6 Bay of Biscay Sole

Type of assessment in 2013: update.

Data revisions this year: Compared to last year assessment, there is only very limited change in data due to small revisions of 2012 landings and of 2012 commercial LPUE and survey CPUE.

6.1 General

6.1.1 Ecosystem aspects

See Stock Annex

6.1.2 Fishery description

See Stock Annex

6.1.3 Summary of ICES advice for 2014 and management applicable to 2013 and 2014

ICES advice for 2014:

Since 2010 the ICES advice is to decrease the fishing mortality step by step to the F_{MSY} (0.26 for the Bay of Biscay sole) until 2015.

The advice provided for 2014:

ICES advises on the basis of the transition to the MSY approach that catches in 2014 should be no more than 3270 tonnes. All catches are assumed to be landed.

Management applicable to 2013 and 2014

The sole landings in the Bay of Biscay are subject to a TAC regulation. The 2013 TAC was set at 4100 t. The 2014 TAC is set at 3800 t. The minimum landing size is 24 cm and the minimum mesh size is 70 mm for trawls and 100 mm for fixed nets, when directed on sole. Since 2002, the hake recovery plan has increased the minimum mesh size for trawl to 100 mm in a large part of the Bay of Biscay but since 2006 trawlers using a square mesh panel were allowed to use 70 mm mesh size in this area.

Since the end of 2006, the French vessels must have a Special Fishing Permit when their sole annual landing is above 2 t or to be allowed to have more than 100 kg on board.

The Belgian vessel owners get monthly non transferable individual quota for sole. The amount is related to the capacity of the vessel.

A regulation establishing a management plan has been adopted in February 2006. The objective was to bring the spawning stock biomass of Bay of Biscay sole above the precautionary level of 13 000 tonnes in 2008 by gradually reducing the fishing mortality rate on the stock. Once this target is reached, the Council has to decide on a long-term target fishing mortality and a rate of reduction in the fishing mortality for application until the target has been reached. However, although the stock was estimated above the SSB target in 2008 by ICES in 2009, the long-term target fishing mortality rate and the associated rate of reduction have not yet been set.

6.2 Data

6.2.1 Commercial catches and discards

The WG estimates of landings and catches are shown in Table 6.1a. The WG landing estimates are the figure obtained by crossing auction sales, available logbooks and data communicated by the administrations of countries involved in the Bay of Biscay sole fishery. The French catches are predominant. Since 2005, the same method has been used to estimate them and, because they are nearly exclusively landed in Bay of Biscay harbours, the record of the auction sales allows thus to consider that the reliability of theirs estimates is satisfactory all along the series.

The official landings are lower up to 2008 than the WG landings estimates but they become largely higher in 2009-2010 because since 2009, a new method has been implemented to calculate the French official landings. This important discrepancy in 2009-2010 was likely caused by some assumptions in the algorithm implemented to calculate French official landings in these years and which have been modified in 2011. Consequently the official and the WG landing estimates are closer since 2011. However, the WG method to estimate landings is considered to continue to provide the best available estimates of the landing series.

The 2012 landings estimate was revised less than 0.1 % higher to 4321 t.

In 2002, landings were increased to 5486 t by hydrodynamic conditions very favourable to the fixed nets' fishery (frequent strong swell periods in the first quarter). In the absence of such apparently rare conditions, the landings in 2003-2008 were ranging from between 4000 t and 4800 t before falling to 3650 t in 2009 and increasing to 4632 t in 2011 (Table 6.1a).

The 2013 landings figure (4234 t) is 5.4 % above the landings predicted by the 2013 WG at status quo mortality (4016 t).

Discards estimates were provided for the French offshore trawler fleet from 1984 to 2003 using the RESSGASC surveys. Because these estimates depend largely on some questionable hypothesis, their monitoring was not continued in 2004 and they are no longer used in the assessment. However, this survey allowed affirmation that the discards of offshore trawlers are low at age 2 and above. This low level has been confirmed by observations at sea in recent years. These observations have also shown that discards of beam trawlers and gillnetters are generally low but that the inshore trawlers fleet may have occasionally high discards of sole. Unfortunately, they are difficult to estimate because the effort data of inshore trawlers are not precise enough to allow estimating them by relevant areas. However, the French and Belgian discards data should be analysed as soon as possible to investigate if these difficulty can be circumvented before a future benchmark.

6.2.2 Biological sampling

The quarterly French sampling for length compositions is by gear (trawl or fixed net) and by boat length (below or over 12 m long). The split of the French landings in these components is made as described in Stock Annex. The 2012 split was slightly revised because of the very small correction in the database (Table 6.1 b).

Length compositions are available on a quarterly basis from 1984 for the French fleets and from 1994 for the Belgian beam trawlers. The 2013 sampling level is given in table 1.3. The French length distributions are shown on Figures 6.1 a, b & c from 1984 onwards. The relative length distribution of landings in 2013 is shown by country in Table 6.2.

Even though age reading from otoliths now uses the same method in France and Belgium (see Stock Annex), the discrepancy between French and Belgian mean weight at age, noticed

by preceding WGs, are still present. A work was carried out in the beginning of 2012 (PGCCDBS, 2012) to compare the age reading methods. The conclusion is that there was no bias between readers from the three countries using otoliths prepared with the staining technique. All readers produced the same age estimates (i.e. no bias) of otoliths with or without staining.

However, a likely effect of the weight at age samples process may also be presumed (weight-length relationship used in France and straight estimate in Belgium) and should be investigated. International age compositions are estimated using the same procedure as in previous years, as described in Stock Annex. International mean weights at age of the catch are French-Belgian quarterly weighted mean weights. The catch numbers at age are shown in Table 6.3 and Figures 6.2 a & b, and the mean catch weight at age in Table 6.4.

6.2.3 Abundance indices from surveys

Since 2007, a new beam trawl survey (ORHAGO) is carried out by France to provide a sole abundance index in the Bay of Biscay. This survey is coordinated by the ICES WGBEAM.

At the 2013 meeting of the WGBEAM 2013, several CPUE series were compared. The one based on all the reference stations and carried out by daylight was estimated to provide the abundance index to retain for the Bay of Biscay sole.

The 2013 WGHMM assessment was carried out according to a 2013 revised stock annex, which adds the ORHAGO survey to the tuning files. This was a consequence of the interim Benchmark during the WGHMM 2013 who considered that the addition of the survey tuning fleet appears to be useful to the assessment. This survey series were revised in 2014 for a change in the length hauls from calculated to observed values (when available from 2008 onwards), for some errors in the age-length keys (in 2007, 2009 and 2012) and for some missing values in 2011. These revisions are mainly small and they have very limited consequences on the last year assessment XSA outputs (Figure 6.3).

The figure 6.4 shows the ORHAGO time series by age group excepted at age 0, for which the ORHAGO series is not considered to provide a reliable abundance index. At other ages, the big year class 2007 can be followed, from year to year up to 2012. The data show a low abundance for the age 2. For 2013, we are back to an abundance of exploited stock (ages 2-8) close to 2007 – 2008.

6.2.4 Commercial catch- effort data

The French La Rochelle and Les Sables trawler series of commercial fishing effort data and LPUE indices were completely revised in 2005. A selection of fishing days (or trips before 1999) was made by a double threshold (sole landings > 10% and *nephrops* landings <= 10%) for a group of vessels. The process is described in the Stock Annex.

The risk that the sole 10 % threshold may lead to an underestimate of the decrease in stock abundance was pointed out by RG in 2010. This general point is acknowledged by this working group. However in this particular case using the knowledge about the fishery this threshold was set to avoid the effect of changing target species, which may also affect the trend in LPUE. Indeed, the choice of target species may affect effort repartition between sole major habitat and peripheral areas where sole abundance is lower. Because 10% is a minimum for sole percentage in catch when carrying out mixed species trawling on sole grounds, according to fishermen, this percentage was retained to ensure that sole LPUE are not driven by a fishing strategy evolution (the targeting of cephalopods more particularly).

The La Rochelle LPUE series (FR-ROCHELLE) shows a decreasing trend from 1990 to 2001. Later on, the series does not exhibit any trend but some up and down variations (Table 6.5.a

and Figure 6.5). The Les Sables d'Olonne LPUE series (FR-SABLES) shows also a declining trend up to 2003. Thereafter, it shows a short increase in 2004-2005 but the trend is flat from 2005 onwards.

Two new series of tuning were added to the assessment according to the WKFLAT 2011: the Bay of Biscay offshore trawler fleet (14 – 18 m) in the second quarter (FR-BB-OFF-Q2) and the Bay of Biscay inshore trawler fleet (10 – 12 m) in the fourth quarter (FR-BB-IN-Q4) for 2000 to the last year. A selection of fishing days was made by a double threshold (sole landings > 6% and *nephrops* landings <= 10%) The process is described in the Stock Annex.

Unfortunately, the fishing effort for the FR-BB-OFF-Q2 is not available for 2013. It's due to the use of the electronic logbooks, for which the fishing effort is not a required value. This data are not well exported in the official database, and the majority of the fishing effort is equal to 1. Therefore, the commercial LPUE could not be calculated for this fleet and year.

However, LPUE of the FR-BB-IN-Q4 fleet are provided using paper logbooks which are still used by this fleet. Its LPUE trend shows a decrease from 2013 to 2014 (Figure 6.5).

The Belgian LPUE series was relatively constant from 1990 to 1996, declined severely afterwards until 2002 but has increased in 2003 to return to the 1997-2000 level. Later on, its trend was flat until 2009, but it changed to an increasing one in 2010. After an increase until 2012, the LPUE are decreasing to be close the 2004 value.

For the ORHAGO survey, the trend of the CPUE are similar to those of the commercial tuning fleets available in recent years and, more particularly, it is close to the trend of the Belgian beam trawler fleet and it shows also a decrease from 2012 to 2013.

Consequently, all the LPUE and CPUE series available show a decrease in the last year of the series.

6.3 Assessment

6.3.1 Input data

See stock annex

6.3.2 Model

As in previous years, the model chosen by the Group to assess this stock was XSA.

The age range in the assessment is 2-8+, as last year assessment.

The year range used is 1984-2013.

Catch-at-age analysis and Data screening

The results of exploratory XSA runs, which are not included in this report, are available in ICES files.

A separable VPA was run to screen the catch-at-age data. The same settings as last year were used: terminal F of 0.6 on age 4 and terminal S of 0.9. There were no anomalous residuals apparent in recent years.

Four commercial LPUE series are used in the assessment: La Rochelle offshore trawlers (FR-ROCHELLE) and Les Sables d'Olonne offshore trawlers (FR-SABLES) 1991 to 2009, the Bay of Biscay offshore trawlers in the second quarter (FR-BB-OFF-Q2) 2000 to 2012 and the Bay

of Biscay inshore trawlers in the last quarter (FR-BB-IN-Q4) 2000 to last year. The data for these four tuning series are in table 6.6.

The table below summarizes the available information on the commercial tuning fleets and the survey.

FLEET TYPE	ACRONYM	PERIOD	AGE	RANGE	LAND-ING CONTRIBUTION
Offshore otter trawlers	FR-SABLES	1991 – 2009	1 – 8		<1 %
Offshore otter trawlers	FR-ROCHELLE	1991 – 2009	1 – 8		<1 %
Inshore otter trawlers	FR-BB-IN-Q4	2000 – 2013	1 – 8		<1 %
Offshore otter trawlers	FR-BB-OFF-Q2	2000 – 2012	1 – 8		<1 %
Beam trawler survey	FR-ORHAGO	2007 – 2013	0 – 8		0 %

XSA tuning runs (low shrinkage s.e. = 2.5, no taper, other settings as in last year tuning) were carried out on data from each fleet individually. The results show no trend and small residuals for all fleets (Figure 6.6a & b) except for the FR-BB-OFF-Q2 for age 2 in 2009, 2010 and 2011 and for FR-ORHAGO at age 5 in 2007 and at age 6 in 2008 and in 2010.

Result of XSA runs

The final XSA was run using the same settings than in last year assessment with the ORHAGO survey (FR-ORHAGO) in the tuning data.

The Figure 6.2b shows a distribution of catches at age, between age 3 and 6. The strong age 3 last year is found in the age 4 this year which is the most important of this year series.

As last year assessment, the weight of the ORHAGO survey in age estimate is major, far above the weight of other fleets from age 2 to 6 (Table 6.7), 98 % for age 2, 80 % for age 3, and 68 % for age 4 for example.

			2013 XSA			**2014 XSA**
Catch data range			84-12			84-13
Catch age range			2-8+			2-8+
Fleets	FR – SABLES	91-09	2-7	FR – SABLES	91-09	2-7
	FR – ROCHELLE	91-09	2-7	FR – ROCHELLE	91-09	2-7
	FR-BB-IN-Q4	00-12	3-7	FR-BB-IN-Q4	00-13	3-7
	FR-BB-OFF-Q2	00-12	2-6	FR-BB-OFF-Q2	00-12	2-6
				FR-ORHAGO	07-13	2-8
Taper			No			No
Ages catch dep. Stock size			No			No
Q plateau			6			6
F shrinkage se			1.5			1.5
Year range			5			5
age range			3			3
Fleet se threshold			0.2			0.2
F bar range			3-6			3-6

The results are given in Table 6.7. The log-catchability residuals are shown in Figure 6.6 a & b and retrospective results in Figure 6.7. The retrospective pattern shows a small F overestimation and a small SSB underestimation in 2012. The F overestimation is mainly due to the revision in estimated F values at age 4 and 5. The SSB underestimation is linked to this F overestimation at age 4 and 5, but also at age 3.

Because of the lack of the FR-BB-OFF-Q2 2013 abundance indices in the tuning data, the estimated survivors at age 2 are only based on the ORHAGO survey.

At age 3, the only one commercial fleet estimated survivors to have a significant weight is the FR-BB-INQ4 (around 17%) and it increases 34% at age 6. The FR-BB-OFF-Q2 has less weight than the others fleets, the maximum is at age 5 around 20%. The two discontinuied commercial fleets FR-SABLES and FR-ROCHELLE have minor weight and only at age 6 and 7 (less than 14%). At age 6, the fleets FR-BB-IN-Q4 and FR-ORHAGO have more or less the same estimated survivors around 34%.

Fishing mortalities and stock numbers at age are given in Tables 6.8 and 6.9 respectively. The results are summarised in Table 6.10. Trends in yield, F, SSB and recruitments are plotted in Figure 6.8. Fishing mortality in 2013 is estimated by XSA to have been at 0.47. Fishing mortality was 0.36 in 2011, and 0.42 in 2012. The fishing mortalities in 2010 is a bit higher and the fishing mortalities in 2011 is lower than the value calculated at the last year working group.

6.4 Estimating year class abundance

In the 2013 assessment, the 2012 recruitment estimate (10.1 million age 2 fish) was replaced by the $GM_{93\text{-}10}$ because of the lack of reliability of the recruitment estimated from XSA, as illustrated by the retrospective analysis. The 2012 recruitment is estimated to be 11.1 million age 2 fish in the 2014 assessment, which is the lowest value from the series.

Last year assessment (WGHMM, 2013) estimated the 2012 recruitment (at age 2) at a low level (10.2 millon) compared to average recruitments estimated in previous years ($GM_{93\text{-}10}$ = 22.7 millions). As this recruitment was usually not well estimated (as shown by the retrospective patterns of previous assessments in Figure 6.7) and as this was the first year for which the ORHAGO survey was used in the assessment, it was decided to replace this estimate with the $GM_{93\text{-}10}$. It must be noted that the largest contribution in the estimation of the recruitment comes now from the ORHAGO survey. In this year assessment (WGBIE, 2014), the retrospective analyses show that the 2012 recruitment was well estimated and that this recruitment is confirmed to be at a low level. The group therefore considers that, with the inclusion of the ORHAGO survey, the estimate of the recruitment for last year (2013 in this year assessment) has improved compared to previous assessment and decided to keep the value estimated by the assessment model.

The WG agreed to keep this calculation of the GM (1993 to n-2) to be homogeneous with the previous assessment.

Recruitment at age 2

Year class	Thousands	Basis	Survey	Commercial	Shrinkage
2011	10 678	XSA	97.7 %	0 %	2.3 %
2012 & subsequent	22 699	GM(93-11)			

6.5 Historic trends in biomass, fishing mortality and recruitment

A full summary of the time series of XSA results is given in Table 6.10 and illustrated in Figure 6.8.

Since 1984, fishing mortality gradually has increased, peaked in 2002 and decreased substantially the following two years. It increased in 2005 and, later on stabilized at around 0.42 (= Fpa) until 2012, this year it is estimated at the higher value since 2009 (0.47).

The SSB trend in earlier years increases from 12 300 t in 1984 to 16 500 t in 1993, afterwards it shows a continuous decrease to 9700 t in 2003. After a 22 % increase between 2003 and 2006, the SSB remains close to 11 700 t from 2007 to 2009. Since 2010, the SSB is above Bpa (13 000 t) but is also decreasing since 2011. The SSB value for 2012 is reassess from 14 600 t to 15 300 t. The 2013 SSB is estimated to 13 700 t, lower (12%) than in 2012.

The recruitment values are lower since 1993. Between 2004 and 2008 the series is stable around 17 or 18 million and the 2007 year class is the highest value since 1984. The 2010 and 2011 values are closed to the $GM_{93\text{-}11}$ (22.7 million). However, the 2012 and 2013 values are the lowest of the series (11.1 million and 10.7 million respectively).

6.5.1 Catch options and prognosis

Although the increase in F the two past years, the WG did not consider that there was a trend in the last years (Figure 6.7). Thus, the exploitation pattern is the mean over the period 2011-2013 (for age 2 to above). This *status quo* F is estimated at 0.42 for the run.

The recruits at age 2 from 2014 to 2016 are assumed equal to $GM_{93\text{-}11}$. Stock numbers at age 3 and above in 2014 are the XSA survivors estimates.

Weights at age in the landings are the 2011-2013 means using the new fresh/gutted transformation coefficient of French landing which was changed from 1.11 to 1.04 in 2007. Weights at age in the stock are the 2011-2013 means using the old fresh/gutted transformation coefficient of French landing (1.11). The predicted spawning biomass is consequently still comparable to the biomass reference point of the management plan.

6.5.2 Short term predictions

Input values for the catch forecast are given in Table 6.11.

The landings forecasts (Table 6.12) is 3435 t in 2014 (TAC is set at 3800 t), 23 % lower than the 2013 landings (4234 t).

Assuming recruitment at $GM_{93\text{-}11,}$ the SSB is predicted to decrease to 12 750 t in 2014 and increase to 13 760 t in 2015, fishing at *status quo* F in 2014. It will continue to grow at *status quo* F, to reach 14 700 t in 2016 (Tables 6.12 and 6.13).

The proportional contributions of recent year classes to the landings in 2015 and to the SSB in 2016 are given in Table 6.14. Year classes for which $GM_{93\text{-}11}$ recruitment has been assumed (2012 to 2014) contribute 48.6 % of the 2015 landings and 54.6 % of the 2016 SSB.

6.6 Yield and Biomass Per Recruit

Results for yield and SSB per recruit conditional on *status quo* F, are given in Table 6.15 a & b, and in Figure 6.9. The F_{sq} (0.42) is 10 % below F_{max} (0.46) and 49 % higher than $F_{0.1}$ (0.21). Long-term equilibrium landings and SSB (at F *status quo* and assuming GM recruitment) are estimated to be 4676 t and 16 920 t respectively (Table 6.15a & b).

6.6.1 Biological reference points

WGHMM 2010 proposals for MSY approach reference points are given below with technical basis with the value adopted for the precautionary approach reference points:

	Type	Value	Technical basis
MSY	MSY Btrigger	13000 t	Bpa
Approach	FMSY	0.26	Fmax (as estimated by WGHMM 2010) because no stock-recruitment relationship, limited variations of recruitment, Fishing mortality pattern known with a low uncertainty
	Blim	Not defined	
Precautionary	Bpa	13 000t	The probability of reduced recruitment increases when SSB is below 13 000 t, based on the historical development of the stock.
Approach	Flim	0.58	Based on the historical response of the stock.
	Fpa	0.42	Flim * 0.72

The basis for setting Flim was kept (historical response of the stock) and its value remains coherent with the historical SSB trend. Consequently, Fpa is unchanged.

The fishing mortality pattern is known with a low uncertainty because of the limited discards and the satisfactory sampling level of the catches.

The WKFLAT 2011 decided that Fmax remains unchanged as well as FMSY which is set to Fmax. This year the F_{max} is higher than the WG 2011, 2012 and 2013 estimates. The working group carried out a preliminary examination of the MSY reference point. Following recommendations from WKMSYREF2, it was decided to use the software PlotMSY and Eqsim.

EqSim

EqSim (stochastic equilibrium reference point software) provides MSY reference points based on the equilibrium distribution of stochastic projections. Productivity parameters (i.e. year vectors for natural mortality, weights-at-age, maturities, and selectivity) are re-sampled at random from the last 3-5 years of the assessment (although there may be no variability in these values). Recruitments are resampled from their predictive distribution. The software also allows the incorporation of assessment/advice error. Uncertainty in the stock-recruitment model is taken into account by applying model averaging using smooth AIC weights (Buckland et al. 1997). The method is described in more detail in Annex 8 of ICES WGMG (2013).

Unfortunately, the results obtained using EqSim software were not thought to be trustworthy, and the WG decided that further work was needed.

