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

3-10 May 2018

ICES HQ, Copenhagen, Denmark

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Executive Summary

The ICES Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE) met at ICES headquarters in Copenhagen, Denmark during 3–10 May 2018. There were 18 participants assessing the status of 23 stocks distributed from ICES Divisions 3.a–4.a though mostly distributed in Sub Areas 7, 8 and 9. 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 ten stocks and provide a first draft of the ICES advice for 2018 for fourteen stocks, three 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 northern stock of white anglerfish, 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 the European seabass in the Bay of Biscay. Analytical assessments for the black angler fish in ICES Area 7 and divisions 8.a.b,d,e 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, where available.

All four anglerfish stocks and European seabass in the Bay of Biscay were benchmarked and category assessment methods have been agreed with the exception of the black anglerfish in ICES Area 7 and divisions 8.a,b,d,e. The two stocks of hake were reviewed assessing the progress made towards addressing the issues identified in preparation for a future benchmark (see Annex 5) together with the longer-term benchmarks (2020 and after, see section 1.) particularly for the *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, simulated sample data for several stocks were submitted to ICES and notification of this was not presented until the working group began. As the assessments carried out in National Laboratories are completed prior to the meeting as mentioned in the ToRs, it was not possible to assess the impact of such simulated data on the assessment and forecast. **This is an important matter of concerns for the group members**.

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

1 Introduction

1.1 Participants

Name	Country
Esther Abad	Spain
Ricardo Alpoim	Portugal
Santiago Cerviño	Spain
Anne Cooper	ICES Secretariat
Mickael Drogou	France
Spyros Fifas	France
Dorleta Garcia	Spain
Hans Gerritsen	Ireland
Agurtzane Urtizberea Ijurco	Spain
Ane Iriondo	Spain
Muriel Lissardy	France
Sarah Louise Miller	ICES Secretariat
Teresa Moura	Portugal
Lisa Readdy	UK (Chair)
Paz Sampedro	Spain
Cristina Silva	Portugal
Yolanda Vila	Spain
Ching-Maria Villanueva	France

Contact details for each participant are given in Annex 1.

1.2 Terms of Reference

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

2018/2/ACOM12 The Working Group for the Bay of Biscay and Iberian Waters Ecoregion (WGBIE), chaired by Lisa Readdy (UK), will meet in Copenhagen, Denmark, 3–10May 2018to:

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) Estimate MSY proxy reference points for the category 3 and 4 stocks in need of new advice in 2018:

i) Update the MSY proxy reference points for those classified as category 3 and 4 stocks with existing proxy reference points using most recent data. For those stocks without reference points listed below, collate necessary data and information in order to estimate MSY proxy reference points prior to the Expert Group meeting. The official ICES data call included a call for length and life history parameters for each stock in the table below;

Stock code	Stock name description	EG	Data Category
ank.27.78abd	Black anglerfish (*Lophius budegassa*) in subarea 7 Divisions 8.abd (Celtic Sea and Bay of Biscay).	WGBIE	3.2
nep.fu.30	Norway lobster (*Nephrops norvegicus*) in Division 9.a, Functional Unit 30 (Atlantic Iberian waters East and Gulf of Cadiz)	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 for the meeting must be available to the group on the dates specified in the 2018 ICES data call.

WGBIE will report by 25 May 2018 for the attention of ACOM.

Fish Stock	Stock Name	Stock Coordinator	Assess. Coord. 1	Assess. Coord. 2	Advice
anp.27.78ab	Anglerfish (*Lophius piscatorius*) in Subarea 7 andDivisions 8.a,b.d	Ireland	Spain	none	Update
anb.27.78ab	Anglerfish (*L. budegassa*) in Subarea 7 and Divisions 8.a,b,d	Spain	Ireland	none	Update
anb.27.8c9a	Anglerfish (*L. budegassa*) in Divisions 8.c and 9.a	Portugal	Portugal	Spain	Update
anp.27,8c9a	Anglerfish (*L. piscatorius*) in Divisions 8.c and 9.a	Spain	Spain	Portugal	Update
bss.27.8ab	Seabass in Divisions 8.a,b	France	France	none	Update
bss.27.8c9a	Seabass in Divisions 8.c and 9.a	France	France	none	Saly
hke.27.3a46-8abd	Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock);	Spain	Spain	none	Update
hke.27.8c9a	Hake in Division 8.c and 9.a (Southern stock);	Spain	Spain	Portugal	Update
mgb.27.8c9a	Megrim (*Lepidorhombus boscii*) in Divisions 8.c and 9.a	Spain	Spain	none	Update
mgw,27.8c9a	Megrim (*Lepidorhombus whiffiagonis*) in Divisions 8.c and 9.a	Spain	Spain	none	Update
mgb.27.78	Megrim (*L. boscii*) in Subarea 7. & Divisions 8.a,b,d,e	Ireland	Ireland	None	Update
mgw.27.78	Megrim (*L. whiffiagonis*) in Subarea 7. & Divisions 8.a,b,d,e	Spain	Spain	none	Update
sol.27.8ab	Sole in Divisions 8.a,b,d (Bay of Biscay)	France	France	none	Update
ple.27.89a	Plaice in Subarea 8. and Division 9.a	none	none	none	Saly
whg.27.89a	Whiting in Subarea 8. and Division 9.a	none	none	none	Saly

pol.27.89a	Pollack in Subarea 8. and Division 9.a	Spain	Spain	none	Saly
sol.27.8c9a	Sole in Divisions 8.c and 9.a	none	none	none	Saly
nep.fu.2324	*Nephrops* in Divisions 8.a,b (Bay of Biscay, FU 23, 24)	France	France	none	Update[1]
nep.fu.25	*Nephrops* in North Galicia (FU 25)	Spain	Spain	none	Saly
nep.fu.31	*Nephrops* in the Cantabrian Sea (FU 31)	Spain	Spain	none	Saly
nep.fu.2627	*Nephrops* in West Galicia and North Portugal (FU 26-27)	Spain	Spain	Portugal	Saly
nep.fu.2829	*Nephrops* in Southwest and South Portugal (FU 28-29)	Portugal	Portugal	Spain	Saly
nep.fu.30	*Nephrops* in Gulf of Cadiz (FU 30)	Spain	Spain	Portugal	Update[1]

1. Update assessment due in October 2018

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 69% of total stock landings. The TAC for both species combined was set at 42 496 t for 2017 and 2018. Since 2002 the landings of both species combined have been above the average of the timeseries.

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 assessments were based on examining commercial LPUEs and survey data (biomass, abundance indices and length distributions from surveys). This year both stocks were benchmarked with *Lophius piscatorius* attaining an analytical assessment with reference points and forecast. *L. budegassa*, however, continues with assessing the status of the stock through examination of survey data.

For *L. piscatorius* the available data indicate that the biomass has been increasing as a consequence of the good recruitment observed in 2001 and 2004 and is above MSY $B_{trigger}$. Fishing mortality is estimated to be at F_{MSY} having been above for the entire timeseries. There is evidence of good recruitments in the more recent period with the last year of good recruitment in 2014. Recruitment in 2011, 2012 and 2013 although lower than in previous years is estimated to be above the Geometric mean of the series.

For *L. budegassa* combined survey data gives indication that the biomass has increased since the mid 2000's as a consequence of several good incoming recruitments. The combined surveys show evidence of a large recruitment in 2013 dropping to similar levels seen historically.

Although the stocks are assessed separately they are managed together. More details on the anglerfish assessments 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 2017 were 2 307 t. The combined TAC was set at 3 955 t in 2017 and 2018.

The two species were benchmarked this year and are assessed separately, using a surplus-production model (software SPiCT), 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 an estimated 11 839 tonnes in 2018. The biomass has been estimated to be above the biomass reference point MSY $B_{trigger}$ since 2005. Fishing mortality peaked during the late 1980's but has since declined, now below F_{MSY} (0.24) from 2011. 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 2005. Since then an increase was observed and in 2016 was the highest estimated biomass of the time series. Fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2016, fishing mortality is estimated to be the lowest value of the timeseries.

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 by-catch. The two species are landed and recorded together in ports' statistics. Information form landings was available for 2017 for *L. boscii* this provide a split for the two species. The 2017 and 2018 TAC were set at 15 045 t and 13 528 t respectively. Landings in recent years were relatively stable around 15 000t. Discarding of smaller megrim is substantial and also includes individuals above the minimum landing size of 20 cm. The discards were variable, between 2 000 and 4 000 t

The *L. whiffiagonis* is 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 most recent period, 2015-2017 show a slight increase. Recruitment has fluctuated without trend over the timeseries with 2016 and 2017 giving above average values. Biomass has steadily declined to its lowest level in 2006, increasing since then. The 2017 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 last year. Data on catch, landings and discards for 2017, were 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, advice for this stock was not requested and therefore not provided.

Currently this stock is classified as a Data Limited Stock in category 5 as only data on catch for one year was available with very limited information from surveys.

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 2017 were 1 173 t (of which 21% correspond to *L. whiffiagonis*). The agreed combined TAC for megrim and four-spot megrim in ICES Divisions 8.c and 9.a was 1 159 t in 2017 and 1 387 t in 2018.

The species are assessed separately, using XSA.

For *L. whiffiagonis* the assessment indicates that fishing mortality has increased since 2010 with a sharp decline from 2016. The SSB values in 2007-2010 were the lowest in the series but since 2011, SSB has increased and is now estimated to be above MSY $B_{trigger}$. After a very high recruitment (at age 1) in 2010 the recruitment has decreased to an average value. There are indications of high recruitment in 2015-2017.

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 to 2017 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 value in 2017 estimated to be below F_{MSY}.

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 and 3 462 t for 2016 and 2017, respectively. Landings have been declining and are now 3 249 t in 2017.

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 2017 F is estimated to be at 0.3, below 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 MSY $B_{trigger}$ at 10 600t and the recruitment values are lower since 1992. Between 2004 and 2008 the recruitment series is stable at around 17 or 18 million with the 2009-year class providing the highest value since the early 1990s. The 2010 and 2011 values are 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 has 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 trammel nets. 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 557 t and 595 t for 2016 and 2017 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 remains 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. 2017 landings saw a slight reduction down to 104 700 t with a corresponding drop in discarding. Since 2009, landings have been above the agreed TAC except for the two most recent years.

The stock was benchmarked in 2014 (ICES, 2014) with one of the main objectives to address a strong retrospective pattern which appeared in the 2013 assessment. The strong retrospective pattern returned in last year's assessment, but was found, through further investigation that the input control file was not fully updated. This has now been rectified and the strong bias pattern has reduced.

This year, the assessment was carried out according to the stock annex, and 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 (765 million). In 2014, the recruitment decreased below mean level (355 million), with the exception of 2016 and 2017. From high levels at the start of the series (103 838 t in 1980), the SSB decreased steadily to a low level at the end of the 90s (24 356 t in 1998). Since that year, SSB has increased to the highest value of the series in 2016 (346 653 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 0.24 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 2016 and 2017 were 12 443 t and 9 171 t, respectively. Total discards in 2016 were 2 313 t and 1 676 t in 2017, 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 170 million. Fishing mortality increased from the beginning of the time-series (F=0.36 in 1982) peaking in 1995 at 1.19; declining to 0.79 in 1999 and remaining relatively stable until 2009 (F=0.96). F then progressively decreased to reach 0.44 in 2017. The SSB was very high at the beginning of the time-series with values around 40 000 t, then decreased to a minimum of 5 800t in 1998. Since then biomass has continuously increased, reaching 23 885 t in 2017, 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 2018 was 3 614 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 from 2003, so information about discards is considerably weaker for the earlier period.

This stock was benchmark in 2016 and 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 0 t for the whole Division 8.c for 2017 to 2019. However, a scientific quota was established for *Nephrops* in FU 25 in order to undertake an observer programme to obtain data to continue to assess the status of the stock.

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 2017 from the five FUs combined were 418 t. The TAC set for the whole Division 9.a was 336 t and 281 t for 2017 and 2018.

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 considered negligible.

According to the ICES data-limited approach, this stock is considered as category 3.1.4. The 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, decreasing again in recent years. The landings in 2009-2011 was stable at around 150 t, increasing to 283 t in the years 2012-2017.

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 and 2017 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. However, there was uncertainty around the reference points and the stock was recategorized to a category 4 stock. The underwater TV survey continues to be used 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. The available data suggests that discards can be considered negligible (<5%).

The seabass stock in the Bay of Biscay was benchmarked during WKBASS2017 and WKBASS2018 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 assumption of constant F relating to recreation survey data collected around 2010.

The only available tuning index fluctuates without trend with the years 2012 to 2016 showing a decline, 2017 gives an increase. Estimated biomass has been declining in the recent period after an increase from its lowest level in 1999. Recruitment is variable with 2016 estimated to be above the geometric mean of the time-series. Fishing mortality, estimated as age 4-15, has been increasing and has fluctuated over the timeseries with a slight declining trend. Although the assessment was updated during the working group the working group found some issues with the reference points and these will be reviewed and advice released in October.

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 and 2017 are 947 t and 952 t, respectively. 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 updated timeseries of landings and discards including 2017 data 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 types 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 updated timeseries of landings and discards including 2017 data 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 tonnes, 2017 landings saw a decline down to 1 925 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 updated timeseries of landings and discards including 2017 data 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 2017 was set in order to prepare the datasets for the working group and progress on the use of InterCatch.

For most of the stocks assessed by WGBIE, InterCatch was used mainly to download un-raised data. The data delivered to accessions via worksheet format was, for some stocks, 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 and the species sections.

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 were made aware of an issue with the sampling level in Q1 and Q2 of 2017 from France (WD12). Because of the lack of market sampling for length (biological and onboard sampling was unaffected), efforts were made to try and fill the deficiency in the number of samples by use of simulation techniques. Both simulated data and actual data were uploaded to InterCatch combined making it impossible to distinguish true samples from simulated ones. Due to the timing in notifying the working group it was not possible to assess the impact of such simulated data on the assessment and the group recommended that sensitivities with and without the simulated data are carried out.

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 four years working groups the files were processed externally using R script. Because of the complexity of the data, with the number of countries and métiers, 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
Hake in Subareas 4, 6, and 7 and Divisions 3.a, 8.a,b,d (Northern stock)	Update	WKSouth 2014		Yes	
Hake in Divisions 8.c and 9.a (Southern stock)	Update	WKSouth 2014		Yes	

1.9.1 Benchmark planning

The WG reviewed the stocks to be benchmarked and agreed that these should be reviewed periodically between the 2018 and 2019 working groups. 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 hake benchmark are within the benchmark issues lists at Annex 5.

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.

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 21–26 May will update the Bay of Biscay and Iberian mixed fisheries analysis carried out in 2017. 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. The group agreed to work on this intersessionally.

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 re-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, of which there are 5. In order to assess these stocks and their status in relation to biological reference points they would require landings and discards data with associated length and age, survey or commercial indices of abundance or biomass. If newly developed indices are appropriate the EWG would be in a position to provide more robust advice on fishing opportunities in the following year.

Many of the stocks have recruitment indices available with no adult indices, therefore, it would be advantageous to develop and use adult biomass indices to help reduce the uncertainty in the spawning stock biomass estimates. Further research and appropriate evaluation is recommended in the development of such indices for stocks where standard surveys are not appropriate due to catchability issues.

For the stocks of hake, megrim, four spot megrim, anglerfish and seabass further studies are required to better understand the mixing between areas and the biology over time such as growth, maturity, length-weight, sex-ratio 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.

1.13 References

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

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

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

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

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

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

Table 1.4a Biological sampling levels by stock and country. Number of fish measured and aged from landings in 2017.

		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	8c &9a	8.c &9.a	8.a,b	8.c &9.a
Belgium	No. lengths	11298		3647		10542				
	No. ages	0		0						
	No. samples**	50		25		25				
E & W (UK)	No. lengths	36295		18684		24861				
	No. ages	0		0						
	No. samples*	539		135		280				
France	No. lengths	11900		9228		16010				
	No. ages	0		0						
	No. samples*	567		506		510				
Portugal	No. lengths	0	111	0	782					5279
	No. ages***	0	0	0						
	No. samples*	0	51	0	62					295
Republic of	No. lengths	6641		4340		23333				
Ireland	No. ages	0		0						
	No. samples**	112		94		121				
Spain	No. lengths	39817	4924	29352	3944	40272	9498	28048		3284
	No. ages	0	0	0			535	711		
	No. samples	138	268	85	237	44	149	189		151
Denmark	No. lengths	0		0						
	No. ages	0		0						
	No. samples	0		0						
Total	No. lengths	105951	5035	65251						
	No. ages	0	0	0						
Total nb. in international landings ('000)		8585346	233	7297334						
Nb. measured as % of annual nb. caught		0.001%	2.2%	0.001%						

*** 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.a,b	8.c &9.a	8.ab FU 23-24	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 (UK)	No. lengths	1823									
	No. ages	0									
	No. samples*	67									
E & W (UK)	No. lengths	18324									
	No. ages	0									
	No. samples*	336									
France	No. lengths	24608		13569			3183		82	2007	277
	No. Ages*****	0					331		0		
	No. samples****	1190		340			373		11	143	37
Portugal	No. lengths	0	16464			6970		2985			1651
	No. ages***	0									
	No. samples*	0	313			34		182			32
Republic of	No. lengths	7836									
Ireland	No. ages*****	0									
	No. samples*	135									
Spain	No. lengths	68665	79380		255	10404		991	524	421	
	No. ages	0							0		
	No. samples*	258	699		1	17		48	62	5	
Denmark	No. lengths	5488									
	No. ages	0									
	No. samples*	150									
Total	No. lengths	126744									
	No. ages	0									
Total No. in international landings ('000)		99448975	59906			14409			n/a		
Nb. meas. as % of annual nb. caught		0.12%	0.17%		0.58%	0.12%			n/a		

*** 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 2017

		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	0		-		2582			16841	
	No. ages	0		-					243	
	No. samples	0		-		25			4	
E & W (UK)	No. lengths	2823		388		3398				
	No. ages	0		0						
	No. samples	111		19		310				
France	No. lengths	785		850		2706			19526	
	No. ages	0		0					1762	
	No. samples	78		115		203			329	
Portugal (a)	No. lengths	0		0						
	No. ages	0		0						
	No. samples	0		0						
Republic of	No. lengths	2060		2771		6421				
Ireland	No. ages	0		0						
	No. samples	57		57		54				
Spain	No. lengths	4799	71	931	141	8502	611	3523		11
	No. ages	0	0	0						
	No. samples	562	278	340	72	235	497	529		152
Denmark	No. lengths	0		0						
	No. ages	0		0						
	No. samples	0		0						
Total	No. lengths	10467	71	4940						
	No. ages	0	0	0						
Total no. in international discards ('000)		8256922	n/a	7227382						
Nb. meas. as % of annual nb. Discarded		0.0001%	n/a	0.0001%						

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										
	No. ages										
	No. samples										
E & W (UK)	No. lengths										
	No. ages										
	No. samples										
France	No. lengths			2573				154		1645	
	No. Ages										
	No. samples			82				602		135	
Portugal (a)	No. lengths		735								
	No. ages										
	No. samples		26								
Republic of	No. lengths										
Ireland	No. ages										
	No. samples										
Spain	No. lengths		5062								
	No. ages										
	No. samples		591								
Denmark	No. lengths										
	No. ages										
	No. samples										
Total	No. lengths										
	No. ages										
Total no. in international discards ('000)											
Nb. meas. as % of annual nb. Discarded											

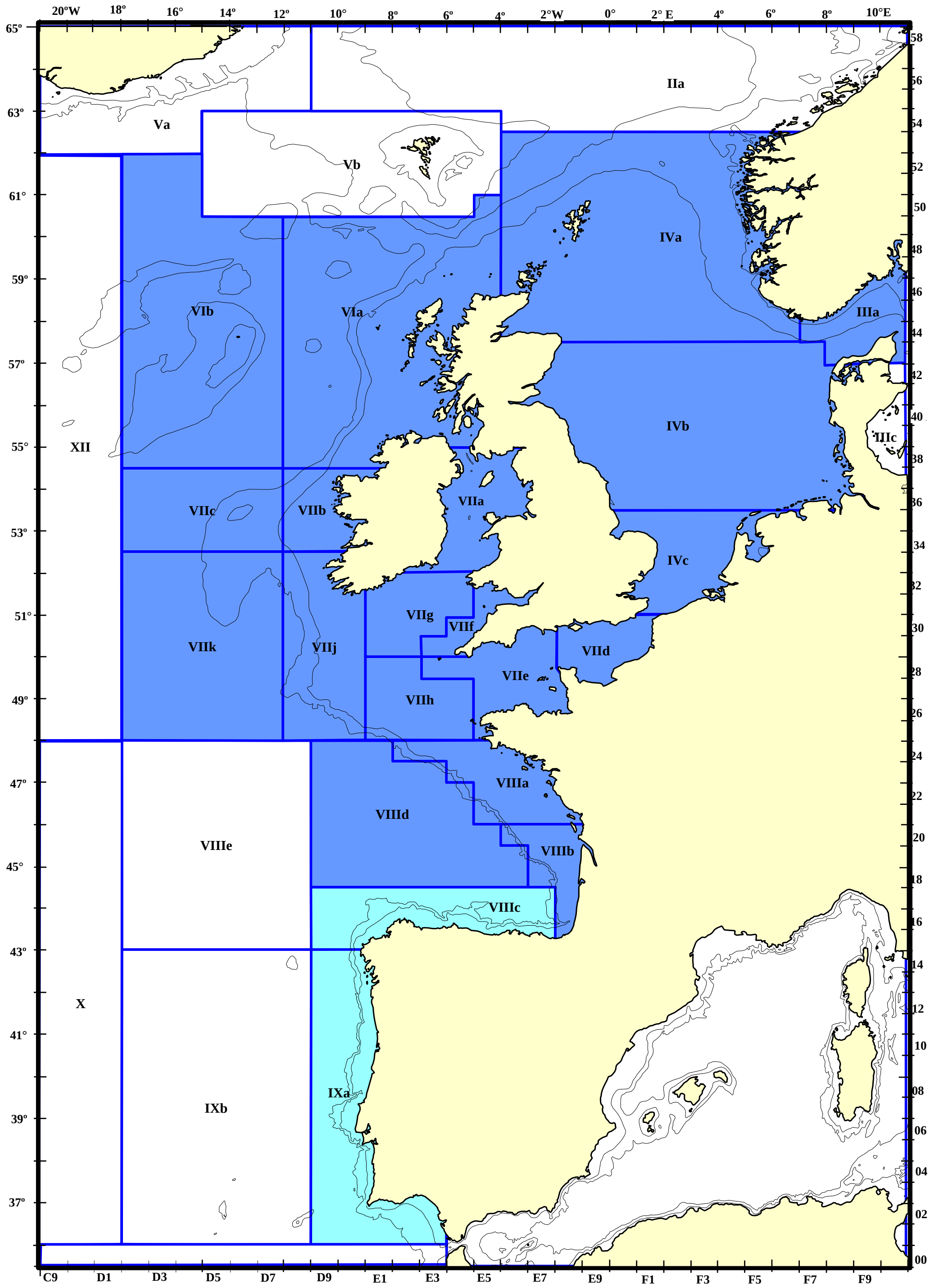

Figure 0.1. Map of ICES Divisions. Northern (3.a, 4, 6, 7. and 8.abd) and Southern (8.c and 9.a) Divisions with different shading.

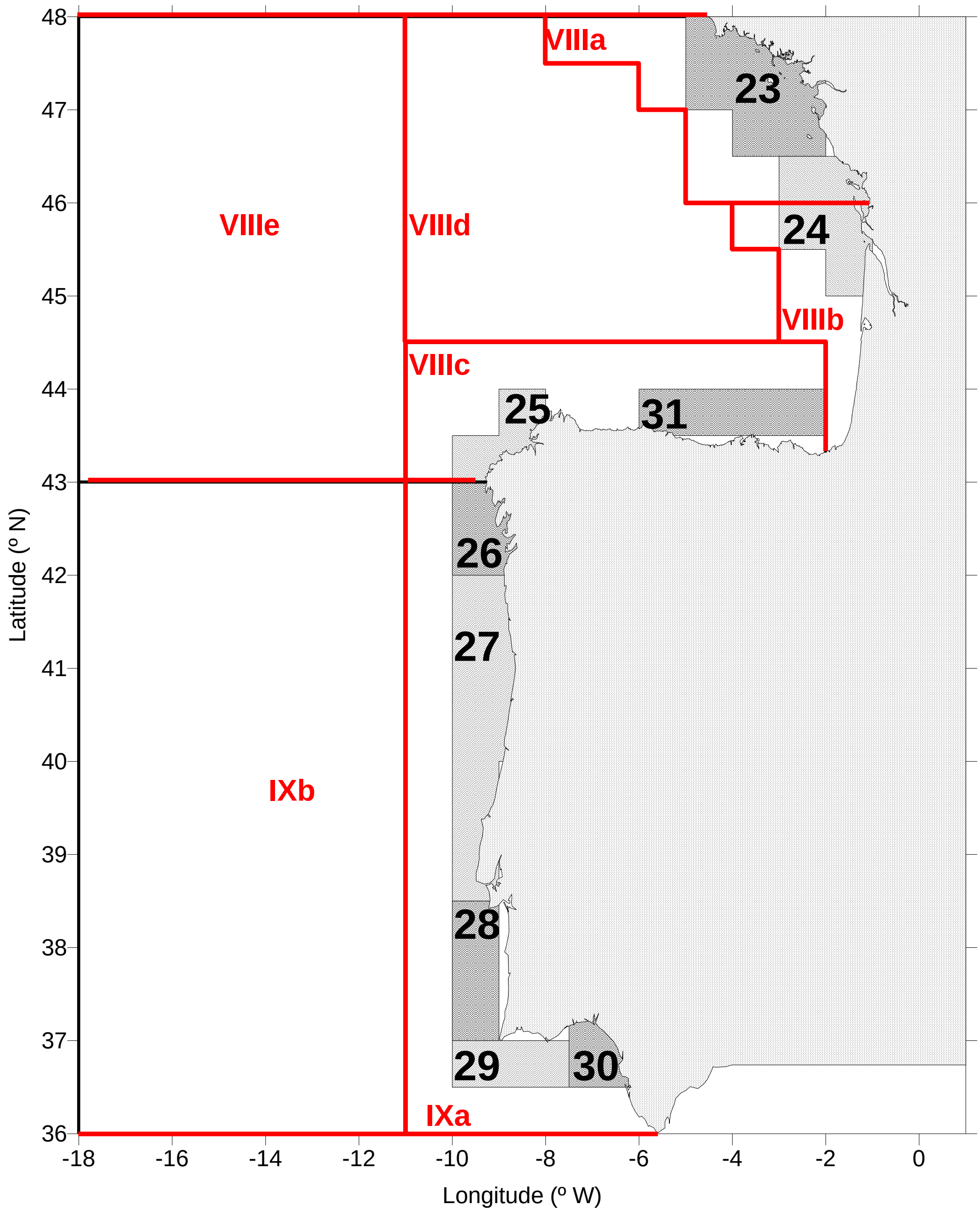

Figure 1.2. ICES Division 8, 9.a. *Nephrops* Functional Units. Division 8.ab (Management Area N): FUs 23-24. Division 8.c (Management Area O): FUs 25 and 31. Division 9.a (Management Area Q): FUs 26-30.

2 Description of Commercial Fisheries and Research Surveys

2.1 Fisheries description

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

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

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

Under the implementation of the mixed fisheries approach in the ICES WG's new information updating some national fleet segmentations was presented in WGHMM reports, 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 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 more recent 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 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 sampling design, established since 2009, which can affect the fishery data supplied to this WG, it has been agreed to detail the métiers related with the stocks assessed by this WG, trying to find the correspondence with the Fishing Units.

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

FU	Fleet for InterCatch	DCF métier (Level 6)	Description	FR	IR	SP	UK
FU1	LLS_DEF	LLS_DEF_0_0_0	Set longline directed to demersal fish			X	X
FU2							
FU3	GNS_DEF	GNS_DEF_100-219_0_0	Set gillnet directed to demersal fish (100-219 mm)	X	X	X	
FU4	OTB_DEF	OTB_DEF_70-99_0_0	Bottom otter trawl directed to demersal fish (70-99 mm)		X	X	X
		OTB_DEF_100-119_0_0	Bottom otter trawl directed to demersal fish (100-119 mm)		X	X	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	
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 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 operating in Portuguese waters of Division 9.a compounded by bottom otter trawlers targeting crustaceans (55 mesh size), and bottom otter 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 also been compiled for the southern stock 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 for the uploading of Iberian data in to 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) targeting mostly anglerfish 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 is required in this case.

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 WGBIE and previous to that the WGHMM in 2010. The DCF acronym and the new ICES survey acronym which will be used throughout this WG report and Stock Annexes are presented below. 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
Combined IGFS/EVHOE WIBTS survey	-	-	FR_IE_IBTS
Irish Monkfish survey		SIAMISS / IAMS	IE_Monksurvey

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).

2.2.16 Combined EVHOE IGFS survey (FR_IE_IBTS)

The Irish IBTS Q4 groundfish survey (IGFS-WIBTS-Q4) covers areas 27.7bgjk. The French EVHOE-WIBTS-Q4 survey covers areas 27.7j8ab. Both surveys are coordinated and largely standardised under WGIBTS and both use a GOV trawl. Together the two surveys cover the majority of the ank.27.78abd and mon.27.78abd stock areas up to depths of 200–300 m. This is where most of the young fish occur. Older fish migrate to deeper waters and are not fully available to these surveys.

Data for Irish and French IBTS Q4 groundfish surveys (IGFS and EVHOE) were obtained from DATRAS, quality checked and cleaned. The two surveys were combined into a single index (with the survey code FR_IE_IBTS) by weighting their average catches by the area covered by each survey series (IGFS gets a weight of approximately 45% and EVHOE 55%). Because the main recruitment area appears to change over time and sometimes occurs in the Irish survey area, sometimes in the French area and sometimes in both; the combined survey gives a more coherent recruitment signal than the two separate surveys.

An index of catch numbers-at-length per hour fished was calculated for the years 2003 onwards.

2.2.17 Irish monkfish survey (IE_Monksurvey)

Irish anglerfish survey data in area 27.7 are available for the years 2007, 2008 (under the acronym SIAMISS), 2016 onwards (IAMS). These surveys were designed to estimate the biomass of anglerfish and they cover a significant part of the stock in all depths up to 1000 m.

The survey index consists of catch numbers-at-length per swept-area.

The midpoint of the survey period is in January or February. However, because the survey data are available for the current year at the time of the assessment working group, it is beneficial to include the current year's survey in the assessment. The only way to do that in the current assessment framework is to offset the survey by a small amount so the survey is nominally taking place on the 31st of December of the previous year.

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

3.1 General

Stock description and management units

The stock assessment area (27.78.abd) is the same for both species of anglerfish (*Lophius piscatorius* and *Lophius budegassa*). The two stocks are managed through TACs for the two species combined. There is a separate TAC for area 27.7 and for areas 27.8.abde. Catches in 27.8.e are negligible.

ICES advice applicable to 2018

For L. budegassa: *ICES advises that when the precautionary approach is applied, landings should be no more than 10 757 tonnes in each of the years 2017 and 2018. ICES cannot quantify the corresponding total catches.*

For L. piscatorius: *ICES advises that when the precautionary approach is applied, landings should be no more than 26 691 tonnes in each of the years 2017 and 2018. ICES cannot quantify the corresponding total catches.*

Management applicable to 2018

Species: Anglerfish ***Lophiidae***	Zone: 7 (ANF/07.)[1,2]	Zone: 8a, 8b, 8d and 8e (ANF/8ABDE.)
Belgium	3 097	-
Germany	345	-
Spain	1 231	1 368
France	19 875	7 612
Ireland	2 540	-
The Netherlands	401	-
United Kingdom	6 027	-
Union	33 516	8 980
TAC	33 516 Precautionary TAC	8 980 Precautionary TAC

The combined TAC for 27.7 and 27.8abde was 42 496 tonnes, this was 13% above the combined advice for the two species of 37 448. The advice in 2018 did not include area 27.7a (which was added to the stock assessment area at the WKAngler benchmark in

[1] Special condition: of which up to 10 % may be fished in 8a, 8b, 8d and 8e

[2] Article 12(1) states: It shall be prohibited to fish or retain on board any of the following species in the Porcupine Bank during the period from 1 May to 31 May 2018: cod, megrims, anglerfish, haddock, whiting, hake, Norway lobster, plaice, pollack, saithe, skates and rays, common sole, tusk, blue ling, ling and picked dogfish.

2018). However, landings from 27.7a have contributed less than 1% of the total landings in recent years.

The fishery

Both species of anglerfish (*L. piscatorius* and *L. budegassa*) are taken in a mixed fishery, mainly with hake, megrim and *Nephrops*.

The fishery for anglerfish developed in the late 1960s and landings quickly reached around 25 000 tonnes (for both *Lophius* species combined). Since then, landings have fluctuated between 20 and 40 thousand tonnes per year (Figure 3.2.1).

France takes the vast majority of the landings; followed by Spain, the UK and Ireland. Minor landings have been recorded for Belgium, Germany and Portugal (Figure 3.1.1.).

Around 2/3 of the catches are taken by otter trawlers targeting demersal fish; gillnets take 10-20% and the remainder is taken by beam trawlers and otter trawlers targeting *Nephrops.*

Around 80% of the catches is taken in area 27.7.

Information from stakeholders

WGBIE did not receive information from stakeholders regarding these stocks

3.1.1 Data

Data revisions

The catch data from 2002–2016 were re-compiled by the WKAnglerfish 2018 benchmark. No revised catch data were submitted after the benchmark

Landings and Discards

Figure 3.1.1 shows the time-series of the official landings of the combined species. Table 3.1.1 gives the ICES estimates of landings and discards by species as well as the official landings.

The combined-species landings are split into species at national level, based on the species composition in the sampling data. Figure 3.1.2 shows the proportions of the two species over time by country. The proportions vary by country but the trends are similar between countries. The overall proportion of *L piscatorius* in the combined *Lophius* landings varied between 65% and 82% with a mean of 74%. The FR_IE_IBTS survey shows very similar trends in species proportion to the overall international landings proportion. The survey proportion appears to be offset by about a year, presumably because the survey includes more young fish.

Effort

Figure 3.1.3 shows that the fishing effort in the main fleets catching anglerfish has declined substantially since the early 1990s. Figure 3.1.4 shows that the LPUE of *L. piscatorius* has increased around threefold since the 1990s. The LPUE of *L. budegassa*, however, (Figure 3.1.5) does not show a clear trend.

3.1.2 Figures and Tables

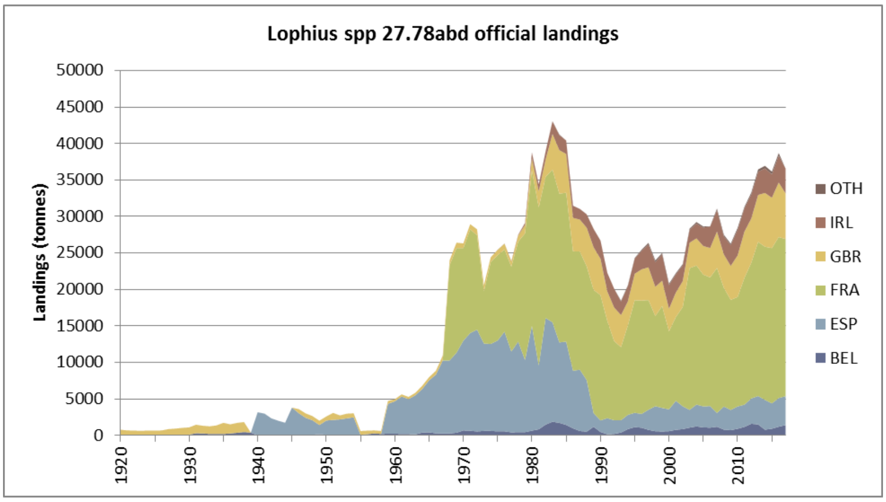

Figure 3.1.1. ***Lophius*** **spp in 27.78abd. Time-series of the official landings.**

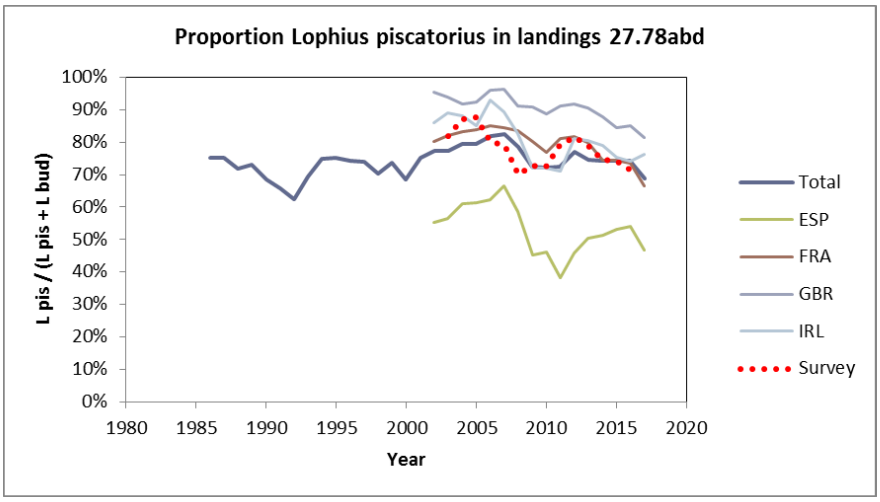

Figure 3.1.2. ***Lophius*** **spp in 27.78abd. Species composition by country. The species proportion in the combined FR_IE_IBTS survey is also shown (but not used to split the catches).**

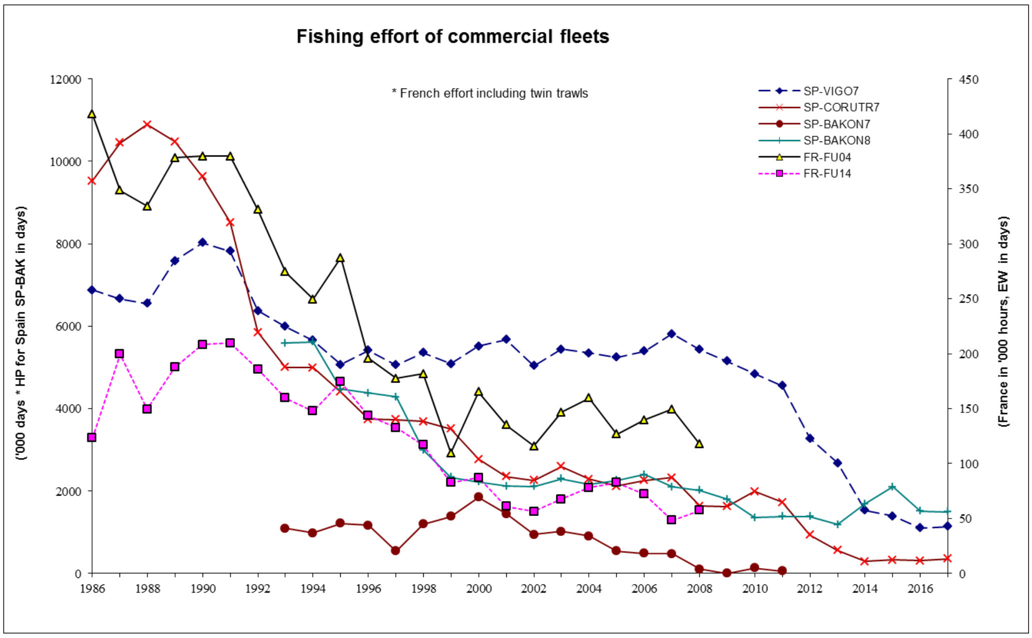

Figure 3.1.3. ***Lophius*** **spp in 27.78abd. Effort by the main fleets.**

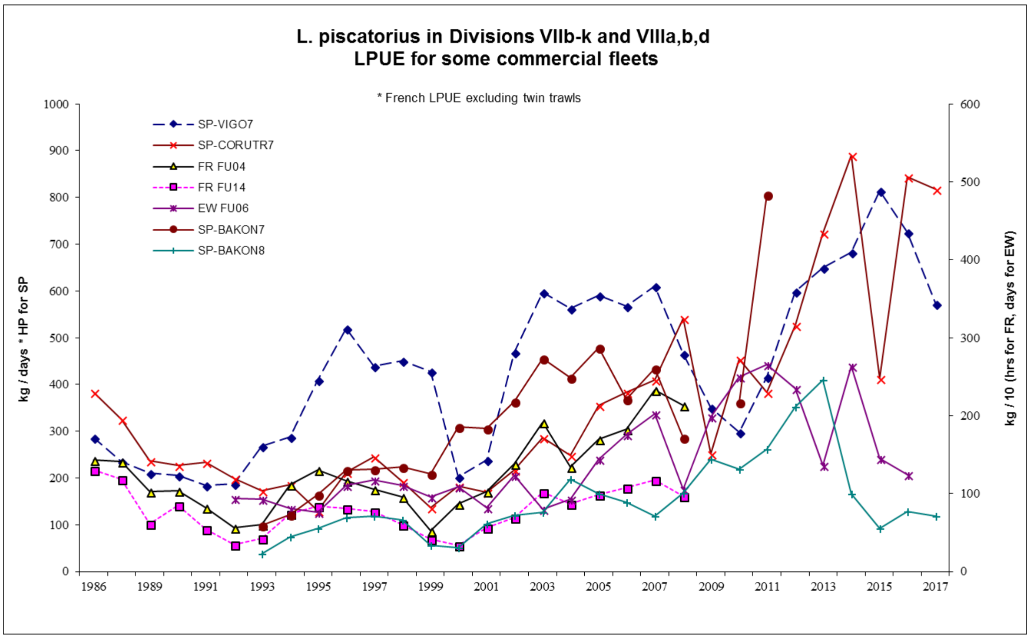

Figure 3.1.4. ***Lophius piscatorius*** **in 27.78abd. LPUE of** ***L. piscatorius*** **by the main fleets.**

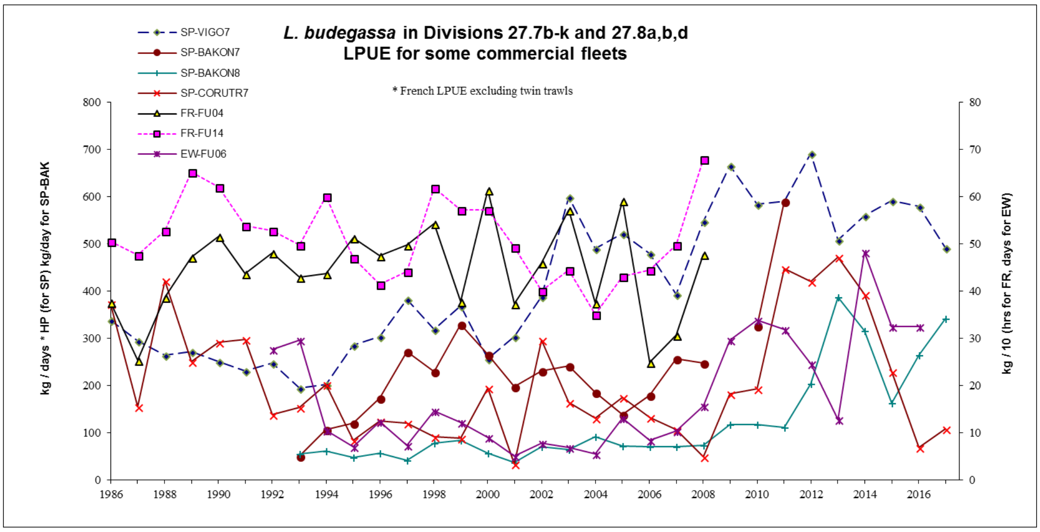

Figure 3.1.5. *Lophius budegassa* in 27.78abd. LPUE of *L. budegassa* by the main fleets.

Table 3.1.1. ***Lophius*** **spp in 27.78abd. Time-series of the ICES estimates of the landings and discards and official landings.**

Year	*Lophius piscatorius*					*Lophius budegassa*				*L. piscatorius + budegassa*		
	Landings				Disc	Landings			Disc	ICES Lan	Offi-cial	Disc
	7a	7bk	8abd	total	78abd	7bk	8abd	total	78abd	78abd	78abd	78abd
1986	1315	19545	4123	24983		6443	1774	8217		33200	31475	
1987	1182	17181	4729	23092		5115	2503	7618		30710	31035	
1988	1219	16148	3948	21315		6346	2035	8381		29696	30299	
1989	2885	18240	2889	24014		6434	2387	8821		32835	28296	
1990	1229	16374	3379	20982		7060	2571	9631		30613	26704	
1991	603	14002	2159	16764		6254	2525	8779		25543	22283	
1992	851	11404	1362	13617		6008	2168	8176		21793	20099	
1993	1437	11870	1588	14895		4648	1919	6567		21462	18454	
1994	1081	14075	2045	17201		3949	1796	5745		22946	20565	
1995	1303	16618	3112	21033		5204	1750	6954		27987	24316	
1996	1171	18174	3987	23332		5979	2114	8093		31425	25437	
1997	1323	17742	3918	22983		6187	1929	8116		31099	26376	
1998	902	16787	2787	20476		6509	2089	8598		29074	23977	
1999	542	16776	1473	18791		5068	1670	6738		25529	24988	
2000	505	12909	1031	14445		5219	1425	6644		21089	20785	
2001	611	15056	1624	17291		4478	1250	5728		23019	22227	
2002	672	17874	3537	22083		4734	1771	6505		28588	23468	
2003	639	21980	5315	27933	2511	6256	1916	8171	179	36105	28332	2690
2004	604	22479	5945	29028	2411	5358	2178	7537	676	36565	29226	3087
2005	489	21882	5498	27869	2110	5214	1974	7187	727	35056	28633	2837
2006	418	21947	5287	27652	892	4675	1456	6131	704	33783	28671	1596
2007	428	25424	5361	31213	816	4857	1751	6608	413	37821	31087	1229
2008	290	21097	5666	27053	993	6039	1360	7399	1585	34452	27493	2579
2009	218	17145	4472	21835	2078	6478	1809	8287	2113	30122	26257	4191
2010	177	17555	4483	22215	2672	6812	1815	8626	1436	30841	28430	4107
2011	235	19309	5114	24657	1832	7416	1933	9348	971	34006	31307	2802
2012	295	23007	4887	28188	2330	5959	2471	8429	1459	36618	33268	3789
2013	269	25782	4560	30611	1684	7274	3200	10475	2285	41086	36447	3970
2014	253	23276	4945	28474	1859	6114	3718	9832	2570	38306	36934	4428
2015	234	23103	4521	27859	2324	6284	3365	9649	1460	37508	36137	3784
2016	656	24836	3919	29411	3585	6127	4093	10220	2441	39630	38690	6026
2017	312	22169	3154	25635	2175	7518	4172	11690	1770	37325	36563	3945

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

Type of assessment

Update Category 1 assessment.

Feedback from ADG

Feedback is not relevant after change of assessment method at WKAngler benchmark 2018.

Feedback from EG audit 2017

No issues identified

3.2.1 Data

3.2.1.1 French landings sampling in 2017

WGBIE were made aware of an issue with the sampling level in Q1 and Q2 of 2017 from France (WD12). Because of the lack of market sampling for length (biological and onboard sampling was unaffected), efforts were made to try to fill the deficiency in the number of samples by use of simulation techniques. Both simulated data and actual data were uploaded to InterCatch combined making it impossible to distinguish true samples from simulated ones. Due to the timing in notifying the working group it was not possible to assess the impact of such simulated data on the assessment and the group recommended that sensitivities with and without the simulated data are carried out.

The simulation was based on commercial landings market categories.

The French onshore sampling program was discontinued at the end of 2016. This is due to a planned shift in its implementation towards an external subcontracting program that was supposed to start on January 2017, similar to the French at-sea sampling. This move was finally implemented only from the 1st of July 2017, where both the onshore ad at-sea samplings are now under the same tender and handled by subcontractors. This shift led to the absence of onshore sampling in the French continental harbours during the 1st quarter, a 30% coverage of planned sampling for the 2nd quarter and a completed planned sampling collections for both quarters 3 and 4. As France always makes use of the two sources of length sampling for the landings (at-sea retained fraction and onshore), for the preparation of data for assessment working groups, the disruption of the onshore samplings in 2017 may result in a lowering of the number of samples, at different orders of magnitude depending on the stocks. An indicator was computed to assess the possible impact of the lack of onshore samples for a given stock, métier and quarter per stratum. This indicator was estimated based on two factors: dependence and importance. A more detailed explanation of the methodology applied to estimate this indicator can be found on a working document specifically for the WGBIE stocks (see. Quemar *et al*. 2018). Catch numbers at length and age

The stock annex describes the methods for filling-in unsampled landings and discards. Figure 3.2.1 shows that only about half of the landings had length data associated with them. More than half of the discards were unsampled and had to be estimated from the discard rate of the sampled catches. However, discard rate are relatively low so this affects only a small proportion of the total catch weight.

Figure 3.2.2 shows the quarterly length frequency distribution of the catch data.

The length data are converted to pseudo-ages by first estimating the mean lengths-at-age in each quarter from a von Bertalanffy growth function (VBGF) with the parameters L_{inf} = 171 cm; K=0.1075; t0=0. Then, for each quarter and year, a mixture distribution is estimated for the length distribution of the catches with the mean values predicted by the VBGF and standard deviations that increase linearly from 3cm at age 0 to 10cm at age 9. This mixture distribution is then used as an age-length key which is then applied to the catch, landings and discard numbers-at-length. The resulting numbers and weights-at-age are used as inputs for the assessment model. Table 3.2.1 gives an overview of the model inputs.

The historic stock weights were slightly revised; a mistake was found in the way stock weights were assigned to ages where there was no data. This resulted in a slightly different estimate of the historic SSB.

Figure 3.2.3a and 3.2.3b shows the age distribution of the catches in terms of abundance and biomass. Catch numbers are generally highest at ages 1 or 2. The highest biomass in the catches is at ages 3-5. Note that this stock is assumed to mature at age 5

Figure 3.2.4 shows the cohort tracking of the catch numbers-at-age. Cohort tracking is reasonably consistent up to age 7.

Figure 3.2.5 shows the proportion of discards-at-age. Nearly all 0-group anglerfish are discarded; around 80% of 1-year-olds are discarded and in recent years an increasing proportion of 2-year-olds have been discarded.

Surveys

The surveys are described in detail in the stock annex.

The survey data are converted to pseudo-ages in the same way as the catch data (see above and stock annex for more details).

The combined IGFS-WIBTS-Q4 and EVHOE-WIBTS-Q4 surveys (FR_IR_IBTS for short) very consistent cohort tracking for the younger ages (Figure 3.2.6a). Note that no index was available in 2017 because the French survey did not take place in that year due to mechanical issues.

The IE_Monksurvey only consists of three recent years of data but appears to track the 2014 and 2010 cohorts (Figure 3.2.6b).

The SP_Porcupine survey tracks cohorts very consistently up to at least age 7 (Figure 3.2.6c).

Figure 3.2.7a and b show the internal and external consistency of the surveys. The FR_IR_IBTS is very consistent for young ages; the IE_Monksurvey is too short to clearly show internal consistency and the SP_Porcupine survey is somewhat noisy at ages 1 and 6 but otherwise quite consistent (Figure 3.2.7a). The FR_IBTS and SP_Porcupine have very similar signals for the 1-year olds but less so for the 2 and 3-year-olds. Figure 3.2.7c shows the overall abundance indices of the surveys.

Biological

The stock annex describes the background to the estimates of the biological parameters.

- Maturity is assumed to be 0% for ages 0-4 and 100% for ages 5–7+
- Natural mortality is assumed to be 0.25 for all ages and years

3.2.2 Historical stock development

Model used: a4a (+length-split based on VBGF to estimate age comp)

Software used*:* R package Fla4a (version 1.1.3) in R (version 3.4.1)

An overview of the available input data by year and age is shown in Figure 3.2.8.

Model specification (see stock annex for details):

```
fmodel: ~factor(replace(age, age > 6, 6)) + factor(year)
srmodel: ~factor(year)
n1model: ~factor(age)
qmodel:
  FR_IE_IBTS:    ~1
  IE_MONKSURVEY: ~I(1/(1 + exp(-age)))
  SP-PORC:       ~factor(replace(age, age > 5, 5))
vmodel:
  catch:         ~s(age, k = 3)
  FR_IE_IBTS:    ~1
  IE_MONKSURVEY: ~1
  SP-PORC:       ~1
```

The F-bar range was set to ages 3–6

Data screening and exploratory model runs

The data were thoroughly explored using the functionality of FLR and other packages. The sensitivity of the model to inclusion of the tuning fleets was explored and the final WKAnglerfish assessment outputs were compared to the first retrospective run of the current model. The details of the data exploration can be found in the presentations folder on the WGBIE SharePoint.

Final update assessment

Figure 3.2.9 shows the patterns in F-at-age and catchability estimated by the model. F is estimated to be quite low for age 0; then gradually increases over ages 1 to 5 and decreases again for age 6 and 7+ (F is forced to be the same for ages 6 and 7+). This may indicate reduced availability of older fish to the fishery as they move to deeper water. Alternatively it could indicate higher natural mortality. The catchability (Q) of the FR_IE_IBTS survey is set to be the same for all ages; for the IE_Monkfish survey, Q increases along a logistic function. This survey uses commercial fishing gear and the catchability follows a similar pattern to the estimated F-at-age. For the SP_Porcupine survey, Q is freely estimated for ages 2, 3, and 4; ages 5 and 6 are bound. This pattern could also indicate reduced availability of older fish.

Figure 3.2.10 shows the residuals. These do not show any pattern except for the 2-year-olds of the FR_IE_IBTS survey for which most of the residuals are positive; indicating the survey catches more 2-year olds than expected if the catchability is constant for all ages.

Figure 3.2.11 shows the summary plot as well as the retrospective analysis. The recruits appear to be estimated with quite high precision but in some years, the retrospective estimates are outside the confidence limits; indicating that the precision of the recruitment estimate might be lower than estimated. The 2017 estimate of recruitment is highly uncertain because there was no recruitment index available for 2017.

Fishing mortality shows a decreasing trend since 2004 (Figure 3.2.11) and is now close to F_{MSY}. There is no strong retrospective bias.

SSB shows a steady increasing trend since 2005 and continues to rise. There is a retrospective adjustment of SSB at the start of the time-series (in the period where no survey data are available). This is probably caused by slight changes in the F-pattern as additional years of data gets added; because this is a separable model, these changes affect the entire time-series.

Mohn's rho was calculated using the default 5 peels of the mohn() function in the package icesAdvice 1.4-1

Parameter	Mohn's Rho
Recruitment	-0.181
F_{bar}	0.090
SSB	0.049

Comparison with previous assessments

This is the first year since 2007 than an analytical assessment has been carried out.

State of the stock

Fishing mortality is above (but very close to) F_{MSY} and has been below F_{MSY}upper for the last 4 years. SSB has been above $B_{trigger}$ and is now at the highest value in the time-series.

3.2.3 Biolog0069cal reference points

Biological reference points were established by WKAngler (2018).

	Type	Value	Technical basis
MSY	MSY $B_{trigger}$	22 278 t	B_{pa}
Approach	F_{MSY}	0.28	Median Eqsim estimate for landings (F_{MSY} catch = 0.30)
	F_{MSY} range	0.181- 0.39	
	B_{lim}	16 032 t	B_{loss}
Precautionary	B_{pa}	22 278 t	B_{lim} + assessment error
Approach	F_{lim}	0.53	F with 5% probability of SSB <B_{lim}
	F_{pa}	0.36	F_{lim} + assessment error

WGBIE re-calculated the reference points based on the most recent assessment and found that the F_{MSY} is quite sensitive to the addition of an extra year of data. It was estimated to be 0.36. WGBIE considers that F_{MSY} = 0.28 is a conservative estimate of the reference point (F has always been above F_{MSY} and yet the stock has seen a dramatic increase in SSB). WGBIE proposes to further examine the sensitivity of F_{MSY} and present this at WGBIE 2019. WGBIE does not propose to update the reference points in the short term unless they are considered to be inappropriate.

3.2.4 Short-term projections

Short-term projections were carried out as described in the stock annex except for the following:

- Because there is no recruitment index available for 2017, the recruitment estimate for this year is highly uncertain. Therefore, it was replaced by GM recruitment.
- Because F shows a trend, F_{2018} was scaled to the last year. Because this is a separable assessment, this means that $F_{2018}=F_{2017}$.

Table 3.2.3 gives the catch options. Figure 3.2.12 shows the contributions of the cohorts to the 2019 forecasted landings and 2020 SSB. The 2017 assumed GM recruitment contributes 24% to the forecasted landings; the 2018 GM contributes another 8%.

3.2.5 Uncertainties in the assessment and forecast

This is the first time since 2006 that ICES has provided advice based on an analytical assessment of this stock. Previously, the advice was based on a category 3 assessment.

WKAnglerfish (2018) has shown that the estimated stock trends are robust to various assumptions on growth, natural mortality, the selection of tuning fleets and model specification.

The estimate of the FMSY Reference point appears to be sensitive to the retrospective pattern in SSB in the early part of the time-series. The current FMSY of 0.28 is considered to be conservative because the stock has increased considerably during the last 15 years even though fishing effort was well above 0.28 during that period.

The recruitment estimates are informed by the combined IGFS-WIBTS-Q4 and EVHOE-WIBTS-Q4 survey index (FR_IE_IBTS), which was not available for 2017 because the EVHOE-WIBTS-Q4 survey did not take place. Therefore, the 2017 recruitment estimate was replaced with GM recruitment. The IGFS-WIBTS-Q4 survey recorded above-average recruitment for 2017 so GM recruitment is likely to be conservative.

Apart from the recruitment estimate for 2017, the missing EVHOE-WIBTS-Q4 index in 2017 is not thought to affect the current assessment. Sensitivity runs showed that removing the entire survey index does not affect the assessment outputs strongly.

3.2.6 Management considerations

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.

3.2.7 Recommendations for the next benchmark

- Further explore SS3 as an assessment model for this stock
- Explore alternative methods like delay-difference production
- Refine a4a model settings and age-split
- Update growth parameters with any new tagging data etc.
- Further investigate stock structure

3.2.8 Figures and tables

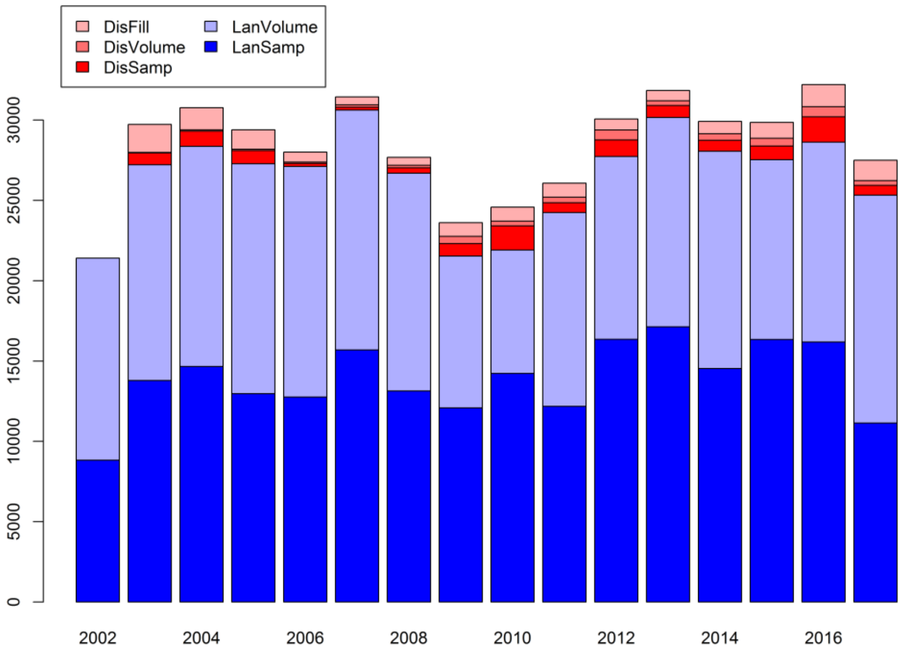

Figure 3.2.1. *Lophius piscatorius* in 27.78abd. Allocations of unsampled landings and discards by year. Dark blue represents the sampled landings; light blue represents landings for which only the tonnage was available but no sampling data; Red represents the sampled discards; medium pink represents discards for which an estimate of the tonnage was available but no sampling data and light pink represents discards for which no information was available.

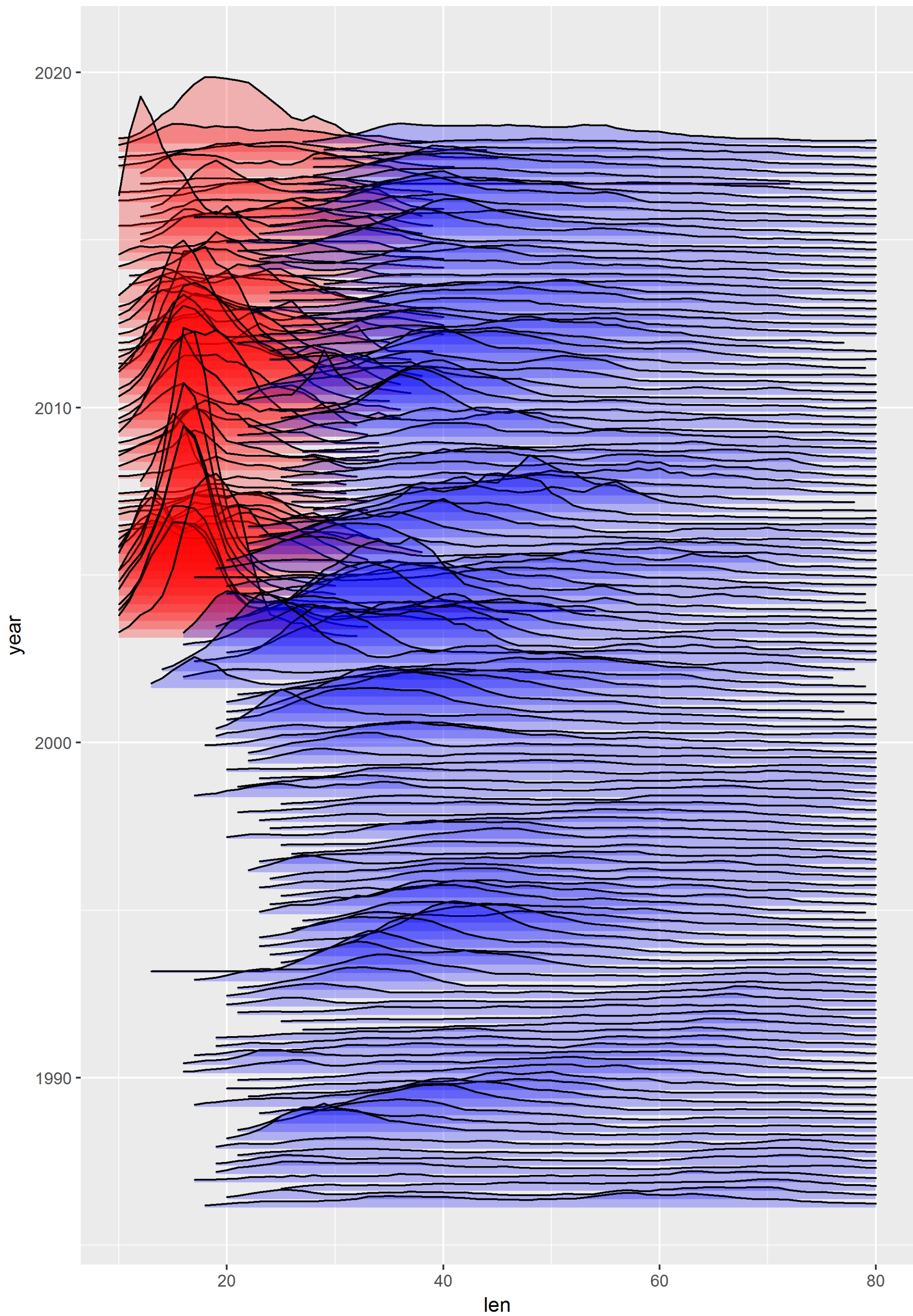

Figure 3.2.2. ***Lophius piscatorius*** **in 27.78abd. Quarterly length frequency distributions of the landings (blue) and discards (red). No discard data were available prior to 2003.**

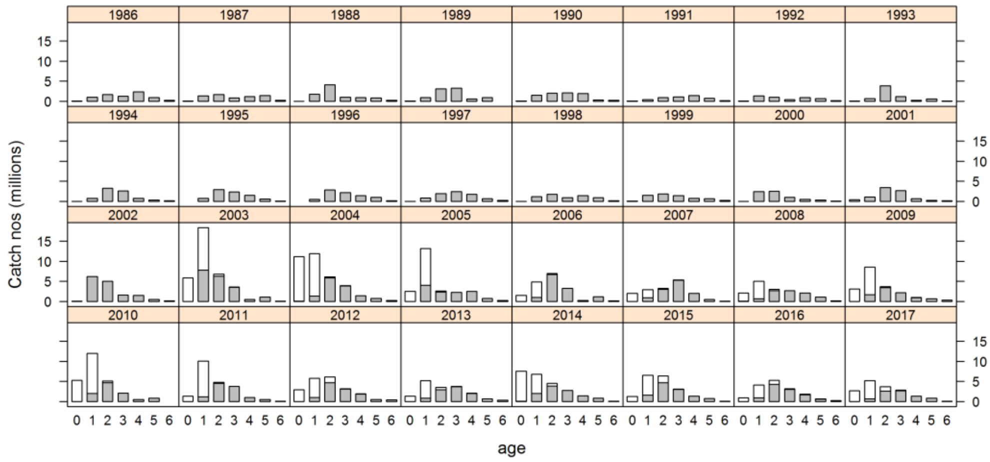

Figure 3.2.3a. ***Lophius piscatorius*** **in 27.78abd. Age distributions of the catches by year in terms of abundance.**

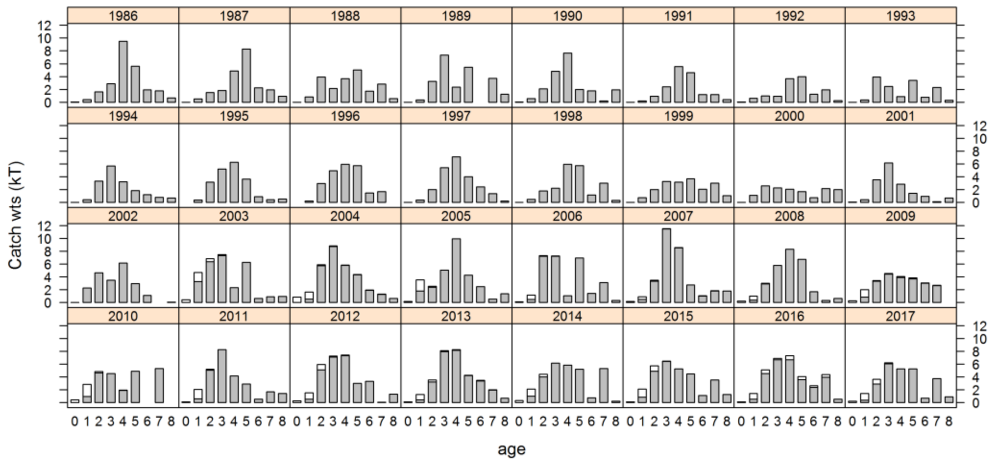

Figure 3.2.3b. ***Lophius piscatorius*** **in 27.78abd. Age distribution of the catches by year in terms of biomass.**

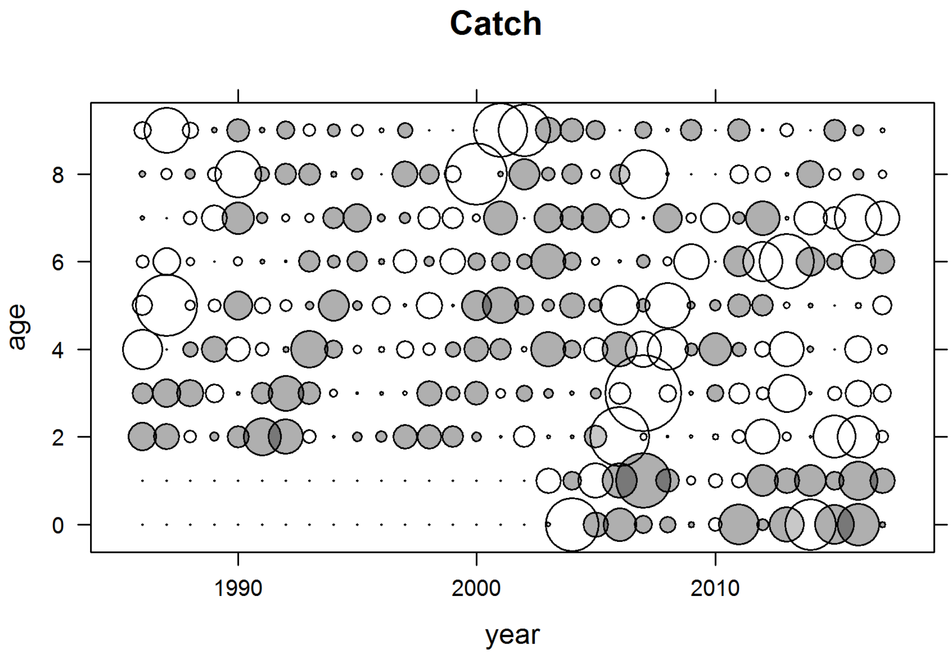

Figure 3.2.4 ***Lophius piscatorius*** **in 27.78abd. Standardised proportion at age per year of the catch numbers. Cohorts can be tracked consistently up to age 7.**

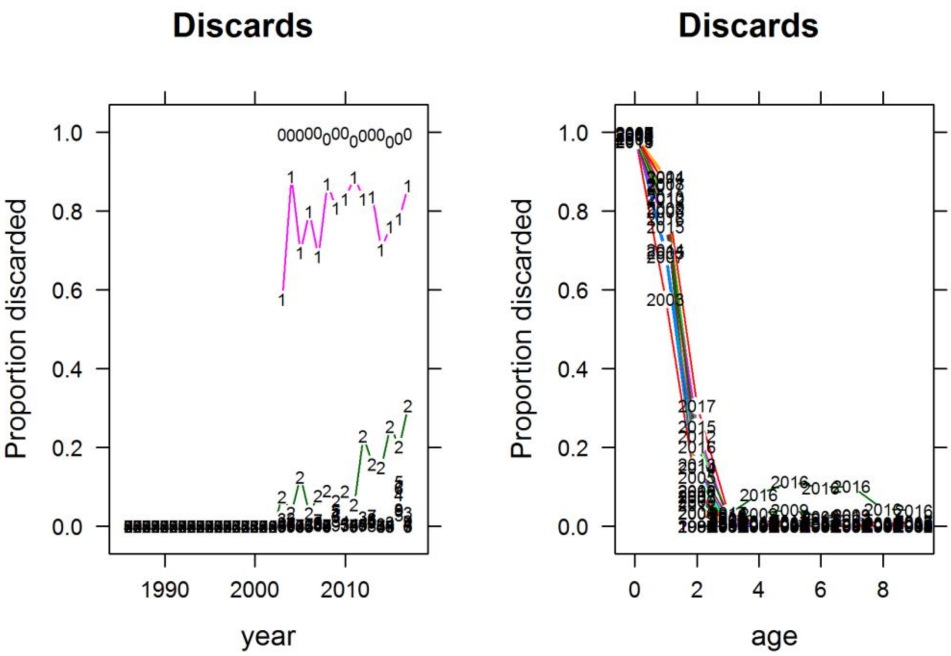

Figure 3.2.5. ***Lophius piscatorius*** **in 27.78abd. Proportions of discards-at-age over time (left) and by age (right).**

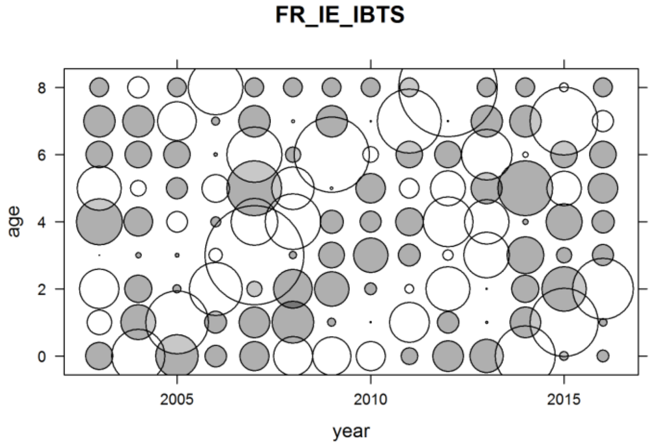

Figure 3.2.6a. ***Lophius piscatorius*** **in 27.78abd. Standardised proportion-at-age per year of the FR_IE_IBTS index. Cohorts can be tracked consistently up to age 4.**

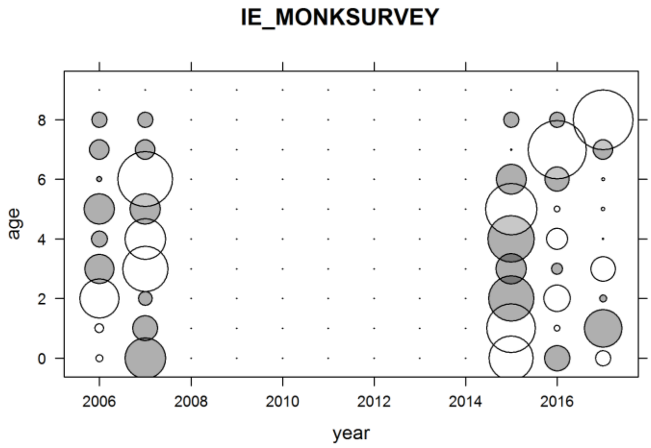

Figure 3.2.6b. ***Lophius piscatorius*** **in 27.78abd. Standardised proportion-at-age per year of the IE_Monksurvey index. The index is still very short but it appears that some**

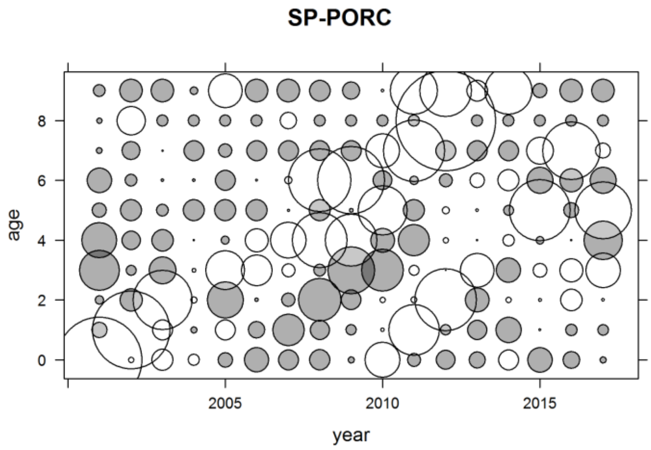

Figure 3.2.6c. ***Lophius piscatorius*** **in 27.78abd. Standardised proportion at age per year of the SP_Porcupine index. Cohorts can be tracked consistently up to age 6.**

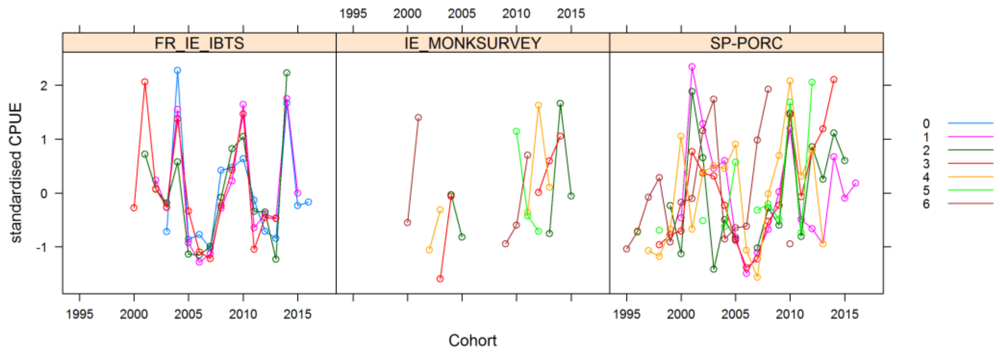

Figure 3.2.7a. *Lophius piscatorius* in 27.78abd. Internal consistency of the survey indices.

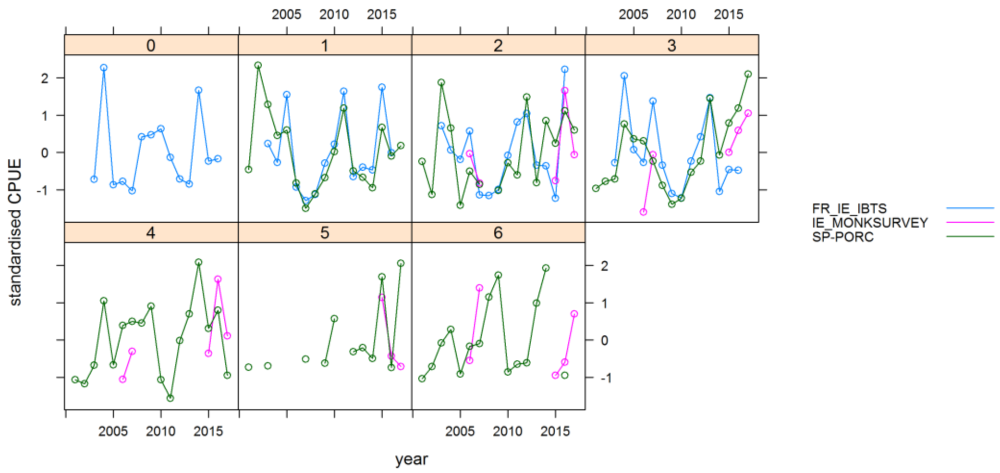

Figure 3.2.7b. *Lophius piscatorius* in 27.78abd. External consistency of the survey indices.

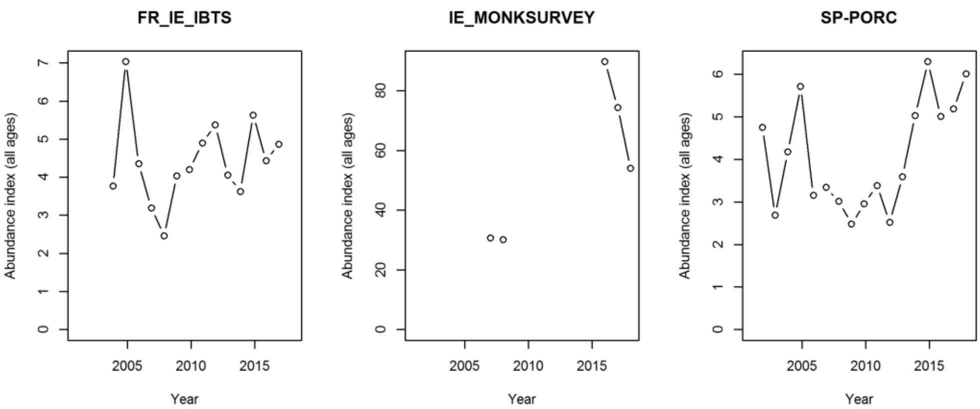

Figure 3.2.7c. *Lophius piscatorius* in 27.78abd. Overall survey abundance trends (all ages combined).

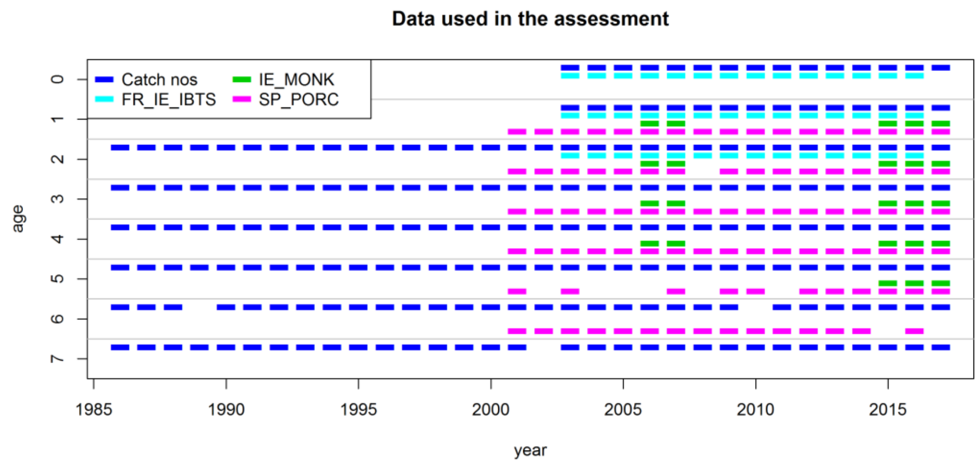

Figure 3.2.8. ***Lophius piscatorius*** **in 27.78abd. Overview of the available catch and survey data. Age 7 is a plus group.**

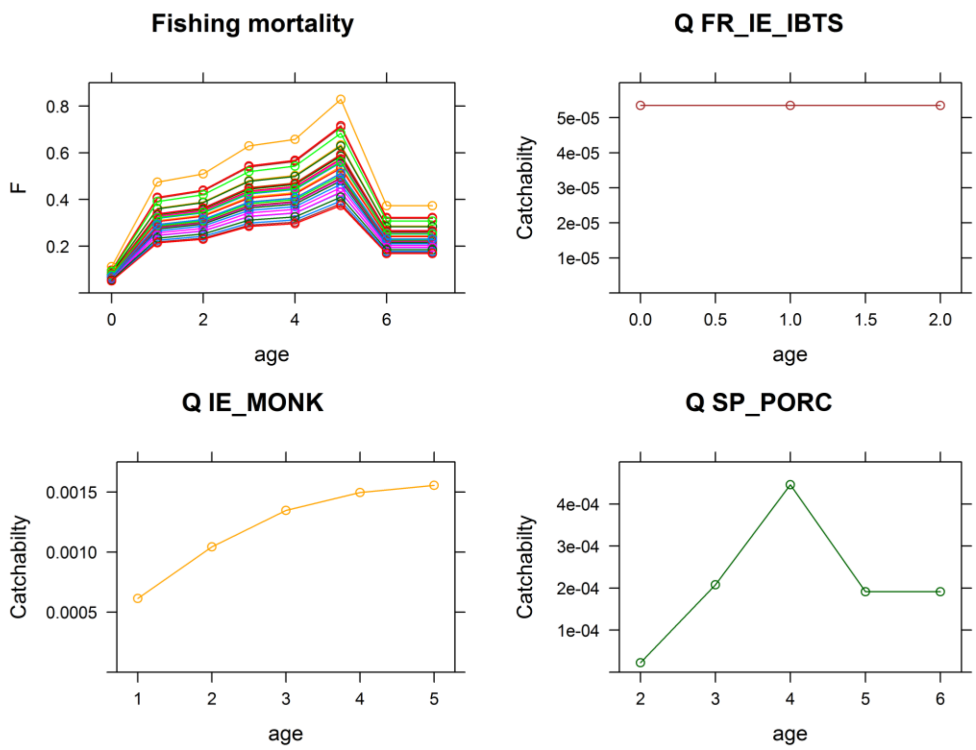

Figure 3.2.9. ***Lophius piscatorius*** **in 27.78abd. Pattern in F-at-age (colours indicate years) and catch-ability-at-age of the surveys.**

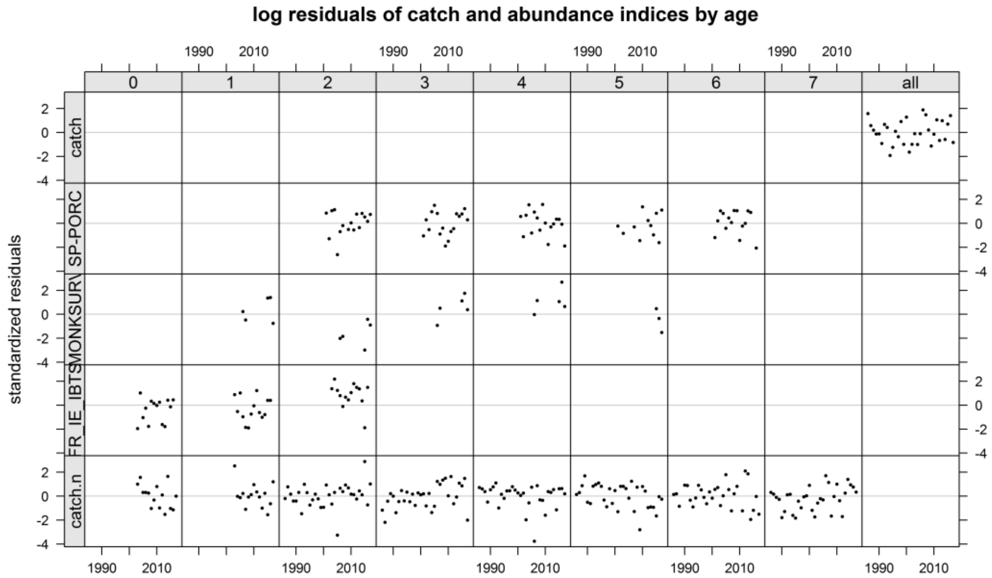

Figure 3.2.10. ***Lophius piscatorius*** **in 27.78abd. Standardised residuals of the catch and the surveys.**

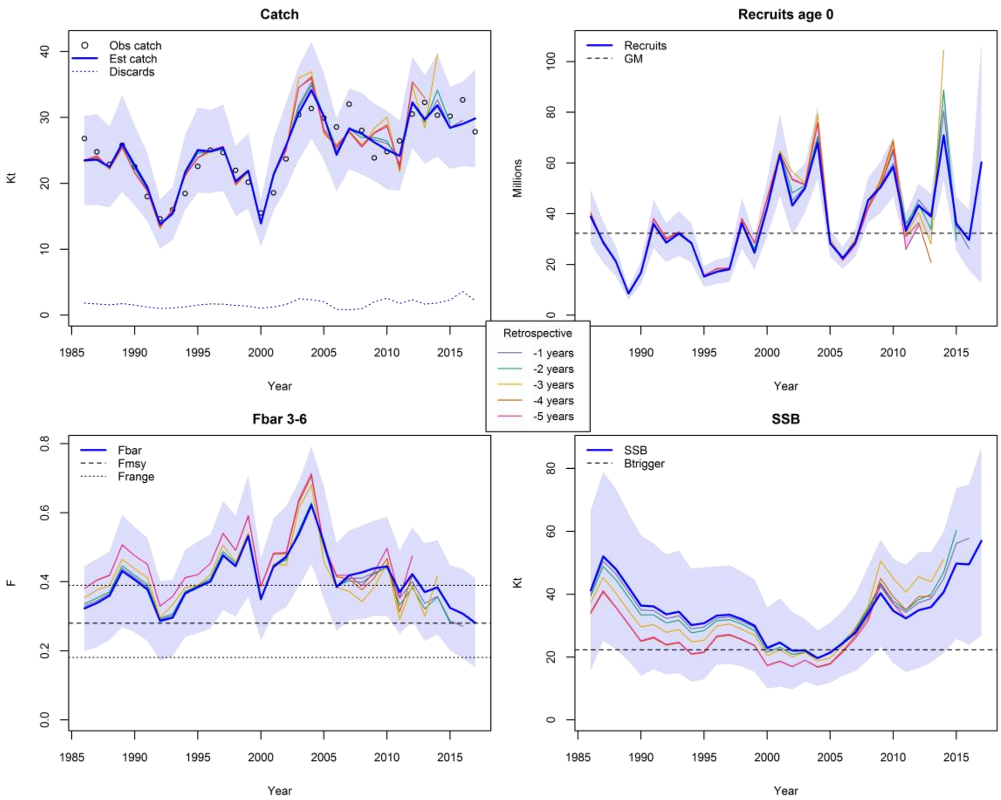

Figure 3.2.11. ***Lophius piscatorius*** **in 27.78abd. Summary plot of the assessment outputs. Light blue areas are the 95% confidence intervals. The coloured lines are the retrospective runs.**

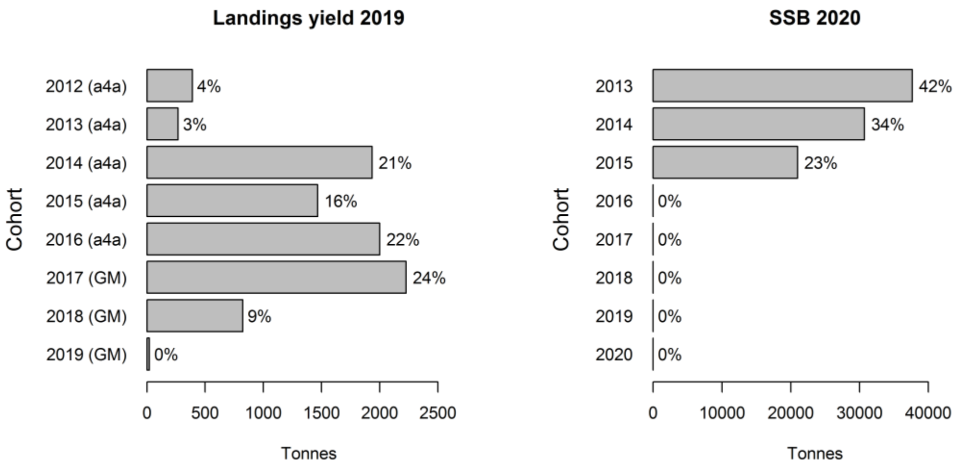

Figure 3.2.12. *Lophius piscatorius* in 27.78abd. Cohort contributions to the forecast landings in 2019 and SSB in 2020.

