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Report of the Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE)

13–19 May 2016

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Contents

Executive Summary

The ICES Working Group for the Bay of Biscay and the Iberic waters Ecoregion (WGBIE) met in Copenhagen, Denmark during 13–14 May 2016. There were 22 stocks in its remit distributed from ICES Divisions 3.a–4.a though mostly distributed in Sub Areas 7, 8 and 9. There were 21 participants, some of whom joined the meeting remotely. The group was tasked with conducting assessments of stock status for 22 stocks using analytical, forecast methods or trends indicators to provide catch forecasts for eight stocks and provide a first draft of the ICES advice for 2016 for fourteen stocks. For the remaining stocks, the group had to update catch information and indices of abundance where needed. Depending on the result of this update, namely if it would change the perception of the stock, the working group drafted new advice.

Analytical assessments using age-structured models were conducted for the northern and southern stocks of megrim and the Bay of Biscay sole. The two hake stocks and one southern stock of anglerfish were assessed using models that allow the use of only length-structured data (no age data). A surplus-production model, without age or length structure, was used to assess the second southern stocks of anglerfish. No analytical assessments have been provided for the northern stocks of anglerfish after 2006. This is mostly due to ageing problems and to an increase in discards in recent years, for which there is no reliable data at the stock level. The state of stocks for which no analytical assessment could be performed was inferred from examination of commercial LPUE or CPUE data and from survey information.

Three *nephrops* stocks from the Bay of Biscay and the Iberian waters are scheduled for benchmark assessments in October 2016. The WGBIE meeting spent some time reviewing the progress towards the benchmark (see Annex 6) together with longer term benchmarks (2017 and after, see section 1.) for sea bass in the Bay of Biscay, all anglerfish and hake stocks assessed by the WG. For the northern megrim stock, the schedule an inter-benchmark meeting was completed successfully and the group reviewed the outcome and accepted the category 1 update assessment.

A recurrent issue significantly constrained the group's ability to address the terms of reference this year. Despite an ICES data call with a deadline of six weeks before the meeting, data for several stocks were resubmitted during the meeting which lead to increased workloads during the working group, as in that case, the assessments could not be carried out in National Laboratories prior to the meeting as mentioned in the ToRs. **This is an important matter of concerns for the group members**.

Section 1 of the report presents a summary by stock and discusses general issues. Section 2 provides descriptions of the relevant fishing fleets and surveys used in the assessment of the stocks. Sections 3–18 contains the single stock assessments.

1 Introduction

1.1 Participants

Name	Country
Esther Abad	Spain
Ricardo Alpoim	Portugal
Ewen Bell	UK
Maria de Fatima Borges	Portugal
Santiago Cerviño	Spain
Anne Cooper	ICES Secretariat
Mickael Drogou	France
Spyros Fifas	France
Dorleta Garcia	Spain
Hans Gerritsen	Ireland
Isabel González Herraiz	Spain
Agurtzane Urtizberea Ijurco	Spain
Ane Iriondo	Spain
Muriel Lissardy	France
David Miller	ICES Secretariat
Joao Figueiredo Pereira	Portugal
Lisa Readdy	UK (Chair)
Paz Sampedro	Spain
Cristina Silva	Portugal
Joana Silva	UK
Yolanda Vila	Spain
Ching-Maria Villanueva	France

Contact details for each participant are given in Annex 1.

1.2 Terms of Reference

WGBIE– Working Group for the Bay of Biscay and Iberian Waters Ecoregion

2015/2/ACOM12 The Working Group for the Bay of Biscay and Iberian Waters Ecoregion (WGBIE), chaired by Lisa Readdy* (UK), will meet in the ICES Secretariat, 13–19 May 2016 to:

a) Address generic ToRs for Regional and Species Working Groups

b) Assess the progress on the benchmark preparation of *Nephrops*;

c) Check the relevance of the reopening procedure and report on reopened advice if appropriate.

The assessments will be carried out on the basis of the stock annex. The assessments must be available for audit on the first day of the meeting.

Material and data relevant to the meeting must be available to the group no later than 1st April 2016 according to the Data Call 2016.

WGBIE will report by 31 May 2016 for the attention of ACOM. Concerning ToR c) the group will report on the ACOM guidelines on reopening procedure of the advice before 14 October and will report on reopened advice before 28 October.

Fish Stock	Stock Name	Stock Coordinator	Assess. Coord. 1	Assess. Coord. 2	Advice
anp-78ab	Anglerfish (L. piscatorius) in Divisions 7.b-k and 8.a,b	Spain	Spain	UK	Same advice or Update
anb-78ab	Anglerfish (Lophius budegassa) in Divisions 7.b-k and 8.a,b	UK	UK	Spain	Same advice or Update
anb-8c9a	Anglerfish (Lophius budegassa) in Divisions 8.c and 9.a	Portugal	Portugal	Spain	Update
anp-8c9a	Anglerfish (L. piscatorius) in Divisions 8.c and 9.a	Spain	Spain	Portugal	Update
bss-8ab	Sea bass in Divisions 8.a,b	France	France	none	Same advice or Update
bss-8c9a	Sea bass in Divisions 8.c and 9.a	France	France	none	No new assessment
hke-nrtn	Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock);	Spain	Spain	none	Update
hke-soth	Hake in Division 8.c and 9.a (Southern stock);	Spain	Spain	Portugal	Update
mgb-8c9a	Megrim (Lepidorhombus boscii) in Divisions 8.c and 9.a	Spain	Spain	none	Update
mgw-8c9a	Megrim (Lepidorhombus whiffiagonis) in Divisions 8.c and 9.a	Spain	Spain	none	Update
mgw-78	Megrim (L. whiffiagonis) in Subarea 7. & Divisions 8.a,b,d,e	Spain	Spain	none	Update
sol-bisc	Sole in Divisions 8.a,b,d (Bay of Biscay)	France	France	none	Update
ple-89a	Plaice in Subarea 8. and Division 9.a	Ireland	Ireland	none	No new assessment
whg-89a	Whiting in Subarea 8. and Division 9.a	Ireland	Ireland	none	No new assessment
pol-89a	Pollack in Subarea 8. and Division 9.a	France	France	none	No new assessment
sol-8c9a	Sole in Divisions 8.c and 9.a	Portugal	Portugal	none	No new assessment
nep-2324	*Nephrops* in Divisions 8.a,b (Bay of Biscay, FU 23, 24)	France	France	none	Update
nep-25	*Nephrops* in North Galicia (FU 25)	Spain	Spain	none	Update
nep-31	*Nephrops* in the Cantabrian Sea (FU 31)	Spain	Spain	none	Update
nep-2627	*Nephrops* in West Galicia and North Portugal (FU 26-27)	Spain	Spain	Portugal	Update

nep-2829	*Nephrops* in Southwest and South Portugal (FU 28-29)	Portugal	Portugal	Spain	Update
nep-30	*Nephrops* in Gulf of Cadiz (FU 30)	Spain	Spain	Portugal	Update

1.3 Summary by Stock

The stocks assessed within WGBIE are distributed from ICES Division 3.a–9.a (Figure 1.1). Figure 1.2 shows the distribution areas of the *Nephrops* Functional Units (FUs). Brief summaries are given here and more detailed information can be found in the relevant stock sections.

Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Divisions 7.b-k and 8.a, b, d

Both species are caught on the same grounds and by the same fleets and are usually not separated by species in the landings. Anglerfish is an important component of mixed fisheries taking hake, megrim, sole, cod, plaice and *Nephrops*. Spain and France together contribute about 80% of total stock landings. The TAC for both species combined was set at 42 496 t for 2015 and 2016. For 2015, landings were estimated to be 35 585 t, which is a decline in landings from the previous year.

Age determination problems and an increase in the uncertainty in the discard levels have prevented the performance of an analytical assessment since 2007. Since then, the assessment is based on examining commercial LPUEs and survey data (biomass, abundance indices and length distributions from surveys). Four surveys are available, covering a large part of the distribution area of the stocks, with little overlap between them.

For *L. piscatorius* the available data indicate that the biomass has been increasing as a consequence of the good recruitment observed in 2001, 2002 and 2004 and has stabilized in recent years. There is evidence of good recruitments in 2008, 2009 and 2010. 2008 and 2009 recruitments have entered the fishery giving one of the highest yields of the time-series. Recruitment in 2011, 2012 and 2013 were lower than in previous years but there is indication that the 2014 recruitment could be high.

For *L. budegassa* survey data give indication that the biomass has increased since the mid 2000’s as a consequence of several good incoming recruitments. A strong recruitment was observed in 2008. The EVHOE-WIBTS-Q4 shows evidence of large recruitment in 2011, 2012 and 2013 and a slightly lower level for 2014 and 2015. Length frequency distributions from the two available surveys show contradictory signals for 2009, 2011 and 2012 recruitments, but the working group considers that the trend of EVHOE is more representative due to the larger coverage of the survey.

In view of available data, the WG considers that fishing at present level should not harm either stock. More details on the anglerfish assessment can be found in Section 3.

Anglerfish (*L. piscatorius* and *L. budegassa*) in Divisions 8.c and 9.a

Both species are caught in mixed bottom-trawl fisheries and in artisanal fisheries using mainly fixed nets. The two species are usually landed together for the majority of commercial categories and they are recorded together in the ports’ statistics. Landings of both species combined in 2015 were 2 790 t. The combined TAC was set at 2 987t in 2015and 2 569 t in 2016.

The two species are assessed separately, using a surplus-production model (software ASPIC), tuned with commercial LPUE series for *L. budegassa* and a length based SS3 implementation for *L. piscatorius*.

Biomass of *L. piscatorius* decreased during the 1980s and early 1990s, but has progressively increased over the last two decades to 8 015 tonnes in 2014 declining again since then but remaining above the biomass reference point MSY $B_{trigger}$. Fishing mortality peaked during the late 1980's but has since declined, now below F_{MSY} (0.31) from 2008. Recruitment has been relatively low in recent years and shows little evidence of strong year classes since 2001.

Trends in relative biomass of *L. budegassa* indicate a steady decrease since the beginning of the series until 2001. Since then a slight recovery was observed and in 2016 the biomass is estimated to be at 108% of B_{MSY}. Fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2015, fishing mortality is estimated to be below F_{MSY}.

Although the stocks are assessed separately, they are managed together.

More details are provided in Section 4.

Megrim *(Lepidorhombus whiffiagonis)* in Divisions 7.b–k and 8.a,b,d

L. whiffiagonis in Div. 7.b-k and 8.a, b, d is caught in a mixed demersal fishery catching anglerfish, hake and *Nephrops*, both as a targeted species and as valuable bycatch. The 2015 and 2016 TAC were set at 19 101 t, including a 5% contribution of L. boscii in the landings for which stock there is no assessment. Landings in recent years were relatively stable around 15 000t. Discarding of smaller megrim is substantial and also includes individuals above the minimum landing size of 20 cm. The discards were variable, between 2 000 and 4 000 t

After several years without assessment, a Bayesian catch-at-age model was investigated during a benchmark held in 2012 and again in 2016. The underlying issues with the catch-at-age data were resolved in 2016 and it was concluded that the model could be considered as a full analytical assessment. The model fit to the data are adequate and the WG considers that the current assessment can be fully accepted and not only as indicator of trends. Catch, landing and discard data and survey indices do not appear to indicate the presence of important changes in trends of recruitment or the overall biomass.

Details of the assessment are presented in Section 5.

Megrims (*L. whiffiagonis* and *L. boscii*) in Divisions 8.c and 9.a

Southern megrims *L. whiffiagonis* and *L. boscii* are caught in mixed fisheries targeting demersal fish including hake, anglerfish and *Nephrops* and are not separated by species in the landings. The majority of the catches are taken by Spanish trawlers. Landings of both species combined in 2015 were 1 424 t (of which 80% correspond to *L. whiffiagonis*). The agreed combined TAC for megrim and four-spot megrim in ICES Divisions 8.c and 9.a was 1 377 t in 2015 and 1 363 t in 2016.

The species are assessed separately, using XSA.

For *L. whiffiagonis* the assessment indicates that fishing mortality has increased since 2011. The SSB values in 2007-2010 were the lowest in the series but since 2011, SSB has increased to a value close to the average of the historical series. After a very high recruitment (at age 1) in 2010 the recruitment has decreased to an average value.

For *L. boscii* the assessment indicates that SSB decreased gradually from 1989 to 2001, the lowest value in the series, and has since increased. In 2015 the SSB is estimated to be one of the highest of the series. Recruitment has fluctuated around 45 million fish during all the series. Very weak year classes are found in 1993, 1998 and 2008. The highest value occurred in 2014 at 90 million but needs to be confirmed when more data are made available. Estimates of fishing mortality values show two different periods: an initial period with values around 0.5 from 1989 to 1996 followed by a decreasing trend with the lowest value estimated in 2012 (F=0.24). In 2014 and 2015, F has increased (F=0.41 in 2015).

Details of the assessments are presented in Section 6.

Sole in Divisions 8.a, b (Bay of Biscay)

Bay of Biscay sole is caught in ICES divisions 8.a and b. The fishery has two main components: one is a French gillnet fishery directed at sole (about two thirds of total catch) and the other one is a trawl fishery (French otter or twin trawlers and Belgian beam trawlers). The TAC was set at 3 800 t for 2015 and 3 420 t for 2016. Landings in 2016 declined further to 3 641 t.

Discards are not included in the assessment as discards are considered to be low for the ages included in the assessment, which starts at age 2.

Since 1984, fishing mortality has gradually increased, peaking in 2002, decreased substantially the following two years. After 2005, F was stable at around 0.43 (= F_{pa}). In 2015 F is estimated at 0.44, above F_{pa} and F_{MSY}. The SSB trend in earlier years increased from 1984 to a high value in 1993. Afterwards SSB shows a continuous decrease until 2003, the lowest value of the series. SSB has been increasing and was above B_{pa} from 2004–2013. In 2014, SSB dropped below B_{pa} at 10 600t and the recruitment values are lower since 1992. Between 2004 and 2008 the recruitment series is stable at around 17 or 18 million with the 2009-year class providing the highest value since the early 1990s. The 2010 and 2011 values are closed to the GM93-13 (21.3 million). However, the 2012 and 2013 values are the lowest of the series (12.5 million). In 2014, the recruitment increased to 15.5 million.

Details on the assessment are in Section 7.

Sole in subdivisions 8.c and 9.a

Portugal and Spain are the main participants in this fisheries. *Solea solea* is mainly caught with gillnets and trammelnets. In Portugal *Solea solea* is caught together with and other similar species *Solea senegalensis* and *Pegusa lascaris* and it is only in recent years that official catches are reported separated by species. Total landings of *solea solea* was 681 t and 646 t for 2014 and 2015 respectively. The available information is insufficient to evaluate stock trends and exploitation status. Therefore, the state of the sole in Divisions 8.c and 9.a is unknown.

Details on the assessment are in Section 8

Hake in Division 3.a, Subareas 4, 6 and 7 and divisions 8.a, b, d (Northern stock)

Hake is caught in nearly all fisheries in Subareas 7, 8. and in some fisheries in Subareas 4, 6. In recent years, Spain accounted for the main part of the landings, followed by France. Stock landings have been steadily increasing throughout the last decade, from 36 700 t in 2001 to 101 100 t in 2015, the highest value since 1963. Since 2009, landings have been above the agreed TAC.

The stock had a benchmark assessment in February 2014 (WKSOUTH, 2014). One of the main objectives of the workshop was to address a strong retrospective pattern which appeared in the 2013 assessment. It was felt that this pattern was mainly due to changes in the size of hake caught by the majority of the fleets which the assessment model had difficulties coping with. Most of the benchmark workshop was thus focused on obtaining the most appropriate way to account for the changes in retention and selectivity for the two most influential fleets and the group agreed that the model was an improvement in terms of taking into account the changes in stock structure and accepted the assessment model with the proviso that the model be developed and fine-tuned as more data and information become available.

This year, the assessment was carried out following the stock annex, revised during the benchmark, and although the retrospective patterns are still present, the group accepted the assessment as appropriate to providing advice. The recruitment appears to fluctuate without substantial trend over the whole series with the 2008 being the highest of the whole series (806 million). In 2013, the recruitment decreased below mean level (374 million). From high levels at the start of the series (100 000 t in 1980), the SSB decreased steadily to a low level at the end of the 90s (26 000 t in 1998). Since that year, SSB has increased to the highest value of the series in 2015 (361 000 t). The fishing mortality is calculated as the average annual F for sizes 15–80 cm. This measure of F is nearly identical with the average F for ages 1–5. Values of F increased from values around 0.5-0.6 in the late 70s and early 80s to values around 1.0 during the 90s. They declined sharply afterwards to 0.21 in 2012 and increased up to 0.23 in 2014.

Details about the assessment of this stock are provided in Section 9.

Hake in Divisions 8.c and 9.a

Hake in Divisions 8.c and 9.a is caught in a mixed fishery by Spanish and Portuguese trawlers and artisanal fleets. Spain accounts for the main part of the landings. Total landings in 2014 were 12 011 t and 11 790 t in 2015. Total discards in 2014 were 2 602 t and 2 290 t in 2015.

The southern hake stock had a benchmark assessment in February 2014 (WKSOUTH). One of the main issues addressed during the benchmark workshop was related to the difficulties encountered by the GADGET model in its search for the set of parameters that maximize the likelihood function. The work confirmed that the model fitting procedure is finding a genuine optimum and can thus continue to be used as the assessment model. Further work to improve the optimization characteristics of the model has been suggested and implemented intersessionally.

The recruitment (age 0) is highly variable and presents two different periods: one from 1982–2003 with mean figures around 70 million, ranging from 40 to 120, and a recent period from 2004 to latest with a mean of 100 million ranging from 65 to 170 million. Fishing mortality increased from the beginning of the time-series (F=0.36 in 1982) peaking in 1995 at 1.19; declining to 0.79 in 1999 and remaining relatively stable until 2009 (F=0.95). F then progressively decreased to reach 0.52 in 2015. The SSB was very high at the beginning of the time-series with values around 40 000 t, then decreased to a minimum of 5 800t in 1998. Since then biomass has continuously increased, reaching 20 120 t in 2015, slightly below the 2014 figure (20 653 t)

Details on the assessment of this stock are in Section 10.

Nephrops in ICES Division 8.a,b

There are two Functional Units in ICES Division 8.a,b: FU 23 (Bay of Biscay North) and FU 24 (Bay of Biscay South), see Figure 1.2. *Nephrops* in these FUs are exploited by French trawlers almost exclusively. Landings declined until 2000, from 5 900 t in 1988 to 3 100 t in 2000. After that year, they increased again to around 3 700 t, staying at that level for some time. Since 2006 landings have been around 3,300 t. In 2012 and 2013, a reduction in the landings occurred (2 520 t in 2012, 2 380 t in 2013) followed by an increase to 3 569 t in 2015. The agreed TAC for 2016 was 3 899 t.

A French regulation increased the minimum landing size in 2006 and several effort and gear selectivity regulations have also been put in place in recent years. The use of selective devices for trawlers targeting *Nephrops* became compulsory in 2008. All these measures are expected to be contributing in various ways to the changing patterns of landings and discards observed recently. In general, discards values after year 2000 have been higher than in earlier years, although sampling only occurred on a regular basis starting from 2003, so information about discards is considerably weaker for the earlier period.

This stock underwent an inter-benchmark protocol in 2012. The outcome of this process was inconclusive with a recommendation that the work undertaken should be considered in a full benchmark scheduled in October this year.

No quantitative analytical assessment was carried out this year, however, based on the stability of the commercial LPUEs in recent years with no update, the WG considered that the perception of the stock has not changed when compared to last assessment.

Details can be found in Section 11.

Nephrops in ICES Division 8.c

There are two Functional Units in Division 8.c (Figure 1.2): FU 25 (North Galicia) and FU 31 (Cantabrian Sea).

Nephrops are caught in the mixed bottom-trawl fishery in the North and Northwest Iberian Atlantic. Landings from both FUs have declined dramatically in recent years reaching less than 15 t in each FU in 2015, below the TAC in recent years, which has not been restrictive. The TACs were set at 60 t and 46 t for the whole Division 8.c for 2015 and 2016, respectively.

A recovery plan for southern hake and Iberian *Nephrops* stocks has been in force since 2006. The aim of the recovery plan is to rebuild the stocks within 10 years, with a reduction of 10% in F relatively to the previous year and the TAC set accordingly (Council Regulation (EC) No. 2166/2005).

According to the ICES data-limited approach, both stocks are considered as category 3.1.4. The two stocks are assessed by the analysis of the LPUE series trend. The perception of the stocks is the same as last year indicating an extremely low abundance level.

Additional details are provided in Section 12.

Nephrops in ICES Division 9.a

There are five Functional Units in Div. 9.a (Figure 1.2): FU 26 (West Galicia); FU 27 (North Portugal); FU 28 (Alentejo, Southwest Portugal); FU 29 (Algarve, South Portugal) and FU 30 (Gulf of Cádiz).

Landings in 2015 from the five FUs combined were 274 t. The TAC set for the whole Division 9.a was 254 t and 320 t for 2015 and 2016.

A recovery plan for southern hake and Iberian *Nephrops* stocks has been in force since 2006. The aim of the recovery plan is to rebuild the stocks within 10 years, with a reduction of 10% in F relatively to the previous year and the TAC set accordingly (Council Regulation (EC) No. 2166/2005).

FU 26+27 (West Galicia and North Portugal): The fishery shares the same characteristics of that in Division 8.c, described above.

Landings are reported by Spain and minor quantities by Portugal. Spanish fleets fish in FU 26 and FU 27, whereas Portuguese artisanal fleets fish with traps in FU 27. Two periods can be distinguished in the time-series of landings available 1975-2014. During 1975-1989, the mean landing was 680 t, fluctuating between 575 and 800 t approximately. Since 1990 onwards there has been a marked downward trend in landings, being below 50 t from 2005 to 2011. In the last four years, landings continued to decrease and were below 10 t. Discards rates are negligible.

According to the ICES data-limited approach, this stock is considered as category 3.1.4. These FU 26-27 are assessed by the analysis of the LPUE series trend, as was done in 2012. The perception of the stocks is the same as last year indicating an extremely low abundance level.

FU 28+29 (SW and S Portugal): *Nephrops* is taken by a multispecies and mixed bottom-trawl fishery. The trawl fleet comprises two components, one targeting fish operating along the entire coast, and another one targeting crustaceans, operating mainly in the southwest and south, in deep waters. There are two main target species in the crustacean fishery, Norway lobster and deep-water rose shrimp, with different but overlapping depth distributions. In years of high rose shrimp abundance, the fleet directs its effort preferably to this species.

For the period 1984–1992, the recorded landings from FUs 28 and 29 have fluctuated between 420 and 530 t, with a long-term average of about 480 t, falling drastically in the period 1990–1996, down to 132 t. From 1997 to 2005 landings have increased to levels observed during the early 1990s but decreased again in recent years. The value landings in 2009-2011 was approximately at the same level (≈ 150 t), increasing to around 200 t in the years 2012-2015.

According the ICES data-limited approach, this stock is classified in the category 3.2.0. The advice is based on survey and fishery cpue and effort trends. A standardized effort shows a consistent declining trend since 2005 reaching a historic low in 2009-2010. In the following years, the effort had a slight increase however still remaining at a low level. The fleet standardized cpue, used as index of biomass, decreased in the period 2006-2011. The update of the index does not change the perception of the stock status, the index has been increasing in recent year.

FU 30 (Gulf of Cádiz): *Nephrops* in the Gulf of Cádiz is caught in a mixed fishery by the trawl fleet. Landings are markedly seasonal with high values from April to September. Landings were reported by Spain and minor quantities by Portugal. Landings increased from 100 t in the mid 90s to a higher level at the beginning of the 2000s. Landings have decreased again until 2008 and then remained around 100 t from 2008 to 2012. From 2013, landings dropped to around 20 t, the main reason being is that the quota in 2012 was exceeded and the European Commission applied a sanction so that the *Nephrops* fishery was closed with vessels only fishing for *Nephrops* for a few days during the summer and winter periods.

According to the ICES data-limited approach, this stock is considered as category 3.2.0. FU 30 is assessed by the analysis of the LPUE series trend. The update of the LPUE series and abundance survey index shows two conflicting signals. The LPUE decreasing while the survey index is increasing however, WG express concerns over the ability of those two indices to reflect variations in the abundance in 2013 and 2014. The WG considers that no new information is available to change the perception of the status of the stock.

The five *Nephrops* FUs (assessed as 3 separate stocks) are managed jointly, with a single TAC set for the whole of Division 9.a. This may lead to unbalanced exploitation of the individual stocks. The northernmost stocks (FUs 26-27) are at extremely low levels, whereas the southern ones (FUs 28-29 and FU 30) are in better condition. To protect the stock in these Functional Units, management should be implemented at the Functional Unit level.

Additional details can be found in Section 13.

European Sea bass in Division 8.a,b

Sea bass in the Bay of Biscay are targeted by France (more than 90% of international landings) by line fisheries which take place mainly from July to October, by nets, pelagic trawlers, and in mixed bottom-trawl fisheries from November to April on prespawning and spawning grounds when sea bass aggregate. Since the late 90s total landings are stable around 2 500 t. Landing of netters have however increased since 2011 due to a decrease of sole quotas from 2011 and a redistribution of effort towards this species combined with good weather condition in 2014. Recreational fisheries are an important part of the total removals but these are not accurately quantified. Discards are known to take place but are not fully quantified. Anecdotal information suggests that discards may be very low in the area.

Last year, 2015, during the expert working group a decision was made to categorize this stock as data limited category 3.2.0 and based its advice on a commercial LPUE index. However, this year the methodology was change in how this index was produced and the working group concluded that that there was insufficient information to indicate a change in the perception of the stock.

Additional details can be found in Section 14.

European Sea bass in Division 8.c, 9.a

Spanish and Portuguese vessels represent almost of the total annual landings in divisions 8.c and 9.a. Commercial landings represent 821 t in 2015, a slight decline on the previous year. A peak of landings is observed in the early 90’s and in 2013, reaching more than 1 000 t, and lowest landings have been observed in 1980 and 1981 and more recently in 2003 (466 t). No discards have been observed for this stock by the observer program.

No stock assessment is carried out as the stock is considered as category 5.2.0. Information on abundance or exploitation is not yet available and this year, there are no new data available that change the perception of the stock.

Additional details can be found in Section 15.

Plaice in Subarea 8. and Division 9.a

Plaice (*Pleuronectes platessa*) are caught as a bycatch by various fleets and gear types covering small-scale artisanal and trawl fisheries. Portugal and France are the main participants in this fishery with Spain playing a minor role. Present fishery statistics are considered to be preliminary as there are concerns about the reliability of the French data from 2008–09. Landings may also contain misidentified flounder (*Platichthys flesus*) as they are often confounded at sales auctions in Portugal. The quantity of discarding is uncertain. For these reasons, the landings are unlikely to be a good indicator of total removals and ICES considers that it is not possible to quantify the catches.

This stock is currently ranked as a Data Limited Stock in category 5.2 as only landings data are available. This year, there are no new data available that change the perception of the stock.

Additional details can be found in Section 16.

Pollack in Subarea 8. and Division 9.a

Landings have been reported by the three countries with quota: France, Spain and Portugal. Pollack is exploited by several type of gears. The main part of the landings are made by gillnets and lines. Since the early 2000s, the landings have been relatively stable between 1 500 t and 2 000 t.

Discards estimates in the Spanish fleet indicate that the discards may be low.

The stock is currently ranked as a Data Limited Stock in category 5.2 as there is information on landings only. This year, there are no new data available that change the perception of the stock.

Additional details can be found in Section 17.

Whiting in Subarea 8 and Division 9.a

Whiting (*Merlangius merlangus*) are caught in mixed demersal fisheries primarily by France and Spain. Present fishery statistics are considered to be preliminary. Total landings in recent years have fluctuated around 2 000 t. Whiting has never been recorded in Spanish discards and is negligible in Portuguese discards. However there are indications that some discarding occurs in the French fleet.

This species is at the southern extent of its range in the Bay of Biscay and Iberian Peninsula. It is not clear whether this is a separate stock from a biological point of view.

This stock is currently ranked as a Data Limited Stock in category 5.2 as there is information on landings only. This year, there are no new data available that change the perception of the stock.

Additional details can be found in Section 18.

1.4 Data available

Catch (totals and/or age–length structured) and effort data according to species, country, area and métier were requested in the ICES standard data call for WGBIE. A deadline of the 6 April 2016 was set in order to prepare the datasets for the working group and progress on the use of InterCatch.

For some stocks, the group noted that some data were very poor and recommends that a basic data check be carried out by the data providers before uploading the data in InterCacth. This includes checking if the landings by métier are consistent with the historical landings and checking the quality of the length or age frequency distributions. A substantial increase in workload was reported for the stocks where data were considered poor and data were continuously resubmitted during the working group.

For most of the stocks assessed by WGBIE, InterCatch was used mainly to download un-raised data. The data delivered to accessions via worksheet format was used as the primary data source and compared to the data submitted on InterCatch.

The main data problems detected by the Working Group and for which action is required are described in the "Stock Data Problems" table included in Annex 07.

Several stocks assessed by the Group are managed by means of TACs that apply to areas different from those corresponding to individual stocks, notably in Subarea 7, as well as for the *Nephrops* FUs in 8.c and 9.a, or to a combination of species in the cases of anglerfish and megrim.

Biological sampling levels by country and stock are summarized in Table 1.4a and b.

1.5 Stock Data Problems Relevant to Data Collection

WGBIE identified a number of issues for further discussion by the WGDATA in relation to stock data problems relevant to data collection. These are listed in the table included in Annex 07 of the report.

1.6 Frequency of assessment

The following table provides the review and evaluation carried out by WGBIE for the criteria identified by ICES in relation to the frequency of assessment.

The frequency of assessments was discussed at the ACOM December 2014 meeting and a subgroup was established to develop a set of criteria to be applied in identifying candidate stocks for less frequent assessment.

Stock code	Stock name	lifespan	Stock status relative to FMSY	Stock status relative to MSYBtrigger	Percentage of recruiting year classes in catch	Mohn's rho
anb-8c9a	Black-bellied anglerfish in Divisions 8c and 9a	medium	Green tick	Green tick	Unknown.	-0.22
anp-8c9a	White anglerfish in Divisions 8c and 9a	medium	Green tick	Green tick	0.60%	-0.1
hke-nrtn	Hake in Subareas 4, 6, and 7 and Divisions 3a, 8a,b,d (Northern stock)	medium	Green tick	Green tick	7%	-0.66
hke-soth	Hake in Divisions 8c and 9a (Southern stock)	medium	Red X	Green tick	<5% on average	0.203
mgb-8c9a	Four-spot megrim in Divisions 8c and 9a	medium	Red X	Green tick	1% on average last 5 years	0.06
mgw-78	Megrim in Divisions 7b–k and 8a,b,d	medium	Red x	Green tick	0.06%	0.13
mgw-8c9a	Megrim in Divisions 8c and 9a	medium	Red X	Green tick	32% on average	0.09
sol-bisc	Sole in Divisions 8a, b	medium	Red X	Red X	16% on average	0.01

1.7 Estimation of precautionary reference points

With the exception of megrim in subareas 7 and 8 all category 1 stocks assessed by WGBIE were reviewed by WKMSYREF4 and MSY and PA reference points were either calculated or evaluated. Megrim in ICES Subareas 7 and 8 was benchmarked in 2016 and reference points were calculated and subsequently reviewed and accepted by WGBIE.

1.8 Use of InterCatch by WGBIE

Progress has been made by the group with regards to the use of InterCatch. However, only one stock is using InterCatch exclusively as a tool to compute the model entry files. Several stocks are partly using InterCatch in this process but as a place to hold all the raw data with the files being processed and raised externally.

Previously, northern hake files were exclusively processed with in InterCatch, this year the files were processed both with in InterCatch and externally using R script. Because of the complexity of the data, with the number of countries and métier, raising the data were cumbersome and difficult with no one year being repeatable. It was therefore necessary to produce a simplified and repeatable process. R script was developed and the resulting raised data were compared to that raised with in InterCatch. It was found that the raising of the length distribution data with in InterCatch produced results which were not as expected unlike the R script. Further details of the analysis can be found in the northern hake section, section 09. Given the results from using the R Script the WG decided to use the R script to re-raise the historic time-series.

1.9 Stock annexes

All stocks assessed by this WG have a stock annex.

1.10 Proposals for future benchmarks

The following table summarizes WGBIE proposals for short and long-term benchmarking.

Name	Assement status	Latest Benchmark	Benchmark next year	Planning Year +2	Comments
Sea Bass in Divisions 8.a,b	No new assessment	IBP New 2012	Yes		With Sea Bass in Divisions IVbc and 7.a,d-h
Anglerfish (Lophius budegassa) in Divisions 7.b-k and 8.a,b,d	Update	WKFLAT 2012	Data compilation		All Anglerfish together
Anglerfish (Lophius piscatorius) in Divisions 7.b-k and 8.a,b,d	Update	WKFLAT 2012	Data compilation		All Anglerfish together
Anglerfish (Lophius budegassa) in Divisions 8.c and 9.a	Update	WKFLAT 2012	Data compilation		All Anglerfish together
Anglerfish (Lophius piscatorius) in Divisions 8.c and 9.a	Update	WKFLAT 2012	Data compilation		All Anglerfish together
Hake in Subareas 4, 6, and 7 and Divisions 3a, 8a,b,d (Northern stock)	Update	WKSouth 2014		Yes	
Hake in Divisions 8c and 9a (Southern stock)	Update	WKSouth 2014		Yes	

1.10.1 Benchmark planning

The WG reviewed the situation this year and decided to go ahead with the benchmarks proposed for 2016 and 2017. The ICES benchmark preparation tables by stock were reviewed during the WG meeting. The WG identified potential directions of solution to improve the assessments of those stocks without deciding yet on any preferred options for *Nephrops* and bass. It was however not possible during the WG to make a proposal for external experts.

It was agreed during the WG that ICES will launch a data-call on data availability for anglerfish and that a scoping meeting will be organized for the beginning of 2017 to assess the availability and quality of the data and start preparing for a benchmark later in the year or early in 2018.

A preliminary time table for a data analysis workshop and the benchmark workshop has been proposed. Given the data constraints it appears that the beginning of 2017 would be the best timing for the scoping meeting.

The updated tables and relevant comments regarding the 2016 and 2017 benchmarks are included in Annex 06 ("Benchmark planning").

1.10.2 Longer-term benchmark planning

WGBIE is also proposing longer term benchmarks and issues that should be addressed in the next round of benchmarks, although they are several years in the future. For 2018, the group proposed a benchmark for both stocks of hake (*Merluccius merluccius*) assessed by WGBIE, to address issues related to stock identity as well as the inclusion of commercial tuning series for the larger fish and to further develop the assessment methods used.

1.11 Mixed Fisheries considerations

Some progress has been made on the development of a mixed-fishery analysis since last year. The WG notes however that the Working Group on Mixed Fisheries Advice that will meet from 23–27 May will update the Iberian mixed fisheries analysis carried out in 2015. The WG also noted that mixed fishery analyses of the Bay of Biscay and Iberian waters was carried out during an STECF meeting from 25–29 May 2015 on the development of a multiannual mixed fishery management plan for the Southwestern Waters (EWG 15-04).

1.12 Assessment and forecast auditing process

WGBIE carried out the standard audits of individual assessments and forecasts were available for all stocks assessed. WGBIE stocks subjected to review are shown in the table below. Following a template provided by ICES secretariat, the choice of assessment model, the model configuration and the data used in the assessments have been checked against the corresponding settings described in the Stock Annex. Not all audits could be completed by the end of the meeting and the remaining stocks were audited after the meeting. No concerns were raised by the auditors.

Fish Stock	Stock Name	Stock Coord.	Advice	Review
anp-78ab	Anglerfish (*L. piscatorius*) in Divisions 7.b-k and 8.a,b	Spain/UK	Update	Ireland/France
anb-78ab	Anglerfish (*Lophius budegassa*) in Divisions 7.b-k and 8.a,b	Spain/UK	Update	Ireland/France
anb-8c9a	Anglerfish (*Lophius budegassa*) in Divisions 8.c and 9.a	Portugal	Update	France/Spain
anp-8c9a	Anglerfish (*L. piscatorius*) in Divisions 8.c and 9.a	Spain	Update	France/Spain
hke-nrtn	Hake in Division IIIa, Subareas IV, VI and 7. and Divisions 8.a,b,d (Northern stock);	Spain	Update	Spain/UK
hke-soth	Hake in Division 8.c and 9.a (Southern stock);	Spain	Update	Spain/Portugal
mgb-8c9a	Megrim (*Lepidorhombus boscii*) in Divisions 8.c and 9.a	Spain	Update	France
mgw-8c9a	Megrim (*Lepidorhombus whiffiagonis*) in Divisions 8.c and 9.a	Spain	Update	Spain
mgw-78	Megrim (*L. whiffiagonis*) in Subarea 7. & Divisions 8.a,b,d,e	Spain	Update	Portugal
sol-bisc	Sole in Divisions 8.a,b,d (Bay of Biscay)	France	Update	Spain
nep-2324	*Nephrops* in Divisions 8.a,b (Bay of Biscay, FU 23, 24)	France	Biennial 1st year	Spain
nep-25	*Nephrops* in North Galicia (FU 25)	Spain	Biennial 1st year	France
nep-31	*Nephrops* in the Cantabrian Sea (FU 31)	Spain	Biennial 1st year	UK
nep-2627	*Nephrops* in West Galicia and North Portugal (FU 26-27)	Portugal	Biennial 1st year	Spain
nep-2829	*Nephrops* in Southwest and South Portugal (FU 28-29)	Portugal	Biennial 1st year	Spain
nep-30	*Nephrops* in Gulf of Cadiz (FU 30)	Spain/Portugal	Biennial 1st year	UK

1.13 Ecosystem overviews

Last year, 2015, Iñigo Martínez (ICES) requested a review of the draft report "Ecosystem Overview", section Bay of Biscay and Iberian waters, and to include considerations from WGBIE. WGBIE had a subgroup meeting and provided comments for consideration. This year the group reviewed the advice sheets produced as result of the finalized report.

1.14 References

ICES. 2016. Report of the Workshop to consider FMSY ranges for stocks in ICES categories 1 and 2 in Western Waters (WKMSYREF4), 13–16 October 2015, Brest, France. ICES CM 2015/ACOM:58. 183 pp.

ICES. 2012a. Report of the Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim (WGHMM), 10-16 May 2012, ICES Headquarters, Copenhagen. ICES CM 2012/ACOM:11. 599 pp.

ICES. 2012b. Report of the Study Group on *Nephrops* Surveys (SGNEPS), 6–8 March 2012, Acona, Italy. ICES CM 2012/SSGESST:19. 36 pp.

ICES. 2012c Report of the Inter Benchmark Protocol on *Nephrops* (IBPNephrops 2012), March 2012, By correspondence. ICES CM 2012/ACOM:42. 5 pp.

ICES. 2010a. Report of the Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim (WGHMM), 5 - 11 May 2010, Bilbao, Spain. ICES CM 2010/ACOM:11. 571 pp.

ICES. 2010b ICES Workshop on Iberian mixed fisheries management plan evaluation of Southern hake, *Nephrops* and anglerfish, 22 - 26 November 2010, Lisbon, Portugal. ICES CM 2010/ ACOM:63. 96 pp.

Table 1.4a Biological sampling levels by stock and country. Number of fish measured and aged from landings in 2015

		ANGLER (L.PISC.)		ANGLER (L.BUDE.)		MEGRIM (L.WHIFF.)		MEGRIM (L. BOSCII)	SOLE (S. SOLEA)	
		VIIb–k & VIIIa,b,d	VIIIc & IXa	VIIb–k & VIIIa,b,d	VIIIc & IXa	VIIb–k & VIIIa,b,d	VIIIc & IXa	VIIIc & IXa	VIIIa,b	VIIIc & IXa
Belgium	No. lengths	7972		4490		5473			9293	
	No. ages					523			188	
	No. samples**	341		61		151			56	
E & W (UK)	No. lengths	12 908		2 952		16125				
	No. ages					1245				
	No. samples*	97		69		378				
France	No. lengths	20431		14 816		NA			21018	
	No. ages					NA			1598	
	No. samples*	1 277		1 277		NA			181	
Portugal	No. lengths		221		1158		61	2956		
	No. ages***									
	No. samples*		72		106		3	64		
Republic of	No. lengths	6262		2 587		36487				
Ireland	No. ages					0				
	No. samples**	100		71		255				
Spain	No. lengths	5907	7635	11 717	5188	18377	6142	28818		
	No. ages					908	910	957		
	No. samples	80	289	78	284	90	151	196		
Denmark	No. lengths									
	No. ages									
	No. samples									
Total	No. lengths	40572		36 562						
	No. ages									
Total nb. in international landings ('000)		25266	1748		1042					
Nb. measured as % of annual nb. caught										

*** Vessels, ** Categories**

***** Ages, surveys, **** Boxes/hauls (for sampling on board)**

******* Otoliths collected and prepared but not read**

Table 1.4a (continued)

		HAKE		*NEPHROPS*			SEA BASS		POLLACK	WHITING	PLAICE
		IIIa, IV, VI, VII & VIIIa,b	VIIIc & IXa	VIIIab FU 23-24	VIIIc FU 25-31	IXa FU 26-30	VIIIab	VIIIc & IXa	VIII & IXa	VIII & IXa	VIII & IXa
Scotland (UK)	No. lengths	10606							0	0	0
	No. ages	-							0	0	0
	No. samples*	125							0	0	0
E & W (UK)	No. lengths	17265							0	0	0
	No. ages								0	0	0
	No. samples*	901							0	0	0
France	No. lengths	NA							???	???	???
	No. Ages*****	-							0	0	0
	No. samples****	NA							???	???	???
Portugal	No. lengths	-	21098			9104			0	0	2233
	No. ages***	-							0	0	0
	No. samples*	-	466			40			0	0	92
Republic of	No. lengths	9202							0	0	0
Ireland	No. ages*****								0	0	0
	No. samples*	158							0	0	0
Spain	No. lengths	65734	58755		1930	1870			0	521	0
	No. ages		1173						0	0	0
	No. samples*	458			44	30			0	8	0
Denmark	No. lengths	12960							0	0	0
	No. ages								0	0	0
	No. samples*	968							0	0	0
Total	No. lengths	123356							0	521	2233
	No. ages								0	0	0
Total No. in international landings ('000)		80787	63715		43	6224					
Nb. meas. as % of annual nb. caught		0.2%	0.92		4.5%	0.2%					

*** Vessels, ** Categories**

***** Ages, surveys, **** Boxes/hauls (for sampling on board)**

******* Otoliths collected and prepared but not read**

Table 1.4b Biological sampling levels by stock and country. Number of fish measured and aged from discards in 2015

		Angler (L.pisc.)		Angler (L.bude.)		Megrim (L.whiff.)		Megrim (L. boscii)	Sole (S. solea)	
		VIIb–k & VIIIa,b,d	VIIIc & IXa	VIIb–k & VIIIa,b,d	VIIIc & IXa	VIIb–k & VIIIa,b,d	VIIIc & IXa	VIIIc & IXa	VIIIa,b	VIIIc & IXa
Belgium	No. lengths					699				
	No. ages					129				
	No. samples					36				
E & W (UK)	No. lengths					993				
	No. ages					73				
	No. samples	140		140		286				
France	No. lengths	1601		2 530		NA				
	No. ages					NA				
	No. samples	816		816		NA				
Portugal (a)	No. lengths									
	No. ages									
	No. samples									
Republic of	No. lengths	2169		1 458		19318				
Ireland	No. ages									
	No. samples	51		51		337				
Spain	No. lengths	1		43		1854				
	No. ages									
	No. samples	1		40		350				
Denmark	No. lengths									
	No. ages									
	No. samples									
Total	No. lengths	3771		4 031						
	No. ages									
Total no. in international discards ('000)										
Nb. meas. as % of annual nb. Discarded										

Table 1.4b (continued)

		HAKE		*NEPHROPS*			SEA BASS		POLLACK	WHITING	PLAICE
		IIIa, IV, VI, VII & VIIIa,b	VIIIc & IXa	VIIIab FU 2324	VIIIc FU 2531	IXa FU 26-30	VIIIab	VIIIc & IXa	VIII & IXa	VIII & IXa	VIII & IXa
Scotland (UK)	No. lengths								0	0	0
	No. ages								0	0	0
	No. samples								0	0	0
E & W (UK)	No. lengths								0	0	0
	No. ages								0	0	0
	No. samples								0	0	0
France	No. lengths								0	0	0
	No. Ages								0	0	0
	No. samples								0	0	0
Portugal (a)	No. lengths								0	0	0
	No. ages								0	0	0
	No. samples								0	0	0
Republic of	No. lengths								0	0	0
Ireland	No. ages								0	0	0
	No. samples								0	0	0
Spain	No. lengths								0	0	0
	No. ages								0	0	0
	No. samples								0	0	0
Denmark	No. lengths								0	0	0
	No. ages								0	0	0
	No. samples								0	0	0
Total	No. lengths								0	0	0
	No. ages								0	0	0
Total no. in international discards ('000)											
Nb. meas. as % of annual nb. Discarded											

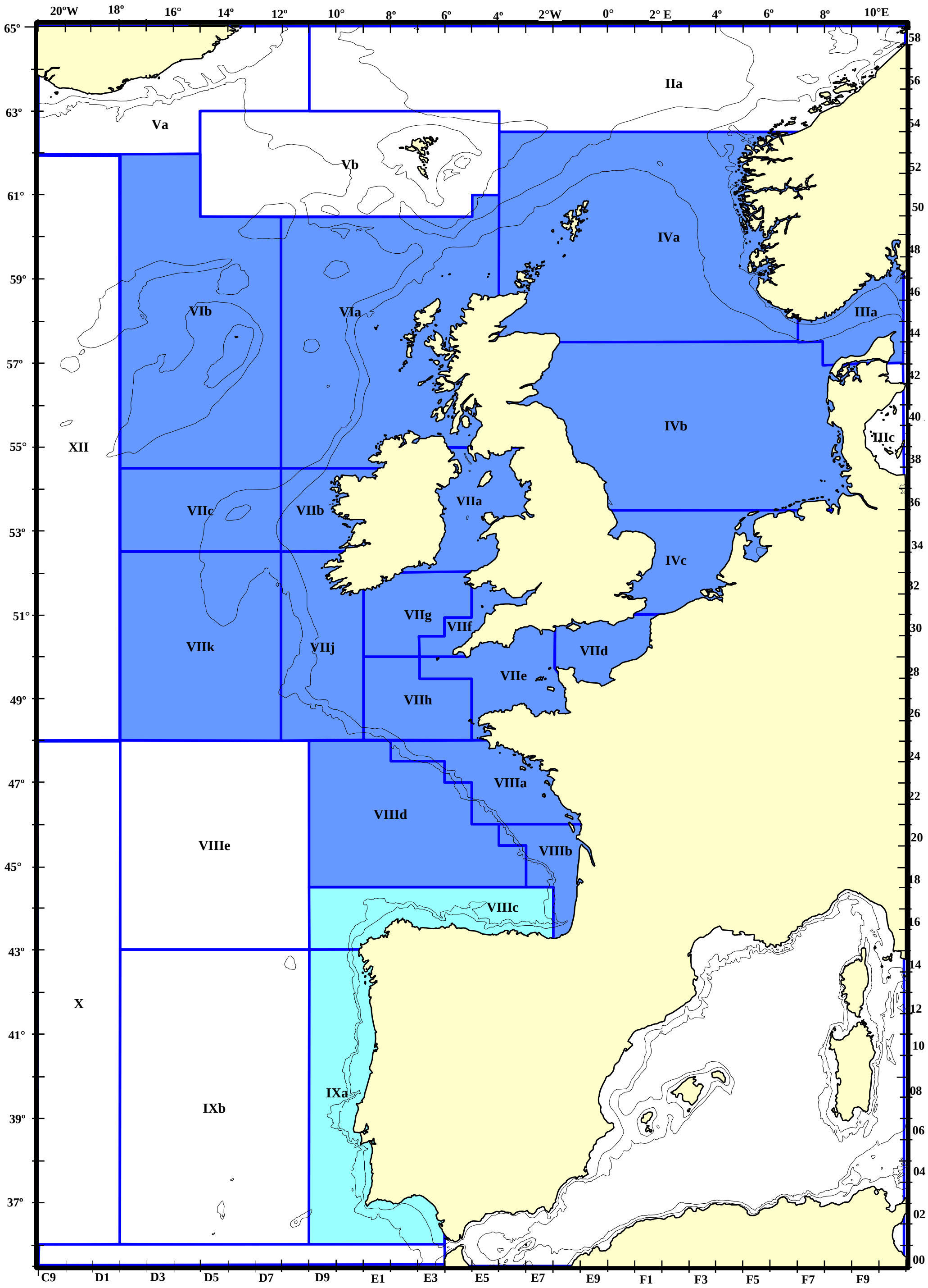

Figure 0.1. Map of ICES Divisions. Northern (3.a, 4, 6, 7. and 8.abd) and Southern (8.c and 9.a) Divisions with different shading.

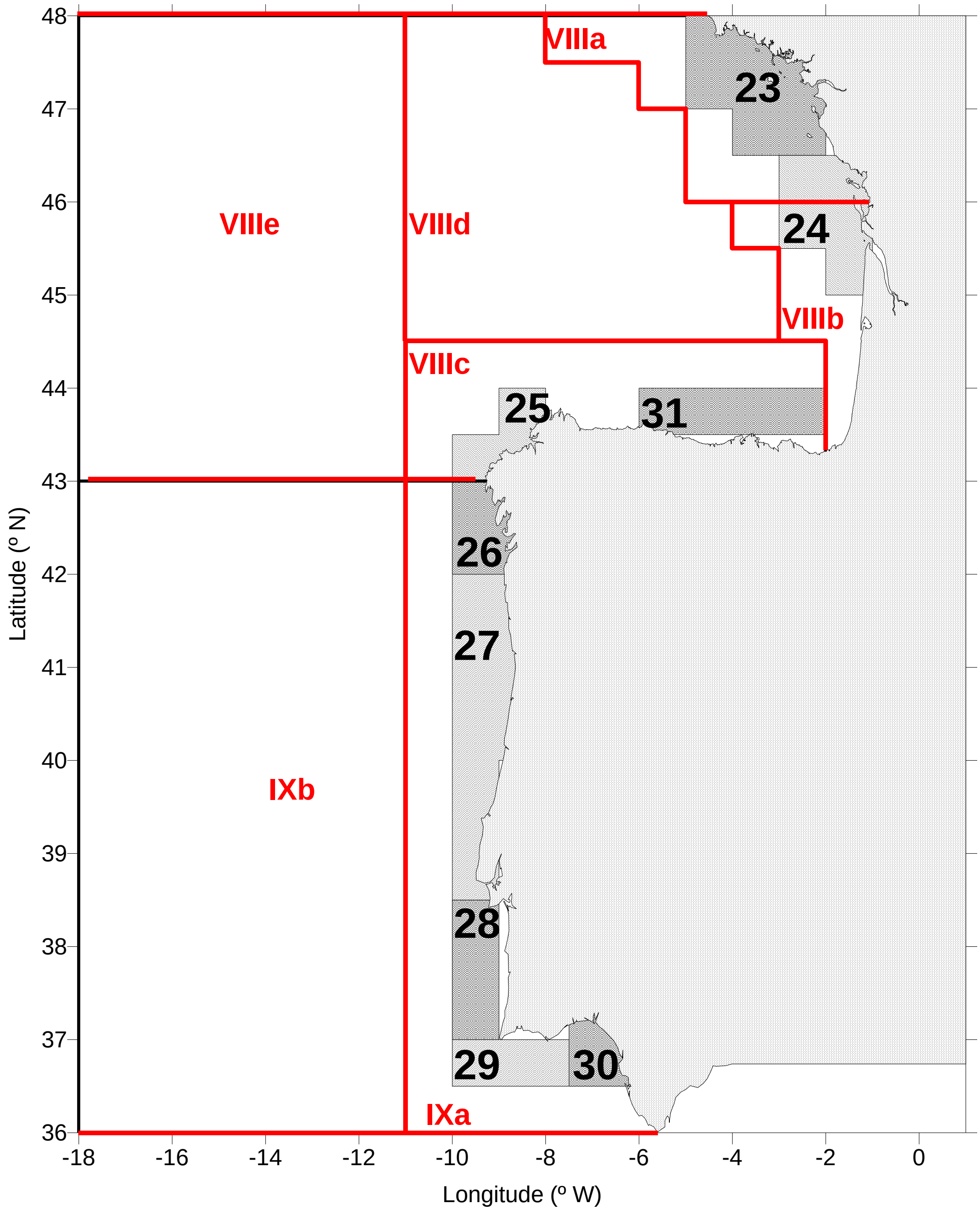

Figure 1.2. ICES Division 8, 9.a. *Nephrops* Functional Units. Division 8.ab (Management Area N): FUs 23-24. Division 8.c (Management Area O): FUs 25 and 31. Division 9.a (Management Area Q): FUs 26-30.

2 Description of Commercial Fisheries and Research Surveys

2.1 Fisheries description

This Section describes the fishery units relevant to the stocks assessed in this WG. Additionally, to facilitate the use of InterCatch, it presents the "fleets" that the WG proposes to use for data submission in InterCatch.

2.1.1 Celtic – Biscay Shelf (Subarea 7 and Divisions 8.a,b,d).

The fleets operating in the ICES Subarea 7 and Divisions 8.a,b,d are used in this WG following the Fishery Units (FU) defined by the "ICES Working Group on Fisheries Units in subareas 7 and 8" (ICES, 1991):

Under the implementation of the mixed fisheries approach in the ICES WG's new information updating some national fleet segmentations was presented in WGHMM reports in the last few years, from general overviews (ICES, 2004; ICES, 2005) to detailed national descriptions: French fleets (ICES, 2006), Irish fleets (ICES, 2007), and Spanish fleets (ICES, 2008). This new information in relation to the métiers definition did not change the Fishery Units used in the single-stock assessments. However, the hierarchical disaggregation of FU into métiers is essential not only for carrying out mixed-fisheries assessments, but also for a deeper understanding of the fisheries behaviour.

Fishery Unit	Description	Sub-area
FU1	Longline in medium to deep water	7
FU2	Longline in shallow water	7
FU3	Gillnets	7
FU4	Non-Nephrops trawling in medium to deep water	7
FU5	Non-Nephrops trawling in shallow water	7
FU6	Beam trawling in shallow water	7
FU8	Nephrops trawling in medium to deep water	7
FU9	Nephrops trawling in shallow to medium water	8
FU10	Trawling in shallow to medium water	8
FU12	Longline in medium to deep water	8
FU13	Gillnets in shallow to medium water	8
FU14	Trawling in medium to deep water	8
FU15	Miscellaneous	7 & 8
FU16	Outsiders	3.a, 4, 5 & 6
FU00	French unknown	

The EU Data Collection Framework (DCF; Council Regulation (EC) 199/2008; EC Regulation 665/2008; Decision 2008/949/EC) establishes a framework for the collection of economic, biological and transversal data by Member States. One of the most relevant changes of this new period with respect to the previous Data Collection Regulation (DCR; Reg. (EC) No 1639/2001) has been the inclusion of the ecosystem approach by means of moving from stock-based sampling to métier-based sampling. The new DCF defines the métier as "*a group of fishing operations targeting the same species or a similar assemblage of species, using similar gear, during the same period of the year and/or within the same area, and which are characterized by a similar exploitation pattern*". Due to the new sampling design, established since 2009, which can affect the fishery data supplied to this WG, it has been agreed to detail the métiers related with the stocks assessed by this WG, trying to find the correspondence with the Fishing Units.

Data for stock assessment are typically provided to stock coordinators either still according to the old FUs and the traditional tuning fleets or to the DCF métiers. In the case of discards and/or biological data, although sampling may be done at the DCF métier Level 6, estimates are often re-aggregated to Level 5 due to low sampling levels reached by countries. Thus, this WG agreed to use DCF Level 5 (without mesh size) as the “fleet” level to introduce data in InterCatch. The table below shows the “fleets” to be used for InterCatch and their correspondence with the old Fishery Units and the DCF métiers at Level 6.

FU	Fleet for InterCatch	DCF Métier (Level 6)	Description	FR	IR	SP	UK
FU1	LLS_DEF	LLS_DEF_0_0_0	Set longline directed to demersal fish			X	X
FU2							
FU3	GNS_DEF	GNS_DEF_100-219_0_0	Set gillnet directed to demersal fish (100-219 mm)	X	X	X	
FU4	OTB_DEF	OTB_DEF_70-99_0_0	Bottom otter trawl directed to demersal fish (70-99 mm)		X	X	X
		OTB_DEF_100-119_0_0	Bottom otter trawl directed to demersal fish (100-119 mm)			X	X
FU5	OTB_DEF		Otter trawl directed to demersal Fish shallow water				X
FU6	TBB_DEF		Beam trawl				X
FU8	OTB_CRU						
FU9	OTB_CRU	OTB_CRU_70-99_0_0	Bottom otter trawl directed to crustaceans (70-99 mm)	X	X		X
FU10	OTB_DEF						
FU12	LLS_DEF	LLS_DEF_0_0_0	Set longline directed to demersal fish	X		X	
FU13	GNS_DEF	GNS_DEF_45-59_0_0	Set gillnet directed to demersal fish (45-59 mm)	X			
		GNS_DEF_>=100_0_0	Set gillnet directed to demersal fish (at least 100 mm)	X		X	
FU14	OTB_DEF	OTB_DEF_>=70_0_0	Bottom otter trawl directed to demersal fish (at least 70 mm)	X		X	
	OTB_MCF	OTB_MCF _>=70_0_0	Bottom otter trawl directed to mixed cephalopods and demersal fish (at least 70 mm)			X	
	OTT_DEF	OTT_DEF _>=70_0_0	Multi-rig otter trawl directed to demersal fish (at least 70 mm)	X			
	OTB_CRU	OTB_CRU _>=70_0_0	Bottom otter trawl directed to crustaceans (at least 70 mm)	X			
	OTT_CRU	OTT_CRU _>=70_0_0	Multi-rig otter trawl directed to crustaceans (at least 70 mm)	X			
	OTB_MPD	OTB_MPD _>=70_0_0	Bottom otter trawl directed to mixed pelagic and demersal fish (at least 70 mm)			X	
	PTB_DEF	PTB_DEF _>=70_0_0	Bottom pair trawl directed to demersal fish (at least 70 mm)			X	
FU15	SSC_DEF		Fly shooting seine directed to demersal fish				
FU16	OTB_DEF	OTB_DEF _100-119_0_0	Bottom otter trawl directed to demersal fish (100-119 mm)	X		X	X
	LLS_DEF	LLS_DEF _0_0_0	Set longline directed to demersal fish			X	
	SSC_DEF		Fly shooting seine directed to demersal fish				
FU00	PTM_DEF		Midwater pair trawl directed to demersal fish				

For the Bay of Biscay sole stock, the correspondence with DCF métiers is somewhat complicated because the fleets used are:

Inshore-gillnets (French gillnetters with length < 12 m) (GNx or GTx)

Offshore-gillnets (French gillnetters with length > 12 m) (GNx or GTx)

Inshore-trawlers (French trawlers with length < 12 m) (OTx, TBx, PTx)

Offshore-trawlers (French trawlers with length > 12 m)

In other words, the fleets used correspond to netters and trawlers fishing for sole in the Bay of Biscay, grouped according to vessel length.

2.1.2 Atlantic Iberian Peninsula Shelf (Divisions 8.c and 9.a).

The Fishery Units operating in the Atlantic Iberian Peninsula waters were described originally in the report of the "Southern hake task force" meeting (STECF, 1994), and have been used for several years in this WG as follows:

Country	Fishery Unit	Description
Spain	Small Gillnet	Gillnet fleet using "beta" gear (60 mm mesh size) for targeting hake in Divisions 8c and 9.a North
	Gillnet	Gillnet fleet using "volanta" gear (90 mm mesh size) for targeting hake in Division 8c
		Gillnet fleet using "rasco"gear (280 mm mesh size) for targeting anglerfish in Division 8c
	Longline	Longline fleet targeting a variety of species (hake, great fork beard, conger) in Division 8c
	Northern Artisanal	Miscellaneous fleet exploiting a variety of species in Divisions 8c and 9.a North
	Southern Artisanal	Miscellaneous fleet exploiting a variety of species in Division 9.a South (Gulf of Cádiz)
	Northern Trawl	Miscellaneous fleet operating in Divisions 8c and 9.a North composed of bottom pairtrawlers targeting blue whiting and hake (55 mm mesh size, and 25 m of vertical opening); and two types of bottom otter trawlers (70 mm mesh size): trawlers using the "baca" gear (1.5 of vertical opening) targeting hake, anglerfish, megrim and Nephrops, and trawlers using "jurelera" (often referred to as "HVO", high vertical opening, in the present report) gear (>5m of vertical opening) targeting mackerel and horse mackerel.
	Southern Trawl	Bottom otter trawlers operating in Division 9.a South (Gulf of Cádiz) exploiting a variety of species (sparids, cephalopods, sole, hake, horse mackerel, blue whiting, shrimp, Norway lobster).
Portugal	Artisanal	Miscellaneous fleet with two components (inshore and offshore) operating in Portuguese waters of Division 9.a involving gillnet (80 mm mesh size), trammel (100 mm mesh size), longline and other gears. Species caught: hake, octopus, pout, horse mackerel and others
	Trawl	Trawl fleet opertaing in Portuguese waters of Division 9.a copmpounded by bottom otter trawlers targeting crustaceans (55 mesh size), and bottom oter trawlers targeting different species of fish (65 mm mesh size).

The Spanish and Portuguese fleets operating in the Atlantic Iberian Peninsula shelf were segmented into métiers under the EU project IBERMIX (DG FISH/2004/03-33), and the results were described in Section 2 of the 2007 WGHMM report (ICES, 2007).

The correspondence between Fishing Units and DCF métiers has been also compiled for the southern stocks fleets and is presented in the following table. As for the Celtic-Biscay shelf, sampling inconsistencies among biological and commercial data make the use of the DCF Level 5 preferable to introduce Iberian data in InterCatch. This re-aggregation affects the Spanish gillnet operating in the Northern Spanish waters, because the set gillnet ("*beta*") directed to hake (GNS_DEF_60-79_0_0) and the set gillnet ("volanta") also targeting hake (GNS_DEF_80-99_0_0) must be sampled together. It must take into account that the set gillnet using more than 280 mm mesh size (GNS_DEF_280_0_0) targets mostly anglerfish and cannot be distinguished at Level 5 (the level proposed for the InterCatch fleets) from the two gillnet métiers previously mentioned (which are directly mainly to hake). So a revision of the current InterCatch fleet proposal may be required in this case (to be decided by the WG by mid-September, as stated at the start of Section 2.1).

COUNTRY	FU	FLEET FOR INTERCATCH	MÉTIERS (LEVEL 6)	DESCRIPTION (MESH SIZE IN BRACKETS)	SP	PT
	Gillnet		GNS_DEF_80-99_0_0	Set gillnet directed to demersal species (80-99 mm)	X	
		GNS_DEF	GNS_DEF_280_0_0	Set gillnet directed to demersal species (at least 280 mm)	X	
	Northern Arisanal		GNS_DEF_60-79_0_0	Set gillnet directed to demersal fish (60-79 mm)	X	
	Longline	LLS_DEF	LLS_DEF_0_0_0	Set longline directed to demersal fish	X	
Spain	Southern artisanal	LLS_DWS	LLS_DWS_0_0_0	Set longline directed to deep-water species	X	
		PTB_DEF	PTB_DEF _>= 55_0_0	Pair bottom trawl directed to demersal fish (at least 55 mm)	X	
	Northern Trawl	OTB_DEF	OTB_DEF_>=55_0_0	Otter bottom trawl directed to demersal fish (at least 55 mm)	X	
		OTB_MPD	OTB_MPD_>=55_0_0	Otter bottom trawl directed to mixed pelagic and demersal fish (at least 55 mm)	X	
	Southern trawl	OTB_DEM	OTB_DEM_>=55_0_0	Otter bottom trawl directed to demersal species (at least 55 mm)	X	
		GTR_DEF	GTR_DEF_>=100_0_0	Trammelnet directed to demersal fish (at least 100 mm)		X
	Artisanal	GNS_DEF	GNS_DEF_80-99_0_0	Set gillnet directed to demersal fish (80-99 mm)		X
Portugal		LLS_DEF	LLS_DEF_0_0_0	Set longline directed to demersal fish		X
		LLS_DWS	LLS_DWS_0_0_0	Set longline directed to deep-water species		X
	Trawl	OTB_CRU	OTB_CRU_>=55_0_0	Otter bottom trawl directed to crustaceans (at least 55 mm)		X
		OTB_DEF	OTB_DEF_60-69_0_0	Otter bottom trawl directed to demersal fish (60-69 mm)		X

2.2 Description of surveys

This section gives a brief description of the surveys referred to in this WG report. The surveys are listed in the following table, including the acronym used by WGHMM in 2010, the DCF acronym and the new ICES survey acronym which will be used throughout this WG report and Stock Annexes. The new survey acronyms used this year were provided by ICES Secretariat, aiming for consistency across all ICES Expert Groups. When ICES Secretariat has not included a survey in the list for which it has provided acronyms, the WGHMM 2010 acronym will remain in use.

Survey	WGHMM 2010 acronym	DCF acronym	ICES survey acronym as of 2011
Spanish groundfish survey – quarter 4	SP-GFS	IBTS-EA-4Q	SpGFS-WIBTS-Q4
Spanish Porcupine groundfish survey	SP-PGFS	IBTS-EA	SpPGFS-WIBTS-Q4
Spanish Cadiz groundfish survey – Autumn	SP-GFS-caut		SPGFS-caut-WIBTS-Q4
Spanish Cadiz groundfish survey – Spring	SP-GFS-cspr		SPGFS-cspr-WIBTS-Q1
Portuguese groundfish survey – October	P-GFS-oct	IBTS-EA-4Q	PtGFS-WIBTS-Q4
Portuguese groundfish survey – July (terminated)	P-GFS-jul		----
Portuguese crustacean trawl survey / Nephrops TV survey offshore Portugal	P-CTS	UWFT (FU 28-29)	PT-CTS (UWTV (FU 28-29))
Portuguese winter groundfish survey/Western IBTS 1st quarter	PESCADA-BD		PtGFS-WIBTS-Q1
French EVHOE groundfish survey	EVHOE	IBTS-EA-4Q	EVHOE-WIBTS-Q4
French RESSGASC groundfish survey (ended in 2002)	RESSGASC		----
French Bay of Biscay sole beam trawl survey	ORHAGO		ORHAGO
French Nephrops survey in Bay of Biscay	LANGOLF		LANGOLF
UK west coast groundfish survey (ended in 2004)	UK-WCGFS		-----
UK Western English Channel Beam Trawl Survey			UK-WECBTS
UK Bottom-trawl Survey			EN-Cefas-A, B
English fisheries science partnership survey	EW-FSP		FSP-Eng-Monk
Irish groundfish survey	IGFS	IBTS-EA-4Q	IGFS-WIBTS-Q4

A brief description of each survey follows. A general map identifying survey areas can be found in ICES IBTS WG reports.

2.2.1 Spanish groundfish survey (SpGFS-WIBTS-Q4)

The SpGFS-WIBTS-Q4 covers the northern Spanish shelf comprised in ICES Division 8c and the northern part of 9.a, including the Cantabrian Sea and off Galicia waters. It is a bottom-trawl survey that aims to collect data on the distribution, relative abundance and biology of commercial fish species such as hake, monkfish and white anglerfish, megrim, four-spot megrim, blue whiting and horse mackerel. Abundance indices are estimated by length and in some cases by age, with indices also estimated for *Nephrops*, and data collected for other demersal fish and invertebrates. The survey is ca. 120 hauls and is from 30–800 m depths, usually starts at the end of the 3rd quarter (September) and finishes in the 4th quarter.

2.2.2 Spanish Porcupine groundfish survey (SpPGFS-WIBTS-Q4)

The SpPGFS-WIBTS-Q4 occurs at the end of the 3rd quarter (September) and start of the 4th quarter. It is a bottom-trawl survey that aims to collect data on the distribution, relative abundance and biology of commercial fish in ICES Division 7.b-k, which corresponds to the Porcupine Bank and the adjacent area in western Irish waters between 180–800m. The survey area covers 45 880 Km^2 and approximately 80 hauls per year are carried out.

2.2.3 Cadiz groundfish surveys - Spring (SPGFS-cspr-WIBTS-Q1) and Autumn (SPGFS-caut-WIBTS-Q4)

The bottom-trawl surveys SPGFS-cspr-WIBTS-Q1 and SPGFS-caut-WIBTS-Q4 occur in the southern part of ICES Division 9.a, the Gulf of Cádiz, and collect data on the distribution, relative abundance, and biology of commercial fish species. The area covered is 7 224 Km^2 and extends from 15–800m. The primary species of interest are hake, horse mackerel, wedge sole, sea breams, mackerel and Spanish mackerel. Data and abundance indices are also collected and estimated for other demersal fish species and invertebrates such as rose and red shrimps, *Nephrops* and cephalopod molluscs.

2.2.4 Portuguese groundfish survey October (PtGFS-WIBTS-Q4)

PtGFS-WIBTS-Q4 extends from latitude 41°20' N to 36°30' N (ICES Div. 9.a) and from 20–500m depth. The survey takes place in Autumn. The main objectives of the survey is to estimate the abundance and study the distribution of the most important commercial species in the Portuguese trawl fishery (hake, horse mackerel, blue whiting, sea bream and *Nephrops*), mainly to monitor the abundance and distribution of hake and horse mackerel recruitment. The surveys aim to carry out ca. 90 stations per year.

2.2.5 Portuguese crustacean trawl survey / *Nephrops* TV survey offshore Portugal (PT-CTS (UWTV (FU 28-29))

The PT-CTS (UWTV (FU 28-29)) survey is carried out in May-July and covers the southwest coast (Alentejo or FU 28) and the south coast (Algarve or FU 29). The main objectives are to estimate the abundance, to study the distribution and the biological characteristics of the main crustacean species, namely *Nephrops norvegicus* (Norway lobster), *Parapenaeus longirostris* (rose shrimp) and *Aristeus antennatus* (red shrimp). The average number of stations in the period 1997–2004 was 60. Sediment samples have been collected since 2005 with the aim to study the characteristics of the *Nephrops* fishing grounds. In 2008 and 2009, the crustacean trawl survey conducted in Functional Units 28 and 29, was combined with an experimental video sampling.

2.2.6 Portuguese winter groundfish survey/Western IBTS 1st quarter (PtGFS-WIBTS-Q1)

The PtGFS-WIBTS-Q1survey has been carried out along the Portuguese continental waters from latitude 41°20' N to 36°30' N (ICES Div. 9.a) and from 20–500m depth. The winter groundfish survey plan comprises 75 fishing stations, 66 at fixed positions and 9 at random. The main aim of the survey is to estimate spawning biomass of hake.

2.2.7 French EVHOE groundfish survey (EVHOE-WIBTS-Q4)

The EVHOE-WIBTS-Q4 survey covers the Celtic Sea with ICES Divisions 7.f,g,h,j, and the French part of the Bay of Biscay in divisions 8ab. The survey is conducted from 15 to 600 m depths, usually in the fourth quarter, starting at the end of the October. The primary species of interest are hake, monkfish, anglerfish, megrim, cod, haddock and whiting, with data also collected for all other demersal and pelagic fish. The sampling strategy is stratified random allocation, the number of set per stratum based on the 4 most important commercial species (hake, monkfish and megrim) leaving at least two stations per stratum and 140 valid tows are planned every year although this number depends on available sea time.

2.2.8 French RESSGASC groundfish survey (RESSGASC)

The RESSGASC survey was conducted in the Bay of Biscay from 1978–2002. Over the years 1978–1997 the survey was conducted with quarterly periodicity. It was conducted twice a year after that (in Spring and Autumn). Survey data prior to 1987 are normally excluded from the time-series, since there was a change of vessel at that time.

2.2.9 French Bay of Biscay sole beam trawl survey (ORHAGO)

The ORHAGO survey was launched in 2007, with the aim of producing an abundance index and biological parameters such as length distribution for the Bay of Biscay sole. It is usually carried out in November, with approximately 23 days of duration and sampling 70–80 stations. It uses beam trawl gear and is coordinated by the ICES WGBEAM.

2.2.10 French *Nephrops* survey in the Bay of Biscay (LANGOLF)

This survey commenced in 2006 specifically for providing abundance indices of *Nephrops* in the Bay of Biscay. It is carried out on the area of the Central Mud Bank of the Bay of Biscay (ca.11680 km^2), in the second quarter (May apart from the 1st year when the survey occurred in April), using twin trawl, with hours of trawling around dawn and dusk. The whole mud bank is divided to five sedimentary strata and the sampling allocation combines the surface by stratum and the fishing effort concentration. 70-80 experimental hauls are carried out by year. Since the IBP *Nephrops* 2012, this survey is included as tuning series in the stock assessment.

2.2.11 UK west coast groundfish survey (UK-WCGFS)

This survey, which ended in 2004, was conducted in March in the Celtic sea with ca. 62 hauls. It does not include the 0-age group with one of the primary aims to investigate the 1 and 2 age groups. Numbers-at-age for this abundance index are estimated from length compositions using a mixed distribution by statistical method.

2.2.12 English fisheries science partnership survey (FSP-Eng-Monk)

The FSP-Eng-Monk survey, part of the English fisheries science partnership programme, has been carried out every year since 2003 with 208 valid hauls in 2010. The aims of the survey are to investigate abundance and size composition of anglerfish on the main UK anglerfish fishing grounds off the southwest coast of England within ICES Subdivisions 7.e–h.

2.2.13 English Western English Channel Beam Trawl Survey

Since 1989 the survey has remained relatively unchanged, apart from small adjustments to the position of individual hauls to provide an improved spacing. In 1995, two inshore tows in shallow water (8-15m) were introduced. The survey now consists of 58 tows of 30 minutes duration, with a towing speed or 4 knots in an area within 35 miles radius of Start Point. The objective is to provide indices of abundance, which are independent of commercial fisheries, of all age groups of sole and plaice on the western Channel grounds, and an index of recruitment of young (1–3 year-old) sole prior to full recruitment to the fishery.

2.2.14 English Bottom-trawl Survey

This bottom-trawl survey covered the Irish, Celtic Sea and Western English Channel but it was discontinued in 2004.

2.2.15 Irish groundfish survey (IGFS-WIBTS-Q4)

The IGFS-WIBTS-Q4 is carried out in 4th quarter in divisions 6.a, 7.b,c,g,j, though only part of 6.a and the border of Division 7.c, in depths of 30–600m. The annual target is 170 valid tows of 30 minute duration which are carried out in daylight hours at a speed of 4 knots. Data are collected on the distribution, relative abundance and biological parameters of a large range of commercial fish such as haddock, whiting, plaice and sole with survey data provided also for cod, white and black anglerfish, megrim, lemon sole, hake, saithe, ling, blue whiting and a number of elasmobranchs as well as several pelagics (herring, horse mackerel and mackerel).

3 Anglerfish (*Lophius piscatorius and Lophius budegassa*) in Divisions 7.b-k and 8.a,b,d

There has been no accepted assessment for either *L. piscatorius* or *L. budegassa* since 2007. The Working Group in 2007 found that the input data showed deficiencies, especially as discarding was known to be increasing and that ageing problems had become more obvious. The stock went through a benchmark process during 2012 (WKFLAT 2012) but no analytical assessment was found acceptable.

L. piscatorius and L. budegassa:

Type of assessment in 2015: Same Advice as Last Year (SALY).

Data revisions this year: EHVOE survey 2011 index revised for *L. piscatorius* and *L. budegassa*. Revised LPUE for UK (E&W) for *L. budegassa* in 2014.

Review Group issues:

The RG noted that unless discarding of small fish is taken into account, it may be difficult to develop a length-based analytical assessment for this stock.

3.1 General

3.1.1 Summary of ICES advice for 2016 and management for 2015 and 2016

ICES advice for 2016

Lophius piscatorius

ICES advises that when the precautionary approach is applied, landings in 2016 should be no more than 26 691 tonnes. ICES cannot quantify the corresponding total catches.

Lophius budegassa

ICES advises that when the precautionary approach is applied, landings in 2016 should be no more than 10 757 tonnes. ICES cannot quantify the corresponding total catches.

Management of the two anglerfish species under a combined TAC prevents effective control of the single-species exploitation rates and could lead to overexploitation of either species.

Management applicable for 2015 and 2016

The TAC applied to both species and including Division 7.a was set at 42 496 t for 2015 and for 2016.

Since 1st February 2006 a ban on gillnet at depth greater than 200 m was set in Subareas 6.a,b and 7.b,c,j,k.

3.1.2 Landings

Landings have increased since 2000 and have fluctuated around 33 000 t since 2003. The landings of both species combined were estimated to be 28 880 t in 2010, 28 357 t in 2011 and 33 373 t in 2012. Estimated landings of 36 855 t in 2013 are at the highest level over the last 10 years and the fourth highest of the time-series, landings of 36 200 in 2014, are close to levels seen in 2013 but in 2015 decreased to 35 585 t. In the last year, estimated landings in Subarea 7 are stable, with an apparent decrease in Subarea 8

(Table 3.1-1).There was a revision for the Spanish data for the years 2011 to 2012 due to the new method in estimating the landings. Although the total landings for the two species combined are similar to the previous estimates this has had an affect on how the species are split for assessment purposes. Therefore, the WG decided not to use these data until details of the sampling used and the effects of the new method are clarified.

3.1.3 Discards

Estimates of discards have been carried out and new data have been made available to the working group by all countries for the first time. This information shows that an increasing proportion of small fish of both species are caught and discarded. After an extensive analysis of discard data by WKFLAT 2012, discard estimates were considered not to be precise with a high level of uncertainty due to raising methods using very limited sampling, therefore the group decided not to use the discard estimates in the assessment or for advice purposes.

Table 3.1-1. Anglerfish in Divisions 7.b-k and 8.a,b,d -Total landings from 1984–2015: Working Group estimates

Year	7.b–k	8.a,b,d	Total
1977			19 895
1978			23 445
1979			29 738
1980			38 880
1981			39 450
1982			35 285
1983			38 280
1984	28 847	7 909	36 756
1985	28 491	7 161	35 652
1986	25 987	5 897	31 883
1987	22 295	7 233	29 528
1988	22 494	5 983	28 477
1989	24 674	5 276	29 950
1990	23 434	5 950	29 384
1991	20 256	4 684	24 940
1992	17 412	3 530	20 942
1993	16 517	3 507	20 024
1994	18 023	3 841	21 864
1995	21 822	4 862	26 684
1996	24 153	6 102	30 255
1997	23 928	5 846	29 774
1998	23 295	4 876	28 171
1999	21 845	3 143	24 988
2000	18 129	2 456	20 585
2001	19 534	2 875	22 409
2002	22 648	3 571	26 220
2003	28 552	4 681	33 233
2004	29 510	5 640	35 150
2005	27 908	5 167	33 075
2006	26 795	4 823	31 618
2007	30 121	5 213	35 334
2008	26 724	5 032	31 756
2009	22 733	5 193	27 926
2010	23 338	5 542	28 880
2011	22 458	5 900	28 357
2012	24 370	9 004	33 373
2013*	25 994	10 861	36 855
2014	27 950	8 251	36 200
2015**	27 919	7 666	35 585

*** revised**

**** preliminary**

3.2 Anglerfish *(L. piscatorius)* in Divisions 7.b-k and 8.a,b,d

3.2.1 Data

3.2.1.1 Commercial Catch

The Working Group estimates of landings of *L. piscatorius* by fishery unit (defined in Section 2 of the report) are given in Table 3.2-1.

The landings have declined steadily from 23 666 t in 1986 to 12 766 t in 1992, then increased to 22 162 t in 1996 and declined to 13 941 t in 2000. The landings have increased since then reaching the maximum of the time-series in 2007 (28 977 t). The 2008 value shows a 16% drop to 24 376 t. In 2009 the decreasing trend continued with a 24 % drop (18 844 t) and in 2010 landings recovered to historic mean levels at 19 521 t.

The 2011 landings started an increasing trend with landings estimates of 20 370 t. The 2012 landings showed a further increase to 24 409 t. In 2013 a slight decrease of the landings gave a figure of 23 759 t. In 2014 the estimated landings of *L. piscatorius* were 25 328 t, similar to 2015 preliminary estimated data 25266 t.

3.2.1.2 Commercial LPUE

Effort and LPUE data for the three Spanish fleets and English FU6 were available up to 2014 (Table 3.2-2 and Figure 3.2-1), but in 2015 the effort and LPUE of the fleet SP-BAKON8 was not updated in 2015 due to a change in the way data were reported as it is now using e-logbooks for the first time. Fishing effort for most fleets showed a decrease until the mid-1990's. Effort remained relatively stable thereafter, from 2011 to 2015 a sharp decrease in SP-VIGO7 (69 % reduction) and SP-CORUTR7 (81 % reduction) was recorded maybe due to the vessels with in the fleet landing under a different country but operating as in previous years.

All the commercial LPUE series decreased steadily until 1992. Since then, they have increased up to 2007 except for the 2 BAKA fleets. Most showed a decline in 2008. In 2009 and 2010 EW-FU06 and both BAKA fleets showed an increasing trend but SP-VIGO7 and SP-CORUTR7 showed a decreasing one. In 2011 all available fleets showed an increasing trend that continues in 2012 for all fleets with the exception of EW-FU06. Since 2013 LPUE of Spanish fleet SP-VIGO7 increased, and showed the highest LPUE of the time-series in 2015. Meanwhile, SP-CORUTR7 decreased in 2015, though it should be noted that this fleet is currently represented by one single boat targeting hake, so any trend should be viewed with caution. LPUE for EW-FU06 increased in 2014 with the second highest LPUE of the time-series but in 2015 decreased again by 55%.

3.2.1.3 Surveys data

3.2.1.3.1 The French EVHOE-WIBTS-Q4 survey

This survey covers the largest proportion of the area of stock distribution. Standardized biomass and abundance indices are given in Figure 3.2-2 and the length distributions in Figure 3.2-3.

The biomass indices show an overall increasing trend from the start of the time-series in 1997–2012 and a decrease thereafter. The 2014 and 2015 estimates were below-average. Abundance in numbers shows three peaks in 2001, 2002, 2004. Since 2005 the abundance in numbers remained relatively stable although the estimates in the last three years were lower than those of the preceding years

The length distribution shows that these peaks in numbers of abundance correspond to strong incoming year classes that can be tracked from year to year with modes between 10–25 cm for the first age group (in 2001, 2002, 2004, 2008, 2009, 2010 ,2011 and 2014), 25–45 for the second (2002, 2003, 2005, 2009, 2010, 2011 and 2015) and 45-55 for the third (2003, 2004, 2006, 2010 and 2011), although, the third mode is not as clearly defined.

Recruitment in 2014 seems reasonably high, although not as strong as in 2001, 2002 and 2004. The 2015 recruitment is very low and it does not show signals of second age group (25–45 cm). The high peak at 20 cm is a consequence of the sampling procedure, where the whole catch was not sampled due to a high catch of herring in one single haul, with the remaining species catch being estimated using the subsample ratio.

In Figure 3.2-4 and, Figure 3.2-5 the distribution of recruits (identified as individuals of less than 23 cm) show that contrasting to the years 2001, 2002 and 2004 where the recruits were found in both Celtic Sea and Bay of Biscay areas along the shelf, the recruits were found almost only south of the Celtic Sea and in the Bay of Biscay in 2008 and 2009. The results from 2010–2012 show a uniform distribution of recruits through the sampling area of the survey. 2013 shows a uniform distribution with low levels of recruitment. In 2014 the recruitment was found only in the Bay of Biscay area, but in 2015 they are mainly distributed in the Celtic Sea.

3.2.1.3.2 The Spanish Porcupine Groundfish Survey (SPPGFS (WIBTS-Q4))

This survey was initiated in 2001 and covers the Porcupine Bank. Standardized biomass and abundance indices are given in Figure 3.2-6 and the length distributions in Figure 3.2-7. Although covering a small area of the total stock distribution, similar pulses of recruitment are detected in 2001 and to a lower extent in the years 2002 to 2004. In 2010 a recruitment level similar to 2002-2004 was found. In 2011 the recruitment level was low and in 2012 the recruitment returned to medium values. In 2013 a revision of the indices for the period 2003-2012 was presented with no effects in the trends of the series. 2013 values are the second higher of the series for both biomass and abundance indices. 2014 values are the maximum of the series for both indices, in 2015 the recruitment returned to low levels.

3.2.1.3.3 The Irish Groundfish Survey (IGFS-WIBTS-Q4)

Abundance indices in numbers per ten square kilometres from this survey are given in Table 3.2-3 and length distributions from 2001 to 2015 in Figure 3.2-8. The index shows the same drop as the EVHOE-WIBTS-Q4 and the SPPGFS (WIBTS-Q4) after the peak in 2004. The 2009 index showed a recovery in abundance, although it was still lower than the 2005 value. In 2010 and 2011 a value close to the 2004 maximum has been found. In 2012 a value similar to the 2009 medium level was recorded. In 2013 the value continued in medium levels but higher than in 2012. In 2014 the index shows the maximum of the series with 114.9 Nb/10 Km^2, and the length distribution of the catch shows the highest recruitment of the series. In 2015 the index is the second highest of the time-series, with the presence of a second age group 25–45 cm following the high recruitment of the previous year.

3.2.1.3.4 Other surveys

Other surveys may be indicative of this species' spatial distribution, abundance and biomass in subareas 7 and 8, such as:

- English Cefas Q1 Southwest Ecosystem Survey (Q1SWECOS)
- Q3 UK (E&W) beam trawl survey in divisions 7afg
- Q1 Irish Anglerfish and Megrim Survey (IAMS) (Gerritsen, H, WD01)
- Q1 Irish Beam trawl Ecosystem survey (IBES) (Gerritsen, H, WD02).

The Q1 Irish Anglerfish and Megrim Survey (IAMS) is specifically designed to provide an abundance index for anglerfish and it is expected that this survey will be used in future assessments.

3.2.2 Biological reference points

A Stochastic Production Model in Continuous Time (SPiCT) was applied to *L. piscatorius* and was used to determine stock status in WKProxy (2016). The input data were time-series of landings from 1986–2014, LPUE from a Spanish fleet SP-VIGOTR7 from 1986–2014 and an abundance index from the French quarter 4 EVHOE survey for the period 1997–2014. Thus proxies of MSY reference points were defined using the methods developed in WKProxy (2016).

REFERENCE POINT	ESTIMATE	CILOW	CIUPP	CV
B_{MSYS}	41.2628	15.9815	106.537	50.22
F_{MSYS}	0.5696	0.2278	1.4243	48.34
MSY_S	23.4958	20.2627	27.2448	7.41

The result was that the stock was in desirable status.

Estimated States	ESTIMATE	CILOW	CIUPP	CV
B_2015.25	45.6391	15.5043	134.3457	58.16
F_2015.25	0.4867	0.167	1.4182	57.55
B_2015.25/Bmsy	1.1061	0.7666	1.5959	18.49
F_2015.25/Fmsy	0.8544	0.602	1.2126	17.64

3.2.3 Conclusion

LPUE's and survey data (biomass, abundance indices and length distributions) give indication that the biomass has been increasing as a consequence of the good recruitment observed in 2001, 2002 and 2004 and has stabilized in recent years. There is evidence of good recruitments in 2008, 2009, 2010 and 2011. 2008 and 2009.These have entered the fishery giving higher yields Recruitment in 2012 and 2013 was lower than previous years In 2014 the all surveys show very high recruitment, however, this is not picked up by EVHOE-WIBTS-Q4 in the following year (although it is detected by the IGFS-WIBTS-Q4 survey).

Landings data submitted by the main countries created problems in the estimation of landings due to different levels of métiers combinations comparatively to the previous year (Annex 7).

The problems described above, prevented further analysis of the discards data available for *L. piscatorius*. However, future submission of discards information will allow for a more extensive analysis of the estimates so that catch information can be presented with greater confidence.

Preliminary information on discards shows that an increasing proportion of small fish are caught and discarded (WKFLAT12) and results from 2014 data made available for the first time to the working group shows that around nine percent of the catch is discarded. Due to the low levels of sampling and the uncertainties in the precision of the estimates the group recommends that the discard estimates are not used in the assessment or for advice purposes.

As discard information has been made available to the working group further years submissions will allow for a more extensive analysis of the estimates so that catch information can be presented with confidence

With the discarding of small fish caught, measures should be taken to ensure good survival of the recent recruits such as spatial and technical measures.

The Working Group concludes that in view of the available data, continuing fishing at present level should not harm the stock.

3.2.4 Comments on the assessment

For *L. piscatorius* the EVHOE-WIBTS-Q4 survey mainly covers the shelf area in the Celtic Sea and Bay of Biscay. The estimated biomass index with the survey shows a variable, but overall increasing trend over time, but with a decrease in the last two years. However, adult anglerfish are known to migrate down the slope as they grow, and this is where the majority of the fishery occurs. The survey is a good index of recruitment for the stock and may not reflect the trends in the adult biomass. The other indices, IGFS-WIBTS-Q4 and SPPGFS -WIBTS-Q4 show a different picture of the stock in the final years with increasing number and biomass, respectively. The EVHOE-WIBTS-Q4 survey shows lower than average estimates for recruitment in 2015 when excluding the 20cm length class which is considered not well estimated. The commercial LPUE indices show conflicting trends but there is no evidence of an overall decrease in LPUE in recent years.

Data from surveys give scope for the use of length based models for assessment, growth studies and aging validation that should be initiated as soon as possible.

Table 3.2-1 *Lophius piscatorius* in Divisions 7.b-k and 8a,b,d - Landings in tonnes by Fishery Unit.

			7.b,c,e–k						8.a,b,d		
		Medium/Deep	Shallow		Shallow/medium			Shallow	Medium/Deep		TOTAL
Year	Gillnet	Trawl	Trawl	Beam Trawl	Neph.Trawl	Unallocated	Neph.Trawl	Trawl	Trawl	Unallocated	7 +8
	(Unit 3+13)	(Unit 4)	(Unit 5)	(Unit 6)	(Unit 8)		(Unit 9)	(Unit 10)	(Unit 14)		
1986	429	13781	2877	1437	1021	0	746	720	2657	0	23666
1987	560	11414	2900	1520	787	0	1035	542	3152	0	21909
1988	643	9812	3105	1814	774	0	927	534	2487	0	20095
1989	781	8448	5259	2998	754	0	673	444	1772	0	21130
1990	1021	8787	3950	1736	880	0	410	391	2578	0	19753
1991	1752	7563	2793	1142	752	0	284	218	1657	0	16160
1992	1773	6254	1492	998	887	0	254	166	942	0	12766
1993	1742	5776	2125	1258	969	0	360	278	950	0	13458
1994	1377	7344	2595	1523	1236	0	261	198	1586	0	16120
1995	1915	8461	3195	1805	1242	0	501	429	1954	228	19730
1996	2244	9796	2658	2189	1149	138	441	379	2229	938	22162
1997	2538	9225	2945	2031	964	39	429	376	2045	1068	21660
1998	3398	8714	2138	1722	812	3	397	149	1699	542	19572
1999	3162	9037	2369	1409	780	19	98	116	1259	0	18250
2000	2034	7067	1642	1434	726	6	91	77	863	0	13941
2001	2002	7880	2293	1978	886	17	146	76	1402	0	16681
2002	2719	9465	2609	1836	924	22	247	96	1908	0	19826
2003	3498	12332	2786	1983	974	81	470	168	2575	0	24865
2004	5004	12770	2642	2460	852	14	457	218	3296	0	27714

2005	5154	11556	2400	2388	594	7	342	165	2936	2	25543
2006	3741	13409	2216	2421	700	3	429	218	2758	2	25898
2007	4594	14949	2382	2836	660	11	286	244	3015	0	28977
2008	5107	11766	1885	1990	491	10	227	325	2573	1	24376
2009	3957	9938	358	1880	48	16	221	0	2153	275	18844
2010	3398	9851	539	2503	21	31	301	0	2373	504	19521
2011	2152	8968	548	3019	12	1658	231	0	2285	1497	20370
2012	2905	10392	513	3231	14	1260	195	0	3731	2168	24409
2013*	2045	11118	392	3081	71	1191	216	0	4245	1400	23759
2014	2681	15018	494	2568	102	342	286	0	3754	84	25328
2015**	2404	15182	579	2670	0**	415	0**	0	4006	10	25266
*** revised**											
**** preliminary**											

Table 3.2-2 ***L. piscatorius*** **in Divisions 7.b-k and 8.a,b,d Effort and LPUE data**

EFFORT	YEAR	SP-VIGO7 in Sub-Area VII ('000 days*HP)	SP-CORUTR7 in Sub-Area VII ('000 days*HP)	French Benthic trawlers* Celtic Sea FU04 ('000 hrs)	French Benthic Twin Trawls Celtic Sea ('000 hrs)	French Benthic trawlers* Bay of Biscay FU14 ('000 hrs)	French Benthic Twin Trawls Bay of Biscay ('000 hrs)	EW FU06 Beam trawlers in VII ('00 days)	SP-BAKON7 (days)	SP-BAKON8 (days)
	1986	6 875	9 527	418	N/A	123	N/A	N/A		
	1987	6 662	10 453	349	N/A	199	N/A	N/A		
	1988	6 547	10 886	334	N/A	150	N/A	N/A		
	1989	7 585	10 483	378	N/A	187	N/A	N/A		
	1990	8 021	9 630	380	N/A	208	N/A	N/A		
	1991	7 822	8 522	380	N/A	210	N/A	N/A		
	1992	6 370	5 852	331	N/A	186	N/A	100		
	1993	5 988	5 001	274	N/A	159	N/A	114	1 094	5 590
	1994	5 655	4 990	249	N/A	148	N/A	116	980	5 619
	1995	5 070	4 403	287	N/A	174	N/A	127	1 214	4 474
	1996	5 416	3 746	196	121	144	19	126	1 170	4 378
	1997	5 058	3 738	178	133	133	33	126	540	4 286
	1998	5 360	3 684	182	134	117	40	121	1 196	3 002
	1999	5 084	3 512	110	110	83	59	115	1 384	2 337
	2000	5 519	2 773	165	104	87	49	104	1 850	2 227
	2001	5 678	2 356	135	133	61	66	186	1 451	2 118
	2002	5 041	2 258	116	120	57	75	111	949	2 107
	2003	5 437	2 597	147	136	68	81	166	1 022	2 296

	2004	5 347	2 292	160	133	78	89	174	910	2 159
	2005	5 246	2 120	127	137	83	121	109	544	2 263
	2006	5 392	2 257	140	145	72	101	94	487	2 398
	2007	5 812	2 323	149	152	48	127	97	476	2 098
	2008	5 432	1 640	118	126	58	113	138	105	2 017
	2009	5 155	1 626					75	0	1 807
	2010	4 843	1 988					77	138	1 358
	2011	4 553	1 725					82	57	1 384
	2012	3 276	937					84		1 384
	2013	2 683	563					146		1 185
	2014	1 530	292					79		1 694
	2015	1 395	329					133		
				French Benthic	French Benthic	French Benthic	French Benthic			
LPUE	YEAR	Vigo	La Coruna	trawlers*	Twin Trawls	trawlers*	Twin Trawls	EW (FU06)	SP-BAKON7	SP-BAKON8
		in Sub-Area VII	in Sub-Area VII	Celtic Sea	Celtic Sea	Bay of Biscay	Bay of Biscay	Beam trawlers in VII		
				FU04		FU14				
		(kg/days*HP)	(kg/days*HP)	(kg/10 hrs)	(kg/10 hrs)	(kg/10 hrs)	(kg/10 hrs)	(kg/days)	(kg/day)	(kg/day)
	1986	286	383	143		131				
	1987	235	326	142		119				
	1988	182	272	132		110				
	1989	210	236	102		61				
	1990	206	228	104		85				
	1991	184	234	82		55				
	1992	188	200	56		35		94		
	1993	268	172	60		42		93	60	23

1994	289	187	111		75		81	73	44
1995	410	131	131		84		77	99	56
1996	520	212	117	159	81	113	110	130	70
1997	440	245	105	133	78	84	117	132	71
1998	451	193	95	113	60	66	111	134	66
1999	428	136	52	76	42	44	95	125	34
2000	203	182	87	73	34	45	109	186	31
2001	239	170	103	119	56	85	82	184	61
2002	469	218	138	152	69	120	123	218	72
2003	598	286	191	186	102	154	80	274	76
2004	563	249	134	188	87	172	93	249	119
2005	591	356	170	146	99	133	144	287	100
2006	568	383	183	196	108	137	175	221	89
2007	611	409	233	214	118	151	202	261	71
2008	466	542	214	190	97	122	106	171	101
2009	350	252					198		144
2010	298	454					250	217	132
2011	417	384					266	484	157
2012	599	526					235		212
2013	649	724					136		246
2014	683	891					263		100
2015	815	412					145		

Table 3.2-3 *L. piscatorius* in Divisions 7.b-k and 8.a,b,d– Abundance indices in Nb/sq Km from 2003–2015 from the IGFS-WIBTS-Q4.

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Nb/sqKm	69.3	94.4	67.5	33.1	21.1	19.4	45.2	83.6	80.8	49.6	60.1	114.9	99.5

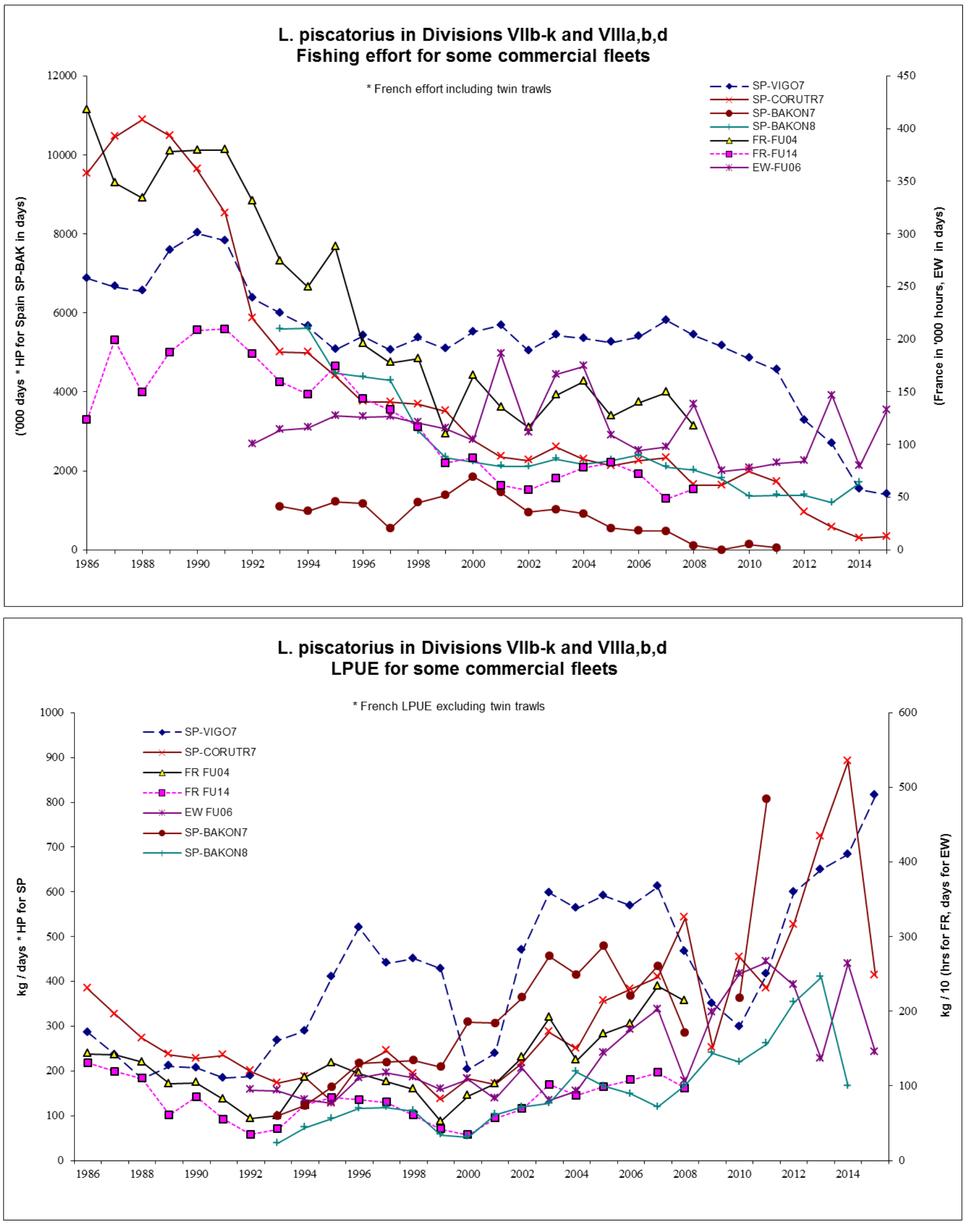

Figure 3.2-1 ***L. piscatorius*** **in Divisions 7.b-k and 8.a,b,d- Effort and LPUE data**

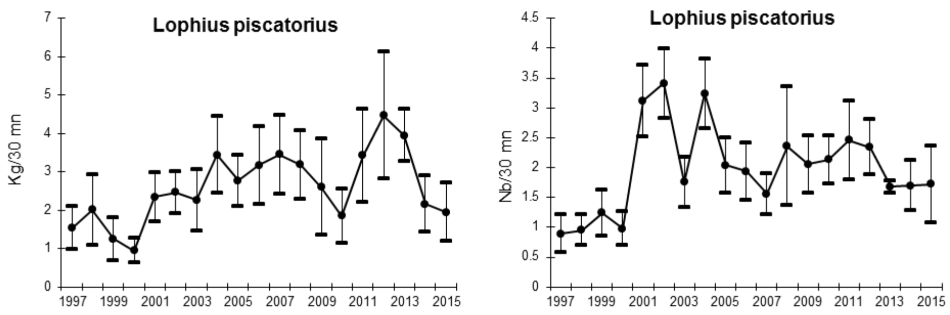

Figure 3.2-2 ***L. piscatorius*** **in Divisions 7.b-k and 8a,b,d- Time-series of the EVHOE-WIBTS-Q4 survey indices Kg (left) and Nb (right) per 30 minutes tow from 1997–2015.**

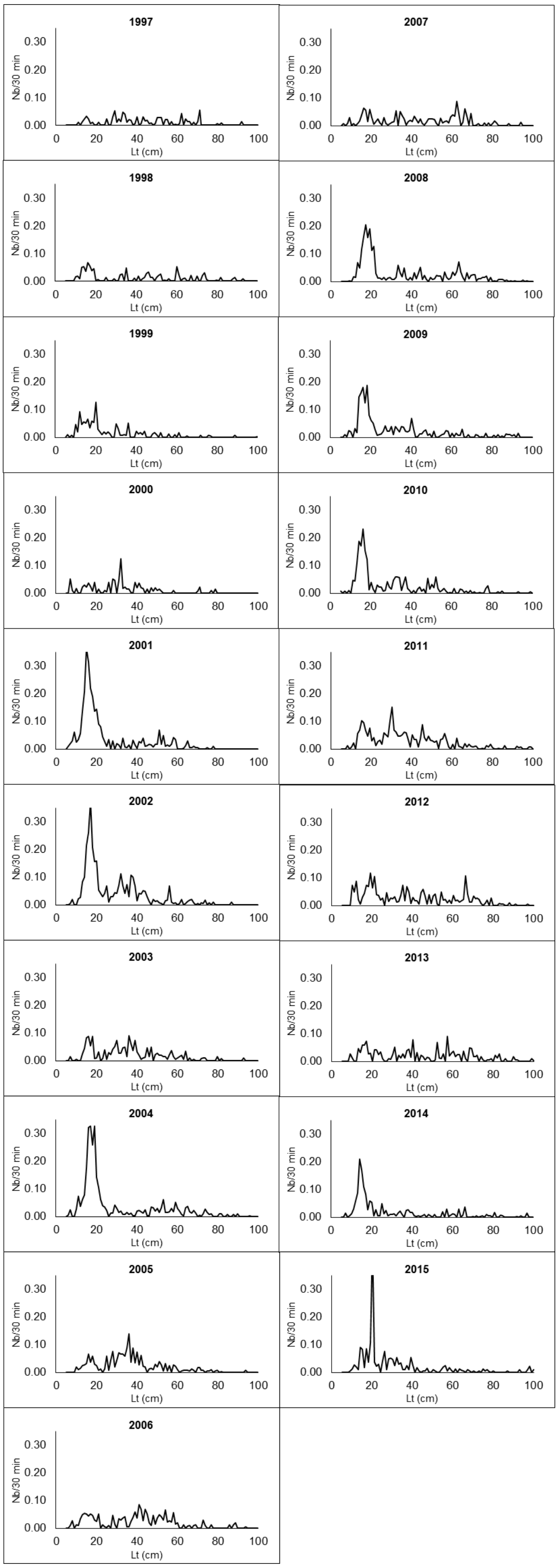

Figure 3.2-3 - *L. piscatorius* in Divisions 7.b-k and 8.a,b,d. Time-series of the EVHOE-WIBTS-Q4 Length distributions in Nb per 30 minutes tow from 1997–2015.

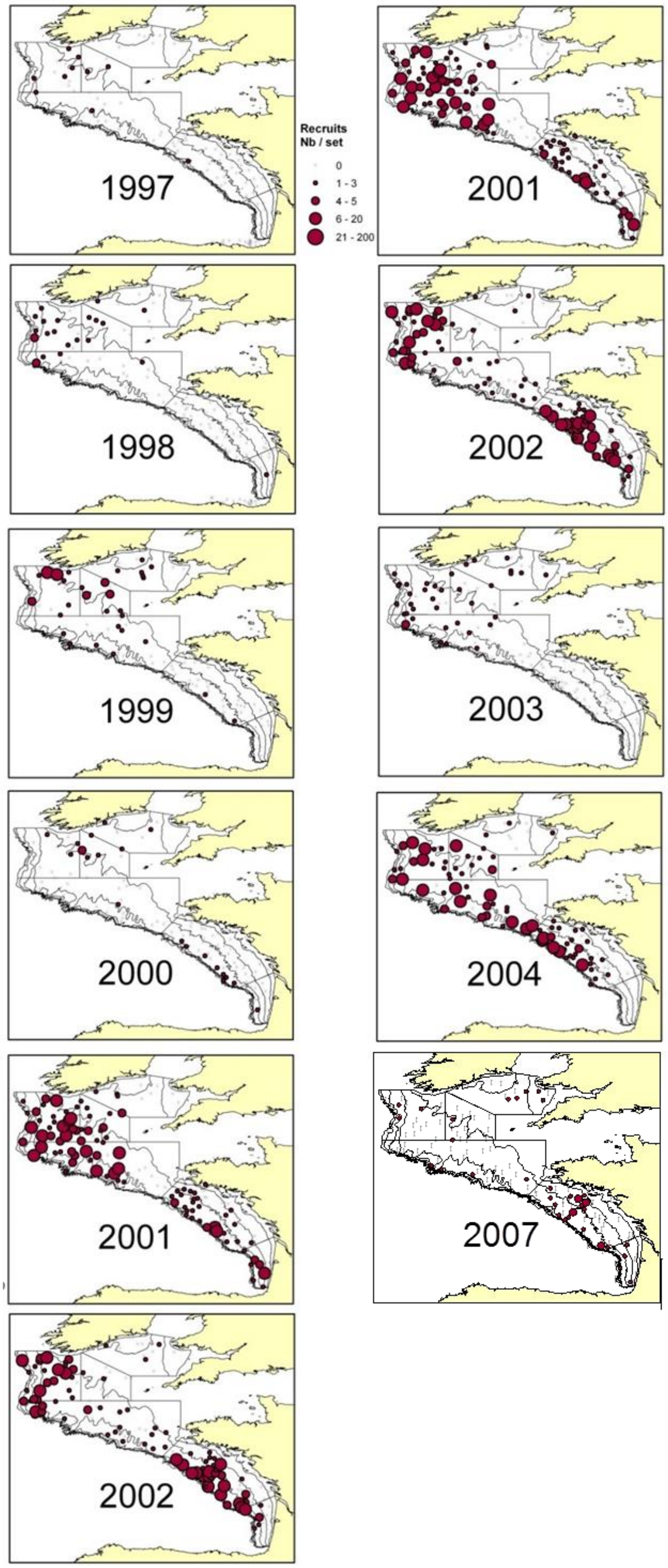

Figure 3.2-4 – *L. piscatorius* in Divisions 7.b-k and 8.a,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 1997–2007.

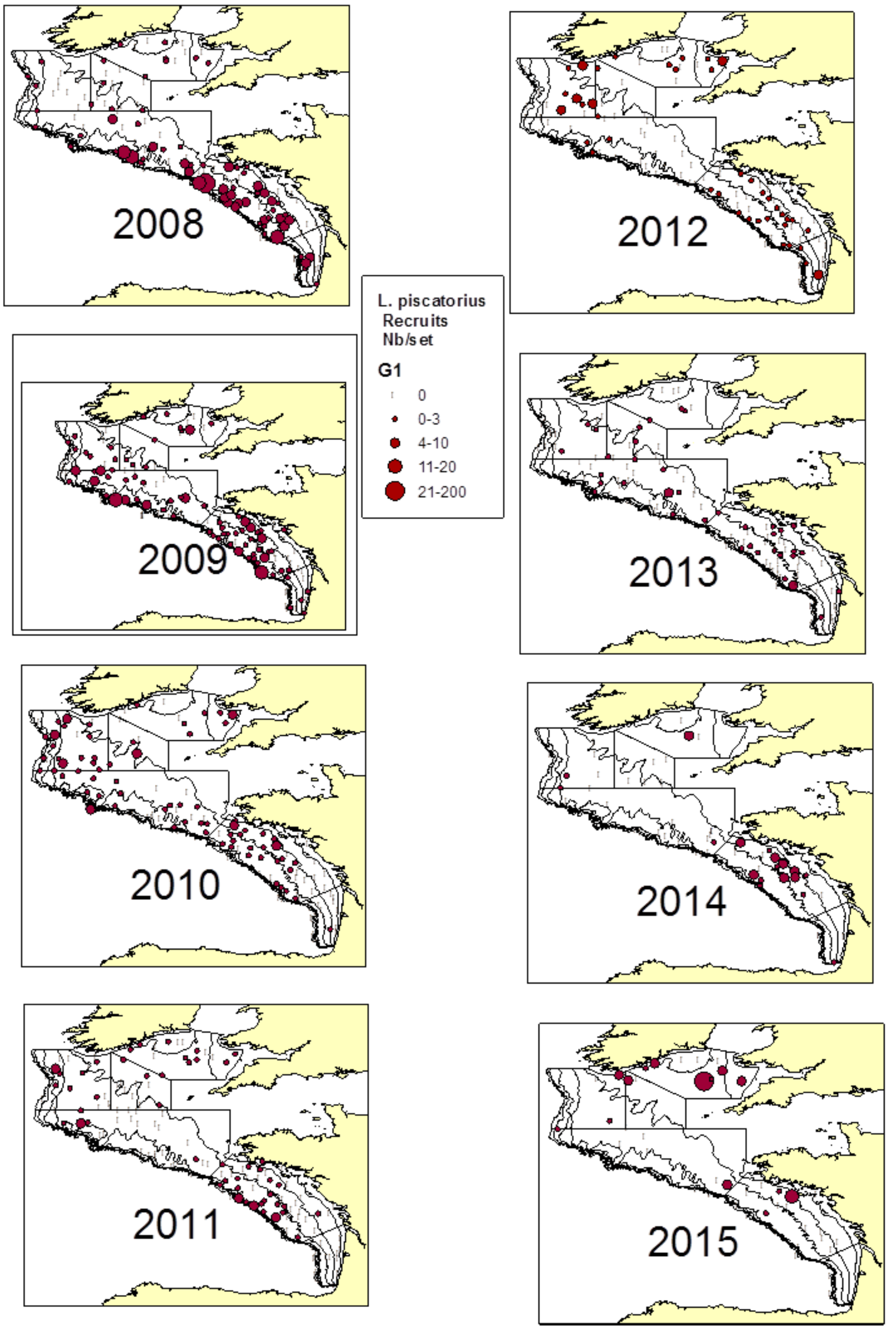

Figure 3.2-5 – L. *piscatorius* in Divisions 7.b-k and 8a,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 2008–2015.

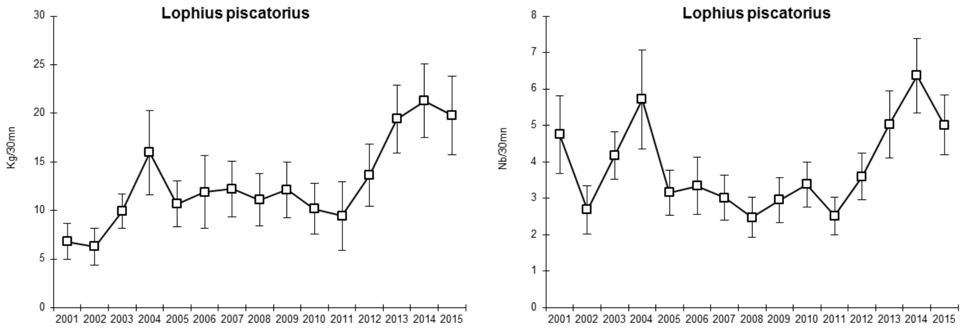

Figure 3.2-6 - *L. piscatorius* in Divisions 7.b-k and 8a,b,d- Time-series of the SPPGFS (WIBTS-Q4) survey indices Kg (left) and Nb (right) per 30 minutes tow from 2001–2015

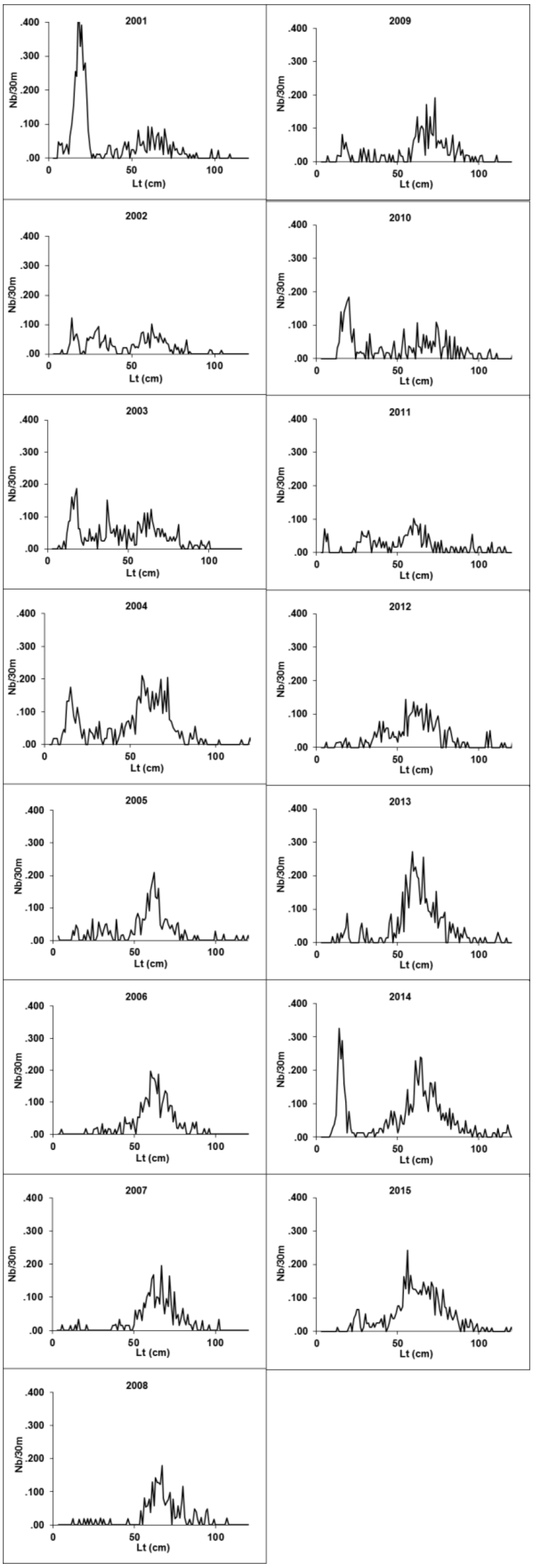

Figure 3.2-7 - *L. piscatorius* in Divisions 7.b-k and 8a,b,d- Time-series of the SPPGFS (WIBTS-Q4) Length distributions in Nb per 30 minutes tow from 2001–2015

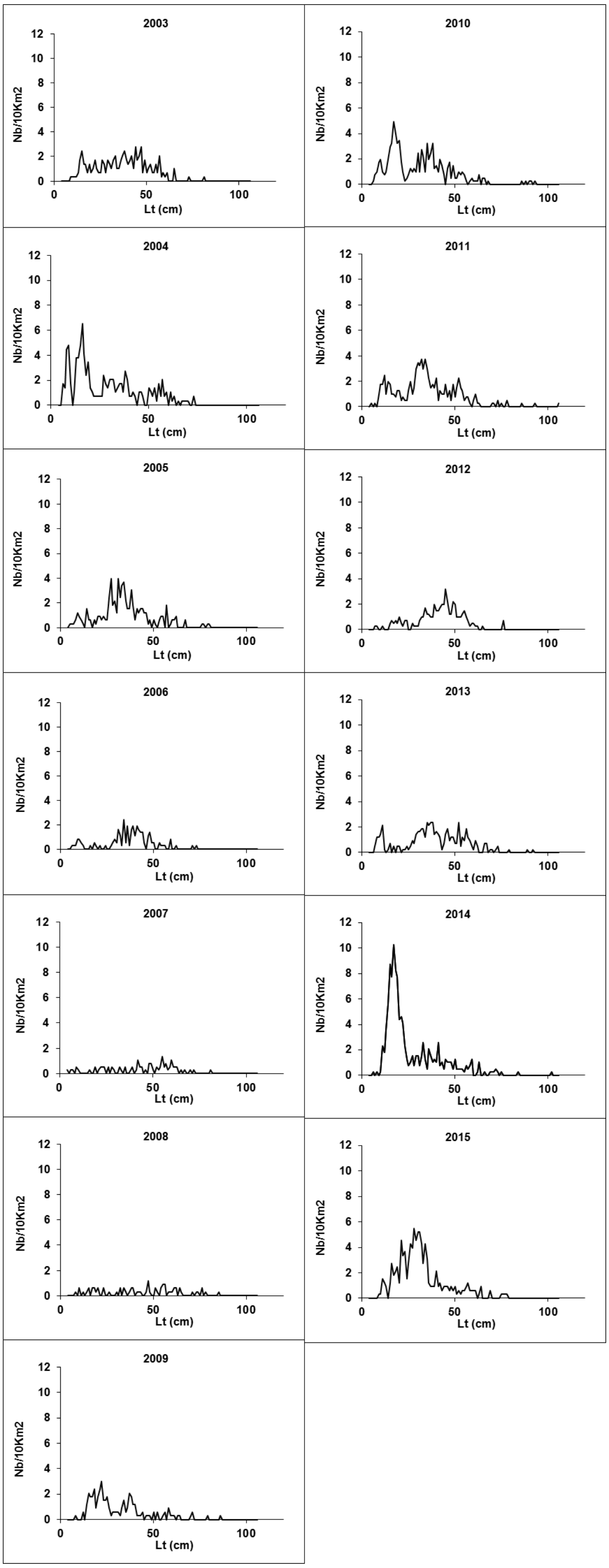

Figure 3.2-8 - ***L. piscatorius*** **in Divisions 7.b-k and 8.a,b,d Time-series of the IGFS-WIBTS-Q4 Length distributions in Nb per 10 Km² from 2001–2015**

3.3 *Anglerfish (L. budegassa)* in Divisions 7.b-k and 8.a,b,d

3.3.1 Data

3.3.1.1 Commercial Catch

The Working Group estimates of landings of *L. budegassa* by fishery unit (defined in Section 2) are given in Table 3.3-1.

The landings have fluctuated over the studied period between 5 720 t–12 655 t with a succession of high (1989–1991, 1998 and 2009–2014) and low values (1994, 2001 and 2006). The total estimated landings dropped from 2003–2006 and since then have risen to the highest of the time-series with an estimated landings value of 12 655 t in 2013. Although landings have since decreased to 10 872 t in 2014 and 10 319 t in 2015, these are still among the highest values of the time-series.

3.3.1.2 Commercial Effort and LPUE

Effort and LPUE data were available in 2015 for the two Spanish fleets, and for the English EW-FU06 (Table 3.3-2 and Figure 3.3-1). The effort and LPUE of the fleet SP-BAKON8 was not updated in 2015 due to a change in the way data were reported as it is now using e-logbooks for the first time. Fishing effort for most fleets shows a decrease until the early 2000's. Effort remained relatively stable thereafter for EW-FU6 and SP-BAKON7 but the effort in the other fleets reduced again in recent years. SP-CORUTR7 is currently represented by one single boat targeting hake, so any trend should be viewed with caution.

LPUEs have fluctuated over the time-series with increasing trends since 2006 and conflicting trends for the most recent period. In 2012 the LPUE for the SP-VIGO7 fleet was the highest of the time-series, the other fleets SP-CORUTR7 and SP-BAKON8 showed their series maximum in 2013 and the EW-FU06 in 2014. In the last year, LPUE for both EW-FU06 and SP-CORUTR7 decreased, contrary to the SP-VIGO7 fleet that, although not substantially, shows signs of increase.

3.3.1.3 Surveys data

3.3.1.3.1 The French EVHOE-WIBTS-Q4 survey

This survey covers the largest proportion of the area of stock distribution. Standardized biomass and abundance indices are given in Figure 3.3-2. The biomass index shows patterns of increase and decrease over the time-series, with a continuous increase from 2005 to its maximum value in 2008 followed again by a decrease to 2003-2005 levels. The most recent year continues the decline in biomass, since 2012, to below the average of the time-series. The abundance index shows a similar pattern reach its highest values in the time-series in 2008 and 2013. In 2009 and 2010 the indices returned to 2004-2005 levels, the most recent year shows a decline in abundance and it is below the mean level for the time-series.

The length distributions (Figure 3.3-3.) show that the above mentioned results correspond to strong incoming year classes from 2004 until 2008 that can be tracked from year to year with modes between 10–17 cm for the first age group (since 2004), 18–32 for the second (2005, 2007 and 2008), 33–45 for the third and 50–55 for the fourth (more obvious in 2008).

For 2009 the length distribution does not show a strong signal of recruitment nor can the signal from 2008's strong recruitment be followed. 2010 shows a medium level recruitment and 2011, 2012 and 2013 gives the strongest signals of the time-series for recruits. Since 2014, there is signs of lower recruitment, with smaller fish decreasing in abundance in the last two years.

The localization of juveniles (individuals less than 16 cm) caught during the survey from 1997 to 2008 show two nursery areas one in the western Celtic Sea and another in the northwestern area of the Bay of Biscay (Figure 3.3-4 and Figure 3.3-5), in some of the years, juveniles are also found in a more southern area of the Bay of Biscay in deeper waters. In 2010 to 2014 the normal pattern was found again with a more confined distribution in the western Celtic Sea. In 2015, juvenile *L. budegassa* were primarily found in the most western area of the survey grid, showing a contraction in their spatial distribution.

3.3.1.3.2 The English Fisheries Science Partnership survey.

This survey samples a fraction of each of the areas 7.e, 7.f, 7.g and 7.h and was discontinued in 2013. The survey covers a restricted area of the species distribution but the pulses of recruitment observed in the EVHOE-WIBTS-Q4 surveys are also present in the FSP-ENG-MONK survey in the following year. Length distribution of *L. budegassa* catches are available and presented in Figure 3.3–6.

For 2009 the English survey has recorded its historical maximum for recruitment and the good recruitment can be tracked from 2008. In 2010–2012 the recruitment returned to low levels and the good recruitments from 2008 and 2009 can be followed.

The first mode of this survey's length distributions tends to be found at slightly larger lengths than the first mode of the EVHOE-WIBTS-Q4 survey and strong recruitment signal according to EVHOE-WIBTS-Q4 in a given year tends to be followed by a strong signal around 16–28 cm for this survey in the following year. However, the strong incoming year class from the EVHOE-WIBTS-Q4 in 2011 does not appear in the FSP-ENG-MONK in 2012.

3.3.1.3.3 Other surveys

The coverage of the other surveys (IGFS-WIBTS-Q4 and SPPGFS (WIBTS-Q4)) are mostly outside the preferred area of the distribution of the species. Therefore, information is scarce. However, in recent years the Irish Groundfish Survey (IGFS-WIBTS-Q4) has shown similar patterns to that seen in the EVHOE-WIBTS-Q4 survey, suggesting a possible expansion or northerly movement of the stocks distribution. Length distributions (Figure 3.3-7) and index of abundance, Table 3.3-3, in numbers per ten square kilometres from this survey are presented.

The abundance index shows a similar drop after the peak in 2013, for 2014as that shown in the EVHOE-WIBTS-Q4. However, in the last year contrary to the later survey, the IGFS-WIBTS-Q4 shows a stable abundance index of *L. budegassa*. The estimated abundance since 2013 were the highest of the time-series. The length distributions also show similar recruitment patterns in the previous two years of the survey with 2013 giving the highest abundance of the time-series. Contrary to the EVHOE-WBITS-Q4 survey, the Irish Groundfish Survey shows a higher recruitment (fish < 20 cm) in the last year.

Other surveys may be indicative of this species' spatial distribution, abundance and biomass in subareas 7 and 8, such as:

- English Cefas Q1 Southwest Ecosystem Survey (Q1SWECOS)
- Q3 UK (E&W) beam trawl survey in divisions 7afg
- Q1 Irish Anglerfish and Megrim Survey (IAMS) (Gerritsen, H, WD01)
- Q1 Irish Beam trawl Ecosystem survey (IBES) (Gerritsen, H, WD02).

The Q1 Irish Anglerfish and Megrim Survey (IAMS) is specifically designed to provide an abundance index for anglerfish and it is expected that this survey will be used in future assessments.

3.3.2 Biological reference points

Contrary to L. *piscatorius* proxies of MSY reference points were not determined in WKProxy 2016 due to problems with the high uncertainty in estimated landings and the cpue index from the EHVOE-WIBTS-Q4 survey. Although, the later shows variable confidence intervals it suggests an overall constant trend. Therefore, the model susceptibility to these makes the SPiCT model unable to converge with no reference points determined.

3.3.3 Conclusion

Survey data give indication that the biomass has shown a continuous increase since the mid 2000's as a consequence of several good incoming recruitments. There is good evidence of a strong incoming recruitment for 2008. The EVHOE-WIBTS-Q4 shows evidence of a medium level of recruitment in 2010 and in the most recent year and record strong recruitment from 2011–2013. Length frequency distributions from two of the available surveys, EVHOE-WIBTS-Q4 and FSP-ENG-MONK, show contradictory signals for 2009, 2011 and 2012 recruitments, but the working group considers that the trend of the EVHOE-WIBTS-Q4 is more representative due to the larger coverage of the survey.

Preliminary information on discards shows that an increasing proportion of small fish are caught and discarded (WKFLAT12) and results from 2014 data available for the first time to the working group shows that around 11 percent of the catch is discarded. Due to the low levels of sampling and the uncertainties in the precision of the estimates the group recommends that the discard estimates are not used in the assessment or for advice purposes.

Landings data submitted by the main countries created problems in the estimation of landings due to different levels of métiers combinations comparatively to the previous year (Annex 7).

The problems described above, prevented further analysis of the discards data available for *L. budegassa*. However, future submission of discards information will allow for a more extensive analysis of the estimates so that catch information can be presented with greater confidence.

When good recruitment occurs, measures should be taken to ensure good survival of the recent recruits such as spatial and technical measures.

In the past, the precautionary buffer was not applied due to a steady decrease in fishing effort since the early 1990s. The survey index used for advice, has fluctuated without a clear overall trend with high uncertainty in some years. Therefore, the perception of the stock has not changed.

Comments on the assessment

Data from surveys give scope for the use of length based models for assessment, growth studies and aging validation that should be initiated as soon as possible.

Table 3.3-1 *Lophius budegassa* in Divisions 7.b-k and 8.a,b,d - Landings in tonnes by Fishery Unit.

	VIIb,c,e-k						VIIIa,b,d				
Year	Gill-Net (Unit 3+13)	Medium/Deep Trawl (Unit 4)	Shallow Trawl (Unit 5)	Beam Trawl (Unit 6)	Shallow/medium Neph.Trawl (Unit 8)	Unallocated	Neph.Trawl (Unit 9)	Shallow Trawl (Unit 10)	Medium/Deep Trawl (Unit 14)	Unallocated	TOTAL VII +VIII
1986	23	5126	348	540	406	0	443	150	1181	0	8217
1987	30	3493	696	462	434	0	483	116	1904	0	7619
1988	34	4072	1095	751	394	0	435	102	1498	0	8382
1989	40	4398	976	505	515	0	446	112	1829	0	8820
1990	53	4818	631	905	653	0	550	156	1865	0	9632
1991	0	4416	934	397	507	0	475	117	1933	0	8780
1992	0	4808	301	305	594	0	459	191	1518	0	8176
1993	0	3415	429	405	399	0	433	101	1385	0	6566
1994	0	2935	265	209	540	0	232	49	1515	0	5744
1995	10	3963	455	159	617	0	312	62	1286	90	6953
1996	118	4587	477	245	524	28	374	109	1239	392	8092
1997	134	4836	602	132	474	9	313	17	1128	471	8114
1998	179	5565	246	230	288	1	258	72	1454	305	8599
1999	18	4311	119	282	338	0	144	76	1450	0	6739
2000	57	4489	161	284	228	0	124	31	1270	0	6645
2001	41	3758	107	266	306	0	121	29	1100	0	5728
2002	30	4272	147	251	372	0	112	14	1195	0	6394
2003	92	5748	337	342	376	5	195	26	1248	0	8368
2004	122	4684	242	343	376	0	254	9	1407	0	7436
2005	73	4837	162	409	329	0	235	56	1431	0	7532
2006	9	3661	145	271	218	0	286	1	1128	1	5720
2007	92	3874	168	306	250	0	243	0	1424	0	6357
2008	21	4620	187	392	254	0	235	0	1669	0	7379
2009	72	5963	24	441	36	0	354	0	2047	145	9082
2010	224	6137	9	597	27	0	379	0	1763	223	9359
2011	172	3562	11	591	16	1747	378	0	1413	96	7988
2012	110	4314	6	483	6	1135	275	0	2250	384	8964
2013	155	5564	4	551	64	1332	559	0	3564	862	12655
2014	719	5048	27	595	74	282	730	0	3176	221	10872
2015*	761	5012	26	557	0	312	0	0	3556	94	10319

* Provisional. *Nephrops* trawl landings aggregated with other trawl gears.

Table 3.3-2 *L. budegassa* in Divisions 7.b-k and 8.a,b,d- Effort and LPUE data

EFFORT	SP-VIGO7 in Division VII ('000 days*HP)	SP-CORUTR7 in Division VII ('000 days*HP)	French Benthic trawlers* Celtic Sea FU04 ('000 hrs)	French Benthic Twin Trawls Celtic Sea ('000 hrs)	French Benthic trawlers* Bay of Biscay FU14 ('000 hrs)	French Benthic Twin Trawls Bay of Biscay ('000 hrs)	EW FU06 Beam trawlers in VII ('00 days)	SP-BAKON7 (days)	SP-BAKON8 (days)
1986	6875	9527	418	N/A	123	N/A	N/A		
1987	6662	10453	349	N/A	199	N/A	N/A		
1988	6547	10886	334	N/A	150	N/A	N/A		
1989	7585	10483	378	N/A	187	N/A	N/A		
1990	8021	9630	380	N/A	208	N/A	N/A		
1991	7822	8522	380	N/A	210	N/A	N/A		
1992	6370	5852	331	N/A	186	N/A	100		
1993	5988	5001	274	N/A	159	N/A	114	1094	5590
1994	5655	4990	249	N/A	148	N/A	116	980	5619
1995	5070	4403	287	N/A	174	N/A	127	1214	4474
1996	5416	3746	196	121	144	19	126	1170	4378
1997	5058	3738	178	133	133	33	126	540	4286
1998	5360	3684	182	134	117	40	121	1196	3002
1999	5084	3512	110	110	83	59	115	1384	2337
2000	5519	2773	165	104	87	49	104	1850	2227
2001	5678	2356	135	133	61	66	186	1451	2118
2002	5041	2258	116	120	57	75	111	949	2107
2003	5437	2597	147	136	68	81	166	1022	2296
2004	5347	2292	160	133	78	89	174	910	2159
2005	5246	2120	127	137	83	121	109	544	2263
2006	5392	2257	140	145	72	101	94	487	2398
2007	5812	2323	149	152	48	127	97	476	2098
2008	5432	1640	118	126	58	113	138	105	2017
2009	5155	1626					75	0	1807
2010	4843	1988					77	138	1358
2011	4553	1725					82	57	1384
2012	3276	937					84		1384
2013	2683	563					146		1185
2014	1530	292					79		1694
2015	1395	329					133		

LPUE	Vigo in Division VII (kg/days*HP)	La Coruna in Division VII (kg/days*HP)	French Benthic trawlers* Celtic Sea FU04 (kg/10 hrs)	French Benthic Twin Trawls Celtic Sea (kg/10 hrs)	French Benthic trawlers* Bay of Biscay FU14 (kg/10 hrs)	French Benthic Twin Trawls Bay of Biscay (kg/10 hrs)	EW (FU06) Beam trawlers in VII (kg/10days)	SP-BAKON7 (kg/day)	SP-BAKON8 (kg/day)
1986	339	37	38		51				
1987	294	16	25		48				
1988	265	42	39		53				
1989	272	25	47		65				
1990	250	29	52		62				
1991	231	30	44		54				
1992	248	14	48		53		28		
1993	194	15	43		50		30	51	55
1994	203	20	44		60		11	108	61
1995	286	8	51		47		7	120	49
1996	304	12	47	65	42	58	12	173	57
1997	383	12	50	63	44	48	7	273	42
1998	319	9	54	64	62	68	15	229	78
1999	369	9	38	55	57	63	12	329	85
2000	257	19	61	50	57	73	9	265	56
2001	304	3	37	41	49	71	5	198	37
2002	389	30	46	48	40	66	8	232	71
2003	600	16	57	53	45	64	7	242	65
2004	490	13	38	46	35	55	6	185	92
2005	522	18	59	56	43	58	13	140	72
2006	479	13	25	27	44	56	8	179	70
2007	393	11	31	28	50	64	10	256	70
2008	547	5	48	43	68	86	16	248	74
2009	666	18					30		118
2010	584	19					34	326	117
2011	590	45					32	590	112
2012	692	42					25		204
2013	509	47					13		387
2014	560	39					48		317
2015	593	23					32		

Table 3.3-3 - *L. budegassa* in Divisions 7.b-k and .8.a,b,d– Abundance indices in Nb/10 Km² from the IGFS-WIBTS-Q4.

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
NB/10 KM2	10.1	39.1	22.1	16.0	12.5	34.1	30.9	41.2	23.7	14.7	80.9	60.2	60.4

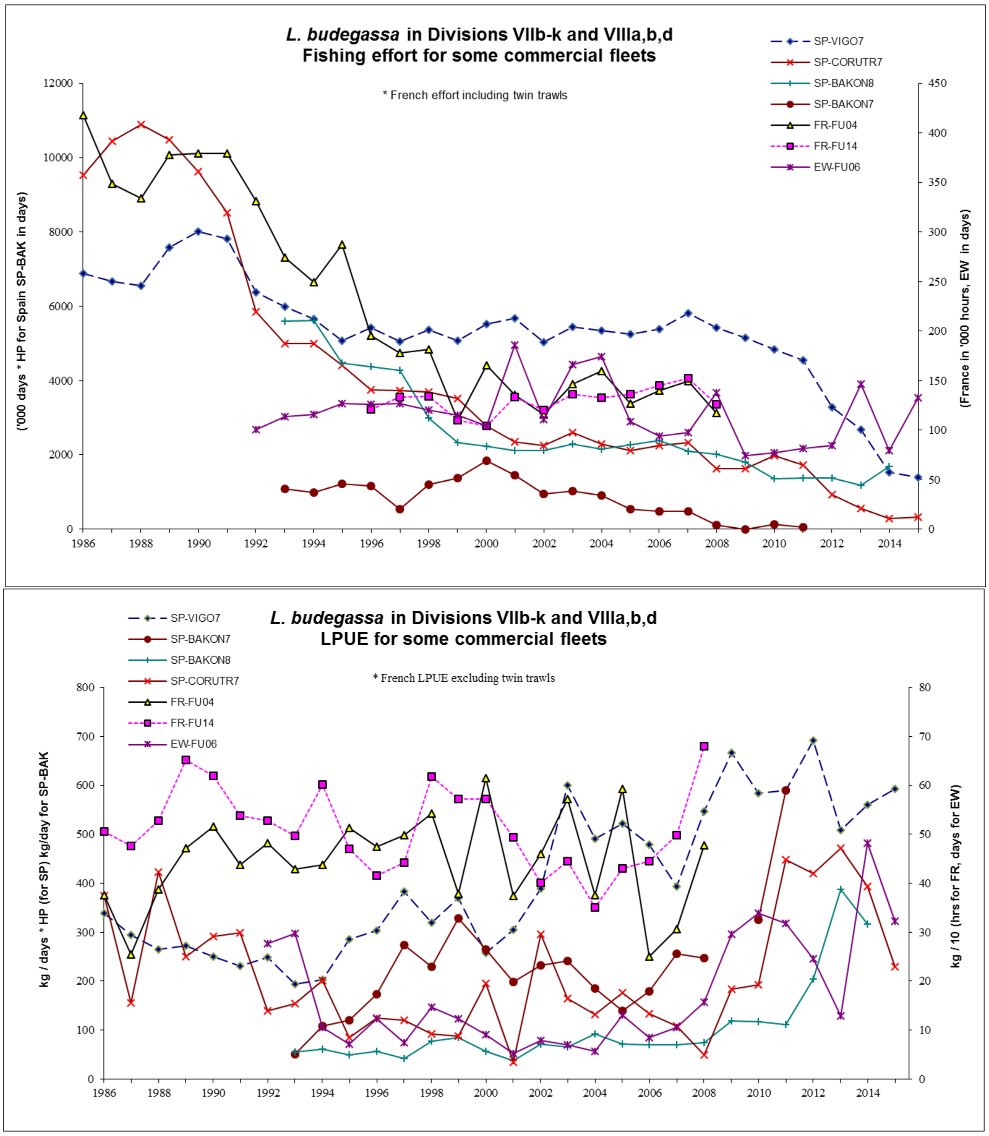

Figure 3.3-1 ***L. budegassa*** **in Divisions 7.b-k and 8.a,b,d Effort and LPUE data**

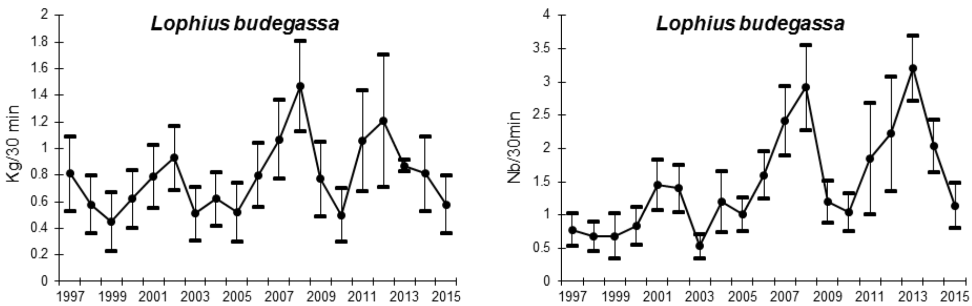

Figure 3.3-2 ***L. budegassa*** **in Divisions 7.b-k and .8a,b,d. Time-series of the EVHOE-WIBTS-Q4 survey's indices Kg (left) and Nb (right) per 30 minutes tow from 1997–2015**

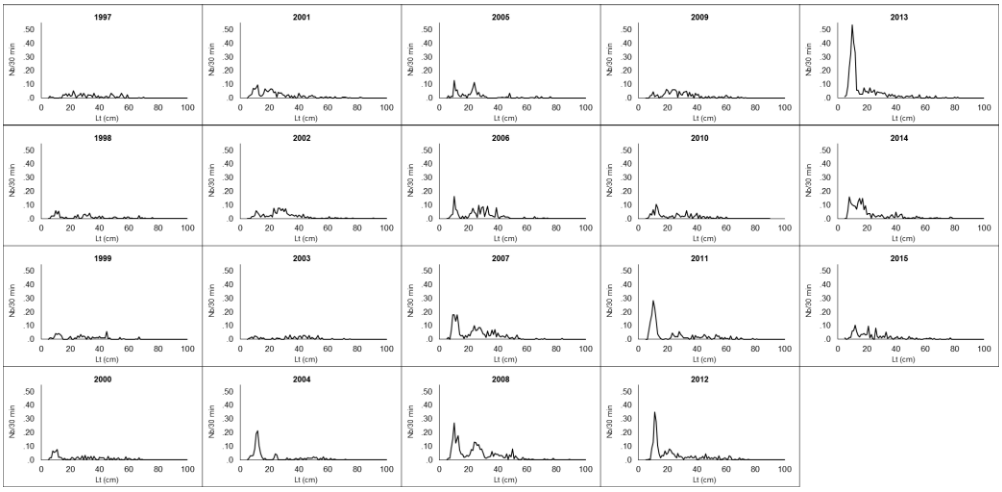

Figure 3.3-3 - *L. budegassa* in Divisions 7.b-k and 8.a,b,d- Time-series of the EVHOE-WIBTS-Q4 length distributions in Nb per 30 minutes tow from 1997–2015.

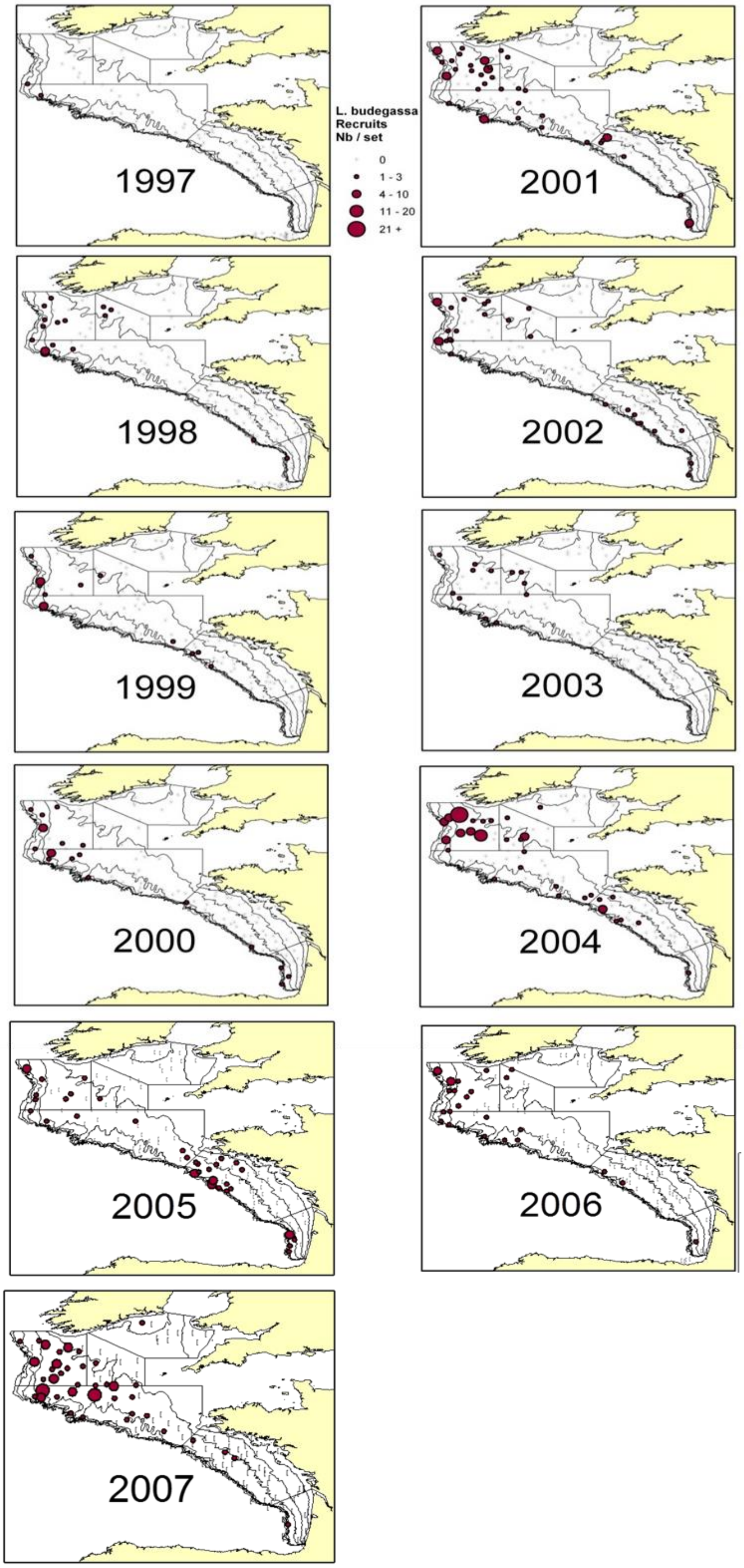

Figure 3.3-4 – *L. budegassa* in Divisions 7.b-k and 8.a,b,d, distribution of recruits (lt < 16 cm) in Nb per 30min observed in the EVHOE-WIBTS-Q4 surveys from 1997–2007.

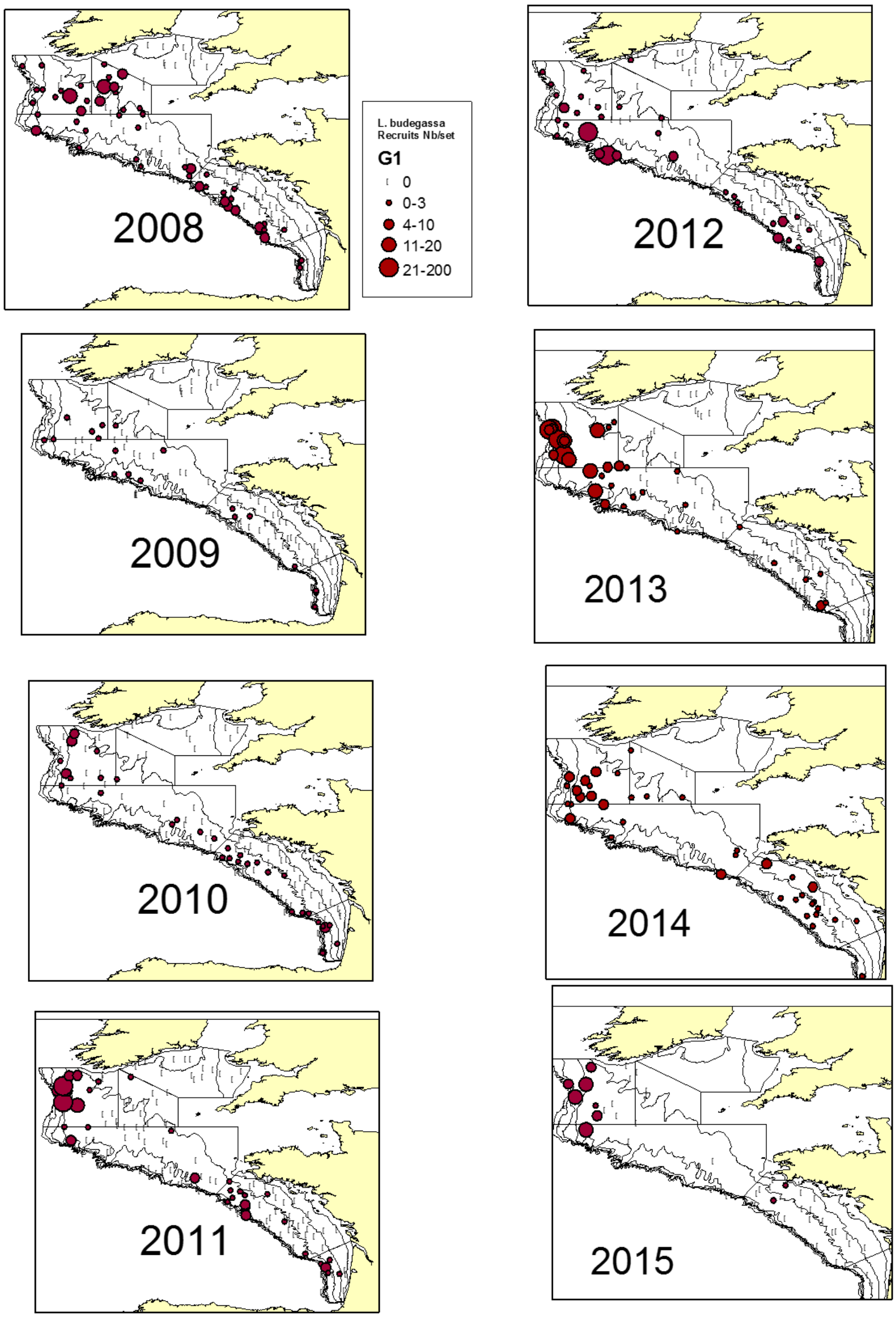

Figure 3.3-5 – *L. budegassa* in Divisions 7.b-k and 8.a,b,d, distribution of recruits (lt < 16 cm) in Nb per 30min observed in the EVHOE-WIBTS-Q4 surveys from 2007–2015.

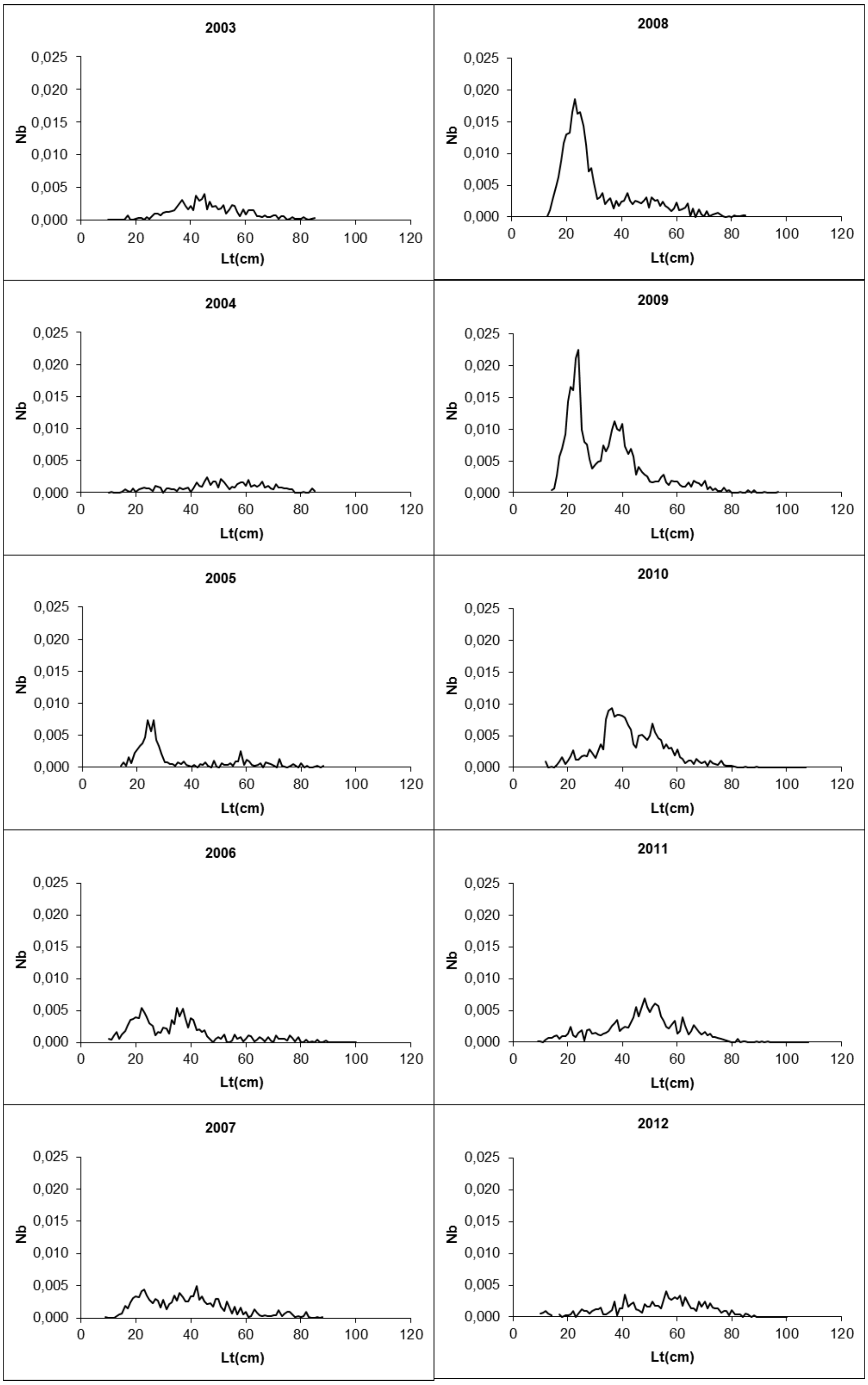

Figure 3.3-6 - *L. budegassa* in Divisions 7.b-k and 8.a,b,d- Time-series of the FSP-ENG-MONK length distributions in Nb per 30 minutes tow from 2003–2012.

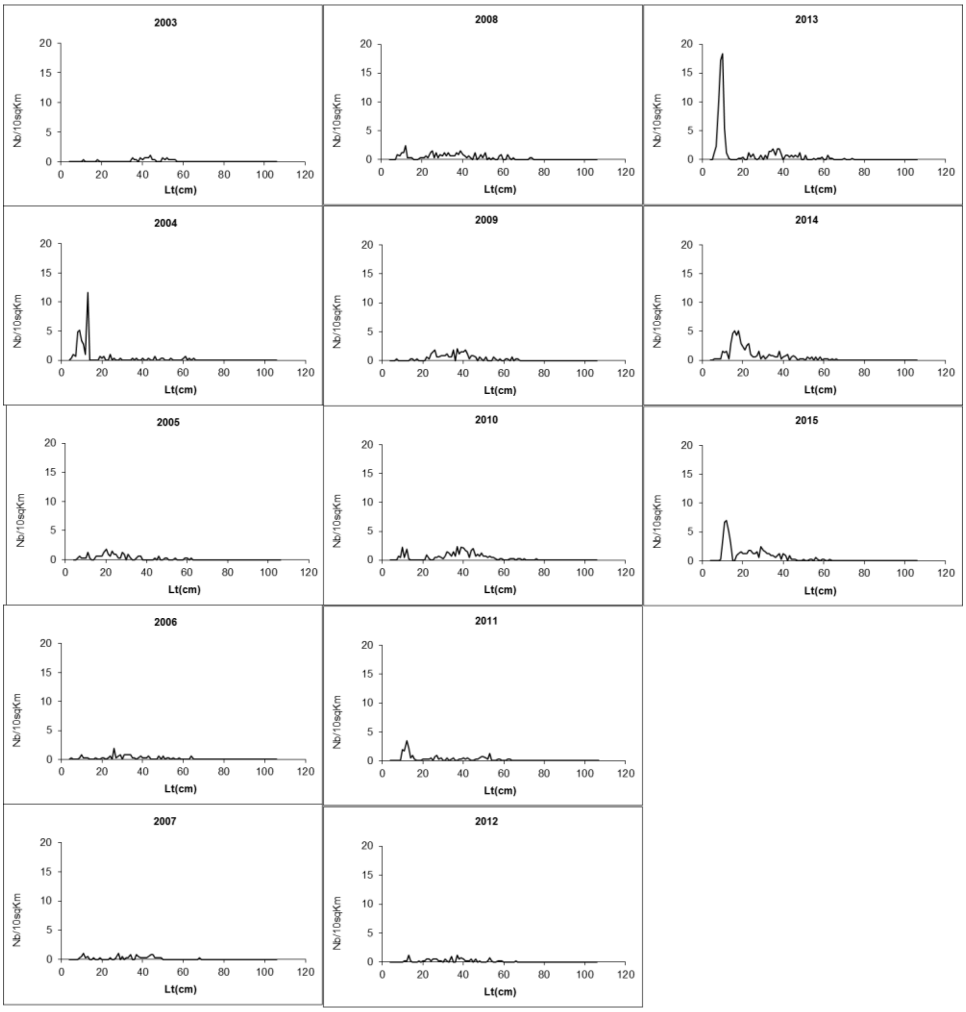

Figure 3.3-7 - *L. budegassa* in Divisions 7.b-k and 8.a,b,d- Time-series of the IGFS-WIBTS-Q4 length distributions in Nb per 10 km² from 2003–2015.

4 Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Divisions 8c and 9a

L. piscatorius and L. budegassa

Type of assessment in 2016: Update (the assessment models and settings were approved in the benchmark WKFLAT-2012).

Software used: SS3 for *L. piscatorius* and ASPIC for *L. budegassa.*

Data revisions this year: For *Lophius budegassa*, the abundance and biomass values for 2014 from survey SpGFS-WIBTS-Q4were revised.

4.1 General

Two species of anglerfish, *Lophius piscatorius* and *L. budegassa*, are found in ICES Divisions 8c and 9a. Both species are caught in mixed bottom-trawl fisheries and in artisanal fisheries using mainly fixed nets.

The two species are not usually landed separately, for the majority of the commercial categories, and they are recorded together in the ports' statistics. Therefore, estimates of each species in Spanish landings from Divisions 8c and 9a and Portuguese landings of Division 9a are derived from their relative proportions in market samples.

The total anglerfish landings are given in Table 4.1.1 by ICES division, country and fishing gear. Landings increasing in the early eighties and reaching maximum in 1986 (9433 t) and 1988 (10021 t), and decreasing after that to the minimum in 2001 (1801 t) and 2002 (1802 t). In 2002-2005 period landings increased reaching 4541 t, this period was followed by another one where landings gradually declined and in 2011 landings were less than half of the 2005 amount (2085 t). From 2011 to 2014 landings slightly increased to 2989 t with a decrease by 7% in 2015 (1748 t of *L. piscatorius* and 1042 t of *L. budegassa*).

The species proportion in the landings has changed since 1986. In the beginning of the time-series (1980-1986) *L. piscatorius* represented more than 70% of the total anglerfish landings. After 1986 the proportion of *L. piscatorius* decreased and in 1999-2002 both species had approximately the same weight in the annual landings. Since then the *L. piscatorius* proportion increased. The mean proportion of *L. piscatorius* in the landings from 2005 to 2015 is 66%.

ICES performs assessments for each species separately. The benchmark assessment of anglerfish in Division 8c and 9a was carried out in 2012, a new assessment using Stock Synthesis (SS3) for *L. piscatorius* was approved and new settings and data were incorporate to the ASPIC model for *L. budegassa.*

The ageing estimation problems, detected in a previous benchmarck (see WGHMM2007 report) continue unsolved for *L. piscatorius* (ICES, 2012a) and no new studies were carried out for *L. budegassa*. The grow pattern inferred from mark-recapture and length composition analysis (Landa *et al*., 2008) was used in the assessment of *L. piscatorius*.

4.2 Summary of ICES advice for 2016 and management for 2015 and 2016

ICES advice for 2016:

As both species of anglerfish are caught in the same fisheries and are subject to a combined TAC, the same multiplicative factor for current fishing mortality is assumed for both species. The change is driven by *L. piscatorius*, as it is the species in poorest condition. Following the ICES MSY approach implies fishing mortality to be decreased by 10%.

ICES advises the following landings for 2016 on the basis of the MSY approach:

L. piscatorius: less than 1343 t; L. budegassa: less than 1070 t; Combined anglerfish: less than 2413 t.

Management applicable for 2015 and 2016:

The two species are managed under a common TAC that was set at 2987 t for 2015 and 2569 t for 2016.The reported landings in 2015 were 93% of the established TAC.

