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

4–11 May 2017

Cadiz, Spain

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

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Executive Summary

The ICES Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE) met in Cádiz, Spain during 4–11 May 2017. There are now 23 stocks in its remit distributed from ICES Divisions 3.a–4.a though mostly distributed in Sub Areas 7, 8 and 9. There were 22 participants, some of whom joined the meeting remotely. The group was tasked with conducting assessments of stock status for 23 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 2017 for eighteen stocks, two of which the advice will be delayed until October. 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 one of the northern and both southern stocks of megrim and sole in the Bay of Biscay. 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 stock of anglerfish and an age-length structure model was used for the first time for the European seabass in the Bay of Biscay. Analytical assessments for the northern stocks of anglerfish have not been provided since 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 catch, commercial lpue or CPUE data and from survey information.

Two *nephrops* stocks from the Bay of Biscay and the Iberian waters and European seabass in the Bay of Biscay were benchmarked and category 1 assessment methods have been agreed. All stock of anglerfish are due to be benchmarked early 2018 and the WGBIE meeting spent some time reviewing the progress towards the benchmark (see Annex 6) together with longer term benchmarks (2019 and after, see section 1.) for the two stocks of hake stocks and *nephrops* in FU25 assessed by the WG.

A recurrent issue significantly constrained the group's ability to fully 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, the assessments carried out in National Laboratories prior to the meeting as mentioned in the ToRs had to be re-run to incorporate the major changes. 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 assessment

1 Introduction

1.1 Participants

NAME	COUNTRY
Esther Abad	Spain
Ricardo Alpoim	Portugal
Santiago Cerviño	Spain
Mickael Drogou	France
Spyros Fifas	France
Dorleta Garcia	Spain
Hans Gerritsen*	Ireland
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Sarah Louise Miller	ICES Secretariat
Joao Figueiredo Pereira	Portugal
Lisa Readdy	UK (Chair)
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Cristina Silva	Portugal
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***By correspondence**

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

2017/2/ACOM12: The Working Group for the Bay of Biscay and Iberian Waters Ecoregion (WGBIE), chaired by Lisa Readdy (UK), will meet in Cádiz, Spain, 4–11 May 2017 to:

1) Address generic ToRs for Regional and Species Working Groups;

2) Review and assess the progress on the benchmark preparation of southern hake and anglerfish stocks;

3) Analyse the data available on *Solea* species in Divisions 8.c and 9.a at a species-specific level;

4) Estimate MSY proxy reference points for the category 3 and 4 stocks in need of new advice in 2017 (see table below).

i) Collate necessary data and information for the stocks listed below prior to the Expert Group meeting. An official ICES data call was made for length and select life history parameters for each stock in the table below;

ii) Propose appropriate MSY proxies for each of the stocks listed below by using methods provided in the ICES Technical Guidelines (i.e. peer reviewed methods that were developed by WKLIFE V, WKLIFE VI, and WKProxy) along with available data and expert judgement.

Stock code	Stock name description	EG	Data Category
Nep-2829	Norway lobster (*Nephrops norvegicus*) in Division 9.a, functional units 28–29 (Atlantic Iberian waters East and southwestern and southern Portugal)	WGBIE	3.2

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 22 March 2017 according to the Data Call 2017.

WGBIE will report by 25 May 2017 for the attention of ACOM.

Fish Stock	Stock Name	Stock Coordinator	Assess. Coord. 1	Assess. Coord. 2	Advice
anp-78ab	Anglerfish (*Lophius piscatorius*) in Divisions 7.b-k and 8.a,b	Spain	France	UK	Saly
anb-78ab	Anglerfish (*L. budegassa*) in Divisions 7.b-k and 8.a,b	UK	Ireland	Spain	Saly
anb-8c9a	Anglerfish (*L. 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	Seabass in Divisions 8.a,b	France	France	none	Update
bss-8c9a	Seabass in Divisions 8.c and 9.a	France	France	none	Update
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
mgb-78	Megrim (*L. boscii*) in Subarea 7. & Divisions 8.a,b,d,e	Ireland	Ireland	None	New assessment
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	Update
whg-89a	Whiting in Subarea 8. and Division 9.a	Ireland	Ireland	none	Update
pol-89a	Pollack in Subarea 8. and Division 9.a	France	France	none	Update
sol-8c9a	Sole in Divisions 8.c and 9.a	Portugal	Portugal	none	Update
nep-2324	*Nephrops* in Divisions 8.a,b (Bay of Biscay, FU 23, 24)	France	France	none	Update[1]

nep-25	*Nephrops* in North Galicia (FU 25)	Spain	Spain	none	Saly
nep-31	*Nephrops* in the Cantabrian Sea (FU 31)	Spain	Spain	none	Saly
nep-2627	*Nephrops* in West Galicia and North Portugal (FU 26-27)	Spain	Spain	Portugal	Saly
nep-2829	*Nephrops* in Southwest and South Portugal (FU 28-29)	Portugal	Portugal	Spain	Update

1. Update assessment due in October 2017

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) also assessed by the working group (WG). 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 2016 and 2017. Since 2015 there has been a decline in landings to 35 575 t and 30 638 t for 2015 and 2016, respectively.

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). Seven surveys are available, covering a large part of the distribution area of the stocks, with some 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 a number of years with the last year of good recruitment in 2014. The strong recruitment between 2008 to 2010identified in the WVHOE-WIBTS-Q4 survey have entered the fishery giving some 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 with uncertainty around recruitment in 2015 and 2016 with contradictory signals from the different surveys presented.

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. The EVHOE-WIBTS-Q4 shows evidence of large recruitment in 2011, 2012 and 2013 and lower level for 2014to 2016, similar to those seen historically. Length frequency distributions from the available surveys show contradictory signals for 2009, 2011 and 2012 recruitments, but the working group considers that the trend of EVHOE-WIBTS-Q4 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 2016 were 2 802 t. The combined TAC was set at 2 569 t in 2016 and 2 955 t in 2017.

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 stock synthesis 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 2017 the biomass is estimated to be at 120% of B_{MSY}. Fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2016, 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 and L. boscii)* in Divisions 7.b-k and 8.a,b,d

Lepidorhombus spp. in Div. 7.b-k and 8.a, b, d are caught in a mixed demersal fishery catching anglerfish, hake and *Nephrops*, both as a targeted species and as valuable bycatch. The two species are landed and recorded together in ports' statistics. Information form landings samples was not available to provide a split for the two species; therefore, survey data was used. The 2016 and 2017 TAC were set at 19 101 t and 15 043 t respectively. Landings in recent years were relatively stable around 15 000 t. 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

The *L. whiffiagonis* is now assessed with a Bayesian catch-at-age model considered as a full analytical assessment since 2016. Catch, landing and discard data have varied without trend over the time-series the recent period show a slight decline to the lowest levels. Recruitment fluctuates without trend with 2015 giving above average values. Biomass has steadily declined to its lowest level in 2006, increasing since then. The 2016 is estimated to be the highest of the time series.

The *L. boscci* was added to the terms of reference for assessment for the first time this year. Data on catch, landings and discards, was not available to the group and official landings are recorded under the combined species of *lepidhorombus* spp. Data available from surveys did not provide adequate information to assess the status of the stock and advice is provided using the proportion of *l. boscii* in the combined *lepidhorombus spp*. from survey data and applying this to the advised catch of *l. whiffiagonis*.

Currently this stock is classified as a Data Limited Stock in category 6 as there very limited information from surveys and it is considered a bycatch species.

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 2016 were 1 717 t (of which 17% correspond to *L. whiffiagonis*). The agreed combined TAC for megrim and four-spot megrim in ICES Divisions 8.c and 9.a was 1 363 t in 2016 and 1 159 t in 2017.

The species are assessed separately, using XSA.

For *L. whiffiagonis* the assessment indicates that fishing mortality has increased since 2010. 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. There are indications of another high recruitment in 2015.

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 and 2016 the SSB is estimated to be among 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 around 100 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 values estimated in 2012 and 2016 (F=0.23 and 0.22, respectively). In 2014 and 2015, F increased to level seen in the historical time period (F=0.44 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 3 420 t for 2016 and 2017. Landings in 2016 declined further to 3 266 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 2016 F is estimated at 0.36, below F_{pa} and above 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 10 600 t 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 close to the GM93-14 (21 million). However, the 2012 and 2013 values are the lowest of the series (13 million). Since 2014, the recruitment is increasing.

Details on the assessment are in Section 7.

Sole in subdivisions 8.c and 9.a

Portugal and Spain are the main participants in these fisheries with *Solea solea* mainly caught with gillnets and trammelnets. In Portugal *Solea solea* is caught together with 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 689 t and 557 t for 2015 and 2016 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 107 500 t in 2016, the highest value of the time-series. Since 2009, landings have been above the agreed TAC.

The stock was benchmarked in 2014 (WKSOUTH, 2014) with one of the main objectives 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 according to the stock annex, and although the retrospective patterns are still present, the group accepted the assessment as appropriate for providing advice. The recruitment appears to fluctuate without substantial trend over the whole series with the 2008 estimated to be the highest of the time-series (734 million). In 2013, the recruitment decreased below mean level (318 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 2016 (390 234 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 0.26 in 2012 and have remained stable since.

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 2015 and 2016 were 11 790 t and 12 440 t, respectively. Total discards in 2015 were 2 290 t and 2 310 t in 2016, increasing from very low levels.

The southern hake stock was benchmarked in 2014 to address 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.

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 98 million ranging from 64 to 169 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=0.96). F then progressively decreased to reach 0.57 in 2016. The SSB was very high at the beginning of the time-series with values around 40 000 t, then decreased to a minimum of 5 800 t in 1998. Since then biomass has continuously increased, reaching 18 842 t in 2016, above the average of the series.

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 5 875 t in 1988 to 3 069 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 4 091 t in 2016. The agreed TAC for 2017 was 4 160 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 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 was benchmark in 2016 to review the methods proposed using an underwater TV survey. The outcome of this process classified the stock as a category 1 stock and the methods developed were appropriate for assessing the stock for the provision of advice.

No quantitative analytical assessment was carried out during the working group as the survey used for the assessment had not been completed. An update of the assessment will be carried out after the working group and advice provided in October.

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 46 t and 0 t for the whole Division 8.c for 2016 and 2017, 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 2016 from the five FUs combined were 413 t. The TAC set for the whole Division 9.a was 320 t and 336 t for 2016 and 2017.

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, 2012 quantities have been similar and at very low levels. 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 1975–2016. 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 five 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* are 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, declining 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 landings in 2009–2011 was stable at around 150 t, increasing to 283 t in the years 2012–2016.

According the ICES data-limited approach, this stock is classified in the category 3.2.0. The advice is based on survey, fishery Lpues and effort trends. Standardised 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 low levels. The fleet standardised lpue, used as an index of biomass, decreased in the period 2006–2011, increase since then. The proxy reference points where updated using the new lpue time-series, length data and catches the results indicate that the stock is exploited at levels below the F_{MSY} reference point.

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. 2016 landings have increased back to levels seen prior to this period with the inclusion of the unreported landings.

This stock was benchmark in 2016 to review the methods proposed using an underwater TV survey. The outcome of this process classified the stock as a category 1 stock and the methods developed were appropriate for assessing the stock for the provision of advice.

No quantitative analytical assessment was carried out during the working group as the survey used for the assessment had not been completed. An update of the assessment will be carried out after the working group and advice provided in October.

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 seabass in Division 8.a,b

Seabass 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, nets, pelagic trawlers, and in mixed bottom-trawl fisheries from November to April on pre-spawning and spawning grounds when seabass 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 can be considered negligible (<5%).

The seabass stock in the Bay of Biscay was benchmarked during WKBASS2017 and was classified as a category one stock with a full analytical assessment for the first time using an age-length based Stock Synthesis model (SS3; Methot 2000, 2011).

The assessment included both recreational and commercial landings and is tuned by a commercial landings per unit of effort series. Since 2000, commercial landings have fluctuated without trend and the recreational catch gives similar fluctuations and trends given that the values are based on the proportion of recreational to commercial landings in 2010.

The only available tuning index fluctuates without trend with the last three years showing a decline. Estimated biomass has been declining over the series with a slight increase from 2010 to 2013 followed by a decline to below B_{pa}. Recruitment is variable with 2013 and 2014 above the geometric mean of the time-series. Fishing mortality, estimated as age 4–15, has been increasing and has been above F_{MSY} since 2000.

Additional details can be found in Section 14.

European seabass in Division 8.c, 9.a

Spanish and Portuguese vessels represent almost all 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, provisional estimates of landings for 2016 are 947 t. A peak in landings is observed in 1989–90 and again in 2013, reaching more than 1 000 t, and lowest landings have been observed in 1980, 1981 and 1985 and more recently in 2003 (466 t). Discards from observer programmes show that discarding is negligible for this stock.

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 the update of the landings data do not change the perception of the stock. Advice for this stock is based on the precautionary approach applying a precautionary buffer the most recent advised catch. Landings are twice the advised catch and it is uncertain whether the 2018 and 2019 advice will have any impact on the stock given that this is not limited by management with only having a minimum landing size of 36 cm (EC regulation 850/98).

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 5.2.0 as only landings data are available. This year, the additional of landings and discards for 2015 and 2016 do not change the perception of the stock.

Additional details can be found in Section 16.

Pollack in Subarea 8. and Division 9.a

Pollack is mainly caught by France and Spain by several type of gears; nets, lines and trawls. Most of the landings are from gillnets fisheries. 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 classified as a Data Limited Stock in category 5.2.0 as the only available information is on catches. This year, the additional of landings and discards for 2015 and 2016 do not 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, provision 2016 landings, one of the highest of the time series, is estimated to be 2 525 t. Whiting has never been recorded in Spanish discards and is negligible in Portuguese discards. However, there are indications that 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.

The stock is classified as a Data Limited Stock in category 5.2.0 as the only available information is on catches. This year, the additional of landings and discards for 2015 and 2016 do not change the perception of the stock.

Additional details can be found in Section 18.

1.4 Available data

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 during the working group were resubmitted. 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 stock coordinators and assessors where data were continuously resubmitted during the working group. The working group (WG) recommends that a basic data check be carried out by the data providers before uploading the data in to InterCatch, see Annex 2 for the full list of recommendations.

For most of the stocks assessed by WGBIE, InterCatch was used mainly to download unraised 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 section 1.5, the species sections and 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 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, for the last three years working groups the files were processed 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 to extract and raise the data held within InterCatch.

1.7 Assessment and forecast auditing process

WGBIE carried out the standard audits of individual assessments and forecasts were available for all category 1 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. Only minor corrections were raised by the auditors and these were corrected accordingly.

1.8 Stock annexes

All stocks assessed by this WG have a stock annex.

1.9 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
Anglerfish (*Lophius budegassa*) in Divisions 7.b-k and 8.a,b,d	Update	WKFLAT 2012	Data compilation		All Anglerfish together
Anglerfish (*L. piscatorius*) in Divisions 7.b-k and 8.a,b,d	Update	WKFLAT 2012	Data compilation		All Anglerfish together
Anglerfish (*L. budegassa*) in Divisions 8.c and 9.a	Update	WKFLAT 2012	Data compilation		All Anglerfish together
Anglerfish (*L. 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	
Nephrops in FU 25				Yes	

1.9.1 Benchmark planning

The WG reviewed the stocks to be benchmarked during 2018 and agreed that these should continue as planned. As part of the review 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 hake. It was however not possible during the WG to make a proposal for external experts.

The updated tables and relevant comments regarding the 2018 and 2019 benchmarks are included in Annex 06 ("Benchmark planning").

1.9.2 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 2019-20, the group proposed a benchmark for Nephrops FU 25 to review new information and further develop the assessment methods used.

1.10 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 22–26 May will update the Iberian mixed fisheries analysis carried out in 2016. The WG also noted that mixed fishery analyses of the Bay of Biscay requires some development.

The WG reviewed the fisheries overview advice and provided additional fisheries information for each of the countries and metiers for the species within the Bay of Biscay and Iberian Waters ecoregion.

1.11 Ecosystem overviews

During, 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. This year WGBIE reviewed the 2016 released advice and provide further feedback comments and edits for consideration.

1.12 Research needs of relevance for the expert group

The group assess a number of data limited stocks classified as category 5 and 6, of which there are 5. In order to assess these stocks and their status in relation to biological reference points they would require survey or commercial indices of abundance or biomass to appropriately advice on fishing opportunities in the following year. Research on the development of appropriate biomass or abundance indices for stocks where standard surveys are not appropriate due to catchability issues would be required.

For the hake and anglerfish stocks further studies are required to better understand the biology of these species over time such as growth, maturity, length-weight and natural mortality. To fully make use of new research on these stocks it would be beneficial to focus on developing appropriate assessment methods and reviewing the performance of such models through comprehensive sensitivity analyses.

Mixed-fisheries is an important aspect for the species assessed within the group. Mixed fisheries models have been developed for the Celtic sea and Iberian ecoregions and the group recommended that a mixed-fisheries model with advice should be developed for the Bay of Biscay.

1.13 Upgrade of category 3 to category 1 stock assessment

Table 2.1.1. Template to identify potential candidate stocks for category 1 assessment.

- Which is the current category number (3 or 4)? **3**
- Are there already plans for a benchmark in 1–2 years?
  The plan was to be benchmarked in 2016. It was included in the Data Evaluation Workshop in June 2016, but failed to make it to the WKNEPH in October 2016, due to unforeseen problems of the stock coordinator being unable to attend which could not be replaced.
- What are the necessary requirements to do the upgrade to category 1?
  - Resources needed: **Guidance and reviewing expertise**
    - Within ICES – **Confirmed: Stock coordinator: Portugal; stock assessors: Portugal; Survey experts: UK (by correspondence)**
    - Outside ICES
  - Drivers for the process leading up to category 1:
    - Revised stock identification and delineation – **done**
    - New data that can be made available – A**vailable data include:**
      - **Landings since 1975, more reliable series 1984-2016**
      - **Landings length compositions 1984-2016 by sex**
      - **Onboard sampling data, discards negligible**
      - **Survey indices Crustacean Bottom Trawl Survey 1997-2016**
      - **Standardized CPUE 1998-2016 and derived standardized effort for the same period (from the analysis of logbooks and VMS data)**
      - **Fishing grounds defined based on VMS information**
      - **Spatial distribution of effort, spatial distribution of nominal CPUE**
      - **Data on substrate sediment composition of the fishing grounds**
      - **L_{50} and maturity ogive for females and L_{50} for males**
      - **Growth parameters and Natural Mortality (from tagging)**
      - **Survival studies**
      - **Weight ~ Length relationship parameters**
    - Want to achieve models with assessment and reference points – **Y**es
    - Want to achieve models with forecasts (according to management requirements) – **Yes**
  - Could there be sufficient data suitable for age or length based models and forecast?
  - Necessary information on stock identity/delineation – **Yes**
  - Catch/landings by age or length time series (incl. levels of sampling) – **Yes**
  - Fishery independent and/or fishery dependent index time series by age or length (representative of stock development; adequate time series, ability to track cohorts) – **Yes**
  - Weight, maturity and natural mortality at age or length – **Yes**
- Could there be sufficient data suitable for surplus production models and forecast?
  - Necessary information on stock identity/delineation – **Yes**
  - Catch/landings time series with sufficient contrast in data (taking into account discards and their causes) – **Yes**
  - Fishery independent and/or fishery dependent index time series (exploitable biomass; representative of stock development; adequate time series) with sufficient contrast - **Yes**

- Potentially standardized effort data time series (i.e. taken care of issues such as technical creep… i.e. so that it could be consider as an indicator of F) – **Yes**
- If available, are the diagnostics of a preliminary SPiCT (or similar surplus production model) assessment ok? (including uncertainty and retro pattern of F/FMSY and B/BMSY) – **SPiCT was tested with this stock in WKLIFE-V and reported residual diagnostics were considered appropriate**
- If necessary potential priors on model external or internal parameters

- Integrated stock assessment models (*i.e.* flexible models that can combine various types of biological and fishery data, *e.g.* data on age-frequencies, length frequencies, age-at-length, growth, fecundity, biomass indices, tagging data, etc, and often allow for considerable data gaps; such models may *e.g.* be developed with the Stock Synthesis software) considered? **No, it was considered that SS3 was not appropriate for *Nephrops* stocks.**
- Assessment and forecasts consistent with client management needs

  Yes

CONCLUSIONS: Can be considered as potential candidate for Category 1.

Table 1.4a Biological sampling levels by stock and country. Number of fish measured and aged from landings in 2016.

		Angler (L.pisc.)		Angler (L.bude.)		Megrim (L.whiff.)		Megrim (L. l	Sole (S. solea)	
		7.b–k & 8.a,l	8.c & 9.a	7.b–k & 8.a,l	8.c & 9.a	7.b–k & 8.a,l	8c & 9a	8.c & 9.a	8.a,b	8.c & 9.a
Belgium	No. lengths	9179		5299		7960			15226	
	No. ages					636			379	
	No. samples**	26		25		25			4	
E & W (UK)	No. lengths	12174		3412		27917				
	No. ages	124		66						
	No. samples*	120		66		681				
France	No. lengths	15944		10763		22041			24818	
	No. ages								1603	
	No. samples*	1027		620		691			344	
Portugal	No. lengths		157		987		67	3534		5612
	No. ages***									
	No. samples*		45		66		7	63		276
Republic of	No. lengths	3359		3359		12558				
Ireland	No. ages									
	No. samples**	95		95		101				
Spain	No. lengths	3871	5871	9683	2883	2347	**4596**	21318		
	No. ages						736	686		
	No. samples	37	256	36	224	15	92	136		

		Angler (L.pisc.)		Angler (L.bude.)		Megrim (L.whiff.)		Megrim (L. l	Sole (S. solea)	
		7.b–k & 8.a,l	8.c & 9.a	7.b–k & 8.a,l	8.c & 9.a	7.b–k & 8.a,l	8c & 9a	8.c & 9.a	8.a,b	8.c & 9.a
Belgium	No. lengths	14141.495	15136.336	16131.178	17126.019	18120.86	19115.701	20110.542	21105.383	
	No. ages					122			-135	
	No. samples	5.4392523	2.3738318	-0.6915888	-3.7570093	-6.8224299	-9.8878505	-12.953271	-16.018692	
E & W (UK)	No. lengths	26308.25	30244	34179.75	38115.5	42051.25				
	No. ages	8		-50						
	No. samples	709.75	850	990.25	1130.5	1270.75				
France	No. lengths	26262.561	27919.626	29576.692	31233.757	32890.822	34547.888	36204.953	37862.019	
	No. ages								1603	
	No. samples	261.28972	175.14019	88.990654	2.8411215	-83.308411	-169.45794	-255.60748	-341.75701	
Portugal	No. lengths		5373.0274		6873.7671		8374.5068	9124.8767	9875.2466	10625.616
	No. ages***									
	No. samples*		206.19178		258.36986		310.54795	336.63699	362.72603	388.81507
Republic of	No. lengths	13324.583		17924.083		22523.583				
Ireland	No. ages									
	No. samples	101.5		104.5		107.5				
Spain	No. lengths	13289.143	14805.393	16321.643	17837.893	19354.143	**20870.393**	22386.643		
	No. ages						636	586		
	No. samples	106.28571	104.42857	102.57143	100.71429	98.857143	97	95.142857		

Table 1.4a Biological sampling levels by stock and country. Number of fish measured and aged from landings in 2016 (continued)

		Angler (L.pisc.)		Angler (L.bude.)		Megrim (L.whiff.)		Megrim (L. l	Sole (S. solea)	
		7.b–k & 8.a,l	8.c & 9.a	7.b–k & 8.a,l	8.c & 9.a	7.b–k & 8.a,l	8c & 9a	8.c & 9.a	8.a,b	8.c & 9.a
Denmark	No. lengths									
	No. ages									
	No. samples									
Total	No. lengths	44527		32516						
	No. ages	124		66						
Total nb. in international landings ('000)		21046	327		340					
Nb. measured as % of annual nb. caught										

		Angler (L.pisc.)		Angler (L.bude.)		Megrim (L.whiff.)		Megrim (L. l	Sole (S. solea)	
		7.b–k & 8.a,l	8.c & 9.a	7.b–k & 8.a,l	8.c & 9.a	7.b–k & 8.a,l	8c & 9a	8.c & 9.a	8.a,b	8.c & 9.a
Denmark	No. lengths									
	No. ages									
	No. samples									
Total	No. lengths	20505		8494						
	No. ages	8		-50						
Total nb. in international landings ('000)		-8535.8571	-14450.929	-20366	-26281.071					
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*			Seabass		Pollack	Whiting	Plaice
		3.a, 4, 6, 7 &	8.c & 9.a	8.ab FU 23-2	8.c FU 25-31	9.a FU 26-30	8.ab	8.c & 9.a	8 & 9.a	8 & 9.a	8 & 9.a
Scotland (UI	No. lengths	1997									
	No. ages	-									
	No. samples	74									
E & W (UK)	No. lengths	27247									
	No. ages										
	No. samples	825									
France	No. lengths	27375		30866					118	???	???
	No. Ages***	-							1153		
	No. samples	1232		756						???	???
Portugal	No. lengths	-	21098			9104					2233
	No. ages***	-									
	No. samples	-	466			40					92
Republic of	No. lengths	8487									
Ireland	No. ages*****										
	No. samples	143									
Spain	No. lengths	42317	58755		4395	1870			17	521	
	No. ages		1173								
	No. samples	127			33	30				8	
Denmark	No. lengths	11456									
	No. ages										
	No. samples	225									
Total	No. lengths	144941								521	2233
	No. ages										
Total No. in international		55466	63715		300	6224					
Nb. meas. as % of annual :		0.26%	0.92		1.50%	0.20%					

*** 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 2016

		Angler (L.pisc.)		Angler (L.bude.)		Megrim (L.whiff.)		Megrim (L. boscii)	Sole (S. solea)	
		7.b–k & 8.a,b,d	8.c & 9.a	7.b–k & 8.a,b,d	8.c & 9.a	7.b–k & 8.a,b,d	8.c & 9.a	8.c & 9.a	8.a,b	8.c & 9.a
Belgium	No. lengths	5569		2885		5142				
	No. ages					204				
	No. samples	26		25		25				
E & W (UK)	No. lengths					5281				
	No. ages	165		101		295				
	No. samples	110		110		470				
France	No. lengths			837		2229				
	No. ages									
	No. samples			150		297				
Portugal (a)	No. lengths									
	No. ages									
	No. samples									
Republic of	No. lengths	1583		2801		2745				
Ireland	No. ages									
	No. samples	35		35		32	245	403		
Spain	No. lengths	68	31	776	10	5557	882	3305		
	No. ages									
	No. samples	357	103	357	168	357				
Denmark	No. lengths									
	No. ages									
	No. samples									
Total	No. lengths	5569		7299						
	No. ages									
Total no. in international discards ('000)										
Nb. meas. as % of annual nb. Discarded										

Table 1.4b (continued)

		Hake		*Nephrops*			Seabass		Pollack	Whiting	Plaice
		3.a, 4, 6, 7 & 8.a,b	8.c & 9.a	8.ab FU 2324	8.c FU 2531	9.a FU 26-30	8.ab	8.c & 9.a	8. & 9.a	8 & 9.a	8 & 9.a
Scotland (UK)	No. lengths	6545									
	No. ages										
	No. samples	132									
E & W (UK)	No. lengths	883									
	No. ages										
	No. samples	329									
France	No. lengths	6109		3108			190		51		
	No. Ages										
	No. samples	794		117					37		
Portugal (a)	No. lengths					6997					
	No. ages										
	No. samples					37					
Republic of	No. lengths	1736									
Ireland	No. ages										
	No. samples	43									
Spain	No. lengths	4216				6838					
	No. ages										
	No. samples	467				18					
Denmark	No. lengths	951									
	No. ages										
	No. samples	122									
Total	No. lengths	51395				13835					
	No. ages										
Total no. in international discards ('000)		0.17%									
Nb. meas. as % of annual nb. Discarded											

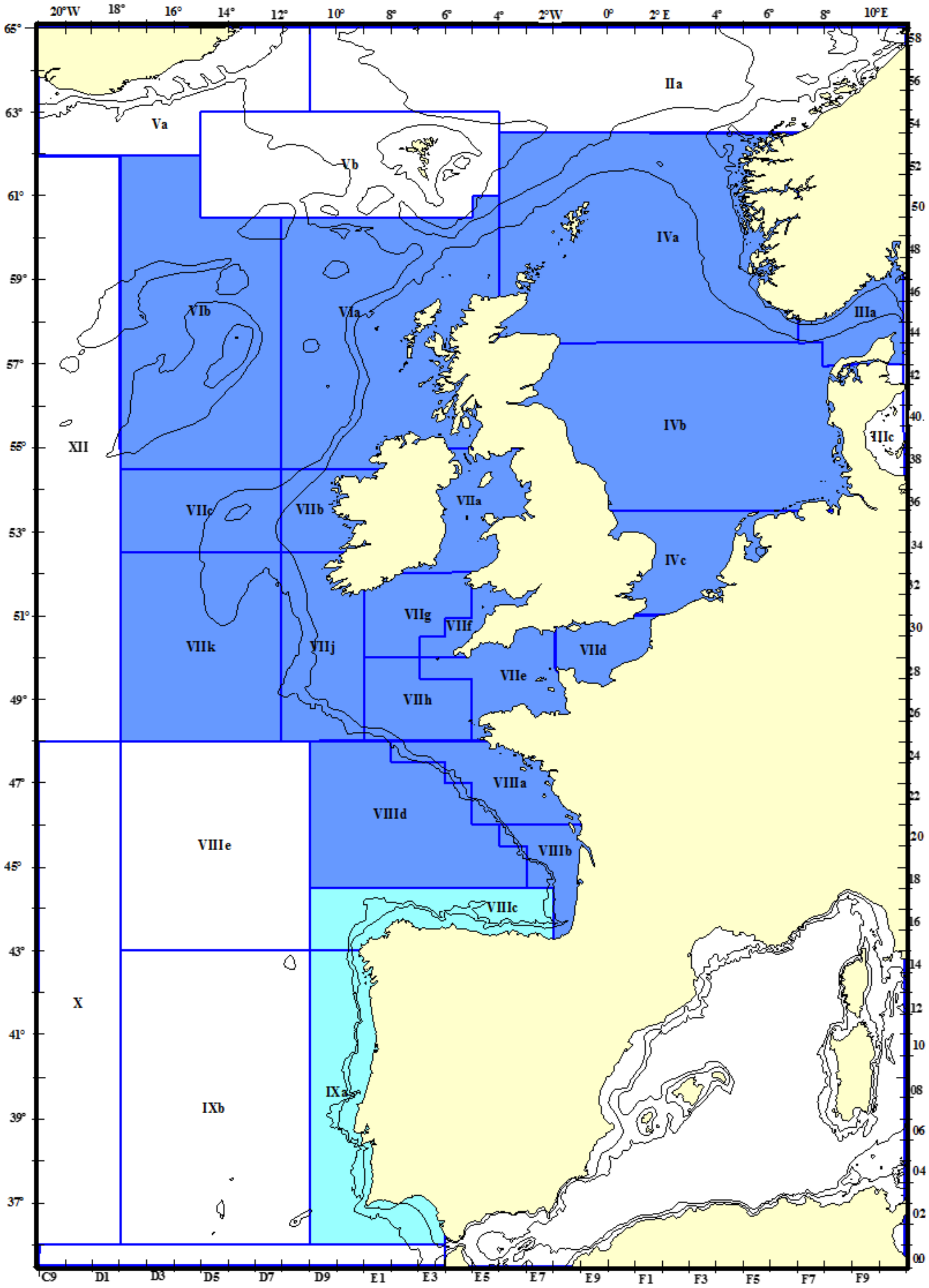


Figure 0.1. Map of ICES Divisions. Northern (3.a, 4, 6, 7. and 8.abd) and Southern (8.c and 9.a) Divisions with different shading.

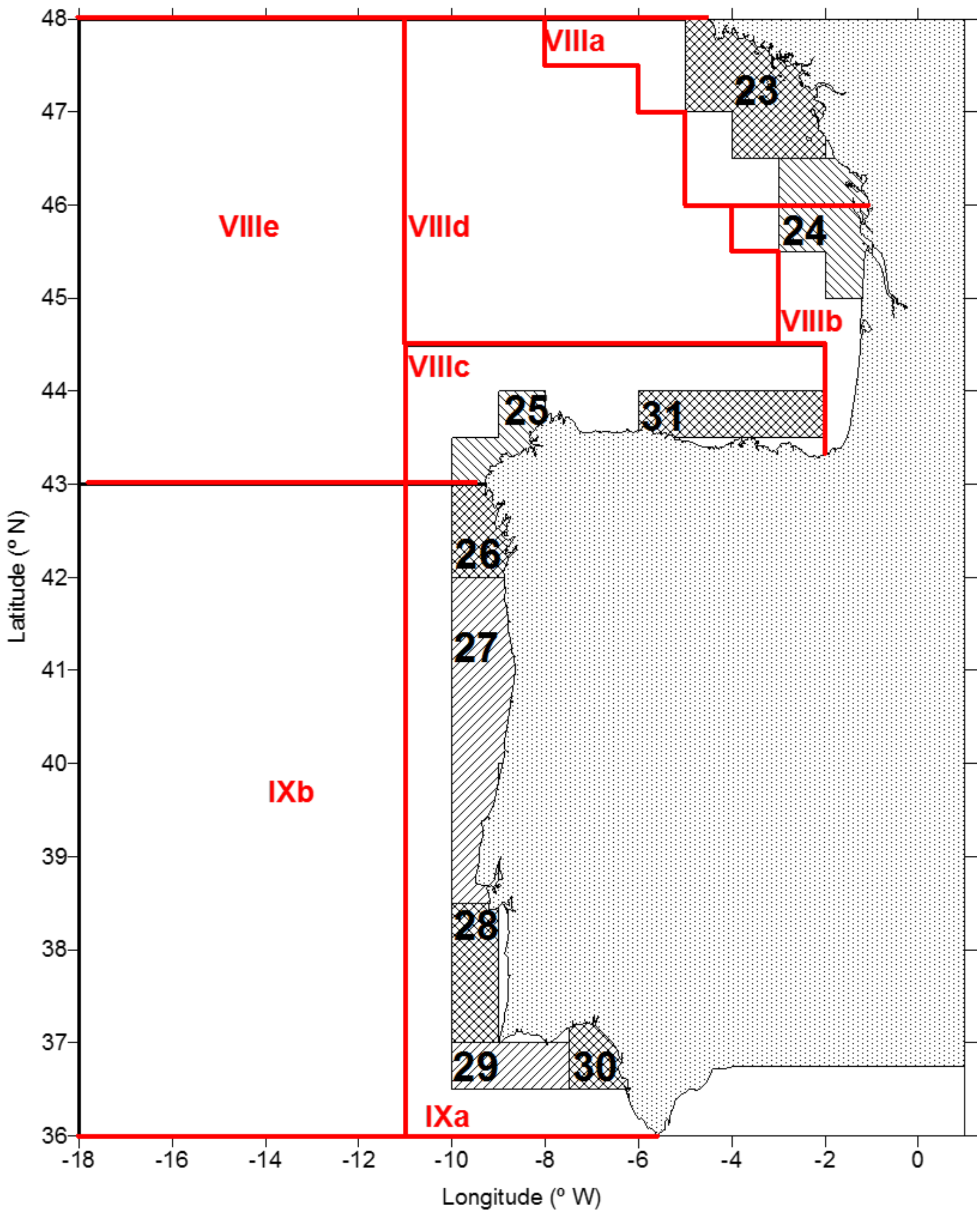


Figure 1.2. ICES Division 8, 9.a. Nephrops Functional Units. Division 8.ab (Management Area N): FUs 23–24. Division 8.c (Management Area O): FUs 25 and 31. Division 9.a (Management Area Q): FUs 26–30.

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 both 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	X
FU5	OTB_DEF		Otter trawl directed to demersal Fish shallow water				X
FU6	TBB_DEF		Beam trawl		X		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	X	
FU14	OTB_DEF	OTB_DEF_>=70_0_0	Bottom otter trawl directed to demersal fish (at least 70 mm)	X	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	X		
	OTB_CRU	OTB_CRU _>=70_0_0	Bottom otter trawl directed to crustaceans (at least 70 mm)	X	X		
	OTT_CRU	OTT_CRU _>=70_0_0	Multi-rig otter trawl directed to crustaceans (at least 70 mm)	X	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	

FU	Fleet for InterCatch	DCF MÉTIER (Level 6)	DESCRIPTION	FR	IR	SP	UK
FU15	SSC_DEF		Fly shooting seine directed to demersal fish		X		
FU16	OTB_DEF	OTB_DEF _100-119_0_0	Bottom otter trawl directed to demersal fish (100-119 mm)	X	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		X		
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 (SPGFS-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 fishing 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 2016: Same Advice as Last Year (SALY).

Data revisions this year: The EVHOE-WIBTS-Q4 survey time series index, length frequency data and spatial distribution maps were updated for both *L. piscatorius* and *L. budegassa* from 1997-2016. The main reason relates to changes in the final step indices calculation recently developed using R software, which may have created rounding issues, with additional historical data QA/QC procedures recently done as data are to be moved into a new central database. Length frequency data were estimated by the WG as data provided were by area and by sex, with no total values, so WG followed the methodology of the previous years but revision may be required to assure it follows current survey data collection protocol.

Effort and LPUE for 2015 SP-BAKON8 fleet were made available to the WG. Estimated Irish landings for *L. budegassa* were revised for 2015.

Review Group issues:

The University of Maine RG noted that the biomass index estimated by the IGFS-WIBTS-Q4 surveys should be used instead of abundance, these estimates will be revised during the benchmark of 2019. RG commented about the methodology used to estimate the reference points, but this analysis was done during ICES (2016). The RG mentioned for either one or both stocks issues with catch estimations, commercial tuning indices, survey indices and more relevel biological information (especially for *L. budegassa* where reference points are currently unavailable) should be considered. The WG hopes to address the majority of these issues in time for the benchmark early in 2018.

3.1 General

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

ICES advice for 2017

Lophius piscatorius

ICES advises that when the precautionary approach is applied, landings in 2017 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 2017 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 2017 and 2018

The TAC applied to both species and including Division 7.a was set at 42 496 t for 2017 and 2018.

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. However, since 2014 to 2016 there has been a decrease, with 30 638 t in 2016. In 2014 and 2015, estimated landings in Subarea 7 were stable ca. 27 900 t but in 2016 landings decreased to 22 789 t, with an apparent increase from 2015 to 2016 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 effect 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 2015 and 2016. This information shows that an increasing proportion of small fish of both species are caught and discarded. See sections 3.2.1.1 and 3.3.1.1 for more detail. After an extensive analysis of discard data by WKFLAT 2012, historic 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 for advice purposes.

Table 3.1-1. Anglerfish in Divisions 7.b-k and 8.a,b,d -Total landings from 1984–2016: 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	7909	36 756
1985	28 491	7161	35 652
1986	25 987	5897	31 883
1987	22 295	7233	29 528
1988	22 494	5983	28 477
1989	24 674	5276	29 950
1990	23 434	5950	29 384
1991	20 256	4684	24 940
1992	17 412	3530	20 942
1993	16 517	3507	20 024
1994	18 023	3841	21 864
1995	21 822	4862	26 684
1996	24 153	6102	30 255
1997	23 928	5846	29 774
1998	23 295	4876	28 171
1999	21 845	3143	24 988
2000	18 129	2456	20 585
2001	19 534	2875	22 409
2002	22 648	3571	26 220
2003	28 552	4681	33 233
2004	29 510	5640	35 150
2005	27 908	5167	33 075
2006	26 795	4823	31 618
2007	30 121	5213	35 334
2008	26 724	5032	31 756
2009	22 733	5193	27 926
2010	23 338	5542	28 880
2011	22 458	5900	28 357
2012	24 370	9004	33 373
2013	25 994	10 861	36 855
2014	27 950	8251	36 200
2015*	27 909	7666	35 575
2016**	22 789	7849	30 638

* revised landings **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. Since 2011, estimates of unallocated or non-reported landings have been included in the table. These were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each metier.

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.

From 2011 to 2015 landings show an increasing trend with estimates ranging from 20 370 t to 25 266 t however, in 2016 estimated values decreased to 21 046 t.

Discard data were submitted by the main countries in the fishery for the years 2015 and 2016. However discard data were not available for all fleets, areas and seasons. Therefore the proportion of discards was only estimated for the fleets, areas and seasons where both landings and discard data were submitted (including cases where zero values were submitted). In 2015 40% of the landings did not have associated discard estimates; in 2016 this figure was 43%. Figure X shows that the main gear type with landings that were not paired with discard estimates was OTB. In 2015 the proportion of the discarded catch from the paired landings-discards was 8%; in 2016 this figure was 14%. A longer time-series over all fleets is required to determine whether these proportions are reasonable and consistent over time and therefore the WG cannot provide accurate catch advice at this time.

3.2.1.2 Commercial LPUE

Effort and LPUE data for the three Spanish fleets and English FU6 were available up to 2016 (Table 3.2-2 and Figure 3.2-1). For, the fleet SP-BAKON8 data for effort and LPUE were made available to this year's WG for 2015, previous change to e-logbooks reporting system prevented 2016 value to be available in time for the 2016 WG meeting. Data for this fleet were updated to include effort and lpue for 2015 and 2016. Fishing effort for most fleets showed a decrease until the mid–1990's. Effort remained relatively stable thereafter, from 2011 to 2016 a sharp decrease in SP-VIGO7 (75 % reduction) and SP-CORUTR7 (81 % reduction) was recorded maybe due to the vessels within 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 53% in 2015 but it increased again in 2016, 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 and 2016 decreased again by 53%.

3.2.1.3 Surveys data

The French EVHOE-WIBTS-Q4 survey

This survey covers the largest proportion of the area of stock distribution. The EVHOE-WIBTS-Q4 survey time series index, length frequency data and spatial distribution maps were updated for *L. piscatorius* from 1997–2016 .for reasons given in section 3. Standardized biomass and abundance indices are given in Figure 3.3-2. Although, these indices have been updated for the entire time series and presented to the WG in 2017 there seems to be no major differences. Length frequency data were estimated by the WG following the same methodology as previous years, as data provided were by area and by sex, without total values, but revision may be required to assure it follows current survey data collection protocol.

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. From 2014 to 2016 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 with a sharp decrease in 2016.

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, 2014 and 2015), 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 and 2016 recruitment is very low and they do not show signals of second age group (25–45 cm). The high peak at 20 cm of 2015 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 mainly found in the Bay of Biscay area, but in 2015 and 2016 they are mainly distributed in the Celtic Sea.

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, and in 2016 increased slightly.

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 2016 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 2016 the index shows the maximum of the series with 116.6 Nb/10 Km^2, and the length distribution of the catch shows two peaks at the smallest age-group 10-25 cm and in the second age group 25–45.

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, 2016a)
- Q1 Irish Beam trawl Ecosystem survey (IBES) (Gerritsen, H, 2016b).

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 ICES (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 ICES (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). In 2016 IGFS-WIBTS-Q4 and SPPGFS (WIBTS-Q3) survey show higher recruitment values than in 2015, but the estimated recruitment values for the EVHOE-WIBTS-Q4 survey are very low.

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 time series of length distribution from EVHOE-WIBTS-Q4, have been updated to take account of the changes outlined in section 3. The length distribution shows strong recruitment for 2001, 2002, 2004, 2008, 2009, 2010 , 2011, 2014 and 2015. Similar to the previous index estimates.

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. Preliminary analysis for 2015 and 2016 discards data were looked at for *L. piscatorius*. However, discard data were not available for all fleets, areas and seasons which means that only partial proportion of discards was estimated. Future submission of discards information over a longer time series and over all fleets will allow for a more extensive analysis of the estimates so that catch information can be presented with greater confidence.

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 three 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 2016. 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

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

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
2016*	2796	10889	515	2800	16	5	25	0	3994	5	21046

* preliminary

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

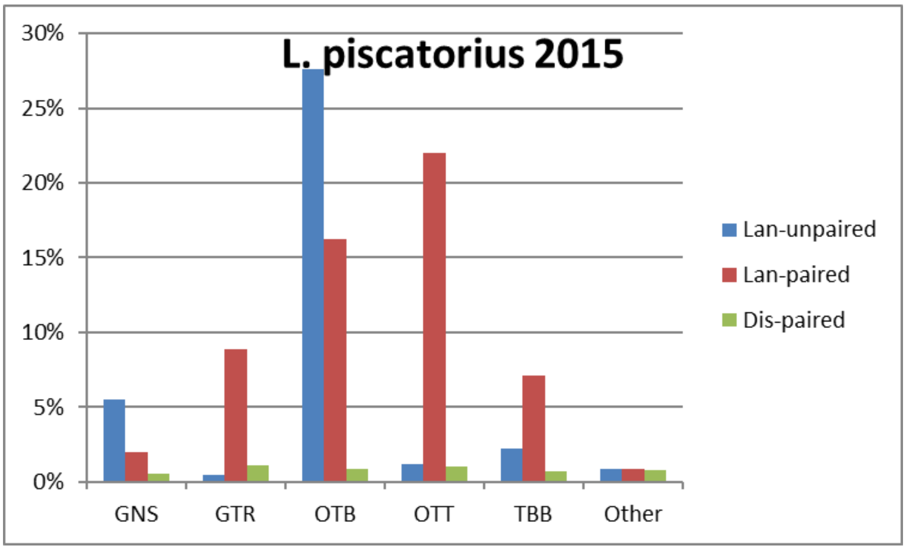
EFFORT	YEAR	SP-VIGO7	P-CORUTR	French Benth trawlers*	French Benthic Twin Trawls	French Benthic trawlers*	French Benthic Twin Trawls	EW FU06	SP-BAKON7	SP-BAKON8
		in Sub-Area V	Sub-Area V	Celtic Sea	Celtic Sea	Bay of Biscay	Bay of Biscay	m trawlers in VII		
				FU04		FU14				
		('000 days*HP	00 days*HP	('000 hrs)	('000 hrs)	('000 hrs)	('000 hrs)	('00 days)	(days)	(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		2106
	2016	1 103	314					151		1514

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

				French Benthic	French Benthic	French Benthic	ench Benthic				
LPUE	YEAR	Vigo	La Coruna	trawlers*	Twin Trawls	trawlers*	Twin Trawls	EW (FU06)	SP-BAKON7	SP-BAKON8	
		in Sub-Area V	Sub-Area V	Celtic Sea	Celtic Sea	Bay of Biscay	ay of Bisca	m trawlers ir			
				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		56	
	2016	726	845					124		77	

Table 3.2-3 *L. piscatorius* in Divisions 7.b-k and 8.a,b,d– Abundance indices in Nb/sq Km from 2003–2016 from the IGFS-WIBTS-Q4.

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	116.6



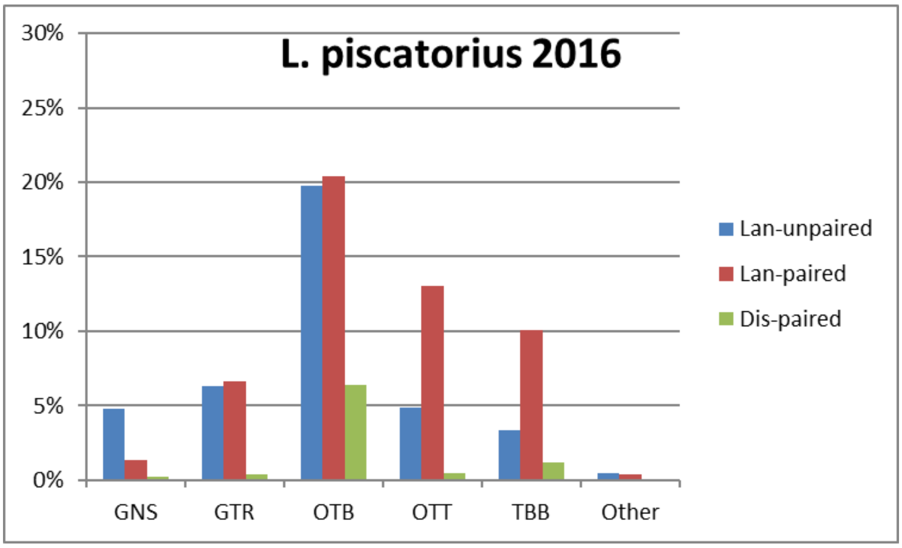


Figure X. Discards and landings of *L piscatorius* reported to ICES for 2015 and 2016. Landings strata that did not have matching discard estimates are shown in blue (Lan-unpaired); landings with matching discards are shown in red (Lan-paired) and discards are shown in green (Dis-paired).

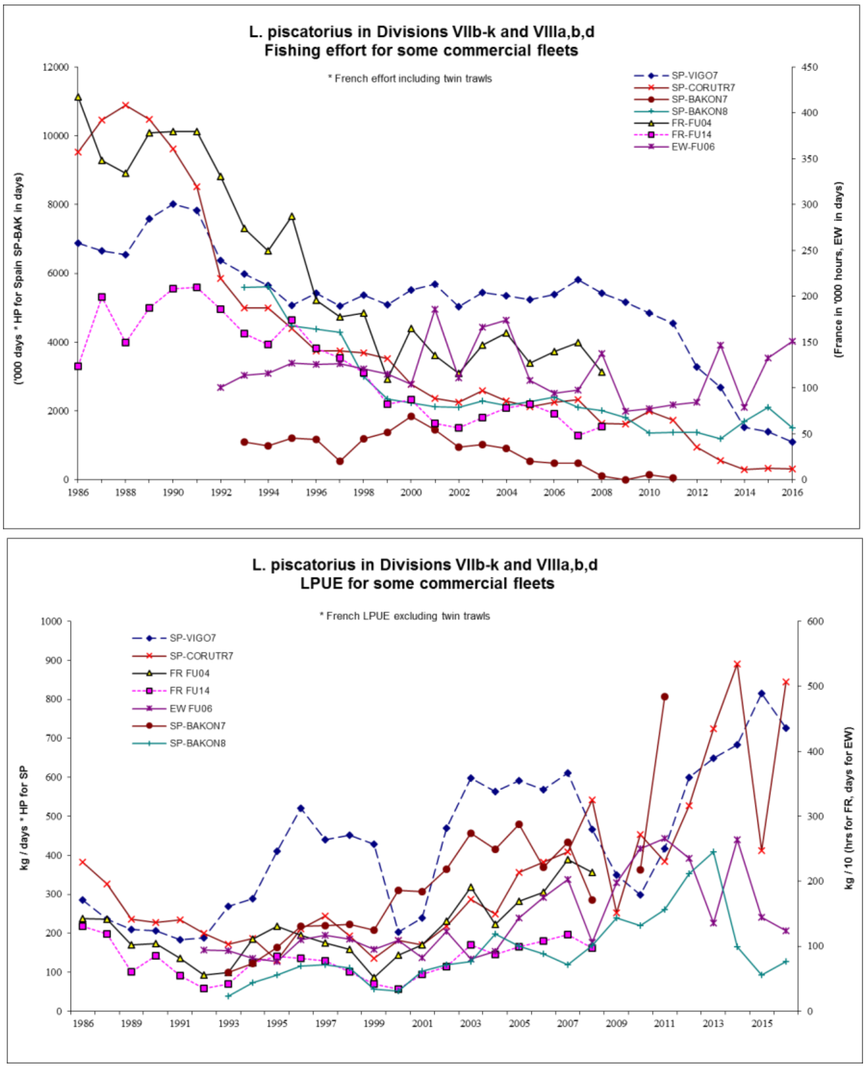


Figure 3.2-1 ***L. piscatorius*** **in Divisions 7.b-k and 8.a,b,d- Effort and LPUE data**

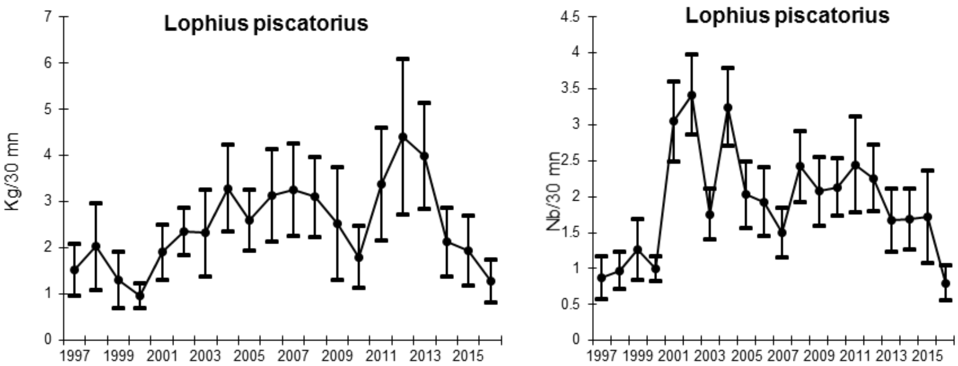


Figure 3.2-2 ***L. piscatorius*** **in Divisions 7.b-k and 8a,b,d- Time-series of the EVHOE-WIBTS-Q4 survey indices for biomass (Kg - left) and numbers (Nb -(right) per 30 minutes tow from 1997–2016. Numbers refer to number of recruits (lt ≤ 25 cm). (Updated time-series for WG 2017).**

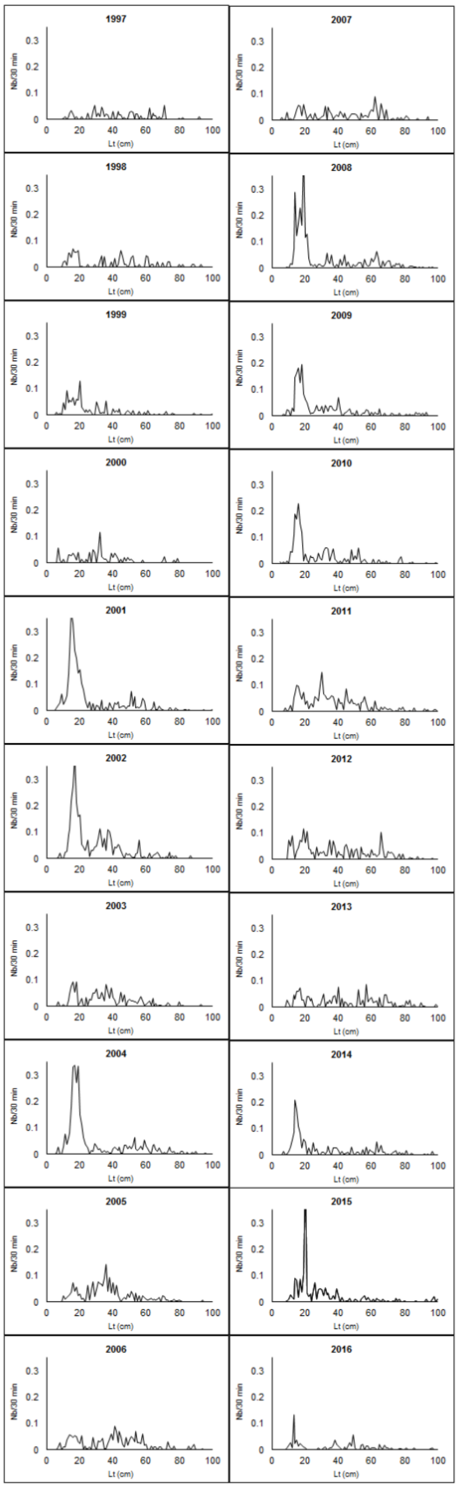


Figure 3.2-3 - *L. piscatorius* in Divisions 7.b-k and 8.a,b,d. Time-series of the EVHOE-WIBTS-Q4 Length distributions in Nb per 30 minutes tow from 1997–2016 (WG estimations/calculations - updated time-series for WG 2017)

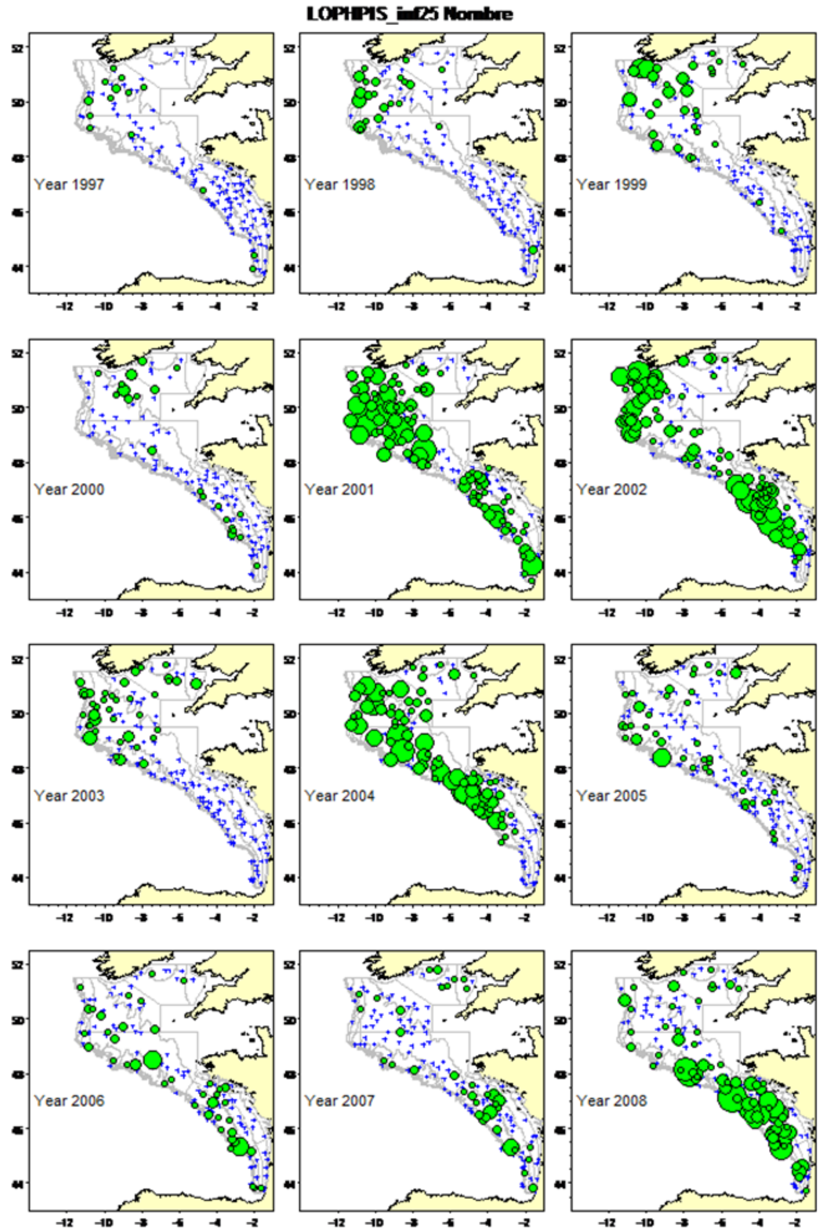


Figure 3.2-4 – *L. piscatorius* in Divisions 7.b-k and 8.a,b,d, distribution of recruits (lt < 25 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 1997–2008. Please see scale in figure 3.3-5 (updated time-series for WG 2017).

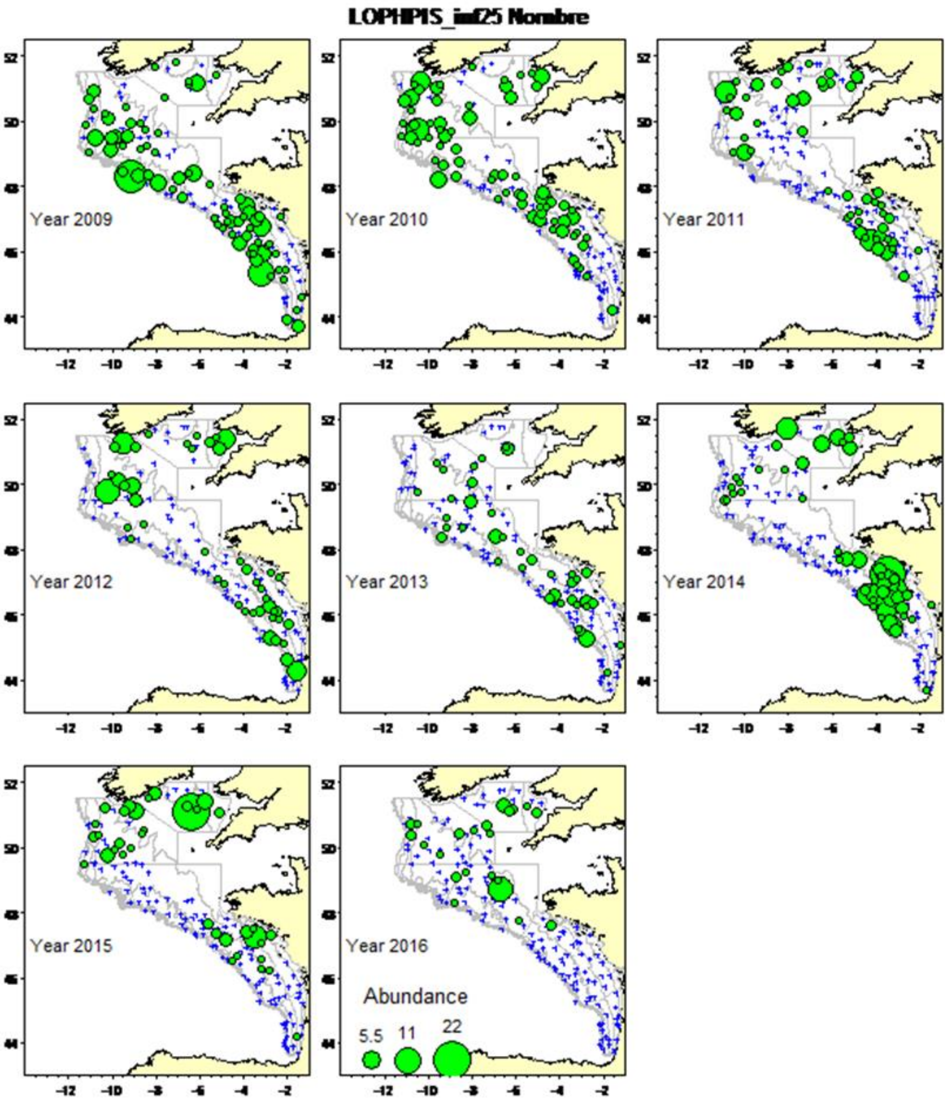


Figure 3.2-5 – L. *piscatorius* in Divisions 7.b-k and 8a,b,d, distribution of recruits (lt < 25 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 2009–2016 (updated time-series for WG 2017).

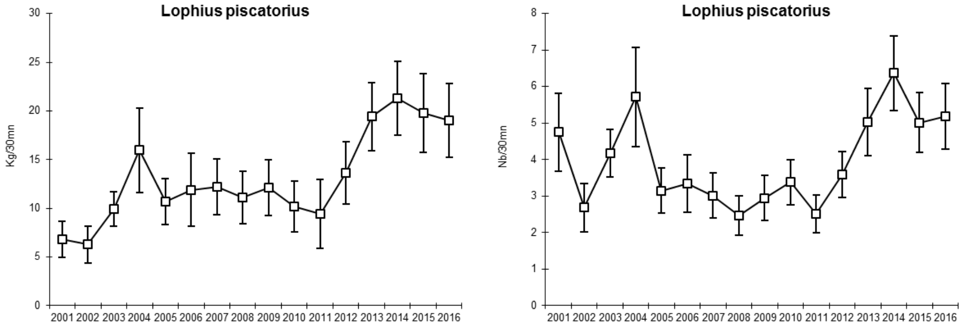


Figure 3.2-6 - *L. piscatorius* in Divisions 7.b-k and 8a,b,d- Time-series of the SPPGFS (WIBTS-Q4) survey indices Kg (left) and Nb (right) per 30 minutes tow from 2001–2016.

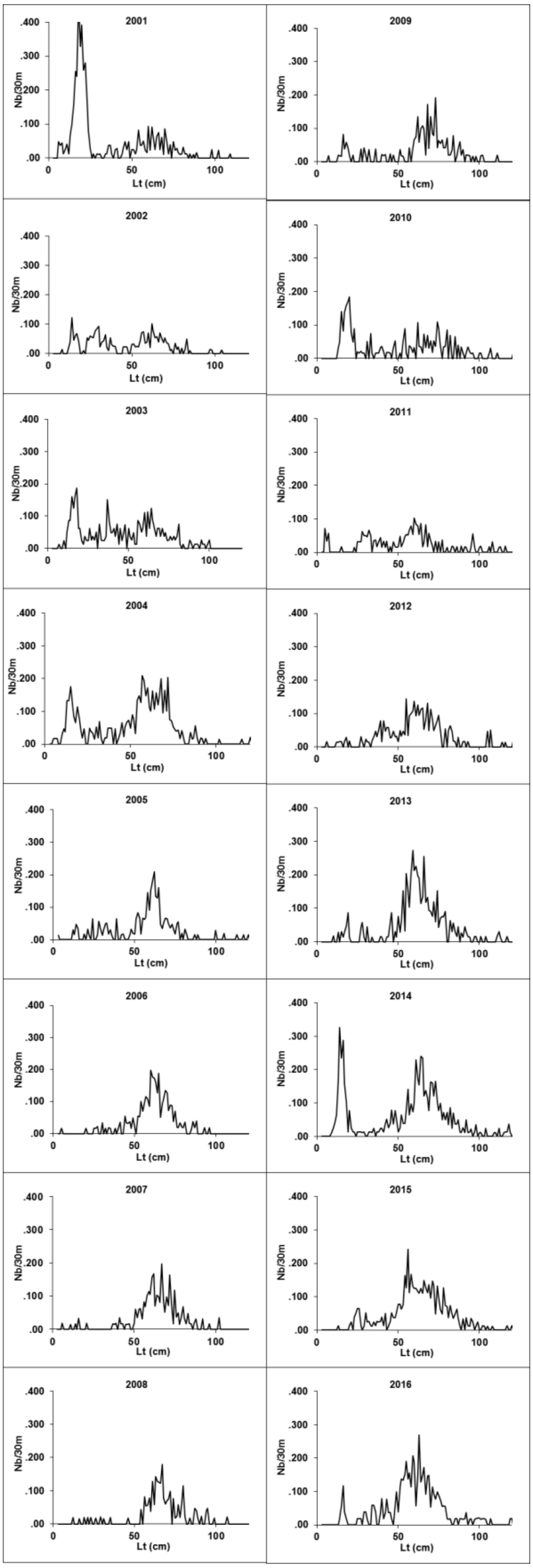


Figure 3.2-7 - *L. piscatorius* in Divisions 7.b-k and 8a,b,d- Time-series of the SPPGFS (WIBTS-Q4) Length distributions in Nb per 30 minutes tow from 2001–2016.

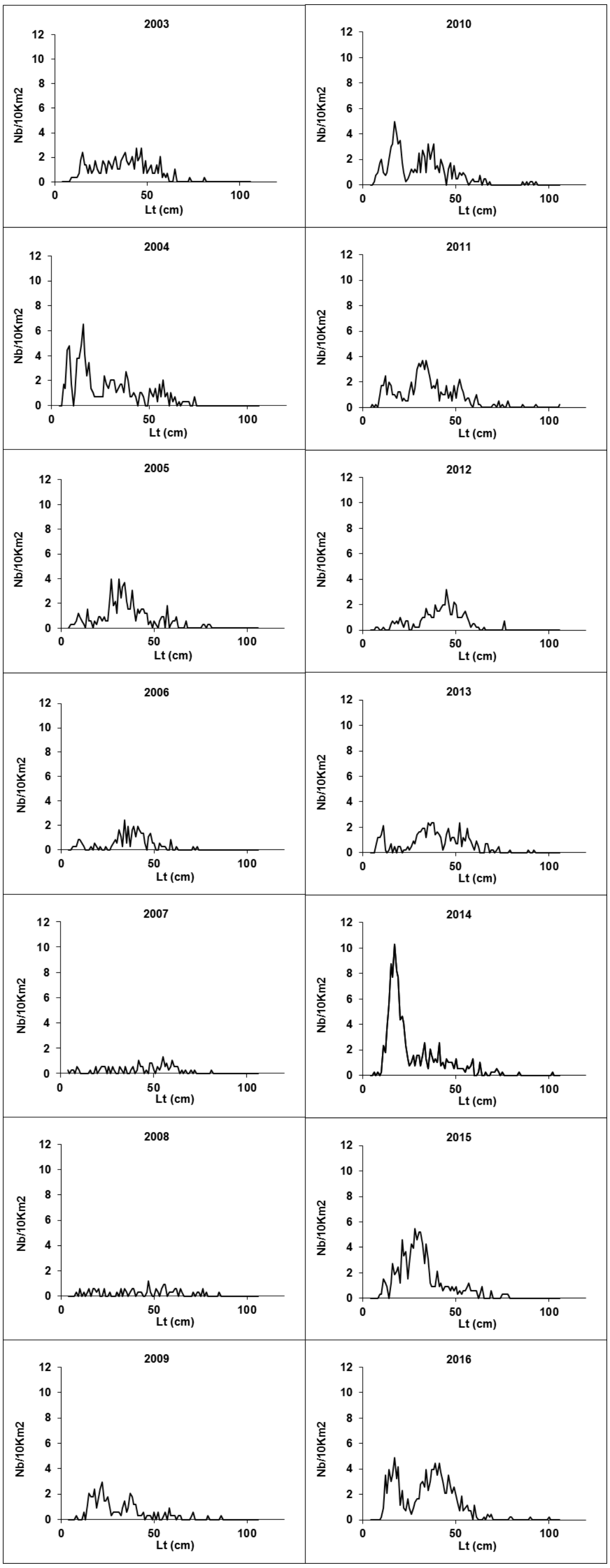


Figure 3.2-8 - *L. piscatorius* in Divisions 7.b-k and 8.a,b,d Time-series of the IGFS-WIBTS-Q4 Length distributions in Nb per 10 Km² from 2001–2016.

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. Since 2011, estimates of unallocated or non-reported landings have been included in the table. These were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each metier.

The landings have fluctuated over the studied period between 5 720 t–12 655 t with a succession of high (1989–1991, 1998 and 2009–2016) 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, 10 309 t in 2015, 9 593 t in the last year, these are still among the highest values of the time-series.

Discard data were submitted by the main countries in the fishery for the years 2015 and 2016. However, discard data were not available for all fleets, areas and seasons. Therefore, the proportion of discards was only estimated for the fleets, areas and seasons where both landings and discard data were submitted (including cases where zero values were submitted). In 2015, 43% of the landings did not have associated discard estimates (unpaired-landings); in 2016 this figure was 44%. Figure XX shows that the main gear type with landings that were not paired with discard estimates was OTB. In 2015 the proportion of the discarded estimates with associated landings (paired landings) was 18%; in 2016 this figure was 20%. A longer time-series over all fleets is required to determine whether these proportions are reasonable and consistent over time and therefore the WG cannot provide accurate catch advice at this time.

3.3.1.2 Commercial Effort and LPUE

Effort and LPUE data were available in 2016 for the three Spanish fleets, and for the English EW-FU06 (Table 3.3-2 and Figure 3.3-1). For the fleet SP-BAKON8, data for effort and LPUE were made available to this year's WG for 2015, previous change to e-logbooks reporting system prevented 2016 value to be available in time for the 2016 WG meeting. Data for this fleet were updated to include effort and LPUE for 2015 and 2016. Fishing effort for most fleets shows a decrease until the early 2000's. Meanwhile, most of the fleets show signs of a reduction in effort. EW-FU06 effort shows no signs of clear trend with fluctuations since 2000's however, an upward trend is shown since 2014. 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 2015, LPUE for EW-FU06, SP-CORUTR7 and SP-BAKON8 decreased, contrary to the SP-VIGO7 fleet that, although not substantially, shows signs of increase. In the last year LPUE show signs of stability for SP-VIGO7 and EW-FU06, while SP- CORUTR7 LPUE decreased substantially from 23 in 2015 to 7 kg/days*HP in 2016. New data for SP-BAKON 8 show an increase though still below the highest values observed in 2013 and 2014.

3.3.1.3 Surveys data

The French EVHOE-WIBTS-Q4 survey

This survey covers the largest proportion of the area of stock distribution. The EVHOE-WIBTS-Q4 survey time series index, length frequency data and spatial distribution maps were updated for *L. budegassa* from 1997-2016 for reasons given in section 3. Standardized biomass and abundance indices are given in Figure 3.3-2 Although these indices have been updated for the entire time series and presented to the WG in 2017 there seems to be no major differences. Length frequency data were estimated by the WG as data provided were by area and by sex, without total values, so WG followed previous methodology but revision may be required to assure it follows current survey data collection protocol.

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 are signs of lower recruitment, with smaller fish decreasing in abundance in the last three years. Biomass and recruitment in 2016 gives similar values to those in the previous year therefore, do not suggest any change to the current stock status.

The localization of juveniles (individuals ≤ 20 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 and 2016, juveniles of *L. budegassa* were primarily found in the most western area of the survey grid, showing a contraction in their spatial distribution.

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 for the years 2003-2012 and presented in Figure 3.3–6.

In 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.

Other surveys

The areas covered by 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 IGFS-WIBTS-Q4 abundance index shows a similar drop after the peak in 2013, to that shown in the EVHOE-WIBTS-Q4. However, in 2014 and 2015 contrary to the later survey, the IGFS-WIBTS-Q4 shows a stable abundance index of *L. budegassa*, with an increase in 2016. The estimated abundance since 2013 was 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, which again suggests a possible expansion or northerly movement of the stocks distribution, including nursery grounds.

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, 2016a)
- Q1 Irish Beam trawl Ecosystem survey (IBES) (Gerritsen, H, 2016b).

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. budegassa* proxies of MSY reference points were not determined in ICES (2016)due to problems with the high uncertainty in estimated landings and with the cpue index from the EHVOE-WIBTS-Q4 survey. Although, the later shows variable confidence intervals it suggests an overall constant trend. Therefore, the SPiCT model susceptibility to these make the model unable to converge and no reference were 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 period records strong recruitment from 2011–2013. Since 2014, there is a decline with signs of lower recruitment in 2015 and 2016. 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 WG 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 WG shows that around 11% of the catch is discarded. Preliminary analysis for 2015 and 2016 discards data were looked at for *L. budegassa*. However, discard data were not available for all fleets, areas and seasons which means that only partial proportion of discards was estimated. Future submission of discards information over a longer time series and over all fleets will allow for a more extensive analysis of the estimates so that catch information can be presented with greater confidence.

Due to the low levels of sampling and the uncertainties in the precision of the estimates the WG recommends that the discard estimates are not used in the assessment or for advice purposes at this time.

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).

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 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	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

Table 3.3-1 *Lophius budegassa* 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/Dee	Shallow	Shallow/medium				Shallow	Medium/Deep		TOTAL
Year	Gillnet	Trawl	Trawl	Beam Trawl	Neph.Trawl	Jnallocated	Neph.Trawl	Trawl	Trawl	Jnallocated	7 +8
	(Unit 3+13)	(Unit 4)	(Unit 5)	(Unit 6)	(Unit 8)		(Unit 9)	(Unit 10)	(Unit 14)		
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	5003**	26	557	0*	312	0	0	3556	94	10309**
2016***	570	4255	24	689	4	228	20	0	3778	27	9593
1999	18	4311	119	282	338	0	144	76	1450	0	6739

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

**** Revised in 2017 WG meeting**

*****Preliminary**

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

EFFORT			French Benth	French Benthic	French Benthic	French Benthic			
	SP-VIGO7	P-CORUTR	trawlers*	Twin Trawls	trawlers*	Twin Trawls	EW FU06	SP-BAKON7	SP-BAKON8
	in Sub-Area V	Sub-Area V	Celtic Sea	Celtic Sea	Bay of Biscay	Bay of Biscay	m trawlers in VII		
			FU04		FU14				
YEAR	00 days*HP	00 days*HP	('000 hrs)	('000 hrs)	('000 hrs)	('000 hrs)	('00 days)	(days)	(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		2 106
2016	1 103	314					151		1 514

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

LPUE			French Benthic	French Benthic	French Benthic	ench Benthic			
	Vigo	La Coruna	trawlers*	Twin Trawls	trawlers*	Twin Trawls	EW (FU06)	P-BAKON7	P-BAKON8
	in Sub-Area V	Sub-Area V	Celtic Sea	Celtic Sea	Bay of Biscay	ay of Bisca	m trawlers in VII		
			FU04		FU14				
YEAR	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	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		163
2016	580	7					33		264

Table 3.3-3 - ***L. budegassa*** **in Divisions 7.b-k and .8.a,b,d– Abundance indices in Nb/10 Km^2 from the IGFS-WIBTS-Q4.**

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	78.5

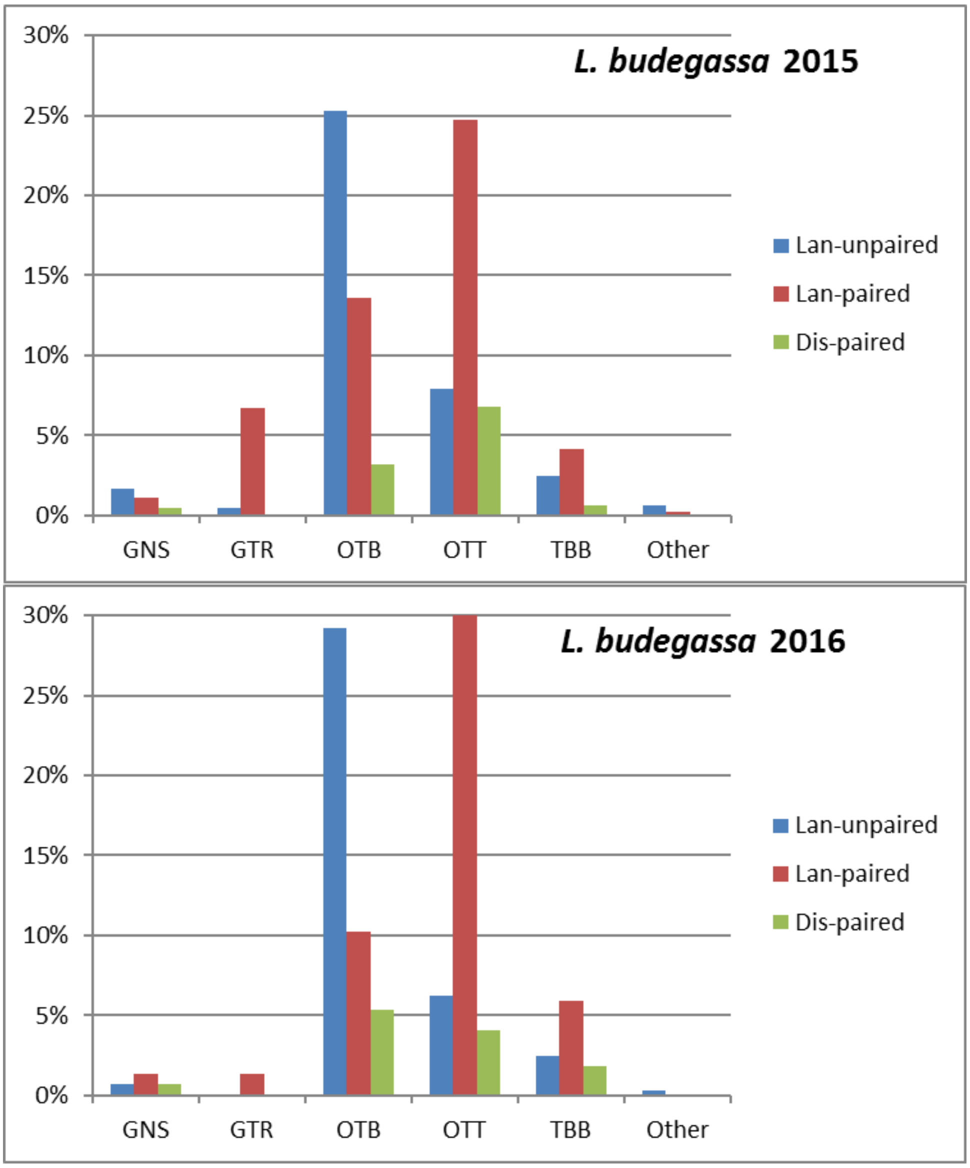


Figure XX. Discards and landings of *L. budegassa* reported to ICES for 2015 and 2016. Landings strata that did not have matching discard estimates are shown in blue (Lan-unpaired); landings with matching discards are shown in red (Lan-paired) and discards are shown in green (Dis-paired).

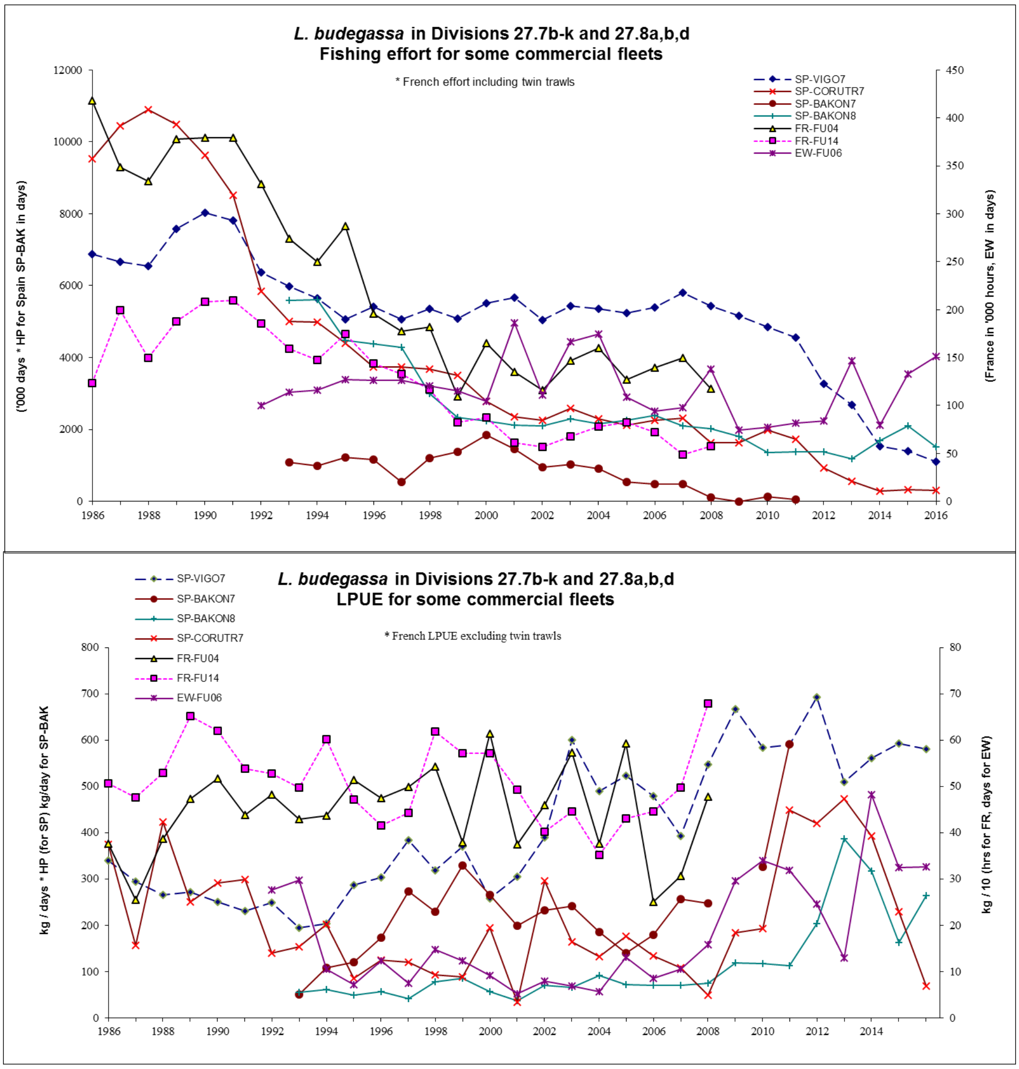


Figure 3.3-1 ***L. budegassa*** **in Divisions 7.b-k and 8.a,b,d Effort and LPUE data**

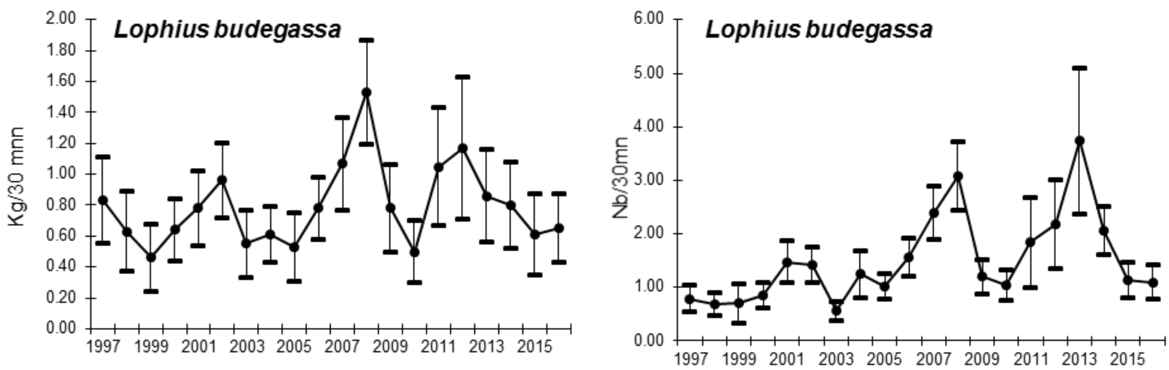


Figure 3.3-2 ***L. budegassa*** **in Divisions 7.b-k and .8a,b,d. Time-series of the EVHOE-WIBTS-Q4 survey's indices for biomass(Kg - left) and numbers (Nb -(right) per 30 minutes tow from 1997–2016. Numbers refer to number of recruits (lt ≤ 20 cm) . (Updated time-series for WG 2017).**

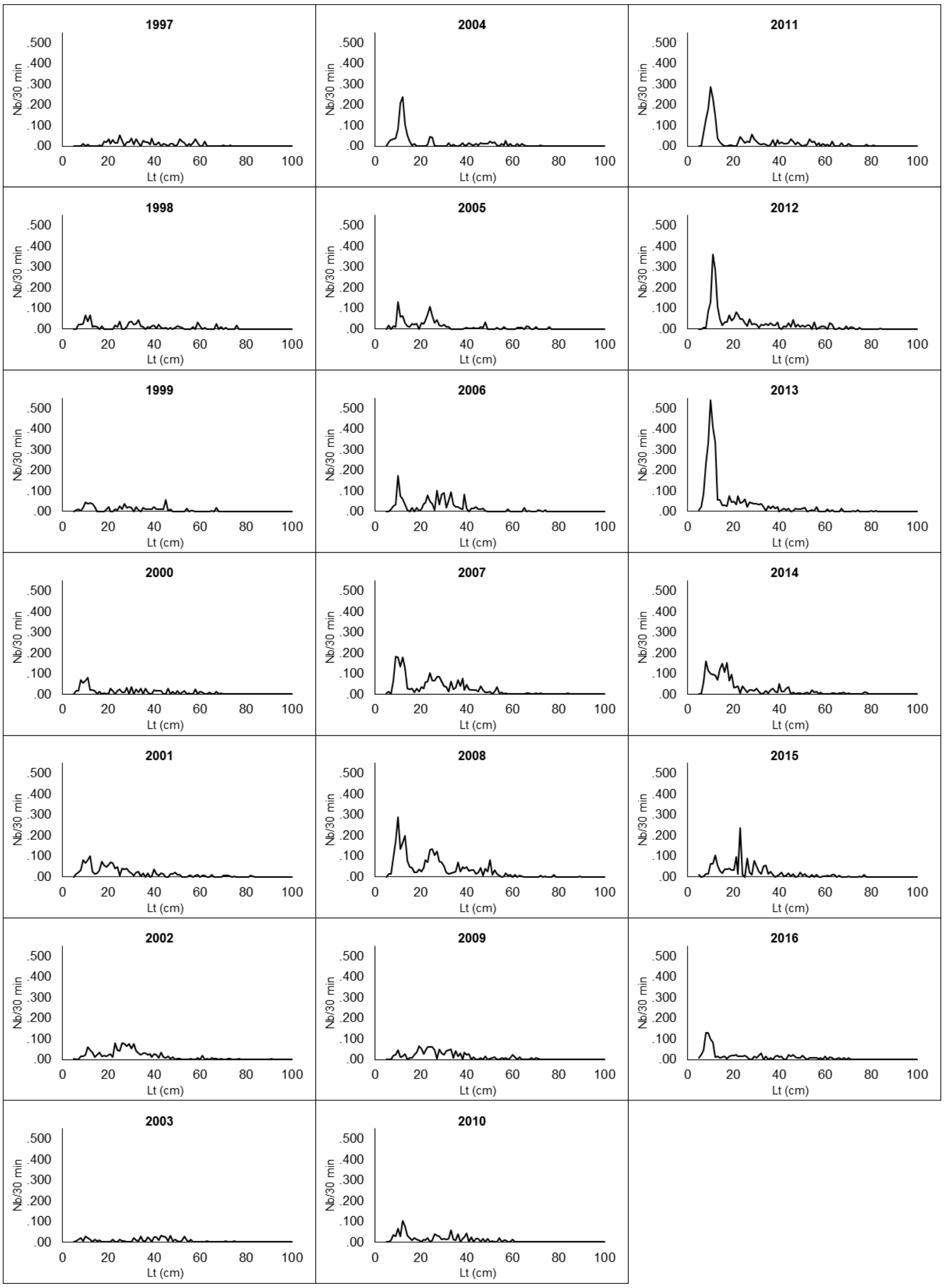


Figure 3.3-3 - *L. budegassa* in Divisions 7.b-k and 8.a,b,d- Time-series of the EVHOE-WIBTS-Q4 length distributions in Nb per 30 minutes tow from 1997–2016 (WG estimations/calculations - updated time-series for WG 2017)

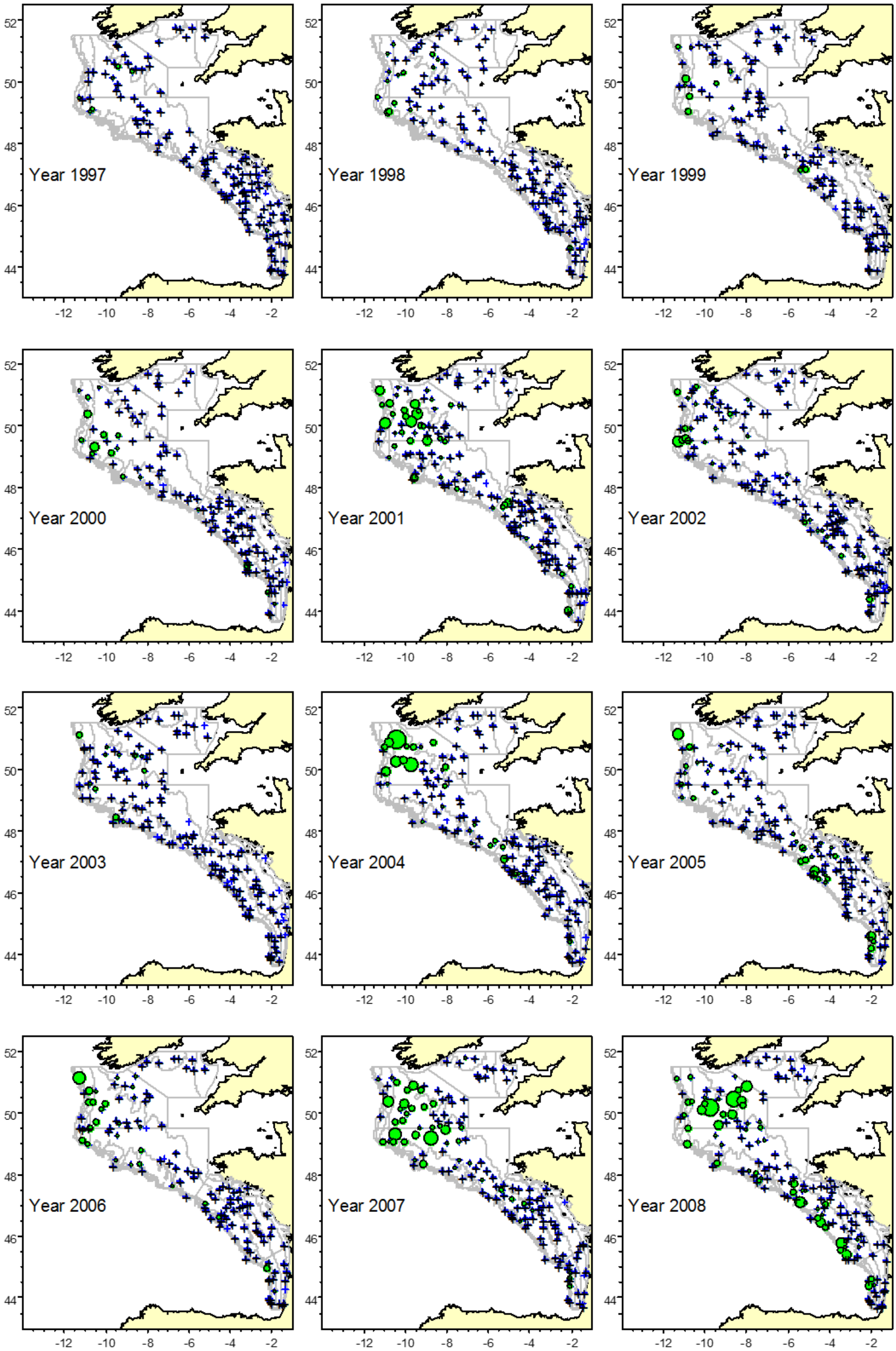


Figure 3.3-4 – *L. budegassa* in Divisions 7.b-k and 8.a,b,d, distribution of recruits (lt ≤ 20 cm) in Nb per 30min observed in the EVHOE-WIBTS-Q4 surveys from 1997–2008. Please see scale in figure 3.3-5 (updated time-series for WG 2017).

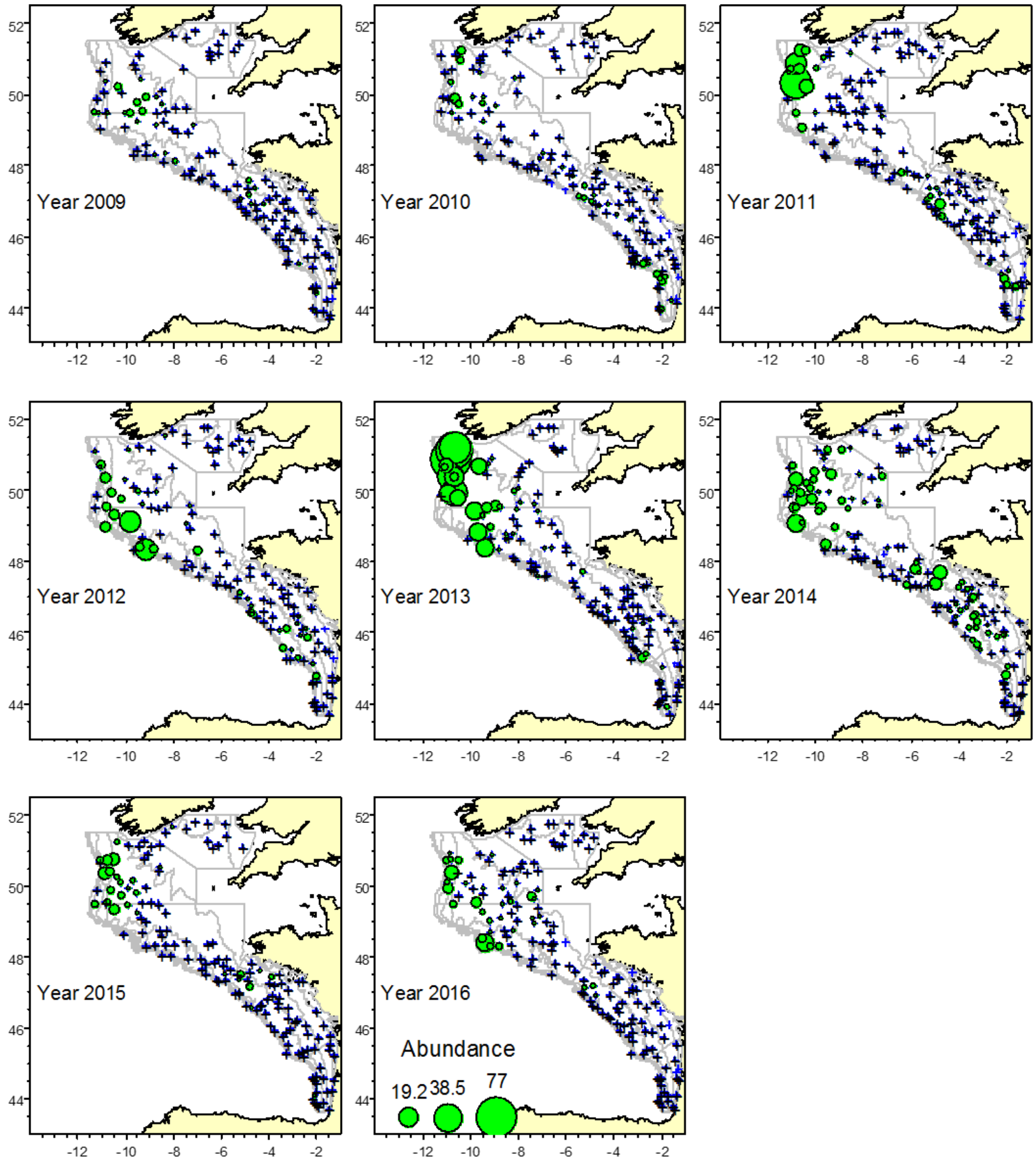


Figure 3.3-5 – *L. budegassa* in Divisions 7.b-k and 8.a,b,d, distribution of recruits (lt ≤20 cm) in Nb per 30min observed in the EVHOE-WIBTS-Q4 surveys from 2009–2016 (updated time-series for WG 2017).

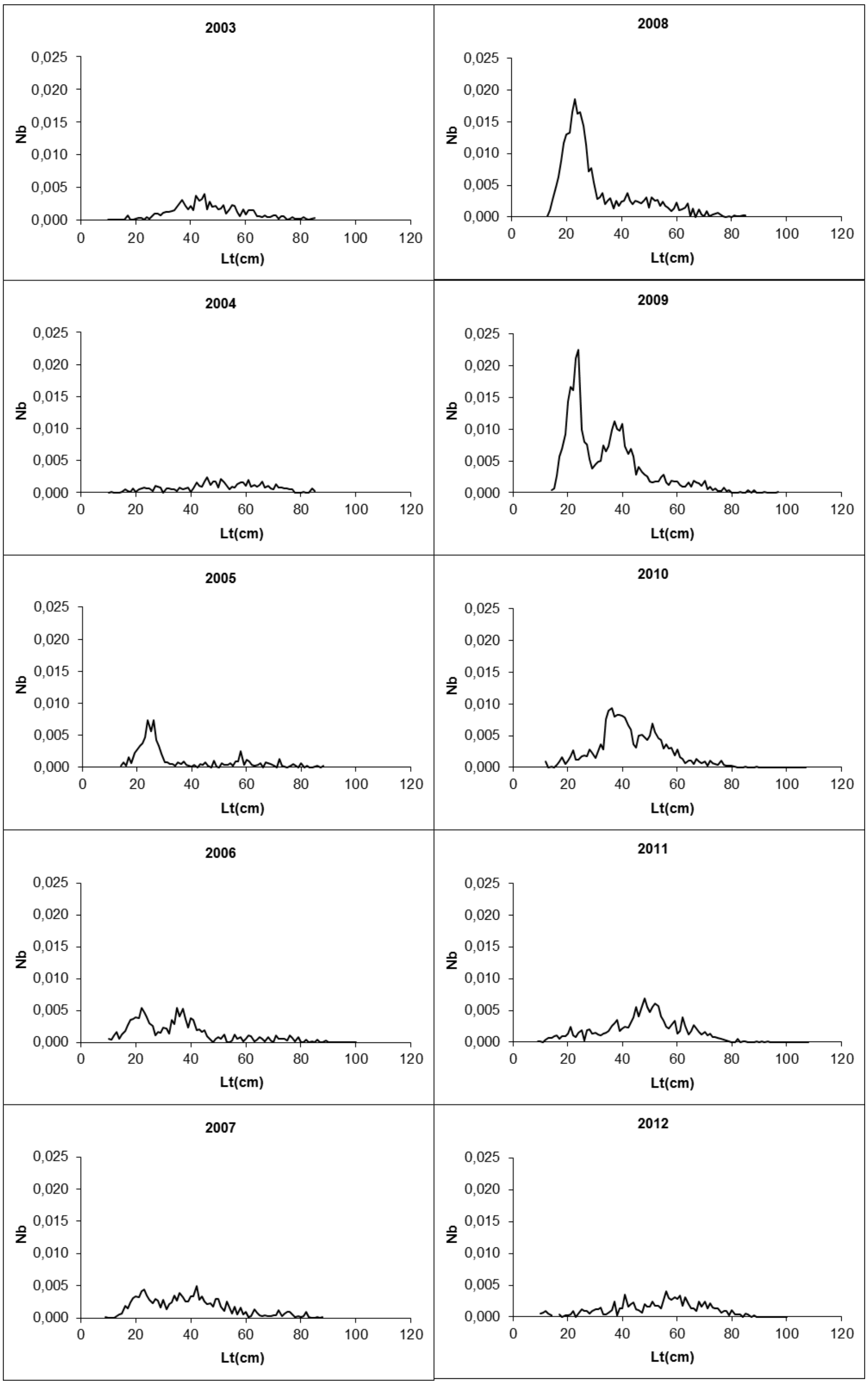


Figure 3.3-6 - *L. budegassa* in Divisions 7.b-k and 8.a,b,d- Time-series of the FSP-ENG-MONK length distributions in Nb per 30 minutes tow from 2003–2012.

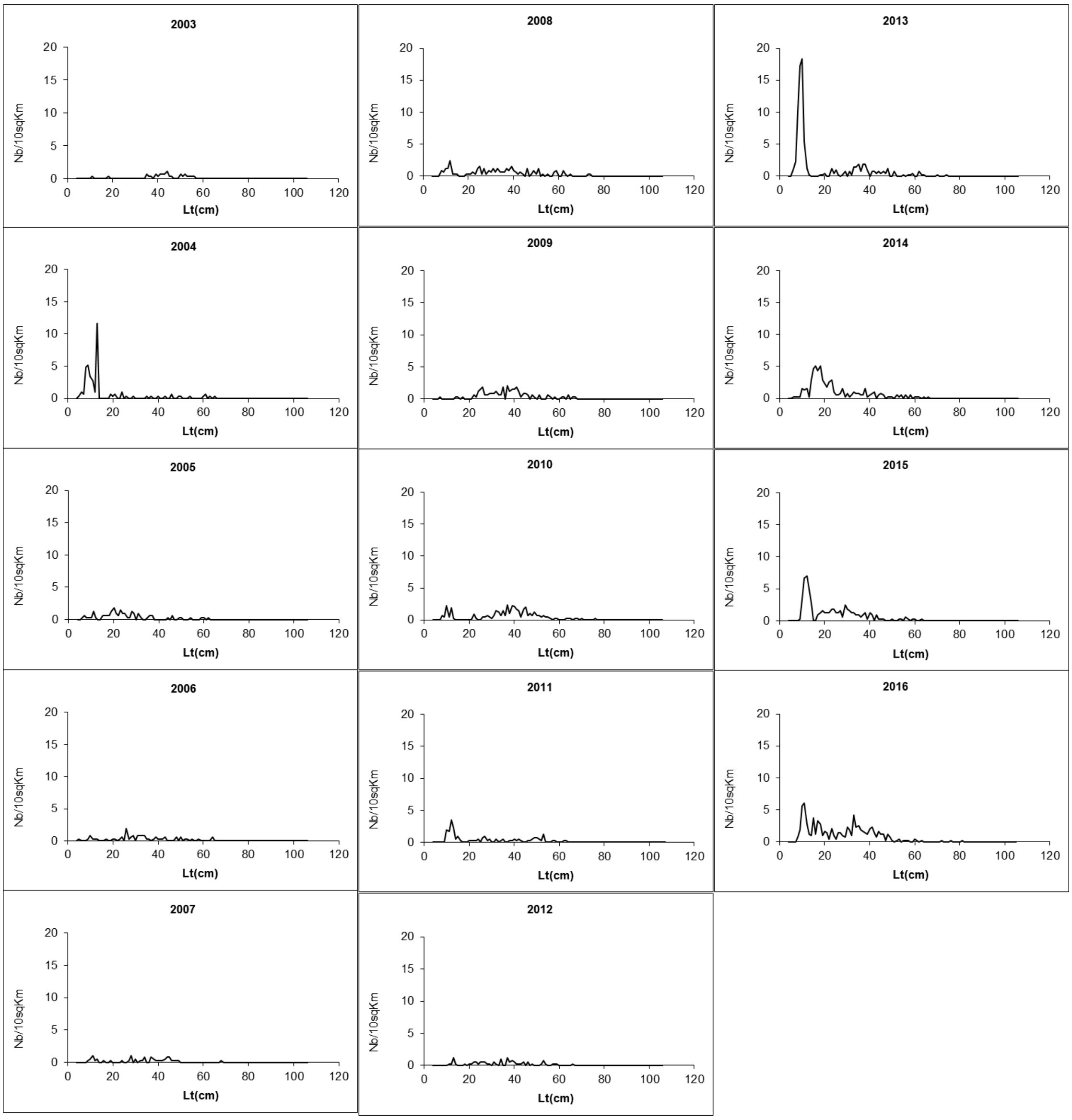


Figure 3.3-7 - *L. budegassa* in Divisions 7.b-k and 8.a,b,d- Time-series of the IGFS-WIBTS-Q4 length distributions in Nb per 10 km² from 2003–2016.

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

L. piscatorius and *L. budegassa*

Type of assessment in 2017: 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: No revisions were carried out.

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 (9 433 t) and 1988 (10 021 t), and decreasing after that to the minimum in 2001 (1 801 t) and 2002 (1 802 t). In 2002–2005 period landings increased reaching 4 541 t, this period was followed by another one where landings gradually declined and in 2011 landings were less than half of the 2005 amount (2 085 t). From 2011 to 2014 landings slightly increased to 2989 t with a decrease by 7% in 2015 (1 748 t of *L. piscatorius* and 1 042 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 2016 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 2017 and management for 2016 and 2017

ICES advice for 2017

ICES gave a separate advice for each of these species in 2016. ICES advises that when the MSY approach is applied, catches in 2017 should be no more than 2253 tonnes for *Lophius piscatorius* and no more than 2122 tonnes for *L. budegassa*. All catches are assumed to be landed.

Management applicable for 2016 and 2017

The two species are managed under a common TAC that was set at 2569 t for 2016 and 3955 t for 2017. The reported landings in 2016 were 109% 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. Both species of anglerfish are reported together because of their similarity but they are assessed and their advice is provided 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 the advice is given separately.

Table 4.1.1 Anglerfish (L piscatorius and L. budegasa) Divisions 8c and 9a. Tonnes landed by the main fishing fleets for 1978—2016 as determined by the Working Group

Table 4.1.1 ANGLERFISH (*L. piscatorius and L. budegassa*) - Divisions 8c and 9a.
Tonnes landed by the main fishing fleets for 1978-2016 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 / Non-reported	TOTAL
1978	n/a	n/a		n/a	506			n/a	222	728	355	0	n/a
1979	n/a	n/a		n/a	625			n/a	435	1 060	516	0	n/a
1980	4 008	1 477		5 485	786			n/a	654	1 440	6 926	0	6 926
1981	3 909	2 240		6 149	1 040			n/a	679	1 719	7 867	0	7 867
1982	2 742	3 095		5 837	1 716			n/a	598	2 314	8 151	0	8 151
1983	4 269	1 911		6 180	1 426			n/a	888	2 314	8 494	0	8 494
1984	3 600	1 866		5 466	1 136			409	950	2 495	7 961	0	7 961
1985	2 679	2 495		5 174	977			466	1 355	2 798	7 972	0	7 972
1986	3 052	3 209		6 261	1 049			367	1 757	3 172	9 433	0	9 433
1987	3 174	2 571		5 745	1 133			426	1 668	3 227	8 973	0	8 973
1988	3 583	3 263		6 846	1 254			344	1 577	3 175	10 021	0	10 021
1989	2 291	2 498		4 789	1 111			531	1 142	2 785	7 574	0	7 574
1990	1 930	1 127		3 057	1 124			713	1 231	3 068	6 124	0	6 124
1991	1 993	854		2 847	878			533	1 545	2 956	5 802	0	5 802
1992	1 668	1 068		2 736	786			363	1 610	2 758	5 493	0	5 493
1993	1 360	959		2 319	699			306	1 231	2 237	4 556	0	4 556
1994	1 232	1 028		2 260	629			149	549	1 327	3 587	0	3 587
1995	1 755	677		2 432	814			134	297	1 245	3 677	0	3 677
1996	2 146	850		2 995	749			265	574	1 589	4 584	0	4 584
1997	2 249	1 389		3 638	838			191	860	1 889	5 527	0	5 527
1998	1 660	1 507		3 167	865			209	829	1 903	5 070	0	5 070
1999	1 116	1 140		2 256	750			119	692	1 561	3 817	0	3 817
2000	710	612		1 322	485			146	675	1 306	2 628	0	2 628
2001	614	364		978	247			117	459	823	1 801	0	1 801
2002	559	415		974	344			104	380	828	1 802	0	1 802
2003	1 190	771		1 961	617			96	529	1 242	3 203	0	3 203
2004	1 510	1 389		2 898	549			77	602	1 229	4 127	0	4 127
2005	1 651	1 719		3 370	653			60	458	1 171	4 541	0	4 541
2006	1 490	1 371		2 861	801			68	381	1 250	4 111	0	4 111
2007	1 327	1 076		2 404	866			78	303	1 247	3 651	0	3 651
2008	1 280	1 238		2 518	473			50	246	770	3 288	0	3 288
2009	1 151	1 207		2 358	386			43	262	691	3 049	0	3 049
2010	665	1 036		1 701	355			72	203	630	2 331	0	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
2016	579	964	9	1 551	179	146	3	127	377	832	2 384	419	2 802

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. From 2001 to 2016, the Spanish landings were on average 40% from the trawl fleet (mean lengths in 2016 of 57 cm and 66 cm in Divisions 8c and 9a, respectively) and 60% from the gillnet fishery (mean length of 82 cm in Division 8c in 2016). For the same period, Portuguese landings were on average 11% from bottom trawlers (mean length of 52 cm in 2016) and 89% from the artisanal fleet (mean length of 85 cm in 2016).

4.3.4 Data

4.3.4.1 Commercial catches and discards

Total landings by country and gear for the period 1978–2016, as estimated by the WG, are given in Table 4.3.1. Unallocated and non-reported landings for this stock are available for the years from 2011 to 2016. The unallocated and non-reported values are considered realistic and are taken into account for the assessment. Estimates of unallocated or non-reported landings were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each métier and quarter.

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 2016 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 2016 are shown in Table 1.4. 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 2016.The annual length compositions for all fleets combined for the period 1986–2016 are presented in Figure 4.3.1.

Landings in number, the mean length and mean weight in the landings between 1986 and 2016 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 2016 mean weight and mean length of landings increased with respect to the previous year being 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 1983–2016 are summarized in Table 4.3.5.

The abundance index from Spanish survey SpGFS-WIBTS-Q4 is shown in Figure 4.3.2 (WD11, this report). 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 and 2016, the abundance indices were the lowest of the series (Figure 4.3.2) and almost 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 data series from the artisanal fleet from the port of Cedeira in Division 8c 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 and decrease in 2016.

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 2016 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 from 2013 to 2016 were 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.

A variance-covariance matrix (Hessian calculation) was calculated to represent uncertainty in the derived quantities (spawning biomass, fishing mortality and recruitment).

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 2016, estimated at 209 thousands, was the third 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 0.39 in 2005 to 0.16 in 2011. Respect to 2015, landings and F increased in 201 by 2% and 5% respectively. From 2005 to 2012 SSB was at stable medium values around 6.5 kt, increasing to 8.5 kt in 2016.

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 (2016), two years (2016 and 2015), three years (2016, 2015, 2014) and four years (2016, 2015, 2014, 2013) 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.

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 $F_{2014\text{-}2016}$ over lengths 30–130 cm, was used for 2017. In the case of recruitment, the geometric mean of the whole period (1980–2016) was used following the default option indicated in the Stock Annex.

Projected landings in 2018 and SSB at the beginning of 2019 for different management options in 2018 are presented in Table 4.3.8. Under F *status quo* scenario in 2018 is expected a small decrease in landings with respect to 2017, and a decrease in SSB in 2019 with respect to 2018.

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	1.44	0.30	2.21	6.35
F0.1	0.23	0.92	0.19	2.09	12.37
F40%	0.40	0.55	0.11	1.72	21.34
F35%	0.35	0.64	0.13	1.85	18.59
F30%	0.30	0.74	0.15	1.95	16.00

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 23%. The fishing mortality of $F_{30\%}$, $_{35\%}$ and $_{40\%}$ is estimated in 0.15, 0.13 and 0.11 respectively. The *status quo* F is below F_{max} 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 2010 to 2016. SSB in 2016 is estimated at 8.5 kt which is well above of B_{pa} (2600 t) and MSY $B_{trigger}$ (5400 t). Fishing mortality in 2016 has increased by 31% related to 2011. F in 2016 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 and non-reported landings, for years 2011–2016, are included in the stock assessment, as the estimates were considered realistic information. However the importance of unallocated/non-reported 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.

Table 4.3.1 Anglerfish (*L. piscatorius*) Divisions 8c and 9a. Tonnes landed by the main fishing fleets for 1978 —2016 as determined by the Working Group

Table 4.3.1 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.
Tonnes landed by the main fishing fleets for 1978-2016 as determined by the Working Group.

	Div. 8c				Div. 9a					
	SPAIN				SPAIN			PORTUGAL		
Year	Trawl	Gillnet	Others	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	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
1981	2 750	1 931		4 681	535				352	887
1982	1 915	2 682		4 597	875				310	1 185
1983	3 205	1 723		4 928	726				460	1 186
1984	3 086	1 690		4 776	578			186	492	1 256
1985	2 313	2 372		4 685	540			212	702	1 454
1986	2 499	2 624		5 123	670			167	910	1 747
1987	2 080	1 683		3 763	320			194	864	1 378
1988	2 525	2 253		4 778	570			157	817	1 543
1989	1 643	2 147		3 790	347			259	600	1 206
1990	1 439	985		2 424	435			326	606	1 366
1991	1 490	778		2 268	319			224	829	1 372
1992	1 217	1 011		2 228	301			76	778	1 154
1993	844	666		1 510	72			111	636	819
1994	690	827		1 517	154			70	266	490
1995	830	572		1 403	199			66	166	431
1996	1 306	745		2 050	407			133	365	905
1997	1 449	1 191		2 640	315			110	650	1 075
1998	912	1 359		2 271	184			28	497	710
1999	551	1 013		1 564	79			9	285	374
2000	269	538		808	107			4	340	451
2001	231	294		525	57			16	190	263
2002	385	341		726	110			29	168	307
2003	911	722		1 633	312			29	305	645
2004	1 260	1 269		2 528	264			27	335	626
2005	1 378	1 622		3 000	371			29	244	643
2006	1 166	1 247		2 413	260			29	260	549
2007	955	1 009		1 964	181			13	192	386
2008	894	1 168		2 062	138			11	127	275
2009	850	1 058		1 909	213			10	148	371
2010	313	955		1 268	158			2	119	279
2011	243	483	73	799	59	28	48	46	80	260
2012	271	527	67	866	54	20	42	6	163	285
2013	274	718	38	1 029	47	30	50	15	154	296
2014	358	947	28	1 334	91	47	4	30	122	294
2015	324	802	4	1 129	86	53	2	34	200	375
2016	376	846	3	1 225	76	67	1	8	120	273

n/a: not available

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

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	4.4	7.6	0.8
2016	0.03	n/a	0.0	24.2	2.8

n/a: not available
CV: coefficient of variation

Table 4.3.3 Anglerfish (*L. piscatorius)* Divisions 8c and 9a. Length composition by fleet and adjusted length composition for total landings (thousands) in 2016. Ajusted TOTAL: Ajusted to landings from fleets without length composition.

Table 4.3.3 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.
Length composition by fleet and ajusted length composition for total landings (thousands) in 2016.
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.09	0.00	0.00	0.09	0.09	0.09
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.12	0.00	0.12	0.11	0.00	0.00	0.11	0.23	0.23
30	0.17	0.00	0.17	0.00	0.00	0.00	0.00	0.17	0.17
31	1.12	0.00	1.12	0.00	0.00	0.00	0.00	1.12	1.13
32	1.30	0.00	1.30	0.00	0.00	0.00	0.00	1.30	1.30
33	1.43	0.00	1.43	0.11	0.09	0.00	0.20	1.64	1.65
34	3.51	0.00	3.51	0.00	0.00	0.00	0.00	3.51	3.54
35	1.61	0.00	1.61	0.00	0.00	0.00	0.00	1.61	1.63
36	3.27	0.00	3.27	0.21	0.00	0.00	0.21	3.48	3.50
37	2.43	0.00	2.43	0.25	0.00	0.00	0.25	2.68	2.70
38	3.30	0.00	3.30	0.10	0.00	0.00	0.10	3.40	3.42
39	3.11	0.00	3.11	0.13	0.00	0.00	0.13	3.24	3.27
40	3.08	0.00	3.08	0.32	0.00	0.00	0.32	3.40	3.43
41	3.78	0.00	3.78	0.19	0.00	0.00	0.19	3.97	4.00
42	4.35	0.00	4.35	0.21	1.61	0.00	1.82	6.17	6.20
43	3.85	0.00	3.85	0.15	0.00	0.00	0.15	4.00	4.04
44	5.11	0.00	5.11	0.13	0.00	0.00	0.13	5.23	5.27
45	5.31	0.00	5.31	0.09	0.00	0.00	0.09	5.40	5.46
46	5.10	0.00	5.10	0.29	0.05	0.00	0.34	5.44	5.48
47	4.55	0.05	4.61	0.36	0.00	0.00	0.36	4.97	5.01
48	4.60	0.00	4.60	0.51	0.07	0.00	0.57	5.17	5.21
49	4.30	0.00	4.30	0.62	0.00	0.00	0.62	4.92	4.97
50	3.17	0.10	3.27	0.85	0.00	0.00	0.85	4.12	4.16
51	4.40	0.19	4.59	0.27	0.00	0.00	0.27	4.86	4.91
52	3.53	0.15	3.67	0.27	0.00	0.09	0.36	4.03	4.07
53	4.01	0.32	4.32	0.90	0.22	0.03	1.15	5.47	5.54
54	3.44	0.11	3.55	0.87	0.00	0.00	0.87	4.41	4.46
55	2.46	0.39	2.85	0.42	0.00	0.00	0.42	3.27	3.31
56	2.69	0.28	2.97	0.59	0.09	0.00	0.68	3.65	3.69
57	3.53	0.49	4.02	0.49	0.00	0.12	0.61	4.63	4.71
58	2.86	0.45	3.31	0.49	0.00	0.16	0.65	3.96	4.03
59	2.88	0.28	3.17	0.57	0.00	0.15	0.72	3.89	3.95
60	2.70	1.28	3.98	0.43	0.00	0.12	0.56	4.55	4.66
61	2.83	1.07	3.90	0.23	0.22	0.09	0.54	4.44	4.54
62	2.46	1.44	3.89	0.34	0.01	0.06	0.42	4.31	4.44
63	2.21	1.76	3.97	0.60	0.00	0.00	0.60	4.56	4.71
64	2.55	1.68	4.23	0.14	0.00	0.19	0.32	4.55	4.69
65	1.76	2.10	3.86	0.21	0.00	0.21	0.42	4.28	4.42
66	1.39	2.35	3.74	0.32	0.00	0.03	0.35	4.09	4.24
67	1.52	3.41	4.93	0.62	0.01	0.04	0.67	5.60	5.83
68	1.28	3.26	4.54	0.22	0.00	0.03	0.25	4.78	5.00
69	1.66	3.07	4.72	0.33	0.01	0.06	0.40	5.12	5.34
70	2.13	4.11	6.24	0.45	0.00	0.60	1.05	7.29	7.56
71	1.54	4.36	5.91	0.21	0.00	0.06	0.27	6.18	6.46
72	1.28	4.98	6.26	0.04	0.00	0.30	0.34	6.60	6.92
73	2.50	3.70	6.21	0.48	0.00	1.61	2.09	8.29	8.55
74	1.31	4.34	5.65	0.50	0.00	0.27	0.77	6.42	6.71
75	1.72	4.83	6.56	0.22	0.00	0.12	0.33	6.89	7.22
76	1.09	4.20	5.28	0.50	0.00	0.24	0.74	6.03	6.33
77	1.25	3.46	4.70	0.19	0.00	0.06	0.25	4.95	5.21
78	1.88	3.75	5.63	0.11	0.00	0.20	0.31	5.94	6.20
79	0.92	3.32	4.24	0.37	0.00	0.09	0.46	4.70	4.93
80	0.63	3.36	3.99	0.05	0.08	0.31	0.43	4.42	4.66
81	1.24	2.88	4.12	0.29	0.02	0.30	0.62	4.74	4.96
82	1.33	2.78	4.11	0.13	0.00	0.21	0.34	4.45	4.67
83	0.51	2.77	3.28	0.29	0.00	2.25	2.54	5.81	6.02
84	0.71	2.80	3.52	0.17	0.00	0.09	0.25	3.77	3.97
85	1.79	3.19	4.98	0.13	0.00	0.35	0.48	5.46	5.71
86	0.95	2.95	3.90	0.17	0.00	0.21	0.38	4.28	4.50
87	1.02	2.42	3.44	0.24	0.01	0.15	0.40	3.85	4.04
88	0.63	2.11	2.74	0.27	0.07	0.00	0.33	3.07	3.22
89	0.81	2.15	2.96	0.39	0.00	0.30	0.69	3.65	3.81
90	1.12	2.69	3.81	0.08	0.00	2.11	2.19	6.01	6.20
91	0.63	1.75	2.38	0.11	0.09	0.01	0.21	2.59	2.72
92	1.07	2.11	3.18	0.02	0.00	0.15	0.18	3.36	3.52
93	0.47	2.76	3.23	0.12	0.00	0.11	0.23	3.46	3.66
94	0.50	1.60	2.09	0.04	0.00	0.16	0.20	2.29	2.42
95	0.26	1.80	2.06	0.02	0.00	0.00	0.02	2.09	2.21
96	0.65	2.15	2.80	0.00	0.00	0.03	0.03	2.83	2.99
97	0.34	1.74	2.07	0.00	0.00	0.03	0.03	2.10	2.23
98	0.80	1.71	2.51	0.29	0.00	0.06	0.34	2.86	2.99
99	0.18	1.81	1.99	0.07	0.00	0.01	0.08	2.07	2.19
100+	2.87	13.97	16.83	1.34	0.07	2.20	3.60	20.44	21.44
TOTAL	152.84	126.75	279.60	20.29	2.73	13.98	37.00	316.59	326.64
Tonnes	502.57	991.52	1494.09	96.21	7.72	120.41	224.34	1718.43	1791.50
Mean Weight (g)	3288.13	7822.36	5343.70	4741.00	2831.18	8614.73	6063.85	5427.86	5484.55
Mean length (cm)	57.11	81.81	68.31	65.59	52.18	84.61	71.79	68.72	69.03

Table 4.3.4 Anglerfish *(L. piscatorius)*- Divisions 8c and 9a. Numbers, mean weight and mean length of landings between 1986 and 2016.

Table 4.3.4 ANGLERFISH (*L. piscatorius*). Divisions 8c and 9a.
Numbers, mean weight and mean length of landings between 1986 and 2016.