Table 3.2.1. ***Lophius piscatorius*** **in 27.78abd. Stock assessment model input data: catch.n is the catch numbers-at-age (thousands); p.dis is the proportion of the catch numbers that are discarded; catch.wt and stock wt are the catch and stock weights-at-age (kg). FR_IE_IBTS (n/hr); IE_MONK (n/km^2) and SP_PORC (n/30mis) are the tuning indices.**

CATCH.N	0	1	2	3	4	5	6	7	8	9
1986			1606	1207	2303	911	213	154	46	38
1987			1625	810	1142	1357	258	163	68	60
1988			4048	945	861	816	205	239	41	38
1989			3039	3279	561	897		321	83	22
1990			2007	2057	1884	326	200	15	135	4
1991			887	1047	1361	757	135	105	28	17
1992			962	411	884	660	139	167	16	7
1993			3865	1100	198	568	85	204	18	32
1994			3233	2556	761	313	125	70	48	13
1995			2876	2328	1498	600	97	38	39	35
1996			2808	2160	1437	942	158	148		29
1997			1897	2388	1712	670	267	123	12	11
1998			1747	931	1436	931	124	259	22	
1999			1856	1430	766	609	249	252	76	
2000			2460	980	499	280	92	182	144	
2001			3448	2668	675	247	103	8	49	74
2002			5035	1624	1506	507	125		3	79
2003	5866	18354	6829	3567	529	1077	63	68	67	3
2004	11123	11880	6104	3961	1455	728	200	113	43	7
2005	2491	13188	2629	2295	2510	704	261	45	91	10
2006	1498	4852	6916	3221	277	1184	162	261	23	
2007	2034	2955	3285	5320	2010	479	108	151	126	8
2008	2085	5035	2968	2645	2102	1112	180	29	46	23
2009	3055	8544	3640	2189	959	645	333	232		6
2010	5320	12046	5135	2061	488	804		455		
2011	1356	10107	4826	3797	1041	485	62	141	103	5
2012	2925	5824	6111	3171	1888	487	377	5	91	28
2013	1311	5202	3502	3738	2067	709	368	174	48	33
2014	7533	6838	4513	2808	1454	854	77	451	13	
2015	1274	6586	6338	3079	1338	746	117	307	81	5
2016	959	4147	5314	3148	1807	683	282	374	36	14
2017	2650	5179	3706	2810	1372	852	71	319	63	25

P.DIS	0	1	2	3	4	5	6	7	8	9
2003	0.995	0.576	0.075	0.018	0.006	0.001	0.000	0.000	0.009	0.000
2004	0.994	0.888	0.034	0.020	0.009	0.006	0.006	0.006	0.005	0.000
2005	0.994	0.694	0.125	0.001	0.001	0.002	0.000	0.003	0.001	0.000
2006	0.998	0.799	0.033	0.000	0.002	0.002	0.004	0.000	0.000	
2007	1.000	0.684	0.078	0.003	0.002	0.008	0.010	0.016	0.006	0.009
2008	0.983	0.869	0.090	0.001	0.001	0.001	0.003	0.003	0.001	0.001
2009	0.998	0.808	0.065	0.014	0.032	0.041	0.025	0.029		0.003
2010	0.999	0.831	0.089	0.003	0.012	0.006		0.001		
2011	0.978	0.887	0.054	0.002	0.005	0.001	0.002	0.003	0.002	0.000
2012	0.992	0.831	0.229	0.023	0.007	0.005	0.004	0.002	0.004	0.003
2013	0.995	0.836	0.158	0.019	0.013	0.013	0.019	0.028	0.001	0.010
2014	0.995	0.702	0.149	0.006	0.000	0.000	0.000	0.000	0.000	
2015	0.977	0.761	0.253	0.011	0.003	0.001	0.000	0.000	0.000	0.000
2016	0.985	0.781	0.202	0.029	0.081	0.113	0.098	0.101	0.043	0.040
2017	0.996	0.865	0.306	0.034	0.007	0.001	0.000	0.000	0.002	0.013

CATCH.WT	0	1	2	3	4	5	6	7	8	9
1986	0.124	0.385	1.015	2.367	4.114	6.131	9.079	11.449	14.196	18.266
1987	0.141	0.385	0.941	2.226	4.263	6.116	8.619	11.733	13.371	17.131
1988	0.125	0.466	0.964	2.276	4.225	6.177	8.383	11.809	13.617	17.818
1989	0.120	0.384	1.067	2.239	4.196	6.069	9.071	11.474	14.863	16.974
1990	0.118	0.352	1.027	2.331	4.077	6.112	8.891	10.518	14.141	16.787
1991	0.127	0.391	1.016	2.302	4.092	6.108	8.930	11.254	14.758	17.149
1992	0.120	0.451	1.003	2.252	4.133	6.016	9.010	11.453	14.457	18.111
1993	0.080	0.500	1.017	2.217	4.378	6.000	9.166	11.244	15.376	17.544
1994	0.140	0.549	1.027	2.208	4.202	5.799	9.367	10.963	14.261	16.719
1995	0.099	0.496	1.093	2.231	4.172	6.042	9.329	11.180	13.821	17.566
1996	0.099	0.414	1.040	2.278	4.120	6.073	9.127	11.341	14.325	18.212
1997	0.126	0.455	1.035	2.266	4.145	5.961	9.029	10.992	15.191	18.915
1998	0.127	0.412	1.019	2.371	4.138	6.117	9.077	11.449	13.597	18.052
1999	0.123	0.462	1.071	2.260	4.094	6.038	8.271	11.808	13.310	18.052
2000	0.110	0.452	1.034	2.298	4.077	5.979	7.909	11.724	13.768	18.052
2001	0.098	0.363	1.021	2.293	4.207	5.769	9.034	10.442	13.941	16.996
2002	0.117	0.362	0.921	2.132	4.095	5.833	8.959	11.511	13.224	18.322
2003	0.071	0.255	0.999	2.088	4.390	5.811	9.704	12.753	13.856	18.781
2004	0.077	0.136	0.965	2.231	4.015	5.970	9.607	11.389	14.338	22.171
2005	0.061	0.267	0.954	2.206	3.961	6.054	9.354	11.196	14.864	17.539
2006	0.070	0.232	1.053	2.243	3.707	5.874	8.694	11.780	13.866	18.052
2007	0.071	0.297	1.047	2.161	4.252	5.731	9.494	12.075	14.027	18.772
2008	0.087	0.195	1.002	2.194	3.951	6.064	9.367	11.389	13.485	17.013
2009	0.085	0.233	0.943	2.063	4.202	5.921	9.148	11.490	14.325	17.499
2010	0.078	0.235	0.941	2.202	3.970	6.104	9.071	11.717	14.325	18.052
2011	0.086	0.201	1.080	2.178	3.995	5.972	8.651	12.008	13.741	17.730
2012	0.084	0.259	0.972	2.289	3.914	6.182	8.826	12.180	14.318	16.832
2013	0.091	0.244	1.008	2.164	3.993	6.016	9.386	11.446	14.614	19.050
2014	0.040	0.311	0.983	2.192	4.015	6.096	9.570	11.772	17.234	18.052

2015	0.096	0.320	0.907	2.108	3.936	6.005	9.258	11.516	15.451	19.068
2016	0.083	0.338	0.963	2.189	4.059	5.954	9.264	11.616	15.321	19.863
2017	0.086	0.278	0.981	2.201	3.839	6.197	9.628	11.694	14.409	18.534

STOCK.WT	0	1	2	3	4	5	6	7	8	9
1986	0.014	0.197	0.702	1.784	3.394	5.451	7.844	10.637	14.196	17.411
1987	0.014	0.222	0.643	1.788	3.397	5.459	7.780	10.637	13.189	15.344
1988	0.014	0.248	0.589	1.788	3.413	5.451	7.857	10.526	13.617	17.407
1989	0.014	0.186	0.748	1.719	3.436	5.360	7.867	10.491	13.329	16.974
1990	0.014	0.203	0.661	1.801	3.400	5.451	7.842	10.518	13.194	17.411
1991	0.014	0.189	0.701	1.736	3.428	5.448	7.841	10.530	13.278	16.036
1992	0.014	0.227	0.647	1.751	3.444	5.441	7.845	10.567	13.329	18.256
1993	0.014	0.122	0.679	1.736	3.448	5.380	7.867	10.460	13.329	17.140
1994	0.014	0.253	0.711	1.736	3.424	5.381	7.867	10.461	13.279	16.082
1995	0.014	0.221	0.769	1.725	3.455	5.362	7.867	10.637	13.189	17.411
1996	0.014	0.260	0.618	1.777	3.430	5.448	7.813	10.538	13.329	15.810
1997	0.014	0.199	0.752	1.732	3.425	5.443	7.851	10.570	13.329	18.612
1998	0.014	0.187	0.730	1.739	3.433	5.449	7.849	10.503	13.597	17.411
1999	0.014	0.199	0.694	1.800	3.364	5.480	7.849	10.637	12.837	17.411
2000	0.014	0.217	0.691	1.736	3.423	5.455	7.831	10.518	12.896	17.411
2001	0.014	0.219	0.708	1.733	3.438	5.368	7.867	10.442	13.271	16.148
2002	0.014	0.200	0.609	1.718	3.438	5.265	7.867	10.637	13.224	15.528
2003	0.014	0.133	0.738	1.648	3.498	5.184	7.867	10.637	13.936	17.411
2004	0.022	0.094	0.720	1.727	3.410	5.403	7.867	10.577	13.329	19.087
2005	0.014	0.129	0.608	1.768	3.411	5.441	7.867	10.763	12.955	17.411
2006	0.007	0.135	0.713	1.646	3.495	5.290	7.867	10.545	13.187	17.411
2007	0.013	0.144	0.690	1.744	3.443	5.338	7.867	10.710	13.019	17.411
2008	0.010	0.128	0.677	1.692	3.387	5.406	7.867	10.637	12.641	17.411
2009	0.014	0.117	0.695	1.667	3.444	5.378	7.998	10.823	13.329	17.411
2010	0.010	0.135	0.698	1.650	3.476	5.291	7.867	10.659	13.329	17.411
2011	0.014	0.113	0.787	1.693	3.430	5.336	7.867	10.765	13.079	17.411
2012	0.014	0.138	0.662	1.797	3.369	5.506	7.948	10.637	13.570	16.359
2013	0.015	0.136	0.649	1.731	3.392	5.457	7.867	10.842	13.329	20.000
2014	0.019	0.134	0.717	1.694	3.405	5.483	7.867	11.026	13.329	17.411
2015	0.014	0.162	0.655	1.680	3.418	5.448	7.867	10.842	13.329	18.975
2016	0.014	0.159	0.684	1.713	3.416	5.460	7.997	10.759	13.329	19.273
2017	0.014	0.149	0.690	1.708	3.419	5.493	7.867	10.848	14.435	18.963

FR_IE_IBTS	0	1	2	3	4	5	6	7	8	9
2003	0.882	1.155	1.078	0.543		0.102				0.010
2004	4.066	0.883	0.827	0.955	0.145	0.136			0.015	0.008
2005	0.732	1.860	0.729	0.605	0.345	0.041		0.041		
2006	0.826	0.530	1.023	0.546	0.139	0.072	0.029	0.010	0.013	
2007	0.554	0.338	0.362	0.835	0.270		0.078			0.025
2008	2.092	0.421	0.357	0.533	0.491	0.108	0.018	0.018		
2009	2.151	0.875	0.418	0.399	0.115	0.066	0.167			0.010
2010	2.322	1.148	0.770	0.378	0.147	0.034	0.080	0.021		
2011	1.504	1.910	1.117	0.551	0.120	0.110		0.069		
2012	0.888	0.679	1.204	0.667	0.465	0.100		0.017	0.026	0.007
2013	0.752	0.819	0.669	0.851	0.390	0.024	0.109			0.012
2014	3.420	0.778	0.664	0.408	0.276		0.068			0.019
2015	1.397	1.969	0.327	0.513	0.053	0.109		0.059	0.006	
2016	1.465	1.026	1.660	0.509	0.139	0.034		0.034		0.002

IE_MONK	0	1	2	3	4	5	6	7	8	9
2006	6.696	7.951	8.249	4.318	2.669		0.811			
2007	2.713	4.614	3.947	11.915	4.630		2.253			
2015	28.720	34.967	4.314	12.263	4.496	4.076	0.521	0.369		
2016	9.883	18.559	17.502	15.178	9.694	1.466	0.779	1.308		
2017	13.037	6.052	8.110	17.451	5.717	0.992	1.736		0.873	

SP_PORC	0	1	2	3	4	5	6	7	8	9
2001	2.934	0.227	0.254	0.564	0.609	0.067	0.012	0.061	0.003	0.023
2002	0.451	0.819	0.086	0.704	0.556		0.058	0.004	0.012	
2003	1.075	0.597	0.654	0.752	0.801	0.077	0.149	0.070		
2004	1.150	0.421	0.423	1.833	1.648		0.202			0.038
2005	0.196	0.452	0.031	1.542	0.804		0.030	0.019		0.079
2006	0.027	0.150	0.204	1.503	1.325		0.136			
2007	0.099	0.008	0.137	1.103	1.379	0.133	0.146		0.009	
2008	0.076	0.091		0.624	1.356		0.327	0.001		0.002
2009	0.323	0.181	0.106	0.251	1.577	0.100	0.412			0.007
2010	1.134	0.328	0.246	0.370	0.610	0.461	0.038	0.162		0.037
2011	0.178	0.576	0.185	0.883	0.367		0.068	0.184		0.078
2012	0.141	0.220	0.579	1.104	1.125	0.191	0.072		0.045	0.119
2013	0.267	0.184	0.147	2.338	1.474	0.226	0.303			0.096
2014	1.570	0.124	0.460	1.219	2.151	0.139	0.439			0.196
2015	0.036	0.466	0.346	1.853	1.286	0.799		0.208		0.019
2016	0.255	0.303	0.509	2.146	1.523	0.065	0.025	0.360		
2017	0.657	0.363	0.412	2.816	0.669	0.910		0.184		

Table 3.2.2. ***Lophius piscatorius*** **in 27.78abd. Summary of the assessment. Landings, discards, catch, estimated catch, total-stock biomass in kilotonnes, recruitment in millions. CV is the relative standard error.**

YEAR	LAN	DIS*	CAT	CATEST	TSB	SSB	CV	RECR	CV	FBAR	CV
1986	24.981	1.833	26.814	23.495	83.980	41.196	0.31	38.891	0.14	0.323	0.19
1987	23.091	1.694	24.785	23.602	83.206	52.019	0.26	28.806	0.14	0.339	0.19
1988	21.314	1.564	22.878	22.508	79.542	48.033	0.27	21.254	0.14	0.360	0.19
1989	24.015	1.762	25.777	26.061	78.731	42.234	0.28	8.514	0.15	0.431	0.19
1990	20.982	1.539	22.521	22.728	73.003	36.409	0.31	16.729	0.14	0.406	0.19
1991	16.763	1.230	17.993	19.446	61.894	36.130	0.28	35.943	0.14	0.378	0.20
1992	13.617	0.999	14.616	13.813	56.874	33.575	0.29	28.598	0.14	0.287	0.20
1993	14.895	1.093	15.988	15.430	60.091	34.388	0.29	32.233	0.14	0.296	0.19
1994	17.201	1.262	18.463	21.705	71.868	30.164	0.31	28.423	0.14	0.367	0.18
1995	21.033	1.543	22.576	25.053	77.955	30.753	0.30	15.243	0.14	0.385	0.17
1996	23.333	1.712	25.045	24.851	71.616	33.183	0.24	17.139	0.14	0.401	0.17
1997	22.983	1.686	24.669	25.415	66.860	33.509	0.24	18.109	0.14	0.476	0.17
1998	20.474	1.502	21.976	20.340	56.855	32.057	0.25	36.297	0.14	0.445	0.17
1999	18.792	1.379	20.171	21.923	52.663	30.017	0.25	24.652	0.14	0.533	0.17
2000	14.451	1.060	15.511	13.921	48.572	22.922	0.29	42.346	0.13	0.350	0.18
2001	17.294	1.269	18.563	21.303	60.143	24.626	0.29	63.330	0.13	0.445	0.16
2002	22.083	1.620	23.703	25.749	65.354	22.032	0.29	43.271	0.14	0.472	0.16
2003	27.933	2.482	30.416	30.675	69.668	22.133	0.23	50.117	0.10	0.538	0.14
2004	29.028	2.338	31.366	34.146	71.399	19.644	0.23	68.030	0.11	0.622	0.14
2005	27.869	2.062	29.931	30.175	69.116	21.398	0.23	28.397	0.10	0.513	0.16
2006	27.652	0.881	28.533	24.338	71.669	24.447	0.22	22.530	0.10	0.385	0.17
2007	31.213	0.801	32.014	28.286	79.219	27.749	0.23	28.742	0.10	0.419	0.16
2008	27.053	0.971	28.024	27.536	78.692	33.913	0.23	45.276	0.10	0.427	0.16
2009	21.835	2.027	23.862	26.249	72.669	40.322	0.21	50.478	0.10	0.439	0.16
2010	22.215	2.584	24.799	25.090	72.156	34.704	0.24	58.527	0.10	0.444	0.16
2011	24.657	1.777	26.434	24.203	80.900	32.328	0.27	33.335	0.10	0.370	0.17
2012	28.188	2.334	30.522	32.286	93.787	34.889	0.27	43.222	0.10	0.422	0.16
2013	30.611	1.682	32.293	29.722	93.221	35.902	0.25	38.901	0.12	0.370	0.20
2014	28.474	1.854	30.329	31.839	97.134	40.669	0.24	70.901	0.13	0.384	0.18
2015	27.859	2.314	30.173	28.437	101.081	49.719	0.24	36.082	0.15	0.325	0.19
2016	29.083	3.581	32.663	29.031	112.296	49.468	0.26	29.712	0.21	0.308	0.22
2017	25.634	2.202	27.835	29.854	123.879	56.963	0.27	60.252	0.41	0.281	0.23

*** Discards before 2003 were estimated from the proportion of the catch that was discarded over the period 2003-26**

Table 3.2.3. *Lophius piscatorius* in 27.78abd. Catch options: Catch, landings and discards in 2019 in tonnes; F of the catch, landings and discards in 2019; SSB in 2020 in kilotonnes; dSSB, dLand and dCatch are the change in SSB, landings and catch with the previous year (%).

Basis19	Catch19	Land19	Disc19	FCatch19	FLand19	FDis19	SSB20	dSSB	dLand	dCatch
F_{MSY}	30933	28878	2055	0.28	0.27108	0.00892	80342	-0.63	3.08	4.24
F_{MSY}lower	20935	19554	1381	0.181	0.17523	0.00577	88348	9.27	-30.2	-29.45
F_{MSY}upper	40993	38250	2743	0.39	0.37758	0.01242	72382	-10.48	36.53	38.14
F = Fsq	31041	28979	2062	0.28113	0.27217	0.00896	80256	-0.74	3.44	4.61
F = 0	0	0	0	0	0	0	105382	30.33	-100	-100
F = 0.181	20935	19554	1381	0.181	0.17523	0.00577	88348	9.27	-30.2	-29.45
F = 0.18	20829	19455	1374	0.18	0.17427	0.00573	88433	9.37	-30.56	-29.81
F = 0.19	21884	20439	1445	0.19	0.18395	0.00605	87585	8.32	-27.05	-26.25
F = 0.2	22928	21413	1515	0.2	0.19363	0.00637	86745	7.28	-23.57	-22.73
F = 0.21	23962	22378	1584	0.21	0.20331	0.00669	85915	6.26	-20.12	-19.25
F = 0.22	24987	23334	1653	0.22	0.21299	0.00701	85093	5.24	-16.71	-15.79
F = 0.23	26002	24280	1721	0.23	0.22267	0.00733	84280	4.24	-13.34	-12.37
F = 0.24	27007	25218	1789	0.24	0.23235	0.00765	83475	3.24	-9.99	-8.99
F = 0.25	28003	26146	1856	0.25	0.24204	0.00796	82680	2.26	-6.67	-5.63
F = 0.26	28989	27066	1923	0.26	0.25172	0.00828	81892	1.28	-3.39	-2.31
F = 0.27	29966	27976	1989	0.27	0.2614	0.0086	81113	0.32	-0.14	0.98
F = 0.28	30933	28878	2055	0.28	0.27108	0.00892	80342	-0.63	3.08	4.24
F = 0.29	31892	29771	2120	0.29	0.28076	0.00924	79580	-1.58	6.26	7.47
F = 0.3	32841	30656	2185	0.3	0.29044	0.00956	78825	-2.51	9.42	10.67
F = 0.31	33781	31533	2249	0.31	0.30012	0.00988	78079	-3.43	12.55	13.84
F = 0.32	34713	32401	2312	0.32	0.30981	0.01019	77340	-4.35	15.65	16.98
F = 0.33	35636	33260	2375	0.33	0.31949	0.01051	76609	-5.25	18.72	20.09
F = 0.34	36550	34112	2438	0.34	0.32917	0.01083	75886	-6.15	21.76	23.17
F = 0.35	37455	34955	2500	0.35	0.33885	0.01115	75170	-7.03	24.77	26.22
F = 0.36	38352	35791	2561	0.36	0.34853	0.01147	74462	-7.91	27.75	29.25
F = 0.37	39241	36618	2622	0.37	0.35821	0.01179	73761	-8.77	30.7	32.24
F = 0.38	40121	37438	2683	0.38	0.36789	0.01211	73068	-9.63	33.63	35.2
F = 0.39	40993	38250	2743	0.39	0.37758	0.01242	72382	-10.48	36.53	38.14

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

Type of assessment

Category 3 assessment using survey trends.

Feedback from ADG

ADG discussed whether to apply the PA buffer, which has never been applied to this stock because of a steady decrease in fishing effort since the early 1990s. ADG and ACOM decided applying the PA buffer could not be justified.

Feedback from EG audit 2017

No issues identified

3.3.1 Data

Catch numbers at length

The stock annex describes the methods for filling-in unsampled landings and discards. Figure 3.3.1 shows that about 1/3 of the landings had length data associated with them. About half of the discards were unsampled and had to be estimated from the discard rate of the sampled catches. However, discard rate are relatively low so this affects only a small proportion of the total catch weight.

Figure 3.3.2 shows the quarterly length frequency distribution of the catch data.

Figure 3.2.3 shows the length distribution of the catches in terms of abundance and biomass. Catch numbers are generally highest at size classes 10-20cm. The highest biomass in the catches is around 50-60cm. Note that the females mature around 65cm.

Surveys

The surveys are described in detail in the stock annex.

The combined IGFS-WIBTS-Q4 and EVHOE-WIBTS-Q4 surveys (FR_IR_IBTS for short) biomass index used as the basis of the advice. However, the 2017 EVHOE survey did not take place; therefore, there is no combined survey index for this year.

Figure 3.3.4a shows the distribution of the catches of recruits on the two IBTS surveys. Recruitment generally occurs in the Celtic Sea and in some years in Biscay. Figure 3.3.4b shows the distribution of the catches weights on the two IBTS surveys. During some years, the catches are highest along the area covered by the IGFS survey, in other years the EVHOE survey has higher catches. It is unclear whether this is due to movement of the stock or whether it is due to factors affecting the catchability on the surveys (e.g. weather, gear performance)

Figure 3.3.5 shows the biomass and recruitment indices of the two surveys as well as the combined index. The combined survey biomass index is much more stable than the single-survey indices but the uncertainty around the index is still considerable. Both surveys agree on a very strong 2013 recruitment and this cohort is expected to contribute to the increase in biomass seen in 2016. The IGFS survey recorded a similar biomass estimate to 2017

Table 3.3.1 provides the index data.

3.3.2 Biological reference points

Working document "WD Reference points for black anglerfish in 27abd" describes the estimation of an MSY proxy reference point for this stock. The mean-length Z method was applied to the catch data for the period 2003–2017 with the following life-history parameters:

PARAMETER	VALUE
L_{inf}	175
K	0.078
T0	0
M	0.3
a	0.0195
b	2.93
maxage	10
Lc	36

F01 = 0.23 was estimated in an equilibrium yield-per-recruit analysis, using the catch length frequency distribution of all years combined, together with the parameters listed above.

The mean-length Z analysis was then performed using the mlen_effort() function in the code from https://github.com/ices-tools-dev/ICES_MSY. A proxy of fishing effort was obtained from the *L. piscatorius* assessment in 27.78abd by dividing the TSB estimate by the catches. Figure 3.3.6 shows the outputs. F is estimated to be below the proxy reference point of F01 in the most recent year.

3.3.3 Uncertainties in the assessment

The combined IGFS-WIBTS-Q4 and EVHOE-WIBTS-Q4 surveys cover a large part of the stock distribution. Most of the depth range of the stock is also covered by the surveys (most of the abundance occurs in depths < 500m). However, catch rates are quite low (typically less than 2 fish per 30 minute haul). Therefore, the uncertainty around the index is relatively large.

The EVHOE-WIBTS-Q4 survey was not available for 2017; therefore, the advice is based on the most recent data available (2012-16).

Although the uncertainty of the biomass is quite large, there is some additional information that suggests that the stock size has increased in recent years:

- The IGFS-WIBTS-Q4 survey results indicated that the biomass in 2016 and 2017 were the two highest observed (Figure 3).
- Both IGFS-WIBTS-Q4 and EVHOE-WIBTS-Q4 surveys registered very strong recruitment in 2013 (Figure 3). These fish are expected to contribute considerably to the biomass in 2016 and 2017
- The biomass of white anglerfish in the same stock area continues to increase and the proportion of black anglerfish in the catches is virtually unchanged, suggesting that black anglerfish biomass is increasing at a similar rate.

3.3.4 Management considerations

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. However, currently the stock size of both species is increasing and neither species appears to be at risk of overexploitation.

3.3.5 Recommendations for the next benchmark

- Further explore SS3 as an assessment model for this stock
- Explore alternative methods like delay-difference production
- Update growth parameters with any new tagging data etc.
- Further investigate stock structure

3.3.6 Figures and tables

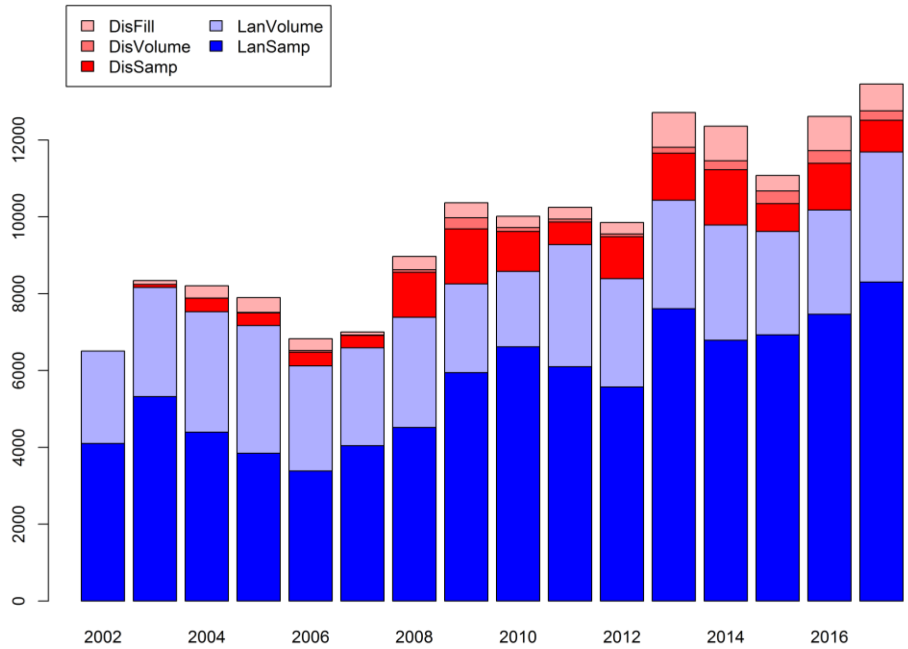

Figure 3.3.1. *Lophius budegassa* in 27.78abd. Allocations of unsampled landings and discards by year. Dark blue represents the sampled landings; light blue represents landings for which only the tonnage was available but no sampling data; Red represents the sampled discards; medium pink represents discards for which an estimate of the tonnage was available but no sampling data and light pink represents discards for which no information was available.

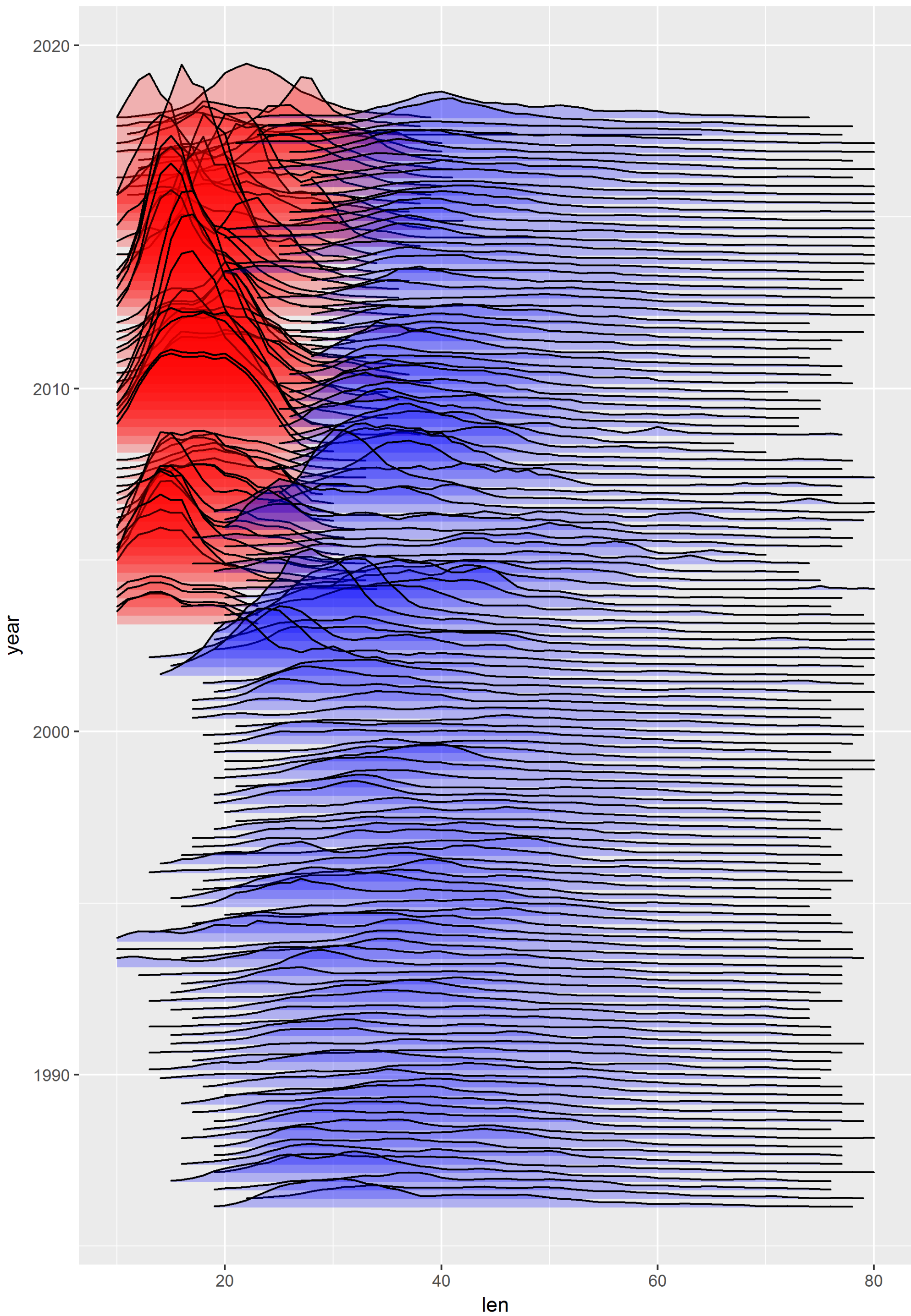

Figure 3.3.2. ***Lophius budegassa*** **in 27.78abd. Quarterly length frequency distributions of the landings (blue) and discards (red). No discard data were available prior to 2003.**

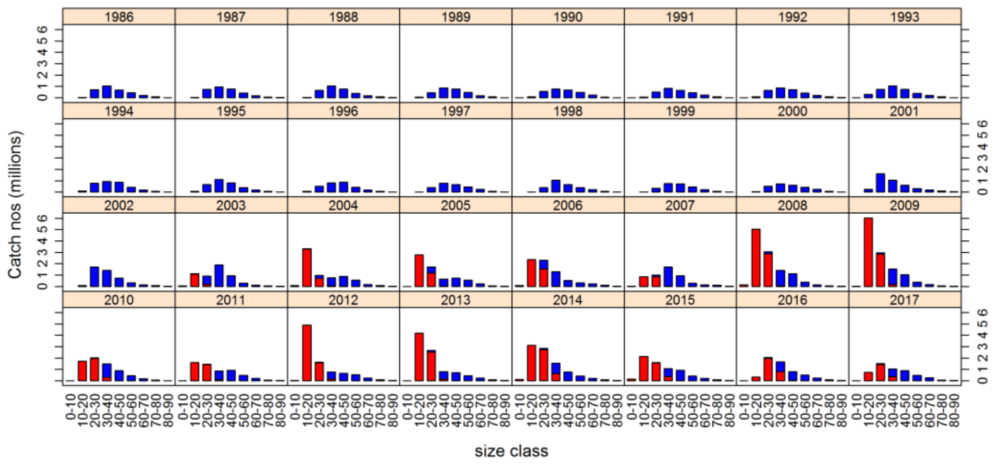

Figure 3.3.3a. ***Lophius budegassa*** **in 27.78abd. Length distributions of the catches by year in terms of abundance.**

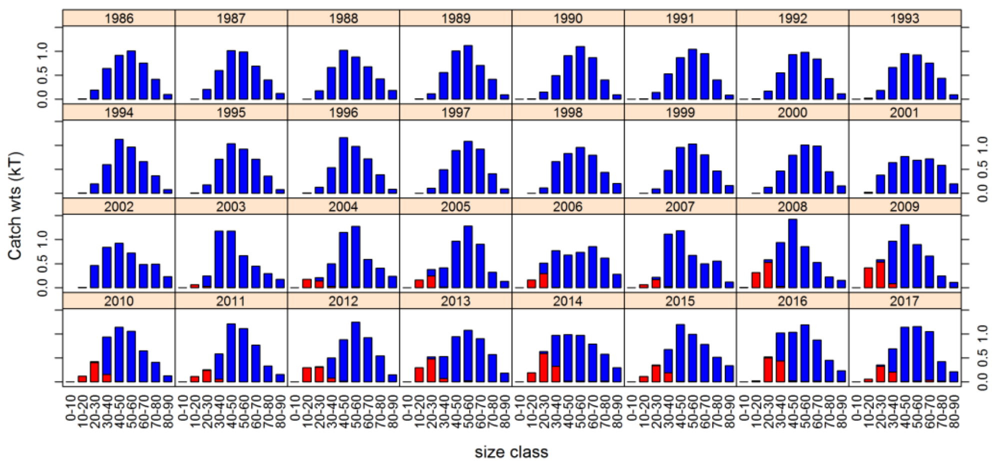

Figure 3.3.3b. ***Lophius budegassa*** **in 27.78abd. Length distributions of the catches by year in terms of biomass.**

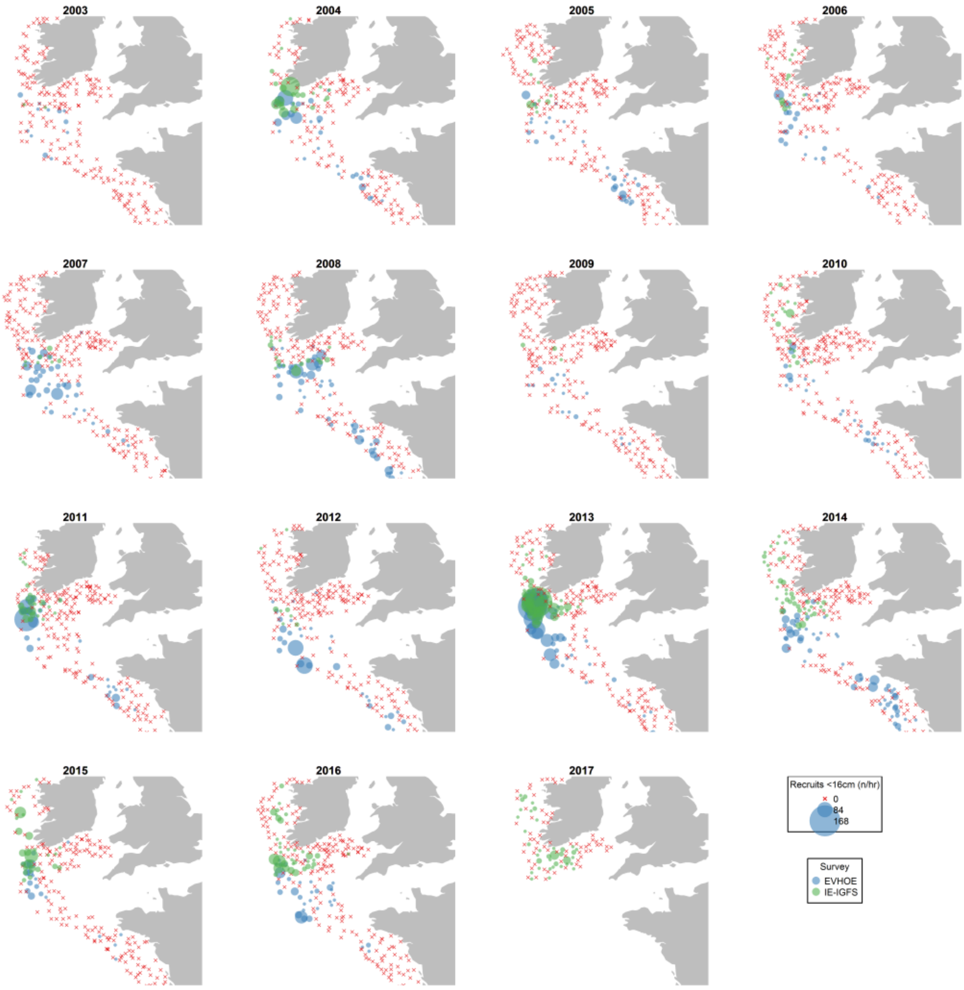

Figure 3.3.4a. ***Lophius budegassa*** **in 27.78abd. Abundance of recruits on the IGFS-WIBTS-Q4 and EVHOE-WIBTS-Q4 surveys.**

Figure 3.3.4b. ***Lophius budegassa*** **in 27.78abd. Catch weights on the IGFS-WIBTS-Q4 and EVHOE-WIBTS-Q4 surveys.**

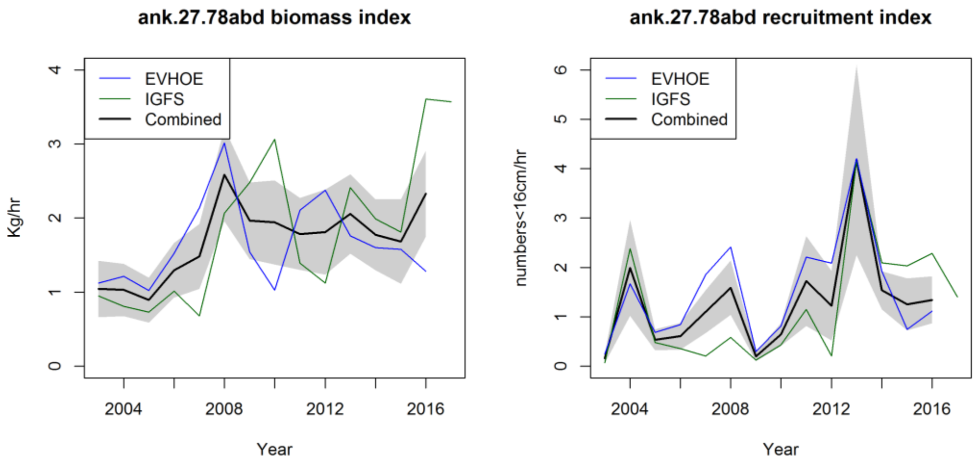

Figure 3.3.5. ***Lophius budegassa*** **in 27.78abd. Survey trends in terms of biomass (left) and recruits (<16cm; right). The grey areas indicate the 95% confidence intervals of the combined index**

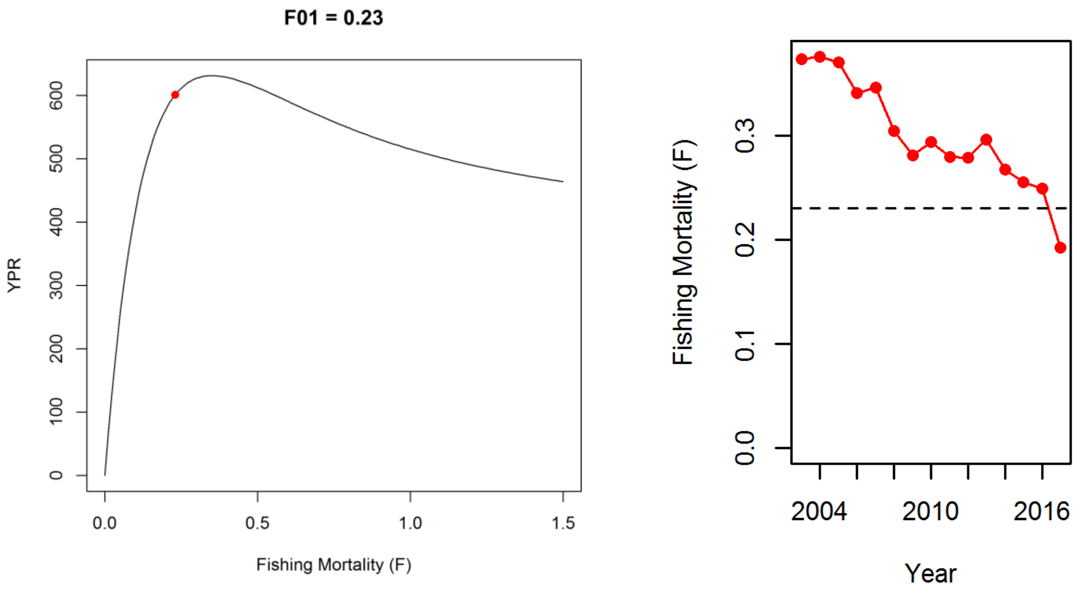

Figure 3.3.5. ***Lophius budegassa*** **in 27.78abd. YPR analysis (left) and length-based Z (with effort) estimate of fishing mortality (right), the dashed line is F01.**

Table 3.3.1. ***Lophius budegassa*** **in 27.78abd. Biomass and recruitment index for the individual surveys (EVHOE and IGFS) and combined. Estimated values (Est) and 95% confidence limits (CiLo and CiHi). The average of the last 2 years and the preceding 3 years and its ratio are given at the bottom of the table. This is the basis for the catch advice.**

	Biomass (kg / hr)					Recruitment (nos < 16cm / hr)				
	EVHOE	IGFS	Combined			EVHOE	IGFS	Combined		
Year	Est	Est	CiHi	Est	CiLo	Est	Est	CiHi	Est	CiLo
2003	1.121	0.948	0.664	1.043	1.423	0.248	0.074	0.067	0.158	0.249
2004	1.213	0.807	0.678	1.030	1.382	1.672	2.381	1.019	1.991	2.963
2005	1.024	0.733	0.590	0.893	1.197	0.688	0.478	0.322	0.535	0.748
2006	1.523	1.015	0.925	1.294	1.663	0.843	0.355	0.338	0.608	0.879
2007	2.137	0.683	1.047	1.483	1.919	1.854	0.209	0.671	1.106	1.541
2008	3.014	2.066	1.959	2.587	3.216	2.414	0.583	1.039	1.590	2.141
2009	1.540	2.482	1.449	1.964	2.480	0.294	0.126	0.107	0.202	0.298
2010	1.026	3.062	1.376	1.942	2.509	0.813	0.435	0.415	0.643	0.871
2011	2.106	1.393	1.299	1.785	2.271	2.209	1.151	0.816	1.725	2.634
2012	2.374	1.124	1.236	1.812	2.387	2.088	0.205	0.520	1.226	1.932
2013	1.762	2.414	1.521	2.055	2.589	4.208	4.155	2.253	4.177	6.102
2014	1.601	1.989	1.298	1.776	2.253	1.922	2.094	1.154	1.539	1.925
2015	1.581	1.810	1.114	1.684	2.253	0.750	2.029	0.727	1.254	1.780
2016	1.282	3.607	1.750	2.328	2.907	1.120	2.287	0.870	1.344	1.819
2017		3.572					1.402			
2015-16	Average A			2.006						
2012-14	Average B			1.881						
	Ratio (A/B)			1.067						

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

L. piscatorius and L. budegassa

Type of assessment in 2018: Benchmark (the assessment models and settings were approved in the benchmark WKANGLER-2018).

Software used: Stock Synthesis (SS) for *L. piscatorius* and SPiCT for *L. budegassa.*

Data revisions this year: A new series of French landings (2012-16) has been included. Minor changes in Spanish landings from 2002 to 2012. Spanish trawl discards series has been revised from 2002-2012.

4.1 General

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

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

The total anglerfish landings are given in Table 4.1.1 by ICES division, country and fishing gear. Landings increasing in the early eighties and reaching maximum in 1986 (9433 t) and 1988 (10021 t), and decreasing after that to the minimum in 2001 (1801 t). In 2002-2005 period landings increased reaching 4757 t, this period was followed by another one where landings gradually declined and in 2011 landings were less than half of the 2005 amount (2179 t). From 2011 to 2014 landings slightly increased to 3130 t, to decrease the next 3 years to 2307 t in 2017.

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 2008 to 2017 is 63%.

ICES performs assessments for each species separately. The benchmark assessment of anglerfish in Division 8c and 9a was carried out in 2018 (ICES, 2018a), a new assessment using SPiCT for *L. budegassa* was approved and new settings and data were incorporated to the Stock Synthesis (SS) model for *L. piscatorius.*

The ageing estimation problems, detected in a previous benchmark (see WKFLAT report) continue unsolved for *L. piscatorius* (ICES, 2018a) 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 2018 and management for 2017 and 2018

ICES advice for 2018:

ICES gave a separate advice for each of these species in 2017. ICES advises that when the MSY approach is applied, catches in 2018 should be no more than 2197 tonnes for *Lophius piscatorius* and no more than 2349 tonnes for *L. budegassa*. All catches are assumed to be landed.

Management applicable for 2017 and 2018:

The two species are managed under a common TAC that was set at 3955 t for 2017 and 3955 t for 2018. The reported landings in 2017 were 55% 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. budegassa*) - Divisions 8c and 9a.
Tonnes landed by the main fishing fleets for 1978-2017 as determined by the Working Group.

	Div. 8c						Div. 9a						Div. 8c+9a		Div. 8c+9a
	SPAIN			FRANCE			SPAIN			PORTUGAL					
Year	Trawl	Gillnet	Others	Trawl	Gillnet	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL	SUBTOTAL	Unallocated / Non-reported	TOTAL
1978	n/a	n/a				n/a	506	0	0	n/a	222	728			
1979	n/a	n/a				n/a	625	0	0	n/a	435	1 060			
1980	4 008	1 477	0	0	0	5 485	786	0	0	n/a	654	1 440	6 926	0	6 926
1981	3 909	2 240	0	0	0	6 149	1 040	0	0	n/a	679	1 719	7 867	0	7 867
1982	2 742	3 095	0	0	0	5 837	1 716	0	0	n/a	598	2 314	8 151	0	8 151
1983	4 269	1 911	0	0	0	6 180	1 426	0	0	n/a	888	2 314	8 494	0	8 494
1984	3 600	1 866	0	0	0	5 466	1 136	0	0	409	950	2 495	7 961	0	7 961
1985	2 679	2 495	0	0	0	5 174	977	0	0	466	1 355	2 798	7 972	0	7 972
1986	3 052	3 209	0	0	0	6 261	1 049	0	0	367	1 757	3 172	9 433	0	9 433
1987	3 174	2 571	0	0	0	5 745	1 133	0	0	426	1 668	3 227	8 973	0	8 973
1988	3 583	3 263	0	0	0	6 846	1 254	0	0	344	1 577	3 175	10 021	0	10 021
1989	2 291	2 498	0	0	0	4 789	1 111	0	0	531	1 142	2 785	7 574	0	7 574
1990	1 930	1 127	0	0	0	3 057	1 124	0	0	713	1 231	3 068	6 124	0	6 124
1991	1 993	854	0	0	0	2 847	878	0	0	533	1 545	2 956	5 802	0	5 802
1992	1 668	1 068	0	0	0	2 736	786	0	0	363	1 610	2 758	5 493	0	5 493
1993	1 360	959	0	0	0	2 319	699	0	0	306	1 231	2 237	4 556	0	4 556
1994	1 232	1 028	0	0	0	2 260	629	0	0	149	549	1 327	3 587	0	3 587
1995	1 755	677	0	0	0	2 432	814	0	0	134	297	1 245	3 677	0	3 677
1996	2 146	850	0	0	0	2 995	749	0	0	265	574	1 589	4 584	0	4 584
1997	2 249	1 389	0	0	0	3 638	838	0	0	191	860	1 889	5 527	0	5 527
1998	1 660	1 507	0	0	0	3 167	865	0	0	209	829	1 903	5 070	0	5 070
1999	1 110	1 140	0	0	0	2 250	750	0	0	119	692	1 561	3 811	0	3 811
2000	710	612	0	0	0	1 322	485	0	0	146	675	1 306	2 628	0	2 628
2001	614	364	0	0	0	978	247	0	0	117	459	823	1 801	0	1 801
2002	587	415	0	61	8	1 072	344	0	0	104	380	828	1 900	0	1 900
2003	1 190	771	0	55	0	2 016	617	0	0	96	529	1 242	3 258	0	3 258
2004	1 513	1 389	0	87	32	3 021	549	0	0	77	602	1 229	4 250	0	4 250
2005	1 651	1 719	0	160	55	3 586	653	0	0	60	458	1 171	4 757	0	4 757
2006	1 490	1 371	0	72	6	2 938	801	0	0	68	351	1 220	4 158	0	4 158
2007	1 327	1 076	0	26	7	2 437	866	0	0	78	303	1 247	3 683	0	3 683
2008	1 280	1 238	0	31	9	2 558	473	0	0	50	246	770	3 328	0	3 328
2009	1 151	1 207	0	20	10	2 389	386	0	0	43	262	691	3 080	0	3 080
2010	689	1 036	0	14	3	1 742	355	0	0	72	203	630	2 372	0	2 372
2011	504	598	105	18	2	1 227	244	88	146	122	199	798	2 025	154	2 179
2012	504	616	89	14	2	1 226	194	60	132	161	533	1 080	2 306	339	2 645
2013	555	860	52	23	7	1 497	173	85	140	114	412	925	2 421	288	2 710
2014	644	1 073	35	30	11	1 793	212	93	8	143	408	864	2 657	474	3 130
2015	653	983	5	13	14	1 668	206	114	3	161	422	906	2 574	395	2 969
2016	656	988	9	12	10	1 674	202	146	3	127	377	856	2 530	419	2 948
2017	410	879	1	4	11	1 305	215	128	2	98	440	883	2 188	119	2 307

n/a: not available

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

4.3.1 General

4.3.1.1 Ecosystem aspects

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

4.3.1.2 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 2008 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 2003 to 2017, the Spanish landings were on average 37% from the trawl fleet (mean lengths in 2017 of 65 cm and 66 cm in Divisions 8c and 9a, respectively) and 60% from the gillnet fishery (mean length of 81 cm in Division 8c in 2017). For the same period, Portuguese landings were on average 11% from bottom trawlers (mean length of 56 cm in 2017) and 89% from the artisanal fleet (mean length of 74 cm in 2017).

4.3.2 Data

4.3.2.1 Commercial catches and discards

Total landings by country and gear for the period 1978–2017, 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 2017. 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 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 2006 with 99 t. The Spanish gillnet fleet discards value are only available from 2013 to 2017 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.

4.3.2.2 Biological sampling

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

The sampling levels for Portugal in 2017 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 2017. The annual length compositions for all fleets combined for the period 1986–2017 are presented in Figure 4.3.1.

Landings in number, the mean length and mean weight in the landings between 1986 and 2017 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 2017 mean weight and mean length of landings increased with respect to the previous year and the mean length of 73 cm is the highest value 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 relation, updated during the benchmark (ICES, 2018a), maturity ogive and natural mortality used in the assessment are described in the Stock Annex.

4.3.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2017 are summarized in Table 4.3.5.

The abundance index from Spanish survey SpGFS-WIBTS-Q4 is shown in Figure 4.3.2 (WD03, 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, 2016, and 2017 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.

4.3.2.4 Commercial catch-effort data

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

The A Coruña fleet index, used in the assessment as abundance index from 1982–2012, is not available since 2013.

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

For each fleet the proportion of the landings in the stock is also given in the table. In 2007 a dataseries from the artisanal fleet from the port of Cedeira in Division 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, and in 2017 Portuguese trawl fleet target crustaceans showed the highest LPUE of the time-series with 2 k/hour.

4.3.3 Assessment

A new model assessment was adopted in 2018 benchmark (WKANGLER). The assessment approved in the WKANGLER (ICES, 2018a) was updated with 2017 data.

4.3.3.1 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 2017 were not included in the assessment.

4.3.3.2 Model

The Stock Synthesis (SS) 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.

4.3.3.3 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). For Spanish survey the last 3 years, model is overestimating the index. 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. However, some high positive residual are evident for SPGFS index. 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 Portuguese artisanal fleet has an asymptotic selection pattern, retaining all fish above 60 cm.

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 spawning biomass and recruitment. The annual F summary reported in the standard SS output files (with both point estimate and standard deviation) does not correspond to the F summary used here (the average of over lengths 30 to 130). The uncertainty of F could not be calculated from the variance-covariance matrix.

4.3.3.4 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 2 million. Along the time-series other high recruitment values were detected in 1989, 1990, 1994 and 2001. Since 2006 the recruitment has been below 1 million except in 2010, 2011 and 2014. The abundance of age0 in 2015, estimated at 211 thousands, was the lowest value throughout the time-series. Landings steadily decreased from 3.8 Kt in 2005 to 1.1Kt in 2011, coinciding with the decrease in F, from 0.39 in 2005 to 0.13 in 2011. Respect to 2016, landings and F decreased in 2017 by 20% and 19% respectively. Since 2005 SSB was above 6 kt and it steady increased to the highest value of the time-series estimated at the beginning of 2018 with 12 kt.

4.3.3.5 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 (2017), two years (2017 and 2016), three years (2017-2015), four years (2017-2014) and five years of data (2017-2013) 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 over-estimation of F. Nevertheless, there was no strong retrospective pattern and the assessment was accepted for projections.

4.3.4 Catch options and prognosis

4.3.4.1 Short-term projections

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

For fishing mortality, the F *status quo* equal to 0.143, estimated as the average of fishing mortality the last three years $F_{2015\text{-}2017}$ over lengths 30–130 cm, was used for 2018. In the case of recruitment, the geometric mean of a recent period (2003–2017) was used following the option indicated in the Stock Annex when a trend in the time-series was detected.

Projected landings in 2019 and SSB at the beginning of 2020 for different management options in 2019 are presented in Table 4.3.8. Under F *status quo* scenario in 2019 is expected a small decrease in landings with respect to 2018, and a decrease in SSB in 2020 with respect to 2019.

4.3.4.2 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	0.13	1.94	0.28	2.10	6. 22
F0.1	0.25	1.21	0.173	1.98	11. 97
F40%	0.40	0.76	0.109	1.68	19. 20
F35%	0.35	0.89	0.127	1.79	16. 75
F30%	0.30	1.03	0.147	1.89	14. 37

The F that maximizes the yield-per-recruit, F_{max}, is estimated at 0.28 which is over F_{sq} (0.143) and which corresponds to a SPR level of 13%. 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 0.173 and it is corresponding to a SPR level of 25%. The fishing mortality of $F_{30\%}$, $_{35\%}$ and $_{40\%}$ is estimated in 0.147, 0.127 and 0.109 respectively. The *status quo* F is below F_{max}, $F_{0.1}$, and $F_{30\%}$ and above from $F_{35\%}$ and $F_{40\%}$.

4.3.5 Biological Reference Points of stock biomass and yield.

Reference points for this stock have been updated in the Benchmark WKANGLER (ICES, 2018a). The new accepted values are presented in the following table:

Framework	Rerence Point	Value	Rational
Precautionary approach	Blim	1993 t	Bloss
	Bpa	2769 t	Blim*exp (1.645*0.2)
	Flim	0.56	Stochastic simulations of recruitment with Blim as
	Fpa	0.40	Flim*exp(-0.2*1.645)
MSY approach	F_{MSY}	0.24	Stochastic simulation, F maximises median
	$F_{MSY-lower}$	0.16	Stochastic simulations, 5% reduction in long-term yield compared with MSY.
	$F_{MSY-upper}$	0.33	
	MSY Btrigger	6283 t	5^{th} percentile of SSB when fishing at F_{MSY}

The estimated F_{MSY} (0.24) differs substantially from the value F_{MSY}=0.31 used previously.

4.3.6 Comments on the assessment

The spawning-stock biomass has increased from 2007 to 2018. SSB in 2018 is estimated at 11.8 kt which is well above of B_{pa} (2769 t) and MSY $B_{trigger}$ (6283 t). Fishing mortality in 2017 has decreased by 20% related to 2016. F in 2017 is estimated to be at a value of 0.126, below F_{pa} (0.4) and F_{MSY} (0.24). An increase in landings occurred from 1.1 kt in 2011 to 2.0 kt in 2014 and they decreased to 1.5 kt in 2017.

4.3.7 Quality considerations

The available unallocated and non-reported landings, for years 2011–2017, 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.

4.3.8 Management considerations

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

4.3.9 References

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4.3.10 Tables and Figures

Table 4.3.1 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.
Tonnes landed by the main fishing fleets for 1978-2017 as determined by the Working Group.

	Div. 8c						Div. 9a						Div. 8c+9a		Div. 8c+9a
	SPAIN			FRANCE			SPAIN			PORTUGAL					
Year	Trawl	Gillnet	Others	Trawl	Gillnet	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL	SUBTOTAL	Unallocated / Non-reported	TOTAL
1978	n/a	n/a				n/a	258				115	373			
1979	n/a	n/a				n/a	319				225	544			
1980	2 806	1 270				4 076	401				339	740	4 816	0	4 816
1981	2 750	1 931				4 681	535				352	887	5 568	0	5 568
1982	1 915	2 682				4 597	875				310	1 185	5 782	0	5 782
1983	3 205	1 723				4 928	726				460	1 186	6 114	0	6 114
1984	3 086	1 690				4 776	578			186	492	1 256	6 032	0	6 032
1985	2 313	2 372				4 685	540			212	702	1 454	6 139	0	6 139
1986	2 499	2 624				5 123	670			167	910	1 747	6 870	0	6 870
1987	2 080	1 683				3 763	320			194	864	1 378	5 141	0	5 141
1988	2 525	2 253				4 778	570			157	817	1 543	6 321	0	6 321
1989	1 643	2 147				3 790	347			259	600	1 206	4 996	0	4 996
1990	1 439	985				2 424	435			326	606	1 366	3 790	0	3 790
1991	1 490	778				2 268	319			224	829	1 372	3 640	0	3 640
1992	1 217	1 011				2 228	301			76	778	1 154	3 382	0	3 382
1993	844	666				1 510	72			111	636	819	2 329	0	2 329
1994	690	827				1 517	154			70	266	490	2 007	0	2 007
1995	830	572				1 403	199			66	166	431	1 834	0	1 834
1996	1 306	745				2 050	407			133	365	905	2 955	0	2 955
1997	1 449	1 191				2 640	315			110	650	1 075	3 714	0	3 714
1998	912	1 359				2 271	184			28	497	710	2 981	0	2 981
1999	545	1 013				1 558	79			9	285	374	1 932	0	1 932
2000	269	538				808	107			4	340	451	1 259	0	1 259
2001	231	294				525	57			16	190	263	788	0	788
2002	385	341		51	7	784	110			29	168	307	1 090	0	1 090
2003	911	722		46	0	1 679	312			29	305	645	2 324	0	2 324
2004	1 262	1 269		73	27	2 631	264			27	335	626	3 257	0	3 257
2005	1 378	1 622		134	46	3 180	371			29	244	643	3 824	0	3 824
2006	1 166	1 247		60	5	2 478	260			29	230	519	2 997	0	2 997
2007	955	1 009		22	6	1 992	181			13	192	386	2 378	0	2 378
2008	894	1 168		26	8	2 096	138			11	127	275	2 371	0	2 371
2009	850	1 058		17	9	1 935	213			10	148	371	2 306	0	2 306
2010	370	955		12	2	1 339	158			2	119	279	1 618	0	1 618
2011	243	483	73	15	2	816	59	28	48	46	80	260	1 077	80	1 157
2012	271	527	67	12	2	880	54	20	42	6	163	285	1 165	230	1 395
2013	274	718	38	19	6	1 054	47	30	50	15	154	296	1 350	190	1 541
2014	358	947	28	25	9	1 368	91	47	4	27	122	291	1 659	374	2 032
2015	324	802	4	11	12	1 152	86	53	2	34	200	375	1 527	244	1 771
2016	376	846	3	10	8	1 243	76	67	1	8	120	273	1 516	294	1 809
2017	248	726	1	3	8	986	106	66	1	30	138	341	1 327	119	1 446

n/a: not available

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

Trawl

Year	Weight (t)	CV	% Trawl Catches	% Total Catches
1994	20.9	34.05	2.4	1.0
1995	n/a	n/a	n/a	n/a
1996	n/a	n/a	n/a	n/a
1997	5.4	68.13	0.3	0.1
1998	n/a	n/a	n/a	n/a
1999	0.7	n/a	0.1	0.0
2000	6.2	n/a	1.6	0.5
2001	n/a	n/a	n/a	n/a
2002	n/a	n/a	n/a	n/a
2003	26.2	n/a	2.1	1.1
2004	64.9	n/a	4.1	2.0
2005	56.2	n/a	3.1	1.5
2006	99.3	n/a	6.5	3.3
2007	17.2	n/a	1.5	0.7
2008	5.1	n/a	0.5	0.2
2009	24.5	n/a	3.6	1.1
2010	12.5	n/a	2.3	0.8
2011	30.1	n/a	9.1	2.6
2012	66.7	n/a	11.4	4.8
2013	65.8	n/a	17.0	4.3
2014	24.4	n/a	5.2	1.2
2015	20.8	n/a	4.4	1.2
2016	0.03	n/a	0.0	0.0
2017	13.3	n/a	3.1	0.9

Gillnet

Year	Weight (t)	CV	% Gillnet Catches	% Total Catches
2013	143.8	n/a	16.1	9.3
2014	0.0	n/a	0.0	0.0
2015	7.6	n/a	0.8	0.4
2016	24.2	n/a	2.4	1.3
2017	17.0	n/a	1.9	1.2

n/a: not available
CV: coefficient of variation

Table 4.3.3 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.
Length composition by fleet and ajusted length composition for total landings (thousands) in 2017.
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	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.04
21	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.04
22	0.10	0.00	0.10	0.00	0.00	0.00	0.00	0.10	0.10
23	0.07	0.00	0.07	0.00	0.00	0.00	0.00	0.07	0.08
24	0.04	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.04
25	0.11	0.00	0.11	0.00	0.00	0.00	0.00	0.11	0.12
26	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.04
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.08	0.00	0.08	0.00	0.00	0.00	0.00	0.08	0.08
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.02	0.02
31	0.06	0.00	0.06	0.07	0.00	0.00	0.07	0.13	0.13
32	0.04	0.00	0.04	0.17	0.00	0.00	0.17	0.21	0.22
33	0.03	0.00	0.03	0.15	0.00	0.00	0.15	0.19	0.19
34	0.27	0.00	0.27	0.23	0.00	0.00	0.23	0.50	0.51
35	0.27	0.00	0.27	0.09	0.00	0.00	0.09	0.37	0.37
36	0.34	0.00	0.34	0.27	0.00	0.00	0.27	0.61	0.62
37	0.54	0.00	0.54	0.39	1.57	0.00	1.96	2.50	2.51
38	0.62	0.00	0.62	0.59	1.13	0.00	1.72	2.34	2.35
39	0.67	0.00	0.67	0.57	0.46	0.21	1.25	1.92	1.94
40	0.39	0.00	0.39	0.82	0.00	0.00	0.82	1.21	1.22
41	0.61	0.00	0.61	0.75	0.46	0.00	1.20	1.82	1.83
42	0.91	0.00	0.91	0.35	0.00	0.00	0.35	1.26	1.28
43	0.63	0.04	0.67	0.32	0.18	0.00	0.50	1.18	1.19
44	0.47	0.04	0.51	0.37	0.09	0.21	0.67	1.18	1.19
45	0.95	0.00	0.95	0.44	0.19	4.24	4.87	5.82	5.83
46	1.10	0.04	1.14	0.25	0.09	1.36	1.69	2.83	2.85
47	1.20	0.04	1.24	0.29	0.19	0.00	0.48	1.71	1.73
48	1.08	0.02	1.10	0.18	0.75	0.00	0.93	2.03	2.04
49	0.50	0.00	0.50	0.37	0.10	0.00	0.46	0.96	0.97
50	0.77	0.08	0.85	0.37	0.10	0.00	0.46	1.31	1.33
51	1.15	0.04	1.19	0.34	0.09	0.13	0.56	1.75	1.78
52	2.08	0.16	2.24	0.41	0.00	0.00	0.41	2.65	2.69
53	1.36	0.14	1.50	0.28	0.00	0.00	0.28	1.78	1.81
54	2.05	0.11	2.16	0.42	0.02	0.00	0.44	2.60	2.65
55	1.71	0.26	1.97	0.31	0.12	0.00	0.44	2.41	2.46
56	1.68	0.44	2.13	0.31	0.32	0.00	0.63	2.76	2.83
57	2.32	0.44	2.77	0.37	0.00	0.00	0.37	3.14	3.21
58	1.45	0.33	1.78	0.28	0.00	2.46	2.74	4.52	4.58
59	1.04	0.46	1.49	0.31	0.03	0.13	0.48	1.97	2.03
60	1.54	1.08	2.62	0.07	0.27	0.00	0.35	2.96	3.09
61	2.07	1.49	3.56	0.15	0.00	0.00	0.15	3.71	3.88
62	1.66	1.65	3.31	0.19	0.02	0.00	0.21	3.52	3.71
63	1.85	1.86	3.72	0.33	0.00	0.43	0.75	4.47	4.68
64	2.23	1.83	4.06	0.28	1.04	0.00	1.32	5.38	5.59
65	1.74	2.07	3.81	0.61	0.00	0.00	0.61	4.42	4.64
66	1.28	2.52	3.80	0.24	0.00	0.00	0.24	4.04	4.30
67	1.52	2.65	4.17	0.37	0.00	0.43	0.79	4.96	5.24
68	1.47	2.86	4.33	0.91	0.00	0.00	0.91	5.24	5.53
69	1.58	3.12	4.70	0.26	0.00	0.00	0.26	4.96	5.27
70	1.35	3.57	4.93	0.51	0.00	0.00	0.51	5.44	5.80
71	1.27	3.62	4.88	0.29	0.00	0.00	0.29	5.18	5.54
72	1.42	4.23	5.65	0.40	0.00	0.22	0.62	6.27	6.68
73	1.21	3.62	4.84	0.26	0.00	0.00	0.26	5.10	5.46
74	0.74	4.21	4.95	0.58	0.00	0.00	0.58	5.53	5.93
75	0.72	4.34	5.06	0.26	0.00	0.22	0.47	5.53	5.94
76	1.03	3.68	4.72	0.36	0.00	0.00	0.36	5.08	5.44
77	0.90	2.55	3.45	0.08	0.00	0.00	0.08	3.54	3.78
78	0.44	2.91	3.36	0.31	0.00	0.00	0.31	3.67	3.95
79	0.63	2.83	3.46	0.15	0.00	0.00	0.15	3.61	3.88
80	0.41	2.67	3.08	0.17	0.47	0.65	1.29	4.38	4.63
81	0.61	2.46	3.07	0.43	0.00	0.00	0.43	3.51	3.74
82	0.63	2.48	3.11	0.10	0.02	0.00	0.12	3.24	3.48
83	0.87	2.32	3.19	0.13	0.00	0.00	0.13	3.32	3.55
84	0.49	1.91	2.40	0.25	0.03	0.00	0.28	2.69	2.87
85	0.34	1.66	2.00	0.37	0.00	0.48	0.84	2.85	3.00
86	0.40	1.95	2.35	0.07	0.00	0.00	0.07	2.43	2.61
87	0.36	2.08	2.44	0.30	0.42	0.41	1.13	3.57	3.77
88	0.53	1.44	1.97	0.21	0.09	0.00	0.30	2.27	2.41
89	0.65	1.49	2.14	0.09	0.03	0.20	0.33	2.47	2.62
90	0.44	2.23	2.67	0.14	0.00	0.24	0.38	3.05	3.27
91	0.31	1.28	1.59	0.05	0.05	0.00	0.10	1.68	1.81
92	0.54	1.67	2.21	0.28	0.00	0.48	0.76	2.97	3.13
93	0.56	1.70	2.26	0.26	0.00	0.26	0.53	2.78	2.95
94	0.32	1.18	1.51	0.45	0.03	0.00	0.48	1.98	2.10
95	0.29	1.20	1.49	0.19	0.00	0.43	0.62	2.11	2.22
96	0.05	1.20	1.24	0.34	0.02	0.00	0.37	1.61	1.72
97	0.28	1.10	1.38	0.42	0.02	0.32	0.77	2.15	2.26
98	0.59	1.23	1.83	0.09	0.02	0.35	0.46	2.29	2.41
99	0.55	0.82	1.36	0.00	0.03	0.89	0.93	2.29	2.37
100+	1.60	13.18	14.78	1.90	0.55	4.46	6.91	21.68	22.91
TOTAL	64.3	106.6	170.9	22.9	9.0	19.2	51.2	222.1	233.0
Tonnes	277.2	805.0	1082.2	116.5	30.3	138.3	285.1	1367.2	1446.1
Mean Weight (g)	4311	7550	6332	5080	3355	7195	5570	6156	6205
Mean length (cm)	64.6	81.0	74.8	66.3	55.7	74.5	67.5	73.1	73.4
Measured weight (t)	n/a	n/a	n/a	n/a	0.36	0.40	n/a	n/a	n/a

Table 4.3.4 ANGLERFISH (*L. piscatorius*). Divisions 8c and 9a.
Numbers, mean weight and mean length of landings between 1986 and 2017.

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
2017	233	6 205	73

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

	SpGFS-WIBTS-Q4					PtGFS-WIBTS-Q4		
	September-October (total area Miño-Bidasoa)					October		
Year	Hauls	kg/30 min		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
2017**	112	0.53	0.30	0.18	0.07	89	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

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 day)
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	12	21 948	6	61	6	6 747	9	191	18	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	13	29 540	14.9
2005	391	10	20 663	19	248	6	10 302	24	639	17	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	6	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	4	9 003	8	165	10	22 746	7.3
2011	92	8	12 835	7	--	--	--	--	146	13	18 617	7.9
2012	132	9	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	--	--	--	--	--	--	--	
2017	76	5	12 449	6	--	--	--	--	--	--	--	

	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	--	0.8	--
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	16	--	0.2	--
2013	8	<1	27	--	0.3	--	7	<1	12	--	0.6	--
2014	16	1	32	--	0.5	--	13	1	16	--	0.8	--
2015	18	1	17	--	1.1	--	16	1	14	--	1.2	--
2016	4	<1	12	--	0.3	--	4	<1	11	--	0.3	--
2017	16	1	8	--	2.0	--	15	1	11	--	1.3	--

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	699	15 164	9 524	4 817	0.506	0.302
1981	1 924	16 242	11 126	5 566	0.500	0.331
1982	7 266	15 356	11 704	5 782	0.494	0.379
1983	2 013	14 186	10 488	6 113	0.583	0.493
1984	778	13 895	8 706	6 031	0.693	0.512
1985	1 802	12 913	8 340	6 139	0.736	0.537
1986	6 492	10 697	7 715	6 870	0.890	0.808
1987	3 746	7 342	4 759	5 139	1.080	0.932
1988	1 090	7 247	3 116	6 321	2.029	1.404
1989	3 296	5 919	2 469	4 995	2.023	1.097
1990	2 244	4 905	2 400	3 790	1.579	0.819
1991	1 065	4 769	2 202	3 640	1.653	0.839
1992	1 307	4 476	2 104	3 382	1.608	0.872
1993	1 675	3 754	1 960	2 329	1.188	0.631
1994	3 097	3 786	2 048	2 007	0.980	0.506
1995	1 855	4 578	2 308	1 835	0.795	0.337
1996	341	6 517	3 264	2 956	0.906	0.390
1997	281	7 485	4 331	3 715	0.858	0.452
1998	221	6 782	4 728	2 981	0.631	0.382
1999	731	5 766	4 577	1 933	0.422	0.296
2000	632	5 079	4 243	1 256	0.296	0.239
2001	3 652	4 920	3 983	788	0.198	0.166
2002	1 655	5 789	4 184	1 093	0.261	0.191
2003	352	7 917	4 804	2 326	0.484	0.294
2004	2 113	9 333	5 876	3 258	0.554	0.334
2005	1 394	9 553	6 817	3 827	0.561	0.386
2006	1 274	8 983	6 532	2 998	0.459	0.346
2007	716	8 784	6 307	2 377	0.377	0.280
2008	769	9 065	6 662	2 372	0.356	0.259
2009	878	9 126	7 042	2 307	0.328	0.255
2010	1 491	8 928	7 145	1 620	0.227	0.183
2011	1 190	9 348	7 473	1 156	0.155	0.133
2012	531	10 547	8 245	1 396	0.169	0.139
2013	835	11 716	9 197	1 540	0.167	0.136
2014	1 471	12 615	10 292	2 033	0.198	0.169
2015	211	12 901	10 778	1 771	0.164	0.147
2016	272	13 396	11 168	1 809	0.162	0.156
2017	386	13 369	11 456	1 447	0.126	0.126
2018	760*	13296	11839			

*geometric.mean(2003-2017)

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

SSB(2018)	Rec proj	F(30-130cm)	Land(2018)	SSB(2019)
11 839	760	0.143	1556	11 552

Fmult	Fland (30-130cm)	Landings(2019)	SSB(2020)
0	0	0	12 542
0.1	0.0143	145	12 376
0.2	0.029	288	12 213
0.3	0.043	429	12 052
0.4	0.057	567	11 893
0.5	0.072	703	11 737
0.6	0.086	837	11 583
0.7	0.1	969	11 432
0.8	0.114	1099	11 283
0.9	0.129	1227	11 137
1	0.143	1352	10 992
1.1	0.157	1476	10 850
1.2	0.172	1598	10 710
1.3	0.186	1718	10 572
1.4	0.2	1836	10 436
1.5	0.21	1952	10 303
1.6	0.23	2066	10 171
1.7	0.24	2179	10 041
1.8	0.26	2289	9914
1.9	0.27	2398	9788
2	0.29	2506	9664

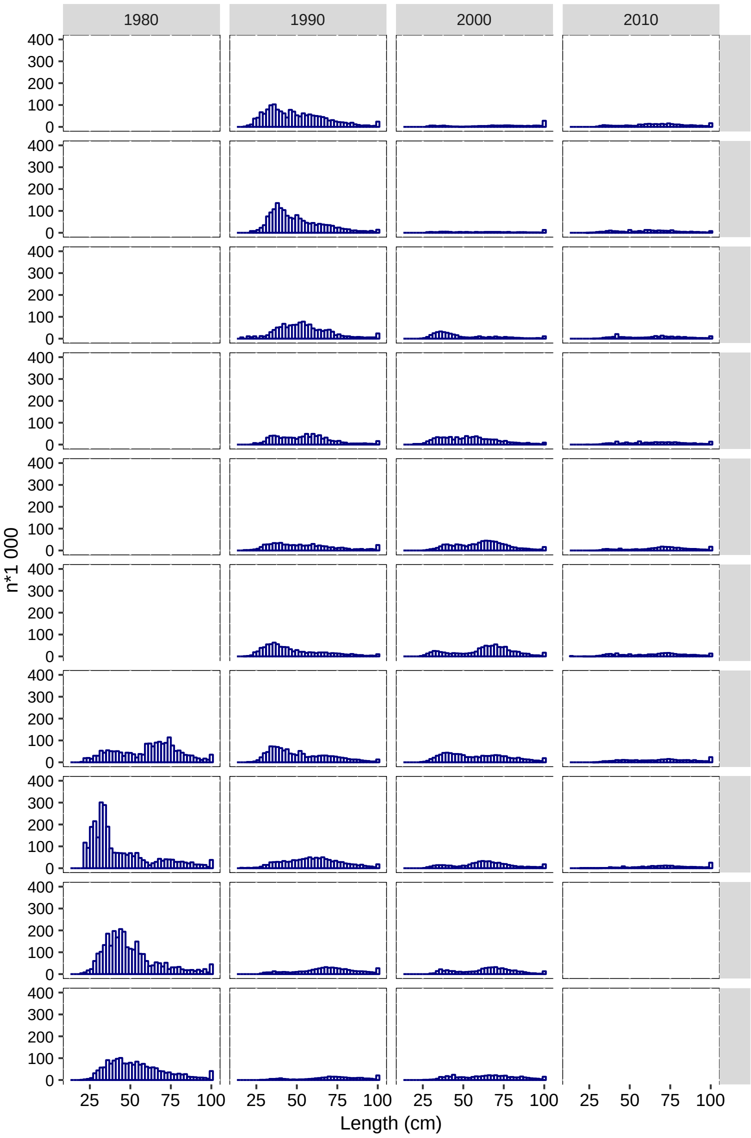


Figure 4.3.1. ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Length distributions of landings (thousands for 1986 to 2017).

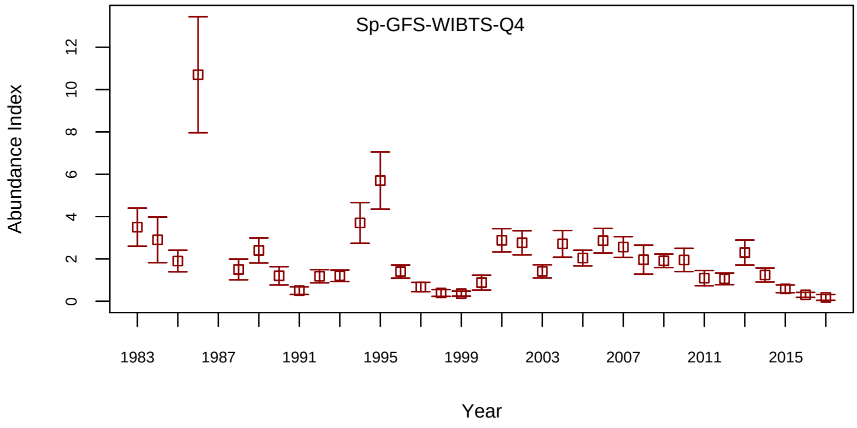


Figure 4.3.2 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.Abundance index from survey SpGFS-WIBTS-Q4 in numbers/30 min. Bars represent 95% confidence intervals.

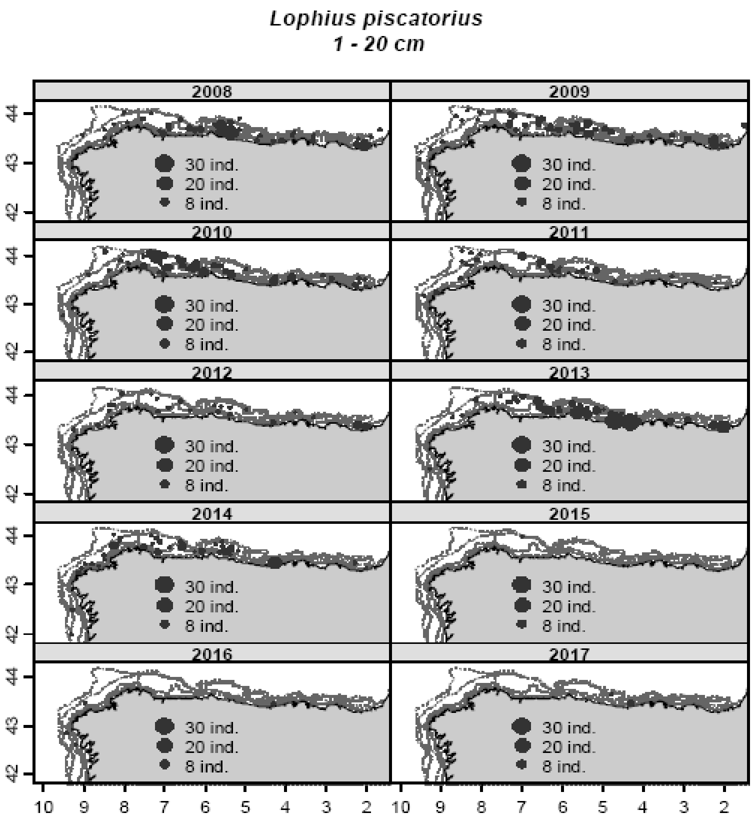


Figure 4.3.3. ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a.Spatial distribution of juveniles (length 0- 20 cm) in North Spanish Coast demersal survey (SpGFS-WIBTS-Q4) between 2008 and 2017.

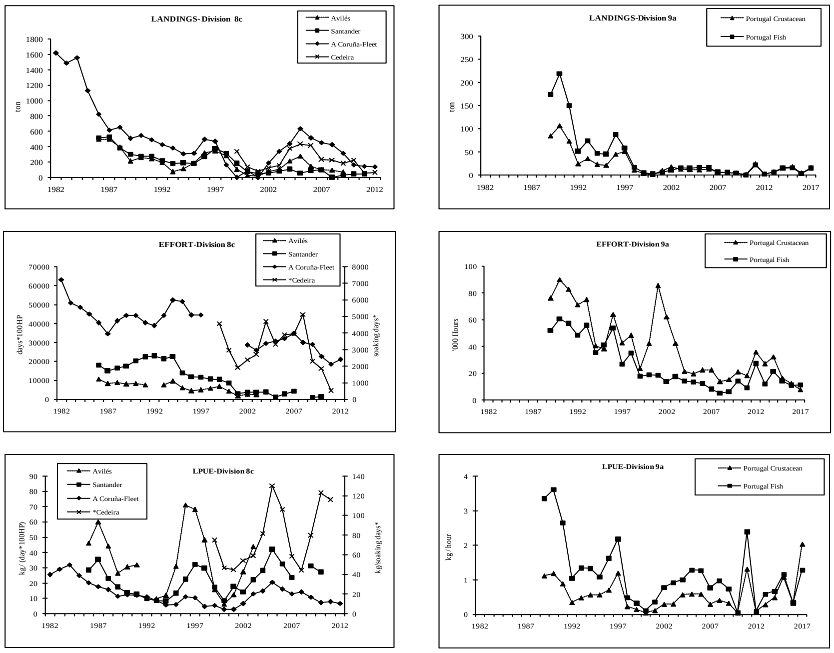


Figure 4.3.4 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Trawl and gillnet landings, effort and LPUE data between 1986-2017.

Figure 4.3.4. ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Trawl and gillnet landings, effort and LPUE data between 1986-2017.

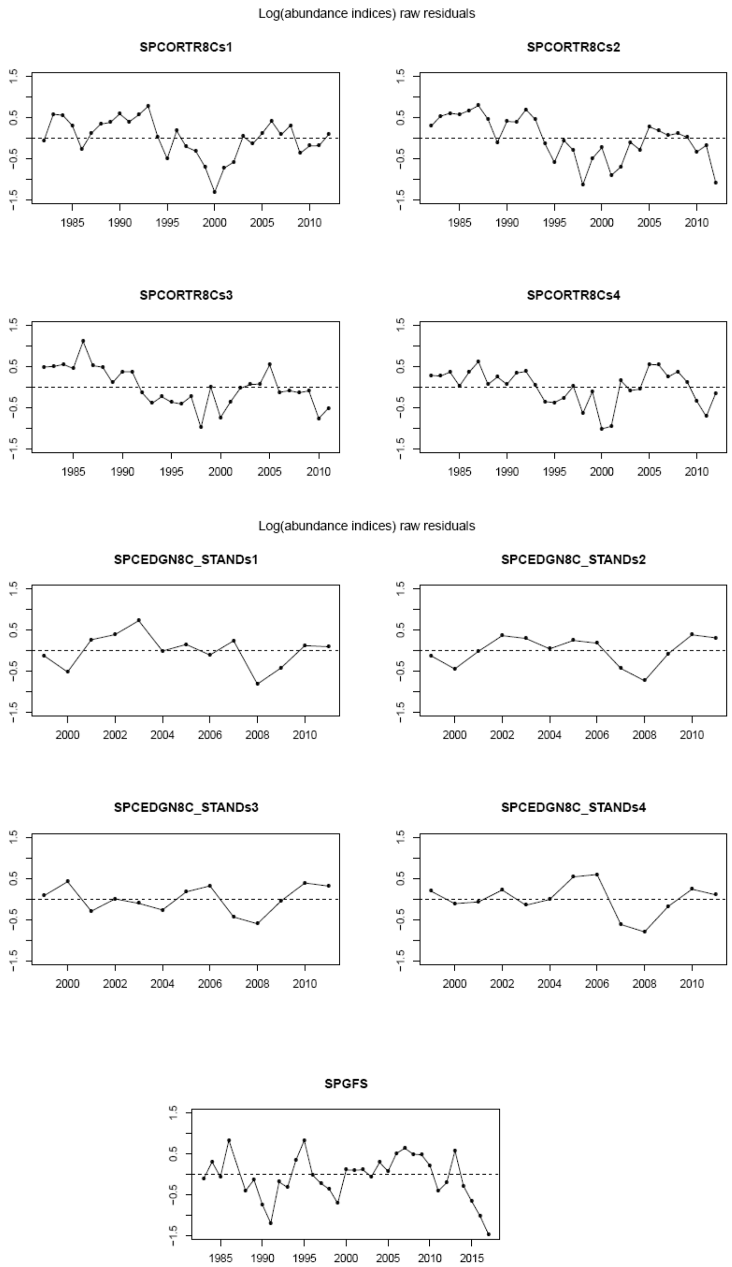


Figure 4.3.5 ANGLERFISH (*L. piscatorius*) Divisions 8c and 9a. Residuals of the fits to the surveys in log(abundance indices). A Coruña and Cedeira are by quarters.

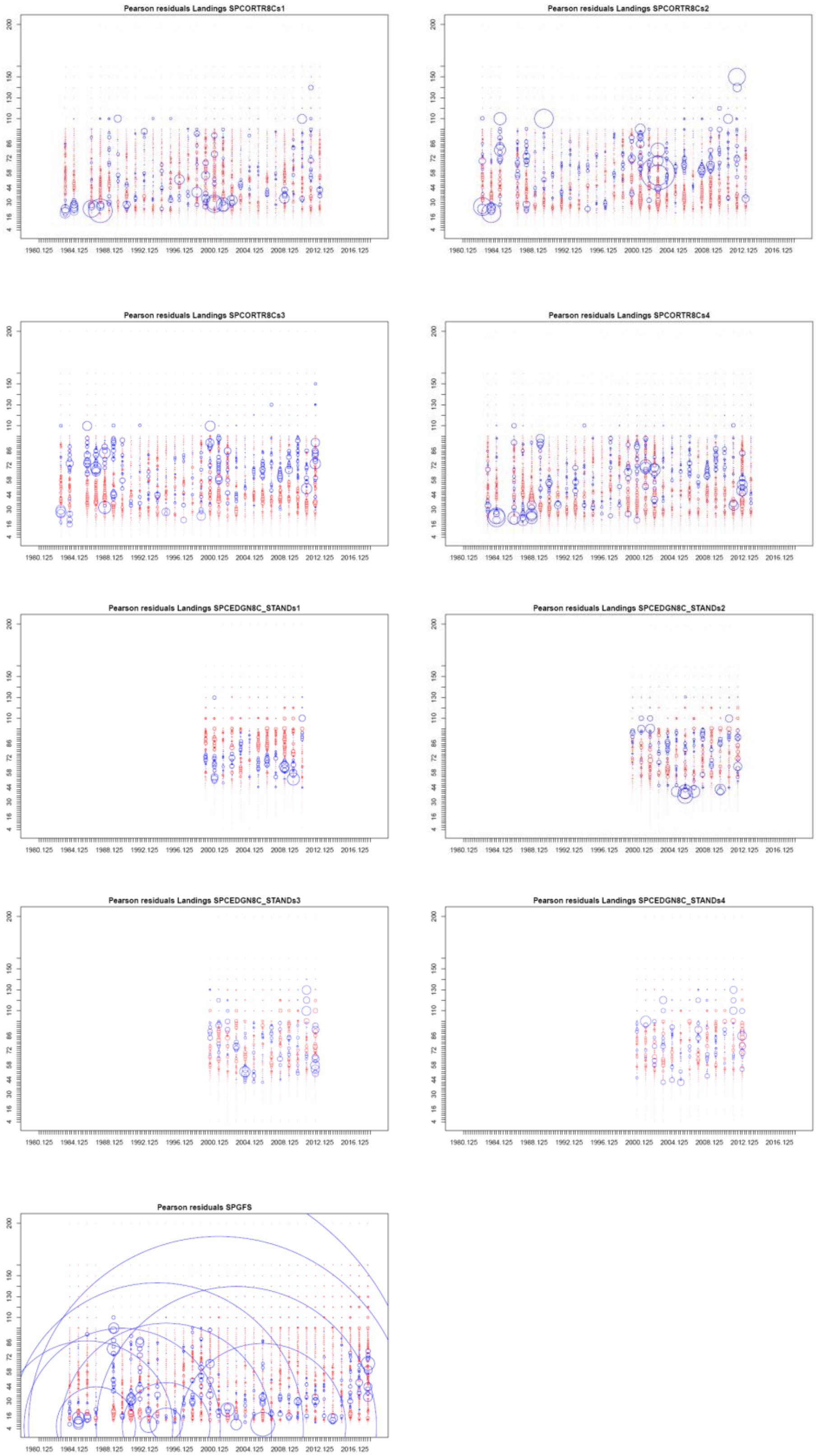


Figure 4.3.6 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Pearson residuals of the fit to the length distributions of the abundance indices. Blue=positive residuals and red=negative residuals.

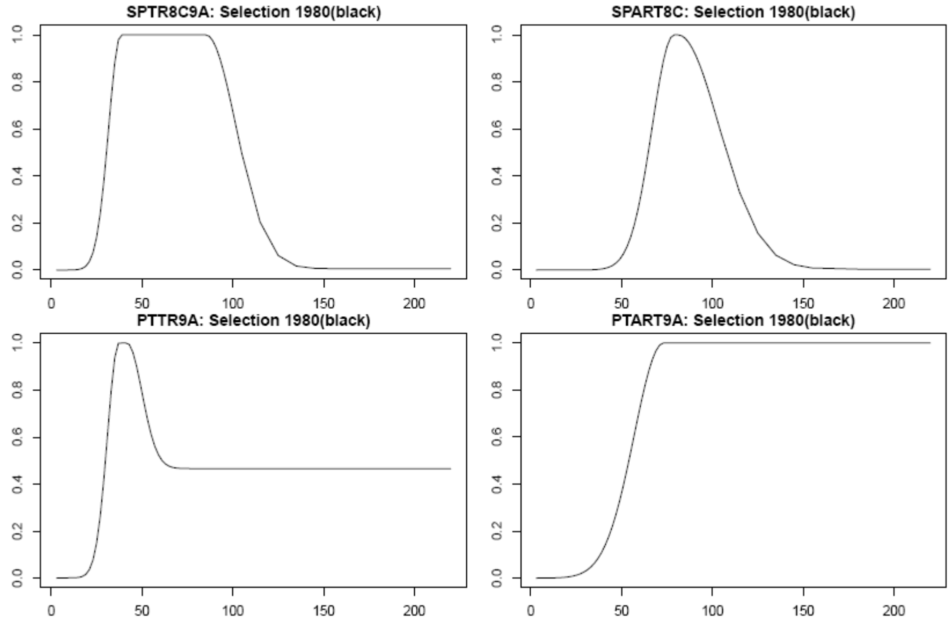


Figure 4.3.7 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Relative selection patterns at length by fishery estimated by SS.

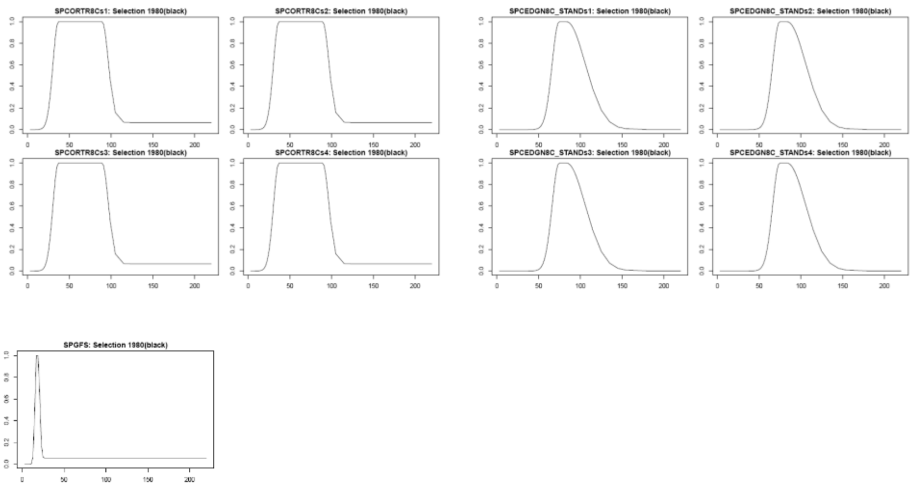


Figure 4.3.8 ANGLERFISH (*L. piscatorius*) Divisions 8c and 9a.Relative selection patterns at length by abundance index estimated by SS. A Coruña and Cedeira indices are by quarter.

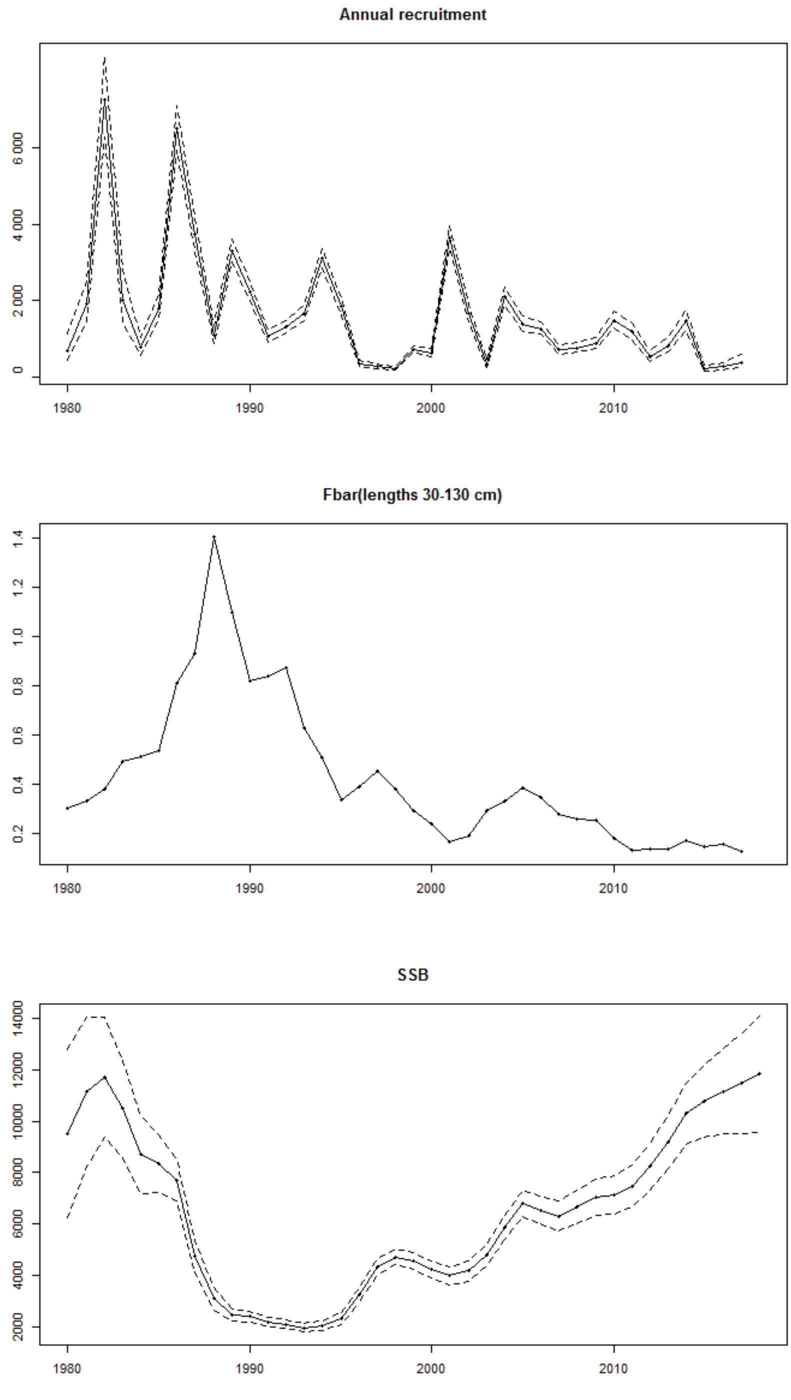


Figure 4.3.9 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Summary plots of stock trends (with 90% intervals).