PlotMSY

This software (equilibrium approach with variance) is intended to provide robust estimation of deterministic (i.e. no future process error) MSY estimates that could be applied easily and widely. It fits three stock-recruit functions, namely the Ricker, Beverton-Holt, and a smooth Hockey-stick (Mesnil and Rochet, 2010), to estimate MSY quantities. Uncertainty in MSY estimates is characterised by MCMC sampling of the stock-recruit parameters and sampling from the distributions of other productivity parameters (i.e. natural mortality, weights-at-age, maturities, and selectivity).

Stock-recruit model uncertainty is taken into account by model averaging of the three functions. ICES WGMG (2013), Annex 7 provides a more detailed description of the method.

The main inputs for this software are F_{pa}, Fl_{im}, B_{pa} and B_{lim}. For B_{lim} which is currently not defined for sole, the WG decided to use a value close to B_{loss} = 9600 t. The number of MCMC fits calculated and used for confidence interval was set to 1000.

The stock-recruitment values obtained from the assessment do not show any clear stock-recruitment signal to allow a clear estimation of a stock-recruitment curve. There are no data sufficiently close to the origin to allow an understanding of what may happen at lower stock biomasses. The fits of the 3 stock recruitment relationships are presented in Figure 6.10. Beverton-Holt and Ricker model give similar results. The breakpoint of the smooth Hockey-Stick model is estimated at a SSB of about 12 500 tonnes.

Equilibrium yield and SSB based on the three stock and recruitment models estimates are presented in Figures 6.11 to 6.13, together with box plots of F_{MSY} and F_{crash}, and proxies for F_{MSY} based on the yield per recruit (F_{max}, $F_{0.1}$), and based on SSB per recruit ($F_{30\%}$ and $F_{35\%}$ SPR). Values of F_{MSY} reference points estimated for the 3 stock recruitment relationships are presented in Table 6.16a & b. The F_{MSY} calculated for each S/R relationship are quite different: 0.4 for Ricker model (close to F_{pa}), 0.46 for Hockey stick and 0.24 for Beverton-Holt model close to current F_{MSY}.

The figure 6.14 shows the probability of SSB being below B_{lim} at different values of F using the weighted combination of stock-recruit models. The fishing mortalities associated with a 5% probability for SSB to fall below B_{lim} was estimated at 0.4, close to potential F_{MSY} candidates for Bay of Biscay sole as the median value for the F_{MSY} estimated with the combination of the three S/R relationships equal to 0.37 (Table 6.17b). Fishing at that level of fishing mortality may thus be too risky with regards to precautionary limits.

It must be noted also that the current F_{max} is estimated at 0.46, which is above the fishing mortalities associated with a 5% probability for SSB to fall below B_{lim}. Fishing at F_{max} would thus be in conflict with precautionary considerations.

Furthermore, PlotMSY was used with historical series of SSBs and recruitments estimated from both assessment of WGHMM 2013 (data from 1984 to 2012) and this year assessment (1984 – 2013). It was found that adding one year of data changed substantially the weights of the 3 SR models (Table 6.18 a & b) and the value of the F_{MSY} based on a combination of three stock recruitment relationships.

As a consequence, the WG considers that further work is needed in order to make proposals for a revision of FMSY for the Bay of Biscay sole.

6.6.2 Comments on the assessment

Sampling

The sampling level (table 1.3) for this stock is considered to be satisfactory.

The ORHAGO survey provides information on several year classes at age 2. This series is now used in the assessment. At other ages, it is particularly useful to have a survey in the tuning file because the new use of electronic logbooks has caused some obvious wrong recordings of effort which limit available commercial tuning data in 2012 and the lack of FR-BB-OFF-Q2 2013 abundance indices.

Stopping the use of fleets of La Rochelle and Les Sables tuning series led to a paucity of information at age 2 in 2012, which were only provided by the Offshore Q2 tuning fleet (when the data was available). That is no more the case with incorporation of the ORHAGO survey in the assessment.

The same age reading method is now adopted by France and Belgium, however a discrepancy still exist between French and Belgian weights at age which has to be investigated.

Discarding

Available data on discards have shown that discards may be important at age 1. Discard at age 2 were assumed to be low in the past because the high commercial value of the sole catches but there are some reports of high-grading practices due to the landing limits adopted by some producers' organisations. The data available for discards do not seem representative to use them in the assessment, but the WKFLAT 2011 and the 2012 review group recommended that further work should include investigation on the monitoring of the inshore trawlers discards.

Consistency

Since the 2013 assessment, the ORHAGO survey has been included in the tuning fleets. This survey is the only one tuning fleet which provides a recruit index series up to 2013 because no LPUE data are available in 2013 for the only one commercial tuning fleet which can also provide a recruitment index. The incorporation of a survey in the assessment is considered to have improved the XSA recruit estimates in the assessment terminal year.

A few more years of survey data may improve our ability to confirm the quality of these estimates. The 2012 low recruitment appears to be estimated fairly well by the available tuning series (ORHAGO weight 98 %).

The GM is used only for the 2014 recruitment; this GM estimate has now a lower contribution in predicted landings and SSB. Furthermore, it is worth noting that variability of the recruit series has increased since 2001 and that, in recent period (until 2011), the use of GM estimate has led several times to forecast an increase in SSB which was superior to the one observed in following years.

The retrospective pattern in F shows a small overestimation in 2012 (Figure 6.7) which is mainly due to the revised F values at age 4 and 5. The definition of reference groups of vessels and the use of thresholds on species percentage to build the French series of commercial fishing effort data and LPUE indices is considered to provide representative LPUE of change in stock abundance by limiting the effect of long term change in fishing power (technological creep) and of change in fishing practices in the sole fishery.

The figure 6.15 shows the difference between the assessments in 2013 and in 2014. SSB in 2012 is revised slightly higher and F in 2012 revised slightly lower

Misreporting

Misreporting is likely to be limited for this stock but it may have occurred for fish of the smallest market size category in some years. There are some reports of high-grading practices due to the landing limits adopted by some producers' organisations.

Industry input

The traditional meeting with representatives of the fishing industry can't be held in France prior to the WG to present the data used by the 2014 WGBIE to assess the state of the Bay of Biscay sole stock. A document was sent to present the available data to the French fishing industry. They haven't made any comments except for the FMSY, they emphasised that the F_{MSY} needs to be reevaluated.

6.6.3 Management considerations

The assessment indicates that SSB has decreased continuously to 9700 t in 2003, since a peak in 1993 (16 500 t), has increased to 12 400 t in 2006 but it remains close to 11 700 t thereafter

and since 2010 is above 13 000 t. It is estimated to be 12 750 t (below B_{pa} = 13 000 t) in 2014 assuming XSA recruitment value for 2013, but an increase is predicted by the short term prediction, and SSB is assumed to be above B_{pa} in 2015 and after.

The (EC) 388/2006 management plan is agreed for the Bay of Biscay sole but a long-term F target has not yet been set. This plan was not evaluated by ICES.

Table 6.1 a: Bay of Biscay sole (Division VIIIa,b). Internationals landings and catches used by the Working Group (in tonnes).

	Official landings						WG	Discards [2]	WG
Years	Belgium	France[1]	Nether.	Spain	Others	Total	landings		catches
1979	0	2376		62*		2443	2619	-	-
1980	33*	2549		107*		2689	2986	-	-
1981	4*	2581*	13*	96*		2694	2936	-	-
1982	19*	1618*	52*	57*		1746	3813	-	-
1983	9*	2590	32*	38*		2669	3628	-	-
1984	na	2968	175*	40*		3183	4038	99	4137
1985	25*	3424	169*	308*		3925	4251	64	4315
1986	52*	4228	213*	75*		4567	4805	27	4832
1987	124*	4009	145*	101*		4379	5086	198	5284
1988	135*	4308		0		4443	5382	254	5636
1989	311*	5471		0		5782	5845	356	6201
1990	301*	5231		0		5532	5916	303	6219
1991	389*	4315		3		4707	5569	198	5767
1992	440*	5928		0		6359	6550	123	6673
1993	400*	6096		13		6496	6420	104	6524
1994	466*	6627		2***		7095	7229	184	7413
1995	546*	5326		0		5872	6205	130	6335
1996	460*	3842		0		4302	5854	142	5996
1997	435*	4526		0		4961	6259	118	6377
1998	469*	3821	44	0		4334	6027	127	6154
1999	504	3280		0		3784	5249	110	5359
2000	451	5293		5***		5749	5760	51	5811
2001	361	4350	201	0		4912	4836	39	4875
2002	303	3680		2***		3985	5486	21	5507
2003	296	3805		4***		4105	4108	20	4128
2004	324	3739		9***		4072	4002	-	-
2005	358	4003		10		4371	4539	-	-
2006	393	4030		9		4432	4793	-	-
2007	401	3707		9		4117	4363	-	-
2008	305	3018		11	2*	3336	4299	-	-
2009	364	4391				4755	3650	-	-
2010	451	4248				4699	3966	-	-
2011	386	4259				4645	4632	-	-
2012	385	3819				4204	4321	-	-
2013	312	4181				4492	4234**	-	-

[1] including reported in VIII or VIIIc,d [2] Discards = Partial estimates for the French offshore trawlers fleet

* reported in VIII ** Preliminary *** reported as S*olea* spp (*Solea lascaris* and s*olea solea*) in VIII

Table **6.1 b** : Bay of Biscay sole (Division VIIIa,b). Contribution (in %) to the total landings by differents fleets.

Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Shrimp trawlers	7	7	8	11	6	5	4	3	3	2	2	2	1	1	1
Inshore trawlers	29	28	27	25	31	29	30	25	27	25	17	13	13	12	13
Offshore otter trawlers	61	62	60	60	59	60	45	45	47	46	41	41	39	31	28
Offshore beam trawlers	0	1	0	0	0	0	1	1	2	3	5	5	7	7	6
Fixed nets	3	3	5	4	4	6	20	26	20	24	35	39	40	49	52

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Shrimp trawlers	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inshore trawlers	11	13	12	11	10	5	8	9	7	8	9	7	8	9	6
Offshore otter trawlers	29	26	26	30	30	24	21	24	18	24	23	21	19	21	19
Offshore beam trawlers	6	9	8	7	8	10	8	8	6	7	8	8	9	9	7
Fixed nets	52	53	54	52	52	61	63	59	70	60	60	63	64	61	69

Year	2009	2010	2011	2012	2013
Shrimp trawlers	0	0	0	0	0
Inshore trawlers	6	8	7	8	7
Offshore otter trawlers	21	19	17	17	18
Offshore beam trawlers	10	11	8	9	7
Fixed nets	63	61	67	66	68

Table 6.2 : Bay of Biscay Sole - 2013

French and Belgian relative length distribution of landings

Length(cm)	France	Belgium
19	0.02	0.00
20	0.01	0.00
21	0.03	0.00
22	0.08	0.00
23	0.69	0.00
24	2.94	2.27
25	5.49	4.47
26	7.69	5.50
27	9.36	8.57
28	10.96	11.02
29	12.76	9.95
30	13.01	12.18
31	11.03	8.55
32	7.43	9.10
33	5.04	7.34
34	3.39	5.12
35	2.48	5.55
36	1.78	2.92
37	1.40	2.67
38	1.14	1.86
39	0.88	1.00
40	0.61	1.03
41	0.49	0.32
42	0.32	0.29
43	0.34	0.15
44	0.22	0.07
45	0.15	0.07
46	0.10	0.00
47	0.06	0.00
48	0.05	0.00
49	0.02	0.00
50	0.01	0.00
51	0.00	0.00
52	0.00	0.00
53	0.01	0.00
54	0.00	0.00
55	0.00	0.00
Total	100	100

MLS= 24 cm

Table 6.3: Bay of Biscay Sole, Catch number at age (in thousands)

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Age										
2	5901	8493	6126	3794	4962	4918	7122	4562	4640	1897
3	3164	4606	4208	5634	5928	6551	6312	6302	7279	7816
4	2786	2479	2673	3578	4191	3802	4423	4512	4920	6879
5	2034	1962	2301	2005	2293	3147	2833	2083	2991	3661
6	1164	906	1512	1482	1388	2046	972	1113	2236	1625
7	880	708	1044	690	874	967	1018	1063	1124	566
+gp	1181	729	1235	714	766	499	870	981	951	708
TOTALNUM	17110	19883	19099	17897	20402	21930	23550	20616	24141	23152
TONSLAND	4038	4251	4805	5086	5382	5845	5916	5569	6550	6420
SOPCOF %	107	103	102	102	101	101	100	102	100	100

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
2	2603	3249	3027	3801	4096	2851	5677	3180	5198	4274
3	5502	5663	5180	9079	5550	5113	7015	6528	4777	6309
4	8803	6356	5409	5380	6351	4870	5143	4948	4932	2236
5	5040	3644	2343	3063	2306	2764	2542	1776	3095	1220
6	1968	1795	1697	1578	1237	1314	955	899	1269	729
7	970	843	1366	692	785	902	421	513	615	377
+gp	696	986	1319	877	1188	977	444	486	432	250
TOTALNUM	25582	22536	20341	24470	21513	18791	22197	18330	20318	15395
TONSLAND	7229	6205	5854	6259	6027	5249	5760	4836	5486	4108
SOPCOF %	100	100	100	100	101	100	101	101	101	101

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
2	3411	3976	3535	3885	3173	2860	2084	1516	1302	2317
3	5415	3464	4436	5181	4794	3986	7707	5222	4680	2988
4	3291	3738	2747	2615	2886	2233	3758	8347	4264	3818
5	917	2309	2012	1419	1353	1501	1272	1019	3787	3215
6	661	991	1030	1262	938	946	484	570	1008	1446
7	272	461	530	686	892	541	269	275	225	275
+gp	333	508	1537	946	1193	960	284	516	517	601
TOTALNUM	14300	15447	15827	15994	15229	13027	15858	17465	15783	14660
TONSLAND	4002	4539	4793	4363	4299	3650	3966	4632	4321	4234
SOPCOF %	101	102	101	100	100	102	100	100	100	101

Table 6.4: Bay of Biscay Sole, Catch weight at age (in kg)

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Age										
2	0.121	0.106	0.102	0.141	0.134	0.136	0.131	0.143	0.146	0.145
3	0.168	0.174	0.173	0.201	0.19	0.188	0.179	0.192	0.196	0.197
4	0.213	0.252	0.245	0.285	0.272	0.258	0.241	0.26	0.262	0.267
5	0.269	0.313	0.328	0.376	0.357	0.354	0.348	0.325	0.341	0.341
6	0.329	0.39	0.409	0.467	0.495	0.437	0.436	0.437	0.404	0.439
7	0.368	0.457	0.498	0.497	0.503	0.543	0.601	0.535	0.49	0.569
+gp	0.573	0.698	0.657	0.682	0.604	0.799	0.854	0.715	0.715	0.677
SOPCOFAC	1.0712	1.0302	1.0197	1.0248	1.008	1.0055	1.0039	1.0183	1.0004	1.0008

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Age										
2	0.147	0.16	0.159	0.142	0.161	0.177	0.171	0.152	0.171	0.18
3	0.195	0.206	0.204	0.193	0.212	0.219	0.207	0.22	0.208	0.226
4	0.251	0.252	0.268	0.256	0.257	0.246	0.276	0.265	0.263	0.307
5	0.324	0.308	0.319	0.319	0.335	0.305	0.343	0.341	0.32	0.361
6	0.421	0.403	0.399	0.406	0.41	0.404	0.452	0.428	0.466	0.487
7	0.569	0.484	0.453	0.502	0.501	0.533	0.573	0.519	0.592	0.657
+gp	0.774	0.658	0.625	0.678	0.7	0.582	0.755	0.619	0.681	0.642
SOPCOFAC	1.0016	1.0023	0.9998	1.0048	1.0091	1.0006	1.0066	1.01	1.0122	1.0056

Year	2004	2005	2006	2007*	2008*	2009*	2010*	2011*	2012*	2013*
Age										
2	0.19	0.189	0.195	0.176	0.174	0.17	0.179	0.193	0.182	0.207
3	0.227	0.226	0.242	0.225	0.229	0.215	0.206	0.223	0.224	0.24
4	0.29	0.298	0.282	0.298	0.287	0.275	0.272	0.253	0.257	0.272
5	0.391	0.367	0.347	0.326	0.352	0.317	0.337	0.342	0.307	0.305
6	0.493	0.43	0.42	0.388	0.392	0.361	0.414	0.432	0.369	0.364
7	0.643	0.468	0.455	0.419	0.401	0.447	0.477	0.489	0.414	0.519
+gp	0.81	0.656	0.533	0.511	0.519	0.601	0.768	0.606	0.585	0.524
SOPCOFAC	1.0104	1.0153	1.0136	1.0026	1	1.0158	1.0019	1.0046	1.0023	1.0081

(*) for 2007 to 2013, French catch weight at age computed using the new fresh/gutted transformation coefficient (1.04)
Before 2007, the French fresh/gutted transformation coefficient is 1.11
The Belgian fresh/gutted transformation coefficient is 1.04 in 2013

Table **6.5 a** : Bay of Biscay sole LPUE and indices of fishing effort for French offshore trawlers.

Year	CPUE Inshore (10-12 m) trawlers of French sole fishery	CPUE Offshore (14-18m) trawlers of French sole fishery	Orhago Survey beam trawler	LPUE La Rochelle offshore trawlers of French sole fishery	LPUE Les Sables offshore trawlers of French sole fishery	LPUE Other harbours * offshore trawlers of French sole fishery	LPUE All offshore trawlers of French sole fishery	effort index All offshore trawlers of French sole fishery
	Q4	Q2	kg/10km	(kg/h)	(kg/h)	(kg/h)	(kg/h)	(1000 h)
1984	-	-		6.0	6.9	5.0	5.9	557
1985	-	-		5.6	6.5	4.3	4.9	454
1986	-	-		7.2	7.2	4.5	5.5	526
1987	-	-		6.6	5.9	4.6	5.4	816
1988	-	-		6.4	6.7	4.1	5.1	944
1989	-	-		5.5	6.1	4.5	5.1	996
1990	-	-		7.1	6.3	4.9	5.7	975
1991	-	-		6.5	6.5	4.7	5.4	954
1992	-	-		5.4	5.6	4.9	5.1	884
1993	-	-		4.6	6.4	4.9	5.2	791
1994	-	-		5.0	6.6	5.8	5.6	944
1995	-	-		4.6	5.4	5.0	5.2	742
1996	-	-		4.9	6.0	5.0	5.4	628
1997	-	-		4.1	5.3	4.6	4.7	774
1998	-	-		4.2	5.3	4.2	4.2	834
1999	-	-		3.7	5.9	4.2	4.5	524
2000	5.7	3.5		4.0	5.7	4.7	4.7	577
2001	5.8	3.4		3.4	4.0	5.2	4.7	454
2002	4.8	4.1		4.4	5.0	4.6	4.6	430
2003	5.8	3.9		4.1	3.9	4.8	4.6	447
2004	5.4	3.6		4.0	4.1	4.7	4.4	448
2005	5.2	3.4		3.9	5.2	4.2	4.2	495
2006	5.8	2.2		3.4	5.4	4.5	4.5	465
2007	4.8	3.7	6.6	3.5	5.3	4.6	4.5	440
2008	3.9	3.2	4.4	4.1	5.6	4.6	4.5	468
2009	4.4	2.1	6.4	3.3	5.2	na	na	na
2010	4.5	3.5	7.4	3.6	5.7	na	na	na
2011	4.6	3.5	6.1	na	na	na	na	na
2012	6.0	3.6	7.0	na	na	na	na	na
2013	4.1		6.6	na	na	na	na	na

* French offshore trawlers in other harbours than in La Rochelle and Les Sables
na : non available

Table **6.5 b** : Bay of Biscay sole fishing effort and LPUE for Belgian beam trawlers.