There is no minimal landing size for anglerfish but an EU Council Regulation (2406/96) laying down common marketing standards for certain fishery products fixes a minimum weight of 500 g for anglerfish. In Spain this minimum weight was put into effect in 2000.

Management considerations

Lophius piscatorius and *L. budegassa* are subject to a common TAC, so the joint status of these species should be taken into account when formulating management advice. Both species of anglerfish are reported together because of their similarity but are assessed separately.

It should be noted that both anglerfish are essentially caught in mixed fisheries. Hence, management measures applied to these species may have implications for other stocks and vice versa. It is necessary to take into account that a recovery plan for hake and *Nephrops* is taking place in the same area.

Although these stocks are assessed separately they are managed together. Due to the differences in the current status of the individual stocks, it is difficult to give common advice.

Table 4.1.1 ANGLERFISH (*L. piscatorius* and *L. budegassa*) - Divisions 8c and 9a.
Tonnes landed by the main fishing fleets for 1978-2015 as determined by the Working Group.

	Div. 8c				Div. 9a						Div. 8c+9a		Div. 8c+9a
	SPAIN				SPAIN			PORTUGAL					
Year	Trawl	Gillnet	Others	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL	SUBTOTAL	Unallocated	TOTAL
1978	n/a	n/a		n/a	506			n/a	222	728	n/a		n/a
1979	n/a	n/a		n/a	625			n/a	435	1 060	n/a		n/a
1980	4 008	1 477		5 485	786			n/a	654	1 440	6 926		6 926
1981	3 909	2 240		6 149	1 040			n/a	679	1 719	7 867		7 867
1982	2 742	3 095		5 837	1 716			n/a	598	2 314	8 151		8 151
1983	4 269	1 911		6 180	1 426			n/a	888	2 314	8 494		8 494
1984	3 600	1 866		5 466	1 136			409	950	2 495	7 961		7 961
1985	2 679	2 495		5 174	977			466	1 355	2 798	7 972		7 972
1986	3 052	3 209		6 261	1 049			367	1 757	3 172	9 433		9 433
1987	3 174	2 571		5 745	1 133			426	1 668	3 227	8 973		8 973
1988	3 583	3 263		6 846	1 254			344	1 577	3 175	10 021		10 021
1989	2 291	2 498		4 789	1 111			531	1 142	2 785	7 574		7 574
1990	1 930	1 127		3 057	1 124			713	1 231	3 068	6 124		6 124
1991	1 993	854		2 847	878			533	1 545	2 956	5 802		5 802
1992	1 668	1 068		2 736	786			363	1 610	2 758	5 493		5 493
1993	1 360	959		2 319	699			306	1 231	2 237	4 556		4 556
1994	1 232	1 028		2 260	629			149	549	1 327	3 587		3 587
1995	1 755	677		2 432	814			134	297	1 245	3 677		3 677
1996	2 146	850		2 995	749			265	574	1 589	4 584		4 584
1997	2 249	1 389		3 638	838			191	860	1 889	5 527		5 527
1998	1 660	1 507		3 167	865			209	829	1 903	5 070		5 070
1999	1 116	1 140		2 256	750			119	692	1 561	3 817		3 817
2000	710	612		1 322	485			146	675	1 306	2 628		2 628
2001	614	364		978	247			117	459	823	1 801		1 801
2002	559	415		974	344			104	380	828	1 802		1 802
2003	1 190	771		1 961	617			96	529	1 242	3 203		3 203
2004	1 510	1 389		2 898	549			77	602	1 229	4 127		4 127
2005	1 651	1 719		3 370	653			60	458	1 171	4 541		4 541
2006	1 490	1 371		2 861	801			68	381	1 250	4 111		4 111
2007	1 327	1 076		2 404	866			78	303	1 247	3 651		3 651
2008	1 280	1 238		2 518	473			50	246	770	3 288		3 288
2009	1 151	1 207		2 358	386			43	262	691	3 049		3 049
2010	665	1 036		1 701	355			72	203	630	2 331		2 331
2011	458	598	105	1 160	216	88	146	122	199	770	1 930	154	2 085
2012	432	610	89	1 131	163	60	132	161	533	1 049	2 180	339	2 519
2013	495	853	52	1 400	142	85	140	114	412	893	2 293	288	2 582
2014	545	1 073	35	1 653	211	93	8	143	408	863	2 516	474	2 989
2015	557	943	5	1 505	190	114	3	161	422	890	2 395	395	2 790

n/a: not available

4.3 Anglerfish (*L. piscatorius*) in Divisions 8c and 9a

4.3.1 General

4.3.2 Ecosystem aspects

The ecosystem aspects of the stock are common with *L. budegassa,* and are described in the Stock Annex.

4.3.3 Fishery description

L. piscatorius is mainly caught by Spanish and Portuguese bottom trawlers and gillnet fisheries. For some gillnet fishery, it is an important target species, while it is also a by catch of the trawl fishery targeting hake or crustaceans (see Stock Annex). Since 2001 Spanish landings were on average 88% of total landings of the stock.

The length distribution of the landings is considerably different between both fisheries, with the gillnet landings showing higher mean lengths compared to the trawl landings. Since 2001–2015, the Spanish landings were on average 45% from the trawl fleet (mean lengths in 2015 of 56 cm and 52 cm in Divisions 8c and 9a, respectively) and 54% from the gillnet fishery (mean length of 79 cm in Division 8c in 2015). For the same period, Portuguese landings were on average 11% from bottom trawlers (mean length of 61 cm in 2015) and 89% from the artisanal fleet (mean length of 61 cm in 2015).

4.3.4 Data

4.3.4.1 Commercial catches and discards

Total landings by country and gear for the period 1978–2015, as estimated by the WG, are given in Table 4.3.1. Unallocated landings for this stock are available for the years from 2011 to 2015. The unallocated values are considered realistic and are taken into account for the assessment. Since 2011 there was an increasing trend in official landing with increases of 15% and 23% in 2013 and 2014 respectively. In 2015 official landings decreased by 8%. Unallocated landings represent between 7 and 19% of total landings and not a specific trend was observed.

Spanish discards estimates of *L. piscatorius*in weight and associated coefficient of variation (CV) are shown in the Table 4.3.2. For the available time-series anglerfish discards represent less than 18% of Spanish trawl catches. The maximum value of the time-series occurred in 2013 with 66 t. The Spanish gillnet fleet discards value are only available from 2013 to 2015 with quantities between 0 t and 144 t. The occasional high and the zero value of discards reported for the gillnet fleet could be related with a very low sampling level. *L. piscatorius* discards in the Portuguese trawl fisheries are considered negligible (Fernández&Prista, 2012; Prista *et al*., 2014). Based on the partial information on the Spanish and Portuguese discards the WG concluded that discards could be considered negligible.

4.3.4.2 Biological sampling

The procedure for sampling of this species is the same as for *L. budegassa* (see Stock Annex).

The sampling levels for 2015 are shown in Table 1.3. The métier sampling adopted in Spain and Portugal in 2009, following the requirement of the EU Data Collection

Framework, can have an effect in the provided data. Spanish sampling levels are similar to previous years but an important reduction of Portuguese sampling levels was observed in 2009-2011, since 2012 Portugal increased the sampling effort.

Length composition

Table 4.3.3 gives the available annual length compositions by ICES division, country and gear and adjusted length composition for total stock landings for 2015.The annual length compositions for all fleets combined for the period 1986–2015 are presented in Figure 4.3.1.

Landings in number, the mean length and mean weight in the landings between 1986 and 2015 are showed in Table 4.3.4. The lowest total number in landings (year 2001) is 4% of the maximum value (year 1988). After 2001, increases were observed up to 2006, with decreases every year since then to year 2011. Mean lengths and mean weights in the landings increased sharply between 1995 and 2000. In 2002 low values of mean lengths and mean weights were observed, around the minimum of the time-series, due to the increase in smaller individuals. After that, increases were observed reaching 71 cm in 2010. In 2015 mean weight and mean length of landings decreased with respect to the previous year but they were above average values of the time-series.

Biological information

The growth pattern used in the assessment follows a *von* Bertalanffy model with fixed k=0.11 and L_{inf} estimated by the model. Length-weight relationship, maturity ogive and natural mortality used in the assessment are described in the Stock Annex.

4.3.4.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2015 are summarized in Table 4.3.5.

The abundance index from Spanish survey SpGFS-WIBTS-Q4 is shown in Figure 4.3.2. Since 2000 the highest abundance values were detected in 2001 and 2006, since this year a downward trend was observed. In 2011, the abundance and biomass indices decreased by 44% and 40%, respectively, relative to 2010 values. In 2013 an increase in the index in biomass and in number was observed. In 2015, the abundance index was one of the lowest of the series (Figure 4.3.2) and no individuals < 20 cm were recorded (Figure 4.3.3).

Since 2013 the SpGFS-WIBTS-Q4 is conducted using a different vessel. The results of two inter-calibration experiments carried out between the two oceanographic vessels in 2012 and 2014 indicated that catches of white anglerfish has not been affected by the change of the vessel.

4.3.4.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 4.3.6 and Figure 4.3.4 for Spanish trawlers (Division 8c) from the ports of Santander and Avilés since 1986, for A Coruña since 1982 and for the Portuguese trawlers (Division 9a) since 1989. A Coruña fleet series (landings, effort and LPUE) were updated to incorporate years at the beginning of the series (1982–1985). Three series are presented for A Coruña fleet: A Coruña port for trips that are exclusively landed in the port, A Coruña trucks for trips that are landed in other ports and A Coruña fleet that takes into account all the trips of the fleet. For 2014 only information for A Coruña port was provided. Also a review of A Coruña port series for the period 2009–2013 is available to the WG (WD WD-04, ICES 2015a).

Although A Coruña port is a potential abundance series to be used in the assessment a previous analysis of the whole time-series must be done before taking it into account. The A Coruña fleet index, used in the assessment as abundance index from 1982–2012, is not available since 2013.

For the Portuguese fleets, until 2011 most logbooks were filled in paper but have thereafter been progressively replaced by e-logbooks. In 2013 more than 90% of the logbooks are being completed in the electronic version. The LPUEs series were revised from 2012 onwards. To revise the series backwards further refinement of the algorithm is required.

For each fleet the proportion of the landings in the stock is also given in the table. In 2007 a dataseries from the artisanal fleet from the port of Cedeira in Division 8.c was provided. This LPUE series is annually standardized to incorporate a new year data, latest available standardized series, from 1999–2011, is presented. Due to the reduction in the number of vessels of Cedeira fleet, this tuning series could not be considered as a representative abundance index of the stock and it is no longer recorded. Standardized effort provided for Portuguese trawl fleets (1989–2008) and their corresponding LPUEs are also given in Table 4.3.6, but not represented in Figure 4.3.4.

All fleets show a general decrease in landings during the eighties and early nineties. A slight landings increase in 1996 and 1997 can be observed in all fleets. From 2000 to 2005 Spanish fleets of A Coruña, Avilés and Cedeira show an increase in landings while the Portuguese fleets are stabilized at low levels. Since 2005–2009 landings from A Coruña and Cedeira fleets showed an overall decreasing trend. Proportion in total landings is higher for the Cedeira and A Coruña fleets. Landings for both Portuguese fleets increased in 2014 and 2015.

Effort trends show a general decline since the mid-nineties in all trawl fleets. In last five years they kept low effort values with some slight fluctuations. The artisanal fleet of Cedeira despite fluctuations along the time-series shows an overall increasing trend until 2008. After this year the effort sharply declined to the minimum value of the series in 2011. From 2007–2011 the effort from A Coruña fleet was reduced by 47%, showing the lowest values of the series in 2011. The Portuguese Crustacean fleet shows high effort values in 2001 and 2002 that might be related to a change in the target species due to very high abundance of rose shrimp during that period.

LPUEs from all available fleets show a general decline during the eighties and early nineties followed by some increase. From 2002 to 2005 LPUEs increased for all fleets. This general LPUE trend is consistent between fleets including the artisanal fleet. In 2009 and 2010 an important increase of Cedeira LPUE was observed. Portuguese fleets shown a one-off increase in 2011.

4.3.5 Assessment

A new model assessment was adopted in 2012 benchmark (WKFLAT2012). The assessment approved in the WGHMM2012 was updated with 2015 data.

4.3.5.1 Input data

Input data used in the assessment are presented in the Stock Annex.

Due to the problems described in previous section (see Commercial catch-effort data), the A Coruña-fleet and Cedeira-fleet abundance indices for 2013, 2014 and 2015were not included in the assessment.

4.3.5.2 Model

The Stock Synthesis 3 (SS3) software was selected to be used in the assessment (Methot, 2000). The description of the model including the structure, settings, and parameters assumptions are provided in the Stock Annex.

4.3.5.3 Assessment results

The model diagnosis is carried out means the analysis of residuals of abundance indices. Residual plots of the fits to the abundance indices are shown in Figure 4.3.5. Although some minor trends have been detected, as it happens for A Coruña indices from 1995 to 2000, it can be considered that the model follows trends of the abundance indices used in the model (A Coruña, Cedeira and the Spanish survey). Pearson residual plots are presented for the model fits to the length-composition data of the abundance indices (Figure 4.3.6). There were not detected specific patterns in any of the abundance indices. Some high positive residual are evident for A Coruña indices in the first and second quarter. Nevertheless, the model fits reasonably well.

The model estimates size-based selectivity functions for commercial fleets (Figure 4.3.7) and for population abundance indices (Figure 4.3.8). All the selection patterns were assumed constant over the time. The selection pattern for the Spanish trawl fleet is efficient for a wide range of lengths, since the smaller fish until very large individuals. The Spanish artisanal fleet is most efficient at a narrow length range and for large fish, mainly from 75 to 90 cm. The Portuguese trawl fleet selection pattern indicates that this fishery is most efficient at the length range between 30 and 60 cm. This selection pattern shows strange selection over larger fish that could be an effect of an insufficient length sampling.

The selection patterns are equal for all quarters in A Coruña and Cedeira indices. For A Coruña index the selection pattern has a wide length range while Cedeira index shows the selectivity is directed to larger individuals. The Spanish survey index shows well defined selectivity to the smaller individuals.

4.3.5.4 Historic trends in biomass, fishing mortality and recruitment

Table 4.3.7 and Figure 4.3.9 provide the summary of results from the assessment model and observed landings. Maximum values of recruitment are recorded at the beginning of the time-series (1982, 1986 and 1987) with values over the 4 million. Along the time-series other high recruitment values were detected in 1989, 1994 and 2001. Since 2006 the recruitment has been below 1 million except in 2010, 2011 and 2014.The abundance of age0 in 2015, estimated at 178 thousands, was the lowest value throughout the time-series. Landings steadily decreased from 3.6 Kt in 2005 to 1.1Kt in 2011, coinciding with the decrease in F, from 0.38 in 2005 to 0.16 in 2011. Respect to 2014, landings and F decreased in 2015 by 13% and 9% respectively. From 2005 to 2012 SSB was at stable medium values around 6.5 kt, increasing to 8 kt in 2014 and in 2015.

4.3.5.5 Retrospective pattern for SSB, fishing mortality, yield and recruitment

In order to assess the consistency of the assessment from year to year, a retrospective analysis was carried out. It was conducted by removing one year (2015), two years (2015 and 2014), three years (2015, 2014, 2013) and four years (2015, 2014, 2013, 2012) of data while using the same model configuration (Figure 4.3.10). All the retrospective analysis runs were similar in the estimates of recruitment. Although there is some uncertainty in recent recruitment estimates no consistent bias was observed. Retrospective analysis showed an underestimation of the SSB in the final years an overestimation of F. Nevertheless, there was no strong retrospective pattern and the assessment was accepted for projections.

A retrospective analysis based on 7 peel years was also carried out to estimate the Mohn's Rho index for fishing mortality. The estimated Rho=-0.10 indicates that fishing mortality is overestimated by 10%.

4.3.6 Catch options and prognosis

4.3.6.1 Short-term projections

This year the projections were performed on the basis of present assessment.

For fishing mortality, the F *status quo* equal to 0.21, estimated as the average of fishing mortality the last three years $F_{2013\text{-}2015}$ over lengths 30–130 cm, was used for 2016. In the case of recruitment, the geometric mean of the whole period (1980–2015) was used following the default option indicated in the Stock Annex.

Projected landings in 2017 and SSB at the beginning of 2018 for different management options in 2017 are presented in Table 4.3.8. Under F *status quo* scenario in 2017 is expected a very small decrease in landings with respect to 2016, and a decrease in SSB in 2018 with respect to 2017.

4.3.6.2 Yield and biomass per recruit analysis

The summary table of Yield and SSB per recruit analysis is given in the table below:

	SPR level	Fmult	F(30-130cm)	YPR(land)	SSB/R
Fmax	0.12	1.42	0.30	2.20	6.36
F0.1	0.24	0.90	0.19	2.08	12.37
F40%	0.40	0.54	0.11	1.73	21.13
F35%	0.35	0.63	0.13	1.85	18.38
F30%	0.30	0.73	0.15	1.96	15.81

The F that maximizes the yield-per-recruit, F_{max}, is estimated at 0.30 which is over F_{sq} (0.21) and which corresponds to a SPR level of 12%. The $F_{0.1}$, rate of fishing mortality at which the slope of the YPR curve falls to 10% of its value at the origin, is equal to 0.19 and it is corresponding to a SPR level of 24%. The fishing mortality of $F_{30\%,\ 35\%\ \text{and}\ 40\%}$ is estimated in 0.15, 0.13 and 0.11 respectively. The *status quo* F is below Fax and above from any of the reference points based on SSB per recruit analysis.

4.3.7 Biological Reference Points of stock biomass and yield.

In 2015, the WKMSREF4 has estimated new reference points for this stock (ICES, 2016a,b). The new accepted values are presented in the following table:

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	5400 t	5th percentile of SSB_{2015} (WGBIE2015)	ICES, 2016a
	F_{MSY}	0.31	F that maximises median equilibrium yield	ICES, 2016a
	F_{MSY} range [lower, upper]	0.18, 0.41	5% reduction in long-term yield compared with MSY	ICES, 2016a
Precautionary approach	B_{lim}	1900 t	Bloss (lowest value of SSB)	ICES, 2016b
	B_{pa}	2600 t	Blim x exp(1.645 x σ), where σ = 0.2	ICES, 2016b
	F_{lim}	0.60	Segmented regression with Blim as breakpoint	ICES, 2016b
	F_{pa}	0.43	Flim x exp (-σ x 1.645), where σ=0.2	ICES, 2016b

The estimated F_{MSY} (0.31) differs substantially from the value $F_{0.1}$=0.19 used previously as a proxy of F_{MSY}.

4.3.8 Comments on the assessment

The spawning-stock biomass has increased from 2011 to 2014 decreasing slightly in 2015. SSB in 2016 is estimated at 8 thousand tonnes which is well above of B_{pa} (2600 t) and MSY $B_{trigger}$ (5400 t). Fishing mortality in 2014 has increased by 44% related to 2011. F in 2015 is estimated to be at a value of 0.21, below F_{pa} (0.43) and F_{MSY} (0.31). An increase in landings occurred from 1.1 kt in 2011 to 2.0 kt in 2014 and they decreased to 1.7 in 2015.

4.3.9 Quality considerations

The available unallocated landings, for years 2011–2015, are included in the present stock assessment, as the estimates were considered realistic information. However the importance of unallocated landings is difficult to assess and the results of the assessment could be affected by the inclusion of these data.

Uncertainty of the assessment model may have increased due to the missing data for commercial abundance indices since 2011.

4.3.10 Management considerations

Management considerations are describing for both anglerfish stocks in section 4.2.

4.3.11 References

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Table 4.3.1 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.
Tonnes landed by the main fishing fleets for 1978-2015 as determined by the Working Group.

	Div. 8c				Div. 9a						Div. 8c+9a		Div. 8c+9a
	SPAIN				SPAIN			PORTUGAL					
Year	Trawl	Gillnet	Others	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL	SUBTOTAL	Unallocated	TOTAL
1978	n/a	n/a		n/a	258				115	373			
1979	n/a	n/a		n/a	319				225	544			
1980	2 806	1 270		4 076	401				339	740	4 816		4 816
1981	2 750	1 931		4 681	535				352	887	5 568		5 568
1982	1 915	2 682		4 597	875				310	1 185	5 782		5 782
1983	3 205	1 723		4 928	726				460	1 186	6 114		6 114
1984	3 086	1 690		4 776	578			186	492	1 256	6 032		6 032
1985	2 313	2 372		4 685	540			212	702	1 454	6 139		6 139
1986	2 499	2 624		5 123	670			167	910	1 747	6 870		6 870
1987	2 080	1 683		3 763	320			194	864	1 378	5 141		5 141
1988	2 525	2 253		4 778	570			157	817	1 543	6 321		6 321
1989	1 643	2 147		3 790	347			259	600	1 206	4 996		4 996
1990	1 439	985		2 424	435			326	606	1 366	3 790		3 790
1991	1 490	778		2 268	319			224	829	1 372	3 640		3 640
1992	1 217	1 011		2 228	301			76	778	1 154	3 382		3 382
1993	844	666		1 510	72			111	636	819	2 329		2 329
1994	690	827		1 517	154			70	266	490	2 007		2 007
1995	830	572		1 403	199			66	166	431	1 834		1 834
1996	1 306	745		2 050	407			133	365	905	2 955		2 955
1997	1 449	1 191		2 640	315			110	650	1 075	3 714		3 714
1998	912	1 359		2 271	184			28	497	710	2 981		2 981
1999	551	1 013		1 564	79			9	285	374	1 938		1 938
2000	269	538		808	107			4	340	451	1 259		1 259
2001	231	294		525	57			16	190	263	788		788
2002	385	341		726	110			29	168	307	1 032		1 032
2003	911	722		1 633	312			29	305	645	2 278		2 278
2004	1 260	1 269		2 528	264			27	335	626	3 154		3 154
2005	1 378	1 622		3 000	371			29	244	643	3 644		3 644
2006	1 166	1 247		2 413	260			29	260	549	2 963		2 963
2007	955	1 009		1 964	181			13	192	386	2 350		2 350
2008	894	1 168		2 062	138			11	127	275	2 337		2 337
2009	850	1 058		1 909	213			10	148	371	2 280		2 280
2010	313	955		1 268	158			2	119	279	1 547		1 547
2011	243	483	73	799	59	28	48	46	80	260	1 060	80	1 140
2012	271	527	67	866	54	20	42	6	163	285	1 151	230	1 381
2013	274	718	38	1 029	47	30	50	15	154	296	1 325	190	1 516
2014	358	947	28	1 334	91	47	4	30	122	294	1 628	374	2 001
2015	324	802	4	1 129	86	53	2	34	200	375	1 504	244	1 748

n/a: not available

Table 4.3.2 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.
Weight and percentage of discards for Spanish fleets.

	Trawl			Gillnet	
Year	Weight (t)	CV	% Catches	Weight (t)	% Catches
1994	20.9	34.05	2.4		
1995	n/a	n/a	n/a		
1996	n/a	n/a	n/a		
1997	5.4	68.13	0.3		
1998	n/a	n/a	n/a		
1999	0.8	71.30	0.1		
2000	5.7	33.64	1.5		
2001	n/a	n/a	n/a		
2002	n/a	n/a	n/a		
2003	25.1	54.42	2.0		
2004	48.2	32.53	3.1		
2005	44.1	30.97	2.5		
2006	43.7	48.33	3.0		
2007	17.1	28.44	1.5		
2008	4.9	56.47	0.5		
2009	20.0	26.11	3.6		
2010	11.5	36.87	2.4		
2011	22.6	19.27	7.0		
2012	62.6	43.65	11.4		
2013	65.8	n/a	17.0	143.8	16.1
2014	24.4	n/a	5.2	0.0	0.0
2015	20.8	n/a	4.8	7.6	0.9

n/a: not available
CV: coefficient of variation

Table 4.3.3 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.
Length composition by fleet and ajusted length composition for total landings (thousands) in 2015.
Ajusted TOTAL: ajusted to landings from fleets without length compostion.

	Div. 8c			Div. 9a				Div. 8c+9a	
	SPAIN			SPAIN	PORTUGAL				
Length (cm)	Trawl	Gillnet	TOTAL	Trawl	Trawl	Artisanal	TOTAL	TOTAL	Ajusted TOTAL
14	0.000	0.000	0.000	0.000	0.000	1.72	1.72	1.72	1.72
15	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
16	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
17	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
18	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
19	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
20	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
21	0.197	0.000	0.197	0.231	0.000	0.00	0.23	0.43	0.43
22	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
23	0.044	0.000	0.044	0.026	0.000	0.00	0.03	0.07	0.07
24	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
25	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
26	0.044	0.000	0.044	0.049	0.000	0.00	0.05	0.09	0.10
27	0.044	0.000	0.044	0.026	0.000	0.00	0.03	0.07	0.07
28	0.088	0.000	0.088	0.053	0.000	0.00	0.05	0.14	0.15
29	0.358	0.000	0.358	0.130	0.000	0.00	0.13	0.49	0.50
30	1.181	0.000	1.181	0.783	0.000	0.00	0.78	1.96	2.00
31	0.814	0.000	0.814	0.167	0.000	0.00	0.17	0.98	1.00
32	1.828	0.000	1.828	0.692	0.000	0.00	0.69	2.52	2.58
33	2.073	0.000	2.073	0.680	0.000	0.00	0.68	2.75	2.81
34	3.214	0.000	3.214	1.036	0.000	0.00	1.04	4.25	4.33
35	2.808	0.000	2.808	0.557	0.000	0.00	0.56	3.37	3.42
36	4.386	0.000	4.386	2.555	0.000	0.00	2.55	6.94	7.04
37	3.320	0.000	3.320	1.069	0.000	0.00	1.07	4.39	4.44
38	4.052	0.000	4.052	2.153	0.611	0.00	2.76	6.82	6.88
39	2.945	0.000	2.945	0.993	0.000	0.00	0.99	3.94	4.01
40	2.980	0.000	2.980	0.916	0.000	0.00	0.92	3.90	3.96
41	2.290	0.000	2.290	0.902	0.000	0.00	0.90	3.19	3.25
42	2.645	0.000	2.645	0.993	0.636	6.42	8.05	10.69	10.73
43	2.491	0.000	2.491	1.336	0.266	0.00	1.60	4.09	4.14
44	1.525	0.000	1.525	0.656	0.132	0.00	0.79	2.31	2.34
45	2.028	0.000	2.028	0.874	0.445	0.50	1.82	3.85	3.89
46	1.968	0.000	1.968	0.793	0.170	0.00	0.96	2.93	2.99
47	1.735	0.033	1.769	0.632	0.132	1.01	1.77	3.54	3.58
48	1.442	0.000	1.442	0.509	0.009	0.13	0.65	2.09	2.12
49	1.340	0.000	1.340	0.621	0.000	0.24	0.87	2.21	2.23
50	1.751	0.029	1.780	0.779	0.000	5.33	6.11	7.89	7.93
51	0.856	0.087	0.943	0.390	0.102	0.00	0.49	1.44	1.46
52	1.005	0.267	1.272	0.132	0.000	1.14	1.27	2.54	2.58
53	1.241	0.149	1.390	0.425	0.105	0.53	1.06	2.45	2.49
54	0.807	0.144	0.951	0.445	1.446	0.26	2.15	3.11	3.13
55	0.788	0.243	1.032	0.175	0.000	2.14	2.32	3.35	3.38
56	0.986	0.346	1.333	0.329	0.000	2.66	2.99	4.32	4.36
57	1.272	0.497	1.769	0.188	0.000	0.80	0.99	2.76	2.81
58	1.074	0.377	1.452	0.261	0.029	1.01	1.30	2.75	2.80
59	0.810	0.693	1.503	0.278	0.000	0.99	1.26	2.77	2.83
60	1.014	1.341	2.355	0.110	0.208	0.56	0.87	3.23	3.33
61	1.085	1.508	2.593	0.367	0.000	1.62	1.99	4.58	4.71
62	1.124	1.528	2.652	0.262	0.029	1.57	1.86	4.51	4.64
63	1.503	1.972	3.475	0.261	0.147	1.56	1.97	5.45	5.60
64	1.148	1.757	2.906	0.480	0.073	0.29	0.84	3.75	3.89
65	1.146	2.168	3.314	0.101	0.042	0.16	0.30	3.61	3.78
66	0.836	2.716	3.552	0.280	0.397	0.79	1.47	5.02	5.20
67	1.286	2.772	4.059	0.048	0.362	2.50	2.91	6.97	7.17
68	1.326	2.763	4.090	0.248	0.000	0.52	0.77	4.86	5.04
69	0.835	3.674	4.509	0.144	0.479	0.71	1.33	5.84	6.10
70	1.799	4.301	6.100	0.255	0.105	1.61	1.97	8.07	8.38
71	1.092	4.016	5.108	0.266	0.000	1.25	1.52	6.63	6.91
72	1.522	4.636	6.158	0.551	0.433	0.99	1.98	8.13	8.46
73	1.318	4.884	6.202	0.138	0.426	1.83	2.39	8.59	8.93
74	0.926	4.662	5.588	0.297	0.009	0.71	1.02	6.61	6.94
75	1.103	4.947	6.050	0.222	0.000	1.10	1.32	7.37	7.72
76	0.920	4.080	5.000	0.255	0.073	0.27	0.60	5.60	5.86
77	1.159	3.587	4.746	0.314	0.000	1.07	1.38	6.13	6.40
78	0.789	3.248	4.037	0.265	0.000	0.20	0.46	4.50	4.73
79	0.697	3.296	3.992	0.177	0.000	0.34	0.52	4.51	4.73
80	1.016	2.708	3.725	0.228	0.000	0.03	0.25	3.98	4.19
81	0.629	2.558	3.187	0.193	0.000	0.03	0.22	3.41	3.60
82	1.126	2.558	3.684	0.657	0.122	0.00	0.78	4.46	4.67
83	0.930	2.508	3.437	0.235	0.000	0.70	0.94	4.37	4.56
84	0.635	2.568	3.203	0.297	0.000	0.61	0.91	4.11	4.29
85	0.757	2.431	3.188	0.214	0.029	0.14	0.38	3.57	3.75
86	0.387	1.862	2.248	0.111	0.000	0.15	0.26	2.51	2.63
87	0.809	2.184	2.993	0.346	0.000	0.40	0.74	3.74	3.89
88	0.439	2.187	2.626	0.032	0.000	0.38	0.42	3.04	3.18
89	0.928	1.970	2.898	0.070	0.000	0.24	0.31	3.21	3.35
90	0.867	2.269	3.136	0.099	0.000	0.51	0.61	3.75	3.90
91	0.814	1.671	2.485	0.052	0.000	0.37	0.42	2.90	3.03
92	0.640	1.178	1.818	0.167	0.000	0.70	0.87	2.68	2.78
93	0.618	1.594	2.212	0.014	0.000	0.13	0.14	2.36	2.45
94	0.456	1.450	1.906	0.060	0.000	0.00	0.06	1.97	2.06
95	0.235	1.306	1.542	0.045	0.000	0.03	0.07	1.61	1.70
96	0.657	1.232	1.889	0.057	0.397	0.56	1.01	2.90	2.98
97	0.295	1.369	1.664	0.054	0.000	0.00	0.05	1.72	1.81
98	0.523	1.194	1.717	0.077	0.000	0.03	0.10	1.82	1.90
99	0.227	0.960	1.187	0.000	0.000	0.00	0.00	1.19	1.25
100+	2.086	7.894	9.980	0.567	0.362	0.40	1.33	11.31	11.87
TOTAL	96	112	209	31	8	50	89	298	307
Tonnes	324	802	1 126	86	34	200	321	1 446	1 504
Mean Weight (g)	3 365	7 137	5 398	2 748	4 392	4 007	3 596	4 858	4 902
Mean length (cm)	56.3	79.4	68.8	51.6	61.1	60.6	57.5	65.4	65.7

Table 4.3.4 ANGLERFISH (*L. piscatorius*). Divisions 8c and 9a.
Numbers, mean weight and mean length of landings between 1986 and 2015.

Year	Total (thousands)	Mean Weight (g)	Mean Length (cm)
1986	1 872	3 670	61
1987	2 806	1 832	44
1988	2 853	2 216	50
1989	1 821	2 744	54
1990	1 677	2 261	49
1991	1 657	2 197	50
1992	1 256	2 692	54
1993	857	2 719	54
1994	704	2 850	54
1995	876	2 093	48
1996	1 153	2 564	52
1997	1 043	3 560	60
1998	583	5 113	68
1999	290	6 674	71
2000	190	6 885	72
2001	127	6 189	64
2002	381	2 766	50
2003	784	2 907	54
2004	809	3 456	61
2005	856	4 259	63
2006	923	3 211	58
2007	553	4 251	62
2008	540	4 327	63
2009	492	4 630	64
2010	288	5 569	71
2011	249	4 252	62
2012	244	4 711	65
2013	269	4 929	66
2014	289	5 630	70
2015	307	4 902	66

Table 4.3.5 ANGLERFISH (*L. piscatorius*). Divisions 8c and 9a.
Abundance indices from Spanish and Portuguese surveys.

	SpGFS-WIBTS-Q4 September-October (total area Miño-Bidasoa)					PtGFS-WIBTS-Q4 October		
Year	Hauls	kg/30 min		nº/30 min		Hauls	kg/60 min	nº/60 min
		Yst	se	Yst	se			
1983	145	2.03	0.29	3.50	0.46	117	n/a	n/a
1984	111	2.60	0.47	2.90	0.55	na	n/a	n/a
1985	97	1.33	0.36	1.90	0.26	150	n/a	n/a
1986	92	4.28	0.80	10.70	1.40	117	n/a	n/a
1987	ns	ns	ns	ns	ns	81	n/a	n/a
1988	101	3.33	0.70	1.50	0.25	98	n/a	n/a
1989	91	0.44	0.08	2.40	0.30	138	0.09	0.07
1990	120	1.19	0.22	1.20	0.22	123	0.46	0.05
1991	107	0.71	0.22	0.50	0.09	99	+	+
1992	116	0.76	0.15	1.18	0.16	59	0.09	0.01
1993	109	0.88	0.16	1.20	0.14	65	0.08	0.01
1994	118	1.66	0.62	3.70	0.49	94	+	0.02
1995	116	2.19	0.32	5.70	0.69	88	0.05	0.03
1996*	114	1.54	0.26	1.40	0.16	71	0.27	0.18
1997	116	1.69	0.39	0.67	0.11	58	0.49	0.03
1998	114	1.40	0.37	0.39	0.08	96	+	+
1999*	116	0.75	0.23	0.36	0.06	79	+	+
2000	113	0.57	0.19	0.88	0.18	78	+	+
2001	113	1.09	0.24	2.88	0.28	58	+	+
2002	110	1.34	0.21	2.76	0.29	67	0.06	0.04
2003*	112	1.67	0.40	1.41	0.16	80	0.29	0.15
2004*	114	2.09	0.32	2.71	0.32	79	0.16	0.12
2005	116	3.05	0.54	2.04	0.19	87	0.12	0.04
2006	115	1.88	0.40	2.86	0.30	88	+	+
2007	117	1.65	0.25	2.56	0.25	96	+	+
2008	115	1.85	0.37	1.96	0.35	87	+	+
2009	117	1.07	0.17	1.91	0.17	93	+	+
2010	114	1.29	0.25	1.95	0.28	87	+	+
2011	114	0.77	0.16	1.09	0.18	86	+	+
2012	115	1.11	0.27	1.06	0.14	ns	ns	ns
2013**	114	2.09	0.64	2.30	0.30	93	0.34	0.02
2014**	116	1.57	0.36	1.24	0.17	81	0.00	0.00
2015**	114	1.14	0.25	0.58	0.10	90	0.00	0.00

Yst = stratified mean
se = standard error
ns = no survey
n/a = not available
+ = less than 0.01
* For Portuguese Surveys - R/V Capricornio, other years R/V Noruega
** For Spanish Surveys - R/V Miguel Oliver, other years R/V Coornide de Saavedra

Table 4.3.6 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.
Landings, fishing effort and landings per unit effort for trawl and gillnet fleets.
For landings the percentage relative to total annual stock landings is given.

	SP-AVITR8C				SP-SANTR8C				STAND-SP-CEDGNS8C			
Year	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp	LANDINGS	%	EFFORT (soaking days)	LPUE (kg/soaking
1986	500	7	10 845	46.1	516	8	18 153	28.4				
1987	500	10	8 309	60.2	529	10	14 995	35.3				
1988	401	6	9 047	44.3	387	6	16 660	23.3				
1989	214	4	8 063	26.5	305	6	17 607	17.3				
1990	260	7	8 497	30.6	278	7	20 469	13.6				
1991	245	7	7 681	31.9	281	8	22 391	12.6				
1992	198	6	--	--	222	7	22 833	9.7				
1993	76	3	7 635	9.9	186	8	21 370	8.7				
1994	116	6	9 620	12.0	188	9	22 772	8.2				
1995	192	10	6 146	31.2	186	10	14 046	13.2				
1996	322	11	4 525	71.1	270	9	12 071	22.4				
1997	345	9	5 061	68.1	381	10	11 776	32.3				
1998	286	10	5 929	48.3	316	11	10 646	29.7				
1999	108	6	6 829	15.8	182	9	10 349	17.6	342	18	4 582	74.5
2000	28	2	4 453	6.3	75	6	8 779	8.6	140	11	2 981	46.8
2001	23	3	1 838	12.5	54	7	3 053	17.6	87	11	1 932	44.8
2002	75	7	2 748	27.5	57	6	3 975	14.3	130	13	2 398	54.3
2003	111	5	2 526	44.0	85	4	3 837	22.1	159	7	2 703	59.0
2004	216	7	--	--	106	3	3 776	28.1	382	12	4 677	81.6
2005	278	8	--	--	59	2	1 404	41.9	434	12	3 325	130.4
2006	148	5	--	--	89	3	2 718	32.7	415	14	3 911	106.2
2007	101	4	--	--	103	4	4 334	23.8	233	10	3 976	58.6
2008	99	4	--	--	--	--	--	--	228	10	5 133	44.3
2009	69	3	--	--	35	2	1 125	31.3	183	8	2 300	79.5
2010	--	--	--	--	44	3	1 628	27.1	231	15	1 880	122.7
2011	--	--	--	--	44	4	--	--	60	6	522	115.9
2012	--	--	--	--	22	2	--	--	63	5	--	--

	SP-CORTR8C-PORT				SP-CORTR8C-TRUCKS				SP-CORTR8C-FLEET			
Year	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)
1982	1618	28	63 313	26					1618	28	63 313	25.6
1983	1490	24	51 008	29					1490	24	51 008	29.2
1984	1560	26	48 665	32					1560	26	48 665	32.1
1985	1134	18	45 157	25					1134	18	45 157	25.1
1986	825	12	40 420	20					825	12	40 420	20.4
1987	618	12	34 651	18					618	12	34 651	17.8
1988	656	10	41 481	16					656	10	41 481	15.8
1989	508	10	44 410	11					508	10	44 410	11.4
1990	550	15	44 403	12					550	15	44 403	12.4
1991	491	13	40 429	12					491	13	40 429	12.1
1992	432	13	38 899	11					432	13	38 899	11.1
1993	385	17	44 478	9					385	17	44 478	8.7
1994	245	12	39 602	6	63	3	12 795	5	309	15	52 397	5.9
1995	260	14	41 476	6	57	3	10 232	6	316	17	51 708	6.1
1996	413	14	35 709	12	83	3	8 791	9	496	17	44 501	11.2
1997	411	11	35 494	12	59	2	9 108	6	470	13	44 602	10.5
1998	138	5	29 508	5	30	1	--	--	168	6	--	--
1999	168	9	30 131	6	--	--	--	--	--	--	--	--
2000	85	7	30 079	3	2	0	--	--	88	7	--	--
2001	84	11	29 935	3	--	--	--	--	--	--	--	--
2002	130	13	21 948	6	61	6	6 747	9	191	19	28 695	6.7
2003	228	10	18 519	12	115	5	7 608	15	342	15	26 127	13.1
2004	277	9	19 198	14	162	5	10 342	16	439	14	29 540	14.9
2005	391	11	20 663	19	248	7	10 302	24	639	18	30 965	20.6
2006	242	8	19 264	13	273	9	12 866	21	515	17	32 130	16.0
2007	222	9	21 651	10	233	10	13 187	18	455	19	34 838	13.1
2008	274	12	20 212	14	153	7	9 812	16	428	18	30 024	14.2
2009	165	7	16 152	10	152	7	12 930	12	317	14	29 092	10.9
2010	129	8	16 680	8	70	5	9 003	8	165	11	22 746	7.3
2011	92	8	12 835	7	--	--	--	--	146	13	18 617	7.9
2012	132	10	14 446	9	--	--	--	--	142	10	21 110	6.7
2013	122	8	14 736	8	--	--	--	--	--	--	--	
2014	114	6	18 060	6	--	--	--	--	--	--	--	
2015	88	5	13 309	7	--	--	--	--	--	--	--	

	PT-CRUST						PT-FISH					
Year	LANDINGS	%	EFFORT (1000 hours)	EFFORT (1000 hauls)	LPUE (kg/hour)	LPUE (kg/haul)	LANDINGS	%	EFFORT (1000 hours)	EFFORT (1000 hauls)	LPUE (kg/hour)	LPUE (kg/haul)
1989	85	2	76	23	1.1	3.7	175	3	52	18	3.3	9.9
1990	106	3	90	20	1.2	5.2	219	6	61	17	3.6	12.8
1991	73	2	83	17	0.9	4.4	151	4	57	15	2.6	9.8
1992	25	1	71	15	0.3	1.6	51	2	49	14	1.0	3.7
1993	36	2	75	13	0.5	2.7	75	3	56	13	1.3	5.7
1994	23	1	41	8	0.6	3.0	47	2	36	10	1.3	4.9
1995	22	1	38	8	0.6	2.8	45	2	41	9	1.1	4.9
1996	45	2	64	14	0.7	3.1	88	3	54	12	1.6	7.1
1997	51	1	43	11	1.2	4.5	59	2	27	9	2.2	6.7
1998	11	<1	48	11	0.2	1.0	17	1	35	10	0.5	1.8
1999	3	<1	24	8	0.1	0.4	6	<1	18	6	0.3	1.0
2000	2	<1	42	10	0.0	0.2	2	<1	19	6	0.1	0.4
2001	9	1	85	18	0.1	0.5	7	1	19	5	0.4	1.4
2002	18	2	62	10	0.3	1.9	11	1	14	4	0.8	2.4
2003	13	1	42	10	0.3	1.3	16	1	17	6	0.9	2.8
2004	12	<1	21	7	0.6	1.9	14	<1	14	4	1.0	3.3
2005	12	<1	20	5	0.6	2.2	17	<1	13	4	1.3	4.7
2006	13	<1	22	5	0.6	2.4	16	1	12	4	1.3	4.2
2007	7	<1	22	6	0.3	1.1	6	<1	8	3	0.8	2.1
2008	6	<1	14	4	0.4	1.5	5	<1	5	2	1.0	2.9
2009	5	<1	15	--	0.3	--	5	<1	6	--	0.7	--
2010	1	<1	21	--	0.0	--	1	<1	14	--	0.1	--
2011	24	2	18	--	1.3	--	22	2	9	--	2.4	--
2012	3	<1	36	--	0.1	--	3	<1	27	--	0.1	--
2013	8	<1	27	--	0.3	--	7	<1	12	--	0.6	--
2014	16	<1	32	--	0.5	--	14	<1	22	--	0.7	--
2015	18	1	17	--	1.1	--	16	1	14	--	1.2	--

Table 4.3.7 ANGLERFISH (*L. piscatorius*) - Division 8c and 9a.
Summary of the assessment results.

Year	Recruit Age0 (thousands)	Total Biomass (t)	Total SSB (t)	Landings (t)	Yield/SSB	F (30-130 cm)
1980	425	13 554	7 566	4 817	0.64	0.32
1981	1 676	15 216	9 923	5 566	0.56	0.33
1982	6 733	14 658	11 200	5 782	0.52	0.37
1983	2 934	13 671	10 193	6 113	0.60	0.51
1984	797	13 578	8 445	6 031	0.71	0.54
1985	1 695	12 903	8 223	6 139	0.75	0.55
1986	5 993	10 829	7 765	6 870	0.88	0.83
1987	4 061	7 456	4 863	5 139	1.06	0.96
1988	1 631	7 384	3 291	6 321	1.92	1.48
1989	3 002	5 772	2 485	4 995	2.01	1.22
1990	2 399	4 752	2 257	3 790	1.68	0.89
1991	921	4 661	2 117	3 640	1.72	0.88
1992	1 169	4 414	2 103	3 382	1.61	0.92
1993	1 391	3 526	1 902	2 329	1.22	0.69
1994	2 890	3 354	1 851	2 007	1.08	0.60
1995	2 165	3 895	1 932	1 835	0.95	0.39
1996	451	5 763	2 756	2 956	1.07	0.43
1997	208	6 877	3 823	3 715	0.97	0.48
1998	181	6 327	4 330	2 981	0.69	0.39
1999	481	5 402	4 288	1 939	0.45	0.30
2000	570	4 734	4 010	1 256	0.31	0.25
2001	3 164	4 470	3 722	788	0.21	0.19
2002	1 590	5 191	3 807	1 034	0.27	0.20
2003	397	7 269	4 392	2 279	0.52	0.31
2004	1 747	8 696	5 533	3 156	0.57	0.33
2005	1 129	9 009	6 531	3 646	0.56	0.38
2006	1 364	8 532	6 327	2 932	0.46	0.37
2007	587	8 173	6 006	2 349	0.39	0.31
2008	516	8 319	6 169	2 338	0.38	0.29
2009	725	8 234	6 419	2 280	0.36	0.29
2010	1 034	7 807	6 376	1 548	0.24	0.21
2011	1 038	7 948	6 488	1 140	0.18	0.16
2012	457	8 680	6 919	1 382	0.20	0.18
2013	640	9 355	7 428	1 516	0.20	0.18
2014	1 181	9 772	8 015	2 002	0.25	0.23
2015	178	9 596	8 008	1 748	0.22	0.21

Table 4.3.8 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.
Catch option table.

SSB(2016)	Rec proj	F(30-130cm)	Land(2016)	SSB(2017)
7 941	1 084	0.21	1 623	7984

Fmult	Fland (30-130cm)	Landings(2017)	SSB(2018)
0	0	0	9638
0.1	0.02	179	9453
0.2	0.04	354	9272
0.3	0.06	525	9096
0.4	0.08	692	8923
0.5	0.1	855	8754
0.6	0.12	1014	8589
0.7	0.15	1170	8428
0.8	0.17	1322	8270
0.9	0.19	1471	8115
1	0.21	1616	7965
1.1	0.23	1758	7817
1.2	0.25	1897	7673
1.3	0.27	2033	7532
1.4	0.29	2165	7394
1.5	0.31	2295	7259
1.6	0.33	2422	7126
1.7	0.35	2546	6997
1.8	0.37	2667	6871
1.9	0.4	2785	6747
2	0.42	2901	6626

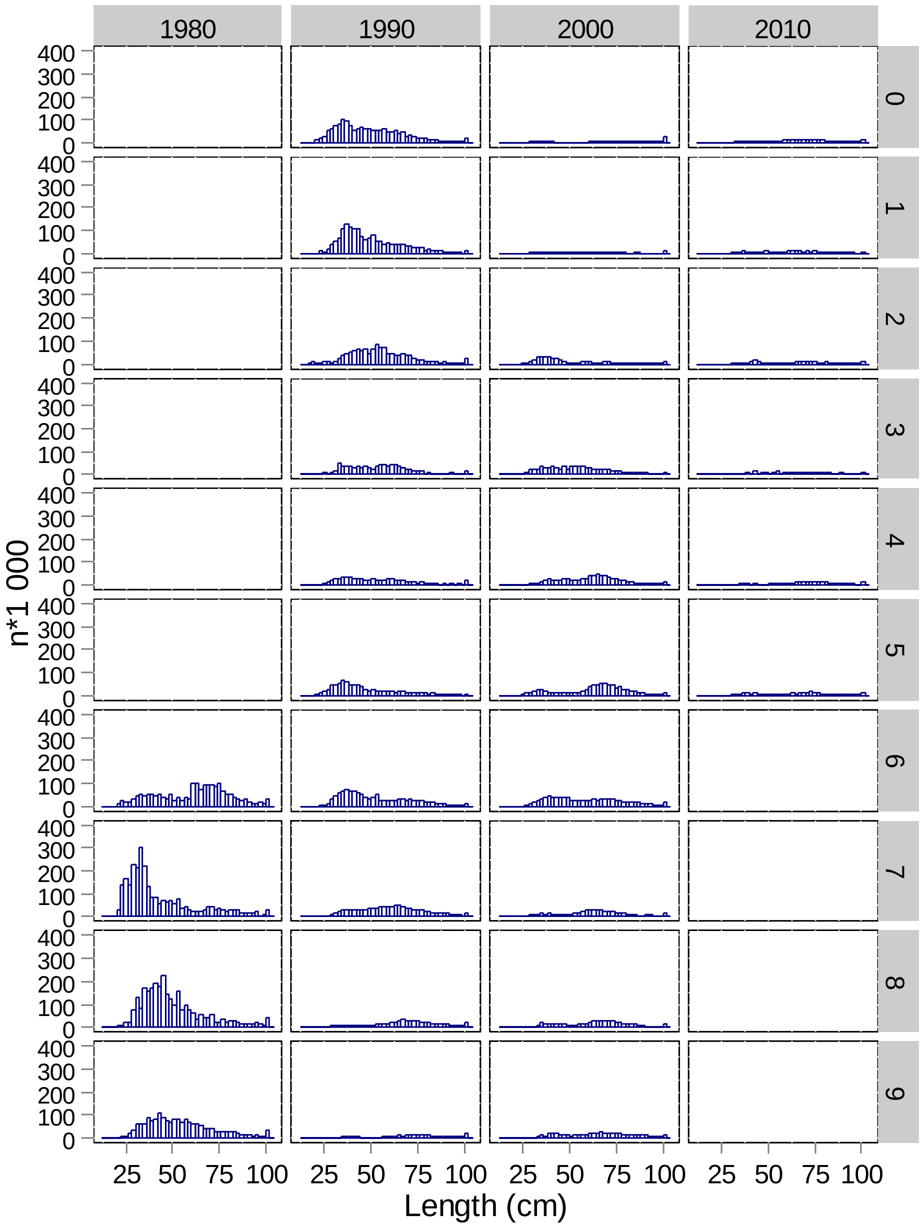


Figure 4.3.1. ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Length distributions of landings (thousands for 1986 to 2015

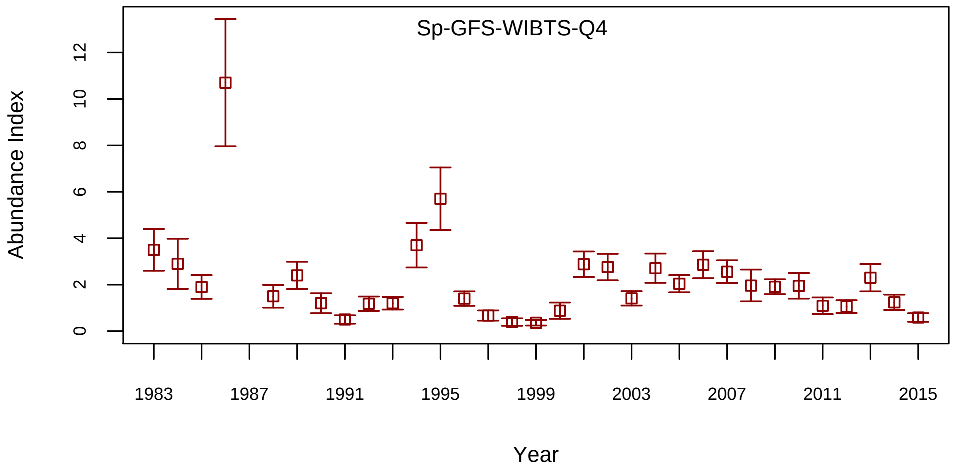


Figure 4.3.2 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Abundance index from survey SpGFS-WIBTS-Q4 in numbers/30 min. Bars represent 95% confidence intervals.

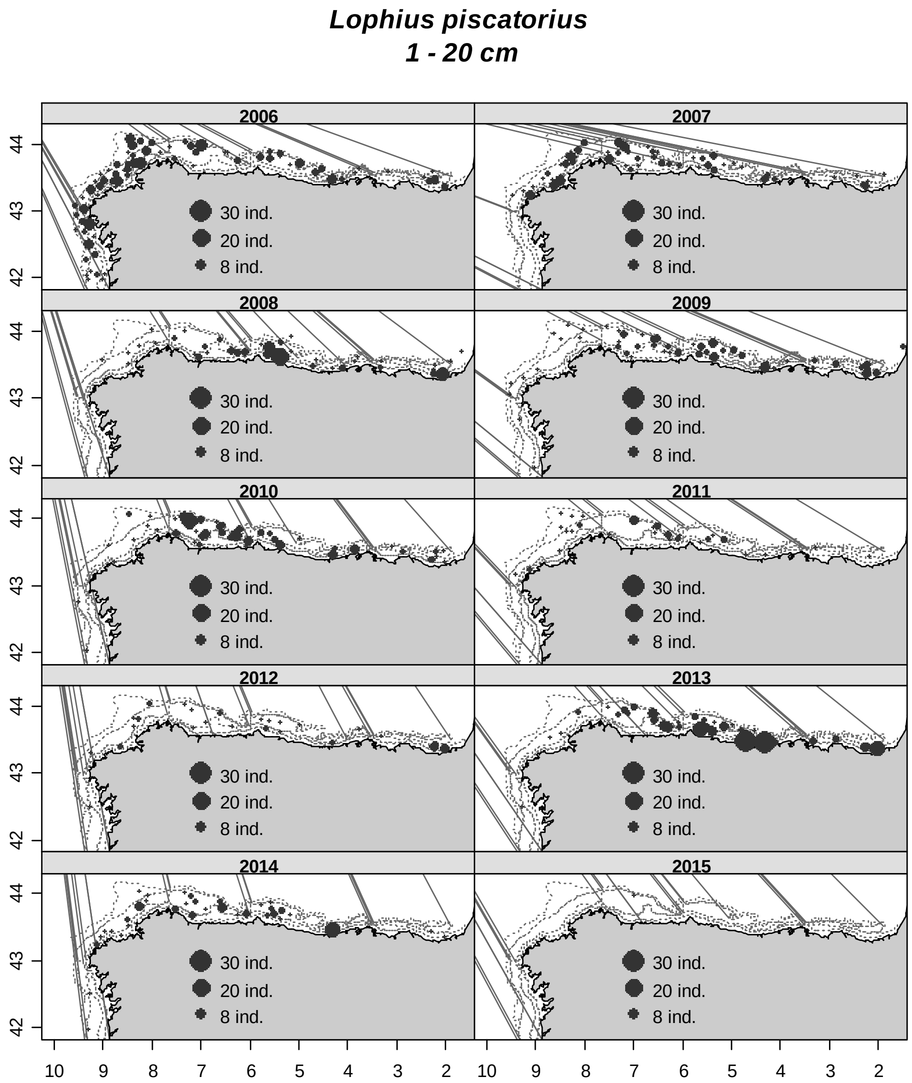


Figure 4.3.3. ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Spatial distribution of juveniles (length 0- 20 cm) in North Spanish Coast demersal survey (SpGFS-WIBTS-Q4) between 2006 and 2015

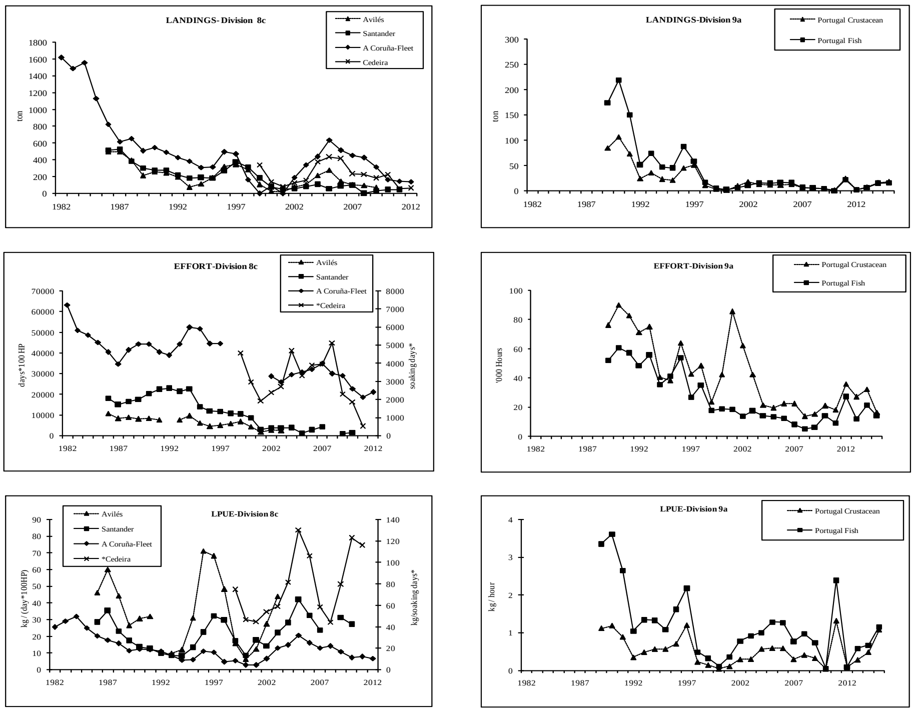


Figure 4.3.4ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a Trawl and gillnet landings, effort and LPUE data between 1986–2015

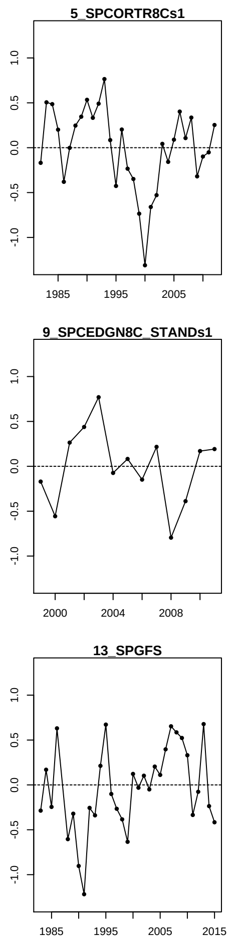


Figure 4.3.5 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Residuals of the fits to the surveys in log(abundance indices). A Coruña and Cedeira are by quarters

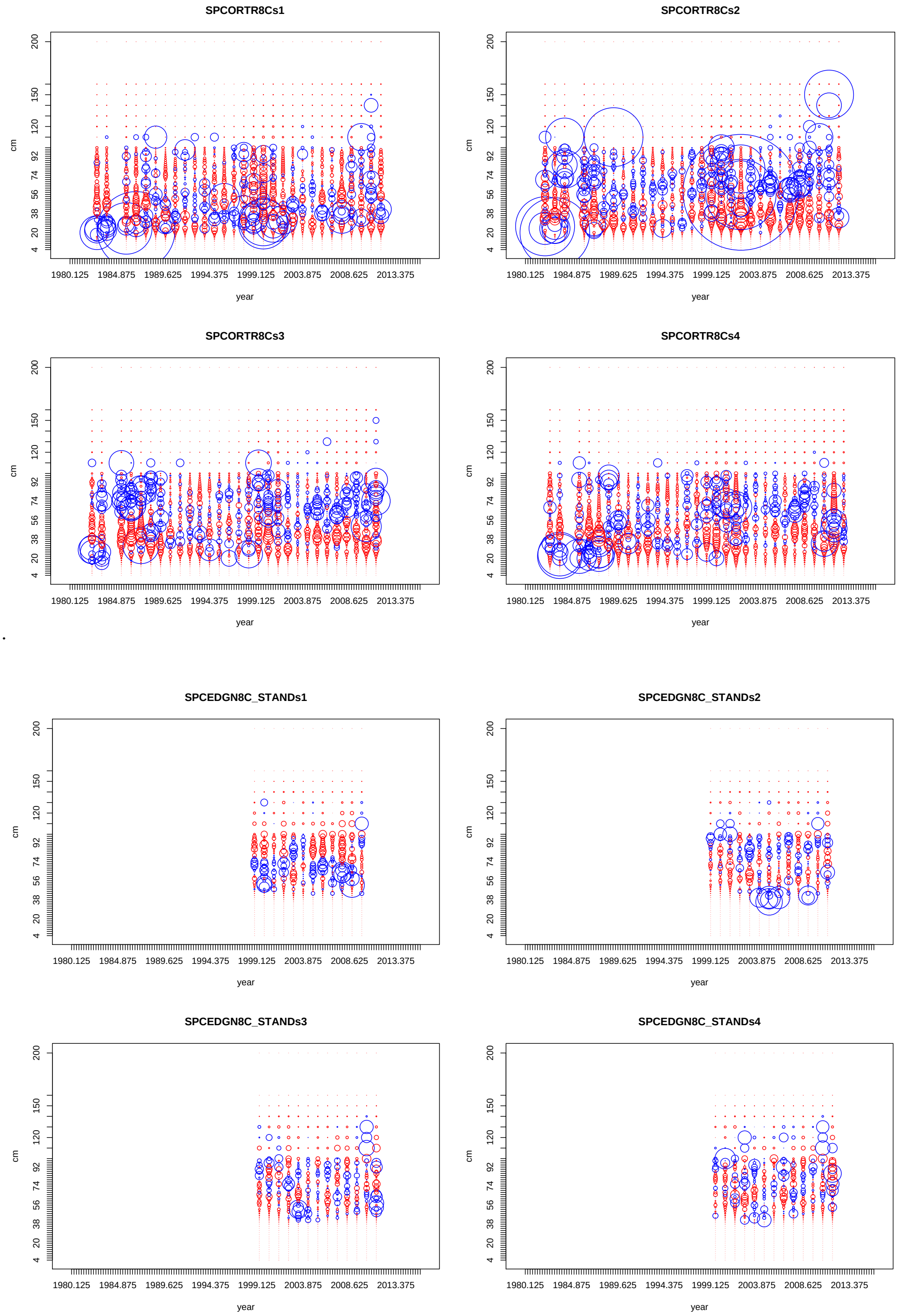


Figure 4.3.6 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Pearson residuals of the fit to the length distributions of the abundance indices. Blue=positive residuals and red=negative residuals

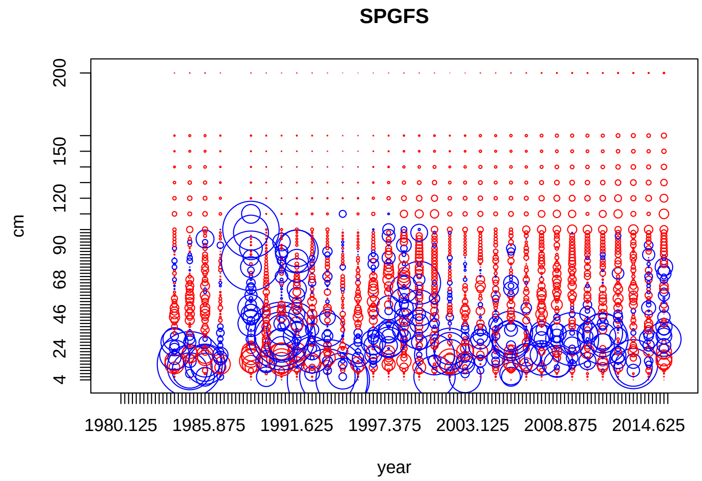


Figure 4.3.6 (continued)

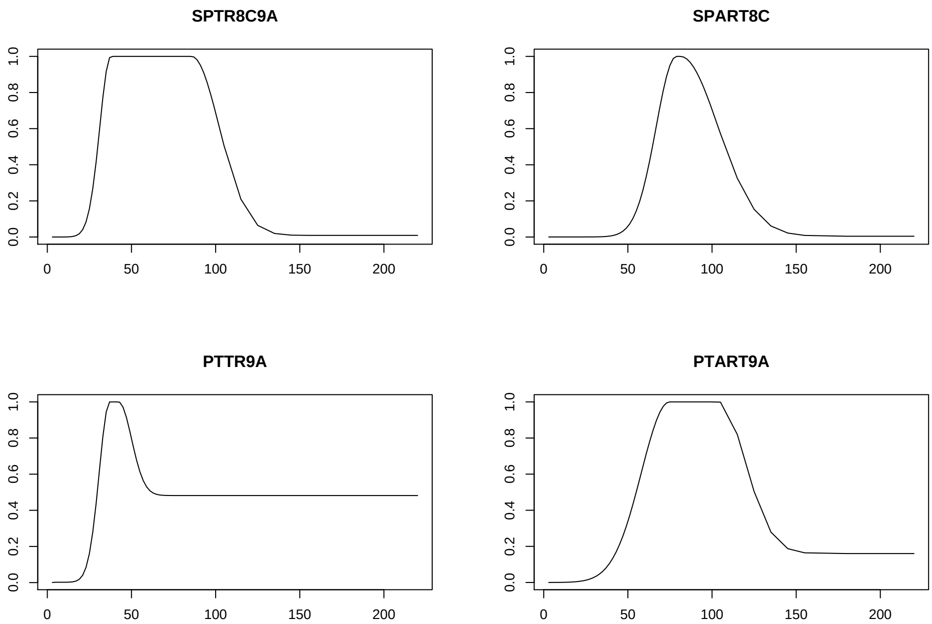


Figure 4.3.7 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Relative selection patterns at length by fishery estimated by SS3

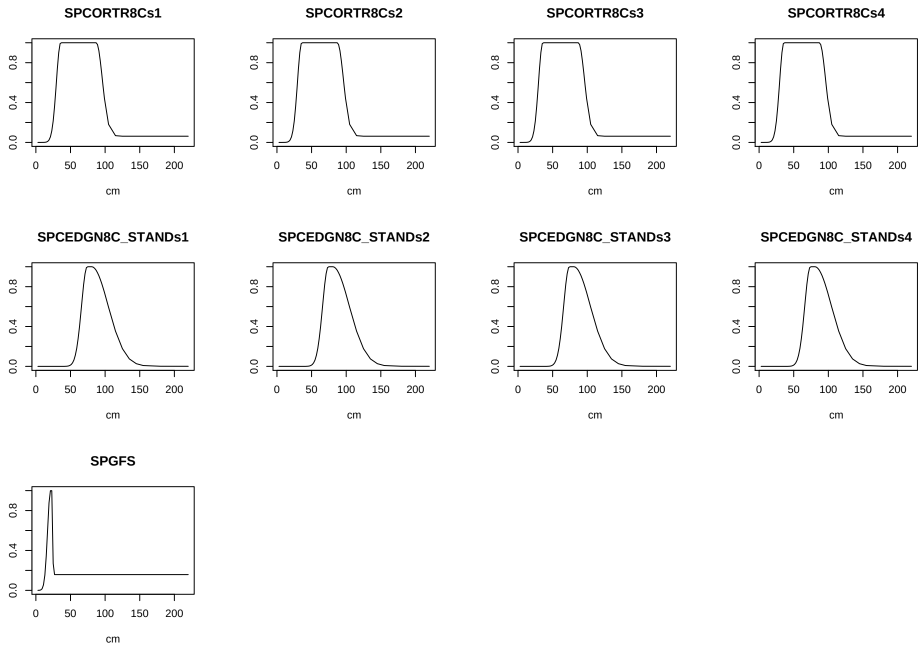


Figure 4.3.8 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Relative selection patterns at length by abundance index estimated by SS3. A Coruña and Cedeira indices are by quarter.

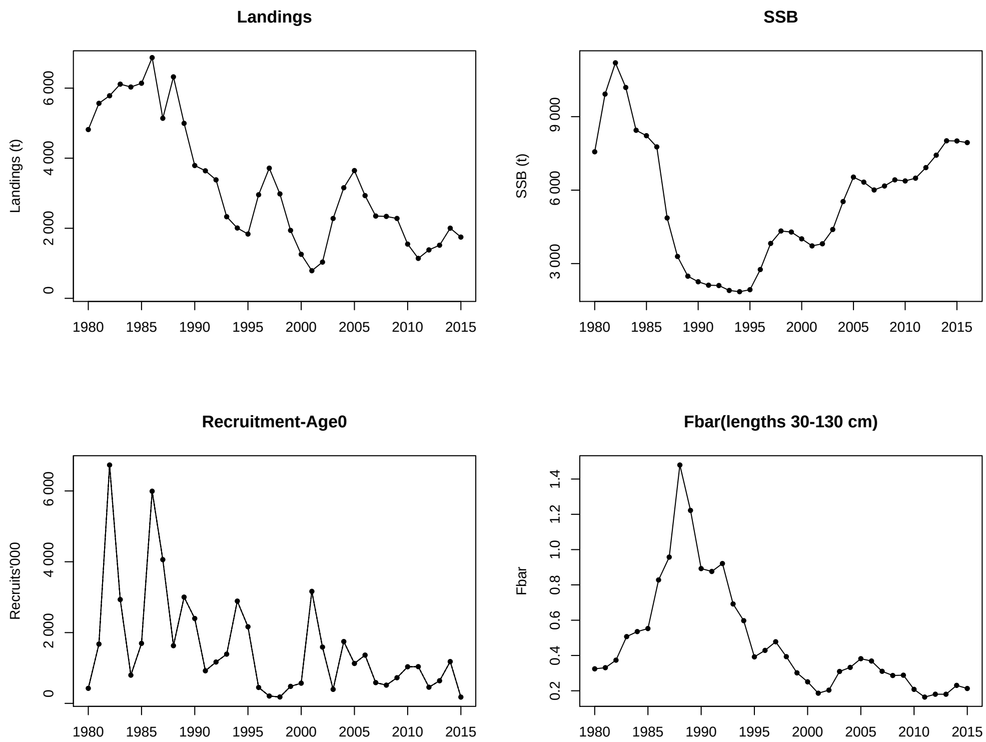


Figure 4.3.9 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Summary plots of stock trends

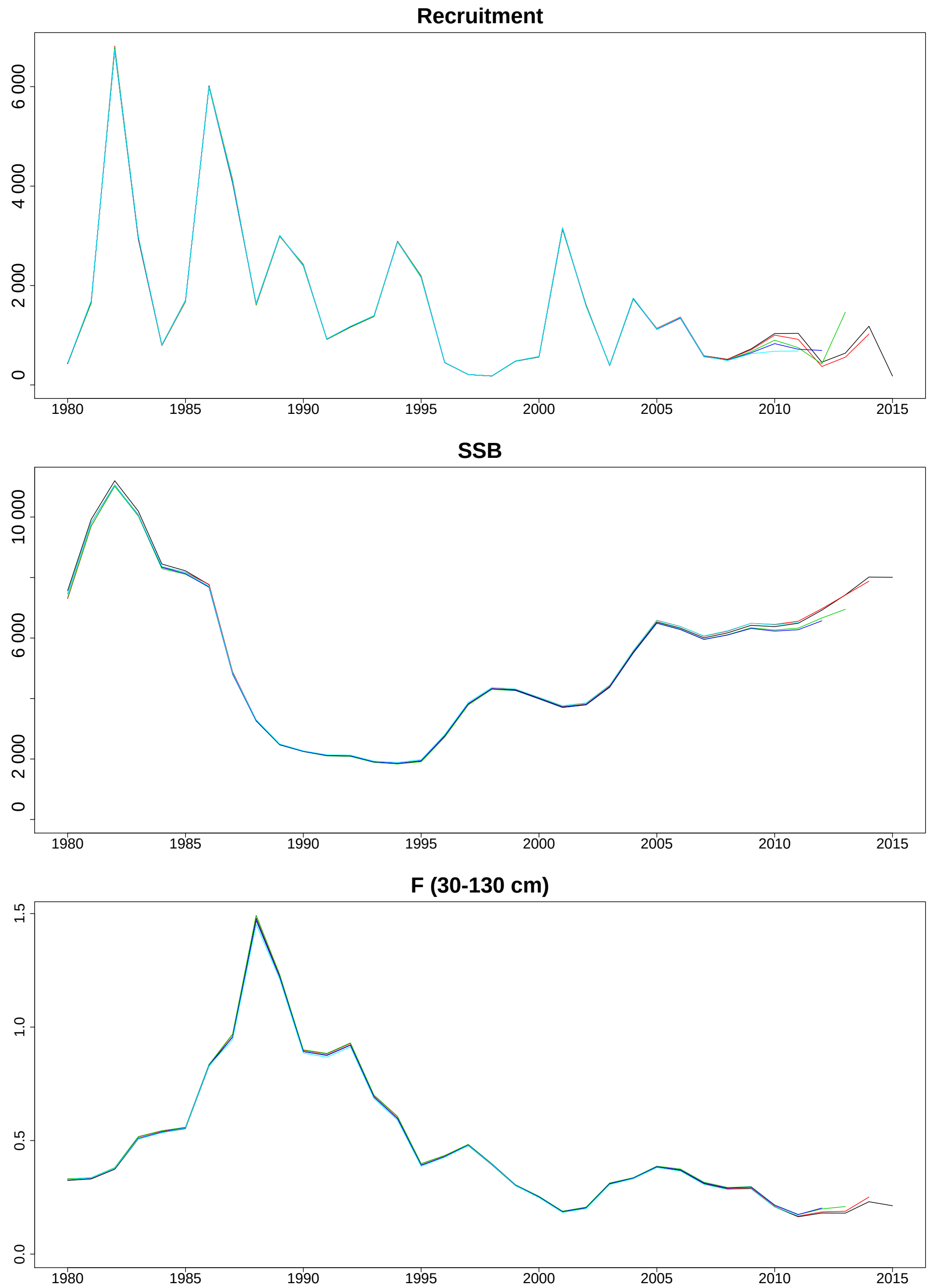


Figure 4.3.10 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Retrospective plots from SS3

4.4 Anglerfish (*Lophius budegassa*) in Divisions 8c and 9a

4.4.1 General

4.4.1.1 Ecosystem aspects

Biological/ecosystem aspects are common with *L. piscatorius* and are described in the Stock Annex.

4.4.2 Fishery description

L. budegassa is caught by Spanish and Portuguese bottom trawlers and gillnet fisheries. As *L. piscatorius*, *L. budegassa* is an important target species for the artisanal fleet, while it is a by catch for the trawl fleet targeting hake or crustaceans (see Stock Annex).

The length distribution of the landings is considerably different between both fisheries, with the gillnet landings showing higher mean lengths compared to the trawl landings. Since 2006, the Spanish landings were on average split 72% from the trawl fleet (mean lengths in 2015 of 41 cm in both Divisions 8.c and 9.a), 22% from the gillnet fleet (mean length of 52 cm in 2015 in Division 8.c) and 6% from others fleets. Portuguese landings, for the same period, were on average split, 32 % from the trawl fleet (mean length of 47 cm in 2015) and 68% from the artisanal fleet (mean length of 52 cm in 2015).

4.4.3 Data

4.4.3.1 Commercial catches and discards

Total landings of *L. budegassa* by country and gear for the period 1978–2015, as estimated by the Working Group, are given in Table 4.4.1. See historical landings analysis in the Stock Annex. Unallocated landings for this stock were available from 2011 to 2015. The unallocated values were considered realistic and are taken into account for the assessment. From 2002 to 2007 landings increased to 1 301 t, decreasing afterwards to levels between 770–784 t in 2009–2010. Since 2010 catches fluctuated between 945 t and 1 139 t.

Spanish trawl discards estimates of *L. budegassa* in weight and associated coefficient of variation (CV) are shown in Table 4.4.2. The estimated Spanish discards rate observed from 1994–2015, shows two peaks, in 2006 (92 t) and 2010 (61 t). The coefficient of variation for weight data varied from 24–99%.

Sampling effort and percentage of occurrence of *L. budegassa* discards in the trawl Portuguese fisheries were presented for the 2004–2013 period (Prista *et al*. 2014 – WD3 WGBIE 2014). The maximum occurrence of discards in the trawl fleet targeting fish was 2% (sampling effort varies between 50 and 194 hauls per year). The maximum occurrence of discards in the trawl fleet targeting crustaceans was 8% (sampling effort varies between 28 and 111 hauls per year). Due to the low frequency of discards, it is not possible to apply to anglerfish, the algorithm used in the WD for hake, at that moment discards estimates have not been calculated. The same situation was observed in 2014 and 2015.

Partial information on the Spanish and Portuguese discards was available and the WG concluded that discards could be considered negligible.

4.4.3.2 Biological sampling

The procedure for sampling of this species is the same as for *L. piscatorius* (see Stock Annex).

The sampling levels for 2015 are shown in Table 1.3. The métier sampling adopted in Spain and Portugal in 2015, following the requirement of EU Data Collection Framework, can have an effect on the provided data. Spanish sampling levels are similar to previous years but an important reduction of Portuguese sampling levels was observed in 2009-2011, since 2012 Portugal increased the sampling effort.

Length composition

Table 4.4.3 gives the annual length compositions by ICES division, country and gear and the adjusted length composition for total stock landings (excluding unallocated landings, length composition are not used in the actual assessment of *L. budegassa*) for 2015. The annual length compositions between 1986 and 2015 are presented in Figure 4.4.1.

In 2002 an increase of smaller individuals is apparent (around 30-35 cm), that is confirmed in the 2003 length distribution. In 2006 and 2007 there was an increase in the number of smaller individuals which was confirmed by the lowest annual mean lengths (37 and 39 cm) observed since 1986. From 2008 to 2013 these small fish were not observed, in 2014 a small mode was observed at smaller lengths decreasing the annual mean length, but in 2015 there are much lower levels of small fish in the sampled catches. The total annual landings in numbers and the annual mean length and mean weight are in Table 4.4.4.

In 2005 the total number of landed individuals was low, being 9% of the maximum value (year 1987). In 2006 and 2007 the number of landed fish more than doubled the 2005 number. The number of landed fish decreased to a minimum in 2009. In 2010 and 2011 the number increased, but since then have been decreasing being in recent years at minimum levels. The mean weight continued at relative high levels.

4.4.3.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2015 are summarized in Table 4.4.5.and Figure 4.4.2. The Portuguese survey was not performed in 2012. Considering the very small amount of caught anglerfish in the two surveys, these indices were not considered to reflect the change in the abundance of this species.

Nevertheless the absence of *L budegassa* in the Portuguese surveys and the near zero numbers of *L. budegassa* less than 21 cm in the Spanish surveys in the last two years (2014-2015) suggests a lack of recruitment.

4.4.3.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 4.4.6 and Figure 4.4.3 for Spanish trawlers from ports of Santander, Avilés and A Coruña (all in Division 8.c) since 1986 and for Portuguese trawlers (Division 9.a) since 1989. For each fleet the proportion related to the total landings is also given in the table.

Since 2013 Spain only provided information for A Coruña port series. Effort data in 2013 for this tuning fleet was calculated using the information from electronic logbooks and following different criteria than those established for previous years. In order to check the consistency of the Spanish time-series a backward revision of the time-series should be realized to compare the different methods of estimating and sources of information employed.

Three LPUE series were presented in the past for the A Coruña fleet: "A Coruña port" for trips that are exclusively landed in the port, "A Coruña trucks" for trips that are landed in other ports and "A Coruña fleet" that takes into account all the trips of the fleet. The LPUE series used in the assessment (A Coruña fleet) was not updated for 2013-2015. The new revision was carried out only for the A Coruña port series, it was not possible during the WG to analyse the potentiality of using this series for the assessment instead of the incomplete A Coruña fleet series.

For the Portuguese fleets, until 2011 most logbooks were filled in paper but have thereafter been progressively replaced by e-logbooks. Since 2013 more than 90% of the logbooks are being completed in the electronic version. The LPUE series were revised from 2012 onwards. To revise the series backwards further refinement of the algorithms is required.

Excluding the Avilés and Santander fleets, from the late eighties to mid-nineties the overall trend in landings for all fleets was decreasing. A slight increase was observed from 1995 to 1998 in all fleets. The A Coruña trawler fleet showed in 2002 the most important drop in landings and in relative proportion of total landings. The lowest observed landings for both trawlers and gillnets was in 2009. From 2009 onwards an increasing trend was observed, especially for the Portuguese fleets.

Effort trends are analysed in section 4.3.2.4.

LPUEs of Spanish Aviles and Santander fleets show high values during the second half of the 90's, while the Portuguese fleets have fluctuated. Despite the variability, from 2000 to 2005, a decreasing trend was observed for all fleets and since then a slightly increasing trend can be observed. From 2010–2012 an increase in catches rates were observed especially in the Portuguese fleets. After a decrease in the LPUEs of both Portuguese groundfish trawl fleets, LPUEs increased in 2015 being at their high or highest levels of the series.

4.4.4 Assessment

In WKFLAT2012 the assessment of the status of each anglerfish species was carried out separately, the white anglerfish based on SS3 model and the black anglerfish based on ASPIC (Prager, 1994; Prager, 2004). This year an update of that assessment was carried out.

4.4.4.1 Input data

At the WKFLAT2012 it was accepted, as the basis for advice, to run the ASPIC model with the following dataseries. Except for the Spanish fleet 'A Coruña', all series were updated till 2015 for this assessment:

- Spanish fleet 'A Coruña': the longest of the potential tuning series and represents the bulk of the fishery (SPCORTR8c: 1982-2012).
- Portuguese Trawler fleet directing to crustaceans (PT.crust.tr: 1989-2015).
- Portuguese Trawler fleet directing to groundfish (PT.fish.tr: 1989-2015).

The input data are presented in Table 4.4.7.

4.4.4.2 Model

The ASPIC (version 5.34.8) model (which implements the Schaeffer population growth model) was used for the WKFLAT 2012 assessment. Runs were performed conditioning on yield rather than on effort. The model options, the starting estimates and the minimum and maximum constraints of each parameter are indicated in the input file (Table 4.4.7).

4.4.4.3 Assessment results

During the WGHMM 2013, using the Stock Annex/WKFLAT2012 settings, with the inclusion of the new 2011 and 2012 data, the fit of the ASPIC model gets worse than the one performed at the benchmark. The model continued to show strong sensitivity to the starting guess settings (*B1/K*, *MSY*, *K*, seed and q's) leading to different levels of B/B_{MSY} and F/F_{MSY}, nevertheless it keeps the trends in the relative biomass and fishing mortality.

It was suggested, by the ADGBBI (June 2013), that until the next benchmark the WG should explore the sensitivity of B/B_{MSY} and F/F_{MSY} (like retrospective pattern) by keeping the *B1/K* fixed (e.g. at the current value or based on some expert judgment about the state of the stock in the beginning of the time-series). Following this suggestion in the WGBIE 2014 the *B1/K* was fixed at 0.6. Fixing *B1/K* the model became stable and is no more sensitivity to the starting guess settings of *MSY*, *K and* seed. This value seems reasonable but doesn´t have a strong scientific basis, it was also the value agreed in the benchmark for the starting guess.

The correlation coefficient between input fleets is acceptable but the *r* square between observed and fitted cpue values are low (assessment results were uploaded in the ICES SharePoint in the Data folder). Point estimates and bias-corrected bootstrap confidence intervals for parameters are presented in Table 4.4.8, whereas Figure 4.4.4 plots observed and estimated cpues for each of the series used in the model. B_{2016}/B_{MSY} and F_{2015}/F_{MSY} have respectively 0.98% and 0.33% of bias and both have more than 15% relative inter-quartile ranges. Biomass in 2016 is estimated to be 111% of B_{MSY} with 90% bias-corrected confidence interval between 89% and 130%. Fishing mortality in 2015 is estimated to be 0.52 times F_{MSY} with 90% bias-corrected confidence interval between 0.42 and 0.67 times F_{MSY}. MSY is estimated to be 1856 t with 90% CI from 1718 t to 1963 t.

Trends in relative biomass (Figure 4.4.5) indicate a steady decrease since the beginning of the series till 2001, since then a slight recovery was observed, been in 2016 at 111% of B_{MSY}. Fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2015, fishing mortality is estimated to be below F_{MSY}.

Comparison between the update assessments since the 2012 benchmark are showed in Table 4.4.9 and Figure 4.4.6. Fixing B1/K at 0.60 don´t change the trend of the previous assessments and the 2014-2016 results are in the middle of the previous assessments.

A retrospective analysis was done taking one year each time to the accepted assessment (Figure 4.4.7). Despite some retrospective pattern (downwards for F and upwards for B) in all series the model shows good stability.

A retrospective analysis based on 7 peel years was also carried out to estimate the Mohn's Rho index for fishing mortality. The estimated Rho=-0.22 indicates that fishing mortality is overestimated by 22%.

4.4.5 Projections

Projections were performed based on the "benchmark settings" with B1/K fixed at 0.60 ASPIC estimates. The projected B/B_{MSY} and yield are presented in Table 8.4.10, where each column corresponds to a fishing mortality scenario. Projections were performed for F *status quo* (assumed as the average of the last 3 years - F 2013-2015), F_{MSY} and with zero catches. A set of projections were performed with the necessary F to obtain 2017 yield for both anglerfish species combined corresponding to the 2016 TAC (2569 t) and +/-15% 2015 TAC. New projections were done not specified in the stock annex which took in to account the new Reference Points (see table below) for *L.budegassa*. A set of projections were also done using the F multipliers used in the projections of *L. piscatorius*.

For *L. budegassa*, fishing mortality equal to F *status quo* in 2017 is expected to keep the stock above B_{MSY} in 2018. The biomass is expected to increase in the near future under all fishing mortality scenarios with the exception of projections based on high values of F such as F_{lim} or the Fs that bring biomass to levels of MSY $B_{trigger}$ or B_{lim} (Table 4.4.10).

4.4.6 Biological Reference Points

WKFLAT (ICES, 2012) endorsed the basis for MSY reference points previously assumed by ICES (i.e. F_{MSY} based on the ASPIC output and a proxy for MSY $B_{trigger}$ as 50% of B_{MSY} of the ASPIC output). WKMSYRef4 / ICES (2016a) approved new reference points as described in the following table.

FRAMEWORK	REFERENCE POINT	VALUE	TECHNICAL BASIS	SOURCE
MSY approach	MSY $B_{trigger}$	50% B_{MSY}	B_{MSY} is implicitly estimated from the surplus production model. Biomass values are expressed relative to B_{MSY}.	(ICES, 2012)
	F_{MSY}	Relative value.	Implicit, estimated from the surplus production model. Fishing mortality values are expressed relative to F_{MSY}.	(ICES, 2012)
	F_{MSY} range	(0.78 F_{MSY}, F_{MSY})	Implicit, estimated from the surplus production model. Fishing mortality values are expressed relative to F_{MSY}.	(ICES, 2016a)
Precautionary approach	B_{lim}	30% B_{MSY}	BMSY is implicitly estimated from the surplus production model. Biomass values are expressed relative to B_{MSY}.	(ICES, 2016b)
	B_{pa}	Not defined		
	F_{lim}	1.70 FMSY	Implicit, estimated from the surplus production model. Fishing mortality values are expressed relative to F_{MSY}.	(ICES, 2016b)
	F_{pa}	Not defined		
Management plan	SSB_{MGT}	Not defined		
	F_{MGT}	Not defined		

4.4.7 Comments on the assessment

From previous sensitivity analyses (ICES, 2014; 2015) fixing *B1/K* the model became stable and is no more sensitivity to the starting guess settings. The *B1/K* was fixed at 0.6, this was the value agreed at the benchmark for the starting value. This value is reasonable as it is thought that the fishery started late 70's early 80's, but there is no strong scientific basis.

During the benchmark (WKFLAT 2012) the same model (SS3) applied to the white anglerfish was tested for the black anglerfish with some promising results but need to be tested more carefully before its application. SS3 is a length-based model so the length sampling is key information for this stock. A benchmark for this stock was considered during the WG (see section 1).

4.4.8 Quality considerations

Three LPUE series were presented in the past for the A Coruña fleet: "A Coruña port" for trips that are exclusively landed in the port, "A Coruña trucks" for trips that are landed in other ports and "A Coruña fleet" that takes into account all the trips of the fleet. The LPUE series used in the assessment (A Coruña fleet) was not update for 2013–2015. The new revision was carried out only for the A Coruña port series, it was not possible during the WG to analyse the potentiality of using this series for the assessment instead of the incomplete A Coruña fleet series.

For the Portuguese fleets, until 2011 most logbooks were filled in paper but have thereafter been progressively replaced by e-logbooks. Since 2013 more than 90% of the logbooks are being completed in the electronic version. The LPUE series were revised from 2012 onwards in 2015. To revise the series backwards further refinement of the algorithms is required.

4.4.9 Management considerations

Management considerations are in section 4.2.

Table 4.4.1. ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Tonnes landed by the main fishing fleets for 1978-2015 as determined by the Working Group.

	Div. 8c				Div. 9a						Div. 8c+9a		
	SPAIN				SPAIN			PORTUGAL					
Year	Trawl	Gillnet	Others	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL	SUBTOTAL	Unallocated	TOTAL
1978	n/a	n/a		n/a	248			n/a	107	355	355		355
1979	n/a	n/a		n/a	306			n/a	210	516	516		516
1980	1203	207		1409	385			n/a	315	700	2110		2110
1981	1159	309		1468	505			n/a	327	832	2300		2300
1982	827	413		1240	841			n/a	288	1129	2369		2369
1983	1064	188		1252	699			n/a	428	1127	2379		2379
1984	514	176		690	558			223	458	1239	1929		1929
1985	366	123		489	437			254	653	1344	1833		1833
1986	553	585		1138	379			200	847	1425	2563		2563
1987	1094	888		1982	813			232	804	1849	3832		3832
1988	1058	1010		2068	684			188	760	1632	3700		3700
1989	648	351		999	764			272	542	1579	2578		2578
1990	491	142		633	689			387	625	1701	2334		2334
1991	503	76		579	559			309	716	1584	2162		2162
1992	451	57		508	485			287	832	1603	2111		2111
1993	516	292		809	627			196	596	1418	2227		2227
1994	542	201		743	475			79	283	837	1580		1580
1995	924	104		1029	615			68	131	814	1843		1843
1996	840	105		945	342			133	210	684	1629		1629
1997	800	198		998	524			81	210	815	1813		1813
1998	748	148		896	681			181	332	1194	2089		2089
1999	565	127		692	671			110	406	1187	1879		1879
2000	441	73		514	377			142	336	855	1369		1369
2001	383	69		452	190			101	269	560	1013		1013
2002	173	74		248	234			75	213	522	770		770
2003	279	49		329	305			68	224	597	926		926
2004	250	120		370	285			50	267	603	973		973
2005	273	97		370	283			31	214	527	897		897
2006	323	124		447	541			39	121	701	1148		1148
2007	372	68		440	684			66	111	861	1301		1301
2008	386	70		456	336			40	119	495	951		951
2009	301	148		449	172			34	114	320	769		769
2010	352	81		432	197			70	84	351	784		784
2011	214	115	32	361	157	60	98	75	119	510	871	74	945
2012	161	83	22	265	109	40	90	156	370	765	1030	109	1139
2013	221	135	14	370	95	55	90	100	258	598	968	98	1066
2014	187	126	7	319	120	47	4	113	286	569	888	100	988
2015	233	141	1	375	103	62	2	126	222	515	890	152	1042

n/a: not available

Table 4.4.2. ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Weight and percentage of discards for Spanish trawl and gillnet fleets.

TRAWL

Year	Weight (t)	CV	% Trawl Catches	% Total Catches
1994	6.1	24.4	0.6	0.4
1995	n/a	n/a	n/a	n/a
1996	n/a	n/a	n/a	n/a
1997	21.3	35.2	1.6	1.2
1998	n/a	n/a	n/a	n/a
1999	19.7	43.7	1.6	1.0
2000	8.7	35.1	1.1	0.6
2001	n/a	n/a	n/a	n/a
2002	n/a	n/a	n/a	n/a
2003	1.1	53.6	0.2	0.1
2004	8.1	70.2	1.5	0.8
2005	13.6	45.6	2.4	1.5
2006	92.0	56.8	9.6	8.0
2007	0.3	98.8	0.0	0.0
2008	1.9	59.4	0.3	0.2
2009	29.3	53.8	5.8	3.8
2010	61.2	63.2	10.0	7.8
2011	12.4	33.2	3.2	1.3
2012	5.8	52.8	2.1	0.5
2013	22.3	n/a	6.6	2.1
2014	27.8	n/a	8.3	2.8
2015	0.5	n/a	0.2	0.0

GILLNETS

Year	Weight (t)	CV	% Gillnets Catches	% Total Catches
2014	0.1	n/a	0.03	0.01
2015	0.4	n/a	0.18	0.04

n/a: not available

CV: coefficient of variation

Table 4.4.3 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Length composition by fleet for landings in 2015 (thousands).
Ajusted Total: Ajusted to landings from fleets without length composition.

	Div.8c			Div.9a				Div. 8c+9a	
	SPAIN			SPAIN	PORTUGAL				Adjusted
Length (cm)	Trawl	Gillnet	TOTAL	Trawl	Trawl	Artisanal	TOTAL	TOTAL	TOTAL
25	0.000	0.000	0.000	0.000	0.033	0.000	0.033	0.033	0.033
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.575	0.000	0.575	0.000	0.009	0.006	0.015	0.590	0.668
28	0.638	0.000	0.638	0.000	0.000	0.000	0.000	0.638	0.724
29	0.404	0.000	0.404	0.000	0.000	0.000	0.000	0.404	0.459
30	1.774	0.155	1.929	0.000	0.041	0.000	0.041	1.970	2.231
31	1.902	0.000	1.902	0.106	0.277	0.000	0.383	2.285	2.556
32	2.228	0.042	2.270	0.129	0.151	0.000	0.280	2.550	2.874
33	4.088	0.295	4.383	0.156	0.491	1.208	1.855	6.238	6.851
34	4.107	0.646	4.753	0.085	1.206	0.000	1.291	6.044	6.698
35	4.739	1.213	5.952	0.082	2.906	0.449	3.438	9.389	10.205
36	5.499	1.384	6.883	0.256	3.514	0.078	3.847	10.730	11.695
37	4.812	0.884	5.695	0.401	3.748	0.449	4.598	10.293	11.117
38	5.158	1.210	6.367	0.657	4.041	1.657	6.355	12.723	13.672
39	6.193	2.617	8.811	0.915	3.440	2.148	6.503	15.314	16.628
40	6.193	1.544	7.737	1.089	3.173	4.798	9.060	16.798	17.991
41	7.157	1.929	9.086	1.001	3.918	1.584	6.504	15.589	16.953
42	6.351	2.226	8.577	1.464	3.962	2.548	7.975	16.552	17.909
43	8.065	2.851	10.916	1.420	3.268	3.514	8.202	19.117	20.785
44	6.695	1.967	8.662	1.688	2.709	4.512	8.909	17.571	18.970
45	5.240	2.168	7.409	1.089	3.472	3.096	7.657	15.066	16.214
46	5.592	1.400	6.992	0.993	1.661	3.065	5.718	12.710	13.789
47	4.082	0.908	4.990	0.922	3.501	2.109	6.532	11.522	12.321
48	3.013	1.629	4.641	1.249	1.828	1.198	4.275	8.916	9.713
49	3.162	1.771	4.934	0.438	0.758	4.829	6.025	10.959	11.685
50	2.447	1.288	3.735	0.840	0.790	2.150	3.780	7.515	8.133
51	1.978	1.783	3.762	0.470	1.680	11.209	13.360	17.121	17.693
52	2.381	1.986	4.367	0.649	1.344	0.904	2.897	7.264	7.942
53	1.984	2.694	4.678	0.348	1.853	2.049	4.250	8.928	9.607
54	1.558	2.512	4.070	0.350	0.456	1.072	1.878	5.948	6.546
55	1.630	3.319	4.949	0.217	0.278	1.296	1.791	6.740	7.438
56	1.585	3.162	4.747	0.167	1.996	1.475	3.638	8.385	9.049
57	2.293	2.350	4.644	0.225	1.140	1.585	2.949	7.593	8.251
58	1.542	2.909	4.451	0.336	0.817	1.381	2.533	6.984	7.631
59	1.837	2.779	4.615	0.110	1.097	2.136	3.343	7.958	8.597
60	2.052	2.059	4.111	0.174	1.546	0.508	2.229	6.340	6.919
61	1.459	1.722	3.181	0.171	0.959	0.969	2.099	5.280	5.733
62	1.597	1.298	2.895	0.306	0.571	9.217	10.094	12.989	13.422
63	1.195	1.378	2.573	0.038	0.701	1.011	1.750	4.323	4.676
64	1.091	0.980	2.071	0.218	0.643	0.460	1.321	3.392	3.702
65	1.103	1.000	2.103	0.147	1.077	0.228	1.452	3.555	3.859
66	1.137	0.675	1.812	0.137	0.653	0.281	1.070	2.883	3.146
67	0.838	0.399	1.237	0.049	0.569	0.389	1.008	2.245	2.419
68	0.564	0.695	1.259	0.136	0.000	1.369	1.505	2.764	2.952
69	0.533	0.799	1.332	0.182	0.206	0.074	0.463	1.795	2.000
70	0.877	0.364	1.241	0.098	0.577	0.000	0.675	1.916	2.097
71	0.631	0.399	1.030	0.044	0.639	0.000	0.683	1.714	1.859
72	0.487	0.315	0.802	0.221	0.165	0.000	0.386	1.188	1.326
73	0.548	0.328	0.876	0.181	0.056	0.888	1.125	2.001	2.144
74	0.378	0.131	0.509	0.235	0.088	0.452	0.774	1.284	1.384
75	0.283	0.294	0.577	0.297	0.428	0.607	1.332	1.909	2.027
76	0.262	0.213	0.475	0.381	0.010	1.025	1.416	1.891	2.007
77	0.211	0.071	0.282	0.372	0.010	0.244	0.626	0.908	0.996
78	0.165	0.081	0.246	0.390	0.114	0.161	0.665	0.910	0.996
79	0.236	0.041	0.277	0.322	0.000	0.244	0.566	0.843	0.924
80	0.157	0.000	0.157	0.218	0.089	0.244	0.551	0.708	0.759
81	0.123	0.180	0.303	0.157	0.000	0.000	0.157	0.460	0.523
82	0.037	0.057	0.094	0.225	0.033	0.731	0.989	1.083	1.126
83	0.054	0.047	0.101	0.177	0.056	1.027	1.261	1.362	1.400
84	0.130	0.024	0.154	0.225	0.008	0.161	0.394	0.548	0.599
85	0.040	0.000	0.040	0.151	0.033	0.000	0.184	0.224	0.250
86	0.037	0.032	0.069	0.095	0.000	0.000	0.095	0.164	0.186
87	0.019	0.000	0.019	0.068	0.000	0.000	0.068	0.087	0.099
88	0.000	0.000	0.000	0.158	0.000	0.000	0.158	0.158	0.179
89	0.018	0.050	0.068	0.141	0.008	0.000	0.149	0.217	0.245
90	0.000	0.000	0.000	0.254	0.000	0.302	0.556	0.556	0.590
91	0.037	0.027	0.064	0.037	0.009	0.000	0.046	0.111	0.124
92	0.000	0.027	0.027	0.137	0.000	0.000	0.137	0.164	0.186
93	0.018	0.000	0.018	0.000	0.128	0.000	0.128	0.146	0.148
94	0.000	0.000	0.000	0.143	0.000	0.000	0.143	0.143	0.162
95	0.000	0.000	0.000	0.026	0.000	0.000	0.026	0.026	0.030
96	0.000	0.000	0.000	0.034	0.000	0.000	0.034	0.034	0.039
97	0.000	0.000	0.000	0.000	0.000	0.050	0.050	0.050	0.050
98	0.000	0.000	0.000	0.034	0.000	0.000	0.034	0.034	0.039
99	0.000	0.000	0.000	0.065	0.000	0.083	0.148	0.148	0.157
100+	0.000	0.000	0.000	0.074	0.000	0.472	0.546	0.546	0.556
TOTAL	133	65	199	24	69	84	177	376	406
Landings (t)	233	141	374	103	126	222	452	826	890
Mean Weight (g)	1753	2152	1884	4245	1835	2651	2553	2199	2195
Mean Length (cm)	45.4	51.8	47.5	53.2	46.5	52.0	50.0	48.7	48.7
Measured weight (t)	n/a	n/a	n/a	n/a	1.4	0.7	2.2	n/a	n/a

n/a: not available

Table 4.4.4 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Number, mean weight and mean length of landings between 1986 and 2015.

	Total (thousands)	Mean Weight (g)	Mean Length (cm)
1986	1704	1504	43
1987	4673	820	34
1988	2653	1395	43
1989	1815	1420	44
1990	1590	1468	44
1991	1672	1294	42
1992	1497	1410	45
1993	1238	1799	48
1994	1063	1486	44
1995	1583	1157	40
1996	1146	1422	44
1997	1452	1248	41
1998	1554	1380	42
1999	1268	1487	42
2000	680	2010	47
2001	435	2329	49
2002	514	1497	41
2003	507	1826	46
2004	468	1974	47
2005	408	2198	49
2006	1030	1115	37
2007	1036	1255	39
2008	503	1889	48
2009	298	2585	51
2010	387	1940	45
2011	531	1641	43
2012	435	2366	49
2013	361	2678	50
2014	442	2011	43
2015	406	2195	49

Table 4.4.5 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Abundance indices from Spanish and Portuguese surveys.

	SpGFS-WIBTS-Q4					PtGFS-WIBTS-Q4		
	September-October (total area Miño-Bidasoa)					October		
Year	Hauls	kg/30 min		N/30 min		Hauls	N/60 min	kg/60 min
		Yst	Sst	Yst	Sst			
1983	145	0.68	0.17	0.50	0.09	117	n/a	n/a
1984	111	0.60	0.17	0.60	0.11	na	n/a	n/a
1985	97	0.46	0.11	0.50	0.07	150	n/a	n/a
1986	92	1.42	0.32	2.50	0.33	117	n/a	n/a
1987	ns	ns	ns	ns	ns	81	n/a	n/a
1988	101	2.27	0.38	1.50	0.21	98	n/a	n/a
1989	91	0.45	0.10	0.90	0.21	138	0.23	0.19
1990	120	1.52	0.47	1.50	0.22	123	0.11	0.17
1991	107	0.83	0.14	0.60	0.10	99	+	0.02
1992	116	1.16	0.19	0.80	0.11	59	+	+
1993	109	0.90	0.20	0.90	0.13	65	0.02	0.04
1994	118	0.75	0.17	1.00	0.12	94	0.06	0.09
1995	116	0.72	0.12	1.00	0.11	88	0.02	0.08
1996*	114	0.95	0.17	1.30	0.18	71	0.27	0.50
1997	116	1.16	0.20	0.97	0.11	58	0.03	0.01
1998	114	0.88	0.18	0.57	0.09	96	0.02	0.12
1999*	116	0.43	0.12	0.26	0.06	79	0.08	0.07
2000	113	0.66	0.18	0.40	0.08	78	0.13	0.13
2001	113	0.19	0.06	0.52	0.10	58	+	+
2002	110	0.26	0.09	0.33	0.07	67	0	0
2003*	112	0.36	0.11	0.35	0.10	80	0.22	0.21
2004*	114	0.76	0.23	0.44	0.12	79	0.14	0.21
2005	116	0.64	0.20	1.62	0.30	87	0.01	+
2006	115	1.08	0.22	1.16	0.19	88	0.02	0.46
2007	117	0.59	0.12	0.48	0.08	96	0.02	0.03
2008	115	0.35	0.09	0.29	0.05	87	0.07	0.36
2009	117	0.30	0.08	0.35	0.08	93	0.02	+
2010	127	0.35	0.09	0.53	0.09	87	0.09	0.18
2011	111	0.63	0.15	0.52	0.08	86	0.02	0.06
2012	115	0.61	0.10	0.74	0.11	ns	ns	ns
2013**	114	1.27	0.36	1.40	0.35	93	0.02	0.03
2014**	116	1.11	0.27	0.87	0.15	81	0.00	0.00
2015**	114	0.55	0.13	0.36	0.08	90	0.00	0.00

Yst = stratified mean
Sst = mean standar error
ns = no survey
n/a = not available
+ = less than 0.01
* For Portuguese Surveys - R/V Capricornio, other years R/V Noruega
** For Spain Surveys - R/V Miguel Oliver, other years R/V Cornide Saavedra

Table 4.4.6 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Landings, fishing effort, standardized fishing effort, landings per unit effort and standardized landings per unit effort for trawl and gillnet fleets.
For landings the percentage relative to total annual stock landings is given.

	Avilés, SP-AVITR8C				Santander, SP-SANTR8C				Standardized Cedeira, STAND-SP-CEDGNS8C			
Year	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (soaking days)	LPUE (kg/soaking day)
1986	64	3	10845	5.9	21	1	18153	1.1	--	--	--	--
1987	85	2	8309	10.3	16	0	14995	1.1	--	--	--	--
1988	125	3	9047	13.9	30	1	16660	1.8	--	--	--	--
1989	119	5	8063	14.7	32	1	17607	1.8	--	--	--	--
1990	58	2	8497	6.8	40	2	20469	1.9	--	--	--	--
1991	52	2	7681	6.7	62	3	22391	2.8	--	--	--	--
1992	33	2	--	--	107	5	22833.0	4.7	--	--	--	--
1993	53	2	7635	7.0	143	6	21370	6.7	--	--	--	--
1994	65	4	9620	6.7	196	12	22772	8.6	--	--	--	--
1995	141	8	6146	23.0	126	7	14046	9.0	--	--	--	--
1996	162	10	4525	35.8	89	5	12071	7.4	--	--	--	--
1997	143	8	5061	28.3	122	7	11776	10.4	--	--	--	--
1998	91	4	5929	15.3	114	5	10646	10.7	--	--	--	--
1999	41	2	6829	5.9	67	4	10349	6.5	14	1	4 582	3.0
2000	23	2	4453	5.1	44	3	8779	5.0	4	<1	2 981	1.3
2001	12	1	1838	6.7	28	3	3053	9.3	6	1	1 932	3.0
2002	11	1	2748	4.1	16	2	3975	4.1	7	1	2 398	3.0
2003	9	1	2526	3.6	15	2	3837	4.0	3	<1	2 703	0.9
2004	32	3	--	--	23	2	3776.0	6.0	5	1	4 677	1.1
2005	54	6	--	--	7	1	1404.0	4.9	2	<1	3 325	0.7
2006	16	1	--	--	18	2	2717.5	6.8	4	<1	3 911	1.0
2007	11	1	--	--	19	1	4333.7	4.5	2	<1	3 976	0.6
2008	10	1	--	--	--	--	--	--	0	<1	5 133	0.1
2009	5	1	--	--	8	1	1124.8	6.8	4	1	2 300	1.7
2010	--	--	--	--	19.4	2	1627.8	11.9	4	1	1 880	2.1
2011	--	--	--	--	36.4	4	--	--	1	<1	522	1.3
2012	--	--	--	--	21.8	2	--	--	4	<1	--	--

	A Coruña-Port, SP-CORTR8C-PORT				A Coruña-Trucks, SP-CORTR8C-TRUCKS				A Coruña-Fleet, SP-CORTR8C-FLEET			
Year	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)
1982	655	28	63 313	10.3	--	--	--	--	655	28	63 313	10.3
1983	765	32	51 008	15.0	--	--	--	--	765	32	51 008	15.0
1984	574	30	48 665	11.8	--	--	--	--	574	30	48 665	11.8
1985	253	14	45 157	5.6	--	--	--	--	253	14	45 157	5.6
1986	352	14	40 420	8.7	--	--	--	--	352	14	40 420	8.7
1987	673	18	34 651	19.4	--	--	--	--	673	18	34 651	19.4
1988	570	15	41 481	13.7	--	--	--	--	570	15	41 481	13.7
1989	344	13	44 410	7.7	--	--	--	--	344	13	44 410	7.7
1990	288	12	44 403	6.5	--	--	--	--	288	12	44 403	6.5
1991	225	10	40 429	5.6	--	--	--	--	225	10	40 429	5.6
1992	211	10	38 899	5.4	--	--	--	--	211	10	38 899	5.4
1993	199	9	44 478	4.5	--	--	--	--	199	9	44 478	4.5
1994	166	11	39 602	4.2	37	2	12 795	2.9	204	13	52 397	3.9
1995	353	19	41 476	8.5	75	4	10 232	7.3	428	23	51 708	8.3
1996	334	21	35 709	9.4	68	4	8 791	7.8	403	25	44 501	9.0
1997	298	16	35 494	8.4	43	2	9 108	4.8	341	19	44 602	7.7
1998	323	15	29 508	10.9	72	3	--	--	394	19	--	--
1999	374	20	30 131	12.4	--	--	--	--	--	--	--	--
2000	287	21	30 079	9.6	6	0	--	--	293	21	--	--
2001	281	28	29 935	9.4	--	--	--	--	--	--	--	--
2002	76	10	21 948	3.5	31	4	6 747	4.6	107	14	28 695	3.7
2003	85	9	18 519	4.6	43	5	7 608	5.6	128	14	26 127	4.9
2004	68	7	19 198	3.5	40	4	10 342	3.8	107	11	29 540	3.6
2005	54	6	20 663	2.6	32	4	10 302	3.1	86	10	30 965	2.8
2006	70	6	19 264	3.6	81	7	12 866	6.3	151	13	32 130	4.7
2007	109	8	21 651	5.1	113	9	13 187	8.6	223	17	34 838	6.4
2008	163	17	20 212	8.1	98	10	9 812	10.0	261	27	30 024	8.7
2009	80	10	16 152	5.0	67	9	12 930	5.2	147	19	29 092	5.1
2010	74	9	16 680	4.4	87	11	9 003	9.7	199	25	22 746	8.7
2011	64	7	12 835	5.0	--	--	--	--	144	15	18 617	7.7
2012	102	9	14 446	7.0	--	--	--	--	172	15	21 110	8.2
2013	88	8	14 736	6.0	--	--	--	--	--	--	--	--
2014	79	8	18 060	4.4	--	--	--	--	--	--	--	--
2015	67	6	13 309	5.0	--	--	--	--	--	--	--	--

	Portugal Crustacean, PT-TRC9A						Portugal Fish, PT-TRF9A					
Year	LANDINGS	%	EFFORT (1000 hours)	EFFORT (1000 hauls)	LPUE (kg/hour)	LPUE (kg/haul)	LANDINGS	%	EFFORT (1000 hours)	EFFORT (1000 hauls)	LPUE (kg/hour)	LPUE (kg/haul)
1989	89	3	76	23	1.17	3.92	183	7	52	18	3.51	10.4
1990	127	5	90	20	1.41	6.19	261	11	61	17	4.29	15.2
1991	101	5	83	17	1.22	6.05	208	10	57	15	3.65	13.5
1992	94	4	71	15	1.32	6.19	193	9	49	14	3.97	14.1
1993	64	3	75	13	0.85	4.78	132	6	56	13	2.37	10.1
1994	26	2	41	8	0.64	3.38	53	3	36	10	1.50	5.5
1995	22	1	38	8	0.58	2.84	46	2	41	9	1.11	5.0
1996	45	3	64	14	0.70	3.11	88	5	54	12	1.62	7.1
1997	38	2	43	11	0.88	3.32	43	2	27	9	1.60	4.9
1998	70	3	48	11	1.45	6.30	111	5	35	10	3.16	11.5
1999	41	2	24	8	1.72	5.00	69	4	18	6	3.85	12.2
2000	66	5	42	10	1.56	6.55	76	6	19	6	4.04	12.6
2001	59	6	85	18	0.69	3.21	42	4	19	5	2.27	8.5
2002	47	6	62	10	0.75	4.81	28	4	14	4	2.00	6.2
2003	30	3	42	10	0.71	3.11	38	4	17	6	2.17	6.7
2004	23	2	21	7	1.07	3.51	27	3	14	4	1.90	6.2
2005	12	1	20	5	0.63	2.42	19	2	13	4	1.38	5.0
2006	18	2	22	5	0.80	3.31	22	2	12	4	1.73	5.6
2007	34	3	22	6	1.53	5.61	31	2	8	3	3.98	10.5
2008	21	2	14	4	1.50	5.40	19	2	5	2	3.56	10.6
2009	18	2	15	--	1.14	--	16	2	6	--	2.65	--
2010	37	5	21	--	1.75	--	34	4	14	--	2.37	--
2011	39	4	18	--	2.15	--	36	4	9	--	3.91	--
2012	81	7	36	--	2.26	--	75	7	16	--	4.73	--
2013	52	5	27	--	1.92	--	48	4	12	--	3.95	--
2014	60	6	17	--	3.52	--	56	6	16	--	3.45	--
2015	66	6	17	--	3.99	--	61	6	14	--	4.29	--

Table 4.4.7 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
ASPIC input settings and data (landings in tonnes, SPCORTR8c LPUE in kg/days*100HP, PT LPUEs in tonnes/hour trawl).

FIT ## Run type (FIT, BOT, or IRF)
Southern Anglerfish - ank
LOGISTIC YLD SSE
2 ## Verbosity
1000 95 ## Number of bootstrap trials, <= 1000
1 10000 ## 0=no MC search, 1=search, 2=repeated srch; N trials
1.0000E-08 ## Convergence crit. for simplex
3.0000E-08 8 ## Convergence crit. for restarts, N restarts
1.0000E-04 ## Conv. crit. for F; N steps/yr for gen. model
8.0000 ## Maximum F when cond. on yield
1.0 ## Stat weight for B1>K as residual (usually 0 or 1)
3 ## Number of fisheries (data series)
8.5900E-01 1.2000E+00 9.8100E-01 ## Statistical weights for data series
0.6 ## B1/K (starting guess, usually 0 to 1)
1.81126E+03 ## MSY (starting guess)
1.81126E+04 ## K (carrying capacity) (starting guess)
8.2523E-04 1.1196E-07 2.7279E-07 ## q (starting guesses -- 1 per data series)
1 1 1 1 1 1 ## Estimate flags (0 or 1) (B1/K,MSY,K,q1...qn)
1.81126E+02 3.62252E+03 ## Min and max constraints -- MSY
1.81126E+03 3.62252E+05 ## Min and max constraints -- K
1025957 ## Random number seed
36 ## Number of years of data in each series

SPCORTR8c			PT.crust.tr		PT.fish.tr	
CC			I1		I1	
1980	-1.00E+00	2.11E+03	1980	-1.00E+00	1980	-1.00E+00
1981	-1.00E+00	2.30E+03	1981	-1.00E+00	1981	-1.00E+00
1982	1.03E+01	2.37E+03	1982	-1.00E+00	1982	-1.00E+00
1983	1.50E+01	2.38E+03	1983	-1.00E+00	1983	-1.00E+00
1984	1.18E+01	1.93E+03	1984	-1.00E+00	1984	-1.00E+00
1985	5.61E+00	1.83E+03	1985	-1.00E+00	1985	-1.00E+00
1986	8.71E+00	2.56E+03	1986	-1.00E+00	1986	-1.00E+00
1987	1.94E+01	3.83E+03	1987	-1.00E+00	1987	-1.00E+00
1988	1.37E+01	3.70E+03	1988	-1.00E+00	1988	-1.00E+00
1989	7.74E+00	2.58E+03	1989	1.17E-03	1989	3.51E-03
1990	6.49E+00	2.33E+03	1990	1.41E-03	1990	4.29E-03
1991	5.56E+00	2.16E+03	1991	1.22E-03	1991	3.65E-03
1992	5.41E+00	2.11E+03	1992	1.32E-03	1992	3.97E-03
1993	4.47E+00	2.23E+03	1993	8.53E-04	1993	2.37E-03
1994	3.89E+00	1.58E+03	1994	6.37E-04	1994	1.50E-03
1995	8.28E+00	1.84E+03	1995	5.82E-04	1995	1.11E-03
1996	9.05E+00	1.63E+03	1996	7.03E-04	1996	1.62E-03
1997	7.65E+00	1.81E+03	1997	8.79E-04	1997	1.60E-03
1998	1.09E+01	2.09E+03	1998	1.45E-03	1998	3.16E-03
1999	1.24E+01	1.88E+03	1999	1.72E-03	1999	3.85E-03
2000	9.55E+00	1.37E+03	2000	1.56E-03	2000	4.04E-03
2001	9.40E+00	1.01E+03	2001	6.86E-04	2001	2.27E-03
2002	3.74E+00	7.70E+02	2002	7.54E-04	2002	2.00E-03
2003	4.89E+00	9.26E+02	2003	7.14E-04	2003	2.17E-03
2004	3.63E+00	9.72E+02	2004	1.07E-03	2004	1.90E-03
2005	2.76E+00	8.97E+02	2005	6.34E-04	2005	1.38E-03
2006	4.69E+00	1.15E+03	2006	8.01E-04	2006	1.73E-03
2007	6.39E+00	1.30E+03	2007	1.53E-03	2007	3.98E-03
2008	8.69E+00	9.51E+02	2008	1.50E-03	2008	3.56E-03
2009	5.05E+00	7.69E+02	2009	1.14E-03	2009	2.65E-03
2010	8.75E+00	7.84E+02	2010	1.75E-03	2010	2.37E-03
2011	7.71E+00	9.45E+02	2011	2.15E-03	2011	3.91E-03
2012	8.17E+00	1.14E+03	2012	2.26E-03	2012	4.73E-03
2013	-1.00E+00	1.07E+03	2013	1.92E-03	2013	3.95E-03
2014	-1.00E+00	9.88E+02	2014	3.52E-03	2014	3.45E-03
2015	-1.00E+00	1.04E+03	2015	3.99E-03	2015	4.29E-03

Table 4.4.8 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
ASPIC results: parameter estimates, non parametric bootstrap relative bias and bias corrected confidence interval, interquartil (IQ) range and relative range. Ye(2016): equilibrium yield available in 2016; Y(Fmsy): yield availabe at Fmsy in 2016; Ye2016/MSY: equilibrium yield available in 2016 as proportion of MSY;fmsy (1): fishing effort rate at MSY for SPCORTR8c; fmsy (2): fishing effort rate at MSY for P-TRC; fmsy (3): fishing effort rate at MSY for P-TRF (K, MSY, Yield, and Biomass in tonnes).

	WG2016 (WKFLAT2012/Stock Annex settings), B1/K fixed at 0.60							
			Bootstrap Confidence Interval					
Parameter	Point estimates	Relative bias	Lower 80%	Higher 80%	Lower 90%	Higher 90%	IQ-Range	Relative IQ-Range
B1/K	0.60	0.00%	0.60	0.60	0.60	0.60	0.00	0.00%
K	31610	0.80%	27000	38490	25800	41510	6073	19.20%
q(1)	6.62E-04	1.78%	5.02E-04	8.44E-04	4.66E-04	9.07E-04	1.83E-04	27.70%
q(2)	1.18E-07	1.88%	8.95E-08	1.54E-07	8.12E-08	1.66E-07	3.32E-08	28.20%
q(3)	2.60E-07	2.45%	1.93E-07	3.35E-07	1.77E-07	3.62E-07	7.40E-08	28.50%
MSY	1856	0.30%	1746	1937	1718	1963	100	5.40%
Ye(2016	1834	-1.53%	1770	1933	1745	1945	82	4.50%
Y.(Fmsy	1087	-0.09%	1077	1102	1074	1106	13	1.20%
Bmsy	15810	0.80%	13500	19250	12900	20760	3037	19.20%
Fmsy	0.117	1.98%	0.091	0.144	0.082	0.153	0.028	23.60%
fmsy(1)	177.3	1.28%	155.4	203.5	150.3	209.6	24.68	13.90%
fmsy(2)	997200	1.51%	857300	1157000	827600	1208000	157300	15.80%
fmsy(3)	451600	1.08%	389100	535600	373600	559700	71500	15.80%
B./Bmsy	1.11	0.98%	0.94	1.26	0.89	1.30	0.16	14.60%
F./Fmsy	0.52	0.33%	0.44	0.63	0.42	0.67	0.09	18.10%
Ye./MSY	0.99	-1.76%	0.94	1.00	0.92	1.00	0.02	2.40%
q2/q1	1.78E-04	0.46%	1.56E-04	2.06E-04	1.50E-04	2.15E-04	2.57E-05	14.50%
q3/q1	3.93E-04	1.06%	3.41E-04	4.59E-04	3.26E-04	4.77E-04	6.37E-05	16.20%

Table 4.4.9 ANGLERFISH (*L. budegassa*) – Divisions 8c and 9a.
(K, MSY, Yield, and Biomass in tonnes)

		WG2013	WG2014		WG2015		WG2016
Outputs	**WKFLAT2012**	**Benchmark Settings**	**Benchmark Settings**	**Bench. Set. B1/K fixed**	**Benchmark Settings**	**Bench. Set. B1/K fixed**	**Bench. Set. B1/K fixed**
B1/K	**0.93**	**0.44**	**0.44**	**0.60**	**0.19**	**0.60**	**0.60**
MSY	**1375**	**1881**	**1900**	**1633**	**3622**	**1749**	**1856**
K	**43910**	**58390**	**59360**	**47260**	**101800**	**38600**	**31610**
q(1)	**3.09E-04**	**4.22E-04**	**4.22E-04**	**4.08E-04**	**5.33E-04**	**5.15E-04**	**6.62E-04**
q(2)	**4.85E-08**	**6.78E-08**	**6.78E-08**	**6.57E-08**	**8.78E-08**	**8.65E-08**	**1.18E-07**
q(3)	**1.17E-07**	**1.58E-07**	**1.58E-07**	**1.53E-07**	**2.02E-07**	**1.99E-07**	**2.60E-07**
TOF	**1.07E+01**	**1.14E+01**	**1.14E+01**	**1.14E+01**	**1.18E+01**	**1.19E+01**	**1.30E+01**
mse	**1.60E-01**	**1.57E-01**	**1.57E-01**	**1.55E-01**	**1.53E-01**	**1.53E-01**	**1.62E-01**
rmse	**4.01E-01**	**3.96E-01**	**3.96E-01**	**3.93E-01**	**3.91E-01**	**3.91E-01**	**4.03E-01**
CI	**0.5015**	**0.2162**	**0.2114**	**0.3080**	**0.1013**	**0.3345**	**0.3707**
CN	**1.0000**	**0.9438**	**0.9356**	**1.0000**	**0.6994**	**1.0000**	**1.0000**
Rest	**111**	**19**	**8**	**7**	**82**	**7**	**8**
Error	**0**	**0**	**0**	**0**	**11**	**0**	**0**
r sq 1	**0.181**	**0.165**	**0.165**	**0.169**	**0.139**	**0.148**	**0.120**
rsq 2	**0.010**	**0.132**	**0.131**	**0.125**	**0.366**	**0.336**	**0.446**
rsq 3	**0.052**	**0.029**	**0.028**	**0.031**	**0.106**	**0.121**	**0.222**
Y.@Fmsy	**1436**	**1300**	**1352**	**1463**	**1476**	**1718**	**1087**
Bmsy	**21950**	**29190**	**29680**	**23630**	**50890**	**19300**	**15810**
Fmsy	**0.063**	**0.064**	**0.064**	**0.069**	**0.071**	**0.091**	**0.117**
B./Bmsy	**1.040**	**0.684**	**0.705**	**0.893**	**0.399**	**0.982**	**1.109**
F./Fmsy	**0.522**	**0.806**	**0.589**	**0.539**	**0.706**	**0.587**	**0.517**

B./Bmsy: By+1/Bmsy

F./Fmsy: F_y/Fmsy

Y.@Fmsy: yield fishing at Fmsy for the next year of the assessment.

ERROR 11: Estimate of MSY is at or near maximum bound, 3.622E+03

Table 4.4.10. ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.

Point estimates of B/BMSY(from 2015 to 2019) and Yield (from 2016 to 2019) for projections with F status quo (Fsq), FMSY, zero catches. Reductions to obtain yields equal to 2016 TAC, and +/- 15% 2016 TAC are also presented. The value of F2016/FMSY is equal to Fsq (mean F of 2013-2015) in all scenarios proposed. Values for F/FMSY are also given.

Fishing mortality trends in relation to F_{MSY}

year	F_{MSY}	Fsq	zero catches	Flow	Flim	MSY Btrigger (2018)	Blim (2018)	-15% TAC= 2184 t	TAC = 2569 t	+15% TAC = 2954 t
2016	0.541	0.541	0.541	0.541	0.541	0.541	0.541	0.541	0.541	0.541
2017	1.000	0.541	0.000	0.780	1.700	8.336	12.830	0.415	0.494	0.575
2018	1.000	0.541	0.000	0.780	1.700	8.336	12.830	0.415	0.494	0.575
2019	1.000	0.541	0.000	0.780	1.700	8.336	12.830	0.415	0.494	0.575

Biomass trends in relation to B_{MSY}

year	F_{MSY}	Fsq	zero catches	Flow	Flim	MSY Btrigger (2018)	Blim (2018)	-15% TAC= 2184 t	TAC = 2569 t	+15% TAC = 2954 t
2016	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109
2017	1.153	1.153	1.153	1.153	1.153	1.153	1.153	1.153	1.153	1.153
2018	1.134	1.192	1.265	1.161	1.049	0.500	0.300	1.209	1.198	1.188
2019	1.117	1.228	1.370	1.169	0.966	0.228	0.082	1.259	1.239	1.219
2020	1.103	1.259	1.467	1.175	0.897	0.106	0.023	1.305	1.276	1.247

Yield

year	F_{MSY}	Fsq	zero catches	Flow	Flim	MSY Btrigger (2018)	Blim (2018)	-15% TAC= 2184 t	TAC = 2569 t	+15% TAC = 2954 t
2016	1135.0	1135.0	1135.0	1135.0	1135.0	1135.0	1135.0	1135.0	1135.0	1135.0
2017	2122.0	1177.0	0.0	1675.0	3469.0	12020.0	14970.0	910.2	1078.0	1249.0
2018	2088.0	1214.0	0.0	1687.0	3175.0	5347.0	4004.0	951.4	1118.0	1284.0
2019	2060.0	1248.0	0.0	1697.0	2936.0	2467.0	1108.0	988.5	1154.0	1315.0

Table 4.4.10. (cont.) ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.

Fishing mortality trends in relation to F_{MSY}

year	*L piscatorius* F_{MSY}	*L piscatorius* Flow	*L piscatorius* *F* upp	*L piscatorius* Fpa	*L piscatorius* Flim	*L piscatorius* MSY Btrigger (2018)	*L piscatorius* Bpa (2018)	*L piscatorius* Blim (2018)
2016	0.541	0.541	0.541	0.541	0.541	0.541	0.541	0.541
2017	0.793	0.455	1.053	1.105	1.547	1.708	4.247	5.536
2018	0.793	0.455	1.053	1.105	1.547	1.708	4.247	5.536
2019	0.793	0.455	1.053	1.105	1.547	1.708	4.247	5.536

Biomass trends in relation to B_{MSY}

year	*L piscatorius* F_{MSY}	*L piscatorius* Flow	*L piscatorius* *F* upp	*L piscatorius* Fpa	*L piscatorius* Flim	*L piscatorius* MSY Btrigger (2018)	*L piscatorius* Bpa (2018)	*L piscatorius* Blim (2018)
2016	1.109	1.109	1.109	1.109	1.109	1.109	1.109	1.109
2017	1.153	1.153	1.153	1.153	1.153	1.153	1.153	1.153
2018	1.160	1.203	1.127	1.121	1.067	1.048	0.791	0.685
2019	1.166	1.249	1.105	1.093	0.997	0.964	0.562	0.424
2020	1.171	1.290	1.086	1.069	0.939	0.895	0.408	0.269

Yield

year	*L piscatorius* F_{MSY}	*L piscatorius* Flow	*L piscatorius* *F* upp	*L piscatorius* Fpa	*L piscatorius* Flim	*L piscatorius* MSY Btrigger (2018)	*L piscatorius* Bpa (2018)	*L piscatorius* Blim (2018)
2016	1135.0	1135.0	1135.0	1135.0	1135.0	1135.0	1135.0	1135.0
2017	1702.0	995.7	2227.0	2330.0	3184.0	3484.0	7546.0	9193.0
2018	1712.0	1036.0	2181.0	2269.0	2961.0	3187.0	5270.0	5579.0
2019	1720.0	1073.0	2141.0	2217.0	2777.0	2944.0	3784.0	3498.0

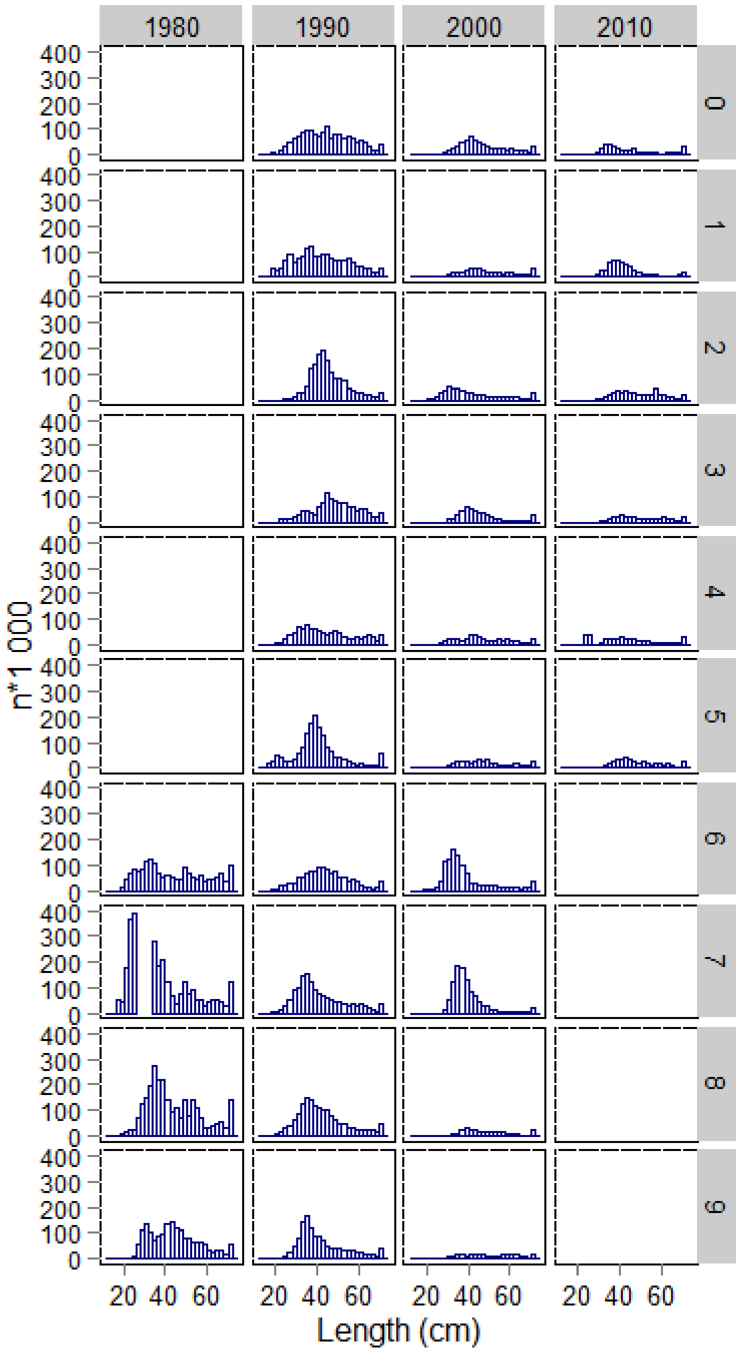


Figure 4.4.1 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a. Length distributions of landings (thousands for 1986–2015).

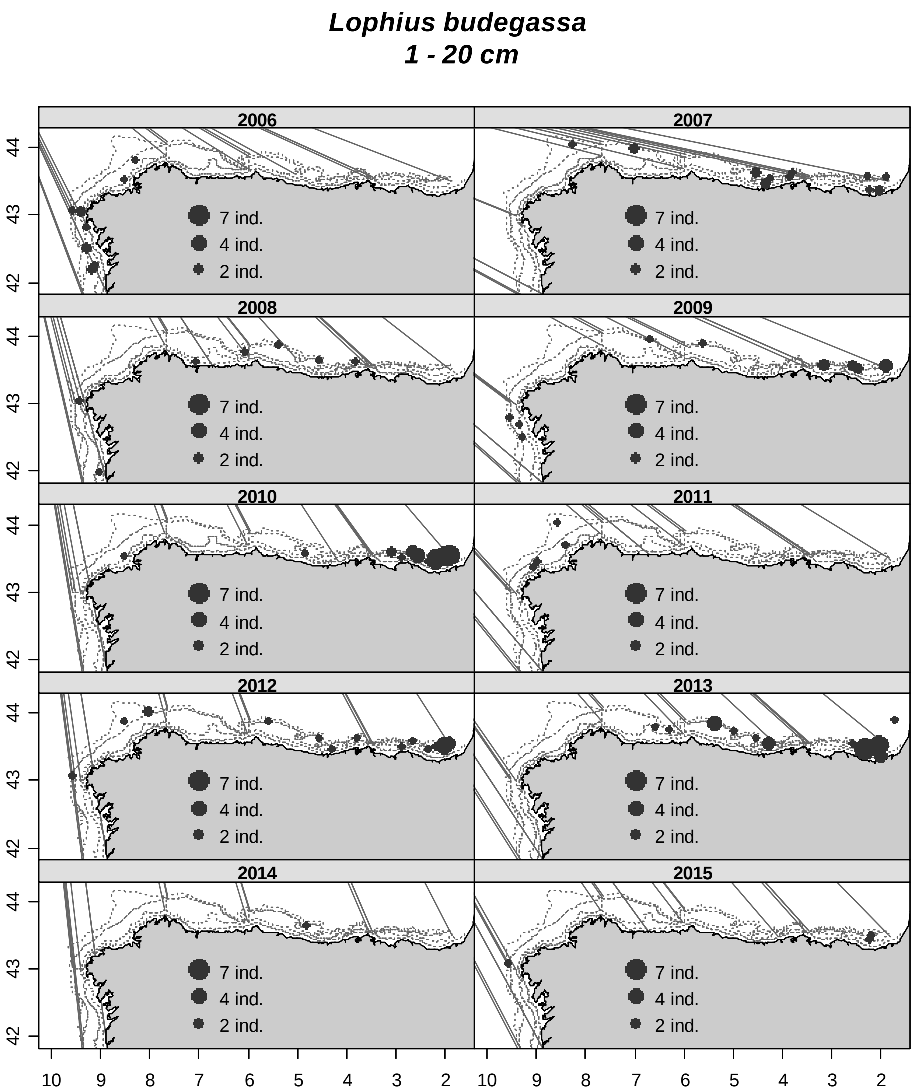


Figure 4.4.2 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a. Distribution of black anglerfish (*L. budegassa*) juveniles (0–20 cm) in SpGFS-WIBTS-Q4 between 2006–2015.

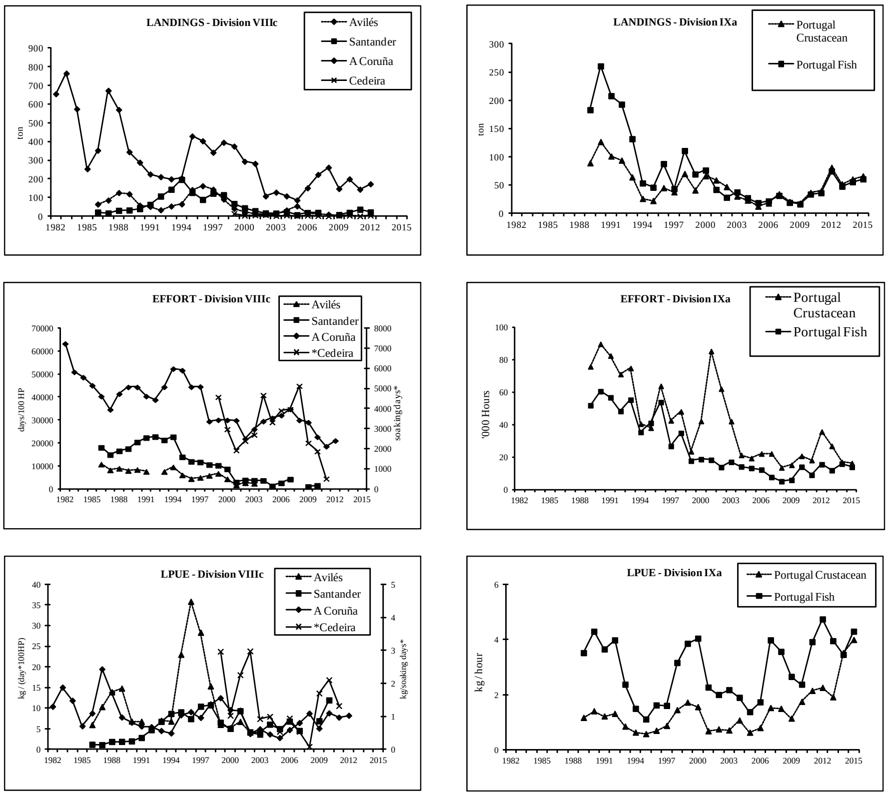


Figure 4.4.3 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a. Trawl and gillnet landings, effort and LPUE data between 1986–2015.

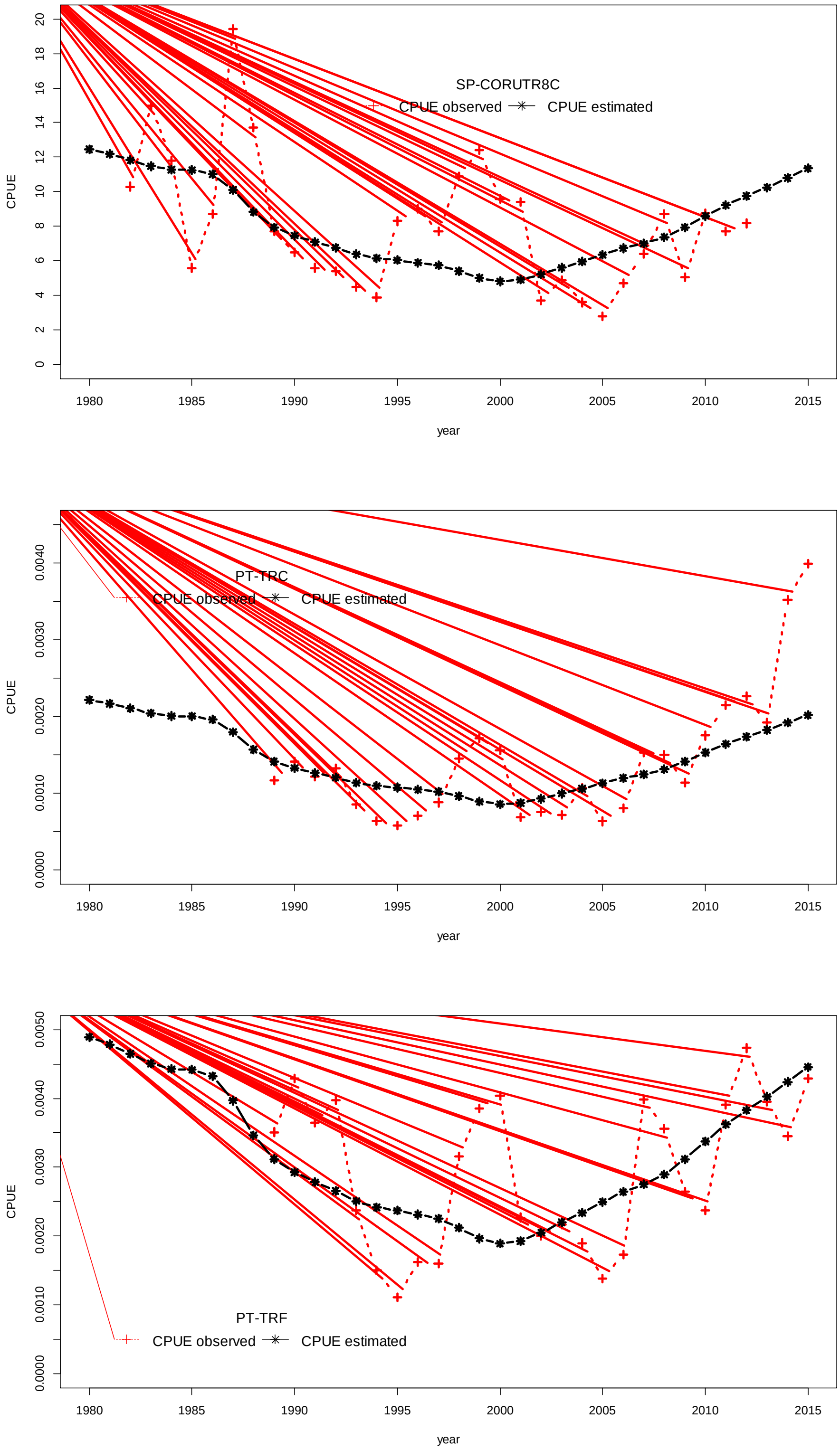


Figure 4.4.4. ANGLERFISH (*L. budegassa*)– Divisions 8.c and 9.a. Observed cpue for the three commercial fleets and estimated values by the model.

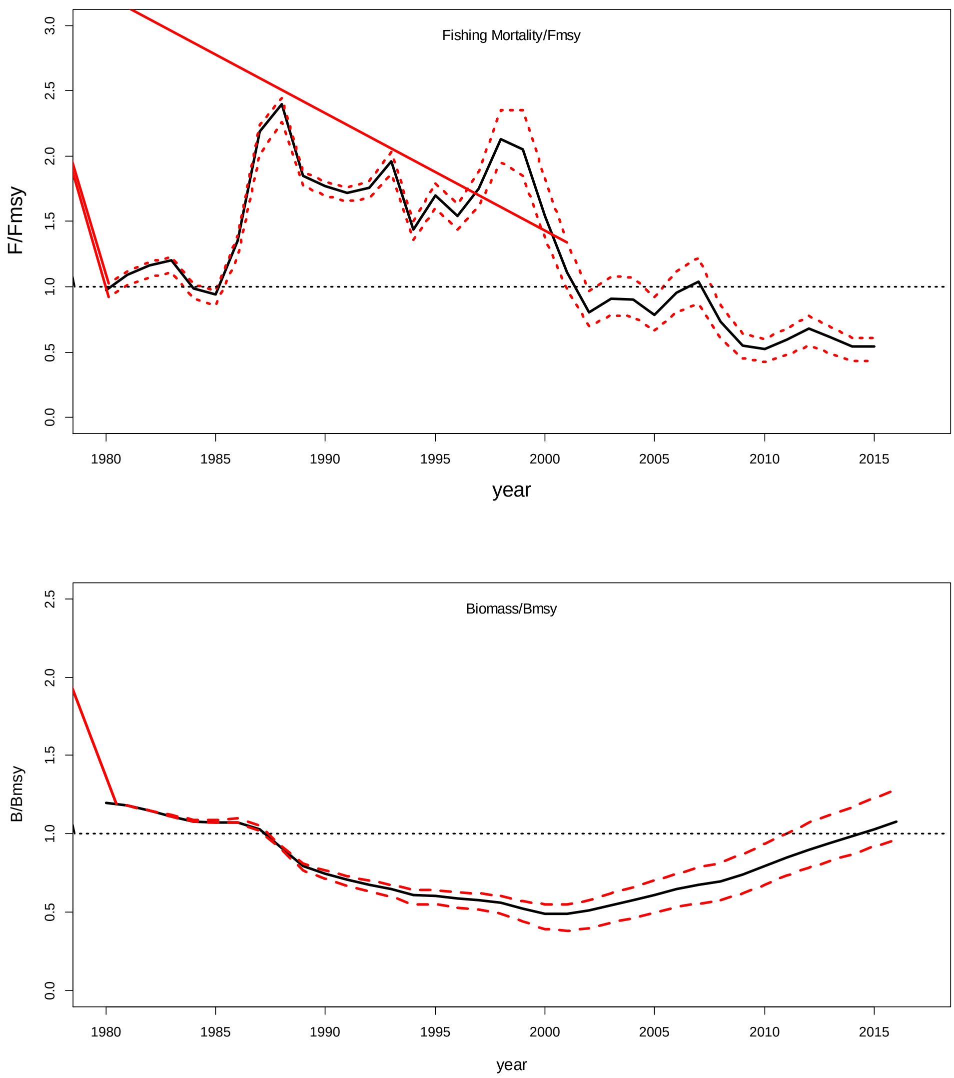


Figure 4.4.5. ANGLERFISH (*L. budegassa*) – Divisions 8c and 9a. Confidence intervals (80%) of the F/F_{MSY} and B/B_{MSY} ratios.

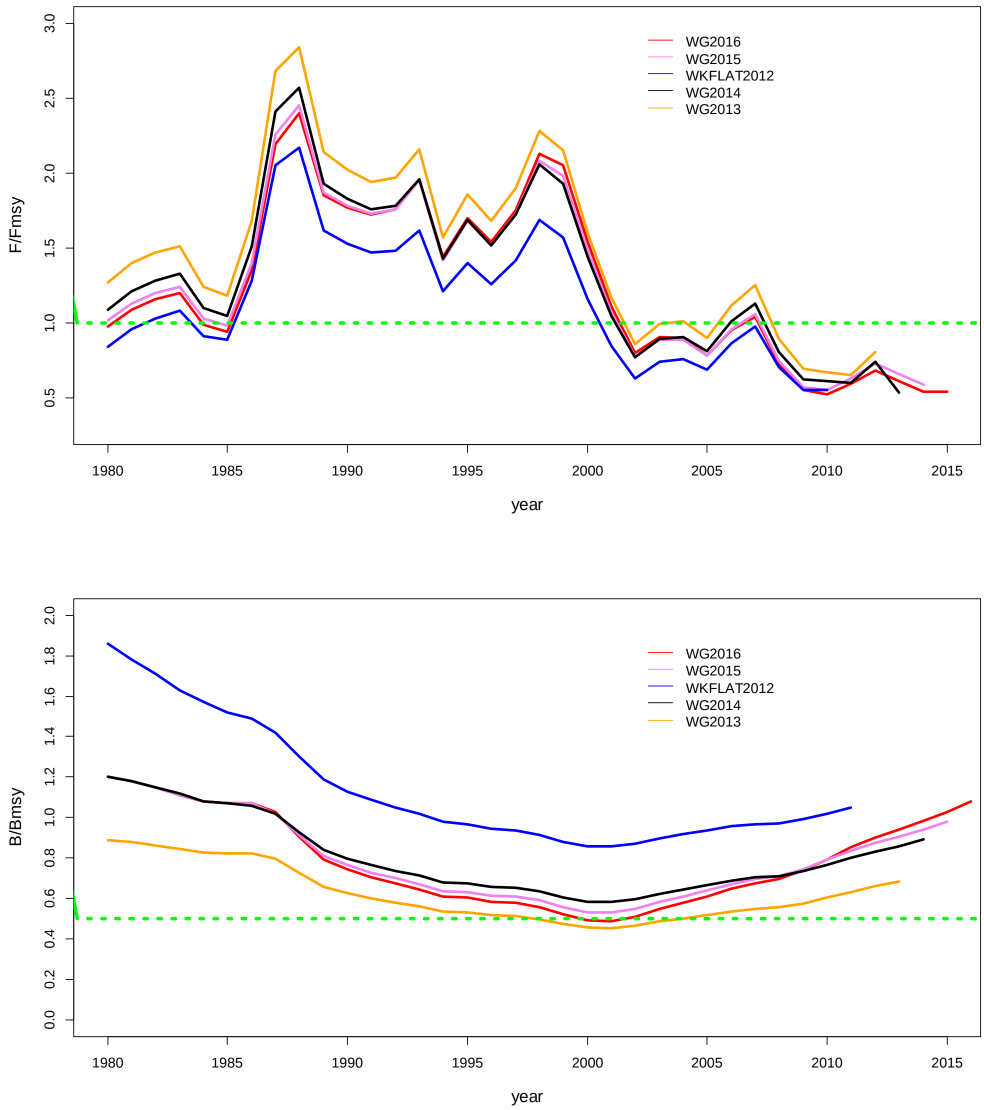
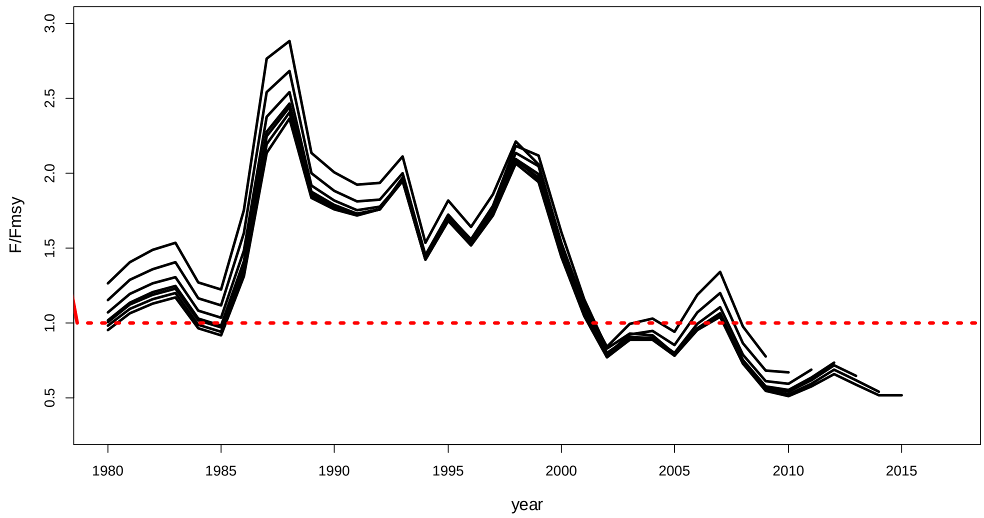


Figure 4.4.6. ANGLERFISH (*L. budegassa*) – Divisions 8c and 9a. Trends of the F/FMSY and B/BMSY ratios from the, 2012 benchmark, 2013, 2014, 2015 and 2016 WG assessments.



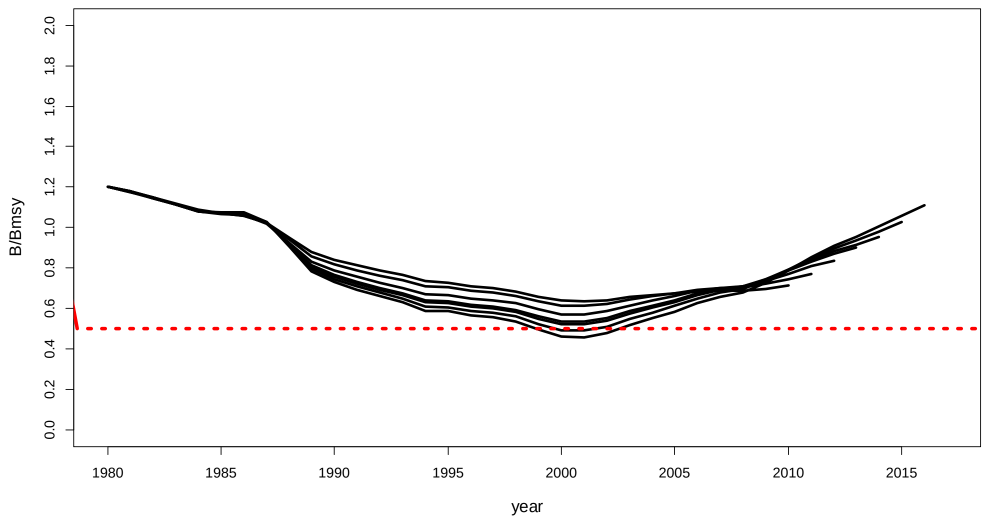


Figure 4.4.7 ANGLERFISH (*L. budegassa*) – Divisions 8c and 9a. Retro analysis of the F/FMSY and B/BMSY ratios of 2016 WG assessment.

5 Megrim (*Lepidorhombus whiffiagonis*) in Divisions 7b-k and 8a,b,d

Assessment type: An update assessment has been carried out as this stock was benchmarked in 2016 executing a full assessment for this stock and is now category 1.

Data revisions: data revision was done in the Inter-Benchmark 2016 and no additional revision has been done for this WG.

5.1 General

5.1.1 Fishery description

Megrim in the Celtic Sea, west of Ireland, and in the Bay of Biscay are caught in a mixed fishery predominantly by French followed by Spanish, UK and Irish demersal vessels. In 2015, the four countries together have reported around 97% of the total landings (Table 5.1.1.1.). Estimates of total landings (including unreported or miss-reported landings) and catches (landings&discards) as used by the Working Group up to 2015 are shown in Table 5.1.1.2.

5.1.2 Summary of ICES Advice for 2016 and Management applicable for 2015 and 2016

ICES advice for 2016

ICES advises that when the precautionary approach is applied, landings in 2016 should be no more than 18 216 tonnes. ICES cannot quantify the corresponding catches.

Management applicable for 2015 & 2016

The 2015 TAC was set at 19 101 t and 2016 TAC 20 056 t, including a 5% contribution of *L. boscii* in the landings for which there is no assessment.

The minimum landing size of megrim was reduced from 25 to 20 cm length in 2000.

5.2 Data

5.2.1 Commercial catches and discards

Stock catches for the period 1984-2015, as estimated by the WG, are given in Table 5.2.1.1. This is the first year where all landing and discard data have been uploaded to Intercatch, so it has been the tool to extract and make data allocations.

Landings in 2015 are lower than in 2015 (13%), reaching up to 11 570 t.

Spanish data since 2011 has been provided by SGP, the official national administration responsible for fishery statistics. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations. They show a decreasing trend from 2009 onwards. During Inter-Benchmark 2016, France landing dataseries were updated from 2003–2014. Landing data from France shows a decreasing trend from 2013 onwards. Landing information from year 2015 by UK, Ireland and Belgium show a slight increase.

Regarding discard data, French discards were provided from 2004–2014 to the Inter-Benchmark 2016, and they have been updated in 2015. There is a decrease in all discard information provided by Ireland, Spain, UK and Belgium but the most significant decreases are the Spanish discards with a decrease of 62% in the last year.

Discard data available by country and the procedure to derive them are summarized in Table 5.2.1.1. The discards decrease in year 2000 can be partly explained by the reduction in the minimum landing size from 25 cm to 20 cm. Since 2000, fluctuating trends are observed with a peak in 2004 and the minimum observed level in year 2015.

In the following table the discard ratio in percentage (%) from catches in weight of the most recent years is presented.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Discard ratio (%)	11%	13%	15%	20%	30%	20%	24%	19%	21%	18%	26%	24%	20%	24%	16%	12%

5.2.2 Biological sampling

Age and Length distribution provided by countries are explained in Stock Annex- Meg 78 (Annex E).

Age

Spain, Ireland, UK and Belgium provided numbers-at-age in Intercatch and consequently completed number and weights at age up to 2015. Age distribution for landings and discards from 2002–2015 are presented in Figure 5.2.2.1.

Lengths

Table 5.2.2.1 shows the available original length composition of landings by Fishing Unit in 2015.

Natural Mortality

M=0.2 has been used as input data for all ages and years in the final model.

However, an extensive review of methods to estimate M for megrim and their impact on the assessment results was presented in IBP Megrim 2016. But they were not used because more in deep work is needed for their approval.

5.2.3 Survey data

UK survey Deep Waters (UK-WCGFS-D, Depth > 180 m) and UK Survey Shallow Waters (UK-WCGFS-S, Depth < 180 m) indices for the period 1987–2004 and French EVHOE survey (EVHOE-WIBTS-Q4) results for the period 1997–2015 are summarized in Table 5.2.3.1.

The UK-WCGFS-D and UK-WCGFS-S show the same pattern in the indices for ages 2 and 3 since 1997; in agreement with the high values of EVHOE-WIBTS-Q4 age 1 index for the years 1998 and 2000. These high indices in the Deep component of the UK Surveys are even more remarkable in 2003 for all ages and in 2004 for the younger ages.

EVHOE-WIBTS-Q4 indices for age 1+2 showed no evident trend. Oscillations of high and low values are present in all the time-series (Figure 5.2.3.1). In Figure 5.2.3.4 the time-series of the age composition of abundances from 2007 to 2015 of EVHOE survey is presented.

An abundance index in ages was provided for Irish Groundfish Survey (IGFS-WIBTS-Q4) from 2003-2015. For the last five years of the dataseries, the survey provides the lowest values of older ages and a sharp decrease of medium age individuals. For the younger ages, it is quite stable in the last five years.

A revised abundance index in ages was provided for the Spanish Porcupine Groundfish Survey (SpPGFS-WIBTS-Q4) from 2001 to 2015 due to a change in the calculation methodology of the tow trawling time. In Figure 5.2.3.3 the time-series of the age composition of abundances from 2007–2015 is presented.

When comparing Spanish, French and Irish survey biomass indices some contradictory signals are detected (Figure 5.2.3.2). The EVHOE-WIBTS-Q4 index decreased from 2001 until 2005 and since then has sharply increased until 2011. In the last years 2015, it slightly increased. The SpPGFS-WIBTS-Q4 Porcupine survey (SP-PGFS) shows fluctuation trends from year 2003 to 2008. Afterwards, an increasing trend is observed until 2014 with a slight decrease in 2015.

Irish Groundfish Survey (IGFS-WIBTS-Q4) gives the highest estimates in 2005 with a decrease in trend to 2007 and increasing again till 2009 in agreement with EVHOE-WIBTS-Q4. In 2011 a slight increase occurred in agreement with Spanish survey and in the last years remains stable.

For a more detailed inspection of the abundances indices of different age groups, these were inspected along the whole dataseries for surveys (Figure 5.2.3.2). Ages groups were identified as: i) age 1+age 2; ii) age 3+age 4+age 5 and iii) age 6+age 7 +age 8+age 9+age 10+. The most abundant age group was ii) at the beginning and the end of the dataseries for all the surveys but it shows a decreasing trend in the last three years. Age group i) appear most abundant during years 2005 to 2008. As a consequence it is difficult to conclude on the recent abundance trends by age group.

It must be noted that the areas covered by the three surveys almost do not overlap (Figure 5.2.3.5). There is some overlap between the northern component of EVHOE-WIBTS-Q4 and the southern coverage of IGFS-WIBTS-Q4, whereas the eastern boundary of SP-PGFS essentially coincides with the western one of IGFS-WIBTS-Q4.

5.2.4 Commercial catch and effort data

For 2012 Benchmark, a new Irish trawler index was provided as the result of the revision carried out for the Irish Otter trawl fleet. Irish beam trawl (TBB) data are limited to TBB with mesh sizes of 80-89mm, larger mesh sizes are disused since 2006.

The general level of effort is described in Figure 5.2.4.1. SP-CORUTR7 and SP-VIGOTR7 fleets have decreased sharply until 1993, since then it has been decreasing slightly. SP-VIGOTR7 showed a very slight increase in 2007, decreasing slightly till 2014. SP-CANTAB7 remains quite stable since 1991 and decreased slightly since 2000. In 2009, no effort has been deployed by this fleet but in 2010, some trips were recorded, for the last four years no effort was deployed. The effort of the French benthic trawlers fleet in the Celtic Sea decreased until 2008 and no more information was provided to the WG.

Commercial series of catch-at-age and effort data were available for three Spanish fleets in Subarea 7 (Figure 5.2.4.2): A Coruña (SP-CORUTR7) from 1984–2015, Cantábrico (SP-CANTAB7) from 1984–2010 as no effort has been deployed by this fleet in subarea 7 during the last four years and Vigo (SP-VIGOTR7) from 1984–2015. The cpue of SP-CORUTR7 has fluctuated until 1990, when it started to decrease, with a slight increase in 2003 and a peak in cpue in 2011 and a decrease afterwards. Over the same period, SP-VIGOTR7 has remained relatively stable until 1999, reaching in 2004 the historical maximum. In the last years it was fluctuations with a decrease in 2015. SP-CANTAB7 LPUE was fluctuating and after 2011 no effort was deployed.

From 1985 to 2008, LPUEs from four French trawling fleets: FR-FU04, Benthic Bay of Biscay, Gadoids Western Approaches and *Nephrops* Western Approaches were available. (Table 5.2.4.1.& Figure 5.2.4.3). No data from 2009 onwards was deployed by this fleet.

The LPUE of all Irish beam trawlers fleets oscillates up and down. From 2007 an increase in the LPUE is observed with a peak in 2013 (Figure 5.2.4.4).

Summarizing no particular LPUE changes have been observed, so no stock changes is observed.