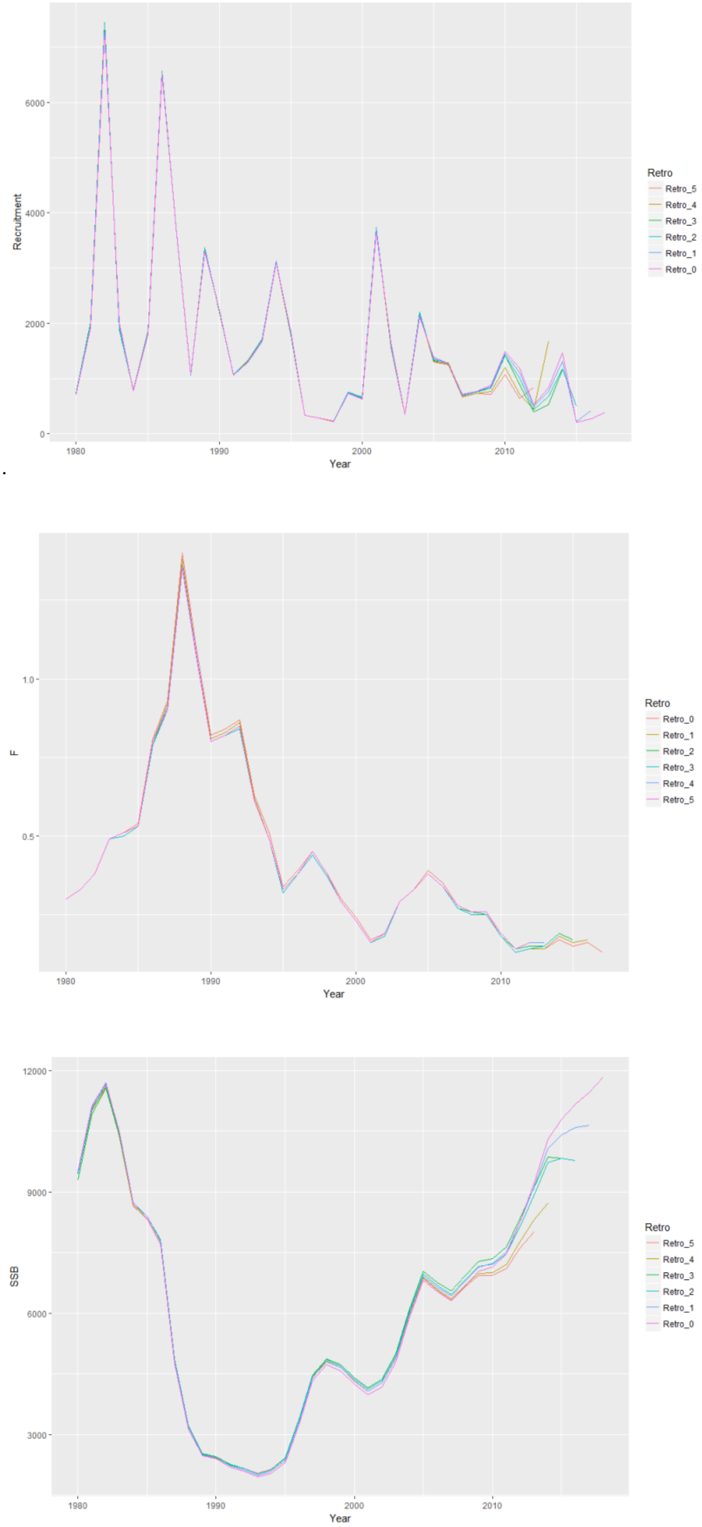


Figure 4.3.10 ANGLERFISH (*L. piscatorius*) - Divisions 8c and 9a. Retrospective plots from SS.

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.

4.4.1.2 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). French trawl, gillnet and trammelnet fisheries also catch *L. budegassa*, but reported values corresponds to <1% (on average) of the total landings of the stock.

The length distribution of the landings traditionally is considerably different between both fisheries, with the gillnet landings showing higher mean lengths compared to the trawl landings, exceptionally in 2017 the mean lengths of the trawl and artisanal fisheries are similar. Since 2008, the Spanish landings were on average split 68% from the trawl fleet (mean lengths in 2017 of 45.2 cm in Divisions 8.c and 9.a), 26% from the gillnet fleet (mean length in 2017 of 60.2 cm in Division 8.c) and 5% from others fleets. Portuguese landings, for the same period, were on average split, 30% from the trawl fleet (mean length of 51.5 cm in 2017) and 70% from the artisanal fleet (mean length of 51.7 cm in 2017). Since 2008, the French landings were on average split 68% from the trawl fleet, 32% from the gillnet fleet and almost 0% from others fleets.

4.4.2 Data

4.4.2.1 Commercial catches and discards

Total landings of *L. budegassa* by country and gear for the period 1978–2017, as estimated by the Working Group, are given in Table 4.4.1. French landing data were available to WGBIE from 2002 to 2017. Portuguese and Spanish landing data and discards were revised for WKANGLER 2018 (benchmark). Unallocated/non reported landings for this stock were available from 2011 to 2016. See historical landings analysis in the Stock Annex. 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 métier and quarter.

From 2002 to 2007 landings increased to 1 306 t, decreasing afterwards to levels between 774–754 t in 2009–2010. From 2010 to 2016 catches fluctuated between 1 022 t and 1 250 t but decreased to 861 t in 2017

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 1994–2017, shows two peaks, in 2006 (114 t) and in 2010 (64 t). 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 anglerfish in the discards, it is not possible to apply the algorithm used in the WD for hake. For this reason, discards estimates have not been calculated since 2014

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

4.4.2.2 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 2017 are shown in Table 1.4. The métier sampling adopted in Spain and Portugal in 2017, 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 2017. The annual length compositions between 1986 and 2017 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 presented in Table 4.4.4.

In 2005 the estimated 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 estimated number of landed fish decreased to a minimum in 2009. In 2010 and 2011 this value increased, but since then have been decreasing to minimum levels. The estimated mean weight continued at relative high levels.

4.4.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2017 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.

The absence of *L budegassa* in the Portuguese groundfish survey and the near zero numbers of *L. budegassa* less than 21 cm in the Spanish bottom trawl surveys on the Northern Spanish Shelf in 2014-2015 suggests a lack of recruitment in the area surveyed . The small peak of individuals below 20 cm observed in the 2016 Spanish survey is the first signal of recruitment since 2013 (WD03) but in 2017 no smaller fish were observed.

4.4.2.4 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 2013-2017. 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 4.3.4.4.

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. LPUEs from the Portuguese groundfish trawl fleets reached a maximum value in 2016 but decreased in 2017.

4.4.3 Assessment

In WKANGLER 2018 the assessment of the status of each anglerfish species was carried out separately. A new model was proposed for the assessment of *L. budegassa*, a stochastic production model in continuous-time (SPiCT; Pedersen and Berg, 2017). Nevertheless WGBIE updated the ASPIC with the 2017 data in order to compare both models.

4.4.3.1 Input data

At the WKANGLER it was accepted, that the SPiCT model should run with the same data as the ASPIC. With the exception for the Spanish fleet 'A Coruña', all following dataseries were updated until 2017 for the assessments:

- Total landings since 1980-2017 (discards are considered negligible).
- 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: 1989–2017).
- Portuguese Trawler fleet directing to groundfish (PT.fish.tr: 1989–2017).

The input data are presented in Table 4.4.7.

4.4.3.2 Aspic Model (the outgoing model)

The ASPIC (version 5.34.8) model (which implements the Schaeffer population growth model) runs were performed conditioning on yield rather than on effort. *B1/K* was fixed at 0.6 to stabilize the model. The model options, the starting estimates and the minimum and maximum constraints of each parameter are described in the Stock Annex in the assessments done previous to WKANGLER 2018 and after 2014.

4.4.3.2.1 Assessment results

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_{2018}/B_{MSY} and F_{2017}/F_{MSY} have 0.54% and 0.34% of bias having 12.60% and 16.00% of relative interquartile ranges respectively. Biomass in 2018 is estimated to be 126% of B_{MSY} with 95% bias-corrected confidence interval between 100% and 146%. Fishing mortality in 2017 is estimated to be 0.37 times F_{MSY} with 95% bias-corrected confidence interval between 0.30 and 0.48 times F_{MSY}. MSY is estimated to be 1929 t with 95% CI from 1791 t to 2041 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 2018 at 126% of B_{MSY}. Fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2017, fishing mortality is estimated to be below F_{MSY}.

Comparison between the ASPIC update assessments since the 2012 benchmark are showed in Table 4.4.9. The 2018 ASPIC results are consistent with the previous assessments.

A retrospective analysis was done taking one year each time to the accepted assessment (Figure 4.4.6). Despite some retrospective pattern (downwards for F and upwards for B) in all series the model shows good stability.

4.4.3.3 SPiCT Model (the new model)

The SPiCT model, accepted at the WGANGLER 2018, assumes the Schaefer population growth model (fixed parameter) and the default biomass and catches observed/process error ratios (alpha and beta, respectively).

SPiCT data, all assumed at the beginning of the year:

- Total landings since 1980-2017 (discards are considered negligible).
- SPN A Coruña trawl (1982 - 2012) (Index1)
- PRT Bottom-trawl crustacean (1989 - 2017) (Index2)
- PRT Bottom-trawl fish (1989 - 2017) (Index3)

The input data are presented in Table 4.4.7. and Figure 4.4.7.

SPiCT settings:

- Euler time-step (years): 1/16 (default)
- Production curve shape: assume Schaefer (n=2).
- Alpha (Biomass observation and process errors ratio): estimated by the model (default priors).
- Beta Catch observation and process errors ratio): estimated by the model (default priors).
- Other parameters: default (estimated by the model).

4.4.3.3.1 Assessment diagnostics

No significant bias (the mean of the residuals different from zero) is observed in the OSA (one-step-ahead) residuals. The diagnostics show some autocorrelation for index 1 - PT-TRC9A (the Portuguese trawl crustacean series) but were considered not meaningful. Both QQ-plot and the Shapiro test shows normality in the residuals (Figure 4.4.8.).

Some retrospective pattern is observed, suggesting some past underestimation of fishing mortality and overestimation of biomass, however each peel of the retro is within the 95% confidence intervals of the assessment (Figure 4.4.9.). The Mohn´s rho statistic (Mohn, 1999) to measure the retrospective pattern was preformed given for B/B_{MSY} 0.1247197 and for F/F_{MSY} -0.1272501. These values show no strong retrospective pattern.

4.4.3.3.2 Assessment results

SPiCT results are presented in Table 4.4.10 and Figure 4.4.10. Biomass in 2018 is estimated to be 161% of B_{MSY} with 95% confidence interval between 100% and 261%. Fishing mortality in 2017 is estimated to be 0.29 times F_{MSY} with 95% confidence interval between 0.16 and 0.52 times F_{MSY}. MSY is estimated to be 1878 t with 95% CI from 1342 t to 2628 t.

The stock biomass (B) increased from 2005 to 2016 decreasing in the last years and is estimated to be above MSY Btrigger over the whole time-series (Figure 4.4.10). Fishing mortality (F) has decreased since 1994 and is estimated to have been below FMSY since 1998.

Comparison between trends of the F/F_{MSY} and B/B_{MSY} ratios from the 2016, 2017 and 2018 ASPIC WG assessments and the 2018 SPiCT WG assessment is showed in Figure 4.4.11. The change in the assessment model resulted in a more optimistic perception of the state of the stock in relation to the reference points (relative reference points).

At the WKANGLER 2018 and at the WGBIE 2018 it was accepted the SPiCT model as the basis for advice. The SPiCT model was considered more reliable than ASPIC since it does not require the fixation of parameters, such as B1/k, to be stable.

4.4.4 Projections

The F (F *status quo*) in the intermediate year was assumed as the mean of the Fs during 2017. SPiCT, as it was setup, divide the year in 16 parts estimating 16 Fs during each year.

The projected B/B_{MSY} and yield are presented in Table 8.4.11, where each column corresponds to a fishing mortality scenario. Projections were performed for F_{MSY}, zero catches and F *status quo.* 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 multiplier corresponding to F_{MSY} of *L. piscatorius*.

The new assessment model (SPiCT) is more optimistic in estimating the status of the stock and hence the ratio between the fishing mortality and F_{MSY} is lower. Consequently projections under the MSY approach provide higher catch advice. If fishing at F_{MSY}, catches should be increased to ~5500 tonnes, values never reached by this fishery. Looking at the historical catches and respective relative biomass and fishing mortality, it is observed that when catch values attained their maximum (~4000 tonnes) the biomass decreased in the following years. WGBIE agreed that those values give greater uncertainty especially considering that historical catches have never been at this level before. A stepwise procedure to achieve F_{MSY} is recommended and two more scenarios were forecasted in addition to the ones required by ICES: 1) assuming F_{MSY} as the lower confidence interval value of F_{MSY} estimate; 2) and Flower (0.78 of F_{MSY}). With the exception of reaching MSY Btrigger and B_{lim} in 2020 scenarios, all other scenarios keep the stock above B_{MSY} in 2020 (Table 8.4.11).

WGBIE agreed that a good stepwise approach to F_{MSY} was the lower confidence interval value of F_{MSY} scenario, which gives fishing opportunities of no more than 2682 tonnes, an increase of 12% when comparing to last year's advice.

4.4.5 Biological Reference Points

WKANGLER (ICES, 2018) reiterates the basis for MSY reference points previously assumed by ICES (i.e. F_{MSY} based on the SPiCT output and a proxy for MSY $B_{trigger}$ as 50% of B_{MSY} of the SPiCT output).

FRAMEWORK	REFERENCE POINT	VALUE	TECHNICAL BASIS	SOURCE
MSY approach	MSY $B_{trigger}$	50% B_{MSY}	Relative value. B_{MSY} is estimated directly from the assessment model and changes when the assessment is updated.	(ICES, 2018)
	F_{MSY}	Relative value.	Relative value. F_{MSY} is estimated directly from the assessment model and changes when the assessment is updated.	(ICES, 2018)
	F_{MSY} range	(0.78 F_{MSY}, F_{MSY})	Relative value. F_{MSY} is estimated directly from the assessment model and changes when the assessment is updated.	(ICES, 2018)
Precautionary approach	B_{lim}	30% B_{MSY}	Relative value (equilibrium yield at this biomass is 50% of MSY).	(ICES, 2018)
	B_{pa}	Not defined		
	F_{lim}	1.70 F_{MSY}	Relative value (the F that drives the stock to Blim).	(ICES, 2018)
	F_{pa}	Not defined		
Management plan	SSB_{MGT}	Not defined		
	F_{MGT}	Not defined		

4.4.6 Comments on the assessment

This stock was benchmarked in 2018 (ICES, 2018a); therefore, the present assessment is not fully comparable with previous year's assessment.

The SPiCT diagnostics show some autocorrelation for PT-TRC9A (the Portuguese trawl series) but was not considered a matter of concern. Some retrospective pattern is observed, suggesting some past underestimation of fishing mortality and overestimation of biomass, however each peel of the retro is within the 95% confidence intervals of the assessment.

The SPiCT (Pedersen and Berg, 2016) model was considered more reliable than ASPIC since it does not require the fixation of parameters, such as B1/k, to be stable. The SPiCT model with these settings was accepted as the basis for advice (ICES, 2018 Benchmark).

4.4.7 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 2013–2017. 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.

4.4.8 Management considerations

Management considerations are in section 4.2.

4.4.9 References

ICES. 2018. Report of the Benchmark Workshop on Anglerfish stocks in the ICES areas(WKANGLER), 12–16 February 2018, Copenhagen, Denmark. ICES CM 2018/ACOM:XX. XXX pp.

Mohn, R. 1999. The retrospective problem in sequential population analysis: An investigation using cod fishery and simulated data. – ICES Journal of Marine Science, 56: 473–488.

Pedersen, M.W. and Berg, C.W. 2017. A stochastic surplus production model in continuous time. Fish and Fisheries, 18: 226-243

Table 4.4.1. ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Tonnes landed by the main fishing fleets for 1978-2017 as determined by the Working Group.

	Div. 8c							Div. 9a						Div. 8c+9a		
	SPAIN			FRANCE				SPAIN			PORTUGAL				Unallocated/	
Year	Trawl	Gillnet	Others	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	202	74		10	1	0	288	234	0	0	75	213	522	810		810
2003	279	49		9	0	0	338	305	0	0	68	224	597	934		934
2004	251	120		14	5	0	391	285	0	0	50	267	603	993		993
2005	273	97		26	9	0	405	283	0	0	31	214	527	933		933
2006	323	124		12	1	0	460	541	0	0	39	121	701	1161		1161
2007	372	68		4	1	0	444	684	0	0	66	111	861	1306		1306
2008	386	70		5	1	0	462	336	0	0	40	119	495	957		957
2009	301	148		3	1	0	454	172	0	0	34	114	320	774		774
2010	319	81		2	1	0	403	197	0	0	70	84	351	754		754
2011	261	115	32	3	0	0	411	185	60	98	75	119	538	948	74	1022
2012	233	89	22	2	0	0	346	140	40	90	156	370	796	1141	109	1250
2013	280	143	14	4	1	0	442	126	55	90	100	258	629	1071	98	1169
2014	285	126	7	5	2	0	425	120	47	4	116	286	573	998	100	1098
2015	329	181	1	2	2	0	516	119	62	2	126	222	531	1047	152	1199
2016	280	142	5	2	2	0	431	126	79	2	120	257	583	1014	125	1139
2017	163	153	0	1	3	0	319	109	62	1	68	302	542	861		861

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

TRAWL

Year	Weight (t)	CV	% Trawl Catches	% Total Catches
1994	6.1	24.4	0.6	0.4
1995	n/a	n/a	n/a	n/a
1996	n/a	n/a	n/a	n/a
1997	21.3	35.2	1.6	1.2
1998	n/a	n/a	n/a	n/a
1999	19.7	43.7	1.6	1.0
2000	8.7	35.1	1.1	0.6
2001	n/a	n/a	n/a	n/a
2002	n/a	n/a	n/a	n/a
2003	1.4	n/a	0.2	0.1
2004	10.9	n/a	2.0	1.1
2005	9.3	n/a	1.7	1.0
2006	114.0	n/a	11.7	9.8
2007	4.2	n/a	0.4	0.3
2008	4.9	n/a	0.7	0.5
2009	23.3	n/a	4.7	3.0
2010	63.5	n/a	11.0	8.4
2011	19.7	n/a	4.2	1.9
2012	5.9	n/a	1.6	0.5
2013	22.3	n/a	5.2	1.9
2014	27.8	n/a	6.4	2.5
2015	0.5	n/a	0.1	0.0
2016	0.4	n/a	0.1	0.0
2017	3.7	n/a	1.3	0.4

GILLNETS

Year	Weight (t)	CV	% Gillnets Catches	% Total Catches
2011	10.6	n/a		
2012	14.3	n/a		
2013	0	n/a		
2014	0.1	n/a	0.03	0.00
2015	0.4	n/a	0.15	0.03
2016	5.0	n/a	2.20	0.44
2017	10.9	n/a	4.82	1.26

n/a: not available

CV: coefficient of variation

Table 4.4.3 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Length composition by fleet for landings in 2017 (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
20	0.127	0.000	0.127	0.000	0.000	0.000	0.000	0.127	0.146
21	0.000	0.000	0.000	0.747	0.000	0.000	0.747	0.747	0.859
22	0.196	0.000	0.196	0.000	0.000	0.000	0.000	0.196	0.227
23	0.165	0.000	0.165	0.000	0.000	0.000	0.000	0.165	0.190
24	0.248	0.000	0.248	0.000	0.000	0.000	0.000	0.248	0.287
25	0.343	0.000	0.343	0.046	0.000	5.517	5.563	5.907	5.967
26	0.652	0.000	0.652	1.468	0.000	0.000	1.468	2.120	2.441
27	1.299	0.000	1.299	0.261	0.000	0.000	0.261	1.560	1.802
28	1.549	0.000	1.549	1.138	0.000	0.000	1.138	2.687	3.099
29	1.354	0.000	1.354	1.332	0.000	5.517	6.849	8.204	8.614
30	2.144	0.000	2.144	3.439	0.053	1.060	4.552	6.696	7.545
31	1.673	0.000	1.673	4.182	0.013	1.060	5.255	6.929	7.816
32	1.832	0.000	1.832	4.460	0.078	0.000	4.538	6.370	7.323
33	1.836	0.000	1.836	2.289	0.186	0.000	2.475	4.310	4.939
34	1.891	0.167	2.057	3.460	0.320	11.035	14.815	16.872	17.713
35	2.708	0.000	2.708	1.785	0.367	2.212	4.363	7.072	7.762
36	2.082	0.173	2.255	1.616	0.327	2.696	4.639	6.894	7.490
37	2.106	0.000	2.106	1.712	0.413	0.000	2.125	4.231	4.816
38	2.984	0.080	3.064	2.167	0.527	1.060	3.754	6.818	7.622
39	1.661	0.080	1.741	1.466	1.140	0.184	2.791	4.531	5.024
40	3.556	0.173	3.730	1.442	1.339	0.576	3.356	7.086	7.887
41	2.525	0.000	2.525	0.932	1.519	1.196	3.647	6.172	6.706
42	1.844	0.487	2.331	2.042	1.281	1.342	4.665	6.996	7.671
43	2.850	0.167	3.017	0.633	1.227	1.151	3.011	6.028	6.596
44	2.092	1.159	3.251	2.037	1.318	1.679	5.035	8.286	9.112
45	2.605	0.291	2.896	0.879	0.946	0.812	2.638	5.533	6.121
46	1.870	0.050	1.921	0.486	1.369	1.344	3.199	5.119	5.493
47	2.071	0.160	2.230	0.423	1.160	1.600	3.183	5.414	5.828
48	2.030	0.833	2.863	2.269	0.548	2.601	5.418	8.281	9.077
49	1.891	0.519	2.411	0.964	0.831	1.295	3.090	5.501	6.027
50	1.953	0.536	2.489	1.058	0.407	1.009	2.474	4.963	5.517
51	1.920	0.862	2.782	0.856	0.327	1.849	3.032	5.813	6.386
52	1.677	0.700	2.377	1.438	0.435	4.675	6.548	8.925	9.520
53	1.217	0.735	1.952	0.682	0.224	2.559	3.464	5.416	5.832
54	1.402	1.462	2.864	0.648	1.100	0.772	2.520	5.384	5.945
55	0.954	1.069	2.023	0.639	0.510	0.480	1.628	3.651	4.075
56	1.055	1.150	2.205	0.641	0.459	1.537	2.636	4.841	5.295
57	1.020	0.704	1.724	0.621	0.571	2.116	3.308	5.032	5.403
58	0.960	0.801	1.762	0.186	0.343	2.544	3.073	4.834	5.147
59	0.607	0.847	1.454	0.219	0.164	2.384	2.767	4.221	4.491
60	1.106	1.169	2.275	0.690	0.089	0.513	1.292	3.567	4.039
61	0.598	1.027	1.626	0.199	0.158	3.198	3.555	5.181	5.476
62	0.728	1.776	2.505	0.094	0.252	1.782	2.127	4.632	5.058
63	0.606	2.319	2.925	0.282	1.377	1.668	3.327	6.252	6.778
64	0.623	0.998	1.621	0.334	0.648	1.002	1.984	3.606	3.920
65	0.819	1.322	2.141	0.340	0.322	1.068	1.730	3.871	4.272
66	0.710	2.239	2.948	0.098	0.253	1.153	1.503	4.451	4.952
67	0.522	1.722	2.244	0.196	0.185	1.102	1.484	3.727	4.127
68	0.802	1.271	2.073	0.203	0.154	1.199	1.556	3.629	3.998
69	0.581	1.333	1.914	0.247	0.218	2.648	3.113	5.027	5.378
70	0.653	0.956	1.609	0.239	0.225	6.399	6.863	8.471	8.769
71	0.657	0.719	1.376	0.427	0.240	1.149	1.817	3.193	3.480
72	0.617	0.806	1.424	0.353	1.069	0.483	1.906	3.329	3.614
73	0.900	0.643	1.543	0.855	0.091	0.761	1.708	3.251	3.627
74	0.553	0.149	0.701	0.195	0.203	3.874	4.272	4.973	5.114
75	0.506	0.134	0.640	0.260	0.013	0.000	0.273	0.913	1.053
76	0.772	0.151	0.923	0.181	0.427	3.599	4.207	5.131	5.304
77	0.395	0.212	0.607	0.184	0.040	0.144	0.368	0.975	1.100
78	0.408	0.097	0.505	0.248	0.208	0.000	0.456	0.961	1.078
79	0.477	0.036	0.513	0.399	0.194	0.337	0.931	1.444	1.584
80	0.286	0.085	0.371	0.240	0.027	0.337	0.604	0.976	1.070
81	0.124	0.116	0.240	0.099	0.000	1.763	1.862	2.103	2.156
82	0.543	0.021	0.564	0.241	0.000	0.000	0.241	0.805	0.929
83	0.079	0.000	0.079	0.191	0.042	0.709	0.941	1.021	1.062
84	0.218	0.013	0.231	0.037	0.013	0.932	0.983	1.213	1.255
85	0.209	0.000	0.209	0.046	0.215	0.000	0.261	0.470	0.510
86	0.133	0.000	0.133	0.083	0.000	0.000	0.083	0.216	0.250
87	0.140	0.013	0.153	0.133	0.000	0.000	0.133	0.286	0.330
88	0.000	0.045	0.045	0.097	0.000	0.476	0.573	0.618	0.640
89	0.074	0.000	0.074	0.122	0.038	0.000	0.160	0.235	0.265
90	0.112	0.000	0.112	0.069	0.000	0.144	0.213	0.326	0.354
91	0.062	0.000	0.062	0.032	0.026	0.000	0.058	0.121	0.135
92	0.032	0.000	0.032	0.070	0.171	0.000	0.241	0.274	0.289
93	0.153	0.000	0.153	0.054	0.000	0.000	0.054	0.207	0.239
94	0.000	0.000	0.000	0.014	0.000	0.000	0.014	0.014	0.016
95	0.062	0.000	0.062	0.000	0.013	0.000	0.013	0.076	0.085
96	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
97	0.149	0.000	0.149	0.032	0.000	0.000	0.032	0.181	0.209
98	0.062	0.000	0.062	0.000	0.000	0.000	0.000	0.062	0.072
99	0.000	0.000	0.000	0.060	0.000	0.000	0.060	0.060	0.069
100+	0.032	0.045	0.077	0.199	0.025	0.821	1.046	1.123	1.165
TOTAL	78	33	111	59	26	101	186	297	324
Landings (t)	163	153	315	109	68	302	479	794	861
Mean Weight (g)	2074	4676	2838	1870	2562	2983	2573	2672	2662
Mean Length (cm)	47.2	60.2	51.0	42.6	51.5	51.7	48.8	49.6	49.5
Measured weight (t)	n/a	n/a	n/a	n/a	1171.3	738.8	1910.1	n/a	n/a

n/a: not available

Table 4.4.4 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Number, mean weight and mean length of landings between 1986 and 2017.

	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
2017	323	2665	50

Table 4.4.5 ANGLERFISH (*L. budegassa*) - 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		N/30 min		Hauls	N/60 min	kg/60 min
		Yst	Sst	Yst	Sst			
1983	145	0.68	0.17	0.50	0.09	117	n/a	n/a
1984	111	0.60	0.17	0.60	0.11	na	n/a	n/a
1985	97	0.46	0.11	0.50	0.07	150	n/a	n/a
1986	92	1.42	0.32	2.50	0.33	117	n/a	n/a
1987	ns	ns	ns	ns	ns	81	n/a	n/a
1988	101	2.27	0.38	1.50	0.21	98	n/a	n/a
1989	91	0.45	0.10	0.90	0.21	138	0.23	0.19
1990	120	1.52	0.47	1.50	0.22	123	0.11	0.17
1991	107	0.83	0.14	0.60	0.10	99	+	0.02
1992	116	1.16	0.19	0.80	0.11	59	+	+
1993	109	0.90	0.20	0.90	0.13	65	0.02	0.04
1994	118	0.75	0.17	1.00	0.12	94	0.06	0.09
1995	116	0.72	0.12	1.00	0.11	88	0.02	0.08
1996*	114	0.95	0.17	1.30	0.18	71	0.27	0.50
1997	116	1.16	0.20	0.97	0.11	58	0.03	0.01
1998	114	0.88	0.18	0.57	0.09	96	0.02	0.12
1999*	116	0.43	0.12	0.26	0.06	79	0.08	0.07
2000	113	0.66	0.18	0.40	0.08	78	0.13	0.13
2001	113	0.19	0.06	0.52	0.10	58	+	+
2002	110	0.26	0.09	0.33	0.07	67	0	0
2003*	112	0.36	0.11	0.35	0.10	80	0.22	0.21
2004*	114	0.76	0.23	0.44	0.12	79	0.14	0.21
2005	116	0.64	0.20	1.62	0.30	87	0.01	+
2006	115	1.08	0.22	1.16	0.19	88	0.02	0.46
2007	117	0.59	0.12	0.48	0.08	96	0.02	0.03
2008	115	0.35	0.09	0.29	0.05	87	0.07	0.36
2009	117	0.30	0.08	0.35	0.08	93	0.02	+
2010	127	0.35	0.09	0.53	0.09	87	0.09	0.18
2011	111	0.63	0.15	0.52	0.08	86	0.02	0.06
2012	115	0.61	0.10	0.74	0.11	ns	ns	ns
2013**	114	1.27	0.36	1.40	0.35	93	0.02	0.03
2014**	116	1.11	0.27	0.87	0.15	81	0.00	0.00
2015**	114	0.55	0.13	0.36	0.08	90	0.00	0.00
2016**	114	0.51	0.10	0.40	0.06	85	0.02	0.30
2017**	112	0.55	0.15	0.35	0.08	89	0.09	0.05

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

Table 4.4.6 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.

Landings, fishing effort, standardized fishing effort, landings per unit effort and standardized landings per unit effort for trawl and gillnet fleets.

For landings the percentage relative to total annual stock landings is given.

	Avilés, SP-AVITR8C				Santander, SP-SANTR8C				Standardized Cedeira, STAND-SP-CEDGNS8C			
Year	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (days*100hp)	LPUE (kg/day*100hp)	LANDINGS	%	EFFORT (soaking days)	LPUE (kg/soaking day)
1986	64	3	10845	5.9	21	1	18153	1.1	--	--	--	--
1987	85	2	8309	10.3	16	0	14995	1.1	--	--	--	--
1988	125	3	9047	13.9	30	1	16660	1.8	--	--	--	--
1989	119	5	8063	14.7	32	1	17607	1.8	--	--	--	--
1990	58	2	8497	6.8	40	2	20469	1.9	--	--	--	--
1991	52	2	7681	6.7	62	3	22391	2.8	--	--	--	--
1992	33	2	--	--	107	5	22833.0	4.7	--	--	--	--
1993	53	2	7635	7.0	143	6	21370	6.7	--	--	--	--
1994	65	4	9620	6.7	196	12	22772	8.6	--	--	--	--
1995	141	8	6146	23.0	126	7	14046	9.0	--	--	--	--
1996	162	10	4525	35.8	89	5	12071	7.4	--	--	--	--
1997	143	8	5061	28.3	122	7	11776	10.4	--	--	--	--
1998	91	4	5929	15.3	114	5	10646	10.7	--	--	--	--
1999	41	2	6829	5.9	67	4	10349	6.5	14	1	4 582	3.0
2000	23	2	4453	5.1	44	3	8779	5.0	4	<1	2 981	1.3
2001	12	1	1838	6.7	28	3	3053	9.3	6	1	1 932	3.0
2002	11	1	2748	4.1	16	2	3975	4.1	7	1	2 398	3.0
2003	9	1	2526	3.6	15	2	3837	4.0	3	<1	2 703	0.9
2004	32	3	--	--	23	2	3776.0	6.0	5	1	4 677	1.1
2005	54	6	--	--	7	1	1404.0	4.9	2	<1	3 325	0.7
2006	16	1	--	--	18	2	2717.5	6.8	4	<1	3 911	1.0
2007	11	1	--	--	19	1	4333.7	4.5	2	<1	3 976	0.6
2008	10	1	--	--	--	--	--	--	0	<1	5 133	0.1
2009	5	1	--	--	8	1	1124.8	6.8	4	1	2 300	1.7
2010	--	--	--	--	19.4	3	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	9	21 948	3.5	31	4	6 747	4.6	107	13	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	3	10 302	3.1	86	9	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	10	16 680	4.4	87	12	9 003	9.7	199	26	22 746	8.7
2011	64	6	12 835	5.0	--	--	--	--	144	14	18 617	7.7
2012	102	8	14 446	7.0	--	--	--	--	172	14	21 110	8.2
2013	88	8	14 736	6.0	--	--	--	--	--	--	--	--
2014	79	7	18 060	4.4	--	--	--	--	--	--	--	--
2015	67	6	13 309	5.0	--	--	--	--	--	--	--	--
2016	89	8	13 718	6.5	--	--	--	--	--	--	--	--
2017	64	7	12 449	5.2	--	--	--	--	--	--	--	--

	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	3	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	6	36	--	2.26	--	75	6	16	--	4.73	--
2013	52	4	27	--	1.92	--	48	4	12	--	3.95	--
2014	60	5	17	--	3.52	--	56	5	16	--	3.45	--
2015	66	5	17	--	3.99	--	61	5	14	--	4.29	--
2016	62	5	12	--	5.05	--	57	5	11	--	5.30	--
2017	35	4	8	--	4.54	--	32	4	11	--	2.87	--

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

Year	Catch	SPCORTR8c	PT.crust.tr	PT.fish.tr
1980	2.11E+03			
1981	2.30E+03			
1982	2.37E+03	1.03E+01		
1983	2.38E+03	1.50E+01		
1984	1.93E+03	1.18E+01		
1985	1.83E+03	5.61E+00		
1986	2.56E+03	8.71E+00		
1987	3.83E+03	1.94E+01		
1988	3.70E+03	1.37E+01		
1989	2.58E+03	7.74E+00	1.17E-03	3.51E-03
1990	2.33E+03	6.49E+00	1.41E-03	4.29E-03
1991	2.16E+03	5.56E+00	1.22E-03	3.65E-03
1992	2.11E+03	5.41E+00	1.32E-03	3.97E-03
1993	2.23E+03	4.47E+00	8.53E-04	2.37E-03
1994	1.58E+03	3.89E+00	6.37E-04	1.50E-03
1995	1.84E+03	8.28E+00	5.82E-04	1.11E-03
1996	1.63E+03	9.05E+00	7.03E-04	1.62E-03
1997	1.81E+03	7.65E+00	8.79E-04	1.60E-03
1998	2.09E+03	1.09E+01	1.45E-03	3.16E-03
1999	1.88E+03	1.24E+01	1.72E-03	3.85E-03
2000	1.37E+03	9.55E+00	1.56E-03	4.04E-03
2001	1.01E+03	9.40E+00	6.86E-04	2.27E-03
2002	8.10E+02	3.74E+00	7.54E-04	2.00E-03
2003	9.34E+02	4.89E+00	7.14E-04	2.17E-03
2004	9.93E+02	3.63E+00	1.07E-03	1.90E-03
2005	9.33E+02	2.76E+00	6.34E-04	1.38E-03
2006	1.16E+03	4.69E+00	8.01E-04	1.73E-03
2007	1.31E+03	6.39E+00	1.53E-03	3.98E-03
2008	9.57E+02	8.69E+00	1.50E-03	3.56E-03
2009	7.74E+02	5.05E+00	1.14E-03	2.65E-03
2010	7.54E+02	8.75E+00	1.75E-03	2.37E-03
2011	1.02E+03	7.71E+00	2.15E-03	3.91E-03
2012	1.25E+03	8.17E+00	2.26E-03	4.73E-03
2013	1.17E+03		1.92E-03	3.95E-03
2014	1.10E+03		3.52E-03	3.45E-03
2015	1.20E+03		3.99E-03	4.29E-03
2016	1.14E+03		5.05E-03	5.30E-03
2017	8.61E+02		4.54E-03	2.87E-03

Table 4.4.8 ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
ASPIC results: parameter estimates, non parametric bootstrap relative bias and bias corrected confidence interval, interquartil (IQ) range and relative range. Ye(2018): equilibrium yield available in 2018; Y(Fmsy): yield availabe at Fmsy in 2018; Ye2018/MSY: equilibrium yield available in 2018 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).

WG2018 (WKFLAT2012/Stock Annex settings), B1/K fixed at 0.60

Parameter	Point estimates	Relative bias	Bootstrap Confidence Interval 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	27710	0.32%	24160	32540	22300	35530	4206	15.20%
q(1)	7.86E-04	1.17%	5.99E-04	9.71E-04	5.24E-04	1.09E-03	1.90E-04	24.20%
q(2)	1.48E-07	1.70%	1.15E-07	1.84E-07	9.93E-08	2.05E-07	3.58E-08	24.20%
q(3)	3.04E-07	1.61%	2.34E-07	3.81E-07	2.00E-07	4.20E-07	7.65E-08	25.10%
MSY	1929	0.23%	1839	2001	1791	2041	81	4.20%
Ye(2018)	1804	-1.67%	1703	1905	1611	1948	105	5.80%
Y.(Fmsy)	908	-0.09%	898	920	893	927	12	1.30%
Bmsy	13860	0.32%	12080	16270	11150	17770	2103	15.20%
Fmsy	0.139	1.67%	0.113	0.166	0.101	0.183	0.026	18.90%
fmsy(1)	177.2	1.60%	155	198.3	146.3	215.8	23.43	13.20%
fmsy(2)	942700	1.15%	815800	1073000	753800	1152000	141600	15.00%
fmsy(3)	457300	1.29%	395000	528700	371900	570100	68100	14.90%
B./Bmsy	1.26	0.54%	1.10	1.39	1.00	1.46	0.16	12.60%
F./Fmsy	0.37	0.34%	0.32	0.43	0.30	0.48	0.06	16.00%
Ye./MSY	0.94	-1.76%	0.85	0.99	0.79	1.00	0.08	8.30%
q2/q1	1.88E-04	1.08%	1.64E-04	2.17E-04	1.54E-04	2.31E-04	2.79E-05	14.80%
q3/q1	3.88E-04	1.05%	3.39E-04	4.50E-04	3.12E-04	4.82E-04	5.47E-05	14.10%

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

		WG2013	WG2014		WG2015		WG2016	WG2017	WG2018
Outputs	**WKFLAT2012**	**Benchmark Settings**	**Benchmark Settings**	**Bench. Set. B1/K fixed**	**Benchmark Settings**	**Bench. Set. B1/K fixed**	**Bench. Set. B1/K fixed**	**Bench. Set. B1/K fixed**	**Bench. Set. B1/K fixed**
B1/K	0.93	0.44	0.44	0.60	0.19	0.60	0.60	0.60	0.60
MSY	1375	1881	1900	1633	3622	1749	1856	1906	1929
K	43910	58390	59360	47260	101800	38600	31610	28820	27710
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	7.86E-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	1.48E-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	3.04E-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	1.46E+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	1.74E-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	4.17E-01
CI	0.5015	0.2162	0.2114	0.3080	0.1013	0.3345	0.3707	0.3919	0.4218
CN	1.0000	0.9438	0.9356	1.0000	0.6994	1.0000	1.0000	1.0000	1.0000
Rest	111	19	8	7	82	7	8	9	9
Error	0	0	0	0	11	0	0	0	0
r sq 1	0.181	0.165	0.165	0.169	0.139	0.148	0.120	0.103	0.100
rsq 2	0.010	0.132	0.131	0.125	0.366	0.336	0.446	0.481	0.503
rsq 3	0.052	0.029	0.028	0.031	0.106	0.121	0.222	0.311	0.158
Y.@Fmsy	1436	1300	1352	1463	1476	1718	1087	2266	2380
Bmsy	21950	29190	29680	23630	50890	19300	15810	14410	13860
Fmsy	0.063	0.064	0.064	0.069	0.071	0.091	0.117	0.132	0.139
B./Bmsy	1.040	0.684	0.705	0.893	0.399	0.982	1.109	1.204	1.255
F./Fmsy	0.522	0.806	0.589	0.539	0.706	0.587	0.517	0.451	0.366

B./Bmsy: By+1/Bmsy

F./Fmsy: F_y/Fmsy

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

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

Table 4.4.10. ANGLERFISH (*L. budegassa*) Divisions 8c and 9a. SPiCT summary results

```
 [1] "Convergence: 0  MSG: relative convergence (4)"
 [2] "Objective function at optimum: 37.6870422"
 [3] "Euler time step (years):  1/16 or 0.0625"
 [4] "Nobs C: 38,  Nobs I1: 29,  Nobs I2: 29,  Nobs I3: 31"
 [5] ""
 [6] "Residual diagnostics (p-values)"
 [7] "     shapiro   bias    acf   LBox shapiro bias acf LBox  "
 [8] " C    0.8678 0.4558 0.1030 0.2471       -    -   -    -  "
 [9] " I1   0.6325 0.5982 0.0046 0.0150       -    -  **    *  "
[10] " I2   0.3125 0.5784 0.0585 0.2936       -    -   .    -  "
[11] " I3   0.0708 0.8577 0.0169 0.0650       .    -   *    .  "
[12] ""
[13] "Priors"
[14] "     logn  ~  dnorm[log(2), 2^2]"
[15] " logalpha  ~  dnorm[log(1), 2^2]"
[16] "  logbeta  ~  dnorm[log(1), 2^2]"
[17] ""
[18] "Fixed parameters"
[19] "   fixed.value  "
[20] " n           2  "
[21] ""
[22] "Model parameter estimates w 95% CI "
[23] "            estimate        cilow        ciupp    log.est  "
[24] " alpha1 1.349973e+00    0.8201404 2.222093e+00  0.3000848  "
[25] " alpha2 1.219112e+00    0.7195389 2.065538e+00  0.1981230  "
[26] " alpha3 1.412469e+00    0.9014557 2.213163e+00  0.3453393  "
[27] " beta   1.459519e-01    0.0237841 8.956397e-01 -1.9244780  "
[28] " r      4.961145e-01    0.2218364 1.109509e+00 -0.7009485  "
[29] " rc     4.961145e-01    0.2218364 1.109509e+00 -0.7009485  "
[30] " rold   4.961145e-01    0.2218364 1.109509e+00 -0.7009485  "
[31] " m      2.108087e+03 1498.3974125 2.965857e+03  7.6535364  "
[32] " K      1.699678e+04 6990.2910834 4.132740e+04  9.7407792  "
[33] " q1     1.684000e-04    0.0000590 4.811000e-04 -8.6890651  "
[34] " q2     3.473000e-04    0.0001217 9.910000e-04 -7.9654008  "
[35] " q3     9.280000e-04    0.0003233 2.664100e-03 -6.9824540  "
[36] " sdb    2.177681e-01    0.1587964 2.986399e-01 -1.5243245  "
[37] " sdf    1.466682e-01    0.0988114 2.177034e-01 -1.9195821  "
[38] " sdi1   2.939811e-01    0.1974748 4.376503e-01 -1.2242397  "
[39] " sdi2   2.654838e-01    0.1808612 3.897002e-01 -1.3262015  "
[40] " sdi3   3.075907e-01    0.2266312 4.174715e-01 -1.1789852  "
[41] " sdc    2.140650e-02    0.0036137 1.268044e-01 -3.8440601  "
[42] " "
[43] "Deterministic reference points (Drp)"
[44] "          estimate        cilow        ciupp   log.est  "
[45] " Bmsyd 8498.3901946 3495.1455417 2.066370e+04  9.047632  "
[46] " Fmsyd    0.2480573    0.1109182 5.547547e-01 -1.394096  "
[47] " MSYd  2108.0873655 1498.3974125 2.965857e+03  7.653536  "
[48] "Stochastic reference points (Srp)"
[49] "          estimate        cilow        ciupp   log.est rel.diff.Drp  "
[50] " Bmsys 7969.0517106 3347.5586458 18970.775985  8.983321  -0.06642428  "
[51] " Fmsys    0.2364392    0.1027243     0.544209 -1.442064  -0.04913761  "
[52] " MSYs  1878.0463291 1341.9851909  2628.239148  7.537987  -0.12248954  "
[53] ""
[54] "States w 95% CI (inp$msytype: s)"
[55] "                     estimate        cilow        ciupp    log.est  "
[56] " B_2017.00      1.418605e+04 5053.1266183 3.982566e+04  9.5600146  "
[57] " F_2017.00      6.760050e-02    0.0243201 1.879033e-01 -2.6941402  "
[58] " B_2017.00/Bmsy 1.780143e+00    1.1134450 2.846040e+00  0.5766938  "
[59] " F_2017.00/Fmsy 2.859106e-01    0.1582087 5.166903e-01 -1.2520760  "
[60] ""
[61] "Predictions w 95% CI (inp$msytype: s)"
[62] "                   prediction        cilow        ciupp    log.est  "
[63] " B_2018.00      1.288445e+04 4616.5937852 3.595922e+04  9.4637767  "
[64] " F_2018.00      6.379090e-02    0.0225602 1.803744e-01 -2.7521441  "
[65] " B_2018.00/Bmsy 1.616811e+00    1.0006337 2.612423e+00  0.4804559  "
[66] " F_2018.00/Fmsy 2.697985e-01    0.1452867 5.010178e-01 -1.3100799  "
[67] " Catch_2018.00  8.332658e+02  571.6495341 1.214611e+03  6.7253526  "
[68] " E(B_inf)       1.299939e+04           NA           NA  9.4726575  "
```

Table 4.4.11. ANGLERFISH (*L. budegassa*) - Divisions 8c and 9a.
Point estimates of B/BMSY(from 2018 to 2020) and Yield (from 2018 to 2019) for projections under several F scenarios.
The value of F2017/FMSY is equal to Fsq (mean of 2017 Fs) in all scenarios proposed. Values for F/FMSY are also given.

Fishing mortality trends in relation to F_{MSY}

scenario / year	F_{MSY} = Fupper	Fsq	zero catches	Flower	Flim	MSY Btrigger (2020)	Blim (2020)	F_{MSY} low 95% CI	*L piscatorius* F_{MSY}
2018	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275	0.275
2019	1.000	0.275	0.000	0.780	1.700	6.107	8.428	0.434	0.462

Biomass trends in relation to B_{MSY}

scenario / year	F_{MSY} = Fupper	Fsq	zero catches	Flower	Flim	MSY Btrigger (2020)	Blim (2020)	F_{MSY} low 95% CI	*L piscatorius* F_{MSY}
2018	1.617	1.617	1.617	1.617	1.617	1.617	1.617	1.617	1.617
2019	1.660	1.660	1.660	1.660	1.660	1.660	1.660	1.660	1.660
2020	1.462	1.690	1.784	1.528	1.269	0.500	0.300	1.637	1.628

Yield

scenario / year	F_{MSY} = Fupper	Fsq	zero catches	Flower	Flim	MSY Btrigger (2020)	Blim (2020)	F_{MSY} low 95% CI	*L piscatorius* F_{MSY}
2018	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0
2019	5573.5	1750.8	0.0	4523.7	8360.3	14960.7	15508.9	2682.4	2838.0

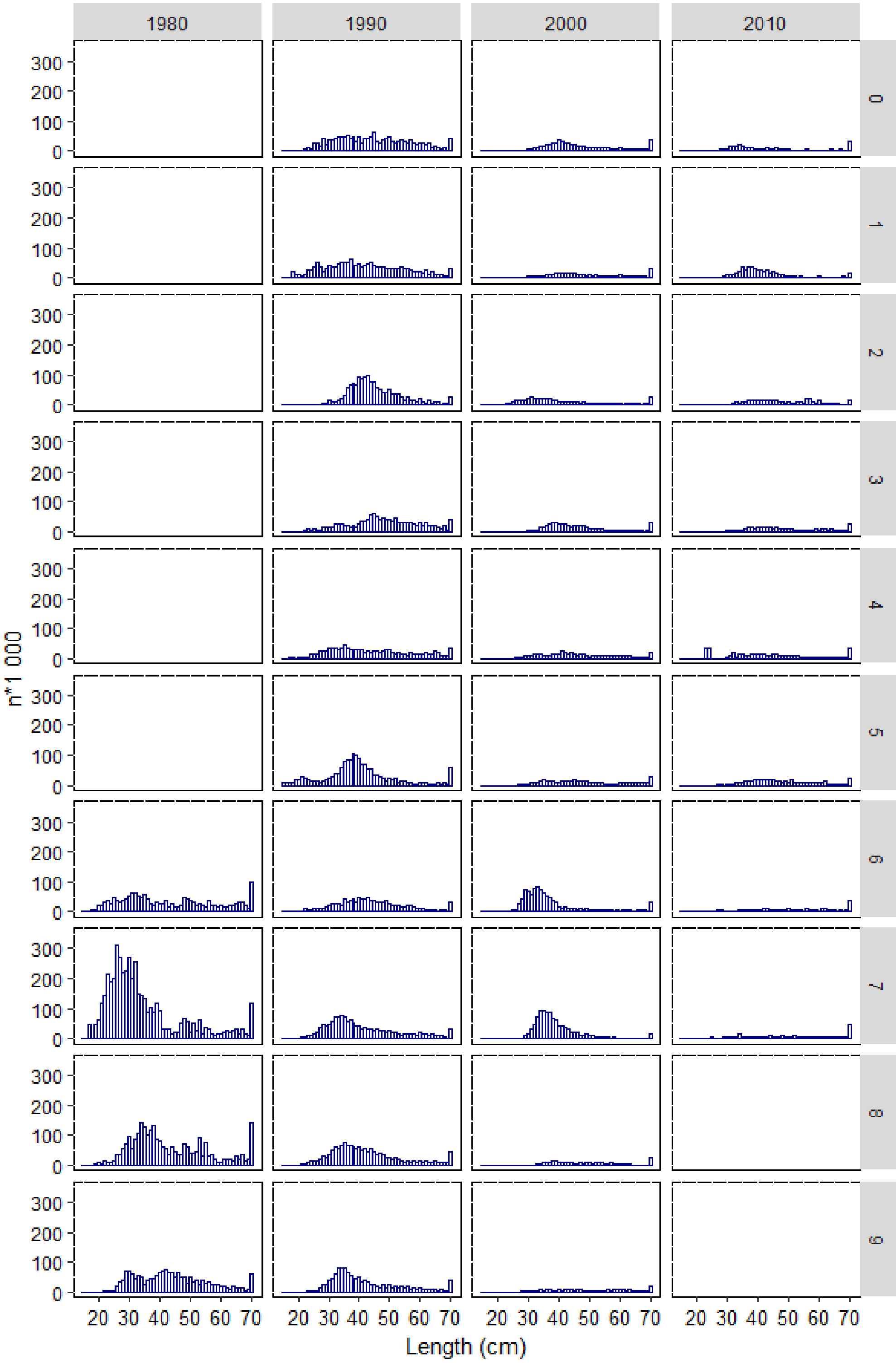


Figure 4.4.1 ANGLERFISH (*L. budegassa*) Divisions 8c and 9a. Length distributions of landings (thousands for 1986–2017).

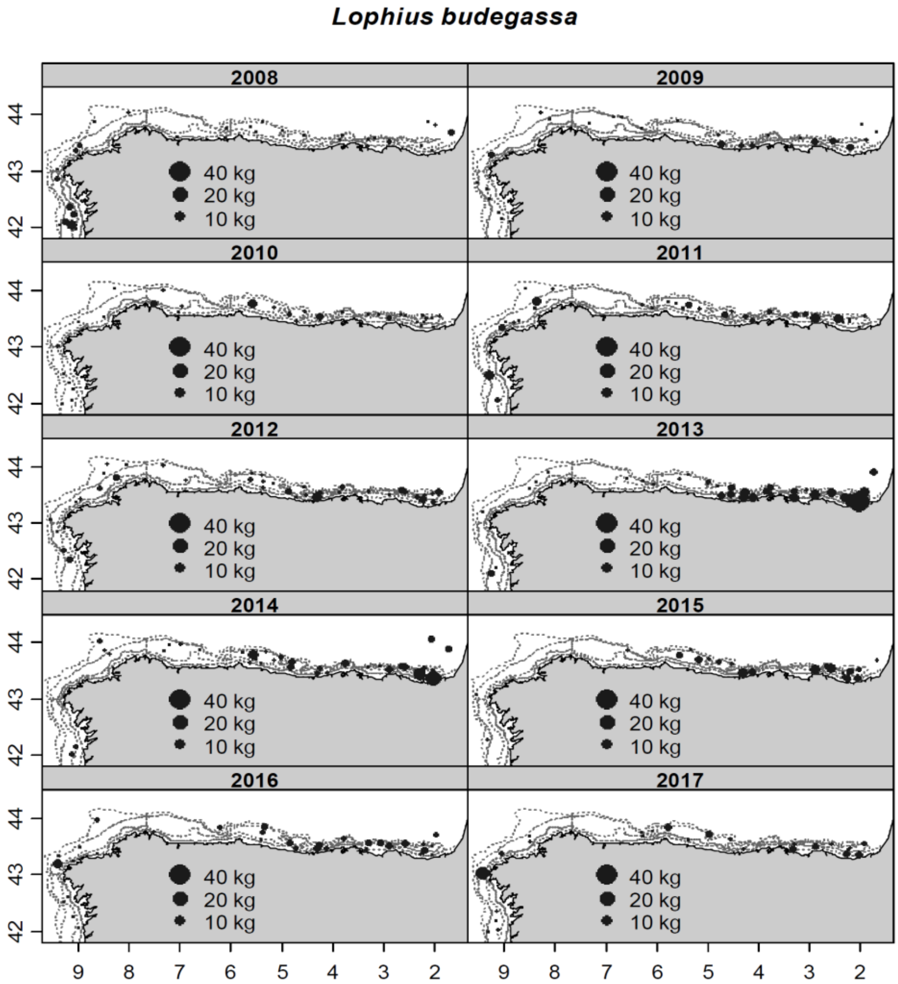


Figure 4.4.2 ANGLERFISH (*L. budegassa*) Divisions 8c and 9a. Distribution of black anglerfish (*L. budegassa*) juveniles (0–20 cm) in SpGFS-WIBTS-Q4 between 2008–2017.

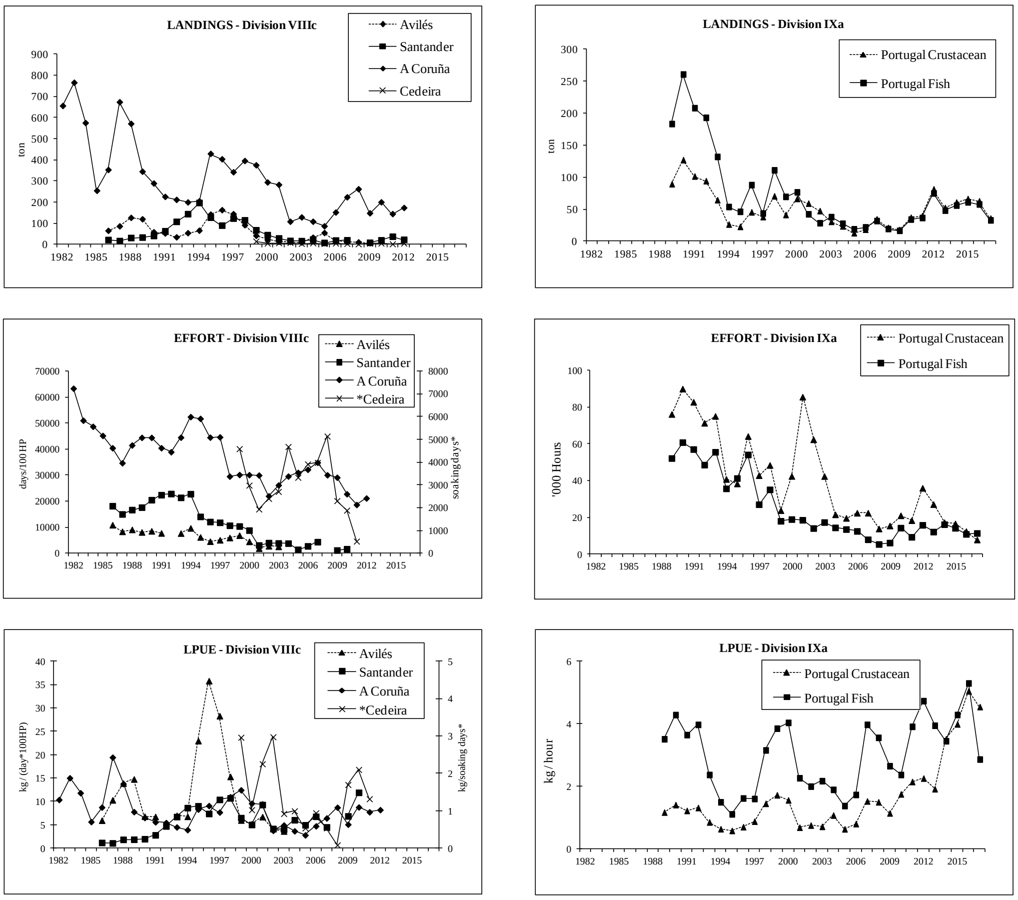


Figure 4.4.3 ANGLERFISH (*L. budegassa*) Divisions 8c and 9a. Trawl and gillnet landings, effort and LPUE data between 1986–2017.

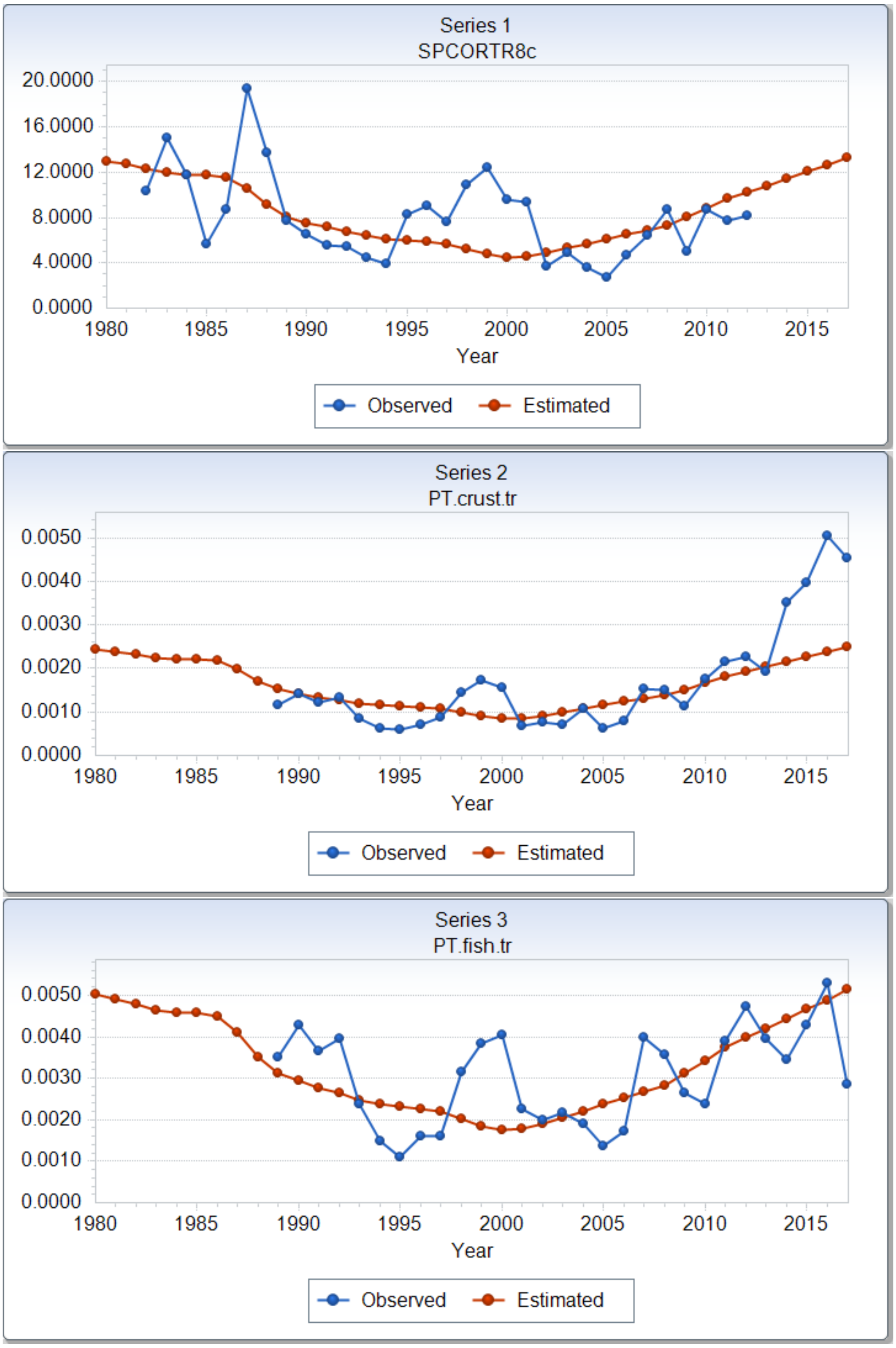


Figure 4.4.4. ANGLERFISH (*L. budegassa*) Divisions 8.c and 9.a. Observed cpue for the three commercial fleets and estimated values by the model.

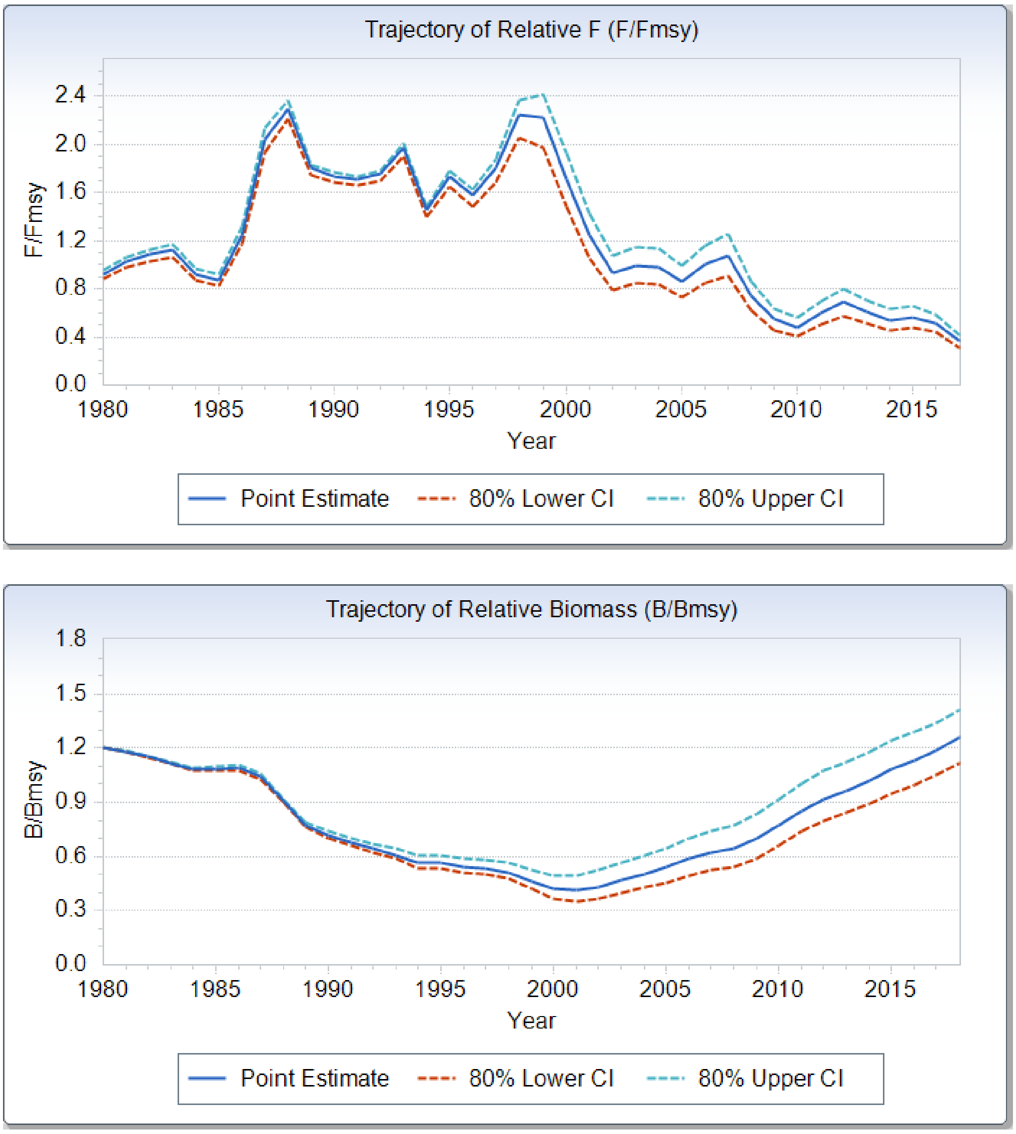


Figure 4.4.5. ANGLERFISH (*L. budegassa*) Divisions 8c and 9a. Confidence intervals (80%) of the F/F$_{MSY}$ and B/B$_{MSY}$ ratios.

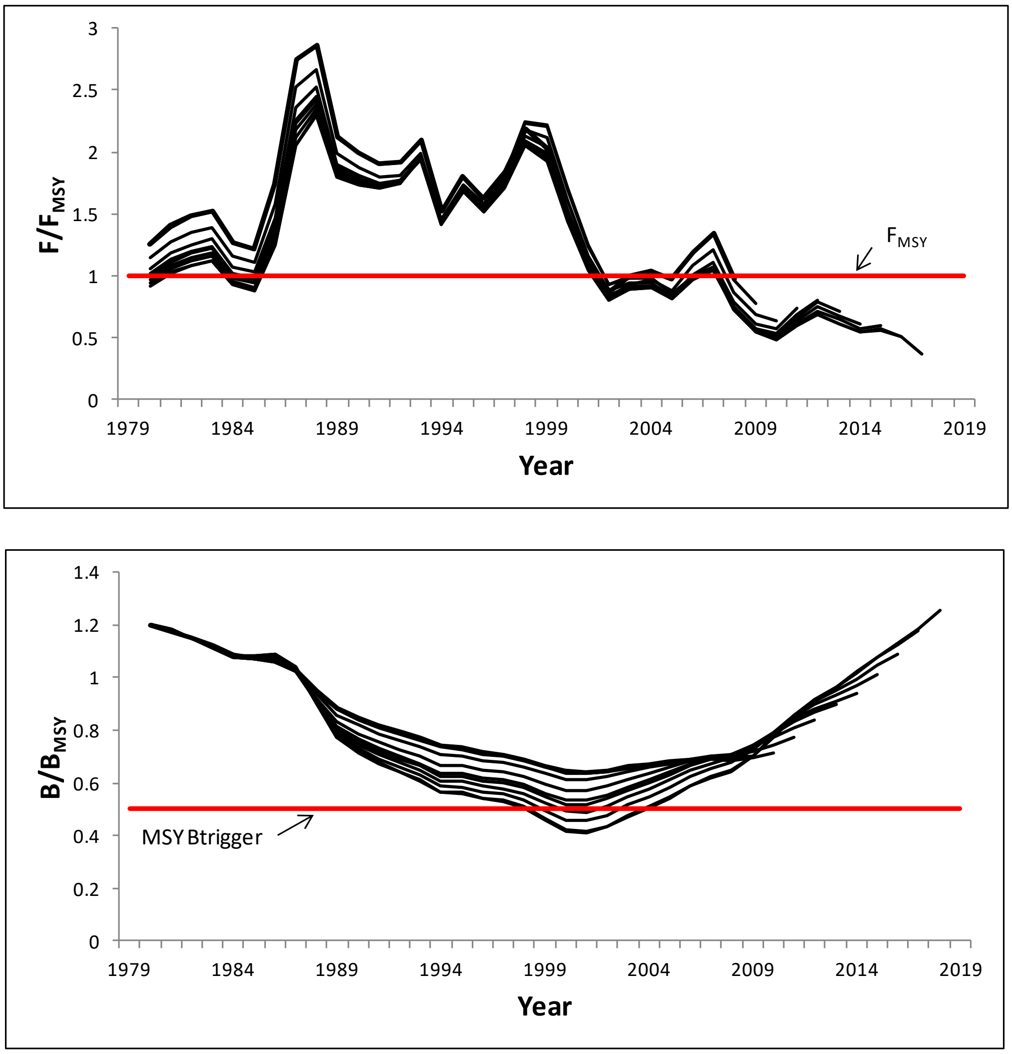


Figure 4.4.6 ANGLERFISH (*L. budegassa*) Divisions 8c and 9a. Retro analysis of the F/FMSY and B/BMSY ratios of 2018 WG assessment.

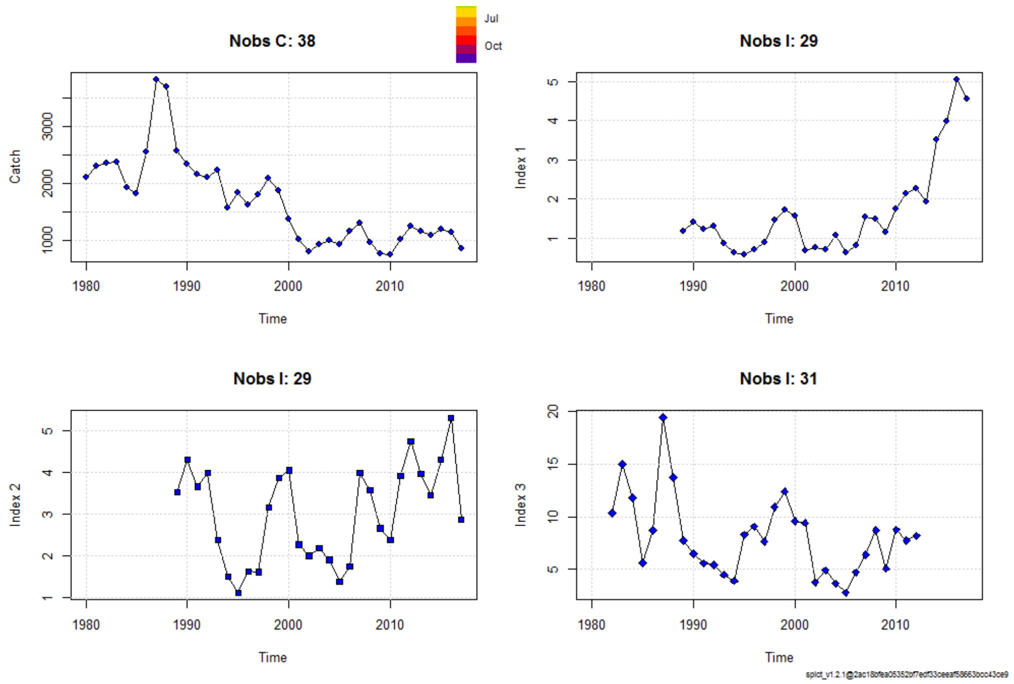


Figure 4.4.7. Catch; Index 1 - PRT Bottom-trawl crustacean (1989–2017); Index 2 - PRT Bottom-trawl fish (1989–2017); Index 3 - SPN A Coruña trawl (1982–2012).

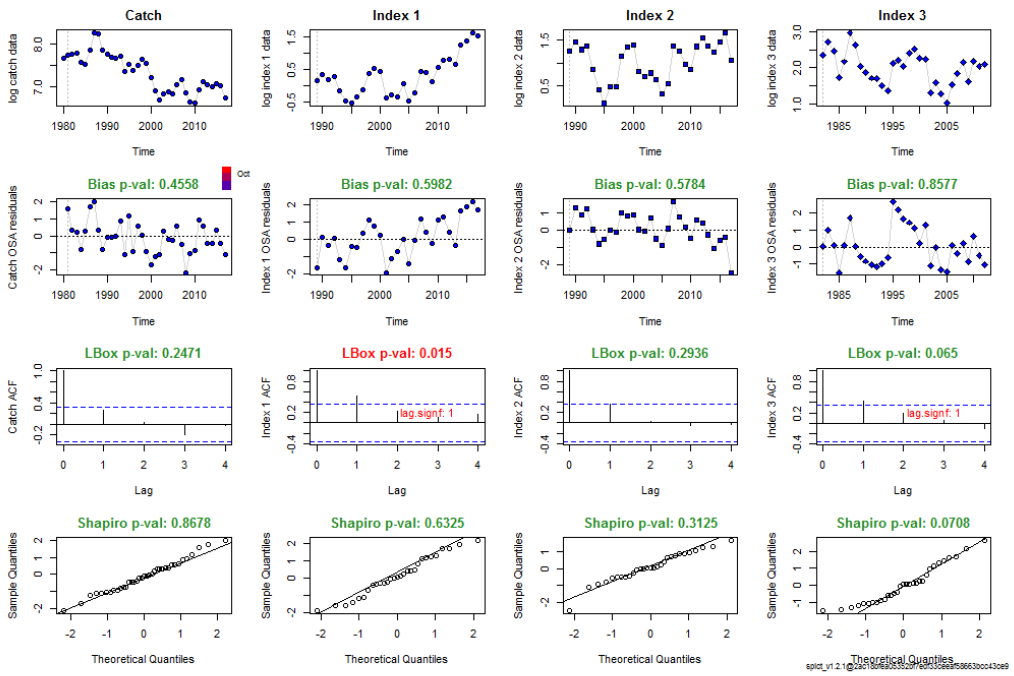


Figure 4.4.8. Ank.27.8c.9a SPiCT diagnostics. Row1. Log of the input dataseries. Row 2. OSA residuals with the p-value of a test for bias. Row 3. Empirical autocorrelation of the residuals with tests for significant autocorrelation. Row 4. Tests for normality of the residuals, QQ-plot and Shapiro test.

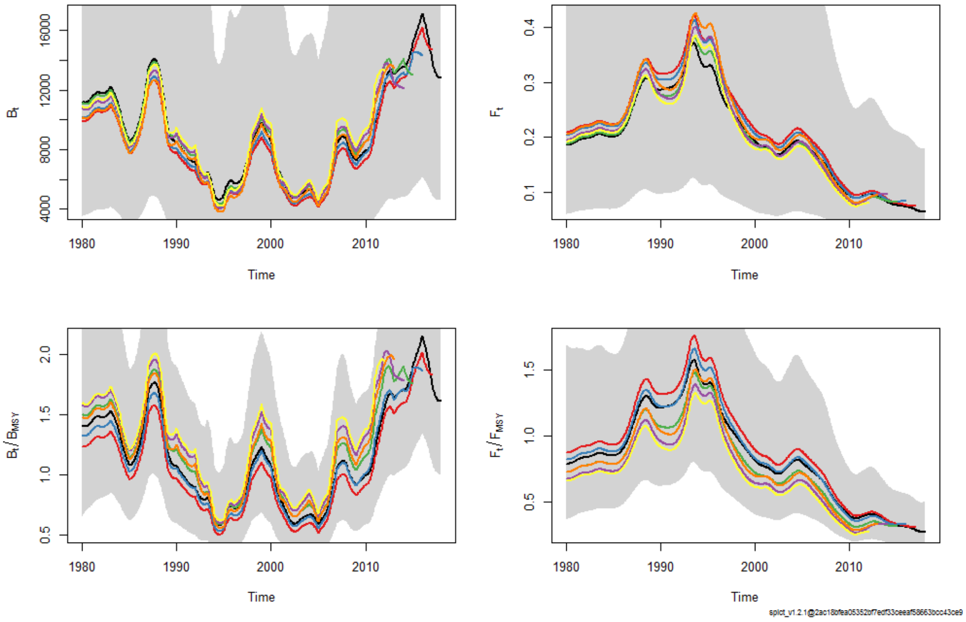


Figure 4.4.9.. Ank.27.8c.9a. 6 years retrospective analysis. Upper panels absolute biomass and fishing mortality. Under panels relative biomass and fishing mortality.

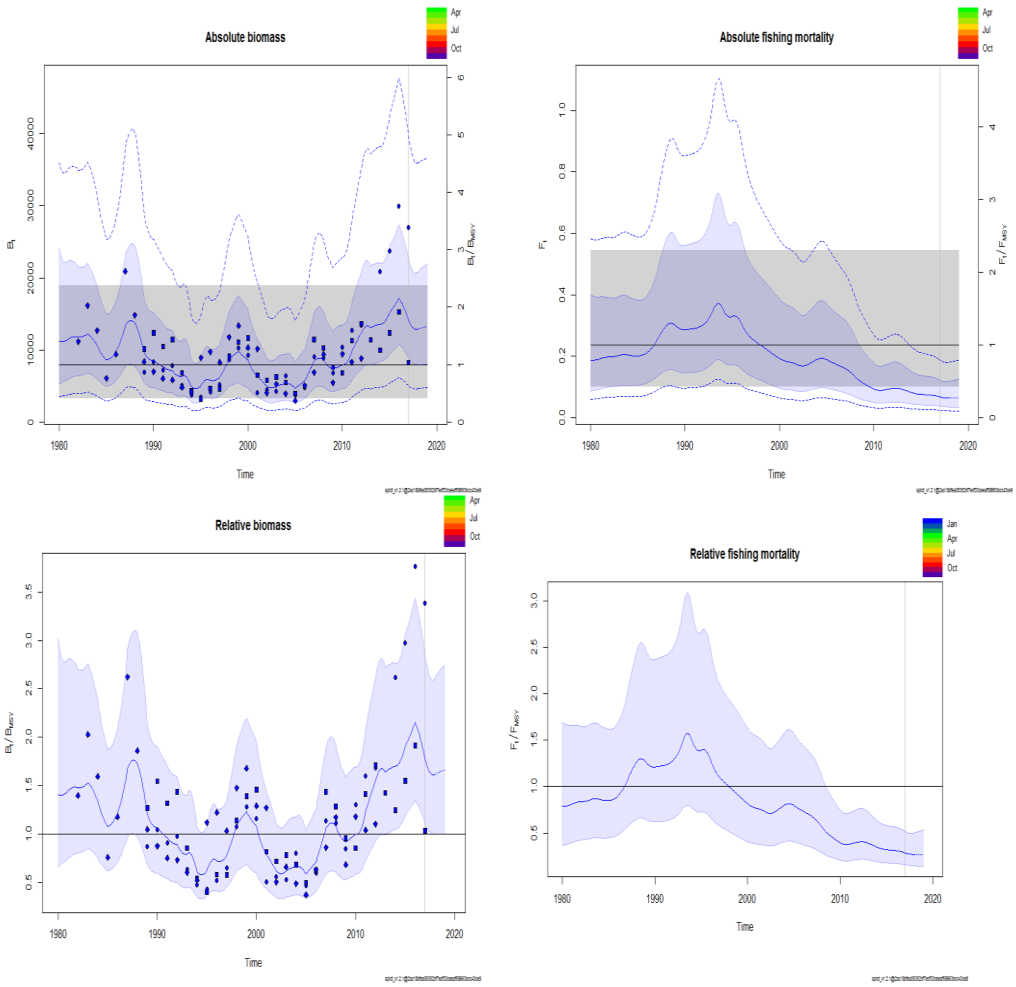
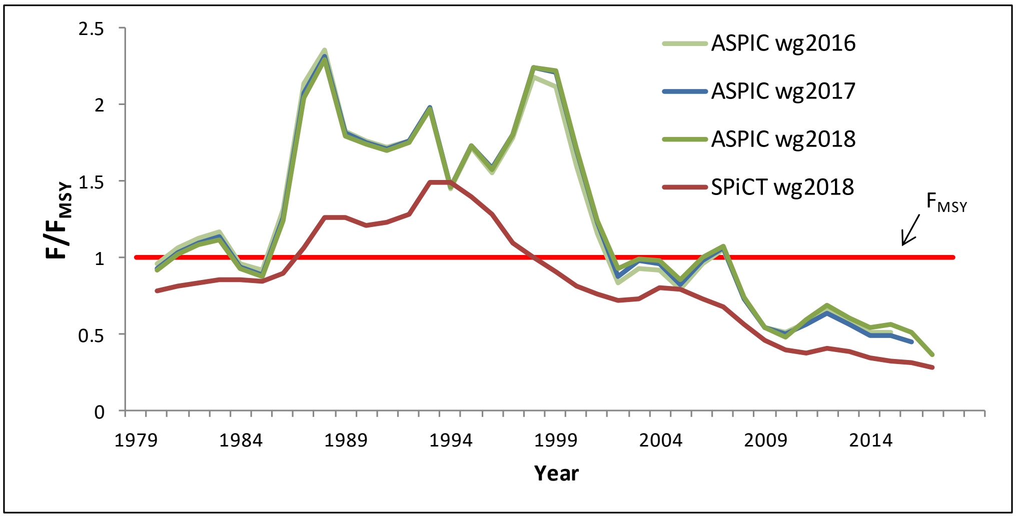


Figure 4.4.10. Ank.27.8c.9a. SPiCT results Upper panels absolute biomass and fishing mortality. Under panels relative biomass and fishing mortality.



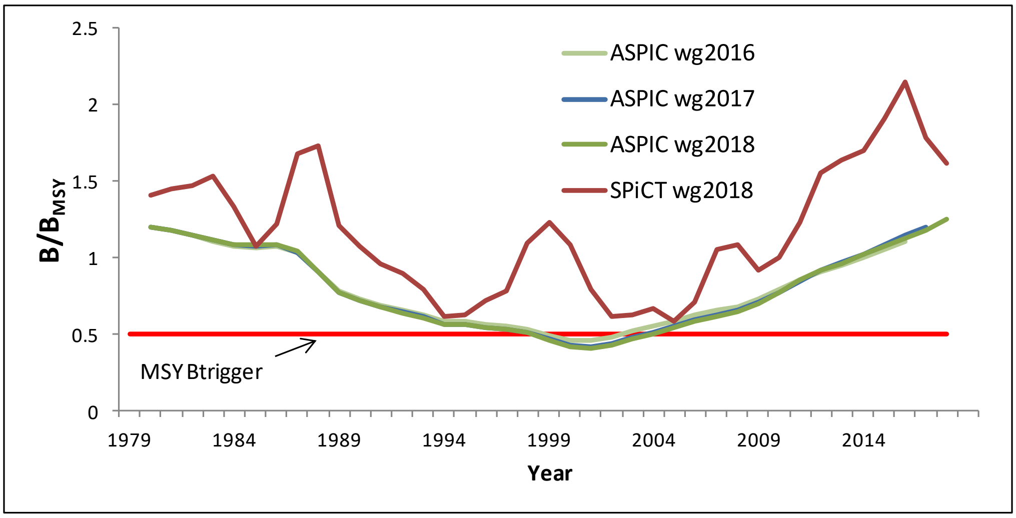


Figure 4.4.11. ANGLERFISH (*L. budegassa*) – Divisions 8c and 9a. Trends of the F/FMSY and B/BMSY ratios from the 2016, 2017 and 2018 ASPIC WG assessments compared with the 2018 SPiCT WG assessment.

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 2018 and management for 2017 and 2018

ICES advice for 2018(as extracted from ICES Advice 2017):

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. whiffiagonis, ICES advises that when the MSY approach is applied, catches in 2018 should be no more than 15 720 tonnes. If discard rates do not change from the average of the last three years (2014–2016), this implies landings of no more than 12 884 tonnes.

For L. Boscii, ICES advises that when the precautionary approach is applied, catches in 2018 should be reduced by at least 20% relative to the average catches of 2014–2016. ICES is not able to quantify the corresponding catch value.

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

XXX t (both megrim species) = XXX t (*L. boscii* single-species landings advice) + 12 884 t (*L. whiffiagonis* landings advice).

Management applicable for 2018:

The agreed TAC for the combined species was set at 15 045 t for 2017 and 13 528 t for 2018.

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

Assessment type: Precautionary approach based on ICES framework for category 6 stocks.

Data revisions: Survey indices updated and commercial landings, discards and length data added.

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

5.1.1 General

5.1.1.1 Fishery description

Four spot 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 (see stock annex for details).

5.1.1.2 Summary of ICES Advice for 2019 and Management applicable for 2018 and 2019

ICES advice for 2019

ICES advises that when the precautionary approach is applied, catches in 2019 should be reduced by at least 20% relative to the average catches of 2014–2017. ICES is not able to quantify the corresponding catch value.

Management applicable for 2018 & 2019

The agreed TAC for four-spot megrim in ICES Divisions 7b-k and 8abd was 350 t for 2018 and is 280 t for 2019.

5.1.2 Data

5.1.2.1 Commercial catches and discards

Four-spot megrim was included in the 2018 data call for the first time. Data on commercial catch and discard information was made available to the working group from France, Ireland and Spain.

5.1.2.2 Biological sampling

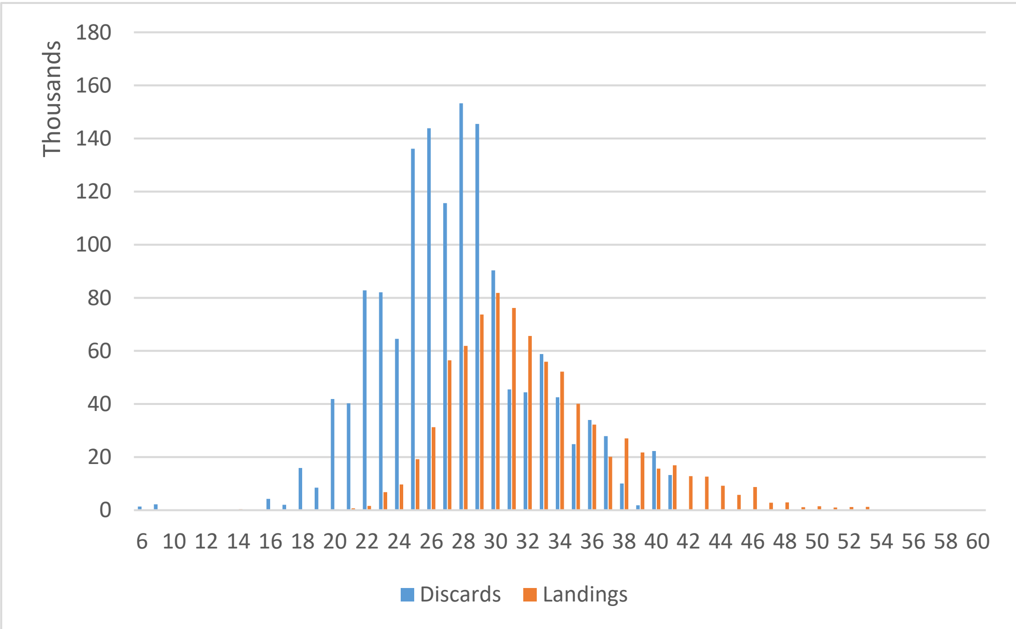
Four-spot megrim was included in the 2018 data call for the first time. Data on length was made available to the working group from Ireland and Spain.

Age

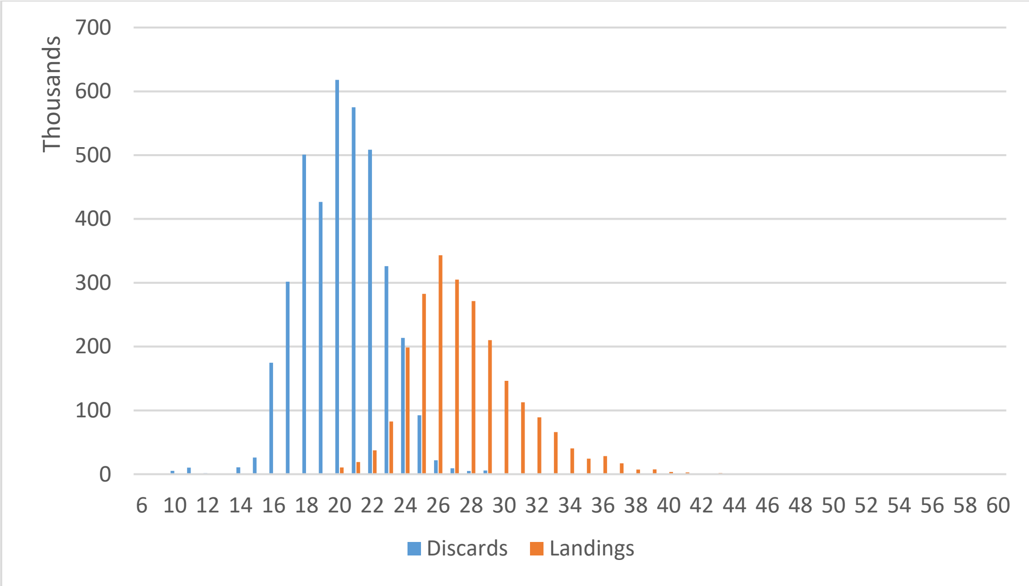
Not available.

Lengths

	Number of Length Samples	Number of Length Measurements
Ireland	**402**	**34,736**
GNS_DEF_120-219_0_0_all	2	36
MIS_MIS_0_0_0_HC	1	141
OTB_CRU_100-119_0_0_all	85	14,046
OTB_CRU_70-99_0_0_all	78	1,306
OTB_DEF_100-119_0_0_all	109	9,325
OTB_DEF_70-99_0_0_all	93	4,172
SSC_DEF_100-119_0_0_all	13	1,021
TBB_DEF_70-99_0_0_all	21	4,689
Spain	**424**	**13,396**
OTB_DEF_>=70_0_0	29	496
OTB_DEF_100-119_0_0	22	3,702
OTB_DEF_70-99_0_0	372	9,040
OTB_MPD_>=70_0_0	1	158
Grand Total	**826**	**48,132**



Length frequency distribution of landings and discards from Irish fleets



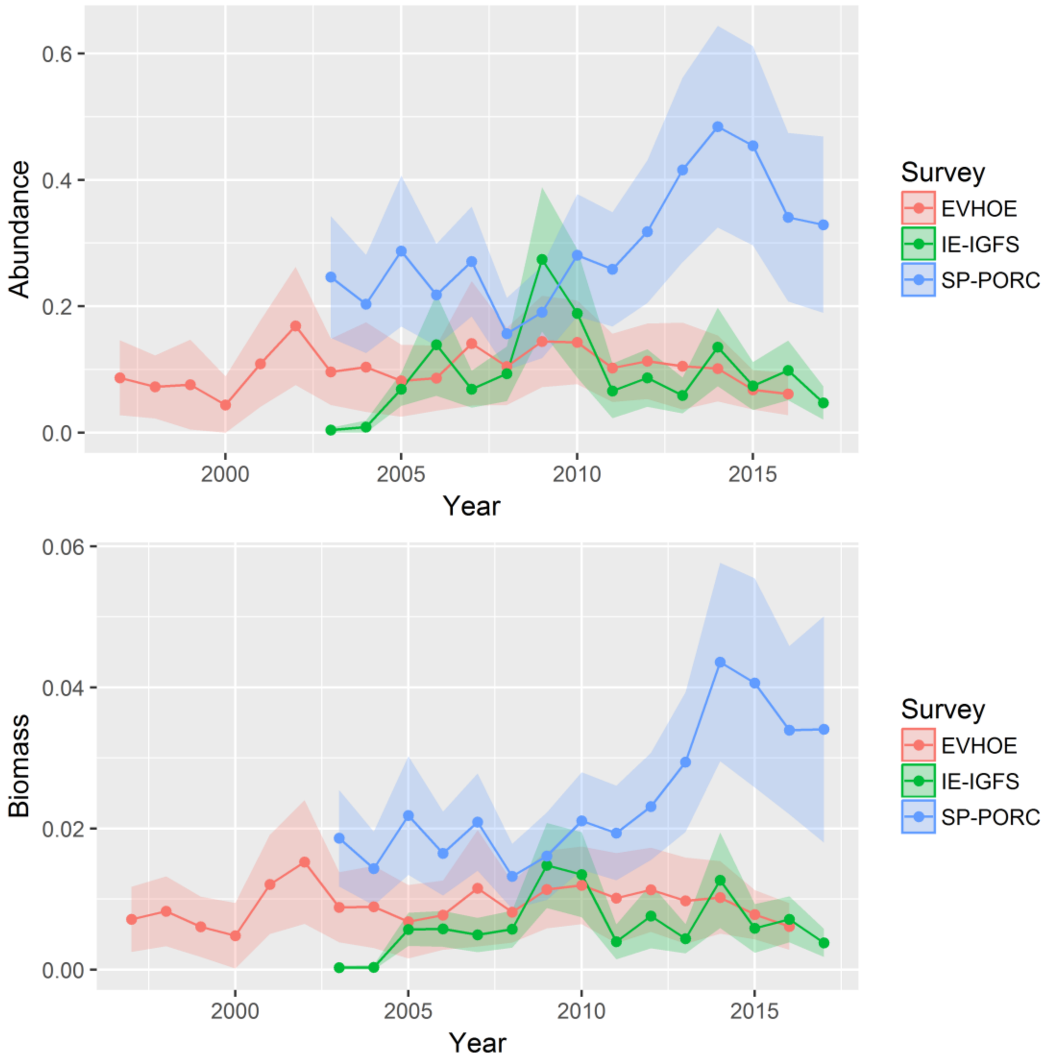
Length frequency distribution of landings and discards from Spanish fleets

Natural Mortality

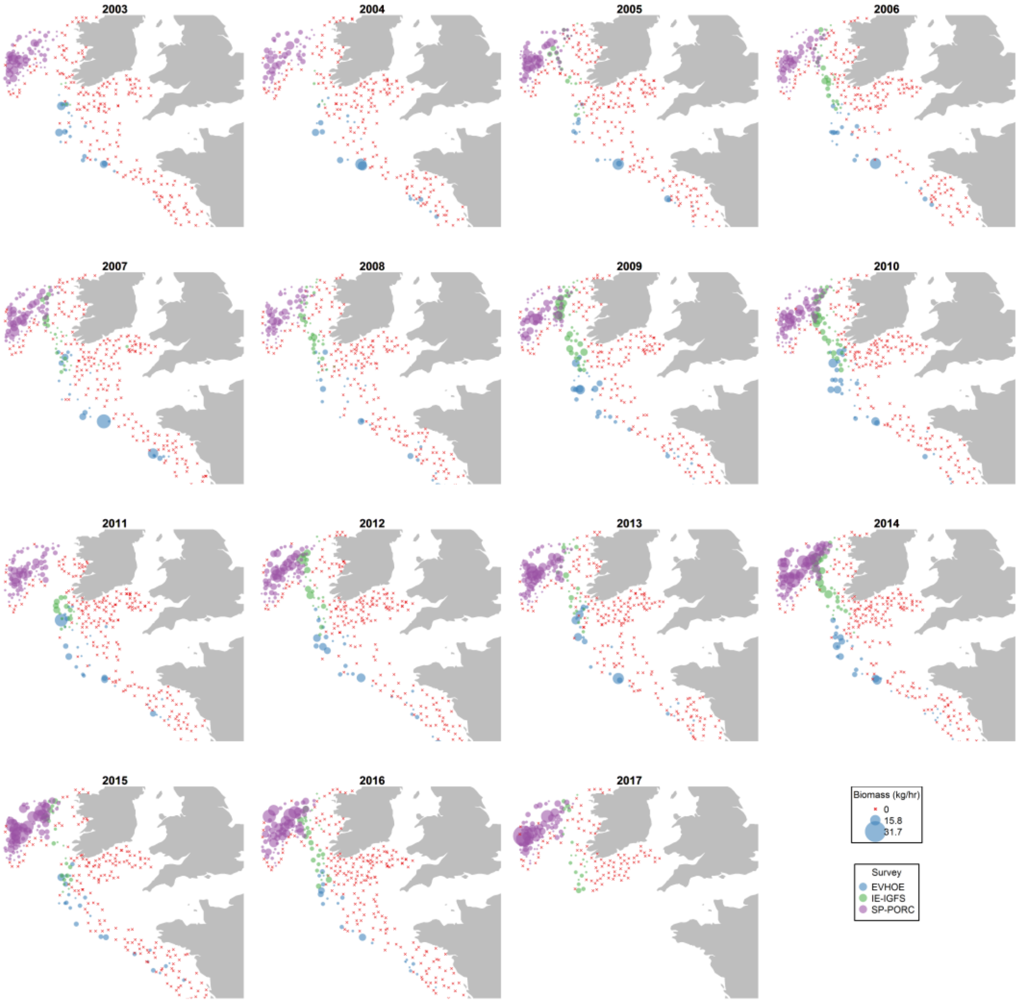
Not included in assessment.