Year	Landing (t)	Effort (1000 h)	LPUE (kg/h)
1976	26.3	1.7	15.5
1977	64.4	3.4	18.7
1978	29.8	1.7	17.7
1979			
1980	33.1	1.9	17.9
1981	4.1	0.3	16.4
1982	20.5	1.1	18.6
1983	10.2	0.6	17.3
1984			
1985	26.7	1.6	17.2
1986	52.0	2.8	18.4
1987	124.0	7.7	16.1
1988	134.7	5.6	24.1
1989	311.0	16.7	18.6
1990	309.4	9.0	34.3
1991	400.5	9.8	41.0
1992	452.9	14.8	30.6
1993	399.7	10.7	37.5
1994	467.6	13.5	34.6
1995	446.7	13.5	33.0
1996	459.8	13.6	33.9
1997	435.4	16.2	26.9
1998	463.1	17.8	26.1
1999	498.7	20.8	24.0
2000	459.2	19.2	23.9
2001	368.2	17.5	21.1
2002	310.6	16.5	18.8
2003	295.8	12.5	23.6
2004	318.7	12.2	26.2
2005	365.1	15.0	24.3
2006	392.9	16.7	23.5
2007	404.2	16.3	24.8
2008	305.1	12.9	23.6
2009	363.3	16.2	22.5
2010	451.3	13.1	34.3
2011	386.4	12.7	30.4
2012	385.2	9.7	39.5
2013	311.9	11.8	26.3

Table 6.6: Sole 8ab, available tuning data (landings); SOLE VIIIa,b commercial landings (N in 10-3) and survey catch - Fishing effort in hours; Series, year and range used in tuning are shown in bold type**

FR - SABLES

Year	Fishing effort	1	2	3	4	5	6	7	8
1991	33763	30.5	**242.1**	**332.8**	**194.7**	**73.8**	**32.4**	**23.6**	19.5
1992	30445	3.7	**236.8**	**285.8**	**130.2**	**59.5**	**32.1**	**15.0**	11.9
1993	34273	3.7	**152.0**	**441.3**	**224.0**	**75.7**	**27.0**	**8.0**	10.9
1994	20997	1.2	**94.1**	**157.4**	**184.3**	**77.3**	**24.2**	**13.4**	10.8
1995	31759	7.3	**173.4**	**228.1**	**177.1**	**69.1**	**34.1**	**15.9**	19.5
1996	31518	13.0	**193.0**	**222.6**	**169.8**	**55.6**	**37.8**	**29.4**	23.2
1997	27040	5.0	**140.9**	**290.9**	**114.2**	**49.0**	**26.7**	**10.6**	11.4
1998	16260	0.8	**86.9**	**112.1**	**113.6**	**31.4**	**13.8**	**8.1**	7.7
1999	12528	0.0	**64.9**	**53.2**	**39.7**	**26.8**	**15.0**	**15.2**	17.6
2000	11271	3.4	**81.3**	**121.3**	**45.0**	**15.7**	**8.4**	**4.7**	4.7
2001	9459	2.3	**32.9**	**64.5**	**35.2**	**9.5**	**5.5**	**3.1**	2.2
2002	10344	7.2	**76.9**	**60.3**	**37.5**	**19.3**	**8.4**	**3.9**	1.7
2003	7354	1.5	**38.9**	**49.1**	**14.3**	**7.8**	**4.0**	**1.7**	0.6
2004	6909	2.7	**38.4**	**36.5**	**22.7**	**5.7**	**3.8**	**1.7**	1.8
2005	6571	6.6	**46.4**	**26.6**	**25.2**	**15.3**	**6.4**	**3.3**	3.2
2006	6223	7.7	**63.1**	**29.7**	**11.9**	**6.6**	**3.7**	**2.4**	6.3
2007	5954	1.0	**32.6**	**28.4**	**18.0**	**12.4**	**10.6**	**6.6**	8.2
2008	4321	0.0	**22.8**	**22.8**	**16.4**	**8.1**	**5.2**	**4.9**	7.8
2009	3577	0.7	**23.0**	**22.2**	**9.8**	**7.1**	**4.2**	**2.4**	5.7

FR - ROCHEL

Year	Fishing effort	1	2	3	4	5	6	7	8
1991	15250	14.7	**134.8**	**157.4**	**88.9**	**30.3**	**11.6**	**6.7**	5.5
1992	12491	0.8	**99.4**	**130.1**	**58.7**	**21.2**	**9.1**	**4.5**	2.8
1993	12146	0.6	**53.3**	**126.5**	**51.8**	**17.2**	**6.4**	**2.1**	2.0
1994	8745	0.7	**42.4**	**56.5**	**52.9**	**19.4**	**6.4**	**2.7**	1.5
1995	4260	1.9	**25.9**	**31.3**	**20.7**	**7.2**	**2.4**	**1.1**	1.1
1996	10124	10.6	**113.1**	**74.6**	**34.3**	**8.8**	**5.0**	**3.1**	2.8
1997	12491	3.8	**74.1**	**117.6**	**35.8**	**12.6**	**7.3**	**2.6**	2.6
1998	10841	1.6	**77.7**	**65.4**	**57.9**	**11.3**	**4.7**	**2.9**	2.8
1999	8311	0.0	**53.7**	**31.6**	**19.0**	**10.1**	**6.4**	**4.3**	2.1
2000	8334	4.8	**64.0**	**44.4**	**19.2**	**6.7**	**2.8**	**1.5**	2.5
2001	7074	2.3	**24.7**	**39.9**	**23.7**	**5.5**	**3.3**	**1.9**	1.8
2002	6957	9.0	**89.2**	**36.3**	**11.8**	**5.4**	**2.3**	**1.3**	0.4
2003	5028	2.2	**37.8**	**40.0**	**9.1**	**3.7**	**1.7**	**0.5**	0.2
2004	1899	1.0	**12.1**	**11.8**	**4.4**	**1.0**	**0.7**	**0.3**	0.4
2005	3292	2.4	**17.3**	**10.5**	**8.8**	**5.2**	**2.4**	**1.1**	1.3
2006	2304	1.5	**11.0**	**8.3**	**3.9**	**2.4**	**1.3**	**0.6**	1.9
2007	2553	0.2	**12.3**	**21.5**	**4.5**	**1.8**	**1.6**	**0.7**	1.0
2008	1887	0.2	**11.3**	**14.6**	**5.4**	**2.1**	**1.1**	**1.1**	1.5
2009	1176	0.1	**4.8**	**7.1**	**2.3**	**1.3**	**0.7**	**0.4**	0.6

FR-BB-IN-Q4

Year	Fishing effort	1	2	3	4	5	6	7	8
2000	1432	4.06	20.99	**11.21**	**3.34**	**1.00**	**0.34**	**0.23**	**0.09**
2001	1803	18.04	37.14	**6.56**	**2.03**	**0.77**	**0.66**	**0.32**	**0.52**
2002	2276	15.06	23.83	**11.09**	**1.62**	**1.00**	**0.99**	**0.64**	**0.51**
2003	2913	1.65	29.53	**32.18**	**4.54**	**0.87**	**0.53**	**0.38**	**0.50**
2004	3081	4.25	24.42	**24.00**	**8.76**	**3.48**	**2.96**	**0.56**	**1.38**
2005	5000	9.89	47.26	**16.31**	**13.09**	**5.31**	**2.12**	**1.11**	**2.71**
2006	6941	22.99	81.92	**26.66**	**6.63**	**4.55**	**3.84**	**2.57**	**5.98**
2007	4015	2.73	34.44	**16.08**	**7.27**	**3.72**	**3.09**	**0.68**	**2.19**
2008	3681	0.58	13.91	**15.86**	**8.59**	**2.98**	**1.67**	**1.23**	**1.24**
2009	3615	2.66	47.84	**14.71**	**3.36**	**1.81**	**1.53**	**0.64**	**1.37**
2010	4298	1.47	21.52	**33.04**	**9.33**	**2.97**	**0.92**	**0.44**	**1.05**
2011	4601	3.12	37.28	**20.73**	**12.51**	**3.30**	**1.65**	**0.73**	**1.49**
2012	2789	1.08	9.19	**20.31**	**13.61**	**7.14**	**1.41**	**0.92**	**1.11**
2013	2632	2.93	10.34	**7.18**	**6.83**	**2.79**	**2.47**	**0.90**	**1.69**

Table 6.6: cont'd

FR-BB-OFF-Q2

Year	Fishing effort	1	2	3	4	5	6	7	8
2000	5567	0.00	**22.92**	**28.32**	**23.17**	**9.54**	**2.72**	0.90	1.66
2001	5039	0.01	**14.87**	**30.25**	**20.82**	**5.69**	**3.64**	1.42	1.08
2002	5604	0.01	**36.79**	**33.91**	**17.16**	**9.07**	**4.09**	2.12	0.53
2003	3324	0.02	**22.88**	**27.61**	**6.99**	**1.85**	**0.81**	0.08	0.03
2004	4809	0.00	**13.97**	**43.91**	**14.51**	**1.37**	**0.70**	0.26	0.40
2005	4535	3.67	**13.13**	**19.61**	**16.22**	**5.78**	**0.56**	0.43	0.57
2006	2235	0.00	**3.50**	**9.56**	**2.91**	**1.50**	**0.97**	0.33	0.31
2007	4013	0.00	**13.41**	**46.11**	**6.41**	**1.18**	**1.69**	0.24	0.54
2008	3211	0.00	**16.58**	**23.51**	**7.36**	**2.33**	**0.40**	0.83	0.49
2009	968	0.00	**0.70**	**5.05**	**1.69**	**0.53**	**0.16**	0.10	0.22
2010	2279	0.00	**1.55**	**27.23**	**7.96**	**2.16**	**0.12**	0.03	0.07
2011	2882	0.00	**0.97**	**12.40**	**23.98**	**1.61**	**0.82**	0.39	1.11
2012	2049	0.00	**4.35**	**14.98**	**7.62**	**4.68**	**0.42**	0.32	0.37

FR-ORHAGO

Year	Fishing effort	1	2	3	4	5	6	7	8
2007	100	69	**164.2**	**68.9**	**28**	**15.5**	**9.5**	**0.8**	**2.2**
2008	100	343.3	**128.3**	**70.8**	**22.7**	**4.2**	**2.5**	**3**	**1.3**
2009	100	87.1	**490.1**	**101.2**	**20.5**	**4.9**	**1.9**	**0.4**	**2.2**
2010	100	170.4	**193.3**	**161.9**	**21.1**	**2.9**	**0.1**	**0.9**	**0.7**
2011	100	102.7	**208.9**	**76.8**	**30.5**	**3**	**1.7**	**2.1**	**3.2**
2012	100	64	**89.5**	**102.5**	**55.3**	**22.9**	**5.5**	**3.3**	**5.7**
2013	100	168.8	**84.5**	**50.6**	**61.8**	**24.3**	**16.1**	**4.7**	**3.5**

Table 6.7: XSA tuning diagnostic

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

SOLE VIIIa,b

CPUE data from file tunfilt.dat

Catch data for 30 years. 1984 to 2013. Ages 2 to 8.

Fleet,	First, Last, First, Last, Alpha, Beta , year, year, age , age
FR-SABLES	, 1991, 2013, 2, 7, .000, 1.000
FR-ROCHELLE	, 1991, 2013, 2, 7, .000, 1.000
FR-BB-IN-Q4	, 2000, 2013, 3, 7, .750, 1.000
FR-BB-OFF-Q2	, 2000, 2013, 2, 6, .250, .500
FR-ORHAGO	, 2007, 2013, 2, 7, .830, .960

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 6

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 = .200

Prior weighting not applied

Tuning converged after 66 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,	2004,	2005,	2006,	2007,	2008,	2009,	2010,	2011,	2012,	2013
2,	.235,	.257,	.218,	.254,	.193,	.086,	.102,	.075,	.131,	.259
3,	.377,	.352,	.449,	.500,	.502,	.351,	.312,	.353,	.308,	.440
4,	.427,	.429,	.462,	.461,	.511,	.409,	.577,	.578,	.481,	.394
5,	.290,	.533,	.384,	.408,	.408,	.483,	.383,	.267,	.498,	.723
6,	.370,	.514,	.426,	.393,	.460,	.493,	.250,	.263,	.407,	.318
7,	.413,	.422,	.506,	.496,	.471,	.465,	.224,	.196,	.140,	.164

1

XSA population numbers (Thousands)

	AGE					
YEAR ,	2,	3,	4,	5,	6,	7,
2004 ,	1.71E+04,	1.81E+04,	9.95E+03,	3.83E+03,	2.25E+03,	8.46E+02,
2005 ,	1.84E+04,	1.23E+04,	1.13E+04,	5.88E+03,	2.59E+03,	1.41E+03,
2006 ,	1.90E+04,	1.29E+04,	7.80E+03,	6.63E+03,	3.12E+03,	1.40E+03,
2007 ,	1.82E+04,	1.38E+04,	7.44E+03,	4.45E+03,	4.08E+03,	1.84E+03,
2008 ,	1.90E+04,	1.28E+04,	7.59E+03,	4.24E+03,	2.68E+03,	2.49E+03,
2009 ,	3.64E+04,	1.41E+04,	6.99E+03,	4.12E+03,	2.55E+03,	1.53E+03,
2010 ,	2.26E+04,	3.02E+04,	9.01E+03,	4.20E+03,	2.30E+03,	1.41E+03,

Table 6.7: cont'd

2011 , 2.21E+04, 1.85E+04, 2.00E+04, 4.58E+03, 2.59E+03, 1.62E+03,

2012 , 1.11E+04, 1.85E+04, 1.17E+04, 1.01E+04, 3.17E+03, 1.81E+03,

2013 , 1.07E+04, 8.82E+03, 1.23E+04, 6.57E+03, 5.58E+03, 1.91E+03,

Estimated population abundance at 1st Jan 2014

, 0.00E+00, 7.46E+03, 5.14E+03, 7.52E+03, 2.88E+03, 3.67E+03,

Taper weighted geometric mean of the VPA populations:

, 2.33E+04, 1.78E+04, 1.12E+04, 6.03E+03, 3.29E+03, 1.78E+03,

Standard error of the weighted Log(VPA populations) :

, .2913, .2668, .2679, .2768, .2960, .3818,

1

Log catchability residuals.

Fleet : FR-SABLES

Age , 1991, 1992, 1993

2 , -.22, -.13, -.37

3 , .11, -.18, .17

4 , .14, -.26, -.08

5 , .09, -.15, -.10

6 , -.19, .17, -.39

7 , -.06, -.15, -.27

Age , 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003

2 , -.40, -.07, -.20, -.11, -.02, -.17, .20, -.16, .22, -.12

3 , -.10, -.17, -.02, .21, .00, -.41, .40, .08, .26, .01

4 , .37, .15, .02, .02, .45, -.22, .14, -.05, .14, -.29

5 , .23, .00, -.11, -.24, .16, .28, -.08, -.27, .35, -.17

6 , .03, -.24, .24, -.02, -.40, .42, -.04, -.22, .36, .04

7 , .18, .06, .47, -.01, .11, .54, .08, -.23, .07, .09

Age , 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013

2 , .30, .48, .79, .24, .13, -.38, 99.99, 99.99, 99.99, 99.99

3 , -.29, -.18, -.02, -.07, .11, .10, 99.99, 99.99, 99.99, 99.99

4 , -.19, -.15, -.47, .04, .27, -.02, 99.99, 99.99, 99.99, 99.99

5 , -.49, .23, -.74, .34, .28, .40, 99.99, 99.99, 99.99, 99.99

6 , -.33, .16, -.55, .26, .32, .36, 99.99, 99.99, 99.99, 99.99

7 , -.14, .07, -.15, .63, .34, .30, 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

Mean Log q, -15.0807, -14.5264, -14.4858, -14.6712, -14.6672, -14.6672,

S.E(Log q), .3114, .1979, .2337, .3069, .2975, .2761,

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, 4.93, -3.200, 34.75, .04, 19, 1.25, -15.08,

3, .98, .089, 14.45, .64, 19, .20, -14.53,

4, .81, 1.313, 13.49, .73, 19, .19, -14.49,

Table 6.7: cont'd

5, 1.09, -.296, 15.19, .41, 19, .34, -14.67,

6, 1.38, -1.010, 17.21, .29, 19, .41, -14.67,

7, .73, 2.329, 12.61, .81, 19, .17, -14.57,

1

Fleet : FR-ROCHELLE

Age , 1991, 1992, 1993

2 , -.08, -.17, -.45

3 , .20, -.04, .00

4 , .45, .13, -.21

5 , .47, .18, -.07

6 , .12, .34, -.25

7 , .01, .08, -.03

Age , 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003

2 , -.39, -.03, .34, -.05, .20, -.02, .20, -.22, .70, .16

3 , -.21, -.11, .06, .12, -.10, -.48, -.26, -.07, .19, .23

4 , .30, .31, -.14, -.07, .48, -.24, -.10, .15, -.31, -.06

5 , .20, .22, -.35, -.35, .01, .19, -.16, -.05, -.06, -.06

6 , .12, -.35, -.11, -.01, -.53, .52, -.30, .10, .00, .10

7 , -.01, -.06, -.10, -.11, .02, .22, -.23, .11, -.09, -.22

Age , 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013

2 , .37, .12, -.03, .04, .19, -.90, 99.99, 99.99, 99.99, 99.99

3 , -.09, -.38, -.26, .54, .54, .12, 99.99, 99.99, 99.99, 99.99

4 , -.23, -.21, -.29, -.20, .29, -.06, 99.99, 99.99, 99.99, 99.99

5 , -.47, .32, -.29, -.27, .23, .29, 99.99, 99.99, 99.99, 99.99

6 , -.19, .41, -.07, -.25, .13, .21, 99.99, 99.99, 99.99, 99.99

7 , -.04, .20, -.01, -.23, .21, .16, 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
Mean Log q, -15.0150, -14.5677, -14.7887, -15.1453, -15.2045, -15.2045,
S.E(Log q), .3454, .2720, .2591, .2652, .2727, .1427,

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, 2.16, -1.655, 20.75, .11, 19, .71, -15.01,
3, 1.16, -.541, 15.32, .41, 19, .32, -14.57,
4, .78, 1.400, 13.59, .71, 19, .20, -14.79,
5, .87, .677, 14.27, .60, 19, .23, -15.15,
6, 1.58, -1.511, 19.36, .29, 19, .42, -15.20,
7, .85, 1.984, 14.00, .91, 19, .11, -15.21,
1

Fleet : FR-BB-IN-Q4

Age , 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003
2 , No data for this fleet at this age
3 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, .26, -.36, .28, .70
4 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, .39, -.52, -.69, .13
5 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, .09, -.32, -.12, -.70
6 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, -.45, .05, .66, -.29
7 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, -.17, -.11, .61, .35

Table 6.7: cont'd

Age , 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013
2 , No data for this fleet at this age
3 , .24, -.27, -.07, -.05, .10, -.19, -.34, -.35, .09, -.04
4 , .30, .10, -.51, .17, .45, -.48, .26, -.31, .73, -.03
5 , .50, .22, -.51, .26, .17, -.22, .00, -.15, .53, .27
6 , .89, .06, .07, .10, .05, .06, -.73, -.33, -.06, -.08
7 , .25, -.05, .53, -.53, -.18, -.33, -1.00, -.73, -.15, -.15

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
Mean Log q, -14.4790, -14.9115, -15.1954, -15.1508, -15.1508,
S.E(Log q), .3026, .4316, .3614, .4121, .4719,

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, 1.09, -.281, 14.92, .45, 14, .34, -14.48,
4, 1.04, -.094, 15.15, .29, 14, .47, -14.91,
5, .68, 1.315, 13.07, .59, 14, .24, -15.20,
6, 1.04, -.085, 15.41, .32, 14, .44, -15.15,
7, 2.88, -1.768, 30.36, .07, 14, 1.22, -15.27,
1

Fleet : FR-BB-OFF-Q2

Age , 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003
2 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, .42, .46, .88, .93

3 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, -.41, -.12, .23, .17

4 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, .38, .25, .16, .00

5 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, .78, .52, .84, -.13

6 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, .74, 1.20, 1.43, .44

7 , No data for this fleet at this age

Age , 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013

2 , .44, .37, -.29, .52, .89, -1.76, -1.34, -2.03, .52, 99.99

3 , .20, -.17, -.19, .75, .38, -.12, -.07, -.58, -.07, 99.99

4 , -.06, -.01, -.64, -.39, -.03, -.26, .25, .32, .01, 99.99

5 , -.86, .30, -.52, -.94, .01, -.21, .28, -.38, .32, 99.99

6 , -.44, -.70, .34, .03, -.74, -.40, -1.53, .04, -.43, 99.99

7 , 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

Mean Log q, -15.9013, -14.5233, -14.7571, -15.4033, -15.9348,

S.E(Log q), 1.0335, .3452, .2922, .5749, .8295,

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, -1.65, -1.597, .09, .03, 13, 1.60, -15.90,

3, 1.75, -1.110, 18.14, .17, 13, .60, -14.52,

4, .64, 2.270, 12.74, .78, 13, .16, -14.76,

5, .64, .910, 12.94, .37, 13, .37, -15.40,

6, 4.38, -.670, 43.24, .00, 13, 3.72, -15.93,

Table 6.7: cont'd

1

Fleet : FR-ORHAGO

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
2	99.99	99.99	99.99	.11	-.24	.36	-.08	-.01	-.12	-.02
3	99.99	99.99	99.99	.01	.12	.24	-.09	-.31	-.06	.09
4	99.99	99.99	99.99	.17	-.02	-.13	-.20	-.63	.41	.40
5	99.99	99.99	99.99	.82	-.44	-.19	-.83	-.98	.46	1.16
6	99.99	99.99	99.99	1.08	.22	.03	-3.03	-.31	.79	1.22
7	99.99	99.99	99.99	-.51	.49	-1.04	-.37	.31	.61	.93

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	-9.1028	-9.3774	-9.8545	-10.6270	-11.3029	-11.3029
S.E(Log q)	.1897	.1743	.3668	.8265	1.4506	.7131

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	.79	1.641	9.25	.93	7	.13	-9.10
3	1.33	-1.469	9.28	.80	7	.21	-9.38
4	1.45	-.757	10.15	.36	7	.55	-9.85
5	.43	1.399	9.45	.55	7	.33	-10.63
6	.24	2.254	8.81	.63	7	.26	-11.30
7	.32	1.487	8.69	.49	7	.21	-11.24

1

Fleet disaggregated estimates of survivors :