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
2016	327	5 485	69

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

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	1.56	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
2016**	114	0.76	0.28	0.30	0.06	85	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

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	--	--	--	--	--	--	--	
2016	138	8	13 718	10	--	--	--	--	--	--	--	

	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	--
2016	4	<1	12	--	0.3	--	4	<1	11	--	0.3	--

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

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	420	13 599	7 678	4 817	0.63	0.33
1981	1 639	15 235	9 995	5 566	0.56	0.33
1982	6 782	14 672	11 247	5 782	0.51	0.38
1983	2 931	13 678	10 217	6 113	0.60	0.51
1984	794	13 518	8 416	6 031	0.72	0.54
1985	1 689	12 830	8 172	6 139	0.75	0.56
1986	6 033	10 777	7 726	6 870	0.89	0.84
1987	4 100	7 435	4 835	5 139	1.06	0.98
1988	1 602	7 343	3 250	6 321	1.94	1.52
1989	3 000	5 732	2 450	4 995	2.04	1.25
1990	2 423	4 724	2 235	3 790	1.70	0.91
1991	909	4 617	2 087	3 640	1.74	0.89
1992	1 160	4 369	2 066	3 382	1.64	0.94
1993	1 384	3 481	1 868	2 329	1.25	0.71
1994	2 905	3 295	1 811	2 007	1.11	0.61
1995	2 178	3 825	1 879	1 835	0.98	0.40
1996	444	5 671	2 685	2 956	1.10	0.44
1997	210	6 778	3 744	3 715	0.99	0.49
1998	179	6 236	4 255	2 981	0.70	0.40
1999	480	5 320	4 218	1 939	0.46	0.31
2000	567	4 657	3 941	1 256	0.32	0.26
2001	3 155	4 393	3 653	788	0.22	0.19
2002	1 595	5 120	3 739	1 034	0.28	0.21
2003	387	7 167	4 318	2 279	0.53	0.32
2004	1 749	8 583	5 449	3 156	0.58	0.34
2005	1 135	8 905	6 446	3 646	0.57	0.39
2006	1 371	8 415	6 232	2 932	0.47	0.38
2007	586	8 058	5 903	2 349	0.40	0.32
2008	525	8 202	6 065	2 338	0.39	0.29
2009	742	8 133	6 326	2 280	0.36	0.29
2010	1 062	7 733	6 301	1 548	0.25	0.21
2011	1 125	7 911	6 437	1 140	0.18	0.16
2012	506	8 706	6 905	1 382	0.20	0.18
2013	701	9 499	7 486	1 516	0.20	0.18
2014	1 348	10 084	8 205	2 002	0.24	0.22
2015	149	10 135	8 388	1 748	0.21	0.20
2016	209	10 430	8 550	1 791	0.21	0.21

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

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

SSB(2017)	Rec proj	F(30-130cm)	Land(2017)	SSB(2018)
8 690	1 043	0.21	1 738	8579

Fmult	Fland (30-130cm)	Landings(2018)	SSB(2019)
0	0	0	9868
0.1	0.02	175	9676
0.2	0.04	346	9489
0.3	0.06	512	9307
0.4	0.08	675	9129
0.5	0.1	834	8954
0.6	0.12	989	8784
0.7	0.14	1140	8618
0.8	0.17	1288	8456
0.9	0.19	1432	8297
1	0.21	1572	8142
1.1	0.23	1710	7991
1.2	0.25	1844	7843
1.3	0.27	1975	7698
1.4	0.29	2103	7556
1.5	0.31	2227	7418
1.6	0.33	2349	7283
1.7	0.35	2468	7151
1.8	0.37	2585	7022
1.9	0.39	2698	6896
2	0.41	2809	6773

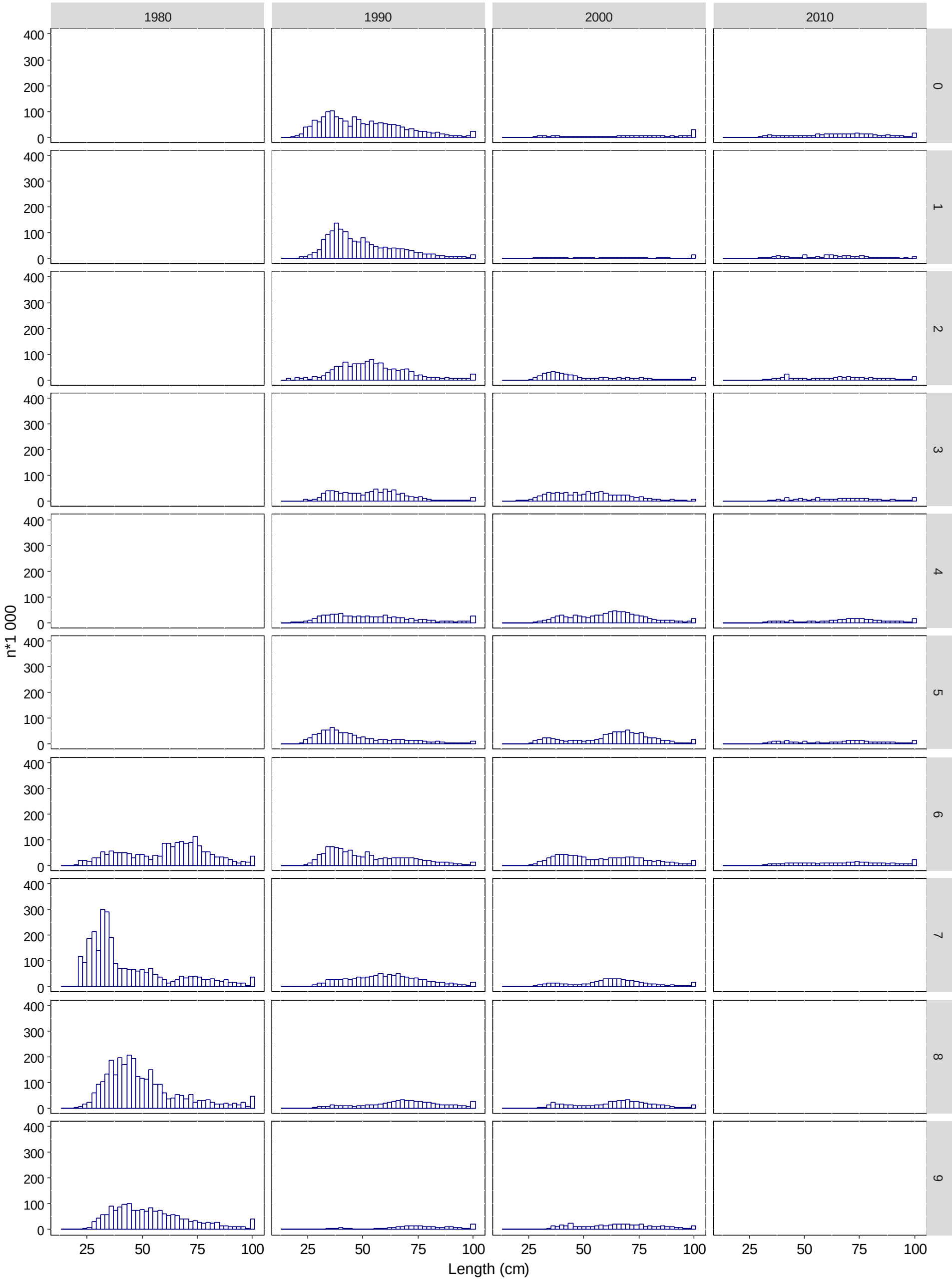


Figure 4.3.1 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Length distributions of landings (thousands for 1986 to 2016)*

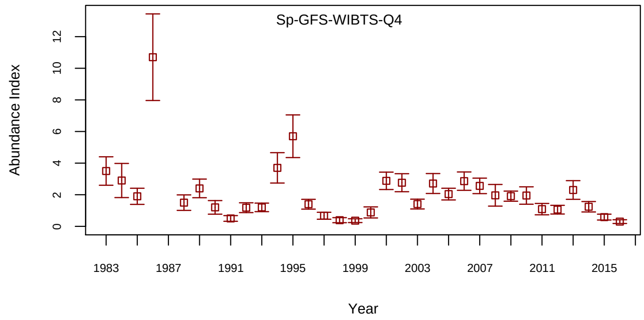


Figure 4.3.2 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.Abundance index from survey SpGFS-WIBTS-Q4 in numbers/30 min. Bars represent 95% confidence intervals.

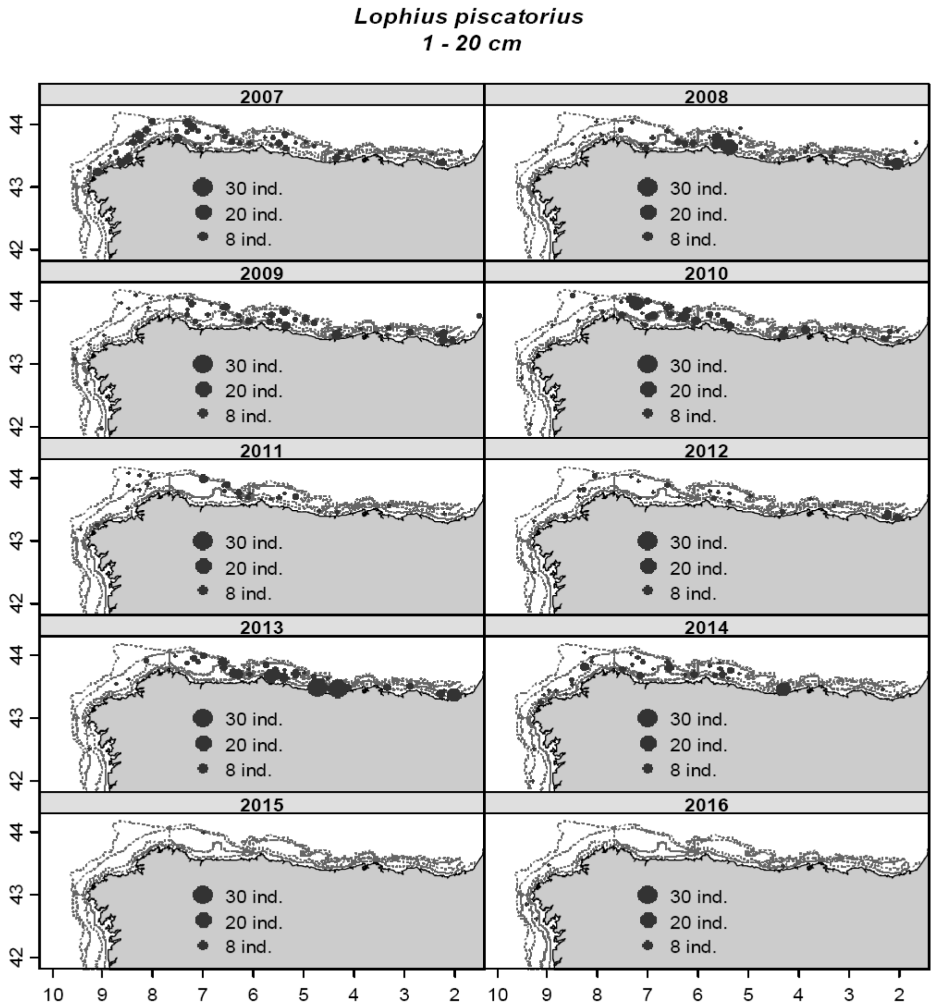


Figure 4.3.3. ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.Spatial distribution of juveniles (length 0- 20 cm) in North Spanish Coast demersal survey (SpGFS-WIBTS-Q4) between 2007and 2016.

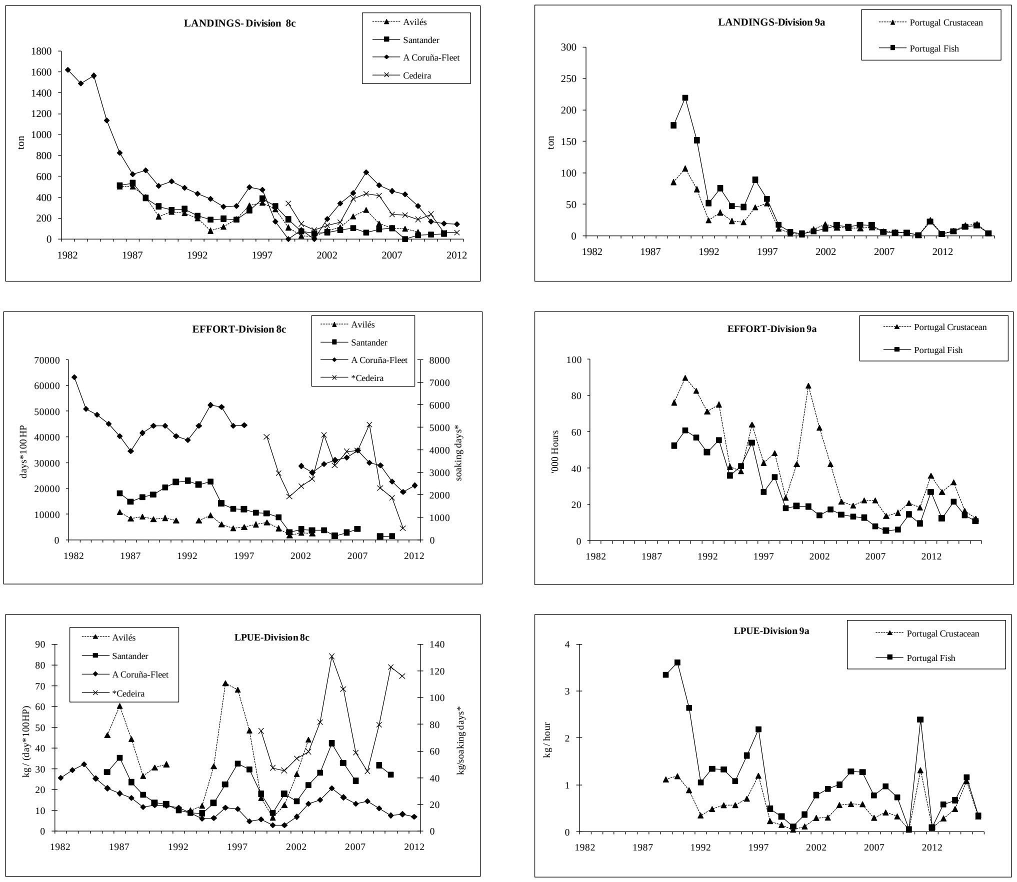


Figure 4.3.4. ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Trawl and gillnet landings, effort and LPUE data between 1986—2016.

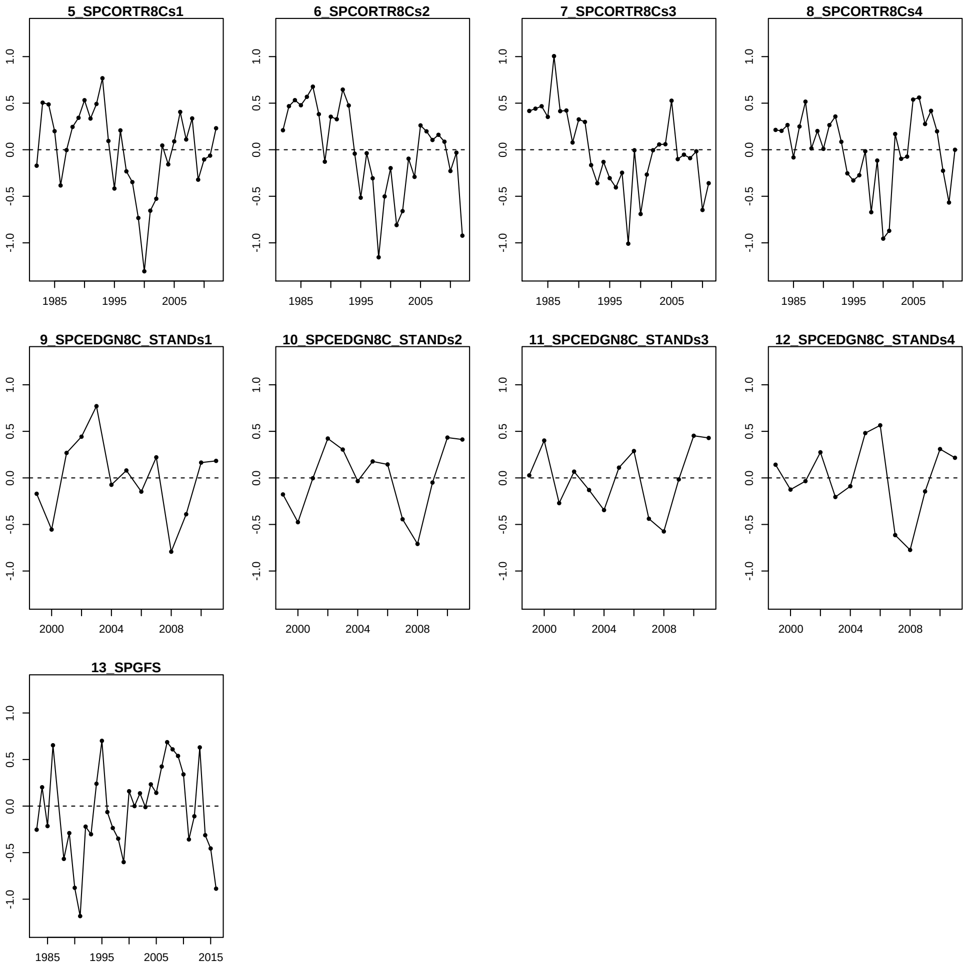


Figure 4.3.5 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Residuals of the fits to the surveys in log(abundance indices). A Coruña and Cedeira are by quarters.

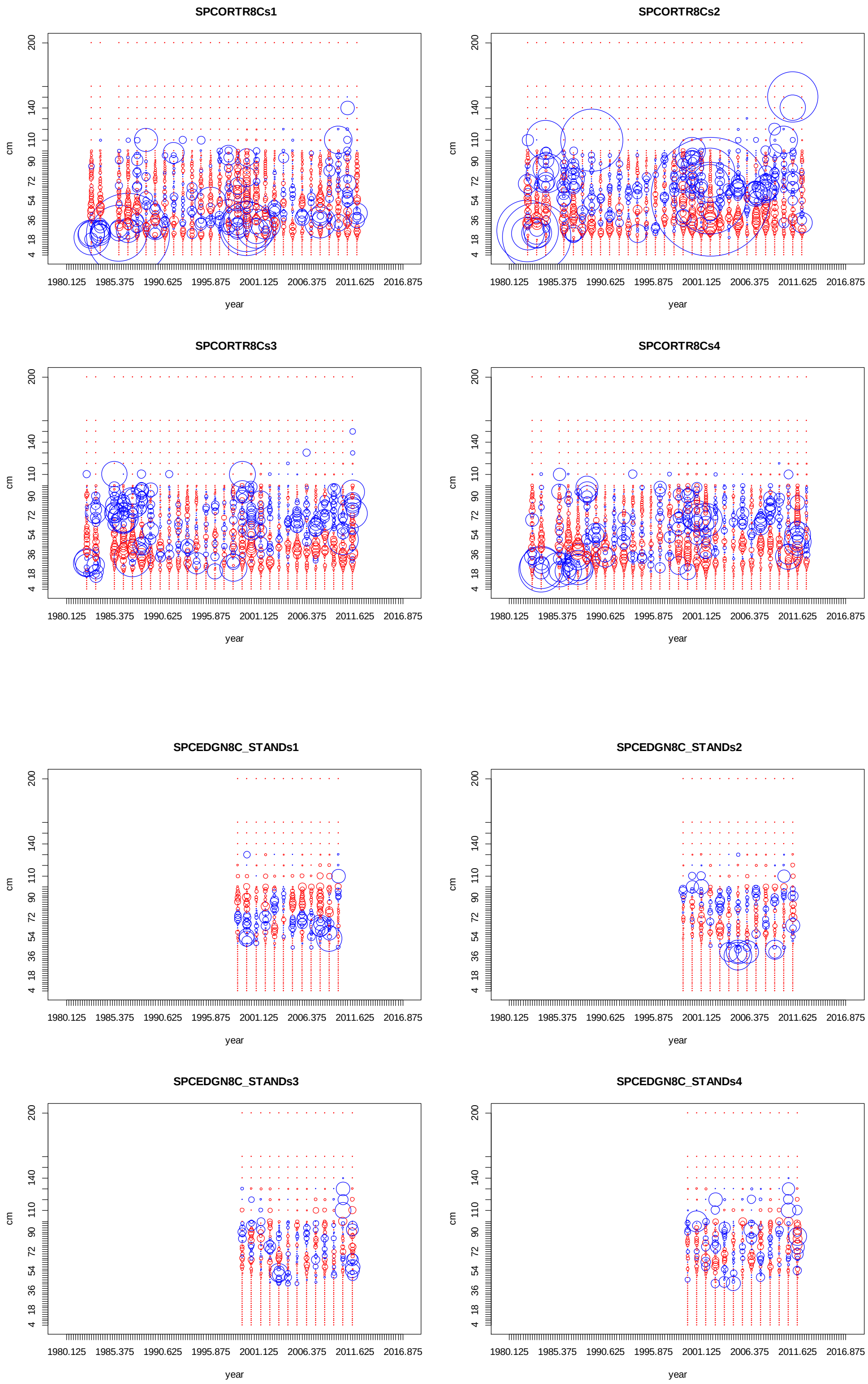


Figure 4.3.6 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.Pearson residuals of the fit to the length distributions of the abundance indices. Blue=positive residuals and red=negative residuals.

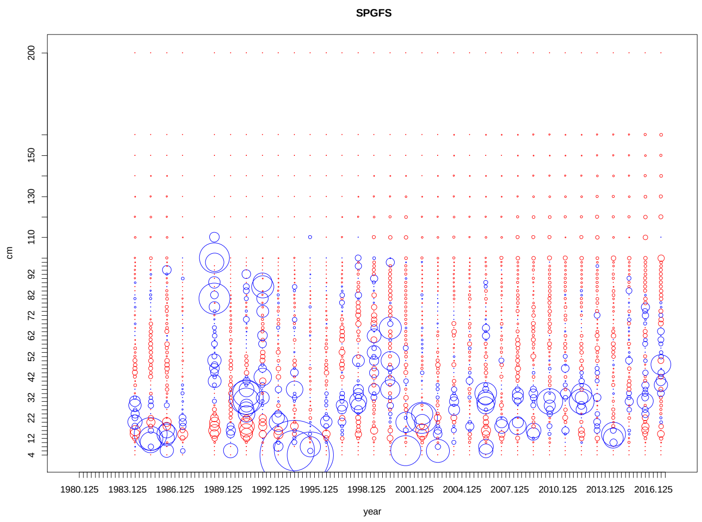


Figure 4.3.6 (continued)

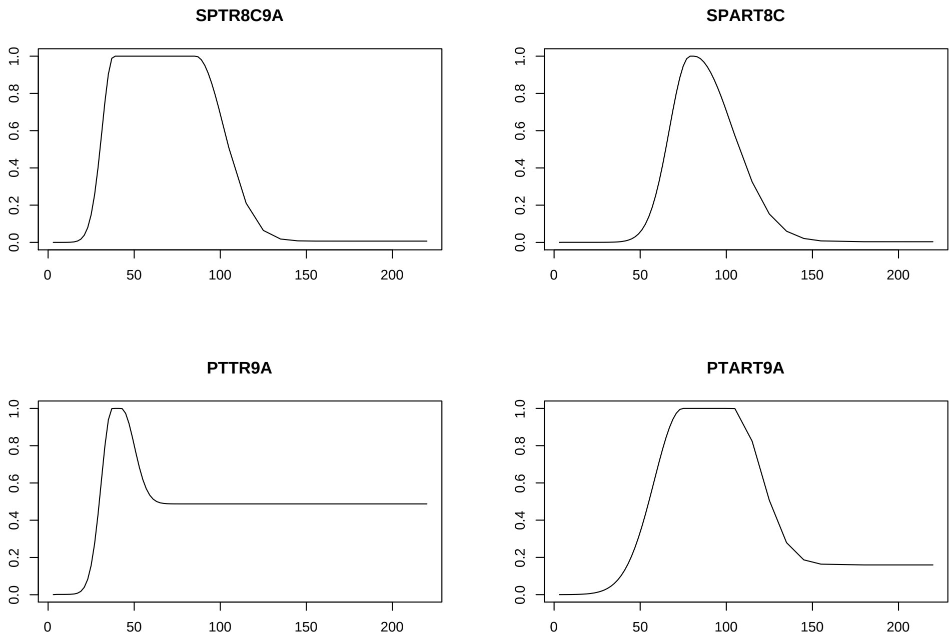


Figure 4.3.7 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Relative selection patterns at length by fishery estimated by SS3.

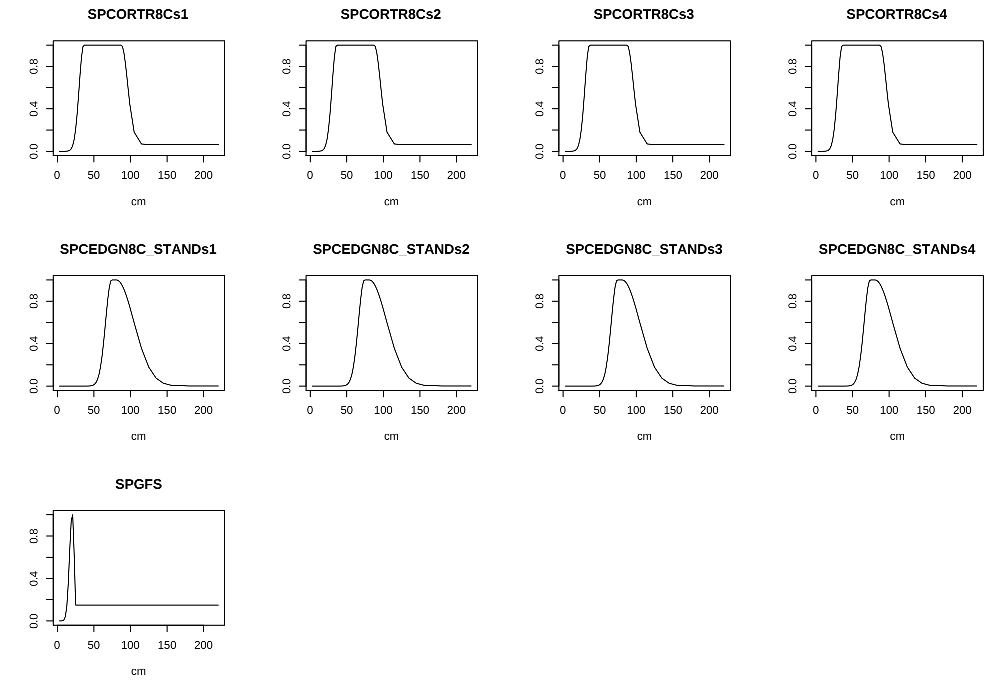


Figure 4.3.8 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.Relative selection patterns at length by abundance index estimated by SS3. A Coruña and Cedeira indices are by quarter.

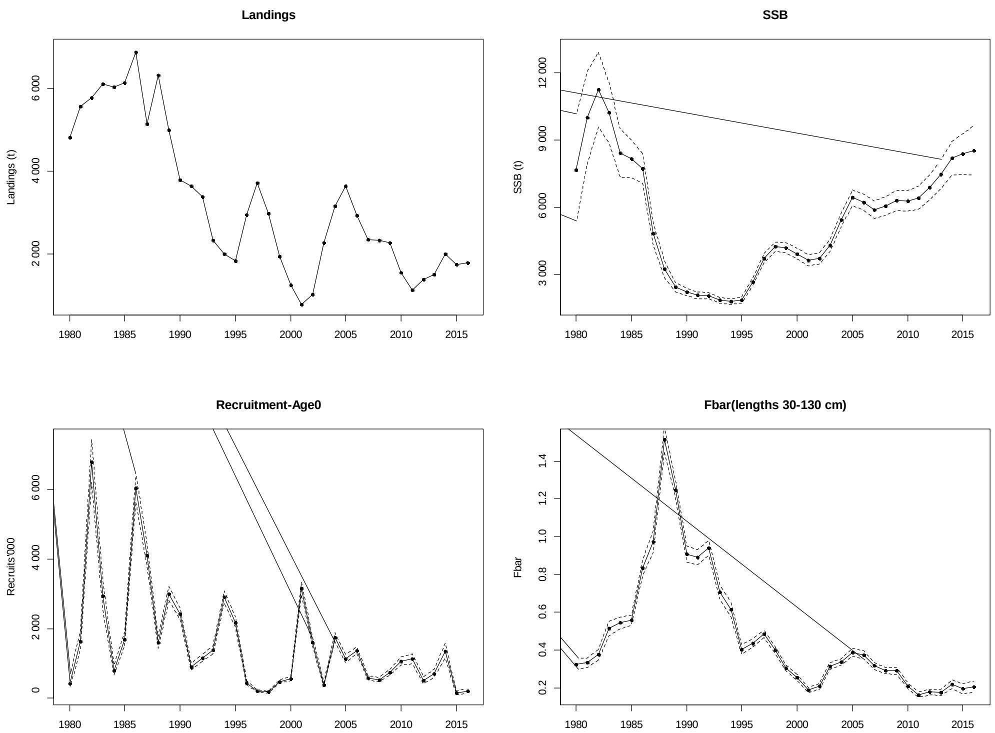


Figure 4.3.9 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Summary plots of stock trends (with 90% intervals).

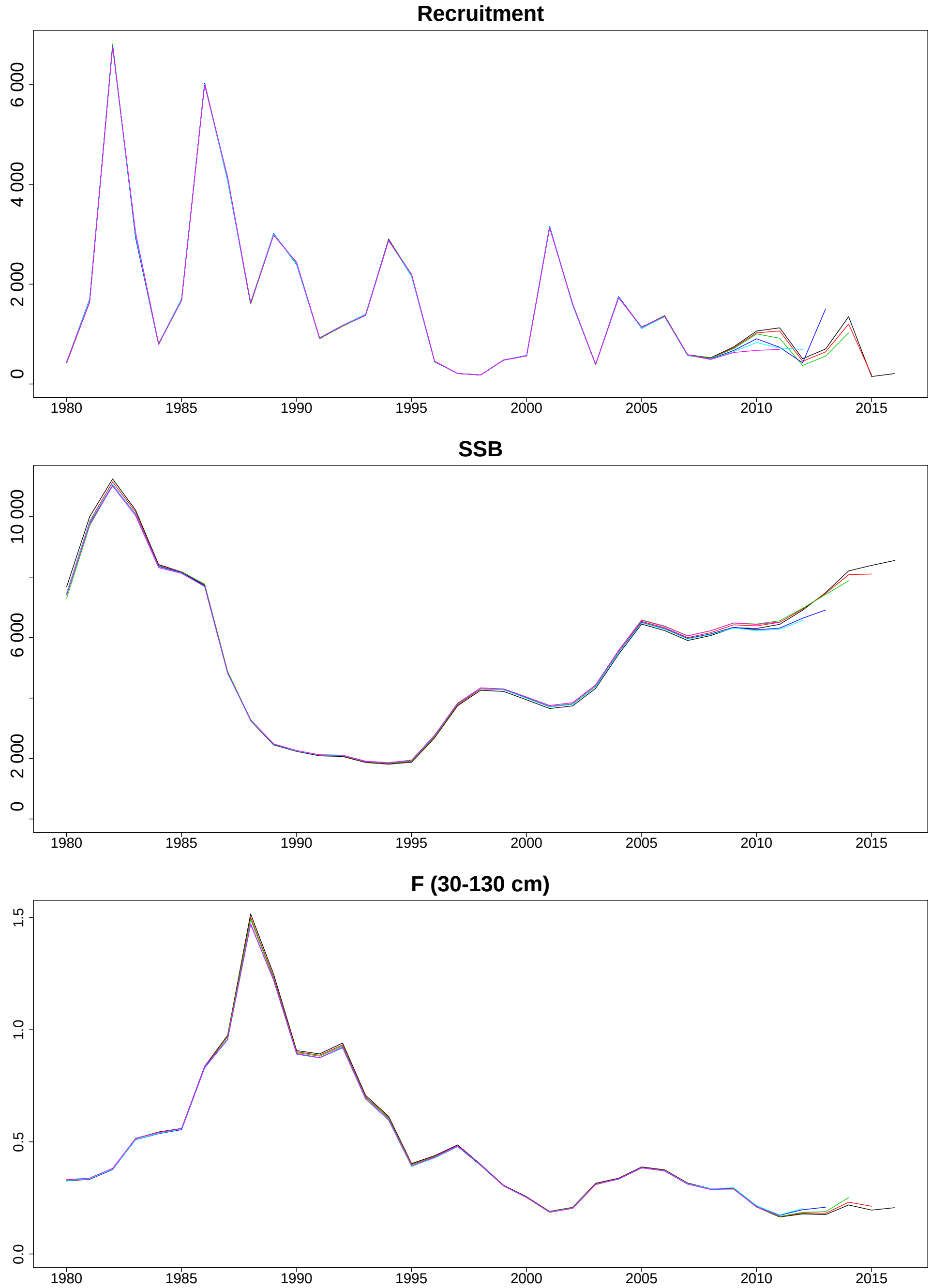


Figure 4.3.10ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Retrospective plots from SS3.

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 69% from the trawl fleet (mean lengths in 2016 of 48 cm in both Divisions 8.c and 9.a in 2016), 24% from the gillnet fleet (mean length of 54 cm in 2016 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 51 cm in 2016) and 68% from the artisanal fleet (mean length of 60 cm in 2016).

4.4.3 Data

4.4.3.1 Commercial catches and discards

Total landings of *L. budegassa* by country and gear for the period 1978–2016, as estimated by the Working Group, are given in Table 4.4.1. See historical landings analysis in the Stock Annex. Unallocated/non reported landings for this stock were available from 2011 to 2016. The unallocated/non reported values were considered realistic and are taken into account for the assessment. Estimates of unallocated or non-reported landings were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each metier and quarter.

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 and gillnet discards estimates of *L. budegassa* in weight and associated coefficient of variation (CV) are shown in Table 4.4.2. The estimated Spanish trawl discards rate observed from 1994–2016, shows two peaks, in 2006 (92 t) and 2010 (61 t). The coefficient of variation for weight data varied from 24–99%. The estimated Spanish gillnet discards are almost null.

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, 2015 and 2016.

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 both *L. piscatorius* and *L.budegassa* Stock Annexes).

The sampling levels for 2016 are shown in Table 1.4. The métier sampling adopted in Spain and Portugal in 2016, 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/non reported landings, length composition are not used in the actual assessment of *L. budegassa*) for 2016. The annual length compositions between 1986 and 2016 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 since then the levels of small fish in the sampled catches decreased. 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 1983–2016 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 2014-2015 suggests a lack of recruitment. The small peak of individuals below 20 cm observed in the 2016 Spanish survey is the first signal of recruitment since 2013 (WD11).

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 2013-2016. 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 being in 2016 at their 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 data series. Except for the Spanish fleet 'A Coruña', all series were updated till 2016 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: 1989–2016).
- Portuguese Trawler fleet directing to groundfish (PT.fish.tr: 1989–2016).

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_{2017}/B_{MSY} and F_{2016}/F_{MSY} have respectively 0.21% and 1.23% of bias and both have more than 14% relative inter-quartile ranges. Biomass in 2017 is estimated to be 120% of B_{MSY} with 95% bias-corrected confidence interval between 94% and 143%. Fishing mortality in 2016 is estimated to be 0.45 times F_{MSY} with 95% bias-corrected confidence interval between 0.36 and 0.61 times F_{MSY}. MSY is estimated to be 1906 t with 95% CI from 1 752 t to 2030 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 2017 at 120% 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. The 2017 results are consistent with 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.

The stock biomass (B) has been increasing since 2001 and is estimated to be above MSY Btrigger over most of the time-series. Fishing mortality (F) has decreased since 1999 and is estimated to have been below F_{MSY} since 2008.

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 2014-2016), F_{MSY} and with zero catches. A set of projections were done which took in to account the Reference Points (see table below) for *L.budegassa*. A projection was also done using the F multipliers corresponding to F_{MSY} of *L. piscatorius*. Table 8.4.11 shows projections for 2018 for every F option at 0.01 unit intervals between F_{lower} and F_{upper} .

For *L. budegassa*, fishing mortality equal to F *status quo* in 2018 is expected to keep the stock above B_{MSY} in 2019. 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}	Relative value. BMSY is estimated directly from the assessment model and changes when the assessment is updated.	(ICES, 2012)
	F_{MSY}	Relative value.	Relative value. FMSY is estimated directly from the assessment model and changes when the assessment is updated.	(ICES, 2012)
	F_{MSY} range	(0.78 F_{MSY}, F_{MSY})	Relative value. FMSY is estimated directly from the assessment model and changes when the assessment is updated.	(ICES, 2016a)
Precautionary approach	B_{lim}	30% B_{MSY}	Relative value (equilibrium yield at this biomass is 50% of MSY).	(ICES, 2016b)
	B_{pa}	Not defined		
	F_{lim}	1.70 FMSY	Relative value (the F that drives the stock to Blim).	(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 2013–2016. 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)* in Divisions 8c and 9a. Tonnes landed by the main fishing fleets for 1998–2016 as determined by the wotking Group

	Div. 8c				Div. 9a						Div. 8c+9a		
	SPAIN				SPAIN			PORTUGAL				Unallocated/	
Year	Trawl	Gillnet	Others	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL	SUBTOTAL	Non reported	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
2016	203	118	5	326	103	79	2	120	257	560	886	125	1011

n/a: not available

Table 4.4.2 ANGLERFISH *(L. budegassa)* in Divisions 8c and 9a. Weight and percentage of dicards 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
2016	0.4	n/a	0.1	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
2016	5.0	n/a	2.47	0.49

n/a: not available

CV: coefficient of variation

Table 4.4.3 ANGLERFISH *(L. budegassa)* in Divisions 8c and 9a. Length composition by fleet for landings in 2016 (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
17	0.000	0.000	0.000	0.281	0.000	0.000	0.281	0.281	0.338
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.652	0.000	0.000	0.652	0.652	0.783
21	0.000	0.000	0.000	0.326	0.052	0.000	0.377	0.377	0.443
22	0.000	0.000	0.000	0.326	0.108	0.000	0.434	0.434	0.499
23	0.000	0.000	0.000	0.652	0.026	0.000	0.677	0.677	0.809
24	0.000	0.000	0.000	0.000	0.108	0.000	0.108	0.108	0.108
25	0.000	0.000	0.000	0.326	0.218	0.000	0.544	0.544	0.610
26	0.120	0.000	0.120	2.576	0.218	0.000	2.794	2.914	3.459
27	0.000	0.000	0.000	3.938	0.212	0.000	4.151	4.151	4.947
28	0.000	0.000	0.000	4.217	0.264	0.000	4.481	4.481	5.333
29	0.239	0.000	0.239	0.000	0.171	0.000	0.171	0.410	0.458
30	0.050	0.000	0.050	0.000	0.108	0.000	0.108	0.157	0.167
31	0.148	0.000	0.148	1.984	0.132	0.000	2.116	2.265	2.696
32	1.091	0.000	1.091	2.371	0.254	0.000	2.625	3.716	4.416
33	1.056	0.000	1.056	0.240	0.315	0.000	0.555	1.611	1.873
34	2.384	0.000	2.384	2.856	0.661	0.000	3.517	5.900	6.960
35	1.906	2.801	4.707	0.000	1.016	0.000	1.016	5.724	6.675
36	2.976	0.334	3.310	0.077	0.958	0.000	1.035	4.345	5.030
37	2.890	0.112	3.002	0.163	1.144	0.000	1.307	4.309	4.949
38	2.891	0.054	2.945	3.460	1.103	0.135	4.698	7.643	8.938
39	2.256	3.092	5.348	0.620	2.417	0.109	3.145	8.493	9.700
40	3.362	2.415	5.777	0.278	2.102	0.055	2.436	8.213	9.437
41	2.314	0.236	2.549	0.082	2.506	0.520	3.109	5.658	6.190
42	2.685	1.632	4.317	1.046	3.091	3.065	7.202	11.518	12.603
43	3.319	3.729	7.048	0.552	2.506	1.059	4.118	11.166	12.702
44	3.730	0.086	3.815	0.345	1.404	0.163	1.912	5.728	6.569
45	3.509	0.178	3.688	0.330	1.029	0.568	1.928	5.616	6.428
46	3.899	0.248	4.147	0.800	1.380	2.139	4.318	8.466	9.466
47	3.511	1.357	4.868	0.551	1.428	1.175	3.154	8.022	9.118
48	3.747	0.131	3.878	1.739	0.325	1.435	3.499	7.377	8.513
49	2.674	0.415	3.089	1.457	0.708	1.100	3.265	6.353	7.272
50	3.084	2.418	5.503	1.314	0.977	1.830	4.120	9.623	11.001
51	2.558	0.221	2.780	0.646	0.256	1.305	2.207	4.987	5.680
52	2.365	0.745	3.110	0.484	0.893	2.307	3.685	6.795	7.521
53	1.854	0.285	2.138	0.503	0.542	2.451	3.496	5.634	6.168
54	2.360	0.457	2.817	0.421	0.802	1.424	2.646	5.463	6.118
55	1.845	0.271	2.116	0.601	0.786	0.516	1.903	4.019	4.568
56	1.008	1.509	2.517	0.282	2.682	4.368	7.332	9.849	10.415
57	1.268	0.516	1.784	0.197	2.224	1.704	4.124	5.908	6.309
58	0.891	0.958	1.849	0.223	1.863	3.318	5.403	7.253	7.671
59	0.899	1.321	2.221	0.264	0.907	3.904	5.075	7.296	7.798
60	0.748	1.195	1.943	0.167	1.582	0.478	2.227	4.170	4.597
61	0.974	1.826	2.800	2.824	1.551	3.254	7.629	10.429	11.566
62	1.133	1.871	3.004	3.887	0.336	2.675	6.897	9.902	11.295
63	1.321	0.743	2.064	0.206	0.924	3.429	4.559	6.623	7.082
64	0.990	1.962	2.952	0.462	0.495	3.584	4.542	7.494	8.184
65	1.032	0.419	1.451	0.282	2.099	1.960	4.340	5.792	6.142
66	0.584	1.242	1.826	0.506	0.259	0.190	0.955	2.781	3.253
67	0.890	1.230	2.120	2.220	0.690	1.315	4.225	6.345	7.223
68	1.148	1.304	2.452	0.137	0.793	0.773	1.703	4.156	4.679
69	0.982	2.087	3.069	0.089	0.244	1.212	1.544	4.613	5.252
70	0.934	1.570	2.504	0.279	0.458	2.474	3.211	5.715	6.278
71	1.102	0.652	1.754	0.283	0.249	0.103	0.635	2.389	2.800
72	0.634	1.146	1.780	0.386	0.455	0.125	0.966	2.746	3.184
73	0.485	0.509	0.994	0.411	0.194	1.358	1.963	2.957	3.241
74	0.725	0.120	0.844	0.177	0.386	6.416	6.979	7.823	8.030
75	0.226	0.238	0.465	0.160	0.037	1.537	1.734	2.199	2.325
76	0.917	0.084	1.001	0.226	0.073	0.073	0.372	1.373	1.621
77	0.389	0.135	0.524	0.125	0.141	0.000	0.266	0.790	0.921
78	0.196	0.065	0.261	0.636	0.055	0.097	0.787	1.048	1.230
79	0.354	0.016	0.370	0.077	0.058	0.054	0.189	0.558	0.649
80	0.121	0.000	0.121	0.039	0.005	0.000	0.044	0.165	0.197
81	0.419	0.000	0.419	0.084	0.000	1.641	1.725	2.144	2.246
82	0.057	0.000	0.057	0.155	0.048	0.026	0.230	0.287	0.330
83	0.095	0.000	0.095	0.267	0.334	0.151	0.752	0.847	0.921
84	0.532	0.053	0.585	0.079	0.000	0.071	0.150	0.735	0.869
85	0.349	0.000	0.349	0.000	0.000	0.000	0.000	0.349	0.419
86	0.092	0.000	0.092	0.471	0.000	0.000	0.471	0.563	0.676
87	0.297	0.032	0.329	0.191	0.000	0.796	0.987	1.316	1.421
88	0.049	0.000	0.049	0.374	0.095	0.450	0.918	0.968	1.053
89	0.065	0.015	0.081	0.394	0.000	0.000	0.394	0.474	0.570
90	0.130	0.000	0.130	0.132	0.000	0.000	0.132	0.262	0.314
91	0.000	0.000	0.000	0.078	0.000	0.000	0.078	0.078	0.094
92	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93	0.000	0.008	0.008	0.000	0.400	0.000	0.400	0.408	0.410
94	0.066	0.008	0.074	0.020	0.000	0.000	0.020	0.094	0.113
95	0.000	0.000	0.000	0.000	0.000	0.047	0.047	0.047	0.047
96	0.000	0.000	0.000	0.000	0.000	0.039	0.039	0.039	0.039
97	0.000	0.008	0.008	0.000	0.000	0.000	0.000	0.008	0.009
98	0.000	0.000	0.000	0.014	0.023	0.000	0.037	0.037	0.040
99	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100+	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	87	44	131	53	50	69	172	303	340
Landings (t)	203	118	320	103	120	257	479	799	885
Mean Weight (g)	2330	2674	2446	1934	2399	3722	2787	2639	2602
Mean Length (cm)	49.9	54.3	51.4	45.8	50.4	60.4	53.0	52.3	52.0
Measured weight (t)	n/a	n/a	n/a	n/a	1.4	0.8	2.2	n/a	n/a

n/a: not available

Table 4.4.4 ANGLERFISH *(L. budegassa)* in Divisions 8c and 9a. Number, mean weight and mean length of landings between 1986 and 2016

nish

	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
2016	340	2602	52

Table 4.4.6 ANGLERFISH *(L. budegassa)* in 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 percentagerelative to total annual stock landings is given

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	--	--	--	--	--	--	--	--
2016	89	9	13 718	6.5	--	--	--	--	--	--	--	--

	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	--
2016	62	6	12	--	5.05	--	57	6	11	--	5.30	--

Table 4.4.7 ANGLERFISH *(L. budegassa)* in Divisions 8c and 9a. ASPIC input settings and data (landings in tonnes, SPCORTR8c LPUE in Kg7days*100HP, PT LPUE 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
37 ## 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
2016	-1.00E+00	1.01E+03	2016	5.05E-03	2016	5.30E-03

Table 4.4.8 ANGLERFISH *(L. budegassa)* in Divisions 8c and 9a. ASPIC result parameter estimates, non parametric bootstrap, relative bias and bias corrected, confidence interval, interquartile (IQ) range and relative range

Ye(2017): equilibrium yield available in 2017; Y(Fmsy): yield availabe at Fmsy in 2017; Ye2017/MSY: equilibrium yield available in 2017 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).

	WG2017 (WKFLAT2012/Stock Annex settings), B1/K fixed at 0.60							
			Bootstrap Confidence Interval					
Parameter	Point estimates	Relative bias	Lower 80%	Higher 80%	Lower 95%	Higher 95%	IQ-Range	Relative IQ-Range
B1/K	0.60	0.00%	0.60	0.60	0.60	0.60	0.00	0.00%
K	28820	0.92%	24710	34310	22790	37720	5111	17.70%
q(1)	7.50E-04	1.40%	5.81E-04	9.40E-04	4.97E-04	1.04E-03	1.86E-04	24.80%
q(2)	1.38E-07	1.69%	1.06E-07	1.73E-07	9.14E-08	1.95E-07	3.73E-08	27.10%
q(3)	2.96E-07	1.36%	2.31E-07	3.79E-07	1.98E-07	4.25E-07	7.38E-08	25.00%
MSY	1906	0.07%	1807	1986	1752	2030	98	5.20%
Ye(2017)	1827	-1.86%	1760	1929	1689	1965	89	4.90%
Y.(Fmsy)	1057	-0.12%	1048	1072	1043	1077	13	1.20%
Bmsy	14410	0.92%	12360	17150	11390	18860	2556	17.70%
Fmsy	0.132	1.29%	0.105	0.161	0.093	0.177	0.030	22.60%
fmsy(1)	176.3	0.75%	158.1	204.9	149	216	22.83	12.90%
fmsy(2)	961500	0.65%	838900	1109000	777900	1191000	137000	14.20%
fmsy(3)	447100	1.02%	384300	513600	356000	552500	66990	15.00%
B./Bmsy	1.20	0.21%	1.02	1.35	0.94	1.43	0.17	14.20%
F./Fmsy	0.45	1.23%	0.39	0.55	0.36	0.61	0.09	19.00%
Ye./MSY	0.96	-1.78%	0.88	1.00	0.82	1.00	0.06	6.40%
q2/q1	1.83E-04	0.75%	1.62E-04	2.11E-04	1.51E-04	2.26E-04	2.60E-05	14.20%
q3/q1	3.94E-04	0.48%	3.45E-04	4.55E-04	3.20E-04	4.88E-04	5.97E-05	15.10%

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

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

Outputs	WKFLAT2012	WG2013 Benchmark Settings	WG2014 Benchmark Settings	WG2014 Bench. Set. B1/K fixed	WG2015 Benchmark Settings	WG2015 Bench. Set. B1/K fixed	WG2016 Bench. Set. B1/K fixed	WG2017 Bench. Set. B1/K fixed
B1/K	0.93	0.44	0.44	0.60	0.19	0.60	0.60	0.60
MSY	1375	1881	1900	1633	3622	1749	1856	1906
K	43910	58390	59360	47260	101800	38600	31610	28820
q(1)	3.09E-04	4.22E-04	4.22E-04	4.08E-04	5.33E-04	5.15E-04	6.62E-04	7.50E-04
q(2)	4.85E-08	6.78E-08	6.78E-08	6.57E-08	8.78E-08	8.65E-08	1.18E-07	1.38E-07
q(3)	1.17E-07	1.58E-07	1.58E-07	1.53E-07	2.02E-07	1.99E-07	2.60E-07	2.96E-07
TOF	1.07E+01	1.14E+01	1.14E+01	1.14E+01	1.18E+01	1.19E+01	1.30E+01	1.38E+01
mse	1.60E-01	1.57E-01	1.57E-01	1.55E-01	1.53E-01	1.53E-01	1.62E-01	1.68E-01
rmse	4.01E-01	3.96E-01	3.96E-01	3.93E-01	3.91E-01	3.91E-01	4.03E-01	4.10E-01
CI	0.5015	0.2162	0.2114	0.3080	0.1013	0.3345	0.3707	0.3919
CN	1.0000	0.9438	0.9356	1.0000	0.6994	1.0000	1.0000	1.0000
Rest	111	19	8	7	82	7	8	9
Error	0	0	0	0	11	0	0	0
r sq 1	0.181	0.165	0.165	0.169	0.139	0.148	0.120	0.103
rsq 2	0.010	0.132	0.131	0.125	0.366	0.336	0.446	0.481
rsq 3	0.052	0.029	0.028	0.031	0.106	0.121	0.222	0.311
Y.@Fmsy	1436	1300	1352	1463	1476	1718	1087	2266
Bmsy	21950	29190	29680	23630	50890	19300	15810	14410
Fmsy	0.063	0.064	0.064	0.069	0.071	0.091	0.117	0.132
B./Bmsy	1.040	0.684	0.705	0.893	0.399	0.982	1.109	1.204
F./Fmsy	0.522	0.806	0.589	0.539	0.706	0.587	0.517	0.451

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)* in Divisions 8c and 9a. Font estimates of B/BMSY from 2017 to 2021 and Yield (from 2017 to 2020) for projections under several scenarios. The value of F2017/FMSY is equal to Fsq (mean F of 2014-2016) in all scenarios provided. Values for F/FMSY are also given.

Fishing mortality trends in relation to F_{MSY}

year \ scenario	F_{MSY}	Fsq	zero catches	Flow	Flim	MSY Btrigger (2019)	Blim (2019)	*L piscatorius* F_{MSY}
2017	0.477	0.477	0.477	0.477	0.477	0.477	0.477	0.477
2018	1.000	0.477	0.000	0.780	1.700	8.127	12.140	0.703
2019	1.000	0.477	0.000	0.780	1.700	8.127	12.140	0.703
2020	1.000	0.477	0.000	0.780	1.700	8.127	12.140	0.703

Biomass trends in relation to B_{MSY}

year \ scenario	F_{MSY}	Fsq	zero catches	Flow	Flim	MSY Btrigger (2019)	Blim (2019)	*L piscatorius* F_{MSY}
2017	1.204	1.204	1.204	1.204	1.204	1.204	1.204	1.204
2018	1.252	1.252	1.252	1.252	1.252	1.252	1.252	1.252
2019	1.214	1.294	1.371	1.247	1.114	0.500	0.300	1.259
2020	1.183	1.331	1.479	1.243	1.008	0.213	0.077	1.265
2021	1.157	1.362	1.575	1.240	0.923	0.093	0.020	1.270

Yield

year \ scenario	F_{MSY}	Fsq	zero catches	Flow	Flim	MSY Btrigger (2019)	Blim (2019)	*L piscatorius* F_{MSY}
2017	1116.0	1116.0	1116.0	1116.0	1116.0	1116.0	1116.0	1116.0
2018	2349.0	1157.0	0.0	1858.0	3824.0	12590.0	15270.0	1682.0
2019	2283.0	1193.0	0.0	1851.0	3432.0	5190.0	3781.0	1691.0
2020	2229.0	1223.0	0.0	1845.0	3124.0	2236.0	975.4	1698.0

Table 4.4.11 ANGLERFISH *(L. budegassa)* in Divisions 8c and 9a. Point estimates of B/B_{MSY} for 2019, F/F_{MSY} in 2018 and Yield in 2018 for every F option at 0.01 unit intervals between $F_{MSY\ lower}$ and $F_{MSY\ upper}$

Scenario	Yield (2018)	F/F_{MSY} (2018)	B/B_{MSY} (2019)
F = $F_{MSY\ lower}$	1858.0	0.780	1.247
F = 0.79F_{MSY}	1880.0	0.790	1.246
F = 0.80F_{MSY}	1903.0	0.800	1.244
F = 0.81F_{MSY}	1926.0	0.810	1.243
F = 0.82F_{MSY}	1948.0	0.820	1.241
F = 0.83F_{MSY}	1971.0	0.830	1.240
F = 0.84F_{MSY}	1993.0	0.840	1.238
F = 0.85F_{MSY}	2016.0	0.850	1.237
F = 0.86F_{MSY}	2038.0	0.860	1.235
F = 0.87F_{MSY}	2061.0	0.870	1.234
F = 0.88F_{MSY}	2083.0	0.880	1.232
F = 0.89F_{MSY}	2105.0	0.890	1.231
F = 0.90F_{MSY}	2128.0	0.900	1.229
F = 0.91F_{MSY}	2150.0	0.910	1.228
F = 0.92F_{MSY}	2172.0	0.920	1.226
F = 0.93F_{MSY}	2194.0	0.930	1.225
F = 0.94F_{MSY}	2217.0	0.940	1.223
F = 0.95F_{MSY}	2239.0	0.950	1.222
F = 0.96F_{MSY}	2261.0	0.960	1.220
F = 0.97F_{MSY}	2283.0	0.970	1.219
F = 0.98F_{MSY}	2305.0	0.980	1.217
F = 0.99F_{MSY}	2327.0	0.990	1.216
F = $F_{MSY\ upper}$	2349.0	1.000	1.214

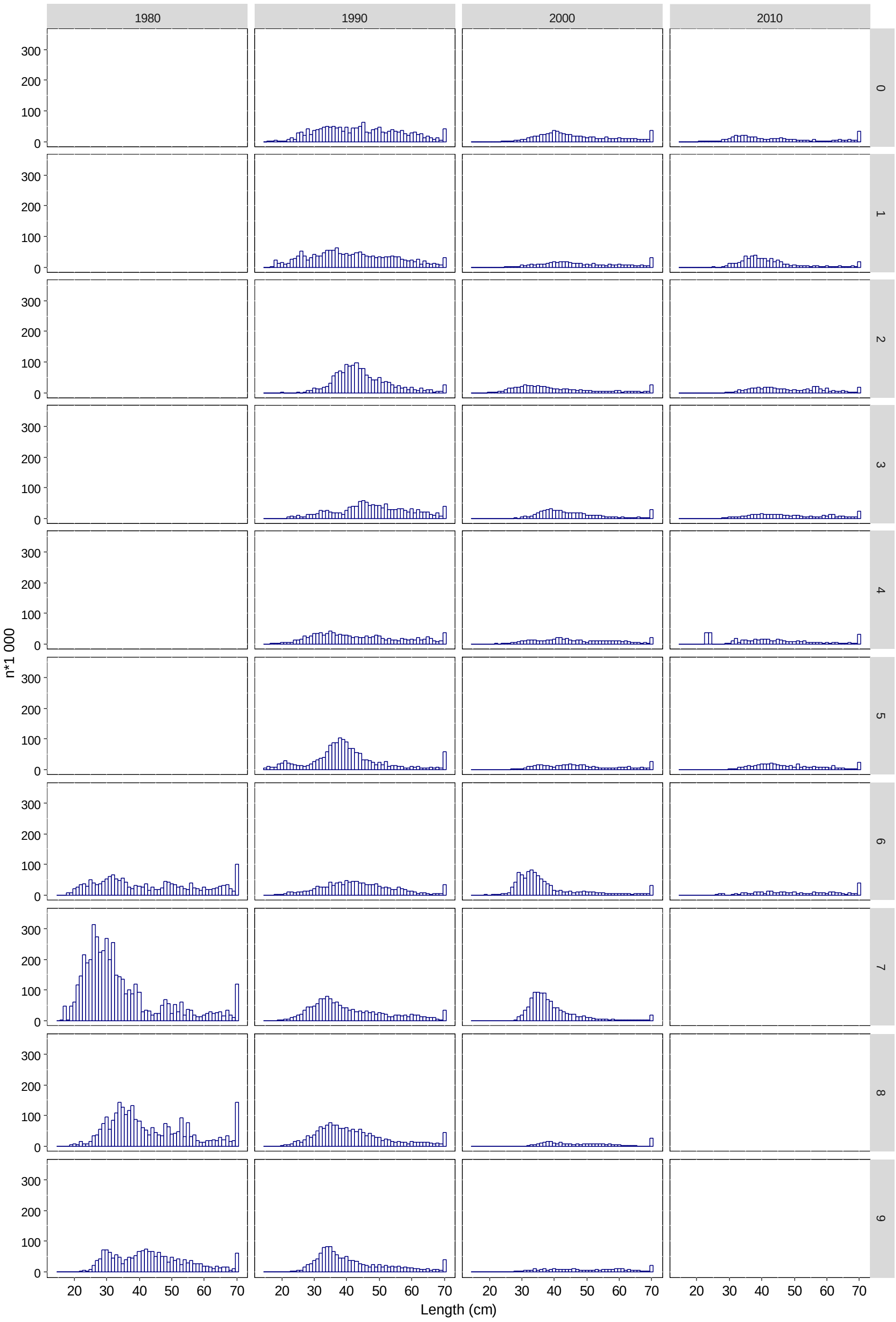


Figure 4.4.1 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a. Length distributions of landings (thousands for 1986–2016).

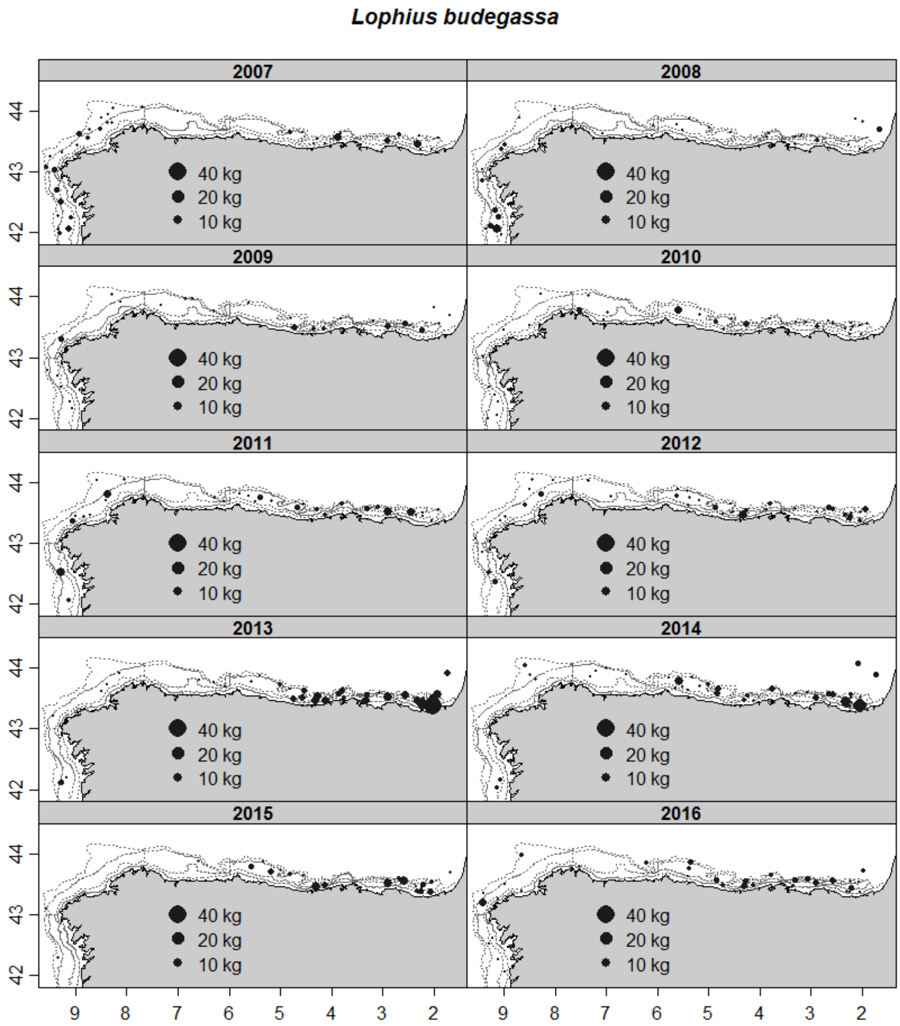


Figure 4.4.2 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a. Distribution of black anglerfish (*L. budegassa*) juveniles (0–20 cm) in SpGFS-WIBTS-Q4 between 2007–2016.

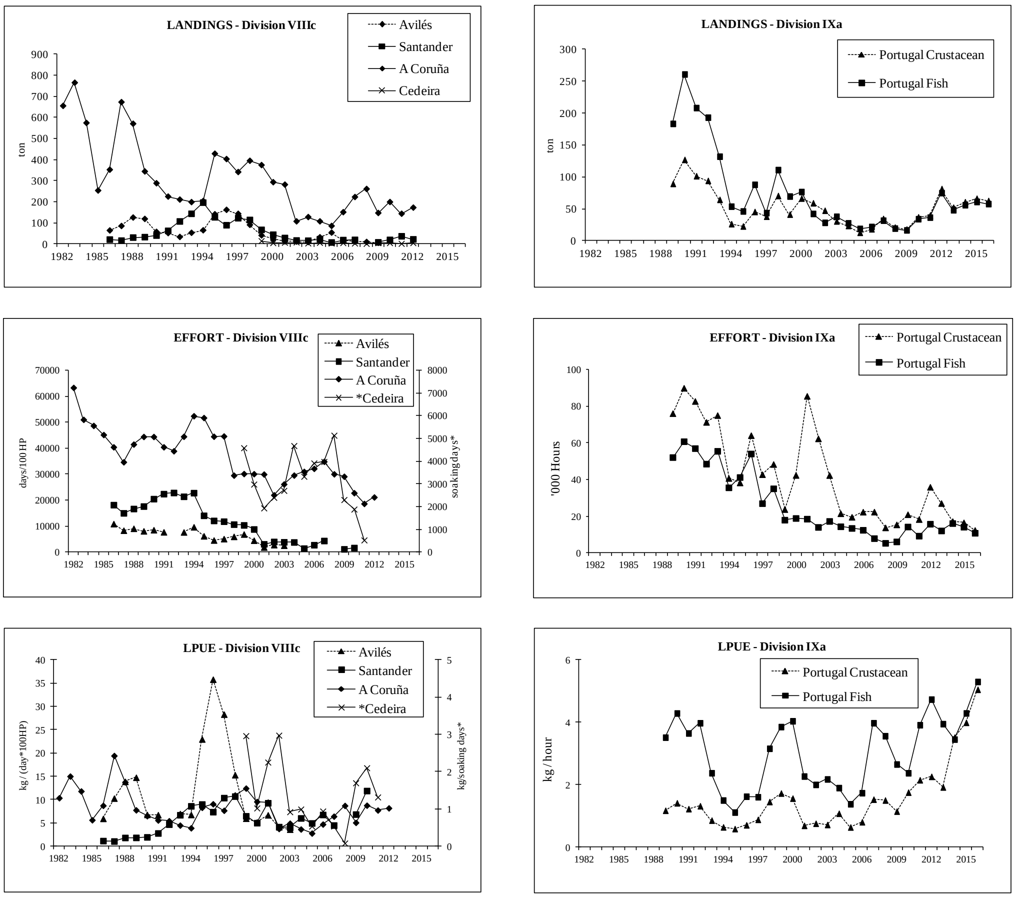


Figure 4.4.3 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a. Trawl and gillnet landings, effort and LPUE data between 1986–2016.

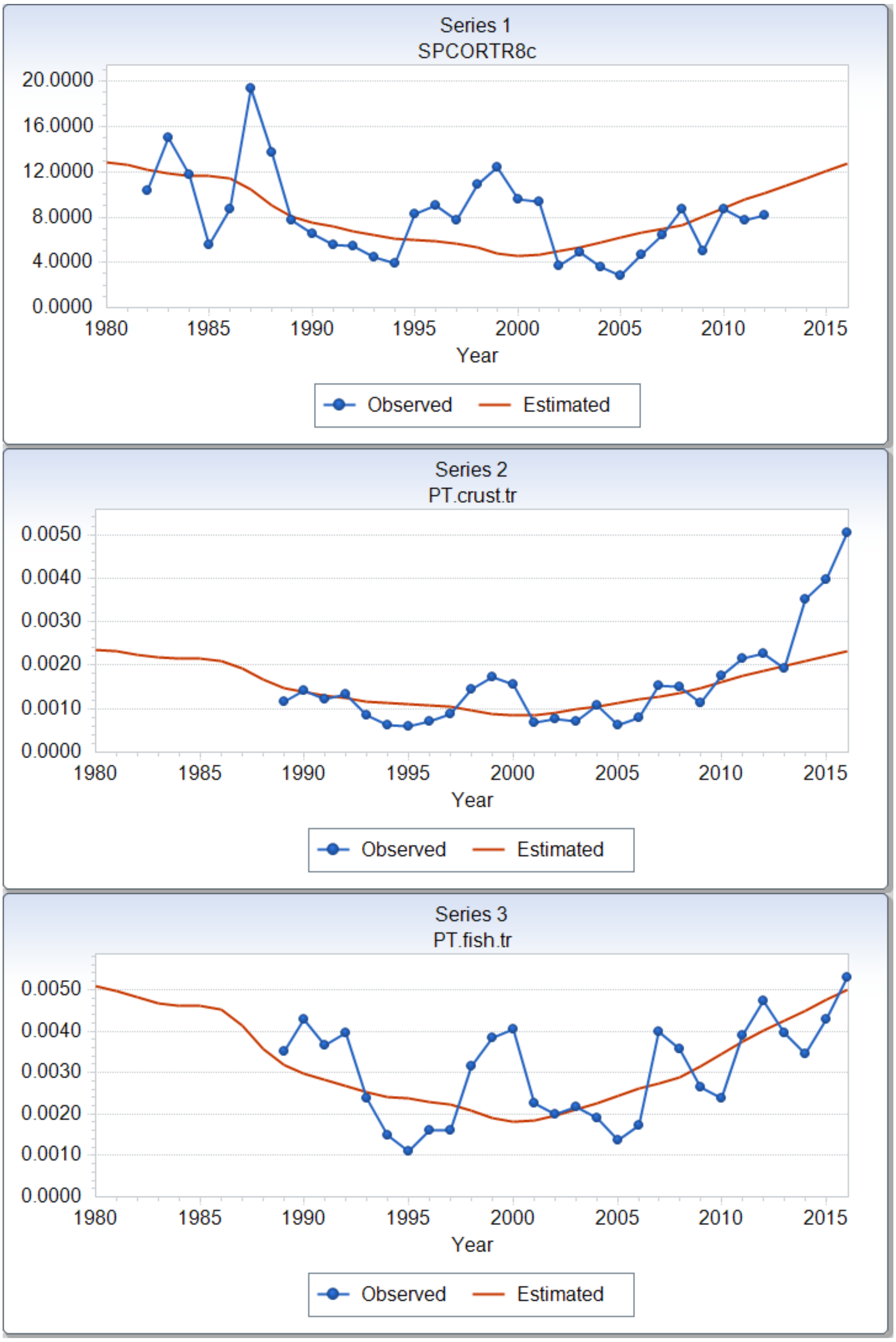


Figure 4.4.4. ANGLERFISH (*L. budegassa*)– Divisions 8.c and 9.a. Observed cpue for the three commercial fleets and estimated values by the model.

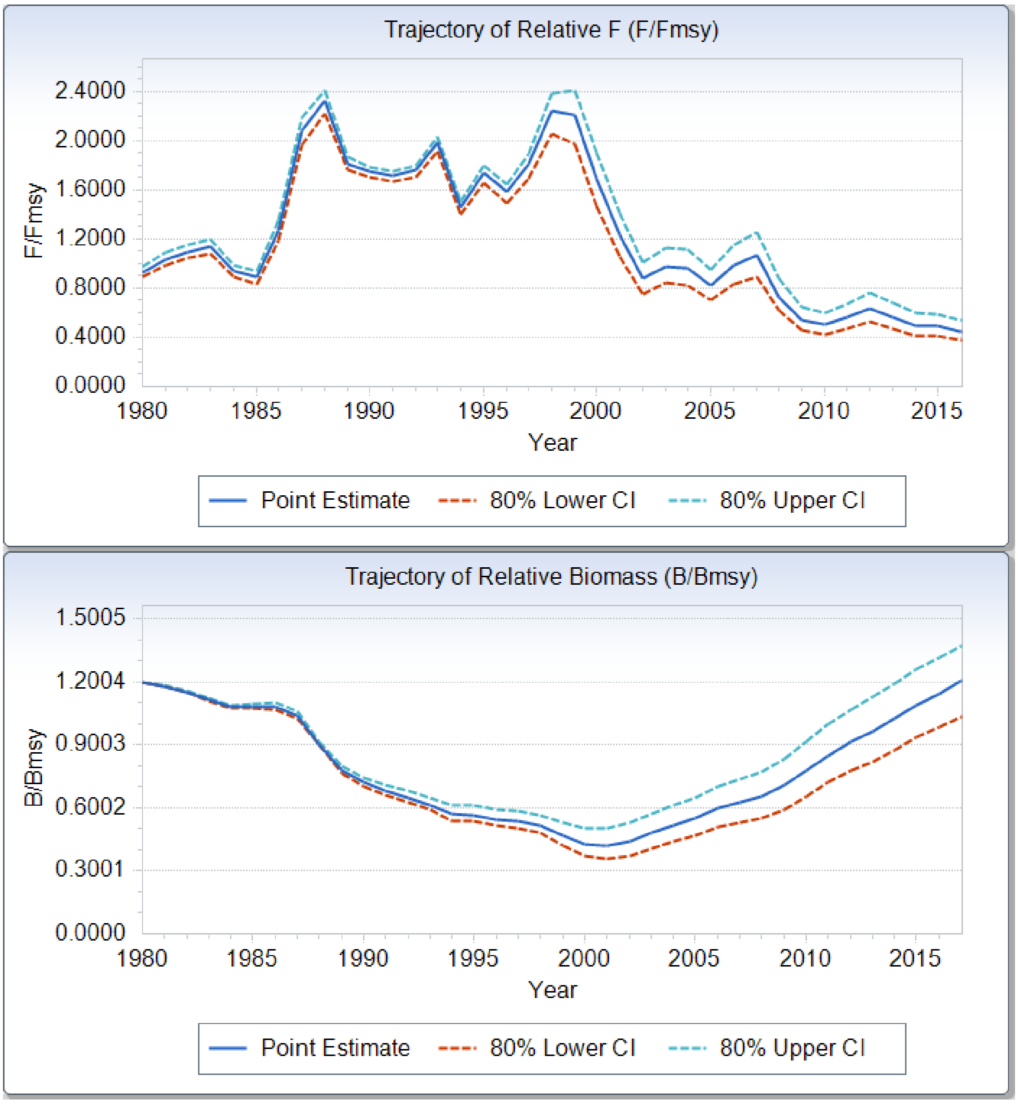


Figure 4.4.5. ANGLERFISH (*L. budegassa*) – Divisions 8c and 9a. Confidence intervals (80%) of the F/FMSY and B/BMSY ratios.

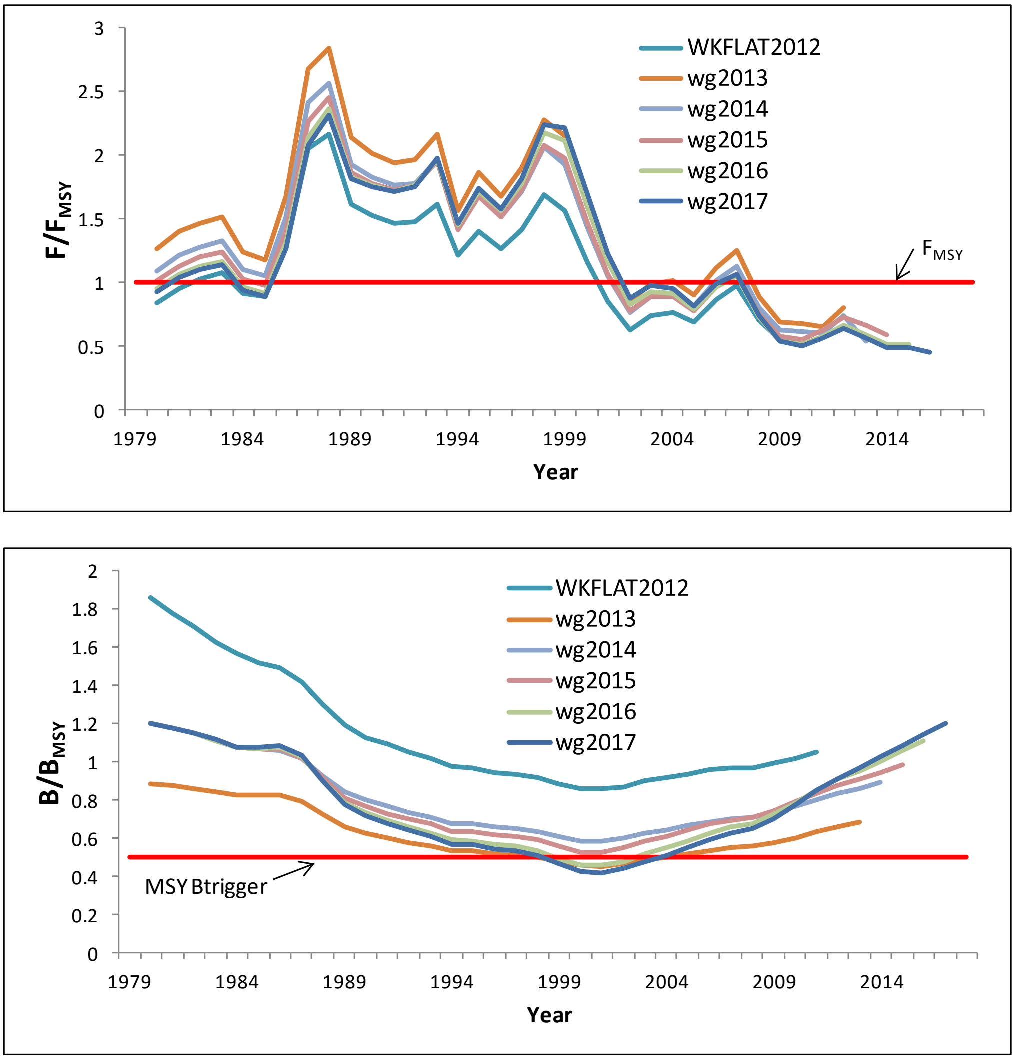


Figure 4.4.6. ANGLERFISH (*L. budegassa*) – Divisions 8c and 9a. Trends of the F/F$_{MSY}$ and B/BMSY ratios from the, 2012 benchmark, 2013, 2014, 2015, 2016 and 2017 WG assessments.

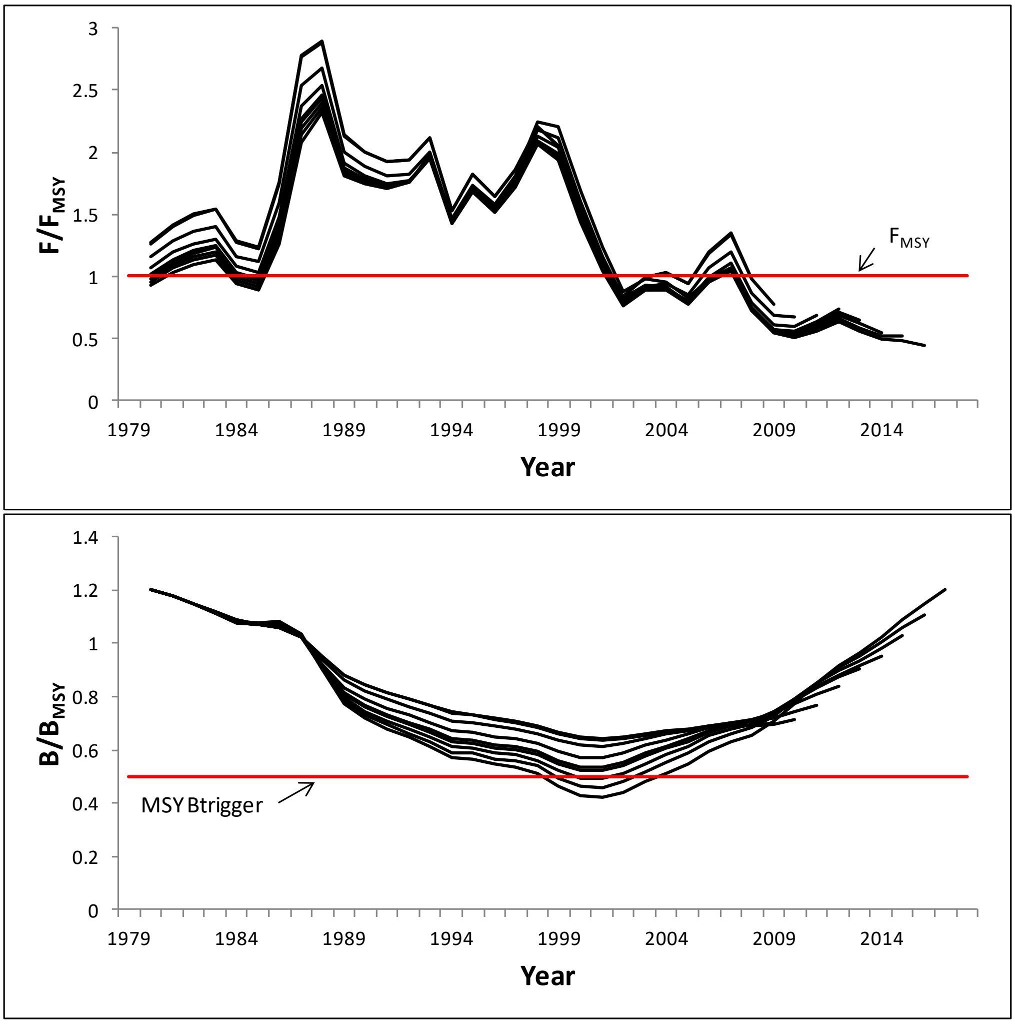


Figure 4.4.7 ANGLERFISH (*L. budegassa*) – Divisions 8c and 9a. Retro analysis of the F/FMSY and B/BMSY ratios of 2016 WG assessment.

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

Lepidorhombus whiffiagonis:

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.

Lepidorhombus boscii:

Assessment type: First assessment.

Data revisions: First assessment **(**survey indices included)

General

See Stock annex general aspects related to megrim assessment.

Ecosystem aspects

See Stock annex for ecosystem aspects related to megrim assessment.

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 2016, the four countries together have reported around 96% 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 2016 are shown in Table 5.1.1.2.

Summary of ICES advice for 2017 and management for 2016 and 2017

ICES advice for 2017 (as extracted from ICES Advice 2016, Book 6):

The two megrim species are not separated in the landings and a single TAC covers both of them. ICES considers that management of the two megrim species under a combined TAC prevents effective control of the single-species exploitation rates and could lead to overexploitation of either species. Therefore, this year's advice is based on the single-species F_{MSY} and the ICES precautionary approach for category 6 stocks.

For *L. whiffiagoni*s, ICES advises that when the MSY approach is applied, catches in 2017 should be no more than 16 021 tonnes. If discard rates do not change from the average of the last three years (2013–2015), this implies landings of no more than 13 709 tonnes.

For *L. Boscii*, as there is no catch information available discards could not be quantified for the ICES advised that when the precautionary approach is applied, landings in 2018 should be no more than 350 t.

If the TAC continues to be set for both megrim species combined, then the combined megrim Laingins in 2018 should be no more than:

14 059 t (both megrim species) = 350 t (*L. boscii* single-species landings advice) + 13 709 t (*L. whiffiagonis* landings advice).

Management applicable for 2016 and 2017:

The agreed TAC for the combined species was set at 20 056 t and 15 043 for 2016 and 2017, respectively.

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

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

5.1.1 General

See general section for both species

5.1.2 Data

5.1.2.1 Commercial catches and discards

Stock catches for the period 1984–2016, as estimated by the WG, are given in Table 5.1.2.1.1. This is the second 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 2016 are slightly lower than in 2015 (1%), reaching up to 11 548 t.

Since 2011, estimates of unallocated or non-reported landings have been included in the assessment. These were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each métier.

Spanish data show a decreasing trend from 2009 onwards. During Inter-Benchmark 2016, France landing data series were updated from 2003–2014. Landing data from France shows a decreasing trend from 2013 onwards with a slight increase in 2016. Landing information from year 2016 by Ireland and Belgium show a slight increase however UK shows a slight decrease.

Regarding discard data, French discards were provided from 2004–2014 to the Inter-Benchmark 2016, and they have been updated in 2016. There is an increase in all discard information provided by Ireland, Spain, UK and Belgium but the most significant increase are the Belgium discards with an increase from 4 t to 42 t in the last year.

Discard data available by country and the procedure to derive them are summarized in Table 5.1.2.1.1. 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	Discard ratio (%)
2000	11%
2001	13%
2002	15%
2003	20%
2004	30%
2005	20%
2006	24%
2007	19%
2008	21%
2009	18%
2010	26%
2011	24%
2012	20%
2013	24%
2014	16%
2015	12%
2016	17%

5.1.2.2 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 2016. Age distribution for landings and discards from 2002–2016 are presented in Figure 5.1.2.2.1.

Lengths

Table 5.1.2.2.1 shows the available original length composition of landings by Fishing Unit in 2016.

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.

5.1.2.3 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 1997–2016 are summarized in Table 5.1.2.3.1.

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 5.1.2.3.1). In Figure 5.1.2.3.4 the time-series of the age composition of abundances from 2007 to 2016 of EVHOE survey is presented. During WGBIE 2017, due to changes in rounded calculations made by IFREMER the age time series was recalculated again.

An abundance index in ages was provided for Irish Groundfish Survey (IGFS-WIBTS-Q4) from 2003-2016. For the last five years of the data series, the survey provides the lowest values of older ages and a sharp decrease of medium age individuals. For the younger ages, it shows an increasing trend in the last four years.

A revised abundance index in ages was provided for the Spanish Porcupine Groundfish Survey (SpPGFS-WIBTS-Q4) from 2001 to 2016 due to a change in the calculation methodology of the tow trawling time. In Figure 5.1.2.3.3 the time-series of the age composition of abundances from 2007–2016 is presented.

When comparing Spanish, French and Irish survey biomass indices some contradictory signals are detected (Figure 5.1.2.3.1). The EVHOE-WIBTS-Q4 index decreased from 2001 until 2005 and since then has sharply increased until 2011. In the last years 2016, 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 with a slight decrease in 2015 and an increase again in 2016.

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 with an increase in 2016.

For a more detailed inspection of the abundances indices of different age groups, these were inspected along the whole data series for surveys (Figure 5.1.2.3.2). 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 data series 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 5.1.2.3.5). 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.

5.1.2.4 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 5.1.2.4.1. 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 six 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 5.1.2.4.2): A. Coruña (SP-CORUTR7) from 1984–2016, Cantábrico (SP-CANTAB7) from 1984–2010 as no effort has been deployed by this fleet in subarea 7 during the six years and Vigo (SP-VIGOTR7) from 1984–2016. 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 decreasing trend. 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 5.1.2.4.1 and Figure 5.1.2.4.3). 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 5.1.2.4.4).

Summarizing, no particular lpue changes have been observed.

An analysis of the abundance indices of different age groups in data series for commercial fleets was carried out (Figure 5.1.2.4.5). 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 of the data series. 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 data series but a marked decrease in abundance index of old fish was observed for French fleet. In 2016, an increase of young and older ages is observed in Spanish fleet and Irish fleets.

5.1.3 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.

5.1.3.1 Data Exploratory Analysis

In summary, the stock catch-at-age matrix shows three periods: 1984–1989; 1990–1998 and 1999–2016.

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 slight increase in ages 1 and 2 in EVHOE-WIBTSQ4 survey (Figure 5.1.3.1.1). Otherwise, in SpPGFS-WIBTS-Q4 a decrease in age 1 and increase in age 2 was observed. Thus, the figure 5.1.3.1.1. shows little or no cohort tracking in the surveys. Presumably this is a consequence of lack of variability in recruitment, leading to lack of contrast between cohorts.

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 year an increase of ages 1–2 are observed. However, IRTBB shows a slight decrease of ages 1–2.

The time-series of catch-at-age (Figure 5.1.3.1.2) 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 data series.

The analysis of landings is presented since 1990 (Figure 5.1.3.1.3). 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 2016, ages 1 and 2 decreased slightly and ages 8 and 9 increased significantly.

The signal coming from the discard data showed that at the beginning of the data series discards of age 1 was low (Figure 5.1.3.1.4-5). Discards of this age increased along the data series, particularly from 2003 onwards. From year 2010 to 2013, ages 1 to 3 appear to be highly discarded but in 2015 and 2016 general discards decrease.

5.1.3.2 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.

5.1.3.3 Results

The model results were analysed looking at three different kinds of plots: convergence plots (to analyse the convergence behaviour 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 were done in relation to the inclusion of discards information from France in IBP Megrim 2016, which are included as data instead of being estimated by the model. Settings used in WGBIE 2017 are listed in Table 5.1.3.3.1.

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 5.1.3.3.1 to Figure 5.1.3.3.3) 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 5.1.3.3.4. 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 5.1.3.3.5. The SSB shows an overall decreasing trend from the start of the series in 1984–2005 with a marked increasing trend till 2016. 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 an increase in the last two years. The fishing mortality showed three marked periods which coincide with the data periods, 1984–1989, 1990–1998 and 1999–2016. 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 2016 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.

5.1.4 Retrospective pattern

Retrospective analysis was conducted for 5 years, the retrospective time-series of most relevant indicators are shown in Figures 5.1.4.1. 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.

5.1.5 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. During WGBIE 2017 a short R script was added to the short term projection script to enable the change of last year recruitment data if it is not considered credible. As the recruitment at age 1 estimated by the model for the year 2016 was not considered credible, it was replaced by geometric mean of all the recruitments since 1984 except the last two years (1984–2014). The Baranov population equation was used to project the recruitment one year forward.

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 2018 and SSB in 2019 predicted for various levels of fishing mortality in 2018 are given in Table 5.1.5.1. Maintaining F status quo in 2018 is expected to result in an increase in landings with respect to 2017 and an increase in SSB in 2018 with respect to 2017.

5.1.6 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 5.1.6.1. and included in the Stock Annex.

5.1.7 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 5.1.1.1.1. .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**				422			2230	**2652**	**18514**
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**	**16901**
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	2863	2804	147	2436		246	1	**11569**	634	513	47	308		4		**1507**	**13076**
2016	3141	2672	2694	145	2593		302	1	**11548**	1276	649	74	404		42		**2445**	**13992**

Table 5.1.1.1.2. 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
2016	11548	2445	13992	20056

(1) for both megrim species and VIIa included.

Table 5.1.2.1.1. 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**
2016	**FR16**	**SP16 (*)**	**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 5.1.2.2.1 Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Length composition by fleet (thousands).

Length	FRANCE	SPAIN
class (cm)	OTB_DEF_>=70_99_0_0 VII	OTB_DEF_70-99_0_0. Otter trawl-med&deep VII
10		0
11		0
12		0
13		0
14		0
15		0
16		0
17		0
18		0
19		0
20		0
21		0
22		0
23		7
24	0.58	98
25	0.00	389
26	2.33	608
27	8.41	581
28	12.34	472
29	7.38	402
30	6.53	340
31	1.65	295
32	0.54	263
33	1.12	243
34	0.40	193
35	0.40	160
36	0.67	120
37	0.67	110
38	2.28	95
39	3.13	66
40	1.97	66
41	3.84	61
42	1.25	46
43	3.13	40
44	2.06	28
45	3.26	22
46	3.93	25
47	2.50	19
48	3.35	10
49	1.07	14
50	0.54	8
51	0.27	5
52	1.16	1
53	0.13	1
54		0
55		1
56		0
57		0
58		0
59		0
60		0
61		0
62		0
63		0
64		0
65		0
66		0
67		0
68		0
69		0
70		0
TOTAL	77	4786

Table 5.1.2.3.1. 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 (NEW TIME SERIES PROVIDED IN WGBIE 2017)								
		Age								
	Effort	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1997	100	1.28	2.73	1.93	2.32	3.41	3.14	2.64	1.57	1.13
1998	100	1.28	1.15	1.15	1.28	0.77	2.05	2.05	0.90	0.38
1999	100	2.36	6.08	1.58	4.40	7.93	5.76	2.88	2.39	2.99
2000	100	1.92	2.61	4.56	2.07	2.25	2.20	1.90	2.28	1.41
2001	100	2.06	3.24	1.53	1.33	1.86	2.98	4.96	2.51	2.19
2002	100	4.23	1.73	4.04	3.24	5.71	2.85	5.75	3.21	1.64
2003	100	3.54	2.91	2.38	3.98	2.62	4.96	2.34	2.19	2.05
2004	100	1.00	4.95	3.00	2.39	4.40	3.26	3.05	4.11	3.04
2005	100	1.15	1.83	4.85	1.62	4.91	2.23	2.45	1.12	1.74
2006	100	2.14	1.81	2.85	5.57	2.47	3.22	5.00	2.24	2.53
2007	100	4.71	4.88	3.35	1.89	3.77	4.09	5.16	3.66	3.44
2008	100	1.55	9.12	12.04	6.67	4.60	5.87	5.03	1.72	0.79
2009	100	3.75	4.41	10.81	3.35	2.32	2.34	0.97	0.41	
2010	100	3.49	3.26	3.48	8.15	3.84	2.33	2.22	2.76	4.30
2011	100	0.00	4.55	4.91	5.70	4.61	5.31	2.18	0.91	2.02
2012	100	1.23	1.26	2.55	1.44	2.00	1.60	2.51	2.14	1.47
2013	100	3.28	4.51	7.00	9.59	2.16	4.92	5.76	0.87	1.83
2014	100	0.35	1.57	0.88	1.77	1.90	2.10	1.54	0.52	
2015	100	1.54	1.75	4.32	2.95	2.74	1.89	0.72	0.18	0.26
2016	100	0.81	2.28	1.90	2.31	1.84	3.06	1.17	2.63	0.72

		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
2016	100	28	211	370	207	108	83	75	37	27	39

	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
2016	100	15	1104	6137	3263	4137	2248	2176	1712

Table 5.1.2.3.1 (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
2016	2.62	14.90

	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
			2016	14.77	207.93

	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
2016	1224

Table 5.1.2.4.1. 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	0.0	89.7	17.9
2016	NA	NA	NA	NA	3.3	0.0	96.6	17.8

(*) LPUEs, no discards available

Table 5.1.3.3.1. 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 5.1.5.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Catch forecast: management option table.

F scaled

Recluit 2017=R(GM84-14)

2017

Quantile	Rec_2017	SSB_2017	TSB_2017	Fbar_2017	Catch_2017	Land_2017	Disc_2017	Rec_2018	SSB_2018	TSB_2018
5%	221412	70846	95486	0.19	14676	11884	2537	221412	76899	101667
50%	**227470**	**81357**	**107879**	**0.22**	**16025**	**12920**	**3084**	**227470**	**89644**	**115361**
95%	233507	93335	122210	0.26	17636	14072	3879	233507	104783	131601

2018

Fmult	F_2018	Catch_2018	Land_2018	Disc_2018	Rec_2019	SSB_2019	TSB_2019
0	0.00	0	0	0	227470	116398	142351
0.1	0.02	1959	1614	344	227470	114082	139928
0.2	0.04	3875	3188	683	227470	111820	137625
0.3	0.07	5749	4728	1016	227470	109614	135433
0.4	0.09	7577	6226	1345	227470	107445	133185
0.5	0.11	9368	7689	1668	227470	105344	131012
0.6	0.13	11114	9114	1986	227470	103330	128939
0.7	0.15	12823	10509	2299	227470	101299	126853
0.8	0.18	14491	11867	2608	227470	99315	124826
0.9	0.20	16124	13192	2912	227470	97441	122874
1	**0.22**	**17713**	**14483**	**3211**	**227470**	**95628**	**120913**
1.1	0.24	19275	15746	3507	227470	93795	119042
1.2	0.26	20806	16982	3797	227470	91992	117176
1.3	0.28	22299	18183	4082	227470	90213	115368
1.4	0.31	23764	19356	4362	227470	88535	113614
1.5	0.33	25190	20495	4640	227470	86895	111915
1.6	0.35	26579	21620	4913	227470	85243	110258
1.7	0.37	27946	22709	5182	227470	83643	108617
1.8	0.39	29272	23775	5447	227470	82107	106994
1.9	0.42	30566	24820	5710	227470	80593	105425
2	0.44	31841	25842	5968	227470	79149	103886

Table 5.1.6.1. 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

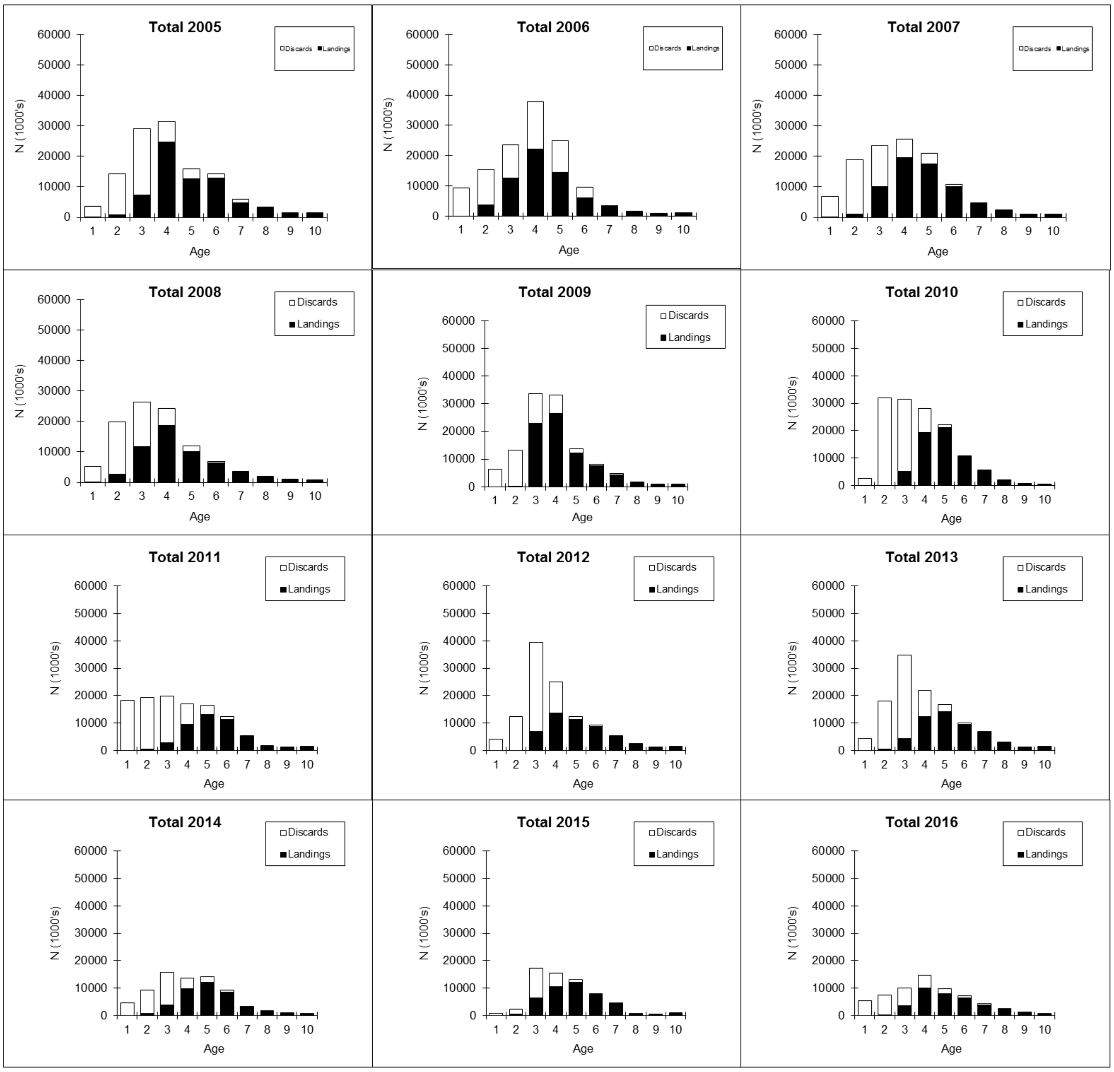


Figure 5.1.2.2.1. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Age composition of catches for the years 2002–2016.

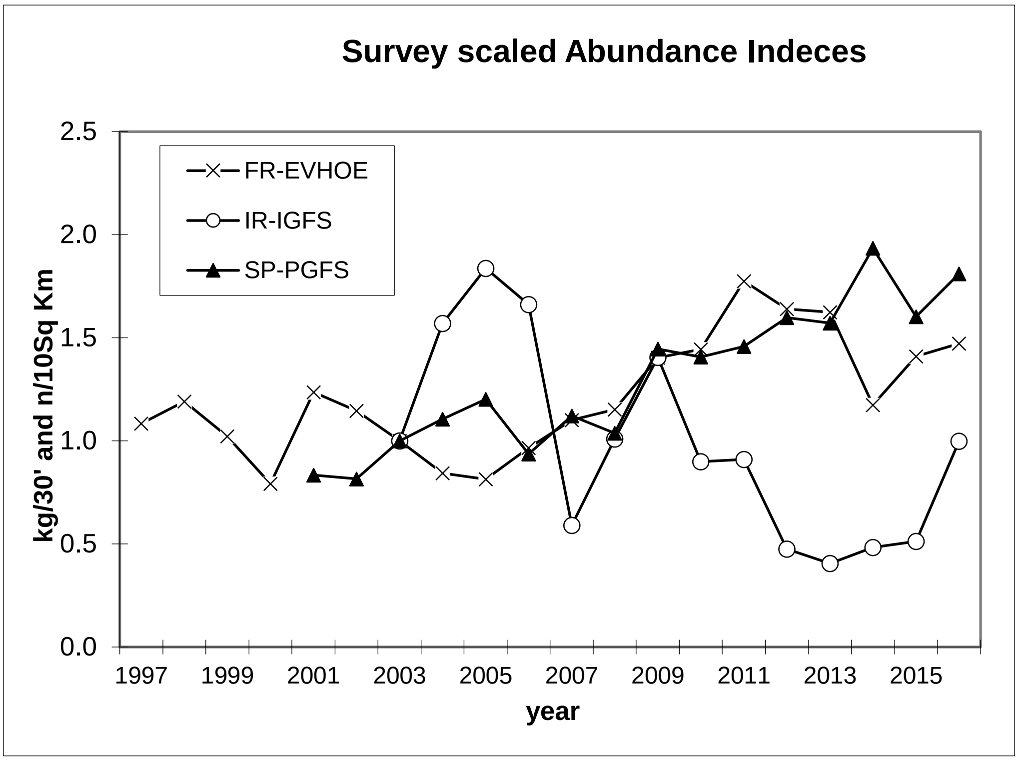


Figure 5.1.2.3.1. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Scaled Biomass Indices for FR-EVHOE, SP-PGFS and IR-IGFS.

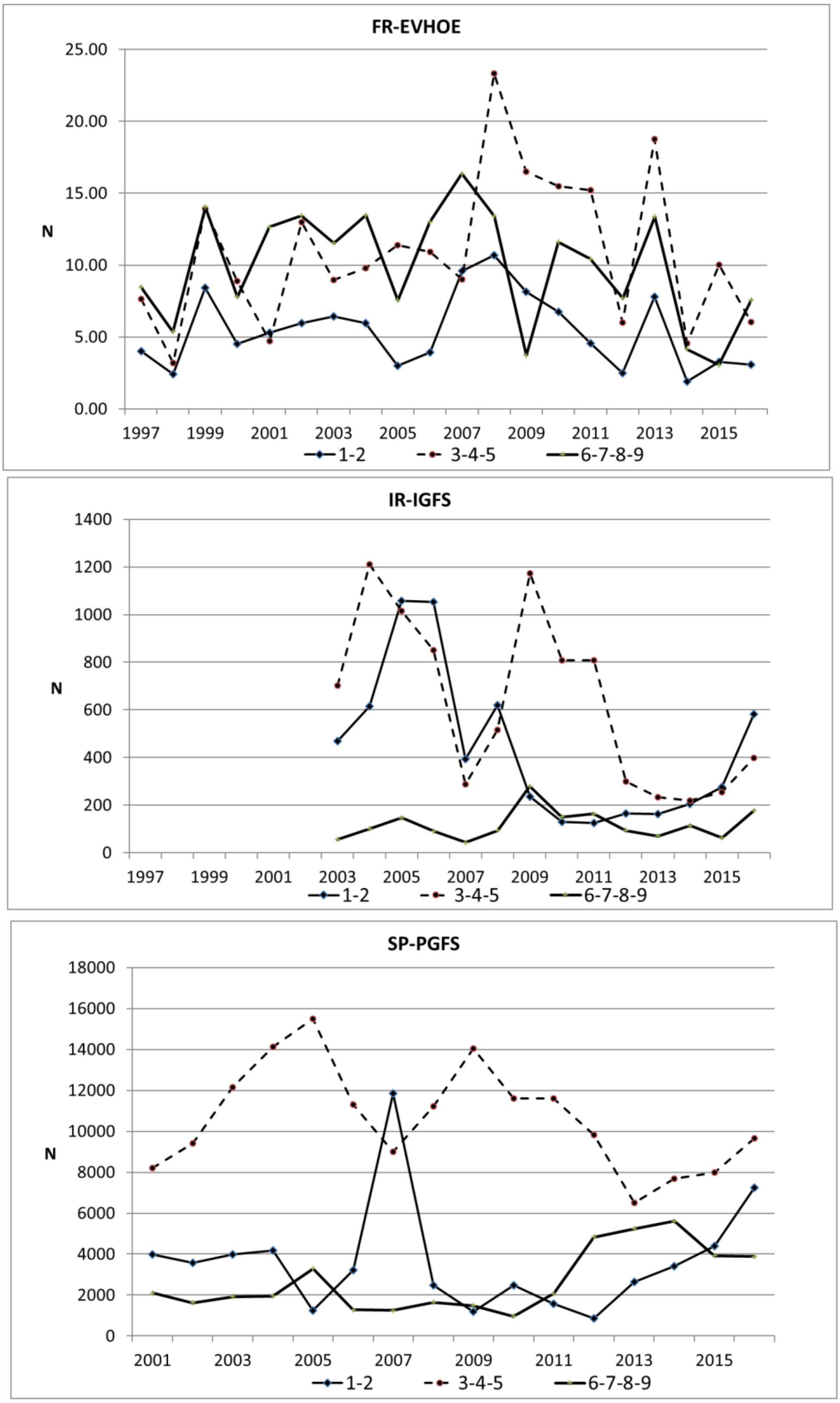


Figure 5.1.2.3.2. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Abundance Indices for EVHOE, IGFS and SP-PGFS by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+.

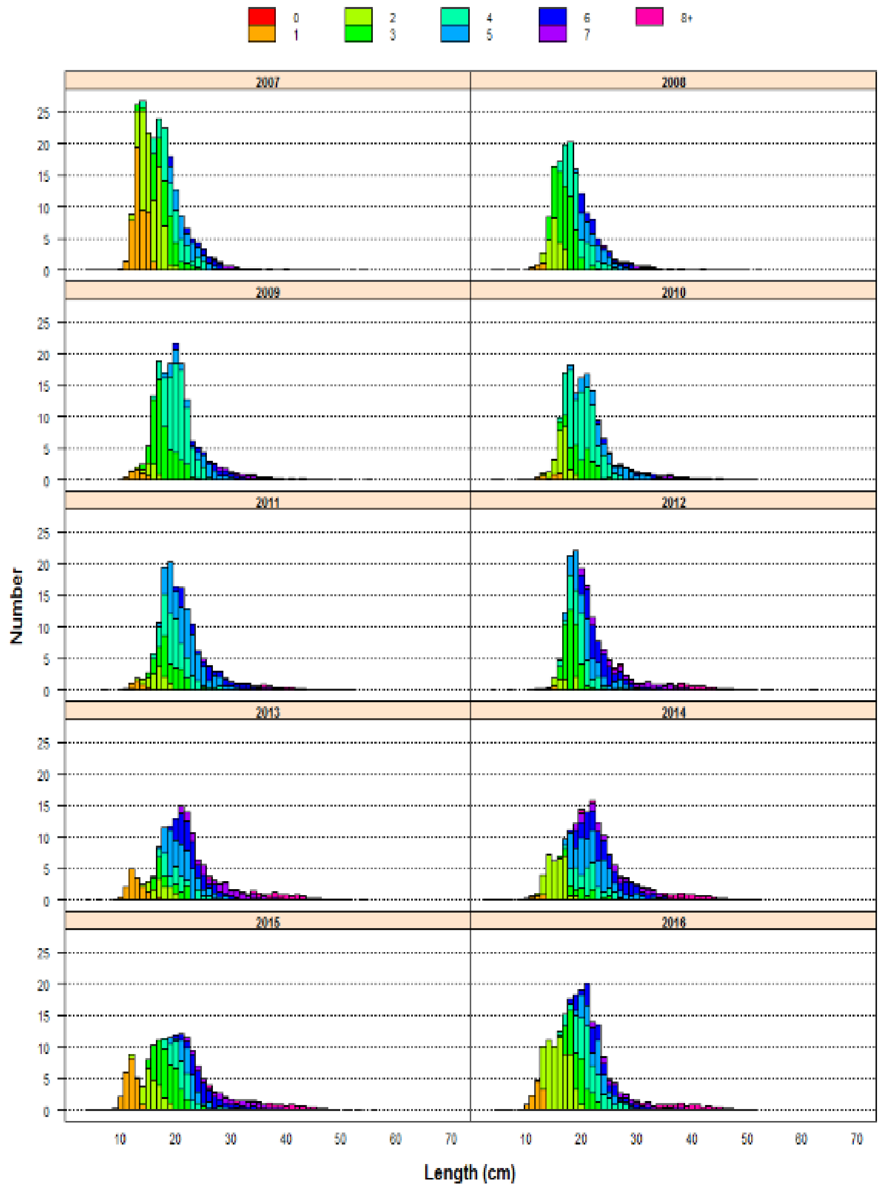


Figure 5.1.2.3.3. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Age composition of SP-PORCUPINE survey in abundance (numbers).

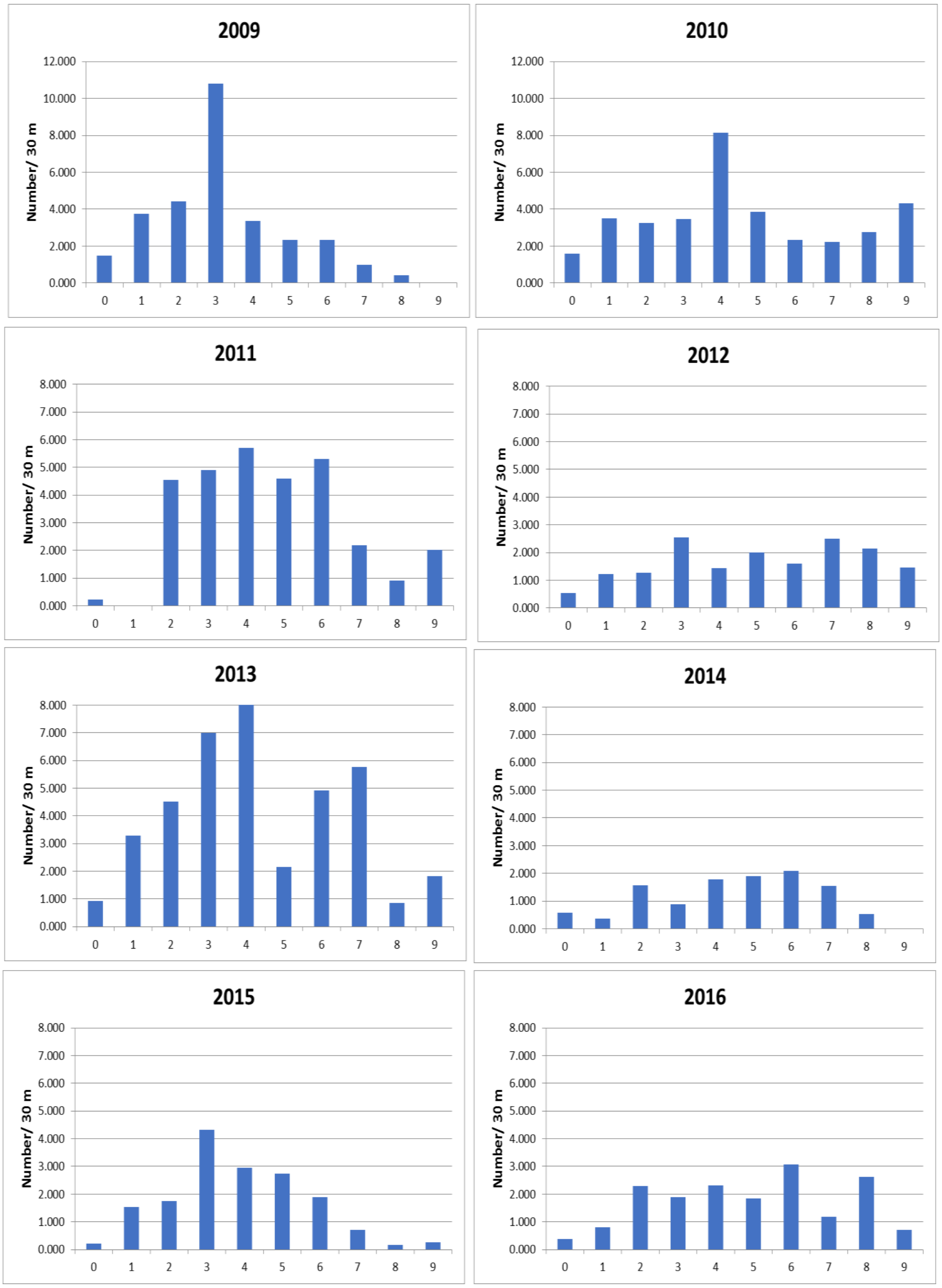


Figure 5.1.2.3.4. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Age composition of FR-EVHOE survey in abundance (numbers/30min haul).

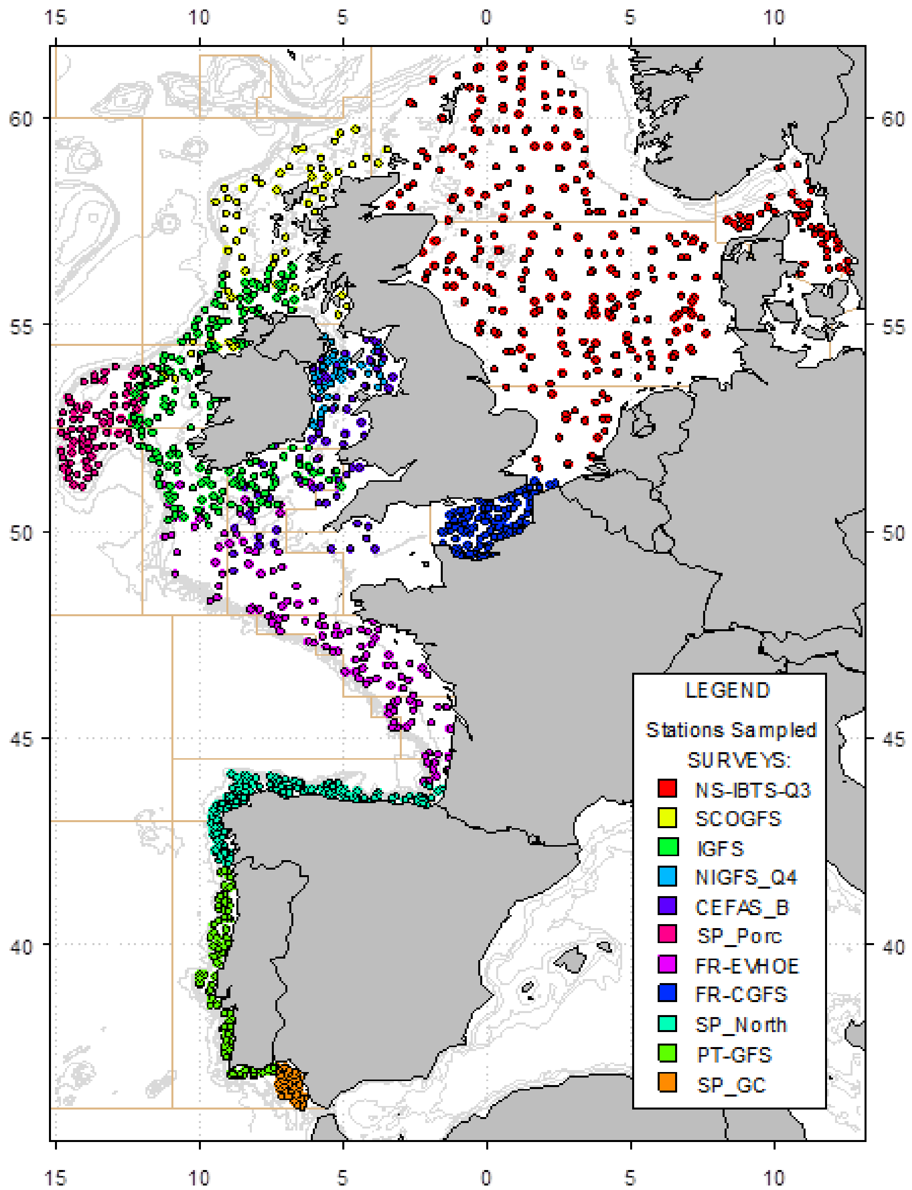


Figure 5.1.2.3.5. Station positions for the IBTS Surveys carried out in the Western Atlantic and North Sea Area in autumn/winter of 2008. (From IBTSWG 2009 Report). Just to be used as general location of the Surveys.

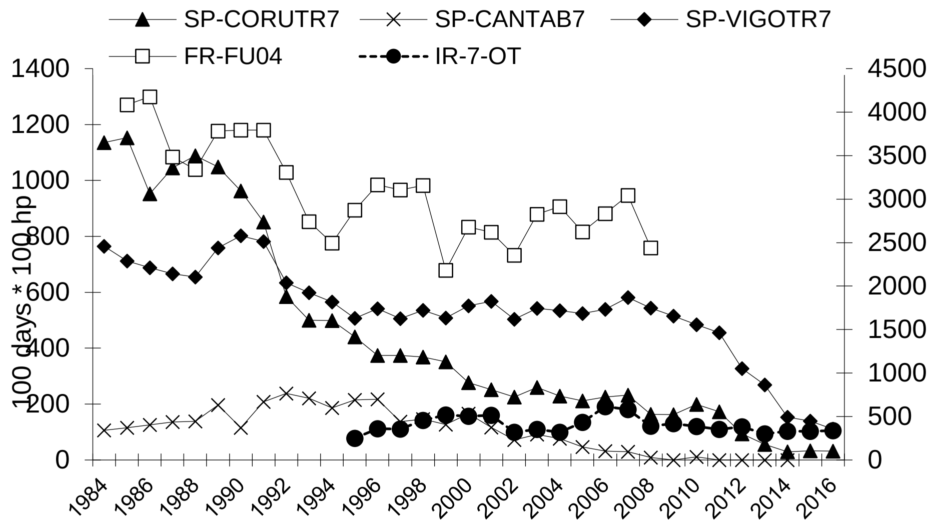


Figure 5.1.2.4.1. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Evolution of effort for different bottom-trawler fleets.

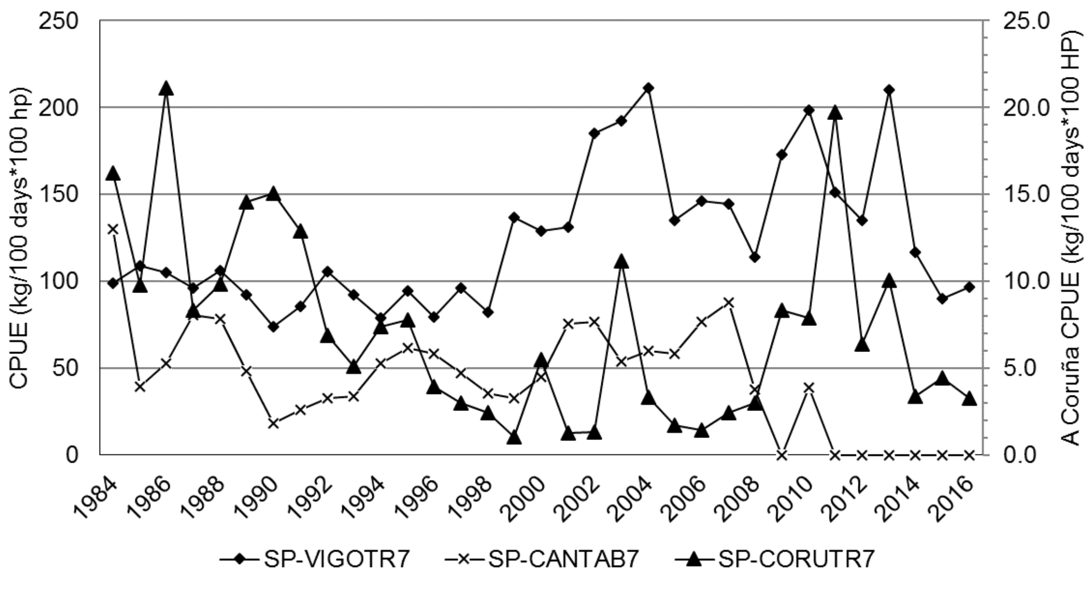


Figure 5.1.2.4.2. Megrim *(L. whiffiagonis*) in Divisions 7b,c,e–k and 8a,b,d. Spanish cpue for different bottom-trawler fleets.

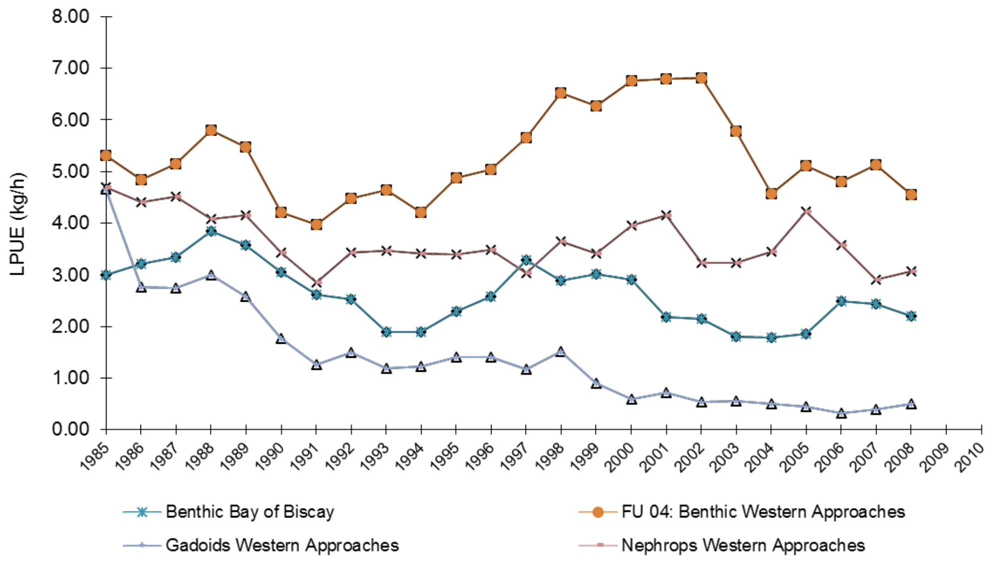


Figure 5.1.2.4.3. Megrim (*L. whiffiagonis*) in Divisions 7b,c,e–k and 8a,b,d. French LPUE for different bottom-trawler fleet.

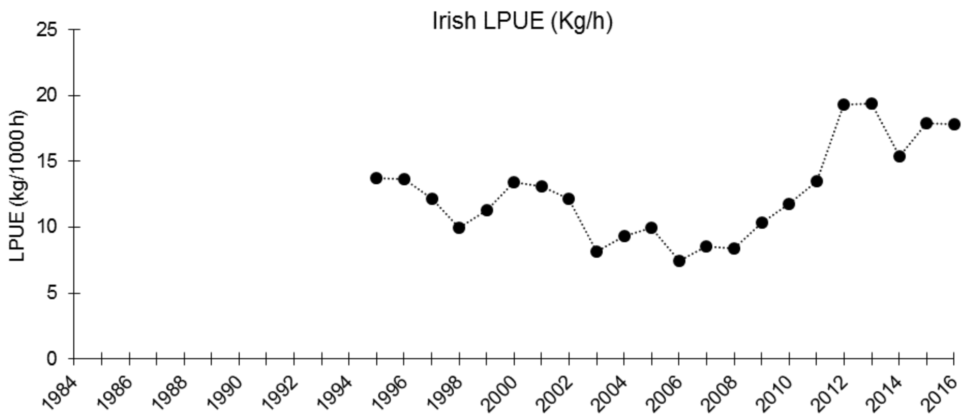


Figure 5.1.2.4.4. Megrim (*L. whiffiagonis*) in Divisions 7b,c,e–k and 8a,b,d. Irish LPUE for beam trawl fleet.

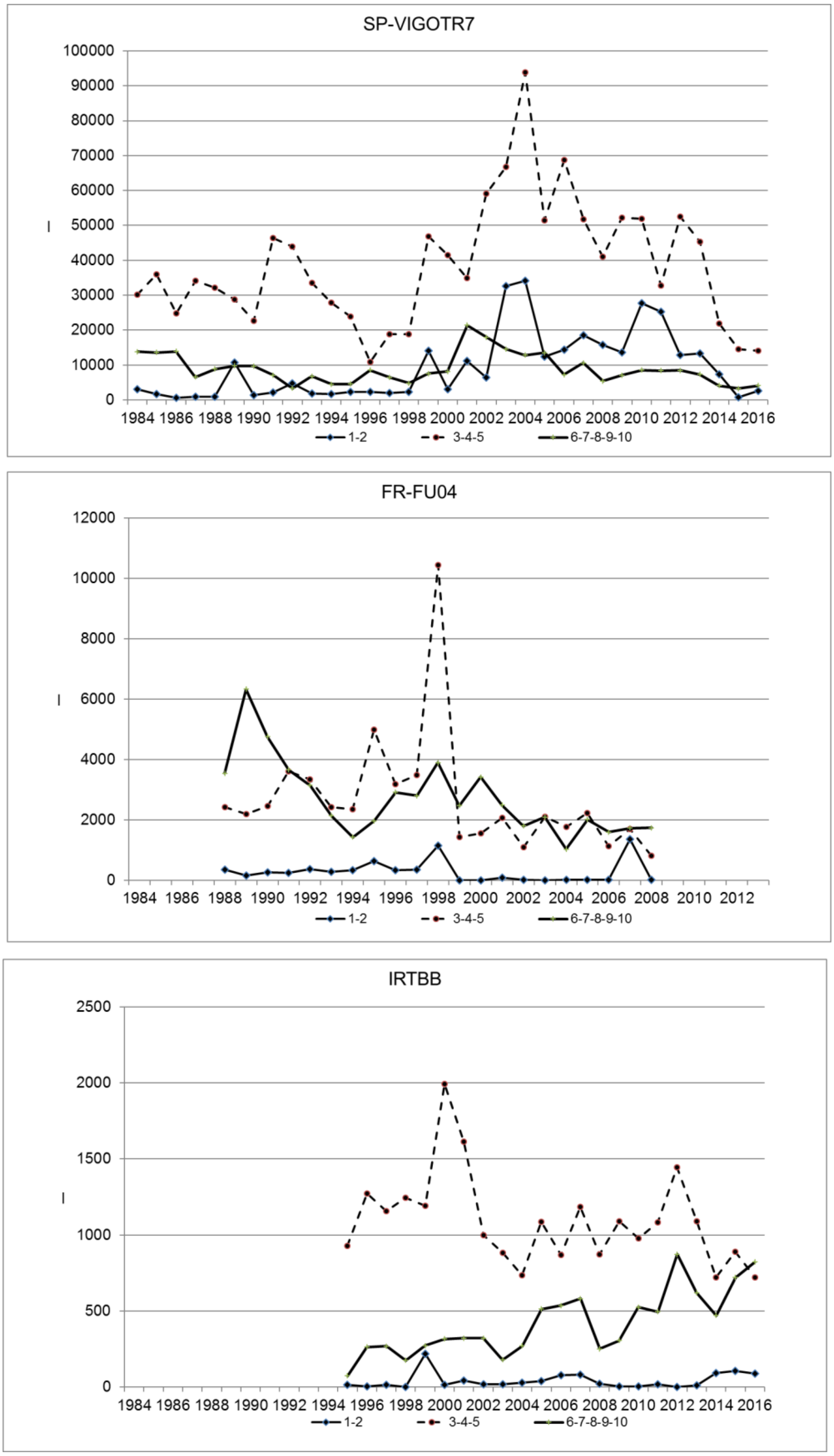


Figure 5.1.2.4.5. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Abundance Indices for SP-VIGOTR7, FR-FU04 and IRTBB by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+.

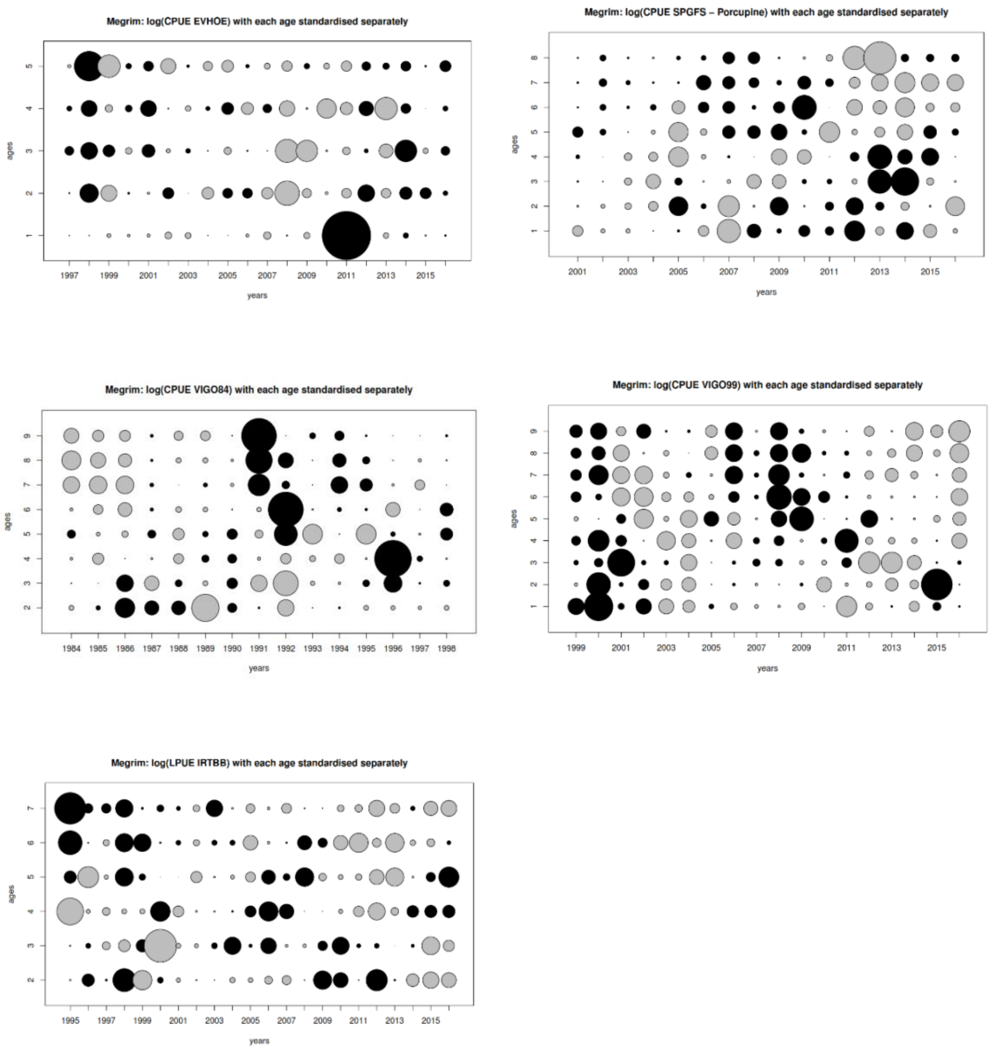


Figure 5.1.3.1.1. Megrim *(L. whiffiagonis)* in Divisions 7b–k and 8a,b,d. Bubble plots of the standardized log abundance indices of the surveys and commercial fleets used as tuning fleets (grey positive and black negative black).