5.1.2.3 Survey data

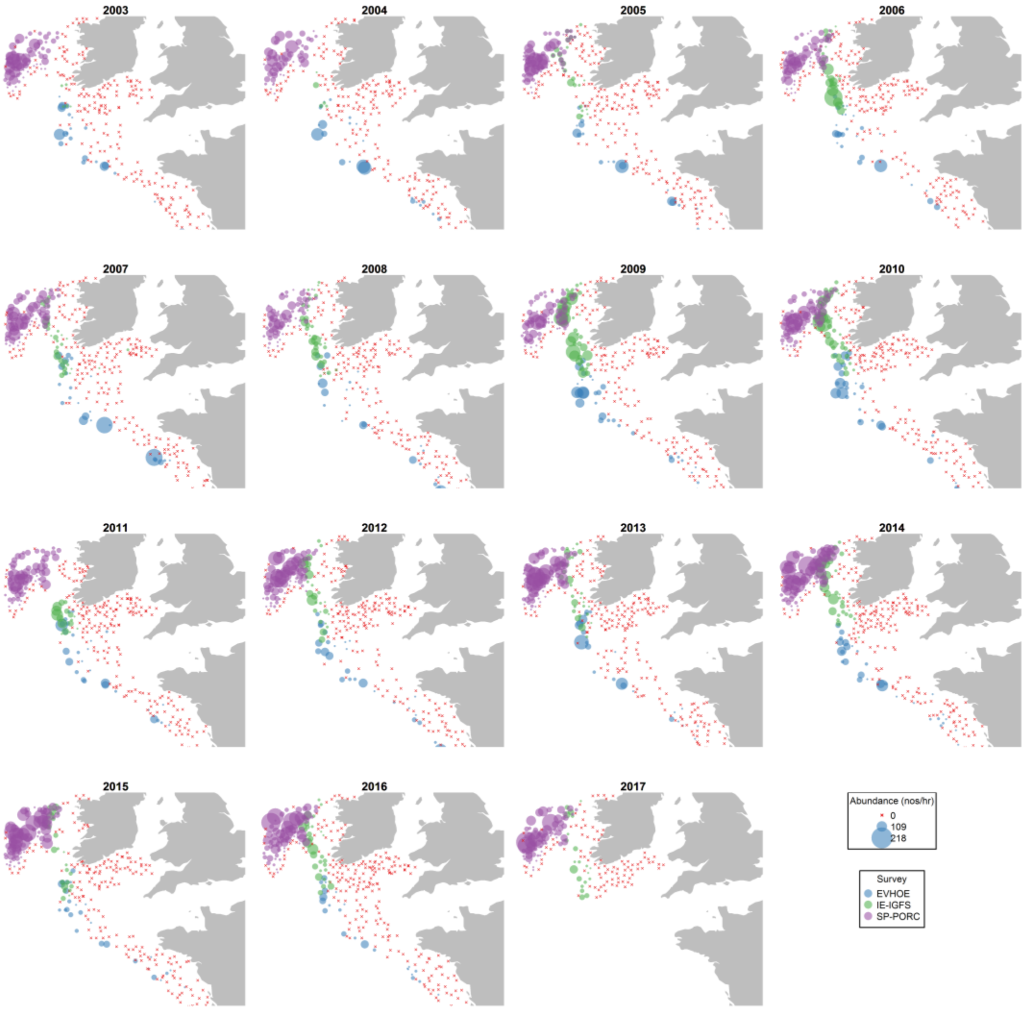
Survey data were extracted from DATRAS for Spanish Porcupine (SpPorc), Irish Groundfish Survey (IE-IGFS) and French EVHOE surveys (no French survey data were available for 2017). The Spanish Porcupine index was initially down weighted by an arbitrary factor of 10 because the Baka trawl used was highly 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.

5.1.2.4 Commercial catch and effort data

Four-spot megrim was included in the WGBIE data call for the first time in 2018. Commercial catch and effort data were available to the working group from France, Ireland and Spain.

Commercial catch of Four-Spot Megrim by gear type for French, Irish and Spanish fleets

	Discards	Landings	Grand Total	% Discarded
France	**5,963**	**57,727**	**63,690**	**9%**
GTR_DEF_100-119_0_0_all		195	195	0%
MIS_MIS_0_0_0_HC		899	899	0%
OTB_CRU_All_0_0_All		352	352	0%
OTB_DEF_100-119_0_0		19,441	19,441	0%
OTB_DEF_70-99_0_0		29,708	29,708	0%
OTT_DEF_>=70_0_0	3,553	1,055	4,608	77%
OTT_DEF_100-119_0_0_all	2,386	5,393	7,779	31%
OTT-CRU	24	625	649	4%
SSC_DEF_All_0_0_All		61	61	0%
Ireland	**288,367**	**130,405**	**418,772**	**69%**
GNS_DEF_120-219_0_0_all		340	340	0%
MIS_MIS_0_0_0_HC		222	222	0%
OTB_CRU_100-119_0_0_all	2,162	5,093	7,255	30%
OTB_CRU_70-99_0_0_all	8,404	3,014	11,418	74%
OTB_DEF_100-119_0_0_all	187,036	55,308	242,344	77%
OTB_DEF_70-99_0_0_all	90,766	28,467	119,233	76%
SSC_DEF_100-119_0_0_all		7,771	7,771	0%
TBB_DEF_70-99_0_0_all	0	30,190	30,190	0%
Spain	**272,505**	**438,910**	**711,415**	**38%**
GNS_DEF_>=100_0_0		430	430	0%
GNS_DEF_120-219_0_0		100	100	0%
MIS_MIS_0_0_0_HC		980	980	0%
OTB_DEF_>=70_0_0		40,310	40,310	0%
OTB_DEF_100-119_0_0		34,350	34,350	0%
OTB_DEF_70-99_0_0	272,505	358,590	631,095	43%
OTB_MCF_>=70_0_0		450	450	0%
OTB_MPD_>=70_0_0		3,630	3,630	0%
PTB_DEF_>=70_0_0		70	70	0%
Grand Total	**566,835**	**627,042**	**1,193,878**	**47%**

Commercial catch of Four-Spot Megrim by area for French, Irish and Spanish fleets

	Discards	Landings	Grand Total	% Discarded
France	**5,963**	**57,727**	**63,690**	**9%**
27.7.b		3,909	3,909	0%
27.7.c		7,253	7,253	0%
27.7.d		97	97	0%
27.7.e		845	845	0%
27.7.f		182	182	0%
27.7.g	24	2,492	2,516	1%
27.7.h	240	7,177	7,416	3%
27.7.j	2,147	29,374	31,521	7%
27.7.k		1,018	1,018	0%
27.8.a	3,553	3,640	7,193	49%
27.8.b		1,351	1,351	0%
27.8.d		389	389	0%
Ireland	**288,367**	**130,405**	**418,772**	**69%**
27.7.b	60,884	9,490	70,374	87%
27.7.d		19	19	0%
27.7.g	40	83,733	83,773	0%
27.7.j	227,444	37,163	264,607	86%
Spain	**272,505**	**438,910**	**711,415**	**38%**
27.7.b	22,964	28,430	51,394	45%
27.7.c.2	46,982	89,430	136,412	34%
27.7.h	2,891	5,320	8,211	35%
27.7.j.2	198,412	260,110	458,522	43%
27.7.k.2	1,256	9,750	11,006	11%
27.8.a		10,430	10,430	0%
27.8.b		35,340	35,340	0%
27.8.d.2		100	100	0%
Grand Total	**566,835**	**627,042**	**1,193,878**	**47%**

5.1.3 Assessment

The proportion of *Lepidorhombus boscii* averaged over the period 2007-2016 in the EVHOE and 2007-2017 in the IGFS surveys was used to split the two species in the 2019 advice for *Lepidorhombus whiffiagonis*. There was no data from the EVHOE survey in 2017.

5.1.3.1 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.

5.1.3.2 Model

No model was used in the assessment.

5.1.3.3 Results

The proportion of *Lepidorhombus boscii* averaged over the period 2007-2016 in the EVHOE and 2007-2017 in the IGFS surveys was found to be 0.052 and this proportion was used to split the two species in the 2019 advice for *Lepidorhombus whiffiagonis*. The stock status relative to candidate reference points is unknown. The precautionary buffer was applied in 2017. Therefore, the precautionary buffer will not be applied this year.

5.1.4 Retrospective pattern

No retrospective was produced.

5.1.5 Short-term forecasts

No short-term forecast was produced.

5.1.6 Biological reference points

No biological reference points were produced.

5.1.7 Conclusions

This was the second year that an assessment was carried out for this stock and the first year that the stock was included in the WGBIE data call. Landings advice was produced based on the ICES framework for category 6 stocks.

The quality of this assessment was improved on the previous year by the addition of commercial landings, discards and length data. However the lack of French EVHOE survey data hampered the assessment. There is still a requirement for substantial port sampling to provide an accurate species split for the landings as it is unsure how the survey catches relate to the commercial catches.

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.

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

5.2.1 General

See general section for both species

5.2.2 Data

5.2.2.1 Commercial catches and discards

Stock catches for the period 1984–2017, as estimated by the WG, are given in Table 5.1.1.1. 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 2017 are higher than in 2016 (20%), reaching up to 13 784 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 dataseries were updated from 2003–2014. Landing data from France shows an increasing trend from 2015 onwards. Landing information for year 2017 by Ireland and UK show a slight decrease however Belgium shows a slight increase.

Regarding discard data, French discards were provided from 2004–2014 to the Inter-Benchmark 2016, and they have been updated in 2017. There is an increase in all discard information provided by Spain and UK and a significant decrease from France from 1276 t to 783 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	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Discard ratio (%)	11%	13%	15%	20%	30%	20%	24%	19%	21%	18%	26%	24%	20%	24%	16%	12%	17%	14%

5.2.2.2 Biological sampling

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

WGBIE were made aware of an issue with the sampling level in Q1 and Q2 of 2017 from France (WD12). Because of the lack of market sampling for length (biological and onboard sampling was unaffected), efforts were made to try to fill the deficiency in the number of samples by use of simulation techniques. Both simulated data and actual data were uploaded to InterCatch combined making it impossible to distinguish true samples from simulated ones. Due to the timing in notifying the working group it was not possible to assess the impact of such simulated data on the assessment and the group recommended that sensitivities with and without the simulated data are carried out. The simulation was based on commercial landings market categories.

Age

Spain, Ireland, UK and Belgium provided numbers-at-age in Intercatch and consequently completed number and weights at age up to 2017. Age distribution for landings and discards from 2009–2017 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 2017.

Natural Mortality

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

5.2.2.3 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. French EVHOE survey was not updated for year 2017 due to technical problems during the survey.

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.

An abundance index in ages was provided for Irish Groundfish Survey (IGFS-WIBTS-Q4) from 2003-2017. For the last five years of the dataseries, the survey provides the lowest values of older ages and a sharp decrease of medium age individuals. For the younger ages, it shows an increasing trend and a slight decrease in the last year.

A revised abundance index in ages was provided for the Spanish Porcupine Groundfish Survey (SpPGFS-WIBTS-Q4) from 2001 to 2017 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 2007–2017 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 fluctuations until 2017.

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 and a decrease in 2017.

For a more detailed inspection of the abundances indices of different age groups, these were inspected along the whole dataseries 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 dataseries for all the surveys but it shows a decreasing trend in the last three years. Age group i) appear most abundant during years 2005 to 2008. As a consequence it is difficult to conclude on the recent abundance trends by age group.

It must be noted that the areas covered by the three surveys almost do not overlap (Figure 5.1.2.3.5). 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.

5.2.2.4 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 1984–2017, 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 1984–2017. 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.& 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 dataseries 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 dataseries. Age group i) appear more abundant than older ages (iii) from 2003 onwards in the Spanish fleet. French fleets appear to land mostly old individual at the beginning of the dataseries but a marked decrease in abundance index of old fish was observed for French fleet. In 2017, an increase of young ages is observed in Irish fleets.

5.2.3 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.

5.2.3.1 Data Exploratory Analysis

In summary, the stock catch-at-age matrix shows three periods: 1984–1989; 1990–1998 and 1999–2017.

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 an increase in age 1 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 of 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 a decrease of ages 1-2 are observed. However, IRTBB shows a slight increase 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 dataseries.

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 2017, ages 1 and 2 increased significantly mainly due to OTT_DEF_100-119_0_0_of all fleet from the 4th quarter of 2017 from France.

The signal coming from the discard data showed that at the beginning of the dataseries discards of age 1 was low (Figure 5.1.3.1.4-5). Discards of this age increased along the dataseries, particularly from 2003 onwards. From year 2010 to 2013, ages 1 to 3 appear to be highly discarded but in the last three years 2015-2017 general discards decrease.

5.2.3.2 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.

5.2.3.3 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 2018 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 2017. 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 1999–2017. 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 2017 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. In the last three years there is an increasing trend in landings and discards.

5.2.4 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.

5.2.5 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 2018 was not considered credible, it was replaced by geometric mean of all the recruitments since 1984 except the last two years (1984-2015). 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 not a decreasing trend of F in the results of the assessment time-series, F status quo is unscaled and the mean of the last three years is used for the projections. For the recruitment of years 2018 and 2019, the geometric mean of the recruitment posteriors in all assessment years except for the final 2 is used.

Landings in 2019 and SSB in 2020 predicted for various levels of fishing mortality in 2019 are given in Table 5.1.5.1. Maintaining F status quo in 2019 is expected to result in an increase in landings with respect to 2018 and an increase in SSB in 2019 with respect to 2018.

5.2.6 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 in the Stock Annex, were F_{MSY} ranges have been also included.

5.2.7 Conclusions

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

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

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

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

	Landings									Discards								
	France	Spain	U.K. (England & Wales)	U.K. (Scotland)	Ireland	Northern Ireland	Belgium	Unallocated	Total landings	France	Spain	U.K.	Ireland	Northern Ireland	Belgium	Others	Total discards	Total catches
1984									**16659**							2169	**2169**	**18828**
1985									**17865**							1732	**1732**	**19597**
1986	4896	10242	2048		1563		178		**18927**							2321	**2321**	**21248**
1987	5056	8772	1600		1561		125		**17114**							1705	**1705**	**18819**
1988	5206	9247	1956		995		173		**17577**							1725	**1725**	**19302**
1989	5452	9482	1451		2548		300		**19233**							2582	**2582**	**21815**
1990	4336	7127	1380		1381		147		**14370**							3284	**3284**	**17654**
1991	3709	7780	1617		1956		32		**15094**							3282	**3282**	**18376**
1992	4104	7349	1982		2113		52		**15600**							2988	**2988**	**18588**
1993	3640	6526	2131		2592		40		**14929**							3108	**3108**	**18037**
1994	3214	5624	2309		2420		117		**13684**							2700	**3284**	**16968**
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**
2017	5101	3178	2512	176	2458		360		**13784**	783	706	265	378		40		**2173**	**15957**

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

	Total landings	Total discards	Total catches	Agreed TAC (1)
1984	16659	2169	18828	
1985	17865	1732	19597	
1986	18927	2321	21248	
1987	17114	1705	18819	16460
1988	17577	1725	19302	18100
1989	19233	2582	21815	18100
1990	14370	3284	17654	18100
1991	15094	3282	18376	18100
1992	15600	2988	18588	18100
1993	14929	3108	18037	21460
1994	13684	2700	16384	20330
1995	15862	3206	19068	22590
1996	15109	3026	18135	21200
1997	14230	3066	17296	25000
1998	14345	5371	19716	25000
1999	13305	3297	16601	20000
2000	15031	1870	16750	20000
2001	15778	2262	18040	16800
2002	15987	2813	18800	14900
2003	15711	4008	19719	16000
2004	14358	6243	20602	20200
2005	12888	3275	16163	21500
2006	12037	3751	15788	20425
2007	13060	3033	16092	20425
2008	11048	2860	13908	20425
2009	15064	3278	18342	20425
2010	15101	5343	20444	20106
2011	13226	4187	17413	20106
2012	14433	3704	18137	19101
2013	16025	4885	20910	19101
2014	13277	2569	15846	19101
2015	11569	1507	13076	19101
2016	11548	2445	13992	20056
2017	13784	2173	15957	15043

(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**
2017	**FR17**	**SP17 (*)**	**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 (7h)	OTB_DEF_70-99_0_0. Otter trawl-med&deep 7
10		0
11		0
12		0
13		0
14		0
15		0
16		0
17		0
18		0
19		0
20		2
21		10
22		25
23		78
24		309
25		690
26		1186
27		1220
28		1221
29		977
30		895
31	8348	738
32	5565	653
33	2783	466
34		422
35	8348	329
36	13913	280
37	25043	235
38	27080	196
39	12423	187
40	17243	160
41	9640	139
42	24101	146
43	14460	117
44	9640	69
45	14460	66
46	9640	54
47	4820	50
48		31
49		21
50		17
51		7
52		3
53		3
54		1
55		0
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	207506	11001

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

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.

	Abundance Indices by kilograms and numbers by 30 minutes haul duration.										
		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
2017	100	20	213	273	113	52	32	24	11	22	29
	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		
2017	100	10	1869	5166	3608	2563	3122	1650	1079		

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
2017	NO updated information	

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
			2017	14.11	190.65

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
2017	798

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
2017	NA	NA	NA	NA	2.6	0.0	85.5	16.1

(*) 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.

Short term forecast table										
Model: NMEG0-R1										
Projection: 3										
Quantile	Rec_2018	SSB_2018	TSB_2018	Fbar_2018	Catch_2018	Land_2018	Disc_2018	Rec_2019	SSB_2019	TSB_2019
5%	222260	83417	116423	0.2	16913	13225	3317	222260	92367	121318
50%	228120	96660	139587	0.22	18528	14397	4131	228120	111887	145742
95%	234080	113016	172782	0.25	20432	15642	5242	234080	138612	181475
Table for quantile: 0.5										
Fmult	F_2019	Catch_2019	Land_2019	Disc_2019	Rec_2020	SSB_2020	TSB_2020			
0	0	0	0	0	228120	144860	174352			
0.1	0.022	2414	1926	484	228120	141982	171425			
0.2	0.045	4775	3807	960	228120	139173	168622			
0.3	0.067	7083	5645	1428	228120	136497	165759			
0.4	0.089	9341	7438	1888	228120	133865	163030			
0.5	0.112	11550	9192	2339	228120	131290	160354			
0.6	0.134	13711	10901	2783	228120	128834	157738			
0.7	0.157	15816	12579	3222	228120	126380	155264			
0.8	0.179	17874	14210	3652	228120	123966	152737			
0.9	0.201	19895	15811	4077	228120	121642	150402			
1	0.224	21879	17370	4493	228120	119300	148028			
1.1	0.246	23808	18892	4903	228120	117072	145752			
1.2	0.268	25704	20375	5308	228120	114884	143460			
1.3	0.291	27553	21820	5706	228120	112755	141241			
1.4	0.313	29373	23240	6100	228120	110657	139105			
1.5	0.336	31143	24614	6487	228120	108602	137012			
1.6	0.358	32891	25968	6867	228120	106637	134925			
1.7	0.38	34602	27303	7241	228120	104728	132881			
1.8	0.403	36263	28600	7607	228120	102821	130868			
1.9	0.425	37879	29875	7969	228120	100918	128946			
2	0.447	39474	31109	8322	228120	99108	127093			

Table 5.1.6.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Reference points table updated in WGBIE 2018.

They have been last updated in WGBIE 2016.

From the IBP megrim (ICES, 2016):	Type	Value	Technical Basis
MSY approach	MSY $B_{trigger}$	41 800	BPA, because the fishery has not been at FMSY in the last 10 years
	F_{MSY}	0.191	F giving maximum yield at equilibriumComputed using Eqsim.
	F_{MSY} ranges	0.122-0.289	Stochastic simulations, 5% reduction in long-term yield compared with MSY.
Precautionary approach	B_{lim}	37 100	B_{loss}, which is the lowest biomass observed corresponding to year 2006
	B_{pa}	41 800	$B_{lim}e^{1.645\,\sigma}$ where $\sigma = 0.07$isthe standard deviation of the logarithm of SSB in 2014
	F_{lim}	0.533	It is the F that gives 50% probability of SSB being above B_{lim} in the long term. It is computed using Eqsim based on segmented regression with the breakpoint fixed at B_{lim}, without advice/assessment error and without $B_{trigger}$
	F_{pa}	0.451	$F_{lim}e^{-1.645\,\sigma}$ where $\sigma = 0.105$ is the standard deviation of the logarithm of F in 2014

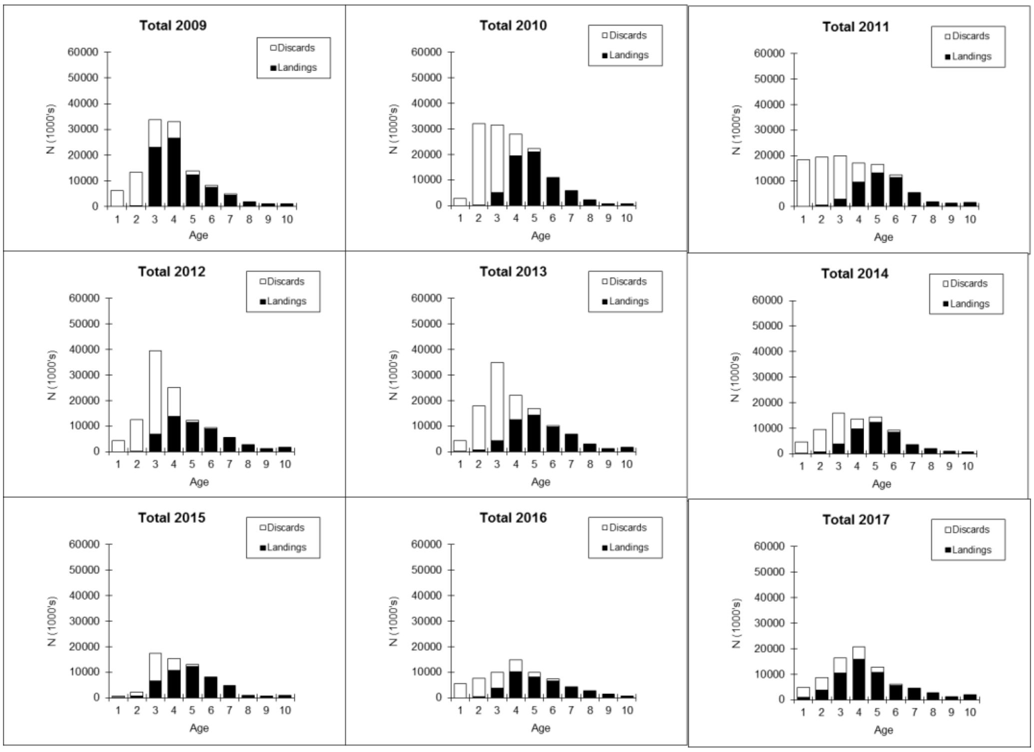


Figure 5.1.2.2.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Age composition of catches for the years 2009–2017.

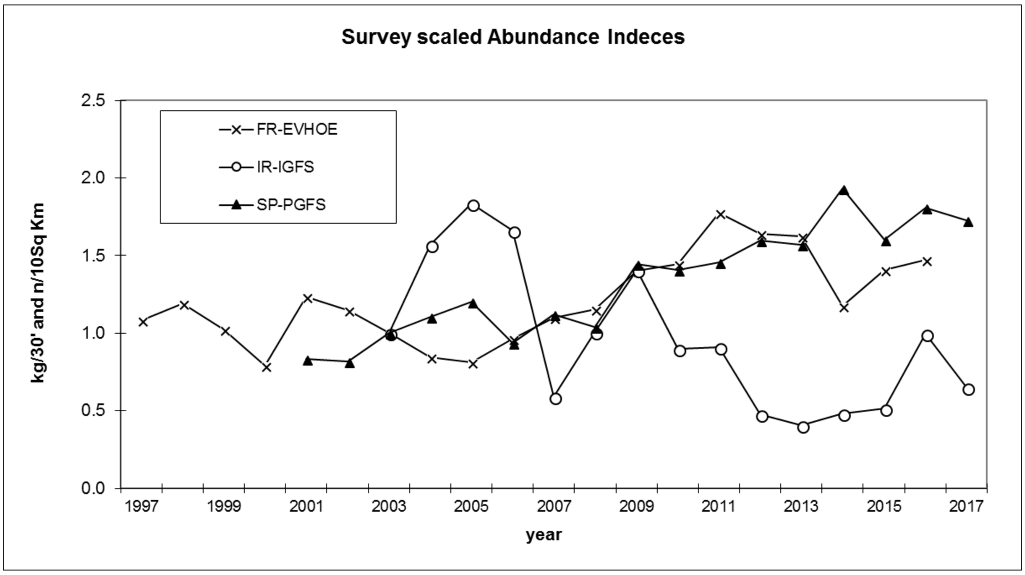


Figure 5.1.2.3.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Scaled Biomass Indices for FR-EVHOE, SP-PGFS and IR-IGFS.

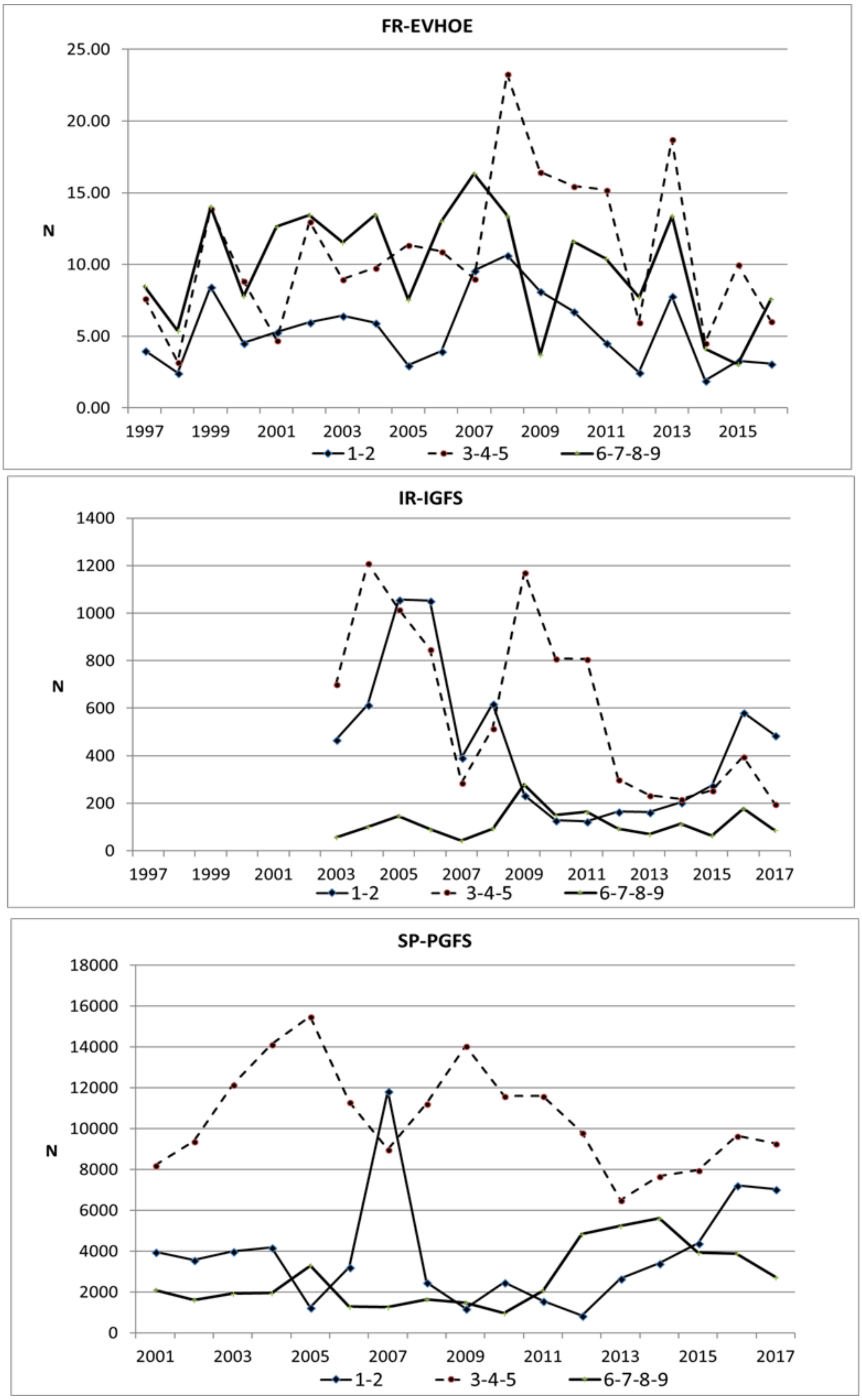


Figure 5.1.2.3.2. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Abundance Indices for EVHOE, IGFS and SP-PGFS by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+.

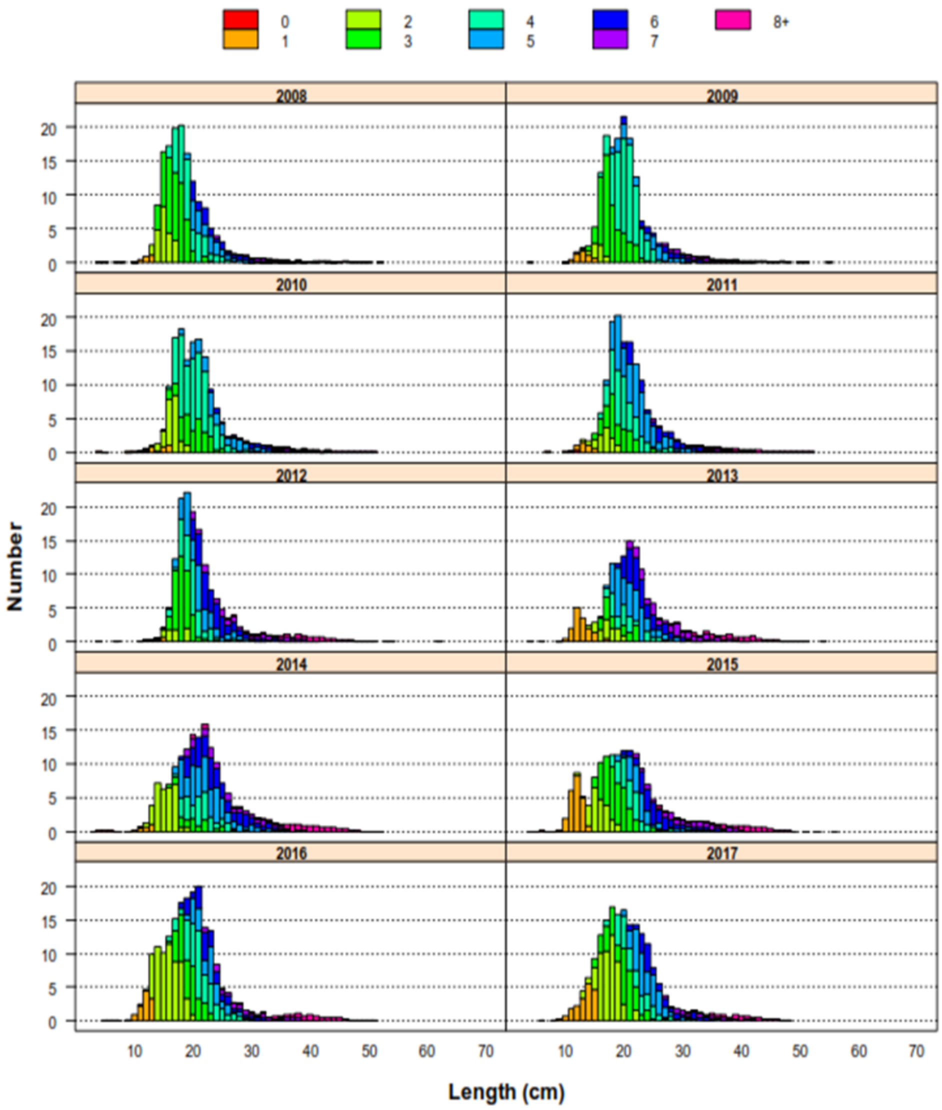


Figure 5.1.2.3.3. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Age composition of SP-PORCUPINE survey in abundance (numbers).

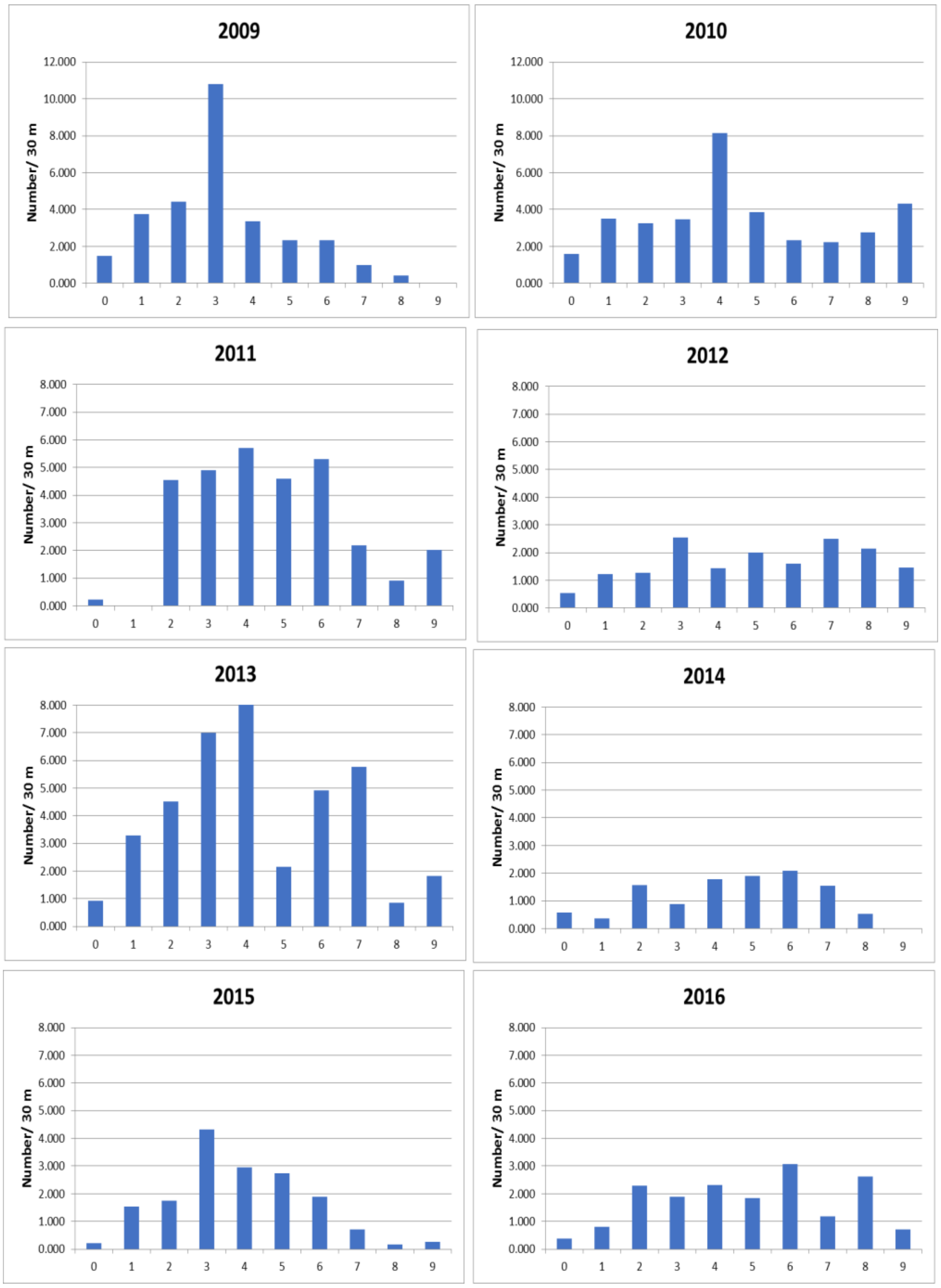


Figure 5.1.2.3.4. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Age composition of FR-EVHOE survey in abundance (numbers/30min haul).

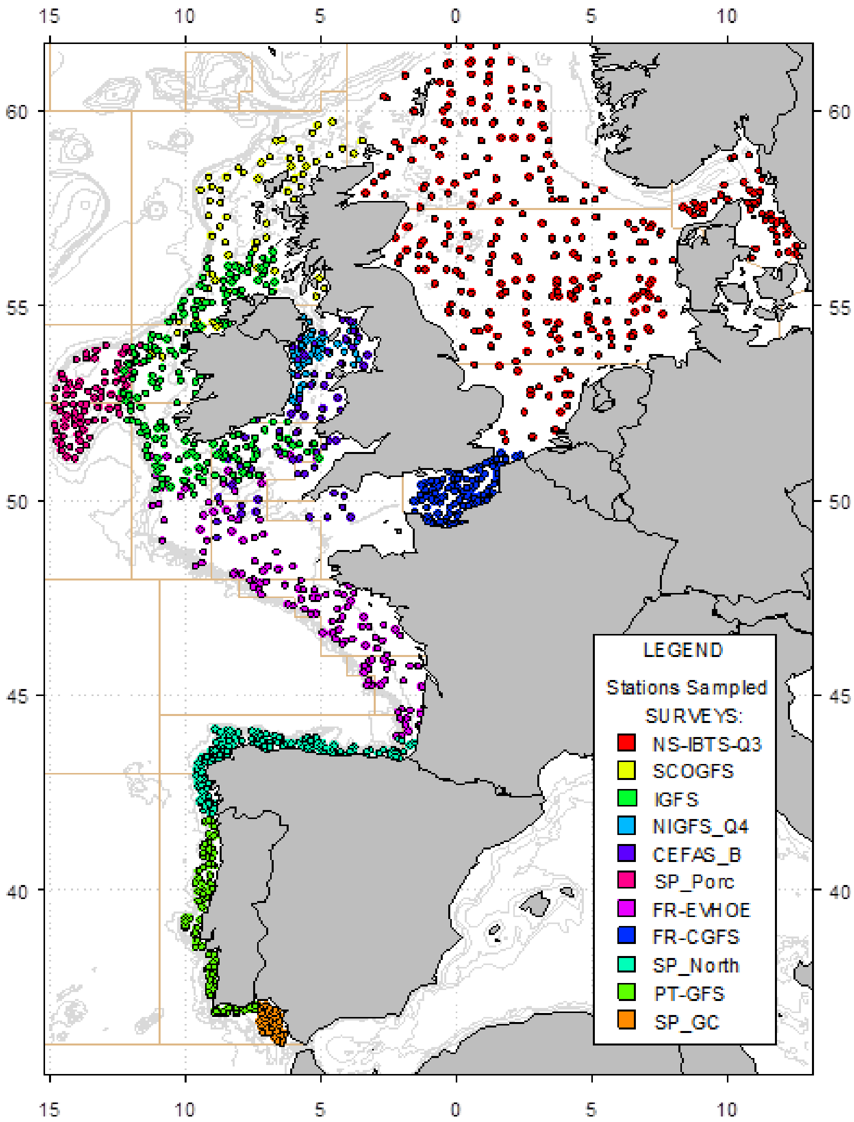


Figure 5.1.2.3.5. Station positions for the IBTS Surveys carried out in the Western Atlantic and North Sea Area in autumn/winter of 2008. (From IBTSWG 2009 Report). Just to be used as general location of the Surveys.

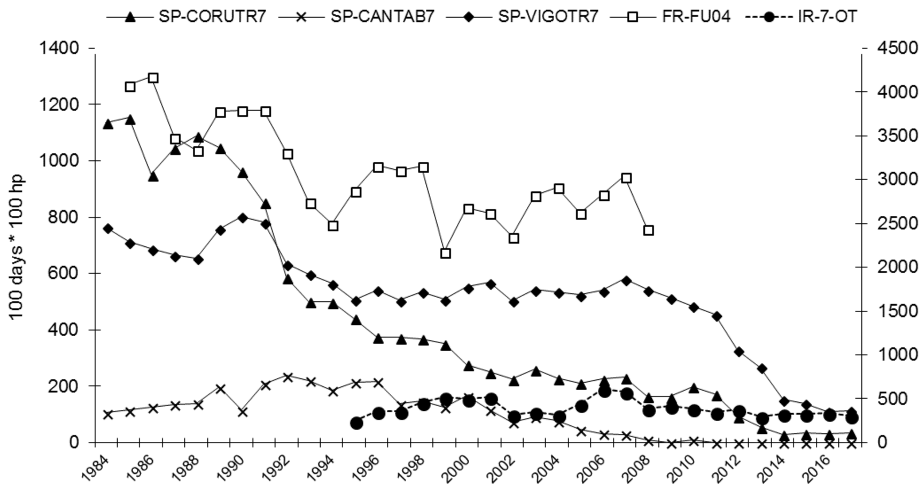


Figure 5.1.2.4.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Evolution of effort for different bottom-trawler fleets.

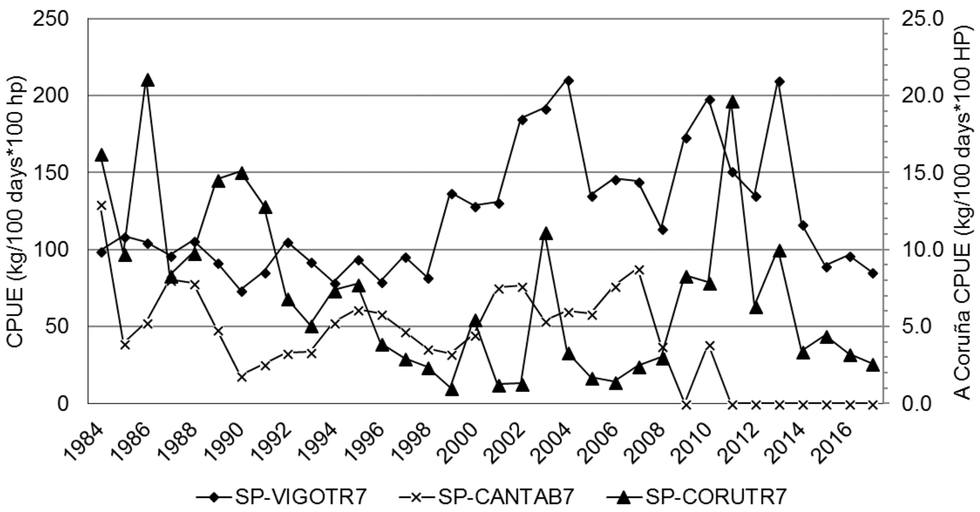


Figure 5.1.2.4.2. Megrim (*L. whiffiagonis*) in Divisions 7b,c,e-k and 8a,b,d. Spanish cpue for different bottom-trawler fleets.

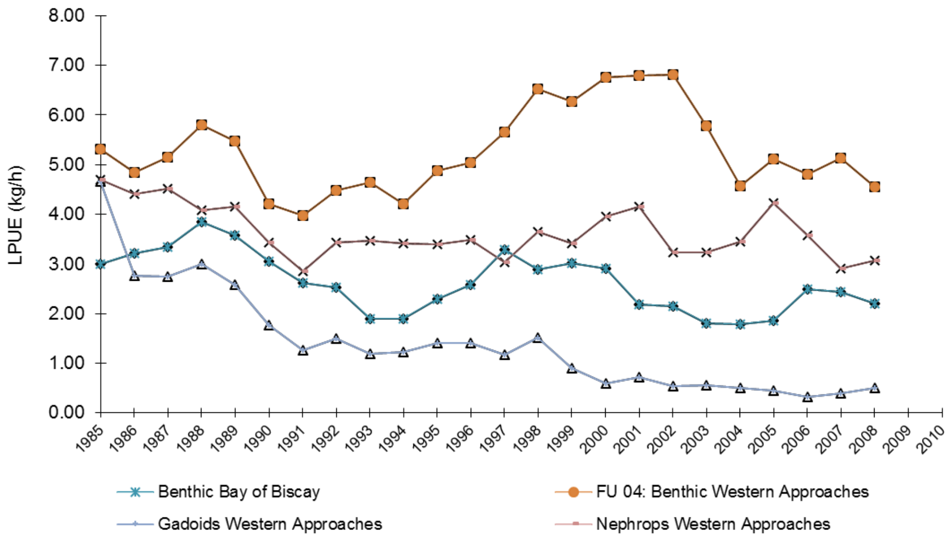


Figure 5.1.2.4.3. Megrim (*L. whiffiagonis*) in Divisions 7b,c,e-k and 8a,b,d. French LPUE for different bottom-trawler fleet.

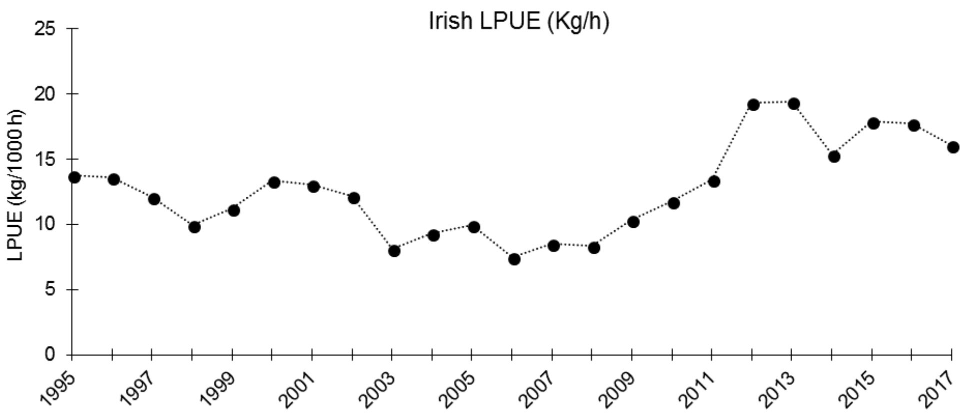


Figure 5.1.2.4.4. Megrim (*L. whiffiagonis*) in Divisions 7b,c,e-k and 8a,b,d. Irish LPUE for beam trawl fleet.

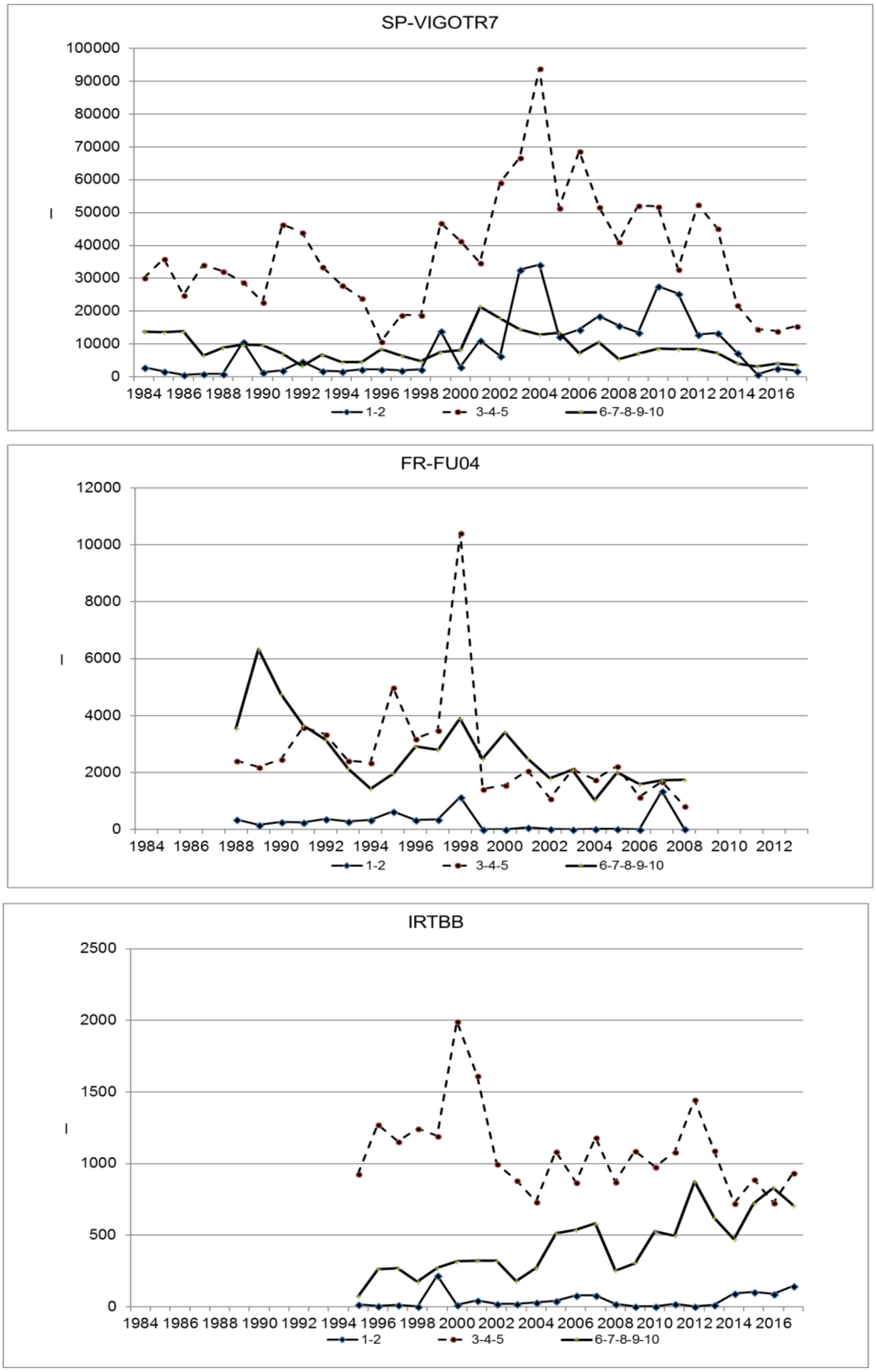


Figure 5.1.2.4.5. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Abundance Indices for SP-VIGOTR7, FR-FU04 and IRTBB by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+.

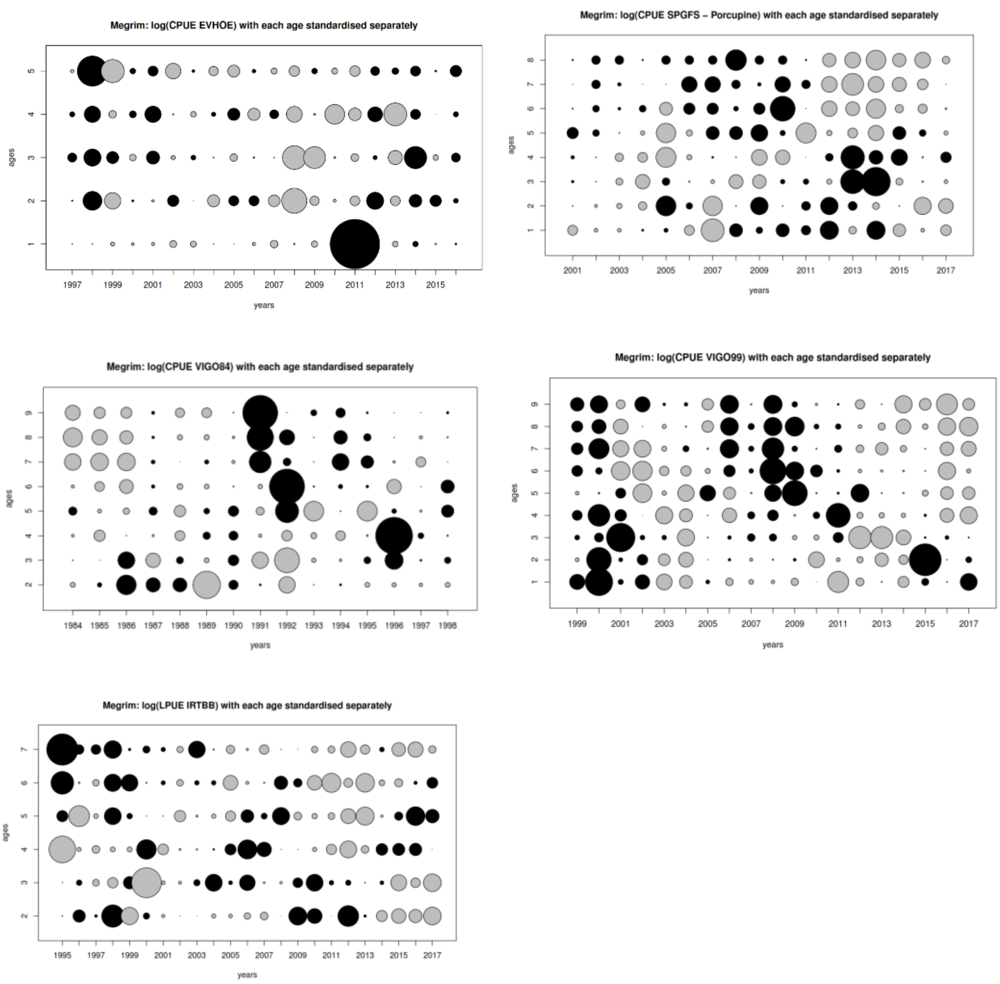


Figure 5.3.1.1. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Bubble plots of the standardized log abundance indices of the surveys and commercial fleets used as tuning fleets.

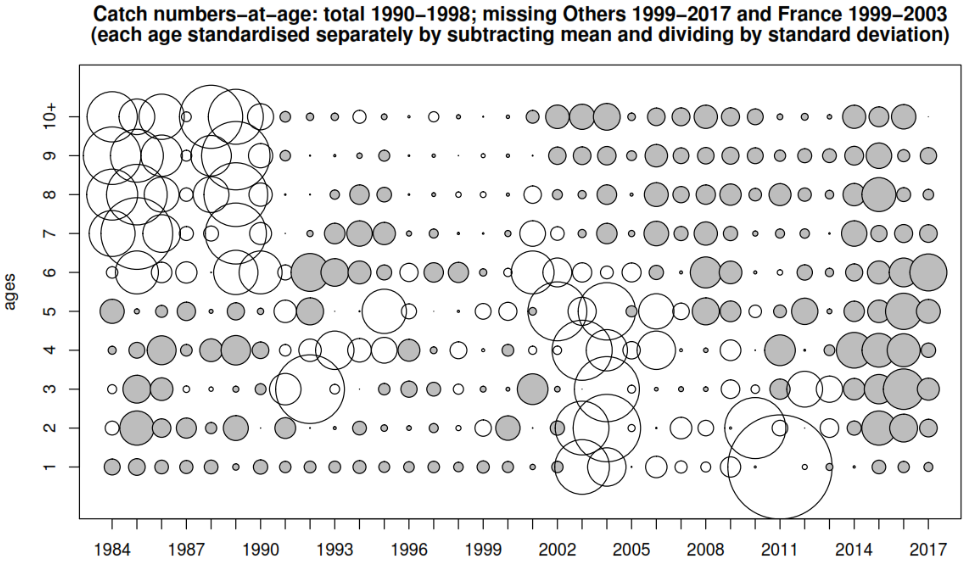


Figure 5.3.1.2. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Bubble plots for catch numbers-at-age from 1984 to 2017.

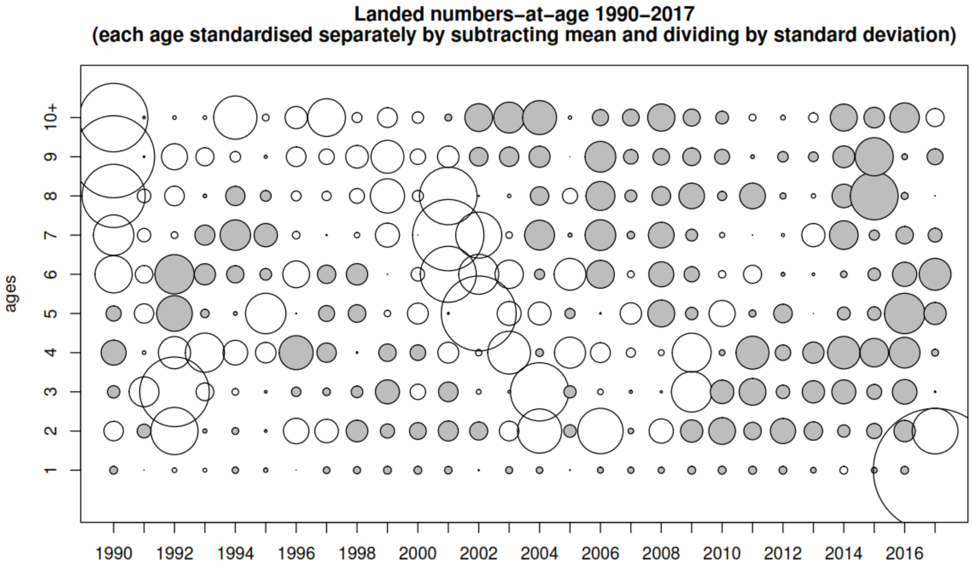


Figure 5.1.3.1.3. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Bubble plots for landing numbers-at-age from 1990–2017 (white positive and grey negative).

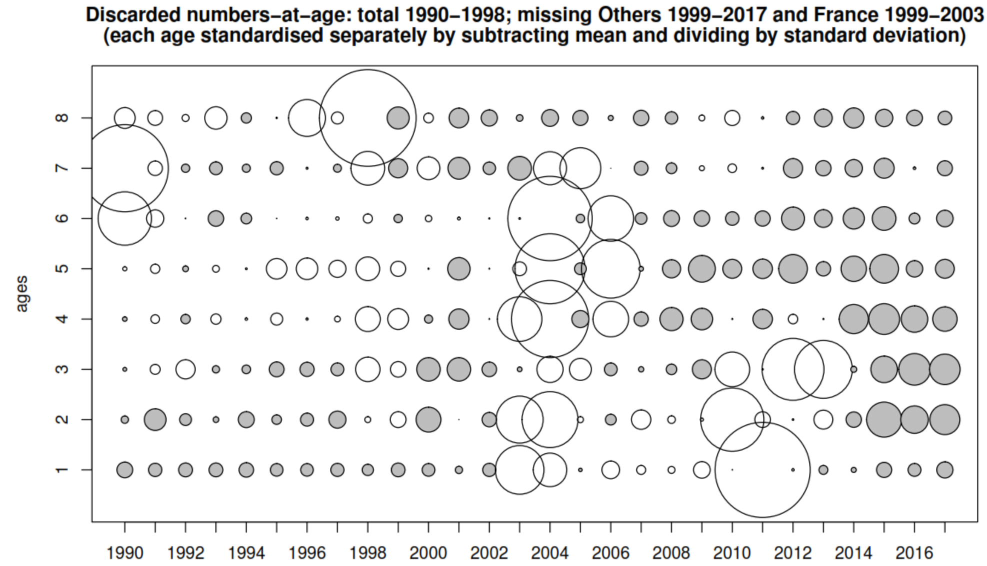


Figure 5.1.3.1.4. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Bubble plots for discarded numbers-at-age from 1990–2017 (white positive and grey negative).

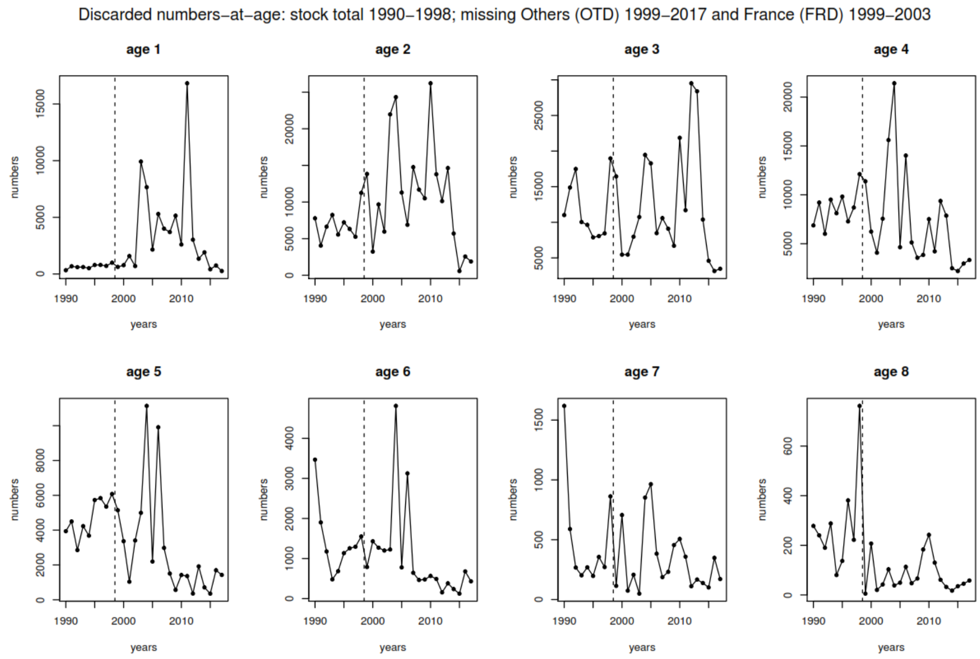


Figure 5.1.3.1.5. Megrim (*L. whiffiagonis*) in Divisions 7b-k and 8a,b,d. Discarded numbers-at-age separated by age from 1990–2017.

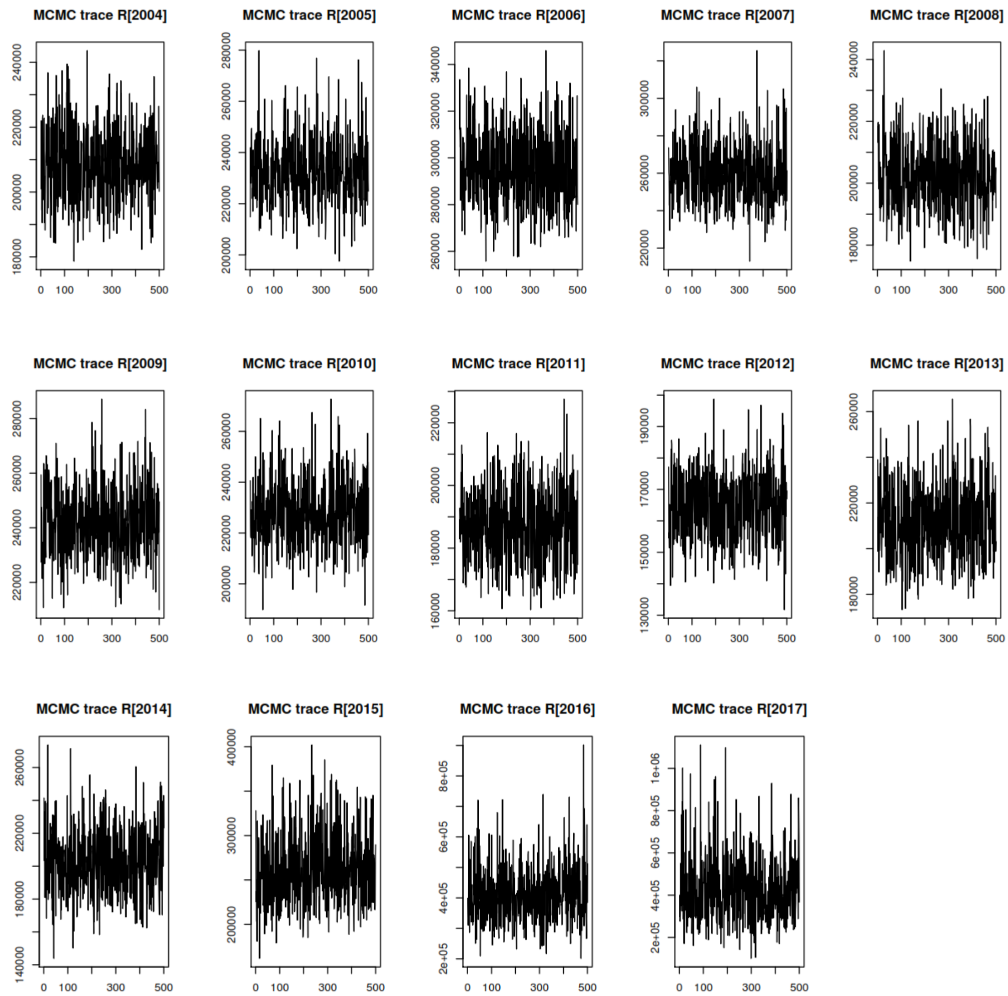


Figure 5.1.3.3.1. Trace plots of recruitment draws from 2004 to 2017.

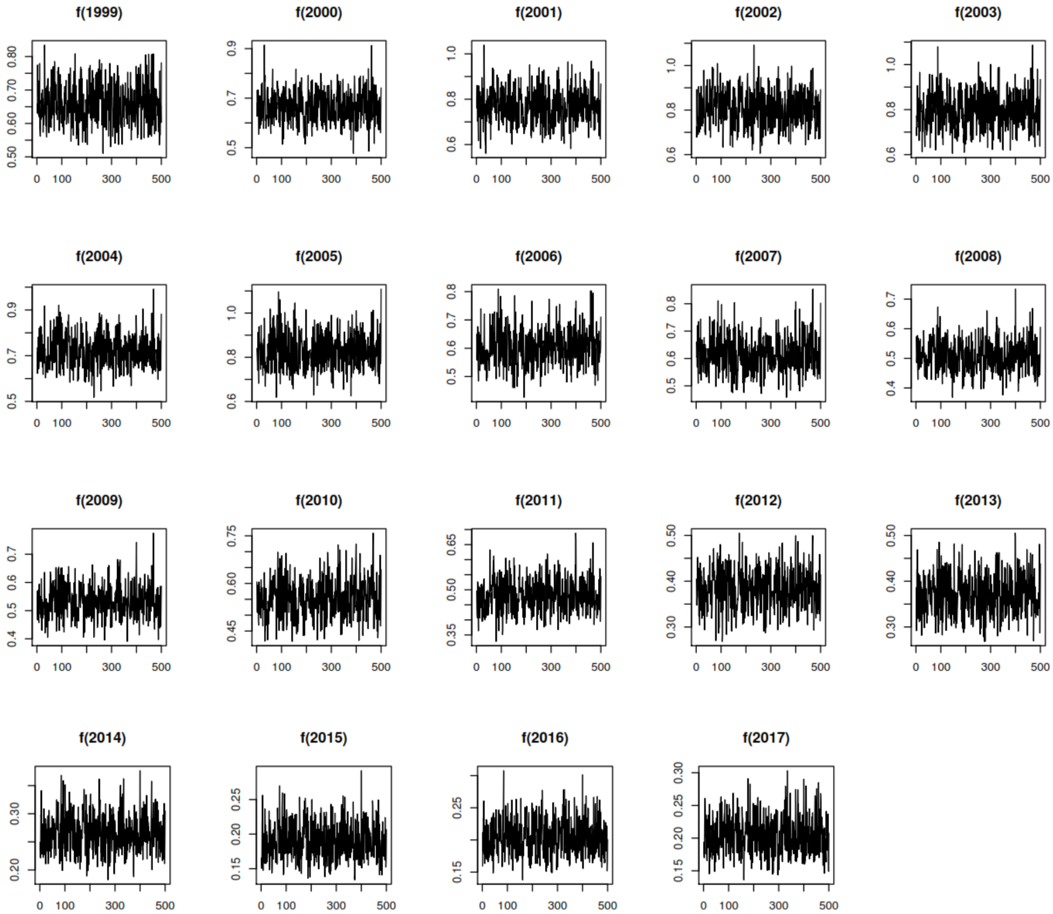


Figure 5.1.3.3.2. Trace plots of f(y) fishing mortality in ages 9 and 10 from 1999 to 2017.

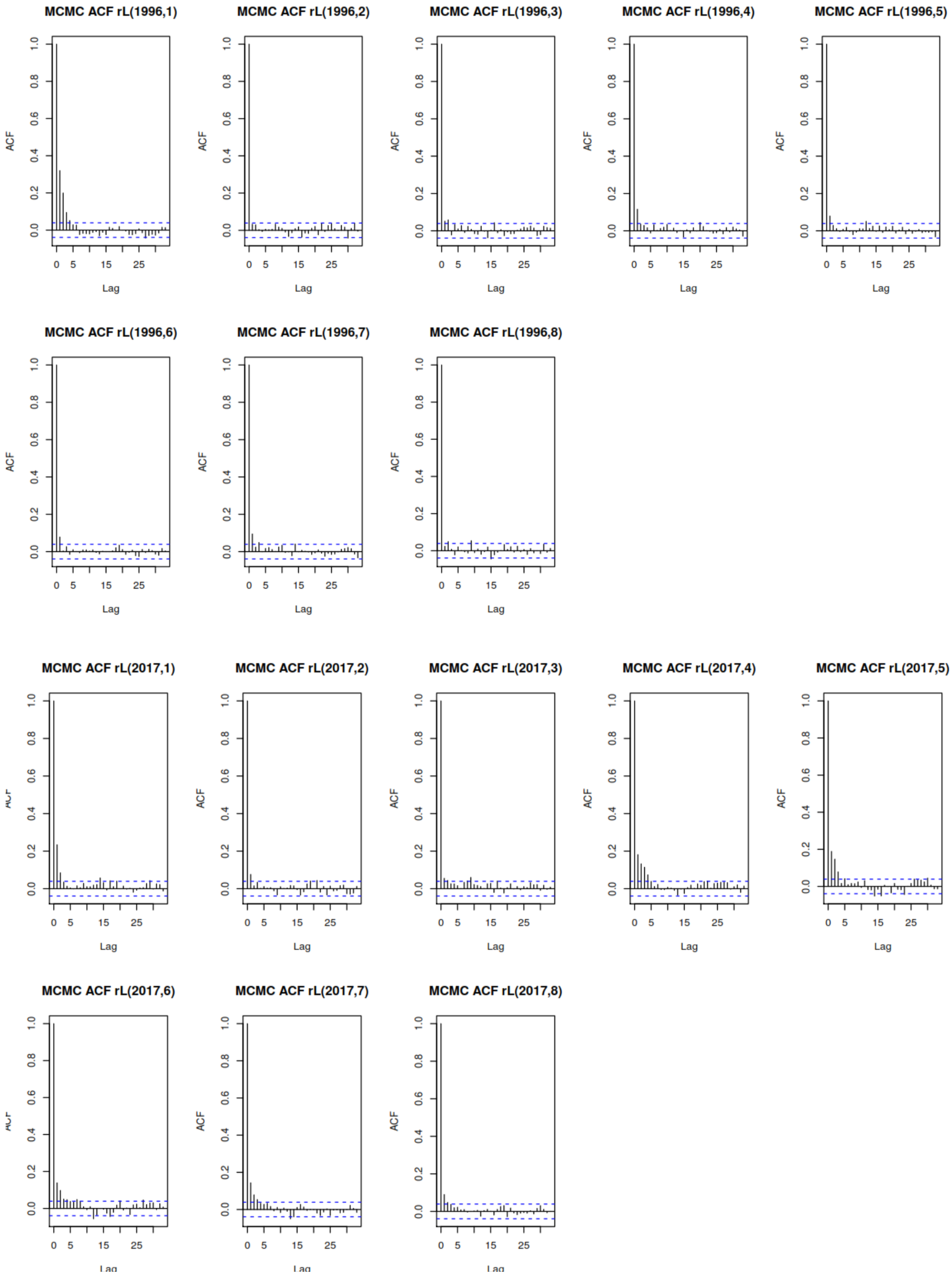
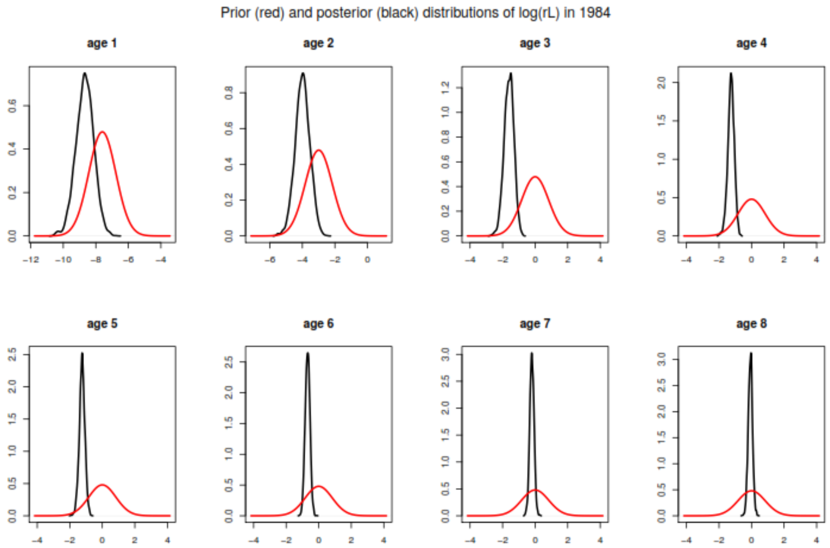
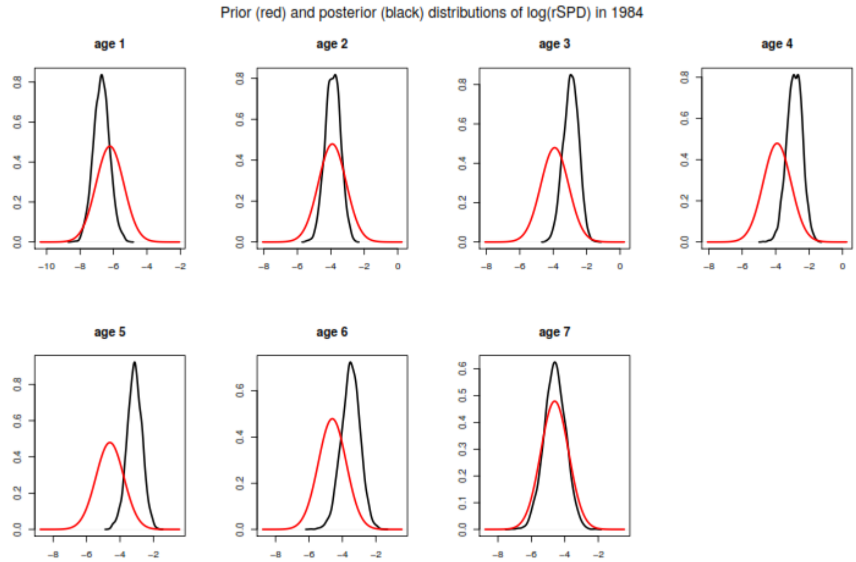
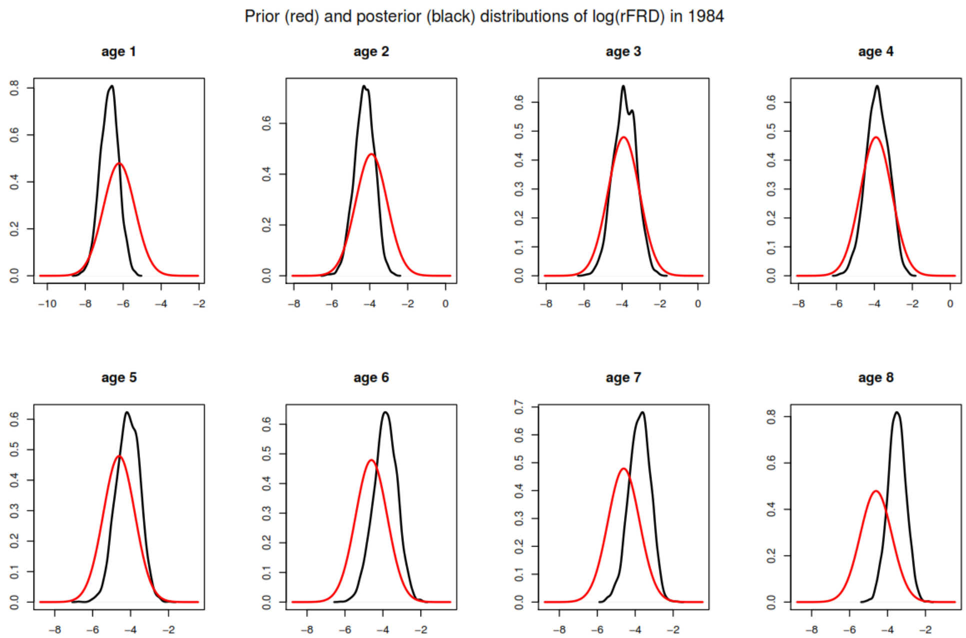


Figure 5.1.3.3.3. Autocorrelation plots of rL for years 1996 and 2017.


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


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

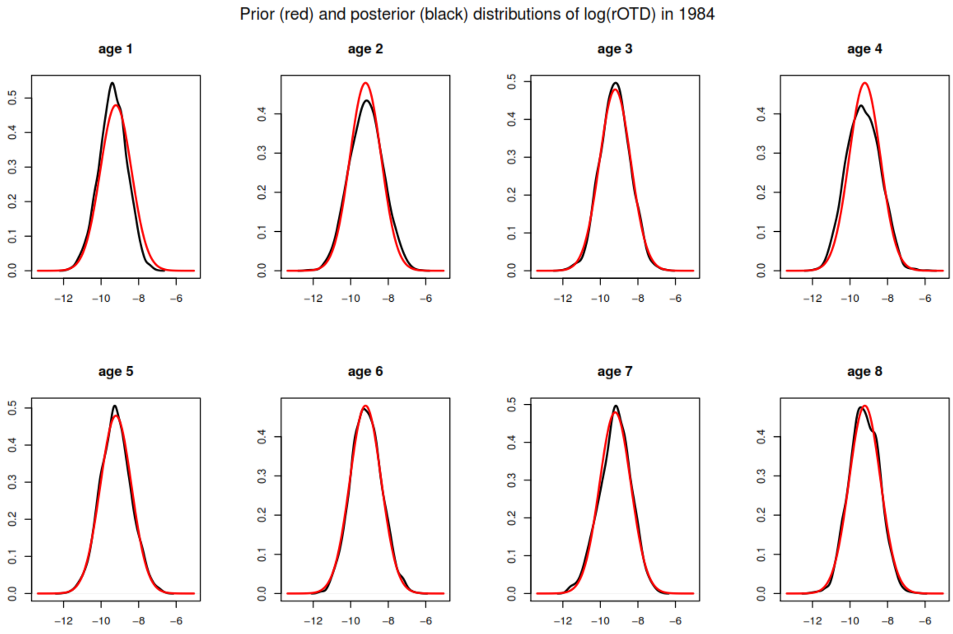


Figure 5.1.3.3.4. Prior (red) and posterior distribution of log (L) in 1984, log (rSPD) at age in 1984, log (rFRD) at age in 1984 and log (rOTD) at age in 1984.

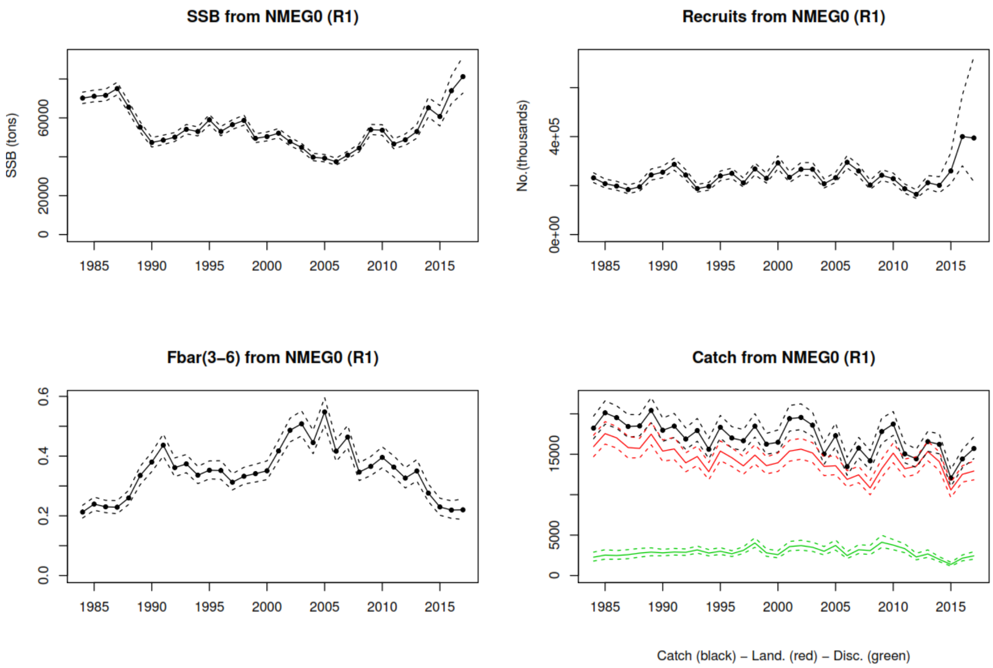
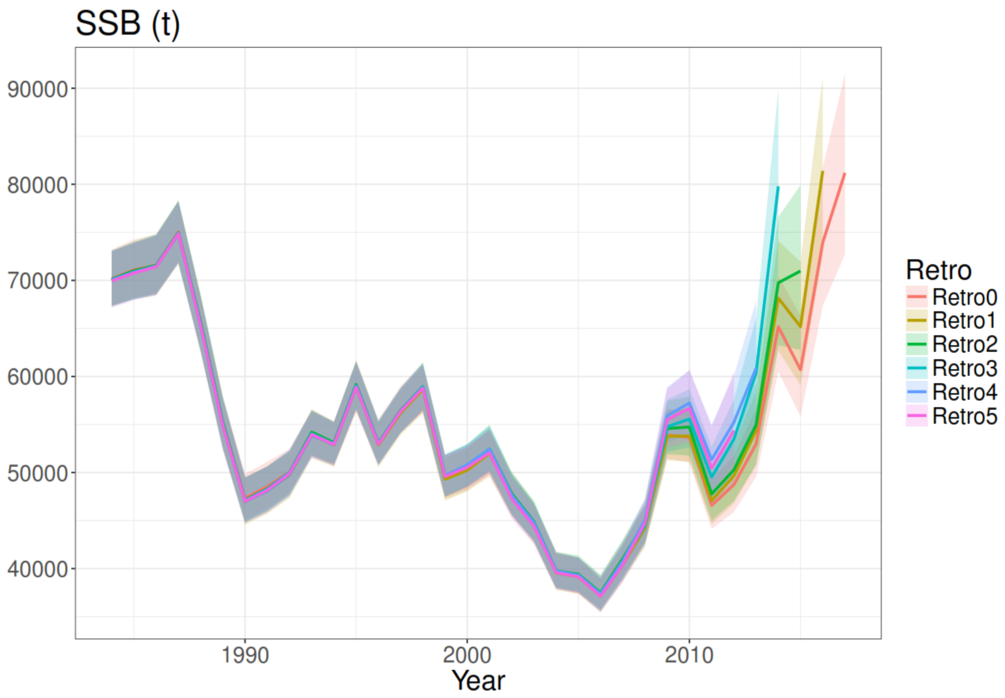


Figure 5.1.3.3.5. WGBIE 2018 results of time-series of spawning-stock biomass (SSB), recruits, Fbar, catch, landings and discards from 1984 to 2017. The solid dotted lines correspond to the median of the distribution and the dashed lines with 5% and 95% quantiles.


SSB (t)
90000
80000
70000
60000
50000
40000
1990
2000
2010
Year
Retro
Retro0
Retro1
Retro2
Retro3
Retro4
Retro5

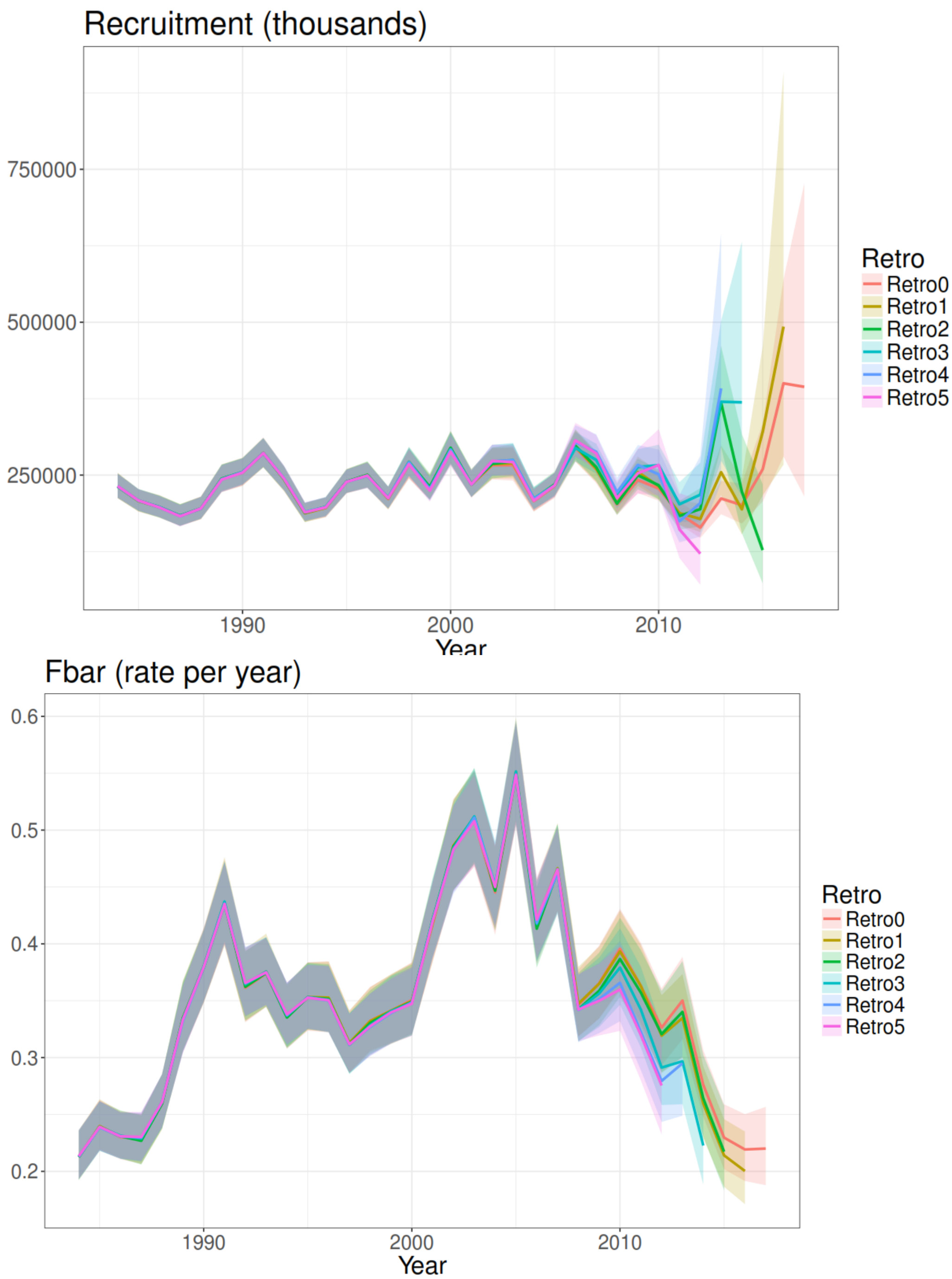


Figure 5.1.4.1. Time-series of median SSB, recruitment and Fbar in retrospective analysis.

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

Lepidorhombus whiffiagonis:

Type of assessment in 2018: Update.

Data revisions this year:

No revisions this year.

Lepidorhombus boscii:

Type of assessment in 2018: Update.

Data revisions this year:

No revisions this year.

General

See Stock annex general aspects related to megrim assessment.

Ecosystem aspects

See Stock annex for ecosystem aspects related to megrim assessment.

Fishery description

See Stock annex for fishery description.

Summary of ICES advice for 2018 and management for 2017 and 2018

ICES advice for 2018(as extracted from ICES Advice on fishing opportunities, catch and effort2017):

The two megrim species (*L.whiffiagonis* and *L.boscii*) are not separated in the landings and a single TAC covers both species. For these reasons, ICES advice in the past (prior to 2016) was based on a common multiplier of the current F for both megrim species; the value of the multiplier 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, the advice since 2016 is based on the single-species F_{MSY}.

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 the past), would result in combined megrim catches in 2018 of no more than:

1657 t (both megrim species) = 292 t (*L. whiffiagonis* single-species catch advice) + 1365 t (*L. boscii* catch resulting from the *L. whiffiagonis* F-multiplier).

Management applicable for 2017 and 2018:

The agreed combined TAC for megrim and four-spot megrim in ICES Divisions 8c and 9a was 1159 t in 2017 and 1387 t in 2018.

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 2017 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 2017 was 247 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 and it maintains stable. Historical landings for both species combined are shown in Figure 6.1.1. In 2017, international landings are 1174 t, according to last year's values.

Discards estimates were available from "observers on board sampling programme" for Spain in the years displayed in Table 6.1.2(a). Discards in number represent between 10-47% 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 whole period and in Table 6.1.3.(a) for 2017. 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 2017. 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.

A new maturity ogive based on microscopic method has been presented (WD 07, this report) and its use could be considered in a future after review of the method used and results.

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 RV.

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

The Spanish survey (SpGFS-WIBTS-Q4) covers the distribution area and depth strata of this species in Spanish waters 8c and 9a (WD 03, 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. Since 2014 the gear used was similar to the gear used in the survey before 2013. A new inter-calibration exercise was conducted in 2014 and the index was 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 2014 year 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 1988–2017 (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 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 2017 decreases again after an increase. 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 also some values above averages. Avilés show a decreasing trend.