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2011

FR-SABLES
Age, 2,
Survivors, 0.,
Raw Weights, .000,

FR-ROCHELLE
Age, 2,
Survivors, 0.,
Raw Weights, .000,

FR-BB-IN-Q4
Age, 2,
Survivors, 0.,
Raw Weights, .000,

FR-BB-OFF-Q2
Age, 2,
Survivors, 0.,
Raw Weights, .000,

FR-ORHAGO
Age, 2,
Survivors, 7307.,
Raw Weights, 18.765,

Fleet, Estimated, Int, Ext, Var, N, Scaled, Estimated

Table 6.7: cont'd

, Survivors, s.e, s.e, Ratio, , Weights, F

FR-SABLES , 1., .000, .000, .00, 0, .000, .000

FR-ROCHELLE , 1., .000, .000, .00, 0, .000, .000

FR-BB-IN-Q4 , 1., .000, .000, .00, 0, .000, .000

FR-BB-OFF-Q2 , 1., .000, .000, .00, 0, .000, .000

FR-ORHAGO , 7307., .203, .000, .00, 1, .977, .264

F shrinkage mean , 17641., 1.50,,,, .023, .118

Weighted prediction :

Survivors, Int, Ext, N, Var, F

at end of year, s.e, s.e, , Ratio,

7458., .20, .13, 2, .666, .259

1

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 2010

FR-SABLES

Age, 3, 2,

Survivors, 0., 0.,

Raw Weights, .000, .000,

FR-ROCHELLE

Age, 3, 2,

Survivors, 0., 0.,

Raw Weights, .000, .000,

FR-BB-IN-Q4

Age, 3, 2,

Survivors, 4947., 0.,

Raw Weights, 6.566, .000,

FR-BB-OFF-Q2

Age, 3, 2,

Survivors, 0., 8618.,

Raw Weights, .000, .491,

FR-ORHAGO

Age, 3, 2,

Survivors, 5649., 4571.,

Raw Weights, 16.100, 13.729,

Fleet, Estimated, Int, Ext, Var, N, Scaled, Estimated

, Survivors, s.e, s.e, Ratio, , Weights, F

FR-SABLES , 1., .000, .000, .00, 0, .000, .000

FR-ROCHELLE , 1., .000, .000, .00, 0, .000, .000

FR-BB-IN-Q4 , 4947., .313, .000, .00, 1, .176, .454

FR-BB-OFF-Q2 , 8618., 1.072, .000, .00, 1, .013, .285

FR-ORHAGO , 5125., .143, .106, .74, 2, .799, .441

F shrinkage mean , 6423., 1.50,,,, .012, .366

Weighted prediction :

Survivors, Int, Ext, N, Var, F

at end of year, s.e, s.e, , Ratio,

5142., .13, .06, 5, .448, .440

1

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2009

Table 6.7: cont'd

FR-SABLES

Age, 4, 3, 2,
Survivors, 0., 0., 0.,
Raw Weights, .000, .000, .000,

FR-ROCHELLE

Age, 4, 3, 2,
Survivors, 0., 0., 0.,
Raw Weights, .000, .000, .000,

FR-BB-IN-Q4

Age, 4, 3, 2,
Survivors, 7295., 8196., 0.,
Raw Weights, 3.379, 5.052, .000,

FR-BB-OFF-Q2

Age, 4, 3, 2,
Survivors, 0., 7013., 985.,
Raw Weights, .000, 3.862, .400,

FR-ORHAGO

Age, 4, 3, 2,
Survivors, 11172., 7082., 7473.,
Raw Weights, 4.387, 12.389, 11.178,

Fleet, Estimated, Int, Ext, Var, N, Scaled, Estimated
, Survivors, s.e, s.e, Ratio, , Weights, F

FR-SABLES , 1., .000, .000, .00, 0, .000, .000

FR-ROCHELLE , 1., .000, .000, .00, 0, .000, .000

FR-BB-IN-Q4 , 7822., .259, .057, .22, 2, .205, .381

FR-BB-OFF-Q2 , 5834., .340, .572, 1.68, 2, .104, .484

FR-ORHAGO , 7772., .135, .112, .83, 3, .680, .383

F shrinkage mean , 5418., 1.50,,,, .011, .513

Weighted prediction :

Survivors, Int, Ext, N, Var, F
at end of year, s.e, s.e, , Ratio,
7525., .11, .09, 8, .824, .394

1

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2008

FR-SABLES

Age,	5,	4,	3,	2,
Survivors,	0.,	0.,	0.,	0.,
Raw Weights,	.000,	.000,	.000,	.000,

FR-ROCHELLE

Age,	5,	4,	3,	2,
Survivors,	0.,	0.,	0.,	0.,
Raw Weights,	.000,	.000,	.000,	.000,

FR-BB-IN-Q4

Age,	5,	4,	3,	2,
Survivors,	3795.,	5958.,	2030.,	0.,
Raw Weights,	3.469,	1.503,	2.150,	.000,

Table 6.7: cont'd

FR-BB-OFF-Q2

Age,	5,	4,	3,	2,
Survivors,	0.,	2910.,	1615.,	754.,
Raw Weights,	.000,	3.264,	1.643,	.166,

FR-ORHAGO

Age,	5,	4,	3,	2,
Survivors,	9186.,	4350.,	2126.,	2654.,
Raw Weights,	.622,	1.952,	5.271,	4.629,

Fleet,	Estimated,	Int,	Ext,	Var,	N, Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F
FR-SABLES	,	1.,	.000,	.000,	.00, 0,	.000, .000
FR-ROCHELLE	,	1.,	.000,	.000,	.00, 0,	.000, .000
FR-BB-IN-Q4	,	3456.,	.226,	.276,	1.22, 3,	.284, .634
FR-BB-OFF-Q2	,	2301.,	.230,	.242,	1.05, 3,	.202, .845
FR-ORHAGO	,	2778.,	.136,	.211,	1.55, 4,	.497, .742
F shrinkage mean	,	6052.,	1.50,,,,			.018, .409

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2884.,	.11,	.13,	11,	1.191,	.723

1

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 2007

FR-SABLES

Age,	6,	5,	4,	3,	2,
Survivors,	0.,	0.,	0.,	0.,	2521.,
Raw Weights,	.000,	.000,	.000,	.000,	1.631,

FR-ROCHELLE

Age,	6,	5,	4,	3,	2,
Survivors,	0.,	0.,	0.,	0.,	1499.,
Raw Weights,	.000,	.000,	.000,	.000,	1.326,

FR-BB-IN-Q4

Age,	6,	5,	4,	3,	2,
Survivors,	3384.,	6210.,	2702.,	2603.,	0.,
Raw Weights,	3.997,	3.160,	1.243,	1.850,	.000,

FR-BB-OFF-Q2

Age,	6,	5,	4,	3,	2,
Survivors,	0.,	5057.,	5048.,	3441.,	630.,
Raw Weights,	.000,	1.242,	2.698,	1.414,	.145,

FR-ORHAGO

Age,	6,	5,	4,	3,	2,
Survivors,	12489.,	5836.,	1957.,	3366.,	5250.,
Raw Weights,	.303,	.566,	1.613,	4.537,	4.047,

Fleet,	Estimated,	Int,	Ext,	Var,	N, Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F
FR-SABLES	,	2521.,	.319,	.000,	.00, 1,	.054, .435
FR-ROCHELLE	,	1499.,	.354,	.000,	.00, 1,	.044, .651
FR-BB-IN-Q4	,	3787.,	.217,	.200,	.92, 4,	.339, .310
FR-BB-OFF-Q2	,	4333.,	.223,	.207,	.93, 4,	.182, .276
FR-ORHAGO	,	3901.,	.139,	.197,	1.42, 5,	.366, .302

Table 6.7: cont'd

F shrinkage mean , 3018., 1.50,,,, .015, .376

Weighted prediction :

Survivors, Int, Ext, N, Var, F
at end of year, s.e, s.e, , Ratio,
3673., .10, .11, 16, 1.033, .318

1
Age 7 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 2006

FR-SABLES

Age,	7,	6,	5,	4,	3,	2,
Survivors,	0.,	0.,	0.,	0.,	1629.,	1670.,
Raw Weights,	.000,	.000,	.000,	.000,	4.149,	1.381,

FR-ROCHELLE

Age,	7,	6,	5,	4,	3,	2,
Survivors,	0.,	0.,	0.,	0.,	1652.,	1774.,
Raw Weights,	.000,	.000,	.000,	.000,	2.197,	1.123,

FR-BB-IN-Q4

Age,	7,	6,	5,	4,	3,	2,
Survivors,	1257.,	1384.,	1260.,	1912.,	1216.,	0.,
Raw Weights,	3.558,	3.106,	3.095,	1.218,	1.744,	.000,

FR-BB-OFF-Q2

Age,	7,	6,	5,	4,	3,	2,

Table 6.7: cont'd

Survivors, 0., 954., 1006., 1879., 1301., 3590.,
Raw Weights, .000, .763, 1.216, 2.645, 1.333, .123,

FR-ORHAGO

Age, 7, 6, 5, 4, 3, 2,
Survivors, 3705., 3246., 551., 1200., 1858., 1159.,
Raw Weights, 1.460, .235, .555, 1.581, 4.277, 3.428,

Fleet,	Estimated,	Int,	Ext,	Var,	N, Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	, Weights,	F
FR-SABLES	, 1639.,	.172,	.011,	.06,	2, .140,	.148
FR-ROCHELLE	, 1692.,	.220,	.034,	.15,	2, .084,	.144
FR-BB-IN-Q4	, 1334.,	.204,	.063,	.31,	5, .321,	.179
FR-BB-OFF-Q2	, 1423.,	.223,	.156,	.70,	5, .153,	.169
FR-ORHAGO	, 1584.,	.155,	.202,	1.30,	6, .291,	.153

F shrinkage mean , 425., 1.50,,,, .011, .480

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
1468.,	.09,	.07,	21,	.778,	.164

Table 6.8: Bay of Biscay Sole, Fishing mortality (F) at age

Terminal Fs derived using XSA (With F shrinkage)

	YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
	AGE											
	2	0.2966	0.36	0.2575	0.1743	0.2169	0.2026	0.2653	0.1439	0.1484	0.0834	0.11
	3	0.243	0.3537	0.2708	0.3546	0.3986	0.436	0.3836	0.3526	0.3188	0.3536	0.3269
	4	0.3357	0.2721	0.3176	0.3457	0.4306	0.4264	0.5239	0.461	0.4538	0.4979	0.7508
	5	0.3478	0.3718	0.3868	0.3709	0.3461	0.5918	0.5761	0.4438	0.5604	0.6392	0.7393
	6	0.3194	0.2291	0.4837	0.4097	0.421	0.5238	0.3223	0.4128	1.0867	0.6	0.7585
	7	0.3352	0.2917	0.3973	0.3766	0.4005	0.5159	0.4757	0.6156	0.845	0.7975	0.7816
	+gp	0.3352	0.2917	0.3973	0.3766	0.4005	0.5159	0.4757	0.6156	0.845	0.7975	0.7816
0	FBAR 3- 6	0.3115	0.3066	0.3647	0.3702	0.3991	0.4945	0.4515	0.4176	0.6049	0.5227	0.6439

	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	AGE											
	2	0.1561	0.1143	0.1844	0.2115	0.1309	0.2731	0.2199	0.2472	0.2023	0.2347	0.2574
	3	0.3281	0.3534	0.5132	0.3957	0.393	0.4785	0.5093	0.5249	0.4719	0.3768	0.3522
	4	0.6804	0.5274	0.6667	0.7309	0.6364	0.7662	0.6507	0.8087	0.4417	0.4271	0.4295
	5	0.7171	0.5059	0.5703	0.596	0.7298	0.7199	0.5789	1.0045	0.416	0.29	0.533
	6	0.5635	0.7756	0.6737	0.4203	0.7197	0.5282	0.5311	0.9655	0.5987	0.3695	0.5139
	7	0.7708	1.0119	0.7511	0.752	0.5465	0.467	0.5329	0.7547	0.7633	0.4126	0.4224
	+gp	0.7708	1.0119	0.7511	0.752	0.5465	0.467	0.5329	0.7547	0.7633	0.4126	0.4224
0	FBAR 3- 6	0.5722	0.5406	0.606	0.5357	0.6197	0.6232	0.5675	0.8259	0.4821	0.3659	0.4571

	YEAR	2006	2007	2008	2009	2010	2011	2012	2013	FBAR **-**
	AGE									
	2	0.2176	0.2542	0.1934	0.0863	0.102	0.0749	0.1313	0.2589	0.155
	3	0.4493	0.5005	0.502	0.3513	0.3124	0.3528	0.3083	0.4401	0.3671
	4	0.4621	0.4613	0.5106	0.4089	0.5772	0.578	0.481	0.3938	0.4843
	5	0.3843	0.4085	0.4082	0.4828	0.3828	0.2666	0.4982	0.7229	0.4959
	6	0.4263	0.3929	0.4598	0.4935	0.25	0.2626	0.4065	0.3181	0.3291
	7	0.5059	0.4964	0.4714	0.4653	0.2238	0.1964	0.1404	0.164	0.1669
	+gp	0.5059	0.4964	0.4714	0.4653	0.2238	0.1964	0.1404	0.164	
0	FBAR 3- 6	0.4305	0.4408	0.4701	0.4341	0.3806	0.365	0.4235	0.4687	

Table 6.9: Bay of Biscay Sole, Stock number at age (start of year) Numbers*10-3**

Terminal Fs derived using XSA (With F shrinkage)

	YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
	AGE											
	2	24168	29535	28365	24939	26755	28190	32127	35773	35365	24922	26261
	3	15418	16255	18646	19839	18956	19489	20829	22295	28029	27586	20746
	4	10270	10941	10327	12869	12592	11514	11402	12843	14179	18438	17526
	5	7280	6643	7542	6801	8240	7407	6801	6110	7329	8149	10140
	6	4475	4652	4144	4635	4247	5275	3708	3459	3547	3786	3892
	7	3248	2942	3348	2312	2784	2522	2827	2431	2071	1083	1880
	+gp	4345	3021	3946	2384	2431	1296	2405	2231	1740	1345	1340
0	TOTAL	69204	73988	76317	73778	76005	75692	80101	85142	92261	85309	81784

	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	AGE											
	2	23631	29458	23726	22585	24431	24972	16933	24951	24532	17143	18421
	3	21286	18291	23775	17853	16539	19394	17196	12297	17632	18132	12267
	4	13538	13874	11623	12876	10875	10102	10875	9350	6583	9953	11255
	5	7485	6203	7408	5400	5610	5207	4248	5134	3768	3829	5875
	6	4381	3306	3384	3790	2692	2447	2294	2155	1701	2249	2593
	7	1649	2256	1377	1561	2252	1186	1305	1220	742	846	1407
	+gp	1916	2160	1734	2347	2427	1246	1231	851	489	1032	1544
0	TOTAL	73885	75548	73029	66411	64826	64553	54083	55958	55448	53183	53361

	YEAR	2006	2007	2008	2009	2010	2011	2012	2013	2014	GMST 84-**	AMST 84-**
	AGE											
	2	19003	18197	18971	36376	22598	22091	11120	10678	0	24615	25158
	3	12886	13832	12770	14147	30193	18465	18547	8823	7458	18233	18752
	4	7804	7440	7588	6994	9009	19989	11741	12330	5142	11102	11522
	5	6628	4449	4244	4120	4205	4577	10147	6567	7525	5898	6101
	6	3120	4084	2675	2553	2300	2595	3172	5579	2884	3234	3362
	7	1403	1843	2495	1529	1410	1621	1806	1912	3673	1780	1913
	+gp	4051	2530	3322	2701	1486	3036	4142	4170	4671		
0	TOTAL	54896	52375	52065	68420	71202	72374	60674	50059	31352		

Table 6.10: Bay of Biscay Sole, Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR3-6
1984	24168	14818	12323	4038	0.3277	0.3115
1985	29535	16063	13370	4251	0.3179	0.3066
1986	28365	17077	14485	4805	0.3317	0.3647
1987	24939	18668	15489	5086	0.3284	0.3702
1988	26755	18525	15372	5382	0.3501	0.3991
1989	28190	17800	14481	5845	0.4036	0.4945
1990	32127	18422	14844	5916	0.3985	0.4515
1991	35773	19129	14822	5569	0.3757	0.4176
1992	35365	20563	16007	6550	0.4092	0.6049
1993	24922	19939	16410	6420	0.3912	0.5227
1994	26261	19335	15891	7229	0.4549	0.6439
1995	23631	17707	14288	6205	0.4343	0.5722
1996	29458	17803	13872	5854	0.422	0.5406
1997	23726	16538	13377	6259	0.4679	0.606
1998	22585	16518	13303	6027	0.4531	0.5357
1999	24431	16033	12397	5249	0.4234	0.6197
2000	24972	15585	11915	5760	0.4834	0.6232
2001	16933	13109	10629	4836	0.455	0.5675
2002	24951	13232	9823	5486	0.5585	0.8259
2003	24532	13412	9671	4108	0.4248	0.4821
2004	17143	14245	11244	4002	0.3559	0.3659
2005	18421	14550	11611	4539	0.3909	0.4571
2006	19003	15433	12317	4793	0.3891	0.4305
2007	18197	14463	11529	4363	0.3784	0.4408
2008	18971	14512	11544	4299	0.3724	0.4701
2009	36376	16642	11558	3650	0.3158	0.4341
2010	22598	17897	13781	3966	0.2878	0.3806
2011	22091	19922	15919	4632	0.291	0.365
2012	11120	17657	15340	4321	0.2817	0.4235
2013	10678	15804	13709	4234	0.3088	0.4687
Arith. Mean	24207	16713	13377	5122	0.3861	0.4832
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		
GM 93-2011 =	22699					

Table 6.11: Multifleet prediction input data

Sole in Bay of Biscay
Multi fleet input data

MFDP version 1a
Run: 2014_
Time and date: 15:35 22/05/2014
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input Fs are 2011-2013 means at age 2 to 8
Catch and stock wts are 2011-2013 means
Recruits are 1993-2011 GM
unscaled F

2014

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	22699	0.1	0.32	0	0	0.207	0.1550	0.194
3	7458	0.1	0.83	0	0	0.244	0.3671	0.229
4	5142	0.1	0.97	0	0	0.277	0.4843	0.261
5	7525	0.1	1	0	0	0.337	0.4959	0.318
6	2884	0.1	1	0	0	0.410	0.3291	0.388
7	3673	0.1	1	0	0	0.499	0.1669	0.474
8	4671	0.1	1	0	0	0.601	0.1669	0.572

2015

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	22699	0.1	0.32	0	0	0.207	0.1550	0.194
3		0.1	0.83	0	0	0.244	0.3671	0.229
4		0.1	0.97	0	0	0.277	0.4843	0.261
5		0.1	1	0	0	0.337	0.4959	0.318
6		0.1	1	0	0	0.410	0.3291	0.388
7		0.1	1	0	0	0.499	0.1669	0.474
8		0.1	1	0	0	0.601	0.1669	0.572

2016

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	22699	0.1	0.32	0	0	0.207	0.1550	0.194
3		0.1	0.83	0	0	0.244	0.3671	0.229
4		0.1	0.97	0	0	0.277	0.4843	0.261
5		0.1	1	0	0	0.337	0.4959	0.318
6		0.1	1	0	0	0.410	0.3291	0.388
7		0.1	1	0	0	0.499	0.1669	0.474
8		0.1	1	0	0	0.601	0.1669	0.572

Input units are thousands and kg - output in tonnes

Table 6.12: Bay of Biscay Sole Multifleet prediction, management option table

MFDP version 1a
Run: 2014_
Time and date: 15:35 22/05/2014
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Basis

F(2014) = mean F(11-13) unscaled (age 2 to above)
R14 = GM (1993 to n-2) = 22.7 million

2014

Biomass	SSB	Landings FMult	Landings FBar	Yield
16299	12752	1.0000	0.4191	3435

2015

Biomass	SSB	Landings FMult	Landings FBar	Landing Yield	2016 Biomass	SSB
17727	13763	0.0000	0.0000	0	22975	18795
.	13763	0.1000	0.0419	421	22485	18324
.	13763	0.2000	0.0838	828	22011	17867
.	13763	0.3000	0.1257	1223	21552	17425
.	13763	0.4000	0.1676	1606	21108	16998
.	13763	0.5000	0.2095	1976	20678	16584
.	13763	0.6000	0.2514	2336	20261	16184
.	13763	0.7000	0.2934	2684	19858	15796
.	13763	0.8000	0.3353	3022	19467	15421
.	13763	0.9000	0.3772	3350	19089	15058
.	13763	1.0000	0.4191	3668	18722	14706
.	13763	1.1000	0.4610	3976	18366	14365
.	13763	1.2000	0.5029	4275	18022	14034
.	13763	1.3000	0.5448	4566	17688	13714
.	13763	1.4000	0.5867	4847	17364	13404
.	13763	1.5000	0.6286	5121	17050	13103
.	13763	1.6000	0.6705	5386	16745	12812
.	13763	1.7000	0.7124	5644	16449	12529
.	13763	1.8000	0.7543	5895	16163	12255
.	13763	1.9000	0.7962	6138	15884	11989
.	13763	2.0000	0.8382	6374	15614	11731

Bpa = 13000 t
Fpa = 0.42

Input units are thousands and kg - output in tonnes

Table 6.13: Bay of Biscay sole - Detailed predictions

MFDP version 1a
Run: 2014_
Time and date: 15:35 22/05/2014
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Year: 2014 F multiplier: 1 Fleet1 HCFba 0.4191