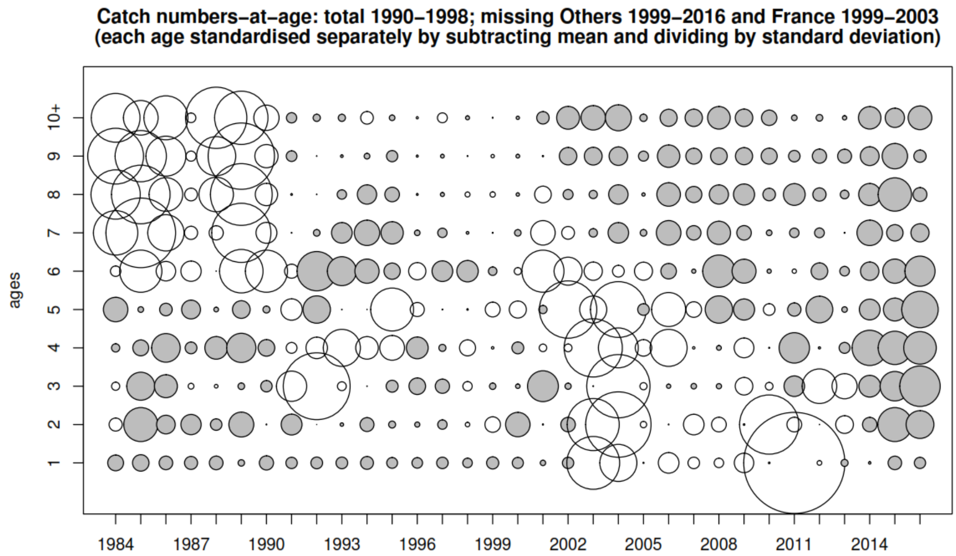


Figure 5.1.3.1.2. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Bubble plots for catch numbers-at-age from 1984–2016 (white positive and grey negative).

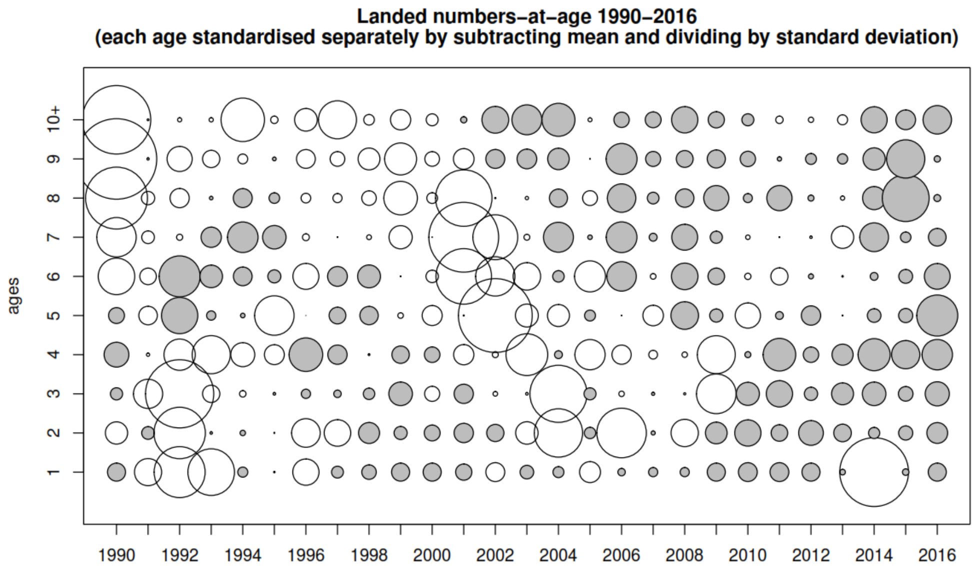


Figure 5.1.3.1.3. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Bubble plots for landing numbers-at-age from 1990–2016 (white positive and grey negative).

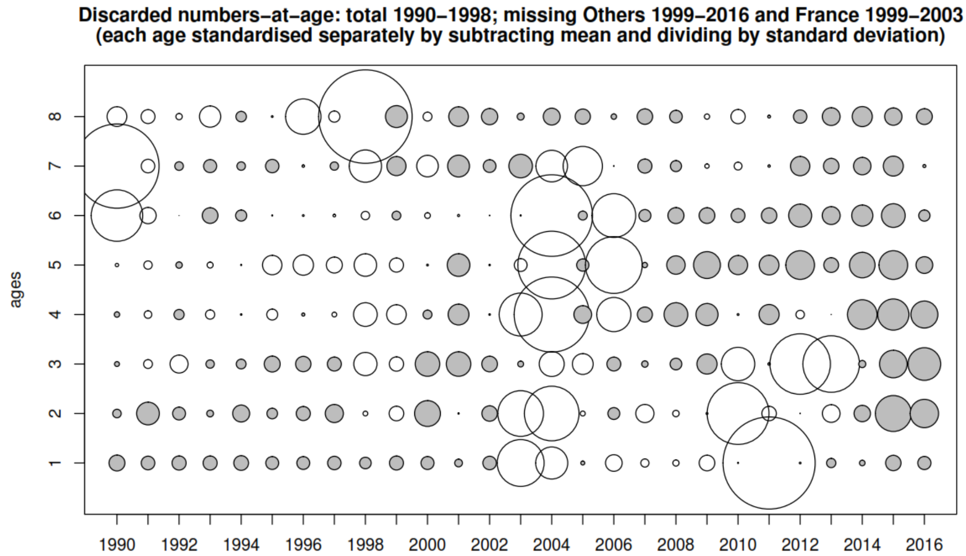


Figure 5.1.3.1.4. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Bubble plots for discarded numbers-at-age from 1990–2016 (white positive and grey negative).

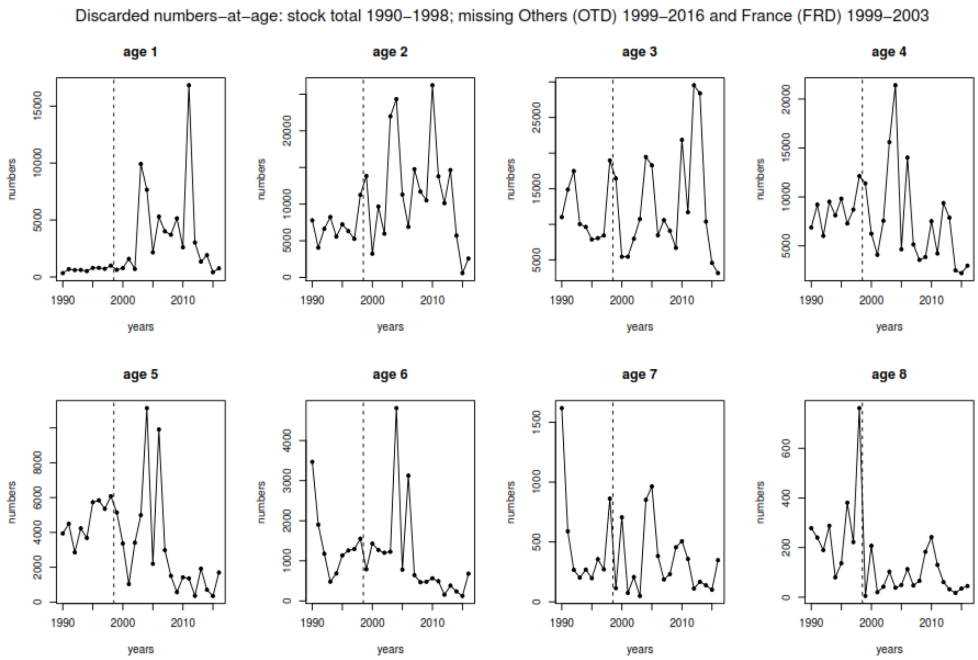


Figure 5.1.3.1.5. Megrim (*L. whiffiagonis*) in Divisions 7b–k and 8a,b,d. Discarded numbers-at-age separated by age from 1990–2016.

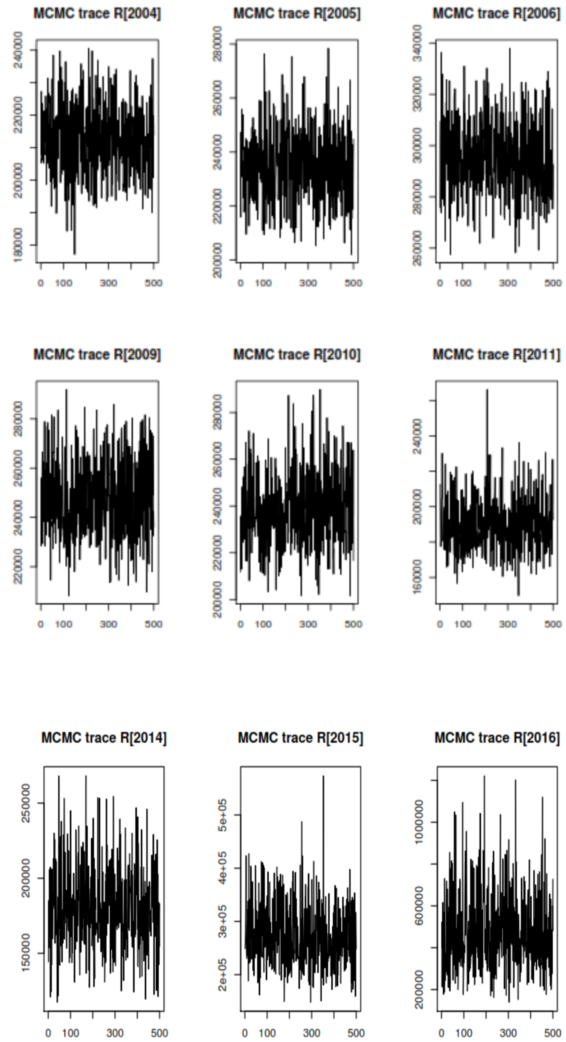


Figure 5.1.3.3.1. Trace plots of recruitment draws from 2004 to 2016.

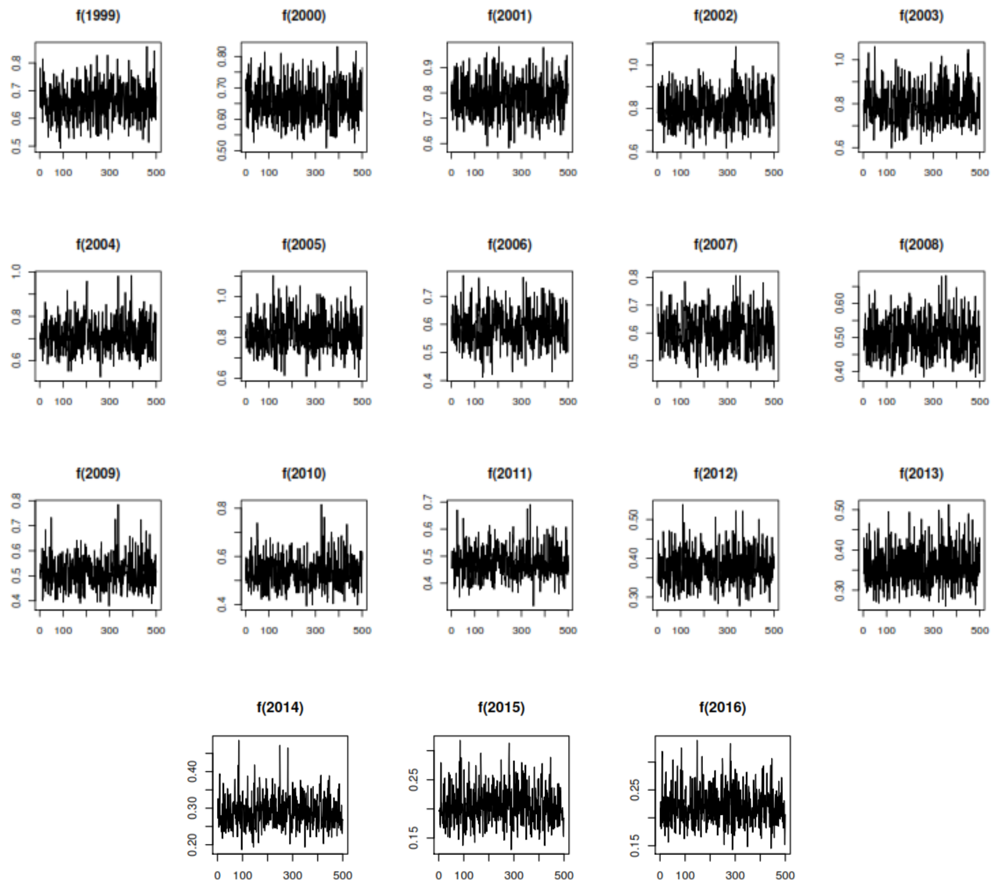


Figure 5.1.3.3.2. Trace plots of f(y) fishing mortality in ages 9 and 10 from 1999 to 2016.

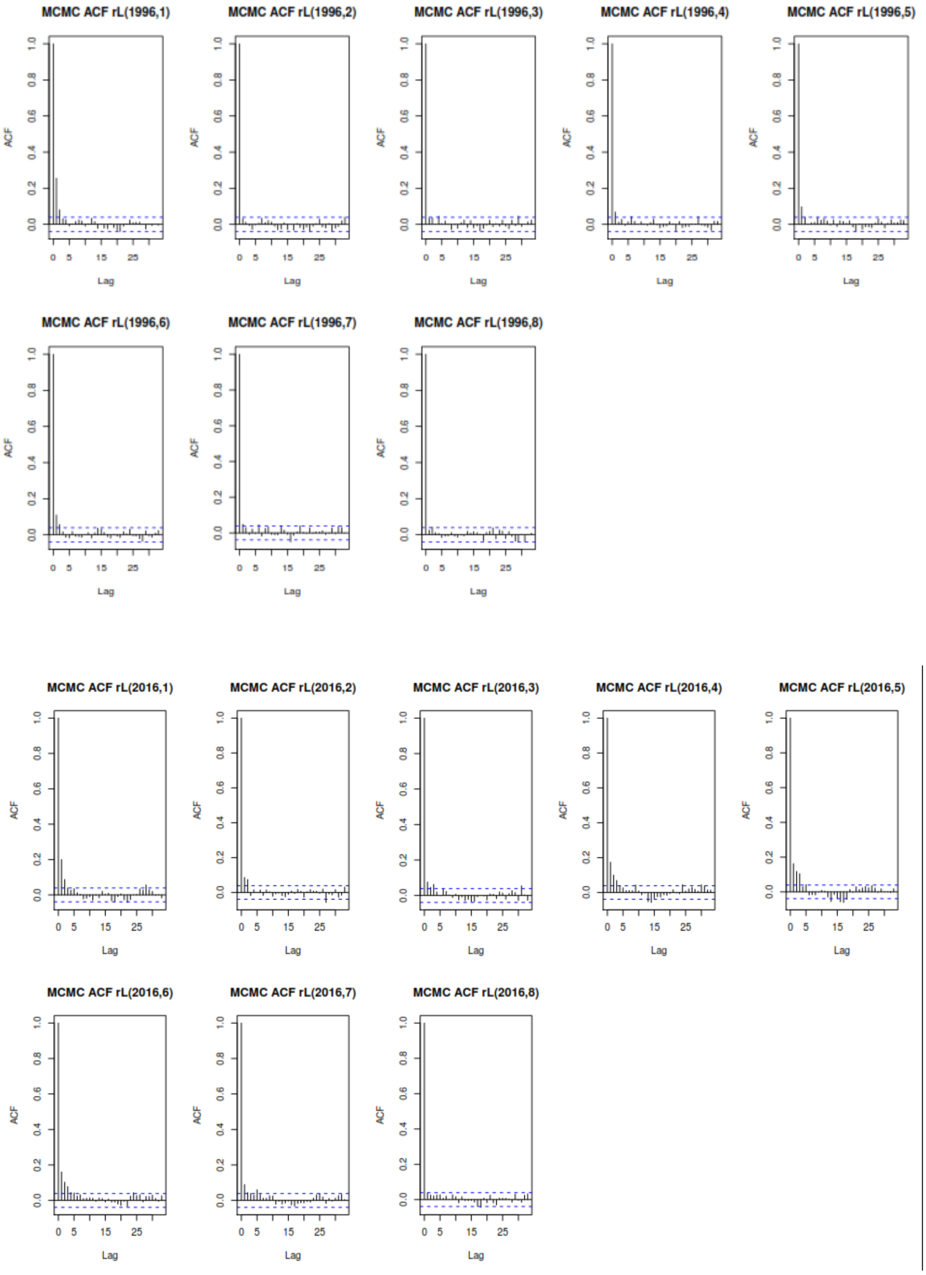
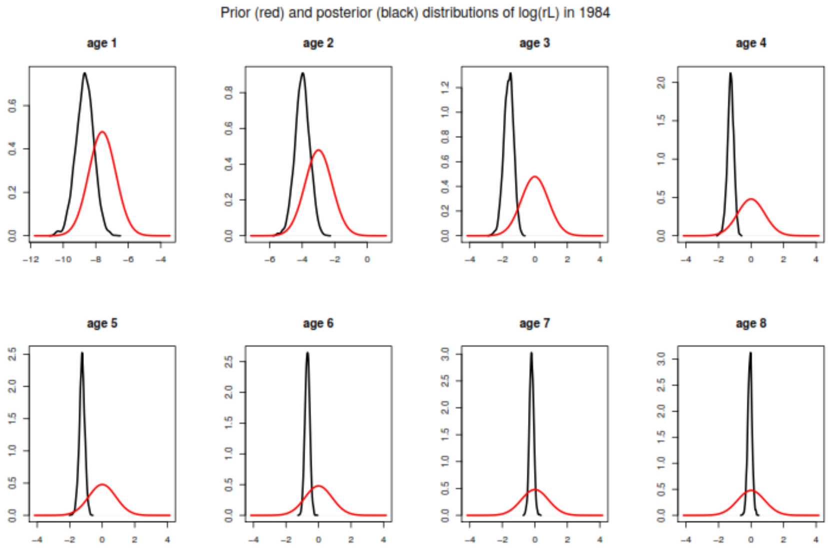
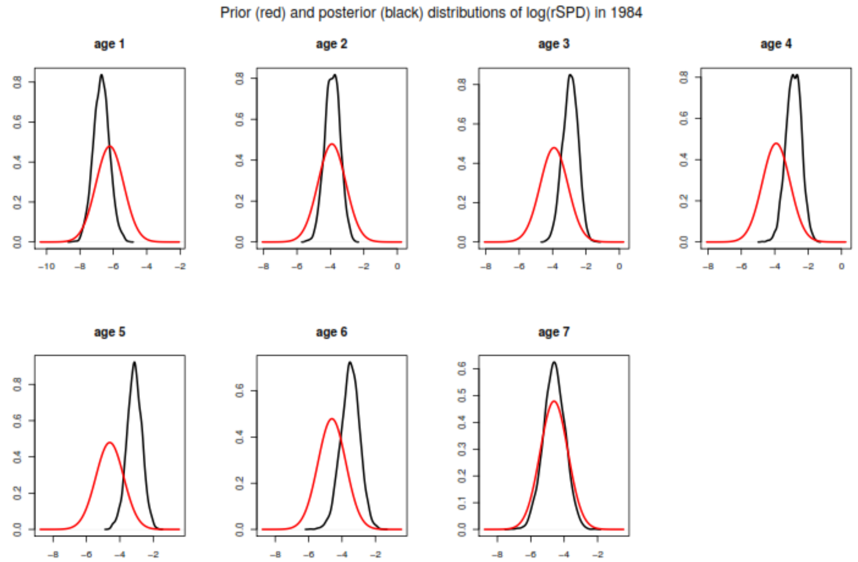


Figure 5.1.3.3.3. Autocorrelation plots of rL for years 1996 and 2016


Prior (red) and posterior (black) distributions of log(rL) in 1984
age 1
age 2
age 3
age 4
age 5
age 6
age 7
age 8


Prior (red) and posterior (black) distributions of log(rSPD) in 1984
age 1
age 2
age 3
age 4
age 5
age 6
age 7

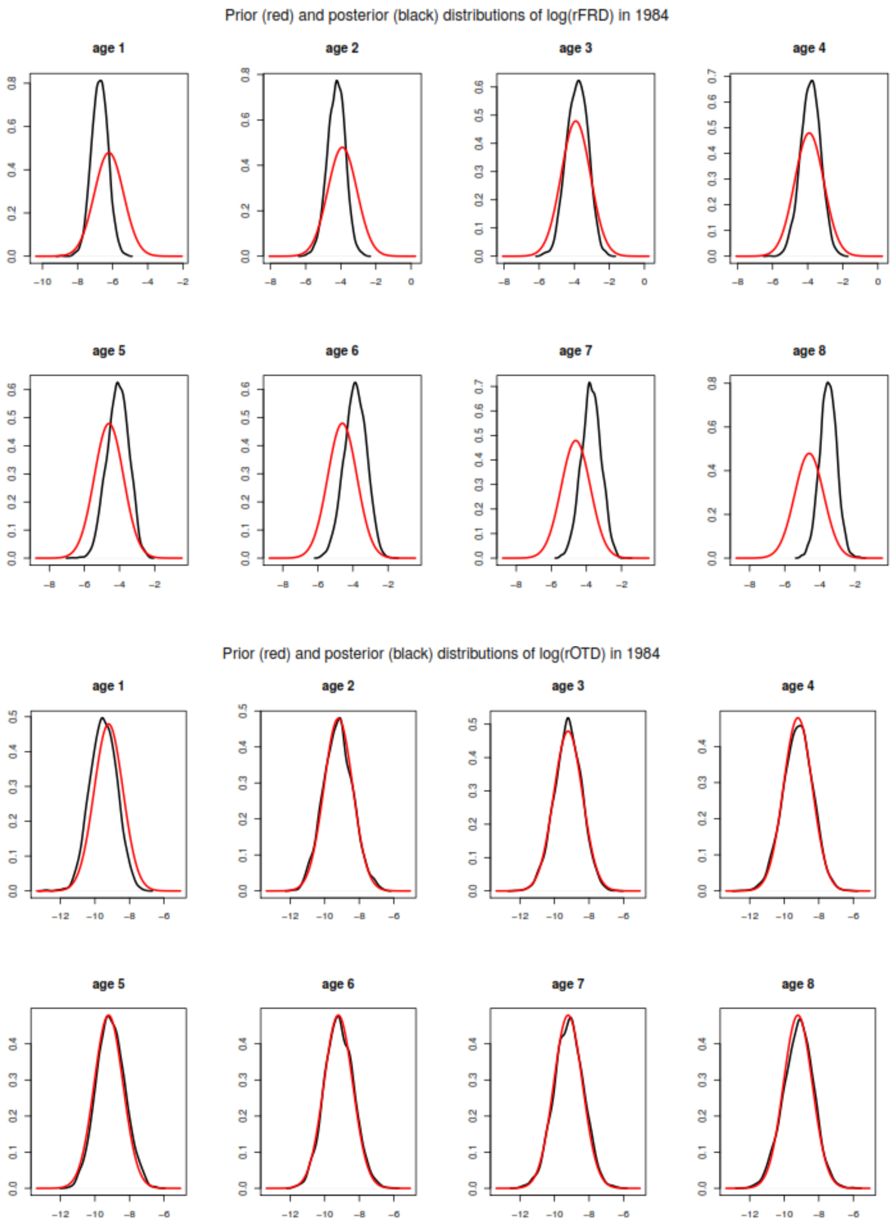


Figure 5.1.3.3.4. Prior (red) and posterior distribution of log (L) in 1984, log (rSPD) at age in 1984, log (rFRD) at age in 1984 and log (rOTD) at age in 1984.

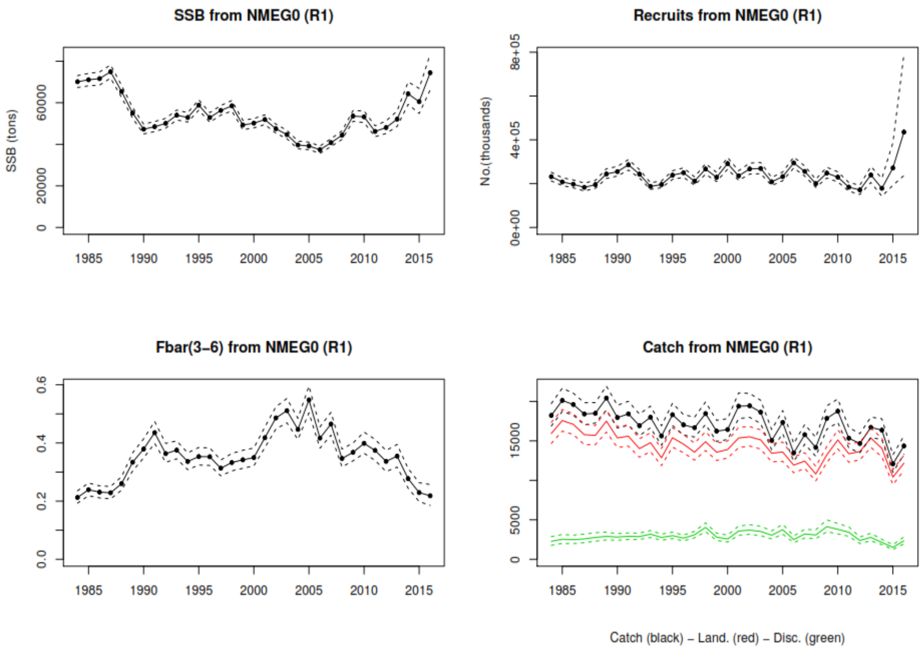


Figure 5.1.3.3.5. WGBIE 2017 results of time series of spawning stock biomass (SSB), recruits, Fbar, catch, landings and discards from 1984 to 2016. The solid dotted lines correspond with the median of the distribution and the dashed lines with 5% and 95% quantiles.

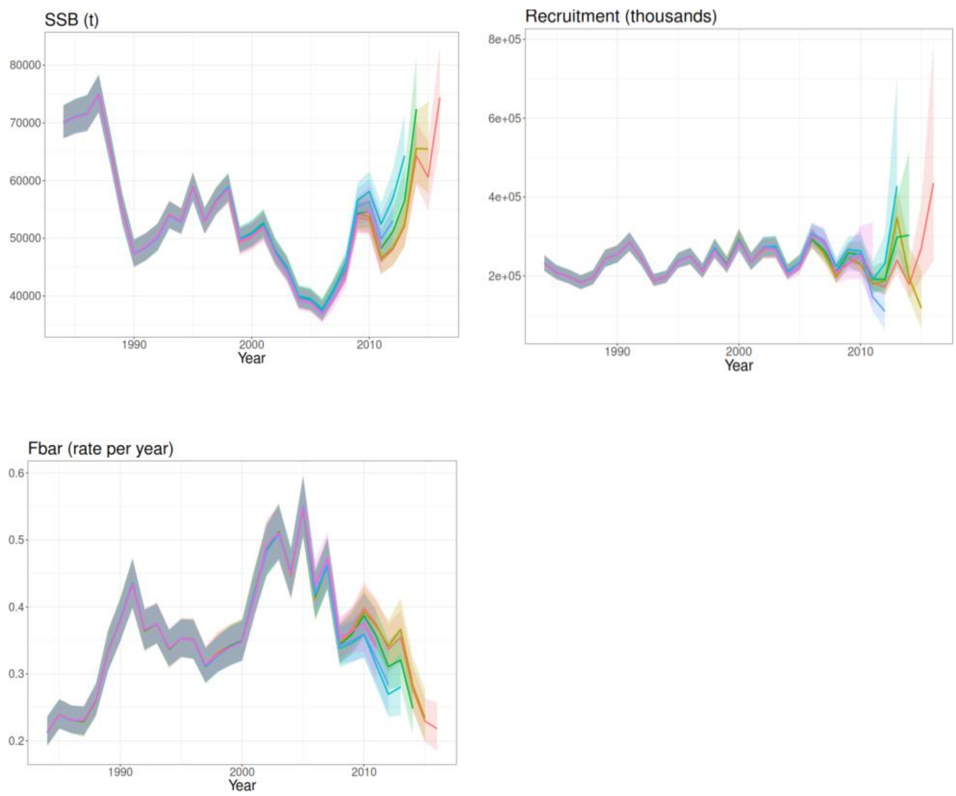


Figure 5.1.4.1. Time series of median SSB, recruitment and Fbar in retrospective analysis.

5.2 Megrim (*L. boscii*) in Divisions 7b–k and 8a,b,d

5.2.1 General

See general section for both species

5.2.1.1 Data

5.2.1.2 Commercial catches and discards

Four-spot megrim was not included in the 2017 data call and consequently no commercial catch and discard information was available to the working group.

5.2.1.3 Biological sampling

Four-spot megrim was not included in the 2017 data call and consequently no biological information was available to the working group.

Age

Not available.

Lengths

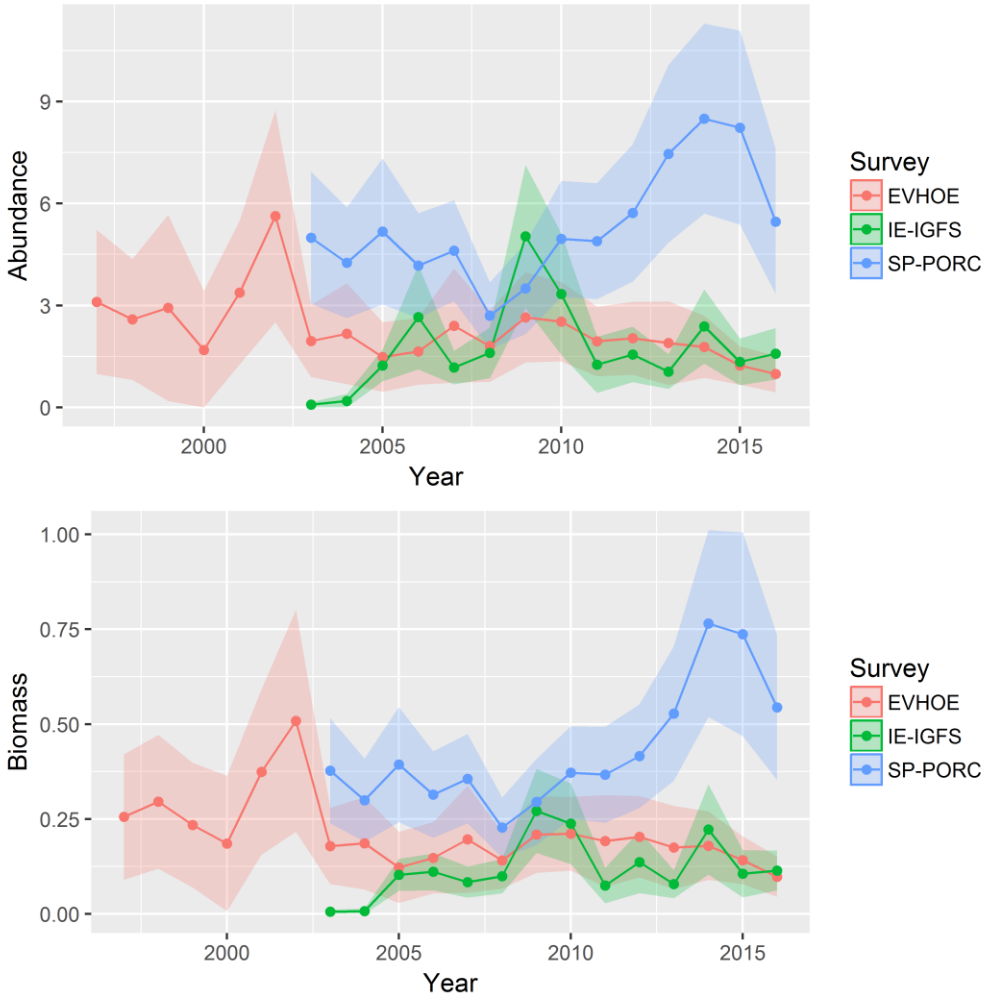
Not available.

Natural Mortality

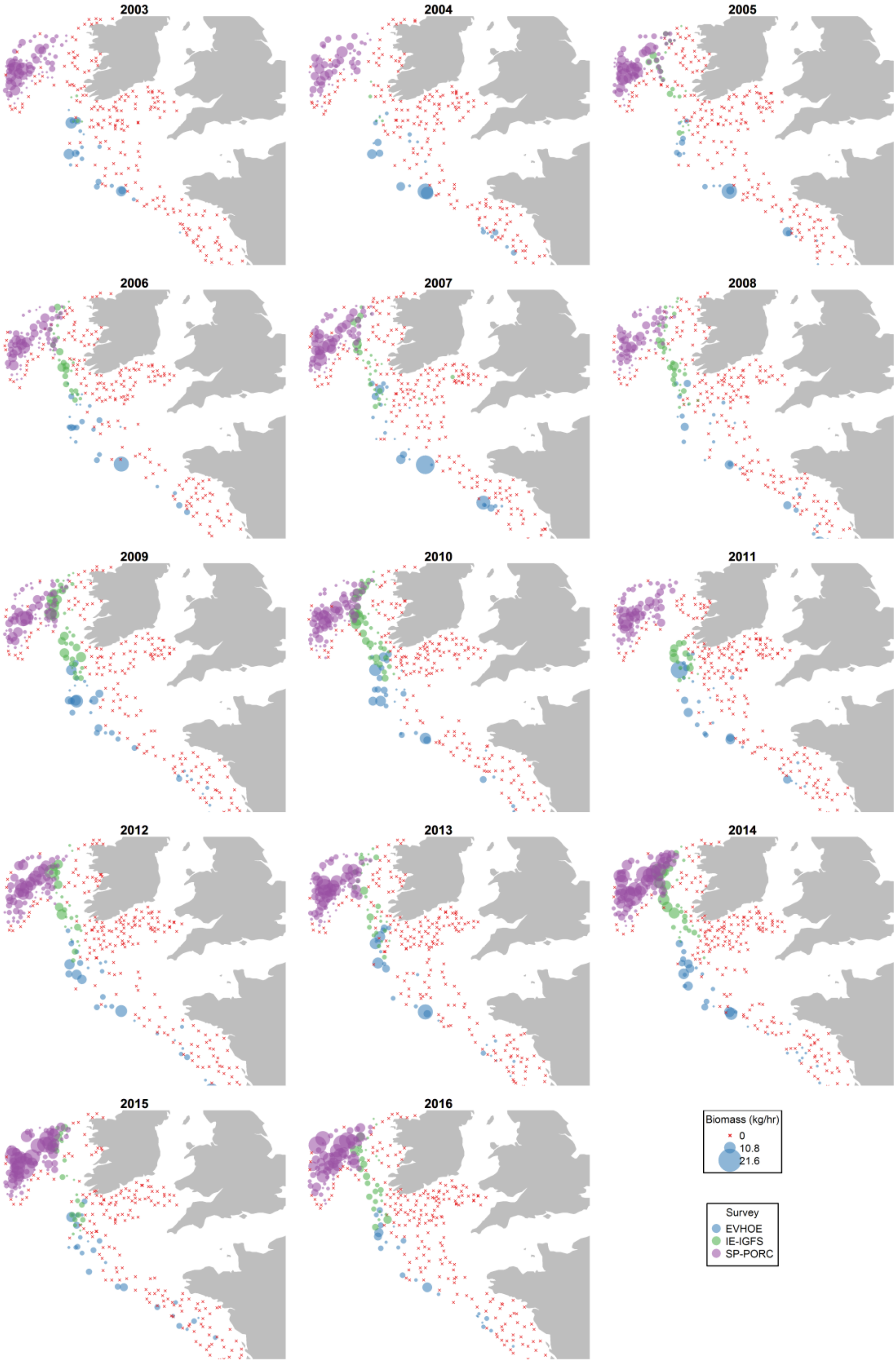
Not included in assessment.

5.2.1.4 Survey data

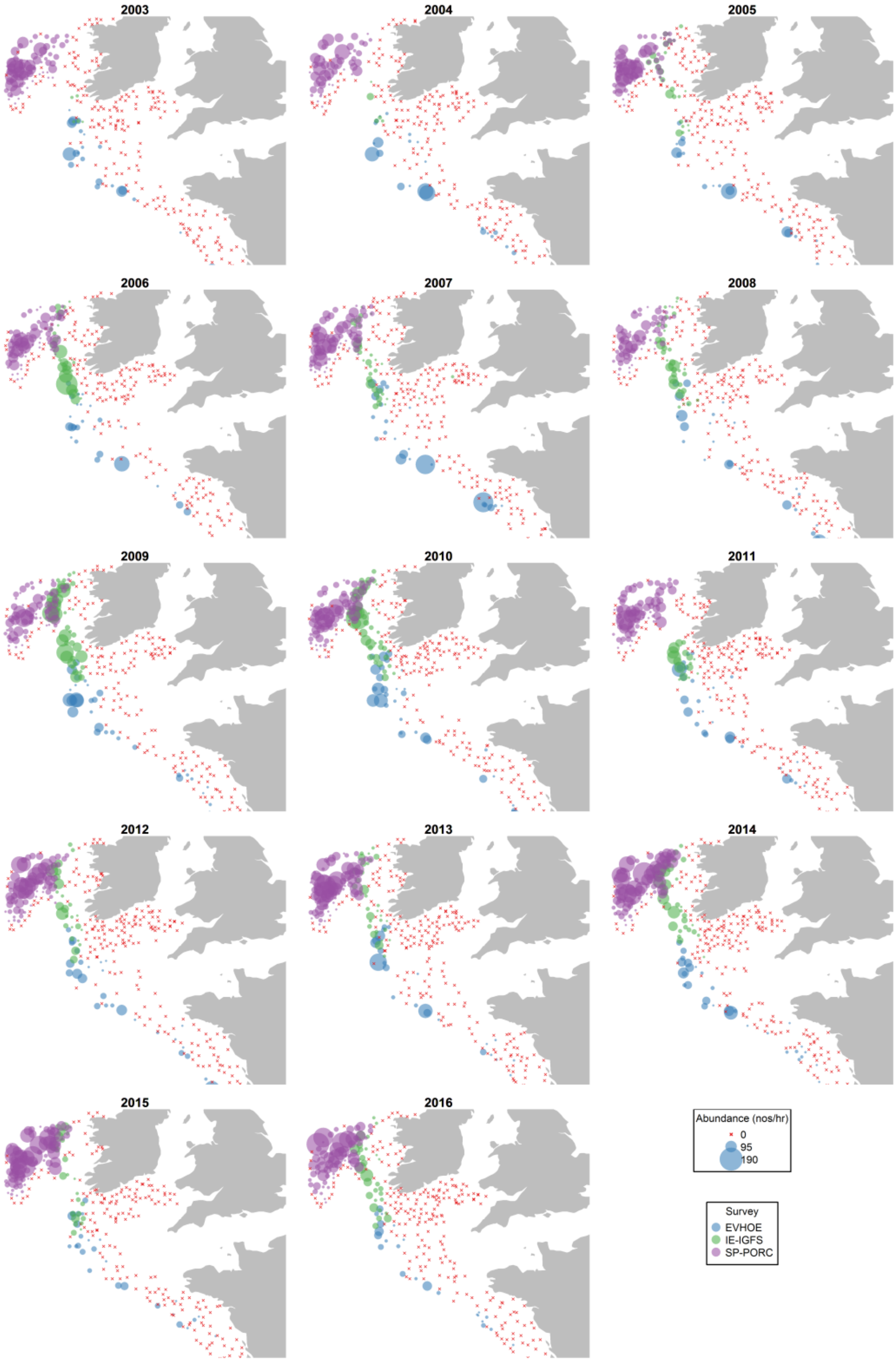
Survey data was extracted from DATRAS for Spanish Porcupine (SpPorc), Irish Groundfish Survey (IE-IGFS) and French EVHOE surveys. The Spanish Porcupine index was initially down weighted by an arbitrary factor of 10 because the Baka trawl used was highly more efficient at catching megrim than the GOV trawl used in the Irish and French surveys. Due to the large differences in catchability between Baka and GOV gears it was decided not to include the Spanish Porcupine index in the final assessment. Inter-calibration correction will be required based on comparison of Four-spot catches in the area where the Spanish and Irish surveys overlap. No difference was found between the Irish and the French surveys in the area where they overlap.



Biomass and abundance indices of Four-spot megrim from French EVHOE, Irish IGFS and Spanish Porcupine Surveys.



Biomass index of Four-spot megrim from French EVHOE, Irish IGFS and Spanish Porcupine Surveys.



Abundance index of Four-spot megrim from French EVHOE, Irish IGFS and Spanish Porcupine Surveys.

5.2.1.5 Commercial catch and effort data

Four-spot megrim was not included in the 2017 data call and consequently no commercial catch and effort data were available to the working group.

5.2.2 Assessment

The proportion of *Lepidorhombus boscii* averaged over the period 2007–2016 in the EVHOE and IGFS surveys was used to split the two species in the 2018 advice for *Lepidorhombus whiffiagonis*.

5.2.2.1 Data Exploratory Analysis

The following exploratory analyses were carried out for quality control reasons: sample weights were checked against expected weights (as estimated from length-weight parameters). Excessive raising factors (from sample to catch weight) were checked. Abundance indices (numbers per hour) were calculated for each survey series using all valid hauls and ignoring the spatial stratification.

5.2.2.2 Model

No model was used in the assessment.

5.2.2.3 Results

The proportion of *Lepidorhombus boscii* averaged over the period 2007–2016 in the EVHOE and IGFS surveys was found to be 0.034 and this proportion was used to split the two species in the 2018 advice for *Lepidorhombus whiffiagonis*. The stock status relative to candidate reference points is unknown. The precautionary buffer was never applied. Therefore, the precautionary buffer will be applied in 2017. Discarding is likely to be >5% of the catch but the information is uncertain, therefore no catch advice can be given.

5.2.3 Retrospective pattern

No retrospective was produced.

5.2.4 Short term forecasts

No short term forecast was produced.

5.2.5 Biological reference points

No biological reference points were produced.

5.2.6 Conclusions

This was the first year that an assessment was carried out for this stock and landings advice was produced based on the ICES framework for category 6 stocks.

The quality of this assessment was hampered by the lack of commercial landings, discards and catch rate data. The inclusion of this stock in the 2018 data call should resolve this issue although substantial port sampling will be required to provide an accurate species split for the landings.

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

Lepidorhombus whiffiagonis:

Type of assessment in 2017: Update.

Data revisions this year:

No revisions this year.

Lepidorhombus boscii:

Type of assessment in 2017: Update.

Data revisions this year:

No revisions this year.

Review Group issues for *L. boscii* and *L. whiffiagonis*:

'The RG recommends that this assessment be used as a basis for management advice'

Some technical comments have been taking account in the report. Other recommendations are more appropriated to be addressed in a future benchmark.

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 2017 and management for 2016 and 2017

ICES advice for 2017 (as extracted from ICES Advice 2016, Book 6):

The two megrim species are not separated in the landings and a single TAC covers both of them. For these reasons, ICES provided advice in previous years applying a common multiplier of the current F for both megrim species; the value of the multiplier used in the advice corresponded to that required to get fishing mortality for both stocks at or below FMSY in the advice year. ICES considers that management of the two megrim species under a combined TAC prevents effective control of the single-species exploitation rates and could lead to overexploitation of either species. Therefore, this year's advice is based on the single-species FMSY.

If the TAC continues to be set for both megrim species combined, then using the common F-multiplier approach (as has been done in the ICES advice in previous years), would result in combined megrim catches in 2017 of no more than:

1363 t (both megrim species) = 1197 t (*L. boscii* single-species catch advice) + 166 t (*L. whiffiagonis* catch resulting from the *L. boscii* F-multiplier).

Management applicable for 2016 and 2017:

The agreed combined TAC for megrim and four-spot megrim in ICES Divisions 8c and 9a was 1363 t in 2016 and 1159 t in 2017.

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

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 2016 are given in Table 6.1.1. Since 2011, estimates of unallocated or non-reported landings have been included in the assessment. These were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each métier. 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 8c and 9a for 2016 was 235 t. Landings reached a peak of 977 t in 1990, followed by a steady decline till 2002. Some increase in landings has been observed since then, but landings have again decreased annually since 2007 till 2010 were 83 t, the lowest value of the entire series occurred. Since 2011, the stock increased again. Historical landings for both species combined are shown in Figure 6.1.1. In 2016, international landings are 1322 t, according to last year 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 10–47% 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 1986–2016 and in Table 6.1.3.(a). Unallocated/non reported value is raised to total length distribution. The bulk of sampled specimens corresponds to fish of 20-30 cm.

Sampling levels for both species are given in Table 1.4.

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 to 2016. 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 summarised in Table 6.1.6. In 2012, Portuguese surveys were not conducted due to budgetary constraints of national scope turned unfeasible to repair the R/V.

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 8c and 9aN (WD 11, this report). 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. 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 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 to 2014year classes appear to be in low values except for 2010. However, since 2015, there is a very important increase in age 1, being the 2016 value the highest 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 standardised 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 standardised 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 9a covers the period 1988–2016 (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 2016 increases again after a decrease. The lpue shows a general decreasing trend till 2009. Since 2010 is increasing with only two decreasing values in 2013 and 2014.

Avilés (SP-AVSOTBDEF) effort presents a slightly decreasing 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 standardised log (landed numbers-at-age per unit effort) values for these commercial fleets, with the standardisation 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 bubbles alternate values.

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 and 2016, the lowest values 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 and 1992, and has since remained at low levels, with the exception of a peak in 1997–1998. Lpue for the last years represent a slightly increase in relation to the previous years.

6.1.3 Assessment

An update assessment was conducted, according to the Stock Annex specifications. Assessment years are 1986–2016 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 to 2016 and the 2016 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 higher 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 to 4. The bottom panel of the same figure displays standardised (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(c) 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 recruitment and underestimation of F 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. Residuals in A. Coruña tuning fleet in the last years present mainly negative 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 (0.00055 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 decreasing values in the last two years, more accused the last year. 2016 value represents a similar value for catches of previous year. 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 high recruitment (at age 1) value in the series in 2010 and the followings decreases and increases, the last two years' the recruitments show significant increases, with a very high values.

Bubble plots of standardised (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 Fbar) 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 till 2011 when appears to be slightly increasing again. However, 2016 represents a decrease in all the ages. 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 to 7+ for some years.

6.1.3.4 Year class strength and recruitment estimations

The 2013 year class is estimated to have 2.7 million fish at 1 year of age, based on the Spanish survey (SpGFS-WITBS-Q4) (71% of weight), two commercial fleets SP-LCGOTBDEF (13% of weight) and SP-AVSOTBDEF (12% of weight) and F shrinkage (3%).

The 2014 year class is estimated to have 9.7 million individuals at 1 year of age based on the information from the Spanish survey (SpGFS-WIBTS-Q4) (68% of weight), P-shrinkage (29% of the weight) and F shrinkage (4%).

The 2015 year class is estimated to have 9.8 million fish at 1 year of age, based on the information from the Spanish survey (SpGFS-WIBTS-Q4) (64% of weight), P-shrinkage (31% of the weight) and F shrinkage (6%).

The working group considered that the XSA last year recruitment is well estimated this year. The signal from the survey index is in accordance with the estimated value and also age 1 is well represented in catch data. . Working Group estimates of year-class strength used for prediction can be summarised as follows:

Recruitment at age 1:

Year class	Thousands	Basis	Surveys	Commercial	Shrinkage
2013	2773	XSA	71%	25%	3%
2014	9793	XSA	68%	0%	33%
2015	9859	XSA)	64%	0%	37%
2016	3149	GM (98–14)			

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 2396 t in 1990 to 989 t in 1995. From 1996 to 2000, it remained relatively stable at low levels with an average value of around 1300 t. Starting from 2001, SSB is estimated to have been even lower. The values for 2001–2010 are the lowest in the series, with SSB in 2008 (673 t) corresponding to the lowest values. Since 2011, SSB values are increasing, being 1340 t, this year value, the highest of the last years.

After a decline from 2006 (0.40) to 2010 (0.07), and a following increasing trend, the last two years represent a decrease, more pronounced in 2016, falling to 0.21.

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, from 2011 to 2014, values of recruitments decreased again. In 2015 and 2016 the recruitment seems to be very high, with values 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 Fbar=0.33 for landings and Fbar=0.02 for discards, being 0.35 for catches).

According with stock annex, GM recruitment is computed over years 1998–final assessment year minus 2.

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 2017 and 2018 are predicted to be 449 t and 463 t respectively, and discards 38 t and 27 t respectively. SSB would decrease from the 1 708 t estimated for 2017 to 1 562 t in 2018 and to 1 288 t in 2019.

The contributions of recent year classes to the predicted landings in 2018 and SSB in 2019, assuming $GM_{98\text{-}14}$ recruitment, are presented in Table 6.1.16. The assumed $GM_{98\text{-}14}$ age 1 recruitment for the 2016 and 2017 year classes contributes 11% to landings in 2018 and 27% to the predicted SSB at the beginning of 2019. 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 versus Fbar). Assuming s*tatus quo* exploitation Fbar=0.33 for landings and Fbar=0.02 for discards and $GM_{98\text{-}14}$ for recruitment, the equilibrium yield would be 203 t of landings and 24 t of discards with an SSB of 715 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 others very high in 2015 and 2016.

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 with minor shifts (Figure 6.1.10).

Megrim starts to contribute strongly to SSB at 2 years of age. Around 27% of the predicted SSB in 2019 relies on year classes for which recruitment has been assumed to be $GM_{98\text{–}14}$.

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 by-catch 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 8abd 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 8c, 9a. Landings, discards and catch (t).

	Spain landings			Portugal landings	Unallocated/ Non reported	Total landings	Discards	Total catch
Year	8c	9a***	Total	9a				
1986	508	98	606	53	0	659	46	705
1987	404	46	450	47	0	497	40	537
1988	657	59	716	101	0	817	42	859
1989	533	45	578	136	0	714	47	761
1990	841	25	866	111	0	977	45	1022
1991	494	16	510	104	0	614	41	655
1992	474	5	479	37	0	516	42	558
1993	338	7	345	38	0	383	38	421
1994	440	8	448	31	0	479	13	492
1995	173	20	193	25	0	218	40	258
1996	283	21	305	24	0	329	44	373
1997	298	12	310	46	0	356	52	408
1998	372	8	380	66	0	446	36	482
1999	332	4	336	7	0	343	43	386
2000	238	5	243	10	0	253	35	288
2001	167	2	169	5	0	175	19	193
2002	112	3	115	3	0	117	19	137
2003	113	3	116	17	0	134	15	148
2004	142	1	144	5	0	149	11	159
2005	120	1	121	26	0	147	19	166
2006	173	2	175	35	0	210	16	226
2007	139	2	141	14	0	155	0.4	155
**2008	114	2	116	17	0	133	11	144
2009	74	2	77	7	0	84	11	94
2010	66	8	74	10	0	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
2016	171	1	172	15	48	235	63	298

*Data revised in WG2015
** Data revised in WG2010
***9a is without Gulf of Cádiz

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

Year	1994	1997	1999	2000	2003	2004	2005	2006	2007	2008	2009
Weight Ratio	0.03	0.14	0.12	0.13	0.11	0.07	0.14	0.08	0.00	0.08	0.13
CV	50.83	32.23	33.4	48.41	19.93	29.24	43.17	31.62	55.01	58.8	52.9
Number Ratio	0.10	0.38	0.34	0.45	0.26	0.16	0.28	0.21	0.01	0.20	0.36

Year	2010	2011*	2012	2013	2014	2015	2016
Weight Ratio	0.06	0.23	0.12	0.07	0.06	0.07	0.21
CV	61.6	23.7	28.8	30.3	44.7	49.8	57.1
Number Ratio	0.27	0.57	0.37	0.24	0.20	0.29	0.47

All discard data revised in WG2011
*Data revised in WG2013

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

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	138	138	138	138	138	138	138	138	104	138	138
2	339	339	339	339	339	339	339	339	93	339	339
3	425	425	425	425	425	425	425	425	136	425	425
4	130	130	130	130	130	130	130	130	51	130	130
5	10	10	10	10	10	10	10	10	3	10	10
6	4	4	4	4	4	4	4	4	1	4	4
7	1	1	1	1	1	1	1	1	0	1	1

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	41	138	270	27	10	10	0	4	20	0	0
2	453	339	471	611	338	338	239	164	223	19	11
3	857	425	284	160	82	82	57	28	61	108	0
4	142	130	197	73	31	31	12	6	38	115	0
5	1	10	26	19	9	9	4	5	11	28	0
6	5	4	6	0	1	1	0	3	4	13	0
7	3	1	0	0	1	1	0	2	1	4	0

	2008	2009	2010	2011*	2012	2013	2014	2015	2016
1	0	96	16	12	8	330	442	624	1074
2	126	142	119	2044	808	53	94	10	373
3	86	21	6	346	85	13	16	4	3
4	8	15	1	1	41	5	2	1	1
5	5	7	2	2	2	0	0	0	0
6	2	7	0	0	1	0	0	0	0
7	0	3	1	0	1	0	0	0	0

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

Length (cm)	Total
10	
11	
12	
13	
14	
15	
16	
17	
18	726
19	9077
20	84471
21	174469
22	157288
23	157673
24	123399
25	118485
26	150935
27	129191
28	86083
29	75581
30	59715
31	39449
32	42251
33	36271
34	25829
35	22528
36	25115
37	25165
38	18590
39	12771
40	11913
41	8423
42	7091
43	3277
44	2631
45	2241
46	1576
47	811
48	411
49	72
50+	488
Total	1613999

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

Mean lengths and mean weights in landings since 1990.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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	25.7
Mean weight (g)	105	108	129	108	124	121	120	118	119	127	134	124	137	134

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mean length (cm)	26.1	25.32	26.15	26.68	26.64	27.58	29.4	27.63	28.2	29.39	28.6	28.72	26.81
Mean weight (g)	137	127	137	148	146.8	163.2	187.4	159.5	163.2	187.5	170.7	172.3	145.7

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

Catch numbers at age Numbers*10**-3

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
1	1352	2359	3316	1099	4569	1357	1401	858	133	848	537
2	2377	2728	3769	2328	2560	2777	817	2128	568	461	1911
3	798	882	1168	808	905	931	807	442	1835	384	167
4	649	404	748	641	878	700	1130	536	552	630	289
5	505	293	534	505	333	647	595	361	625	245	506
6	202	81	182	191	377	142	78	103	330	70	148
+gp	194	71	130	253	558	59	68	36	119	72	81
TOTALNUM	6077	6818	9847	5825	10180	6613	4896	4464	4162	2710	3639
TONSLAND	705	537	858	761	1022	655	558	421	492	258	373
SOPCOF %	95	95	95	99	99	100	100	101	100	101	101

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE											
1	535	416	491	620	378	369	368	210	346	110	90
2	1919	1307	524	282	387	233	299	264	276	526	161
3	1153	1335	1157	671	331	341	277	211	438	582	232
4	77	891	719	526	253	95	179	247	171	276	297
5	367	218	448	361	221	165	80	187	156	183	142
6	308	329	105	83	161	81	54	102	87	110	81
+gp	116	149	207	161	118	37	48	72	41	36	56
TOTALNUM	4475	4645	3651	2704	1849	1321	1305	1293	1515	1823	1059
TONSLAND	408	482	386	288	194	136	149	160	166	226	155
SOPCOF %	100	100	101	101	100	99	101	100	98	100	100

YEAR	*2008	2009	2010	2011**	2012**	2013**	2014	2015	2016
AGE									
1	133	170	149	2054	812	359	469	712	1187
2	370	111	39	1087	275	152	705	224	1275
3	215	159	53	156	834	320	420	536	218
4	153	102	112	220	157	612	432	239	116
5	168	80	97	266	192	81	518	257	87
6	60	60	81	209	106	61	74	191	85
+gp	35	29	43	184	139	89	144	82	96
TOTALNUM	1134	711	574	4176	2515	1674	2762	2241	3064
TONSLAND	144	95	88	371	293	250	399	297	298
SOPCOF %	100	101	100	100	100	101	100	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 8c and 9a. Catch weights at age (kg).

Mean weight at age

YEAR		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE												
	1	0.041	0.046	0.043	0.045	0.04	0.035	0.031	0.031	0.039	0.051	0.041
	2	0.095	0.079	0.086	0.094	0.091	0.085	0.075	0.073	0.063	0.044	0.08
	3	0.113	0.086	0.098	0.114	0.121	0.102	0.116	0.102	0.099	0.087	0.081
	4	0.163	0.142	0.149	0.163	0.165	0.145	0.155	0.146	0.13	0.126	0.127
	5	0.215	0.175	0.191	0.223	0.206	0.173	0.209	0.194	0.15	0.164	0.164
	6	0.315	0.311	0.289	0.292	0.24	0.251	0.318	0.235	0.19	0.21	0.21
+gp		0.477	0.415	0.424	0.52	0.369	0.42	0.534	0.538	0.344	0.34	0.354
SOPCOFAC		0.9502	0.9535	0.9509	0.995	0.9874	1.0041	0.9983	1.005	1.0004	1.0091	1.014

YEAR		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE												
	1	0.033	0.032	0.033	0.037	0.039	0.038	0.047	0.0480	0.0510	0.057	0.061
	2	0.062	0.061	0.058	0.057	0.078	0.07	0.083	0.0820	0.0770	0.082	0.088
	3	0.095	0.095	0.084	0.089	0.085	0.111	0.115	0.1090	0.1080	0.11	0.11
	4	0.126	0.13	0.118	0.119	0.117	0.115	0.149	0.1300	0.1400	0.15	0.144
	5	0.14	0.154	0.159	0.161	0.148	0.162	0.194	0.1570	0.1640	0.174	0.197
	6	0.198	0.189	0.216	0.215	0.171	0.205	0.252	0.2030	0.1990	0.223	0.236
+gp		0.341	0.324	0.296	0.296	0.256	0.387	0.382	0.3190	0.3790	0.39	0.366
SOPCOFAC		1.0005	1.0047	1.0057	1.0107	1.0046	0.9944	1.0061	1.0008	0.9847	1.0034	0.9966

YEAR		*2008	2009	2010	2011**	2012**	2013**	2014	2015	2016
AGE										
	1	0.033	0.031	0.037	0.026	0.027	0.039	0.035	0.037	0.041
	2	0.084	0.088	0.091	0.088	0.089	0.079	0.097	0.102	0.086
	3	0.118	0.135	0.116	0.135	0.138	0.127	0.13	0.133	0.147
	4	0.145	0.16	0.168	0.134	0.164	0.179	0.166	0.174	0.198
	5	0.187	0.189	0.203	0.201	0.172	0.232	0.22	0.197	0.244
	6	0.246	0.246	0.228	0.242	0.228	0.281	0.264	0.277	0.304
+gp		0.409	0.404	0.37	0.371	0.343	0.391	0.381	0.388	0.388
SOPCOFAC		1.0034	1.0062	0.9989	0.9976	1.0031	1.0124	0.9988	0.9986	1.0012

* Data revised in WG2010 from original value presented

** Data revised in WG2014 from original value presented

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

	Biomass Index						Abundance index					Recruitment index		
												At age 1	At age 0	At age 1
	Portugal (k/h)			Spain (k/30 min)			Portugal (n/h)		Spain (n/30 min)			Portugal (n)	Spain (n/30 min)	
	October	Crustaceans	s.e	Mean	s.e.		Crustaceans	s.e.	Mean	s.e.		October		
1983				0.96	0.14	1983			14.0	2.45	1983		1.88	7.72
1984				1.92	0.34	1984			28.0	4.57	1984		0.32	16.08
1985				0.89	0.15	1985			9.0	1.34	1985		0.10	2.74
1986				1.65	0.2	1986			33.0	6.22	1986		13.78	11.19
1987				ns		1987			ns		1987		ns	ns
1988				3.52	0.64	1988			43.0	8.82	1988		0.65	16.60
1989				3.13	0.5332	1989			42.0	7.04	1989		2.90	13.96
1990	0.08			3.08	0.86	1990			28.0	5.5	1990	5	0.11	9.13
1991	0.11			1.22	0.17	1991			10.0	1.67	1991	5	1.26	1.38
1992	0.11			1.39	0.2	1992			18.0	3.35	1992	8	0.01	12.03
1993	0.04			1.46	0.24	1993			15.0	3.23	1993	1	0.00	2.76
1994	0.05			1.02	0.2	1994			8.0	1.87	1994 +		0.60	0.05
1995	0.01			1.03	0.16	1995			11.0	1.86	1995 +		0.41	7.38
A,1996 +				1.64	0.22	A,1996			21.0	3.6	A,1996 +		0.45	11.26
1997 +		1.41	1.04	1.79	0.25	1997	7.22	4.82	20.0	3.26	1997 +		0.15	5.91
1998	0.01	0.20	0.09	1.47	0.23	1998	1.09	0.51	14.8	2.64	1998 +		0.02	2.56
A,B,1999 +		0.11	0.11	1.59	0.29	A,B,1999	0.57	0.53	15.5	3.05	A,B,1999 +		0.56	1.26
2000 +		0.06	0.05	1.8	0.35	2000	0.27	0.17	19.4	4.46	2000 +		0.05	6.92
2001	0	0.04	0.03	1.45	0.28	2001	0.07	0.04	12.8	2.77	2001 +		0.19	1.97
2002	0.04	0.07	0.04	1.26	0.24	2002	0.21	0.10	12.1	2.65	2002 +		0.08	2.53
A,2003	0.01	0.07	0.05	0.82	0.16	A,2003	0.16	0.08	7.2	1.26	A,2003	0.05	0.05	1.91
A,2004	0.01	ns		1.08	0.2	A,2004	ns		8.44	1.39	A,2004 +		0.14	1.83
2005	0.01	0.37	0.20	1.29	0.21	2005	0.71	0.35	9.76	1.73	2005 +		0.08	2.21
2006	0.02	0.29	0.18	1.03	0.18	2006	0.43	0.24	6.38	1.16	2006		0.00	0.89
2007	0	0.15	0.09	1.13	0.24	2007	0.49	0.37	6.87	1.52	2007		0.01	1.87
2008	0	0.25	0.11	0.68	0.15	2008	1.49	0.71	4.33	1.07	2008		0.00	0.23
2009	0.00	*0.05	0.03	0.80	0.12	2009	*0.19	0.10	4.17	0.59	2009		0.19	0.20
2010	0.01	0.20	0.10	0.89	0.16	2010	0.56	0.23	10.15	1.97	2010		0.01	7.63
2011	0.00	0.84	0.67	1.83	0.35	2011	1.75	1.30	17.45	3.86	2011		0.00	1.94
2012	ns	ns	ns	1.38	0.19	2012	ns	ns	9.07	1.29	2012		0.03	0.58
**2013	0	0.20	0.13	2.44	0.39	2013	0.43	0.22	15.89	2.58	2013		0.02	3.24
2014	0.02	0.30	0.18	1.34	0.21	2014	0.81	0.41	9.04	1.26	2014		0.40	1.32
2015	0.06	0.27	0.14	1.86	0.26	2015	0.89	0.39	30.75	5.64	2015		0.28	25.46
2016	0.06	0.26	0.13	2.71	0.28	2016	0.90	0.35	43.10	5.35	2016		0.02	26.31

+ 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 8c and 9a. Tuning data.

FLT01: SP-LCGOTBDEF 1000 Days by 100 HP (thousand)

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
10	69	254	25	11	8	7	7	10.6	2016

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
1	26.31	14.54	0.88	0.57	0.30	0.30	0.18	114	2016

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
10	38	261	65	47	43	48	56	1.6	2016

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

	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
2016	40	10.6	3.77	15	1.6	9.55	12.3	16.4	0.75

[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 8c and 9a. Tuning diagnostic.

Lowestoft VPA Version 3.1

21/04/2017 10:29

Extended Survivors Analysis

Megrim (L. whiffiagonis.) in Divisions 27.7.8c and 27.7.9a

CPUE data from file fleetw.txt

Catch data for 31 years. 1986 to 2016. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF	1986	2016	3	6	0	1
SP-AVSOTBDEF	1986	2016	3	6	0	1
SP-GFS	1990	2016	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 = .00055

Final year F values

Age	1	2	3	4	5	6
Iteration **	0.1428	0.2121	0.2035	0.217	0.3429	0.3619
Iteration **	0.143	0.212	0.204	0.217	0.343	0.362

Regression weights

	1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1	0	0	0	0	1	0	0.123	0.207	0.084	0.143
2	0	0	0	0	0	0	0.102	0.377	0.144	0.212
3	0	0	0	0	0	0	0.203	0.45	0.553	0.203
4	0	0	0	0	0	0	0.357	0.464	0.502	0.217
5	0	0	0	0	0	1	0.336	0.585	0.56	0.343
6	0.273	0.307	0.271	0.351	0.742	0.338	0.541	0.591	0.443	0.362

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

Run title : Megrim (L. whiffiagonis.) in Divisions 27.7.8c and 27.7.9a

At 21/04/2017 10:38

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	1996
AGE											
1	0.1591	0.2199	0.3682	0.1201	0.4767	0.2859	0.14	0.1963	0.067	0.0997	0.0616
2	0.4078	0.5532	0.6539	0.4808	0.4513	0.6041	0.2789	0.3267	0.1929	0.3473	0.3403
3	0.3052	0.259	0.4884	0.2767	0.3469	0.2922	0.3488	0.2389	0.5225	0.1932	0.203
4	0.4523	0.2494	0.3656	0.5483	0.55	0.4971	0.6992	0.4134	0.5305	0.3393	0.218
5	0.6262	0.3789	0.6111	0.4525	0.6226	1.0787	1.1045	0.5024	1.3059	0.477	0.5048
6	0.4358	0.187	0.43	0.4589	0.7377	0.5976	0.3365	0.5562	1.3049	0.4591	0.5996
+gp	0.4358	0.187	0.43	0.4589	0.7377	0.5976	0.3365	0.5562	1.3049	0.4591	0.5996
FBAR 2- 4	0.3884	0.3539	0.5026	0.4353	0.4494	0.4645	0.4423	0.3263	0.4153	0.2933	0.2538

Table 8 Fishing mortality (F) at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE											
1	0.0797	0.1077	0.2201	0.1882	0.1253	0.1477	0.142	0.0722	0.1468	0.0535	0.0355
2	0.325	0.2845	0.1924	0.1896	0.1718	0.1059	0.1714	0.1435	0.128	0.3475	0.1033
3	0.3549	0.3951	0.4398	0.4032	0.3558	0.2254	0.177	0.1757	0.3751	0.4332	0.2535
4	0.1355	0.5144	0.3837	0.3664	0.2597	0.1623	0.1768	0.2368	0.2108	0.4312	0.4124
5	0.4745	0.697	0.5329	0.3381	0.2576	0.2695	0.1999	0.2834	0.2308	0.3664	0.4137
6	0.6697	1.0931	0.8985	0.1735	0.2473	0.141	0.132	0.4226	0.206	0.2531	0.2735
+gp	0.6697	1.0931	0.8985	0.1735	0.2473	0.141	0.132	0.4226	0.206	0.2531	0.2735
FBAR 2- 4	0.2718	0.398	0.3387	0.3197	0.2624	0.1645	0.175	0.1853	0.238	0.404	0.2564

Table 8 Fishing mortality (F) at age

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	FBAR 14-16
AGE										
1	0.0884	0.1327	0.0234	0.5307	0.3535	0.1229	0.2069	0.0838	0.1428	0.1445
2	0.2004	0.0989	0.0406	0.2371	0.1216	0.102	0.3765	0.144	0.2121	0.2442
3	0.1955	0.1238	0.0626	0.2261	0.2887	0.2031	0.4499	0.5526	0.2035	0.402
4	0.2644	0.1336	0.1204	0.3964	0.3738	0.3566	0.464	0.5024	0.2169	0.3945
5	0.4349	0.2148	0.1816	0.4637	0.7311	0.3363	0.5851	0.5604	0.3428	0.4961
6	0.3071	0.2713	0.3515	0.7424	0.3384	0.5414	0.5906	0.4433	0.3617	0.4652
+gp	0.3071	0.2713	0.3515	0.7424	0.3384	0.5414	0.5906	0.4433	0.3617	
FBAR 2- 4	0.2201	0.1188	0.0745	0.2865	0.2613	0.2205	0.4302	0.3997	0.2108	

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

Run title : Megrim (L. whiffiagonis.) in Divisions 27.7.8c and 27.7.9a

At 21/04/2017 10:38

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	1996
AGE											
1	10160	13206	11898	10729	13316	6031	11855	5319	2268	9879	9928
2	7845	7095	8678	6741	7790	6768	3710	8438	3579	1737	7321
3	3353	4272	3341	3695	3412	4061	3029	2298	4983	2416	1005
4	1971	2023	2700	1678	2294	1975	2483	1750	1482	2420	1631
5	1199	1027	1291	1533	794	1083	983	1010	947	714	1411
6	632	525	575	574	799	349	302	267	500	210	363
+gp	602	458	407	753	1166	143	261	92	176	214	196
TOTAL	25762	28606	28890	25702	29570	20412	22623	19175	13936	17590	21854

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE											
1	7716	4501	2746	3994	3548	2971	3072	3334	2801	2336	2850
2	7642	5833	3309	1804	2709	2563	2098	2182	2540	1980	1813
3	4265	4521	3593	2235	1222	1868	1888	1447	1548	1830	1145
4	671	2449	2493	1895	1223	701	1221	1295	994	871	971
5	1074	480	1198	1391	1076	772	488	837	837	659	463
6	697	547	196	576	812	681	483	327	516	544	374
+gp	259	243	380	1112	592	310	427	229	242	177	257
TOTAL	22325	18574	13915	13007	11181	9865	9677	9652	9477	8396	7874

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

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	GM 98-14
AGE											
1	1738	1512	7116	5512	3014	3430	2773	9793	9859	0	3149
2	2252	1302	1084	5691	2654	1733	2483	1846	7373	6999	
3	1338	1509	966	852	3676	1924	1281	1395	1309	4884	
4	728	901	1092	743	556	2255	1286	669	657	874	
5	526	457	646	792	409	313	1292	662	331	433	
6	251	279	302	441	408	161	183	589	309	193	
+gp	145	134	159	383	531	233	353	251	347	374	
TOTAL	6978	6095	11364	14414	11249	10049	9652	15205	20186	13758	

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

Run title : Megrim (*L. whiffiagonis*) in Divisions 27.7.8c and 27.7.9a

At 21/04/2017 10:38

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	10160	2606	2256	705	0.3124	0.3884
1987	13206	2356	1899	537	0.2828	0.3539
1988	11898	2573	2161	858	0.3971	0.5026
1989	10729	2712	2330	761	0.3266	0.4353
1990	13316	2818	2396	1022	0.4266	0.4494
1991	6031	1822	1625	655	0.403	0.4645
1992	11855	1823	1552	558	0.3594	0.4423
1993	5319	1579	1409	421	0.2989	0.3263
1994	2268	1298	1217	492	0.4043	0.4153
1995	9879	1329	989	258	0.2608	0.2933
1996	9928	1658	1331	373	0.2802	0.2538
1997	7716	1595	1380	408	0.2957	0.2718
1998	4501	1504	1373	482	0.3511	0.398
1999	2746	1224	1145	386	0.3372	0.3387
2000	3994	1352	1244	288	0.2315	0.3197
2001	3548	1046	934	194	0.2078	0.2624
2002	2971	965	872	136	0.1559	0.1645
2003	3072	1097	984	149	0.1514	0.175
2004	3334	936	812	160	0.1969	0.1853
2005	2801	976	863	166	0.1924	0.238
2006	2336	932	828	226	0.2729	0.404
2007	2850	873	742	155	0.2089	0.2564
2008	1738	730	673	144	0.214	0.2201
2009	1512	719	676	95	0.1405	0.1188
2010	7116	916	733	88	0.1201	0.0745
2011	5512	1267	1122	371	0.3307	0.2865
2012	3014	1262	1184	293	0.2474	0.2613
2013	3430	1128	1026	250	0.2437	0.2205
2014	2773	1185	1097	399	0.3637	0.4302
2015	9793	1244	986	297	0.3013	0.3997
2016	9859	1670	1340	298	0.2224	0.2108
Arith. Mean	6103	1458	1264	375	0.2754	0.3084
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

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

MFDP version 1a
Run: meg
Time and date: 14:12 26/04/2017
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

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	3149	0.2	0.34	0	0	0.036	0.0119	0.063	0.2155	0.033
2	6999	0.2	0.9	0	0	0.091	0.1758	0.099	0.0440	0.064
3	4884	0.2	1	0	0	0.135	0.3657	0.136	0.0102	0.096
4	874	0.2	1	0	0	0.176	0.4417	0.176	0.0032	0.120
5	433	0.2	1	0	0	0.213	0.6035	0.213	0.0009	0.088
6	193	0.2	1	0	0	0.271	0.5507	0.271	0.0007	0.064
7	374	0.2	1	0	0	0.378	0.5514	0.378	0.0000	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	3149	0.2	0.34	0	0	0.036	0.0119	0.063	0.2155	0.033
2	.	0.2	0.9	0	0	0.091	0.1758	0.099	0.0440	0.064
3	.	0.2	1	0	0	0.135	0.3657	0.136	0.0102	0.096
4	.	0.2	1	0	0	0.176	0.4417	0.176	0.0032	0.120
5	.	0.2	1	0	0	0.213	0.6035	0.213	0.0009	0.088
6	.	0.2	1	0	0	0.271	0.5507	0.271	0.0007	0.064
7	.	0.2	1	0	0	0.378	0.5514	0.378	0.0000	0.038

2019 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	3149	0.2	0.34	0	0	0.036	0.0119	0.063	0.2155	0.033
2	.	0.2	0.9	0	0	0.091	0.1758	0.099	0.0440	0.064
3	.	0.2	1	0	0	0.135	0.3657	0.136	0.0102	0.096
4	.	0.2	1	0	0	0.176	0.4417	0.176	0.0032	0.120
5	.	0.2	1	0	0	0.213	0.6035	0.213	0.0009	0.088
6	.	0.2	1	0	0	0.271	0.5507	0.271	0.0007	0.064
7	.	0.2	1	0	0	0.378	0.5514	0.378	0.0000	0.038

Input units are thousands and kg - output in tonnes

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

MFDP version 1a
Run: meg
Time and date: 14:12 26/04/2017
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2017		Catch	Landings		Discards	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield
1846	1708	1	0.3277	449	0.0191	38

2018		Catch	Landings		Discards		2019	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield	Biomass	SSB
1655	1562	0	0.0000	0	0.0000	0	1960	1862
.	1562	0.1	0.0328	55	0.0019	3	1891	1794
.	1562	0.2	0.0655	109	0.0038	6	1825	1728
.	1562	0.3	0.0983	160	0.0057	9	1761	1665
.	1562	0.4	0.1311	208	0.0077	12	1700	1604
.	1562	0.5	0.1639	255	0.0096	15	1641	1546
.	1562	0.6	0.1966	300	0.0115	17	1585	1490
.	1562	0.7	0.2294	344	0.0134	20	1531	1437
.	1562	0.8	0.2622	385	0.0153	22	1479	1385
.	1562	0.9	0.2950	425	0.0172	25	1429	1336
.	1562	1	0.3277	463	0.0191	27	1381	1288
.	1562	1.1	0.3605	500	0.0210	30	1335	1243
.	1562	1.2	0.3933	535	0.0230	32	1291	1199
.	1562	1.3	0.4261	568	0.0249	34	1249	1157
.	1562	1.4	0.4588	601	0.0268	37	1208	1117
.	1562	1.5	0.4916	632	0.0287	39	1169	1078
.	1562	1.6	0.5244	662	0.0306	41	1131	1041
.	1562	1.7	0.5571	691	0.0325	43	1095	1005
.	1562	1.8	0.5899	718	0.0344	45	1060	970
.	1562	1.9	0.6227	745	0.0364	47	1027	937
.	1562	2	0.6555	770	0.0383	49	995	905

Input units are thousands and kg - output in tonnes

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

MFDP version 1a
Run: meg
Time and date: 14:12 26/04/2017
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2017 F multiplier: 1 Fleet1 HCFbar: 0.3277 Fleet1 DFbar: 0.0191

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0119	30	2	0.2155	552	18	3149	113	1071	38	1071	38
2	0.1758	1005	99	0.044	251	16	6999	634	6299	571	6299	571
3	0.3657	1358	185	0.0102	38	4	4884	659	4884	659	4884	659
4	0.4417	285	50	0.0032	2	0	874	154	874	154	874	154
5	0.6035	180	38	0.0009	0	0	433	92	433	92	433	92
6	0.5507	75	20	0.0007	0	0	193	52	193	52	193	52
7	0.5514	145	55	0	0	0	374	141	374	141	374	141
Total		3077	449		844	38	16906	1846	14128	1708	14128	1708

Year: 2018 F multiplier: 1 Fleet1 HCFbar: 0.3277 Fleet1 DFbar: 0.0191

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0119	30	2	0.2155	552	18	3149	113	1071	38	1071	38
2	0.1758	295	29	0.044	74	5	2054	186	1848	167	1848	167
3	0.3657	1279	174	0.0102	36	3	4600	621	4600	621	4600	621
4	0.4417	894	158	0.0032	6	1	2746	484	2746	484	2746	484
5	0.6035	190	41	0.0009	0	0	459	98	459	98	459	98
6	0.5507	75	20	0.0007	0	0	194	52	194	52	194	52
7	0.5514	104	39	0	0	0	267	101	267	101	267	101
Total		2867	463		669	27	13468	1655	11184	1562	11184	1562

Year: 2019 F multiplier: 1 Fleet1 HCFbar: 0.3277 Fleet1 DFbar: 0.0191

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0119	30	2	0.2155	552	18	3149	113	1071	38	1071	38
2	0.1758	295	29	0.044	74	5	2054	186	1848	167	1848	167
3	0.3657	375	51	0.0102	10	1	1350	182	1350	182	1350	182
4	0.4417	842	148	0.0032	6	1	2586	456	2586	456	2586	456
5	0.6035	597	127	0.0009	1	0	1441	307	1441	307	1441	307
6	0.5507	79	22	0.0007	0	0	205	56	205	56	205	56
7	0.5514	84	32	0	0	0	218	82	218	82	218	82
Total		2303	411		644	25	11002	1381	8718	1288	8718	1288

Input units are thousands and kg - output in tonnes

Table 6.1.16 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa
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			2013	2014	2015	2016	2017
Stock No. (thousands) of		1 year-olds	2773	9793	9859	3149	3149
Source			XSA	XSA	XSA	GM98-14	GM98-14
Status Quo F:							
% in	2017	catch	10.3	38.8	23.6	4.1	-
% in	2018		8.4	32.4	36.1	6.9	4.1
% in	2017	SSB	9.0	38.6	33.5	2.2	-
% in	2018	SSB	6.3	31.0	39.8	10.7	2.4
% in	2019	SSB	4.3	23.8	35.4	14.1	13.0

GM : geometric mean recruitment

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

a) 2018 catches **b) 2019 SSB**

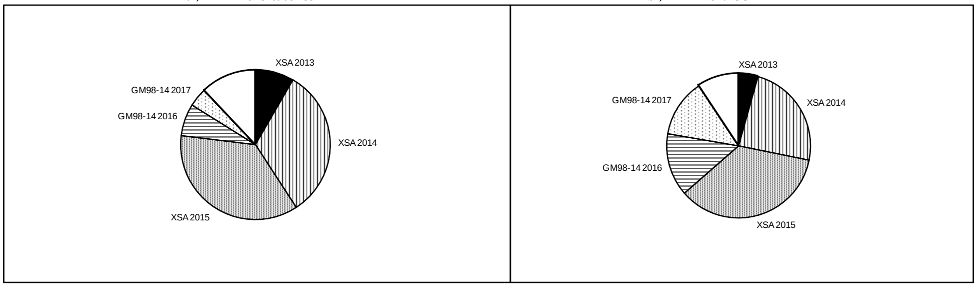


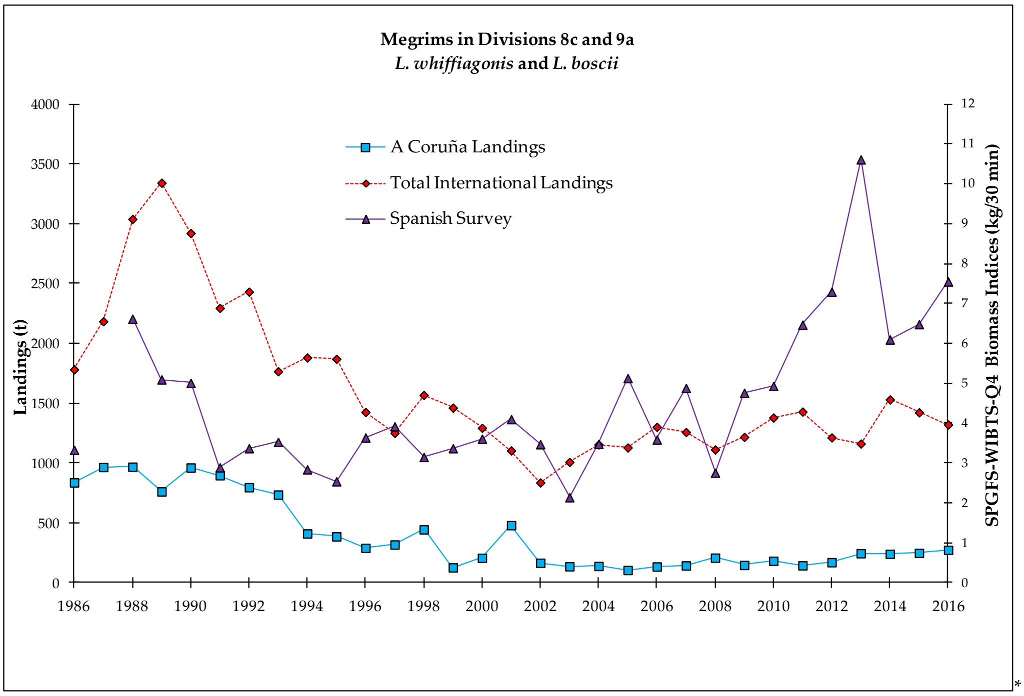
Table 6.1.17. Megrim (*L. whiffiagonis*) in Divisions 8c and 9a, yield per recruit results.

MFYPR version 2a
Run: meg
Time and date: 14:15 26/04/2017
Yield per results

Catch	Landings			Discards								
FMult	Fbar	CatchNos	Yield	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	1.1209	4.7748	1.0899	4.7748	1.0899
0.1	0.0328	0.1413	0.0355	0.0019	0.0233	0.0009	4.6973	0.8478	3.9572	0.8169	3.9572	0.8169
0.2	0.0655	0.2273	0.0533	0.0038	0.0458	0.0018	4.1578	0.6772	3.4196	0.6465	3.4196	0.6465
0.3	0.0983	0.2832	0.0624	0.0057	0.0676	0.0027	3.7721	0.5618	3.0356	0.5313	3.0356	0.5313
0.4	0.1311	0.3211	0.0668	0.0077	0.0887	0.0035	3.4802	0.4793	2.7454	0.4489	2.7454	0.4489
0.5	0.1639	0.3472	0.0687	0.0096	0.1092	0.0043	3.2498	0.4178	2.5167	0.3876	2.5167	0.3876
0.6	0.1966	0.3654	0.069	0.0115	0.129	0.005	3.0622	0.3704	2.3308	0.3403	2.3308	0.3403
0.7	0.2294	0.3779	0.0684	0.0134	0.1483	0.0057	2.9055	0.3329	2.1757	0.303	2.1757	0.303
0.8	0.2622	0.3864	0.0673	0.0153	0.167	0.0064	2.7721	0.3026	2.0438	0.2728	2.0438	0.2728
0.9	0.295	0.3918	0.07	0.0172	0.1852	0.0071	2.66	0.2775	1.9299	0.2479	1.9299	0.2479
1	0.3277	0.3948	0.0644	0.0191	0.2028	0.0077	2.5553	0.2566	1.8301	0.227	1.8301	0.227
1.1	0.3605	0.3961	0.0628	0.021	0.2199	0.0084	2.4654	0.2387	1.7417	0.2093	1.7417	0.2093
1.2	0.3933	0.3959	0.0612	0.023	0.2366	0.009	2.385	0.2234	1.6627	0.1941	1.6627	0.1941
1.3	0.4261	0.3947	0.0595	0.0249	0.2527	0.0096	2.3124	0.21	1.5915	0.1809	1.5915	0.1809
1.4	0.4588	0.3926	0.0579	0.0268	0.2684	0.0101	2.2464	0.1983	1.5269	0.1693	1.5269	0.1693
1.5	0.4916	0.3897	0.0564	0.0287	0.2837	0.0107	2.1861	0.1879	1.4679	0.159	1.4679	0.159
1.6	0.5244	0.3863	0.0548	0.0306	0.2986	0.0112	2.1307	0.1786	1.4138	0.1499	1.4138	0.1499
1.7	0.5571	0.3825	0.0533	0.0325	0.313	0.0117	2.0796	0.1703	1.3639	0.1416	1.3639	0.1416
1.8	0.5899	0.3783	0.0519	0.0344	0.3271	0.0122	2.0322	0.1628	1.3178	0.1342	1.3178	0.1342
1.9	0.6227	0.3737	0.0505	0.0364	0.3408	0.0127	1.9881	0.1559	1.2749	0.1275	1.2749	0.1275
2.0	0.6555	0.3690	0.0492	0.0383	0.3541	0.0131	1.9469	0.1497	1.2350	0.1213	1.235	0.1213

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1	0.3277
FMax	0.5785	0.1896
F0.1	0.3324	0.1089
F35%SPR	0.5117	0.1677

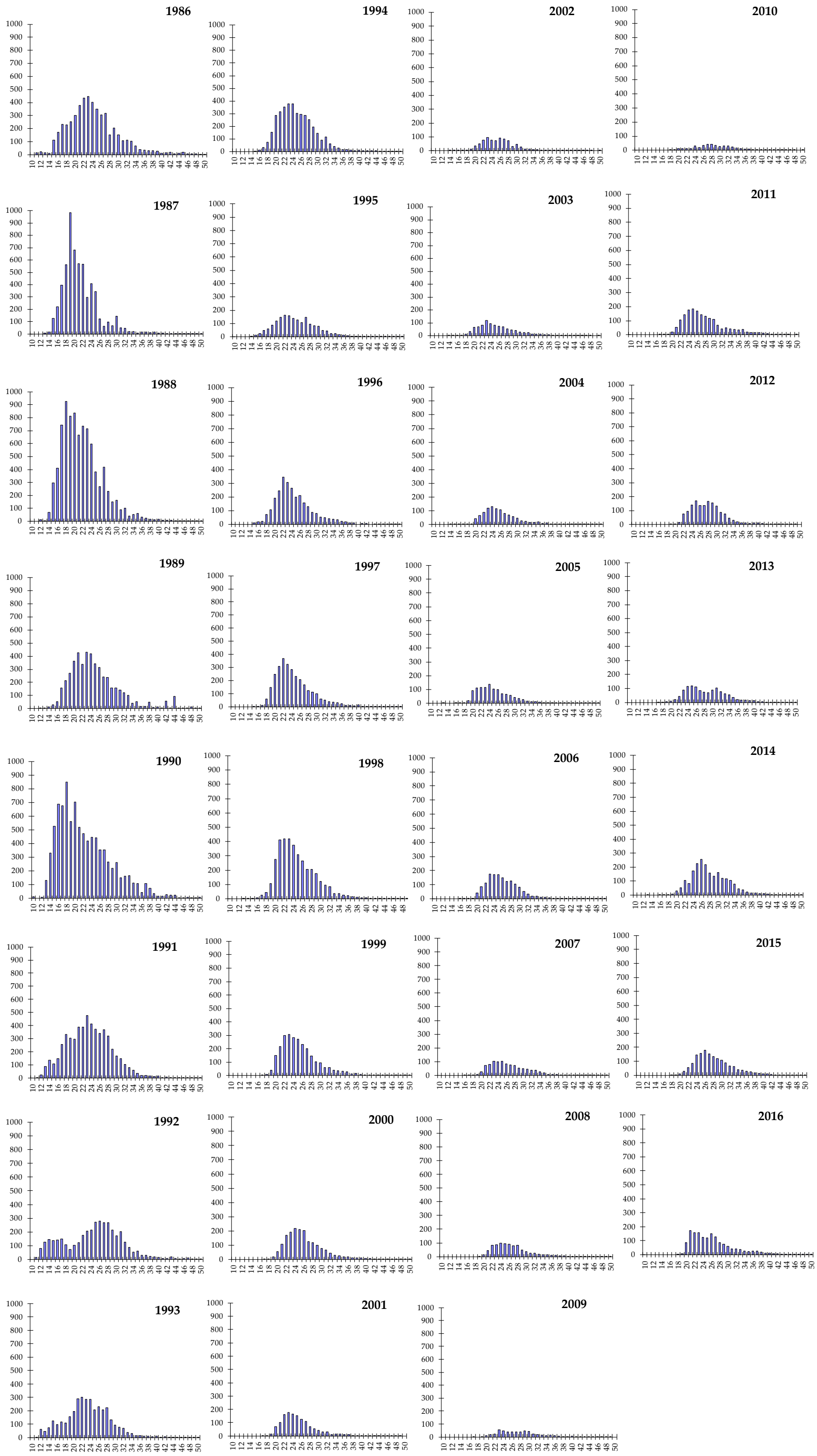
Weights in kilograms



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 8c and 9a. Annual length compositions of landings ('000)



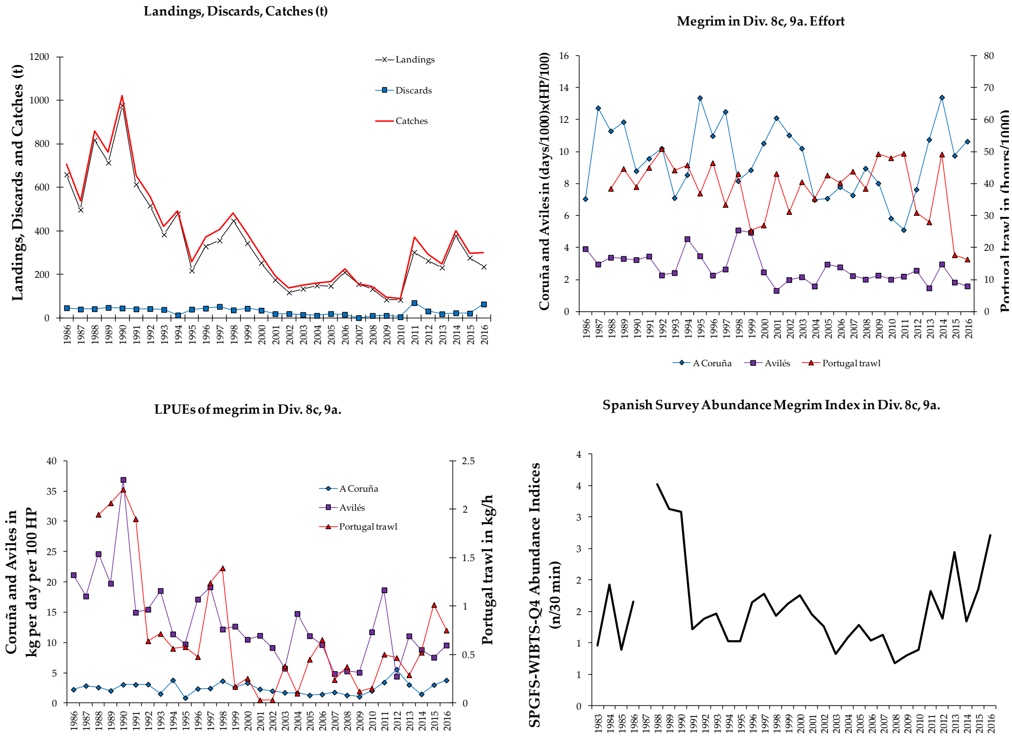
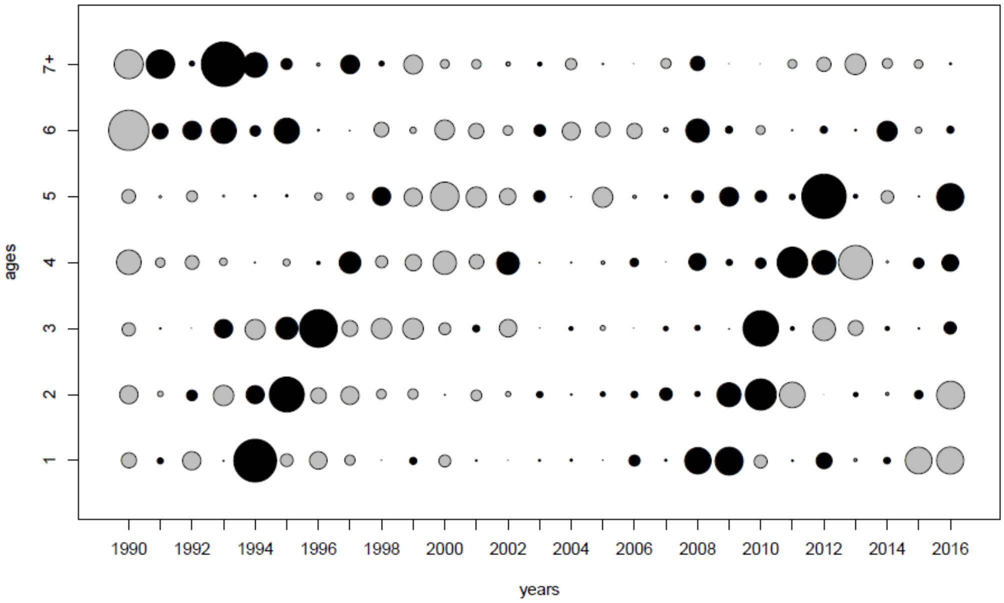


Figure 6.1.3(a) Megrim (*L.whiffiagonis*) in Divisions 8c, 9a. Catches (t), Efforts, LPUEs and Abundance Indices. Standardized log (abundance index at age) from survey SpGFS-WIBTS-Q4

(black bubbles means <0)

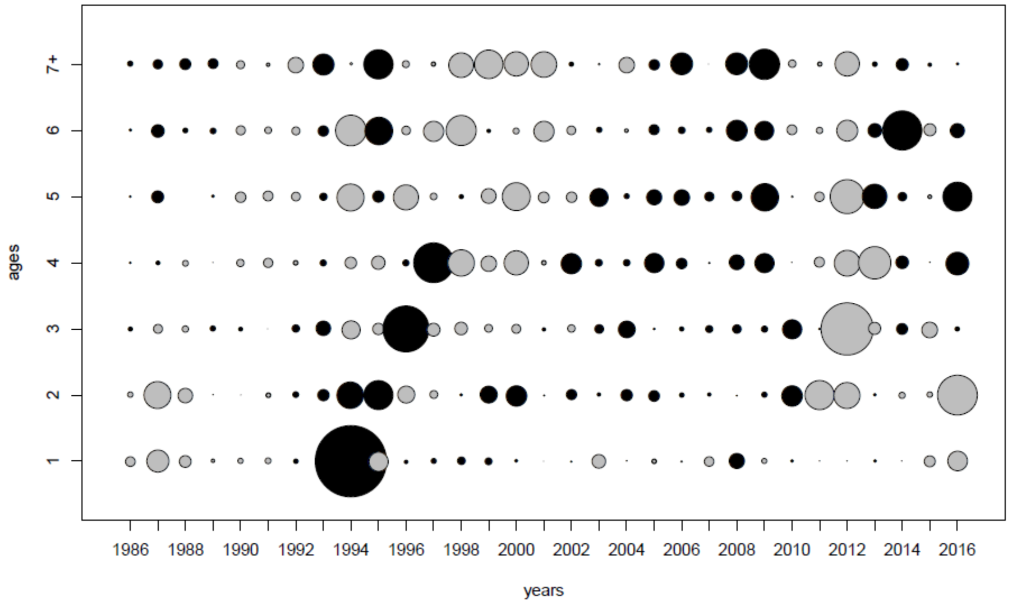


* 2013 data not included in the assessment

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

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)

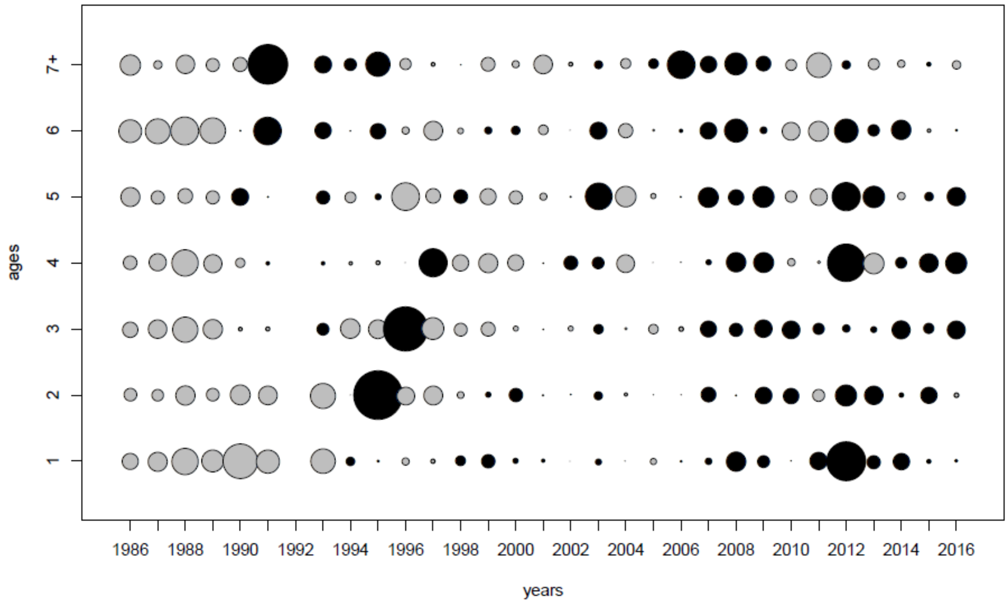
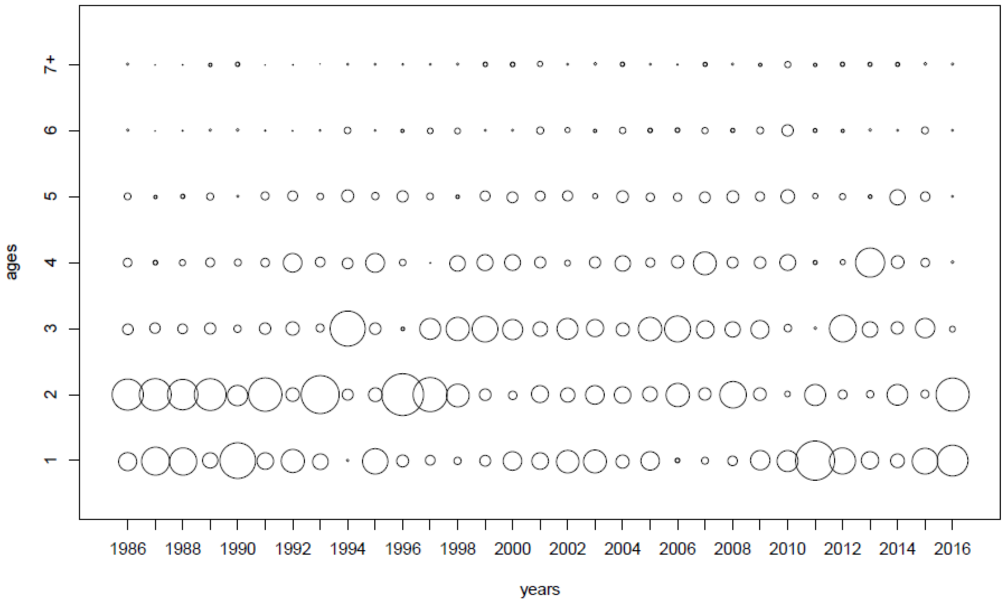


Figure 6.1.3(c): Megrim (*L. whiffiagonis*) in Divisions 8c & 9a

Catches proportions at age



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

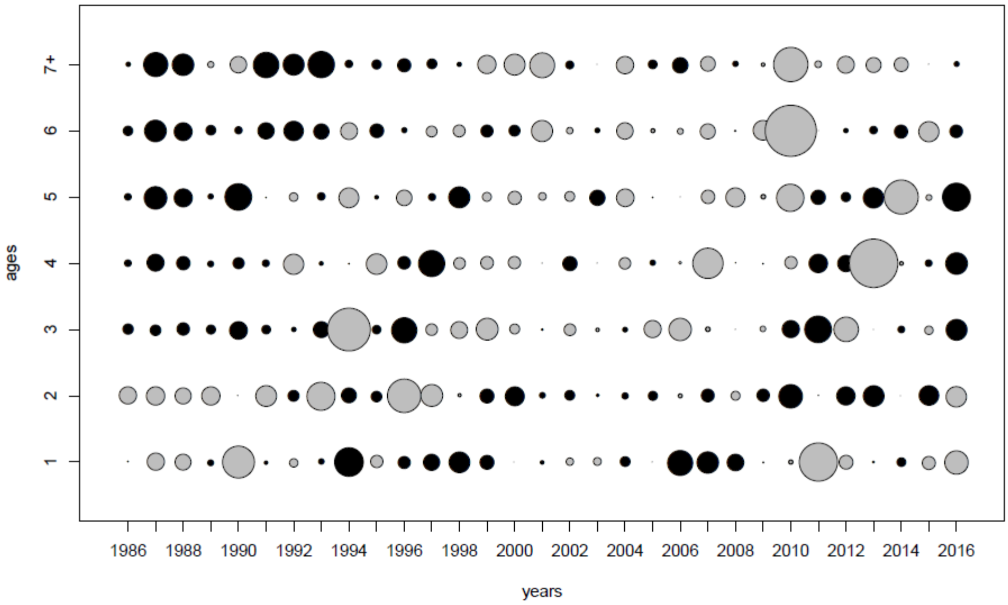
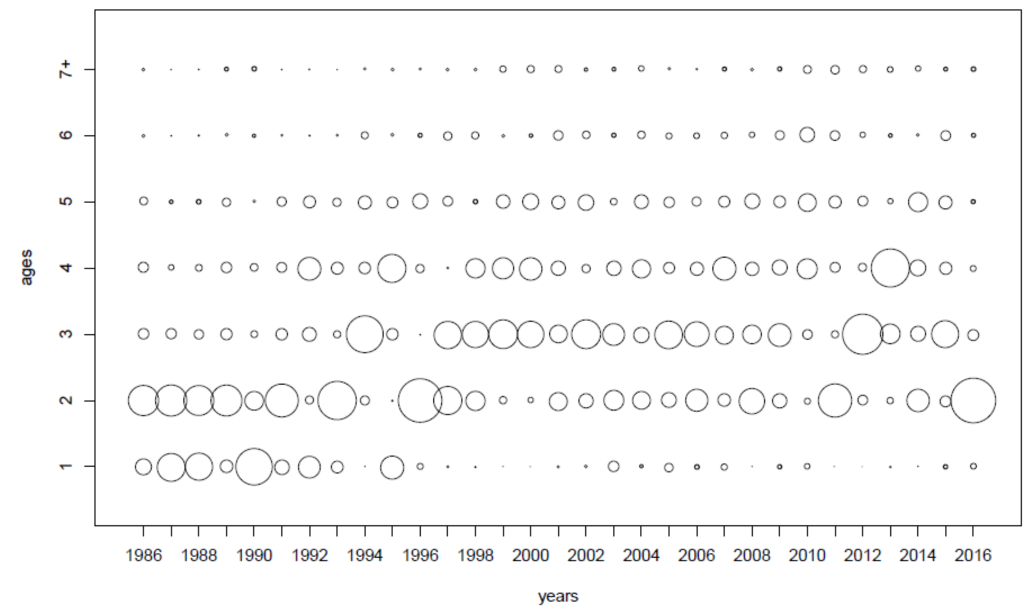


Figure 6.1.4(a). Megrim (*L. whiffiagonis*) in Divisions 8c & 9a.

Landings proportions at age



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

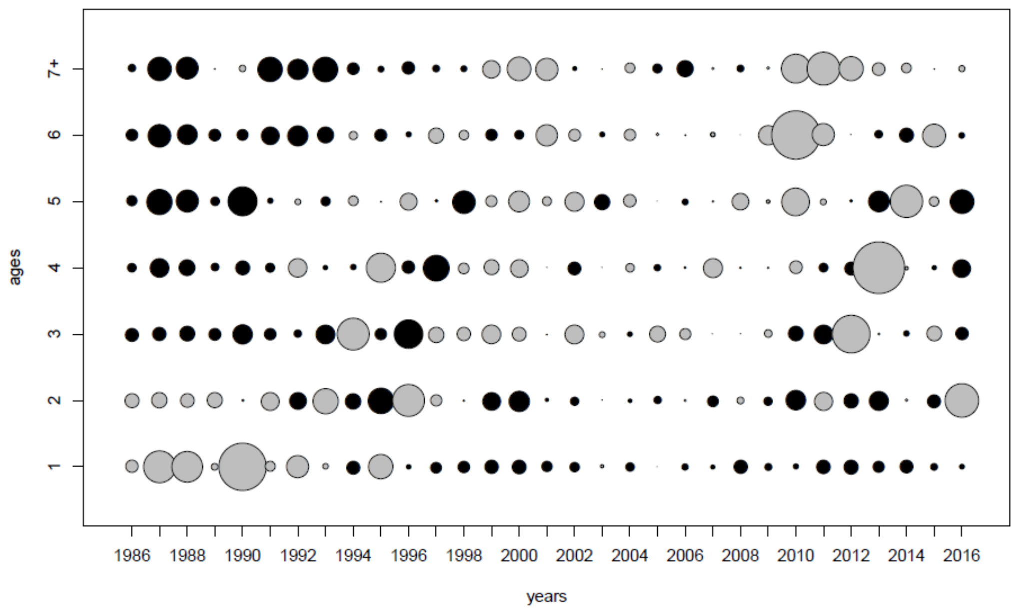
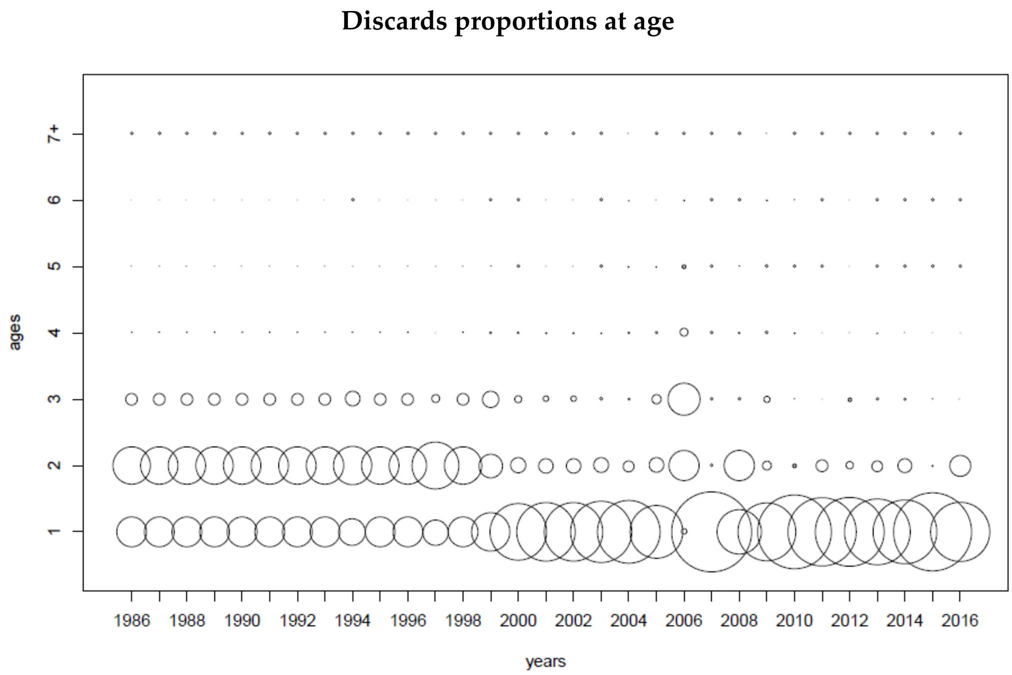


Figure 6.1.4(b). Megrim (*L. whiffiagonis*) in Divisions 8c & 9a.



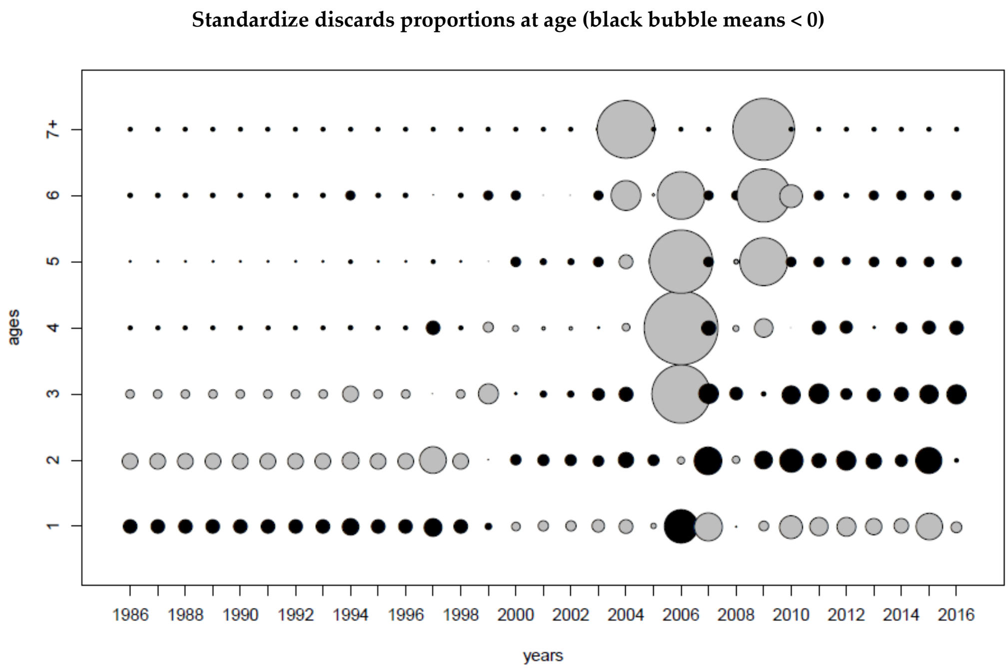


Figure 6.1.4(c). Megrim (*L. whiffiagonis*) in Divisions 8c & 9a.

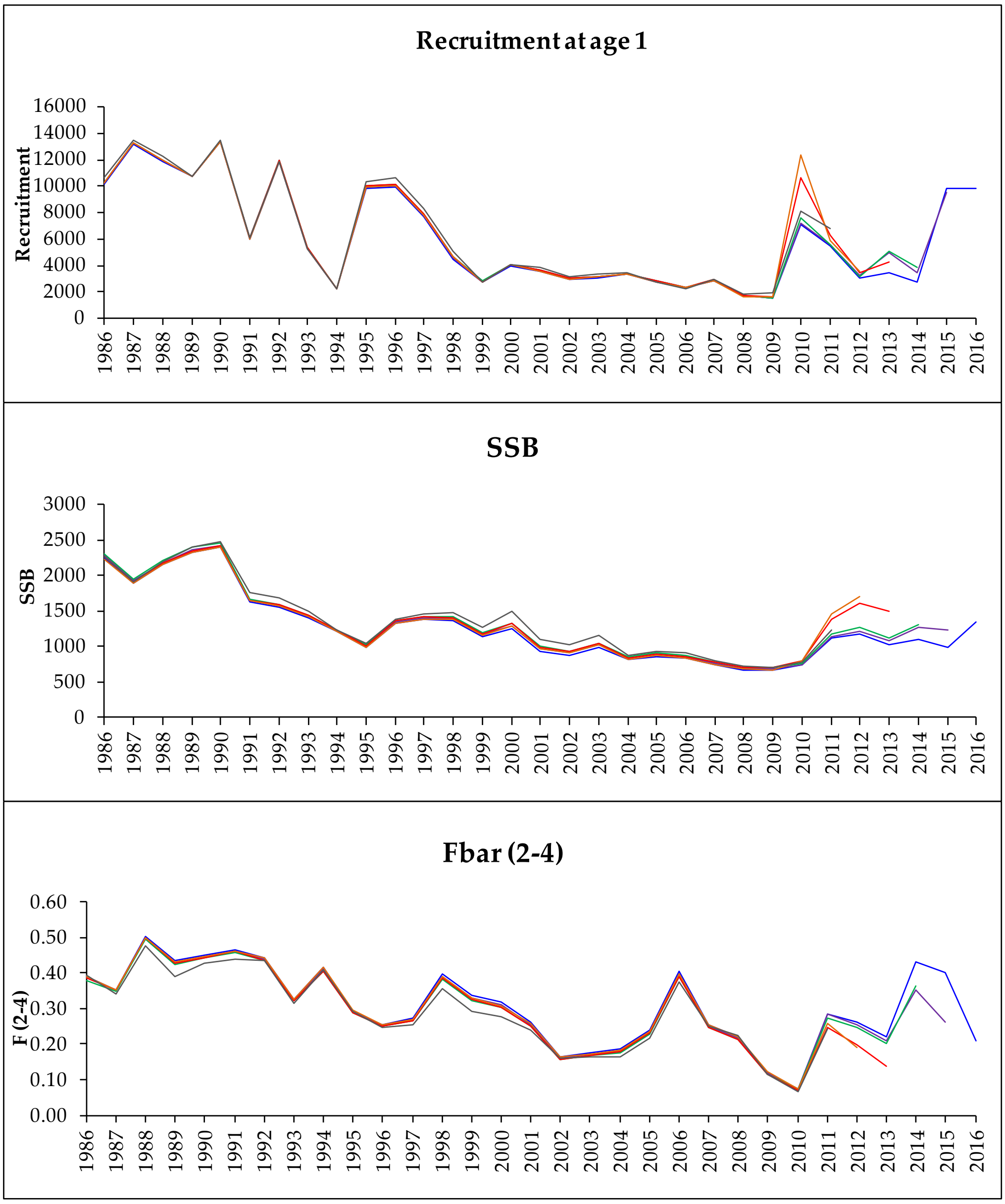


Figure 6.1.5. Megrim (*L. whiffiagonis*) in Divisions 8c and 9a. Retrospective XSA

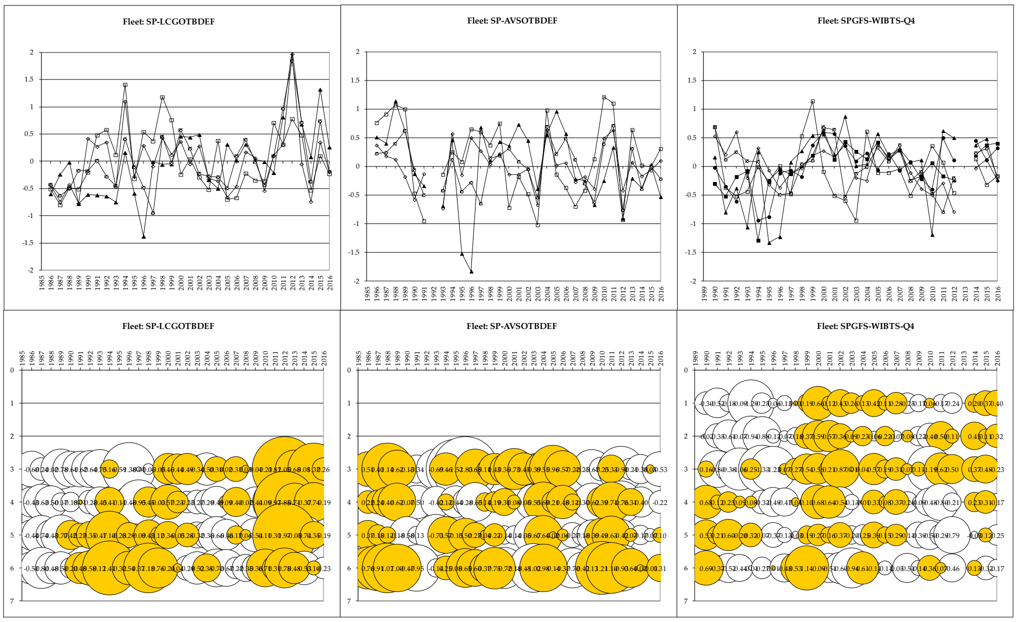


Figure 6.1.6. Megrim in Divisions 8c and 9a. LOG CATCHABILITY RESIDUAL PLOTS (XSA)

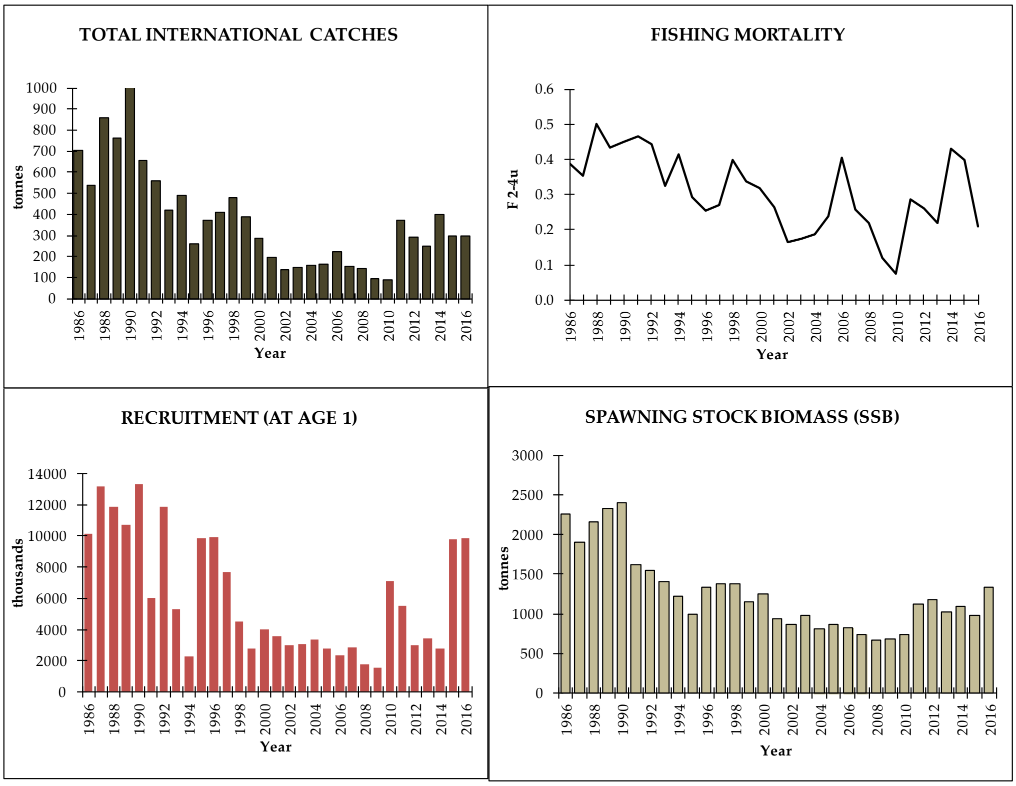
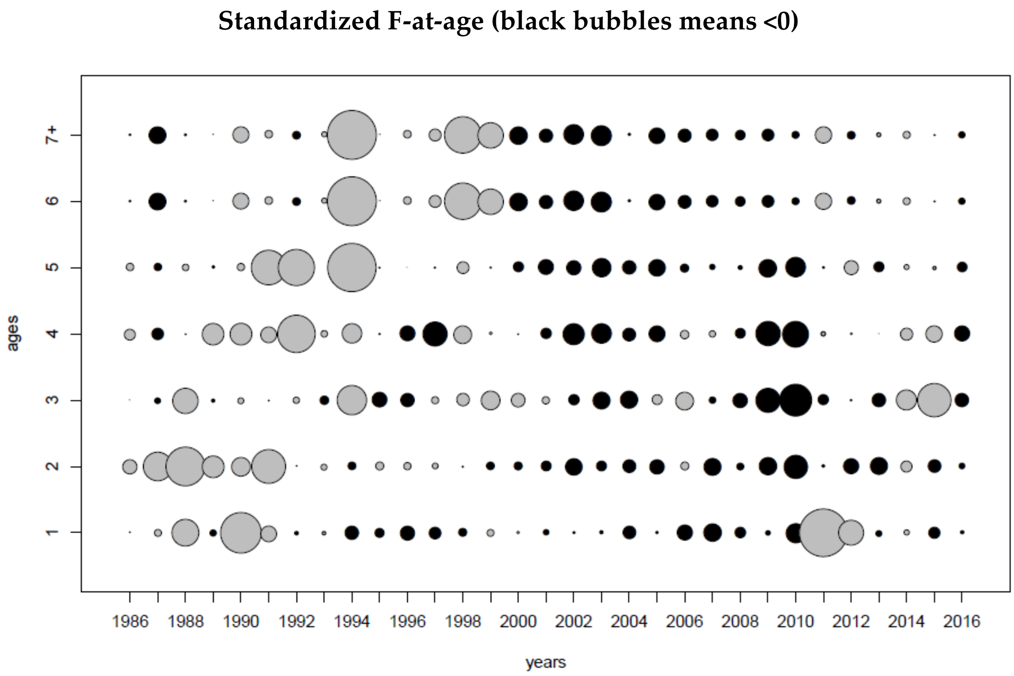


Figure 6.1.7(a). Megrim (*L. whiffiagonis*) in Divisions 8c and 9a. Stock Summar



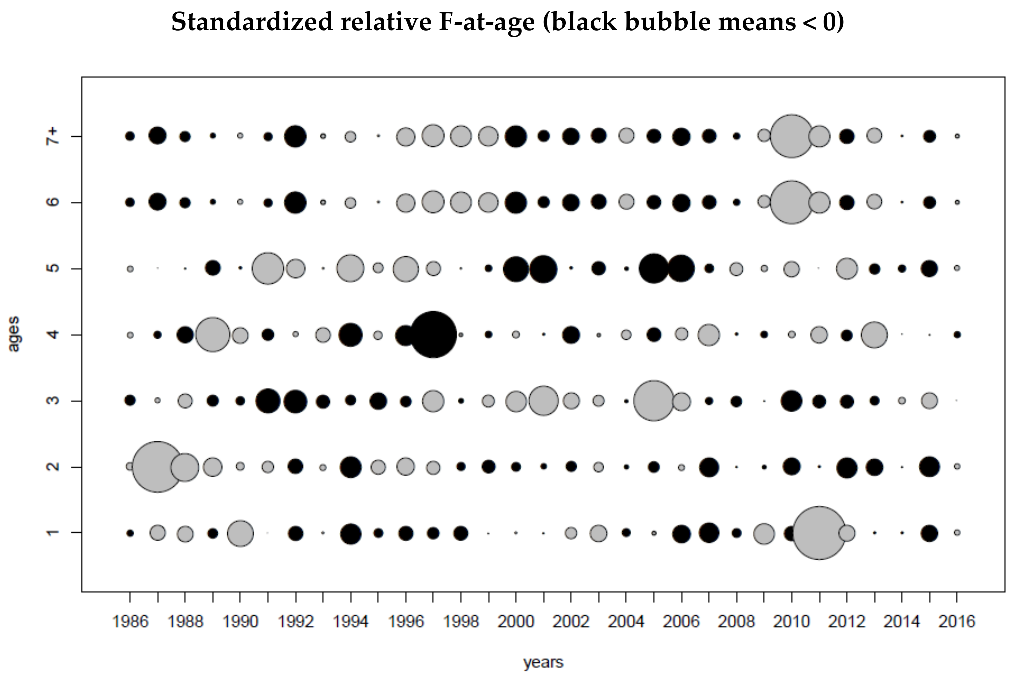
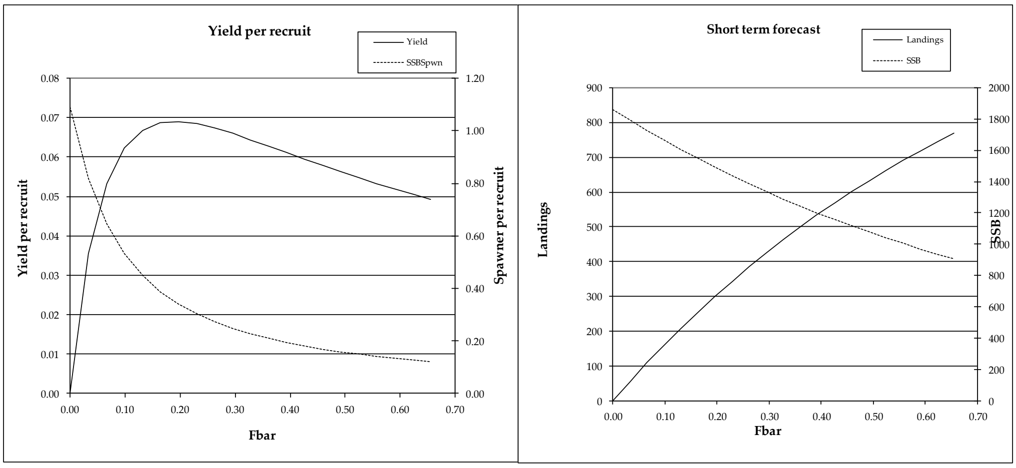


Figure 6.1.7(b). Megrim (*L. whiffiagonis*) in Divisions 8c & 9a



MFYPR version 2a
Run: meg
Time and date: 14:15 26/04/2017

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar	1.0000	0.3277
FMax	0.5785	0.1896
F0.1	0.3324	0.1089
F35%SPR	0.5117	0.1677

MFDP version 1a
Run: meg
Time and date: 14:12 26/04/2017
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 8c and 9a, forecast summary

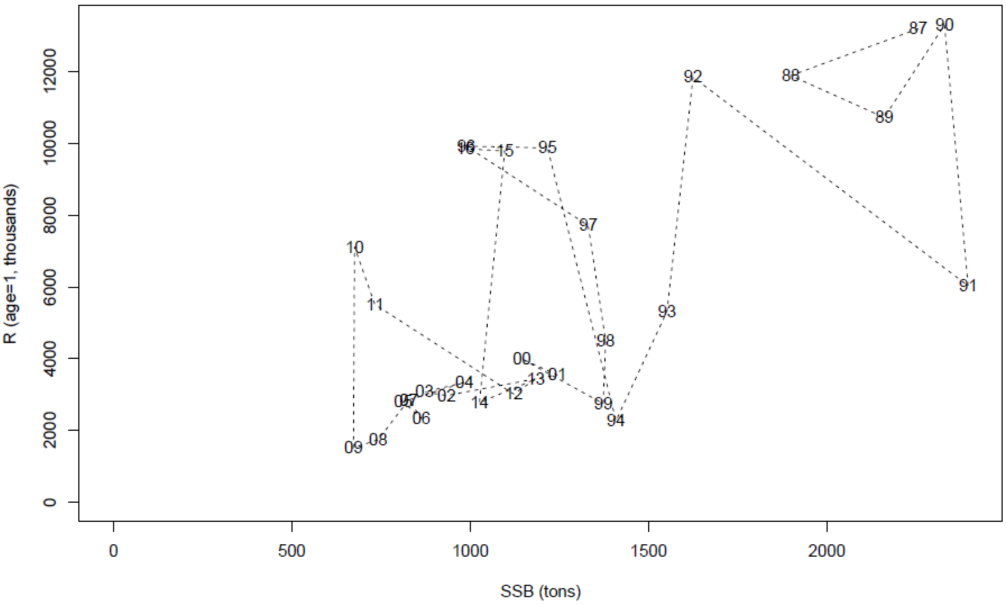


Figure 6.1.9. Megrim (*L.whiffiagonis*) in Divisions 8c and 9a. SSB-Recruitment plot.