Commercial fleets not used in the assessment to tune the model

Portuguese effort values are quite variable, except in 1990 and 2000 when they are significantly lower and in the last three years, the lowest values in the time-series (Table 6.1.8 and Figure 6.1.3(a)). The Portuguese LPUE series was 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 1986–2017 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 2017 and the 2017indices 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 positive values. Until 1997 many of the survey residuals were negative, whereas many are positive since 1999. Since 2008, there is not a clear trend. 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 (0.00028 difference) and close to zero that we have confidence that the assessment has converged. The results presented correspond to a run of 130 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 so in the last year. 2017 value represents a similar value for catches of previous years. The SSB values in 2007-2010 are the lowest in the series. Since 2011 values are significantly higher, especially the last two years. After a high recruitment (at age 1) value in the series in 2010 and the followings decreases and increases, the last three years’ the recruitments show significant increases, with 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 F_{bare}) 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, 2017 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 2014 year class is estimated to have 13.5 million fish at 1 year of age, based on the Spanish survey (SpGFS-WITBS-Q4) (70% of weight), two commercial fleets SP-LCGOTBDEF (13% of weight) and SP-AVSOTBDEF (14% of weight) and F shrinkage (3%).

The 2015 year class is estimated to have 11.7 million individuals at 1 year of age based on the information from the Spanish survey (SpGFS-WIBTS-Q4) (69% of weight), P-shrinkage (27% of the weight) and F shrinkage (4%).

The 2016 year class is estimated to have 8.2 million fish at 1 year of age, based on the information from the Spanish survey (SpGFS-WIBTS-Q4) (66% of weight), P-shrinkage (28% 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**
2014	13500	XSA	70%	27%	3%
2015	11700	XSA	69%	0%	31%
2016	8170	XSA)	66%	0%	34%
2017	3559	GM (98-15)			

6.1.4 Historic trends in biomass, fishing mortality and recruitment

From Table 6.1.12 and Figure 6.1.7, we see that SSB decreased from 2382 t in 1990 to 983 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 (660 t) corresponding to the lowest values. Since 2011, SSB values are significantly increasing, being 1991 t this year value, the highest of the last years.

After a decline from 2006 (0.41) to 2010 (0.08), and a following increasing trend, the last two years represent a decrease, more pronounced in 2017, falling to 0.16.

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 the last three years the recruitment seem to be very high, with values similar to those of middle nineties. The 2015 recruitment value is the highest of the time-series

6.1.4.1 Catch Options and prognosis

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

6.1.4.2 Short-term projections

Short-term projections have been made using MFDP.

The input data for deterministic short-term predictions are shown in Table 6.1.13. Average F_{bar} for the last three years is assumed for the interim year. The exploitation pattern is the scaled F-at-age computed for each of the last five years and then the average of these scaled five years was weighted to the final year. This selection pattern was split into selection-at-age of landings and discards (corresponding to F_{bar} = 0.28 for landings and F_{bar}=0.016 for discards, being 0.29 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 2018and 2019 are predicted to be 612 t and 615 t respectively, and discards 30 t and 21 t respectively. SSB would decrease from the 2503 t estimated for 2018 to 2241 t in 2019 and to 1900 t in 2020.

The contributions of recent year classes to the predicted landings in 2019 and SSB in 2020, assuming $GM_{98\text{-}15}$ recruitment, are presented in Table 6.1.16. The assumed $GM_{98\text{-}15}$ age 1 recruitment for the 2017 and 2018 year classes contributes 9% to landings in 2019 and 23% to the predicted SSB at the beginning of 2020. Megrim starts to contribute strongly to SSB at 2 years of age (see maturity ogive in Table 6.1.13).

6.1.4.3 Yield and biomass per recruit analysis

The results of the yield- and SSB-per-recruit analyses are in Table 6.1.17 (see also left panel of Figure 6.1.8, which plots yield-per-recruit and SSB-per-recruit vs. Fbar). Assuming s*tatus quo* exploitation Fbar = 0.28 for landings and Fbar=0.016 for discards and $GM_{98\text{-}15}$ for recruitment, the equilibrium yield would be 255 t of landings and 20 t of discards with an SSB of 1002 t.

6.1.5 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 the last three years.

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}	**0.191**	
	F_{MSY} lower	**0.122**	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

6.1.6 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 23% of the predicted SSB in 2020 relies on year classes for which recruitment has been assumed to be $GM_{98\text{-}15}$.

6.1.7 Management considerations.

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

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

Working group considers that this stock could be just “the tail” of the much larger stock of megrim in ICES Subarea 7 and Divisions 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	Total landings	Discards	Total catch
Year	8c	9a*	Total	9a				
1986	508	98	606	53		659	46	705
1987	404	46	450	47		497	40	537
1988	657	59	716	101		817	42	859
1989	533	45	578	136		714	47	761
1990	841	25	866	111		977	45	1022
1991	494	16	510	104		614	41	655
1992	474	5	479	37		516	42	558
1993	338	7	345	38		383	38	421
1994	440	8	448	31		479	13	492
1995	173	20	193	25		218	40	258
1996	283	21	305	24		329	44	373
1997	298	12	310	46		356	52	408
1998	372	8	380	66		446	36	482
1999	332	4	336	7		343	43	386
2000	238	5	243	10		253	35	288
2001	167	2	169	5		175	19	193
2002	112	3	115	3		117	19	137
2003	113	3	116	17		134	15	148
2004	142	1	144	5		149	11	159
2005	120	1	121	26		147	19	166
2006	173	2	175	35		210	16	226
2007	139	2	141	14		155	0.4	155
**2008	114	2	116	17		133	11	144
2009	74	2	77	7		84	11	94
2010	66	8	74	10		83	5	88
^2011	242	0	242	34	26	302	69	371
^2012	151	11	161	18	83	262	31	293
^2013	128	3	131	11	90	231	18	250
2014	225	5	231	30	116	377	23	399
2015	188	2	190	23	63	276	21	297
2016	171	1	172	15	48	235	63	298
2017	189	4	193	16	39	247	41	288

^Data revised in WG2015

*9a is without Gulf of Cádiz till 2016

** Data revised in WG2010

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	2017
Weight Ratio	0.06	0.23	0.12	0.07	0.06	0.07	0.21	0.14
CV	61.6	23.7	28.8	30.3	44.7	49.8	57.1	28.9
Number Ratio	0.27	0.57	0.37	0.24	0.20	0.29	0.47	0.34

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	2017
1	0	96	16	12	8	330	442	624	1074	492
2	126	142	119	2044	808	53	94	10	373	410
3	86	21	6	346	85	13	16	4	3	43
4	8	15	1	1	41	5	2	1	1	0
5	5	7	2	2	2	0	0	0	0	0
6	2	7	0	0	1	0	0	0	0	0
7	0	3	1	0	1	0	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	1856
19	14846
20	55073
21	106976
22	163074
23	212043
24	212352
25	222169
26	169672
27	164099
28	134457
29	97260
30	77853
31	58847
32	40677
33	29637
34	15456
35	10039
36	9675
37	9983
38	8315
39	5812
40	6709
41	5020
42	3783
43	3905
44	1898
45	1098
46	923
47	219
48	86
49	180
50+	
Total	1843993

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	2017
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	26.41
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	134.1

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	2017
AGE										
1	133	170	149	2054	812	359	469	712	1187	530
2	370	111	39	1087	275	152	705	224	1275	1160
3	215	159	53	156	834	320	420	536	218	877
4	153	102	112	220	157	612	432	239	116	64
5	168	80	97	266	192	81	518	257	87	81
6	60	60	81	209	106	61	74	191	85	35
+gp	35	29	43	184	139	89	144	82	96	41
TOTALNUM	1134	711	574	4176	2515	1674	2762	2241	3064	2788
TONSLAND	144	95	88	371	293	250	399	297	298	288
SOPCOF %	100	101	100	100	100	101	100	100	100	101

* 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	2017
AGE										
1	0.033	0.031	0.037	0.026	0.027	0.039	0.035	0.037	0.041	0.038
2	0.084	0.088	0.091	0.088	0.089	0.079	0.097	0.102	0.086	0.081
3	0.118	0.135	0.116	0.135	0.138	0.127	0.13	0.133	0.147	0.131
4	0.145	0.16	0.168	0.134	0.164	0.179	0.166	0.174	0.198	0.184
5	0.187	0.189	0.203	0.201	0.172	0.232	0.22	0.197	0.244	0.217
6	0.246	0.246	0.228	0.242	0.228	0.281	0.264	0.277	0.304	0.295
+gp	0.409	0.404	0.37	0.371	0.343	0.391	0.381	0.388	0.388	0.43
SOPCOFAC	1.0034	1.0062	0.9989	0.9976	1.0031	1.0124	0.9988	0.9986	1.0012	1.006

* 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
2017	0.06	0.21	0.09	3.75	0.39	2017	2.04	1.37	50.23	6.04	2017		0.00	15.42

+ 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
** Since 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	2017								
1	1	0	1						
1	7							Eff.	
10	13.0	32.1	24.9	24.3	21.5	11.1	6.7	7.1	1986
10	105.5	114.2	46.8	22.4	15.1	7.5	5.8	12.7	1987
10	18.5	55.0	41.2	32.3	22.9	10.2	5.5	11.3	1988
10	4.6	24.4	23.6	25.7	20.8	9.8	5.7	11.9	1989
10	6.1	23.7	25.3	34.1	32.9	17.6	10.5	8.8	1990
10	6.8	31.1	30.5	36.8	32.3	16.0	9.0	9.6	1991
10	1.2	16.6	21.3	31.1	31.1	16.9	13.5	10.2	1992
10	0.2	12.0	15.1	20.7	17.8	8.2	3.9	7.1	1993
10	0.0	4.9	72.9	40.0	58.6	41.7	8.8	8.5	1994
10	65.1	4.1	19.6	42.9	15.4	4.2	2.9	13.4	1995
10	1.4	64.0	3.2	20.6	54.7	17.2	10.1	11.0	1996
10	1.1	37.2	56.8	5.7	29.0	27.0	9.3	12.5	1997
10	0.7	20.1	56.1	69.8	19.8	40.8	18.4	8.2	1998
10	0.8	8.6	44.3	46.5	38.3	10.7	21.4	8.8	1999
10	1.5	7.0	46.7	64.3	61.6	15.6	18.2	10.5	2000
10	2.6	25.7	25.8	31.0	33.4	27.1	19.0	12.1	2001
10	2.0	12.8	43.6	12.1	32.9	17.3	6.9	11.0	2002
10	25.9	19.2	20.0	20.1	12.2	10.0	8.5	10.2	2003
10	2.2	12.0	13.5	20.4	19.2	14.3	13.5	7.0	2004
10	5.7	12.4	27.6	12.6	13.5	8.3	5.6	7.1	2005
10	3.4	17.9	24.8	17.5	13.3	9.5	3.8	7.8	2006
10	12.9	19.2	21.7	27.7	16.7	10.0	8.0	7.3	2007
10	0.2	21.9	20.2	14.9	16.3	5.5	3.8	9.0	2008
10	6.0	17.2	22.6	12.7	8.8	5.9	2.8	8.0	2009
10	1.6	7.0	12.1	25.4	24.5	18.1	10.3	5.8	2010
10	2.3	134.6	27.5	38.0	31.8	15.8	9.3	5.1	2011
10	2.3	108.1	392.9	68.3	76.2	27.9	18.2	7.6	2012
10	1.6	19.9	54.6	89.3	9.8	7.2	6.8	10.8	2013
10	2.8	33.7	17.9	16.2	17.0	2.6	5.3	13.4	2014
10	16.4	32.2	64.7	25.3	26.3	19.8	7.1	9.8	2015
10	69.4	254.4	24.7	11.1	8.2	7.1	7.3	10.6	2016
10	10.0	178.8	193.9	15.9	19.0	7.0	4.7	8.7	2017

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

1986	2017								
1	1	0	1						
1	7							Eff.	
10	408.3	516.4	427.9	208.7	181.7	153.1	91.6	3.9	1986
10	589.9	470.6	510.4	242.2	145.3	167.8	55.4	3.0	1987
10	1458.2	905.1	749.0	357.4	154.7	193.1	84.9	3.4	1988
10	835.9	513.9	538.8	252.8	145.1	174.1	67.7	3.3	1989
10	4366.2	949.0	224.8	173.4	45.8	49.9	70.8	3.2	1990
10	980.1	855.3	228.9	99.8	83.6	14.7	7.3	3.5	1991
10								10.2	1992
10	1149.0	1489.5	91.4	99.7	52.6	24.9	19.4	2.4	1993
10	19.0	175.6	547.0	135.3	132.9	51.0	23.7	4.5	1994
10	40.5	2.4	43.0	139.5	69.5	25.9	14.3	3.5	1995
10	135.0	796.8	14.0	116.8	258.6	74.2	62.5	2.3	1996
10	96.0	880.4	621.3	34.1	153.4	127.8	46.3	2.6	1997
10	16.0	308.5	374.9	233.1	51.9	69.5	38.1	5.1	1998
10	10.3	109.8	397.8	262.9	162.2	38.0	69.7	4.9	1999
10	28.7	54.3	238.7	229.5	146.0	35.7	52.8	2.5	2000
10	36.6	199.6	192.6	121.6	115.1	83.5	85.2	1.3	2001
10	54.5	157.6	238.5	64.6	92.9	53.5	46.8	2.0	2002
10	26.1	84.5	105.0	70.5	31.4	24.1	28.1	2.2	2003
10	52.5	231.5	208.5	248.0	193.4	102.9	59.9	1.6	2004
10	118.2	181.5	309.0	117.1	106.9	58.6	26.1	3.0	2005
10	42.8	181.8	235.7	120.5	83.2	45.5	12.4	2.8	2006
10	24.6	48.0	72.4	93.0	40.7	24.5	19.9	2.2	2007
10	5.0	153.3	85.0	50.6	48.7	18.1	15.7	2.0	2008
10	12.4	41.2	66.8	49.6	39.1	38.7	21.2	2.3	2009
10	49.8	45.0	66.0	160.3	135.6	120.9	61.5	2.0	2010
10	6.4	483.1	95.2	133.1	167.6	133.8	109.7	2.2	2011
10	0.4	27.8	117.6	22.7	29.1	17.7	27.9	2.6	2012
10	10.6	35.1	128.7	279.4	38.4	31.1	62.1	1.5	2013
10	7.2	116.4	64.5	72.8	116.6	21.5	53.2	3.0	2014
10	32.8	42.3	100.0	52.4	62.9	62.9	33.0	1.8	2015
10	37.6	261.5	65.3	47.3	43.4	48.0	55.6	1.6	2016
10	40.1	416.5	352.2	21.5	33.9	22.4	45.0	2.0	2017

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

1988	2017								
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
1	15.42	25.02	8.71	0.33	0.35	0.21	0.15	112	2017

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
2017	47	8.7	5.43	25	2.0	12.52	12.7	15.4	0.83

[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

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Extended Survivors Analysis

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

CPUE data from file fleetw.txt

Catch data for 32 years. 1986 to 2017. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF	1986	2017	3	6	0	1
SP-AVSOTBDEF	1986	2017	3	6	0	1
SP-GFS	1990	2017	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 130 iterations

Total absolute residual between iterations
129 and 130 = .00028

Final year F values

Age	1	2	3	4	5	6
Iteration **	0.0744	0.1641	0.1409	0.1822	0.2932	0.2361
Iteration **	0.074	0.164	0.141	0.182	0.293	0.236

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	0	0	0	1	0	0	0.308	0.06	0.119	0.074
2	0	0	0	0	0	0	0.406	0.236	0.145	0.164
3	0	0	0	0	0	0	0.457	0.625	0.381	0.141
4	0	0	0	0	0	0	0.472	0.515	0.261	0.182
5	0	0	0	0	1	0	0.604	0.576	0.356	0.293
6	0.328	0.282	0.356	0.755	0.354	0.555	0.61	0.468	0.378	0.236

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
2008	1730	2220	1330	723	515	237
2009	1500	1300	1480	894	453	270
2010	7050	1070	960	1070	639	299
2011	5480	5640	844	738	774	436
2012	2990	2630	3630	550	405	393
2013	3250	1710	1900	2220	308	158
2014	1950	2340	1270	1270	1260	179
2015	13500	1180	1270	656	649	565
2016	11700	10400	760	559	321	298
2017	8170	8470	7380	425	352	184

Estimated population abundance at 1st Jan 2018

0	6210	5890	5250	290	215

Taper weighted geometric mean of the VPA populations:

5050	3520	2160	1260	757	386

Standard error of the weighted Log(VPA populations) :

0.6893	0.6924	0.5909	0.5313	0.4562	0.4559

1

Log catchability residuals.

Fleet : SP-LCGOTBDEF

Age	1986	1987
1	No data for this fleet at this age	
2	No data for this fleet at this age	
3	-0.64	-0.29
4	-0.45	-0.65
5	-0.45	-0.76
6	-0.52	-0.8

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.06	-0.83	-0.66	-0.67	-0.69	-0.79	0.11	-0.65	-1.44	-0.05
4	-0.53	-0.2	-0.21	-0.02	-0.32	-0.48	0.37	-0.14	-0.52	-0.99
5	-0.45	-0.8	0.4	0.26	0.33	-0.5	1.07	-0.32	0.27	-0.13
6	-0.49	-0.52	-0.23	0.49	0.58	0.12	1.38	-0.32	0.52	0.36

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.1	-0.08	0.44	0.4	0.46	-0.37	-0.53	0.28	-0.02	0.26
4	0.43	-0.04	0.56	0.24	-0.26	-0.29	-0.29	-0.5	0.08	0.38
5	0.38	0.11	0.35	-0.05	0.3	-0.34	-0.37	-0.66	-0.46	0.17
6	1.13	0.7	-0.24	0.04	-0.28	-0.49	0.36	-0.7	-0.66	-0.22

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.01	-0.04	-0.26	0.77	2.01	0.64	0.04	1.39	0.84	0.53
4	-0.05	-0.47	0.07	0.93	1.83	0.69	-0.39	0.73	-0.04	0.55
5	0.05	-0.57	0.08	0.29	1.94	-0.07	-0.75	0.34	-0.19	0.52
6	-0.33	-0.36	0.68	0.29	0.79	0.47	-0.54	0.12	-0.23	0.1

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	-6.2945	-5.9393	-5.4783	-5.4783
S.E(Log q)	0.6917	0.5634	0.5689	0.5601

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	1.2	-0.773	6.02	0.34	32	0.83	-6.29
4	1.49	-1.788	5.35	0.31	32	0.81	-5.94
5	1.53	-1.576	4.87	0.23	32	0.85	-5.48
6	1.22	-0.809	5.33	0.31	32	0.68	-5.44
1							

Fleet : SP-AVSOTBDEF

Age	1986	1987
1	No data for this fleet at this age	
2	No data for this fleet at this age	
3	0.5	0.39
4	0.24	0.25
5	0.38	0.18
6	0.77	0.93

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	1.13	0.61	-0.14	-0.35	99.99	-0.71	0.45	-1.54	-1.85	0.67
4	0.4	0.64	-0.05	-0.49	99.99	-0.41	0.13	-0.43	-0.28	-0.65
5	0.12	-0.19	-0.56	-0.12	99.99	-0.74	0.57	-0.16	0.49	0.25
6	1.08	1.01	-0.47	-0.92	99.99	-0.11	0.25	0.11	0.65	0.61

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.11	0.43	0.37	0.73	0.45	-0.38	0.55	0.97	0.56	-0.23
4	0.16	0.22	0.34	0.13	-0.03	-0.52	0.73	0.24	0.51	0.15
5	0.02	0.23	-0.12	-0.12	-0.01	-0.67	0.65	0.04	0.07	-0.24
6	0.35	0.71	-0.7	-0.15	-0.45	-0.97	0.98	-0.12	-0.34	-0.68

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.26	-0.66	-0.26	0.33	-0.91	-0.21	-0.38	0.14	0.08	-0.6
4	-0.29	-0.61	0.42	0.72	-0.74	0.33	-0.38	0.02	-0.03	-0.71
5	-0.17	-0.39	0.49	0.65	-0.42	0.07	-0.15	-0.06	0.13	-0.22
6	-0.37	0.16	1.21	1.1	-0.9	0.65	0.04	0.03	0.34	-0.15

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

Age	3	4	5	6
Mean Log q	-4.6045	-4.4598	-4.1573	-4.1573
S.E(Log q)	0.6851	0.4321	0.3602	0.674

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	0.88	0.669	4.98	0.5	31	0.61	-4.6
4	0.8	1.672	4.98	0.72	31	0.34	-4.46
5	0.84	1.395	4.56	0.71	31	0.3	-4.16
6	1.09	-0.305	3.84	0.29	31	0.73	-4.01
1							

Fleet : SP-GFS

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1	99.99	99.99	-0.27	-0.55	-0.14	-0.1	-1.42	-0.23	-0.03	-0.11
2	99.99	99.99	-0.01	-0.36	-0.67	-0.07	-1.01	-0.99	-0.12	-0.06
3	99.99	99.99	0.11	-0.85	-0.43	-1.11	0.21	-1.38	-1.29	0.03
4	99.99	99.99	0.69	0.12	0.24	0.08	0.08	-0.32	-0.51	-0.49
5	99.99	99.99	0.54	0.22	0.61	-0.21	0.33	-0.08	-0.37	-0.15
6	99.99	99.99	0.69	-0.32	-0.48	-0.4	-0.01	-0.25	0.01	-0.47

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	0.01	0.17	0.68	0.12	0.43	0.25	0.11	0.41	0.08	0.27
2	-0.18	0.37	0.56	0.57	0.35	0.06	0.2	-0.1	0.18	-0.12
3	0.24	0.51	0.54	0.17	0.84	-0.01	0.01	0.54	0.15	0.26
4	0.05	0.12	0.7	0.67	-0.54	-0.12	0.01	0.34	0.1	0.37
5	-0.06	0.21	0.29	0.19	0.41	-0.21	-0.23	0.41	0.17	0.32
6	0.5	1.09	-0.07	-0.49	-0.57	-0.89	0.61	-0.09	-0.07	-0.02

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	-0.33	-0.24	0.09	-0.17	-0.28	99.99	0.56	0.09	0.28	0.33
2	0.05	-0.3	-0.49	0.52	0.08	99.99	0.5	0.56	-0.04	0.53
3	0.03	0.08	-1.23	0.58	0.46	99.99	0.34	0.57	0.4	0.23
4	-0.26	-0.09	-0.47	-0.8	-0.21	99.99	0.24	0.33	0.01	-0.32
5	-0.1	-0.4	-0.5	-0.27	-0.79	99.99	-0.01	0.13	-0.23	-0.22
6	-0.46	-0.11	0.35	0.07	-0.43	99.99	0.15	-0.28	-0.14	-0.12

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	-6.6994	-6.5347	-6.307	-6.307
S.E(Log q)	0.6266	0.389	0.3398	0.4426

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
1	0.53	3.874	7.78	0.73	27	0.41	-7.21
2	0.66	2.568	7.26	0.7	27	0.45	-6.83

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	0.98	0.083	6.71	0.49	27	0.63	-6.7
4	0.78	2.085	6.65	0.78	27	0.28	-6.53
5	0.77	1.993	6.37	0.75	27	0.25	-6.31
6	1.17	-0.758	6.47	0.43	27	0.51	-6.39

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2016

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	1	0	0	0	0	0	0
SP-AVSOTBDEF	1	0	0	0	0	0	0
SP-GFS	8650	0.432	0	0	1	0.662	0.054
P shrinkage mea	3520	0.69				0.278	0.128
F shrinkage mea	2218	1.5				0.059	0.196

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6213	0.36	0.41	3	1.148	0.074

Age 2 Catchability dependent on age and year class strength

Year class = 2015

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	1	0	0	0	0	0	0
SP-AVSOTBDEF	1	0	0	0	0	0	0
SP-GFS	8776	0.328	0.129	0.4	2	0.692	0.113
P shrinkage mea	2164	0.59				0.266	0.395
F shrinkage mea	4648	1.5				0.041	0.204

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5888	0.28	0.43	4	1.514	0.164

Age 3 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-LCGOTBDEF	8882	0.702	0	0	1	0.134	0.086
SP-AVSOTBDEF	2893	0.696	0	0	1	0.137	0.242
SP-GFS	5640	0.289	0.072	0.25	3	0.695	0.132
F shrinkage mea	1638	1.5				0.034	0.395

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5247	0.25	0.17	6	0.688	0.141

Age 4 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-LCGOTBDEF	549	0.451	0.133	0.3	2	0.182	0.1
SP-AVSOTBDEF	168	0.376	0.326	0.87	2	0.271	0.296
SP-GFS	320	0.244	0.244	1	4	0.525	0.166
F shrinkage mea	117	1.5				0.022	0.401

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
290	0.19	0.19	9	1.047	0.182

Age 5 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-LCGOTBDEF	329	0.367	0.326	0.89	3	0.178	0.201
SP-AVSOTBDEF	188	0.268	0.08	0.3	3	0.355	0.329
SP-GFS	208	0.231	0.149	0.64	4	0.449	0.302
F shrinkage mea	105	1.5				0.017	0.528

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
215	0.16	0.11	11	0.697	0.293

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

Year class = 2011

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	135	0.327	0.179	0.55	4	0.215	0.211
SP-AVSOTBDEF	121	0.26	0.084	0.32	4	0.309	0.232
SP-GFS	110	0.216	0.11	0.51	5	0.459	0.252
F shrinkage mea	138	1.5				0.017	0.206

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
119	0.15	0.07	14	0.444	0.236

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

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

At 25/04/2018 16:34

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	0.1597	0.2205	0.3691	0.1202	0.4775	0.2864	0.1403	0.196	0.0667	0.1002	0.0622
2	0.4086	0.5563	0.6568	0.4826	0.4518	0.6059	0.2795	0.3279	0.1924	0.3456	0.3427
3	0.308	0.2597	0.4929	0.2786	0.3489	0.2926	0.3504	0.2397	0.5253	0.1926	0.2017
4	0.4582	0.2524	0.3671	0.5569	0.5558	0.5016	0.7011	0.4162	0.5329	0.3422	0.2173
5	0.6413	0.3864	0.6226	0.4552	0.6404	1.106	1.128	0.5049	1.3288	0.4806	0.5112
6	0.4496	0.1937	0.443	0.4738	0.746	0.6298	0.3535	0.583	1.3218	0.4778	0.6076
+gp	0.4496	0.1937	0.443	0.4738	0.746	0.6298	0.3535	0.583	1.3218	0.4778	0.6076
FBAR 2- 4	0.3916	0.3561	0.5056	0.4394	0.4522	0.4667	0.4437	0.3279	0.4169	0.2935	0.2539

Table 8 Fishing mortality (F) at age

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE											
1	0.0806	0.1099	0.2214	0.1908	0.1278	0.1497	0.1438	0.0727	0.1473	0.0538	0.0361
2	0.3284	0.2884	0.1968	0.1909	0.1747	0.1082	0.1742	0.1457	0.1291	0.3491	0.104
3	0.3585	0.401	0.4485	0.4158	0.359	0.2299	0.1815	0.1791	0.3824	0.4382	0.255
4	0.1345	0.5224	0.3923	0.3772	0.2711	0.1642	0.1812	0.2444	0.2159	0.4439	0.4198
5	0.4722	0.6888	0.5471	0.3489	0.2681	0.2851	0.2027	0.2923	0.2402	0.3783	0.4326
6	0.6855	1.0814	0.8753	0.1801	0.258	0.1481	0.1414	0.4307	0.2143	0.2663	0.2857
+gp	0.6855	1.0814	0.8753	0.1801	0.258	0.1481	0.1414	0.4307	0.2143	0.2663	0.2857
FBAR 2- 4	0.2738	0.4039	0.3458	0.328	0.2682	0.1674	0.179	0.1897	0.2424	0.4104	0.2596

Table 8 Fishing mortality (F) at age

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	FBAR 15-17
AGE											
1	0.0888	0.1338	0.0236	0.5346	0.3568	0.1302	0.3082	0.06	0.1194	0.0744	0.0846
2	0.2038	0.0995	0.0409	0.2397	0.1228	0.1032	0.4058	0.2364	0.1453	0.1641	0.1819
3	0.1969	0.1263	0.0629	0.2284	0.2928	0.2054	0.4569	0.625	0.3814	0.1408	0.3824
4	0.2665	0.1348	0.1231	0.3995	0.3789	0.3637	0.4717	0.5151	0.2607	0.1821	0.3193
5	0.4469	0.217	0.1835	0.4781	0.7411	0.3429	0.6042	0.5762	0.3561	0.2931	0.4085
6	0.3275	0.2821	0.3562	0.7552	0.3543	0.5554	0.6096	0.4679	0.378	0.236	0.3606
+gp	0.3275	0.2821	0.3562	0.7552	0.3543	0.5554	0.6096	0.4679	0.378	0.236	
FBAR 2- 4	0.2224	0.1202	0.0757	0.2892	0.2648	0.2241	0.4448	0.4589	0.2625	0.1623	

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

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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	10125	13173	11873	10720	13299	6022	11824	5328	2277	9827	9847
2	7832	7066	8651	6720	7783	6754	3703	8413	3586	1744	7278
3	3327	4261	3317	3672	3396	4056	3017	2292	4963	2422	1010
4	1951	2002	2691	1659	2276	1961	2478	1740	1477	2403	1636
5	1179	1010	1273	1526	778	1069	972	1006	939	710	1397
6	616	508	562	559	793	336	289	258	497	204	359
+gp	587	443	398	734	1157	138	250	89	175	207	194
TOTAL	25617	28465	28765	25591	29480	20335	22534	19127	13914	17516	21723

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	7634	4419	2733	3945	3483	2933	3036	3309	2792	2322	2808
2	7576	5766	3242	1793	2669	2510	2067	2152	2519	1973	1801
3	4230	4467	3538	2180	1213	1835	1844	1422	1523	1813	1139
4	676	2420	2449	1850	1178	694	1194	1259	973	851	958
5	1078	484	1175	1355	1039	735	482	815	807	642	447
6	686	550	199	557	782	650	453	322	498	520	360
+gp	255	244	386	1075	570	296	401	225	234	169	247
TOTAL	22135	18350	13722	12754	10934	9653	9476	9505	9347	8289	7761

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

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	GM 98-15
AGE												
1	1729	1500	7049	5482	2991	3250	1954	13514	11660	8173	0	3559
2	2218	1296	1074	5636	2630	1714	2336	1176	10420	8473	6213	
3	1329	1481	960	844	3631	1904	1266	1275	760	7378	5888	
4	723	894	1069	738	550	2218	1270	656	559	425	5247	
5	515	453	639	774	405	308	1262	649	321	352	290	
6	237	270	299	436	393	158	179	565	298	184	215	
+gp	138	130	157	378	511	228	345	240	334	214	258	
TOTAL	6889	6023	11248	14289	11111	9781	8612	18074	24353	25199	18111	

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 25/04/2018 16:34

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	10125	2581	2232	705	0.3158	0.3916
1987	13173	2334	1878	537	0.2859	0.3561
1988	11873	2555	2143	858	0.4003	0.5056
1989	10720	2689	2307	761	0.3299	0.4394
1990	13299	2804	2382	1022	0.4291	0.4522
1991	6022	1810	1613	655	0.406	0.4667
1992	11824	1807	1538	558	0.3629	0.4437
1993	5328	1571	1400	421	0.3006	0.3279
1994	2277	1294	1213	492	0.4058	0.4169
1995	9827	1321	983	258	0.2626	0.2935
1996	9847	1649	1324	373	0.2817	0.2539
1997	7634	1582	1369	408	0.298	0.2738
1998	4419	1490	1361	482	0.3541	0.4039
1999	2733	1208	1130	386	0.3416	0.3458
2000	3945	1318	1212	288	0.2377	0.328
2001	3483	1018	908	194	0.2137	0.2682
2002	2933	938	846	136	0.1607	0.1674
2003	3036	1065	953	149	0.1563	0.179
2004	3309	919	797	160	0.2008	0.1897
2005	2792	957	844	166	0.1967	0.2424
2006	2322	915	811	226	0.2786	0.4104
2007	2808	857	728	155	0.213	0.2596
2008	1729	716	660	144	0.2183	0.2224
2009	1500	708	666	95	0.1427	0.1202
2010	7049	906	724	88	0.1216	0.0757
2011	5482	1253	1109	371	0.3345	0.2892
2012	2991	1241	1164	293	0.2517	0.2648
2013	3250	1106	1009	250	0.2477	0.2241
2014	1954	1127	1059	399	0.3768	0.4448
2015	13514	1281	939	297	0.3163	0.4589
2016	11660	1895	1490	298	0.2	0.2625
2017	8173	2264	1991	288	0.1447	0.1623
Arith. Mean	6282	1474	1274	372	0.2746	0.3106
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: 13:42 26/04/2018
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

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	3559	0.2	0.34	0	0	0.038	0.0102	0.064	0.1263	0.035
2	6213	0.2	0.9	0	0	0.089	0.1646	0.098	0.0388	0.062
3	5888	0.2	1	0	0	0.134	0.3237	0.135	0.0077	0.091
4	5247	0.2	1	0	0	0.180	0.3469	0.180	0.0019	0.125
5	290	0.2	1	0	0	0.222	0.4304	0.222	0.0000	0.062
6	215	0.2	1	0	0	0.284	0.4573	0.284	0.0000	0.038
7	258	0.2	1	0	0	0.396	0.4573	0.396	0.0000	0.000

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	3559	0.2	0.34	0	0	0.038	0.0102	0.064	0.1263	0.035
2	.	0.2	0.9	0	0	0.089	0.1646	0.098	0.0388	0.062
3	.	0.2	1	0	0	0.134	0.3237	0.135	0.0077	0.091
4	.	0.2	1	0	0	0.180	0.3469	0.180	0.0019	0.125
5	.	0.2	1	0	0	0.222	0.4304	0.222	0.0000	0.062
6	.	0.2	1	0	0	0.284	0.4573	0.284	0.0000	0.038
7	.	0.2	1	0	0	0.396	0.4573	0.396	0.0000	0.000

2020 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	3559	0.2	0.34	0	0	0.038	0.010	0.064	0.126	0.035
2	.	0.2	0.9	0	0	0.089	0.165	0.098	0.039	0.062
3	.	0.2	1	0	0	0.134	0.324	0.135	0.008	0.091
4	.	0.2	1	0	0	0.180	0.347	0.180	0.002	0.125
5	.	0.2	1	0	0	0.222	0.430	0.222	0.000	0.062
6	.	0.2	1	0	0	0.284	0.457	0.284	0.000	0.038
7	.	0.2	1	0	0	0.396	0.457	0.396	0.000	0.000

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: 13:42 26/04/2018
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2018 Biomass	SSB	Catch FMult	Landings FBar	Yield	Discards FBar	Yield
2648	2503	1	0.2784	612	0.0161	30

2019 Biomass	SSB	Catch FMult	Landings FBar	Yield	Discards FBar	Yield	2020 Biomass	SSB
2353	2241	0	0.0000	0	0.0000	0	2749	2633
.	2241	0.1	0.0278	71	0.0016	2	2663	2548
.	2241	0.2	0.0557	139	0.0032	5	2579	2465
.	2241	0.3	0.0835	205	0.0048	7	2499	2385
.	2241	0.4	0.1114	268	0.0065	9	2422	2308
.	2241	0.5	0.1392	330	0.0081	11	2347	2234
.	2241	0.6	0.1670	389	0.0097	13	2276	2162
.	2241	0.7	0.1949	446	0.0113	15	2206	2093
.	2241	0.8	0.2227	501	0.0129	17	2139	2027
.	2241	0.9	0.2506	554	0.0145	19	2075	1962
.	2241	1	0.2784	605	0.0161	21	2012	1900
.	2241	1.1	0.3062	654	0.0177	23	1952	1841
.	2241	1.2	0.3341	702	0.0194	25	1894	1783
.	2241	1.3	0.3619	748	0.0210	27	1838	1727
.	2241	1.4	0.3898	792	0.0226	29	1784	1673
.	2241	1.5	0.4176	835	0.0242	31	1732	1621
.	2241	1.6	0.4454	877	0.0258	33	1681	1571
.	2241	1.7	0.4733	917	0.0274	34	1633	1523
.	2241	1.8	0.5011	955	0.0290	36	1586	1476
.	2241	1.9	0.5290	992	0.0307	38	1540	1431
.	2241	2	0.5568	1028	0.0323	39	1497	1388

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: 13:42 26/04/2018
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2018 F multiplier 1 1 HCFbar: 0.2784 Fleet1 DFbar: 0.0161

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0102	31	2	0.1263	382	14	3559	135	1210	46	1210	46
2	0.1646	842	82	0.0388	198	12	6213	553	5592	498	5592	498
3	0.3237	1478	200	0.0077	35	3	5888	787	5888	787	5888	787
4	0.3469	1401	252	0.0019	8	1	5247	946	5247	946	5247	946
5	0.4304	93	21	0	0	0	290	64	290	64	290	64
6	0.4573	72	20	0	0	0	215	61	215	61	215	61
7	0.4573	86	34	0	0	0	258	102	258	102	258	102
Total		4003	612		623	30	21670	2648	18700	2503	18700	2503

Year: 2019 F multiplier 1 1 HCFbar: 0.2784 Fleet1 DFbar: 0.0161

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0102	31	2	0.1263	382	14	3559	135	1210	46	1210	46
2	0.1646	344	34	0.0388	81	5	2542	226	2288	204	2288	204
3	0.3237	1042	141	0.0077	25	2	4151	555	4151	555	4151	555
4	0.3469	924	166	0.0019	5	1	3461	624	3461	624	3461	624
5	0.4304	968	215	0	0	0	3031	673	3031	673	3031	673
6	0.4573	52	15	0	0	0	154	44	154	44	154	44
7	0.4573	82	33	0	0	0	245	97	245	97	245	97
Total		3443	605		493	21	17143	2353	14540	2241	14540	2241

Year: 2020 F multiplier 1 1 HCFbar: 0.2784 Fleet1 DFbar: 0.0161

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0102	31	2	0.1263	382	14	3559	135	1210	46	1210	46
2	0.1646	344	34	0.0388	81	5	2542	226	2288	204	2288	204
3	0.3237	426	58	0.0077	10	1	1698	227	1698	227	1698	227
4	0.3469	651	117	0.0019	4	0	2440	440	2440	440	2440	440
5	0.4304	638	142	0	0	0	1999	444	1999	444	1999	444
6	0.4573	541	154	0	0	0	1614	459	1614	459	1614	459
7	0.4573	69	27	0	0	0	207	82	207	82	207	82
Total		2701	533		477	20	14059	2012	11456	1900	11456	1900

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			2011	2012	2013	2014	2015
Stock No. (thousands) of	1 year-olds		3130	5086	3250	3250	3250
Source			XSA	XSA	GM98-12	GM98-12	GM98-12
Status Quo F:							
% in	2015	landings	10.4	20.2	8.3	6.0	-
% in	2016		10.2	24.6	14.1	8.2	6.6
% in	2015	SSB	10.8	29.3	16.7	3.3	-
% in	2016	SSB	8.4	25.5	20.8	16.8	3.6
% in	2017	SSB	5.4	19.8	18.1	20.9	18.4

GM : geometric mean recruitment

Megrim (*L. whiffiagonis*) in Divisions VIIIc ar : Year-class % contribution to

a) 2016 landings **b) 2017 SSB**

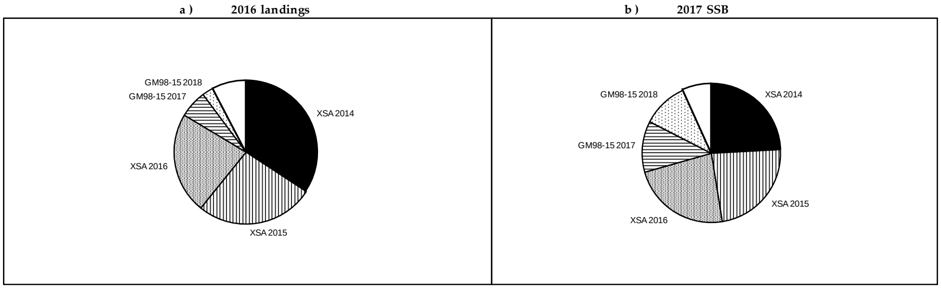


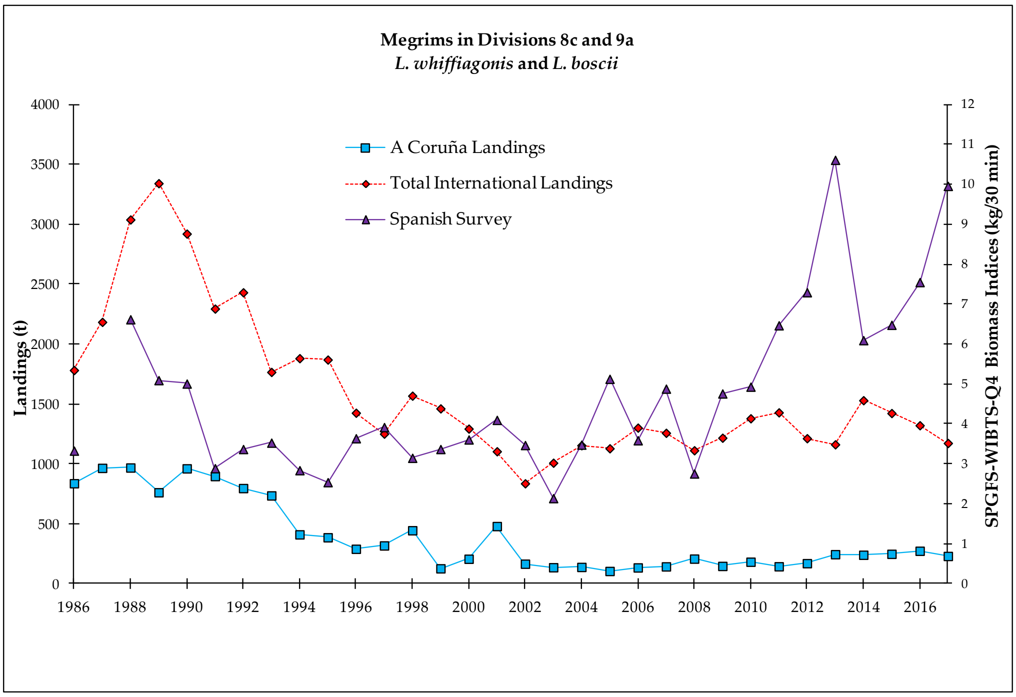
Table 6.1.17. Megrim (*L. whiffiagonis*) in Divisions 8c and 9a, yield-per-recruit results.

MFYPR version 2a
Run: meg
Time and date: 16:27 26/04/2018
Yield per results

Catch FMult	Landings Fbar	CatchNos	Yield	Discards Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNos Jan	SSBJan	SpwnNos Spwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	1.1609	4.7748	1.1286	4.7748	1.1286
0.1	0.0278	0.1221	0.032	0.0016	0.0147	0.0006	4.835	0.9213	4.0943	0.8891	4.0943	0.8891
0.2	0.0557	0.2037	0.0503	0.0032	0.0291	0.0012	4.3579	0.7604	3.6182	0.7282	3.6182	0.7282
0.3	0.0835	0.2612	0.0609	0.0048	0.0432	0.0018	4.0026	0.6457	3.264	0.6136	3.264	0.6136
0.4	0.1114	0.3032	0.0672	0.0065	0.0569	0.0024	3.726	0.5602	2.9885	0.5283	2.9885	0.5283
0.5	0.1392	0.3348	0.0706	0.0081	0.0703	0.003	3.5034	0.4945	2.7669	0.4626	2.7669	0.4626
0.6	0.167	0.3588	0.0724	0.0097	0.0835	0.0035	3.3194	0.4426	2.584	0.4108	2.584	0.4108
0.7	0.1949	0.3774	0.0731	0.0113	0.0963	0.004	3.1642	0.4006	2.4298	0.3689	2.4298	0.3689
0.8	0.2227	0.3919	0.073	0.0129	0.1089	0.0045	3.031	0.3662	2.2976	0.3346	2.2976	0.3346
0.9	0.2506	0.4031	0.07	0.0145	0.1212	0.005	2.92	0.3374	2.1826	0.3059	2.1826	0.3059
1	0.2784	0.4118	0.0717	0.0161	0.1333	0.0055	2.8129	0.313	2.0815	0.2816	2.0815	0.2816
1.1	0.3062	0.4185	0.0707	0.0177	0.1451	0.006	2.7221	0.2922	1.9917	0.2609	1.9917	0.2609
1.2	0.3341	0.4236	0.0696	0.0194	0.1567	0.0064	2.6406	0.2742	1.9111	0.2429	1.9111	0.2429
1.3	0.3619	0.4273	0.0684	0.021	0.168	0.0069	2.5669	0.2585	1.8384	0.2273	1.8384	0.2273
1.4	0.3898	0.43	0.0672	0.0226	0.1791	0.0073	2.4999	0.2446	1.7723	0.2135	1.7723	0.2135
1.5	0.4176	0.4316	0.0659	0.0242	0.19	0.0077	2.4386	0.2323	1.7119	0.2013	1.7119	0.2013
1.6	0.4454	0.4326	0.0647	0.0258	0.2007	0.0082	2.3822	0.2214	1.6563	0.1905	1.6563	0.1905
1.7	0.4733	0.4328	0.0635	0.0274	0.2112	0.0086	2.33	0.2116	1.6051	0.1807	1.6051	0.1807
1.8	0.5011	0.4325	0.0623	0.029	0.2214	0.009	2.2817	0.2027	1.5577	0.1719	1.5577	0.1719
1.9	0.529	0.4318	0.0612	0.0307	0.2315	0.0093	2.2367	0.1946	1.5135	0.1639	1.5135	0.1639
2.0	0.5568	0.4306	0.0600	0.0323	0.2414	0.0097	2.1946	0.1873	1.4723	0.1567	1.4723	0.1567

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1	0.2784
FMax	0.7402	0.2061
F0.1	0.4149	0.1155
F35%SPR	0.6353	0.1769

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).

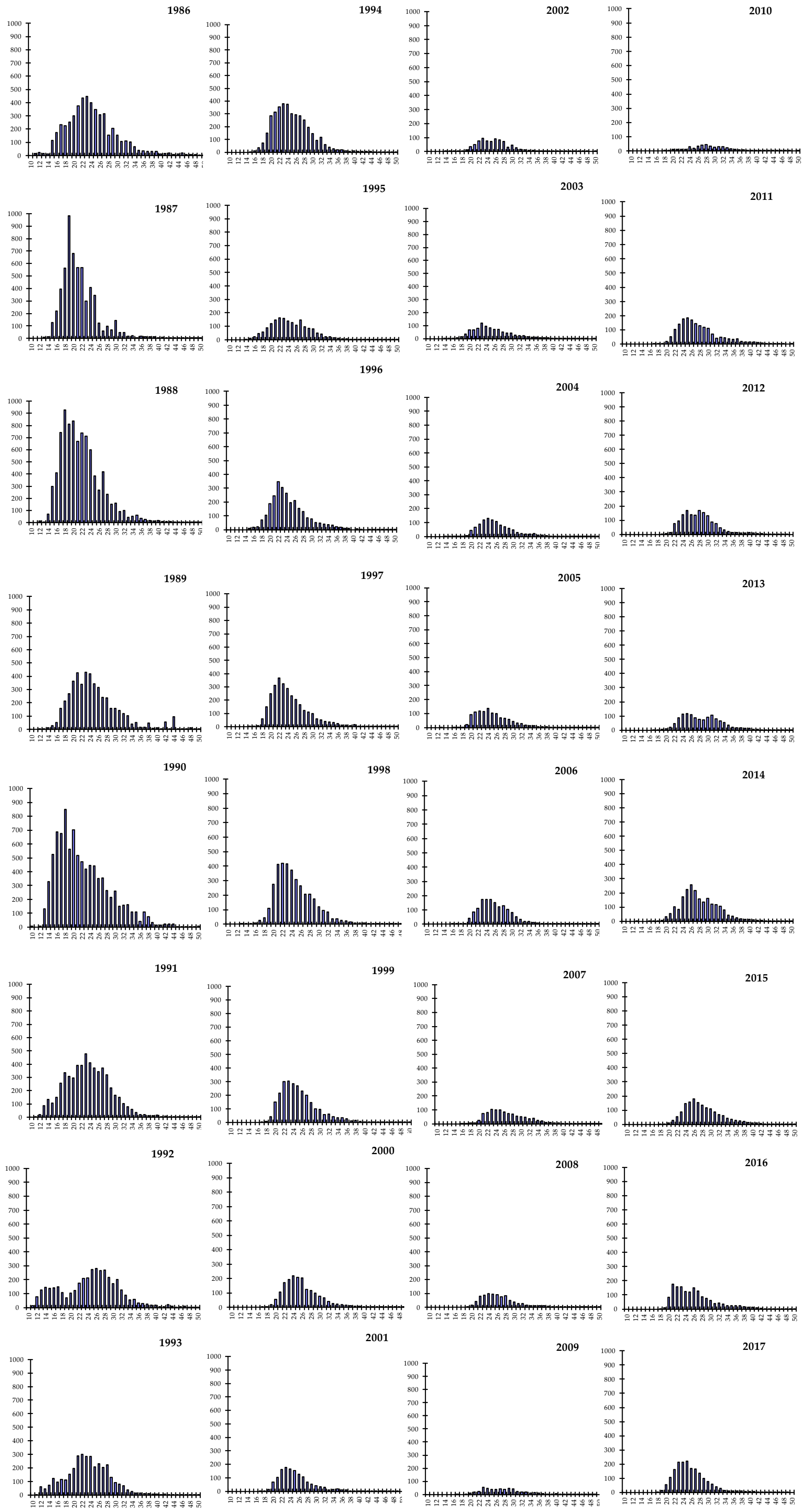


Figure 6.1.2 Megrim (*L. whiffiagonis*) in Divisions 8c and 9a. Annual length compositions of landings ('000)

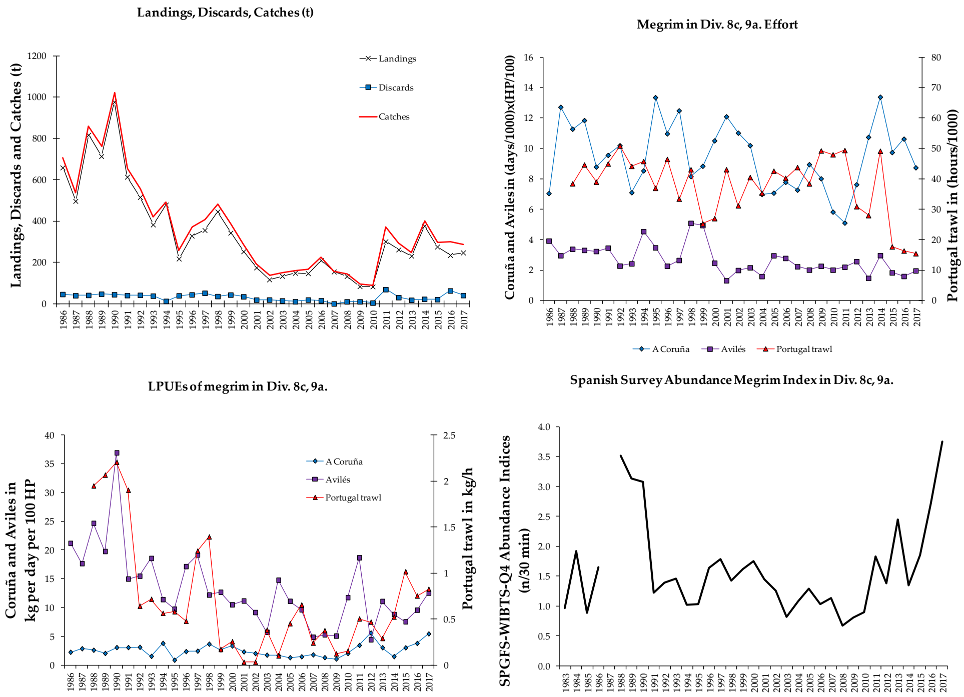
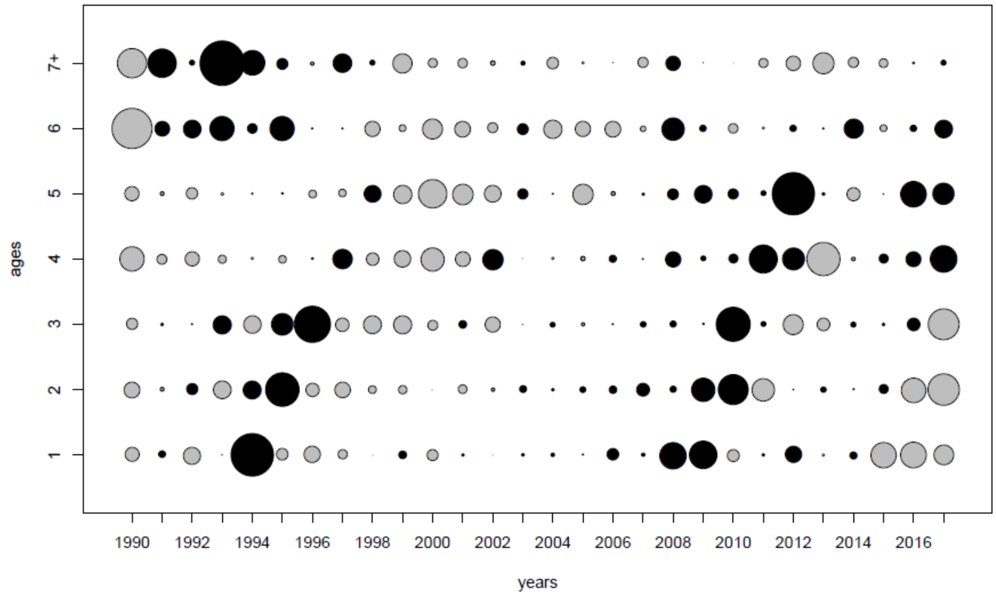


Figure 6.1.3(a) Megrim (*L.whiffiagonis*) in Divisions 8c, 9a. Catches (t), Efforts, LPUEs and Abundance Indices.

Standardized log (abundance index at age) from survey SpGFS-WIBTS-Q4

(black bubbles means <0)

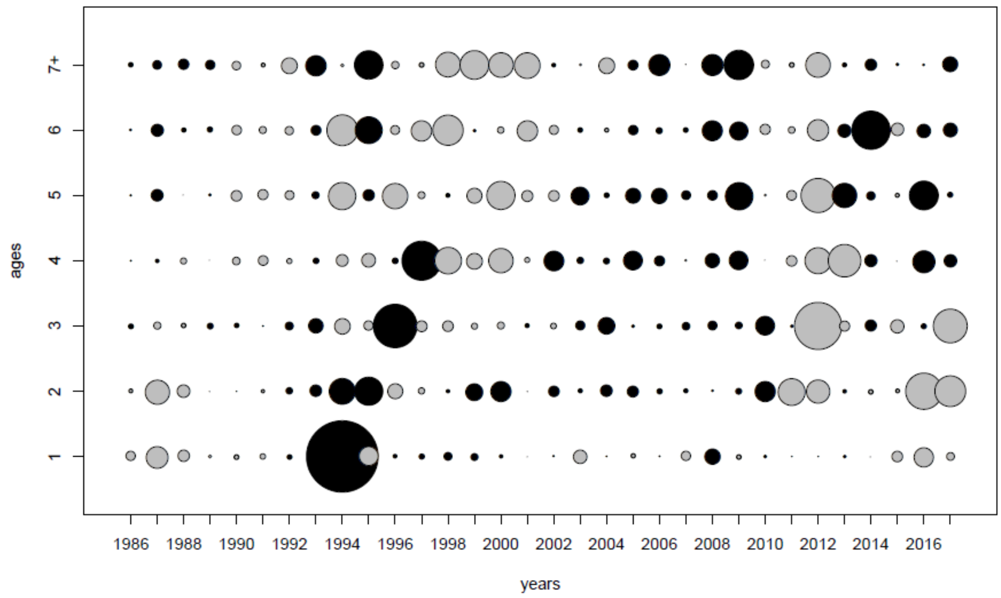


*** 2013 data not included in the assessment**

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)

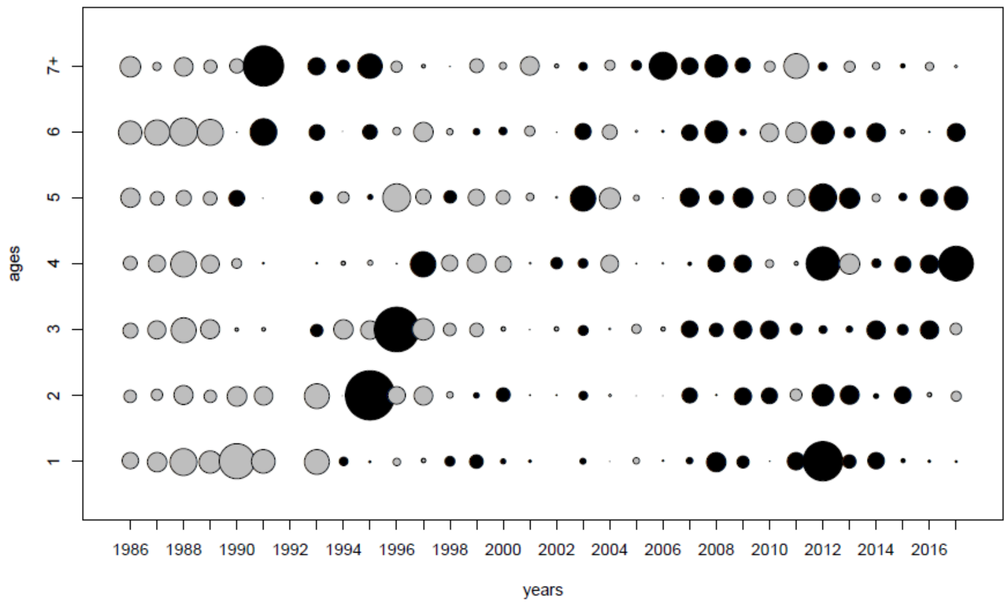
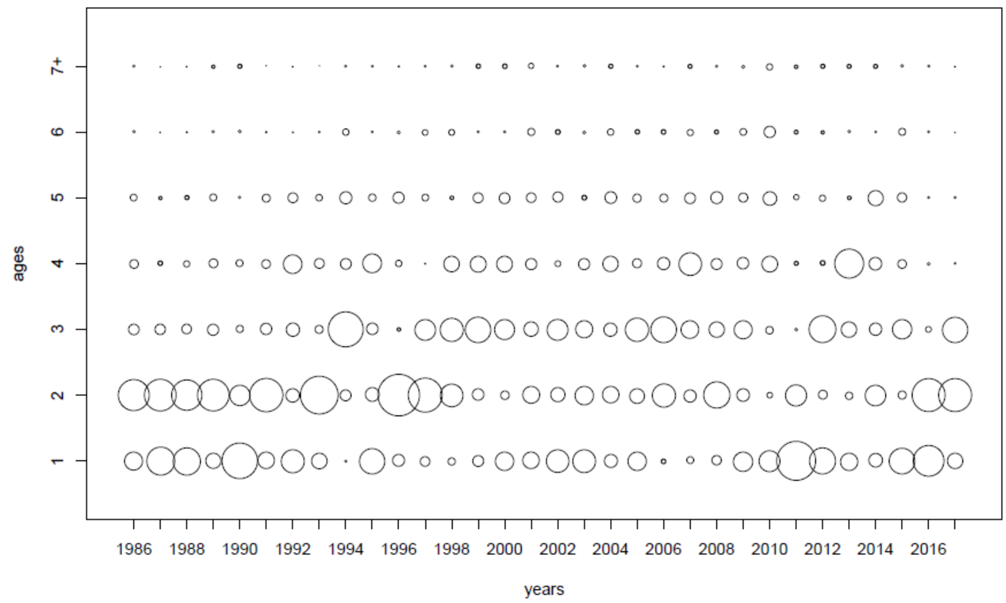


Figure 6.1.3(c): Megrim (*L. whiffiagonis*) in Divisions 8c & 9a

Catches proportions at age



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

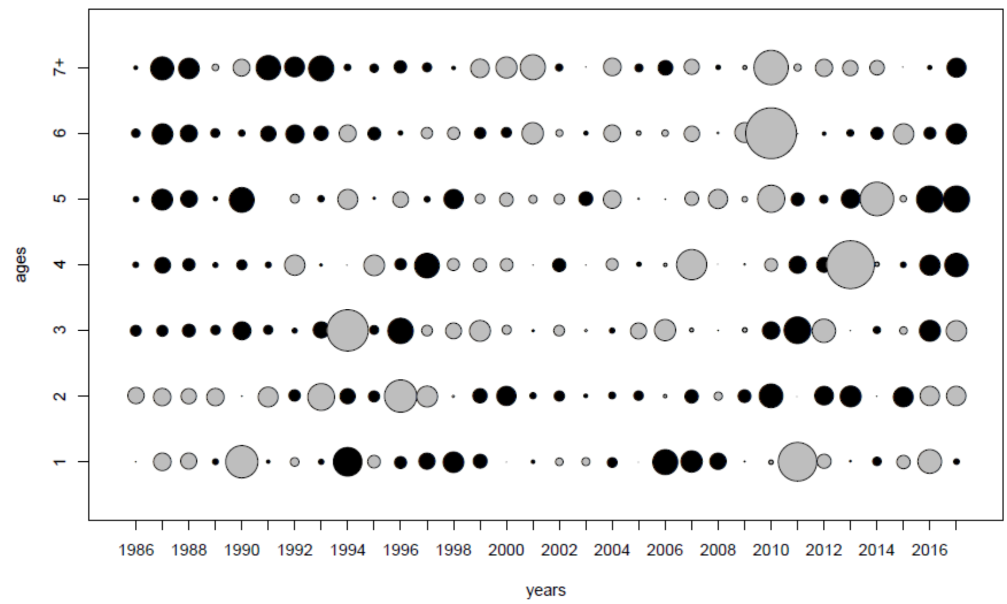
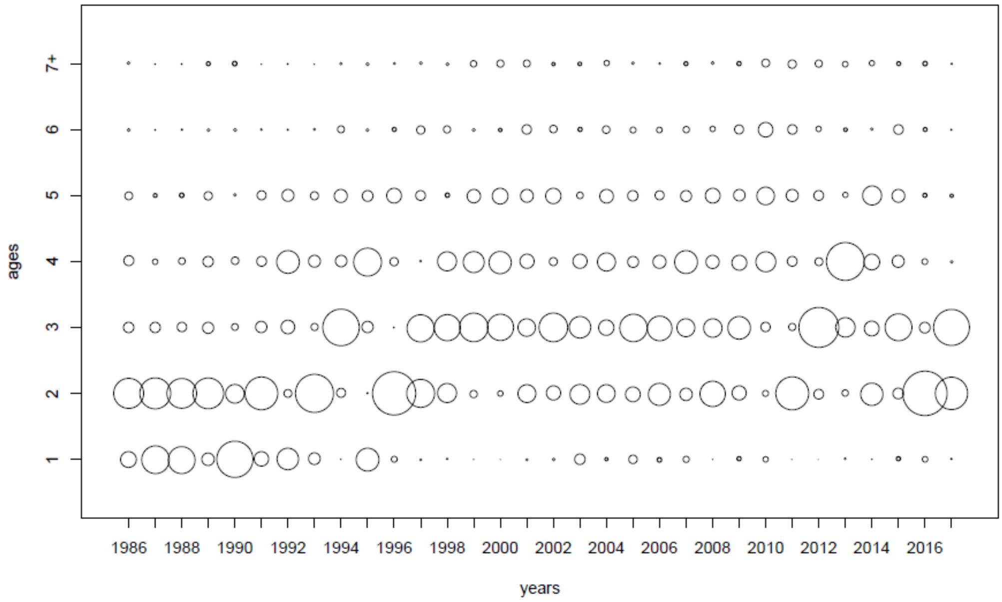


Figure 6.1.4(a). Megrim (*L. whiffiagonis*) in Divisions 8c & 9a.

Landings proportions at age



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

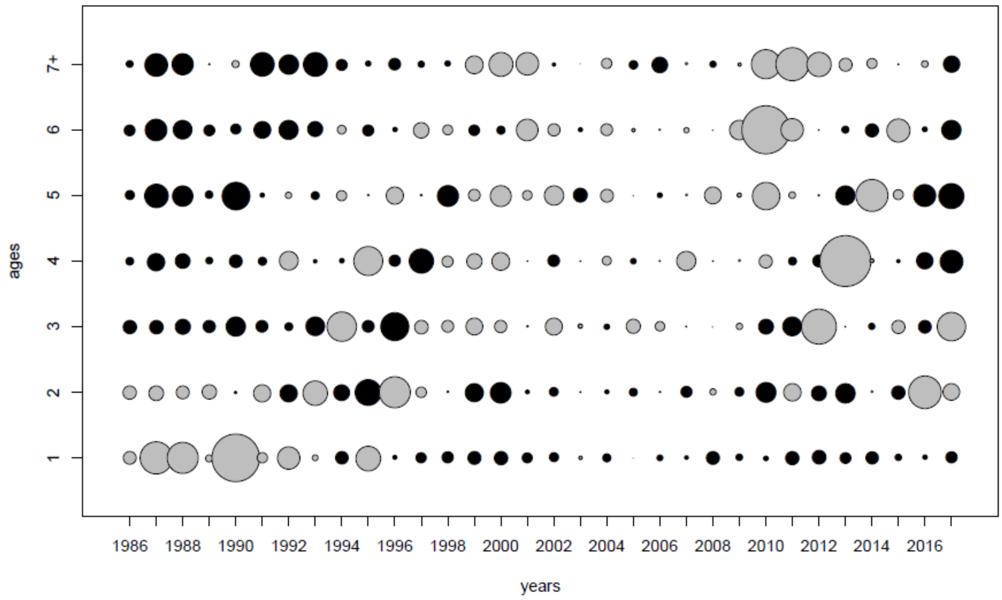
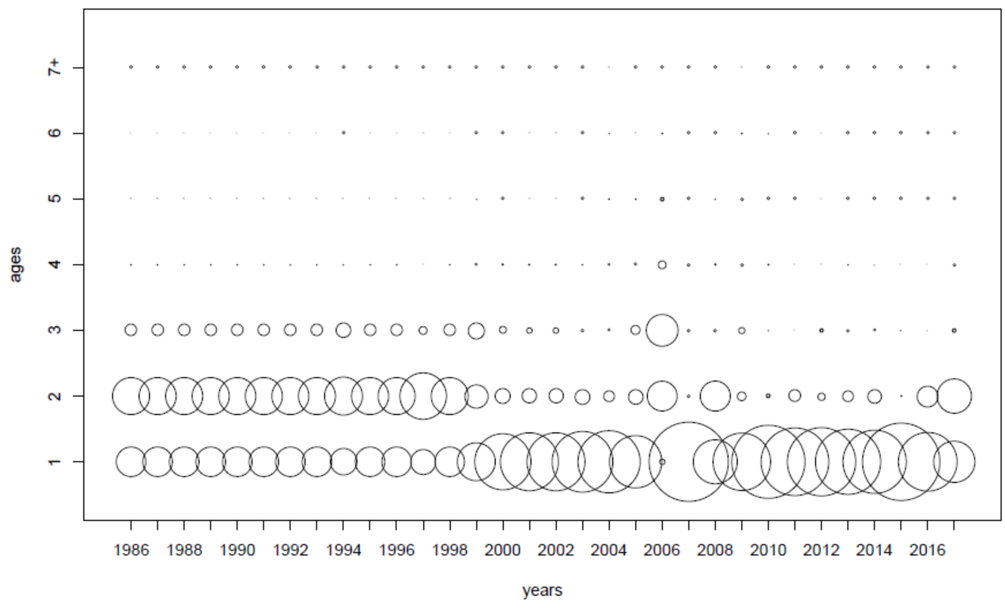


Figure 6.1.4(b). Megrim (*L. whiffiagonis*) in Divisions 8c & 9a.

Discards proportions at age



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

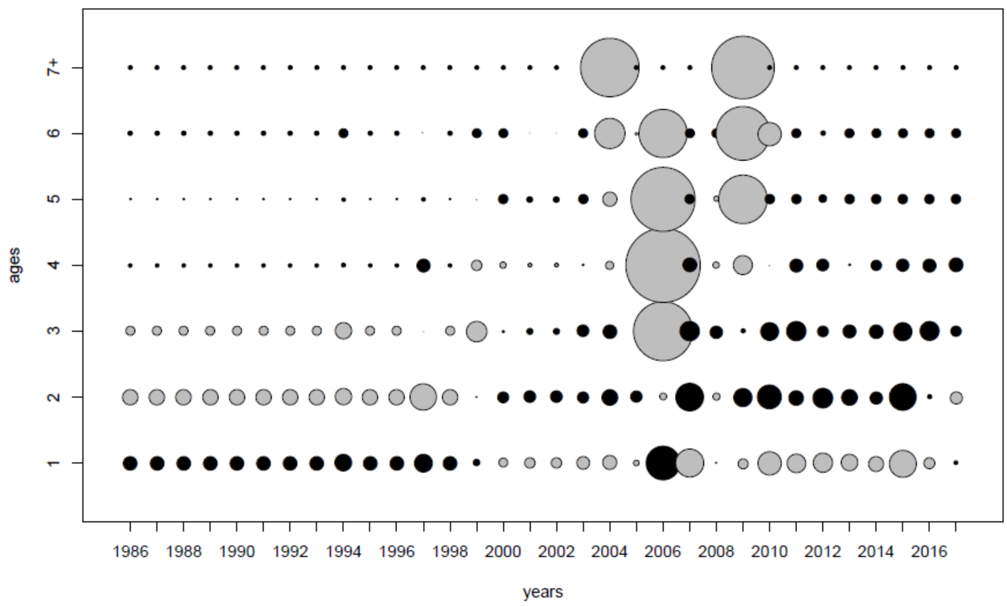


Figure 6.1.4(c). Megrim (*L. whiffiagonis*) in Divisions 8c & 9a.

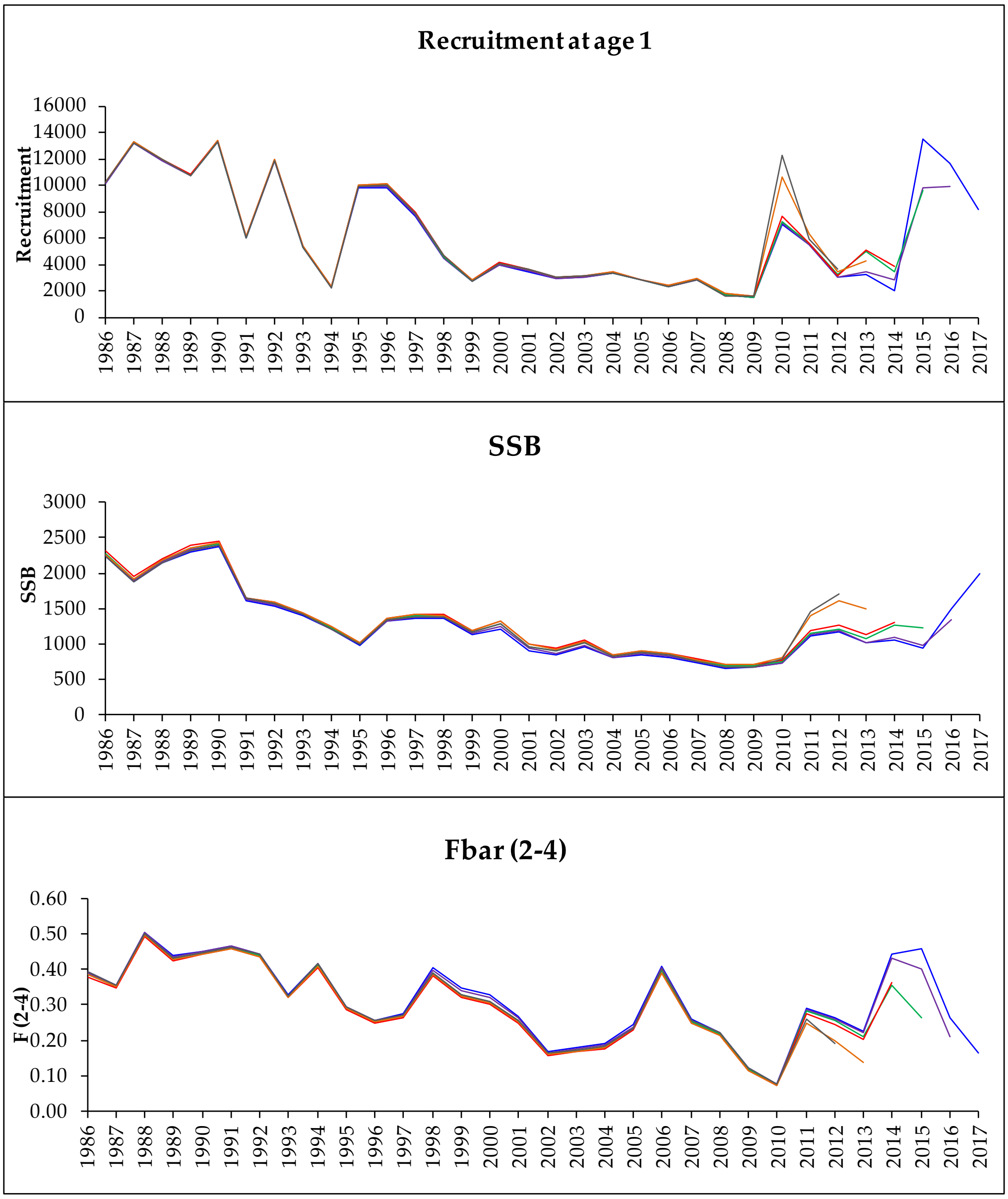


Figure 6.1.5. Megrim (*L. whiffiagonis*) in Divisions 8c and 9a. Retrospective XSA

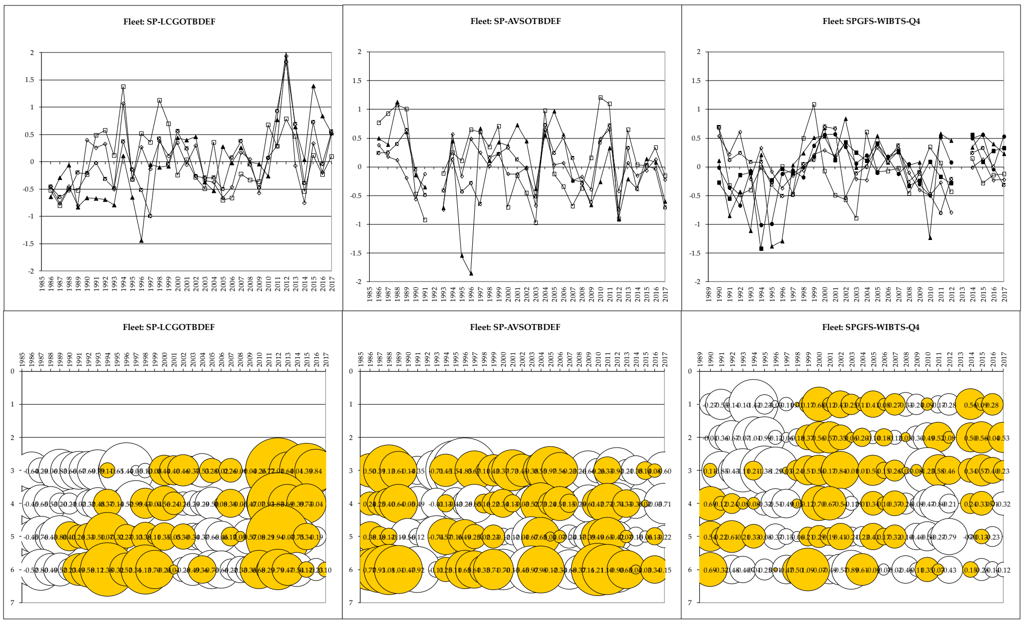


Figure 6.1.6. Megrim in Divisions 8c and 9a. LOG-CATCHABILITY RESIDUAL PLOTS (XSA)

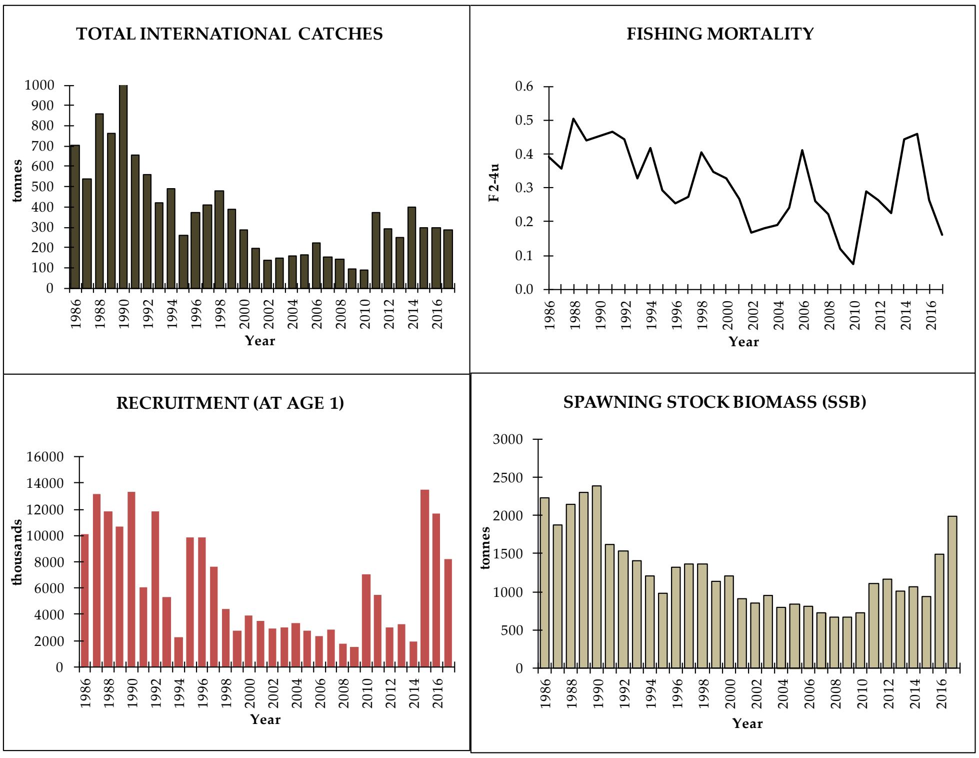
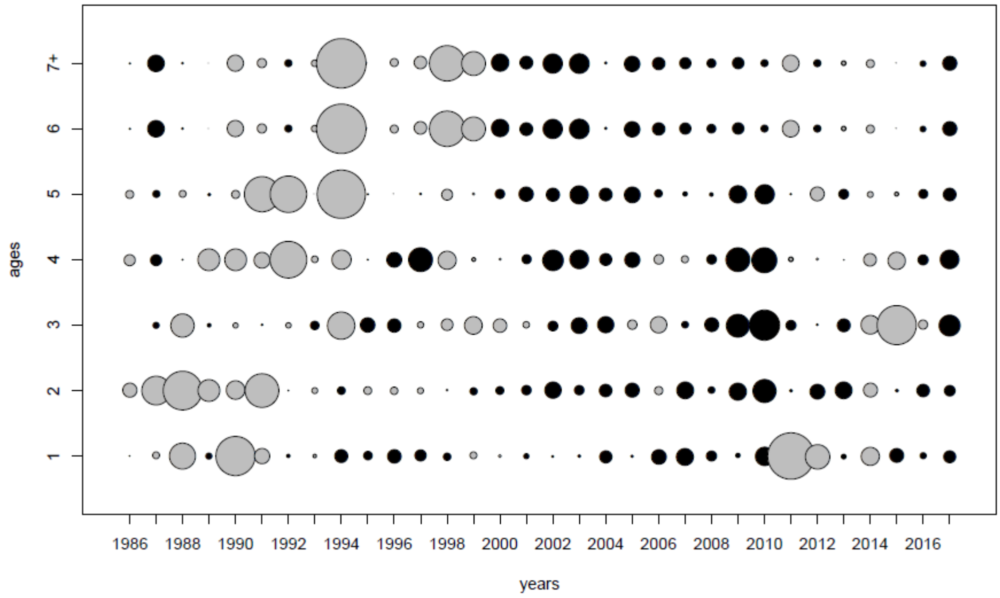


Figure 6.1.7(a) Megrim (*L. whiffiagonis*) in Divisions 8c and 9a. Stock Summary

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



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

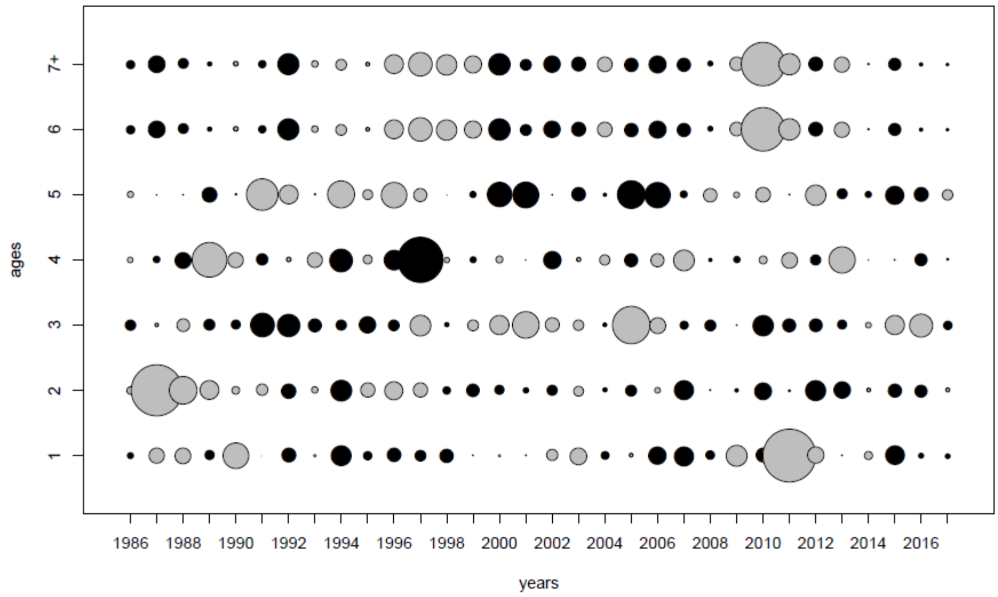
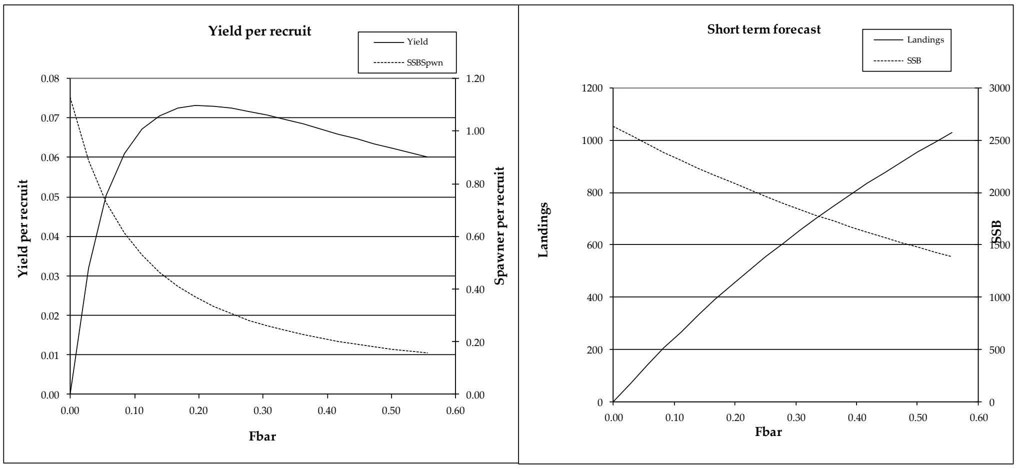


Figure 6.1.7(b): Megrim (*L. whiffiagonis*) in Divisions 8c & 9a



MFYPR version 2a
Run: meg
Time and date: 16:27 26/04/2018

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar	1.0000	0.2784
FMax	0.7402	0.2061
F0.1	0.4149	0.1155
F35%SPR	0.6353	0.1769

MFDP version 1a
Run: meg
Time and date: 13:42 26/04/2018
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

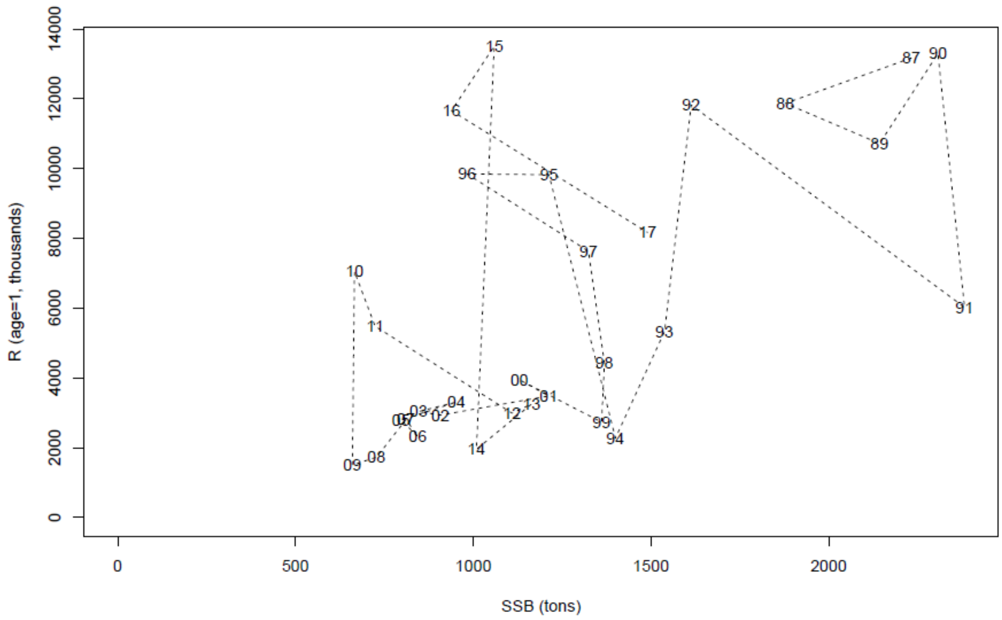


Figure 6.1.9. Megrim (*L.whiffiagonis*) in Divisions 8c and 9a. SSB-Recruitment plot.

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

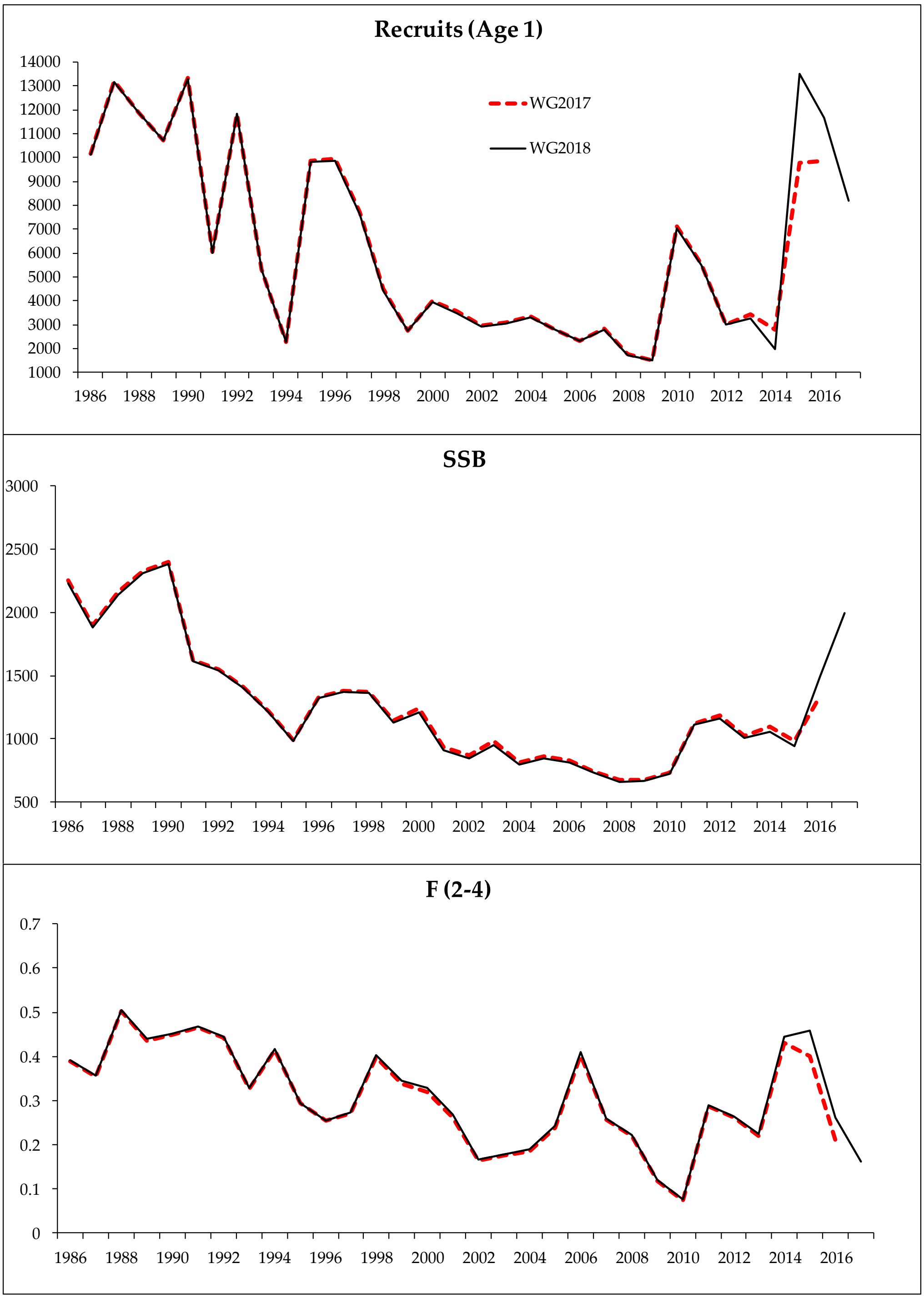


Figure 6.1.10. Megrim (*L. whiffiagonis*) in Div. 8c and 9a. Recruits, SSB and F estimates from WG17 and WG18

6.2 Megrim (*Lepidorhombus boscii*) in Divisions 8c and 9a

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 2017 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 1297 t, the highest value after 1995. In 2017, the landings value of 926 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 1986-2017. 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.

A new maturity ogive based on microscopic method has been presented (WD 07, this report) and its use could be considered in a future after review of the method used and results.

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 2017. The October survey was conducted with a different vessel and gear in 2003 and 2004. Excluding these two years, the biomass indices from this survey in 2007 and 2011 were the highest observed since

1994, whereas the value in 2010 is the second lowest in the series. In 2011, both the biomass and abundance indices from the Crustacean survey are the highest in the time-series. In 2012, Portuguese Survey was not carried out due to budgetary constraints of national scope turned unfeasible to repair the RV. Last year values are increasing 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. In 2017, the survey presents the second highest values in both indices (WD 03, this report).

The recruitment index for age 0 in 2005 was very high and also in 2009 and 2014. The 2017 value is not so high than previous above. 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), 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 fleets SP-LCGOTBDEF for the period 1986-2017 ,SP-AVSOTBDEF for the period 1986-2015 and for the Portuguese trawl fleet fishing in Division 9a for the period 1988–2017 (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 2017 a small decrease in relation to last year. For the Portuguese fleets, until 2011 most logbooks were filled in paper but have thereafter been progressively replaced by e-logbooks. In 2013 more than 90% of the logbooks are being completed in the electronic version. The LPUE series were revised from 2012 onwards. To revise the series backwards further refinement of the algorithms is required.

Commercial fleets used in the assessment to tune the model

Because of the trend in the residuals, A Coruña fleet (SP-LCGOTBDEF) was split in two (SP-LCGOTBDEF -1 and SP-LCGOTBDEF-2) for tuning, considering values until 1999 and from 2000 to 2017, 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, 2017 value represents a low decrease 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 shows a slightly declining trend until these three last years, 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. Since 2014, there is an increasing trend and 2017 value is the highest over the years.

6.2.3 Assessment

An update assessment was conducted, according to the Stock Annex specifications. Assessment years are 1986-2017 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 0.18 in 2017.

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

6.2.4.2 Year-class strength and recruitment estimations

The 2015 year class estimate is 56 million individuals, obtained by averaging estimates coming from the Spanish survey tuning data (97% of weight) and F-shrinkage (3% weight).

The 2016 year class estimate is 60 million individuals, estimated from the Spanish survey (95% of weight) and F-shrinkage (5% weight).

The 2017 year class estimate is 32 million individuals, obtained a value from the Spanish survey (100% 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 1990-2015 has been used for computation of 2017 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
2015	56925	XSA	97%	-	3%
2016	60765	XSA	95%	-	5%
2017	53614	$GM_{90\text{-}15}$		-	
2018	53614	$GM_{90\text{-}15}$			

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 6727 t in 1988 to 3214 t in 2001, the lowest value in the series, and has since increased. In 2017 the SSB is estimated at 7494 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 85 million fish.

Estimates of fishing mortality values show two different periods: an initial one with higher values from 1986 to 1996 and, following a decrease in 1997, a second period stabilised at a lower level than the first, with small ups and downs. From 2007, the F has been decreasing till 2013. After two years of higher values, the last two represents a fall in F, giving the lowest of the time-series.

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} = 0.15 for landings and F_{bar} = 0.12 for discards, being 0.28 for catches). The recruitment in 2017 (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 2018 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 2019, and their consequences in terms of projected landings and stock biomass. Figure 6.2.8 (right panel) plots short-term yield and SSB vs. 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 2018 and 2019 are 1585 and 1739 t, respectively. Projected discards for the same years are 574 and 506 t.

