0.35	4013
2010	*(6900)*[1]	*(270)*	8499	669	13392	0.47	4758
2011	*(6900)*[1]	*(270)*	7021	835	10989	0.46	3870
2012	*(6900)*[1]	*(270)*	5716	1011	9188	0.64	4060

[1] No direct estimates available for recruits 2010-2012: SS3 predictions are shown.

Table 10.1.31. Sea bass 47: Inputs to yield per recruit model based on age and length SS3 model. (Only combined fleet inputs are shown).

AGE	M	PMAT	STOCK WT (KG)	F_{BAR}(09-11): ALL FLEETS	CATCH WT (KG)
0	0.2	0		0.000	0.000
1	0.2	0		0.000	0.129
2	0.2	0		0.001	0.462
3	0.2	0		0.020	0.661
4	0.2	0.107	0.662	0.099	0.812
5	0.2	0.281	0.871	0.218	0.973
6	0.2	0.486	1.077	0.324	1.157
7	0.2	0.663	1.294	0.396	1.370
8	0.2	0.790	1.528	0.438	1.610
9	0.2	0.873	1.779	0.461	1.871
10	0.2	0.924	2.044	0.473	2.148
11	0.2	0.954	2.318	0.480	2.431
12	0.2	0.972	2.596	0.483	2.715
13	0.2	0.983	2.873	0.485	2.994
14	0.2	0.989	3.145	0.486	3.267
15	0.2	0.993	3.409	0.486	3.529
16	0.2	0.996	3.663	0.486	3.779
17	0.2	0.997	3.905	0.487	4.016
18	0.2	0.998	4.134	0.487	4.240
19	0.2	0.999	4.350	0.487	4.451
20	0.2	0.999	4.553	0.487	4.647
21	0.2	0.999	4.743	0.487	4.831
22	0.2	0.999	4.919	0.487	5.001
23	0.2	1.000	5.083	0.487	5.159
24	0.2	1.000	5.234	0.487	5.305
25	0.2	1.000	5.374	0.487	5.439
26	0.2	1.000	5.504	0.487	5.564
27	0.2	1.000	5.622	0.487	5.678
28	0.2	1.000	5.732	0.487	5.782
29	0.2	1.000	5.832	0.487	5.878
30	0.2	1.000	6.042	0.487	6.080

Table 10.1.32. Sea bass 47: Yield per recruit output table. Multiplier and F(5–11) giving Fspr35% are shaded. Multipliers are applied by fleet to mean F 2009–2011. (Only combined fleet results are shown).

F_{MULT}	F(5-11)	SSB/R	% SPR/SPR(F0)	YPR-TOTAL INTERNATIONAL
0	0.000	3.232	1.000	0.000
0.1	0.040	2.352	0.728	0.120
0.2	0.080	1.806	0.559	0.185
0.3	0.120	1.447	0.448	0.224
0.433	0.173	1.130	0.350	0.255
0.5	0.199	1.014	0.314	0.266
0.6	0.239	0.877	0.271	0.277
0.7	0.279	0.771	0.238	0.286
0.8	0.319	0.686	0.212	0.292
0.9	0.359	0.617	0.191	0.297
1	0.399	0.561	0.173	0.301
1.1	0.439	0.513	0.159	0.305
1.2	0.478	0.473	0.146	0.307
1.3	0.518	0.438	0.136	0.309
1.4	0.558	0.408	0.126	0.311
1.5	0.598	0.382	0.118	0.313
1.6	0.638	0.359	0.111	0.314
1.7	0.678	0.338	0.105	0.316
1.8	0.718	0.320	0.099	0.317
1.9	0.757	0.303	0.094	0.318
2	0.797	0.288	0.089	0.319

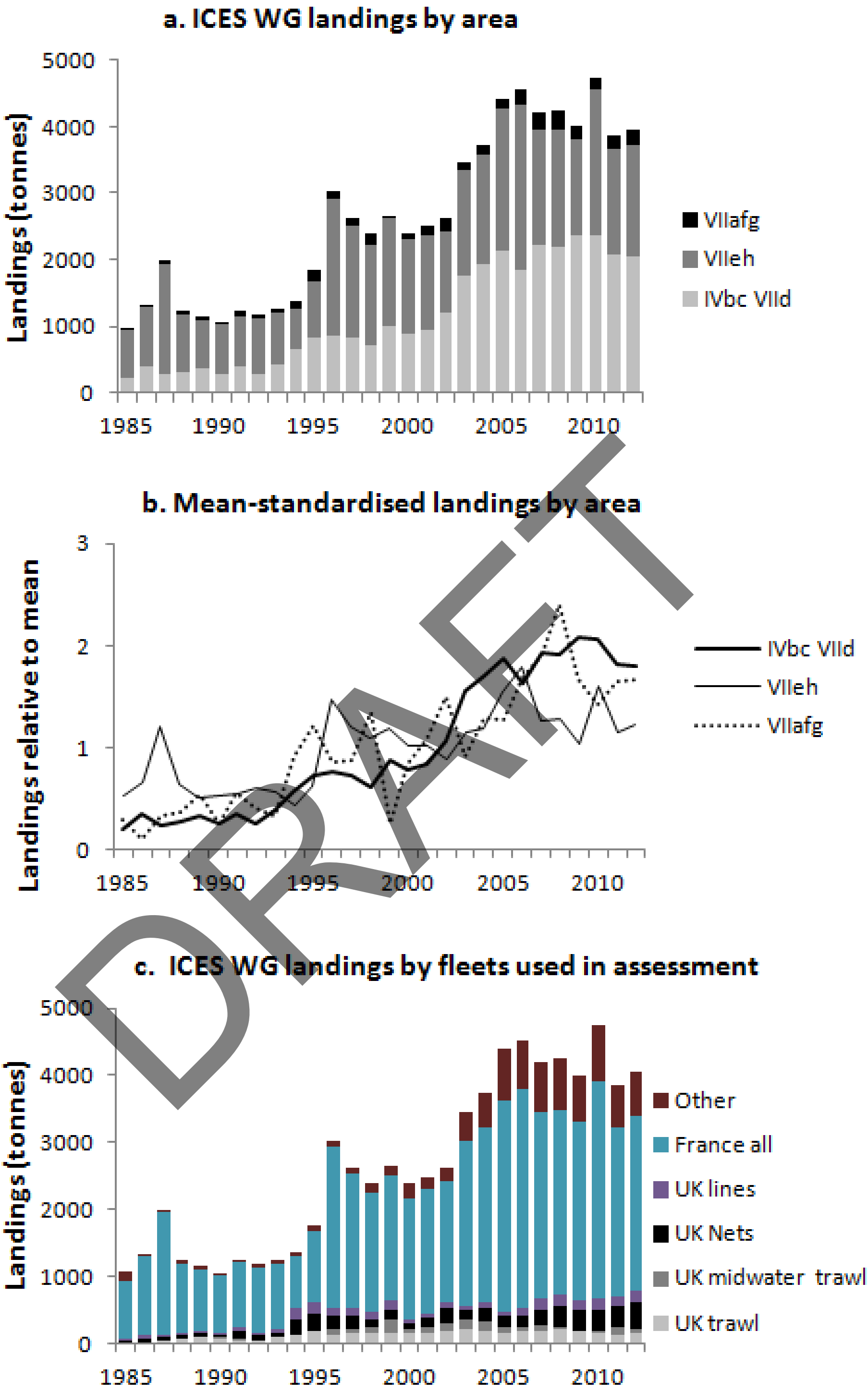


Figure 10.1.1. Bass-47: Trends in landings by area and by fleets used in assessment.

(Source: Official Catch Statistics 1950–2010 dataset 2011 and 1992–2011 dataset 2013, ICES, Copenhagen; French landings provided by Ifremer from 2000 onwards, and adjustments to pre-2000 French statistics in line with ratio of Ifremer to official figures in later years.)

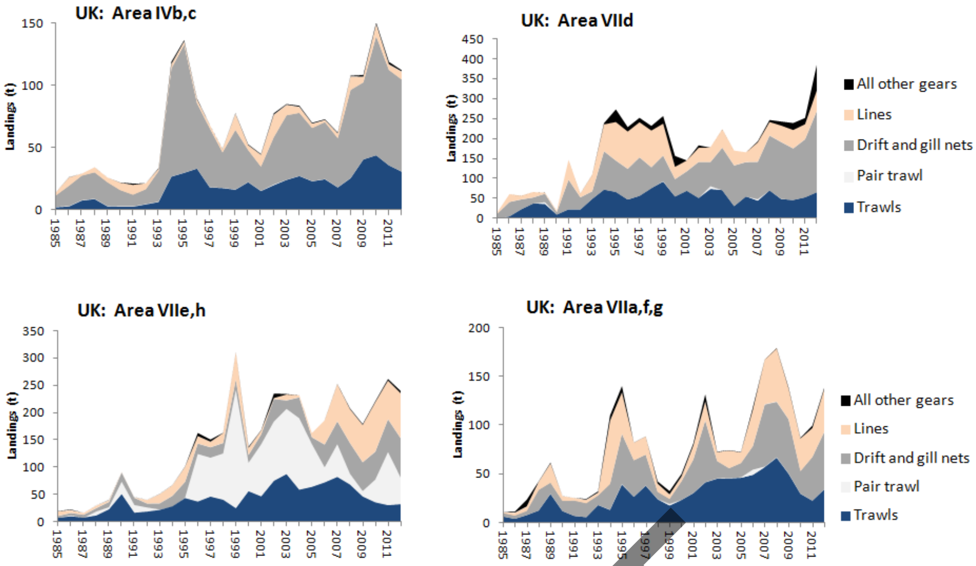


Figure 10.1.2. Bass-47. Landings by area and gear type for UK commercial fishing fleets (pair trawl = offshore pelagic trawl fishery).

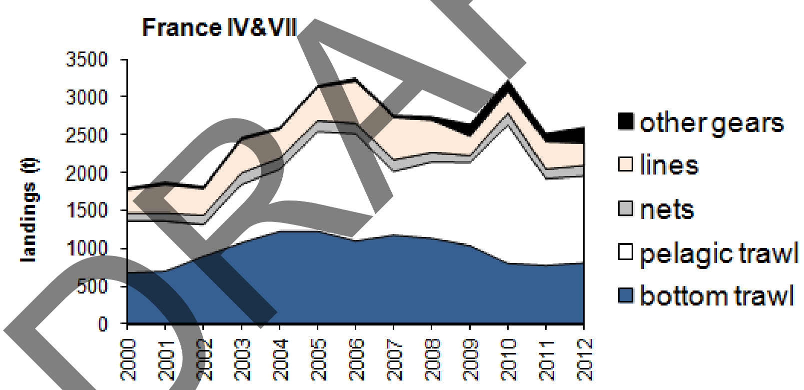


Figure 10.1.3. Bass-47. Landings by gear type for French commercial fishing fleets (pelagic trawl = offshore pelagic trawl fishery).

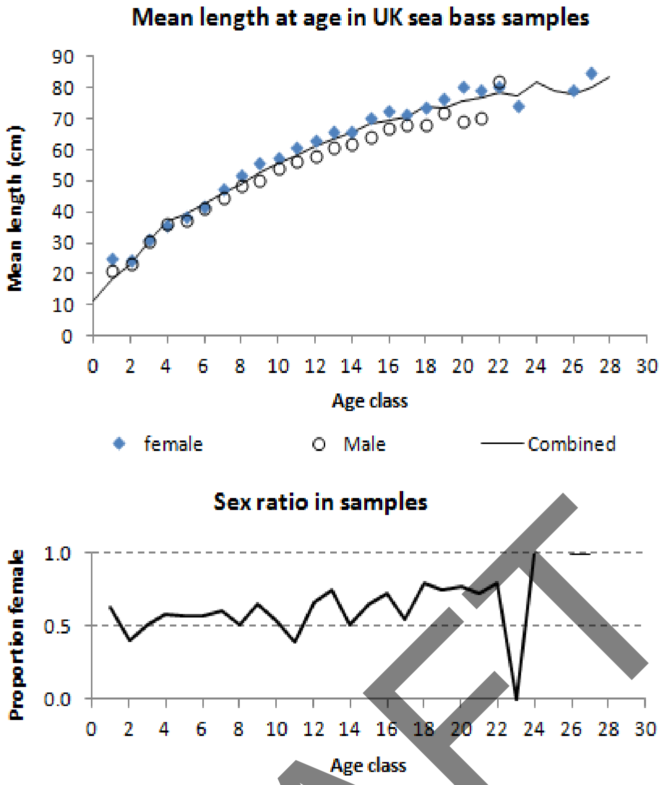


Figure 10.1.4. Top: mean length-at-age for male and female bass sampled since 1985 mainly from UK commercial catches plus some fish caught on surveys (other than Thames and Solent surveys where the fish are unsexed). Bottom: proportion female in samples.

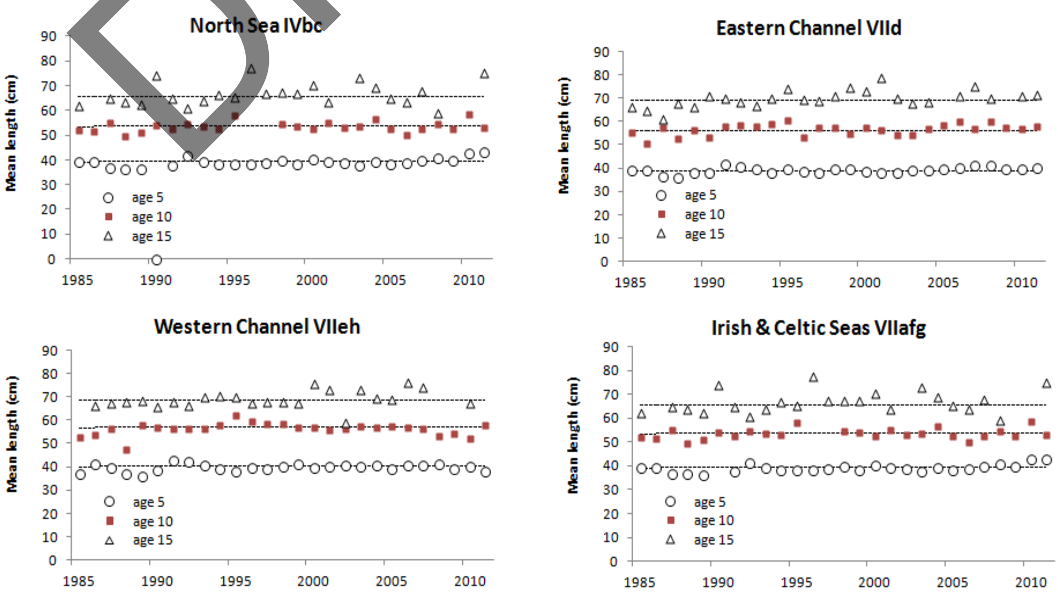


Figure 10.1.5. Mean length-at-age for combined-sex sea bass sampled mainly from UK commercial catches, by year, for fish aged 5, 10 and 15. Dotted lines are the series means.

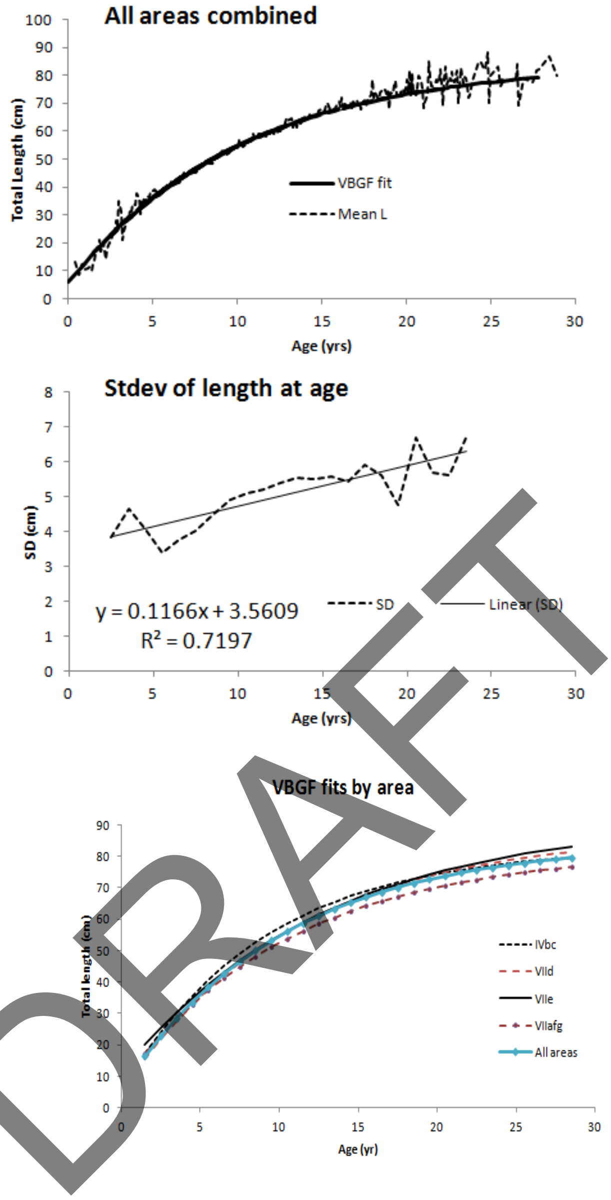


Figure 10.1.6. Top: von Bertalanffy growth curve fitted to all UK data for sea bass from 1985–2011. Dotted line shows mean lengths in 1-month age bins (curve is fitted to individual fish data). Middle: standard deviation of length-at-age distributions in raw age data. Bottom: fitted VBGF curves by ICES area.

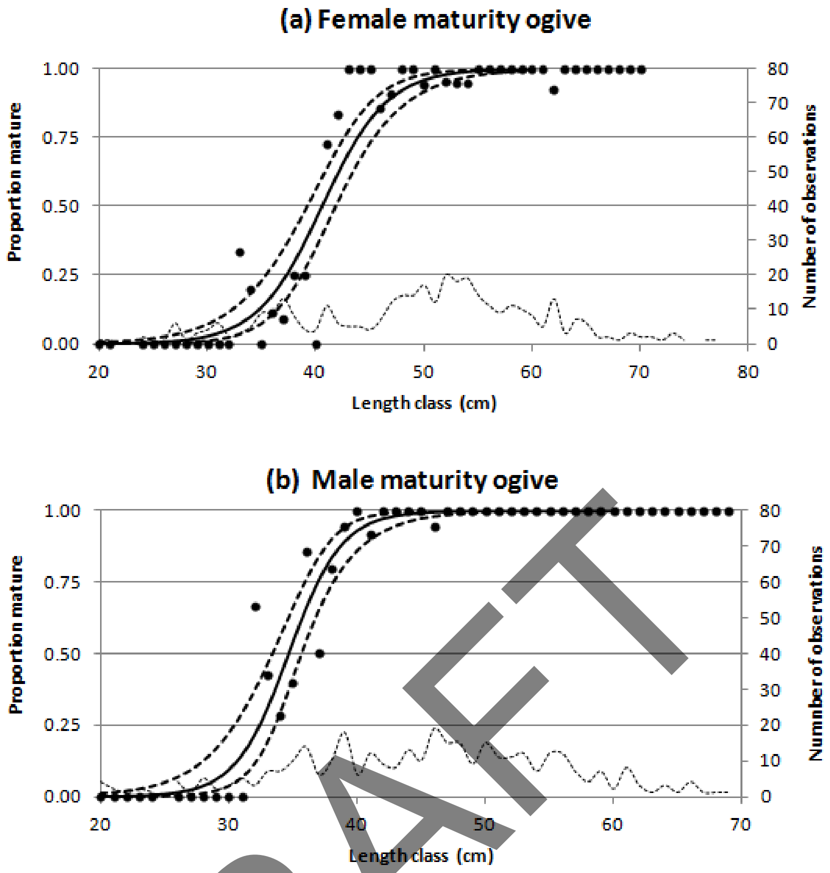


Figure 10.1.7. Logistic maturity ogives (with 95% confidence intervals) fitted to individual maturity records for sea bass during December–April 1982–2003. Points are proportion mature by length class in the raw data. Dotted line is the number of observations per length class.

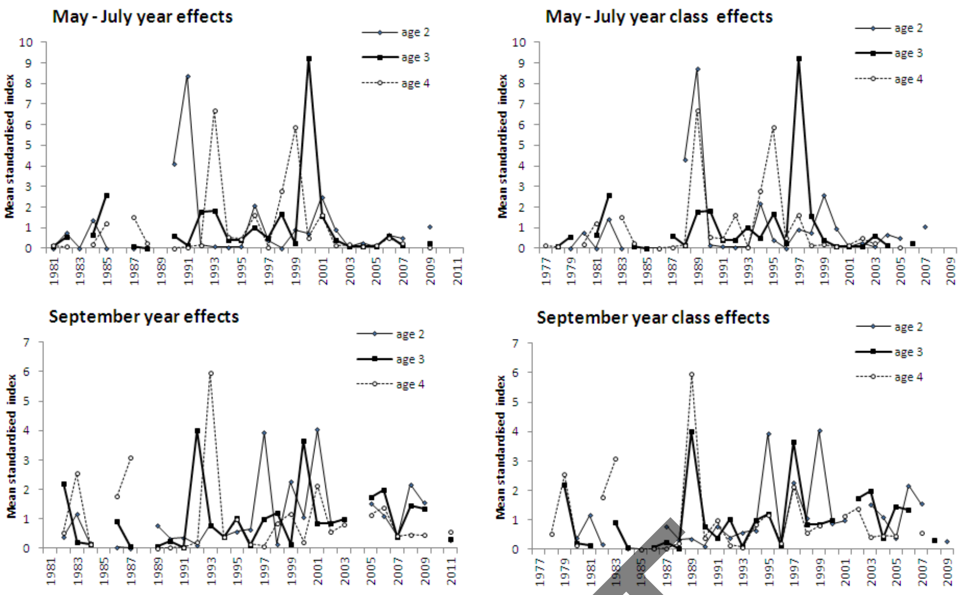


Figure 10.1.8. Sea bass in the Northeast Atlantic. UK(England) Solent sea bass survey: mean-standardized indices at ages 2, 3 and 4 plotted against year (left-hand plots) and year class (right-hand plots) for surveys in May–July (top) and September (bottom).