(Numbers in graph, 1987–2014, are recruitment years)

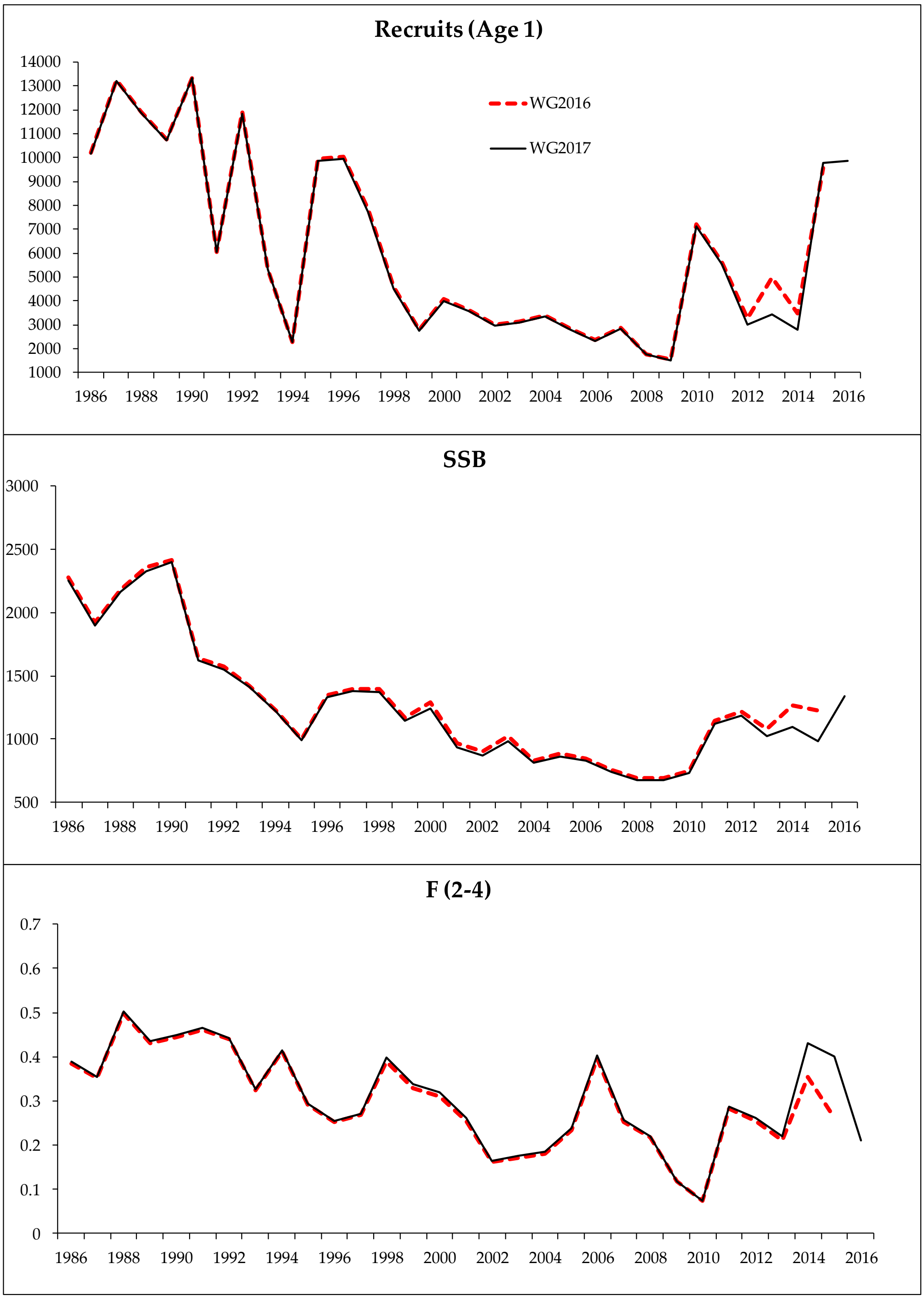


Figure 6.1.10. Megrim (*L. whiffiagonis*) in Div. 8c and 9a. Recruits, SSB and F estimates from WG15 and WG16

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 to 2016 are given in Table 6.2.1. Since 2011, estimates of unallocated or non-reported landings have been included in the assessment. These were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each métier. 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 1 297 t, the highest value after 1995. In 2016, the landings value of 1087 t is slightly lower than 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 1986–2016. Unallocated/non reported 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 summarised in Table 6.2.6.

Two Portuguese surveys, named "Crustacean" (PT-CTS (UWTV(FU28–29)) and "October" (PtGFS-WIBTS-Q4), provide indices for 2016. 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 R/V. Last year values are quite stable in both surveys.

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, the abundance values of 2013 is not included in the assessment models. The two last years values are the highest of the time series (WD 11, this report).

The recruitment index for age 0 in 2005 was very high and also in 2009 and 2014. The 2016 value is not so high than previous above but in relation to the time series is close to them. 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) standardised 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, 2009 and 2014 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), and 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 Spanish trawl fleet SP-LCGOTBDEF for the period 1986–2015,for the Portuguese trawl fleet fishing in Division 9a for the period 1988–2016 and for the Spanish SP-AVSOTBDEF for the period 1986–2015 (see also Figure 6.2.3). As SP-AVSOTBDEF is not use in the assessment, the sampling for this species in this port has been suspended since 2015. After very high value in 2010, the Lpue of Coruña (SP-LCGOTBDEF) shows in 2016 a small decrease in relation to last year. For the Portuguese fleets, until 2011 most log-books were filled in paper but have thereafter been progressively replaced by e-logbooks. In 2013 more than 90% of the log-books 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 2016, as indicated in the Stock Annex. In Figure 6.2.3(b), the bubble plots of log (abundance index at age) standardised 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, 2016 value represent a low increase in relation to last year.

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 was 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 2016 value is 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, followed by a decrease in 2016.

6.2.3 Assessment

An update assessment was conducted, according to the Stock Annex specifications. Assessment years are 1986-2016 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, 2005 and 2009 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 2000's. After that, positive survey residuals are more abundant in this period.

Table 6.2.10 presents the fishing mortality-at-age estimates. Fbar ($=F_{2\text{-}4}$) is estimated to be 0.22 in 2016.

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

6.2.4.2 Year class strength and recruitment estimations

The 2014 year class estimate is 104 million individuals, obtained by averaging estimates coming from the Spanish survey tuning data (96% of weight) and F-shrinkage (4% weight).

The 2015 year class estimate is 45 million individuals, estimated from the Spanish survey (95% of weight) and F-shrinkage (5% weight).

The 2016 year class estimate is 25 million individuals, obtained a value from the Spanish survey (78% weight) and F-shrinkage (22% 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 1990–2014 has been used for computation of 2016 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
2014	104 986	XSA	96%	-	4%
2015	45 653	XSA	95%	-	5%
2016	44 930	$GM_{90\text{-}14}$		-	
2017	44 930	$GM_{90\text{-}14}$			

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 summarised in Table 6.2.12 and Figure 6.2.7(a).

SSB decreased gradually from 6753 t in 1988 to 3247 t in 2001, the lowest value in the series, and has since increased. In 2015 the SSB is estimated at 7385 t, the highest of the time series.

Recruitment has fluctuated around 48 million fish during all the series. Very weak year classes are found in 1993 and 1998. The second highest value occurred in 2012, while 2014 value is the highest in the series, with 104 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 stabilised at a lower level, with small ups and downs. From 2007, the F has been decreasing till 2013. After three years of higher values, 2016 represents a falling in F, with a value of 0.22.

There seems to be interannual variability in the relative fishing exploitation pattern at age (F over Fbar, 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 $F_{bar} = 0.22$ for landings and $F_{bar} = 0.11$ for discards, being 0.34 for catches). The recruitment in 2016 (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 2017 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 2018, and their consequences in terms of projected landings and stock biomass. Figure 6.2.8 (right panel) plots short-term yield and SSB versus F_{bar}. 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 2017 and 2018 are 1729 and 1869 t, respectively. Projected discards for the same years are 620 and 436 t.

Under F *status quo*, projected SSB values for 2018 and 2019 are about 7685 t in 2018 and 7040 t in 2019.

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_{90-14} recruitment is assumed contribute in a 18% to catches in 2018 and with a 38% to SSB in 2019.

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 versus F_{bar}.

Under F s*tatus quo* ($F_{bar} = 0.22$ for landings and $F_{bar} = 0.11$ for discards), yield-per-recruit is 0.03 kg for landings and 0.01 kg for discards and SSB-per-recruit is 0.11 kg. Assuming GM_{90-14} recruitment of 43 million, the equilibrium yield would be around 1249 t of landings and 364 t of discards, with an SSB value of 5459 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	$F_{pa} = F_{lim} \times \exp(-\sigma \times 1.645)$ σ=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 2016 shows minor differences in SSB and in Recruitment in recent years (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 2017 and 2018 would result in some biomass increase for 2017 and 2018.

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 8c and 9a. Both are taken as bycatch in mixed bottom trawl fisheries.

Assuming status quo F for both species in 2017 (average of estimated F over 2014-2016, corresponding to Fbar = 0.33 for landings and Fbar = 0.02 for discards for *L. whiffiagonis* and Fbar = 0.22 for landings and Fbar = 0.11 for discards for *L. boscii*), Figure 6.3.2 gives the combined predicted landings for 2018 and individual SSB for 2019, 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 2014–2016) for both species, predicted combined landings in 2017 are 2178 t and individual SSBs in 2018 are 1288 t for *L. whiffiagonis* and 7040 t for *L. boscii*.

Table 6.2.1. Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Total landings (t)

	Spain landings			Portugal landings	Unallocated/ Non reported	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
2016	403	276	679	105	303	1087	332	1419

+Data revised in WG2015

***9a 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 8c, 9a. Discard/Total Catch ratio and estimated CV for Spain from sampling on board

Year	1994	1997	1999	2000	2003	2004	2005	2006	2007	2008	2009
Weight Ratio	0.30	0.28	0.24	0.29	0.21	0.30	0.32	0.27	0.25	0.20	0.23
CV	23.2	11.2	14.4	16.5	10.2	23.1	24.0	48.4	18.3	22.6	21.1
Number Ratio	0.50	0.63	0.59	0.61	0.47	0.55	0.55	0.42	0.47	0.42	0.39

Year	2010	2011*	2012	2013	2014	2015	2016
Weight Ratio	0.19	0.24	0.39	0.35	0.41	0.34	0.23
CV	18.8	16.0	15.5	23.2	17.8	20.1	16.4
Number Ratio	0.62	0.50	0.52	0.63	0.67	0.60	0.47

Table. 6.2.2(b). Four-spot megrim (*L. boscii*) in Divisions 8c, 9a. Discards in numbers at age (thousands) for Spanish trawlers

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
0	1289	1289	1289	1289	1289	1289	1289	1289	678	1289	1289
1	3322	3322	3322	3322	3322	3322	3322	3322	2741	3322	3322
2	4322	4322	4322	4322	4322	4322	4322	4322	4134	4322	4322
3	2211	2211	2211	2211	2211	2211	2211	2211	2710	2211	2211
4	605	605	605	605	605	605	605	605	581	605	605
5	94	94	94	94	94	94	94	94	189	94	94
6	20	20	20	20	20	20	20	20	55	20	20
7	4	4	4	4	4	4	4	4	11	4	4

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
0	256	1289	2933	354	208	208	238	33	10	1	100
1	3273	3322	3954	6148	5673	5673	4479	6393	3515	1233	3248
2	6099	4322	2734	1207	1750	1750	989	3053	5482	2497	4541
3	2108	2211	1815	1888	1025	1025	495	693	609	1445	757
4	146	605	1088	1218	477	477	50	163	183	486	105
5	90	94	3	171	67	67	2	27	56	168	44
6	3	20	0	12	4	4	0		23	22	7
7	0	4	1	2	1	1			6	9	1

	2008	2009	2010	2011*	2012	2013	2014	2015	2016
0	202	2	2879	30	682	275	0	157	2
1	2342	1525	10362	5132	5313	5499	5645	2437	1606
2	2374	2490	1301	3595	2480	4379	11089	7061	5506
3	1384	1970	696	544	1057	3030	2139	4588	785
4	52	480	283	174	15	707	582	532	232
5	10	51	83	37	5	39	161	26	70
6	3	7	11	1	2	12	11	4	30
7	3		1		0	2	0	0	1

Table 6.2.3(a). Four-spot megrim (*L. boscii*). Divisions 8c and 9a. Annual length distributions in landings.

Length (cm)	Total
10	
11	
12	
13	
14	
15	3316
16	10155
17	18739
18	49949
19	272498
20	764074
21	1106762
22	1289035
23	1246080
24	1239982
25	870062
26	703957
27	466987
28	395011
29	252040
30	180090
31	106432
32	57774
33	28464
34	19993
35	8744
36	5403
37	4597
38	1636
39	1228
40	766
41	411
42	323
43	73
44	
45	
46	46
47	147
48	256
49	
50+	
Total	9105029

Table 6.2.3(b). Four-spot megrim (*L. boscii*) Divisions 8c and 9a.

Mean lengths and mean weights in landings since 1990.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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	22.9
Mean weight (g)	116	118	122	128	111	96	107	112	109	113	121	114	105	101

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Mean length (cm)	22.7	22.7	22.9	23.5	23.6	23.6	24.1	23.7	23.7	23.9	24.2	24.1	24.2
Mean weight (g)	98	97.0	99.4	109.1	109.7	110.7	118.4	112.2	112.0	114.0	117.8	117.4	118.6

Table 6.2.4. Four-spot megrim (*L. boscii*) in Divisions 8c, 9a. Catch numbers at age.

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
0	1289	1289	1289	1289	1289	1289	1289	1289	678	1289	1289
1	3432	5605	4847	4055	4766	4482	4168	3868	2824	4743	3719
2	7797	15902	14414	11462	9506	8001	6989	6656	7049	6527	6458
3	5901	7284	7666	7603	4096	5539	6211	4307	7225	8349	3478
4	4545	4198	5384	6514	4434	2516	5784	4404	2849	6201	4419
5	1226	1438	2460	3573	2405	2744	2294	1245	1801	1150	1990
6	869	589	1181	1798	1403	1048	758	655	894	602	224
+gp	233	145	467	634	807	483	71	282	457	284	555
TOTALNUM	25292	36450	37708	36928	28706	26102	27564	22706	23777	29145	22132
TONSLAND	1408	2021	2586	3037	2354	2129	2353	1822	1920	2058	1466
SOPCOF %	100	100	100	100	100	99	103	99	100	100	100

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE											
0	256	1289	2933	354	208	208	238	33	10	1	100
1	3308	3367	3992	6193	5840	5863	4846	6785	3638	1267	3257
2	7343	5526	3895	1862	2888	4139	3791	5568	8004	5232	6147
3	4978	6447	4596	3533	2276	3386	3368	3777	3604	5951	3390
4	890	3545	4996	4000	2870	1220	1526	2602	2024	2639	2705
5	1714	792	1405	2020	1937	454	501	1155	1426	1156	1909
6	1069	849	235	797	941	240	447	279	802	274	855
+gp	443	353	489	840	358	360	142	337	399	228	461
TOTALNUM	20001	22168	22541	19599	17318	15870	14859	20536	19907	16748	18824
TONSLAND	1204	1501	1442	1414	1221	1028	1067	1354	1358	1427	1396
SOPCOF %	102	100	101	100	100	100	101	101	100	101	101

YEAR	*2008	2009	2010	2011**	2012**	2013**	2014	2015	2016
AGE									
0	202	2	2879	30	682	275	0	157	2
1	2357	1546	10377	5139	5342	5499	5646	2438	1610
2	3935	3136	2364	4397	3260	4919	11954	7412	6739
3	4879	4887	3568	2454	4101	4820	4249	7742	2844
4	2204	4640	3817	2833	1926	4113	3214	3622	2495
5	1003	1662	2529	2711	1620	1363	2983	1580	1936
6	354	640	496	1164	991	846	751	1105	1153
+gp	298	222	438	399	422	371	562	462	559
TOTALNUM	15232	16735	26468	19127	18344	22206	29359	24518	17338
TONSLAND	1182	1413	1562	1397	1321	1427	1942	1745	1419
SOPCOF %	101	100	101	101	101	101	100	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 8c, 9a. Mean weights at age in Catchs (kg).

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE											
0	0.004	0.004	0.004	0.004	0.003	0.004	0.004	0.003	0.005	0.004	0.003
1	0.013	0.027	0.027	0.027	0.019	0.022	0.021	0.014	0.023	0.030	0.023
2	0.034	0.046	0.049	0.055	0.051	0.055	0.052	0.052	0.056	0.046	0.043
3	0.055	0.062	0.069	0.079	0.081	0.097	0.093	0.092	0.082	0.082	0.054
4	0.090	0.089	0.100	0.108	0.134	0.114	0.120	0.136	0.114	0.096	0.106
5	0.129	0.125	0.138	0.144	0.154	0.164	0.159	0.174	0.148	0.143	0.135
6	0.159	0.151	0.167	0.167	0.183	0.190	0.225	0.218	0.178	0.168	0.209
+gp	0.263	0.239	0.280	0.275	0.272	0.263	0.351	0.295	0.243	0.255	0.231
SOPCOFAC	1.0014	1.0022	1.0034	0.9996	1.0009	0.9930	1.0284	0.9892	1.0015	0.9963	0.9993

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE											
0	0.004	0.004	0.006	0.006	0.004	0.006	0.008	0.006	0.0060	0.006	0.005
1	0.016	0.019	0.018	0.023	0.024	0.024	0.025	0.027	0.021	0.023	0.022
2	0.030	0.040	0.045	0.057	0.050	0.057	0.066	0.053	0.050	0.06	0.045
3	0.063	0.073	0.072	0.066	0.073	0.090	0.088	0.081	0.083	0.091	0.079
4	0.091	0.105	0.090	0.087	0.099	0.109	0.123	0.108	0.108	0.104	0.114
5	0.123	0.137	0.147	0.126	0.122	0.163	0.142	0.131	0.122	0.136	0.123
6	0.180	0.179	0.197	0.169	0.166	0.209	0.201	0.175	0.132	0.176	0.152
+gp	0.252	0.293	0.268	0.228	0.255	0.247	0.247	0.235	0.197	0.233	0.198
SOPCOFAC	1.0171	1.0027	1.009	1.001	1.0012	0.9993	1.0129	1.0069	1.0038	1.0066	1.0109

YEAR	*2008	2009	2010	2011**	2012**	2013**	2014	2015	2016
AGE									
0	0.005	0.004	0.004	0.003	0.009	0.004	0.002	0.008	0.004
1	0.017	0.025	0.012	0.02	0.033	0.017	0.024	0.026	0.022
2	0.053	0.045	0.056	0.039	0.052	0.045	0.044	0.04	0.048
3	0.079	0.069	0.084	0.078	0.076	0.063	0.071	0.066	0.086
4	0.112	0.104	0.108	0.099	0.105	0.099	0.101	0.099	0.107
5	0.151	0.142	0.141	0.128	0.127	0.131	0.133	0.136	0.13
6	0.201	0.175	0.182	0.168	0.159	0.159	0.165	0.172	0.149
+gp	0.235	0.288	0.271	0.24	0.199	0.21	0.222	0.23	0.217
SOPCOFAC	1.0063	1.0011	1.0104	1.009	1.006	1.0065	1.0046	1.0018	1.0032

* 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 8c, 9a

Abundance and Recruitment indices of Portuguese and Spanish surveys.

	Biomass Index						Abundance index					At age 1	At age 0	At age 1
	Portugal (k/h)			Spain (k/30 min)			Portugal (n/h)		Spain (n/30 min)			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
2016	0.12	1.80	0.65	4.84	0.32	2016	35.62	12.16	86.70	5.19	2016		2.43	18.06

+ 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 8c and 9a. Tuning data

FLT01: SP-LCGOTBDEF1. 1000 Days by 100 HP (thousand)

1986	1999									
1	1	0	1							
1	7								Eff.	
10		98	376	337	251	95	30	13	7.1	1986
10		473	963	565	318	97	31	16	12.7	1987
10		35	202	200	163	76	30	19	11.3	1988
10		11	86	126	136	83	39	22	11.9	1989
10		5	104	60	174	105	73	38	8.8	1990
10		10	89	145	93	189	80	41	9.6	1991
10		0.4	20	100	168	105	39	2	10.2	1992
10		0.1	37	98	227	85	46	17	7.1	1993
10		0	62	208	169	156	87	46	8.5	1994
10		1	33	278	301	124	83	24	13.4	1995
10		1	33	34	222	133	20	51	11.0	1996
10		0.4	23	111	40	143	125	59	12.5	1997
10		0.3	82	420	350	98	127	62	8.2	1998
10		0.3	62	210	331	165	33	45	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	144	349	303	164	153	10.5	2000
10		14	148	219	475	436	242	83	12.1	2001
10		7	126	214	91	66	45	70	11.0	2002
10		19	287	363	214	75	67	22	10.2	2003
10		29	341	496	440	219	60	81	7.0	2004
10		10	248	383	253	196	114	68	7.1	2005
10		7	364	625	305	151	41	40	7.8	2006
10		2	261	403	415	298	143	82	7.3	2007
10		3	313	727	481	227	88	81	9.0	2008
10		8	145	524	640	226	87	34	8.0	2009
10		0.1	146	520	743	616	132	105	5.8	2010
10		0	48	224	424	594	323	133	5.1	2011
10		1	107	719	562	505	302	123	7.6	2012
10		0	87	336	806	313	170	65	10.8	2013
10		0.1	119	332	427	431	99	55	13.4	2014
10		0.1	67	619	625	322	218	80	9.8	2015
10		0.1	244	402	449	383	230	117	10.6	2016

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
1	2.4	18.1	45.4	10.6	4.3	2.8	2.0	1.1	114	2016

Table 6.2.8. Four-spot megrim (*L. boscii*). LPUE data by fleet in Divisions 8c, 9a.

	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	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
2016	233.8	10.6	22.0				84.9	16.4	5.2

[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

*** Sampling suspended in 2015.

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic.

Lowestoft VPA Version 3.1

28/04/2017 14:16

Extended Survivors Analysis

Four spot megrim (*L. boscii*) Divisions 27.7.8c and 27.7.9a

CPUE data from file fleetb.txt

Catch data for 31 years. 1986 to 2016. Ages 0 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF1	1986	2016	3	6	0	1
SP-LCGOTBDEF2	2000	2016	3	6	0	1
SP-GFS	1988	2016	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

1

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
0	0.003	0.008	0	0.065	0.001	0.011	0.006	0	0.004	0
1	0.089	0.088	0.078	0.247	0.16	0.158	0.119	0.174	0.032	0.049
2	0.221	0.147	0.161	0.164	0.157	0.144	0.214	0.41	0.363	0.116
3	0.345	0.274	0.275	0.279	0.256	0.215	0.328	0.29	0.512	0.229
4	0.518	0.396	0.456	0.359	0.374	0.327	0.348	0.38	0.432	0.305
5	0.824	0.367	0.594	0.486	0.470	0.381	0.408	0.46	0.325	0.435
6	0.621	0.342	0.424	0.350	0.434	0.312	0.351	0.413	0.307	0.419

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6
2007	38000	42400	34300	12800	7400	3760	2040
2008	2.81E+04	3.10E+04	3.18E+04	2.25E+04	7.45E+03	3.61E+03	1.35E+03
2009	63900	22800	23200	22500	14000	4100	2050
2010	50200	52400	17300	16200	14000	7260	1860
2011	49300	38500	33500	12000	10000	7990	3650
2012	66800	40300	26900	23400	7620	5650	4090
2013	48100	54100	28200	19100	15500	4500	3160
2014	105000	39100	39300	18600	11200	8940	2450
2015	45700	86000	26900	21400	11400	6300	4620
2016	25400	37200	68200	15300	10500	6060	3730

Estimated population abundance at 1st Jan 2017

0	20800	29000	49700	9980	6320	3210

Taper weighted geometric mean of the VPA populations:

45600	37900	27200	16100	8850	4100	1780

Standard error of the weighted Log(VPA populations) :

0.3335	0.3355	0.3852	0.3532	0.4075	0.447	0.5304

1

Log catchability residuals.

Fleet : SP-LCGOTBDEF1

Age	1986
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
4	0.3
5	0.07
6	-0.26

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	0.87	-0.09	-0.41	-0.76	-0.19	-0.45	-0.03	-0.1	0.36	-0.56
4	0.28	-0.6	-0.54	-0.2	-0.58	-0.08	0.32	0.49	0.12	0.04
5	-0.24	-0.82	-0.85	-0.18	0.42	-0.01	-0.24	0.53	0.79	-0.34
6	-0.16	-0.42	-0.25	0.12	0.78	0.01	0.3	0.67	0.96	-0.1

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	-0.31	0.7	0.41	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	-0.46	0.64	0.27	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	-0.07	0.77	0.18	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	0.31	0.52	0.58	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

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	-6.7119	-5.848	-5.4161	-5.4161
S.E(Log q)	0.5015	0.4152	0.5096	0.4894

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	2.061	8.03	0.66	14	0.26	-6.71
4	0.95	0.186	6.02	0.53	14	0.41	-5.85
5	-33.55	-4.658	103.91	0	14	10.62	-5.42
6	1.15	-0.484	4.88	0.47	14	0.51	-5.2
1							

Fleet : SP-LCGOTBDEF2

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	-0.6	0.34	-0.27	0.2	0.43	0.1	0.5
4	99.99	99.99	99.99	-0.03	0.77	-0.47	-0.36	0.41	-0.31	-0.17
5	99.99	99.99	99.99	-0.2	1	-0.63	-0.22	-0.03	0.21	-0.5
6	99.99	99.99	99.99	0.17	0.23	-0.31	0.02	0.25	0.08	-0.55

Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	0.17	0.16	-0.16	0.17	-0.39	0.09	-0.42	-0.42	0.16	-0.06
4	0.16	0.24	-0.07	0.04	-0.18	0.36	0.01	-0.29	0.1	-0.2
5	0.36	-0.07	-0.1	0.29	0.15	0.3	0.05	-0.29	-0.3	-0.03
6	0.15	-0.06	-0.43	0.06	0.31	0.08	-0.23	-0.49	-0.39	-0.06

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	-5.6749	-5.0089	-4.7334	-4.7334
S.E(Log q)	0.3245	0.3191	0.3796	0.2856

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	1.07	-0.272	5.4	0.5	17	0.36	-5.67
4	1	-0.006	5	0.61	17	0.33	-5.01
5	0.91	0.494	5.06	0.67	17	0.35	-4.73
6	0.97	0.247	4.89	0.81	17	0.28	-4.8

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

Fleet : SP-GFS

Age		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	0	99.99	0.47	1.61	-1.06	0.23	0.24	-1.12	0.82	0.02	0.98
	1	99.99	0.41	-0.1	0.12	-0.28	0.53	0.11	-1.12	0.26	0.05
	2	99.99	0.13	-0.36	-0.18	-0.45	-0.88	-0.17	-0.47	-0.97	0.07
	3	99.99	-0.34	-0.87	-1.02	-0.83	-0.57	-0.72	-0.56	-0.69	-0.56
	4	99.99	-1.07	-0.62	-0.31	-0.68	-0.34	-0.61	-0.2	-0.4	-0.71
	5	99.99	-0.46	-0.59	0.24	-0.1	-0.02	-0.82	-0.23	-0.46	0.12
	6	99.99	0	-0.06	0.2	-0.36	0.02	0.06	0.04	-0.36	0.06

Age		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	0	1.29	-0.89	-0.15	-0.07	-0.7	-0.21	99.99	0	1.02	-1.04
	1	-0.02	0.01	0.28	0.39	0.48	-0.1	99.99	0.3	0.4	-0.23
	2	-0.26	-0.21	0.25	0.06	0.37	0.32	99.99	0.05	0.55	0.24
	3	0.19	-0.09	-0.11	0.18	0.6	0.44	99.99	0.12	0.63	0.3
	4	-0.1	0.05	-0.47	0.43	0.89	0.44	99.99	0.15	0.32	-0.17
	5	-0.14	0.41	-0.51	-0.22	1.12	-0.1	99.99	-0.46	0.67	-0.39
	6	-0.06	-0.02	-0.17	-0.24	-0.08	-0.04	99.99	-0.18	0.09	0.24

Age		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	0	-0.33	-0.89	0.49	-0.86	-0.56	-0.22	99.99	0.1	-0.27	1.09
	1	-0.43	-0.44	-0.24	0.59	-0.52	-0.3	99.99	-0.19	-0.1	0.14
	2	0.18	-0.41	0.07	0.56	0.61	0.39	99.99	0.21	0.13	0.16
	3	0.56	-0.32	0.26	0.33	0.85	0.96	99.99	0.31	0.62	0.32
	4	0.54	-0.22	0.52	0.15	0.57	1.02	99.99	0.45	0.48	-0.1
	5	0.31	-0.65	0.82	-0.19	-0.05	0.41	99.99	0.88	0.23	0.21
	6	0.12	-0.08	0.3	-0.37	-0.46	0.03	99.99	0.19	0	0.32

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	-10.1849	-7.5741	-7.2241	-7.262	-7.288	-7.3783	-7.3783
S.E(Log q)	0.7738	0.3857	0.405	0.5723	0.5288	0.4972	0.2066

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	0.69	1.017	10.34	0.3	27	0.53	-10.18
1	0.85	0.784	8.03	0.51	27	0.33	-7.57
2	1.03	-0.117	7.15	0.46	27	0.42	-7.22
3	1.47	-1.021	6.13	0.16	27	0.84	-7.26
4	1.64	-1.6	6.14	0.2	27	0.84	-7.29
5	0.96	0.159	7.41	0.44	27	0.49	-7.38
6	0.96	0.585	7.41	0.89	27	0.2	-7.41

Terminal year survivor and F summaries :

Age 0 Catchability constant w.r.t. time and dependent on age

Year class = 2016

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	61743	0.788	0	0	1	0.784	0
F shrinkage mean	407	1.5				0.216	0.004

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
20831	0.7	2.34	2	3.349	0

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

Age 1 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	30771	0.352	0.163	0.46	2	0.945	0.046
F shrinkage mean	10580	1.5				0.055	0.129

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
29029	0.34	0.21	3	0.611	0.049

Age 2 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	51331	0.268	0.088	0.33	3	0.965	0.112
F shrinkage mean	20635	1.5				0.035	0.259

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
49715	0.26	0.12	4	0.461	0.116

Age 3 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	9422	0.334	0	0	1	0.441	0.241
SP-GFS	10674	0.261	0.146	0.56	3	0.532	0.216
F shrinkage mean	6772	1.5				0.027	0.322

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
9977	0.21	0.09	5	0.425	0.229

Age 4 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	5920	0.241	0.173	0.72	2	0.627	0.323
SP-GFS	7242	0.293	0.169	0.58	4	0.347	0.271
F shrinkage mean	4966	1.5				0.026	0.375

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6321	0.19	0.1	7	0.534	0.305

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

Age 5 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	2953	0.209	0.145	0.69	3	0.607	0.466
SP-GFS	3670	0.257	0.155	0.6	5	0.368	0.39
F shrinkage mean	3440	1.5				0.025	0.412

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3211	0.16	0.09	9	0.583	0.435

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

Year class = 2010

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	1646	0.179	0.081	0.45	4	0.539	0.491
SP-GFS	2523	0.199	0.13	0.65	6	0.446	0.346
F shrinkage mean	2713	1.5				0.015	0.325

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2007	0.13	0.1	11	0.728	0.419

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6
2007	38000	42400	34300	12800	7400	3760	2040
2008	2.81E+04	3.10E+04	3.18E+04	2.25E+04	7.45E+03	3.61E+03	1.35E+03
2009	63900	22800	23200	22500	14000	4100	2050
2010	50200	52400	17300	16200	14000	7260	1860
2011	49300	38500	33500	12000	10000	7990	3650
2012	66800	40300	26900	23400	7620	5650	4090
2013	48100	54100	28200	19100	15500	4500	3160
2014	105000	39100	39300	18600	11200	8940	2450
2015	45700	86000	26900	21400	11400	6300	4620
2016	25400	37200	68200	15300	10500	6060	3730

Estimated population abundance at 1st Jan 2017

0	20800	29000	49700	9980	6320	3210

Taper weighted geometric mean of the VPA populations:

45600	37900	27200	16100	8850	4100	1780

Standard error of the weighted Log(VPA populations) :

0.3335	0.3355	0.3852	0.3532	0.4075	0.447	0.5304

1

Log catchability residuals.

Fleet : SP-LCGOTBDEF1

Age	1986
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
4	0.3
5	0.07
6	-0.26

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	0.87	-0.09	-0.41	-0.76	-0.19	-0.45	-0.03	-0.1	0.36	-0.56
4	0.28	-0.6	-0.54	-0.2	-0.58	-0.08	0.32	0.49	0.12	0.04
5	-0.24	-0.82	-0.85	-0.18	0.42	-0.01	-0.24	0.53	0.79	-0.34
6	-0.16	-0.42	-0.25	0.12	0.78	0.01	0.3	0.67	0.96	-0.1

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	-0.31	0.7	0.41	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	-0.46	0.64	0.27	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	-0.07	0.77	0.18	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	0.31	0.52	0.58	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

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	-6.7119	-5.848	-5.4161	-5.4161
S.E(Log q)	0.5015	0.4152	0.5096	0.4894

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	2.061	8.03	0.66	14	0.26	-6.71
4	0.95	0.186	6.02	0.53	14	0.41	-5.85
5	-33.55	-4.658	103.91	0	14	10.62	-5.42
6	1.15	-0.484	4.88	0.47	14	0.51	-5.2
1							

Fleet : SP-LCGOTBDEF2

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
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	-0.6	0.34	-0.27	0.2	0.43	0.1	0.5
4	99.99	99.99	99.99	-0.03	0.77	-0.47	-0.36	0.41	-0.31	-0.17
5	99.99	99.99	99.99	-0.2	1	-0.63	-0.22	-0.03	0.21	-0.5
6	99.99	99.99	99.99	0.17	0.23	-0.31	0.02	0.25	0.08	-0.55

Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	0.17	0.16	-0.16	0.17	-0.39	0.09	-0.42	-0.42	0.16	-0.06
4	0.16	0.24	-0.07	0.04	-0.18	0.36	0.01	-0.29	0.1	-0.2
5	0.36	-0.07	-0.1	0.29	0.15	0.3	0.05	-0.29	-0.3	-0.03
6	0.15	-0.06	-0.43	0.06	0.31	0.08	-0.23	-0.49	-0.39	-0.06

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	-5.6749	-5.0089	-4.7334	-4.7334
S.E(Log q)	0.3245	0.3191	0.3796	0.2856

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	1.07	-0.272	5.4	0.5	17	0.36	-5.67
4	1	-0.006	5	0.61	17	0.33	-5.01
5	0.91	0.494	5.06	0.67	17	0.35	-4.73
6	0.97	0.247	4.89	0.81	17	0.28	-4.8

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

Fleet : SP-GFS

Age		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	0	99.99	0.47	1.61	-1.06	0.23	0.24	-1.12	0.82	0.02	0.98
	1	99.99	0.41	-0.1	0.12	-0.28	0.53	0.11	-1.12	0.26	0.05
	2	99.99	0.13	-0.36	-0.18	-0.45	-0.88	-0.17	-0.47	-0.97	0.07
	3	99.99	-0.34	-0.87	-1.02	-0.83	-0.57	-0.72	-0.56	-0.69	-0.56
	4	99.99	-1.07	-0.62	-0.31	-0.68	-0.34	-0.61	-0.2	-0.4	-0.71
	5	99.99	-0.46	-0.59	0.24	-0.1	-0.02	-0.82	-0.23	-0.46	0.12
	6	99.99	0	-0.06	0.2	-0.36	0.02	0.06	0.04	-0.36	0.06

Age		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	0	1.29	-0.89	-0.15	-0.07	-0.7	-0.21	99.99	0	1.02	-1.04
	1	-0.02	0.01	0.28	0.39	0.48	-0.1	99.99	0.3	0.4	-0.23
	2	-0.26	-0.21	0.25	0.06	0.37	0.32	99.99	0.05	0.55	0.24
	3	0.19	-0.09	-0.11	0.18	0.6	0.44	99.99	0.12	0.63	0.3
	4	-0.1	0.05	-0.47	0.43	0.89	0.44	99.99	0.15	0.32	-0.17
	5	-0.14	0.41	-0.51	-0.22	1.12	-0.1	99.99	-0.46	0.67	-0.39
	6	-0.06	-0.02	-0.17	-0.24	-0.08	-0.04	99.99	-0.18	0.09	0.24

Age		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	0	-0.33	-0.89	0.49	-0.86	-0.56	-0.22	99.99	0.1	-0.27	1.09
	1	-0.43	-0.44	-0.24	0.59	-0.52	-0.3	99.99	-0.19	-0.1	0.14
	2	0.18	-0.41	0.07	0.56	0.61	0.39	99.99	0.21	0.13	0.16
	3	0.56	-0.32	0.26	0.33	0.85	0.96	99.99	0.31	0.62	0.32
	4	0.54	-0.22	0.52	0.15	0.57	1.02	99.99	0.45	0.48	-0.1
	5	0.31	-0.65	0.82	-0.19	-0.05	0.41	99.99	0.88	0.23	0.21
	6	0.12	-0.08	0.3	-0.37	-0.46	0.03	99.99	0.19	0	0.32

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	-10.1849	-7.5741	-7.2241	-7.262	-7.288	-7.3783	-7.3783
S.E(Log q)	0.7738	0.3857	0.405	0.5723	0.5288	0.4972	0.2066

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	0.69	1.017	10.34	0.3	27	0.53	-10.18
1	0.85	0.784	8.03	0.51	27	0.33	-7.57
2	1.03	-0.117	7.15	0.46	27	0.42	-7.22
3	1.47	-1.021	6.13	0.16	27	0.84	-7.26
4	1.64	-1.6	6.14	0.2	27	0.84	-7.29
5	0.96	0.159	7.41	0.44	27	0.49	-7.38
6	0.96	0.585	7.41	0.89	27	0.2	-7.41

Terminal year survivor and F summaries :

Age 0 Catchability constant w.r.t. time and dependent on age

Year class = 2016

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	61743	0.788	0	0	1	0.784	0
F shrinkage mean	407	1.5				0.216	0.004

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
20831	0.7	2.34	2	3.349	0

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

Age 1 Catchability constant w.r.t. time and dependent on age

Year class = 2015

Fleet	ES	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	30771	0.352	0.163	0.46	2	0.945	0.046
F shrinkage mean	10580	1.5				0.055	0.129

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
29029	0.34	0.21	3	0.611	0.049

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

Year class = 2014

Fleet	ES	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	51331	0.268	0.088	0.33	3	0.965	0.112
F shrinkage mean	20635	1.5				0.035	0.259

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
49715	0.26	0.12	4	0.461	0.116

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

Year class = 2013

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	9422	0.334	0	0	1	0.441	0.241
SP-GFS	10674	0.261	0.146	0.56	3	0.532	0.216
F shrinkage mean	6772	1.5				0.027	0.322

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
9977	0.21	0.09	5	0.425	0.229

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

Year class = 2012

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF1	1	0	0	0	0	0	0
SP-LCGOTBDEF2	5920	0.241	0.173	0.72	2	0.627	0.323
SP-GFS	7242	0.293	0.169	0.58	4	0.347	0.271
F shrinkage mean	4966	1.5				0.026	0.375

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6321	0.19	0.1	7	0.534	0.305

Table 6.2.9. Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Tuning diagnostic (continued)

Age 5 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	2953	0.209	0.145	0.69	3	0.607	0.466
SP-GFS	3670	0.257	0.155	0.6	5	0.368	0.39
F shrinkage mean	3440	1.5				0.025	0.412

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3211	0.16	0.09	9	0.583	0.435

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

Year class = 2010

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	1646	0.179	0.081	0.45	4	0.539	0.491
SP-GFS	2523	0.199	0.13	0.65	6	0.446	0.346
F shrinkage mean	2713	1.5				0.015	0.325

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2007	0.13	0.1	11	0.728	0.419

Table 6.2.10. Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Estimates of fishing mortality at age.

Run title : Four spot megrim (L. boscii) Divisions 27.7.8c and 27.7.9a

At 28/04/2017 14:18

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1986
AGE	
0	0.02
1	0.0639
2	0.2425
3	0.3781
4	0.7205
5	0.6267
6	1.0246
+gp	1.0246
FBAR 2- 4	0.447

Table 8 Fishing mortality (F) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
0	0.0276	0.0252	0.0269	0.0359	0.0227	0.0245	0.0494	0.0157	0.0242	0.0338
1	0.1135	0.1375	0.1033	0.1315	0.1687	0.095	0.0951	0.1457	0.1453	0.0901
2	0.4679	0.4738	0.5545	0.3733	0.3399	0.4309	0.2163	0.2511	0.5846	0.3013
3	0.3756	0.4327	0.4951	0.3908	0.3887	0.4841	0.52	0.3858	0.5328	0.7276
4	0.5097	0.5303	0.8255	0.6094	0.4443	0.9312	0.7751	0.8007	0.6803	0.6067
5	0.524	0.6459	0.8367	0.864	1.0065	0.9755	0.5179	0.879	0.9288	0.4813
6	0.7162	1.174	1.6622	0.9881	1.3116	0.8811	0.8587	0.9041	0.8557	0.4531
+gp	0.7162	1.174	1.6622	0.9881	1.3116	0.8811	0.8587	0.9041	0.8557	0.4531
FBAR 2- 4	0.451	0.4789	0.625	0.4579	0.391	0.6154	0.5038	0.4792	0.5992	0.5452

Table 8 Fishing mortality (F) at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
0	0.0094	0.0687	0.0933	0.0109	0.0062	0.0058	0.0052	0.001	0.0002	0
1	0.1139	0.1637	0.3132	0.2905	0.25	0.2407	0.1801	0.1988	0.1427	0.0329
2	0.258	0.2827	0.2895	0.2351	0.2132	0.2822	0.2419	0.3243	0.3811	0.3138
3	0.402	0.3792	0.4032	0.4653	0.5037	0.416	0.3916	0.405	0.3607	0.5469
4	0.4071	0.5628	0.5736	0.7506	0.8862	0.5598	0.3341	0.6021	0.3958	0.4917
5	0.5031	0.79	0.4554	0.4822	1.0829	0.3223	0.4722	0.4568	0.8048	0.4136
6	0.5201	0.5034	0.5729	0.5102	0.4347	0.3504	0.6112	0.5285	0.6754	0.3427
+gp	0.5201	0.5034	0.5729	0.5102	0.4347	0.3504	0.6112	0.5285	0.6754	0.3427
FBAR 2- 4	0.3557	0.4082	0.4221	0.4836	0.5344	0.4193	0.3225	0.4438	0.3792	0.4508

Table 8 Fishing mortality (F) at age

YEAR	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	FBAR 14-16
AGE											
0	0.0029	0.008	0	0.0655	0.0007	0.0113	0.0063	0	0.0038	0.0001	0.0013
1	0.0887	0.0878	0.0778	0.2472	0.1596	0.1583	0.1192	0.1738	0.0318	0.049	0.0849
2	0.221	0.1471	0.1615	0.1637	0.1569	0.1439	0.2143	0.4098	0.3629	0.1157	0.2961
3	0.3449	0.2742	0.275	0.2791	0.2556	0.215	0.3278	0.2905	0.512	0.2295	0.344
4	0.5176	0.3961	0.4564	0.3594	0.3743	0.3274	0.3479	0.3797	0.4322	0.3054	0.3725
5	0.8235	0.3668	0.5936	0.4862	0.4703	0.3814	0.4076	0.4598	0.3248	0.4354	0.4067
6	0.6212	0.3419	0.4237	0.3502	0.4338	0.3121	0.3512	0.4135	0.3067	0.4187	0.3796
+gp	0.6212	0.3419	0.4237	0.3502	0.4338	0.3121	0.3512	0.4135	0.3067	0.4187	
FBAR 2- 4	0.3612	0.2725	0.2976	0.2674	0.2622	0.2288	0.2967	0.36	0.4357	0.2169	

Table 6.2.11 Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Estimates of stock numbers at age.

Run title : Four spot megrim (L. boscii) Divisions 27.7.8c and 27.7.9a

At 28/04/2017 14:18

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1986
AGE	
0	71964
1	61240
2	40019
3	20713
4	9782
5	2910
6	1498
+gp	394
TOTAL	208519

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

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE										
0	52364	57204	53641	40389	63476	58975	29547	48082	59685	42893
1	57753	41706	45668	42751	31901	50804	47118	23025	38753	47700
2	47033	42212	29760	33721	30689	22063	37823	35077	16296	27436
3	25709	24119	21518	13994	19007	17887	11740	24944	22341	7436
4	11619	14458	12810	10738	7751	10550	9024	5715	13885	10736
5	3897	5714	6966	4594	4780	4070	3404	3404	2101	5757
6	1273	1889	2452	2470	1585	1430	1256	1660	1157	679
+gp	309	732	841	1396	714	132	532	835	537	1668
TOTAL	199957	188034	173657	150053	159904	165910	140445	142742	154754	144306

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

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AGE										
0	30374	21466	36397	36030	37232	39921	51068	36974	52825	51823
1	33951	24636	16409	27146	29179	30295	32496	41595	30242	43241
2	35688	24804	17124	9822	16621	18605	19498	22221	27916	21468
3	16619	22575	15307	10495	6357	10995	11487	12533	13155	15613
4	2941	9103	12649	8374	5396	3145	5938	6358	6844	7509
5	4792	1603	4245	5836	3237	1821	1471	3481	2851	3772
6	2913	2372	596	2204	2950	897	1080	751	1805	1044
+gp	1195	977	1225	2300	1112	1336	339	898	887	862
TOTAL	128473	107535	103952	102207	102084	107015	123378	124811	136524	145332

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

YEAR	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	GM 90-14
AGE												
0	37965	28118	63948	50220	49296	66793	48077	104986	45653	25445	0	44930
1	42428	30992	22838	52354	38511	40333	54068	39113	85956	37235	20831	
2	34256	31790	23242	17300	33474	26880	28188	39292	26915	68169	29029	
3	12842	22484	22467	16191	12025	23428	19058	18628	21353	15329	49715	
4	7398	7447	13994	13973	10028	7625	15470	11242	11406	10477	9977	
5	3760	3610	4103	7259	7986	5647	4500	8945	6296	6061	6321	
6	2042	1351	2048	1855	3655	4085	3157	2451	4624	3725	3211	
+gp	1088	1129	704	1626	1242	1728	1374	1818	1920	1791	2971	
TOTAL	141780	126922	153344	160777	156217	176519	173893	226475	204123	168233	122056	

Table 6.2.12. Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Summary of landings and XSA results.

Run title : Four spot megrim (L. boscii) Divisions 27.7.8c and 27.7.9a

At 28/04/2017 14:18

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	71964	5181	4302	1408	0.3273	0.447
1987	52364	7314	6041	2021	0.3345	0.451
1988	57204	7842	6753	2586	0.383	0.4789
1989	53641	7812	6748	3037	0.45	0.625
1990	40389	6765	5989	2354	0.3931	0.4579
1991	63476	6644	5774	2129	0.3687	0.391
1992	58975	6395	5455	2353	0.4313	0.6154
1993	29547	6046	5340	1822	0.3412	0.5038
1994	48082	6433	5612	1920	0.3421	0.4792
1995	59685	5948	5013	2058	0.4106	0.5992
1996	42893	5250	4439	1466	0.3303	0.5452
1997	30374	4465	3915	1204	0.3075	0.3557
1998	21466	5080	4586	1501	0.3273	0.4082
1999	36397	4595	4091	1442	0.3525	0.4221
2000	36030	4454	3850	1414	0.3673	0.4836
2001	37232	3847	3247	1221	0.376	0.5344
2002	39921	4174	3426	1028	0.3001	0.4193
2003	51068	4759	3767	1067	0.2832	0.3225
2004	36974	5023	4094	1354	0.3308	0.4438
2005	52825	4940	4101	1358	0.3311	0.3792
2006	51823	5693	4704	1427	0.3034	0.4508
2007	37965	5511	4647	1396	0.3004	0.3612
2008	28118	6045	5369	1182	0.2201	0.2725
2009	63948	6022	5302	1413	0.2665	0.2976
2010	50220	6469	5794	1562	0.2696	0.2674
2011	49296	6089	5373	1397	0.26	0.2622
2012	66793	7622	6164	1321	0.2143	0.2288
2013	48077	6492	5657	1427	0.2522	0.2967
2014	104986	7333	6408	1942	0.3031	0.36
2015	45653	8308	6733	1745	0.2592	0.4357
2016	25445	8364	7385	1419	0.1922	0.2169
Arith. Mean	48156	6029	5164	1644	0.3203	0.4133
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 6.2.13. Four-spot megrim (*L. boscii*) in Divisions 8c and 9a.

Prediction with management option table: Input data

MFDP version 1a
Run: ldb
Time and date: 19:45 30/04/2017
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2017 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight LWt	Exploit pattern	Weight DWt
0	44930	0.2	0	0	0	0.005	0.0000	0.002	0.0054	0.005
1	36782	0.2	0.55	0	0	0.024	0.0002	0.036	0.1264	0.024
2	29029	0.2	0.86	0	0	0.046	0.1378	0.069	0.1225	0.043
3	49715	0.2	0.97	0	0	0.072	0.1745	0.086	0.1688	0.056
4	9977	0.2	0.99	0	0	0.102	0.3581	0.107	0.0508	0.079
5	6321	0.2	1	0	0	0.131	0.4633	0.133	0.0140	0.104
6	3211	0.2	1	0	0	0.161	0.4218	0.161	0.0055	0.125
7	2971	0.2	1	0	0	0.216	0.4267	0.216	0.0007	0.136

2018 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight LWt	Exploit pattern	Weight DWt
0	44930	0.2	0	0	0	0.005	0.0000	0.002	0.0054	0.005
1 .		0.2	0.55	0	0	0.024	0.0002	0.036	0.1264	0.024
2 .		0.2	0.86	0	0	0.046	0.1378	0.069	0.1225	0.043
3 .		0.2	0.97	0	0	0.072	0.1745	0.086	0.1688	0.056
4 .		0.2	0.99	0	0	0.102	0.3581	0.107	0.0508	0.079
5 .		0.2	1	0	0	0.131	0.4633	0.133	0.0140	0.104
6 .		0.2	1	0	0	0.161	0.4218	0.161	0.0055	0.125
7 .		0.2	1	0	0	0.216	0.4267	0.216	0.0007	0.136

2019 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight LWt	Exploit pattern	Weight DWt
0	44930	0.2	0	0	0	0.005	0.0000	0.002	0.0054	0.005
1 .		0.2	0.55	0	0	0.024	0.0002	0.036	0.1264	0.024
2 .		0.2	0.86	0	0	0.046	0.1378	0.069	0.1225	0.043
3 .		0.2	0.97	0	0	0.072	0.1745	0.086	0.1688	0.056
4 .		0.2	0.99	0	0	0.102	0.3581	0.107	0.0508	0.079
5 .		0.2	1	0	0	0.131	0.4633	0.133	0.0140	0.104
6 .		0.2	1	0	0	0.161	0.4218	0.161	0.0055	0.125
7 .		0.2	1	0	0	0.216	0.4267	0.216	0.0007	0.136

Input units are thousands and kg - output in tonnes

Table 6.2.14. Megrim (*L. boscii*) in Div. 8c and 9a catch forecast: management option table.

MFDP version 1a
Run: ldb
Time and date: 19:45 30/04/2017
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2017

		Catch	Landings		Discards	
Biomass	**SSB**	**FMult**	**FBar**	**Yield**	**FBar**	**Yield**
9076	8125	1	0.2235	1729	0.114	620

2018							2019	
		Catch	**Landings**		**Discards**			
Biomass	**SSB**	**FMult**	**FBar**	**Yield**	**FBar**	**Yield**	**Biomass**	**SSB**
8569	7685	0	0.0000	0	0.0000	0	10588	9687
.	7685	0.1	0.0223	221	0.0114	49	10273	9376
.	7685	0.2	0.0447	433	0.0228	97	9968	9076
.	7685	0.3	0.0670	638	0.0342	144	9675	8787
.	7685	0.4	0.0894	835	0.0456	189	9393	8509
.	7685	0.5	0.1117	1024	0.0570	233	9121	8241
.	7685	0.6	0.1341	1206	0.0684	276	8859	7982
.	7685	0.7	0.1564	1382	0.0798	318	8606	7734
.	7685	0.8	0.1788	1550	0.0912	358	8362	7494
.	7685	0.9	0.2011	1713	0.1026	398	8127	7263
.	7685	1	0.2235	1869	0.1140	436	7901	7040
.	7685	1.1	0.2458	2020	0.1254	474	7683	6826
.	7685	1.2	0.2682	2165	0.1368	510	7472	6619
.	7685	1.3	0.2905	2304	0.1482	545	7269	6419
.	7685	1.4	0.3129	2439	0.1596	580	7074	6227
.	7685	1.5	0.3352	2568	0.1711	613	6885	6042
.	7685	1.6	0.3575	2693	0.1825	646	6703	5863
.	7685	1.7	0.3799	2813	0.1939	678	6527	5691
.	7685	1.8	0.4022	2928	0.2053	709	6358	5525
.	7685	1.9	0.4246	3040	0.2167	739	6195	5364
.	7685	2	0.4469	3147	0.2281	768	6037	5210

Input units are thousands and kg - output in tonnes

Table 6.2.15. Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Single option prediction. Detail Tables.

MFDP version 1a
Run: ldb
Time and date: 19:45 30/04/2017
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2017 F multiplier: 1 Fleet1 HCFbar: 0.2235 Fleet1 DFbar: 0.114

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0054	219	1	44930	243	0	0	0	0
1	0.0002	6	0	0.1264	3966	97	36782	897	20230	494	20230	494
2	0.1378	3206	220	0.1225	2850	121	29029	1330	24965	1143	24965	1143
3	0.1745	6693	577	0.1688	6475	363	49715	3599	48224	3491	48224	3491
4	0.3581	2676	285	0.0508	380	30	9977	1020	9877	1009	9877	1009
5	0.4633	2127	282	0.014	64	7	6321	831	6321	831	6321	831
6	0.4218	1006	162	0.0055	13	2	3211	516	3211	516	3211	516
7	0.4267	942	203	0.0007	2	0	2971	641	2971	641	2971	641
Total		16656	1729		13969	620	182936	9076	115799	8125	115799	8125

Year: 2018 F multiplier: 1 Fleet1 HCFbar: 0.2235 Fleet1 DFbar: 0.114

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0054	219	1	44930	243	0	0	0	0
1	0.0002	6	0	0.1264	3945	96	36587	893	20123	491	20123	491
2	0.1378	2930	201	0.1225	2605	111	26534	1215	22819	1045	22819	1045
3	0.1745	2466	213	0.1688	2386	134	18320	1326	17770	1287	17770	1287
4	0.3581	7745	826	0.0508	1099	87	28876	2951	28587	2922	28587	2922
5	0.4633	1826	242	0.014	55	6	5427	713	5427	713	5427	713
6	0.4218	1006	162	0.0055	13	2	3211	516	3211	516	3211	516
7	0.4267	1046	226	0.0007	2	0	3301	712	3301	712	3301	712
Total		17027	1869		10324	436	167186	8569	101239	7685	101239	7685

Year: 2019 F multiplier: 1 Fleet1 HCFbar: 0.2235 Fleet1 DFbar: 0.114

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0054	219	1	44930	243	0	0	0	0
1	0.0002	6	0	0.1264	3945	96	36587	893	20123	491	20123	491
2	0.1378	2915	200	0.1225	2591	110	26393	1209	22698	1040	22698	1040
3	0.1745	2254	194	0.1688	2181	122	16745	1212	16243	1176	16243	1176
4	0.3581	2854	304	0.0508	405	32	10641	1087	10534	1077	10534	1077
5	0.4633	5286	701	0.014	160	17	15707	2064	15707	2064	15707	2064
6	0.4218	864	139	0.0055	11	1	2757	443	2757	443	2757	443
7	0.4267	1102	238	0.0007	2	0	3478	750	3478	750	3478	750
Total		15282	1776		9514	380	157238	7901	91540	7040	91540	7040

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 years classes

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	2014	2015	2016	2017	2018
Stock No. (thousands) of 0 year-olds	104986	45653	44930	44930	44930
Source	XSA	XSA	GM90-14	GM90-14	GM90-14
Status Quo F:					
% in 2017 catch	40.0	14.5	4.1	0.0	-
% in 2018	39.6	15.0	13.5	4.2	0.0
% in 2017 SSB	43.0	14.1	6.1	0.0	-
% in 2018 SSB	38.0	16.7	13.6	6.4	0.0
% in 2019 SSB	29.3	15.3	16.7	14.8	7.0

GM : geometric mean recruitment

Four-spot megrim (*L. boscii*) in Divisions 8c and 9a : Year-class % contribution to

a) 2018 catches **b) 2019 SSB**

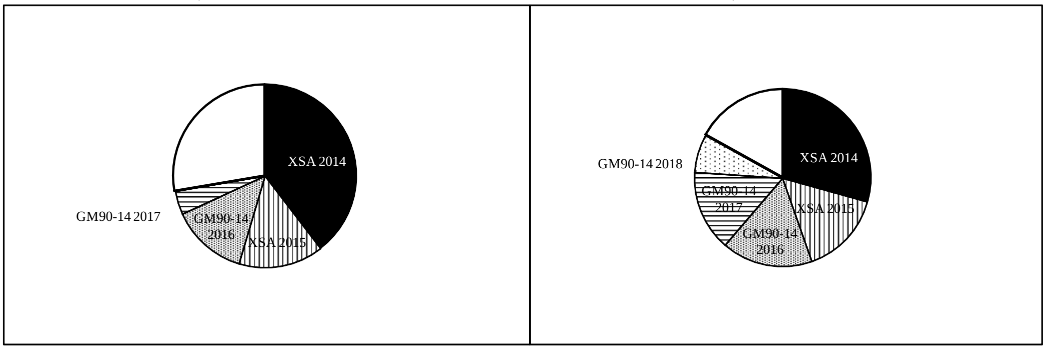


Table 6.2.17. Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Yield per recruit results.

MFYPR version 2a
Run: ldb
Time and date: 15:33 28/04/2017
Yield per results

Catch	Landings			Discards								
FMult	Fbar	CatchNos	Yield	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	0.5318	4.0334	0.5115	4.0334	0.5115
0.1	0.0223	0.088	0.0136	0.0114	0.0274	0.0012	4.9414	0.4218	3.4605	0.4016	3.4605	0.4016
0.2	0.0447	0.1441	0.0212	0.0228	0.053	0.0023	4.5354	0.3472	3.0569	0.3271	3.0569	0.3271
0.3	0.067	0.1811	0.0255	0.0342	0.0769	0.0033	4.2327	0.2938	2.7564	0.2739	2.7564	0.2739
0.4	0.0894	0.2062	0.0278	0.0456	0.0993	0.0042	3.9975	0.2541	2.5234	0.2343	2.5234	0.2343
0.5	0.1117	0.2233	0.029	0.057	0.1203	0.005	3.8089	0.2236	2.3369	0.204	2.3369	0.204
0.6	0.1341	0.2349	0.0294	0.0684	0.1401	0.0057	3.6538	0.1997	2.184	0.1801	2.184	0.1801
0.7	0.1564	0.2427	0.0293	0.0798	0.1587	0.0064	3.5237	0.1804	2.0559	0.161	2.0559	0.161
0.8	0.1788	0.2478	0.029	0.0912	0.1762	0.007	3.4127	0.1647	1.9469	0.1453	1.9469	0.1453
0.9	0.2011	0.2508	0.03	0.1026	0.1927	0.0076	3.32	0.1516	1.8529	0.1324	1.8529	0.1324
1	0.2235	0.2523	0.0278	0.114	0.2083	0.0081	3.2326	0.1407	1.7706	0.1215	1.7706	0.1215
1.1	0.2458	0.2528	0.0271	0.1254	0.2231	0.0086	3.1582	0.1314	1.6981	0.1123	1.6981	0.1123
1.2	0.2682	0.2523	0.0264	0.1368	0.2371	0.0091	3.0917	0.1233	1.6334	0.1044	1.6334	0.1044
1.3	0.2905	0.2513	0.0257	0.1482	0.2504	0.0095	3.0319	0.1164	1.5754	0.0976	1.5754	0.0976
1.4	0.3129	0.2498	0.025	0.1596	0.263	0.0099	2.9778	0.1103	1.523	0.0916	1.523	0.0916
1.5	0.3352	0.2479	0.0243	0.1711	0.2751	0.0102	2.9284	0.105	1.4753	0.0863	1.4753	0.0863
1.6	0.3575	0.2457	0.0237	0.1825	0.2866	0.0105	2.8831	0.1002	1.4317	0.0816	1.4317	0.0816
1.7	0.3799	0.2434	0.023	0.1939	0.2975	0.0108	2.8414	0.096	1.3916	0.0775	1.3916	0.0775
1.8	0.4022	0.2409	0.0224	0.2053	0.308	0.0111	2.8029	0.0921	1.3547	0.0737	1.3547	0.0737
1.9	0.4246	0.2383	0.0219	0.2167	0.318	0.0114	2.767	0.0887	1.3204	0.0704	1.3204	0.0704
2.0	0.4469	0.2356	0.0213	0.2281	0.3276	0.0116	2.7337	0.0856	1.2886	0.0673	1.2886	0.0673

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1	0.2235
FMax	0.6308	0.141
F0.1	0.3848	0.086
F35%SPR	0.6051	0.1352

Weights in kilograms

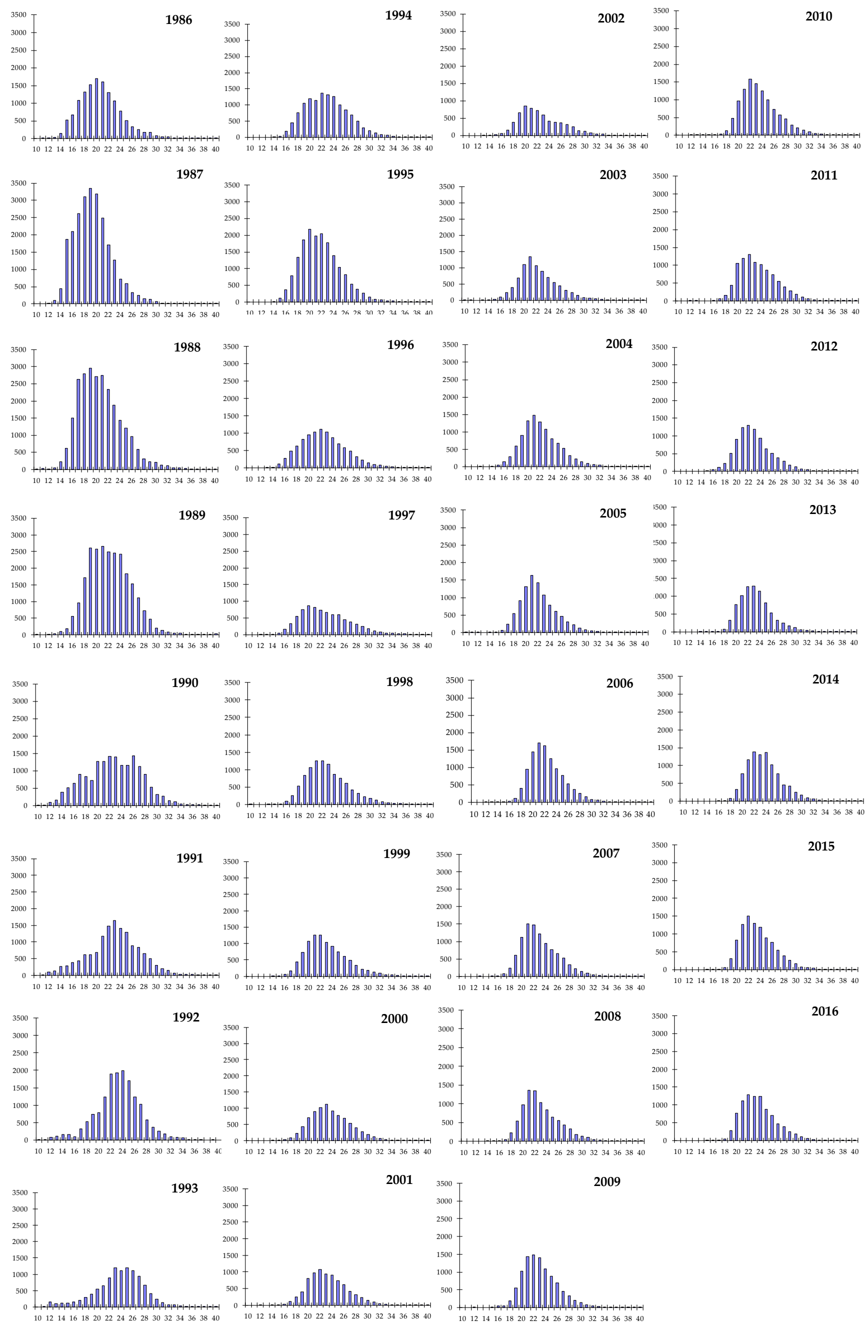


Figure 6.2.1. Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Annual length compositions of landings ('000).

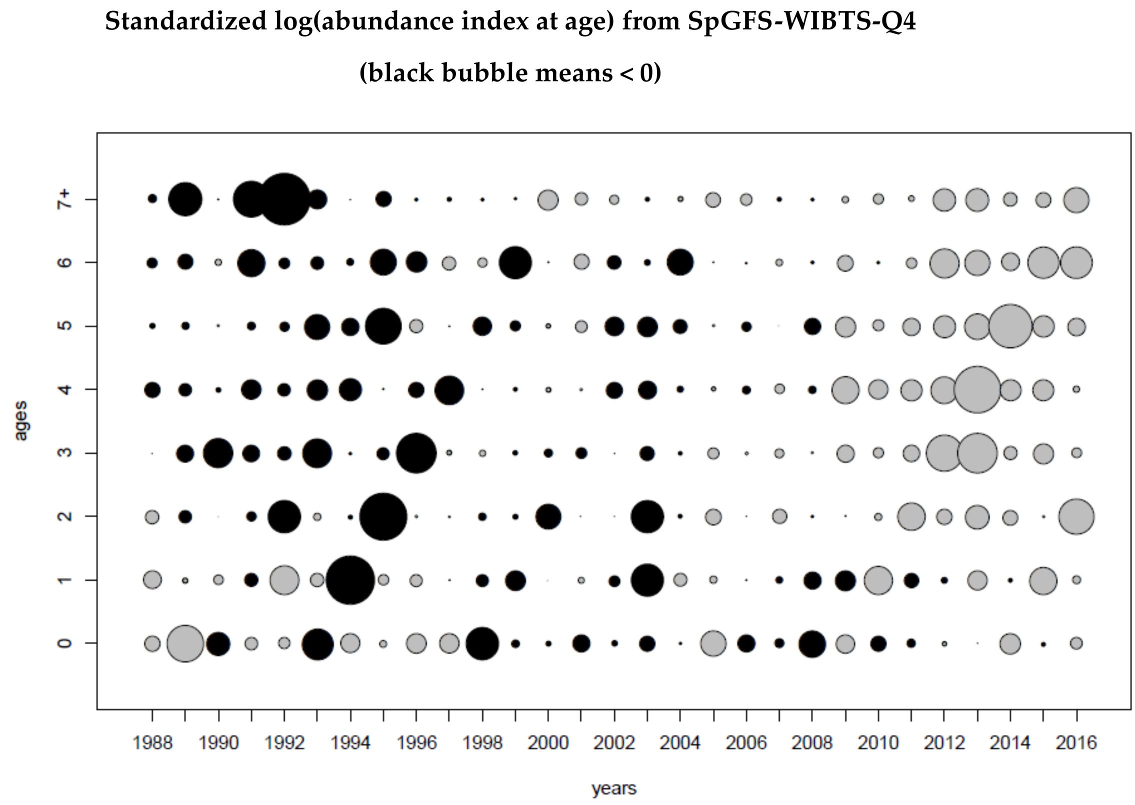


Figure 6.2.2: Four-spot megrim (*L. boscii*) in Divisions 8c&9a

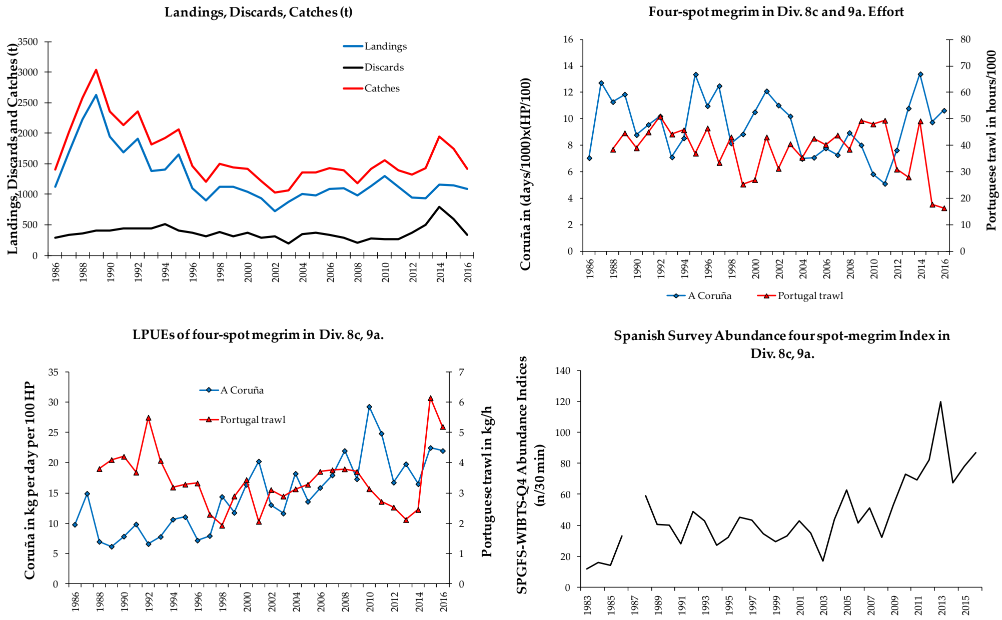
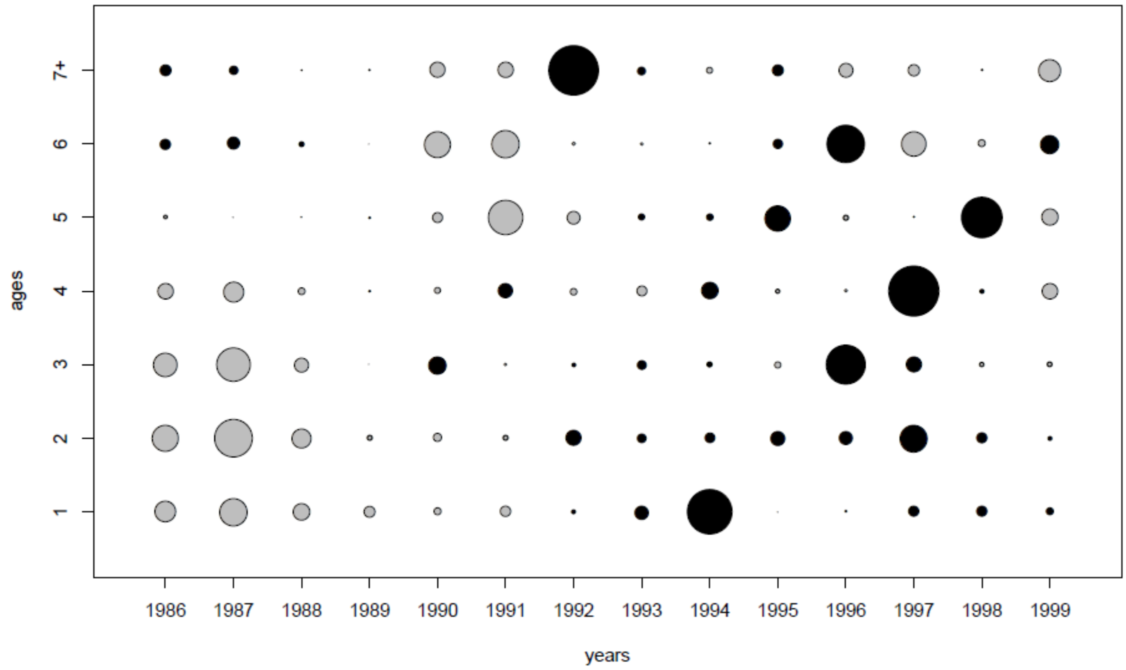


Figure 6.2.3(a). Four-spot megrim (*L.boscii*) in Divisions 8c and 9a. Landings (t), Efforts, lpues and Abundance Indices.

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)

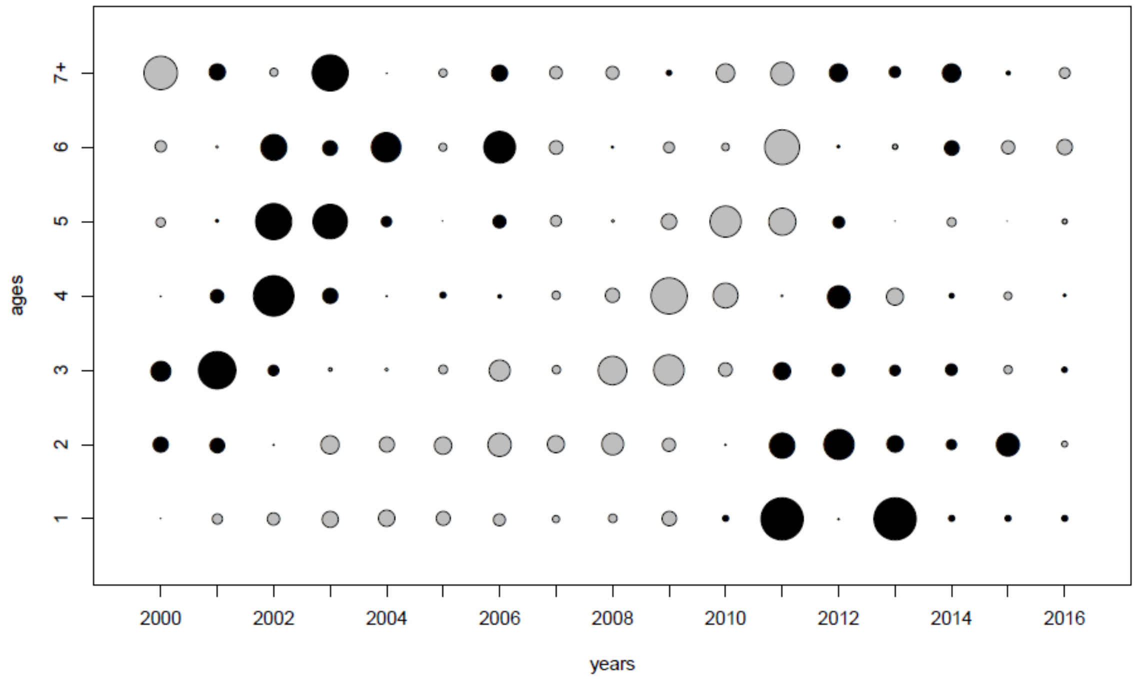
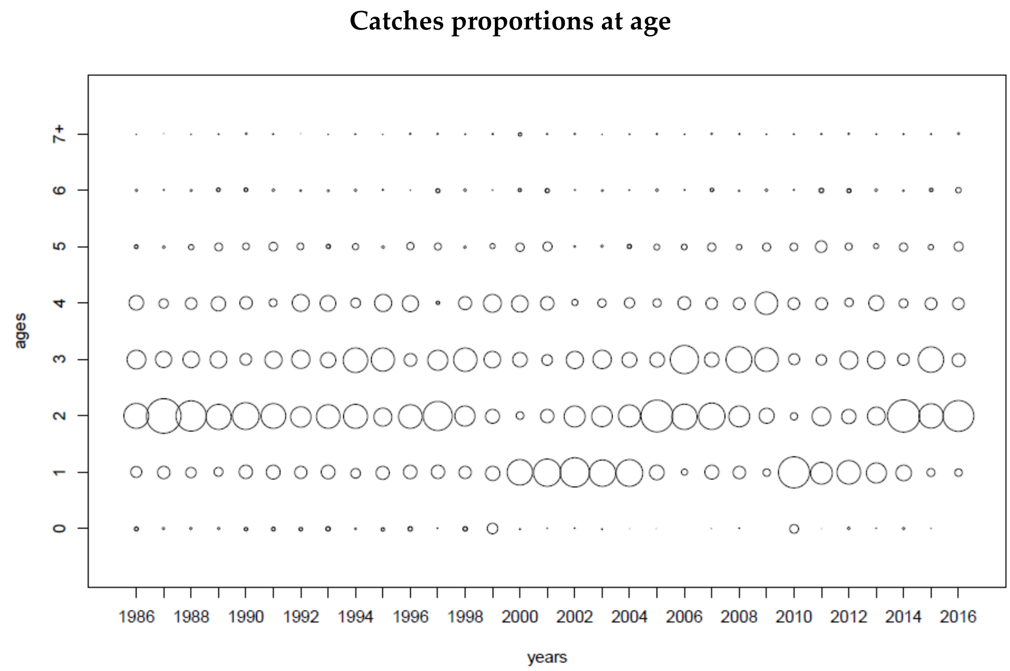


Figure 6.2.3(b). Four-spot megrim (*L. boscii*) in Divisions 8c&9a



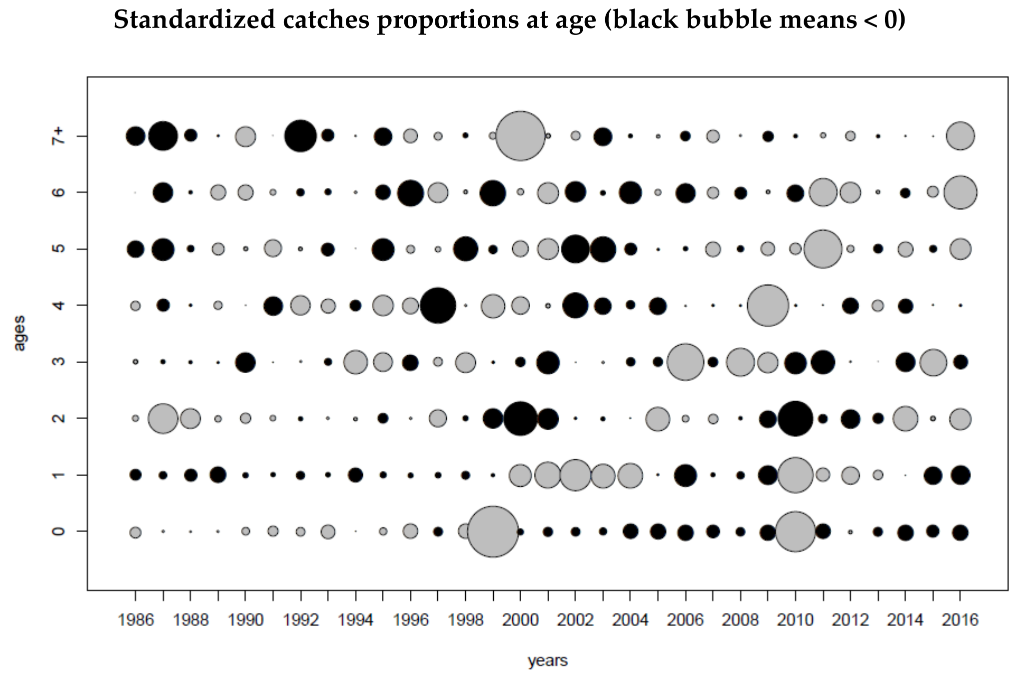
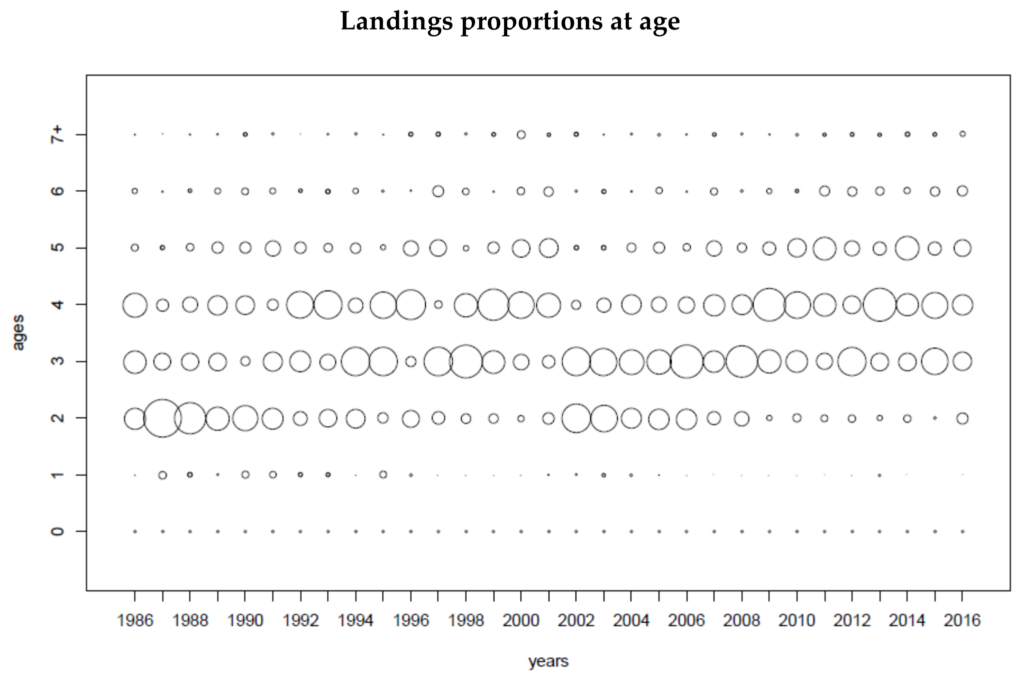


Figure 6.2.4(a). Four-spot megrim (L. boscii) in Divisions 8c & 9a.



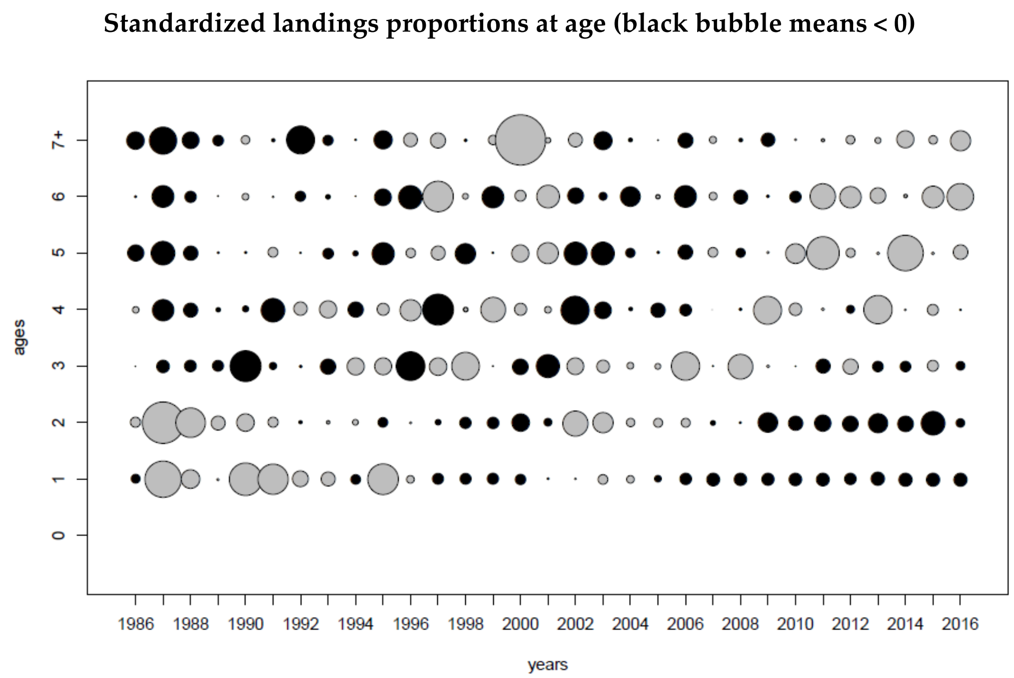
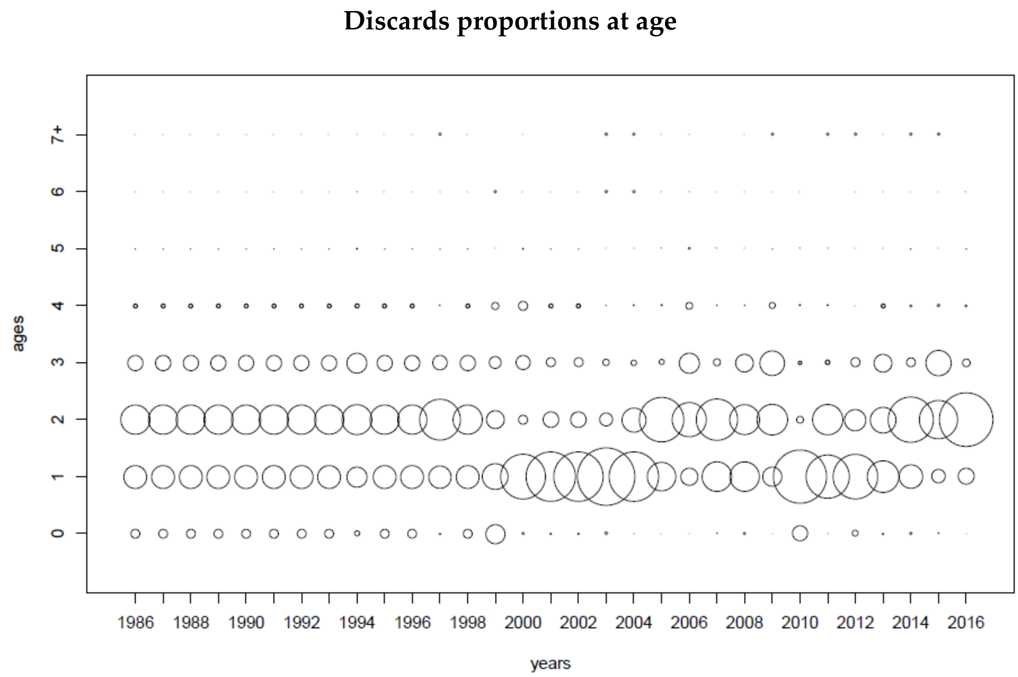


Figure 6.2.4(b). Four-spot megrim (*L. boscii*) in Divisions 8c & 9a.



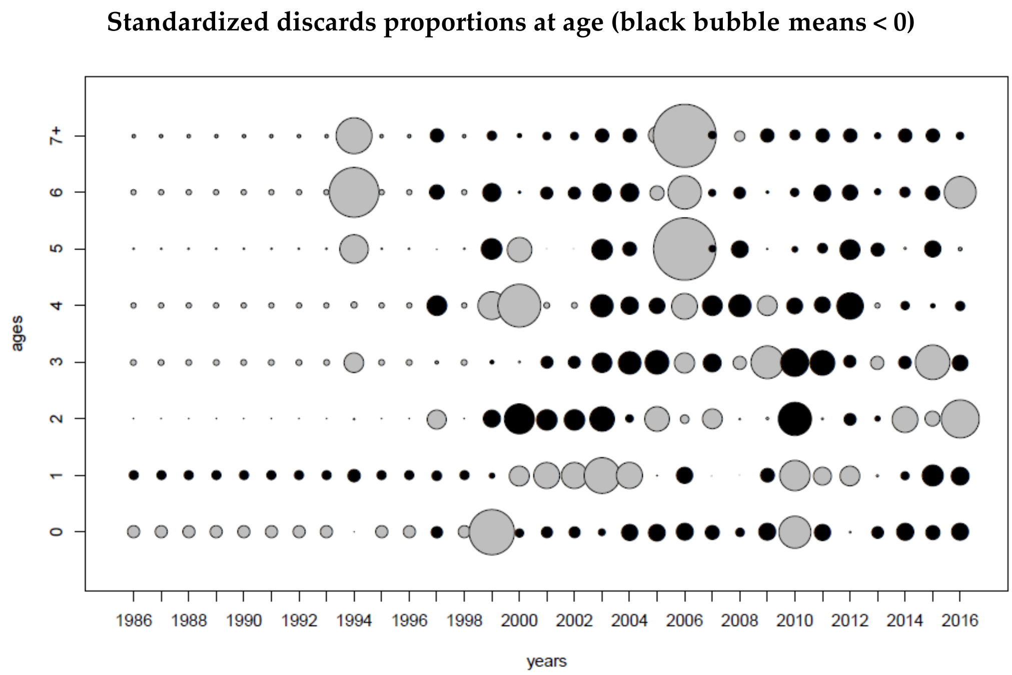


Figure 6.2.4(c). Four-spot megrim (*L. boscii*) in Divisions 8c & 9a.

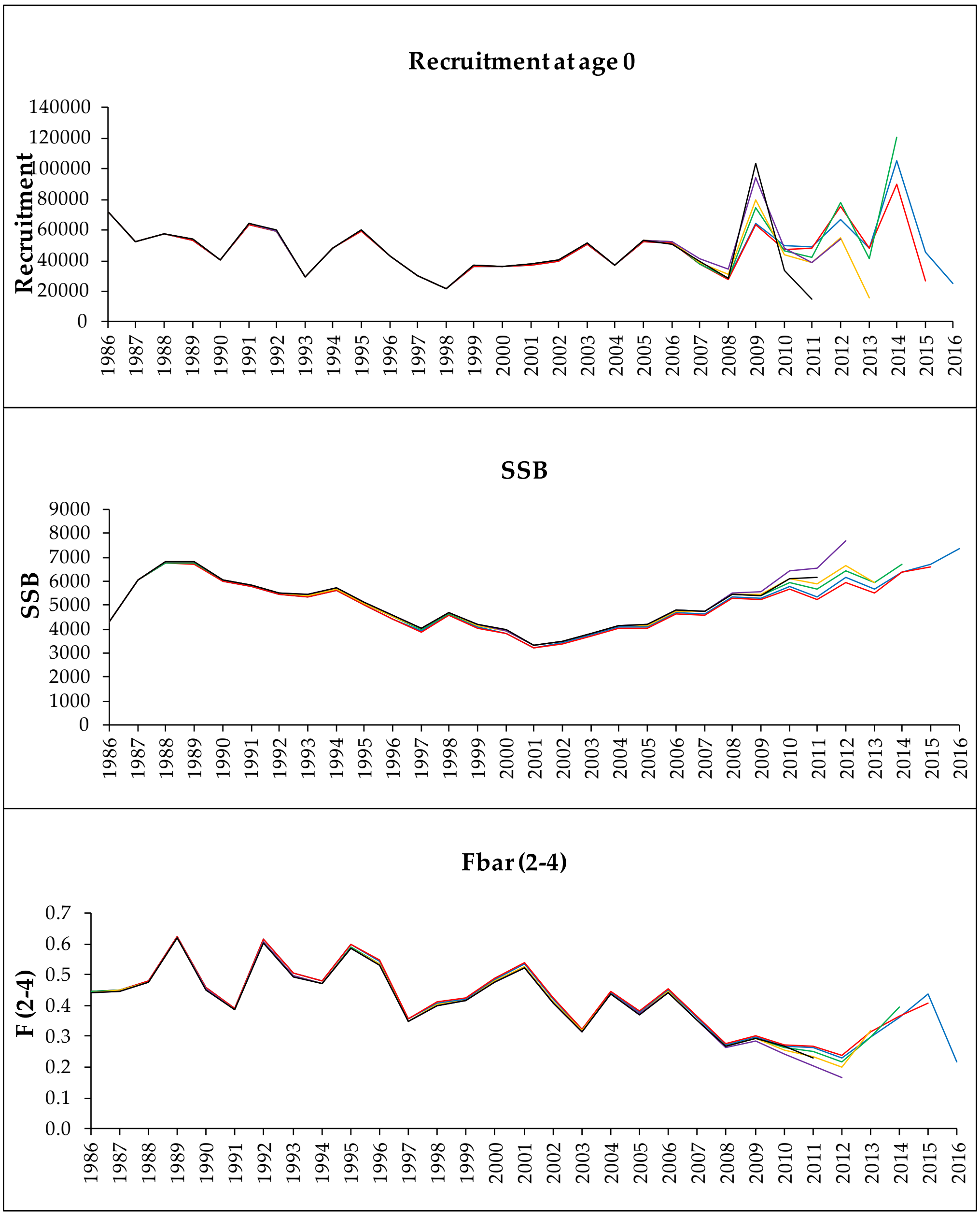


Figure 6.2.5. Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Retrospective XSA

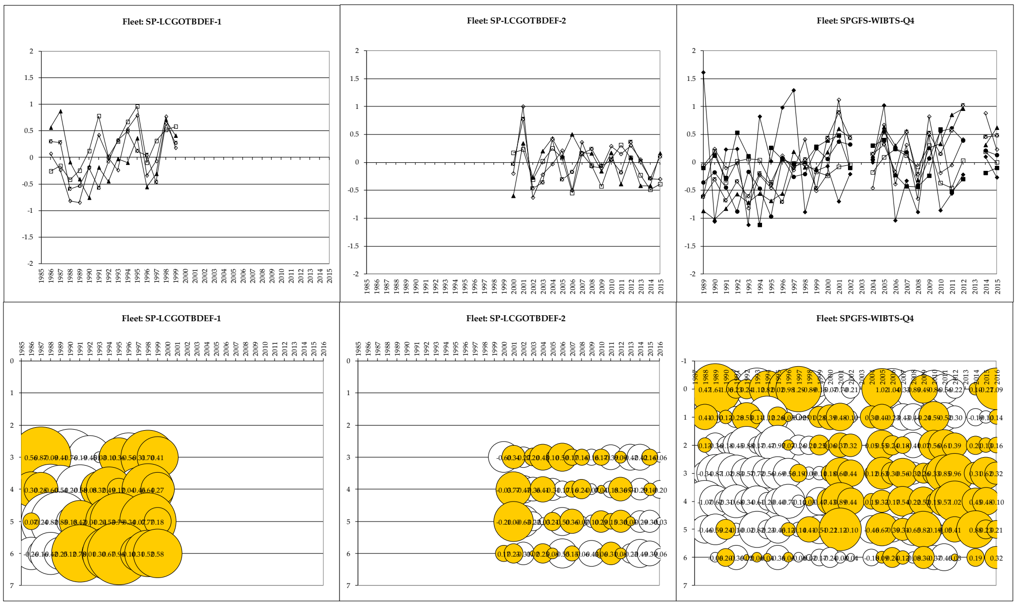


Figure 6.2.6. Four spot megrim (*L. boscii*) in Divisions 8c and 9a. LOG CATCHABILITY RESIDUAL PLOTS (XSA)

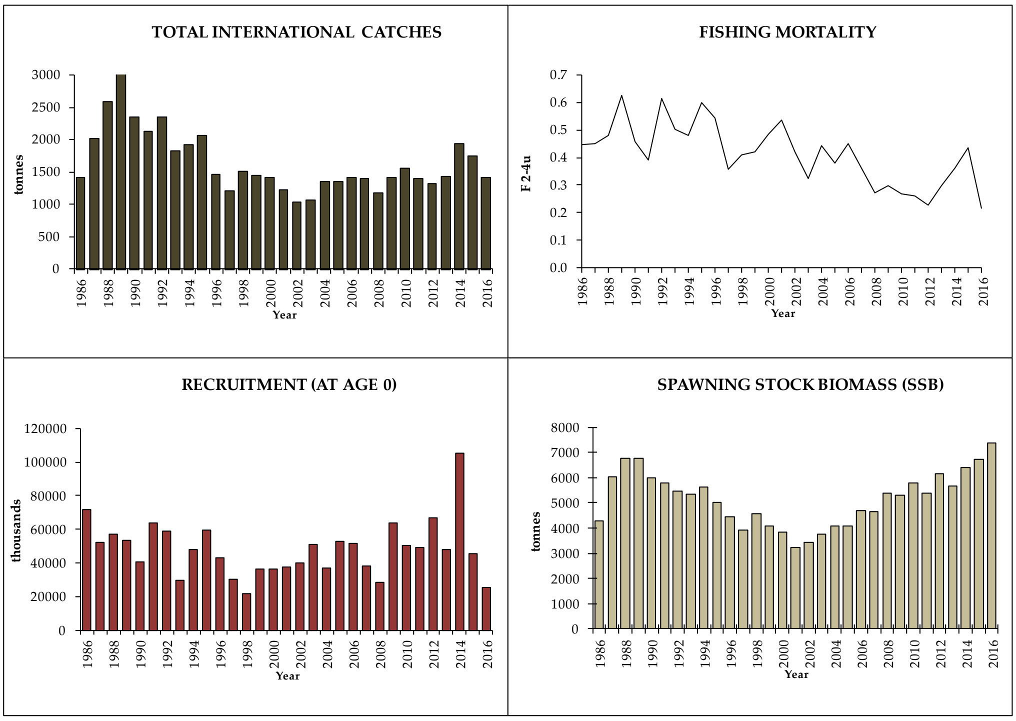
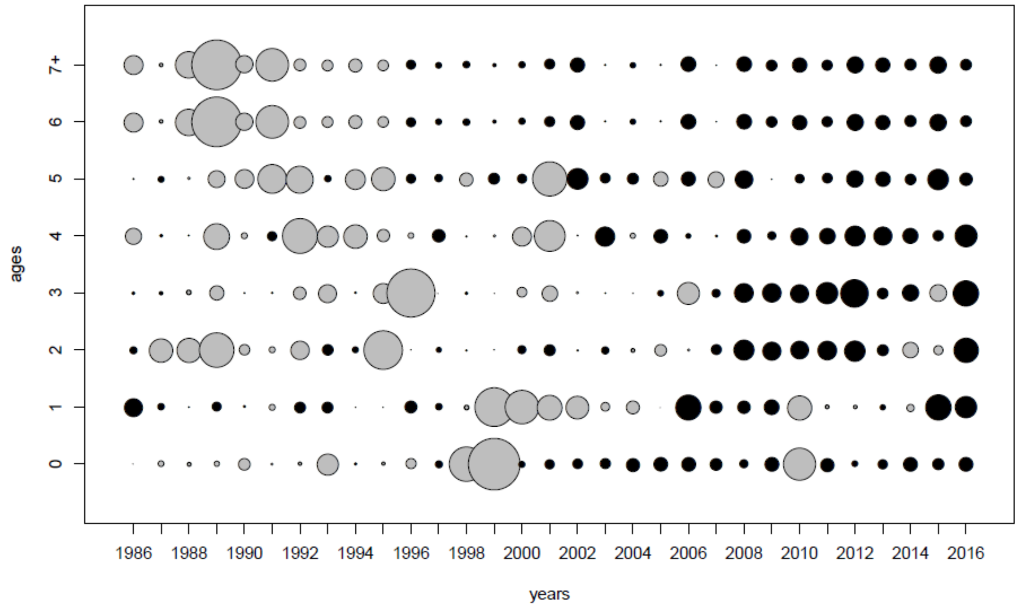


Figure 6.2.7(a). Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Stock Summary

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



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

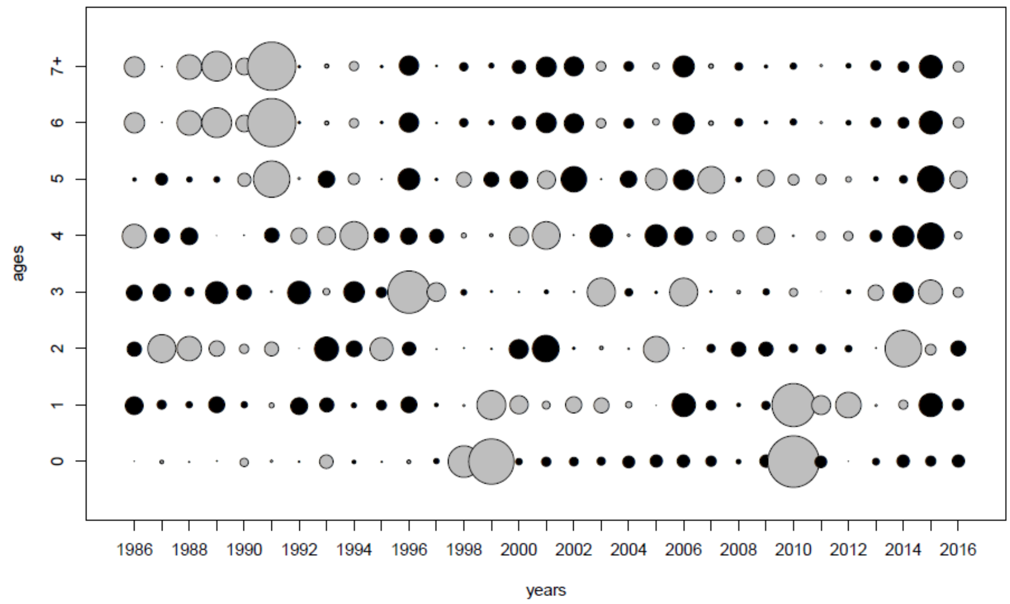
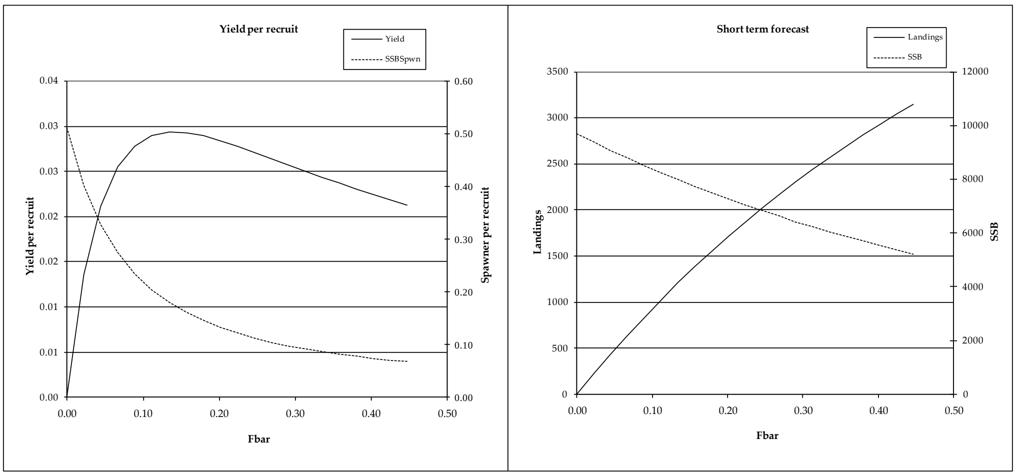


Figure 6.2.7(b): Four-spot megrim (*L. boscii*) in Divisions 8c&9a.



MFYPR version 2a
Run: ldb
Time and date: 15:33 28/04/2017

Reference point	F multiplier	Absolute F
Fleet1 Landings Fba	1.0000	0.2235
FMax	0.6308	0.1410
F0.1	0.3848	0.0860
F35%SPR	0.6051	0.1352

MFDP version 1a
Run: ldb
Time and date: 19:45 30/04/2017
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 8c and 9a. Forecast summary.

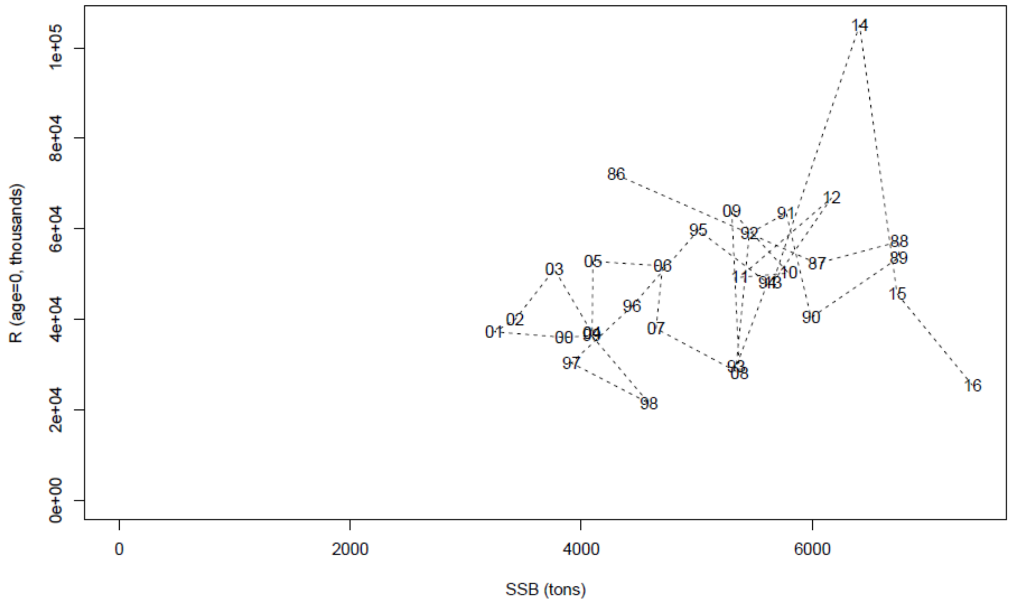


Figure 6.2.9. Four spot megrim (*L.boscii*) in Divisions 8c and 9a. SSB-Recruitment plot.

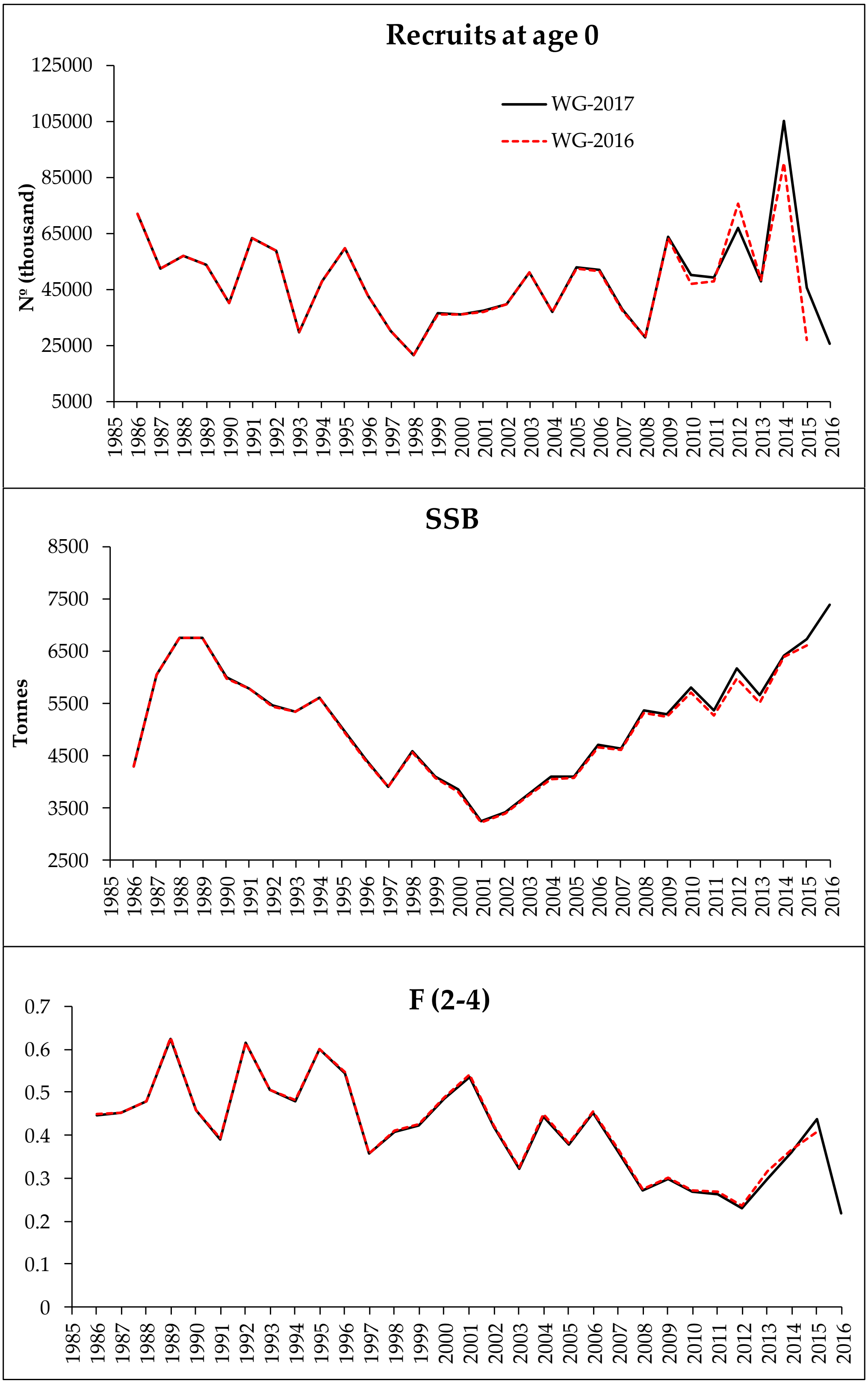


Figure 6.2.10. Four-spot megrim (*L. boscii*). Recruits, SSB and Fs from WG14 and WG15.

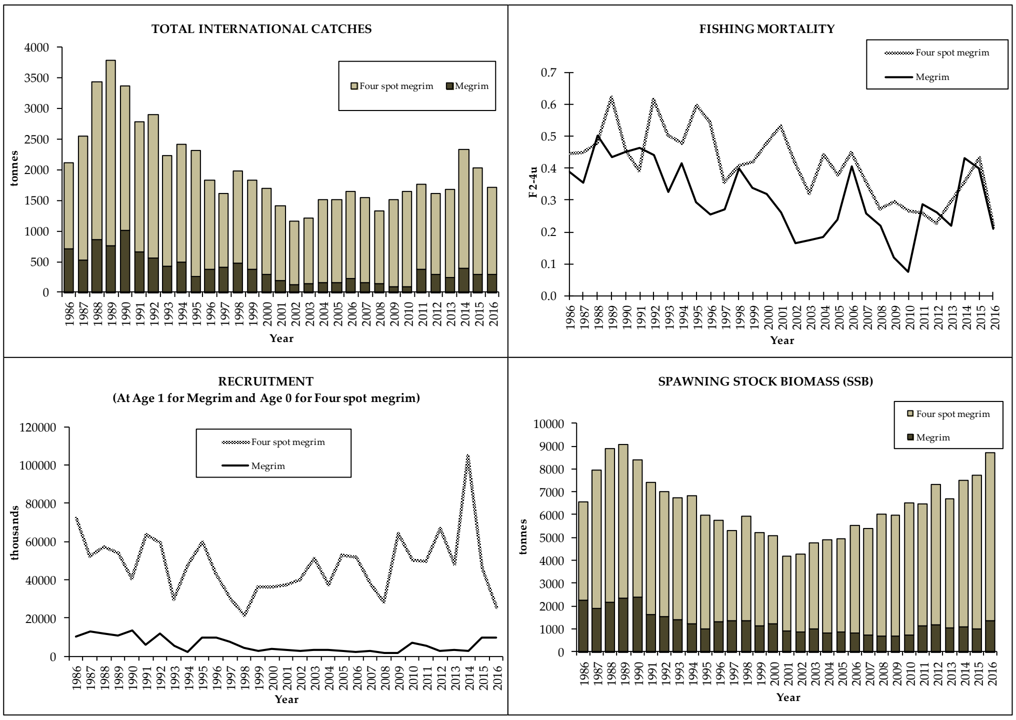


Figure 6.3.1. Stock trends for both stocks. Megrim and Four-spot megrim in Divisions 8c and 9a

7 Bay of Biscay Sole

Type of assessment in 2016: update.

Data revisions this year: Compared to last year assessment, there is only very limited change in data due to small revisions of 2015 landings and of 2015 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 2017 and management applicable to 2016 and 2017

ICES advice for 2016

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 2017: ICES advises that when the maximum sustainable yield (MSY) approach is applied, catches in 2017 should be no more than 3107 tonnes. All catches are assumed to be landed because the discards are less than 5% for this stock (4% in 2016).

Management applicable to 2016 and 2017

The sole landings in the Bay of Biscay are subject to a TAC regulation. The 2016 TAC was set at 3420 t and the 2017 TAC was set at same level 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 since 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 Bpa. 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 to 31 May and from 1 October to 31 December.

A season closure was also applied during the spawning period, 1 January to the 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 2015 landings estimate was revised to 3334 t, this is less than a 0.08 % increase.

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 2016 landings figure (3266 t) is 13.9 % below the landings predicted by the 2016 WG at status quo mortality (3793 t).

Discards estimates were provided for the French offshore trawler fleet from 1984 to 2003 using the RESSGASC surveys. Because these estimates depend largely on some questionable hypothesis, their monitoring was not continued in 2004 and they are no longer used in the assessment. However, this survey allowed affirmation that the discards of offshore trawlers are low at age 2 and above. This low level has been confirmed by observations at sea in recent years. These observations have also shown that discards of beam trawlers and gillnetters are generally low but that the inshore trawlers fleet may have occasionally high discards of sole. Unfortunately, they are difficult to estimate because the effort data of inshore trawlers are not precise enough to allow estimating them by relevant areas. 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 % (4 %) for 2016 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 2015 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 2016 sampling level is given in table 1.3 (section 1). The French length distributions are shown on Figures 7.1a to d from 1984 onwards. The relative length distribution of landings in 2016 is shown by country in Table 7.2.

Even though 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 in the beginning of 2012 (PGCCDBS, 2012) to compare the age reading methods. The conclusion is that there was no bias between readers from the three countries using otoliths prepared with the staining technique. All readers produced the same age estimates (i.e. no bias) of otoliths with or without staining.

However, a likely effect of the weight at age samples process may also be presumed (weight-length relationship used in France and straight estimate in Belgium) and should be investigated. International age compositions are estimated using the same procedure as in previous years, as described in Stock Annex. International mean weights at age of the catch are French-Belgian quarterly weighted mean weights. The catch numbers at age are shown in Table 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 about the fishery this threshold was set to avoid the effect of changing target species, which may also affect the trend in lpue. Indeed, the choice of target species may affect effort repartition between sole major habitat and peripheral areas where sole abundance is lower. Because 10% is a minimum for sole percentage in catch when carrying out mixed species trawling on sole grounds, according to fishermen, this percentage was retained to ensure that sole lpue are not driven by a fishing strategy evolution (the targeting of cephalopods more particularly).

The La Rochelle lpue series (FR-ROCHELLE) shows a decreasing trend from 1990 to 2001. Later on, the series does not exhibit any trend but some up and down variations (Table 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. This data is 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 and a small increase in 2016 (Figure 7.4).

The Belgian lpue series was relatively constant from 1990 to 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 lower than 2015 but remains at a high level.

For the ORHAGO survey, the trend of the CPUE shows an increase since 2008 despite some annual fluctuations.

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 1984–2016.

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	2000–2016	1–8	<1 %
Offshore otter trawlers	FR-BB-OFF-Q2	2000–2012	1–8	<1 %
Beam trawler survey	FR-ORHAGO	2007–2016	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, 2015 and 2016 and at age 6 in 2008, 2010 and since 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 age 2 and 5. This year the landings are concentrated on age 3 and 4.

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 to 6 (Table 7.7), 96 % for age 2, 76 % for age 3, and 72 % for age 4 for example:

			2016 XSA		2017 XSA
Catch data range			84–15		84–16
Catch age range			2–8+		2–8+
Fleets	FR – SABLES	91-09	2–7	91–09	2–7
	FR – ROCHELLE	91-09	2–7	91–09	2–7
	FR-BB-IN-Q4	00-15	3–7	00–16	3–7
	FR-BB-OFF-Q2	00-12	2–6	00–12	2–6
	FR-ORHAGO	07-15	2–8	07–16	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 a well estimation on F, SSB for 2015 data.

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 well estimated for 2015.

At age 3, the only one commercial fleet estimated survivors to have a significant weight is the FR-BB-INQ4 (around 23 %) and it increases by 53 % at age 7. The FR-BB-OFF-Q2 has year after year less weight than the others fleets, the maximum is at age 7 at around 5 %. 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 the same estimated survivors around 49 %.

Fishing mortalities and stock numbers at age are given in Tables 7.8 and 7.9 respectively. The results are summarised in Table 7.10. Trends in yield, F, SSB and recruitments are plotted in Figure 7.7. Fishing mortality in 2016 is estimated by XSA to have been at 0.36. Fishing mortality was 0.44 in 2014, and 0.43 in 2015.

7.3.2.1 Estimating year class abundance

In this year's assessment the retrospective analyses shows that since 2012 the recruitments were well estimated by XSA (except for 2014) and that the recruitments are confirmed to increase since 2013. As the estimate of the recruitment for last year (2015 in this year's assessment) is well estimated, as shown by the retrospective pattern for recruits, we can keep the value estimated by the assessment model.

Recruitment at age 2

Year class	Thousands	Basis	Survey	Commercial	Shrinkage
2013	20 152	XSA	76 %	23 %	1.5 %
2014	18 246	XSA	96 %	0 %	1.5 %
2015 & subsequent	21 031	GM(93-14)			

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 stabilised at around the new Fpa (= 0.43). The graph shows a low decrease the last years of the series.

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 Bpa (10 600 t) has been decreasing since 2012. The SSB value for 2014 and 2015 are below the Bpa. The 2016 SSB is estimated to 11 028 t, lower (5 %) than the estimated value from WGBIE 2016 (10 468 t).

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 $GM_{93–14}$ (21 million). However, the 2012 and 2013 values are the lowest of the series (12.9 million and 13 million respectively). After these two low values, an increase is shown and the recruits are now estimated to be close to the $GM_{93–14}$ for last year.

7.3.3 Catch options and prognosis

Because of the stability around the Fpa 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 2014–2016 for age 2 and above. This *status quo* F is estimated at 0.41 for the run.

The recruits at age 2 from 2017 to 2019 are assumed equal to GM_{93-14}. Stock numbers at age 3 and above are the XSA survivor estimates.

Weights at age in the landings are the 2014–2016 means using the new fresh/gutted transformation coefficient of French landing which was changed from 1.11 to 1.04 in 2007. Weights at age in the stock are the 2014–2016 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 3964 t in 2017 (TAC is set at 3420 t), higher than the 2016 landings (3266 t).

Assuming recruitment at $GM_{93–14}$, the SSB is predicted to increase to 12 360 t in 2017 and increase to 12 936 t in 2018, fishing at *status quo* F in 2017. It will continue to grow at *status quo* F, to reach 13 368 t in 2019 (Tables 7.12 and 7.13).

The proportional contributions of recent year classes to the landings in 2018 and to the SSB in 2019 are given in Table 7.14. Year classes for which GM_{93-14} recruitment has been assumed (2015 to 2017) contribute 36.8 % of the 2018 landings and 59.6 % of the 2019 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} (0.41) is 27 % above F_{max} (0.3) and largely higher than $F_{0.1}$ (0.11). Long-term equilibrium landings and SSB (at F *status quo* and assuming GM recruitment) are estimated to be 4574 t and 14 116 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	10 600 t	Bpa
Approach	F_{MSY}	0.33	F_{MSY} without Btrigger
	Blim	7600 t	Blim = Bpa / exp(σ x 1.645)
Precautionary	Bpa	10 600 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 was available). That is no more the case with incorporation of the ORHAGO survey in the assessment.

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

Discarding

Available data on discards have shown that discards may be important at age 1 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 high-grading practices due to the landing limits adopted by some producers' organisations. The data available for discards do not seem representative to use them in the assessment.

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.

The GM is used only for recruitments prediction (2017–2019) recruitment; this GM estimate has a low contribution in predicted landings and SSB because the recruits in terminal year is 18 246 million and the GM_{93-14} is 21 031 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 a well estimation in 2015 (Figure 7.6).

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 2016 and in 2017. The SSB, F and recruits at age 2was not revised.

Misreporting

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

Industry input

The traditional meeting with representatives of the fishing industry was organized in France prior to the WG to present the data used by the 2016 WGBIE to assess the state of the Bay of Biscay sole stock. 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 addition to the Community measures of the management plan (EC 388/2006) and the operating rules defined within the framework of the Western Waters Advisory Council, the French fishery has set up a national fisheries management regime from 2015 for the Bay of Biscay sole stock. Since 2016, this management regime provides for:

- For gilnetters a biological stop of activity for 21 days per period of 7 consecutive days during the first quarter of the year (In 2015, the gillnetters had to make a 15–day stop, only for sole, per period of 5 consecutive days in the first quarter);

- For bottom trawlers, the obligation to use a mesh size greater than or equal to 80 mm (the regulatory mesh being 70 mm) from 1 January to 31 May and from 1 October to 31 December.

Management considerations

The assessment indicates that SSB has decreased continuously to 9641 t in 2003, since a peak in 1993 (16 379 t), has increased to 12 220 t in 2006 but it remains close to 11 700 t thereafter and since 2004 is above the Bpa. It is estimated to be 12 360 t (above B_{pa} = 10 600 t) in 2017 assuming $GM_{93–14}$ recruitment value for 2017, and an increase is predicted by the short term prediction, and SSB is assumed to increase in 2018 and 2019.

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 8a,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	3644	-	-
2016	288	3054		4		3346	3266**	-	-

[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 7.1b : Bay of Biscay sole (Division 8a,b). Contribution (in %) to the total landings by different fleets.

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	2016
Shrimp trawlers	0	0	0	0	0	0	0	0
Inshore trawlers	6	8	7	8	7	8	7	8
Offshore otter trawlers	21	19	17	17	18	18	15	15
Offshore beam trawlers	10	11	8	9	7	8	8	9
Fixed nets	63	61	67	66	68	65	70	68

Table 7.2 Bay of Biscay Sole- 2016. French and Belgian relative length distribution of landings

Table 7.2 : Bay of Biscay Sole - 2016

French and Belgian relative length distribution of landings

Length(cm)	France	Belgium
21	0.01	
22	0.05	
23	0.47	1.07
24	2.70	4.31
25	4.59	7.66
26	6.49	11.86
27	8.20	13.62
28	9.88	13.28
29	11.90	11.42
30	11.97	9.65
31	10.25	6.39
32	8.65	5.87
33	5.73	3.92
34	4.17	2.83
35	2.99	2.59
36	2.39	1.59
37	1.64	1.38
38	1.57	0.98
39	1.52	0.57
40	1.07	0.40
41	0.84	0.20
42	0.85	0.11
43	0.62	0.09
44	0.42	0.02
45	0.33	0.00
46	0.24	
47	0.13	
48	0.08	
49	0.09	
50	0.06	
51	0.02	
52	0.05	
53	0.01	
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	2016
2	3535	3885	3173	2860	2084	1516	1302	2312	3472	2316	1047
3	4436	5181	4794	3986	7707	5222	4680	2939	2948	3079	3130
4	2747	2615	2886	2233	3758	8347	4264	3777	1630	1594	2432
5	2012	1419	1353	1501	1272	1019	3787	3205	2236	1883	1117
6	1030	1262	938	946	484	570	1008	1450	1669	1194	721
7	530	686	892	541	269	275	225	286	729	859	686
+gp	1537	946	1193	960	284	516	517	635	481	582	773
TOTALNUM	15827	15994	15229	13027	15858	17465	15783	14604	13165	11507	9906
TONSLAND	4793	4363	4299	3650	3966	4632	4321	4235	3928	3644	3266
SOPCOF %	101	100	100	102	100	100	100	101	109	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*	2016*
Age											
2	0.195	0.176	0.174	0.17	0.179	0.193	0.182	0.208	0.177	0.197	0.191
3	0.242	0.225	0.229	0.215	0.206	0.223	0.224	0.24	0.241	0.225	0.237
4	0.282	0.298	0.287	0.275	0.272	0.253	0.257	0.272	0.281	0.316	0.286
5	0.347	0.326	0.352	0.317	0.337	0.342	0.307	0.304	0.296	0.312	0.351
6	0.42	0.388	0.392	0.361	0.414	0.432	0.369	0.368	0.348	0.387	0.372
7	0.455	0.419	0.401	0.447	0.477	0.489	0.414	0.518	0.394	0.365	0.385
+gp	0.533	0.511	0.519	0.601	0.768	0.606	0.585	0.521	0.576	0.517	0.527
SOPCOFAC	1.0136	1.0026	1	1.0158	1.0019	1.0046	1.0023	1.0082	1.0942	1.0987	1.1

(*) for 2007 to 2016, 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 2016.