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.155	3106	603	22699	4699	7264	1504	7264	1504
3	0.3671	2187	501	7458	1820	6190	1510	6190	1510
4	0.4843	1886	492	5142	1424	4988	1382	4988	1382
5	0.4959	2811	894	7525	2533	7525	2533	7525	2533
6	0.3291	772	300	2884	1181	2884	1181	2884	1181
7	0.1669	538	255	3673	1834	3673	1834	3673	1834
8	0.1669	684	391	4671	2807	4671	2807	4671	2807
Total		11985	3435	54052	16299	37195	12752	37195	12752

Year: 2015 F multiplier: 1 Fleet1 HCFba 0.4191

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.155	3106	603	22699	4699	7264	1504	7264	1504
3	0.3671	5158	1181	17589	4292	14599	3562	14599	3562
4	0.4843	1715	447	4675	1295	4535	1256	4535	1256
5	0.4959	1071	341	2867	965	2867	965	2867	965
6	0.3291	1110	431	4147	1699	4147	1699	4147	1699
7	0.1669	275	130	1878	938	1878	938	1878	938
8	0.1669	936	535	6389	3840	6389	3840	6389	3840
Total		13371	3668	60244	17727	41678	13763	41678	13763

Year: 2016 F multiplier: 1 Fleet1 HCFba 0.4191

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.155	3106	603	22699	4699	7264	1504	7264	1504
3	0.3671	5158	1181	17589	4292	14599	3562	14599	3562
4	0.4843	4044	1054	11026	3054	10695	2962	10695	2962
5	0.4959	974	310	2606	877	2606	877	2606	877
6	0.3291	423	164	1580	647	1580	647	1580	647
7	0.1669	396	188	2700	1348	2700	1348	2700	1348
8	0.1669	927	530	6330	3804	6330	3804	6330	3804
Total		15028	4029	64530	18722	45774	14706	45774	14706

Input units are thousands and kg - output in tonnes

Table 6.14: 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	2014
Stock No. (thousands) of 2 year-olds	22091	11120	10678	22699	22699	22699
Source	XSA	XSA	XSA	GM93-2011	GM93-2011	GM93-2011
Status Quo F:						
% in 2014 landings	26.0	14.3	14.6	17.5	-	-
% in 2015	11.8	9.3	12.2	32.2	16.4	-
% in 2014 SSB	19.9	10.8	11.8	11.8	-	-
% in 2015 SSB	12.3	7.0	9.1	25.9	10.9	-
% in 2016 SSB	9.2	4.4	6.0	20.1	24.2	10.2

GM : geometric mean recruitment

Sole in VIIIa,b : Year-class % contribution to

a) 2015 landings **b) 2016 SSB**

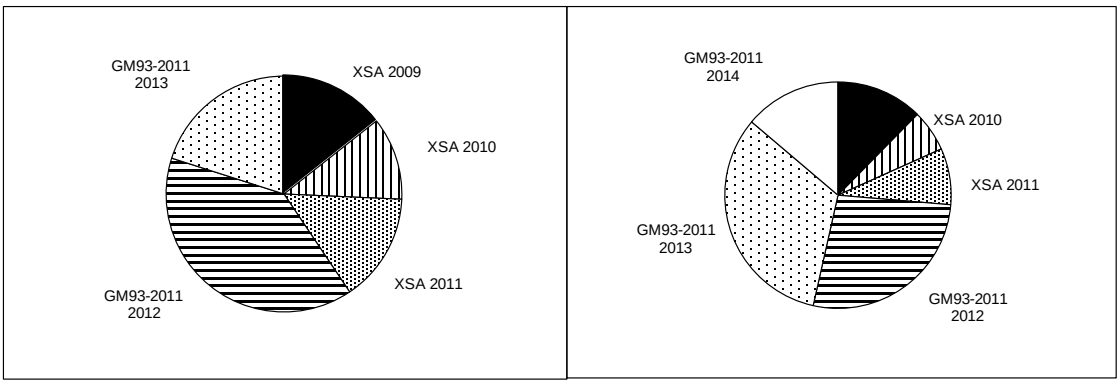


Table 6.15a: Bay of Biscay Sole Multifleet Yield per recruit

MFYPR version 2a
Run: 2014_
Time and date: 15:37 22/05/2014
Yield per results

Landings FMult	Landings Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	10.5083	4.9475	9.6499	4.7624	9.6499	4.7624
0.1000	0.0419	0.2011	0.0762	8.5000	3.8059	7.6452	3.6217	7.6452	3.6217
0.2000	0.0838	0.3429	0.1240	7.0844	3.0138	6.2332	2.8305	6.2332	2.8305
0.3000	0.1257	0.4465	0.1545	6.0512	2.4455	5.2033	2.2631	5.2033	2.2631
0.4000	0.1676	0.5243	0.1743	5.2757	2.0270	4.4312	1.8454	4.4312	1.8454
0.5000	0.2095	0.5841	0.1870	4.6804	1.7121	3.8392	1.5314	3.8392	1.5314
0.6000	0.2514	0.6310	0.1952	4.2145	1.4710	3.3764	1.2910	3.3764	1.2910
0.7000	0.2934	0.6684	0.2004	3.8437	1.2834	3.0086	1.1043	3.0086	1.1043
0.8000	0.3353	0.6987	0.2035	3.5441	1.1356	2.7120	0.9572	2.7120	0.9572
0.9000	0.3772	0.7235	0.2052	3.2988	1.0176	2.4696	0.8399	2.4696	0.8399
1.0000	0.4191	0.7441	0.2060	3.0954	0.9223	2.2691	0.7454	2.2691	0.7454
1.1000	0.4610	0.7614	0.2063	2.9249	0.8446	2.1014	0.6684	2.1014	0.6684
1.2000	0.5029	0.7762	0.2061	2.7804	0.7805	1.9596	0.6050	1.9596	0.6050
1.3000	0.5448	0.7888	0.2057	2.6568	0.7273	1.8386	0.5524	1.8386	0.5524
1.4000	0.5867	0.7997	0.2051	2.5500	0.6826	1.7343	0.5083	1.7343	0.5083
1.5000	0.6286	0.8093	0.2045	2.4569	0.6447	1.6438	0.4711	1.6438	0.4711
1.6000	0.6705	0.8177	0.2038	2.3752	0.6124	1.5645	0.4394	1.5645	0.4394
1.7000	0.7124	0.8252	0.2031	2.3028	0.5845	1.4946	0.4121	1.4946	0.4121
1.8000	0.7543	0.8319	0.2024	2.2384	0.5604	1.4324	0.3886	1.4324	0.3886
1.9000	0.7962	0.8379	0.2017	2.1805	0.5393	1.3768	0.3680	1.3768	0.3680
2.0000	0.8382	0.8433	0.2011	2.1282	0.5207	1.3268	0.3500	1.3268	0.3500

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.4191
FMax	1.1008	0.4613
F0.1	0.5124	0.2147
F35%SPR	0.4535	0.1900

Weights in kilograms

Table 6.15b: Bay of Biscay Sole Multifleet Yield per recruit (Long term equilibrium)

Long-term equilibrium at F status quo

landings	SSB
Yield * GM	SSBSpwn * GM
4676	16920

GM (93-11) for recruits (age 2)
22699

Table 6.16a: PlotMSY results: values of F_{MSY} reference points estimated for the 3 stock recruitment relationships (data range: 1984 to 2012)

	Ricker	Beverton-Holt	Smooth hockeystick
Deterministic	0.298	0.186	0.385
Mean	0.310	0.194	0.397
5%ile	0.233	0.150	0.293
25%ile	0.270	0.172	0.347
50%ile	0.301	0.188	0.390
75%ile	0.340	0.211	0.443
95%ile	0.419	0.258	0.520
CV	0.184	0.175	0.176
N	999	1000	1000

Table 6.16b: PlotMSY results: values of F_{MSY} reference points estimated for the 3 stock recruitment relationships (data range: 1984 to 2013)

	Ricker	Beverton-Holt	Smooth hockeystick
Deterministic	0.386	0.242	0.461
Mean	0.399	0.244	0.460
5%ile	0.246	0.160	0.368
25%ile	0.309	0.192	0.413
50%ile	0.376	0.229	0.452
75%ile	0.460	0.281	0.499
95%ile	0.626	0.370	0.577
CV	0.341	0.282	0.143
N	1000	1000	1000

Table 6.17a & b: PlotMSY results: aggregated percentiles (models equally weighted)

a)

Percentage	Fmsy
0.05	0.163
0.25	0.210
0.5	0.295
0.75	0.372
0.95	0.471

Data range (1984 to 2012)

b)

Percentage	Fmsy
0.05	0.178
0.25	0.261
0.5	0.372
0.75	0.455
0.95	0.566

Data range (1984 to 2013)

Table 6.18a: PlotMSY results: weights of each stock recruitment relationship (data range: 1984 to 2012)

Automatically specified weights

Ricker	Beverton-Holt	Smooth hockeystick
0.211	0.539	0.250

Table 6.18b: PlotMSY results: weights of each stock recruitment relationship (data range: 1984 to 2013)

Automatically specified weights

Ricker	Beverton-Holt	Smooth hockeystick
0.082	0.473	0.445

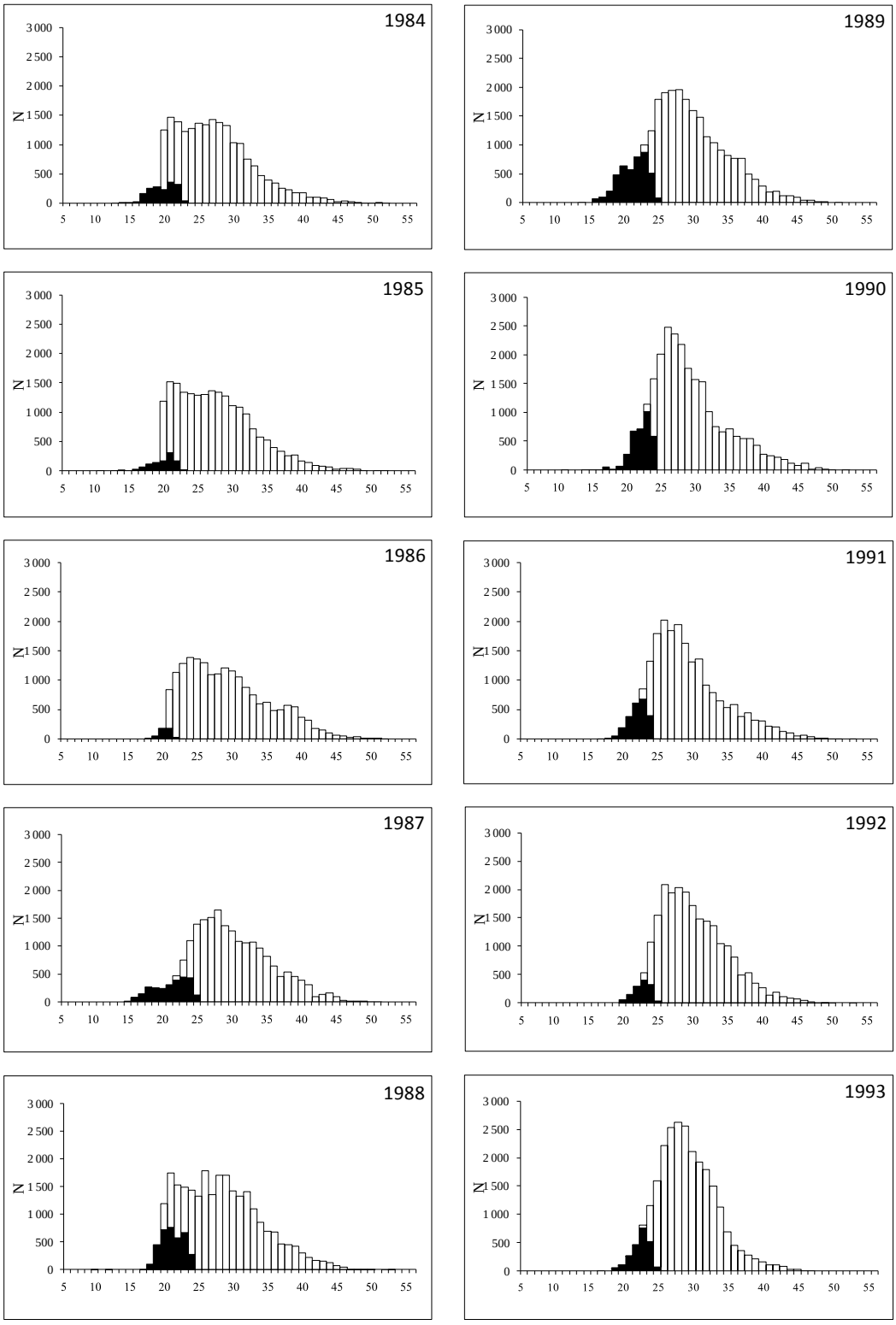


Figure 6.1 a: **Bay of Biscay sole French length distribution from 1984 to 1993**

Total French landings

Discard estimates of the French offshore trawlers fleet

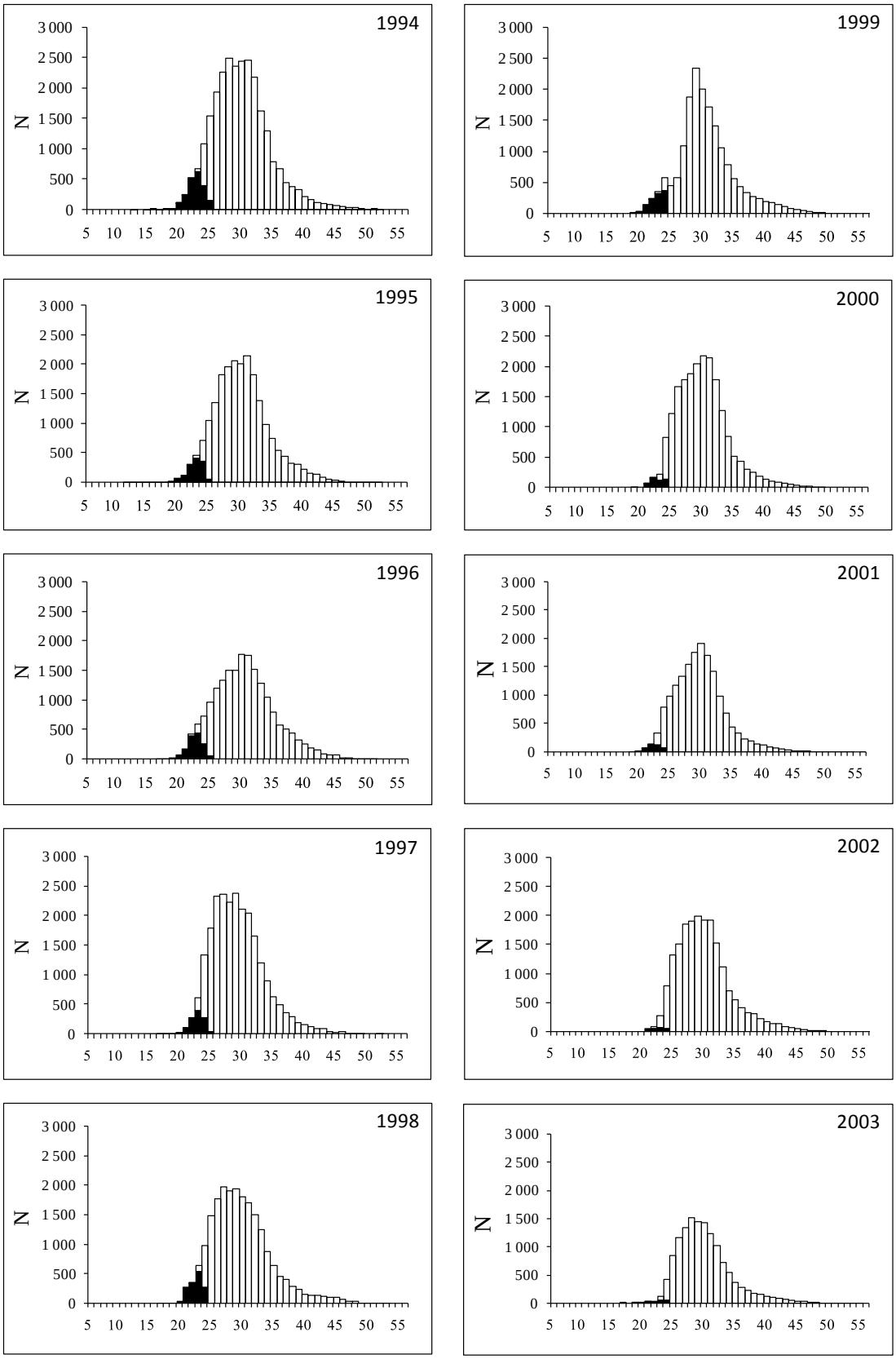


Figure 6.1 b: **Bay of Biscay sole French length distribution from 1994 to 2003**

Total French landings

Discard estimates of the French offshore trawler fleet (1994 to 2003)

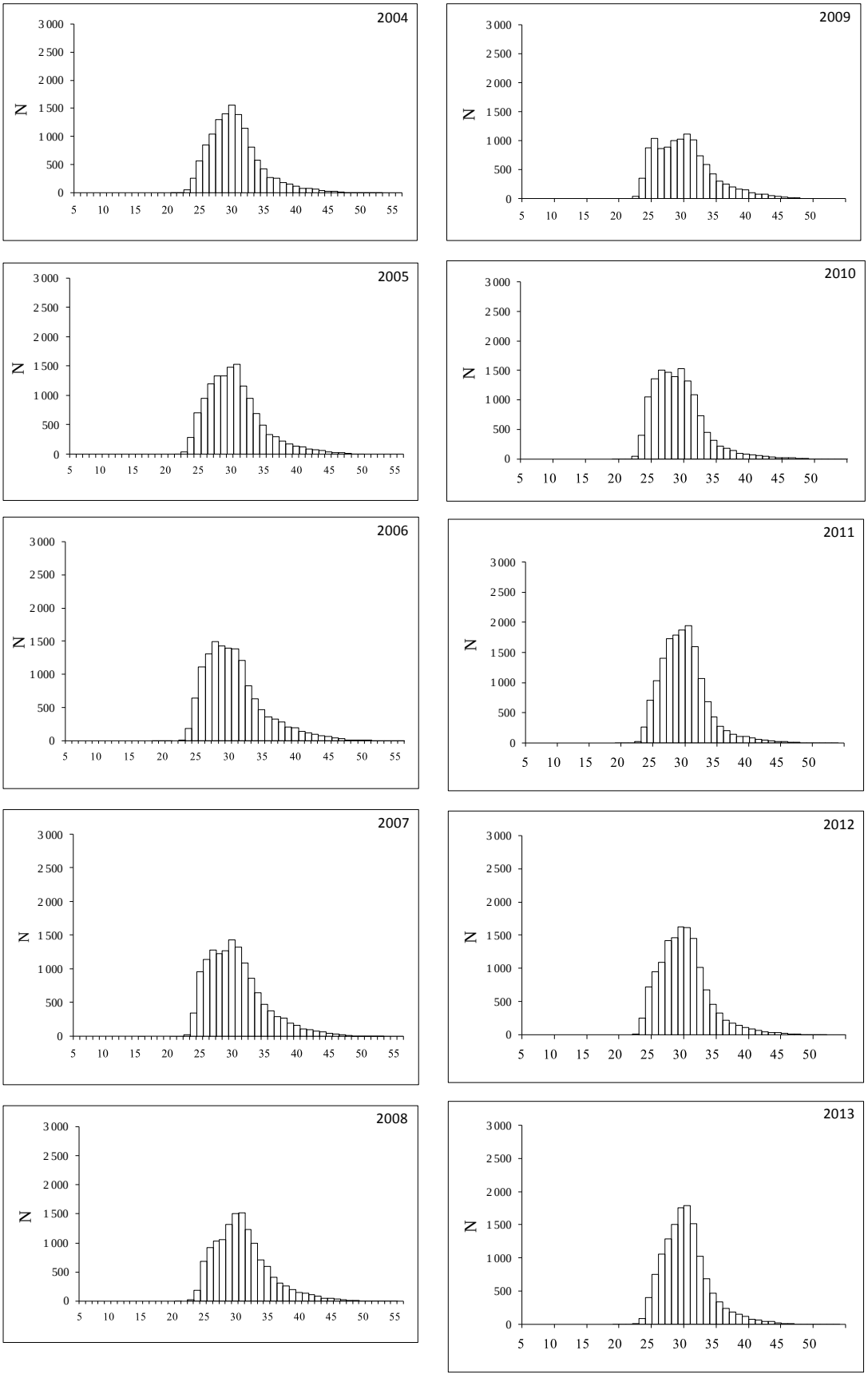
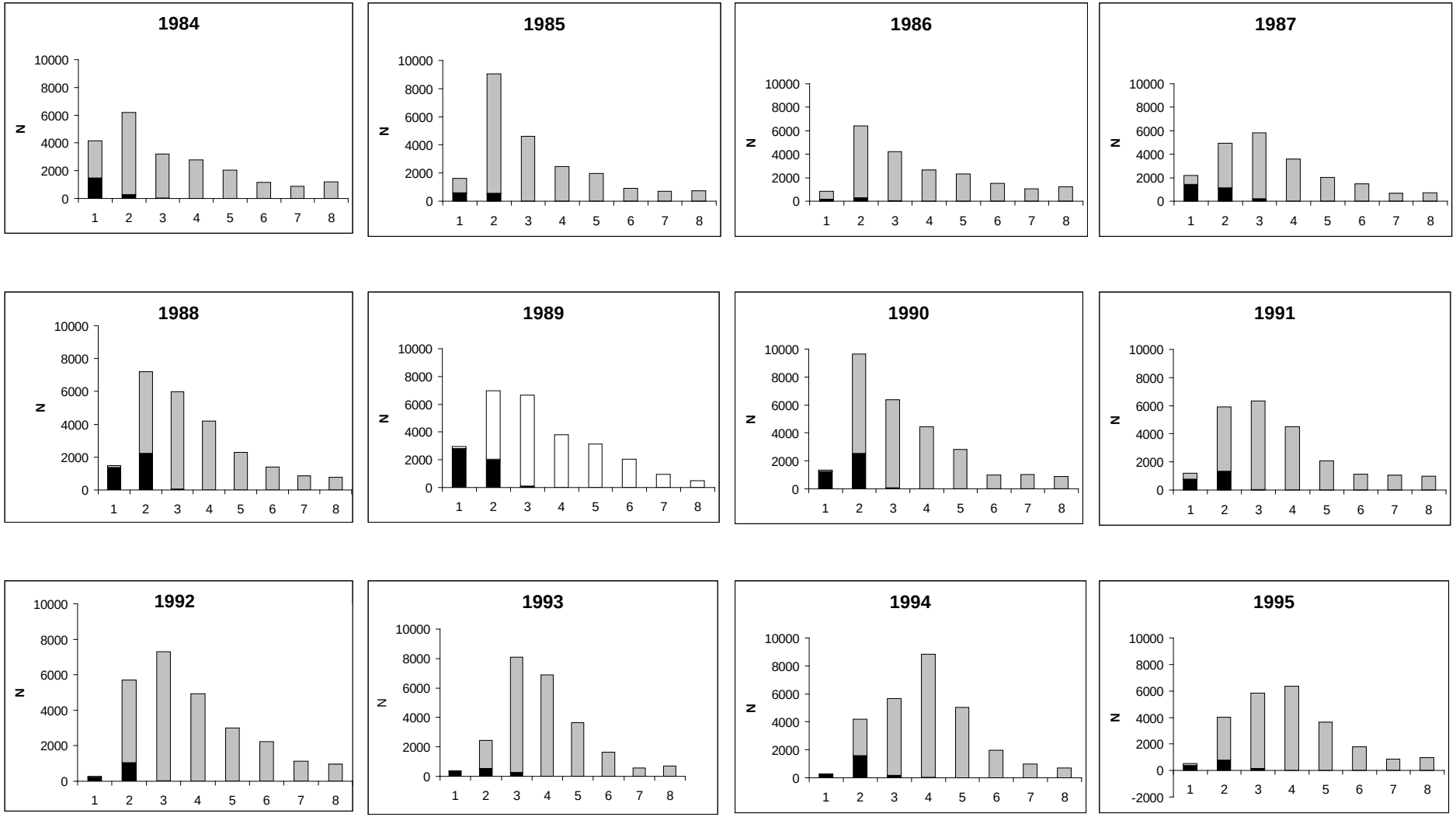