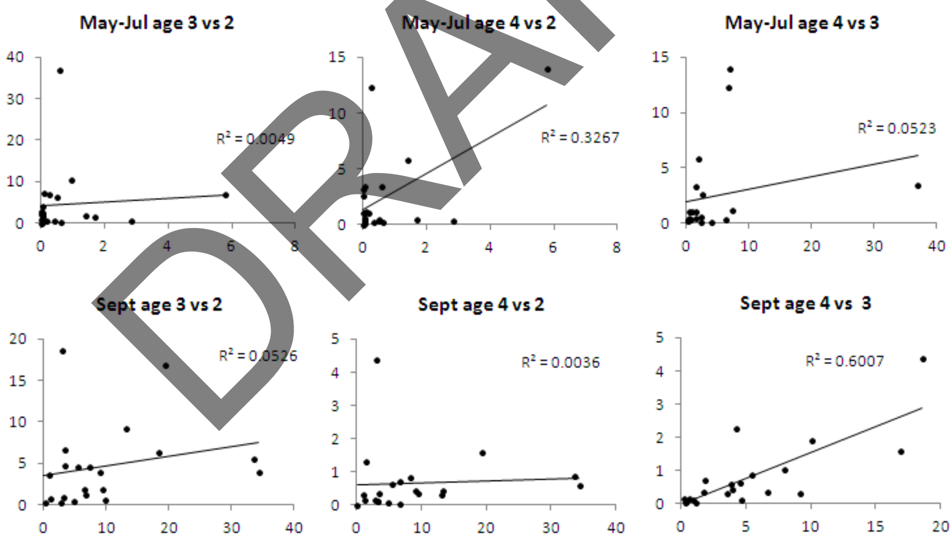


Figure 10.1.9. Sea bass in the Northeast Atlantic. UK(England) Solent sea bass survey: Internal consistency plots of abundance indices at successive ages in year classes: surveys in May–July (top) and September (bottom).

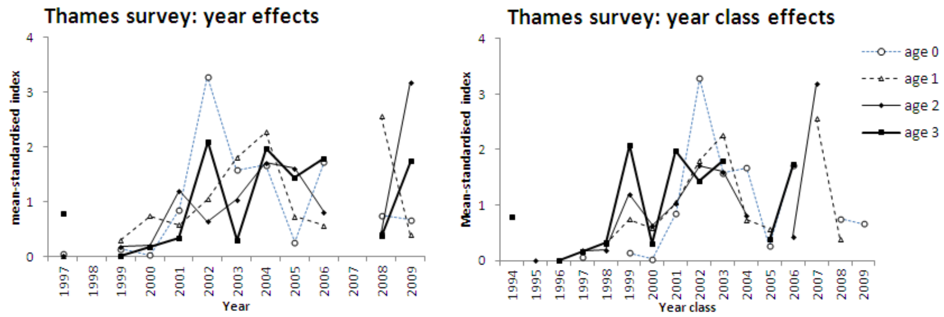


Figure 10.1.10. Sea bass in the Northeast Atlantic. UK(England) Thames sea bass survey in November: mean-standardized indices at ages 0–3 plotted against year (left-hand plots) and year class (right-hand plots).

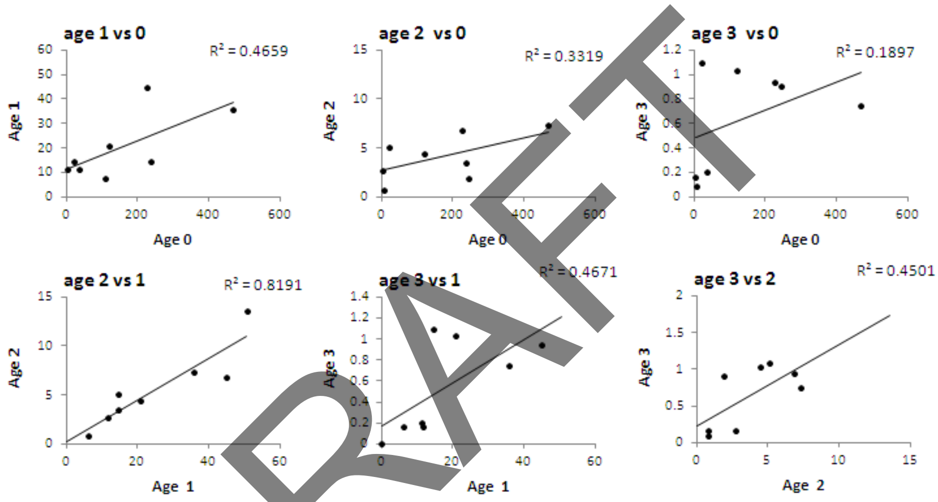


Figure 10.1.11. Sea bass in the Northeast Atlantic. UK(England) Thames sea bass survey in November: Internal consistency plots of abundance indices at successive ages in year classes.

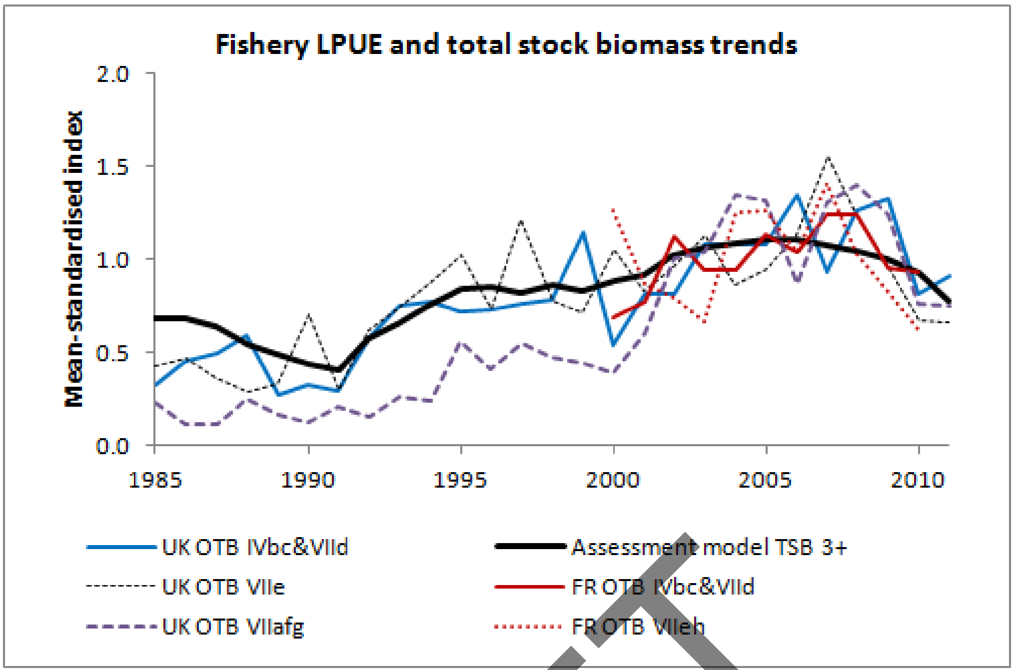


Figure 10.1.12. Mean-standardized trends in lpue of UK>10 m and French otter trawlers, IVbc, VIId, VIIeh and VIIafg (standardised to 2000–2011 period common to all series. The total stock biomass estimates for 3-year-old and older sea bass from the final Stock Synthesis age and length model are included.

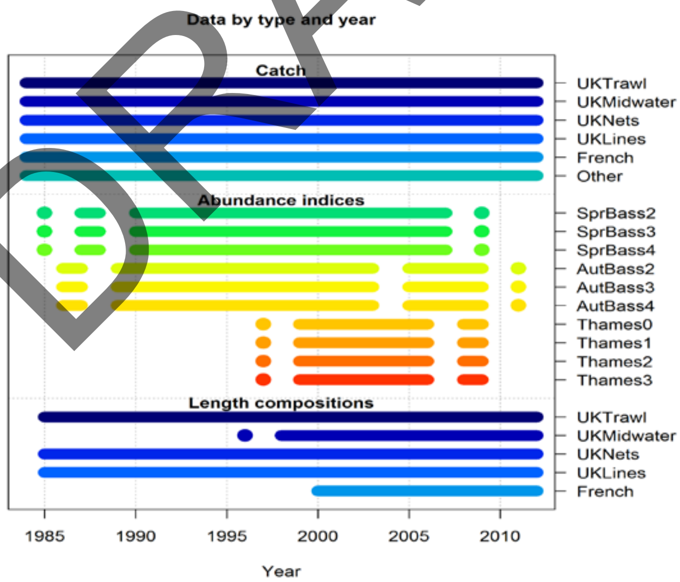


Figure 10.1.13. Bass-47: Stock Synthesis model inputs for the length-based model.

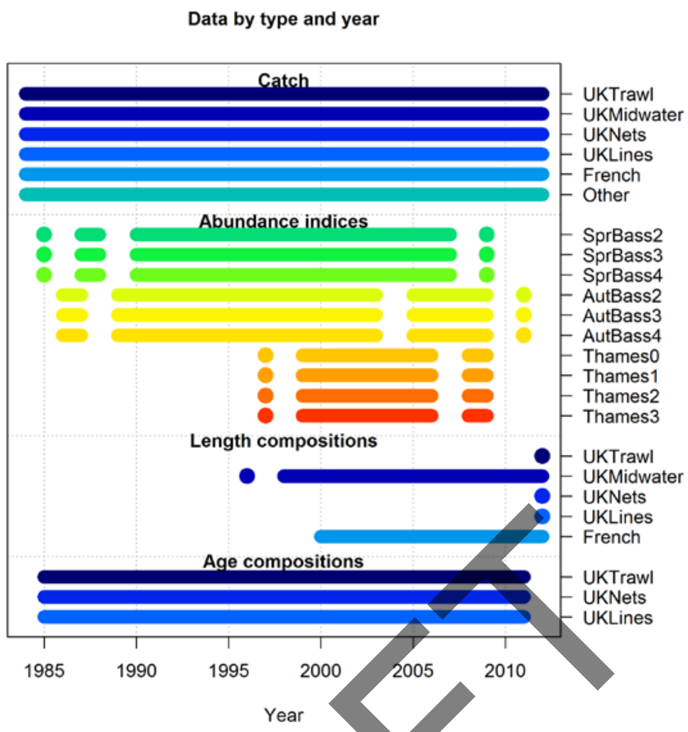


Figure 10.1.14. Bass-47: Stock Synthesis model inputs for the age and length based model.

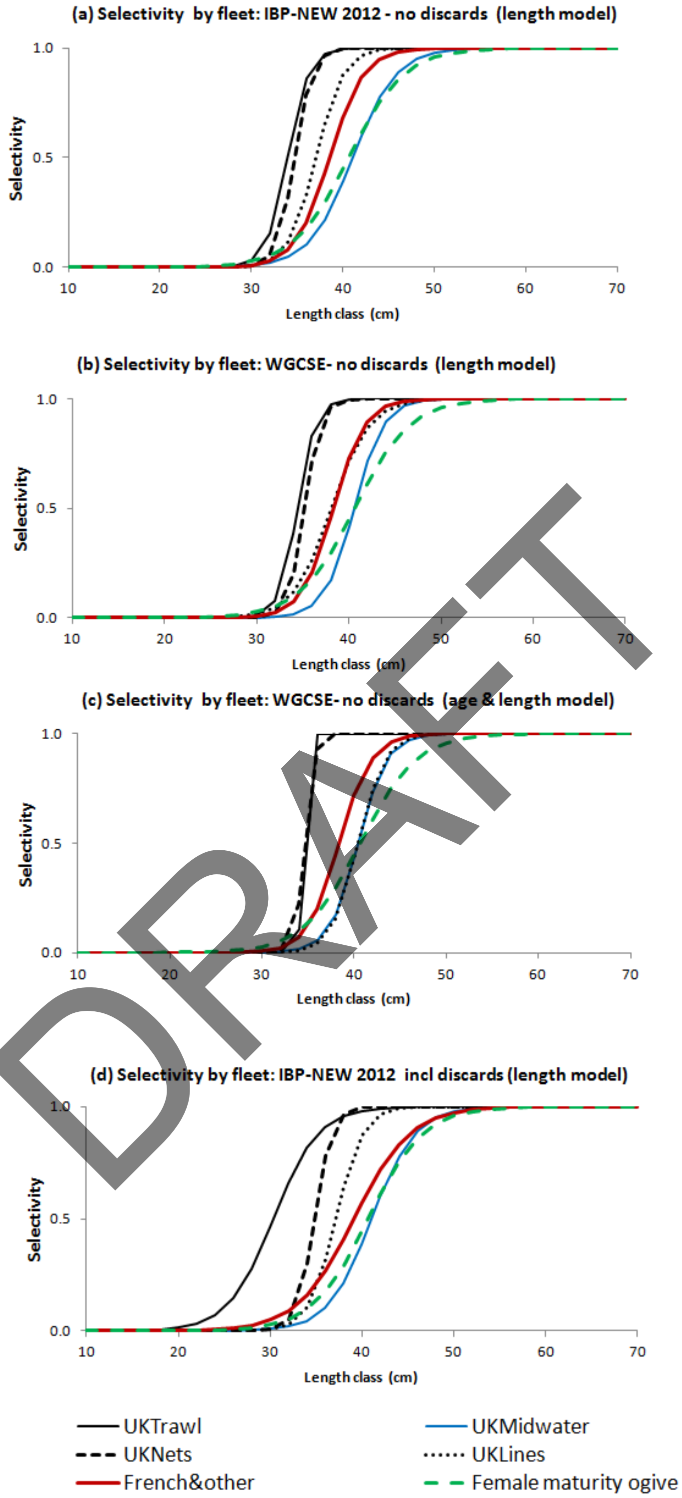
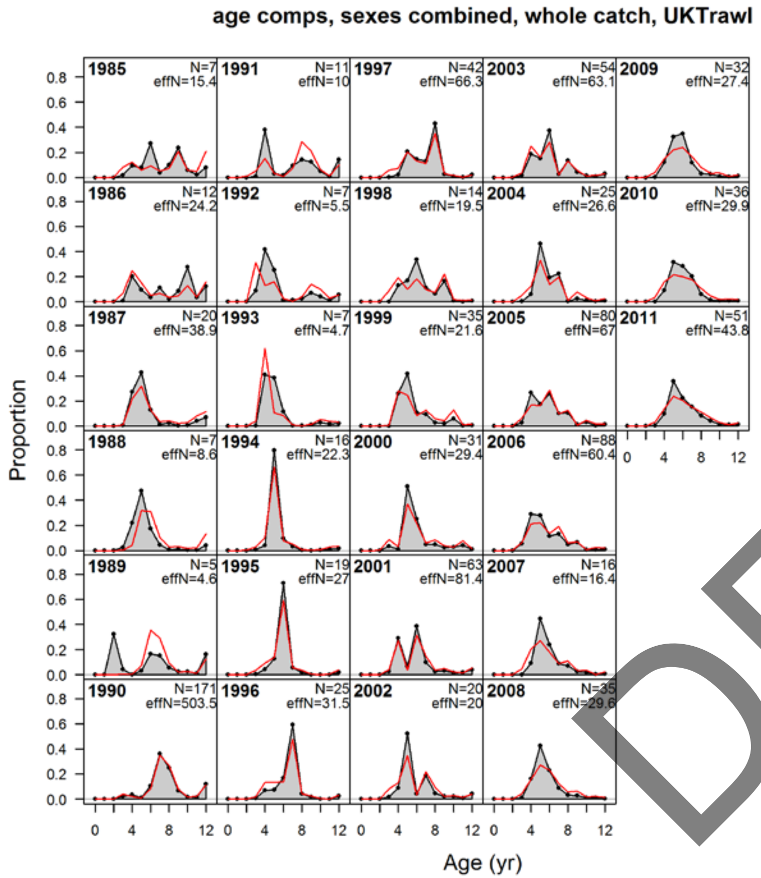


Figure 10.1.15. Bass-47: SS3 estimates of fishery selection patterns, in comparison with the female maturity ogive: plot (a) and (b) give the selectivity curves from the IBPNEW 2012 and WGCSE 2013 length-based model runs excluding discards. Plot (c) shows the selection curves from the WGCSE 2013 age & length assessment; Plot (d) gives the selection curves from the IBPNEW 2012 run including UK trawl discards by length from 2002 and French estimates of volumes discarded.

A



B

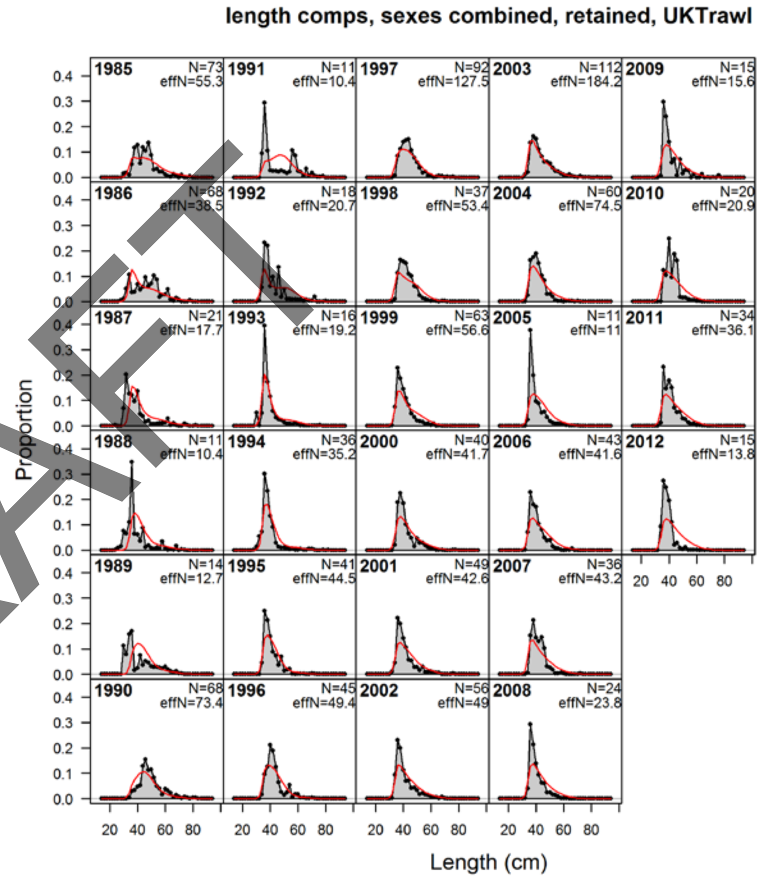
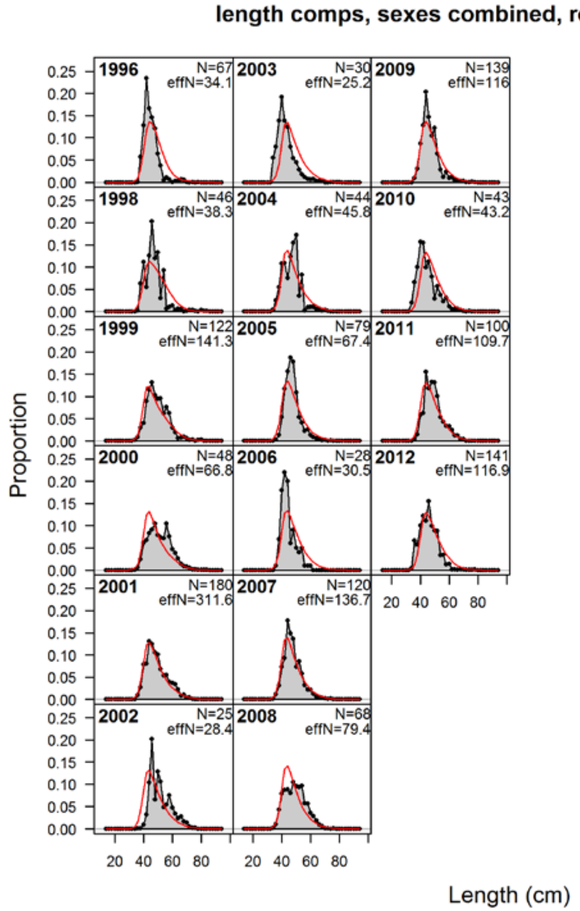


Figure 10.1.16. Bass-47: Observed and SS3-fitted UK trawl landings compositions. Left: fit of age compositions in the age & length-based model; Right: fit of length compositions in the length model. Fit to 2012 length composition in the age & length model is shown bottom right of plot (a).