Table 7.5: Bay of Biscay sole LPUE and indices of fishing effort for French offshore trawlers

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	na	6.6	na	na
2014	5.3	na	7.8	na	na
2015	4.2	na	7.7	na	na
2016	4.4	na	8.3	na	na

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

Table 7.5b. Bay of Biscay sole fishing effort and LPUE for Belgian beam trawlers

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
2016	287.7	9.0	32.0

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	9.92	47.38	**16.34**	**13.12**	**5.33**	**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	3.44	41.19	**22.91**	**13.82**	**3.64**	**1.82**	**0.80**	**1.65**
2012	3088	1.14	9.74	**21.55**	**14.44**	**7.58**	**1.50**	**0.98**	**1.17**
2013	3155	3.39	11.97	**8.32**	**7.92**	**3.24**	**2.88**	**1.05**	**1.98**
2014	4767	16.34	92.97	**16.11**	**4.90**	**3.70**	**2.73**	**0.85**	**1.08**
2015	2422	5.80	31.08	**7.09**	**2.38**	**1.96**	**1.22**	**0.83**	**0.46**
2016	1975	1.90	13.83	**8.95**	**2.40**	**1.68**	**1.08**	**0.48**	**1.95**

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**
2016	100	130	**192.4**	**114.0**	**26.6**	**18.9**	**8.5**	**4.9**	**5.6**

Table 7.7: XSA tuning diagnostic

Lowestoft VPA Version 3.1

18/04/2017 10:08

Extended Survivors Analysis

SOLE VIIIa,b

CPUE data from file tunfilt.dat

Catch data for 33 years. 1984 to 2016. Ages 2 to 8.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FR-SABLES ,	1991,	2016,	2,	7,	.000,	1.000
FR-ROCHELLE ,	1991,	2016,	2,	7,	.000,	1.000
FR-BB-IN-Q4 ,	2000,	2016,	3,	7,	.750,	1.000
FR-BB-OFF-Q2 ,	2000,	2016,	2,	6,	.250,	.500
FR-ORHAGO ,	2007,	2016,	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 76 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,	2007,	2008,	2009,	2010,	2011,	2012,	2013,	2014,	2015,	2016
2,	.261,	.198,	.093,	.095,	.082,	.112,	.206,	.264,	.129,	.062
3,	.518,	.524,	.363,	.342,	.324,	.343,	.349,	.388,	.350,	.230
4,	.473,	.542,	.437,	.610,	.668,	.424,	.455,	.296,	.333,	.456
5,	.416,	.424,	.533,	.423,	.290,	.648,	.577,	.473,	.580,	.365
6,	.405,	.472,	.524,	.289,	.303,	.458,	.487,	.596,	.441,	.405
7,	.521,	.494,	.486,	.244,	.236,	.167,	.201,	.428,	.623,	.434

XSA population numbers (Thousands)

	AGE					
YEAR ,	2,	3,	4,	5,	6,	7,
2007 ,	1.77E+04,	1.35E+04,	7.30E+03,	4.39E+03,	3.99E+03,	1.78E+03,
2008 ,	1.85E+04,	1.24E+04,	7.25E+03,	4.12E+03,	2.62E+03,	2.41E+03,
2009 ,	3.40E+04,	1.38E+04,	6.63E+03,	3.82E+03,	2.44E+03,	1.48E+03,
2010 ,	2.41E+04,	2.80E+04,	8.65E+03,	3.87E+03,	2.03E+03,	1.31E+03,
2011 ,	2.03E+04,	1.98E+04,	1.80E+04,	4.26E+03,	2.29E+03,	1.37E+03,
2012 ,	1.29E+04,	1.69E+04,	1.30E+04,	8.35E+03,	2.88E+03,	1.53E+03,
2013 ,	1.31E+04,	1.05E+04,	1.09E+04,	7.69E+03,	3.95E+03,	1.65E+03,
2014 ,	1.58E+04,	9.64E+03,	6.68E+03,	6.24E+03,	3.91E+03,	2.20E+03,
2015 ,	2.02E+04,	1.09E+04,	5.92E+03,	4.50E+03,	3.52E+03,	1.95E+03,
2016 ,	1.82E+04,	1.60E+04,	6.98E+03,	3.84E+03,	2.28E+03,	2.05E+03,

Table 7.7: Cont'd

Estimated population abundance at 1st Jan 2017

, 0.00E+00, 1.55E+04, 1.15E+04, 4.00E+03, 2.41E+03, 1.38E+03,

Taper weighted geometric mean of the VPA populations:

, 2.29E+04, 1.71E+04, 1.05E+04, 5.82E+03, 3.18E+03, 1.76E+03,

Standard error of the weighted Log(VPA populations) :

, .2621, .2751, .2999, .2833, .2903, .3768,

Log catchability residuals.

Fleet : FR-SABLES

Age	1991	1992	1993	1994	1995	1996
2	-.23	-.14	-.38	-.41	-.08	-.21
3	.11	-.19	.16	-.11	-.18	-.03
4	.13	-.27	-.09	.36	.14	.01
5	.08	-.16	-.11	.22	-.01	-.12
6	-.19	.16	-.39	.03	-.25	.24
7	-.06	-.15	-.27	.19	.07	.48

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
2	-.12	-.03	-.18	.20	-.17	.22	-.13	.30	.48	.81
3	.20	-.01	-.42	.39	.07	.26	.01	-.29	-.18	-.01
4	.01	.44	-.23	.13	-.06	.14	-.30	-.19	-.15	-.47
5	-.24	.15	.27	-.09	-.28	.34	-.17	-.50	.23	-.74
6	-.03	-.40	.42	-.04	-.22	.35	.04	-.34	.16	-.54
7	.00	.11	.55	.09	-.21	.09	.09	-.12	.07	-.14

Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2	.25	.14	-.31	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	-.04	.15	.13	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	.05	.31	.03	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	.34	.30	.49	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	.27	.33	.40	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	.65	.36	.32	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7
Mean Log q	-15.0701	-14.5169	-14.4730	-14.6552	-14.6481	-14.6481
S.E(Log q)	.3128	.1993	.2361	.3153	.3008	.2840

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	5.21	-3.209	36.12	.03	19	1.32	-15.07
3	1.02	-.084	14.59	.63	19	.21	-14.52
4	.84	1.018	13.67	.72	19	.20	-14.47
5	1.15	-.482	15.54	.39	19	.37	-14.66
6	1.41	-1.068	17.39	.28	19	.42	-14.65
7	.73	2.226	12.62	.81	19	.17	-14.54

1

Fleet : FR-ROCHELLE

Age	1991	1992	1993	1994	1995	1996
2	-.09	-.18	-.46	-.39	-.04	.33
3	.19	-.04	-.01	-.22	-.11	.05
4	.44	.12	-.22	.29	.30	-.15
5	.45	.17	-.08	.19	.21	-.36
6	.11	.33	-.26	.11	-.35	-.11
7	.01	.08	-.03	.00	-.06	-.09

Table 7.7: Cont'd

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
2	-.06	.19	-.03	.19	-.23	.70	.16	.37	.12	-.01
3	.11	-.10	-.49	-.27	-.08	.19	.23	-.09	-.38	-.25
4	-.08	.47	-.25	-.11	.14	-.32	-.06	-.23	-.21	-.29
5	-.35	.01	.18	-.16	-.06	-.06	-.06	-.47	.32	-.28
6	-.01	-.53	.52	-.29	.09	-.01	.11	-.20	.41	-.06
7	-.10	.03	.23	-.21	.13	-.08	-.22	-.02	.20	.00

Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2	.06	.20	-.83	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	.57	.57	.14	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	-.19	.33	.00	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	-.27	.26	.37	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	-.24	.14	.26	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	-.20	.23	.18	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7
Mean Log q	-15.0044	-14.5582	-14.7759	-15.1294	-15.1855	-15.1855
S.E(Log q)	.3372	.2801	.2603	.2718	.2741	.1426

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	-1.521	19.76	.13	19	.64	-15.00
3	1.22	-.725	15.63	.38	19	.35	-14.56
4	.82	1.140	13.77	.69	19	.21	-14.78
5	.91	.440	14.53	.57	19	.25	-15.13
6	1.60	-1.554	19.48	.29	19	.42	-15.19
7	.85	1.971	13.98	.91	19	.11	-15.18

Fleet : FR-BB-IN-Q4

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
2	No data for this fleet at this age									
3	99.99	99.99	99.99	.30	-.32	.32	.74	.28	-.22	-.02
4	99.99	99.99	99.99	.42	-.48	-.65	.17	.35	.15	-.47
5	99.99	99.99	99.99	.05	-.36	-.15	-.74	.47	.20	-.54
6	99.99	99.99	99.99	-.50	-.01	.60	-.34	.83	.00	.01
7	99.99	99.99	99.99	-.21	-.14	.57	.30	.21	-.11	.48

Age	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2	No data for this fleet at this age									
3	.01	.16	-.12	-.19	-.41	.20	-.29	.08	-.23	-.28
4	.22	.53	-.37	.38	-.10	.56	.14	-.40	-.29	-.14
5	.21	.14	-.14	.09	-.11	.76	-.09	-.25	.21	.23
6	.03	-.03	.05	-.64	-.25	-.04	.30	-.06	-.22	.27
7	-.56	-.22	-.36	-.99	-.62	-.09	-.08	-.80	.15	-.41

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	-14.5125	-14.9404	-15.1499	-15.0692	-15.0692
S.E(Log q)	.3037	.3904	.3628	.3627	.4654

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	.94	.211	14.24	.48	17	.30	-14.51
4	.78	.862	13.63	.50	17	.31	-14.94
5	.83	.588	13.99	.43	17	.31	-15.15
6	.88	.388	14.17	.39	17	.33	-15.07
7	2.42	-1.860	26.58	.10	17	.97	-15.24

Table 7.7: Cont'd

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 Fleet : FR-BB-OFF-Q2

  Age  ,  1997,  1998,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006
     2 , 99.99, 99.99, 99.99,   .42,   .46,   .88,   .93,   .44,   .38,  -.27
     3 , 99.99, 99.99, 99.99,  -.43,  -.13,   .22,   .16,   .19,  -.18,  -.19
     4 , 99.99, 99.99, 99.99,   .36,   .24,   .15,  -.01,  -.06,  -.01,  -.65
     5 , 99.99, 99.99, 99.99,   .74,   .47,   .80,  -.17,  -.90,   .26,  -.55
     6 , 99.99, 99.99, 99.99,   .72,  1.17,  1.39,   .41,  -.48,  -.73,   .32
     7 , No data for this fleet at this age

  Age  ,  2007,  2008,  2009,  2010,  2011,  2012,  2013,  2014,  2015,  2016
     2 ,   .55,   .92, -1.69, -1.41, -1.95,   .35, 99.99, 99.99, 99.99, 99.99
     3 ,   .76,   .40,  -.11,   .00,  -.68,   .01, 99.99, 99.99, 99.99, 99.99
     4 ,  -.38,   .01,  -.21,   .28,   .44,  -.14, 99.99, 99.99, 99.99, 99.99
     5 ,  -.97,   .00,  -.17,   .33,  -.35,   .52, 99.99, 99.99, 99.99, 99.99
     6 ,   .01,  -.76,  -.39, -1.43,   .13,  -.36, 99.99, 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,  -15.8985,  -14.5034,  -14.7369,  -15.3531,  -15.8860,
 S.E(Log q),    1.0152,     .3644,     .3044,     .5849,     .8057,

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,   -1.61,   -1.412,       .29,     .03,     13,    1.57,  -15.90,
  3,    2.06,   -1.244,     19.62,     .11,     13,     .73,  -14.50,
  4,     .64,    2.104,     12.72,     .76,     13,     .17,  -14.74,
  5,     .56,    1.159,     12.31,     .39,     13,     .32,  -15.35,
  6,    1.61,    -.333,     20.85,     .03,     13,    1.35,  -15.89,

 Fleet : FR-ORHAGO

  Age  ,  2007,  2008,  2009,  2010,  2011,  2012,  2013,  2014,  2015,  2016
     2 ,   .09,  -.26,   .39,  -.20,   .04,  -.33,  -.32,   .54,   .01,   .04
     3 ,   .05,   .17,   .27,   .01,  -.40,   .06,  -.16,  -.03,  -.10,   .12
     4 ,   .11,  -.03,  -.14,  -.22,  -.53,   .17,   .49,   .05,   .00,   .09
     5 ,   .48,  -.76,  -.43, -1.07, -1.25,   .43,   .51,   .59,   .72,   .77
     6 ,   .47,  -.38,  -.54, -3.51,  -.79,   .30,  1.08,  1.35,  1.07,   .92
     7 , -1.09,  -.09, -1.63,  -.91,  -.12,   .16,   .47,   .85,  1.09,   .50

 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,   -9.0560,   -9.3774,   -9.7679,  -10.2677,  -10.6674,  -10.6674,
 S.E(Log q),     .2926,     .1894,     .2669,     .7872,    1.4405,     .8893,

 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,     .69,    1.349,      9.30,     .71,     10,     .19,   -9.06,
  3,    1.05,    -.249,      9.37,     .73,     10,     .21,   -9.38,
  4,    1.24,    -.746,      9.94,     .55,     10,     .34,   -9.77,
  5,     .45,    1.462,      9.29,     .47,     10,     .33,  -10.27,
  6,     .20,    2.995,      8.51,     .64,     10,     .21,  -10.67,
  7,     .31,    1.739,      8.47,     .44,     10,     .25,  -10.74,
```

Table 7.7: Cont'd

```
Fleet disaggregated estimates of survivors :

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

Year class = 2014

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,    16209.,
Raw Weights,     9.977,

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           ,     16209.,   .307,      .000,    .00,   1,  .957,     .060

  F shrinkage mean  ,      5797.,   1.50,,,,                        .043,     .159

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
    15514.,       .30,      .21,    2,    .706,   .062

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

Year class = 2013

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,     8728.,        0.,
Raw Weights,     8.141,      .000,

FR-BB-OFF-Q2
        Age,         3,         2,
  Survivors,        0.,        0.,
Raw Weights,      .000,      .000,

FR-ORHAGO
        Age,         3,         2,
  Survivors,    13014.,    11647.,
```

```
Raw Weights,    19.869,      7.418,
```

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          ,       8728.,  .312,       .000,    .00,   1,  .227,     .294
FR-BB-OFF-Q2         ,          1.,  .000,       .000,    .00,   0,  .000,     .000
FR-ORHAGO            ,      12627.,  .168,       .049,    .29,   2,  .761,     .212

  F shrinkage mean  ,       7056.,   1.50,,,,                         .012,     .352

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
    11529.,       .15,      .10,    4,    .665,   .230

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

Year class = 2012

FR-SABLES
        Age,         4,          3,          2,
  Survivors,        0.,         0.,         0.,
Raw Weights,      .000,       .000,       .000,

FR-ROCHELLE
        Age,         4,          3,          2,
  Survivors,        0.,         0.,         0.,
Raw Weights,      .000,       .000,       .000,

FR-BB-IN-Q4
        Age,         4,          3,          2,
  Survivors,     3488.,      3183.,         0.,
Raw Weights,     3.926,      4.572,       .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,     4381.,      3612.,      6872.,
Raw Weights,     8.084,     11.158,      3.641,

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          ,       3321.,  .250,       .046,    .18,   2,  .267,     .529
FR-BB-OFF-Q2         ,          1.,  .000,       .000,    .00,   0,  .000,     .000
FR-ORHAGO            ,       4284.,  .147,       .158,   1.07,   3,  .719,     .432

  F shrinkage mean  ,       4226.,   1.50,,,,                         .014,     .437

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     4001.,       .13,      .10,    6,    .780,   .456

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

Year class = 2011

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,
```

Table 7.7: Cont'd

```
FR-BB-IN-Q4
        Age,         5,          4,          3,          2,
  Survivors,     3046.,      1799.,      2597.,         0.,
Raw Weights,     4.980,      3.081,      3.456,       .000,

FR-BB-OFF-Q2
        Age,         5,          4,          3,          2,
  Survivors,        0.,         0.,         0.,         0.,
Raw Weights,      .000,       .000,       .000,       .000,

FR-ORHAGO
        Age,         5,          4,          3,          2,
  Survivors,     5181.,      2420.,      2345.,      1753.,
Raw Weights,     1.018,      6.344,      8.434,      2.916,

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         ,      2522.,   .215,       .152,    .71,   3,  .375,     .352
FR-BB-OFF-Q2        ,         1.,   .000,       .000,    .00,   0,  .000,     .000
FR-ORHAGO           ,      2365.,   .146,       .126,    .86,   4,  .610,     .371

  F shrinkage mean  ,      1576.,   1.50,,,,                         .014,     .515

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     2408.,       .12,      .08,    8,    .691,   .365

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

Year class = 2010

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,     1797.,      1702.,       921.,      1029.,         0.,
Raw Weights,     4.791,      2.680,      1.721,      2.006,       .000,

FR-BB-OFF-Q2
        Age,         6,          5,          4,          3,          2,
  Survivors,        0.,         0.,         0.,         0.,      1953.,
Raw Weights,      .000,       .000,       .000,       .000,       .158,

FR-ORHAGO
        Age,         6,          5,          4,          3,          2,
  Survivors,     3460.,      2831.,      1439.,      1174.,       985.,
Raw Weights,      .292,       .548,      3.543,      4.896,      1.859,

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         ,      1449.,   .201,       .162,    .81,   4,  .488,     .388
FR-BB-OFF-Q2        ,      1953.,  1.053,       .000,    .00,   1,  .007,     .301
FR-ORHAGO           ,      1307.,   .147,       .138,    .94,   5,  .486,     .422
```

```
  F shrinkage mean  ,      1179.,   1.50,,,,                       .019,     .459

Weighted prediction :

Survivors,        Int,       Ext,    N,    Var,     F
at end of year,   s.e,       s.e,     ,   Ratio,
     1375.,       .12,       .09,   11,    .712,   .405
```

Table 7.7: Cont'd

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

Year class = 2009

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,       796.,        966.,        936.,       1388.,       1465.,          0.,
Raw Weights,      2.825,       2.994,       1.865,       1.022,       1.198,        .000,

FR-BB-OFF-Q2
        Age,          7,           6,           5,           4,           3,           2,
  Survivors,         0.,          0.,          0.,          0.,       1215.,        171.,
Raw Weights,       .000,        .000,        .000,        .000,        .818,        .097,

FR-ORHAGO
        Age,          7,           6,           5,           4,           3,           2,
  Survivors,      1989.,       3519.,       2165.,       1960.,       1278.,       1246.,
Raw Weights,       .745,        .183,        .381,       2.104,       2.925,       1.145,

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         ,       992.,   .199,       .106,     .53,   5,  .528,     .505
FR-BB-OFF-Q2        ,       987.,   .356,       .604,    1.70,   2,  .049,     .508
FR-ORHAGO           ,      1580.,   .162,       .114,     .70,   6,  .399,     .346

  F shrinkage mean  ,      1287.,   1.50,,,,                       .024,     .410

Weighted prediction :