An analysis of the abundance indices of different age groups in dataseries for commercial fleets was carried out (Figure 5.2.4.5). Ages groups were identified as: i) age 1+age 2; ii) age 3+age 4+age 5 and iii) age 6+age 7+age 8+age 9+age 10+. For Spanish and Irish commercial fleets, the most abundant age group was ii) at the beginning and the end of the dataseries. Age group i) appear more abundant than older ages (iii) from 2003 onwards in the Spanish fleet. French fleets appear to land mostly old individual at the beginning of the dataseries but a marked decrease in abundance index of old fish was observed for French fleet. In 2015, a decrease is observed in Spanish fleet but an increase is observed in Irish fleets, but the proportion of age groups catches is maintained.

Based on age groups of commercial fleets, a decrease in small ages is observed mainly from Spanish fleet.

5.3 Assessment

An analytical assessment was conducted using updated French landings and discards data. With the inclusion of French discard data, some changes to the model were executed in relation to the discard estimation coefficient and data input from the Bayesian model.

5.3.1 Data Exploratory Analysis

In summary, the stock catch-at-age matrix shows three periods: 1984–1989; 1990–1998 and 1999–2015.

The data analysed consist of landed, discarded and catch numbers-at-age and abundance indices-at-age. Five of the available fleets were considered appropriate to inclusion in the assessment model as tuning fleets: Spanish Porcupine survey (SpPGFS_WIBTS-Q4), French Survey (EVHOE-WIBTSQ4), Vigo commercial trawl cpue series separated in two periods: 1984–1998 (VIGO84) and 1999–2010 (VIGO99), and Irish Otter trawlers lpue (IRTBB), based on their representativeness of megrim stock abundance. An exploratory data analyses was performed to examine their ability to track cohorts through time.

Several exploratory analyses were carried out on the data with the software R. The analysis of the standardized log abundance indices revealed a decrease in ages 1 and 2 in EVHOE-WIBTSQ4 survey (Figure 5.3.1.1). Otherwise, in SpPGFS-WIBTS-Q4 an increase in ages 1 and 2 was observed and a decrease in ages 4 and 5.

The analysis of the standardized log abundance indices revealed year trends for VIGO99 and the same decrease in the index of old individuals was detected by this fleet in 2008 and 2009. In the last years negative values of ages 1-2 are observed. However, IRTBB shows positive values of ages 1-2.

The time-series of catch-at-age (Figure 5.3.1.2) showed very low catches of ages 1–5 from 1984 to 1989. From 2004 to 2010, the catch of older ages (>6) was remarkably low, whereas catches of ages 1 and 2 increased markedly from 2003. This could be a result of an underestimation of catches of these ages (specially age 1) before this year, probably, due to the sparseness of discard data in that period. For ages 6 and older, large discrepancies in the amount caught before and after 1990 are apparent, with large catches of these ages before 1990 and a decrease of all ages at the end of the dataseries.

The analysis of landings is presented since 1990 (Figure 5.3.1.3). Landings of ages 1 and 2 decreased from the beginning of the series to the last years where negative values have increased from 2009 onwards. In fact, the proportion of older ages in the landings decreased significantly from 2004 to 2009, as already discussed in relation to the catch. In 2015, ages 1 decreased significantly and older ages too.

The signal coming from the discard data showed that at the beginning of the dataseries discards of age 1 was low (Figure 5.3.1.4-5). Discards of this age increased along the dataseries, particularly from 2003 onwards. From year 2010 to 2013, ages 1 to 3 appear to be highly discarded but in 2014 and 2015 general discards decrease.

5.3.2 Model

The model explored during the benchmark is an adaptation of one developed originally for the southern hake stock, published in Fernández *et al*. (2010). It is a statistical catch-at-age model that allows incorporating data at different levels of aggregation in different years and also allows for missing discards data by certain fleets and/or in some years. These are all relevant features in the megrim stock.

The model is described in Stock Annex.

5.3.3 Results

The model results were analysed looking at three different kinds of plots: convergence plots (to analyse the convergence behavior of the MCMC chains), diagnostic plots (to analyse the goodness of the fit) and, finally, plots of the models estimates (displaying the estimated stock status over time).

Regarding the settings of the prior for the final run, some changes have been done in relation to the inclusion of discards information from France, which will be included as data instead of being estimated by the model. Settings used in WGBIE 2016 are listed in Table 5.3.3.1.

In order to be sure that the model has produced a representative sample of the posterior distribution, the MCMC chain was examined for behaviour ("convergence" properties). This was done by examining trace plots and autocorrelation plots for most parameters in the model (Figure 5.3.3.1 to Figure 5.3.3.3) showing a good behaviour.

Model diagnostics plots examined were: prior-posterior plots and time-series and bubble plots of the residuals. Prior-posterior distributions are shown in Figures 5.3.3.4. Posterior distributions for log-population abundance in first assessment year (1984), log-f(y) and log-catchabilities of abundance indices were much more concentrated than the priors and were often centred at different places. This indicated that the model was able to extract information from the data in order to substantially revise the prior distribution. In these cases, the model fits are mostly driven by the data, with the prior having only a small influence. The posterior distributions for log-rSPD, log-rFR or log-rOTD in the first assessment year (1984) were similar to the prior distributions in most of the cases. This was especially true for log-rOTD, were data directly associated with it was not available to the model. This indicates that the available data does not contain very much information concerning these parameters and that the priors have to be chosen carefully trying to be realistic.

Results of time-series of estimated spawning-stock biomass (SSB), reference fishing mortality (F_{bar}), recruits and catch, landings and discards are shown in Figure 5.3.3.5. The SSB shows an overall decreasing trend from the start of the series in 1984–2005 with a marked increasing trend till 2015. The uncertainty in the SSB was low in the whole time-series. The median recruitment fluctuated between 200000 and 300000 thousand in the whole series with a decrease in the last two years. The fishing mortality showed three marked periods which coincide with the data periods, 1984–1989, 1990–1998 and 1999–2015. The lowest F_{bar} was observed in the first period and the highest one in the year 2005 and then it decreases to its lowest in 2015 with small uncertainty. This decreasing F trend in recent years explains the increase of SSB since catches and recruitment remain relatively constant. Overall, the catches showed weak decreasing trend with a minimum in 2015 with landings showing similar trend and discards remain stable with a minimum in 2015.

5.4 Retrospective pattern

Retrospective analysis was conducted for 5 years, the retrospective time-series of most relevant indicators are shown in Figures 5.4.1. In terms of SSB, estimates were very similar throughout the entire time-series and there was a downward revision of SSB. The recruitment estimates towards the end of the time-series showed significant revisions in the retrospective analysis, but this is something common, as recruitment in the most recent year(s) is usually not correctly estimated by assessment models. The fishing mortality was revised upward year by year.

5.5 Short-term forecasts

Short-term projections have been made using Rscript developed by Fernández *et al.* (2010). Some modifications have been done to the script during IBP 2016 as the previous results of the projection were inconsistent with the stock dynamic estimated by the assessment model.

For the current projection, the following short-term forecast settings are agreed: the average of the last three years is used to average F-at-age, the proportion landed-at-age, and the vectors of weight-at-age and maturity-at-age. As there is a decreasing trend of F in the results of the assessment time-series, F status quo is scaled to F_{bar} of the final assessment year. For the recruitment, the geometric mean of the recruitment posteriors in all assessment years except for the final 2 is used.

Landings in 2017 and SSB in 2018 predicted for various levels of fishing mortality in 2017 are given in Table 5.5.1. Maintaining F status quo in 2017 is expected to result in an increase in landings with respect to 2016 and an increase in SSB in 2017 with respect to 2016.

5.6 Biological reference points

Biological reference points were calculated in IBP Megrim 2016 and reviewed by WGBIE 2016 and RGPA 2016. The reference points for this stock used methods based on the recommendations from WKMSYREF4 (ICES, 2016). They are listed in Table 5.6.1. and included in the Stock Annex.

During WGBIE 2016 there was an update of the reference points calculated in the IBP Megrim 2016. A sensitivity analysis of the reference points obtained in the per recruit equilibrium analysis was done to the number of years assumed for the biological parameters and the exploitation pattern. It was observed that the highest the number of years assumed, the lowest the value of the reference point was (Figure 5.6.1.). This could be explained due to a change in the selection pattern or mean weight at age (Figure 5.6.2.). So it was considered that the default 10 year range used for biological parameters was not adequate. 3 years range was considered appropriate as this was the year range used in the calculations of yield-per-recruit done in the IBP Megrim 2016.

5.7 Conclusions

The incorporation of the requested data, mainly French discards data (but also French landings review) was completed and the script to deal with these new data were updated. The model results show that the new data does not alter substantially the perception of stock status and F compared with the preliminary model performed by WGBIE (2015).

The group considers that the model diagnosis is adequate to evaluate the quality fit. The use of the Bayesian statistical catch-at-age model, the methodology for deriving biological reference points, the methodology for short-term forecast and the estimation of discards are statistically sound and adequate to the stock. The WG considers it can be used for future advice.

Nevertheless, as in most stock assessments, the stock–recruitment relationship and natural mortality remain uncertain, which have an impact in the assessment and the reference points that should be investigated in the future.

Table 5.1.1.1. .Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Nominal landings and catches (t) by country provided by the Working Group.

	Landings									Discards								
	France	Spain	U.K. (England & Wales)	U.K. (Scotland)	Ireland	Northern Ireland	Belgium	Unallocated	Total landings	France	Spain	U.K.	Ireland	Northern Ireland	Belgium	Others	Total discards	Total catches
1984									**16659**							2169	**2169**	**18828**
1985									**17865**							1732	**1732**	**19597**
1986	4896	10242	2048		1563		178		**18927**							2321	**2321**	**21248**
1987	5056	8772	1600		1561		125		**17114**							1705	**1705**	**18819**
1988	5206	9247	1956		995		173		**17577**							1725	**1725**	**19302**
1989	5452	9482	1451		2548		300		**19233**							2582	**2582**	**21815**
1990	4336	7127	1380		1381		147		**14370**							3284	**3284**	**17654**
1991	3709	7780	1617		1956		32		**15094**							3282	**3282**	**18376**
1992	4104	7349	1982		2113		52		**15600**							2988	**2988**	**18588**
1993	3640	6526	2131		2592		40		**14929**							3108	**3108**	**18037**
1994	3214	5624	2309		2420		117		**13684**							2700	**2700**	**16384**
1995	3945	6129	2658		2927		203		**15862**		554		422			2230	**3206**	**19068**
1996	4146	5572	2493		2699		199		**15109**				410			2616	**3026**	**18135**
1997	4333	5472	2875		1420		130		**14230**		414		568			2083	**3066**	**17296**
1998	4232	4870	2492		2621		129		**14345**		381		681			4309	**5371**	**19716**
1999	3751	4615	2193		2597		149		**13305**		3135		162				**3297**	**16601**
2000	4173	6047	2185		2512		115		**15031**		1033	208	630				**1870**	**16750**
2001	3645	7575	1710		2767		80		**15778**		1275	250	736				**2262**	**18040**
2002	2929	8797	1787		2413		62		**15987**		1466	435	912				**2813**	**18800**
2003	3227	8340	1732		2249		163		**15711**		3147	279	582				**4008**	**19719**
2004	2817	7526	1622		2288		106		**14358**	1003	4511	257	472				**6243**	**20602**
2005	2972	5841	1764		2155		156		**12888**	697	1831	289	458				**3275**	**16163**
2006	2763	5916	1509		1751		99		**12037**	382	2568	271	529				**3751**	**15788**
2007	2745	6895	1462		1763		195		**13060**	330	2114	272	317				**3033**	**16092**
2008	2578	5402	1387		1514		167		**11048**	329	1479	289	764				**2860**	**13908**
2009	3032	8062	1840		1918	2	209		**15064**	674	1761	389	454				**3278**	**18342**
2010	3651	7095	1805		2283	5	261		**15101**	937	3489	463	453				**5343**	**20444**
2011	3235	3500	1845		2227		330	2089	**13226**	847	2097	898	344				**4187**	**17413**
2012	4012	4055	1744		3047		609	966	**14433**	796	2668	88	152				**3704**	**18137**
2013	4549	4982	2918		3038		538		**16025**	748	3792	53	286		5		**4885**	**20910**
2014	4311	3318	2753	176	2391		179	150	**13277**	795	1337	72	360		5		**2569**	**15846**
2015	3073	2864	2804	147	2436		246		**11569**	634	513	47	308		4		**1507**	**13076**

Table 5.1.1.2. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Nominal landings and catches (t) provided by the Working Group.

	Total landings	Total discards	Total catches	Agreed TAC (1)
1984	16659	2169	18828	
1985	17865	1732	19597	
1986	18927	2321	21248	
1987	17114	1705	18819	16460
1988	17577	1725	19302	18100
1989	19233	2582	21815	18100
1990	14370	3284	17654	18100
1991	15094	3282	18376	18100
1992	15600	2988	18588	18100
1993	14929	3108	18037	21460
1994	13684	2700	16384	20330
1995	15862	3206	19068	22590
1996	15109	3026	18135	21200
1997	14230	3066	17296	25000
1998	14345	5371	19716	25000
1999	13305	3297	16601	20000
2000	15031	1870	16750	20000
2001	15778	2262	18040	16800
2002	15987	2813	18800	14900
2003	15711	4008	19719	16000
2004	14358	6243	20602	20200
2005	12888	3275	16163	21500
2006	12037	3751	15788	20425
2007	13060	3033	16092	20425
2008	11048	2860	13908	20425
2009	15064	3278	18342	20425
2010	15101	5343	20444	20106
2011	13226	4187	17413	20106
2012	14433	3704	18137	19101
2013	16025	4885	20910	19101
2014	13277	2569	15846	19101
2015	11569	1507	13076	19101

(1) for both megrim species and VIIa included.

Table 5.2.1.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Discards information and derivation.

	FR	SP	IR	UK
1984	FR84-85	-	-	-
1985	FR84-85	-	-	-
1986	(FR84-85)	(SP87)	-	-
1987	(FR84-85)	SP87	-	-
1988	(FR84-85)	SP88	-	-
1989	(FR84-85)	(SP88)	-	-
1990	(FR84-85)	(SP88)	-	-
1991	FR91	(SP94)	-	-
1992	(FR91)	(SP94)	-	-
1993	(FR91)	(SP94)	-	-
1994	(FR91)	SP94	-	-
1995	(FR91)	(SP94)	IR	-
1996	(FR91)	(SP94)	IR	-
1997	(FR91)	(SP94)	IR	-
1998	(FR91)	(SP94)	IR	-
1999	-	SP99	IR	-
2000	-	SP00	IR	UK
2001	-	SP01	IR	UK
2002	-	(SP01)	IR	UK
2003	-	SP03	IR	UK
2004	FR04	SP04	IR	UK
2005	FR05	SP05	IR	UK
2006	FR06	SP06	IR	UK
2007	FR07	SP07	IR	UK
2008	FR08	SP08	IR	UK
2009	FR09	SP09	IR	UK
2010	FR10	SP10	IR	UK
2011	FR11	SP11 (*)	IR	UK
2012	FR12	SP12 (*)	IR	UK
2013	FR13	SP13 (*)	IR	UK
2014	FR14	SP14 (*)	IR	UK
2015	FR15	SP15 (*)	IR	UK

- In bold: years where discards sampling programs provided information

- In (): years for which the length distribution of discards has been derived

(*) Scientific estimates were provided.

Table 5.2.2.1 Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Length composition by fleet (thousands).

Length	FRANCE		SPAIN	IRELAND	UNITED KINGDOM		
class (cm)	OTB_DEF_>=70_99_0_0 VII	OTT_DEF_100-119_0_0	OTB_DEF_70-99_0_0. Otter trawl-med&deep VII	ALL FISHING UNITS	FU03:Fixed nets	FU05:Otter trawl-shallow	FU06:Beam trawl-all depths
10			0		0	0	0
11			0		0	0	0
12			0		0	0	0
13			0		0	0	0
14			0		0	0	0
15		0	0		0	0	0
16		0	0		0	0	0
17		0	0		0	0	0
18		0	0		0	0	0
19		0	0	0	0	0	0
20		0	0	6	0	0	0
21		0	0	22	0	0	0
22		0	0	20	0	0	0
23		3	1	84	0	0	0
24		0	68	98	0	0	1
25		30	390	200	0	0	11
26		0	723	198	0	0	38
27	0.40	109	776	188	0	0	47
28	0.00	0	698	246	0	2	88
29	3.60	182	622	426	0	4	88
30	0.00	0	483	536	0	6	83
31	2.40	229	397	593	0	9	102
32	0.00	0	287	514	0	8	90
33	5.20	246	223	541	0	16	102
34	0.00	0	227	451	0	32	95
35	0.80	259	183	516	0	23	118
36	0.00	0	148	385	0	37	95
37	4.00	242	112	345	1	38	104
38	0.00	0	101	316	1	51	103
39	4.40	222	87	285	1	45	110
40	0.00	0	76	208	1	43	96
41	6.40	209	44	209	1	26	105
42	0.00	0	40	136	1	26	86
43	6.00	168	39	123	1	19	86
44	3.60	122	33	90	0	12	64
45	3.60	78	22	73	0	7	56
46			23	72	0	4	45
47	1.20	51	17	41	0	3	37
48			10	38	0	0	26
49		21	6	39	0	0	23
50			7	35	0	0	20
51		8	3	23	0	0	15
52			2	11	0	0	10
53		2	3	5	0	0	6
54			2	5	0	0	5
55		1	1	1	0	0	3
56			0	1	0	0	2
57			0	0	0	0	1
58			0	0	0	0	0
59			0	2	0	0	0
60			0		0	0	0
61			0		0	0	0
62			0				0
63			0				0
64			0				0
65			0				0
66			0				0
67			0				0
68			0				0
69			0				0
70			0				0
TOTAL	42	2182	5853	7080	8	413	1961

Table 5.2.3.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Abundance Indices for UK-WCGFS-D, UK-WCGFS-S, IGFS, SP-PGFS and FR- EVHOE.

		UK-WCGFS-D							**Effort in hours**	
		Age								
	Effort	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1987	100		863	5758	0	0	0	95	1753	151
1988	100	8	256	59	49	0	228	1008	1262	632
1989	100		70	188	471	2540	788	3067	680	1060
1990	100	8	526	1745	553	2584	1985	974	1154	974
1991	100		415	1375	1250	989	912	1677	593	731
1992	100	7	28	425	414	349	189	206	132	121
1993	100		122	382	1758	1505	728	739	666	718
1994	100		69	1593	1542	2663	1325	1278	825	595
1995	100	47	582	747	1755	1686	1303	548	281	421
1996	100	15	69	475	549	1580	1231	870	327	117
1997	100		329	751	1702	1518	541	149	47	17
1998	100		120	797	1432	1134	866	242	246	13
1999	100		237	270	734	760	302	94	33	17
2000	100		143	1004	619	681	395	67	35	13
2001	100	20	384	690	1426	581	460	376	226	45
2002	100		162	2680	1915	1349	761	690	315	104
2003	100		330	1705	3149	2662	1451	676	417	179
2004	100	168	1001	1382	1069	897	628	208	47	
		UK-WCGFS-S							**Effort in hours**	
		Age								
	Effort	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1987	100		499	3082	641	891	180	794	264	587
1988	100		47	55	585	95	367	0	50	93
1989	100		616	574	547	1540	576	361	297	198
1990	100		375	1057	816	661	1220	195	454	176
1991	100	2	373	829	822	394	460	550	178	293
1992	100		149	278	323	193	109	164	93	36
1993	100		470	877	1140	601	327	321	143	233
1994	100		74	1000	1301	998	521	374	185	153
1995	100	28	435	878	1167	1054	805	488	359	130
1996	100	2	64	401	389	823	592	372	152	43
1997	100	3	284	1028	550	540	289	202	75	29
1998	100	4	30	438	665	381	209	97	48	21
1999	100		69	82	222	214	103	53	41	20
2000	100		72	377	249	313	169	81	52	20
2001	100	2	131	297	594	104	145	122	80	37
2002	100		134	808	506	757	339	326	181	82
2003	100	5	184	289	639	416	328	113	102	36
2004	100	50	343	467	270	394	303	124	49	21
		FR-EVHOE								
		Age								
	Effort	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1997	100	0.77	3.92	2.47	1.47	1.59	0.91	0.61	0.35	0.15
1998	100	1.61	0.66	4.48	3.07	1.52	0.98	0.84	0.43	0.14
1999	100	0.54	3.48	0.72	2.14	3.38	1.66	0.70	0.30	0.27
2000	100	1.38	2.79	2.64	1.35	1.22	0.73	0.40	0.28	0.14
2001	100	0.94	0.51	1.87	2.36	2.72	1.87	1.40	0.38	0.22
2002	100	3.12	2.28	4.24	3.18	1.67	0.68	0.49	0.23	0.10
2003	100	2.53	2.95	2.40	3.21	0.67	0.65	0.25	0.19	0.11
2004	100	0.97	4.64	1.70	0.96	0.77	0.66	0.33	0.25	0.12
2005	100	0.86	3.48	2.94	0.91	0.57	0.48	0.13	0.07	0.12
2006	100	2.77	5.06	3.25	0.25	0.86	0.36	0.38	0.21	0.07
2007	100	4.05	3.91	1.63	1.39	2.03	0.66	0.43	0.24	0.10
2008	100	0.54	5.52	3.72	2.05	0.69	0.38	0.22	0.06	0.01
2009	100	1.55	3.09	7.90	0.94	0.45	0.21	0.06	0.01	0.00
2010	100	2.71	2.67	2.75	4.59	1.20	0.54	0.25	0.21	0.13
2011	100	0.08	5.03	5.17	3.63	1.60	0.97	0.27	0.04	0.12
2012	100	1.26	3.89	7.87	1.89	0.94	0.78	0.66	0.08	0.03
2013	100	0.89	3.34	3.93	4.63	0.49	0.52	0.35	0.04	0.07
2014	100	0.43	4.17	2.09	4.81	1.49	0.40	0.10	0.03	
2015	100	1.19	1.52	3.68	3.70	2.02	1.15	0.27	0.01	0.02

		IGFS									
		Age									
	Effort	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
2003	100	0	152	316	368	238	96	36	14	5	2
2004	100	0	153	461	595	454	162	57	30	12	3
2005	100	29	414	643	431	370	215	68	44	18	17
2006	100	44	505	548	481	215	154	68	10	7	5
2007	100	1	100	293	125	91	70	25	7	7	3
2008	100	5	140	481	349	101	66	60	17	12	5
2009	100	3	1	234	371	455	346	159	53	44	23
2010	100	6	1	128	377	259	173	90	38	13	10
2011	100	5	2	121	333	331	144	69	40	25	30
2012	100	4	24	141	140	108	52	36	16	9	33
2013	100	9	31	132	93	83	58	30	10	8	22
2014	100	40	62	143	106	56	57	52	22	23	17
2015	100	26	127	149	154	57	44	30	16	10	7

	NEW	**SP-PGFS**							
		Age							
	Effort	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7+**
2001	100	43	1770	2208	2842	3434	1941	1357	740
2002	100	6	1069	2502	3168	3997	2237	1107	515
2003	100	11	1081	2913	4105	5262	2789	1284	636
2004	100	7	719	3457	5498	5569	3071	1125	828
2005	100	77	633	626	2279	8249	4959	2605	688
2006	100	5	1776	1443	3275	4719	3312	901	383
2007	100	30	4856	6990	3556	3622	1814	852	399
2008	100	14	260	2219	5406	4010	1807	1219	428
2009	100	6	534	661	5320	7097	1635	877	606
2010	100	39	318	2158	2557	6723	2313	494	476
2011	100	37	393	1174	2510	3940	5141	1452	626
2012	100	5	157	692	3759	2862	3207	2926	1902
2013	100	6	1473	1184	1174	1619	3703	2657	2579
2014	100	39	243	3174	1001	2286	4400	3409	2198
2015	100	23	2220	2188	4056	2078	1847	2099	1830

Table 5.2.3.1 (cont). Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Abundance Indices by kilograms and numbers by 30 minutes haul duration.

	FR-EVHOEFS Abundance Indices by kilograms and numbers by 30 minutes haul duration	
	kg/30'	Nb/30'
1997	1.98	12.35
1998	2.20	13.96
1999	1.82	13.43
2000	1.42	11.14
2001	2.21	17.04
2002	2.03	16.55
2003	1.77	13.14
2004	1.50	10.67
2005	1.43	9.88
2006	1.7	15.63
2007	1.96	14.6
2008	2.05	13.65
2009	2.5	14.8
2010	2.57	15.53
2011	3.21	17.14
2012	2.97	17.69
2013	2.91	14.58
2014	2.13	13.82
2015	2.51	13.77

	SP-PGFS Abundance Indices by kilograms and numbers by 30 minutes haul duration				
	OLD	SP-PGFS	NEW	SP-PGFS	
	kg/30'	Nb/30'	AÑO	kg/30'	Nb/30'
2001	6.80	143.34	**2001**	6.80	143.34
2002	6.66	147.00	**2002**	6.66	146.00
2003	8.15	180.79	**2003**	8.16	180.81
2004	7.45	167.47	**2004**	9.01	202.72
2005	8.28	170.17	**2005**	9.81	201.19
2006	6.03	125.37	**2006**	7.64	158.14
2007	7.31	177.38	**2007**	9.15	221.18
2008	5.99	109.70	**2008**	8.46	153.61
2009	8.11	113.68	**2009**	11.79	165.49
2010	8.52	112.56	**2010**	11.47	150.76
2011	9.82	126.60	**2011**	11.89	152.72
2012	10.82	130.21	**2012**	13.03	155.08
2013	12.82	124.92	**2013**	12.82	143.96
			2014	15.78	166.68
			2015	13.07	163.42

	IGFS Abundance Indices by numbers by 10 square kilometers
2003	1227
2004	1926
2005	2254
2006	2039
2007	725
2008	1238
2009	1724
2010	1103
2011	1116
2012	583
2013	497
2014	593
2015	629

Table 5.2.4.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. French and Spanish cpues for different bottom-trawl fleets.

	French (single and twin bottom trawls combined) CPUE (kg/h)				Spanish CPUE (kg/(100day*100 hp))			Irish LPUE ('000 h)
	Benthic Bay of Biscay	Benthic Western Approaches	Gadoids Western Approaches	Nephrops Western Approaches	A Coruña -VII	Cantábrico- VII	Vigo-VII	Otter trawlers
1984					16.3	130.1	99.1	-
1985	3.0	5.3	4.7	4.7	9.8	39.5	108.9	-
1986	3.2	4.8	2.8	4.4	21.1	52.8	105.1	-
1987	3.3	5.1	2.7	4.5	8.3	80.7	96.2	-
1988	3.8	5.8	3.0	4.1	9.8	78.3	106.1	-
1989	3.6	5.5	2.6	4.2	14.6	48.1	92.1	-
1990	3.1	4.2	1.8	3.4	15.1	18.4	73.8	-
1991	2.6	4.0	1.3	2.8	12.9	25.9	85.4	-
1992	2.5	4.5	1.5	3.4	6.9	32.8	105.6	-
1993	1.9	4.6	1.2	3.5	5.1	33.5	92.3	-
1994	1.9	4.2	1.2	3.4	7.4	52.7	78.7	-
1995	2.3	4.9	1.4	3.4	7.8	61.3	94.3	13.7
1996	2.6	5.0	1.4	3.5	3.9	58.4	79.3	13.6
1997	3.3	5.6	1.2	3.0	3.0	46.9	96.0	12.1
1998	2.9	6.5	1.5	3.6	2.4	35.7	82.4	10.0
1999	3.0	6.3	0.9	3.4	1.1	32.5	137.0	11.3
2000	2.9	6.8	0.6	4.0	5.5	45.0	128.9	13.4
2001	2.2	6.8	0.7	4.1	1.3	75.6	131.2	13.1
2002	2.1	6.8	0.5	3.2	1.3	76.4	185.3	12.2
2003	1.8	5.8	0.6	3.2	11.2	54.0	192.1	8.2
2004	1.8	4.6	0.5	3.4	3.3	60.0	211.0	9.3
2005	1.9	5.1	0.4	4.2	1.7	58.46	135.3	10.0
2006	2.5	4.8	0.3	3.6	1.4	76.42	146.1	7.5
2007	2.4	5.1	0.4	2.9	2.4	87.86	144.3	8.5
2008	2.2	4.6	0.5	3.1	3.0	37.58	114.0	8.4
2009	NA	NA	NA	NA	8.3	0.00	173.2	10.3
2010	NA	NA	NA	NA	7.9	38.78	198.3	11.8
2011	NA	NA	NA	NA	19.7	0.0	151.2	13.5
2012	NA	NA	NA	NA	6.4	0.0	135.3	19.3
2013	NA	NA	NA	NA	10.0	0.0	210.2	19.4
2014	NA	NA	NA	NA	3.4	0.0	116.7	15.4
2015	NA	NA	NA	NA	4.5		89.7	17.9

(*) LPUEs, no discards available

Table 5.6.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Reference points table updated in WGBIE 2016.

From the IBP megrim (ICES, 2016):	Type	IBP Megrim 2016 Value	WGBIE 2016 NEW Value	Technical Basis
MSY approach	MSY $B_{trigger}$	41 800	41 800	B_{pa}, because the fishery has not been at F_{MSY} in the last 10 years
	F_{MSY}	0.161	0.191	F giving maximum yield at equilibrium. Computed using Eqsim. Using 3 years range for bio. Parameters.
Precautionary approach	B_{lim}	37 100	37 100	B_{loss}, which is the lowest biomass observed corresponding to year 2006
	B_{pa}	41 800	41 800	$B_{lim}e^{1.645\,\sigma}$ where $\sigma = 0.07$is the standard deviation of the logarithm of SSB in 2014
	F_{lim}	0.489	0.533	It is the F that gives 50% probability of SSB being above Blim in the long term. It is computed using Eqsim based on segmented regression with the breakpoint fixed at Blim, without advice/assessment error and without Btrigger
	F_{pa}	0.412	0.451	$F_{lim}e^{-1.645\,\sigma}$ where $\sigma = 0.105$ is the standard deviation of the logarithm of F in 2014

Table 5.3.3.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. IBP 2016 Prior distributions of final run.

$LN(\mu,\psi)$ denotes the lognormal distribution with median μ and coefficient of variation ψ, and $\Gamma(u,v)$ denotes the Gamma distribution with mean u/v and variance u/v^2.

Parameter and prior distribution	Values used in prior settings
$N(y,1) \sim LN(medrec, 2)$	$medrec = 250000$
$N(1984,a) \sim LN(medrec \exp[-(a-1)M - \sum_{j=1}^{a-1} medF(j)], 2), a = 2,\ldots,9$	$medrec$ as above, $M = 0.2$, $medF = (0.05,0.1,0.3,0.3,0.3,0.3,0.3,0.3,0.3)$
$N(1984,10+) \sim LN(medrec \exp[-9M - \sum_{j=1}^{9} medF(j)]/\{1-\exp[-M - medF(9)]\}, 2)$	$medrec, M, medrecF$ as above
$f(y) \sim LN(med_f, CV_f)$	$med_f = 0.3, CV_f = 1$
$\rho \sim Uniform(0,1)$	
$r_L(1984,a) \sim LN(medr_L(a),1), a = 1,\ldots,8$	$medr_L = (0.0005,0.05,1,1,1,1,1,1)$
$r_L(y,9) = r_L(y,10+) = 1$	
$r_{SPD}(1984,a) \sim LN(medr_{SPD}(a),1), a = 1,\ldots,7$	$medr_{SPD} = (0.002,0.02,0.02,0.02,0.01,0.01,0.01)$
$r_{IRD}(1984,a) \sim LN(medr_{IRD}(a),1), a = 1,\ldots,8$	$medr_{IRD} = (0.001,0.01,0.01,0.01,0.005,0.005,0.005,0.001)$
$r_{UKD}(1984,a) \sim LN(medr_{UKD}(a),1), a = 1,\ldots,8$	$medr_{UKD} = (0.00001,0.001,0.001,0.001,0.001,0.001,0.001,0.001)$
$r_{FRD}(1984,a) \sim LN(medr_{FRD}(a),1), a = 1,\ldots,8$	$medr_{FRD} = (0.002,0.02,0.02,0.02,0.01,0.01,0.01,0.01)$
$r_{OTD}(1984,a) \sim LN(medr_{OTD}(a),1), a = 1,\ldots,8$	$medr_{OTD} = (0.002,0.02,0.02,0.02,0.01,0.01,0.01,0.002)$
$r_{SPD}(y,7) = r_{SPD}(y,a) = r_{IRD}(y,a) = r_{UKD}(y,a) = r_{FRD}(y,a) = r_{OTD}(y,a) = 0, \ a = 8,9,10+$	
$\tau_C(a), \tau_L(a), a = 1,2,3; \tau_D(a), a = 1,\ldots,8$	$\Gamma(4,0.345)$
$\tau_C(a), \tau_L(a), a = 4,\ldots,10+$	$\Gamma(10,0.1)$
$\tau_{SPD}(a), a = 1,\ldots,7; \tau_{IRD}(a), \tau_{UKD}(a), \tau_{FRD}(a) a = 1,\ldots,8$	$\Gamma(4,0.345)$
$\log[q_k(a)] \sim N(\mu_{Ik}, \tau_{Ik}), a \le 8$, index $k = 1,\ldots,5$	$\mu_{Ik} = -7, \ \tau_{Ik} = 0.2$
$q_k(a) = q_k(8), a > 8$, indices k with ages > 8	
$\tau_k(a)$, index $k = 1,\ldots,5$	$\Gamma(4,0.345)$

Table 5.5.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Catch forecast: management option table.

Short term forecast table							
F scaled							
Recluit 2016=R(GM84-13)							
2016							
Rec_2016	**SSB_2016**	**TSB_2016**	**Fbar_2016**	**Catch_2016**	**Land_2016**	**Disc_2016**	**SSB_2017**
234864	**80624**	**101074**	**0.22**	**15951**	**13018**	**2924**	**86360**

2017						
Fmult	F_2017	Catch_2017	Land_2017	Disc_2017	Rec_2018	SSB_2018
0	0	0	0	0	234864	109941
0.1	0.02	1954	1678	272	234864	107639
0.2	0.04	3859	3315	540	234864	105330
0.3	0.06	5717	4906	803	234864	103112
0.4	0.09	7530	6461	1062	234864	100931
0.5	0.11	9300	7977	1317	234864	98859
0.6	0.13	11028	9449	1568	234864	96831
0.7	0.15	12712	10886	1814	234864	94808
0.8	0.17	14369	12284	2057	234864	92800
0.9	0.19	15969	13647	2295	234864	90863
1	**0.22**	**17540**	**14969**	**2531**	**234864**	**89011**
1.1	0.24	19070	16263	2763	234864	87218
1.2	0.26	20564	17525	2991	234864	85447
1.3	0.28	22025	18759	3214	234864	83721
1.4	0.3	23456	19968	3435	234864	82026
1.5	0.32	24853	21143	3652	234864	80350
1.6	0.34	26207	22295	3866	234864	78734
1.7	0.37	27536	23412	4076	234864	77171
1.8	0.39	28830	24492	4282	234864	75619
1.9	0.41	30098	25558	4487	234864	74113
2	0.43	31341	26593	4688	234864	72634

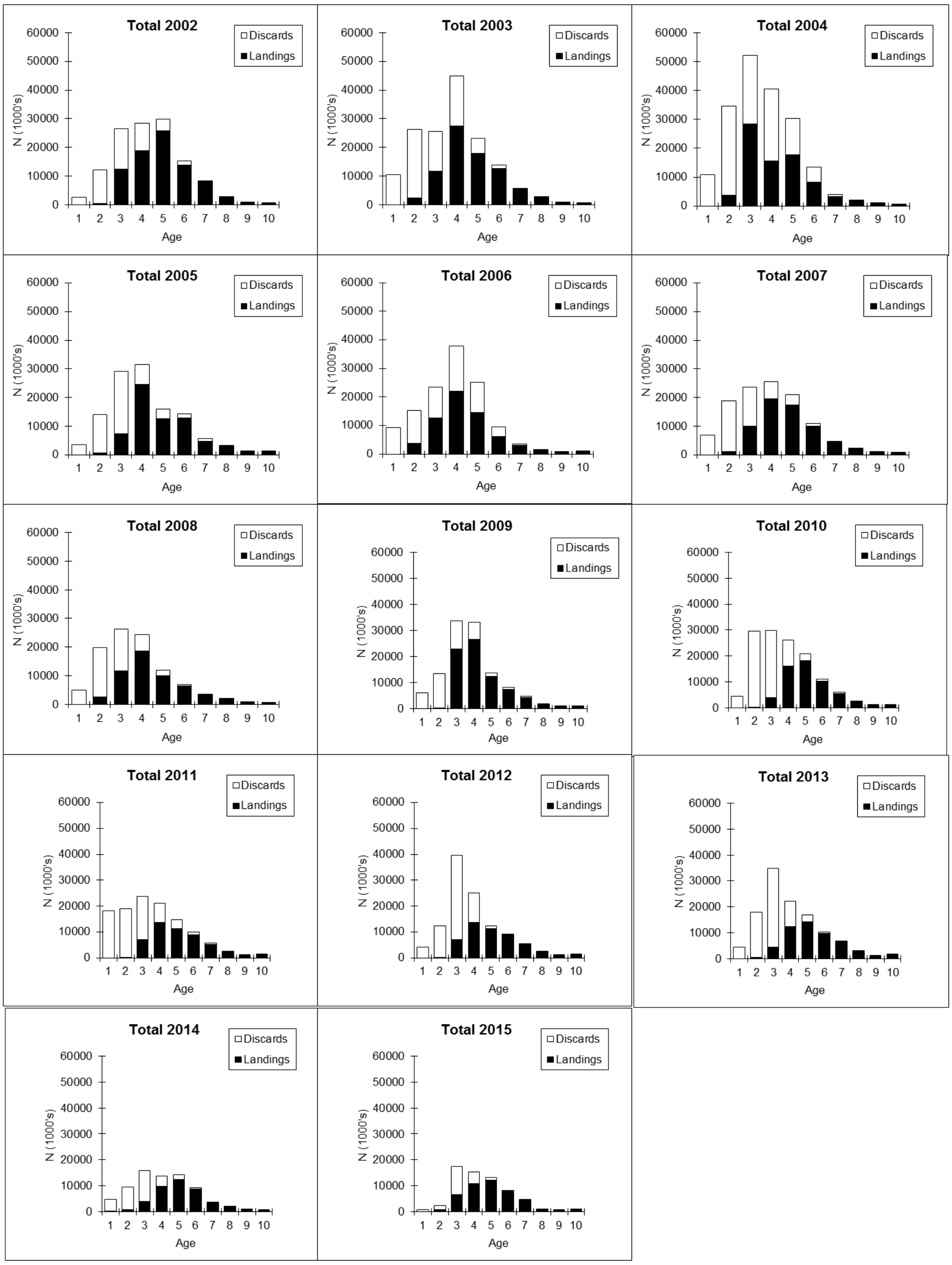


Figure 5.2.2.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Age composition of catches for the years 2002–2015.

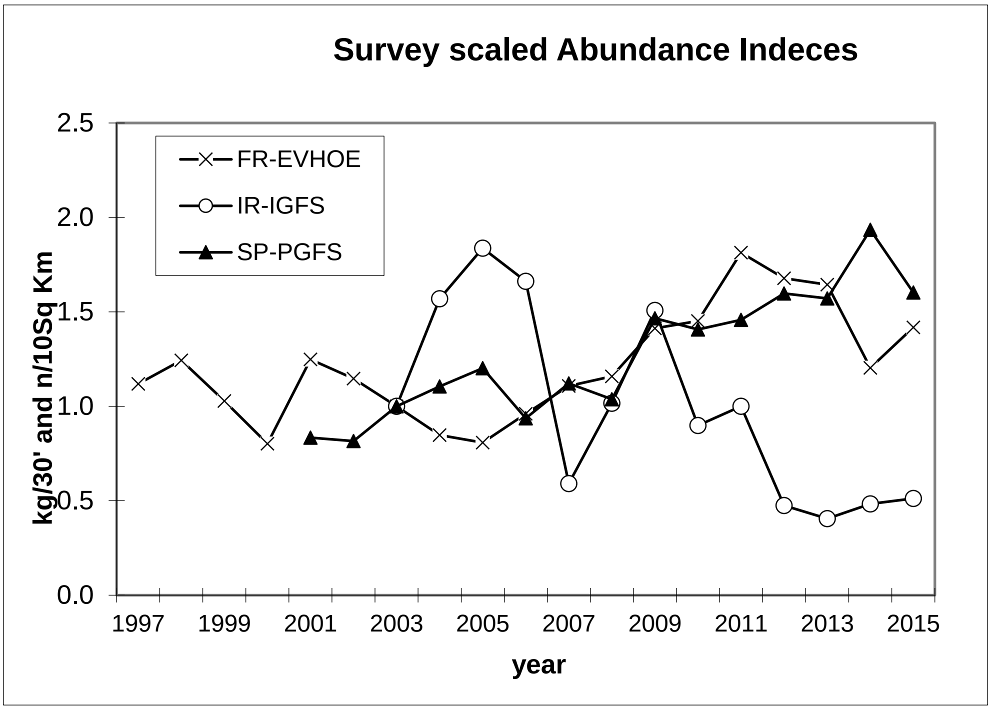


Figure 5.2.3.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Scaled Biomass Indices for FR-EVHOE, SP-PGFS and IR-IGFS.

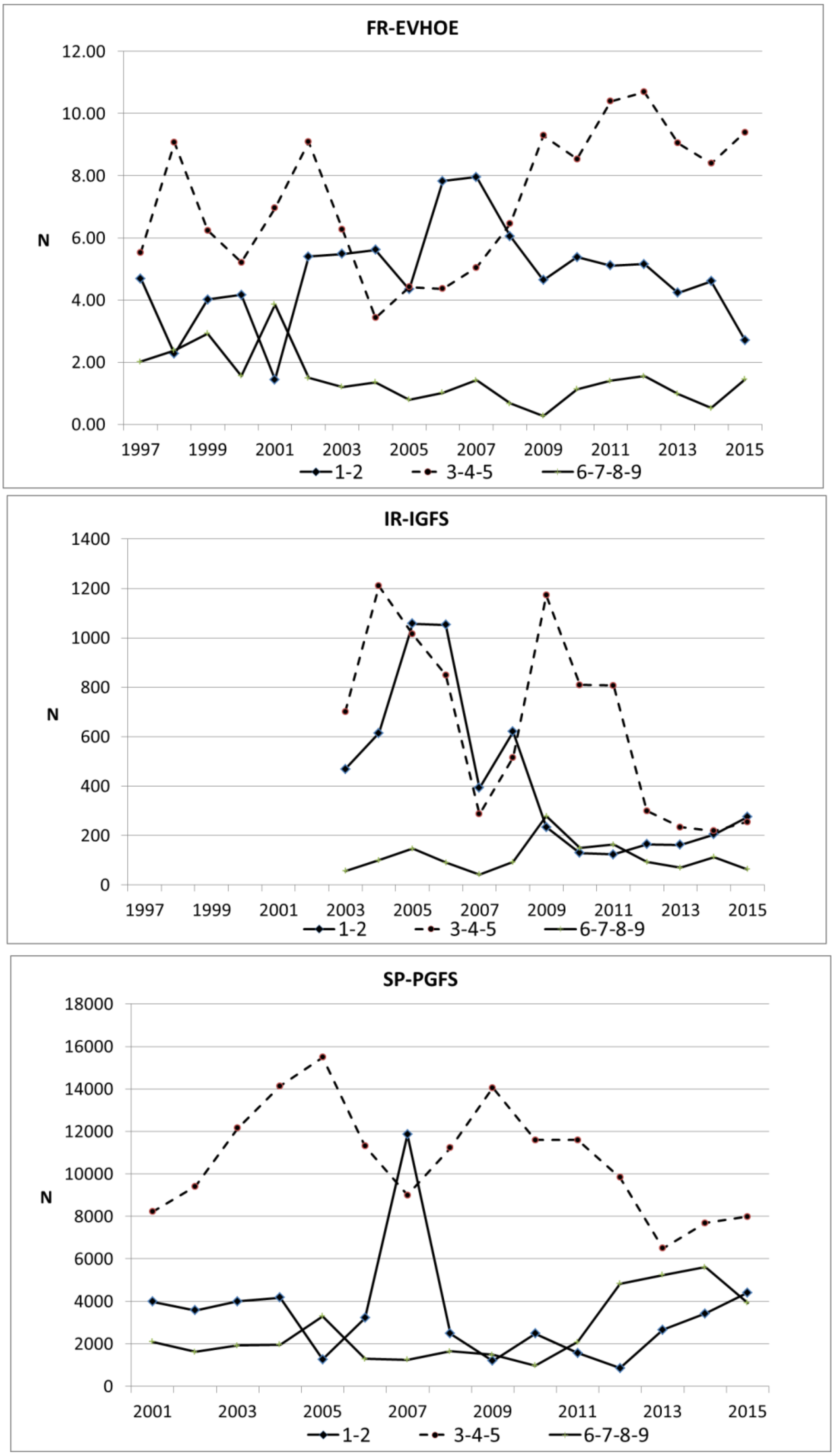


Figure 5.2.3.2. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Abundance Indices for EVHOE, IGFS and SP-PGFS by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+.

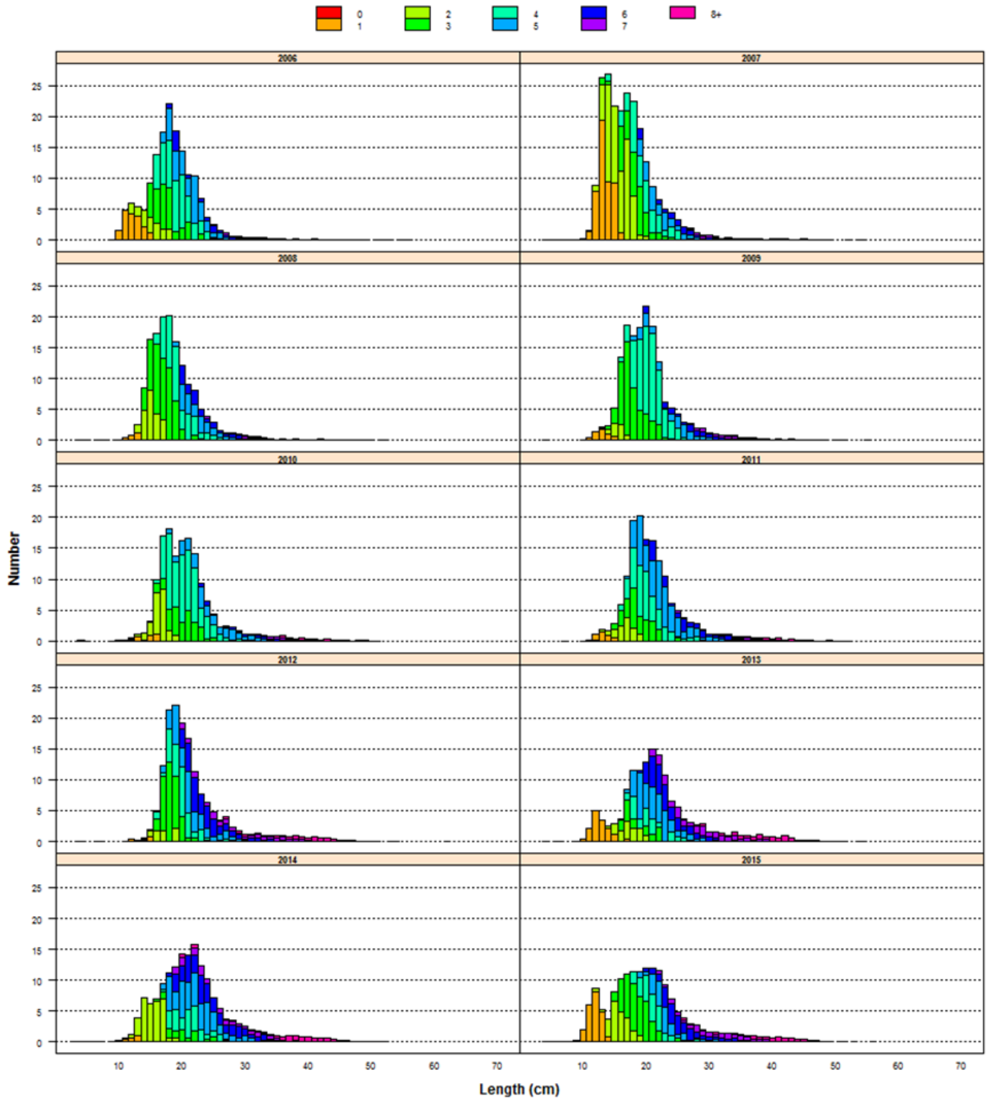


Figure 5.2.3.3. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Age composition of SP-PORCUPINE survey in abundance (numbers).

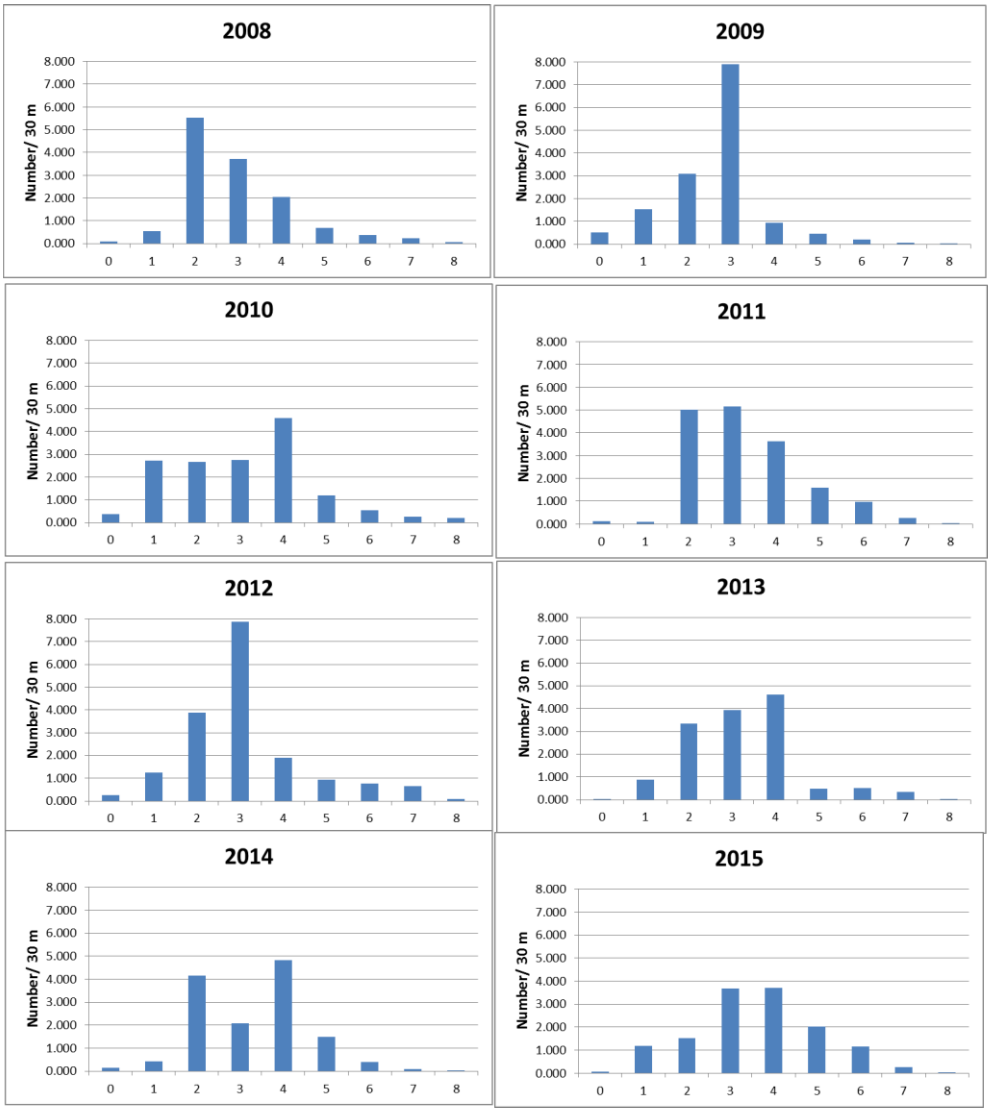


Figure 5.2.3.4. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Age composition of FR-EVHOE survey in abundance (numbers/30min haul).

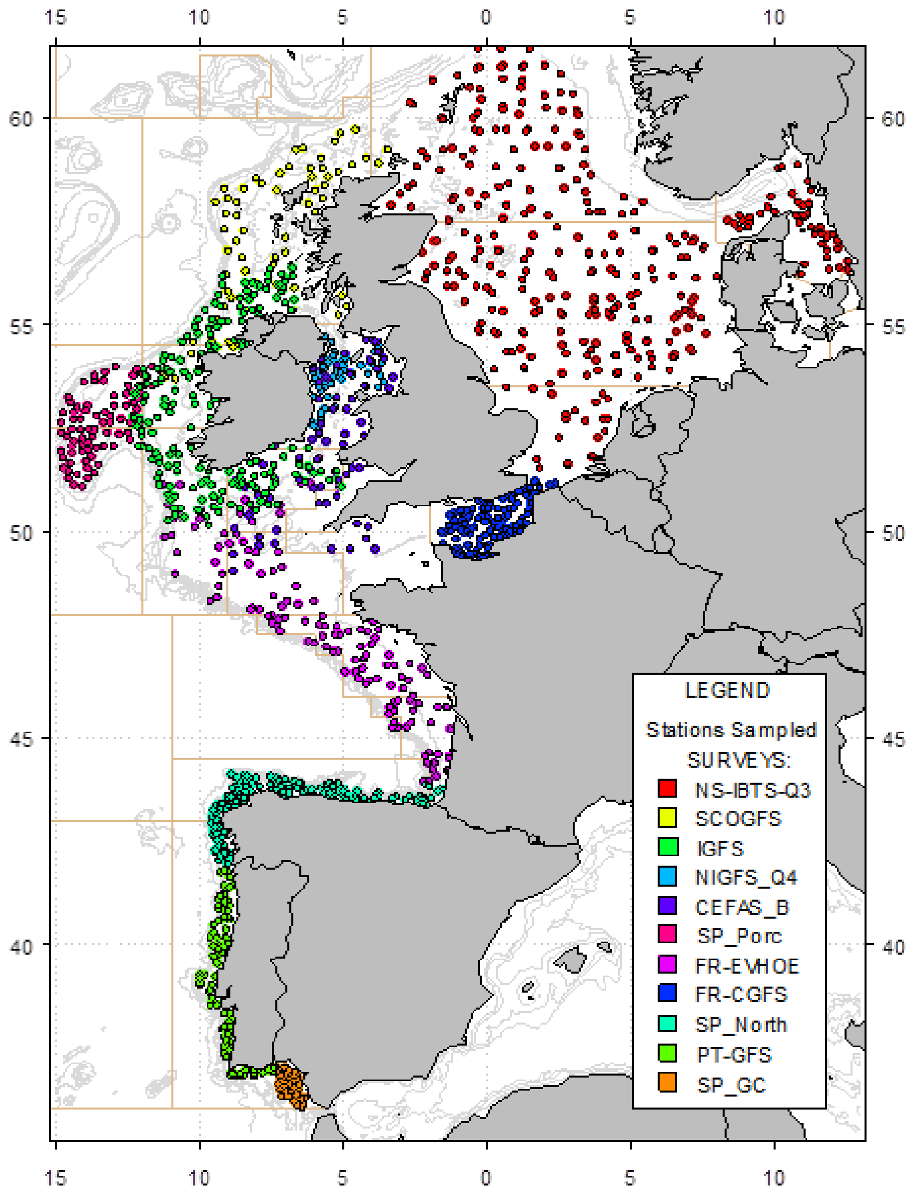


Figure 5.2.3.5. Station positions for the IBTS Surveys carried out in the Western Atlantic and North Sea Area in autumn/winter of 2008. (From IBTSWG 2009 Report). Just to be used as general location of the Surveys.

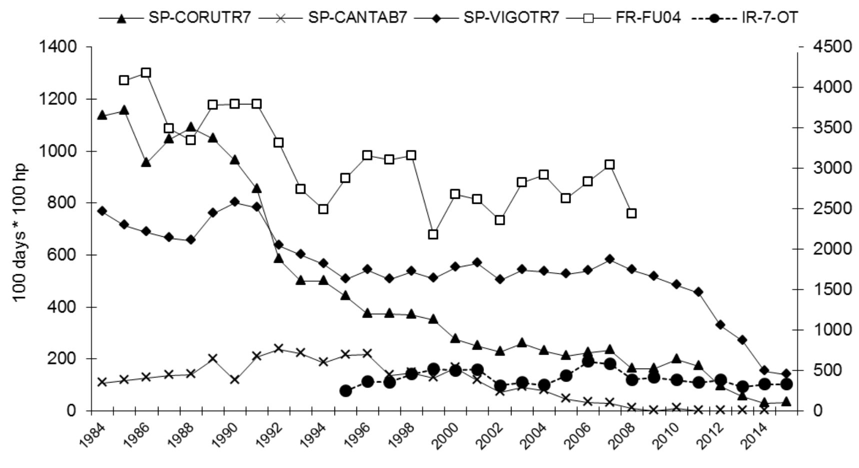


Figure 5.2.4.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Evolution of effort for different bottom-trawler fleets.

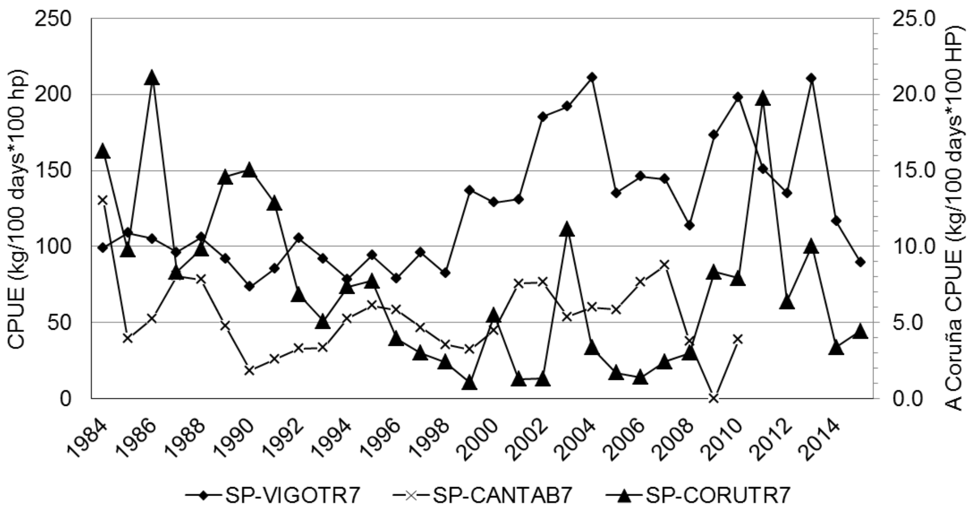


Figure 5.2.4.2. Megrim (*L. whiffiagonis*) in Divisions 7b,c,e-k and 8a,b,d. Spanish cpue for different bottom-trawler fleets.

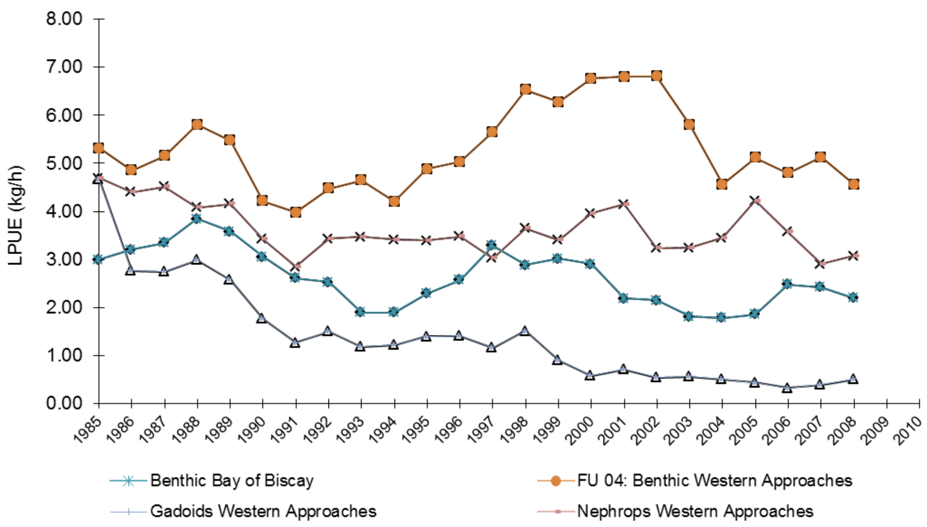


Figure 5.2.4.3. Megrim (*L. whiffiagonis*) in Divisions 7b,c,e-k and 8a,b,d. French LPUE for different bottom-trawler fleet.

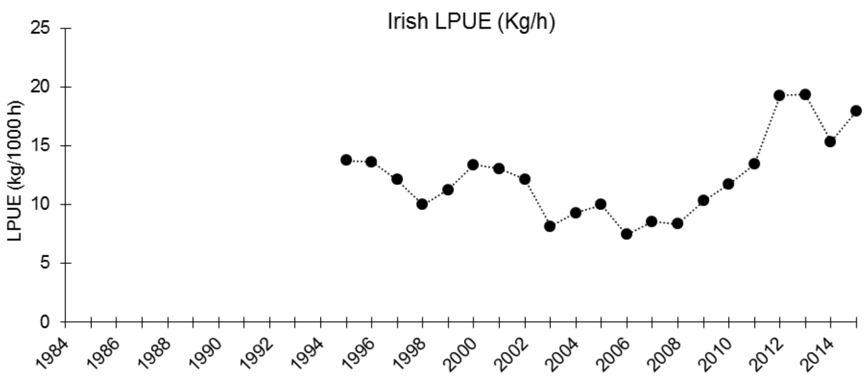


Figure 5.2.4.4. Megrim (*L. whiffiagonis*) in Divisions 7b,c,e-k and 8a,b,d. Irish LPUE for beam trawl fleet.

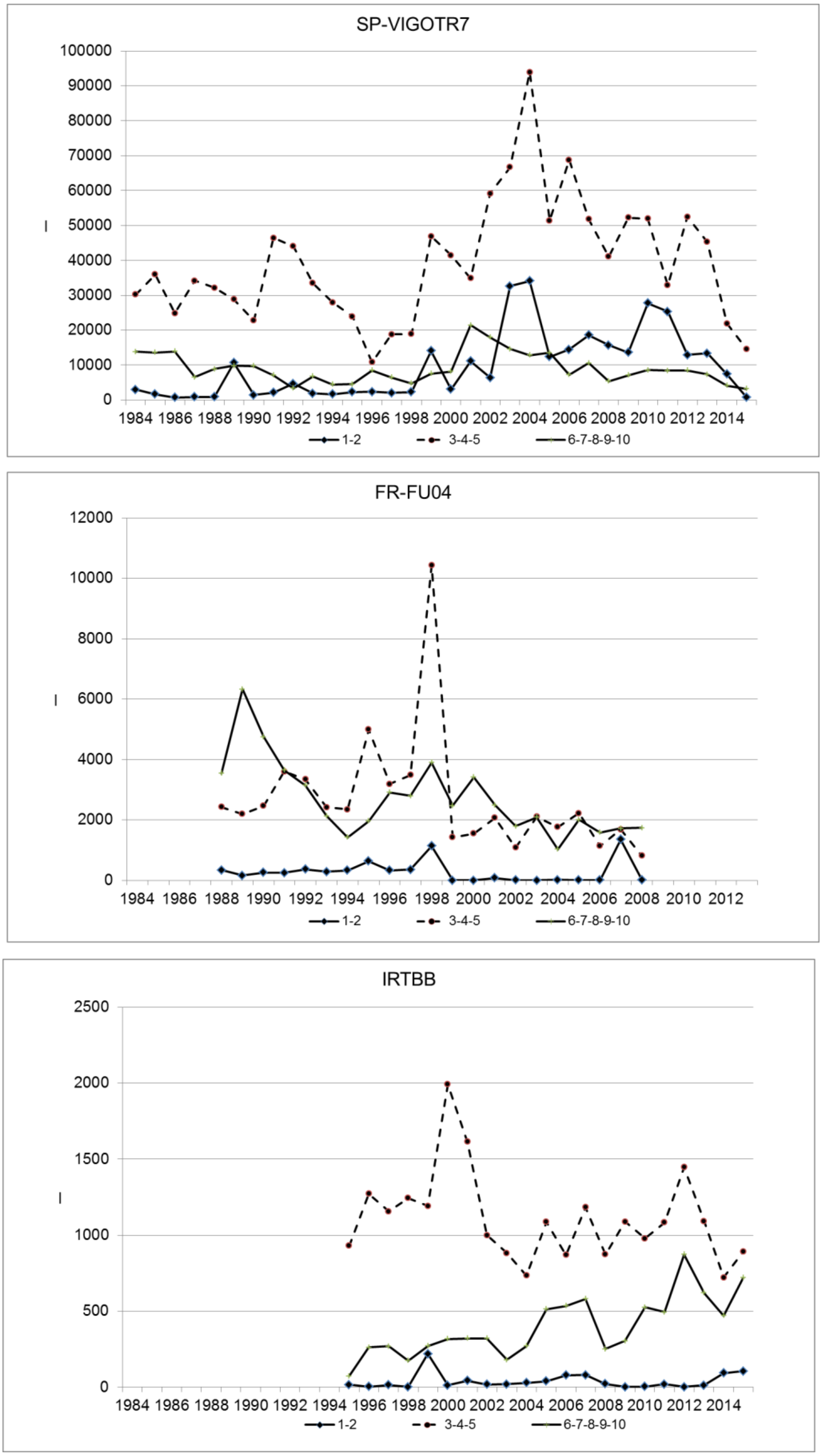


Figure 5.2.4.5. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Abundance Indices for SP-VIGOTR7, FR-FU04 and IRTBB by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+.

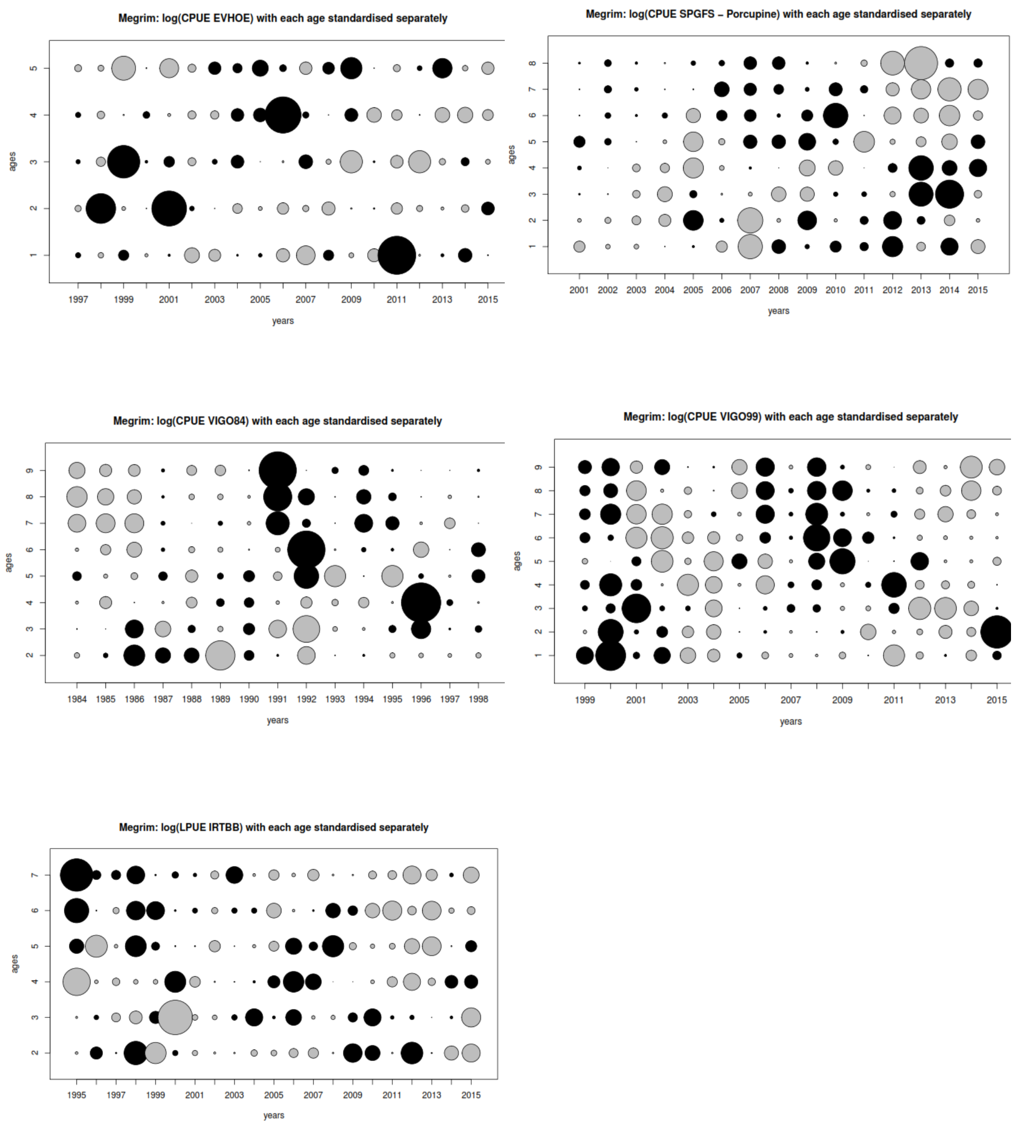


Figure 5.3.1.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Bubble plots of the standardized log abundance indices of the surveys and commercial fleets used as tuning fleets.

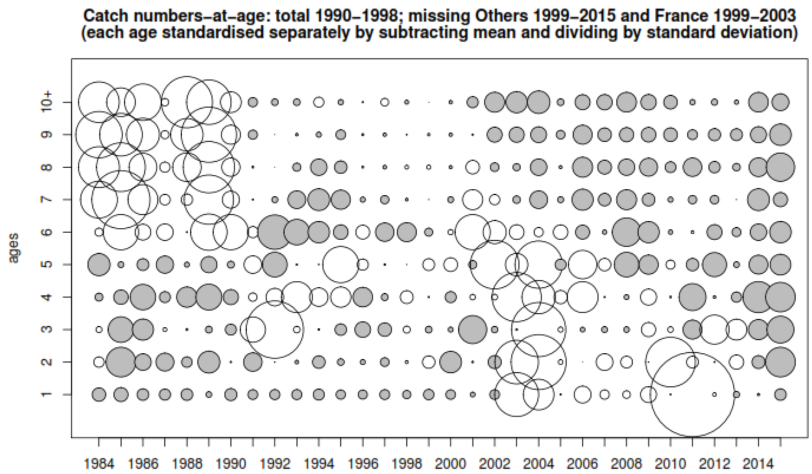


Figure 5.3.1.2. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Bubble plots for catch numbers-at-age from 1984–2015.

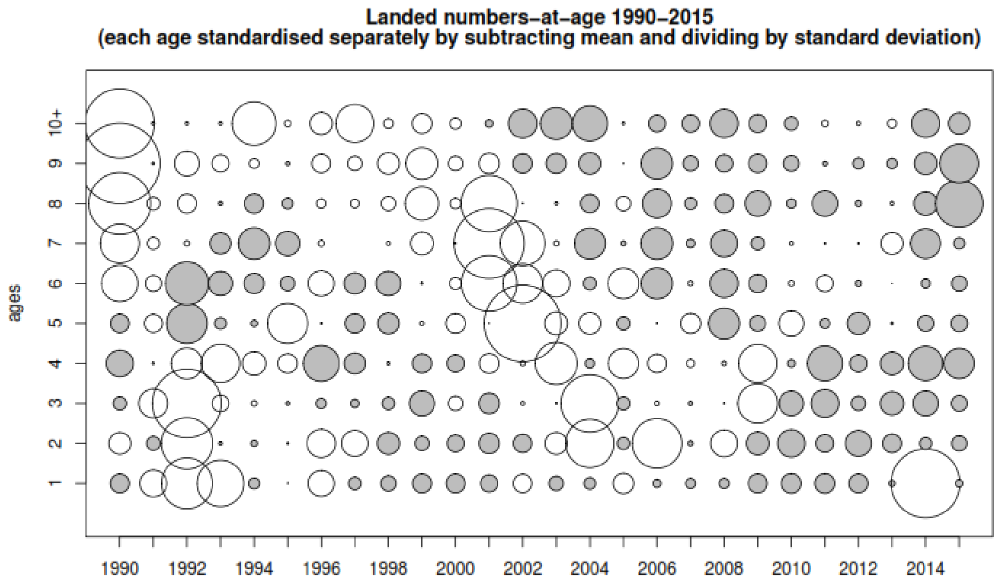


Figure 5.3.1.3. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Bubble plots for landing numbers-at-age from 1990–2015.

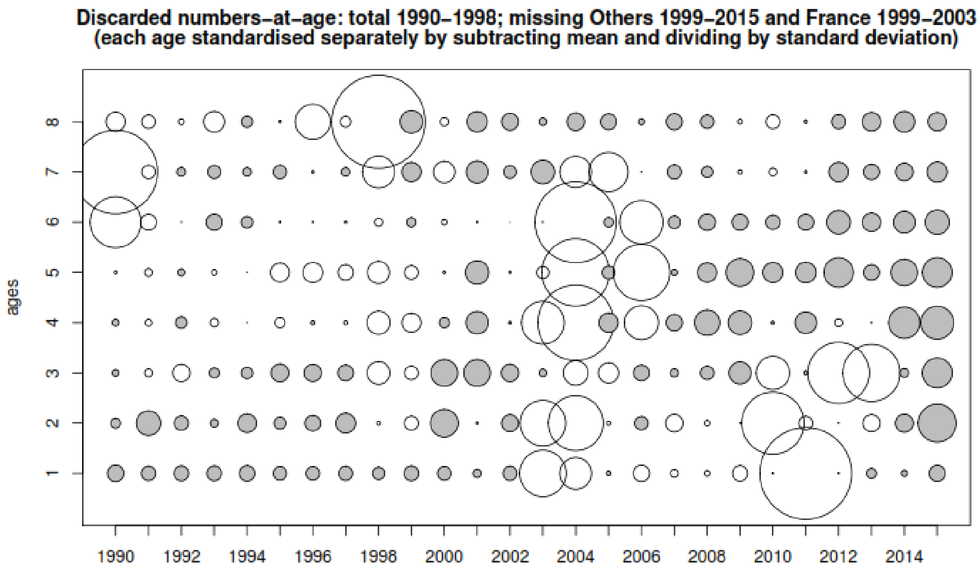


Figure 5.3.1.4. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Bubble plots for discarded numbers-at-age from 1990–2015.

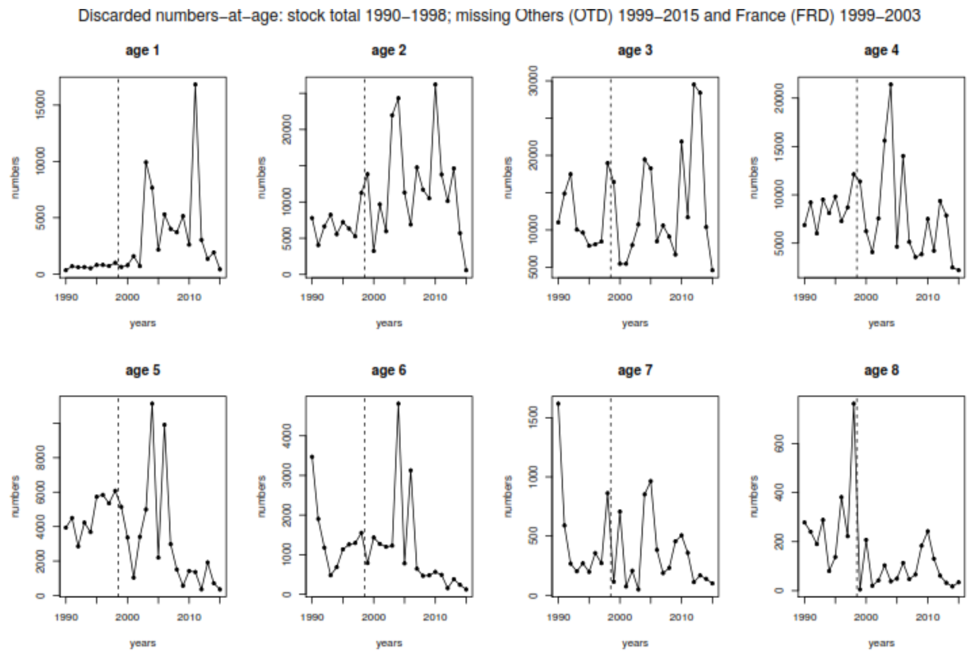


Figure 5.3.1.5. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Discarded numbers-at-age separated by age from 1990–2015.

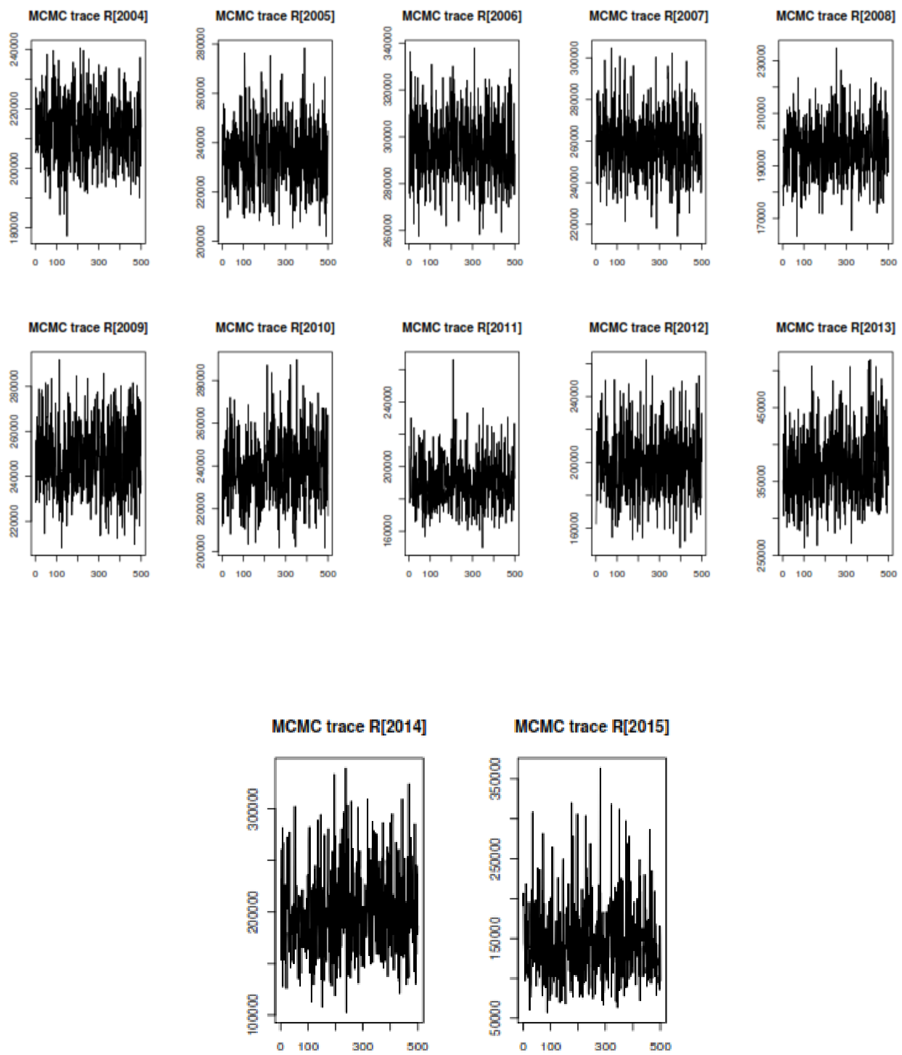


Figure 5.3.3.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Trace plots of recruitment draws from 2004–2015.

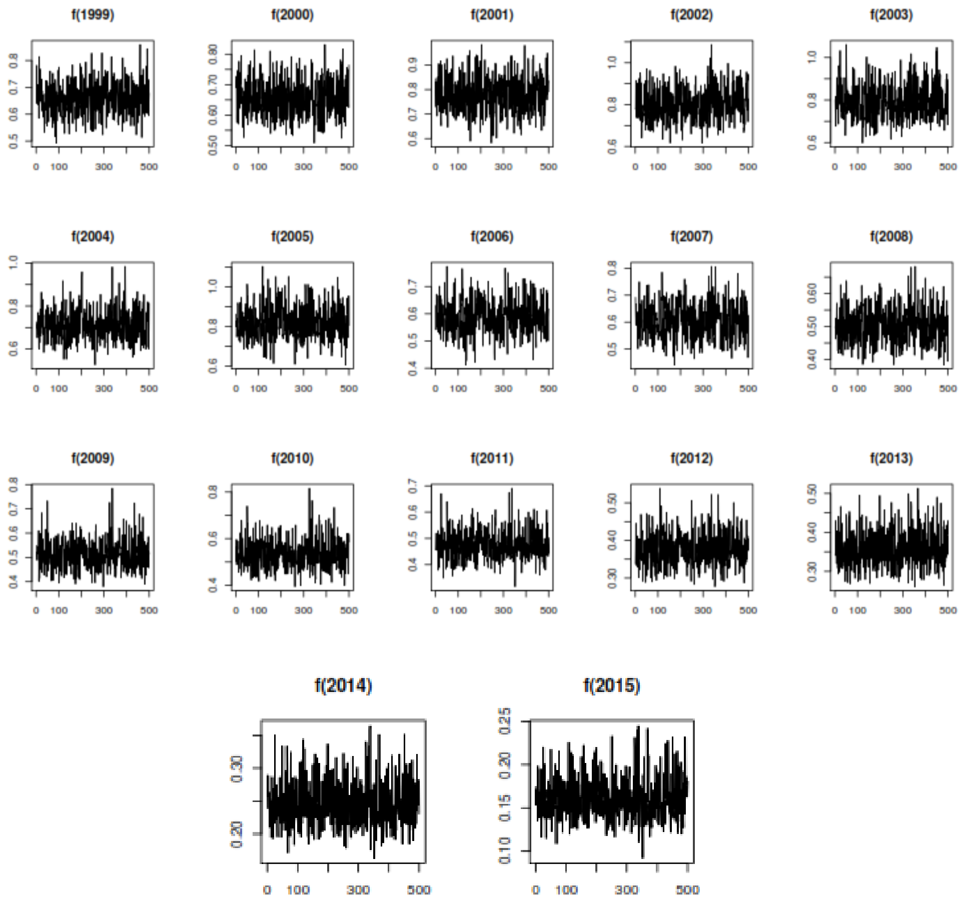


Figure 5.3.3.2. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Trace plots of f(y) fishing mortality in ages 9 and 10 from 1999–2015.

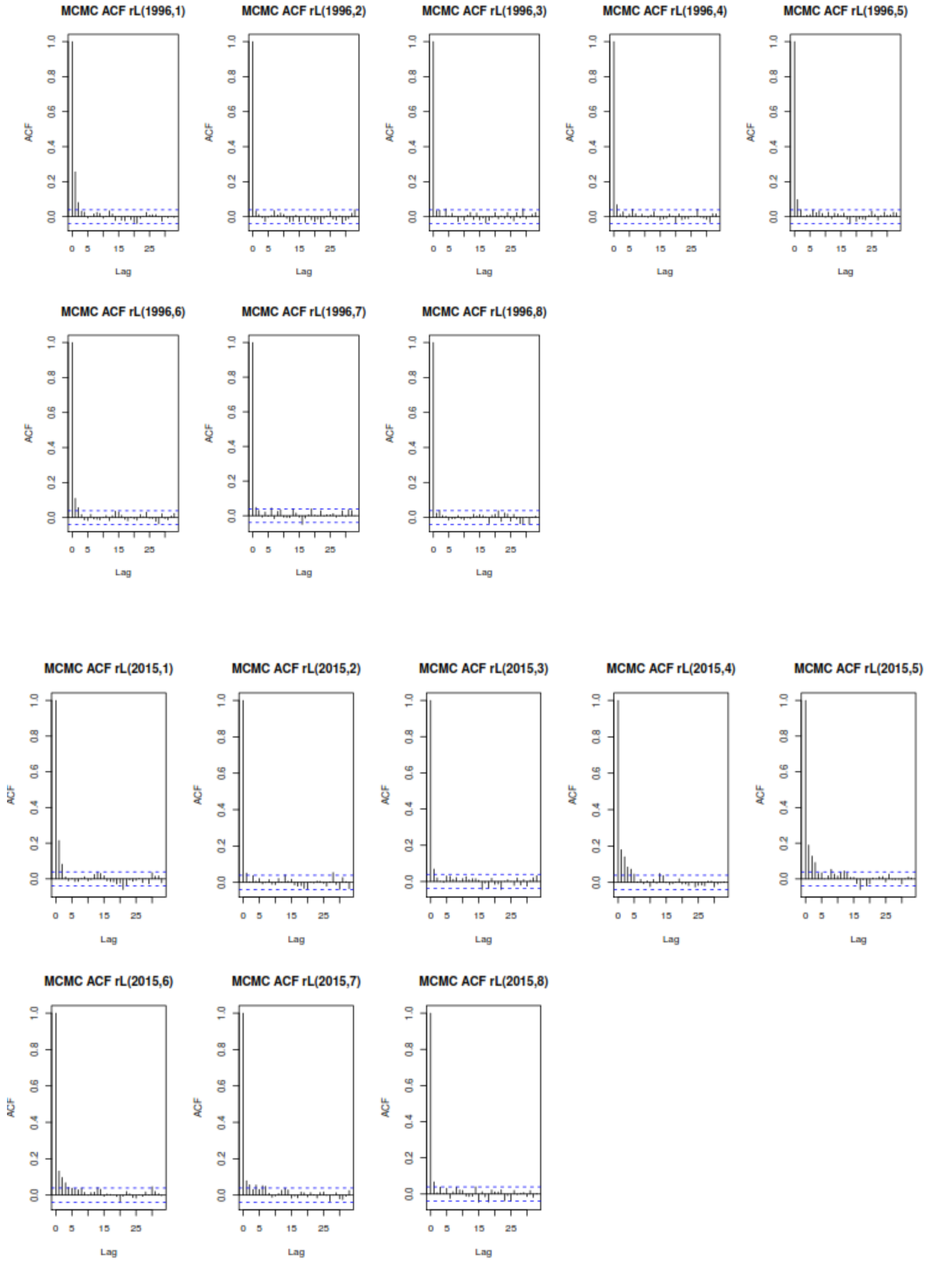


Figure 5.3.3.3. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Autocorrelation plots of rL for years 1996 and 2015.

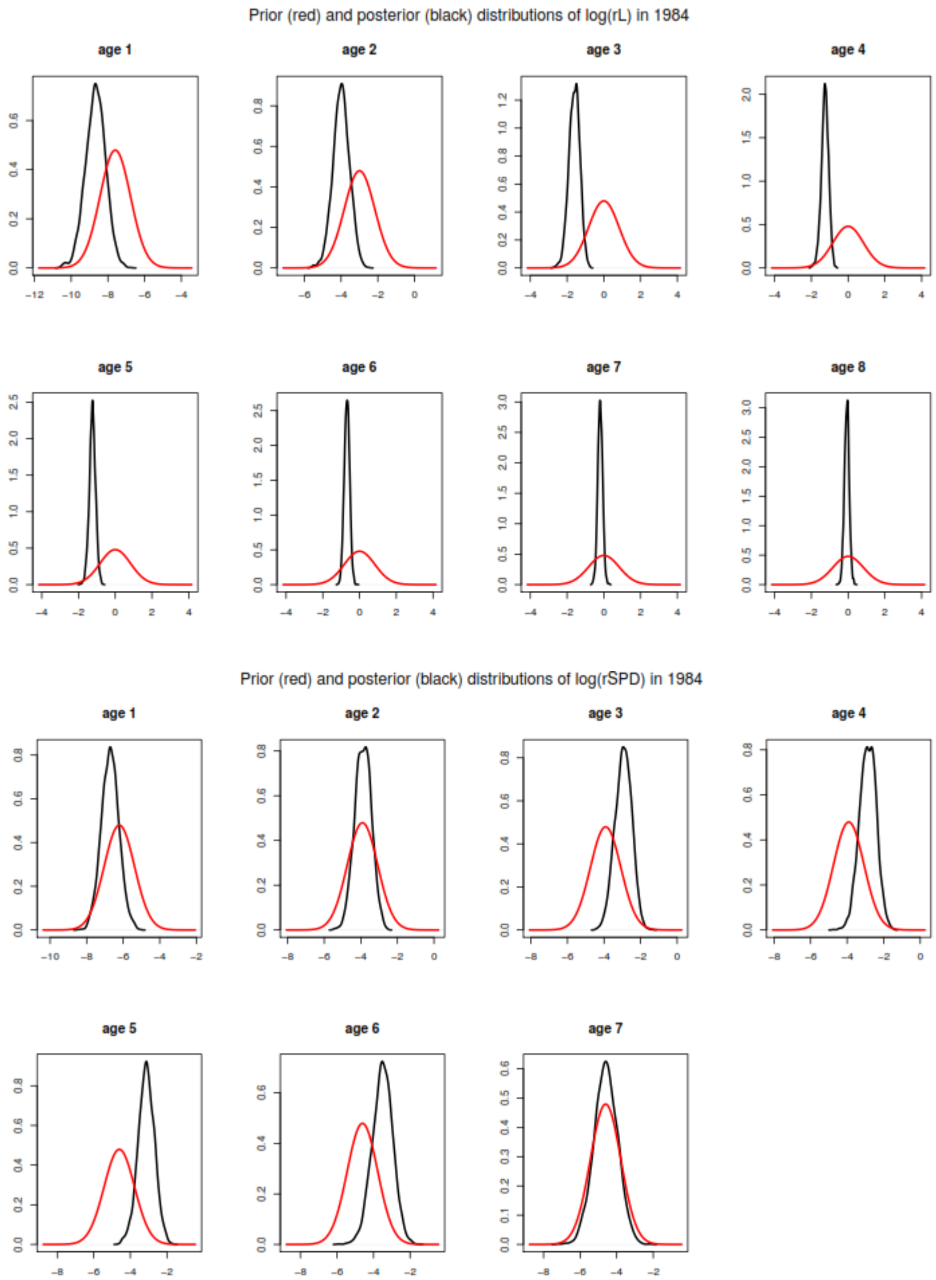


Figure 5.3.3.4. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Prior (red) and posterior distribution of log (L) in 1984, log (rSPD) at age in 1984.

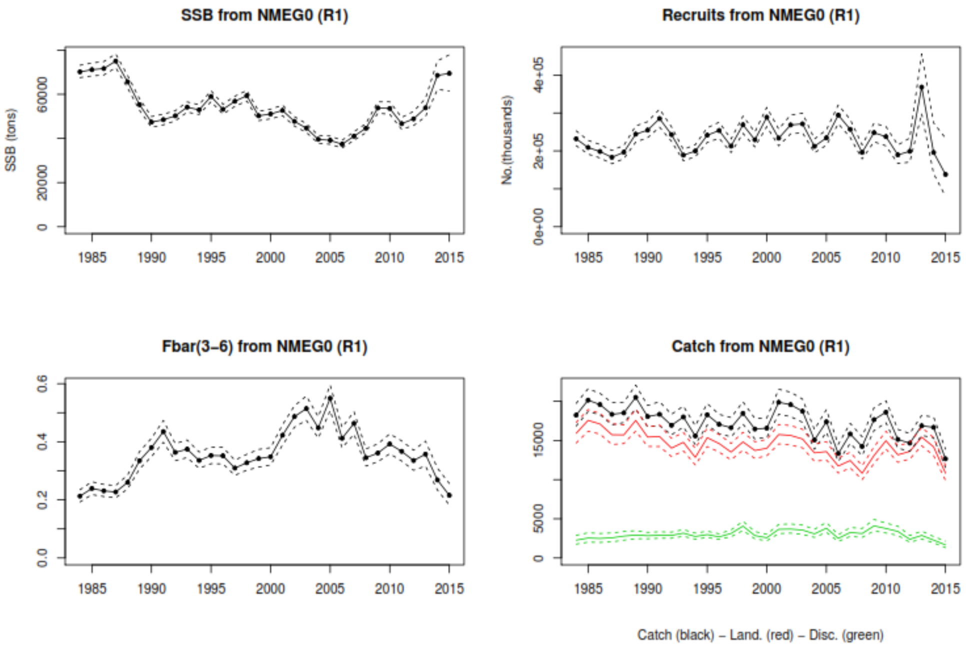


Figure 5.3.3.5. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Time-series of spawning-stock biomass (SSB), recruits, F_{bar}, catch, landings and discards from 1984–2015. The solid dotted lines correspond to the median of the distribution and the dashed lines with 5% and 95% quantiles.

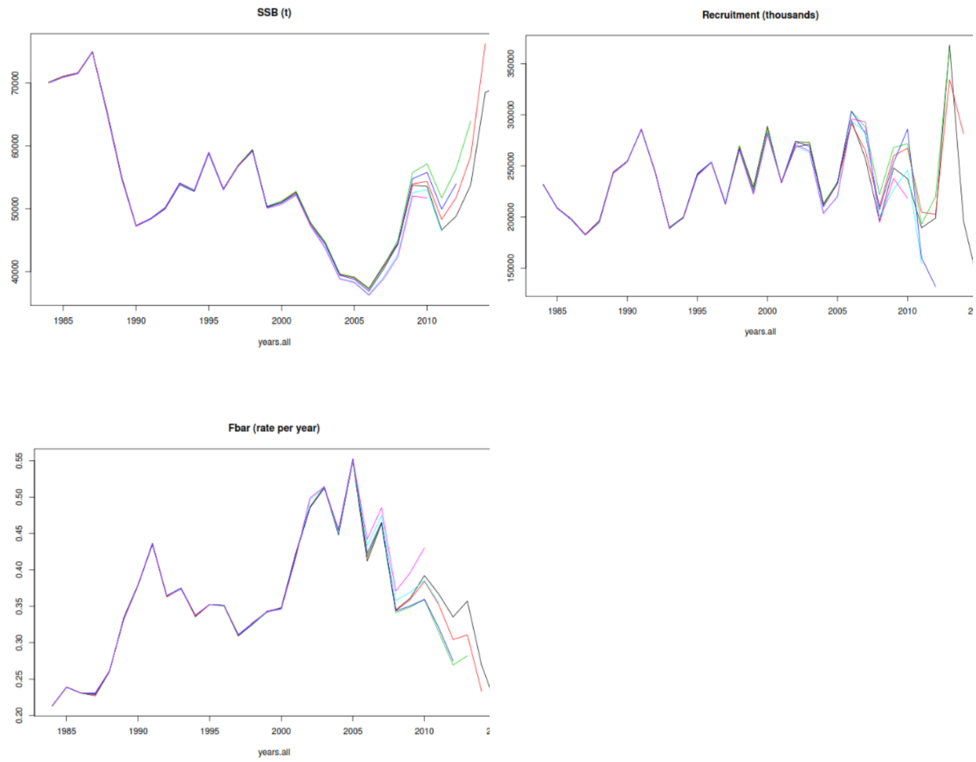


Figure 5.4.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Time-series of median SSB, recruitment and Fbar in retrospective analysis.

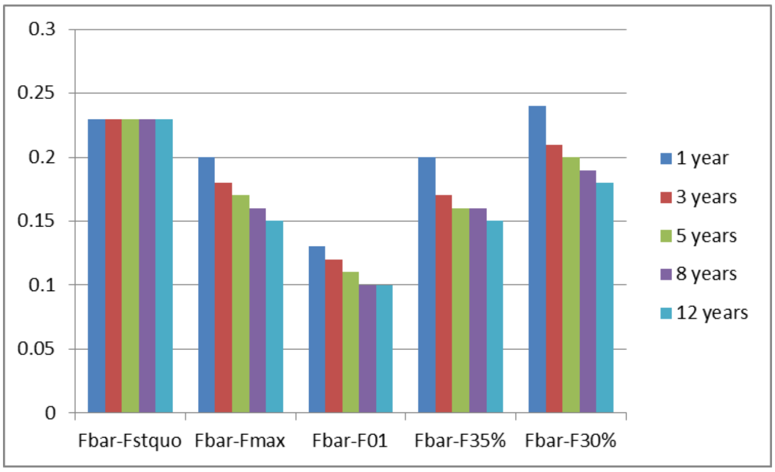


Figure 5.6.1. Megrim (*L. whiffiagonis*) in Divisions 7.b-k and 8.a,b,d. Sensitivity of the reference points obtained in the per recruit equilibrium analysis to the number of years assumed for the biological parameters and the exploitation pattern.

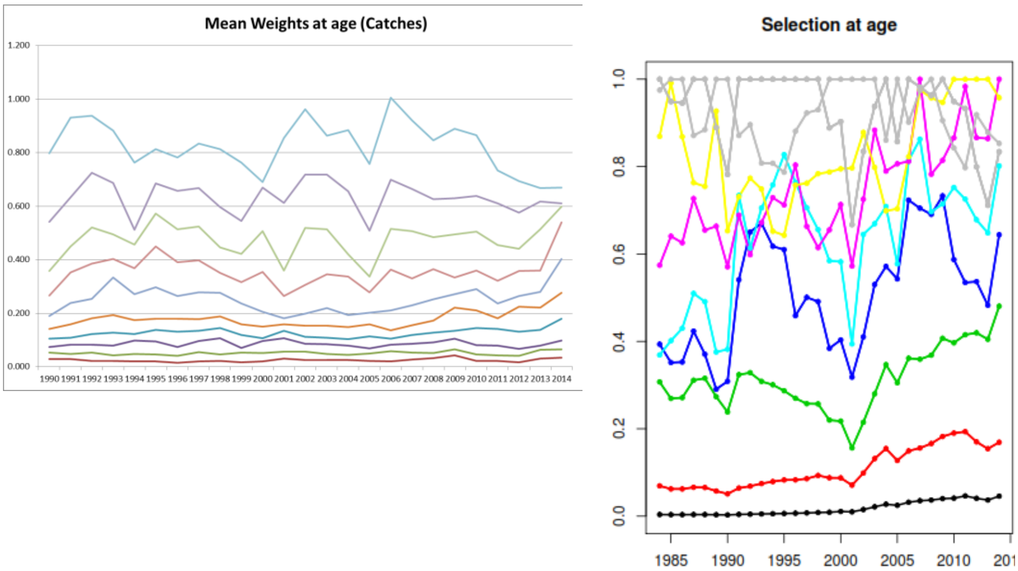


Figure 5.6.2. Megrim (*L. whiffiagonis*) in Divisions 7.b-k and V8.a,b,d. Time-series of mean weight at age and selection at age.

6 Megrims (*Lepidorhombus whiffiagonis* and *L. boscii*) in Divisions 8.c and 9.a

Lepidorhombus whiffiagonis:

Type of assessment in 2016: Update.

Data revisions this year:

No revisions this year.

Lepidorhombus boscii:

Type of assessment in 2016: Update.

Data revisions this year:

No revisions this year.

General

See Stock annex general aspects related to megrim assessment.

Ecosystem aspects

See Stock annex for ecosystem aspects related to megrim assessment.

Fishery description

See Stock annex for fishery description.

Summary of ICES advice for 2016 and management for 2015 and 2016

ICES advice for 2016(as extracted from ICES Advice 2015, Book 7):

Because the two megrim species (*L. whiffiagonis* and *L. boscii*) are not separated in the landings, the advice of the two stocks is linked. Fsq is above F_{MSY} for *L. boscii* and for *L. whiffiagonis*. To get fishing mortality for both stocks at or below F_{MSY}, the F multiplier of *L. boscii* is applied to both stocks.

For *L. boscii*, following the ICES MSY approach implies fishing mortality to be reduced to 0.17 (F_{MSY}), resulting in landings of no more than 841 t in 2016. If discard rates do not change from the average of the last five years (2010–2014), this implies catches of no more than 1072 t. This is expected to lead to an SSB of 6918 t in 2017. For *L. whiffiagonis*, the ICES MSY approach implies a reduction in fishing mortality to 0.15, resulting in catches of no more than 186 t in 2016. If the discard rate do not change from the average of the last five years (2010–2014), this implies landings of no more 172 t. This is expected to lead to an SSB of 1051 t in 2017.

Management applicable for 2015 and 2016:

The agreed combined TAC for megrim and four-spot megrim in ICES Divisions 8.c and 9.a was 1377 t in 2015 and 1363 t in 2016.

6.1 Megrim (*L. whiffiagonis)* in Divisions 8.c and 9.a

6.1.1 General

See general section for both species.

6.1.2 Data

6.1.2.1 Commercial catches and discards

Working Group estimates of landings, discards and catches for the period 1986 to 2015 are given in Table 6.1.1. Estimates of catches currently include an unallocated landing category. These estimates are considered the best information available at this time. In 2015, data revised for period 2011-2013 were provided. This revision produced an improvement in the allocation of sampling trips and data revised are used in the assessment. The total estimated international landings in Divisions 8.c and 9.a for 2015 was 276 t. Landings reached a peak of 977 t in 1990, followed by a steady decline to 117 t in 2002. Some increase in landings has been observed since then, but landings have again decreased annually 2007–2010 were the lowest value of the entire series occurred. Since 2011, the stock is increasing again. Historical landings for both species combined are shown in Figure 6.1.1. In 2015, international landings are 1424 t, according to last year's values.

Discards estimates were available from "observers on board sampling programme" for Spain in the years displayed in Table 6.1.2(a). Discards in number represent between 10-45% of the total catch, with the exception of the year 2007 when discards have been very low and 2011 with discards extremely high. Following recommendations, during the Benchmark WKSOUTH in 2014, an effort was made to complete the time-series back until 1986 in years without samplings. Total discards are given in tons in Table 6.1.1 and in numbers-at-age in Table 6.1.2(b), these data are included in the assessment model.

6.1.2.2 Biological sampling

Annual length compositions of total stock landings are displayed in Figure 6.1.2 for the period 1986–2015 and in Table 6.1.3. (a). Unallocated value is raised to total length distribution. The bulk of sampled specimens corresponds to fish of 21-36 cm.

Sampling levels for both species are given in Table 1.3.

Mean lengths and mean weights in landings since 1990 are shown in Table 6.1.3(b). The mean length and mean weight values in 2013 are the highest in the historic series.

Age compositions of catches are presented in Table 6.1.4 and weights-at-age of catches in Table 6.1.5, from 1986–2015. These values were also used as the weights-at-age in the stock.

More biological information, the parameters used in the length-weight relationship, natural mortality and maturity ogive are shown in the stock annex.

6.1.2.3 Abundance indices from surveys

Two Portuguese (PtGFS-WIBTS-Q4, also called "October" survey, and PT-CTS (UWTV (FU 28-29)), also called "Crustacean" survey) and one Spanish (SpGFS-WIBTS-Q4) survey indices are summarized in Table 6.1.6. In 2012, Portuguese surveys were not conducted due to budgetary constraints of national scope turned unfeasible to repair the RV.

As noted in the Stock Annex, indices from these Portuguese surveys are not considered representative of megrim abundance, due to the very low catch rates.

The Spanish survey (SpGFS-WIBTS-Q4) covers the distribution area and depth strata of this species in Spanish waters (covering both 8.c and 9.a). Total biomass and abundance indices from this survey were higher during the period 1988–1990, subsequently declining to lower mean levels, which are common through the rest of the time-series. There has been an overall declining trend in the abundance index after year 2000, with the values for 2008 and 2009 being the two lowest in the entire series. Since then, there is a general increasing trend. (Figure 6.1.3(a), bottom right panel). In 2013 the survey was carried out in a new vessel and with new fishing doors. This year the abundance indices were high for flatfish and benthic species. Although there was an inter-calibration exercise between both vessels, the results were not consistent with the results of the inter-calibration, therefore the working group decided not to include the abundance index value for that year in the assessment model. In 2014 the gear used was similar to the gear used in the survey before 2013. A new inter-calibration exercise was conducted in 2014. The index for 2014 was found consistent with the index before 2013 and the working group decided to use it. However for 2013 the index is still inconsistent with the time-series and the group decided not to include it. The gear configuration continues being the same in 2015 and the index is suitable to include.

The Spanish survey recruitment index for age 1 (Recruitment age) indicate an extremely weak year class in 1994, followed by better values. From 2000–2014year classes appear to be in low values except for 2010. However, in 2015, there is a very important increase in age 1, being the highest value for the time-series.

Catch numbers-at-age per unit effort and effort values for the Spanish survey are given in Table 6.1.7. In addition, Figure 6.1.3(b) displays a bubble plot of log (survey indices-at-age), with the values for each age standardized by subtracting the mean and dividing by the standard deviation over the years. The size of the bubbles is related to the magnitude of the standardized value, with white and black bubbles corresponding to positive and negative values, respectively. The figure indicates that the survey is quite good at tracking cohorts through time and highlights the weakness of the last few cohorts.

6.1.2.4 Commercial catch-effort data

The commercial LPUE and effort data of the Portuguese trawlers fishing in Division 9.a covers the period 1988–2015 (Table 6.1.8 and Figure 6.1.3(a)).

It is known that the Northern Spanish coastal bottom otter trawl fleet is a fleet deploying a variety of fishing strategies with different target species. In fact, these fishing strategies are identified under the current DCF sampling programme, so that they can be then re-aggregated under two DFC métiers: bottom otter trawl targeting demersal species (OB_DEF_>=55_0_0) and OTB targeting pelagic stocks accompanied by some demersal species (OTB_MPD_>55_0_0). Therefore, the LPUE of these métiers was recovered backwards (until 1986) and two new time-series of bottom otter trawl targeting demersal species, one per port (A Coruña and Avilés), were provided to the Benchmark WKSOUTH in 2014. These new tuning fleets (SP-LCGOTBDEF and SP-AVSOTBDEF) were accepted to tune the assessment model instead of the old ones A Coruña trawl (SP-CORUTR8c) and Avilés trawl (SP-AVILESTR). The LPUEs and effort values are given in Table 6.1.8 and Figure 6.1.3(a).

Commercial fleets used in the assessment to tune the model

Before 2003, A Coruña (SP-LCGOTBDEF) effort was generally stable. After that year, the trend was similar but in lower values. The 2011 effort value is the lowest in the series. In 2014, effort is the highest value and in 2015 decreases again. The LPUE shows relatively high stable values for 1986–2002. Since 2003 LPUE shows lower values, is increasing since 2010 till 2012 followed by two years decreasing and an increase in 2015.

Avilés (SP-AVSOTBDEF) effort does not present any trend throughout the whole period. The highest value occurred in 1998 and the lowest in 2001. LPUE shows a decreasing from 1986 to 2003. Since then, it has had a further upward and downward fluctuation, with a peak in 2011. Landed numbers-at-age per unit effort and effort data for these fleets are given in Table 6.1.7.

Figure 6.1.3(c) displays bubble plots of standardized log (landed numbers-at-age per unit effort) values for these commercial fleets, with the standardization performed by subtracting the mean and dividing by the standard deviation over the years. The panel corresponding to A Coruña trawl fleet clearly indicates below average values from year 2003 to 2010, but since then, values are above average except for 2014.

Commercial fleets not used in the assessment to tune the model

Portuguese effort values are quite variable, except in 2001 and 2002 when they are significantly lower and in 2015, the lowest value in the time-series (Table 6.1.8 and Figure 6.1.3(a)). The LPUE series were revised from 2012 onwards. To revise the series backwards further refinement of the algorithms is required. The LPUE shows a steep decrease between 1990–1992, and has since remained at low levels, with the exception of a peak in 1997–1998. LPUE for the last two years represent an increase in relation to the previous year.

6.1.3 Assessment

An update assessment was conducted, according to the Stock Annex specifications. Assessment years are 1986–2014 and ages 1–7+.

6.1.3.1 Input data

It follows the Stock Annex, incorporating discards and landed numbers-at-age resulting in catch numbers-at-age as input data from 1986–2015 and the 2015 indices from A Coruña (SP-LCGOTBDEF) tuning fleet and Avilés tuning fleet (SP-AVSOTBDEF) and Spanish survey (SpGFS-WIBTS-Q4).

6.1.3.2 Model

Data screening

Figure 6.1.4(a) shows catch proportion at age where larger proportions can be observed for ages 1 and 2 till 2000 due to the high discards at these ages in this period, and for age 1 also since 2011. The top panel of Figure 6.1.4(b) shows landings proportions at age, indicating that the bulk of the landings consisted of ages 1 and 2 before 1994, shifting after that mostly to ages 2–4. The bottom panel of the same figure displays standardized (subtracting the mean and dividing by the standard deviation over the years) proportions at age, indicating the same change around the mid 1990's, with proportions at age decreasing for ages 1 and 2 and increasing for the older ages. Some weak and strong cohorts can be noticed in this figure, particularly around the mid 1990's.

The 2010 year shows an increase in landings of older ages, especially ages 5 to 7+. In the last period, the high abundance of age 1 in the Spanish survey in 2010 can be tracked following years. Figure 6.1.4(a) shows discards proportion at age, being more abundant for age 1 from 2000 onwards. Before this year, discarding was higher in age 2. Visual inspection of Figures 6.1.3(b) and 6.1.3(c) indicates that all tuning series are good up to age 5 in relation to their internal consistency. Age 6 is harder to track along cohorts, particularly for the Spanish survey and the A Coruña tuning fleet.

Final run

XSA model was selected for use in this assessment. Model description and settings are those detailed in the Stock Annex.

The retrospective analysis shows a small but consistent pattern of overestimation of SSB and underestimation of F and recruitment in recent years (Figure 6.1.5).

6.1.3.3 Assessment results

Diagnostics from the XSA run are presented in Table 6.1.9 and log-catchability residuals plotted in Figure 6.1.6. For all tuning fleets the magnitude of the residuals is larger for older ages. Residuals in A Coruña tuning fleet in the last years present mainly positive values. Until 1997 many of the survey residuals were negative, whereas many are positive since 1999. Since 2008, there appears to be a change towards negative survey residuals again. Several year effects are apparent in all tuning series. As has been the case in the last few years the model shows that it hasn't converged, however the differences which activate this criteria was so small (0.00062 difference) and close to zero that we have confidence that the assessment has converged. The results presented correspond to a run of 140 iterations, as increasing the number of iterations led to larger total absolute residuals value between iterations.

Fishing mortality and population numbers-at-age from the final XSA run are given in Tables 6.1.10 and 6.1.11, respectively, and summary results presented in Table 6.1.12 and Figure 6.1.7(a).

Fishing mortality presents an increasing trend since 2011, which may be explained by the increase in catches in that years. 2015 values represent a decrease for both, F and catches. The SSB values in 2007–2010 are the lowest in the series. Since 2011 values are significantly higher and more or less stable. After a very high recruitment (at age 1) value in the series in 2010 and the followings decreases and increases, the last year the recruitment value shows a significant increase, with a very high value.

Bubble plots of standardized (by subtracting the mean and dividing by the standard deviation over the years) estimated F-at-age and relative F-at-age (F-at-age divided by F_{bar}) are presented in Figure 6.1.7(b). The top panel of the figure indicates that fishing mortality has been lower for all ages since about year 2000. The reduction occurred earlier for ages 1 and 2, at around 1994. In terms of the relative exploitation pattern-at-age (bottom panel of the figure), the most obvious changes are the reduction for ages 1 and 2 around 1994 and the increase for age 3 soon after that. This might be related to discarding practices. There is no clear pattern over time in the age 4 selection, whereas for ages 5 and older there seems to have been an increase during the mid to late 1990's but they have since come back down to lower values. Since 2010, there appears to have been an increase of the relative exploitation towards older ages, with high values above the average for ages 5–7+.

6.1.3.4 Year-class strength and recruitment estimations

The 2012 year class is estimated to have 5.0 million fish at 1 year of age, based on the Spanish survey (SpGFS-WITBS-Q4) (60% of weight), two commercial fleets SP-LCGOTBDEF (20% of weight) and SP-AVSOTBDEF (16% of weight) and F shrinkage (6%).

The 2013 year class is estimated to have 3.5 million individuals at 1 year of age based on the information from the Spanish survey (SpGFS-WIBTS-Q4) (71% of weight), P-shrinkage (26% of the weight) and F shrinkage (3%).

The 2014 year class is estimated to have 9.6 million fish at 1 year of age, based on the information from the Spanish survey (SpGFS-WIBTS-Q4) (63% of weight), P-shrinkage (32% of the weight) and F shrinkage (6%).

The working group considered that the XSA last year recruitment is poorly estimated. In accordance with the stock annex specifications, GM recruitment is computed over years 1998–2013. Working Group estimates of year-class strength used for prediction can be summarized as follows:

Recruitment-at-age 1:

YEAR CLASS	THOUSANDS	BASIS	SURVEYS	COMMERCIAL	SHRINKAGE
2012	4984	XSA	60%	36%	6%
2013	3482	XSA	71%	0%	29%
2014	3301	GM (98-13)			
2015	3301	GM (98-132)			

6.1.3.5 Historic trends in biomass, fishing mortality and recruitment

From Table 6.1.12 and Figure 6.1.7, we see that SSB decreased from 2416 t in 1990 to 1001 t in 1995. From 1996–2003, it remained relatively stable at low levels with an average value of around 1300 t. Starting from 2004, SSB is estimated to have been even lower. The values for 2004-2010 are the lowest in the series, with SSB in 2008 (689 t) corresponding to the lowest values. Since 2011, SSB values are increasing, being 1264 t, the 2014 value, the highest of the last years. In 2015 the value is quite similar, 1223 t.

After a decline from 2006 (0.39) to 2010 (0.07), the fishing mortality follows an increasing trend, with a decrease in 2015.

Recruitment (at age 1) varies substantially throughout the time-series, but shows a general decline from the high levels seen until the 1992 year class. Since 1998 recruitment has been continuously at low levels (recruitment in 2009 is estimated to be the lowest value of the series). In 2010 a good recruitment occurred, with a value more similar to those estimated for the previous decade. However, in 2011 and 2012, values of recruitments decreased again. 2013 showed a small increase followed by a decrease in the last year. In 2015 the recruitment seems to be very high, with a value similar to those of middle nineties.

6.1.3.6 Catch Options and prognosis

Stock projections were calculated according to the settings specified in the Stock Annex.

6.1.3.7 Short-term projections

Short-term projections have been made using MFDP.

The input data for deterministic short-term predictions are shown in Table 6.1.13. Average F_{bar} for the last three years is assumed for the interim year. The exploitation pattern is the scaled F-at-age computed for each of the last five years and then the average of these scaled five years was weighted to the final year. This selection pattern was split into selection-at-age of landings and discards (corresponding to F_{bar} = 0.26 for landings and F_{bar}=0.02 for discards, being 0.28 for catches).

According with stock annex, GM recruitment is computed over years 1998-final assessment year minus 2. Age 2 for 2016 is replaced by the recruitment GM reduced by total estimated mortality obtained from the fishing mortality of age 1 of the last year and the natural mortality.

Management options for catch prediction are in Table 6.1.14. Figure 6.1.8 shows the short-term forecast summary. The detailed output by age group is given in Table 6.1.15 for landings and discards.

Under *status quo* F, landings in 2016 and 2017 are predicted to be 285 t and 266 t respectively, and discards 25 t and 24 t respectively. SSB would decrease from the 1085 t estimated for 2016 to 1 000 t in 2017 and to 928 t in 2018.

The contributions of recent year classes to the predicted landings in 2017 and SSB in 2018, assuming GM_{98-13} recruitment, are presented in Table 6.1.16. The assumed GM_{98-12} age 1 recruitment for the 2015 and 2016 year classes contributes 16% to landings in 2017 and 40% to the predicted SSB at the beginning of 2018. Megrim starts to contribute strongly to SSB at 2 years of age (see maturity ogive in Table 6.1.13).

6.1.3.8 Yield and biomass per recruit analysis

The results of the yield- and SSB-per-recruit analyses are in Table 6.1.17 (see also left panel of Figure 6.1.8, which plots yield-per-recruit and SSB-per-recruit vs. F_{bar}). Assuming s*tatus quo* exploitation F_{bar} = 0.26 for landings and F_{bar}=0.02 for discards and GM_{98-13} for recruitment, the equilibrium yield would be 206 t of landings and 24 t of discards with an SSB of 820 t.

6.1.4 Biological reference points

The stock–recruitment time-series is plotted in Figure 6.1.9.All recruitment values since 1998 have been low, until 2010, with a high recruitment value, followed by not so higher ones and another very high in 2015.

See Stock Annex for information about Biological reference points.

The BRP are:

	Type	*Value*	*Technical basis*
MSY Approach	**MSY $B_{trigger}$**	**980 t**	B_{pa}
	F_{MSY}	**0.19**	
	F_{MSY} lower	**0.12**	based on 5% reduction in yield
	F_{MSY} upper (with advice rule)	**0.29**	based on 5% reduction in yield
	F_{MSY} upper (without advice rule)	**0.24**	based on 5% reduction in yield
	$F_{P.05}$	**0.24**	5% risk to B_{lim} without $B_{trigger}$.
Precautionary Approach	**B_{lim}**	**700 t**	B_{loss} estimated in 2015
	B_{pa}	**980 t**	1.4 B_{lim}
	F_{lim}	**0.45**	Based on segmented regression simulation of recruitment with B_{lim} as the breakpoint and no error
	F_{pa}	**0.32**	$F_{pa} = F_{lim} \times \exp(-\sigma \times 1.645)$ σ=0.2

6.1.5 Comments on the assessment

The behaviour of commercial fleets with regards to landings of age 1 individuals appears to have changed in time. Hence, data from commercial fleets used for tuning is only taken for ages 3 and older, as how it is set in the stock annex. However, the Spanish survey (SpGFS-WIBTS-Q4) provides good information on age 1 abundance.

Comparison of this assessment with the one performed last year shows that there are quite similar without appreciable shifts (Figure 6.1.10)

Megrim starts to contribute strongly to SSB at 2 years of age. Around 40% of the predicted SSB in 2018 relies on year classes for which recruitment has been assumed to be GM_{98-13}.

6.1.6 Management considerations.

It should be taken into account that megrim, *L. whiffiagonis,* is caught in mixed fisheries. There is a common TAC for both species of megrim (*L. whiffiagonis* and *L. boscii*), so the joint status of the two species should be taken into consideration when formulating management advice. Megrims are bycatch in mixed fisheries generally directed to white fish. Therefore, fishing mortality of megrims could be influenced by restrictions imposed on demersal mixed fisheries, aimed at preserving and rebuilding the overexploited stocks of southern hake and *Nephrops*.

This is a small stock (average stock SSB since 1986 is 1300 t). Managing according to a very low F for megrim could cause serious difficulties for the exploitation of other stocks in the mixed fishery (choke species effect). Both Iberian megrim stocks are assessed separately but managed together, situation that may produce inconsistencies when these stocks are considered in a mixed fisheries approach. In fact, this effect was observed in the results of the last mixed fisheries analysis developed for Iberian stocks by the WGMIXFISH_METH (ICES, 2013).Of course, any F to be applied for the management of megrim must be in conformity with the precautionary approach.

Working group considers that this stock could be just “the tail” of the much larger stock of megrim in ICES Subarea 7 and Divisions 8.a,b,d and suggests to reconsider the stock limits and the inclusion in the Northern megrim stock. This option was studied during the Stock Identification Methods Working Group (SIMWG) in 2015 and the conclusion was that SIMWG did not find strong evidence to support combining the northern and southern stock areas and recommends that the current stock separation stand till more studies are developed (ICES, 2015)

Table. 6.1.1 Megrim (*L. whiffiagonis*) in Divisions 8.c, 9.a. Landings, discards and catch (t).

	Spain landings			Portugal landings	Unallocated	Total landings	Discards	Total catch
Year	8c	9a***	Total	9a				
1986	508	98	606	53		659	46	705
1987	404	46	450	47		497	40	537
1988	657	59	716	101		817	42	859
1989	533	45	578	136		714	47	761
1990	841	25	866	111		977	45	1022
1991	494	16	510	104		614	41	655
1992	474	5	479	37		516	42	558
1993	338	7	345	38		383	38	421
1994	440	8	448	31		479	13	492
1995	173	20	193	25		218	40	258
1996	283	21	305	24		329	44	373
1997	298	12	310	46		356	52	408
1998	372	8	380	66		446	36	482
1999	332	4	336	7		343	43	386
2000	238	5	243	10		253	35	288
2001	167	2	169	5		175	19	193
2002	112	3	115	3		117	19	137
2003	113	3	116	17		134	15	148
2004	142	1	144	5		149	11	159
2005	120	1	121	26		147	19	166
2006	173	2	175	35		210	16	226
2007	139	2	141	14		155	0.4	155
**2008	114	2	116	17		133	11	144
2009	74	2	77	7		84	11	94
2010	66	8	74	10		83	5	88
*+2011	242	0	242	34	26	302	69	371
*+2012	151	11	161	18	83	262	31	293
*+2013	128	3	131	11	90	231	18	250
*2014	225	5	231	30	116	377	23	399
*2015	188	2	190	23	63	276	21	297

+Data revised in WG2015

***IXa is without Gulf of Cádiz

** Data revised in WG2010

* Official data by country and unallocated landings

Table. 6.1.2(a) Megrim (*L. whiffiagonis*) in Divisions 8.c, 9.a. Discard/Total Catch ratio and estimated CV for Spain from sampling on board

Year	1994	1997	1999	2000	2003	2004	2005	2006	2007	2008
Weight Ratio	0.03	0.14	0.12	0.13	0.11	0.07	0.14	0.08	0.00	0.08
CV	50.83	32.23	33.4	48.41	19.93	29.24	43.17	31.62	55.01	58.8
Number Ratio	0.10	0.38	0.34	0.45	0.26	0.16	0.28	0.21	0.01	0.20

Year	2009	2010	2011*	2012	2013	2014	2015
Weight Ratio	0.13	0.06	0.23	0.12	0.07	0.06	0.07
CV	52.9	61.6	23.7	28.8	30.3	44.7	49.8
Number Ratio	0.36	0.27	0.57	0.37	0.24	0.20	0.29

All discard data revised in WG2011

*Data revised in WG2013

Table. 6.1.2(b) Megrim (*L. whiffiagonis*) in Divisions 8.c, 9.a. Discards in numbers-at-age (thousands) for Spanish trawlers

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	138	138	138	138	138	138	138	138	104	138
2	339	339	339	339	339	339	339	339	93	339
3	425	425	425	425	425	425	425	425	136	425
4	130	130	130	130	130	130	130	130	51	130
5	10	10	10	10	10	10	10	10	3	10
6	4	4	4	4	4	4	4	4	1	4
7	1	1	1	1	1	1	1	1	0	1

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	138	41	138	270	27	10	10	0	4	20
2	339	453	339	471	611	338	338	239	164	223
3	425	857	425	284	160	82	82	57	28	61
4	130	142	130	197	73	31	31	12	6	38
5	10	1	10	26	19	9	9	4	5	11
6	4	5	4	6	0	1	1	0	3	4
7	1	3	1	0	0	1	1	0	2	1

	2006	2007	2008	2009	2010	2011*	2012	2013	2014	2015
1	0	0	0	96	16	12	8	330	442	624
2	19	11	126	142	119	2044	808	53	94	10
3	108	0	86	21	6	346	85	13	16	4
4	115	0	8	15	1	1	41	5	2	1
5	28	0	5	7	2	2	2	0	0	0
6	13	0	2	7	0	0	1	0	0	0
7	4	0	0	3	1	0	1	0	0	0

Table 6.1.3(a) Megrim (*L. whiffiagonis*) Divisions 8.c and 9.a. Annual length distributions in landings in 2015.

Length (cm)	Total
10	
11	
12	
13	
14	
15	
16	
17	
18	427
19	2712
20	9973
21	29550
22	55465
23	86298
24	147036
25	156788
26	179564
27	154345
28	134409
29	117388
30	108607
31	88555
32	67747
33	62958
34	41580
35	35561
36	28707
37	25450
38	19094
39	15095
40	9827
41	8905
42	5617
43	3963
44	3004
45	1511
46	1062
47	627
48	334
49	463
50+	156
Total	1602777

Table 6.1.3(b) Megrim (*L. whiffiagonis*) Divisions 8.c and 9.a.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Mean length (cm)	22.3	23.5	24.6	23.4	25.1	24.7	24.6	24.6	24.7	25.3	25.8	25.1	26
Mean weight (g)	105	108	129	108	124	121	120	118	119	127	134	124	137

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mean length (cm)	25.7	26.1	25.32	26.15	26.68	26.64	27.58	29.4	27.63	28.2	29.39	28.6	28.72
Mean weight (g)	134	137	127	137	148	146.8	163.2	187.4	159.5	163.2	187.5	170.7	172.3

***Mean lengths and mean weights in landings since 1990**

Table 6.1.4 Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a. Catch numbers-at-age.

Catch numbers at age Numbers*10**-3

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE										
1	1352	2359	3316	1099	4569	1357	1401	858	133	848
2	2377	2728	3769	2328	2560	2777	817	2128	568	461
3	798	882	1168	808	905	931	807	442	1835	384
4	649	404	748	641	878	700	1130	536	552	630
5	505	293	534	505	333	647	595	361	625	245
6	202	81	182	191	377	142	78	103	330	70
+gp	194	71	130	253	558	59	68	36	119	72
TOTALNUM	6077	6818	9847	5825	10180	6613	4896	4464	4162	2710
TONSLAND	705	537	858	761	1022	655	558	421	492	258
SOPCOF %	95	95	95	99	99	100	100	101	100	101

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE										
1	537	535	416	491	620	378	369	368	210	346
2	1911	1919	1307	524	282	387	233	299	264	276
3	167	1153	1335	1157	671	331	341	277	211	438
4	289	77	891	719	526	253	95	179	247	171
5	506	367	218	448	361	221	165	80	187	156
6	148	308	329	105	83	161	81	54	102	87
+gp	81	116	149	207	161	118	37	48	72	41
TOTALNUM	3639	4475	4645	3651	2704	1849	1321	1305	1293	1515
TONSLAND	373	408	482	386	288	194	136	149	160	166
SOPCOF %	101	100	100	101	101	100	99	101	100	98

YEAR	2006	2007	*2008	2009	2010	2011**	2012**	2013**	2014	2015
AGE										
1	110	90	133	170	149	2054	812	359	469	712
2	526	161	370	111	39	1087	275	152	705	224
3	582	232	215	159	53	156	834	320	420	536
4	276	297	153	102	112	220	157	612	432	239
5	183	142	168	80	97	266	192	81	518	257
6	110	81	60	60	81	209	106	61	74	191
+gp	36	56	35	29	43	184	139	89	144	82
TOTALNUM	1823	1059	1134	711	574	4176	2515	1674	2762	2241
TONSLAND	226	155	144	95	88	371	293	250	399	297
SOPCOF %	100	100	100	101	100	100	100	101	100	100

* Data revised in WG2010 from original value presented

** Data revised in WG2014 from original value presented

Table 6.1.5 Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a. Catch weights at age (kg).

Mean weight at age										
YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE										
1	0.041	0.046	0.043	0.045	0.04	0.035	0.031	0.031	0.039	0.051
2	0.095	0.079	0.086	0.094	0.091	0.085	0.075	0.073	0.063	0.044
3	0.113	0.086	0.098	0.114	0.121	0.102	0.116	0.102	0.099	0.087
4	0.163	0.142	0.149	0.163	0.165	0.145	0.155	0.146	0.13	0.126
5	0.215	0.175	0.191	0.223	0.206	0.173	0.209	0.194	0.15	0.164
6	0.315	0.311	0.289	0.292	0.24	0.251	0.318	0.235	0.19	0.21
+gp	0.477	0.415	0.424	0.52	0.369	0.42	0.534	0.538	0.344	0.34
SOPCOFAC	0.9502	0.9535	0.9509	0.995	0.9874	1.0041	0.9983	1.005	1.0004	1.0091
YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE										
1	0.041	0.033	0.032	0.033	0.037	0.039	0.038	0.047	0.0480	0.0510
2	0.08	0.062	0.061	0.058	0.057	0.078	0.07	0.083	0.0820	0.0770
3	0.081	0.095	0.095	0.084	0.089	0.085	0.111	0.115	0.1090	0.1080
4	0.127	0.126	0.13	0.118	0.119	0.117	0.115	0.149	0.1300	0.1400
5	0.164	0.14	0.154	0.159	0.161	0.148	0.162	0.194	0.1570	0.1640
6	0.21	0.198	0.189	0.216	0.215	0.171	0.205	0.252	0.2030	0.1990
+gp	0.354	0.341	0.324	0.296	0.296	0.256	0.387	0.382	0.3190	0.3790
SOPCOFAC	1.014	1.0005	1.0047	1.0057	1.0107	1.0046	0.9944	1.0061	1.0008	0.9847
YEAR	2006	2007	*2008	2009	2010	2011**	2012**	2013**	2014	2015
AGE										
1	0.057	0.061	0.033	0.031	0.037	0.026	0.027	0.039	0.035	0.037
2	0.082	0.088	0.084	0.088	0.091	0.088	0.089	0.079	0.097	0.102
3	0.11	0.11	0.118	0.135	0.116	0.135	0.138	0.127	0.13	0.133
4	0.15	0.144	0.145	0.16	0.168	0.134	0.164	0.179	0.166	0.174
5	0.174	0.197	0.187	0.189	0.203	0.201	0.172	0.232	0.22	0.197
6	0.223	0.236	0.246	0.246	0.228	0.242	0.228	0.281	0.264	0.277
+gp	0.39	0.366	0.409	0.404	0.37	0.371	0.343	0.391	0.381	0.388
SOPCOFAC	1.0034	0.9966	1.0034	1.0062	0.9989	0.9976	1.0031	1.0124	0.9988	0.9986

* Data revised in WG2010 from original value presented

** Data revised in WG2014 from original value presented

Table 6.1.6 Megrim (*L. whiffiagonis*) Divisions 8.c, 9.a. Abundance and Recruitment indices from Portuguese and Spanish surveys.

	Biomass Index Portugal (k/h)			Spain (k/30 min)	
	October	Crustaceans	s.e	Mean	s.e.
1983				0.96	0.14
1984				1.92	0.34
1985				0.89	0.15
1986				1.65	0.2
1987				ns	
1988				3.52	0.64
1989				3.13	0.5332
1990	0.08			3.08	0.86
1991	0.11			1.22	0.17
1992	0.11			1.39	0.2
1993	0.04			1.46	0.24
1994	0.05			1.02	0.2
1995	0.01			1.03	0.16
A,1996 +				1.64	0.22
1997 +		1.41	1.04	1.79	0.25
1998	0.01	0.20	0.09	1.47	0.23
A,B,1999 +		0.11	0.11	1.59	0.29
2000 +		0.06	0.05	1.8	0.35
2001	0	0.04	0.03	1.45	0.28
2002	0.04	0.07	0.04	1.26	0.24
A,2003	0.01	0.07	0.05	0.82	0.16
A,2004	0.01	ns		1.08	0.2
2005	0.01	0.37	0.20	1.29	0.21
2006	0.02	0.29	0.18	1.03	0.18
2007	0	0.15	0.09	1.13	0.24
2008	0	0.25	0.11	0.68	0.15
2009	0.00	*0.05	0.03	0.80	0.12
2010	0.01	0.20	0.10	0.89	0.16
2011	0.00	0.84	0.67	1.83	0.35
2012	ns	ns	ns	1.38	0.19
**2013	0	0.20	0.13	2.44	0.39
2014	0.02	0.30	0.18	1.34	0.21
2015	0.06	0.27	0.14	1.86	0.26

	Abundance index Portugal (n/h)		Spain (n/30 min)	
	Crustaceans	s.e.	Mean	s.e.
1983			14.0	2.45
1984			28.0	4.57
1985			9.0	1.34
1986			33.0	6.22
1987			ns	
1988			43.0	8.82
1989			42.0	7.04
1990			28.0	5.5
1991			10.0	1.67
1992			18.0	3.35
1993			15.0	3.23
1994			8.0	1.87
1995			11.0	1.86
A,1996			21.0	3.6
1997	7.22	4.82	20.0	3.26
1998	1.09	0.51	14.8	2.64
A,B,1999	0.57	0.53	15.5	3.05
2000	0.27	0.17	19.4	4.46
2001	0.07	0.04	12.8	2.77
2002	0.21	0.10	12.1	2.65
A,2003	0.16	0.08	7.2	1.26
A,2004	ns		8.44	1.39
2005	0.71	0.35	9.76	1.73
2006	0.43	0.24	6.38	1.16
2007	0.49	0.37	6.87	1.52
2008	1.49	0.71	4.33	1.07
2009	*0.19	0.10	4.17	0.59
2010	0.56	0.23	10.15	1.97
2011	1.75	1.30	17.45	3.86
2012	ns	ns	9.07	1.29
2013	0.43	0.22	15.89	2.58
2014	0.81	0.41	9.04	1.26
2015	0.89	0.39	30.75	5.64

	Recruitment index		
	At age 1	**At age 0**	**At age 1**
	Portugal (n)	Spain (n/30 min)	
	October		
1983		1.88	7.72
1984		0.32	16.08
1985		0.10	2.74
1986		13.78	11.19
1987		ns	ns
1988		0.65	16.60
1989		2.90	13.96
1990	5	0.11	9.13
1991	5	1.26	1.38
1992	8	0.01	12.03
1993	1	0.00	2.76
1994 +		0.60	0.05
1995 +		0.41	7.38
A,1996 +		0.45	11.26
1997 +		0.15	5.91
1998 +		0.02	2.56
A,B,1999 +		0.56	1.26
2000 +		0.05	6.92
2001 +		0.19	1.97
2002 +		0.08	2.53
A,2003	0.05	0.05	1.91
A,2004 +		0.14	1.83
2005 +		0.08	2.21
2006		0.00	0.89
2007		0.01	1.87
2008		0.00	0.23
2009		0.19	0.20
2010		0.01	7.63
2011		0.00	1.94
2012		0.03	0.58
2013		0.02	3.24
2014		0.40	1.32
2015		0.28	25.46

+	less than 0.04
ns	no survey
A	Portuguese October Survey with different vessel and gear (Capricórnio and CAR net)
B	Portuguese Crustacean Survey covers partial area only with a different Vessel (Mestre Costeiro)
*	Revised in WG2011
**	From 2013 new vessel for Spanish survey (Miguel Oliver)

Table 6.1.7 Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a. Tuning data.

FLT01: SP-LCGOTBDEF 1000 Days by 100 HP (thousan

1986	2015								
1	1	0	1						
1	7							Eff.	
10	13	32	25	24	22	11	7	7.1	1986
10	105	114	47	22	15	8	6	12.7	1987
10	19	55	41	32	23	10	5	11.3	1988
10	5	24	24	26	21	10	6	11.9	1989
10	6	24	25	34	33	18	10	8.8	1990
10	7	31	30	37	32	16	9	9.6	1991
10	1	17	21	31	31	17	14	10.2	1992
10	0	12	15	21	18	8	4	7.1	1993
10	0	5	73	40	59	42	9	8.5	1994
10	65	4	20	43	15	4	3	13.4	1995
10	1	64	3	21	55	17	10	11.0	1996
10	1	37	57	6	29	27	9	12.5	1997
10	1	20	56	70	20	41	18	8.2	1998
10	1	9	44	47	38	11	21	8.8	1999
10	2	7	47	64	62	16	18	10.5	2000
10	3	26	26	31	33	27	19	12.1	2001
10	2	13	44	12	33	17	7	11.0	2002
10	26	19	20	20	12	10	9	10.2	2003
10	2	12	14	20	19	14	13	7.0	2004
10	6	12	28	13	13	8	6	7.1	2005
10	3	18	25	17	13	10	4	7.8	2006
10	13	19	22	28	17	10	8	7.3	2007
10	0	22	20	15	16	5	4	9.0	2008
10	6	17	23	13	9	6	3	8.0	2009
10	2	7	12	25	24	18	10	5.8	2010
10	2	135	27	38	32	16	9	5.1	2011
10	2	108	393	68	76	28	18	7.6	2012
10	2	20	55	89	10	7	7	10.8	2013
10	3	34	18	16	17	3	5	13.4	2014
10	16	32	65	25	26	20	7	9.8	2015

FLT02: SP-AVSOTBDEF 1000 Days by 100 HP (thousand) (*)

1986	2015								
1	1	0	1						
1	7							Eff.	
10	408	516	428	209	182	153	92	3.9	1986
10	590	471	510	242	145	168	55	3.0	1987
10	1458	905	749	357	155	193	85	3.4	1988
10	836	514	539	253	145	174	68	3.3	1989
10	4366	949	225	173	46	50	71	3.2	1990
10	980	855	229	100	84	15	7	3.5	1991
10								10.2	1992
10	1149	1490	91	100	53	25	19	2.4	1993
10	19	176	547	135	133	51	24	4.5	1994
10	41	2	43	140	70	26	14	3.5	1995
10	135	797	14	117	259	74	62	2.3	1996
10	96	880	621	34	153	128	46	2.6	1997
10	16	309	375	233	52	69	38	5.1	1998
10	10	110	398	263	162	38	70	4.9	1999
10	29	54	239	230	146	36	53	2.5	2000
10	37	200	193	122	115	84	85	1.3	2001
10	54	158	239	65	93	53	47	2.0	2002
10	26	84	105	70	31	24	28	2.2	2003
10	53	231	208	248	193	103	60	1.6	2004
10	118	182	309	117	107	59	26	3.0	2005
10	43	182	236	120	83	46	12	2.8	2006
10	25	48	72	93	41	24	20	2.2	2007
10	5	153	85	51	49	18	16	2.0	2008
10	12	41	67	50	39	39	21	2.3	2009
10	50	45	66	160	136	121	62	2.0	2010
10	6	483	95	133	168	134	110	2.2	2011
10	0	28	118	23	29	18	28	2.6	2012
10	11	35	129	279	38	31	62	1.5	2013
10	7	116	64	73	117	22	53	3.0	2014
10	33	42	100	52	63	63	33	1.8	2015

FLTO3: SPGFS-WIBTS-Q4 (n/30 min)

1988	2015								
1	1	0.75	0.83						
1	7								
1	16.60	12.48	5.18	4.54	2.66	0.74	0.53	101	1988
1	13.96	11.20	5.38	5.64	1.47	0.48	0.43	91	1989
1	9.13	7.69	3.04	3.61	1.26	1.36	1.57	120	1990
1	1.38	3.23	1.45	1.84	0.87	0.23	0.03	107	1991
1	12.03	1.07	1.57	2.24	1.14	0.21	0.15	116	1992
1	2.76	8.79	0.66	1.69	0.85	0.17	0.01	109	1993
1	0.05	0.65	4.24	1.30	0.71	0.27	0.04	118	1994
1	7.38	0.20	0.55	1.65	0.70	0.17	0.10	116	1995
1	11.26	6.45	0.25	1.03	1.00	0.35	0.27	114	1996
1	5.91	7.54	3.44	0.46	0.99	0.39	0.06	116	1997
1	2.56	4.30	4.33	2.08	0.41	0.60	0.15	114	1998
1	1.26	4.47	4.36	2.50	1.46	0.46	0.77	116	1999
1	6.92	2.46	2.84	3.42	2.14	0.70	0.39	113	2000
1	1.97	4.60	1.14	2.31	1.58	0.61	0.40	113	2001
1	2.53	3.15	3.74	0.44	1.38	0.51	0.29	110	2002
1	1.91	1.44	1.66	1.14	0.52	0.26	0.16	112	2003
1	1.83	1.94	1.31	1.30	0.80	0.66	0.47	114	2004
1	2.21	1.58	2.04	1.43	1.57	0.60	0.25	116	2005
1	0.89	1.40	1.57	0.82	0.88	0.61	0.22	115	2006
1	1.87	0.94	1.27	1.24	0.68	0.44	0.42	117	2007
1	0.23	1.54	1.23	0.56	0.52	0.18	0.08	115	2008
1	0.20	0.44	1.52	0.91	0.40	0.30	0.22	117	2009
1	7.63	0.26	0.28	0.75	0.52	0.50	0.21	114	2010
1	1.94	12.47	1.32	0.30	0.63	0.40	0.39	111	2011
1	0.58	2.22	4.81	0.41	0.16	0.30	0.56	115	2012
0	3.24	1.63	3.29	5.63	0.67	0.35	0.87	114	2013
1	1.32	2.80	1.30	1.38	1.21	0.20	0.42	116	2014
1	25.46	1.24	1.45	0.75	0.73	0.46	0.38	114	2015

Table 6.1.8 Megrim (*L. whiffiagonis*). LPUE data by fleet in Divisions 8.c and 9.a.

	SP-LCGOTBDEF			SP-AVSOTBDEF			Portugal trawl in 9a		
Year	Landings (t)	Effort	LPUE [1]	Landings (t)	Effort	LPUE [1]	Landings (t)	Effort	LPUE [2]
1986	16	7.1	2.24	83	3.9	21.17			
1987	36	12.7	2.85	52	3.0	17.65			
1988	29	11.3	2.59	83	3.4	24.65	74.9	38.5	1.95
1989	24	11.9	2.03	65	3.3	19.76	92.2	44.7	2.06
1990	27	8.8	3.05	120	3.2	36.91	86.0	39.0	2.20
1991	29	9.6	3.05	52	3.5	14.96	85.5	45.0	1.90
1992	32	10.2	3.10	35	2.3	15.46	32.6	50.9	0.64
1993	11	7.1	1.53	45	2.4	18.55	31.7	44.2	0.72
1994	32	8.5	3.79	52	4.5	11.39	25.8	45.8	0.56
1995	12	13.4	0.86	34	3.5	9.72	21.4	37.0	0.58
1996	26	11.0	2.36	39	2.3	17.13	22.2	46.5	0.48
1997	30	12.5	2.43	51	2.6	19.16	41.5	33.4	1.24
1998	30	8.2	3.65	62	5.1	12.19	60.1	43.1	1.39
1999	23	8.8	2.65	63	4.9	12.67	4.3	25.3	0.17
2000	35	10.5	3.33	26	2.5	10.49	6.9	27.0	0.25
2001	28	12.1	2.30	15	1.3	11.15	1.3	43.1	0.03
2002*	22	11.0	2.01	18	2.0	9.14	1.0	31.2	0.03
2003*	18	10.2	1.73	12	2.2	5.72	15.3	40.5	0.38
2004	12	7.0	1.66	23	1.6	14.77	3.4	35.4	0.10
2005	9	7.1	1.29	33	3.0	11.10	19.0	42.6	0.45
2006	11	7.8	1.44	27	2.8	9.62	26.3	40.3	0.65
2007**	13	7.3	1.78	11	2.2	4.85	10.5	43.8	0.24
2008**	12	9.0	1.30	11	2.0	5.27	14.4	38.4	0.37
2009	9	8.0	1.06	11	2.3	5.05	6.0	49.3	0.12
2010	12	5.8	2.02	24	2.0	11.74	7.3	48.0	0.15
2011	17	5.1	3.43	41	2.2	18.67	24.8	49.4	0.50
2012	43	7.6	5.58	11	2.6	4.40	14.5	30.9	0.47
2013***	33	10.8	3.02	16	1.5	11.07	8.1	28.0	0.29
2014	20	13.4	1.47	26	3.0	8.80	25.7	49.2	0.52
2015	29	9.8	3.00	14	1.8	7.54	18.0	17.7	1.02

[1] LPUE as catch (kg) per fishing day per 100 HP.

[2] LPUE as catch (kg) per hour.

* Effort from Portuguese trawl revised from original value presented

** Effort from Portuguese trawl revised in WG2010 from original value presented

*** Effort from SP-LCGOTBDEF and SP-AVSOTBDEF revised in WG2015 from original value presented

Table 6.1.9. Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a. Tuning diagnostic.

Lowestoft VPA Version 3.1

2/05/2016 13:42

Extended Survivors Analysis

Megrim (L. whiffiagonis.) in Divisions 8c and 9a

CPUE data from file fleetw.txt

Catch data for 30 years. 1986 to 2015. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF	1986	2015	3	6	0	1
SP-AVSOTBDEF	1986	2015	3	6	0	1
SP-GFS	1990	2015	1	6	0.75	0.83

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 3

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 3

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 = 1.500

Minimum standard error for population
estimates derived from each fleet = .200

Prior weighting not applied

Tuning had not converged after 140 iterations

Total absolute residual between iterations
139 and 140 = .00062

Final year F values

Age	1	2	3	4	5	6
Iteration **	0.0859	0.1076	0.2785	0.399	0.5185	0.4088
Iteration **	0.086	0.108	0.279	0.399	0.518	0.409

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	0.053	0.035	0.088	0.131	0.023	0.520	0.322	0.083	0.161	0.086
2	0.344	0.102	0.197	0.099	0.040	0.233	0.118	0.091	0.232	0.108
3	0.427	0.250	0.193	0.121	0.062	0.222	0.282	0.196	0.388	0.278
4	0.418	0.403	0.260	0.132	0.118	0.394	0.365	0.346	0.443	0.399
5	0.353	0.394	0.420	0.211	0.178	0.450	0.724	0.326	0.557	0.518
6	0.240	0.260	0.287	0.259	0.342	0.721	0.324	0.532	0.561	0.409

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
2006	2360	2000	1850	893	679	570
2007	2890	1830	1160	989	482	391
2008	1740	2290	1350	738	541	266
2009	1530	1310	1540	914	466	291
2010	7220	1100	970	1110	656	309
2011	5600	5780	865	746	812	449
2012	3260	2730	3750	567	412	424
2013	4980	1930	1980	2310	322	163
2014	3480	3760	1440	1340	1340	190
2015	9560	2430	2440	803	702	629

Estimated population abundance at 1st Jan 2016

0	7190	1780	1510	441	343

Taper weighted geometric mean of the VPA populations:

5020	3500	2250	1390	832	425

Standard error of the weighted Log(VPA populations) :

0.6452	0.6271	0.5184	0.4742	0.4166	0.4507

Log catchability residuals.

Fleet : SP-LCGOTBDEF

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.56	-0.2	0.02	-0.74	-0.57	-0.58	-0.6	-0.7	0.2	-0.54
4	-0.42	-0.62	-0.48	-0.17	-0.18	0.02	-0.27	-0.44	0.42	-0.1
5	-0.44	-0.74	-0.43	-0.75	0.41	0.27	0.35	-0.45	1.1	-0.28
6	-0.51	-0.81	-0.49	-0.52	-0.2	0.44	0.54	0.08	1.4	-0.35

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-1.33	0.02	-0.03	-0.02	0.48	0.48	0.52	-0.32	-0.47	0.34
4	-0.46	-0.93	0.45	-0.04	0.55	0.21	-0.23	-0.28	-0.3	-0.5
5	0.3	-0.07	0.45	0.11	0.34	-0.08	0.24	-0.32	-0.38	-0.68
6	0.54	0.36	1.19	0.79	-0.27	0	-0.33	-0.57	0.37	-0.73

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.06	0.34	0.07	0.02	-0.17	0.85	2.07	0.69	-0.02	0.69
4	0.08	0.4	-0.02	-0.44	0.09	0.98	1.85	0.7	-0.4	0.53
5	-0.47	0.14	0.05	-0.54	0.12	0.29	1.98	-0.06	-0.77	0.3
6	-0.7	-0.25	-0.4	-0.38	0.71	0.31	0.76	0.49	-0.56	0.05

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	-6.3956	-5.9978	-5.5403	-5.5403
S.E(Log q)	0.6381	0.5589	0.5796	0.5945

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	1.07	-0.267	6.31	0.37	30	0.69	-6.4
4	1.43	-1.384	5.47	0.27	30	0.78	-6
5	1.67	-1.6	4.74	0.17	30	0.95	-5.54
6	1.35	-1.062	5.32	0.25	30	0.8	-5.51
1							

Fleet : SP-AVSOTBDEF

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.52	0.42	1.15	0.64	-0.11	-0.32	99.99	-0.68	0.47	-1.5
4	0.23	0.25	0.41	0.62	-0.06	-0.49	99.99	-0.41	0.13	-0.43
5	0.38	0.19	0.13	-0.15	-0.58	-0.13	99.99	-0.7	0.58	-0.14
6	0.77	0.91	1.07	1	-0.45	-0.98	99.99	-0.17	0.25	0.06

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-1.81	0.69	0.11	0.43	0.34	0.74	0.45	-0.4	0.55	0.96
4	-0.26	-0.63	0.14	0.18	0.29	0.05	-0.05	-0.56	0.68	0.2
5	0.51	0.3	0.08	0.22	-0.15	-0.16	-0.08	-0.66	0.63	0.01
6	0.66	0.59	0.39	0.79	-0.74	-0.2	-0.51	-1.07	0.98	-0.16

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.58	-0.21	-0.24	-0.66	-0.23	0.34	-0.91	-0.22	-0.51	-0.62
4	0.47	0.12	-0.3	-0.62	0.39	0.72	-0.76	0.3	-0.42	-0.21
5	0.05	-0.28	-0.18	-0.38	0.5	0.64	-0.4	0.07	-0.18	-0.11
6	-0.39	-0.72	-0.45	0.12	1.22	1.1	-0.94	0.66	0.01	-0.05

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	-4.644	-4.4767	-4.2053	-4.2053
S.E(Log q)	0.7071	0.4211	0.37	0.7139

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	0.76	1.267	5.39	0.5	29	0.53	-4.64
4	0.82	1.318	4.97	0.66	29	0.34	-4.48
5	0.81	1.438	4.68	0.68	29	0.29	-4.21
6	1.26	-0.701	3.56	0.21	29	0.89	-4.08
1							

Fleet : SP-GFS

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	99.99	99.99	99.99	99.99	-0.24	-0.49	-0.13	-0.05	-1.29	-0.21
2	99.99	99.99	99.99	99.99	0.04	-0.3	-0.56	-0.02	-0.88	-0.83
3	99.99	99.99	99.99	99.99	0.2	-0.76	-0.34	-1.02	0.29	-1.29
4	99.99	99.99	99.99	99.99	0.69	0.13	0.26	0.1	0.1	-0.31
5	99.99	99.99	99.99	99.99	0.51	0.19	0.58	-0.19	0.31	-0.06
6	99.99	99.99	99.99	99.99	0.69	-0.42	-0.56	-0.48	-0.03	-0.31

Age		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	1	-0.02	-0.09	0.02	0.22	0.69	0.14	0.46	0.28	0.15	0.45
	2	-0.07	-0.03	-0.14	0.4	0.64	0.61	0.39	0.13	0.27	-0.02
	3	-1.18	0.09	0.29	0.56	0.56	0.24	0.89	0.03	0.06	0.59
	4	-0.47	-0.45	0.04	0.09	0.66	0.61	-0.53	-0.14	-0.02	0.32
	5	-0.37	-0.11	0	0.18	0.25	0.14	0.33	-0.2	-0.26	0.37
	6	0	-0.5	0.54	1.17	-0.12	-0.55	-0.64	-0.99	0.61	-0.14

Age		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	1	0.13	0.3	-0.24	-0.16	0.1	-0.15	-0.3	99.99	-0.01	0.45
	2	0.27	-0.02	0.12	-0.17	-0.36	0.54	0.13	99.99	0.02	-0.12
	3	0.22	0.34	0.1	0.13	-1.15	0.64	0.52	99.99	0.25	-0.25
	4	0.07	0.37	-0.25	-0.08	-0.48	-0.78	-0.21	99.99	0.2	0.07
	5	0.14	0.26	-0.12	-0.38	-0.49	-0.3	-0.77	99.99	-0.06	0.05
	6	-0.14	-0.07	-0.56	-0.16	0.35	0.06	-0.49	99.99	0.09	-0.39

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	-6.7951	-6.5717	-6.3521	-6.3521
S.E(Log q)	0.6176	0.3801	0.327	0.5076

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.51	3.686	7.86	0.71	25	0.4	-7.34
2	0.64	2.649	7.38	0.7	25	0.4	-6.99

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	0.9	0.451	6.88	0.47	25	0.57	-6.8
4	0.73	2.457	6.73	0.78	25	0.25	-6.57
5	0.77	1.79	6.43	0.72	25	0.24	-6.35
6	1.35	-1.139	6.63	0.31	25	0.66	-6.47
1							

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2014

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	1	0	0	0	0	0	0
SP-AVSOTBDEF	1	0	0	0	0	0	0
SP-GFS	11316	0.427	0	0	1	0.628	0.055
P shrinkage mean	3501	0.63				0.317	0.169
F shrinkage mean	2580	1.5				0.055	0.223

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7187	0.34	0.53	3	1.535	0.086

Age 2 Catchability dependent on age and year class strength

Year class = 2013

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	1	0	0	0	0	0	0
SP-AVSOTBDEF	1	0	0	0	0	0	0
SP-GFS	1658	0.288	0.056	0.19	2	0.707	0.115
P shrinkage mean	2253	0.52				0.262	0.086
F shrinkage mean	1314	1.5				0.031	0.143

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1784	0.25	0.1	4	0.391	0.108

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

Year class = 2012

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	3004	0.649	0	0	1	0.195	0.15
SP-AVSOTBDEF	811	0.719	0	0	1	0.158	0.469
SP-GFS	1401	0.344	0.129	0.38	2	0.599	0.297
F shrinkage mean	1864	1.5				0.048	0.231

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1511	0.28	0.21	5	0.743	0.278

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

Year class = 2011

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	621	0.435	0.26	0.6	2	0.203	0.299
SP-AVSOTBDEF	337	0.372	0.116	0.31	2	0.292	0.496
SP-GFS	444	0.272	0.13	0.48	3	0.476	0.397
F shrinkage mean	543	1.5				0.029	0.335

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
441	0.2	0.11	8	0.548	0.399

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

Year class = 2010

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	399	0.358	0.29	0.81	3	0.169	0.459
SP-AVSOTBDEF	276	0.271	0.098	0.36	3	0.319	0.612
SP-GFS	372	0.207	0.057	0.27	4	0.491	0.486
F shrinkage mean	409	1.5				0.021	0.45

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
343	0.15	0.08	11	0.527	0.518

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2009

Fleet	Est Su	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	416	0.33	0.483	1.47	4	0.226	0.347
SP-AVSOTBDEF	315	0.263	0.171	0.65	4	0.31	0.437
SP-GFS	329	0.222	0.153	0.69	5	0.44	0.423
F shrinkage mean	350	1.5				0.024	0.401

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
343	0.15	0.14	14	0.893	0.409

Table 6.1.10. Megrim (*L. whiffiagonis*) Div. 8.c and 9.a. Estimates of fishing mortality-at-age.

Run title : Megrim (L. whiffiagonis.) in Divisions 8c and9a

At 2/05/2016 13:44

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEA	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE										
1	0.1583	0.2191	0.367	0.1199	0.4756	0.2847	0.1393	0.1959	0.067	0.0989
2	0.4063	0.5495	0.6503	0.4783	0.4501	0.6017	0.2773	0.3247	0.1924	0.3474
3	0.3027	0.2577	0.4829	0.2743	0.3442	0.2911	0.3466	0.2372	0.5177	0.1925
4	0.4463	0.2466	0.3631	0.5381	0.5427	0.4913	0.6949	0.4096	0.5248	0.3346
5	0.6128	0.3713	0.6007	0.4478	0.6018	1.0461	1.0749	0.4968	1.2762	0.4687
6	0.4262	0.1811	0.4172	0.4458	0.7238	0.562	0.3173	0.5242	1.2674	0.436
+gp	0.4262	0.1811	0.4172	0.4458	0.7238	0.562	0.3173	0.5242	1.2674	0.436
FBAR 2	0.3851	0.3513	0.4988	0.4302	0.4457	0.4614	0.4396	0.3238	0.4116	0.2915

Table 8 Fishing mortality (F) at age

YEA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE										
1	0.0609	0.0786	0.1053	0.2183	0.1851	0.1227	0.1453	0.14	0.0714	0.1458
2	0.3369	0.3204	0.2796	0.1874	0.1877	0.1684	0.1034	0.1682	0.1412	0.1266
3	0.2031	0.3499	0.3871	0.4289	0.389	0.3509	0.2199	0.1722	0.1718	0.3672
4	0.2171	0.1356	0.5032	0.3724	0.3529	0.2472	0.1594	0.1716	0.2291	0.2052
5	0.494	0.4718	0.6977	0.5135	0.324	0.2448	0.2528	0.1957	0.273	0.2214
6	0.5818	0.6442	1.0793	0.9006	0.1647	0.2337	0.1326	0.1221	0.4105	0.1965
+gp	0.5818	0.6442	1.0793	0.9006	0.1647	0.2337	0.1326	0.1221	0.4105	0.1965
FBAR 2	0.2524	0.2686	0.3899	0.3295	0.3099	0.2555	0.1609	0.1707	0.1807	0.233

Table 8 Fishing mortality (F) at age

YEA	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	FBAR 13-15
AGE											
1	0.0529	0.035	0.0881	0.131	0.0231	0.5196	0.3222	0.0829	0.1612	0.0859	0.11
2	0.3444	0.1022	0.197	0.0985	0.04	0.233	0.1181	0.0909	0.2325	0.1076	0.1437
3	0.4269	0.2504	0.1929	0.1214	0.0623	0.2223	0.2822	0.1963	0.3875	0.2785	0.2874
4	0.4178	0.4034	0.2603	0.1316	0.1177	0.3943	0.3654	0.3456	0.4426	0.399	0.3957
5	0.3534	0.3943	0.4205	0.2105	0.1784	0.4498	0.7241	0.3257	0.5566	0.5183	0.4669
6	0.24	0.2603	0.287	0.2588	0.3422	0.7214	0.3236	0.5318	0.5613	0.4086	0.5006
+gp	0.24	0.2603	0.287	0.2588	0.3422	0.7214	0.3236	0.5318	0.5613	0.4086	
FBAR 2	0.3964	0.252	0.2167	0.1172	0.0733	0.2832	0.2552	0.211	0.3542	0.2617	

Table 6.1.11. Megrim (*L. whiffiagonis*) Div. 8.c and 9.a. Estimates of stocks numbers-at-age

Run title : Megrim (L. whiffiagonis.) in Divisions 8c and 9a

At 2/05/2016 13:44

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEA	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE										
1	10204	13248	11931	10749	13340	6053	11908	5330	2267	9956
2	7868	7131	8712	6768	7806	6788	3728	8482	3587	1736
3	3377	4291	3370	3723	3434	4074	3045	2313	5019	2423
4	1992	2043	2715	1702	2317	1993	2493	1763	1494	2449
5	1218	1044	1307	1546	814	1102	998	1019	958	724
6	643	540	590	587	809	365	317	279	508	219
+gp	612	471	418	770	1181	150	274	97	179	223
TOTAL	25916	28769	29042	25845	29701	20526	22764	19282	14012	17729

Table 10 Stock number at age (start of year) Numbers*10**-3

YEA	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE										
1	10042	7825	4600	2767	4055	3619	3015	3113	3366	2819
2	7384	7735	5923	3389	1821	2759	2621	2135	2216	2566
3	1004	4316	4597	3667	2301	1236	1909	1935	1477	1575
4	1636	671	2491	2556	1955	1277	712	1254	1333	1019
5	1435	1078	480	1233	1442	1125	816	497	865	868
6	371	717	551	195	604	854	721	519	335	539
+gp	201	267	245	379	1166	622	328	460	234	253
TOTAL	22072	22610	18885	14186	13345	11491	10123	9913	9827	9639

Table 10 Stock number at age (start of year) Numbers*10**-3

YEA	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	GM 98-13
AGE												
1	2359	2893	1744	1531	7224	5601	3258	4984	3482	9564	0	3301
2	1995	1832	2287	1307	1099	5780	2728	1933	3756	2426	7187	
3	1851	1158	1354	1538	970	865	3749	1984	1445	2437	1784	
4	893	989	738	914	1115	746	567	2314	1335	803	1511	
5	679	482	541	466	656	812	412	322	1341	702	441	
6	570	391	266	291	309	449	424	163	190	629	343	
+gp	185	268	154	140	163	390	552	236	366	268	488	
TOTAL	8533	8012	7083	6186	11536	14644	11688	11937	11915	16830	11754	

Table 6.1.12 Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a. Summary of landings and XSA results.