A



B

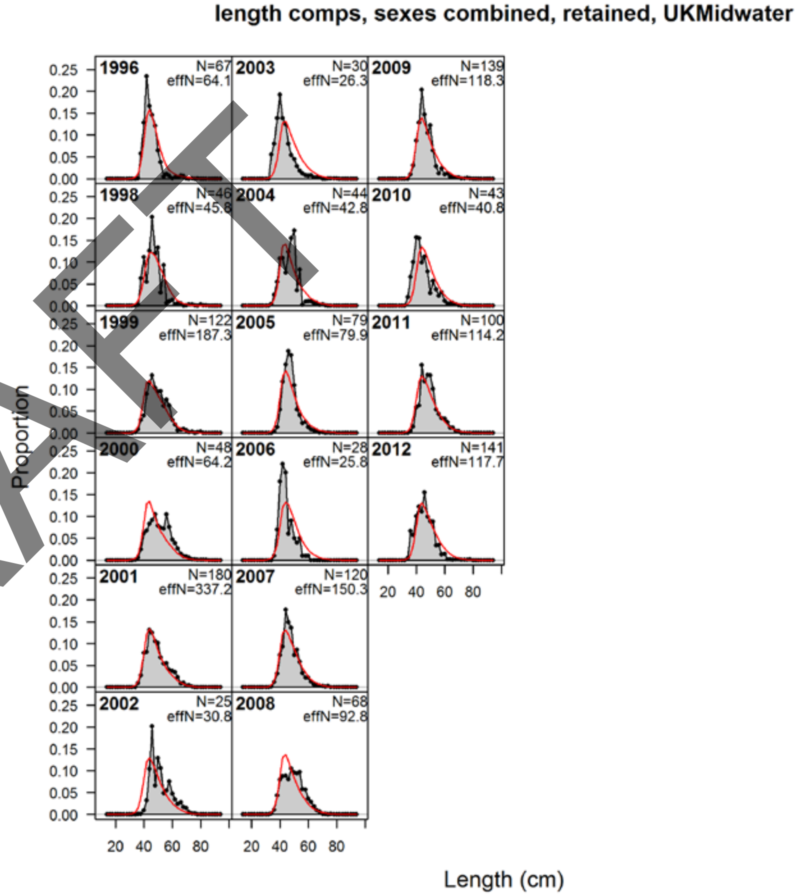
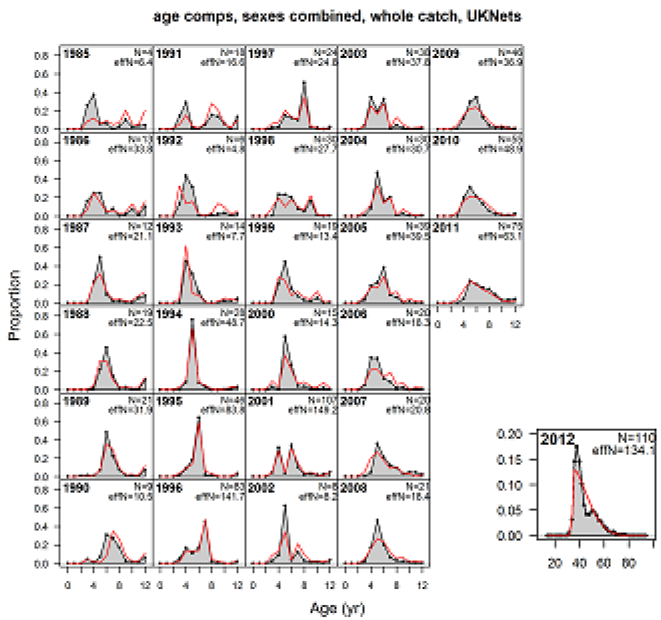


Figure 10.1.17. Bass-47: Observed and SS3-fitted UK midwater (pair) trawl landings compositions. Left: fit of length compositions in the length & age based model; Right: fit of length compositions in the length model.

a)



(b)

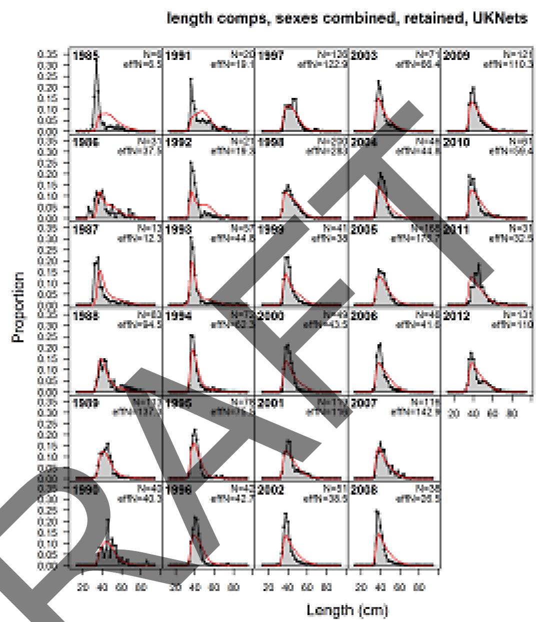
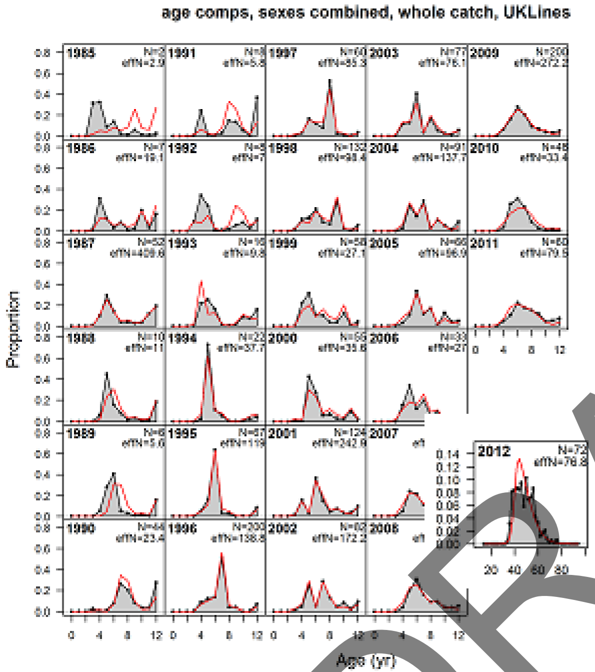


Figure 10.1.18. Bass-47: Observed and SS3-fitted UK fixed/drift net landings compositions. Left: fit of age compositions in the age and length-based model; Right: fit of length compositions in the length model. Fit to 2012 length composition in the age and length model is shown bottom right of plot (a).

a)



(b)

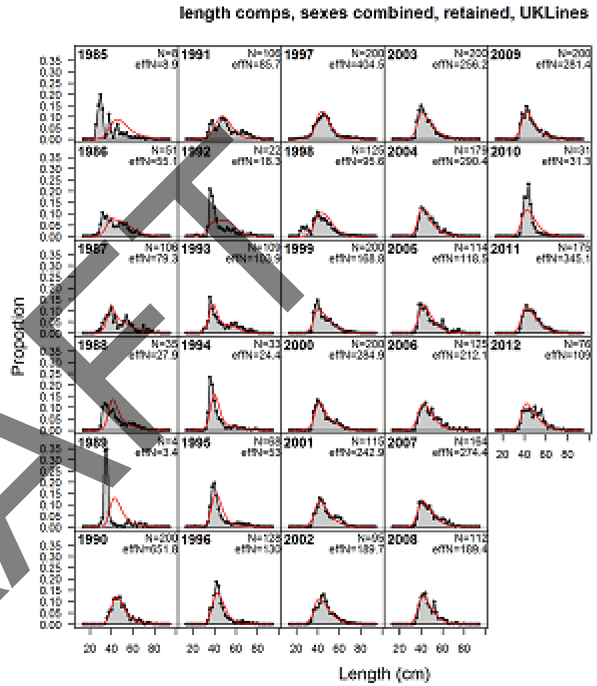


Figure 10.1.19. Bass-47: Observed and SS3-fitted UK lines landings compositions. Left: fit of age compositions in the age & length-based model; Right: fit of length compositions in the length model. Fit to 2012 length composition in the age & length model is shown bottom right of plot (a).

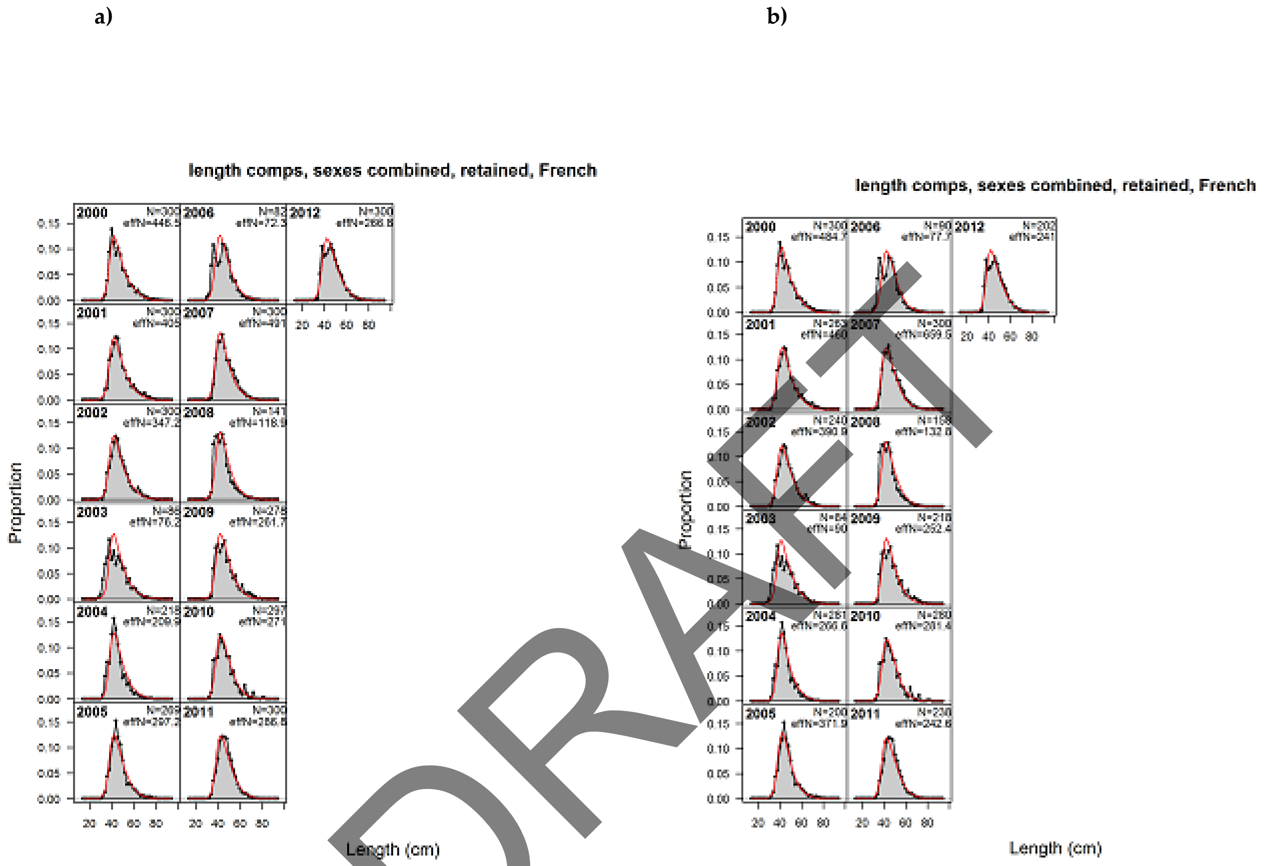
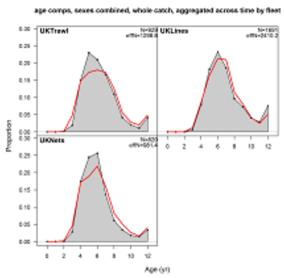
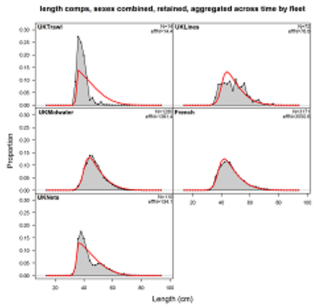


Figure 10.1.20. Bass-47. Observed and SS3-fitted French (combined fleet) landings compositions. Left: fit of length compositions in the age & length-based model; Right: fit of length compositions in the length model.

a) (b)





c)

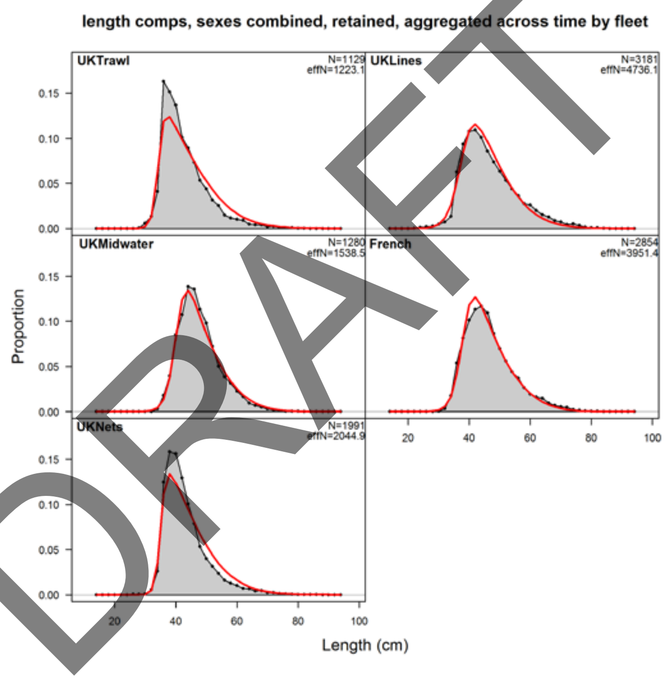
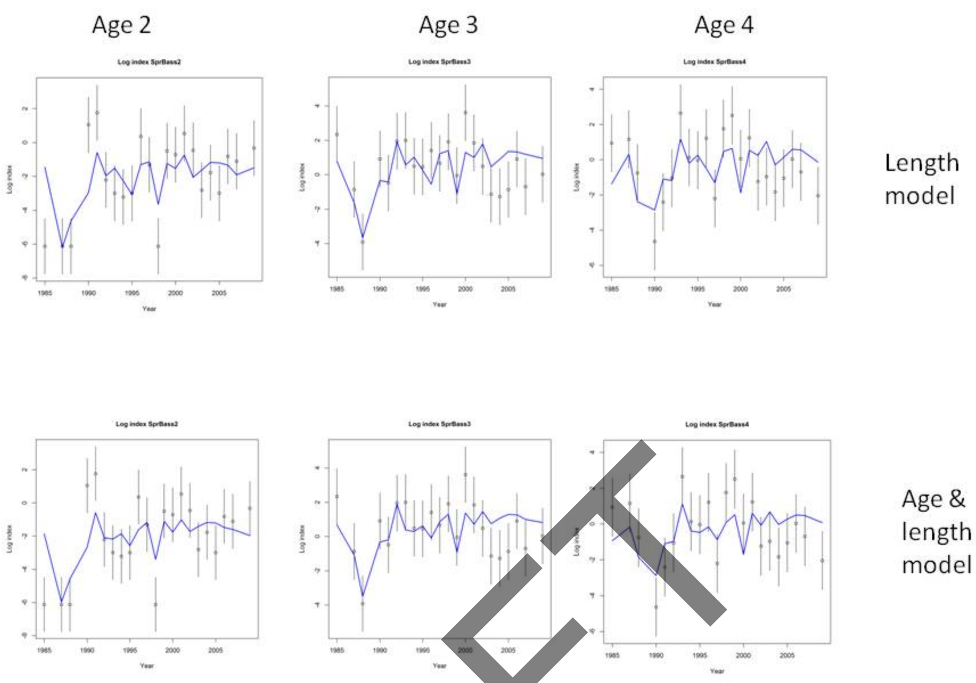


Figure 10.1.21. Bass-47: Observed and SS3-fitted landings compositions, aggregated across time by fleet. (a): fit of age compositions in the age & length-based model; (b): fit of length compositions in the age & length model (UK trawl, nets and lines fleets: 2012 only) (c) fit of length compositions in the length model.

a) Solent Spring survey



b) Solent autumn survey

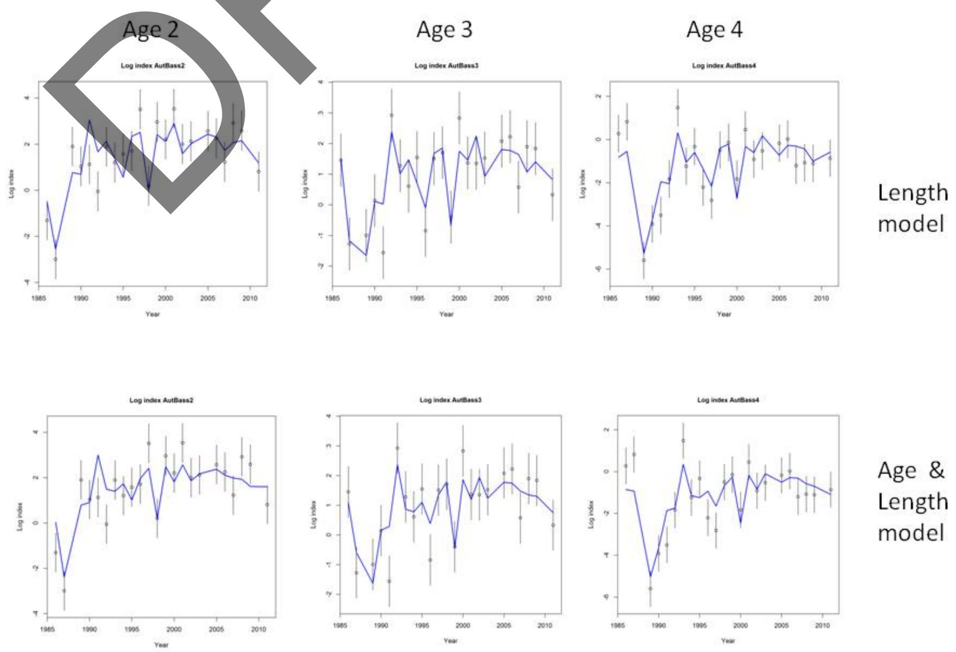


Figure 10.1.22. Bass-47: Observed and SS3-fitted survey indices: (a) Solent spring survey; (b) Solent autumn survey.

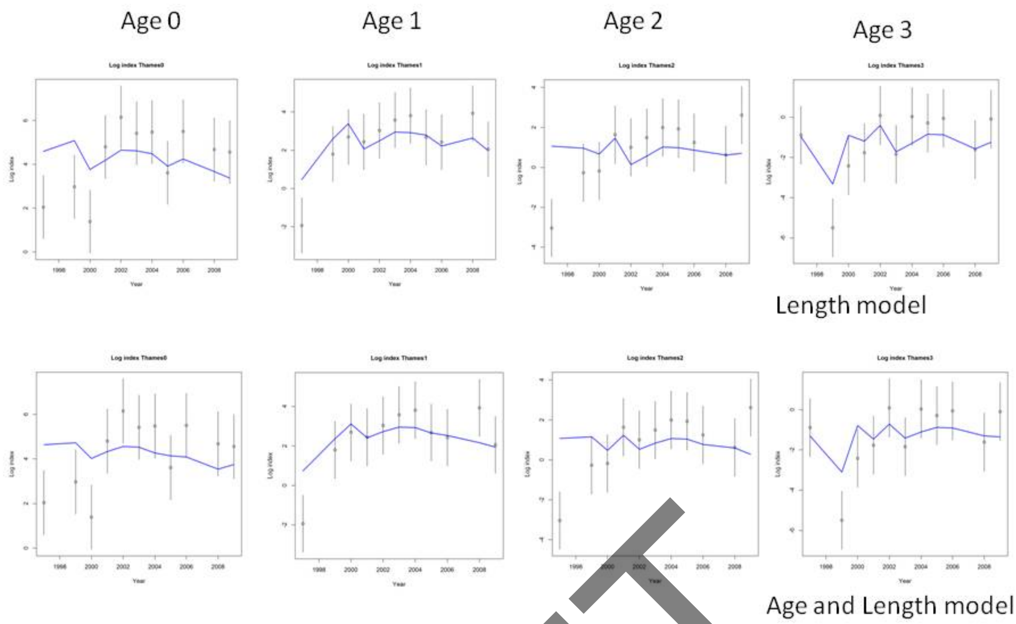


Figure 10.1.23. Bass-47: Observed and SS3-fitted survey indices for Thames survey: top row is from SS3 length based model; bottom row is age & length SS3 model.

Figure 10.1.24. Bass-47: Trends in spawning–stock biomass, mean fishing mortality and recruitment from the baseline length-based and age and length based SS3 model runs with first year for main recruit deviations set to (a) 1975 and (b) 1965. (F's only shown up to 2011).