Survivors,        Int,       Ext,    N,    Var,     F
at end of year,   s.e,       s.e,     ,   Ratio,
     1202.,       .13,       .10,   14,    .738,   .434
```

Table 7.8. Bay of Biscay Sole, Fishing mortality (F) at age

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGE												
2	0.2969	0.3603	0.2581	0.1746	0.2171	0.203	0.2658	0.1442	0.1486	0.0835	0.1103	0.1565
3	0.2432	0.354	0.2711	0.3556	0.3996	0.4366	0.3846	0.3534	0.3196	0.3542	0.3275	0.3292
4	0.3359	0.2723	0.3181	0.3463	0.4324	0.428	0.5251	0.4629	0.4553	0.4998	0.7529	0.6828
5	0.348	0.3721	0.3873	0.3717	0.3468	0.5959	0.5796	0.4454	0.5644	0.6428	0.7445	0.7212
6	0.3197	0.2293	0.4844	0.4105	0.4223	0.5257	0.3259	0.4169	1.0958	0.6077	0.7674	0.5711
7	0.3354	0.292	0.3978	0.3773	0.4017	0.5184	0.4785	0.6266	0.8613	0.8145	0.8022	0.7906
+gp	0.3354	0.292	0.3978	0.3773	0.4017	0.5184	0.4785	0.6266	0.8613	0.8145	0.8022	0.7906
0 FBAR 3- 6	0.3117	0.3069	0.3652	0.371	0.4003	0.4965	0.4538	0.4197	0.6088	0.5261	0.6481	0.5761

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE												
2	0.1146	0.1848	0.2117	0.1311	0.2736	0.2206	0.2484	0.2037	0.236	0.2602	0.2229	0.2615
3	0.3545	0.5149	0.3968	0.3935	0.4797	0.5106	0.5273	0.4752	0.3802	0.3548	0.4563	0.5184
4	0.5303	0.6701	0.7353	0.6392	0.768	0.6536	0.8128	0.4451	0.4319	0.4353	0.4672	0.4727
5	0.5092	0.5757	0.6017	0.739	0.7262	0.5816	1.0152	0.4198	0.2931	0.5428	0.3922	0.4155
6	0.7852	0.6816	0.4268	0.7333	0.5408	0.5398	0.9754	0.6127	0.3745	0.5223	0.4391	0.4048
7	1.0436	0.7712	0.7704	0.5604	0.4831	0.5549	0.7789	0.7819	0.4286	0.4311	0.5199	0.5206
+gp	1.0436	0.7712	0.7704	0.5604	0.4831	0.5549	0.7789	0.7819	0.4286	0.4311	0.5199	0.5206
0 FBAR 3- 6	0.5448	0.6106	0.5402	0.6263	0.6287	0.5714	0.8327	0.4882	0.37	0.4638	0.4387	0.4529

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	FBAR **-**
AGE										
2	0.1984	0.0927	0.0953	0.0817	0.1117	0.2056	0.2636	0.1288	0.0622	0.1515
3	0.5235	0.3633	0.3416	0.3241	0.3433	0.3495	0.388	0.3504	0.2297	0.3227
4	0.5417	0.4372	0.6097	0.6682	0.4237	0.4547	0.2962	0.3331	0.4563	0.3619
5	0.424	0.5331	0.4235	0.2899	0.6475	0.5768	0.4727	0.5802	0.3655	0.4728
6	0.4722	0.5243	0.289	0.3026	0.4583	0.4868	0.5961	0.441	0.4046	0.4806
7	0.494	0.4856	0.2442	0.2362	0.1674	0.2013	0.4284	0.6229	0.4338	0.4951
+gp	0.494	0.4856	0.2442	0.2362	0.1674	0.2013	0.4284	0.6229	0.4338	
0 FBAR 3- 6	0.4903	0.4645	0.4159	0.3962	0.4682	0.4669	0.4383	0.4262	0.364	

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	24152	29514	28315	24898	26730	28138	32082	35708	35326	24880	26192	23580
3	15407	16241	18627	19793	18919	19467	20782	22254	27970	27550	20708	21223
4	10265	10931	10314	12851	12550	11480	11383	12800	14142	18384	17494	13504
5	7275	6638	7533	6790	8225	7369	6771	6092	7290	8116	10091	7455
6	4472	4648	4140	4627	4236	5261	3674	3432	3531	3751	3861	4337
7	3246	2940	3344	2308	2777	2513	2814	2400	2047	1068	1849	1622
+gp	4343	3018	3941	2380	2425	1291	2395	2203	1719	1326	1317	1884
0 TOTAL	69162	73930	76214	73647	75863	75518	79901	84889	92024	85077	81512	73605

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE												
2	29393	23685	22565	24389	24935	16886	24842	24385	17060	18247	18596	17750
3	18245	23717	17815	16522	19356	17162	12254	17534	17999	12192	12729	13464
4	13817	11582	12824	10840	10086	10841	9319	6544	9864	11135	7737	7298
5	6173	7357	5362	5562	5176	4234	5103	3741	3794	5795	6520	4387
6	3280	3357	3743	2658	2404	2266	2141	1673	2224	2561	3047	3985
7	2217	1353	1536	2210	1155	1266	1195	731	820	1384	1374	1777
+gp	2121	1704	2309	2382	1213	1194	834	481	1000	1519	3967	2439
0 TOTAL	75246	72753	66154	64563	64324	53848	55688	55088	52762	52833	53969	51101

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	GMST 84-**	AMST 84-**
AGE												
2	18538	33953	24110	20305	12946	13080	15751	20152	18246	(21031)	23127	23901
3	12365	13756	28001	19833	16930	10476	9636	10950	16031	15514	17414	18030
4	7254	6628	8655	18005	12979	10867	6683	5915	6979	11529	10848	11260
5	4116	3819	3873	4257	8352	7687	6240	4497	3836	4001	5949	6168
6	2620	2437	2027	2295	2882	3955	3907	3520	2278	2408	3206	3337
7	2406	1479	1305	1374	1534	1649	2199	1948	2049	1375	1741	1868
+gp	3203	2612	1375	2572	3519	3654	1445	1312	2300	2550		
0 TOTAL	50502	64683	69347	68641	59143	51369	45863	48293	51718	37377		

Table 7.10. Bay of Biscay Sole, Summary (without SOP correction)

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR3-6
1984	24152	14809	12316	4038	0.3279	0.3117
1985	29514	16050	13359	4251	0.3182	0.3069
1986	28315	17056	14469	4805	0.3321	0.3652
1987	24898	18636	15462	5086	0.3289	0.371
1988	26730	18485	15336	5382	0.3509	0.4003
1989	28138	17752	14439	5845	0.4048	0.4965
1990	32082	18361	14788	5916	0.4001	0.4538
1991	35708	19046	14747	5569	0.3776	0.4197
1992	35326	20489	15939	6550	0.4109	0.6088
1993	24880	19864	16341	6420	0.3929	0.5261
1994	26192	19246	15809	7229	0.4573	0.6481
1995	23580	17616	14206	6205	0.4368	0.5761
1996	29393	17706	13784	5854	0.4247	0.5448
1997	23685	16449	13295	6259	0.4708	0.6106
1998	22565	16422	13211	6027	0.4562	0.5402
1999	24389	15936	12306	5249	0.4265	0.6263
2000	24935	15494	11830	5760	0.4869	0.6287
2001	16886	13025	10551	4836	0.4583	0.5714
2002	24842	13154	9758	5486	0.5622	0.8327
2003	24385	13315	9596	4108	0.4281	0.4882
2004	17060	14105	11121	4002	0.3599	0.37
2005	18247	14394	11481	4539	0.3953	0.4638
2006	18596	15170	12115	4793	0.3956	0.4387
2007	17750	14106	11245	4363	0.388	0.4529
2008	18538	14058	11163	4299	0.3851	0.4903
2009	33953	15782	11014	3650	0.3314	0.4645
2010	24110	17224	12996	3966	0.3052	0.4159
2011	20305	18671	14879	4632	0.3113	0.3962
2012	12946	16763	14261	4321	0.303	0.4682
2013	13080	15637	13123	4235	0.3227	0.4669
2014	15751	12629	10136	3928	0.3875	0.4383
2015	20152	13241	9860	3644	0.3696	0.4262
2016	18246	14294	11028	3266	0.2962	0.364
Arith. Mean	23616	16212	12908	4985	0.388	0.4843
0Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		
GM93-2014=	21031					

Table 7.11. Multifleet prediction input data

Sole in Bay of Biscay
Multi fleet input data

MFDP version 1a
Run: 2016_unscaled_
Time and date: 15:47 11/04/2017
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input Fs are 2014-2016 means at age 2 to 8
Catch and stock wts are 2014-2016 means
Recruits are 1993-2014 GM
unscaled F

2017

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	21031	0.1	0.32	0	0	0.200	0.1515	0.188
3	15514	0.1	0.83	0	0	0.248	0.3227	0.234
4	11529	0.1	0.97	0	0	0.313	0.3619	0.294
5	4001	0.1	1	0	0	0.339	0.4728	0.320
6	2408	0.1	1	0	0	0.392	0.4806	0.369
7	1375	0.1	1	0	0	0.406	0.4950	0.381
8	2550	0.1	1	0	0	0.572	0.4950	0.540

2018

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	21031	0.1	0.32	0	0	0.200	0.1515	0.188
3		0.1	0.83	0	0	0.248	0.3227	0.234
4		0.1	0.97	0	0	0.313	0.3619	0.294
5		0.1	1	0	0	0.339	0.4728	0.320
6		0.1	1	0	0	0.392	0.4806	0.369
7		0.1	1	0	0	0.406	0.4950	0.381
8		0.1	1	0	0	0.572	0.4950	0.540

2019

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	21031	0.1	0.32	0	0	0.200	0.1515	0.188
3		0.1	0.83	0	0	0.248	0.3227	0.234
4		0.1	0.97	0	0	0.313	0.3619	0.294
5		0.1	1	0	0	0.339	0.4728	0.320
6		0.1	1	0	0	0.392	0.4806	0.369
7		0.1	1	0	0	0.406	0.4950	0.381
8		0.1	1	0	0	0.572	0.4950	0.540

Input units are thousands and kg - output in tonnes

Table 7.12. Bay of Biscay Sole Multifleet prediction, management option table

MFDP version 1a
Run: 2016_unscaled_
Time and date: 15:47 11/04/2017
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Basis

F(2017) = mean F(14-16) unscaled (age 2 to above)
R17 = GM (1993 to n-2) = 21 million

2017

Biomass	SSB	Landings FMult	Landings FBar	Yield
15988	12360	1.0000	0.4095	3964

2018

Biomass	SSB	Landings FMult	Landings FBar	Landing Yield	2019 Biomass	SSB
16587	12936	0.0000	0.0000	0	21909	18102
.	12936	0.1000	0.0409	490	21334	17543
.	12936	0.2000	0.0819	963	20781	17006
.	12936	0.3000	0.1228	1418	20248	16489
.	12936	0.4000	0.1638	1856	19735	15992
.	12936	0.5000	0.2047	2279	19240	15512
.	12936	0.6000	0.2457	2686	18764	15051
.	12936	0.7000	0.2866	3079	18304	14606
.	12936	0.8000	0.3276	3457	17862	14178
.	12936	0.9000	0.3685	3822	17435	13766
.	12936	1.0000	0.4095	4174	17024	13368
.	12936	1.1000	0.4504	4513	16628	12985
.	12936	1.2000	0.4914	4840	16246	12617
.	12936	1.3000	0.5323	5156	15877	12261
.	12936	1.4000	0.5733	5460	15521	11918
.	12936	1.5000	0.6142	5754	15179	11588
.	12936	1.6000	0.6552	6037	14848	11270
.	12936	1.7000	0.6961	6311	14529	10962
.	12936	1.8000	0.7371	6575	14220	10666
.	12936	1.9000	0.7780	6830	13923	10381
.	12936	2.0000	0.8190	7077	13636	10105

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_unscaled_
Time and date: 15:47 11/04/2017
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Year: 2017 F multiplier: 1 Fleet1 HCFba 0.4095

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1515	2818	531	21031	4213	6730	1348	6730	1348
3	0.3227	4083	957	15514	3853	12877	3198	12877	3198
4	0.3619	3341	983	11529	3605	11183	3497	11183	3497
5	0.4728	1440	460	4001	1358	4001	1358	4001	1358
6	0.4806	878	324	2408	944	2408	944	2408	944
7	0.495	513	196	1375	558	1375	558	1375	558
8	0.495	951	514	2550	1458	2550	1458	2550	1458
Total		14024	3964	58408	15988	41124	12360	41124	12360

Year: 2018 F multiplier: 1 Fleet1 HCFba 0.4095

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1515	2818	531	21031	4213	6730	1348	6730	1348
3	0.3227	4304	1009	16354	4061	13574	3371	13574	3371
4	0.3619	2946	867	10166	3179	9861	3083	9861	3083
5	0.4728	2615	836	7264	2465	7264	2465	7264	2465
6	0.4806	823	304	2256	884	2256	884	2256	884
7	0.495	503	192	1347	547	1347	547	1347	547
8	0.495	808	436	2165	1238	2165	1238	2165	1238
Total		14815	4174	60584	16587	43198	12936	43198	12936

Year: 2019 F multiplier: 1 Fleet1 HCFba 0.4095

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1515	2818	531	21031	4213	6730	1348	6730	1348
3	0.3227	4304	1009	16354	4061	13574	3371	13574	3371
4	0.3619	3106	914	10716	3351	10395	3250	10395	3250
5	0.4728	2306	737	6406	2174	6406	2174	6406	2174
6	0.4806	1494	551	4097	1606	4097	1606	4097	1606
7	0.495	471	180	1263	512	1263	512	1263	512
8	0.495	723	390	1937	1107	1937	1107	1937	1107
Total		15220	4311	61803	17024	44401	13368	44401	13368

Input units are thousands and kg - output in tonnes

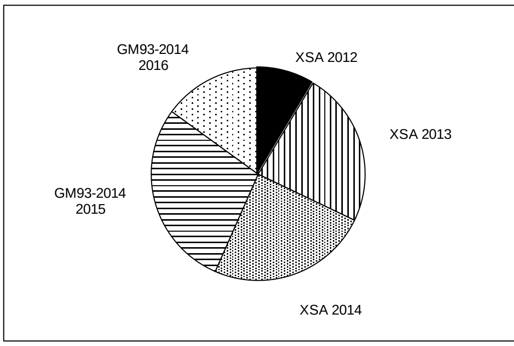
Table 7.14. Stock numbers of recruits and their source for recent year classes used in predictions and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2012	2013	2014	2015	2016	2017
Stock No. (thousands) of 2 year-olds	15751	20152	18246	21031	21031	21031
Source	XSA	XSA	XSA	GM93-2014	GM93-2014	GM93-2014
Status Quo F:						
% in 2017 landings	11.6	24.8	24.1	13.4	-	-
% in 2018	7.3	20.0	20.8	24.2	12.7	-
% in 2017 SSB	11.0	28.3	25.9	10.9	-	-
% in 2018 SSB	6.8	19.1	23.8	26.1	10.4	-
% in 2019 SSB	3.8	12.0	16.3	24.3	25.2	10.1

GM : geometric mean recruitment

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

a) 2018 landings



b) 2019 SSB

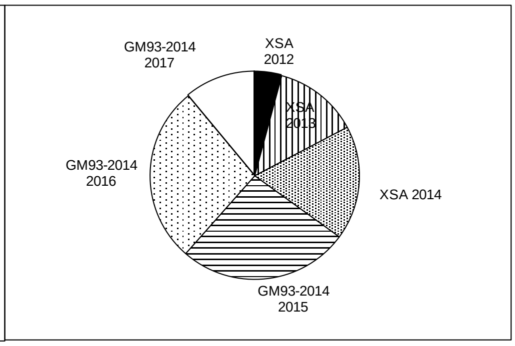


Table 7.15a. Bay of Biscay Sole Multifleet Yield per recruit

MFYPR version 2a
Run: 2016_unscaled_
Time and date: 15:48 11/04/2017
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	4.7381	9.6499	4.5560	9.6499	4.5560
0.1000	0.0409	0.2918	0.1230	7.5936	3.1312	6.7387	2.9500	6.7387	2.9500
0.2000	0.0819	0.4400	0.1739	6.1151	2.3390	5.2635	2.1588	5.2635	2.1588
0.3000	0.1228	0.5303	0.1979	5.2153	1.8725	4.3670	1.6931	4.3670	1.6931
0.4000	0.1638	0.5915	0.2097	4.6067	1.5676	3.7616	1.3891	3.7616	1.3891
0.5000	0.2047	0.6359	0.2156	4.1653	1.3542	3.3233	1.1765	3.3233	1.1765
0.6000	0.2457	0.6698	0.2182	3.8290	1.1973	2.9900	1.0205	2.9900	1.0205
0.7000	0.2866	0.6966	0.2191	3.5632	1.0776	2.7272	0.9015	2.7272	0.9015
0.8000	0.3276	0.7185	0.2190	3.3471	0.9833	2.5141	0.8080	2.5141	0.8080
0.9000	0.3685	0.7367	0.2184	3.1674	0.9074	2.3372	0.7329	2.3372	0.7329
1.0000	0.4095	0.7522	0.2175	3.0152	0.8450	2.1877	0.6712	2.1877	0.6712
1.1000	0.4504	0.7655	0.2164	2.8843	0.7928	2.0596	0.6197	2.0596	0.6197
1.2000	0.4914	0.7771	0.2153	2.7704	0.7485	1.9482	0.5761	1.9482	0.5761
1.3000	0.5323	0.7873	0.2142	2.6700	0.7105	1.8505	0.5387	1.8505	0.5387
1.4000	0.5733	0.7965	0.2132	2.5809	0.6774	1.7638	0.5063	1.7638	0.5063
1.5000	0.6142	0.8046	0.2122	2.5011	0.6484	1.6864	0.4779	1.6864	0.4779
1.6000	0.6552	0.8120	0.2112	2.4290	0.6226	1.6168	0.4529	1.6168	0.4529
1.7000	0.6961	0.8188	0.2102	2.3637	0.5997	1.5538	0.4305	1.5538	0.4305
1.8000	0.7371	0.8249	0.2093	2.3040	0.5791	1.4965	0.4105	1.4965	0.4105
1.9000	0.7780	0.8306	0.2085	2.2493	0.5605	1.4440	0.3925	1.4440	0.3925
2.0000	0.8190	0.8358	0.2077	2.1989	0.5436	1.3958	0.3762	1.3958	0.3762

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.4095
FMax	0.7349	0.3009
F0.1	0.2745	0.1124
F35%SPR	0.3283	0.1344

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
4574	14116

GM (93-14) for recruits (age 2)
21031

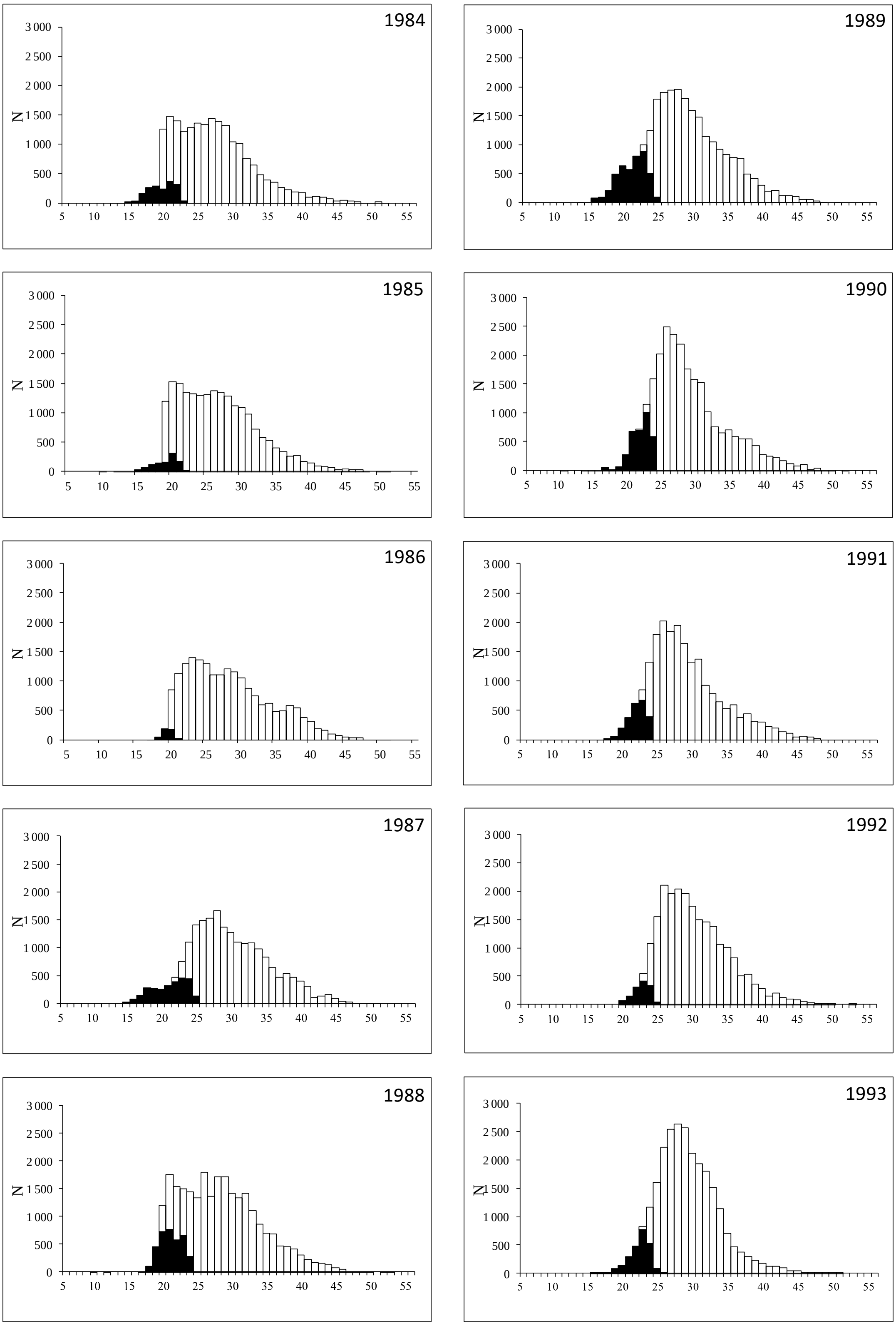


Figure 7.1 a: **Bay of Biscay sole French length distribution from 1984 to 1993**

Total French landings
Discard estimates of the French offshore trawlers fleet

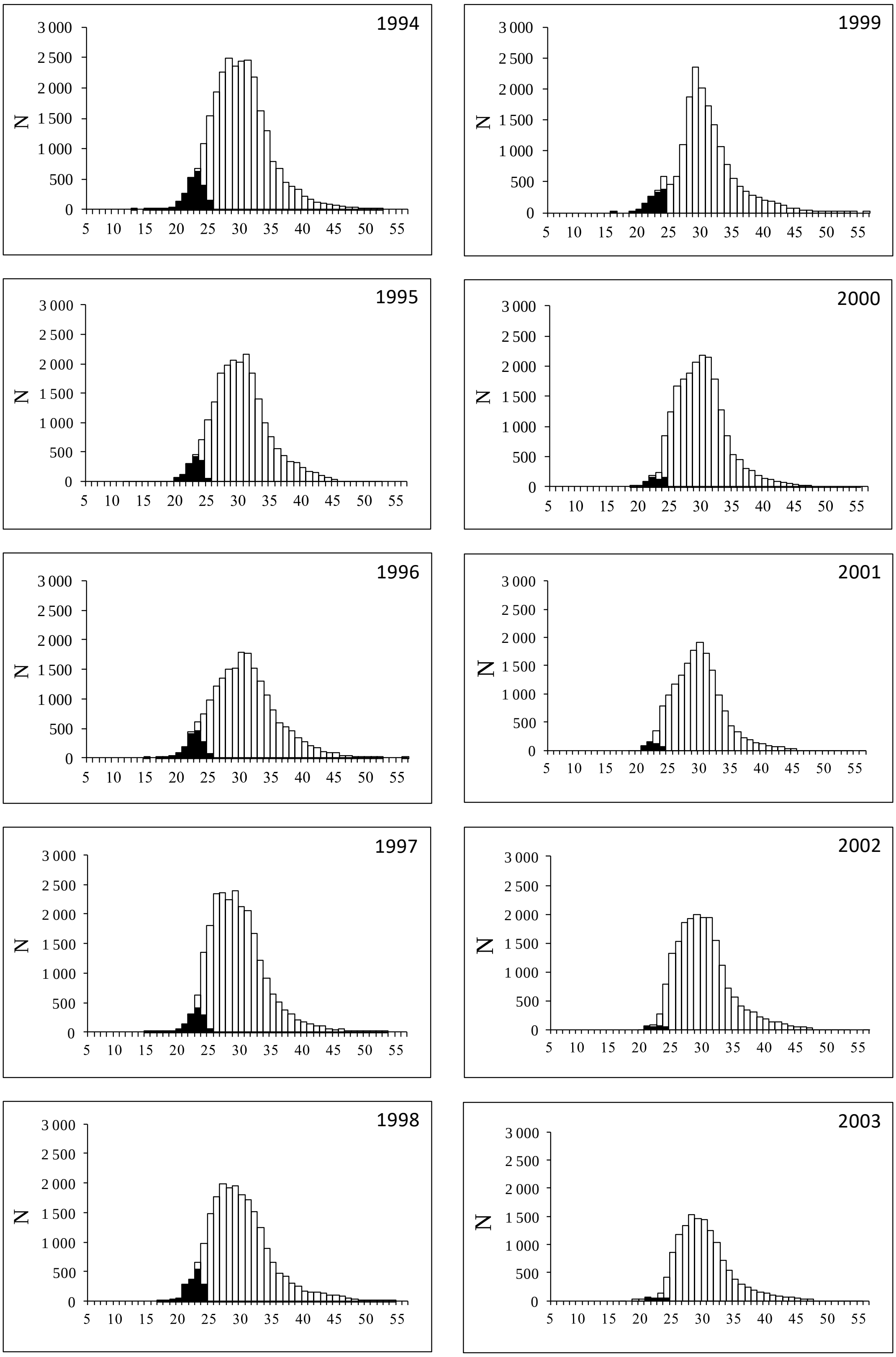


Figure 7.1 b: Bay of Biscay sole French length distribution from 1994 to 2003

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

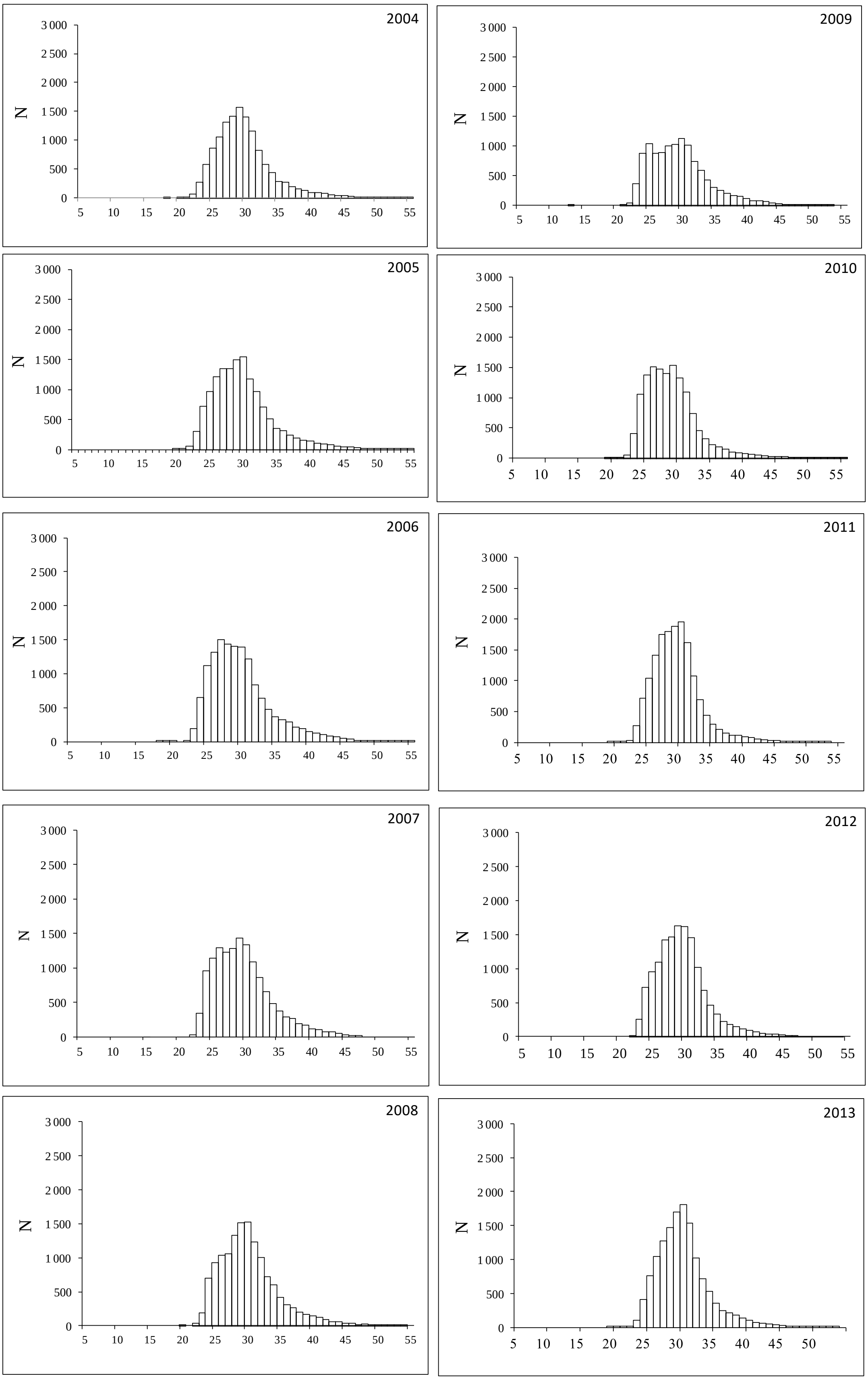


Figure 7.1 c: Bay of Biscay sole French length distribution from 2004 to 2013

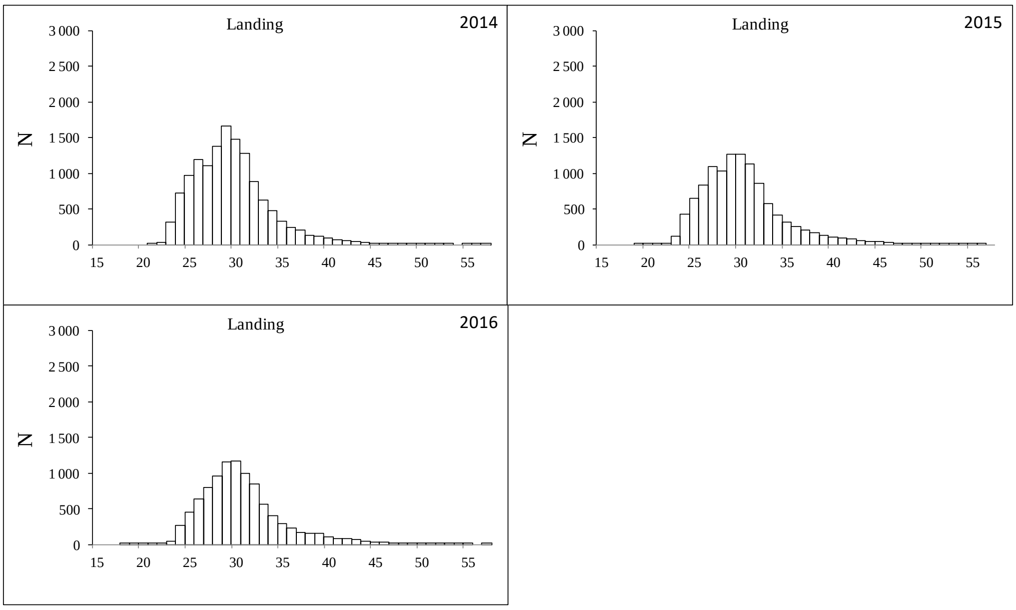
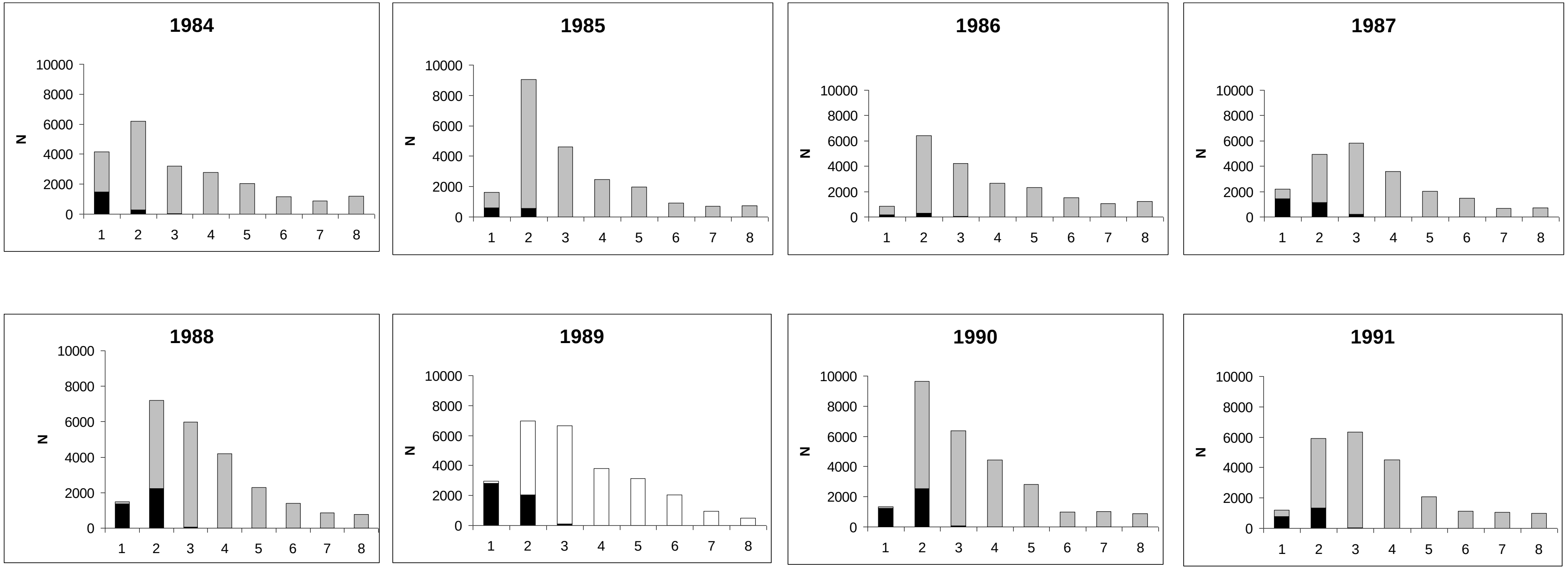


Figure 7.1 d: Bay of Biscay sole French length distribution from 2014 to 2016


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

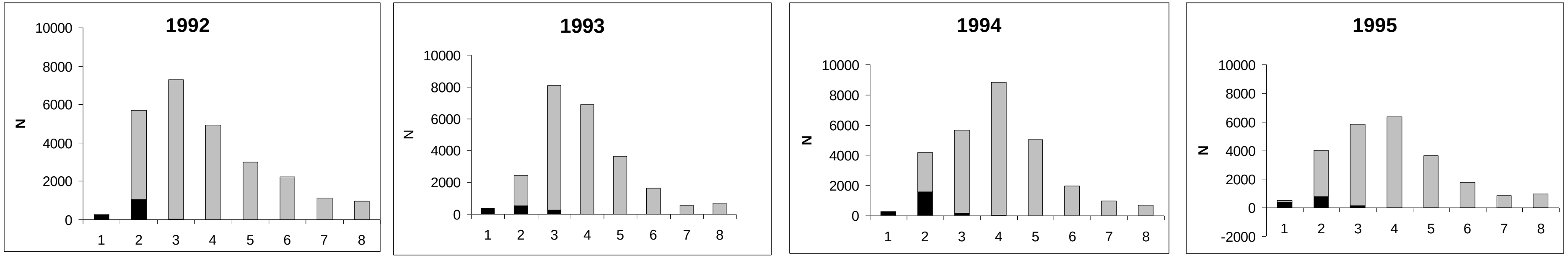
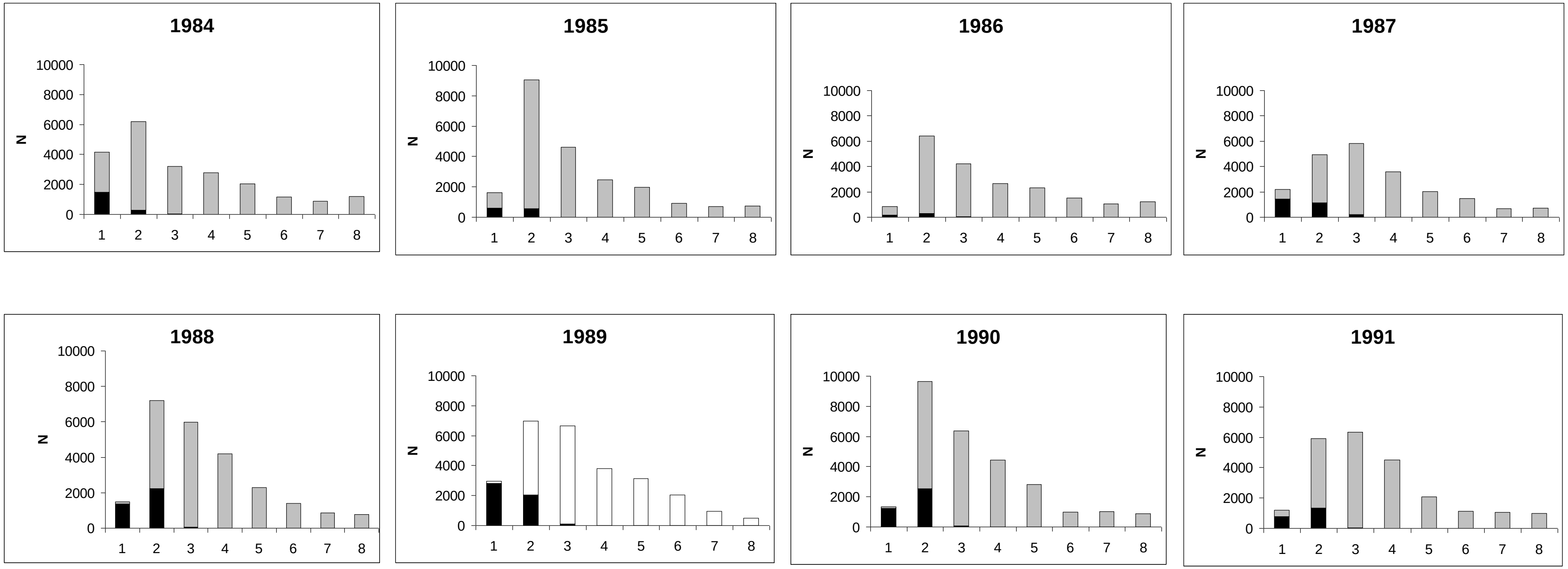


Figure 7.2 a: Bay of Biscay sole landings and discards age distributions from 1984 to 1995

(numbers in thousand)

Total landings
Discard estimates of the French offshore trawlers fleet


1984
1985
1986
1987
1988
1989
1990
1991
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10000
8000
6000
4000
2000
0
1 2 3 4 5 6 7 8

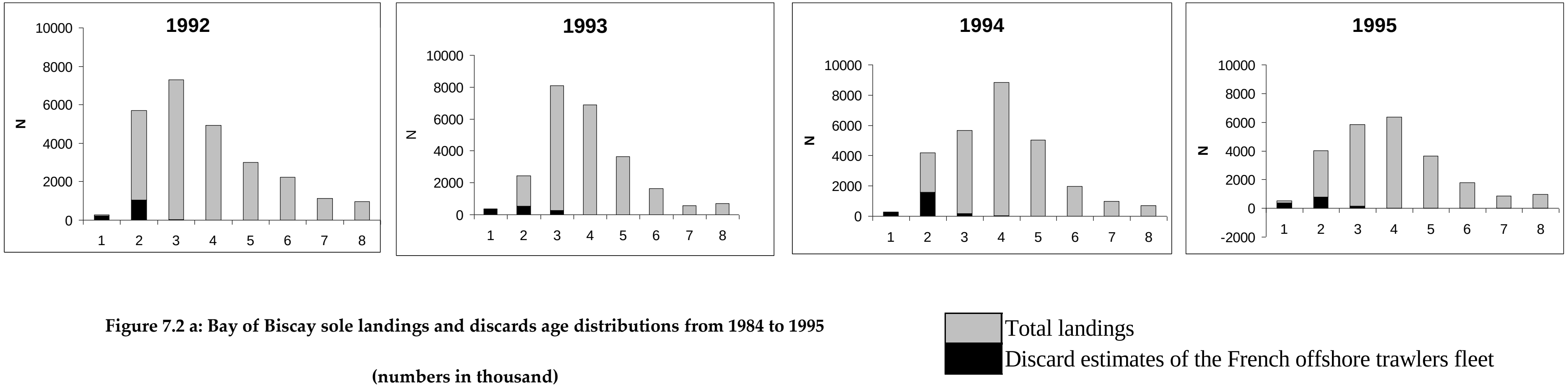
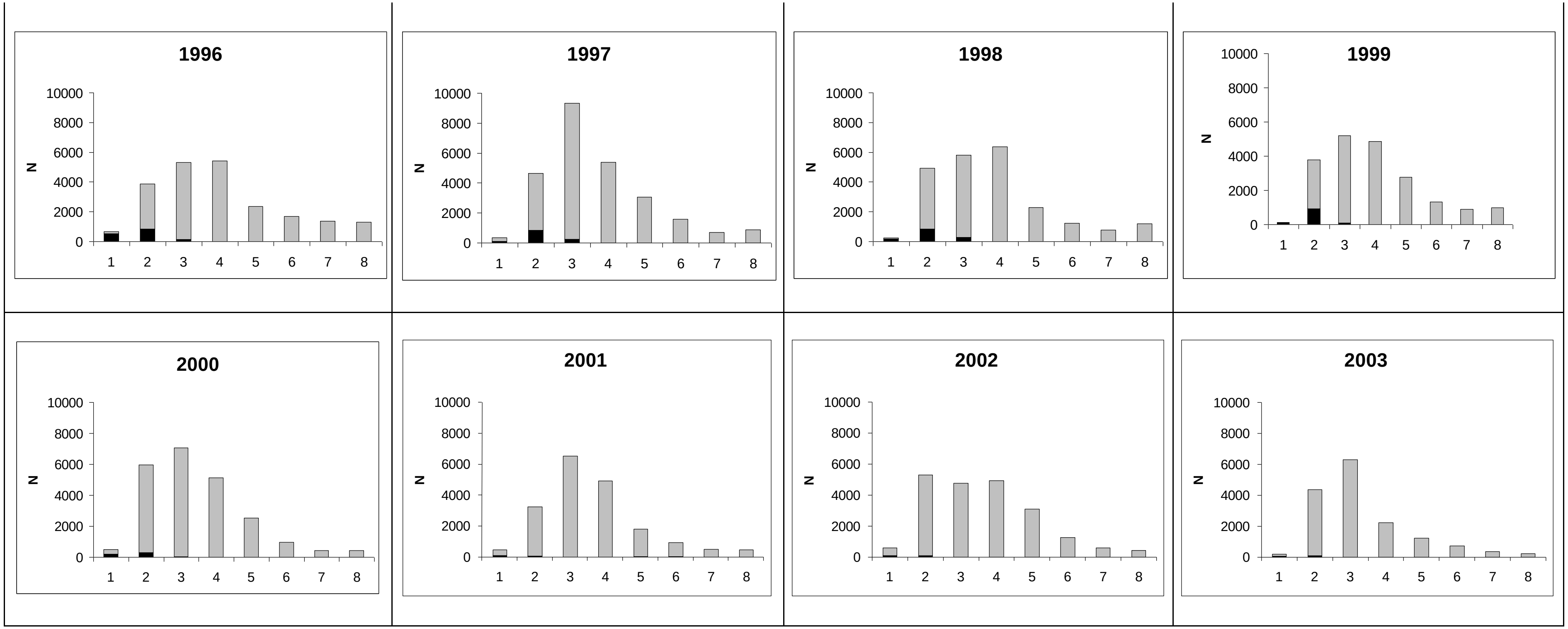


Figure 7.2 a: Bay of Biscay sole landings and discards age distributions from 1984 to 1995

(numbers in thousand)


1996
1997
1998
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2000
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2002
2003
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10000
8000
6000
4000
2000
0
1 2 3 4 5 6 7 8

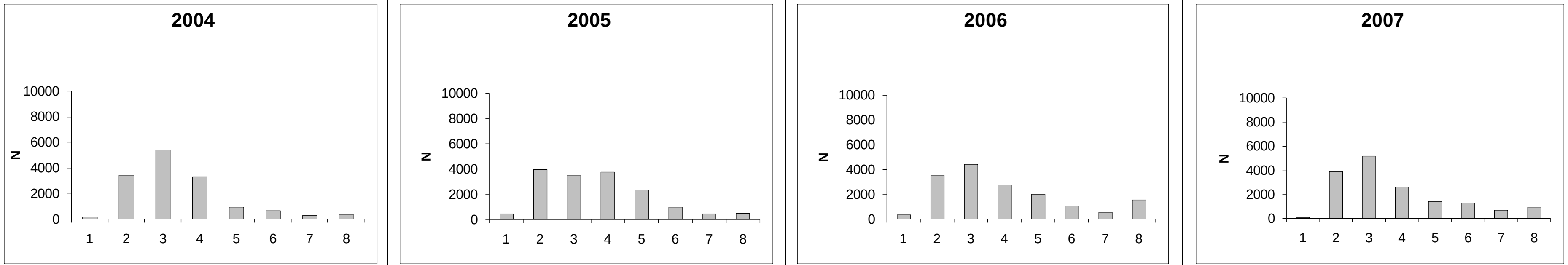
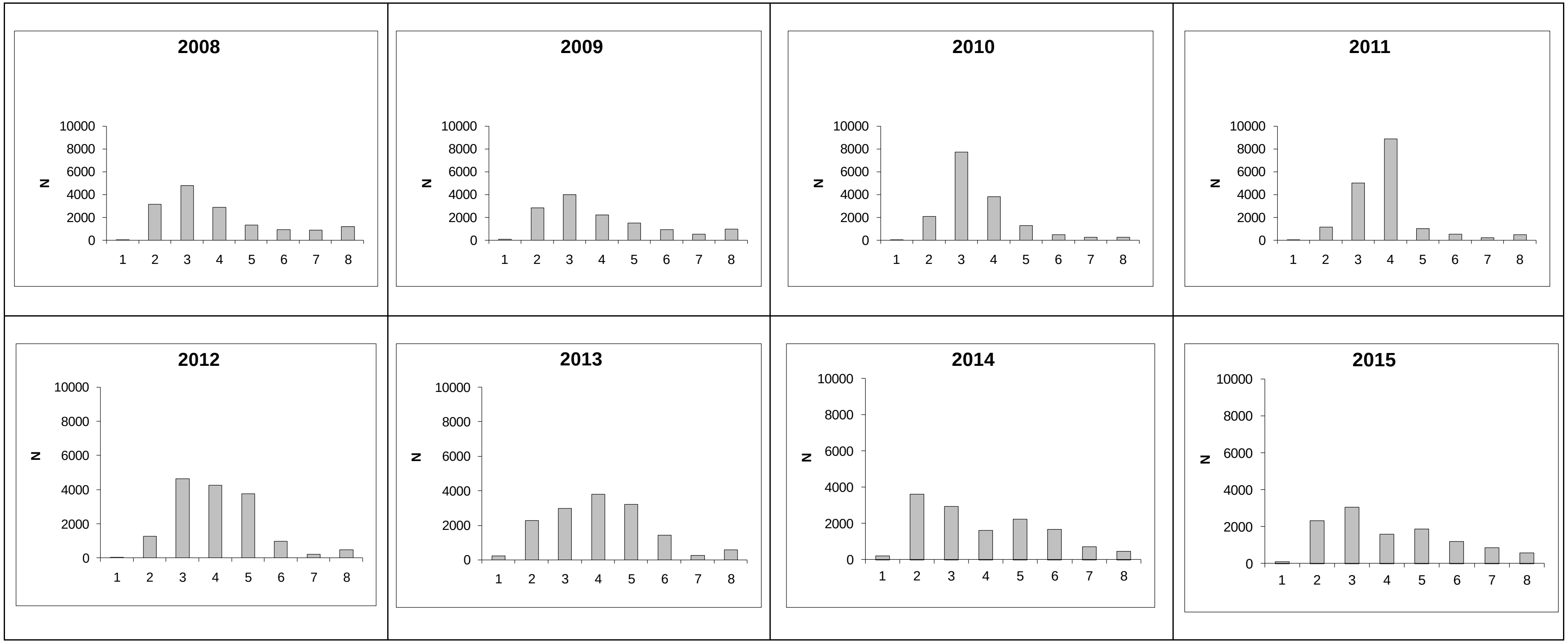


Figure 7.2 b: Bay of Biscay sole landings and discards age distributions from 1996 to 2007

(numbers in thousand)

Total landings
Discard estimates of the French offshore trawlers fleet


2008
2009
2010
2011
2012
2013
2014
2015
N
10000
8000
6000
4000
2000
0
1 2 3 4 5 6 7 8

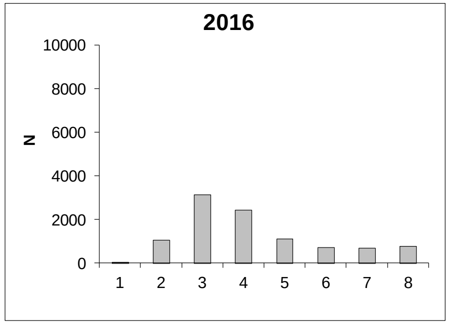


Figure 7.2 c: Bay of Biscay sole landings and discards age distributions from 2008 to 2016 **(numbers in thousand)**

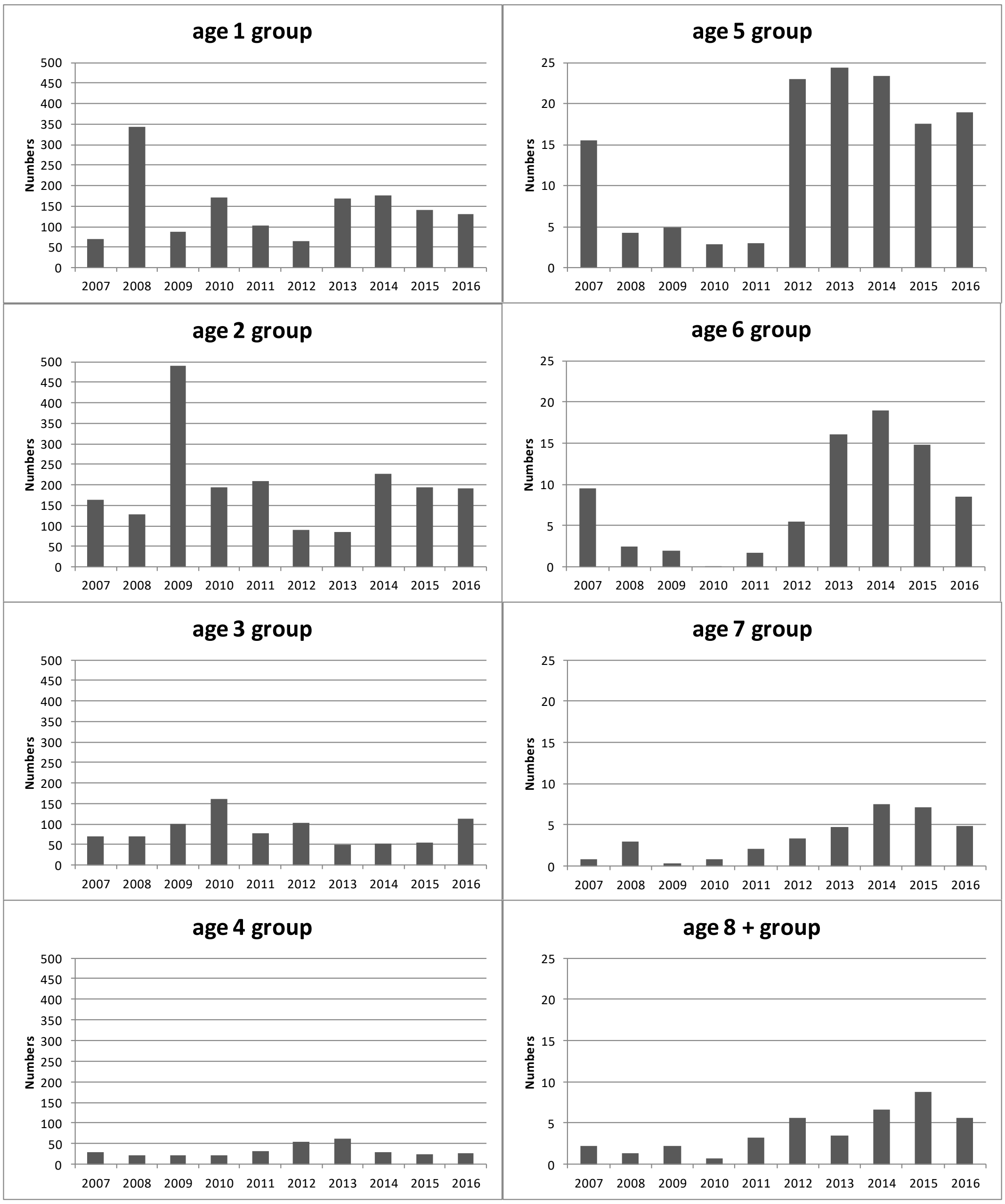


Figure 7.3: Orhago survey time series

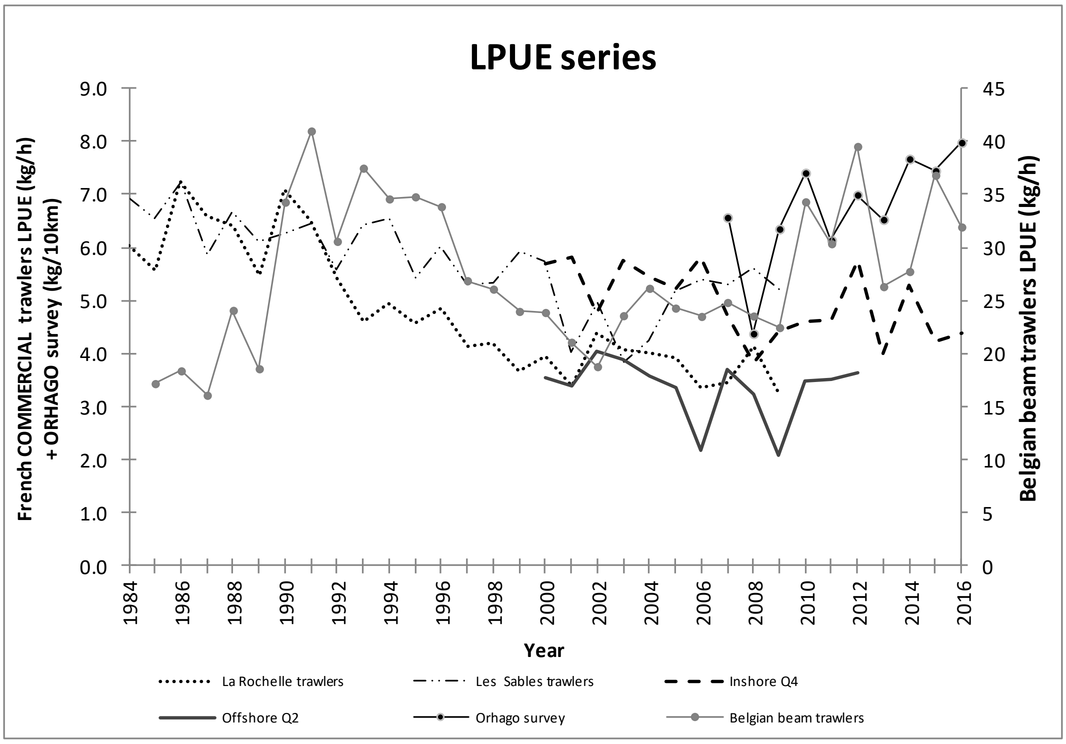


Figure 7.4: Bay of Biscay sole (Division 8a,b). lpue trends of the 5 available commercial tuning fleets and CPUE of the ORHAGO survey (for sole greater than the minimum landing size, i.e. 24 cm).

LOG CATCHABILITY RESIDUAL PLOTS (XSA)

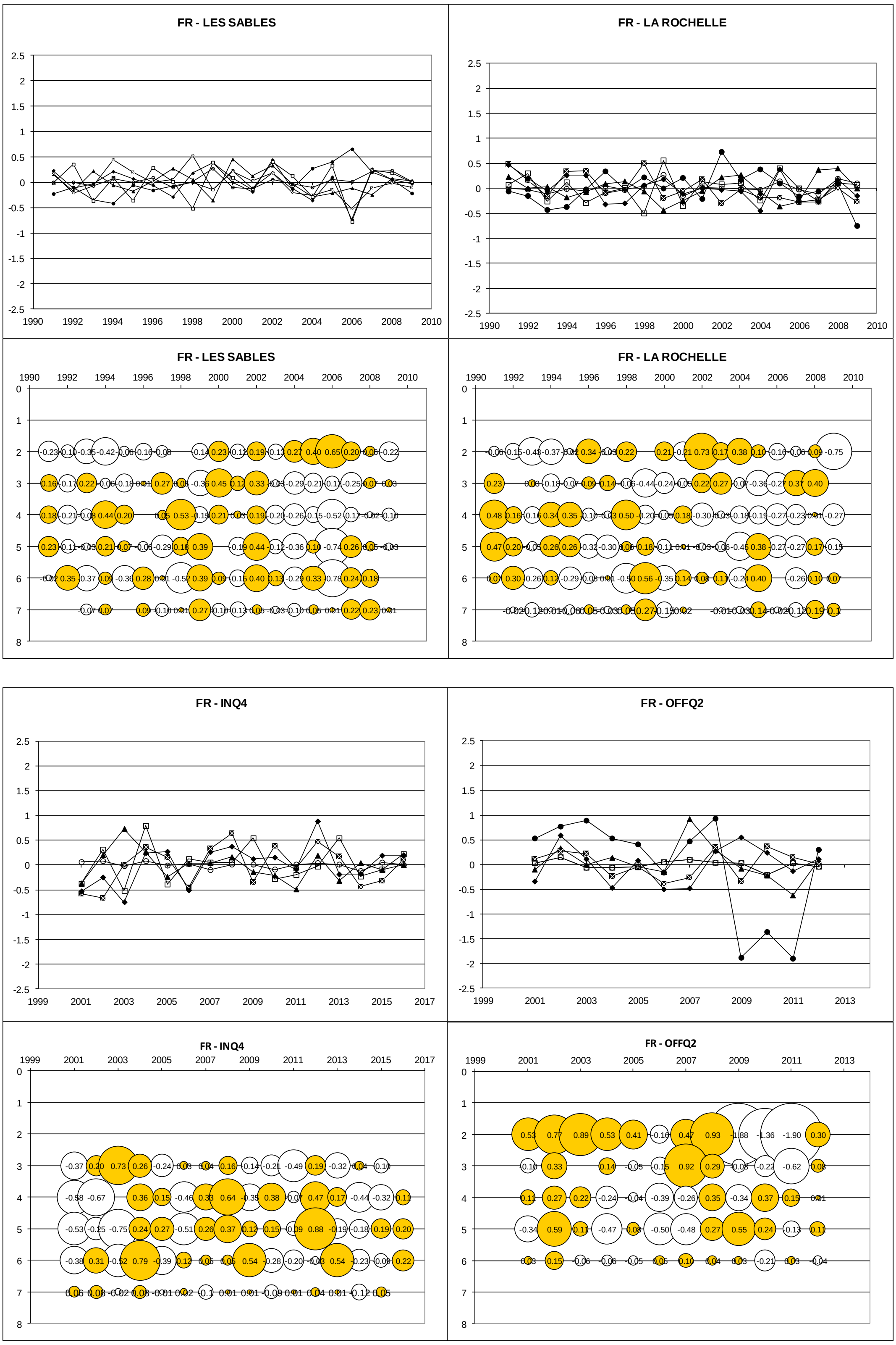


Figure 7.5a: Bay of Biscay sole (Division 8a,b)

XSA (No Taper, mean q, s.e. shrink = 2.5, s.e. min = .2)

LOG CATCHABILITY RESIDUAL PLOTS (XSA)

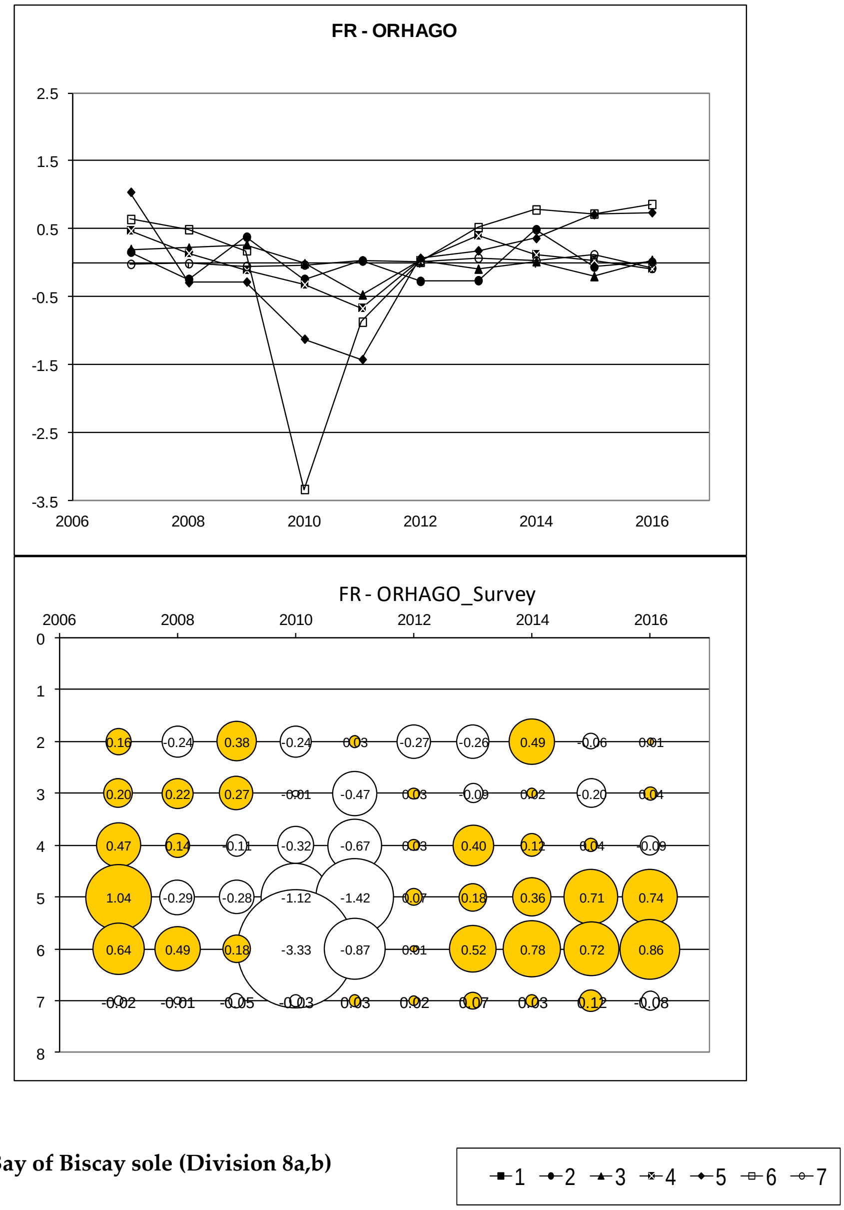


Figure 7.5b: Bay of Biscay sole (Division 8a,b)

XSA (No Taper, mean q, s.e. shrink = 2.5, s.e. min = .2)

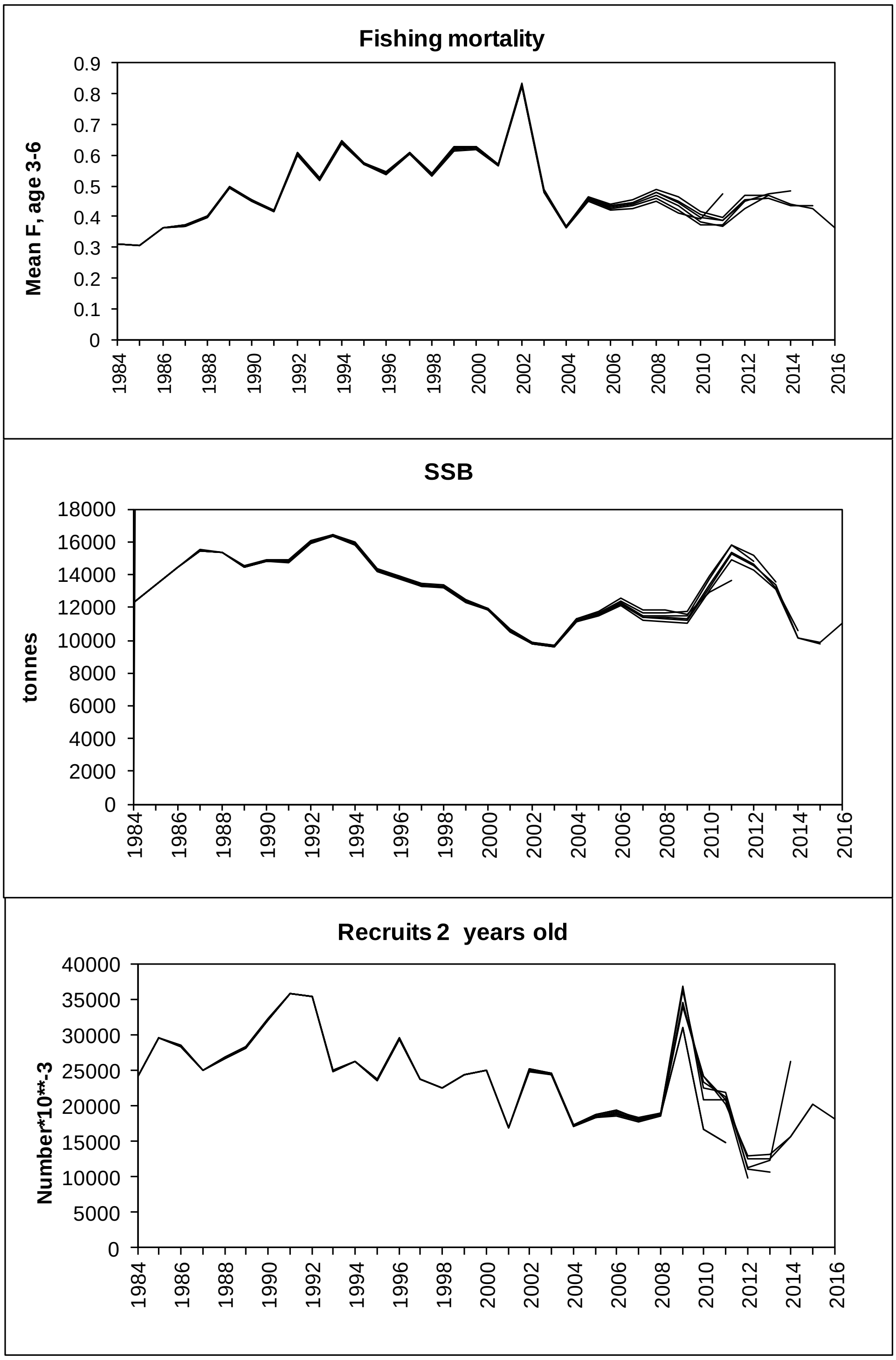


Figure 7.6: Bay of Biscay sole (Division 8a,b) - Retrospective results

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

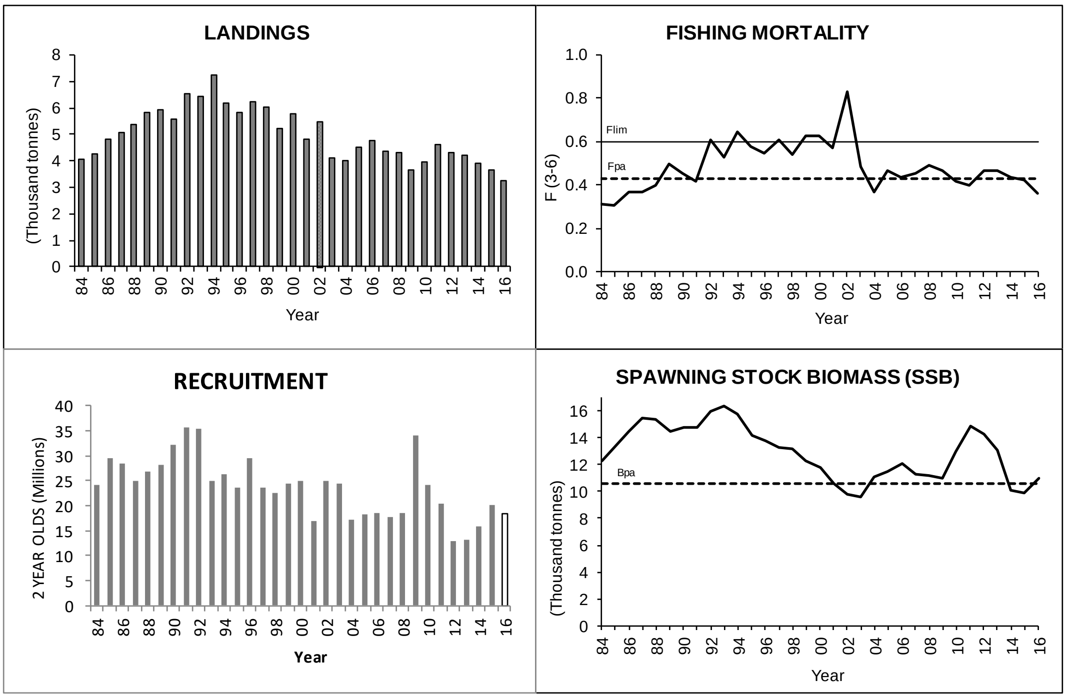
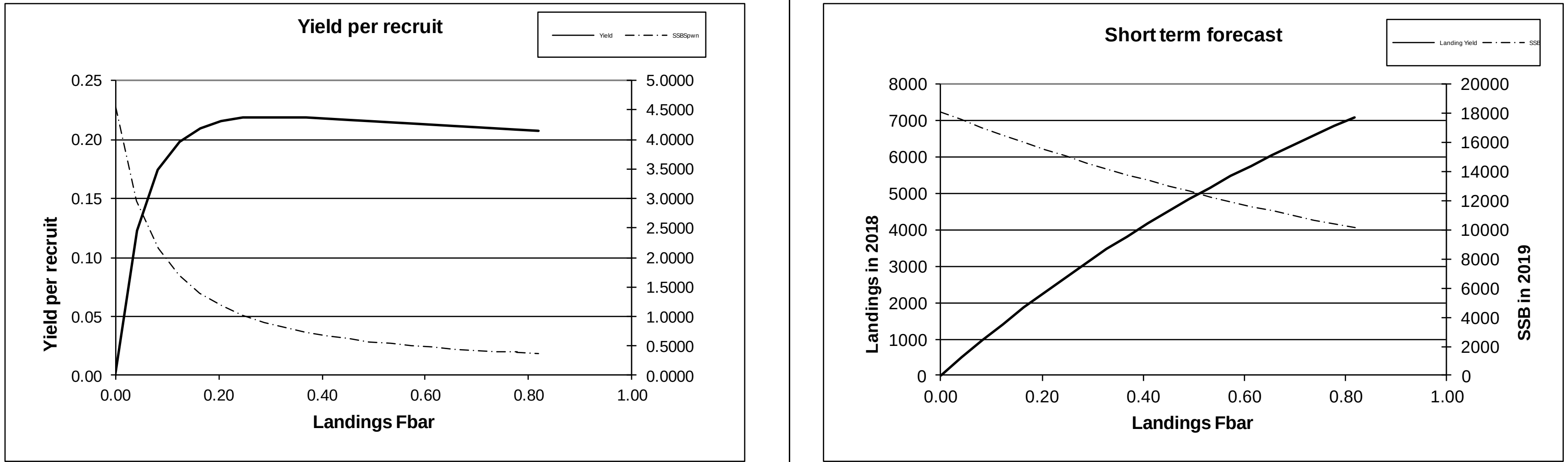


Figure 7.7: Sole in Division 8a,b (Bay of Biscay) – Trends for Landings, F, R, SSB



MFYPR version 2a
Run: 2016_unscaled_
Time and date: 15:48 11/04/2017

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.4095
FMax	0.7349	0.3009
F0.1	0.2745	0.1124
F35%SPR	0.3283	0.1344

Weights in kilograms

MFDP version 1a
Run: 2016_unscaled_
Time and date: 15:47 11/04/2017
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 8a,b (Bay of Biscay)

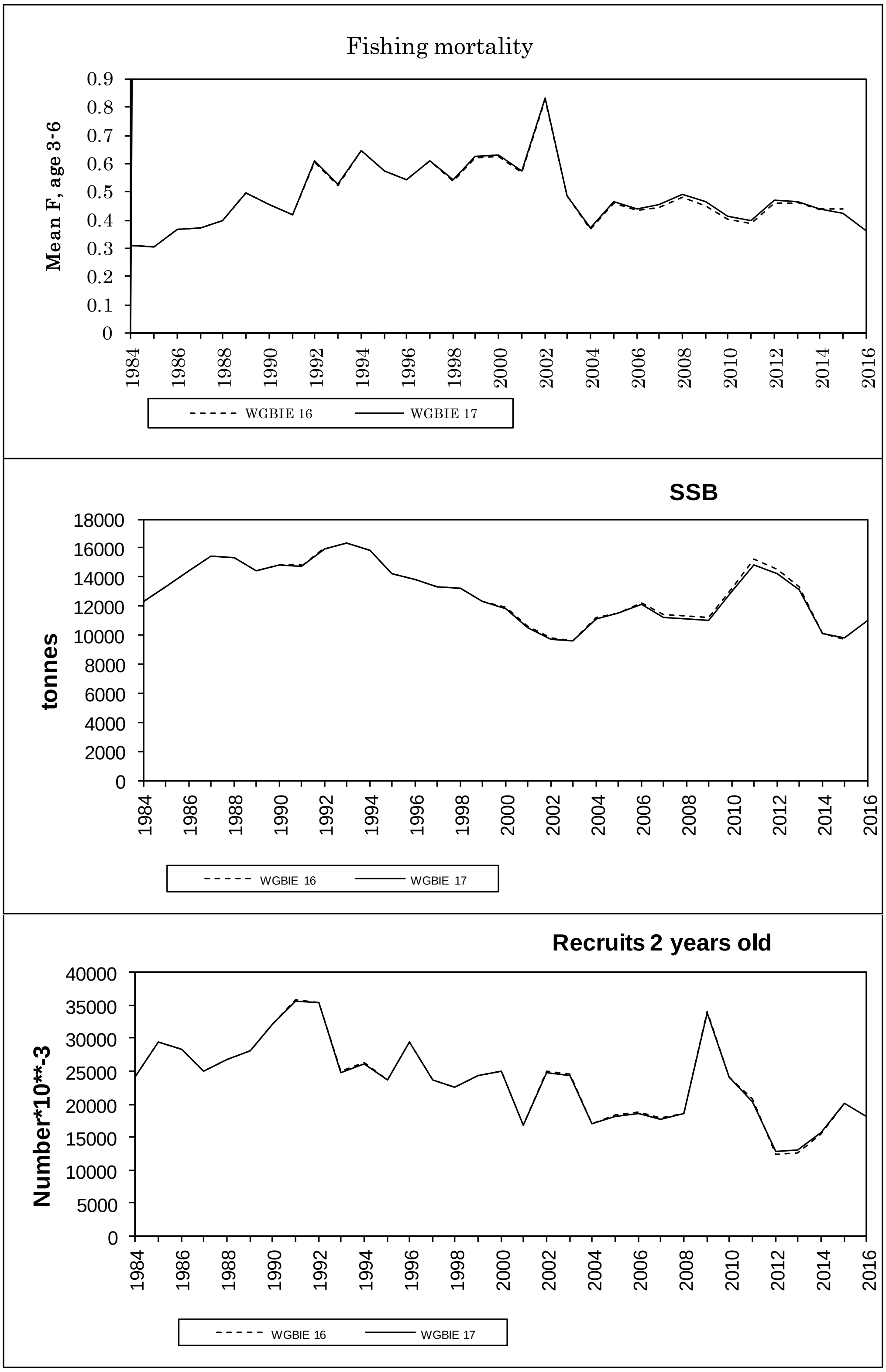


Figure 7.9: Bay of Biscay sole (Division 8a,b) - WG16 / WG17 comparison

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 25 cm 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).

Growth studies based on S. *solea* otolith readings in the Portuguese coast indicate Linf of 52.1 cm 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 trawl nets, fishing grounds and vessel's size. A precautionary TAC is in place for *Solea spp*. in ICES divisions 8.ce, subareas 9 and 10. Sole is under the Landing Obligation in Divisions 8.abde (all bottom trawls, mesh sizes between 70 mm and 100 mm, all beam trawls, mesh sizes between 70 mm and 100 mm and all trammel and gill nets, mesh size larger or equal to 100 mm) and in Division 9.a (all trammel nets and gill nets, mesh size larger or equal to 100 mm). In Portugal all catches of sole from all gears and mesh sizes are under the landing obligation (more restrictively than required by European regulations).

8.4 Fisheries data

Table 8.4.1 presents sole species landings from the official statistics for Division 8.c and 9.a. There is some evidence that *Solea* spp. May have been misclassified in the past for Portuguese landings in Division 9.a, which means *Solea solea* official landings might not then have corresponded only to this species but a mix of *Solea solea* with very few *Solea senegalensis* and some *Pegusa lascaris*. Using port sampling length data, it was possible to separate the *Solea* spp. **a**nd apply the proportions to provide a raised landings total for: *Solea solea* and an additional mix, for Portuguese landings in Division 9.a (Borges, *et al***.,** 2014). Landings of *Pegusa lascaris* are not considered here, since the species is not under a TAC management regime.

Based on the DCF discard sampling in Portugal and Spain, discards for Sole (*Solea solea*) are considered negligible (zero in both 2015 and 2016). Presently, only damaged specimens are discarded, while specimens under the minimum conservation reference size are landed under the landing obligation (in negligible numbers).

Based on negligible discards, Figure 8.4.1 shows the trend in catches for the available time series.

Landings length compositions for *Solea solea* (MLS = 24 cm) are presented for the Portuguese area, from Borges *et al.* (2014) (Figure 8.4.2) and for the most recent sampling year (Figure 8.4.3), 2016, from a sampling effort of 276 samples consisting of a total of 5 612 individuals.

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). A series of abundance indices from Spanish research surveys is available (Figure 8.5.1).

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 from 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, namely *Solea senegalensis*, the information is only partially available in the official catches reported to ICES. The best option would presently appear to be to provide advice for *Solea solea* from the official landings. This may be provided to the EU which can set a TAC for common sole in Divisions 8.c and 9.a and request a delegated TAC for the other species to be defined by Spain and Portugal.

Advice has been provided on the basis of a category 5 stock, but this may be progressed to a category 3, either inter-setionally or next year

Table 8.4.1. *Solea solea* in Divisions 8.c and 9.a. Landings in tonnes.

Year	*Solea solea*	Solea spp*	Total
2000	159	741	900
2001	189	653	842
2002	115	508	623
2003	116	670	786
2004	171	668	839
2005	520	446	966
2006	467	203	670

2007	380	180	560
2008	454	211	665
2009	450	199	649
2010	581	283	864
2011	644	86	730
2012	589	39	628
2013	687	34	721
2014	681	41	722
2015	646	43	689
2016	557	-	557

*** *Solea* spp. (*S. solea,* and *S. senegalensis*).**

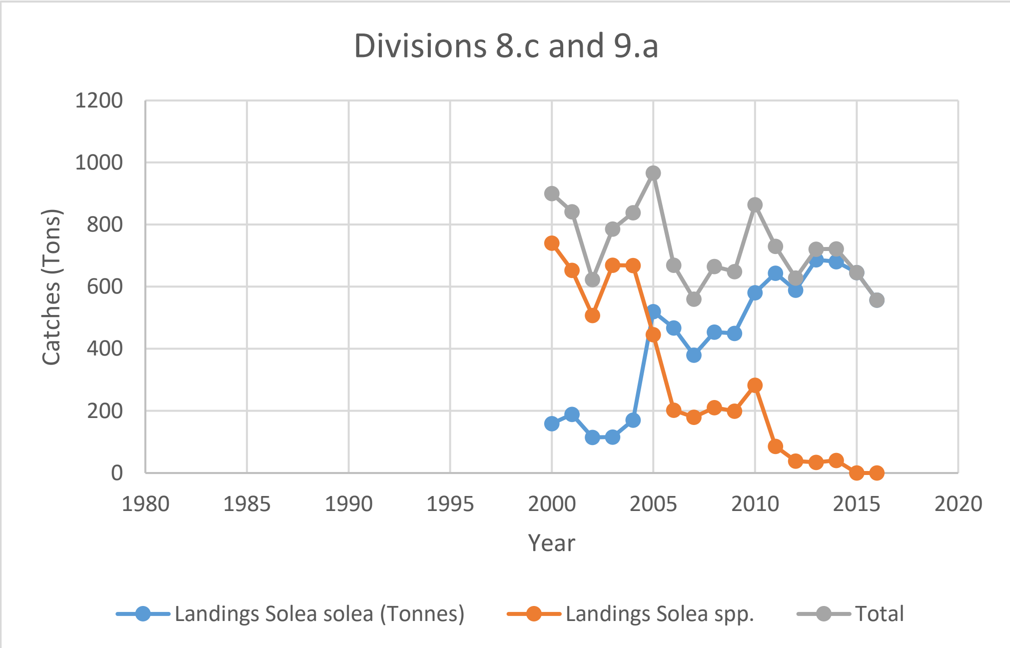


Figure 8.4.1. *Solea solea* catches from 2000, including *Solea senegalensis* in *Solea* spp. and the total of the two.

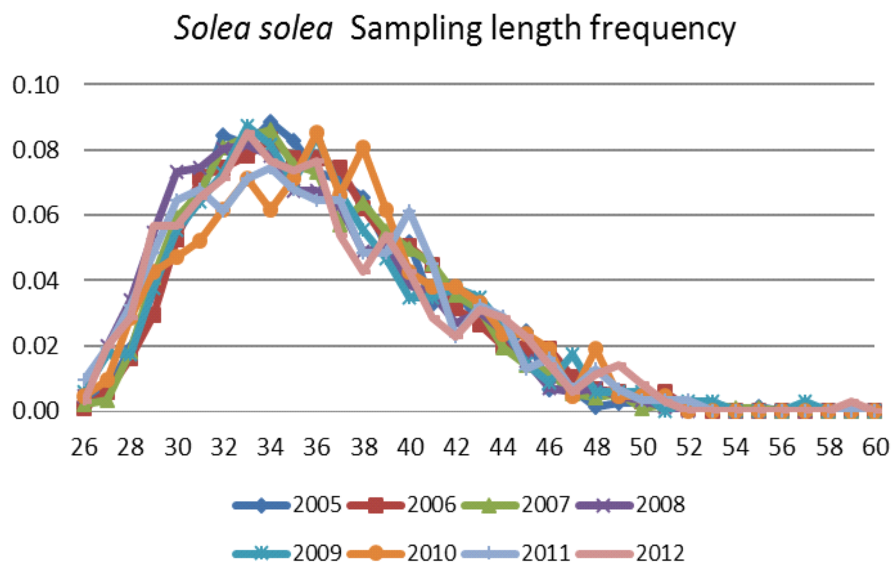


Figure 8.4.2. Division 9.a (Portugal. *Solea solea* sampling length frequency from all métiers harbour sampling DCF-IPMA.

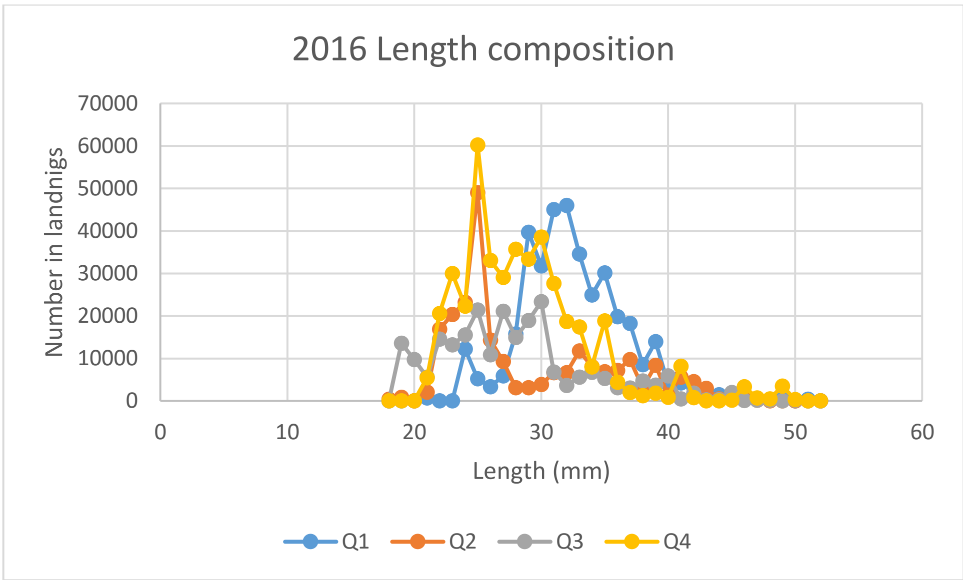


Figure 8.4.3. Quarterly length-frequency distribution for *Solea solea* from ICES 9.a.

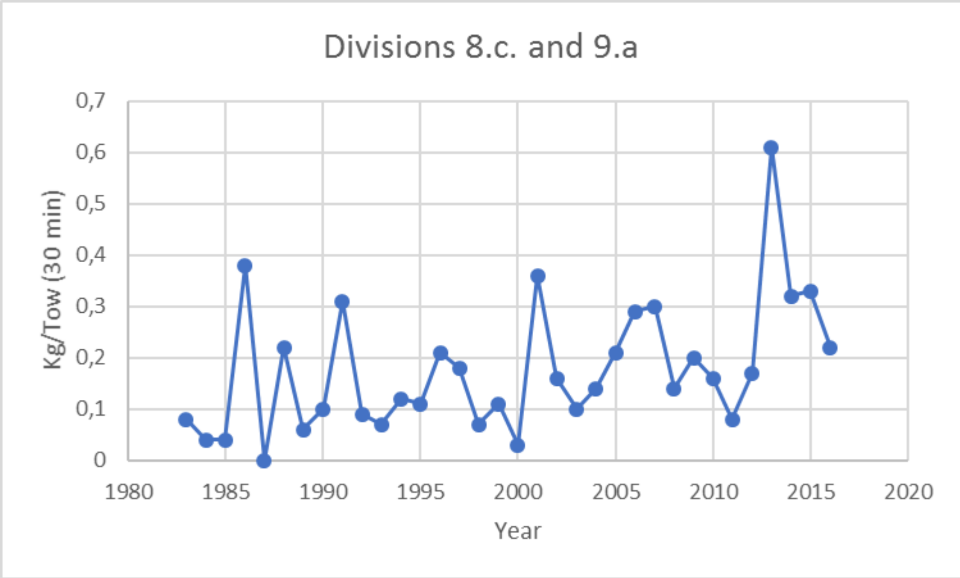


Figure 8.5.1. Spanish Survey derived abundance index for *Solea solea*.

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

Type of assessment: update (stock benchmarked in 2014), stock on observation list.

Data revisions: Northern Ireland Discards for 2015 included (~4t). EVHOE survey index revised.

Review Group issues: In 2016 a detailed review was made by the University of Maine. Most of the issues raised will be considered in the next benchmark. Additionally, the review group highlighted the year effect in some survey residuals and the high retrospective pattern.

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 2017

The stock was considered to be above any potential MSY $B_{trigger}$. Following the ICES MSY framework implied fishing mortality to be reduced to 0.28, resulting in landings of 111 865 t and total catches of 123 777 t in 2017.

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)	2011	2012	2013	2014	2015	2016	2017
3a, 3b,c,d (EC Zone)	1661	1661	2093	2466	2738	2997	3371
2a (EC Zone), 4	1935	1935	2438	2874	3190	3492	3928
Vb (EC Zone), 6, 7, XII, XIV	30900	30900	38938	45896	50944	61902	67658
8a,b,d,e	20609	20609	25970	30610	33977	40393	8767
Total Northern Stock [IIa-8abd]	55105	55105	69 440	81846	90849	108784	119765

Management for 2016 and 2017

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 3a) 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 on board. 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 TACs for 2016 and 2017 (108 784 t and 119 765 t) were slightly below the ICES advised TAC (109 592 t and 123 777 t respectively). 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 3a, Subareas 4, 6 and 7, and Divisions 8a,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. In 2014 and 2015, the differences between scientific and official landings decreased greatly which produced a big decrease in unallocated landings. In 2017 the unallocated landings were reported by area so they are now included in the corresponding area and the unallocated column is no longer needed in Table 9.1. 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 107 500 t in 2015, the highest in the whole time series. The catches in 2016, 118 600 t, were above the 2016 TAC (108 784 t).

The discard data sampling and data availability are presented in the Stock Annex. Table 9.2 presents discard data available to the group from 2006 to 2016. 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. In 2016, the discards have increased for all the fleets expect for Spanish trawlers in area seven. In turn, the number of individuals have increased in a higher proportion, for all the fleets except for OTHER. Overall, in the las year the mean weight of the discarded individuals have decreased in a 50%.

9.2.2 Biological sampling

The sampling level is given in Table 1.3.

Length compositions of the 2016 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 to 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 five peaks in 2002, 2004, 2008, 2012 and 2016. 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 the last two years the index has increased and the index in 2016 almost triplicates the value of 2015.

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%. The index increased in the last two years but the increase in 2016 was not as sharp as that observed in EVHOE index.

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. In 2016 the index decreased again but the decrease was moderate. 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 9.2 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. In 2016 a significant recruitment increased was observed in the whole area and the increase specially marked in the Bay of Biscay.

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 1982–2016 are given in Table 9.4 and Figure 9.3.

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 considered 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 pair trawlers operating in Divisions 8a,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 was reported as it is now using e-logbooks for the first time.

Assessment

This is an update assessment.

9.2.5 Input data

See Stock Annex (under "*Input data for SS3*").

9.2.5.1 Data Revisions

Northern Ireland reported 4 tonnes of discards for 2015 that were included into the assessment input data. This supposed a minor change that do not have any impact in the output indicators. On the other hand, France revised the way the EVHOE index was calculated. The index used until last year and the new index are shown in Figure 9.4. The differences between both indices are small in general but there were a couple of years with significant differences.

9.2.6 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).

9.2.7 Comparison of assessment results using the old and new EVHOE indices.

The new EVHOE index produce slightly higher recruitments in the initial part of the time series (Figure 9.5). In the last part of the assessment the differences were negligible.

9.2.8 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 year pattern for EVHOE-WIBTS-Q4 and IGFS-WIBTS-Q4 surveys in the last three years. This could be due to the observed length frequency distributions that show a peak to the right of the distribution mode. Otherwise their behaviour is "fairly random" with no 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 can vary from year to year since then. The variation is modelled using a random walk as described in the stock annex. The selection pattern has changed significantly since 2002 but in the last four years the change has been slight (Figure 9.8, bottom left and right plots). 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 t) 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 the three summary indicators (F, SSB and Recruitment) the model results are sensitive to the exclusion of recent data. The inclusion of 2012 data resulted in a translation of the whole time-series of the three indicators. Afterwards the inclusion of new data impacted mainly in the most recent estimates. Until 2013 the inclusion of new data provoked a revision upwards of the SSB and downwards of the fishing mortality but since that year the revision is in the opposite direction. The trends of the series were almost identical but the absolute levels were slightly different. The big retrospective pattern in the last part of the series is provoked by the revision of recruitment in recent years.

Figure 9.10 shows the differences of the time series in percentage in comparison with the last year estimates. In this plot, the differences in the central part are of the time series are more apparent due to the scale change. The retrospective pattern is significant in the whole time-series especially for Recruitment and SSB and it is even higher since 2008.

9.2.9 Historic trends in biomass, fishing mortality and recruitment

Summary results from SS3 are given in Table 9.5 and Figure 9.11.

For recruitment, fluctuations appear to be without substantial trend over the whole series. The recruitment in 2008 was the highest in the whole series 730 millions of individuals. After a low recruitment in 2015 (310 millions) the recruitment in 2016 is well above the historical mean (530 millions).

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 2016 (290 000 t).

The fishing mortality is calculated as the average annual F for sizes 15–80 cm. This measure of F is nearly identical to 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. Since 2012 F is quite stable and slightly below Fmsy (0.28). The F estimate for 2016 is equal to 0.27.

The 90% confidence intervals are quite narrow (Figure 9.11). These intervals correspond with the uncertainty estimated by the SS3 model and do not include all the existing uncertainty. For example, it does not include the uncertainty in the input data. In the next benchmark the data weighting in SS3 should be revisited in order to get more realistic confidence intervals.

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) = 0.26.

The recruitment used for projections in this WG is the GM calculated from 1978 to the final assessment year minus 2.

Landings in 2018 and SSB in 2019 predicted for various levels of fishing mortality in 2018 are given in Table 9.6 and Figure 9.12. Maintaining status quo F in 2018 is expected to result in an increase in catch and SSB with respect to 2017.

Some discards are not included in the assessment. They mainly concern fleets for which discards data were not made available during the 2014 benchmark (non-Spanish trawlers in Subareas VII and VIII), or fleets for which discards have only been reported for the last few years (gillnets). For the latter, it is not yet clear if discarding is representative of the discarding behaviour of the fleet.

To produce total catch forecast for 2018, including discards not in the assessment the total landings forecasted by the model is multiplied by ratio of discards to calculate the discards. This was then added to the forecasted catch, to estimate the total catch. Table 9.7 provides the intermediate year options for the advised catch forecasts.

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 9.8 and Figure 9.13. The F-multiplier in Table 9.8 is with respect to status quo F (average F in the final 3 assessment years, 2014–2016). Considering the yield and SSB per recruit curves, F_{max}, $F_{0.1}$, $F_{35\%}$ and $F_{30\%}$ are respectively estimated to be 112%, 69%, 73% and 88% of status quo F. The maximum equilibrium yield per recruit is similar to 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 Approach	MSY $B_{trigger}$	45 000	Bpa (ICES 2016)
	F_{MSY}	0.28	Fmsy in the combined stock recruitment relationship (ICES 2016)
Precautionary Approach	B_{lim}	32 000	SSB2006 Low level of SSB followed by a sharp increase, lower level of SSB would led to lower recruitment level.
	B_{pa}	45 000	1.4Blim (ICES 2016)
	F_{lim}	0.87	Fishing mortality resulting in a 5% probability of SSB falling below B_{lim} (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 worsens again in the following assessment working group when 2013 data was included (ICES, 2014). The retrospective pattern in recruitment increased with the revision of 2014 LFD data in the 2016 assessment working group. 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 the future, more work will be needed to understand what is driving such a retrospective pattern. A more detailed fleet disaggregation and the inclusion of all the discards in the assessment could help to decrease the retrospective pattern. Apart of that, the estimation of the growth parameters with the latest data available outside the model is considered critical. The growth was fixed in 2013 to the estimate of 2011 assessment year estimates but the parameters could be incorrect as the model is no longer able to estimate the parameters consistently year by year. The revision of growth parameters could also help improving the quality of the assessment fit. A complete list of issues to be considered in the next benchmark is available in Annex 5 of the report.

The EVHOE index was resubmitted with correction on the Wednesday, one day before the end of the meeting. This did not allow the group appropriate time to review and assess these changes. The preliminary estimates of SSB and F are within the uncertainty bounds of the accepted assessment. Given that the hake assessment has a retrospective pattern the group agreed that the new index be incorporated into next year's update assessment.

9.6 Management considerations

The big increase in SSB and decrease in fishing mortality are the consequence of the strong recruitments in 2008 and 2012. 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.

Table 9.1. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock. Estimates of landings ('000 t) by area for 1961–2016.

	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
2016*	1	20	11.4	49.4	26.5	0	107.5	0.1	4.2	0.3	2.3	4.2	11.1	118.6

(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) Unallocated landings for years 2011-2014 were revised in 2015.

Table 9.2. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,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	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
SPTRAWL7	na	**537**	**1712**	**2010**	**5674**	**5077**	**5054**	**3495**	**1464**	**2604**	**615**
	na	*4526*	*21437*	*17542*	*27619*	*27954*	*26452*	*38293*	*8335*	*5241*	2006
TRAWLOTH	**na**	**na**	**na**	**1025**	**1192**	**130**	**1142**	**2934**	**2510**	**1560**	**1665**
	na	*na*	*na*	*6814*	*3831*	*1037*	*5101*	*16863*	*7483*	*4460*	11269
FRNEP8	**532**	**767**	**858**	**4283**	**726**	**871**	**624**	**1475**	**392**	**1133**	**2310**
	18031	*24277*	*18245*	*68524*	*14709*	21208	*25228*	32535	*4099*	19126	50343
SPTRAWL8	**206**	**471**	**352**	**580**	**101**	**292**	**364**	**379**	**184**	**589**	**655**
	3397	*10002*	*7153*	*7925*	*1719*	*5036*	*5329*	*5552*	*2718*	*8011*	16293
GILLNET	**na**	**na**	**na**	**na**	**na**	**na**	**1503**	**1256**	**42**	**857**	**1175**
	na	*na*	*na*	*na*	*na*	*na*	*4061*	*3283*	*53*	*623*	1600
LONGLINE	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**558**	3
	na	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*402*	0
OTHER	**484**	**390**	**446**	**3135**	**4425**	**7533**	**6183**	**6287**	**4343**	**4151**	**4675**
	na	*na*	*na*	*na*	*na*	*na*	*na*	*16855*	*4866*	4171	4435
Total Weight (t)	**1222**	**2165**	**3368**	**11033**	**12118**	**13903**	**14870**	**15826**	**8935**	**11452**	**11098**
Total Number ('000)	*21428*	*39654*	*47488*	*101349*	*48325*	*58210*	*66171*	*113381*	*27554*	42034	85946

Table 9.3. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Landings (L) and Length Frequency Distribution (LFD) provided in 2016.

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 3a, Subareas 4, 6 and 7 and Divisions 8a,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
2016	872	334	2611	508	11030	46

* Before 1988 landings and effort refer to Vigo trawl fleet only, from 1988 to 2002 t

** 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 3a, Subareas 4, 6 and 7 and Divisions 8a,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	304112	116722	76696	50551	NA	50551	0.66	0.52
1979	283534	125851	97911	51096	NA	51096	0.52	0.55
1980	316489	124161	100483	57265	NA	57265	0.57	0.65
1981	599540	107717	86475	53918	NA	53918	0.62	0.67
1982	418396	99728	70398	54994	NA	54994	0.78	0.69
1983	152160	107849	69158	57507	NA	57507	0.83	0.63
1984	295900	115404	83620	63286	NA	63286	0.76	0.67
1985	686703	100455	80312	56099	NA	56099	0.7	0.8
1986	412289	85629	61012	57092	NA	57092	0.94	0.91
1987	487329	84492	47228	63369	NA	63369	1.34	1
1988	530902	83868	49688	64823	2	64825	1.3	1.02
1989	506464	82882	47762	66473	73	66546	1.39	1.09
1990	538463	75535	44295	59954	NA	59954	1.35	1
1991	317821	74652	44539	58129	NA	58129	1.31	0.94
1992	330559	77182	45268	56617	NA	56617	1.25	1.01
1993	602754	66904	43205	52144	NA	52144	1.21	1.08
1994	329784	59848	33366	51259	356	51615	1.54	1.1
1995	165603	65557	32134	57621	NA	57621	1.79	1.13
1996	401880	59356	37306	47210	NA	47210	1.27	1.01
1997	275848	50138	31651	42465	NA	42465	1.34	1.07
1998	452656	48405	25997	35060	NA	35060	1.35	1.01
1999	223378	52164	29147	39814	349	40163	1.37	0.99
2000	199135	57448	31971	42026	83	42109	1.31	0.92
2001	341926	56489	37514	36675	NA	36675	0.98	0.78
2002	265328	58252	37769	40107	NA	40107	1.06	0.83
2003	157143	61778	37543	43162	2110	45272	1.15	0.82
2004	329055	63379	42139	46417	2552	48969	1.1	0.83
2005	217285	58930	40113	46550	4676	51226	1.16	0.97
2006	292674	55194	32475	41467	1816	43283	1.28	0.87
2007	452723	61430	38281	45028	2191	47219	1.18	0.76
2008	734328	76794	44733	47739	3248	50987	1.07	0.63
2009	247176	121006	67034	58818	9871	68689	0.88	0.51
2010	257528	195733	123089	72799	9415	82214	0.59	0.39
2011	265486	250481	201049	87540	13775	101315	0.44	0.31
2012	487330	266692	227026	85677	12225	97902	0.38	0.26
2013	318837	274021	228246	77753	11637	89390	0.34	0.26
2014	217489	301883	241117	89940	7047	96987	0.37	0.26
2015	309968	325976	272795	93670	7396	101066	0.34	0.25
2016	529458	332535	290234	109106	9939	119045	0.38	0.27
Arith.Mean	365524	114936	82840	57980	5198	60512		
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 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Catch option table.

SSB(2017)	Rec proj	F(15-80cm)	Catch(2017)	Land(2017)	SSB(2018)
265666	335071	0.26	100357	93588	267673

Fmult	Fcatch(15-80cm)	Catch(2018)	Land(2018)	Disc(2018)	SSB(2019)
0	0	0	0	0	401929
0.1	0.0259	12099	11254	845	390412
0.2	0.0519	23817	22144	1672	379262
0.3	0.0778	35167	32684	2483	368467
0.4	0.1037	46161	42885	3276	358014
0.5	0.1297	56811	52758	4054	347891
0.6	0.1556	67129	62314	4815	338088
0.7	0.1815	77125	71564	5561	328594
0.8	0.2075	86811	80519	6292	319398
0.9	0.2334	96195	89187	7008	310490
1	0.2594	105289	97580	7710	301860
1.1	0.2853	114102	105704	8397	293500
1.2	0.3112	122642	113571	9071	285400
1.3	0.3372	130919	121188	9731	277551
1.4	0.3631	138942	128564	10378	269945
1.5	0.389	146719	135706	11013	262575
1.6	0.415	154257	142623	11634	255431
1.7	0.4409	161565	149321	12244	248506
1.8	0.4668	168650	155808	12842	241794
1.9	0.4928	175519	162091	13427	235286
2	0.5187	182179	168177	14002	228977

Table 9.7. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Basis for the catch options in the advice.

Variable	Value	Notes
F (2017)	0.26	Mean F(2014–2016).
SSB (2018)	267673	
R (2017/2018)	335071	GM (1978–2014); in thousands.
Total catch (2017)	105223	Forecasted catch from the assessment model (based on F(2017) = Mean F(2014–2016) plus additional discards.
Wanted catch (2017)	93588	Based on average discard rates observed during 2014–2016.
Unwanted catch (2017)	11635	Based on average discard rates observed during 2014–2016.

Table 9.8. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,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
0.85	0.1	0.03	0.09	0.09	2.70
0.72	0.2	0.05	0.16	0.15	2.31
0.62	0.3	0.08	0.21	0.20	1.99
0.54	0.4	0.1	0.25	0.24	1.73
0.47	0.5	0.13	0.27	0.26	1.51
0.42	0.6	0.16	0.29	0.28	1.34
0.37	0.7	0.18	0.31	0.29	1.19
0.33	0.8	0.21	0.32	0.30	1.06
0.30	0.9	0.23	0.32	0.30	0.95
0.27	1	0.26	0.33	0.31	0.86
0.25	1.1	0.29	0.33	0.31	0.78
0.22	1.2	0.31	0.33	0.31	0.72
0.21	1.3	0.34	0.33	0.30	0.66
0.19	1.4	0.36	0.33	0.30	0.60
0.17	1.5	0.39	0.32	0.30	0.56
0.16	1.6	0.41	0.32	0.30	0.52
0.15	1.7	0.44	0.32	0.29	0.48
0.14	1.8	0.47	0.32	0.29	0.45
0.13	1.9	0.49	0.31	0.28	0.42
0.12	2	0.52	0.31	0.28	0.39

	SPR level	Fmult	F(15-80cm)	YPR(catch)	YPR(landings)	SSB PR
Fmax	0.24	1.1	0.29	0.33	0.31	0.78
F0.1	0.38	0.68	0.18	0.3	0.29	1.21
F35%	0.35	0.75	0.19	0.31	0.29	1.12
F30%	0.3	0.89	0.23	0.32	0.3	0.96

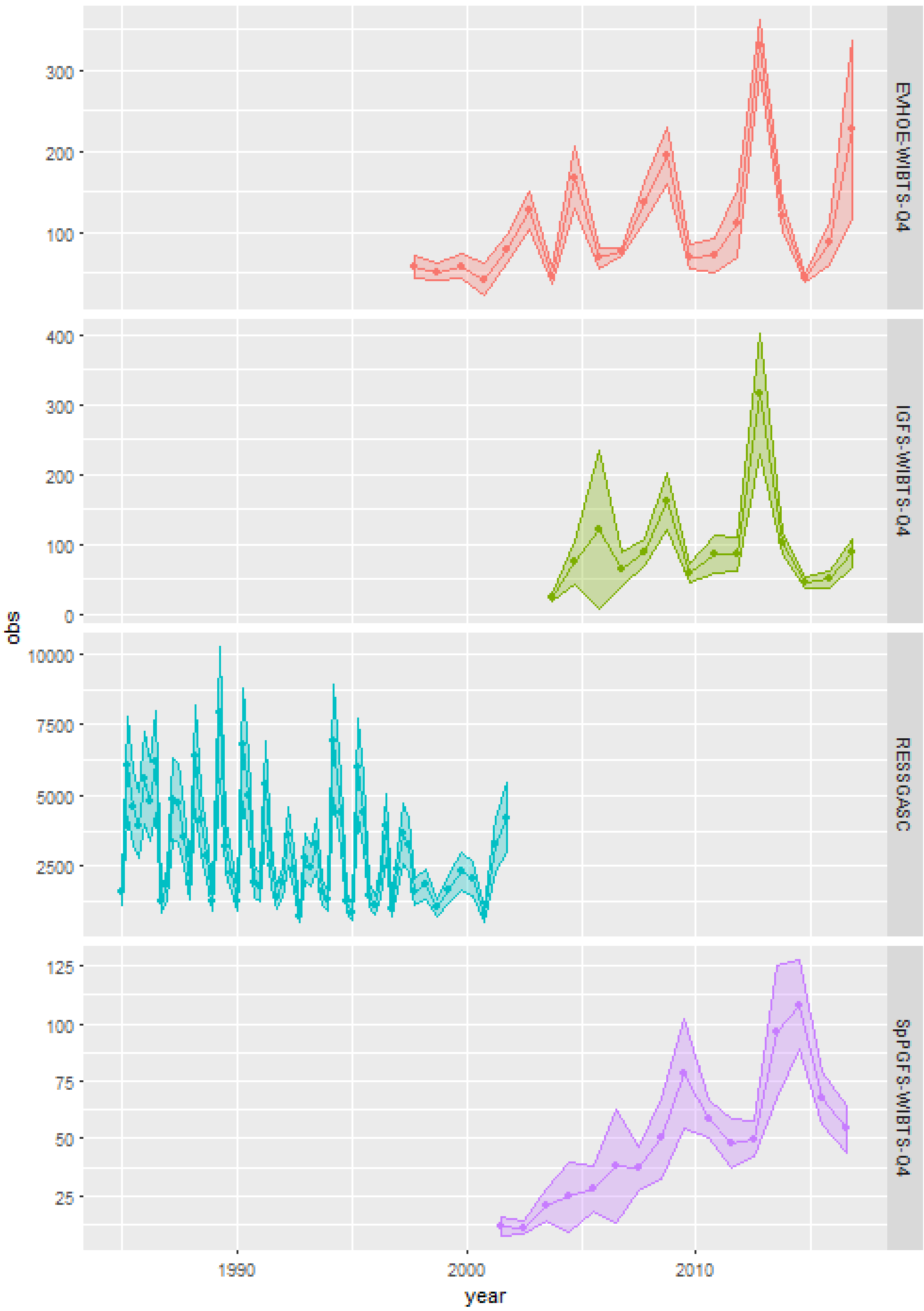


Figure 9.1. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Abundance indices from surveys.

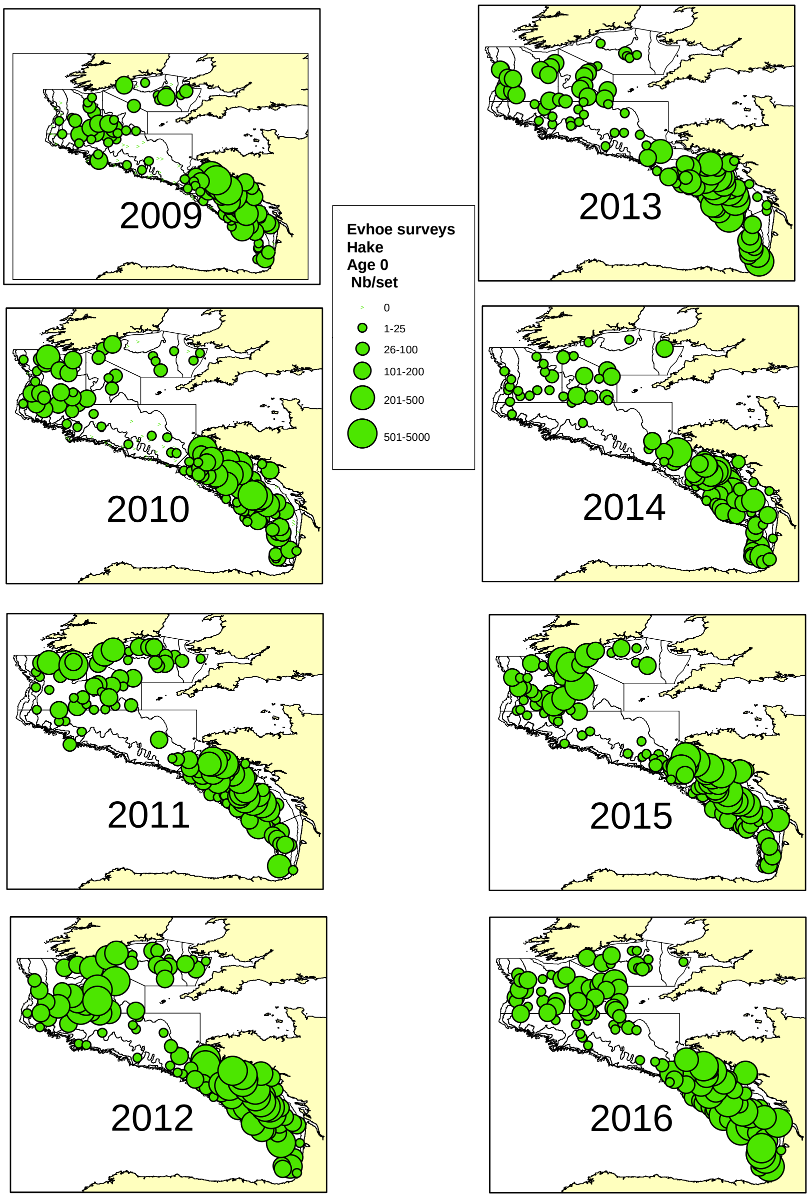


Figure 9.2. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Spatial distribution of hake (0–20 cm) indices from EVHOE–WIBTS-Q4 survey from 2006 to 2016.

Figure 9.3. Northern Hake. Effective effort indices and LPUE values of commercial fleets estimated by National laboratories.

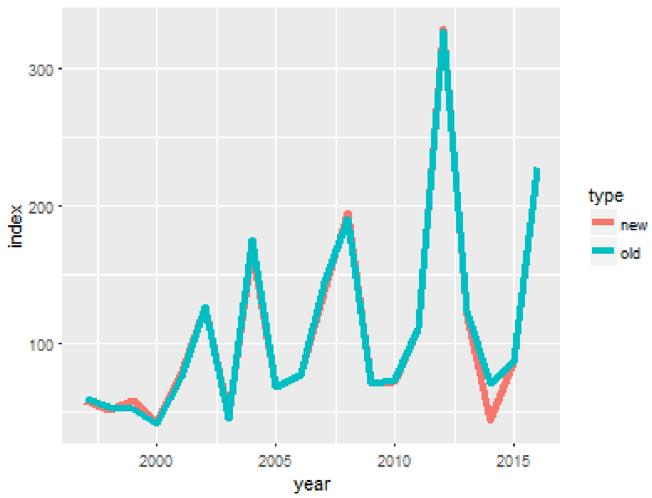


Figure 9.4. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Comparison between the EVHOE time series used until 2016 (blue) and the new time series (red).

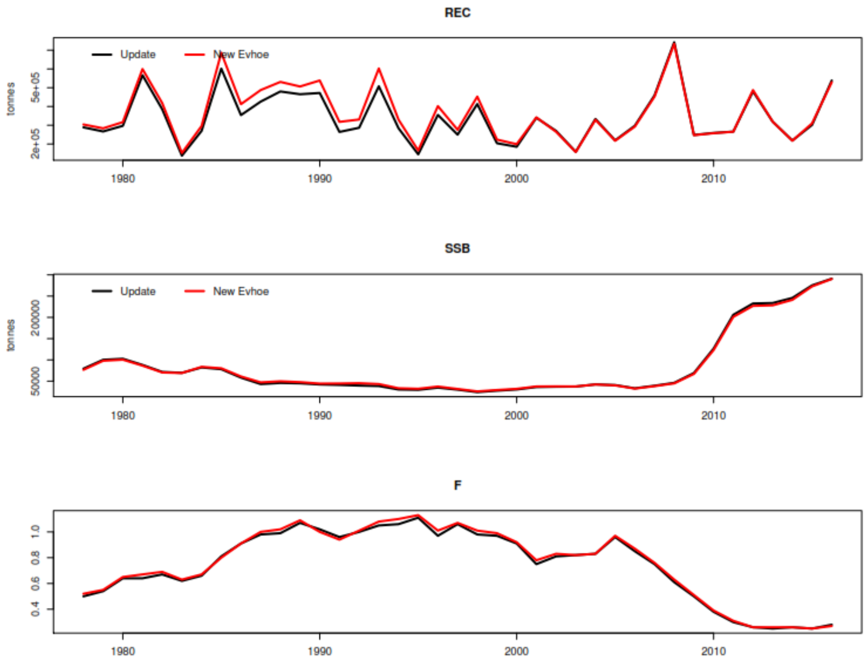


Figure 9.5. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Comparison between results indicators obtained with the EVHOE time series used until 2016 (black) and the new time series (red).

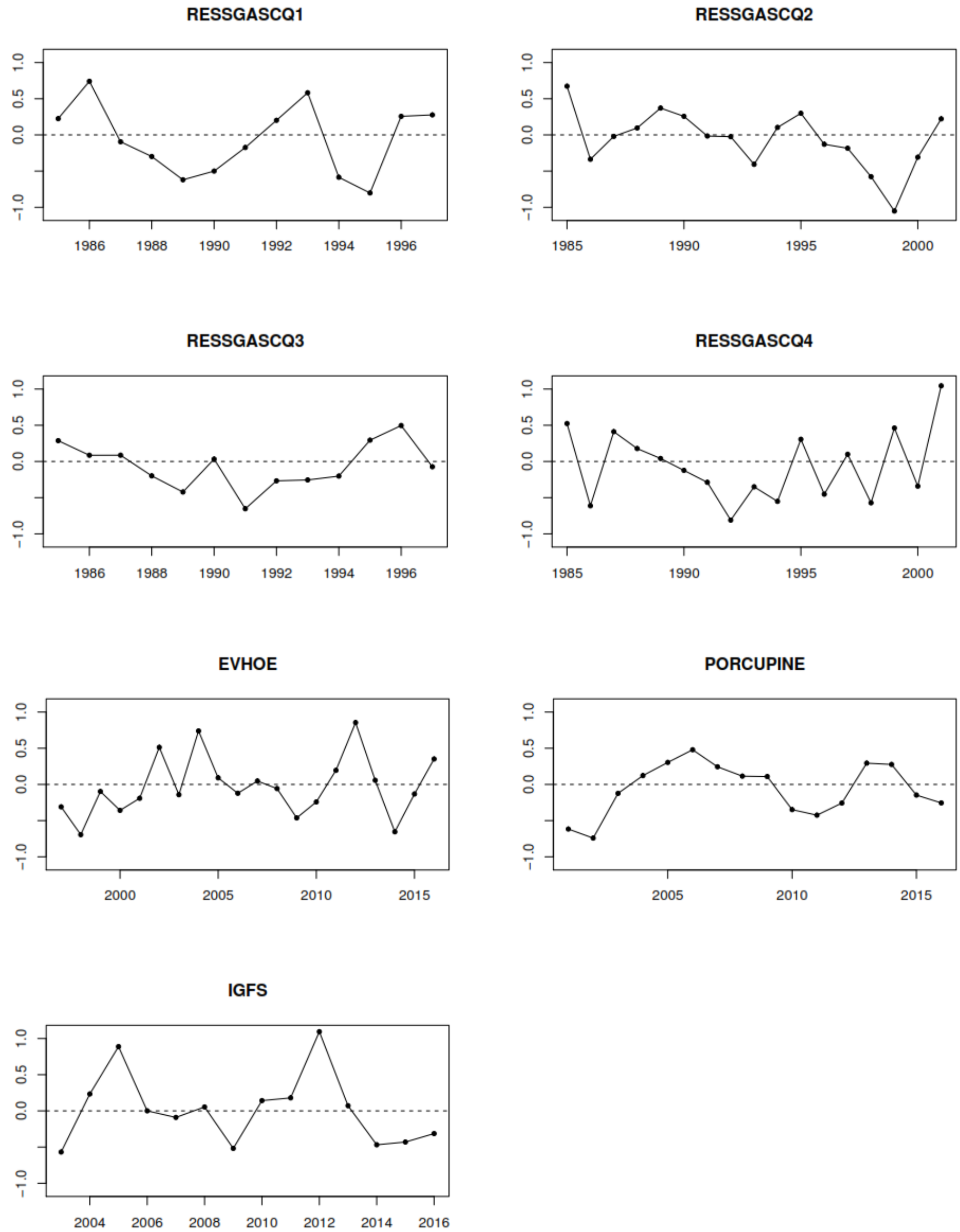


Figure 9.6. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Residuals of the fits to the surveys log(abundance indices). For RESSGASC, EVHOE, PORCUPINE and IGFS, fits are by quarter.

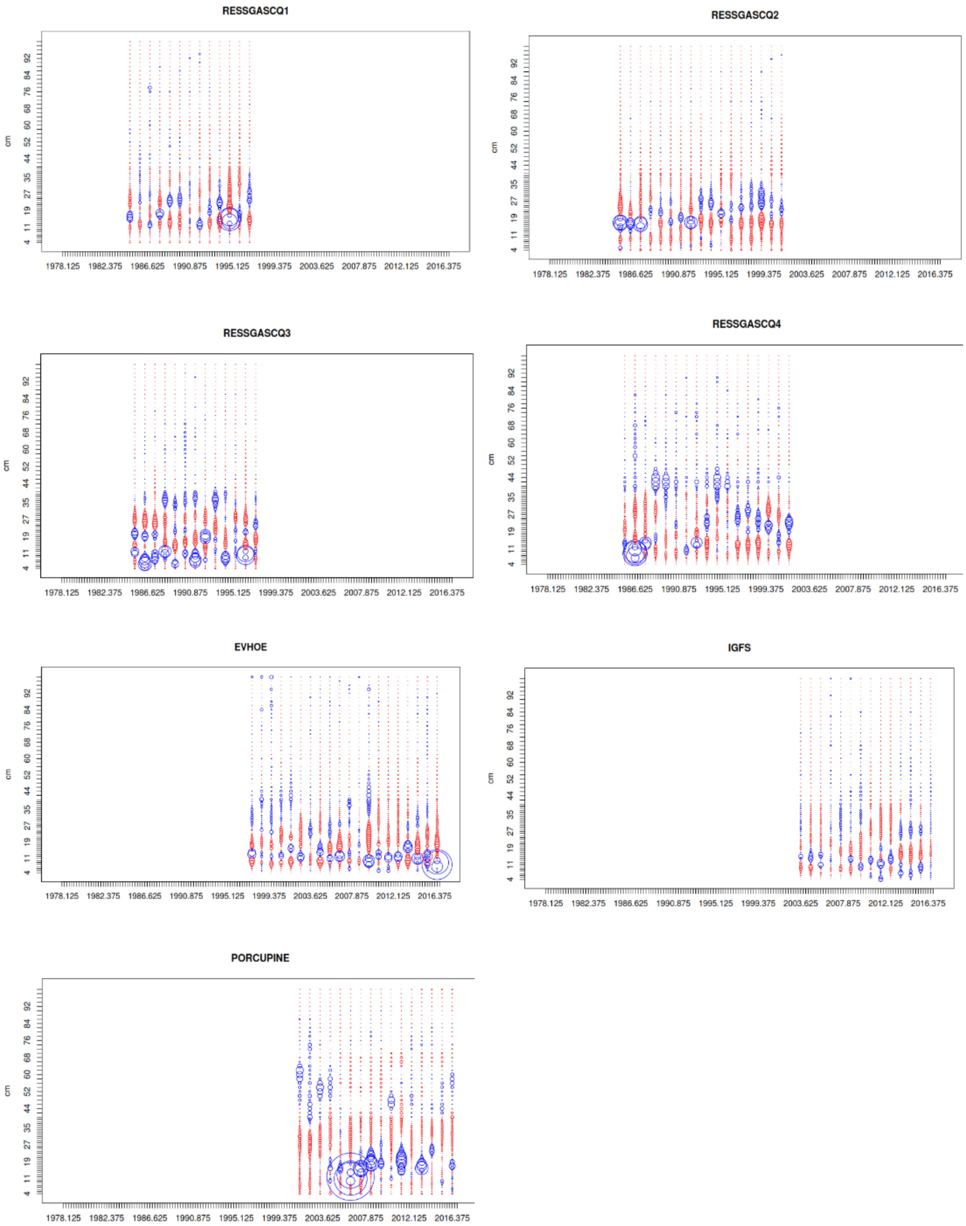


Figure 9.7. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter. Blue and red denote positive and negative residuals, respectively.

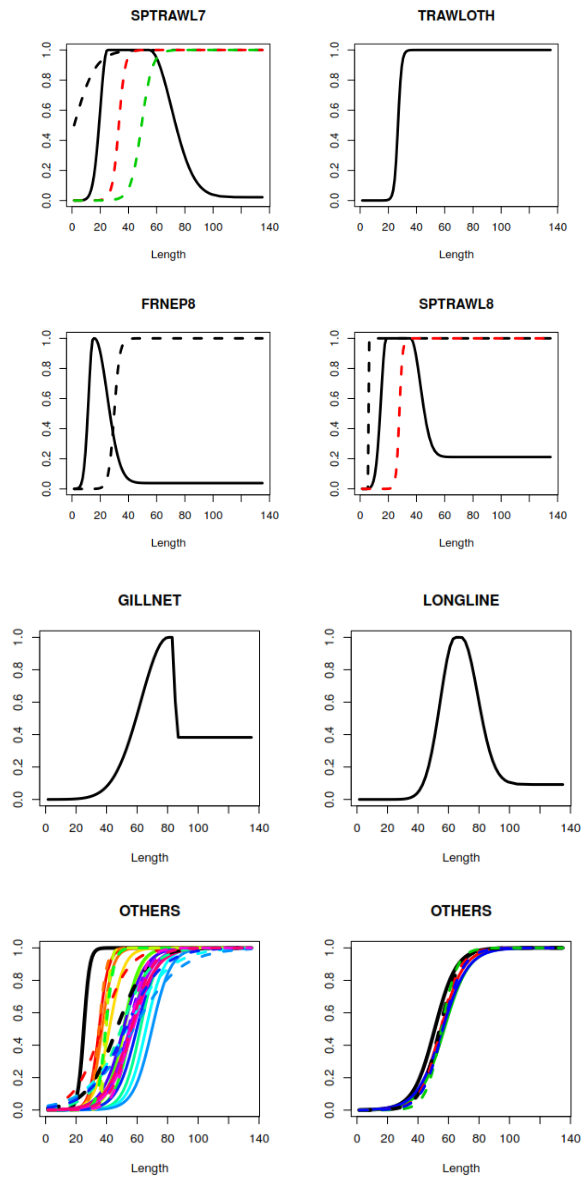


Figure 9.8. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Selection patterns (solid lines) and retention functions (dashed lines) at length by commercial fleet estimated by SS3. For SPTRAWL7, retention functions for 1978–1997, 1998–2009 and 2010–2013 are in black, red and green respectively. For SPTRAWL84, retention functions for 1978–1997 and 1998–2013 are in black and red respectively. For OTHERS, the plot in the left correspond with the selectivities in the whole series, black lines correspond with the selection and retention functions from 1978 to 2002, for the rest of the years the yellow and red colours correspond with the beginning of the series since 2003, the purple-pink colours with the last years and the green-yellow colours with the years in the middle of the series. The plot in the right shows the selectivity curves in the las four years, 2013 (black), 2014 (red), 2015 (blue) and 2016 (green).

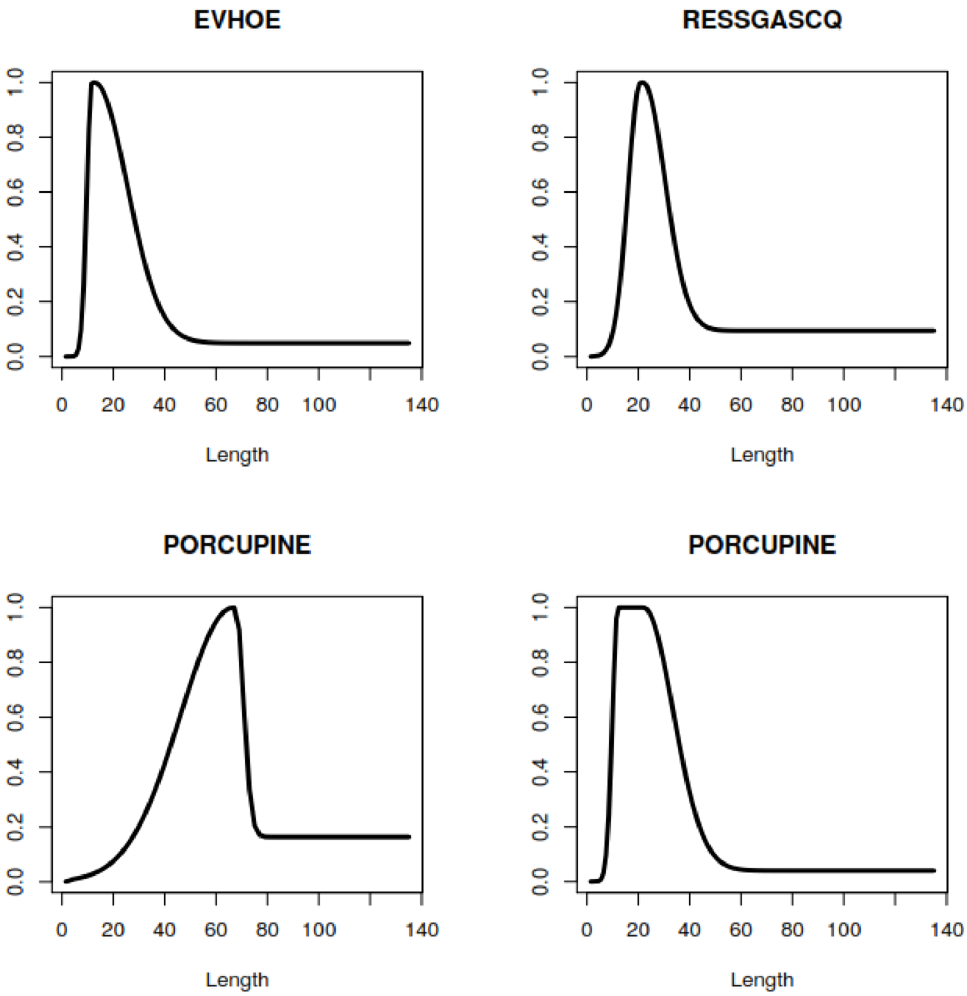


Figure 9.8 (continued). Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Selection patterns at length for surveys estimated by SS3.

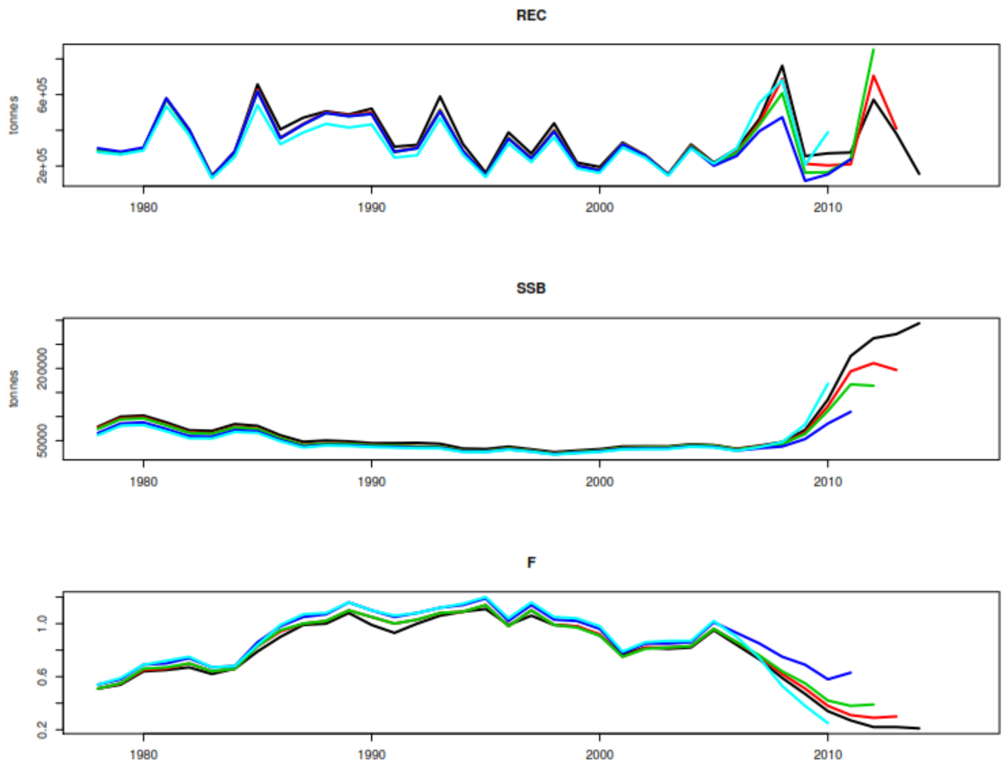


Figure 9.9. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Retrospective plot from SS3.

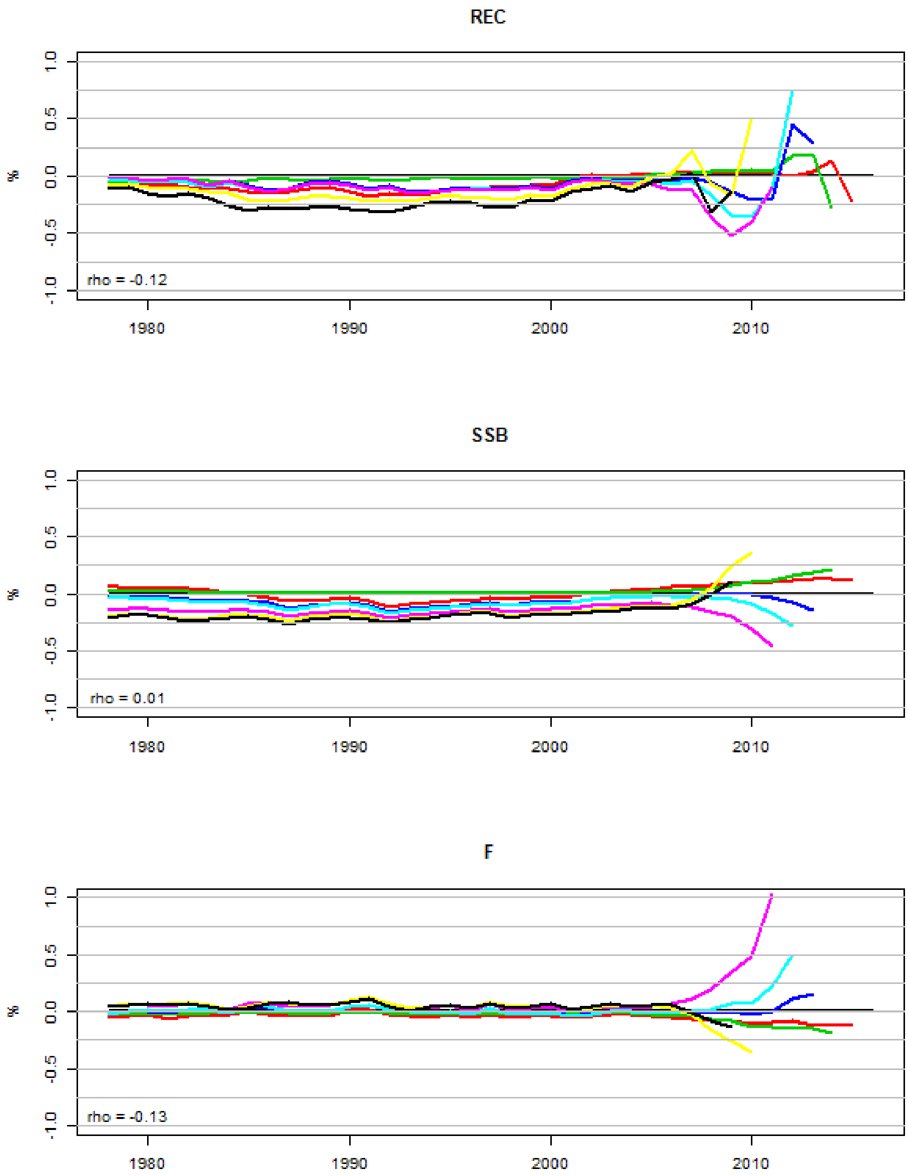


Figure 9.10. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Differences between time series in the retrospective analysis plot from SS3 for 2009–2015.

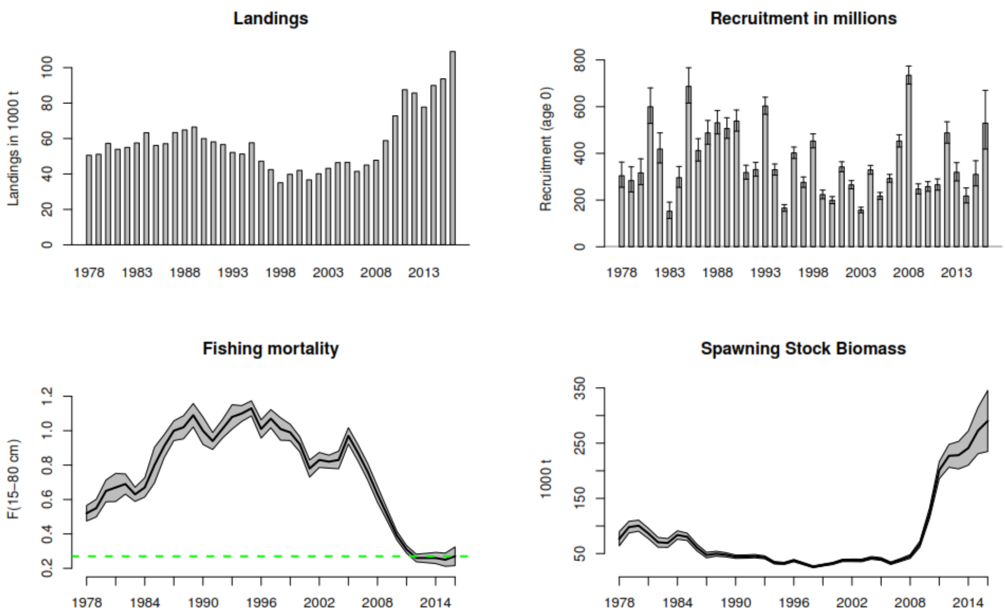


Figure 9.11. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Summary plot of stock trends.

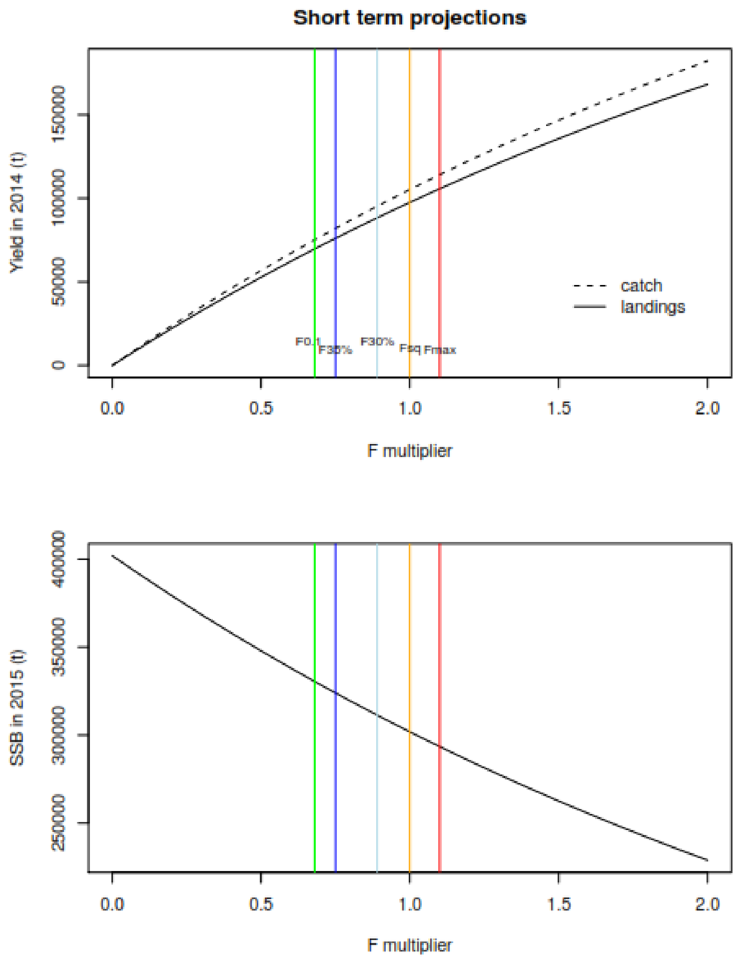


Figure 9.12. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Short term projections

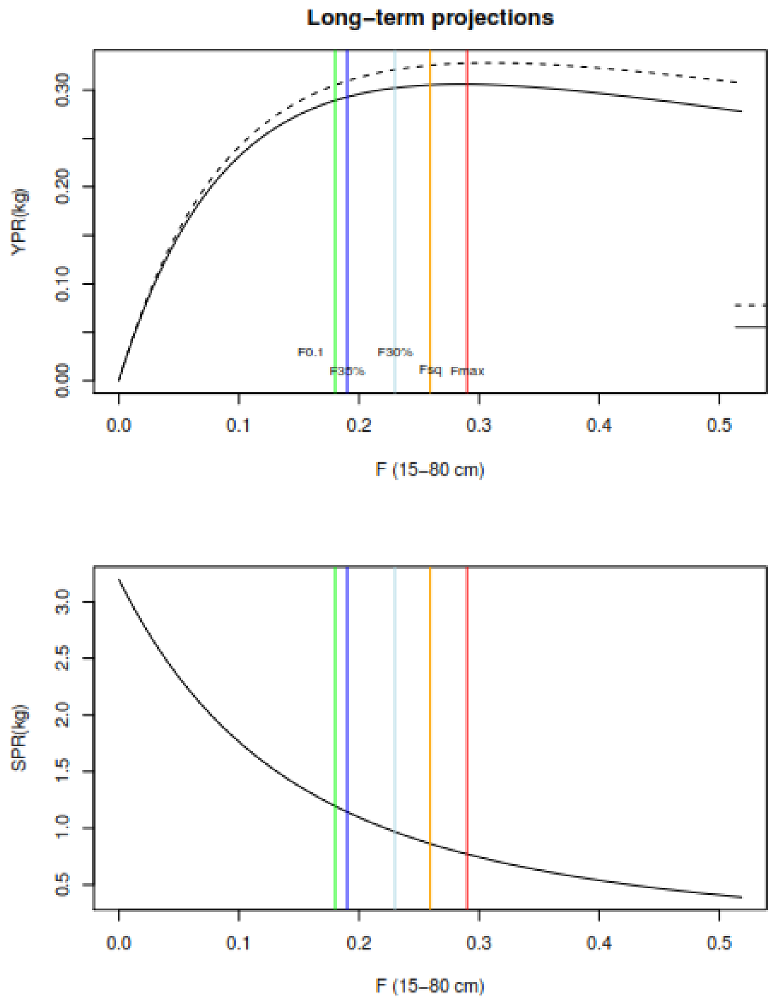


Figure 9.13. Hake in Division 3a, Subareas 4, 6 and 7 and Divisions 8a,b,d (Northern stock). Equilibrium yield and SSB per recruit.

10 Southern Stock of Hake

10.1 General

The type of assessment is "update" based on a previous benchmark assessment (WKSOUTH, 2014).

A very complete review of the last year assessment was provided by a reviewer group (RG) from the University of Maine (UMaine, 2016). It includes some generic recommendations, as well as some perceived southern hake caveats that helped to produce this report. The recommendations in the RG report can be classified in 2 categories: (1) those that can only be addressed in a benchmark workshop (split sexes, change length-weight relationship or join both hake stocks); and those that can be addressed with additional explanations or clarifications in the report or the technical annex (errors in survey trend plots; description of residuals diagnosis, description of likelihood profiles or adding a map for surveys. All were addressed throughout this report (but the map which will have to be added next year), amending or extending the text explanations as required.

10.1.1 Fishery description

Fishery description is available in the Stock Annex (Annex G).

10.1.2 ICES advice for 2017 and Management applicable to 2016 and 2017.

ICES Advice for 2017

ICES advised that when the MSY approach is applied, catches in 2017 should be no more than 8 049 tonnes. Since this stock is only partially under the EU landing obligation, "ICES was not in a position to advice on landings corresponding to the advised catch".

Management Applicable for 2016 and 2017

Hake is managed by TAC, effort control and technical measures. The agreed TAC for Southern Hake in 2016 was 10 674 t and in 2017 it is 10 520 t.

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%. The 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.

This stock is under a partial landing obligation since 2016. A 7% *de minimis* applies to this stock in 2016 and 2017.

10.2 Data

10.2.1 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 or non-reported landings have been included in the assessment. These were estimated based on the sampled vessels (Spanish concurrent sampling) raised to the total effort for each métier.

In 2016, overall landings increased (12 443 t compared to 11 786 t in 2015). Portuguese official landings were 1 973 t, below those of 2015 (2000 t). Spanish official landings were 8 063 t in 2016 while they had been 6 758 t in 2015. Non-reported landings decreased to 2 174 t from 2 789 t in 2015. Total landings in 2015 were 11 786 t and they increased to 12 443 t in 2016. Total discards in 2016 were 2 313 t while they had been 2 292 t in 2015, a slight increase, but within the range observed in the previous three years and comparable to the range observed since 2007. Total catches were 14 077 t in 2015 and 14 756 t in 2016. TACs were 10 674 t in 2016, which means total catches overshot the TAC.

Length distributions for 2016 landings and discards are presented in Figure 10.1. and in Tab 10.2. Mean size has lately been variable but stable in landings (from 33.8 cm to 33.4 to 33.7 between 2014 and 2016), as well as in discards (from 21.9 to 20.0 to 22.0 in the latest 3 years). Catch lengths varied from 27.9 to 26.4 to 28.3 cm. These all may be related to the variability in the strength of recruitment.

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. L_{50} have oscillated from 31.7 cm in 2014, 36.3 in 2015, to 34.5 cm in 2016. Mean historical figures have been around 36 cm.

10.2.2 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 in 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 three surveys together cover the whole geographic area of the stock and are conducted simultaneously as to minimize any sources of variability. They are part of the IBTS system, which further ensures the methodology employed is the same.

The Portuguese Autumn survey (PtGFS-WIBTS-Q4) showed variable abundance indices with a maximum in 1981 and a minimum in 1993 (the survey did not take place in 2012). Five-year centred moving averages show a trough in 1994 and are now close to their peak (highest in 2011 and currently at the second highest). The Spanish ground fish survey (SpGFS-WIBTS-Q4) shows low values for biomass and abundance in the early 2000s. These values increased from 2004 peaking to a historical maximum in 2009, after which they remained relatively stable until 2012. From 2013 they became more variable, oscillating about the overall mean of 206 ind/30min. 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. In the latest years, all surveys carry the same trends with a peak in 2015 falling in 2016, all then reaching values slightly above their historical means.

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 log-books maintained in DGRM and compiled by IPMA. For the Portuguese fleets, until 2011 most log-books were filled in paper but have thereafter been progressively replaced by e-logbooks for those vessels covered by the obligation (vessel longer than 15m). All vessels in the recovery plan are required to be equipped with an e-logbook. The standardized CPUE from the Portuguese bottom-trawl fleet targeting roundfish is calculated by fitting a GLM to log-book 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 use of 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).

10.3 Assessment

The assessment carried out used the gadget model (length-age based) as decided by WKSOUTH (2014) and described in the stock annex (Annex G).

10.3.1 Model diagnostics

Likelihood profiles for each parameter estimated by the model are presented in Figure 10.5. The plot show the parameter value *versus* the estimated likelihood. The values on the horizontal axes of the plots represent multiplicative factors with respect to the estimated parameter value 1 ± 10%. 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 that each parameter has on the likelihood value, the plots are presented with two different options (scaled and unscaled y axis). This diagnostic confirms that 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 to 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, to the possible exception of PtGFS-WIBTS-Q4 for lengths 4-19 cm and for lengths 20–34 cm, which appear to display some trend. This means that abundance at these two length groups can be underestimated by the model in recent years. It is however remarkable that recruitment for both surveys in 2016 was estimated with quite small residuals.

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 to 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 in 2 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 data sets, 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 residual values are quite small (maximum ~0.3). The model accounts for data precision, when weighing individual likelihood components (defined in the Stock Annex). So, data sets with larger model residuals will have less impact on the overall model fit. It is also remarkable that survey residuals in 2016 (Fig 10.6 - h, i, j) are smaller than in previous years.

10.3.2 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), in agreement with our assumption that before 1992 (when the minimum landing size was implemented) the importance of discards was relatively low. The discard selection pattern was similar to that of the Cadiz landings selection pattern in years prior to 2005. Since then, the Cadiz fleet increased its landings length and are now modelled together with the rest of the landings (1994–end). 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 previous assessments.

Historic trends in biomass, fishing mortality, yield and recruitment

Model estimates of abundance at length in 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. In 2015 and 2016 there are again robust recruitments.

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: one from 1982 to 2003 with mean figures around 70 million (ranging from 40 to 120 mill); another between 2005 and 2009, with mean figures of 121 mill; and another between 2010 and 2016, around 85 mill, with a peak in 2015 (113 mill). Recruitment in 2016, the latest recruitment available, was accepted (98 096 mill). This parameter has been typically poorly estimated as evidenced by the retrospective pattern (Fig 10.10). However, this year the 3 surveys shows similar relative figures (slightly above historical means) and the model diagnosis show a good fit for both trends (near zero residuals in 2016) and length distributions (quite small residuals in 2016). These particular circumstances, make the model estimate credible.

Fishing mortality increased from the beginning of the time series (F=0.36 in 1982) peaking in 1995–97 to around 1.19; declining to 0.79 in 1999 and remaining relatively stable until 2009 (F=0.96). F then progressively declined with oscillations and, reached 0.57 in 2016. The SSB was very high at the beginning of the time series with values around 45 000 t, then decreased to a minimum of 5 724 t in 1998. Since then biomass has tended to increase, reaching 18 842 in 2016.

Retrospective pattern for SSB, fishing mortality, yield and recruitment

Figure 10.10 presents the results of the assessments performed using the retrospective data series from 2016–2011. There is a clear trend in the retrospective pattern for recruitment, F and SSB, as in previous years. Recruitment shows high variability, whereas SSB shows a tendency to be overestimated, in contrast to F which shows a tendency to be underestimated.

10.4 Catch options and prognosis

10.4.1 Short-term projections

The methodology used was developed during the latest benchmark (WKSOUTH, 2014) and WKMSREF4 (2015), and is described in the Stock Annex. The 2016 recruitment figure was accepted and F was scaled to the mean of the last 3 years. There is a decreasing trend in F (Fig 10.9), although this parameter is generally underestimated, as can be seen from the retrospective pattern. Short term projections are presented in Fig. 10.11 and Table 10.7. Note that mortality in GADGET is length based and F multipliers do not apply linearly, e.g. if Fmult=1, F is 0.64 and if Fmult=0.5, F is 0.31.

In 2017 the expected SSB is 23 333 t. Fsq for the intermediate year (2017) is estimated as the average of the F of the last 3 years (0.64). Recruitment for 2016 is the value estimated by the model (98 096 mill). Recruitment used for projections in years 2017–2018 was the geometric mean of 1989–2015 which is 80 187 mill. During the intermediate year, 2017, the expected yield (landings) is 15 272 t and the SSB at the end of the year is expected to be 24 643 t.

Different F multipliers applied in 2018 provide management alternatives according to different scenarios. Under Fsq (Fmult=1), F would be 0.64, the expected yield would be 15 473 t and SSB in 2019 would be 23 693 t. Decreasing F by 10% (F mult=0.9), F would be 0.57, the yield and SSB in 2019, 14 297 t and 25 772 t, respectively. With the MSY approach (F=0.25), Fmult would be 0.41, the yield 7 366 t and SSB in 2019 would be 38 286 t.

10.4.2 Long-term projections

Long-term projections are plotted in Figure 10.12. This projection lasts until the year 2050 with a recruitment equal to the geometric mean of years 1989–2015.

The following table shows the expected figures for different reference Fs:

	F (1-3)	Yield	SSB
Fsq	0.64	15473	23693
Flow	0.17	5229	42230
Fmsy	0.25	7366	38289
Fupp	0.36	10009	33463

10.5 Biological reference points

Reference points were estimated by WKMSYRef4 (ICES 2016). MSY Btrigger was set as a Bpa by ACOM (ICES, 2016).

Reference points

PA Reference points	Value	Rational
Blim	8 000	Hockey stick breakpoint (8 000 t if rounded)
Bpa	11 100	Blim * 1.4
Flim	1.05	F corresponding to the slope of the hockey stick SSB-Rec relationship
Fpa	0.75	Flim / 1.4
MSY Reference points		
FMSY	0.25	
FMSY lower	0.17	
FMSY upper	0.36	
BMSY	73 330	
MSY	18 139	
MSY Btrg	11 100	

10.6 Comments on the assessment

Updates of the index SP-CORUTR were 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 and 2016 it returned to values above average.

The retrospective pattern shows a trend to overestimate SSB and underestimate F (SSB Mohn's rho = -0.284; F Mohn's rho = 0.227).

10.7 Management considerations

The stock is in a healthy status (SSB in 2017 is 23 333 t, well above Bpa = 11 100 t). However, the stock continues to be overexploited (F 2016=0.57, well above Fmsy = 0.25), although inside precautionary limits (Fpa=0.75). The stock has been exploited above Fmsy since the beginning of the assessment period (1982). This implies that there is less potential yield extracted from the stock, even though it can withstand the fishing pressure.

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 and the stock has returned to a healthy state.

The retrospective pattern shows a general trend to overestimate SSB and underestimate F.

Hake is a top predator eating mainly blue whiting, horse mackerel and other hake (cannibalism, particularly of juveniles by adults). There may be some impact of this in the rate of recovery of the population, particularly in areas of greater aggregations. The main hake predators in the area are common and bottlenose dolphin, the populations of which are thought to be rising.

Table 10-1 Hake southern stock.Catch estimates (*000) by country and gear

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**
2016	0,91	1,64	1,30	0,42		2,28	1,51	2,15	**8,06**	1,22	0,75	0,16	**1,97**	0,23	2,17	**2,31**	**12,44**	**14,8**

Table 10.2 Hake Southern stock. Length compositions (thousands)

Table 10.2 HAKE SOUTHERN STOCK - length compositions (thousands)

Length (cm) (4 to 100+ each 2)	Land	Disc	Catch
4	0	0	0
6	3	43	46
8	30	142	172
10	208	388	596
12	562	1209	1771
14	674	1081	1755
16	960	2400	3360
18	1114	3414	4528
20	1122	4202	5324
22	1037	4514	5551
24	1195	4427	5622
26	2222	3312	5534
28	3398	1635	5033
30	3231	279	3510
32	2737	91	2828
34	2987	27	3014
36	2638	15	2653
38	1746	9	1755
40	1214	13	1227
42	1162	7	1169
44	640	2	642
46	436	0	436
48	384	0	384
50	413	0	413
52	362	0	362
54	359	0	359
56	394	0	394
58	276	0	276
60	253	0	253
62	217	0	217
64	180	0	180
66	126	0	126
68	100	0	100
70	84	0	84
72	55	0	55
74	51	0	51
76	40	0	40
78	28	0	28
80	15	0	15
82	12	0	12
84	8	0	8
86	6	0	6
88	4	0	4
90	4	0	4
92	3	0	3
94	3	0	3
96	2	0	2
98	1	0	1
TOTAL	32696	27210	59906
Nominal Weight (tons)	12,21	2,31	14,52
SOP	12,26	2,27	14,53
SOP / NW	1,00	1,02	1,00
Mean length (cm)	33,7	22,0	28,3

* without French landings

Table 10.3.Hake Southern stock. Portuguese groundfish surveys: biomass, abundance and recruitment indices

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
								No surveys								
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
2016											18,7	1,5	272,9	25,2	179,4	86

Data marked with * relate to 40 mm cod end mesh size, else 20 mm; *** R/V Capricornio, other years R/V Noruega; (1) n/hour <20 cm converted to Noruega and NCT; (**) whole area not covered

Since 2002 tow duration is 30 min for autumn survey

Depth strata: 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

Table 10.4.Hake Southern stockSpanish groundfish surveys: biomass, abundance and recruitment indices for total area

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
2016	7,67	0,65	114	211,3	18,3	185	5,90	0,92	45	87,6	6,50	0,76	44	113,5

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	45,9	40279
1990	749	17	44430	1138	42,0	27112
1991	501	12	40440	1245	38,0	32761
1992	589	15	38910	1325	36,2	36590
1993	514	12	44504	871	29,8	29259
1994	473	12	39589	789	36,2	21814
1995	831	20	41452	1026	44,9	22865
1996	722	20	35728	894	41,4	21585
1997	732	21	35211	906	48,5	18662
1998	895	27	32563	913	42,0	21742
1999	691	23	30232	1092	50,5	21605
2000	590	20	30102	1162	35,9	32382
2001	597	20	29923	1210	46,4	26105
2002	232	11	21823	970	45,7	21235
2003	274	15	18493	962	41,6	23104
2004	259	12	21112	800	41,8	19123
2005	330	16	20663	965	44,8	21535
2006	518	27	19264	908	42,3	21485
2007	621	29	21201	724	40,0	18108
2008	762	38	20212	936	47,8	19588
2009	640	40	16162	964	44,5	21670
2010	553	40	13744	800	44,6	17942
2011	538	47	11532	542	44,9	12068
2012	498	42	11887	895	52,5	17050
2013*	542	37	14736	893	49,7	17962
2014*	493	27	18060	727	48,7	14942
2015*	411	31	13309	839	60,9	13773
2016*	514	38	13718	752	46,0	16352

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	0,00
1983	0,44	45,80	81,48	22,95	22,95	0,00
1984	0,45	43,05	69,48	22,18	22,18	0,00
1985	0,42	43,14	44,09	18,94	18,94	0,00
1986	0,45	40,02	40,96	17,16	17,16	0,00
1987	0,51	36,77	50,14	16,18	16,18	0,00
1988	0,65	27,03	71,24	16,65	16,65	0,00
1989	0,65	19,90	78,06	13,79	13,79	0,00
1990	0,70	16,28	82,33	13,19	13,19	0,00
1991	0,69	16,45	69,85	12,83	12,83	0,00
1992	0,84	15,52	52,39	14,27	13,80	0,47
1993	0,91	12,76	61,12	12,17	11,48	0,68
1994	0,89	8,89	119,53	10,86	9,86	0,99
1995	1,19	7,08	51,19	14,34	12,24	2,10
1996	1,16	8,51	101,15	11,62	9,71	1,91
1997	1,18	6,49	80,71	10,77	8,50	2,27
1998	0,94	5,72	57,82	9,36	7,68	1,68
1999	0,79	7,43	67,13	8,69	7,17	1,52
2000	0,88	8,69	70,44	9,74	7,90	1,83
2001	0,86	8,85	49,49	9,24	7,58	1,66
2002	0,82	9,28	70,40	8,18	6,69	1,49
2003	0,84	9,07	59,57	8,21	6,74	1,46
2004	0,73	9,06	78,68	7,86	6,94	0,91
2005	0,78	9,38	127,87	10,31	8,33	1,98
2006	0,89	10,74	94,93	14,08	10,82	3,26
2007	0,95	12,67	169,16	17,44	14,93	2,50
2008	0,92	12,44	116,54	19,11	16,80	2,31
2009	0,96	14,32	106,16	22,17	19,24	2,93
2010	0,72	14,30	64,06	16,95	15,37	1,58
2011	0,82	17,25	88,09	19,01	17,06	1,95
2012	0,80	16,52	89,44	16,40	14,57	1,82
2013	0,67	15,06	66,33	13,91	11,35	2,55
2014	0,74	18,41	84,66	14,48	11,88	2,60
2015	0,63	17,02	113,47	13,84	11,55	2,29
2016	0,57	18,84	98,10	14,52	12,21	2,31

Landings do not include France data presented in table 10.1

Discards time series begin in 1992 the year of implementation of MLS (27 cm). Before that zero discards assumed.

Table 10.7 Short term projections

Table 10.7. Short term projections

SSB 2017	BIO 2017	F 2017	Yield 2017	Catch 2017	SSB 2018	BIO 2018
23333	30377	0,64	15272	18231	24643	30546

Fmult	F 2018	Yield 2018	Catch 2018	SSB 2019	
0,00	0,00	0	0	51997	
0,10	0,06	1955	2268	48343	
0,20	0,12	3812	4424	44866	
0,28	**0,17**	5229	6071	42230	*Flow*
0,40	0,25	7240	8414	38518	
0,41	**0,25**	7366	8561	38286	*Fmsy*
0,43	0,26	7693	**8942**	37686	*TAC-15%*
0,50	0,31	8819	10255	35628	
0,52	0,32	9046	**10520**	35215	*equal TAC*
0,58	**0,36**	10009	11646	33463	*Fupp*
0,60	0,37	10310	11998	32918	
0,61	0,38	10396	**12098**	32763	*TAC+15%*
0,70	0,44	11719	13647	30377	
0,80	0,51	13047	15204	27998	
0,90	0,57	14297	16673	25772	
0,91	**0,58**	14423	16820	25550	*F-10%*
1,00	**0,64**	15473	18057	23693	*Fsq*
1,84	1,27	22740	26707	**11100**	*Bpa-Btrg*
2,17	1,55	24547	28905	**8000**	*Blim*

There is a EC Recovery Plan (-10% annual F redution; +-15% TAC constrain)
Fmsy = 0.25
TAC 2017 = 10520 (-+15% [12098, 8942])
Recruitment = 80 237 t mill (gemetric mean 1989-15)

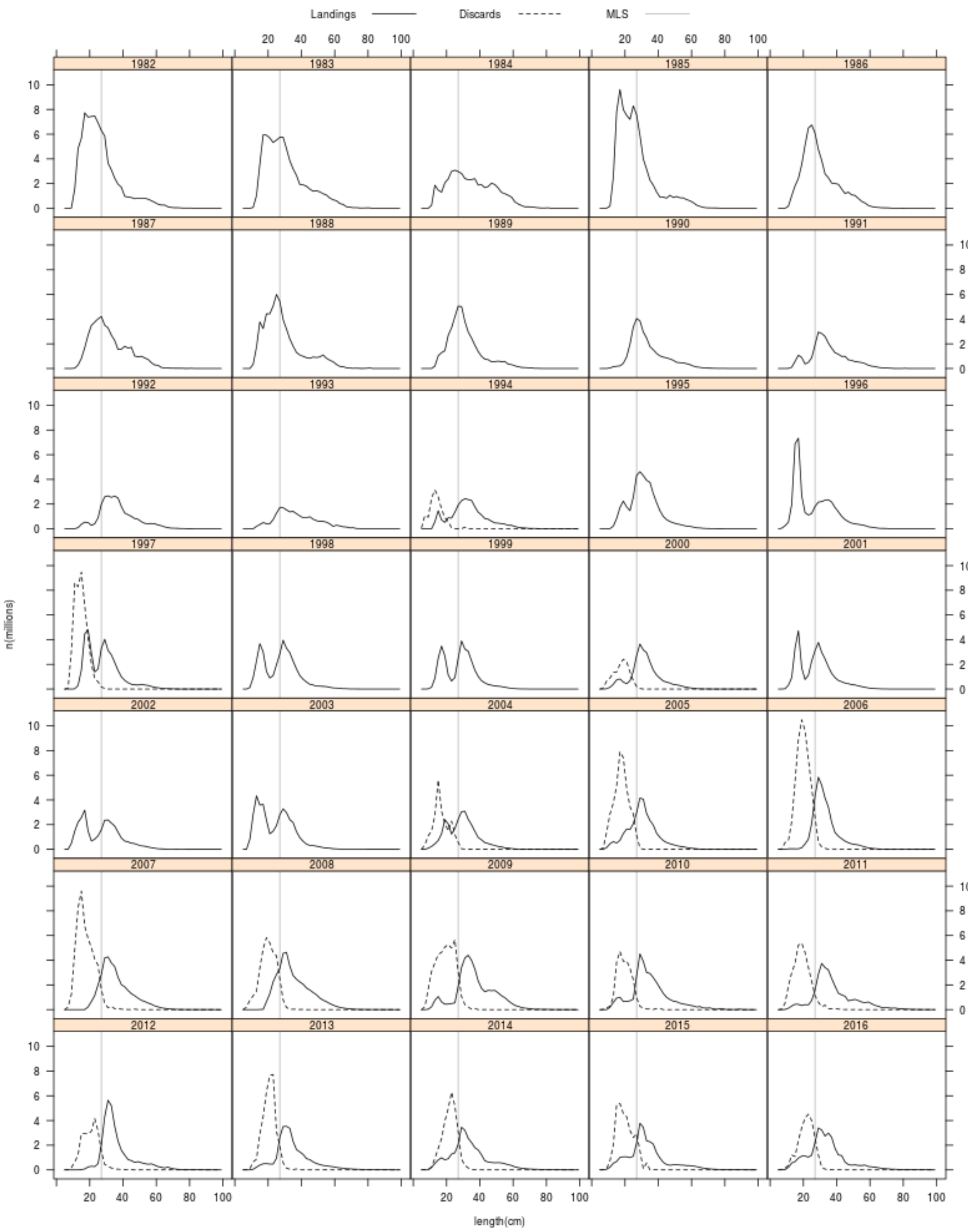


Figure 10.1. Length distribution of catches used in the assessment. Landings (1982-latest year) plus Cadiz landings from 1994–2004. Discards from 1992–latest year (dashed line). Minimum landing size (MLS) since 1992 at 27 cm.

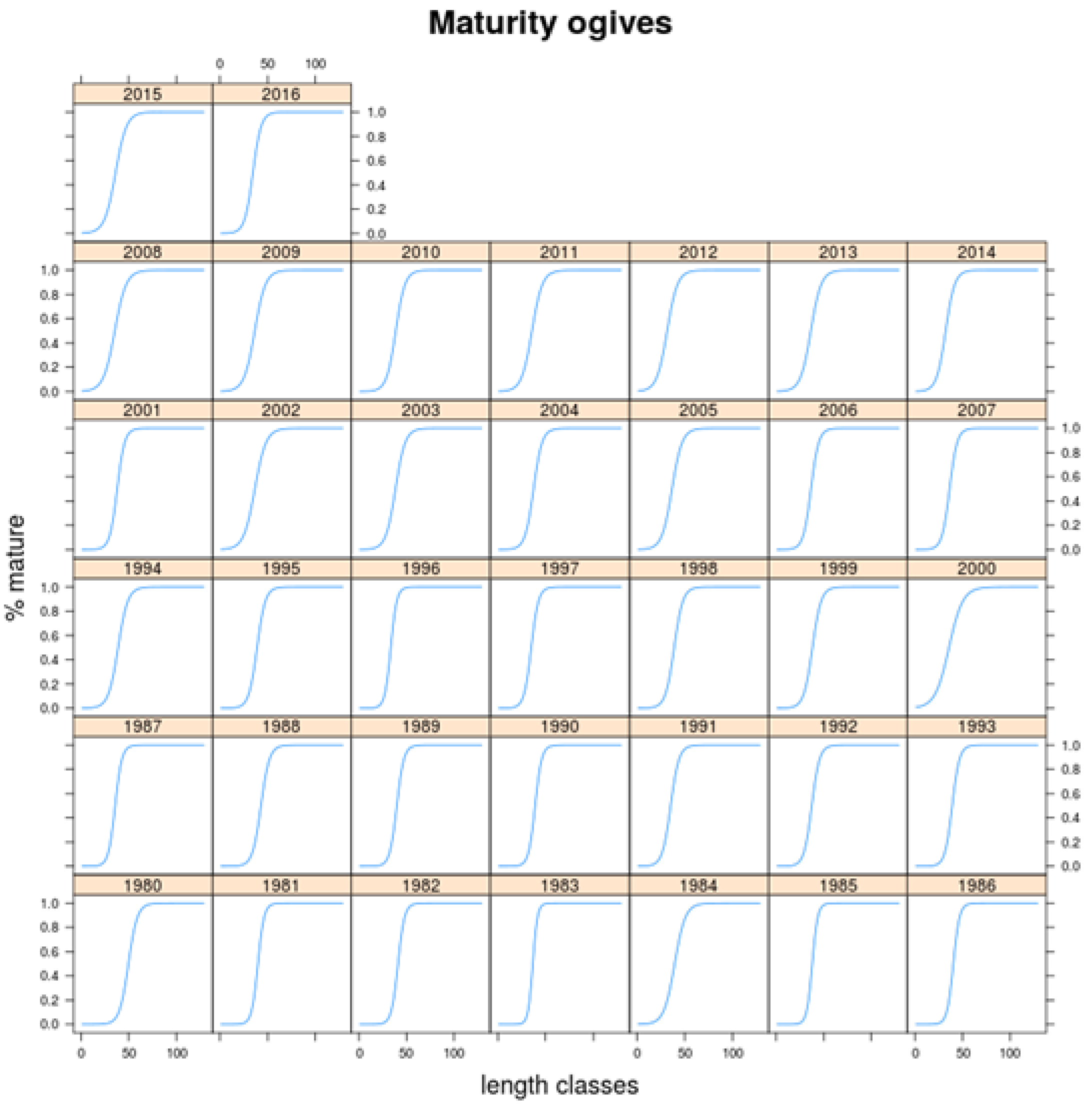


Figure 10.2. Maturity ogives from 1986 to 2016

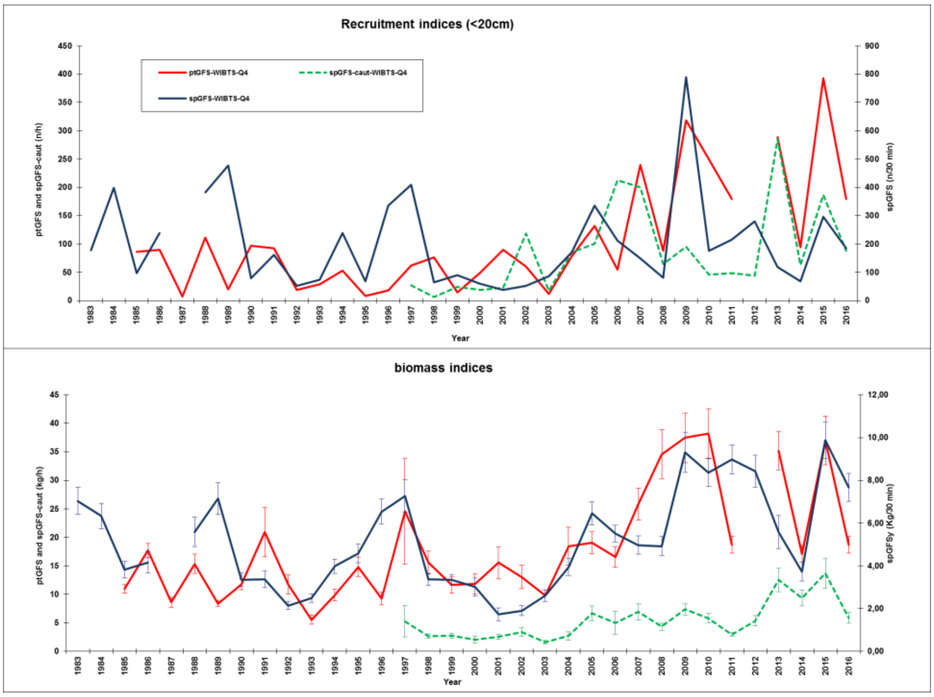


Figure. HAKE SOUTHERN STOCK - Recruitment and biomass Indices from groundfish surveys. Vertical bars = 90% CI.

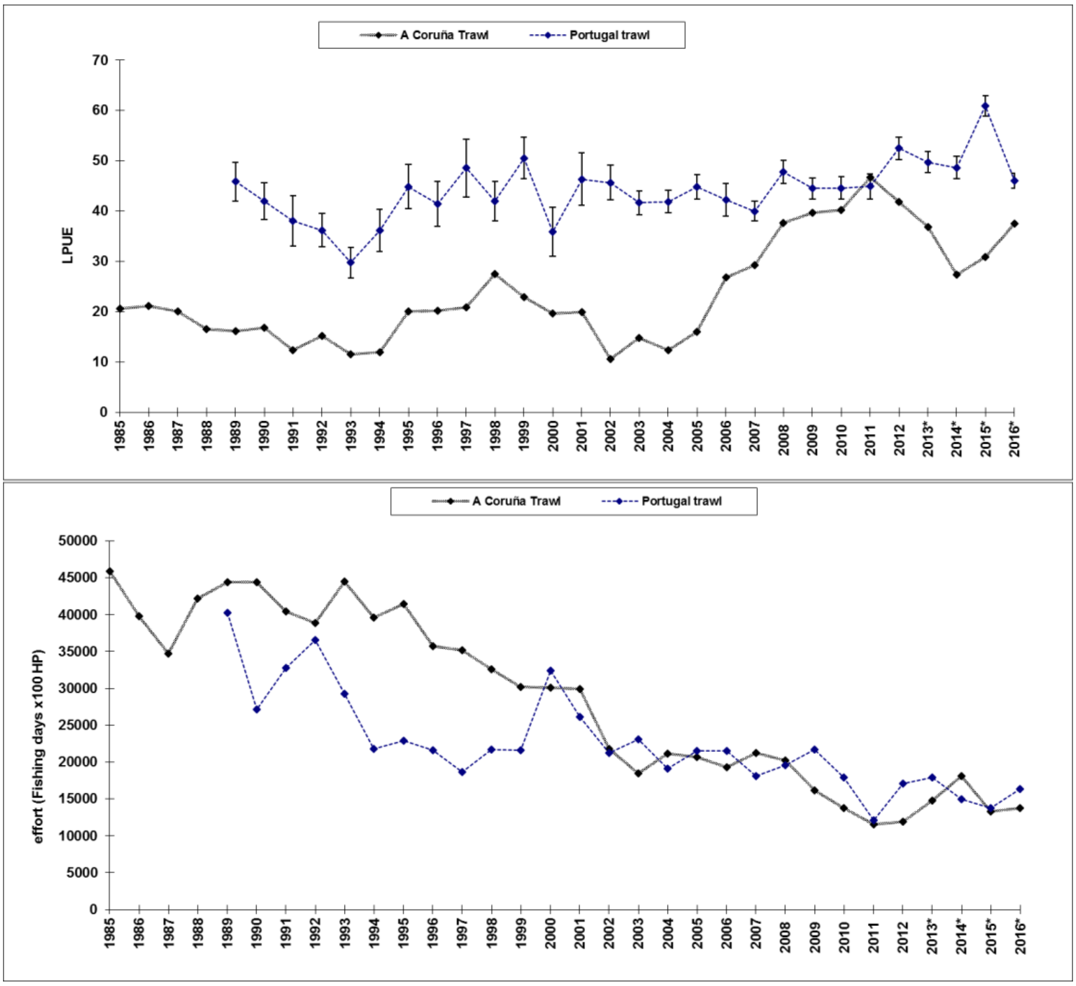


Figure 10.4. HAKE SOUTHERN STOCK- Lpue and fishing effort trends for trawl fleets. Vertical bars = 90% CI.

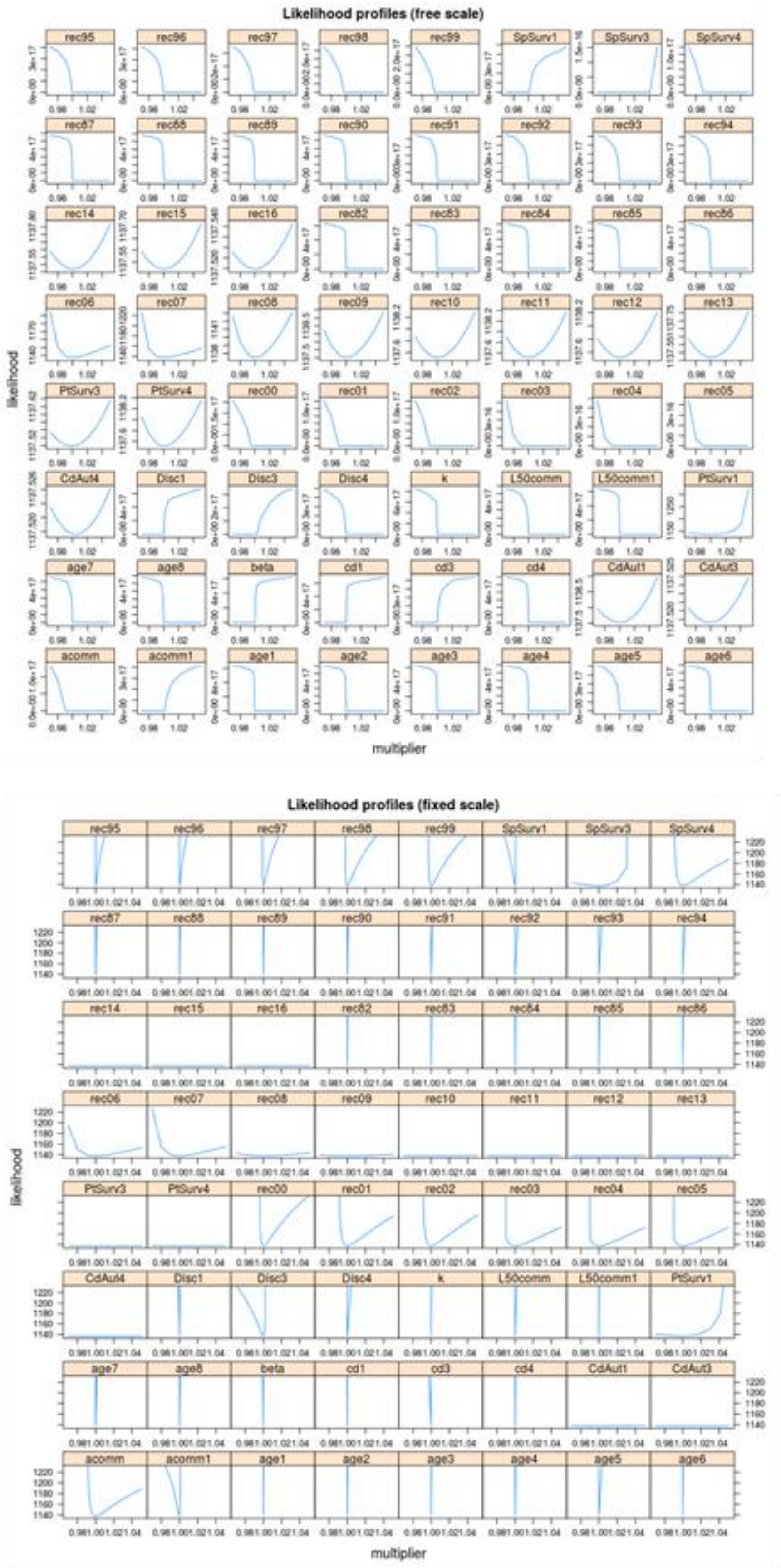


Figure 10.5. Gadget convergence with likelihood profiles. Free scaled (upper panel) and fixed scaled (lower panel)

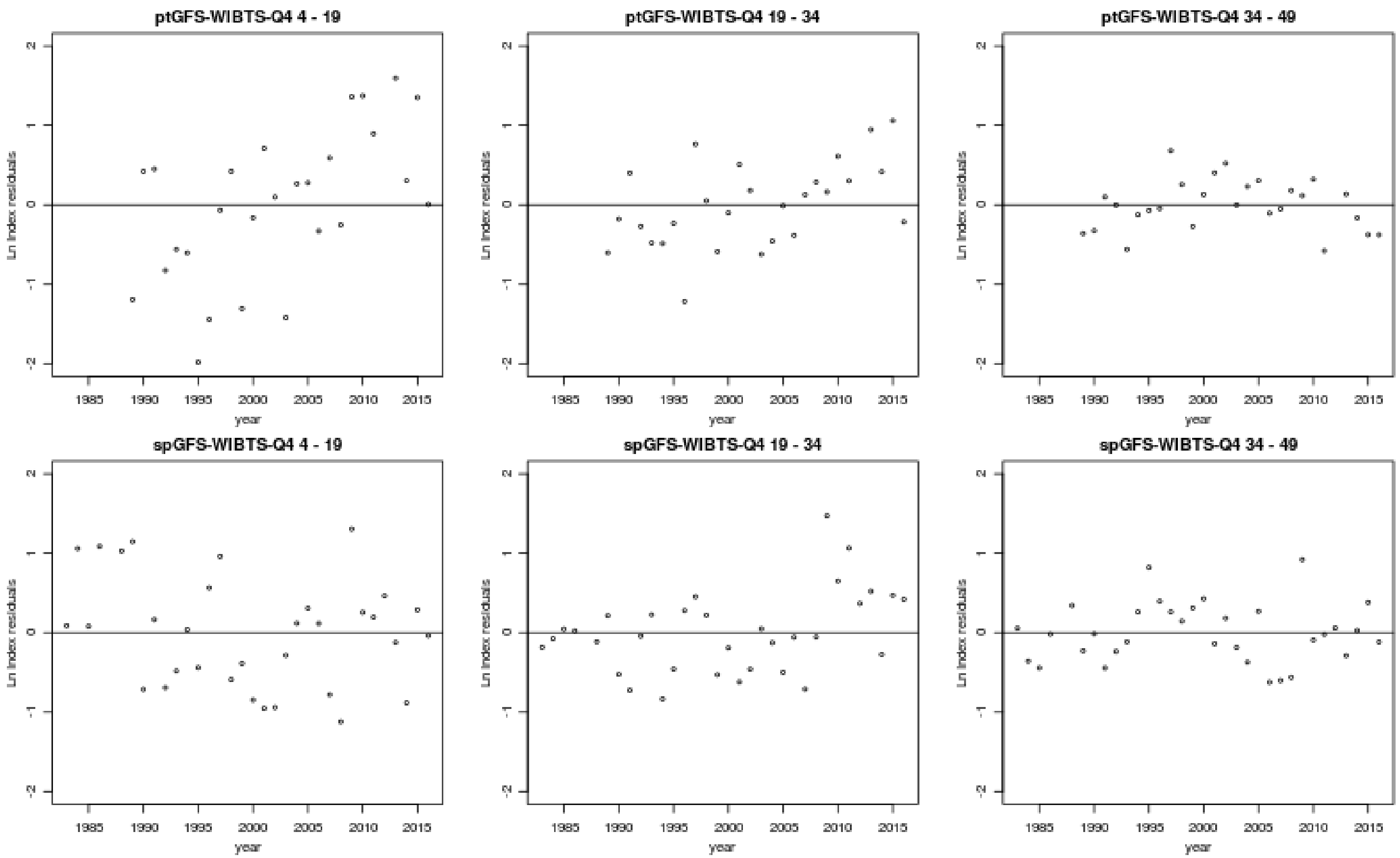
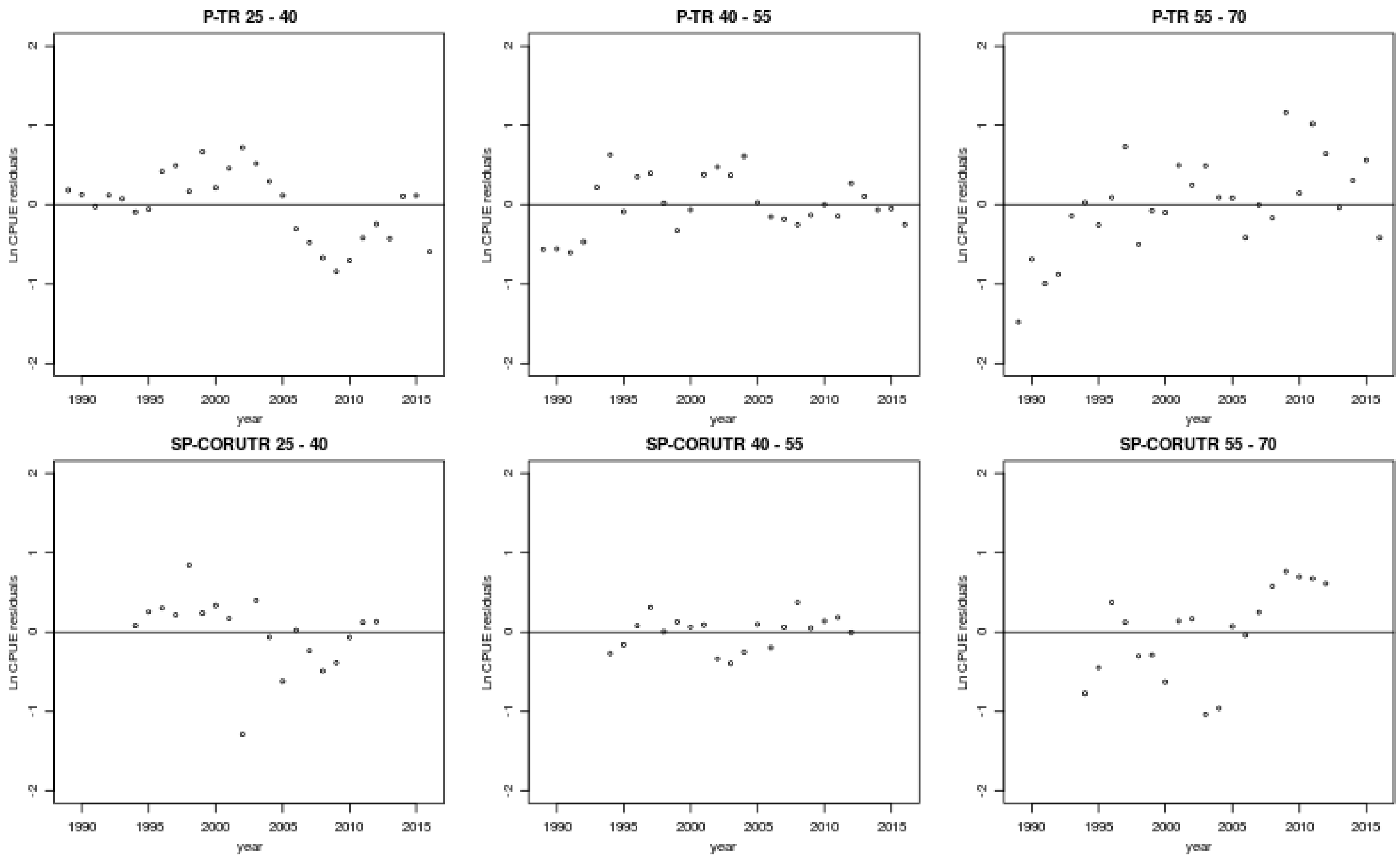
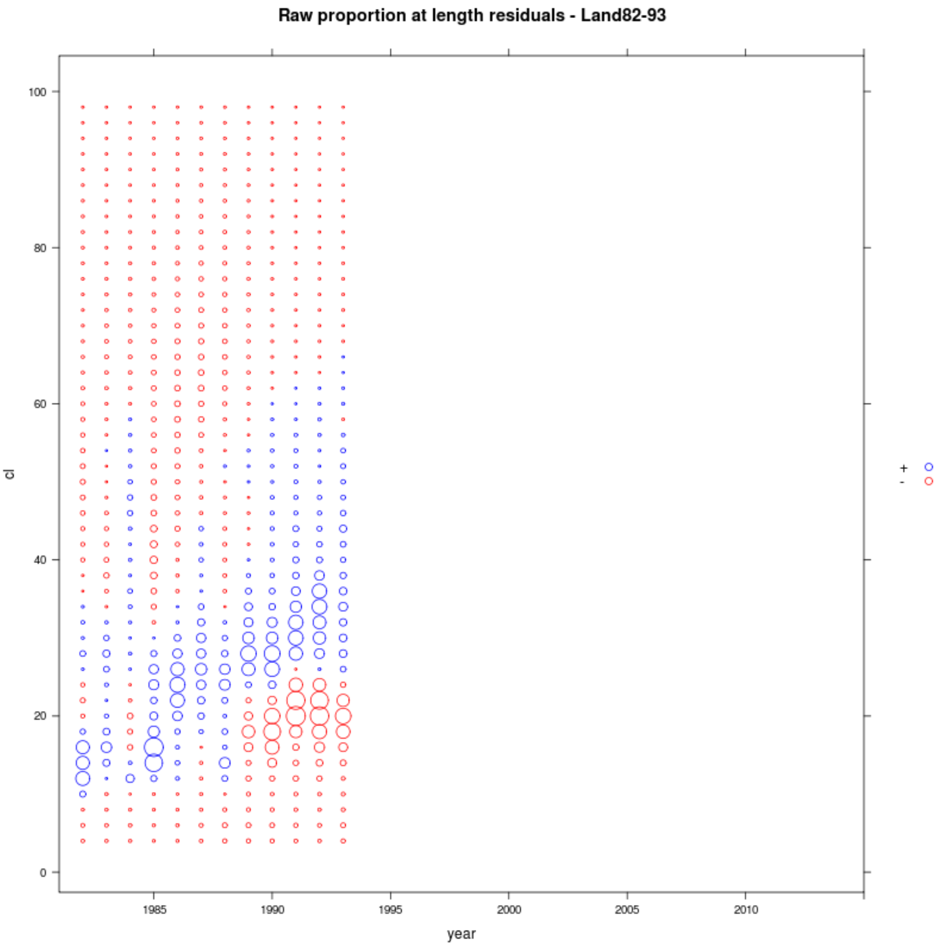


Figure 10.6Diagnostics Residuals (10.6 a and b). Observed vs. expected length proportions (10.6 c-i))

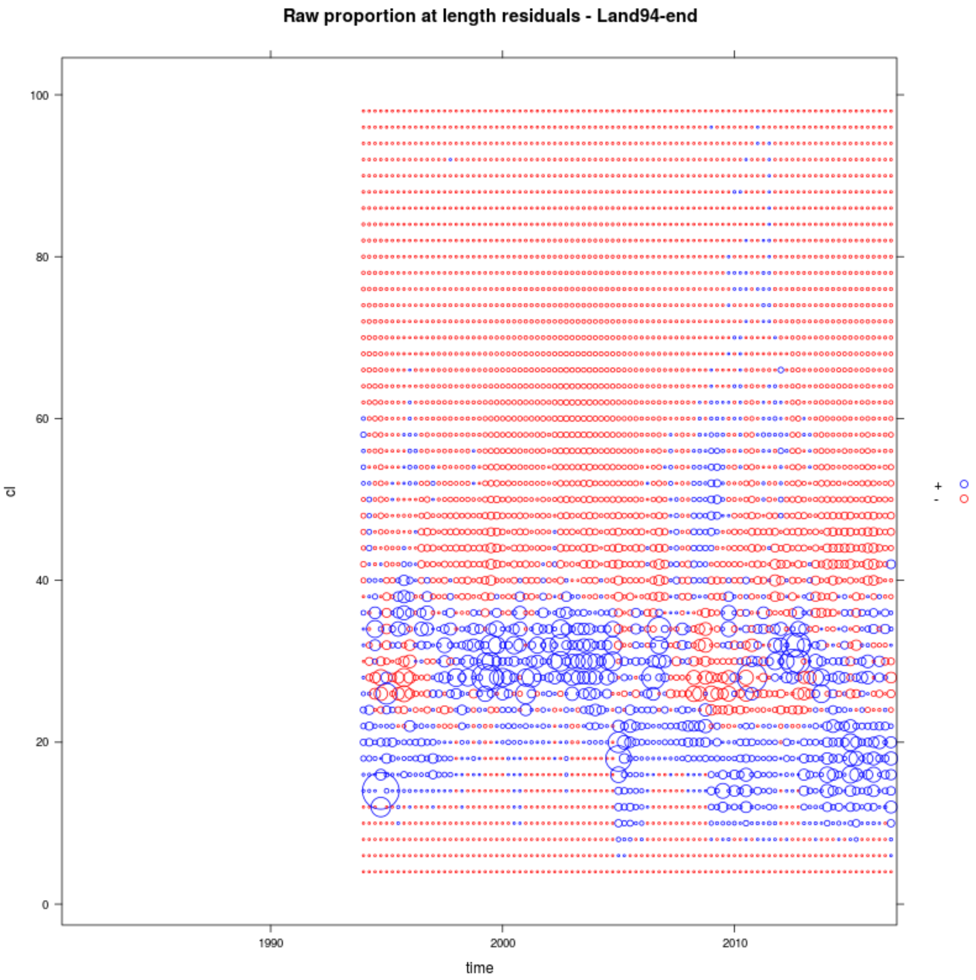
(10.6 a) Survey residuals by 15 cm groups (4–19, 19–34, 34–49 cm)



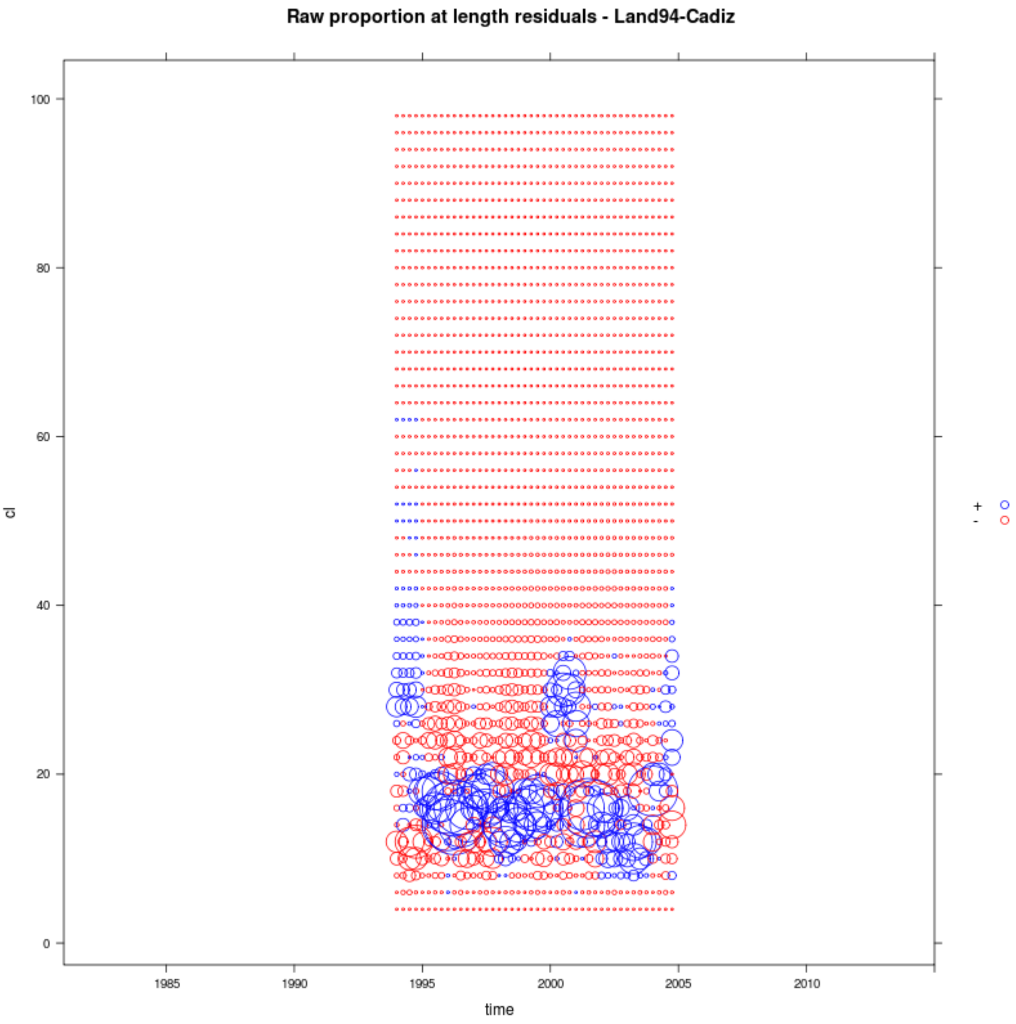
(10.6 b) Lpue residuals by 15 cm groups (25–40, 40–55, 55–70 cm)



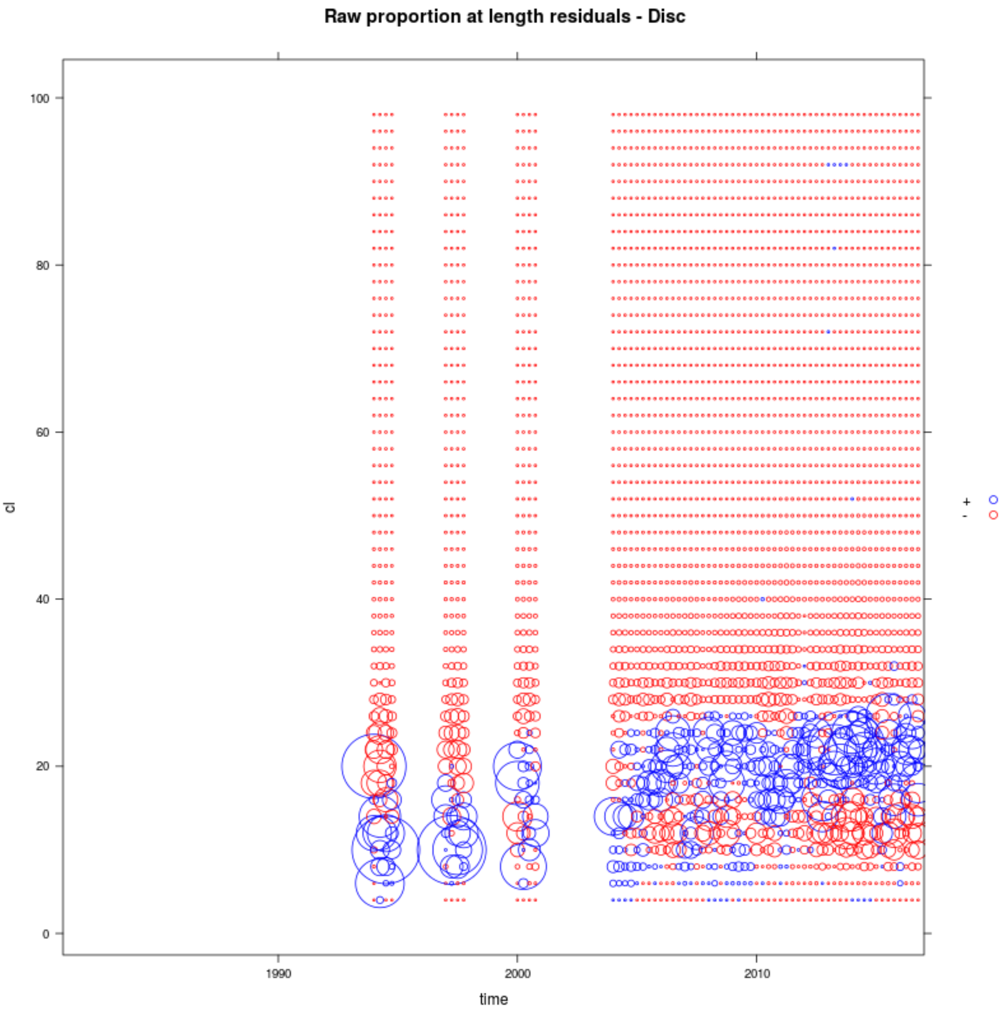
(10.6 c). Bubble plot for landings length distribution from 1982 to 1993.



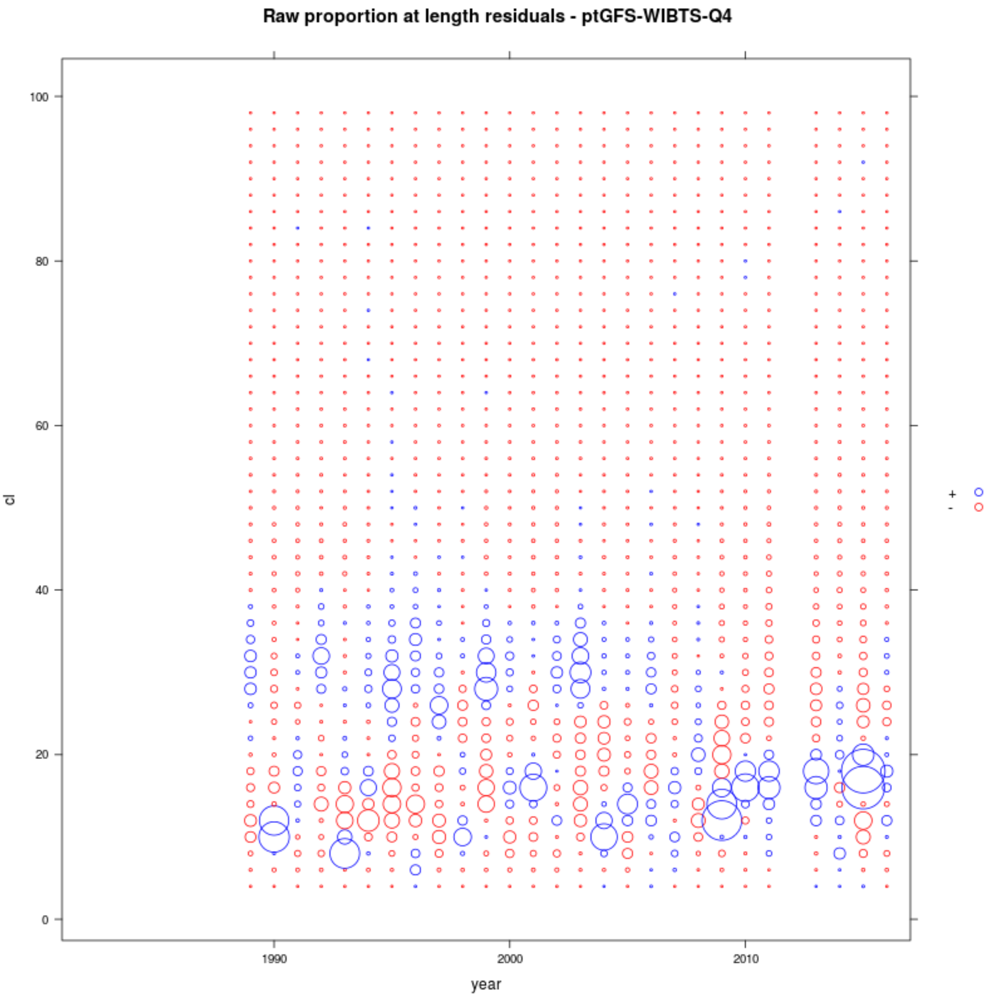
(10.6 d). Bubble plot for landings length distribution from 1994 to last year



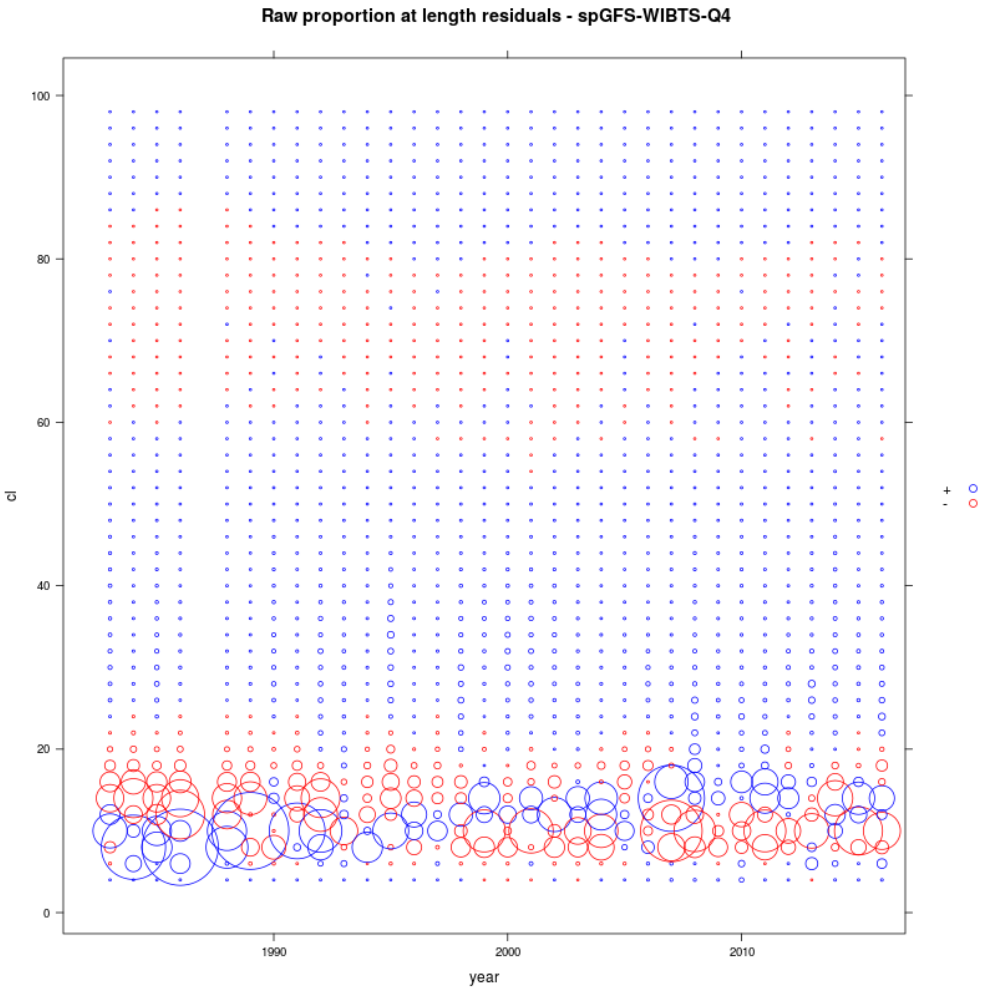
(10.6 e). Bubble plot for Cadiz landings length distribution from 1982 to 2004



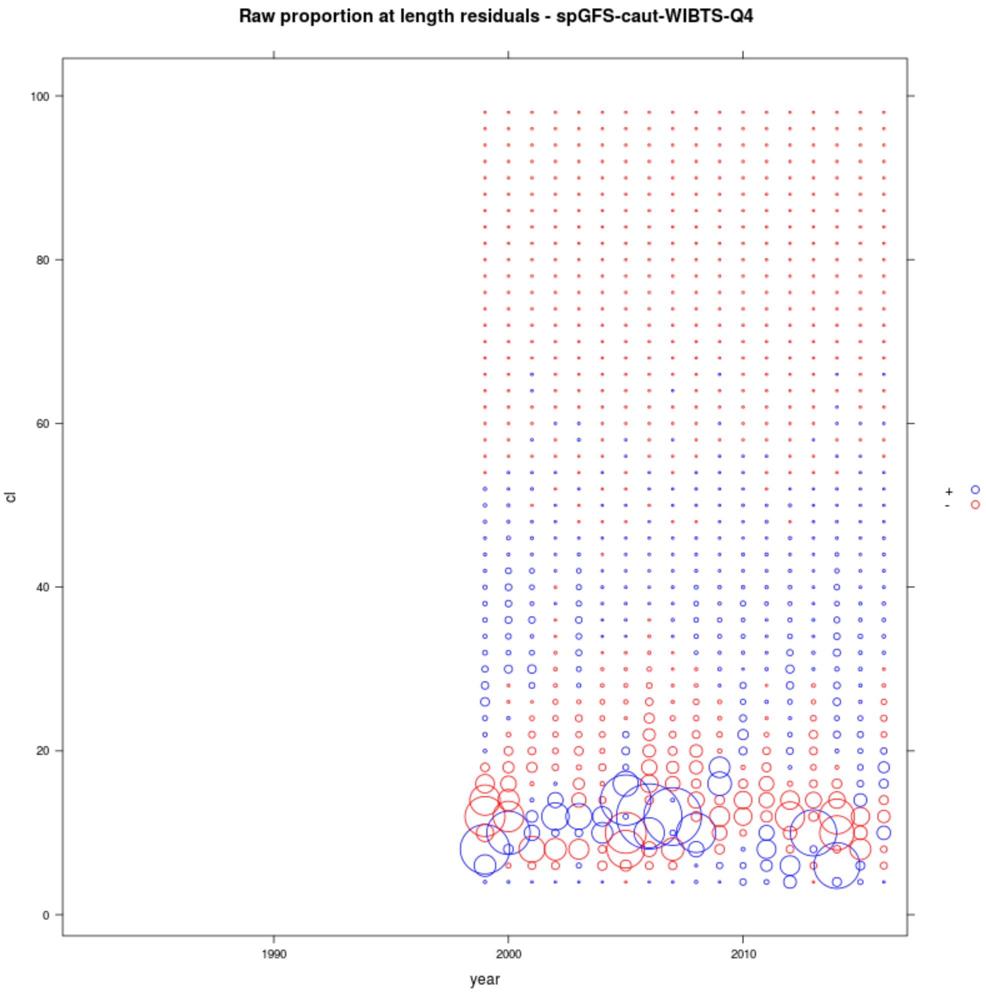
(10.6 f). Bubble plot for Discards length distribution for years 1993, 97, 99, 2004-end



(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)

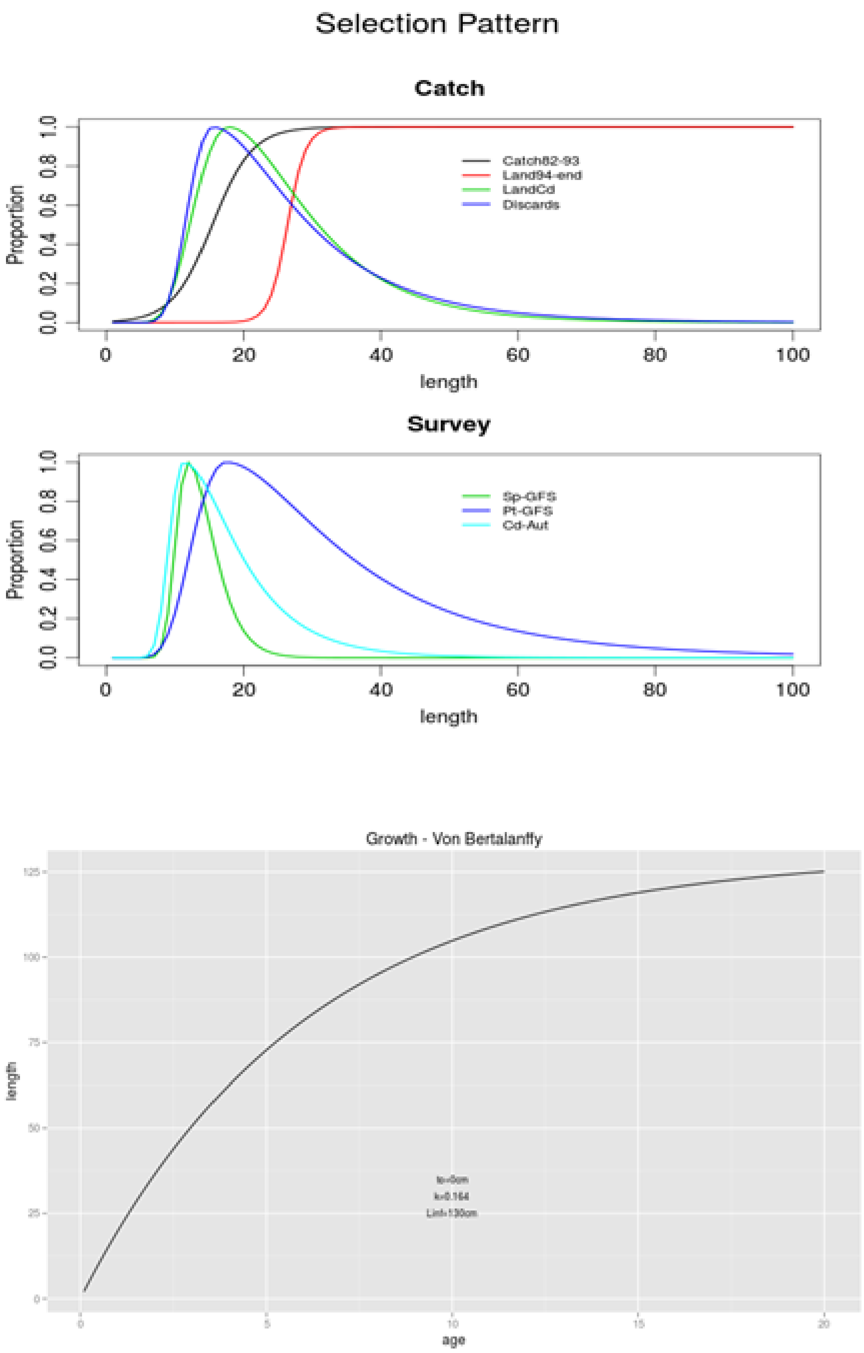


Figure 10.7. Selection pattern (upper panel) and von Bertalanffy growth with k parameter estimated by the model (lower panel)

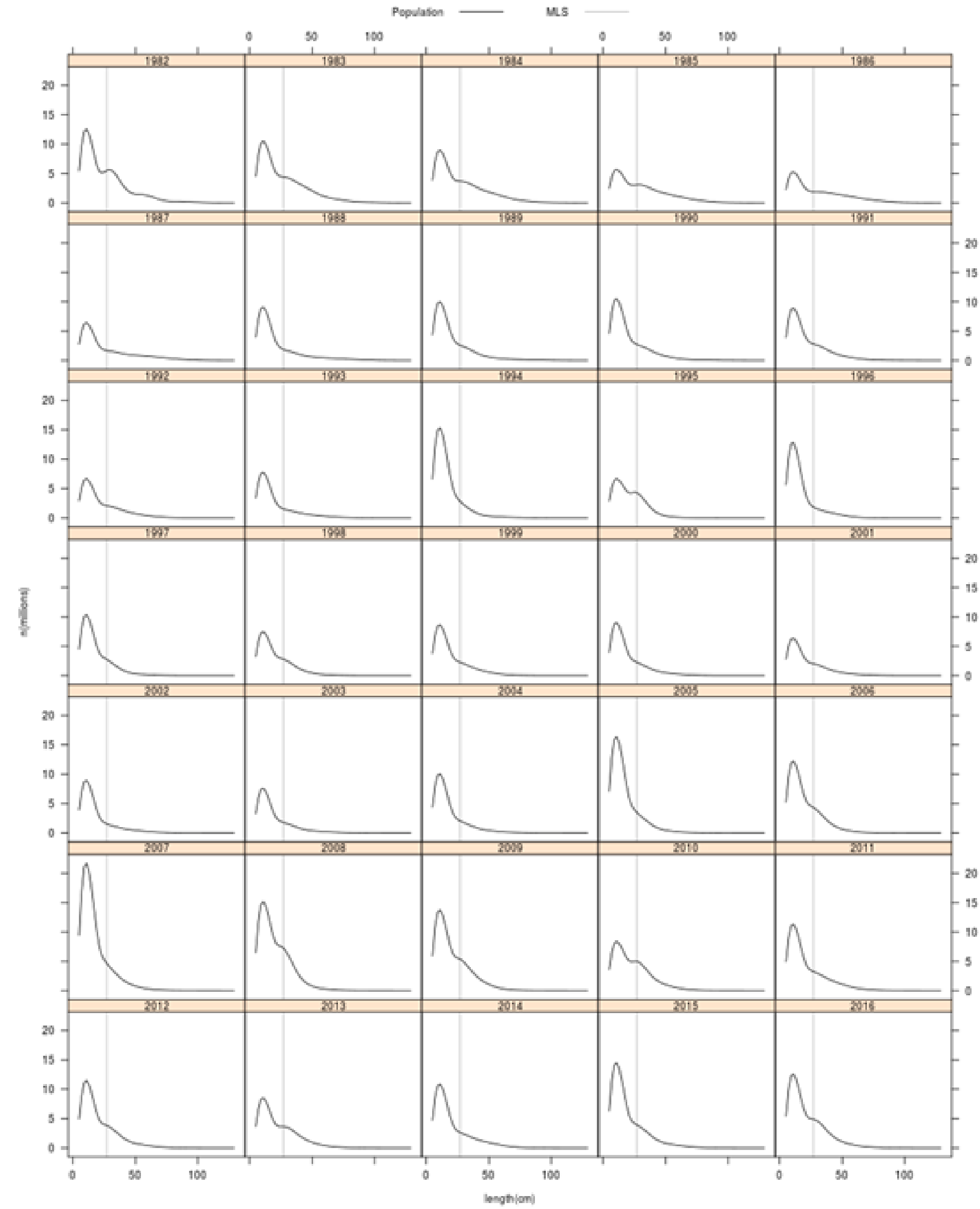


Figure 10.8. Population length distribution at the beginning of the 4th quarter

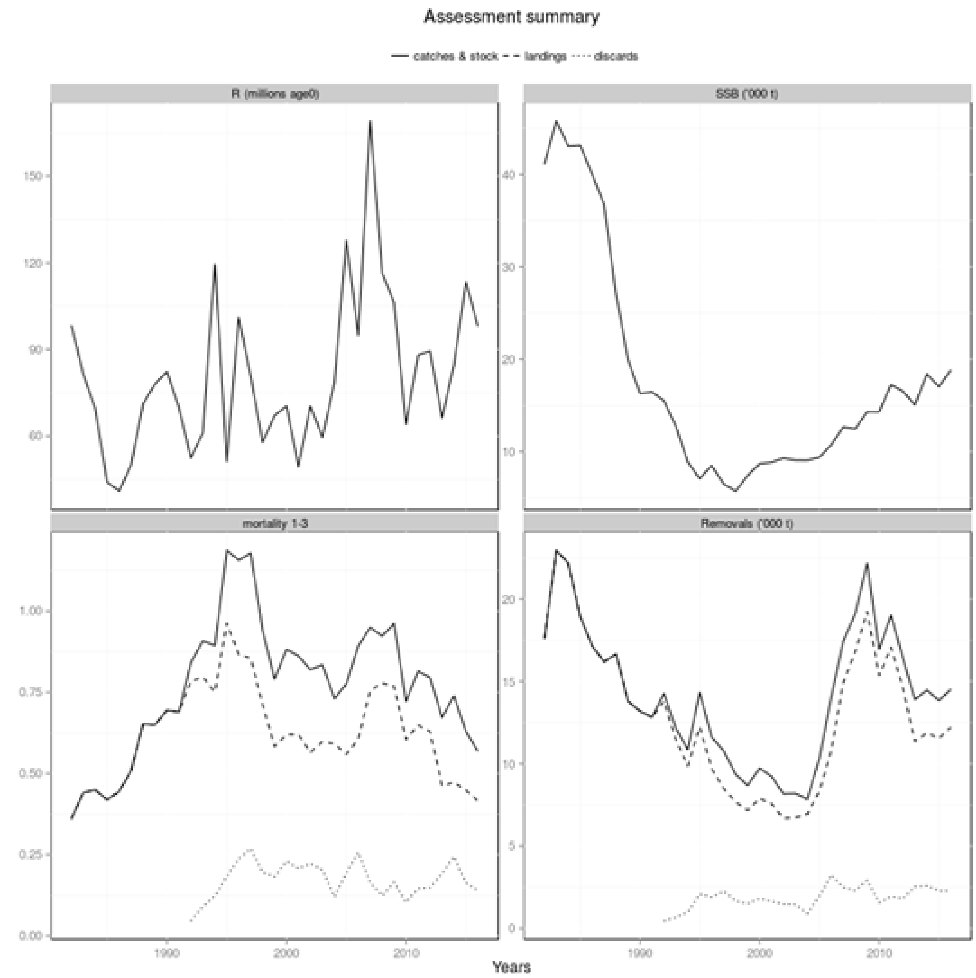


Figure 10.9. Summary plot. SSB and removals (catch, landings and discards). Fishing mortality (F) for ages 1–3.

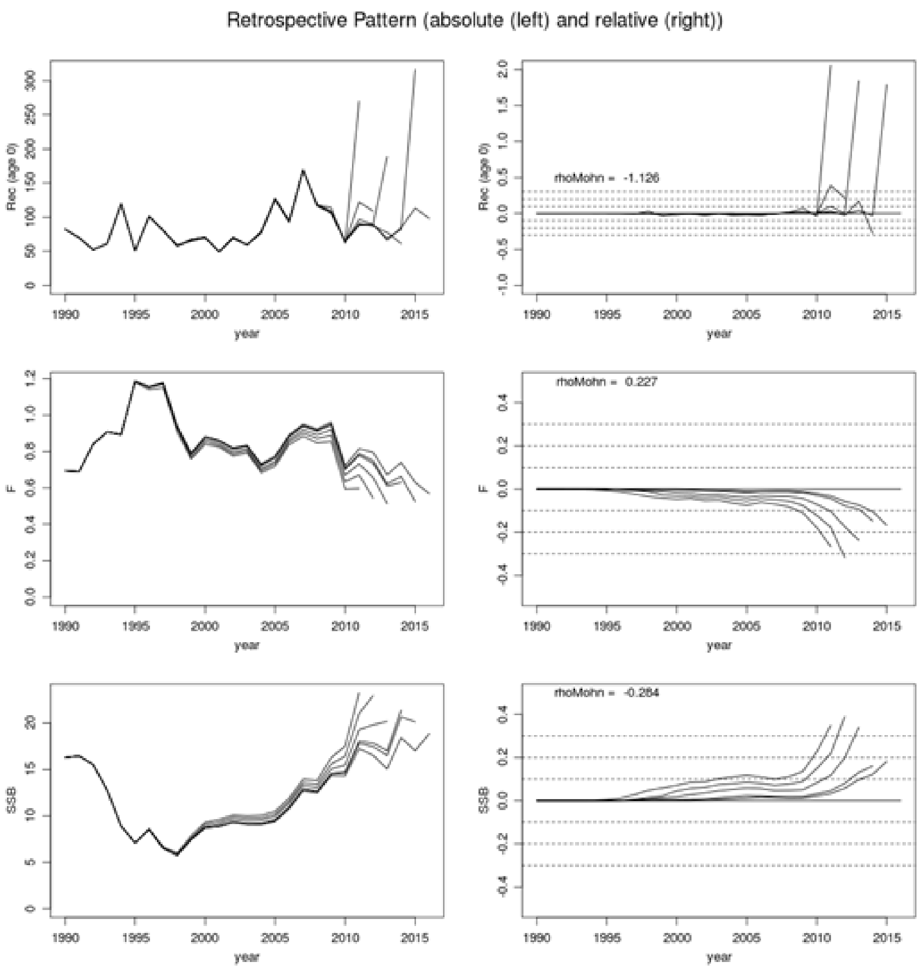


Figure 10.10. Retrospective plots (absolute and relative).

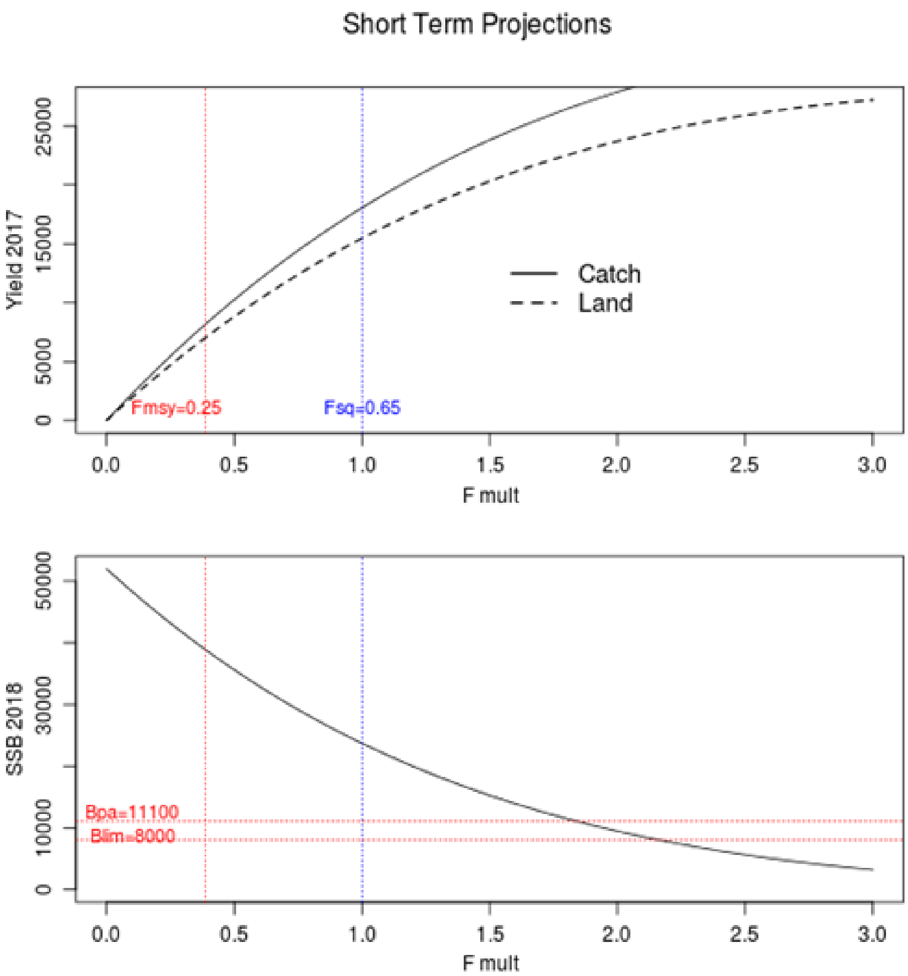


Figure 10.11. Short term projections

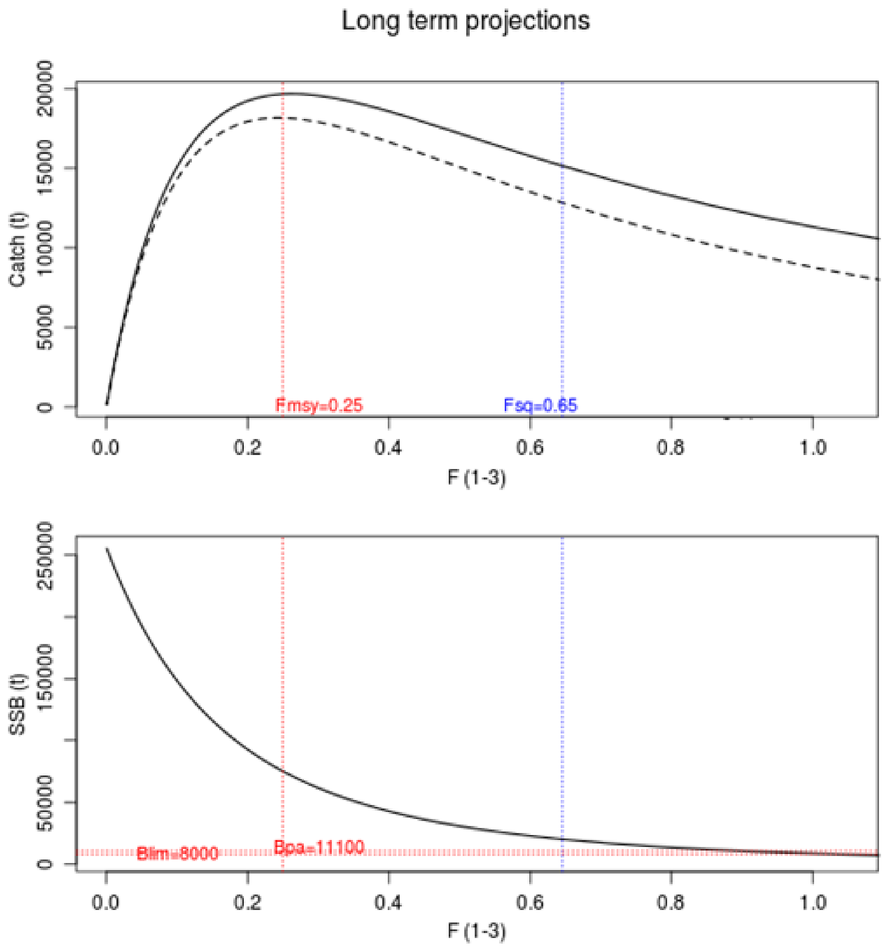


Figure 10.12. Long term yield and SSB per recruit

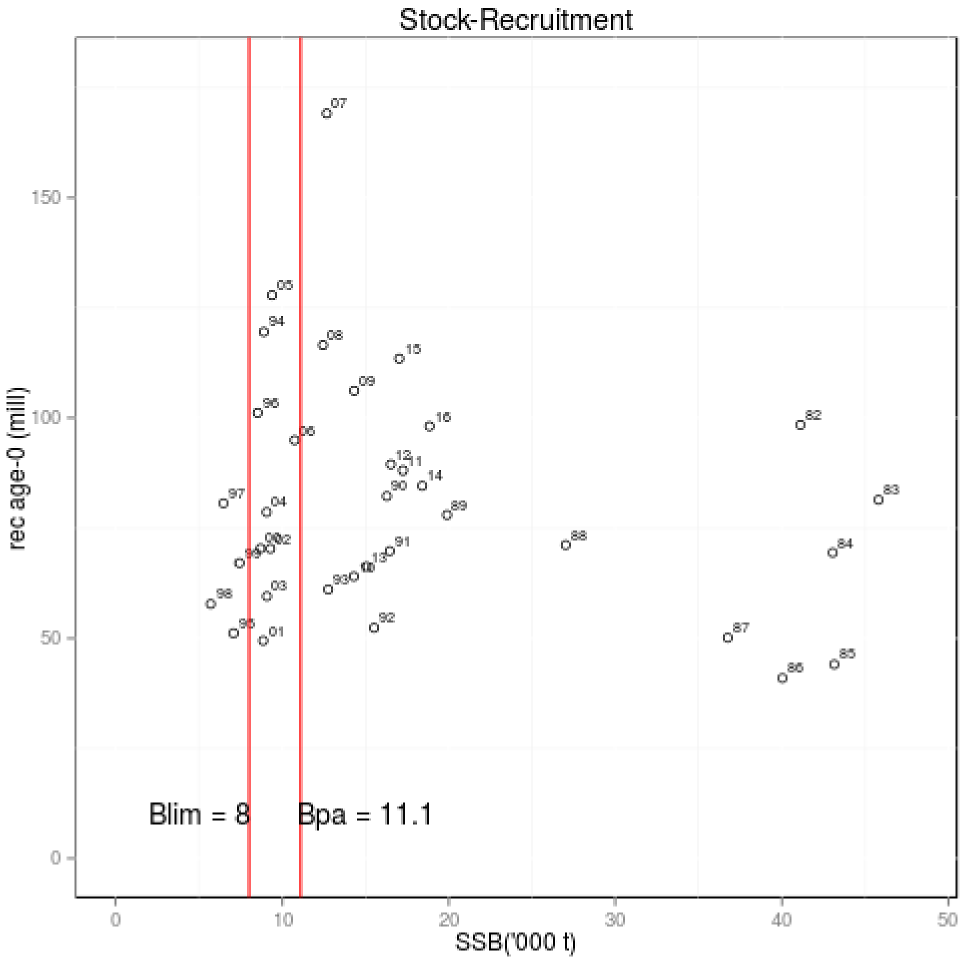


Figure 10.13. Stock-Recruitment plot

11 *Nephrops* (Divisions VIII ab, FU 23–24)

Type of assessment: update assessment

Main changes from the last assessment (WGBIE2016): The stock was benchmarked by WKNEP 2016 and assessment based on UWTV survey conducted since 2014 was validated as analytical method.

Previously, some changes had 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).

ICES description	VIIIa,b
Functional Units	Bay of Biscay North, VIII a (FU 23)
	Bay of Biscay South, VIII 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 2017

For many years the advice was biennial. The stock was classified under category 3 and only trends of the yearly assessment were taken into account for the advice. The UWTV survey routinely carried out since 2014 was validated as standard assessment method by the 2016's benchmark workshop (WKNEP). As consequence of that, the advice became yearly and the stock was categorised in group 1. The latest advice provided in 2016 recommended "… when the MSY approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of 2013–2015, catches in 2017 should be no more than 6 376 tonnes. This implies landings of no more than 4 160 t".

11.1.4 Management applicable for 2016 and 2017

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

2017

Species:	Norway lobster *Nephrops norvegicus*	**Zone:**	VIIIa, VIIIb, VIIId and VIIIe (NEP/8ABDE.)
Spain	250		
France	3 910		
Union	4 160		
TAC	4 160		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. For 2017, as consequence of the 2016's advice based on the validated UWTV survey the TAC was fixed at 4 160 t. In 2016, total nominal landings reached 4 091 t corresponding to a slight TAC overshot.

For a long-time, a minimum landing size of 26 mm CL (8.5 cm total length) was adopted by the French producers' organisations (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 VIIIa, VIIIb and VIIId."

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 VIIIa, VIIIb 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 2016). In the beginning of 2006, the French producers' organisations 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 VIIIa,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 a strong reduction of the landings occurred (2 520 t and 2 380 t respectively). During the three recent years, landings increased continuously (2 807 t in 2014; 3 569 t in 2015; 4 091 t in 2016). Landings since 2008 have been reached under the new selectivity regulations.

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 1987–2016) and in a lesser degree in the removals (sex 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 (2003–2016) reached a higher level of 2 020 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 2016, 201 million individuals were estimated to have been discarded (2 530 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 (569 trips and 1 630 hauls have been sampled over 14 years). In spite of 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 2007–2016 the percentage of cross-validation item by item between logbooks and sales was comprised in a wide range of 69 to 90% (80% for 2015 and 85% in 2016). 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

Trawl survey (LANGOLF)

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 vs. sedimentary structure. Therefore, as regards the investigations carried out during the IBP *Nephrops* 2012, its results for abundance indices were included in the assessment (WGHMM 2012, 2013; WGBIE 2014). Nevertheless, the relative improvement in retrospective analysis did not substantially modify the quality of the stock assessment performed by XSA model. The time series provided by this survey was interrupted in 2014.

UWTV survey (LANGOLF-TV)

A new experimental survey counting UWTV burrows as routinely operated for many *Nephrops* stocks on areas VI and VII has been undertaken since 2014 on a yearly basis (WD 8). The UWTV survey named "LANGOLF-TV" aimed to demonstrate the technical feasibility of such a survey in the local context and to identify the necessary competences and equipment for its sustainability. The burrows counting was carried out by the Irish scientific vessel "Celtic Voyager" on the basis of a systematic sampling plan. For the first two years, UWTV experiments were combined with trawling operations 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 trawl survey for the purpose of providing *Nephrops* LFDs by sex and estimating the proportion of other burrowing crustaceans (mainly Munida) which can induce bias in the burrows counting (WD 4).

From 2016 onwards, the trawling operations were not conducted any more as they were considered not necessary for the further analytical investigations on the stock exclusively based on the UWTV tools. A longer survey duration in 2016 allowed to cover for the first time the area contained in the outline of the Central Mud Bank no belonging to any sedimentary stratum: this area known as not trawled due to rough sea bottom is crossed by muddy channels and concentrate a moderate fishing effort targeting *Nephrops* (Fig. 11.3). Investigations on the basis of stratified statistical estimators (Table 11.4) as well as on geostatistics (Table 11.5; Fig. 11.4 and 11.5) were carried out and examined by WKNEP 2016 which validated the UWTV approach.

The survey occurred in different seasons within year (September 2014, July 2015, and May 2016) as it is constrained by the schedule time for UWTV Irish equipment and staff.

A new survey was carried out during the WGBIE 2017 meeting (May) and its results will be available for assessment and advice in the late summer.

11.2.4 Commercial catch-effort data.

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 log-book 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 11.6; Figure 11.6). 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 11.6), 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) and 2016 (19.7 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 sea bottom 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

Analytical assessment based on the recently adopted UWTV survey was carried for the first time in November 2016 after the WKNEP benchmark in order to propose advice 2017 for the stock. This assessment was performed on the UWTV results for 2016 and on the averaged 2013–2015 LFDs and mean weights for landings and discards. Details of this assessment are provided below. The estimated status quo harvest rate was equal to 5.4%.

Variable	Value	Source	Notes
Abundance in TV assessment	4167.746	ICES (2016)	UWTV 2016 (cumulative bias=1.24)
Mean weight in landings	23.325	ICES (2016)	Average 2013–2015
Mean weight in discards	10.877	ICES (2016)	Average 2013–2015
Discard rate (total)	53.35%	ICES (2016)	Average 2013–2015 (proportion by number)
Discard survival rate	30%	ICES (2016)	Only applies in scenarios where discarding is allowed.
Dead discard rate (total)	44.46%	ICES (2016)	Average 2013–2015 (proportion by number), only applies in scenarios where discarding is allowed.

11.4 Catch options and prognosis

For 2017, the catch option table containing updated information on the fishery (mean weight for landings and discards, discard rate, survival rate for discards) is given below.

Variable	Value	Source	Notes
Abundance in TV assessment	Available in autumn 2017	ICES (2017)	UWTV 2017 (May)
Mean weight in landings	24.809	ICES (2017)	Average 2014-2016
Mean weight in discards	11.950	ICES (2017)	Average 2014–2016
Discard rate (total)	52.98%	ICES (2017)	Average 2014–2016 (proportion by number)
Discard survival rate	30%	ICES (2017)	Only applies in scenarios where discarding is allowed.
Dead discard rate (total)	44.09%	ICES (2017)	Average 2014–2016 (proportion by number), only applies in scenarios where discarding is allowed.

11.5 Biological reference points

A FMSY proxy was provided for this stock as part of the response to the EU request to provide a framework for the classification of stock status relative to MSY proxies for selected category 3 and category 4 stocks (ICES, 2016). With the availability of UWTV surveys, ICES has now been able to assess the stock as a category 1 one. The MSY reference point proxies provided previously for this stock have therefore been replaced by MSY reference points.

The FMSY reference point (harvest rate of 7.7%; ICES, 2016) is based on the average realised harvest rates of functional units with an observed history of sustainable exploitation, while also taking into account the low harvest rates applied to the FUs 23–24 stock in the recent past.

11.6 Comments on the assessment

The continuation of the French *Nephrops* trawlers onboard sampling programme will avoid the use of "derived" data for missing years (13 years on 29). Since 2009, there has been a relevant improvement of the sampling design as many trips were sampled in the Southern part of the fishery. Derivation based on probabilistic approach should improve knowledge in further analytical retrospective investigations on this stock.

The upgrade to category 1 stocks is the consequence of a representative sampling on the whole Central Mud Bank of the Bay of Biscay as performed in 2016. In addition to unbiased spatial fishery information as VMS this results demonstrates the accurate knowledge of the stock area and of its sedimentary heterogeneous structure.

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 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 for the last three years whereas fishing effort remained stable or slightly growing up and as 2015–2016 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 a fixed period within year (May).

11.8 Management considerations

Many positive signals on recent years (increase of Lpues, landings, removals) and relative stability of burrow indices from UWTV surveys 2014–2016 suggest a stock status within safety limits although the current perception for the stock could not be changed while UWTV survey indices are not updated for 2017.

Table 11.1. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Estimates of catches (t) by FU for 1960-2016

	Landings (1)					Total Discards		Catches
Year	FU 23-24 (2	FU 23	FU 24	Unallocated (MA	Total	FU 23-24		Total
	VIIIa,b	VIIIa	VIIIb	N)(3)	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	1822	▪	5391
2016	na	3873	217	na	4091	2531	▪	6622

(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
2015	sampled
2016	sampled

Table 11.3.a Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 1987-2001

Landings CL mm	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
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	14	0	0	0	0
16	0	158	59	0	0	0	0	0	0	0	14	0	0	0	0
17	149	230	77	12	35	62	0	0	0	0	0	0	0	0	0
18	331	553	131	64	30	0	0	31	20	0	0	0	0	14	13
19	1296	1886	901	48	79	138	0	72	61	0	0	0	0	11	38
20	3129	4227	2791	529	474	450	464	206	341	48	448	25	72	116	284
21	6476	8882	7039	1947	1572	1595	1285	482	1573	414	1313	288	219	433	643
22	13501	16050	12971	5913	4733	3948	3878	2824	2395	1311	2799	985	849	1015	2116
23	21337	25374	18073	10910	7854	9701	7398	5366	5523	2799	4638	3171	1888	2531	6261
24	24339	33950	21960	13293	15521	20948	11949	9650	8731	6071	10005	6484	4032	5462	8915
25	32476	36294	25650	16440	19747	27876	21011	15079	14348	13239	19837	13980	10717	11357	17106
26	29670	29808	22747	18205	22106	26617	23732	18312	19769	16779	19380	13535	10590	10212	13745
27	28086	28380	22091	16109	21900	28410	26044	21181	25126	18384	22823	16602	12724	11528	17098
28	24925	26017	19087	19595	21214	32091	27580	20488	20914	15744	19466	14432	12058	12639	15835
29	18703	20920	14227	16250	17138	24760	20627	16527	15909	16332	20878	11832	9448	11473	13779
30	18407	17862	13688	12055	14762	19828	21414	15903	19164	20214	21487	16335	16187	13888	16168
31	11419	13156	9037	11088	12408	14281	13452	11207	13333	14009	9791	8539	9209	9828	11316
32	10185	12822	8410	8540	8635	12786	12711	11490	13667	14392	9622	9237	9745	8936	11335
33	8528	8848	7127	10649	7273	9297	11369	7022	7117	8576	6334	5947	6000	6333	8250
34	5926	7812	6967	10543	7987	7318	7355	6684	7584	6524	4816	6619	5910	5225	6185
35	5763	5935	6214	7637	5425	5928	6307	5646	4677	6578	4737	6700	5267	4895	5213
36	4033	5064	4532	6274	4979	4998	4608	4337	3709	4133	2568	5308	4291	3242	4037
37	4024	3754	3545	4841	4541	4195	4089	3752	3496	4226	2135	4722	3230	2946	2901
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3527	2588	2687	2369
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2169	2186	2027	2297
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3084	2353	1862	1908
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1362	1020	941
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797	863
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1049	761	534	530
44	965	704	1192	1401	1089	1050	745	500	915	414	219	748	708	413	383
45	641	581	1194	955	1058	766	684	550	700	464	253	902	429	421	523
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248	294
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213	368
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205	188
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177	183
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154	160
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109	135
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85	102
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133	82
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63	40
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75	53
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18	24
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20	46
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16	29
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7	26
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2	21
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8	7
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1	2
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0	5
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4	0
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1	0
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	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	**288974**	**324498**	**244875**	**213779**	**217338**	**274286**	**240638**	**188879**	**202294**	**182041**	**188694**	**161549**	**135304**	**133383**	**172819**
/eights	**5397**	**5875**	**4835**	**4972**	**4754**	**5681**	**5109**	**4092**	**4452**	**4118**	**3610**	**3865**	**3209**	**3069**	**3730**

Table 11.3.b Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 2002-2016

Landings CL mm	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	20	7	0	0	0	0	0	0	0	0	0	0	0	0
18	0	14	0	25	5	4	12	0	0	0	0	0	0	0	0
19	0	0	14	27	0	0	0	0	0	1	0	5	0	0	0
20	107	87	47	82	5	4	77	37	14	22	35	31	1	16	21
21	325	280	249	270	70	14	191	73	75	6	25	151	74	130	138
22	1122	661	899	771	131	18	208	288	252	11	235	682	180	575	532
23	5513	1614	2194	2588	227	48	322	473	386	111	334	1002	764	1121	772
24	10061	3966	5664	6511	822	188	721	1929	1238	515	1399	3162	1836	2523	1341
25	12951	8164	10930	13678	2844	1201	2742	3670	3940	1803	3843	7873	4419	3478	3842
26	21403	13297	13998	17811	6376	5684	6319	8258	8499	4773	7875	13242	7910	6651	7285
27	19433	17614	16094	22006	12010	9439	10891	12759	14173	7520	11079	14926	12869	9702	12566
28	22074	18572	15350	21879	14647	13248	12640	15732	15390	8991	11920	13260	13788	14431	16617
29	16559	16843	14808	18027	14591	12516	12890	13524	15340	9602	11120	13397	14560	13726	18269
30	18105	17264	14143	15570	13690	12219	10726	13271	15736	8821	9636	10296	12662	13690	16596