Run title : Megrim (L. whiffiagonis.) in Divisions 8c and 9a

At 2/05/2016 13:44

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2- 4
1986	10204	2629	2278	705	0.3095	0.3851
1987	13248	2378	1920	537	0.2797	0.3513
1988	11931	2594	2181	858	0.3935	0.4988
1989	10749	2738	2356	761	0.3231	0.4302
1990	13340	2839	2416	1022	0.423	0.4457
1991	6053	1839	1641	655	0.3991	0.4614
1992	11908	1844	1573	558	0.3548	0.4396
1993	5330	1593	1422	421	0.2961	0.3238
1994	2267	1307	1226	492	0.4012	0.4116
1995	9956	1344	1001	258	0.2577	0.2915
1996	10042	1676	1345	373	0.2773	0.2524
1997	7825	1616	1398	408	0.2919	0.2686
1998	4600	1526	1393	482	0.346	0.3899
1999	2767	1248	1168	386	0.3305	0.3295
2000	4055	1399	1289	288	0.2234	0.3099
2001	3619	1083	968	194	0.2004	0.2555
2002	3015	999	905	136	0.1503	0.1609
2003	3113	1136	1021	149	0.1459	0.1707
2004	3366	956	831	160	0.1925	0.1807
2005	2819	1000	885	166	0.1876	0.233
2006	2359	953	848	226	0.2665	0.3964
2007	2893	893	760	155	0.2039	0.252
2008	1744	746	689	144	0.2091	0.2167
2009	1531	732	690	95	0.1378	0.1172
2010	7224	931	745	88	0.1182	0.0733
2011	5601	1288	1141	371	0.3252	0.2832
2012	3258	1298	1215	293	0.2411	0.2552
2013	4984	1226	1083	250	0.2309	0.211
2014	3482	1381	1264	399	0.3157	0.3542
2015	9564	1482	1223	297	0.2427	0.2617
Arith. Mean	6095	1489	1296	378	0.2692	0.3004
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 6.1.13. Megrim (*L. whiffiagonis*) in Division 8.c, 9.a. Prediction with management option table: Input data

MFDP version 1a
Run: MEG
Time and date: 16:38 03/05/2016
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2016 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
1	3301	0.2	0.34	0	0	0.033	0.006	0.063	0.229	0.031
2	2480	0.2	0.9	0	0	0.091	0.119	0.100	0.035	0.063
3	1784	0.2	1	0	0	0.133	0.266	0.134	0.008	0.089
4	1511	0.2	1	0	0	0.163	0.396	0.164	0.003	0.112
5	441	0.2	1	0	0	0.204	0.524	0.205	0.001	0.116
6	343	0.2	1	0	0	0.258	0.522	0.259	0.001	0.092
7	488	0.2	1	0	0	0.375	0.523	0.375	0.000	0.038

2017 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
1	3301	0.2	0.34	0	0	0.033	0.006	0.063	0.229	0.031
2	.	0.2	0.9	0	0	0.091	0.119	0.100	0.035	0.063
3	.	0.2	1	0	0	0.133	0.266	0.134	0.008	0.089
4	.	0.2	1	0	0	0.163	0.396	0.164	0.003	0.112
5	.	0.2	1	0	0	0.204	0.524	0.205	0.001	0.116
6	.	0.2	1	0	0	0.258	0.522	0.259	0.001	0.092
7	.	0.2	1	0	0	0.375	0.523	0.375	0.000	0.038

2018 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
1	3301	0.2	0.34	0	0	0.033	0.006	0.063	0.229	0.031
2	.	0.2	0.9	0	0	0.091	0.119	0.100	0.035	0.063
3	.	0.2	1	0	0	0.133	0.266	0.134	0.008	0.089
4	.	0.2	1	0	0	0.163	0.396	0.164	0.003	0.112
5	.	0.2	1	0	0	0.204	0.524	0.205	0.001	0.116
6	.	0.2	1	0	0	0.258	0.522	0.259	0.001	0.092
7	.	0.2	1	0	0	0.375	0.523	0.375	0.000	0.038

Input units are thousands and kg - output in tonnes

Table 6.1.14. Megrim (*L. whiffiagonis*) in Div. 8.c and 9.a catch forecast: management option table

MFDP version 1a
Run: MEG
Time and date: 16:38 03/05/2016
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2016		Catch	Landings		Discards	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield
1179	1085	1	0.2603	285	0.0153	25

2017		Catch	Landings		Discards		2018	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield	Biomass	SSB
1091	1000	0	0.0000	0	0.0000	0	1370	1274
.	1000	0.1	0.0260	32	0.0015	3	1328	1233
.	1000	0.2	0.0521	62	0.0031	5	1288	1194
.	1000	0.3	0.0781	91	0.0046	8	1250	1156
.	1000	0.4	0.1041	120	0.0061	10	1213	1119
.	1000	0.5	0.1301	146	0.0077	13	1178	1084
.	1000	0.6	0.1562	172	0.0092	15	1144	1051
.	1000	0.7	0.1822	197	0.0107	17	1111	1018
.	1000	0.8	0.2082	221	0.0123	20	1079	987
.	1000	0.9	0.2342	244	0.0138	22	1049	957
.	1000	1	0.2603	266	0.0153	24	1019	928
.	1000	1.1	0.2863	287	0.0169	26	991	901
.	1000	1.2	0.3123	308	0.0184	28	964	874
.	1000	1.3	0.3383	327	0.0199	30	938	848
.	1000	1.4	0.3644	346	0.0215	32	912	823
.	1000	1.5	0.3904	364	0.0230	34	888	799
.	1000	1.6	0.4164	382	0.0245	36	865	776
.	1000	1.7	0.4425	398	0.0261	38	842	754
.	1000	1.8	0.4685	415	0.0276	40	820	732
.	1000	1.9	0.4945	430	0.0291	42	799	712
.	1000	2	0.5205	445	0.0307	44	779	692

Input units are thousands and kg - output in tonnes

Table 6.1.15. Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a. Single option prediction: Detail Tables.

MFDP version 1a
Run: MEG
Time and date: 16:38 03/05/2016
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2016 F multiplier: 1 Fleet1 HCFbar: 0.2603 Fleet1 DFbar: 0.0153

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0062	17	1	0.2294	614	19	3301	108	1122	37	1122	37
2	0.1185	248	25	0.0349	73	5	2480	226	2232	203	2232	203
3	0.2664	378	51	0.0081	12	1	1784	237	1784	237	1784	237
4	0.3959	450	74	0.003	3	0	1511	247	1511	247	1511	247
5	0.5241	164	34	0.0007	0	0	441	90	441	90	441	90
6	0.522	127	33	0.0006	0	0	343	89	343	89	343	89
7	0.5227	182	68	0	0	0	488	183	488	183	488	183
Total		1566	285		702	25	10348	1179	7921	1085	7921	1085

Year: 2017 F multiplier: 1 Fleet1 HCFbar: 0.2603 Fleet1 DFbar: 0.0153

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0062	17	1	0.2294	614	19	3301	108	1122	37	1122	37
2	0.1185	213	21	0.0349	63	4	2135	194	1922	175	1922	175
3	0.2664	369	49	0.0081	11	1	1742	231	1742	231	1742	231
4	0.3959	331	54	0.003	3	0	1110	181	1110	181	1110	181
5	0.5241	309	63	0.0007	0	0	830	170	830	170	830	170
6	0.522	79	21	0.0006	0	0	214	55	214	55	214	55
7	0.5227	150	56	0	0	0	403	151	403	151	403	151
Total		1469	266		691	24	9735	1091	7343	1000	7343	1000

Year: 2018 F multiplier: 1 Fleet1 HCFbar: 0.2603 Fleet1 DFbar: 0.0153

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0062	17	1	0.2294	614	19	3301	108	1122	37	1122	37
2	0.1185	213	21	0.0349	63	4	2135	194	1922	175	1922	175
3	0.2664	318	43	0.0081	10	1	1500	199	1500	199	1500	199
4	0.3959	323	53	0.003	2	0	1084	177	1084	177	1084	177
5	0.5241	227	47	0.0007	0	0	610	125	610	125	610	125
6	0.522	149	39	0.0006	0	0	402	104	402	104	402	104
7	0.5227	111	42	0	0	0	300	112	300	112	300	112
Total		1359	245		689	24	9331	1019	6939	928	6939	928

Input units are thousands and kg - output in tonnes

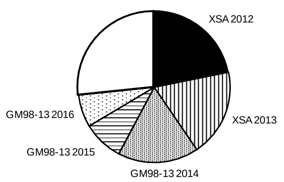
Table 6.1.16 **Megrim (*L. whiffiagonis*) in Divisions 8c and 9a**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			2012	2013	2014	2015	2016
Stock No. (thousands)			4984	3482	3301	3301	3301
of		1 year-olds					
Source			XSA	XSA	GM98-13	GM98-13	GM98-13
Status Quo F:							
% in	2016	catch	23.8	16.7	9.6	6.4	-
% in	2017		21.8	18.7	17.3	8.7	6.9
% in	2016	SSB	22.7	21.8	18.7	3.4	-
% in	2017	SSB	17.0	18.1	23.1	17.5	3.7
% in	2018	SSB	11.2	13.5	19.1	21.4	18.8

GM : geometric mean recruitment

Megrim (*L. whiffiagonis*) in Divisions 8c and 9a : Year-class % contribution to

a) 2017 catches **b) 2018 SSB**



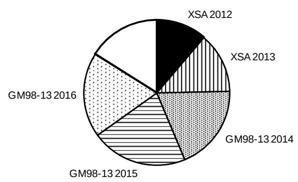


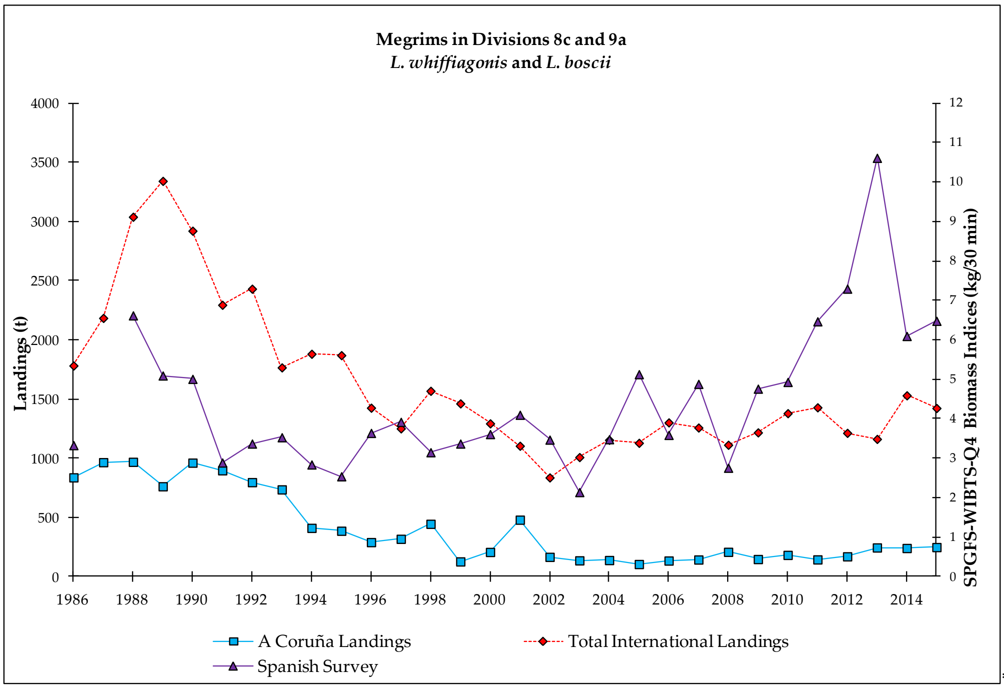
Table 6.1.17. Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a, yield-per-recruit results.

MFYPR version 2a
Run: MEG
Time and date: 16:41 03/05/2016
Yield per results

Catch FMult	Landings Fbar	CatchNos	Yield	Discards Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	1.0955	4.7748	1.0664	4.7748	1.0664
0.1	0.026	0.1263	0.0324	0.0015	0.0237	0.0009	4.7698	0.8487	4.0299	0.8197	4.0299	0.8197
0.2	0.0521	0.2047	0.0494	0.0031	0.0467	0.0017	4.2653	0.6901	3.5271	0.6613	3.5271	0.6613
0.3	0.0781	0.2565	0.0585	0.0046	0.0691	0.0025	3.8973	0.5804	3.161	0.5518	3.161	0.5518
0.4	0.1041	0.2919	0.0632	0.0061	0.0908	0.0032	3.6142	0.5005	2.8797	0.472	2.8797	0.472
0.5	0.1301	0.3166	0.0654	0.0077	0.1119	0.004	3.3878	0.4399	2.655	0.4116	2.655	0.4116
0.6	0.1562	0.3339	0.0661	0.0092	0.1323	0.0047	3.2011	0.3926	2.47	0.3645	2.47	0.3645
0.7	0.1822	0.346	0.0658	0.0107	0.1522	0.0053	3.0436	0.3546	2.3141	0.3267	2.3141	0.3267
0.8	0.2082	0.3542	0.065	0.0123	0.1716	0.006	2.9081	0.3236	2.1803	0.2958	2.1803	0.2958
0.9	0.2342	0.3594	0.06	0.0138	0.1904	0.0066	2.79	0.2977	2.0636	0.2701	2.0636	0.2701
1	0.2603	0.3624	0.0624	0.0153	0.2087	0.0073	2.6853	0.2759	1.9607	0.2483	1.9607	0.2483
1.1	0.2863	0.3637	0.061	0.0169	0.2264	0.0079	2.592	0.2571	1.8688	0.2297	1.8688	0.2297
1.2	0.3123	0.3636	0.0594	0.0184	0.2437	0.0084	2.5078	0.2409	1.7861	0.2136	1.7861	0.2136
1.3	0.3383	0.3625	0.0579	0.0199	0.2606	0.009	2.4314	0.2267	1.7112	0.1996	1.7112	0.1996
1.4	0.3644	0.3604	0.0563	0.0215	0.2769	0.0095	2.3616	0.2141	1.6428	0.1871	1.6428	0.1871
1.5	0.3904	0.3577	0.0548	0.023	0.2928	0.0101	2.2975	0.2029	1.58	0.176	1.58	0.176
1.6	0.4164	0.3544	0.0533	0.0245	0.3083	0.0106	2.2383	0.1929	1.5221	0.1661	1.5221	0.1661
1.7	0.4425	0.3506	0.0519	0.0261	0.3234	0.011	2.1833	0.1838	1.4685	0.1572	1.4685	0.1572
1.8	0.4685	0.3465	0.0505	0.0276	0.3381	0.0115	2.1322	0.1756	1.4187	0.1491	1.4187	0.1491
1.9	0.4945	0.3421	0.0491	0.0291	0.3524	0.012	2.0845	0.1681	1.3722	0.1417	1.3722	0.1417
2.0	0.5205	0.3375	0.0478	0.0307	0.3663	0.0124	2.0399	0.1612	1.3287	0.1349	1.3287	0.1349

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4	1	0.2603
FMax	0.6138	0.1597
F0.1	0.3556	0.0925
F35%SPR	0.5795	0.1508

Weights in kilograms



*

Spanish Landings of 2008 revised in WG2010 from original value presented

Figure 6.1.1 Historical landings and biomass indices of Spanish survey of megrims (both species combined).

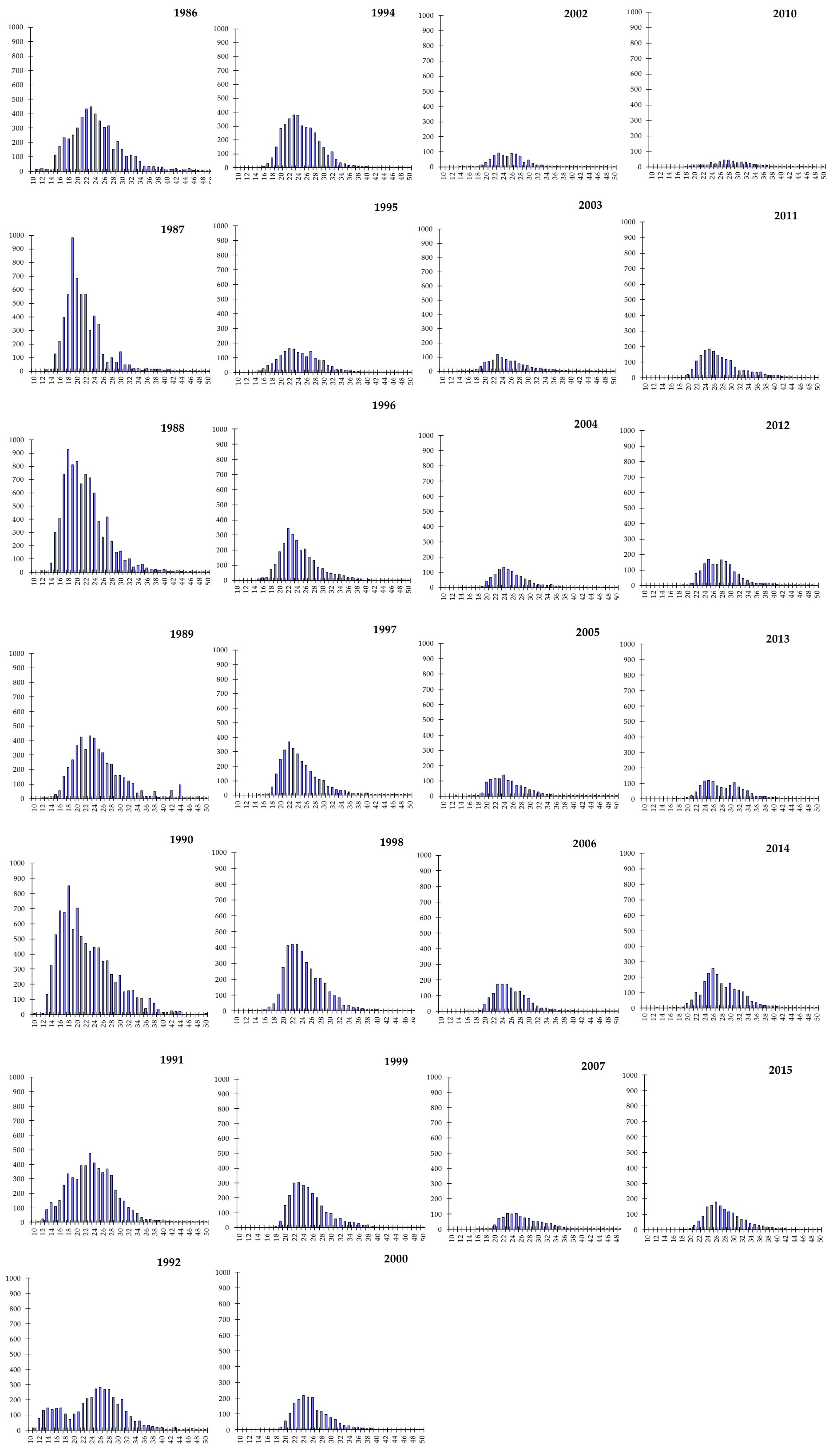
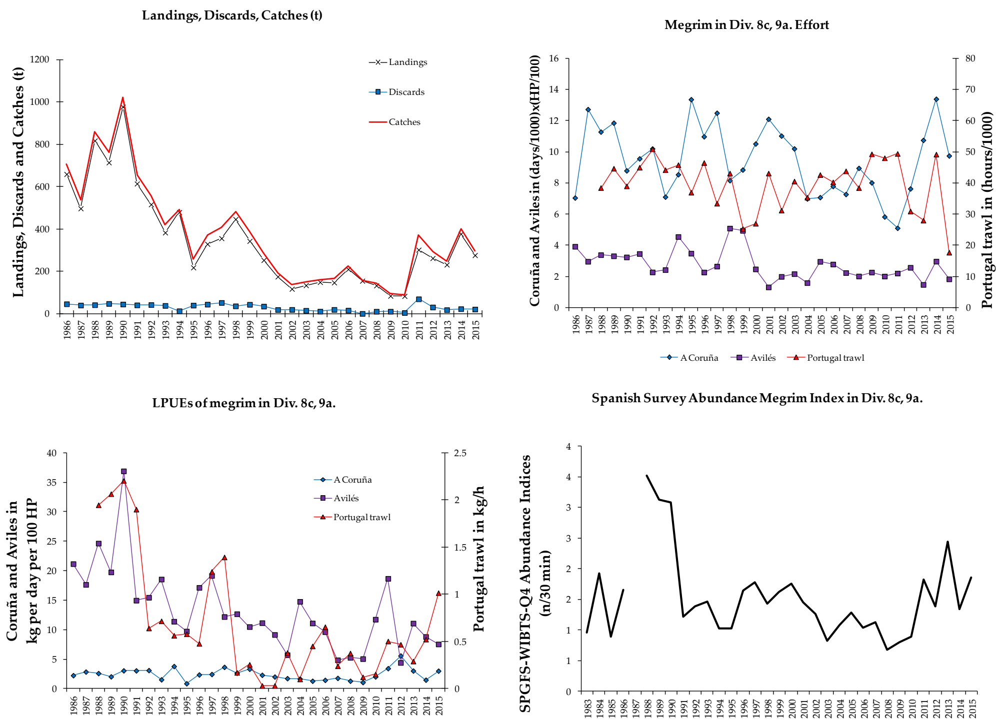


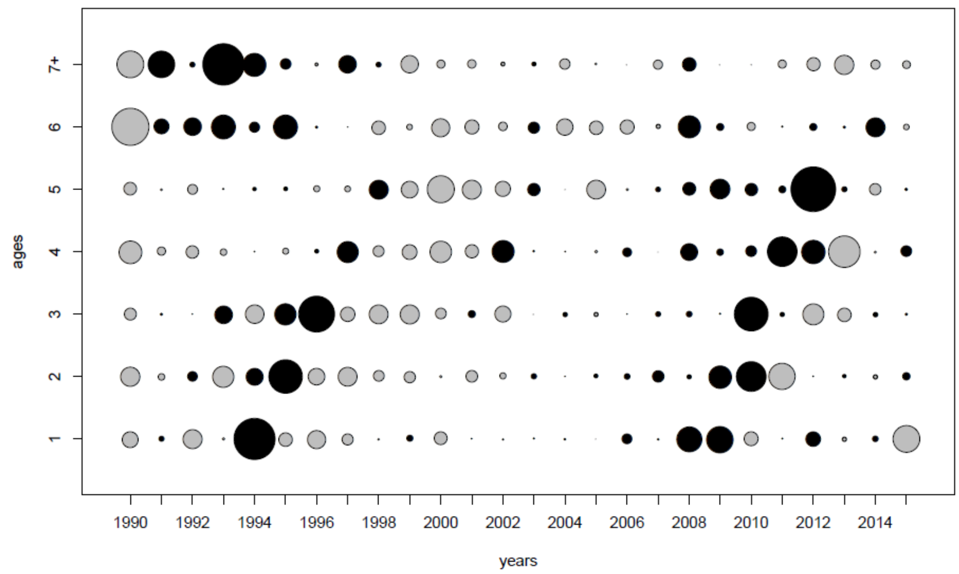
Figure 6.1.2 Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a. Annual length compositions of landings ('000)



Spanish Landings of 2008 revised in WG2010 from original value presented
* Portuguese Trawl Effort of 2007 and 2008 revised in WG2010 from original value presented

Figure 6.1.3(a) Megrim (*L.whiffiagonis*) in Divisions 8.c, 9.a. Catches (t), Efforts, LPUEs and Abundance Indices.

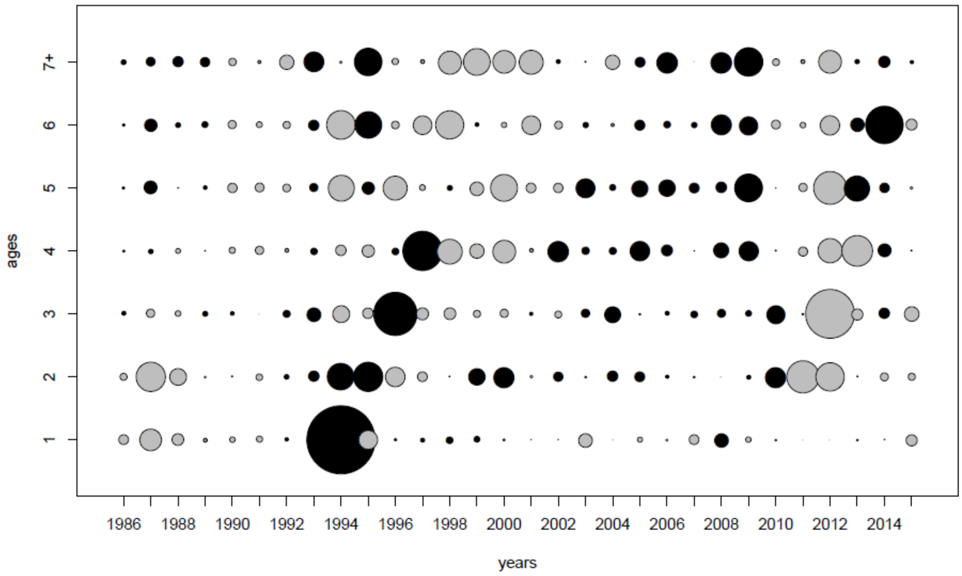
Standardized log (abundance index at age) from survey SpGFS-WIBTS-Q4 (black bubbles means <0)



* 2013 data not included in the assessment

Figure 6.1.3(b): Megrim (*L. whiffiagonis*) in Divisions 8.c & 9.a

Standardized log (abundance index at age) from A Coruña fleet (SP-LCGOTBDEF) (black bubble means < 0)



Standardized log (abundance index at age) from Avilés fleet (SP-AVSOTBDEF) (black bubble means < 0)

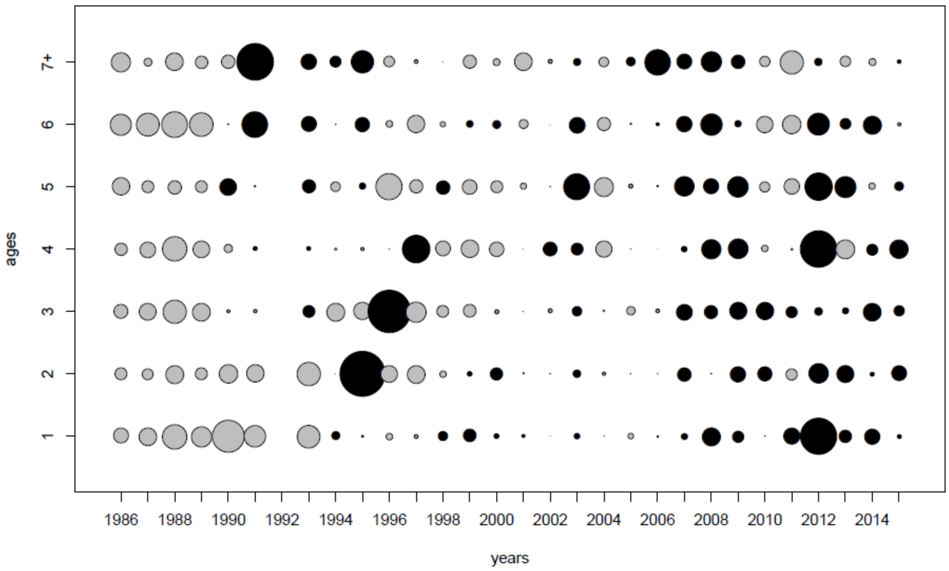
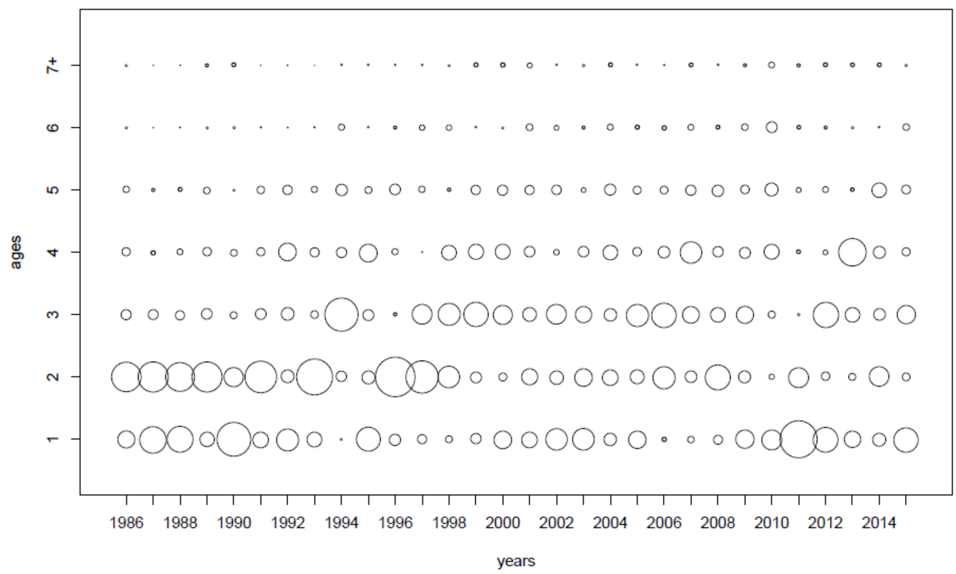


Figure 6.1.3(c): Megrim (*L. whiffiagonis*) in Divisions 8.c & 9.a

Catches proportions at age



Standardized catches proportions at age (black bubble means < 0)

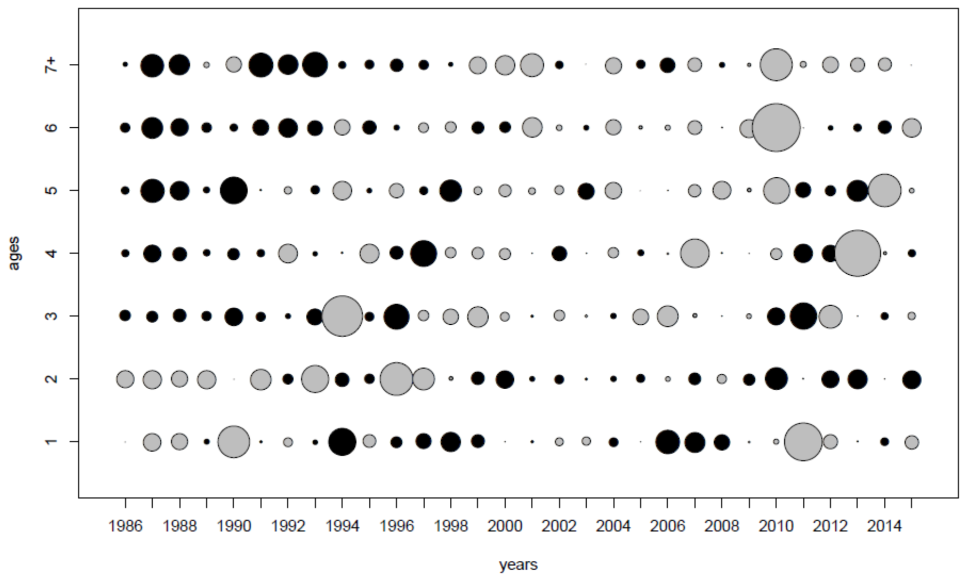
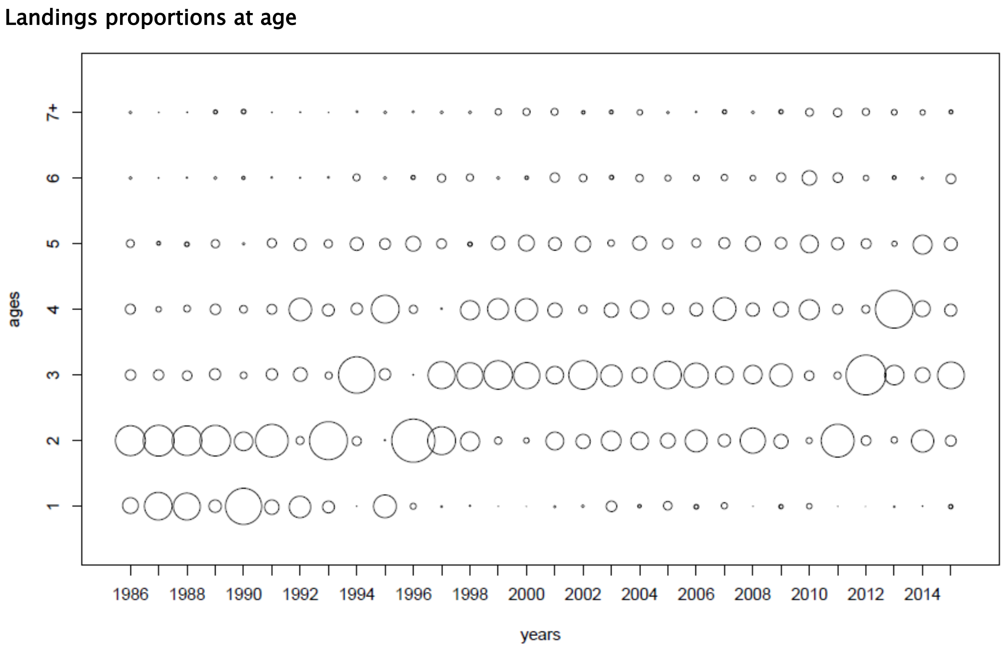


Figure 6.1.4(a). Megrim (*L. whiffiagonis*) in Divisions 8.c & 9.a.



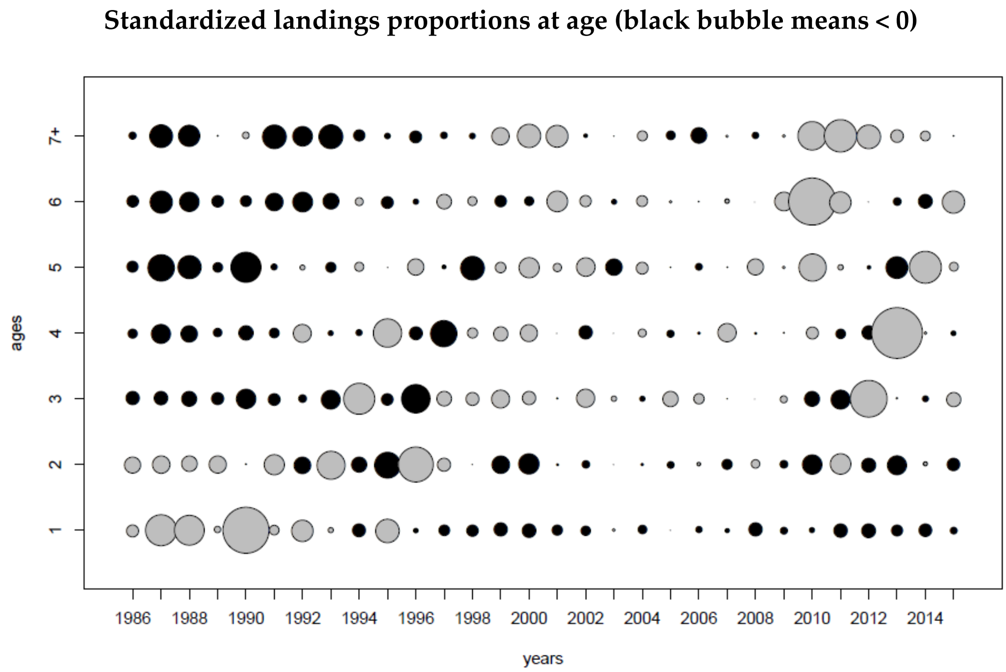
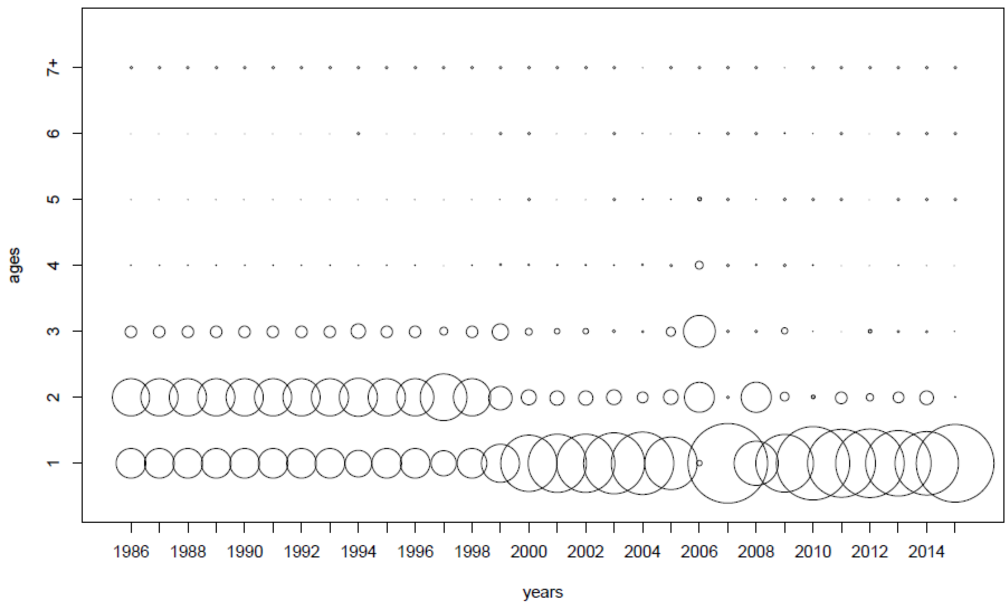


Figure 6.1.4(b). Megrim (*L. whiffiagonis*) in Divisions 8.c & 9.a.

Discards proportions at age



Standardize discards proportions at age (black bubble means < 0)

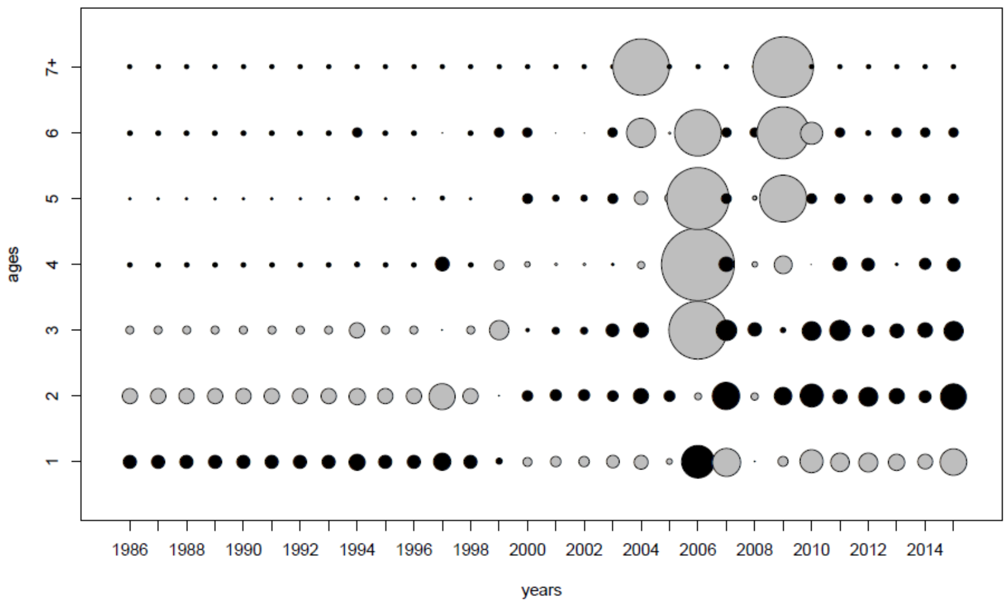


Figure 6.1.4(c). Megrim (*L. whiffiagonis*) in Divisions 8.c & 9.a.

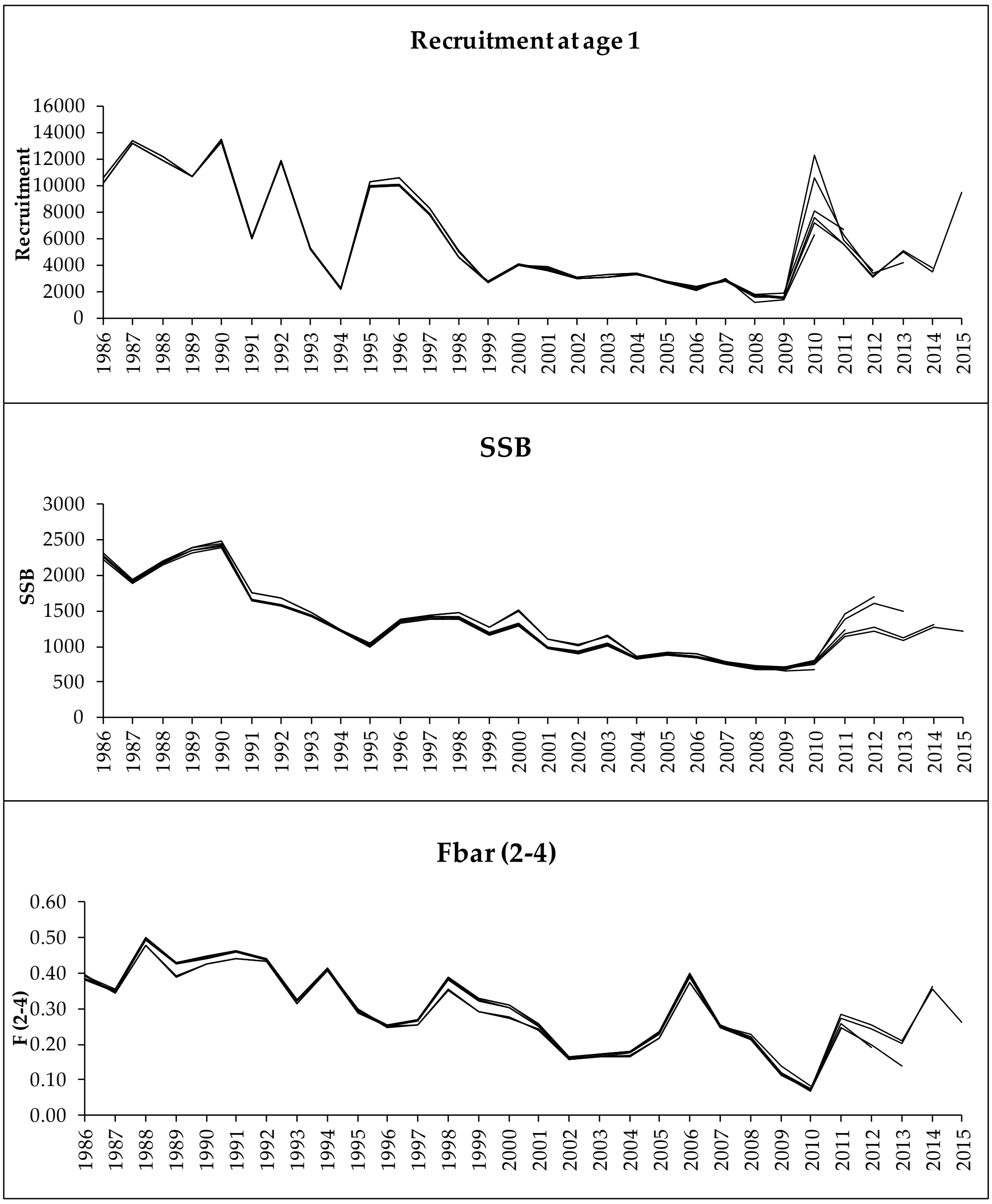


Figure 6.1.5. Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a. Retrospective XSA

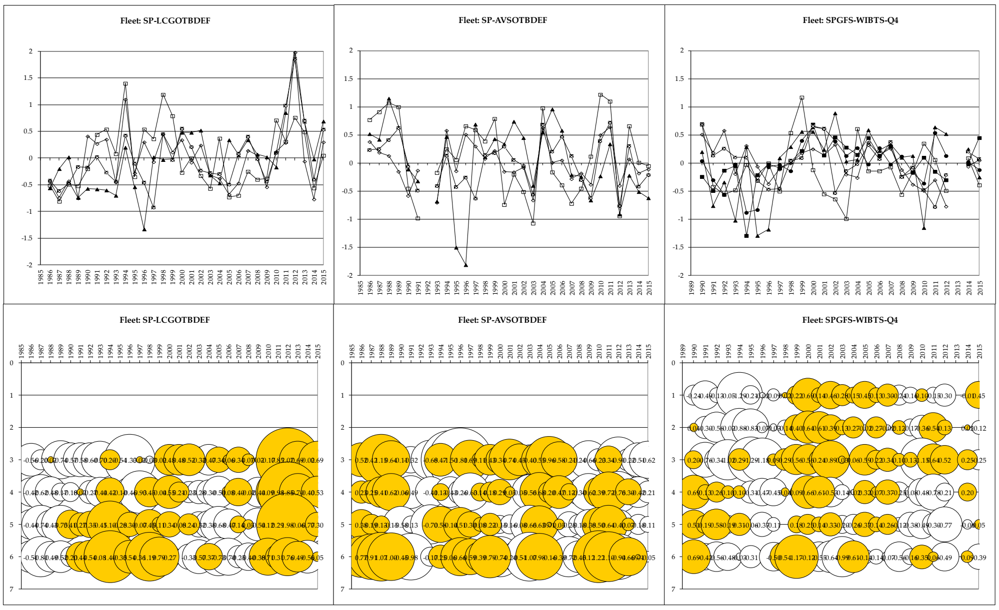


Figure 6.1.6. Megrim in Divisions 8.c and 9.a. LOG-CATCHABILITY RESIDUAL PLOTS (XSA)

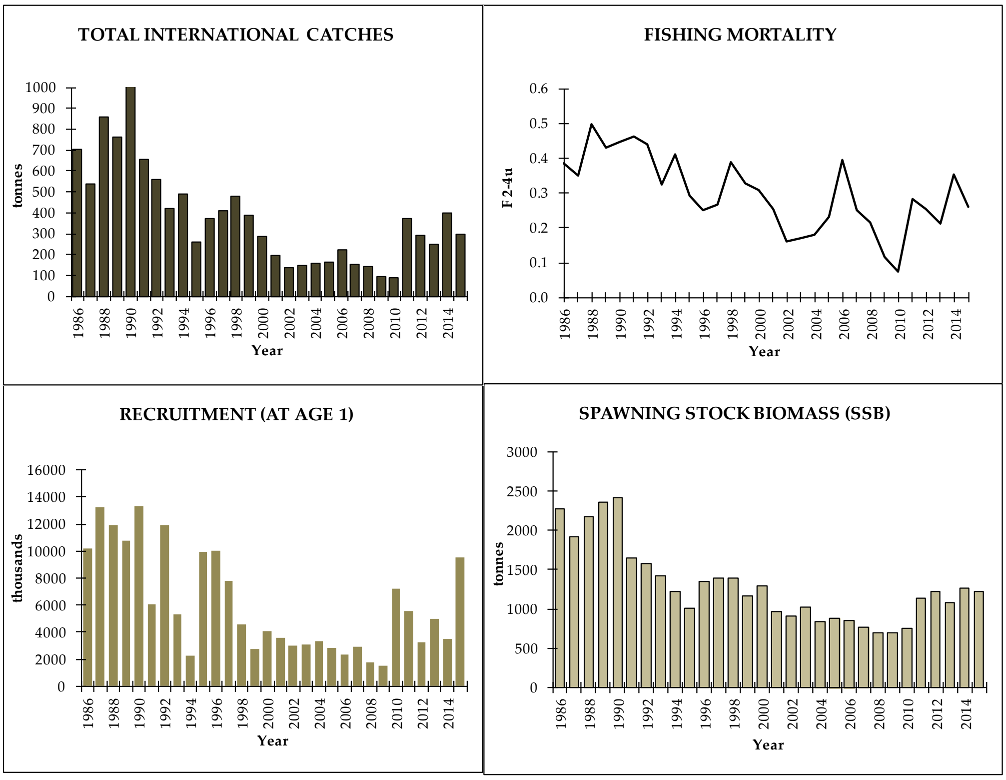
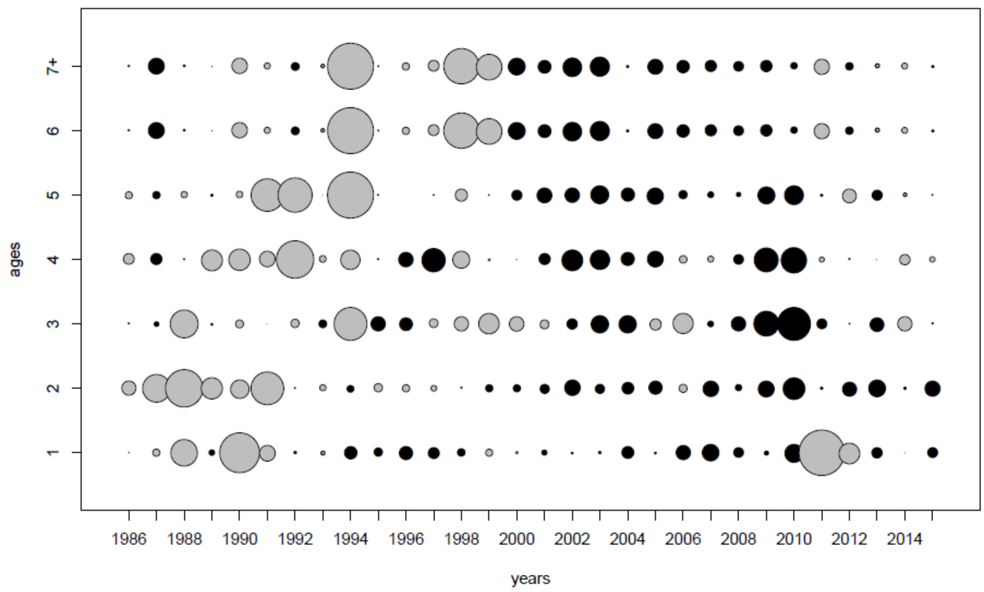


Figure 6.1.7(a) Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a. Stock Summary

Standardized F-at-age (black bubbles means <0)



Standardized relative F-at-age (black bubble means < 0)

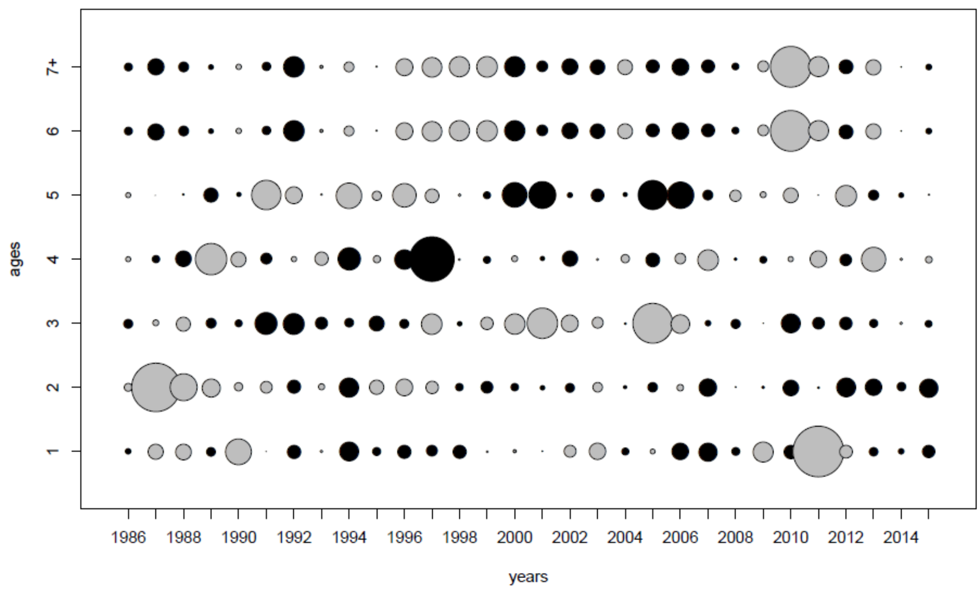
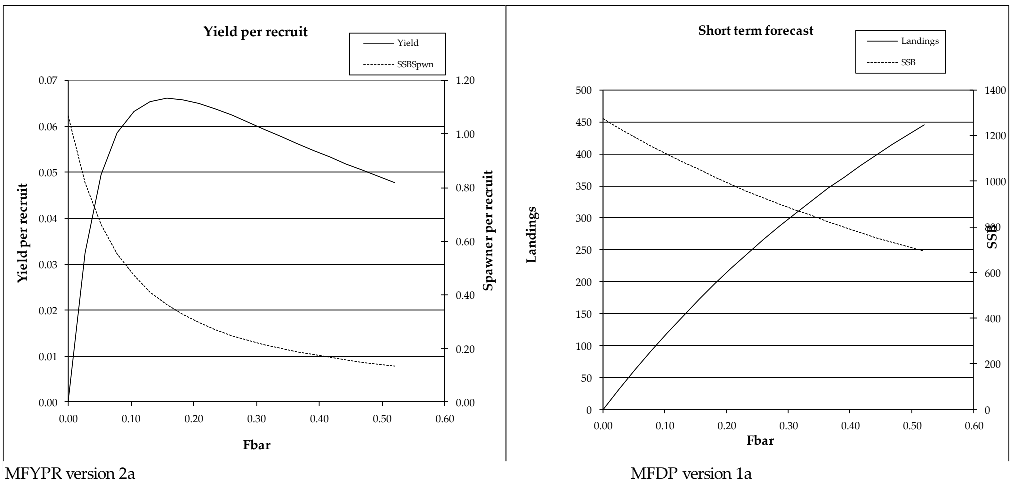


Figure 6.1.7(b): Megrim (*L. whiffiagonis*) in Divisions 8.c & 9.a



MFYPR version 2a
Run: MEG
Time and date: 16:41 03/05/2016

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar	1.0000	0.2603
FMax	0.6138	0.1597
F0.1	0.3556	0.0925
F35%SPR	0.5795	0.1508

MFDP version 1a
Run: MEG
Time and date: 16:38 03/05/2016
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Input units are thousands and kg - output in tonnes

Figure 6.1.8. Megrim (*L. whiffiagonis*) in Divisions 8.c and 9.a, forecast summary

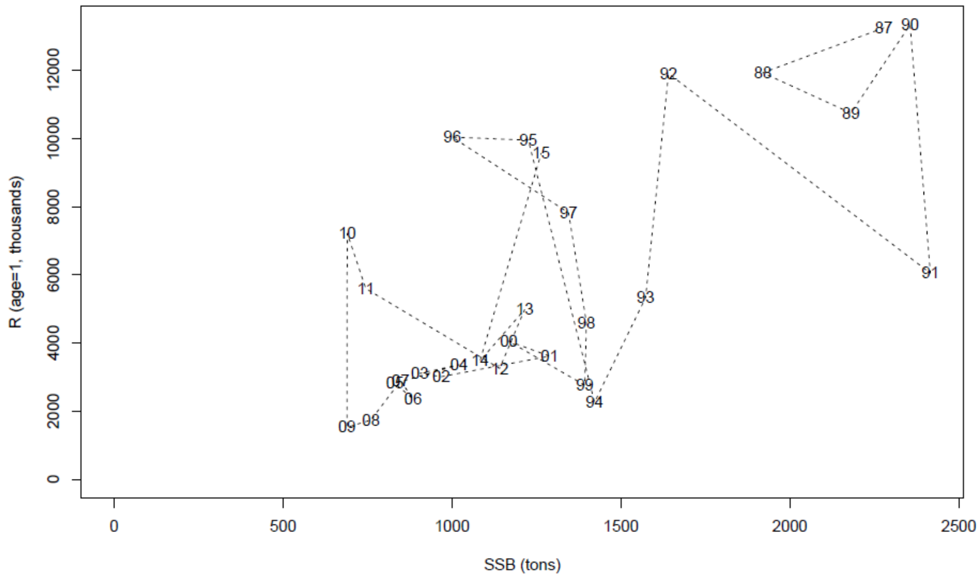


Figure 6.1.9. Megrim (*L.whiffiagonis*) in Divisions 8.c and 9.a. SSB-Recruitment plot. (numbers in graph, 1987–2014, are recruitment years)

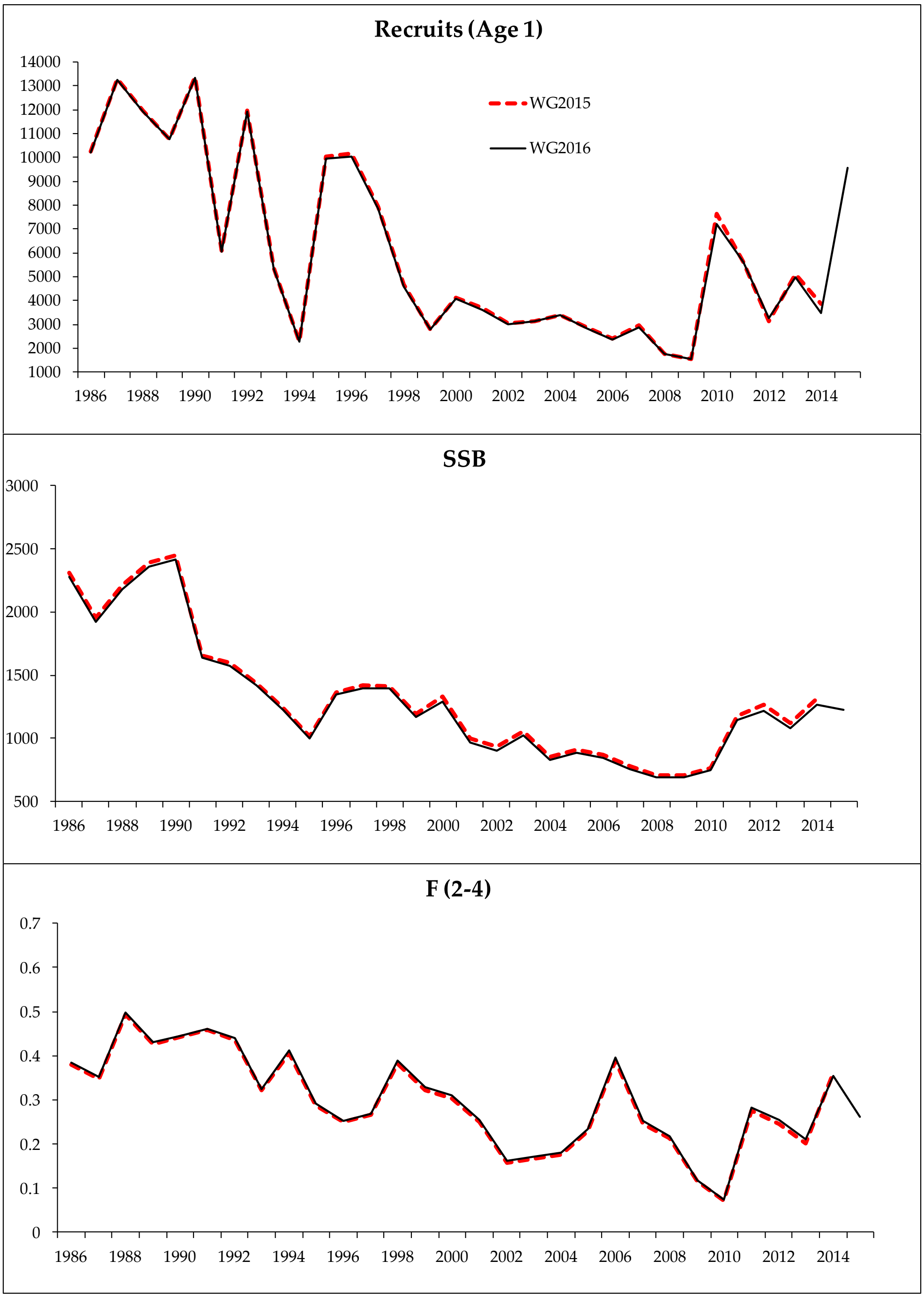


Figure 6.1.10. Megrim (*L. whiffiagonis*) in Div. 8.c and 9.a. Recruits, SSB and F estimates from WG15 and WG16

6.2 Four-spot megrim (*Lepidorhombus boscii*)

6.2.1 General

See general section for both species.

6.2.2 Data

6.2.2.1 Commercial catches and discards

The WG estimates of four-spot megrim international landings, discards and catches for the period 1986–2015 are given in Table 6.2.1. Estimates of catches currently include an unallocated landing category. These estimates are considered the best information available at this time. In 2015, data revised for period 2011-2013 were provided. This revision produced an improvement in the allocation of sampling trips and data revised are used in the assessment. Landings reached a peak of 2629 t in 1989 and have generally declined since then to their lowest value of 720 t in 2002. There has been some increase again in the last few years. Landings in 2010 are 1297 t, the highest value after 1995. After a similar value in 2011, landings in 2013 are 931 t, a significant drop. In 2015, the landings value of 1148 t is quite similar to the last year.

Discards estimates were available from "observers on board sampling programme" for Spain in the years displayed in Table 6.2.2(a). Discard / Total Catch ratio and CV are also presented, where discards in number represent between 39-67% of the total catch. Following the ICES recommendations in the advice sheet and using the same methodology described for *L. whiffiagonis* in section 6.1.2.1, discards missing data were also estimated for *L. boscii* in the Benchmark WKSOUTH in 2014. Spanish discards in numbers-at-age are shown in Table 6.2.2(b), indicating that the bulk of discards (in numbers) is for ages 1 to 3. Total discards are given in tons in Table 6.2.1

6.2.2.2 Biological sampling

Annual length compositions of total stock landings are given in Figure 6.2.1 and Table 6.2.3(a) for the period 1986-2015. Unallocated value is raised to total length distribution.

Mean length and weights in landings since 1990 are shown in the Table 6.2.3(b).

Age compositions of catches are presented in Table 6.2.4 Weights-at-age of catches (given in Table 6.2.5) were also used as weights-at-age in the stock. There is some variability in the weights-at-age through the historical time-series.

For more information about biological data see Stock Annex.

6.2.2.3 Abundance indices from surveys

Portuguese and Spanish survey indices are summarized in Table 6.2.6.

Two Portuguese surveys, named "Crustacean" (PT-CTS (UWTV(FU28-29))) and "October" (PtGFS-WIBTS-Q4), provide indices for 2014. The October survey was conducted with a different vessel and gear in 2003 and 2004. Excluding these two years, the biomass indices from this survey in 2007 and 2011 were the highest observed since 1994, whereas the value in 2010 is the second lowest in the series. In 2011, both the biomass and abundance indices from the Crustacean survey are the highest in the time-series. In 2012, Portuguese Survey was not carried out due to budgetary constraints of national scope turned unfeasible to repair the RV.

Total biomass, abundance and recruitment indices from the Spanish Groundfish Survey (SpGFS-WIBTS-Q4) are also presented in Table 6.2.6. Total biomass indices from this survey generally remained stable after a maximum level in 1988 till 2003, when a very low value was obtained (as done in previous years, the 2003 index has been excluded from the assessment, as it was felt to be too much in contradiction with the rest of the time-series). Since then, this was followed by the period of the higher values till present days, with the only exception of 2008. In 2013, the biomass and the abundance indices were the highest of the series. For the same raison that for *L. whiffiagonis*, survey carried out in a new vessel and with new fishing doors, the abundance values of 2013 is not included in the assessment models.

The recruitment index for age 0 in 2005 was very high and also in 2009 and 2014. The high index in 2009 applies to all ages and not just the recruitment (see Table 6.2.7, which gives abundance indices by age, and Figure 6.2.2, which is a bubble plot of log(abundance index at age) standardized by subtracting the mean and dividing by the standard deviation over the years). Since 2009, almost all ages appears to be above average. From Figure 6.2.2, the survey appears to have been quite good at tracking cohorts, in the last ten years, good cohorts of 2005 and 2009 can be followed, especially the second one.

6.2.2.4 Commercial catch-effort data

Two new commercial tuning indices were provided also for this stock as in the case of *L. whiffiagonis*. The LPUEs of the métiers of bottom otter trawl targeting demersal species, previously describe in section 6.1.2.4, one per port (A Coruña and Avilés), were made available for the benchmark WKSOUTH in 2014. From these new tuning fleets, SP-LCGOTBDEF and SP-AVSOTBDEF, only the first one was accepted to tune the assessment model. The LPUEs and effort values and landed numbers-at-age are given in Table 6.2.7 and Figure 6.2.3(a).

These fleets operate in different areas, each covering only a small part of the distribution of the stock, which may partly explain differences between patterns from these fleets and those from the Spanish survey in some years. Furthermore, commercial catches are mostly composed of ages 3 and 4, while the Spanish survey catches mostly fish of ages 1 and 2.

Table 6.2.8 displays landings (in tonnes), fishing effort and LPUE for the two Spanish trawl fleets just mentioned for the period 1988-2015 and for the Portuguese trawl fleet fishing in Division 9.a for the period 1988–2015 (see also Figure 6.2.3). After very high value in 2010, the LPUE of Coruña (SP-LCGOTBDEF) shows in 2015 an increase in relation to last year. A decrease is observed in the LPUE from Avilés (SP-AVSOTBDEF) in 2015. For the Portuguese fleets, until 2011 most logbooks were filled in paper but have thereafter been progressively replaced by e-logbooks. In 2013 more than 90% of the logbooks are being completed in the electronic version. The LPUE series were revised from 2012 onwards. To revise the series backwards further refinement of the algorithms is required.

Commercial fleets used in the assessment to tune the model

Because of the trend in the residuals, A Coruña fleet (SP-LCGOTBDEF) was split in two (SP-LCGOTBDEF -1 and SP-LCGOTBDEF-2) for tuning, considering values until 1999 and from 2000 to 2015, as indicated in the Stock Annex. In Figure 6.2.3(b), the bubble plots of log (abundance index at age) standardized by subtracting the mean and dividing by the standard deviation over the years) of these two fleets are presented.

Some cohorts can be followed in the time-series. The effort of this fleet had been generally stable till year 2009, when effort is declining to its lowest value in the series, reached in 2011. After this year, the effort is increasing till 2014 the highest value of the time-series, decreasing in 2015 again.

Commercial fleets not used in the assessment to tune the model

The effort of the Avilés fleet (SP-AVSOTBDEF) present two periods, the first one with a mean value of 3.2 and the second with 2.2 (days/1000)x(HP/100). The value in 2013 is one of the lowest of the series and it is similar in 2015.

The effort of the Portuguese trawl fleet appears to fluctuate within stable bounds, with the lowest values corresponding to 1999 and 2000. It shows a slightly declining trend through the 1990s until these two lowest years and a slightly increasing one since then. The 2015 value represents a significant decrease, being the lowest of the time-series.

The LPUE series from the Avilés trawl fleet (SP-AVSOTBDEF) shows a generally upwards trend during all the series. The LPUE of the Portuguese trawl fleet has generally declined since 1992, with an increase in the last year till 2010, when the values started a decreasing trend. The value in 2015 is the highest over the years.

6.2.3 Assessment

An update assessment was conducted, according to the Stock Annex specifications. Assessment years are 1986-2015 and ages 0-7+.

6.2.4 Model

Data screening

Figures 6.2.4(a), (b) and (c) are bubble plots representing catch, landings and discards proportions at age. These plots clearly indicate that the bulk of the landings generally corresponds to ages 2 to 4 and the discards at ages 1-2. Although in the last years, it seems to be an increase in age 5 and a decrease in age 2. The bottom panel of Figures 6.2.4(a), (b) and (c) also present bubble plots corresponding to standardized catch, landings and discards proportions at age, showing that the one corresponding to landings is the best to follow cohorts.

Very weak cohorts corresponding to year classes of 1993 and 1998 can be clearly identified from the standardized landing proportions at age matrix and good cohorts corresponding to year classes of 1991, 1992, 1995 and 2005 can also be tracked.

Final XSA run

Settings for the assessment are those detailed in the Stock Annex.

The retrospective analysis shows no particular worrying features (Figure 6.2.5). The model has a tendency to underestimate F and an overestimate SSB in the last years.

6.2.4.1 Assessment results

Diagnostics from the XSA final run are presented in Table 6.2.9 and log-catchability residuals plotted in Figure 6.2.6. Diagnostics and residuals are similar to those found in the previous assessment. Many of the survey residuals are negative until the mid-2000's. After that, positive survey residuals are more abundant in this period.

Table 6.2.10 presents the fishing mortality-at-age estimates. F_{bar} (=F_{2-4}) is estimated to be 0.40 in 2015.

Population numbers-at-age estimates are presented in Table 6.2.11.

6.2.4.2 Year-class strength and recruitment estimations

The 2013 year class estimate is 48.2 million individuals, obtained by averaging estimates coming from the Spanish survey tuning data (95% of weight) and F-shrinkage (5% weight).

The 2014 year class estimate is 90 million individuals, estimated from the Spanish survey (95% of weight) and F-shrinkage (5% weight).

The 2015 year class estimate is 27.1 million individuals, obtained a value from the Spanish survey (79% weight) and F-shrinkage (21% weight).

The working group considered that the XSA last year recruitment is poorly estimated. Following the procedure stated in the Stock Annex, the geometric mean of estimated recruitment over the years 1990-2013 has been used for computation of 2015 and subsequent year classes, for prediction purposes. Working Group estimates of year-class strength used for prediction are:

Recruitment-at-age 0:

Year class	Thousand	Basis	Survey	Commercial	Shrinkage
2013	48207	XSA	95%	-	5%
2014	90047	XSA	95%	-	5%
2015	43283	GM90-13		-	
2016	43283	GM90-13			

6.2.4.3 Historic trends in biomass, fishing mortality, and recruitment

Estimated fishing mortality and population numbers-at-age from the XSA run are given in Tables 6.2.10 and 6.2.11. Further results, including SSB estimates, are summarized in Table 6.2.12 and Figure 6.2.7(a).

SSB decreased gradually from 6742 t in 1989 to 3216 t in 2001, the lowest value in the series, and has since increased. In 2015 the SSB is estimated at 6615 t, one of the highest.

Recruitment has fluctuated around 45 million fish during all the series. Very weak year classes are found in 1993 and 1998. The second highest value occurred in 2009, while 2014 value is the highest in the series, with 90 million fish.

Estimates of fishing mortality values show two different periods: an initial one with higher values from 1989 to 1996 and, following a decrease in 1997, a second period stabilized at a lower level, with small ups and downs. From 2007, the F has been decreasing till the last three years, especially in the last, when a significant increase has occurred with a value of 0.40.

There seems to be interannual variability of the relative fishing exploitation pattern at age (F over F_{bar}, see Figure 6.2.7(b), bottom panel), with alternating periods of time with higher and lower relative exploitation pattern on the older ages.

6.2.5 Catch options and prognosis

Stock projections were calculated according to the settings specified in the Stock Annex.

6.2.5.1 Short-term projections

Short-term projections have been made using MFDP software. The input data for deterministic short-term projections are given in Table 6.2.13. Average F_{bar} for the last three years is assumed for the interim year. The exploitation pattern was the scaled F-at-age computed for each of the last five years and then the average of these scaled five years was weighted to the final year. This selection pattern was split into selection-at-age of landings and discards (corresponding to Fbar = 0.21 for landings and Fbar = 0.16 for discards, being 0.36 for catches). The recruitment in 2015 (age 0) has been replaced by GM (according with stock annex, GM is computed over years 1990-final assessment year minus 2), age 1 in 2016 has been recalculated from GM reduced by total estimated mortality obtained from the fishing mortality of age 0 of the last year and the natural mortality.

Table 6.2.14 gives the management options for 2017, and their consequences in terms of projected landings and stock biomass. Figure 6.2.8 (right panel) plots short-term yield and SSB vs. Fbar. The detailed output by age group, assuming F *status quo*, is given in Table 6.2.15 for landings and discards. Under this scenario, projected landings for 2016 and 2017 are 1411 and 1497 t, respectively. Projected discards for the same years are 743 and 601 t.

Under F *status quo*, projected SSB values for 2017 and 2018 are about 6940 t in 2017 and 6422 t in 2018.

The contributions of recent year classes to the projected landings and SSB are presented in Table 6.2.16. The year classes for which GM_{90-13} recruitment is assumed contribute in a 5% to catches in 2017 and with a 28% to SSB in 2018.

6.2.5.2 Yield and biomass per recruit analysis

The analysis is conducted following the Stock Annex specifications and results presented in Table 6.2.17. The left panel of Figure 6.2.8 plots yield-per-recruit and SSB-per-recruit vs. F_{bar}.

Under F s*tatus quo* (F_{bar} = 0.21 for landings and F_{bar} = 0.16 for discards), yield-per-recruit is 0.02 kg for landings and 0.01 kg for discards and SSB-per-recruit is 0.11 kg. Assuming GM_{90-13} recruitment of 43 million, the equilibrium yield would be around 1004 t of landings and 450 t of discards, with an SSB value of 4809 t.

6.2.5.3 Biological reference points

The stock–recruitment time-series is plotted in Figure 6.2.9. See Stock Annex for more information about Biological reference points.

The BRP are:

	Type	Value	Technical basis
MSY Approach	**MSY $B_{trigger}$**	**4600 t**	Bpa
	F_{MSY}	**0.19**	
	F_{MSY} lower	**0.13**	based on 5% reduction in yield
	F_{MSY} upper (with advice rule)	**0.29**	based on 5% reduction in yield
	F_{MSY} upper (without advice rule)	**0.29**	based on 5% reduction in yield
	$F_{P.05}$	**0.40**	5% risk to B_{lim} without $B_{trigger}$.
Precautionary Approach	**B_{lim}**	**3300 t**	B_{loss} estimated in 2015
	B_{pa}	**4600 t**	1.4 B_{lim}
	F_{lim}	**0.57**	Based on segmented regression simulation of recruitment with B_{lim} as the breakpoint and no error
	F_{pa}	**0.41**	$F_{pa} = F_{lim} \times \exp(-\sigma \times 1.645)$ $\sigma=0.2$

6.2.6 Comments on the assessment

Two commercial fleets (SP-LCGOTBDEF-1 and SP-LCGOTBDEF-2) and the Spanish survey (SpGFS-WIBTS-Q4) were used for tuning. The commercial fleet data used for tuning corresponds to ages 3 and older, which are not well represented in the survey. The Spanish survey covers a large part of the distribution area of the stock. The survey appears to have been quite good at tracking cohorts.

With the new settings, discards data and new tuning fleets, the model converges. It seems that the convergence issue is solved for this stock.

Comparison of this assessment with the one performed in 2015 shows minor differences in SSB in recent years which have been revised downward (Figure 6.2.10).

6.2.7 Management considerations

This assessment indicates that SSB decreased substantially between 1988 and 2001, the year with lowest SSB, and that there has been a smooth increasing trend from 2001 to present. Fishing at *status quo* F during 2016 and 2017 would result in some biomass increase for 2016 and 2017.

There is no evidence of reduced recruitment at low stock levels.

As with *L. whiffiagonis,* it should be noted that four-spot megrim (*L. boscii*) is caught in mixed fisheries, and management measures applied to this species may have implications for other stocks. Both species of megrim are subject to a common TAC, so the joint status of these species should be taken into account when formulating management advice.

6.3 Combined Forecast for Megrims (*L. whiffiagonis* and *L. boscii*)

Figure 6.3.1 plots total international landings and estimated stock trends for both species of megrim in the same graph, in order to facilitate comparisons. The two species of megrim are included in the landings from ICES Divisions 8.c and 9.a. Both are taken as bycatch in mixed bottom-trawl fisheries.

Assuming status quo F for both species in 2016 (average of estimated F over 2013-2015, corresponding to Fbar = 0.26 for landings and Fbar = 0.02 for discards for *L. whiffiagonis* and Fbar = 0.21 for landings and Fbar = 0.16 for discards for *L. boscii*), Figure 6.3.2 gives the combined predicted landings for 2017 and individual SSB for 2018, under different multiplying factors of their respective status quo F values. The combined projected values for the two species have been computed as the sum of the individual projected values obtained for each species separately under its assumed exploitation pattern. As usual, the exploitation pattern for each species has been assumed to remain constant during the forecast period.

At status quo F (average F over 2013–2015) for both species, predicted combined catches in 2016 are 1763 t and individual SSBs in 2017 are 928 t for *L. whiffiagonis* and 6422 t for *L. boscii*.

Table 6.2.1. Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Total landings (t).

	Spain landings			Portugal landings	Unallocated	Total landings	Discards	Total catch
Year	8c	9a***	Total	9a				
1986	799	197	996	128		1124	284	1408
1987	995	586	1581	107		1688	333	2021
1988	917	1099	2016	207		2223	363	2586
1989	805	1548	2353	276		2629	408	3037
1990	927	798	1725	220		1945	409	2354
1991	841	634	1475	207		1682	447	2129
1992	654	938	1592	324		1916	437	2353
1993	744	419	1163	221		1384	438	1822
1994	665	561	1227	176		1403	517	1920
1995	685	826	1512	141		1652	406	2058
1996	480	448	928	170		1098	368	1466
1997	505	289	794	101		896	308	1204
1998	725	284	1010	113		1123	378	1501
1999	713	298	1011	114		1125	317	1442
2000	674	225	899	142		1041	373	1414
2001	629	177	807	124		931	290	1221
2002	343	247	590	130		720	308	1028
2003	393	314	707	169		876	191	1067
2004	534	295	829	177		1006	348	1354
2005	473	321	794	189		983	375	1358
2006	542	348	891	201		1092	335	1427
2007	591	295	886	218		1104	292	1396
**2008	546	262	808	172		980	202	1182
2009	577	342	919	215		1134	279	1413
2010	616	484	1100	197		1297	265	1562
*+2011	390	384	774	181	172	1128	269	1397
*+2012	240	239	479	98	374	952	369	1321
*+2013	338	283	621	80	230	931	496	1427
*2014	427	313	739	142	273	1154	788	1942
*2015	460	255	715	137	296	1148	597	1745

+Data revised in WG2015
***IXa is without Gulf of Cádiz
** Data revised in WG2010
* Official data by country and unallocated landings

Table. 6.2.2(a) Four-spot megrim (*L. boscii*) in Divisions 8.c, 9.a. Discard/Total Catch ratio and estimated CV for Spain from sampling on board

Year	1994	1997	1999	2000	2003	2004	2005	2006	2007	2008
Weight Ratio	0.30	0.28	0.24	0.29	0.21	0.30	0.32	0.27	0.25	0.20
CV	23.2	11.2	14.4	16.5	10.2	23.1	24.0	48.4	18.3	22.6
Number Ratio	0.50	0.63	0.59	0.61	0.47	0.55	0.55	0.42	0.47	0.42

Year	2009	2010	2011*	2012	2013	2014	2015
Weight Ratio	0.23	0.19	0.24	0.39	0.35	0.41	0.34
CV	21.1	18.8	16.0	15.5	23.2	17.8	20.1
Number Ratio	0.39	0.62	0.50	0.52	0.63	0.67	0.60

**All discard data revised in WG2011
*Data revised in WG2013

Table. 6.2.2(b) Four-spot megrim (*L. boscii*) in Divisions 8.c, 9.a. Discards in numbers-at-age (thousands) for Spanish trawlers

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	1289	1289	1289	1289	1289	1289	1289	1289	678	1289
1	3322	3322	3322	3322	3322	3322	3322	3322	2741	3322
2	4322	4322	4322	4322	4322	4322	4322	4322	4134	4322
3	2211	2211	2211	2211	2211	2211	2211	2211	2710	2211
4	605	605	605	605	605	605	605	605	581	605
5	94	94	94	94	94	94	94	94	189	94
6	20	20	20	20	20	20	20	20	55	20
7	4	4	4	4	4	4	4	4	11	4

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
0	1289	256	1289	2933	354	208	208	238	33	10
1	3322	3273	3322	3954	6148	5673	5673	4479	6393	3515
2	4322	6099	4322	2734	1207	1750	1750	989	3053	5482
3	2211	2108	2211	1815	1888	1025	1025	495	693	609
4	605	146	605	1088	1218	477	477	50	163	183
5	94	90	94	3	171	67	67	2	27	56
6	20	3	20	0	12	4	4	0		23
7	4	0	4	1	2	1	1			6

	2006	2007	2008	2009	2010	2011*	2012	2013	2014	2015
0	1	100	202	2	2879	30	682	275	0	157
1	1233	3248	2342	1525	10362	5132	5313	5499	5645	2437
2	2497	4541	2374	2490	1301	3595	2480	4379	11089	7061
3	1445	757	1384	1970	696	544	1057	3030	2139	4588
4	486	105	52	480	283	174	15	707	582	532
5	168	44	10	51	83	37	5	39	161	26
6	22	7	3	7	11	1	2	12	11	4
7	9	1	3		1		0	2	0	0

Table 6.2.3(a) Four-spot megrim (*L. boscii*) Divisions 8.c and 9.a. Annual length distributions in landings in 2015.

Length (cm)	Total
10	
11	
12	
13	
14	
15	55
16	408
17	7382
18	59343
19	314085
20	827341
21	1266196
22	1498142
23	1295963
24	1194427
25	895341
26	767151
27	536378
28	389803
29	260471
30	173377
31	79916
32	60022
33	33619
34	16643
35	10949
36	9929
37	8026
38	5667
39	1003
40	410
41	
42	191
43	
44	
45	
46	
47	
48	
49	
50+	
Total	9712235

Table 6.2.3(b) Four-spot megrim (*L. boscii*) Divisions 8.c and 9.a. Mean lengths and mean weights in landings since 1990

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Mean length (cm)	23.1	23.5	23.8	24.2	23.3	22.3	23	23.3	23.3	23.5	24.2	23.8	23.1
Mean weight (g)	116	118	122	128	111	96	107	112	109	113	121	114	105

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mean length (cm)	22.9	22.7	22.7	22.9	23.5	23.6	23.6	24.1	23.7	23.7	23.9	24.2	24.1
Mean weight (g)	101	98	97.0	99.4	109.1	109.7	110.7	118.4	112.2	112.0	114.0	117.8	117.4

Table 6.2.4 Four-spot megrim (*L. boscii*) in Divisions 8.c, 9.a. Catch numbers-at-age.

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE										
0	1289	1289	1289	1289	1289	1289	1289	1289	678	1289
1	3432	5605	4847	4055	4766	4482	4168	3868	2824	4743
2	7797	15902	14414	11462	9506	8001	6989	6656	7049	6527
3	5901	7284	7666	7603	4096	5539	6211	4307	7225	8349
4	4545	4198	5384	6514	4434	2516	5784	4404	2849	6201
5	1226	1438	2460	3573	2405	2744	2294	1245	1801	1150
6	869	589	1181	1798	1403	1048	758	655	894	602
+gp	233	145	467	634	807	483	71	282	457	284
TOTALNUM	25292	36450	37708	36928	28706	26102	27564	22706	23777	29145
TONSLAND	1408	2021	2586	3037	2354	2129	2353	1822	1920	2058
SOPCOF %	100	100	100	100	100	99	103	99	100	100

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE										
0	1289	256	1289	2933	354	208	208	238	33	10
1	3719	3308	3367	3992	6193	5840	5863	4846	6785	3638
2	6458	7343	5526	3895	1862	2888	4139	3791	5568	8004
3	3478	4978	6447	4596	3533	2276	3386	3368	3777	3604
4	4419	890	3545	4996	4000	2870	1220	1526	2602	2024
5	1990	1714	792	1405	2020	1937	454	501	1155	1426
6	224	1069	849	235	797	941	240	447	279	802
+gp	555	443	353	489	840	358	360	142	337	399
TOTALNUM	22132	20001	22168	22541	19599	17318	15870	14859	20536	19907
TONSLAND	1466	1204	1501	1442	1414	1221	1028	1067	1354	1358
SOPCOF %	100	102	100	101	100	100	100	101	101	100

YEAR	2006	2007	*2008	2009	2010	2011**	2012**	2013**	2014	2015
AGE										
0	1	100	202	2	2879	30	682	275	0	157
1	1267	3257	2357	1546	10377	5139	5342	5499	5646	2438
2	5232	6147	3935	3136	2364	4397	3260	4919	11954	7412
3	5951	3390	4879	4887	3568	2454	4101	4820	4249	7742
4	2639	2705	2204	4640	3817	2833	1926	4113	3214	3622
5	1156	1909	1003	1662	2529	2711	1620	1363	2983	1580
6	274	855	354	640	496	1164	991	846	751	1105
+gp	228	461	298	222	438	399	422	371	562	462
TOTALNUM	16748	18824	15232	16735	26468	19127	18344	22206	29359	24518
TONSLAND	1427	1396	1182	1413	1562	1397	1321	1427	1942	1745
SOPCOF %	101	101	101	100	101	101	101	101	100	100

* Data revised in WG2010 from original value presented

** Data revised in WG2014 from original value presented

Table 6.2.5 Four-spot megrim (*L. boscii*) in Divisions 8.c, 9.a. Mean weights at age in Catchs (kg).

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE										
0	0.004	0.004	0.004	0.004	0.003	0.004	0.004	0.003	0.005	0.004
1	0.013	0.027	0.027	0.027	0.019	0.022	0.021	0.014	0.023	0.030
2	0.034	0.046	0.049	0.055	0.051	0.055	0.052	0.052	0.056	0.046
3	0.055	0.062	0.069	0.079	0.081	0.097	0.093	0.092	0.082	0.082
4	0.090	0.089	0.100	0.108	0.134	0.114	0.120	0.136	0.114	0.096
5	0.129	0.125	0.138	0.144	0.154	0.164	0.159	0.174	0.148	0.143
6	0.159	0.151	0.167	0.167	0.183	0.190	0.225	0.218	0.178	0.168
+gp	0.263	0.239	0.280	0.275	0.272	0.263	0.351	0.295	0.243	0.255
SOPCOFAC	1.0014	1.0022	1.0034	0.9996	1.0009	0.9930	1.0284	0.9892	1.0015	0.9963

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE										
0	0.003	0.004	0.004	0.006	0.006	0.004	0.006	0.008	0.006	0.0060
1	0.023	0.016	0.019	0.018	0.023	0.024	0.024	0.025	0.027	0.021
2	0.043	0.030	0.040	0.045	0.057	0.050	0.057	0.066	0.053	0.050
3	0.054	0.063	0.073	0.072	0.066	0.073	0.090	0.088	0.081	0.083
4	0.106	0.091	0.105	0.090	0.087	0.099	0.109	0.123	0.108	0.108
5	0.135	0.123	0.137	0.147	0.126	0.122	0.163	0.142	0.131	0.122
6	0.209	0.180	0.179	0.197	0.169	0.166	0.209	0.201	0.175	0.132
+gp	0.231	0.252	0.293	0.268	0.228	0.255	0.247	0.247	0.235	0.197
SOPCOFAC	0.9993	1.0171	1.0027	1.009	1.001	1.0012	0.9993	1.0129	1.0069	1.0038

YEAR	2006	2007	*2008	2009	2010	2011**	2012**	2013**	2014	2015
AGE										
0	0.006	0.005	0.005	0.004	0.004	0.003	0.009	0.004	0.002	0.008
1	0.023	0.022	0.017	0.025	0.012	0.02	0.033	0.017	0.024	0.026
2	0.06	0.045	0.053	0.045	0.056	0.039	0.052	0.045	0.044	0.04
3	0.091	0.079	0.079	0.069	0.084	0.078	0.076	0.063	0.071	0.066
4	0.104	0.114	0.112	0.104	0.108	0.099	0.105	0.099	0.101	0.099
5	0.136	0.123	0.151	0.142	0.141	0.128	0.127	0.131	0.133	0.136
6	0.176	0.152	0.201	0.175	0.182	0.168	0.159	0.159	0.165	0.172
+gp	0.233	0.198	0.235	0.288	0.271	0.24	0.199	0.21	0.222	0.23
SOPCOFAC	1.0066	1.0109	1.0063	1.0011	1.0104	1.009	1.006	1.0065	1.0046	1.0018

* Data revised in WG2010 from original value presented

** Data revised in WG2014 from original value presented

Table 6.2.6 Four-spot megrim (*L. boscii*) Divisions 8.c, 9.a Abundance and Recruitment indices of Portuguese and Spanish surveys.

	Biomass Index						Abundance index					Recruitment index		
	Portugal (k/h)			Spain (k/30 min)			Portugal (n/h)		Spain (n/30 min)			At age 1	At age 0	At age 1
												Portugal (n)	Spain (n/30 min)	
	October	Crustacean	SE	Mean	SE		Crustacean	SE	Mean	SE		October		
1983				0.67	0.13	1983			11.80	1.80	1983		0.98	5.74
1984				0.76	0.08	1984			15.80	2.00	1984		1.80	7.83
1985				0.71	0.11	1985			14.00	1.74	1985		0.15	7.45
1986				1.68	0.28	1986			32.60	3.82	1986		2.99	16.36
1987				ns	-	1987			ns	-	1987		ns	ns
1988				3.10	0.33	1988			59.20	6.49	1988		2.90	24.64
1989				1.97	0.28	1989			40.75	6.24	1989		8.49	16.68
1990	0.26			1.93	0.14	1990			40.30	3.00	1990	153	0.44	19.06
1991	0.18			1.67	0.17	1991			27.70	2.62	1991	26	2.53	9.25
1992	0.14			1.98	0.20	1992			49.10	5.20	1992	42	2.37	35.00
1993	0.11			2.07	0.25	1993			43.30	5.39	1993	8	0.30	21.38
1994	0.16			1.82	0.23	1994			26.90	3.63	1994	2	3.48	2.94
1995	0.08			1.51	0.12	1995			32.30	2.78	1995	4	1.92	19.58
A,1996	0.10			2.00	0.19	A,1996			44.80	4.05	A,1996	16	3.57	20.56
1997	0.06	2.97	1.31	2.17	0.22	1997	31.57	15.52	43.50	3.84	1997	1	3.54	13.34
1998	0.04	2.66	0.87	1.80	0.20	1998	26.46	10.68	34.30	4.45	1998	+	0.27	9.57
A,B,1999	+	0.04	0.02	1.93	0.24	A,B,1999	1.23	1.07	29.30	3.22	A,B,1999	+	0.94	7.46
2000	0.08	2.18	0.84	1.89	0.28	2000	20.61	8.47	33.00	4.56	2000	16	1.07	13.96
2001	0.09	1.72	0.75	2.65	0.25	2001	17.17	7.08	42.70	3.35	2001	25	0.59	16.95
2002	0.02	2.78	1.02	2.21	0.22	2002	40.61	13.69	34.60	3.33	2002	1	1.04	9.95
A,2003	1.36	3.65	1.20	1.32	0.16	A,2003	60.80	20.97	16.90	1.54	A,2003	8	0.65	4.95
A,2004	1.27	ns		2.40	0.24	A,2004	ns		43.94	3.71	A,2004	5	1.19	21.10
2005	0.05	2.62	0.85	3.84	0.41	2005	34.51	12.03	62.89	6.16	2005	+	4.71	17.70
2006	0.10	1.63	0.56	2.56	0.24	2006	19.89	6.49	41.47	3.02	2006		0.59	14.70
2007	0.14	2.20	0.70	3.75	0.35	2007	32.30	11.30	51.10	4.30	2007		0.88	11.30
2008	0.07	2.50	0.87	2.08	0.22	2008	26.27	9.60	32.20	3.00	2008		0.37	8.13
2009	0.06	*1.50	0.65	3.96	0.32	2009	*12.22	5.88	52.83	3.97	2009		3.37	7.42
2010	0.03	4.03	1.44	4.04	0.38	2010	63.78	22.64	72.75	6.82	2010		0.65	34.22
2011	0.14	4.55	1.78	4.64	0.39	2011	68.56	26.34	69.26	5.72	2011		0.91	8.90
2012	ns	ns	ns	5.92	0.47	2012	ns	ns	82.14	5.98	2012		1.71	11.58
**2013	0.10	1.45	0.51	8.17	1.13	2013	23.81	8.02	119.99	17.48	2013		1.32	25.86
2014	0.12	1.40	0.56	4.75	0.28	2014	20.31	8.18	67.42	3.72	2014		3.72	12.32
2015	0.13	1.66	0.52	4.62	0.48	2015	27.29	8.25	78.00	7.47	2015		1.12	33.18

+ less than 0.04

ns no survey

A Portuguese October Survey with different vessel and gear (Capricórnio and CAR net)

B Portuguese Crustacean Survey covers partial area only with a different Vessel (Mestre Costeiro)

* Revised in WGHMM2011

** From 2013 new vessel for Spanish survey (Miguel Oliver)

Table 6.2.7 Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Tuning data

FLT01: SP-LCGOTBDEF1. 1000 Days by 100 HP (thousand)

1986	1999								
1	1	0	1						
1	7							Eff.	
10	98.0	375.9	336.9	251.4	95.4	30.2	13.3	7.1	1986
10	473.1	962.6	565.0	317.7	96.7	31.3	16.0	12.7	1987
10	34.7	202.0	199.7	162.9	75.5	30.2	19.4	11.3	1988
10	11.1	86.3	125.5	135.7	82.8	38.8	22.3	11.9	1989
10	4.6	103.7	60.3	173.8	104.6	72.9	38.4	8.8	1990
10	10.3	89.1	145.1	93.2	189.0	79.9	40.8	9.6	1991
10	0.4	19.5	100.0	168.0	105.2	39.0	2.3	10.2	1992
10	0.1	36.6	98.2	227.4	84.9	46.4	16.7	7.1	1993
10	0.0	62.1	207.7	169.1	155.7	86.6	46.3	8.5	1994
10	1.2	32.9	277.8	301.4	123.8	83.4	24.0	13.4	1995
10	0.8	33.2	34.0	222.2	132.9	20.0	51.4	11.0	1996
10	0.4	22.5	111.1	39.9	142.8	125.3	58.9	12.5	1997
10	0.3	81.6	420.5	349.7	98.2	127.0	62.0	8.2	1998
10	0.3	62.0	209.8	331.2	165.4	32.7	44.6	8.8	1999

FLT02: SP-LCGOTBDEF2. 1000 Days by 100 HP (thousand)

2000	2015								
1	1	0	1						
1	7							Eff.	
10	0.4	70.4	143.7	348.5	303.1	164.1	153.3	10.5	2000
10	14.1	147.9	219.0	475.1	436.2	242.3	82.5	12.1	2001
10	7.1	125.5	214.2	91.2	65.9	44.7	70.0	11.0	2002
10	19.5	287.1	362.6	213.6	75.2	66.6	22.4	10.2	2003
10	29.0	341.5	495.6	440.5	219.1	60.2	81.3	7.0	2004
10	10.4	248.2	383.1	252.6	195.9	114.3	68.4	7.1	2005
10	7.0	364.0	624.8	304.5	150.8	41.3	40.1	7.8	2006
10	1.9	261.0	403.1	415.2	297.7	143.0	82.0	7.3	2007
10	2.7	313.1	726.9	480.7	227.4	87.5	80.5	9.0	2008
10	8.5	145.2	523.6	639.7	226.2	87.4	33.6	8.0	2009
10	0.1	145.7	519.8	743.2	616.4	132.4	105.4	5.8	2010
10	0.0	48.1	224.0	423.8	593.7	323.2	133.0	5.1	2011
10	0.8	107.5	718.6	562.5	504.6	302.1	122.7	7.6	2012
10	0.0	86.9	336.3	806.5	313.4	170.5	64.7	10.8	2013
10	0.1	118.8	332.4	427.1	431.1	98.9	55.0	13.4	2014
10	0.1	66.6	619.0	625.5	322.0	217.6	80.4	9.8	2015

FLT03: SPGFS-WIBTS-Q4 (n/30 min)

1988	2015									
1	1	0.75	0.83							
0	7								Eff.	
1	2.9	24.6	20.6	7.3	1.9	1.1	0.4	0.3	101	1988
1	8.5	16.7	8.4	3.6	2.1	1.1	0.3	0.1	91	1989
1	0.4	19.1	13.0	2.2	2.8	1.6	0.7	0.4	120	1990
1	2.5	9.3	9.3	3.7	1.6	1.0	0.2	0.1	107	1991
1	2.4	35.0	4.1	4.1	2.1	1.0	0.4	0.0	116	1992
1	0.3	21.4	16.7	2.3	1.5	0.5	0.4	0.2	109	1993
1	3.5	2.9	11.2	6.3	1.5	0.7	0.4	0.4	118	1994
1	1.9	19.6	2.4	4.4	3.2	0.3	0.2	0.2	116	1995
1	3.6	20.6	14.4	1.4	1.9	2.4	0.3	0.3	114	1996
1	3.5	13.3	14.0	8.7	1.1	1.5	1.0	0.3	116	1997
1	0.3	9.6	10.0	9.2	3.6	0.7	0.8	0.3	114	1998
1	0.9	7.5	10.9	6.0	2.9	1.0	0.2	0.3	116	1999
1	1.1	14.0	5.4	5.2	4.1	1.7	0.6	0.9	113	2000
1	0.6	17.0	12.7	4.7	3.8	2.2	1.0	0.7	113	2001
1	1.0	10.0	12.7	7.4	1.8	0.7	0.3	0.6	110	2002
0	0.7	5.0	4.1	4.1	1.7	0.6	0.5	0.3	112	2003
1	1.2	21.1	11.3	6.1	2.7	0.8	0.2	0.5	114	2004
1	4.7	17.7	22.4	11.2	4.0	1.6	0.6	0.7	116	2005
1	0.6	14.7	13.3	8.2	2.5	1.0	0.5	0.6	115	2006
1	0.9	11.3	21.3	10.2	4.9	1.4	0.7	0.3	117	2007
1	0.4	8.1	11.7	7.9	2.6	0.8	0.5	0.3	115	2008
1	3.4	7.4	13.6	14.1	9.6	3.1	1.1	0.5	117	2009
1	0.6	34.2	16.6	10.8	7.2	2.2	0.5	0.6	114	2010
1	0.9	8.9	33.8	13.8	7.7	2.8	0.9	0.5	111	2011
1	1.7	11.6	22.1	31.1	9.6	3.4	1.7	1.0	115	2012
0	1.3	25.9	29.6	35.7	21.1	3.9	1.5	1.0	114	2013
1	3.7	12.3	21.8	12.1	7.6	8.0	1.1	0.7	116	2014
1	1.1	33.2	14.3	15.9	7.6	3.3	1.9	0.7	114	2015

Table 6.2.8 Four-spot megrim (*L. boscii*). LPUE data by fleet in Divisions 8.c, 9.a.

	SP-LCGOTBDEF			SP-AVSOTBDEF			Portugal trawl in IXa		
Year	Landings(t)	Effort	LPUE [1]	Landings(t)	Effort	LPUE [1]	Landings(t)	Effort	LPUE [2]
1986	69.0	7.1	9.8	26.5	3.9	6.8			
1987	189.8	12.7	14.9	30.7	3.0	10.4			
1988	78.6	11.3	7.0	47.3	3.4	14.0	146	38.5	3.8
1989	72.9	11.9	6.2	36.1	3.3	10.9	183	44.7	4.1
1990	68.8	8.8	7.8	63.8	3.2	19.7	164	39.0	4.2
1991	94.0	9.6	9.8	42.1	3.5	12.2	166	45.0	3.7
1992	67.2	10.2	6.6	35.2	2.3	15.5	280	50.9	5.5
1993	55.2	7.1	7.8	38.9	2.4	16.1	180	44.2	4.1
1994	90.8	8.5	10.6	63.7	4.5	14.0	146	45.8	3.2
1995	147.6	13.4	11.0	85.9	3.5	24.7	121	37.0	3.3
1996	78.7	11.0	7.2	37.1	2.3	16.4	155	46.5	3.3
1997	99.0	12.5	7.9	49.5	2.6	18.7	76	33.4	2.3
1998	117.4	8.2	14.4	56.2	5.1	11.0	83	43.1	1.9
1999	103.9	8.8	11.7	55.9	4.9	11.3	73	25.3	2.9
2000	172.3	10.5	16.4	34.1	2.5	13.8	93	27.0	3.4
2001	245.0	12.1	20.2	16.5	1.3	12.5	89	43.1	2.1
2002	143.8	11.0	13.0	22.5	2.0	11.3	97	31.2	3.1
2003	118.7	10.2	11.6	12.4	2.2	5.7	117	40.5	2.9
2004	127.3	7.0	18.2	23.5	1.6	14.8	111	35.4	3.1
2005	96.0	7.1	13.6	45.0	3.0	15.2	140	42.6	3.3
2006	123.5	7.8	15.9	32.3	2.8	11.6	149	40.3	3.7
2007*	130.5	7.3	17.9	19.9	2.2	8.9	165	43.8	3.8
2008*	196.8	9.0	22.0	14.5	2.0	7.2	146	38.4	3.8
2009	138.8	8.0	17.3	42.0	2.3	18.5	183	49.3	3.7
2010	170.7	5.8	29.3	51.1	2.0	25.4	150	48.0	3.1
2011	126.9	5.1	24.8	43.1	2.2	19.6	134	49.4	2.7
2012	127.8	7.6	16.7	11.1	2.6	4.3	78	30.9	2.5
2013**	212.8	10.8	19.8	19.5	1.5	13.2	59	28.0	2.1
2014	220.8	13.4	16.5	31.9	3.0	10.7	120	49.2	2.4
2015	219.1	9.8	22.5	13.8	1.8	7.5	109	17.7	6.1

[1] LPUE as catch (kg) per fishing day per 100 HP

[2] LPUE as catch (kg) per hour.

* Effort from Portuguese trawl revised in WG2010 from original value presented

** Effort from SP-LCGOTBDEF and SP-AVSOTBDEF revised in WG2015 from original value presented

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8.c and 9.a. Tuning diagnostic.

Lowestoft VPA Version 3.1

3/05/2016 13:54

Extended Survivors Analysis

Four spot megrim (*L. boscii*) Division 8c and 9a

CPUE data from file fleetb.txt

Catch data for 30 years. 1986 to 2015. Ages 0 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF1	1986	2015	3	6	0	1
SP-LCGOTBDEF2	2000	2015	3	6	0	1
SP-GFS	1988	2015	0	6	0.75	0.83

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 = 1.500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 34 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0	0	0.003	0.008	0	0.07	0.001	0.01	0.006	0	0.006
1	0.033	0.089	0.089	0.079	0.249	0.172	0.163	0.104	0.173	0.037
2	0.316	0.223	0.148	0.164	0.166	0.159	0.158	0.222	0.344	0.361
3	0.551	0.348	0.277	0.278	0.284	0.259	0.218	0.368	0.305	0.394
4	0.497	0.525	0.402	0.462	0.364	0.383	0.334	0.354	0.451	0.464
5	0.42	0.84	0.375	0.608	0.497	0.48	0.395	0.419	0.472	0.418
6	0.357	0.639	0.354	0.437	0.364	0.449	0.322	0.37	0.431	0.319

XSA population numbers (Thousands)

YEAR \ AGE	0	1	2	3	4	5	6
2006	51500	43000	21300	15500	7450	3720	1010
2007	37500	42100	34000	12700	7320	3710	2000
2008	27800	30600	31600	22300	7360	3550	1310
2009	63400	22600	22900	22300	13900	4030	2000
2010	47000	51900	17100	16000	13800	7140	1800
2011	47900	35900	33100	11900	9830	7860	3560
2012	75800	39200	24700	23100	7500	5490	3980
2013	48200	61400	27300	17300	15200	4400	3030
2014	90000	39200	45300	17900	9790	8760	2370
2015	27100	73700	27000	26300	10800	5110	4470

Estimated population abundance at 1st Jan 2016

0	22000	58200	15400	14500	5560	2750

Taper weighted geometric mean of the VPA populations:

45400	37700	26300	16100	8690	3980	1710

Standard error of the weighted Log(VPA populations) :

0.3296	0.3361	0.359	0.366	0.4106	0.4426	0.5191

Log catchability residuals.

Fleet : SP-LCGOTBDEF1

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
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	0.56	0.87	-0.09	-0.41	-0.76	-0.19	-0.46	-0.03	-0.1	0.36
4	0.3	0.28	-0.6	-0.54	-0.2	-0.58	-0.09	0.32	0.48	0.12
5	0.07	-0.24	-0.83	-0.85	-0.19	0.42	-0.01	-0.25	0.53	0.79
6	-0.26	-0.16	-0.41	-0.25	0.12	0.79	0.02	0.3	0.67	0.97

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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	-0.56	-0.31	0.7	0.42	99.99	99.99	99.99	99.99	99.99	99.99
4	0.04	-0.46	0.64	0.28	99.99	99.99	99.99	99.99	99.99	99.99
5	-0.33	-0.07	0.77	0.19	99.99	99.99	99.99	99.99	99.99	99.99
6	-0.1	0.32	0.52	0.59	99.99	99.99	99.99	99.99	99.99	99.99

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
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	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

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	-6.7098	-5.8449	-5.4113	-5.4113
S.E(Log q)	0.5018	0.4162	0.511	0.4932

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	0.57	2.052	8.03	0.66	14	0.26	-6.71
4	0.95	0.178	6.01	0.53	14	0.41	-5.84
5	-30.73	-4.667	95.92	0	14	9.74	-5.41
6	1.16	-0.504	4.86	0.47	14	0.52	-5.19

Fleet : SP-LCGOTBDEF2

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
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	99.99	99.99	99.99	99.99	-0.6	0.34	-0.27	0.2	0.43	0.1
4	99.99	99.99	99.99	99.99	-0.06	0.75	-0.5	-0.39	0.38	-0.34
5	99.99	99.99	99.99	99.99	-0.23	0.98	-0.64	-0.24	-0.05	0.2
6	99.99	99.99	99.99	99.99	0.15	0.22	-0.31	0.03	0.24	0.07

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
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	0.51	0.17	0.17	-0.15	0.18	-0.38	0.1	-0.3	-0.38	-0.1
4	-0.2	0.13	0.22	-0.09	0.02	-0.2	0.34	-0.01	-0.16	0.13
5	-0.52	0.34	-0.08	-0.11	0.28	0.13	0.29	0.04	-0.3	-0.08
6	-0.54	0.14	-0.06	-0.43	0.06	0.3	0.07	-0.22	-0.49	-0.39

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	-5.6698	-4.9697	-4.6953	-4.6953
S.E(Log q)	0.322	0.32	0.3849	0.291

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	-0.34	5.33	0.53	16	0.36	-5.67
4	0.95	0.256	5.18	0.64	16	0.31	-4.97
5	0.88	0.684	5.14	0.69	16	0.34	-4.7
6	0.97	0.259	4.86	0.81	16	0.28	-4.77

Fleet : SP-GFS

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	99.99	99.99	0.49	1.63	-1.04	0.25	0.25	-1.1	0.84	0.03
1	99.99	99.99	0.4	-0.11	0.11	-0.29	0.52	0.1	-1.13	0.25
2	99.99	99.99	0.14	-0.35	-0.18	-0.44	-0.87	-0.16	-0.46	-0.96
3	99.99	99.99	-0.32	-0.86	-1	-0.81	-0.55	-0.7	-0.54	-0.67
4	99.99	99.99	-1.1	-0.64	-0.33	-0.7	-0.36	-0.63	-0.22	-0.41
5	99.99	99.99	-0.48	-0.61	0.23	-0.11	-0.04	-0.84	-0.24	-0.47
6	99.99	99.99	0	-0.07	0.19	-0.36	0.02	0.05	0.03	-0.36

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
0	0.99	1.31	-0.87	-0.13	-0.06	-0.69	-0.19	99.99	0.02	1.04
1	0.05	-0.03	0	0.28	0.38	0.47	-0.1	99.99	0.3	0.4
2	0.08	-0.25	-0.2	0.26	0.07	0.38	0.33	99.99	0.06	0.57
3	-0.54	0.21	-0.07	-0.09	0.2	0.62	0.46	99.99	0.14	0.65
4	-0.73	-0.12	0.03	-0.48	0.41	0.88	0.43	99.99	0.14	0.31
5	0.11	-0.15	0.4	-0.51	-0.23	1.13	-0.09	99.99	-0.46	0.68
6	0.06	-0.06	-0.03	-0.17	-0.23	-0.07	-0.01	99.99	-0.16	0.11

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0	-1.02	-0.3	-0.87	0.51	-0.78	-0.51	-0.33	99.99	0.26	0.27
1	-0.23	-0.43	-0.44	-0.24	0.6	-0.44	-0.27	99.99	-0.21	0.05
2	0.26	0.19	-0.39	0.09	0.58	0.63	0.49	99.99	0.02	0.13
3	0.33	0.58	-0.29	0.29	0.36	0.88	0.99	99.99	0.38	0.33
4	-0.18	0.53	-0.22	0.51	0.14	0.57	1.02	99.99	0.62	0.53
5	-0.39	0.31	-0.65	0.83	-0.19	-0.05	0.43	99.99	0.89	0.49
6	0.27	0.13	-0.06	0.32	-0.34	-0.44	0.04	99.99	0.22	0.03

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	-10.1987	-7.5656	-7.2299	-7.2777	-7.2642	-7.3593	-7.3593
S.E(Log q)	0.7574	0.3873	0.4154	0.5745	0.5541	0.5191	0.1999

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	0.6	1.551	10.4	0.38	26	0.44	-10.2
1	0.79	1.092	8.18	0.53	26	0.31	-7.57
2	1.14	-0.528	6.81	0.36	26	0.48	-7.23
3	1.48	-1.056	6.13	0.17	26	0.85	-7.28
4	1.72	-1.621	5.98	0.17	26	0.92	-7.26
5	0.98	0.067	7.38	0.41	26	0.52	-7.36
6	0.99	0.159	7.4	0.88	26	0.2	-7.39

Terminal year survivor and F summaries :

Age 0 Catchability constant w.r.t. time and dependent on age

Year class = 2015

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	1	0	0	0	0	0	0
SP-GFS	28814	0.772	0	0	1	0.79	0
F shrinkage mean	8066	1.5				0.21	0.017

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
22043	0.69	0.58	2	0.851	0.006

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2014

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	1	0	0	0	0	0	0
SP-GFS	63728	0.351	0.087	0.25	2	0.946	0.034
F shrinkage mean	11664	1.5				0.054	0.173

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
58155	0.34	0.29	3	0.833	0.037

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

Year class = 2013

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	1	0	0	0	0	0	0
SP-GFS	14857	0.29	0.167	0.57	2	0.945	0.373
F shrinkage mean	28594	1.5				0.055	0.211

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
15401	0.29	0.16	3	0.552	0.361

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

Year class = 2012

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	13089	0.332	0	0	1	0.514	0.429
SP-GFS	15881	0.319	0.156	0.49	3	0.449	0.365
F shrinkage mean	20948	1.5				0.037	0.288

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
14528	0.23	0.1	5	0.414	0.394

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

Year class = 2011

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	5105	0.237	0.249	1.05	2	0.612	0.496
SP-GFS	6298	0.278	0.233	0.84	4	0.36	0.419
F shrinkage mean	7095	1.5				0.027	0.38

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5556	0.18	0.13	7	0.743	0.464

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

Year class = 2010

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	2334	0.212	0.061	0.29	3	0.598	0.478
SP-GFS	3600	0.249	0.227	0.91	5	0.377	0.334
F shrinkage mean	2474	1.5				0.025	0.456

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2752	0.16	0.13	9	0.773	0.418

Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2009

Fleet	Estir Surv	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	2104	0.182	0.112	0.62	4	0.546	0.389
SP-GFS	3605	0.207	0.165	0.79	6	0.439	0.245
F shrinkage mean	1870	1.5				0.015	0.428

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2661	0.14	0.12	11	0.904	0.319

Table 6.2.10 Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Estimates of fishing mortality-at-age.

Run title : Four spot megrim (L. boscii) Division 8c and 9a

At 3/05/2016 13:59

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE										
0	0.02	0.0276	0.0252	0.0269	0.0359	0.0227	0.0245	0.0495	0.0157	0.0242
1	0.064	0.1135	0.1375	0.1033	0.1316	0.1688	0.0952	0.0952	0.1458	0.1457
2	0.2426	0.4681	0.4741	0.555	0.3735	0.3401	0.4312	0.2167	0.2515	0.5854
3	0.3783	0.3758	0.4331	0.4956	0.3913	0.389	0.4847	0.5205	0.3868	0.5338
4	0.7218	0.5101	0.5308	0.8268	0.6106	0.4451	0.9324	0.7767	0.8024	0.6834
5	0.6278	0.5258	0.6469	0.8384	0.8673	1.0109	0.9793	0.5193	0.8833	0.9335
6	1.0255	0.7186	1.1843	1.6712	0.993	1.3269	0.891	0.8671	0.9092	0.8658
+gp	1.0255	0.7186	1.1843	1.6712	0.993	1.3269	0.891	0.8671	0.9092	0.8658
FBAR 2- 4	0.4476	0.4514	0.4793	0.6258	0.4585	0.3914	0.6161	0.5046	0.4802	0.6008

Table 8 Fishing mortality (F) at age

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE										
0	0.0339	0.0094	0.0689	0.0936	0.011	0.0062	0.0058	0.0052	0.001	0.0002
1	0.0904	0.1142	0.1644	0.3143	0.2917	0.2509	0.2416	0.1807	0.1995	0.1435
2	0.3023	0.259	0.2836	0.291	0.2362	0.2143	0.2835	0.2432	0.3257	0.383
3	0.7295	0.404	0.3813	0.405	0.4687	0.5071	0.4191	0.3942	0.408	0.363
4	0.6087	0.409	0.5673	0.5787	0.7567	0.8994	0.5663	0.3376	0.6088	0.4
5	0.4851	0.5059	0.7967	0.4614	0.4895	1.1059	0.3309	0.4814	0.464	0.8233
6	0.4576	0.527	0.5082	0.5825	0.5213	0.4452	0.3653	0.6381	0.5457	0.6947
+gp	0.4576	0.527	0.5082	0.5825	0.5213	0.4452	0.3653	0.6381	0.5457	0.6947
FBAR 2- 4	0.5468	0.3573	0.4107	0.4249	0.4872	0.5403	0.423	0.325	0.4475	0.382

Table 8 Fishing mortality (F) at age

YEAR	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	FBAR 13-15
AGE											
0	0	0.0029	0.008	0	0.0701	0.0007	0.01	0.0063	0	0.0064	0.0042
1	0.0331	0.0893	0.0889	0.0786	0.2495	0.1724	0.1632	0.1041	0.1733	0.0372	0.1049
2	0.3161	0.2226	0.1483	0.1637	0.1656	0.1586	0.1576	0.2224	0.3445	0.3615	0.3094
3	0.5512	0.3484	0.2767	0.2777	0.284	0.2593	0.2179	0.3685	0.3048	0.3935	0.3556
4	0.4966	0.5247	0.4019	0.4624	0.3644	0.3834	0.3337	0.3541	0.4507	0.4637	0.4229
5	0.4203	0.8397	0.3746	0.608	0.4965	0.4802	0.3951	0.4192	0.4723	0.4184	0.4367
6	0.3566	0.6385	0.3538	0.4372	0.3639	0.4486	0.3219	0.3696	0.4315	0.319	0.3734
+gp	0.3566	0.6385	0.3538	0.4372	0.3639	0.4486	0.3219	0.3696	0.4315	0.319	
FBAR 2- 4	0.4546	0.3652	0.2756	0.3013	0.2713	0.2671	0.2364	0.315	0.3667	0.4062	

Table 6.2.11 Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Estimates of stock numbers-at-age.

Run title : Four spot megrim (L. boscii) Division 8c and 9a

At 3/05/2016 13:59

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE										
0	71931	52338	57185	53613	40371	63379	58918	29523	47963	59500
1	61216	57726	41685	45653	42728	31887	50724	47071	23005	38655
2	40003	47014	42190	29743	33708	30670	22051	37758	35039	16280
3	20703	25696	24103	21500	13980	18997	17871	11730	24891	22309
4	9770	11611	14448	12797	10723	7740	10541	9012	5707	13842
5	2906	3886	5708	6957	4583	4768	4060	3397	3393	2094
6	1497	1270	1881	2447	2463	1576	1420	1248	1655	1149
+gp	394	308	728	839	1392	710	131	529	832	533
TOTAL	208420	199850	187927	173549	149949	159727	165717	140269	142484	154362

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE										
0	42792	30264	21406	36281	35916	37099	39793	50899	36780	52507
1	47548	33868	24547	16360	27050	29086	30186	32392	41457	30083
2	27356	35564	24736	17051	9782	16543	18529	19409	22135	27803
3	7423	16554	22473	15252	10436	6324	10931	11425	12461	13085
4	10711	2930	9049	12566	8329	5347	3118	5886	6307	6784
5	5722	4771	1594	4201	5768	3200	1781	1449	3438	2809
6	674	2884	2355	588	2168	2894	867	1047	733	1770
+gp	1655	1183	969	1210	2262	1091	1290	329	876	869
TOTAL	143881	128019	107130	103509	101711	101584	106496	122836	124188	135711

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	GM 90-13
AGE												
0	51472	37528	27845	63439	46987	47921	75809	48207	90047	27096	0	43283
1	42980	42141	30635	22615	51938	35864	39207	61450	39220	73724	22043	
2	21338	34043	31555	22949	17116	33134	24713	27267	45335	27002	58155	
3	15521	12736	22310	22274	15951	11875	23149	17284	17873	26301	15401	
4	7452	7323	7360	13851	13815	9831	7502	15242	9789	10789	14528	
5	3723	3713	3548	4032	7142	7857	5486	4399	8758	5107	5556	
6	1010	2002	1313	1997	1797	3559	3980	3026	2368	4471	2752	
+gp	834	1067	1097	687	1575	1209	1683	1317	1757	1856	3765	
TOTAL	144330	140553	125662	151844	156321	151250	181528	178191	215148	176346	122200	

Table 6.2.12 Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Summary of landings and XSA results.

Run title : Four spot megrim (L. boscii) Division 8c and 9a

At 3/05/2016 13:59

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 0	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2- 4
1986	71931	5178	4299	1408	0.3275	0.4476
1987	52338	7308	6037	2021	0.3348	0.4514
1988	57185	7835	6746	2586	0.3833	0.4793
1989	53613	7805	6742	3037	0.4505	0.6258
1990	40371	6756	5981	2354	0.3936	0.4585
1991	63379	6635	5766	2129	0.3693	0.3914
1992	58918	6386	5448	2353	0.4319	0.6161
1993	29523	6035	5330	1822	0.3418	0.5046
1994	47963	6422	5601	1920	0.3428	0.4802
1995	59500	5933	5000	2058	0.4116	0.6008
1996	42792	5230	4422	1466	0.3316	0.5468
1997	30264	4443	3895	1204	0.3091	0.3573
1998	21406	5056	4563	1501	0.3289	0.4107
1999	36281	4566	4064	1442	0.3548	0.4249
2000	35916	4417	3816	1414	0.3705	0.4872
2001	37099	3814	3216	1221	0.3796	0.5403
2002	39793	4133	3388	1028	0.3034	0.423
2003	50899	4725	3737	1067	0.2856	0.325
2004	36780	4988	4063	1354	0.3333	0.4475
2005	52507	4903	4069	1358	0.3337	0.382
2006	51472	5643	4660	1427	0.3062	0.4546
2007	37528	5460	4602	1396	0.3033	0.3652
2008	27845	5977	5308	1182	0.2227	0.2756
2009	63439	5949	5236	1413	0.2699	0.3013
2010	46987	6362	5705	1562	0.2738	0.2713
2011	47921	5947	5262	1397	0.2655	0.2671
2012	75809	7473	5967	1321	0.2214	0.2364
2013	48207	6396	5514	1427	0.2588	0.315
2014	90047	7319	6389	1942	0.304	0.3667
2015	27096	7908	6615	1745	0.2638	0.4062
Arith. Mean	47827	5900	5048	1652	0.3269	0.422
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 6.2.13 Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Prediction with management option table: Input data

MFDP version 1a
Run: LDB
Time and date: 15:15 03/05/2016
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2016 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
0	43283	0.2	0	0	0	0.005	0.0000	0.002	0.0059	0.005
1	35211	0.2	0.55	0	0	0.024	0.0003	0.035	0.1615	0.024
2	58155	0.2	0.86	0	0	0.044	0.0295	0.066	0.2458	0.041
3	15401	0.2	0.97	0	0	0.071	0.1855	0.084	0.1672	0.054
4	14528	0.2	0.99	0	0	0.101	0.4051	0.105	0.0548	0.078
5	5556	0.2	1	0	0	0.131	0.5039	0.132	0.0123	0.104
6	2752	0.2	1	0	0	0.165	0.4447	0.165	0.0032	0.128
7	3765	0.2	1	0	0	0.220	0.4475	0.220	0.0005	0.105

2017 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
0	43283	0.2	0	0	0	0.005	0.0000	0.002	0.0059	0.005
1	.	0.2	0.55	0	0	0.024	0.0003	0.035	0.1615	0.024
2	.	0.2	0.86	0	0	0.044	0.0295	0.066	0.2458	0.041
3	.	0.2	0.97	0	0	0.071	0.1855	0.084	0.1672	0.054
4	.	0.2	0.99	0	0	0.101	0.4051	0.105	0.0548	0.078
5	.	0.2	1	0	0	0.131	0.5039	0.132	0.0123	0.104
6	.	0.2	1	0	0	0.165	0.4447	0.165	0.0032	0.128
7	.	0.2	1	0	0	0.220	0.4475	0.220	0.0005	0.105

2018 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
0	43283	0.2	0	0	0	0.005	0.0000	0.002	0.0059	0.005
1	.	0.2	0.55	0	0	0.024	0.0003	0.035	0.1615	0.024
2	.	0.2	0.86	0	0	0.044	0.0295	0.066	0.2458	0.041
3	.	0.2	0.97	0	0	0.071	0.1855	0.084	0.1672	0.054
4	.	0.2	0.99	0	0	0.101	0.4051	0.105	0.0548	0.078
5	.	0.2	1	0	0	0.131	0.5039	0.132	0.0123	0.104
6	.	0.2	1	0	0	0.165	0.4447	0.165	0.0032	0.128
7	.	0.2	1	0	0	0.220	0.4475	0.220	0.0005	0.105

Input units are thousands and kg - output in tonnes

Table 6.2.14. Megrim (*L. boscii*) in Div. 8.c and 9.a catch forecast: management option table

MFDP version 1a
Run: LDB
Time and date: 15:15 03/05/2016
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2016 Biomass	SSB	Total FMult	Landings FBar	Yield	Discards FBar	Yield
8191	7180	1	0.2067	1411	0.1559	743

2017 Biomass	SSB	Total FMult	Landings FBar	Yield	Discards FBar	Yield	2018 Biomass	SSB
7782	6940	0	0.0000	0	0.0000	0	9810	8953
.	6940	0.1	0.0207	180	0.0156	68	9506	8653
.	6940	0.2	0.0413	352	0.0312	134	9213	8365
.	6940	0.3	0.0620	517	0.0468	199	8931	8088
.	6940	0.4	0.0827	675	0.0624	261	8659	7822
.	6940	0.5	0.1034	827	0.0780	322	8398	7565
.	6940	0.6	0.1240	972	0.0936	381	8147	7319
.	6940	0.7	0.1447	1112	0.1092	438	7905	7081
.	6940	0.8	0.1654	1246	0.1247	494	7672	6853
.	6940	0.9	0.1860	1374	0.1403	548	7448	6633
.	6940	1	0.2067	1497	0.1559	601	7232	6422
.	6940	1.1	0.2274	1616	0.1715	652	7024	6218
.	6940	1.2	0.2480	1729	0.1871	702	6823	6022
.	6940	1.3	0.2687	1838	0.2027	750	6631	5833
.	6940	1.4	0.2894	1942	0.2183	797	6445	5651
.	6940	1.5	0.3101	2043	0.2339	843	6266	5476
.	6940	1.6	0.3307	2139	0.2495	887	6093	5308
.	6940	1.7	0.3514	2231	0.2651	931	5927	5145
.	6940	1.8	0.3721	2320	0.2807	973	5767	4989
.	6940	1.9	0.3927	2405	0.2963	1014	5613	4838
.	6940	2	0.4134	2487	0.3119	1053	5464	4693

Table 6.2.15 Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Single option prediction. Detail Tables.

MFDP version 1a
Run: LDB
Time and date: 15:15 03/05/2016
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2016 F multiplier: 1 Fleet1 HCFbar: 0.2067 leet1 DFbar: 0.1559

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0059	231	1	43283	225	0	0	0	0
1	0.0003	9	0	0.1615	4771	115	35211	845	19366	465	19366	465
2	0.0295	1365	90	0.2458	11377	469	58155	2559	50013	2201	50013	2201
3	0.1855	2195	185	0.1672	1978	107	15401	1090	14939	1058	14939	1058
4	0.4051	4308	451	0.0548	583	45	14528	1462	14383	1447	14383	1447
5	0.5039	1999	263	0.0123	49	5	5556	728	5556	728	5556	728
6	0.4447	901	148	0.0032	6	1	2752	453	2752	453	2752	453
7	0.4475	1240	273	0.0005	1	0	3765	829	3765	829	3765	829
Total		12018	1411		18997	743	178651	8191	110774	7180	110774	7180

Year: 2017 F multiplier: 1 Fleet1 HCFbar: 0.2067 Fleet1 DFbar 0.1559

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0059	231	1	43283	225	0	0	0	0
1	0.0003	9	0	0.1615	4774	115	35229	845	19376	465	19376	465
2	0.0295	576	38	0.2458	4797	198	24521	1079	21088	928	21088	928
3	0.1855	5152	435	0.1672	4644	252	36155	2560	35070	2483	35070	2483
4	0.4051	2628	275	0.0548	356	28	8862	891	8773	883	8773	883
5	0.5039	2702	356	0.0123	66	7	7510	984	7510	984	7510	984
6	0.4447	889	146	0.0032	6	1	2715	447	2715	447	2715	447
7	0.4475	1123	247	0.0005	1	0	3409	751	3409	751	3409	751
Total		13079	1497		14875	601	161683	7782	97941	6940	97941	6940

Year: 2018 F multiplier: 1 Fleet1 HCFbar: 0.2067 Fleet1 DFbar 0.1559

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0059	231	1	43283	225	0	0	0	0
1	0.0003	9	0	0.1615	4774	115	35229	845	19376	465	19376	465
2	0.0295	576	38	0.2458	4800	198	24534	1079	21099	928	21099	928
3	0.1855	2173	183	0.1672	1958	106	15245	1079	14788	1047	14788	1047
4	0.4051	6170	645	0.0548	835	65	20803	2093	20595	2072	20595	2072
5	0.5039	1648	217	0.0123	40	4	4581	600	4581	600	4581	600
6	0.4447	1201	198	0.0032	9	1	3669	604	3669	604	3669	604
7	0.4475	1055	232	0.0005	1	0	3203	705	3203	705	3203	705
Total		12831	1514		12647	490	150547	7232	87311	6422	87311	6422

Input units are thousands and kg - output in tonnes

Table 6.2.16	**Four-spot megrim (*L. boscii*) in Divisions 8c and 9a**
	Stock numbers of recruits and their source for recent year classes used in
	predictions, and the relative (%) contributions to catches and SSB (by weight) of these year classes

Year-class	2013	2014	2015	2016	2017
Stock No. (thousands) of 0 year-olds	48207	90047	43283	43283	43283
Source	XSA	XSA	GM90-13	GM90-13	GM90-13
Status Quo F:					
% in 2016 catch	13.6	26.0	5.3	0.0	-
% in 2017	14.4	32.7	11.2	5.5	0.0
% in 2016 SSB	14.7	30.7	6.5	0.0	-
% in 2017 SSB	12.7	35.8	13.4	6.7	0.0
% in 2018 SSB	9.3	32.3	16.3	14.5	7.2

GM : geometric mean recruitment

Four-spot megrim (*L. boscii*) in Divisions 8c and 9a : Year-class % contribution to

a) 2017 catches **b) 2018 SSB**

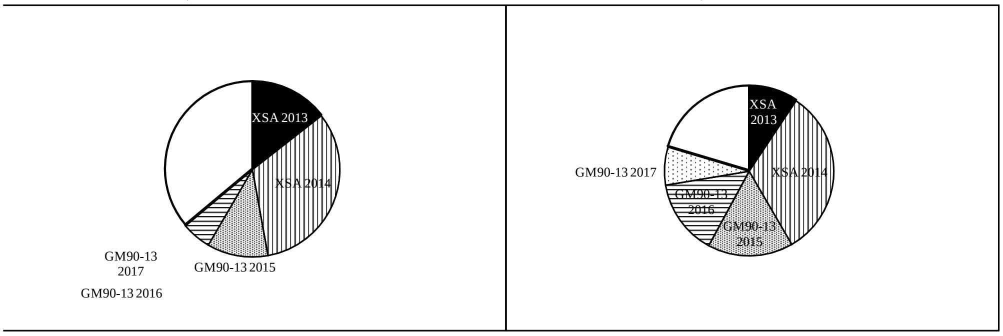


Table 6.2.17 Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Yield-per-recruit results.

MFYPR version 2a
Run: LDB
Time and date: 16:45 03/05/2016
Yield per results

Catch FMult	Landings Fbar	CatchNos	Yield	Discards Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	0.5357	4.0334	0.5159	4.0334	0.5159
0.1	0.0207	0.0859	0.0139	0.0156	0.0372	0.0015	4.9038	0.4171	3.4234	0.3975	3.4234	0.3975
0.2	0.0413	0.1368	0.0211	0.0312	0.0719	0.0029	4.4781	0.3383	3.0005	0.3188	3.0005	0.3188
0.3	0.062	0.1676	0.0248	0.0468	0.1043	0.0041	4.1643	0.2828	2.6894	0.2635	2.6894	0.2635
0.4	0.0827	0.1861	0.0265	0.0624	0.1346	0.0053	3.9226	0.2422	2.4502	0.223	2.4502	0.223
0.5	0.1034	0.1966	0.027	0.078	0.1629	0.0063	3.7301	0.2114	2.2602	0.1923	2.2602	0.1923
0.6	0.124	0.2019	0.0267	0.0936	0.1896	0.0073	3.5726	0.1874	2.1052	0.1685	2.1052	0.1685
0.7	0.1447	0.2036	0.0261	0.1092	0.2145	0.0082	3.441	0.1683	1.976	0.1495	1.976	0.1495
0.8	0.1654	0.2029	0.0252	0.1247	0.238	0.009	3.3291	0.1529	1.8664	0.1342	1.8664	0.1342
0.9	0.186	0.2004	0.02	0.1403	0.2601	0.0098	3.23	0.1402	1.7721	0.1216	1.7721	0.1216
1	0.2067	0.1968	0.0232	0.1559	0.281	0.0104	3.1481	0.1296	1.6899	0.1111	1.6899	0.1111
1.1	0.2274	0.1925	0.0222	0.1715	0.3006	0.0111	3.0735	0.1206	1.6174	0.1023	1.6174	0.1023
1.2	0.248	0.1876	0.0211	0.1871	0.3191	0.0117	3.0069	0.1129	1.553	0.0947	1.553	0.0947
1.3	0.2687	0.1823	0.0201	0.2027	0.3367	0.0122	2.9471	0.1063	1.4952	0.0882	1.4952	0.0882
1.4	0.2894	0.1769	0.0191	0.2183	0.3532	0.0127	2.8929	0.1005	1.443	0.0825	1.443	0.0825
1.5	0.3101	0.1714	0.0182	0.2339	0.3689	0.0132	2.8436	0.0955	1.3956	0.0775	1.3956	0.0775
1.6	0.3307	0.1658	0.0173	0.2495	0.3838	0.0136	2.7983	0.091	1.3522	0.0732	1.3522	0.0732
1.7	0.3514	0.1603	0.0165	0.2651	0.3979	0.014	2.7567	0.087	1.3125	0.0692	1.3125	0.0692
1.8	0.3721	0.1549	0.0157	0.2807	0.4113	0.0143	2.7182	0.0834	1.2758	0.0658	1.2758	0.0658
1.9	0.3927	0.1496	0.0149	0.2963	0.424	0.0147	2.6824	0.0802	1.2418	0.0626	1.2418	0.0626
2.0	0.4134	0.1445	0.0142	0.3119	0.4361	0.0150	2.6491	0.0772	1.2102	0.0598	1.2102	0.0598

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1	0.2067
FMax	0.5102	0.1055
F0.1	0.3324	0.0687
F35%SPR	0.5462	0.1129

Weights in kilograms

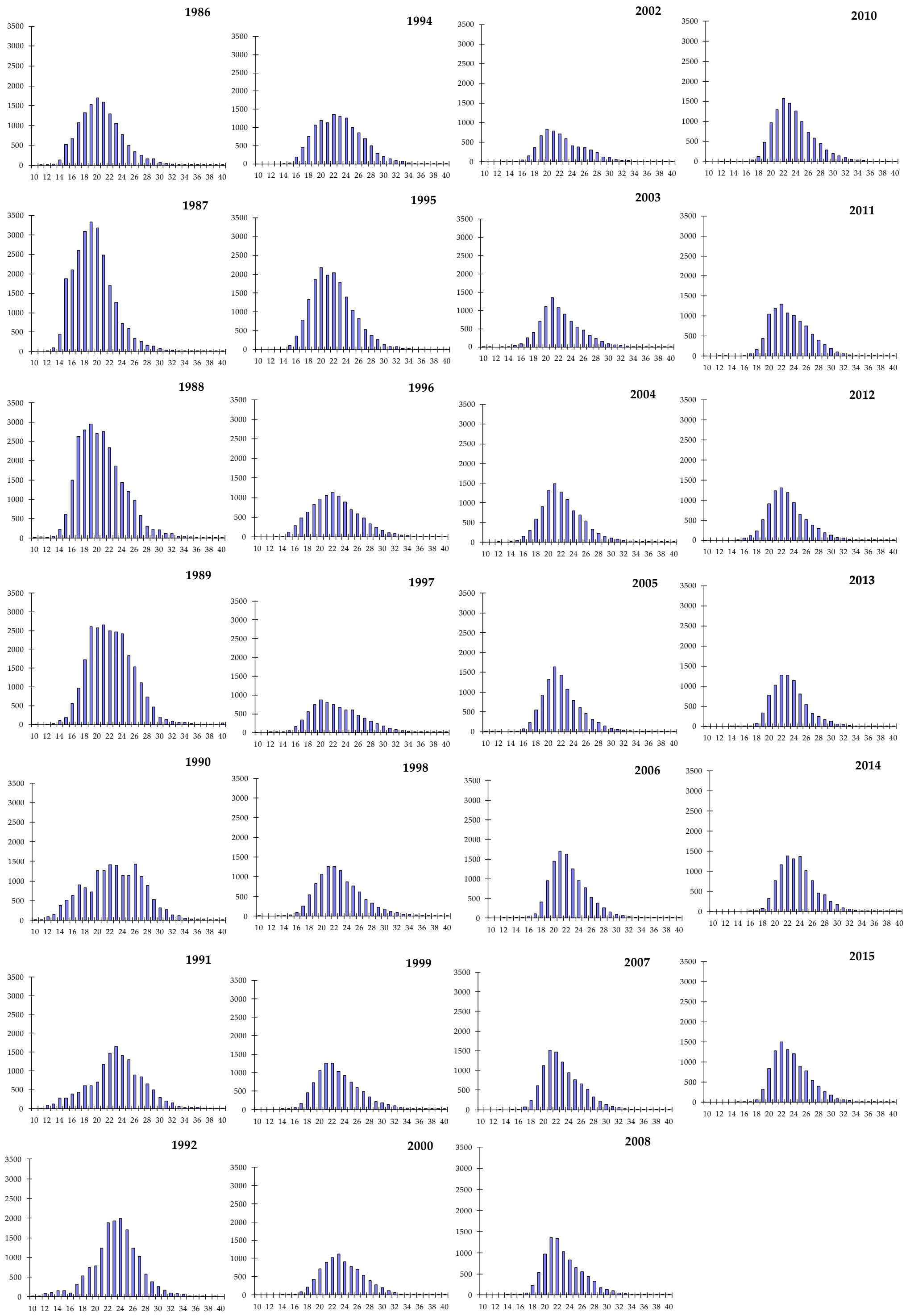


Figure 6.2.1 Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Annual length compositions of landings ('000)

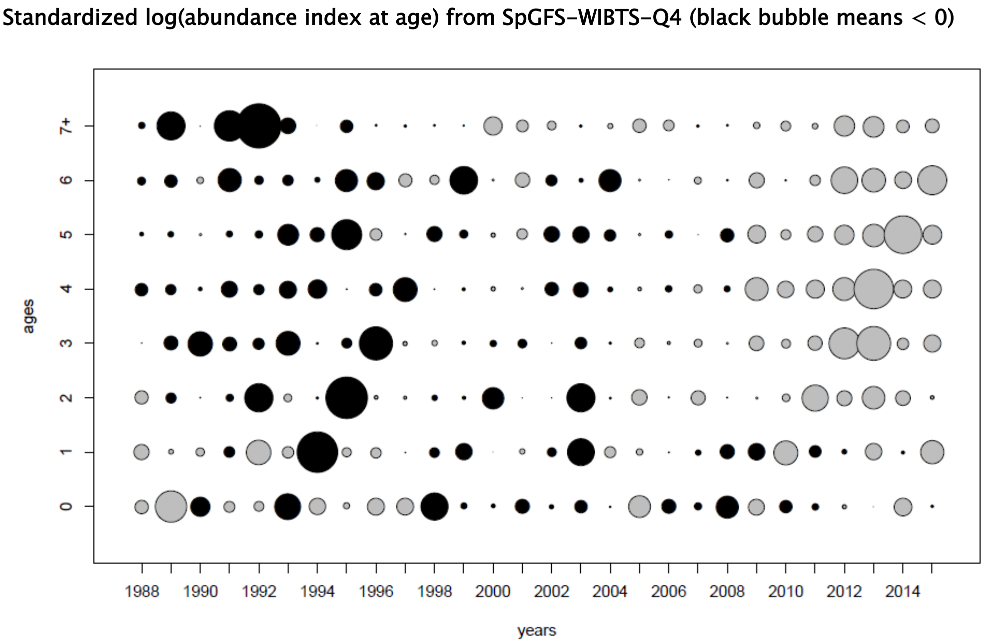
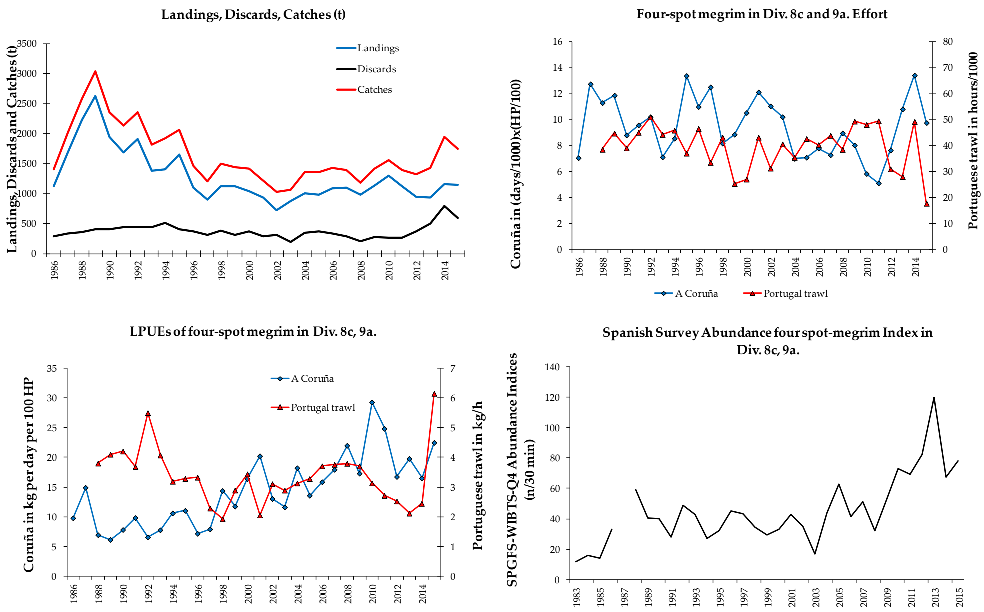


Figure 6.2.2: Four-spot megrim (*L. boscii*) in Divisions 8.c&9.a

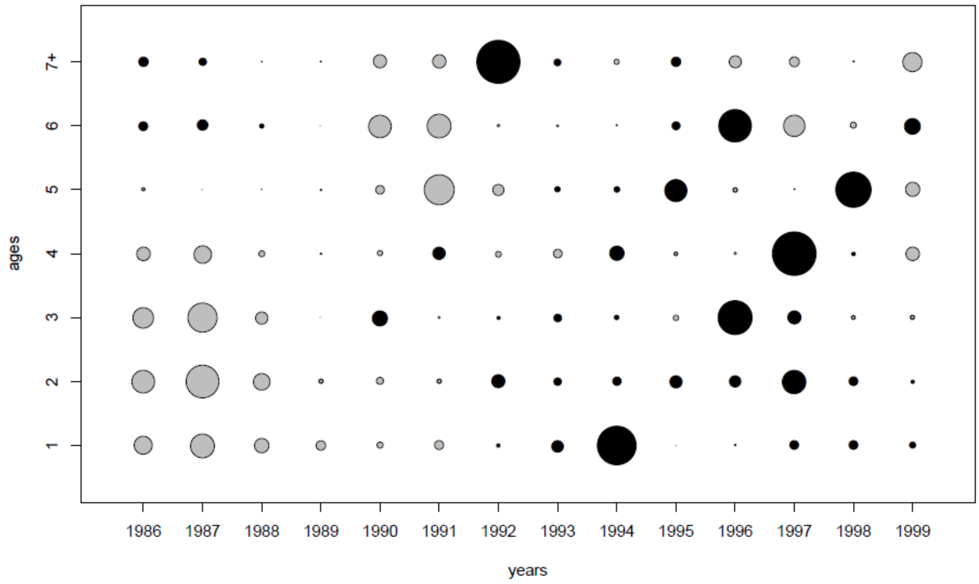


* Spanish Landings of 2008 revised in WG2010 from original value presented

* Portuguese Trawl Effort of 2007 and 2008 revised in WG2010 from original value presented

Figure 6.2.3(a) Four-spot megrim (*L.boscii*) in Divisions 8.c and 9.a. Landings (t), Efforts, LPUEs and Abundance Indices.

Standardized log(abundance index at age) from SP-LCGOTBDEF-1 (black bubble means < 0)



Standardized log(abundance index at age) from SP-LCGOTBDEF-2 (black bubble means < 0)

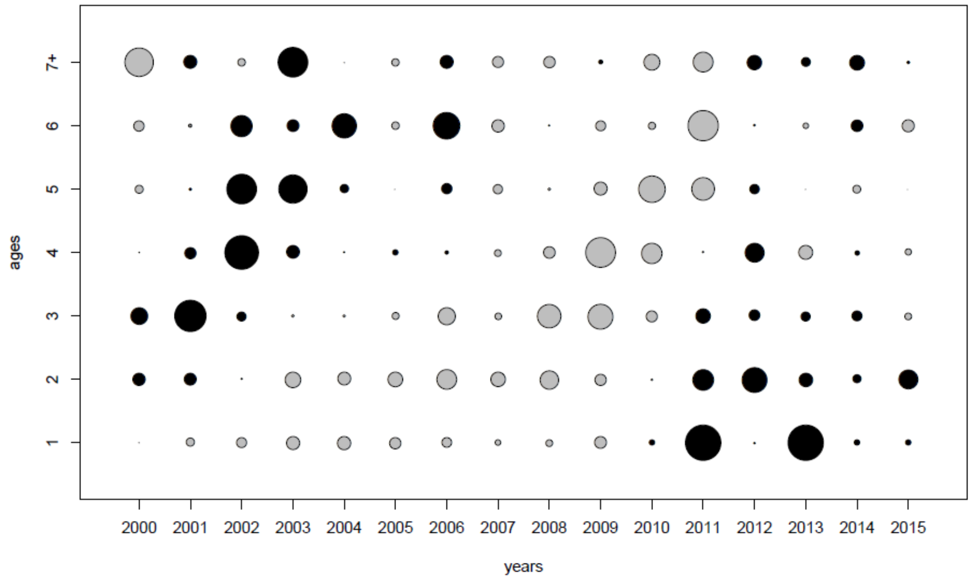
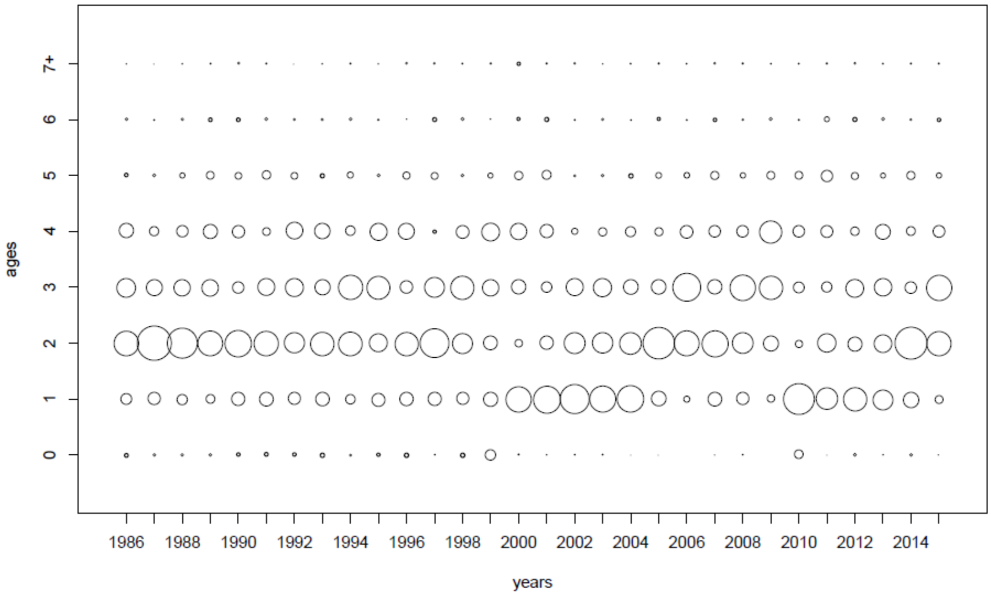


Figure 6.2.3(b): Four-spot megrim (*L. boscii*) in Divisions 8.c&9.a

Catches proportions at age



Standardized catches proportions at age (black bubble means < 0)

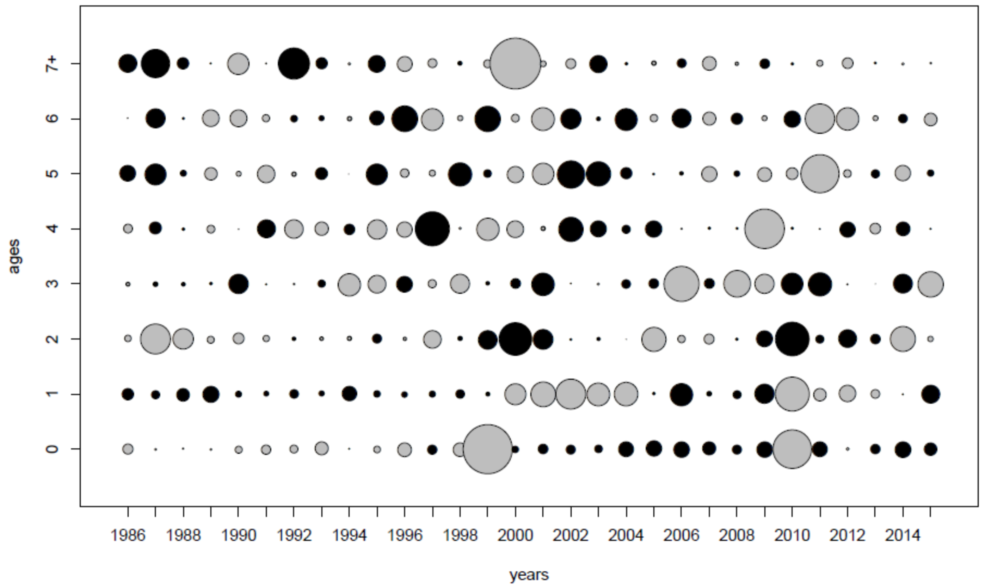
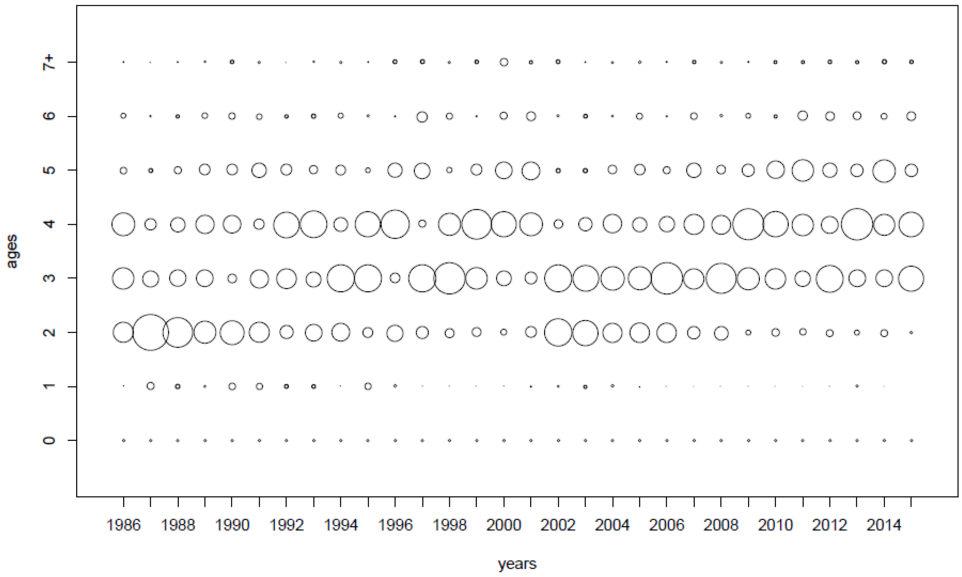


Figure 6.2.4(a). Four-spot megrim (L. boscii) in Divisions 8.c & 9.a.

Landings proportions at age



Standardized landings proportions at age (black bubble means < 0)

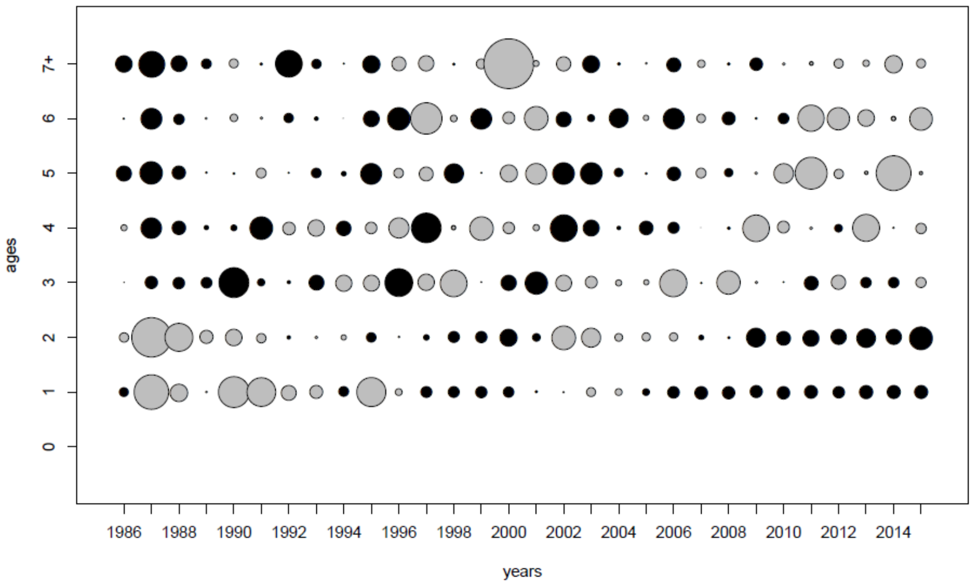
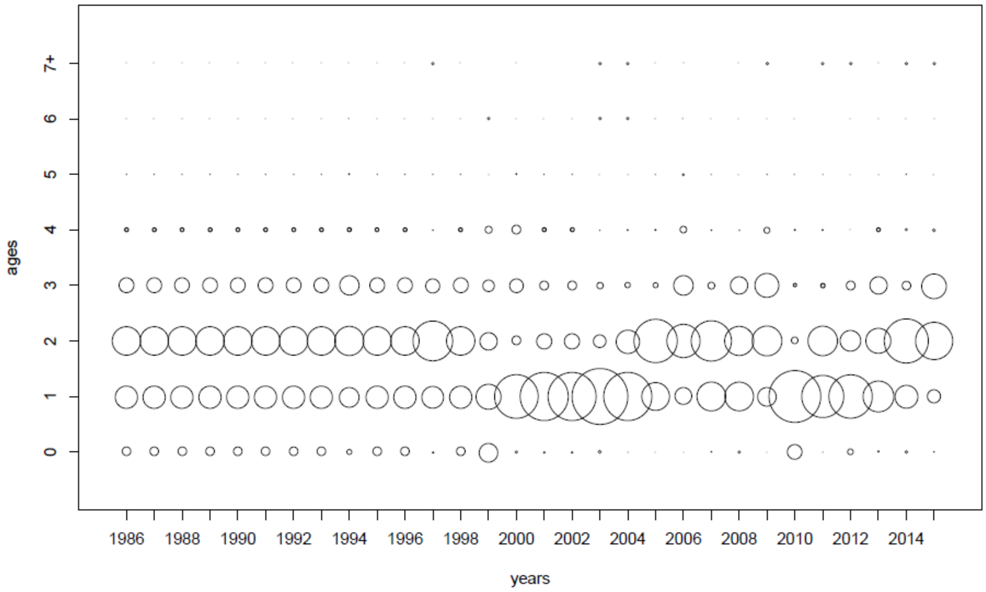


Figure 6.2.4(b). Four-spot megrim (*L. boscii*) in Divisions 8.c & 9.a.

Discards proportions at age



Standardized discards proportions at age (black bubble means < 0)

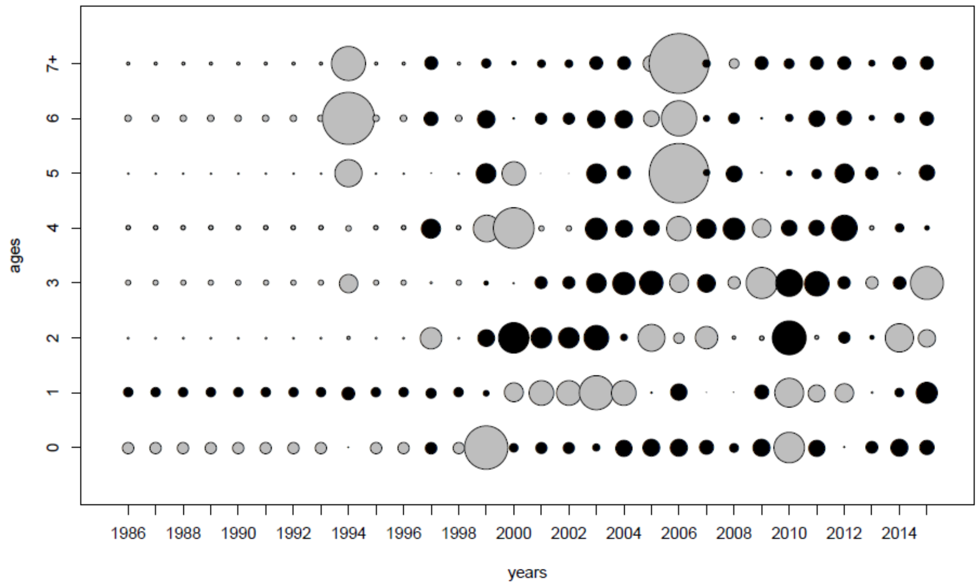


Figure 6.2.4(c). Four-spot megrim (*L. boscii*) in Divisions 8.c & 9.a.