Figure 6.1 c: Bay of Biscay sole French length distribution from 2004 to 2013


1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
N
10000
8000
6000
4000
2000
0
-2000
1 2 3 4 5 6 7 8

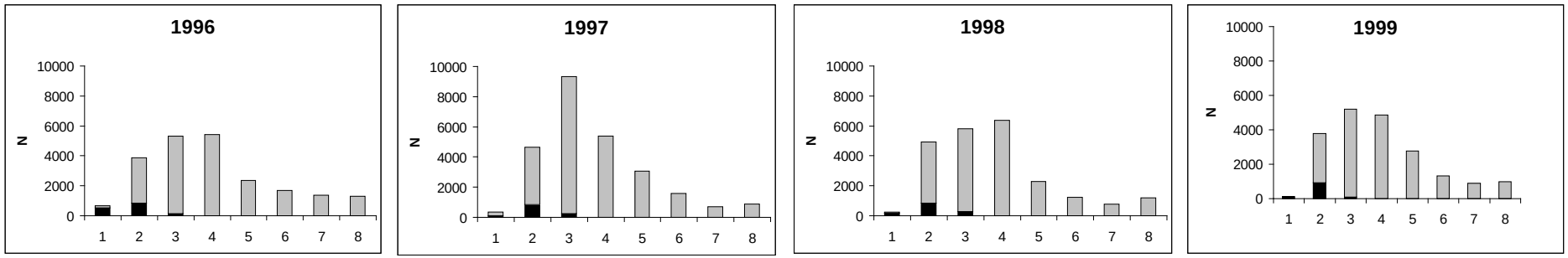
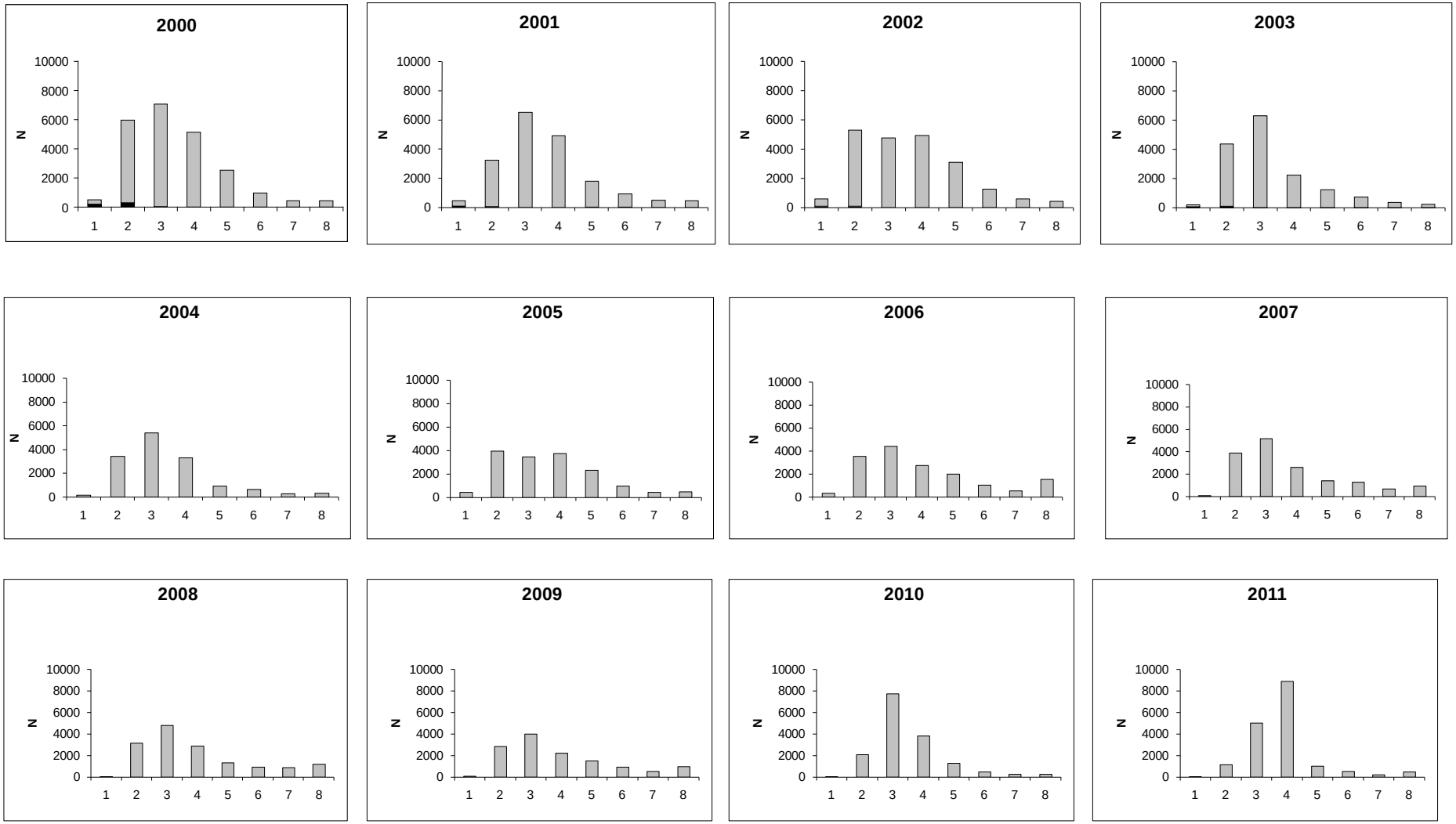


Figure 6.2 a: **Bay of Biscay sole landings and discards age distributions from 1984 to 1999 (numbers in thousands)**


2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
N
0
2000
4000
6000
8000
10000
1
2
3
4
5
6
7
8

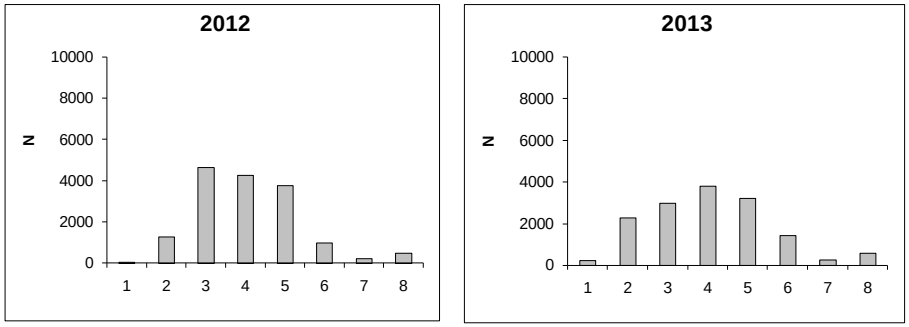


Figure 6.2 b: **Bay of Biscay sole landings and discards age distributions from 2000 to 2013 ; landings age distribution since 2004 (numbers in thousands)**

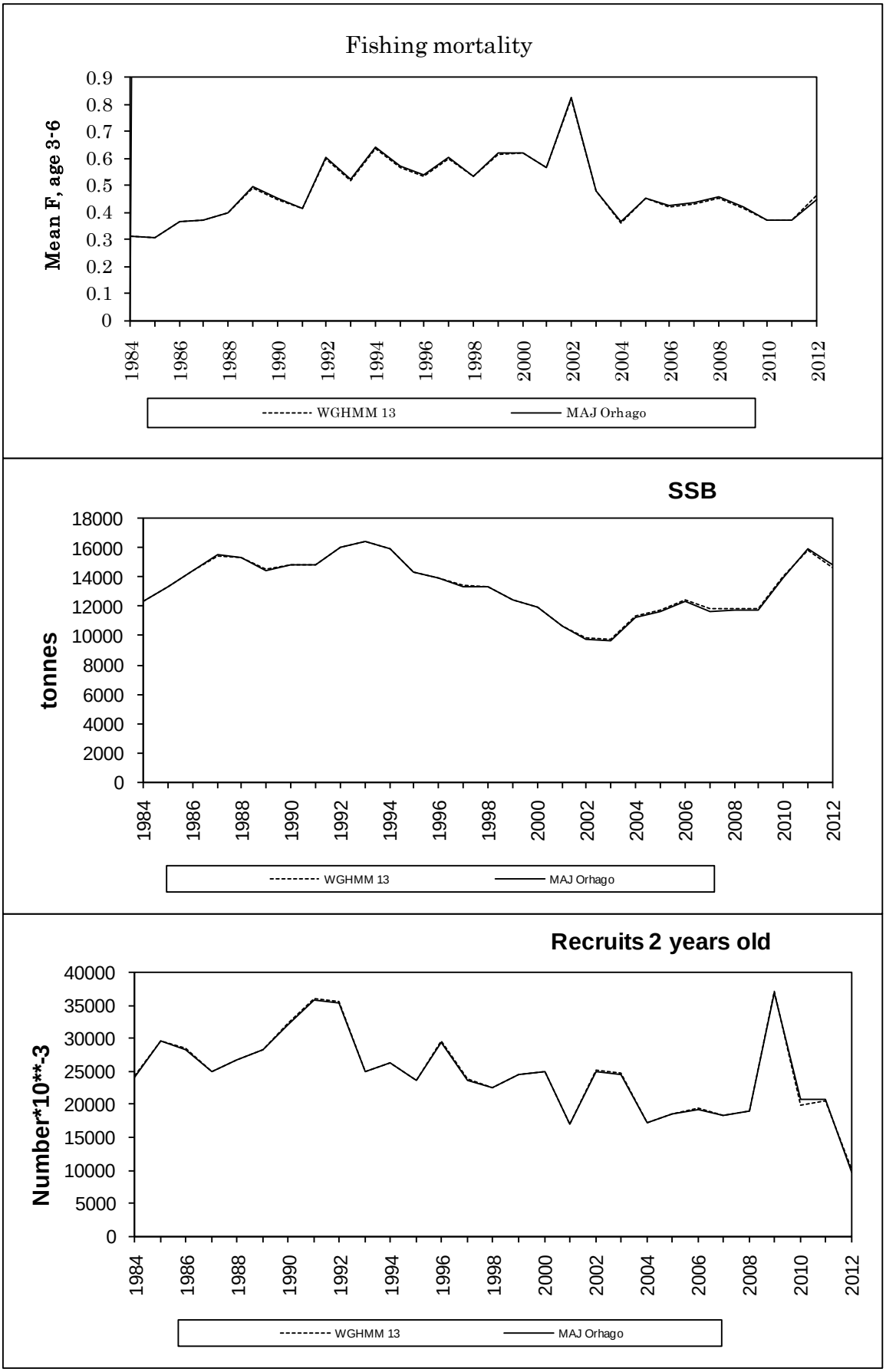


Figure 6.3: Bay of Biscay sole (Division VIIIa,b) – comparison WG13 vs WG13 with Orhago survey corrected in 2014.

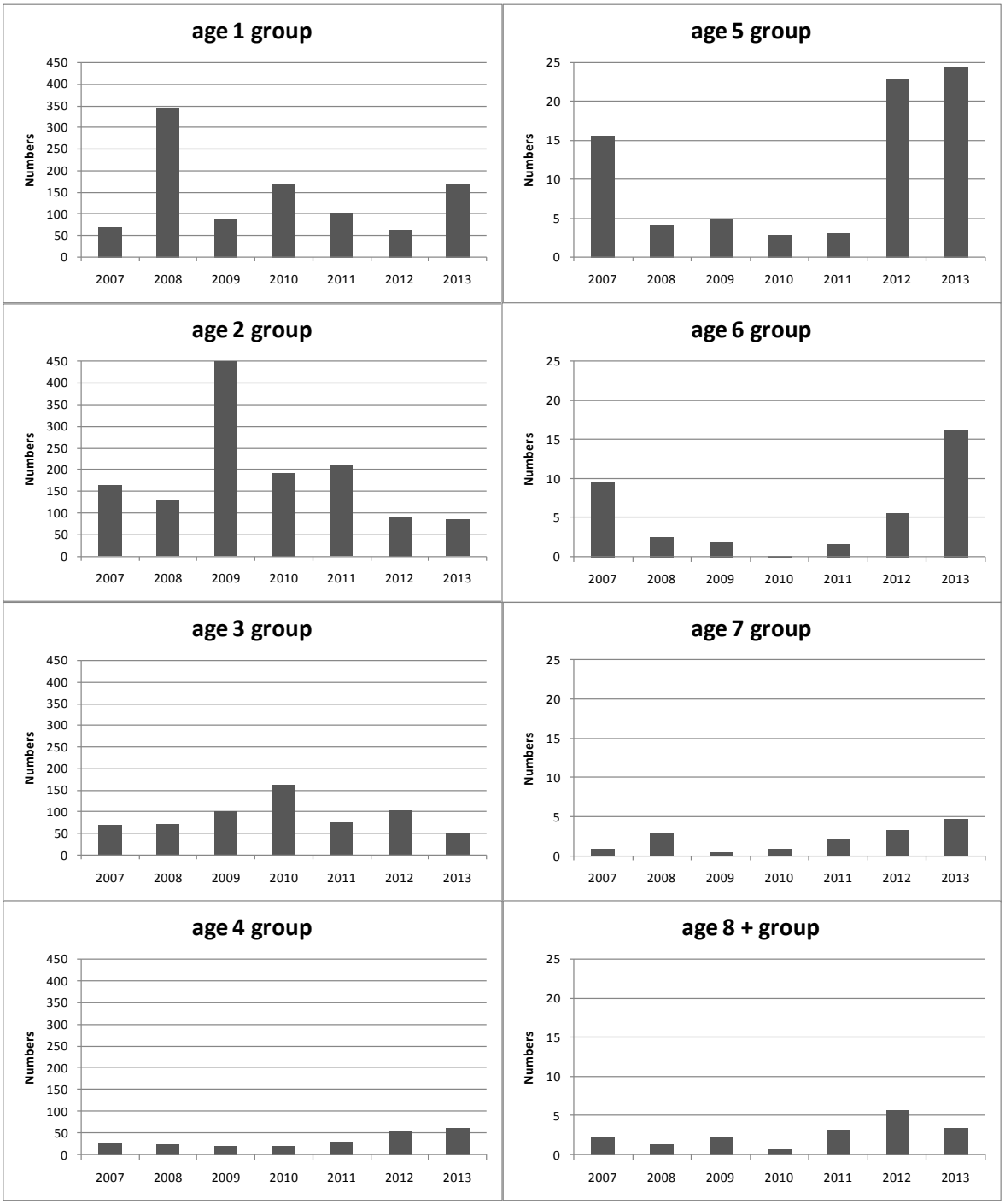


Figure 6.4: Orhago survey time series

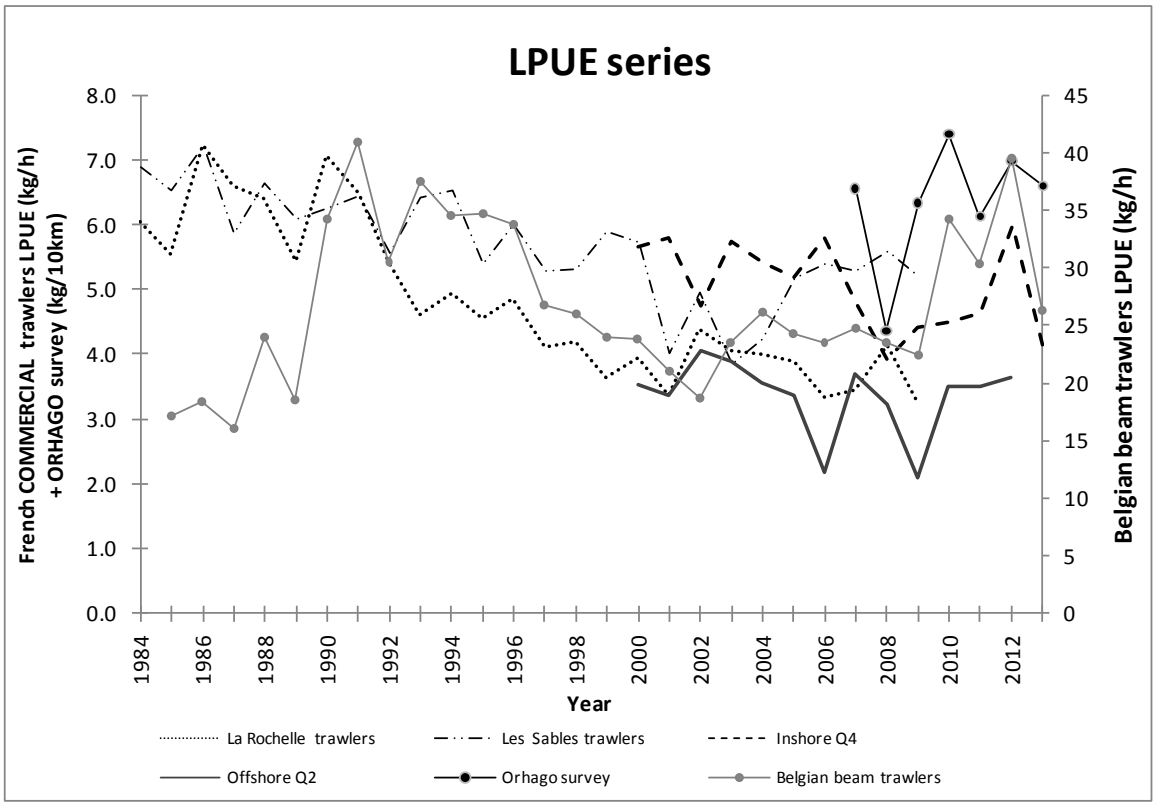


Figure 6.5: Bay of Biscay sole (Division VIIIa,b). LPUE trends of the 5 available commercial tuning fleets and CPUE of the ORHAGO survey (for sole greater than the minimum landing size, i.e. 24cm)

LOG CATCHABILITY RESIDUAL PLOTS (XSA)