31	9989	13345	12353	12634	11814	10698	9772	10859	12749	8253	8393	9137	11051	12456	16820
32	10284	11276	10322	9907	9694	9274	8845	9310	11366	6954	7414	7116	10354	12021	13096
33	7813	8253	8020	7800	8421	7859	7436	7086	8851	6175	6069	5558	6509	9882	12519
34	5308	6195	6298	6537	7112	6539	6425	5985	7140	5467	4505	4123	6657	7881	8416
35	4309	4653	4673	5100	5135	6529	5366	4568	5852	4541	3507	2783	4961	6122	6809
36	3157	3818	3308	3369	4104	4735	3867	3697	3626	4260	2649	1978	3264	5219	6474
37	2049	3075	2875	2597	3196	3839	3121	2565	3024	3648	1976	1472	2682	4511	4785
38	2224	2660	2098	2380	2662	2639	2398	1871	2247	3911	1563	998	1783	3311	3342
39	1559	2174	1683	1650	1956	2245	2043	1491	1630	3472	1314	936	1844	2726	2850
40	1398	1936	1555	1628	1599	1711	1633	1190	1280	3296	1103	518	843	2676	1976
41	764	1423	1188	1154	1171	1227	1190	878	966	2740	878	438	669	1635	1394
42	632	1403	889	953	990	1111	1015	742	742	2497	635	351	412	1284	1185
43	640	1054	774	842	741	710	805	540	560	2157	558	320	343	883	749
44	432	810	707	640	633	746	706	473	509	1762	536	249	234	637	658
45	416	808	613	605	595	518	536	396	442	1177	478	177	206	467	708
46	328	535	485	415	479	373	405	307	305	1024	441	181	159	236	368
47	241	456	388	353	440	311	361	262	290	858	378	88	151	216	332
48	188	339	313	339	382	257	294	245	237	656	381	98	87	149	230
49	79	206	318	288	319	237	262	196	204	557	212	74	72	200	195
50	115	253	306	276	287	190	228	156	160	501	160	46	63	108	123
51	73	170	214	176	246	163	201	115	135	383	132	37	58	68	83
52	46	150	152	184	201	138	116	110	120	296	128	32	24	46	88
53	51	120	111	142	137	140	121	98	97	198	96	24	42	33	56
54	20	80	90	104	156	115	95	63	95	271	93	17	18	29	59
55	30	57	47	109	137	79	73	75	79	152	58	15	11	26	23
56	13	23	86	69	117	60	67	54	75	132	46	8	5	15	21
57	6	47	49	58	134	70	41	31	67	98	48	22	10	18	7
58	6	22	27	43	134	45	40	48	47	105	52	3	8	5	7
59	3	10	32	41	85	33	19	23	48	79	33	12	3	3	8
60	11	8	10	19	115	33	23	14	42	48	22	3	2	3	5
61	0	5	5	28	40	23	7	8	30	39	15	8	1	0	3
62	0	4	3	16	21	9	9	9	16	55	18	1	1	7	3
63	1	1	5	9	19	9	7	10	7	23	11	2	1	0	0
64	0	0	8	8	18	10	6	3	16	12	8	0	0	1	1
65	1	0	1	14	11	9	1	3	9	11	7	0	0	1	1
66	0	1	1	6	10	1	0	2	3	11	3	0	0	0	1
67	0	0	1	5	8	1	0	2	3	6	1	0	0	0	0
68	0	0	2	4	7	3	0	0	4	7	0	0	0	0	0
69	0	1	0	1	6	2	0	1	1	2	2	0	0	0	0
70	0	0	0	2	4	0	0	0	1	2	0	0	0	0	1
71	0	1	0	1	5	0	0	0	1	1	0	0	0	0	0
72	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0
74	0	0	0	0	4	0	0	0	0	1	0	0	1	0	0
75	0	0	0	1	4	0	0	0	0	0	1	0	0	0	2
Total	**180442**	**163771**	**154405**	**179758**	**128777**	**117273**	**115274**	**123504**	**138120**	**108011**	**101424**	**114853**	**121594**	**138920**	**161371**
Weights	**3679**	**3886**	**3571**	**3991**	**3447**	**3176**	**3030**	**2987**	**3398**	**3559**	**2520**	**2380**	**2807**	**3569**	**4091**

Table 11.3.c Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 1987-2001.

Total Discards

CL mm'	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
10	0	1318	75	0	0	546	199	134	185	82	1325	0	93	186	950
11	0	2152	152	0	114	807	313	208	279	125	1611	85	150	291	1341
12	0	3508	308	0	0	1190	491	323	419	191	1952	128	240	455	1890
13	0	5695	624	1	93	1749	768	501	627	291	2354	162	384	710	2654
14	78	9194	1261	2	258	2556	1198	774	936	441	2823	660	613	1104	3713
15	2074	14706	2539	7	1249	3708	1858	1189	1388	666	3364	1741	977	1710	5164
16	3974	23183	5074	22	2240	5320	2854	1811	2040	999	3980	1861	1548	2631	7126
17	13577	35760	9395	71	4638	7521	4326	2727	2961	1484	4671	3527	2433	4008	9732
18	29288	53448	19148	235	10619	10421	6429	4034	4221	2171	5432	5003	3776	6016	13110
19	28370	76547	34910	766	12852	14070	9295	5825	5877	3114	6254	5991	5753	8843	17354
20	60253	230038	153497	2426	22797	18408	12961	8143	7938	4347	7125	12091	8534	12628	22483
21	45446	129602	100993	31048	18043	23225	17283	10932	10337	5862	8028	9973	12205	17372	28397
22	51268	61144	47652	26066	24289	17350	17709	13186	9925	7591	14964	23278	16667	25140	49505
23	23074	25627	17991	11687	15611	20991	15746	11862	12053	6558	10661	21641	17635	22623	54819
24	7213	10004	6496	3836	13741	20860	12123	10225	9074	6765	10758	19750	15698	21146	34491
25	2686	3535	2479	1516	14722	13478	10054	7645	7037	6720	10252	20487	18666	20177	30416
26	672	1008	694	570	7131	6137	5513	4390	4741	4030	4720	10676	8465	8496	11137
27	270	335	240	181	1711	3200	2863	2452	2817	2088	2639	7502	4774	4780	6340
28	0	117	70	78	999	1759	1449	1143	1117	874	1096	3019	2202	2630	2658
29	0	32	20	25	138	654	517	434	415	431	584	1357	813	1245	1183
30	0	10	7	7	291	256	268	208	249	263	287	686	695	679	665
31	0	3	2	2	97	94	84	69	84	89	64	129	208	273	226
32	0	1	1	1	0	39	40	34	42	45	30	481	115	112	114
33	0	0	0	0	0	14	18	11	11	13	10	231	38	40	47
34	0	0	0	0	0	6	6	5	6	5	4	151	20	17	20
35	0	0	0	0	0	2	2	2	2	2	2	88	10	8	7
36	0	0	0	0	0	1	1	1	1	1	0	48	5	3	4
37	0	0	0	0	0	0	0	0	0	0	0	74	2	2	1
38	0	0	0	0	0	0	0	0	0	0	0	44	1	1	1
39	0	0	0	0	0	0	0	0	0	0	0	36	0	0	1
40	0	0	0	0	0	0	0	0	0	0	0	57	0	0	0
41	0	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	0
43	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
46	0	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	0
48	0	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	0
50	0	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	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	0	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	**268244**	**686969**	**404228**	**78546**	**151634**	**174362**	**124368**	**88267**	**84780**	**55250**	**104994**	**150995**	**122720**	**163330**	**305547**
'eights	**1767**	**4123**	**2634**	**627**	**1213**	**1354**	**1007**	**741**	**706**	**495**	**805**	**1453**	**1148**	**1455**	**2537**

Table 11.3.d Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 2002-2016.

Total Discards

CL mm	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
10	1268	28	0	0	0	22	0	82	0	0	0	0	0	0	0
11	1817	0	0	94	0	171	38	135	2	0	0	0	0	0	0
12	2597	70	363	413	70	202	98	79	0	237	0	0	0	75	76
13	3696	294	1722	1085	234	122	235	177	97	596	532	0	28	184	76
14	5233	636	3152	3190	1138	900	389	291	83	834	665	229	101	606	327
15	7354	1198	5548	7287	3102	1288	189	1157	155	941	1425	870	281	1476	578
16	10227	3386	6784	13528	7810	2959	1027	2315	822	1230	4544	1313	1300	2354	569
17	14027	5927	8836	15094	11655	3636	1832	3059	1333	2430	4737	4179	1647	3242	2717
18	18895	8078	10161	19795	16139	4590	2626	4843	2309	3630	8066	3372	2808	5073	5207
19	24883	11506	17361	19522	25891	5244	6473	6485	3532	4546	8024	8730	3822	8084	9685
20	31890	12142	19250	22265	39742	8735	11444	12766	5692	7227	10125	9682	6457	9246	9420
21	39629	18597	25898	32409	54220	11585	15630	16772	7699	10393	12145	15281	9195	10952	12022
22	24662	21416	25210	35523	69870	17930	24730	18701	11689	15161	14034	20618	11284	11324	15704
23	48438	28429	26756	40041	70094	24086	27560	21693	13672	13837	12904	26287	15130	14109	18312
24	39179	26501	21343	36279	55408	30615	29638	24105	16963	15551	14889	21750	14000	16820	19435
25	22841	23211	20085	30222	52660	32917	28007	20736	14670	16545	10873	17823	18051	18746	22159
26	17386	17357	12006	19003	38812	27376	23127	14205	11852	10047	7747	10188	11947	15874	24994
27	8069	9680	6436	8498	20124	20567	10129	9188	8558	8127	4304	5439	8155	11931	17139
28	4129	6187	3487	4603	10263	10365	5893	5927	5986	3201	919	2824	5026	8056	11441
29	1494	2537	2115	1201	4188	4464	3225	3163	3360	2086	588	2146	2316	5771	10887
30	876	1605	1901	1600	2578	2868	1923	3261	1876	2011	680	945	1672	4714	5283
31	214	1326	1115	1417	1109	1316	925	1824	1274	1246	125	922	1263	2033	4343
32	119	574	735	526	592	737	454	839	716	492	200	684	1482	1745	2458
33	44	313	503	296	544	484	421	671	350	265	13	365	384	812	3193
34	21	261	385	553	411	537	1025	830	274	272	145	494	433	1108	1071
35	7	176	424	260	230	265	206	332	242	174	24	233	125	147	874
36	4	113	108	46	73	336	78	197	55	59	3	260	391	243	774
37	1	83	74	246	25	299	153	188	162	149	146	130	45	298	573
38	1	93	31	116	99	40	93	269	16	97	68	81	71	246	576
39	0	15	139	147	0	3	369	55	33	24	0	33	230	65	598
40	0	37	73	37	169	47	0	66	38	25	3	0	122	175	72
41	0	34	60	20	0	40	0	8	4	0	0	0	7	46	148
42	0	4	12	31	0	20	53	0	4	157	0	0	0	508	186
43	0	14	13	0	0	11	0	38	0	4	4	0	152	199	0
44	0	0	13	0	0	0	0	14	6	0	0	0	0	12	0
45	0	13	0	0	36	0	0	0	0	5	0	0	0	56	0
46	0	0	0	0	0	0	0	0	6	0	0	0	0	44	77
47	0	0	0	0	0	0	0	0	0	6	0	0	7	0	0
48	0	0	0	0	0	0	0	8	0	0	0	36	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0
50	0	0	0	0	0	11	0	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	39	0	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	**329002**	**201841**	**222102**	**315346**	**487288**	**214788**	**198031**	**174480**	**113530**	**121603**	**117935**	**154914**	**117930**	**156400**	**200973**
Weights	**2620**	**1977**	**1932**	**2698**	**4544**	**2411**	**2123**	**1833**	**1275**	**1263**	**1012**	**1521**	**1326**	**1822**	**2531**

Table 11.3.e Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 1987-2001.

Total catches

CL mm/	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
10	0	1318	75	0	0	546	199	134	185	82	1325	0	93	186	950
11	0	2152	152	0	114	807	313	208	279	125	1611	85	150	291	1341
12	0	3508	308	0	0	1190	491	323	419	191	1952	128	240	455	1890
13	0	5695	624	1	93	1749	768	501	627	291	2354	162	384	710	2654
14	78	9194	1261	2	258	2556	1198	774	936	441	2823	660	613	1104	3713
15	2074	14706	2539	7	1249	3708	1858	1189	1388	666	3378	1741	977	1710	5164
16	3974	23341	5134	22	2240	5320	2854	1811	2040	999	3994	1861	1548	2631	7126
17	13727	35990	10072	83	4673	7583	4326	2727	2961	1484	4671	3527	2433	4008	9732
18	29620	54001	19279	239	10649	10421	6429	4065	4241	2171	5432	5003	3776	6031	13122
19	29666	78433	35810	814	12931	14209	9295	5897	5938	3114	6254	5991	5753	8854	17392
20	63382	234265	156289	2955	23271	18858	13425	8348	8279	4394	7573	12116	8605	12744	22767
21	51922	138484	108031	32996	19615	24820	18569	11413	11910	6276	9341	10260	12424	17805	29040
22	64770	77194	60622	31979	29023	21298	21587	16010	12320	8902	17764	24263	17516	26155	51621
23	44411	51001	36064	22597	23464	30692	23143	17227	17576	9357	15299	24812	19523	25155	61081
24	31551	43954	28456	17129	29262	41808	24072	19876	17805	12836	20763	26235	19730	26608	43406
25	35162	39829	28130	17956	34469	41355	31065	22724	21385	19960	30089	34467	29383	31534	47522
26	30342	30817	23441	18775	29237	32754	29245	22702	24510	20810	24100	24211	19056	18708	24882
27	28357	28715	22331	16290	23611	31610	28907	23633	27943	20472	25462	24104	17498	16307	23438
28	24925	26134	19157	19672	22213	33851	29028	21631	22031	16618	20563	17450	14261	15269	18493
29	18703	20952	14247	16275	17276	25413	21145	16961	16324	16763	21463	13189	10261	12718	14962
30	18407	17871	13696	12061	15053	20084	21682	16111	19413	20478	21774	17021	16882	14567	16833
31	11419	13159	9038	11090	12505	14375	13535	11276	13418	14098	9856	8668	9417	10102	11542
32	10185	12823	8410	8541	8635	12825	12751	11524	13710	14436	9652	9718	9860	9048	11448
33	8528	8848	7128	10650	7273	9311	11387	7033	7128	8589	6344	6178	6038	6373	8297
34	5926	7812	6967	10543	7987	7324	7361	6688	7590	6529	4820	6770	5930	5242	6204
35	5763	5935	6214	7637	5425	5931	6309	5648	4678	6580	4739	6787	5277	4903	5220
36	4033	5064	4532	6274	4379	4999	4609	4338	3709	4134	2568	5356	4295	3245	4041
37	4024	3754	3545	4841	4541	4195	4089	3753	3496	4227	2135	4796	3232	2947	2903
38	3131	3106	3193	4966	2393	3933	2391	2771	2879	2788	1142	3571	2589	2688	2370
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2205	2186	2027	2298
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3140	2353	1862	1908
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1363	1020	941
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797	863
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1055	762	534	530
44	965	704	1192	1401	1089	1050	745	500	915	414	219	778	708	413	383
45	641	581	1194	955	1058	766	684	550	700	464	253	904	429	421	523
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248	294
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213	368
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205	188
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177	183
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154	160
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109	135
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85	102
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133	82
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63	40
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75	53
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18	24
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20	46
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16	29
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7	26
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2	21
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8	7
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1	2
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0	5
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4	0
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1	0
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	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	**557218**	**1011467**	**649102**	**292325**	**368972**	**448648**	**365006**	**277146**	**287074**	**237291**	**293688**	**312544**	**258025**	**296713**	**478366**
Weights	**7164**	**9997**	**7470**	**5599**	**5967**	**7034**	**6116**	**4833**	**5159**	**4614**	**4415**	**5318**	**4357**	**4523**	**6267**

Table 11.3.f Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 2002-2016.

Total catches

CL mm	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
10	1268	28	0	0	0	22	0	82	0	0	0	0	0	0	0
11	1817	0	0	94	0	171	38	135	2	0	0	0	0	0	0
12	2597	70	363	413	70	202	98	79	0	237	0	0	0	75	76
13	3696	294	1722	1085	234	122	235	177	97	596	532	0	28	184	76
14	5233	636	3152	3190	1138	900	389	291	83	834	665	229	101	606	327
15	7354	1198	5548	7287	3102	1289	189	1157	155	941	1425	870	281	1476	578
16	10227	3386	6784	13528	7810	2359	1027	2315	822	1230	4544	1313	1300	2354	569
17	14027	5947	8843	15094	11655	3636	1832	3059	1333	2430	4737	4179	1647	3242	2717
18	18895	8092	10161	19820	16144	4593	2638	4843	2309	3630	8066	3372	2808	5073	5207
19	24883	11506	17376	19549	25891	5244	6473	6485	3532	4546	8024	8735	3822	8084	9685
20	31997	12229	19297	22348	39747	8738	11521	12803	5706	7249	10160	9713	6458	9262	9441
21	40555	18877	26146	32679	54289	11598	15820	16845	7775	10398	12170	15433	9269	11082	12160
22	25784	22077	26109	36293	70001	17948	24938	18989	11941	15171	14269	21300	11464	11899	16237
23	53951	30042	28950	42629	70322	24134	27882	22167	14058	13948	13238	27289	15894	15231	19084
24	49240	30467	27006	42790	56230	30803	30359	26034	18202	16065	16288	24913	15836	19343	20775
25	35792	31376	31015	43900	55504	34119	30750	24406	18610	18348	14716	25696	22470	22223	26001
26	38790	30654	26004	36814	45189	33060	29446	22463	20352	14820	15622	23430	19857	22526	32279
27	27502	27294	22530	30504	32134	30006	21020	21948	22730	15647	15383	20365	21024	21633	29705
28	26203	24759	18837	26482	24909	23613	18533	21659	21375	12191	12838	16084	18814	22487	28058
29	18053	19381	16923	19228	18779	16980	16115	16687	18700	11687	11708	15543	16876	19498	29156
30	18981	18868	16044	17170	16268	15087	12649	16531	17612	10832	10315	11241	14334	18403	21879
31	10203	14672	13469	14051	12923	12014	10697	12682	14024	9500	8518	10059	12314	14489	21163
32	10403	11849	11057	10433	10286	10011	9299	10150	12082	7447	7614	7801	11836	13766	15554
33	7857	8566	8523	8095	8965	8343	7857	7757	9201	6440	6082	5923	6892	10695	15712
34	5329	6456	6684	7090	7524	7076	7449	6815	7414	5739	4649	4617	7091	8990	9487
35	4316	4829	5097	5361	5366	6793	5573	4900	6094	4715	3531	3016	5087	6270	7683
36	3161	3931	3416	3415	4177	5071	3945	3894	3681	4319	2652	2237	3654	5462	7247
37	2050	3158	2949	2844	3221	4138	3273	2753	3186	3797	2122	1602	2727	4809	5358
38	2225	2752	2129	2496	2760	2679	2491	2139	2263	4007	1632	1079	1854	3556	3918
39	1560	2189	1822	1797	1956	2247	2412	1546	1662	3496	1314	968	2075	2791	3448
40	1399	1973	1628	1665	1768	1758	1633	1257	1318	3321	1107	518	965	2851	2048
41	764	1457	1248	1174	1171	1267	1190	886	971	2740	878	438	676	1681	1542
42	632	1407	901	984	990	1130	1069	742	746	2654	635	351	412	1792	1370
43	641	1068	787	842	741	722	805	578	560	2161	563	320	495	1082	749
44	432	810	719	640	633	746	706	487	515	1762	536	249	234	649	658
45	416	821	613	605	631	518	536	396	442	1182	478	177	206	523	708
46	328	535	485	415	479	373	405	307	312	1024	441	181	159	280	445
47	241	456	388	353	440	311	361	262	290	865	378	88	158	216	332
48	188	339	313	339	382	257	294	254	237	656	381	134	87	149	230
49	79	206	318	288	319	237	262	196	204	557	212	74	72	223	195
50	115	253	306	276	287	201	228	156	160	501	160	46	63	108	123
51	73	170	214	176	246	163	201	115	135	383	132	37	58	68	83
52	46	150	152	184	201	138	116	110	120	296	128	32	24	46	88
53	51	120	111	142	137	140	121	98	97	198	96	24	42	33	56
54	20	80	90	104	156	115	95	63	95	271	93	17	18	29	59
55	30	57	47	109	137	79	73	75	79	152	58	15	11	26	23
56	13	23	86	69	117	60	67	54	75	132	46	8	5	15	21
57	6	47	49	58	134	70	41	31	67	98	48	22	10	18	7
58	6	22	27	43	134	45	80	48	47	105	52	3	8	5	7
59	3	10	32	41	85	33	19	23	48	79	33	12	3	3	8
60	11	8	10	19	115	33	23	14	42	48	22	3	2	3	5
61	0	5	5	28	40	23	7	8	30	39	15	8	1	0	3
62	0	4	3	16	21	9	9	9	16	55	18	1	1	7	3
63	1	1	5	9	19	9	7	10	7	23	11	2	1	0	0
64	0	0	8	8	18	10	6	3	16	12	8	0	0	1	1
65	1	0	1	14	11	9	1	3	9	11	7	0	0	1	1
66	0	1	1	6	10	1	0	2	3	11	3	0	0	0	1
67	0	0	1	5	8	1	0	2	3	6	1	0	0	0	0
68	0	0	2	4	7	3	0	0	4	7	0	0	0	0	0
69	0	1	0	1	6	2	0	1	1	2	2	0	0	0	0
70	0	0	0	2	4	0	0	0	1	2	0	0	0	0	1
71	0	1	0	1	5	0	0	0	1	1	0	0	0	0	0
72	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0
74	0	0	0	0	4	0	0	0	0	1	0	0	1	0	0
75	0	0	0	1	4	0	0	0	0	0	1	0	0	0	2
Total	**509443**	**365612**	**376507**	**495103**	**616065**	**332060**	**313305**	**297984**	**251649**	**229614**	**219358**	**269767**	**239523**	**295319**	**362344**
Weights	**6299**	**5863**	**5503**	**6689**	**7990**	**5587**	**5154**	**4820**	**4673**	**4822**	**3532**	**3900**	**4133**	**5391**	**6622**

Table 11.3.g Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 1987-2001.

Removals=Landings+dead catches (discard survival rate : 30%)

CL mm/	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
10	0	322	52	0	0	382	139	34	130	57	328	0	65	130	665
11	0	1507	106	0	80	565	219	146	195	88	1128	60	105	204	939
12	0	2455	216	0	0	833	344	226	293	134	1366	89	168	319	1323
13	0	3987	437	0	65	1224	538	351	439	203	1648	114	263	437	1858
14	55	6436	883	1	181	1789	839	542	655	309	1976	462	429	773	2599
15	1452	10294	1777	5	875	2595	1301	832	972	466	2369	1219	684	1197	3615
16	2782	16386	3611	15	1568	3724	1998	1268	1428	699	2800	1302	1084	1842	4988
17	9654	25262	7074	62	3282	5326	3028	1909	2072	1039	3270	2463	1703	2806	6812
18	20833	37967	13534	229	7464	7294	4500	2855	2974	1520	3802	3502	2643	4226	9190
19	21155	55469	25338	584	9075	9987	6507	4150	4175	2180	4378	4194	4027	6201	12186
20	45306	165254	110239	2228	16432	13336	9537	5906	5898	3090	5436	8489	6045	8956	16022
21	38288	99604	77733	23681	14202	17852	13384	8134	8809	4518	6933	7269	8763	12593	20521
22	49389	58851	46327	24159	21736	16093	16274	12054	9343	6624	13274	17280	12516	18613	36769
23	37489	43313	30667	19090	18781	24395	18420	13669	13960	7390	12101	18320	14232	18368	44635
24	29387	40953	26507	15979	25139	35550	20435	16808	15083	10807	17535	20310	15021	20264	33059
25	34356	38768	27386	17501	30052	37311	28048	20431	19274	17944	27014	28321	23783	25481	38397
26	30141	30514	23233	18604	27098	30913	27591	21385	23088	19601	22684	21008	16516	16159	21541
27	28276	28615	22259	16236	23098	30650	28048	22897	27098	19846	24670	21853	16066	14873	21536
28	24925	26099	19136	19649	21914	33323	28594	21288	21696	16356	20234	16545	13600	14480	17695
29	18703	20942	14241	16268	17235	25217	20989	16831	16199	16633	21287	12782	10017	12345	14607
30	18407	17868	13693	12059	14965	20008	21602	16049	19338	20399	21688	16815	16674	14363	16633
31	11419	13158	9038	11089	12476	14347	13510	11255	13392	14072	9836	8629	9354	10020	11475
32	10165	12823	8410	8541	8635	12813	12739	11514	13697	14423	9643	9574	9826	9014	11414
33	8528	8848	7128	10649	7273	9306	11382	7030	7124	8585	6341	6109	6027	6361	8283
34	5926	7812	6967	10543	7987	7322	7360	6687	7588	6527	4819	6725	5924	5237	6198
35	5763	5935	6214	7637	5425	5930	6309	5647	4678	6580	4738	6761	5274	4901	5218
36	4033	5064	4532	6274	4979	4999	4609	4338	3709	4133	2568	5341	4294	3244	4040
37	4024	3754	3545	4841	4541	4195	4089	3753	3496	4226	2135	4774	3231	2947	2902
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3558	2589	2688	2370
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2195	2186	2027	2298
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1356	982	3123	2353	1862	1908
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1363	1020	941
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797	863
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1053	761	534	530
44	965	704	1192	1401	1089	1050	745	500	915	414	219	769	708	413	383
45	641	581	1194	955	1058	766	684	550	700	464	253	904	429	421	523
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248	294
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213	368
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205	188
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177	183
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154	160
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109	135
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85	102
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133	82
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63	40
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75	53
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18	24
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20	46
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16	29
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7	26
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2	21
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8	7
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1	2
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0	5
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4	0
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1	0
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	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	**476745**	**805376**	**527834**	**268762**	**323482**	**396340**	**327696**	**250666**	**261640**	**220716**	**262190**	**267245**	**221208**	**247714**	**386702**
Weights	**6634**	**8760**	**6673**	**5411**	**5603**	**6628**	**5814**	**4610**	**4947**	**4465**	**4173**	**4882**	**4013**	**4087**	**5506**

Table 11.3.h Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 2002-2016.

Removals=Landings+dead catches (discard survival rate : 30%)

CL mm	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
10	888	19	0	0	0	16	0	58	0	0	0	0	0	0	0
11	1272	0	0	66	0	119	27	94	1	0	0	0	0	0	0
12	1818	49	254	289	49	142	69	56	0	166	0	0	0	53	53
13	2587	206	1205	760	164	85	164	124	68	417	372	0	20	129	53
14	3663	445	2206	2233	797	630	272	204	58	584	466	160	71	424	229
15	5148	839	3883	5101	2171	902	132	810	108	658	998	609	136	1033	405
16	7159	2370	4749	9469	5467	2072	719	1621	575	861	3181	919	910	1648	399
17	9819	4169	6193	10565	8158	2545	1282	2141	933	1701	3316	2925	1153	2270	1902
18	13226	5669	7112	13882	11302	3216	1851	3390	1616	2541	5646	2360	1966	3551	3645
19	17418	8055	12167	13692	18124	3671	4531	4540	2472	3183	5617	6116	2676	5659	6779
20	22430	8586	13522	15668	27825	6118	8087	8973	3998	5081	7122	6809	4521	6488	6615
21	28666	13298	18377	22957	38024	8123	11131	11813	5465	7281	8527	10848	6510	7797	8553
22	18385	15653	18546	25636	49040	12569	17519	13379	8434	10623	10058	15114	8079	8502	11525
23	39420	21514	20924	30617	49293	16909	19614	15659	9957	9797	9367	19403	11355	10998	13591
24	37486	22517	20604	31906	39608	21619	21468	18803	13113	11400	11821	18387	11636	14297	14945
25	28940	24412	24990	34834	39706	24243	22348	18185	14209	13385	11454	20349	17054	16600	19353
26	33574	25447	22402	31113	33545	24847	22508	18202	16796	11806	13298	20373	16273	17763	24781
27	25081	24390	20599	27955	26097	23835	17982	19191	20163	13209	14092	18733	18578	18053	24563
28	24964	22903	17791	25101	21831	20503	16765	19881	19579	11231	12563	15237	17306	20070	24626
29	17605	18619	16289	18868	17523	15641	15148	15738	17692	11061	11531	14899	16181	17766	25890
30	18718	18387	15474	16690	15495	14227	12072	15553	17049	10229	10111	10957	13832	16989	20294
31	10138	14274	13134	13626	12590	11619	10419	12135	13641	9126	8480	9783	11935	13879	19860
32	10367	11677	10836	10276	10108	9790	9163	9898	11867	7299	7554	7595	11391	13242	14816
33	7844	8472	8372	8007	8802	8197	7731	7556	9096	6361	6078	5814	6777	10451	14754
34	5323	6377	6568	6924	7400	6915	7142	6566	7332	5657	4606	4469	6961	8657	9165
35	4314	4776	4970	5282	5297	6714	5511	4801	6021	4663	3524	2946	5049	6225	7421
36	3160	3897	3384	3401	4155	4971	3921	3835	3665	4301	2651	2159	3537	5389	7015
37	2050	3133	2927	2770	3214	4048	3228	2696	3138	3753	2078	1563	2713	4720	5186
38	2225	2725	2120	2461	2731	2667	2463	2059	2258	3978	1611	1055	1833	3483	3745
39	1560	2184	1780	1753	1956	2246	2301	1529	1652	3489	1314	959	2006	2772	3268
40	1399	1962	1606	1654	1717	1744	1633	1237	1306	3313	1106	518	929	2798	2026
41	764	1447	1230	1168	1171	1255	1190	884	969	2740	878	438	674	1667	1498
42	632	1406	897	975	990	1125	1053	742	745	2607	635	351	412	1640	1315
43	641	1064	783	842	741	718	805	567	560	2160	561	320	449	1022	749
44	432	810	715	640	633	746	706	483	514	1762	536	249	234	645	658
45	416	817	613	605	620	518	536	396	442	1181	478	177	206	506	708
46	328	535	485	415	479	373	405	307	310	1024	441	181	159	267	422
47	241	456	388	353	440	311	361	262	290	863	378	88	156	216	332
48	188	339	313	339	382	257	294	251	237	656	381	124	87	149	230
49	79	206	318	288	319	237	262	196	204	557	212	74	72	217	195
50	115	253	306	276	287	198	228	156	160	501	160	46	63	108	123
51	73	170	214	176	246	163	201	115	135	383	132	37	58	68	83
52	46	150	152	184	201	138	116	110	120	296	128	32	24	46	88
53	51	120	111	142	137	140	121	98	97	198	96	24	42	33	56
54	20	80	90	104	156	115	95	63	95	271	93	17	18	29	59
55	30	57	47	109	137	79	73	75	79	152	58	15	11	26	23
56	13	23	86	69	117	60	67	54	75	132	46	8	5	15	21
57	6	47	49	58	134	70	41	31	67	98	48	22	10	18	7
58	6	22	27	43	134	45	68	48	47	105	52	3	8	5	7
59	3	10	32	41	85	33	19	23	48	79	33	12	3	3	8
60	11	8	10	19	115	33	23	14	42	48	22	3	2	3	5
61	0	5	5	28	40	23	7	8	30	39	15	8	1	0	3
62	0	4	3	16	21	9	9	9	16	55	18	1	1	7	3
63	1	1	5	9	19	9	7	10	7	23	11	2	1	0	0
64	0	0	8	8	18	10	6	3	16	12	8	0	0	1	1
65	1	0	1	14	11	9	1	3	9	11	7	0	0	1	1
66	0	1	1	6	10	1	0	2	3	11	3	0	0	0	1
67	0	0	1	5	8	1	0	2	3	6	1	0	0	0	0
68	0	0	2	4	7	3	0	0	4	7	0	0	0	0	0
69	0	1	0	1	6	2	0	1	1	2	2	0	0	0	0
70	0	0	0	2	4	0	0	0	1	2	0	0	0	0	1
71	0	1	0	1	5	0	0	0	1	1	0	0	0	0	0
72	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0
74	0	0	0	0	4	0	0	0	0	1	0	0	1	0	0
75	0	0	0	1	4	0	0	0	0	0	1	0	0	0	2
Total	**410743**	**305060**	**309877**	**400500**	**469879**	**267624**	**253896**	**245640**	**217590**	**193133**	**183978**	**223293**	**204145**	**248399**	**302052**
'eights	**5513**	**5270**	**4923**	**5880**	**6627**	**4864**	**4517**	**4270**	**4290**	**4443**	**3229**	**3444**	**3735**	**4844**	**5863**

Table 11.4. Total number of burrows (106), densities/m² and CVs by spatial stratum and for the Bay of Biscay. Year 2016 after including rough sea bottom contained in the outline of the Central Mud Bank (16 164 km² instead of 11 676 km² for the five sedimentary strata sensu stricto). Rough numbers of burrows with no correction by cumulative bias factor (equal to 1.24; WKNEP, 2016).

	2016 (160 stations)				
	nb/m²	total burrows	CV (%)	% burrows	% surf
	0.386	**4505.52**	**7.86**		
CB	0.258	654.41	19.84	14.52%	21.72%
CL	0.237	272.72	20.87	6.05%	9.87%
LI	0.283	1319.12	13.86	29.28%	39.94%
VS	0.839	531.18	17.92	11.79%	5.42%
VV	0.642	1728.09	14.52	38.35%	23.05%

	2016 (196 stations)				
	nb/m²	total burrows	CV (%)	% burrows	% surf
	0.320	**5167.67**	**7.84**		
CB	0.258	654.41	19.84	12.66%	15.69%
CL	0.237	272.72	20.87	5.28%	7.13%
LI	0.283	1319.12	13.86	25.53%	28.85%
VS	0.839	531.18	17.92	10.28%	3.92%
VV	0.642	1728.09	14.52	33.44%	16.65%
RO	0.148	662.15	29.61	12.81%	27.76%

11.8.1

Table 11.5. Estimation of the abundance of *Nephrops* burrows (10^6) by UWTV for years 2014 and 2015 (results 2016 not yet available; rough numbers of burrows with no correction by cumulative bias factor equal to 1.24; WKNEP, 2016).

Year	**2014**		**2015**	
Number of data	204	204	114	114
Method of estimate for average (A=arithmetic; KO=ordinary kriging)	A	KO	A	KO
Estimation	0.415930	0.425463	0.410321	0.414796
CV geo	0.052829	0.046598	0.180002	0.183475
CV iid	0.072647	-	0.082643	-
Surface (km²)	11 676	11 676	11 676	11 676
Abundance (Estimation * Surface)	4 856	4 968	4 791	4 843

Table 11.6. 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	13.81
1988	777	471	16.52
1989	862	664	12.99
1990	801	708	11.31
1991	717	728	9.84
1992	841	757	11.12
1993	805	735	10.96
1994	690	671	10.30
1995	609	627	9.72
1996	715	598	11.97
1997	638	539	11.83
1998	622	489	12.72
1999	505	423	11.93
2000	438	405	10.82
2001	697	417	16.71
2002	527	371	14.20
2003	487	356	13.68
2004	410	321	12.74
2005	455	336	13.57
2006	414	306	13.50
2007	401	291	13.76
2008	410	271	15.15
2009	384	279	13.78
2010	471	253	18.61
2011	422	279	15.13
2012	348	229	15.17
2013	288	224	12.83
2014	252	198	12.73
2015	451	231	19.52
2016	475	241	19.74

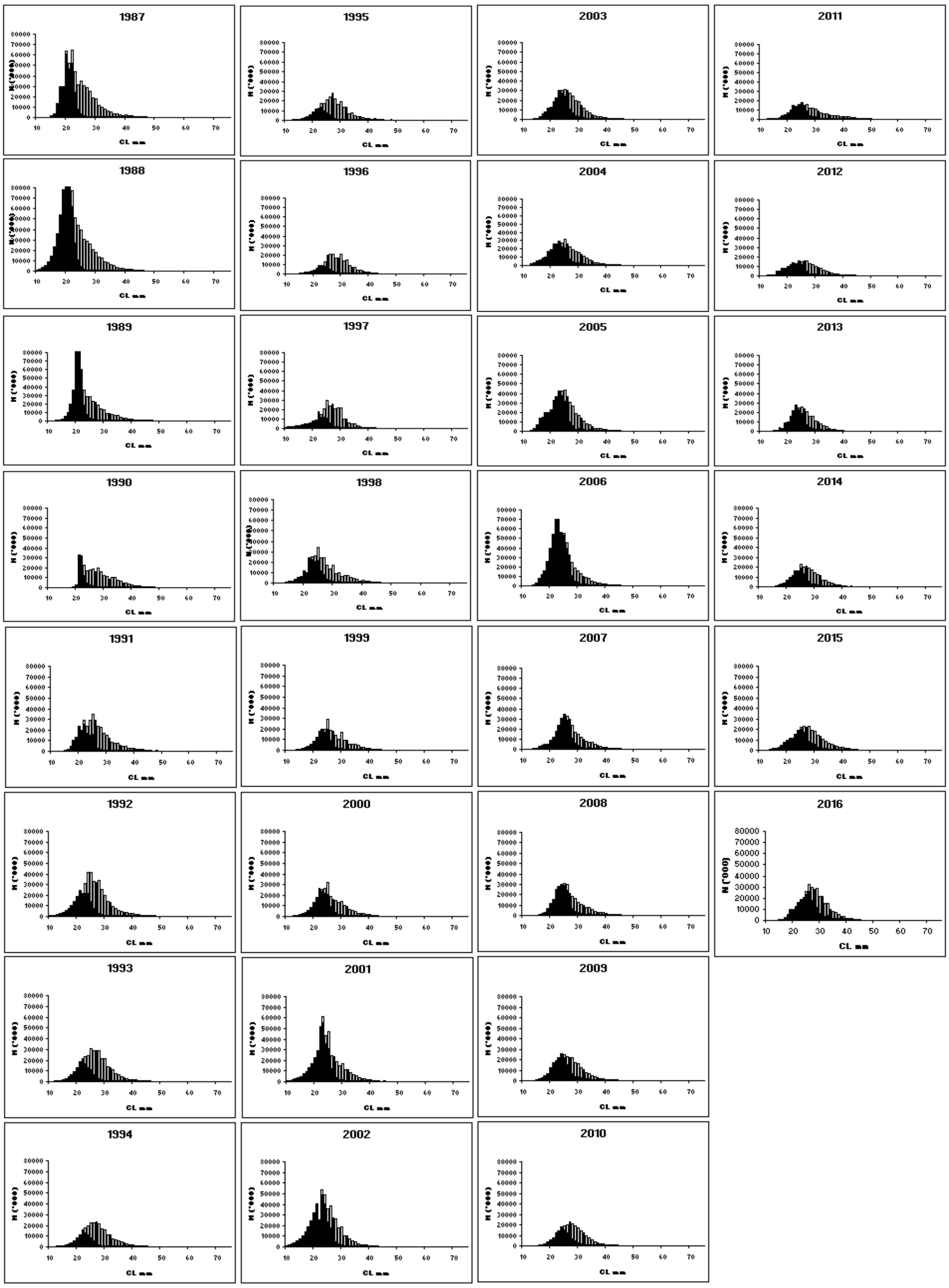


Figure 11.1. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) catches (landings in white and discards in black) length distributions in 1987-2016.

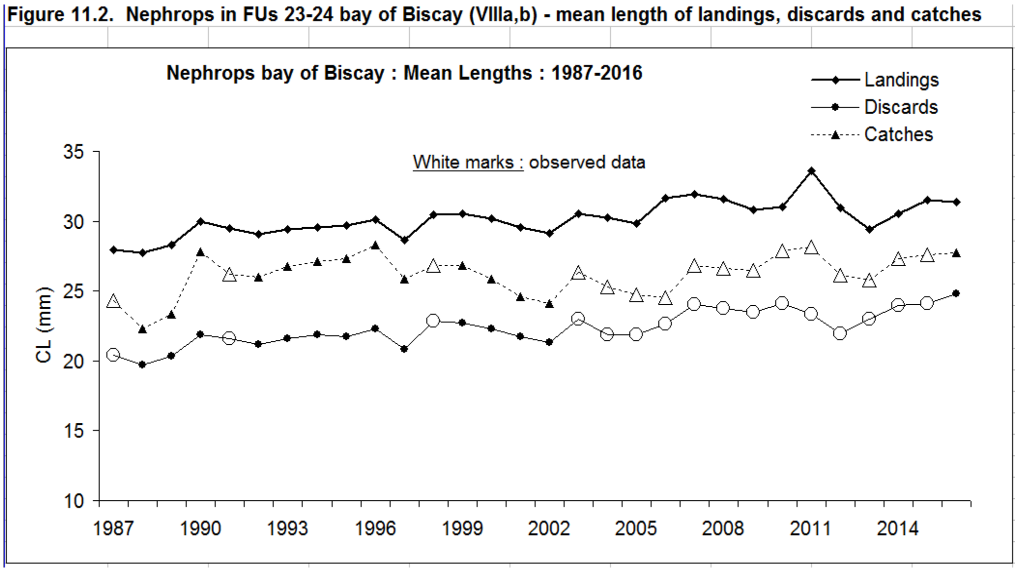
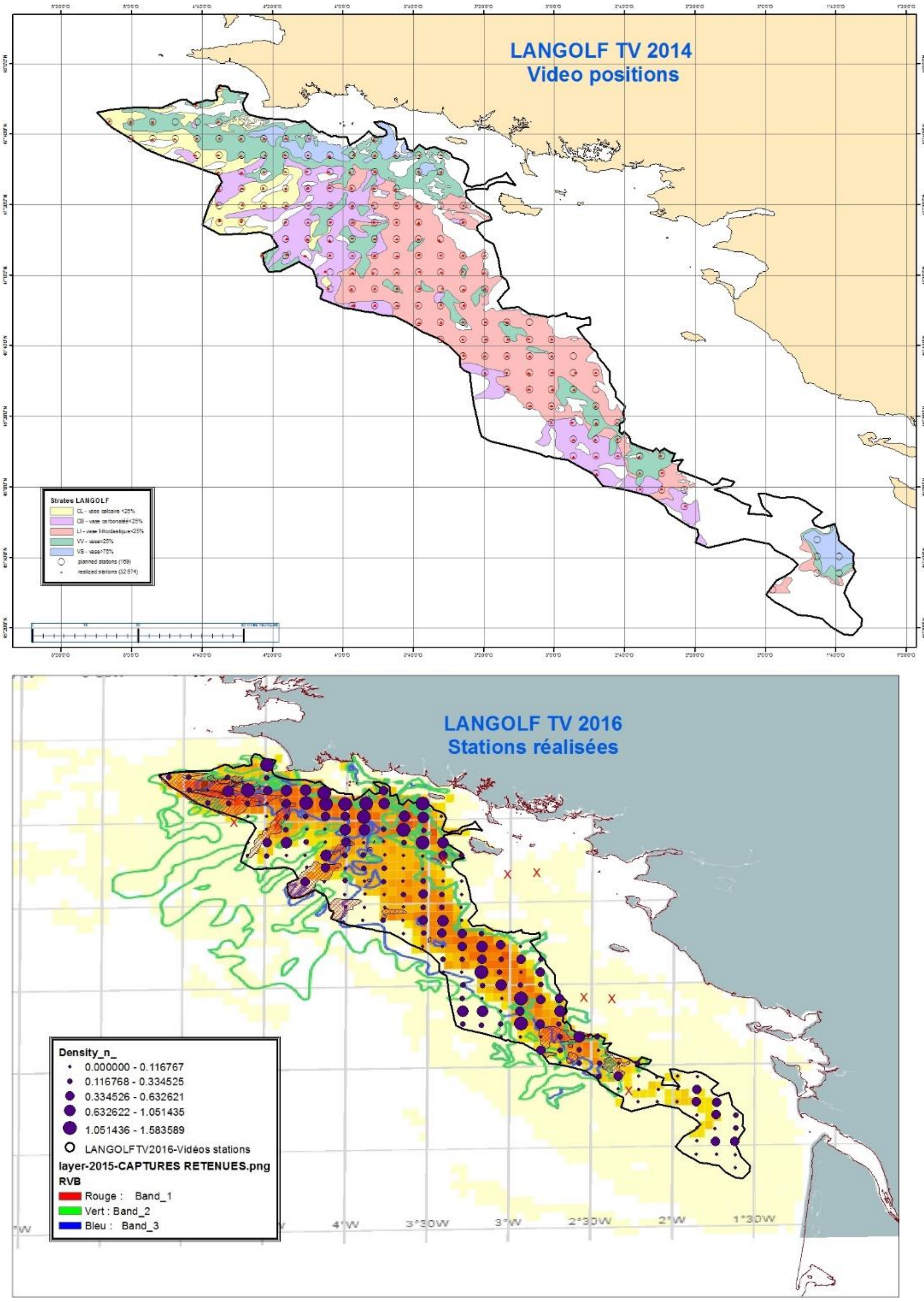


Figure 11.2 Nephrops in FUs 23-24 bay of Biscay (VIIa,b)-mean length of landings, discards and catches



18.8.2

Figure 11.3. Above: spatial stratification of the Bay of Biscay according to sedimentary criteria (see Stock Annex). Below: UWTV stations on a systematic grid (example of the year 2016) and VMS data for retained catches of *Nephrops* (example of the year 2015; source: National Fisheries Direction; compilation: SIH Ifremer).

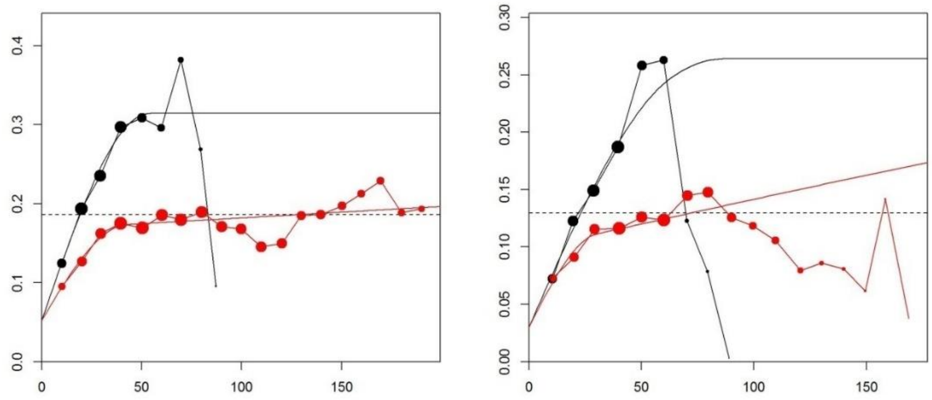


Figure 11.4. Experimental variograms (circles proportional to the number of pairs) and models (continuous curves) for the main anisotropic directions (red: NW->SE, black: SW->NE).

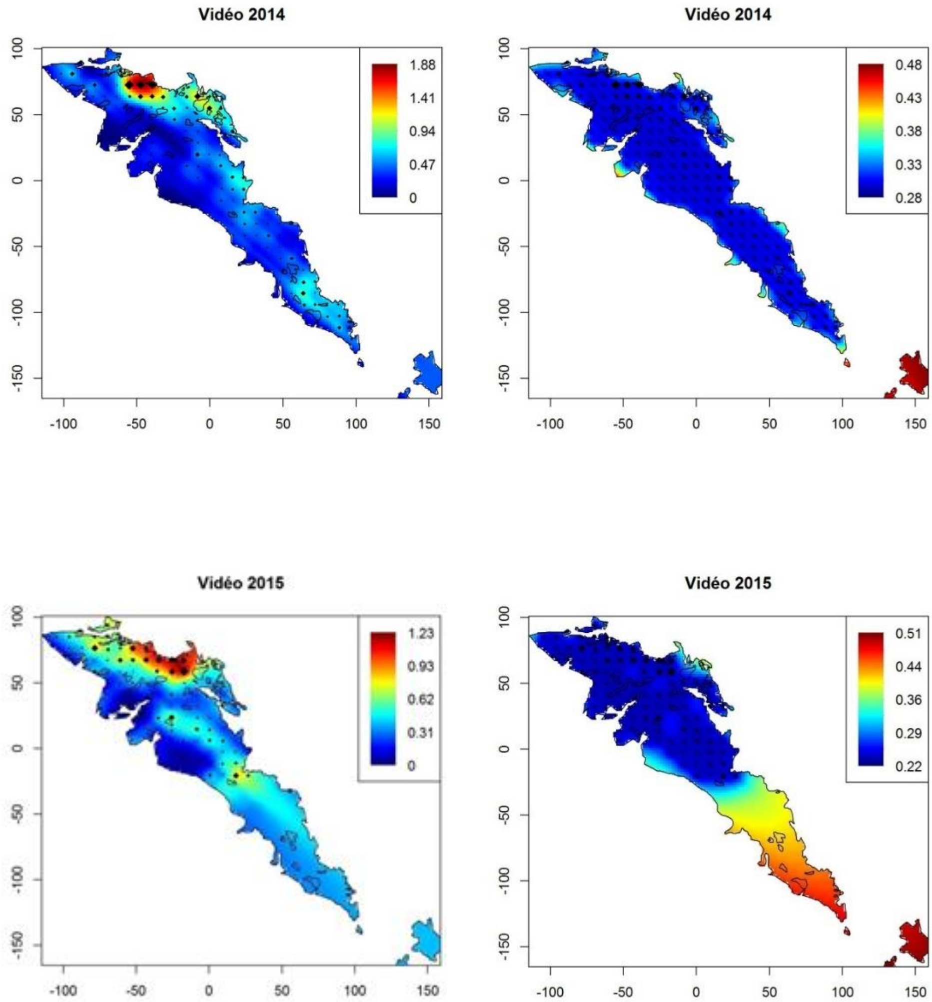


Figure 11.5. Years 2014 and 2015. Estimation of the burrows densities /m² using ordinary kriging (left column) error of kriging (right column).

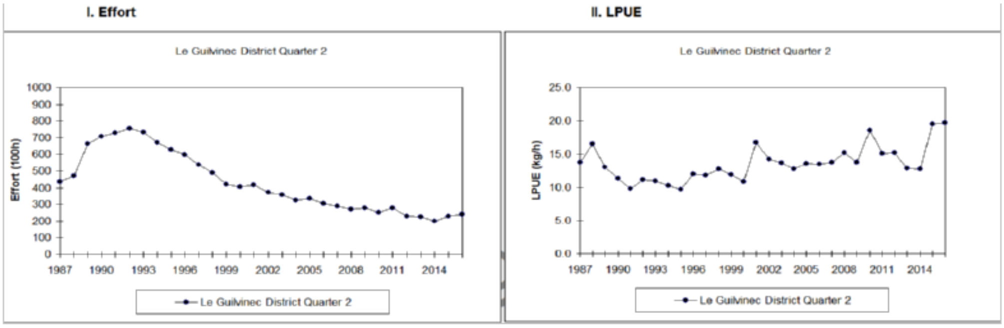


Figure 11.6. Nephrops in FUs 23–24 Bay of Biscay (VIIIa,b). Effort and lpue values for standardised commercial fleets.

12 *Nephrops* in Division 8c

The ICES Division 8c 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 2017 and management applicable to 2017, 2018 and 2019

ICES advice for 2017

The advice for these *Nephrops* stocks is triennial and valid for 2017, 2018 and 2019.

ICES advises that when the precautionary approach is applied, there should be zero catch in each of the years 2017, 2018, and 2019.

To protect the stock in these functional units, ICES advises that management should be implemented at the functional unit level.

Management applicable to 2016 and 2017

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 46 t and zero catch were set for the whole of Division 8c for 2016 and 2017, 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

Spanish landings are based on sales notes which are compiled and standardized by IEO. Since 2013, trips from sales notes are also combined with their respective logbooks, which allow georeferencing the catches.

The Spanish concurrent sampling is used to raise the FU 25 observed landings to total effort by metier since 2012. When the estimated landings exceed the official landings, the difference is provided to InterCatch as non-reported landings.

Landings were reported only by Spain. The time series of the commercial landings (Figure 12.1.1) shows a clear declining trend. 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. In 2016, total landings estimated by the WG were 77 t representing an increase of more five times landings in the previous year. This estimates is considered the best information available at this time. 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 *Nephrops* landings were collected by the biological sampling programme. 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 2000–2016, respectively. Length frequency distributions for the time series are also presented in two figures (Figure 12.1.3a for the period 1982–2007 and Figure 12.1.3b for the period 2008–2016).

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 2016, the mean size in both sexes increased in relation to the previous year. Mean carapace length in females was 37.0 mm while 39.3 mm for males in last year.

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 *metiers*: 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 up to 2011. The lowest effort was observed in 2011, representing approximately 15% of fishing effort in the 70's. In 2012, effort increased and remained stable around 1572 trips. Effort increased in 232 trips during 2016. 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 also declining (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 and 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

No update of the assessment was performed.

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 Stakeholders information

Fishing industry presented a working document to the WG with qualitative and quantitative information about *Nephrops*' fishery in FU25 (WD10, 2016). The WG decided that the lpue data provided, only for years 2015 and 2016, could be used as an abundance index in a future Benchmark as long as the time series is continued and extended historically.

12.1.6 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	Non-reported	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	0	10
2014	9	0	9
2015	14	0	14
2016	13	65	77

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 2000–2016.

Size, CL/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	0
28	32	79	30	2	26	25	15	8	4		2	1	2	9	1	3	0
29	24	125	43	5	28	25	18	11	6	0	2	2	1	2	1	2	10
30	85	112	105	14	46	43	25	19	10	1	9	2	2	12	3	18	37
31	60	129	102	26	45	56	39	36	10	1	9	3	3	2	2	11	31
32	127	288	198	36	60	66	55	44	15	1	18	3	3	3	2	14	49
33	95	319	181	51	71	87	69	69	13	3	20	5	3	5	5	25	73
34	219	302	272	66	70	83	62	75	16	4	27	13	2	5	7	26	97
35	218	265	308	85	91	98	85	90	25	5	34	25	4	18	12	47	183
36	158	243	259	110	98	102	88	101	31	6	30	21	4	8	16	26	153
37	144	285	236	123	101	88	87	105	37	9	34	23	5	9	13	22	137
38	113	238	185	147	98	92	80	101	35	10	26	63	3	6	13	22	193
39	82	192	129	130	81	69	67	86	37	10	23	45	1	15	11	12	121
40	134	212	186	129	96	81	64	90	47	12	20	78	8	11	13	16	180
41	64	115	99	81	78	61	59	73	44	12	23	61	4	7	9	11	96
42	73	150	117	79	63	52	49	63	38	11	23	50	3	6	8	12	59
43	30	103	67	65	57	47	44	59	35	12	24	52	1	15	8	10	58
44	48	98	109	52	39	36	32	46	29	14	22	34	3	7	7	10	38
45	40	68	78	46	44	34	30	42	23	13	21	24	3	7	4	6	36
46	20	35	65	57	35	26	26	37	22	11	22	17	1	7	5	5	18
47	10	22	34	42	26	20	18	30	20	14	22	13	1	2	4	5	17
48	17	24	35	37	23	14	17	22	16	9	17	15	0	4	2	3	13
49	11	18	23	27	16	13	11	16	14	8	14	17	2	3	2	3	11
50	13	18	24	27	19	11	14	18	10	8	13	12	0	2	2	2	13
51	8	16	34	20	13	7	9	11	11	6	11	7	1	2	1	2	8
52	8	10	18	16	12	8	8	8	9	6	8	7	0	2	1	2	6
53	2	15	13	11	9	6	7	7	8	7	9	4	1	2	2	2	5
54	5	4	4	9	7	5	4	4	6	5	7	7	0	2	1	1	4
55	7	7	9	6	6	5	4	3	6	6	7	6	1	1	1	1	3
56	2	5	6	5	5	3	9	3	4	4	4	5	0	1	1	1	2
57	3	0	5	7	4	3	4	2	5	3	5	4	0	0	0	0	2
58	4	1	9	4	4	3	2	2	4	3	3	4	0	1	1	0	1
59	0	1	4	5	3	2	1	1	3	3	2	1	0	1	0	0	1
60	2	1	2	2	2	2	1	1	2	3	3	3	0	0	0	0	1
61	2		1	1	3	1	1	1	2	1	1	3	1		0		0
62	0	0	3	3	2	1	7	1	1	2	1	6	0	1	0	0	0
63	0	0	10	0	2	1	1	1	1	2	1	1	0		0	0	0
64	0	0	0	1	2	1	6	0	1	1	0	2	0	0	0	0	0
65	0	0	4	1	2	1	1	0	1	1	1	1	0		0		0
66	0	0	1	2	1	1	0	0	1	1	1	1	0	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	0
69	0		0	2	1	1	0	0	1	1	0	0	0	0	0		0
70	1		2	1	1	1	0	0	0	1	0	0	0		0		0
71	0		0	1	2	0	6	0	0	1	0		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		0
76			0	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	1658
Total weight (tonnes)	81	147	143	89	75	63	62	67	39	21	34	44	10	10	9	14	77
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	0.047
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	38.2

Table 12.1.3. ***Nephrops*** **FU 25: North Galicia. Fishing effort and lpue.**

		Effort (trips)		LPUE (kg/trip)	
Year	Landings (t)	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
2016	11		1589		6.6

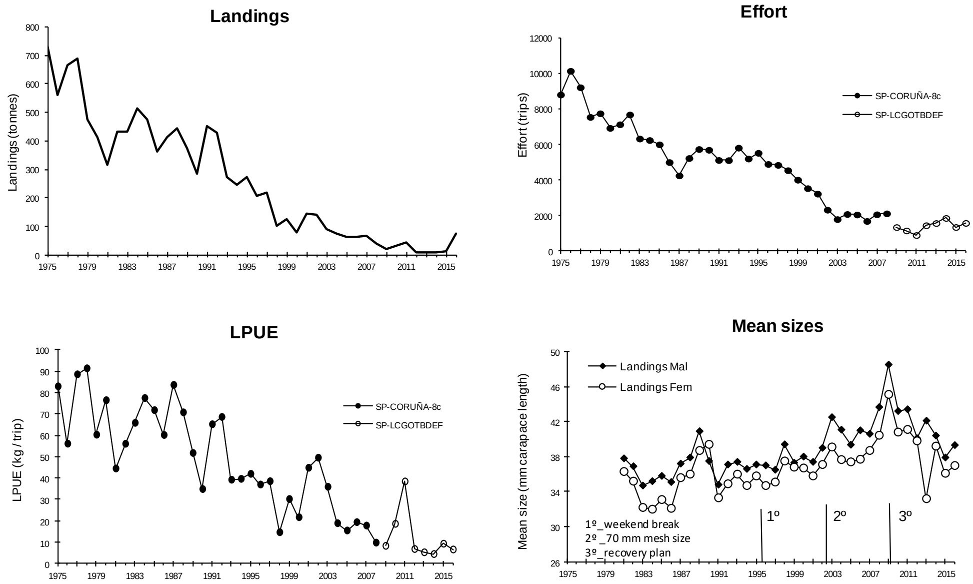


Figure 12.1.1. ***Nephrops*** **FU25, North Galicia. Long-term trends in landings, effort, lpue and mean sizes**

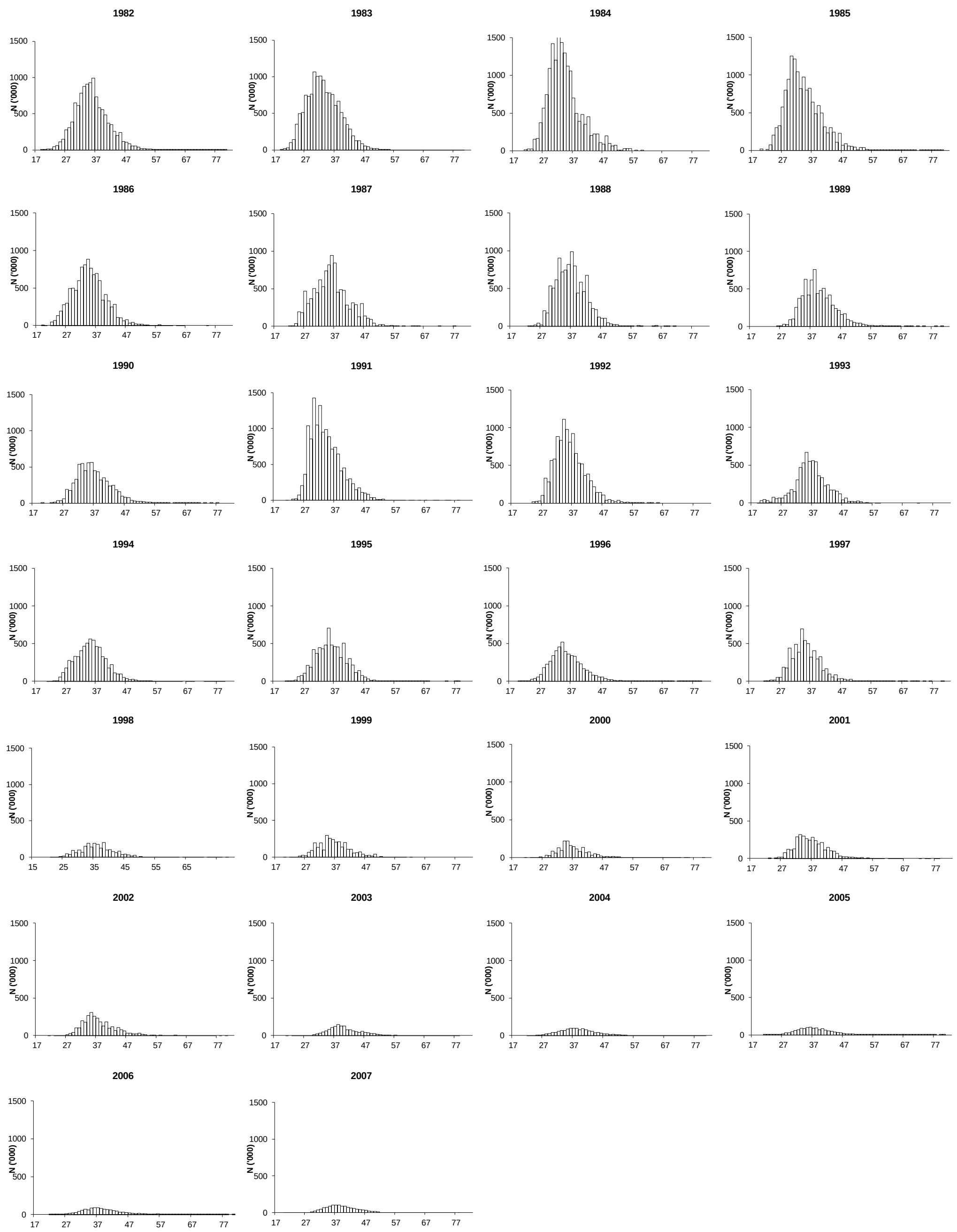


Figure 12.1.2a. ***Nephrops*** **FU25, North Galicia. Length distributions in landings for 1982–2007 period.**

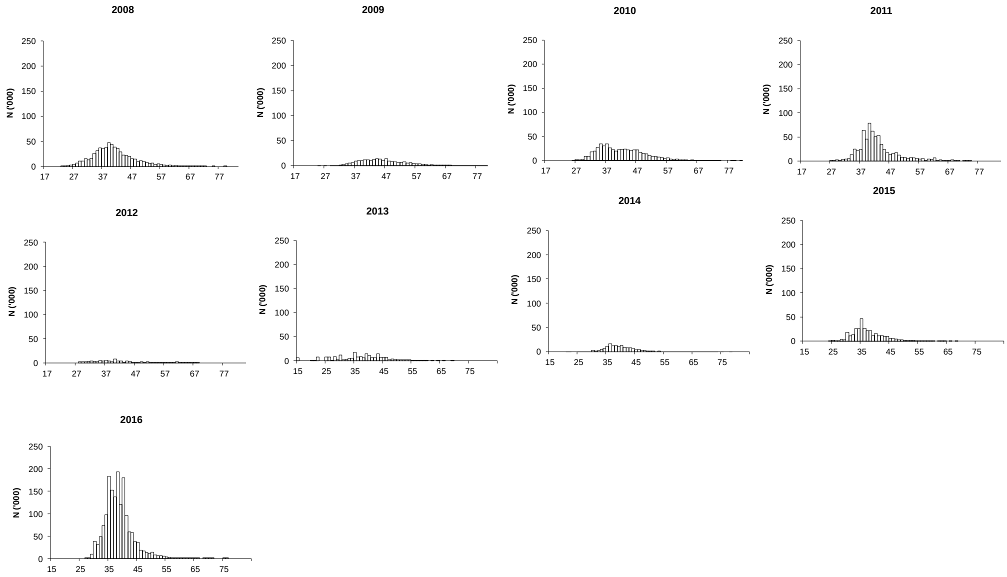


Figure 12.1.2b. *Nephrops* FU25, North Galicia. Length distributions in landings for the period 2008–2016.

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 2017 and management applicable to 2017, 2018 and 2019

ICES advice for 2017

The advice for these *Nephrops* stocks is triennial and valid for 2017, 2018 and 2019.

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 46 t and zero catch t were set for the whole of Division 8c for 2016 and 2017, 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

Spanish landings are based on sales notes which are compiled and standardized by IEO. Since 2013, trips from sales notes are also combined with their respective logbooks, which allow georeferencing the catches.

The Spanish concurrent sampling is used to raise the FU 31 observed landings to total effort by metier since 2013. When the estimated landings exceed the official landings, the difference is provided to InterCatch as non-reported landings. No differences have been obtained for this stock up to date.

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 1983–2016. 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 2016.

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. A new increase of the mean size was observed in 2013 but in general, the mean size is fluctuating since 2011. Mean size in 2016 increases recording values of 52.1 mm CL for males and 45.8 mm CL for females in the last year.

12.2.2.3 Commercial catch-effort data

The fishing effort and lpue data series includes three bottom trawl fleets operating in the Cantabrian Sea with home harbors in Avilés, Santander and Gijón. In last years, the information of the different fleets is intermittent, although Santander data series 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 to 2016 (expressed in trips) shows an increasing trend from 2010 to 2014, ranging between 850 trips to 1083 trips (Figure 12.2.1). In 2015 and 2016 fishing effort decreased again up to 777 trips last year. 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

No update of the assessment was performed.

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 (1983–2016).

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	3	0	3
2016	4	0	4

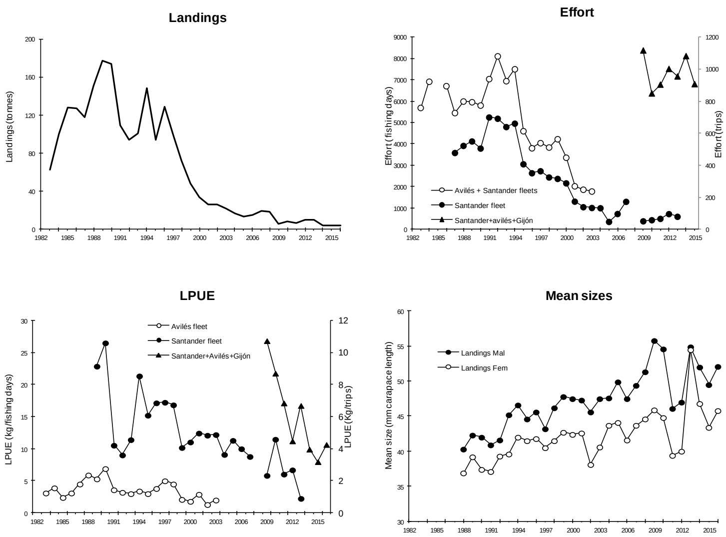


Figure 12.2.1. ***Nephrops*** **FU31, Cantabrian Sea. Long-term trends in landings, effort, lpue and mean sizes**

12.3 Summary for Division VIIIc

Nephrops in Division VIIIc includes two FUs (North Galicia, FU 25 and Cantabrian Sea, FU 31). Table 12.3.1 shows the landings in Division 8c. Landings from both FUs have declined dramatically.

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. However, landings estimates in *Nephrops* FU25 in 2016 show a significative increase of 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. 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 8c. Landings by FU (tonnes).

Year	FU 25	FU 25 Nonreported	FU 31	DIVISION 8c
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	11	10	31
2013	10		10	20
2014	9		4	13
2015	14		4	18
2016	13	65	4	81

13 *Nephrops* in Division 9a

The ICES Division 9a 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 Cadiz.

13.1 *Nephrops* FU 26–27, West Galicia and North Portugal (Division 9a)

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 ICES Advice for 2017 and management applicable to 2017, 2018 and 2019

ICES advice for 2017

The advice for these *Nephrops* stocks is triennial and valid for 2017, 2018 and 2019.

ICES advises that when the precautionary approach is applied, there should be zero catch in each of the years 2017, 2018, and 2019.

To protect the stock in these functional units, ICES advises that management should be implemented at the functional unit level.

Management applicable to 2016 and 2017

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 9a was 320 t for 2016 and 336 t for 2017, 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 117 days and 126 days for Spanish vessels and at 113 days for Portuguese vessels for these two years (Annex II b of Council Regulations nos. 72/2016 and 127/2017). 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

Spanish landings are based on sales notes which are compiled and standardized by IEO. Since 2013, trips from sales notes are also combined with their respective logbooks, which allow georeferencing the catches.

Since 2013, the Spanish concurrent sampling is used to raise the FU26–27 observed landings to total effort by métier. When the estimated landings exceed the official landings, the difference is provided to InterCatch as non-reported landings.

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 by-catch 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.Landings were minimal since 2012 (less than 10). In 2015, landings were only 2 t. 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 t in 2015. In 2016, landings increased lightly in FU 26 by the Spanish fleet and FU 27 by the Portuguese fleet. So, estimated landings in 2016 were three times more than 2015 (6 t). Table 13.1.1 shows total landings in FU26–27 for the time series. Information on discards was sent to the WG through Intercatch although no discards are recorded in these FUs.

13.1.3.2 Biological sampling

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 2016 increased in relation to the previous period. In 2016 males achieved a mean carapace length of 45.1 mm and females 37.5 mm. Annual length compositions for males and females combined, mean size and mean weight in landings for the period 1988-2016 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

No update of the assessment was performed.

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.*

Tabla 13.1.1. ***Nephrops*** **FU26–27, West Galicia and North Portugal. Landings in tonnes by Functional Units and country.**

	Spain		Portugal	Unallocated/Nonreported		Total
Year	FU 26**	FU 27	FU 27	FU26	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
2016	3	<1	3	1		6

**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 1988–2016 period.**

Lenght (mm)	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	2016
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	2
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	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	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	1
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	3
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	6
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	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	3
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	3
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	4
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	6
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	2
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	2
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	4
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	3
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	7
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	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	3
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	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	4
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	8
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	1
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	4
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	2
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	3
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	5
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	2
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	1
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	1
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	1
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	2
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	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	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	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	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	1
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	1
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	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	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	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	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	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	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	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	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	1
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	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	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	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	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	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			
Total 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	92
Total weight (t)	727	708	450	603	636	522	448	511	331	432	344	246	132	132	87	72	70	42	44	46	36	25	19	16	7	2	4	1	6
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	0.071	0.099	0.080	0.086	0.081	0.059	0.057	0.069
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	42.2

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
2016	<1	403	0.6

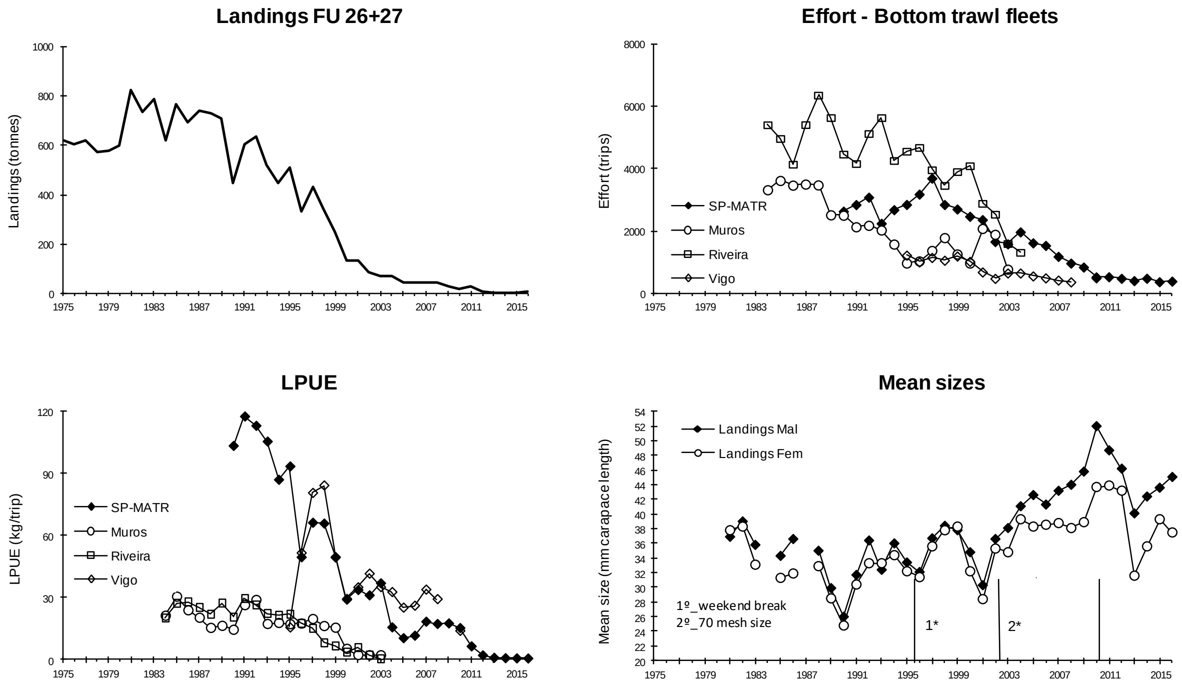


Figure 13.1.1. ***Nephrops*** **FU26-27, West Galicia and North Portugal. Long-term trends in landings, effort and mean sizes.**

1* -weekend break in West Galicia, 2*- 70 mm mesh size, 3*-recovery plan

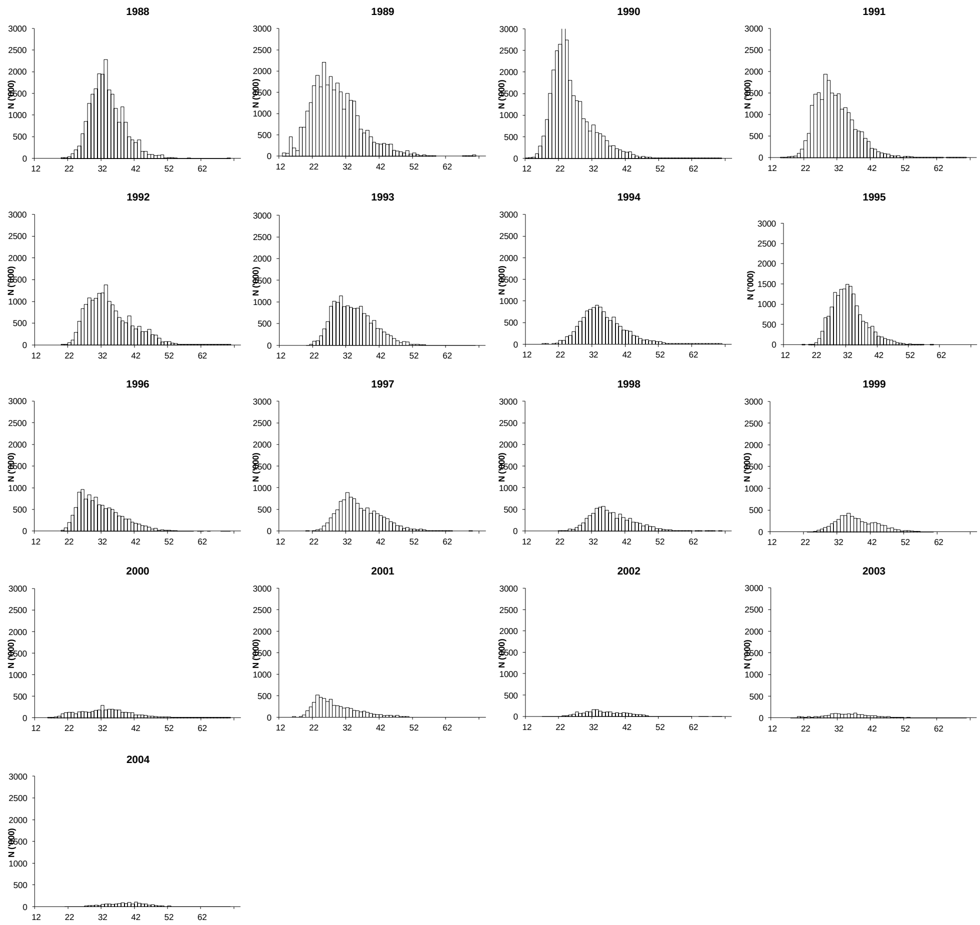


Figure 13.1.2a. ***Nephrops*** **FU26-27. West Galicia and North Portugal. Length distributions in landings for the 1988–2004 period.**

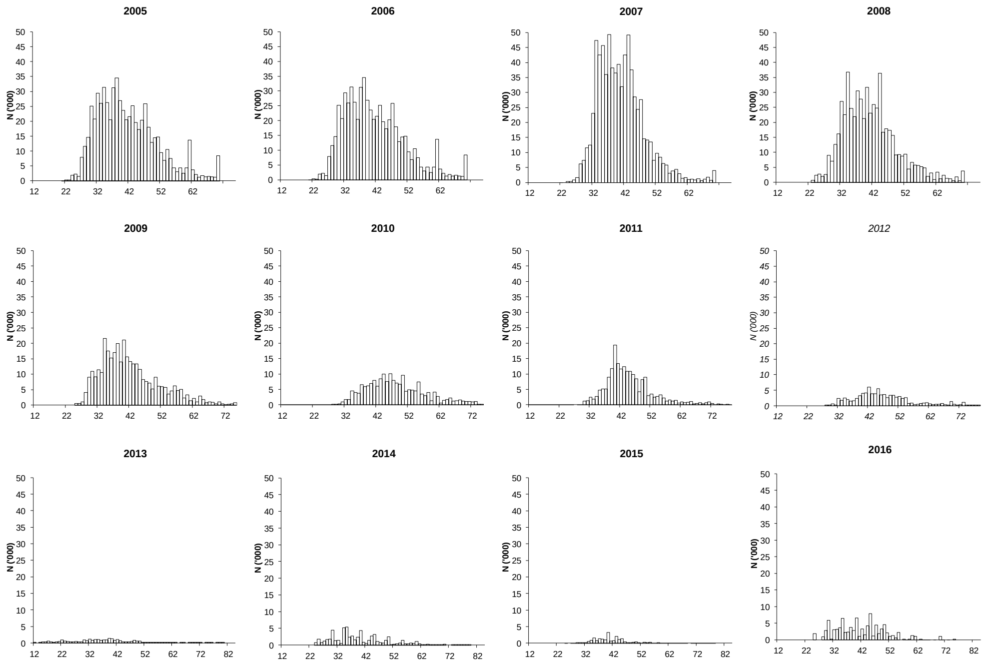


Figure 13.1.2b. ***Nephrops*** **FU26–27. West Galicia and North Portugal. Length distributions in landings for the 2005–2016 period.**

13.2 FU 28-29 (SW and S 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 2017

The advice for these stocks is annual and valid for 2017. Based on the ICES approach for data-limited stocks, ICES advised that catches in 2017 for FUs 28 and 29 should be no more than 260 t.

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 2016 and 2017

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 320 and 336 t for 2016 and 2017, 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 117 and 126 days per vessel for Spanish vessels, 113 days for Portuguese vessels for these two years and 109 days for French vessels (Annex II B of Council Regulations 72/2016 and 127/2017). 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 data series for these Functional Units (FUs). For the time period 1984 to 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 an average value of 220 t in the years 2012-2013. In recent years, the reduced

TAC has limited the fishing activity, and the fishery has been closed for 1.5–2 months in the 2nd semester from 2013 onwards.

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.

Males are the dominant component in all landings with exception for 1995 and 1996 when total female landings exceeded male landings (ICES, 2006). The male:female in 2016 was close to 2:1.

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 2016 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 1.4.

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 R/V "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 R/V 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).

Figure 13.2.3 shows the spatial distribution of the survey biomass index in the last 4 years.

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. 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 1994-2016 (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

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 authorised provided that the by-catch 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). In 2016, this period was extended for February. Besides the closed season, in 2013-2016, the Portuguese vessels had to stop fishing for 1.5 to 2 months, in October-November, due to quota limitations. 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.

Crustacean vessels target 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 (Figure 13.2.4). A standardized CPUE series for *Nephrops* (Figure 13.2.5) is used to estimate the fishing effort in standard hours. The model used to standardize the CPUE is described in the stock annex. An exploratory analysis was carried out aiming a better definition of the fishing areas and depths and to separate the Functional Units 28 and 29. Although not changing the model, this exploratory work was incorporated in the analysis, excluding the records in fishing areas and depths with no *Nephrops*. As a result, the variability explained by the model increased from 33% to 51% (Table 13.2.6).

In the period 2008-2016, the standardized fishing effort has fluctuated around 42 thousand hours (Table 13.2.3).

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 2011-2016 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. The crustacean survey biomass index also shows an increasing trend in the most recent years.

Length-based indicators were used to assess the status of the conservation of the stock. The ratios L_c/L_{mat} and $L_{25\%}/L_{mat}$ indicate that immature individuals are preserved. However, P_{mega}<30% indicates a truncated length distribution of the catch (Table 13.2.7 and Figures 13.2.6 and 13.2.7).

Assuming a constant M of 0.3 for males and 0.2 for females, F was estimated using the Mean Length Z method, as defined in WKLIFE-V (ICES, 2015) and WKProxy (ICES, 2016). The input data and the output of both models are summarized in (Table 13.2.8). Figures 13.2.8 and 13.2.9 show the model diagnostics for G&H model and the F series estimated with THoG model.

G&H model with two periods gives a better fit with a lower AIC. The F was estimated at 0.14 for males and 0.09 for females.

The results indicate that the stock is exploited at a level below the FMSY proxy, either using the Gedamke & Hoenig model or the THoG model, although the latter gives much lower F values. The M value estimated by the THoG model is also greater than it has been assumed for *Nephrops* stocks.

13.2.4 Short-term Projections

No projections were performed. The advice for this stock follows the ICES rules for Data Limited Stocks, category 3.2.0.

13.2.5 Biological reference points

Proxies of MSY reference points were reviewed using the methods developed in WKLIFE and WKProxy (ICES, 2015, 2016a).

$F_{0.1}$ from length-based analysis of the period 1984–2016, was estimated at 0.23 for males and 0.24 for females, as proxies of F_{MSY}. No proxy for B_{MSY} was identified.

13.2.6 Management considerations

Nephrops is taken by a multi-species 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 authorised provided that the by-catch 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). This period was extended for one more month in 2016 (Portaria no. 8-A/2016, de 28th January 2016). 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 South-West and South Portugal (FU 28–29). Total landings per country (tonnes).**

Year	FU 28+29 SW+S Portugal					
	28***	29	28+29			Total
	Spain	Spain	Portugal			
	Trawl	Trawl	Artisanal	Trawl	Total	
1975	137	1510		34	34	1681
1976	132	1752		30	30	1914
1977	95	1764		15	15	1874
1978	120	1979		45	45	2144
1979	96	1532		102	102	1730
1980	193	1300		147	147	1640
1981	270	1033		128	128	1431
1982	130	1177		86	86	1393
1983				244	244	244
1984				461	461	461
1985				509	509	509
1986				465	465	465
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	0	14	3	211	214	229
2013		10	1	198	199	209
2014		8	3	183	186	193
2015		12	4	231	235	247
2016**		21	8	254	262	283

** **Preliminary values**

*** **Spanish landings from FU28 included in FU29**

Table 13.2.2.a. FU 28–29 - Length Composition of *Nephrops* Males (1984–2016)

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 (1984–2016) (continued)

Landings

Age/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	10
30	87	74	139	248	300	533	290	297	60	129	44	5	158	84	36	71	27
31	111	92	123	188	277	573	270	256	93	116	75	22	248	82	49	112	51
32	161	274	233	325	475	757	378	295	129	135	116	32	573	217	120	138	36
33	92	139	281	248	352	437	247	246	108	80	78	21	329	109	47	96	75
34	160	224	257	264	352	574	311	327	150	94	104	52	436	276	119	162	166
35	100	173	274	275	347	333	194	252	121	76	83	31	356	155	144	263	128
36	158	163	265	195	224	263	168	256	83	59	77	34	248	191	119	202	173
37	162	167	247	234	167	293	172	224	109	57	78	64	211	145	108	191	155
38	106	99	254	197	147	226	164	265	73	58	125	69	206	216	144	179	240
39	81	109	229	174	93	175	100	173	75	61	71	39	126	95	129	125	300
40	96	159	254	215	165	152	100	188	77	63	84	44	112	162	160	139	247
41	102	130	163	163	108	129	125	163	102	53	55	49	114	113	90	117	179
42	91	195	163	168	177	152	190	198	128	105	75	68	140	171	129	142	185
43	47	181	167	172	113	118	95	82	76	38	51	45	79	64	58	85	182
44	86	173	122	121	122	176	144	90	61	51	65	43	87	89	104	127	222
45	61	140	113	103	131	140	96	83	60	25	39	19	52	42	59	92	187
46	85	144	106	76	103	117	118	71	38	25	26	15	46	81	59	62	211
47	88	120	111	75	97	113	61	60	48	25	43	18	47	89	83	61	129
48	55	80	104	83	90	66	54	65	48	23	35	12	30	67	26	28	157
49	37	79	86	59	58	52	41	38	34	24	23	12	32	53	36	48	92
50	65	93	103	94	82	69	28	42	36	20	25	11	19	59	25	58	69
51	34	71	72	65	41	40	30	37	27	17	20	15	17	37	32	56	58
52	53	88	94	73	65	45	37	48	29	32	30	24	33	47	64	70	26
53	18	41	69	58	31	22	22	21	24	13	16	9	22	18	25	45	34
54	31	54	53	57	50	24	33	27	23	19	21	24	32	36	44	48	52
55	19	34	28	46	26	12	15	10	20	12	14	15	15	16	24	60	41
56	19	29	43	29	57	14	11	8	15	13	8	25	24	20	20	43	51
57	19	37	37	25	16	9	6	6	17	11	9	25	20	15	20	27	36
58	13	23	26	21	12	9	7	7	20	7	11	45	7	12	10	14	45
59	10	15	16	13	15	8	9	5	11	4	6	19	7	8	9	16	38
60	8	15	25	16	24	12	6	3	9	7	5	13	4	10	7	10	30
61	14	9	11	8	11	8	8	4	8	4	5	7	9	7	4	4	21
62	6	10	11	15	16	8	8	3	15	8	6	22	3	1	12	4	10
63	1	4	11	11	7	7	7	1	8	4	6	7	2	4	3	3	14
64	1	9	11	8	10	10	7	1	10	6	5	17	2	3	8	3	10
65	4	6	5	4	3	10	7	1	9	2	3	9	1	1	2	1	9
66	1	5	8	3	7	3	4	2	11	1	3	5	3	2	3	2	6
67		4	3	5	2	2	6	1	6	1	3	3	3	1	2	1	4
68		1	6	6	2	3	4	0	8	0	4	3	3	1	1	0	4
69	0	3	3	2	2	2	4	1	4	1	0	2	1		1	0	8
70	0	6	2	4	3	4	5	0	4	1	0	1	3	1	1	0	3
71		2	2	4	1	1	3	1	2	0	0	0	1		1	0	3
72		2	2	4	1	3	4	0	3	1	0	1	3	0	1		2
73	0	0	1	1	1	2	2		1	0	0	1	1		1		0
74		0	1	1	1	3	1		1	1	0	1	1		1		0
75		0	1	0	0	1	1		1	1	2	0	1		0		0
76		0	0	0	0	0	1		1	0		0	0			0	
77			0	0	0	0	1		1	0	0	0	0				0
78					0	1			0			0					0
79			0		0	1	0		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**	**3725**
Landings (t)	**117**	**190**	**222**	**205**	**205**	**231**	**162**	**159**	**114**	**73**	**79**	**72**	**149**	**132**	**114**	**147**	**166**

Table 13.2.2.b. FU 28–29 - Length Composition of *Nephrops* Females (1984–2016)

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 (1984–2016) (continued)

Landings

Age/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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				4
22	18	0		3	10	88	14	26	12	1	0			3	1		4
23	6	7	0	9	43	54	37	34	11	4	1	1		7	1	0	1
24	49	7	10	19	62	135	44	53	25	22	10	1	5	7	3		2
25	24	15	11	36	101	129	55	130	23	23	11	1	8	18	10	5	19
26	81	24	15	67	211	272	113	227	38	80	12	3	17	7	10	7	19
27	139	34	34	67	266	294	152	298	73	138	20	7	40	36	17	13	46
28	64	44	107	98	336	242	179	355	81	170	26	7	51	33	23	23	44
29	171	90	127	173	395	420	392	458	123	149	51	4	130	59	60	39	57
30	152	131	237	241	406	654	321	365	145	205	67	7	164	119	80	85	219
31	131	167	195	152	334	565	305	317	129	132	99	26	330	129	99	143	149
32	283	316	296	360	530	857	510	409	252	209	145	45	397	290	203	208	307
33	153	184	467	270	433	448	272	253	182	110	91	51	195	194	105	146	214
34	235	252	429	314	400	462	341	386	177	122	140	96	297	278	202	167	325
35	193	158	470	255	324	254	249	351	187	103	120	56	165	232	188	303	362
36	225	174	351	194	222	203	162	213	103	83	144	60	138	166	153	203	193
37	213	144	302	203	178	182	142	240	121	90	119	73	98	199	151	162	203
38	85	108	300	206	151	178	152	247	134	83	106	151	76	206	148	171	125
39	92	112	213	160	113	89	173	138	123	86	95	113	46	61	121	136	112
40	79	133	186	284	136	84	114	109	125	62	80	68	46	67	145	134	130
41	66	79	110	170	82	73	129	73	95	83	65	65	37	41	66	104	82
42	67	91	80	192	122	116	112	56	75	94	52	80	35	65	90	87	112
43	41	55	87	132	70	70	44	16	30	25	28	80	33	9	27	54	59
44	49	56	57	75	66	61	46	21	24	43	40	41	27	13	40	58	48
45	23	29	51	68	66	50	35	18	28	17	25	21	10	9	17	56	25
46	38	33	40	37	51	39	54	19	14	22	19	11	10	11	17	36	28
47	52	26	25	25	44	35	23	9	26	16	18	15	11	13	18	16	14
48	25	12	24	28	37	18	11	8	20	7	12	9	5	7	5	8	3
49	21	15	19	18	24	24	7	7	13	6	7	7	6	5	7	8	5
50	10	15	26	24	20	23	7	3	13	8	7	2	6	5	4	8	14
51	10	9	22	14	13	17	11	5	11	3	6	5	6	1	3	7	4
52	16	6	19	21	13	17	7	3	7	3	4	4	9	5	4	9	8
53	6	6	10	13	8	10	2	1	8	3	2	3	5	1	3	6	0
54	5	2	2	14	7	6	9	1	8	1	2	5	5	3	8	12	2
55	1	2	3	10	4	5	1	1	3	4	0	5	2	1	3	12	2
56	3	1	3	7	6	2	1	0	3	0	0	2	1	1	6	10	1
57	1	0	2	4	2	3	1		1	0	0	1	3	2	2	4	0
58		1	1	1	2	0	1	0	1	1	0	4	2	0		1	0
59	0	1	0	0	1	1	1			0	0	2	0	1	1	3	0
60		0		0		2			1		0	2	0		2	3	1
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**	**2946**
Landings (t)	**84**	**79**	**135**	**130**	**140**	**151**	**112**	**114**	**74**	**60**	**52**	**45**	**65**	**66**	**66**	**85**	**88**

Table 13.2.3. SW and S Portugal (FUs 28–29): Effort and CPUE of Portuguese trawlers, 1994–2016.

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	87,872	1.8
1999	26	8.1	79,359	2.7
2000	27	7.4	109,653	1.8
2001	33	8.2	80,019	3.4
2002	31	11.5	67,039	5.4
2003	32	10.5	51,578	7.2
2004	23	15.0	79,280	4.7
2005	25	15.3	62,708	6.2
2006	25	11.0	46,505	6.2
2007	26	10.5	50,401	5.8
2008	27	7.0	39,741	5.6
2009	27	4.9	30,359	5.0
2010	25	5.2	29,613	5.0
2011	26	4.5	34,176	4.4
2012	21	10.2	43,568	5.2
2013	24	8.2	36,677	5.7
2014	24	7.5	33,656	5.7
2015	22	10.5	30,263	5.3
2016*	22	11.5	41,899	6.8
* provisional; ** standardized CPUE				

Table 13.2.4. SW and S Portugal (FUs 28–29): *Nephrops* CPUEs (kg/hour) in research trawl surveys, 1994-2016.

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	2.5
1998	0.7	0.02	ns	Jun-98	1.2
1999	0.3	0.02	ns	Jun-99	2.3
2000	1.0	0.92	ns	Jun-00	1.4
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	
2005	ns	0.09	0.16	Jun-05	4.7
2006	ns	0.19	0.06	Jun-06	2.5
2007	ns	0.04	0.73	Jun-07	2.8
2008	ns	0.13	0.25	Jun-08	3.9
2009	ns	0.13	ns	Jun-09	2.2
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	2.3
2014	ns	0.06	ns	Jul-14	0.9
2015	ns	0.21	ns	Jul-15	2.9
2016	ns	0.69	ns	Jun-16	4.0
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, 1994–2016.

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
2016	39.5	35.8	ns	ns	43.5	41.6	ns	ns	38.7	36.1

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			85700	116400		
year	18	20668.8	85682	95731	< 2.2e-16	17.8%
month	11	2885.1	85671	92846	< 2.2e-16	2.5%
depth.class2	2	2612.5	85669	90233	< 2.2e-16	2.2%
catdps	1	2252	85668	87981	< 2.2e-16	1.9%
cat_pnep	1	29962.3	85667	58019	< 2.2e-16	25.7%
catPRT2	2	1505.4	85665	56514	< 2.2e-16	1.3%
Total	**35**	**59886.1**				**51.4%**

AIC: 313112

Table 13.2.7. Length-based indicators for *Nephrops* Males and females in FU 28–29

		Conservation				Optimizing Yield	MSY
		L_c/L_{mat}	$L_{25\%}/L_{mat}$	$L_{max5\%}/L_{inf}$	P_{mega}	L_{mean}/L_{opt}	$L_{mean}/L_{F=M}$
	Ref	>1	>1	>0.8	>30%	~1 (>0.9)	≥1
2014	M	1.09	1.25	0.83	0.14	0.89	1.02
	F	1.03	1.12	0.80	0.04	0.88	0.96
2015	M	1.09	1.25	0.86	0.13	0.90	1.03
	F	1.03	1.12	0.76	0.02	0.87	0.95
2016	M	1.02	1.21	0.83	0.09	0.86	1.02
	F	0.97	1.08	0.73	0.01	0.84	0.95

Table 13.2.8. Results from the application of the Mean Length Z approach

		Males	Females
	Input:		
	LFD period	1984-2016	1984-2016
	Effort series	1998-2016	1998-2016
	W~L relationship		
	a =	0.00028	0.00056
	b =	3.2229	3.0288
	External M*	0.3	0.2
Method	**Results**		
Gedamke & Hoenig	Z =	0.44	0.29
	F* =	0.14	0.09
THoG	q estimate =	0.009	0.005
	q estimate* =	0.025	0.011
	M estimate =	0.41	0.25
	F_{2016} estimate =	0.03	0.02
	F_{2016} estimate* =	0.10	0.04
Y/R	F_{MSY} proxy: $F_{0.1}$ =	0.22	0.24

Note: Estimates with * indicate that an external value of M was used

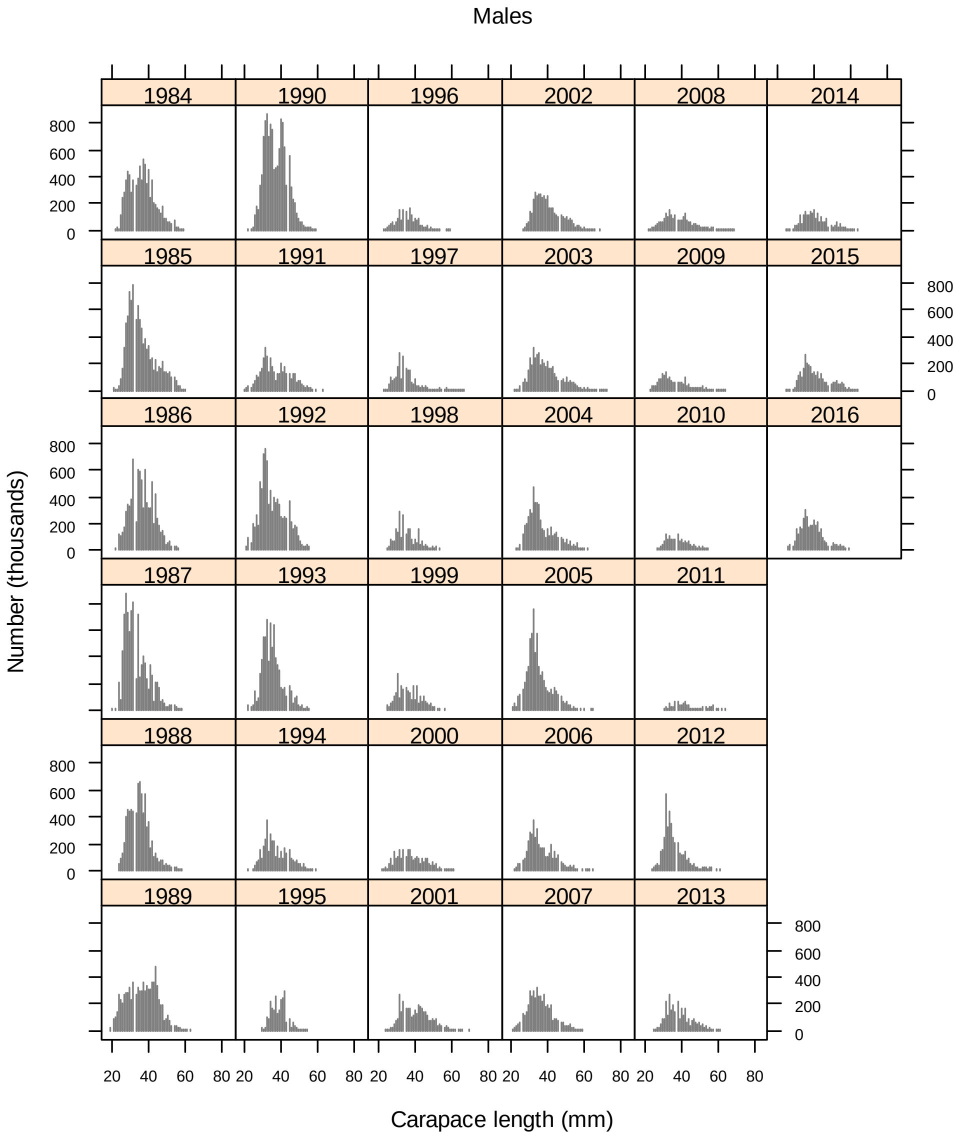


Figure 13.2.2.a. SW and S Portugal (FU 28–29) male length distributions for the period 1984–2016.

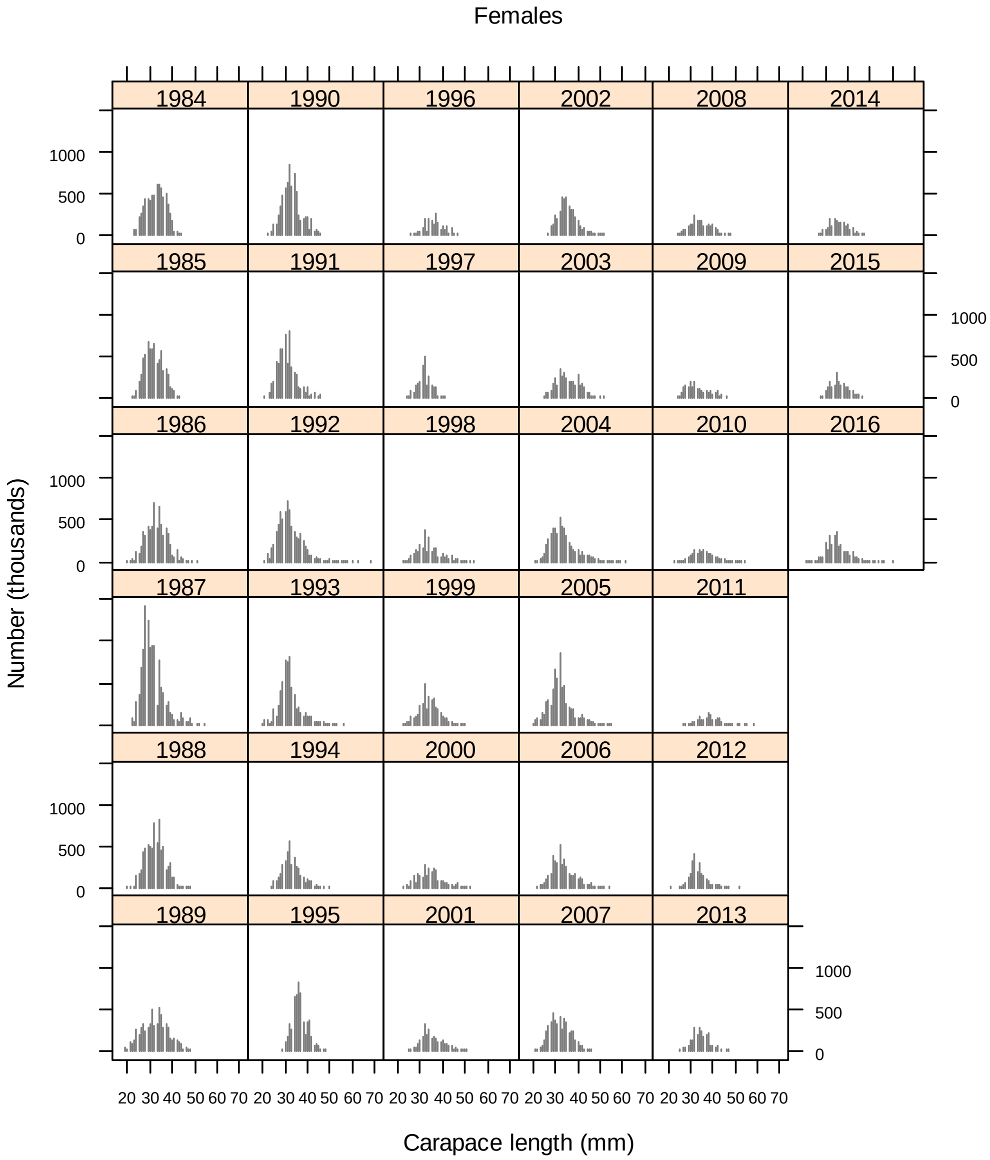


Figure 13.2.2.b. SW and S Portugal (FU 28–29) female length distributions for the period 1984–2016.

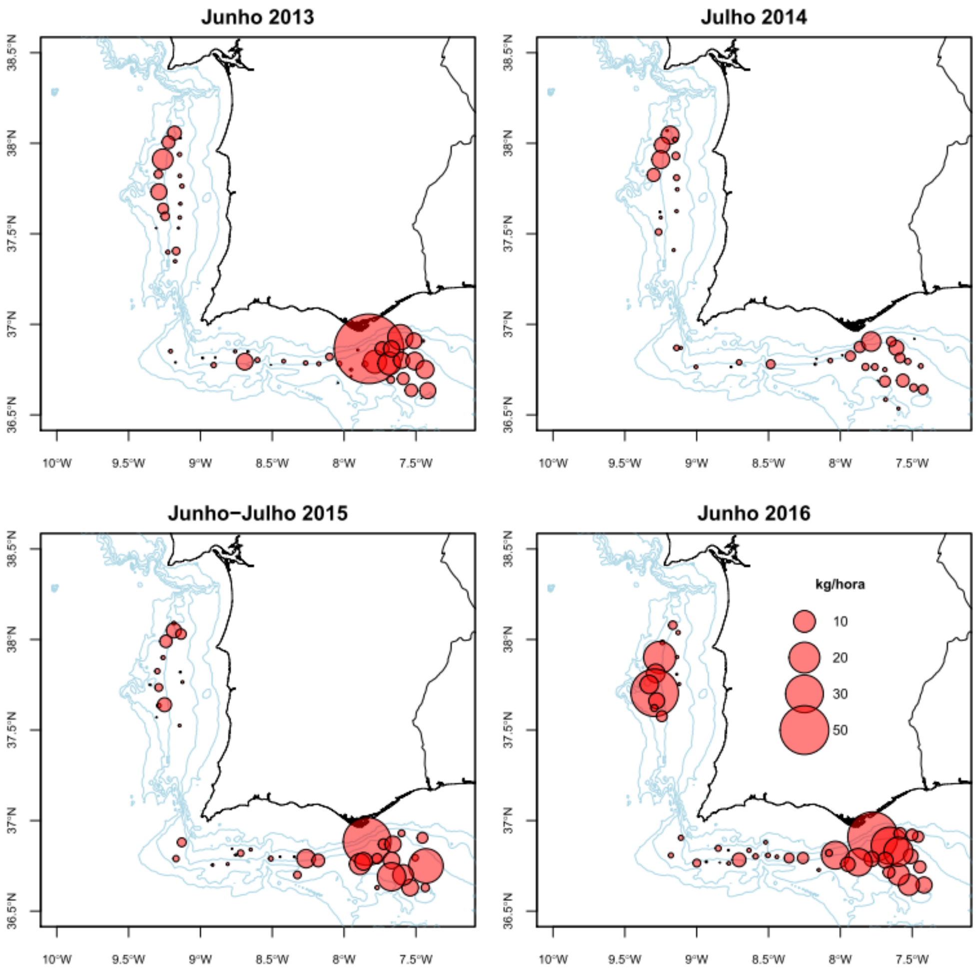


Figure 13.2.3. Spatial distribution of *Nephrops* biomass survey index in the period 2013–2016.

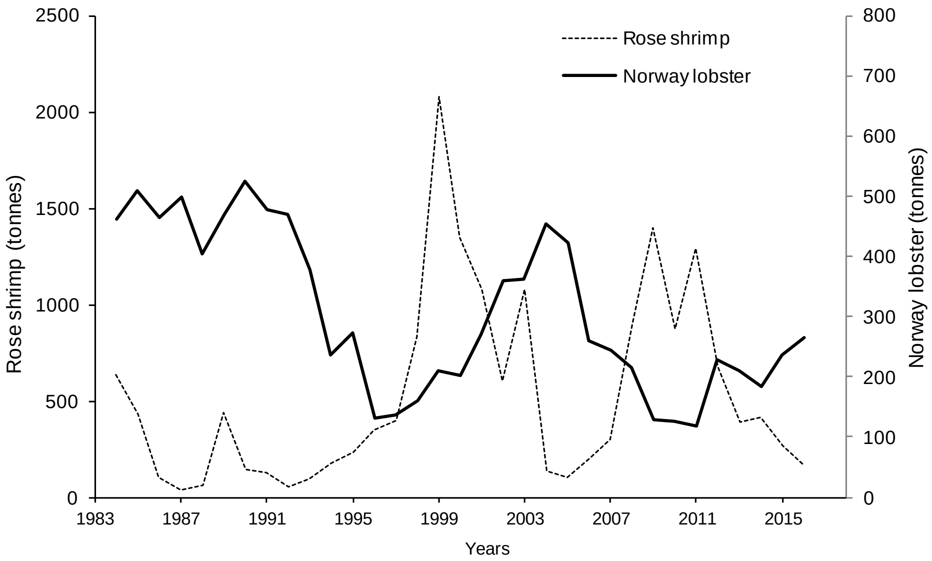


Figure 13.2.4. FUs 28–29: Landings of the two main target species of the Crustacean Fishery in the period 1984–2016.

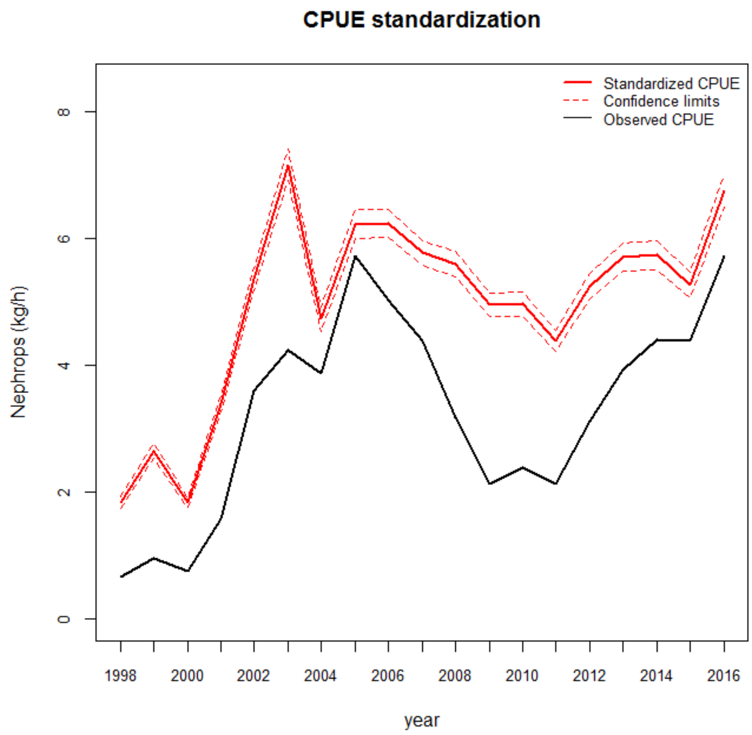


Figure 13.2.5. Comparison of standardized and observed *Nephrops* CPUE.

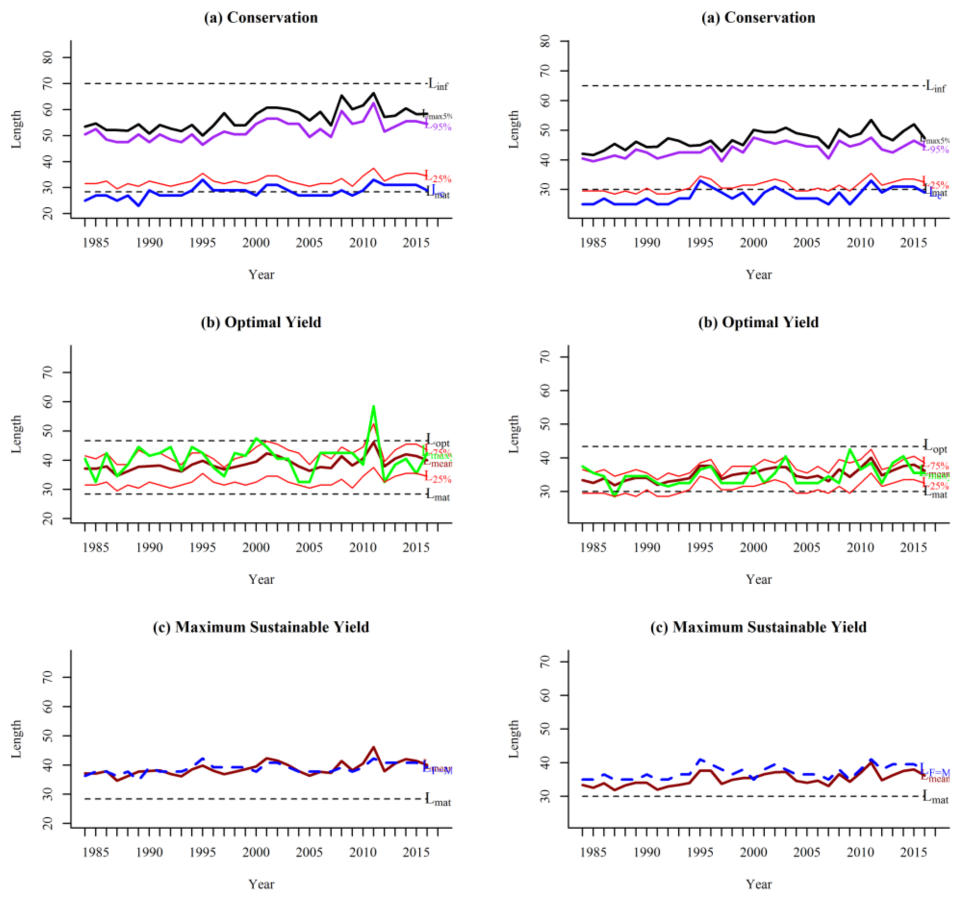


Figure 13.2.6. Length-based indicators for *Nephrops* in FUs 28–29. Left panel: males, right panel: females.

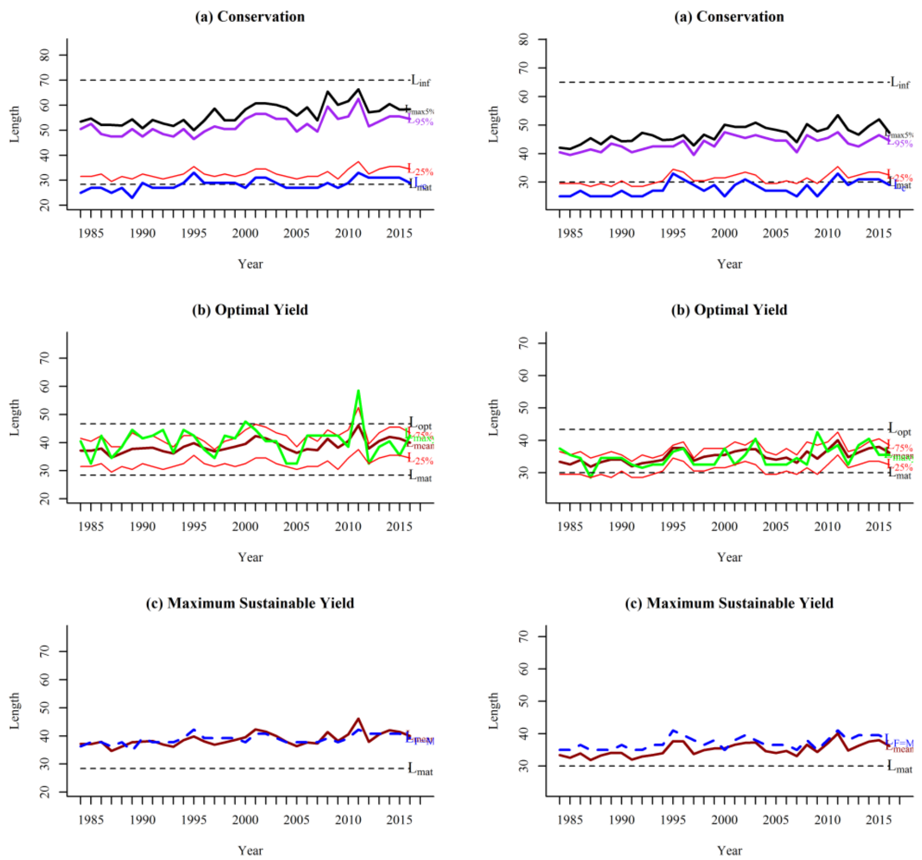


Figure 13.2.7. Length-based indicators ratios for *Nephrops* in FUs 28–29. Left panel: males, right panel: females.

Figure 13.2.8. *Nephrops* FU 28–29. Mean Length Z (Gedamke & Hoenig) model diagnostics.

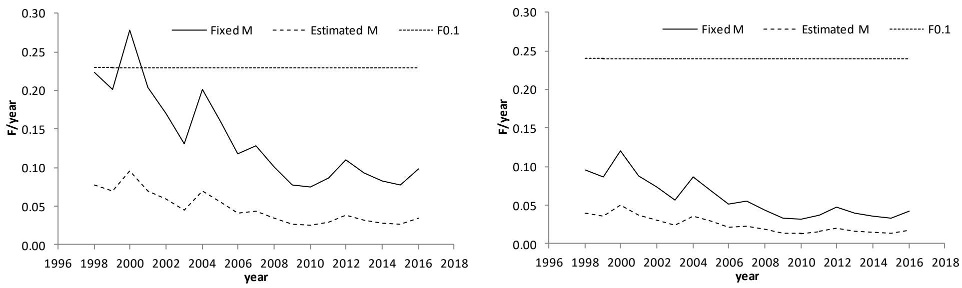


Figure 13.2.9. *Nephrops* FU 28–29. Fishing mortality from THoG model using an external fixed M or an M estimated by the model. Left panel: males, right panel: females.

13.3 *Nephrops* in FU 30 (Gulf of Cadiz)

Type of assessment:

Nephrops FU 30 was benchmarked by WKNEP 2016 and was upgraded to category 1. The UWTV survey based approach was agreed for this stock.

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 2017 and Management applicable for 2017

ICES Advice for 2017

ICES advises that when the precautionary approach is applied, catches should be no more than 76 t in 2017.

To protect the stock in this functional unit, ICES advises that management should be implemented at the functional unit level.

Management applicable for 2016 and 2017

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 9a was 320 t for 2016 and 336 t for 2017, 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 117 and 126 days for Spanish vessels and at 113 days for Portuguese vessels for these two years (Annex II b of Council Regulations nos. 72/2016 and 127/2017). 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

Landings in this FU are reported by Spain and also minor quantities by Portugal. Spanish landings are based on sales notes which are compiled and standardized by IEO. Since 2013, trips from sales notes are also combined with their respective logbooks, which allow georeferencing the catches.

The total landings in 2016 were estimated by this WG for first time since the concurrent sampling was satisfactory implemented last year. The Spanish concurrent sampling is used to raise the FU 30 observed landings to total effort by métier. When the estimated landings exceed the official landings, the difference is provided to InterCatch as non-reported landings

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. Landings drop during the 2013–2015 period up to a mean value of 22 t since the quota in 2012 was exceeded and the European Commission applied a sanction to be paid in 3 years (2013–2015 period). Moreover, the *Nephrops* fishery was closed in 2013 and vessels could only go fishing *Nephrops* a few days in summer and winter. 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 the last years. In 2016, total estimated landings were 124 t. It is represent almost four times landings in 2015. This estimate is considered the best information available at this time.

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. The sampling effort has been increased with an additional number of *Nephrops* directed sampling since summer 2016 in order to improve the quality of the commercial length distributions.

Figure 13.3.3 shows the annual landings length distribution for males, females and both sexes combined during the period 2001–2016. 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 to 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, on board concurrent sampling is carried out, as required by the DCF (Reg. EC 1343/2007). Outside of the *Nephrops* fishing season, a higher 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 sampling in 2013 was probably influenced by the closure of *Nephrops* fishery.

Mean size of males and females in *Nephrops* landings in the period 2001-2016 are shown in Figure 13.3.1. The mean sizes show a slight increasing trend from 2006 to 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 was investigated in collaboration with the observed. The number of sampling and the number of individuals sampled was low in two last years and they could distort the sex-ratio and the mean size in both sexes. The mean size in 2016 was 31.2 mm CL in males and 30.3 mm in females. Length frequency distribution shows an increase of smaller sizes in 2016 (see Figure 13.3.3.

The sex-ratio as proportion of males in landings is shown in Figure 13.3.4. This shows a stable proportion of males since 2009.

13.3.2.3 Mean weight in landings

The mean weights in landings are shown for the all-time series in Figure 13.3.5. Since 2009 an increasing trend of the mean weight was observed but declined in 2013 remaining stable since then (around 31 g). In 2016 a decreasing of the mean weight in landings was observed up to 23.2 g. The mean weight was 28.41 g in the period 2014-2016.

13.3.2.4 Abundance indices from surveys

Trawl 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 2016 are shown in Table 13.3.3.

Two different periods can be observed in the time series. From 1993 to 1998 the overall abundance index trend was decreasing, while from 1998 to 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 but the last year showed a pronounced increase. The survey abundance index shows an increasing trend since 2012 suggesting that the *Nephrops* abundance stock is not in bad conditions (Figure 13.3.6). 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 2001–2016 are presented in Figure 13.3.7. In 2015 and 2016, an increase of the smaller individuals was observed. The time series of *Nephrops* mean sizes for males, females and combined sexes obtained in these surveys are shown in Figure 13.3.8. No apparent trends are observed. The mean size ranged in 2016 was 31.9 mm CL for males and 28.3 for females.

UWTV surveys

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). This survey in 2014 was considered exploratory, two additional UWTV surveys are available (2015 and 2016) and the next survey will be carried out in May 2017.

The surveys are based on a randomized isometric grid design with stations spaced 4 nm. The method used during the surveys are according to WKNEPHTV (ICES, 2007),

WKNEPHBID (ICES, 2008), SGNEPS (ICES, 2009, 2010, 1012) and WGNEPS (2013, 2014, 2015). A description of UWTV surveys carried out in FU 30 since 2014 is documented in the stock annex and in the WD presented in WKNEP 2016 (WD 13 Vila *et al.*, 2016).

The mean burrow density observed in 2015, adjusted to the cumulative bias, was 0.097 burrows/m^2 while a lower mean burrow density was observed in 2016 (0.075 burrows/m^2) (Table 13.3.4). In general, the range of the observations was relatively high in both years (0.00-0.345 burrows/m^2 in 2015 and 0.00-0.328 burrows/m^2).

The final modeled density surfaces in 2015 and 2016 are shown as a heat maps and bubble plots in Figure 13.3.9. The abundance estimate derived from the krigged burrow surface (and adjusted for the cumulative bias) was 298 million burrows (CV= 7.6%) in 2015 and 232 million burrow (CV=7.3%) in 2016. The spatial pattern of burrow density is not consistent betweenyears, the reasons presented below explain some of these differences..

In UWTV survey carried out in 2015, the number of stations and the space between them was increased in relation to 2014. However, the border was under sampled mainly in the shallower limit. In addition, an overestimation of the number of burrows may have occurred. Many participants in the survey were not experienced in the quantification of *Nephrops* burrows. In 2016, the area was better covered, with more stations in the border. Moreover, the identification of the *Nephrops* burrows was carried out by three scientist who participated in the two previous surveys and therefore with more experience. A more realistic result was obtained in 2016 UWTV survey according to the VMS information (WD13 Vila *et al.*, 2016).

The *Nephrops* abundance estimate obtained from the bottom trawl survey (IBTS-surveys) carried out in the Gulf of Cadiz in March 2016 increased in relation to the previous year (see Figure 13.3.6). So, the reduction of the *Nephrops* abundance estimated from UWTV survey in 2016 could be caused by an under sampling of the border area together with an overestimation of the number of burrows, not by a decrease in *Nephrops* abundance in FU 30.

UWTV surveys results were evaluated in the Benchmark Workshop on *Nephrops* Stocks (WKNEP) last year (ICES, 2016). WKNEP 2016 concluded that the UWTV survey in FU 30 is appropriate for providing scientific advice on the abundance of this stock.

13.3.2.5 Commercial catch-Effort data

Figure 13.3.1 and Table 13.3.5 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 to 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 2009–2012 period. As a consecuence of the sanction in 2012, the effort drop in the 2013–2015 period (mean value 283 fishing days) (Figure 13.3.1). In 2016, fishing effort increased up to 443 fishing days.

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. After a drop of the lpue in 2014, commercial abundance index trend shows an increasing trend. In 2016 lpue was 10% higher than previous year (Figure 13.3.1).Lpue in 2013-2015 period must be taken with caution as in this period was applied the penalty for exceeding the quota in 2012, 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 the last years. On the other hand, lpue in 2016 is estimated using official landings and not the total landings estimated by the WG, so this index could be higher since the landings estimated this year were much larger.

The overall lpue trend is quite similar to the abundance trawl survey index in the stratum of 200–700 m from 1996 to 2013 (no survey was carried out in 2003) despite the trawl survey index have fluctuated in some years (see Figure 13.3.6). 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 trawl survey index show two different signals probably due to the special situation after the penalty in 2012. In 2016, both indices increased (Figure 13.3.6).

13.3.3 Assessment

Nephrops FU 30 was previously considered as category 3.2.0 according to the ICES data-limited approach (ICES, 2012). This stock was benchmarked in October 2016 (ICES, 2016) and was upgraded to category 1 since this date. The assessment is based on UWTV approach outlined in WKNEP 2016 and using parameters in the stock annex (ICES, 2016).

13.3.4 Catch options

Inputs table to the catch options are given below. Table 13.3.6. shows the UWTV abundance, estimates of mean weight and HR for 2015 and 2016.

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Variable	**Value**	**Source**	**Notes**
Stock abundance	Available in October 2017	ICES (2017)	UWTV survey 2017
Mean weight in landings	28.41 g	ICES (2017)	Average 2014-2016
Mean weight in discards		ICES (2017)	Not relevant
Discard proportion		ICES (2017)	Negligible
Discard survival rate		ICES (2017)	Not relevant
Dead discard rate		ICES (2017)	Negligible

A prediction of landings for the FU 30 using approach agreed procedure proposed at WKNEP 2016 and outlined in the stock annex will be made on the basis of the 2017 UWTV survey. This will be presented in October 2017 for the provision of advice.

13.3.5 Biological reference points

F_{MSY} proxy ($F_{0.1}$) derived from the SCA (Separable Cohort Analysis) model during WKNEP 2016 (ICES, 2016), corresponds to a harvest rate of 9.5% but this resulted in recommended catches much higher than experienced historically. WKNEP 2016 agreed to derive the harvest rate (HR) from historical experience in this stock and from experience with similar stocks as an interim solution, until a firmer basis for generating advice from UWTV survey abundance estimates can be developed (ICES, 2016). Taken into account the *Nephrops* FU 30 fishery history, HR was estimated ranging between 1.5% in recent year (2010–2012) and 4% when landings achieved the highest value (2003). The last period (2013–2015) was not considered because TAC was limiting the fishery as a consequence of the penalty applied for exceeding the TAC in 2012. So WKNEP 2016 recommended setting an initial F_{MSY} proxy to 4% and moving gradually towards this level although with no current definition of the transition scheme. As the UWTV survey approach is recently initiated for the FU 30, this should be taken with caution for the definition of the transition scheme towards F_{MSY} proxy. The EWG (Annex 2) and WKNEP 2016 recommended a new EG on reference points that will examine the methodology for all *Nephrops* reference points with focus on M and growth.

A summary of results and conclusions from WKNEP 2016 was presented to this WG (WD09 Vila and Herraiz, 2017). A WD was also presented to this WG regarding to an update model for Harvest Ratio estimation for *Nephrops* stocks in FU 23–24 (Bay of Biscay), FU 30 (Gulf of Cadiz) and FU 3–4 (Skagerrak-Kattegat) using a domed selection pattern instead sigmoid selection pattern in the SCA model (WD07, 2016). WG considered necessary more discussion and a thorough review of the method and assumptions presented before applying it. The WG supports the proposal of a specific workshop before the 2018 assessment WGs.

13.3.6 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 months (*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 months 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	Non-reported	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
2016	35	<1	89	124

** 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 (2005–2016) 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
2016	20.5	31.0	0.0	0.1

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	4.38	194	0.5	15	2.73	118

ns = no survey

**= no sampled

Table 13.3.4. ***Nephrops*** **FU 30, Gulf of Cadiz. Results summary table for geostatistical analysis of UWTV survey**

Year	Nª stations	Mean density adjusted	Area Surveyed	Domine area	Geoestatistical Abundance estimate adjusted	CV on burrow estimate
		Burrow/m2	Km2	Km2	Millions burrows	
2015	58	0.0905	3000	3000	298	7.60
2016	58	0.0776	3000	3000	233	7.26

Table 13.3.5. ***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
2016***	124	29	64.6	443

*Landings, LPUE and fishing effort from fishing trips with at least 10% *Nephrops* .

** Ayamonte landings are included since 2002

*** In 2016 Total landings were estimated by the WG

Table 13.3.6. ***Nephrops*** **FU30, Gulf of Cadiz. Summary for 2015 and 2016.**

Year	Landing in number	Total discard in number*	Removals in number	UWTV Abundance estimates	95% conf. intervals	Harvest Rate	Mean weight in landings	Mean weight in discard	Discard rate	Dead discard rate
	millions	millions	millions	millions	millions	%	g	g	%	%
2015	0.80	0	0.80	298	45	0.3	30.8	NA	0	0
2016	5.35	0	5.35	233	34	2.3	23.2	NA	0	0

* Discards are considered negligible and are not included in the assessmet

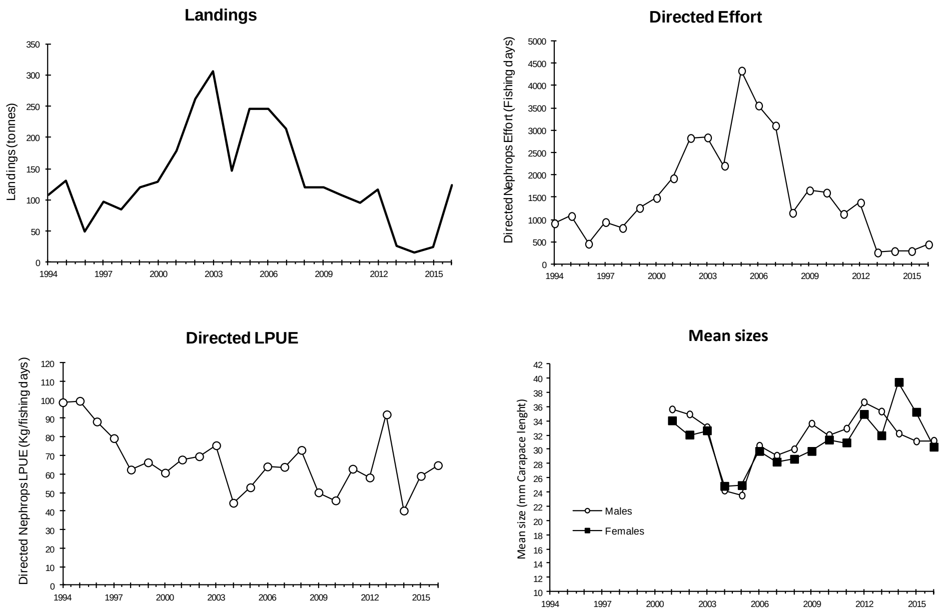


Figure 13.3.1. ***Nephrops*** **FU 30, Gulf of Cádiz. Long term trends in landings,** ***Nephrops*** **directed effort and lpue and mean sizes.**

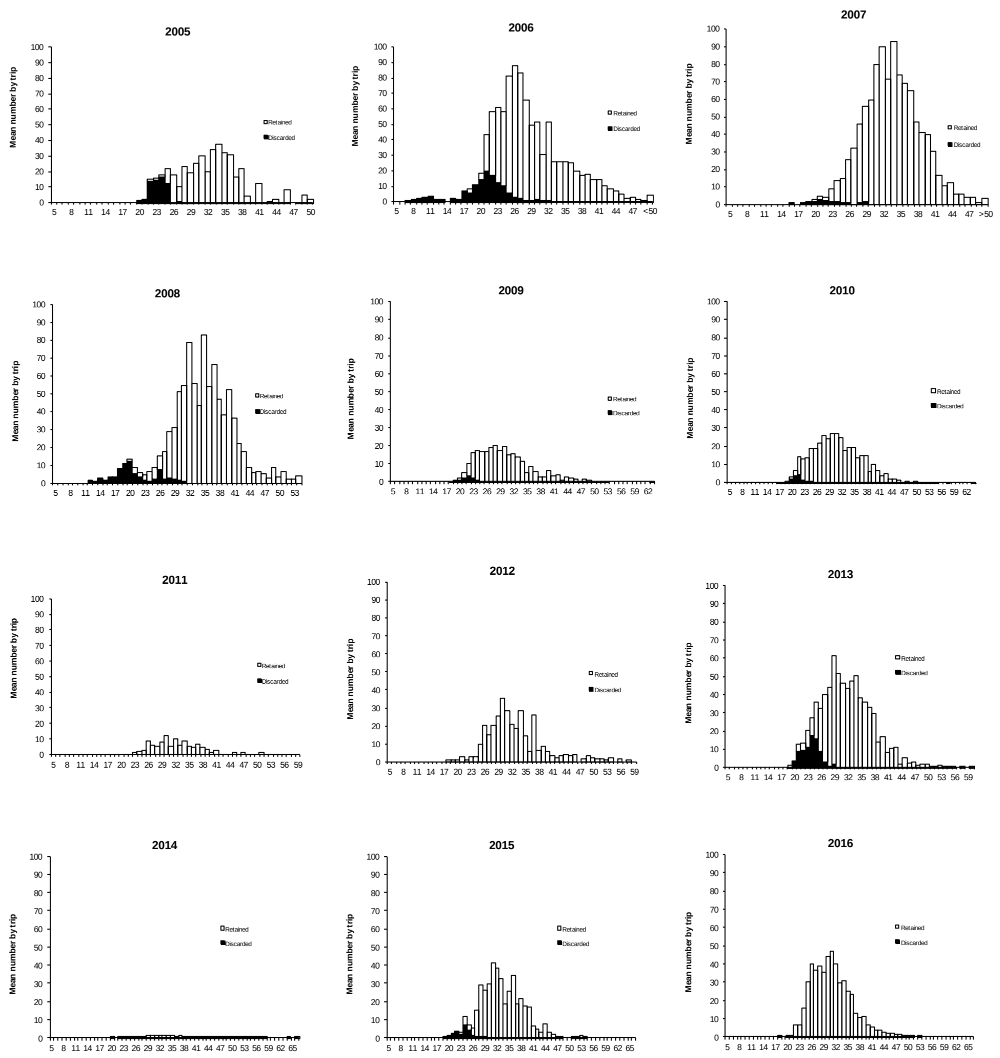


Figure 13.3.2. ***Nephrops*** **FU 30, Gulf of Cadiz. Length distribution of retained and discarded fractions** ***Nephrops*** **from discards program (2005–2016 period).**

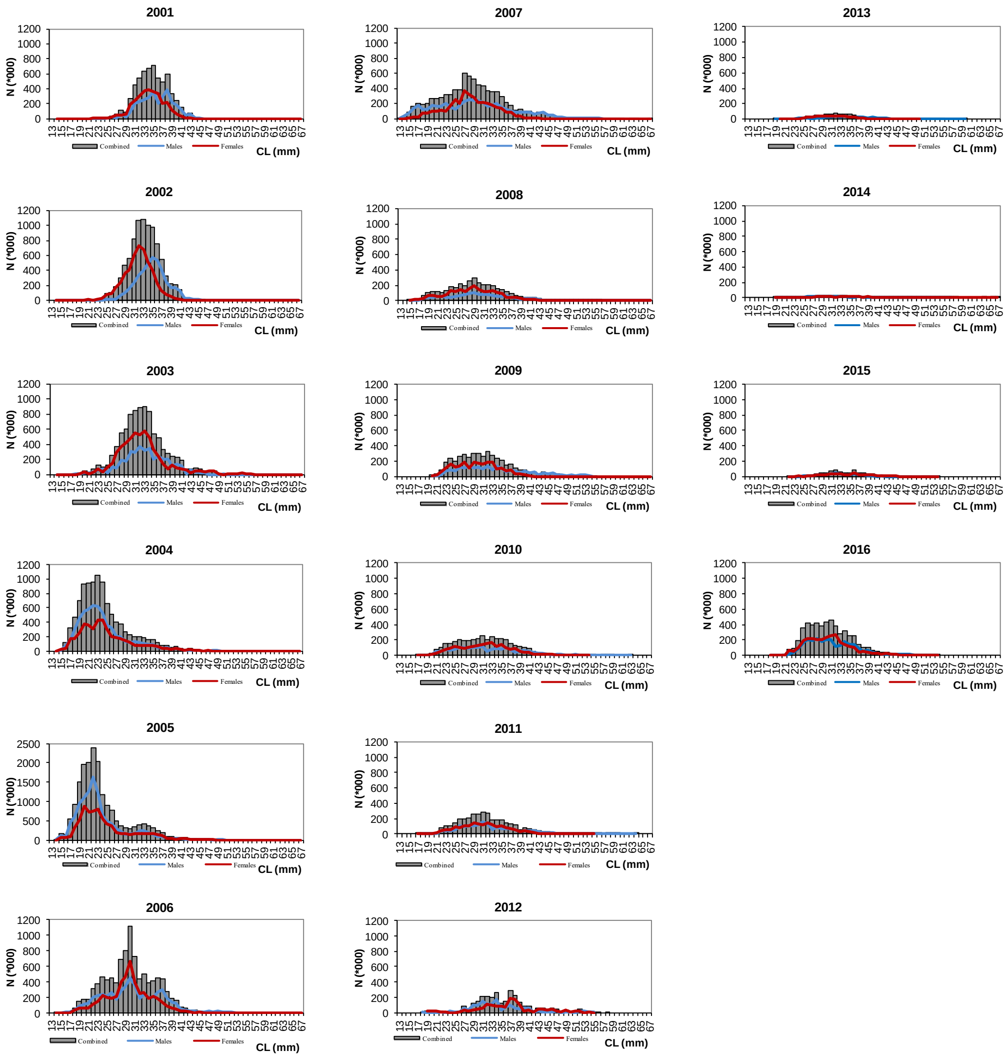


Figure 13.3.3. ***Nephrops*** **FU30, Gulf of Cádiz. Length distributions of landings for the period 2001–2016**

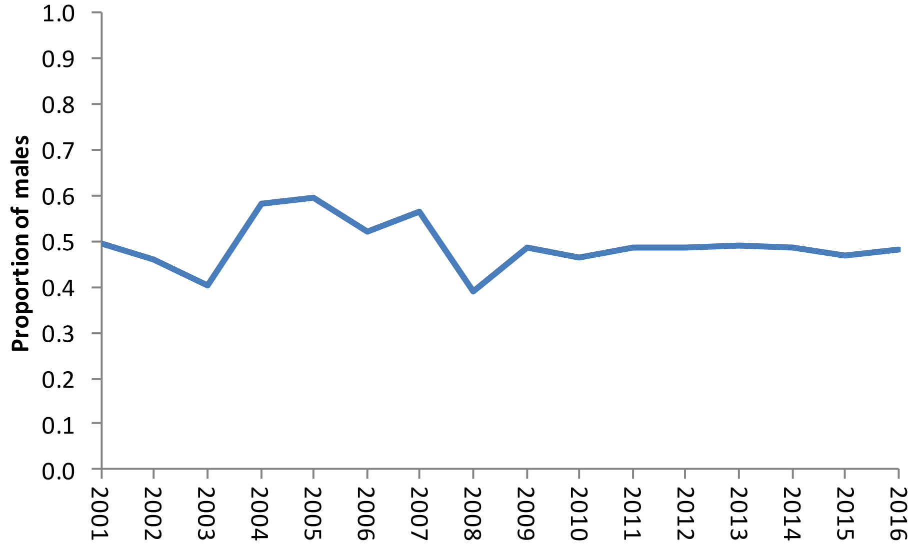


Figure 13.3.4. ***Nephrops*** **in FU 30, Gulf of Cadiz. Proportion of males in landings in the time series.**

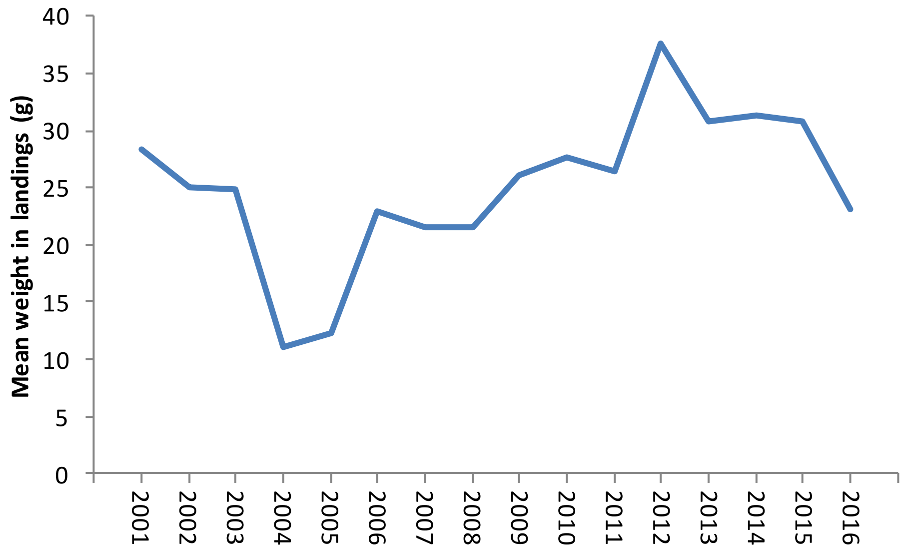
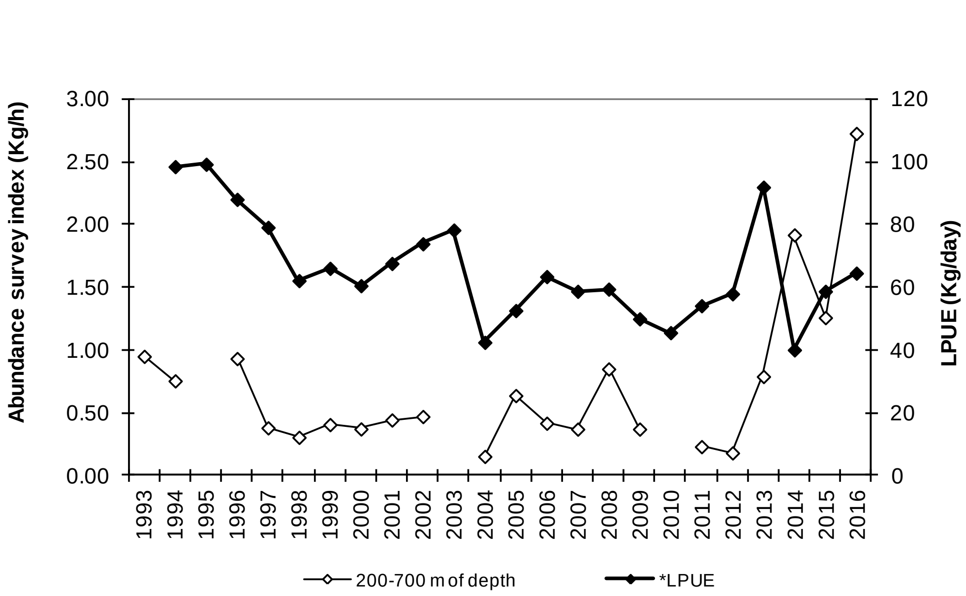


Figure 13.3.5. ***Nephrops*** **in FU 30, Gulf of Cadiz. Mean weight trend in commercial landings.**



* 1995 and 2010: strata 500-700 m no sampled

** 2003: no survey

Figure 13.3.6. ***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.**

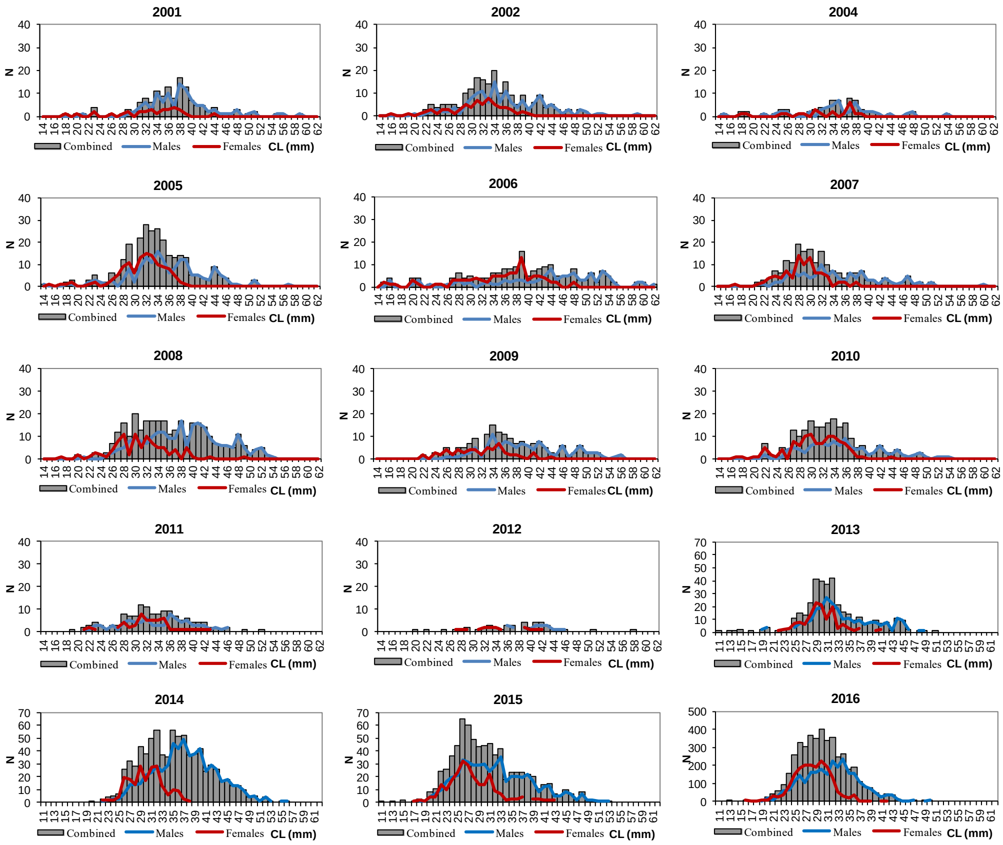


Figure 13.3.7. *Nephrops* FU30, Gulf of Cádiz. Length distributions from Spanish bottom trawl surveys (SPGFS-cspr-WIBTS-Q1) for 2001–2016 period.

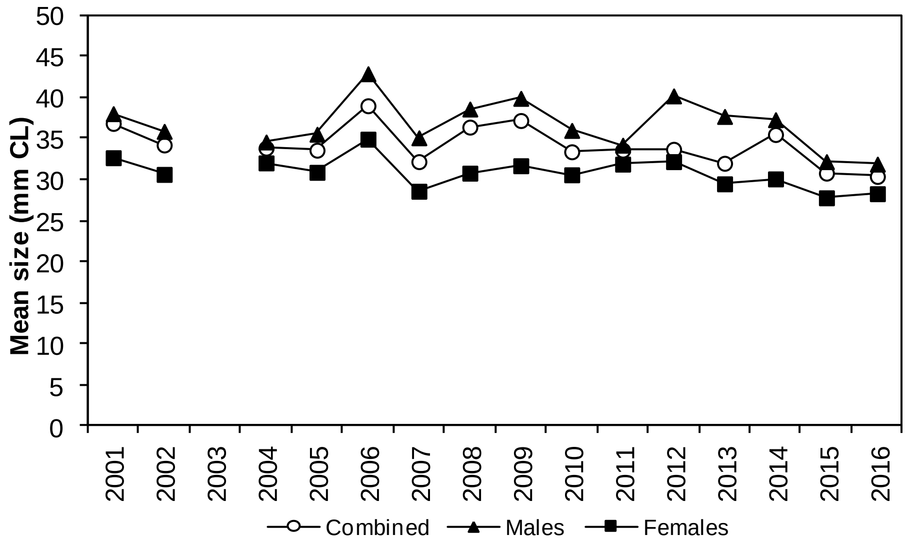


Figure 13.3.8. ***Nephrops*** **FU30, Gulf of Cádiz. Mean size in spring bottom trawl surveys (SPGFS-cspr-WIBTS-Q1) for the period 2001–2016.**

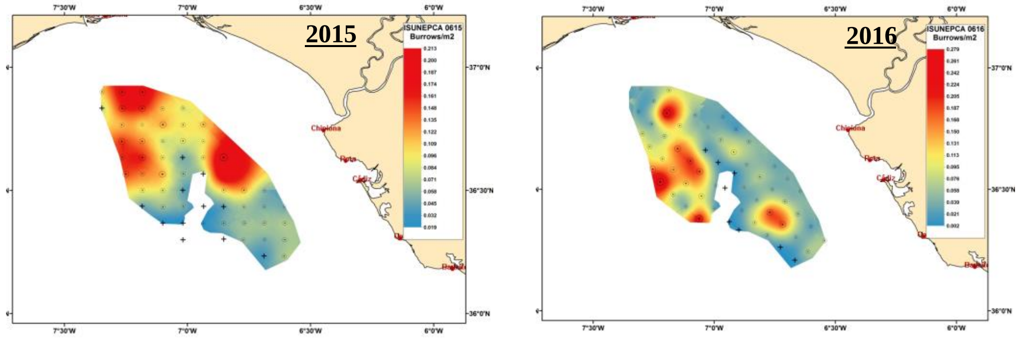


Figure 13.3.9. ***Nephrops*** **FU 30, Gulf of Cadiz. Contour plots of the krigged density estimates for the UWTV surveys in 2015 and 2016.**

14 Seabass (*Dicentrarchus labrax*) in Divisions 8.a-b (Bay of Biscay North and Central)

Type of assessment: update (stock benchmarked in 2017). **Data revisions**: None. **Review Group issues:** None.

14.1 General

14.1.1 Stock definition and ecosystem aspects

This section is described in the Stock Annex.

14.1.2 Fishery description

The general description of the fishery is now presented in the Stock Annex.

Seabass in the Bay of Biscay, are targeted by France with more than 96% of international landings in 2016. Spain is responsible for 4% of the catches essentially in the area 8.b in 2016 (mainly bottom trawlers).

For France, lines fishery (hand lines and longlines) takes place from July to October, while nets, pelagic and bottom trawls fisheries take place from November to April on pre spawning and spawning grounds when seabass is aggregated. In 2016, nets represent 38% of the landings of the area, lines 33%, bottom trawl 16%, and pelagic trawl 8%.

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

ICES advice for 2017

The stock has been assessed at ICES through a “survey trends assessment”. ICES advised 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 (ICES, 2015).