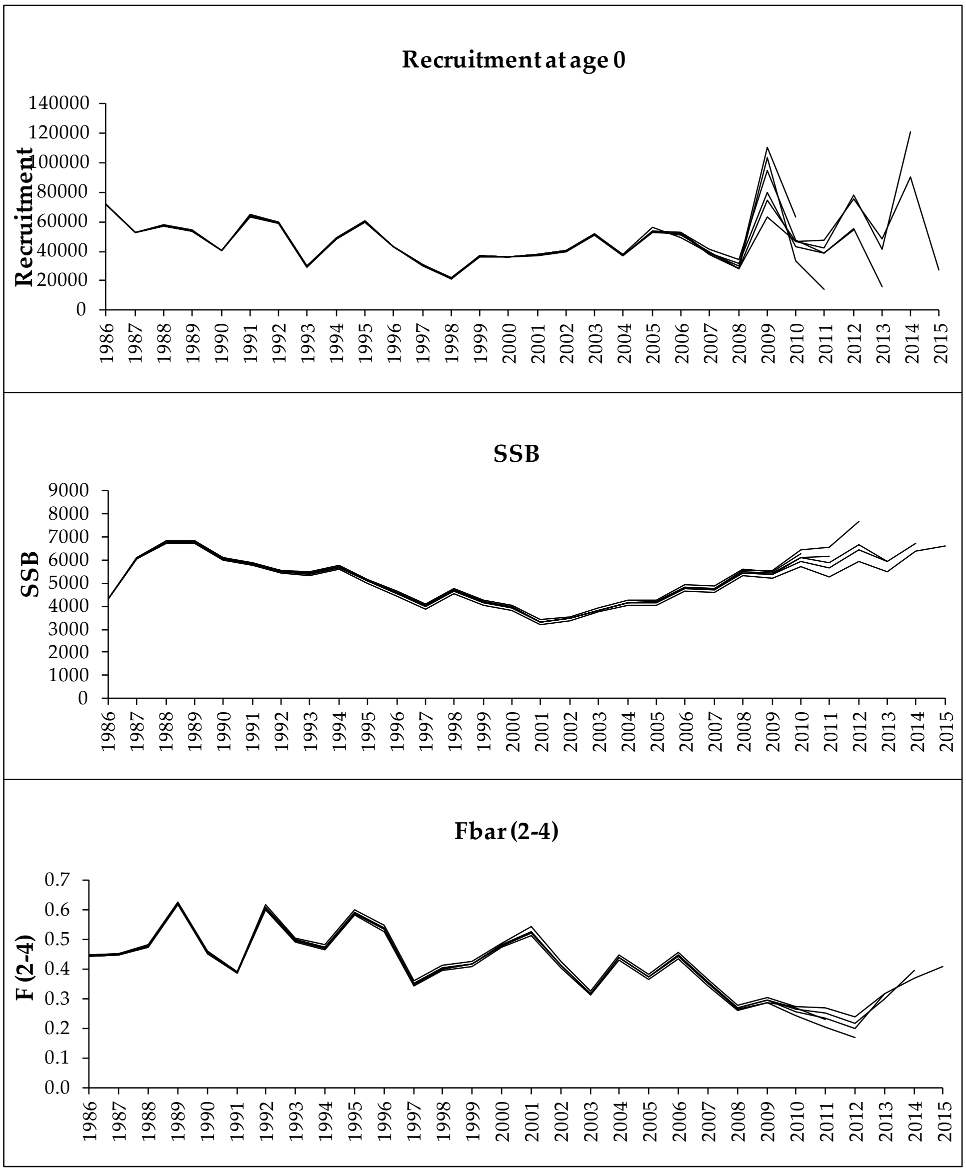


Figure 6.2.5. Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Retrospective XSA

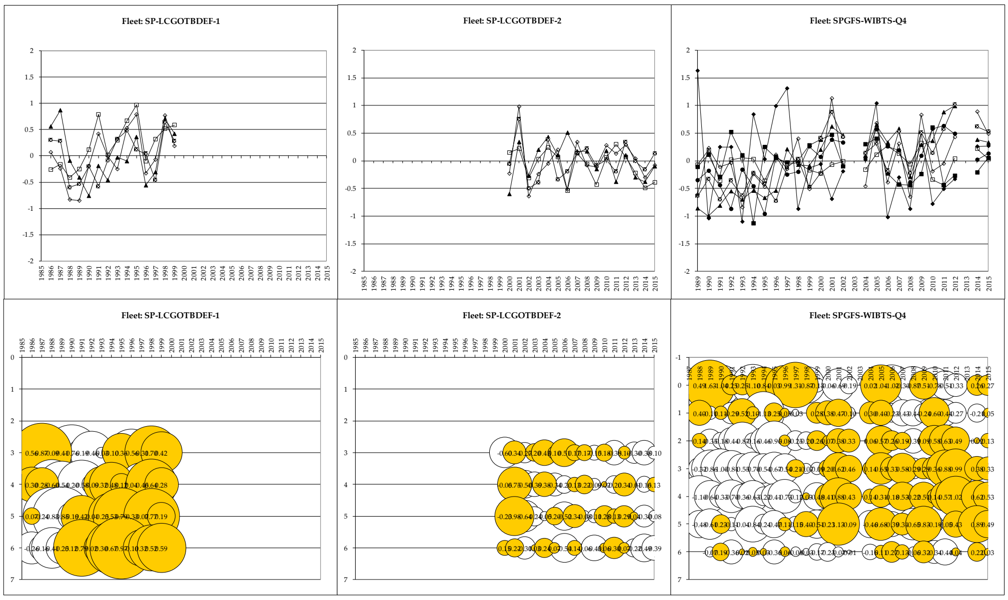


Figure 6.2.6. Four spot megrim (*L. boscii*) in Divisions 8.c and 9.a. LOG-CATCHABILITY RESIDUAL PLOTS (XSA)

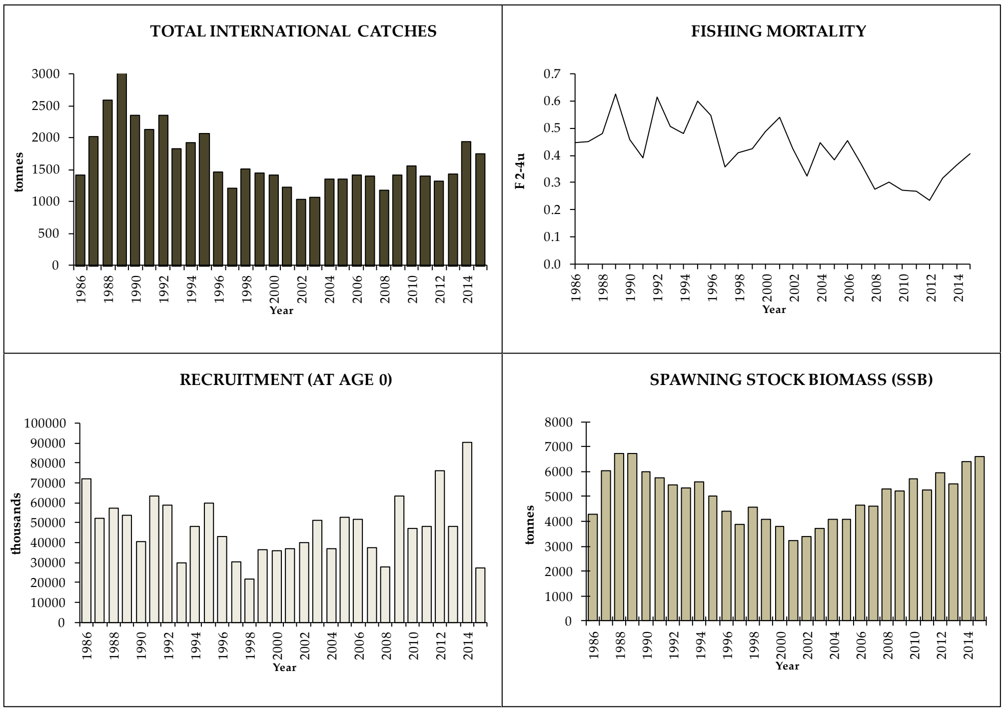
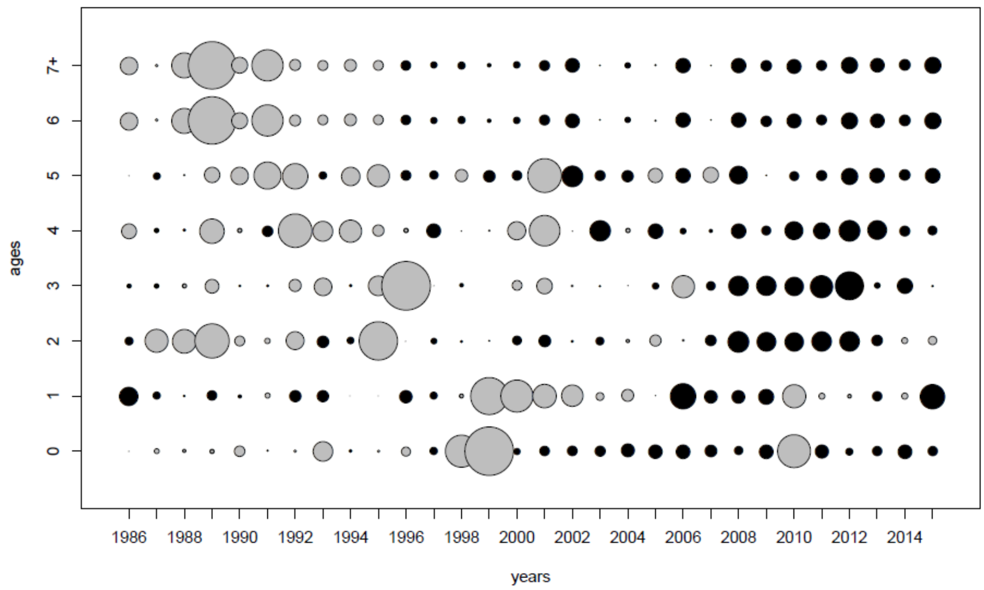


Figure 6.2.7(a). Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Stock Summary

Standardized F-at-age (black bubbles means <0)



Standardized relative F-at-age (black bubble means < 0)

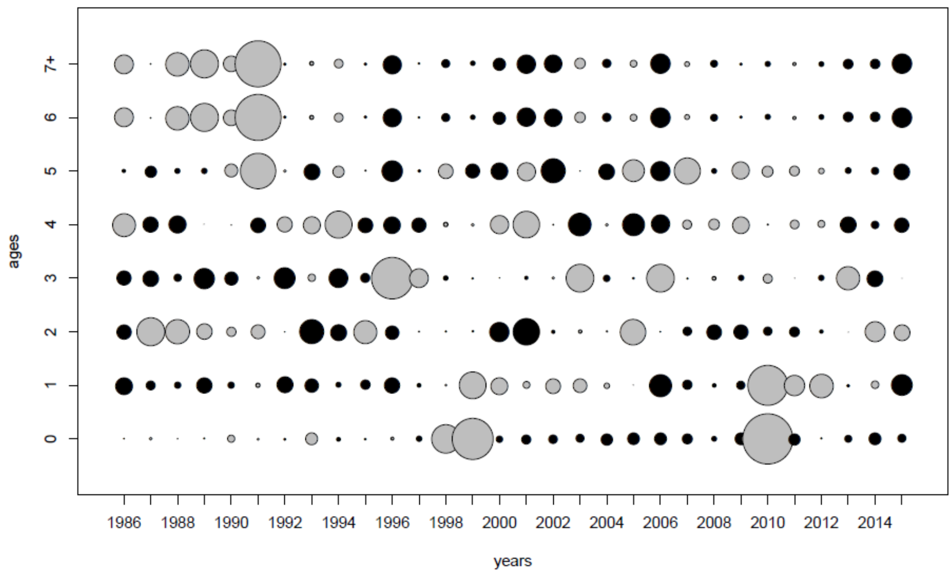
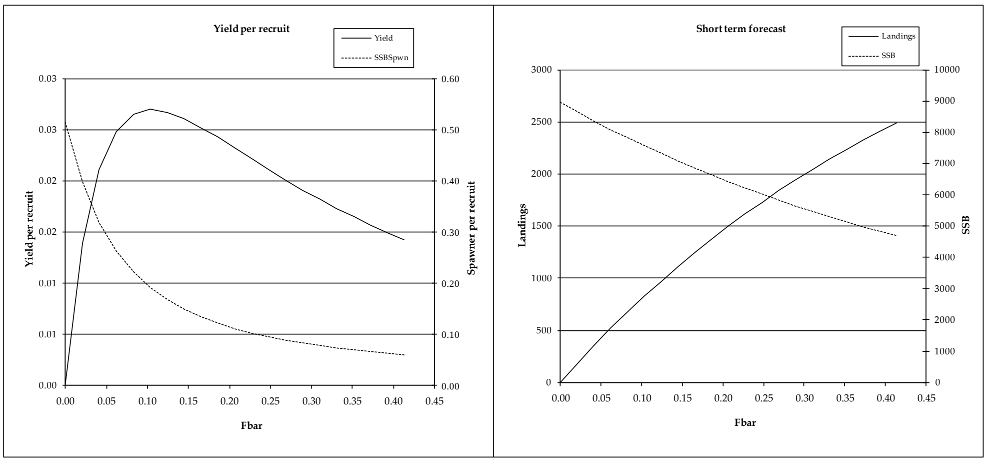


Figure 6.2.7(b): Four-spot megrim (*L. boscii*) in Divisions 8.c&9.a



MFYPR version 2a
Run: LDB
Time and date: 16:45 03/05/2016

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.2067
FMax	0.5102	0.1055
F0.1	0.3324	0.0687
F35%SPR	0.5462	0.1129

MFDP version 1a
Run: LDB
Time and date: 15:15 03/05/2016
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Input units are thousands and kg - output in tonnes

Figure 6.2.8. Four-spot megrim (*L. boscii*) in Divisions 8.c and 9.a. Forecast summary

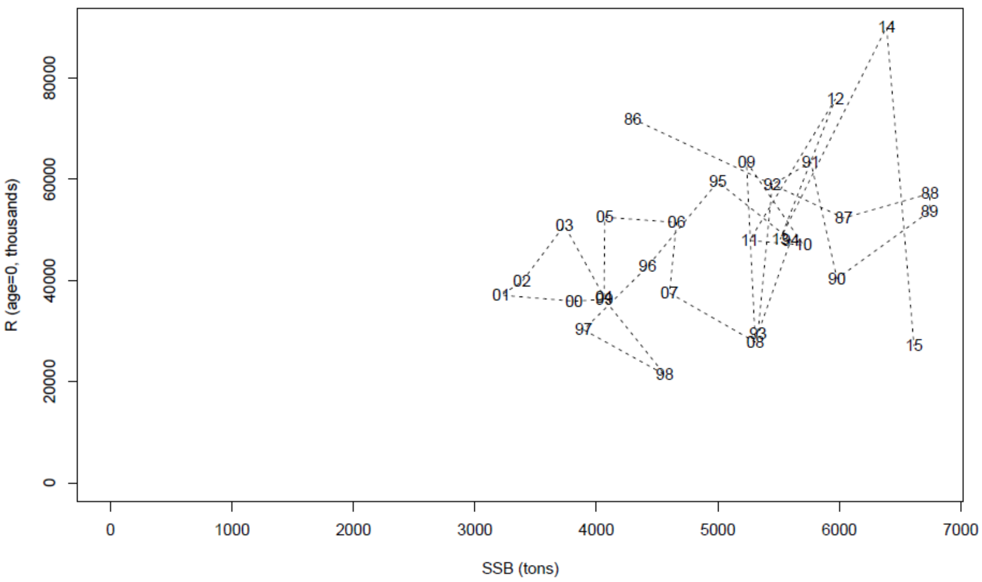


Figure 6.2.9. Four spot megrim (*L.boscii*) in Divisions 8.c and 9.a. SSB-Recruitment plot.

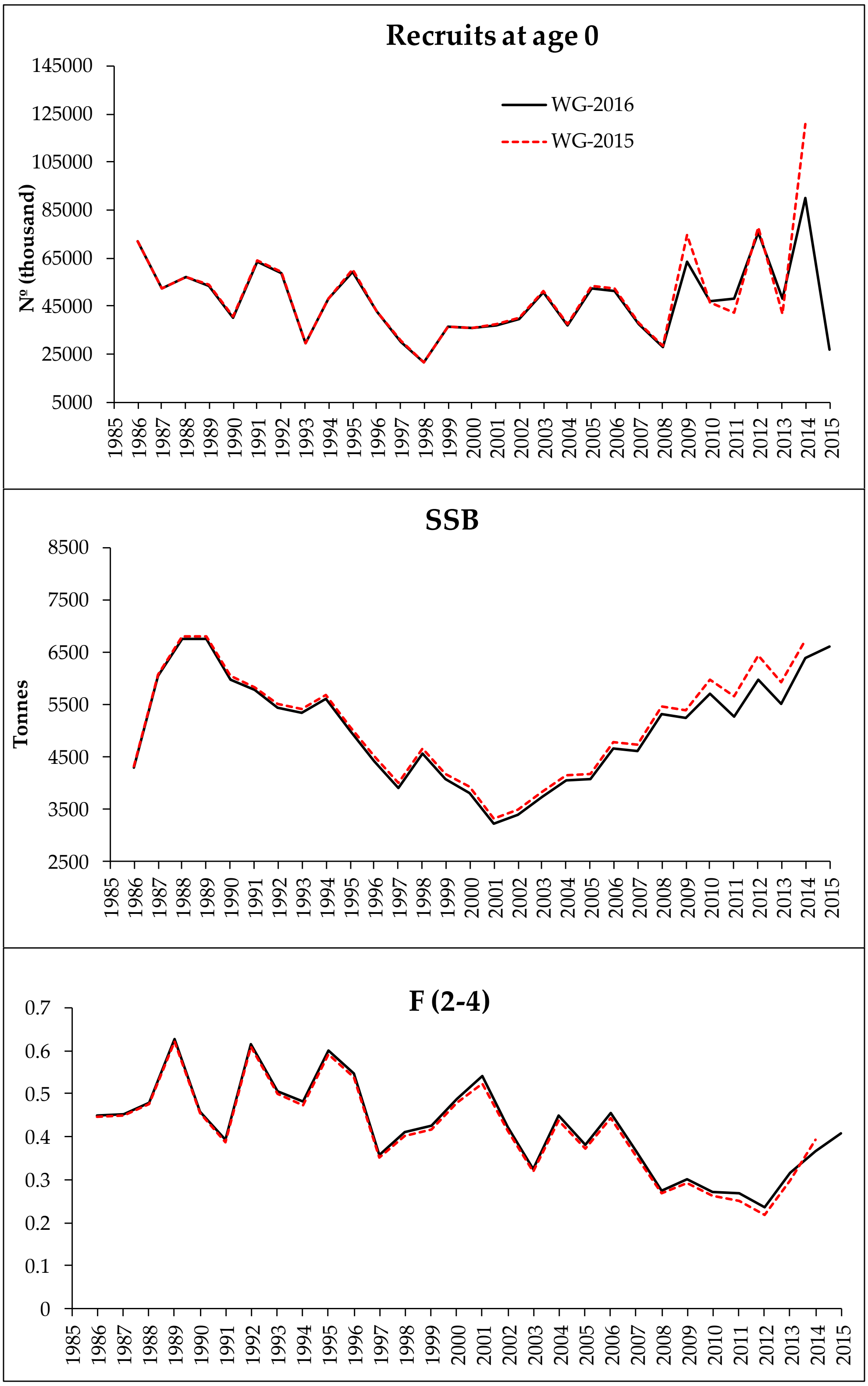


Figure 6.2.10. Four-spot megrim (*L. boscii*). Recruits, SSB and Fs from WG14 and WG15

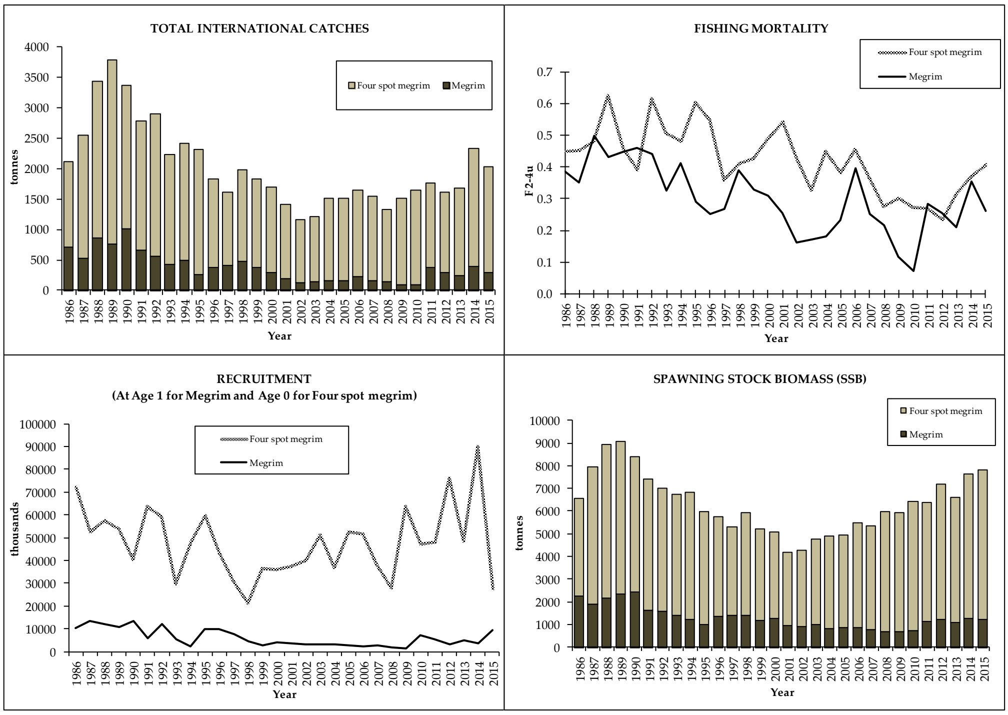
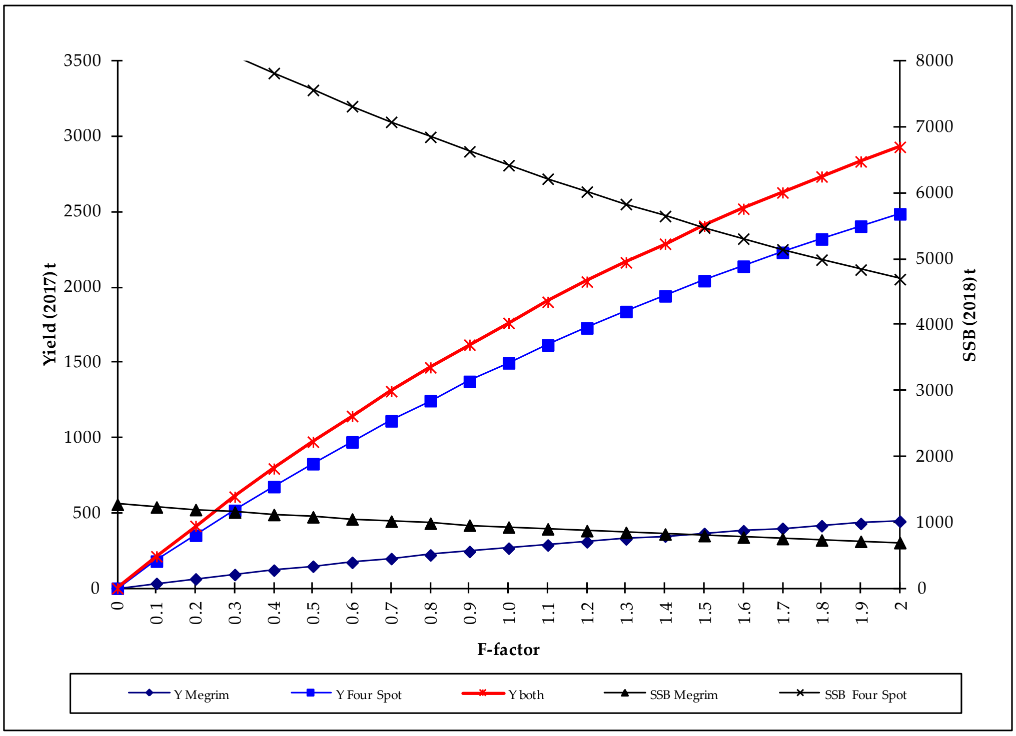


Figure 6.3.1. Stock trends for both stocks. Megrim and Four-spot megrim in Divisions 8.c and 9.a.



Combined Short-term Forecasts assuming status quo in 2014 and 2015

Figure 6.3.2. Megrims (*L. whiffiagonis and L. boscii*) in Divisions 8.c and 9.a.

7 Bay of Biscay Sole (*Solea solea*) in Divisions 8.a,b

Type of assessment in 2015: update.

Data revisions this year: Compared to last year assessment, there is only very limited change in data due to small revisions of 2014 landings and of 2014 commercial LPUE and survey cpue.

7.1 General

7.1.1 Ecosystem aspects

See Stock Annex

7.1.2 Fishery description

See Stock Annex

7.1.3 Summary of ICES advice for 2016 and management applicable to 2015 and 2016

ICES advice for 2015:

Since 2010 the ICES advice is to decrease the fishing mortality step by step to the F_{MSY} (0.26[1] for the Bay of Biscay sole) until 2015.

The advice provided for 2016: ICES advises on the basis of the transition to the MSY approach that catches in 2016 should be no more than 2393 tonnes. All catches are assumed to be landed because the discards are less than 5% for this stock (1.6% in 2015).

Management applicable to 2015 and 2016

The sole landings in the Bay of Biscay are subject to a TAC regulation. The 2015 TAC was set at 3800 t and the 2016 TAC was set at 3420 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 European Fishing Authorization when their sole annual landing is above 2 t or be allowed to have more than 100 kg on board.

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

A regulation establishing a management plan was 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

1 Change in 2016 after the WKMSYRef4 in October, 2015 at 0.33.

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.

A proposal for a management plan for sole in the Bay of Biscay was evaluated by ICES (2013b, 2014). The plan aims to decrease fishing mortality by applying a constant TAC until F is estimated to have reached F_{MSY}. The plan has provisions to reduce the TAC if F increases in two consecutive years, and to base the TAC on F = F_{MSY} if SSB is estimated to be below B_{pa}. ICES considered the plan to be precautionary for all the constant TAC values tested (up to 4500 t) and that values not exceeding 4300 t would allow reaching F_{MSY} by 2020.

In addition of this proposal the industry implemented a mesh size restriction of >=80 mm for the bottom trawls for the periods 1 January–31 May and from 1 October–31 December.

A season closure was also applied during the spawning period, 1 January–31 March, for the directed fishery for common sole. The fishery during the spawning period is closed for 21 days, which consists of 3 periods of seven consecutive days.

7.2 Data

7.2.1 Commercial catches and discards

The WG estimates of landings and catches are shown in Table 7.1a. 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 us to consider that the reliability of their estimates is satisfactory for the full time-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 which was 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 2014 landings estimate was revised to 3928 t, this is less than a 0.15 % decrease.

In 2002, landings increased to 5486 t due to very favourable weather conditions for 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 ranged between 4000 t and 4800 t before falling to 3650 t in 2009 and increasing to 4632 t in 2011 (Table 7.1a).

The 2015 landings figure (3641 t) is 7.6 % below the landings predicted by the 2015 WG at status quo mortality (3939 t).

Discards estimates were provided for the French offshore trawler fleet from 1984–2003 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. The analyse of the discards with the data from the Obsmer project shows that the discards for the sole in the Bay of Biscay are less than 5 % (1.64%) for 2015 for all fleets.

7.2.2 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 2014 split was slightly revised because of the very small correction in the database (Table 7.1 b).

Length compositions are available on a quarterly basis from 1984 for the French fleets and from 1994 for the Belgian beam trawlers. The 2015 sampling level is given in table 1.3 (section 1). The French length distributions are shown on Figures 7.1 a–d from 1984 onwards. The relative length distribution of landings in 2015 is shown by country in Table 7.2.

Although age reading from otoliths now uses the same method as in France and Belgium (see Stock Annex), the discrepancy between French and Belgian mean weight at age, noticed by preceding WGs, are still present. Work was carried out at 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 7.3 and Figures 7.2 a b, & c and the mean catch weight at age in Table 7.4.

7.2.3 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.

In 2015 the survey vessel was changed, however the gear configuration and method were the same as in previous year and the conclusion of the WGBEAM2016 was: “This change has had no consequence on the gear configuration”. On this basis, the WG agreed to retain the ORHAGO abundance indices in the assessment.

The figure 7.3 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.

7.2.4 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 of 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 fishers, 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 7.5.a and Figure 7.4). 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 since 2013. This is due to the use of the electronic logbooks, for which the fishing effort is not a required value. These 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.

However, LPUE for the FR-BB-IN-Q4 fleet is provided using paper logbooks which are still used by this fleet. Its LPUE are variables and the trend shows a decrease from 2014 to 2015 (Figure 7.4).

The Belgian LPUE series was relatively constant from 1990–1996, declining severely until 2002 but 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. The last value is higher than 2014 and it’s the second highest value since 1997.

For the ORHAGO survey, the trend of the cpue is close to the trend of the Belgian beam trawler fleet and it also shows an increase from 2007.

Consequently, except the commercial fleet FR-BB-IN-Q4, all the LPUE and cpue series available show an increase in the last year of the series.

7.3 Assessment

7.3.1 Input data

See stock annex

7.3.2 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 1984–2015.

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 7.6.

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

Fleet type	Acronym	Period	Age range	Landing 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 – 2015	1 – 8	<1 %
Offshore otter trawlers	FR-BB-OFF-Q2	2000 – 2012	1 – 8	<1 %
Beam trawler survey	FR-ORHAGO	2007 – 2015	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 7.5 a & 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 2015 and at age 6 in 2008, 2010 and in 2014.

Result of XSA runs

The final XSA was run using the same settings than in last year assessment.

The Figure 7.2 c shows a distribution of catches-at-age, between ages 2–6. The strong age 2 last year is now found in the age 3 this year.

As in last year's assessment, the weight of the ORHAGO survey age estimate is major, far above the weight of other fleets from age 2–6 (Table 7.7), 95 % for age 2, 75 % for age 3, and 71 % for age 4 for example.

			2015 XSA			2016 XSA
Catch data range			84-14			84-15
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	00-14	3-7	FR-BB-IN-Q4	00-15	3-7
	FR-BB-OFF-Q2	00-12	2-6	FR-BB-OFF-Q2	00-12	2-6
	FR-ORHAGO	07-14	2-8	FR-ORHAGO	07-15	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 7.7. The log-catchability residuals are shown in Figure 7.5 a & b and retrospective results in Figure 7.6. The retrospective pattern shows an F overestimation and a small SSB overestimation in 2014.

Because of the lack of the FR-BB-OFF-Q2 2014 abundance indices in the tuning data, the estimated survivors at age 2 are only based on the ORHAGO survey. The recruits at age 2 were overestimated for 2014.

At age 3, the only one commercial fleet estimated survivors to have a significant weight is the FR-BB-INQ4 (around 24%) and it increases by 49% at age 7. The FR-BB-OFF-Q2 has less weight than the others fleets, the maximum is at age 7 at around 12%. The two discontinued commercial fleets FR-SABLES and FR-ROCHELLE have no more weight at all ages. At age 6, the fleets FR-BB-IN-Q4 and FR-ORHAGO have more or less the same estimated survivors around 45%.

Fishing mortalities and stock numbers-at-age are given in Tables 7.8 and 7.9 respectively. The results are summarized in Table 7.10. Trends in yield, F, SSB and recruitments are plotted in Figure 7.7. Fishing mortality in 2015 is estimated by XSA to have been at 0.44. Fishing mortality was 0.46 in 2013, and 0.44 in 2014.

7.3.2.1 Estimating year-class abundance

In this year's assessment the retrospective analyses shows that the 2012 and 2013 recruitments were well estimated and that the recruitments are confirmed to be at a low level. The group therefore considers that, the estimate of the recruitment for last year (2015 in this year's assessment) is not well estimated as shown by the retrospective pattern for recruits and decided to change the value estimated by the assessment model by the geometric mean (1993 to n-2). The WG agreed to keep this calculation of the GM to be homogeneous with the previous assessment.

Recruitment-at-age 2

Year class	Thousands	Basis	Survey	Commercial	Shrinkage
2012	15 476	XSA	75%	25%	1.5%
2013	21 322	GM(93-13)			
2014 & subsequent	21 322	GM(93-13)			

Historic trends in biomass, fishing mortality and recruitment

A full summary of the time-series of XSA results are given in Table 7.10 and illustrated in Figure 7.7.

Since 1984, fishing mortality gradually increased, peaked in 2002 and decreased substantially the following two years. It increased in 2005 and, later on stabilized at around the new F_{pa} (= 0.43).

The SSB trend in earlier years increases from 12 300 t in 1984 to 16 400 t in 1993, afterwards it shows a continuous decrease to 9600 t in 2003. After an increase between 2003 and 2006, the SSB remains close to 11 300 t from 2007 to 2009. Since 2004, the SSB although above the new B_{pa} (10 600 t) has been decreasing since 2012. The SSB value for 2014 and 2015 are below the B_{pa}. The 2015 SSB is estimated to 9 733 t, lower (19%) than the estimated value from WGBIE 2015.

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_{93-13} (21.3 million). However, the 2012 and 2013 values are the lowest of the series (14.5 million and 13.3 million respectively). Since 2014, the recruitment is estimated to be below GM of the time-series 1993–2013.

7.3.3 Catch options and prognosis

Because of the stability around the F_{pa} for the F, the WG did not consider that there was a trend (Figure 7.7). Thus, the exploitation pattern is the mean over the period 2013-2014 for age 2 and 2013–2015 for ages 3 and above. This *status quo* F is estimated at 0.45 for the run.

The recruits at age 2 from 2015–2018 are assumed equal to GM_{93-13}. Stock numbers-at-age 3 are derived from the GM (as described in the stock annex) at age 4 and above are the XSA survivor estimates.

Weights at age in the landings are the 2013-2015 means using the new fresh/gutted transformation coefficient of French landing which was changed from 1.11–1.04 in 2007. Weights at age in the stock are the 2013-2015 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.

7.3.3.1 Short-term predictions

Input values for the catch forecast are given in Table 7.11.

The landings forecasts (Table 7.12) is 3793 t in 2016 (TAC is set at 3420 t), closed to the 2015 landings (3641 t).

Assuming recruitment at $GM_{93-13,}$ the SSB is predicted to increase to 10 468 t in 2016 and increase to 11 310 t in 2017, fishing at *status quo* F in 2016. It will continue to grow at *status quo* F, to reach 11 789 t in 2018 (Tables 7.12 and 7.13).

The proportional contributions of recent year classes to the landings in 2017 and to the SSB in 2018 are given in Table 7.14. Year classes for which $GM_{93\text{-}13}$ recruitment has been assumed (2014–2016) contribute 47.5 % of the 2017 landings and 62.6 % of the 2018 SSB.

7.3.3.2 Yield and Biomass per Recruit

Results for yield and SSB per recruit conditional on *status quo* F, are given in Table 7.15 a & b, and in Figure 7.8. The F_{sq} (0.45) is 31 % above F_{max} (0.34) and largely higher than $F_{0.1}$ (0.14). Long-term equilibrium landings and SSB (at F *status quo* and assuming GM recruitment) are estimated to be 4537 t and 12 706 t respectively (Table 7.15a & b).

7.3.4 Biological reference points

WKMSYRef4 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	10600 t	Bpa
Approach	F_{MSY}	0.33	F_{MSY} without Btrigger
	Blim	7600 t	Blim = Bpa / exp(σ x 1.645)
Precautionary	Bpa	10600 t	The third lowest value
Approach	Flim	0.6	In equilibrium gives a 50% probability of SSB>Blim
	Fpa	0.43	Fpa = Flim x exp(-σ x 1.645)

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

7.3.5 Comments on the assessment

Sampling

The sampling level (table 1.3, section 1) for this stock is considered to be satisfactory.

The ORHAGO survey provides information on several year classes at age 2. 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 2013 and the lack of FR-BB-OFF-Q2 (since 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 2013, which were only provided by the Offshore Q2 tuning fleet (when the data were 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 for some trawlers. 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 highgrading practices due to the landing limits adopted by some producers' organizations. The data available for discards do not seem representative to use them in the assessment.

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 since 2013 for the only one commercial tuning fleet which can also provide a recruitment index.

While the previous year was not well estimated by XSA, the results confirm the good estimate of the low recruits in 2012 and 2013 with the inclusion of the ORHAGO survey in the assessment (weight 95 % for age 2).

The GM is used for the 2015 and 2016 recruitment; this GM estimate has a low contribution in predicted landings and SSB because the recruits in terminal year is 20 110 millions and the $GM_{93\text{-}13}$ is 21 322 millions. Furthermore, it is worth noting that variability of the recruit series has increased since 2001 and that, in recent period (until 2011).

The retrospective pattern in F shows an overestimation in 2014 (Figure 7.6) 8.7 %.

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 7.9 shows the difference between the assessments in 2015 and in 2016. The SSB was not revised and F in 2014 revised higher.

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 highgrading practices due to the landing limits adopted by some producers' organizations.

Industry input

The traditional meeting with representatives of the fishing industry was not organized in France prior to the WG to present the data used by the 2015 WGBIE to assess the state of the Bay of Biscay sole stock, but a document was provided. As in the previous year, anecdotal information from industry have highlighted that the abundance of sole in some parts of the Bay of Biscay have increased to levels close to that seen 20 years ago. In order not to use all their yearly quota at the beginning of this year, they had to reduce their fishing effort.

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 2004 is above the B_{pa}. It is estimated to be 10 468 t (below B_{pa} = 10 600 t) in 2016 assuming $GM_{93\text{-}13}$ recruitment value for 2015, but an increase is predicted by the short-term prediction, and SSB is assumed to be above B_{pa} in 2017 and 2018.

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 has not been evaluated by ICES.

Table 7.1 a: Bay of Biscay sole (Division 8.a,b). Internationals landings and catches used by the Working Group (in tonnes).

	Official landings						WG	Discards [2]	WG
Years	Belgium	France	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	4235	-	-
2014	307	3793		10		4110	3928	-	-
2015	302	3465		8		3775	3641**	-	-

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

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

Table **7.1 b** : Bay of Biscay sole (Division 8a,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	2014	2015
Shrimp trawlers	0	0	0	0	0	0	0
Inshore trawlers	6	8	7	8	7	8	7
Offshore otter trawlers	21	19	17	17	18	18	15
Offshore beam trawlers	10	11	8	9	7	8	8
Fixed nets	63	61	67	66	68	65	70

Table 7.2 : Bay of Biscay Sole - 2015

French and Belgian relative length distribution of landings

Length(cm)	France	Belgium
21	0.01	
22	0.07	
23	1.03	0.54
24	3.73	4.89
25	5.74	10.52
26	7.41	13.46
27	9.72	14.92
28	9.19	13.06
29	11.25	11.78
30	11.29	10.11
31	10.09	6.50
32	7.64	5.39
33	5.14	3.33
34	3.62	2.02
35	2.82	1.42
36	2.21	0.93
37	1.82	0.47
38	1.44	0.26
39	1.17	0.12
40	0.97	0.11
41	0.85	0.07
42	0.70	0.03
43	0.48	0.01
44	0.41	0.04
45	0.38	0.00
46	0.27	
47	0.11	
48	0.15	
49	0.11	
50	0.08	
51	0.05	
52	0.03	
53	0.00	
Total	100	100

MLS= 24 cm

Table 7.3: Bay of Biscay Sole, Catch number-at-age (in thousands)

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Age											
2	5901	8493	6126	3794	4962	4918	7122	4562	4640	1897	2603
3	3164	4606	4208	5634	5928	6551	6312	6302	7279	7816	5502
4	2786	2479	2673	3578	4191	3802	4423	4512	4920	6879	8803
5	2034	1962	2301	2005	2293	3147	2833	2083	2991	3661	5040
6	1164	906	1512	1482	1388	2046	972	1113	2236	1625	1968
7	880	708	1044	690	874	967	1018	1063	1124	566	970
+gp	1181	729	1235	714	766	499	870	981	951	708	696
TOTALNUM	17110	19883	19099	17897	20402	21930	23550	20616	24141	23152	25582
TONSLAND	4038	4251	4805	5086	5382	5845	5916	5569	6550	6420	7229
SOPCOF %	107	103	102	102	101	101	100	102	100	100	100

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2	3249	3027	3801	4096	2851	5677	3180	5198	4274	3411	3976
3	5663	5180	9079	5550	5113	7015	6528	4777	6309	5415	3464
4	6356	5409	5380	6351	4870	5143	4948	4932	2236	3291	3738
5	3644	2343	3063	2306	2764	2542	1776	3095	1220	917	2309
6	1795	1697	1578	1237	1314	955	899	1269	729	661	991
7	843	1366	692	785	902	421	513	615	377	272	461
+gp	986	1319	877	1188	977	444	486	432	250	333	508
TOTALNUM	22536	20341	24470	21513	18791	22197	18330	20318	15395	14300	15447
TONSLAND	6205	5854	6259	6027	5249	5760	4836	5486	4108	4002	4539
SOPCOF %	100	100	100	101	100	101	101	101	101	101	102

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2	3535	3885	3173	2860	2084	1516	1302	2312	3460	2314
3	4436	5181	4794	3986	7707	5222	4680	2939	2932	3052
4	2747	2615	2886	2233	3758	8347	4264	3777	1624	1590
5	2012	1419	1353	1501	1272	1019	3787	3205	2231	1884
6	1030	1262	938	946	484	570	1008	1450	1668	1200
7	530	686	892	541	269	275	225	286	730	858
+gp	1537	946	1193	960	284	516	517	635	483	580
TOTALNUM	15827	15994	15229	13027	15858	17465	15783	14604	13128	11478
TONSLAND	4793	4363	4299	3650	3966	4632	4321	4235	3928	3641
SOPCOF %	101	100	100	102	100	100	100	101	110	110

Table 7.4: Bay of Biscay Sole, Catch weight at age (in kg)

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Age											
2	0.121	0.106	0.102	0.141	0.134	0.136	0.131	0.143	0.146	0.145	0.147
3	0.168	0.174	0.173	0.201	0.19	0.188	0.179	0.192	0.196	0.197	0.195
4	0.213	0.252	0.245	0.285	0.272	0.258	0.241	0.26	0.262	0.267	0.251
5	0.269	0.313	0.328	0.376	0.357	0.354	0.348	0.325	0.341	0.341	0.324
6	0.329	0.39	0.409	0.467	0.495	0.437	0.436	0.437	0.404	0.439	0.421
7	0.368	0.457	0.498	0.497	0.503	0.543	0.601	0.535	0.49	0.569	0.569
+gp	0.573	0.698	0.657	0.682	0.604	0.799	0.854	0.715	0.715	0.677	0.774
SOPCOFAC	1.0712	1.0302	1.0197	1.0248	1.008	1.0055	1.0039	1.0183	1.0004	1.0008	1.0016

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Age											
2	0.16	0.159	0.142	0.161	0.177	0.171	0.152	0.171	0.18	0.19	0.189
3	0.206	0.204	0.193	0.212	0.219	0.207	0.22	0.208	0.226	0.227	0.226
4	0.252	0.268	0.256	0.257	0.246	0.276	0.265	0.263	0.307	0.29	0.298
5	0.308	0.319	0.319	0.335	0.305	0.343	0.341	0.32	0.361	0.391	0.367
6	0.403	0.399	0.406	0.41	0.404	0.452	0.428	0.466	0.487	0.493	0.43
7	0.484	0.453	0.502	0.501	0.533	0.573	0.519	0.592	0.657	0.643	0.468
+gp	0.658	0.625	0.678	0.7	0.582	0.755	0.619	0.681	0.642	0.81	0.656
SOPCOFAC	1.0023	0.9998	1.0048	1.0091	1.0006	1.0066	1.01	1.0122	1.0056	1.0104	1.0153

Year	2006	2007*	2008*	2009*	2010*	2011*	2012*	2013*	2014*	2015*
Age										
2	0.195	0.176	0.174	0.17	0.179	0.193	0.182	0.208	0.177	0.198
3	0.242	0.225	0.229	0.215	0.206	0.223	0.224	0.24	0.242	0.227
4	0.282	0.298	0.287	0.275	0.272	0.253	0.257	0.272	0.282	0.318
5	0.347	0.326	0.352	0.317	0.337	0.342	0.307	0.304	0.297	0.312
6	0.42	0.388	0.392	0.361	0.414	0.432	0.369	0.368	0.348	0.385
7	0.455	0.419	0.401	0.447	0.477	0.489	0.414	0.518	0.394	0.365
+gp	0.533	0.511	0.519	0.601	0.768	0.606	0.585	0.521	0.572	0.512
SOPCOFAC	1.0136	1.0026	1	1.0158	1.0019	1.0046	1.0023	1.0082	1.0951	1.0978

(*) for 2007 to 2015, 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 2015

Table **7.5 a** : Bay of Biscay sole LPUE and indices of fishing effort for French offshore trawlers.

Year	CPUE			LPUE	LPUE
	Inshore (10-12 m) trawlers of French sole fishery Q4	Offshore (14-18m) trawlers of French sole fishery Q2	Orhago Survey beam trawler kg/10km	La Rochelle offshore trawlers of French sole fishery (kg/h)	Les Sables offshore trawlers of French sole fishery (kg/h)
1984	-	-		6.0	6.9
1985	-	-		5.6	6.5
1986	-	-		7.2	7.2
1987	-	-		6.6	5.9
1988	-	-		6.4	6.7
1989	-	-		5.5	6.1
1990	-	-		7.1	6.3
1991	-	-		6.5	6.5
1992	-	-		5.4	5.6
1993	-	-		4.6	6.4
1994	-	-		5.0	6.6
1995	-	-		4.6	5.4
1996	-	-		4.9	6.0
1997	-	-		4.1	5.3
1998	-	-		4.2	5.3
1999	-	-		3.7	5.9
2000	5.7	3.5		4.0	5.7
2001	5.8	3.4		3.4	4.0
2002	4.8	4.1		4.4	5.0
2003	5.8	3.9		4.1	3.9
2004	5.4	3.6		4.0	4.1
2005	5.2	3.4		3.9	5.2
2006	5.8	2.2		3.4	5.4
2007	4.7	3.7	6.6	3.5	5.3
2008	3.8	3.2	4.4	4.1	5.6
2009	4.4	2.1	6.4	3.3	5.2
2010	4.6	3.5	7.4	3.6	5.7
2011	4.6	3.5	6.1	na	na
2012	5.8	3.6	7.0	na	na
2013	4.0		6.6	na	na
2014	5.3		7.8	na	na
2015	4.2		7.7	na	na

* French offshore trawlers in other harbours than in La Rochelle and Les Sables

na : non available

Table **7.5 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
2014	307.4	11.1	27.8
2015	302.0	8.2	36.8

Table 7.6: Sole 8ab, available tuning data (landings); 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	5006	9.90	47.27	**16.31**	**13.09**	**5.31**	**2.12**	**1.11**	**2.71**
2006	7248	23.93	85.26	**27.74**	**6.90**	**4.74**	**3.99**	**2.68**	**6.22**
2007	4110	2.75	34.73	**16.22**	**7.33**	**3.75**	**3.11**	**0.69**	**2.21**
2008	3820	0.58	14.07	**16.05**	**8.70**	**3.02**	**1.69**	**1.25**	**1.25**
2009	3615	2.66	47.84	**14.71**	**3.36**	**1.81**	**1.53**	**0.64**	**1.37**
2010	4279	1.48	21.80	**33.47**	**9.45**	**3.01**	**0.93**	**0.44**	**1.06**
2011	5085	3.41	40.80	**22.69**	**13.69**	**3.61**	**1.80**	**0.79**	**1.63**
2012	3088	1.14	9.74	**21.55**	**14.44**	**7.58**	**1.50**	**0.98**	**1.17**
2013	3155	3.38	11.91	**8.28**	**7.88**	**3.22**	**2.86**	**1.04**	**1.97**
2014	4767	16.31	92.80	**16.08**	**4.89**	**3.69**	**2.72**	**0.85**	**1.08**
2015	2422	5.71	30.54	**6.95**	**2.32**	**1.90**	**1.18**	**0.80**	**0.45**

Table 7.6: 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	2047	0.00	**4.33**	**14.92**	**7.59**	**4.66**	**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**	**28.0**	**15.5**	**9.5**	**0.8**	**2.2**
2008	100	343	**128.3**	**70.8**	**22.7**	**4.2**	**2.5**	**3.0**	**1.3**
2009	100	87	**490.1**	**101.2**	**20.5**	**4.9**	**1.9**	**0.4**	**2.2**
2010	100	170	**193.3**	**161.9**	**21.1**	**2.9**	**0.1**	**0.9**	**0.7**
2011	100	103	**208.9**	**76.8**	**30.5**	**3.0**	**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	169	**84.5**	**50.6**	**61.8**	**24.3**	**16.1**	**4.7**	**3.5**
2014	100	175	**228.0**	**51.3**	**28.1**	**23.4**	**18.9**	**7.5**	**6.6**
2015	100	141	**193.6**	**55.9**	**23.1**	**17.5**	**14.8**	**7.1**	**8.8**

Table 7.7: XSA tuning diagnostic

```
Lowestoft VPA Version 3.1

  16/05/2016  14:26

Extended Survivors Analysis

SOLE 8.a,b

cpue data from file tunfilt.dat

Catch data for  32 years. 1984 to 2015. Ages  2 to   8.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                     ,    year, year,  age ,  age
FR-SABLES            ,   1991, 2015,   2,     7,   .000,  1.000
FR-ROCHELLE          ,   1991, 2015,   2,     7,   .000,  1.000
FR-BB-IN-Q4          ,   2000, 2015,   3,     7,   .750,  1.000
FR-BB-OFF-Q2         ,   2000, 2015,   2,     6,   .250,   .500
FR-ORHAGO            ,   2007, 2015,   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   73 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,  2006,  2007,  2008,  2009,  2010,  2011,  2012,  2013,  2014,  2015

     2,  .221,  .259,  .197,  .092,  .095,  .080,  .116,  .215,  .268,  .129
     3,  .452,  .511,  .517,  .359,  .340,  .323,  .333,  .368,  .411,  .356
     4,  .464,  .466,  .528,  .429,  .598,  .662,  .422,  .434,  .317,  .363
     5,  .388,  .411,  .415,  .510,  .411,  .282,  .636,  .573,  .438,  .649
     6,  .431,  .399,  .465,  .507,  .271,  .290,  .439,  .472,  .588,  .396
     7,  .513,  .506,  .483,  .473,  .232,  .217,  .159,  .190,  .408,  .607
```

Table 7.7: Cont'd

XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7
2006	1.88E+04	1.28E+04	7.78E+03	6.57E+03	3.09E+03	1.39E+03
2007	1.79E+04	1.36E+04	7.38E+03	4.42E+03	4.03E+03	1.82E+03
2008	1.87E+04	1.25E+04	7.40E+03	4.19E+03	2.65E+03	2.45E+03
2009	3.41E+04	1.39E+04	6.73E+03	3.95E+03	2.50E+03	1.51E+03
2010	2.42E+04	2.81E+04	8.77E+03	3.97E+03	2.14E+03	1.36E+03
2011	2.08E+04	1.99E+04	1.81E+04	4.36E+03	2.38E+03	1.48E+03
2012	1.25E+04	1.74E+04	1.30E+04	8.46E+03	2.98E+03	1.61E+03
2013	1.25E+04	1.00E+04	1.13E+04	7.73E+03	4.05E+03	1.74E+03
2014	1.55E+04	9.15E+03	6.29E+03	6.61E+03	3.95E+03	2.29E+03
2015	2.01E+04	1.07E+04	5.49E+03	4.15E+03	3.86E+03	1.98E+03

Estimated population abundance at 1st Jan 2016

0.00E+00	1.60E+04	6.79E+03	3.46E+03	1.96E+03	2.35E+03

Taper weighted geometric mean of the VPA populations:

2.30E+04	1.72E+04	1.07E+04	5.93E+03	3.26E+03	1.78E+03

Standard error of the weighted Log(VPA populations) :

.2689	.2858	.3020	.2771	.2840	.3767

1

Log catchability residuals.

Fleet : FR-SABLES

Age	1991	1992	1993	1994	1995
2	-.23	-.13	-.38	-.41	-.08
3	.11	-.19	.16	-.11	-.17
4	.13	-.27	-.09	.37	.14
5	.08	-.16	-.11	.23	.00
6	-.19	.17	-.39	.03	-.24
7	-.06	-.15	-.27	.18	.07

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2	-.21	-.12	-.03	-.18	.20	-.17	.22	-.13	.30	.48
3	-.03	.20	-.01	-.42	.39	.07	.26	.01	-.29	-.18
4	.02	.01	.44	-.22	.14	-.06	.14	-.29	-.19	-.15
5	-.12	-.24	.15	.28	-.08	-.27	.34	-.17	-.49	.23
6	.24	-.02	-.40	.42	-.04	-.22	.36	.04	-.34	.16
7	.48	-.01	.11	.54	.08	-.22	.08	.09	-.13	.07

Age	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2	.80	.25	.14	-.32	99.99	99.99	99.99	99.99	99.99	99.99
3	-.02	-.05	.14	.12	99.99	99.99	99.99	99.99	99.99	99.99
4	-.47	.04	.29	.02	99.99	99.99	99.99	99.99	99.99	99.99
5	-.74	.34	.29	.45	99.99	99.99	99.99	99.99	99.99	99.99
6	-.55	.26	.32	.38	99.99	99.99	99.99	99.99	99.99	99.99
7	-.15	.64	.35	.31	99.99	99.99	99.99	99.99	99.99	99.99

Table 7.7: Cont'd

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,	-15.0733,	-14.5210,	-14.4788,	-14.6636,	-14.6589,	-14.6589,
S.E(Log q),	.3107,	.1990,	.2351,	.3111,	.2991,	.2793,

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,	5.00,	-3.165,	35.09,	.04,	19,	1.27,	-15.07,
3,	1.00,	-.023,	14.54,	.63,	19,	.21,	-14.52,
4,	.83,	1.130,	13.60,	.72,	19,	.19,	-14.48,
5,	1.12,	-.390,	15.36,	.40,	19,	.36,	-14.66,
6,	1.39,	-1.033,	17.28,	.29,	19,	.42,	-14.66,
7,	.73,	2.304,	12.61,	.81,	19,	.17,	-14.55,

1

Fleet : FR-ROCHELLE

Age ,	1991,	1992,	1993,	1994,	1995
2 ,	-.09,	-.18,	-.45,	-.39,	-.04
3 ,	.20,	-.04,	-.01,	-.21,	-.11
4 ,	.45,	.13,	-.21,	.30,	.31
5 ,	.46,	.17,	-.08,	.20,	.22
6 ,	.12,	.34,	-.26,	.11,	-.35
7 ,	.01,	.08,	-.03,	-.01,	-.06

Age ,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	2003,	2004,	2005
2 ,	.33,	-.05,	.20,	-.02,	.19,	-.23,	.70,	.16,	.37,	.12
3 ,	.06,	.11,	-.10,	-.49,	-.27,	-.08,	.19,	.23,	-.09,	-.38
4 ,	-.14,	-.07,	.48,	-.25,	-.11,	.14,	-.32,	-.06,	-.23,	-.21
5 ,	-.35,	-.35,	.01,	.18,	-.16,	-.05,	-.06,	-.06,	-.47,	.32
6 ,	-.11,	-.01,	-.53,	.52,	-.30,	.09,	.00,	.10,	-.20,	.41
7 ,	-.10,	-.10,	.02,	.23,	-.22,	.12,	-.08,	-.22,	-.03,	.20

Age ,	2006,	2007,	2008,	2009,	2010,	2011,	2012,	2013,	2014,	2015
2 ,	-.02,	.06,	.20,	-.84,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
3 ,	-.26,	.56,	.56,	.13,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
4 ,	-.29,	-.20,	.31,	-.02,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
5 ,	-.29,	-.27,	.24,	.34,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
6 ,	-.07,	-.24,	.13,	.23,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
7 ,	.00,	-.22,	.22,	.16,	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
Mean Log q,	-15.0076,	-14.5623,	-14.7818,	-15.1377,	-15.1963,	-15.1963,
S.E(Log q),	.3369,	.2775,	.2599,	.2686,	.2733,	.1427,

Table 7.7: Cont'd

```
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,    1.96,   -1.505,     19.72,     .13,     19,     .64,  -15.01,
 3,    1.20,    -.662,     15.52,     .39,     19,     .34,  -14.56,
 4,     .80,    1.236,     13.70,     .70,     19,     .21,  -14.78,
 5,     .89,     .555,     14.40,     .59,     19,     .24,  -15.14,
 6,    1.58,   -1.524,     19.39,     .29,     19,     .42,  -15.20,
 7,     .85,    1.997,     13.98,     .91,     19,     .11,  -15.20,
1


Fleet : FR-BB-IN-Q4

 Age  ,  1996,  1997,  1998,  1999,  2000,  2001,  2002,  2003,  2004,  2005
    2 , No data for this fleet at this age
    3 , 99.99, 99.99, 99.99, 99.99,   .28,  -.34,   .30,   .72,   .26,  -.25
    4 , 99.99, 99.99, 99.99, 99.99,   .41,  -.49,  -.66,   .16,   .33,   .13
    5 , 99.99, 99.99, 99.99, 99.99,   .08,  -.34,  -.12,  -.72,   .49,   .21
    6 , 99.99, 99.99, 99.99, 99.99,  -.46,   .03,   .64,  -.31,   .87,   .04
    7 , 99.99, 99.99, 99.99, 99.99,  -.18,  -.11,   .60,   .33,   .24,  -.08


 Age  ,  2006,  2007,  2008,  2009,  2010,  2011,  2012,  2013,  2014,  2015
    2 , No data for this fleet at this age
    3 ,  -.05,  -.03,   .13,  -.15,  -.22,  -.44,   .15,  -.25,   .13,  -.24
    4 ,  -.49,   .20,   .49,  -.40,   .35,  -.12,   .55,   .08,  -.33,  -.22
    5 ,  -.52,   .23,   .15,  -.17,   .08,  -.12,   .77,  -.07,  -.31,   .35
    6 ,   .05,   .07,   .01,   .06,  -.66,  -.26,  -.04,   .31,  -.03,  -.33
    7 ,   .52,  -.55,  -.20,  -.33,  -.99,  -.67,  -.09,  -.10,  -.80,   .13

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,  -14.4955,  -14.9362,  -15.1799,  -15.1224,  -15.1224,
S.E(Log q),     .3021,     .3897,     .3783,     .3826,     .4762,


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,     .96,     .148,     14.30,     .51,     16,     .30,  -14.50,
 4,     .81,     .734,     13.80,     .50,     16,     .32,  -14.94,
 5,     .82,     .560,     14.01,     .42,     16,     .32,  -15.18,
 6,     .92,     .211,     14.58,     .36,     16,     .37,  -15.12,
 7,    2.76,   -1.888,     29.30,     .08,     16,    1.15,  -15.26,
1
```

Table 7.7: Cont'd

```
Fleet : FR-BB-OFF-Q2

 Age  ,  1996,  1997,  1998,  1999,  2000,  2001,  2002,  2003,  2004,  2005
    2 , 99.99, 99.99, 99.99, 99.99,   .42,   .46,   .88,   .93,   .44,   .37
    3 , 99.99, 99.99, 99.99, 99.99,  -.43,  -.13,   .22,   .16,   .19,  -.18
    4 , 99.99, 99.99, 99.99, 99.99,   .37,   .24,   .15,   .00,  -.06,  -.01
    5 , 99.99, 99.99, 99.99, 99.99,   .75,   .48,   .81,  -.17,  -.90,   .27
    6 , 99.99, 99.99, 99.99, 99.99,   .73,  1.18,  1.41,   .42,  -.47,  -.72
    7 , No data for this fleet at this age


 Age  ,  2006,  2007,  2008,  2009,  2010,  2011,  2012,  2013,  2014,  2015
    2 ,  -.28,   .54,   .91, -1.70, -1.41, -1.97,   .39, 99.99, 99.99, 99.99
    3 ,  -.20,   .75,   .39,  -.11,   .00,  -.68,  -.01, 99.99, 99.99, 99.99
    4 ,  -.65,  -.39,  -.01,  -.22,   .27,   .44,  -.13, 99.99, 99.99, 99.99
    5 ,  -.55,  -.97,  -.01,  -.20,   .31,  -.36,   .51, 99.99, 99.99, 99.99
    6 ,   .33,   .02,  -.76,  -.40, -1.48,   .11,  -.38, 99.99, 99.99, 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,  -15.9014,  -14.5113,  -14.7459,  -15.3678,  -15.9076,
S.E(Log q),    1.0197,     .3618,     .3055,     .5862,     .8158,



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,   -1.56,   -1.466,       .59,     .03,     13,    1.52,  -15.90,
 3,    2.01,   -1.214,     19.37,     .12,     13,     .71,  -14.51,
 4,     .63,    2.151,     12.70,     .76,     13,     .17,  -14.75,
 5,     .56,    1.162,     12.30,     .38,     13,     .32,  -15.37,
 6,    2.20,    -.473,     25.63,     .01,     13,    1.86,  -15.91,
1


Fleet : FR-ORHAGO

 Age  ,  2006,  2007,  2008,  2009,  2010,  2011,  2012,  2013,  2014,  2015
    2 , 99.99,   .08,  -.27,   .38,  -.21,   .01,  -.29,  -.27,   .56,   .01
    3 , 99.99,   .04,   .16,   .27,   .01,  -.40,   .03,  -.09,   .05,  -.07
    4 , 99.99,   .10,  -.05,  -.15,  -.23,  -.53,   .18,   .44,   .13,   .11
    5 , 99.99,   .57,  -.68,  -.38, -1.00, -1.18,   .51,   .60,   .60,   .97
    6 , 99.99,   .61,  -.25,  -.43, -3.43,  -.68,   .40,  1.20,  1.49,  1.09
    7 , 99.99,  -.97,   .03, -1.51,  -.81,  -.06,   .25,   .56,   .95,  1.21


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,   -9.0537,   -9.3837,   -9.7768,  -10.3681,  -10.8184,  -10.8184,
S.E(Log q),     .3034,     .1855,     .2815,     .8089,    1.4929,     .9107,
```

Table 7.7: Cont'd

```
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,     .73,    1.093,      9.26,     .70,      9,     .22,   -9.05,
 3,    1.13,    -.595,      9.36,     .76,      9,     .22,   -9.38,
 4,    1.29,    -.874,      9.98,     .56,      9,     .37,   -9.78,
 5,     .42,    1.653,      9.30,     .53,      9,     .31,  -10.37,
 6,     .17,    4.502,      8.50,     .81,      9,     .13,  -10.82,
 7,     .29,    1.728,      8.45,     .46,      9,     .23,  -10.86,
1

Fleet disaggregated estimates of survivors :

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

Year class = 2013

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,    16160.,
Raw Weights,     8.596,


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        ,         1.,   .000,      .000,    .00,   0,  .000,     .000
FR-BB-OFF-Q2       ,         1.,   .000,      .000,    .00,   0,  .000,     .000
FR-ORHAGO          ,     16160.,   .320,      .000,    .00,   1,  .951,     .128

  F shrinkage mean  ,     13120.,   1.50,,,,                         .049,     .155
```

Table 7.7: Cont'd

```
 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     15995.,       .31,      .05,    2,    .148,   .129
1
 Age  3   Catchability constant w.r.t. time and dependent on age

 Year class = 2012

 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,     5347.,         0.,
 Raw Weights,     7.226,       .000,


 FR-BB-OFF-Q2
         Age,         3,          2,
   Survivors,        0.,         0.,
 Raw Weights,      .000,       .000,


 FR-ORHAGO
         Age,         3,          2,
   Survivors,     6337.,     11887.,
 Raw Weights,    17.512,      5.240,


 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         ,      5347.,   .311,       .000,     .00,   1,  .238,     .434
 FR-BB-OFF-Q2        ,         1.,   .000,       .000,     .00,   0,  .000,     .000
 FR-ORHAGO           ,      7325.,   .171,       .265,    1.55,   2,  .748,     .334

   F shrinkage mean  ,      6795.,   1.50,,,,                         .015,     .356

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      6790.,       .15,      .15,    4,   1.027,   .356

1
 Age  4   Catchability constant w.r.t. time and dependent on age

 Year class = 2011

 FR-SABLES
         Age,         4,          3,          2,
   Survivors,        0.,         0.,         0.,
 Raw Weights,      .000,       .000,       .000,
```

Table 7.7: Cont'd

```
FR-ROCHELLE
        Age,         4,          3,          2,
  Survivors,        0.,         0.,         0.,
Raw Weights,      .000,       .000,       .000,


FR-BB-IN-Q4
        Age,         4,          3,          2,
  Survivors,     2771.,      3930.,         0.,
Raw Weights,     4.311,      4.760,       .000,


FR-BB-OFF-Q2
        Age,         4,          3,          2,
  Survivors,        0.,         0.,         0.,
Raw Weights,      .000,       .000,       .000,


FR-ORHAGO
        Age,         4,          3,          2,
  Survivors,     3876.,      3640.,      2641.,
Raw Weights,     7.901,     11.537,      3.639,


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          ,      3329.,  .251,       .174,     .69,   2,  .278,     .375
FR-BB-OFF-Q2         ,         1.,  .000,       .000,     .00,   0,  .000,     .000
FR-ORHAGO            ,      3536.,  .151,       .092,     .61,   3,  .708,     .356

  F shrinkage mean  ,      2403.,   1.50,,,,                         .014,     .488

Weighted prediction :

Survivors,         Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     3458.,        .13,      .07,    6,    .523,   .363

1
Age  5   Catchability constant w.r.t. time and dependent on age

Year class = 2010

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,     2791.,      1411.,      1522.,         0.,
Raw Weights,     3.436,      2.358,      2.718,       .000,
```

Table 7.7: Cont'd

```
FR-BB-OFF-Q2
        Age,         5,          4,          3,          2,
  Survivors,        0.,         0.,         0.,      2904.,
Raw Weights,      .000,       .000,       .000,       .209,


FR-ORHAGO
        Age,         5,          4,          3,          2,
  Survivors,     5146.,      2240.,      1785.,      1460.,
Raw Weights,      .719,      4.322,      6.587,      2.294,


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         ,     1904.,   .217,       .224,    1.03,  3,  .369,     .663
FR-BB-OFF-Q2        ,     2904.,  1.058,       .000,     .00,  1,  .009,     .481
FR-ORHAGO           ,     1957.,   .149,       .155,    1.04,  4,  .603,     .650

  F shrinkage mean  ,     2991.,   1.50,,,,                      .019,     .469

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     1960.,       .12,      .10,    9,    .834,   .649


1
Age  6   Catchability constant w.r.t. time and dependent on age

Year class = 2009

FR-SABLES
        Age,         6,          5,          4,          3,          2,
  Survivors,        0.,         0.,         0.,         0.,         0.,
Raw Weights,      .000,       .000,       .000,       .000,       .000,


FR-ROCHELLE
        Age,         6,          5,          4,          3,          2,
  Survivors,        0.,         0.,         0.,         0.,         0.,
Raw Weights,      .000,       .000,       .000,       .000,       .000,


FR-BB-IN-Q4
        Age,         6,          5,          4,          3,          2,
  Survivors,     1691.,      1724.,      2547.,      2721.,         0.,
Raw Weights,     4.328,      2.858,      1.745,      2.083,       .000,


FR-BB-OFF-Q2
        Age,         6,          5,          4,          3,          2,
  Survivors,        0.,         0.,         0.,      2325.,       328.,
Raw Weights,      .000,       .000,       .000,      1.432,       .166,


FR-ORHAGO
        Age,         6,          5,          4,          3,          2,
  Survivors,     7014.,      4287.,      3662.,      2430.,      2372.,
Raw Weights,      .272,       .598,      3.198,      5.047,      1.823,
```

Table 7.7: Cont'd

```
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         ,       1984.,   .204,       .121,     .59,   4,  .459,     .454
FR-BB-OFF-Q2        ,       1896.,   .354,       .598,    1.69,   2,  .067,     .471
FR-ORHAGO           ,       2889.,   .150,       .127,     .85,   5,  .456,     .333

  F shrinkage mean  ,       2230.,   1.50,,,,                          .019,     .413

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     2353.,       .12,      .10,   12,    .819,   .396

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

Year class = 2008

FR-SABLES
        Age,        7,          6,          5,          4,          3,          2,
  Survivors,       0.,         0.,         0.,         0.,         0.,         0.,
Raw Weights,     .000,       .000,       .000,       .000,       .000,       .000,

FR-ROCHELLE
        Age,        7,          6,          5,          4,          3,          2,
  Survivors,       0.,         0.,         0.,         0.,         0.,         0.,
Raw Weights,     .000,       .000,       .000,       .000,       .000,       .000,

FR-BB-IN-Q4
        Age,        7,          6,          5,          4,          3,          2,
  Survivors,    1116.,       953.,       909.,      1699.,       627.,         0.,
Raw Weights,    2.263,      1.947,      1.124,       .694,       .837,       .000,

FR-BB-OFF-Q2
        Age,        7,          6,          5,          4,          3,          2,
  Survivors,       0.,         0.,         0.,       858.,       497.,       238.,
Raw Weights,     .000,       .000,       .000,      1.115,       .575,       .066,

FR-ORHAGO
        Age,        7,          6,          5,          4,          3,          2,
  Survivors,    3290.,      4329.,      1786.,      1167.,       656.,       797.,
Raw Weights,     .592,       .122,       .235,      1.272,      2.028,       .721,

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         ,       1004.,   .214,       .124,     .58,   5,  .489,     .595
FR-BB-OFF-Q2        ,        684.,   .239,       .232,     .97,   3,  .125,     .785
FR-ORHAGO           ,       1041.,   .175,       .254,    1.45,   6,  .354,     .579

  F shrinkage mean  ,       1357.,   1.50,,,,                          .032,     .471

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
      978.,       .13,      .11,   15,    .842,   .607
```

Table 7.8: Bay of Biscay Sole, Fishing mortality (F) at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE											
2	0.2967	0.3601	0.2578	0.1744	0.217	0.2028	0.2655	0.1441	0.1485	0.0835	0.1102
3	0.2431	0.3538	0.271	0.355	0.399	0.4363	0.384	0.353	0.3192	0.3539	0.3272
4	0.3358	0.2722	0.3178	0.346	0.4314	0.4271	0.5244	0.4619	0.4545	0.4988	0.7518
5	0.3479	0.3719	0.387	0.3713	0.3464	0.5936	0.5776	0.4445	0.5622	0.6408	0.7416
6	0.3195	0.2292	0.484	0.41	0.4215	0.5246	0.3239	0.4146	1.0908	0.6034	0.7625
7	0.3353	0.2918	0.3975	0.3769	0.401	0.517	0.4769	0.6204	0.852	0.8052	0.7907
+gp	0.3353	0.2918	0.3975	0.3769	0.401	0.517	0.4769	0.6204	0.852	0.8052	0.7907
0 FBAR 3- 6	0.3116	0.3068	0.365	0.3706	0.3996	0.4954	0.4525	0.4185	0.6067	0.5242	0.6458

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE											
2	0.1563	0.1144	0.1846	0.2116	0.131	0.2732	0.2203	0.2477	0.203	0.2352	0.2586
3	0.3286	0.3539	0.514	0.3962	0.3932	0.479	0.5096	0.5261	0.4732	0.3786	0.3532
4	0.6815	0.5287	0.6681	0.7328	0.6377	0.7668	0.652	0.8096	0.4434	0.4291	0.4324
5	0.719	0.5074	0.5728	0.5984	0.7338	0.7227	0.5798	1.0094	0.4169	0.2915	0.537
6	0.5669	0.78	0.6773	0.4232	0.7254	0.5337	0.535	0.9688	0.6051	0.3707	0.518
7	0.7796	1.026	0.7603	0.7603	0.5527	0.4736	0.5424	0.7654	0.7696	0.4198	0.4245
+gp	0.7796	1.026	0.7603	0.7603	0.5527	0.4736	0.5424	0.7654	0.7696	0.4198	0.4245
0 FBAR 3- 6	0.574	0.5425	0.608	0.5377	0.6225	0.6256	0.5691	0.8285	0.4847	0.3675	0.4602

YEAR	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	FBAR **-**
AGE											
2	0.2206	0.2594	0.1967	0.0923	0.095	0.0797	0.1163	0.2153	0.2679	0.1289	0.2041
3	0.4524	0.5106	0.5173	0.3592	0.3397	0.3231	0.3327	0.3677	0.4106	0.356	0.3781
4	0.4641	0.4663	0.5279	0.4289	0.5983	0.6619	0.4218	0.4339	0.3167	0.3628	0.3711
5	0.3884	0.4113	0.4151	0.5103	0.4112	0.2816	0.6359	0.5725	0.438	0.6494	0.5533
6	0.4314	0.3989	0.4647	0.5068	0.2708	0.2902	0.4394	0.4717	0.5878	0.3955	0.485
7	0.5127	0.5059	0.4828	0.4733	0.2324	0.2173	0.1589	0.19	0.4085	0.6067	0.4017
+gp	0.5127	0.5059	0.4828	0.4733	0.2324	0.2173	0.1589	0.19	0.4085	0.6067	
0 FBAR 3- 6	0.4341	0.4468	0.4812	0.4513	0.405	0.3892	0.4575	0.4615	0.4383	0.4409	

Table 7.9: Bay of Biscay Sole, Stock number-at-age (start of year) Numbers*10-3**

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE												
2	24161	29526	28343	24921	26744	28167	32107	35743	35347	24903	26230	23609
3	15413	16249	18637	19819	18940	19479	20808	22277	28002	27570	20728	21258
4	10268	10937	10321	12861	12573	11499	11393	12824	14162	18414	17511	13522
5	7278	6641	7538	6796	8234	7390	6788	6102	7311	8134	10118	7471
6	4474	4650	4143	4632	4242	5269	3694	3447	3540	3771	3878	4361
7	3247	2941	3346	2310	2781	2518	2821	2417	2061	1076	1866	1637
+gp	4344	3019	3944	2382	2428	1293	2401	2219	1731	1337	1330	1901
0 TOTAL	69186	73963	76272	73721	75943	75615	80012	85029	92154	85204	81661	73759

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE												
2	29429	23707	22578	24411	24963	16910	24907	24456	17109	18343	18771	17875
3	18272	23749	17836	16533	19376	17188	12276	17592	18063	12237	12816	13622
4	13848	11606	12853	10859	10096	10860	9342	6564	9917	11193	7777	7376
5	6189	7385	5384	5589	5193	4243	5119	3762	3812	5842	6572	4424
6	3294	3372	3768	2678	2428	2281	2150	1688	2243	2577	3090	4033
7	2238	1366	1550	2233	1173	1288	1209	738	834	1401	1389	1816
+gp	2142	1720	2330	2407	1232	1214	843	486	1017	1538	4010	2493
0 TOTAL	75413	72905	66299	64710	64462	53984	55847	55286	52996	53132	54425	51640

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	GMST 84-**	AMST 84-**
AGE											
2	18684	34100	24167	20808	12466	12547	15476	20110	(21322)	23430	24201
3	12478	13888	28134	19885	17386	10041	9154	10712	15995	17796	18352
4	7397	6731	8774	18126	13025	11279	6290	5494	6790	11081	11464
5	4187	3948	3966	4365	8461	7729	6613	4147	3458	5978	6199
6	2653	2502	2145	2379	2980	4053	3945	3862	1960	3219	3347
7	2449	1508	1364	1480	1610	1738	2288	1983	2353	1754	1880
+gp	3261	2665	1436	2771	3693	3850	1508	1333	1636		
0 TOTAL	51109	65341	69986	69813	59621	51239	45275	47640	32192		

( ) age 2 replaced by GM 93-2013 = 21322

Table 7.10: Bay of Biscay Sole, Summary (without SOP correction)

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR3-6
1984	24161	14814	12320	4038	0.3278	0.3116
1985	29526	16057	13365	4251	0.3181	0.3068
1986	28343	17068	14478	4805	0.3319	0.365
1987	24921	18654	15477	5086	0.3286	0.3706
1988	26744	18507	15356	5382	0.3505	0.3996
1989	28167	17779	14462	5845	0.4041	0.4954
1990	32107	18395	14819	5916	0.3992	0.4525
1991	35743	19092	14789	5569	0.3766	0.4185
1992	35347	20530	15976	6550	0.41	0.6067
1993	24903	19905	16379	6420	0.392	0.5242
1994	26230	19295	15854	7229	0.456	0.6458
1995	23609	17666	14251	6205	0.4354	0.574
1996	29429	17760	13833	5854	0.4232	0.5425
1997	23707	16498	13340	6259	0.4692	0.608
1998	22578	16475	13262	6027	0.4545	0.5377
1999	24411	15990	12357	5249	0.4248	0.6225
2000	24963	15547	11879	5760	0.4849	0.6256
2001	16910	13073	10596	4836	0.4564	0.5691
2002	24907	13200	9796	5486	0.56	0.8285
2003	24456	13370	9641	4108	0.4261	0.4847
2004	17109	14184	11190	4002	0.3576	0.3675
2005	18343	14485	11557	4539	0.3927	0.4602
2006	18771	15302	12220	4793	0.3922	0.4341
2007	17875	14272	11387	4363	0.3831	0.4468
2008	18684	14247	11328	4299	0.3795	0.4812
2009	34100	15984	11193	3650	0.3261	0.4513
2010	24167	17461	13221	3966	0.3	0.405
2011	20808	19078	15213	4632	0.3045	0.3892
2012	12466	17005	14548	4321	0.297	0.4575
2013	12547	15735	13316	4235	0.318	0.4615
2014	15476	12581	10134	3928	0.3876	0.4383
2015	20110	13111	9733	3641	0.3741	0.4409
Arith. Mean	23801	16347	13040	5039	0.3888	0.4851
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		
GM 93-2013 =	21322					

Table 7.11: Multifleet prediction input data

Sole in Bay of Biscay
Multi fleet input data

MFDP version 1a
Run: 2016_
Time and date: 17:01 16/05/2016
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input Fs are 2013-2015 means at age 3 to 8
Input Fs are 2013-2014 means at age 2
Catch and stock wts are 2013-2015 means
Recruits are 1993-2013 GM
unscaled F

2016

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	21322	0.1	0.32	0	0	0.207	0.2416	0.194
3	15152	0.1	0.83	0	0	0.251	0.3781	0.236
4	6790	0.1	0.97	0	0	0.309	0.3711	0.291
5	3458	0.1	1	0	0	0.323	0.5533	0.304
6	1960	0.1	1	0	0	0.389	0.4850	0.367
7	2353	0.1	1	0	0	0.451	0.4017	0.426
8	1636	0.1	1	0	0	0.565	0.4017	0.535

2017

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	21322	0.1	0.32	0	0	0.207	0.2416	0.194
3		0.1	0.83	0	0	0.251	0.3781	0.236
4		0.1	0.97	0	0	0.309	0.3711	0.291
5		0.1	1	0	0	0.323	0.5533	0.304
6		0.1	1	0	0	0.389	0.4850	0.367
7		0.1	1	0	0	0.451	0.4017	0.426
8		0.1	1	0	0	0.565	0.4017	0.535

2018

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	21322	0.1	0.32	0	0	0.207	0.2416	0.194
3		0.1	0.83	0	0	0.251	0.3781	0.236
4		0.1	0.97	0	0	0.309	0.3711	0.291
5		0.1	1	0	0	0.323	0.5533	0.304
6		0.1	1	0	0	0.389	0.4850	0.367
7		0.1	1	0	0	0.451	0.4017	0.426
8		0.1	1	0	0	0.565	0.4017	0.535

Input units are thousands and kg - output in tonnes

Table 7.12: Bay of Biscay Sole Multifleet prediction, management option table

MFDP version 1a	**Basis**
Run: 2016_	
Time and date: 17:01 16/05/2016	**F(2016) = mean F(13-14) unscaled (age 2)**
Fbar age range (Total) : 3-6	**F(2016) = mean F(13-15) unscaled (age 3 to above)**
Fbar age range Fleet 1 : 3-6	**R15 and R16 = GM (1993 to n-2) = 21.3 million**

2016

Biomass	SSB	Landings FMult	Landings FBar	Yield
14179	10468	1.0000	0.4469	3793

2017

2017 Biomass	2017 SSB	Landings FMult	Landings FBar	Landing Yield	2018 Biomass	2018 SSB
15045	11310	0.0000	0.0000	0	20257	16306
.	11310	0.1000	0.0447	477	19699	15772
.	11310	0.2000	0.0894	936	19161	15258
.	11310	0.3000	0.1341	1379	18644	14764
.	11310	0.4000	0.1788	1805	18146	14288
.	11310	0.5000	0.2234	2216	17667	13831
.	11310	0.6000	0.2681	2611	17205	13390
.	11310	0.7000	0.3128	2992	16761	12967
.	11310	0.8000	0.3575	3359	16333	12559
.	11310	0.9000	0.4022	3713	15920	12166
.	11310	1.0000	0.4469	4054	15523	11789
.	11310	1.1000	0.4916	4383	15141	11425
.	11310	1.2000	0.5363	4699	14773	11075
.	11310	1.3000	0.5809	5005	14418	10738
.	11310	1.4000	0.6256	5299	14076	10413
.	11310	1.5000	0.6703	5583	13747	10101
.	11310	1.6000	0.7150	5857	13429	9800
.	11310	1.7000	0.7597	6121	13124	9510
.	11310	1.8000	0.8044	6375	12829	9230
.	11310	1.9000	0.8491	6621	12545	8961
.	11310	2.0000	0.8938	6858	12271	8702

Bpa = 10600 t
Fpa = 0.43

Input units are thousands and kg - output in tonnes

Table 7.13: Bay of Biscay sole - Detailed predictions

MFDP version 1a
Run: 2016_
Time and date: 17:01 16/05/2016
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Year: 2016 F multiplier: 1 Fleet1 HCFba 0.4469

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.2416	4364	848	21322	4414	6823	1412	6823	1412
3	0.3781	4554	1076	15152	3803	12576	3157	12576	3157
4	0.3711	2010	584	6790	2096	6586	2033	6586	2033
5	0.5533	1405	428	3458	1118	3458	1118	3458	1118
6	0.485	720	264	1960	763	1960	763	1960	763
7	0.4017	743	316	2353	1060	2353	1060	2353	1060
8	0.4017	517	276	1636	925	1636	925	1636	925
Total		14312	3793	52671	14179	35393	10468	35393	10468

Year: 2017 F multiplier: 1 Fleet1 HCFba 0.4469

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.2416	4364	848	21322	4414	6823	1412	6823	1412
3	0.3781	4554	1076	15152	3803	12576	3157	12576	3157
4	0.3711	2780	808	9394	2900	9112	2813	9112	2813
5	0.5533	1722	524	4239	1371	4239	1371	4239	1371
6	0.485	661	242	1799	701	1799	701	1799	701
7	0.4017	345	147	1092	492	1092	492	1092	492
8	0.4017	763	408	2415	1365	2415	1365	2415	1365
Total		15188	4054	55413	15045	38057	11310	38057	11310

Year: 2018 F multiplier: 1 Fleet1 HCFba 0.4469

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.2416	4364	848	21322	4414	6823	1412	6823	1412
3	0.3781	4554	1076	15152	3803	12576	3157	12576	3157
4	0.3711	2780	808	9394	2900	9112	2813	9112	2813
5	0.5533	2382	725	5864	1896	5864	1896	5864	1896
6	0.485	810	297	2206	859	2206	859	2206	859
7	0.4017	317	135	1002	452	1002	452	1002	452
8	0.4017	671	359	2124	1201	2124	1201	2124	1201
Total		15878	4248	57064	15523	39707	11789	39707	11789

Input units are thousands and kg - output in tonnes

Table 7.14: 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	2011	2012	2013	2014	2015	2016
Stock No. (thousands) of 2 year-olds	12547	15476	20110	21322	21322	21322
Source	XSA	XSA	XSA	GM93-2013	GM93-2013	GM93-2013
Status Quo F:						
% in 2016 landings	11.3	15.4	28.4	22.4	-	-
% in 2017	6.0	12.9	19.9	26.5	20.9	-
% in 2016 SSB	10.7	19.4	30.2	13.5	-	-
% in 2017 SSB	6.2	12.1	24.9	27.9	12.5	-
% in 2018 SSB	3.8	7.3	16.1	23.9	26.8	12.0

GM : geometric mean recruitment

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

a) 2017 landings **b) 2018 SSB**

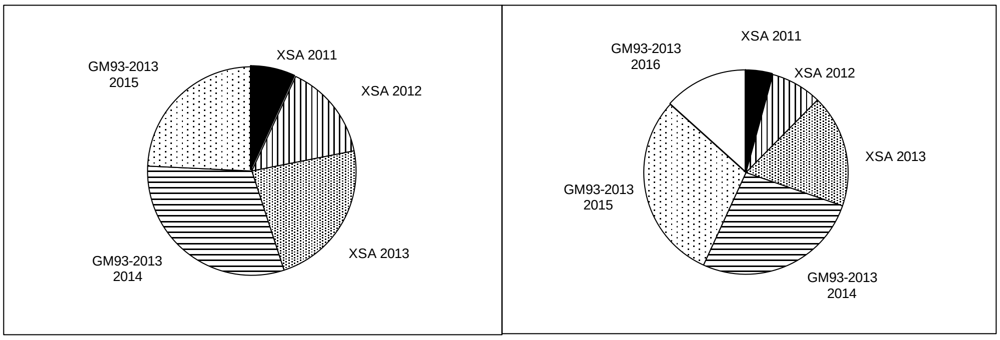


Table 7.15a: Bay of Biscay Sole Multifleet Yield-per-recruit

MFYPR version 2a
Run: 2016_
Time and date: 17:06 16/05/2016
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	4.7210	9.6499	4.5341	9.6499	4.5341
0.1000	0.0447	0.2828	0.1134	7.6838	3.1902	6.8306	3.0046	6.8306	3.0046
0.2000	0.0894	0.4380	0.1646	6.1348	2.3732	5.2865	2.1889	5.2865	2.1889
0.3000	0.1341	0.5357	0.1900	5.1609	1.8750	4.3175	1.6921	4.3175	1.6921
0.4000	0.1788	0.6027	0.2031	4.4942	1.5450	3.6553	1.3633	3.6553	1.3633
0.5000	0.2234	0.6515	0.2097	4.0099	1.3134	3.1756	1.1329	3.1756	1.1329
0.6000	0.2681	0.6885	0.2129	3.6427	1.1438	2.8127	0.9645	2.8127	0.9645
0.7000	0.3128	0.7176	0.2141	3.3547	1.0154	2.5289	0.8371	2.5289	0.8371
0.8000	0.3575	0.7411	0.2142	3.1226	0.9154	2.3009	0.7382	2.3009	0.7382
0.9000	0.4022	0.7605	0.2137	2.9316	0.8358	2.1138	0.6596	2.1138	0.6596
1.0000	0.4469	0.7768	0.2128	2.7714	0.7711	1.9574	0.5959	1.9574	0.5959
1.1000	0.4916	0.7907	0.2119	2.6351	0.7177	1.8247	0.5435	1.8247	0.5435
1.2000	0.5363	0.8027	0.2108	2.5174	0.6729	1.7106	0.4997	1.7106	0.4997
1.3000	0.5809	0.8132	0.2098	2.4148	0.6349	1.6114	0.4625	1.6114	0.4625
1.4000	0.6256	0.8225	0.2088	2.3243	0.6022	1.5243	0.4307	1.5243	0.4307
1.5000	0.6703	0.8308	0.2078	2.2439	0.5738	1.4472	0.4032	1.4472	0.4032
1.6000	0.7150	0.8382	0.2069	2.1720	0.5489	1.3783	0.3791	1.3783	0.3791
1.7000	0.7597	0.8449	0.2060	2.1071	0.5269	1.3165	0.3579	1.3165	0.3579
1.8000	0.8044	0.8510	0.2052	2.0482	0.5074	1.2606	0.3391	1.2606	0.3391
1.9000	0.8491	0.8566	0.2045	1.9946	0.4898	1.2098	0.3223	1.2098	0.3223
2.0000	0.8938	0.8617	0.2038	1.9455	0.4739	1.1635	0.3072	1.1635	0.3072

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.4469
FMax	0.7602	0.3397
F0.1	0.3060	0.1367
F35%SPR	0.3280	0.1466

Weights in kilograms

Table 7.15b: Bay of Biscay Sole Multifleet Yield-per-recruit (Long-term equilibrium)

Long-term equilibrium at F status quo

landings	SSB
Yield * GM	SSBSpwn * GM
4537	12706

GM (93-12) for recruits (age 2)
21322

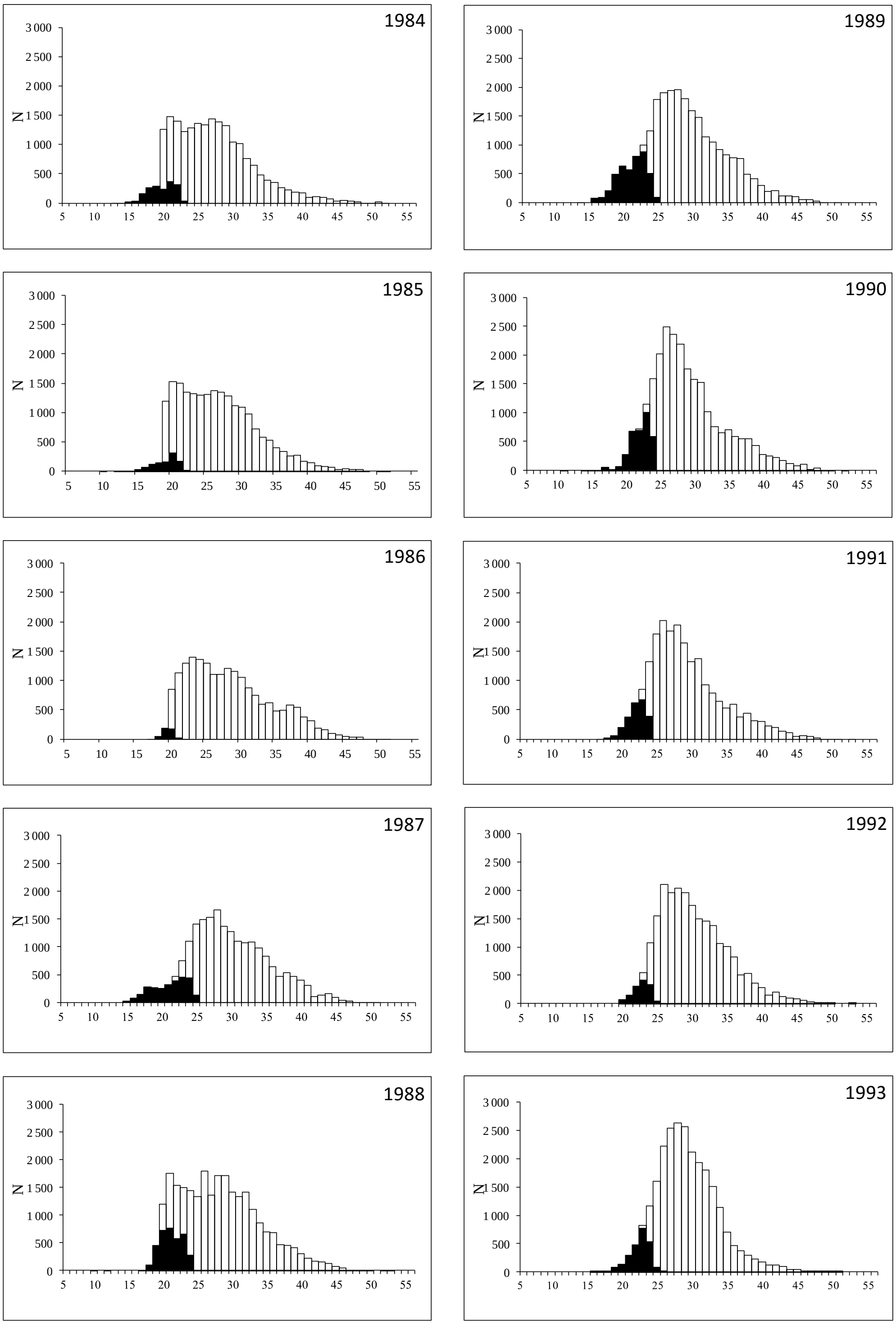


Figure 7.1 a: Bay of Biscay sole French length distribution from 1984 to 1993

Total French landings
Discard estimates of the French offshore trawlers fleet

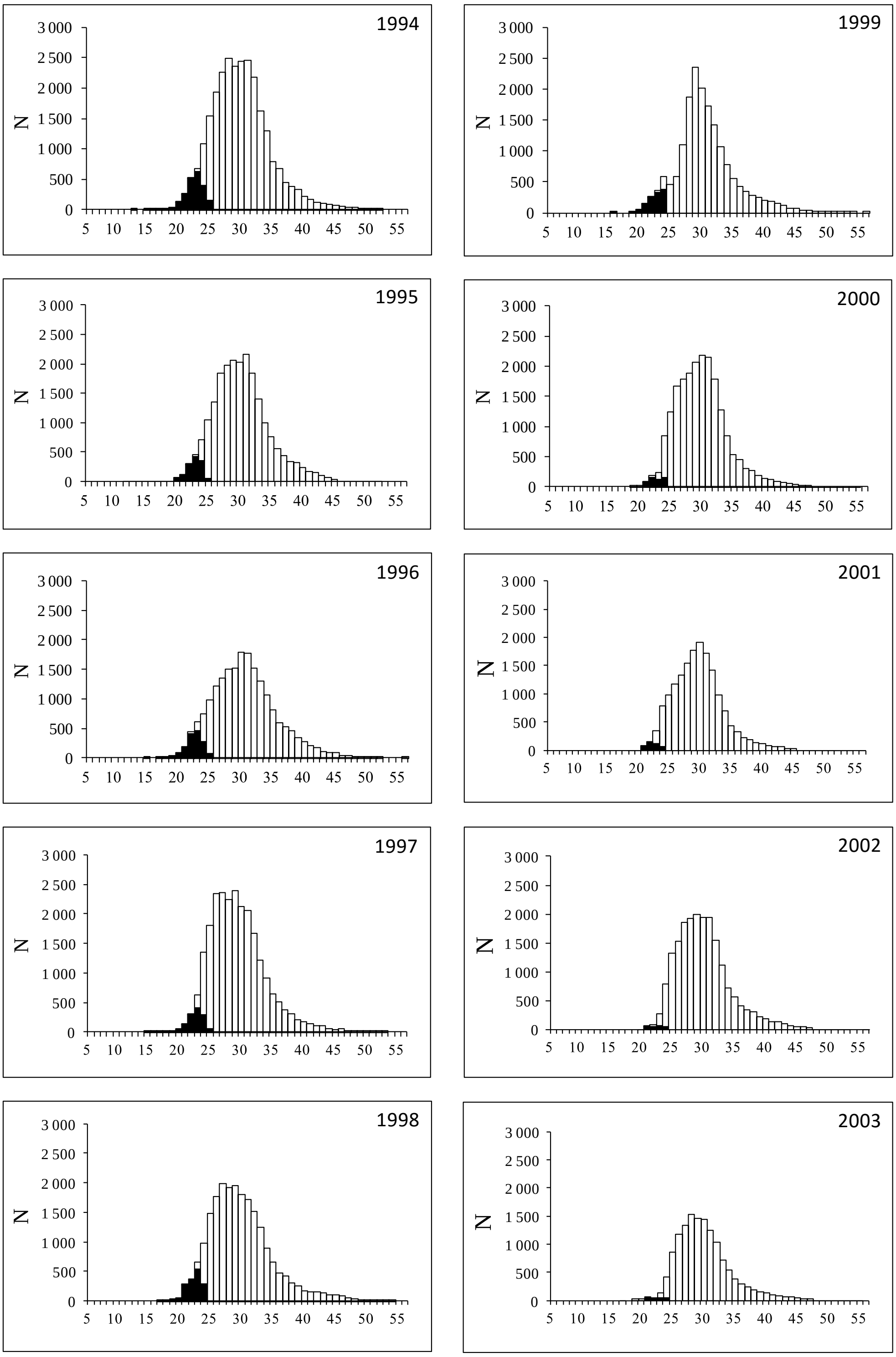


Figure 7.1 b: **Bay of Biscay sole French length distribution from 1994 to 2003**

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

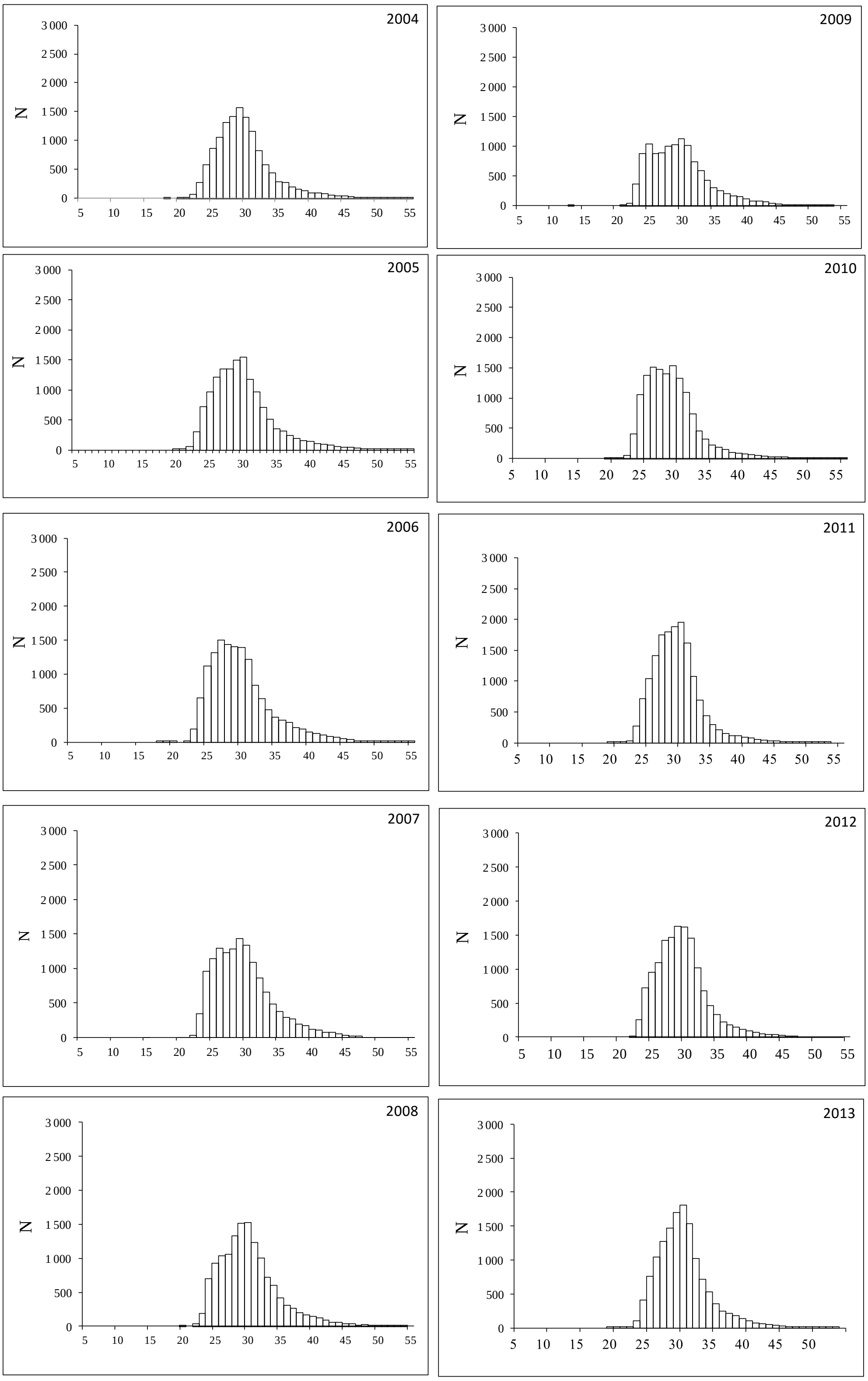


Figure 7.1 c: Bay of Biscay sole French length distribution from 2004–2013

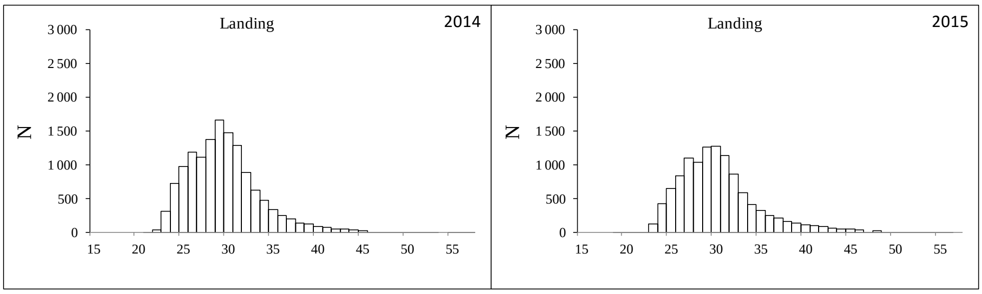


Figure 7.1 d: Bay of Biscay sole French 2014 and 2015 length distribution

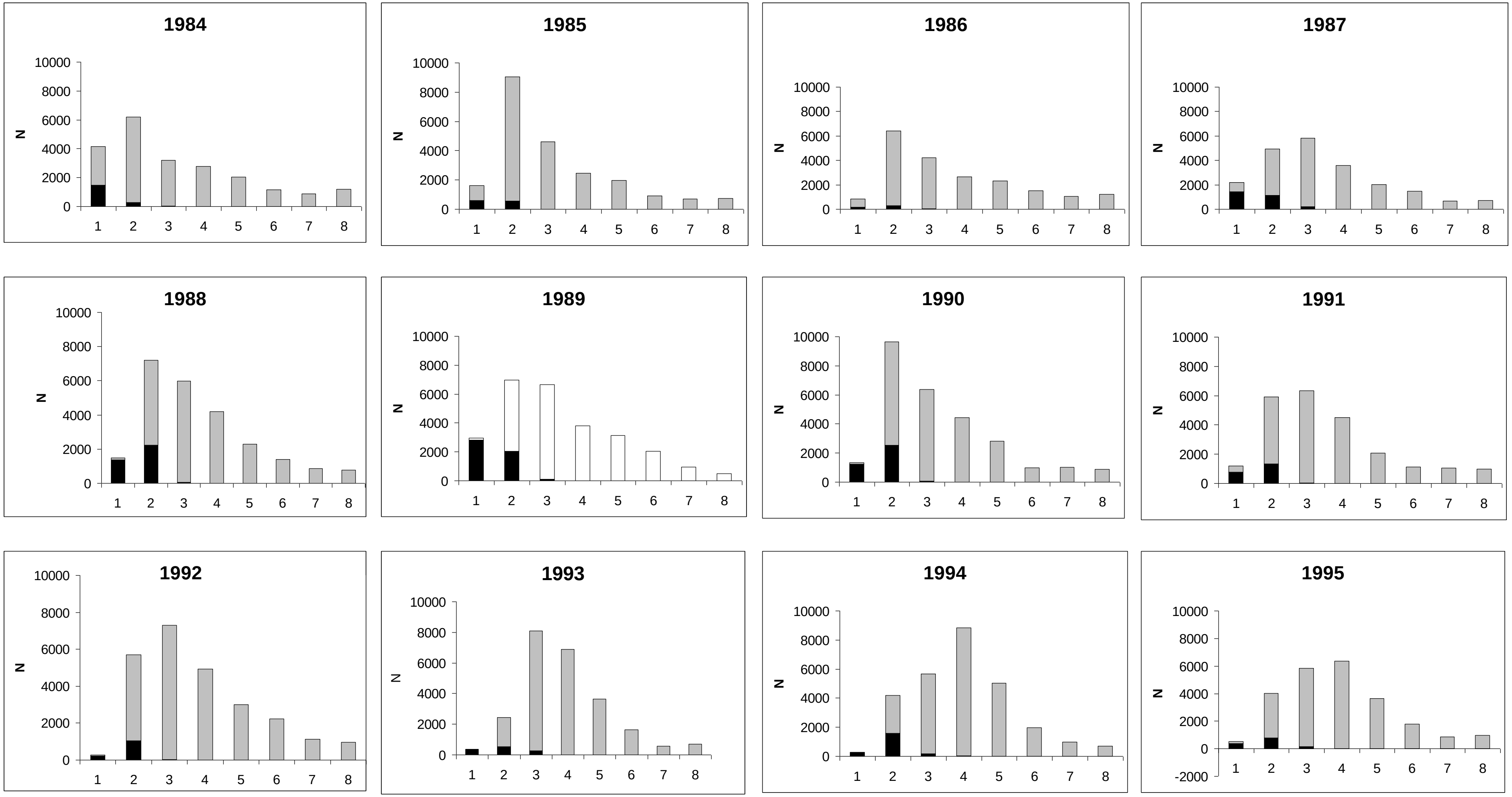


Figure 7.2 a: Bay of Biscay sole landings and discards age distributions from 1984–1995 (numbers in thousand)

Total landings
Discard estimates of the French offshore trawlers fleet

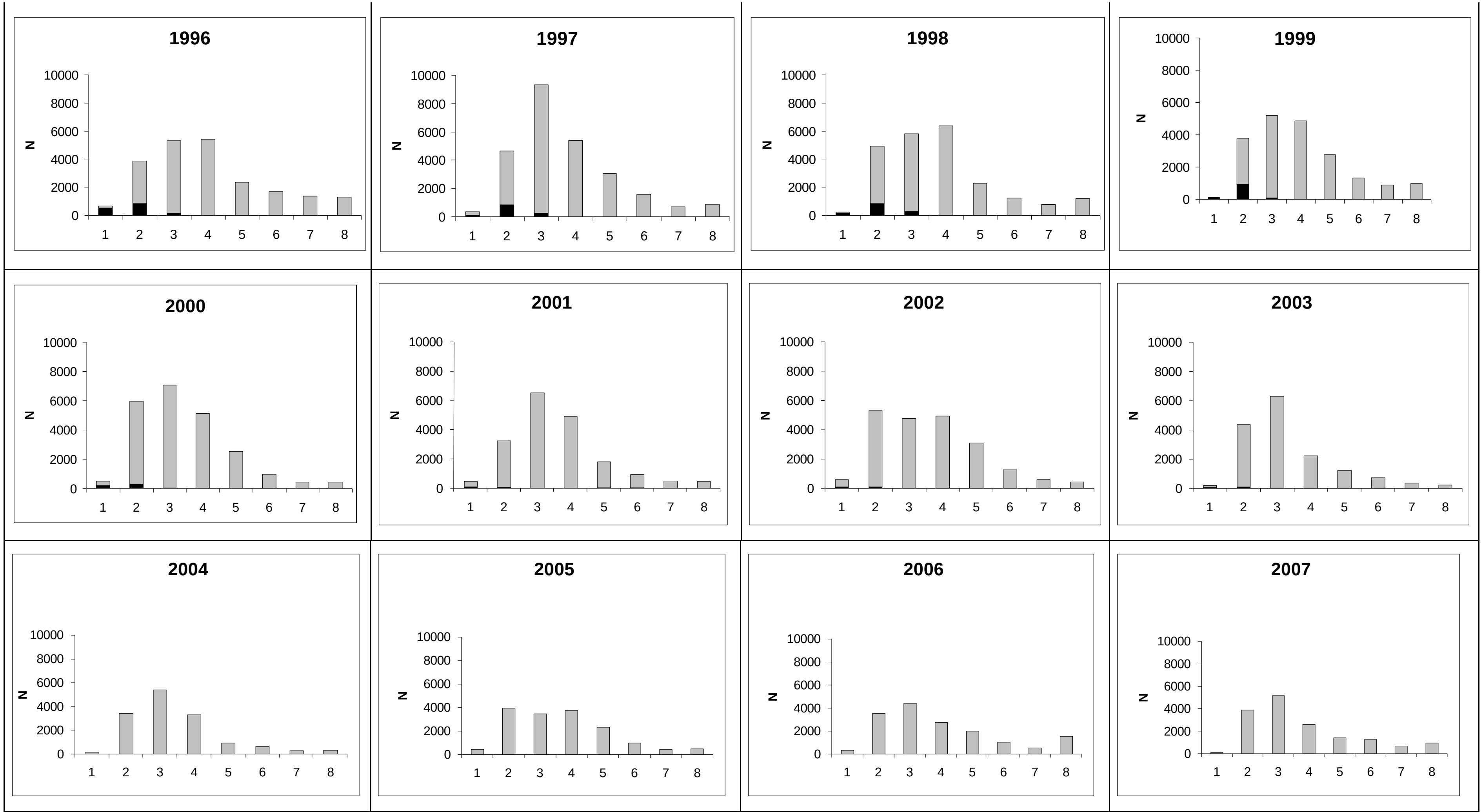


Figure 7.2 b: Bay of Biscay sole landings and discards age distributions from 1996–2007 (numbers in thousand)

Total landings
Discard estimates of the French offshore trawlers fleet

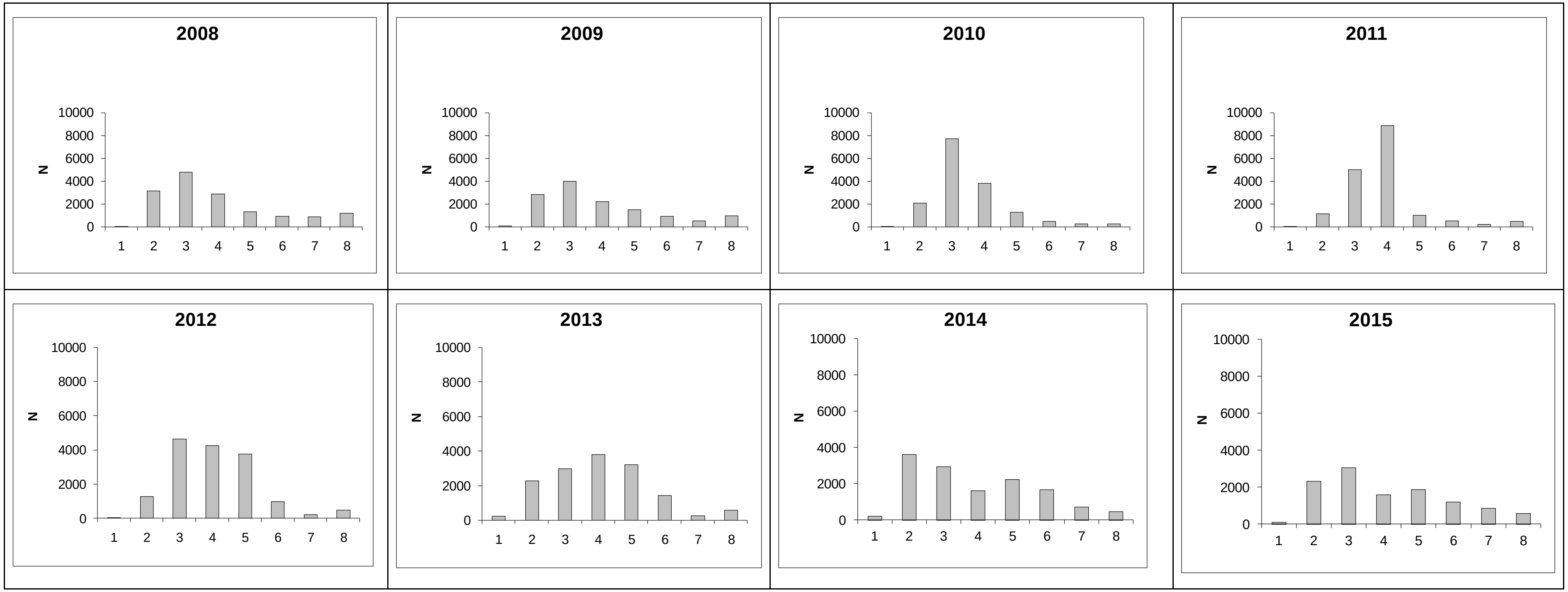


Figure 7.2 c: Bay of Biscay sole landings and discards age distributions from 2008–2015

(numbers in thousand)

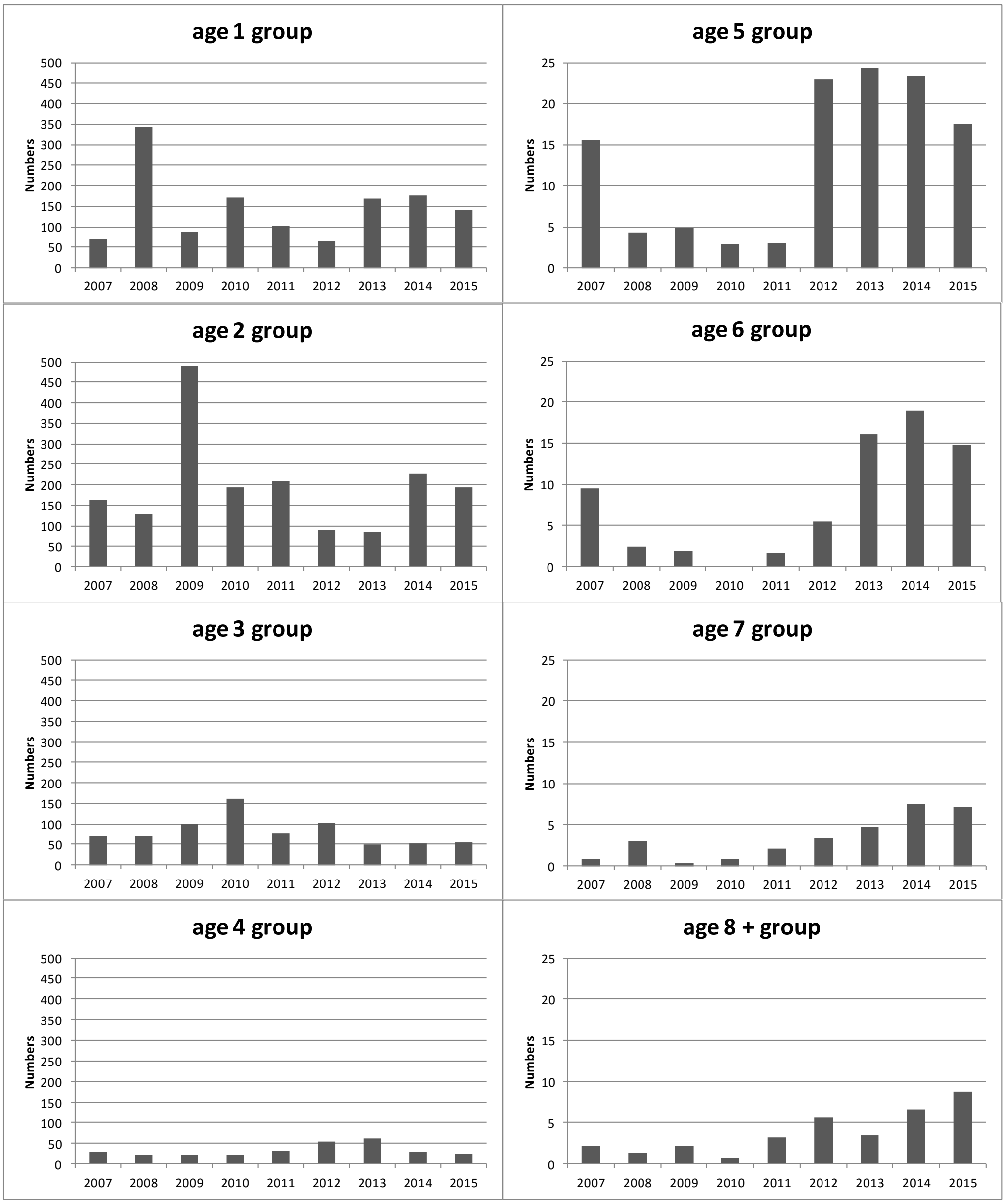


Figure 7.3: Orhago survey time-series

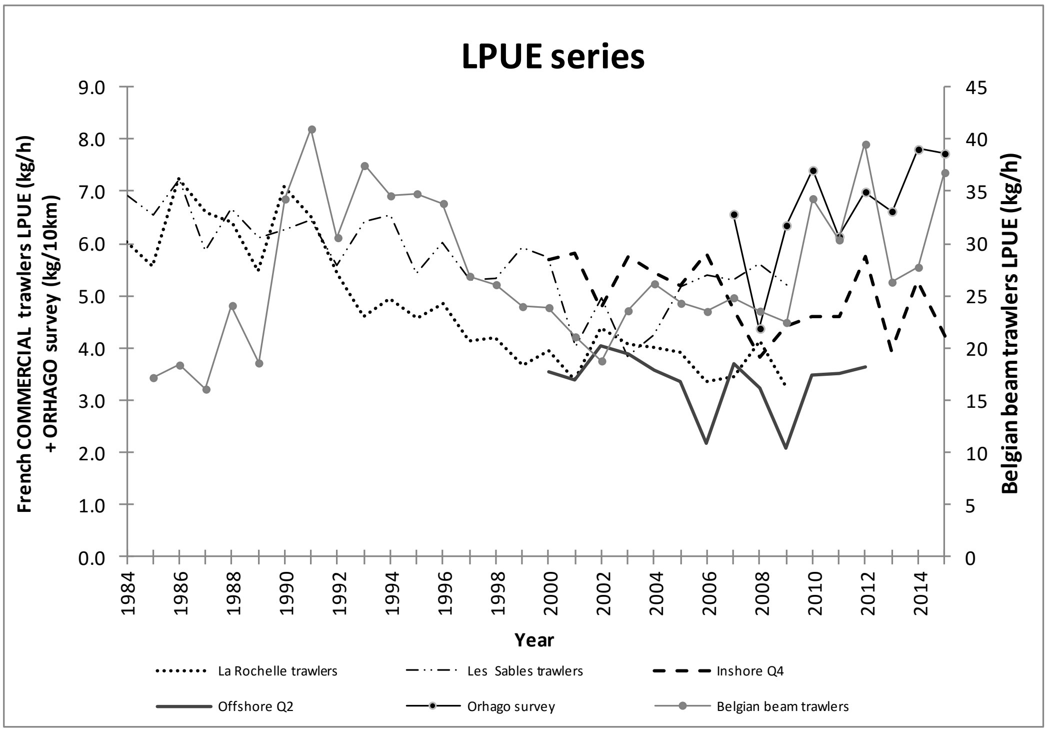
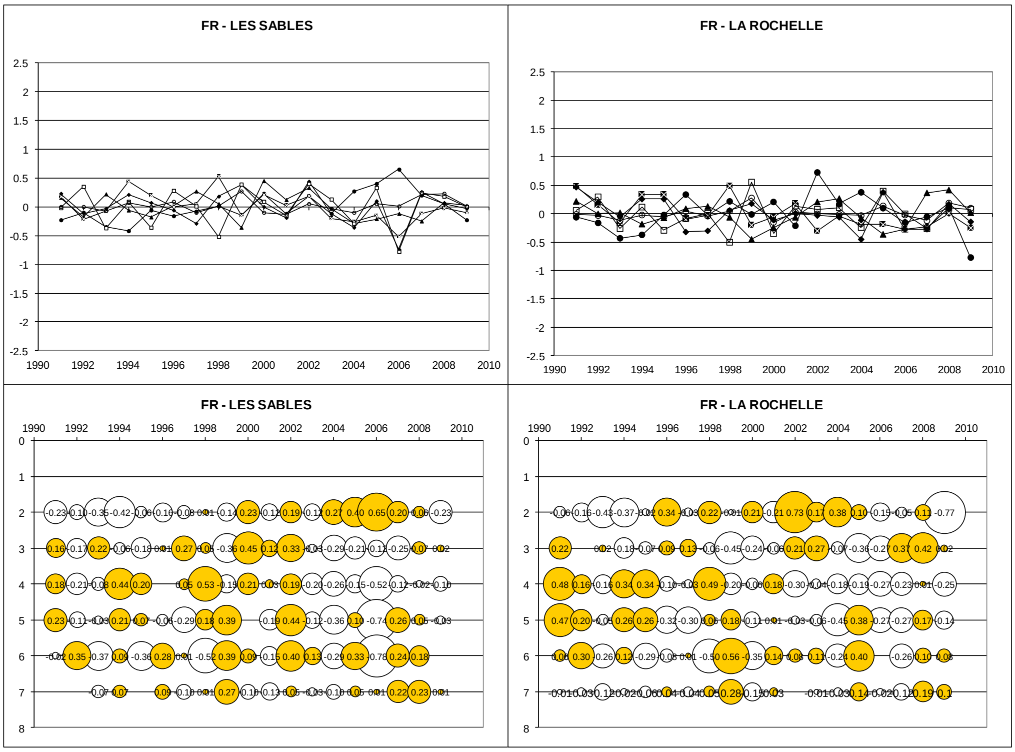
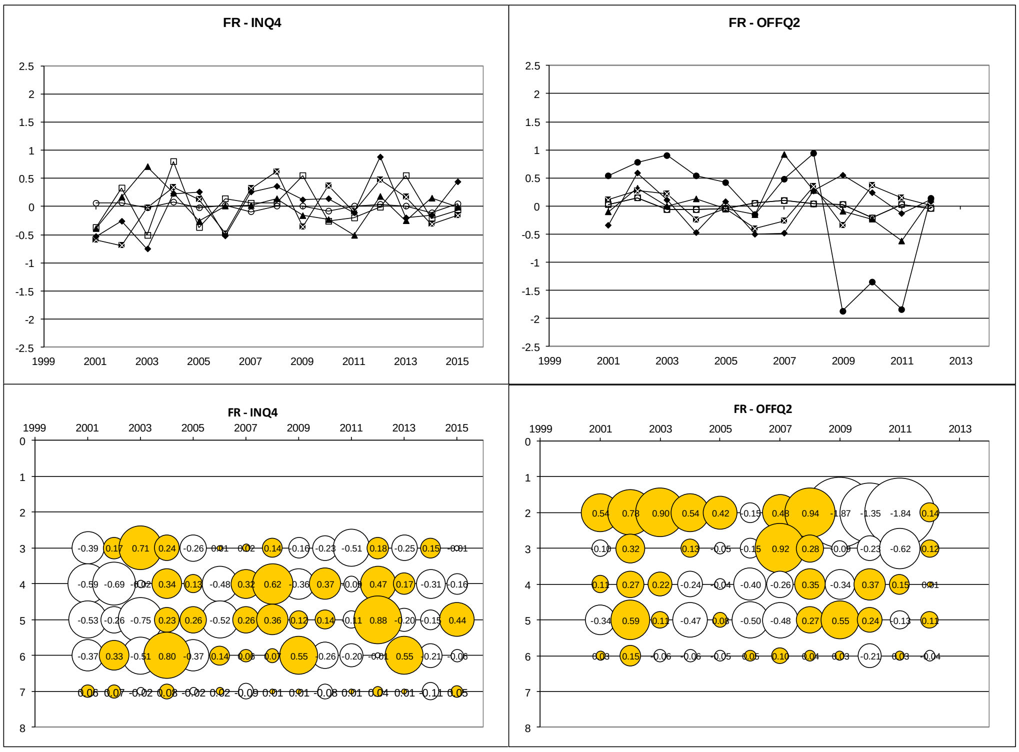


Figure 7.4: Bay of Biscay sole (Division 8.a,b). LPUE trends of the 5 available commercial tuning fleets and cpue of the ORHAGO survey (for sole greater than the minimum landing size, i.e. 24 cm)

LOG-CATCHABILITY RESIDUAL PLOTS (XSA)





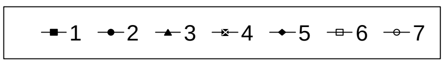


Figure 7.5a: Bay of Biscay sole (Division 8.a,b)

XSA (No Taper, mean q, s.e. shrink = 2.5, s.e. min = .2)

LOG-CATCHABILITY RESIDUAL PLOTS (XSA)

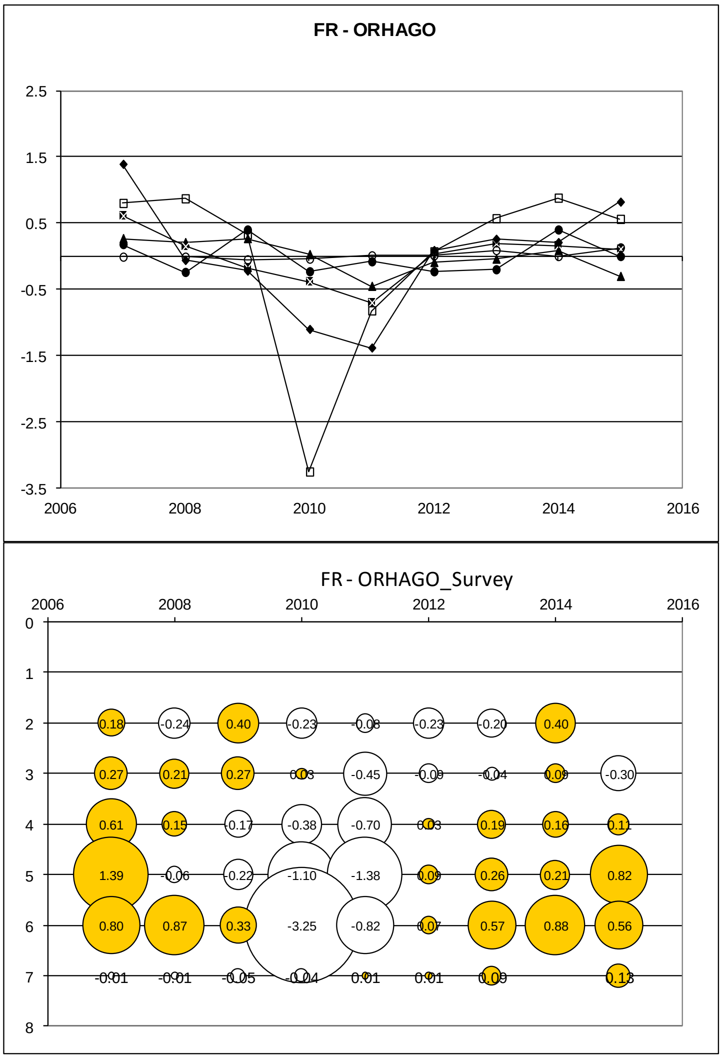
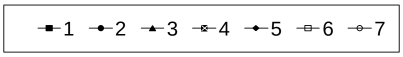


Figure 7.5b: Bay of Biscay sole (Division 8.a,b)



XSA (No Taper, mean q, s.e. shrink = 2.5, s.e. min = .2)

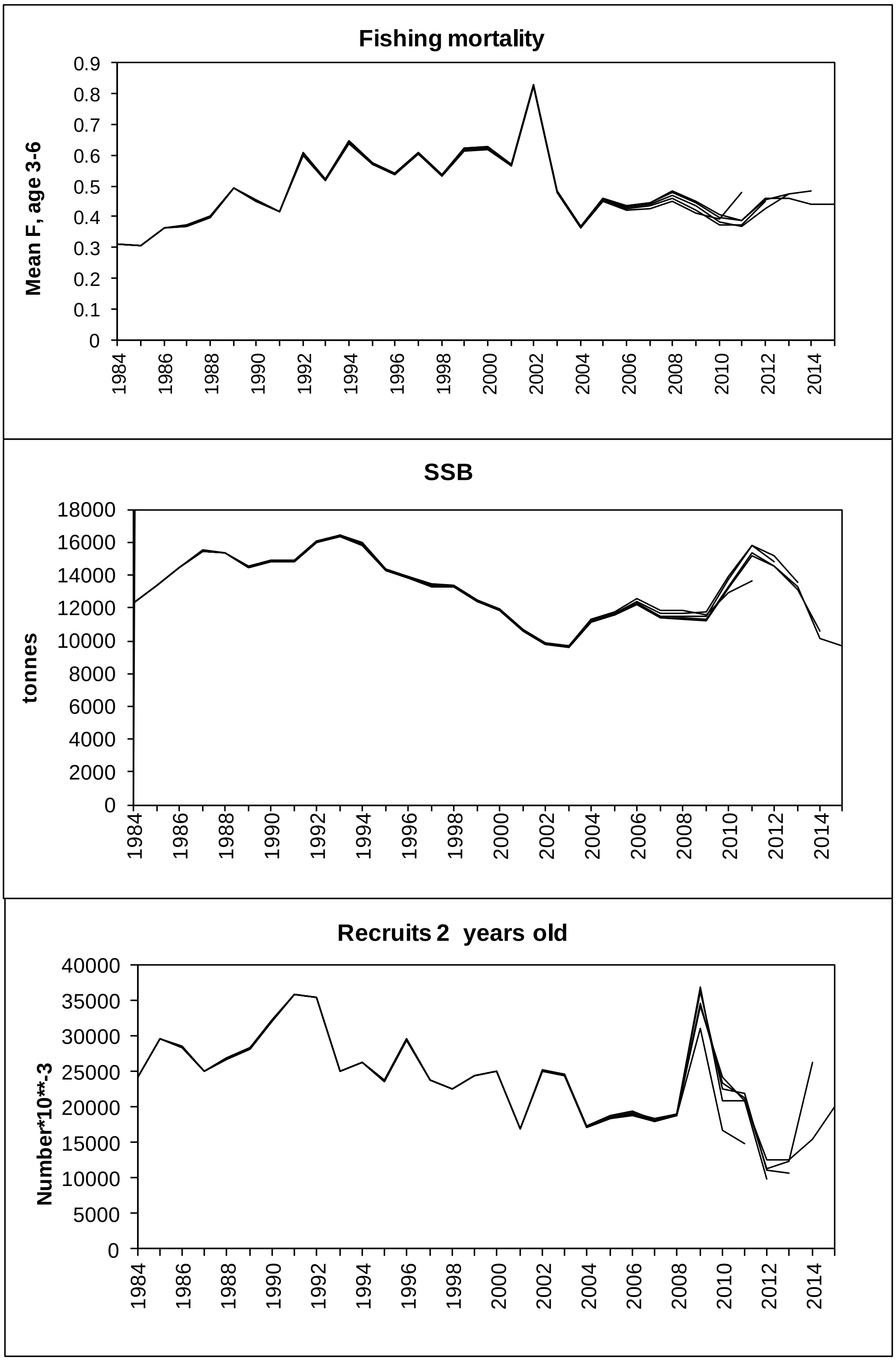


Figure 7.6: Bay of Biscay sole (Division 8.a,b) - Retrospective results

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

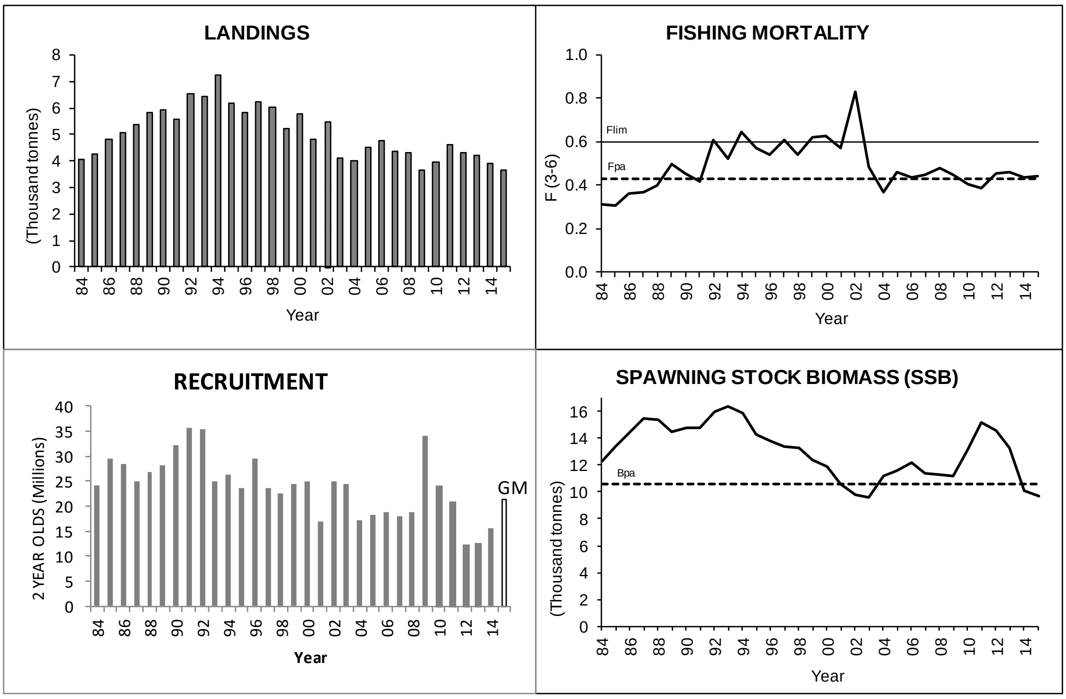
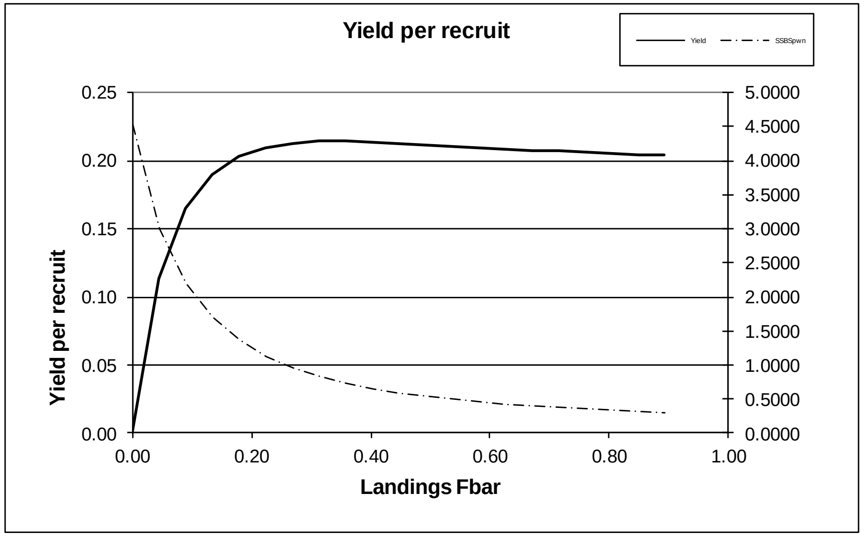
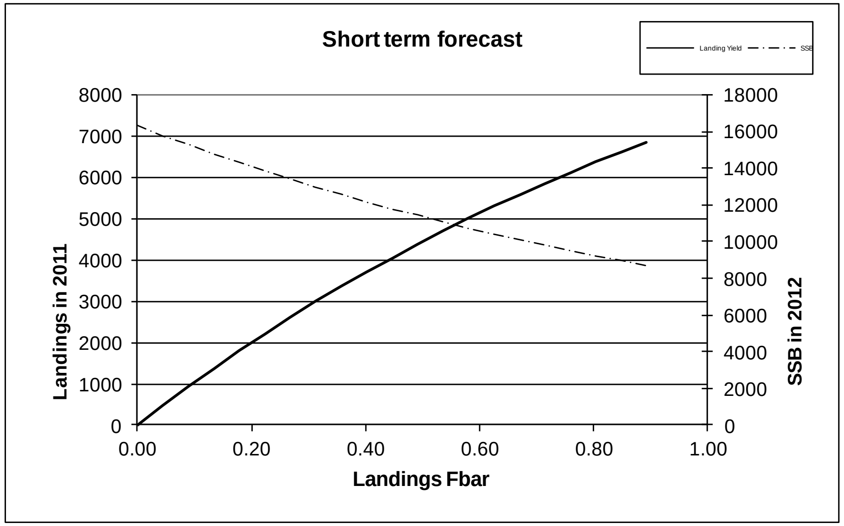


Figure 7.7: Sole in Division 8.a,b (Bay of Biscay) – Trends for Landings, F, R, SSB





MFYPR version 2a
Run: 2016_
Time and date: 17:06 16/05/2016

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.4469
FMax	0.7602	0.3397
F0.1	0.3060	0.1367
F35%SPR	0.3280	0.1466

Weights in kilograms

MFDP version 1a
Run: 2016_
Time and date: 17:01 16/05/2016
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input units are thousands and kg - output in tonnes

Figure 7.8: Sole in Division 8.a,b (Bay of Biscay)

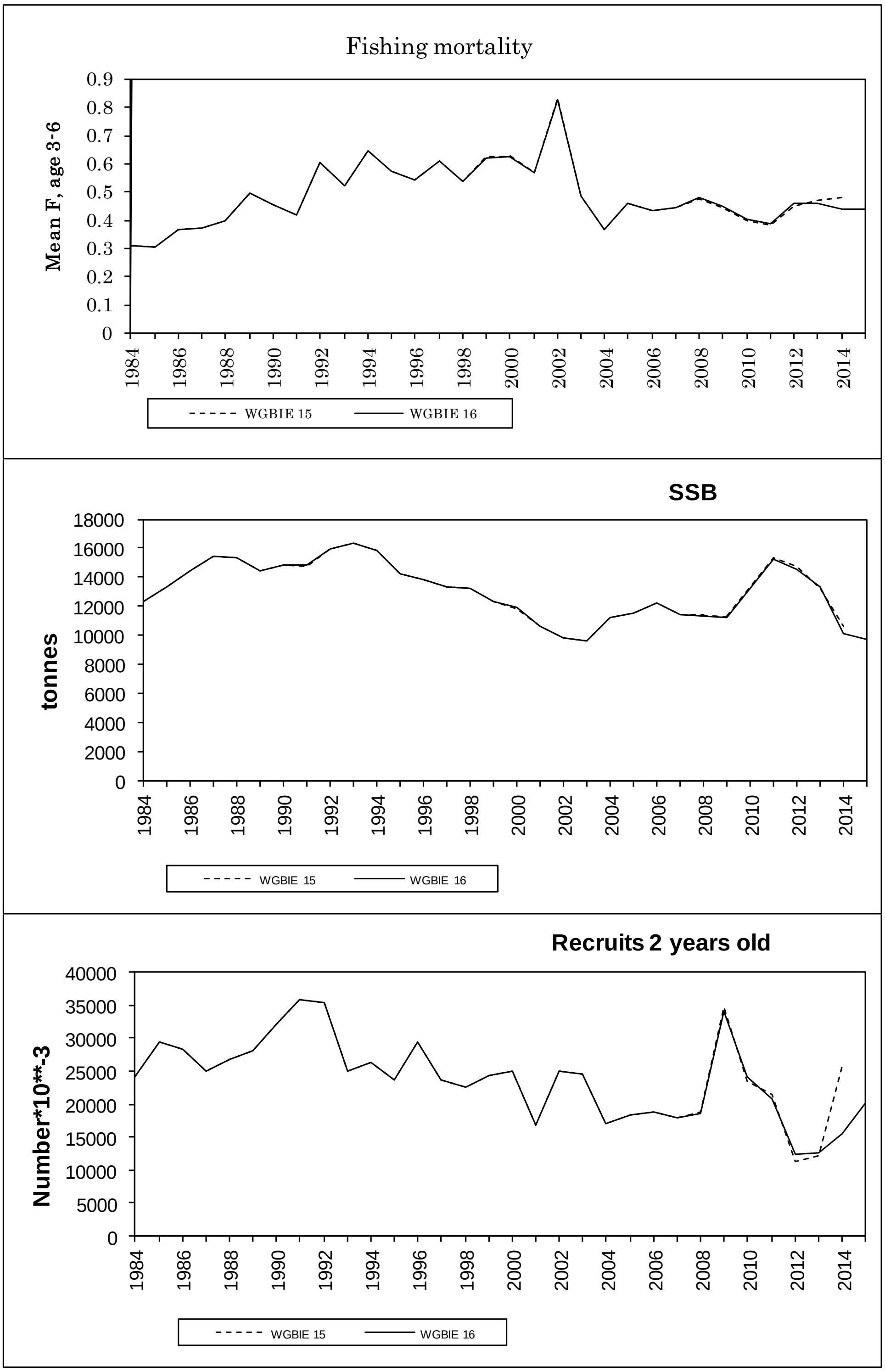


Figure 7.9: Bay of Biscay sole (Division 8.a,b) - WG15 / WG16 comparison

8 Sole (*Solea solea*) in Divisions 8.c and 9.a

8.1 General biology

Common sole (*Solea solea*) spawning takes place in winter/early spring and varies with latitude starting earlier in the south (Vinagre, 2007). Larvae migrate to estuaries where juveniles concentrate until they reach approximately 2 years of age and move to deeper waters. In Portuguese waters, sole length of first maturity is estimated as 25cm for males and 27 cm for females (Jardim, *et al.*, 2011). Sole is a nocturnal predator and therefore more susceptible to be captured by fisheries at night than in daytime. It feeds on polychaetes, molluscs and amphipods. S. *solea* is abundant in the Tagus estuary and uses this habitat as its nursery ground (Cabral and Costa, 1999).

Recent growth studies based on S. *solea* otolith readings in the Portuguese coast indicate Linf of 52.1cm for females and 45.7cm for males. The growth coefficient (k) estimate of females (K=0.23) was slightly higher than for males (k=0.21) and to -0.11 and 1.57 for females and males respectively (Teixeira and Cabral, 2010). Maximum length observed between 2004 and 2011 from the landings sampling program (PNAB-DCF) attained 60cm. According to Vinagre (2007) S. *solea* off the Portuguese coast presents higher growth rates compared with the northern European coasts.

8.2 Stock identity and possible assessment areas;

There is no clear information to support the definition of the common sole stock for ICES Subdivision 8.c and 9.a.

8.3 Management regulations (TACs, minimum landing size)

The minimum landing size of sole is 24 cm. There are other regulations regarding the mesh size for trammel and trawlnets, fishing grounds and vessel's size. A precautionary TAC is in place for *Solea spp*. in ICES divisions 8.ce, subareas 9 and 10.

8.4 Fisheries data

Table 8.11 presents all soles species for the official landings and ICES estimates by country, for Division 8.c and 9.a. There is evidence of *solea* species misclassification for Portuguese landings in Division 9.a, which means *solea solea* official landings might not correspond only to this species but a mix of species including *Solea senegalensis*. Using port sampling length data, it was possible to separate the *solea* complex **a**nd apply the proportions to provide a raised landings total for: *Solea solea***,** S. *senegalensis* and *Pegusa lascaris*, for Portuguese landings in Division 9.a (Borges, et al**.,** 2014).

Landings length compositions for *Solea solea* are presented for the Portuguese area (Figure 8.12) (Borges, *et al.*, 2014).

Based on the DCF discard sampling in Portugal discards for Sole (Solea solea) are considered negligible and only occur due to the minimum landing size or damaged specimens.

8.5 Survey data, recruit series

Solea solea may be found along the Portuguese coast mainly from very shallow waters and estuaries up to 100 m depth. This species is rarely caught in the existing Portuguese bottom-trawl research surveys (Jardim *et al.,* 2011). In order to monitor this sole species a dedicated independent research survey is necessary.

8.6 Biological sampling

Existing biological sampling is based on fishery data from commercial vessel landings.

8.7 Population biology parameters and a summary of other research

Solea solea maturity ogives by sex, length-weight relationship, sex-ratio by length are based on port sampling and are available from 2012 for Division 9.a (Jardim, *et al.*, 2011).

8.8 General problems

Solea solea (SOL) is officially reported to ICES and provided by Spain and Portugal and to the EWG in INTERCATCH by Division. For the other sole species known to be distributed in 8.c and 9.a *Pegusa lascaris* and *Solea senegalensis* the information is only partially available in the official catches reported to ICES. Therefore, further work is necessary to revise the database of sole species.

8.9 References

Borges, M.F., Moreira, A., Alcoforado, B., 2014. Sole (*Solea solea*) in Portuguese waters (Div. IXa). Working Document to WGNEW 2014.

Cabral H. and Costa, M.J. 1999. Differential use of nursery areas within the Tagus estuary by sympatric soles, *Solea solea* and *Solea senegalensis*. *Environmental Biology of Fishes* 56: 389_397,1999

Jardim, E., Alpoim, R., Silva, C., Fernandes, A.C, Chaves, C., Dias, M., Prista, N., Costa, A.M., 2011. Portuguese data of sole, plaice, whiting and pollock provided to WGHMM in 2011. Working document to WGNEW 2012.

Teixeira, C M., and Cabral, H.N., 2010. Comparative analysis of the diet, growth and reproduction of the soles, *Solea, solea* and *Solea senegalensis*, occurring in sympatry along the Portuguese coast. *Journal of the Marine Biological Association of the UK*, 2010,90(5), 995_1003.

Vinagre C.M.B. 2007. Ecology of the juveniles of the soles, *Solea solea* (Linnaeus, 1758) and *Solea senegalensis* Kaup, 1858, in the Tagus estuary. Tese de Doutoramento em Biologia, especialidade Biologia Marinha e Aquacultura. 214 p.

Table 8.11. Sole in Divisions 8.c and 9.a. Official landings and ICES estimates of soles: *Solea solea, Pegusa Lascaris, Solea senegalensis* and unsorted *solea* (*Solea* spp.) (in tonnes).

Year	S. solea	P. lascaris *	S. senegalensis	Solea spp**	Total
2000	159	117		741	1017
2001	189	142		653	984
2002	115	98		508	721
2003	116	99		670	885
2004	171	120		668	959
2005	520	139		446	1105
2006	467	89		203	759
2007	380	55		180	615***
2008	454	80		211	745***
2009	450	138		199	787***
2010	581	161		283	1025***
2011	644	173		86	903***
2012	589	104		39	732***
2013	687	152		34	873***
2014##	681	107		41	829***
2015##	646	70		43	759***

** For *Solea* spp. (*S. solea, S. senegalensis, and Pegusa lascaris*).

*** Spanish and Portuguese data included for Division 8c and 9a.

Portuguese landings only (DGRM).

Preliminary

The compilation of official landings statistics are ambiguous and requires further work.

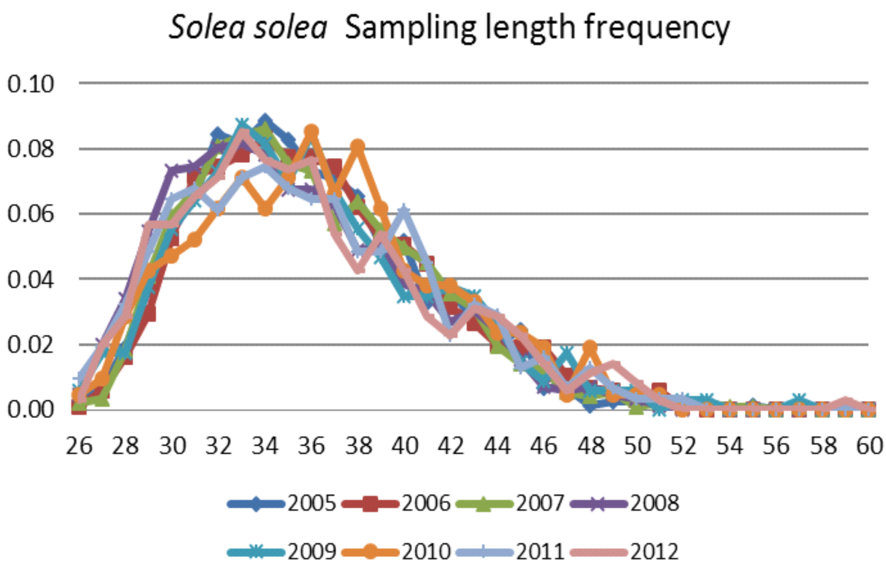


Figure 8.11- Division 9.a (Portugal. *Solea solea* sampling length frequency from all métiers harbour sampling DCF-IPMA.

9 Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock)

Type of assessment: update (stock benchmarked in 2014), stock on observation list. **Data revisions**: Yearly length frequency distributions since 2013, total landings of French *nephrops* trawlers in area 8.a,b,d in 2014 and total discards in OTHER fleet in 2014. **Review Group issues:** They suggested including all the discards in the assessment model.

9.1 General

9.1.1 Stock definition and ecosystem aspects

This section is described in the Stock Annex.

9.1.2 Fishery description

The general description of the fishery is now presented in the Stock Annex.

9.1.3 Summary of ICES advice for 2016 and management for 2015 and 2016

ICES advice for 2016

The stock was considered to be above any potential MSY $B_{trigger}$. Following the ICES MSY framework implied fishing mortality to be reduced to 0.27, resulting in landings of 96 651 tonnes and total catches of 109 592 tonnes in 2016.

Like the main stocks of the EU, the Northern hake stock is managed by a TAC and quotas. The TACs for recent years are presented below:

TAC (T)	2010	2011	2012	2013	2014	2015	2016
3.a, 3.b,c,d (EC Zone)	1661	1661	1661	2093	2466	2738	2997
2.a (EC Zone), 4	1935	1935	1935	2438	2874	3190	3492
5.b (EC Zone), 6, 7, 12, 14	30900	30900	30900	38938	45896	50944	61902
8.a,b,d,e	20609	20609	20609	25970	30610	33977	40393
Total Northern Stock [2.a-8.abd]	55105	55105	55105	69 440	81846	90849	108784

Management for 2015 and 2016

The minimum legal sizes for fish caught in Sub areas 4-6-7 and 8 is set at 27 cm total length (30cm in Division 3.a) since 1998 (Council Reg. no 850/98).

From 14th of June 2001, an Emergency Plan was implemented by the Commission for the recovery of the Northern hake stock (Council Regulations N°1162/2001, 2602/2001 and 494/2002). In addition to a TAC reduction, 2 technical measures were implemented. A 100 mm minimum mesh size has been implemented for otter trawlers when hake comprises more than 20% of the total amount of marine organisms retained onboard. This measure did not apply to vessels less than 12 m in length and which return to port within 24 hours of their most recent departure. Furthermore, two areas have been defined, one in Sub area 7 and the other in Sub area 8, where a 100 mm minimum mesh size is required for all otter trawlers, whatever the amount of hake caught.

There are explicit management objectives for this stock under the EC Reg. No 811/2004 implementing measures for the recovery of the northern hake stock. It is aiming at increasing the quantities of mature fish to values equal to or greater than 140 000t. This is to be achieved by limiting fishing mortality to 0.25 and by allowing a maximum change in TAC between years of 15%.

According to ICES advice for 2012, due to the new perspective of historical stock trends, resulting from the new assessment, the previously defined precautionary reference points are no longer appropriate. In particular, the absolute levels of spawning biomass, fishing mortality, and recruitment have shifted to different scales. As a consequence, the TAC corresponding to the current recovery plan (EC Reg. No. 811/2004) should not be considered, because the plan uses target values based on precautionary reference points that are no longer appropriate.

The initial TAC for 2015 (78 457 t) was revised upwards (90 849 t) by the EC after 2014 assessment working group.

The TAC for 2016 (108 784 t) was slightly below the ICES advised TAC (109 592 t). The difference was due to the way the STECF calculated the TAC adjustments for stocks subject to the landing obligation.

9.2 Data

9.2.1 Commercial catches and discards

Total landings from the Northern stock of hake by area for the period 1961–2015 as used by the WG are given in Table 9.1. They include landings from Division 3.a, Subareas 4, 6 and 7, and Divisions 8.a,b,d, as reported to ICES. Unallocated landings are also included in the table; they are high over the first decade (1961–1970), when the uncertainties in the fisheries statistics were high. In the years 2011, 2012 and 2013, they have increased again due to differences between official statistics and scientific estimations. Since 2014, the differences between scientific and official landings decreased greatly which produced a big decrease in unallocated landings. The scientific landings for 2011, 2012 and 2013 were revised before the assessment working group and resulted in an increase of 7910, 10 444 and 981 tonnes in landings respectively. The group decided to use scientific revised estimates to carry out the assessment. The unallocated landings were divided by métier using scientific information provided by the research institutes. Table 1 of the Stock Annex provides a historical perspective of the level of aggregation at which landings have been available to the WG.

Except for 1995, landings decreased steadily from 66 500 t in 1989 to 35 000 t in 1998. Up to 2003, landings fluctuated around 40 000 t. Since then, with the exception of 2006, landings have been increasing up to 95 045 t in 2015, the highest value since 1961. The catches in 2015, 105 963 t, were slightly below the 2015 TAC (108 784t).

The discard data sampling and data availability are presented in the Stock Annex. Table 9.2 presents discard data available to the group from 1999–2015. The discards increased significantly since 2009. The increase was general to all the fleets. In 2014 the discards were the lowest in recent years. It is remarkable the case of gillnetters which did not discard before 2012 and since that year they have had high level of discards.

9.2.2 Biological sampling

The sampling level is given in Table 1.3.

Length compositions of the 2015 landings by Fishery Unit and quarter were provided by Ireland, France, Scotland, Spain, UK(E&W) and Denmark.

Length compositions samples are not available for all FUs of each country in which landings are observed (see Stock Annex). Only the main FUs are sampled (Table 9.3).

9.2.3 Abundance indices from surveys

Four surveys provide relative indices of hake abundance over time. The French RESSGASC survey was conducted in the Bay of Biscay from 1978–2002, the EVHOE-WIBTS-Q4 survey conducted in the Bay of Biscay and in Celtic Sea with a new design since 1997, the SpPGFS-WIBTS-Q4 survey conducted on the Porcupine Bank since 2001, and the Irish Groundfish Survey (IGFS-WIBTS-Q4) beginning in 2003 in the west of Ireland and the Celtic Sea. A brief description of each survey is given in the Stock Annex. Figure 9.1 present the abundances indices obtained for these surveys.

From 1985 until the end of the survey in 2002, the index from RESSGASC followed a slightly decreasing trend. The index from 2002 is not considered reliable and is not presented on the figure.

Throughout the available time-series, the abundance index provided by EVHOE-WIBTS-Q4 showed four peaks in 2002, 2004, 2008 and 2012. The index obtained in 2012 reached the highest value of the series, 193% higher than previous year. In 2013 and 2014 the index accumulated a decrease of 78%. In 2015 the index increased slightly.

The abundance index provided by IGFS-WIBTS-Q4 is consistent with EVHOE WIBTS-Q4 survey over recent years. It showed a peak in 2008 and the abundance index obtained in 2012 achieved the higher value of the series, 268% higher than previous year index. The accumulated decrease in 2013 and 2014 was equal to 86%. In 2015 the index increased slightly.

SpPGFS-WIBTS-Q4 survey is conducted on Porcupine's Bank since 2001. The abundance index follows an increasing trend since 2003, reaching its highest value in 2009 and slightly decreases in 2010 and 2011. After two years of an increasing trend with an accumulated increase of 218% the index decreased sharply in 2015. The peaks detected by EVHOE-WIBTS-Q4 and IGFS-WIBTS-Q4 are detected in this survey one year after. This is consistent with the fact that this survey catches bigger individuals.

The spatial distribution of the EVHOE-WIBTS-Q4 index for hakes from 0 to 20cm is given in Figure 9.3 for the most recent years. It is apparent from this figure that inter-annual variations in abundance are different between areas (7 and 8). In 2012, both areas display large abundance, even higher than in 2008, another year with high abundance index over recent years. After a decreasing trend since 2012 the recruitment abundance shows a weak increase in 2015.

9.2.4 Commercial catch-effort data

A description of the commercial LPUE indices available to the group is given in the Stock Annex. They are not used in the assessment model.

Effort and LPUE data for the period 1982–2015 are given in Table 9.4 and Figure 9.2.

Since the start of the time-series the effort of A Coruña and Vigo trawler fleets operating in Subarea 7 show a decreasing trend. The LPUE of A Coruña trawlers has fluctuated, with an increasing trend reaching its maximum value in 2011 and after a sharp decreased in 2012 and 2013 it has an increasing trend since 2014. Over the same period, LPUE from Vigo trawlers operating in Subarea 7 followed a slightly decreasing trend, becoming less variable during the last 15 years. It must be taken into account that while A Coruña trawl fleet is targeting hake, the Vigo trawl fleet is directed to megrim, taking hake only as bycatch.

LPUE from Ondarroa pairtrawlers operating in Divisions 8.a,b, shows an increasing trend until 2009. The increase in LPUE in 2008 and 2009 was very high, especially in 2009. Until 2012 the LPUE decreased, although not to the low levels of the beginning of the time-series. In 2013 it increased slightly again followed by a decrease in 2014. Since 1999 the effort has a decreasing trend. The LPUE was not updated in 2015 due to a change in the way data were reported as it is now using e-logbooks for the first time.

9.2.5 Assessment

This is an update assessment.

9.2.6 Input data

See Stock Annex (under "*Input data for SS3*").

9.2.6.1 Compilation of Length Frequency Distributions.

In 2015 a problem with the calculation of length–frequency distributions (LFD) was detected. This year, the calculation was carried out using R statistical software instead of Intercatch. The new procedure allowed using a more detailed stratification of the data when calculating the LFDs and it solved the problem detected last year. In order to be consistent along time the procedure was applied to the data since 2013 when Intercatch was first used. The LFDs obtained were in agreement with those observed before 2013.

In SS3 it is not necessary that all the data has a length distribution assigned, it is enough to provide the proportion at length of the catch for the whole stratum (fleet/quarter and catch category (landings or discards) combination). Furthermore, if for one stratum there is no LFD data available or the available data are not reliable the model can work without it. Hence, unlike in Intercatch in R no allocations were done in the stratums without LFD data.

For all the samples with observed LFDs, first the catch in weight by length was calculated using the weight-at-length relationship agreed for this stock (W(g)= 0.00513*L(cm)^3.074; ICES, 1991b).

Then, for SPTRAWL7, FRNEP8, SPTRAWL8, GILLNET and LONGLINE fleets all the samples within each stratum were aggregated by length class summing up the catch weight at length. The obtained length distribution of catch in weight was divided by total catch in the stratum to obtain the proportion of individuals in each length class, which was then used in SS3. For TRAWLOTH and OTHER fleet the data were further disaggregated. In TRAWLOTH the target species was taken into account and the data were divided in the samples coming from métiers with *Nephrops* as target stock and from métiers with demersal stocks as target. In OTHER fleet the samples were divided in two groups considering the gear, trawlers and non-trawlers. Within these groups the proportion by length was calculated in the same way done for the rest of the fleets. Finally, the overall proportion by length within the stratum was calculated using a weighted mean of the proportion in each group. The weighting factor was the total catch in weight in each group taking into account both sampled and non-sampled data.

The code use to produce the LFDs is available in the ICES SharePoint site.

The biggest differences between LFDs calculated using Intercatch and R were detected in 2014 for TRAWLOTH, GILLNET and OTHER fleet, the less homogeneous fleets in terms of métiers and countries involved (Figure 9.4). As in Intercatch season was used to define the stratums for the allocations, in TRAWLOTH fleet the LFD in season 3, the season with highest sampled landings, was biasing the LFD in the rest of the seasons. In GILLNET fleet a sample that we were not able to identify in 2015 biased the LFD in seasons 1, 2 and 4. This year the sample was identified and removed from the LFD observations which produced sensible LFDs for all the seasons. The LFD in IC of OTHER fleet was influenced by the LFD of trawlers that catch small individuals. Using R the LFDs of trawlers and non-trawlers were calculated separately, the final LFD obtained was wider and with bigger individuals.

9.2.7 Model

The Stock Synthesis 3 (SS3) assessment model (Methot and Wetzel 2013) was selected for use in this assessment. Model description and settings are presented in the Stock Annex (under "*Current assessment*" for model description and "*SS3 settings (input data and control files)*" for model settings).

9.2.8 Comparison of assessment results using Intercatch or R to calculate LFD.

The new LFDs produce a slight increase in the recruitment estimates from 2008–2011 which in turn produces a significant increase in the SSB of the final years (Figure 9.5). The new LFD, especially in the OTHER fleet, has bigger individuals; hence the model needs to increase the recruitment in 2008–2011 in order to have enough big individuals in recent years.

9.2.9 Assessment results

Residuals of the fits to the surveys log(abundance indices) are presented in Figure 9.6. The greater part of the upward trend, until 2012, in relative abundance observed in all three contemporary trawl surveys (EVHOE-WIBTS-Q4, SpPGFS-WIBTS-Q4 and IGFS-WIBTS-Q4) has been captured by the model but there is still some residual trend apparent in the graphs. Pearson residuals of their length frequency distributions show a "fairly random" behaviour with no particular trend or lack of fit (Figure 9.7, where blue and red circles denote positive and negative residuals, respectively). Residuals of the length frequency distributions of the commercial fleets landings and discards (not presented in this report but available on the Share-point) show some patterns, as mentioned in the benchmark report (ICES, 2014a).

The assessment model includes estimation of size-based selectivity functions (selection pattern at length) for commercial fleets and for population abundance indices (surveys). For commercial fleets total catch is subsequently partitioned into discarded and retained portions. Figure 9.8 presents selectivity (for the total catch; solid lines) and retention functions by fleet (dashed lines) estimated by the model. The selection curve is assumed constant over the whole period for all the fleets except for that operating outside areas 7 and 8 (the *others* fleet). For the Spanish trawl fleets in 7, three retention functions are estimated, one for years 1978–1997 (black), a second one for 1998–2009 (red) and a third one for 2010–present (green). For the Spanish trawl fleets in 8, two retention functions are estimated one for years 1978–1997 and a second one for 1998-present The change in retention in 1998 for both trawl fleets was clearly noticed when examining the length frequency distributions of the landings and might be due to a stricter enforcement of the minimum landing size. The most recent change in retention of Spanish trawl fleet in 7 was motivated by the observed change in the mean size of discards from 23.6 cm before 2010 to 28.8 cm after that year. For the French trawlers targeting *Nephrops* in 8, the same retention function is assumed throughout the entire assessment period (1978–present). For the other fleet both selection and retention curves are considered constant until 2002 and are allowed to vary from year to year since then. The variation is modelled using a random walk as described in the stock annex. The assessment currently assumes that the other commercial fleets do not discard fish, although this assumption should be revised as more information on discards becomes available. It is noteworthy the high amount of discards (> 1000 tonnes) of gillnetter fleet in 7 and 8 in the last four years. Before 2012 the discards of this fleet were considered negligible.

The retrospective analysis (Figure 9.9) shows that for F and SSB the model results are sensitive to the exclusion of recent data. The inclusion of 2012 data provoked a revision upwards of the SSB and downwards of the fishing mortality. The trends of the series were almost identical but the absolute levels were slightly different. Afterwards the inclusion of further years of data did not lead to the same patterns only the last years is revised with a tendency to underestimate SSB and overestimate F over the most recent years. In recent assessments a marked retrospective pattern was observed for recruitment in 2008 with sharp increase in recruitment as more years were added to the assessment. This retrospective pattern in recruitment produced a revision upwards of the SSB and downward of F and it is especially marked with the inclusion of 2014 year data.

F2015 (average of F-at-length over lengths 15–80 cm) was estimated at 0.23 and SSB at 360 925 t.

9.2.10 Historic trends in biomass, fishing mortality and recruitment

Summary results from SS3 are given in Table 9.5 and Figure 9.10.

For recruitment, fluctuations appear to be without substantial trend over the whole series. The recruitment in 2008 was the highest in the whole series 800 millions of individuals and in 2015 decreased below mean level (250 million).

From high levels at the start of the series (100 000 t in 1980), the SSB has decreased steadily to a low level at the end of the 90s (26 000 t in 1998). Since that year, SSB has increased to the highest value of the series in 2015 (300 000 t).

The fishing mortality is calculated as the average annual F for sizes 15–80 cm. This measure of F is nearly identical with the average F for ages 1–5. Values of F increased from values around 0.5–0.6 in the late 70s and early 80s to values around 1.0 during the 90s. Between 2006 and 2011 F declined sharply and afterwards it moderated the decrease. In 2015 it reached the minimum in the series (0.22).

9.3 Catch options and prognosis

9.3.1 Short - Term projection

For the current projection, unscaled F is used, corresponding to F(15–80cm) = 0.23.

The recruitment used for projections in this WG is the GM calculated from 1978 to the final assessment year minus 2.

Landings in 2017 and SSB in 2018 predicted for various levels of fishing mortality in 2017 are given in Table 9.6 and Figure 9.11. Maintaining status quo F in 2017 is expected to result in a decrease in landings and SSB with respect to 2016.

9.3.2 Yield and biomass per recruit analysis

Options for long term projection are indicated in the Stock Annex.

Results of equilibrium yield and SSB per recruit are presented in Table 9.7 and Figure 9.12. The F-multiplier in Table 9.7 is with respect to status quo F (average F in the final 3 assessment years, 2013–2015). Considering the yield and SSB per recruit curves, F_{max}, $F_{0.1}$, $F_{35\%}$ and $F_{30\%}$ are respectively estimated to be 126%, 78%, 86% and 100% of status quo F. The maximum equilibrium yield-per-recruit is around 5% above the equilibrium yield at F_{sq}.

9.4 Biological reference points

Biological reference points for the stock of Northern Hake were calculated in 2015 (ICES 2016) in a specific working group.