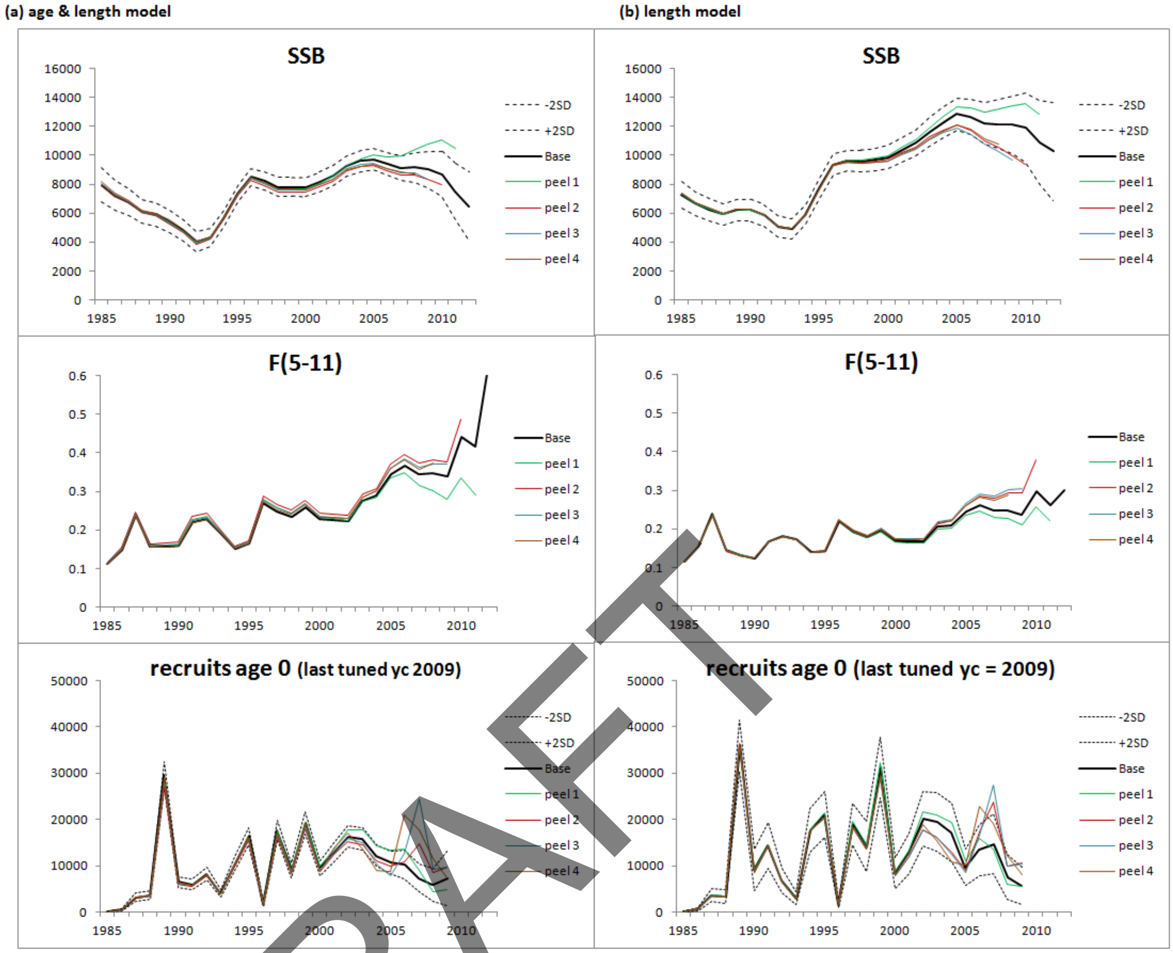
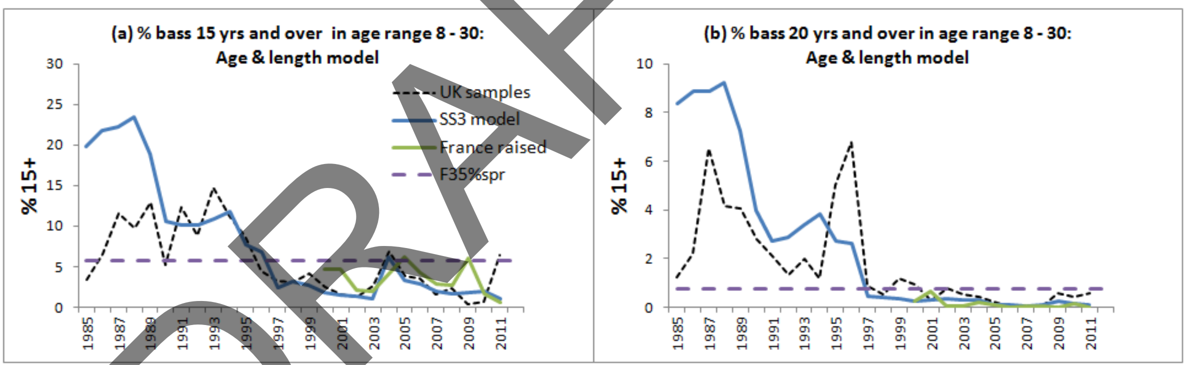


Figure 10.1.25. Bass-47: Retrospective performance of the age & length and length based SS3 models. In each case the full time-series estimates for SSB and recruits are given with +/- 2 SD (dotted lines).

a)

Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Grand Total	15+	20+
	Numbers of bass aged per year and age class																												
1985	196	168	70	124	18	60	177	49	33	30	8	18	6	1	3	8	5	1	1	1	0	0	0	2	0	0	979	28	5
1986	26	256	177	38	104	22	50	176	34	24	34	17	19	10	8	4	6	5	2	0	1	0	1	0	0	0	1014	56	9
1987	57	235	452	138	25	43	12	26	159	42	41	19	27	13	10	19	6	10	9	5	0	1	0	1	1	2	1353	104	29
1988	6	66	385	354	158	37	56	12	25	124	45	43	29	26	22	9	11	10	4	0	0	0	2	1	2	0	1427	116	19
1989	9	31	110	333	294	118	43	60	30	53	227	36	35	59	20	20	9	10	12	4	1	0	1	0	2	0	1517	173	30
1990	260	23	35	128	298	225	73	30	24	16	24	128	9	21	18	15	7	2	14	0	1	0	0	0	0	0	1351	87	17
1991	347	360	32	27	94	318	273	118	16	38	38	19	150	20	23	18	5	13	2	7	0	0	0	0	0	0	1918	238	22
1992	1146	969	711	32	28	73	213	273	86	21	27	15	25	117	8	12	5	7	1	2	2	0	0	0	0	0	3773	179	12
1993	125	1491	923	552	40	30	92	289	270	97	46	56	50	38	130	12	14	12	8	2	1	0	0	0	0	0	4278	267	23
1994	185	346	4254	608	304	32	7	71	203	157	47	28	21	20	15	54	4	4	4	0	0	0	0	0	0	0	6364	122	8
1995	26	101	288	2681	178	113	9	10	18	80	66	37	19	8	9	13	15	7	5	2	2	2	2	1	0	0	3692	85	21
1996	9	269	368	608	2069	150	86	7	15	25	89	66	28	17	13	16	10	16	11	2	2	4	2	0	1	0	3883	122	38
1997	52	139	951	571	477	1817	123	61	14	11	8	72	42	18	10	25	5	2	15	1	1	0	0	0	0	0	4415	119	19
1998	62	444	444	759	287	279	881	82	27	5	7	24	37	25	12	1	1	0	2	4	0	1	0	0	0	0	3384	83	7
1999	18	452	809	352	375	180	205	671	70	62	11	22	19	55	15	7	5	2	4	1	8	1	0	0	0	0	3344	117	16
2000	91	29	1563	1240	351	409	149	190	590	47	21	3	12	9	17	10	6	4	7	1	1	1	0	0	0	0	4751	68	14
2001	141	943	183	1849	674	191	296	139	162	311	32	20	7	8	2	11	5	1	1	0	0	0	1	0	0	0	4977	36	3
2002	261	495	2005	160	767	315	111	178	59	89	242	21	6	2	3	6	3	4	1	1	0	0	2	0	0	0	4731	28	8
2003	58	487	406	1191	94	535	187	80	72	60	52	171	19	5	6	3	5	3	1	1	1	0	0	0	0	0	3437	44	6
2004	23	124	695	364	681	51	201	87	23	34	22	10	60	4	1	0	0	0	0	0	1	1	0	0	0	0	2383	67	2
2005	56	221	288	545	229	262	26	95	25	29	10	3	10	22	0	1	0	0	0	1	0	0	0	0	0	0	1824	34	1
2006	23	190	291	191	235	100	163	20	54	24	8	5	9	2	22	0	2	0	0	0	0	0	0	0	0	0	1339	35	0
2007	7	108	540	454	234	244	114	112	40	49	15	7	5	4	8	2	0	0	0	0	0	0	0	0	0	0	1944	19	0
2008	18	199	876	966	423	171	179	78	64	25	23	12	6	5	1	3	7	0	0	0	0	0	0	0	0	0	3056	22	0
2009	14	230	896	1291	601	152	75	47	34	29	5	6	0	1	0	0	0	2	0	0	0	0	0	0	0	0	3385	3	2
2010	2	212	527	532	444	210	109	31	56	15	8	7	5		3	1	1	0	1	1	0	0	0	0	0	0	2165	12	2
2011	2	75	409	429	410	370	319	110	149	88	56	72	15	26	15	10	6	7	0	0	0	0	0	0	0	0	2568	79	7

b)



c)

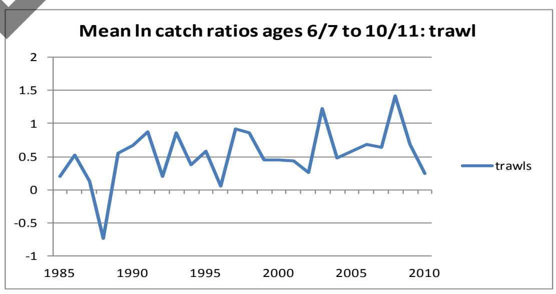
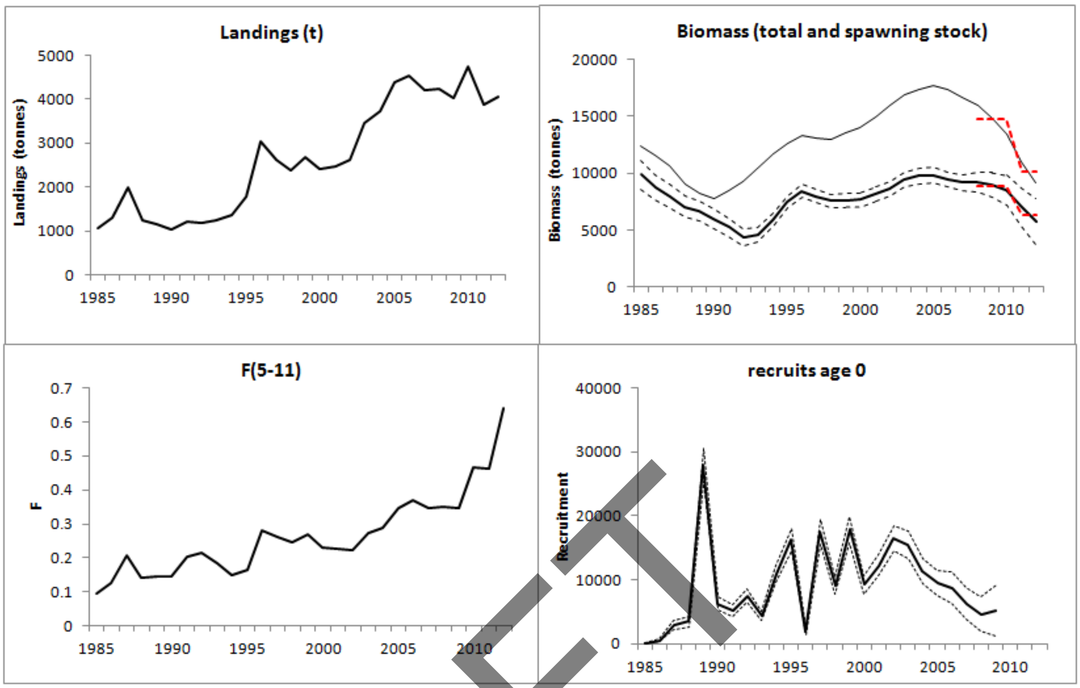


Figure 10.1.26. Bass-47: (a): raw numbers-at-age in the fishery samples collected by Cefas (UK-England) annually since 1985 from Areas IV and VII, for fish of 3 years and older; (b) % contribution of fish aged 15+ and 20+ to total numbers at ages 8 and over in: i) Cefas annual age sample collection (shown in (a)); ii) French raised age compositions for VIIeh 2000–2010 and all areas 2011 and 2012; iii) SS3 model estimates of population numbers from the age&length models (expected % for a stable age distribution at the proposed F_{msy} ref point of F35%spr is shown as dashed lines); (c) trend in mean log catch ratios over age range 6/7 to 10/11, in UK bottom trawl fleet raised age compositions.

a) Age & length model



b) Length only model

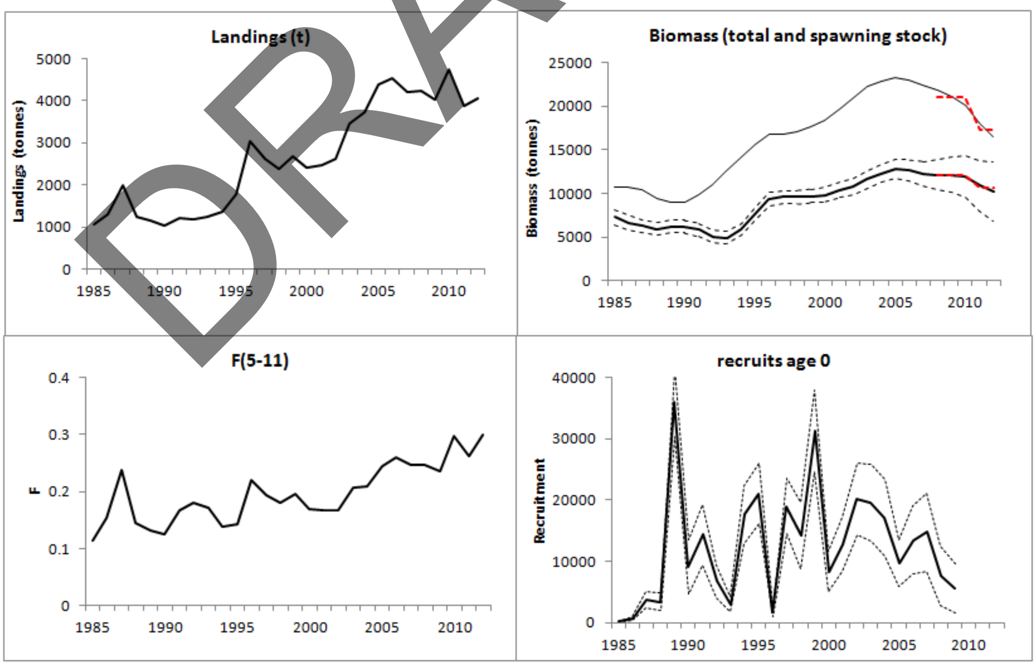
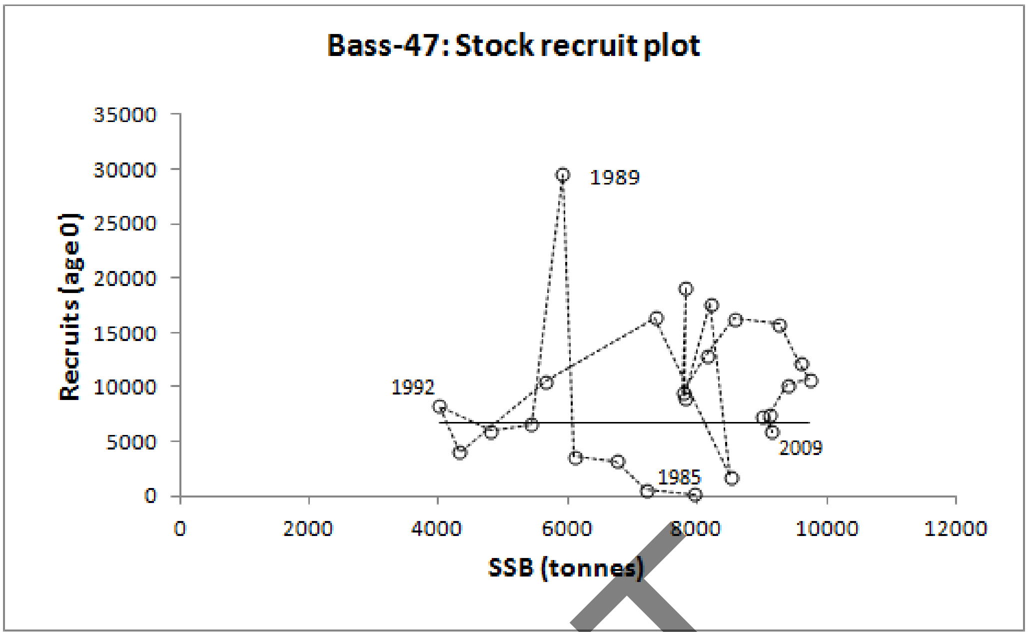


Figure 10.1.27. Bass-47: Stock summary trends for (a) age & length model and (b) length only model. Dashed red lines on SSB and TSB plots for 2008 onwards are mean 2008–2010 and 2011–2012.



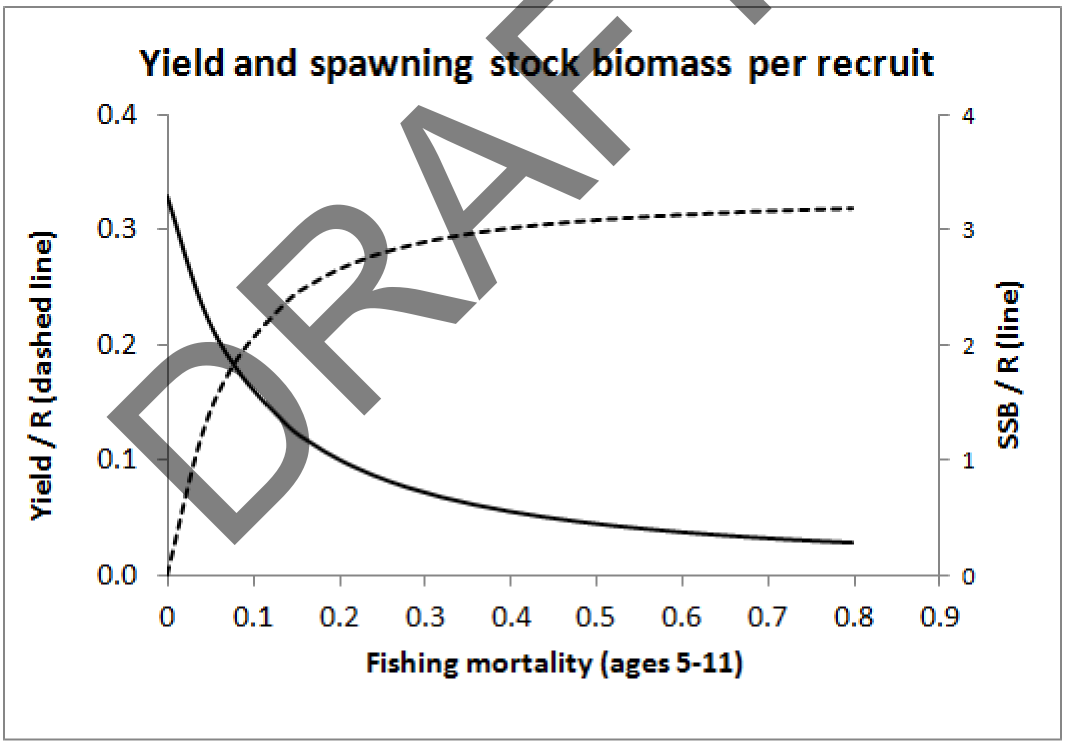


Figure 10.1.28. Bass-47: (Top): stock–recruit scatter from the age & length based SS3 model. Horizontal line is the geometric mean. (Bottom): Yield per recruit (YPR) and spawning–stock biomass per recruit (SPR) derived from the fishing mortality at age and weight-at-age vectors for each fleet in the age & length model.

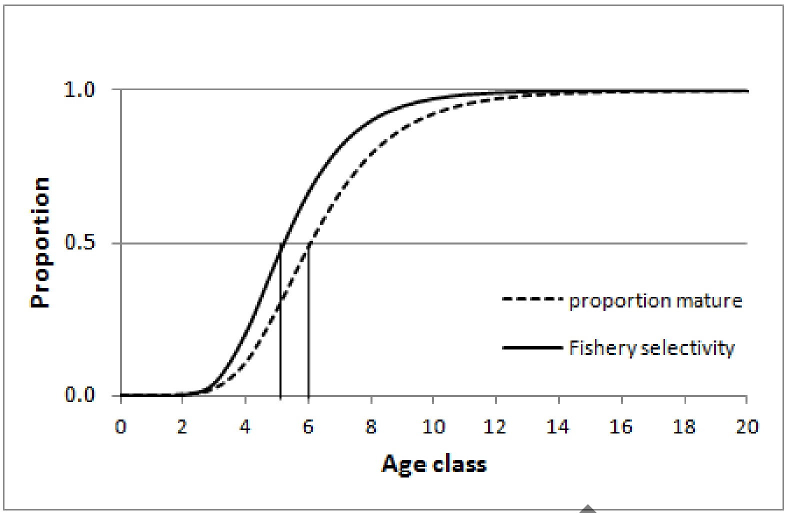


Figure 10.1.29. Bass-47: SS3 estimates of overall fishery selectivity for international landings at age, compared with the SS3 calculations of proportion mature at age based on the length-based maturity parameters.

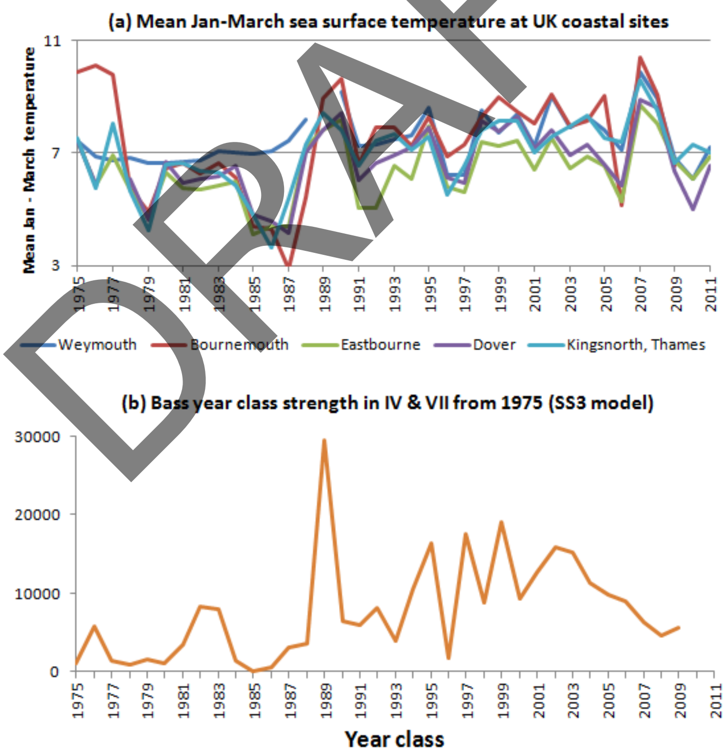


Figure 10.1.30. Bass-47: (a) Mean January–March sea surface temperature estimates for five coastal locations along the south coast of England and the Thames estuary; (b) bass recruitment trends from the update SS3 model including during the 1975–1985 burn-in period. (Temperature data from http://www.cefas.defra.gov.uk/our-science/observing-and-modelling/monitoring-programmes/sea-temperature-and-salinity-trends.aspx).