Under F *status quo*, projected SSB values for 2019 and 2020 are about 8836 t in 2019and 8564 t in 2020.

The contributions of recent year classes to the projected landings and SSB are presented in Table 6.2.16. The year classes for which $GM_{90\text{-}14}$ recruitment is assumed contribute in a 14% to catches in 2019 and with a 39% to SSB in 2020.

6.2.5.2 Yield and biomass per recruit analysis

The analysis is conducted following the Stock Annex specifications and results presented in Table 6.2.17. The left panel of Figure 6.2.8 plots yield-per-recruit and SSB-per-recruit vs. F_{bar}.

Under F s*tatus quo* (F_{bar} = 0.15 for landings and F_{bar} = 0.12 for discards and assuming $GM_{90\text{-}15}$ recruitment of 53 million, the equilibrium yield would be around 1442 t of landings and 461 t of discards, with an SSB value of 7661 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}	0.193	
	F_{MSY} lower	0.125	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.

Since the benchmark in 2014, the model converges. It seems that the convergence issue was solved for this stock.

Comparison of this assessment with the one performed in 2017 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 2018 (average of estimated F over 2015–2017, corresponding to Fbar = 0.28 for landings and Fbar = 0.16 for discards for *L. whiffiagonis* and Fbar = 0.15 for landings and Fbar = 0.12 for discards for *L. boscii*), Figure 6.3.2 gives the combined predicted landings for 2019 and individual SSB for 2020, 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 2015-2017) for both species, predicted combined landings in 2018 are 2344 t and individual SSBs in 2019 are 1900 t for *L. whiffiagonis* and 8564 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
2017	346	265	611	144	172	926	246	1173

^Data revised in WG2015

*9a is without Gulf of Cádiz till 2016

** Data revised in WG2010

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	2017
Weight Ratio	0.19	0.24	0.39	0.35	0.41	0.34	0.23	0.21
CV	18.8	16.0	15.5	23.2	17.8	20.1	16.4	15.2
Number Ratio	0.62	0.50	0.52	0.63	0.67	0.60	0.47	0.39

**All discard data revised in WG2011

*Data revised in WG2013

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	2017
0	202	2	2879	30	682	275	0	157	2	0
1	2342	1525	10362	5132	5313	5499	5645	2437	1606	526
2	2374	2490	1301	3595	2480	4379	11089	7061	5506	2116
3	1384	1970	696	544	1057	3030	2139	4588	785	2305
4	52	480	283	174	15	707	582	532	232	363
5	10	51	83	37	5	39	161	26	70	29
6	3	7	11	1	2	12	11	4	30	1
7	3		1		0	2	0	0	1	0

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	617
16	8805
17	35275
18	149368
19	390525
20	995844
21	1125971
22	1217044
23	943052
24	937323
25	695731
26	554507
27	363902
28	285856
29	189464
30	131240
31	74798
32	45387
33	34577
34	16392
35	5908
36	6744
37	2499
38	2420
39	539
40	2324
41	223
42	598
43	414
44	653
45	676
46	
47	1002
48	
49	
50+	
Total	8219679

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	2017
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	23.7
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	111.8

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	2017
AGE										
0	202	2	2879	30	682	275	0	157	2	0
1	2357	1546	10377	5139	5342	5499	5646	2438	1610	527
2	3935	3136	2364	4397	3260	4919	11954	7412	6739	2458
3	4879	4887	3568	2454	4101	4820	4249	7742	2844	4986
4	2204	4640	3817	2833	1926	4113	3214	3622	2495	2469
5	1003	1662	2529	2711	1620	1363	2983	1580	1936	1817
6	354	640	496	1164	991	846	751	1105	1153	684
+gp	298	222	438	399	422	371	562	462	559	618
TOTALNUM	15232	16735	26468	19127	18344	22206	29359	24518	17338	13559
TONSLAND	1182	1413	1562	1397	1321	1427	1942	1745	1419	1173
SOPCOF %	101	100	101	101	101	101	100	100	100	101

* 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 Catch (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	2017
AGE										
0	0.005	0.004	0.004	0.003	0.009	0.004	0.002	0.008	0.004	0.001
1	0.017	0.025	0.012	0.02	0.033	0.017	0.024	0.026	0.022	0.029
2	0.053	0.045	0.056	0.039	0.052	0.045	0.044	0.04	0.048	0.044
3	0.079	0.069	0.084	0.078	0.076	0.063	0.071	0.066	0.086	0.067
4	0.112	0.104	0.108	0.099	0.105	0.099	0.101	0.099	0.107	0.096
5	0.151	0.142	0.141	0.128	0.127	0.131	0.133	0.136	0.13	0.126
6	0.201	0.175	0.182	0.168	0.159	0.159	0.165	0.172	0.149	0.164
+gp	0.235	0.288	0.271	0.24	0.199	0.21	0.222	0.23	0.217	0.212
SOPCOFAC	1.0063	1.0011	1.0104	1.009	1.006	1.0065	1.0046	1.0018	1.0032	1.0054

* 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

	Portugal (k/h)			Spain (k/30 min)	
	October	Crustacean	SE	Mean	SE
1983				0.67	0.13
1984				0.76	0.08
1985				0.71	0.11
1986				1.68	0.28
1987				ns	-
1988				3.10	0.33
1989				1.97	0.28
1990	0.26			1.93	0.14
1991	0.18			1.67	0.17
1992	0.14			1.98	0.20
1993	0.11			2.07	0.25
1994	0.16			1.82	0.23
1995	0.08			1.51	0.12
^1996	0.10			2.00	0.19
1997	0.06	2.97	1.31	2.17	0.22
1998	0.04	2.66	0.87	1.80	0.20
^<1999	+	0.04	0.02	1.93	0.24
2000	0.08	2.18	0.84	1.89	0.28
2001	0.09	1.72	0.75	2.65	0.25
2002	0.02	2.78	1.02	2.21	0.22
^2003	1.36	3.65	1.20	1.32	0.16
^2004	1.27	ns		2.40	0.24
2005	0.05	2.62	0.85	3.84	0.41
2006	0.10	1.63	0.56	2.56	0.24
2007	0.14	2.20	0.70	3.75	0.35
2008	0.07	2.50	0.87	2.08	0.22
2009	0.06	*1.50	0.65	3.96	0.32
2010	0.03	4.03	1.44	4.04	0.38
2011	0.14	4.55	1.78	4.64	0.39
2012	ns	ns	ns	5.92	0.47
**2013	0.10	1.45	0.51	8.17	1.13
2014	0.12	1.40	0.56	4.75	0.28
2015	0.13	1.66	0.52	4.62	0.48
2016	0.12	1.80	0.65	4.84	0.32
2017	0.22	1.91	0.74	6.21	0.96

Abundance index

	Portugal (n/h)		Spain (n/30 min)	
	Crustacean	SE	Mean	SE
1983			11.80	1.80
1984			15.80	2.00
1985			14.00	1.74
1986			32.60	3.82
1987			ns -	
1988			59.20	6.49
1989			40.75	6.24
1990			40.30	3.00
1991			27.70	2.62
1992			49.10	5.20
1993			43.30	5.39
1994			26.90	3.63
1995			32.30	2.78
^1996			44.80	4.05
1997	31.57	15.52	43.50	3.84
1998	26.46	10.68	34.30	4.45
^<1999	1.23	1.07	29.30	3.22
2000	20.61	8.47	33.00	4.56
2001	17.17	7.08	42.70	3.35
2002	40.61	13.69	34.60	3.33
^2003	60.80	20.97	16.90	1.54
^2004	ns		43.94	3.71
2005	34.51	12.03	62.89	6.16
2006	19.89	6.49	41.47	3.02
2007	32.30	11.30	51.10	4.30
2008	26.27	9.60	32.20	3.00
2009	*12.22	5.88	52.83	3.97
2010	63.78	22.64	72.75	6.82
2011	68.56	26.34	69.26	5.72
2012	ns	ns	82.14	5.98
2013	23.81	8.02	119.99	17.48
2014	20.31	8.18	67.42	3.72
2015	27.29	8.25	78.00	7.47
2016	35.62	12.16	86.70	5.19
2017	37.79	14.77	111.24	13.61

Recruitment index

	At age 1	At age 0	At age 1
	Portugal (n)	Spain (n/30 min)	
	October		
1983		0.98	5.74
1984		1.80	7.83
1985		0.15	7.45
1986		2.99	16.36
1987		ns	ns
1988		2.90	24.64
1989		8.49	16.68
1990	153	0.44	19.06
1991	26	2.53	9.25
1992	42	2.37	35.00
1993	8	0.30	21.38
1994	2	3.48	2.94
1995	4	1.92	19.58
^1996	16	3.57	20.56
1997	1	3.54	13.34
1998	+	0.27	9.57
^<1999	+	0.94	7.46
2000	16	1.07	13.96
2001	25	0.59	16.95
2002	1	1.04	9.95
^2003	8	0.65	4.95
^2004	5	1.19	21.10
2005	+	4.71	17.70
2006		0.59	14.70
2007		0.88	11.30
2008		0.37	8.13
2009		3.37	7.42
2010		0.65	34.22
2011		0.91	8.90
2012		1.71	11.58
2013		1.32	25.86
2014		3.72	12.32
2015		1.12	33.18
2016		2.43	18.06
2017		1.03	23.69

+ less than 0.04
ns no survey
^ Portuguese October Survey with different vessel and gear (Capricórnio and CAR net)
< 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
10		0.1	77	641	494	417	154	132	8.7	2017

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
1	1.0	23.7	31.2	40.1	8.38	4.31	1.17	1.29	112	2017

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
2017	183.0	8.7	20.9				117.6	15.4	7.6

[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

24/04/2018 10:40

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 32 years. 1986 to 2017. Ages 0 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF1	1986	2017	3	6	0	1
SP-LCGOTBDEF2	2000	2017	3	6	0	1
SP-GFS	1988	2017	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 33 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
0	0.008	0	0.066	0.001	0.011	0.006	0	0.003	0	0
1	0.088	0.078	0.249	0.161	0.165	0.117	0.169	0.039	0.039	0.012
2	0.148	0.163	0.165	0.158	0.145	0.225	0.401	0.35	0.146	0.077
3	0.276	0.277	0.282	0.258	0.217	0.331	0.309	0.494	0.219	0.153
4	0.401	0.461	0.364	0.379	0.331	0.353	0.385	0.474	0.29	0.3
5	0.375	0.606	0.495	0.479	0.388	0.415	0.470	0.332	0.504	0.355
6	0.352	0.438	0.362	0.446	0.321	0.360	0.425	0.317	0.432	0.333

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6
2008	27900	30800	31600	22300	7370	3540	1320
2009	6.35E+04	2.27E+04	2.31E+04	2.23E+04	1.39E+04	4.04E+03	1.99E+03
2010	49900	52000	17200	16100	13800	7160	1810
2011	47500	38300	33200	11900	9930	7870	3570
2012	67900	38900	26700	23200	7550	5560	3990
2013	49300	54900	27000	18900	15300	4440	3090
2014	85200	40100	40000	17600	11100	8790	2400
2015	56900	69700	27700	21900	10600	6180	4500
2016	60800	46500	54900	16000	11000	5400	3630
2017	32900	49700	36600	38800	10500	6710	2670

Estimated population abundance at 1st Jan 2018

0	26900	40300	27700	27300	6390	3850

Taper weighted geometric mean of the VPA populations:

46300	38200	27200	16500	8830	4100	1770

Standard error of the weighted Log(VPA populations) :

0.3078	0.3219	0.3688	0.3811	0.402	0.446	0.5271

1

Log catchability residuals.

Fleet : SP-LCGOTBDEF1

Age	1986	1987
0	No data for this fleet at this age	
1	No data for this fleet at this age	
2	No data for this fleet at this age	
3	0.56	0.87
4	0.3	0.28
5	0.06	-0.25
6	-0.27	-0.17

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
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	-0.09	-0.41	-0.76	-0.19	-0.46	-0.03	-0.1	0.37	-0.56	-0.31
4	-0.6	-0.54	-0.2	-0.58	-0.08	0.32	0.49	0.12	0.05	-0.46
5	-0.83	-0.85	-0.19	0.42	-0.02	-0.24	0.53	0.79	-0.33	-0.06
6	-0.41	-0.24	0.14	0.79	0.03	0.32	0.69	0.98	-0.08	0.33

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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	0.7	0.41	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	0.64	0.27	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	0.78	0.19	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	0.54	0.61	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

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

Age	3	4	5	6
Mean Log q	-6.7075	-5.8405	-5.4029	-5.4029
S.E(Log q)	0.5015	0.4161	0.5122	0.5031

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	2.058	8.03	0.66	14	0.26	-6.71
4	0.95	0.176	6	0.53	14	0.41	-5.84
5	-29	-4.672	91.04	0	14	9.21	-5.4
6	1.17	-0.535	4.81	0.46	14	0.53	-5.17
1							

Fleet : SP-LCGOTBDEF2

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
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	-0.57	0.37	-0.24	0.23	0.46	0.13	0.54	0.2
4	99.99	99.99	-0.03	0.78	-0.47	-0.36	0.41	-0.3	-0.17	0.17
5	99.99	99.99	-0.2	0.99	-0.63	-0.22	-0.03	0.21	-0.5	0.36
6	99.99	99.99	0.18	0.24	-0.3	0.03	0.26	0.08	-0.54	0.17

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
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	0.2	-0.12	0.2	-0.36	0.13	-0.38	-0.33	0.15	-0.08	-0.53
4	0.25	-0.06	0.05	-0.18	0.36	0.02	-0.28	0.18	-0.25	-0.11
5	-0.07	-0.1	0.29	0.15	0.29	0.05	-0.29	-0.3	0.1	-0.1
6	-0.05	-0.41	0.07	0.31	0.08	-0.23	-0.49	-0.38	-0.05	-0.18

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	-5.7006	-5.0032	-4.713	-4.713
S.E(Log q)	0.3375	0.3153	0.3682	0.2786

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	1.29	-1.112	4.57	0.49	18	0.43	-5.7
4	1.01	-0.073	4.94	0.6	18	0.33	-5
5	0.91	0.508	5.03	0.68	18	0.34	-4.71
6	0.98	0.194	4.85	0.81	18	0.27	-4.78
1							

Fleet : SP-GFS

Age		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	0	0.5	1.64	-1.03	0.26	0.27	-1.09	0.85	0.05	1.01	1.32
	1	0.4	-0.11	0.12	-0.29	0.52	0.11	-1.12	0.25	0.05	-0.02
	2	0.11	-0.38	-0.21	-0.47	-0.9	-0.19	-0.49	-0.99	0.05	-0.27
	3	-0.36	-0.9	-1.04	-0.85	-0.59	-0.75	-0.58	-0.71	-0.58	0.16
	4	-1.1	-0.64	-0.34	-0.7	-0.36	-0.63	-0.22	-0.41	-0.73	-0.12
	5	-0.5	-0.62	0.21	-0.13	-0.05	-0.85	-0.25	-0.48	0.1	-0.15
	6	-0.01	-0.08	0.2	-0.36	0.02	0.05	0.04	-0.35	0.06	-0.06

Age		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	0	-0.85	-0.12	-0.04	-0.67	-0.18	99.99	0.03	1.05	-1.01	-0.29
	1	0	0.28	0.39	0.47	-0.1	99.99	0.3	0.4	-0.23	-0.43
	2	-0.23	0.23	0.04	0.35	0.3	99.99	0.03	0.54	0.23	0.16
	3	-0.11	-0.14	0.15	0.58	0.42	99.99	0.1	0.61	0.28	0.54
	4	0.03	-0.49	0.4	0.87	0.42	99.99	0.13	0.3	-0.19	0.52
	5	0.39	-0.53	-0.24	1.09	-0.12	99.99	-0.48	0.66	-0.41	0.29
	6	-0.02	-0.17	-0.24	-0.08	-0.05	99.99	-0.18	0.08	0.23	0.12

Age		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	0	-0.85	0.53	-0.83	-0.49	-0.21	99.99	0.33	-0.46	0.24	0
	1	-0.44	-0.24	0.6	-0.52	-0.26	99.99	-0.23	0.11	-0.1	0.08
	2	-0.43	0.05	0.55	0.59	0.38	99.99	0.16	0.06	0.38	0.35
	3	-0.34	0.25	0.31	0.83	0.95	99.99	0.35	0.55	0.24	0.64
	4	-0.23	0.5	0.14	0.55	1	99.99	0.43	0.55	-0.19	0.52
	5	-0.67	0.8	-0.21	-0.07	0.39	99.99	0.86	0.21	0.34	0.42
	6	-0.08	0.3	-0.37	-0.47	0.02	99.99	0.18	0	0.32	0.02

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	-10.2137	-7.5673	-7.2	-7.2328	-7.2563	-7.3366	-7.3366
S.E(Log q)	0.7357	0.378	0.4094	0.5753	0.5345	0.4994	0.2023

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	0.56	1.804	10.43	0.4	28	0.4	-10.21
	1	0.8	1.105	8.17	0.53	28	0.3	-7.57
	2	0.96	0.18	7.31	0.47	28	0.4	-7.2
	3	1.14	-0.422	6.89	0.26	28	0.67	-7.23
	4	1.61	-1.528	6.16	0.2	28	0.84	-7.26
	5	0.93	0.334	7.41	0.46	28	0.47	-7.34
	6	0.96	0.581	7.37	0.89	28	0.19	-7.37
	1							

Terminal year survivor and F summaries :

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

Year class = 2017

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	26936	0.749	0	0	1	1	0
F shrinkage mean	0	1.5				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
26936	0.75	0	1	0	0

Age 1 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	45311	0.342	0.065	0.19	2	0.95	0.01
F shrinkage mean	4254	1.5				0.05	0.106

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
40254	0.33	0.38	3	1.129	0.012

1

Age 2 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	28982	0.264	0.2	0.76	3	0.967	0.074
F shrinkage mean	7669	1.5				0.033	0.255

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
27729	0.26	0.21	4	0.818	0.077

Age 3 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	16080	0.347	0	0	1	0.349	0.247
SP-GFS	37622	0.242	0.112	0.46	4	0.629	0.113
F shrinkage mean	12136	1.5				0.022	0.316

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
27284	0.2	0.2	6	1.017	0.153

1

Age 4 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	5780	0.238	0.017	0.07	2	0.559	0.327
SP-GFS	7380	0.241	0.162	0.67	4	0.421	0.264
F shrinkage mean	5003	1.5				0.021	0.369

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6387	0.17	0.09	7	0.531	0.3

Age 5 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	3457	0.209	0.107	0.51	3	0.628	0.389
SP-GFS	4742	0.266	0.144	0.54	5	0.35	0.298
F shrinkage mean	3105	1.5				0.022	0.425

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3852	0.16	0.09	9	0.557	0.355

1

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

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	1447	0.186	0.1	0.54	4	0.545	0.356
SP-GFS	1715	0.215	0.096	0.45	6	0.44	0.308
F shrinkage mean	1989	1.5				0.016	0.271

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1567	0.14	0.07	11	0.474	0.333

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 24/04/2018 10:41

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1986	1987
AGE		
0	0.02	0.0276
1	0.064	0.1136
2	0.243	0.4685
3	0.3788	0.3768
4	0.7234	0.511
5	0.6291	0.5279
6	1.0246	0.7216
+gp	1.0246	0.7216
FBAR 2- 4	0.4484	0.4521

Table 8 Fishing mortality (F) at age

YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
AGE										
0	0.0253	0.027	0.036	0.0228	0.0245	0.0495	0.0158	0.0243	0.0338	0.0094
1	0.1377	0.1035	0.1317	0.169	0.0954	0.0955	0.146	0.1459	0.0905	0.1141
2	0.4746	0.5558	0.3743	0.3407	0.4319	0.2173	0.2523	0.5864	0.3028	0.2594
3	0.4336	0.4965	0.3923	0.3902	0.4859	0.5218	0.3884	0.5364	0.732	0.4048
4	0.5329	0.8287	0.6125	0.4468	0.9385	0.7804	0.8062	0.6881	0.6142	0.4114
5	0.649	0.8452	0.872	1.0181	0.9872	0.5261	0.8929	0.9444	0.4911	0.5138
6	1.1959	1.6904	1.0137	1.3499	0.9075	0.8848	0.9346	0.8888	0.4681	0.5379
+gp	1.1959	1.6904	1.0137	1.3499	0.9075	0.8848	0.9346	0.8888	0.4681	0.5379
FBAR 2- 4	0.4804	0.627	0.4597	0.3926	0.6187	0.5065	0.4823	0.6036	0.5496	0.3585

Table 8 Fishing mortality (F) at age

YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE										
0	0.0689	0.0936	0.0109	0.0062	0.0058	0.0052	0.001	0.0002	0	0.0029
1	0.1642	0.3143	0.2917	0.2507	0.2419	0.1806	0.1996	0.1433	0.0331	0.0892
2	0.2833	0.2905	0.2362	0.2143	0.2832	0.2435	0.3255	0.3831	0.3157	0.2223
3	0.3821	0.4045	0.4676	0.5072	0.4189	0.3936	0.4088	0.3627	0.5515	0.3478
4	0.5692	0.5807	0.7548	0.8955	0.5666	0.3374	0.6073	0.4013	0.4959	0.5252
5	0.8057	0.464	0.4923	1.0989	0.3283	0.4818	0.4637	0.8192	0.4223	0.8375
6	0.5215	0.5955	0.5261	0.4492	0.3607	0.6299	0.5465	0.6938	0.3535	0.6439
+gp	0.5215	0.5955	0.5261	0.4492	0.3607	0.6299	0.5465	0.6938	0.3535	0.6439
FBAR 2- 4	0.4115	0.4252	0.4862	0.539	0.4229	0.3249	0.4472	0.3824	0.4544	0.3651

Table 8 Fishing mortality (F) at age

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	FBAR 15-17
AGE											
0	0.008	0	0.0659	0.0007	0.0112	0.0062	0	0.0031	0	0	0.001
1	0.0883	0.0783	0.2491	0.1607	0.1648	0.1172	0.169	0.0394	0.039	0.0118	0.03
2	0.1482	0.1626	0.1649	0.1583	0.1451	0.225	0.4008	0.35	0.1458	0.0772	0.191
3	0.2763	0.2774	0.2816	0.2579	0.2174	0.3312	0.3095	0.4943	0.2187	0.153	0.289
4	0.401	0.4614	0.3638	0.379	0.3314	0.3531	0.3854	0.4743	0.2899	0.3	0.355
5	0.3752	0.6057	0.4948	0.4791	0.3883	0.415	0.4702	0.3317	0.5044	0.3555	0.397
6	0.3522	0.4382	0.3617	0.4461	0.3208	0.3605	0.4248	0.3169	0.4318	0.3328	0.361
+gp	0.3522	0.4382	0.3617	0.4461	0.3208	0.3605	0.4248	0.3169	0.4318	0.3328	0.361
FBAR 2- 4	0.2751	0.3005	0.2701	0.2651	0.2313	0.3031	0.3652	0.4395	0.2181	0.1767	

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 24/04/2018 10:41

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1986	1987
AGE		
0	71878	52286
1	61181	57682
2	39937	46985
3	20684	25643
4	9755	11595
5	2902	3875
6	1498	1266
+gp	394	308
TOTAL	208229	199640

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

YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
AGE										
0	57094	53551	40332	63233	58764	29492	47912	59432	42822	30297
1	41642	45578	42677	31854	50604	46946	22979	38613	47492	33893
2	42155	29708	33647	30629	22025	37660	34936	16259	27322	35518
3	24079	21471	13951	18946	17837	11708	24811	22225	7406	16526
4	14404	12778	10700	7716	10500	8984	5689	13776	10642	2916
5	5695	6921	4568	4748	4041	3363	3370	2080	5668	4714
6	1871	2436	2434	1564	1404	1233	1627	1130	662	2840
+gp	724	835	1375	704	129	522	818	524	1625	1164
TOTAL	187664	173279	149683	159394	165305	139908	142142	154039	143639	127869

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

YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE										
0	21404	36286	35941	37059	39810	50888	36811	52558	51509	37739
1	24573	16358	27055	29106	30154	32406	41448	30108	43022	42171
2	24756	17072	9780	16547	18546	19383	22147	27795	21359	34077
3	22436	15269	10453	6323	10934	11439	12439	13094	15515	12753
4	9026	12535	8342	5362	3117	5889	6318	6767	7459	7318
5	1582	4182	5743	3211	1793	1448	3440	2818	3709	3719
6	2309	579	2153	2874	876	1057	732	1772	1017	1990
+gp	950	1191	2246	1083	1304	332	875	870	840	1060
TOTAL	107037	103472	101713	101565	106534	122840	124210	135782	144430	140828

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

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	GM 90-15
AGE												
0	27943	63523	49917	47500	67859	49305	85162	56925	60765	32899	0	53614
1	30807	22695	52007	38264	38863	54941	40119	69725	46464	49748	26936	
2	31580	23090	17182	33190	26678	26985	40006	27738	54880	36585	40254	
3	22338	22295	16067	11928	23195	18892	17642	21938	16003	38834	27729	
4	7374	13874	13832	9926	7546	15280	11106	10600	10956	10529	27284	
5	3544	4043	7161	7871	5563	4435	8788	6185	5401	6712	6387	
6	1318	1994	1806	3574	3991	3089	2398	4496	3634	2670	3852	
+gp	1101	685	1583	1214	1688	1344	1779	1867	1746	2395	2973	
TOTAL	126005	152199	159555	153468	175383	174272	207002	199473	199849	180373	135416	

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 24/04/2018 10:41

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	71878	5173	4294	1408	0.3279	0.4484
1987	52286	7299	6028	2021	0.3353	0.4521
1988	57094	7821	6734	2586	0.384	0.4804
1989	53551	7788	6727	3037	0.4515	0.627
1990	40332	6734	5960	2354	0.395	0.4597
1991	63233	6617	5749	2129	0.3704	0.3926
1992	58764	6366	5430	2353	0.4333	0.6187
1993	29492	6011	5308	1822	0.3432	0.5065
1994	47912	6395	5576	1920	0.3443	0.4823
1995	59432	5910	4978	2058	0.4134	0.6036
1996	42822	5203	4395	1466	0.3336	0.5496
1997	30297	4420	3872	1204	0.311	0.3585
1998	21404	5037	4544	1501	0.3303	0.4115
1999	36286	4556	4054	1442	0.3557	0.4252
2000	35941	4411	3809	1414	0.3712	0.4862
2001	37059	3812	3214	1221	0.3799	0.539
2002	39810	4141	3395	1028	0.3028	0.4229
2003	50888	4727	3739	1067	0.2854	0.3249
2004	36811	4988	4062	1354	0.3333	0.4472
2005	52558	4904	4070	1358	0.3337	0.3824
2006	51509	5647	4663	1427	0.306	0.4544
2007	37739	5462	4602	1396	0.3033	0.3651
2008	27943	5986	5316	1182	0.2224	0.2751
2009	63523	5962	5247	1413	0.2693	0.3005
2010	49917	6397	5726	1562	0.2728	0.2701
2011	47500	6015	5309	1397	0.2631	0.2651
2012	67859	7513	6070	1321	0.2176	0.2313
2013	49305	6403	5565	1427	0.2564	0.3031
2014	85162	7227	6328	1942	0.3069	0.3652
2015	56925	7919	6438	1745	0.271	0.4395
2016	60765	8071	6946	1419	0.2043	0.2181
2017	32899	8489	7494	1173	0.1565	0.1767
Arith. Mean	48403	6044	5176	1630	0.3183	0.4088
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: 14:12 26/04/2018
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

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	53614	0.2	0	0	0	0.004	0.0000	0.002	0.0015	0.004
1	43895	0.2	0.55	0	0	0.024	0.0000	0.034	0.0659	0.024
2	40254	0.2	0.86	0	0	0.044	0.0187	0.069	0.1894	0.041
3	27729	0.2	0.97	0	0	0.071	0.1309	0.086	0.1436	0.054
4	27284	0.2	0.99	0	0	0.100	0.2990	0.106	0.0530	0.069
5	6387	0.2	1	0	0	0.131	0.4166	0.133	0.0137	0.094
6	3852	0.2	1	0	0	0.162	0.3810	0.162	0.0049	0.116
7	2973	0.2	1	0	0	0.218	0.3853	0.218	0.0005	0.094

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	53614	0.2	0	0	0	0.004	0.0000	0.002	0.0015	0.004
1		0.2	0.55	0	0	0.024	0.0000	0.034	0.0659	0.024
2		0.2	0.86	0	0	0.044	0.0187	0.069	0.1894	0.041
3		0.2	0.97	0	0	0.071	0.1309	0.086	0.1436	0.054
4		0.2	0.99	0	0	0.100	0.2990	0.106	0.0530	0.069
5		0.2	1	0	0	0.131	0.4166	0.133	0.0137	0.094
6		0.2	1	0	0	0.162	0.3810	0.162	0.0049	0.116
7		0.2	1	0	0	0.218	0.3853	0.218	0.0005	0.094

2020 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	53614	0.2	0	0	0	0.004	0.0000	0.002	0.0015	0.004
1		0.2	0.55	0	0	0.024	0.0000	0.034	0.0659	0.024
2		0.2	0.86	0	0	0.044	0.0187	0.069	0.1894	0.041
3		0.2	0.97	0	0	0.071	0.1309	0.086	0.1436	0.054
4		0.2	0.99	0	0	0.100	0.2990	0.106	0.0530	0.069
5		0.2	1	0	0	0.131	0.4166	0.133	0.0137	0.094
6		0.2	1	0	0	0.162	0.3810	0.162	0.0049	0.116
7		0.2	1	0	0	0.218	0.3853	0.218	0.0005	0.094

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: 14:12 26/04/2018
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2018

		Catch	Landings		Discards	
Biomass	**SSB**	**FMult**	**FBar**	**Yield**	**FBar**	**Yield**
9826	8821	1	0.1495	1585	0.1287	574

2019 | 2020

		Catch	Landings		Discards			
Biomass	**SSB**	**FMult**	**FBar**	**Yield**	**FBar**	**Yield**	**Biomass**	**SSB**
9787	8836	0	0.0000	0	0.0000	0	12191	11219
.	8836	0.1	0.0150	204	0.0129	56	11881	10912
.	8836	0.2	0.0299	400	0.0257	111	11580	10615
.	8836	0.3	0.0449	589	0.0386	164	11290	10327
.	8836	0.4	0.0598	772	0.0515	216	11009	10050
.	8836	0.5	0.0748	948	0.0643	267	10737	9781
.	8836	0.6	0.0897	1118	0.0772	317	10474	9521
.	8836	0.7	0.1047	1281	0.0901	366	10220	9270
.	8836	0.8	0.1196	1439	0.1029	414	9974	9027
.	8836	0.9	0.1346	1592	0.1158	460	9736	8792
.	8836	1	0.1495	1739	0.1287	506	9506	8564
.	8836	1.1	0.1645	1881	0.1415	551	9283	8344
.	8836	1.2	0.1794	2018	0.1544	594	9067	8132
.	8836	1.3	0.1944	2150	0.1673	637	8858	7926
.	8836	1.4	0.2093	2277	0.1801	679	8656	7726
.	8836	1.5	0.2243	2400	0.1930	720	8460	7533
.	8836	1.6	0.2393	2519	0.2059	760	8271	7346
.	8836	1.7	0.2542	2633	0.2187	799	8088	7166
.	8836	1.8	0.2692	2744	0.2316	837	7910	6991
.	8836	1.9	0.2841	2851	0.2445	875	7738	6821
.	8836	2	0.2991	2954	0.2573	912	7571	6657

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: 14:12 26/04/2018
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2018 F multiplier: 1 HCFbar: 0.1495 Fleet1 DFbar: 0.1287

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0015	73	0	53614	204	0	0	0	0
1	0	1	0	0.0659	2540	60	43895	1036	24142	570	24142	570
2	0.0187	618	42	0.1894	6260	257	40254	1779	34618	1530	34618	1530
3	0.1309	2890	247	0.1436	3170	172	27729	1958	26897	1899	26897	1899
4	0.299	6269	665	0.053	1111	76	27284	2739	27011	2712	27011	2712
5	0.4166	1974	262	0.0137	65	6	6387	838	6387	838	6387	838
6	0.381	1111	180	0.0049	14	2	3852	623	3852	623	3852	623
7	0.3853	867	189	0.0005	1	0	2973	649	2973	649	2973	649
Total		13730	1585		13235	574	205988	9826	125881	8821	125881	8821

Year: 2019 F multiplier: 1 HCFbar: 0.1495 Fleet1 DFbar: 0.1287

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0015	73	0	53614	204	0	0	0	0
1	0	1	0	0.0659	2536	60	43830	1034	24106	569	24106	569
2	0.0187	517	35	0.1894	5232	215	33646	1487	28935	1279	28935	1279
3	0.1309	2790	239	0.1436	3060	166	26765	1890	25962	1833	25962	1833
4	0.299	3964	420	0.053	703	48	17253	1732	17080	1715	17080	1715
5	0.4166	4855	644	0.0137	160	15	15710	2061	15710	2061	15710	2061
6	0.381	981	159	0.0049	13	1	3401	550	3401	550	3401	550
7	0.3853	1108	242	0.0005	1	0	3799	829	3799	829	3799	829
Total		14215	1739		11778	506	198017	9787	118994	8836	118994	8836

Year: 2020 F multiplier: 1 HCFbar: 0.1495 Fleet1 DFbar: 0.1287

Age	Catch F	CatchNos	Yield	DF	DCatchN	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0015	73	0	53614	204	0	0	0	0
1	0	1	0	0.0659	2536	60	43830	1034	24106	569	24106	569
2	0.0187	516	35	0.1894	5225	214	33595	1485	28892	1277	28892	1277
3	0.1309	2332	200	0.1436	2558	139	22371	1579	21700	1532	21700	1532
4	0.299	3827	406	0.053	678	47	16653	1672	16487	1655	16487	1655
5	0.4166	3070	407	0.0137	101	10	9934	1303	9934	1303	9934	1303
6	0.381	2412	391	0.0049	31	4	8365	1353	8365	1353	8365	1353
7	0.3853	1169	255	0.0005	2	0	4008	874	4008	874	4008	874
Total		13325	1693		11203	473	192370	9506	113492	8564	113492	8564

Input units are thousands and kg - output in tonnes

Table 6.2.16 **Four-spot megrim (*L. boscii*) in Divisions 8c and 9a**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to catches and SSB (by weight) of these year classes

Year-class	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**

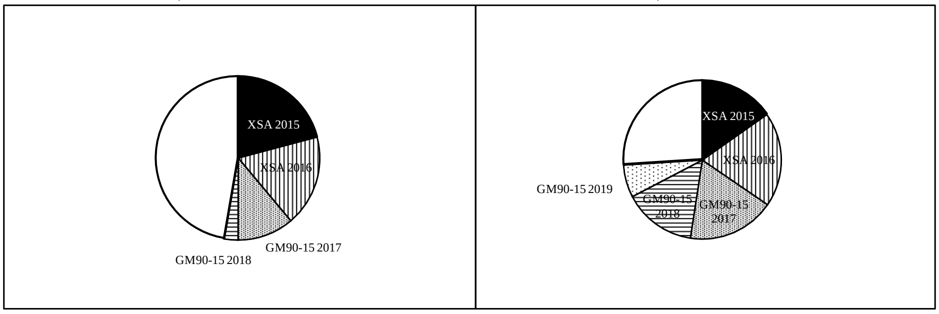


Table 6.2.17 Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Yield-per-recruit results.

MFYPR version 2a
Run: ldb
Time and date: 16:19 26/04/2018
Yield per results

Catch FMult	Landings Fbar	CatchNos	Yield	Discards Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	0.5304	4.0334	0.5122	4.0334	0.5122
0.1	0.015	0.0736	0.0122	0.0129	0.0257	0.0011	5.0218	0.4332	3.5399	0.415	3.5399	0.415
0.2	0.0299	0.1215	0.0195	0.0257	0.0501	0.0022	4.6621	0.3647	3.1816	0.3466	3.1816	0.3466
0.3	0.0449	0.1536	0.0238	0.0386	0.0732	0.0032	4.3881	0.3143	2.9089	0.2963	2.9089	0.2963
0.4	0.0598	0.1752	0.0262	0.0515	0.0951	0.0041	4.1718	0.2758	2.6939	0.2579	2.6939	0.2579
0.5	0.0748	0.1899	0.0276	0.0643	0.116	0.005	3.9962	0.2457	2.5196	0.2278	2.5196	0.2278
0.6	0.0897	0.1995	0.0281	0.0772	0.1358	0.0058	3.8505	0.2216	2.3751	0.2038	2.3751	0.2038
0.7	0.1047	0.2056	0.0282	0.0901	0.1547	0.0066	3.7273	0.202	2.2531	0.1842	2.2531	0.1842
0.8	0.1196	0.2091	0.0279	0.1029	0.1726	0.0073	3.6215	0.1857	2.1485	0.168	2.1485	0.168
0.9	0.1346	0.2106	0.03	0.1158	0.1898	0.008	3.53	0.172	2.0576	0.1545	2.0576	0.1545
1	0.1495	0.2108	0.0269	0.1287	0.2061	0.0086	3.4485	0.1604	1.9778	0.1429	1.9778	0.1429
1.1	0.1645	0.2098	0.0262	0.1415	0.2218	0.0092	3.3766	0.1505	1.9071	0.1331	1.9071	0.1331
1.2	0.1794	0.208	0.0254	0.1544	0.2367	0.0098	3.3123	0.1419	1.8438	0.1245	1.8438	0.1245
1.3	0.1944	0.2056	0.0247	0.1673	0.2509	0.0103	3.2542	0.1344	1.7868	0.1171	1.7868	0.1171
1.4	0.2093	0.2028	0.0239	0.1801	0.2646	0.0108	3.2014	0.1278	1.7351	0.1105	1.7351	0.1105
1.5	0.2243	0.1996	0.0231	0.193	0.2777	0.0113	3.1532	0.1219	1.6879	0.1047	1.6879	0.1047
1.6	0.2393	0.1961	0.0223	0.2059	0.2902	0.0117	3.1089	0.1167	1.6447	0.0995	1.6447	0.0995
1.7	0.2542	0.1925	0.0216	0.2187	0.3022	0.0121	3.0681	0.112	1.6049	0.0949	1.6049	0.0949
1.8	0.2692	0.1888	0.0209	0.2316	0.3138	0.0125	3.0303	0.1077	1.568	0.0907	1.568	0.0907
1.9	0.2841	0.185	0.0202	0.2445	0.3248	0.0129	2.9951	0.1039	1.5338	0.0869	1.5338	0.0869
2.0	0.2991	0.1812	0.0195	0.2573	0.3354	0.0133	2.9622	0.1004	1.5019	0.0835	1.5019	0.0835

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1	0.1495
FMax	0.6673	0.0998
F0.1	0.4217	0.0631
F35%SPR	0.7288	0.109

Weights in kilograms

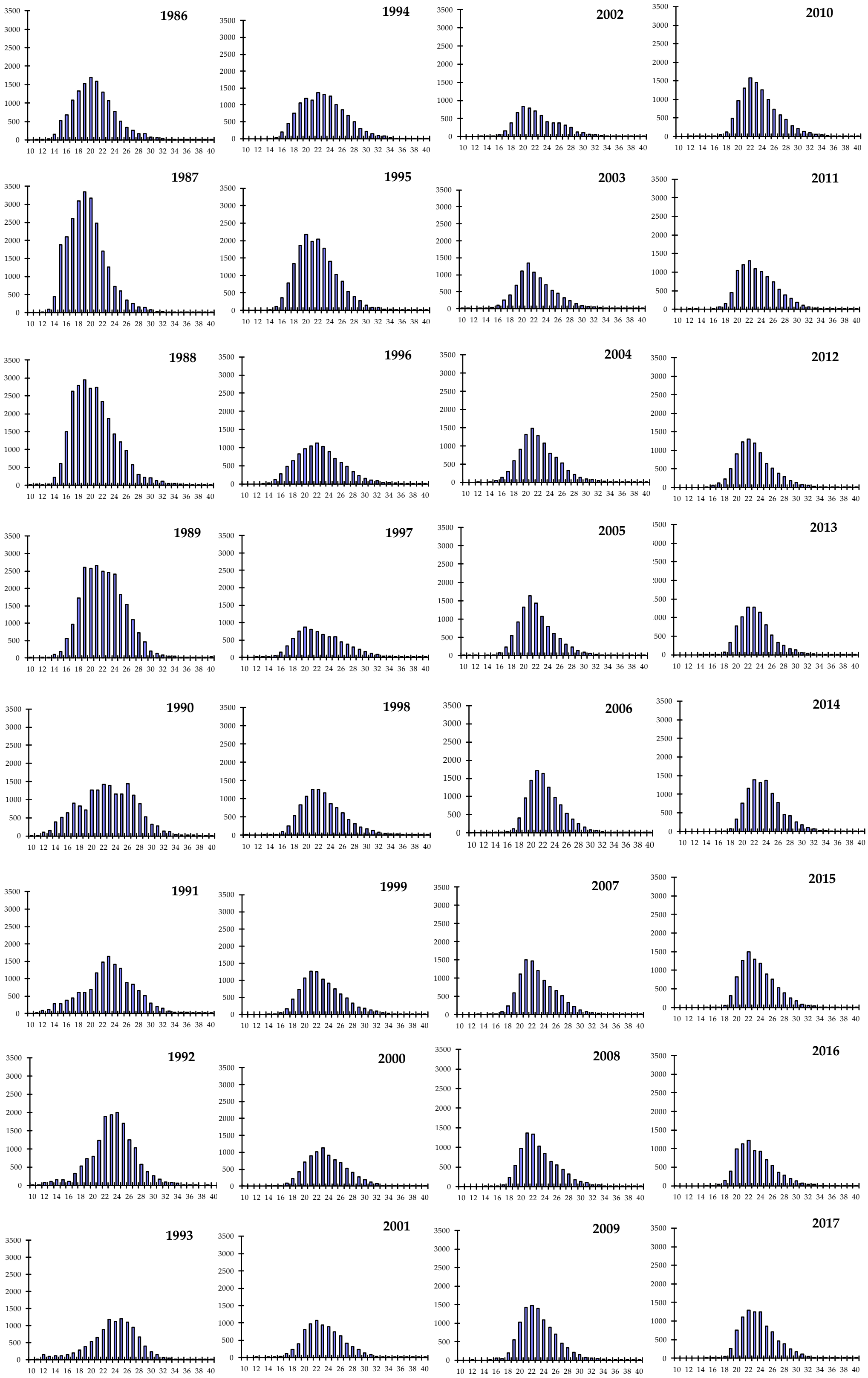


Figure 6.2.1 Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Annual length compositions of landings ('000)

Standardized log(abundance index at age) from SpGFS-WIBTS-Q4

(black bubble means < 0)

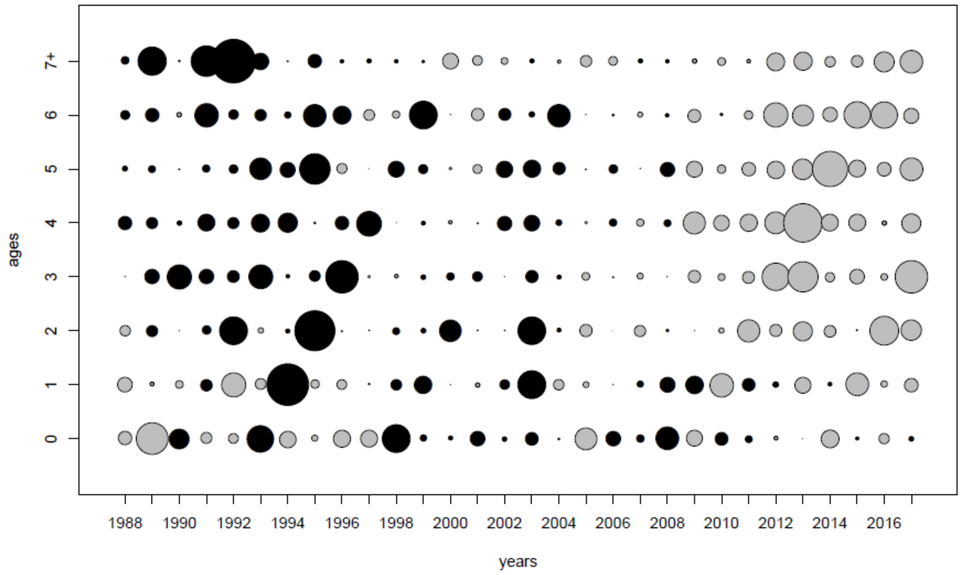
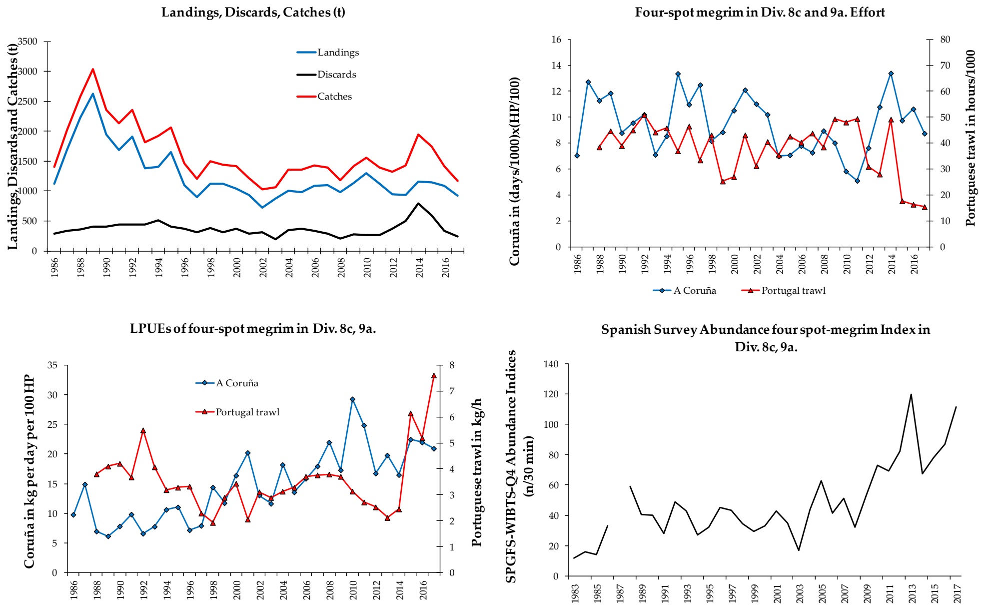


Figure 6.2.2: Four-spot megrim (*L. boscii*) in Divisions 8c&9a



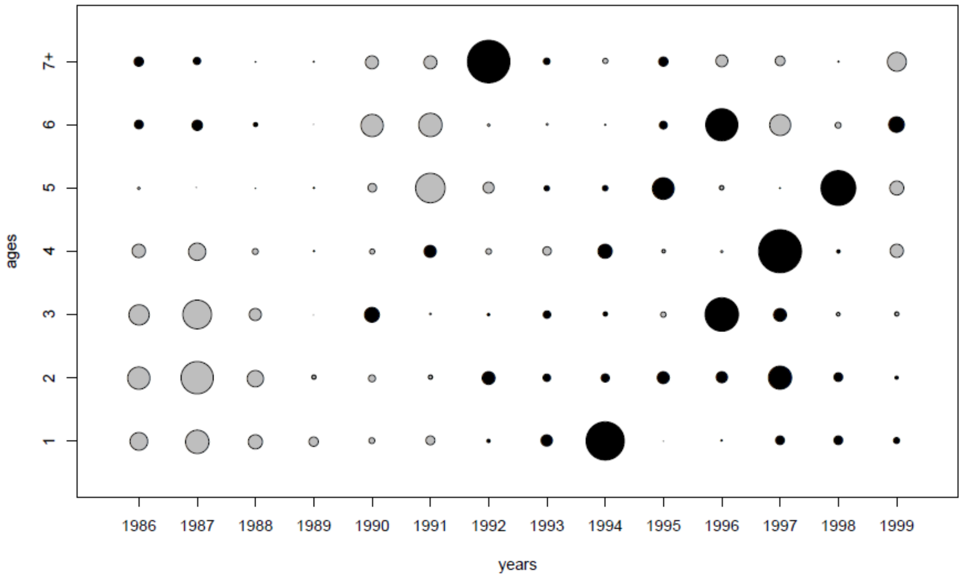
* Spanish Landings of 2008 revised in WG2010 from original value presented

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

Figure 6.2.3(a) Four-spot megrim (*L.boscii*) in Divisions 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)

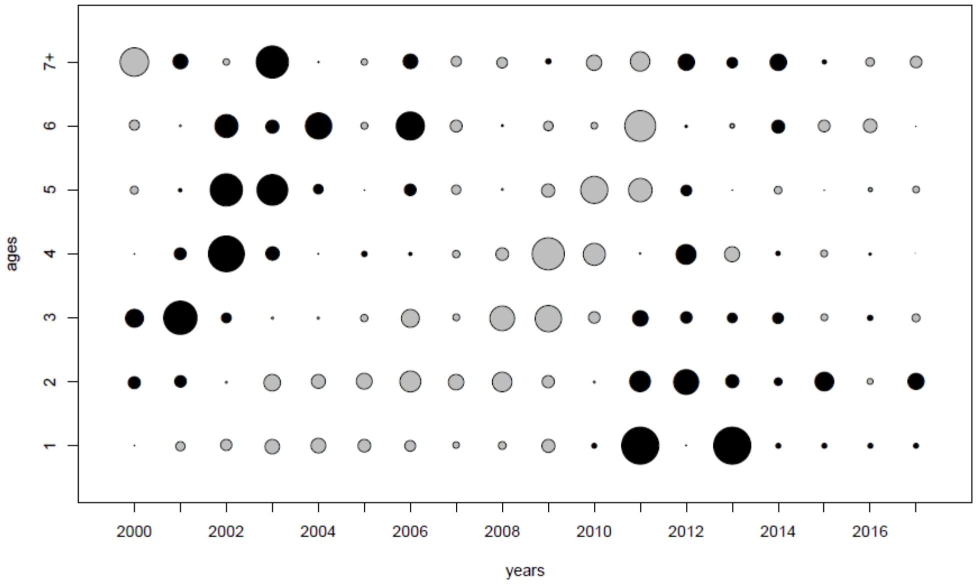
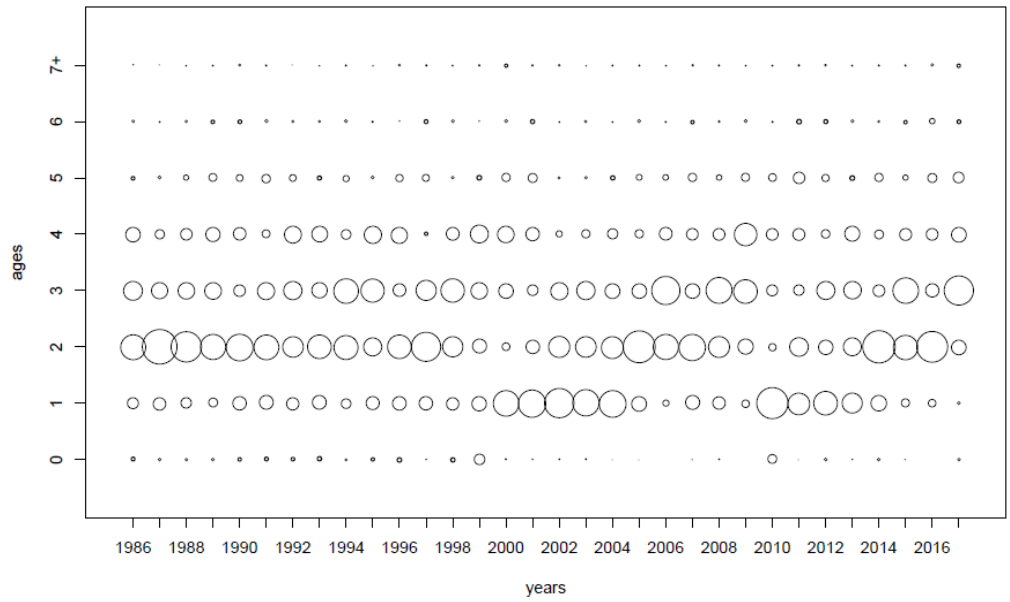


Figure 6.2.3(b): Four-spot megrim (*L. boscii*) in Divisions 8c&9a

Catches proportions at age



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

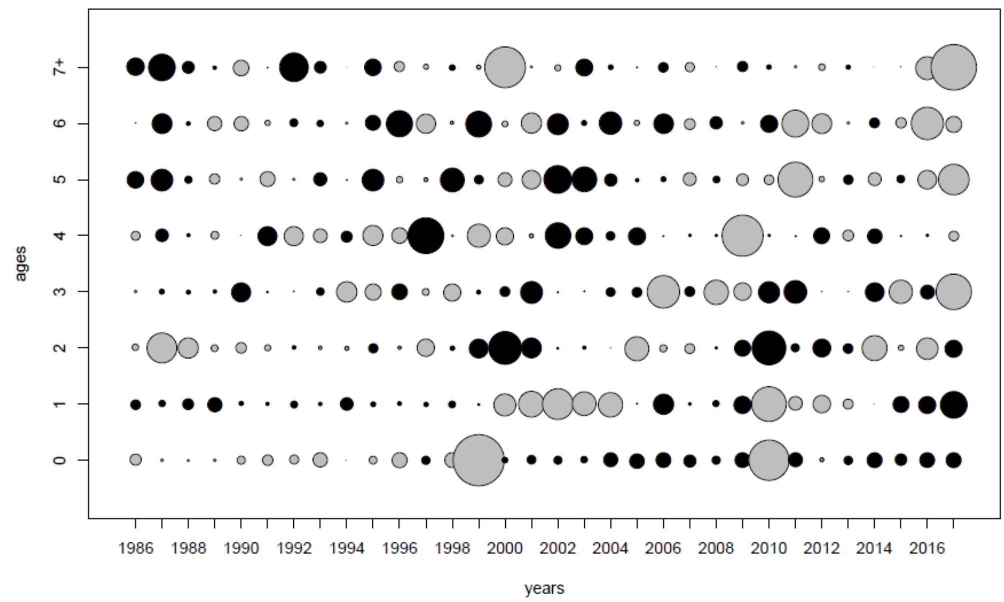
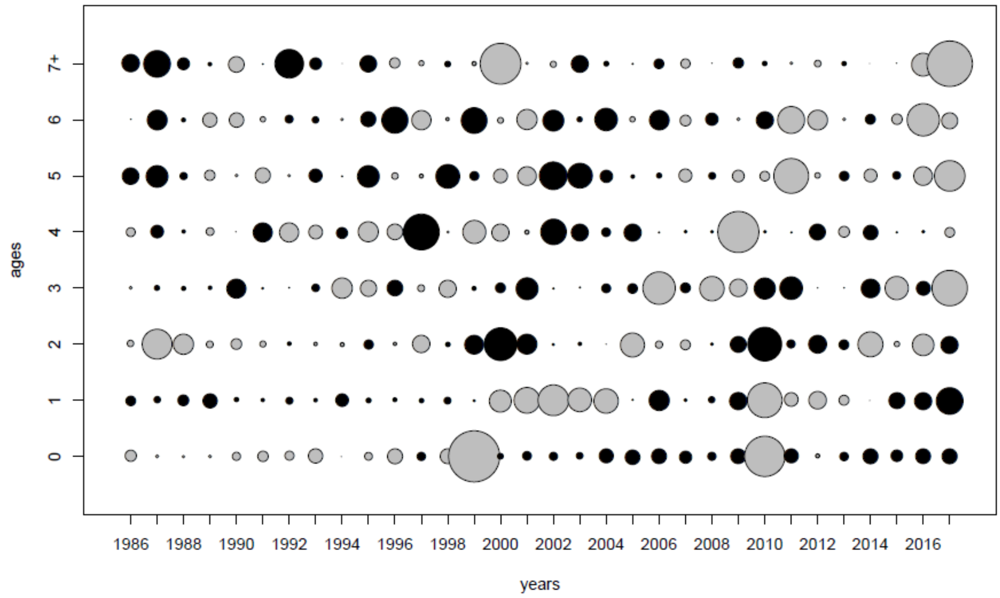


Figure 6.2.4(a). Four-spot megrim (L. boscii) in Divisions 8c & 9a.

Landings proportions at age



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

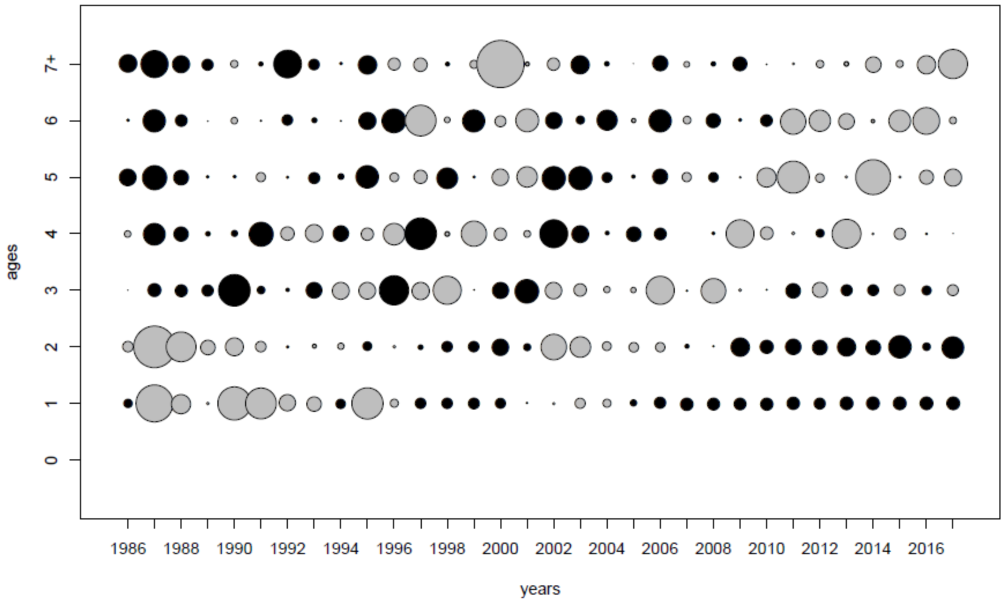
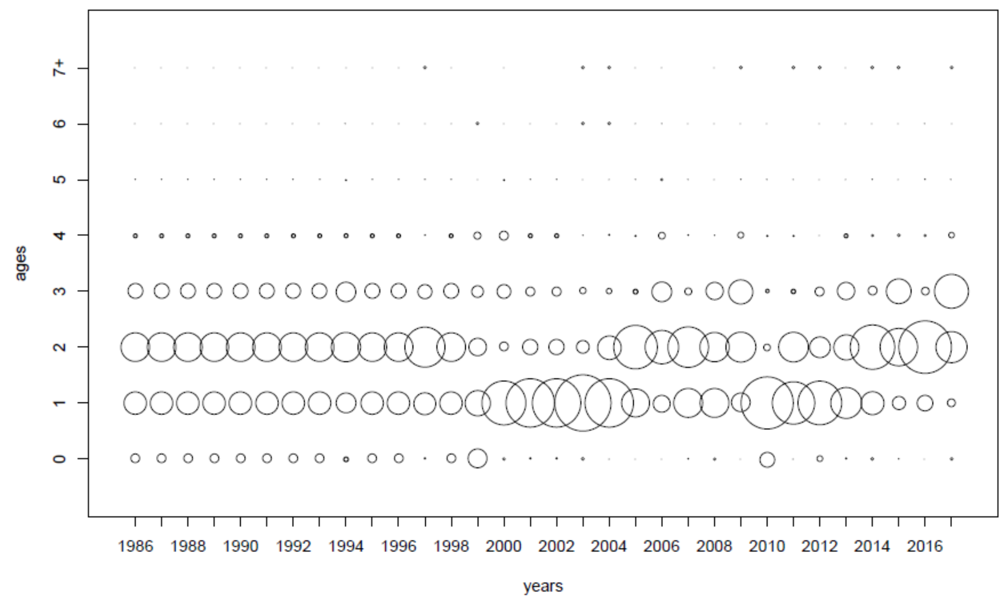


Figure 6.2.4(b). Four-spot megrim (*L. boscii*) in Divisions 8c & 9a.

Discards proportions at age



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

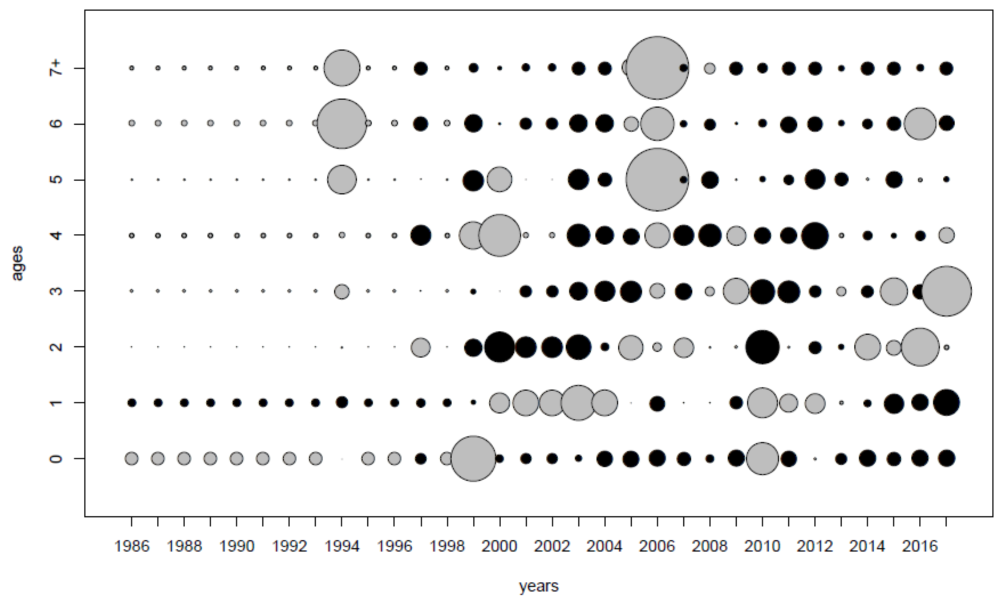


Figure 6.2.4(c). Four-spot megrim (*L. boscii*) in Divisions 8c & 9a.

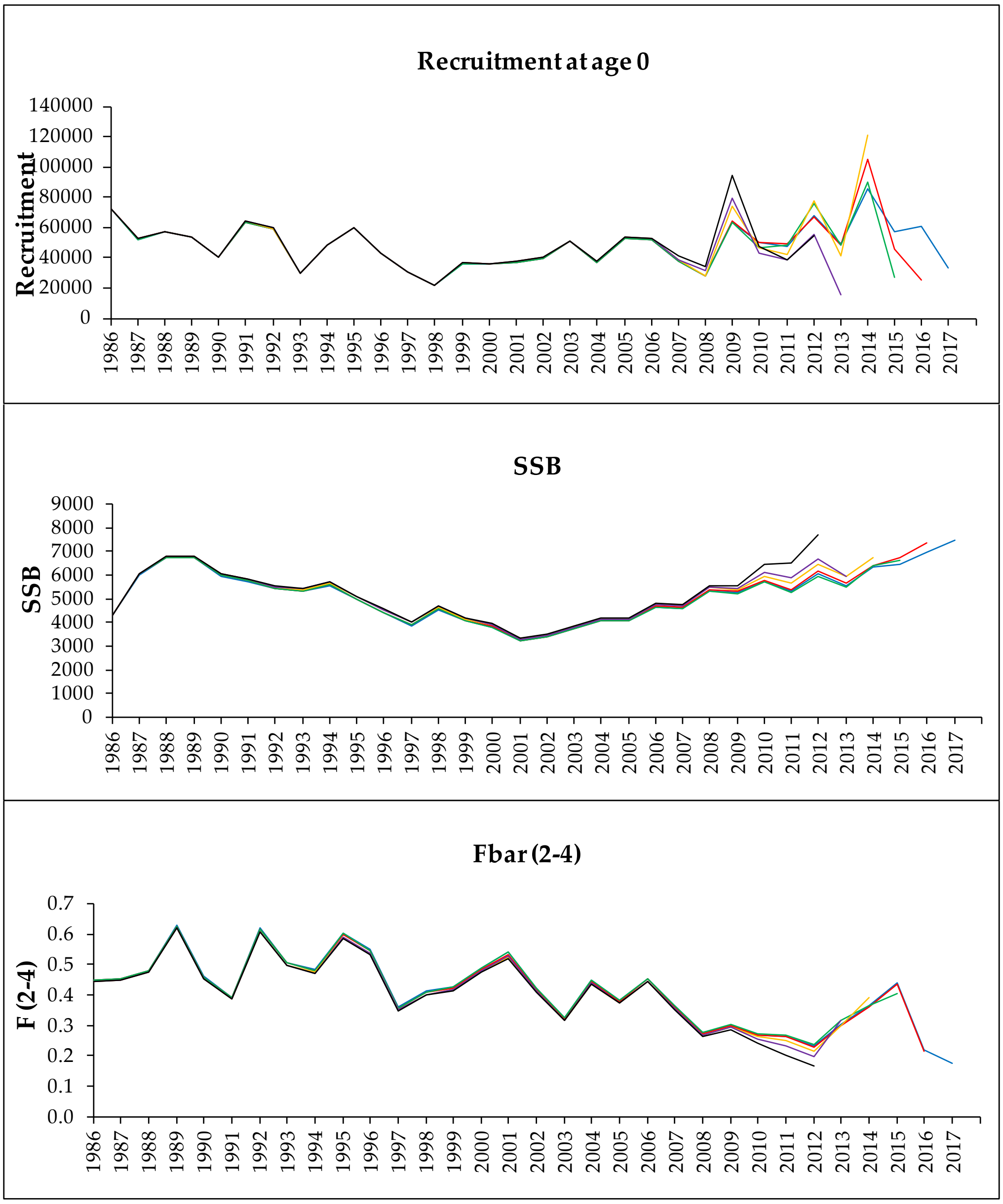


Figure 6.2.5. Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Retrospective XSA

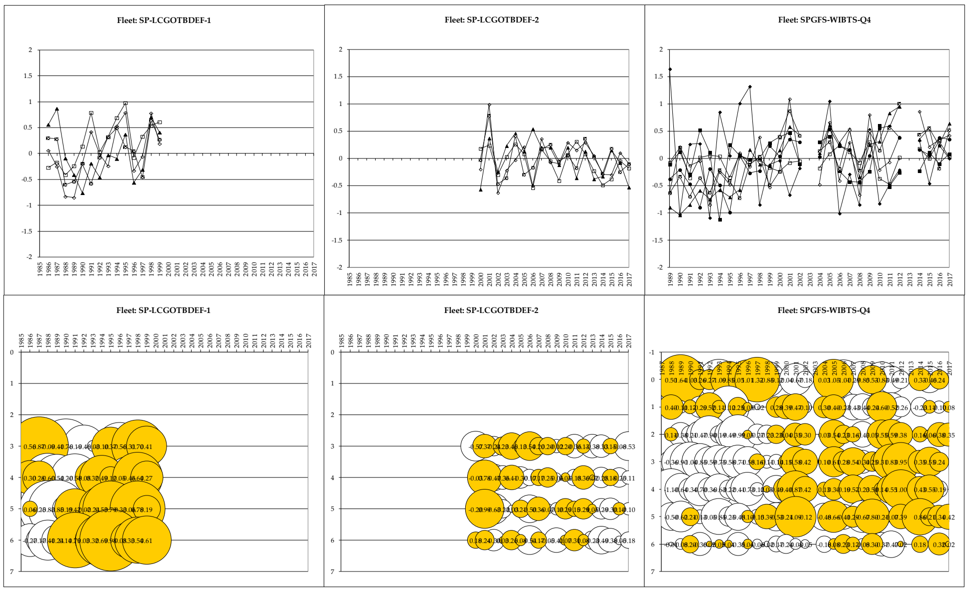


Figure 6.2.6. Four spot megrim (*L. boscii*) in Divisions 8c and 9a. LOG-CATCHABILITY RESIDUAL PLOTS (XSA)

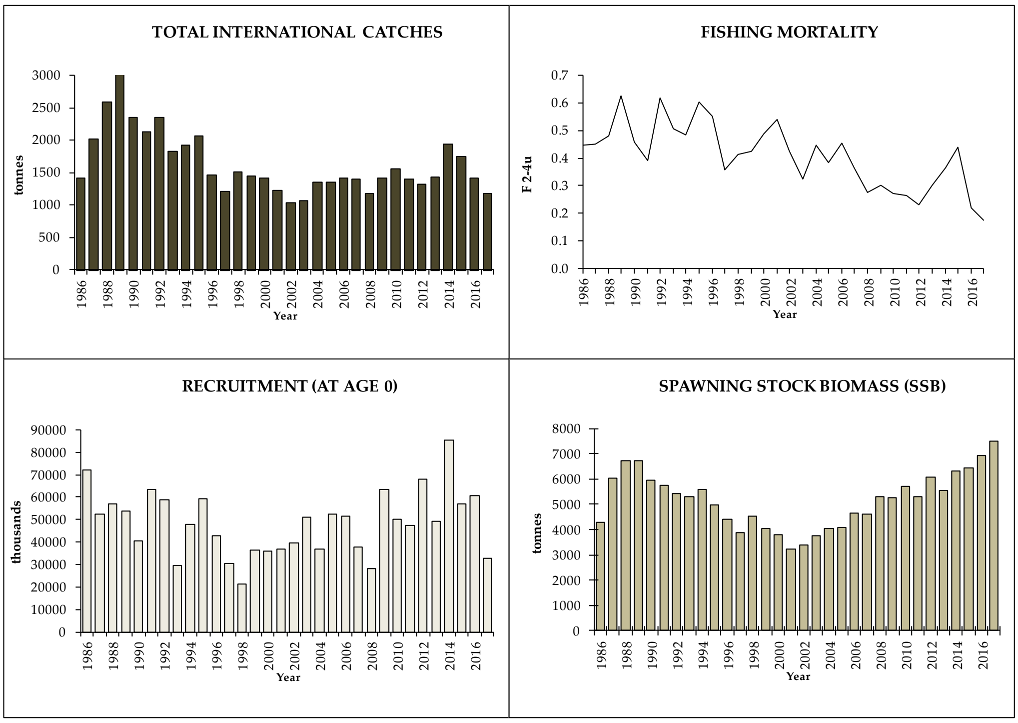
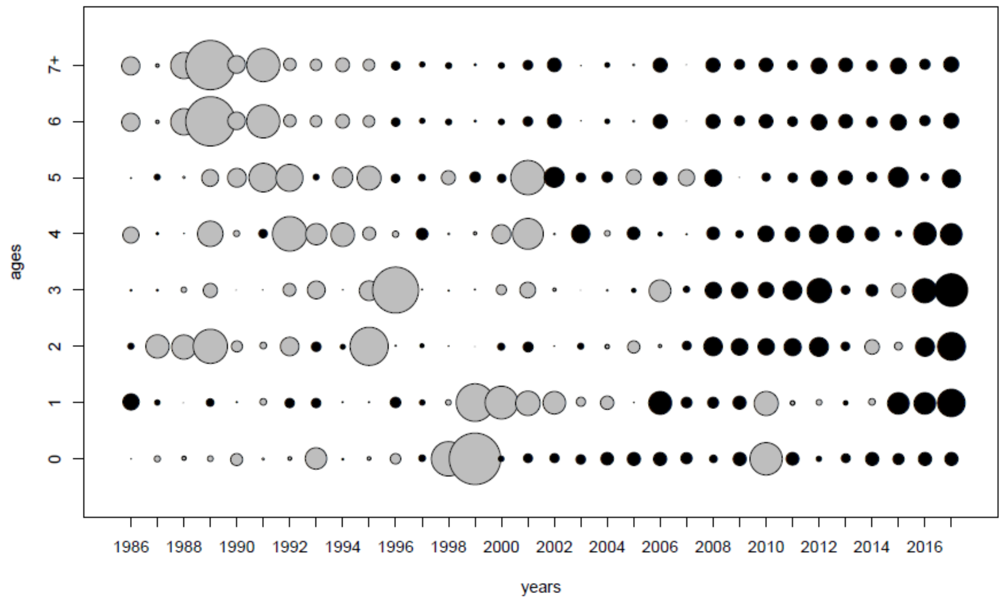


Figure 6.2.7(a). Four-spot megrim (*L. boscii*) in Divisions 8c and 9a. Stock Summary

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



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

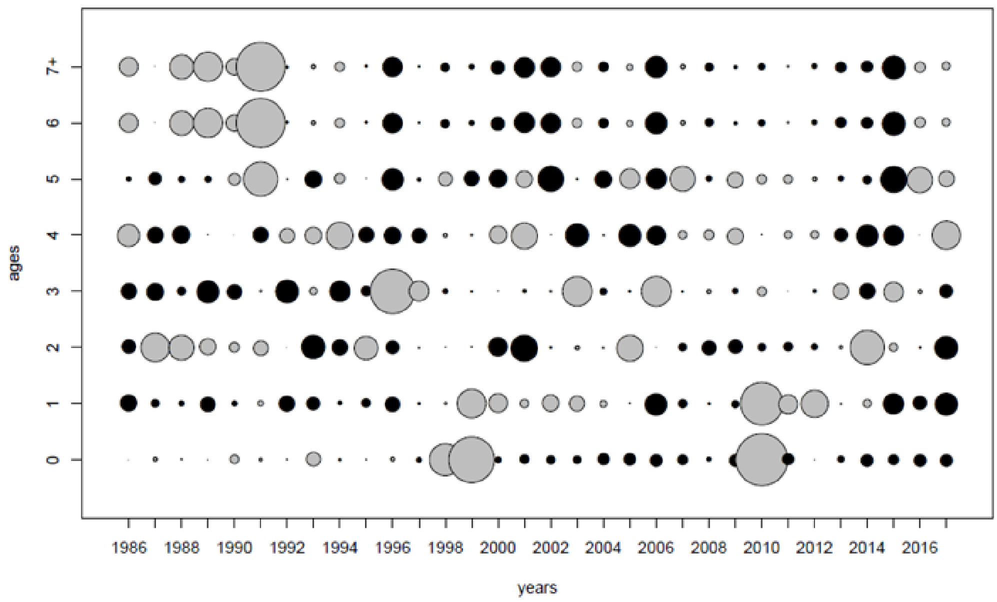
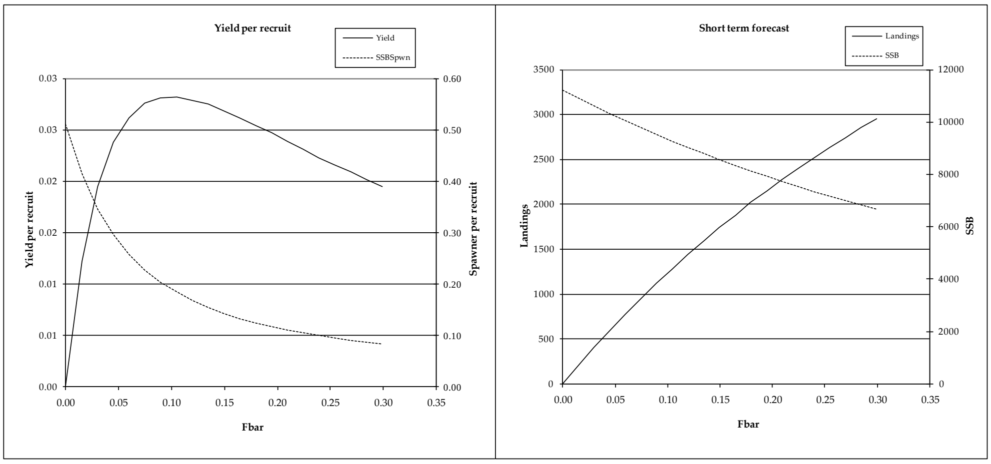


Figure 6.2.7(b): Four-spot megrim (*L. boscii*) in Divisions 8c&9a



MFYPR version 2a
Run: ldb
Time and date: 16:19 26/04/2018

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.1495
FMax	0.6673	0.0998
F0.1	0.4217	0.0631
F35%SPR	0.7288	0.1090

MFDP version 1a
Run: ldb
Time and date: 14:12 26/04/2018
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

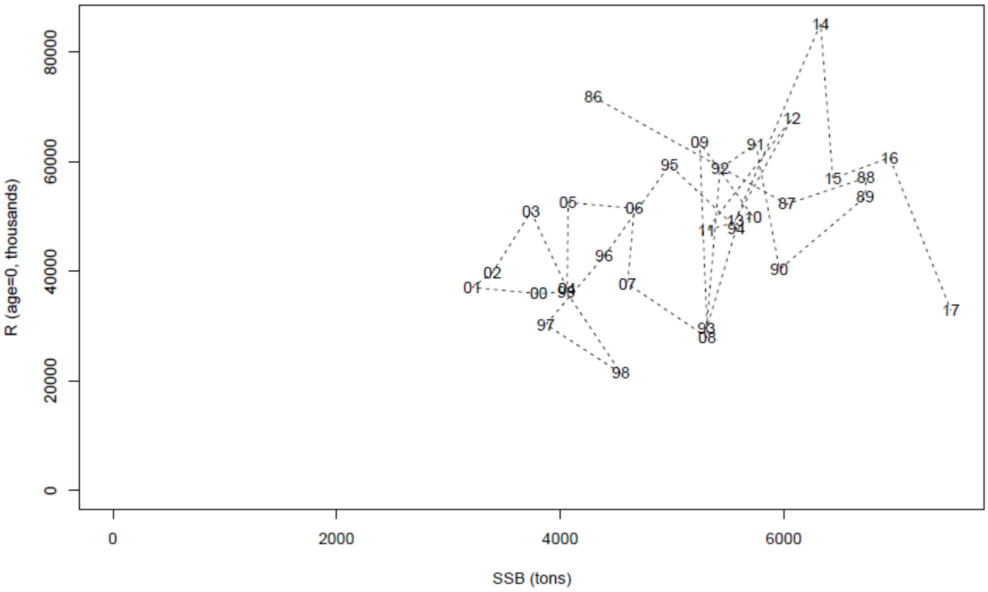


Figure 6.2.9. Four spot megrim (*L.boscii*) in Divisions 8c and 9a. SSB-Recruitment plot

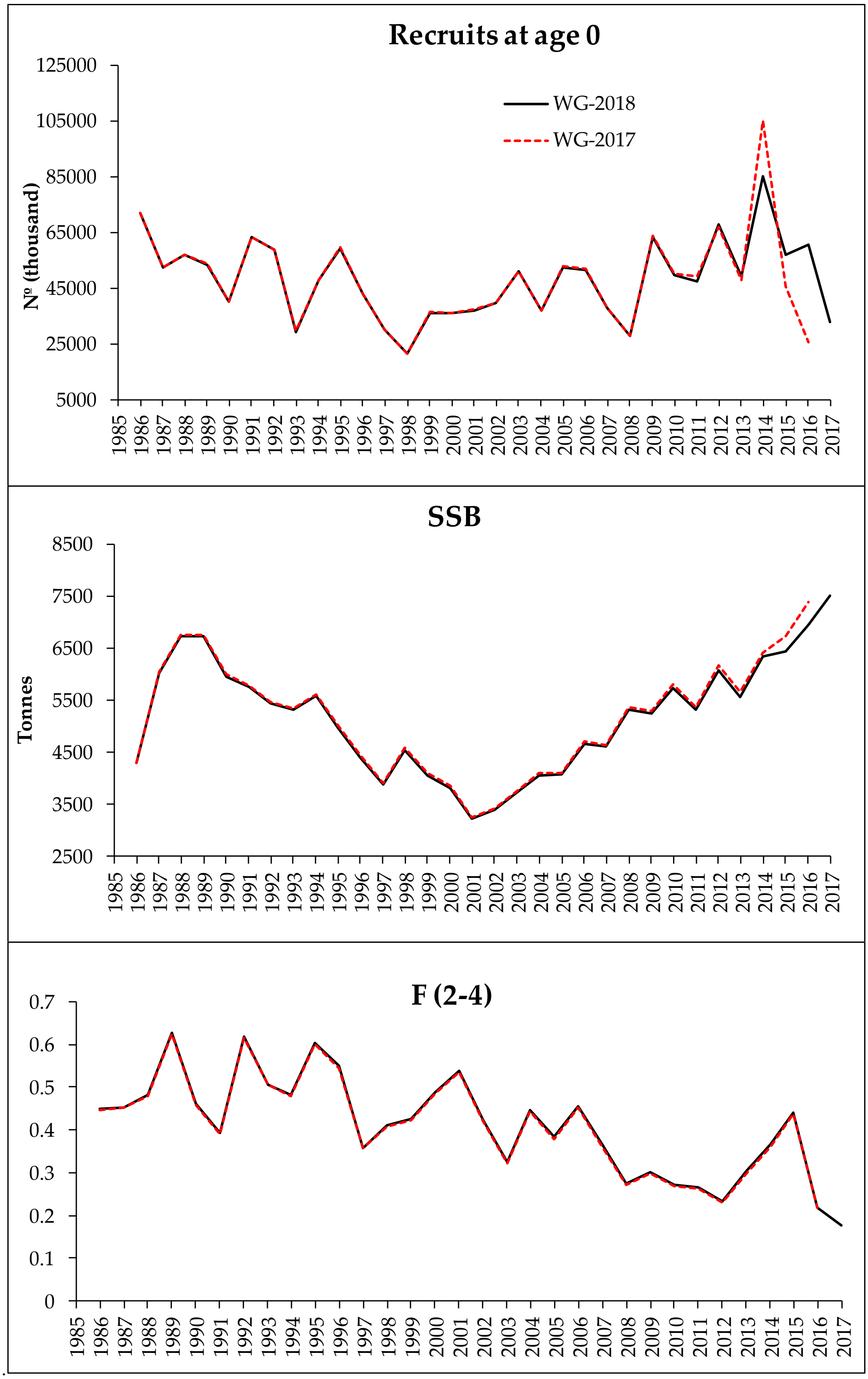


Figure 6.2.10. Four-spot megrim (*L. boscii*). Recruits, SSB and Fs from WG17 and WG18

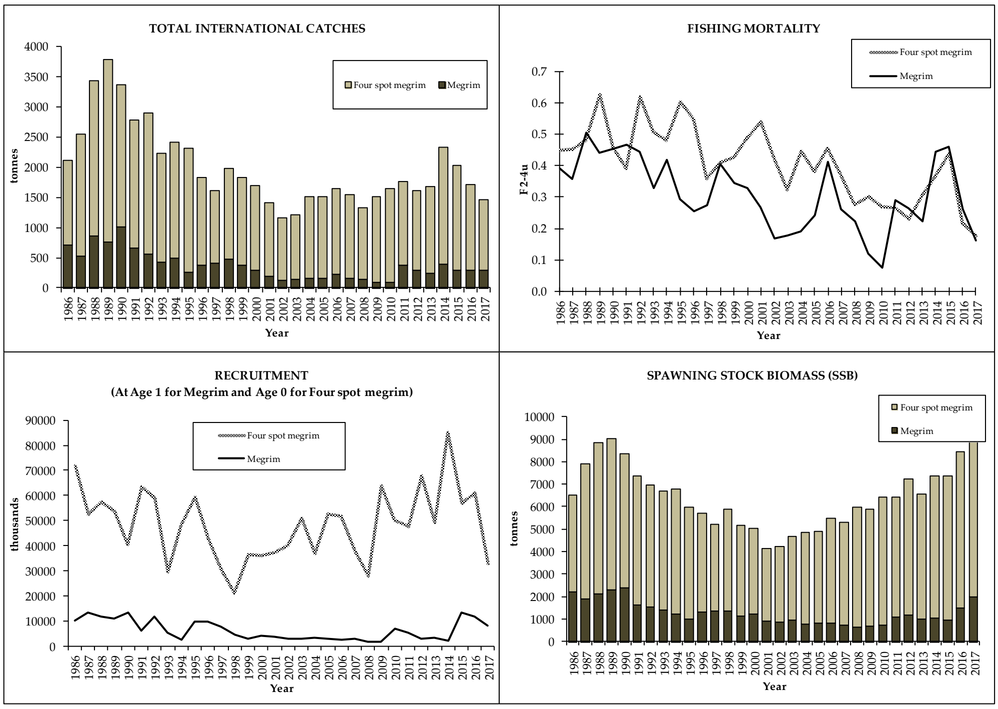
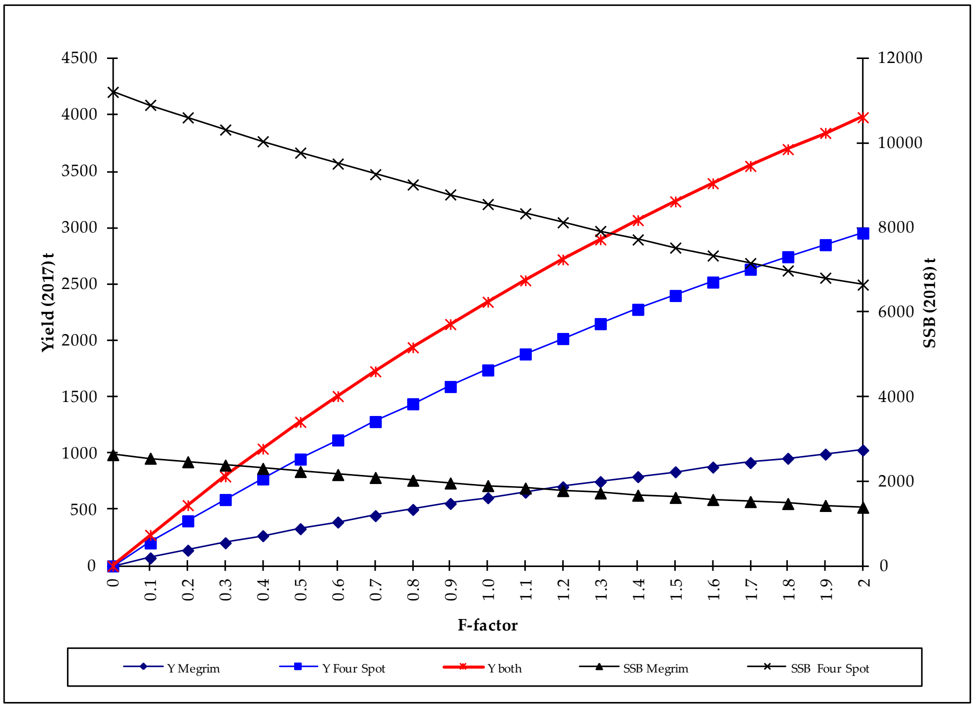


Figure 6.3.1. Stock trends for both stocks. Megrim and Four-spot megrim in Divisions 8c and 9a.



Combined Short-term Forecasts assuming status quo in 2017 and 2018

Figure 6.3.2. Megrims (*L. whiffiagonis and L. boscii*) in Divisions 8c and 9a.

7 Bay of Biscay Sole

Type of assessment in 2017: update.

Data revisions this year: Compared to last year's assessment, there is only very limited change in the data due to small revisions of 2016 landings, 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 2018 and management applicable to 2017 and 2018

ICES advice for 2017

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 2018: ICES advises that when the MSY approach is applied, catches in 2018 should be no more than 3725 tones. A discard rate estimate is now used since last year's assessment to estimate the total catches (1.64% in 2015, 4% in 2016 and 1.7% in 2017).

Management applicable to 2016 and 2017

The sole landings in the Bay of Biscay are subject to a TAC regulation. The 2017 TAC was set at 3420 t and the 2018 TAC was set at 3621 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 2016 landings estimate was revised to 3232 t, this is equal to 1 % decrease.

In 2002, landings increased to 5486 t due to very favourable weather conditions for the fixed nets' fishery (frequent strong swell periods in the first quarter). In the absence of such apparently rare conditions, the landings in 2003–2008 ranged between 4000 t and 4800 t before falling to 3650 t in 2009 and increasing to 4632 t in 2011 (Table 7.1a). Since last year, the landings are at same level between 3230 and 3250 t.

The 2017 landings (3249 t) is 5 % below the landings constraint at the 2017 TAC (3420 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 % (1.7 %) for 2017 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 2016 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 2017 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 2017 is shown by country in Table 7.2.

At the end of 2016, the French onshore sampling program was discontinued, due to a planned shift in its implementation, and a move towards a subcontracted program as is the French at-sea sampling. The fisheries institute Ifremer and the French authority prepared the move well in advance, but a final delay in the call for tenders disrupted the onshore sampling for 6 months.

In order to mitigate the consequences of the disruption for assessment working group, two processes were initiated (WD12). At first, an urgent resumption of the onshore program by Ifremer staff was planned for the second quarter with a minimal sampling allocation and designed to collect information for those stocks most reliant on the onshore sampling. The second phase of the mitigation was a study to investigate the potential use of the size grading of the fish in the French auctions.

WGBIE were made aware of this issue, because of the lack of market sampling for length (biological and onboard sampling was unaffected), efforts were made to try and fill the deficiency in the number of samples by use of simulation techniques. Both simulated data and actual data were uploaded to InterCatch combined making it impossible to distinguish true samples from simulated ones. Due to the timing in notifying the working group it was not possible to assess the impact of such simulated data on the assessment and the group recommended that sensitivities with and without the simulated data are carried out. The simulation was based on commercial landings market categories.

For the sole in 8ab, the samplings simulated represents 69 % of the number of fishes measured (13% of sampling) and for the assessment, it is 33 % of the fish number, which are simulated (7 % of the number of samples).

Although age reading from otoliths now uses the same method as in France and Belgium (see Stock Annex), the discrepancy between French and Belgian mean weight at age, noticed by preceding WGs, are still present. Work was carried out at the beginning of 2012 (PGCCDBS, 2012) to compare the age reading methods. The conclusion is that there was no bias between readers from the three countries using otoliths prepared with the staining technique. All readers produced the same age estimates (i.e. no bias) of otoliths with or without staining.

However, a likely effect of the weight-at-age samples process may also be presumed (weight-length relationship used in France and straight estimate in Belgium) and should be investigated. International age compositions are estimated using the same procedure as in previous years, as described in the 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, 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 which 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 the 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 and by using the knowledge of the fishery this threshold was set to avoid the effect of changing target species, which may also affect the trend in LPUE. Indeed, the choice of target species may affect effort repartition between sole major habitat and peripheral areas where sole abundance is lower. Because 10% is a minimum for sole percentage in catch when carrying out mixed species trawling on sole grounds, according to 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. These data are not well exported in the official database, and the majority of the fishing effort is equal to 1. Therefore, the commercial LPUE could not be calculated for this fleet.

However, LPUE for the FR-BB-IN-Q4 fleet is provided using paper logbooks which are still used by this fleet. Its LPUE are varying and the trend shows a decrease since 2014 (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 2016 but remains at a high level.

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

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 1984–2017.

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	2000–2017	1–8	<1 %
Offshore otter trawlers	FR-BB-OFF-Q2	2000–2012	1–8	<1 %
Beam trawler survey	FR-ORHAGO	2007–2017	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. As last 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, 75 % for age 3, and 72 % for age 4 for example.

			2017 XSA		2018 XSA
Catch data range			84–16		84–17
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	00–16	3–7	00–17	3–7
	FR-BB-OFF-Q2	00–12	2–6	00–12	2–6
	FR-ORHAGO	07–16	2–8	07–17	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 2016 data.

The table 7.8 gives the results of the Mohn's rho calculation that is the results from the most recent assessments and five retrospective assessments with terminal years (2012-2017). Mohn's Rho value is 0.056 for the recruits, 0.035 for SSB and 0.021 for F.

Because of the lack of the FR-BB-OFF-Q2 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 2016.

At age 3, the only one commercial fleet which estimated survivors to have a significant weight is the FR-BB-INQ4 (around 24 %) and it increases by 58 % at age 7. The FR-BB-OFF-Q2 has no weight in the evaluation, is around 0.5% for age 7. The two discontinued commercial fleets FR-SABLES and FR-ROCHELLE have no more weight at all ages. At age 6, the fleets FR-BB-IN-Q4 and FR-ORHAGO have more or less the same estimated survivors around, respectively, 52 % and 47 %.

Fishing mortalities and stock numbers-at-age are given in Tables 7.9 and 7.10 respectively. The results are summarised in Table 7.11. Trends in yield, F, SSB and recruitments are plotted in Figure 7.7. Fishing mortality in 2017 is estimated by XSA to have been at 0.3. Fishing mortality was 0.47 in 2015, and 0.41 in 2016.

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 (2016 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
2014	18 928	XSA	75 %	24 %	1.4 %
2015	16 402	XSA	96 %	0 %	4.3 %
2016 & subsequent	20 976	GM(93-15)			

Historic trends in biomass, fishing mortality and recruitment

A full summary of the time-series of XSA results are given in Table 7.11 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 decrease the two last years of the series.

The SSB trend in earlier years increases from 12 300 t in 1984 to 16 300 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 11 000 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 2017 SSB is estimated to 12801 t, higher (3.6 %) than the estimated value from WGBIE 2017 (12 360 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_{93-15} (21 million). However, the 2012 and 2013 values are the lowest of the series (around 13 million). After these two low values, an increase is shown year after year.

7.3.3 Catch options and prognosis

Although the increase on the two last years 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 2015–2017 for age 2 and above (corresponding to unscaled F).