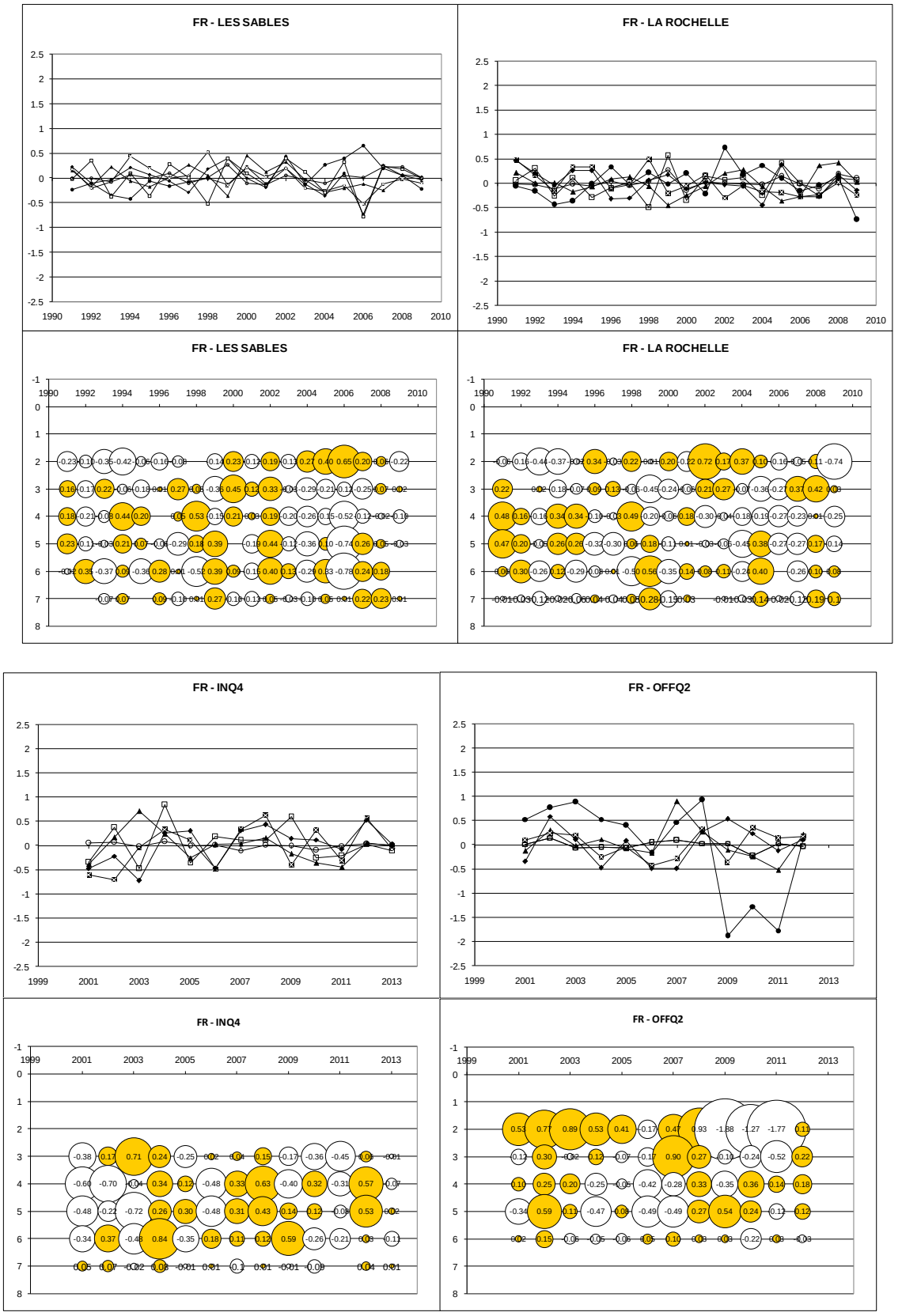


Figure 6.6a: Bay of Biscay sole (Division VIIIa,b)

XSA (No Taper, mean q, s.e. shrink = 1.5, s.e. min = .2)

LOG CATCHABILITY RESIDUAL PLOTS (XSA)

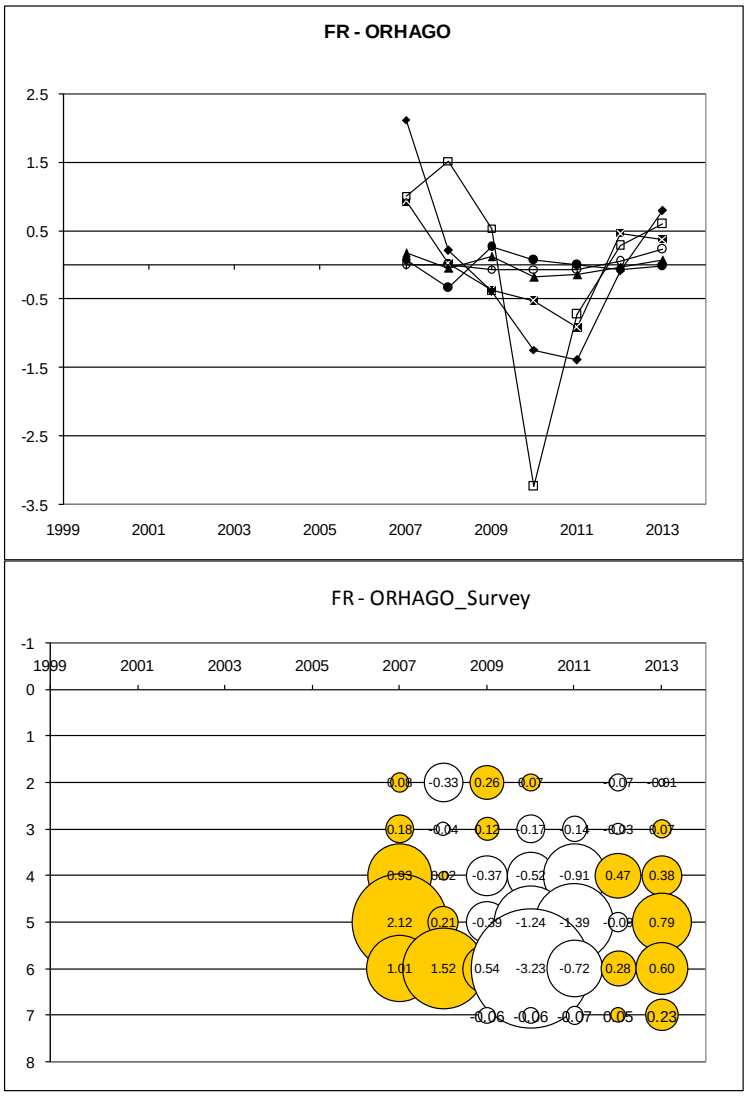


Figure 6.6b: Bay of Biscay sole (Division VIIIa,b)

XSA (No Taper, mean q, s.e. shrink = 1.5, s.e. min = .2)

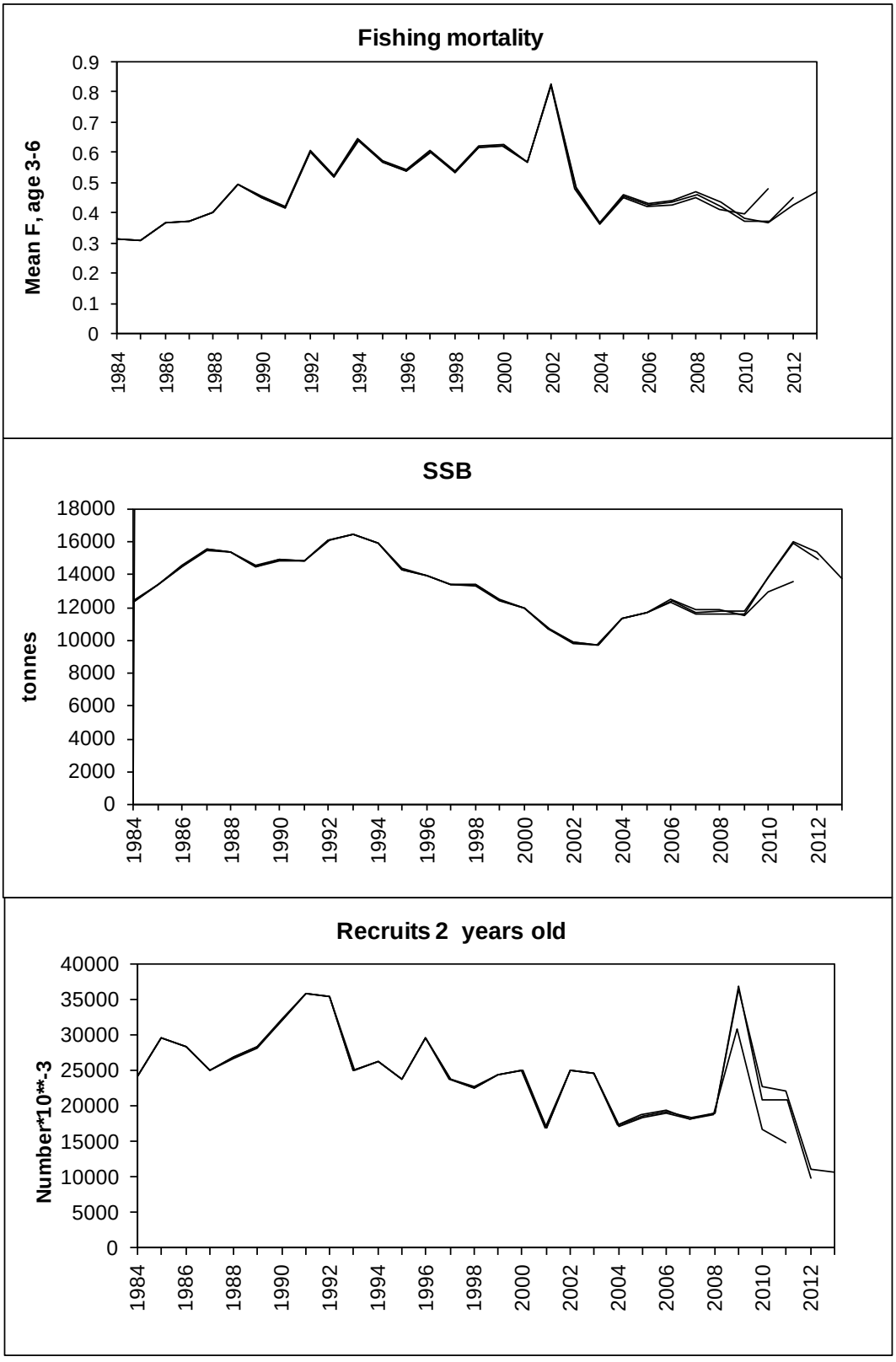


Figure 6.7: Bay of Biscay sole (Division VIIIa,b) - Retrospective results

(No taper, q indep. stock size all ages, q indep. of age>=6, shr.=1.5)

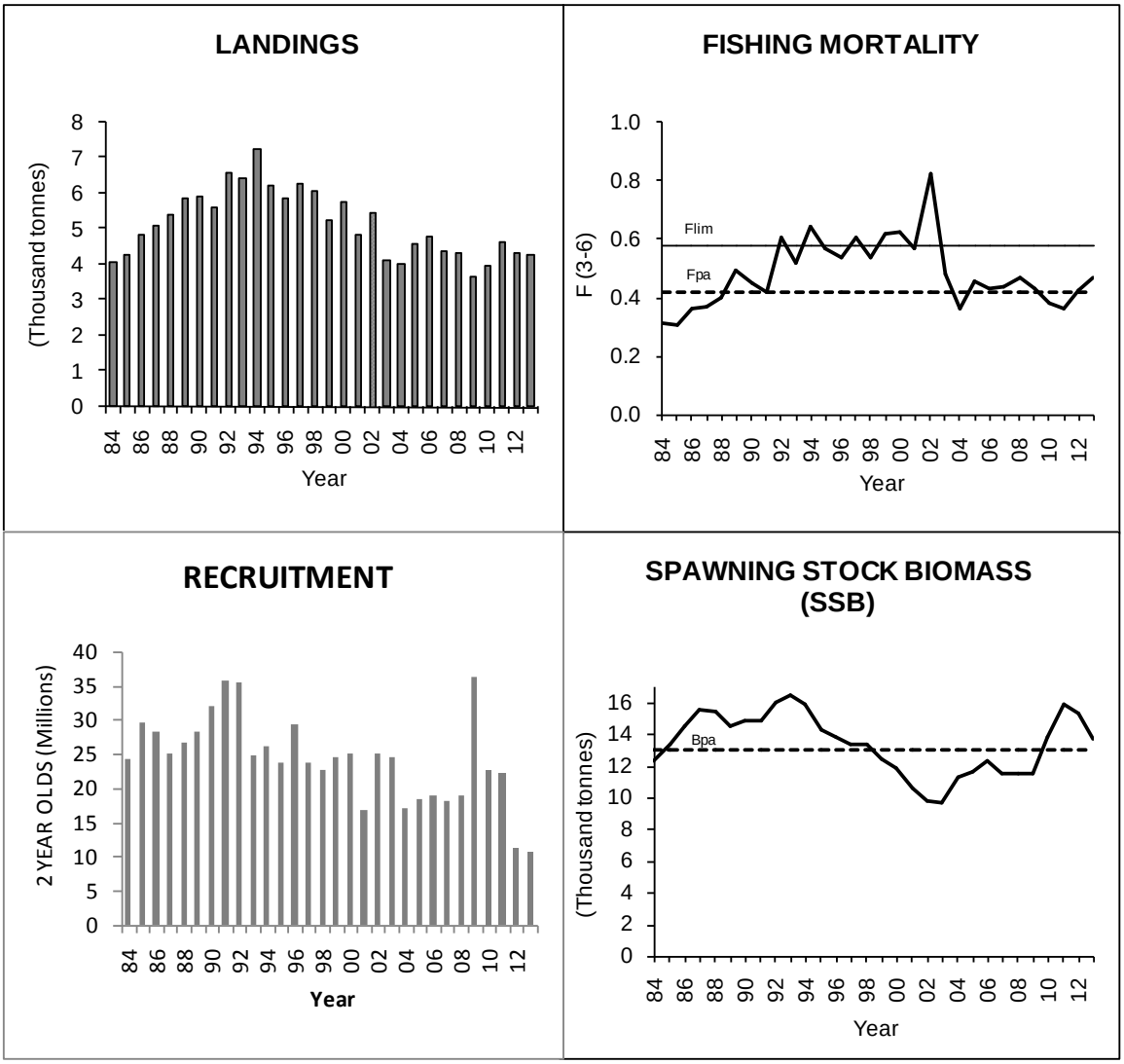
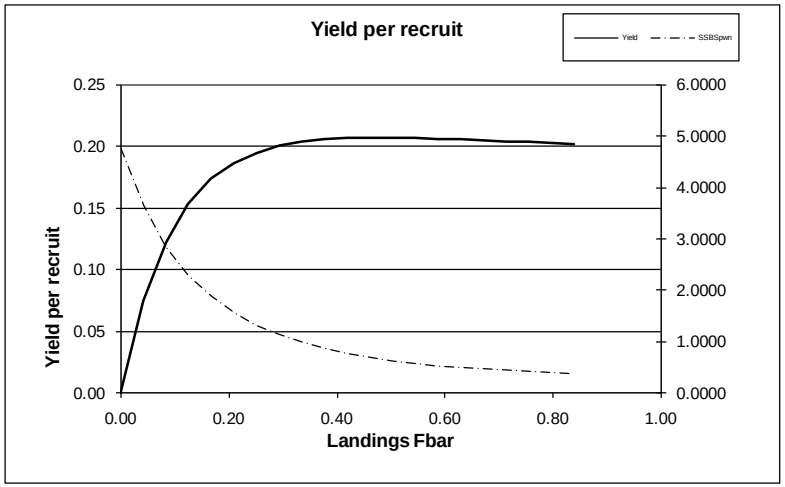
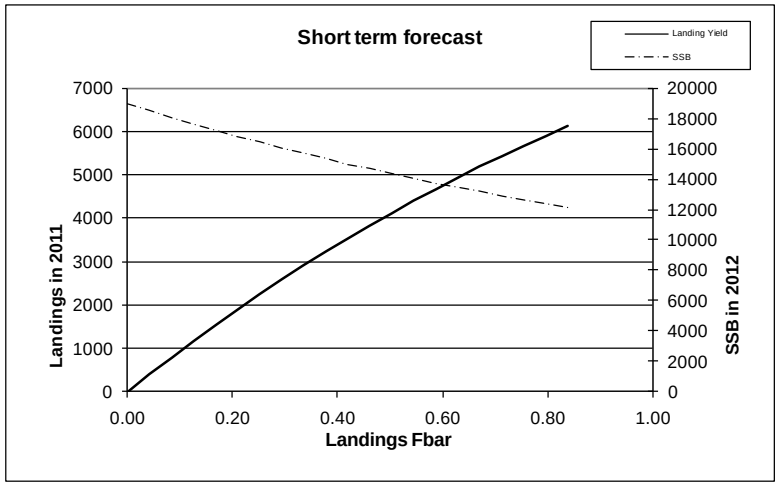


Figure 6.8: Sole in Division VIIIa,b (Bay of Biscay) – Trends for Landings, F, R, SSB





MFYPR version 2a
Run: 2014_sansGM_
Time and date: 13:01 09/05/2014

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.4191
FMax	1.1305	0.4738
F0.1	0.5212	0.2184
F35%SPR	0.4660	0.1953

Weights in kilograms

MFDP version 1a
Run: 2014_sansGM_
Time and date: 12:59 09/05/2014
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input units are thousands and kg - output in tonnes

Figure 6.9: Sole in Division VIIIa,b (Bay of Biscay)

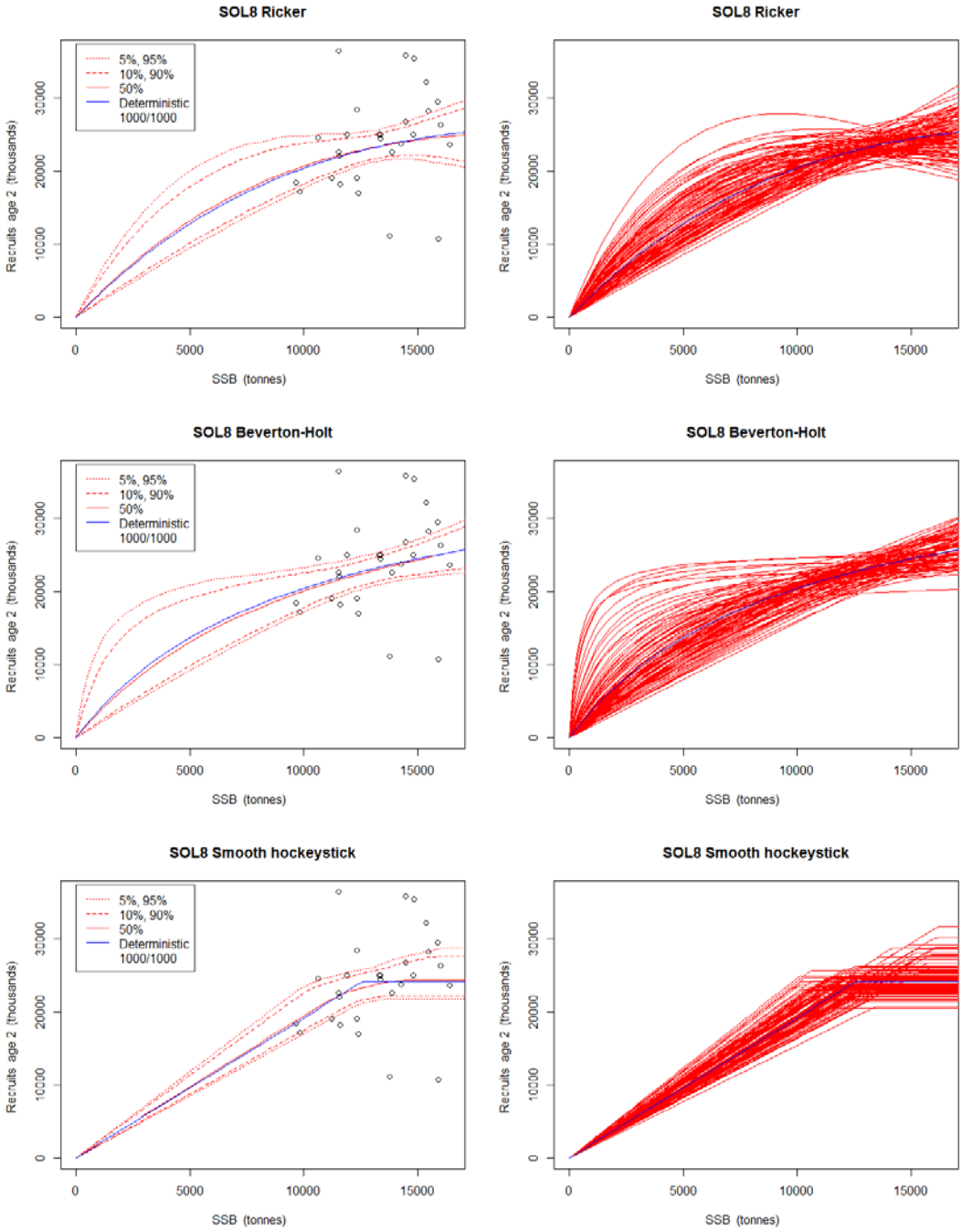


Figure 6.10: Bay of Biscay sole stock–recruit fits for Ricker (top), Beverton–Holt (middle) and smooth Hockey-stick (bottom). The left hand figures illustrate the 95th, 90th, median, 10th, and 5th percentiles from the successful MCMC samples, plotted with the assessment data points; the right hand figures provide 100 illustrative resamples. The estimates derived from MCMC sampling are illustrated in red; the deterministic estimates in blue. The bottom row in the legends indicates the number of successful resamples (i.e. with feasible stock–recruit parameters).