10.2 European sea bass in Divisions VIa, VIIb and VIIj (West of Scotland and Ireland)

Type of assessment

There is no assessment for this stock component.

ICES advice applicable to 2012 (for combined sea bass stocks in NE Atlantic)

Currently there is no TAC for this species and it is not clear whether there should be one or several management units. There is insufficient information to evaluate the status of the European sea bass in the Northeast Atlantic area. Therefore, based on precautionary considerations, ICES advises that catches should not be allowed to increase in 2012.

ICES reiterates its previous recommendation that implementation of 'input' controls (preferably through technical measures aimed at protecting juvenile fish, in conjunction with entry limitations into the offshore fishery in particular) should be promoted *(ICES, 2004).*

ICES advice applicable to 2013 (for combined sea bass stocks in NE Atlantic)

"ICES advises on the basis of the approach to data-limited stocks that commercial catches should be no more than 6000 tonnes. ICES recommends that implementation of 'input' controls should be promoted. This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations)."

10.2.1 General

Stock description and management units

At IBP-NEW (2012a), it was agreed that sea bass in the North Sea (IVb&c) and in the Irish Sea, Channel and Celtic Sea (VIIa,d,e,f,g&h) would be treated as a functional stock unit as there is no clear basis from fishery data, tagging and genetics studies to subdivide the populations in the Irish Sea, Celtic Sea, Channel and North Sea into independent stock units. It was proposed based on previous ICES bass study group reports to allocate sea bass in VIa, VIIb and VIIj to a separate stock, although it is recognised that sea bass in Irish coastal waters of VIIg and VIIa are likely to be from the same stock as in VIIj. As there are negligible commercial fishery catches of sea bass in Irish coastal waters due to the moratorium on commercial fishing for bass by Irish vessels, the splitting of the stock between VIIg and j is not likely to have any impact on the bass assessment in IVb,c and VII a,d–h. Supporting information can be found in the IBP-NEW (ICES 2012a) report.

Management applicable to 2012 and 2013

Sea bass are not subject to EU TACs and quotas. A moratorium on commercial fishing for sea bass has been in place for Irish vessels fishing in Areas VI and VII since 1990, and a minimum landing size of 40 cm applies to Irish fisheries. The official minimum landing size for non-Irish vessels is 36 cm (EC regulation 850/98). In addition, a variety of national restrictions on commercial sea bass fishing are also in place for non-Irish commercial vessels, including licensing, individual landings limitations, larger MLS and seasonal/ area closures. Recreational fishing for sea bass in Ireland is prohibited from 15 May to 15 June, and a bag limit of two fish per 24 hours is in place.

A landings limit of 5 t/boat/week was previously applied to French and UK trawlers landing sea bass (which is not based on a biological point of reference). In France from 2012, following the implementation of a national licensing system for commercial gears targeting sea bass, the landings limits have slightly changed (depending on season and gear)[1].

Fishery in 2012

Landings data used by the WG are given in Table 10.2.1 and Figure 10.2.1. Due to the Irish sea bass moratorium, landings are reported almost exclusively by other countries, mainly France, for which landings have increased in some recent years, although still very low.

10.2.2 Data

Commercial landings data

Landings data are given in Table 10.2.1 and Figure 10.2.1. No other data for sea bass in this area were provided to WGCSE.

Commercial discards

No estimates of sea bass discards are available.

Recreational catches

Recreational marine fishery surveys in Europe are still at an early stage in development and are described by the ICES Working Group on Recreational Fishery Surveys (ICES 2012b). A survey has been conducted recently in Ireland, but estimates were not submitted to WGCSE. The IBP-NEW meeting report (ICES, 2012a) includes some data supplied by a stakeholder on trends in recreational catch rates from an angling club on the southern Irish coast, as well as age compositions of sea bass caught by anglers, which may be applicable also to trends in VIIj.

Biological data

Data on growth and maturity for this stock component were not reviewed by WGCSE.

Survey data

No survey data were available to WGCSE for this stock.

Other relevant data

None.

10.2.3 Historical stock development

No information is available for this stock area.

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1 http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000026844700&dateTexte=&categorieLien=id

10.2.4 Management plans

There are no existing management plans for European sea bass.

10.2.5 Management considerations

Sea bass grow slowly, do not mature until 4–7 years of age, and have been recorded up to 28 years of age. Juvenile bass up to three years of age occupy nursery areas in estuaries whilst adults undertake seasonal migrations from inshore habitats to offshore spawning sites. It is not known to what extent adults from the stock in VIIb,j and VIa are caught by pelagic trawlers targeting mature sea bass on spawning sites in Divisions VIIe–h. After spawning, sea bass tend to return to the same coastal sites each year. The combination of slow growth, late maturity, spawning aggregation and strong site fidelity, increase the vulnerability of sea bass to over-exploitation and localized depletion.

ICES advice sheets for sea bass in the Northeast Atlantic have previously recommended that "implementation of 'input' controls (preferably through technical measures aimed at protecting juvenile fish, in conjunction with entry limitations into the offshore fishery in particular) should be promoted (ICES, 2004)" and that "Any consideration of catch limitation (output control) would need to take into account that sea bass are a bycatch in mixed fisheries to a various extent, depending on gear and country; this incites discarding and should be avoided". Currently, officially reported landings of sea bass in VIa and VIIb,j are mainly for French fleets. Information is needed on the location and composition of these catches so that the stock affiliation can be better evaluated.

Management of sea bass fisheries needs to take into account the distinctive characteristics and economic value of the different fisheries. Sea bass is of high social and economic value to sea angling in Ireland which contributes substantially to local economies.

The current stock structure assumptions are pragmatic, and need further evaluation. Further studies are needed to determine if the sea bass in Irish coastal waters are indeed functionally separate, or if they also mix with the other stock during spawning time and contribute to commercial catches on the offshore spawning grounds.

As bass is, at present, a non-TAC species, there is potential for displacement of fishing effort by non-Irish fleets from other species with limiting quotas. The effort of the pelagic fisheries during winter and spring can shift between the Bay of Biscay and the English Channel and approaches, and there is evidence for such a shift to the Channel in recent years which is likely to have increased the fishing mortality on sea bass in Area VII.

10.2.6 Data needs

Time-series of relative abundance indices need to be developed throughout the range of the stock, for both the adult and pre-recruit components of the stock.

There is a need to develop a time-series of recreational fishery catch, effort, and catch composition.

Catch locations and composition of significant commercial landings should be monitored to help establish the stock affiliation.

Further studies using tagging, genetics, and other stock and individual markers are needed to more accurately define stock boundaries suitable for assessment and management purposes.

Studies are needed to document the survival of recreationally caught and released sea bass. IBP-NEW (ICES 2012a) noted that studies on striped bass in the USA indicated hooking mortalities of around 20% on average.

10.2.7 References

ICES. 2012a. Report of the Inter-Benchmark Protocol on New Species (Turbot and Sea bass; IBPNew 2012). ICES CM 2012/ACOM:45.

ICES. 2012b. Report of the Working Group on Recreational Fisheries Surveys (WGRFS). ICES CM 2012/ACOM:23. 55 pp.

Table 10.2.1. European sea bass in Divisions VIa, VIIb and VIIj. Official landings by country (tonnes). Source: ICES official catch statistics.

	Belgium	Spain	France	UK	Ireland	Total
1995				+		0
1996						0
1997						0
1998		+				0
1999						0
2000			1			1
2001			4			4
2002		0	4			4
2003			2			2
2004	0	2	6	0		8
2005			4			4
2006			2	0		2
2007			10	0		10
2008		0	10	0		10
2009			6	0	1	7
2010			15			15
2011			47	0		47
2002			<0.5	<1		<1

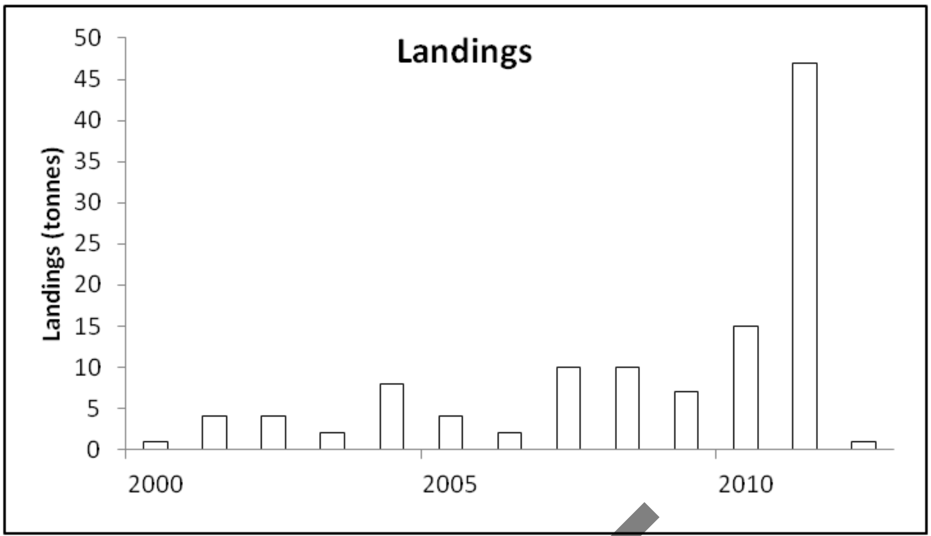

Figure 10.2.1. European sea bass in Divisions VIa, VIIb and VIIj. Official landings by country (tonnes). Source: [ICES official catch statistics](). Figures for 2012 are preliminary.

Annex 1: Participants list

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Annex 3: List of Working Documents presented to WGCSE 2013

WD01: Maturity-at-age estimates for Irish Demersal Stocks in VIa and VIIabgj 2004–2012. Hans Gerritsen. The Marine Institute, Ireland.

WD02: Annual Data File VIIa Cod 2012. Cefas, UK.

WD03: Annual Data File VIIa Plaice 2012. Cefas, UK.

WD04: Annual Data File VIIa Sole 2012. Cefas, UK.

WD05: Annual Data File VIIa Whiting 2012. Cefas, UK.

WD06: Annual Data File VIIe–k Cod 2012. Cefas, UK.

WD07: Annual Data File VIIe–k Cod 2011 final. Cefas, UK.

WD08: Annual Data File Grey Gurnard VI, VIIa–c 2012. Cefas, UK.

WD09: Annual Data File Haddock VIIe–k 2012. Cefas, UK.

WD10: Annual Data File Haddock VIIe–k 2011 final. Cefas, UK.

WD11: Annual Data File Plaice VIIe 2012. Cefas, UK.

WD12: Annual Data File Plaice VIIe 2011 final. Cefas, UK.

WD13: Annual Data File Plaice VIIf&g 2012. Cefas, UK.

WD14: Annual Data File Plaice VIIh–k 2012. Cefas, UK.

WD15: Annual Data File Pollack VIIe–k 2012. Cefas, UK.

WD16: Annual Data File Pollack VIIe–k 2011 final. Cefas, UK.

WD17: Annual Data File Sole VIIe 2012. Cefas, UK.

WD18: Annual Data File Sole VIIf&g 2012. Cefas, UK.

WD19: Annual Data File Sole VIIh–k 2012. Cefas, UK.

WD20: Annual Data File Whiting VIIe–k 2012. Cefas, UK.

WD21: Annual Data File Whiting VIIe–k 2011 final. Cefas, UK.

WD22: Aran, Galway Bay and Slyne Head *Nephrops* Grounds (FU17) 2012 UWTV Survey Report and catch options for 2013. Colm Lordan, Jennifer Doyle, Imelda Hehir, Dermot Fee, Chris Allsop and Ross O'Neill. The Marine Institute, Ireland.

WD23: Porcupine Bank *Nephrops* Grounds (FU16) 2012 UWTV Survey Report and catch options for 2013. Colm Lordan, Jennifer Doyle, Helen Dobby*, Imelda Heir, Dermot Fee, Chris Allsop and Ross O'Neil. The Marine Institute, Ireland.

WD24: The "Smalls" *Nephrops* Grounds (FU22) 2012 UWTV Survey Report and catch options for 2013. Jennifer Doyle, Colm Lordan, Imelda Hehir, Dermot Fee, Sean O'Connor, Patricia Browne and Joanne Casserly. The Marine Institute, Ireland.

WD25: Results of Russian Research and Fishery of Demersal Fish on the Rockall Bank in 2012. Vladimir Khlivnoy. The Polar Research Institute of Marine Fisheries and Oceanography (PINRO), Russia.

WK26: Programme 24: Western Channel Sole and Plaice. Robert Bush, Joana F. Silva and Rob Phillips. Cefas, UK.

Annex 4: Stock Audits

Template for audit of assessments made by EG member.

Audit of (Stock name) Cod 7e-k

Date: 6/6/2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type: U**pdate with benchmark modifications
2) **Assessment**: Full Analytical – Benchmarked WKROUND2012
3) **Forecast**: presented
4) **Assessment model**: XSA
5) **Data issues:** i) New combined survey index has been available used since 2012 benchmark; ii) Discard/highgrading is significant and French self sampling program is mentioned in the report not to reflect the general perception of highgrading in all fleets in 2011 and no 2012 data available at time of working group.
6) **Consistency**: Assessment consistent with last year
7) **Stock status**: SSS > B_{lim}, B_{pa} & MSY_{btrig} and approaching time series max. Mean F and recruitment are around the time series minimum. The stock is heavily recruit dependent.
8) **Man. Plan.**: No management plan.

General comments

This was a well written and comprehensive report. Some of the table references in particular consist of multiple tables under a single table number without individual labels like a,b,c,d etc. This makes it difficult to refer to specific tables or results should that be required.

Technical comments

A lot of trends are well presented and the final assessment, but not much in terms of XSA fit, cohort tracking, catch curves, weighting in the assessment just to see what data is contributing to what and how well. Particularly the survey data, the xsa residuals is really the only quality plot presented.

The assessment is heavily influenced by discard patterns so it's a pity the French self sampling data was not available this year as it had been highlighted previously to give a different picture of highgrading/discarding than the general perception across fleets from the DCF discard sampling program.

Conclusions

The assessment has been performed correctly

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? Yes
- Is the assessment according to the stock annex description? Yes
- Is general ecosystem information provided and is it used in the individual stock sections. Yes
- If a management plan has been agreed, has the plan been evaluated? NA

For update assessments

- Have the data been used as specified in the stock annex? Yes
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex? Yes
- Is there any **major** reason to deviate from the standard procedure for this stock? No
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? Yes

Audit of Cod in Divisions VIb (Rockall)

Date 23 May 2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type:** None
2) **Assessment**: None
3) **Forecast**: None
4) **Assessment model**: None
5) **Data issues**: Data available are as per stock annex.
6) **Consistency**: NA
7) **Stock status**: NA
8) **Man. Plan.**: NA

General comments

The assessment report was brief, to the point and reflected the stock annex.

Technical comments

None

Conclusions

The assessment has been performed to the extent possible for this category of stock.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice?

  Yes

- Is the assessment according to the stock annex description?

  Yes

- Is general ecosystem information provided and is it used in the individual stock sections.

  Some information in the Annex, but no assessment.

- If a management plan has been agreed, has the plan been evaluated?

  No management plan in place

For update assessments

- Have the data been used as specified in the stock annex?

  Yes

- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

  Yes

- Is there any **major** reason to deviate from the standard procedure for this stock?

  N/.A

- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

  Yes

Audit of Haddock in Divisions VIIb, c, e–k

Date 23 May 2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type: U**pdate
2) **Assessment**: Analytical
3) **Forecast**: A short term forecast was presented

4) **Assessment model**: ASAP (XSA in parallel for QC only) – tuning by 1 comm (IR-GAD index) + 1 survey (Fr-Irl-IBTS index)

5) **Data issues**: None – data available as expected.

6) **Consistency**: 2013 assessment consistent with 2012 with little changes to the SSB, R and F trends

7) **Stock status**: B > BTrigger for a at least 3 years (2011-13) but is falling, while, F > FMSY for at least 3 years (2010-12) and is rising. Recruitment low in recent years.

8) **Man. Plan.**: No management plan in place.

General comments

The assessment report was well written, fully documented and ordered and the assessment followed the methods detailed in the stock annex.

Technical comments

One table (Table 7.4.3c) was not referenced in the report text as was one figure (Figure 7.4.5).

There were a number of references to the Benchmark workshop within the report text and a number of these references refer to this incorrectly.

These another minor editorial suggestions were made in the report (WGCSE 2013 sharepoint) to report section 7.4 – had 7b,c,e-k using 'track changes' allowing the stock assessor to review.

Conclusions

The assessment has been performed correctly.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice?

  Yes

- Is the assessment according to the stock annex description?

  Yes

- Is general ecosystem information provided and is it used in the individual stock sections.

  Not within this report, but is detailed in the stock annex.

- If a management plan has been agreed, has the plan been evaluated?

  No management plan in place

For update assessments

- Have the data been used as specified in the stock annex?

  Yes

- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

  Yes

- Is there any **major** reason to deviate from the standard procedure for this stock?

  N/.A

- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

  Yes

Audit of Haddock in VIa (West of Scotland)

Date 03/06/2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

For single stock summary sheet advice:

1) **Assessment type:** update
2) **Assessment**: analytical
3) **Forecast**: presented. In a change from last year, the 2012 low discard ratio was used in the forecast rather than the mean of the last three years. It is assumed that the increase in quota availability and the 2009 strong year class moving into the fishery, will result in less discards. Furthermore, the catch and stock weights for all ages were calculated as the mean of 2010-2012, whereas last year, the weights for age 3-plusgroup were based on linear model projections and for age 1 and 2 on a 3 year average. The recruitment for 2012-2014 was calculated as a geometric mean for the last eight years (2004-2011), instead of a geometric mean for the last six years as used in last year's forecast.
4) **Assessment model**: TSA - tuning by 2 surveys (ScoGFS-WIBTS-Q1 up to 2010 and ScoGFS-WIBTS-Q4 up to 2009) - no commercial indices
5) **Data issues:** The data were available as described in the stock annex. The TSA model uses catch data from 1978 to 1994 and from 2006 to 2012. In 2010 the catch-at-age data from 2006 onwards were re-introduced to the assessment, based on evidence from the improved accuracy of landings statistics. In the last year, the weights-at-age in landings and by extension in the catch and the stock, have increased considerably for the majority of the ages. The mean weight for age 2 is the highest in the time series.
6) **Consistency**: Last year's assessment was accepted. Results from this year's assessment were consistent with those from last year.
7) **Stock status**: In 2005, SSB dropped below Bpa/MSY $B_{trigger}$ and continued to decline in the following years to below B_{lim}. In 2012, SSB has again increased to above MSY $B_{trigger}$. Since 1987, F has been well above F_{pa}. In 2000 F continued to decline and is now below B_{lim}. R is fluctuating without trend. The 2009 year class is above the average in the recent period, but is below the long-term average.
8) **Man. Plan.:** An agreed long-term management plan, which takes into account the recruitment characteristics of this stock, has been evaluated by ICES in 2010 and is waiting to be signed off.

General comments

The document was well structured, although some paragraphs need rephrasing.

Technical comments

The assessment was carried out according to the stock annex. Editorial changes have been made in the report (using track changes).

- The text in the stock annex needs to be updated with respect to section B.3 Surveys (range of the data), section C. Historical stock development (summary of data ranges used in recent assessments), section D Short-term projection (weight-at-age in the stock),...
- Section 3.3.3 Historical stock development-Comparison with previous year's assessment. Some values of F and R have been adjusted. Would it be possible for the stock coordinator to confirm these adjustments.
- The inclusion of a table showing the output of the forecast would increase the readability of the report.
- Section 3.3.3 Historical stock development-State of the stock. Estimate of SSB in 2013 refers to the forecast and therefore it might be better to include this in the next section (3.3.4).
- Section 3.3.4 Short-term projections, refers to annex 5 containing information about the corrected forecast results of last year's assessment. Please delete this reference if it is not longer necessary.
- Table 3.3.1 In order to have an idea on the evaluation of the TAC, it would be nice to include the TAC in this table.
- Table 3.3.8, the IGFS data are not used in the assessment and should not be boxed. Please be aware that the table is not fully depicted.
- Table 3.3.9. Please be aware that the table is not fully depicted.
- Figure 3.34. Please be aware that the figure is not fully depicted.
- Advice sheet:
    - advice for 2014 needs updating (catch refers to 2013 instead of 2014).
    - outlook table: Basis: Fsq=F(09-11) should be Fsq=F(10-12), SSB (2013)=34853 should be SSB(2014)=33854.
    - The values shown under the rationale "Precautionary approach" are referring to the MSY transition instead of Bpa. As the SSB 2015 > Bpa, maybe this option can be deleted.

Conclusions

The update assessment has been performed correctly and gives a valid basis for advice.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? **YES**

- Is the assessment according to the stock annex description? **YES**
- Is general ecosystem information provided and is it used in the individual stock sections.

9) If a management plan has been agreed, has the plan been evaluated**? An agreed long-term management plan, which takes into account the recruitment characteristics of this stock, has been evaluated by ICES in 2010 and is waiting to be signed off.**

- **For update assessments**
- Have the data been used as specified in the stock annex? **YES**
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex? **YES**
- Is there any **major** reason to deviate from the standard procedure for this stock?**NO**
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? **Yes also this stock is to be benchmarked in 2014 so this will address issues of uncertainty and bias in the assessment and forecast.**

Audit of Megrim in VIb (Rockall)

Date 05 June 2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type: U**pdate
2) **Assessment**: There is no accepted analytical assessment. The assessment is based on survey trends in relative biomass
3) **Forecast**: There is no accepted analytical assessment and forecast
4) **Assessment model**: The assessment is based on survey trends in relative biomass from the ISP-Anglerfish survey conducted annually in VIa, IVa and VIb.
5) **Data issues:** There is no age data.
6) **Consistency**: This year same as 2012 assessment is based on survey trends in relative biomass. In 2011 was observed decrease in megrim biomass in VIb from anglerfish (SAMISSQ2) survey. In 2012 the biomass increases considerable.
7) **Stock status**: The state of the stock is unknown.
8) **Man. Plan.**: There is TAC in VI

General comments

The assessment report and advice was well written, fully documented and ordered.