	Type	Value	Technical basis
MSY	MSY $B_{trigger}$	45 000	B_{pa} (ICES 2016)
Approach	F_{MSY}	0.28	Fmsy in the combined stock recruitment relationship (ICES 2016)
	B_{lim}	32 000	SSB2006 Low level of SSB followed by a sharp increase, lower level of SSB would led to lower recruitment level.
Precautionary	B_{pa}	45 000	$1.4B_{lim}$ (ICES 2016)
Approach	F_{lim}	0.87	Fishing mortality resulting in a 5% probability of SSB falling below Blim (ICES 2016)
	F_{pa}	0.62	$F_{lim}/1.4$ (ICES 2016)

9.5 Comments on the assessment

The retrospective pattern in 2008 recruitment was partially corrected in last benchmark (ICES, 2014a) but it worsen again in the following assessment working group when 2013 data were included (ICES, 2014). This year the retrospective pattern in recruitment has been intensified with the revision of 2014 LFD data. This produces an SSB for 2014 75 000 tonnes higher than that estimated in 2015 and a fishing mortality 32% lower. However, the inclusion of 2015 data has not had any impact in the revision upwards of 2008 year recruitment. During the last benchmark assessment the retrospective pattern was related with the length frequency distributions of the fleets and the way they are modelled. The model tried to explain the length frequency distributions observed through an increase in the recruitment. This was partially solved giving more flexibility to the selectivity and retention curves over time. As this pattern has not disappeared, in future, more work will be needed to understand what is driving such a retrospective pattern. The discards of non-Spanish trawlers in 7 and 8 have increased significantly in the recent years. Their length frequency distribution has been made available in Intercatch in the last two years, so it could be advisable to include them in the model. Last year, the inclusion in the assessment of annual Scottish discard LFD of *others* fleet was tested. The impact in the results of the assessment was limited. However the fit to the length frequency distribution was not very good and the working group decided not to include these data in the assessment. However, the working group noted that in the current assessment the fit to the discard data of *others* fleet is done without any length frequency distribution data since 2008. As the Scottish data were considered representative of this discard of this fleet the working group will investigate in future assessment the inclusion of these data into the assessment.

9.6 Management considerations

The big increase in SSB and decrease in fishing mortality are the consequence of the strong recruitment in 2008. However the increase rate should be taken with caution as limited information is currently available on the variation in abundance of large fish and the model is very sensitive to the data and settings used. It must be noted that the fast growth rate estimated by the model combined with the assumed high natural mortality rate (M=0.4 since the 2010 benchmark) generates a rapid turn-over of the hake stock dynamic. This means that short-term predictions in SSB and landings are strongly related to variations in recruitment.

9.7 References.

Methot, R. D. and C. R. Wetzel (2013). "Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management." Fisheries Research 142: 86-99.

ICESa (2014). Report of the Bechmark Wrokshop on Southern megrim and hake (WKSOUTH). 3–7 February 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:40. Copenhagen, Denmark.

ICESb (2014). Report of the Workshop to consider reference points for all stocks (WKMSYREF2. 8-10 January 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:47. Copenhagen, Denmark.

ICESc (2014). Report of the Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE). 7–13 May 2014, Lisbon, Portugal. ICES CM 2014/ACOM:11. Copenhagen, Denmark.

ICES 2015. Report of the Workshop to consider FMSY ranges for stocks in ICES categories 1 and 2 in Western Waters (WKMSYREF4). Brest, France. ICES CM 2015/ACOM:58.

Table 9.1. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock. Estimates of landings ('000 t) by area for 1961–2011.

	Landings (1)							Discards (2)						Catches (3)
Year	3	4	6	7	8abd	Unn.	Total	3	4	6	7	8abd	Total	Total
1961			-	-	-	95.6	95.6						-	95.6
1962			-	-	-	86.3	86.3						-	86.3
1963			-	-	-	86.2	86.2						-	86.2
1964			-	-	-	76.8	76.8						-	76.8
1965			-	-	-	64.7	64.7						-	64.7
1966			-	-	-	60.9	60.9						-	60.9
1967			-	-	-	62.1	62.1						-	62.1
1968			-	-	-	62.0	62.0						-	62.0
1969			-	-	-	54.9	54.9						-	54.9
1970			-	-	-	64.9	64.9						-	64.9
1971		8.5		19.4	23.4	0	51.3						-	51.3
1972		9.4		14.9	41.2	0	65.5						-	65.5
1973		9.5		31.2	37.6	0	78.3						-	78.3
1974		9.7		28.9	34.5	0	73.1						-	73.1
1975		11.0		29.2	32.5	0	72.7						-	72.7
1976		12.9		26.7	28.5	0	68.1						-	68.1
1977		8.5		21.0	24.7	0	54.2						-	54.2
1978		8.0		20.3	24.5	-2.2	50.6						-	50.6
1979		8.7		17.6	27.2	-2.4	51.1						-	51.1
1980		9.7		22.0	28.4	-2.8	57.3						-	57.3
1981		8.8		25.6	22.3	-2.8	53.9						-	53.9
1982		5.9		25.2	26.2	-2.3	55.0						-	55.0
1983		6.2		26.3	27.1	-2.1	57.5						-	57.5
1984		9.5		33.0	22.9	-2.1	63.3						-	63.3
1985		9.2		27.5	21.0	-1.6	56.1						-	56.1
1986		7.3		27.4	23.9	-1.5	57.1						-	57.1
1987		7.8		32.9	24.7	-2.0	63.4						-	63.4
1988		8.8		30.9	26.6	-1.5	64.8						-	64.8
1989		7.4		26.9	32.0	0.2	66.5						-	66.5
1990		6.7		23.0	34.4	-4.2	60.0						-	60.0
1991		8.3		21.5	31.6	-3.4	58.1						-	58.1
1992		8.6		22.5	23.5	2.1	56.6						-	56.6
1993		8.5		20.5	19.8	3.3	52.1						-	52.1
1994		5.4		21.1	24.7	0.0	51.3						*	51.3
1995		5.3		24.1	28.1	0.1	57.6						-	57.6
1996		4.4		24.7	18.0	0.0	47.2						-	47.2
1997		3.3		18.9	20.3	-0.1	42.5						-	42.5
1998		3.2		18.7	13.1	0.0	35.1						-	35.1
1999		4.3		24.0	11.6	0.0	39.8						*	39.8
2000		4.0		26.0	12.0	0.0	42.0						*	42.0
2001		4.4		23.1	9.2	0.0	36.7						-	36.7
2002		2.9		21.2	15.9	0.0	40.1						-	40.1
2003*		3.3		25.4	14.4	0.0	43.2						1.4	44.6
2004*		4.4		27.5	14.5	0.0	46.4						2.6	49.0
2005*		5.5		26.6	14.5	0.0	46.6						4.6	51.1
2006*		6.1		24.7	10.6	0.0	41.5						1.2	42.7
2007*		7.0		27.5	10.6	0.0	45.1						2.2	47.3
2008*		10.7		22.8	14.3	0.0	47.8						3.4	51.2
2009*		13.1		25.3	20.4	0.0	58.8						11.0	69.8
2010*		14.2		33.5	25.1	0.0	72.8						12.1	84.9
2011*		18.8		18.6	16.6	32.0 (4)	87.5						13.9	101.4
2012*		22.4		22.2	16.7	19.3 (4)	85.6						14.9	100.5
2013*	0.3	10.7	5.2	28.5	19.9	13.1 (4)	77.7	0.3	2.9	1.5	6.6	4.1	15.4	93.1
2014*	0.4	12.1	11.4	39.6	23.7	2.7 (4)	89.9	0.3	3.1	1.0	4.0	1.5	9.8	99.7
2015*	0.4	14.6	7.1	44.0	26.2	2.7 (4)	95.0	0.1	3.4	0.1	4.2	3.1	10.9	105.9

(1) Spanish data for 1961-1972 not revised, data for Sub-area VIII for 1973-1978 include data for
Divisions VIIIa,b only. Data for 1979-1981 are revised based on French surveillance data.
Divisions IIIa and IVb,c are included in column "IIIa, IV and VI" only after 1976.
There are some unallocated landings (moreover for the period 1961-1970).
(2) Discard estimates from observer programmes. In years marked with *,
partial discard estimates are available and used in the assessment.
For remaining years for which no values are presented,
some estimates are available but not considered valid and thus not used in the assessment
In the years with data only Spanish discards and discards from French Nephrops trawlers are included.
(3) From 1978 total catches used for the Working Group.
(4) Unnallocated landings for years 2011-2014 were revised in 2015.

Table 9.2. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Summary of discards data available (weight (t) in bold, numbers ('000) in italic)). The discards of Fleet 2 and Fleet 3 (in red) are not included in the assessment,

SS3 Fleets	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
FLEET 1	**1034**	**1530**	na	**537**	**1712**	**2010**	**5674**	**5077**	**5054**	**3495**	**1464**	**2604**
	10666	*17393*	na	*4526*	*21437*	*17542*	*27619*	*27954*	*26452*	*38293*	*8335*	*5241*
FLEET 2	**32**	**94**	**na**	**na**	**na**	**1025**	**1192**	**130**	**1142**	**2934**	**2510**	**1560**
	282	*629*	*na*	*na*	*na*	*6814*	*3831*	*1037*	*5101*	*16863*	*7483*	*4460*
FLEET 3	**1359**	**1597**	**532**	**767**	**858**	**4283**	**726**	**871**	**624**	**1475**	**392**	**1133**
	39550	*37740*	*18031*	*24277*	*18245*	*68524*	*14709*	21208	*25228*	*32535*	*4099*	19126
FLEET 4	**30**	**489**	**206**	**471**	**352**	**580**	**101**	**292**	**364**	**379**	**184**	**589**
	451	*8475*	*3397*	*10002*	*7153*	*7925*	*1719*	*5036*	*5329*	*5552*	*2718*	*8011*
FLEET 5	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**1503**	**1256**	**42**	**857**
	na	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*4061*	*3283*	*53*	*623*
FLEET 6	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**558**
	na	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*402*
FLEET 7	**159**	**873**	**484**	**390**	**446**	**3135**	**4425**	**7533**	**6183**	**6287**	**4343**	**4151**
	na	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*16855*	*4866*	4171
Total Weight (t)	**2614**	**4583**	**1222**	**2165**	**3368**	**11033**	**12118**	**13903**	**14870**	**15826**	**8935**	**11452**
Total Number ('000)	*51724*	*64237*	*21428*	*39654*	*47488*	*101349*	*48325*	*58210*	*66171*	*113381*	*27554*	42034

Table 9.3. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Landings (L) and Length Frequency Distribution (LFD) provided in 2011.

Country		France	Ireland	Spain	UK(E+W)	Scotland	Denmark	Others
Unit	Quarter							
	1	L		L+LFD	L	L		
1 + 2	2	L		L+LFD	L	L		
	3	L		L+LFD	L	L		
	4	L		L+LFD	L	L		
	1	L	L+LFD	L	L+LFD	L		
3	2	L	L+LFD	L	L+LFD	L		
	3	L+LFD	L+LFD	L	L+LFD	L		
	4	L	L+LFD	L	L+LFD	L		
	1	L+LFD	L+LFD	L+LFD	L+LFD	L		
4 + 5 + 6	2	L+LFD	L+LFD	L+LFD	L+LFD	L		
	3	L+LFD	L+LFD	L+LFD	L+LFD	L		
	4	L+LFD	L+LFD	L+LFD	L+LFD	L		
	1	L+LFD			L+LFD	L		L
8	2	L+LFD			L+LFD	L		L
	3	L+LFD			L+LFD	L		L
	4	LFD			L+LFD	L		L
	1	L+LFD						
9	2	L+LFD						
	3	L+LFD						
	4	L+LFD						
	1	L+LFD		L+LFD				
10 + 14	2	L+LFD		L+LFD				L
	3	L+LFD		L+LFD				
	4	L		L+LFD				
	1	L+LFD		L+LFD				
12	2	L+LFD		L+LFD				
	3	L		L+LFD				
	4	L+LFD		L+LFD				
	1	L		L+LFD				
13	2	L		L+LFD				
	3	L+LFD		L+LFD				
	4	L+LFD		L+LFD				
	1	L+LFD	L+LFD		L+LFD	L		L
15	2	L+LFD	L+LFD		L+LFD	L		L
	3	L+LFD	L+LFD		L+LFD	L		L
	4	L+LFD	L+LFD		L	L		L
	1	L+LFD			L+LFD	L+LFD	L+LFD	L+LFD
16	2	L+LFD			L+LFD	L+LFD	L+LFD	L+LFD
	3	L+LFD			L+LFD	L+LFD	L+LFD	L+LFD
	4	L+LFD			L+LFD	L+LFD	L+LFD	L

Table 9.4. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Effort and LPUE values of commercial fleets.

Sub-area VII

	A Coruña trawl in VII			Vigo trawl in VII		
Year	Landings(t)	Effort(days)	LPUE(Kg/day)	Landings(t)	Effort**	LPUE**
1982				2051	75194	27
1983				3284	75233	44
1984				3062	76448	40
1985	5612	14268	393	1813	71241	25
1986	4253	11604	366	2311	68747	34
1987	8191	12444	658	2485	66616	37
1988	6279	12852	489	3640	65466	56
1989	6104	12420	491	1374	75853	18
1990	4362	11328	385	2062	80207	26
1991	3332	9852	338	2007	78218	26
1992	3662	6828	536	1813	63398	29
1993	2670	5748	464	1338	59879	22
1994	3258	5736	568	1858	56549	33
1995	4069	4812	846	1461	50696	29
1996	2770	4116	673	1401	54162	26
1997	1858	4044	459	1099	50576	22
1998	2476	3924	631	1201	53596	22
1999	2880	3732	772	1652	50842	32
2000	3628	2868	1265	1487	55185	27
2001	2585	2640	979	1071	56776	19
2002	1534	2556	600	1152	50410	23
2003	3286	3084	1065	1486	54369	27
2004	2802	2820	994	1595	53472	30
2005	2681	2748	976	1323	52455	25
2006	2498	2688	929	1422	53677	26
2007	2529	2772	912	1459	58123	25
2008	2042	1872	1091	1159	54324	21
2009	2418	1884	1284	1493	51551	29
2010	4934	2484	1986	1326	48432	27
2011	5108	2232	2288	1321	43533	30
2012	2819	1452	1942	1122	32760	34
2013	1474	903	1632	725	26834	27
2014	996	496	2008	482	15297	32
2015	972	397	2449	497	13954	36

* Before 1988 landings and effort refer to Vigo trawl fleet only, from 1988 to 2002 to combined Vigo+Marín trawl fleet

** Effort in days/100HP; LPUE in kg/(day/100HP)

Sub-area VIII

	Ondarroa pair trawl in VIIIabd			Pasajes pair trawl in VIIIa,b,d		
Year	Landings(t)*	Effort(days)	LPUE(Kg/day)	Landings(t)*	Effort(days)	LPUE(Kg/day)
1993	64	68	930	na	na	na
1994	815	362	2250	540	423	1276
1995	3094	959	3226	2089	746	2802
1996	2384	1332	1790	2519	1367	1843
1997	2538	1290	1966	3045	1752	1738
1998	2043	1482	1378	2371	1462	1622
1999	2135	1787	1195	2265	1180	1920
2000	2004	1214	1651	2244	1233	1820
2001	1899	1153	1648	941	587	1603
2002	4314	1281	3368	2570	720	3571
2003	3832	1436	2669	2187	754	2902
2004	3197	1288	2482	1859	733	2535
2005	3350	1107	3026	658	252	2611
2006	4173	1236	3377	516	182	2837
2007	3815	1034	3691	278	105	2644
2008	5473	791	6916	0	0	na
2009	6716	633	10610	0	0	na
2010	8056	844	9545	0	0	na
2011	6357	893	7115	0	0	na
2012	4769	799	5969	0	0	na
2013	4562	518	8801	0	0	na
2014	3467	545	6356	0	0	na

Table 9.5. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Summary of landings and assessment results.

Year	Recruit Age 0	Total Biomass	Total SSB	Landings	Discards[1]	Catch	Yield/SSB	F (15-80 cm)
1978	281637	120626	82187	50551	NA	50551	0.62	0.49
1979	260639	129948	102990	51096	NA	51096	0.5	0.53
1980	290485	127797	105271	57265	NA	57265	0.54	0.63
1981	555498	110505	90498	53918	NA	53918	0.6	0.63
1982	378599	101577	73877	54994	NA	54994	0.74	0.66
1983	135756	107573	71340	57507	NA	57507	0.81	0.61
1984	261746	112996	83803	63286	NA	63286	0.76	0.65
1985	589947	97680	79394	56099	NA	56099	0.71	0.8
1986	351557	80584	59280	57092	NA	57092	0.96	0.89
1987	420334	75910	44027	63369	NA	63369	1.44	0.97
1988	469557	76847	46689	64823	2.2	64825.2	1.39	0.98
1989	458102	76956	45727	66473	72.8	66545.8	1.45	1.06
1990	465839	70952	42915	59954	NA	59954	1.4	1.01
1991	260556	67820	41778	58129	NA	58129	1.39	0.95
1992	281499	66703	40233	56617	NA	56617	1.41	0.99
1993	503517	59084	39098	52144	NA	52144	1.33	1.04
1994	281769	53006	30796	51259	356.2	51615.2	1.66	1.04
1995	144080	59165	30125	57621	NA	57621	1.91	1.1
1996	350084	54503	35173	47210	NA	47210	1.34	0.96
1997	247985	46926	30487	42465	NA	42465	1.39	1.04
1998	408474	44488	24707	35060	NA	35060	1.42	0.96
1999	203240	48882	28069	39814	348.6	40162.6	1.42	0.95
2000	184012	54401	31070	42026	82.6	42108.6	1.35	0.89
2001	336013	54499	36828	36675	NA	36675	1	0.74
2002	267942	57418	37758	40107	NA	40107	1.06	0.8
2003	157810	62587	38150	43162	2109.804	45271.804	1.13	0.8
2004	330745	64841	43297	46417	2552.443	48969.443	1.07	0.81
2005	221437	60783	41714	46550	4675.8487	51225.8487	1.12	0.94
2006	300857	57336	34234	41467	1816.1534	43283.1534	1.21	0.82
2007	466132	64398	40583	45028	2191.4212	47219.4212	1.11	0.72
2008	762072	81587	48196	47739	3247.73	50986.73	0.99	0.58
2009	253592	129702	73034	58818	9870.773	68688.773	0.81	0.47
2010	267738	211283	134723	72799	9414.6677	82213.6677	0.54	0.35
2011	272167	273613	221394	87540	13774.978	101314.978	0.4	0.28
2012	479486	296311	254447	85677	12225.2225	97902.2225	0.34	0.24
2013	340348	306307	258861	77753	11637.1017	89390.1017	0.3	0.23
2014	262186	335637	273372	89940	7047.4663	96987.4663	0.33	0.23
2015	255810	363651	306639	93670	7396.384	101066.384	0.31	0.22
Arith.Mean	335770	112234	81652	56635	4935	58972		
Units	Million of Individuals	Thousands	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	

[1] Discards used in the assessment. In years with (-) discards are not available or considerent unreliable.

Table 9.6. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Catch option table.

SSB(2016)	Rec proj	F(15-80cm)	Catch(2016)	Land(2016)	SSB(2017)
329685	315575	0.23	105655	98842	321533

Fmult	Fcatch(15-80cm)	Catch(2017)	Land(2017)	Disc(2017)	SSB(2018)
0	0	0	0	0	402891
0.1	0.0225	11320	10595	725	391878
0.2	0.045	22314	20881	1433	381189
0.3	0.0676	32990	30867	2124	370814
0.4	0.0901	43359	40561	2798	360743
0.5	0.1126	53430	49973	3456	350966
0.6	0.1351	63211	59112	4099	341476
0.7	0.1577	72711	67985	4726	332262
0.8	0.1802	81940	76601	5339	323318
0.9	0.2027	90904	84966	5937	314633
1	0.2252	99611	93090	6521	306201
1.1	0.2478	108071	100979	7092	298014
1.2	0.2703	116289	108639	7649	290064
1.3	0.2928	124273	116079	8194	282345
1.4	0.3153	132030	123304	8726	274848
1.5	0.3379	139566	130321	9245	267568
1.6	0.3604	146889	137136	9753	260497
1.7	0.3829	154005	143756	10249	253630
1.8	0.4054	160919	150185	10734	246961
1.9	0.428	167638	156430	11208	240482
2	0.4505	174167	162496	11671	234189

Table 9.7. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Yield-per-recruit summary table.

SPR level	Fmult	F(15-80cm)	YPR(catch)	YPR(landings)	SSB PR
1	0	0	0	0	3.2
0.87	0.1	0.02	0.08	0.08	2.77
0.76	0.2	0.05	0.14	0.13	2.42
0.66	0.3	0.07	0.19	0.18	2.12
0.59	0.4	0.09	0.22	0.21	1.88
0.52	0.5	0.11	0.25	0.24	1.67
0.47	0.6	0.14	0.27	0.25	1.49
0.42	0.7	0.16	0.29	0.27	1.34
0.38	0.8	0.18	0.30	0.28	1.21
0.34	0.9	0.2	0.31	0.29	1.09
0.31	1	0.23	0.31	0.29	1.00
0.28	1.1	0.25	0.32	0.30	0.91
0.26	1.2	0.27	0.32	0.30	0.84
0.24	1.3	0.29	0.32	0.30	0.77
0.22	1.4	0.32	0.32	0.30	0.71
0.21	1.5	0.34	0.32	0.30	0.66
0.19	1.6	0.36	0.32	0.29	0.61
0.18	1.7	0.38	0.32	0.29	0.57
0.17	1.8	0.41	0.32	0.29	0.53
0.16	1.9	0.43	0.31	0.29	0.50
0.15	2	0.45	0.31	0.28	0.47

	SPR level	Fmult	F(15-80cm)	YPR(catch)	YPR(landings)	SSB PR
Fmax	0.24	1.29	0.29	0.32	0.3	0.77
F0.1	0.37	0.82	0.18	0.3	0.28	1.19
F35%	0.35	0.88	0.2	0.3	0.29	1.12
F30%	0.3	1.03	0.23	0.31	0.29	0.96

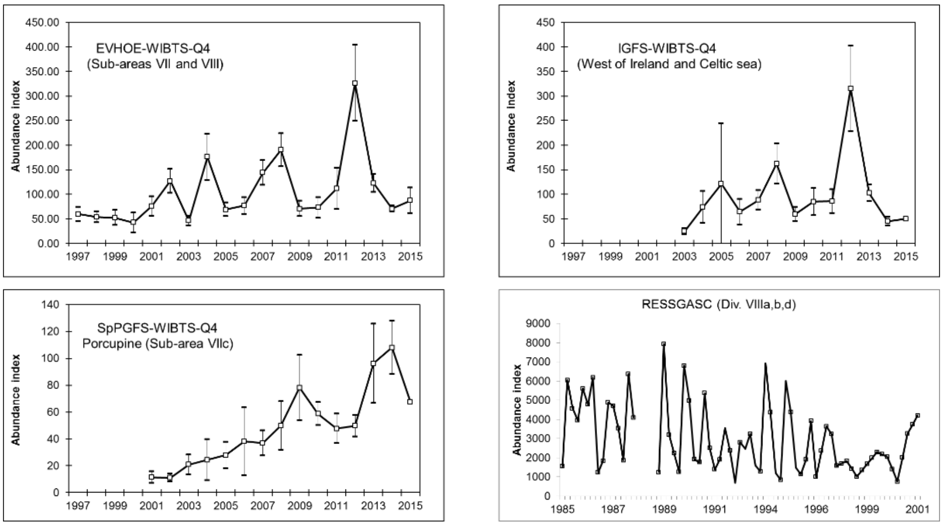


Figure 9.1. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Abundance indices from surveys.

Figure 9.2. Northern Hake. Effective effort indices and LPUE values of commercial fleets estimated by National laboratories.

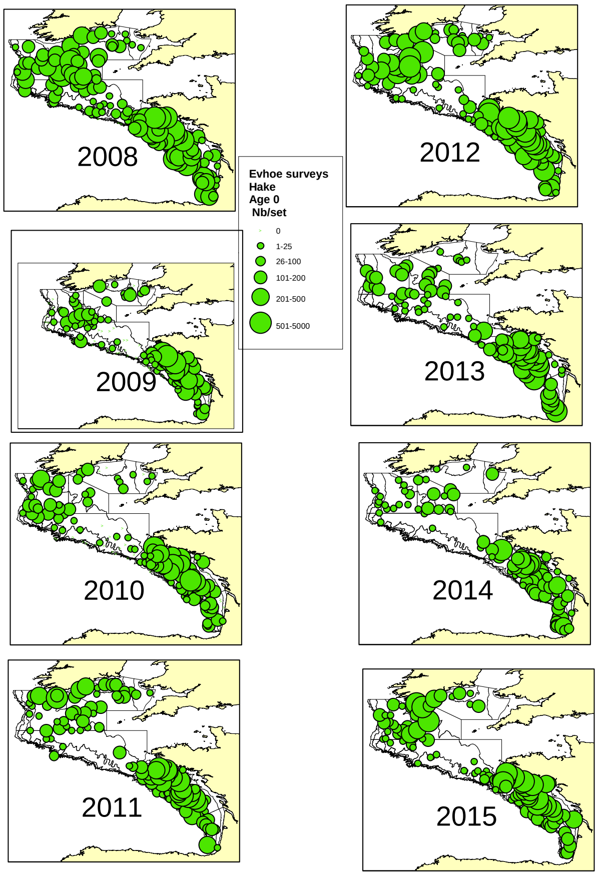


Figure 9.3. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Spatial distribution of hake (0-20 cm) indices from EVHOE-WIBTS-Q4 survey from 2006–2011.

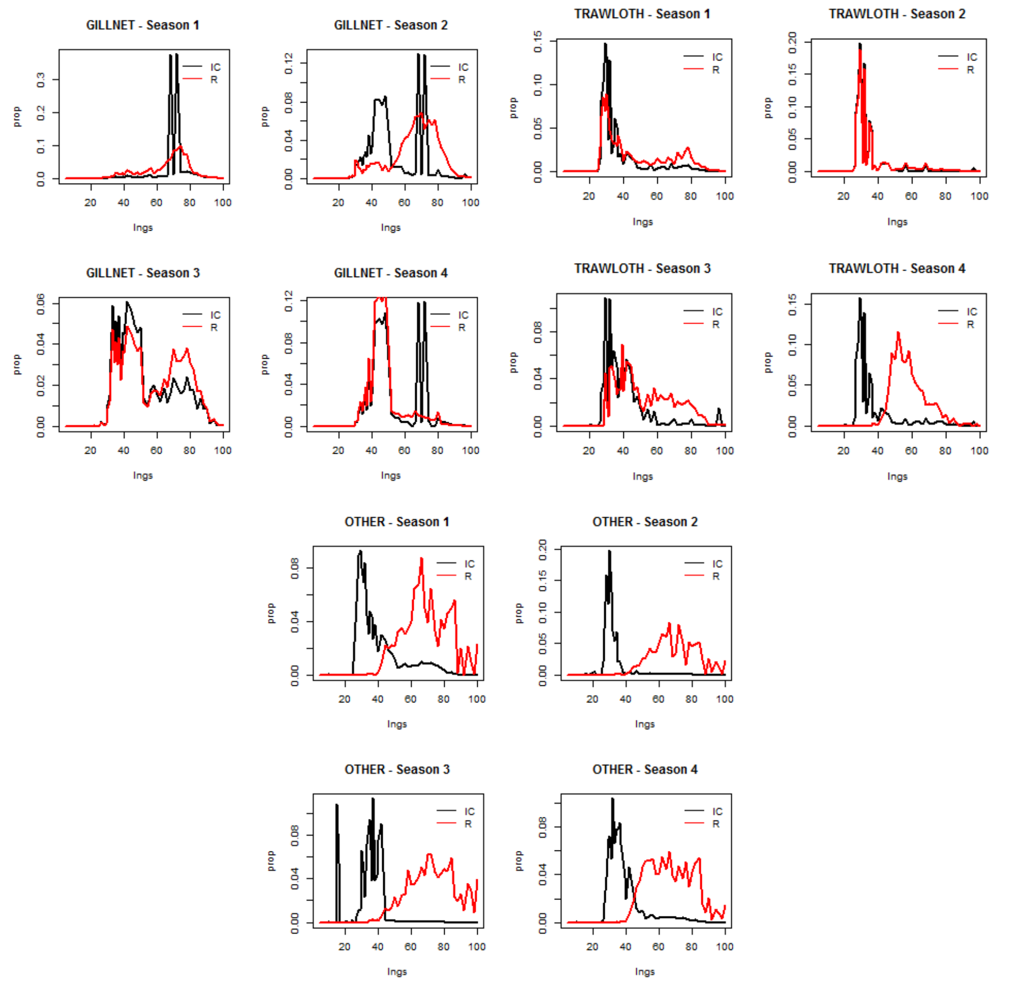


Figure 9.4. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Comparison between the length frequency distributions obtained using Intercatch (black) and R (red) for GILLNETTERS, TRAWLOTH and OTH fleets for 2014 year data.

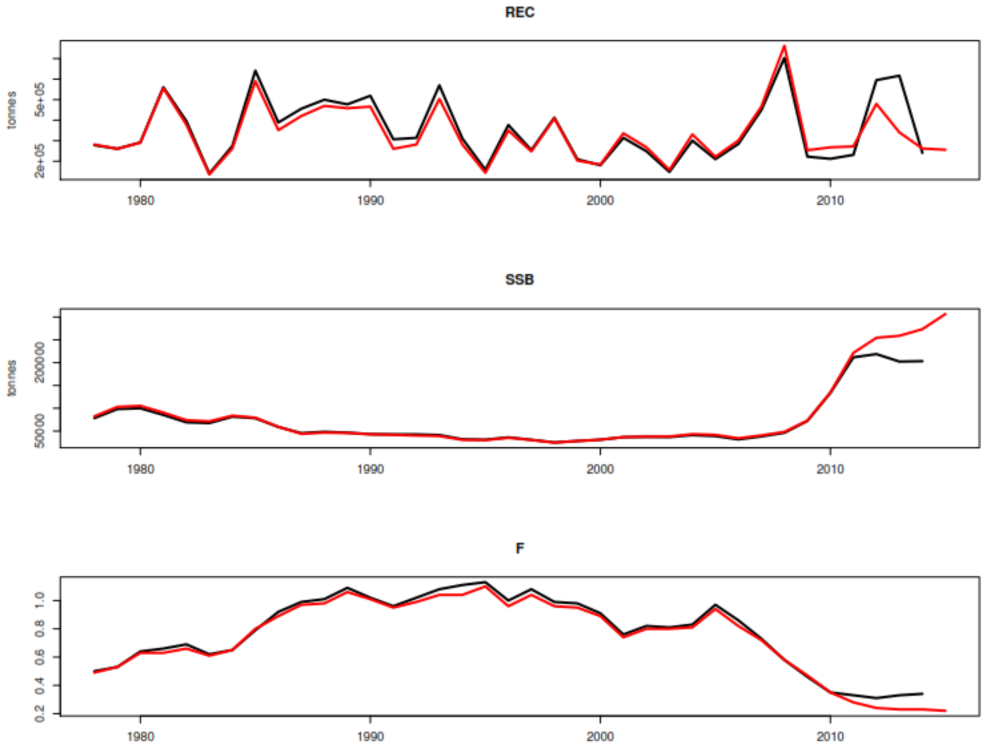


Figure 9.5 Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Recruitment, SSB and fishing mortality (F) time-series for the assessment results using Intercatch for 2013 and 2014 year data (black) and using R since 2013 (red).

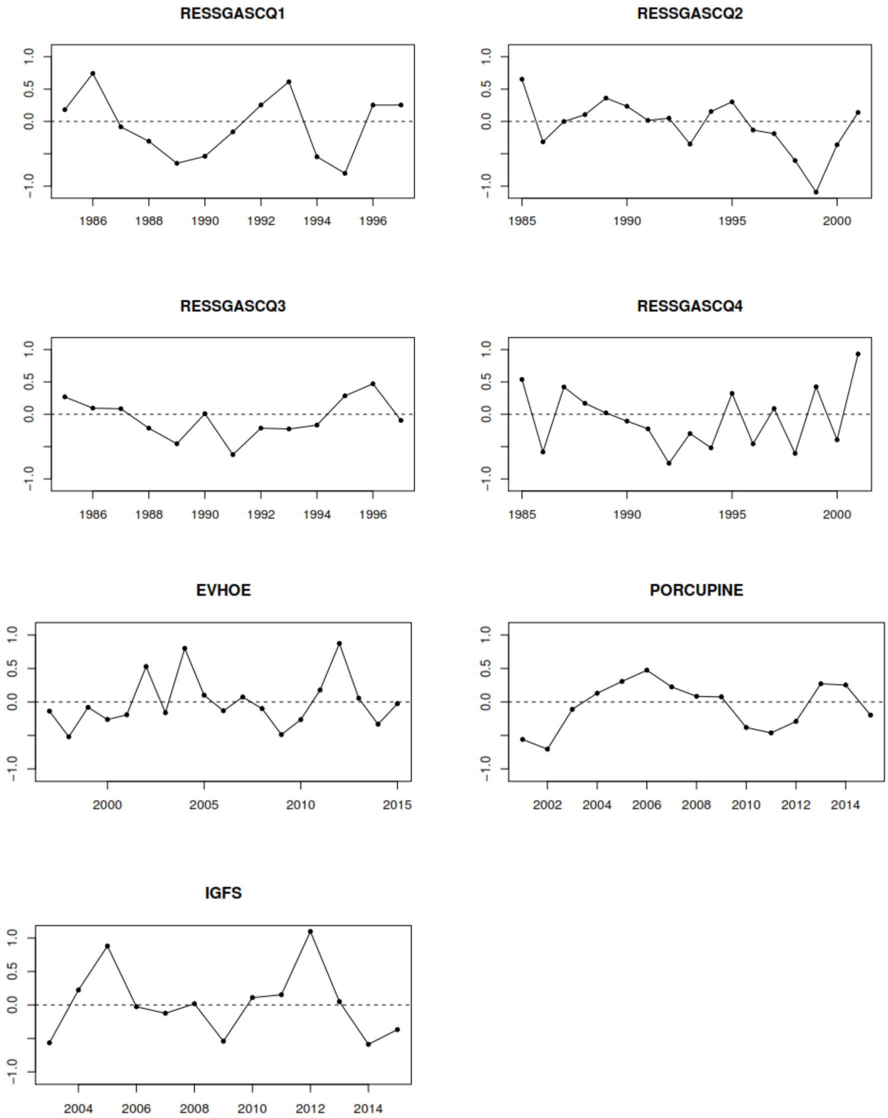


Figure 9.6. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Residuals of the fits to the surveys log(abundance indices). For RESSGASC, EVHOE, PORCUPINE and IGFS, fits are by quarter.

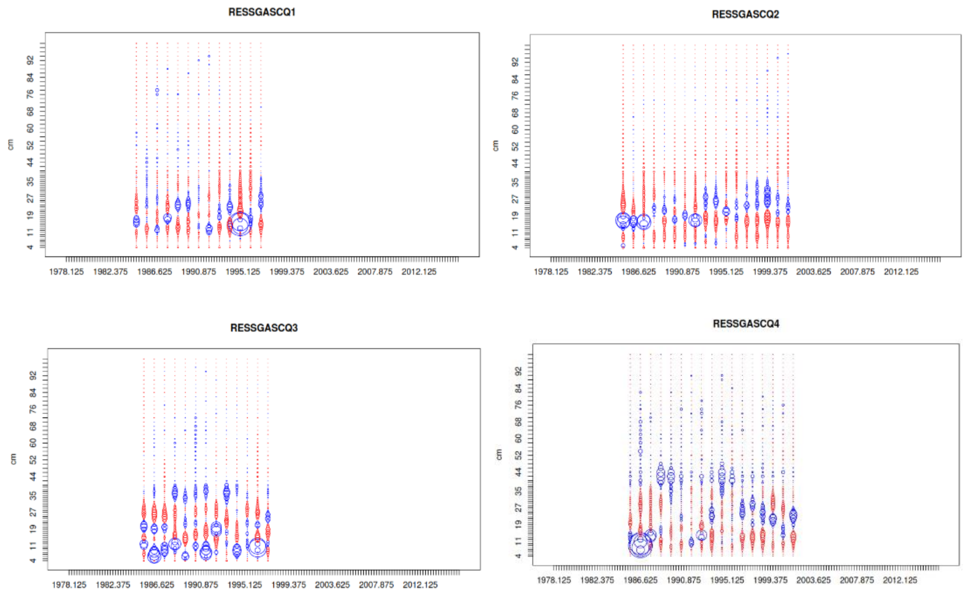


Figure 9.7. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter. Blue and red denote positive and negative residuals, respectively.

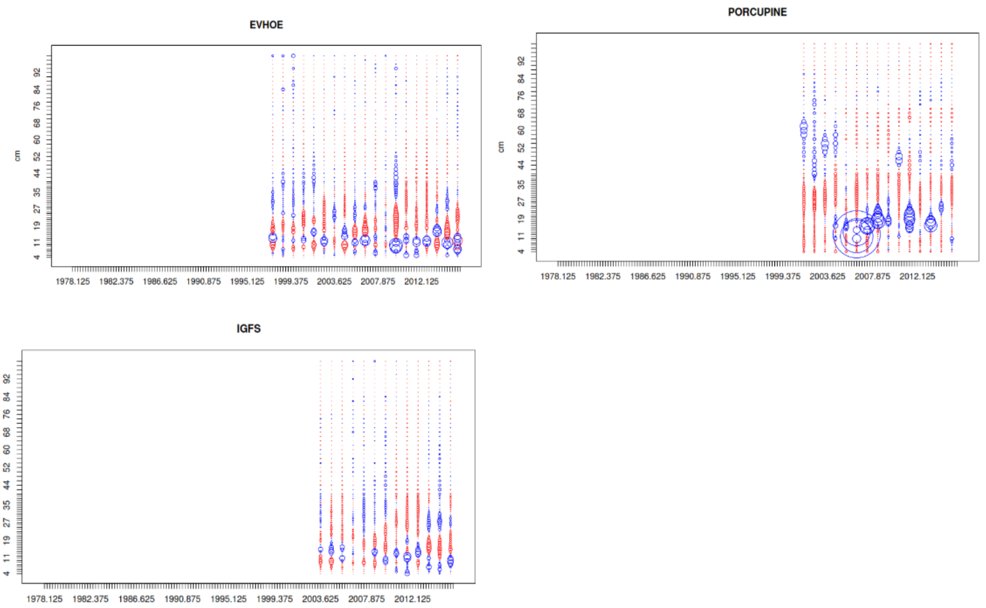


Figure 9.7 (continued). Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter. Blue and red denote positive and negative residuals, respectively.

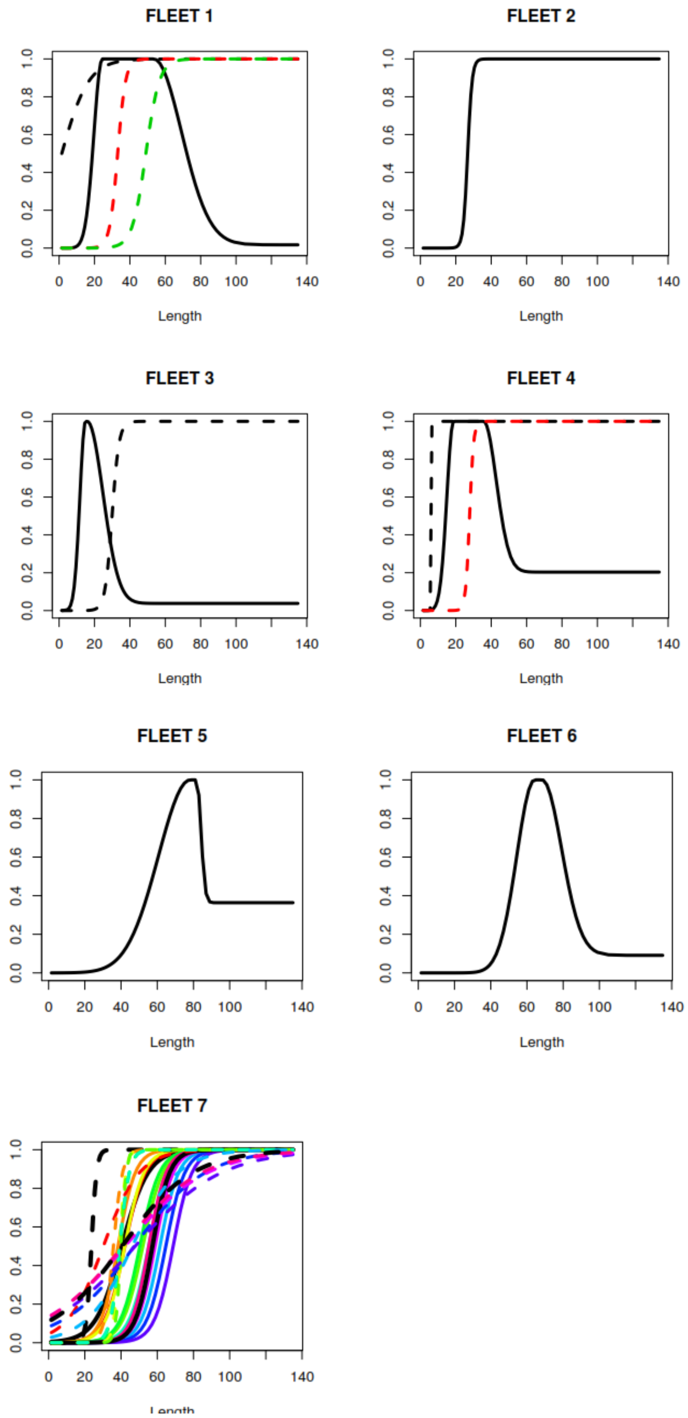


Figure 9.8. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Selection patterns (solid lines) and retention functions (dashed lines) at length by commercial fleet estimated by SS3. For FLEET1, retention functions for 1978–1997, 1998–2009 and 2010–2013 are in black, red and green respectively. For FLEET4, retention functions for 1978–1997 and 1998–2013 are in black and red respectively. For FLEET7, black lines correspond to the selection and retention functions from 1978–2002, the colours for the rest of the years are, 2003 (red), 2004 (orange), 2005 (yellow), 2006 (light green), 2007 (green), 2008 (light blue), 2009 (blue), 2010 (dark blue), 2011 (violet), 2013 (purple) and 2014 (pink).

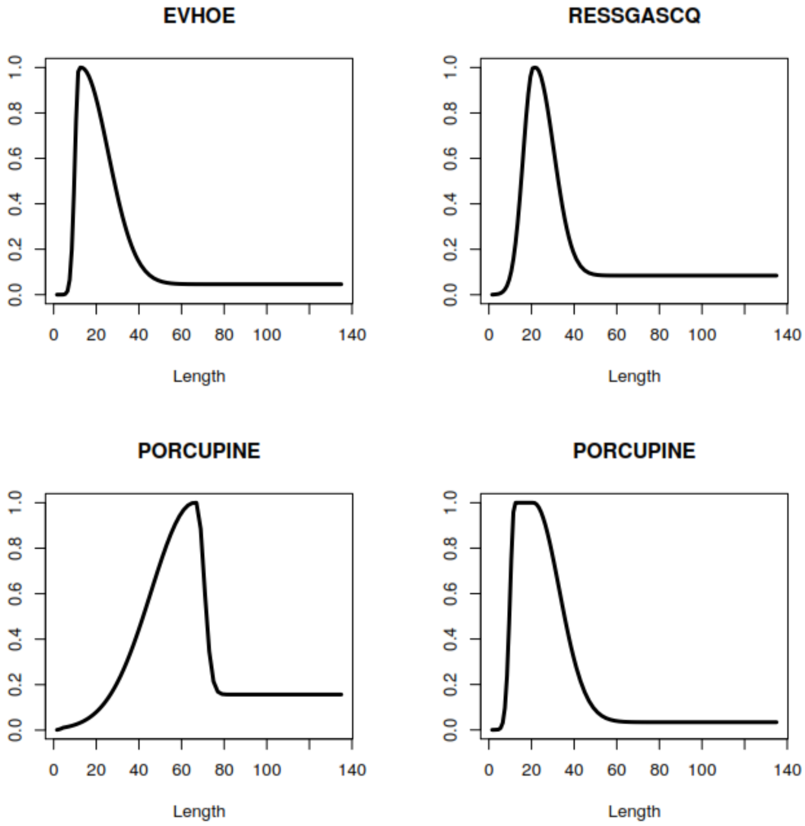


Figure 9.8 (continued). Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Selection patterns at length for surveys estimated by SS3.

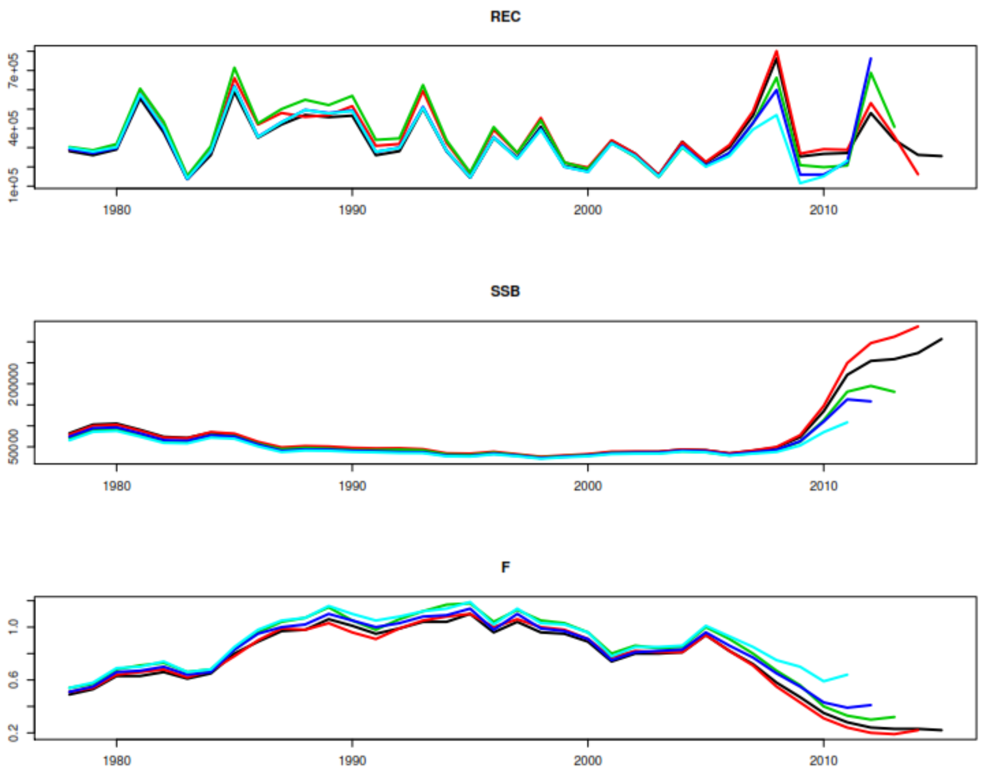


Figure 9.9. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Retrospective plot from SS3.

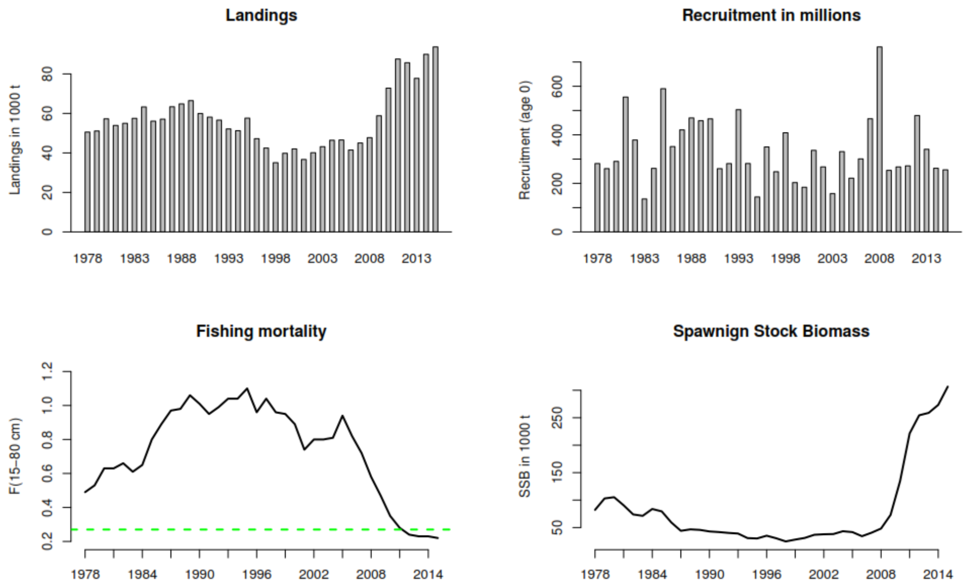


Figure 9.10. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Summary plot of stock trends.

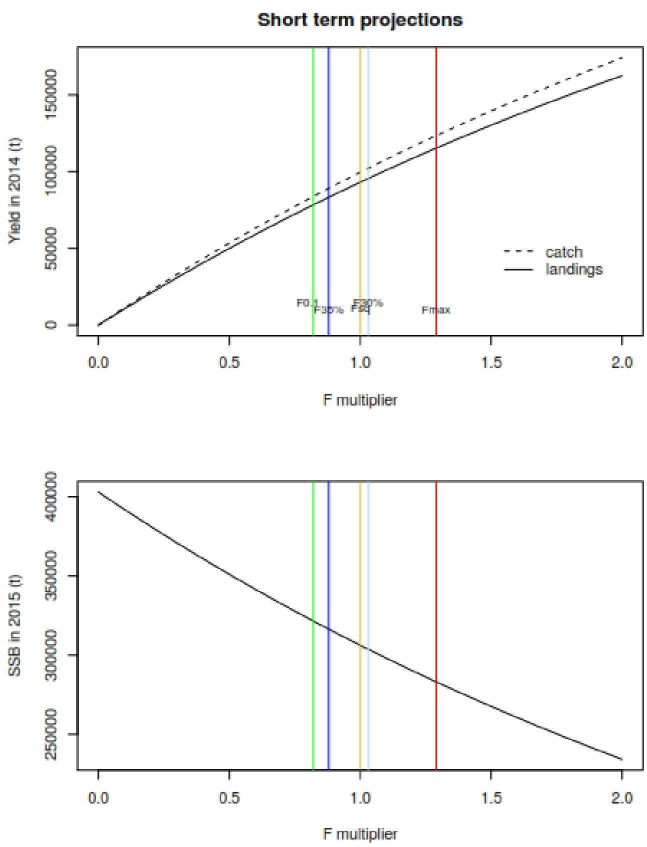


Figure 9.11. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Short-term projections

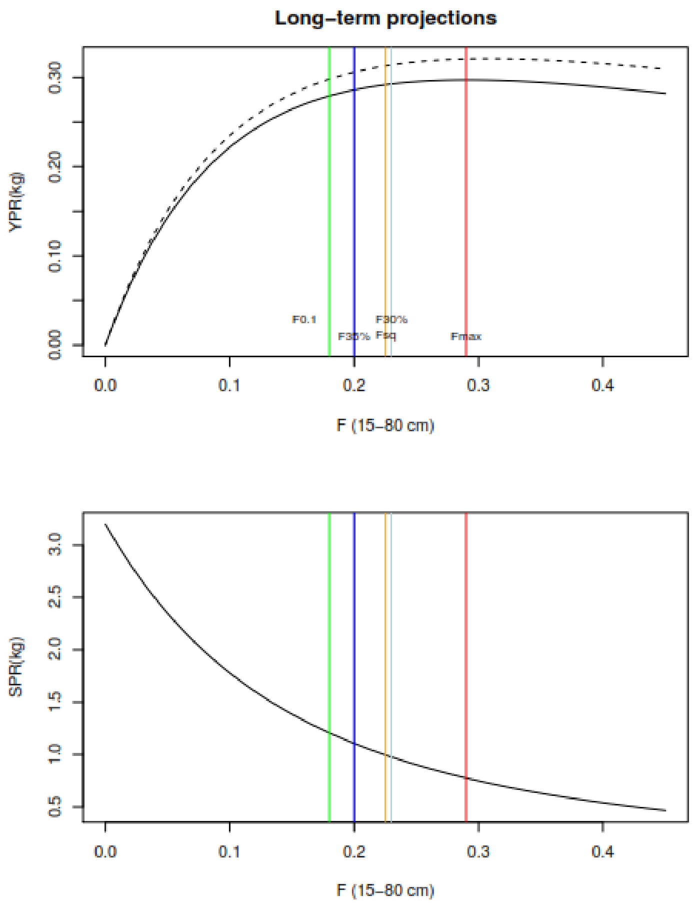


Figure 9.12. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Equilibrium yield and SSB per recruit.

10 Hake in Divisions 8.c and 9.a (Southern stock)

10.1 General

The type of assessment is "update" based on a previous benchmark assessment (WKSOUTH, 2014).

No data revisions in 2016

10.1.1 Fishery description

Fishery description is available in the Stock Annex (Annex G).

10.1.2 ICES advice for 2016 and Management applicable to 2015and 2016.

ICES Advice for 2016

ICES advised that when the MSY approach is applied, catches in 2016 should be no more than 6078 tonnes. Under the EU landing obligation in 2016, this implies landings should be the same as catches. A 7% *de minimis* applies to this stock as of 2016.

Management Applicable for 2015 and 2016

Hake is managed by TAC, effort control and technical measures. The agreed TAC for Southern Hake in 2015 was 13 826t and in 2016 is 10 674t.

A Recovery Plan for southern hake was enacted in 2006 (CE 2166/2005). This plan aimed to rebuild the stock to within safe biological limits by decreasing fishing mortality a maximum of 10% per year with a TAC constrain of 15%. SSB target (35 000 t) is no longer considered suitable under the new assessment model. This regulation includes effort management limiting days at sea that are updated every year Reg. EU Council 104/2015 and 72/2016 (annex II-b). The effort from fishing trips which retain <8% hake are excluded from the regulation.

Technical measures applied to this stock include: (i) minimum landing size of 27 cm, (ii) protected areas, and (iii) minimum mesh size. These measures are set depending on areas and gears by several national regulations.

According to the Spanish Regulations progressively implemented after 2011 AAA/1307/2013 the Spanish quota is shared by individual vessels. This regulation was updated in 2015 (AAA/2534/2015) including a fishing plan for trawlers. Regulations (EU Reg. 850/98) also established a closure for trawling off the southwest coast of Portugal between December and February.

10.1 Data

10.1.1 Commercial Catch: landings and discards

Catches: landings and discards

Southern Hake catches by country and gear for the period 1972-last year, as estimated by the WG, are given in Table 10.1. Since 2011, estimates of unallocated landings have been included in the assessment.

In 2015, landings decreased overall (11786 t compared to 12 011 t in 2014). Portuguese official landings were 2000 t, below those of 2014 (2 374 t). Spanish official landings were 6 758 t in 2015 while they had been 7 256t in 2014. Unallocated landings, on the other hand, increased to 2 789 t from 2246 t in 2014. Total landings in 2014 were 12 011 t and they decreased to 11 786 t in 2015 well below TACs that were16266 t and 13 826 t in 2014 and 2015, respectively. Total discards in 2015 were 2 292t while they had been 2 602 t in 2014, a noteworthy decrease. Total catches were 14 614 tin 2014 and 14 077 t in 2015.

Length distribution for 2015 landings and discards are presented in Figure 10.1 and in Tab 10.2. Mean size has been decreasing in landings (from 35.5 cm to 33.8 to 33.4 between 2013 and 2015), while it has been variable in discards (from 20.6 to 21.9 to 20.0 in the latest 3 years). Catch lengths varied from 27 to 27.9 to 26.4 cm. These all seem to reflect the variability of the strength of recruitment, to variable degrees.

Growth, Length-weight relationship and M

An international length-weight relationship for the whole period (a=0.00659; b=3.01721) has been used since 1999. The assessment model follows a constant von Bertalanffy model with fixed L_{inf} = 130 cm, t_0=0 and estimating k parameter. Natural mortality was assumed to be 0.4 year^{-1} for all ages and years.

Maturity ogive

The stock is assessed with annual maturity ogives for males and females together. The maturity proportion in this assessment year is shown in Figure 10.2. L50 have oscillated from 36.5 cm in 2013 and 31.7 cm in 2014, back to 36.3in 2015. Mean historical figures have been around 36 cm.

10.1.2 Abundance indices from surveys

Biomass, abundance and recruitment indices for the Portuguese and Spanish surveys respectively are presented in Table 10.3 and Table10.4 and Figure 10.3. The Spanish (SpGFS-WIBTS-Q4 and SPGFS-caut-WIBTS-Q4) and the Portuguese (PtGFS-WIBTS-Q4) surveys are used to tune the model, by fitting the model estimates to the observed length proportions and survey trends.

The Portuguese Autumn survey (PtGFS-WIBTS-Q4) showed variable abundance indices with a minimum in 1993 and a maximum in 2010 (the survey did not take place in 2012). There were very high values in recent years and currently it is near the maximum. The Spanish groundfish survey (SpGFS-WIBTS-Q4) shows low values for biomass and abundance in the early 2000s. These values increased from 2004 peaking to a then historical maximum in 2009, after which they remained relatively stable until 2012. In 2013 and 2014there was a further decrease to below the historical mean, but a full recovery to a new maximum was observed in 2015.

The recruitment indices of the SpGFS-WIBTS-Q4, SPGFS-caut-WIBTS-Q4 and PtGFS-WIBTS-Q4 (Figure 10.3) were highly variable in the past, showing good recruitments in recent years. In 2014 the 3 surveys decreased below historical means, but in 2015 the PtGFS-WIBTS-Q4 reached a historical maximum, while both SpGFS-WIBTS-Q4 and SPGFS-caut-WIBTS-Q4 returned to above average values.

For modelling purposes, length distribution calibration is made from the three surveys (SpGFS-WIBTS-Q4, SPGFS-caut-WIBTS-Q4 and PtGFS-WIBTS-Q4). Surveys used for trend calibration are only SpGFS-WIBTS-Q4, and PtGFS-WIBTS-Q4.

Commercial catch-effort data

Effort and respective landings series are collected from Portuguese logbooks maintained in DGRM and compiled by IPMA. For the Portuguese fleets, until 2011 most logbooks were filled in paper but have thereafter been progressively replaced by e-logbooks for those vessels covered by the obligation (vessel longer than 15m). The standardized cpue from the Portuguese bottom trawl fleet targeting roundfish is calculated by fitting a GLM to logbook data on landings and effort (modulated by additional fleet and catch characteristics), following the methods described in the stock annex and accepted by WKROUND (2010). The latest series is based on a renewed extraction of the complete logbook dataset housed in the DGRM (Portuguese administration) databases, which includes both paper and e-logbooks.

Spanish sales' notes and Owners Associations data were compiled by IEO to estimate fleet effort until 2012. After 2012 effort is reported following logbooks. LPUE data are presented in figure 10.4 and table 10.5. Changes in effort and landings estimation method prevent to use these data as a continuous series. The increased surveillance and the implementation of management regulations after 2011 have altered the fleet behaviour preventing its use as a new fleet for model calibration purposes.

The two fleets included in the assessment model are SP-CORUTR (from 1985 to 2012) and P-TR (from 1989 to 2015).

10.2 Assessment

The assessment carried out used the gadget model (length-age based) as decided by WKSOUTH (2014) and described on the stock annex (Annex G).

10.2.1 Model diagnostics

Likelihood profiles for each parameter estimated by the model are presented in Figure 10.5. The values on the horizontal axes of the plots represent multiplicative factors with respect to the estimated parameter value. To check for convergence, the minimum likelihood value must correspond to the estimated parameter value (i.e. the multiplier 1). Due to the distinct impact each parameter has on the likelihood value, the plots are presented scaled and unscaled. In Figure 10.5, all parameter estimates correspond to the minimum of the likelihood.

Residuals for surveys and abundance indices (SpGFS-WIBTS-Q4 and PtGFS-WIBTS-Q4) and commercial fleets (SP-CORUTR and P-TR) are presented in Fig 10.6a–b, grouped in 15 cm classes (from 4–49 cm in surveys and 25 to 70 cm in commercial fleets). Most residuals are within the range of -1 to 1 (±1 s.d.). Surveys' residuals show a random distribution with the possible exception of PtGFS-WIBTS-Q4 for lengths 4-19 cm, which however displays no clear trend.

P-TR (25–40 cm) showed negative residuals with a downward trend between 2005 and 2010 but has since then returned to zero. The perceived trend is within acceptable bounds. Apart from this, the fits for these 3 length groups are quite consistent. The SP-CORUTR (1994–2012) shows also quite consistent random residuals with the exception of the length group 55–70 cm, which shows positive residuals for 6 years (2007–2012).

Figures 10.6 (c-i) present bubble plots of residuals for proportions at length. These proportions are grouped in2 cm classes for all "fleets" used in the model calibration (see Stock Annex for descriptions). The model fits these proportions at length assuming a constant selection pattern for every "fleet" in the years and quarters in which length distributions are observed. The quality of the fit is different for different datasets, but not all of them contribute equally to the overall model fit. Projections are based on the selection patterns estimated only for landings (10.6-d) and discards (10.6-f). The residual analysis shows that there is an underestimation (positive residuals) in the most exploited lengths and overestimation on the larger sizes (negative residuals). Such patterns are not of major concern since the residuals' values are quite small (maximum ~0.3). The model takes into account the data precision when weighting the individual likelihood components (defined in the Stock Annex), so datasets with larger model residuals will have less impact on the overall model fit.

10.2.2 Assessment results

Estimated parameters

The model estimates selection parameters for each “fleet” for which length proportions are fitted. Furthermore, it estimates the von Bertalanffy growth parameter k. Results are presented in Figure 10.7. The selection patterns of different “fleets” of catches (catches in 1982-93; landings in 1994-latest; discards 1992-latest and Cadiz landings (1982-2004) are presented in the upper panel. The pattern corresponding to catches during 1982-93 shows higher relative efficiency for smaller fish (when compared with catches from 1994 onwards), which is in agreement with our assumption that before 1992 (when the minimum landing size was implemented) the importance of discards was relatively lower. The discards (1992-latest) and landings (1994-latest) selection patterns are used for projections. Survey selection patterns are presented in the middle panel. The Portuguese survey PtGFS-WIBTS-Q4 catches relatively larger fish than the Spanish surveys (SpGFS-WIBTS-Q4 and SPGFS-caut-WIBTS-Q4). Both Spanish surveys show a similar pattern. They are both performed with the same vessel and gear in every year, but since 2013 a new vessel has been used (without a significant impact in hake abundance estimates).

The von Bertalanffy k parameter was estimated to be 0.164, the same as in the previous assessment.

Historic trends in biomass, fishing mortality, yield and recruitment

Model estimates of abundance at length at the beginning of the 4th quarter are presented in Figure 10.8. The figure shows a general increase of small fish in 2005-09, that contributes to an increase of large fish in more recent years.

Table 10.6 and Figure 10.9 present summary results with estimated annual values for fishing mortality (averaged over ages 1–3), recruitment (age 0) and SSB, as well as observed landings and discards.

Recruitment (age 0) is highly variable with some definable periods, particularly: one from 1982–2003 with mean figures around 70 million (ranging from 40–120 mill); another between 2005 and 2009with mean figures of 121 mill; and another between 2009 and 2014, around the historic mean (80 mill). In 2015it was 316.37 mill. Following the technical annex, the latest recruitment was replaced with the geometric mean of years 1989–2014 (79.272mill). This parameter has been typically poorly estimated as evidenced by the retrospective pattern (Fig 10.10). Fishing mortality increased from the beginning of the time-series (F=0.36 in 1982) peaking in 1995–97around1.18; declining to 0.78 in 1999 and remaining relatively stable until 2009 (F=1.01). F then progressively decreased to reach 0.52in 2015. The SSB was very high at the beginning of the time-series with values around 40 000 t, then decreased to a minimum of 5 810t in 1998. Since then biomass has continuously increased, reaching 20 120in 2015.

Retrospective pattern for SSB, fishing mortality, yield and recruitment

Figure 10.10 presents the results of the assessments performed using the retrospective dataseries from 2015-2009. There is a less clear trend in the retrospective pattern for recruitment, F and SSB than in previous years. Recruitment shows high variability, whereas SSB show a tendency to be overestimated, in contrast to F which shows a tendency to be underestimated.

10.3 Catch options and prognosis

10.3.1 Short-term projections

The methodology used was developed during the latest benchmark (WKSOUTH, 2014) and described in the Stock Annex. Short-term projections are presented in Figure 10.11 and Table 10.7. Note that mortality in GADGET is length based and F multipliers do not apply linearly, e.g. if F_{mult} is 1, F is 0.52and if F_{mult}=0.5 F is 0.25.

In 2016the expected SSB is 23 101 t. F_{sq} for the intermediate year (2016) is estimated as the average of the last 3 assessment years scaled to last year (0.52). Recruitment for 2015is the geometric mean of 1989–2014 which is 79.272 mill. Recruitment used for projections in years 2016-2017 was the same geometric mean. During the intermediate year, 2016, the expected yield (landings) is 11337t and the SSB at the end of the year is expected to be 25 358t.

Different F multipliers applied in 2017 provide management alternatives according to different scenarios. Under F_{sq} (F_{mult}=1), F would be 0.52, the expected yield would be 12 318 t and SSB in 2017would be 27 074 t. Decreasing F by 10% (F_{mult}=0.9), F would be 0.46, the yield and SSB, 11 320t and 28852 t, respectively. With the MSY approach (F=0.25), F_{mult} would be 0.50, the yield6838t and SSB 37 110t.

10.3.2 Long-term projections

Long-term projections are plotted in Figure 10.12. This projection last until the year 2050 with a recruitment equal to the geometric mean of years 1989–2014.

The following table shows the expected figures for different reference Fs:

	F (1-3)	YIELD	SSB
F_{sq}	0.52	14110	29678
F_{low}	0.17	16617	107673
F_{MSY}	0.25	17396	75928
F_{upp}	0.36	16478	49935

10.4 Biological reference points

Reference points were estimated by WKMSYRef4 (ICES 2016). MSY $B_{trigger}$ was set as a B_{pa} by ACOM (ICES, 2016)

Reference points

PA Reference points	Value	Rational
B_{lim}	7 956	Hockey stick breakpoint (8 000 t if rounded)
B_{pa}	11 100	B_{lim} * 1.4
F_{lim}	1.05	F corresponding to the slope of the hockey stick SSB-Rec relationship
F_{pa}	0.75	Flim / 1.4
MSY Reference points		
F_{MSY}	0.25	
F_{MSY} lower	0.17	
F_{MSY} upper	0.36	
B_{MSY}	73 330	
MSY	18 139	
MSY $B_{trigger}$	11 100	

10.5 Comments on the assessment

Updates of the index SP-CORUTR was not included in the model.

Given the lack of abundance indices for large fish at the beginning of the time-series, the SSB estimates for this period should be considered with caution.

Recruitment was quite high between 2005–2009, after which it returned to a value around the historic mean. In 2015, however, it appears to be particularly high, as indicated by both the research surveys and discard series.

The retrospective pattern shows a trend to overestimate SSB and underestimate F but the strength of the pattern has decreased in 2015 (SSB Mohn's rho = 0.24; F Mohn's rho= -0.203).

10.6 Management considerations

Landings have historically been well above the TACs since 2004. However, for the latest two years they have been below the advised TAC and this year is quite similar.

The recruitment estimated by the model was considered not credible and was replaced with the geometric mean for projections. However, the 3 surveys show levels of recruitment over the historic mean, which is considered a signal of good recruitment for 2015.

The objective of the recovery plan was to rebuild the stock within safe biological limits, meaning to reach an SSB of 35 000 t by 2015. Since the enforcement of the plan the stock historical perception has changed. The SSB of the recovery plan is therefore no longer valid. A B_{lim} = 7 956 t is currently proposed in 2015 (ICES, 2016) based on the Hockey-Stick breakpoint. Recent B_{pa} was set as 11 100. SSB in 2016 is 23 101 t suggest that the stock is inside safe biological limits.

F in 2015 is above FMSY. The stock is therefore being overexploited.

The retrospective pattern shows a general trend to overestimate SSB and underestimate F, although the last model update and the previous retrospective peel fit each other quite well.

Hake is a top predator eating mainly blue whiting, horse mackerel and hake. The main hake predators in the area are common and bottlenose dolphin.

Hake is caught in a mixed fisheries with other demersal (e.g. megrim, monkfish and *nephrops*) and pelagic (e.g. blue whiting, sardine or horse mackerel) species.

Table 10.1 HAKE SOUTHERN STOCK. Catch estimates (´000 t) by country and gear.

	SPAIN									PORTUGAL				FRANCE		TOTAL		
YEAR	**ART**	**GILLNET**	**LONGLINE**	**Cd-Trw**	**Pr-Bk TRW**	**Pa-Trw**	**Ba-Trw**	**DISC**	**LAND**	**ART**	**TRAWL**	**DISC**	**LAND**	**TOTAL**	**UNALLOCATED**	**DISC**	**LAND**	**CATCH**
1972	7,10	-	-	-	10,20				**17,3**	4,70	4,10	**-**	**8,8**			**-**	**26,1**	**26,1**
1973	8,50	-	-	-	12,30				**20,8**	6,50	7,30	**-**	**13,8**	0,20		**-**	**34,8**	**34,8**
1974	1,00	2,60	2,20	-	8,30				**14,1**	5,10	3,50	**-**	**8,6**	0,10		**-**	**22,8**	**22,8**
1975	1,30	3,50	3,00	-	11,20				**19,0**	6,10	4,30	**-**	**10,4**	0,10		**-**	**29,5**	**29,5**
1976	1,20	3,10	2,60	-	10,00				**16,9**	6,00	3,10	**-**	**9,1**	0,10		**-**	**26,1**	**26,1**
1977	0,60	1,50	1,30	-	5,80				**9,2**	4,50	1,60	**-**	**6,1**	0,20		**-**	**15,5**	**15,5**
1978	0,10	1,40	2,10	-	4,90				**8,5**	3,40	1,40	**-**	**4,8**	0,10		**-**	**13,4**	**13,4**
1979	0,20	1,70	2,10	-	7,20				**11,2**	3,90	1,90	**-**	**5,8**	-		**-**	**17,0**	**17,0**
1980	0,20	2,20	5,00	-	5,30				**12,7**	4,50	2,30	**-**	**6,8**	-		**-**	**19,5**	**19,5**
1981	0,30	1,50	4,60	-	4,10				**10,5**	4,10	1,90	**-**	**6,0**	-		**-**	**16,5**	**16,5**
1982	0,27	1,25	4,18	0,49	3,92				**10,1**	5,01	2,49	**-**	**7,5**	-		**-**	**17,6**	**17,6**
1983	0,37	2,10	6,57	0,57	5,29				**14,9**	5,19	2,86	**-**	**8,0**	-		**-**	**22,9**	**22,9**
1984	0,33	2,27	7,52	0,69	5,84				**16,7**	4,30	1,22	**-**	**5,5**	-		**-**	**22,2**	**22,2**
1985	0,77	1,81	4,42	0,79	5,33				**13,1**	3,77	2,05	**-**	**5,8**	-		**-**	**18,9**	**18,9**
1986	0,83	2,07	3,46	0,98	4,86				**12,2**	3,16	1,79	**-**	**4,9**	0,01		**-**	**17,2**	**17,2**
1987	0,53	1,97	4,41	0,95	3,50				**11,4**	3,47	1,33	**-**	**4,8**	0,03		**-**	**16,2**	**16,2**
1988	0,70	1,99	2,97	0,99	3,98				**10,6**	4,30	1,71	**-**	**6,0**	0,02		**-**	**16,7**	**16,7**
1989	0,56	1,86	1,95	0,90	3,92				**9,2**	2,74	1,85	**-**	**4,6**	0,02		**-**	**13,8**	**13,8**
1990	0,59	1,72	2,13	1,20	4,13				**9,8**	2,26	1,14	**-**	**3,4**	0,03		**-**	**13,2**	**13,2**
1991	0,42	1,41	2,20	1,21	3,63				**8,9**	2,71	1,25	**-**	**4,0**	0,01		**-**	**12,8**	**12,8**
1992	0,40	1,48	2,05	0,98	3,79			**0,14**	**8,7**	3,77	1,33	**0,33**	**5,1**	-		**0,5**	**13,8**	**14,3**
1993	0,37	1,26	2,74	0,54	2,67			**0,24**	**7,6**	3,04	0,87	**0,44**	**3,9**	-		**0,7**	**11,5**	**12,2**
1994	0,37	1,90	1,47	0,32		0,82	1,90	**0,29**	**6,8**	2,30	0,79	**0,71**	**3,1**	-		**1,0**	**9,9**	**10,9**
1995	0,37	1,59	0,96	0,46		2,34	2,94	**0,93**	**8,6**	2,56	1,03	**1,18**	**3,6**	-		**2,1**	**12,2**	**14,3**
1996	0,23	1,15	0,98	0,98		1,46	2,17	**0,91**	**7,0**	2,01	0,76	**0,99**	**2,8**	-		**1,9**	**9,7**	**11,6**
1997	0,30	1,04	0,76	0,88		1,32	1,78	**1,07**	**6,1**	1,52	0,90	**1,20**	**2,4**	-		**2,3**	**8,5**	**10,8**
1998	0,32	0,75	0,62	0,53		0,88	1,95	**0,57**	**5,0**	1,67	0,97	**1,11**	**2,6**	-		**1,7**	**7,7**	**9,4**
1999	0,33	0,60	0,00	0,57		0,87	1,59	**0,35**	**4,0**	2,12	1,09	**1,17**	**3,2**	-		**1,5**	**7,2**	**8,7**
2000	0,26	0,85	0,15	0,58		0,83	1,98	**0,62**	**4,7**	2,09	1,16	**1,21**	**3,3**	-		**1,83**	**7,90**	**9,7**
2001	0,32	0,55	0,11	1,20		1,06	1,12	**0,37**	**4,4**	2,02	1,20	**1,29**	**3,2**	-		**1,66**	**7,58**	**9,2**
2002	0,22	0,58	0,12	0,88		1,37	0,75	**0,38**	**3,9**	1,81	0,97	**1,11**	**2,8**	-		**1,49**	**6,70**	**8,2**
2003	0,37	0,43	0,17	1,25		1,36	1,07	**0,41**	**4,7**	1,13	0,96	**1,05**	**2,1**	-		**1,46**	**6,74**	**8,2**
2004	0,48	0,42	0,13	1,06		1,66	1,13	**0,22**	**4,9**	1,27	0,80	**0,69**	**2,1**	-		**0,91**	**6,94**	**7,9**
2005	0,72	0,63	0,09	0,88		2,77	1,14	**0,38**	**6,2**	1,10	0,96	**1,60**	**2,1**	-		**1,98**	**8,30**	**10,3**
2006	0,48	0,71	0,35	0,63		4,70	1,81	**2,65**	**8,7**	1,22	0,91	**0,61**	**2,1**	-		**3,26**	**10,80**	**14,1**
2007	0,83	1,80	0,89	0,50		6,71	2,07	**1,19**	**12,8**	1,41	0,72	**1,31**	**2,1**	-		**2,50**	**14,93**	**17,4**
2008	1,12	2,64	1,51	0,53		6,32	2,44	**1,45**	**14,6**	1,27	0,94	**0,86**	**2,2**	-		**2,31**	**16,77**	**19,1**
2009	1,41	2,92	2,10	0,55		7,37	2,54	**0,98**	**16,9**	1,39	0,96	**1,96**	**2,4**	-		**2,93**	**19,24**	**22,2**
2010	0,72	1,71	1,88	0,68		6,33	1,71	**1,00**	**13,0**	1,61	0,73	**0,58**	**2,3**	0,36		**1,58**	**15,74**	**17,3**
2011	0,42	1,09	0,76	0,53		2,18	1,48	**1,21**	**6,5**	1,72	0,49	**0,74**	**2,2**		8,40	**1,95**	**17,07**	**19,0**
2012	0,34	0,85	1,08	0,50		1,64	1,42	**1,35**	**5,8**	1,79	0,81	**0,00**	**2,6**		6,14	**1,35**	**14,57**	**15,9**
2013	0,64	1,75	1,11	0,62		1,86	1,16	**2,22**	**7,2**	1,93	0,81	**0,00**	**2,7**	0,31	1,46	**2,22**	**11,66**	**13,9**
2014	0,75	1,46	1,60	0,54		1,72	1,18	**2,02**	**7,3**	1,71	0,66	**0,58**	**2,4**	0,14	2,25	**2,60**	**12,01**	**14,6**
2015	0,90	1,11	1,23	0,36		2,01	1,13	2,06	**6,8**	1,24	0,76	0,23	**2,0**	0,24	2,8	**2,29**	**11,79**	**14,1**

Table 10.2 HAKE SOUTHERN STOCK - length compositions (thousands)

Length (cm) (4 to 100+ each 2)	Land	Disc	Catch
4	0	0	0
6	0	5	5
8	51	106	156
10	225	737	962
12	536	2014	2551
14	687	5302	5989
16	1014	5368	6382
18	1065	4567	5632
20	1065	4307	5371
22	993	3207	4201
24	1106	2619	3725
26	2173	2947	5120
28	3785	1550	5335
30	3443	85	3528
32	2352	563	2915
34	2282	4	2286
36	2089	12	2102
38	1387	6	1393
40	960	1	961
42	617	1	618
44	434	0	434
46	377	0	377
48	414	0	414
50	428	0	428
52	395	0	395
54	386	0	386
56	352	0	352
58	346	0	346
60	313	0	313
62	268	0	268
64	209	0	209
66	146	0	146
68	110	0	110
70	82	0	82
72	55	0	55
74	43	0	43
76	34	0	34
78	23	0	23
80	16	0	16
82	18	0	18
84	10	0	10
86	9	0	9
88	4	0	4
90	3	0	3
92	3	0	3
94	2	0	2
96	2	0	2
98	1	0	1
TOTAL	30313	33401	63715
Nominal Weight (tons)	11,55	2,29	13,84
SOP	11,52	2,23	13,75
SOP / NW	1,00	1,03	1,01
Mean length (cm)	33,4	20,0	26,4

*** without France landings**

Table 10.3 HAKE SOUTHERN STOCK - Portuguese groundfish surveys; biomass, abundance and recruitment indices

Year	Winter (ptGFS-WIBTS-Q1)					Summer					Autumn (ptGFS-WIBTS-Q4)					
	Biomass (kg/h)		Abundance (N/h)			Biomass (kg/h)		Abundance (N/h)			Biomass (kg/h)		Abundance (N/h)			
	Mean	s.e.	Mean	s.e.	hauls	Mean	s.e.	Mean	s.e.	hauls	Mean	s.e.	Mean	s.e.	n/hour < 20 cm (1)	hauls
1979 *						11,7		80,4		55	9,5		na			55
1980 * (**)	11,3		178,1		36	15,4		153,0		63	12,5		108,7			62
1981 (Autumn **)	10,7	0,7	122,4	15,5	67	9,9	1,3	87,8	15,5	69	24,4	0,5	734,8	29,3		111
1982	18,1	2,5	265,6	37,5	69	11,0	2,7	93,0	32,8	70	10,6	1,8	119,5	34,7		190
1983 (Autumn **)	27,0	6,0	530,5	151,0	69	15,1	2,3	120,5	20,8	98	13,4	0,5	121,8	4,8		117
1984																
1985						14,3	0,8	170,7	15,6	101	11,0	0,7	128,7	8,4	86,7	150
1986						27,4	1,8	249,4	15,1	118	17,7	1,2	165,6	28,4	90,2	117
1987											8,6	0,9	37,4	3,7	7,3	81
1988											15,3	1,7	177,8	30,8	111,7	98
1989						11,9	0,9	80,8	8,6	114	8,4	0,5	59,6	4,6	19,8	130
1990						9,8	1,0	95,6	13,5	98	11,8	1,0	157,2	26,3	97,2	107
1991						14,2	1,2	104,2	11,3	119	20,9	4,3	195,3	41,5	92,3	80
1992	14,5	1,2	176,4	32,3	88	10,9	1,1	74,1	11,4	81	11,7	1,7	65,2	11,1	18,8	51
1993	9,0	0,7	78,7	16,8	75	11,3	1,7	105,0	34,7	66	5,5	0,8	54,4	12,9	28,4	58
1994											9,9	1,0	98,9	12,1	52,9	77
1995						15,0	1,4	129,3	16,3	81	14,8	1,7	85,8	10,7	7,9	80
1996***											9,2	1,1	109,9	17,8	18,2	63
1997						19,0	1,4	206,5	16,9	86	24,6	9,3	208,0	92,5	62,1	51
1998						10,5	0,8	71,6	8,6	87	15,6	2,0	140,6	21,7	75,9	64
1999***						11,8	0,7	116,2	10,1	65	11,6	1,5	118,3	17,1	14,4	71
2000						16,4	1,6	123,0	15,2	88	11,8	1,8	102,7	19,9	49,2	66
2001						16,6	1,7	132,5	14,2	83	15,6	2,8	164,2	38,5	89,9	58
2002											13,0	2,1	117,6	26,9	60,6	66
2003 ***											9,8	1,0	94,2	8,0	11,9	71
2004 ***											18,4	3,3	402,3	85,2	78,2	79
2005	17,7	2,6	384,0	53,8	68						19,0	1,9	214,2	23,5	131,7	87
2006	16,0	2,0	377,5	55,4	66						16,5	1,8	126,2	11,0	54,7	88
2007	22,4	3,4	609,1	114,1	63						25,8	2,8	370,2	46,7	240,0	96
2008	31,1	4,8	700,6	170,8	67						34,6	4,3	293,6	33,9	87,7	87
2009											37,5	4,4	476,4	75,9	318,6	93
2010											38,2	4,3	418,0	49,8	249,8	87
2011											18,7	1,5	272,9	25,2	179,4	86
2013											35,2	3,4	473,1	62,1	289,0	93
2014											17,1	1,5	195,7	23,9	93,9	81
2015											37,2	4,3	602,1	65,0	393,2	90

NO surveys in 2012

all data concerns 20 mm cod end mesh size except data marked with * which concerns 40 mm

(1) n/hour <20 cm converted to Noruega and NCT

(**) all area not covered

*** R/V Capricornio, other years R/V Noruega

Strata depth:

from 1979 to 1988 covers 20-500 m depth

from 1989 to 2004 covers 20-750 m depth

since 2005 covers 20-500 m depth

since 2002 tow duration is 30 min for autumn survey

Table 10.4 HAKE SOUTHERN STOCK - Spanish groundfish surveys; abundances and recruitment indices for total area (Mino - Bidasoa). Biomass for Cadiz surveys.

	Spanish Survey (SpGFS-WIBTS-Q4) (/30 min)						Cadiz Survey (SPGFS-caut-WIBTS-Q4) (/hour)				Cadiz Survey (SPGFS-cspr-WIBTS-Q1) (/hour)			
	Biomass index (Kg)		Abundance Index (nº)			Recruits (<20cm)	Biomass index (Kg)			Rec (<20cm)	Biomass index (Kg)			Rec (<20cm)
Year	Mean	s.e.	Hauls	Mean	s.e.	Mean	Mean	s.e.	hauls	Mean	Mean	s.e.	hauls	mean
1983	7,04	0,65	107	192,4	25,0	177								
1984	6,33	0,60	94	410,4	53,5	398								
1985	3,83	0,39	97	108,5	14,0	98								
1986	4,16	0,50	92	247,8	46,5	239								
1987														
1988	5,59	0,69	101	390,0	67,4	382								
1989	7,14	0,75	91	487,9	73,1	477								
1990	3,34	0,32	120	85,9	9,1	78								
1991	3,37	0,39	107	166,8	15,8	161								
1992	2,14	0,19	116	59,3	5,4	52								
1993	2,49	0,21	109	80,0	8,0	73					3,04	0,53	30	
1994	3,98	0,33	118	245,0	24,9	240					2,68	0,33	30	
1995	4,58	0,44	116	80,9	8,4	68					4,66	1,28	30	71,5
1996	6,54	0,59	114	345,2	40,5	335					7,66	1,14	31	72,7
1997	7,27	0,78	119	421,4	56,5	410	5,28	2,77	27	26,7	3,34	0,52	30	72,5
1998	3,36	0,28	114	75,9	8,7	65	2,66	0,42	34	6,6	2,93	0,67	31	18,6
1999	3,35	0,25	116	95,3	10,6	89	2,71	0,44	38	23,9	3,03	0,37	38	44,6
2000	3,01	0,43	113	66,9	7,4	59	2,03	0,61	30	18,6	3,02	0,47	41	39,7
2001	1,73	0,29	113	42,0	7,6	37	2,57	0,45	39	22,7	6,01	0,79	40	72,4
2002	1,91	0,23	110	57,1	8,8	53	3,39	0,78	39	118,6	2,74	0,25	41	22,4
2003	2,61	0,27	112	92,8	11,6	86	1,61	0,28	41	17,5				
2004	3,94	0,40	114	177,0	23,5	170	2,72	0,69	40	85,8	3,65	0,47	40	92,7
2005	6,46	0,53	116	344,8	32,2	335	6,68	1,29	42	100,6	10,77	5,65	40	184,3
2006	5,50	0,39	115	224,5	21,9	211	4,99	2,00	41	212,3	2,15	0,40	41	3,7
2007	4,97	0,43	117	158,2	15,0	150	6,92	1,43	37	200,3	3,22	0,68	41	51,1
2008	4,93	0,46	115	99,3	11,5	81	4,33	0,60	41	64,4	3,48	0,67	41	50,5
2009	9,32	0,94	117	559,7	93,9	789	7,35	0,97	43	95,0	4,24	0,06	40	65,6
2010	8,36	0,65	114	201,0	14,9	175	5,82	0,83	44	46,0	6,91	1,09	36	202,5
2011	8,98	0,68	111	241,5	21,0	216	2,97	0,38	40	48,2	3,75	0,50	42	32,2
2012	8,44	0,75	115	297,3	39,5	280	5,38	0,90	37	44,0	3,49	0,65	33	62,9
2013	5,59	0,78	114	136,9	13,6	118	12,52	2,04	43	285,6	5,50	0,56	40	76,5
2014	3,72	0,44	116	78,0	9,6	68	9,33	1,38	45	63,0	6,01	0,65	40	60,4
2015	9,87	0,85	114	316,8	33,7	296	13,67	2,61	43	186,8	6,01	0,69	43	165,3

Since 1997 new depth stratification: 70-120m, 121-200m and 201-500 m

Before 1997: 30-100m, 101-200m and 201-500 m

Table 10.5 HAKE SOUTHERN STOCK. Landings (tonnes), Catch per unit effort and effort for trawl fleets

	A Coruña Trawl			Portugal trawl		
YEAR	Landings	lpue (Kg/day x100 HP)	Effort	Landings	lpue (Kg/hour std)	Effort
1985	945	21	45920			
1986	842	21	39810			
1987	695	20	34680			
1988	698	17	42180			
1989	715	16	44440	1847	46,9	39372
1990	749	17	44430	1138	42,5	26777
1991	501	12	40440	1245	39,0	31914
1992	589	15	38910	1325	37,2	35605
1993	514	12	44504	871	30,8	28319
1994	473	12	39589	789	37,5	21067
1995	831	20	41452	1026	45,9	22330
1996	722	20	35728	894	42,5	21044
1997	732	21	35211	906	50,1	18067
1998	895	27	32563	913	43,4	21024
1999	691	23	30232	1092	52,5	20782
2000	590	20	30102	1162	36,8	31547
2001	597	20	29923	1210	47,8	25296
2002	232	11	21823	970	46,8	20714
2003	274	15	18493	962	43,1	22315
2004	259	12	21112	800	43,3	18491
2005	330	16	20663	965	46,1	20917
2006	518	27	19264	908	44,5	20406
2007	621	29	21201	724	41,5	17436
2008	762	38	20212	936	49,3	18978
2009	640	40	16162	964	46,0	20936
2010	553	40	13744	800	46,2	17316
2011	538	47	11532	542	46,6	11620
2012	498	42	11887	895	54,1	16555
2013*	542	37	14736	893	51,1	17466
2014*	493	27	18060	727	49,7	14616
2015*	411	31	13309	839	61,6	13617

Spanish LPUEs are scientific estimations from a selection of ships that may change from year to year.
***Spanish sampling method changed for effort and landings - not used in the model**

Table 10.6. Southern Hake Stock Assessment summary

Year	Mort (1-3)	SSB ('000 tn)	R (million)	Catch ('000 tn)	Land ('000 tn)	Disc ('000 tn)
1982	0,36	41,10	98,40	17,59	17,59	**
1983	0,44	45,80	81,48	22,95	22,95	**
1984	0,45	43,05	69,48	22,18	22,18	**
1985	0,42	43,14	44,09	18,94	18,94	**
1986	0,45	40,03	40,97	17,16	17,16	**
1987	0,51	36,77	50,14	16,18	16,18	**
1988	0,65	27,03	71,23	16,65	16,65	**
1989	0,65	19,90	78,07	13,79	13,79	**
1990	0,69	16,28	82,33	13,19	13,19	**
1991	0,69	16,46	69,84	12,83	12,83	**
1992	0,84	15,52	52,40	14,27	13,80	0,47
1993	0,91	12,76	61,10	12,17	11,48	0,68
1994	0,89	8,89	119,55	10,86	9,86	0,99
1995	1,19	7,09	51,18	14,34	12,24	2,10
1996	1,16	8,52	101,04	11,62	9,71	1,91
1997	1,18	6,50	80,79	10,77	8,50	2,27
1998	0,94	5,73	57,80	9,36	7,68	1,68
1999	0,79	7,43	67,10	8,69	7,17	1,52
2000	0,88	8,70	70,66	9,74	7,90	1,83
2001	0,86	8,86	49,61	9,24	7,58	1,66
2002	0,82	9,31	70,18	8,18	6,69	1,49
2003	0,83	9,14	59,63	8,21	6,74	1,46
2004	0,73	9,14	79,04	7,86	6,94	0,91
2005	0,77	9,50	126,82	10,31	8,33	1,98
2006	0,88	10,92	94,36	14,08	10,82	3,26
2007	0,94	12,85	169,11	17,44	14,93	2,50
2008	0,92	12,59	116,98	19,11	16,80	2,31
2009	0,95	14,49	106,47	22,17	19,24	2,93
2010	0,71	14,61	64,34	16,95	15,37	1,58
2011	0,79	17,82	90,18	19,01	17,06	1,95
2012	0,75	17,47	88,92	16,40	14,57	1,82
2013	0,62	16,52	69,23	13,91	11,35	2,55
2014	0,66	20,65	82,00	14,48	11,88	2,60
2015*	0,52	20,12	316,37	13,84	11,55	2,29

* Landings do not include France data presented in table 7.1
** Discards time series begin in 1992 the year of implementation of MLS (27 cm). Before that zero discards assumed.
For short term projections 2015 Recruitment (316.4) substituted with geomean (79.3), this implies F moves from 0.52 to 0.56

Table 10.7. Short term projections

SSB 2016	BIO 2016	F 2016	Yield 2016	Catch 2016	SSB 2017	BIO 2017
23101	28030	0,52	11337	13473	25358	30451

Fmult	F 2017	Yield 2017	Catch 2017	SSB 2018	
0,00	0,00	0	0	49982	*zero catch*
0,10	0,05	1483	1741	47180	
0,20	0,10	2906	3414	44480	
0,30	0,15	4270	5021	41907	
0,34	0,17	4849	5703	40820	*Flow*
0,40	0,20	5578	6562	39456	
0,50	0,25	6838	8049	37110	*Fmsy*
0,57	0,29	7705	9073	35503	*TAC-15%*
0,60	0,30	8030	9457	34903	
0,69	0,35	9059	10674	33008	*equal TAC*
0,70	0,35	9177	10813	32792	
0,71	0,36	9303	10962	32561	*Fupp*
0,80	0,41	10273	12112	30786	
0,81	0,41	10411	12275	30535	*TAC+15%*
0,90	0,46	11320	13353	28882	
0,92	0,47	11523	13595	28512	*F-10%*
1,00	0,52	12318	14540	27074	*F sq*
2,27	1,28	21381	25433	11100	*Bpa-Btrg*
2,69	1,57	23172	27638	8000	*Blim*

There is a EC Recovery Plan (-10% annual F redution; +-15% TAC constrain)
Fmsy = 0.25
TAC 2016 = 10674 (-+15% [12275, 9073])
Recruitment = 79 mill (geo mean 1989-13)

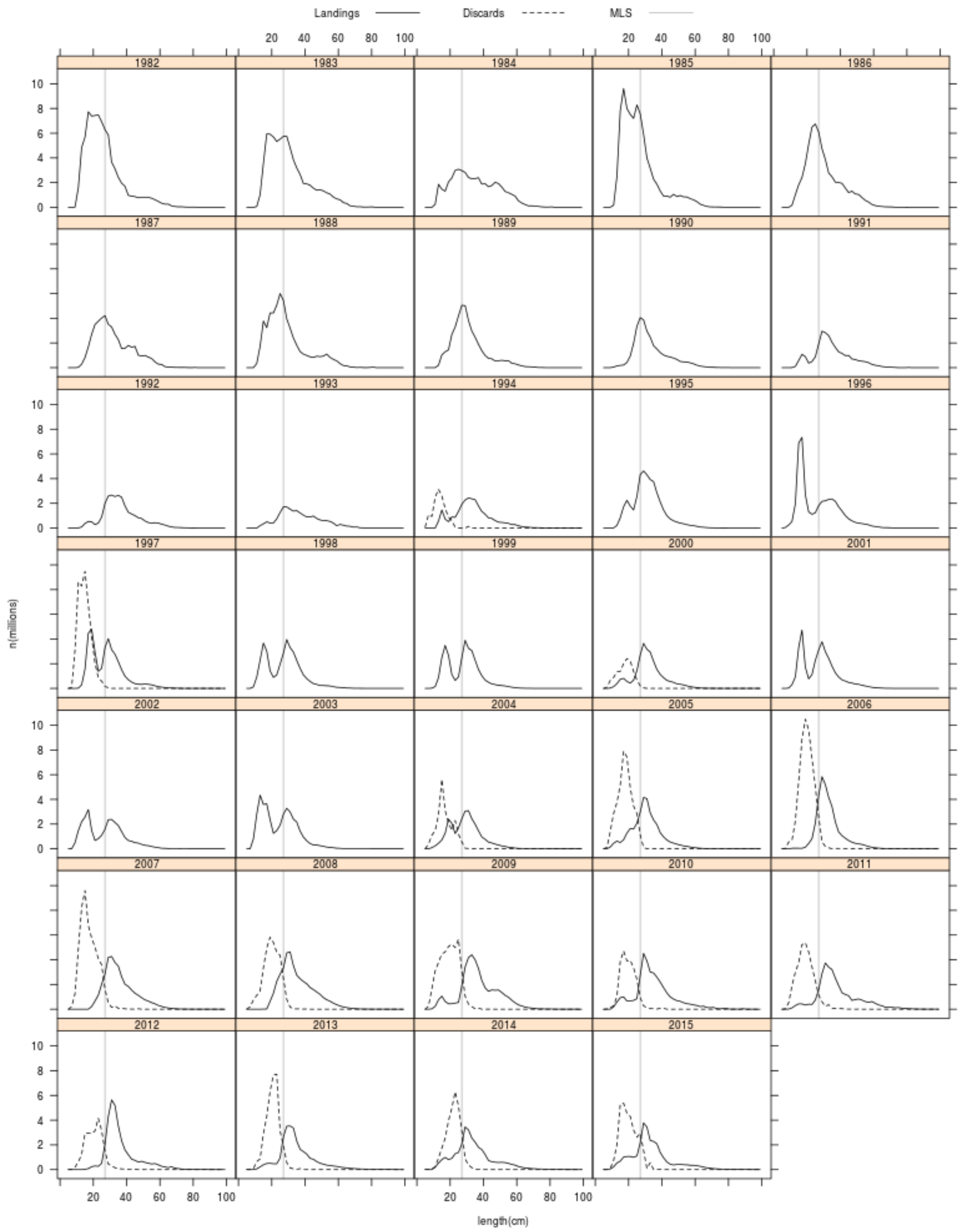


Figure 10.1. Length distribution of catches used in the assessment. Landings (1982–15) plus Cadiz landings from 1994–2004. Discards from 1992–15 (dashed line). Minimum landing size (MLS) since 1992 at 27 cm.

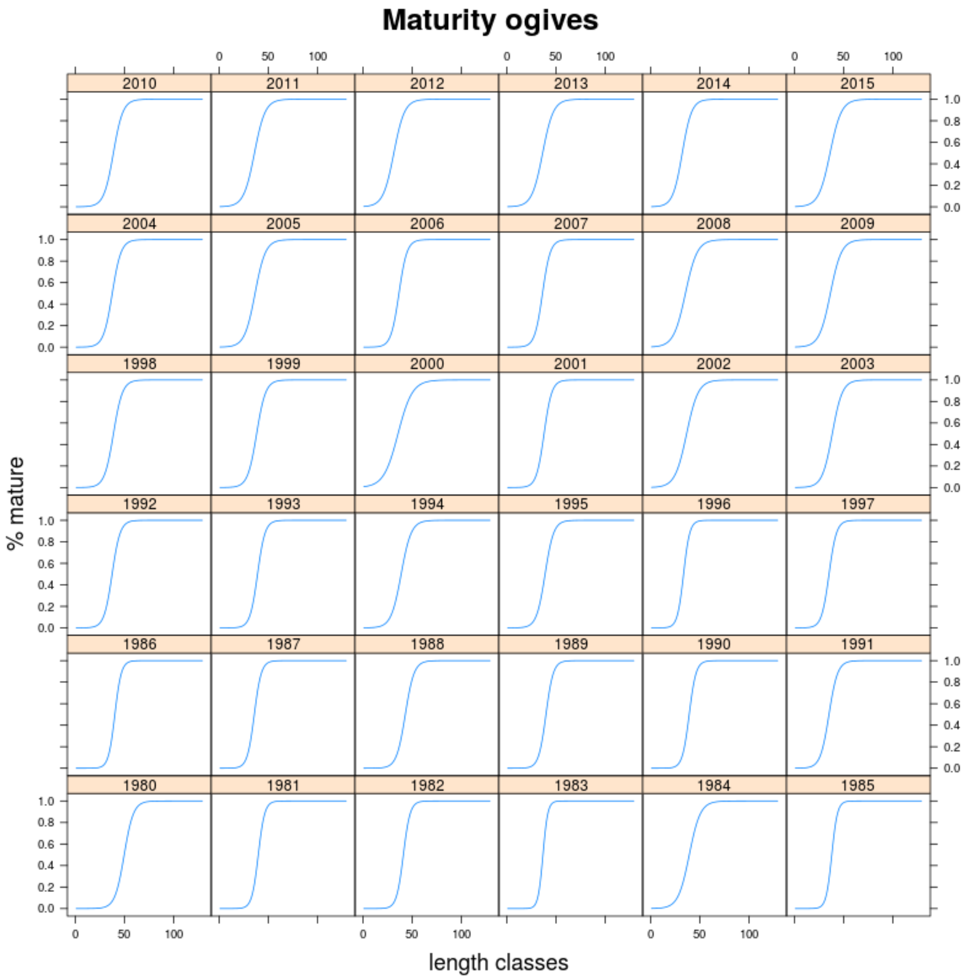


Figure 10.2 Maturity ogives from 1980–2015

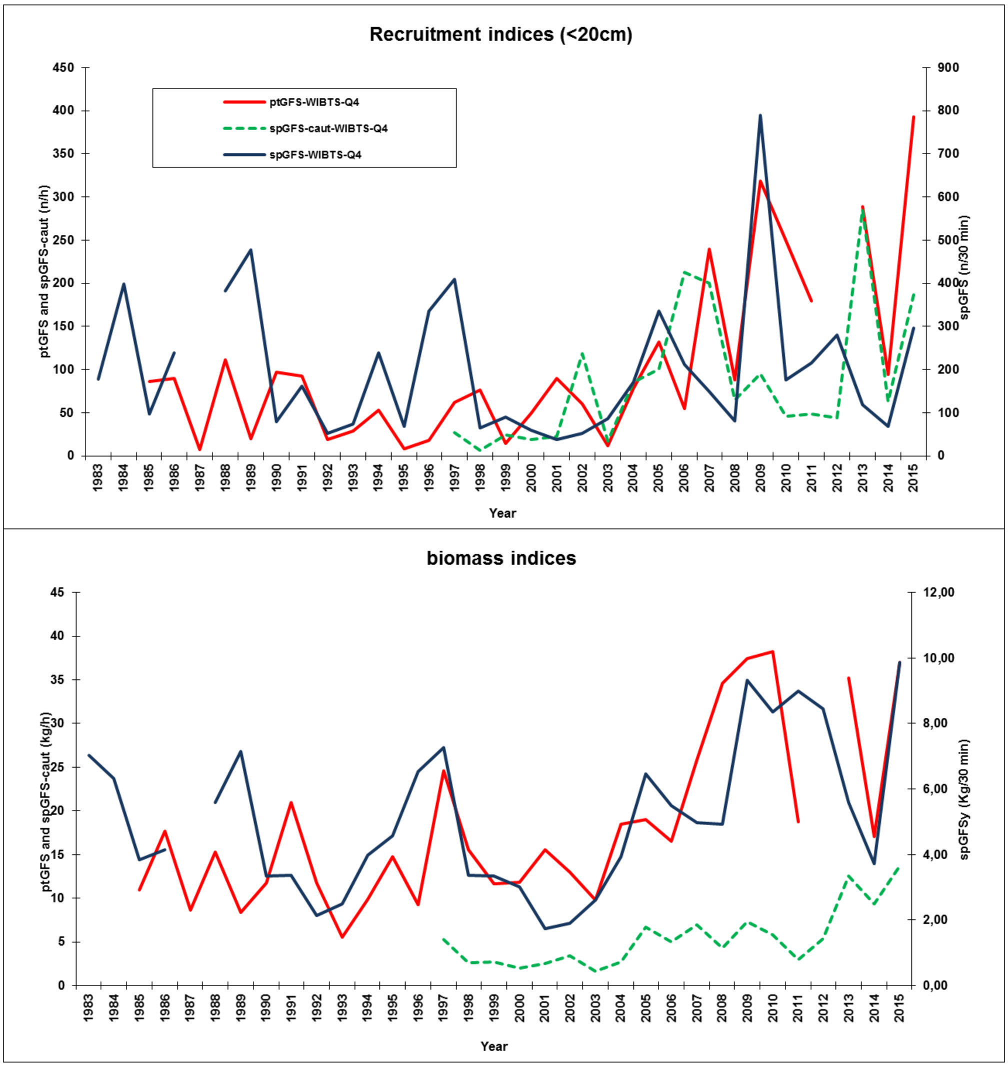


FIGURE 10.3 HAKE SOUTHERN STOCK - Recruitment and biomass Indices from groundfish surveys

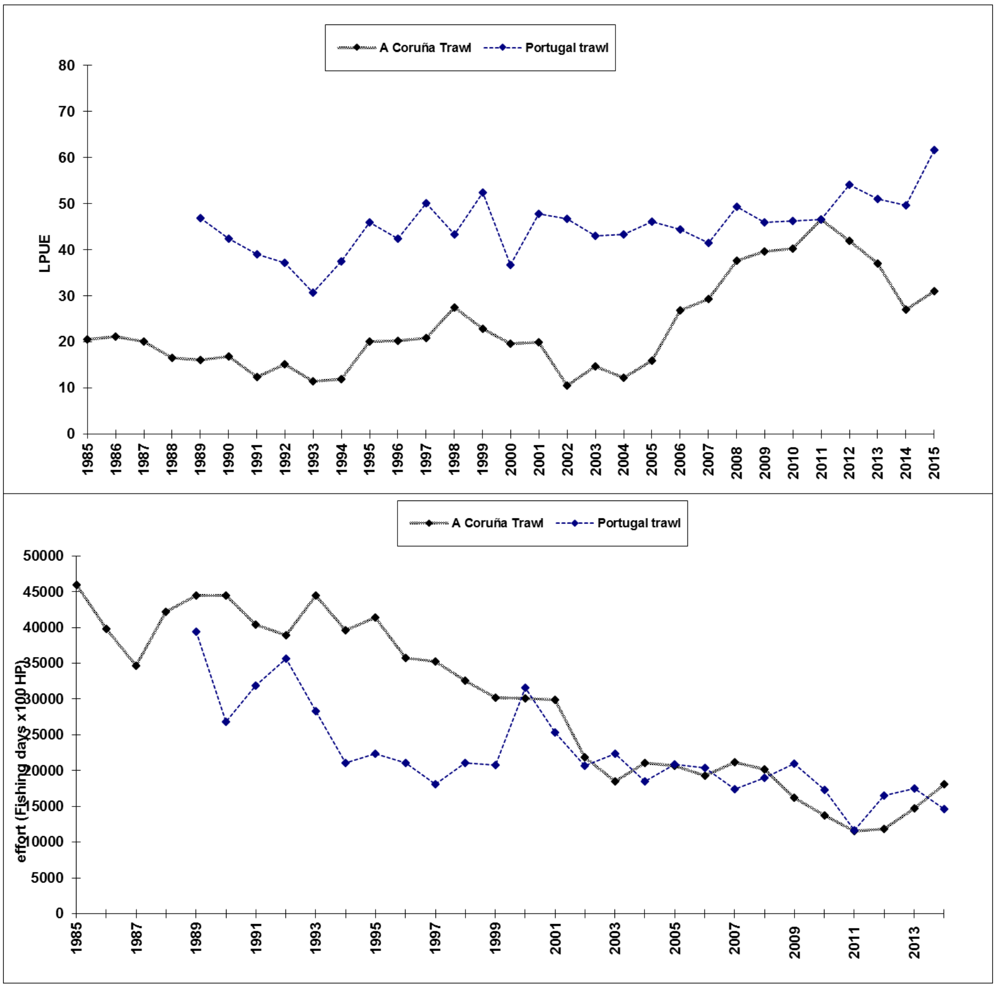


Figure 10.4 HAKE SOUTHERN STOCK- LPUE and fishing effort trends for trawl fleets

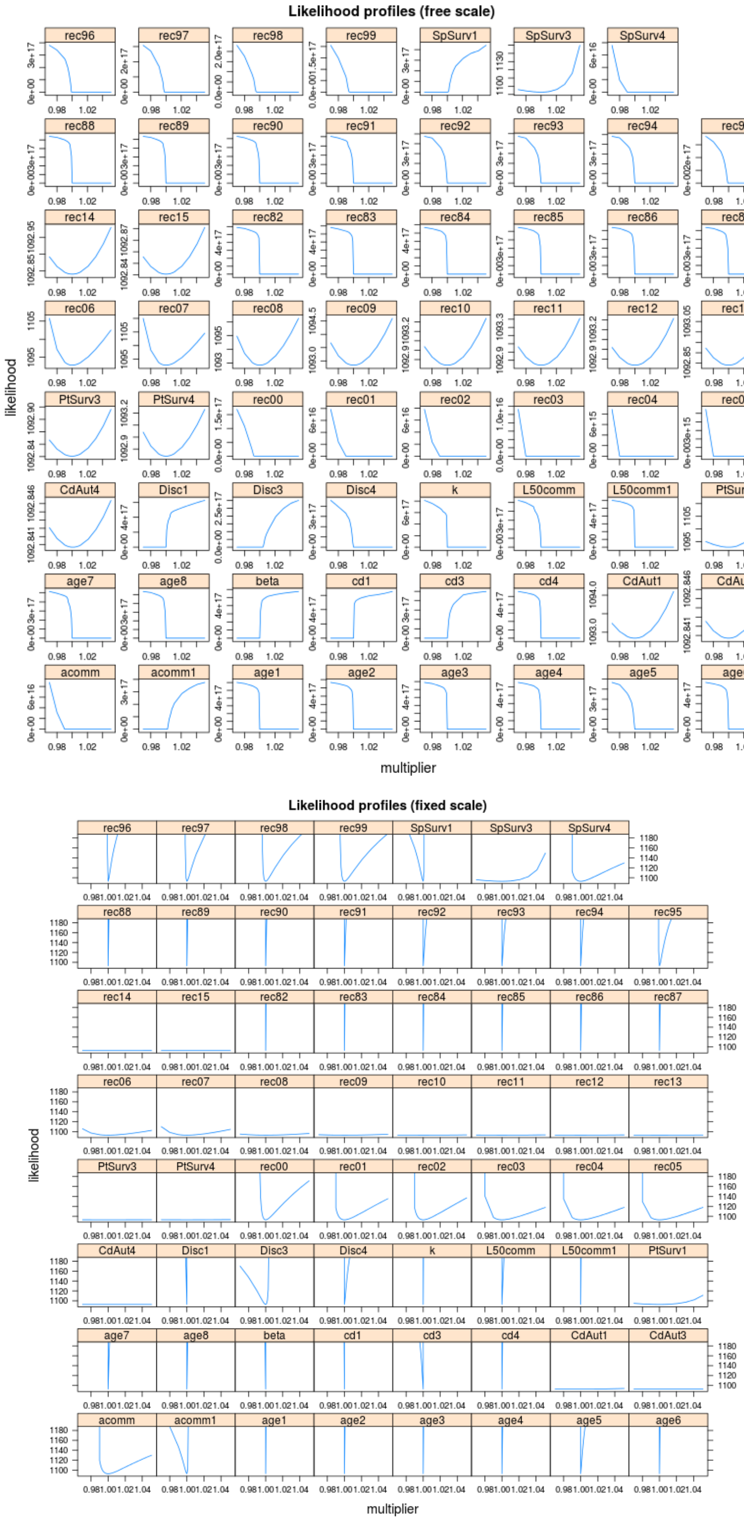
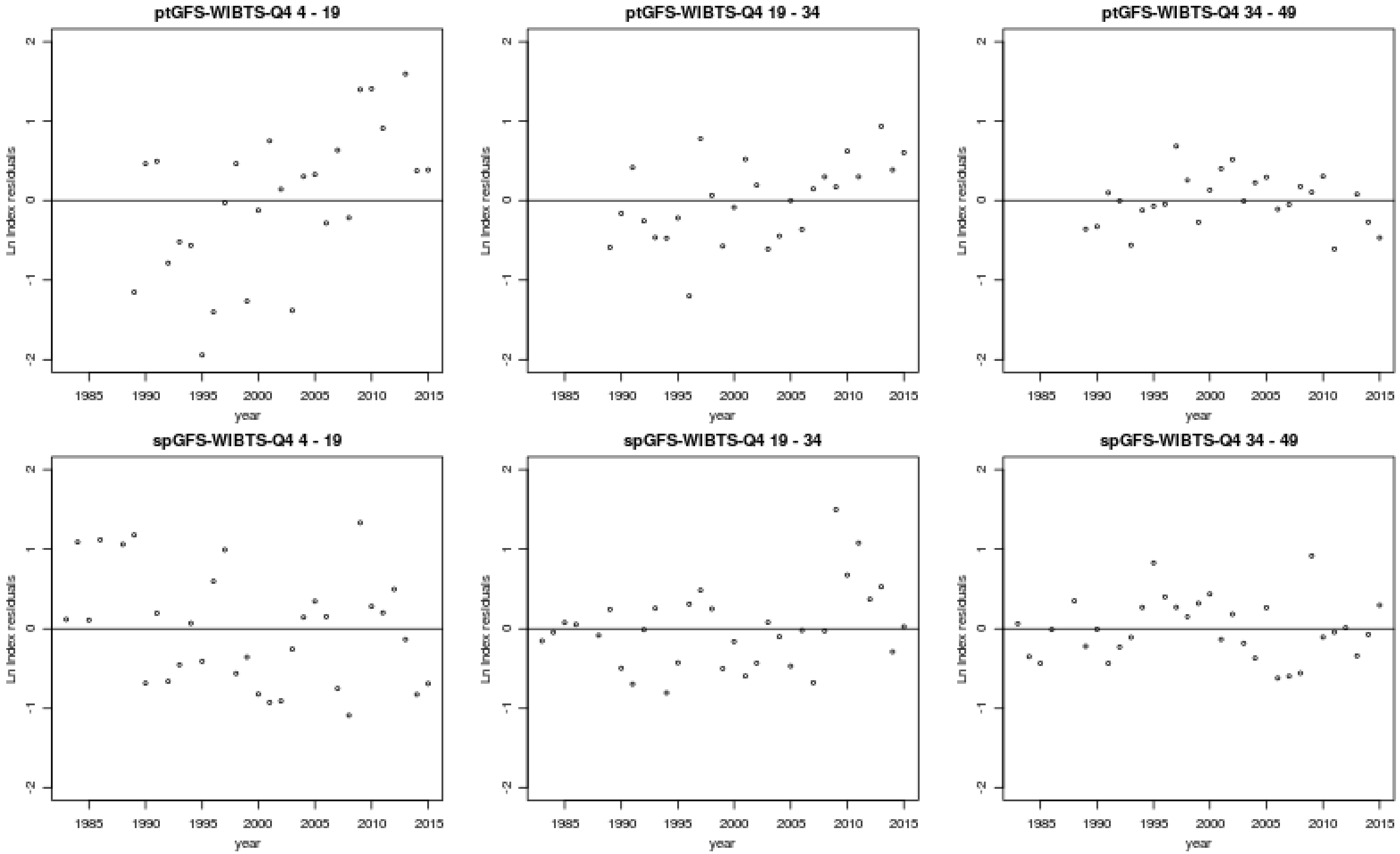
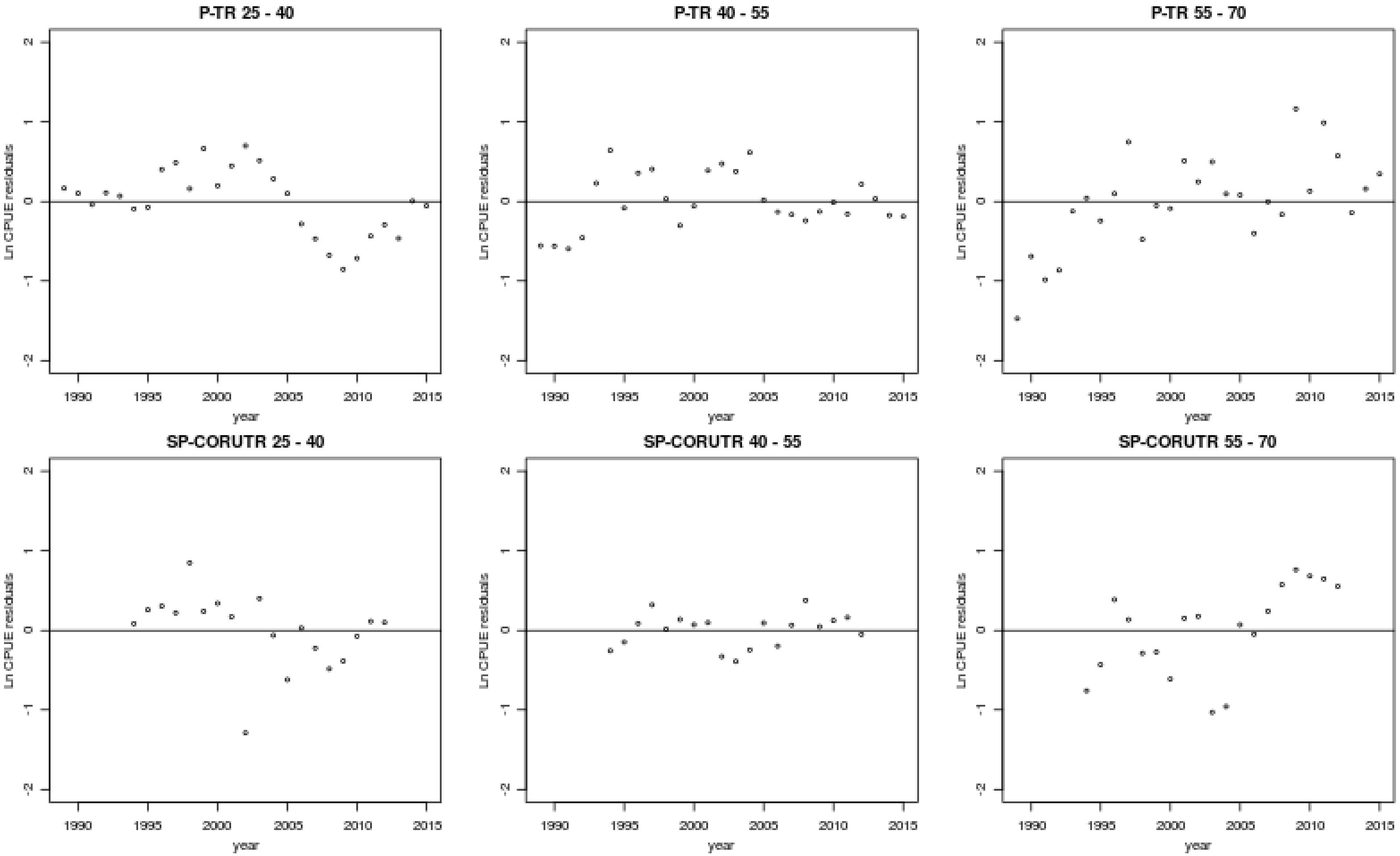


Figure 10.5. Gadget convergence with likelihood profiles. Free scaled (upper panel) and fixed scaled (lower panel)

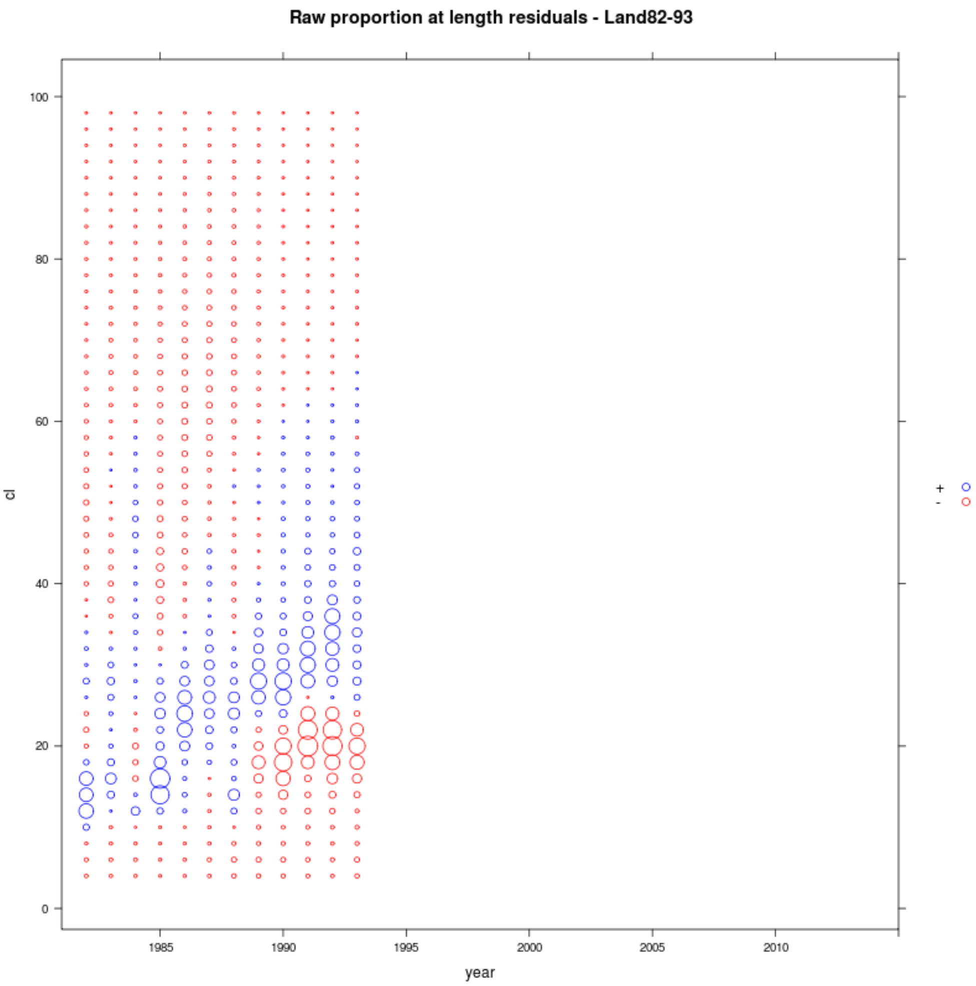
Figure 10.6Diagnostics Residuals (10.6 a and b). Observed vs. expected length proportions (10.6 c–i))



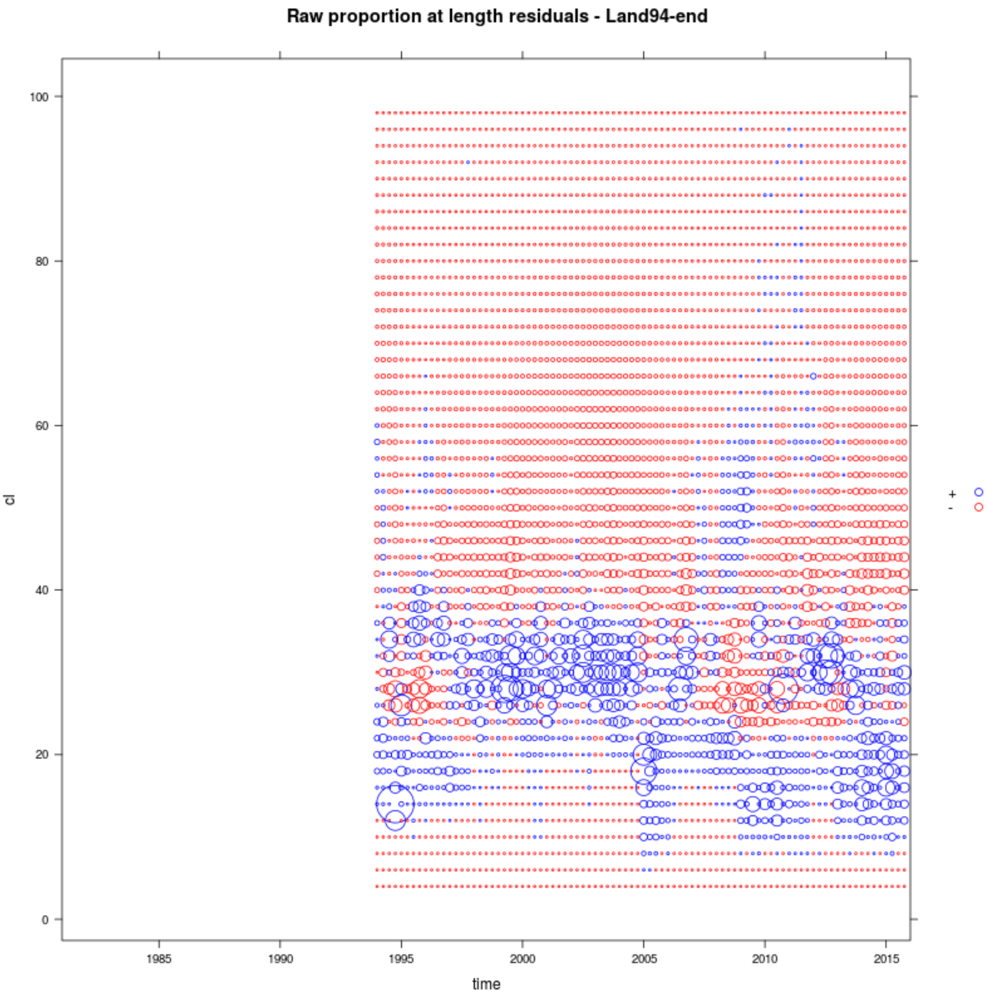
(10.6 a) Survey residuals by 15 cm groups (4-19, 19-34, 34-49 cm)



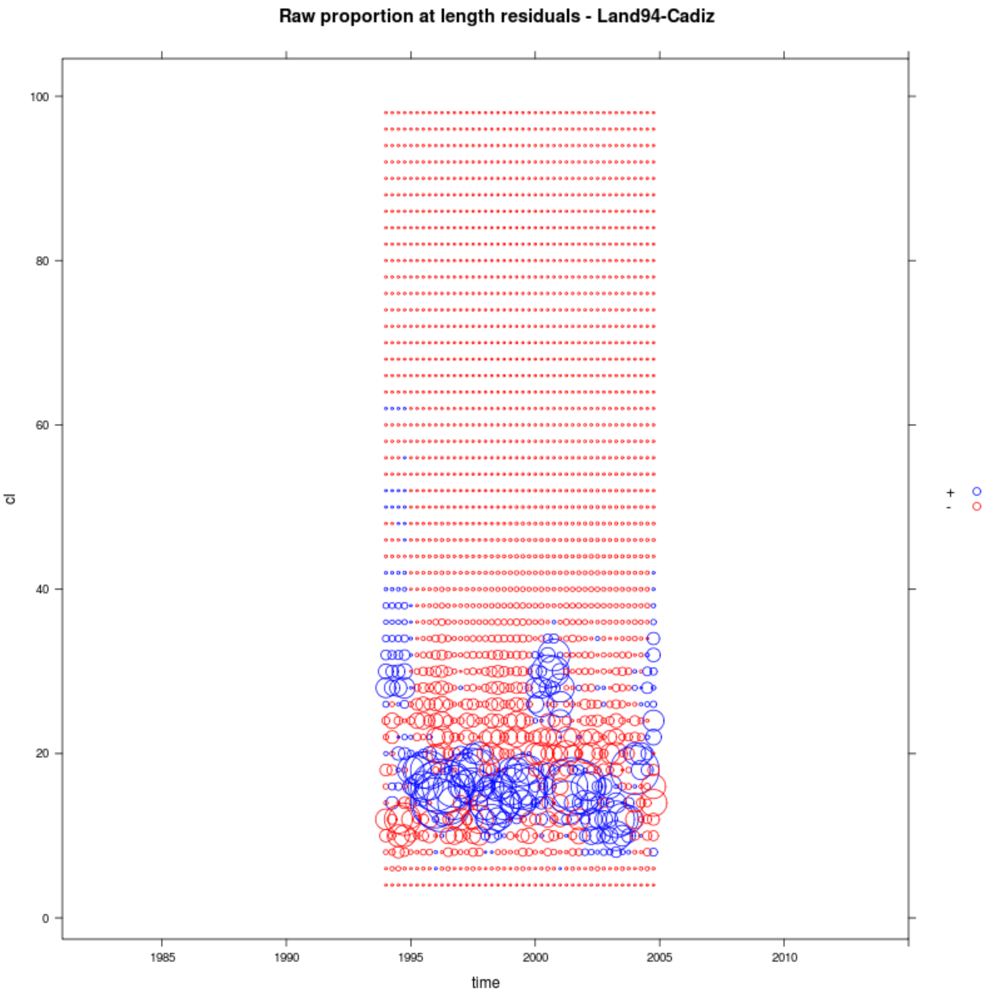
(10.6 b) LPUE residuals by 15 cm groups (25-40, 40-55, 55-70 cm)



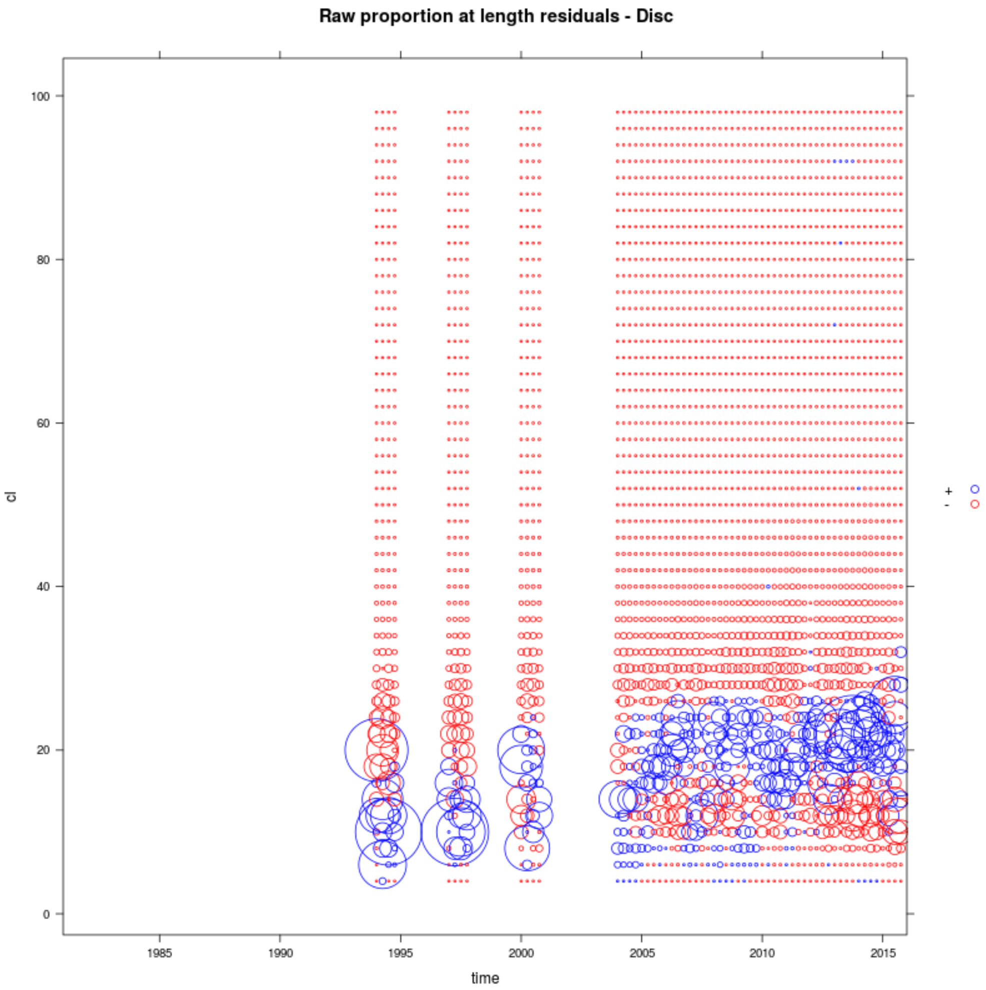
(10.6 c). Bubble plot for landings length distribution from 1982–1993.



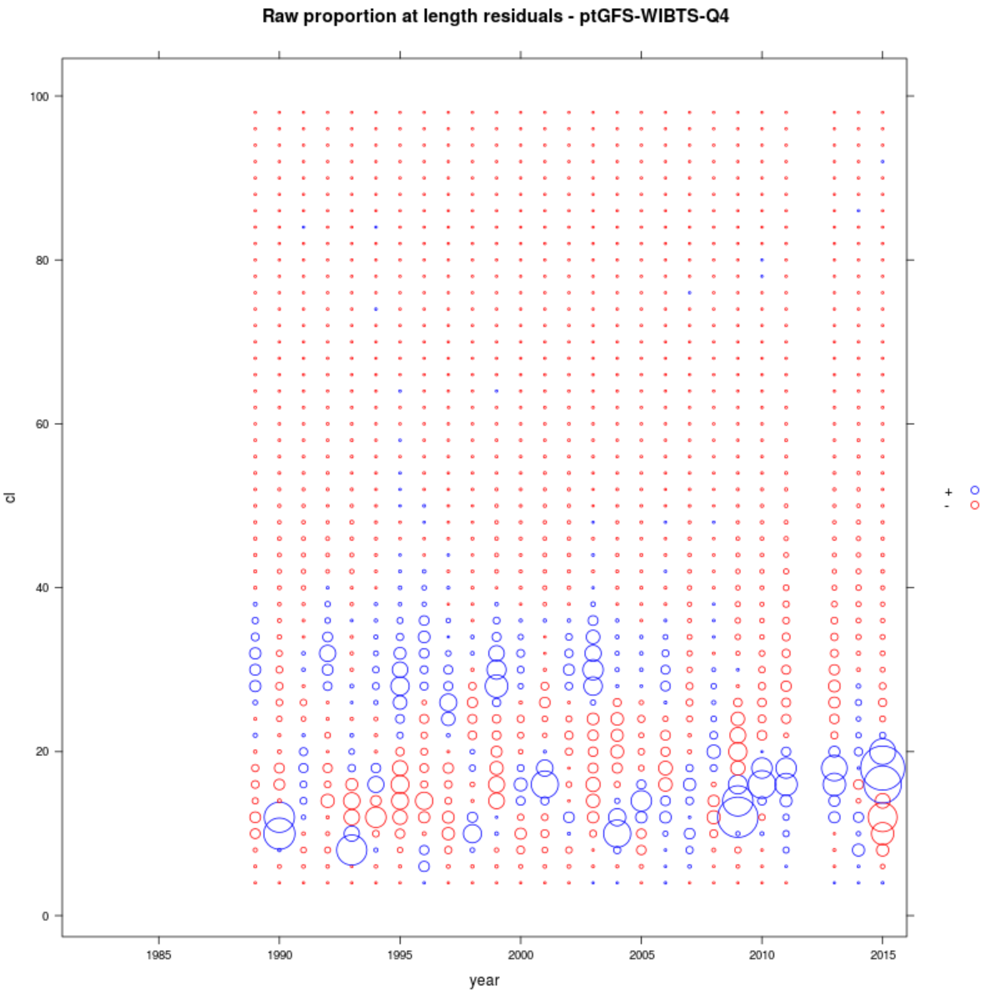
(10.6 d). Bubble plot for landings length distribution from 1994 to last year.



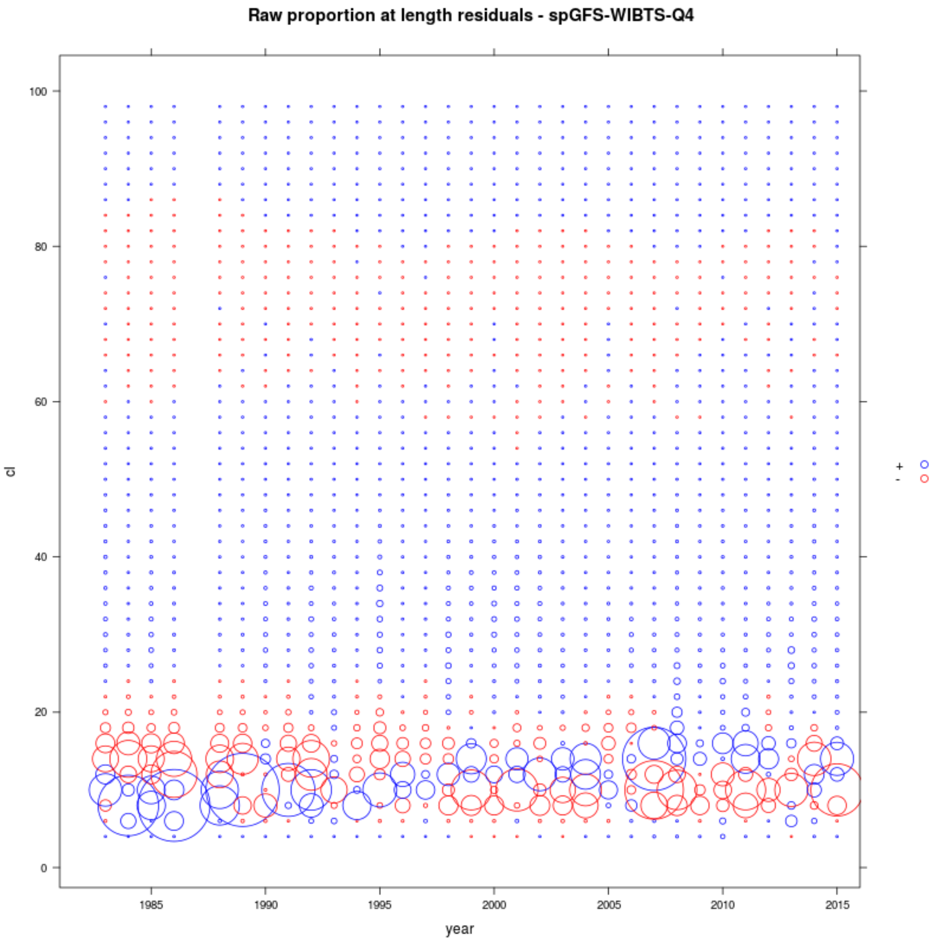
(10.6 e). Bubble plot for Cadiz landings length distribution from 1982–2004.



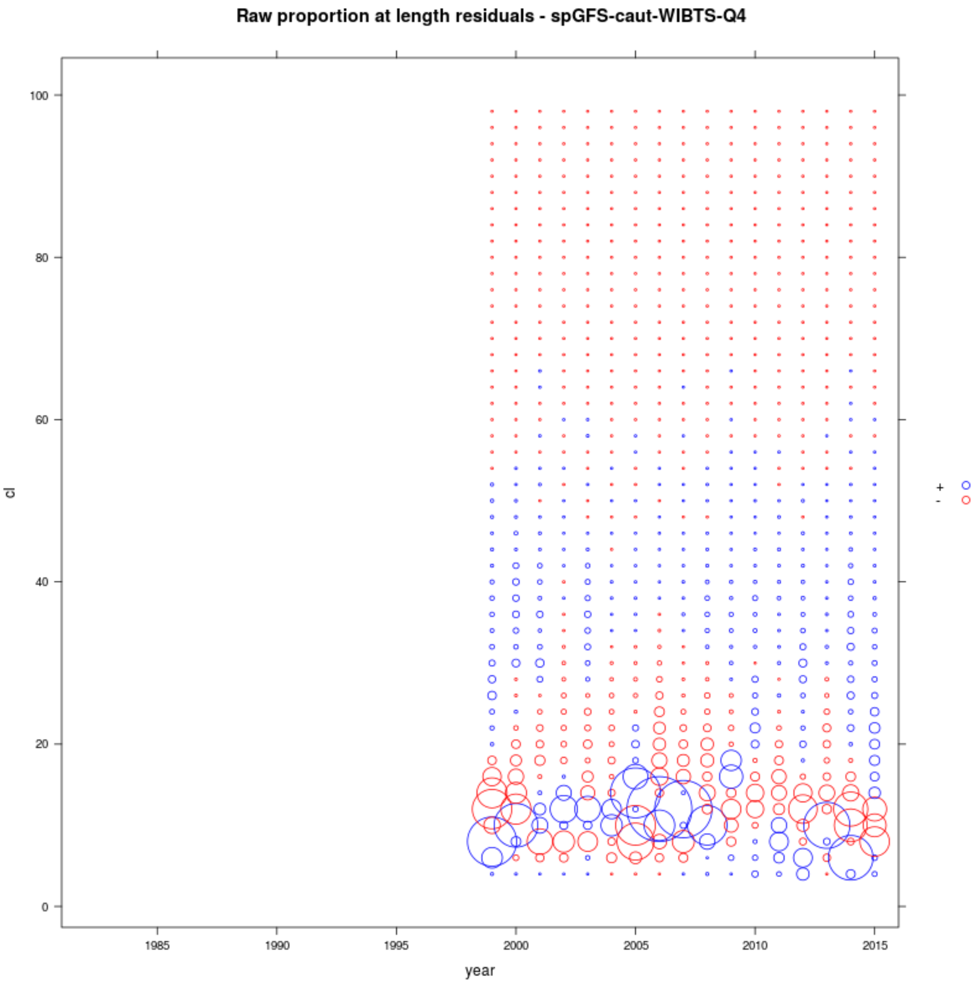
(10.6 f). Bubble plot for Discards length distribution for years 1993, 97, 99, 2004–end.



(10.6 g) Bubble plot for Portuguese demersal survey (ptGFS-WIBTS-Q4)



(10.6 h) Bubble plot for North Spain demersal survey (spGFS-WIBTS-Q4)



(10.6 i) Bubble plot for South Spain (Cadiz) demersal survey (spGFS-caut-WIBTS-Q4)

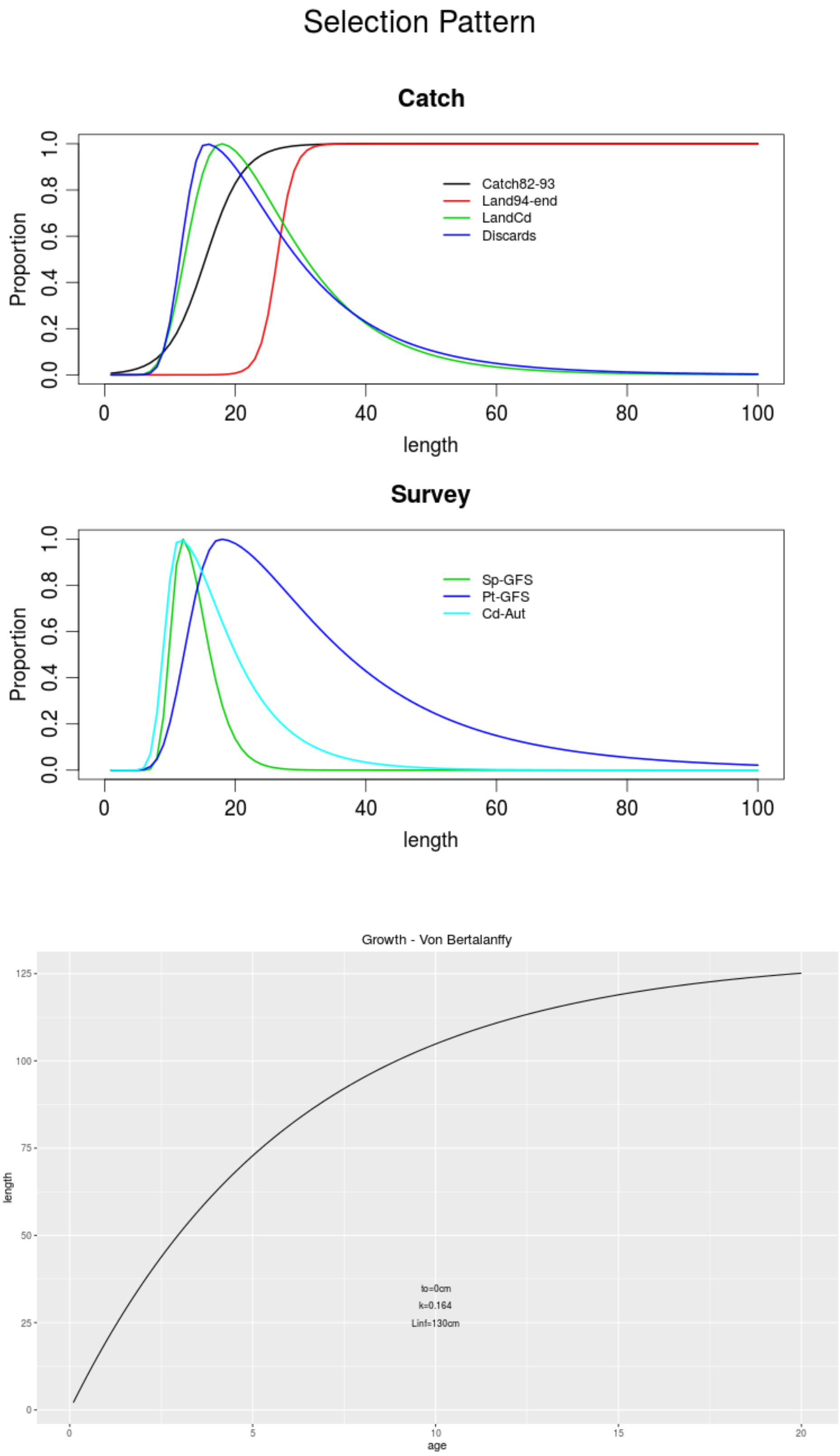


Figure 10.7. Selection pattern (upper panel) and von Bertalanffy growth with k parameter estimated by the model (lower panel)

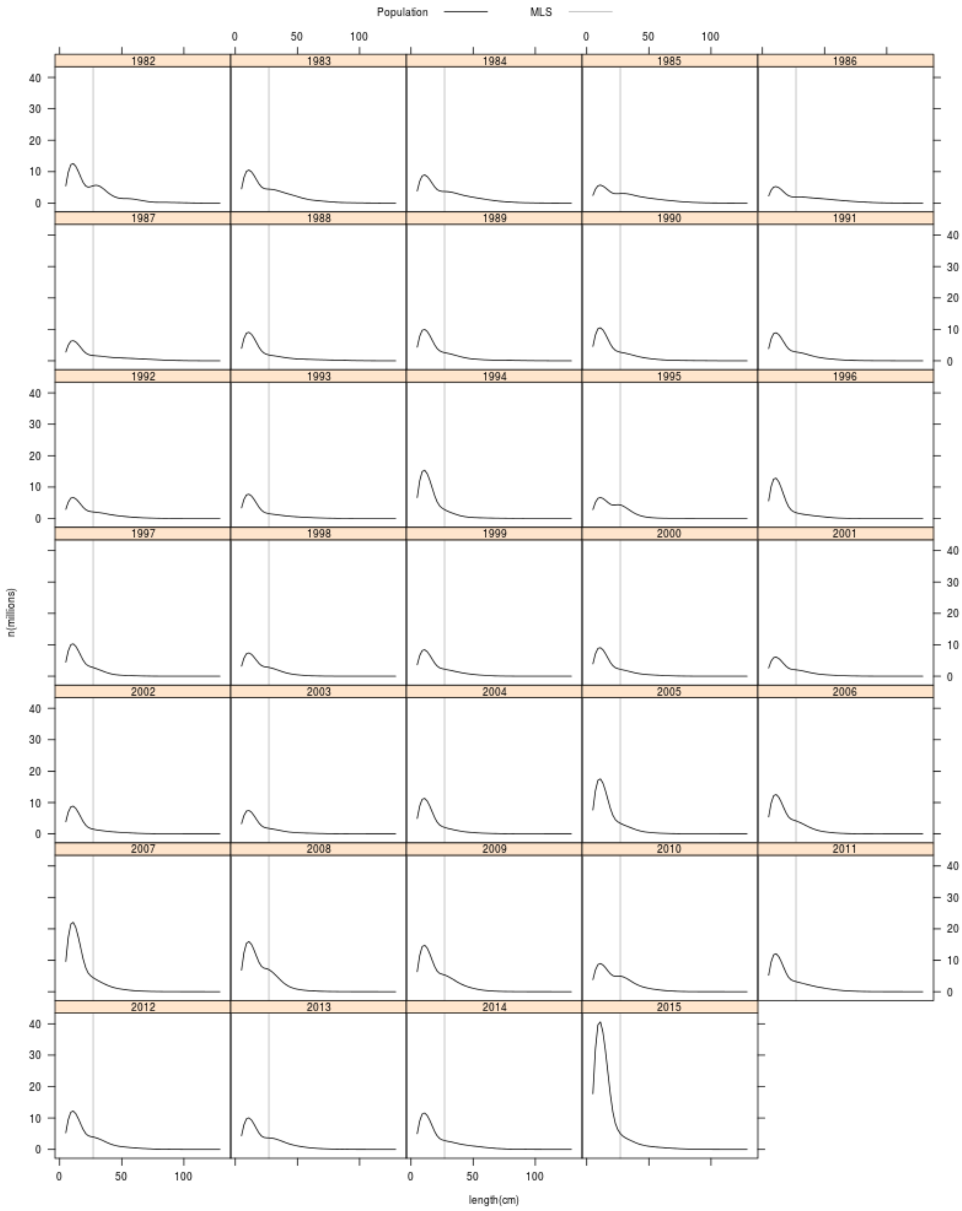


Figure 10.8. Population length distribution at the beginning of the 4th quarter.

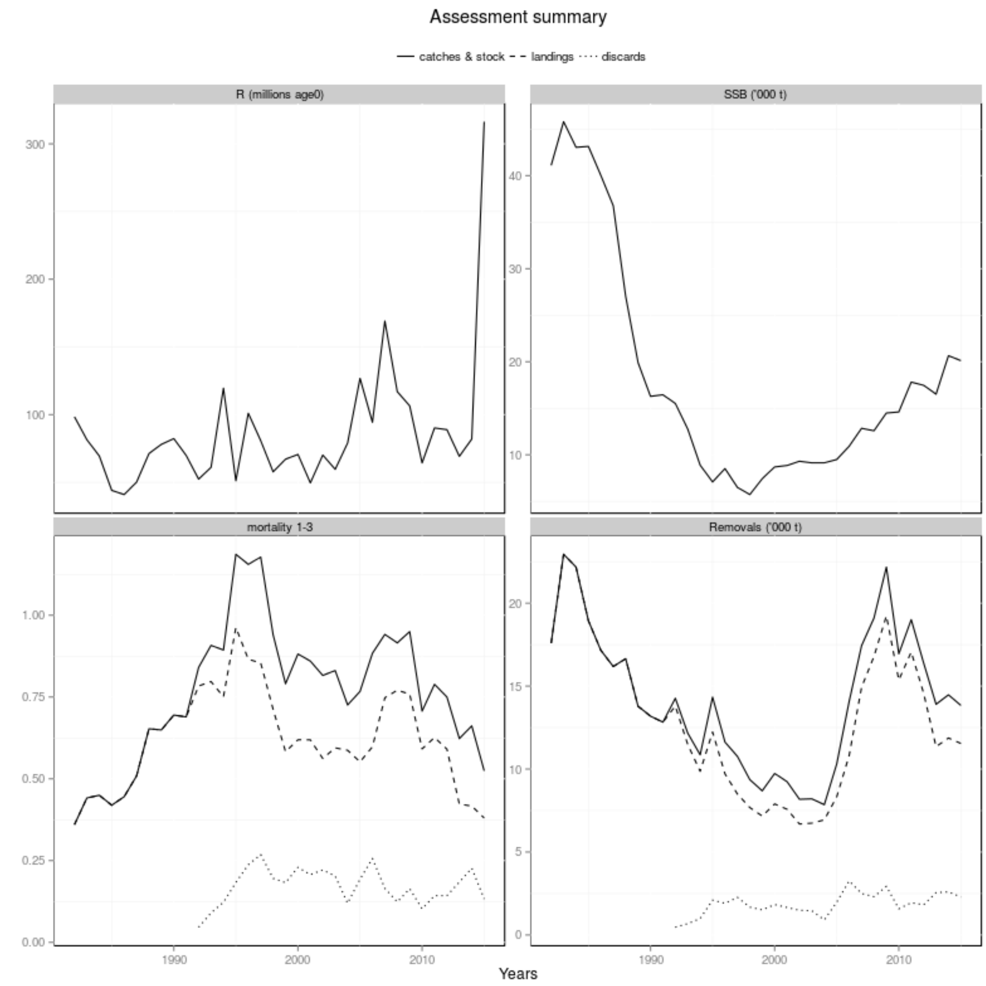


Figure 10.9. Summary plot. SSB and removals (catch, landings and discards). Fishing mortality (F) for ages 1–3.

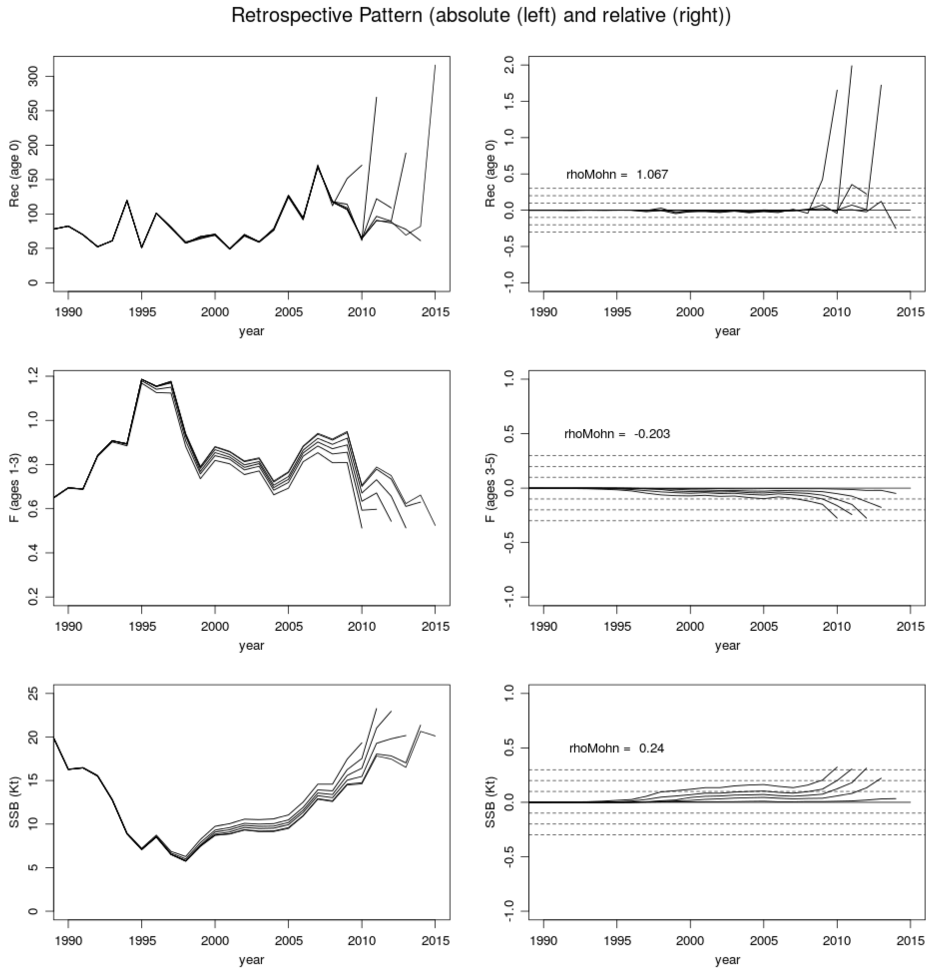


Figure 10.10. Retrospective plots (absolute and relative).

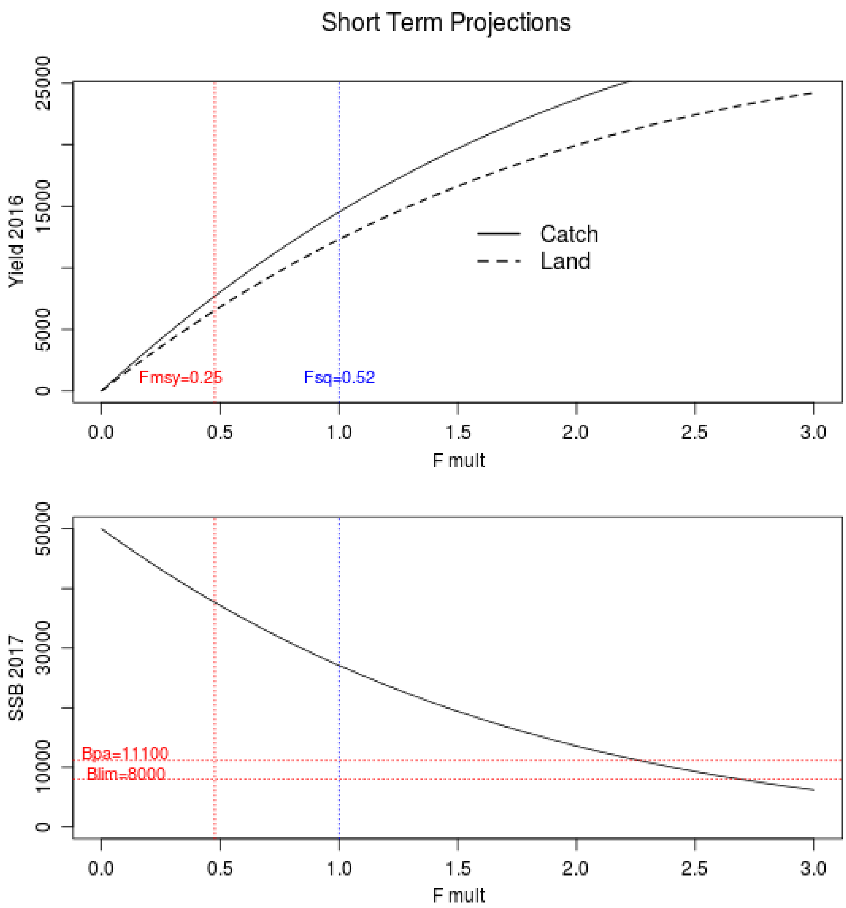


Figure 10.11. Short-term projections

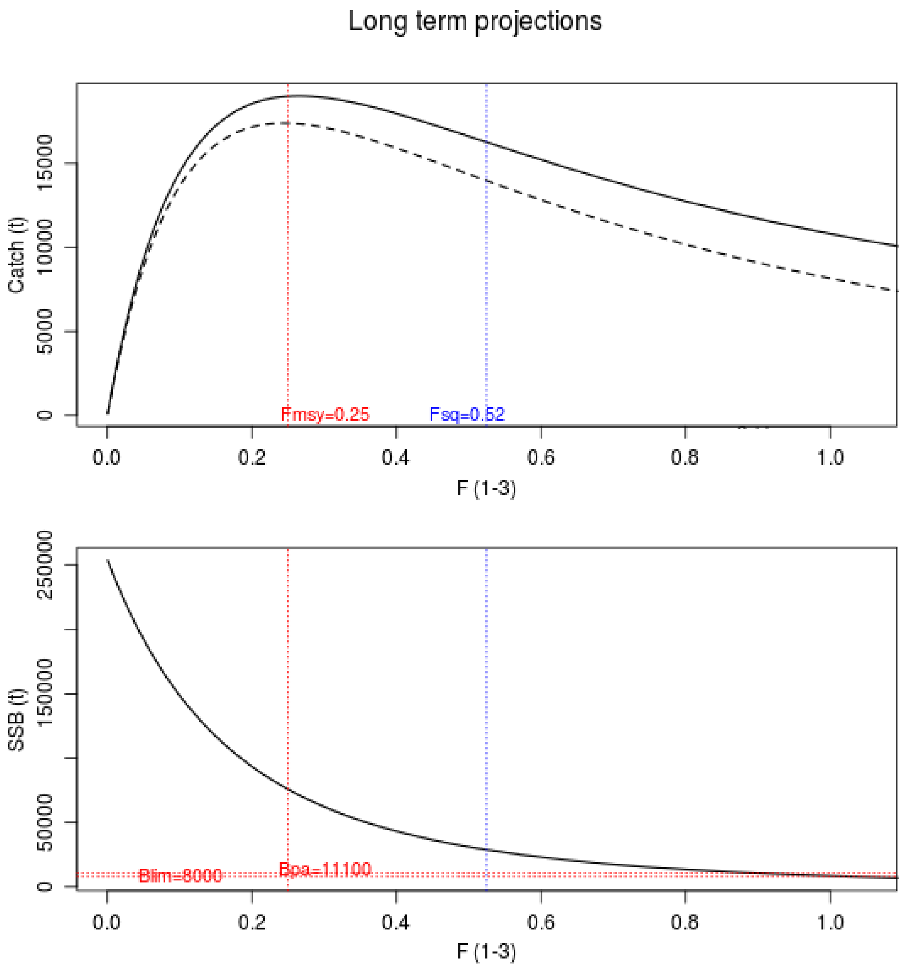


Figure 10.12. Long-term yield and SSB per recruit

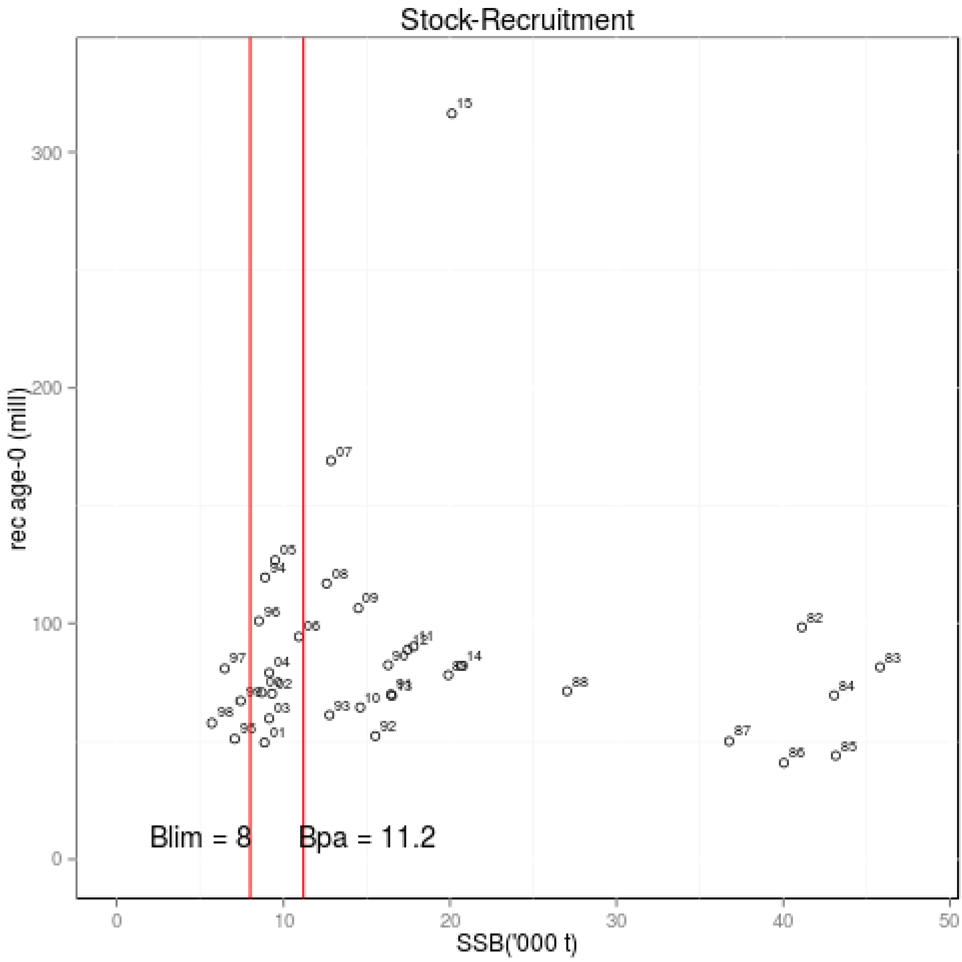


Figure 10.13 Stock–recruitment plot.