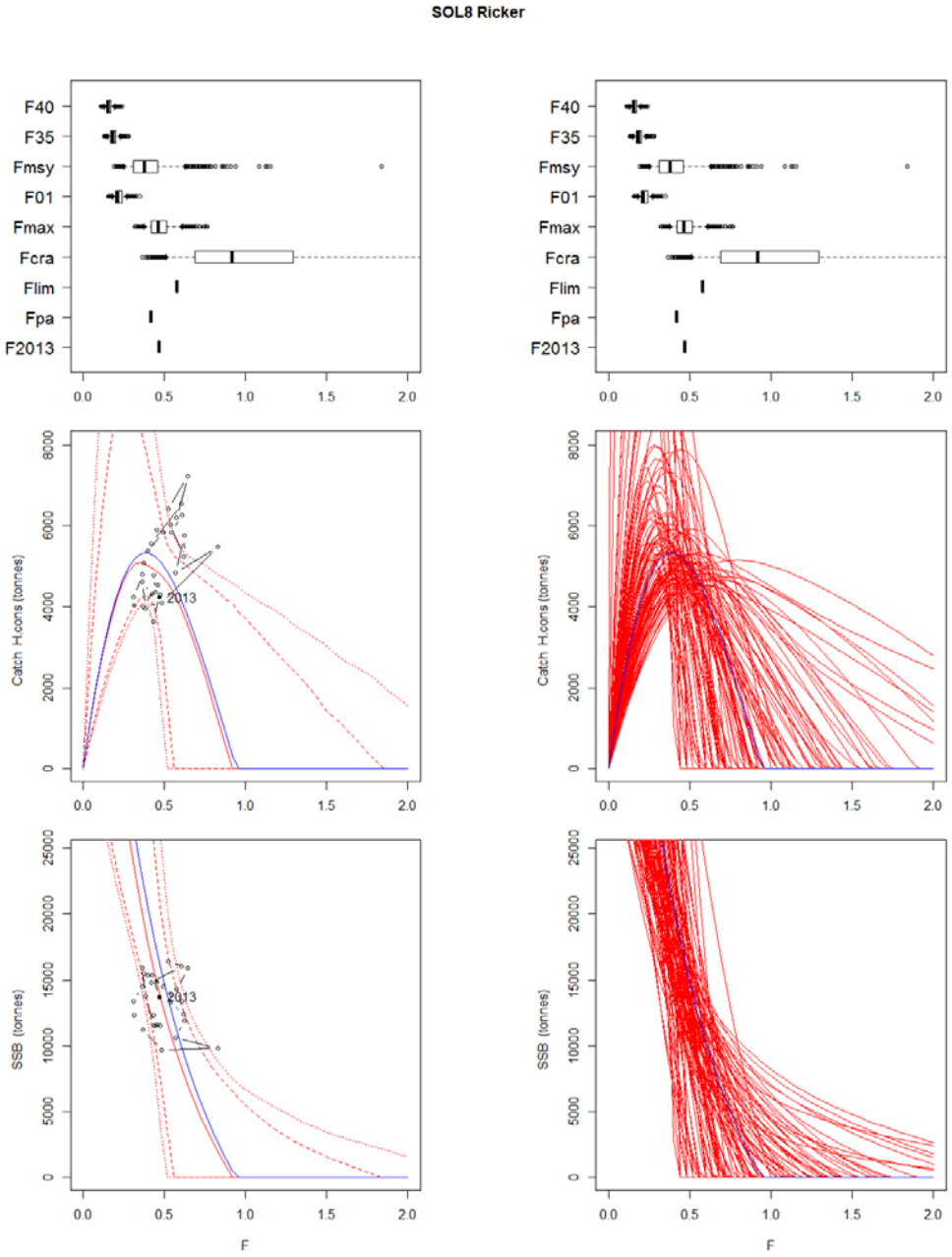


Figure 6.11: Bay of Biscay sole yield and SSB based on the Ricker stock and recruitment model estimates. Top: box plots of Fmsy and Fcrash with proxies for Fmsy based on the yield-per-recruit: Fmax, F0.1, F35% and F40% SPR also Flim, Fpa and F in the final year; middle: equilibrium landings vs. fishing mortality; bottom: equilibrium SSB vs. fishing mortality. The left hand figures illustrate the 95th, 90th, median, 10th, and 5th percentiles from the successful MCMC samples, plotted with the assessment data points; the right hand figures provide 100 illustrative resamples. The estimates derived from MCMC sampling are illustrated in red; the deterministic estimates in blue

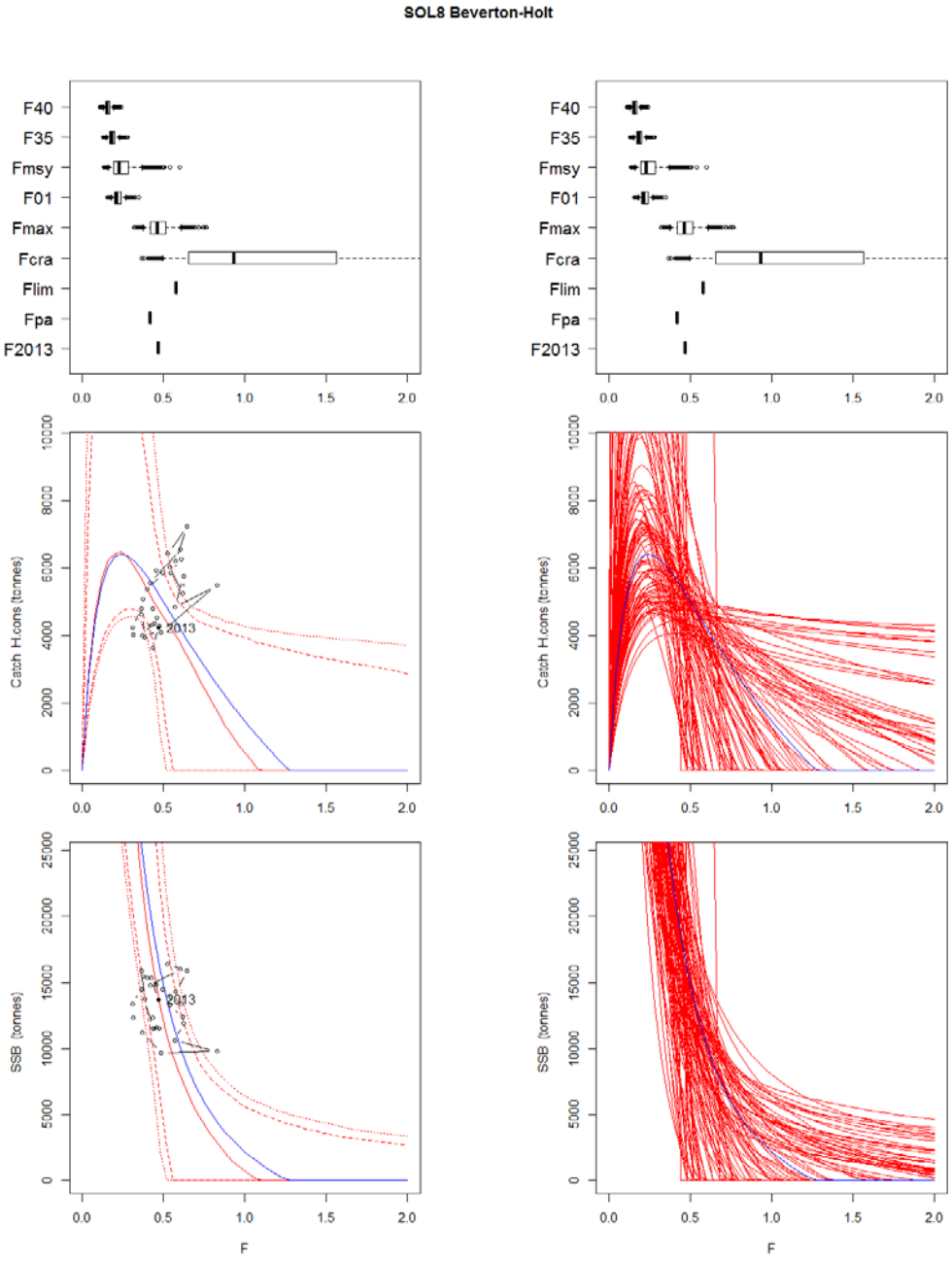


Figure 6.12: Bay of Biscay sole yield and SSB based on the Beverton–Holt stock and recruitment model estimates. Top: box plots of Fmsy and Fcrash with proxies for Fmsy based on the yield-per-recruit: Fmax, F0.1, F35% and F40% SPR also Flim, Fpa and F in the final year; middle: equilibrium landings vs. fishing mortality; bottom: equilibrium SSB vs. fishing mortality. The left hand figures illustrate the 95th, 90th, median, 10th, and 5th percentiles from the successful MCMC samples, plotted with the assessment data points; the right hand figures provide 100 illustrative resamples. The estimates derived from MCMC sampling are illustrated in red; the deterministic estimates in blue

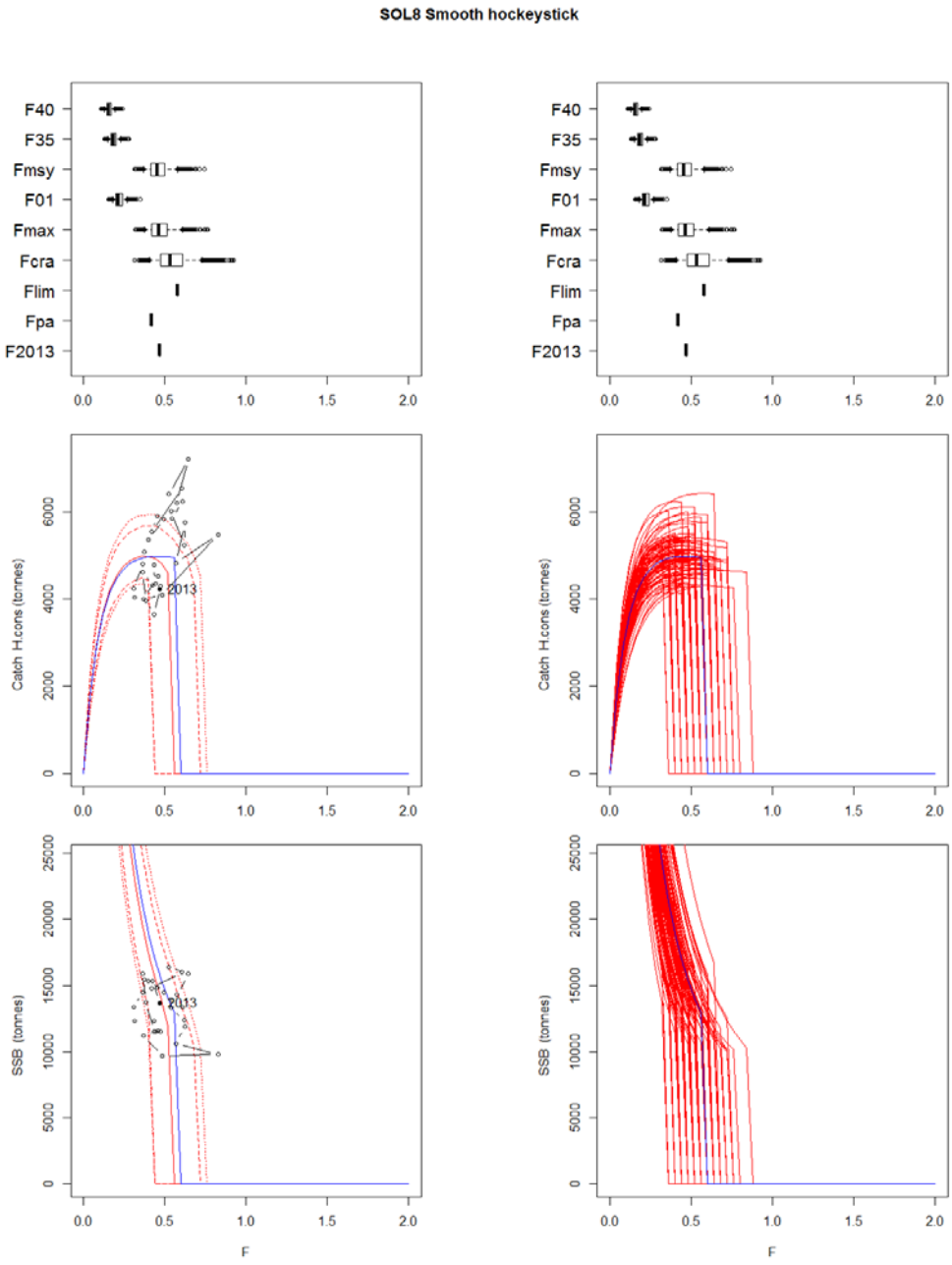


Figure 6.13: Bay of Biscay sole yield and SSB based on the Hockey-stick stock and recruitment model estimates. Top: box plots of Fmsy and Fcrash with proxies for Fmsy based on the yield-per-recruit: Fmax, F0.1, F35% and F40% SPR also Flim, Fpa and F in the final year; middle: equilibrium landings vs. fishing mortality; bottom: equilibrium SSB vs. fishing mortality. The left hand figures illustrate the 95th, 90th, median, 10th, and 5th percentiles from the successful MCMC samples, plotted with the assessment data points; the right hand figures provide 100 illustrative resamples. The estimates derived from MCMC sampling are illustrated in red; the deterministic estimates in blue.

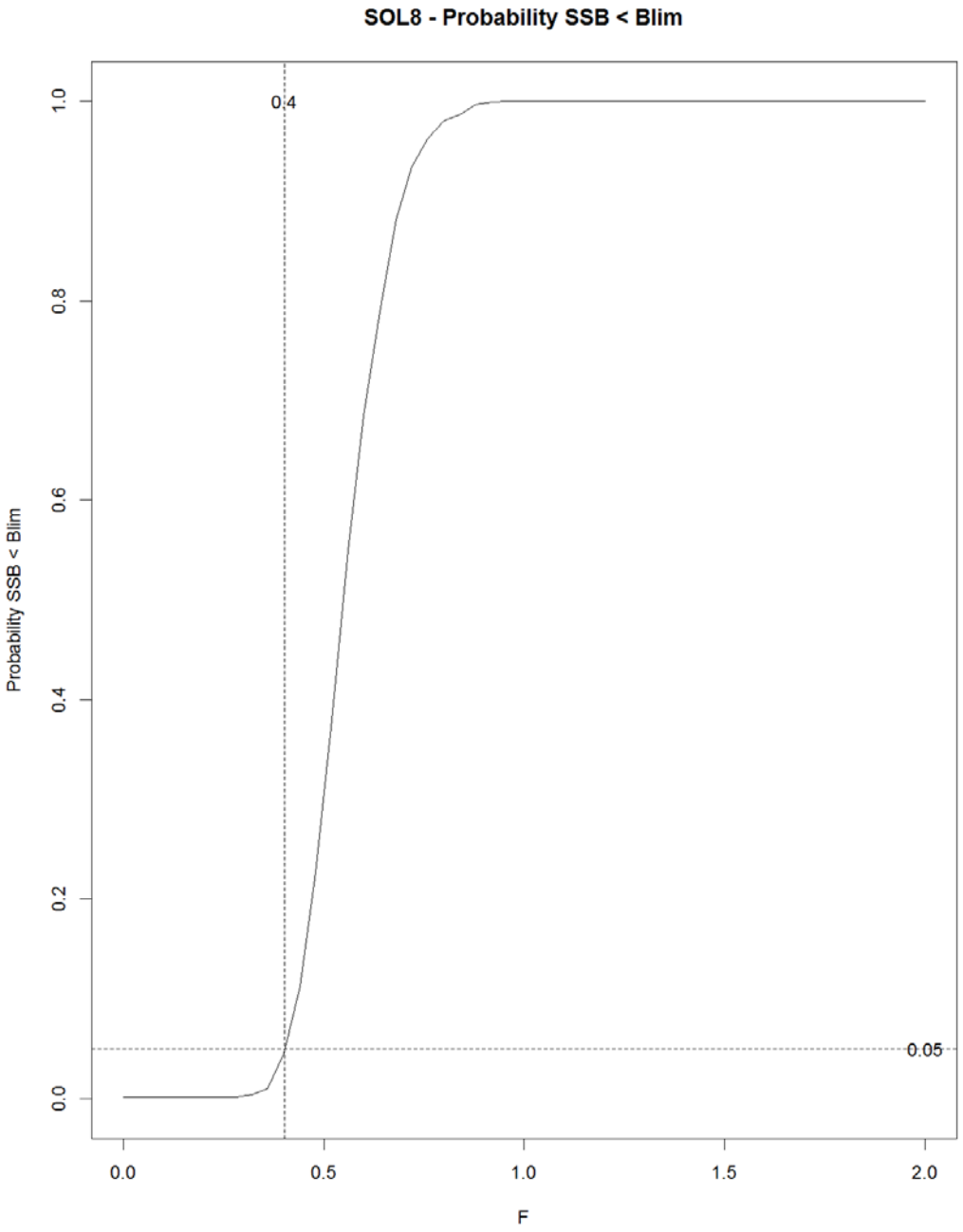


Figure 6.14: Bay of Biscay sole probability of SSB < Blim for the combined analysis weighted by model likelihood, indicating the F value coinciding with a 5% probability.

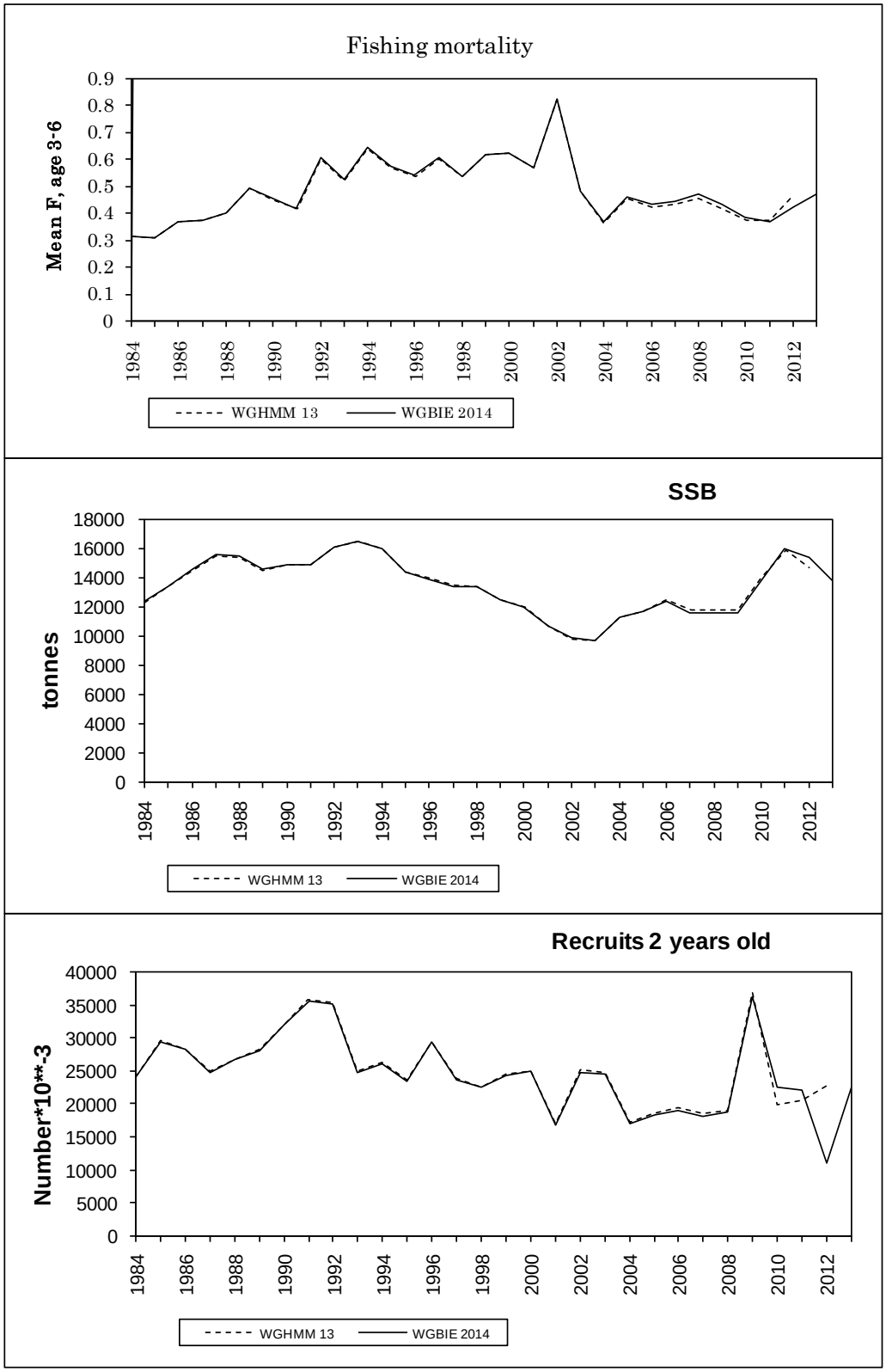


Figure 6.15: Bay of Biscay sole (Division VIIIa,b) - WG13 / WG14 comparison