Technical comments

In section 5.3.2. “Type of assessment in 2011” need change year from 2011 to 2012.

In section 5.3.2.7 presented text from last year report: “Age data will be gathered during the surveys from 2012 onwards”.

It necessary updates Figure 5.3.14, Figure 5.3.15 and Figure 5.3.16

Conclusions

The assessment has been performed correctly. It is based on survey trends in relative biomass. In 2012 the biomass increases considerable. There are big differences in reliability level of the estimate of biomass survey 2012 and it indicating a high level of uncertainty of assessment.

Recommendation for benchmark

Due to lack of age data specific to megrim in VIb, it was not possible to undertake any exploratory age based assessments. Age data must be gathered during the surveys. Intercessional work on a Bayesian state-space surplus production model is continuing.

Audit of : WGCSE Section 3.5: Nephrops in Division FU11 (North Minch)

Date: 23/05/2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type:** Update with 2012 UWTV survey and commercial catch data (benchmarked at WK*NEPH* 2013).
2) **Assessment**: Analytical - survey-based abundance assessment.
3) **Forecast**:A short-term projection was completed to produce a catch-option table for 2014 and is presented but will be updated after the results of 2013 UWTV survey in the summer.
4) **Assessment model**: Underwater television (UWTV).
5) **Data issues:** None.
6) **Consistency:**

Main approach similar to last year except stock benchmarked in 2013 and issues addressed:

- Area recalculated to include latest VMS information.
- Field of View also recalculated.

- Sea loch areas estimated but not used in UWTV abundance estimates as deemed low.
- Creel and trawl fishery length compositions used in methodology.
- Complete range of the per-recruit F_{MSY} proxies were recalculated .
- Confidence intervals within SGNEP 2012 recommendation <20%.

7) **Stock status**:

  - 2012 Abundance estimate (891 million bias adjusted) is 48% decrease from that in 2011 and similar to that levels observed in 2007/2008.
  - Abundance estimate is above $B_{TRIGGER}$ (541 million individuals – bias adjusted lowest observed corrected for VMS area increase).
  - Lpue trend has increased in recent years (2011&2012).
  - Mean size trend is also stable – no sign of decreased recruitment.
  - The calculated harvest ratio in 2012 = 17.9% (dead removals/TV abundance) is second highest in time-series and is above the F_{MSY} proxy ($F_{35\%}$=10.9%).

8) **Man. Plan.**

- No management plan exists for this stock.
- ICES suggests management at the FU level rather than the division level and that the MSY proxies should be used for the basis of management ad-vice.
- The total VIa 2013TAC= 16,690 t.
- In 2012 nominal landings from this FU were 3,388 t and the suggested landings for 2012 were 3,200 t.
- In 2013 the suggested landings were 3,200 t.
- Using the MSY proxy suggests landings of 2,215 t in 2014.
- Discarding of bycatch species remains a concern in the *Nephrops* fishery (mostly haddock and whiting), and technical measures may be needed to limit future discards.

General comments

- Well written and easy to follow.
- WKNEPH 2013 report was not available to check if stock annex and methodology in report is the same.
- Inputs and management option table to be updated with 2013 UWTV survey estimate when it becomes available late in summer to provide up to date advice in October.

Technical comments

- Figure 3.5.9. - 2012 Figure to be inserted
- WKNEPH 2013 report was not available to check if stock annex and methodology in report is the same.
- Inputs and management option table to be updated with 2013 UWTV survey estimate when it becomes available late in summer to provide up to date advice.
- Minor editorial suggestions were made in the report (WGCSE sharepoint, report section nep-11) using track changes for the stock coordinator to review.

Conclusions

Catch limits based on the ICES MSY framework seem suitable for management.

This stock was benchmarked in 2013.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? **YES**

- Is the assessment according to the stock annex description? **YES**
- Is general ecosystem information provided and is it used in the individual stock sections. **YES**
- If a management plan has been agreed, has the plan been evaluated? **There is no specific management plan for the FU11 stock.**

For update assessments

- Have the data been used as specified in the stock annex? **Yes**
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?**Yes**
- Is there any **major** reason to deviate from the standard procedure for this stock?**No**
- Does the update assessment give a valid basis for advice? **Yes**.If not, suggested what other basis should be sought for the advice? **The advice for all *Nephrops* stocks in Subarea VII and Division VIa will be updated in October to include the 2013 UWTV survey results.**

Audit of WGCSE Section 6.4: Nephrops in Division FU14 - Irish Sea East

Date: 24/05/2012

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type: Update with 2012 UWTV survey and commercial catch data (benchmarked at WK*NEPH* 2009).**
2) **Assessment**: Analytical - survey-based abundance assessment.
3) **Forecast**: A short-term projection was completed to produce a catch-option table for 2014 and is presented but will be updated after the results of 2013 UWTV survey in the summer.
4) **Assessment model**: Underwater television (UWTV).
5) **Data issues**: Sampling of catches and discards in 2010-2012 poor due to administrative problems so metrics for these years not updated.
6) **Consistency**: 2013 approach is same as that in 2012 and according to Annex..
7) **Stock status:**
    - 2012 Abundance estimate (652.7 millions bias adjusted), 51% increase with the 2011 abundance (431 millions).
    - No $B_{TRIGGER}$ reference for this stock – due to short time series.
    - 2012 Harvest ratio = 3.9%, below F_{MSY} proxy ($F_{0.1}$=9.8%).

- Lpue trends tend to indicate increasing catch rates, but insufficient sampling has not allowed all of the datasets to be updated in recent years.

8) **Man. Plan.**:

- No management plan exists for this stock.
- ICES suggests management at the FU level rather than the division level and that the MSY proxies should be used for the basis of management advice.
- The total VII 2013TAC= 23 065 t.
- In 2012 nominal landings from this FU were 530 t and the suggested landings for 2012 were 960 t.
- In 2013 the suggested landings were 881 t.
- Using the MSY proxy suggests landings of 1,333t in 2014.
- Insufficient sampling has not allowed all of the datasets to be updated in recent years and this has effect on the inputs to catch option table.

General comments

- Easy to read and follow.
- Forecast Inputs and catch option table to be updated with 2013 UWTV survey estimate when it becomes available late in summer to provide up to date advice in October.

Technical comments

- Some text needs updating for 2012 in relation to the fishery.
- Minor editorial suggestions were made in the report (WGCSE sharepoint, report section nep-11) using track changes for the stock coordinator to review.

Conclusions

Catch limits based on the ICES MSY framework seem suitable for management.

- However, the increase in TV abundance leading to catch advice in 2014 for 1,333t seems quite an increase given the series high in landings from available data presented = 959 t in 2007. Although landings statistics prior to 2006 may be unreliable.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? **YES**
- Is the assessment according to the stock annex description? **YES**
- Is general ecosystem information provided and is it used in the individual stock sections. **YES**
- If a management plan has been agreed, has the plan been evaluated?**n/a**

For update assessments

- Have the data been used as specified in the stock annex? **YES**
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex? **YES**
- Is there any **major** reason to deviate from the standard procedure for this stock?**NO**
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? **Yes and furthermore the forecast inputs and**

catch option table to be updated with 2013 UWTV survey estimate when it becomes available late in summer to provide up to date advice in October.

Audit of NEP 22 (WGCSE section 7.7 – *Nephrops* in Division VIIfg (Smalls Grounds, FU 22)

Date: 23/05/2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type:** Update with 2012 estimates of catch and survey indices.
2) **Assessment**: Analytical (essentially a survey-based abundance assessment).
3) **Forecast**: A short-term forecast for 2014 was presented however this will be updated in October 2013.
4) **Assessment model**: Underwater television (UWTV).
5) **Consistency**:
    a. Historically FU20-22 combined several spatially distinct mud patches. Following the recommendation by WGCSE 2012, FU20–22 was split into FU20–21 and FU22 for the purposes of assessment and advice provision.
    b. This stock has not been formally benchmarked by ICES although the approach used has followed the protocols outlined for other *Nephrops* FUs by WKNEPH 2009 / WKNEPH 2013.
    c. The stock annex for FU 22 was being updated at the time of the WGCSE to accommodate the split with FU21-21.
6) **Stock status**:

The 2012 burrow abundance estimate increased by about 19% in relation to 2011 and is similar to that observed at the start of the series. The F_{2012} (taken as the mean $F_{2010–2012}$) for FU22 is 9.5% and is estimated to be below the $F_{msy\ proxy}$ (10.9%) proposed by ICES for this FU.

7) **Man. Plan.**:
    a. There is no specific management plan for the FU22 stock.
    b. Following the recommendation by WGCSE 2013, FU20–22 was split into FU20–21 and FU22 for the purposes of assessment and advice provision.
    c. The Division VII TAC is 23 065 t for 2013.

d. In 2012 2633 t were landed in FU22 area, which is an increase of 63% from 2011.

e. The suggested landings for 2013 in FU22 are 3100 t.

f. The short-term forecast based on MSY proxies suggests landings for 2014 of 3178 t in FU22. This value will however be updated in October after the latest results from the 2013 UWTV survey become available.

8) **General comments**

The assessment report and advice was well written, fully documented and ordered.

A short-term forecast for 2014 was presented however this will be updated in October 2013.

The bias estimates from the UWTV survey are largely based on expert opinion without precision estimates of the bias. The method to derive landings for the catch options is sensitive to the input estimates of discard rate and mean weight in landings, both with unknown levels of uncertainty. The WGCSE suggests that precision estimates are need for the forecast inputs.

Technical comments

In section 7.7.1., the ICES rectangles covered by FU 22 are incorrect. 31-32E2 should be replaced by 31-32E3.

In section 7.7.4., a mention is made to table 7.7.11 which is not included in the report for FU 22. If this table is in another section (e.g. FU 20-21) this should be stated.

In section 7.7.11 (References) some bibliographic references are listed that are not included in the text.

These and other minor editorial suggestions were made in the report (WGCSE sharepoint, report section nep-22) using track changes for the stock coordinator to review.

Conclusions

The UWTV method used to assess FU22 appears to be appropriate as the basis of management advice. Catch limits based on the ICES MSY framework seem suitable for management. The WGCSE recommends this stock to be benchmarked in 2014.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice?

YES

- Is the assessment according to the stock annex description?

YES

- Is general ecosystem information provided and is it used in the individual stock sections.

YES

- If a management plan has been agreed, has the plan been evaluated?

There is no specific management plan for the FU22 stock.

For update assessments

- Have the data been used as specified in the stock annex?

YES. But stock annex is still on the process of being updated

- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

YES

- Is there any **major** reason to deviate from the standard procedure for this stock?

NO

- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

YES but the advice for all *Nephrops* stock in Subarea VII and Division VIa is going to be updated in October to include the 2013 UWTV survey results.

Audit of nep-17

Date: 27/5/2013

For single stock summary sheet advice:

1) **Assessment type:** Update. Benchmarked at WKNEPH 2009.
2) **Assessment**: Analytical. UWTV survey abundance assessment.
3) **Forecast**: Presented. Outlook table based on 2012 survey & commercial data given in WG report & draft advice sheet. This will be revised following the 2013 summer surveys.
4) **Assessment model**: UWTV survey assessment plus consideration of trends in size composition, sex-ratio and commercial lpue.
5) **Data issues:** Data were available as specified in the stock annex. With the exception of a period of industry non-cooperation, sampling levels appear to have been adequate in recent years.
6) **Consistency**: The assessment was accepted last year. Advice was updated in Nov 2012 on the basis of the summer UWTV survey. The only change to the Nov 2012 results/outlook in this assessment is due to the additional 2012 commercial data.

   The assessment & outlook has been conducted according to the stock annex.

7) **Stock status**: This stock is characterised by substantial inter-annual fluctuations in landings (potentially due to the itinerant nature of much of the fleet) and large variations in UWTV survey abundance. This has resulted in substantial fluctuations in estimated harvest rate.

   The stock is currently harvested at 19.2 % which is well above Fmsy (10.5 %). The abundance in 2012 is 34 % lower than the 2011 value and is at the lowest observed value (no MSY Btrigger has been agreed for this stock).

   Other indicators appear at odds with the declining trend in abundance presenting a picture which is rather difficult to explain:

- There is an increase in commercial LPUE (could potentially be explained by increase in vessels towing quad rigs)
- No increase in mean size in commercial sampling to suggest declining recruitment (mean size has declined since 2008-2010)

There are no PA or limit reference points for this stock.

8) **Man. Plan.**:

a. There is no specific management plan for the FU17 stock.

- The Division VII TAC is 23 065 t for 2013 (an increase of 6 % on 2012)
- In 2012 1135 t were landed from the FU17 stock, which is an increase of ~ 90% from 2011.
- The advice for 2013 (updated in Nov 2012) was 590 t. To protect the stock in this functional unit, management should be implemented at the functional unit level.
- The preliminary advice for 2014 based on the MSY approach is for landings of 605 t in FU17 (minor updates to Nov 2012 advice due to additional commercial data). This value is based on the 2012 survey data and will be updated in October after the latest results from the 2013 UWTV survey become available.

General comments

The report is ordered, generally well written and easy to follow.

The ToR for an 'update' advice stock have largely been addressed. However:

- Intercatch was used 'only for landings data' for this stock. It is not clear why it was not fully used.

The assessment and forecast appear to have been performed according to the stock annex in terms of both input data and model settings. However, the MSY reference points do not appear in the stock annex – it is assumed that these are correct as they are the same as in last year's WG report.

The assessment results and forecast inputs are consistent across tables and the description in the text.

No advice will be published for this stock until the results of the summer surveys are available. Advice expected to be released in Nov 2013.

Technical comments

There were no major errors found in the report, tables or figures. Minor editorial changes have been made in the report (using track changes). Some additional points to note:

- 1st paragraph – not clear what 'This year long-term reference points have been examined for this stock' refers to. There does not seem to be any new examination of reference points this year.
- Table 7.5.5 does not appear to have landings mean sizes for 2001 onwards yet length frequency of the landings appear in Figure 7.5.3.

- Figure 7.5.5 – please make the labeling a bit bigger.
- Section 7.5.6 states that there is no Btrigger given the short time series of survey data. The time series is probably long enough now that a Btrigger could be proposed.
- Section 7.5.10 2nd paragraph – mentions 2011 effort being lowest in time series – the 2012 effort showed a substantial increase.
- Table 7.5.8 – legend refers to shading of years with no sampling – only shading appears to be 2010-2012.

Conclusions

The assessment has been performed correctly and appears to be an adequate basis for management advice. Given the divergent signals in survey & commercial data and limited biological knowledge of this stock, it is appropriate that this is based on a relatively conservative F_{MSY} proxy ($F_{35\%}$ = 10.5 %)

There are a number of issues for this stock requiring further work which the WG recommends should be addressed through the inter-benchmark process:

- Derivation of an MSY Btrigger
- Further investigation of biological & other parameters used as input in derivation of per-recruit analysis (currently from neighbouring stock).
- Potential integration of additional Nephrops grounds in Galway Bay & Slyne Head into the estimate of total abundance

Audit of nep-19

Date: 28/5/2013

For single stock summary sheet advice:

1) **Assessment type:** Update. The stock has not been benchmarked although it follows the UWTV survey protocol benchmarked at WKNEPH 2009.
2) **Assessment**: Analytical. UWTV survey abundance assessment.
3) **Forecast**: Presented. Outlook table based on 2012 survey & commercial data given in WG report & draft advice sheet. This will be revised following the 2013 summer surveys.
4) **Assessment model**: UWTV survey assessment plus consideration of trends in size composition, sex-ratio and commercial lpue.
5) **Data issues:** There appears to be inconsistency between the stock annex and report regarding the availability of discard data. The stock annex shows no discard samples available (Table B.1.1) in recent years while the report refers to discard samples (together with catch samples) being used to derive a discard ogive. Other data appear to be available according to the stock annex.
6) **Consistency**: Last year was the first year that advice for this stock was based on the UWTV survey approach. The assessment follows the same approach this year.

The assessment & outlook has been conducted according to the stock annex.

7) **Stock status**: According to the UWTV survey abundance in this stock in 2012 has declined by about 11 % since 2011. The current harvest rate is 9.3% which is above the Fmsy proxy (7.5 %). There is an insufficient time series of UWTV survey data to comment on trends in abundance & harvest rate.

   Trends in commercial lpue have been relatively stable although effort has not been adjusted to account for an increase in the number of vessels working quad rigs which is likely to result in higher catch rates.

   There are no PA or limit reference points for this stock.

8) **Man. Plan.**:

   a. There is no specific management plan for the FU19 stock.

   - The Division VII TAC is 23 065 t for 2013 (an increase of 6 % on 2012)
   - In 2012 770 t were landed from the FU19 stock, which is an increase of ~ 25% from 2011.
   - The advice for 2013 was landings of no more than 820 t. To protect the stock in this functional unit, management should be implemented at the functional unit level.
   - The preliminary advice for 2014 based on the MSY approach is for landings of 654 t in FU19. This value is based on the 2012 survey data and will be updated in October after the latest results from the 2013 UWTV survey become available.

General comments

The ToR for an 'update' advice stock have largely been addressed. However:

- Intercatch has only partly been used for this stock as not all data were uploaded.

The assessment and forecast appear to have been performed according to the stock annex in terms of both input data and model settings.

No advice will be published for this stock until the results of the summer surveys are available. Advice expected to be released in Nov 2013.

Technical comments

The text and table (7.8.6) on survey abundance estimates require further clarification and checking before they can be used as the basis for advice. Two alternative assumptions are considered for the abundance in the unsurveyed Galley Grounds 1. The abundance estimates referred to in the text for these assumptions match the totals in Table 7.8.6, but the totals do not seem to be the sum of any combination of numbers in the column above. It is not clear how these totals have been derived.

Some editorial changes have been made in the report (using track changes). Some additional points to note:

- Section 7.8.1 – Figure 7.8.7 doesn't seem to be the correct reference.

- Section 7.8.2 – Landings data – the increase in lpue is explained by fleet mobility at times of increased Nephrops emergence. However, this could also potentially be explained by increased catch rates due to use of quad rigs.
- Section 7.8.2 – Discarding – This paragraph is not clear. It suggests that both unsorted catch & discard samples are available to calculate a discard ogive, yet the SA implies that no discard samples have been available in recent years.
- Table 7.8.4 – the table shows 3 different area estimates plus the average. These are confusing and not explained in the text. Suggest that in future only one estimate is presented (Table 7.8.5?)
- First paragraphs & table under 'Abundance indices from UWTV surveys' have been deleted as they are repeated later in the section.
- Paragraph following cumulative bias table is incomplete. Some of the 'mean densities' referred to in this paragraph appear to be the mean of one density and are therefore unlikely to be very reliable estimates.
- Table 7.8.6 should also provide the number of stations in each ground.
- Is there an assumption of discard survival? It does not appear to be mentioned in the report.
- Section 7.8.8 states that the RSE is around 10% which is below the 20% threshold recommended by SGNEPS 2012. Some patches contain only one survey station & therefore have no RSE. The estimate of overall RSE is therefore unlikely to be a reliable estimate of actual RSE and not clear whether the true value would actually be below the 20% threshold.

FU 19 is characterized by a large number of spatially discrete mud patches which causes difficulties in obtaining a reliable abundance estimate with what appears to be a relatively limit survey effort (although the number of stations is not provided in the report). This has resulted in some patches being completely unsurveyed in some years and the abundance on other patches being reliant on a single survey station (assumed to be the case given the lack of CIs on estimates & low burrow counts for some areas). The lack of estimates of CV for some patches also means that the overall CV is unlikely to be truly reflective of actual survey precision.

It appears that survey intensity needs to be increased in this FU in order to be able to provide robust estimates of abundance. An alternative option could be to exclude the small Helvick 1-3 areas from the survey (and abundance estimate) which contribute little in both area and abundance and redistribute effort on the major patches.

Conclusions

Despite the weaknesses described above, the survey should still be regarded as adequate for the provision of advice. The major mud patches (contributing the majority of abundance) appear to be surveyed relatively well and the VMS area to which the densities have been raised is likely to represent an underestimate given that a significant proportion of the fishery is inshore by vessels without VMS. In addition, a conservation F_{MSY} proxy is used as the basis for advice.

Assuming that the source of the totals in Table 7.8.6 can be clarified, then the assessment has been performed correctly and appears to be an adequate basis for management advice.

There are a number of issues for this stock requiring further work which the WG recommends should be addressed through the inter-benchmark process in 2014:

- Strategy for reliably estimating abundance for stock with numerous discrete patches
- Further investigation of biological & other parameters used as input in derivation of per-recruit analysis
- Refining estimates of spatial extent of stock.

Audit of Plaice in West of Ireland Division VII b, c

Date 31st May 2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Update of DCAC run based on additional year of catch data

For single stock summary sheet advice:

DCAC used to estimate a potentially sustainable catch level

1) **Assessment type:** No assessment
2) **Assessment**: not presented
3) **Forecast**: not presented
4) **Assessment model**: N/A
5) Data issues: None
6) **Consistency**: consistent with previous years
7) **Stock status**: Unknown
8) **Man. Plan.**: No plan

General comments

The report is clear and straightforward

Technical comments

N/A

Conclusions

The assessment has been performed correctly

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice?
- Is the assessment according to the stock annex description?
- Is general ecosystem information provided and is it used in the individual stock sections.
- If a management plan has been agreed, has the plan been evaluated?