11 *Nephrops* in Divisions 8.a,b, FUs 23-24 (Norway lobster)

Type of assessment: update assessment

Main changes from the last assessment (WGBIE2015):

No relevant.

Previously, some changes have occurred since the IBP Nephrops 2012:

- *Methodology for discard derivation (probabilistic approach replaced the proportional one).*
- *Scientific time-series provided by the survey LANGOLF included in the tuning data (although the survey was stopped in 2014).*
- *UWTV survey has been conducted since 2014. The stock is planned to be benchmarked in 2016.*

ICES description	8.a,b
Functional Units	Bay of Biscay North, 8.a (FU 23)
	Bay of Biscay South, 8.b (FU 24)

11.1 General

11.1.1 Ecosystem aspects

This section is detailed in Stock Annex.

11.1.2 Fishery description

The general features of the fishery are given in Stock Annex.

11.1.3 ICES Advice for 2016

The advice for the stock is biennial, the latest one provided in 2014 was based on approach for data-limited stocks. It was recommended that "…landings should be no more than 3214 tonnes, assuming that discard rates do not change from the average of the last three years (2011–2013), and a fixed proportion (30%) of discards survive. This corresponds to removals of no more than 4224 tonnes".

11.1.4 Management applicable for 2015 and 2016

Species:	Norway lobster *Nephrops norvegicus*	**Zone:**	VIIIa, VIIIb, VIIId and VIIIe (NEP/8ABDE.)
Spain	234		
France	3 665		
Union	3 899		
TAC	3 899		Analytical TAC

The *Nephrops* fishery is managed by TAC [articles 3, 4, 5(2) of Regulation (EC) No 847/96] along with technical measures. The agreed TAC for 2016 was 3 899 t (the same as for the period 2013–2015) whereas the ICES recommendation was 3 214 t. In 2015, total nominal landings reached 3 569 t.

For a long-time, a minimum landing size of 26 mm CL (8.5 cm total length) was adopted by the French producers' organizations (larger than the EU MLS set at 20 mm CL i.e. 7 cm total length). Since December 2005, a new French MLS regulation (9 cm total length) has been established. This change has already significantly impacted on the data used by the WG (see report WGHMM 2007).

A mesh change was implemented in 2000 and the minimum codend mesh size in the Bay of Biscay was 70 mm instead of the former 55 mm for *Nephrops*, which had replaced 50 mm mesh size in 1990–91. 100 mm mesh size is required in the Hake box. For 2006 and 2007, *Nephrops* trawlers were allowed to fish in the hake box with mesh size smaller than 100 mm once they have adopted a square mesh panel of 100 mm. This derogation was maintained onwards.

As annotated in the Official Journal of the European Union (p.4, art. 27): "In order to ensure sustainable exploitation of the hake and Norway lobster stock and to reduce discards, the use of the latest developments as regards selective gears should be permitted in ICES zones 8.a, b,d".

In agreement with this, the National French Committee of Fisheries (deliberations 39/2007, 1/2008) fixed the rules of trawling activities targeting *Nephrops* in the areas 8.a, 8.b applicable from the 1st April 2008. All vessels catching more than 50 kg of *Nephrops* per day must use a selective device from at least one of the following: (1) a ventral panel of 60 mm square mesh; (2) a flexible grid or (3) a 80 mm codend mesh size. The majority of *Nephrops* directed vessels (Districts of South Brittany) chose the increase of the codend mesh size whereas the ventral squared panel was adopted by multi-purpose trawlers (mainly in harbours outside Brittany).

A licence system was adopted in 2004 and, since then, there has been a cap on the number of *Nephrops* trawlers operating in the Bay of Biscay of 250 (186 in 2015). At the beginning of 2006, the French producers' organizations adopted new additional regulations such as monthly quotas which had some effects on fishing effort limitation.

11.2 Data

11.2.1 Commercial catches and discards

Total catches, landings and discards, of *Nephrops* in division 8.a,b for the period 1960-2015 are given in Table 11.1.

Throughout the mid-60's, the French landings gradually increased to a peak value of 7 000 t in 1973–1974, then fluctuated between 4 500 and 6 000 t during the 80's and the mid-90's. An increase has been noticeable during the early 2000's. Landings remained stable between 2008 and 2009 (3 030 t and 2 987 t) whereas they had decreased compared with previous years (3 176 in 2007, 3 447 t in 2006 and 3 991 t in 2005). In 2010 and 2011, total landings increased (3 398 t and 3 559 t respectively), but in 2012 and 2013 the landings reduced to around 2 520 t and 2 380 t respectively. In 2014, landings increased (2 807 t: +18%), with a further increase in 2015 (3 569 t; +27%). The new selectivity regulations have been implemented since 2008, the effect of these new regulations have not been quantified.

Males usually predominate in the landings (sex ratio, defined as number of females divided by total, fluctuates between 0.31 and 0.46 for the overall period 1987–2015) and in a lesser degree in the removals (sexio ratio in the range 0.35-0.49). Females are less accessible in winter because of burrowing and, also, they have a lower growth rate. The female proportion in landings slightly increased up to the late 1990's/early 2000's, but this trend was not confirmed in recent years probably because of the MLS increase (December 2005) and, moreover, because of the new selectivity regulations (April 2008).

Discards represent most of the catches of the smallest individuals as indicated by the available data (Figure 11.1). The average weight of discards per year in the period up to early 2000's (not routinely sampled) is about 1 551 t whereas discard estimates of the recent sampled years (2003–2015) reached a higher level of 1 954 t. This change in the amount of discards could be due to the restriction of individual quotas (notably applied since 2006), the strength of some recruitments in the middle of 2000's and the change in the MLS (which tends to increase the discards), although the change in the selectivity should tend to reduce the discards. The relative contribution of each of these three factors remains unknown. In 2015, 129 million individuals were estimated to have been discarded (1 492 t).

11.2.2 Biological sampling

Discard data by sampling on board are available for 1987, 1991, 1998 and from 2003. For the intermediate years up to 2002, since the former WGNEPH, numbers discarded at length were derived by the "proportional method" calculating discards by sex for years with no sampling on board by applying identical quarterly LFDs of the preceding sampled year raised to the quarterly landings i.e. for years 1992-1997 derivation used quarterly LFDs from 1991. This method was suspected to induce inter-dependence throughout the time-series, therefore, lack of contrast for annual recruitment. IBP *Nephrops* 2012 even not finally conclusive investigated the probabilistic (logistic) approach developed for the WGHMM since 2007 (Table 11.2; see Stock Annex) and compared with the previous discard derivation. The probabilistic calculation provides wider variations on number of removals for age group 1 and 2 after conversion of the size composition to an age one (under assumptions involving in individual growth by sex according to von Bertalanffy's function as used by previous WGs). Since the WGHMM 2012, the probabilistic method has been chosen: the derivation is performed by sex and quarter using logistic function describing the s-shaped hand-sorting on board and assuming symmetrical densities of probability for yearly LFDs as tested on years with sampling on board before MLS change (up to 2005).

Since 2003, discards have been estimated from sampling catch programmes on board *Nephrops* trawlers, 522 trips and 1 513 hauls have been sampled over 13 years. Despite improvements in agreement between logbook declarations and auction hall sales since the middle of 2000's, the quality of crossed information fluctuates between years. e.g. for years 2007-2014 the percentage of cross-validation item by item between logbooks and sales was variable giving a wide range of values of between 69 to 90% agreement (85% for 2014 and 80% in 2015). Therefore, the total number of trips is usually not well known and needs to be estimated under assumptions. This can be done using the number of auction hall sales, when boats conduct daily trips, which is the case in the northern part of the fishery, but not in the southern one. Discard sampling from the southern part of the fishery was carried out only once in the past (2005), but the sampling plan has been routinely applied since 2010.

The length distribution of landings, discards, catches and removals are presented in Tables 11.3.a-h and in Figure 11.1. Removals at length are obtained by adding the landings and "dead discards" and applying a discard mean survival rate of 30% (Charuau *et al.*, 1982). Combined sex mean lengths are presented for catches, landings and discards in Figure 11.2.

11.2.3 Abundance indices from surveys

For many years, abundance indices were not available for this stock. A survey specifically designed to evaluate abundance indices of *Nephrops* commenced in 2006 (with the most appropriate season: 2nd quarter, hours of trawling: around dawn and dusk and fishing gear: twin trawl). This survey (called LANGOLF; see Stock Annex) occurred once a year in May and its sampling design was stratified by sedimentary structure. The survey was evaluated during the IBP *Nephrops* 2012, and was accepted for providing abundance indices for this stock and included in the assessment (WGHMM 2012, 2013; WGBIE 2014). The time-series provided by this survey ended in 2013 and a new experimental survey combining UWTV burrows counting and trawling indices as routinely operated for many *Nephrops* stocks on areas VI and VII was undertaken in September 2014 and July 2015. Trawling was operated by two commercial vessels applying the same sampling plan (stratified random) and using the same twin trawls (20 mm codend mesh size) as those of the former LANGOLF survey. The burrows counting was undertaken by the Irish scientific vessel "Celtic Voyager" on the basis of a systematic sampling plan. The choice of survey dates is constrained by the schedule time for UWTV Irish equipment and staff. Investigations on the basis of stratified statistical estimators as well as geostatistical analysis were carried out (see WD03; WGBIE 2016). This new information will be presented at the assessment bench in 2016. The UWTV survey was also carried out in May 2016 although the trawling operations associated in 2014 and 2015 were not conducted as they were considered not necessary for the further analytical investigations on the stock based on the UWTV tools.

11.2.4 Commercial catch-effort data.

Commercial fleets used in the assessment to tune the model

Up to 1998, the majority of the vessels were not obliged to keep logbooks because of their size and fishing forms were established by inquiries. Since 1999, logbooks became compulsory for all vessels longer than 10 m. The available logbook data cannot be currently considered as representative for the fishing effort of the whole fishery during the overall time-series. Hence, since 2004, it was attempted to define a better effort index.

Effort data indices, landings and LPUE for the "Le Guilvinec District" *Nephrops* trawlers in the 2nd quarter (noted GV-Q2) are available for the overall time-series (Table 11.4; Figure 11.3). Effort increased from 1987 to 1992, but there has been a decreasing trend since then. In 2012-2015, the lowest fishing effort for the whole period was observed. The downwards trend in effort can be explained by the decrease in the number of fishing vessels following the decommissioning schemes implemented by the EU. The LPUEs of the GV-Q2 fleet were reasonably stable for a long period, fluctuating around a long-term average of 13.3 kg/hour (Figure 11.3), with three pics values occurring in the past (1988, 2001 and 2010). LPUE increased steeply between 2009 and 2010 (+35%: from 13.8 kg/h to 18.6 kg/h), then strongly decreased in the period 2011-2013

(15.1 kg/h in 2011, 15.2 kg/h in 2012, 12.8 kg/h in 2013) The GV-Q2 LPUE index remained stable in 2014 (12.7 kg/h), but it reached the historically highest level in 2015 (19.5 kg/h).

Changes in fishing gear efficiency and individual catch capacities of vessels, imply that the time spent at sea may not be a good indicator of effective effort and hence LPUE trends are possibly biased. Since the early 90's, the number of boats using twin-trawls increased (10% in 1991, more than 90% in recent years, almost 100% in the northern part of the fishery) and also the number of vessels using rock-hopper gear on the rough seabed of the extreme NW part of the central mud bank of the Bay of Biscay. Moreover, an increase in on board computer technology has occurred. The effects of these changes are difficult to quantify as twin-trawling is not always recorded explicitly in the fisheries statistics and improvement due to computing technology is not continuous for the overall time-series.

11.3 Assessment

Expecting conclusions from the incoming benchmark planned in 2016, no analytical assessment was carried out by WGBIE 2016.

11.4 Catch options and prognosis

No short-term projections and yield-per-recruit analysis were carried out.

11.5 Biological reference points

In previous analytical assessments, F_{max} was proposed as a satisfactory FMSY proxy for the stock although the rejection of the XSA assessment for this stock suggests to define new biological reference points based on the new UWTV survey.

11.6 Comments on the assessment

The continuation of the French *Nephrops* trawlers on board sampling programme will avoid the use of "derived" data for missing years (13 years on 29). Since 2009, there has been an improvement of the sampling design as many trips were sampled in the Southern part of the fishery. Derivation based on probabilistic approach should improve diagnostic in further analytical investigations when new alternative assessment methods will be applied.

11.7 Information from the fishing industry

Many exchanges occurred between scientists and the fishing industry prior to the WG in the case of the partnership for the UWTV survey (scientific methodological and financial supporting project). The industry underlined the heterogeneous feature of the whole area of the stock and commented on the application of only one tuning series involved in the northern part of the fishery and its extrapolation to the southern one. They suggested the necessity of applying additional tuning commercial information on the southern part of fishery even its contribution into the overall *Nephrops* directed activity in the Bay of Biscay remains minor. They have been aware of the downwards trend for the stock between the late 2000's and the early 2010's. They emphasized the recent steep upwards change as landings increased between 2013 and 2014 whereas fishing effort remained stable and as 2015 corresponds to the maximum historical level for LPUEs and to the highest value for landings in the last decade. They also considered the necessity to routinely continue assessment on the basis of the recently initiated UWTV survey.

11.8 Management considerations

This year there is no survey coverage of this area to provide advice. Information from commercial data in recent year (increase in LPUEs, stability of the reported discard levels) show positive signals that the stock is not declining but it is premature to change the perception of the stock. Investigations based on the new UWTV survey will be evaluated this year with the potential to provide advice.

Table 11.1. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Estimates of catches (t) by FU for 1960-2015

Year	Landings (1)					Total Discards		Catches
	FU 23-24 (2)	FU 23	FU 24	Unallocated (MA N)(3)	Total	FU 23-24		Total
	VIIIa,b	VIIIa	VIIIb		VIIIa,b used	VIIIa,b		VIIIa,b
1960	3524	-	-	-	3524	-		3524
1961	3607	-	-	-	3607	-		3607
1962	3042	-	-	-	3042	-		3042
1963	4040	-	-	-	4040	-		4040
1964	4596	-	-	-	4596	-		4596
1965	3441	-	-	-	3441	-		3441
1966	3857	-	-	-	3857	-		3857
1967	3245	-	-	-	3245	-		3245
1968	3859	-	-	-	3859	-		3859
1969	4810	-	-	-	4810	-		4810
1970	5454	-	-	-	5454	-		5454
1971	3990	-	-	-	3990	-		3990
1972	5525	-	-	-	5525	-		5525
1973	7040	-	-	-	7040	-		7040
1974	7100	-	-	-	7100	-		7100
1975	-	6460	322	-	6782	-		6782
1976	-	6012	300	-	6312	-		6312
1977	-	5069	222	-	5291	-		5291
1978	-	4554	162	-	4716	-		4716
1979	-	4758	36	-	4794	-		4794
1980	-	6036	71	-	6107	-		6107
1981	-	5908	182	-	6090	-		6090
1982	-	4392	298	-	4690	-		4690
1983	-	5566	342	-	5908	-		5908
1984	-	4485	198	-	4683	-		4683
1985	-	4281	312	-	4593	-		4593
1986	-	3968	367	99	4335	-		4335
1987	-	4937	460	64	5397	1767	*	7164
1988	-	5281	594	69	5875	4138		10013
1989	-	4253	582	77	4835	3007		7842
1990	1	4613	359	87	4972	644		5616
1991	1	4353	401	55	4754	1213	*	5967
1992	0	5123	558	47	5681	1217		6897
1993	0	4577	532	49	5109	974		6084
1994	0	3721	371	27	4092	717		4809
1995	0	4073	380	14	4452	687		5139
1996	0	4034	84	15	4118	487		4606
1997	2	3450	147	41	3610	914		4523
1998	2	3565	300	40	3865	1453	*	5318
1999	2	2873	337	26	3209	1092		4301
2000	0	2848	221	36	3069	1337		4406
2001	1	3421	309	22	3730	2628		6358
2002	2	3323	356	36	3679	2535		6214
2003	1	3564	322	49	3886	1977	*	5863
2004	na	3223	348	5	3571	1932	*	5503
2005	na	3619	372	na	3991	2698	*	6689
2006	na	3026	420	na	3447	4544	*	7990
2007	na	2881	292	na	3176	2411	*	5587
2008	na	2774	256	na	3030	2123	*	5154
2009	na	2816	212	na	2987	1833	*	4820
2010	na	3153	245	na	3398	1275	*	4673
2011	na	3240	319	na	3559	1263	*	4822
2012	na	2290	230	na	2520	1013	*	3533
2013	na	2195	185	na	2380	1521	*	3900
2014	na	2699	108	na	2807	1326	*	4133
2015	na	3425	144	na	3569	1492	*	5061

(1) WG estimates
(2) landings from VIIIa and VIIIb aggregated until 1974
(3) outside FU 23-24

Table 11.2. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Derivation and estimations of discards

1987	sampled
1988	from 1987's logistic function of sorting by quarter+density of probability
1989	from 1987's logistic function of sorting by quarter+density of probability
1990	from 1987's logistic function of sorting by quarter+density of probability
1991	sampled
1992	from 1991's logistic function of sorting by quarter+density of probability
1993	from 1991's logistic function of sorting by quarter+density of probability
1994	from 1991's logistic function of sorting by quarter+density of probability
1995	from 1991's logistic function of sorting by quarter+density of probability
1996	from 1991's logistic function of sorting by quarter+density of probability
1997	from 1991's logistic function of sorting by quarter+density of probability
1998	sampled
1999	from 1998's logistic function of sorting by quarter+density of probability
2000	from 1998's logistic function of sorting by quarter+density of probability
2001	from 1998's logistic function of sorting by quarter+density of probability
2002	from 1998's logistic function of sorting by quarter+density of probability
2003	sampled
2004	sampled
2005	sampled
2006	sampled
2007	sampled
2008	sampled
2009	sampled
2010	sampled
2011	sampled
2012	sampled
2013	sampled
2014	sampled

Table 11.3.a Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 1987-2000

Landings CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	14	0	0	0
16	0	158	59	0	0	0	0	0	0	0	14	0	0	0
17	149	230	77	12	35	62	0	0	0	0	0	0	0	0
18	331	553	131	64	30	0	0	31	20	0	0	0	0	14
19	1296	1886	901	48	79	138	0	72	61	0	0	0	0	11
20	3129	4227	2791	529	474	450	464	206	341	48	448	25	72	116
21	6476	8882	7039	1947	1572	1595	1285	482	1573	414	1313	288	219	433
22	13501	16050	12971	5913	4733	3948	3878	2824	2395	1311	2799	985	849	1015
23	21337	25374	18073	10910	7854	9701	7398	5366	5523	2799	4638	3171	1888	2531
24	24339	33950	21960	13293	15521	20948	11949	9650	8731	6071	10005	6484	4032	5462
25	32476	36294	25650	16440	19747	27876	21011	15079	14348	13239	19837	13980	10717	11357
26	29670	29808	22747	18205	22106	26617	23732	18312	19769	16779	19380	13535	10590	10212
27	28086	28380	22091	16109	21900	28410	26044	21181	25126	18384	22823	16602	12724	11528
28	24925	26017	19087	19595	21214	32091	27580	20488	20914	15744	19466	14432	12058	12639
29	18703	20920	14227	16250	17138	24760	20627	16527	15909	16332	20878	11832	9448	11473
30	18407	17862	13688	12055	14762	19828	21414	15903	19164	20214	21487	16335	16187	13888
31	11419	13156	9037	11088	12408	14281	13452	11207	13333	14009	9791	8539	9209	9828
32	10185	12822	8410	8540	8635	12786	12711	11490	13667	14392	9622	9237	9745	8936
33	8528	8848	7127	10649	7273	9297	11369	7022	7117	8576	6334	5947	6000	6333
34	5926	7812	6967	10543	7987	7318	7355	6684	7584	6524	4816	6619	5910	5225
35	5763	5935	6214	7637	5425	5928	6307	5646	4677	6578	4737	6700	5267	4895
36	4033	5064	4532	6274	4979	4998	4608	4337	3709	4133	2568	5308	4291	3242
37	4024	3754	3545	4841	4541	4195	4089	3752	3496	4226	2135	4722	3230	2946
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3527	2588	2687
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2169	2186	2027
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3084	2353	1862
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1362	1020
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1049	761	534
44	965	704	1192	1401	1089	1050	745	500	915	414	219	748	708	413
45	641	581	1194	955	1058	766	684	550	700	464	253	902	429	421
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	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	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**288974**	**324498**	**244875**	**213779**	**217338**	**274286**	**240638**	**188879**	**202294**	**182041**	**188694**	**161549**	**135304**	**133383**
Weights	**5397**	**5875**	**4835**	**4972**	**4754**	**5681**	**5109**	**4092**	**4452**	**4118**	**3610**	**3865**	**3209**	**3069**

Table 11.3.b Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 2001-2015

Landings CL mm/Y	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	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
17	0	0	20	7	0	0	0	0	0	0	0	0	0	0	0
18	13	0	14	0	25	5	4	12	0	0	0	0	0	0	0
19	38	0	0	14	27	0	0	0	0	0	1	0	5	0	0
20	284	107	87	47	82	5	4	77	37	14	22	35	31	1	16
21	643	925	280	249	270	70	14	191	73	75	6	25	151	74	130
22	2116	1122	661	899	771	131	18	208	288	252	11	235	682	180	575
23	6261	5513	1614	2194	2588	227	48	322	473	386	111	334	1002	764	1121
24	8915	10061	3966	5664	6511	822	188	721	1929	1238	515	1399	3162	1836	2523
25	17106	12951	8164	10930	13678	2844	1201	2742	3670	3940	1803	3843	7873	4419	3478
26	13745	21403	13297	13998	17811	6376	5684	6319	8258	8499	4773	7875	13242	7910	6651
27	17098	19433	17614	16094	22006	12010	9439	10891	12759	14173	7520	11079	14926	12869	9702
28	15835	22074	18572	15350	21879	14647	13248	12640	15732	15390	8991	11920	13260	13788	14431
29	13779	16559	16843	14808	18027	14591	12516	12890	13524	15340	9602	11120	13397	14560	13726
30	16168	18105	17264	14143	15570	13690	12219	10726	13271	15736	8821	9636	10296	12662	13690
31	11316	9989	13345	12353	12634	11814	10698	9772	10859	12749	8253	8393	9137	11051	12456
32	11335	10284	11276	10322	9907	9694	9274	8845	9310	11366	6954	7414	7116	10354	12021
33	8250	7813	8253	8020	7800	8421	7859	7436	7086	8851	6175	6069	5558	6509	9882
34	6185	5308	6195	6298	6537	7112	6539	6425	5985	7140	5467	4505	4123	6657	7881
35	5213	4309	4653	4673	5100	5135	6529	5366	4568	5852	4541	3507	2783	4961	6122
36	4037	3157	3818	3308	3369	4104	4735	3867	3697	3626	4260	2649	1978	3264	5219
37	2901	2049	3075	2875	2597	3196	3839	3121	2565	3024	3648	1976	1472	2682	4511
38	2369	2224	2660	2098	2380	2662	2639	2398	1871	2247	3911	1563	998	1783	3311
39	2297	1559	2174	1683	1650	1956	2245	2043	1491	1630	3472	1314	936	1844	2726
40	1908	1398	1936	1555	1628	1599	1711	1633	1190	1280	3296	1103	518	843	2676
41	941	764	1423	1188	1154	1171	1227	1190	878	966	2740	878	438	669	1635
42	863	632	1403	889	953	990	1111	1015	742	742	2497	635	351	412	1284
43	530	640	1054	774	842	741	710	805	540	560	2157	558	320	343	883
44	383	432	810	707	640	633	746	706	473	509	1762	536	249	234	637
45	523	416	808	613	605	595	518	536	396	442	1177	478	177	206	467
46	294	328	535	485	415	479	373	405	307	305	1024	441	181	159	236
47	368	241	456	388	353	440	311	361	262	290	858	378	88	151	216
48	188	188	339	313	339	382	257	294	245	237	656	381	98	87	149
49	183	79	206	318	288	319	237	262	196	204	557	212	74	72	200
50	160	115	253	306	276	287	190	228	156	160	501	160	46	63	108
51	135	73	170	214	176	246	163	201	115	135	383	132	37	58	68
52	102	46	150	152	184	201	138	116	110	120	296	128	32	24	46
53	82	51	120	111	142	137	140	121	98	97	198	96	24	42	33
54	40	20	80	90	104	156	115	95	63	95	271	93	17	18	29
55	53	30	57	47	109	137	79	73	75	79	152	58	15	11	26
56	24	13	23	86	69	117	60	67	54	75	132	46	8	5	15
57	46	6	47	49	58	134	70	41	31	67	98	48	22	10	18
58	29	6	22	27	43	134	45	40	48	47	105	52	3	8	5
59	26	3	10	32	41	85	33	19	23	48	79	33	12	3	3
60	21	11	8	10	19	115	33	23	14	42	48	22	3	2	3
61	7	0	5	5	28	40	23	7	8	30	39	15	8	1	0
62	2	0	4	3	16	21	9	9	9	16	55	18	1	1	7
63	5	1	1	5	9	19	9	7	10	7	23	11	2	1	0
64	0	0	0	8	8	18	10	6	3	16	12	8	0	0	1
65	0	1	0	1	14	11	9	1	3	9	11	7	0	0	1
66	0	0	1	1	6	10	1	0	2	3	11	3	0	0	0
67	0	0	0	1	5	8	1	0	2	3	6	1	0	0	0
68	0	0	0	2	4	7	3	0	0	4	7	0	0	0	0
69	0	0	1	0	1	6	2	0	1	1	2	2	0	0	0
70	0	0	0	0	2	4	0	0	0	1	2	0	0	0	0
71	0	0	1	0	1	5	0	0	0	1	1	0	0	0	0
72	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0
74	0	0	0	0	0	4	0	0	0	0	1	0	0	1	0
75	0	0	0	0	1	4	0	0	0	0	0	1	0	0	0
Total	**172819**	**180442**	**163771**	**154405**	**179758**	**128777**	**117273**	**115274**	**123504**	**138120**	**108011**	**101424**	**114853**	**121594**	**138920**
Weights	**3730**	**3679**	**3886**	**3571**	**3991**	**3447**	**3176**	**3030**	**2987**	**3398**	**3559**	**2520**	**2380**	**2807**	**3569**

Table 11.3.c Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 1987-2000.

Total Discards

CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10	0	1318	75	0	0	546	199	134	185	82	1325	0	93	186
11	0	2152	152	0	114	807	313	208	279	125	1611	85	150	291
12	0	3508	308	0	0	1190	491	323	419	191	1952	128	240	455
13	0	5695	624	1	93	1749	768	501	627	291	2354	162	384	710
14	78	9194	1261	2	258	2556	1198	774	936	441	2823	660	613	1104
15	2074	14706	2539	7	1249	3708	1858	1189	1388	666	3364	1741	977	1710
16	3974	23183	5074	22	2240	5320	2854	1811	2040	999	3980	1861	1548	2631
17	13577	35760	9995	71	4638	7521	4326	2727	2961	1484	4671	3527	2433	4008
18	29288	53448	19148	235	10619	10421	6429	4034	4221	2171	5432	5003	3776	6016
19	28370	76547	34910	766	12852	14070	9295	5825	5877	3114	6254	5991	5753	8843
20	60253	230038	153497	2426	22797	18408	12961	8143	7938	4347	7125	12091	8534	12628
21	45446	129602	100993	31048	18043	23225	17283	10932	10337	5862	8028	9973	12205	17372
22	51268	61144	47652	26066	24289	17350	17709	13186	9925	7591	14964	23278	16667	25140
23	23074	25627	17991	11687	15611	20991	15746	11862	12053	6558	10661	21641	17635	22623
24	7213	10004	6496	3836	13741	20860	12123	10225	9074	6765	10758	19750	15698	21146
25	2686	3535	2479	1516	14722	13478	10054	7645	7037	6720	10252	20487	18666	20177
26	672	1008	694	570	7131	6137	5513	4390	4741	4030	4720	10676	8465	8496
27	270	335	240	181	1711	3200	2863	2452	2817	2088	2639	7502	4774	4780
28	0	117	70	78	999	1759	1449	1143	1117	874	1096	3019	2202	2630
29	0	32	20	25	138	654	517	434	415	431	584	1357	813	1245
30	0	10	7	7	291	256	268	208	249	263	287	686	695	679
31	0	3	2	2	97	94	84	69	84	89	64	129	208	273
32	0	1	1	1	0	39	40	34	42	45	30	481	115	112
33	0	0	0	0	0	14	18	11	11	13	10	231	38	40
34	0	0	0	0	0	6	6	5	6	5	4	151	20	17
35	0	0	0	0	0	2	2	2	2	2	2	88	10	8
36	0	0	0	0	0	1	1	1	1	1	0	48	5	3
37	0	0	0	0	0	0	0	0	0	0	0	74	2	2
38	0	0	0	0	0	0	0	0	0	0	0	44	1	1
39	0	0	0	0	0	0	0	0	0	0	0	36	0	0
40	0	0	0	0	0	0	0	0	0	0	0	57	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	6	0	0
44	0	0	0	0	0	0	0	0	0	0	0	30	0	0
45	0	0	0	0	0	0	0	0	0	0	0	2	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	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	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**268244**	**686969**	**404228**	**78546**	**151634**	**174362**	**124368**	**88267**	**84780**	**55250**	**104994**	**150995**	**122720**	**163330**
Weights	**1767**	**4123**	**2634**	**627**	**1213**	**1354**	**1007**	**741**	**706**	**495**	**805**	**1453**	**1148**	**1455**

Table 11.3.d Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 2001-2015.

Total Discards

CL mm/Y	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
10	950	1268	28	0	0	0	22	0	82	0	0	0	0	0	0
11	1341	1817	0	0	94	0	171	38	135	2	0	0	0	0	0
12	1890	2597	70	363	413	70	202	98	79	0	237	0	0	0	68
13	2654	3696	294	1722	1085	234	122	235	177	97	596	532	0	28	169
14	3713	5233	636	3152	3190	1138	900	389	291	83	834	665	229	101	566
15	5164	7354	1198	5548	7287	3102	1288	189	1157	155	941	1425	870	281	1190
16	7126	10227	3386	6784	13528	7810	2959	1027	2315	822	1230	4544	1313	1300	2044
17	9732	14027	5927	8836	15094	11655	3636	1832	3059	1333	2430	4737	4179	1647	2885
18	13110	18895	8078	10161	19795	16139	4590	2626	4843	2309	3630	8066	3372	2808	4445
19	17354	24883	11506	17361	19522	25891	5244	6473	6485	3532	4546	8024	8730	3822	6836
20	22483	31890	12142	19250	22265	39742	8735	11444	12766	5692	7227	10125	9682	6457	7822
21	28397	39629	18597	25898	32409	54220	11585	15630	16772	7699	10393	12145	15281	9195	8973
22	49505	24662	21416	25210	35523	69870	17930	24730	18701	11689	15161	14034	20618	11284	9148
23	54819	48438	28429	26756	40041	70094	24086	27560	21693	13672	13837	12904	26287	15130	11534
24	34491	39179	26501	21343	36279	55408	30615	29638	24105	16963	15551	14889	21750	14000	14377
25	30416	22841	23211	20085	30222	52660	32917	28007	20736	14670	16545	10873	17823	18051	15512
26	11137	17386	17357	12006	19003	38812	27376	23127	14205	11852	10047	7747	10188	11947	12982
27	6340	8069	9680	6436	8498	20124	20567	10129	9188	8558	8127	4304	5439	8155	9283
28	2658	4129	6187	3487	4603	10263	10365	5893	5927	5986	3201	919	2824	5026	6290
29	1183	1494	2537	2115	1201	4188	4464	3225	3163	3360	2086	588	2146	2316	4478
30	665	876	1605	1901	1600	2578	2868	1923	3261	1876	2011	680	945	1672	3671
31	226	214	1326	1115	1417	1109	1316	925	1824	1274	1246	125	922	1263	1548
32	114	119	574	735	526	592	737	454	839	716	492	200	684	1482	1332
33	47	44	313	503	296	544	484	421	671	350	265	13	365	384	643
34	20	21	261	385	553	411	537	1025	830	274	272	145	494	433	1004
35	7	7	176	424	260	230	265	206	332	242	174	24	233	125	115
36	4	4	113	108	46	73	336	78	197	55	59	3	260	391	180
37	1	1	83	74	246	25	299	153	188	162	149	146	130	45	288
38	1	1	93	31	116	99	40	93	269	16	97	68	81	71	215
39	1	0	15	139	147	0	3	369	55	33	24	0	33	230	49
40	0	0	37	73	37	169	47	0	66	38	25	3	0	122	172
41	0	0	34	60	20	0	40	0	8	4	0	0	0	7	33
42	0	0	4	12	31	0	20	53	0	4	157	0	0	0	554
43	0	0	14	13	0	0	11	0	38	0	4	4	0	152	215
44	0	0	0	13	0	0	0	0	14	6	0	0	0	0	9
45	0	0	13	0	0	36	0	0	0	0	5	0	0	0	37
46	0	0	0	0	0	0	0	0	0	6	0	0	0	0	26
47	0	0	0	0	0	0	0	0	0	0	6	0	0	7	0
48	0	0	0	0	0	0	0	0	8	0	0	0	36	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
50	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	39	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	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	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**305547**	**329002**	**201841**	**222102**	**315346**	**487288**	**214788**	**198031**	**174480**	**113530**	**121603**	**117935**	**154914**	**117930**	**128712**
Weights	**2537**	**2620**	**1977**	**1932**	**2698**	**4544**	**2411**	**2123**	**1833**	**1275**	**1263**	**1012**	**1521**	**1326**	**1492**

Table 11.3.e Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 1987-2000.

Total catches

CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10	0	1318	75	0	0	546	199	134	185	82	1325	0	93	186
11	0	2152	152	0	114	807	313	208	279	125	1611	85	150	291
12	0	3508	308	0	0	1190	491	323	419	191	1952	128	240	455
13	0	5695	624	1	93	1749	768	501	627	291	2354	162	384	710
14	78	9194	1261	2	258	2556	1198	774	936	441	2823	660	613	1104
15	2074	14706	2539	7	1249	3708	1858	1189	1388	666	3378	1741	977	1710
16	3974	23341	5134	22	2240	5320	2854	1811	2040	999	3994	1861	1548	2631
17	13727	35990	10072	83	4673	7583	4326	2727	2961	1484	4671	3527	2433	4008
18	29620	54001	19279	299	10649	10421	6429	4065	4241	2171	5432	5003	3776	6031
19	29666	78433	35810	814	12931	14209	9295	5897	5938	3114	6254	5991	5753	8854
20	63382	234265	156289	2955	23271	18858	13425	8348	8279	4394	7573	12116	8605	12744
21	51922	138484	108031	32996	19615	24820	18569	11413	11910	6276	9341	10260	12424	17805
22	64770	77194	60622	31979	29023	21298	21587	16010	12320	8902	17764	24263	17516	26155
23	44411	51001	36064	22597	23464	30692	23143	17227	17576	9357	15299	24812	19523	25155
24	31551	43954	28456	17129	29262	41808	24072	19876	17805	12836	20763	26235	19730	26608
25	35162	39829	28130	17956	34469	41355	31065	22724	21385	19960	30089	34467	29383	31534
26	30342	30817	23441	18775	29237	32754	29245	22702	24510	20810	24100	24211	19056	18708
27	28357	28715	22331	16290	23611	31610	28907	23633	27943	20472	25462	24104	17498	16307
28	24925	26134	19157	19672	22213	33851	29028	21631	22031	16618	20563	17450	14261	15269
29	18703	20952	14247	16275	17276	25413	21145	16961	16324	16763	21463	13189	10261	12718
30	18407	17871	13696	12061	15053	20084	21682	16111	19413	20478	21774	17021	16882	14567
31	11419	13159	9038	11090	12505	14375	13535	11276	13418	14098	9856	8668	9417	10102
32	10185	12823	8410	8541	8635	12825	12751	11524	13710	14436	9652	9718	9860	9048
33	8528	8848	7128	10650	7273	9311	11387	7033	7128	8589	6344	6178	6038	6373
34	5926	7812	6967	10543	7987	7324	7361	6688	7590	6529	4820	6770	5930	5242
35	5763	5935	6214	7637	5425	5931	6309	5648	4678	6580	4739	6787	5277	4903
36	4033	5064	4532	6274	4979	4999	4609	4338	3709	4134	2568	5356	4295	3245
37	4024	3754	3545	4841	4541	4195	4089	3753	3496	4227	2135	4796	3232	2947
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3571	2589	2688
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2205	2186	2027
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3140	2353	1862
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1363	1020
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1055	762	534
44	965	704	1192	1401	1089	1050	745	500	915	414	219	778	708	413
45	641	581	1194	955	1058	766	684	550	700	464	253	904	429	421
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	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	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**557218**	**1011467**	**649102**	**292325**	**368972**	**448648**	**365006**	**277146**	**287074**	**237291**	**293688**	**312544**	**258025**	**296713**
Weights	**7164**	**9997**	**7470**	**5599**	**5967**	**7034**	**6116**	**4833**	**5159**	**4614**	**4415**	**5318**	**4357**	**4523**

Table 11.3.f Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 2001-2015.

Total catches

CL mm/Y	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
10	950	1268	28	0	0	0	22	0	82	0	0	0	0	0	0
11	1341	1817	0	0	94	0	171	38	135	2	0	0	0	0	0
12	1890	2597	70	363	413	70	202	98	79	0	237	0	0	0	68
13	2654	3696	294	1722	1085	234	122	235	177	97	596	532	0	28	169
14	3713	5233	636	3152	3190	1138	900	389	291	83	834	665	229	101	566
15	5164	7354	1198	5548	7287	3102	1289	189	1157	155	941	1425	870	281	1190
16	7126	10227	3386	6784	13528	7810	2959	1027	2315	822	1230	4544	1313	1300	2044
17	9732	14027	5947	8843	15094	11655	3636	1832	3059	1333	2430	4737	4179	1647	2885
18	13122	18895	8092	10161	19820	16144	4593	2638	4843	2309	3630	8066	3372	2808	4445
19	17392	24883	11506	17376	19549	25891	5244	6473	6485	3532	4546	8024	8735	3822	6836
20	22767	31997	12229	19297	22348	39747	8738	11521	12803	5706	7249	10160	9713	6458	7838
21	29040	40555	18877	26146	32679	54289	11598	15820	16845	7775	10398	12170	15433	9269	9103
22	51621	25784	22077	26109	36293	70001	17948	24938	18989	11941	15171	14269	21300	11464	9723
23	61081	53951	30042	28950	42629	70322	24134	27882	22167	14058	13948	13238	27289	15894	12656
24	43406	49240	30467	27006	42790	56230	30803	30359	26034	18202	16065	16288	24913	15836	16900
25	47522	35792	31376	31015	43900	55504	34119	30750	24406	18610	18348	14716	25696	22470	18990
26	24882	38790	30654	26004	36814	45189	33060	29446	22463	20352	14820	15622	23430	19857	19633
27	23438	27502	27294	22530	30504	32134	30006	21020	21948	22730	15647	15383	20365	21024	18985
28	18493	26203	24759	18837	26482	24909	23613	18533	21659	21375	12191	12838	16084	18814	20721
29	14962	18053	19381	16923	19228	18779	16980	16115	16687	18700	11687	11708	15543	16876	18204
30	16833	18981	18868	16044	17170	16268	15087	12649	16531	17612	10832	10315	11241	14334	17361
31	11542	10203	14672	13469	14051	12923	12014	10697	12682	14024	9500	8518	10059	12314	14004
32	11448	10403	11849	11057	10433	10286	10011	9299	10150	12082	7447	7614	7801	11836	13353
33	8297	7857	8566	8523	8095	8965	8343	7857	7757	9201	6440	6082	5923	6892	10525
34	6204	5329	6456	6684	7090	7524	7076	7449	6815	7414	5739	4649	4617	7091	8886
35	5220	4316	4829	5097	5361	5366	6793	5573	4900	6094	4715	3531	3016	5087	6237
36	4041	3161	3931	3416	3415	4177	5071	3945	3894	3681	4319	2652	2237	3654	5399
37	2903	2050	3158	2949	2844	3221	4138	3273	2753	3186	3797	2122	1602	2727	4798
38	2370	2225	2752	2129	2496	2760	2679	2491	2139	2263	4007	1632	1079	1854	3526
39	2298	1560	2189	1822	1797	1956	2247	2412	1546	1662	3496	1314	968	2075	2775
40	1908	1399	1973	1628	1665	1768	1758	1633	1257	1318	3321	1107	518	965	2848
41	941	764	1457	1248	1174	1171	1267	1190	886	971	2740	878	438	676	1668
42	863	632	1407	901	984	990	1130	1069	742	746	2654	635	351	412	1839
43	530	641	1068	787	842	741	722	805	578	560	2161	563	320	495	1098
44	383	432	810	719	640	633	746	706	487	515	1762	536	249	234	646
45	523	416	821	613	605	631	518	536	396	442	1182	478	177	206	504
46	294	328	535	485	415	479	373	405	307	312	1024	441	181	159	262
47	368	241	456	388	353	440	311	361	262	290	865	378	88	158	216
48	188	188	339	313	339	382	257	294	254	237	656	381	134	87	149
49	183	79	206	318	288	319	237	262	196	204	557	212	74	72	219
50	160	115	253	306	276	287	201	228	156	160	501	160	46	63	108
51	135	73	170	214	176	246	163	201	115	135	383	132	37	58	68
52	102	46	150	152	184	201	138	116	110	120	296	128	32	24	46
53	82	51	120	111	142	137	140	121	98	97	198	96	24	42	33
54	40	20	80	90	104	156	115	95	63	95	271	93	17	18	29
55	53	30	57	47	109	137	79	73	75	79	152	58	15	11	26
56	24	13	23	86	69	117	60	67	54	75	132	46	8	5	15
57	46	6	47	49	58	134	70	41	31	67	98	48	22	10	18
58	29	6	22	27	43	134	45	80	48	47	105	52	3	8	5
59	26	3	10	32	41	85	33	19	23	48	79	33	12	3	3
60	21	11	8	10	19	115	33	23	14	42	48	22	3	2	3
61	7	0	5	5	28	40	23	7	8	30	39	15	8	1	0
62	2	0	4	3	16	21	9	9	9	16	55	18	1	1	7
63	5	1	1	5	9	19	9	7	10	7	23	11	2	1	0
64	0	0	0	8	8	18	10	6	3	16	12	8	0	0	1
65	0	1	0	1	14	11	9	1	3	9	11	7	0	0	1
66	0	0	1	1	6	10	1	0	2	3	11	3	0	0	0
67	0	0	0	1	5	8	1	0	2	3	6	1	0	0	0
68	0	0	0	2	4	7	3	0	0	4	7	0	0	0	0
69	0	0	1	0	1	6	2	0	1	1	2	2	0	0	0
70	0	0	0	0	2	4	0	0	0	1	2	0	0	0	0
71	0	0	1	0	1	5	0	0	0	1	1	0	0	0	0
72	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0
74	0	0	0	0	0	4	0	0	0	0	1	0	0	1	0
75	0	0	0	0	1	4	0	0	0	0	0	1	0	0	0
Total	**478366**	**509443**	**365612**	**376507**	**495103**	**616065**	**332060**	**313305**	**297984**	**251649**	**229614**	**219358**	**269767**	**239523**	**267632**
Weights	**6267**	**6299**	**5863**	**5503**	**6689**	**7990**	**5587**	**5154**	**4820**	**4673**	**4822**	**3532**	**3900**	**4133**	**5061**

Table 11.3.g Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 1987-2000.

Removals=Landings+dead catches (discard survival rate : 30%)

CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10	0	922	52	0	0	382	139	94	130	57	928	0	65	130
11	0	1507	106	0	80	565	219	146	195	88	1128	60	105	204
12	0	2455	216	0	0	833	344	226	293	134	1366	89	168	319
13	0	3987	437	0	65	1224	538	351	439	203	1648	114	269	497
14	55	6436	883	1	181	1789	839	542	655	309	1976	462	429	773
15	1452	10294	1777	5	875	2595	1301	832	972	466	2369	1219	684	1197
16	2782	16386	3611	15	1568	3724	1998	1268	1428	699	2800	1302	1084	1842
17	9654	25262	7074	62	3282	5326	3028	1909	2072	1039	3270	2469	1703	2806
18	20833	37967	13534	229	7464	7294	4500	2855	2974	1520	3802	3502	2643	4226
19	21155	55469	25338	584	9075	9987	6507	4150	4175	2180	4378	4194	4027	6201
20	45306	165254	110239	2228	16432	13336	9537	5906	5898	3090	5436	8489	6045	8956
21	38288	99604	77733	23681	14202	17852	13384	8134	8809	4518	6933	7269	8763	12593
22	49389	58851	46327	24159	21736	16093	16274	12054	9343	6624	13274	17280	12516	18613
23	37489	43313	30667	19090	18781	24395	18420	13669	13960	7390	12101	18320	14232	18368
24	29387	40953	26507	15979	25139	35550	20435	16808	15083	10807	17535	20310	15021	20264
25	34356	38768	27386	17501	30052	37311	28048	20431	19274	17944	27014	28321	23783	25481
26	30141	30514	23233	18604	27098	30913	27591	21385	23088	19601	22684	21008	16516	16159
27	28276	28615	22259	16236	23098	30650	28048	22897	27098	19846	24670	21853	16066	14873
28	24925	26099	19136	19649	21914	33323	28594	21288	21696	16356	20234	16545	13600	14480
29	18703	20942	14241	16268	17235	25217	20989	16831	16199	16633	21287	12782	10017	12345
30	18407	17868	13693	12059	14965	20008	21602	16049	19338	20399	21688	16815	16674	14363
31	11419	13158	9038	11089	12476	14347	13510	11255	13392	14072	9836	8629	9354	10020
32	10185	12823	8410	8541	8635	12813	12739	11514	13697	14423	9643	9574	9826	9014
33	8528	8848	7128	10649	7273	9306	11382	7030	7124	8585	6341	6109	6027	6361
34	5926	7812	6967	10543	7987	7322	7360	6687	7588	6527	4819	6725	5924	5237
35	5763	5935	6214	7637	5425	5930	6309	5647	4678	6580	4738	6761	5274	4901
36	4033	5064	4532	6274	4979	4999	4609	4338	3709	4133	2568	5341	4294	3244
37	4024	3754	3545	4841	4541	4195	4089	3753	3496	4226	2135	4774	3231	2947
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3558	2589	2688
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2195	2186	2027
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3123	2353	1862
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1363	1020
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1053	761	534
44	965	704	1192	1401	1089	1050	745	500	915	414	219	769	708	413
45	641	581	1194	955	1058	766	684	550	700	464	253	904	429	421
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	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	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**476745**	**805376**	**527834**	**268762**	**323482**	**396340**	**327696**	**250666**	**261640**	**220716**	**262190**	**267245**	**221208**	**247714**
Weights	**6634**	**8760**	**6679**	**5411**	**5603**	**6628**	**5814**	**4610**	**4947**	**4465**	**4173**	**4882**	**4013**	**4087**

Table 11.3.h Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 2001-2015.

Removals=Landings+dead catches (discard survival rate : 30%)

CL mm/Y	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
10	665	888	19	0	0	0	16	0	58	0	0	0	0	0	0
11	939	1272	0	0	66	0	119	27	94	1	0	0	0	0	0
12	1323	1818	49	254	289	49	142	69	56	0	166	0	0	0	48
13	1858	2587	206	1205	760	164	85	164	124	68	417	372	0	20	118
14	2599	3663	445	2206	2233	797	630	272	204	58	584	466	160	71	396
15	3615	5148	839	3883	5101	2171	902	132	810	108	658	998	609	196	833
16	4988	7159	2370	4749	9469	5467	2072	719	1621	575	861	3181	919	910	1431
17	6812	9819	4169	6193	10565	8158	2545	1282	2141	933	1701	3316	2925	1153	2019
18	9190	13226	5669	7112	13882	11302	3216	1851	3390	1616	2541	5646	2360	1966	3112
19	12186	17418	8055	12167	13692	18124	3671	4531	4540	2472	3183	5617	6116	2676	4785
20	16022	22430	8586	13522	15668	27825	6118	8087	8973	3998	5081	7122	6809	4521	5491
21	20521	28666	13298	18377	22957	38024	8123	11131	11813	5465	7281	8527	10848	6510	6411
22	36769	18385	15653	18546	25636	49040	12569	17519	13379	8434	10623	10058	15114	8079	6979
23	44635	39420	21514	20924	30617	49293	16909	19614	15659	9957	9797	9367	19403	11355	9196
24	33059	37486	22517	20604	31906	39608	21619	21468	18803	13113	11400	11821	18387	11636	12587
25	38397	28940	24412	24990	34834	39706	24243	22348	18185	14209	13385	11454	20349	17054	14336
26	21541	33574	25447	22402	31113	33545	24847	22508	18202	16796	11806	13298	20373	16273	15738
27	21536	25081	24390	20599	27955	26097	23835	17982	19191	20163	13209	14092	18733	18578	16200
28	17695	24964	22903	17791	25101	21831	20503	16765	19881	19579	11231	12563	15237	17306	18834
29	14607	17605	18619	16289	18868	17523	15641	15148	15738	17692	11061	11531	14899	16181	16861
30	16633	18718	18387	15474	16690	15495	14227	12072	15553	17049	10229	10111	10957	13832	16260
31	11475	10138	14274	13134	13626	12590	11619	10419	12135	13641	9126	8480	9783	11935	13540
32	11414	10367	11677	10836	10276	10108	9790	9163	9898	11867	7299	7554	7595	11391	12954
33	8283	7844	8472	8372	8007	8802	8197	7731	7556	9096	6361	6078	5814	6777	10333
34	6198	5323	6377	6568	6924	7400	6915	7142	6566	7332	5657	4606	4469	6961	8584
35	5218	4314	4776	4970	5282	5297	6714	5511	4801	6021	4663	3524	2946	5049	6203
36	4040	3160	3897	3384	3401	4155	4971	3921	3835	3665	4301	2651	2159	3537	5345
37	2902	2050	3133	2927	2770	3214	4048	3228	2696	3138	3753	2078	1563	2713	4712
38	2370	2225	2725	2120	2461	2731	2667	2463	2059	2258	3978	1611	1055	1833	3461
39	2298	1560	2184	1780	1753	1956	2246	2301	1529	1652	3489	1314	959	2006	2761
40	1908	1399	1962	1606	1654	1717	1744	1633	1237	1306	3313	1106	518	929	2796
41	941	764	1447	1230	1168	1171	1255	1190	884	969	2740	878	438	674	1658
42	863	632	1406	897	975	990	1125	1053	742	745	2607	635	351	412	1672
43	530	641	1064	783	842	741	718	805	567	560	2160	561	320	449	1033
44	383	432	810	715	640	633	746	706	483	514	1762	536	249	234	644
45	523	416	817	613	605	620	518	536	396	442	1181	478	177	206	493
46	294	328	535	485	415	479	373	405	307	310	1024	441	181	159	254
47	368	241	456	388	353	440	311	361	262	290	863	378	88	156	216
48	188	188	339	313	339	382	257	294	251	237	656	381	124	87	149
49	183	79	206	318	288	319	237	262	196	204	557	212	74	72	213
50	160	115	253	306	276	287	198	228	156	160	501	160	46	63	108
51	135	73	170	214	176	246	163	201	115	135	383	132	37	58	68
52	102	46	150	152	184	201	138	116	110	120	296	128	32	24	46
53	82	51	120	111	142	137	140	121	98	97	198	96	24	42	33
54	40	20	80	90	104	156	115	95	63	95	271	93	17	18	29
55	53	30	57	47	109	137	79	73	75	79	152	58	15	11	26
56	24	13	23	86	69	117	60	67	54	75	132	46	8	5	15
57	46	6	47	49	58	134	70	41	31	67	98	48	22	10	18
58	29	6	22	27	43	134	45	68	48	47	105	52	3	8	5
59	26	3	10	32	41	85	33	19	23	48	79	33	12	3	3
60	21	11	8	10	19	115	33	23	14	42	48	22	3	2	3
61	7	0	5	5	28	40	23	7	8	30	39	15	8	1	0
62	2	0	4	3	16	21	9	9	9	16	55	18	1	1	7
63	5	1	1	5	9	19	9	7	10	7	23	11	2	1	0
64	0	0	0	8	8	18	10	6	3	16	12	8	0	0	1
65	0	1	0	1	14	11	9	1	3	9	11	7	0	0	1
66	0	0	1	1	6	10	1	0	2	3	11	3	0	0	0
67	0	0	0	1	5	8	1	0	2	3	6	1	0	0	0
68	0	0	0	2	4	7	3	0	0	4	7	0	0	0	0
69	0	0	1	0	1	6	2	0	1	1	2	2	0	0	0
70	0	0	0	0	2	4	0	0	0	1	2	0	0	0	0
71	0	0	1	0	1	5	0	0	0	1	1	0	0	0	0
72	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0
74	0	0	0	0	0	4	0	0	0	0	1	0	0	1	0
75	0	0	0	0	1	4	0	0	0	0	0	1	0	0	0
Total	**386702**	**410743**	**305060**	**309877**	**400500**	**469879**	**267624**	**253896**	**245640**	**217590**	**193133**	**183978**	**223293**	**204145**	**229018**
Weights	**5506**	**5513**	**5270**	**4923**	**5880**	**6627**	**4864**	**4517**	**4270**	**4290**	**4443**	**3229**	**3444**	**3735**	**4613**

Table 11.4. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b). Effort and LPUE values of commercial fleets.

Sub-area VIII a,b

	Le Guilvinec District Quarter 2		
Year	Landings(t)	Effort(100h)	LPUE(Kg/h)
1987	603	437	13.8
1988	777	471	16.5
1989	862	664	13.0
1990	801	708	11.3
1991	717	728	9.8
1992	841	757	11.1
1993	805	735	11.0
1994	690	671	10.3
1995	609	627	9.7
1996	715	598	12.0
1997	638	539	11.8
1998	622	489	12.7
1999	505	423	11.9
2000	438	405	10.8
2001	697	417	16.7
2002	527	371	14.2
2003	487	355	13.7
2004	410	321	12.7
2005	455	335	13.6
2006	414	306	13.5
2007	401	291	13.8
2008	410	271	15.1
2009	384	279	13.8
2010	471	253	18.6
2011	422	279	15.1
2012	348	229	15.2
2013	288	224	12.8
2014	252	198	12.7
2015	451	231	19.5

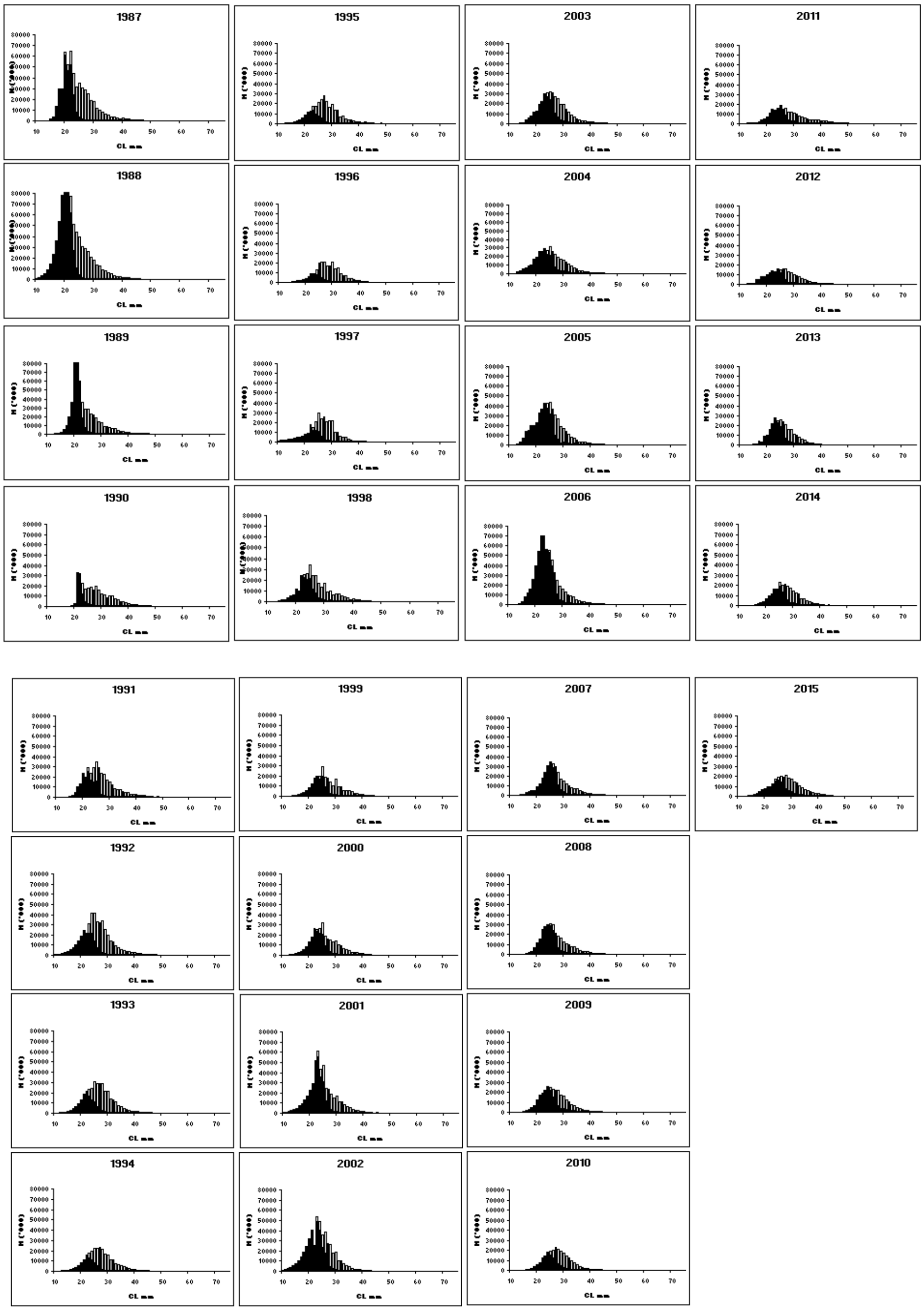


Figure 11.1. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) catches (landings in white and discards in black) length distributions in 1987-2015.

Figure 11.2. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - mean length of landings, discards and cat

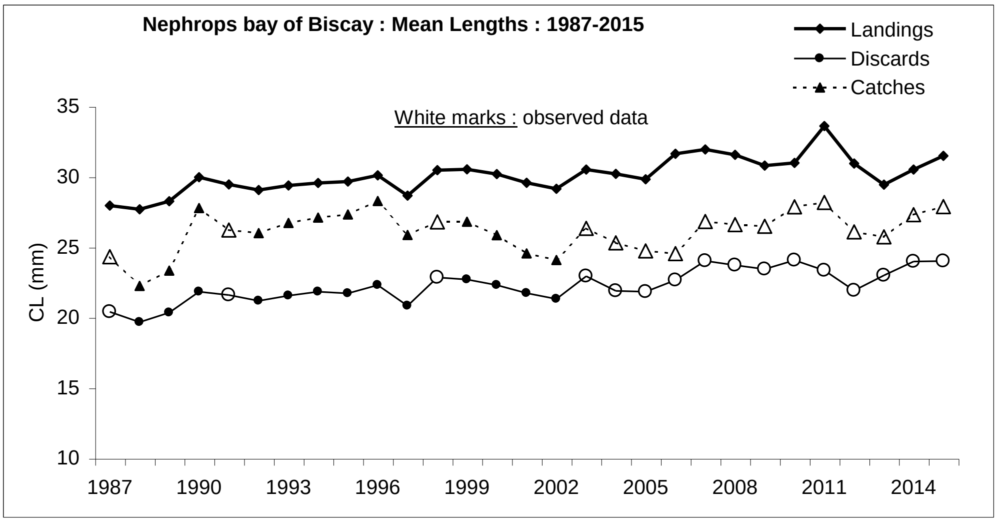
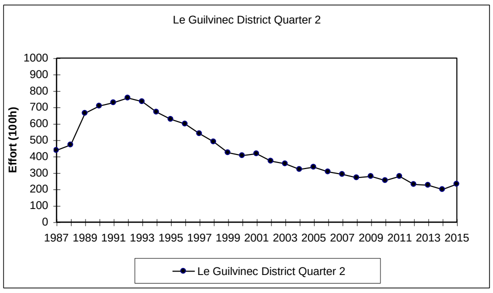
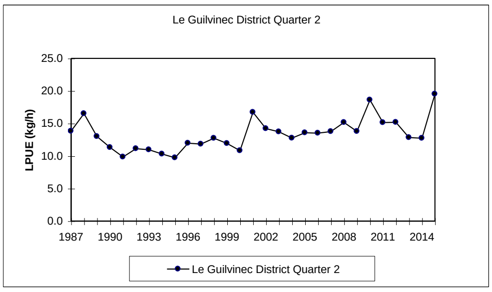


Figure 11.3. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - Effort and LPUE values of standardised commercial fleets.

I. Effort



II. LPUE



12 *Nephrops* in Divisions 8.c, FUs 25,31 (Norway lobster)

The ICES Division 8.c includes two *Nephrops* Functional Units: FU 25, North Galicia and FU 31, Cantabrian Sea.

12.1 *Nephrops* FU 25 (North Galicia)

12.1.1 General

12.1.1.1 Ecosystem aspects

See Annex K

12.1.1.2 Fishery description

See Annex K

12.1.1.3 Summary of ICES Advice for 2016 and management applicable to 2015 and 2016

ICES advice for 2016

The advice for these *Nephrops* stocks is biennial and valid for 2015 and 2016.

ICES advises on the basis of the precautionary considerations that there should be directed fishery and bycatch should be minimized.

To protect the stock in this Functional Unit, ICES advices that management area should be consistent with the assess area. Therefore, management should be implemented at the Functional Unit level.

Management applicable to 2015 and 2016

A recovery plan for southern hake and Iberian *Nephrops* stocks has been in force since the end of January 2006. The aim of the recovery plan is to rebuild the stocks within 10 years, with a reduction of 10% in F relatively to the previous year and the TAC set accordingly (Council Regulation (EC) No. 2166/2005). TACs of 60 t and 46 t were set for the whole of Division 8.c for 2015 and 2016, respectively.

A Fishing Plan for the Northwest Cantabrian ground was established in 2013 (AAA/1307/2013). This new regulation establishes an assignation of the quotas by vessel including *Nephrops*.

12.1.2 Data

12.1.2.1 Commercial catches and discards

Up to 2010, in previous years landings have been estimated by the WG based on IEO scientific estimations. The information was compiled by IEO from sale sheets and Owners Associations where the *Nephrops* landings allocation was carried out based on landing port criteria. Since 2011, the Spanish Authority for Fisheries (Secretaría General de Pesca, SGP) who is also the National Authority for the Data Collection Framework established a new policy and general approach in the provision of official data on catches and fishing effort. So, since 2011 *Nephrops* landings are official landings.

Unlike the IEO scientific estimates, official landings are derived from logbooks. This source of information allows the landings disaggregation by ICES statistical rectangles. In WGHMM 2013 was noticed that some *Nephrops* catches were recorded into statistical rectangles outside the FU 25 definition. In 2012 and 2013 *Nephrops* catches recorded into statistical rectangles outside this FU were considered as part of the landings in FU 25. In 2014 Spanish landings of *Nephrops* have been uploaded to InterCatch broken down by ICES statistical rectangle for first time according to the 2014 ICES Data Call requirements. However, only were uploaded to Intercatch 83.7% of 2014 landings which were recorded inside ICES statistical rectangles defined as FU 31 (WD Nº 3, Castro, 2015). In 2015, all catches were into FU 25 definition.

Landings were reported only by Spain. Since the early 90s landings declined from about 400 t to less than 100 t in 2003. In the period 2004-2015, landings show a continuous decreasing trend up to 9 t in 2014 (Table 12.1.1). Landings increase up to 14 t in 2015. The time-series of the commercial landings (Figure 12.1.1) shows a clear declining trend, with present values representing approximately less than 1% of the landings in the 70s. Information on discards was sent to the WG through InterCatch. There are no discards in this functional unit.

12.1.2.2 Biological sampling

Length frequencies by sex of the *Nephrops* landings are collected as a rule on a monthly basis. The sampling levels are showed in Table 1.3.

Annual length compositions for males and females combined, mean size and mean weight in the landings in the time-series are given in Tables 12.1.2a and 12.1.2b for the period 1982–1999 and 2000–2015, respectively. Length frequency distributions for the time-series are presented in two figures too (Figure 12.1.3a for the period 1982–2007 and Figure 12.1.3b for the period 2008–2015).

Mean sizes in the landings shows an increasing trend in the time-series in both sexes. The maximum value was recorder in 2009, reaching 48.5 and 45.1 mm CL for males and females, respectively. However, decreasing trend was observed from 2010 to 2015 (Figure 12.1.1). In 2015, the mean size in females was 36.1 mm of carapace length while 37.9 mm for males.

12.1.2.3 Commercial catch-effort data

Fishing effort and LPUE data were available for the A Coruña trawl fleet (SP-CORUTR8c) from 1975 (Table 12.1.3 and Figure 12.1.1). The method to estimate the effort has changed since 2009. Before this date the effort series (SP-CORUTR8c) was estimated using a different fleet segmentation. Since implementation of the current DCF sampling program (EC, 2008), the Northwester Spanish OTB fleet was split into two different *métiers*: OTB_DEF_>55_0_0 (trips targeting demersal fish that include *Nephrops*) and OTB_MPD_>55_0_0 (trips targeting pelagic fish accompanied by demersal fish). In 2014 WG were presented a revision of the 2009-2014 effort and LPUE series in FU 25 using only the demersal *métier* OTB_DEF_>55_0_0 and they have been renamed as SP-LCGOTBDEF (WD Nº 4, Castro & Morlan, 2014). As a consequence it must be noted that the method uses to calculate the LPUE of SP-LCGOTBDEF is not consistent across the period as shown in Figure 12.1.1.

The available time-series of effort (Figure 12.1.1) shows a continuous decreasing trend. The lowest effort was observed in 2011, representing approximately 15% of fishing effort in the 70's. In 2012–2014 period, effort increased but decreased again in 2015. In general, effort remains at very low level in the last decade. Effort of the bottom trawl in this fishery is directed primarily at a set of demersal and bottom species, with *Nephrops* making only a small contribution to the whole landings.

The overall trend of LPUE is declining too (Figure 12.1.1). After a period quite variable at the beginning of the time-series, LPUE remained relatively stable at around 40 kg/trip between 1993–1997. Since then, LPUE has fluctuated at low levels but shows a decreasing trend up to 2014, the lowest value recorded in the time-series (4.5 Kg/trip). In 2015, the LPUE value increases slightly up to 9.3 Kg/trip.

12.1.3 Assessment

According to the ICES data-limited approach, this stock is considered as category 3.1.4 (ICES, 2012). FU 25 is assessed by the analysis of the LPUE series trend, as was done in 2014. The results in this year indicate an extremely low abundance level.

12.1.4 Biological reference points

Proxies of MSY reference points were defined using the methods developed in WKLIFE and WKProxy (ICES, 2015, 2016d). $F_{0.1}$, taken as proxy of F_{MSY}, from length–based analysis for the period 1986–2014 was 0.17 for both sexes combined but the value of MSY $B_{trigger}$ proxy is not available.

12.1.5 Management Considerations

Nephrops is taken as by catch in the mixed bottom fishery. The overall trend in landings of *Nephrops* from the North Galicia (FU25) is strongly declining. Landings have dramatically decreased since the beginning of the series (1975–2014), representing less 1% of the landings.

A recovery plan for southern hake and Atlantic Iberian *Nephrops* stocks was approved in December 2005 (Council Regulation (EC) No 2166/2005) and implemented since January 2006. The management objective is to rebuild the stock to safe biological limits within a period of 10 years. This recovery plan includes a procedure for setting the TACs for *Nephrops* stocks, complemented by a system of fishing effort limitation (a reduction of 10% in the fishing mortality rate in the year of its application as compared with the fishing mortality rate estimated for the preceding year, within the limits of ±15% of the preceding year TAC).

A Fishing Plan for the Northwest Cantabrian ground was established in 2013 (AAA/1307/2013). This new regulation establishes an assignation of the quotas by vessel including *Nephrops*.

Table 12.1.1. ***Nephrops*** **FU25, North Galicia. Landings in tonnes.**

Year	Trawl	Unallocated	Total FU
1975	731		731
1976	559		559
1977	667		667
1978	690		690
1979	475		475
1980	412		412
1981	318		318
1982	431		431
1983	433		433
1984	515		515
1985	477		477
1986	364		364
1987	412		412
1988	445		445
1989	376		376
1990	285		285
1991	453		453
1992	428		428
1993	274		274
1994	245		245
1995	273		273
1996	209		209
1997	219		219
1998	103		103
1999	124		124
2000	81		81
2001	147		147
2002	143		143
2003	89		89
2004	75		75
2005	63		63
2006	62		62
2007	67		67
2008	39		39
2009	21		21
2010	34		34
2011	44		44
2012	10	11	21
2013	10		10
2014	9		9
2015	14		14

Table 12.1.2a. *Nephrops* FU25, North Galicia. Length compositions of landings of landings, mean weight (Kg) and mean length (CL, mm) for the period 1982–1999.

Size, CL/Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
15																		
16																		
17																		
18																		
19	1	8			6							5						
20	1	17		16	1				2			34			1			0
21	7	31	9							1		49	1	0	2			
22	10	99	20	8	50	0						32	1	7	5	5		0
23	41	143	18	68	68	6	4		5	15		15	10	6	6	7	1	1
24	53	350	138	198	136	38	1		8	20	13	80	10	19	29	16	2	5
25	105	496	150	300	192	191	16		30	71	19	57	60	64	38	18	6	15
26	142	511	342	326	279	185	42	1	30	203	26	70	118	77	56	53	12	26
27	275	748	519	575	299	467	17	2	59	359	102	71	179	108	91	49	16	21
28	303	731	686	799	495	302	208	23	186	1038	331	105	281	213	179	186	47	67
29	382	761	1004	943	500	365	175	21	174	850	280	134	262	189	225	178	38	91
30	648	1068	1307	1253	470	505	535	84	278	1426	563	176	335	424	266	441	92	194
31	611	1004	1108	1215	602	446	504	95	329	1047	584	152	330	370	342	303	65	136
32	782	1009	1581	1045	779	618	613	248	535	1319	883	308	410	444	404	492	99	197
33	874	956	1323	817	812	526	906	369	547	946	831	472	471	433	454	387	69	100
34	906	782	1193	975	886	741	719	406	448	981	1114	533	507	480	520	695	152	300
35	927	777	1032	797	764	820	745	625	555	883	976	670	564	707	396	543	193	258
36	991	756	972	823	682	945	820	414	563	709	809	549	547	480	360	500	139	241
37	728	610	643	637	694	845	989	618	447	738	923	563	462	462	341	323	192	208
38	582	667	456	484	600	453	799	757	429	641	656	546	454	459	329	407	178	211
39	553	513	360	593	341	491	438	433	315	404	528	362	330	315	257	299	123	138
40	480	438	442	494	416	478	582	477	348	449	517	336	301	507	233	326	203	202
41	368	348	323	307	329	283	461	507	304	279	365	230	178	239	166	141	101	110
42	347	286	412	230	251	226	673	375	235	295	386	243	222	300	145	166	106	106
43	250	194	187	301	283	312	314	417	244	230	296	175	113	219	122	98	81	58
44	193	124	202	239	108	286	236	280	181	146	214	173	99	116	82	57	65	61
45	238	125	205	104	102	125	219	236	157	170	138	158	99	142	74	84	82	72
46	111	87	97	223	64	302	123	209	93	109	138	124	52	74	55	31	35	42
47	100	56	79	65	80	136	104	156	78	97	104	43	38	56	55	37	41	23
48	81	44	181	85	31	108	106	163	71	79	34	69	25	30	37	26	31	26
49	48	23	89	52	42	93	44	90	36	32	45	23	29	12	21	16	16	16
50	48	17	56	48	25	41	30	71	26	34	31	25	18	16	21	28	28	41
51	32	16	64	41	17	9	23	49	22	10	16	17	8	8	12	3	5	6
52	16	6	3	4	20	19	20	41	24	9	33	26	11	6	6	5	9	9
53	12	9	6	34	8	21	5	41	18	13	14	20	10	6	11	4	4	4
54	9	6	25	33	8	1	7	26	8	4	5	2	7	4	7	3	3	5
55	8	6	25	7	4	3	5	13	9	1	12	10	7	3	5	5	3	7
56	3	3	25	5	0	10	3	9	2	3	2	2	4	2	3	0	2	4
57	4	1		6	0	7	4	8	5	3	0		5	1	2	1	0	2
58	1	3	1	0	11	8		5	1	3	0	0	2	1	5	0	1	2
59	3	2		2	1		10	2	2	1	0	0	1	1	5	0	1	0
60	2	2	1	1	0	3	2	8	1	0	1		0	1	3	1	1	0
61	0	2		1	0			4	2				1	1	2	0	0	
62	3	2		1	0			2		1	1		0	1	3	0	0	0
63	1	1		1		1		1	0	0	0		1	1	1	2	0	
64	2	0		3	0	1	2	3	1				0	1	1	0	0	
65	1	0		0	0	1	12	1	0	2	1		0	0	4			
66	0	1		1	0			1	1					0	1	1	0	
67	1	2		0					1	1			0	0	0	1	0	
68	0	1		1			2	0	1				0	0	1	0	0	
69	1	0		1			2	1	1				0		1		0	
70	0	1		1				0	0	0					1	0	1	
71	1	1		0			2		1	0						0	0	
72	1	0				1		0				0			0	0	0	
73	0	1		1					1				0		0			
74	0	1		0	0			1		0			0	0	1	1	0	
75	0	1		1					0	0			1		1		0	
76	1	1		0									0		1	0	0	
77	0	0		0		1			0				1	0	0		0	
78	0	2		1				1		0			0	0	0		0	
79	0	0		0									0		0			
80	1	0		0				0								0	0	
Total number (thousand)	11285	13842	15281	14164	10457	10417	10521	7294	6814	13623	10992	6661	6564	7002	5384	5938	2242	3004
Total weight (tonnes)	431	432	515	477	363	411	444	376	281	452	427	274	246	273	209	219	103	124
Mean weight (kg)	0.038	0.031	0.034	0.034	0.035	0.039	0.042	0.052	0.041	0.033	0.039	0.041	0.037	0.039	0.039	0.037	0.046	0.041
CL Mean length (mm)	35.5	33.0	34.0	33.9	34.4	35.8	36.8	39.4	36.6	33.9	35.9	36.4	35.3	35.8	35.5	35.3	37.8	36.5

Table 12.1.2b. *Nephrops* FU25, North Galicia. Length compositions of landings of landings, mean weight (Kg) and mean length (CL, mm) for the period 2000–2015.

Size, CL/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
15														6		
16																
17																
18																
19										0	0					
20								0		0	0			0		
21	0		1	0		0		0		0	0			0	0	
22					1	1	0	1		0	0			8	0	
23	0	10	2	0	1	1	1	1		0	0					
24	2		2	1	2	2	1	1	0	0	0					1
25	7	10	2	0	7	5	2	1	1	0	0			8	1	2
26	9	19	5	2	7	8	3	5	1		0			8	0	1
27	5	20	14	3	12	13	9	4	3	0	2	0		0	1	1
28	32	79	30	2	26	25	15	8	4		2	1	2	9	1	3
29	24	125	43	5	28	25	18	11	6	0	2	2	1	2	1	2
30	85	112	105	14	46	43	25	19	10	1	9	2	2	12	3	18
31	60	129	102	26	45	56	39	36	10	1	9	3	3	2	2	11
32	127	288	198	36	60	66	55	44	15	1	18	3	3	3	2	14
33	95	319	181	51	71	87	69	69	13	3	20	5	3	5	5	25
34	219	302	272	66	70	83	62	75	16	4	27	13	2	5	7	26
35	218	265	308	85	91	98	85	90	25	5	34	25	4	18	12	47
36	158	243	259	110	98	102	88	101	31	6	30	21	4	8	16	26
37	144	285	236	123	101	88	87	105	37	9	34	23	5	9	13	22
38	113	238	185	147	98	92	80	101	35	10	26	63	3	6	13	22
39	82	192	129	130	81	69	67	86	37	10	23	45	1	15	11	12
40	134	212	186	129	96	81	64	90	47	12	20	78	8	11	13	16
41	64	115	99	81	78	61	59	73	44	12	23	61	4	7	9	11
42	73	150	117	79	63	52	49	63	38	11	23	50	3	6	8	12
43	30	103	67	65	57	47	44	59	35	12	24	52	1	15	8	10
44	48	98	109	52	39	36	32	46	29	14	22	34	3	7	7	10
45	40	68	78	46	44	34	30	42	23	13	21	24	3	7	4	6
46	20	35	65	57	35	26	26	37	22	11	22	17	1	7	5	5
47	10	22	34	42	26	20	18	30	20	14	22	13	1	2	4	5
48	17	24	35	37	23	14	17	22	16	9	17	15	0	4	2	3
49	11	18	23	27	16	13	11	16	14	8	14	17	2	3	2	3
50	13	18	24	27	19	11	14	18	10	8	13	12	0	2	2	2
51	8	16	34	20	13	7	9	11	11	6	11	7	1	2	1	2
52	8	10	18	16	12	8	8	8	9	6	8	7	0	2	1	2
53	2	15	13	11	9	6	7	7	8	7	9	4	1	2	2	2
54	5	4	4	9	7	5	4	4	6	5	7	7	0	2	1	1
55	7	7	9	6	6	5	4	3	6	6	7	6	1	1	1	1
56	2	5	6	5	5	3	9	3	4	4	4	5	0	1	1	1
57	3	0	5	7	4	3	4	2	5	3	5	4	0	0	0	0
58	4	1	9	4	4	3	2	2	4	3	3	4	0	1	1	0
59	0	1	4	5	3	2	1	1	3	3	2	1	0	1	0	0
60	2	1	2	2	2	2	1	1	2	3	3	3	0	0	0	0
61	2		1	1	3	1	1	1	2	1	1	3	1		0	
62	0	0	3	3	2	1	7	1	1	2	1	6	0	1	0	0
63	0	0	10	0	2	1	1	1	1	2	1	1	0		0	0
64	0	0	0	1	2	1	6	0	1	1	0	2	0	0	0	0
65	0	0	4	1	2	1	1	0	1	1	1	1	0		0	
66	0	0	1	2	1	1	0	0	1	1	1	1	0	0	0	0
67	0		2	1	1	1	1	0	1	1	0	2	0		0	
68	0		0	1	1	1	0	0	1	1	1	2	0		0	0
69	0		0	2	1	1	0	0	1	1	0	0	0	0	0	
70	1		2	1	1	1	0	0	0	1	0	0	0		0	
71	0		0	1	2	0	6	0	0	1	0		0		0	
72	0	0	0	1	1	0	6	0	0	1	0	0	0		0	
73			0	1	1	1	0	0	0	1	0	0	0		0	
74	0	0	1	0	1	0	0	0		0	0	0	0			
75	0	0	0	1	0	0	0	0		0			0		0	
76			0	0	0	0	0	0	0	0			0			
77		0		0	0	0	0			0			0			
78		0	0	0	0		0	0		0	0		0		0	
79					0	0				0	0		0			
80	0		0		0	0	0		0	0			0			
Total number (thousand)	1887	3561	3041	1540	1421	1314	1147	1298	612	235	528	650	65.996	206	163	323
Total weight (tonnes)	81	147	143	89	75	63	62	67	39	21	34	44	10	10	9	14
Mean weight (kg)	0.043	0.041	0.047	0.058	0.052	0.048	0.054	0.051	0.064	0.091	0.065	0.068	0.152	0.048	0.056	0.0436
CL Mean length (mm)	36.9	36.5	37.8	40.6	39.0	37.9	39.6	40	42.2	46.9	42.2	42.6	40.0	41.0	39.9	37.2

Table 12.1.3. ***Nephrops*** **FU 25: North Galicia. Fishing effort and LPUE.**

Year	Landings (t)	Effort (trips)		LPUE (kg/trip)	
		SP-CORUTR8c	SP-LCOTBDEF	SP-CORUTR8c	SP-LCOTBDEF
1986	302	5017		60.1	
1987	356	4266		83.5	
1988	371	5246		70.7	
1989	297	5753		51.7	
1990	199	5710		34.9	
1991	334	5135		65.1	
1992	351	5127		68.5	
1993	229	5829		39.2	
1994	207	5216		39.6	
1995	233	5538		42.0	
1996	182	4911		37.0	
1997	187	4850		38.5	
1998	67	4560		14.7	
1999	121	4023		30.1	
2000	77	3547		21.7	
2001	145	3239		44.8	
2002	115	2333		49.5	
2003	65	1804		35.9	
2004	40	2091		18.9	
2005	32	2063		15.5	
2006	33	1699		19.4	
2007	37	2075		17.8	
2008	21	2128		9.9	
2009	11		1355		8.3
2010	22		1164		18.6
2011	35		906		38.4
2012	10		1460		6.8
2013	8		1582		5.3
2014	8		1869		4.5
2015	13		1358		9.3

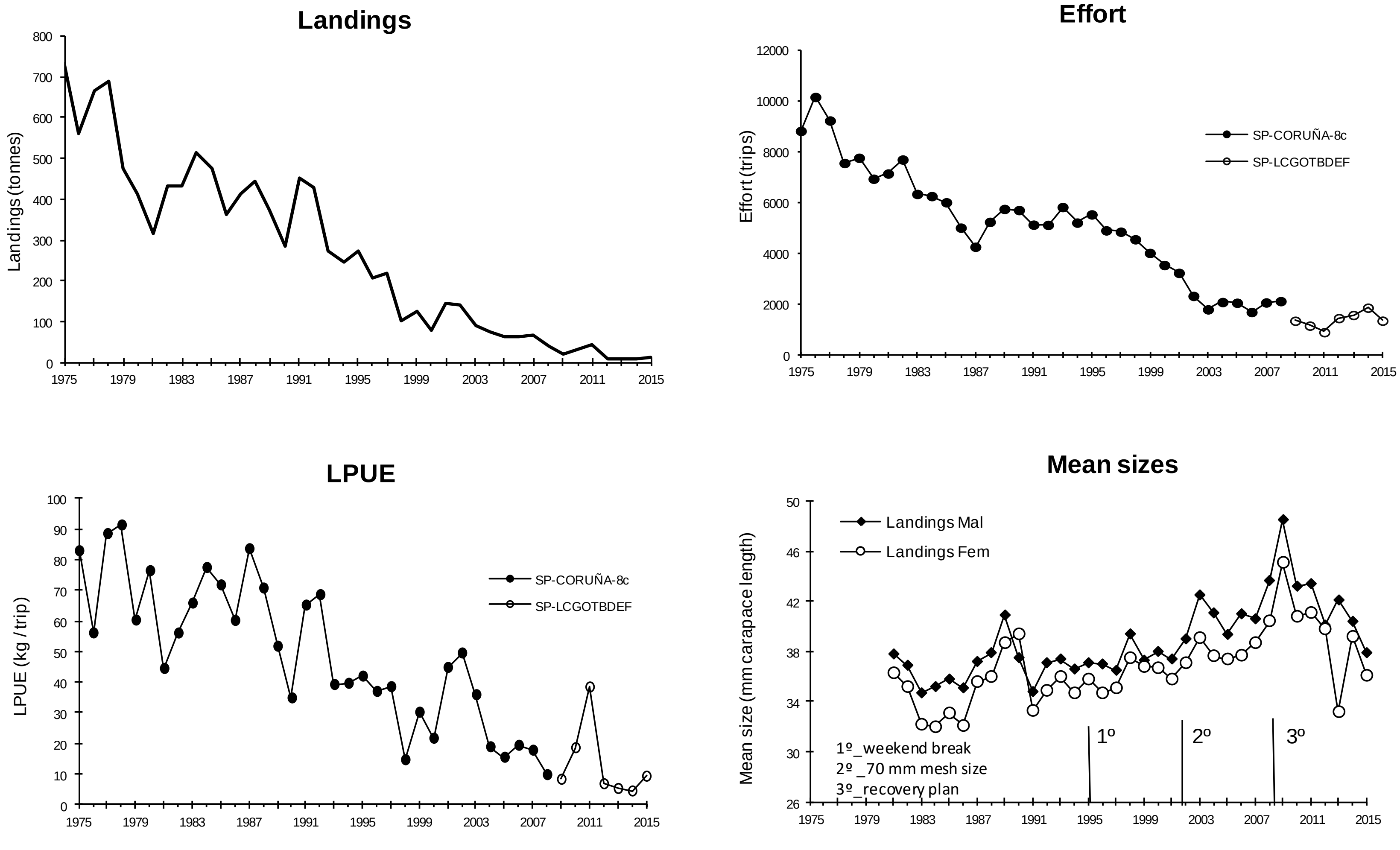


Figure 12.1.1. ***Nephrops*** **FU25, North Galicia. Long-term trends in landings, effort, LPUE and mean sizes.**

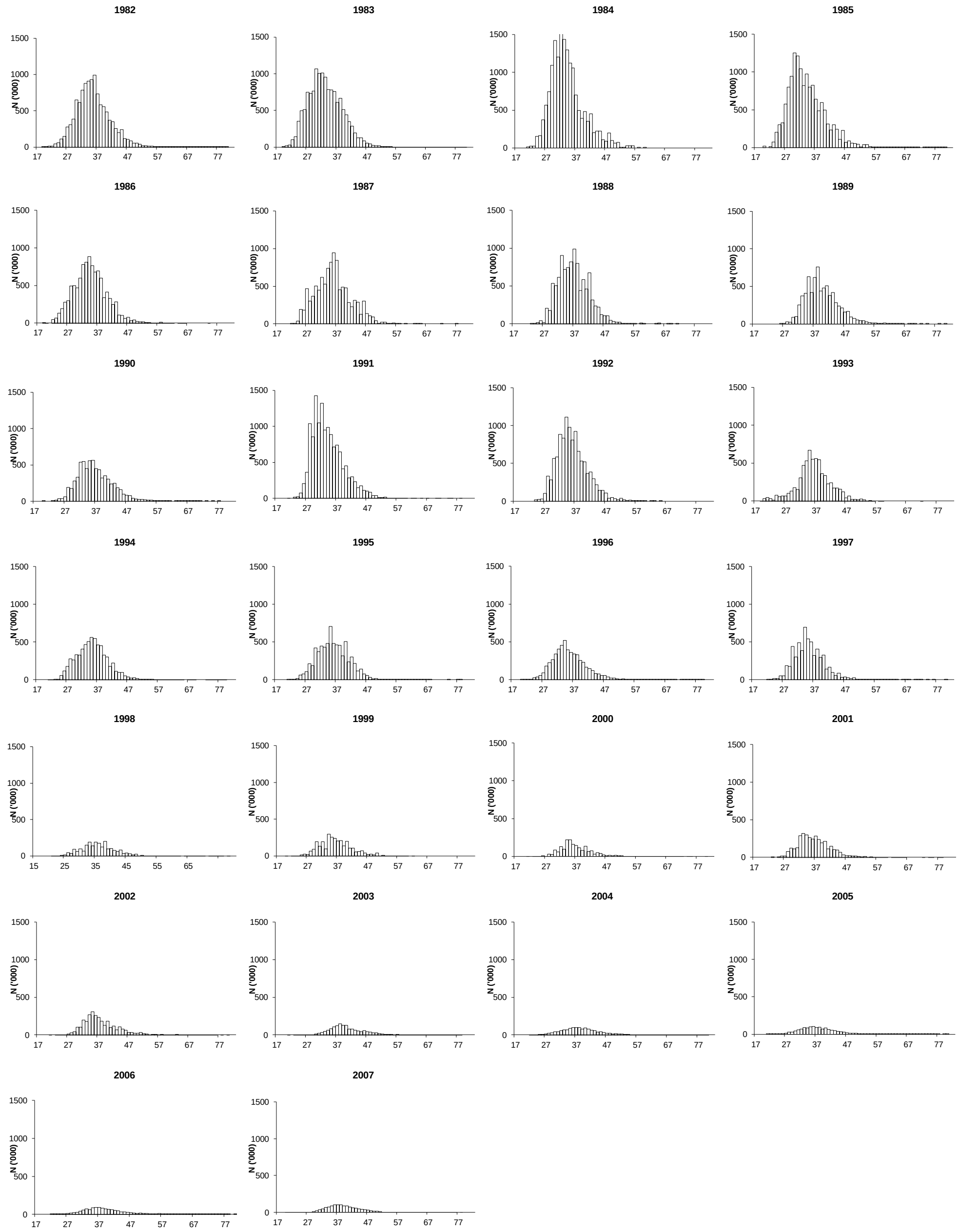


Figure 12.1.2a. *Nephrops* FU25, North Galicia. Length distributions in landings for 1982–2007 period.

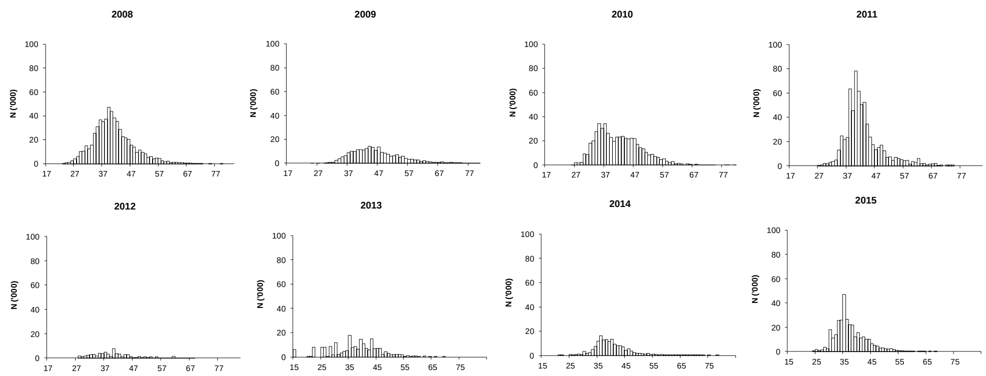


Figure 12.1.2b. *Nephrops* FU25, North Galicia. Length distributions in landings for the period 2008–2015.

12.2 *Nephrops* FU 31 (Cantabrian Sea)

12.2.1 General

12.2.1.1 Ecosystem aspects

See Annex K

12.2.1.2 Fishery description

See Annex K

12.2.1.3 Summary of ICES Advice for 2016 and management applicable to 2015 and 2016

ICES advice for 2016

The advice for these *Nephrops* stocks is biennial and valid for 2015 and 2016.

ICES advises on the basis of the precautionary considerations that there should be no directed fishery and bycatch should be minimized.

To protect the stock in this Functional Unit, ICES advices that management area should be consistent with the assessment area. Therefore, management should be implemented at the Functional Unit level.

Management applicable to 2014 and 2015

TACs of 60 and 46 t were set for the whole of Division 8c for 2015 and 2016, respectively. A fishing effort limitation is also applicable in accordance with the southern hake and *Nephrops* recovery plan.

12.2.2 Data

12.2.2.1 Commercial catches and discards

Up to 2010, landings have been estimated by the WG based on IEO scientific estimations. The information was compiled by IEO from sale sheets and Owners Associations where the *Nephrops* landings allocation was carried out based on landing port criteria. Since 2011, the Spanish Authority for Fisheries (Secretaría General de Pesca, SGP) who is also the National Authority for the Data Collection Framework established a new policy and general approach in the provision of official data on catches and fishing effort. So, since 2011 *Nephrops* landings are official landings.

Unlike the IEO scientific estimates, official landings are derived from logbooks. This source of information allows the landings disaggregation by ICES statistical rectangles. In WGHMM 2013 was noticed that some *Nephrops* catches were recorded into statistical rectangles outside the FU 31 definition. In 2012 and 2013 *Nephrops* catches recorded into statistical rectangles outside this FU were considered as part of the landings in FU 31. In 2014 Spanish landings of *Nephrops* have been uploaded to InterCatch broken down by ICES statistical rectangle for first time according to the 2014 ICES Data Call requirements. However, only were uploaded to InterCatch 77.4% of 2014 landings which were recorded inside ICES statistical rectangles defined as FU 31 (WD Nº 3 Castro, 2015). In 2015, all catches were into FU 31 definition.

Nephrops landings from FU 31 are reported by Spain (the only participant in the fishery) (Table 12.2.1 and Figure 12.2.1) and are available for the period 1983–2015. The highest landings were recorded in 1989 and 1990, with 177 t and 174 t, respectively. Since 1996 landings have declined sharply from 129 t up to 4 t in 2015.

12.2.2.2 Biological sampling

Length frequencies by sex of *Nephrops* landings were collected by the biological sampling programme. The sampling levels are shown in Table 1.3.

Mean size of males and females in the landings fluctuated during 1988-2015 (Figure 12.2.1). Data show a general increasing trend for both sexes to 2009 (Figure 12.2.1), where it was recorded the highest values (males with 55.8 mm and females with 45.9 mm CL). In 2011 the mean carapace length decreased in relation to the previous year, but a new increase of the mean size was observed in 2013. Mean size in 2014 and 2015 declined recording values of 45.9 mm CL for males and 43.4 mm CL for females in the last year.

12.2.2.3 Commercial catch–effort data

The fishing effort and LPUE dataseries includes three bottom-trawl fleets operating in the Cantabrian Sea with home harbours in Avilés, Santander and Gijón. In last years, the information of the different fleets is intermittent, although Santander dataseries is the largest (up to 2013). A new effort series including the Santander, Avilés and Gijón effort together from 2009 to 2014 are presented in this WG. In order to standardize the effort units in Division 8c, the new effort series is expressed in trips.

The available old time-series of effort shows a period of relative stability from the early 1980s to the beginning of the 1990s. Since 1992, effort shows a marked downward trend (Figure 12.2.1) with the lowest value recorded in 2005 (364 fishing days corresponding to Santander fleet). The increase in the use of other gears (HVO and pair trawl) resulted in the reduction in effort by the baca trawl fleet, the only gear fishing for *Nephrops*. After a slight increase in 2006 and 2007, fishing effort declined again and it has remained at low levels in the last five years. The new effort series (Santander+Avilés+Gijón) from 2009–2014 (expressed in trips) shows an increasing trend since 2010, ranging between 850 trips to 1083 trips (Figure 12.2.1). The Santander LPUE series shows fluctuations around the general downward trend (Figure 12.2.1). The LPUE reached the lowest value of the time-series in 2013 (2.3 Kg/fishing days), last available data. The new LPUE series (Santander+Avilés+Gijón) shows a decreasing trend in the time-series suggesting an extremely low *Nephrops* abundance in FU 31.

12.2.3 Assessment

According to the ICES data-limited approach, this stock is considered as category 3.1.4 (ICES, 2012). FU 31 is assessed by the analysis of the LPUE series trend, as was done in 2014. .This year's results indicate stock is at a very low abundance level.

12.2.4 Biological reference points

Proxies of MSY reference points were defined using the methods developed in WKLIFE and WKProxy (ICES, 2015, 2016d). $F_{0.1}$, taken as proxy of F_{MSY}, from length–based analysis for the period 2001–2014 was 0.28 for males and 0.47 for females but the value of MSY $B_{trigger}$ proxy is not available.

12.2.5 Management considerations

Nephrops is taken as bycatch in the mixed bottom fishery. The overall trend in landings of *Nephrops* from the Cantabrian Sea is strongly declining. Landings have dramatically decreased since the beginning of the series (1983–2014), representing less 1% of the landings.

A recovery plan for southern hake and Atlantic Iberian *Nephrops* stocks including a fishing effort reduction was implemented and enforced in 2006.

A Fishing Plan for the Northwest Cantabrian ground was established in 2013 (AAA/1307/2013). This new regulation establishes an assignation of the quotas by vessel including *Nephrops.*

Table 12.2.1. ***Nephrops*** **FU31, Cantabrian Sea. Landings in tonnes.**

Year	Trawl	Creel	Total
1983	63		63
1984	100		100
1985	128		128
1986	127		127
1987	118		118
1988	151		151
1989	177		177
1990	174		174
1991	105	4	109
1992	92	2	94
1993	95	6	101
1994	146	2	148
1995	90	4	94
1996	120	9	129
1997	97	1	98
1998	69	3	72
1999	46	2	48
2000	33	1	34
2001	26	1	27
2002	25	1	26
2003	21	1	22
2004	17	0	17
2005	14	0	14
2006	15	0	15
2007	19	0	19
2008	19	0	19
2009	6	0	6
2010	8	0	9
2011	7	0	7
2012	10	0	10
2013	10	0	10
2014	4	0	4
2015	4	0	4

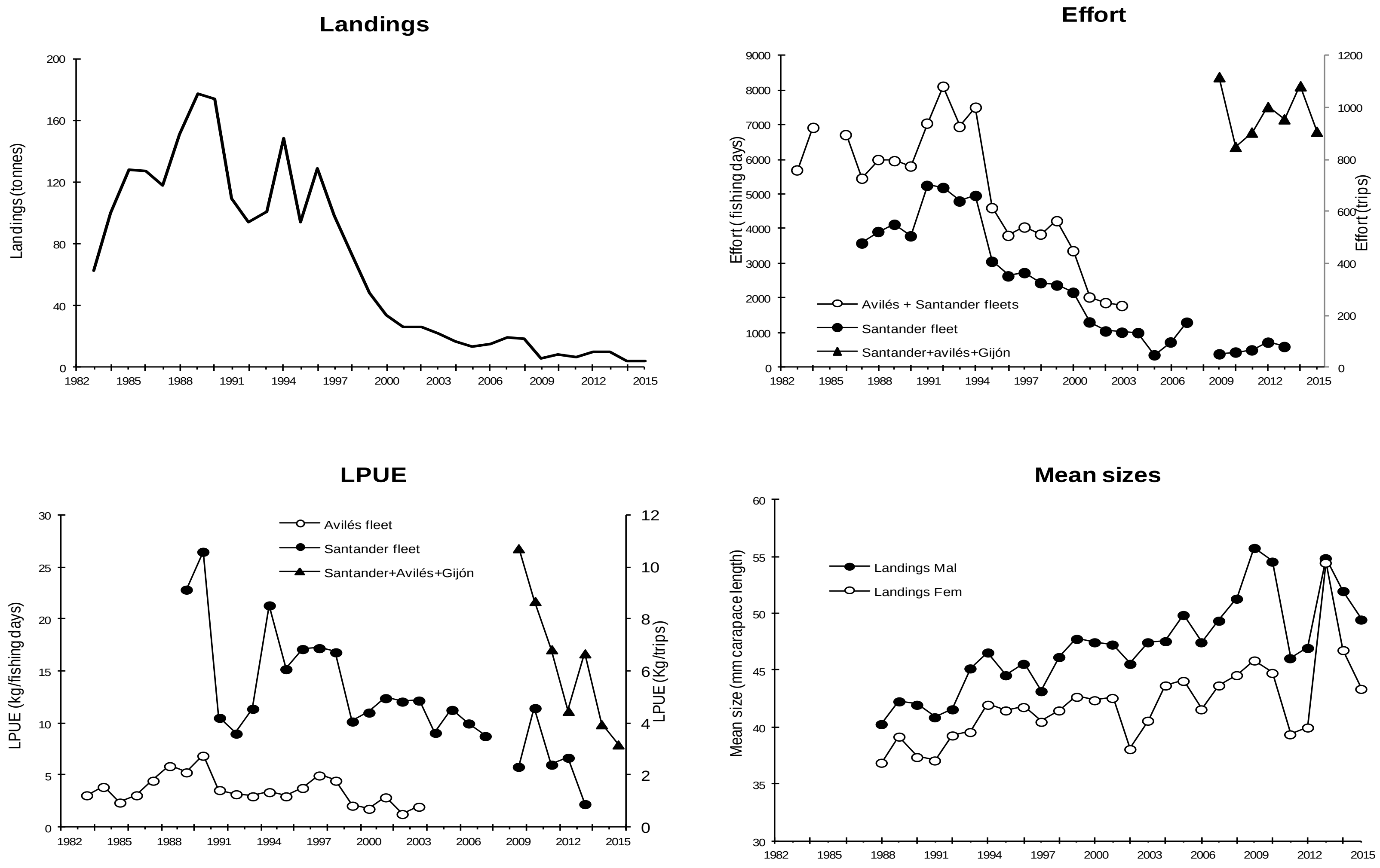


Figure 12.2.1. ***Nephrops*** **FU31, Cantabrian Sea. Long-term trends in landings, effort, LPUE and mean sizes.**

12.3 Summary for Division 8.c

Nephrops in Division 8.c includes two FUs (North Galicia, FU 25 and Cantabrian Sea, FU 31). Table 12.3.1 shows the landings in Division 8.c. Landings from both FUs have declined dramatically. Landings in Division 8.c were below the TAC in recent years, and therefore the TAC has not been restrictive.

The very low levels of landings from FU 25 and FU 31 and the decreasing LPUE trends to 2015 indicate that both stocks are in very poor condition.

A recovery plan for southern hake and Atlantic Iberian *Nephrops* stocks was approved in December 2005 (Council Regulation (EC) No 2166/2005) and implemented since January 2006. This recovery plan includes a procedure for setting the TACs for *Nephrops* stocks, complemented by a system of fishing effort limitation (a reduction of 10% in the fishing mortality rate in the year of its application as compared with the fishing mortality rate estimated for the preceding year, within the limits of ±15% of the preceding year TAC). ICES has not evaluated the recovery plan.

Table 12.3.1. *Nephrops* in Division 8.c. Landings by FU (tonnes).

Year	FU 25	FU 31	Unallocated	DIVISION VIIIc
1975	731			731
1976	559			559
1977	667			667
1978	690			690
1979	475			475
1980	412			412
1981	318			318
1982	431			431
1983	433	63		496
1984	515	100		615
1985	477	128		605
1986	364	127		491
1987	412	118		530
1988	445	151		596
1989	376	177		553
1990	285	174		459
1991	453	109		562
1992	428	94		522
1993	274	101		375
1994	245	148		393
1995	273	94		367
1996	209	129		338
1997	219	98		317
1998	103	72		175
1999	124	48		172
2000	81	34		115
2001	147	27		174
2002	143	26		169
2003	89	22		111
2004	75	17		92
2005	63	14		77
2006	62	15		77
2007	67	19		86
2008	39	19		58
2009	21	6		27
2010	34	8		42
2011	44	7		51
2012	10	10	11	31
2013	10	10		20
2014	9	4		13
2015	14	4		18

13 *Nephrops* in Division 9.a (Norway lobster)

The ICES Division 9.a has five *Nephrops* Functional Units: FU 26, West Galicia; FU 27 North Portugal; FU 28, Alentejo, Southwest Portugal; FU 29, Algarve, South Portugal and FU 30, Gulf of Cádiz.

13.1 *Nephrops* in FU 26–27 (West Galicia and North Portugal)

13.1.1 General

13.1.1.1 Ecosystem aspects

See Annex L

13.1.1.2 Fishery description

See Annex L

13.1.2 Summary of ICES Advice for 2016 and management applicable to 2015 and 2016

ICES advice for 2016

The advice for these *Nephrops* stocks is biennial and valid for 2015 and 2016.

ICES advises on the basis of the precautionary considerations that there should be no directed fishery and bycatch should be minimized.

To protect the stock in this Functional Unit, ICES advices that management area should be consistent with the assess area. Therefore, management should be implemented at the Functional Unit level.

Management applicable to 2015 and 2016

A recovery plan for southern hake and Iberian *Nephrops* stocks has been in force since the end of January 2006. The aim of the recovery plan is to rebuild the stocks within 10 years, with a reduction of 10% in F relative to the previous year and the TAC set accordingly (Council Regulation (EC) No. 2166/2005).

In order to reduce F on *Nephrops* stocks in this Division even further, a seasonal ban was introduced in the trawl and creel fishery for two boxes, located in FU 26 and 28, in the peak of the *Nephrops* fishing season. These boxes are closed for *Nephrops* fishing in June–August and in May–August, respectively.

ICES has not evaluated the current recovery plan for *Nephrops* in relation to the precautionary approach.

The TAC set for the whole Division 9.a was 254 t for 2015 and 320 t for 2016, respectively, of which no more than 6 % may be taken in FUs 26 and 27. The maximum number of fishing days per vessel was fixed at 114 and 117 days for Spanish vessels and at 113 days for Portuguese vessels for these two years (Annex IIb of Council Regulations nos. 104/2015 and 72/2016). The number of fishing days included in these regulations is not applicable to the Gulf of Cadiz (FU 30), which has a different regime.

A Fishing Plan for the Northwest Cantabrian ground was established in 2013 (AAA/1307/2013). This new regulation establishes an assignation of the quotas by vessel including *Nephrops.*

13.1.3 Data

13.1.3.1 Commercial catches and discards

Up to 2010, landings have been estimated by the WG based on IEO scientific estimations. The information was compiled by IEO from sale sheets and Owners Associations where the *Nephrops* landings allocation was carried out based on landing port criteria. Since 2011, the Spanish Authority for Fisheries (Secretaría General de Pesca, SGP) who is also the National Authority for the Data Collection Framework established a new policy and general approach in the provision of official data on catches and fishing effort. So, since 2011 *Nephrops* landings are the official landings.

Unlike the IEO scientific estimates, official landings are derived from logbooks. This source of information allows the landings disaggregation by ICES statistical rectangles. In WGHMM 2013 it was noticed that some *Nephrops* catches were recorded into statistical rectangles outside the FU 26–27 definition. In 2012 and 2013 *Nephrops* catches from statistical rectangles outside this FU were considered as part of the landings in FU 26–27. In 2014 Spanish landings of *Nephrops* have been uploaded to Intercatch broken down by ICES statistical rectangle for the first time according to the 2014 ICES Data Call requirements. However, only the landings recorded inside ICES statistical rectangles defined as FU 26-27 were uploaded to InterCatch, which correspond to 96.3% of 2014 landings (WD Nº 3, Castro, 2015). In 2015, all catches were into FU 26–27 definition.

Landings in these FUs are reported by Spain and minor quantities by Portugal. The catches are taken by the Spanish fleets fishing on the West Galicia (FU 26) and North Portugal (FU 27) fishing grounds, and by the Portuguese fleet fishing on FU 27. *Nephrops* represents a minor percentage in the composition of total trawl landings and can be considered as bycatch although it is a very valuable species.

Along the time-series, landings by the Spanish fleets are mostly from FU 26, together with smaller quantities taken from FU 27. However, since 2011 landings are very low in both FUs. Prior to 1996, no distinction was made between the two FUs, and therefore they are considered together.

Two periods can be distinguished in the time-series of landings available 1975–2015 (Figure 13.1.1). During 1975–1989, the mean landing was 680 t, fluctuating between 575 and 800 t approximately. Since 1990 onwards there has been a marked downward trend in landings, being below 50 t from 2005 to 2011.In the last four years, landings were minimal (less than 10). In 2015, landings were only 2 t. Information on discards was sent to the WG through Intercatch although no discards are recorded in these FUs.

Total Portuguese landings from FU 27 have decreased from almost 100 t in 1988 to just 1 t in 2012-2014 and less than 1 in 2015.

13.1.3.2 Biological sampling

Length frequencies by sex of the *Nephrops* landings are collected monthly. The sampling levels are shown in Table 1.3.

Mean size for both sexes shows an increasing trend from 2001 to 2010 with the highest value recorded in 2010 (52.0 mm CL in males and 43.7 mm CL in females) (Figure 13.1.1). In contrast, mean carapace length declined in both sexes in 2011–2013 period. The mean size in 2014 and 2015 increased in relation to the previous period. In 2015 males achieved a mean carapace length of 43.6 mm and females 39.3 mm. Annual length compositions for males and females combined, mean size and mean weight in landings for the period 1988–2015 are given in Table 13.1.2 and Figure 13.1.2a and Figure 13.1.2b.

13.1.3.3 Commercial catch-effort data

Fishing effort and LPUE estimates are available for Marin trawl fleet (SP-MATR) for the period 1990–2014 (Table 13.1.3). The overall trend for the LPUE of SP-MATR is decreasing, with some stability in the 2007–2009 periods although at very low level (~17.5 Kg/trip). From 2010 to 2015, LPUE downfall again to the lowest recorded in the time-series (0.7 Kg/trip) indicating that the *Nephrops* abundance is at very low level.

Time-series of fishing effort and LPUE of the bottom-trawl fleets with the Spanish home ports of Muros (1984–2003), Riveira, (1984–2004), and Vigo, (1995–2008 and 2010) are also available. These data are plotted in Figure 13.1.1 for complementary information.

13.1.4 Assessment

According to the ICES data-limited approach, this stock is considered as category 3.1.4 (ICES, 2012). FU 26–27 is assessed by the analysis of the LPUE series trend, as was done in 2014. The results in this year indicate an extremely low abundance level.

13.1.5 Biological reference points

Proxies of MSY reference points were defined using the methods developed in WKLIFE and WKProxy (ICES, 2015, 2016d). $F_{0.1}$, taken as proxy of F_{MSY}, from length–based analysis for the period 1988–2014 was 0.137 for both sexes combined but the value of MSY $B_{trigger}$ proxy is not available.

13.1.6 Management Considerations

Nephrops is taken as bycatch in a mixed bottom-trawl fishery. Landings of *Nephrops* have substantially declined since 1995. Recent landings represent less than 1% of the average landings in the early period of the time-series (1975–1992). Fishing effort in FU 26–27 has decreased throughout the time-series.

A recovery plan for southern hake and Iberian *Nephrops* stocks was approved in December 2005 (CE 2166/2005) and implemented since January 2006.

The recovery plan includes a reduction of 10% in the hake F relative to the previous year and TAC set accordingly, within the limits of ±15% of the previous year TAC (Council Regulation (EC) No 2166/2005). Although no clear targets were defined for Norway lobster stocks in the plan, the same 10% reduction has been applied to these stocks effort and TAC. The number of allowed fishing days is set in each year regulations (Council Regulations (EC) Nos. 51/2006, 41/2007, 40/2008, 43/2009, 53/2010, 57/2011, 43/2012, 39/2013, 43/2014, 104/2015 and 72/2016). The recovery plan target and rules have not been changed since it was implemented. This plan also includes a seasonal closure (June-August) for *Nephrops* in an area of the West Galicia (FU 26) fishing grounds, which was amended to the Council Regulation (EC) No 850/98.

A Fishing Plan for the Northwest Cantabrian ground was established in 2013 (AAA/1307/2013). This new regulation establishes an assignation of the quotas by vessel including *Nephrops.*

Table 13.1.1. ***Nephrops*** **FU26–27, West Galicia and North Portugal. Landings in tonnes by Functional Units and country.**

	Spain		Portugal	Unallocated	Total
Year	FU 26**	FU 27	FU 27	FU27	FU 26-27
1975	622				622
1976	603				603
1977	620				620
1978	575				575
1979	580				580
1980	599				599
1981	823				823
1982	736				736
1983	786				786
1984	604		14		618
1985	750		15		765
1986	657		37		694
1987	671		71		742
1988	631		96		727
1989	620		88		708
1990	401		48		449
1991	549		54		603
1992	584		52		636
1993	472		50		522
1994	426		22		448
1995	501		10		511
1996	264	50	17		331
1997	359	68	6		433
1998	295	42	8		345
1999	194	48	6		248
2000	102	21	9		132
2001	105	21	6		132
2002	59	24	4		87
2003	39	26	8		73
2004	38	24	9		71
2005	16	16	11		43
2006	15	17	12		44
2007	20	17	10		47
2008	17	12	13		42
2009	16	5	10		31
2010	3	14	4		21
2011	8	8	4	7	27
2012	3	4	1		8
2013	1	<1	1		3
2014	1	<1	1		4
2015	<1	<1	<1		2

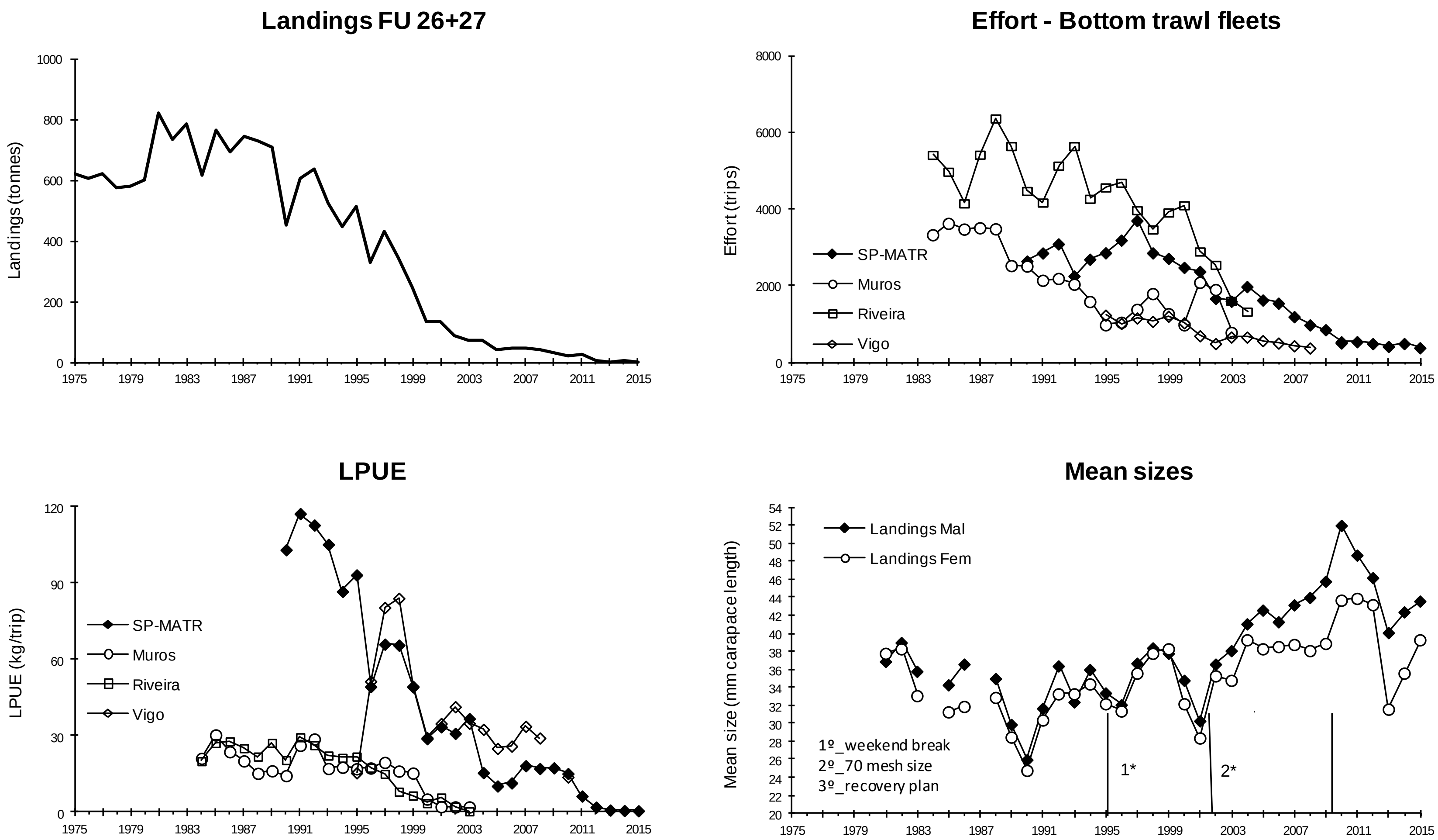
**Prior 1996, landings of Spain recorded in FU 26 include catches in FU 27

Table 13.1.2. ***Nephrops*** **FU26-27, West Galicia and North Portugal. Length compositions, mean weight (Kg) and mean size (CL, mm) in landings for the 1988–2015 period.**

Size, CL/Year	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	2013	2014	2015
12	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
13	0	71	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
14	0	69	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
15	0	451	110	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
16	0	191	289	13	0	0	0	0	0	0	0	0	3	17	0	0	0	0	0	0	0	0	0	0	0	0		
17	0	128	518	17	0	0	7	0	0	0	0	0	3	11	0	0	0	0	0	0	0	0	0	0	0	0		
18	0	683	898	25	0	0	2	1	0	0	0	0	16	19	0	4	0	0	0	0	0	0	0	0	0	0		
19	0	679	1502	38	0	0	0	0	0	0	0	0	38	52	0	4	0	0	0	0	0	0	0	0	0	0		
20	27	1057	2044	97	6	5	10	7	25	3	0	0	86	151	3	29	0	0	0	0	0	0	0	0	0	0		
21	27	1260	2489	199	12	24	19	8	78	0	0	0	119	236	3	27	0	0	1	0	0	0	0	0	0	0		
22	39	1657	2642	398	48	99	84	47	202	12	1	0	129	348	11	11	1	0	1	0	0	0	0	0	0	1		
23	109	1901	3063	568	103	99	77	151	373	26	6	0	127	518	16	31	0	0	0	0	1	0	0	0	0	0		
24	198	1626	2736	1216	284	222	169	338	550	46	7	3	93	466	22	17	1	2	1	0	2	0	0	0	0	0	1	
25	290	2212	1802	1477	541	381	199	672	906	113	45	15	134	441	35	28	1	2	1	0	3	1	0	0	0	0	2	0
26	574	1675	1451	1516	829	542	289	709	960	184	40	43	145	365	56	22	7	2	2	1	2	1	0	0	0	0	1	0
27	854	1878	1333	1351	926	904	409	933	746	306	80	68	129	419	106	40	18	8	5	2	3	1	0	0	0	0	1	0
28	1272	1560	1319	1940	1079	1017	524	1298	842	402	138	109	123	274	74	46	23	12	8	6	9	4	0	0	0	0	2	0
29	1487	1716	913	1797	1023	987	613	1223	706	489	191	134	143	266	86	60	20	15	13	7	7	9	0	0	0	0	2	0
30	1615	1510	845	1501	1069	1140	767	1371	792	681	295	195	172	252	118	90	31	25	20	12	13	11	0	1	1	1	4	0
31	1960	1106	632	1450	1180	890	802	1378	609	719	359	239	182	209	105	102	27	21	21	13	16	9	1	1	0	1	1	0
32	1951	1472	772	1484	1197	912	847	1491	601	888	411	292	285	220	160	95	49	29	35	23	27	11	2	3	2	1	1	0
33	2288	1313	601	1126	1378	878	898	1444	517	780	525	377	176	201	167	84	56	26	40	47	23	11	2	2	2	1	0	1
34	1581	1299	572	1160	1001	849	853	1255	542	745	551	376	192	156	131	83	56	31	51	43	37	22	5	3	2	1	5	1
35	1487	952	518	1044	915	855	745	963	506	637	569	432	200	148	96	91	53	26	48	46	25	18	4	5	2	1	5	2
36	1161	634	407	879	776	901	611	744	433	527	484	360	176	120	110	85	56	21	42	36	22	15	4	5	1	1	2	1
37	838	545	284	651	627	736	546	580	348	484	417	321	175	143	106	111	70	31	51	49	31	17	7	5	2	1	3	1
38	1196	608	294	616	545	682	621	542	346	534	425	308	128	110	76	72	86	35	61	38	28	20	6	9	2	1	1	1
39	837	451	226	600	505	510	475	425	285	406	292	240	128	85	95	79	65	27	43	36	21	14	6	12	3	1	2	1
40	501	325	199	450	666	573	412	455	284	466	393	218	115	65	76	60	90	24	55	39	32	21	7	19	4	1	4	3
41	428	288	165	375	431	385	321	321	213	399	312	182	112	58	88	48	60	21	40	32	23	16	8	13	4	1	1	1
42	367	287	144	220	362	375	314	214	182	360	249	210	66	57	81	54	101	22	47	43	26	14	6	12	6	1	1	1
43	433	296	156	203	425	307	293	188	165	325	292	219	64	36	76	47	73	25	38	49	25	13	9	12	4	1	1	2
44	164	277	87	136	301	251	200	152	127	290	207	193	61	44	52	33	62	20	32	38	36	13	10	11	4	0	3	1
45	165	286	58	110	303	219	178	125	118	218	196	162	58	42	44	34	56	17	18	29	17	12	8	11	5	0	3	1
46	96	135	23	90	350	153	129	116	94	191	178	152	40	28	49	26	29	20	18	24	18	8	10	10	3	0	1	0
47	94	117	45	82	228	104	92	84	56	123	120	84	38	47	42	31	38	26	18	28	17	8	8	9	4	0	1	0
48	71	100	25	49	222	58	96	55	70	117	147	96	23	18	22	13	28	18	12	15	16	7	7	4	3	1	1	0
49	73	76	29	42	148	84	71	46	23	60	105	64	21	16	15	16	18	13	11	14	9	5	7	8	3	0	1	0
50	83	127	14	46	63	81	69	29	31	81	95	54	17	12	12	15	16	15	13	14	9	9	10	9	3	0	2	0
51	15	48	9	14	71	27	59	13	21	43	59	21	17	6	7	15	7	15	7	7	9	6	4	3	3	0	0	0
52	20	75	14	33	71	21	59	18	22	43	55	30	18	6	7	10	12	10	8	10	9	6	5	4	3	0	0	0
53	23	34	13	26	34	20	28	6	13	30	37	33	5	5	6	10	5	7	6	8	4	6	5	3	2	0	0	0
54	14	10	11	23	23	14	12	6	15	42	28	27	8	3	2	8	4	11	10	6	7	4	5	3	3	0	1	0
55	6	27	1	6	13	17	12	1	9	25	26	12	6	7	3	4	5	8	3	6	6	5	7	3	1	0	1	0
56	6	9	1	5	5	10	5	1	9	14	14	14	7	4	3	5	3	4	2	3	6	6	4	2	1	0	0	0
57	10	5	1	2	6	5	10	0	4	8	12	6	5	3	3	2	2	3	2	4	5	5	3	1	0	0	0	0
58	11	5	1	4	6	5	14	0	3	6	11	5	4	5	4	3	3	4	4	4	5	5	4	2	0	0	1	0
59	7	0	4	0	7	2	7	0	0	2	1	5	3	3	0	1	4	3	1	3	2	2	1	1	1	0	0	0
60	2	0	2	0	4	3	3	0	0	1	2	3	2	2	2	2	7	4	2	1	3	3	4	2	1	0	1	0
61	4	0	1	0	3	2	12	0	0	0	2	0	3	2	0	2	1	14	1	2	1	1	3	1	1	0	0	0
62	2	0	1	0	1	0	7	0	0	0	0	0	1	5	0	2	2	4	2	1	3	2	1	1	1	0	0	0
63	1	0	1	0	3	0	5	0	0	1	0	0	3	3	0	2	1	2	1	1	1	1	2	1	0	0	0	0
64	2	0	1	0	3	1	4	0	0	0	1	0	2	2	0	2	1	1	1	1	2	3	2	1	0	0	0	0
65	2	0	1	0	1	0	2	0	0	0	0	0	1	1	1	1	2	2	1	1	1	2	2	1	0	0	0	0
66	3	0	1	0	1	0	2	0	0	0	1	0	2	2	0	1	0	1	1	1	1	1	1	0	1	0	0	0
67	2	4	1	0	1	1	1	0	0	0	1	0	3	1	0	2	1	2	1	1	1	1	1	0	0	0	0	0
68	2	11	1	0	2	2	6	0	0	0	0	0	2	1	0	2	1	1	2	2	2	1	2	1	0	0	0	0
69	1	4	1	0	1	1	0	0	0	0	0	0	2	1	0	1	1	1	2	1	1	1	1	0	1	0	0	0
70	12	25	1	2	12	6	8	0	1	0	3	0	11	1	1	5	4	8	1	1	4	1	1	1	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	1	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
83	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
otal number (thousand)	22409	31275	29319	23087	17811	15360	12003	17411	11828	10827	7383	5302	3822	5712	2169	1666	1257	638	800	752	569	355	191	201	81	20	60	23
Total weight (t)	727	708	450	603	636	522	448	511	331	432	344	246	132	132	87	72	70	42	44	46	42	31	21	27	7	2	4	1
Mean weight (kg)	0.032	0.023	0.015	0.026	0.036	0.034	0.037	0.029	0.028	0.040	0.047	0.046	0.035	0.023	0.040	0.043	0.056	0.066	0.057	0.061	0.063	0.087	0.110	0.134	0.086	0.081	0.059	0.057
CL Mean length (mm)	34.0	29.1	25.9	31.4	34.5	34.3	35.2	32.9	31.9	36.2	38.1	38.1	33.5	29.5	36.0	36.2	40.2	42.0	40.0	41.3	41.5	42.6	48.4	46.5	46.1	35.8	39.4	42.0

Table 13.1.2. *Nephrops* FU26–27, West Galicia and North Portugal. Fishing effort and LPUE for SP-MATR fleet.

		SP-MATR	
Year	Landings (t)	trips	LPUE (kg/trip)
1994	234	2692	113.9
1995	267	2859	93.3
1996	158	3191	49.5
1997	245	3702	66.3
1998	188	2857	66.0
1999	134	2714	49.5
2000	72	2479	28.9
2001	80	2374	33.6
2002	52	1671	31.2
2003	59	1597	24.0
2004	31	1980	19.3
2005	17	1629	10.3
2006	18	1547	11.9
2007	22	1196	18.0
2008	17	980	17.3
2009	15	854	17.4
2010	8	539	15.4
2011	4	543	6.4
2012	1	492	2.2
2013	<1	419	1.0
2014	<1	494	0.8
2015	<1	384	0.7



1* -weekend break in West Galicia, 2*- 70 mm mesh size, 3*-recovery plan

Figure 13.1.1. ***Nephrops*** **FU26–27, West Galicia and North Portugal. Long-term trends in landings, effort and mean sizes.**

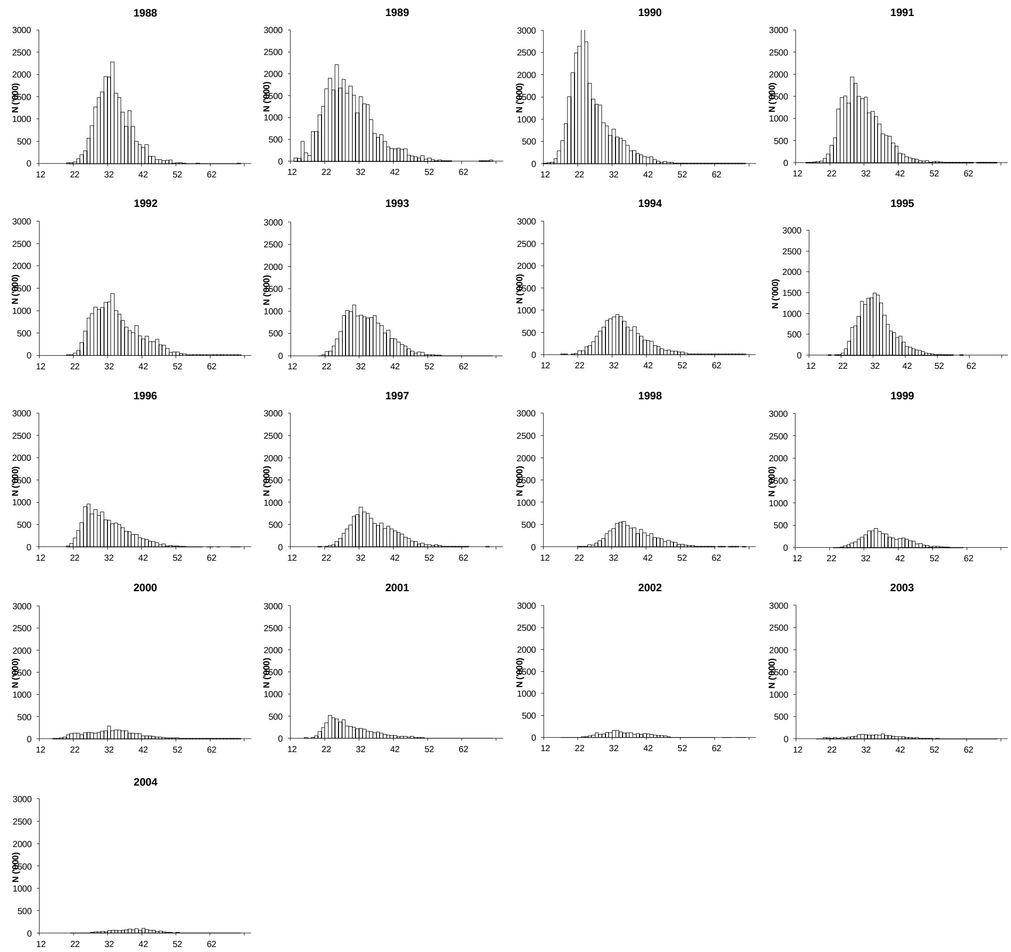


Figure 13.1.2a. ***Nephrops*** **FU26–27. West Galicia and North Portugal. Length distributions in landings for the 1988–2004 period.**

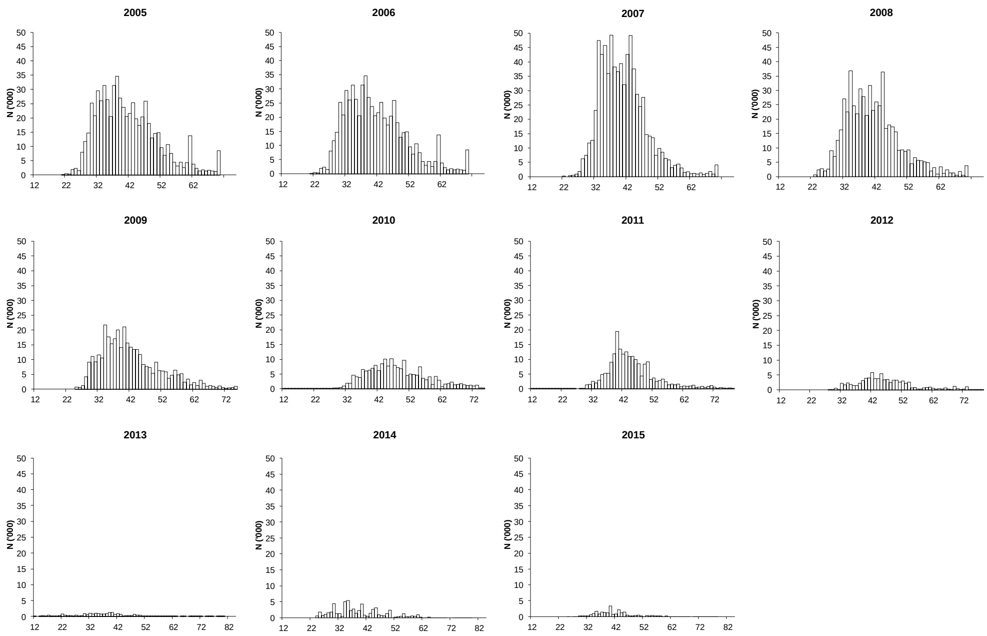


Figure 13.1.2b. ***Nephrops*** **FU26–27. West Galicia and North Portugal. Length distributions in landings for the 2005–2015 period.**

13.2 *Nephrops* in FU 28-29 (Southwest and South Portugal)

13.2.1 General

13.2.1.1 Ecosystem aspects

See the Stock Annex (in Annex L of WG report)

13.2.1.2 Fishery description

See the Stock Annex (in Annex L of WG report)

13.2.1.3 ICES Advice and Management applicable for 2015 and 2016

ICES Advice for 2015 and 2016

The advice for these stocks is biennial and valid for 2015 and 2016. Based on the ICES approach for data-limited stocks, ICES advised that catches in 2015 for FUs 28 and 29 should be no more than 226 tonnes.

To protect the stock in this Functional Unit, ICES advises that management area should be consistent with the assessment area. Therefore, management should be implemented at the Functional Unit level.

Management applicable for 2015 and 2016

A recovery plan for southern hake and Iberian *Nephrops* stocks has been in force since the end of January 2006. The aim of the recovery plan is to rebuild the stocks within 10 years, with a reduction of 10% in F relative to the previous year and the TAC set accordingly (Council Regulation (EC) No. 2166/2005).

In order to reduce F on *Nephrops* stocks in Division 9.a even further, a seasonal ban was introduced in the trawl and creel fishery for two boxes (geographic areas) located in FU 26 and in FU 28, in the peak of the *Nephrops* fishing season. Restrictions are applied to *Nephrops* fishing in these boxes in June–August and May–August, respectively.

ICES has not evaluated the current recovery plan for *Nephrops* in relation to the precautionary approach.

The TAC set for the whole Division 9.a was 254 and 320 t for 2015 and 2016, respectively, of which no more than 6 % may be taken in FUs 26 and 27. The maximum number of fishing days for vessels operating under effort limitations was fixed at 114 and 117 days per vessel for Spanish vessels and at 113 days for Portuguese vessels for these two years (Annex IIb of Council Regulations 104/2015 and 72/2016). The number of fishing days included in these regulations is not applicable to the Gulf of Cadiz (FU 30), which has a different effort management regime.

13.2.2 Data

13.2.2.1 Commercial catches and discards

Table 13.2.1 and Figure 13.2.1 show the landings dataseries for these Functional Units (FUs). For the period 1984–1992, the recorded landings from FUs 28 and 29 have fluctuated between 420 and 530 t, with a long-term average of about 480 t, falling drastically in the period 1990–1996, down to 132 t. From 1997–2005 landings have increased to levels observed during the early 1990s but decreased again in recent years. The value landings in 2009–2011 was approximately at the same level (≈ 150 t), increasing to an average value of 220 t in the years 2012–2013. In recent years, landings have been limited by the TAC. In 2013 the fishery was closed in the last quarter, in 2014 from mid-July to mid-November and in 2015, from end of August to mid-November.

Since 2011, landings include the Spanish official landings. Spanish vessels are licensed for crustaceans in these FUs under a bilateral agreement since 2004. No data from these vessels' operation is available prior to 2011.

Spanish official landings are derived from logbooks. This source of information allows landings disaggregation by ICES statistical rectangles. In 2012 and 2013, *Nephrops* catches recorded in statistical rectangles outside the FUs in Division 9.a were allocated to the closest rectangles in each FU. In 2014–2015, 100% of the caches were into FU 28-29 definition (WD 03).

Males are the dominant component in all landings with exception for 1995 and 1996 when total female landings exceeded male landings (ICES, 2006). For the period 2002-2011 male to female sex-ratio has fluctuated around 1.5:1. The years 2012 and 2013 present a ratio of 2.3:1. The sex-ratio in 2014 and 2015 was close to 1:7.

Information on discards and on the sampling program was sent to the WG through ICES Accessions. The frequency of *Nephrops* occurrence in discards samples is very low. Discards are negligible in this fishery and mostly due to quality and not related to MLS (20 mm of carapace length). Only in 2013, the occurrence of *Nephrops* in discards samples was greater than 30% and a total amount of 3 t was estimated, with a high coefficient of variation (CV = 58%).

13.2.2.2 Biological sampling

Length distributions for both males and females for the Portuguese trawl landings are obtained from samples taken weekly at the main auction port, Vila Real de Sto. António. Sampling frequency in 2014 was at the same level as in previous years, in the months in which fishing was open. The sampling data are raised to the total landings by market category, vessel and month.

The length compositions of the landings are presented in Tables 13.2.2a–b and Figures 13.2.2a–b. The number of samples and measured individuals are presented in Table 1.3.

13.2.2.3 Biomass indices from surveys

Since 1997, several groundfish (PtGFS-WIBTS-Q4) and crustacean trawl surveys (PT-CTS UWTV FU 28–29) were carried out in FUs 28 and 29. Table 13.2.4 and Figure 13.2.1 shows the average *Nephrops* cpues (kg/h trawling) from the crustacean trawl surveys, which can be used as an overall biomass index. As the surveys were performed with a smaller mesh size than the commercial fishery, this information provides a better estimation of the abundance for the smaller lengths of *Nephrops*. There was an increase in the overall biomass index in the period 2003–2005, and also of small individuals in a particular juvenile concentration area in 2005, which could be an indication of higher recruitment.

The RV "NORUEGA" had some technical problems in 2010 and could not trawl in areas deeper than 600 m. The survey plan had to be adapted accordingly. The cpue value obtained for 2010, the highest from the series, was probably affected by this change. In 2011, due to engine failure, the survey did not cover the whole area of

Nephrops distribution. No cpue index was presented for this year. Budgetary constraints of national scope turned unfeasible to repair the RV NORUEGA and the chartering of another research vessel and therefore no survey was conducted in 2012.

The biomass index estimated from the 2013 survey is only comparable to the value of 2009, which covered the same area. Comparing the fraction of the area covered in 2011 and the same area in 2013, the biomass of *Nephrops* increased in the area of Alentejo (FU 28). The survey in 2011 did not cover the main area of concentration in Algarve (FU29). In recent years, there is a large uncertainty associated with the survey indices due to technical problems of the research vessel and partial coverage of the area of distribution.

The survey area was adapted in 2014 taking into account the information from the fishing grounds obtained from VMS data. The 2014 survey was carried out later than in previous years, after the peak of the fishing season and the biomass index was lower (Figure 13.2.1 and 13.2.3).

As shown in ICES (2012a), the distribution of survey indices is in very good agreement with the fishery cpue spatial distribution. The correlation between the average annual cpue from the fishery and the biomass index from the Crustacean survey until 2009 is also high. The values from recent years were highly variable and not taken into account due to the RV operation problems already referred.

In 2005 and 2007, some experiments to collect UWTV images from the *Nephrops* fishing grounds were made with a camera hanged from the trawl headline. In 2008, the images collected from 9 stations in FU 28 with the same procedure looked very promising. In 2009 survey, a two-beam laser pointer was attached to the camera and UWTV images were recorded from 58 of the 65 stations. The trawling speed and the turbidity were the main problems affecting the clarity of the image and the high variation of the height of the camera to the ground resulted in a variable field of view. In 2010 and 2011, no images were collected due to technical problems of the research vessel. It is not guaranteed that this method can be used for abundance estimation (information presented to SGNEPS 2012 – Study Group of *Nephrops* Surveys (ICES, 2012b).

13.2.2.4 Mean sizes

Mean carapace length (CL) data for males and females in the landings and surveys are presented for the period 1994-2015 (Table 13.2.5). Figure 13.2.1 shows the mean CL trends since 1984. The mean sizes of males and females have fluctuated along the period with no apparent trend.

13.2.2.5 Commercial catch-effort data

A standardization of the cpue series was presented to WGHMM in 2008 (ICES, 2008, Silva, C. – WD 25) applying the generalized linear models (GLMs). The data used for this standardization were the crustacean logbooks for the period 1988-2007. The factors retained for the final model (year, month and vessel category) were those which contribute more than 1% to the overall variance. The model explains 17–19% of the variability, when using the cpue in kg/day or kg/haul respectively.

Until 2010, this model was updated each year with the addition of new data.

The issue of effort estimation using standardized cpue from GLMs or other methods taking into account the flexibility of the fleet in relation to target species was further developed in the WGHMM 2010 (ICES, 2010a) and during WKSHAKE2 (ICES, 2010b). Crustacean vessels are targeting two main species, rose shrimp and Norway lobster, which have different market value. Depending on their abundance/availability, the effort is directed at one species or the other. In 2006, the landings of rose shrimp start to increase showing a change in the objectives of the fishery (Figure 13.2.4).

The effort is estimated using the cpue of the fleet. If the cpue of *Nephrops* decreased due to a change in target species (and consequently, fishing grounds), the effort might be overestimated.

The model of cpue standardization used until 2010 never explained more than 20% of the variability (ICES, 2010a). The explanatory variables used were *year*, *month* and *vessel-category*. Considering the behaviour of the fleet in periods of high abundance of rose shrimp, new variables related to the catches of this species and the proportion of *Nephrops* in the total catch were incorporated. As the distributions of rose shrimp and *Nephrops* are fishing ground and depth dependent, the availability and use of VMS data could improve the standardization model, as suggested in Silva and Afonso-Dias, 2011 (WD to WKcpueFFORT).

Taking all this into account, new variables as the fishing depth, the catches of rose shrimp and the proportion of *Nephrops* in the total crustacean catches were incorporated in the new model for cpue standardization and presented to IBP *Nephrops* 2012 (Inter-Benchmark Protocol for *Nephrops* 2012, ICES, 2012c).

The IBP *Nephrops* did not come to a conclusion about the stock assessment method but the WG has agreed to use this new cpue standardization for the trends based assessment and standardized effort estimation.

However, as VMS data are only available since 1998, the use of this method has shortened the length of the time-series. In the models presented before, the cpue was expressed in kg/day and the time-series started in 1988. The cpue in the new model is expressed in kg/hour, the time-series starts 10 years later but the estimation of cpue is based on more reliable effort data.

The overall analysis of the geo-referenced catches confirms the general preference of rose shrimp and *Nephrops* for grounds shallower and deeper than 400 m, respectively. These data also confirm that, in years of higher abundance of rose shrimp, a greater effort is allocated to depths shallower than 400 m. In what concerns the distribution of the fishing effort between the two Functional Units, FU29 represents in average 83% of the total effort. However, the fishing areas (FUs) were found not significantly different and therefore removed from the model.

The factors and levels retained in the final model and updated to include more recent data were:

- year: 1998 –2015
- month: 1–12
- depth interval: [100, 400[, [400, 800[, [800, 1500]
- log catch of rose shrimp: [0, 2[, [2, 5]
- proportion of *Nephrops* in the total catch of crustaceans: [0, 0.25[, [0.25, 1]
- and vessel category: A (standard), B and C. These two categories correspond to vessels less or more productive than the standard type.

The choice of the final model was based on the highest value of explained variance and the smallest AIC. In 2014 assessment, with the data from 1998–2013, the model explained 47% of the total variability, with the proportion of *Nephrops* in the crustacean catches as the most important factor (Table 13.2.6). The explained deviance of the updated model, including data from the period 1998–2015, was reduced to 33%. One possible explanation is that in the last three years, fishing does not cover the whole year, due to the reduced quota.

Figure 13.2.4 shows the annual observed cpue and the estimates from the model, considering the depth interval class [400, 800[, log catch of rose shrimp class [0, 2[, the category of proportion of *Nephrops* [0.25, 1] and vessel category A as the reference factors for *Nephrops* target cpue.

The correlation found between the cpue series derived from the model presented here and the biomass indices from the Crustacean surveys (not considering the estimates after 2009, for the reasons explained before) is high and gives confidence that cpue is reflecting the abundance of *Nephrops* in FU 28 and 29. The trends of the standardized commercial cpue and of the survey biomass index, represented in Figure 13.2.1 by a smooth line, are similar.

The standardized cpue is used to estimate the fishing effort in standard hours.

The effort in 2003-2004 corresponds to only eleven months of fleet operation for each year as the crustacean fishery was experimentally closed in January 2003 and 30 days for *Nephrops* in September–October 2004.

A Portuguese national regulation (Portaria no. 1142, 13th September 2004) closed the crustacean fishery in January-February 2005 and enforced a ban in *Nephrops* fishing for 30 days in September–October 2005. As a result, the effort in 2005 corresponds to nine months.

The recovery plan for southern hake and Iberian *Nephrops* stocks was approved in December 2005 and entered in force at the end of January 2006. This recovery plan includes a reduction of 10% in F relative to the previous year (Council Regulation (EC) No 2166/2005). As a result, the number of fishing days per vessel was progressively reduced. Additional days were allocated in 2010 to Spanish and Portuguese vessels on the basis of permanent cessation of vessels from each country (Commission Decisions nos. 2010/370/EU and 2010/415/EU).

Besides this effort reduction, the Council Regulation (EC) No 850/98 was amended with the introduction of two boxes in Division 9.a, one of them located in FU 28. In the period of higher catches (May-August), this box is closed for *Nephrops* fishing (Council Regulation (EC) No 2166/2005). By way of derogation, fishing with bottom trawls in these areas and periods are authorized provided that the bycatch of Norway lobster does not exceed 2 % of the total weight of the catch. The same applies to creels that do not catch *Nephrops*.

The effort reduction measures were combined with a national regulation closing the crustacean fishery every year in January (Portaria no. 43, 12th January 2006). As a result of these measures, the nominal effort in 2006 to 2011 corresponds to 11 months each year.

In the period 1999–2001, standardized fishing effort increased substantially, remaining high until 2004–2005 (Table 13.2.3 and Figure 13.2.1), with an exceptional drop in 2003. After 2005, the effort presents a decreasing trend until 2009. The effort decline may be related to the effort management measures but also to effort shift to rose shrimp, which presented a large increase in abundance and landings in the period 2007–2011 (Figure 13.2.4).

The standardized effort increased in 2012 due to a higher catch from Portuguese fleet and to the provision of Spanish catches in this year. As stated in section 13.2.2.1, Spanish vessels are licensed for crustaceans in these FUs under a bilateral agreement since 2004, but no official data were available prior to 2011. In 2013, due to the lower availability of rose shrimp and the increase in abundance of Norway lobster, the Portuguese quota was fished until September and the Portuguese crustacean fleet had to stop the operation or to target other crustacean species, resulting in effort reduction. Although the quota had a slight increase in 2014 and 2015, it was still insufficient. The fisheries administration and the industry agreed to stop earlier the fishery and to save part of the quota to be fished in November-December. In regard to the Spanish fleet, the number of fishing days was reduced, due to sanctions imposed by EC related to the catches over quota in 2012, affecting also the operation of this fleet in the Portuguese fishing grounds in the period 2013–2015.

In the period 2008-2015, the standardized fishing effort has fluctuated around 28 thousand hours.

13.2.3 Assessment

The advice is based on the standardized commercial cpue and effort trends. According the ICES data-limited approach, this stock is classified in the category 3.2.0 (ICES, 2012).

The standardized effort shows a consistent declining trend since 2005 reaching a historic low in 2009-2010. In the following years, the effort had a slight increase however still remaining at a low level. Landings and effort show small fluctuations in the period 2011-2015 due to quota limitations resulting from the recovery plan rules, currently in force.

The standardized fleet cpue, used as index of biomass, decreased in the period 2006-2011 reversing the downward trend in recent years. Due to the technical problems recorded in the operation of the research vessel, which affected the crustacean survey series in the period 2010-2013, the trend of the survey index was not used, although the smooth line over this index values shows a trend similar to the standardized commercial cpue.

13.2.4 Short-term Projections

No projections were performed.

13.2.5 Biological reference points

Proxies of MSY reference points were defined by ICES (2016b) using the methods developed in WKLIFE and WKProxy (ICES, 2015, 2016a).

$F_{0.1}$ from length-based analysis of the period 1998–2014, was adopted as proxy of F_{MSY}. The values were 0.31 for males and 0.33 for females. No proxy for B_{MSY} was identified.

13.2.6 Management considerations

Nephrops is taken by a multispecies and mixed bottom-trawl fishery.

A recovery plan for southern hake and Iberian *Nephrops* stocks was approved in December 2005 and in action since the end of January 2006. This recovery plan includes a reduction of 10% in the hake F relative to the previous year and TAC set accordingly, within the limits of ±15% of the previous year TAC (Council Regulation (EC) No 2166/2005). Although no clear targets were defined for Norway lobster stocks in the plan, the same 10% reduction has been applied to these stocks effort and TAC. The number of allowed fishing days is set in each year regulations (Council Regulations (EC) Nos. 51/2006, 41/2007, 40/2008, 43/2009, 53/2010, 57/2011, 43/2012, 39/2013, 43/2014 and 104/2015). The recovery plan target and rules have not been changed since it was implemented.

Besides the recovery plan, the Council Regulation (EC) No 850/98 was amended with the introduction of two boxes in Division 9.a, one of them located in FU 28. In the period of higher catches (May-August), these boxes are closed for *Nephrops* fishing (Council Regulation (EC) No 2166/2005). By derogation, fishing with bottom trawls in these areas and periods are authorized provided that the bycatch of Norway lobster does not exceed 2 % of the total weight of the catch. The same applies to creels that do not catch *Nephrops*.

With the aim of reducing effort on crustacean stocks, a Portuguese national regulation (Portaria no. 1142, 13th September 2004) closed the crustacean fishery in January-February 2005 and enforced a ban in *Nephrops* fishing for 30 days in September – October 2005, in FUs 28-29. This regulation was revoked in January 2006, after the entry in force of the recovery plan and the amendment to the Council Regulation (EC) No 850/98, keeping only one month of closure of the crustacean fishery in January (Portaria no. 43/2006, 12th January 2006). The national regulations are only applicable to the Portuguese fleet.

Portugal and Spain have bilateral agreements for fishing in each other waters. The agreement for the period 2004–2013 was reviewed and extended for 2014-2016. Under this agreement a number of Spanish trawlers are licensed to fish crustaceans in Portuguese waters. No information from landings of these vessels is available for the years prior to 2011.

Table 13.2.1. *Nephrops* in Southwest and South Portugal (FU 28–29). Total landings per country (tonnes).

	FU 28+29 SW+S Portugal					
	28***	29	28+29			Total
	Spain	Spain	Portugal			
Year	Trawl	Trawl	Artisanal	Trawl	Total	
1987			11	498	509	509
1988			15	405	420	420
1989			6	463	469	469
1990			4	520	524	524
1991			5	473	478	478
1992			1	469	470	470
1993			1	376	377	377
1994				237	237	237
1995			1	272	273	273
1996			4	128	132	132
1997			2	134	136	136
1998			2	159	161	161
1999			5	206	211	211
2000			4	197	201	201
2001			2	269	271	271
2002			1	358	359	359
2003			35	335	370	370
2004			31	345	375	375
2005			31	360	391	391
2006			17	274	291	291
2007			18	274	291	291
2008			35	188	223	223
2009			17	133	151	151
2010			16	131	147	147
2011		17	16	117	133	150
2012	<1	14	3	211	214	229
2013		10	1	198	199	209
2014		8	3	183	186	193
2015**		12	4	231	235	247

**** Preliminary values**

***** Spanish landings from FU28 included in FU29**

Table 13.2.3. - SW and S Portugal (FUs 28-29): Effort and cpue of Portuguese trawlers, 1994–2015.

Year	No. of trawlers	CPUE (t/boat)	Estimated hours	CPUE** (kg/hour)
1994	31	7.6		
1995	30	9.1		
1996	25	5.3		
1997	25	5.5		
1998	25	6.4	39,416	4.2
1999	29	7.3	37,078	5.9
2000	33	6.1	47,944	4.3
2001	33	8.2	75,103	3.7
2002	34	10.5	58,697	6.2
2003	35	9.6	41,593	8.2
2004	33	10.4	47,947	7.3
2005	32	11.9	42,173	9.1
2006	30	9.1	33,409	8.3
2007	30	9.1	35,490	7.8
2008	30	6.3	25,608	7.5
2009	30	4.4	24,652	5.5
2010	26	5.0	22,842	5.9
2011	26	4.5	22,683	5.3
2012	21	10.2	29,609	7.4
2013	24	8.2	26,899	7.5
2014	24	7.5	24,308	7.6
2015*	20	11.6	29,776	7.6
* provisional; ** standardized CPUE				

Table 13.2.4. - SW and S Portugal (FUs 28-29): *Nephrops* cpues (kg/hour) in research trawl surveys, 1994–2015.

Year	Demersal surveys			Crustacean surveys	
	CPUE (kg/hour)			Month and year of survey	CPUE (kg/hour)
	Summer	Autumn	Winter		
1994	ns	0.40	ns	May-94	2.3
1995	1.3	0.26	ns	No surveys 1995-96	
1996	ns	0.03	ns		
1997	0.7	0.06	ns	Jun-97	2.6
1998	0.7	0.02	ns	Jun-98	1.2
1999	0.3	0.02	ns	Jun-99	2.5
2000	1.0	0.92	ns	Jun-00	1.6
2001	0.6	0.35	ns	Jun-01	0.8
2002	ns	0.02	ns	Jun-02	2.4
2003	ns	0.19	ns	Jun-03	2.6
2004	ns	0.51	ns	Jun-04	nr
2005	ns	0.09	0.16	Jun-05	4.7
2006	ns	0.19	0.06	Jun-06	2.4
2007	ns	0.04	0.73	Jun-07	2.8
2008	ns	0.13	0.25	Jun-08	4.0
2009	ns	0.13	ns	Jun-09	2.0
2010	ns	0.34	ns	Jun-10	6.8
2011	ns	0.11	ns	Jun-11	nc
2012	ns	ns	ns	ns	ns
2013	ns	0.64	ns	Jun-13	2.2
2014	ns	0.06	ns	Jul-14	1.0
2015	ns	0.18	ns	Jul-15	3.0
ns = no survey nr = not reliable nc = whole area not covered					

Table 13.2.5. - SW and S Portugal (FUs 28-29): Mean sizes (mm CL) of male and female *Nephrops* in Portuguese landings and surveys, 1994–2015.

Year	Landings		Demersal surveys						Crustacean surveys	
	Males	Females	Summer		Autumn		Winter		Males	Females
			Males	Females	Males	Females	Males	Females		
1994	37.4	33.6	ns	ns	39.0	33.6	ns	ns	ns	ns
1995	39.3	37.0	42.1	35.6	42.0	34.9	ns	ns	ns	ns
1996	36.9	36.6	ns	ns	38.6	32.2	ns	ns	ns	ns
1997	35.9	32.8	40.4	36.9	39.1	31.7	ns	ns	43.7	41.9
1998	36.8	34.5	36.0	33.9	40.6	35.9	ns	ns	39.5	36.7
1999	38.7	34.6	45.1	40.4	43.8	32.8	ns	ns	39.7	37.5
2000	38.9	35.2	40.8	37.1	39.0	35.1	ns	ns	41.7	40.2
2001	41.6	36.1	40.5	34.5	47.2	41.6	ns	ns	44.5	39.9
2002	40.7	36.2	na	na	35.0	39.0	ns	ns	44.8	40.7
2003	39.1	36.4	ns	ns	37.5	32.3	ns	ns	39.7	36.7
2004	37.3	33.8	ns	ns	36.7	31.3	ns	ns	39.0	37.0
2005	35.6	33.0	ns	ns	40.6	39.1	40.6	40.9	37.3	35.7
2006	37.2	34.1	ns	ns	36.1	32.8	31.7	35.0	37.7	35.2
2007	36.5	32.8	ns	ns	42.0	38.5	39.0	36.2	38.3	35.0
2008	40.1	35.5	ns	ns	43.2	41.4	46.7	40.6	40.1	36.7
2009	37.4	34.2	ns	ns	45.3	39.8	ns	ns	41.4	36.6
2010	40.1	36.5	ns	ns	39.7	33.7	ns	ns	37.7	36.6
2011	45.0	39.2	ns	ns	43.1	40.0	ns	ns	nc	nc
2012	36.9	34.4	ns	ns	ns	ns	ns	ns	ns	ns
2013	39.7	35.3	ns	ns	42.6	37.3	ns	ns	39.1	39.5
2014	41.3	36.7	ns	ns	46.5	39.2	ns	ns	37.8	35.2
2015	40.9	37.4	ns	ns	42.4	35.2	ns	ns	39.2	37.3
ns = no survey nr = not reliable nc = whole area not covered										

Table 13.2.6 Analysis of deviance for the Gamma-based GLM model fitted to the positive *Nephrops* cpue in the catches.