In 2016 the forecast for 2016 was 14% higher than the observed data for the estimated landings. For 2015 this was 8%. The forecast for 2017 was 17% percent higher than the TAC. The ADG concluded last year that using a TAC constraint may be more appropriate given the above and given that this fishery is a directed fishery. This is also more in line with what is done for other sole stocks. So, the forecast are done with a TAC constraint at 3621 t equal to the 2018 TAC.

The recruits at age 2 from 2018 to 2020 are assumed equal to $GM_{93\text{-}15}$. Stock numbers at age 3 and above are the XSA survivor estimates.

Weights at age in the landings are the 2015–2017 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 2015–2017 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.

7.3.3.1 Short-term predictions

Input values for the catch forecast are given in Table 7.12.

The landings forecasts (Table 7.13) is 3621 t in 2018 (equal to 2018 TAC), higher than the 2017 landings (3232 t). The F corresponding to assumption about catch for this run is 0.33 (equal to F_{MSY}).

Assuming recruitment at $GM_{93\text{–}15}$, the SSB is predicted to increase to 13182 t in 2018 and increase to 14310 t in 2019. It will continue to grow at F_{MSY}, to reach 15356 t in 2020 (Tables 7.13 and 7.14).

The proportional contributions of recent year classes to the landings in 2018 and to the SSB in 2019 are given in Table 7.15. Year classes for which $GM_{93\text{–}15}$ recruitment has been assumed (2016 to 2018) contribute 34.8 % of the 2019 landings and 59.2 % of the 2020 SSB.

7.3.3.2 Yield and Biomass Per Recruit

Results for yield and SSB per recruit, are given in Table 7.16 a & b, and in Figure 7.8. The F corresponding to assumption about catch (0.33) is 8 % above F_{max} (0.3) and largely higher than $F_{0.1}$ (0.11). Long-term equilibrium landings and SSB (at F_{MSY} and assuming GM recruitment) are estimated to be 4866 t and 17781 t respectively (Table 7.16a & 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 $B_{trigger}$
	Blim	7600 t	$B_{lim} = B_{pa} / \exp(\sigma \times 1.645)$
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	$F_{pa} = F_{lim} \times \exp(-\sigma \times 1.645)$

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

7.3.5 Comments on the assessment

Sampling

The sampling level (table 1.3, section 1) for this stock is considered to be satisfactory.

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

Stopping the use of fleets of La Rochelle and Les Sables tuning series led to a paucity of information at age 2 in 2013, which were only provided by the Offshore Q2 tuning fleet (when the data were available). That is no more the case with incorporation of the ORHAGO survey in the assessment.

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

The simulations for data sampling for the quarter 1 and 2 were made by commercial category, and the decomposition of landings 2017 by commercial category is the one observed (and not an average).

This year we can presume that there is more uncertainty than usual given this 'reconstruction' of the data.

Discarding

Available data on discards have shown that discards may be important at age 1 for some trawlers. Discard at age 2 were assumed to be low in the past because the high commercial value of the sole catches but there are some reports of highgrading practices due to the landing limits adopted by some producers' 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 (2018–2020) recruitment; this GM estimate has a low contribution in predicted landings and SSB because the recruits in terminal year is 16402 million and the $GM_{93\text{–}15}$ is 20976 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 2016 (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 are 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 2017 and in 2018. The SSB, the F and recruits at age 2 have been very little 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 highgrading practices due to the landing limits adopted by some producers' organisations.

Industry input

The traditional meeting with representatives of the fishing industry was not organized in France prior to the WG to present the data used by the 2018 WGBIE to assess the state of the Bay of Biscay sole stock.

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 gillnetters 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 9593 t in 2003, since a peak in 1993 (16 324 t), and has increased to 14665 t in 2011. After another decrease between 2011 to 2015, the SSB is now increasing in last year. It is estimated to be 13 182 t (above B_{pa} = 10 600 t) in 2018 assuming $GM_{93\text{–}15}$ recruitment value for 2018, and an increase is predicted by the short-term prediction, and SSB is assumed to increase in 2019 and 2020.

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	62^	3706
2016	288	3054		4		3346	3232	134^	3366
2017	274	2953		8		3236	3249**	55^	3304

[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

^ Calculated from the landings estimate and an estimated discard rate

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	2017
Shrimp trawlers	0	0	0	0	0	0	0	0	
Inshore trawlers	6	8	7	8	7	8	7	8	8
Offshore otter trawlers	21	19	17	17	18	18	15	15	16
Offshore beam trawlers	10	11	8	9	7	8	8	9	8
Fixed nets	63	61	67	66	68	65	70	68	68

Table 7.2 : Bay of Biscay Sole - 2017

French and Belgian relative length distribution of landings

Length(cm)	France	Belgium
21	0.15	
22	0.23	
23	0.50	0.10
24	2.56	1.76
25	4.92	6.76
26	6.98	11.41
27	7.72	13.25
28	9.66	15.48
29	10.80	13.53
30	10.11	11.07
31	10.73	7.57
32	9.11	6.32
33	6.09	3.58
34	4.44	3.18
35	3.02	1.86
36	2.66	1.18
37	2.17	0.99
38	1.53	0.71
39	1.18	0.49
40	1.24	0.31
41	0.99	0.16
42	0.72	0.15
43	0.58	0.05
44	0.52	0.06
45	0.25	0.01
46	0.25	
47	0.14	
48	0.15	
49	0.29	
50	0.07	
51	0.02	
52	0.03	
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	1995
Age												
2	5901	8493	6126	3794	4962	4918	7122	4562	4640	1897	2603	3249
3	3164	4606	4208	5634	5928	6551	6312	6302	7279	7816	5502	5663
4	2786	2479	2673	3578	4191	3802	4423	4512	4920	6879	8803	6356
5	2034	1962	2301	2005	2293	3147	2833	2083	2991	3661	5040	3644
6	1164	906	1512	1482	1388	2046	972	1113	2236	1625	1968	1795
7	880	708	1044	690	874	967	1018	1063	1124	566	970	843
+gp	1181	729	1235	714	766	499	870	981	951	708	696	986
TOTALNUM	17110	19883	19099	17897	20402	21930	23550	20616	24141	23152	25582	22536
TONSLAND	4038	4251	4805	5086	5382	5845	5916	5569	6550	6420	7229	6205
SOPCOF %	107	103	102	102	101	101	100	102	100	100	100	100

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
2	3027	3801	4096	2851	5677	3180	5198	4274	3411	3976	3535	3885
3	5180	9079	5550	5113	7015	6528	4777	6309	5415	3464	4436	5181
4	5409	5380	6351	4870	5143	4948	4932	2236	3291	3738	2747	2615
5	2343	3063	2306	2764	2542	1776	3095	1220	917	2309	2012	1419
6	1697	1578	1237	1314	955	899	1269	729	661	991	1030	1262
7	1366	692	785	902	421	513	615	377	272	461	530	686
+gp	1319	877	1188	977	444	486	432	250	333	508	1537	946
TOTALNUM	20341	24470	21513	18791	22197	18330	20318	15395	14300	15447	15827	15994
TONSLAND	5854	6259	6027	5249	5760	4836	5486	4108	4002	4539	4793	4363
SOPCOF %	100	100	101	100	101	101	101	101	101	102	101	100

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	3173	2860	2084	1516	1302	2312	3767	2531	1144	1533
3	4794	3986	7707	5222	4680	2939	3198	3365	3368	4389
4	2886	2233	3758	8347	4264	3777	1769	1742	2682	2702
5	1353	1501	1272	1019	3787	3205	2426	2057	1193	908
6	938	946	484	570	1008	1450	1810	1305	762	383
7	892	541	269	275	225	286	791	939	759	278
+gp	1193	960	284	516	517	635	522	636	867	498
TOTALNUM	15229	13027	15858	17465	15783	14604	14283	12575	10775	10691
TONSLAND	4299	3650	3966	4632	4321	4235	3928	3644	3232	3249
SOPCOF %	100	102	100	100	100	101	101	101	100	100

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	1995
Age												
2	0.121	0.106	0.102	0.141	0.134	0.136	0.131	0.143	0.146	0.145	0.147	0.16
3	0.168	0.174	0.173	0.201	0.19	0.188	0.179	0.192	0.196	0.197	0.195	0.206
4	0.213	0.252	0.245	0.285	0.272	0.258	0.241	0.26	0.262	0.267	0.251	0.252
5	0.269	0.313	0.328	0.376	0.357	0.354	0.348	0.325	0.341	0.341	0.324	0.308
6	0.329	0.39	0.409	0.467	0.495	0.437	0.436	0.437	0.404	0.439	0.421	0.403
7	0.368	0.457	0.498	0.497	0.503	0.543	0.601	0.535	0.49	0.569	0.569	0.484
+gp	0.573	0.698	0.657	0.682	0.604	0.799	0.854	0.715	0.715	0.677	0.774	0.658
SOPCOFAC	1.0712	1.0302	1.0197	1.0248	1.008	1.0055	1.0039	1.0183	1.0004	1.0008	1.0016	1.0023

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*
Age												
2	0.159	0.142	0.161	0.177	0.171	0.152	0.171	0.18	0.19	0.189	0.195	0.176
3	0.204	0.193	0.212	0.219	0.207	0.22	0.208	0.226	0.227	0.226	0.242	0.225
4	0.268	0.256	0.257	0.246	0.276	0.265	0.263	0.307	0.29	0.298	0.282	0.298
5	0.319	0.319	0.335	0.305	0.343	0.341	0.32	0.361	0.391	0.367	0.347	0.326
6	0.399	0.406	0.41	0.404	0.452	0.428	0.466	0.487	0.493	0.43	0.42	0.388
7	0.453	0.502	0.501	0.533	0.573	0.519	0.592	0.657	0.643	0.468	0.455	0.419
+gp	0.625	0.678	0.7	0.582	0.755	0.619	0.681	0.642	0.81	0.656	0.533	0.511
SOPCOFAC	0.9998	1.0048	1.0091	1.0006	1.0066	1.01	1.0122	1.0056	1.0104	1.0153	1.0136	1.0026

Year	2008*	2009*	2010*	2011*	2012*	2013*	2014*	2015*	2016*	2017*
Age										
2	0.174	0.17	0.179	0.193	0.182	0.208	0.177	0.197	0.188	0.201
3	0.229	0.215	0.206	0.223	0.224	0.24	0.241	0.225	0.237	0.246
4	0.287	0.275	0.272	0.253	0.257	0.272	0.281	0.316	0.285	0.313
5	0.352	0.317	0.337	0.342	0.307	0.304	0.296	0.312	0.351	0.404
6	0.392	0.361	0.414	0.432	0.369	0.368	0.348	0.387	0.371	0.504
7	0.401	0.447	0.477	0.489	0.414	0.518	0.394	0.365	0.381	0.542
+gp	0.519	0.601	0.768	0.606	0.585	0.521	0.576	0.517	0.525	0.588
SOPCOFAC	1	1.0158	1.0019	1.0046	1.0023	1.0082	1.0085	1.0054	1.0027	1.0037

(*) 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 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	5.8	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	5.5	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	3.9	na	6.5	na	na
2014	5.3	na	7.7	na	na
2015	4.2	na	7.4	na	na
2016	3.8	na	8.0	na	na
2017	3.7	na	8.1	na	na

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

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

Year	Landing (t)	Effort (1000 h)	LPUE (kg/h)
1976	26.3	1.7	15.5
1977	64.4	3.4	18.7
1978	29.8	1.7	17.7
1979			
1980	33.1	1.9	17.9
1981	4.1	0.3	16.4
1982	20.5	1.1	18.6
1983	10.2	0.6	17.3
1984			
1985	26.7	1.6	17.2
1986	52.0	2.8	18.4
1987	124.0	7.7	16.1
1988	134.7	5.6	24.1
1989	311.0	16.7	18.6
1990	309.4	9.0	34.3
1991	400.5	9.8	41.0
1992	452.9	14.8	30.6
1993	399.7	10.7	37.5
1994	467.6	13.5	34.6
1995	446.7	13.5	33.0
1996	459.8	13.6	33.9
1997	435.4	16.2	26.9
1998	463.1	17.8	26.1
1999	498.7	20.8	24.0
2000	459.2	19.2	23.9
2001	368.2	17.5	21.1
2002	310.6	16.5	18.8
2003	295.8	12.5	23.6
2004	318.7	12.2	26.2
2005	365.1	15.0	24.3
2006	392.9	16.7	23.5
2007	404.2	16.3	24.8
2008	305.1	12.9	23.6
2009	363.3	16.2	22.5
2010	451.3	13.1	34.3
2011	386.4	12.7	30.4
2012	385.2	9.7	39.5
2013	311.9	11.8	26.3
2014	307.4	11.1	27.8
2015	302.0	8.2	36.8
2016	287.7	9.0	32.0
2017	274.4	8.3	30.3

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	1445	4.19	21.64	**11.55**	**3.44**	**1.03**	**0.35**	**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	3105	4.38	25.12	**24.68**	**9.01**	**3.58**	**3.05**	**0.57**	**1.42**
2005	5055	9.97	47.62	**16.43**	**13.19**	**5.35**	**2.13**	**1.12**	**2.73**
2006	7286	24.13	85.97	**27.98**	**6.95**	**4.78**	**4.03**	**2.70**	**6.27**
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	4603	1.60	23.45	**36.00**	**10.16**	**3.24**	**1.01**	**0.48**	**1.14**
2011	5148	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	3285	3.50	12.34	**8.58**	**8.16**	**3.34**	**2.96**	**1.08**	**2.04**
2014	5017	17.29	98.37	**17.04**	**5.18**	**3.91**	**2.88**	**0.90**	**1.14**
2015	2531	6.07	32.52	**7.42**	**2.49**	**2.05**	**1.27**	**0.87**	**0.48**
2016	2798	2.32	16.95	**10.96**	**2.95**	**2.06**	**1.32**	**0.58**	**2.39**
2017	3781	3.38	23.86	**18.97**	**6.38**	**1.79**	**1.86**	**1.22**	**1.65**

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**
2017	100	126	**163.4**	**96.6**	**36.7**	**14.4**	**12.6**	**7.2**	**10.2**

Table 7.7: XSA tuning diagnostic

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

SOLE VIIIa,b

CPUE data from file tunfilt.dat

Catch data for 34 years. 1984 to 2017. Ages 2 to 8.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
FR-SABLES ,	1991,	2017,	2,	7,	.000,	1.000
FR-ROCHELLE ,	1991,	2017,	2,	7,	.000,	1.000
FR-BB-IN-Q4 ,	2000,	2017,	3,	7,	.750,	1.000
FR-BB-OFF-Q2 ,	2000,	2017,	2,	6,	.250,	.500
FR-ORHAGO ,	2007,	2017,	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 67 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,	2008,	2009,	2010,	2011,	2012,	2013,	2014,	2015,	2016,	2017
2,	.200,	.093,	.094,	.081,	.107,	.200,	.285,	.153,	.066,	.103
3,	.529,	.367,	.343,	.320,	.340,	.333,	.415,	.393,	.279,	.339
4,	.555,	.444,	.620,	.674,	.416,	.449,	.305,	.370,	.552,	.336
5,	.431,	.557,	.434,	.297,	.659,	.560,	.514,	.612,	.414,	.323
6,	.476,	.539,	.308,	.314,	.476,	.502,	.632,	.510,	.424,	.201
7,	.498,	.491,	.254,	.257,	.175,	.212,	.499,	.705,	.558,	.239

XSA population numbers (Thousands)

	AGE					
YEAR ,	2,	3,	4,	5,	6,	7,
2008 ,	1.84E+04,	1.23E+04,	7.12E+03,	4.06E+03,	2.61E+03,	2.39E+03,
2009 ,	3.38E+04,	1.36E+04,	6.54E+03,	3.70E+03,	2.39E+03,	1.47E+03,
2010 ,	2.43E+04,	2.79E+04,	8.55E+03,	3.80E+03,	1.92E+03,	1.26E+03,
2011 ,	2.04E+04,	2.00E+04,	1.79E+04,	4.17E+03,	2.22E+03,	1.27E+03,
2012 ,	1.34E+04,	1.71E+04,	1.32E+04,	8.25E+03,	2.80E+03,	1.47E+03,
2013 ,	1.34E+04,	1.09E+04,	1.10E+04,	7.86E+03,	3.86E+03,	1.57E+03,
2014 ,	1.60E+04,	9.91E+03,	7.08E+03,	6.35E+03,	4.06E+03,	2.12E+03,
2015 ,	1.87E+04,	1.09E+04,	5.92E+03,	4.73E+03,	3.43E+03,	1.95E+03,
2016 ,	1.89E+04,	1.45E+04,	6.64E+03,	3.70E+03,	2.32E+03,	1.87E+03,
2017 ,	1.64E+04,	1.60E+04,	9.95E+03,	3.46E+03,	2.21E+03,	1.37E+03,

Table 7.7: Cont'd

Estimated population abundance at 1st Jan 2018

, 0.00E+00, 1.34E+04, 1.03E+04, 6.43E+03, 2.27E+03, 1.64E+03,

Taper weighted geometric mean of the VPA populations:

, 2.27E+04, 1.71E+04, 1.05E+04, 5.72E+03, 3.13E+03, 1.72E+03,

Standard error of the weighted Log(VPA populations) :

, .2608, .2696, .2968, .2968, .2966, .3756,

Log catchability residuals.

Fleet : FR-SABLES

Age	1991	1992	1993	1994	1995	1996	1997
2	-.23	-.14	-.38	-.41	-.08	-.21	-.12
3	.10	-.19	.16	-.11	-.18	-.03	.20
4	.13	-.28	-.09	.36	.14	.01	.01
5	.07	-.17	-.12	.22	-.01	-.13	-.25
6	-.20	.16	-.40	.02	-.25	.24	-.03
7	-.06	-.15	-.26	.19	.07	.49	.00

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
2	-.04	-.18	.19	-.17	.22	-.13	.30	.48	.81	.26
3	-.01	-.42	.39	.07	.25	.01	-.30	-.18	-.01	-.03
4	.44	-.23	.13	-.06	.13	-.30	-.19	-.15	-.47	.06
5	.15	.27	-.09	-.28	.34	-.18	-.50	.23	-.74	.34
6	-.40	.43	-.03	-.23	.35	.04	-.34	.16	-.54	.27
7	.11	.54	.10	-.20	.08	.08	-.12	.06	-.15	.66

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	.15	-.31	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	.15	.14	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	.33	.04	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	.32	.52	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	.33	.42	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	.37	.33	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

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

Age	2	3	4	5	6	7
Mean Log q	-15.0681	-14.5142	-14.4694	-14.6506	-14.6439	-14.6439
S.E(Log q)	.3149	.1997	.2380	.3205	.3029	.2858

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	5.43	-3.250	37.23	.03	19	1.38	-15.07
3	1.03	-.137	14.64	.63	19	.21	-14.51
4	.86	.911	13.73	.71	19	.21	-14.47
5	1.18	-.575	15.75	.37	19	.39	-14.65
6	1.43	-1.093	17.50	.28	19	.43	-14.64
7	.73	2.224	12.60	.80	19	.17	-14.53

Fleet : FR-ROCHELLE

Age	1991	1992	1993	1994	1995	1996	1997
2	-.09	-.18	-.46	-.40	-.04	.33	-.06
3	.19	-.04	-.01	-.22	-.11	.05	.11
4	.44	.12	-.22	.29	.30	-.15	-.08
5	.45	.17	-.09	.19	.21	-.36	-.36
6	.11	.33	-.26	.11	-.36	-.11	-.01
7	.01	.08	-.03	.00	-.05	-.09	-.10

Table 7.7: Cont'd

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
2	.19	-.03	.19	-.23	.70	.16	.37	.12	-.01	.06
3	-.10	-.49	-.27	-.08	.18	.23	-.09	-.38	-.25	.58
4	.47	-.25	-.12	.14	-.33	-.07	-.23	-.21	-.29	-.18
5	.01	.18	-.17	-.06	-.07	-.07	-.48	.32	-.29	-.27
6	-.54	.52	-.29	.09	-.01	.11	-.21	.40	-.05	-.24
7	.03	.23	-.20	.14	-.09	-.22	-.02	.19	-.01	-.19

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	.21	-.83	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	.58	.15	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	.36	.01	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	.27	.41	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	.14	.28	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	.24	.19	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99

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

Age	2	3	4	5	6	7
Mean Log q	-15.0024	-14.5556	-14.7724	-15.1247	-15.1812	-15.1812
S.E(Log q)	.3372	.2827	.2616	.2764	.2754	.1425

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	1.97	-1.533	19.78	.13	19	.64	-15.00
3	1.25	-.782	15.73	.37	19	.36	-14.56
4	.83	1.044	13.83	.69	19	.22	-14.77
5	.93	.323	14.67	.56	19	.26	-15.12
6	1.61	-1.568	19.55	.28	19	.43	-15.18
7	.84	2.028	13.95	.91	19	.11	-15.18

Fleet : FR-BB-IN-Q4

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
2	No data for this fleet at this age									
3	99.99	99.99	.32	-.32	.32	.74	.30	-.22	.00	.03
4	99.99	99.99	.45	-.47	-.64	.18	.38	.16	-.46	.24
5	99.99	99.99	.08	-.35	-.13	-.73	.50	.21	-.52	.23
6	99.99	99.99	-.48	-.02	.58	-.35	.84	-.02	.02	.03
7	99.99	99.99	-.22	-.14	.56	.28	.21	-.13	.47	-.56

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	No data for this fleet at this age									
3	.18	-.10	-.18	-.44	.19	-.35	.08	-.18	-.28	-.08
4	.57	-.34	.41	-.08	.55	.13	-.44	-.25	-.13	-.26
5	.17	-.08	.13	-.08	.80	-.12	-.22	.20	.18	-.27
6	-.03	.07	-.57	-.24	-.01	.31	-.08	-.15	.11	.00
7	-.22	-.36	-.94	-.55	-.05	-.05	-.70	.21	-.38	.09

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	-14.5148	-14.9520	-15.1612	-15.0568	-15.0568
S.E(Log q)	.3026	.3890	.3596	.3360	.4277

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	.93	.253	14.18	.47	18	.29	-14.51
4	.81	.689	13.86	.46	18	.32	-14.95
5	.81	.720	13.88	.47	18	.30	-15.16
6	.84	.595	13.88	.45	18	.29	-15.06
7	2.02	-1.622	23.31	.14	18	.78	-15.19

Table 7.7: Cont'd

Fleet : FR-BB-OFF-Q2

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
2	99.99	99.99	.42	.46	.89	.93	.44	.38	-.26	.56
3	99.99	99.99	-.43	-.14	.21	.16	.19	-.18	-.19	.77
4	99.99	99.99	.35	.23	.14	-.02	-.07	-.02	-.65	-.38
5	99.99	99.99	.73	.46	.80	-.19	-.92	.26	-.56	-.98
6	99.99	99.99	.71	1.15	1.38	.40	-.50	-.74	.32	.00
7	No data for this fleet at this age									

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	.93	-1.69	-1.42	-1.95	.31	99.99	99.99	99.99	99.99	99.99
3	.40	-.10	.00	-.70	.00	99.99	99.99	99.99	99.99	99.99
4	.03	-.20	.29	.44	-.16	99.99	99.99	99.99	99.99	99.99
5	.00	-.14	.34	-.33	.52	99.99	99.99	99.99	99.99	99.99
6	-.77	-.37	-1.39	.15	-.34	99.99	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	-15.9001	-14.5012	-14.7320	-15.3429	-15.8718
S.E(Log q)	1.0168	.3690	.3048	.5848	.7949

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	-1.45	-1.449	1.29	.03	13	1.41	-15.90
3	2.17	-1.305	20.14	.10	13	.78	-14.50
4	.65	1.984	12.79	.75	13	.18	-14.73
5	.57	1.136	12.35	.38	13	.33	-15.34
6	1.28	-.197	18.15	.04	13	1.06	-15.87

Fleet : FR-ORHAGO

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.10
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.05
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.11
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.41
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	.35
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-1.21

Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	-.25	.39	-.21	.03	-.38	-.35	.54	.10	.01	.02
3	.16	.27	.00	-.43	.03	-.23	-.05	-.08	.24	.03
4	-.01	-.13	-.21	-.53	.14	.46	-.02	.03	.21	-.06
5	-.80	-.44	-1.11	-1.29	.39	.41	.54	.63	.78	.49
6	-.51	-.64	-3.57	-.88	.21	.98	1.21	1.03	.79	1.03
7	-.22	-1.75	-1.00	-.16	.07	.39	.82	1.03	.57	.98

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	-9.0538	-9.3590	-9.7565	-10.1987	-10.5323	-10.5323
S.E(Log q)	.2892	.2034	.2527	.7577	1.3963	.9364

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	.68	1.425	9.30	.69	11	.19	-9.05
3	1.08	-.346	9.34	.66	11	.23	-9.36
4	1.29	-.973	9.96	.55	11	.33	-9.76
5	.53	1.148	9.39	.40	11	.40	-10.20
6	.23	2.496	8.54	.54	11	.26	-10.53

```
 7,     .43,     .959,      8.76,     .24,     11,     .40,  -10.57,
```

Table 7.7: Cont'd

```
Fleet disaggregated estimates of survivors :

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

Year class = 2015

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,    13677.,
Raw Weights,     9.884,

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           ,     13677.,   .302,       .000,    .00,   1,  .957,     .101

  F shrinkage mean  ,      8261.,   1.50,,,,                        .043,     .163

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
    13383.,       .30,      .10,    2,    .353,   .103

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

Year class = 2014

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,     9552.,         0.,
Raw Weights,     7.369,       .000,


FR-BB-OFF-Q2
        Age,         3,          2,
```

```
  Survivors,       0.,         0.,
 Raw Weights,      .000,       .000,
```

Table 7.7: Cont'd

```
 FR-ORHAGO
        Age,        3,          2,
  Survivors,    10701.,     10421.,
 Raw Weights,    15.780,      7.312,

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          ,       9552.,  .311,       .000,    .00,   1,  .238,     .363
 FR-BB-OFF-Q2         ,          1.,  .000,       .000,    .00,   0,  .000,     .000
 FR-ORHAGO            ,      10612.,  .174,       .012,    .07,   2,  .747,     .332

   F shrinkage mean  ,       9863.,   1.50,,,,                        .014,     .353

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
     10338.,       .15,      .03,    4,    .177,   .339

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

 Year class = 2013

 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,     4976.,      4858.,        0.,
 Raw Weights,     4.472,      5.591,      .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,     6052.,      8216.,      7132.,
 Raw Weights,    10.255,     11.972,      5.082,

 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          ,       4910.,  .248,       .012,    .05,   2,  .266,     .421
 FR-BB-OFF-Q2         ,          1.,  .000,       .000,    .00,   0,  .000,     .000
 FR-ORHAGO            ,       7135.,  .147,       .097,    .66,   3,  .722,     .308

   F shrinkage mean  ,       4929.,   1.50,,,,                        .012,     .420

 Weighted prediction :

 Survivors,        Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      6432.,       .13,      .09,    6,    .723,   .336

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

```
Year class = 2012

FR-SABLES
       Age,        5,          4,          3,          2,
  Survivors,      0.,         0.,         0.,         0.,
Raw Weights,    .000,       .000,       .000,       .000,
```

Table 7.7: Cont'd

```
FR-ROCHELLE
       Age,        5,          4,          3,          2,
  Survivors,      0.,         0.,         0.,         0.,
Raw Weights,    .000,       .000,       .000,       .000,

FR-BB-IN-Q4
       Age,        5,          4,          3,          2,
  Survivors,   1724.,      1982.,      1892.,         0.,
Raw Weights,   5.307,      2.610,      2.911,       .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,   3701.,      2810.,      2102.,      3903.,
Raw Weights,   1.156,      5.984,      6.233,      2.320,

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          ,     1828.,   .221,       .042,    .19,   3,  .402,     .387
FR-BB-OFF-Q2         ,        1.,   .000,       .000,    .00,   0,  .000,     .000
FR-ORHAGO            ,     2682.,   .150,       .133,    .88,   4,  .582,     .279

  F shrinkage mean  ,      1168.,   1.50,,,,                         .016,     .554

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     2268.,       .13,      .10,    8,    .812,   .323

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

Year class = 2011

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,   1639.,      1962.,      1280.,      1773.,         0.,
Raw Weights,   6.867,      3.964,      2.339,      2.554,       .000,

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

FR-ORHAGO
       Age,        6,          5,          4,          3,          2,
  Survivors,   4579.,      3562.,      1681.,      1561.,      1159.,
Raw Weights,    .385,       .864,      5.364,      5.469,      2.215,

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          ,      1674.,   .194,       .077,    .40,   4,  .516,     .197
 FR-BB-OFF-Q2         ,         1.,   .000,       .000,    .00,   0,  .000,     .000
 FR-ORHAGO            ,      1658.,   .150,       .145,    .97,   5,  .469,     .199

   F shrinkage mean  ,       547.,   1.50,,,,                       .015,     .510

 Weighted prediction :

 Survivors,         Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
      1640.,       .12,      .09,   10,    .695,   .201

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

 Year class = 2010

 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,    1070.,      1088.,      1199.,       633.,       688.,         0.,
 Raw Weights,    4.076,      4.325,      2.048,      1.290,      1.529,       .000,

FR-BB-OFF-Q2
         Age,        7,          6,          5,          4,          3,          2,
   Survivors,       0.,         0.,         0.,         0.,         0.,      1339.,
 Raw Weights,     .000,       .000,       .000,       .000,       .000,       .119,

FR-ORHAGO
         Age,        7,          6,          5,          4,          3,          2,
   Survivors,    2606.,      2149.,      1840.,       963.,       775.,       671.,
 Raw Weights,     .823,       .242,       .446,      2.959,      3.274,      1.455,

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          ,       989.,   .192,       .106,    .55,   5,  .576,     .237
 FR-BB-OFF-Q2         ,      1339.,  1.055,       .000,    .00,   1,  .005,     .180
 FR-ORHAGO            ,       970.,   .161,       .181,   1.12,   6,  .399,     .241

   F shrinkage mean  ,       795.,   1.50,,,,                       .019,     .287

 Weighted prediction :