For update assessments

- Have the data been used as specified in the stock annex?
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?
- Is there any **major** reason to deviate from the standard procedure for this stock?
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

Audit of Plaice in Division VIIf&g

Date 28/05/2013

General

No formal assessment is presented for this stock given that the "preferred" Aarts and Poos (2009) model failed to converge and other model variants could not provide realistic representations of observed landings and discards in 2012. The state of the stock is inferred from survey data.

For single stock summary sheet advice:

1) **Assessment type:** None
2) **Assessment**: No formal assessment presented
3) **Forecast**: No short and medium term-projections for this stock
4) **Assessment model**: AP assessment model (Aarts and Poos, 2009)
5) **Data issues:** data available as described in stock annex
6) **Consistency**: Not relevant
7) **Stock status**: F appears to be stable or decreasing, recruitment varies without trend and SSB appears to be increasing
8) **Man. Plan.**: No management plan involving this stock

General comments

The report was clearly written and all figures and tables were complete.

Technical comments

Some of the detail in the report might be moved to the stock annex in the future (for an update assessment the report only needs to point out any deviations from the stock annex). Also the figures and tables were not in the order they were mentioned in the text.

Some detailed comments were made in the report document.

Conclusions

No assessment presented

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? YES
- Is the assessment according to the stock annex description? NOT RELEVANT
- Is general ecosystem information provided and is it used in the individual stock sections? – Not in the report, the stock annex has some information on the relationship between temperature and recruitment.
- If a management plan has been agreed, has the plan been evaluated? NOT RELEVANT

For update assessments

- Have the data been used as specified in the stock annex? NO ASSESSMENT
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex? NOT RELEVANT
- Is there any **major** reason to deviate from the standard procedure for this stock? NOT RELEVANT
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? NOT RELEVANT

Audit of Plaice in Division VIIa (Irish Sea)

Date 30/05/2013

General

Update of the analytic assessment used to derive relative trends. ICES WKFLAT (2011) benchmarked this assessment and included estimates of discards-at-age from 2004 into the catch matrix

For single stock summary sheet advice:

1) **Assessment type:** Update with 2012 estimates of catch and survey indices
2) **Assessment**: indicative of trends only
3) **Forecast**: not presented
4) **Assessment model**: Aarts and Poos (2009) model – tuning by 3 surveys
5) Data issues: the data are available as described in stock annex
6) **Consistency**: Last year assessment for trends.
7) **Stock status**: the stock appears to be under-exploited
8) **Man. Plan.**: no management plan involving this stock

General comments

The report was clearly written and complete.

Technical comments

Some of the detail in the report might be moved to the stock annex in the future (for an update assessment the report only needs to point out any deviations from the stock annex). Also the numbering of the tables follows the subsections, while the figures that were referred to in subsection 6.7.3 all started with 6.7.2. Also the figures and tables were not in the order they were mentioned in the text.

Conclusions

The assessment has been performed correctly

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? - Yes
- Is the assessment according to the stock annex description? - Yes
- Is general ecosystem information provided and is it used in the individual stock sections. – Not in the report, the stock annex has some information on the relationship between temperature and recruitment.
- If a management plan has been agreed, has the plan been evaluated? - NA

For update assessments

- Have the data been used as specified in the stock annex? - Yes
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex? Yes
- Is there any **major** reason to deviate from the standard procedure for this stock? - no
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? - yes

Audit of seabass IVbc, VIIa and VIId-h (Irish Sea, Celtic Sea, English Channel and southern North Sea)

Date : 31 May 2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

The audit has been carried out with the following steps:

-Compare the stock annex with the Stock Synthesis control file.

- Make sure any minor deviations from the stock annex are explained / justified.
- Check the raw data and assessment data conform
- Re-run the assessment with the settings given in the SA and the data used for the assessment
- Check the assessment data with what is presented in the report

General remark

The assessment is fully documented and easy to follow. All data, methods, software and model configuration files are provided to allow complete replication of the assessment as present in the stock annex. The modifications to the input data and model configuration are presented in full and the justified

The point to improve next year is the balance of information between the report and the stock annex. The report re-use most of the descriptive sections of the stock annex, so it is difficult to assess what is new or departing from the stock annex. Sometimes the description in the report is more precise than in the stock annex (e.g. age error parameters for Stock Synthesis, natural mortality) which is opposite to how it should be.

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type:** update Update using the assessment developed at IBP-NEW (2012).

2) **Assessment**: analytical using Stock Synthesis for provision of trends based advice. Two complementary analytic assessments are applied; A: Age & length based for selected UK fleets and combined length compositions for French fleets. B: A length only model, including the length composition data for all UK and French fishery fleets.

3) **Forecast**: not presented

4) **Assessment model**: Stock synthesis 3 (SS3 v3.23b) – tuned by data from 3 three surveys. The assessment model treats age groups from three available trawl surveys as independent, resulting in the generation of ten independent abundance index series.

5) **Data issues**: Some minor deviations from the input data as listed in the stock annex are detailed. These were discussed at the working group and are fully documented in the supporting report text.

    a. Recruitment from 2010 – 2012 as forecasts, as there are no survey data.

    b. Exclusion of UK midwater trawl length or age compositions prior to 1996: negligible impact on the assessment.

    c. Use of length compositions for UK midwater trawls in both the age & length and length models from 1996 onwards.

    Further the model start year was set as 1965 (IBPNEW fixed it at 1980). The impact of modifying the burn-in period was evaluated at WGCSE.

6) **Consistency**: NA

7) **Stock status**: SSB decreasing, B ref points undefined. F showing a strong increase recently after 20 years above Fmsy

8) **Man. Plan.**: None

General comments

The assessment is fully documented and easy to follow. All data, methods, software and model configuration files are provided to allow complete replication of the assessment as present in the stock annex. The modifications to the input data and model configuration are presented in full and the justified

Technical comments

Some minor typos to correct:
Page 3 Table 10.1 and figure 10.1 should be 10.1.1
Page 7 figure 4 is mislabeled and should be 10.1.4
Page 9 figure 10.9 should be 10.1.9

Page 17 figure 10.24 should be 10.1.24

Conclusions

The assessment has addressed the TORs relevant to BSS-47 and has provided advice based on the ICES approach for data-limited stocks. The assessment has been conducted according to the IBP-NEW(2012) recommendations. The fishery is described in full in the report sections, with all relevant background information. Recommendations are made for future work to establish a better understanding of the environmental and spatial aspects of the stock. Further, suggestions are made for the collection and incorporation other fishery independent data such as abundance indices from greater range of nursery areas and fishery dependent data from recreational fisheries.

The perception of the stock is robust to any assumption and data deficiency, the main uncertainty being on the recruitment since 2009 after the termination of the last juvenile bass survey.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? Yes
- Is the assessment according to the stock annex description? Yes
- Is general ecosystem information provided and is it used in the individual stock sections.
- If a management plan has been agreed, has the plan been evaluated? NR

For update assessments

- Have the data been used as specified in the stock annex? Yes
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex? Yes
- Is there any **major** reason to deviate from the standard procedure for this stock? No
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? Yes, but there is a need of continued development on input data (biological parameters, recreational statistics, effort series, ageing, …), model settings, and the assessment would benefit from resuming and adding new inshore surveys.

Audit of Sole in West of Ireland Division VII b, c

Date 31st May 2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Update of DCAC run based on additional year of catch data

For single stock summary sheet advice:

DCAC used to estimate a potentially sustainable catch level

1) **Assessment type:** No assessment
2) **Assessment**: not presented
3) **Forecast**: not presented
4) **Assessment model**: N/A
5) Data issues: None
6) **Consistency**: consistent with previous years
7) **Stock status**: Unknown
8) **Man. Plan.**: No plan

General comments

The report is clear and straightforward

Technical comments

N/A

Conclusions

The assessment has been performed correctly

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice?
- Is the assessment according to the stock annex description?
- Is general ecosystem information provided and is it used in the individual stock sections.
- If a management plan has been agreed, has the plan been evaluated?

For update assessments

- Have the data been used as specified in the stock annex?
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?
- Is there any **major** reason to deviate from the standard procedure for this stock?
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

Audit of Celtic Sea Sole in the ICES division VIIf,g (sol-celt)

Date03/06/2013

For single stock summary sheet advice:

1) **Assessment type: update** (with 2012 survey and landings data)
2) **Assessment**: Analytical
3) **Forecast**: Presented

4) **Assessment model**: XSA with tuning from one survey (UK(E&W)-BTS-Q3 from 1988–2012) and two commercial lpue series (UK(E&W)-CBT from 1991–2012 and BEL-CBT from 1971–2003).

5) **Data issues:** None – data available as expected.

6) **Consistency**: Last year's assessment was accepted with no issues raised by the review group.

7) **Stock status**: SSB>MSYtrigger since 2001, Flim<F<Fpa, incoming recruitment above average but different signals are given by beam trawl survey and commercial indices regarding the strength of recruitment.

8) **Man. Plan.**: There are no explicit management plan for Celtic Sea Sole.

General comments

The assessment report was well written, fully documented and ordered and the assessment followed the methods detailed in the stock annex.

Technical comments

In table 7.13.1 repeats the year 2010 twice in the year column

In Figure 7.13.14 'probability' is misspelled.

In the stock annex the references for Trebilcock & Rozarieux (2009) and Horwood (1993) are missing.

Conclusions

The assessment has been performed correctly.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice?

  YES

- Is the assessment according to the stock annex description?

  YES

- Is general ecosystem information provided and is it used in the individual stock sections.

  YES

- If a management plan has been agreed, has the plan been evaluated?

  NA

For update assessments

- Have the data been used as specified in the stock annex?

  YES

- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?

  YES

- Is there any **major** reason to deviate from the standard procedure for this stock?

NO

- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

  YES

Audit of (Sole in Division VIIe (Western Channel))

Date 30/05/2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

For single stock summary sheet advice:

1) **Assessment type: update**
2) **Assessment**: analytical
3) **Forecast**: presented
4) **Assessment model**: XSA – tuning by 3 comm + 3 surveys.
5) **Data issues:** Data was available as described in stock annex.
6) **Consistency:** Assessment benchmarked in 2012 (WKFLAT) and 2012 assessment accepted by ACOM. This year's assessment consistent with last year's.
7) **Stock status**: SSB has been around MSY $B_{trigger}$ for about two decades, with an increase since 2009, F<Fmsy, R fluctuating without trend.
8) **Man. Plan.**: Agreed 2007: (Council Regulation EC. No. 509/2007). Since 2011 in management plan phase; keep F at target value of 0.27 & SSB above SSB_{MSY}. Plan is **not** evaluated by ICES.

General comments

This was a well documented, well ordered and considered section. It was easy to follow and interpret

Technical comments

The assessment was carried out according to the stock annex.

Section 8.3.2 Landings: Table 8.3.1 could be cited and last sentence currently reads 'There were **revisions no revisions** to 2011 landings data used by the WG'

Figure 8.3.3: axes units not stated.

Section 8.3.4 Short Term Projections: Are the year-class years one year out in the text table (under heading 'Estimating year class abundance') or are the year headers one year out in Table 8.3.12? Or is there another reason there are 3931 age 2 fish in Table 8.3.12 in 2013?

Outlook Table: The basis line needs updating (all values are still those from last year's table)

Outlook Table: The MSY approach is simply Fmsy in this case where SSB2014 is greater than Btrig. The numbers are correct but the Basis states the case for when

SSB2014 < Btrig. Suggest altering Basis to read "Fmsy" and delete Fmsy line under 'Other options'.

Outlook Table: The final four options are all stated as "F2013*0.6" under Basis. I think the F values relate to multiples on F2013 of 0.6, 0.8, 1.2 and 1.4 based on F2013 of 0.246 (Table 8.3.13 of report) but could the stock coordinator confirm this.

Detail editorial changes sent to stock coordinator.

Conclusions

The assessment has been performed correctly.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice?
- Is the assessment according to the stock annex description?
- Is general ecosystem information provided and is it used in the individual stock sections.
- If a management plan has been agreed, has the plan been evaluated?

For update assessments

- Have the data been used as specified in the stock annex?
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?
- Is there any **major** reason to deviate from the standard procedure for this stock?
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

Audit of Sol-iris

Date 27/5/2013

For single stock summary sheet advice:

1) **Assessment type:** Update. Last benchmarked at WKFLAT 2011.
2) **Assessment**: Analytical
3) **Forecast**: Presented
4) **Assessment model**: XSA with a single beam trawl survey (UK (E &W)-BTS-Q3) and no commercial CPUE indices. Discards are very low and not included in the assessment.

   The forecast uses MFDP. In the intermediate year, XSA survivors are used for ages 3 and above and the RCT3 estimate is used for recruitment at age 2. Future recruitment is assumed to be a short-term GM.
5) **Data issues:** Data were available as described in the stock annex.
6) **Consistency**: Last year's assessment was accepted. This year's assessment has been performed in the same manner. In a change from last year, the forecast this year assumes a TAC constraint in the intermediate year rather than

status quo F (results in a lower F). It is assumed that the additional fishing controls being imposed on the Belgian fleet (main fleet exploiting this stock) will limit catches in line with the TAC.

7) **Stock status**: SSB has shown a virtually continuous decline since 2001 and is around the lowest level of the whole time series, well below Blim. Recruitment has been well below the long term average for over a decade. F is fluctuating at around Fpa (above Fmsy).

8) **Man. Plan.**: No management plan exists for this stock. Given the continuing low SSB & poor recruitment, ICES advises that it is not possible to identify any non-zero catch which would be compatible with the MSY approach.

General comments

The report is ordered, well written and easy to follow.

The ToR for an 'update' advice stock have largely been addressed. However:

- Intercatch cannot be fully used for this stock – only for landings data. The raw age and length data are required to construct a combined age length key outside IC.
- There is no discussion of potential indicators/thresholds to trigger an update assessment. This would be particularly useful for this stock with continuing low recruitment and SSB as a simple indicator could potentially remove the need for an annual assessment until a threshold value is triggered.

The assessment and forecast has been performed according to the stock annex in terms of both input data and model settings. Model diagnostics show no worrying trends or patterns and indicate good agreement between the catch and survey data. The assessment results and forecast inputs are consistent across tables and the description in the text. (The assessment and forecast input/outputs were not available on the Sharepoint – under Data at the time of the audit).

Technical comments

There were no major errors found in the report, tables or figures. Minor editorial changes have been made in the report (using track changes). Some additional points to note:

- Although the report contains the comments of 2012 RG, it is not clear from the responses (to comments 1 & 2) how the WG has responded to them or whether any action has been taken.
- Table 6.8.3 might be better presented as a figure.
- The output table showing fishing mortalities (6.8.10) should read 'Fbar 10-12' in the final column
- The XSA summary table (6.8.12) shows F in 2013 as 0.16. The footnote should state that this is the F corresponding to a TAC constraint in 2013 (not mean F)
- The description at the end of section 6.8.3 of the detailed output (% contributions etc) of the short-term forecast relates to a forecast in 2014 & 2015 with F status quo (meanF 10-12 =0.31) i.e an increase in fishing mortality from 2013(TAC constraint) to 2014. It might be more informative to describe the outputs relating to F2014=F2013 given that this is one of the options transferred into the advice sheet while the mean F (10-12) option is not.

- The catch options provided in the outlook table in the advice are not all available in the WG report.
- Table 6.8.18 does not seem to be referred to in the text.

Conclusions

The update assessment has been performed correctly and gives a valid basis for advice.

As a result of the mismatch in the perception of stock status between the Belgian industry and the ICES stock assessment, an proposed action plan to investigate the reasons for this difference has been submitted to the EU. The WG considers that it is reasonable to await the results of this review before making recommendations on a future benchmark for this stock.

Audit of whiting whg-7e-k

Date 03/06/2013

General

- There is no new advice for this stock, and the only updated information is that on landings and groundfish surveys.

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type:** update
2) **Assessment:** analytical
3) **Forecast:** presented
4) **Assessment model:** XSA + tuning by 2 commercial fleets + 3 surveys
5) **Data issues:** no specific issues compared to stock annex
6) **Consistency:** This and last year's assessments accepted
7) **Stock status**: B>Blim and B>Bpa; no proposals for Flim or Fpa; no evidence of reduced R
8) **Man. Plan:** No management plans

General comments

This is an update of last year's report, including some new data.

Technical comments

None

Conclusions

The assessment has been performed correctly. Nevertheless, there are some shortcomings with the current assessment (assessment based on landings only, mortality in younger ages likely to be grossly underestimated, changing catchabilities).

The assessment has demonstrated a rapid increase in the stock biomass and a further decline in fishing mortality.

A benchmark assessment of whiting is necessary in the near future. This would be possible if significant progress can be made with the estimation of discards for the main fleets involved in the fishery. The available survey information is only useful at younger ages. Re-establishment of that information at the older ages should be implemented to stabilize the assessment.

Audit of whiting whg-7e-k

Date 05 June 2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

Use bullet points and subheadings (Recommendations, General remarks, etc.) if needed

For single stock summary sheet advice:

Short description of the assessment: extremely useful for reference of ACOM!

1) **Assessment type: U**pdate
2) **Assessment**: Analytical
3) **Forecast**: A short term forecast was presented
4) **Assessment model**: XSA
5) **Data issues**: None – data available as expected.
6) **Consistency**: As previously there were problems of this assessment in the past due to strong retrospective revision in recruitment. This year assessment and retrospective pattern are very consistent therefore. Revisions to landings have been included for 2011 but the corrected assessment (2012) reasonably consistent with the assessments carried out in 2011 (no figures with comparison of the results of new assessment with assessments which were conducted in the previous years in the report).
7) **Stock status**: SSB is above B_{pa} and close to the highest levels observed. Fishing mortality is at the lowest level ever observed. Recruitment 2011 and 2012 is at the lowest observed level.
8) **Man. Plan.**: No management plan in place.

General comments

The assessment report was well written, ordered and the assessment followed the methods detailed in the stock annex.

Technical comments

The title of table 7.15.2 need move up and put before table.

Need to make the title of table 7.15.2 and figure 7.15.2 more exact and to indicate what are presented in that table length distribution of landings or catches including discards.

In the report there is no figure from the comparison of the results of new assessment with assessments which were conducted in the previous years.

In the “Biological” section of the report we recommend that specify the name of the method to calculate the Mean stock weights- and numbers-at-age with further reference to the application.

Conclusions

The assessment has been performed correctly.

The non-inclusion of discard data in the assessment is a major source of uncertainty. The primary uncertainty of this assessment is underestimation of mortality. In 2011-2012 was observed increase mean weight at age 6 and 7 compare to last years and the recruitment 2011 and 2012 is at the lowest observed level.

Recommendation for benchmark

Nevertheless several short-comings still exist with the current assessment and a benchmark assessment of whiting is necessary in the near future. This would only be possible if significant progress can be made with the estimation of discards for the main fleets involved in the fishery.

Audit of (Whiting in Subarea VIb)

Date: 23 May 2013

General

In 2012, ICES provided biennial advice for 2013 and 2014

For single stock summary sheet advice:

1) **Assessment type:** none
2) **Assessment**: not presented
3) **Forecast**: presented
4) **Assessment model**: none
5) Data issues: data are available as described in stock annex
6) **Consistency**: not relevant
7) **Stock status**: unknown
8) **Man. Plan.**: No management plan involving this stock

General comments

No ecosystem information is provided

Technical comments

None

Conclusions

No assessment was performed

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? - Yes

- Is the assessment according to the stock annex description? - Yes
- Is general ecosystem information provided and is it used in the individual stock sections. - No
- If a management plan has been agreed, has the plan been evaluated? – not relevant

For update assessments

- Have the data been used as specified in the stock annex? - yes
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex? - Not relevant
- Is there any **major** reason to deviate from the standard procedure for this stock? - no
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? – not relevant

Audit of Irish Sea cod (cod-iris)

Date 31 May 2013

General

- There is no new advice for this stock. However the assessment is very consistent with last year's run and the advice from last year still holds, and is likely to still hold if the problem in the next bullet point is resolved.
- The input data and model configuration are as documented in the Stock Annex; however there may be a problem with the 2000-2002 input catch-at-age data which are based on reported landings. They should either give the "WG estimates" of landings, or have a removal bias estimated. The model does not estimate catch bias for those years, so in effect they are treated as unbiased which is not in accordance with the port-side observations for those years or model estimates for later years.
- There is a very large divergence between model estimates of removals for 2011 and 2012 and the reported landings (factor of 5 – 10) which is not discussed in the report – increased discarding of older (2+) fish in 2012 may at least partly explain this for 2012 as discards are not included in the model, but not for 2011 where discards estimates at 2+ are very small.
- The main issue for this stock remains the inexplicable failure for the age composition to recover despite the very large reduction in whitefish effort in the Irish Sea, a topic discussed by a subgroup at WGCSE 2013 following a request from the Commission.

For single stock summary sheet advice:

1) **Assessment type: update/SALY**
2) **Assessment**: analytical
3) **Forecast**: not presented
4) **Assessment model**: SAM – tuning by 9 surveys

5) **Data issues**: Main issue is quality of landings data, and exclusion of discards estimates which increased substantially in 2012

6) **Consistency**: Same procedure as last year; results for F, SSB and R are extremely consistent with 2012 WGCSE model run though historical landings are adjusted more noticeably due presumably to the re-estimation of "removals bias" for 2003, 2004 and 2006-12.

7) **Stock status**: SSB remains severely depleted compared to 1970s and 1980s, with a minor recent upturn due to slightly improved recruitment, and remains <B_{lim}. F remains extremely high (> F_{lim} of 1.0) with only a slight declining trend since late 1990s.

8) **Man. Plan.**: Agreed 2008 with target F of 0.4, but evaluated by ICES in 2009 as being not consistent with the ICES Precautionary Approach.

General comments

This was a well documented and well ordered section, although some attention is needed to the description and use of the survey data particularly the age/year shifts for 0-gps and reasons for exclusion of some age groups such as NIGFS-WIBTS-Q4 age 0, and to the years for which removals bias is estimated (or WG estimates of misreporting included), which is not treated consistently through the text and Annex and may be in error for 2000 - 2002.