Management for 2016 and 2017

Sea bass are not subject to EU TACs and quotas. Under EU regulation, the minimum landing size (MLS) of sea bass in the Northeast Atlantic is 36 cm total length, a variety of national restrictions on commercial sea bass fishing are also in place. These include:

- An historical landings limit of 5 t/boat/week for French and UK trawlers landing sea 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[2]

[1]www.comite-peches.fr/wp-content/uploads/B17-2015_Bar-Cadre1.pdf

[2]www.comite-peches.fr/wp-content/uploads/B17-2015_Bar-Cadre1.pdf

- 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 sea bass fisheries in Brittany, France;

No management plan exists for this stock applicable to 2017, beside the regulations mentioned here before.

14.2 Data

14.2.1 Commercial landings and discards

The full description of the commercial landings is now presented in the Stock Annex.

Landings series are available from three sources:

i) Official statistics recorded in the Fishstat database since around the mid-1980s (total landings).

ii) French landings for 2000–2015 from a separate analysis by Ifremer of log-book and auction data. Landings are available per metier.

iii) Spanish landings for 2007–2011 from sale notes and for 2012-2015 from official statistics

Table 14.1. presents official and ICES commercial landings.

For France, discards data are available for all French fleets from 2003 onwards. Discarding of sea bass by commercial fisheries can occur where fishing takes place in areas with sea bass smaller than the minimum landing size (i.e. < 36 cm). Discards rates are relatively low with highest rates done by bottom trawlers (Table 14.2). In 2016, total discards percentage is estimate at 3% of the total catches with an amount of 62 tonnes.

For Spain, observer data from Spanish vessels fishing in area 8, have shown there was no sea bass discards from 2003. No information in 2015 were available on discards for this WG.

14.2.2 Length and age sampling

The full description of the biological sampling is now presented in the Stock Annex.

14.2.2.1 French commercial fishery

The French sampling programme for length compositions of sea bass landings covers sampling at sea and on shore. Data are available from 2000 onwards. French length composition for 8.a-b, across time, all gear combined are presented in Figure 14.1.

The French sampling programme for age compositions of sea bass is based on age–length keys with fixed allocation. For the 8.a-b area, the information is available only from 2008 (not shown).

14.2.2.2 Recreational fishery

The full description of the recreational catches is now presented in the Stock Annex.

In previous reports (ICES, 2016b), partitioning French recreational data between the Biscay and Northern stock was only possible for the 2009-2011 study (Rocklin et al., 2014).

There are no data to indicate how the recreational catch may have changed over time. IBP Bass 2014 considered it more plausible to treat recreational fishing as having a more stable participation and effort over time than the commercial fishery (ICES, 2014). A decision was made during WKBASS assessment meeting to apply a constant recreational fishing ratio to total catches to all years based on the reference year 2010 (ICES, 2017). The annual recreational catch was then calculated by applying the ratio 0.66 to commercial landings (Table 14.3.).

14.2.3 Abundance indices from surveys

Currently, there is no survey providing relative indices of adult or juvenile sea bass abundance over time.

14.2.4 Commercial landing-effort data

The full description of the LPUE is now presented in the Stock Annex.

A relative abundance index was derived from commercial fishery landings and effort data (Laurec and Drogou, 2017). In this model, in order to limit the influence of zeros, vessels have been selected on the basis of the frequency of zeroes in their daily catches of sea bass. For this WG, the selection of vessels has been consisted in eliminating catches with less than 1 kg of sea bass caught. In addition, pelagic trawlers and purse seiners were excluded, and 2009 was considered as the reference year. Results are presented in Figure 14.2.

14.2.5 Biological parameters

The full description of the biological parameters is now presented in the Stock Annex.

14.2.5.1 Growth

In the Bay of Biscay, studies on sea bass growth exist and have been published by Dorel (1986) and Bertignac (1987). To update these studies, sea bass was sampled by Ifremer around the coasts of France in area 8.a-b. A Von Bertalanffy model parameters estimated using an absolute error model minimising $\sum(\text{obs-exp})^2$ in lengths-at-age has been used. Linf was fixed to 80.4 cm (Bertignac, 1987). The standard deviation could be described by the linear model: SD = 0.1861 * age + 2.6955 (samples used from age 0 to age 15). The standard deviation of length-at-age increased with length as expected.

14.2.5.2 Maturity

Sea bass maturity has been studied with samples collected by France in the Bay of Biscay. Samples were derived from French fisheries around the Bay of Biscay coast. The size at which 50% of the females are mature is 42.14 cm (low limit 41.31cm and upper limit 43.08 cm). The Pearson test (p-value = 0.597) identifies a good fit from the model to the data (Figure 14.3)

14.2.5.3 Natural mortality

Because there is no reason to observe older sea bass in the areas 4-7 than in the area 8, the WKBASS 2017 proposed to use the same value for Both Stock (ICES, 2017): Then et al. (2015) t_{max} method, as being more robust than inferences from any single study, set the natural mortality for sea bass to M = 0.24.

14.3 Assessment

This is an update assessment.

14.3.1 Input data

See Stock Annex (under "Input data for SS3").

14.3.2 Data Revisions

There were no data revisions for this update assessment.

14.3.3 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).

14.3.4 Assessment results

The assessment model includes estimation of size-based selectivity functions (selection pattern at length) for commercial and recreational fleets and for LPUE abundance index. Figure 14.4 presents selectivity functions by fleet estimated by the model. The selection curve is assumed constant over the whole period for all the fleets. The selection curve for the LPUE abundance index was assumed identical to that of the commercial fleet. The assessment currently assumes that commercial fleets do not discard fish (discards negligible less than 5% of the total landings). Selectivity curve for the recreational fleet with a very flat slope is questionable, as it is based on a single year of data (i.e. the 2010 survey).

Model fit for the LPUE abundance index was good (Figure 14.5), but poorly informative as no significant trend was contained in this index. The index was useful to scale the model to an appropriate level of abundance.

The retrospective analysis (Figure 14.6) shows that for the three summary indicators (Recruitment, SSB and Fbar) the model results are weakly sensitive to the exclusion of recent data. Indeed, recruitment, SSB and Fbar series showed some variability, however the stock diagnostic is not fundamentally changed from one run to another. In the last 5 years, the SSB is stable around 20 000 t and showing a decreasing trend, while the Fbar is just below 0.20 and showed an increasing trend since 2000. Recruitment was poorly defined in the recent years and showed high variability.

14.3.5 Historic trends in biomass, fishing mortality and recruitment

Summary results from SS3 are given in Table 14.4 and Figure 14.7.

The recruitment is variable over time, with 2007 being the lowest recruitment of the time-series. The level of uncertainty is high, as few information are present in the model to estimate this time series. Note that the lowest recruitment belongs to years with the lowest uncertainties.

Since 2000, the spawning stock biomass (SSB) has fluctuated without trend and is now at the level of B_{pa}. (i.e. 17 500 t). Before 2000, SSB were around 30 000 t, but the uncertainties were huge, as only landing data were available over this period.

The fishing mortality (F) was computed using ages 4 to 15. F has increased and fluctuates around F_{lim} (i.e. 0.207) during the last 10 years.

14.4 Catch options and prognosis

14.4.1 Short-Term projection

Forecast inputs used for projections are compiled in Table 14.5.

For the current projection, scaled F-at-age to the average of the last 3 years are used for commercial and recreational fleets.

The recruitment used for projections is the geometric mean (GM) calculated from 2008 to the final assessment year minus 2 (i.e. 2014).

Landings in 2018 and SSB in 2019 predicted for various levels of fishing mortality in 2018 are given in Table 14.6. Maintaining status quo F in 2018 is expected to result in an increase in catch (from 3653 t to 3719 t) and SSB (from 16124 t to 16644 t) with respect to 2017. However, when the MSY approach is applied, total catches (commercial and recreational) in 2018 should be no more than 3119 t (with all catches assumed to be landed). The resulting SSB would reached in 2019 a level of 17077 t.

14.4.2 Yield and biomass per recruit analysis

Not performed during this WG.

14.5 Biological reference points

Biological reference points for the Bay of Biscay stock of sea bass were calculated in 2017 during the WKBASS benchmark workshop (ICES, 2017).

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger_{proxy}}$	16000 t	5th percentile of the distribution of SSB when fishing at F_{MSY} (ICES 2017)
	$F_{MSY_{proxy}}$	0.147	F that maximizes median long-term yield in stochastic simulations under constant F exploitation (ICES 2017)
Precautionary approach	B_{lim}	12600 t	Lowest observed spawning-stock biomass (ICES 2017)
	B_{pa}	17500 t	$B_{lim} \times \exp(1.645 \times \sigma)$; σ=0.20 (ICES 2017)
	F_{lim}	0.207	F that, at equilibrium from a long-term stochastic projection, leads to a 50% probability of having SSB above B_{lim} (ICES (2017)
	F_{pa}	0.147	$F_{pa} = F_{lim}/1.4$ (ICES 2017)
Management plan	SSB_{mgt}	Not defined	
	F_{mgt}	Not defined	

14.6 Comments on the assessment

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 Bay of Biscay.

A retrospective analysis of the catch times series following the SACROIS methodology is needed and should produce a better estimate than the current rescaled catch time series. It should be interesting to disaggregate also catches data into several fishing fleets (e.g. midwater trawls, bottom trawls, nets, lines…).

Discard rates are considered negligible in the current assessment. Nonetheless, a time-series of discards-at-length or -age may be needed for all fleets, if the impact of technical measures to improve selectivity is to be evaluated as part of any future sea bass management.

The absence of length composition data for French fisheries prior to 2000 is a serious deficiency in the model preventing any evaluation of changes in selectivity that may have occurred, for example due to changes in the mix of gear types (especially with the large decrease in numbers of pair trawlers after 1995).

Continued estimation of recreational catches is needed across the stock range (currently only a year of survey), and information to evaluate historical trends in recreational effort and catches would be beneficial for interpreting changes in age-length compositions over time.

Further research is needed to better understand the spatial dynamics of sea bass (mixing between ICES areas; effects of site fidelity on fishery impacts; spawning site - recruitment ground linkages; environmental influences). Assessment model should be revised according to results of undergoing tagging programs.

Robust relative fishery-independent abundance index is needed for adult sea bass in the Bay of Biscay. Its absence is a major deficiency which reduces the accuracy of the assessment and the ability to make meaningful forecasts. The establishment of a dedicated survey could provide valuable information on trends in abundance and population structure of adult sea bass.

Recruitment indices are needed for the Bay of Biscay area: there is a need for information on recruitment trends in this area. A French study has been undertaken from 2013-2016 to explore the possibility of creating recruitment indices in estuarine waters. There were good results, but it needs support to be routinely carried out (Le Goff et al., 2017).

Model parametrization could be disaggregated by fish sex.

14.7 Management considerations

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 well-known northern stock (4.b-c, 7.a,d-h) productivity of the stock is affected by extended periods of enhanced or reduced recruitment which appear to be related to changes in sea temperature (ICES, 2016a). Warm conditions facilitate northward penetration of sea bass in the Northeast Atlantic, and enhance the growth and survival of young fish in estuarine and other coastal nursery habitats. In the Bay of Biscay there is no reason to observe different dynamics. In terms of numbers of recruits, the Bay of Biscay area looks more productive than in the North.

If no management is put in place, and if a combination of increasing fishing mortality and environmental conditions causing relative successive poor recruitments occur, it could lead in the long term to the same situation than in the North part with a large decline of biomass.

The behaviour of sea bass, forming predictable aggregations for spawning in winter and moving inshore to feed at other times of year, increase their vulnerability to exploitation by offshore and inshore fisheries. The effects of targeting offshore spawning aggregations of sea bass are poorly understood, particularly how the fishing effort is distributed in relation to the mixing of fish from different nursery grounds or summer feeding grounds, given the strong site fidelity of sea bass. Fisheries targeting offshore aggregation are mainly netters and to a lesser extent pelagic trawlers operating from December to March. Note that a high increase in the French landings for the nets fishery is observed from 2011: indeed, as sea bass is currently a non-TAC species, there is potential for displacement of fishing effort from other species with limiting quotas as observed with netters in Bay of Biscay reporting their catches from sole to sea bass. With no effective control on the fishery to limit the increase of the landings as observed in 2014, risks are taken. Many small-scale artisanal fisheries, especially line fishing have developed a high seasonal dependency on sea bass. There is also a significant recreational fishing mortality in inshore waters. 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

Table 14.1. Sea bass in Division 8.a-b. Summary of official and ICES commercial landings data.

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
2016	0	2160	2160	0	93	93	0

Table 14.2. Sea bass in Division 8.a-b. Estimated sea bass discards (tonnes) of French vessels in the Bay of Biscay.

	discards (average 2003–2015), t	landings (average 2003–2015), t	%discards 2003-2015
FR_pelagic	3.9	533.8	1%
FR_nets	25.3	674.4	4%
FR_lines	13.5	819.3	2%
FR_bottom trawlers	40.1	371.9	11%
FR_others	4.9	76.7	6%
FR_total	87.7	2476.1	4%

Table 14.3. Sea bass in Division 8.a-b. Time series used in SS3 for recreational fisheries.

year	commercial landings (t)	recreational landings (t)
1985	3420	2269
1986	3549	2355
1987	3417	2267
1988	3217	2135
1989	3144	2086
1990	2621	1739
1991	2734	1814
1992	2709	1797
1993	2552	1693
1994	2668	1770
1995	2492	1654
1996	2402	1594
1997	2358	1565
1998	2231	1480
1999	2091	1387
2000	2362	1567
2001	2306	1530
2002	2392	1587
2003	2616	1736
2004	2380	1579
2005	2796	1855
2006	2875	1908
2007	2751	1825
2008	2745	1821
2009	2278	1512
2010	2229	1479
2011	2575	1709
2012	2549	1691
2013	2685	1782
2014	2991	1985
2015	2264	1502
2016	2252	1494

Table 14.4. Sea bass in Division 8.a-b. Assessment summary. Weight are in tonnes.

Year	Recruitment Age 0 thousands	SSB tonnes	Total landings tonnes	Yield/SSB	F Ages 4–15 Year-1
1985	43419	30328	5689	0.19	0.152
1986	42386	29283	5904	0.20	0.165
1987	38447	28280	5684	0.20	0.165
1988	32015	27710	5352	0.19	0.159
1989	25312	27688	5230	0.19	0.156
1990	20825	28030	4360	0.16	0.128
1991	17433	29198	4548	0.16	0.129
1992	16317	30131	4506	0.15	0.125
1993	18749	30663	4245	0.14	0.115
1994	29281	30635	4438	0.14	0.121
1995	40150	29510	4146	0.14	0.117
1996	21123	27742	3996	0.14	0.119
1997	24523	25451	3923	0.15	0.126
1998	27828	22963	3711	0.16	0.129
1999	26043	20981	3478	0.17	0.127
2000	31443	20110	3929	0.20	0.149
2001	24953	19754	3836	0.19	0.152
2002	33228	19579	3979	0.20	0.167
2003	43990	19123	4352	0.23	0.192
2004	24314	18407	3959	0.22	0.182
2005	34731	18158	4651	0.26	0.221
2006	43626	17572	4783	0.27	0.238
2007	12828	17080	4576	0.27	0.234
2008	38666	17213	4566	0.27	0.232
2009	16629	17813	3790	0.21	0.187
2010	16289	18935	3708	0.20	0.173
2011	33499	20102	4284	0.21	0.189
2012	18046	20741	4240	0.20	0.183
2013	44991	20801	4467	0.21	0.191
2014	31542	20240	4976	0.25	0.22
2015	26420	18736	3766	0.20	0.175
2016	26420	17857	3746	0.21	0.178
Average	28845	22972	4401	0.20	0.166

Table 14.5. Sea bass in Division 8.a-b. Forecast inputs table.

Age	Numbers at age	Weight in stock	Proportion mature	Commercial F	Commercial mean weights	Recreational F	Recreational mean weight	M
0	26420	0.004	0.000	0.000	0.000	0.000	0.000	0.24
1	20783	0.020	0.000	0.000	0.043	0.000	0.048	0.24
2	16348	0.074	0.000	0.000	0.244	0.000	0.142	0.24
3	15352	0.171	0.002	0.000	0.413	0.000	0.289	0.24
4	17213	0.309	0.023	0.011	0.568	0.002	0.486	0.24
5	5363	0.482	0.130	0.048	0.710	0.005	0.721	0.24
6	7418	0.685	0.366	0.083	0.867	0.011	0.983	0.24
7	2571	0.909	0.622	0.100	1.061	0.022	1.261	0.24
8	1810	1.149	0.801	0.105	1.286	0.038	1.545	0.24
9	2838	1.397	0.900	0.108	1.528	0.058	1.828	0.24
10	623	1.648	0.949	0.109	1.776	0.083	2.104	0.24
11	1372	1.899	0.974	0.109	2.023	0.109	2.369	0.24
12	689	2.144	0.986	0.110	2.265	0.136	2.620	0.24
13	295	2.383	0.992	0.110	2.498	0.162	2.856	0.24
14	312	2.611	0.995	0.111	2.722	0.186	3.076	0.24
15	133	2.829	0.997	0.111	2.934	0.208	3.281	0.24
16+	122	3.244	0.998	0.111	3.548	0.227	3.470	0.24

Age 0,1,2 over-written as follows:

2017 yc 2017 age 0 replaced by 2008–2014 LTGM (26 420 thousand);

2016 yc 2017 age 1 from SS3 survivor estimate at-age 1, 2017 * LTGM / SS3 estimate of age 0 in 2015;

2015 yc 2017 age 2 from SS3 survivor estimate at-age 2, 2017 * LTGM / SS3 estimate of age 0 in 2014.

Table 14.6. Sea bass in Division 8.a-b. Catch options table.

2017		Commercial fishery			Recreational fishery			Total fishery	
Biomass	SSB	Fmult	Fbar	Landings	Fmult	Fbar	Landings	Total Fbar	Total landings
33112	16257	1	0.093	**2207**	1	0.085	**1446**	0.178	**3653**

2018		Commercial fishery			Recreational fishery			Total fishery		2019	
Biomass	SSB	Fmult	Fbar	Landings	Fmult	Fbar	Landings	Total Fbar	Total landings	Biomass	SSB
33555	16124	0.000	0.000	0	0.000	0.000	0	0.000	0	36784	19352
		0.200	0.019	488	0.200	0.017	306	0.036	794	36087	18769
		0.400	0.037	963	0.400	0.034	600	0.071	1562	35414	18207
F = Flower		0.810	0.075	1894	0.810	0.069	1165	0.144	3059	34104	17120
F = Fmsy = Fpa		**0.827**	**0.077**	**1932**	**0.827**	**0.070**	**1187**	**0.147**	**3119**	**34051**	**17077**
		0.845	0.078	1971	0.845	0.072	1211	0.150	3182	33996	17031
		0.900	0.084	2092	0.900	0.076	1283	0.160	3375	33828	16893
		0.955	0.089	2211	0.955	0.081	1354	0.170	3565	33662	16756
		1.010	0.094	2330	1.010	0.086	1424	0.180	3754	33497	16620
		1.070	0.099	2458	1.070	0.091	1499	0.190	3958	33319	16473
		1.124	0.104	2573	1.124	0.095	1567	0.200	4140	33160	16343
		1.180	0.110	2691	1.180	0.100	1636	0.210	4326	32997	16209
F = Fupper		1.190	0.1105	2712	1.190	0.101	1648	0.212	4360	32968	16185
		0.600	0.056	1424	0.600	0.051	881	0.107	2305	34763	17666
SSB(2019) = Bpa		0.663	0.062	1566	0.663	0.056	968	0.118	2534	34563	17500
		0.700	0.065	1650	0.700	0.059	1018	0.124	2668	34446	17404
		0.800	0.074	1872	0.800	0.068	1152	0.142	3024	34135	17146
		1.000	0.093	2308	1.000	0.085	1411	0.178	3719	33527	16644
F = Flim		1.165	0.108	2659	1.165	0.099	1617	0.207	4277	33041	16245
		1.200	0.111	2733	1.200	0.102	1660	0.213	4393	32939	16161
SSB(2019) = MsyBtrigger		1.269	0.118	2875	1.269	0.108	1743	0.226	4618	32742	16000
		1.400	0.130	3146	1.400	0.119	1899	0.249	5045	32371	15696
		1.600	0.149	3547	1.600	0.136	2129	0.284	5676	31821	15248
		1.800	0.167	3939	1.800	0.153	2349	0.320	6288	31289	14815
		2.000	0.186	4319	2.000	0.170	2561	0.356	6881	30774	14399
SSB(2019) = Blim		2.957	0.275	6010	2.957	0.251	3468	0.526	9478	28527	12600

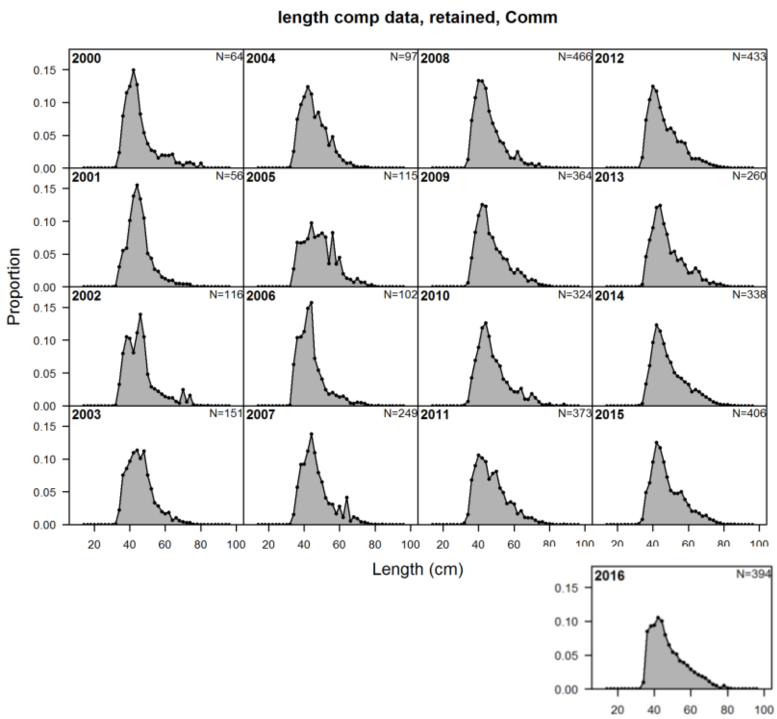


Figure 14.1. Sea bass in Division 8.a-b. Length composition all French fleet combined from 2000 onwards

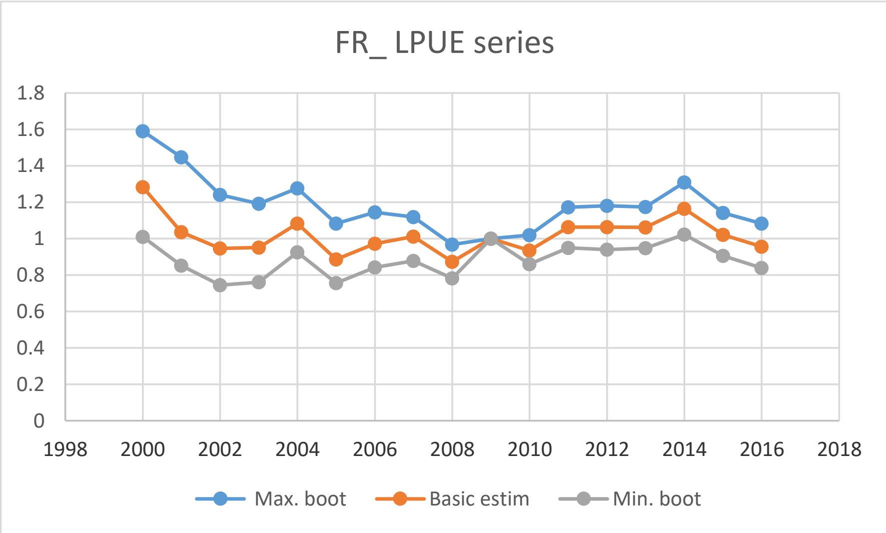


Figure 14.2. Sea bass in Division 8.a-b. LPUE abundance index derived for the Bay of Biscay stock of sea bass. Confidence intervals were estimated by bootstrap, 2009 being considered as the reference year.

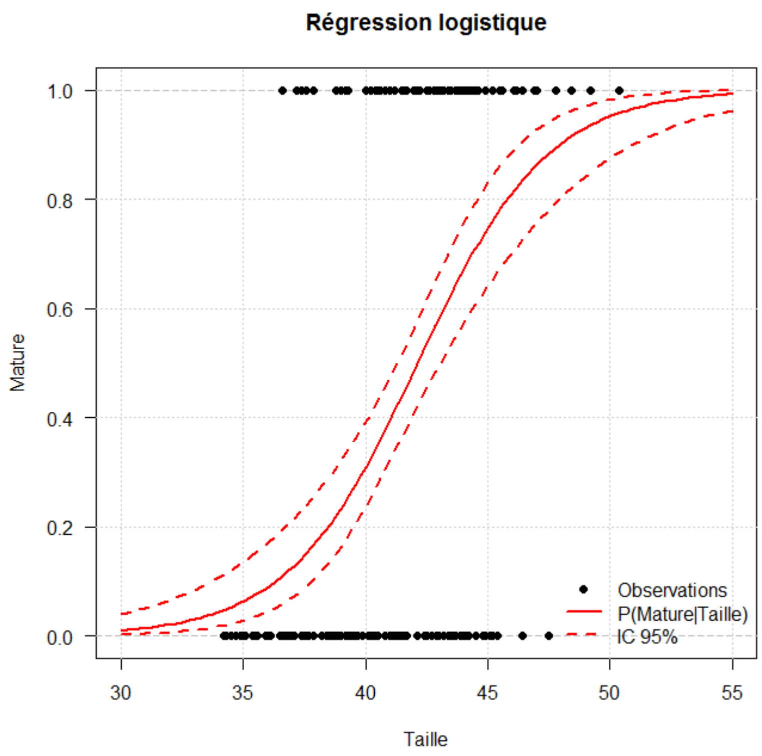


Figure 14.3. Sea bass in Division 8.a-b. Maturity ogive for the Bay of Biscay stock of sea bass.

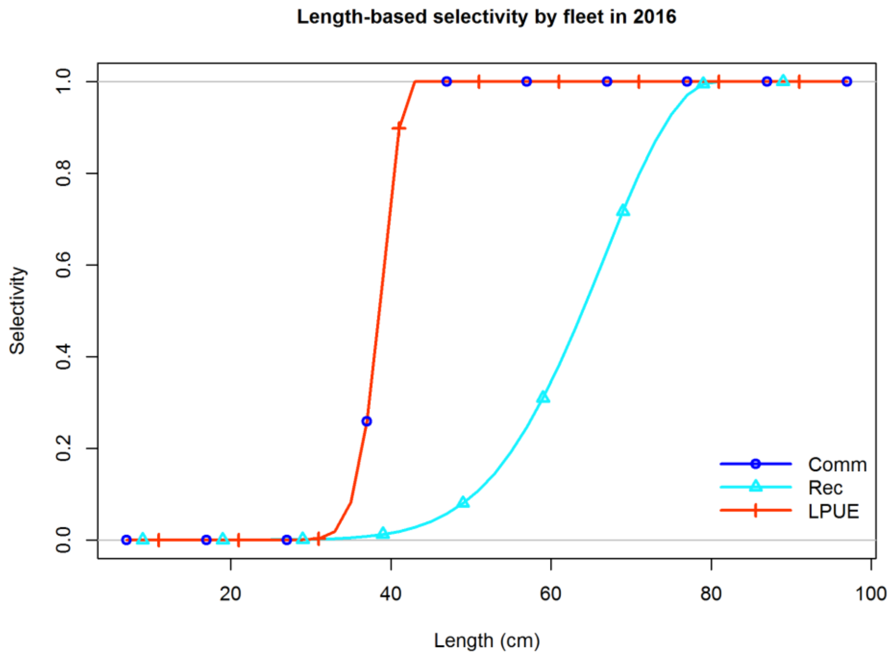


Figure 14.4. Sea bass in Division 8.a-b. Selection patterns at length by commercial and recreational fleets estimated by SS3. Selection pattern for the LPUE abundance index was assumed to follow the one from the commercial fleet.

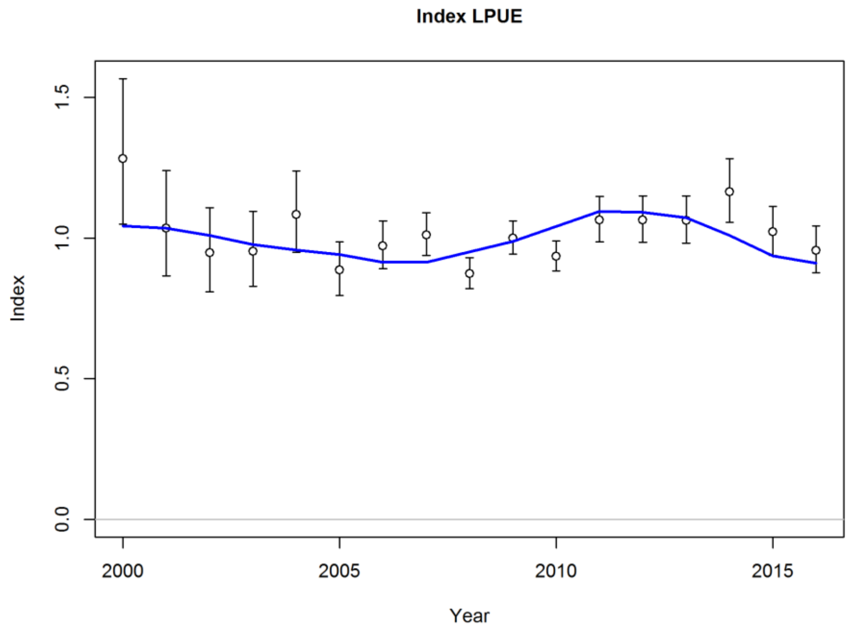


Figure 14.5. Sea bass in Division 8.a-b. Fit to the lpue abundance index.

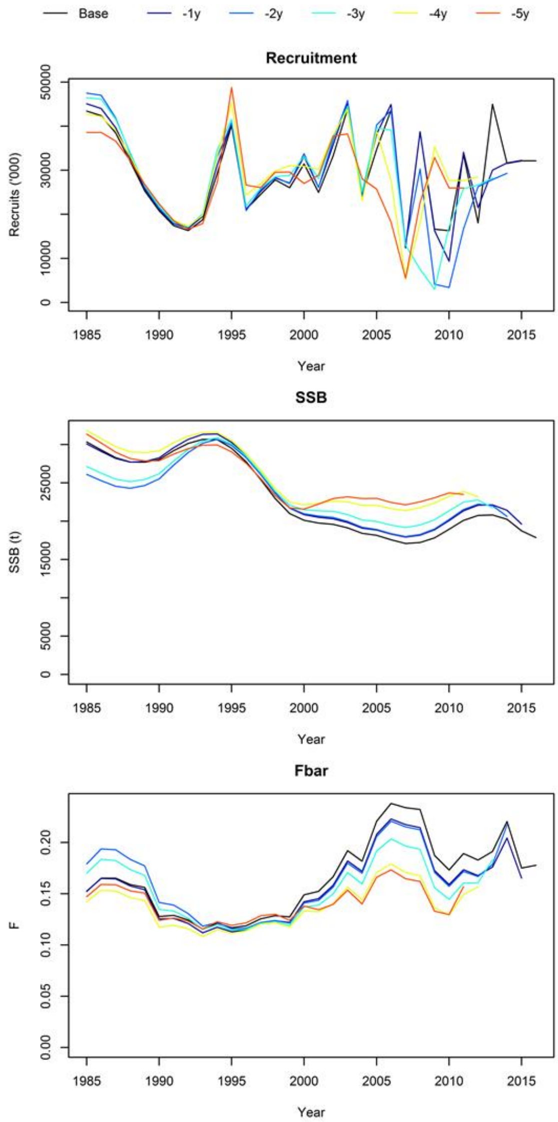


Figure 14.6. Sea bass in Division 8.a-b. Retrospective plot from SS3.

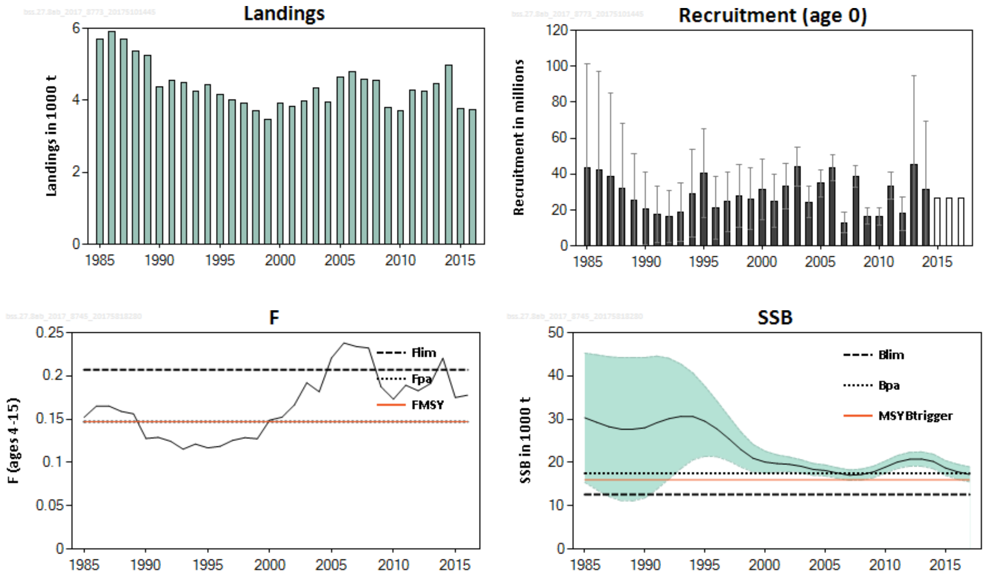


Figure 14.7. Sea bass in Division 8.a-b. Summary plot of stock trends.

15 European Seabass in Division 8c, 9a

15.1 ICES advice applicable to 2014 (June 2014)

"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 sub-stock 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 North-west Africa. The species is at the northern limits of its range around the British Isles and southern Scandinavia. 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. No update of stock identity was available in advance of the data evaluation workshop (WKBASS), so the stock identity was assumed to be the same as previous descriptions with the following Atlantic stocks: Northern (ICES areas IVb-c, VIIa,d-h); Southern Ireland and Western Scotland (ICES areas VIa, VIIb and VIIj); Biscay (ICES areas VIIIa-b); Portugal & Northern Spain (ICES areas VIIIc & IXa) (ICES, 2012, 2014).

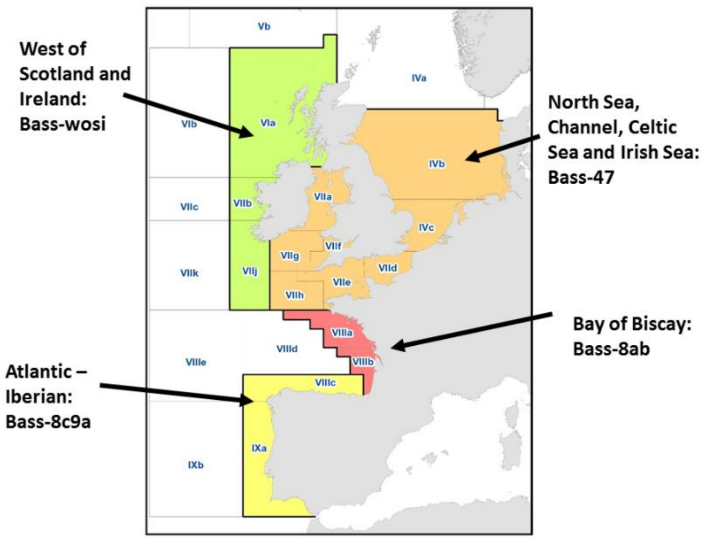


Figure 15-1: stock seabass units defined at ICES (IBP new 2012)

Two large tagging programmes are underway that will provide significant information on the movements of seabass later this year and could indicate the levels of mixing between stocks. The first programme (C-Bass) is being led by the Cefas (UK) and has tagged almost 200 seabass with electronic data storage tags (DSTs) in two locations (Lowestoft and Weymouth). Around 20 tags have been returned and significant effort is being made to improve the geolocation algorithms through the inclusion of bathymetry and temperature at depth. The BARGIP study is being led by IFREMER and has released 1220 fish with DSTs at10 locations in the Channel and Bay of Biscay. So far, 282 tags have been returned and the movements of individual fish are being reconstructed. Cefas and IFREMER are working together to compare geolocation algorithms. Behavioural and genetic studies of seabass are also underway at the Marine Institute, Ireland, with the aim of investigating the distribution of sea bass within Irish waters and the potential existence of an Irish sub-population.

A further study has been done using stable isotope an analysis of (δ13C and δ15N) composition in scales from a number of locations around the Welsh coast (Cambiè *et al.*, 2016). A random forest classification model was used to test for any differences in δ15N and δ13C values between north, mid and south Wales and whether it was possible to correctly assign a fish to the area where it was caught. The classification model correctly assigned about 75% of the fish to their collection region based on isotope composition. The results suggest that two sub-populations of sea bass may exist in Welsh waters, using separate feeding grounds (south vs. mid/north Wales) (Cambiè *et al.*, 2016). Further details of this study will also be provided in advance of the assessment workshop in February 2017.

15.2.2 Management applicable to 2016

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 2017

No new management plan is known at present in 8c, 9a.

15.3 Fisheries data

15.3.1 Commercial landings data

Landings series are given in **Error! Reference source not found.** 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 to 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 9a and 8c. Commercial landings represent 947 tonnes in 2016. 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. Compare to 2015, in 2016, in the all area, an increase of the Portuguese landings is observed (from 436 tonnes in 2015 to 565 tonnes in 2016) and Spain landings are stable (381 tonnes). However landings from Portugal are only from the 9a area, while the Spanish landings are distributed between the two zones 9a and 8c (respectively (165 tonnes and 216 tonnes). Landings per country are given in Figure 15-2, and landings split by country, gear and area are given in Table 15-2 : commercial landings in Iberian waters per country, gear and subareaTable 15-2

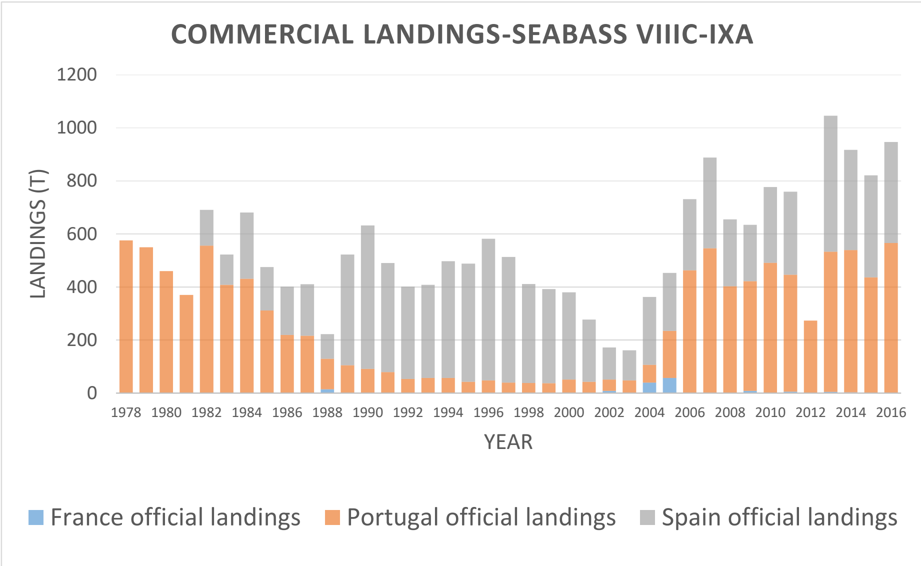


Figure 15-2: commercial landings per country in area 27.7.9a and 27.7.8c (source: intercatch)

15.3.2 Commercial length composition data

Length composition are available in the IXa area (source intercatch) for Portuguese fleet in 2016 and presented yearly in Figure 15-3 and quarterly in Figure 15-4.

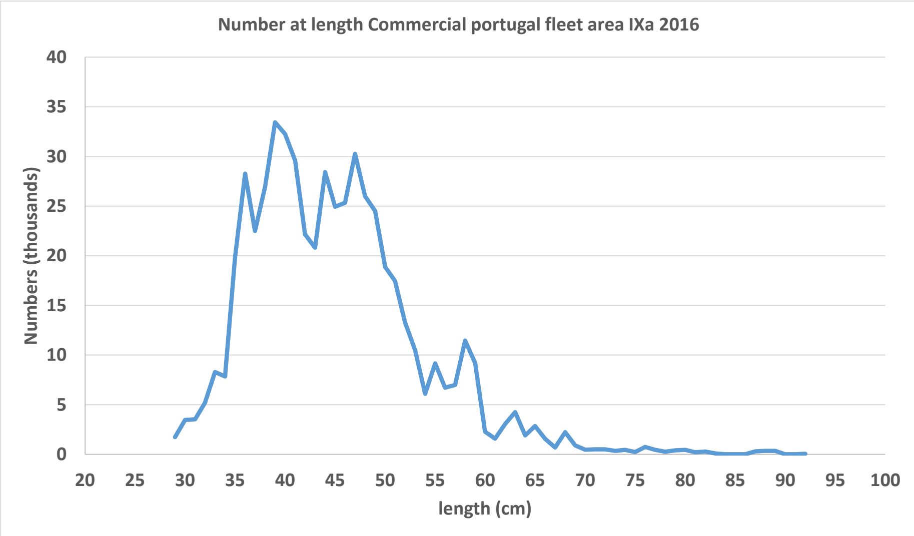


Figure 15-3 : commercial length composition in 2016 for Portuguese fleet landings (source: intercatch)

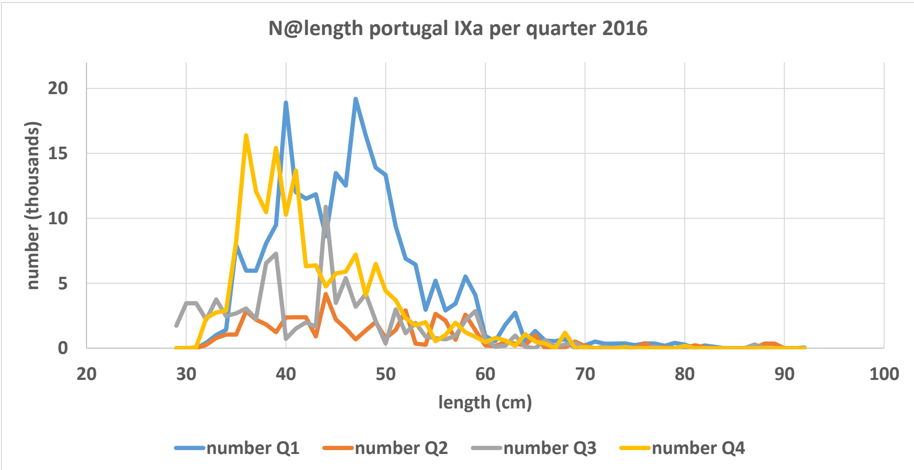


Figure 15-4: commercial quarterly length composition in 2016 for Portuguese fleet landings (source: intercatch)

15.3.3 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 metier in the 2003-2016 periods.

15.3.4 Effort

Some effort data were available (source Intercatch) for Spanish fleet from 2013 and for Portuguese fleet from 2015, showing a global decrease over time (Figure 15-5)

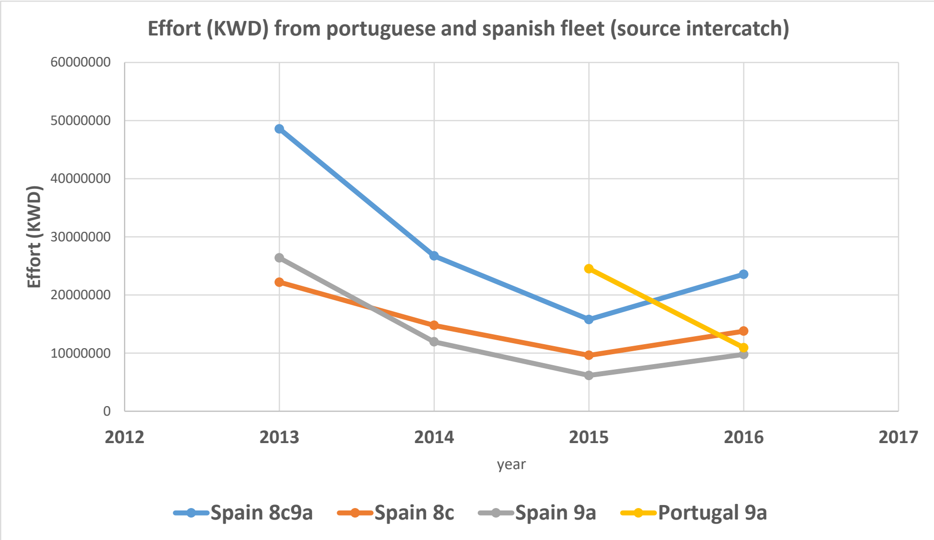


Figure 15-5: Effort (KWD) for Spanish and Portuguese fleet in 8c 9a area (source: intercatch)

15.3.5 Recreational catches

In 2015, a study has been conducted in Spain "*Comparing different survey methods to estimate European sea bass recreational catches in the Basque Country*" (Zaraus 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 analyzed. 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.

In 2016 the AZTI's data for the seabass captures estimation in recreational fisheries in 2016 corresponding only to the landings in the Basque Country, and that despite being mostly in division 27.8.c, (it could be part from 27.8.b) are 117 tonnes: 100 tonnes from the shore, 12 from boat and 5 from spearfishing (Source: AZTIs estimation under Data Collection Framework).

15.4 Assessment model, diagnostics and retrospectives

15.4.1 Previous assessment

Advice for 2014 : Based on ICES approach to data-limited stocks, ICES advised that commercial catches should be no more than 598 t in 2014 (0.8*average landings 2009-2011). All commercial catches are assumed to be landed. Recreational catches cannot be quantified; therefore, total catches cannot be calculated.

Advice for 2015 : There are no new data available that change the perception of the stock. Therefore, the advice for this fishery in 2015 is the same as the advice for 2014 (see ICES, 2013): Based on ICES approach to data-limited stocks, ICES advises that commercial catches should be no more than 598 t. All commercial catches are assumed to be landed. Recreational catches cannot be quantified; therefore, total catches cannot be calculated.

Advice for 2016 and 2017 : the ICES framework for category 5 stocks was applied (ICES, 2012a). For stocks without information on abundance or exploitation, ICES considered that a precautionary reduction of catches should be implemented unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock. The precautionary buffer was applied in 2013 (for the 2014 advice). ICES advises than when the precautionary approach is applied, commercial catches should be no more than 598 tonnes in each of the years 2016 and 2017.

15.4.2 Current assessment

Applying Ices Rules for stocks in categories 3-6, If the PA buffer has not been applied in 2015 or later, then the following guidelines for applying the PA buffer (-20%) should be used: also a new buffer of 20% has to be applied this year to the latest advice, which conduct to a catch advice of 0.8*598=479 tonnes

Note: a precautionary approach has been adopted on this stock in 2013 (-20%) on the average of 2009-2011 years catches. The new buffer of 20% applied this year in WGBIE 2017 to the latest advice doesn't make sense for the WGBIE 2017 group, regarding to the very old period for calculation, the relatively stability in landings over time, the presence of very large individuals up to 92cm in length composition of commercial landings and because seabass is not a targeted species in this area contrary to the other northern stock. The mean of the three last year's catches (2014-2016) applying the buffer (20% less), resulting in a catch advice of 716 tonnes would have been probably more appropriate.

15.5 Recommendations for next benchmark assessment

ICES, WGBIE 2017 encouraged documentation of the quality of the sea bass data for the Iberian waters, and studies to better understand the stock dynamics and movements between the current stock areas.

Seabass in Iberian waters is considered as a 5.2.0 category at present. The ICES framework for category 5 stocks is applied (ICES, 2012a) for catch advice. No information are available at present indicating the level of the stock. A parallel can be done with the 27.7.8ab seabass stock assessed with the same methodology until 2014. In 2015 Ices using a french LPUE index based on log book of French commercial vessels (>10m and

<10m), allowed to assess this stock using the ICES framework for category 3 stocks (ICES, 2012a). The French LPUE was applied as the index of stock biomass. The advice was 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.

A data call has also been written at WGBIE 2017 in order to get material from Spain and Portugal in order to assess the 8c9a stock using an LPUE index calculated with the French methodology. The analyzed data set would correspond to spanish and portuguese logbooks from commercial vessels catching sea bass (<10m if possible, and >10m).

15.6 Management plans

No management plan is known at present for the 8c, 9a stock.

Table 15-1: Sea bass in the 9 and 8c 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

Country	France official landings	Portugal official landings	Spain official landings	Total official landings	Total ICES estimates* **
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
2016	1	565	381	947	947

*** Preliminary**

***-Official landings have been extracted from the Ices Official Catch Statistics Web page (04May 2015) for "BSS" and area 8c, 9a and 9 (9 has been retained for Portuguese statistics because reported as 9a 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 and 2012)**

Table 15-2 : commercial landings in Iberian waters per country, gear and subarea

		landings 2016
Portugal	total IXa	565
	MIS_MIS_0_0_0	565
	total VIIIc	0
	Total Portugal	565
Spain	total IXa	165
	GNS_DEF_60-79_0_0	8
	GNS_DEF_80-99_0_0	0
	GTR_DEF_60-79_0_0	50
	LHM_DEF_0_0_0	3
	LLS_DEF_0_0_0	86
	MIS_MIS_0_0_0_HC	12
	OTB_DEF_>=55_0_0	0
	OTB_MCD_>=55_0_0	0
	PS_SPF_0_0_0	6
	total VIIIc	215
	FPO_CRU_0_0_0_all	0
	GNS_DEF_>=100_0_0	0
	GNS_DEF_60-79_0_0	7
	GNS_DEF_80-99_0_0	3
	GTR_DEF_60-79_0_0	38
	LHM_DEF_0_0_0	2
	LLS_DEF_0_0_0	139
	MIS_MIS_0_0_0	0
	MIS_MIS_0_0_0_HC	3
	OTB_DEF_>=55_0_0	0
	OTB_MPD_>=55_0_0	1
	PS_SPF_0_0_0	21
	PTB_MPD_>=55_0_0	0

16 Plaice in Subarea 8 and Division 9a

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 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 and 2016 catches, which were in the order of 10% and 2% of the French catches for 2015 and 2016. Portugal stated that the discards in the trawl fleet were 0% but no estimates are available for other gears. It is likely that discards are relatively minor but the WG cannot conclude that discarding is less than 5% of the catch.

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 since 2016.

Table 16.1: Plaice in Subarea VIII and Division IXa: official landings by country in tonnes (* 2015/16 provisional)

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
2016*	1	121	47	4	173

Table 16.2: Plaice in Subarea 8 and Division 9a: Catches submitted to intercatch (tonnes).

Catch category	Country	Gear	2014	2015	2016
Discards	France	Nets	-	10	3
		Other	-	2	0
		Trawl	-	4	0
	Spain	Nets	0	-	-
		Trawl	0	-	-
	Portugal	Trawl		0*	0*
Discards Total			0	15	3
Landings	Belgium	Other	1	2	1
	France	Nets	42	46	48
		Other	38	21	12
		Trawl	82	74	62
	Portugal	Other	47	44	47
	Spain	Nets	4	3	3
		Other	1	1	1
		Trawl	1	1	1
Landings Total			217	193	174
Catch Total			217	208	177
Official Landings			220	193	173

*** not in IC, submitted to AC**

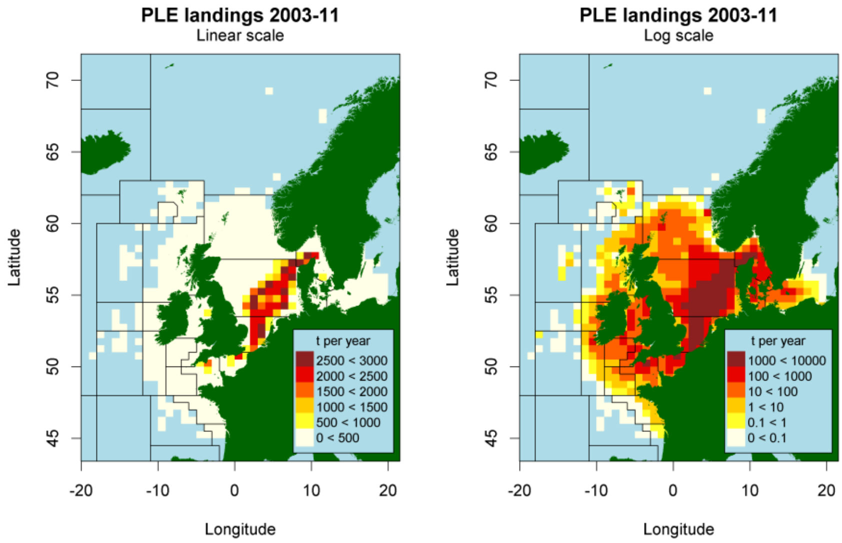


Figure 16.1: International landings of Plaice by statistical rectangle from 2003-2011

17 Pollack in Subarea 8 and Division 9.a

Pollack, *Pollachius pollachius*, is mainly exploited by France and Spain, with minor contribution to landings from UK and Portugal. In the last 17 years, France was responsible of 76% of commercial landings of the stock and Spain for the 19%. The official commercial landing statistics are given in table 17.1. A more detailed description of the fisheries and biology of the species are provided in the stock annex. 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 (*personal communication*). The corrected estimates of landings are presented by this WG in addition to the official landings in Table 17.1.

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. A new series of French landing data by gear from 2000 to 2014 is available from ROMELIGO project (WD 05, this report). As some differences between these data and official French data were found it is needed a review of the data before their integration to build a full time series of landings by gear for French fleets. Recreational catches may be considerable and have not been quantified.

Discard estimates are available from 2015 for the main fleets in Table 17.3. Most fleets did not report pollack in discards and for Spanish netters discards are considered negligible (less than 0.5% of catch). French netters discarded 4% and 11% of their catches in 2015 and 2016 respectively; those represented the 2% and 5% of the commercial catches of the stock.

In 2015 ICES advised that commercial landings should be no more than 1414 tonnes in each of the years 2016 and 2017.

The landings statistics do not show any remarkable changes. The available scientific data for the stock are not sufficient to evaluate the stock trends and exploitation status.

Table 17.1. Pollack in Subarea 8 and Division 9a: Official landings by country in tonnes (*2016 preliminary). The ICES estimate is based on a correction of mixed species (whiting and pollack) landings records in the Portuguese landings from 9a.

Year	Bay of Biscay (Subarea 8)				Iberian waters (Division 9.a)		Total	Unallocated	ICES estimates
	Belgium	Spain	France	UK	Spain	Portugal			
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	195	1244	37	78	18	1573	37	1610
2016*	0	186	1292	25	111	28	1642	19	1661

Table 17.2. Pollack in Subarea 8 and Division 9a: 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	0.2	0	1535
2016	735	128	399	30	185	87	26	28	0	0	1617

Table 17.3. Pollack in Subarea 8 and Division 9a: Discards (tonnes) from France, Spain and Portugal by country and gear as submitted to the working group.

Year	France			Spain		Portugal
	Nets	Trawl	Lines	Lines	Nets	Trawl
2015	28.1	-	-	0	3.5	0
2016	83.1	5.4	4.3	0	0.4	0

18 Whiting in Subarea 8 and Division 9a

Whiting (*Merlangius merlangus*) are caught in mixed demersal fisheries primarily by France and Spain (Table 19.1). There are concerns about the reliability of the French data from 2008-09, 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 19.1. 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 and 2016 are respectively 33% and 25% of the total French Catch weight (Table 19.2).

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 19.1 for information only. WGBIE does not propose to use these as a basis for the advice.

A Commercial abundance index is available from the Basque pair trawl fleet in 8.abd (Figure 19.2; 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 metier -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 19.3). It is not clear whether this is a separate stock from a biological point of view.

Table 19.1: Whiting in Subarea 8 and Division 9a: official landings in tonnes (*2015/16 provisional). The ICES estimate is based on a correction of mixed species (whiting and pollack) landings records in the Portugese 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
2016*	1	2441	20	40	2502	23	2525

*** preliminary**

Table 19.2 Whiting in Subarea 8 and Division 9a: landings submitted to intercatch (tonnes).

Catch cat	Country	Gear	2014	2015	2016
Landings	France	Lines	0*	539	807
		Nets	113*	234	419
		Other	561*	412	491
		Trawl	465*	955	736
	Portugal	Other	0	31**	0
		Trawl	0	2**	0
	Spain	Other	1	0	1
		Traw;	53	55	71
	Other	Other	1	2	1
	Total	land	1194	2231**	2525
ICES best estimate of the landings			1651	2199	2525
Discards	France	Lines	-	10	8
		Nets	-	141	282
		Other	-	313	294
		Trawl	-	597	245
	Total	dis	-	1060	828

*** probably incomplete (official landings: 1579)**

**** no correction for whiting/pollack species mis-identification**

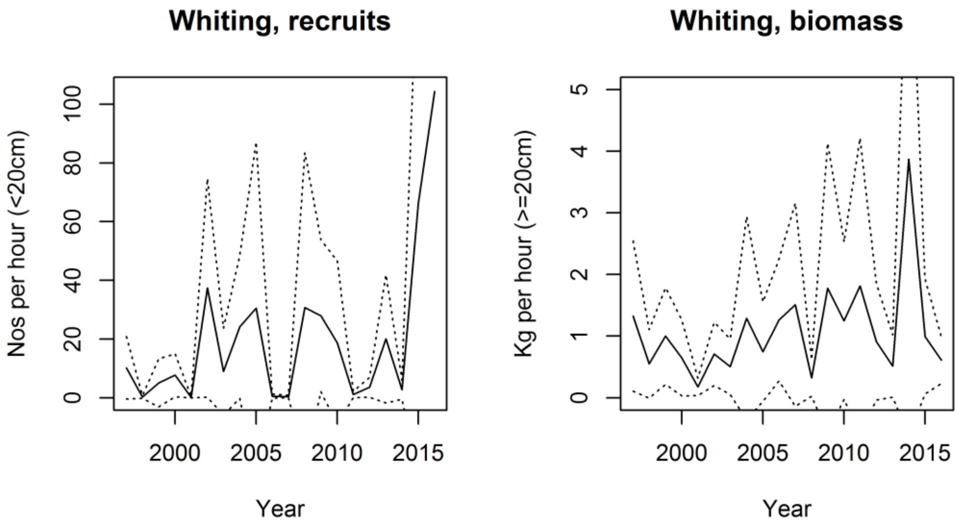


Figure 19.1. EVHOE-WIBTS-Q4 survey indices of recruitment (left) and biomass (right).

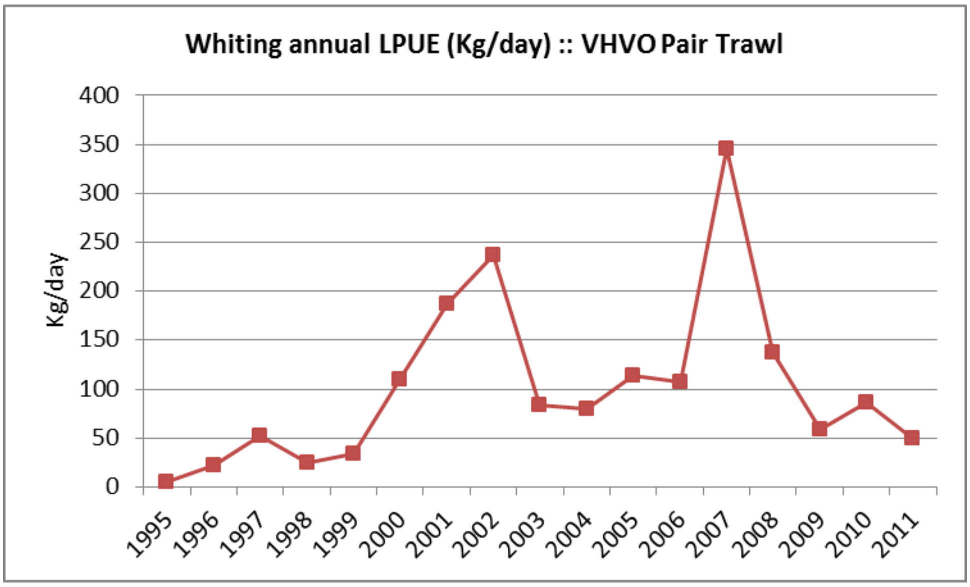


Figure 19.2. Whiting landings per unit effort (LPUEs in kg/day), by year, for basque pair bottom trawl fleet fishing in Divisions VIIIa,b,d, in the period 1995-2011.

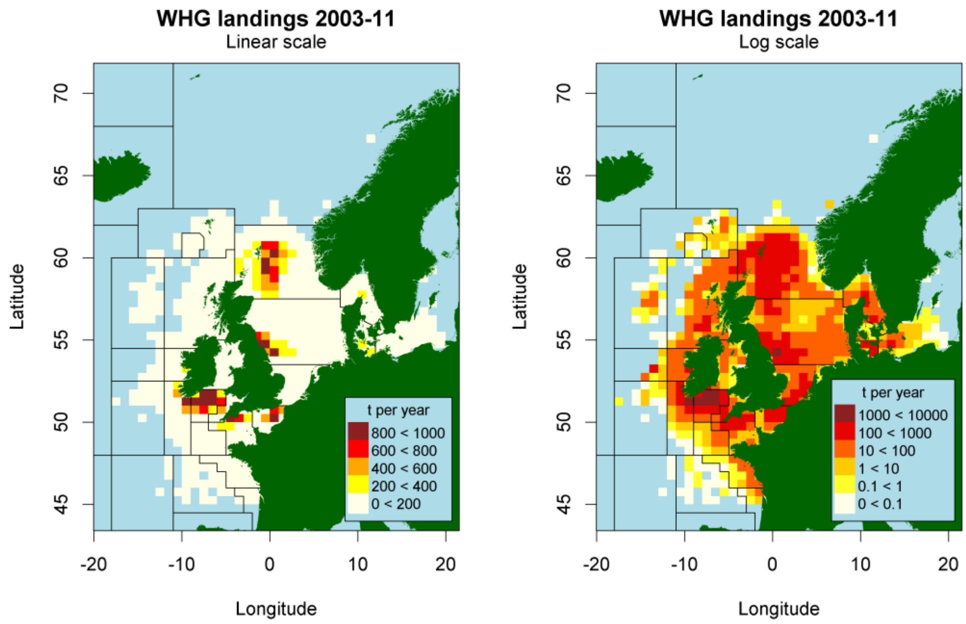


Figure 19.3: International landings of Whiting by statistical rectangle from 2003-2011

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Annex 1: List of participants

Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE) 4–11 May 2017

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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 repsonsibility of coordinating the international data from many countries and updating the assessment. The data are very complex and come with many 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 is that if they are no longer available the advice and assessement would not be easily updated. The EWG appeals to countries to nominate an additional person to share the responsibility of coordinating the data and updating the assesment for the provision of advice.	ICES Secretariat / ACOM
The EWG note that whiting and plaice 8c9a do not have a dedicated stock coordinator/assessor. So that progress can be made on these stocks the EWG appeals to countries to nominate someone to take on the responsibility for coordinating the data and updating/improving the assessment for the provision of advice.	ICES Secretariat / ACOM national labs
The EWG noted that some of the data submissions where revised after the data submission deadline, this included updating historical submissions which require more time to process and check. By submitting data after the deadline the data are not easily processed and this has the potential to effect the quality of the assessment. The EWG appeals to countries to submit data on time so that the stock coordinators have the time to process and check the new information in the appropriate time frame so that the most up to date information is used for the assessment and advice.	ICES Secretariat / ACOM national labs
As in previous year, this year the national labs submit revisions to survey and catch data after the deadline for submission and in some cases towards the end of the working group. This has implications on the quality of the assessment and impacts the subsequent advice. If there are revisions to data the EWG recommends that revisions be submitted prior to the data call deadline. The EWG also request that survey indices be included in the data call, due to the lateness of submission, until ICES is in a position to calculate them internally.	ICES Secretariat / ACOM
The EWG requests that working documents be submitted for review prior to the working group meeting if national labs submit revisions to survey data, catch data or have change raising/sampling methodologies. This will provide the working group with the necessary background to compile a history and audit trail of these changes.	ICES Secretariat / ACOM national labs
A working document was submitted and review by the EWG on methodology on the calculation of MSY reference points for *Nephrops*. The expert group recommends that these methods be review before the EWG adopts them for use in advice. It is also recommended that the workshop to review MSY reference points include the examination M and growth for use in these models.	ICES Secretariat/ ACOM

The EWG recommends that the directed sampling conducted in 2016 for *Nephrops* in FU 30, to improve length distributions, be continued.	National labs
For the proposed benchmarks the EWG recommend that countries which have landings for the stock are involved in the data submission, data evaluation and benchmark process.	ICES Secretariat / ACOM national labs

Annex 3: Terms of Reference for 2018

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

2017/2/ACOMXX The **Working Group for the Bay of Biscay and Iberian waters Ecoregion** [WGBIE], chaired by Lisa Readdy (UK), will meet in ICES HQ, Copenhagen, Denmark (tbc), 3–10 May 2018 (tbc) to:

a) Address generic ToRs for Regional and Species Working Groups;

b) Review and assess the progress on the benchmark preparation of hake stocks;

c) Address the data issue on the different megrim species in area 27.78.

d) Address the data and assessment issues of category 5 stocks.

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 6 April 2018 (tbc) according to the Data Call 2017.

WGBIE will report by XX May (tbc) 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
hke-soth_SA	Hake (Merlucciusmerluccius) in divisions 8.c and 9.a, Southern stock (Cantabrian Sea and Atlantic Iberian waters)	May-17	hke-soth_SA
ldb.27.7b-k.8abd_SA	Four spot megrim (Lepidorhombus boscii) in Divisions 7.b-k and 8.a,b,d	May-17	ldb.27.7b-k.8abd_SA
pol-27.89a_SA	Pollack in Subarea 8 and Division 9a	May-17	pol-27.89a_SA
bss.27.8ab_SA	Bay of Biscay Stock of Sea bass	May-17	bss.27.8ab_SA
anb-8c9a_SA	Southern black anglerfish (Lophius budegassa) in Divisions 8.c, 9.a	May-16	anb-8c9a_SA
ang-78ab_SA	Anglerfish (L. piscatorius and L. budegassa) in Divisions 7.b–k and 8.a,b,d	May-16	ang-78ab_SA
anp-8c9a_SA	Southern white anglerfish (Lophius piscatorius) (Divi-sions 8.c, 9.a)	May-16	anp-8c9a_SA
bss-8ab_SA	European sea bass (Dicentrarchus labrax) in subarea 8.a,b,d (Bay of Biscay)	May-13	bss-8ab_SA
bss-8c9a_SA	European sea bass (Dicentrarchus labrax) in subarea 8.c, 9.a	May-13	bss-8c9a_SA
gug-89a_SA	Grey gurnard (Eutrigla gurnardus) in Subarea 8 and Division 9.a	May-14	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-16	hke-nrtn_SA
mgw-78_SA	Megrim (Lepidorhombus whiffiagonis and L. boscii) in Divisions 7.b-k and 8.a,b,d	May-16	mgw-78_SA

mgw-8c9a_SA	Southern megrims (L. whiffiagonis and L. boscii), Division 8.c, 9.a	May-16	mgw-8c9a_SA
nep-2324_SA	Nephrops in Division 8.a,b, FU 23-24-	Oct-16	nep-2324_SA
nep-25_SA	Nephrops Division 8.c, FU 25 (North Galicia)	May-16	nep-25_SA
nep-2627_SA	Nephrops Division 9.a, FUs 26, 27 (West Galician and North Portugal)	May-16	nep-2627_SA
nep-2829_SA	Nephrops in Division 9.a, FU 28-29 (Southwest and South Portugal)	May-16	nep-2829_SA
nep-30_SA	Nephrops in Division 9.a, FU 30 (Gulf of Cadiz)	Oct-16	nep-30_SA
nep-31_SA	Nephrops in Division 8.c, FU 31 (Cantabrian Sea)	May-16	nep-31_SA
ple-89a_SA	Plaice (Pleuronectes platessa) in Subarea 8 and Division 9.a	May-14	ple-89a_SA
pol-89a_SA	Pollack (Pollachius pollachius) in Subarea 8 and Division 9.a	May-16	pol-89a_SA
sol-8c9a_SA	Sole in subdivisions 8.c and 9.a	May-14	sol-8c9a_SA
sol-bisc_SA	Sole in Division 8.a,b	May-16	sol-8ab_SA
whg-89a_SA	Whiting (Merlangius merlangus) in Subarea 8 and Division 9.a	May-16	whg-89a_SA

Annex 5: Benchmark planning

Stock	anb-78ab	anp-78ab
Stock coordinator	Joana Silva E-mail: joana.silva@cefas.co.uk	Agurtzane Urtizberea Ijurco E-mail: aurtizberea@azti.es
Stock assessor	Joana Silva E-mail: joana.silva@cefas.co.uk	Agurtzane Urtizberea Ijurco E-mail: aurtizberea@azti.es
Data contact	Joana Silva E-mail: joana.silva@cefas.co.uk	Agurtzane Urtizberea Ijurco E-mail: aurtizberea@azti.es

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
Landings	High	Time series of landings available to the WG change frequently from year to year in terms of their fleets and Intercatch data available. Aim would be to standardise the datasets to meaningful fleet/metiers.	Compile time series data (ideally after 1996, but if not possible then a consistent data set from 2009)	Required: Landings by fleet, area, quarter, if possible documentation to explain the caveats of the time series and any issue that may be relevant to provide the WG the best available information on how to aggregate fleets/metiers to a more appropriate level for the assessment and also representative of the national fishing activities. Available: Yes From: national labs
Landings	Low	Landings before 1996	Compile data (Unlikely to get useful data)	Required: landings by fleet, area, quarter Available: unknown From: national labs

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
Landings length data	High	Poor quality data, with different levels of aggregation in terms of length class bins. Aim would be to have 1 cm length group and review the length split for recruitment and to check any trend of fish length landed.	Compile time series data (ideally after 1996, but if not possible then a consistent data set from 2009). Review the length split for recruitment to make sure is consistent and currently meaningful.	Required: Landings length data by fleet, area, quarter by 1 cm length group. Available: Yes From: national labs
Landings	Low	Historic underreporting. To provide the assessment models landings uncertainty.	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
Discards	Medium	Discard levels unknown and may have changed due to minimum landing weight. Again similar issues to landings the data are for different years aggregated differently which makes it difficult to assess a trend in the proportion discarded.	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
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

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
Species split	Medium/high	Quality of species allocation of mixed landings to L pis and L bud is unknown. For some countries unallocated landings data are estimated by the WG but national countries are better placed to inform on how the split of those data should be. Check any trend on species split to inform if landings may favour more one species.	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 Effort and LPUE data. Aim to have for the time series a meaningful and reliable Effort and LPUE data as current fleets are not included.	Develop Effort and 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. Standardisation of Effort and LPUE to make it easier to compare different fleets within countries and between countries.	Data: Effort and LPUE, documentation from national labs to inform any changes in the commercial fleet over time. 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. Some surveys may cover different parts of the stock and although may end up not being used for assessment, may still provide information on the stock status.	Collate available survey data that may be informative for these stocks.	Data: list of surveys and raw data if not available online, including catch, length and age information. Further documentation on procedures of data collection and caveats concerning both species. 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

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
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?
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

Convergence	Sensitivity of assessment, poor convergence to starting parameter values	Explore sensitivity, identify sensible parmeters and check changes in likelihoods	No data needed

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)

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
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.

Issue	Priority	Problem/aim	Work needed	Data required. Are these available? Where should they come from
	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

Stock	Northern Hake	
Stock coordinator	Name Dorleta Garcia	E-mail: dgarcia@azti.es
Stock assessor	Name: Dorleta Garcia	E-mail: dgarcia@azti.es
Data contact	Name: Dorleta Garcia	E-mail: dgarcia@azti.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
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 or Fr)	Someone who carry outs the CPUE standardization and makes it available to be used in the group
Interannual variability in Biological Parameters	Length weight relationship and maturity are constant in the assessment	Collect the data available in different laboratories, analyze the variability over time and include the new data into SS3 if considered neccesary.	Weigth at length and maturity at length over years.	
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)	Weigth at length and maturity at length by sex over years. And sex ratio. Explore literature about life history in other hakes.	
Reproductive potential	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.	Biology/reproduction experts (Maria Korta)

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	Rick Methot/Jim Ianelli/ Daniel Howel
Disaggregation of OTHERS fleet	OTHERs fleet correspond with all the fleets fishing in areas outside 7 and 8abd. It represents a 30% of the catch and it includes vessels operating with different gears. The selection pattern	Dissagregation of the data by gear, put it in the rigth shape to be included in SS3. Adapt the model settings to the new information in order to get a correct fit to the data.	Landings and Discards length distributions over years. There is some data available in Intercatch but if longer series available at the labs it would be useful to get it.	National experts of Denmark, Scotland and Norway
Inclusion of North Sea Surveys	No abundace indices are included for the northern part of the stock	Compilation of the available data in SS3 format. Adapt the model settings to the new information in order to get a correct fit to the data.	Length distribution of the indices over the years and the total index in biomass.	An expert on North Sea demersal surveys
Growth	Since 2013 the model is not able to estimate the growth internally. The growth was fixed to the parameters estimated by the model in 2011.	Try to used the existing data to estimate the growth outside the model.	French tagging data from France,	
Add New Discard Data	25% of the discards are not included in the model	Include all the discards from Gill-netters and TrawlOTH fleet to the model. Adapt the model settings to the new information in order to get a correct fit to the data.	Some data already available in intercatch. Not sure if there is more available regarding TRAWLOTH fleet.	An expert from french that knows the data available and the fishery.
More Precautionay SSB reference points	The review group in 2016 (U.Maine) highligth that the biomass reference points were too low in comparison with the current stock level.	Think on alternatives to current biomass reference points.		

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
Recruitment Environment relatioship	The review group in 2016 (U.Maine) suggest to relate recruitment with environmental variables.	Statistical analysis of available data	Get environmental data from existing data bases.	
Exchange between stocks	The review group in 2016 (U.Maine) suggest to analysze the exchange between both hake stockst.	Revise existing knowledge and data.	Tagging and genetic data.	
Biological credibility of model outcomes	The current model estimates that for more than 20 years the catch was in the order of 80% of the total biomass and about 130% of the SSB. Some work is needed to see if this biologically possible or whether it indicates a problem with the model.	Some simple modelling of stock productivity.	Estimates of growth and Natural mortality	Modlelling of stock productivity

Annex 6: List of Working Documents

WD 01 Survey indices

Hans Gerritsen

Survey data for black and white anglerfish were extracted from DATRAS for the Spanish porcupine survey (SpPorc), the Irish GroundFish Survey (IGFS) and the French EVHOE survey. The sample weights were checked against the expected weights estimated from length-weight parameters and excessive raising factors (from sample to catch weight) were checked.

Indices were calculated for each survey series using all valid hauls and ignoring the spatial stratification. A combined index for the three survey series was also calculated using the spatial coverage (survey area in km2) as weights. The Spanish survey was also down weighted because it was estimated to be 50% more efficient at catching anglerfish than the Irish and French surveys(catches per hour fished); this was based on a comparison of anglerfish catches in the area where the Spanish and Irish surveys overlap. No difference was found between the Irish and the French surveys in the area where they overlap.

WD 02 Preliminary results from length frequency analysis of *Lophius piscatorius* in divisions 7.b-k, 8.a-b and 8.d

Luke Batts, Cóilín Minto, Hans Gerritsen

Much work has been conducted on European anglerfish (*Lophius piscatorius* and *Lophius budgassa*) life history traits over the years and much of this has focused on growth patterns (Farina et al.,2008). These studies have predominantly used calcified structures with annual rings to age fish and produce growth estimates, however there has been well documented difficulties with aging anglerfish this way (Woodroofe et al., 2003; Farina et al., 2008). A notable exception in recent years to this method of growth estimation was part of Landa et al.'s (2013) study, where by using modal progression analysis on length frequency distributions over a number of years they were able to track a cohort of *Lophius piscatorius* through eight successive years of the Spanish Porcupine Bank survey. Thus providing support for the aging by illicia that had also been conducted in the study.

Fisheries surveys are an important aspect of fisheries research and offer fishery independent estimates of abundance and structure of fish populations. Length frequency distributions from surveys have been used across many marine species to produce growth estimates. With this in mind this work has looked at using mixture models to estimate modes of cohorts across years and surveys. The intention is to both estimate credible growth parameters, as well as explore the differences between surveys and the possibility of combining them.

WD 03 White anglerfish (*Lophius piscatorius*): weight-length relationships, weight conversion factors and somatic indices from two stocks in north-eastern Atlantic waters (ICES Div. 8.c-9.a2 and Div. 7.b,c,h,j,k)

Landa, J, Antolínez, A, Castro, B, Hernández, C

Weight-length relationships, weight conversion factors and somatic indices are presented from a decade (2006 to 2015) for two stocks of *Lophius piscatorius* in northern Iberian Atlantic waters (ICES Div. 8.c-9.a2) and in Celtic Sea, south-western Ireland and Porcupine Bank (Div. 7.b,c,h,j,k). A total of 7219 specimens (3596 and 3623 respectively in each stock) were sampled from commercial landings and research surveys. Total length (Lt), total weight (Wt), "commercial" weight (Wgl) and "scientific" weight (Wg) were obtained. The parameters (a, b) in the power relationships weight-length for combined sexes were:

Lt = 0.025 Wt2.853; Lt = 0.020 Wgl2.868; Lt = 0.024 Wg2.861 in Div. 8.c-9.a2;

Lt = 0.027 Wt2.826; Lt = 0.023 Wgl2.825; Lt = 0.023 Wg2.816 in Div. 7.b,c,h,j,k.

Significant differences between stocks were found. The conversion factors between total and gutted weight were: Wt = 1.181 Wgl; Wt = 1.241 Wg in Div. 8.c-9.a2;

Wt = 1.210 Wgl; Wt = 1.262 Wg in Div. 7.b,c,h,j,k.

The parameters can be used in the process of annual assessment of the state of each stock. Gonadosomatic index (GSI), hepatosomatic index (HSI) and Le Cren's condition factor, indicators of reproductive and nutritional status, were seasonally analysed and compared between sexes and stocks. Significant better condition and higher GSI and HSI were found in mature females. Specimens in Div. 7.b,c,h,j,k showed better condition and higher GSI. The parameters obtained were compared with those from previous studies, showing similarities.

WD 04 Coexistence Nephrops/Munida. Explorations from the UWTV survey data on the FU23-24 *Nephrops* stock.

Spyros FIFAS, Michèle SALAUN, Jean-Philippe VACHEROT

Correction factors for the edge effect and for the detection rate have been accurately estimated for the Bay of Biscay *Nephrops* on the years' 2014-2016 UWTV surveys. The present WD involves in the coexistence between Norway lobsters (*Nephrops norvegicus*) and squat lobsters (*Munida* sp.) and a certain capacity of the second species to colonise *Nephrops* burrows affecting by this way the correction factor of the "species identification". The analysis involved in the UWTV data advantaged because of continuous recording on 24h/24. Additionally, information provided by experimental trawling (only for years 2014 and 2015) was also included in this study. Video allows to investigate the basic differences of dial activities for both species: *Nephrops* is active during a more restrictive time interval within a day whereas the activity of *Munida* is more widely spread on 24 h.

WD 05 ROMELIGO: Improvement of the fishery knowledge of striped red mullet, whiting and pollack of the Bay of Biscay (Pollack)

Jean-Pierre Léauté[1], Nathalie Caill-Milly[2], Muriel Lissardy[2]

Striped red mullet (*Mullussur muletus*), whiting (*Merlangius merlangus*) and pollack (*Pollachius pollachius*) are three species for which individualization of stocks is advanced by ICES in western Europe for areas including the Bay of Biscay and the areas bordering the Iberian Peninsula. Since2012, ICES has provided recommendations with regards to these stocks. These recommendations are given for two-year periods and are based on an approach adopted by ICES in 2012 in the case of insufficient data for an analytical evaluation (Data Limited Stocks, DLS). For 2013 and 2014, ICES recommended reducing catches by 20% as a precautionary measure compared to 2009-

2011for the three stocks. Considering that TACs are in force for whiting and pollack in the Bay of Biscay, the lack of diagnosis and the application of a precautionary approach could result in reductions in French fishing possibilities. Rapid improvement of the data available for stocks in the DLS category is therefore a priority.

This project aims to change this situation by contributing to the improvement of the knowledge on these three stocks on the basis of the available data (declaring landing data or sampling data for French fishermen, data from scientific campaigns, etc.) or data to be collected (biological parameters).

WD 06 ROMELIGO: Improvement of the fishery knowledge of striped red mullet, whiting and pollack of the Bay of Biscay (Whiting)

Jean-Pierre Léauté[1], Nathalie Caill-Milly[2], Muriel Lissardy[2]

Striped red mullet (*Mullussur muletus*), whiting (*Merlangius merlangus*) and pollack (*Pollachius pollachius*) are three species for which individualization of stocks is advanced by ICES in western Europe for areas including the Bay of Biscay and the areas bordering the Iberian peninsula. Since 2012, ICES has provided recommendations with regards to these stocks. These recommendations are given for two-year periods and are based on an approach adopted by ICES in 2012 in the case of insufficient data for an analytical evaluation (Data Limited Stocks, DLS). For 2013 and 2014, ICES recommended reducing catches by 20% as a precautionary measure compared to 2009-2011 for the three stocks. Considering that TACs are in force for whiting and pollack in the Bay of Biscay, the lack of diagnosis and the application of a precautionary approach could result in reductions in French fishing possibilities. Rapid improvement of the data available for stocks in the DLS category is therefore a priority.

This project aims to change this situation by contributing to the improvement of the knowledge on these three stocks on the basis of the available data (declaring landing data or sampling data for French fishermen, data from scientific campaigns, etc.) or data to be collected (biological parameters).

WD 07 Updated model for Harvest Ratio estimation for *Nephrops* stocks: WKNEP concerns “fixed”!?

WKNep ended up rejecting the previous length-cohort approaches to estimating MSY harvest rates for *Nephrops* stocks on the basis that there was a discrepancy between the population sizes estimated by the fits compared to the observed TV populations. There are a number of reasons why there could be such a discrepancy including non-stationarity of fishing mortality or recruitment as well as deviation from the assumption of sigmoid selection.

Following discussions at WGNSSK around these issues, a revision to SCA has been produced which allows for domed selection patterns to be estimated. Fits of Jones LCA models undertaken at WKNEP support the hypothesis of a domed selection pattern for both of these FUs. Initially I thought that this would over-parameterise the model, however as you will see later, this does not seem to be the case.

WD 08 Study and assessment of the Bay of Biscay *Nephrops* on the basis of UWTV survey

Spyros FIFAS, Mathieu WOILLEZ, Michèle SALAUN, Jean-Philippe VACHEROT

The UWTV survey "LANGOLF-TV" conducted since 2014 demonstrated the technical feasibility of such a survey in the local context and identified the necessary competences and equipment for its sustainability. The sampling design is based on a systematic grid. During the first two years, 2014 and 2015, video sampling was associated to a trawl one for the purpose of providing *Nephrops* LFDs by sex and estimating the proportion of other burrowing crustaceans (mainly *Munida*) which can induce bias in the burrows counting. In 2016, an additional area contained in the outline of the Central Mud Bank no belonging to any sedimentary stratum was sampled: this area known as not trawled due to rough sea bottom is crossed by muddy channels concentrating a moderate fishing effort vs. *Nephrops*. Investigations on the basis of stratified statistical estimators as well as on geostatistics were carried out and examined by WKNEP 2016 which validated the UWTV approach.

WD 09 Benchmark workshop on *Nephrops* stocks (WKNEP 2016): Results and conclusions for *Nephrops* FU 30 (Gulf of Cadiz)

Vila, Y and González Herráiz, I

The Norway lobster, *Nephrops norvegicus* is a one of the main commercial crustaceans exploited by a unique and highly multispecific bottom trawl fleet in the Gulf of Cadiz (OTB_MCD>=55_0_0) targeted to a variety of demersal species including hake, rose shrimp, cuttlefish, squids, octopus, wedge sole, mullet, sparids, prawns and others (Silva et al., 2007; Castro et al., 2007). *Nephrops* landings are clearly seasonal with high values from April to September. Discarding of *Nephrops* is negligible in this fishery. Despite annual catches of *Nephrops* are small compared with other Atlantic *Nephrops* stock (≈100 t annually in 2009-2013 periods), this species gives valuable revenues for the trawl fleet.

WD 10 Information regarding fishing for *Nephrops Norvegicus* (Norway lobster) in Galicia (FU 25)

Fernández, R., Teixeira, T., Corrás, J.

The Galician coast has historically been very productive in terms of catching *Nephrops norvegicus* (hereinafter referred to as *Nephrops*), with fishing trawlers operating on a number of sandy areas of the seabed. As a result of several significant environmental disasters *Nephrops* populations in some of these areas have collapsed, drastically reducing catch sizes.As the trawling process is carried out in contact with the seabed, it has assisted in the recovery of some of these areas; for example, following the collapse of the Bens landfill site, the seabed was inundated with plastic bags, and trawling equipment is gradually helping to eliminate these items from the affected area. *Nephrops* quotas recommended by the ICES (International Council for the Exploration of the Sea)for the 8.c Division, have been progressively reduced until a TAC (Total Allowable Catch)of zero was approved for 2017 (this recommendation being effective for 3 years).Fishing for *Nephrops* in Galician waters is not monospecific, and in many cases these crustaceans constitute by-catch acquired during mixed demersal trawling, and are caught in addition to hake, monkfish, dory, cuttlefish, mackerel, octopus, dogfish, lobster, etc .Throughout the year, fishing for *Nephrops* is carried out in a specific area of Functional Unit 25(hereinafter FU 25) by approximately 10 boats, although the most prolific months in terms of catch size are from May to August. In 2016 *Nephrops* constituted 3.78 % of the catch from all landings (increasing from 1.45 % in 2015). In recent years, we have observed signs of recovery in stocks of *Nephrops*, with an increase in CPUE (Catch per unit of fishing effort) from 6.46kg/hour in 2015, to 10.81 kg/hour in

2016. This increase in CPUE was also observed in the historical series used by ICES for 2014 and 2015 (2014: 4.5 kg/trip, 2015: 9.3 kg/trip). It is of vital importance to keep these fishing grounds open so that the fishing trawlers can continue operating on the sandy areas of the seabed and facilitate the gradual recovery of the FU 25fishing zone, (in better condition than other Functional Units of the Cantabrian zone).

WD 11 Results on most relevant commercial species captured in the bottom trawl surveys on the Northern Spanish Shelf

M. Blanco, S. Ruiz-Pico, O. Fernández-Zapico, A. Punzón, I. Preciado, F. Velasco

This working document presents the results on the most relevant commercial species captured in the Spanish Groundfish Survey on Northern Spanish shelf in 2016.Biomass, distribution and length distributions are analysed for European hake (*Merluccius merluccius*), four-spot megrim (*Lepidorhombus boscii*), megrim(*Lepidorhombus whiffiagonis*), black anglerfish (*Lophius budegassa*), whiteanglerfish (*Lophius piscatorius*), and Norway lobster (*Nephrops norvegicus*). The presence of some other scarcer species assessed within the WGBIE. Hake abundance decreased from last year, nevertheless it keeps on being on the high values on the last years. Four spotted megrim showed scarce abundance and poor recruitment, though there is a small signal of recruitment on the Galician shelf. Northern megrim presented high abundances for the second year in a row, the recruitment was the best of the series, only slightly higher than in 2015. Both species of angler showed poor abundances, being slightly higher in number than in 2015 for *L. budegassa*. Recruitment of both species was also poor. Norway lobster keeps on being at very low values in all the Cantabrian and Galician shelves. Results of some very scarce species assessed within the WGBIE are also presented, namely sole, seabass, whiting and pollack.

WD 12 A spatial stock assessment model for European hake (Northern stock)

Audric Vigier, Stéphanie Mahévas, Michel Bertignac

Presentation to the EWG on the progress made towards a spatial assessment of the northern stock of hake. The spatial model using the stock synthesis frame work incorporates three areas; Bay of Biscay, Celtic Sea and Southwest Scotland and North Sea. The Spatial dynamics also include recruitment and migration between the three areas.

WD 13 Nephrops (FU 30) UWTV Survey on the Gulf of Cadiz Grounds.

Vila, Y., Burgos, C., and Soriano, M.

Underwater television surveys to monitor the abundance of *Nephrops* populations were pioneered in Scotland in early 90's. The estimation of Norway lobster abundances using UWTV systems involves identification and quantification of burrow density over the known area of *Nephrops* distribution. This can be used to produce a raised abundance estimate for the stock. In last decade, this technique has received detailed attention in a series of ICES workshops aimed at standardising methodologies and quantifying the uncertainties associated with the method (ICES, 2007; ICES, 2008; Campbell et al., 2008). A direct approach of using the UWTV surveys as the basis for catch advice by applying harvest ratios (HRs) was proposed in 2007 (Dobby at al., 2007; ICES, 2007). Currently, ICES considers this methodology as the most appropriate, and suggests that, the so-called UWTV surveys can be used in order to obtain an absolute estimate of the biomass of Norway lobster and it can be use as the basis of the scientific advice according WKNEPH 2009 (ICES, 2009). Thus, UWTV surveys have been extended to many stocks in Atlantic waters and Mediterranean Sea resulting in about 18 stocks prospected with these surveys in 2014.

WD 14 Hake natural mortality estimation based on multispecies model and longevity.

Santiago Cerviño and Camilo Saavedra.

Natural mortality usually set as a constant at time and age (or length) for assessment purposes. However it is well known that M varies on time (for instance depending on predation abundance) or age (or length). Changes in M at age (or size) are dependent on life history processes like growth (small fish has more potential predators) or maturity process that triggers senescence. The objectives of the current work are to present a method that combines two different approaches to estimate a thorough variable M-at-age: (1) a multispecies model that provides a combination of M1 and M2 mortality coming from predation and (2) the known relationship between longevity (tmax) and M, which is further extended to explain how it relates with variable M-at-age and how can it be used to select the best M1 in an multispecies model. The final selected M-at-age was implemented in the single species model and the fit quality compared between constant and variable M-at-age. The model likelihood shows that the hake model with variable M improves the current likelihood assessment model in a 12%. Even with all the uncertainties around the estimated M, it seems like a promising way to produce a variable M-at-age for assessment purposes.

Annex 7: Stock Data Problems

Stock Data Problems Relevant to Data Collection – WGBIE

STOCK	DATA PROBLEM	HOW TO BE ADDRESSED IN	BY WHO1
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.

[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	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. Number of samples and fish measured in the market sampling and observer national programmes upload to Intercatch giving misleading information for some countries as it provides repeated data for the each length category which makes difficult to assess the total numbers sampled. Number of samples and fish measured in the market and observer programmes for France are only preliminary as their quality checks were more drastic than previously and questionable samploes were not included. Ask countries to make sure any QA/QC procedures are done on time for data call so data available are the best estimates possible to avoid reviewing every year. 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

STOCK	DATA PROBLEM	HOW TO BE ADDRESSED IN	BY WHO1
anb-78	Survey data	EHVOE survey time series (1997-2016) recruitment index, length frequency and spatial distribution maps changed and provided during the EG meeting. Ask countries if there are any changes on the time series provided for the index, length frequency and spatial distribution maps to produce and make available to the working group documentation prior to the EG meeting. 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. Number of samples and fish measured in the market sampling and observer national programmes upload to Intercatch giving misleading information for some countries as it provides repeated data for the each length category which makes difficult to assess the total numbers sampled. Number of samples and fish measured in the market and observer programmes for France are only preliminary as their quality checks were more drastic than previously and questionable samploes were not included. Ask countries to make sure any QA/QC procedures are done on time for data call so data available are the best estimates possible to avoid reviewing every year. 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 time series (1997-2016) recruitment index, length frequency and spatial distribution	National laboratories

Stock	Data Problem	How to be addressed in	By who1
		maps changed and provided during the EG meeting. Ask countries if there are any changes on the time series provided for the index, length frequency and spatial distribution maps to produce and make available to the working group documentation prior to the EG meeting. Ask countries to ensure survey data are QA/QC before submission and submitted accordingly before the data call deadline.	
Hke-nrth	Different length distribution aggregation	Ask countries to resubmit data at the appropriate aggregation level	National laboritories
Hke-nrth	Historical revisions	An historical data revision was made just before the working group. Due to time restrictions it was not possible to include this revision in the assessment. Future revisions should be submitted well in advance to the data submission deadline to be able to include the changes on time.	National laboritories
Hke-nrth	Incorrect Data in Intercatch	The data in Intercatch for some countries and years is incorrect. The data submitters should check that all the data in Intercatch is correct to avoid future problems.	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

Stock	Data Problem	How to be addressed in	By who1
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

Annex 8: *Nephrops* in FU 30 (Gulf of Cadiz)

Nephrops FU 30 was benchmarked in October 2016 (ICES, 2016). The UWTV Surveys based Approach was proposed as the model to generate catch options in FU30. The group considered in detail three points:

1. Technology of the survey, including correction for edge effects, detection rate, species identification, etc.;
2. Distribution area and coverage;
3. Derivation of a recommended harvest ratio.

Regarding to the first two bullet point evaluated, the UWTV survey based assessment in FU30 as described in the stock annex is appropriate for providing scientific advice on the abundance of this stock. However, when attempting to derive reference points, with what is deemed to be an accepted method for such stocks, unexpected problems were uncovered that could not be solved in the meeting.

The large differences found between the abundance estimate derived from SCA model and the abundance estimated from the UWTV lead high harvest rates and as consequences recommends catches much higher than the obtained historically in the fishery. The problems could be amended to a variable extent in numerous ways, but in particular by increasing the natural mortality in the SCA model, which again would have an impact on the reference points and subsequently on the harvest rate to be recommended.

WKNEP and reviewers concluded that for deriving reference points, and hence translate the stock abundance estimate to recommended removals, the common length based yield per recruit method is not appropriate for this stock. The reviewers agreed that deriving harvest rates from historical experience and from experience with similar stocks, as suggested by WKNEP is acceptable as an interim solution, until a firmer basis for generating advice from UWTV survey abundance estimates can be developed. A gradual transition towards higher TACs was recommended, but the exact design of such a regime would have to consider economic and social aspects that are outside the remits of the benchmark group.

In May during WGBIE 2017, *Nephrops* FU 30 was presented as a category 1 stock and the assessment on the basis the UWTV survey based approach according to the WKNEPS. However, ADGNEP agreed in October 2017 that in absence of stock specific MSY harvest rate in *Nephrops* FU 30 because of the poor fits in length-frequency model, normally used for calculating F_{MSY} for category 1 in *Nephrops* stocks, the basis of advice for this stock should follow the category 4 approach for Norway lobster stocks and not category 1.

On the basis of ICES precautionary approach, the harvest rate used as the basis of the advice was obtained from the average catch number in 2010–2012 divided by the average UWTV abundance estimates from 2015–2017. Because of the restrictions imposed on the fishery during the years 2013–2015, the previous period to this was used to estimate a harvest rate. This harvest rate corresponds to 1.16%, which is well below the range of maximum sustainable yield (MSY) harvest rate in all other FUs, and so can be considered conservative.

In same sense, the mean weight in 2013–2015 period was relatively high and was not considered representative, so instead this, the 2016 data was used in the calculations of the catch advice.

ADGNEP suggested that if stock specific FMSY reference points can be estimated, *Nephrops* FU 30 will meet the requirements for category 1 assessment.

Table below shows the basis for catch options for 2018 for *Nephrops* FU 30.

Variable	Value	Source	Notes
Stock abundance	371 million individuals	ICES (2017)	UWTV survey 2017
Mean weight in landings	23.20 g	ICES (2017)	Data 2016
Mean weight in discards	-	ICES (2017)	Not relevant
Discard rate	0%	ICES (2017)	Negligible
Discard survival rate	-	ICES (2017)	Not relevant
Dead discard rate	0%	ICES (2017)	Negligible