Source of variation	Df	Deviance	Resid. Df	Resid. Dev	Pr(>F)	% explained
NULL			80414	91280		
year	17	9626.5	80397	81654	< 2.2e-16	10.5%
month	11	2605	80386	79049	< 2.2e-16	2.9%
depth.class2	2	1999.5	80384	77049	< 2.2e-16	2.2%
catdps	1	3205.2	80383	73844	< 2.2e-16	3.5%
cat_pnep	1	9968.4	80382	63875	< 2.2e-16	10.9%
catPRT2	2	2528.3	80380	61347	< 2.2e-16	2.8%
Total	**34**	**29932.9**				**32.8%**

AIC: 310454

Table 13.2.2.a. FU 28–29 - Length Composition of *Nephrops* Males (1984–2015)

Landings (thousands)																
Age/Year	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
17																
18																
19					4	21					0					
20			0	16	4			6	4							4
21		17	9			84		16	37	9						3
22	7	5	14	15		97	9	29	96	38	9				2	0
23	24	7	7	8		143	5	19	55	34			8	4		5
24	14	40	121	209	51	272	27	53	202	42	18		17	9	8	9
25	109	83	115	81	97	229	116	69	181	149	34	3	23	6	16	39
26	250	170	137	446	128	205	182	111	263	72	68	0	36	43	32	33
27	282	326	170	718	208	269	149	94	185	95	77	0	54	95	81	49
28	374	500	289	871	399	280	337	139	506	272	157	0	56	78	65	68
29	439	559	341	727	456	283	415	159	462	382	95	28	38	88	65	109
30	412	742	328	584	442	317	695	239	725	548	187	11	68	104	160	133
31	277	670	389	742	457	230	813	325	755	548	231	24	92	172	129	272
32	373	784	680	806	446	367	866	260	670	674	383	108	151	283	289	88
33	339	531	213	236	428	265	702	133	345	365	149	83	70	90	95	182
34	389	635	609	721	656	328	785	239	451	655	270	215	159	251	269	152
35	478	525	590	245	664	291	755	171	296	475	224	169	147	169	118	175
36	378	463	519	342	572	295	449	138	399	639	221	147	78	154	166	143
37	528	346	322	406	424	356	465	77	351	391	107	262	172	149	167	128
38	496	383	606	355	571	302	479	120	378	344	179	134	113	58	85	75
39	353	309	361	240	326	332	611	126	348	306	95	151	62	46	47	180
40	447	337	323	156	366	316	829	200	248	174	144	232	83	82	83	83
41	247	230	316	335	164	314	797	141	243	158	93	247	78	37	53	184
42	371	246	507	264	215	360	628	174	246	170	168	293	85	33	167	58
43	199	156	198	62	102	364	335	121	242	107	127	65	31	21	43	102
44	194	233	422	215	128	481	553	125	371	179	150	88	42	28	69	63
45	165	144	233	206	93	339	324	90	220	150	87	27	22	21	34	111
46	148	178	189	170	72	231	228	128	167	55	79	58	21	33	38	67
47	129	161	140	74	76	191	202	122	191	96	68	31	38	20	34	59
48	176	212	149	79	85	193	121	62	178	102	78	25	15	9	24	40
49	89	138	104	58	43	73	92	78	111	47	47	16	20	4	13	50
50	91	142	50	34	53	94	58	67	69	30	50	12	9	3	33	32
51	66	120	63	27	34	114	59	44	50	38	29	4	6	7	14	32
52	64	135	66	44	38	77	33	40	35	15	46	11	16	7	31	8
53	45	99	32	37	23	40	19	16	29	18	22	5	6	6	11	13
54	73	101	35	45	22	35	27	29	50	23	18	5	8	16	19	15
55	20	67	25	31	22	37	30	26	29	19	9	3	4	10	8	9
56	20	35	14	20	16	20	30	19	5	5	11	2	4	3	6	13
57	10	33	5	15	12	22	7	10	6	5	11	3	7	16	8	8
58	13	14	8	14	11	17	14		11	4	6		5	3	5	4
59	7	10	3	9	4	16	5	2	9	3	10	0	5	2	3	4
60	3	6	3	4	3	13	2		10	8	1	1	1	4	1	1
61	3	1	4	4	1	5		1	3	2	1	0	1	9	1	2
62	3	1	2	1	2	3		1	7	5	1		2	7	1	3
63	1	1		1	1	4		5	0	1	0		2	3	0	2
64		2	0	2	1			1	3	1	2		0	4	0	1
65	0	0		2	2				3	1	1		0	4		0
66	0			0	1					1			0	4	0	
67	0			0	0	0			6	5				6	0	
68					0	2				0	1			0	0	
69				0										0	0	
70	0			1		0				2				0	0	
71										0					0	
72				0		0				1					0	
73														0		
74	0									1						
75																
76																
77																
78		0			0											
79																
80									0							
81																
82																
83																
Total	**8106**	**9897**	**8709**	**9679**	**7925**	**8329**	**12255**	**4023**	**9249**	**7463**	**3766**	**2466**	**1854**	**2200**	**2491**	**2811**
Landings (t	**292**	**353**	**315**	**277**	**249**	**318**	**351**	**345**	**304**	**232**	**139**	**98**	**65**	**74**	**88**	**116**

Table 13.2.2.a. FU 28–29 - Length Composition of *Nephrops* Males (1984–2015) (continued)

Landings Age/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
17																
18																
19				0				2	0							1
20				0		4		3	1	0	0					
21	3	0	2	0	0	33		5	0	0	0				0	
22	16	1	2	13	4	51	10	20	8	2		0	3		1	
23	8	3	1	3	15	32	22	31	10	4		1	0	3	1	0
24	20	5	2	11	20	107	53	53	26	29	8	0	8		1	1
25	13	6	3	40	45	120	46	65	28	30	10	1	27	8	6	5
26	58	8	11	56	126	153	75	121	32	38	8	3	37	6	7	3
27	85	24	24	87	187	206	94	111	52	63	22	6	47	27	15	8
28	44	24	48	62	205	286	144	141	60	89	14	4	37	25	12	10
29	148	53	60	147	246	330	220	189	62	83	33	5	143	55	35	27
30	87	74	139	248	300	533	290	297	60	129	44	5	158	84	36	71
31	111	92	123	188	277	573	270	256	93	116	75	22	248	82	49	112
32	161	274	233	325	475	757	378	295	129	135	116	32	573	217	120	138
33	92	139	281	248	352	437	247	246	108	80	78	21	329	109	47	96
34	160	224	257	264	352	574	311	327	150	94	104	52	436	276	119	162
35	100	173	274	275	347	333	194	252	121	76	83	31	356	155	144	263
36	158	163	265	195	224	263	168	256	83	59	77	34	248	191	119	202
37	162	167	247	234	167	293	172	224	109	57	78	64	211	145	108	191
38	106	99	254	197	147	226	164	265	73	58	125	69	206	216	144	179
39	81	109	229	174	93	175	100	173	75	61	71	39	126	95	129	125
40	96	159	254	215	165	152	100	188	77	63	84	44	112	162	160	139
41	102	130	163	163	108	129	125	163	102	53	55	49	114	113	90	117
42	91	195	163	168	177	152	190	198	128	105	75	68	140	171	129	142
43	47	181	167	172	113	118	95	82	76	38	51	45	79	64	58	85
44	86	173	122	121	122	176	144	90	61	51	65	43	87	89	104	127
45	61	140	113	103	131	140	96	83	60	25	39	19	52	42	59	92
46	85	144	106	76	103	117	118	71	38	25	26	15	46	81	59	62
47	88	120	111	75	97	113	61	60	48	25	43	18	47	89	83	61
48	55	80	104	83	90	66	54	65	48	23	35	12	30	67	26	28
49	37	79	86	59	58	52	41	38	34	24	23	12	32	53	36	48
50	65	93	103	94	82	69	28	42	36	20	25	11	19	59	25	58
51	34	71	72	65	41	40	30	37	27	17	20	15	17	37	32	56
52	53	88	94	73	65	45	37	48	29	32	30	24	33	47	64	70
53	18	41	69	58	31	22	22	21	24	13	16	9	22	18	25	45
54	31	54	53	57	50	24	33	27	23	19	21	24	32	36	44	48
55	19	34	28	46	26	12	15	10	20	12	14	15	15	16	24	60
56	19	29	43	29	57	14	11	8	15	13	8	25	24	20	20	43
57	19	37	37	25	16	9	6	6	17	11	9	25	20	15	20	27
58	13	23	26	21	12	9	7	7	20	7	11	45	7	12	10	14
59	10	15	16	13	15	8	9	5	11	4	6	19	7	8	9	16
60	8	15	25	16	24	12	6	3	9	7	5	13	4	10	7	10
61	14	9	11	8	11	8	8	4	8	4	5	7	9	7	4	4
62	6	10	11	15	16	8	8	3	15	8	6	22	3	1	12	4
63	1	4	11	11	7	7	7	1	8	4	6	7	2	4	3	3
64	1	9	11	8	10	10	7	1	10	6	5	17	2	3	8	3
65	4	6	5	4	3	10	7	1	9	2	3	9	1	1	2	1
66	1	5	8	3	7	3	4	2	11	1	3	5	3	2	3	2
67		4	3	5	2	2	6	1	6	1	3	3	3	1	2	1
68		1	6	6	2	3	4	0	8	0	4	3	3	1	1	0
69	0	3	3	2	2	2	4	1	4	1	0	2	1		1	0
70	0	6	2	4	3	4	5	0	4	1	0	1	3	1	1	0
71		2	2	4	1	1	3	1	2	0	0	0	1		1	0
72		2	2	4	1	3	4	0	3	1	0	1	3	0	1	
73	0	0	1	1	1	2	2		1	0	0	1	1		1	
74		0	1	1	1	3	1		1	1	0	1	1		1	
75		0	1	0	0	1	1		1	1	2	0	1		0	
76		0	0	0	0	0	1		1	0		0	0			0
77			0	0	0	0	1		1	0	0	0	0			
78					0	1			0			0				
79			0		0	1	0		0	0			0			
80						0			0			0				
81							0		0	0						
82			0				0		0	0						
83									0							
Total	**2680**	**3602**	**4486**	**4575**	**5233**	**7036**	**4259**	**4598**	**2280**	**1822**	**1649**	**1018**	**4170**	**2928**	**2217**	**2959**
Landings (t)	**117**	**190**	**222**	**205**	**205**	**231**	**162**	**159**	**114**	**73**	**79**	**72**	**149**	**132**	**114**	**147**

Table 13.2.2.b. FU 28–29 - Length Composition of Nephrops Females (1984–2015)

Landings (thousands)

Age/Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
17																
18					4											
19		0				35					0					
20	3	1	7		8	21				18						
21	1	1	22	3	21	102		21	9	49						
22	8	21	30	78		88	19	11	102	63			0	13	2	5
23	66	21	7	31	28	135	15	69	38	21	2		0	0	4	4
24	79	102	118	270	153	258	38	173	164	41	22	2	11	20	15	25
25	228	205	104	357	163	197	138	198	203	191	73		13	20	25	27
26	272	284	186	684	220	282	140	436	361	111	92	1	35	102	74	94
27	345	491	359	902	429	326	247	418	448	235	134	0	37	77	91	76
28	431	523	322	1421	471	231	345	598	597	413	170	6	36	152	148	100
29	443	672	419	1253	516	285	491	590	514	523	269	31	45	178	114	121
30	422	588	381	928	499	317	575	771	599	775	326	104	50	199	199	236
31	487	593	418	948	482	501	639	414	736	752	427	182	95	394	168	263
32	485	653	700	946	766	306	859	807	617	824	558	322	198	502	376	485
33	613	415	406	227	527	314	596	375	430	449	283	251	53	163	116	187
34	618	467	654	774	813	511	734	310	369	359	353	641	209	278	298	346
35	562	563	447	447	460	435	519	284	287	194	246	674	184	150	112	287
36	469	329	316	386	489	274	243	130	267	203	237	811	142	135	166	317
37	505	353	400	223	206	318	189	108	333	154	147	692	267	129	171	201
38	383	284	330	269	265	285	207	135	251	100	128	348	151	39	48	184
39	274	142	211	146	288	148	216	74	176	150	66	194	67	35	59	151
40	171	119	80	119	132	131	230	131	147	110	114	344	120	21	89	111
41	58	106	55	65	128	149	73	39	68	108	77	361	63	31	64	81
42	50	36	133	54	43	127	210	62	69	95	73	165	111	18	84	73
43	30	27	21	40	28	109	58	82	26	43	23	64	29	2	34	38
44	17	13	47	147	27	91	77	6	46	42	43	88	90	18	71	34
45	14	11	27	84	19	27	41	21	40	34	13	54	36	8	22	18
46	7	6	5	40	14	38	31	45	25	37	11	13	15	4	28	18
47	5	3	3	26	9	24	16	7	12	29	7	18	23	3	23	7
48	4	1		71	11	29	7	15	18	15	4	15	8	2	6	9
49	1	0	3	17	4	9	1	17	17	23	4	1	6	7	6	4
50	1	0		2	6	3	1	2	32	8	17	1	2	1	6	5
51	0	0	3	4	3	7	2	4	4	5	0			1	2	2
52	1			5	5	8	1		5	6	1	1	0	1	1	3
53	2			2	3	1			9	6	0			0	0	
54				4	1	1			1	1			1	0	1	
55				0	1	1			6	2						
56				3	0	2		5	14	5					0	
57				0	0	1			4	1			0		0	
58				0		0			4	1						
59				1	0	0										
60					0				1	0						
61						1										
62																
63									4	1						
64																
65																
66																
67																
68									4	1						
69																
70																
71																
72																
73																
74																
75																
76																
77																
78																
79																
80																
81																
82																
83																
Total	7052	7032	6218	10978	7243	6126	6962	6358	7059	6198	3920	5385	2095	2702	2621	3509
Landings (t	169	156	150	232	171	151	174	134	165	145	97	174	67	62	72	95

Table 13.2.2.b. FU 28–29 - Length Composition of *Nephrops* Females (1984–2015) (continued)

Landings Age/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
17				0												
18					0				0							
19				1				2	0							0
20		0		0	0	8		4	1							
21	3	1	0	3	12	48	3	15	2	1			7			
22	18	0		3	10	88	14	26	12	1	0			3	1	
23	6	7	0	9	43	54	37	34	11	4	1	1		7	1	0
24	49	7	10	19	62	135	44	53	25	22	10	1	5	7	3	
25	24	15	11	36	101	129	55	130	23	23	11	1	8	18	10	5
26	81	24	15	67	211	272	113	227	38	80	12	3	17	7	10	7
27	139	34	34	67	266	294	152	298	73	138	20	7	40	36	17	13
28	64	44	107	98	336	242	179	355	81	170	26	7	51	33	23	23
29	171	90	127	173	395	420	392	458	123	149	51	4	130	59	60	39
30	152	131	237	241	406	654	321	365	145	205	67	7	164	119	80	85
31	131	167	195	152	334	565	305	317	129	132	99	26	330	129	99	143
32	283	316	296	360	530	857	510	409	252	209	145	45	397	290	203	208
33	153	184	467	270	433	448	272	253	182	110	91	51	195	194	105	146
34	235	252	429	314	400	462	341	386	177	122	140	96	297	278	202	167
35	193	158	470	255	324	254	249	351	187	103	120	56	165	232	188	303
36	225	174	351	194	222	203	162	213	103	83	144	60	138	166	153	203
37	213	144	302	203	178	182	142	240	121	90	119	73	98	199	151	162
38	85	108	300	206	151	178	152	247	134	83	106	151	76	206	148	171
39	92	112	213	160	113	89	173	138	123	86	95	113	46	61	121	136
40	79	133	186	284	136	84	114	109	125	62	80	68	46	67	145	134
41	66	79	110	170	82	73	129	73	95	83	65	65	37	41	66	104
42	67	91	80	192	122	116	112	56	75	94	52	80	35	65	90	87
43	41	55	87	132	70	70	44	16	30	25	28	80	33	9	27	54
44	49	56	57	75	66	61	46	21	24	43	40	41	27	13	40	58
45	23	29	51	68	66	50	35	18	28	17	25	21	10	9	17	56
46	38	33	40	37	51	39	54	19	14	22	19	11	10	11	17	36
47	52	26	25	25	44	35	23	9	26	16	18	15	11	13	18	16
48	25	12	24	28	37	18	11	8	20	7	12	9	5	7	5	8
49	21	15	19	18	24	24	7	7	13	6	7	7	6	5	7	8
50	10	15	26	24	20	23	7	3	13	8	7	2	6	5	4	8
51	10	9	22	14	13	17	11	5	11	3	6	5	6	1	3	7
52	16	6	19	21	13	17	7	3	7	3	4	4	9	5	4	9
53	6	6	10	13	8	10	2	1	8	3	2	3	5	1	3	6
54	5	2	2	14	7	6	9	1	8	1	2	5	5	3	8	12
55	1	2	3	10	4	5	1	1	3	4	0	5	2	1	3	12
56	3	1	3	7	6	2	1	0	3	0	0	2	1	1	6	10
57	1	0	2	4	2	3	1		1	0	0	1	3	2	2	4
58		1	1	1	2	0	1	0	1	1	0	4	2	0		1
59	0	1	0	0	1	1	1			0	0	2	0	1	1	3
60		0		0		2			1		0	2	0		2	3
61	3	1		0	1					0	0	1	0			
62			0	0	0	1	0				0	0	0	0	0	0
63		0	0			0				0	0	2	0			
64					1	0		0	0	0			0			0
65					0	0						0				0
66	0	0				0										0
67												0				0
68																
69																0
70					0					0						0
71																
72																
73																
74																
75																
76																
77																
78																
79																
80																
81																
82																
83																
Total	**2829**	**2540**	**4332**	**3969**	**5304**	**6240**	**4229**	**4871**	**2449**	**2211**	**1628**	**1138**	**2424**	**2306**	**2044**	**2446**
Landings (t)	**84**	**79**	**135**	**130**	**140**	**151**	**112**	**114**	**74**	**60**	**52**	**45**	**65**	**66**	**66**	**85**

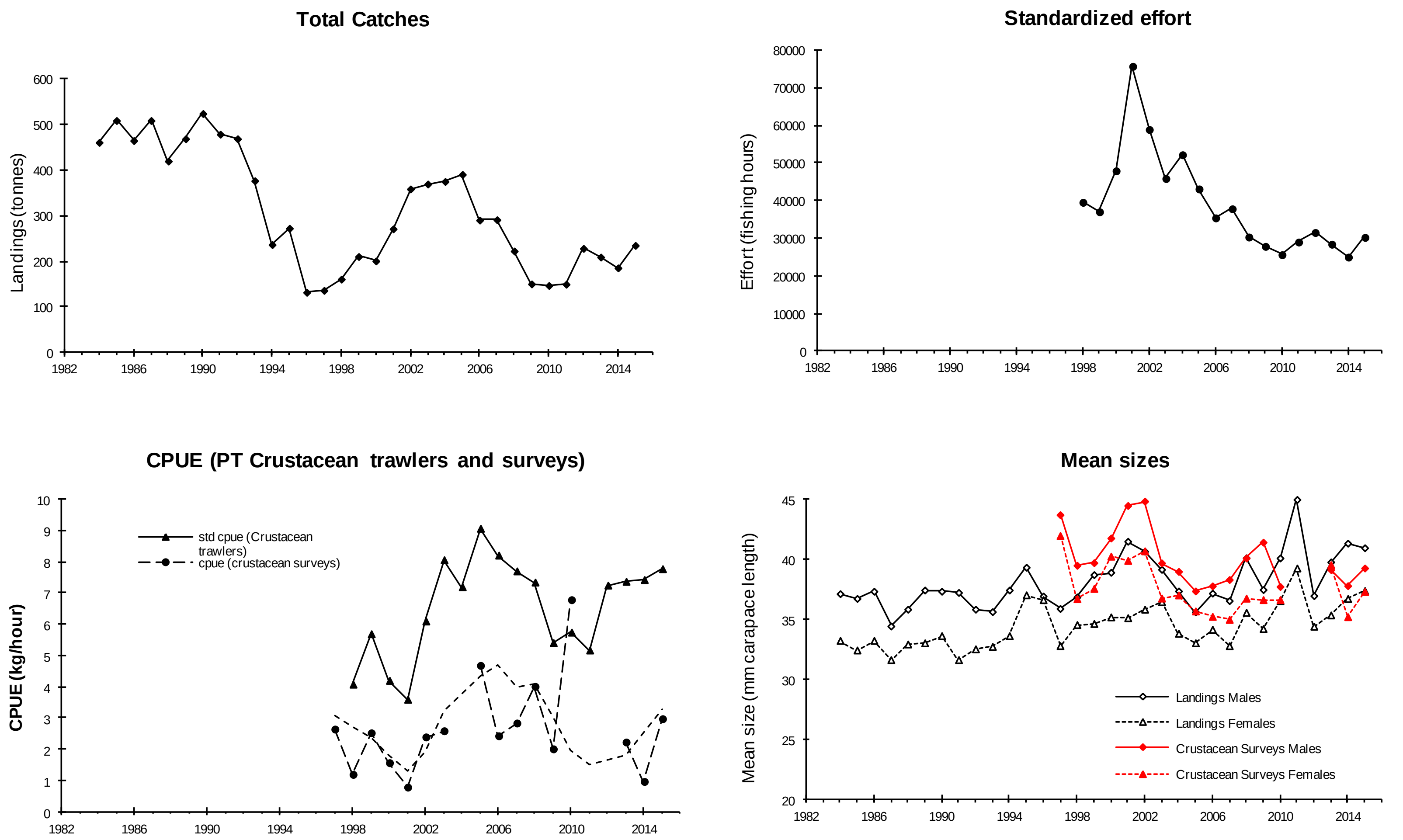


Figure 13.2.1. SW and S Portugal (FU 28+29): landings, effort, biomass indices and mean sizes of *Nephrops* in Portuguese landings and surveys. Note: Values of cpues and effort updated with the new cpue standardization.

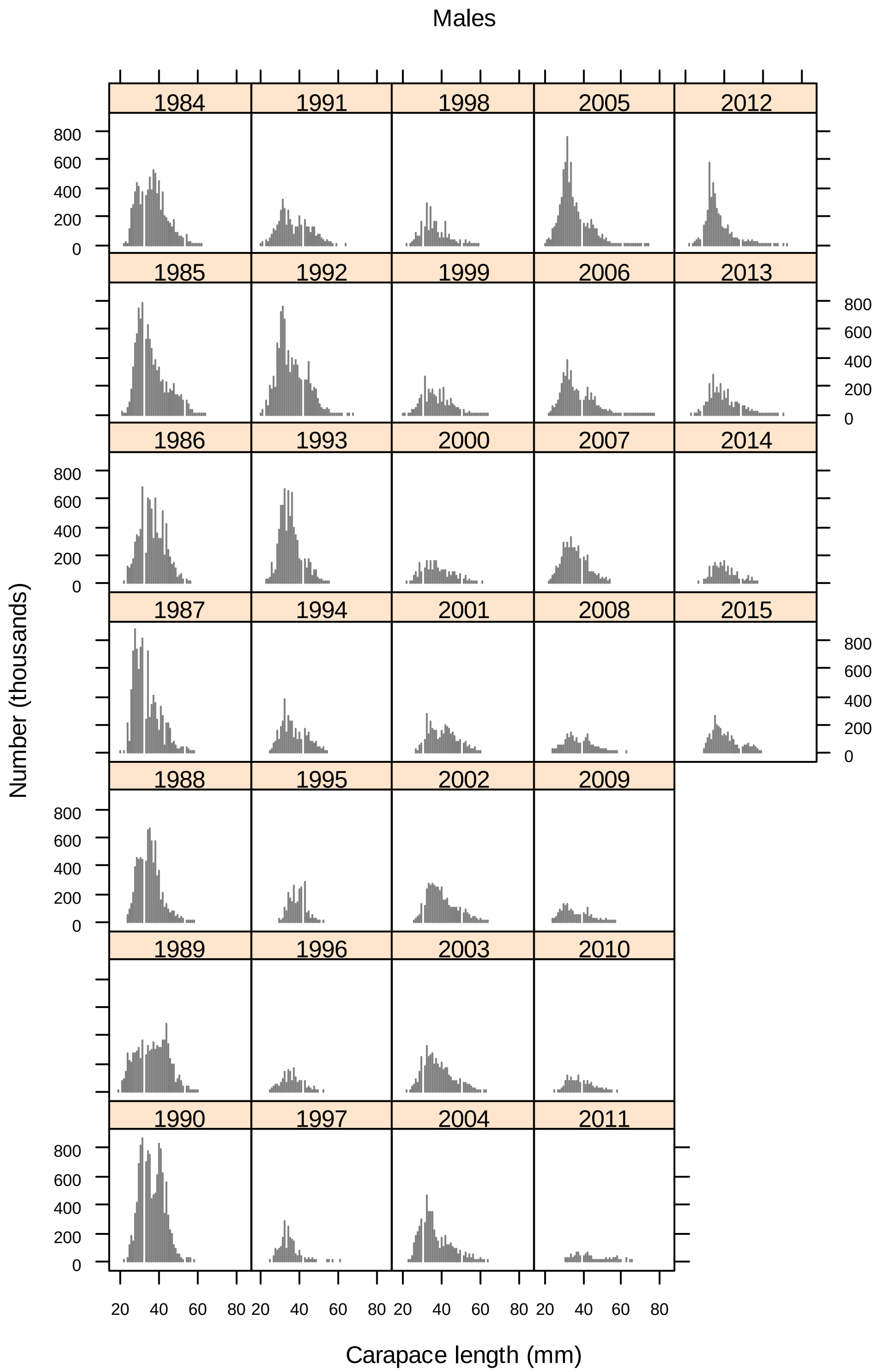


Figure 13.2.2.a. SW and S Portugal (FU 28–29) male length distributions for the period 1984–2015.

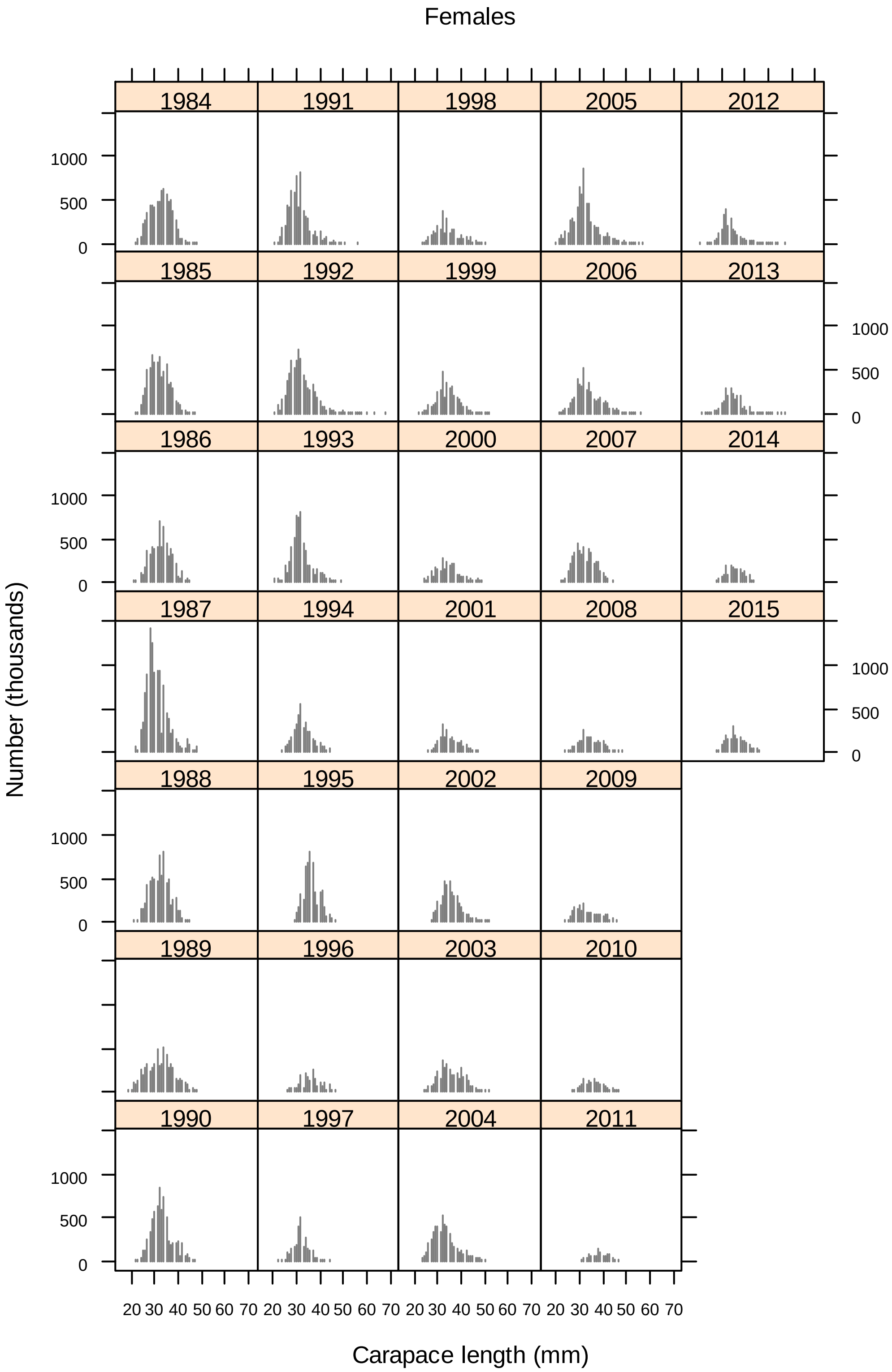


Figure 13.2.2.b. SW and S Portugal (FU 28–29) female length distributions for the period 1984–2015.

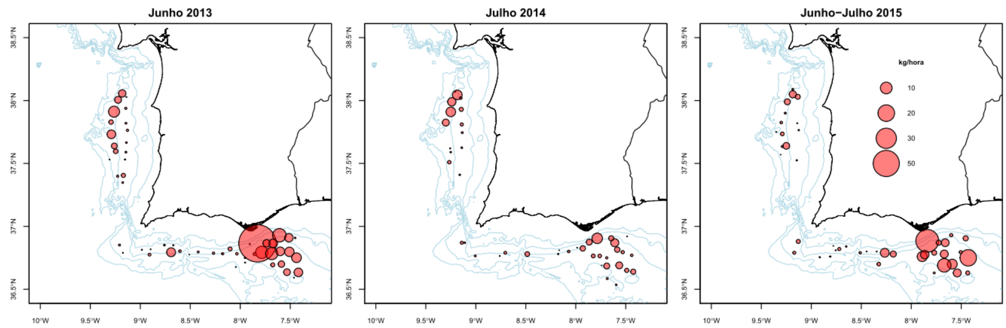


Figure 13.2.3. **Spatial distribution of *Nephrops* biomass survey index in the period 2013–2015.**

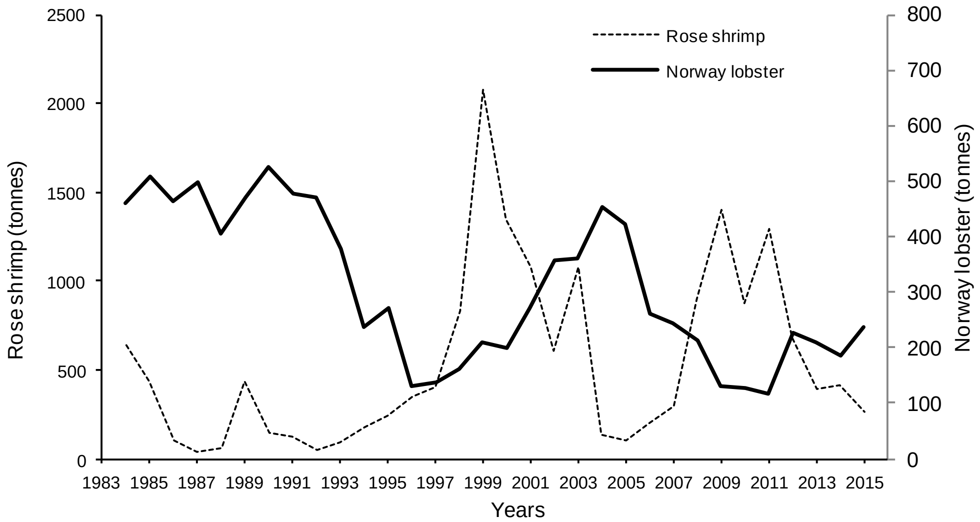


Figure 13.2.4 FUs 28-29: Landings of the two main target species of the Crustacean Fishery in the period 1984–2015.

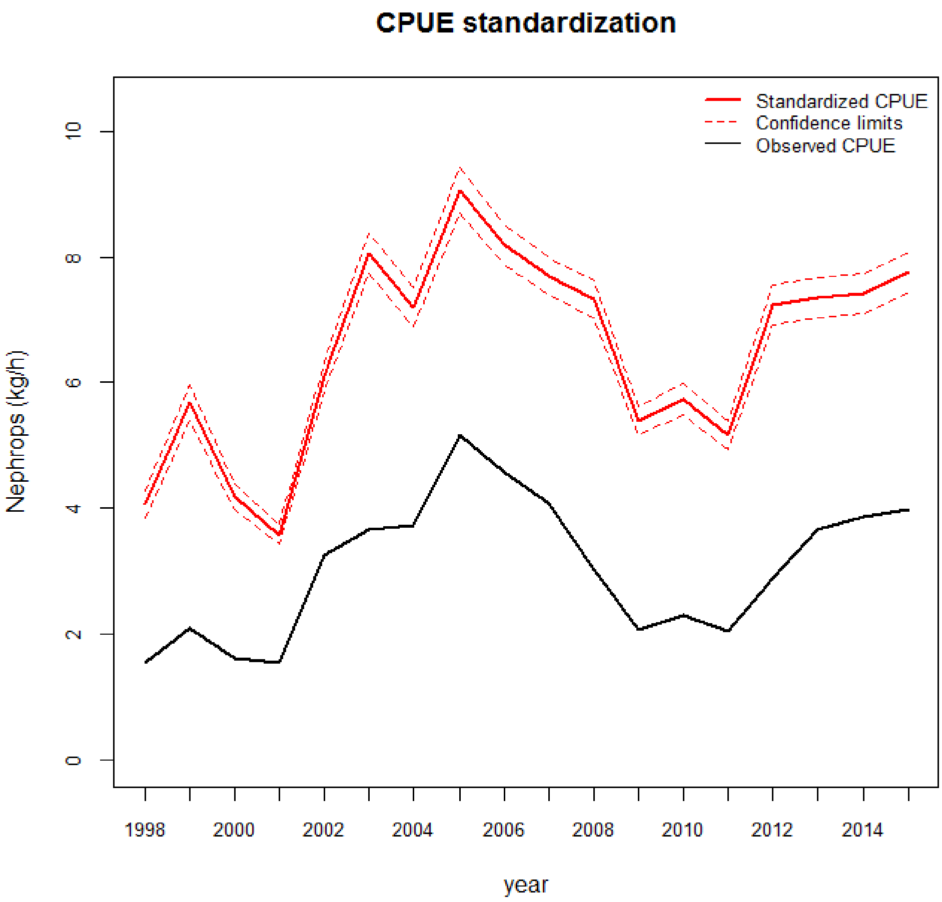


Figure 13.2.5. Comparison of standardized and observed *Nephrops* cpue.

13.3 *Nephrops* in FU 30 (Gulf of Cadiz)

13.3.1 General

13.3.1.1 Ecosystem aspects

See Annex L

13.3.1.2 Fishery description

See Annex L

13.3.1.3 ICES Advice for 2016 and Management applicable for 2015 and 2016

ICES Advice for 2016

The advice for these *Nephrops* stocks is biennial and valid for 2015 and 2016.

Based on the ICES precautionary approach, catches should be no more than 95 tonnes. All catches are assumed to be landed.

To protect the stock in this functional unit, ICES advises that management should be implemented at the functional unit level

Management applicable for 2015 and 2016

A recovery plan for southern hake and Iberian *Nephrops* stocks has been in force since the end of January 2006. The aim of the recovery plan is to rebuild the stocks within 10 years, with a reduction of 10% in F relative to the previous year and the TAC set accordingly (Council Regulation (EC) No. 2166/2005).

An increase of mesh size to 55 mm was established since September of 2009 (Orden ARM/2515/2009) for the bottom-trawl fleet.

The TAC set for the whole Division 9.a was 254 t for 2015 and 320 t for 2016, respectively, of which no more than 6 % may be taken in FUs 26 and 27. The maximum number of fishing days per vessel was fixed at 114 and 117 days for Spanish vessels and at 113 days for Portuguese vessels for these two years (Annex IIb of Council Regulations nos. 104/2015 and 72/2016). The number of fishing days included in these regulations is not applicable to the Gulf of Cadiz (FU 30), which has a different regime.

A modification of the Fishing Plan for the Gulf of Cadiz was established in 2014 (AAA/1710/2014). This new regulation establishes an assignation of the *Nephrops* quotas by vessel.

13.3.2 Data

13.3.2.1 Commercial catch and discard

Up to 2010, landings have been estimated by the WG based on IEO scientific estimations. The information was compiled by IEO from sale sheets and Owners Associations and the *Nephrops* landings allocation was carried out based on landing port criteria. Since 2011, the Spanish Authority for Fisheries (Secretaría General de Pesca, SGP) who is also the National Authority for the Data Collection Framework established a new policy and general approach in the provision of official data on catches and fishing effort. So, since 2011 *Nephrops* landings are official landings.

Unlike the IEO scientific estimates, official landings are derived from logbooks. This source of information allows the landings disaggregation by ICES statistical rectangles. In WGHMM 2013 it was noticed that some *Nephrops* catches were recorded into statistical rectangles outside the FU 30 definition. In 2012 and 2013, *Nephrops* catches recorded into statistical rectangles outside this FU were considered as part of the landings in FU 30. In 2014 Spanish landings of *Nephrops* have been uploaded to InterCatch broken down by ICES statistical rectangle for the first time according to the 2014 ICES Data Call requirements. However, only the landings recorded inside ICES statistical rectangles defined as FU 30 were uploaded to InterCatch, which correspond to 83.8% of 2014 landings (WD Nº 3 Castro, 2015). In 2015, all catches were into FU 30 definition.

Landings in this FU are reported by Spain and also minor quantities by Portugal. Since WGHMM in 2010, *Nephrops* landings in Ayamonte port were incorporated in the Gulf of Cadiz time-series of landings, as well as directed effort and LPUE from 2002 (Tables 13.3.1 and 13.3.4). *Nephrops* total landings in FU 30 decreased from 108 t in 1994 to 49 t in 1996. After that, there has been an increasing trend, reaching 307 t in 2003, dropping to 246 t in 2005-2006 (with the exception for the year 2004 when a decrease of more than 50% was observed). In the 2008-2012 periods, landings remained relatively stable around 100 t but decreased to 26 t in 2013. The reason for this drop is that the quota in 2012 was exceeded and the European Commission applied a sanction of 75.49 t to be paid in 3 years (in 2013-2015 period). So, the *Nephrops* fishery was closed in 2013 and vessels could only go fishing *Nephrops* a few days in summer and winter. Landings were 15 t and 25 t in 2014 and 2015, respectively. A modification of the regulation implemented for the Spanish Administration for the Gulf of Cadiz grounds in 2014 (Orden AAA/1710/2014) establishes the assignment of *Nephrops* quotas by vessel. These facts may have caused unreported *Nephrops* landings in two last years.

Information on discards was sent to the WG through Intercatch. The discarding rate of *Nephrops* in this fishery fluctuates annually but is always low or zero and the discards are considered negligible (Table 13.3.2). Figure 13.3.2 shows the estimated length frequency distributions of the discarded and retained *Nephrops* by trip for the annual discarding program.

13.3.2.2 Biological sampling

The sampling level for the species is given in Table 1.3.

Figure 13.3.3a and 13.3.3b show the annual landings length distribution for males, females and both sexes combined during the period 2001–2015. The length composition of landings is biased for the period 2001 to 2005 since the sampling of landings was not stratified by commercial categories (Silva *et al.*, 2006). A new sampling scheme was applied from 2006–2008 and the information was more reliable. The mean sizes for both sexes remained relatively stable after the sampling scheme was changed, around 29 mm CL for sexes combined.

Since 2009, onboard concurrent sampling is carried out, as required by the DCF (Reg. EC 1343/2007). Outside the *Nephrops* fishing season, a larger proportion of observer trips are likely to not cover *Nephrops* catches whereas when the directed *Nephrops* sampling were carried out in harbours in the past, the length distribution of landings were covered in all months. This fact could reduce the consistency of the length distribution of the catches. The number of monthly sampling in 2013 was probably influenced by the closure of *Nephrops* fishery.

Mean size of males and females in *Nephrops* landings in the period 2001–2015 are shown in Figure 13.3.1. The mean sizes show a slight increasing trend from 2006–2013

(35.3 mm CL in males and 31.9 mm CL in females). In 2014 and 2015, the mean size in females was highest than males the opposite of what it should be expected. It could be due problems in the sampling. This fact is being investigated in collaboration with the observed. The number of sampling and the number of individuals sampled is low and they could distort the sex-ratio and the mean size in both sexes. The sampling effort should be increased to improve the quality of the commercial length distributions.

13.3.2.3 Abundance indices from surveys

The biomass and the abundance indices of *Nephrops* by depth strata, estimated from the Spanish bottom-trawl spring surveys (SPGF-cspr-WIBTS-Q1) carried out from 1993 to 2014 are shown in Table 13.3.3.

Two different periods can be observed in the time-series. From 1993–1998 the overall abundance index trend was decreasing, while from 1998–2009 the index has remained stable although fluctuating widely in some years, except in 2004, which value was the lowest value in the time-series. In 2010 the deeper strata (500–700 m) were not sampled due to a reduction in number of the survey the days, as a consequence of adverse weather conditions. Therefore, only the abundance index for the strata 200-500 m is available for 2010 (Table 13.3.3) and its value is similar to the corresponding strata in previous year. The abundance index was lower in 2011 and 2012 but it increased strongly in 2013 and 2014 (Table 13.3.3). A decline of the survey index was observed in 2015. In this WG, the survey index in 2016 is presented too. The survey abundance index shows an increasing trend since 2012 suggesting that the *Nephrops* abundance stock is not in bad conditions (Figure 13.3.4). This survey is not specifically directed to *Nephrops* and is not carried out during the main *Nephrops* fishing season but it shows a similar trend to the commercial LPUE in the time-series except from 2014 and 2015.

The length distributions of *Nephrops* obtained in the Spanish bottom-trawl spring surveys (SPGF-cspr-WIBTS-Q1) during the period 2001–2015 are presented in Figure 13.3.5a and Figure 13.3.5b. The time-series of *Nephrops* mean sizes for males, females and combined sexes obtained in these surveys are shown in Figure 13.3.6. No apparent trends are observed. The mean size ranged in 2015 was 32.2 mm carapace length for males and 27.8 for females.

An exploratory *Nephrops* UWTV survey on the Gulf of Cadiz fishing grounds was carried out in 2014 within the framework of a project supported by Biodiversity Foundation (Spanish Ministry of Agriculture, Food and Environment) and European Fisheries Fund (EFF) (Vila et al., 2014). Currently, two UWTV surveys are available (2014 and 2015) and the next UWTV survey in FU30 will be carried out in June 2016. UWTV surveys results will be exploited in the Benchmark Workshop on *Nephrops* Stocks (WKNEP) planned for October 2016.

13.3.2.4 Commercial catch– Effort data

Figure 13.3.1 and Table 13.3.4 show directed *Nephrops* effort estimates and LPUE series modified after the incorporation of data from Ayamonte port since 2002.

The directed fishing effort trend is clearly increasing from 1994–2005, where the highest value of the time-series was recorded (4336 fishing days). After that, the effort declined to 2008 (73%) remaining relatively stable during the 2008–2012 period. The closure of the *Nephrops* fishery resulted in a decrease of the fishing effort in 2013 (262 fishing days). In 2014 and 2015 fishing effort slightly increased in relation to the previous year but remained at low level (294 fishing days) (Figure 13.3.1).

LPUE obtained from the directed effort shows a gradual decrease from 1994 to 1998. After 1998, the trend slightly increases until 2003. In 2004, the LPUE decreases to the lowest value recorded (44.3 Kg/fishing day). LPUE then increased until 2008 around 60%. Since 2008 LPUE have declined to 50 Kg/fishing day in 2009 and 45.5 Kg/fishing day in 2010 (about 30% less with respect to 2008). Since 2010, LPUE shows an increasing trend with a high rise in 2013. In 2014, LPUE drop but increased again in 2015 (Figure 13.3.1). LPUE in 2013 must be taken with caution as it does not cover the whole year due of the closure of the *Nephrops* fishery the most part of the year which increases the uncertainty associated with the LPUE index. Moreover, the assignment of *Nephrops* quotas by vessel implemented in 2014 might have caused unreported landings and to contribute to the increases the uncertainty of the commercial index in 2014 and 2015.

The overall LPUE trend is quite similar to the abundance survey index in the stratum of 200–700 m from 1996–2013 (no survey was carried out in 2003) despite the survey index have fluctuated in some years (Figure 13.3.4). The lowest values were detected in 2004 in both series. In 2008, the abundance survey index was well above the commercial LPUE, however, the abundance index drop in 2009 agrees with the commercial LPUE. This fact may be explained by the increase of the rose shrimp abundance in 2008. The increased abundance of rose shrimp is believed to have led to a change in the objectives of the fishery, as rose shrimp achieves a higher market value and its fishing grounds, shallower (90–380 m) and closer to the coast. In 2014 and 2015 LPUE index and abundance survey index show two different signals probably due to the special situation after the penalty in 2012. The LPUE decreasing while the survey index is increasing in 2014 but the values in both indices are inverse in 2015 (Figure 13.3.5).

13.3.3 Assessment

According to the ICES data-limited approach, this stock is considered as category 3.2.0 (ICES, 2012). FU 30 is assessed by the analysis of the LPUE series trend, as was done in 2014. The update of the commercial directed *Nephrops* LPUE series shows an increase in relation to the previous year. .The survey abundance index indicates an increasing trend since 2012 if the index in 2016 presented in this WG is taken into account.

13.3.4 Biological reference points

Proxies of MSY reference points were defined using the methods developed in WKLIFE and WKProxy (ICES, 2015, 2016d). $F_{0.1}$, taken as proxy of F_{MSY}, from length–based analysis for the period 1994–2014 was 0.36 for males and 0.63 for females but the value of MSY $B_{trigger}$ proxy is not available.

13.3.5 Management considerations

Nephrops fishery is taken in mixed bottom-trawl fisheries; therefore HCRs applied to other species will affect this stock.

In 2013 and 2014, *Nephrops* fishery was closed the most part of the year because the quota in 2012 was exceeded and a sanction for the European Commission to be paid in 3 years was applied.

A Recovery Plan for the Iberian stocks of hake and *Nephrops* was approved in December 2005 (CE 2166/2005). This recovery plan includes a reduction of 10% in F relative to the previous year and TAC set accordingly, within the limits of ± 15% of the previous year TAC. By derogation, a different method of effort management method is applied to the Gulf of Cadiz.

Different Fishing Plans for the Gulf of Cadiz have been established by the Spanish Administration since 2004 in order to reduce the fishing effort of the bottom-trawl fleet (ORDENES APA/3423/2004, APA/2858/2005, APA/2883/2006, APA/2801/2007, ARM/2515/2009, ARM/58/2010, ARM/2457/2010; AAA/627/2013). Last plan continue establishing a closed fishing season to 45 days, between September and November, plus 5 additional days to be selected by the ship owner during the duration of this Plan. The potential effect of the closed seasons on the *Nephrops* population has not been evaluated. Additionally, an increase of mesh size to 55 mm or more was implemented at the end of 2009 in order to reduce discards of individuals below the minimum landing size. In 2014, a modification of last Fishing Plan for the Gulf of Cadiz was established (AAA/1710/2014). This new regulation establishes an assignation of the *Nephrops* quotas by vessel.

Regulations were established by the Regional Administration with the aim of distributing the fishing effort throughout the year (Resolutions: 13th February 2008, BOJA nº 40; 16th February 2009, BOJA nº 36; 23th November 2009, BOJA nº 235; 15th October 2010, BOJA nº 209). These regional regulations controlled the days and time when the Gulf of Cadiz bottom-trawl fleet can enter or leave fishing ports. Although the regulations varied among them, they generally allowed a large flexibility during late spring and summer (*e.g.* the 2010 Regulation established a continuous period from Monday 3 am to Thursday 9 pm during May-August, that was implemented in 2011), which is the main *Nephrops* fishing season, with more restricted time period in other months. This flexibility in summer might have induced fleets from the ports closer to *Nephrops* grounds, such as Ayamonte or Isla Cristina, to direct their fishing effort to this species between 2008 and 2011. Currently, this regulation is not implemented.

Table 13.3.1. ***Nephrops*** **FU30, Gulf of Cadiz: Landings in tonnes.**

Year	Spain**	Portugal	Total
1994	108		108
1995	131		131
1996	49		49
1997	97		97
1998	85		85
1999	120		120
2000	129		129
2001	178		178
2002	262		262
2003	303	4	307
2004	143	4	147
2005	243	3	246
2006	242	4	246
2007	211	4	215
2008	117	3	120
2009	117	2	119
2010	106	1	107
2011	93	3	96
2012	115	1	116
2013	26	<1	27
2014	14	<1	15
2015	25	<1	25

** Ayamonte landings are included since 2002

Table 13.3.2. ***Nephrops*** **FU30, Gulf of Cadiz: Mean carapace length of the discarded and retained fraction of** ***Nephrops*****, and percentage of discarded (2005-2015) for the annual discarding program.**

	MEAN CARAPACE LENGTH (mm)		% DISCARDED	
	Discarded fraction	Retained fraction	Weight	Number
2005	23.4	33.5	5.2	15.2
2006	20.5	29.4	4.6	11.8
2007	23.2	33.7	0.5	1.4
2008	20.8	35.2	2.5	7.7
2009	21.2	30.2	2.7	4.0
2010	21.9	31.7	1.3	4.5
2011	-	32.7	0.0	0.0
2012	-	32.6	0.0	0.0
2013	23.9	32.7	3.7	10.9
2014	-	34.5	0.0	0.0
2015	21.2	33.6	2.0	5.4

Table 13.3.3. ***Nephrops*** **FU30, Gulf of Cadiz. Abundance index from Spanish bottom-trawl spring surveys (SPGFS-cspr-WIBTS-Q1).**

Spanish bottom trawl spring surveys						
	200-500 meters		500-700 meters		200-700 meters	
Year	Kg/60'	Nb/60'	Kg/60'	Nb/60'	Kg/60'	Nb/60'
1993	0.77	19	1.16	34	0.95	26
1994	1.23	31	0.60	8	0.94	21
1995	0.55	8	**	**	na	na
1996	0.56	10	1.33	29	0.93	19
1997	0.08	2	0.70	23	0.38	12
1998	0.40	16	0.23	7	0.30	11
1999	0.50	15	0.28	7	0.41	12
2000	0.22	7	0.57	15	0.37	10
2001	0.32	8	0.61	14	0.44	11
2002	0.49	17	0.45	11	0.47	14
2003	ns	ns	ns	ns	ns	ns
2004	0.15	5	0.15	4	0.15	5
2005	0.54	18	0.76	25	0.64	21
2006	0.24	6	0.66	20	0.42	12
2007	0.44	16	0.23	9	0.35	13
2008	0.88	26	0.81	14	0.85	20
2009	0.64	18	0.30	4	0.37	9
2010	0.63	20	**	**	na	na
2011	0.35	11	0.08	2	0.23	7
2012	0.15	4	0.22	4	0.18	4
2013	0.36	13	1.39	51	0.79	29
2014	2.97	84	0.50	9	1.92	52
2015	1.04	45	1.58	52	1.27	48
2016	4.3	194	0.50	15	2.73	118

ns = no survey

**= no sampled

2016*=Provisional data

Table 13.3.4. ***Nephrops*** **FU30, Gulf of Cádiz. Total landings and landings, LPUE and effort at the bottom-trawl fleet making fishing trips with at least 10%** ***Nephrops*** **catches.**

Year	**Total landings (t)	*Landings (t)	*LPUE (kg/day)	*Effort (Fishing days)
1994	108	90	98.6	915
1995	131	107	99.4	1079
1996	49	40	88.2	458
1997	97	75	79.2	943
1998	85	51	62.3	811
1999	120	83	66.2	1259
2000	129	90	60.6	1484
2001	178	130	67.7	1924
2002	262	196	69.4	2827
2003	307	214	75.4	2840
2004	147	98	44.3	2206
2005	246	228	52.7	4336
2006	246	227	64.0	3555
2007	215	198	63.7	3105
2008	120	84	72.9	1150
2009	119	83	50.0	1653
2010	107	73	45.5	1603
2011	97	62	54.6	1135
2012	116	80	58.0	1380
2013	27	24	92.1	262
2014	15	12	40.1	293
2015	25	17	58.8	294

*Landings, LPUE and fishing effort from fishing trips with at least 10% *Nephrops* .

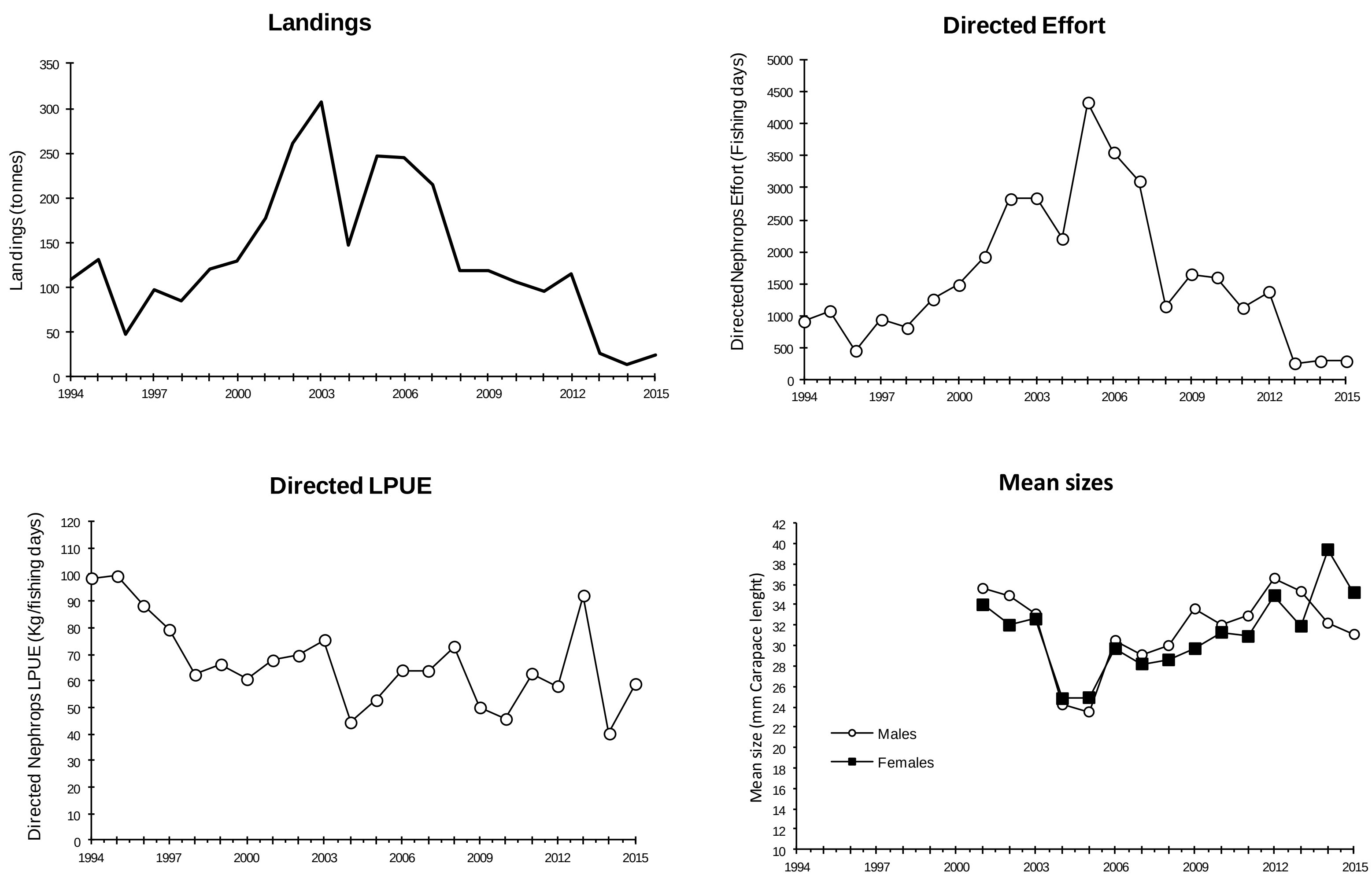


Figure 13.3.1. ***Nephrops*** **FU 30, Gulf of Cádiz. Long-term trends in landings,** ***Nephrops*** **directed effort and LPUE and mean sizes.**

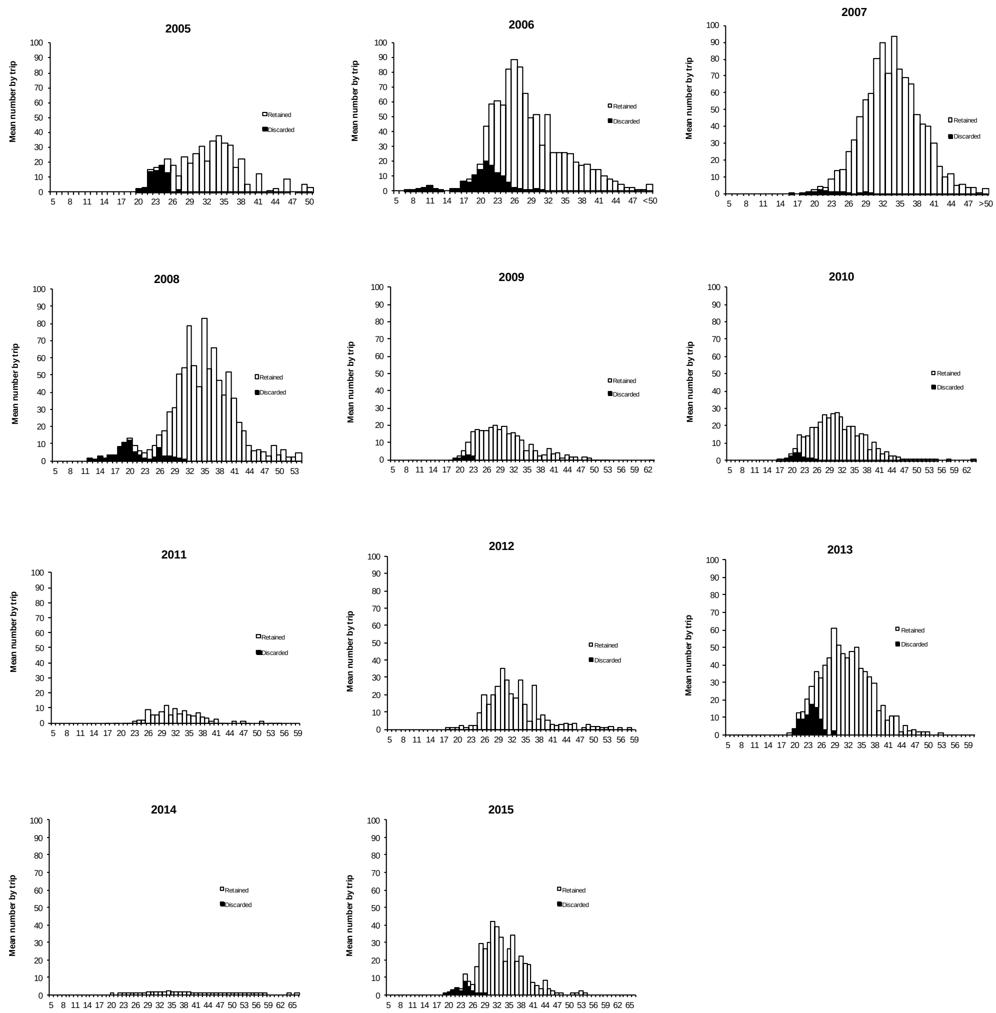


Figure 13.3.2. *Nephrops* FU 30, Gulf of Cadiz. Length distribution of retained and discarded fractions *Nephrops* from discards program (2005–2015 period).

Males Females Combined

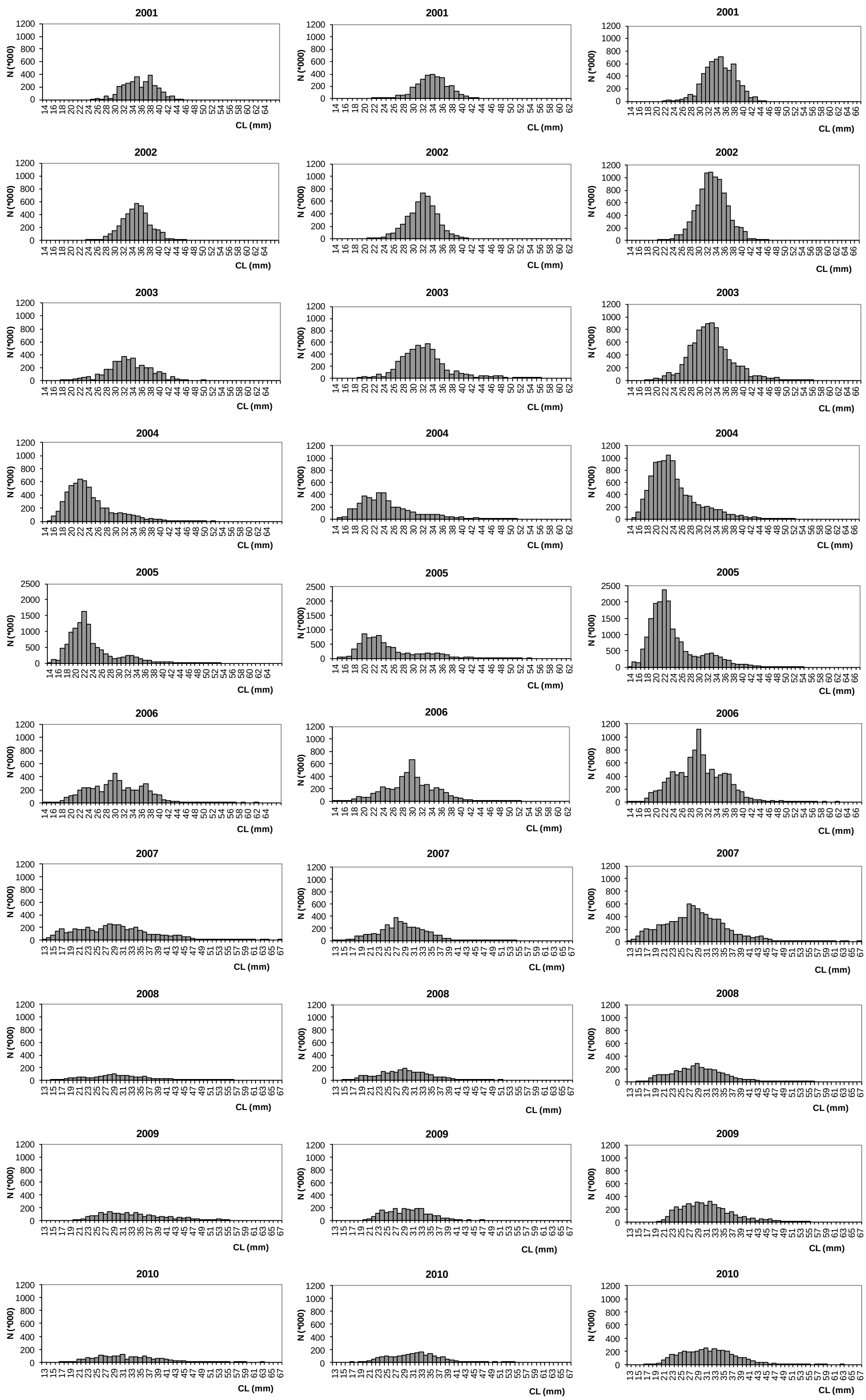


Figure 13.3.3a. *Nephrops* FU30, Gulf of Cádiz. Length distributions of landings for the period 2001–2010.

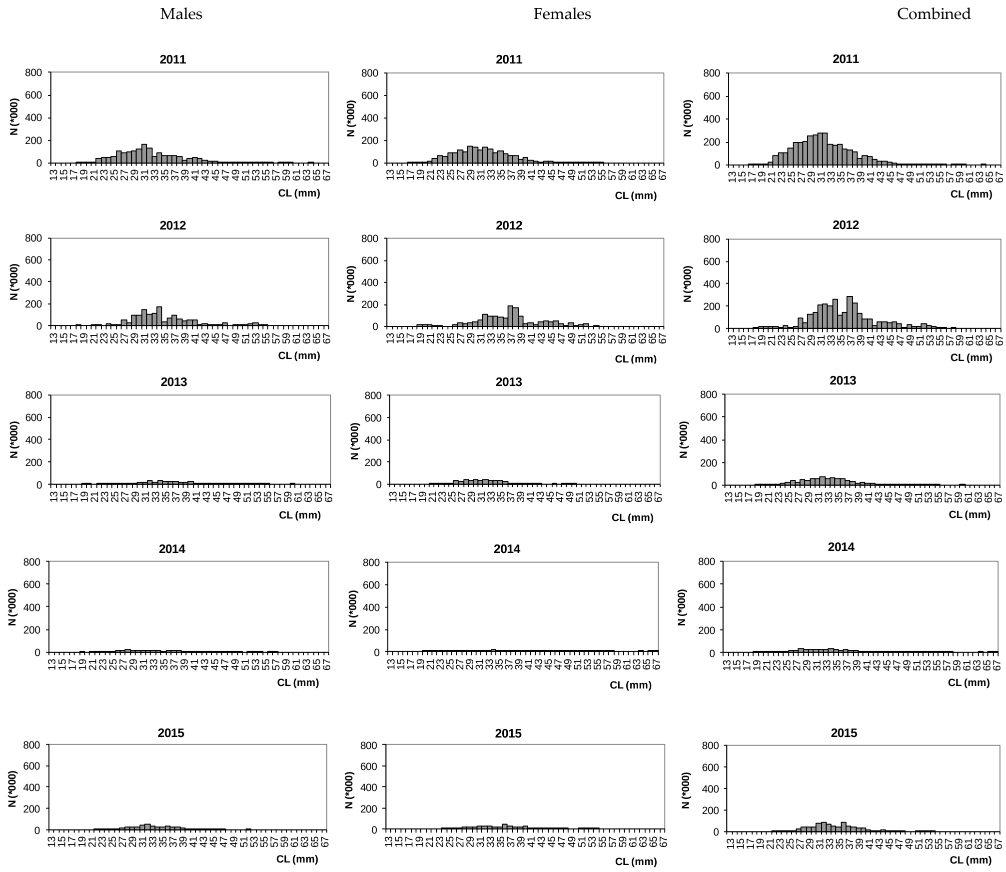
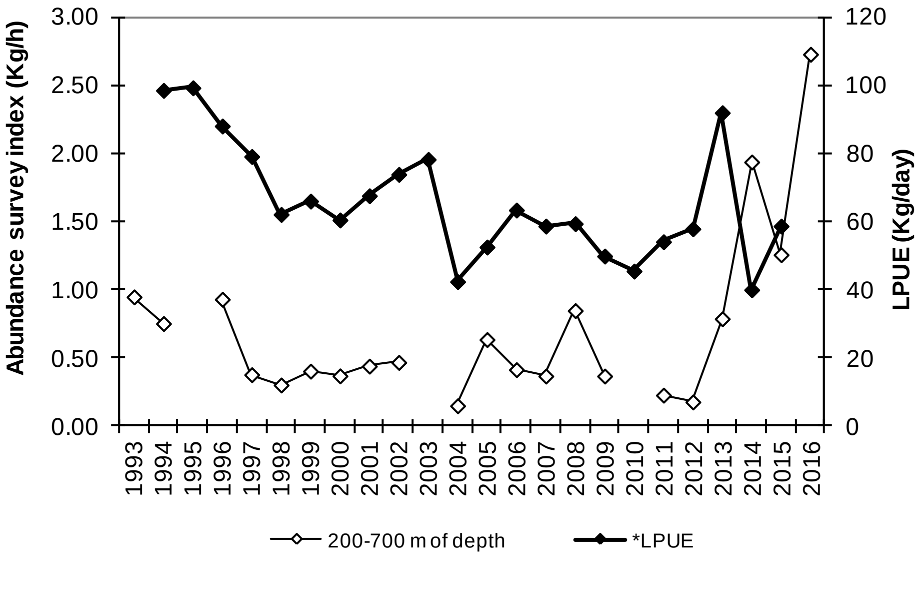


Figure 13.3.3b. *Nephrops* FU30, Gulf of Cadiz. Length distributions of landings for the period 2011–2015.



* 1995 and 2010: strata 500-700 m no sampled

** 2003: no survey

Figure 13.3.4. *Nephrops* FU30, Gulf of Cádiz, Abundance index from Spanish bottom-trawl spring surveys (SPGFS-cspr-WIBT-Q1) and commercial directed *Nephrops* LPUE from the bottom-trawl fleet.

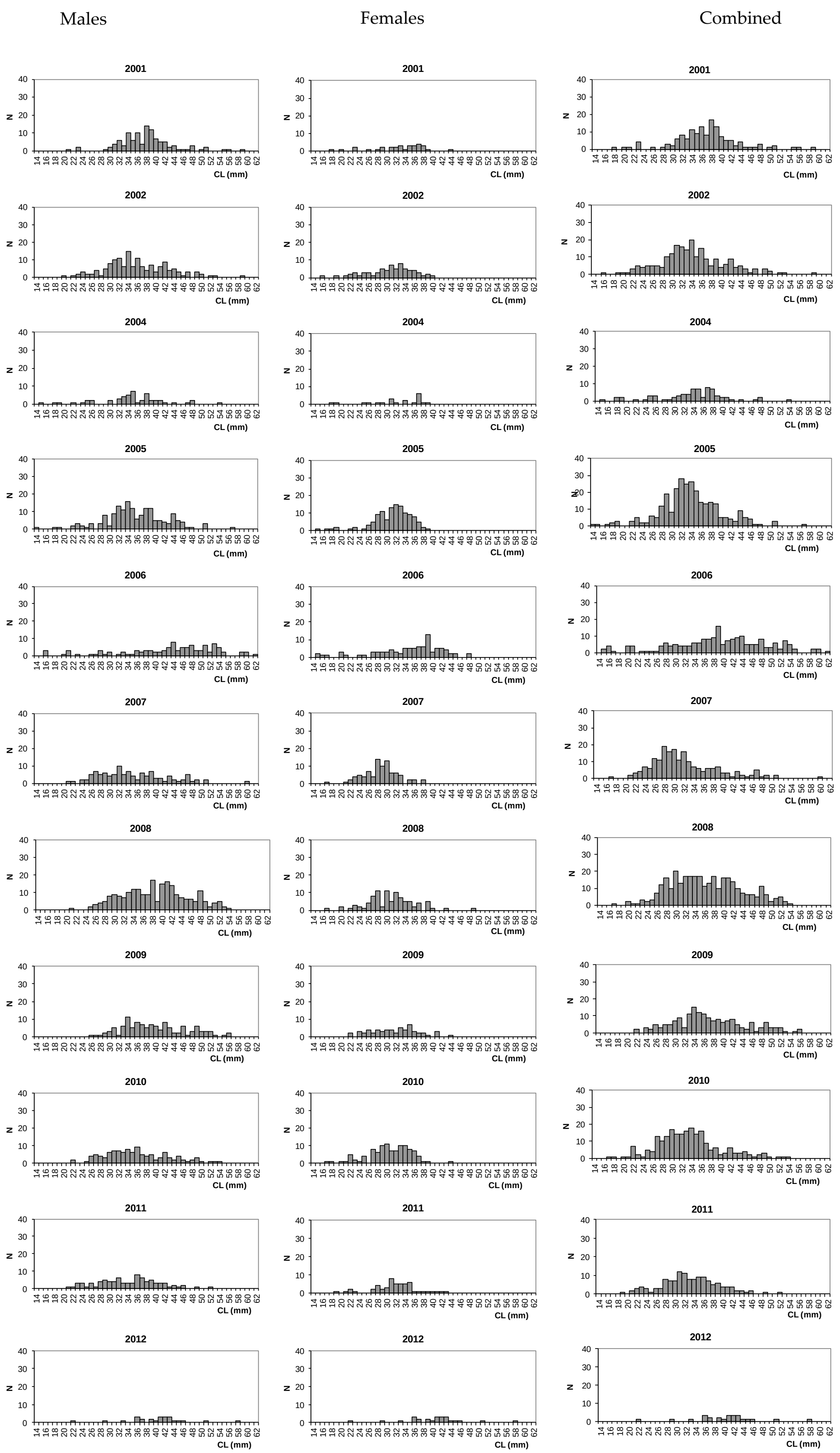


Figure 13.3.5a. ***Nephrops*** **FU30, Gulf of Cádiz. Length distributions from Spanish bottom-trawl surveys (SPGFS-cspr-WIBTS-Q1) for 2001–2012 period.**

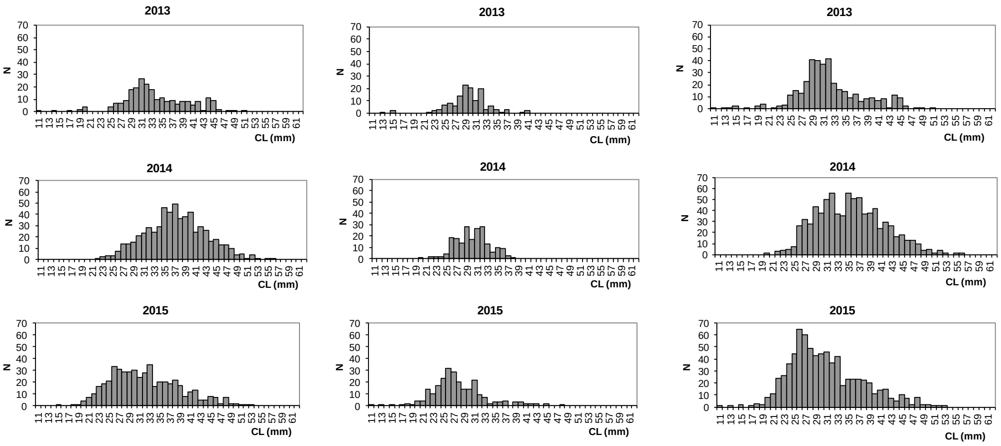


Figure 13.3.5b. ***Nephrops*** **FU30, Gulf of Cádiz. Length distributions from Spanish bottom-trawl surveys (SPGFS-cspr-WIBTS-Q1) for 2013–2015 period.**

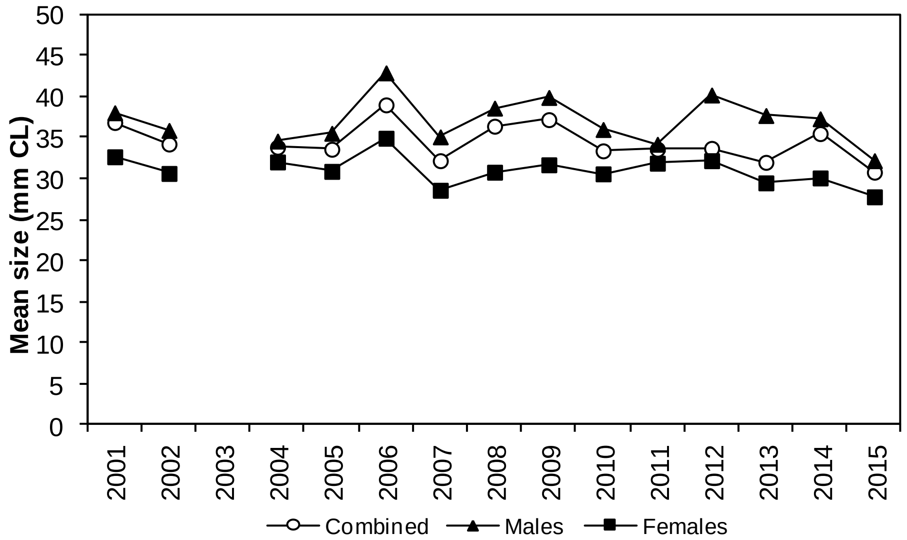


Figure 13.3.6. ***Nephrops*** **FU30, Gulf of Cádiz. Mean size in spring bottom-trawl surveys (SPGFS-cspr-WIBTS-Q1) for the period 2001–2015.**

14 Sea bass (*Dicentrarchus labrax)* in Division 8.a,b (European sea bass)

14.1 ICES advice applicable to 2016 (June 2015)

ICES advises that when the precautionary approach is applied, commercial catches should be no more than 2634 tonnes in each of the years 2016 and 2017.All commercial catches are assumed to be landed. Recreational catches cannot be quantified; therefore, total catches cannot be calculated […]".

14.2 General

14.2.1 Stock ID and substock structure

Bass *Dicentrarchus labrax* is a widely distributed species in Northeast Atlantic shelf waters with a range from southern Norway, through the North Sea, the Irish Sea, the Bay of Biscay, the Mediterranean and the Black Sea to Northwest Africa. The species is at the northern limits of its range around the British Isles and southern Scandinavia. Stock identity of European sea bass was reviewed by WGNEW 2012 and further considered at ICES IBP-NEW 2012. The other stock units defined for sea bass are: west of Scotland and Ireland (6.a and 7.b,j); 4.b,c + 7.a,d–h; 8.a,b and the more southerly population in 8.c 9.a (Figure 14–1). The IBP New 2012 reports that it is clear that further studies are needed on sea bass stock identity, using conventional and electronic tagging, genetics and other individual and population markers (e.g. otolith microchemistry and shape), together with data on spawning distribution, larval transport and VMS data for vessels tracking migrating sea bass shoals, to confirm and quantify the exchange rate of sea bass between sea areas that could form management units for this stock. In the absence of new information the pragmatic view of WGBIE2016 is to continue to assume the presence of discreete sea bass stocks off southern Ireland and in the Bay of Biscay (8.a,b) and Iberian waters (8.c, 9.a).

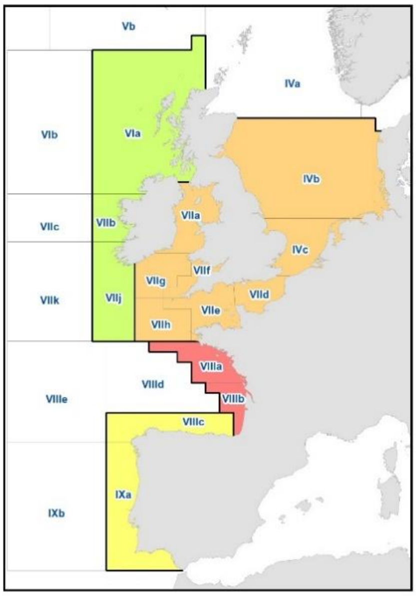


Figure 14-1 : stock sea bass units defined at ICES (IBP new 2012)

14.2.2 Management applicable to 2015

Sea bass are not subject to EU TACs and quotas. Under EU regulation, the minimum landing size (MLS) of bass in the Northeast Atlantic is 36 cm total length, a variety of national restrictions on commercial bass fishing are also in place. These include:

- An historical landings limit of 5 t/boat/week for French and UK trawlers landing bass (which was 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].
- A licensing system from 2012 in France for commercial gears targeting sea bass in order to fix the level of the French commercial fishery (1)
- A MLS of 42 cm for the French recreational fisheries has been implemented in 2013 (French association of anglers)
- A Voluntary closed season from February to mid-March for longline and handline bass fisheries in Brittany, France;

14.2.3 Management applicable to 2016

No new management plan is known at present in the Bay of Biscay. For information in 4.b,c and 7.a,d–h (North Sea, Channel, Celtic Sea and Irish Sea) the European Council has adopted measures to help sea bass recover (Recent scientific analyses have reinforced previous concerns about the state of the stock and advised urgently to reduce fishing by 80%). Effective emergency measures in January 2015 placed a ban on targeting the fish stock by pair-trawling while it is reproducing, during the spawning season, which runs until the end of April 2015.; a 3–fish bag limit for recreational fishers; a monthly catch limit (1.5t for pelagic trawlers; 1.8t for bottom trawlers; 1t for driftnets; 1.3t for liners; 3t for purse-seiners) and an increase in the minimum size of northern sea bass : 36cm to 42 cm from July 2015 (source : http://ec.europa.eu/fisheries/cfp/fishing_rules/sea bass/index_en.htm).Measures were completed in 2016, banning landings depending on gears and months (Figure 14-2) .

[1]www.comite-peches.fr/wp-content/uploads/B17-2015_Bar-Cadre1.pdf

2016 measures	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Bottom trawlers	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	1 t	1 t	1 t	1 t	1 t	1 t
Seiners	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	1 t	1 t	1 t	1 t	1 t	1 t
Pelagic trawlers	X	X	X	X	X	X	1 t	1 t	1 t	1 t	1 t	1 t
Drift Gillnets	X	X	X	X	X	X	1 t	1 t	1 t	1 t	1 t	1 t
Hooks	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t
Lines	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t
Set Gillnets	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t

Figure 14-2 : summary of the 2016 measures adopted by EC for Sea bass in 4.b,c and 7.a, d–h (North Sea, Channel, Celtic Sea and Irish Sea)

14.3 Fisheries data

14.3.1 Commercial landings data

Sea bass in the Bay of Biscay, are targeted by France (more than 96% of international landings in 2015) by line fisheries, nets (mainly from November to April on prespawning and spawning grounds when sea bass is aggregated), pelagic trawlers, and in a mixed bottom-trawl fisheries. In 2015 nets represent 35% of the landings of the area, lines (handlines+longlines) 26%, bottom trawl 16%, and pelagic trawl 8% (but It has to be note that pelagic trawlers were used from 2000–2008 to catch around 25% of the landings of the area decreasing to 9 (the pelagic fishery take place at present essentially in the Channel before 2015).

A high increase in the French landings for the net fishery is observed from 2011. An average of 585 tons during the period 2000–2012 is landed. In 2013, 834 tons have been landed, and 1131 tons in 2014. The main reason is the decrease of sole quotas from 2011 and an effort report on sea bass which become more targeted during the spawning season in winter, combined with good weather condition in 2014 and an increase in fishing technicality. In 2015 a decrease in landings for all gear (except purse-seiners) is observed. French landings by métier are presented in Figure 14–3

Spain is responsible for 3% of the catches of the area (8.b essentially) in 2015, mainly with bottom trawlers. Spanish bass landings from Division 8.a,b,d have increased to around 20 tons in the 90's to around 150 tons in the middle of the 2000's, then a peak to 317 tons in 2011. 71 tons have been landed in 2015.

Table 14–1 presents official and Ices commercial landings.

14.3.2 Length compositions: commercial landings

Error! Reference source not found. gives fleet-raised length compositions for all rench gears (2015 provisional)

14.3.3 Commercial discards

14.3.3.1 France

Discarding of sea bass by commercial fisheries can occur where fishing takes place in areas with bass smaller than the minimum landing size (36cm in most European countries), and where mesh sizes <100mm are in use. For 2009 it's estimated to be 44 tons, for 2010, 20 tons for 2011, 37 tons for 2012 68 tons for 2013

Discarding is thought to be low In 2014, very small number of sebass have been sampled (160 fish have been measured at sea in 2014, 65% for bottom trawlers, 28% for nets and 7% longlines and handlines).

In 2015 numbers of fish sampled is the same than in 2014 (163). This may indicate discarding is low in the area. Estimates of discarding is 69 tonnes for 2015 (3% of discarding for the whole fishery)

14.3.3.2 Spain

Observer data from Spanish vessels fishing in Areas 8, have shown there was no sea bass discard from 2003. No information in 2015 were available on discards for WGBIE.

14.3.4 Recreational catches

Recreational marine fishery surveys in Europe are still at an early stage in development (ICES WGRFS 2012). A French study targeting sea bass was conducted between 2009 and 2011 in 8.a, 8.b, 7e, 7h, 7d, 4c. Estimates of sea bass catches were obtained from a panel of 121 recreational fishers recruited during a random digit dialling screening survey of 15 000 households in the targeted districts (Atlantic and Chanel). The estimated recreational catch of bass in the Bay of Biscay and in the Channel was 3,170t of which 2,350t was kept and 830t released. The precision of the combined Biscay & Channel estimate is relatively low (CV =-26%; note that the figure of 51% given in IBP-NEW 2012 was incorrect). This makes the confidence interval at 95% of the average (3170t) to [1554t; 4786t].

14.3.5 Abundance Indices

No pre and post-recruit surveys are available for the area. In 2015 a study "French Logbook data analysis 2000–2013: possible contribution to the discussion of the sea bass stock(s) structure/annual abundance indices. Alain Laurec, M.Drogou" has been conducted and presented in a Working Document (reference: WD_12).

14.4 Assessment

In 2015 WGBIE proposed to upgrade stock 8.a,b from category 5 to category 3.2

14.4.1 Annual indices of abundance

The working document (A.Laurec; M.Drogou 2015) has been presented to WGBIE 2015. Annual indices of abundance have been assessed by the group. The assessment is also based on the analysis of lpues and total catches. The method uses a multiplicative model with a vessel effect (hull x gear group) and a stratum effect (area*month*year) A logarithmic transformation (in practice decimal logarithms are used) is provided, which excludes using zero catches, which transforms the multiplicative model in an additive model. The vessel effect (in the multiplicative model "not transformed”) is the relative fishing power, with a geometric mean of all the boats being forced to 1. The strata effects is reduced in apparent abundance expressed as landings by effort unit of a medium vessel, with zero logarithmic power and untransformed power. The adjustment is done by minimizing the sum of squared deviations, (logarithms), between predicted values (log10 of fishing power of a vessel + log10 of apparent abundance in the stratum) and observed value (log of capture/effort). It is possible to use not just the sum of squared deviations, but the sum of the weighted deviations for each data given by the effort.

The apparent abundances correspond to the daily landings of an average standard vessel (effort data in hours not enough accurate in logbooks)

The software uses a suitable algorithm, which, in contrast to common linearizable models adjustment, avoid to have to invert a matrix, and is therefore much faster. It thus offers much more limited computing time, which is very useful when processing large amounts of data, and / or when bootstrap techniques are used. Moreover the software used includes a possible data selection in order to conduct the analysis by eliminating (i) some individual vessels and/or some gears and (ii) some geographical areas or some periods.

14.4.1.1 Calculation updated of commercial catch advice from WGBIE 2016

During WGBIE 2015, “old” index was calculated from July to June in order to take into account the whole spawning season (December–March). This lead to some issues to compare it to landings given in a calendar year. For WGBIE 2016, indices («new Index) have been re-evaluated from January to December in order to be consistent with landings. Trends are the same (Figure 14–3 and Table 14–3). After an increase observed during last decade, 2015 shows a stabilization.

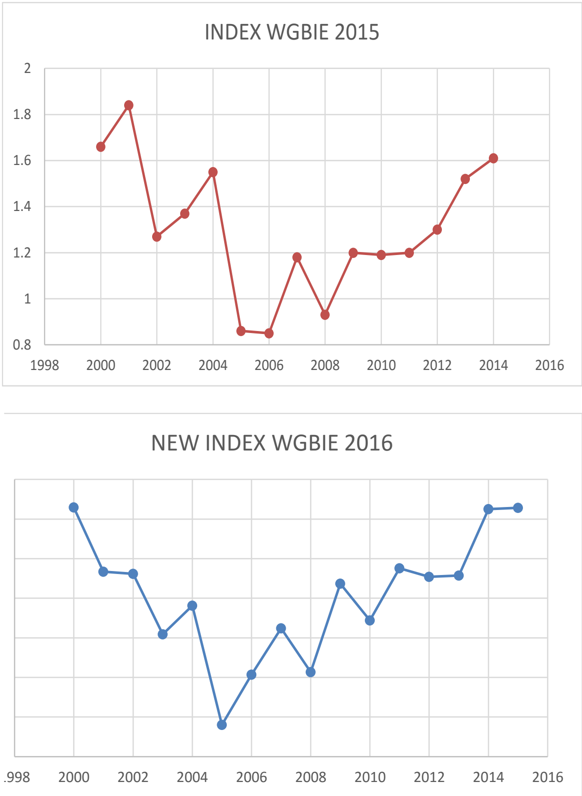


Figure 14-3 : Comparison between "old" Index provided for WGBIE 2015 and "new" Index provided for WGBIE 2016.

14.4.2 Calculation history used for commercial catch advice (details in SA)

14.4.2.1 Calculation of commercial catch advice from WGBIE 2015

For data-limited stocks for which a biomass index is available, ICES uses a harvest control rule based on an index-adjusted status quo catch. The draft advice in 2015 was based on a comparison of the 3 most recent biomass index values with the 4 preceding values, combined with recent catch or landings data (the 3:4 rule)

Any visual check of apparent abundance time-series reveals the combination of a strong seasonal effect, a multiannual trend and apparent added noise. The strongest seasonal effect corresponds to what will be interpreted as spawning migrations and concentrations which take place in late autumn and winter.

During WGBIE 2015, it has been decided not to use the usual calendar year from January to December, but a 12 months period from July to the following June month, the apparent abundance being for most squares low in June-July, without major changes between June and the following July month. Nerveless the analysis has also been carried out using the basic calendar year on a dataseries from 2000–2013. It led to the same seasonal patterns which are simply more difficult to follow between December and January, when the main part of the landings are taken (which corresponds to the spawning season in the Bay of Biscay).

The Working Group decided to retain the seasonal LPUE index as each yearly index fully covers the spawning season (December to March) when the main fishery occurs.

For calculating catch option, mean of landings from 2007–2013 has been calculated. A large period has been retained because of the sea bass long life duration (up to 28 years). For Sea bass the biomass is estimated to have increased by more than 30% between the periods 2008–2011 (average of the 4 years) and 2012–2013 (average of the 3 years). This implies an increase in landings of at most 20%. When the uncertainty cap in relation to the average landings of the last 7 years (2007–2013) is applied, this corresponds to landings in 2016 of no more than 3 037t. Considering that landings in the net fisheries has increased significantly (the bulk of the net fishery historically targets sole and to a lesser extent sea bass but reports effort on sea bass increasing after the decrease of the sole quota from 2012), an additional precautionary action is needed. This would lead to landings of no more than 2437t. The 3:4 Rule was applied based on:

1) High longevity of sea bass (up to 28 years' old)
2) Landings in 2014 were very high (exceptional year due to very good weather condition for netters which take the bulk of the landings during spawning season)

14.4.2.2 Calculation of commercial catch advice from ADG (final Advice 2015)

Following ADG, the 2:3 Rule was finally applied to produce the sea bass advice 2015. The latest Ices advice is also based on a comparison of the two latest index values (index A) with the three preceding values (index B), multiplied by the recent average landings. The index is estimated to have increased by more than 20% and thus the uncertainty cap was applied. The stock status relative to candidate reference points is unknown. Therefore, the precautionary buffer was applied to the advice.

14.4.2.3 Calculation of commercial catch advice from ADG technical notes (June 2015)

"It has been shown that the 2:3 rule has some flaws. An alternative that has been floating on the fringes of the DLS approach is the F_{proxy} approach. Given a biomass index and the catches one can calculate the historical F_{proxy} as

$$_{proxy}F_y = \frac{Y_y}{U_y}$$

Know the question becomes what would be a reasonable advisory F_{proxy}. In the 2:3 world the most recent F_{proxy} is used implicitly. With a potential considering of adding a 20% uncertainty buffer. Results are presented below in Table 14-1

Table 14-1 : Commercial catch advice calculated from Technical notes

Base : WGBIE 2015. Reviewed with Technical Notes with old Index			
YEAR	LANDINGS	INDEX	Fproxy (Landings/Index)
2012	2.546	1.3	1.96
2013	2.685	1.52	1.77
2014	2.991	1.61	1.86
Mean Fproxy 2012-2014		Fproxy_mean	1.86
20% uncertainty buffer (reducing)		Fproxy_mean*0.8 (1)	1.49
2014 Index (2)			1.61
TAC2016 = (1)*(2)			2399

14.4.2.4 Various scenarios for commercial catch advice with various option

Table 14-2 summarizes commercial catch advice resulting from various option, including the use of the new Index.

Table 14-2 : comparison of commercial catch advice using various calculations

Origins of calculation	latest year used	Index used*	Method used	Commercial catch advice resulting
Original calculation : WGBIE 2015	2014	"old index"	3:4 rule	2437 tonnes
Final Advice 2015 (reference)	2014	"old index"	2:3 rule	2634 tonnes
Final Advice 2015	2014	"new index"	2:3 rule	2194 tonnes
Technical Notes (ADG)	2014	"old index"	Fproxy approach	2399 tonnes
Technical Notes (ADG)	2014	"new index"	Fproxy approach	2306 tonnes
WGBIE 2016 "new" assessment reviewed with 2015 data available	2015	"new index"	Fproxy approach	2178 tonnes

***"old index" calculated from July to June (2000-2014)**

"New index" calculated from January to December (2000-2015)

Using the new index with the 2:3 rule is compared to the 2015 final advice. Results indicates that commercial catches should be no more than 2194 tonnes (compared to 2634 tonnes with old Index). The large difference observed is due to the non-use of the uncertainty cap factor (1.2).

If the new index is used on the basis of the technical notes (ADG), results indicates that commercial catches should be no more than 2306 tonnes (compared to 2399 tonnes with old Index), which look pretty consistent.

Finally if the new index is used on the basis of the technical notes (ADG), but including this time the more recent data (2015), results indicates that commercial catches should be no more than 2178 tonnes

14.4.3 Conclusion of assessment

Those various scenario have been discussed during WGBIE 2016 in order to reopen the advice if necessary. The group decided not to modify it. The main reasons are:

- The method to calculate the Index is still under development. A test is conducted using a model with 4 factors instead of a multiplicative model with a vessel effect (hull x gear group) and a stratum effect (area*month*year).The model with 4 factors corresponds to another approach, while probably leading to similar results. This time there would have no prior separation of vessel effects and strata effects in order to extract year effects and months effects: the new method would immediately imposed a model with a vessel effect, an Ices square effect and in each Ices square an year effect and a month effect.
- Even if indices available at present have similar trends from 2000, results in commercial catch advice (if not using Fproxy approach), can lead to various results.
- A full benchmark will occur in 2017 with Bss 8.a,b and Bss 47, which could lead to an assessment for Bss 8.a,b including all data available (age structure

of the area, exchange rate with Bss 47, and commercial Index from French logbook which will be possibly fix at this time)

At this stage, it has to be note that a decrease in landings is observed in 2015, and trends in the indices indicate a stabilization.

14.5 Future Research and data requirements

There are several important limitations to knowledge of sea bass populations, and deficiencies in data, that should be addressed in order to improve the assessments and advice for sea bass in the NE Atlantic. WGBIE 2016 makes the following recommendations:

The establishment of dedicated surveys on nurseries and tagging data on small fish could provide valuable information on trends in abundance and population structure of bass

Recruitment indices are needed for a wider geographic range including the Celtic/Irish Sea and Biscay areas.

Further research is needed to better understand the spatial dynamics of sea bass (mixing between ICES areas; effects of site fidelity on fishery affects; 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.

14.6 Management plans

No management plan is known at present for the 8.a,b stock.

14.7 Management consideration

Sea bass are characterized by slow growth, late maturity and low natural mortality on adults, which imply the need for comparatively low rates of fishing mortality to avoid depletion of spawning potential in each year class. In the 4.b,c, 7.a,d–h stock, dynamic of the stock is closely dependant to some year of good or very poor recruitment. It could be also the case in the Bay of Biscay.

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

The effects of targeting of offshore spawning aggregations of sea bass are poorly understood, particularly how the fishing effort is distributed in relation to mixing of fish from different nursery grounds or summer feeding grounds, given the strong site fidelity of sea bass.

As bass is, at present, a non-TAC species, there is potential for displacement of fishing effort from other species with limiting quotas as observed with nets in Bay of Biscay.

With no effective control on the fishery to limit the increase of the landings as observed in 2014, risks are taken unless strong year classes are produced (a very close parallel could be done with the historic of sea bass fishery in 4.b,c and 7.a,d–h (North Sea, Channel, Celtic Sea and Irish Sea).

14.8 Recommendations for next benchmark assessment

WGBIE proposes a benchmark for 2017 to:

WGCSE and WGBIE proposed a full benchmark for 2017, preferably in conjunction with the other stocks of sea bass particularly the “North” stock. ICES, WGBIE 2015 encouraged documentation of the quality of the sea bass data for the Bay of Biscay, and studies to better understand the stock dynamics and movements between the current stock areas. In the longer term, Stock Synthesis could be configured to include spatially disaggregated data covering populations within Areas 4, 7 and 8, with estimates of exchange rates between the areas.

In 2016, a dedicated survey on nurseries in Bay of Biscay is tested in order to provide a valuable information on trends in abundance and population structure of bass. Benchmark would have to review preliminary data from the survey.

Linked with stock structure, WGBIE preconizes to have a data call including data from Spanish logbook in order to support the French analysis studying stock structuration through logbook analysis.

Table 14 3 Sea bass in the 8.a,b area. ICES and official landings (tons).

VIIIab	Belgium	France	France	Netherlands	Spain	Spain	UK(Eng+Wales +N.Irl+Scotland)
Source	official stats	official stats	Ices stats	official stats	official stats	Ices stats	official stats
1978	0	1146	1146	0	0		0
1979	0	1132	1132	0	0		0
1980	0	1086	1086	0	0		0
1981	0			0	0		0
1982	0			0	0		0
1983	0	1363	1363	0	0		0
1984	0	2886	2886	0	0		0
1985	0	2477	2477	0	0		0
1986	0	2606	2606	0	0		0
1987	0	2474	2474	0	0		5
1988	0	2274	2274	0	0		15
1989	0	2201	2201	0	0		0
1990	0	1678	1678	0	0		0
1991	0	1774	1774	0	17		0
1992	0	1752	1752	0	14		0
1993	0	1595	1595	0	14		0
1994	0	1708	1708	0	17		0
1995	0	1549	1549	0	0		0
1996	0	1459	1459	0	0		0
1997	0	1415	1415	0	0		0
1998	0	1261	1261	0	27		0
1999	0	0	2080	0	11		0
2000	0	2080	2295	0	67		0
2001	0	2020	2238	3	68		0
2002	0	1937	2216	0	176		0
2003	0	2812	2497	0	119		0
2004	0	2561	2284	0	96		0
2005	0	3184	2722	0	74		0
2006	0	3318	2707	0	168		2
2007	1	2984	2677	0	74	90	1
2008	0	1508	2600	0	145		0
2009	1	2339	2152	0	194	126	0
2010	0	2322	2089	0	165	140	2
2011	1	2295	2297	0	311	278	0
2012	0	2325	2348			201	
2013	0		2532	0		153	0
2014	0	2900	2900	0	91	91	0
2015*	0	2193	2193	0	71	71	0

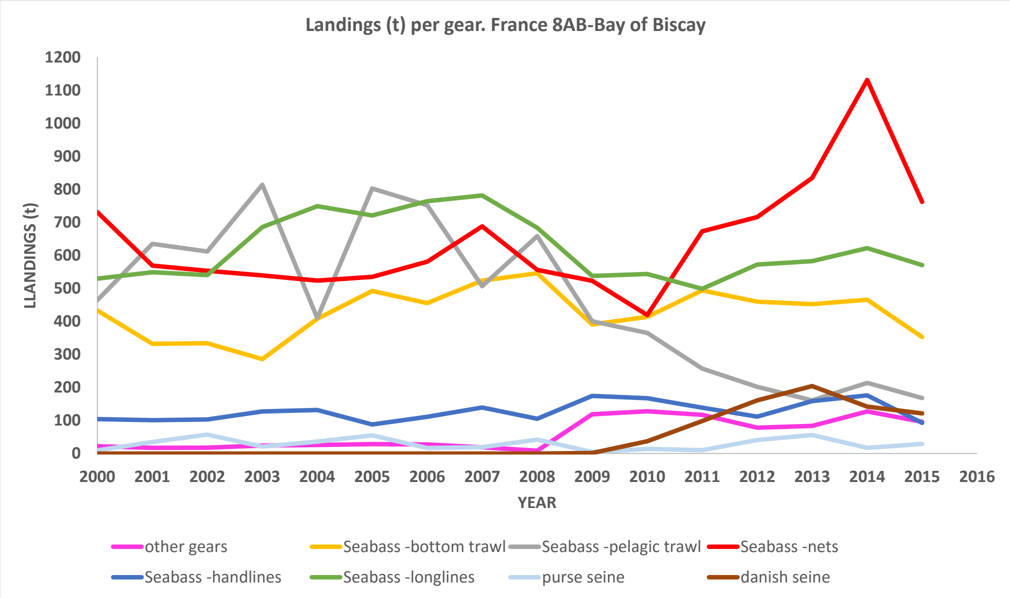


Figure 14-4 : French landings in tons in Bay of Biscay (8.a, 8.b) by gears.

Table 14-3 French Number at length by gear, 2015 (provisional)

length (cm). French 8AB_2015	GTR_DEF	LLS_DEF	MIS_MIS_0_0_0	OTB_DEF_>=70_0_0	PS_DEF_32-54_0_0	PTM_DEF_90-104_0_0	SDN_DEF
24	184	0	0	0	0	0	0
26	1837	0	0	0	0	0	0
28	3530	0	0	0	0	0	0
30	199	0	0	0	0	0	0
32	360	0	699	103	0	0	0
34	408	3762	2969	1591	0	0	0
36	6965	11778	524	25505	0	10	45219
38	18748	26718	699	28178	0	0	30961
40	41237	35902	1572	33800	0	38	22933
42	69931	33312	1048	50941	0	522	14617
44	85281	40650	1397	36756	22	541	11825
46	66654	35520	175	30878	177	795	11105
48	43076	34342	0	14489	266	1222	12135
50	30823	25458	175	9339	155	568	5407
52	27065	23489	175	11234	177	2160	4019
54	22470	25426	0	5208	66	4702	1158
56	32789	23512	0	4548	116	3543	661
58	22517	22210	175	4838	27	2346	726
60	17107	16101	175	5384	25	2804	0
62	14553	9173	0	3302	10	1120	643
64	10408	13884	175	2299	0	1069	0
66	9100	10878	0	1642	3	775	478
68	7181	7252	0	1693	5	601	957
70	6942	8423	0	2019	0	1183	0
72	4310	4606	0	1403	5	1030	0
74	2934	4852	0	554	0	548	0
76	1307	2930	0	828	0	197	0
78	1639	1369	0	307	3	0	0
80	254	952	0	0	0	0	0
82	195	1047	0	0	2	0	0
84	0	0	0	0	0	0	478
86	114	430	0	0	0	0	0

YEAR	INDICES WGBIE 2015		YEAR	INDICES WGBIE 2016
1999/2000	1.66		2000	1.11
2000/2001	1.84		2001	1.03
2001/2002	1.27		2002	1.03
2002/2003	1.37		2003	0.95
2003/2004	1.55		2004	0.99
2004/2005	0.86		2005	0.84
2005/2006	0.85		2006	0.90
2006/2007	1.18		2007	0.96
2007/2008	0.93		2008	0.91
2008/2009	1.2		2009	1.02
2009/2010	1.19		2010	0.97
2010/2011	1.2		2011	1.04
2011/2012	1.3		2012	1.03
2012/2013	1.52		2013	1.03
2013/2014	1.61		2014	1.11
2014/2015			2015	1.11

Table 14-4 : Abundance Index from French logbook used for assessment. Comparison between “old” Index provided for WGBIE 2015 and “new” Index provided for WGBIE 2016.

15 Sea bass (*Dicentrarchus labrax*) in Divisions 8.c, 9.a (European sea bass)

15.1 ICES advice applicable to 2016

"ICES advises that when the precautionary approach is applied, commercial catches should be no more than 598 t in each of the years 2016 and 2017. All commercial catches are assumed to be landed. Recreational catches cannot be quantified; therefore, total catches cannot be calculated."

15.2 General

15.2.1 Stock ID and substock structure

Bass *Dicentrarchus labrax* is a widely distributed species in Northeast Atlantic shelf waters with a range from southern Norway, through the North Sea, the Irish Sea, the Bay of Biscay, the Mediterranean and the Black Sea to Northwest Africa. The species is at the northern limits of its range around the British Isles and southern Scandinavia. Stock identity of European sea bass was reviewed by WGNEW 2012 and further considered at ICES IBP-NEW 2012. The other stock units defined for sea bass are: west of Scotland and Ireland (6.a and 7.b,j); 4.b,c + 7.a,d-h; 8ab and the more southerly population in 8.c 9.a (Figure 15–1). The IBP New 2012 reports that it is clear that further studies are needed on sea bass stock identity, using conventional and electronic tagging, genetics and other individual and population markers (e.g. otolith microchemistry and shape), together with data on spawning distribution, larval transport and VMS data for vessels tracking migrating sea bass shoals, to con-firm and quantify the exchange rate of sea bass between sea areas that could form management units for this stock.

In the absence of new information the pragmatic view of WGBIE2016 is to continue to assume the presence of discreete sea bass stocks off southern Ireland and in the Bay of Biscay (8ab) and Iberian waters (8.c, 9.a).

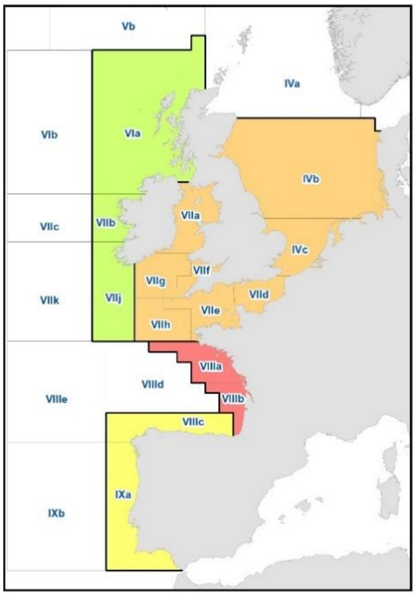


Figure 15-1: stock sea bass units defined at ICES (IBP new 2012)

15.2.2 Management applicable to 2015

Sea bass are not subject to EU TACs and quotas. Under EU regulation, the minimum landing size (MLS) of bass in the Northeast Atlantic is 36 cm total length. A variety of national restrictions on commercial bass fishing are also in place.

- The measures affecting recreational fisheries in Portugal include gear restrictions, a minimum landing size equal to the commercial fishery MLS (36 cm), the total catch of fish and cephalopods by each fisher must be less than 10 kg per day, and prohibition on the sale of catch.

15.2.3 Management applicable to 2016

No new management plan is known at present in 8.c, 9.a. For information in 4.b,c and 7.a,d–h (North Sea, Channel, Celtic Sea and Irish Sea) the European Council has adopted measures to help sea bass recover (Recent scientific analyses have reinforced previous concerns about the state of the stock and advised urgently to reduce fishing by 80%). Effective emergency measures in January 2015 placed a ban on targeting the fish stock by pair-trawling while it is reproducing, during the spawning season, which runs until the end of April 2015.; a 3-fish bag limit for recreational fishers; a monthly catch limit (1.5t for pelagic trawlers; 1.8t for bottom trawlers; 1t for driftnets; 1.3t for liners; 3t for purse-seiners) and an increase in the minimum size of northern sea bass : 36cm to 42 cm from July 2015 (source: http://ec.europa.eu/fisheries/cfp/fishing_rules/sea-bass/index_en.htm).Measures were completed in 2016, banning landings depending on gears and months (Figure 15–2**Error! Reference source not found.**) .

2016 measures	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Bottom trawlers	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	1 t	1 t	1 t	1 t	1 t	1 t
Seiners	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	X (1% by catch)	1 t	1 t	1 t	1 t	1 t	1 t
Pelagic trawlers	X	X	X	X	X	X	1 t	1 t	1 t	1 t	1 t	1 t
Drift Gillnets	X	X	X	X	X	X	1 t	1 t	1 t	1 t	1 t	1 t
Hooks	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t
Lines	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t
Set Gillnets	1.3t	X	X	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t	1.3t

Figure 15-2: summary of the 2016 measures adopted by EC for Sea bass in 4.b,c and 7.a, d–h (North Sea, Channel, Celtic Sea and Irish Sea)

15.3 Fisheries data

15.3.1 Commercial landings data

Landings series are given in Table 15–1 and are derived from:

i) Official statistics recorded in the Fishstat database since around the mid-1970s.

ii) Spanish landings for 2007–2011 from sale notes

iii) Portuguese estimated landings from 1986–2011 including distinction between *Dicentrarchus labrax* and punctatus.

iv) Official landings from recent years

Spanish and Portuguese vessels represent almost of the total annual landings in the area 9.a and 8.c. Commercial landings represent 821 tonnes in 2015. A peak of landings is observed in the early 90’s and in 2013, reaching more than 1000 tons, and lowest landings (637 tons) have been observed in 2004. Artisanal fisheries are mainly observed in this area. In 2015, in the all area, landings were equivalent between Spain (385 tonnes) and Portugal (436 tonnes). However landings from Portugal are only from the 9.a area, while the Spanish landings are distributed between the two zones 9.a and 8.c (respectively (141 tonnes and 244 tonnes). Landings per country, gear and area are given in Table 15–1.

15.3.2 Commercial discards

Portugal: Sea bass discards are recorded by the DCF on-board sampling program. The Portuguese on-board sampling is not covering the Sea Bass fishing area. No discards are observed.

Spain: No bass discards were observed for any métier in the 2003–2014 periods.

15.3.3 Recreational catches

Recreational marine fishery surveys covering different parts of the sea bass stock in the North Sea, Channel, Celtic Sea and Irish Sea have been developed in France, Netherlands, England and Belgium (ICES, 2012c). In 2015, a study has been conducted in Spain "*Comparing different survey methods to estimate European sea bass recreational catches in the Basque Country*" (Zarauz L. *et al*., 2015). This is the first study that estimates sea bass recreational catches in the Basque Country including fishers from shore, boat, and spearfishing. Three different offsite survey methods were used (e-mail, phone, and post) and their performance was compared. Estimates were different depending on the survey method used. Total catch estimates for shore fishing were 129, 156, and 351 tonnes for e-mail, phone, and post surveys, respectively. For boat fishing, estimates varied from 5 tonnes (phone) to 13 tonnes (e-mail and post).For spearfishing, only e-mail surveys were performed and total catch was estimated in 13 tonnes. Potential representation and measurement bias of each survey method were analysed. It was concluded that post surveys assured a full coverage of the target population, but showed very low response rates. Telephone surveys presented the highest response rates, but lower coverage of the target population. E-mail surveys had a low coverage and a low response rate, but it was the cheapest method, and allowed the largest sample size. All surveys methods were affected by recall bias. Recommendations are made about how to improve the surveys (increasing coverage, reducing non-response, and recall bias) to set up a routine cost-effective monitoring program for Basque recreational fisheries. Results show that estimated sea bass recreational catches are comparable to commercial catches, which emphasize the relevance of sampling recreational fishing on a routine basis and including this information into the stock assessment and management processes.

15.4 Recommendations for next benchmark assessment

WGCSE and WGBIE proposed a full benchmark for 2017, preferably in conjunction with the Bay of Biscay stock and the North Stock. ICES, WGBIE 2015 encouraged documentation of the quality of the sea bass data for the Bay of Biscay, and studies to better understand the stock dynamics and movements between the current stock areas. In the longer term, Stock Synthesis could be configured to include spatially disaggregated data covering populations within Areas 4, 7 and 8, with estimates of exchange rates between the areas.

Linked with stock structure, WGBIE preconizes to have a data call including data from Spanish logbook in order to support the French analysis studying stock structuration through logbook analysis study (Laurec A, Drogou M, 2014)

15.5 Management plans

No management plan is known at present for the 8.c, 9.a stock.

15.6 References

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Table 15-1: Sea bass in the 9 and 8.c areas. ICES and official landings (tons).

COUNTRY	FRANCE OFFICIAL LANDINGS	PORTUGAL OFFICIAL LANDINGS	SPAIN OFFICIAL LANDINGS	TOTAL OFFICIAL LANDINGS	TOTAL ICES ESTIMATES***
1978	0	576	0	576	576
1979	0	550	0	550	550
1980	0	460	0	460	460
1981	0	370	0	370	370
1982	0	556	135	691	691
1983	0	408	114	522	522
1984	0	431	250	681	681
1985	0	311	164	475	475
1986	0	219	182	401	580
1987	0	216	194	410	542
1988	14	115	93	222	586
1989	0	105	417	522	1029
1990	1	90	541	632	1042
1991	2	77	411	490	867
1992	0	53	348	401	743
1993	0	57	351	408	694
1994	0	57	440	497	863
1995	0	42	446	488	798
1996	0	48	534	582	956
1997	0	39	474	513	742
1998	0	38	373	411	683
1999	0	37	355	392	720
2000	2	49	329	380	775
2001	0	42	235	277	635
2002	8	43	121	172	518
2003	1	47	113	161	466
2004	39	67	256	362	676
2005	57	177	219	453	753
2006	2	461	268	731	905
2007	1	545	342	888	910
2008	0	403	252	655	614
2009	8	414	212	634	652
2010	2	489	286	777	814
2011	5	441	313	759	777
2012	2	271		273	701
2013	4	529	513	1046	1046
2014	3	536	378	917	917
2015	0	436	385	821	821

*** Preliminary**

***-Official landings have been extracted from the Ices Official Catch Statistics Web page (04 May 2015) for "BSS" and area 8.c, 9.a and 9 (9 has been retained for Portuguese statistics because reported as 9.a prior 2007).**

*****Difference between Ices Statistics and official Statistics are mainly due prior 2006 to Portugal statistics: before 2006 most of the sea bass catches were registered under the code BSE, i.e. (Dicentrarchus sp.). After**

the DCF implementation there was a progressive increase in the correct identification of species in the official statistics (BSS increase, BSE decrease) who consider Dicentrarchus sp landings minus 2.3% of Dicentrarchus punctatus based on DCF market and on-board sampling between 2008–2012)

2015	Landings (t)
Portugal	**436**
IXa	436
MIS_MIS_0_0_0	436
Spain	**385**
IXa	**141**
GNS_DEF_60-79_0_0	4
GNS_DEF_80-99_0_0	0
GTR_DEF_60-79_0_0	37
LHM_DEF_0_0_0	1
LLS_DEF_0_0_0	60
MIS_MIS_0_0_0_HC	38
OTB_MCD_>=55_0_0	0
OTB_MPD_>=55_0_0	0
VIIIc	**244**
GNS_DEF_>=100_0_0	1
GNS_DEF_60-79_0_0	8
GNS_DEF_80-99_0_0	2
GTR_DEF_60-79_0_0	50
LLS_DEF_0_0_0	140
MIS_MIS_0_0_0_HC	29
OTB_DEF_>=55_0_0	11
OTB_MPD_>=55_0_0	2
PS_SPF_0_0_0	1
Total VIIIc, Ixa	**821**

16 Plaice (*Pleuronectes platessa*) in Subarea 8 and Division 9.a

Plaice (*Pleuronectes platessa*) are caught as a bycatch by various fleets and gear types covering small-scale artisanal and trawl fisheries. Portugal and France are the main participants in this fishery with Spain playing a minor role. Present fishery statistics are considered to be preliminary as there are concerns about the reliability of the French data from 2008–2009. Landings may also contain misidentified flounder (*Platichthys flesus*) as they are often confounded at sales auctions in Portugal. The official landings are given in table 16.1 and the catches submitted to the WG are given in table 16.2, the quantity of discarding is uncertain. France submitted discard estimates for the 2015 catches, which were in the order of 10%. The WG considers that the landings are unlikely to be a good indicator of total removals and ICES considers that it is not possible to quantify the catches.

Plaice were not present in sufficient numbers to provide survey abundance indices; the only survey that covers the stock area, EVHOE, only caught 43 plaice in division 8 during its entire time-series (1997–present). The same survey did catch considerable numbers of plaice in the Celtic Sea. No commercial indices are currently available; however the advice might benefit from commercial LPUE data if this was made available to the working group.

Biological information needs to be compiled. However, issues concerning the quality of landings statistics in addition to the lack of survey or commercial abundance indices need to be resolved before an assessment is developed. As this species is at the southern extent of its range in the Bay of Biscay and Iberian Peninsula (Figure 16.1) perhaps merging of the northern and southern stocks would provide the best opportunity to improve the assessment.

This stock is under the EU landing obligation from 2016.

Table 16.1: Plaice in Subarea 8 and Division 9.a: official landings by country in tonnes

YEAR	BELGIUM	FRANCE	PORTUGAL	SPAIN	TOTAL
1994		365	33	1	399
1995		319		12	331
1996		248		14	262
1997		255		3	258
1998		219		6	225
1999	1			3	4
2000	15	193		22	230
2001		201		22	223
2002	1	167		11	179
2003	1	217	1	4	223
2004		229	163	7	399
2005	4	186	1	33	224
2006	2	248	1	4	253
2007	5	214	41	4	264
2008	2	98	89	4	193
2009	2	134	101	9	246
2010	1	200	112	12	325
2011	2	208	64	8	282
2012	3	183	62	3	251
2013	0	147	44	5	196
2014	1	164	51	6	220
2015*	2	141	45	5	193

(* 2015 provisional)

Table 16.2: Plaice in Subarea 8 and Division 9a: Catches submitted to Intercatch (tonnes).

CATCH CATEGORY	COUNTRY	GEAR	2014	2015
Discards	France	Nets	-	10
		Other	-	2
		Trawl	-	4
	Spain	Nets	0	-
		Trawl	0	-
Discards Total			0	15
Landings	Belgium	Other	1	2
	France	Nets	42	46
		Other	38	21
		Trawl	82	74
	Portugal	Other	47	44
	Spain	Nets	4	3
		Other	1	1
		Trawl	1	1
Landings Total			217	193
Catch Total			217	208

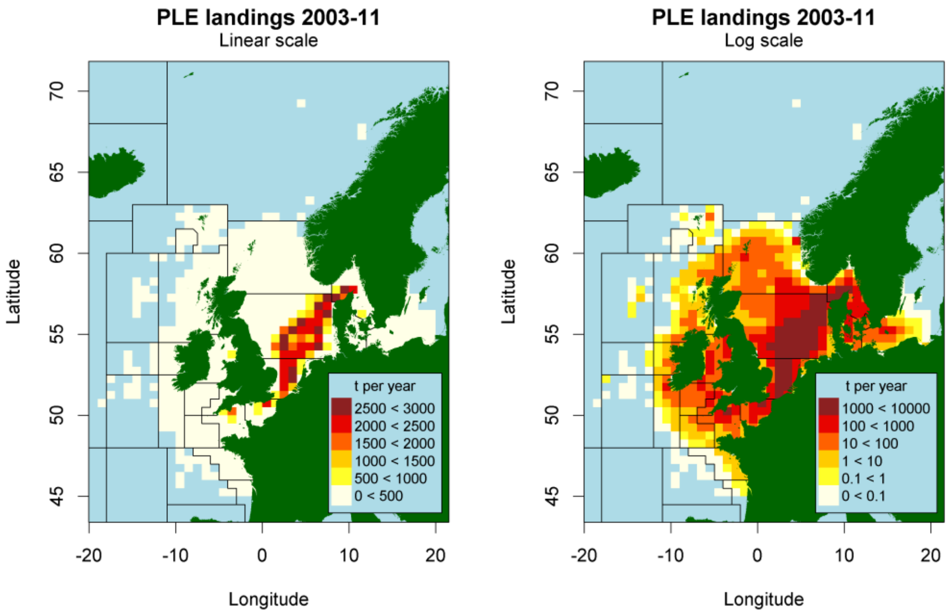

Figure 16.1: International landings of Plaice by statistical rectangle from 2003–2011

17 Pollack (*Pollachius pollachius*) in Subarea 8 and Division 9.a

The official landing statistics are given in table 17.1. There is some mixing in Portuguese markets with whiting (*Merlangius merlangus*) due to use of common names. This resulted in most pollack landings being recorded as whiting from 2004 onwards. Sampling data since 2012 indicates that Portuguese landings of whiting and pollack from 9a consisted of 2% whiting and 98% pollack. The Portuguese authorities informed the group that they can only correct the official landings statistics from 2015, therefore the corrected estimates of landings are presented by this WG in addition to the official landings in Table 17.1. Note that the official corrected figures for 2015 were not available for the WG. Therefore the group will apply these percentage splits to the official landings from 2004. The 2015 values will be updated with the new official landings in time for 2017 EWG.

The landings submitted to the working group are given in Table 17.2. Note that these are not the landings figures used in the advice issued in 2015 because there are many gaps in the data. Recreational catches may be considerable and have not been quantified.

Discard data were only provided for French netters in 2015 (<4% of the catch). Discards are believed to be negligible for most fleets.

In 2015 ICES advised that commercial landings should be no more than 1316 tonnes in each of the years 2016 and 2017. The landings statistics do not show any remarkable changes so the group considered there is no basis to change the advice basis.

Table 17.1: Pollack in Subarea 8 and Division 9.a: Official landings by country in tonnes. The ICES estimate is based on a correction of mixed species (whiting and pollack) landings records in the Portuguese landings from 9a.

AREA	BAY OF BISCAY (SUBAREA VIII)				IBERIAN (DIVISION IXA)		TOTAL	UNALLOC	ICES EST
COUNTRY	BE	ES	FR	UK	ES	PT			
1985	0	2304	2769	23	636	0	5732	0	5732
1986	0	437	2127	5	237	0	2806	0	2806
1987	0	584	2022	1	308	3	2918	0	2918
1988	3	476	1761	6	329	7	2582	0	2582
1989	13	214	1682	4	57	3	1973	0	1973
1990	14	194	1662	2	27	1	1900	0	1900
1991	1	221	1867	1	76	2	2168	0	2168
1992	2	154	1735	0	65	2	1958	0	1958
1993	3	135	1327	0	47	1	1513	0	1513
1994	3	157	1764	0	28	3	1955	0	1955
1995	6	153	1457	2	59	2	1679	0	1679
1996	8	137	1164	0	43	2	1354	0	1354
1997	2	152	1167	1	54	2	1378	0	1378
1998	1	152	956	0	55	1	1165	0	1165
1999	0	120	0	0	36	1	157	0	157
2000	0	121	1315	0	49	15	1500	0	1500
2001	0	346	1142	0	81	41	1610	0	1610
2002	0	170	1467	0	35	45	1717	0	1717
2003	0	142	1245	1	39	31	1458	0	1458
2004	0	211	1145	0	90	12	1458	70	1528
2005	0	306	1311	0	132	0	1755	-4	1751
2006	0	251	1418	171	102	0	1942	6	1948
2007	0	198	1238	62	103	5	1606	104	1710
2008	0	265	814	64	128	31	1302	93	1395
2009	0	218	1508	41	68	3	1838	111	1949
2010	0	265	1269	44	91	2	1671	110	1781
2011	0	322	1453	27	104	2	1908	102	2010
2012	0	159	1094	2	139	2	1396	87	1483
2013	0	251	1345	8	110	3	1717	93	1810
2014	0	185	1610	19	93	1	1908	49	1957
2015*	0	211	1226	38	81	18	1574	35	1609

***2015 provisional**

Table 17.2: Pollack in Subarea 8 and Division 9.a: Landings (tonnes) from France, Spain and Portugal by country and gear as submitted to the working group Note that due to the large amount of missing data, these figures are not used in the advice, except to provide a breakdown by gear.

	France				Spain			Portugal *		Others	
Year	Nets	Trawl	Lines	Others	Lines	Nets	Others	Others	Trawl	---	Total
2001	325	136	75	8	31	53	169	-	-	0	766
2002	358	173	36	5	26	28	134	-	-	0	760
2003	570	202	65	3	31	35	146	-	-	1	1053
2004	542	151	57	4	47	36	222	16.5	0.1	-	1092
2005	378	205	95	6	90	36	161	7.8	0.6	0	988
2006	498	294	92	11	48	29	243	6.7	0.3	171	1400
2007	565	311	133	19	72	51	210	4.5	0.4	62	1433
2008	557	263	138	12	147	95	163	33.3	0	64	1506
2009	679	224	217	5	101	76	97	2.4	0.5	41	1446
2010	-	-	-	-	167	162	93	1.7	0.1	44	470
2011	-	-	-	-	207	199	20	1.2	0.3	26	455
2012	608	170	267	49	123	122	53	-	-	-	1392
2013											
2014					110	147	103	1	0		361
2015	766	178	258	42	145	114	14	18	0	0	1535

18 Whiting (*Merlangius merlangus*) in Subarea 8 and Division 9.a

Whiting (*Merlangius merlangus*) are caught in mixed demersal fisheries primarily by France and Spain (Table 18.1). There are concerns about the reliability of the French data from 2008–2009, which appear to be incomplete. There is some mixing in Portuguese markets with pollack due to use of common names. This resulted in most pollack landings being recorded as whiting from 2004 onwards. Sampling data since 2012, indicates that Portuguese landings of whiting and pollack from 9.a consisted of 2% whiting and 98% Pollack; whiting landed by Portuguese vessels makes up an insignificant amount of the total whiting landings in this area. The Portuguese authorities informed the group that they can only correct the official landings statistics from 2015, therefore the corrected estimates of the landings are presented by this WG in addition to the official landings in Table 18.1. Note that the official corrected figures for 2015 were not available for the WG. Therefore the group will apply these percentage splits to the official landings from 2004. The 2015 values will be updated with the new official landings in time for the 2017 EWG.

Whiting has never been recorded in Spanish discards and is negligible in Portuguese discards. However there are indications that there is considerable discarding by the French fleet. The discards reported by France for 2015 are 33% of the catch weight (Table 18.2). This is the first year discard estimates have been reported.

Whiting are present in the French EVHOE-WIBTS-Q4 survey from the Bay of Biscay. The working group investigated if this survey can provide an index of recruitment and/or biomass (WDXX). The survey regularly catches whiting on inshore stations but the catch rates are highly variable, resulting in very wide confidence limits. The recruitment and biomass indices are given in Figure 18.1 for information only. WGBIE does not propose to use these as a basis for the advice.

Commercial abundance index is available from the Basque pair trawl fleet in 8.abd (Figure 18.2; Very High Vertical Opening gear, VHVO). Traditionally, this fleet obtains the most important whiting Basque catches and its fishing effort can be quantified with accuracy along all the period. However it has to be noted that the whiting is not the main target for this métier -focused at present on hake. The VHVO index has not been updated since WGHMM 2012.

This species is at the southern extent of its range in the Bay of Biscay and Iberian Peninsula (Figure 18.3). It is not clear whether this is a separate stock from a biological point of view.

Table 18.1: Whiting in Subarea 8 and Division 9.a: official landings in tonnes. The ICES estimate is based on a correction of mixed species (whiting and pollack) landings records in the Portuguese landings from 9a.

YEAR	BELGIUM	FRANCE	PORTUGAL	SPAIN	TOTAL	UNALLOC	ICES EST
1994		3496	15	136	3647	0	3647
1995		2645	2	1	2648	0	2648
1996		1544	4	13	1561	0	1561
1997		1895	3	47	1945	0	1945
1998		1750	3	105	1858	0	1858
1999			1	211	212	0	212
2000	2	1106	2	338	1448	0	1448
2001	3	1989	1	288	2281	0	2281
2002	3	1970	1	230	2204	0	2204
2003	1	2275	4	171	2451	0	2451
2004		1965	77	249	2291	-70	2221
2005	3	1662	2	416	2083	-2	2081
2006	2	1420	7	433	1862	-6	1856
2007	4	1617	107	296	2024	-104	1920
2008	1	772	98	187	1058	-93	965
2009	2	1303	114	54	1473	-111	1362
2010	3	2234	114	101	2452	-110	2342
2011	1	2029	105	108	2243	-102	2141
2012	3	1791	90	110	1994	-87	1907
2013	1	1943	95	55	2094	-93	2001
2014	1	1579	65	55	1700	-49	1651
2015*	2	2138	38	56	2234	-35	2199

***2015 provisional**

Table 18.2 Whiting in Subarea 8 and Division 9.a: landings submitted to intercatch (tonnes).

Catch cat	Country	Gear	2014	2015
Landings	France*	Lines	0	539
		Nets	113	234
		Other	561	412
		Trawl	465	955
	Portugal**	Other	0	31
		Trawl	0	2
	Spain	Other	1	0
		Traw;	53	55
	Other	Other	1	2
	Total	land	1194	2231
Discards	France	Lines	-	10
		Nets	-	141
		Other	-	313
		Trawl	-	597
	Total	dis	-	1060

*** probably incomplete (official landings: 1579)**

**** no correction for whiting/pollack species misidentification**

Figure 18.1. EVHOE-WIBTS-Q4 survey indices of recruitment (left) and biomass (right).

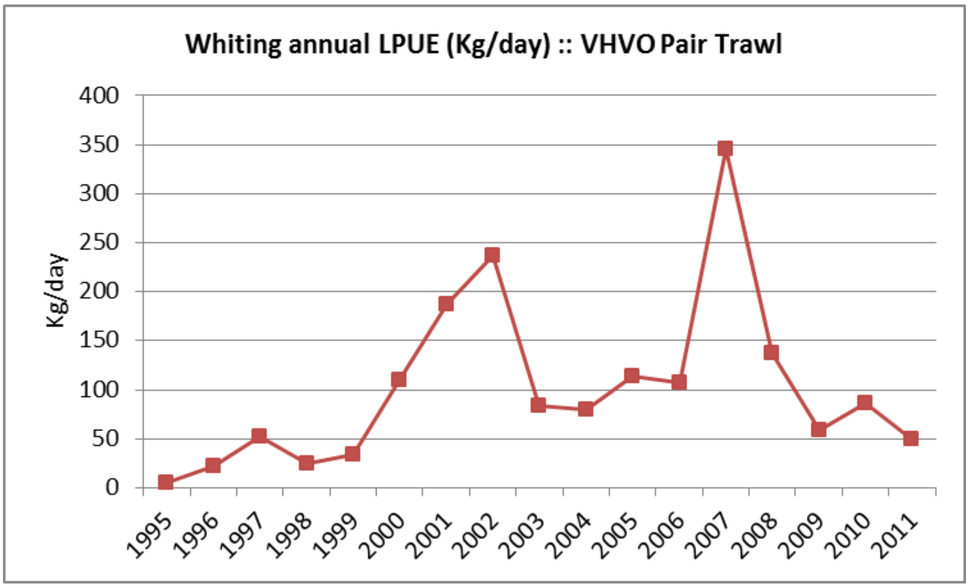

Figure 18.2. Whiting landings per unit effort (LPUEs in kg/day), by year, for Basque pair bottom-trawl fleet fishing in Divisions8.a,b,d, in the period 1995–2011.

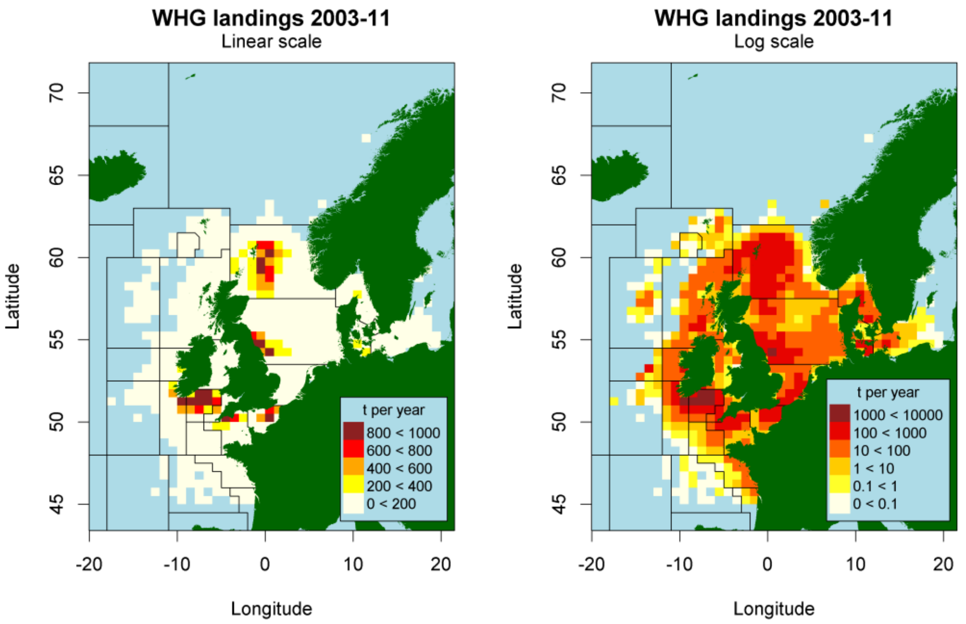

Figure 18.3: International landings of Whiting by statistical rectangle from 2003–2011

Annex 1: List of participants

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13–19 May 2016

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Annex 2: Recommendations

Recommendation	For follow up by:
The EWG note that for the northern stock of hake there is only one stock coordinator/assessor whom has the repsonsibiltiy of coordinating the international data from many countries and updating the assessment. The data are very complex and come with mainy issues which take time to resolve. There is also a risk with only having one person with the responsibility for updating the assessment and providing advice in that if they are no longer available the advice and assessment would not be easily updated. The EWG appeals to countries to nominate an additional person to share the responsibiltiy of coordinating the data and updating the assesment for the provision of advice.	ICES Secretariat / ACOM
A new commercial longline cpue has been proposed for northern hake and the EWG recommends that the methodology be reviewed and appropriateness for advice evaluated.	WGCatch / PGDATA
The EWG noted that there were a number of data aresues this year for some stocks. Countries were supplying information in different formats such as different levels of aggregation for métier, length class distributions and species identification. The EWG would like the RCM to better coordinator the EWG requirements for data needed in the assessments	RCM / ICES Secretariat / ACOM
This year the EWG noted that the data upload to intercatch and/or accessions did not prompt an e-mail notification to some of the stock coordinators or they received multiple e-mails. The group suggested that a check/tick box facility for the uploading countries be implemented so that when all data are uploaded the countries stock coordinators check this box which prompts one e-mail letting the international stock coordinator know that all the data have been submitted for that country and are the final version.	ICES Data Centre
The EWG proposes that InterCatch is set up to be able to have more than one stock coordinator able to access a stocks data.	ICES Data Centre
The EWG found that files uploaded to accessions had multiple naming conventions which made it difficult for the group to distiguish easily their stocks files. The EWG suggests using the ICES stock code and the country code as prefix to these files, in that order and a specific folder for each stock. The EWG also noted that comments about the data located in the e-mails were missing and suggest that these comments also be included in the accessions file with the data.	ICES Secretariat / Data Centre
This year the data call did not include survey indices, therefore for some stocks they did not receive these data until after the deadline when the Chair contacted the responsible countries. The EWG would like to request that these be included in the data call until ICES is in a position to calculate them internally.	ICES Secretariat / ACOM

Annex 3: Terms of Reference for 2017

WGBIE– Working Group for the Bay of Biscay and Iberian waters Ecoregion

2016/2/ACOMXX The **Working Group for the Bay of Biscay and Iberian waters Ecoregion** [WGBIE], chaired by Lisa Readdy (UK), will meet in Cadiz, Spain, 4–11 May 2017 (tbc) to:

a) Address generic ToRs for Regional and Species Working Groups;

b) Review and assess the progress on the benchmark preparation of hake and anglerfish stocks;

c) Address the data issue on the different solea species in area 8.c, 9.a.

The assessments will be carried out on the basis of the stock annex. The assessments must be available for audit on the first day of the meeting.

Material and data relevant for the meeting must be available to the group no later than XX 2017 (tbd) according to the Data Call 2017.

WGBIE will report by XX May (tbd) for the attention of ACOM.

Annex 4: List of Stock Annexes

The table below provides an overview of the WGBIE Stock Annexes. Stock Annexes for other stocks are available on the ICES website Library under the Publication Type "Stock Annexes". Use the search facility to find a particular Stock Annex, refining your search in the left-hand column to include the *year*, *ecoregion*, *species,* and *acronym* of the relevant ICES expert group.

Stock ID	Stock name	Last updated	Link
anb-8c9a_SA	Southern black anglerfish (Lophius budegassa) in Divisions 8.c, 9.a	May 2016	anb-8c9a_SA
ang-78ab_SA	Anglerfish (L. piscatorius and L. budegassa) in Divisions 7.b–k and 8.a,b,d	May 2016	ang-78ab_SA
anp-8c9a_SA	Southern white anglerfish (Lophius piscatorius) (Divi-sions 8.c, 9.a)	May 2016	anp-8c9a_SA
bss-8ab_SA	European sea bass (Dicentrarchus labrax) in subarea 8.a,b,d (Bay of Biscay)	May 2013	bss-8ab_SA
bss-8c9a_SA	European sea bass (Dicentrarchus labrax) in subarea 8.c, 9.a	May 2013	bss-8c9a_SA
gug-89a_SA	Grey gurnard (Eutrigla gurnardus) in Subarea 8 and Division 9.a	May 2014	gug-89a_SA
hke-nrtn_SA	Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern Stock of Hake)	May 2016	hke-nrtn_SA
hke-soth_SA	Hake in Divisions 8.c and 9.a (South Stock of Hake)	May 2016	hke-soth_SA
mgw-78_SA	Megrim (Lepidorhombus whiffiagonis) in Divisions 7.b-k and 8.a,b,d	May 2016	mgw-78_SA
mgw-8c9a_SA	Southern megrims (L. whiffiagonis and L. boscii), Division 8.c, 9.a	May 2016	mgw-8c9a_SA
nep-2324_SA	Nephrops in Division 8.a,b, FU 23-24-	May 2011	nep-2324_SA
nep-25_SA	Nephrops Division 8.c, FU 25 (North Galicia)	May 2016	nep-25_SA
nep-2627_SA	Nephrops Division 9.a, FUs 26, 27 (West Galician and North Portugal)	May 2016	nep-2627_SA
nep-2829_SA	Nephrops in Division 9.a, FU 28-29 (Southwest and South Portugal)	May 2016	nep-2829_SA
nep-30_SA	Nephrops in Division 9.a, FU 30 (Gulf of Cadiz)	May 2016	nep-30_SA
nep-31_SA	Nephrops in Division 8.c, FU 31 (Cantabrian Sea)	May 2016	nep-31_SA

Stock ID	Stock name	Last updated	Link
ple-89a_SA	Plaice (Pleuronectes platessa) in Subarea 8 and Division 9.a	May 2014	ple-89a_SA
pol-89a_SA	Pollack (Pollachius pollachius) in Subarea 8 and Division 9.a	May 2016	pol-89a_SA
sol-8c9a_SA	Sole in subdivisions 8.c and 9.a	May 2014	sol-8c9a_SA
sol-bisc_SA	Sole in Division 8.a,b	May 2016	sol-bisc_SA
whg-89a_SA	Whiting (Merlangius merlangus) in Subarea 8 and Division 9.a	May 2016	whg-89a_SA

Annex 05: Benchmark planning

Stock	BSS-8ab	
Stock coordinator	Mickael Drogou	Mickael.drogou@ifremer.fr
Stock assessor	To define	
Data contact	Mickael Drogou	Mickael.drogou@ifremer.fr

Issue	Problem/Aim	Work needed / possible direction of solution	Data required. Are these available? Where should they come from?
Landings data	Historical landings	Landings, fleet, area yearly required from 2000.	Landings from all the involved countries split by fleet, area
Tuning series	Commercial tuning data are available.	Finalize the appropriate commercial tuning series including 2015.	
Survey tuning series	No survey tuning survey		
Discards	Considered as negligible		
Length compositions	French length composition from 2000 are not yet available but should be in 2015-2016	Supply of length and age distributions for landings. This should include sampling intensities.	French length and age distribution per year from 2000 per Ices area
	Spain Length composition would probably not be available	Spanish Landings represents 3% of the total in 8ab. If not available maybe not an issue	

Issue	Problem/Aim	Work needed / possible direction of solution	Data required. Are these available? Where should they come from?
Biological Parameters	No Biological Parameters available in 2015, but some data are currently collected to have some (maturity, growth curve for nthe area)	Use some of the Biological data (Natural mortality) from the WGCSE assesment.	

Stock	*Nephrops* FU 23-24	
Stock coordinator	Name: Spyros Fifas	E-mail:Spyros.Fifas@ifremer.fr
Stock assessor	Name: Spyros Fifas	E-mail: Spyros.Fifas@ifremer.fr
Data contact	Name: Spyros Fifas, Michèle Salaun	E-mail: Spyros.Fifas@ifremer.fr, Michele.salaun@ifremer.fr

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified1	UWTV survey data for years 2014 and 2015 (planned for July 2015)	Spatially structure models	Data provided from LANGOLF survey (series 2006-2013)+DCF sampling onboard (since 2003)+UWTV survey data (2014-2015)	
Tuning series	Commercial tuning fleet (district of Le Guilvinec 2nd quarter, years 1987-2013)+twin trawl survey LANGOLF (years 1987-2013) not carried out from 2014 onwards	Investigation aiming to include another tuning series corresponding to the Southern part (outside Brittany) of the fishery	Data provided by fishing industry representative	

[1] Include all issues that you think may be relevant, even if you do not have the specific expertise at hand. If need be, the Secretariat will facilitate finding the necessary expertise to fill in the topic. There may be items in this list that result in ‘action points for future work’ rather than being implemented in the assessment in one benchmark.

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified1	UWTV survey data for years 2014 and 2015 (planned for July 2015)	Spatially structure models	Data provided from LANGOLF survey (series 2006-2013)+DCF sampling onboard (since 2003)+UWTV survey data (2014-2015)	
Discards	DCF sampling plan covering period since 2003+sparse years (1987,1991,1998). For validation of the discard derivation method applied on missing years see IBP Nephrops 2012	Additional investigations have to be undertaken on the actual impact of selectivity devices adopted since 1st April 2008 (not enough data for the moment)	DCF samples since 2003	
Biological Parameters	Validation of discard survival rate either as used by WGHMM (WGBIE) for the whole historical series or as updated by recent experiments (higher value of the survival rate)	Spatial variability of female maturity ogives (GLMs vs. compacity of the sediment, depth, etc.)	Maturity database as filled in since 2004-2005	
Assessment method	The IBP 2012 concluded the inadequancy of the CSA (Collie-Sissenwine analysis) because of unlikely variability of predicted SSB and recruitment indices. The XSA assessment was retained although it should be replaced by alternative approaches (length structured models?) or by UWTV survey (nevertheless, this method limits unibiased investigations only on the adult component of Nephrops stocks)			
Biological Reference Points	N/A			

Stock	Nephrops FU 28-29	
Stock coordinator	Name: Cristina Silva	E-mail: csilva@ipma.pt
Stock assessor	Name: Cristina Silva	E-mail: csilva@ipma.pt
Data contact	Name: Cristina Silva	E-mail: csilva@ipma.pt

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified[2]	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Total Catch	Only landings from Portuguese fleet are available in most of the years -> unaccounted mortality Possible separation by Functional Unit?	Review and estimate total catch and total effort	Historical data from Spanish Fleet in these FUs (landings, logbook data) Spatial data (VMS) Portuguese data available	

[2] Include all issues that you think may be relevant, even if you do not have the specific expertise at hand. If need be, the Secretariat will facilitate finding the necessary expertise to fill in the topic. There may be items in this list that result in ‘action points for future work’ rather than being implemented in the assessment in one benchmark.

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified2	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Tuning series	Fishery targeting 2 main species of crustaceans, deep-water rose shrimp and Norway lobster, sharing only partly the same grounds. In periods of high abundance of rose shrimp the vessels spend less effort on Nephrops.	Standardized cpue series for Nephrops related to area/depth, other species dependency	All data available: Logbooks, VMS data	
	Crustacean trawl survey	Estimate abundance/biomass for fishing areas	Crustacean survey series	
Discards	Discarding is minimal in this fishery. Not an issue			
Biological Parameters	Growth parameters and natural mortality estimated by tagging in 1990. Attempts to include a joint tagging program for several Nephrops FUs in DCF not successful due to high costs.			
Assessment method	No analytical assessment approved. XSA, used until 2011, accepted only for trends. The use of standardized cpue has reduced the residuals in catchability and the retrospective pattern but problems of internal consistency remain (IBP, 2012) ICES DLS approach used since 2013	Explore: Length based assessments with different methods (LCA, SS3, ...) Age based assessments using slicing (for comparison) A number of approaches, including trawl surveys, length composition information, and basic fishery data such as landings and effort.	Data available: Landings (partial – missing Spanish data) cpue Survey indices Length distribution Maturity Weight-length relationship Spatial distribution	Helen Dobby/Richard Methot/Jim Ianelli

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified2	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Biological Reference Points	No BRPs adopted	BRPs (Y/R) or proxies depending on the assessment approach		
Management issues	Crustacean fishery directed at rose shrimp and Norway lobster. Norway lobster is the 2nd target species, its importance increases in periods of low abundance of rose shrimp. Recovery Plan for Southern Hake and Iberian Nephrops stocks since 2006. No objectives defined for Nephrops in this plan. 10% reduction in F for Southern Hake resulted in 10% reductions in TAC and effort for Nephrops every year.	Understand the fisheries dynamics and the dependence from rose shrimp. Unlink Nephrops management from Southern Hake recovery. Set management objectives for Nephrops, taking into account the characteristics of the crustacean fishery.		

Stock	Nephrops FU 30	
Stock coordinator	Name: Yolanda Vila	E-mail: yolanda.vila@cd.ieo.es
Stock assessor	Name: Yolanda Vila	E-mail: yolanda.vila@cd.ieo.es
Data contact	Name: Yolanda Vila	E-mail: yolanda.vila@cd.ieo.es

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified3	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Tuning series	- Métier highly multiespecific. Directed effort estimated from trips with at least 10% Nephrops landings. - Trawl survey_ARSA_(SPGF-cspr-WIBTS-Q1) but it is directed to demersal species in general and not to Nephrops	- VMS and logbooks analysis.	VMS are available for 2011-2013 periods. For other year it should be supplied by the Spanish Administration (Secretaría General de Pesca, SGP). Logbooks available	

[3] Include all issues that you think may be relevant, even if you do not have the specific expertise at hand. If need be, the Secretariat will facilitate finding the necessary expertise to fill in the topic. There may be items in this list that result in 'action points for future work' rather than being implemented in the assessment in one benchmark.

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified3	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Discards	Discarding is negligible in this fishery. Not an issue			
Biological Parameters	There is no information about growth parameters and natural mortality in this FU. Maturity ogives are available from 2004, 2009, 2010 and 2011.		Biological parameters information of others FUs	
Assessment method	No analytical assessment	- UWTV survey approach. UWTV exploratory survey was carried out in 2014. However, improvements must be performed in next survey. Annual UWTV will be carried out from 2015.	Nephrops UWTV survey will be carried out in June2015 Data available: Landings LPUE Trawl Survey indices Length distributions Maturity Weight-length relationship	Colm Lordan/Jennifer Doyle/Helen Dobby
Biological Reference Points	N/A			

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified3	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Data to be Considered	Identification of other burrowing species associated to the Nephrops ground	Analysis of the spatial distribution and abundance in Trawl survey_ARSA_(SPGF-cspr-WIBTS-Q1) -Trawls during UWTV survey	Trawl survey_ARSA__(SPGF-cspr-WIBTS-Q1)information available	

Stock	anb-78ab	anp-78ab
Stock coordinator	Joana Silva E-mail: joana.silva@cefas.co.uk	Agurtzane Urtizberea Ijurco
Stock assessor	Joana Silva E-mail: joana.silva@cefas.co.uk	Agurtzane Urtizberea Ijurco
Data contact	Joana Silva E-mail: joana.silva@cefas.co.uk	Agurtzane Urtizberea Ijurco

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
Landings	High	Historic underreporting	Collate any anecdotal or quantitative information on underreporting of landings.	Data: Qualitative or quantitative information on underreporting by year, country and fleet. Available: unknown. From: national labs
			Check if quota were restrictive	Data: Landings and quota by country. Available: yes
Landings	Low	Landings before 1996	Compile data (Unlikely to get useful data)	Required: landings by fleet, area, quarter Available: unknown From: national labs
Landings length data	High	Poor quality data		For current data: improve data collection
Discards	Medium	Discard levels unknown and may have changed due to minimum landing weight.	Estimate discards. (data quality probably poor but discard levels are probably moderate to low)	Data: discards by fleet, (area, quarter) Available: number of observer trips is variable but in principle these data should be available >2002 (DCR) From: national labs

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
Discard length data	Medium	Discard length distribution is unknown and may have changed over time	Estimate discard length frequency distributions.	Data: discard LFD by fleet (area, quarter) Available: number of observer trips is variable but in principle these data should be available >2002 (DCR) From: national labs
Species split	Medium/high	Quality of species allocation of mixed landings to L pis and L bud is unknown.	Collate detailed information on methods used by each country. Apply most appropriate species split on historic data.	Data: description of methods and estimates by year, fleet etc. Available: probably From: national labs
Commercial tuning data	Medium	Need for reliable LPUE data	Develop LPUE series using methods that account for changes in targeting behaviour and or gear. Note that these are subject to accurate landings data which may be a major draw-back.	Data: LPUE Available: raw data are available but would need to be worked up. Also it is unlikely we can estimate the actual landings accurately. From: national labs
Survey data	high	Not all available data are used.	Collate available survey data that may be informative for these stocks.	Data: list of surveys and raw data if not available online Available: yes From: national labs
			Combine surveys covering different parts of the stock	Data: raw survey data Available: yes From: DATRAS etc and national labs
Growth parameters	medium	No reliable growth parameters	Analysis of survey LFD to track cohorts in order to estimate growth parameters.	Data: survey LFD Available: yes, initial analysis shows it is possible to track cohorts for up to 7 years and estimate growth parameters for L pis. Possibly also for L bud. From: DATRAS etc and national labs
			Tagging	Data: tag-recapture data Available: unknown From: national labs, others?

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
Age data	Low	Age data exists but quality unknown.	Compare length-at-age data from existing sources with growth curves derived from length–frequency analysis of the surveys. Identify if certain ageing methods produce realistic results.	Data: age data from commercial catches and surveys Available: yes From: national labs, perhaps RDB
Stock identity	Medium/Low	Stock identity is unknown. (but this is the case for most stocks)	Review publications on genetic or tagging data	Data: literature review Available: unknown From: published and grey literature, contact national labs for any unpublished data
			New genetic or tagging studies	Data: genetic or tagging data Available: any current projects??? From: national labs, universities
Biological data	Low	Limited data on natural mortality, maturity, sex ratio available	Estimate natural mortality using published methods	Data: Available: From:
			Provide existing maturity data or increase sampling levels. Review knowledge of spawning females???	Data: maturity data Available: for males survey data are available, mature females are rarely observed. From: national labs / literature
			Provide sex-ratio data from surveys	Data: sex-ratio at length Available: yes from surveys From: DATRAS etc and national labs

Stock	Southern Hake	
Stock coordinator	Name Santiago Cerviño	E-mail: santiago.cervino@vi.ieo.es
Stock assessor	Name: Santiago Cerviño and Joao Pereira	E-mail: santiago.cervino@vi.ieo.es E-mail: jpereira@ipma.pt
Data contact	Name: Santiago Cerviño and Joao Pereira	E-mail: santiago.cervino@vi.ieo.es E-mail: jpereira@ipma.pt

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
Stock ID	Lack of biological basis for Stock definition	Combined assessment (North and South)	Carry out assessment intersessionally	Rick Methot/Jim Ianelli/ Daniel Howel
cpues	Little information on abundance of large fish. Only one cpue available	Incorporation of cpue from commercial fleets catching adults	Catch and Effort data of available fleets. Ask national DB (Sp and Pt)	Experts on standardize LPUE
Biological Parameters (growth and mortality)	Hake is sex dimorphic species. Accounting for differences on growth, maturity and mortality by sex. Hake is an active cannibal species having a great impact on M at younger classes.	Explore life-history methods to support new parameters figures (Linf, k, M, etc)	Explore literature about life history in other hakes.	
Reproductive potential	Incorporate Portuguese data on maturity. Males and females together may cause bias in reproductive potential estimation.	Move to a female-only SSB.	Sex ratios, female maturity and egg production by length class. Data already available	Biology/reproduction experts (Maria Sainza, Ana Costa, Rosario Dominguez)

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
Convergence	Sensitivity of assessment, poor convergence to starting parameter values	Explore sensitivity, identify sensible parmeters and check changes in likelihoods	No data needed	

Stock	anb-8c9a	anp-8c9a
Stock coordinator	Ricardo Alpoim	Paz Sampedro
Stock assessor	Ricardo Alpoim/Paz Sampedro	Paz Sampedro/Ricardo Alpoim
Data contact	Ricardo Alpoim	Paz Sampedro

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
Stock Identity	Low/Medium	Stock identity is not perfectly known.	Review publications/grey literature on stock structure studies.	Data: literature review. Available: yes From: published papers and grey literature.
Species split	Low/Medium	Species split is based on sampling effort and design.	Review of the methodology and data used to split the species	Available: yes From: Spanish and Portuguese national lab
Commercial tuning data: A Coruña bottom-trawl fleet	Medium	A new commercial A Coruña-LPUE series needs to be available.	Estimate the longest time series of landings, effort and length composition of landings by quarter using logbooks information. From 2013 backwards.	Data: LPUE (landings, effort and length composition) by quarter Available: raw data are available but would need to be worked up. From: Spanish national lab
Portugal Commercial tuning data:	Medium	Explore other LPUE series beside the trawl series	Explore a way to estimate the time series of landings, effort s of the artisanal fleet in order to have a LPUE series.	Available: data are available but they needs to be explored to see if it is possible to produce a LPUE series reliable. From: Portuguese national lab
Survey data	Medium	Anglerfish is not a main target species of the Portuguese surveys, but can provide some information on recruitment	Review data/publications	Available: yes From: Portuguese national lab

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
Biological Parameters	High	1. The ageing criteria proposed in 2007 was rejected at the assessment working group (WGHMM) due to its inconsistencies.	1. Try to get a ageing criteria accepted, or a growth model accepted (especially for L.budegassa)	1. No solution available for the time being.
	Low/Medium	2. An updated and reliable maturity model is needed.	2. To investigate a maturity model, for both sexes combined, based on recent commercial samplings and survey data (if there are any).	2.Possible that some Information is available from DCF (Data Collection Framework).
	High	3. Revision of length frequencies (especially for L.budegassa): way it is done the raise from the sample to the total catches; amplitude of the length classes (the length sample some time is very patchy and when it is raised to the total catch produce large peaks in very few length classes)	3. Review data/publications. Explore the use of length classes of 2,3,4 or 5 cm instead of 1 cm.	Available: yes From: Spanish and Portuguese national lab
Assessment Model (just for L.budegassa)	High	ASPIC needs to fix B1/K in the input files to stabilize.	Explore the possibility to use the SS3 for the assessment of this stock.	Available: If the problems with the data described above are solved From: SS3 Experts. To be done at the benchmark

Annex 06. List of Working Documents

WD 01 Q1 Irish Anglerfish and Megrim Survey (IAMS)

Hans Gerritsen

The 2016 Irish Anglerfish and Megrim Survey (IAMS) took place from 4-24 January and 25 February6 March 2016 on RV Celtic Explorer.

The main objective of the survey is to obtain biomass estimates for anglerfish (*Lophis piscatorius* and L. *budegassa*) in and establish an abundance index for megrim (*Lepidorhombus whiffiaginis* and L. *boscii*) in 6.a (south of 58°N) and 7 (west of 8°W).

Secondary objectives are to collect data on the distribution and relative abundance of anglerfish, megrim and other commercially exploited species. The survey also collects maturity and other biological information for commercial fish species.

The IAMS survey is coordinated with the Scottish Anglerfish and Megrim survey (SIAMISS) and uses the same gear and fishing practices.

WD 02 Q1 Irish Beam Trawl Ecosystem survey (IBES)

Hans Gerritsen

The first annual Irish Beam Trawl Ecosystem (IBES) took place from 6-16 march 2016 on RV Celtic Explorer in the western Celtic sea.

The main objective of the survey is to connect the Irish Anglerfish and Megrim Survey (IAMS) to the UK beam trawl surveys in the Celtic Sea, English Channel and Irish Sea, with the purpose of providing a swept-area biomass estimate for anglerfish (*Lophis piscatorius* and L. *budegassa*) in area 7.

Secondary objectives are to collect data on the distribution and relative abundance of commercially exploited species as well as invertebrates and bycatch species, particularly vulnerable and indicator species. The survey also collects maturity and other biological information for commercial fish species in the western Celtic Sea.

The IBES survey is coordinated with the Cefas Q1 Southwest Ecosystem Survey (Q1SWECOS) and uses the same gear and methods.

WD 03 Standardization of hake LPUE series of the Galician set-longline fleet in Subarea 7

J. Castro1, D. García2, J.L. Cebrian1 and B. Patiño1

WGHMM (now WGBIE) identified a problem in the assessment of northern hake in relation to the scarce information on the abundance of large fish. 2004 WKSOUTH tested the inclusion in SS3 of Galician LPUEs from set-longline fleet targeting hake in ICES Subarea 7. This métier catches mainly adults. However, during WGBIE 2014, a serious inconsistency was detected when updating this LPUE time-series, related to the assumption of the average fishing days by trip employed along the time-series. The current working document provides the revision of this LPUE series by applying the actual number of fishing days by trip recorded in logbooks, which has varied greatly in the final part of the time-series. The revised LPUE indices obtained were then tested in the assessment of northern hake stock. The difference in results between the assessments without LLPUE and the assessment which includes the new LPUE series were minor. In the initial part of the time-series the LPUE matched the abundance closely but in the last period the increase in the LLPUE was much lower than the increase in the stock abundance.

WD 04 Combined EVHOE-IGFS IBTS survey index for monkfish in 78ab

Hans Gerritsen

The scientific advice for the *Lophius piscatorius* and *L. budegassa* stocks (anp-78ab and anb-78ab) is based on a biomass index from the EVHOE IBTS survey. This survey covers the stock range up to around 51°N. The Irish GroundFish Survey (IGFS) is also coordinated by IBTS and uses nearly identical gear and sampling procedures. This survey covers most of the remaining stock area. This working document examines the use of a combined EVHOE-IGFS survey index.

WD 05 Benchmark considerations for *Nephrops* FU23-24

Spyros Fifas

The WD (PowerPoint presentation) summarize the results the progress made towards the 2016 assessment benchmark.

WD 06 EVHOE survey index for whiting and plaice in ICES divisions 89.a.

Hans Gerristsen

The WD presents the results of an exploratory analysis and survey index for whiting and plaice.

WD 07 Benchmark considerations for *Nephrops* FU28-29

Cristina Silva

The WD (PowerPoint presentation) summarize the results the progress made towards the 2016 assessment benchmark.

WD 08 First steps in the estimation of harvest ratio reference points for *Nephrops* FU 30 (Gulf of Cadiz)

Vila, Y. and González Herraiz, I.

The WD summarize the results the progress made towards the 2016 assessment benchmark.

WD 09 Black anglerfish (*Lophius budegassa*): weight-length relationships, weight conversion factors and condition factor trends from a decade of two stocks, in ICES Div. 8.c-9.a (northern Iberian Atlantic waters) and in Div. 7.b,c,h,j,k (Celtic Sea, southwestern Ireland and Porcupine Bank)

Landa, J., Antolínez, A., Castro, B., Hernández, C.

- Weight-length relationships, weight conversion factors and condition factor are presented from a decade (2006 to 2015) for both stocks of black anglerfish (Lophius budegassa) in northern Iberian Atlantic waters (ICES Div. 8.c-9.a) and in Celtic Sea, southwestern Ireland and Porcupine Bank (ICES Div.

7.b,c,h,j,k). A total of 2035 and 1263 specimens were sampled respectively in each stock from commercial landings and research surveys. Total length [Lt (cm)], total weight [Wt (g)], "commercial" weight (gutted with liver) [Wgl (g)] and "scientific" weight (gutted without liver) [Wg (g)] were obtained.

- The weight-length relationships for the combined sexes were: Lt = 0.020 Wt2.916; Lt = 0.017 Wgl2.929; Lt = 0.017 Wg2.922 in Div. 8.c-9.a, and Lt = 0.025 Wt2.841; Lt = 0.013 Wgl2.984; Lt = 0.013 Wg2.971 in Div. 7.b,c,h,j,k.
- The conversion factors (total weight - gutted weight), useful in fisheries management due to the commercial landings of this species are available in gutted weight, were: Wt = 1.186 Wgl; Wt = 1.236 Wg in Div. 8.c-9.a, and Wt = 1.187 Wgl; Wt = 1.233 Wg in Div. 7.b,c,h,j,k.
- These updated values can be used in the process of the annual assessment of the state of both stocks in the ICES Working Group.
- The evolution of the condition factor over the year, indicator of nutritional status evolution, is also estimated for immature and mature individuals of each sex, showing some seasonal variation.
- The results are similar to the previously estimated in other studies.

WD 10 Maturity-at-age estimates for Irish Demersal Stocks in 6.a and VIIabgj 2004-15

Hans Gerritsen

This document provides maturity-at-age estimates for stocks assessed by the WGCSE and WGBIE. All data are obtained on surveys and commercial sampling carried out by the Marine Institute.

Annex 07 Stock Data Problems

Stock Data Problems Relevant to Data Collection – WGBIE

Stock	Data Problem	How to be addressed in	By who[1]
Stock name	Data problem identification	Description of data problem and recommend solution	Who should take care of the recommended solution and who should be notified on these data aresue.
anb-78	Commercial landings data	Different levels of aggregation of métiersyear on year which will affect the data by species. Additional national data submitted for anglerfish species combined, not separated by the different species, which will affect the raising of the data to species. Different aggregation of length groups with implications to the length distribution Additional national data submitted during the meeting related to number of samples and fish measured in the market sampling and observer national programmes. Ask countries to document their methodology and any changes in their aggregation level of métiers if needed to be changed from previous data submitted. Ask countries to resubmit data for anglerfish species separate, national laboratories would be best qualified to distribute data in between the two stocks anb-78 and anp-78. Further explaination on how the division was made (how many samples/measurements were based on) should be provided to the WG. Ask countries to resubmit data accordingly to only WGBIE requirements and before the data call deadline	National laboratories

[1] Recommendations on surveys for be addressed by the SCICOM Steering Group on Ecosystem Surveys, Science and Technology (SSGESST)

Stock	Data Problem	How to be addressed in	By who1
anb-78	Survey data	EHVOE survey data different for 2011 with new survey index for that year provided during the WG meeting. EHVOE survey data for 2015 revised due to discrepancies in the length-weight relationship used to calculate biomass. New index provided during the WG meeting for this year. Ask countries to ensure survey data are QA/QC before submission and submitted accordingly before the data call deadline.	National laboratories
anp-78	Commercial landings data	Different levels of aggregation of métiers year on year which will affect the data by species. Additional national data submitted for anglerfish species combined, not separated by the different species, which will affect the raising of the data to species. Different aggregation of length groups with implications to the length distribution Additional national data submitted during the meeting related to number of samples and fish measured in the market sampling and observer national programmes. Ask countries to document their methodology and any changes in their aggregation level of métiers if needed to be changed from previous data submitted. Ask countries to resubmit data for anglerfish species separate, national laboratories would be best qualified to distribute data in between the two stocks anb-78 and anp-78. Further explaination on how the division was made (how many samples/measurements were based on) should be provided to the WG. Ask countries to resubmit data accordingly to only WGBIE requirements and before the data call deadline	National laboratories
anp-78ab	Survey data	EHVOE survey data different for 2011 with new survey index for that year provided during the WG meeting. Ask countries to ensure survey data are QA/QC before submission and submitted accordingly before the data call deadline.	National laboratories

STOCK	DATA PROBLEM	HOW TO BE ADDRESSED IN	BY WHO1
Hke-nrth	Different length distribution aggregation	Ask countries to resubmit data at the appropriate aggregation level	National laboritories
anp8c9	The 2013-2015 values from the lpue series from Spain (A Coruña fleet) were not used in the assessment because of a change in the data source	Ask Spain to estimate the longest series available(before year 2013) with the new data source and methodology.	National laboratories
anb8c9	The 2013 - 2015 values from the lpue series from Spain (A Coruña fleet) were not used in the assessment because of a change in the data source.	Ask Spain to estimate the longest series available(before year 2013) with the new data source and methodology.	National laboratories
ple89a	None		
pol89a	None		
Whg8a	French data in Intercatch (1139t) were considerably lower than the preliminary official landings (1597t), suggesting that not all data were uploaded	Upload all landings data to IC	Ifremer