Technical comments

Landings figures: The Annex and report state that landings for 2000-2005 are uncertain and are estimated within the model, and compared with port-side observations for 2000, 2001, 2002 and 2005. However the current model only estimates landings for 2003, 2004 and 2006 onwards. The sums-of-products of input catch numbers at age and landings wts at age give ~ the WG estimates for 1991 to 1999, but the reported landings for 2000-2002. Bias for these years is not estimated in the model. From 2003 onwards, the landings estimates from the model (plus the 2005 port side estimate) are well above the reported landings. This means that the 2000-2002 landings are probably substantially biased downwards in the input data – essentially the reported landings for these years are treated as unbiased in the model. This can be seen in the landings plot (Fig. 6.2.32) where there is a sharp dip in landings in 2000 (which also follows from a very weak 1998 year class to confuse matters).

Natural mortality: Stock Annex says M=0.2 for all ages but includes a Lorenzen vector which isn't used or explained.

Maturity ogive: the time series for age 2 should be documented so that the values over the transition can be seen. SAM plots out the proportions mature – the file in the Data folder shows proportion mature at age 2 dropping back down at 0.38 in 2012, but the SSB in the model output for SSB is consistent with Pmat = .65 at age 2.

Tuning indices: UK (E&W)-BTS-Q3: The use of this survey is inconsistently presented. The first text table says its age 0 (the Annex says there is age 0 and 1), and the second text table says the Q3 value for 0 is forwarded shifted to age 1 the following year. However the actual data input file has age 0 forward shifted but still has the alpha/beta as a Q3 values – 0.75-.79 (won't make any difference as its only affected by M, but should be altered for consistency). Also, the tables (incl 6.2.6) indicate that 2010 is the last survey year for the BTS-Q3 , but the input data has a 2012 value (from 2011 survey). Was there data from the Cefas 2012 survey, but not used?

NI-MIK – also forward shifted but the old alphas/betas retained. The forward shifting for this and the Cefas surveys should be explained in the Annex.

Table 6.2.6 should indicate in header or footer that the indices are treated as 1-gp and forward shifted to allow use in SAM model with only ages 1+ included.

I couldn't find any explanation in the text or the Annex for the reasons for excluding data for certain age groups – e.g. age 0 for NIGFS-WIBTS-Q4, given that all the age gps could have been forward shifted as per the MIK and BTS. WKROUND2 stated that the survey consistently picked up year class signals from ages 0 -2. But WKROUND also discarded age 0 from the NIGFS without any explanation.

SAM model settings: It should be possible to check Table 6.2.7 in the report against the WKROUND settings that should be in the Annex. However you have written a new Annex that has the settings used in this year's assessment (same date, time). The Annex should contain the Table 5.9.1 from WKROUND.

Conclusions

The assessment has been performed correctly and in accordance with the procedure developed at WKROUND2.

However there is a problem with handling of fishery landings data for 2000 – 2002 that needs to be resolved to give a correct final assessment, possibly by including landings numbers at age that are raised to the WG estimates of landings including observed key-side misreporting, or extending the years for catch-bias estimation to include 2000-2002, or providing a defensible reason for treating these years as unbiased.

Audit of Haddock in Division VIb (Rockhall)

Date: 29/05/2013

For single stock summary sheet advice:

1) **Assessment type:** Update
2) **Assessment**: Analytical
3) **Forecast**: Presented

   Assessment model: XSA with a single survey index (Scottish Rock-IBTS-Q3 survey) and no commercial cpue indices. Discards have been low in recent years and have been included in the assessment since 1991. Statistical catch-at-age analysis was also performed to verify the consistency of results using StatCam under parametric and non-parametric scenarios.

   The forecast uses MFDP. In the intermediate year, status-quo F is assumed and XSA estimates of recruits-at-age 1+ are used along with the RCT3 estimate of recruits-at-age +1 in 2009. A long-term (1991–2012) geometric mean was used to estimate recruitment in 2012. Future recruitment was assumed to be a long-term 25th percentile, corresponding with the procedure used in the previous assessment.

4) **Data issues**: Data were available as described in the stock annex.
5) **Consistency**: Last year's assessment was accepted. This year's assessment has been performed in the same manner using an identical methodology. Es-

timates of stock dynamics from this year's assessment are reasonably consistent with previous assessments.

6) **Stock status**: SSB has decreased since 2008 and is around the lowest level of the entire time-series, just above B_{lim}. Recruitment has been extremely poor since 2007 and well below the long-term average over the last several years. Fishing mortality has declined and is now at the lowest level of the entire time-series, below F_{MSY}.

7) **Man. Plan.**: A management plan is under development and is currently being evaluated by ICES. ICES will evaluate the EU-Russia proposal for the harvest control component of the management plan and assess the proposal for the protection of juveniles. Recommended management measures include a combined application of TAC and limits of fishing effort as well as effective control and enforcement measures to minimise bycatch and discarding.

General comments

The report is fully documented, well written and adequately ordered. The English language used in the report may need clarification in some sections. The assessment followed the methods detailed in the Stock Annex and used relevant data accordingly. General ecosystem information has been provided in the relevant sections.

Technical comments

No major errors were identified in the report, tables or figures. Minor amendments and suggestions have been made in the report, tables and figures using track changes. Some additional points to note:

- Two tables (4.3.10 and 4.3.11) were not referred to in the main text of the report.
- The table range (Tables 4.3.12–4.3.14) in the "Data screening" section is incorrect. It should read "...are shown in Tables 4.3.12–4.3.13." rather than refer to table 4.3.14, which details XSA diagnostics.
- A new version of Table 4.3.14 may need to be presented so that the table does not become distorted after re-sizing, the row headers are visible and it prints out clearly across multiple pages.
- The column headers in Table 4.3.17. may need to be made more visible. Changing the text alignment in the column headers to centre or left would help.
- The following reference "ICES CM 2003/ACFM:02" has not been cited in the reference section of the Stock Annex.

Conclusions

The update assessment has been performed correctly and gives a valid basis for advice. Output from this year's assessment is reasonably consistent with previous assessments.

Audit of (Plaice in Divisions VIIh-k (Southwest of Ireland))

Date 27/05/2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

For single stock summary sheet advice:

1) **Assessment type: re-examine**
2) **Assessment**: Trends
3) **Forecast**: Presented in report. Not used in the advice.
4) **Assessment model**: Seperable VPA using FLR packages. Landings numbers and weights at age from VIIj-k. Maturity ogive and natural mortalities from plaice in VIIfg.
5) **Data issues:** Only data for VIIj-k were sampled. The assessment was based on sampled ages for VIIj-k raised by official landings for VIj-k. Discard data is not available for this stock.
6) **Consistency**: Last year's assessment was based on a pseudo-cohort catch curve analysis. A separable VPA was also performed but was rejected. This year's assessment modified to address the concerns from last year over the separable VPA.
7) **Stock status**: Fishing mortality has decreased since 2008, but it remains above potential F_{MSY} proxies. Recruitment increasing. The average SSB in the last two years (2011-2012) is 33% higher than the average of the three previous years (2008-2010).
8) **Man. Plan.**: No specific management objectives are known to ICES

General comments

This was a well documented, well ordered and considered section. The assessment is according to the stock annex description.

Technical comments

The text in the stock annex or report needs revising with respect to the following (I'm not sure which)

Stock Annex: *A terminal S of 1.0 was used because the catch curves and catch ratio plots suggest a flat selection pattern after age 4.*

Report: *A terminal S of 1.0 was used because the catch curves and catch ratio plots* ***do not*** *suggest a flat selection pattern after age 4*

Plaice catches from VIIk are described as 'negligible' but discard rates for this stock are described as high based on a 42% discard rate from VIIk. Is it meant that landings from VIIk are negligible, or that the discard rate information came from VIIj or is a statement about discard rates for the stock based on information from a very minor component of the overall catch.

Presentational problem only: If Figure 7.11.2 is used again either the results need to be split into fewer bins or the percentages in the legend need to be to one decimal place.

WG estimate missing in official landings table for 2012 in advice sheet and Table 7.11.1 of report.

Figure numbering needs revising in the captions and text. Some table and figure captions need updating with correct year range. A separate document giving details has been sent to the stock coordinator.

Advice sheet: **Source** needs updating.

Fig. 7.11.5 The sentence "the diagonal lines follow the cohorts" is probably supposed to be in the caption of fig. 7.11.6 in stead of in the caption of fig. 7.11.5

Stock annex: A.3. Ecosystem aspects should be added.

Conclusions

The assessment has been performed correctly.

Whether plaice in VIIh are from the same stock as plaice in VIIj-k or belong to the VIIe or f stock or are a separate stock in their own right can be considered for a future benchmark as suggested in the advice summary sheet. In any case sampling of landings from VIIh, to establish numbers and weights at age for these landings is needed. The possibility of establishing a time series of discards should also be considered.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice?
- Is the assessment according to the stock annex description?
- Is general ecosystem information provided and is it used in the individual stock sections.
- If a management plan has been agreed, has the plan been evaluated?

For update assessments

- Have the data been used as specified in the stock annex?
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?
- Is there any **major** reason to deviate from the standard procedure for this stock?
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

Audit of (Pollack in the Celtic Seas; ICES subareas VI and VII)

Date 28/05/2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

For single stock summary sheet advice:

1) **Assessment type: re-examine**
2) **Assessment**: DCAC (data limited stock; category 4.2.1)
3) **Forecast**: Not presented

4) **Assessment model**: DCAC

5) **Data issues:** No data on catches by recreational fisheries which are suspected to be a large component of Pollack catches.

6) **Consistency**: Results from this year's assessment were consistent with those from last year.

7) **Stock status**: No biomass or F reference points. B, F and R unknown.

8) **Man. Plan.**: No specific management objectives are known to ICES.

General comments

This was a well documented, well ordered and considered section.

Technical comments

There is no stock annex for this stock.

Author has left a note to self on caption to Figure 9.2.4., which needs removing before report publication.

Figure 9.2.8: Does the right hand result have an assumed distribution for the 'Depleted delta'? Does the left hand result not have an assumed distribution for the 'Depleted delta'? The horizontal axis would be better labeled in whole units (but the current labeling may just be a consequence of a standard package).

Conclusions

The assessment has been performed correctly.

Before a future benchmark:

The steps necessary to move towards a full assessment are included in the report section. At present the stock is a data limited stock. To give greater confidence in the DCAC assessment of sustainable catch the priority would be for studies on stock structure (e.g. tagging) and consideration of how to monitor catches from recreational fishing.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice?
- Is the assessment according to the stock annex description?
- Is general ecosystem information provided and is it used in the individual stock sections.
- If a management plan has been agreed, has the plan been evaluated?

For update assessments

- Have the data been used as specified in the stock annex?
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex?
- Is there any **major** reason to deviate from the standard procedure for this stock?
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice?

Audit of (Whiting in Divisions VIa (West of Scotland))

Date 30/05/2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

For single stock summary sheet advice:

1) **Assessment type:** update – Benchmark in 2012
2) **Assessment**: Analytical assessment
3) **Forecast**: Follow the procedure outlined in the stock annex.
4) **Assessment model**: TSA (Time Series Analysis)
5) **Data issues:** Incorrect reporting of landings, (TSA is explicitly design to allow for omission in catch). Survey and commercial data contain different signals concerning the stock. Issues in of changes in survey catchability. Discards account for a large proportion of the total catch (especially by the Nephrops fleet). Low sampling size leading to high variability in mean weight estimates.
6) **Consistency**: Retrospective analysis :All results are within the confidence limits of this year's run
7) **Stock status**: Biomass has declined to record low level in recent year and recruitment is low. Exploitation status is unknown with regards to MSY levels. A 25% TAc decrease is proposed, resulting in a TAC of 230t. Effective management measure should be implemented to reduce discards in the Nephrops TR2 fleet.
8) **Man. Plan.**: Plan under development

General comments

The assessment is according to the stock annex description. The report is ordered, well written and easy to follow.

Technical comments

There were no major errors found in the report, tables or figures. Minor editorial changes have been made in the report (using comments and was sent to the stock coordiantor). The main points to note :

- "A short term projection was made using WGFRANSW following the procedure out-lined in the stock annex". There is not description of short term forecast procedure in the stock annex.
- Mean weight. There are important variations in the weight at age (including for this year). This is explained in the text "These have been variable in recent years due to the variability associated with low sample sizes. Efforts to increase sampling in these fisheries are being pursued." Does this explanation can be extended to the substantial differences in the weight at age between landing and discards? Point not discussed in the report. Does this problem can explained the poor ability of tracking year class strength (figure 3.4.6;7;8;9 and text P129) ? Potential sensitivity of result to bias in weigh es-

timates are not mentioned in the "Uncertainties and bias in the assessment and forecast"

- Irish fourth quarter west coast groundfish survey is sometimes referred as IRGFS-WIBTS-Q4 or IGFS-WIBTS-Q4 (in the report, stock annex and advice sheet). I don't know why one is the good one, but notation needs to be homogeneous.
- Table 3.4.19 not found
- Data screening and exploratory runs section indicate as input data types and characteristics : "IRGFS-WIBTS-Q4, ages 1-4, years 2003-2006 and 2008-2012" , however in the sock annex we can find Tuning data:

Type	Name	Year range	Age range
Tuning fleet 3	IGFS-WIBTS-Q4	2003–2010	1–4

Conclusions

The assessment has been performed correctly.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? Y
- Is the assessment according to the stock annex description? Y
- Is general ecosystem information provided and is it used in the individual stock sections. Ecosystems aspect and stock description are not included in the report but appear in the stock annex.
- If a management plan has been agreed, has the plan been evaluated? No plan

For update assessments

- Have the data been used as specified in the stock annex? Y
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex? Y assessment – No description of the forecast procedure in the stock annex available on the sharepoint (https://groupnet.ices.dk/wgcse2013/Background documents stock annex folder)
- Is there any **major** reason to deviate from the standard procedure for this stock? N
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? Y

Audit 2 of (Whiting in Divisions VIa (West of Scotland))

Date 31/05/2013

Audience to write for: advice drafting group, ACOM, benchmark groups and EG.

General

For single stock summary sheet advice:

1) **Assessment type:** update – Benchmark in 2012

2) **Assessment**: Analytical assessment

3) **Forecast**: Follow the procedure outlined in the stock annex.

4) **Assessment model**: TSA (Time Series Analysis)

5) **Data issues:** Incorrect reporting of landings, (TSA is explicitly design to allow for omission in catch). Survey and commercial data contain different signals concerning the stock. Issues in of changes in survey catchability. Discards account for a large proportion of the total catch (especially by the Nephrops fleet). Low sampling size leading to high variability in mean weight estimates.

6) **Consistency**: Retrospective analysis :All results are within the confidence limits of this year's run

7) **Stock status**: Biomass has declined to record low level in recent year and recruitment is low. Exploitation status is unknown with regards to MSY levels. A 25% TAc decrease is proposed, resulting in a TAC of 230t. Effective management measure should be implemented to reduce discards in the Nephrops TR2 fleet.

8) **Man. Plan.**: Plan under development

General comments

There appears to be some deviation for both assessment and forecast from the procedure described in the annex. The effects of this are likely to be mostly minor for the assessment, but because no short-term forecast exists in the annex it is not clear whether the described procedure for the forecast is appropriate. The report is suitably structured, well written and easy to follow. For my liking though there is insufficient information regarding the fishery, how it has developed historically and how this links to the estimated trends in stock dynamics. I.e. is the model output believable, does the author believe it. I came away from the report with just a number, i.e the TAC advice. I know this is the main purpose for ICES in this endeavour, but from a reviewer or ADG perspective this is not particularly helpful. In Andrzej's defence the same can be said of an ever increasing number of reports from this WG, but it struck me particularly for this stock because I know little about the fisheries myself and because the annex is very light on this topic also.

The stock annex as supplied to the WG includes the section for haddock and cod also.

Technical comments

There were no major errors found in the report, tables or figures. Due to my unfamiliarity with the TSA software and license issues with respect to the NAG routines I did not attempt to re-run the assessment, but trust that the author carried out that part with the relevant data as appropriate. Examination of the input scripts did however suggest that the IRIBTS.Q4 for 2007 seven was removed from the analysis, though no mention of this is made in the stock annex, despite the fact that this was up dated since 2007. The report does mention this removal, based on the classification as an outlier. However, figure 3.4.8 does not suggest anything unusual about this data point. The rational should be explained.

The assessment indicates a strong decline in the F from around 0.8 in the late nineties to very low levels in recent years. The catch curves in the raw survey data and even the catch information itself do not suggest such a decline in F over the period. In fact

F appears to have been near constant with only the Irish survey suggesting a possible decline in F since 2005. It is unclear to me how the model is reconciling the data with these estimates of the dynamics, but I fear that it may well be the timevariant setting on the survey catchability that is affecting the output.

There are systematic biases present in the residuals (termed prediction errors), the period post 2000 for almost all of the age information except the quarter 4 surveys a preponderance of negative residuals is indicated. From the diagnostics it appears unclear what these negative residuals are balanced by, i.e. where the corresponding positive residuals are. 2000 corresponds to the center of the period where only the age compositions of the landings data are used. How can the model estimate numbers-at-age at this point in time when considering time variant q-in the survey indices? The necessary scalar which the model must estimate (presumably the misreporting factor) must be very strongly correlated with the change in survey q's and the F in the fishery, over parameterized in other words. This over parameterization of the model appears to be having a detrimental effect on its performance. If time variant q is used for the surveys it should be provided as one of the standard diagnostics in the report so that the reader can make up their own mind as to whether this is an appropriate model structure. I could not find the data in the r script, but noted that there were three parameters in the model, 23, 33, and 41 which have hit the lower bounds in the parameterization. This should be investigated, but may explain why the model converged despite being over parameterized.

The assessment suggests that F has only been very rarely above Fpa and never above Flim, while SSB is still above Blim yet to all intense and purposes the stock has collapsed with little or no recruitment since 2001. SSB in 1980 was around 140000t and already fished suggesting Bpa as set described in the Annex is therefore likely an SPR ration of less than 10% which would be far too low. It would appear the reference points are unsuitable. The current reference points may relate to a previous assessment set up and may not have been updated since WKROUND 2012. They should not be used until an assessment is made of their suitability.

The input data for recruitment estimates for future cohorts is inconsistent in the forecast procedure as implemented in the report. For the first year a stock recruit estimate is used based on a hockey-stick, but current SSB levels are such that recruitment is dependent on SSB within the model, followed by gm-mean recruitment 03-12. The same method should be used throughout. Recent recruitment levels show little relationship with SSB, certainly 2003-12 are independent of SSB so at current levels of biomass GM is likely to be the more appropriate measure of recruitment. In this case the forecast as presented is overly optimistic.

I could not understand the short-term forecast output table 3.4.18. There appear to be two identical tables set out the first of which has an additional line giving the F-bar range. Other than this they both seem to imply identical F multipliers and the same years. Yet provide different information for predicted yield and SSB. More over the second table suggests that SSB in 2015 and yield in 2014 are insensitive to F in 2014. If this is the correct interpretation of the tables this requires investigation.

Conclusions

The assessment has been performed correctly, but the forecast may be overly optimistic given recent recruitment information. Reference points appear to be unsuitable for management based on this assessment.

Checklist for review process

General aspects

- Has the EG answered those TORs relevant to providing advice? yes
- Is the assessment according to the stock annex description? mostly
- Is general ecosystem information provided and is it used in the individual stock sections. Ecosystems aspect and stock description are not included in the report but appear in the stock annex. yes
- If a management plan has been agreed, has the plan been evaluated? Plan only under development

For update assessments

- Have the data been used as specified in the stock annex? Mostly, the exclusion method of identifying outliers and the rational for removing data outside the benchmark process have not been described sufficiently.
- Has the assessment, recruitment and forecast model been applied as specified in the stock annex? Y assessment – No description of the forecast procedure in the stock annex available on the sharepoint (https://groupnet.ices.dk/wgcse2013/Background documents stock annex folder)
- Is there any **major** reason to deviate from the standard procedure for this stock? N
- Does the update assessment give a valid basis for advice? If not, suggested what other basis should be sought for the advice? Due to the brevity of the report in conjunction with an unfamiliarity with the area I am unable to make that judgement. However the report is in line with ICES requirements.

Audit of Irish Sea whiting (whg-iris)

Date 31 May 2013

General

- There is no new advice for this stock, and the only updated information is for groundfish surveys (not taken through to a Surba update) and recent estimates of Ireland and N.Ireland discard tonnage which are plotted but not tabulated.

For single stock summary sheet advice:

1) **Assessment type:** no assessment update done
2) **Assessment**: trends only, based on groundfish surveys, with supporting information on fishery landings and discards. WGCSE 2012 Surba run is not updated with new data.
3) **Forecast**: not presented
4) **Assessment model**: Surba (not updated)
5) **Data issues**: Main issues are inability to derive a robust time-series of landings and discards at age, and noisy year-class signals in the groundfish surveys.
6) **Consistency**: No new assessment

7) **Stock status**: Surveys indicate that biomass and recruitment remain very low, and that the age profile remains very steep suggesting high mortality (or net emigration with increasing age)

8) **Man. Plan.**: None

General comments

This is a simple update of last year's report, including some new data but no new analyses, as there is no new advice to be given.

Technical comments

None

Conclusions

There is no change to perception of stock status or form of ICES advice given for this stock, which is predominantly a discarded by-catch and for which technical measures are the only possible means of achieving the desired exploitation pattern and rate.

Future work of WGCSE and benchmark assessments should focus on establishing a method for monitoring the effectiveness of selectivity devices in altering the selectivity patterns at length or age. The data collection and modelling should be targeted at this outcome. The reasons for the apparent continued high mortality of adults despite very large reductions in targeted fishing by whitefish trawlers (a problem also with cod and haddock) also needs to be understood