 Survivors,         Int,      Ext,    N,    Var,     F
 at end of year,   s.e,      s.e,     ,   Ratio,
       979.,       .13,      .09,   13,    .669,   .239
```

Table 7.8: Mohn's Rho tables for R, SSB and R

RECRUITS		
Data years	Values used in the calculation	rho
2012/2017	(9765-13434)/13434	-0.273
2013/2017	(10607-13380)/13380	-0.207
2014/2017	(26714-15986)/15986	0.671
2015/2017	(20729-18724)/18724	0.107
2016/2017	(18598-18928)/18928	-0.017
Average rho		**0.056**

SSB		
Data years	Values used in the calculation	rho
2012/2017	(14796-14185)/14185	0.043
2013/2017	(13515-13159)/13159	0.027
2014/2017	(10781-10345)/10345	0.042
2015/2017	(9993-9797)/9797	0.020
2016/2017	(10848-10426)/10426	0.040
Average rho		**0.035**

Fbar		
Data years	Values used in the calculation	rho
2012/2017	(0.4534-0.4727)/0.4727	-0.041
2013/2017	(0.4746-0.4608)/0.4608	0.030
2014/2017	(0.5225-0.4663)/0.4663	0.121
2015/2017	(0.4797-0.4712)/0.4712	0.018
2016/2017	(0.4077-0.4172)/0.4172	-0.023
Average rho		**0.021**

Table 7.9. 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	0.2582	0.1747	0.2172	0.2031	0.2659	0.1443	0.1486	0.0836	0.1104	0.1566
3	0.2432	0.3541	0.2712	0.3558	0.3998	0.4368	0.3849	0.3536	0.3198	0.3543	0.3277	0.3294
4	0.336	0.2724	0.3182	0.3464	0.4328	0.4283	0.5254	0.4634	0.4556	0.5002	0.7534	0.6833
5	0.3481	0.3722	0.3874	0.3719	0.347	0.5968	0.5803	0.4459	0.5653	0.6437	0.7457	0.7222
6	0.3197	0.2294	0.4845	0.4107	0.4225	0.5261	0.3266	0.4178	1.0984	0.6094	0.7694	0.5728
7	0.3355	0.292	0.3979	0.3774	0.402	0.519	0.4791	0.629	0.8649	0.8194	0.8068	0.795
+gp	0.3355	0.292	0.3979	0.3774	0.402	0.519	0.4791	0.629	0.8649	0.8194	0.8068	0.795
0 FBAR 3- 6	0.3117	0.307	0.3653	0.3712	0.4005	0.497	0.4543	0.4202	0.6098	0.5269	0.649	0.5769

YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AGE												
2	0.1147	0.1847	0.2117	0.1312	0.2735	0.2206	0.2488	0.2039	0.2363	0.2614	0.2252	0.2633
3	0.3549	0.5154	0.3967	0.3935	0.4799	0.5104	0.5271	0.4763	0.3808	0.3555	0.4595	0.5261
4	0.5307	0.6714	0.7368	0.6389	0.7677	0.6541	0.8119	0.4447	0.4334	0.4363	0.4686	0.478
5	0.5098	0.5765	0.6038	0.7421	0.7256	0.5812	1.0169	0.4191	0.2928	0.5458	0.3936	0.4174
6	0.7876	0.6832	0.4278	0.7384	0.545	0.5389	0.9738	0.615	0.3735	0.5214	0.443	0.407
7	1.0507	0.7764	0.7741	0.5625	0.4892	0.5625	0.7764	0.7788	0.4313	0.4293	0.5184	0.5281
+gp	1.0507	0.7764	0.7741	0.5625	0.4892	0.5625	0.7764	0.7788	0.4313	0.4293	0.5184	0.5281
0 FBAR 3- 6	0.5458	0.6116	0.5413	0.6282	0.6295	0.5711	0.8324	0.4888	0.3701	0.4647	0.4412	0.4571

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	FBAR **-**
AGE											
2	0.1998	0.0931	0.0943	0.0811	0.1075	0.2005	0.2847	0.1533	0.0656	0.1034	0.1074
3	0.5289	0.3669	0.3434	0.3201	0.3402	0.3327	0.4145	0.3932	0.2792	0.3392	0.3372
4	0.5554	0.4444	0.6195	0.6741	0.4162	0.4486	0.3046	0.3699	0.5522	0.3362	0.4195
5	0.4315	0.5566	0.4343	0.2973	0.6587	0.5601	0.5139	0.6118	0.4137	0.3227	0.4494
6	0.4756	0.5394	0.3085	0.3138	0.4755	0.5017	0.6323	0.5099	0.4237	0.2007	0.3781
7	0.4981	0.4913	0.2545	0.2573	0.1753	0.2119	0.4988	0.7045	0.5577	0.2392	0.5005
+gp	0.4981	0.4913	0.2545	0.2573	0.1753	0.2119	0.4988	0.7045	0.5577	0.2392	
0 FBAR 3- 6	0.4978	0.4768	0.4264	0.4013	0.4727	0.4608	0.4663	0.4712	0.4172	0.2997	

Table 7.10. 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	1996
	AGE													
	2	24149	29509	28304	24889	26723	28126	32072	35694	35316	24872	26182	23561	29372
	3	15405	16238	18622	19783	18911	19460	20772	22246	27958	27541	20701	21214	18228
	4	10264	10929	10311	12847	12541	11473	11377	12791	14134	18373	17486	13497	13809
	5	7274	6637	7531	6787	8221	7361	6765	6087	7282	8109	10081	7448	6167
	6	4472	4647	4139	4625	4234	5258	3667	3426	3526	3744	3855	4328	3273
	7	3246	2939	3343	2307	2776	2511	2811	2393	2041	1064	1842	1616	2208
	+gp	4342	3018	3940	2379	2423	1290	2392	2196	1714	1321	1312	1877	2113
0	TOTAL	69152	73917	76191	73618	75830	75479	79856	84833	91971	85024	81458	73541	75171

	YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	AGE													
	2	23689	22568	24382	24943	16891	24810	24359	17038	18170	18431	17645	18416	33817
	3	23698	17819	16524	19350	17169	12258	17505	17976	12172	12659	13315	12271	13645
	4	11566	12806	10844	10088	10835	9325	6548	9838	11114	7719	7235	7119	6543
	5	7349	5348	5546	5179	4236	5098	3747	3798	5771	6501	4371	4059	3697
	6	3351	3736	2646	2389	2268	2144	1668	2230	2564	3025	3968	2605	2385
	7	1347	1531	2204	1144	1254	1197	733	816	1389	1377	1758	2390	1465
	+gp	1696	2302	2375	1201	1182	835	482	995	1524	3976	2412	3182	2588
0	TOTAL	72697	66111	64521	64294	53835	55668	55042	52690	52704	53688	50704	50042	64141

	YEAR	2010	2011	2012	2013	2014	2015	2016	2017	2018	GMST 84-**	AMST 84-**
	AGE											
	2	24338	20448	13434	13380	15986	18724	18928	16402	(20976)	23013	23757
	3	27879	20040	17060	10917	9907	10881	14535	16039	13383	17182	17816
	4	8555	17895	13166	10984	7082	5922	6645	9948	10338	10648	11094
	5	3796	4166	8252	7857	6346	4726	3702	3461	6432	5890	6112
	6	1917	2225	2800	3864	4060	3435	2319	2215	2268	3197	3327
	7	1259	1274	1471	1575	2117	1952	1867	1374	1640	1730	1855
	+gp	1325	2385	3374	3489	1391	1314	2121	2455	2727		
0	TOTAL	69069	68432	59555	52066	46890	46954	50117	51893	36788		

Table 7.11. Bay of Biscay Sole, Summary (without SOP correction)

	RECRUITS Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR3-6
1984	24149	14807	12314	4038	0.3279	0.3117
1985	29509	16047	13357	4251	0.3183	0.307
1986	28304	17052	14465	4805	0.3322	0.3653
1987	24889	18628	15456	5086	0.3291	0.3712
1988	26723	18476	15328	5382	0.3511	0.4005
1989	28126	17741	14429	5845	0.4051	0.497
1990	32072	18347	14775	5916	0.4004	0.4543
1991	35694	19027	14731	5569	0.3781	0.4202
1992	35316	20472	15924	6550	0.4113	0.6098
1993	24872	19846	16324	6420	0.3933	0.5269
1994	26182	19227	15792	7229	0.4578	0.649
1995	23561	17596	14188	6205	0.4373	0.5769
1996	29372	17684	13765	5854	0.4253	0.5458
1997	23689	16430	13276	6259	0.4715	0.6116
1998	22568	16404	13193	6027	0.4568	0.5413
1999	24382	15920	12290	5249	0.4271	0.6282
2000	24943	15474	11809	5760	0.4878	0.6295
2001	16891	13013	10539	4836	0.4589	0.5711
2002	24810	13153	9761	5486	0.562	0.8324
2003	24359	13307	9593	4108	0.4283	0.4888
2004	17038	14086	11105	4002	0.3604	0.3701
2005	18170	14367	11465	4539	0.3959	0.4647
2006	18431	15106	12076	4793	0.3969	0.4412
2007	17645	13996	11154	4363	0.3911	0.4571
2008	18416	13925	11051	4299	0.389	0.4978
2009	33817	15625	10879	3650	0.3355	0.4768
2010	24338	17072	12820	3966	0.3094	0.4264
2011	20448	18485	14665	4632	0.3158	0.4013
2012	13434	16757	14185	4321	0.3046	0.4727
2013	13380	15738	13159	4235	0.3218	0.4608
2014	15986	12884	10345	3928	0.3797	0.4663
2015	18724	12971	9797	3644	0.372	0.4712
2016	18928	13683	10426	3232	0.31	0.4172
2017	16402	16001	12801	3249	0.2538	0.2997
Arith. Mean	23399	16157	12860	4933	0.3852	0.4842
0 Units	(Thousand	(Tonnes)	(Tonnes)	(Tonnes)		
GM93-2015=	20976					

Table 7.12. Multifleet prediction input data

Sole in Bay of Biscay
Multi fleet input data

MFDP version 1a
Run: TAC_2017_
Time and date: 11:29 04/05/2018
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input Fs are 2015-2017 means at age 2 to 8
Catch and stock wts are 2015-2017 means
Recruits are 1993-2015 GM
unscaled F
Constraint TAC to 2018 TAC (3621)

2018

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	20976	0.1	0.32	0	0	0.208	0.1074	0.195
3	13383	0.1	0.83	0	0	0.251	0.3372	0.236
4	10338	0.1	0.97	0	0	0.323	0.4194	0.305
5	6432	0.1	1	0	0	0.378	0.4494	0.356
6	2268	0.1	1	0	0	0.447	0.3781	0.421
7	1640	0.1	1	0	0	0.456	0.5005	0.429
8	2727	0.1	1	0	0	0.575	0.5005	0.543

2019

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	20976	0.1	0.32	0	0	0.208	0.1074	0.195
3		0.1	0.83	0	0	0.251	0.3372	0.236
4		0.1	0.97	0	0	0.323	0.4194	0.305
5		0.1	1	0	0	0.378	0.4494	0.356
6		0.1	1	0	0	0.447	0.3781	0.421
7		0.1	1	0	0	0.456	0.5005	0.429
8		0.1	1	0	0	0.575	0.5005	0.543

2020

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	20976	0.1	0.32	0	0	0.208	0.1074	0.195
3		0.1	0.83	0	0	0.251	0.3372	0.236
4		0.1	0.97	0	0	0.323	0.4194	0.305
5		0.1	1	0	0	0.378	0.4494	0.356
6		0.1	1	0	0	0.447	0.3781	0.421
7		0.1	1	0	0	0.456	0.5005	0.429
8		0.1	1	0	0	0.575	0.5005	0.543

Input units are thousands and kg - output in tonnes

Table 7.13. Bay of Biscay Sole Multifleet prediction, management option table

MFDP version 1a	**Basis**
Run: TAC_2017_	
Time and date: 11:29 04/05/2018	**F(2018) = mean F(15-17) unscaled (age 2 to above)**
Fbar age range (Total) : 3-6	**R18 = GM (1993 to n-2) = 21 million**
Fbar age range Fleet 1 : 3-6	**TAC constraint to 3621 t (TAC 2018)**

2018

Biomass	SSB	Landings FMult	Landings FBar	Yield
16820	13182	0.8394	0.3324	3621

2019

Biomass	SSB	Landings FMult	Landings FBar	Landing Yield	2020 Biomass	SSB
18104	14310	0.0000	0.0000	0	23750	19822
.	14310	0.1000	0.0396	532	23121	19207
.	14310	0.2000	0.0792	1044	22516	18615
.	14310	0.3000	0.1188	1537	21933	18046
.	14310	0.4000	0.1584	2012	21373	17498
.	14310	0.5000	0.1980	2468	20834	16972
.	14310	0.6000	0.2376	2908	20314	16465
.	14310	0.7000	0.2772	3332	19815	15978
.	14310	0.8000	0.3168	3739	19334	15509
.	14310	0.9000	0.3564	4132	18871	15057
.	14310	1.0000	0.3960	4511	18425	14623
.	14310	1.1000	0.4356	4875	17995	14205
.	14310	1.2000	0.4752	5226	17582	13802
.	14310	1.3000	0.5148	5565	17183	13415
.	14310	1.4000	0.5544	5891	16800	13042
.	14310	1.5000	0.5941	6206	16430	12683
.	14310	1.6000	0.6337	6509	16073	12337
.	14310	1.7000	0.6733	6801	15730	12004
.	14310	1.8000	0.7129	7083	15399	11683
.	14310	1.9000	0.7525	7355	15080	11374
.	14310	2.0000	0.7921	7617	14772	11076

Bpa = 10600 t
Fpa = 0.43

Input units are thousands and kg - output in tonnes

Table 7.14. Bay of Biscay sole - Detailed predictions

MFDP version 1a
Run: TAC_2017_
Time and date: 11:29 04/05/2018
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Year: 2018 F multiplier: 0.8394 Fleet1 HCFba 0.3324

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.0902	1723	336	20976	4363	6712	1396	6712	1396
3	0.283	3147	743	13383	3355	11108	2784	11108	2784
4	0.3521	2928	892	10338	3343	10028	3242	10028	3242
5	0.3772	1929	686	6432	2429	6432	2429	6432	2429
6	0.3174	588	248	2268	1015	2268	1015	2268	1015
7	0.4201	537	231	1640	748	1640	748	1640	748
8	0.4201	893	485	2727	1567	2727	1567	2727	1567
Total		11746	3621	57764	16820	40915	13182	40915	13182

Year: 2019 F multiplier: 1 Fleet1 HCFba 0.396

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1074	2035	398	20976	4363	6712	1396	6712	1396
3	0.3372	4737	1118	17343	4347	14395	3608	14395	3608
4	0.4194	2985	909	9124	2950	8851	2862	8851	2862
5	0.4494	2275	809	6578	2484	6578	2484	6578	2484
6	0.3781	1200	505	3991	1785	3991	1785	3991	1785
7	0.5005	562	241	1494	682	1494	682	1494	682
8	0.5005	977	531	2596	1492	2596	1492	2596	1492
Total		14770	4511	62103	18104	44617	14310	44617	14310

Year: 2020 F multiplier: 1 Fleet1 HCFba 0.396

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1074	2035	398	20976	4363	6712	1396	6712	1396
3	0.3372	4656	1099	17047	4273	14149	3547	14149	3547
4	0.4194	3664	1116	11201	3622	10865	3513	10865	3513
5	0.4494	1877	667	5428	2050	5428	2050	5428	2050
6	0.3781	1141	480	3798	1699	3798	1699	3798	1699
7	0.5005	931	400	2474	1129	2474	1129	2474	1129
8	0.5005	844	459	2244	1289	2244	1289	2244	1289
Total		15149	4619	63167	18425	45669	14623	45669	14623

Input units are thousands and kg - output in tonnes

Table 7.15. 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	2018
Stock No. (thousands) of 2 year-olds	18724	18928	16402	20976	20976	20976
Source	XSA	XSA	XSA	GM93-2015	GM93-2015	GM93-2015
Status Quo F:						
% in 2018 landings	18.9	24.6	20.6	9.5	-	-
% in 2019	10.9	17.6	20.0	25.6	9.3	-
% in 2018 SSB	18.4	24.6	21.1	10.6	-	-
% in 2019 SSB	12.2	17.0	19.9	26.0	10.2	-
% in 2020 SSB	7.4	11.2	13.7	24.4	25.0	9.8

GM : geometric mean recruitment

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

a) 2019 landings **b) 2020 SSB**

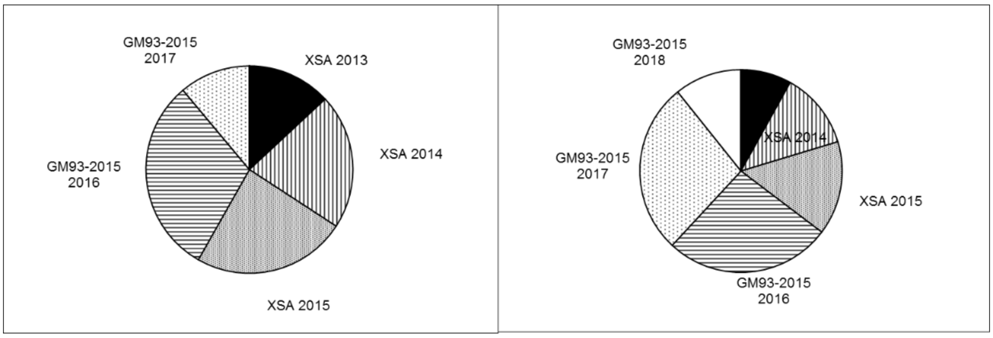


Table 7.16a. Bay of Biscay Sole Multifleet Yield-per-recruit

MFYPR version 2a
Run: 2017_TAC_unsc_
Time and date: 14:21 07/05/2018
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	4.8701	9.6499	4.6822	9.6499	4.6822
0.1000	0.0396	0.2891	0.1269	7.6213	3.2569	6.7656	3.0697	6.7656	3.0697
0.2000	0.0792	0.4357	0.1807	6.1580	2.4573	5.3050	2.2709	5.3050	2.2709
0.3000	0.1188	0.5252	0.2068	5.2662	1.9823	4.4158	1.7966	4.4158	1.7966
0.4000	0.1584	0.5859	0.2203	4.6618	1.6690	3.8139	1.4839	3.8139	1.4839
0.5000	0.1980	0.6301	0.2273	4.2226	1.4475	3.3772	1.2632	3.3772	1.2632
0.6000	0.2376	0.6639	0.2307	3.8877	1.2833	3.0447	1.0996	3.0447	1.0996
0.7000	0.2772	0.6907	0.2320	3.6228	1.1569	2.7822	0.9739	2.7822	0.9739
0.8000	0.3168	0.7125	0.2322	3.4076	1.0568	2.5692	0.8745	2.5692	0.8745
0.9000	0.3564	0.7306	0.2316	3.2287	0.9758	2.3926	0.7941	2.3926	0.7941
1.0000	0.3960	0.7460	0.2306	3.0775	0.9090	2.2436	0.7278	2.2436	0.7278
1.1000	0.4356	0.7592	0.2295	2.9477	0.8529	2.1160	0.6724	2.1160	0.6724
1.2000	0.4752	0.7707	0.2282	2.8350	0.8053	2.0054	0.6253	2.0054	0.6253
1.3000	0.5148	0.7808	0.2268	2.7361	0.7644	1.9085	0.5850	1.9085	0.5850
1.4000	0.5544	0.7898	0.2255	2.6485	0.7288	1.8230	0.5500	1.8230	0.5500
1.5000	0.5941	0.7978	0.2242	2.5703	0.6977	1.7467	0.5194	1.7467	0.5194
1.6000	0.6337	0.8051	0.2229	2.5000	0.6702	1.6784	0.4924	1.6784	0.4924
1.7000	0.6733	0.8116	0.2217	2.4364	0.6458	1.6167	0.4685	1.6167	0.4685
1.8000	0.7129	0.8176	0.2205	2.3786	0.6239	1.5608	0.4471	1.5608	0.4471
1.9000	0.7525	0.8231	0.2194	2.3257	0.6042	1.5098	0.4279	1.5098	0.4279
2.0000	0.7921	0.8281	0.2183	2.2772	0.5864	1.4631	0.4106	1.4631	0.4106

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.3960
FMax	0.7645	0.3028
F0.1	0.2857	0.1131
F35%SPR	0.3458	0.1369

Weights in kilograms

Table 7.16b. Bay of Biscay Sole Multifleet Yield-per-recruit (Long-term equilibrium)

Long-term equilibrium at F =0.33 (constraint TAC)

landings	SSB
Yield * GM	SSBSpwn * GM
4866	17781

GM (93-15) for recruits (age 2)
20976

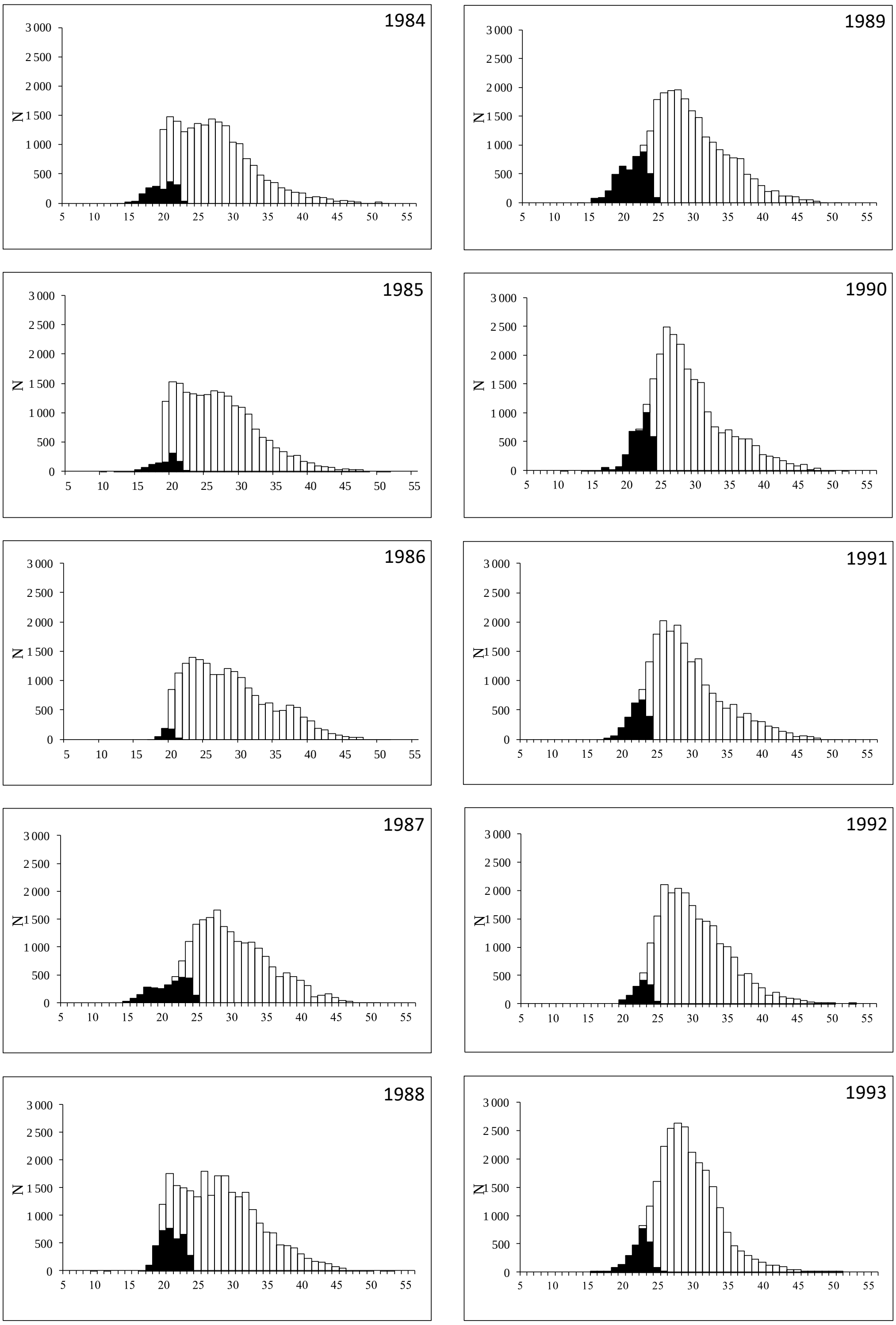


Figure 7.1 a: **Bay of Biscay sole French length distribution from 1984 to 1993**

Total French landings

Discard estimates of the French offshore trawlers fleet

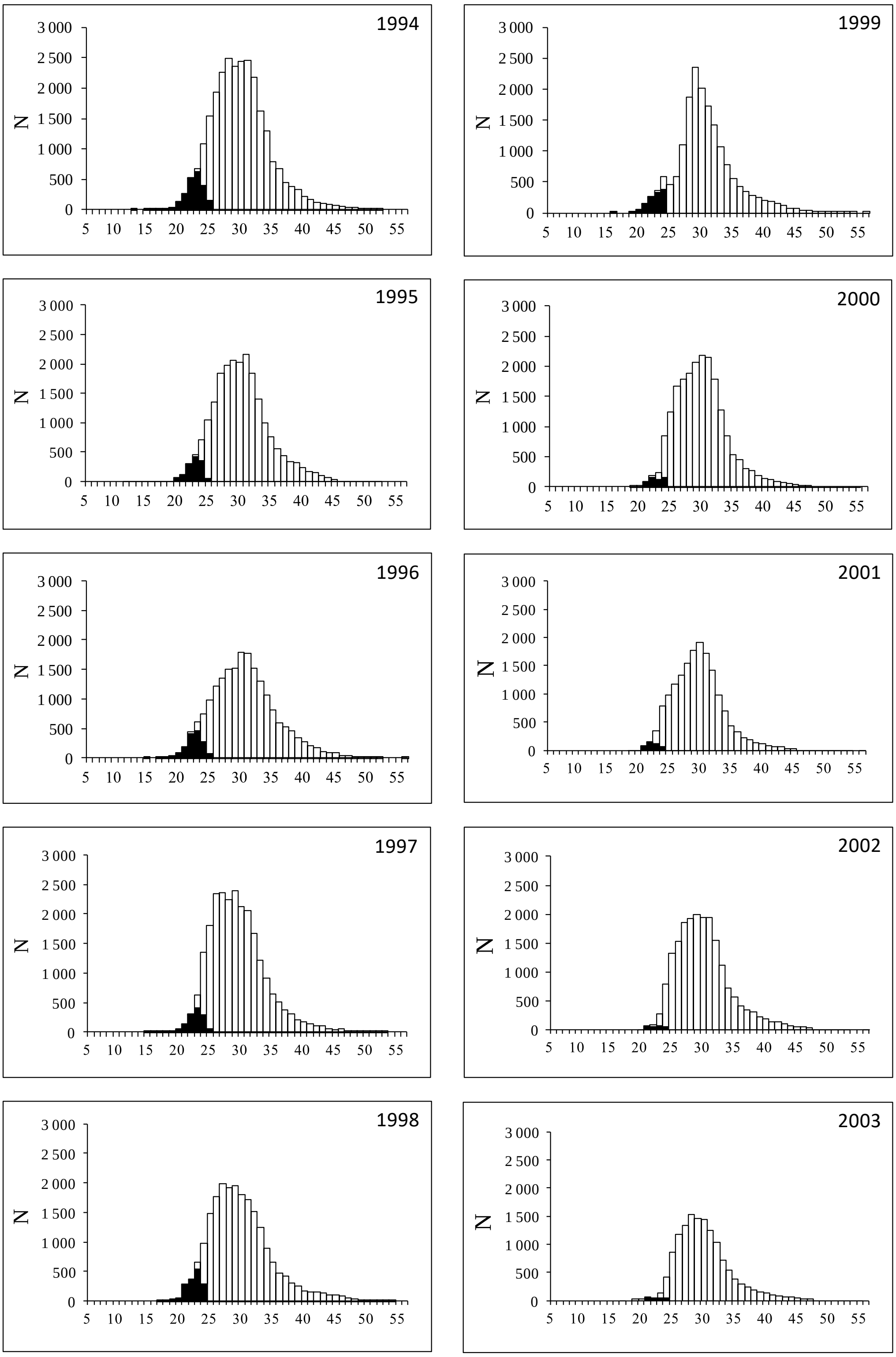


Figure 7.1 b: **Bay of Biscay sole French length distribution from 1994 to 2003**

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

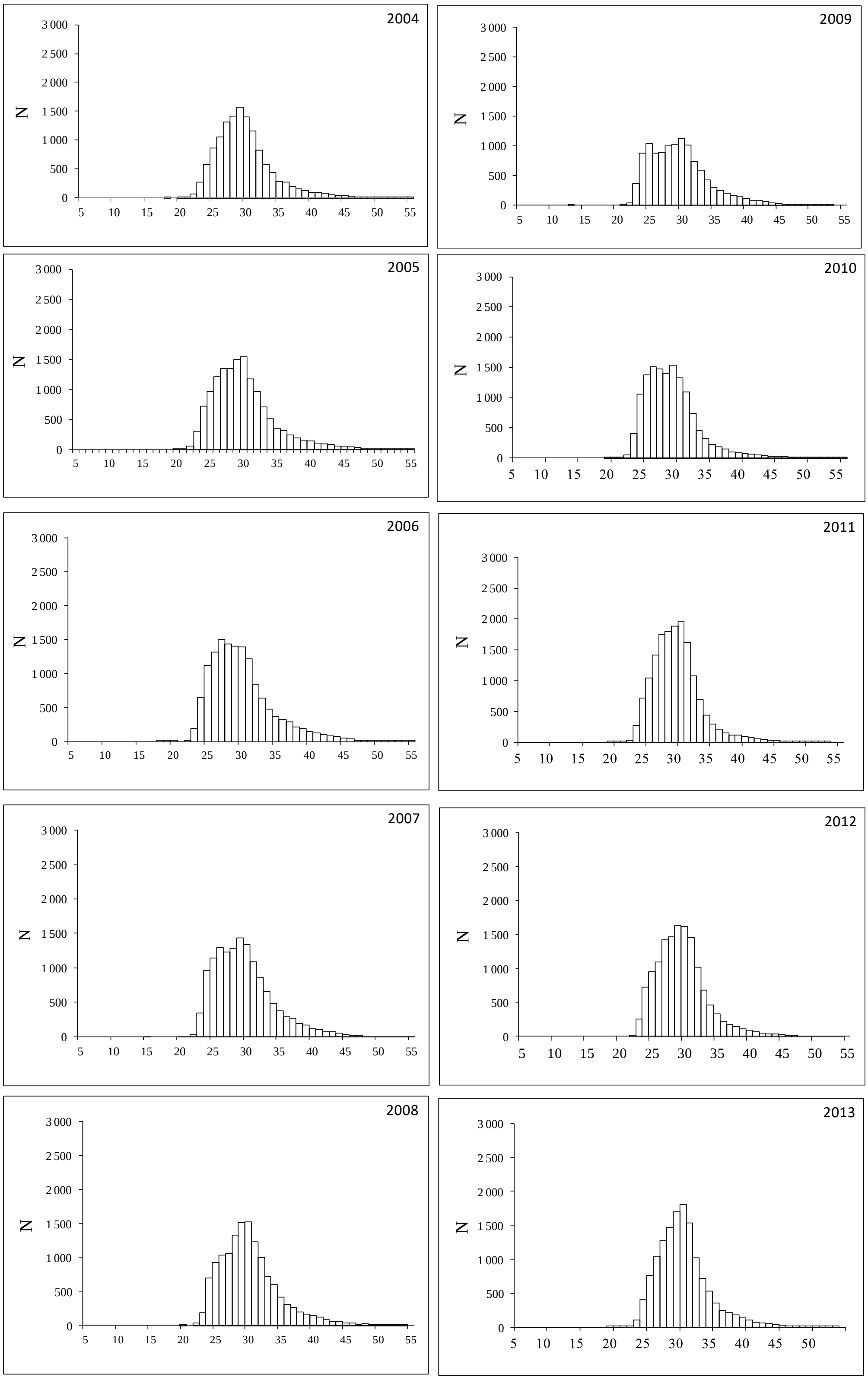


Figure 7.1 c: Bay of Biscay sole French length distribution from 2004 to 2013

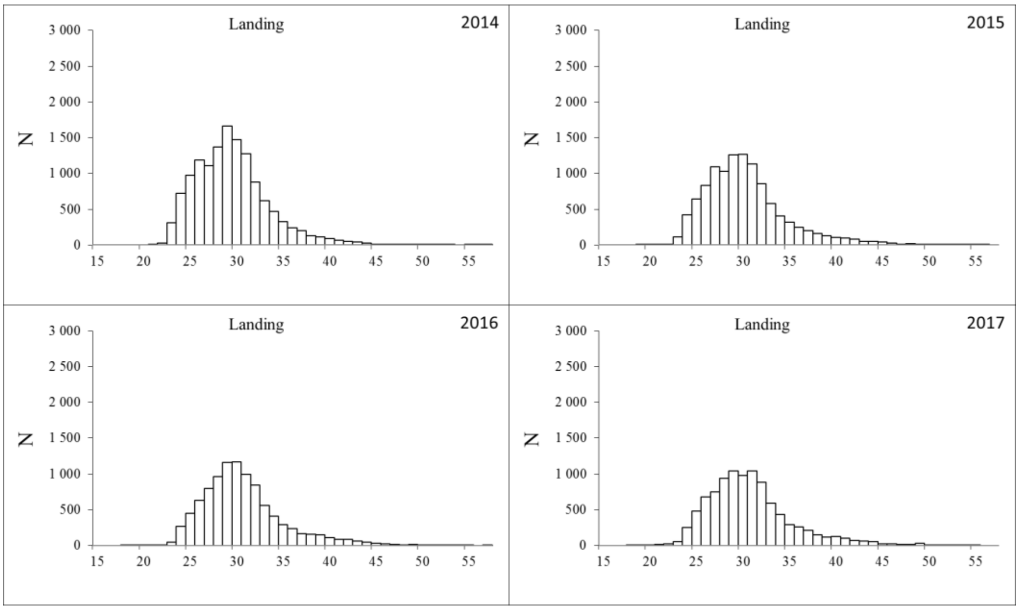


Figure 7.1 d: Bay of Biscay sole French length distribution from 2014 to 2017

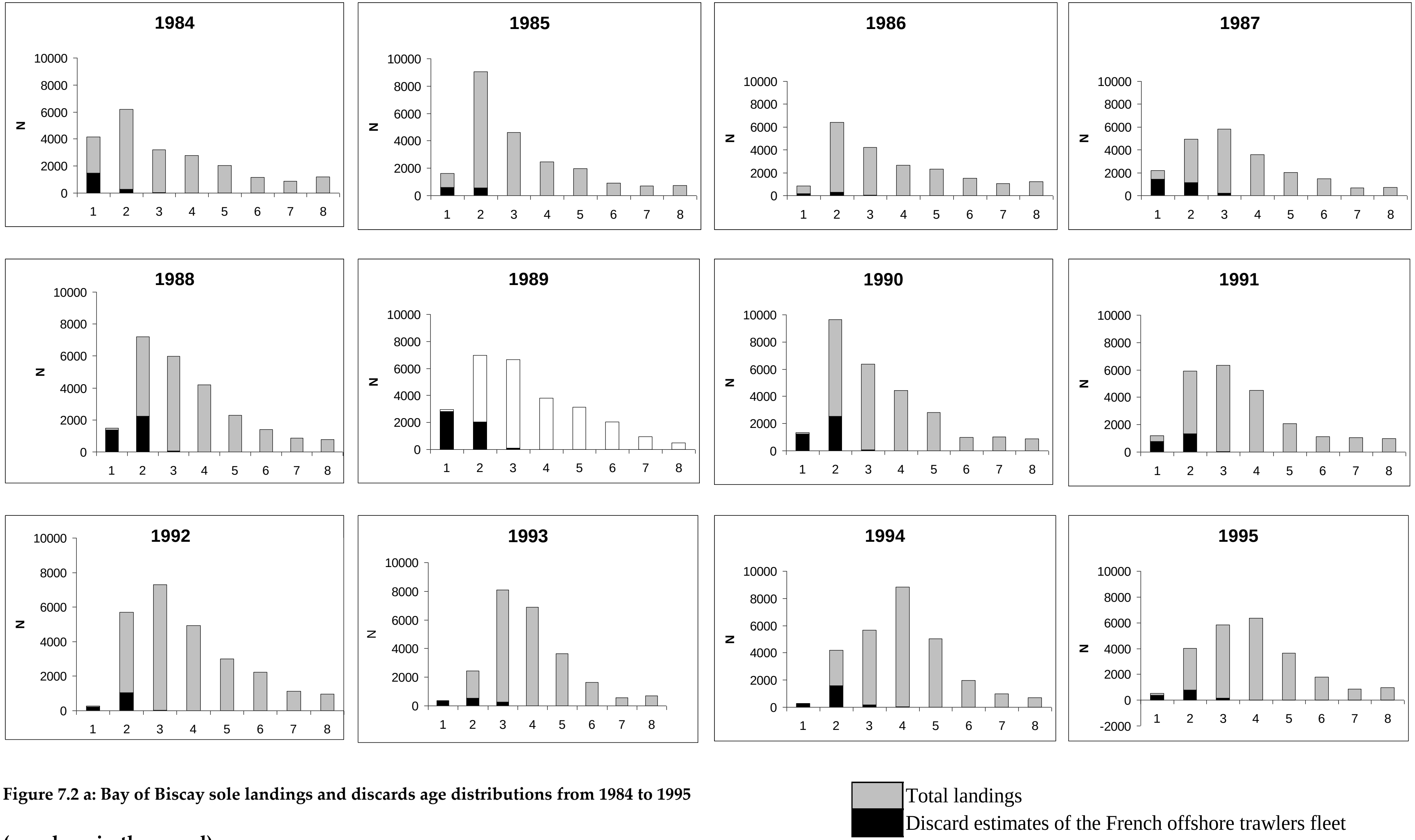


Figure 7.2 a: Bay of Biscay sole landings and discards age distributions from 1984 to 1995

(numbers in thousand)

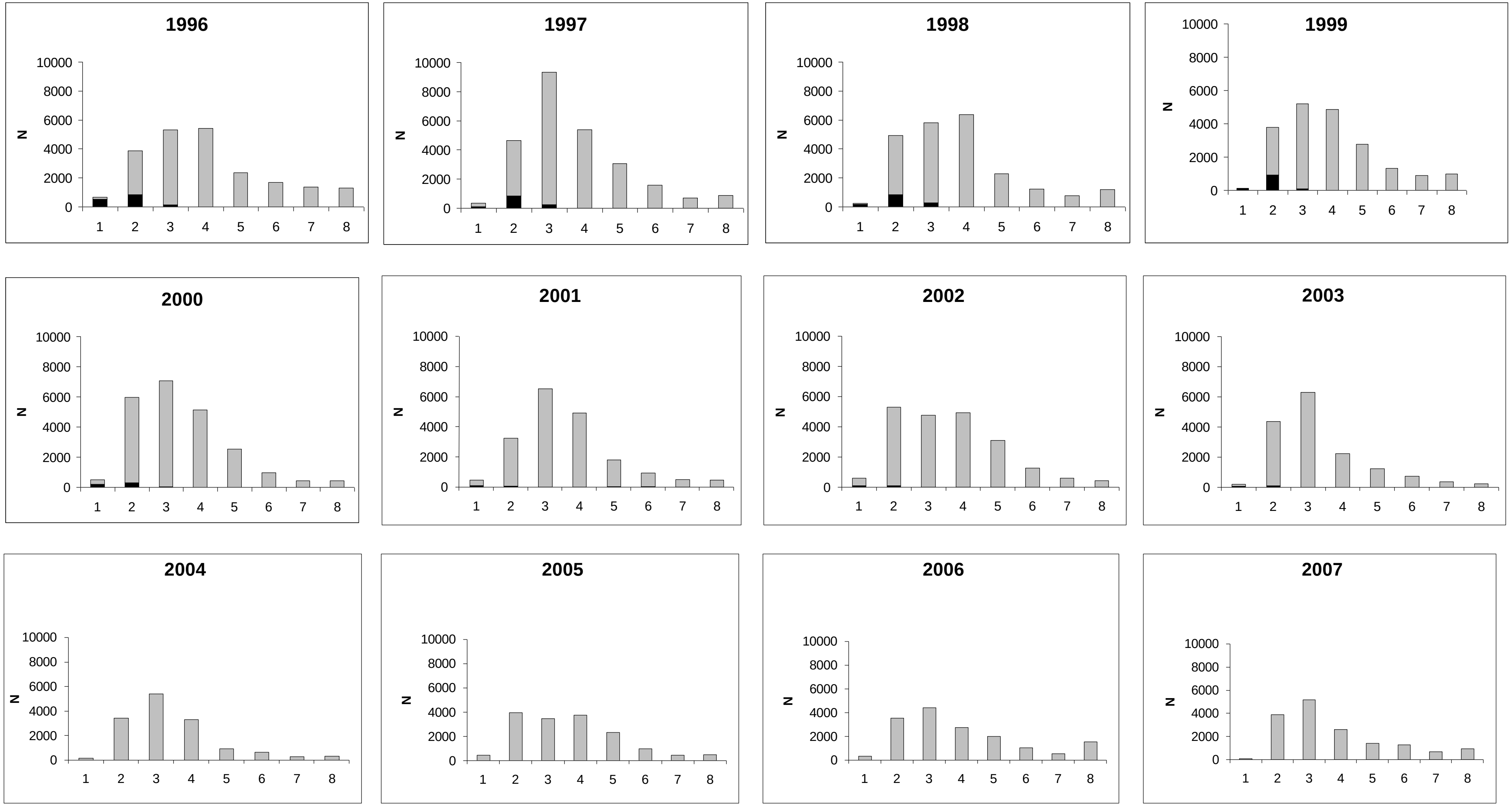


Figure 7.2 b: Bay of Biscay sole landings and discards age distributions from 1996 to 2007

(numbers in thousand)

Total landings
Discard estimates of the French offshore trawlers fleet

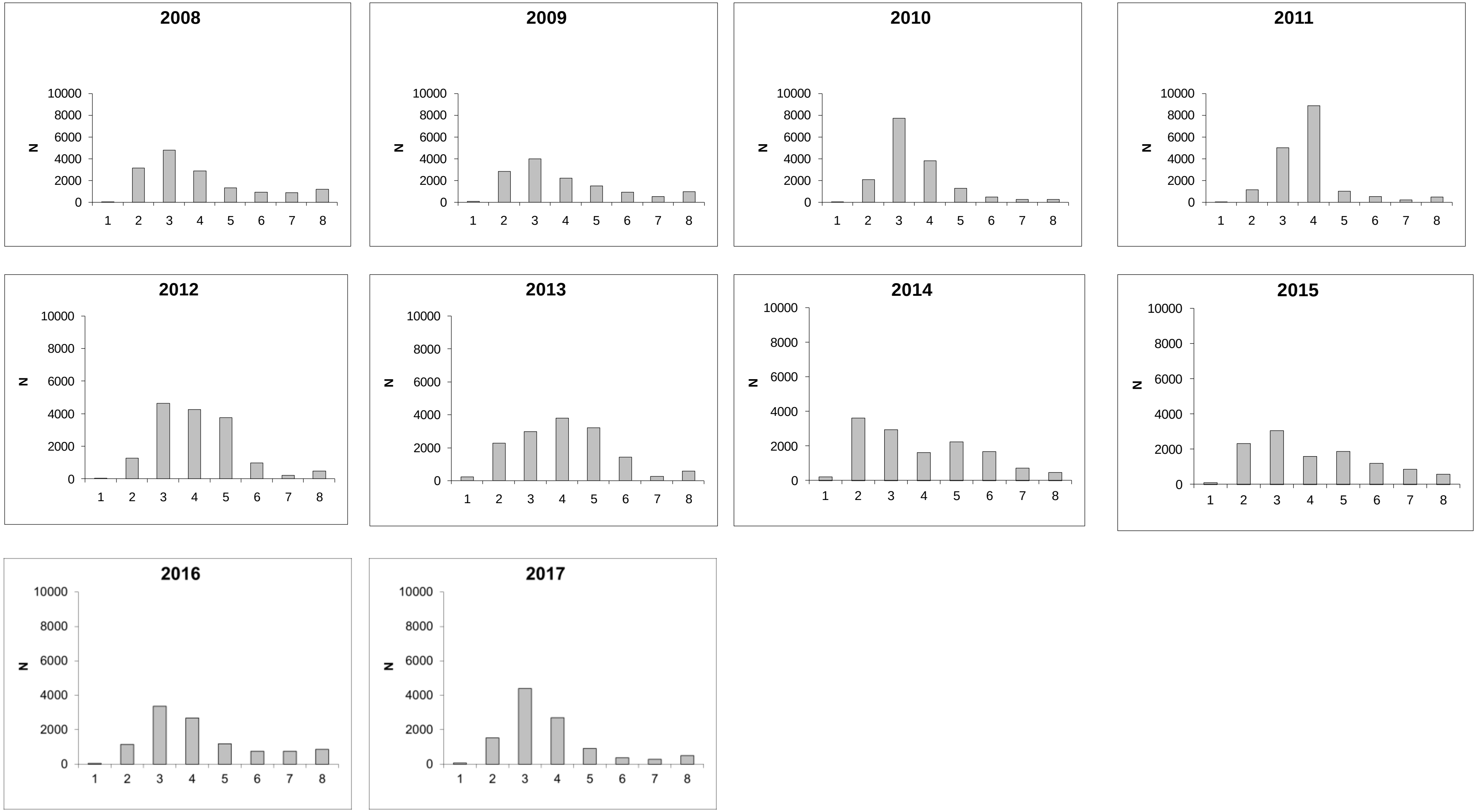


Figure 7.2 c: Bay of Biscay sole landings and discards age distributions from 2008 to 2017 (numbers in thousand)

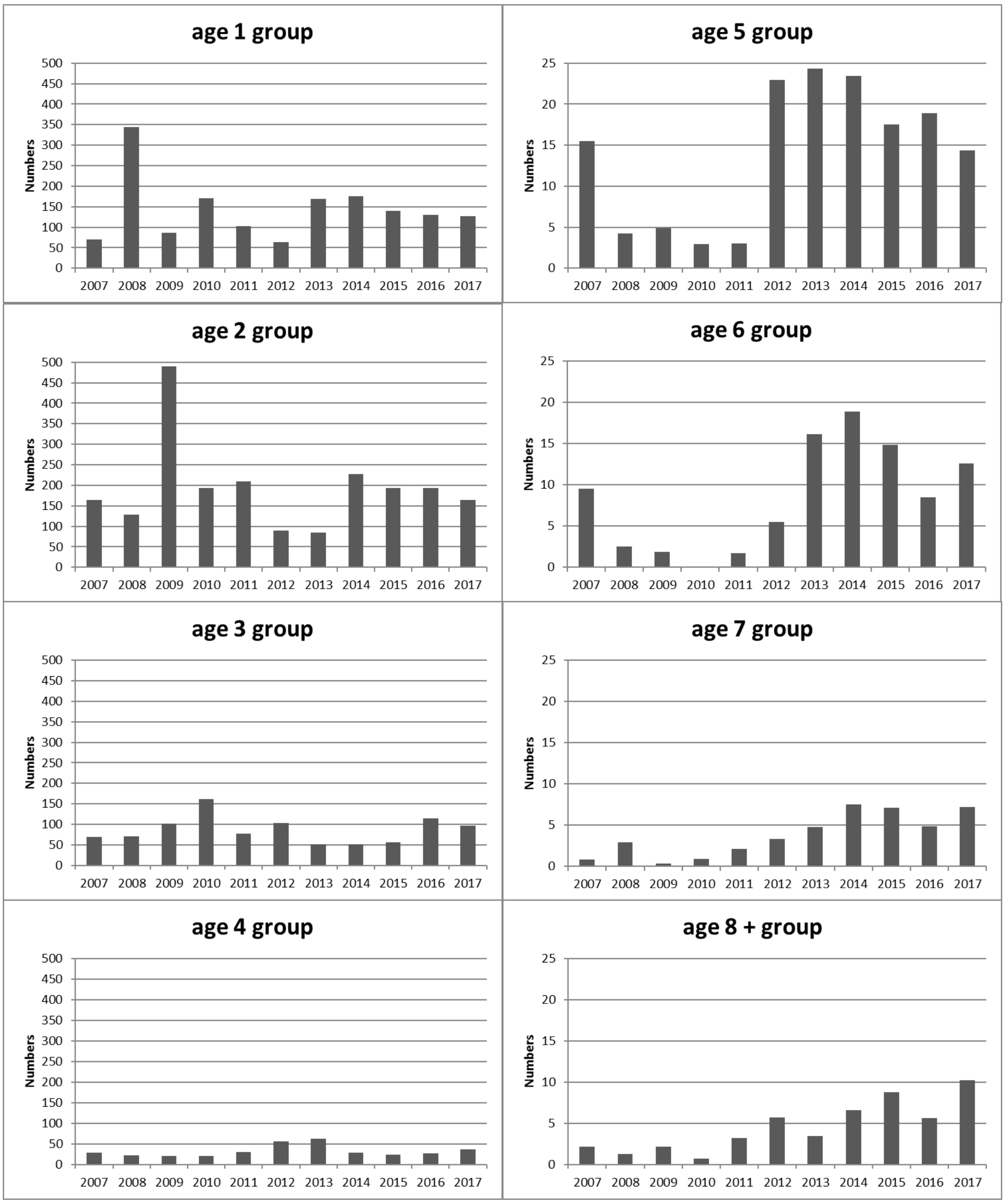


Figure 7.3: Orhago survey time-series

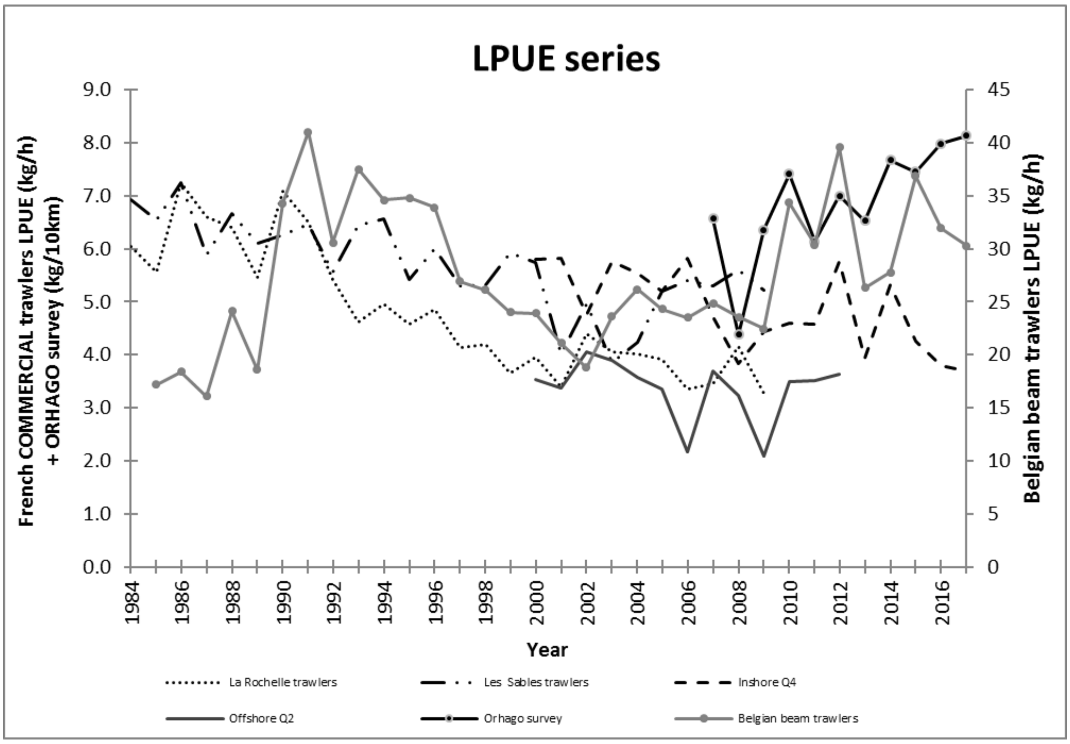


Figure 7.4: Bay of Biscay sole (Division 8a,b). LPUE trends of the 5 available commercial tuning fleets and cpue of the ORHAGO survey (for sole greater than the minimum landing size, i.e. 24 cm).

LOG-CATCHABILITY RESIDUAL PLOTS (XSA)

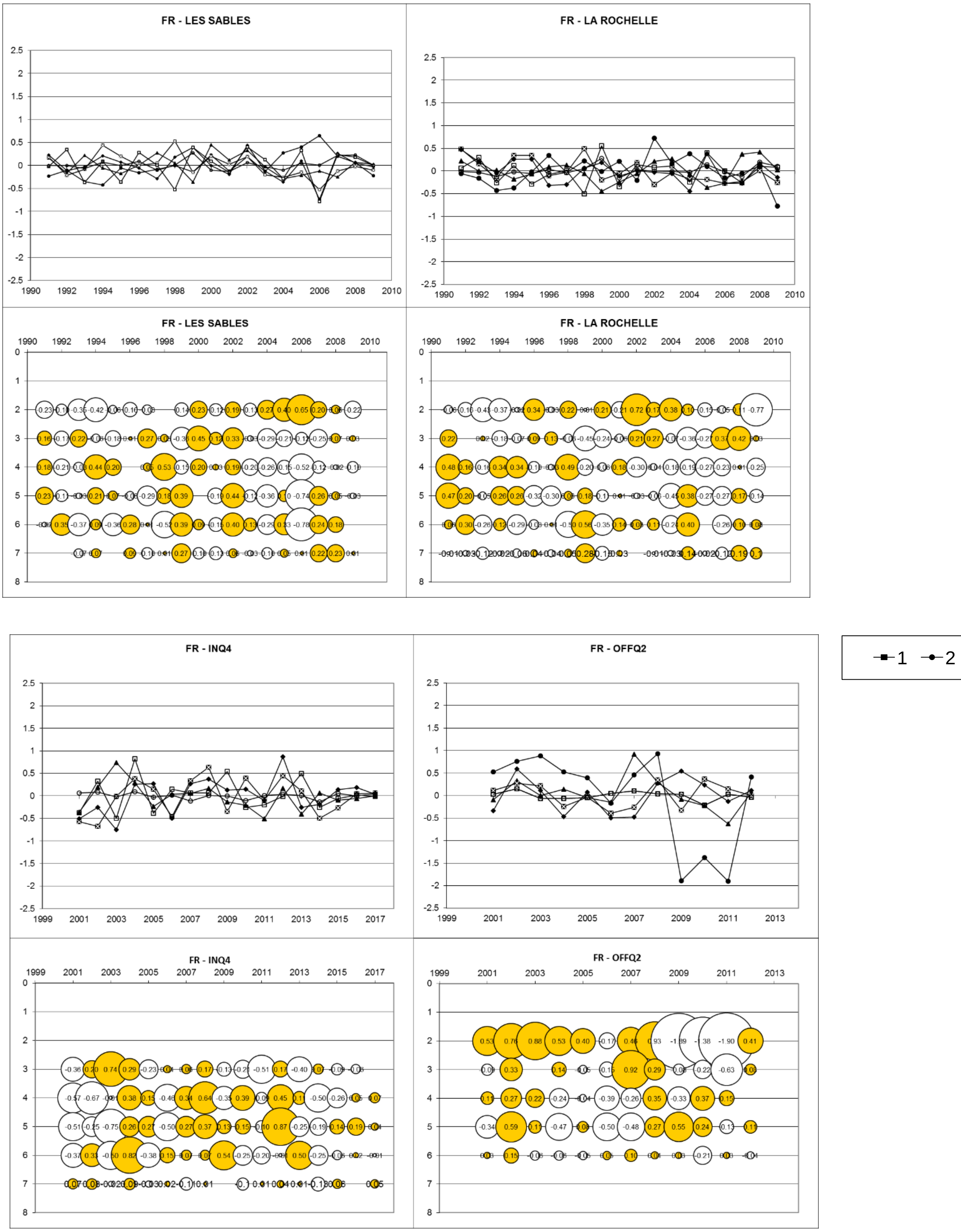


Figure 7.5a: Bay of Biscay sole (Division 8a,b)

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

LOG-CATCHABILITY RESIDUAL PLOTS (XSA)

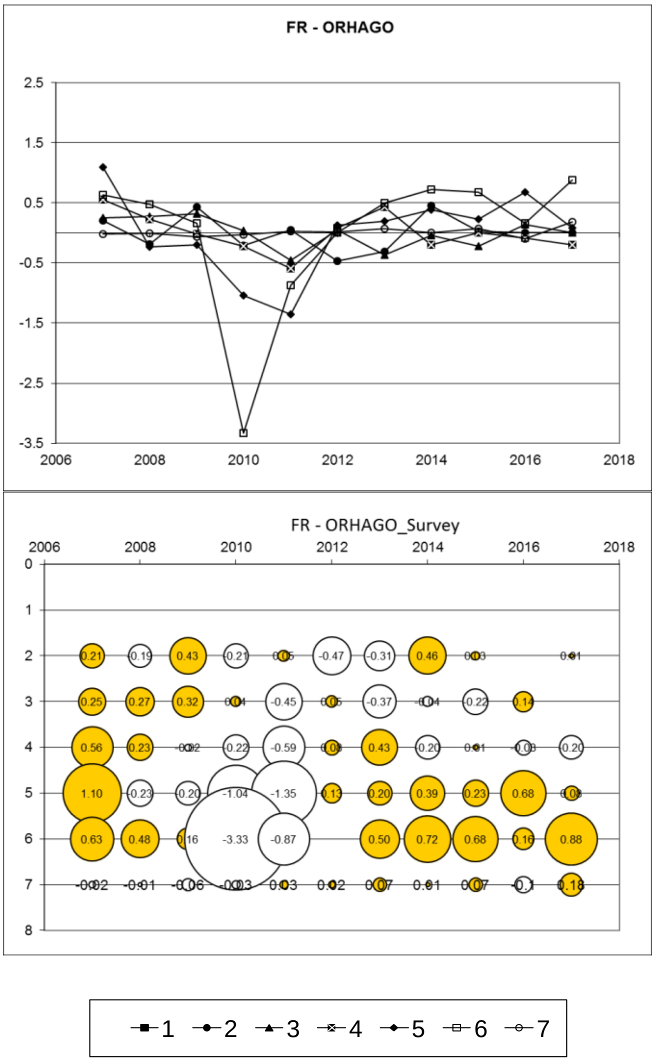


Figure 7.5b: Bay of Biscay sole (Division 8a,b)

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

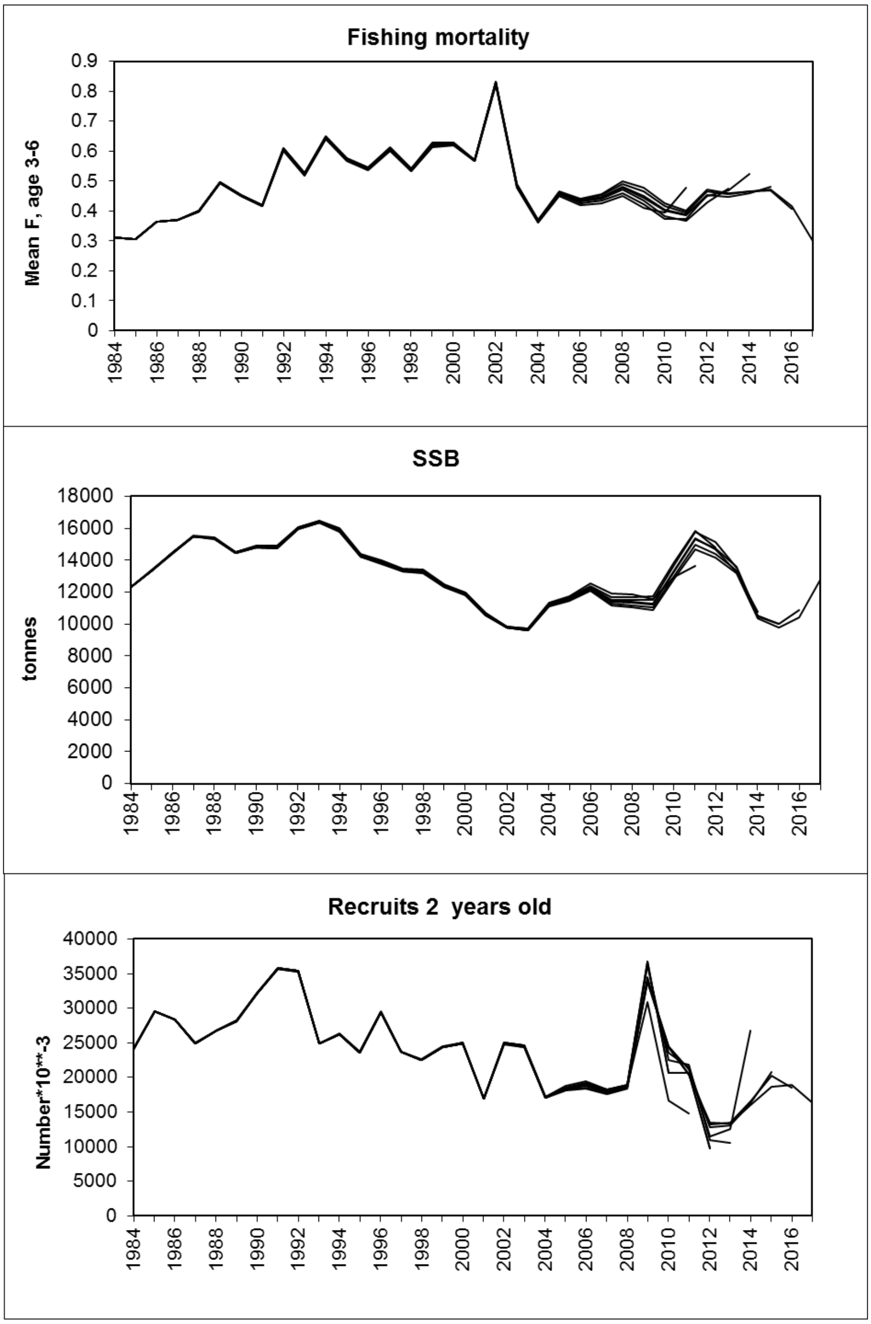


Figure 7.6: Bay of Biscay sole (Division 8a,b) - Retrospective results

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

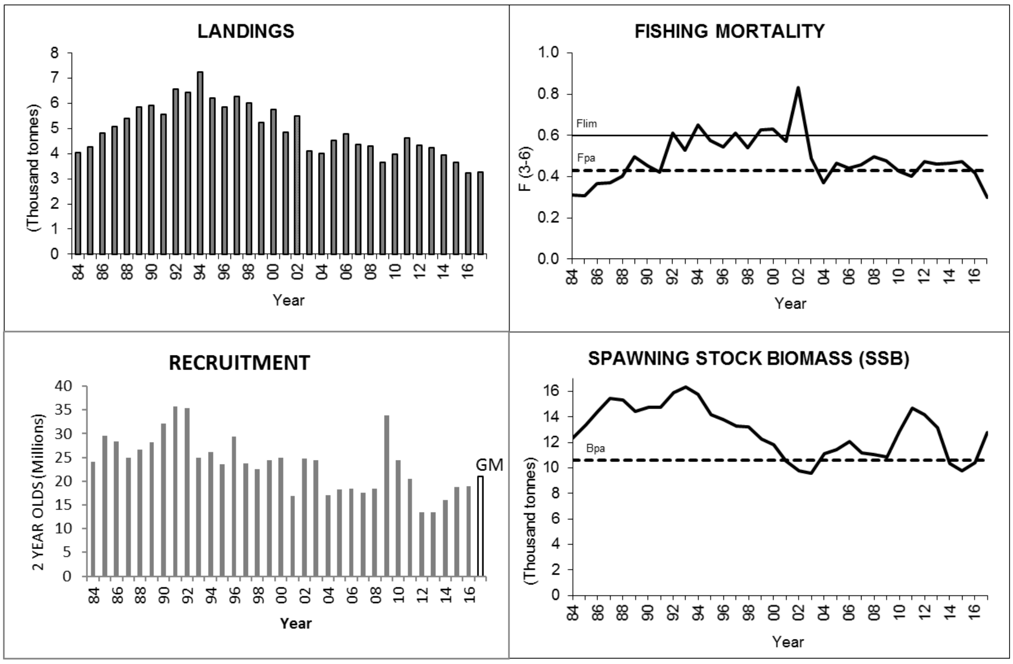
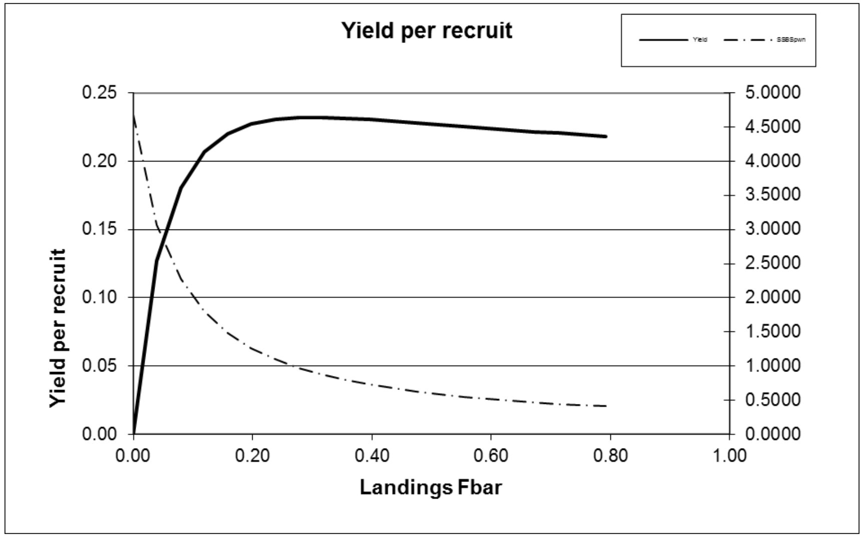
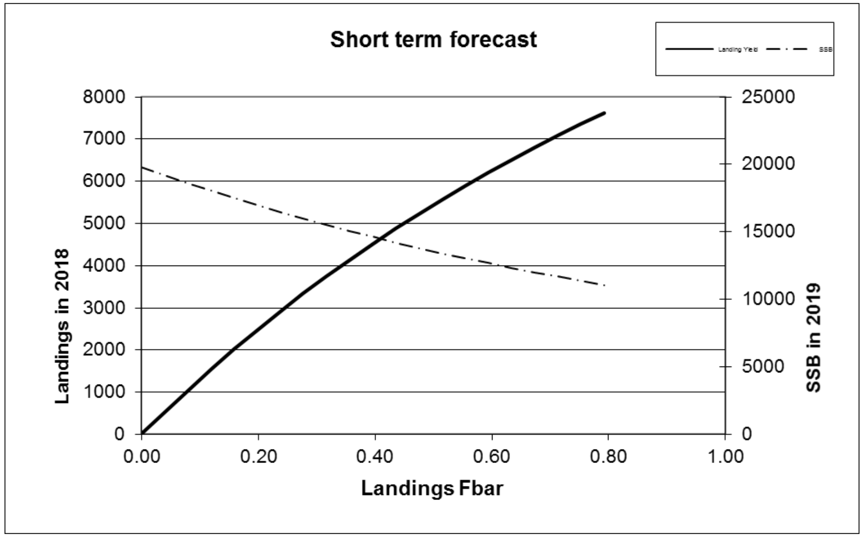


Figure 7.7: Sole in Division 8a,b (Bay of Biscay) – Trends for Landings, F, R, SSB





MFYPR version 2a
Run: 2017_TAC_unsc_
Time and date: 14:21 07/05/2018

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.3960
FMax	0.7645	0.3028
F0.1	0.2857	0.1131
F35%SPR	0.3458	0.1369

Weights in kilograms

MFDP version 1a
Run: TAC_2017_
Time and date: 11:29 04/05/2018
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)

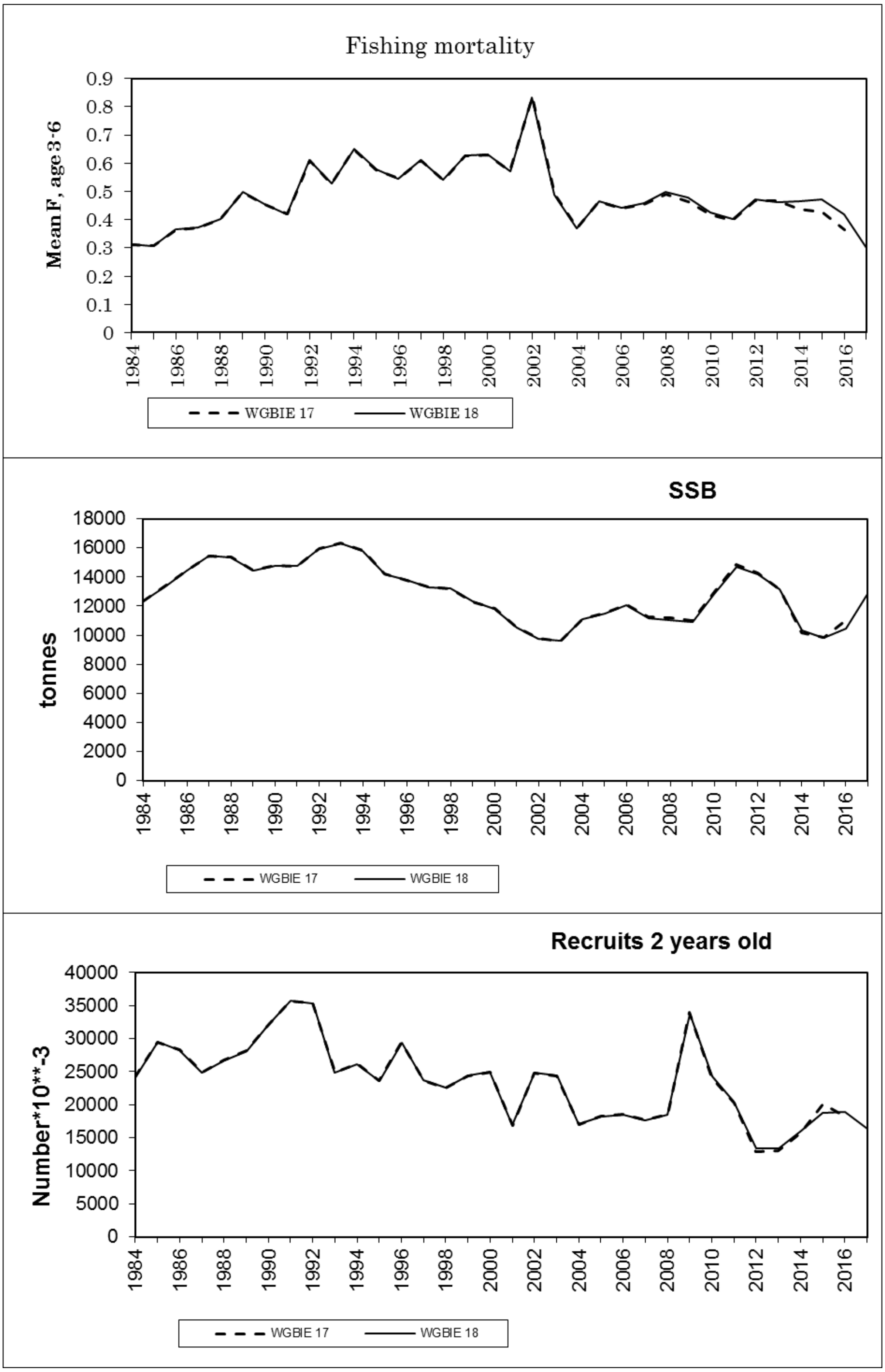


Figure 7.9: Bay of Biscay sole (Division 8a,b) - WG17 / WG18 comparison

8 Sole (*Solea solea*) in Divisions 8.c and 9.a

8.1 General biology

Common sole (*Solea solea*) spawning takes place in winter/early spring and varies with latitude starting earlier in the south (Vinagre, 2007). Larvae migrate to estuaries where juveniles concentrate until they reach approximately 2 years of age and move to deeper waters. In Portuguese waters, sole length of first maturity is estimated as 25cm for males and 27 cm for females (Jardim, *et al.*, 2011). Sole is a nocturnal predator and therefore more susceptible to be captured by fisheries at night than in daytime. It feeds on polychaetes, molluscs and amphipods. S. *solea* is abundant in the Tagus estuary and uses this habitat as its nursery ground (Cabral and Costa, 1999).

Growth studies based on S. *solea* otolith readings in the Portuguese coast indicate Linf of 52.1cm for females and 45.7cm for males. The growth coefficient (k) estimate of females (K=0.23) was slightly higher than for males (k=0.21) and to -0.11 and 1.57 for females and males respectively (Teixeira and Cabral, 2010). Maximum length observed between 2004 and 2011 from the landings sampling program (PNAB-DCF) attained 60cm. According to Vinagre (2007) S. *solea* off the Portuguese coast presents higher growth rates compared with the northern European coasts.

8.2 Stock identity and possible assessment areas;

There is no clear information to support the definition of the common sole stock for ICES Subdivision 8.c and 9.a.

8.3 Management regulations (TACs, minimum landing size)

The minimum landing size of sole is 24 cm. There are other regulations regarding the mesh size for trammel and trawlnets, fishing grounds and vessel's size. A precautionary TAC is in place for *Solea spp*. in ICES divisions 8.ce, subareas 9 and 10. 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 gillnets, mesh size larger or equal to 100 mm) and in Division 9.a (all trammelnets and gillnets, 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). For 2017, a total of 483 samples were collected (PT – 430; SP – 43) and a total of 8563 fish were measured (PT – 5279; SP – 1328).

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.

8.9 References

Borges, M.F., Moreira, A., Alcoforado, B., 2014. Sole (*Solea solea*) in Portuguese waters (Div. IXa). Working Document to WGNEW 2014.

Cabral H. and Costa, M.J. 1999. Differential use of nursery areas within the Tagus estuary by sympatric soles, *Solea solea* and *Solea senegalensis. Environmental Biology of Fishes* 56: 389_397,1999

Jardim, E., Alpoim, R., Silva, C., Fernandes, A.C, Chaves, C., Dias, M., Prista, N., Costa, A.M., 2011. Portuguese data of sole, plaice, whiting and pollock provided to WGHMM in 2011. Working document to WGNEW 2012.

Teixeira, C M., and Cabral, H.N., 2010. Comparative analysis of the diet, growth and reproduction of the soles, *Solea, solea* and *Solea senegalensis,* occurring in sympatry along the Portuguese coast. *Journal of the Marine Biological Association of the UK*, 2010,90(5), 995_1003.

Vinagre C.M.B. 2007. Ecology of the juveniles of the soles, *Solea solea* (Linnaeus, 1758) and *Solea senegalensis* Kaup, 1858, in the Tagus estuary. Tese de Doutoramento em Biologia, especialidade Biologia Marinha e Aquacultura. 214 p.

Table 8.4.1. ***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
2017	595	-	595

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

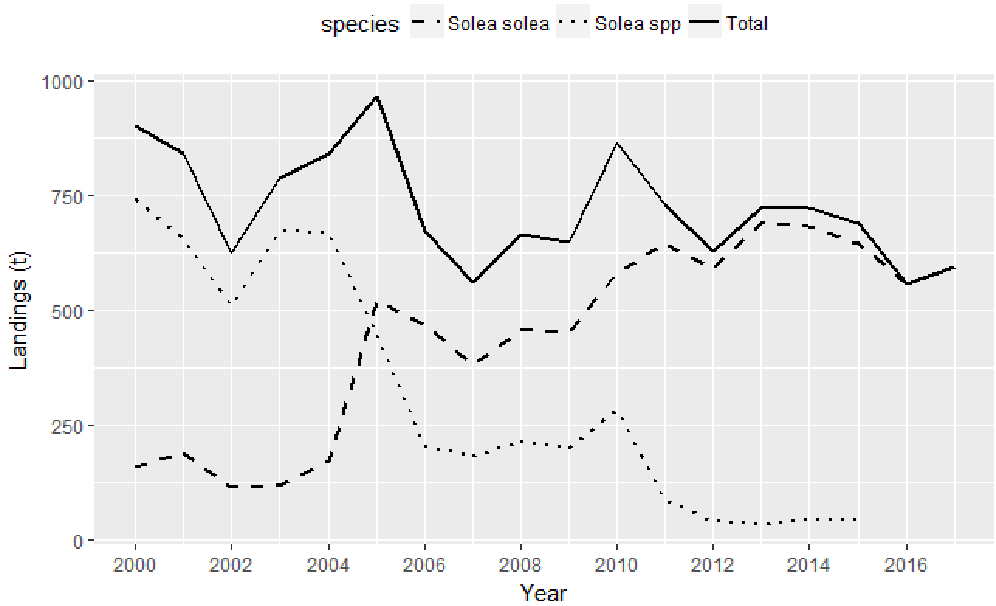


Figure 8.4.1. –*Solea solea* catches from 2000, including *Solea senegalensis* in *Solea* spp. and the total of the two.

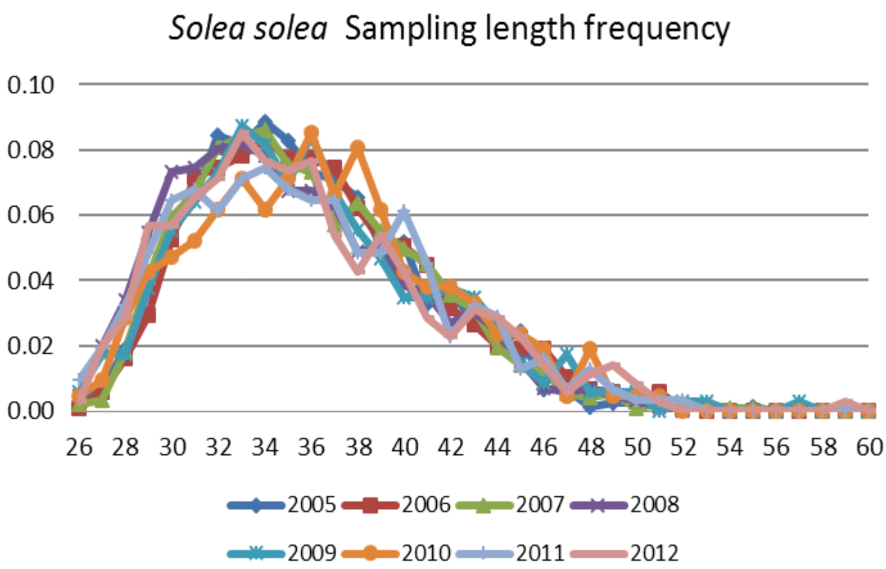


Figure 8.4.2- Division 9.a (Portugal. *Solea solea* sampling length frequency from all métiers harbour sampling DCF-IPMA.

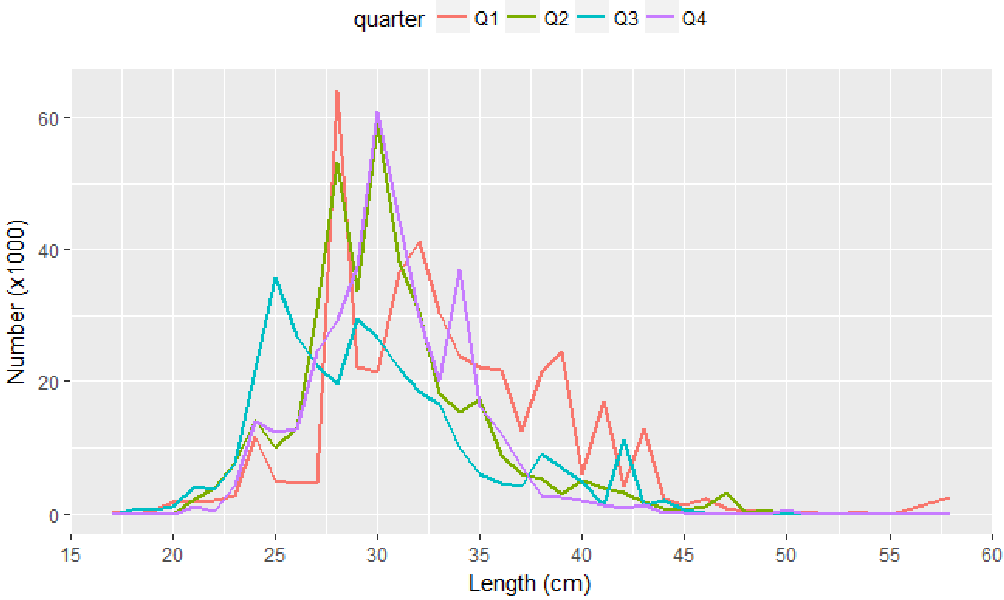


Figure 8.4.3. – Quarterly length–frequency distribution for *Solea solea* from ICES 8.c and 9.a. in 2017

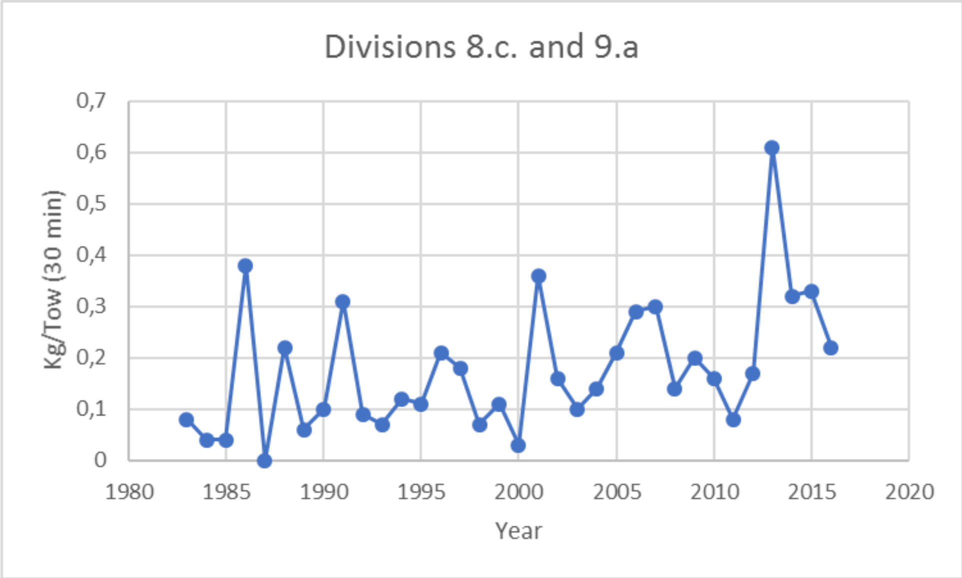


Figure 8.5.1. – Spanish Survey derived abundance index for *Solea solea*.

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

Type of assessment: update (stock benchmarked in 2014), stock on observation list. **Data revisions**: EVHOE survey index revised. **Review Group issues:**

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 2018 and management for 2016 and 2017

ICES advice for 2018

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 128 236 tonnes and total catches of 142 240 tonnes in 2019.

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	2018
3.a, 3.b,c,d (EC Zone)	1661	1661	2093	2466	2738	2997	3371	3136
2a (EC Zone), 4	1935	1935	2438	2874	3190	3492	3928	3653
5.b (EC Zone), 6, 7, 12, 14	30900	30900	38938	45896	50944	61902	67658	62536
8.a,b,d,e	20609	20609	25970	30610	33977	40393	44808	42460
Total Northern Stock [2.a-8.abd]	55105	55105	69 440	81846	90849	108784	119765	111785

Management for 2017 and 2018

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 onboard. This measure did not apply to vessels less than 12 m in length and which return to port within 24 hours of their most recent departure. Furthermore, two areas have been defined, one in Sub area 7 and the other in Sub area 8, where a 100 mm minimum mesh size is required for all otter-trawlers, whatever the amount of hake caught.

There are explicit management objectives for this stock under the EC Reg. No 811/2004 implementing measures for the recovery of the northern hake stock. It is aiming at increasing the quantities of mature fish to values equal to or greater than 140 000t. This is to be achieved by limiting fishing mortality to 0.25 and by allowing a maximum change in TAC between years of 15%.

According to ICES advice for 2012, due to the new perspective of historical stock trends, resulting from the new assessment, the previously defined precautionary reference points are no longer appropriate. In particular, the absolute levels of spawning biomass, fishing mortality, and recruitment have shifted to different scales. As a consequence, the TAC corresponding to the current recovery plan (EC Reg. No. 811/2004) should not be considered, because the plan uses target values based on precautionary reference points that are no longer appropriate.

The TACs for 2017 and 2018 (119 765 t and 111 865 t) were slightly below the ICES advised TAC (123 777 t and 115 335 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 1961–2017 as used by the WG are given in Table 9.1. They include landings from Division 3.a, Subareas 4, 6 and 7, and Divisions 8.a,b,d, as reported to ICES. Unallocated landings are also included in the table; they are high over the first decade (1961-1970), when the uncertainties in the fisheries statistics were high. In the years 2011, 2012 and 2013, they have increased again due to differences between official statistics and scientific estimations. In 2014 and 2015, the differences between scientific and official landings decreased greatly which produced a big decrease in unallocated landings. The 2016 unallocated landings were reported by area and in 2017 there were no unallocated landings, so they disappeared from 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 2016, the highest in the whole time series. From 2009 to 2015 the landings and in 2016 the catches were above the TAC advice. . In 2017, for the first time, the catches, 111 770 t, were below it, 119 765 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 2017. 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 increased for all the fleets expect for Spanish trawlers in area seven. In turn, the number of individuals 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%. In 2017, the total discards decreased for all the fleets, except the Spanish trawlers, with an overall decrease of a 36%. The increase in the Spanish trawlers in division 8.a,b,d was equal to 38%. In some fleets, Spanish trawlers in area 7, Gillnetters in area 7 and 8abd and others there was a significant decrease in the mean weight of the individuals discarded. The mean weight of the discarded individuals in GILLNET and OTHER fleets, the fleets which discarded bigger individuals, has decreased more than 50% in the last two years.

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 2015 and 2016 the index increased and in 2016 it almost tripled the value of 2015. In 2017 the index was not available.

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 moderately in the last three 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 and moderately in 2016. . The peaks detected by EVHOE-WIBTS-Q4 and IGFS-WIBTS-Q4 are detected in this survey one year after as confirms the sharp increase observed in 2017. 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. Since 1985, the LPUE of A Coruña trawlers has fluctuated with an increasing trend In 2012 and 2013 it decreased sharply and has an increasing trend since 2014 reaching its maximum value in 2017 . Over the same period, LPUE from Vigo trawlers operating in Subarea 7 has fluctuated without any clear trend until 2008 when it started increasing. It must be noted that while A Coruña trawl fleet targets hake, the Vigo trawl fleet is directed to megrim, taking hake only as by-catch.

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 has not been updated since 2015 due to a change in the way data was reported as it is now using e-logbooks for the first time.

9.3 Assessment

This is an update assessment.

9.3.1 Input data

See Stock Annex (under "*Input data for SS3*").

9.3.1.1 Data Revisions

France revised the EVHOE index after last year's working group. The differences between both indices are small in general but there were some minor differences in some years.

9.3.2 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).

9.3.3 Comparison of assessment results using the old and new EVHOE indices.

The new EVHOE index produced slightly higher recruitments since 2012 which produced a slight increase in the SSB in the most recent years (Figure 9.4). Assessment results

9.3.4 Model results

Residuals of the fits to the surveys log(abundance indices) are presented in Figure 9.5. The upward trend, 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. In the last four years the IGFS-WIBTS-Q4 survey had negative residuals. The residuals of the other surveys do not show any clear trend. . Pearson residuals of their length frequency distributions show a year pattern for the three surveys in the most recent years., i.e., the model was not able to explain the high abundance of small individuals observed in the distribution of the indices. Otherwise their behaviour is "fairly random" with no trend or lack of fit (Figure 9.6, 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 9.7 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 9.7, bottom left and right plots). The change in the mean weight of the discarded individuals in this fleet seems to be motivated by the increase in the abundance of small individuals and the decrease in the overall selection rather that in the decrease of the retention ogive. 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 (> 6500 tonnes) of gillnetter fleet in 7 and 8 in the recent years. Before 2012 the discards of this fleet were considered negligible.

The retrospective analysis (Figure 9.8) 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 in the recruitment estimates in the whole time series without any trend. The differences were especially big in the most recent estimates. In turn, the change in the recruitment estimates provokes a moderate retrospective pattern in the SSB and fishing mortality. The revision of these indicators do not have the same direction every year. In 2017 there has been an upwards revision of SSB and a downwards of fishing mortality but in the previous three years the revision had the opposite direction. Figure 9.9 shows the differences of the time series in percentage in comparison with the last year estimates. In this plot, the translation in the time series when 2012 data was included is more apparent. The differences in the central part are of the time series are more apparent too due to the scale change. However, the retrospective pattern in the central part of the series when data from 2013 onwards is added is not high. Historic trends in biomass, fishing mortality and recruitment

Summary results from SS3 are given in Table 9.5 and Figure 9.10.

For recruitment, fluctuations appear to be without substantial trend over the whole series. The recruitment in 2008 was the highest in the whole series 765 millions of individuals. After a low recruitment in 2015 (245 millions) the recruitment in the last two years is well above the historical mean (> 490 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 1990s (24 000 t in 1998). Since that year, SSB has increased to the highest value of the series in 2016 (346 000 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 F_{MSY} (0.28). The F estimate for 2017 is equal to 0.25 and the three-year mean equal to 0.23.

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.

9.4 Catch options and prognosis

9.4.1 Short – Term projection

For the current projection, unscaled F is used, corresponding to F(15-80cm) = 0.23.

The recruitment used for projections in this WG is the GM calculated from 1990 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 9.11. Maintaining status quo F in 2019 is expected to result in an increase in catch and SSB with respect to 2018.

9.4.2 Yield and biomass per recruit analysis

Options for long term projection are indicated in the Stock Annex.

Results of equilibrium yield and SSB per recruit are presented in Table 9.7 and Figure 9.12. The F-multiplier in Table 9.7 is with respect to status quo F (average F in the final 3 assessment years, 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 122%, 78%, 87% and 100% of status quo F. The maximum equilibrium yield per recruit is similar to the equilibrium yield at F_{sq}

9.5 Biological reference points

Biological reference points for the stock of Northern Hake were calculated in 2015 (ICES 2016) in a specific working group and the fishing mortality ranges of the multi-annual management plan (MAP)

	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)
MAP	F_{low}	0.18	The lowest F that produces catch in the long term 5% below of the catch at F_{MSY}- (ICES 2015)
	F_{upp}	0.45	The lowest F that produces catch in the long term 5% below of the catch at F_{MSY}- (ICES 2015)

9.6 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. This year the retrospective pattern has improved significantly with the revision of the EVHOE survey and the update of the recruitment settings in the SS3 control file (last year in the seasonal distribution of the assessment parameter and in the last year of main recr_devs).

A more detailed fleet disaggregation and the inclusion of all the discards in the assessment could help to decrease the retrospective pattern and improve the reliability of model outputs. Apart of that, the estimation of the growth parameters with the latest data available, inside or 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.

WGBIE members were made aware of an issue with the sampling level in Q1 and Q2 of 2017 from France (WD12). Because of the lack of market sampling for length (biological and on board sampling was unaffected), efforts were made to try and fill the deficiency in the number of samples by use of simulation techniques. Both simulated data and actual data were uploaded to InterCatch combined making it impossible to distinguish true samples from simulated ones. Due to the timing in notifying the working group it was not possible to assess the impact of such simulated data on the assessment and the group recommended that sensitivities with and without the simulated data are carried out. The simulation was based on commercial landings market categories.

The problem with French data did not have major impact on the compilation of Northern Hake stock data because the simulated French LFD were mainly used to raise French unsampled data. French sampled data are only used to raise data on three fleets, LONGLINE, GILLNET and TRAWLOTH. In the LONGLINE fleet 33% of the samples are simulated for France. Furthermore, the raising in TRAWOTH is divided in *nephrops* trawlers and non-*nephrops* trawlers.

- TRAWLOTH_*Neprophs:* 95% of the samples are French, only 4% of the catch is unsampled and from this 4% , 35% was non-french.
- TRAWLOTH: 78% of the samples are French. 30% of the catch is unsampled and from this 30% 22% was non-french.
- GILLNET: In gillnetters the samples of France represent 78% of the samples in tons. However most of the unsampled catch comes from France 87%.
- LONGLINES: The samples of France represent only the 5%, furthermore almost all the unsampled catches ~99% is French.

9.7 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.

9.8 References.

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9.9 Tables and Figures

Table 9.1. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock. Estimates of landings ('000 t) by area for 1961–2017.

	Landings (1)								Discards (2)						Catches (3)
Year	3	4	6	7	8abd	Unn.		Total	3	4	6	7	8abd	Total	Total
1961			-	-	-	95600		95600						-	95600
1962			-	-	-	86300		86300						-	86300
1963			-	-	-	86200		86200						-	86200
1964			-	-	-	76800		76800						-	76800
1965			-	-	-	64700		64700						-	64700
1966			-	-	-	60900		60900						-	60900
1967			-	-	-	62100		62100						-	62100
1968			-	-	-	62000		62000						-	62000
1969			-	-	-	54900		54900						-	54900
1970			-	-	-	64900		64900						-	64900
1971		8500		19400	23400	0		51300						-	51300
1972		9400		14900	41200	0		65500						-	65500
1973		9500		31200	37600	0		78300						-	78300
1974		9700		28900	34500	0		73100						-	73100
1975		11000		29200	32500	0		72700						-	72700
1976		12900		26700	28500	0		68100						-	68100
1977		8500		21000	24700	0		54200						-	54200
1978		8000		20300	24500	-2249		50551						-	50551
1979		8700		17600	27200	-2404		51096						-	51096
1980		9700		22000	28400	-2835		57265						-	57265
1981		8800		25600	22300	-2782		53918						-	53918
1982		5900		25200	26200	-2306		54994						-	54994
1983		6200		26300	27100	-2093		57507						-	57507
1984		9500		33000	22900	-2114		63286						-	63286
1985		9224		27459	21044	-1628		56099						-	56099
1986		7320		27408	23903	-1539		57092						-	57092
1987		7800		32900	24700	-2031		63369						-	63369
1988		8800		30900	26600	-1477		64823						-	64823
1989		7375		26938	31957	203		66473						-	66473
1990		6680		23011	34424	-4161		59954						-	59954
1991		8328		21546	31635	-3380		58129						-	58129
1992		8561		22475	23465	2116		56617						-	56617
1993		8484		20465	19849	3346		52144						-	52144
1994		5421		21080	24727	31		51259						*	51259
1995		5335		24056	28144	86		57621						-	57621
1996		4445		24738	18036	-9		47210						-	47210
1997		3312		18949	20339	-135		42465						-	42465
1998		3208		18705	13147	0		35060						-	35060
1999		4256		23955	11604	-1		39814						*	39814
2000		4033		25991	11998	4		42026						*	42026
2001		4367		23065	9244	0		36675						-	36675
2002		2944		21226	15935	0		40105						-	40105
2003*		3284		25438	14440	0		43162						1393	44555
2004*		4438		27483	14494	0		46416						2614	49029
2005*		5461		26623	14467	0		46550						4583	51133
2006*		6127		24709	10633	0		41469						1222	42691
2007*		7017		27456	10620	0		45093						2165	47258
2008*		10654		22834	14334	0		47822						3368	51190
2009*		13057		25300	20424	0		58781						11033	69814
2010*		14187		33500	25073	0		72760						12118	84878
2011*		18789		18574	16604	32000	(4)	87540						13903	101443
2012*		22415		22166	16716	19300	(4)	85677						14870	100547
2013*	292	10684	5232	28500	19900	13100	(4)	77708	313	2942	1545	6583	4059	15400	93108
2014*	348	12077	11415	40536	25552	0	(4)	89928	287	3105	951	4021	1458	9800	99728
2015*	447	14618	7065	44396	28497	0	(4)	95023	93	3444	71	4208	3096	10900	105923
2016*	695	19603	11365	49377	26490	0	(4)	107530	142	4189	344	2281	4150	11114	118644
2017*	775	19690	9614	45737	28853	0		104669	148	1777	314	1168	3692	7099	111768

(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 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Summary of discards data available (weight (t) in bold, numbers ('000) in italic)). The discards of Fleet 2 and Fleet 3 (in red) are not included in the assessment,

SS3 Fleets	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SPTRAWL7	na	**537**	**1712**	**2010**	**5674**	**5077**	**5054**	**3495**	**1464**	**2604**	**615**	**652**
	na	*4526*	*21437*	*17542*	*27619*	*27954*	*26452*	*38293*	*8335*	*5241*	2006	3556
TRAWLOTH	**na**	**na**	**na**	**1025**	**1192**	**130**	**1142**	**2934**	**2510**	**1560**	**1665**	**829**
	na	*na*	*na*	*6814*	*3831*	*1037*	*5101*	*16863*	*7483*	*4460*	11269	4786
FRNEP8	**532**	**767**	**858**	**4283**	**726**	**871**	**624**	**1475**	**392**	**1133**	**2310**	**1819**
	18031	*24277*	*18245*	*68524*	*14709*	21208	*25228*	*32535*	*4099*	19126	50343	34579
SPTRAWL8	**206**	**471**	**352**	**580**	**101**	**292**	**364**	**379**	**184**	**589**	**655**	**907**
	3397	*10002*	*7153*	*7925*	*1719*	*5036*	*5329*	*5552*	*2718*	*8011*	16293	14871
GILLNET	**na**	**na**	**na**	**na**	**na**	**na**	**1503**	**1256**	**42**	**857**	**1175**	**656**
	na	*na*	*na*	*na*	*na*	*na*	*4061*	*3283*	*53*	*623*	1600	1143
LONGLINE	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**558**	3	1
	na	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*402*	0	0
OTHER	**484**	**390**	**446**	**3135**	**4425**	**7533**	**6183**	**6287**	**4343**	**4151**	**4675**	**2235**
	na	*na*	*na*	*na*	*na*	*na*	*na*	*16855*	*4866*	4171	4435	5730
Total Weight (t)	**1222**	**2165**	**3368**	**11033**	**12118**	**13903**	**14870**	**15826**	**8935**	**11452**	**11098**	**7099**
Total Number ('000)	*21428*	*39654*	*47488*	*101349*	*48325*	*58210*	*66171*	*113381*	*27554*	42034	85946	64665

Table 9.3. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Landings (L) and Length Frequency Distribution (LFD) provided in 2017.

Unit (Country)	Quarter	France	Ireland	Spain	UK(E+W)	Scotland	Denmark	Others
	1	L		L+LFD	L	L		
1 + 2	2	L		L+LFD	L	L		
	3	L		L+LFD	L	L		
	4	L		L+LFD	L	L		
	1	L	L+LFD	L	L+LFD	L		
3	2	L	L+LFD	L	L+LFD	L		
	3	L+LFD	L+LFD	L	L+LFD	L		
	4	L	L+LFD	L	L+LFD	L		
	1	L+LFD	L+LFD	L+LFD	L+LFD	L		
4 + 5 + 6	2	L+LFD	L+LFD	L+LFD	L+LFD	L		
	3	L+LFD	L+LFD	L+LFD	L+LFD	L		
	4	L+LFD	L+LFD	L+LFD	L+LFD	L		
	1	L+LFD			L+LFD	L		L
8	2	L+LFD			L+LFD	L		L
	3	L+LFD			L+LFD	L		L
	4	LFD			L+LFD	L		L
	1	L+LFD						
9	2	L+LFD						
	3	L+LFD						
	4	L+LFD						
	1	L+LFD		L+LFD				
10 + 14	2	L+LFD		L+LFD				L
	3	L+LFD		L+LFD				
	4	L		L+LFD				
	1	L+LFD		L+LFD				
12	2	L+LFD		L+LFD				
	3	L		L+LFD				
	4	L+LFD		L+LFD				
	1	L		L+LFD				
13	2	L		L+LFD				
	3	L+LFD		L+LFD				
	4	L+LFD		L+LFD				
	1	L+LFD	L+LFD		L+LFD	L		L
15	2	L+LFD	L+LFD		L+LFD	L		L
	3	L+LFD	L+LFD		L+LFD	L		L
	4	L+LFD	L+LFD		L	L		L
	1	L+LFD			L+LFD	L+LFD	L+LFD	L+LFD
16	2	L+LFD			L+LFD	L+LFD	L+LFD	L+LFD
	3	L+LFD			L+LFD	L+LFD	L+LFD	L+LFD
	4	L+LFD			L+LFD	L+LFD	L+LFD	L

Table 9.4. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Effort and LPUE values of commercial fleets.

Sub-area VII

	A Coruña trawl in VII			Vigo trawl in VII		
Year	Landings(t)	Effort(days)	LPUE(Kg/day)	Landings(t)	Effort**	LPUE**
1982				2051	75194	27
1983				3284	75233	44
1984				3062	76448	40
1985	5612	14268	393	1813	71241	25
1986	4253	11604	366	2311	68747	34
1987	8191	12444	658	2485	66616	37
1988	6279	12852	489	3640	65466	56
1989	6104	12420	491	1374	75853	18
1990	4362	11328	385	2062	80207	26
1991	3332	9852	338	2007	78218	26
1992	3662	6828	536	1813	63398	29
1993	2670	5748	464	1338	59879	22
1994	3258	5736	568	1858	56549	33
1995	4069	4812	846	1461	50696	29
1996	2770	4116	673	1401	54162	26
1997	1858	4044	459	1099	50576	22
1998	2476	3924	631	1201	53596	22
1999	2880	3732	772	1652	50842	32
2000	3628	2868	1265	1487	55185	27
2001	2585	2640	979	1071	56776	19
2002	1534	2556	600	1152	50410	23
2003	3286	3084	1065	1486	54369	27
2004	2802	2820	994	1595	53472	30
2005	2681	2748	976	1323	52455	25
2006	2498	2688	929	1422	53677	26
2007	2529	2772	912	1459	58123	25
2008	2042	1872	1091	1159	54324	21
2009	2418	1884	1284	1493	51551	29
2010	4934	2484	1986	1326	48432	27
2011	5108	2232	2288	1321	43533	30
2012	2819	1452	1942	1122	32760	34
2013	1474	903	1632	725	26834	27
2014	996	496	2008	482	15297	32
2015	972	397	2449	497	13954	36
2016	872	334	2611	508	11030	46
2017	902	384	2350	366	11450	32

* 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 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Summary of landings and assessment results.

Year	Recruit Age 0	Total Biomass	Total SSB	Landings	Discards[(1)]	Catch	Yield/SSB	F (15-80 cm)
1978	298362	119063	80488	50551	NA	50551	0.63	0.5
1979	274926	128488	101357	51096	NA	51096	0.5	0.54
1980	303736	126513	103838	57265	NA	57265	0.55	0.64
1981	579898	109327	89265	53918	NA	53918	0.6	0.64
1982	392556	100615	72684	54994	NA	54994	0.76	0.67
1983	139840	106791	70355	57507	NA	57507	0.82	0.62
1984	279464	112391	83045	63286	NA	63286	0.76	0.66
1985	619933	97415	78908	56099	NA	56099	0.71	0.82
1986	359882	80372	58963	57092	NA	57092	0.97	0.91
1987	434200	75347	43524	63369	NA	63369	1.46	0.98
1988	494257	76332	45994	64823	2	64825	1.41	1
1989	478272	76501	45086	66473	73	66546	1.47	1.07
1990	484780	70584	42352	59954	NA	59954	1.42	1.02
1991	270044	67470	41351	58129	NA	58129	1.41	0.96
1992	294630	66461	39836	56617	NA	56617	1.42	1
1993	517317	58877	38743	52144	NA	52144	1.35	1.05
1994	288462	52619	30489	51259	356	51615	1.68	1.06
1995	147553	58746	29596	57621	NA	57621	1.95	1.12
1996	362975	54133	34790	47210	NA	47210	1.36	0.97
1997	255130	46604	30089	42465	NA	42465	1.41	1.06
1998	422379	44199	24356	35060	NA	35060	1.44	0.98
1999	207423	48524	27703	39814	349	40163	1.44	0.97
2000	188288	53985	30600	42026	83	42109	1.37	0.91
2001	346704	54037	36341	36675	NA	36675	1.01	0.75
2002	274312	56990	37273	40107	NA	40107	1.08	0.81
2003	160600	62121	37656	43162	2110	45272	1.15	0.82
2004	340348	64349	42778	46417	2552	48969	1.09	0.83
2005	221565	60224	41195	46550	4676	51226	1.13	0.95
2006	302086	56634	33614	41467	1816	43283	1.23	0.84
2007	471269	63390	39797	45028	2191	47219	1.13	0.74
2008	765300	80005	46978	47739	3248	50987	1.02	0.6
2009	254872	127167	71072	58818	9871	68689	0.83	0.48
2010	270378	207204	131320	72799	9415	82214	0.55	0.36
2011	284226	267900	216114	87540	13775	101315	0.41	0.29
2012	540727	289022	247175	85677	12225	97902	0.35	0.24
2013	375538	301711	252407	77753	11637	89390	0.31	0.24
2014	217417	338838	271088	89940	7047	96987	0.33	0.23
2015	245139	375740	314983	93670	7396	101066	0.3	0.22
2016	593993	391149	346653	109106	9939	119045	0.31	0.23
2017	493394	372434	325230	104671	5616	110287	0.32	0.25
Arith.Mean	356304	125007	93377	59147	5219	61757		
Units	Thousands of Individuals	Thousands	Tonnes	Tonnes	Tonnes	Tonnes	percentage	

[(1)] Discards used in the assessment. In years with (-) discards are not available or considerent unreliable.

Table 9.6. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Catch option table.

SSB(2018)	Rec proj	F(15-80cm)	Catch(2018)	Land(2018)	SSB(2019)
306516	320927	0.23	103246	94813	346623

Fmult	Fcatch(15-80cm)	Catch(2019)	Land(2019)	Disc(2019)	SSB(2020)
0	0	0	0	0	499463
0.1	0.0235	13508	12527	981	486499
0.2	0.047	26642	24699	1942	473896
0.3	0.0705	39412	36528	2885	461643
0.4	0.0939	51830	48021	3808	449729
0.5	0.1174	63904	59190	4714	438144
0.6	0.1409	75645	70044	5601	426880
0.7	0.1644	87063	80592	6471	415926
0.8	0.1879	98166	90842	7324	405274
0.9	0.2114	108964	100804	8161	394915
1	0.2348	119465	110485	8980	384840
1.1	0.2583	129678	119894	9784	375042
1.2	0.2818	139611	129039	10572	365512
1.3	0.3053	149272	137927	11345	356243
1.4	0.3288	158668	146565	12103	347227
1.5	0.3523	167807	154961	12846	338457
1.6	0.3757	176697	163122	13575	329925
1.7	0.3992	185344	171055	14290	321626
1.8	0.4227	193756	178765	14990	313551
1.9	0.4462	201938	186260	15678	305696
2	0.4697	209898	193546	16352	298053

Table 9.7. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Yield per recruit summary table.

SPR level	Fmult	F(15-80cm)	YPR(catch)	YPR(landings)	SSB PR
1	0	0	0	0	3.2
0.86	0.1	0.02	0.08	0.08	2.76
0.75	0.2	0.05	0.14	0.14	2.40
0.66	0.3	0.07	0.19	0.18	2.09
0.58	0.4	0.09	0.22	0.21	1.84
0.51	0.5	0.12	0.25	0.24	1.63
0.45	0.6	0.14	0.27	0.26	1.45
0.41	0.7	0.16	0.29	0.27	1.30
0.37	0.8	0.19	0.30	0.28	1.17
0.33	0.9	0.21	0.31	0.29	1.06
0.30	1	0.23	0.31	0.29	0.96
0.27	1.1	0.26	0.31	0.29	0.87
0.25	1.2	0.28	0.32	0.29	0.80
0.23	1.3	0.31	0.32	0.29	0.73
0.21	1.4	0.33	0.32	0.29	0.68
0.20	1.5	0.35	0.32	0.29	0.62
0.18	1.6	0.38	0.31	0.29	0.58
0.17	1.7	0.4	0.31	0.28	0.54
0.16	1.8	0.42	0.31	0.28	0.50
0.15	1.9	0.45	0.31	0.28	0.47
0.14	2	0.47	0.30	0.27	0.44

	SPR level	Fmult	F(15-80cm)	YPR(catch)	YPR(landings)	SSB PR
Fmax	0.25	1.21	0.28	0.32	0.29	0.79
F0.1	0.38	0.77	0.18	0.29	0.28	1.21
F35%	0.35	0.84	0.2	0.3	0.28	1.12
F30%	0.3	1	0.23	0.31	0.29	0.96

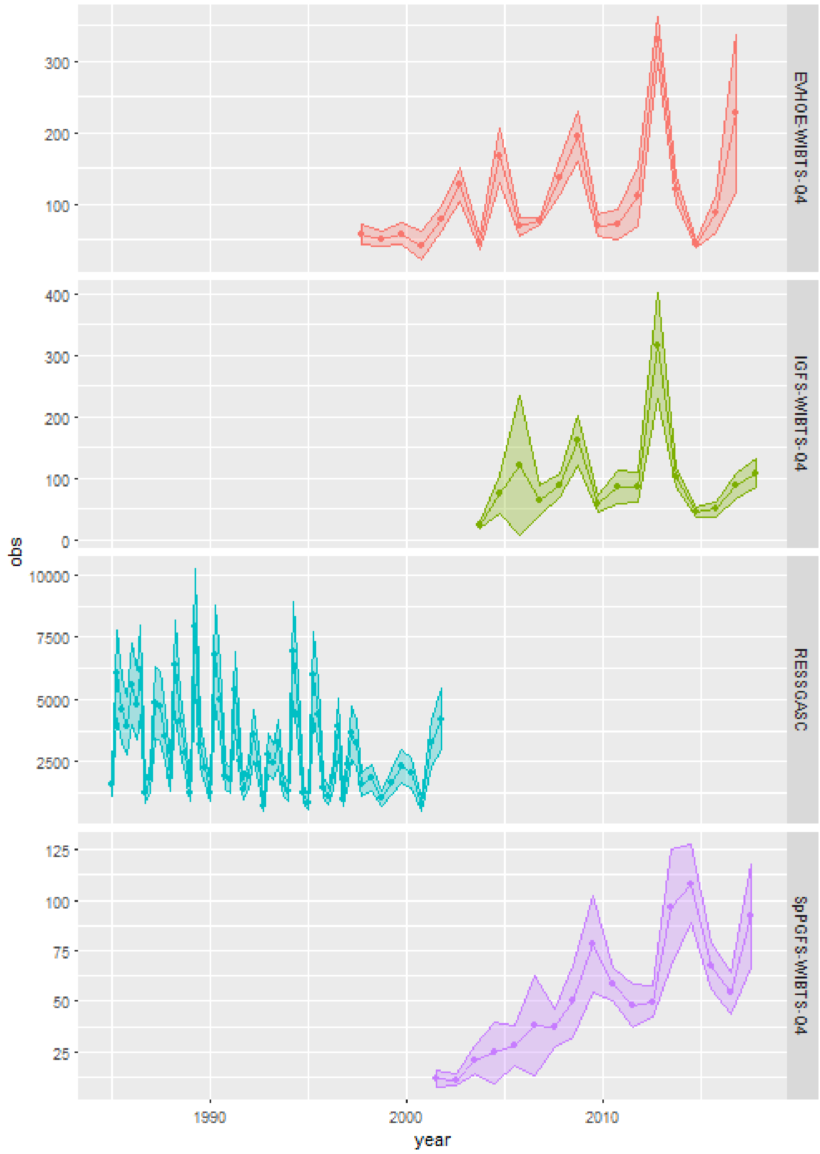


Figure 9.1. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Abundance indices from surveys.

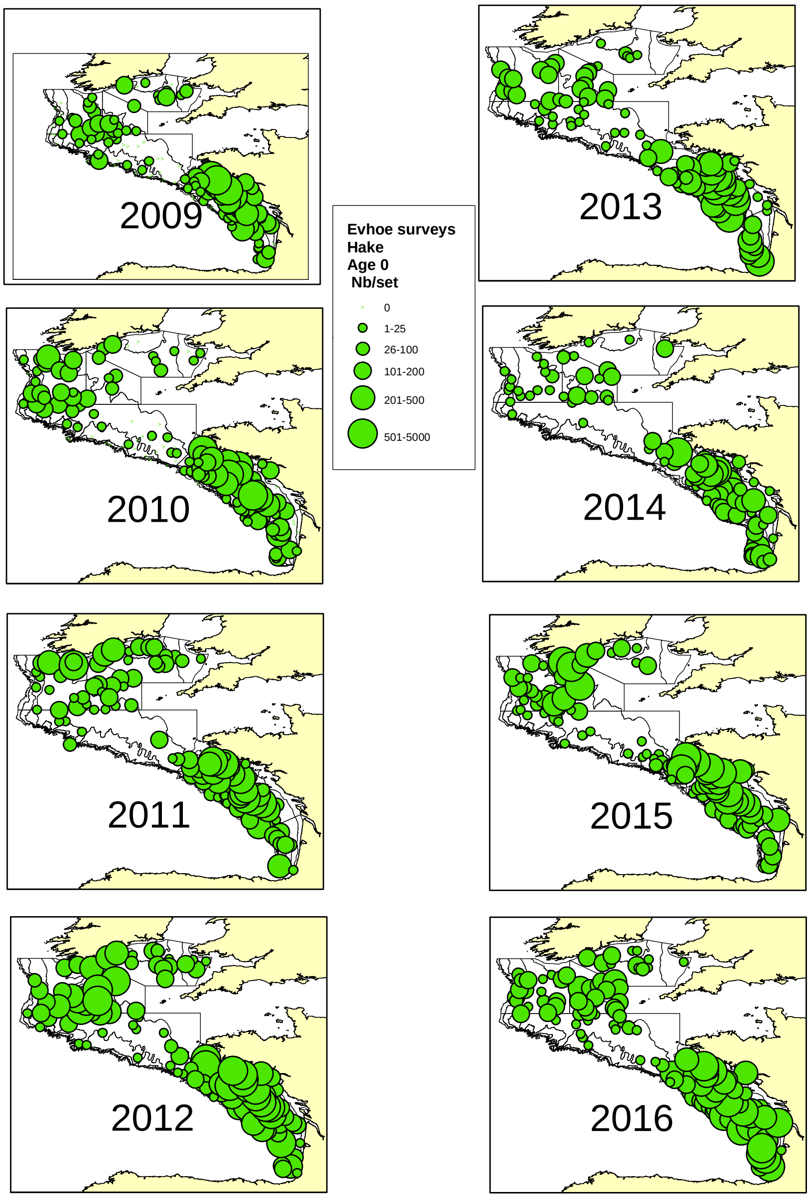
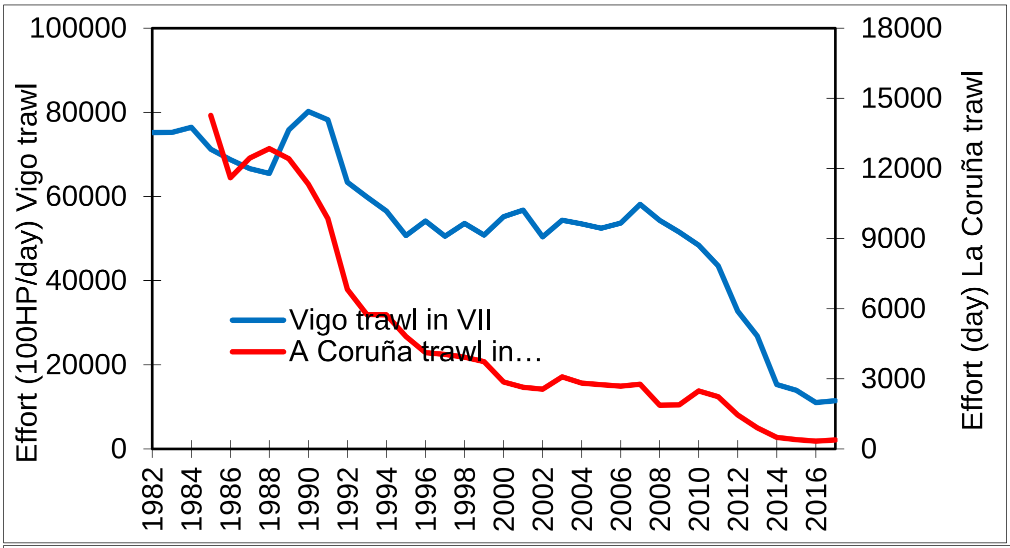


Figure 9.2. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Spatial distribution of hake (0–20 cm) indices from EVHOE-WIBTS-Q4 survey from 2006 to 2016.



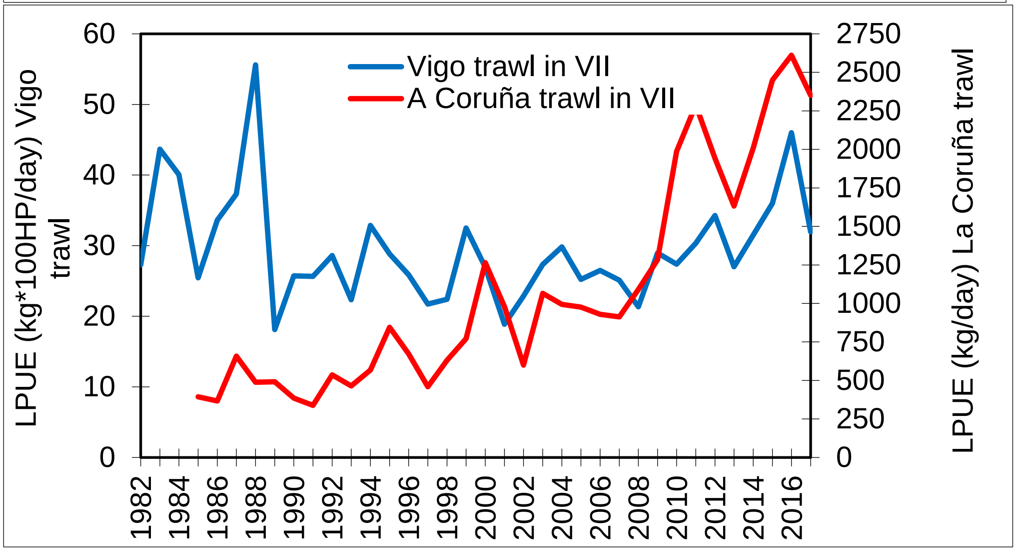


Figure 9.3. Northern Hake. Effective effort indices and LPUE values of commercial fleets estimated by National laboratories.

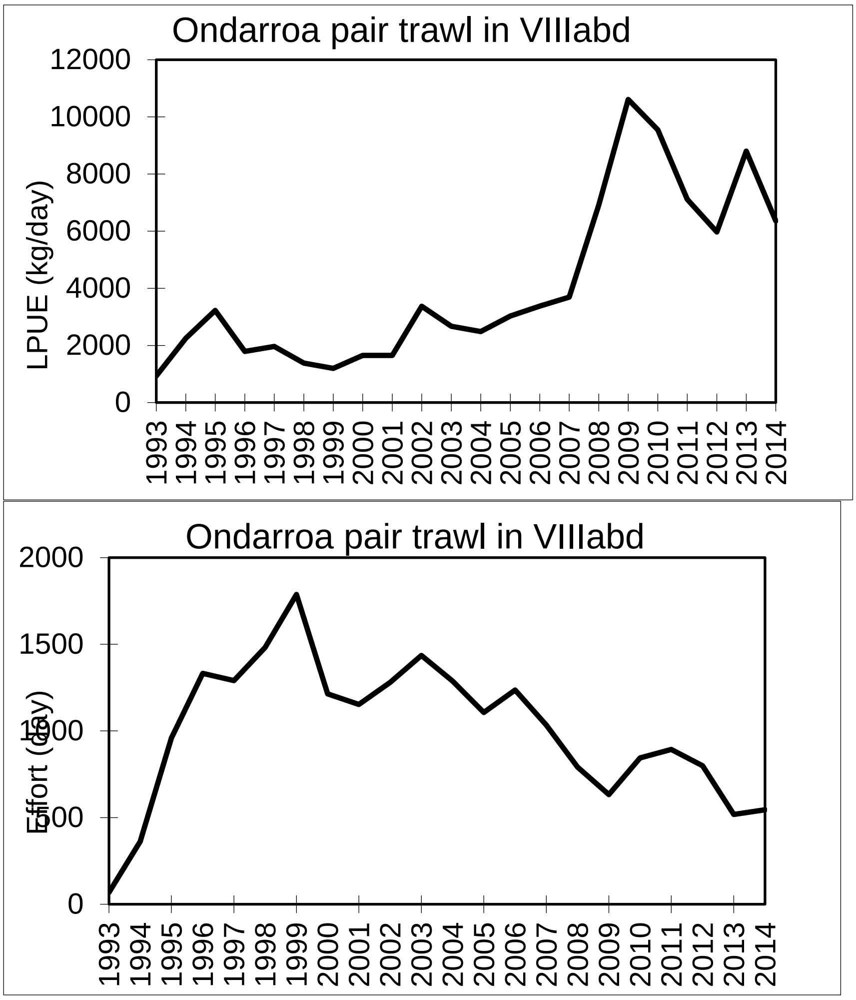


Figure 9.3. Continued

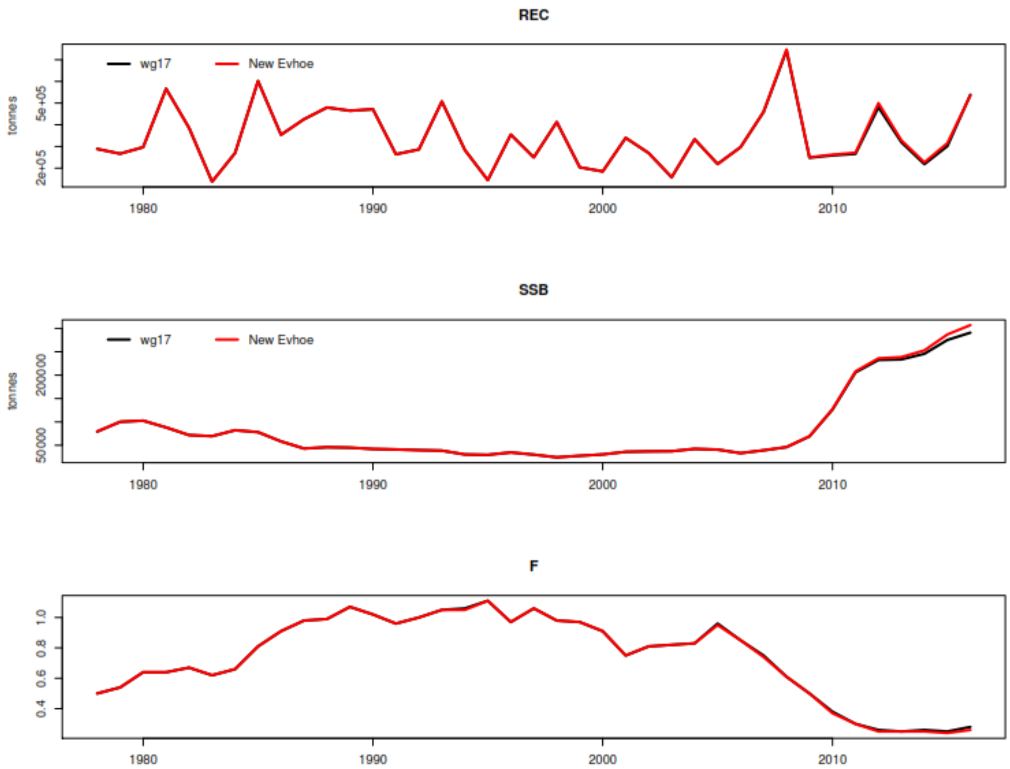


Figure 9.4. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Comparison between results indicators obtained with the EVHOE time series used until 2016 (black) and the new time series (red).

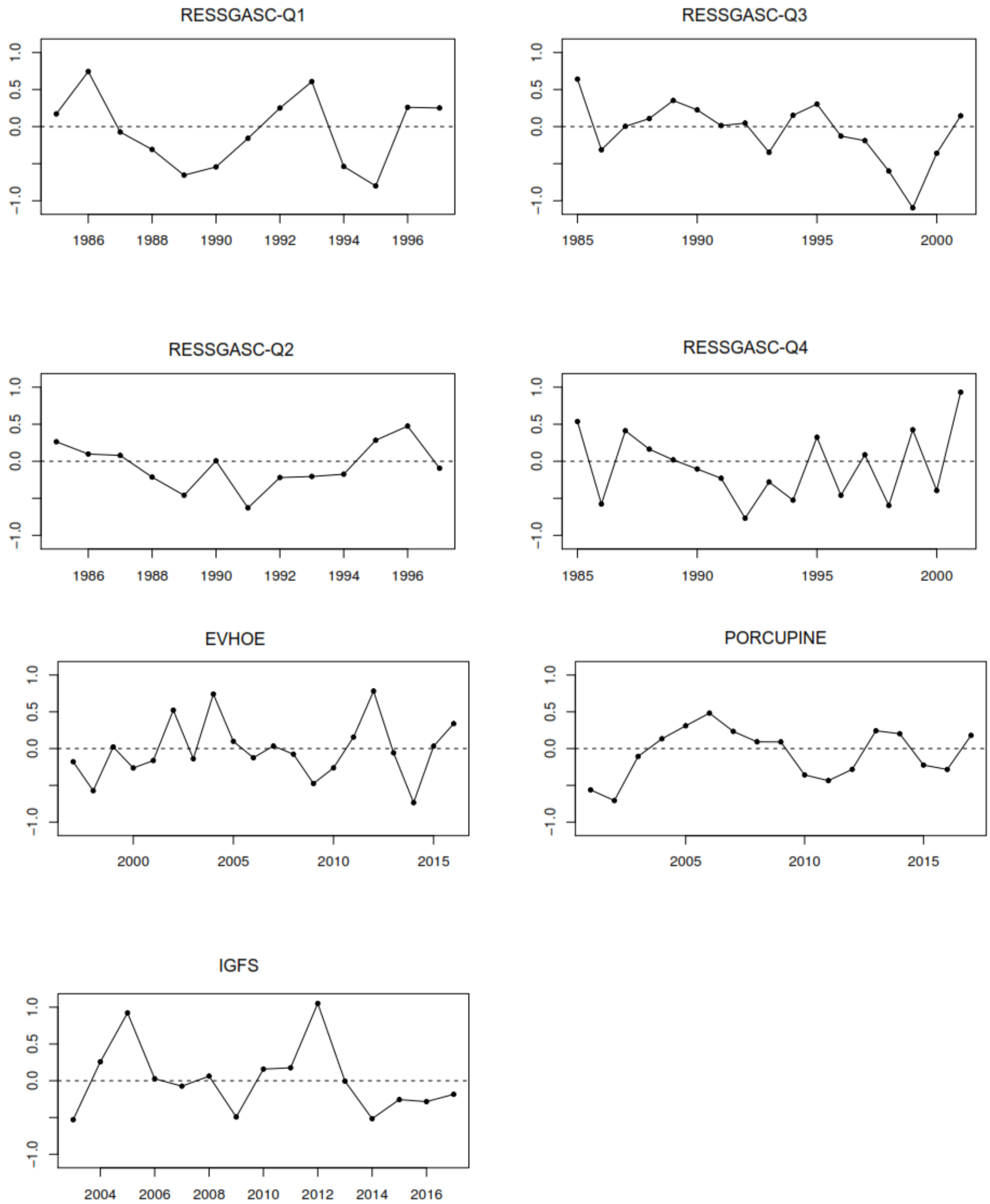


Figure 9.5. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Residuals of the fits to the surveys log(abundance indices). For RESSGASC, EVHOE, PORCUPINE and IGFS, fits are by quarter.

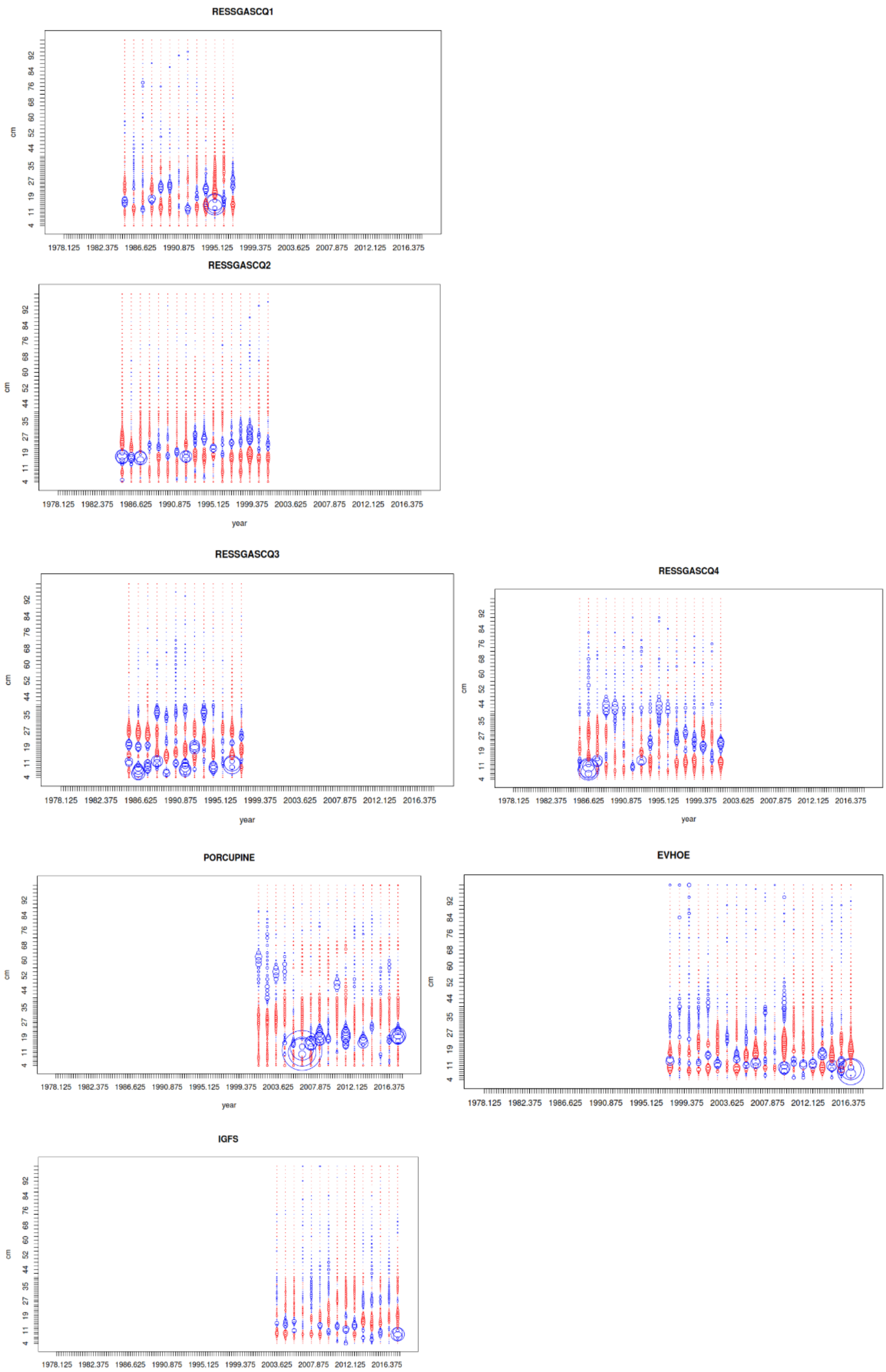
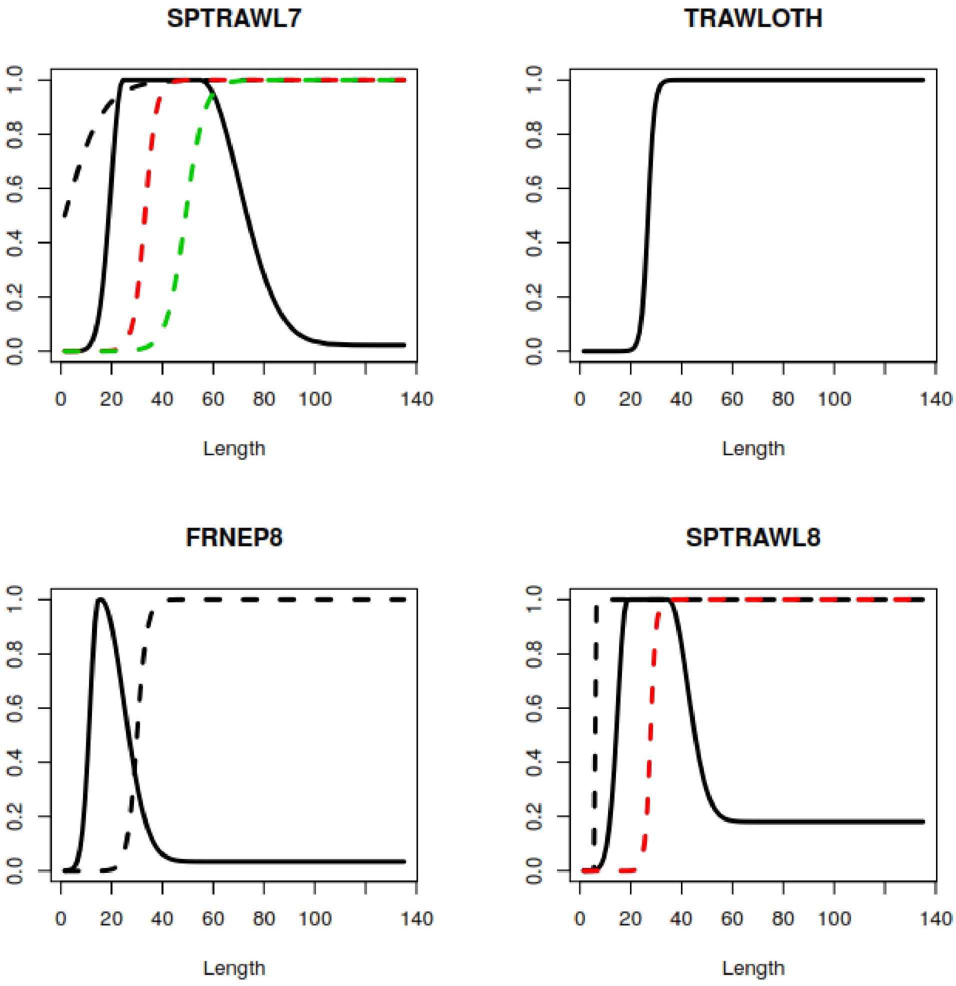


Figure 9.6. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter. Blue and red denote positive and negative residuals, respectively.


SPTRAWL7
TRAWLOTH
FRNEP8
SPTRAWL8
Length
Length
Length
Length
0.0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100
140

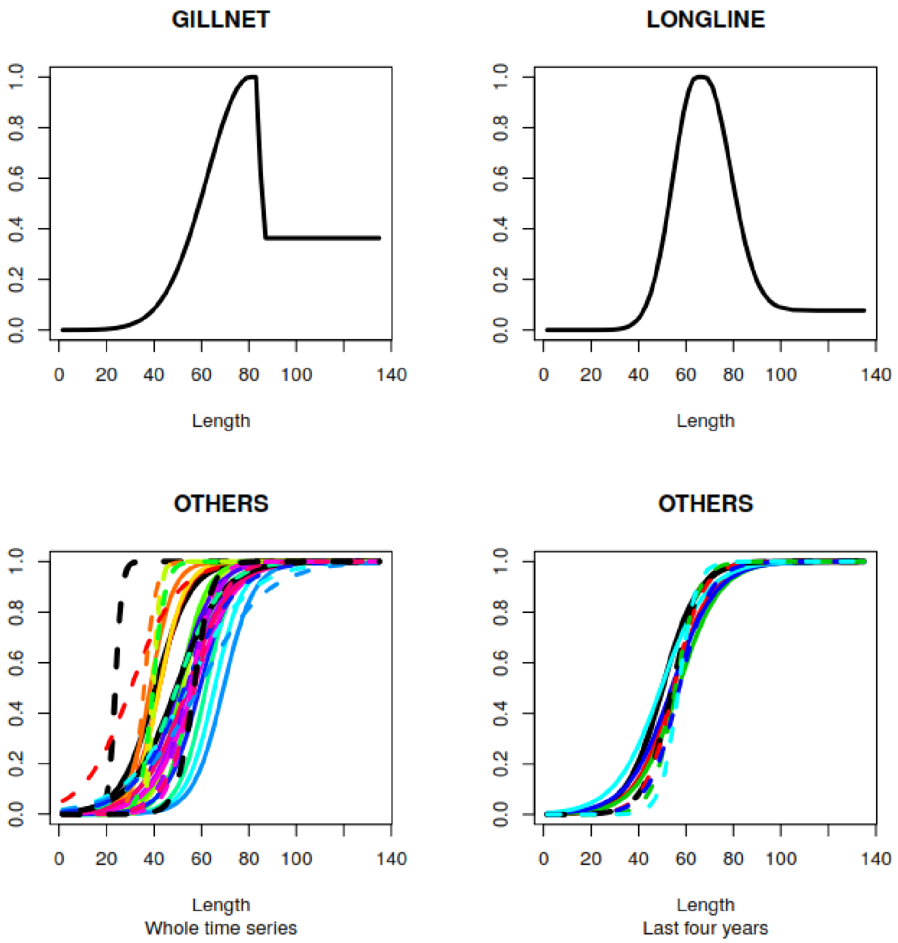


Figure 9.7. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Selection patterns (solid lines) and retention functions (dashed lines) at length by commercial fleet estimated by SS3. For SPTRAWL7, retention functions for 1978–1997, 1998–2009 and 2010-2013 are in black, 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 last five years, 2013 (black), 2014 (red), 2015 (blue), 2016 (green) and 2017 (blue light).

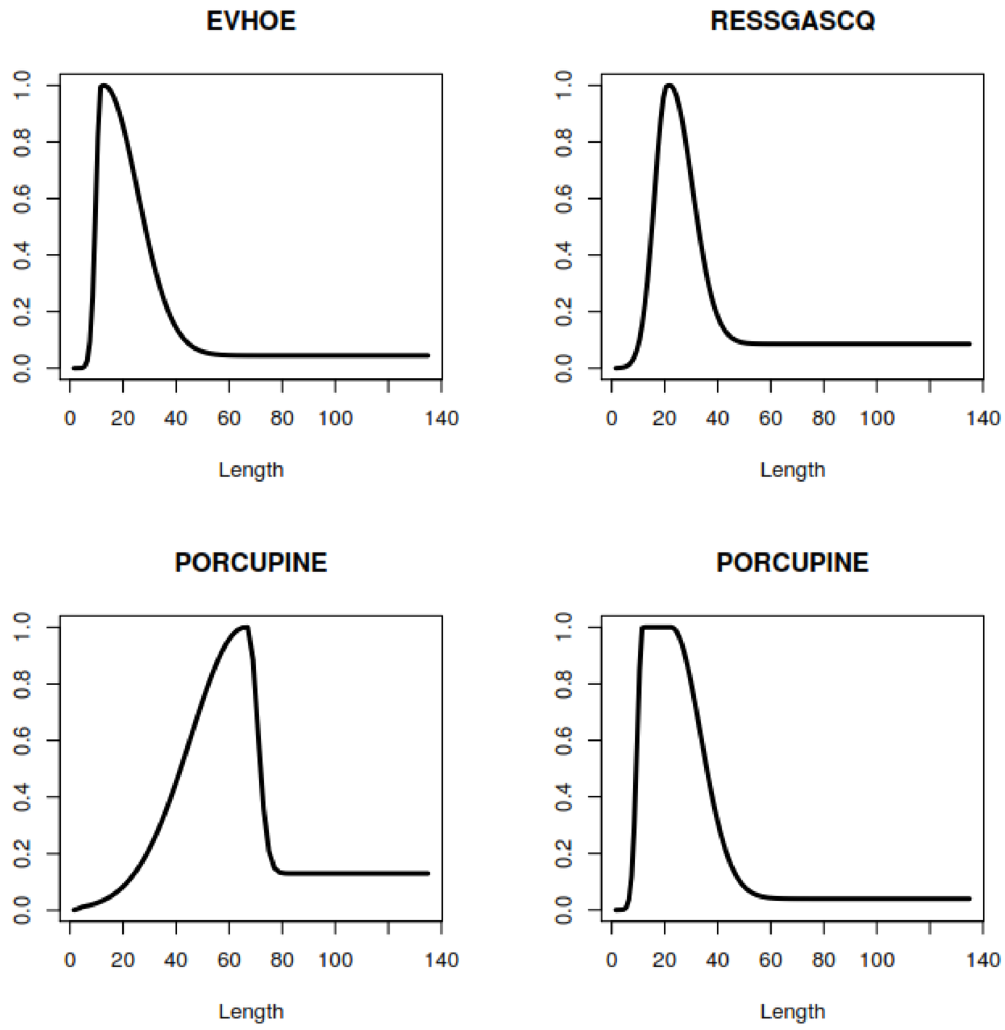


Figure 9.7 (continued). Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Selection patterns at length for surveys estimated by SS3.

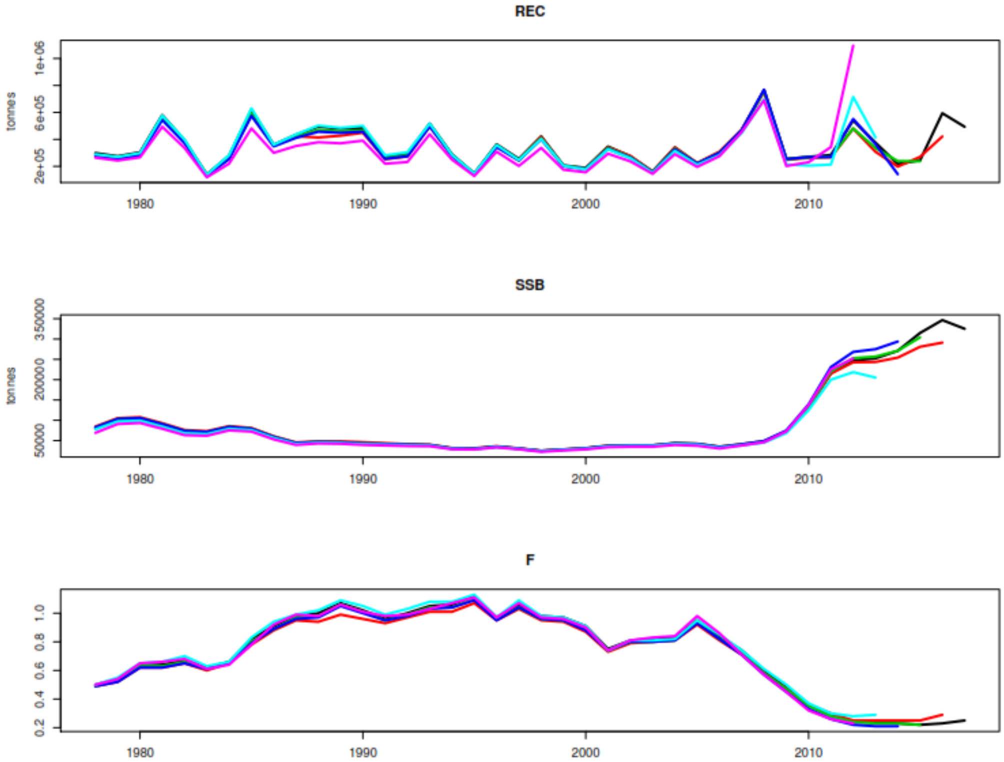


Figure 9.8. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Retrospective plot from SS3.

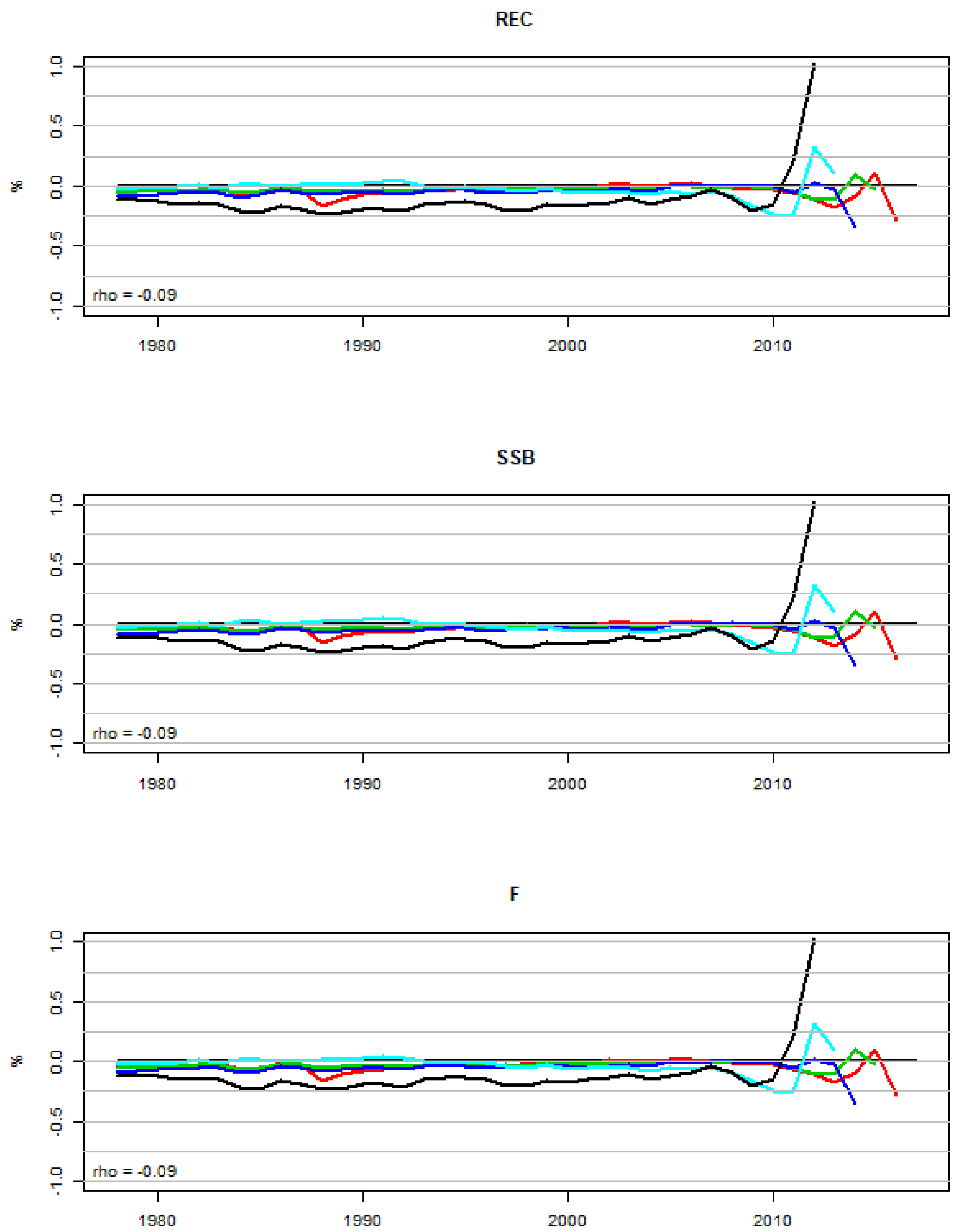


Figure 9.9. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Differences between time series in the retrospective analysis plot from SS3 for 2009–2015.

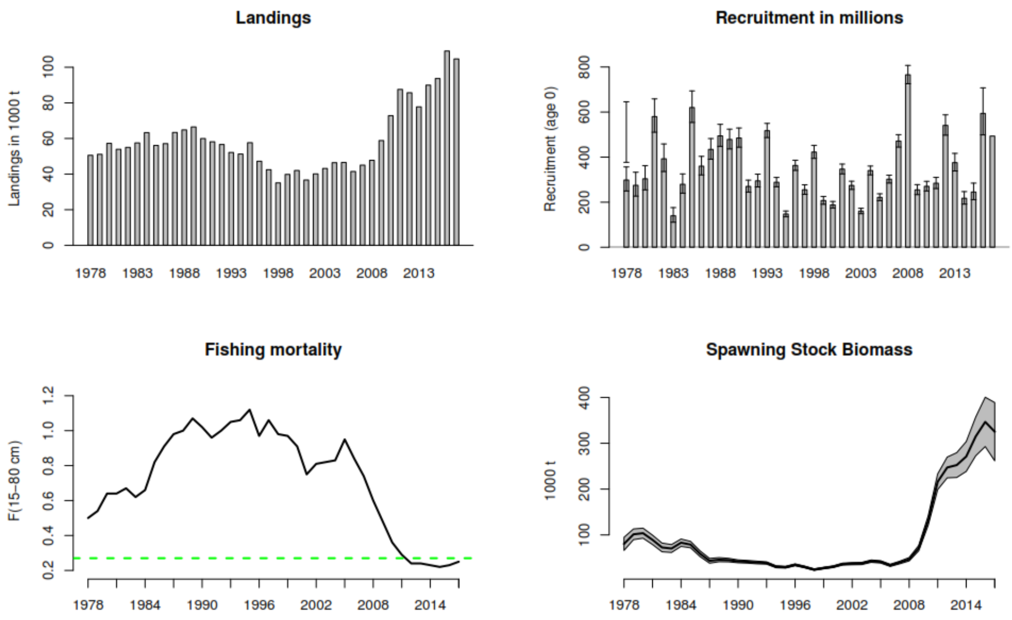


Figure 9.10. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Summary plot of stock trends.

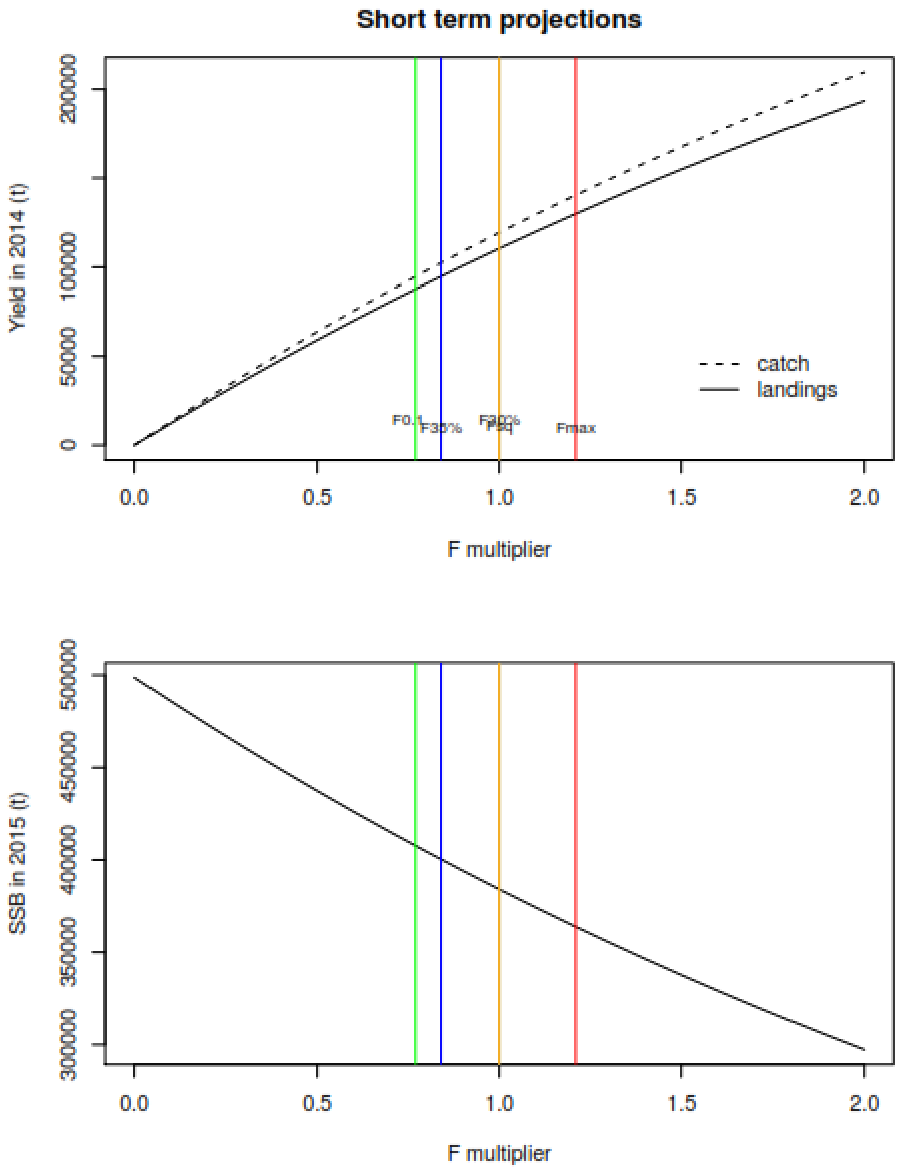


Figure 9.11. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Short term projections

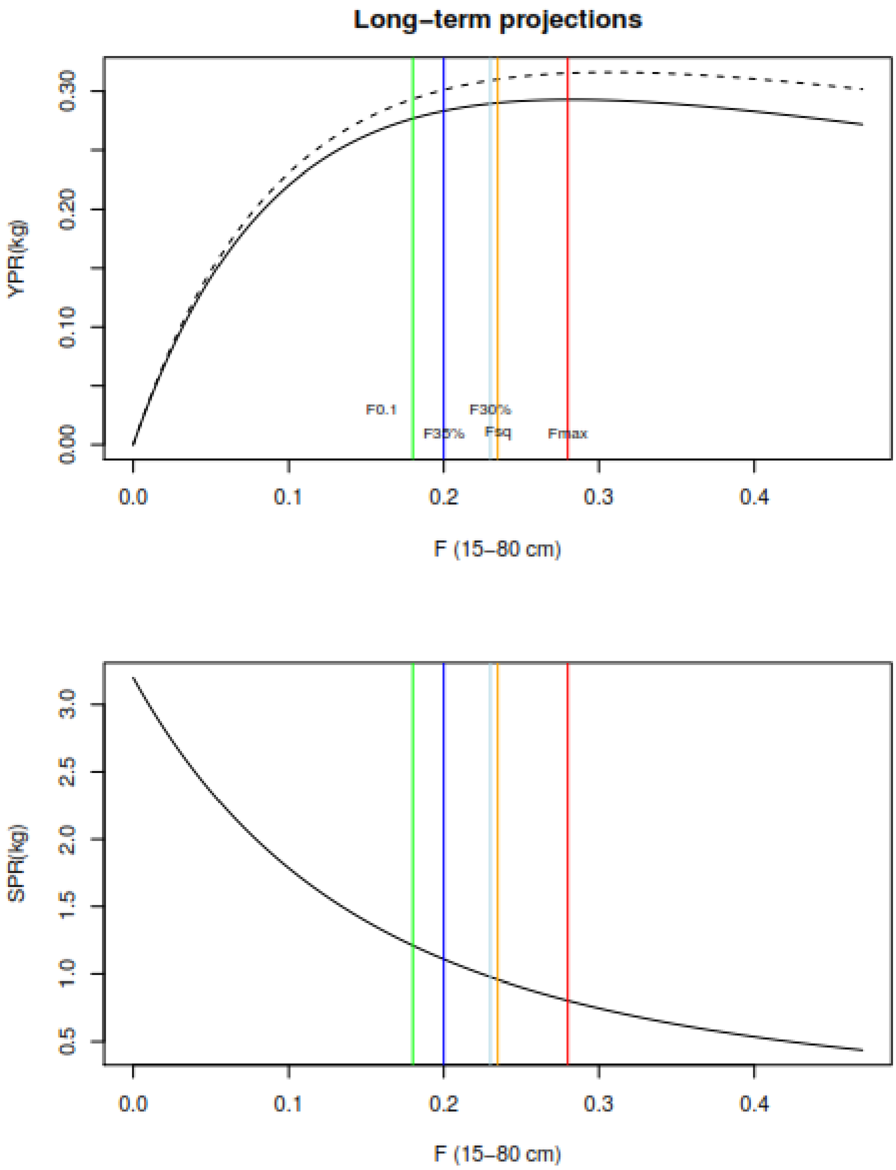


Figure 9.12. Hake in Division 3.a, Subareas 4, 6 and 7 and Divisions 8.a,b,d (Northern stock). Equilibrium yield and SSB per recruit.

10 Southern Stock of Hake

10.1 General

The type of assessment is "update" based on a previous benchmark assessment (WKSOUTH, 2014).

This year assessment was updated with 2017 data with no reviews of previous year's data.

10.1.1 Fishery description

Fishery description is available in the Stock Annex (Annex G).

10.1.2 ICES advice for 2018 and Management applicable to 2017 and 2018.

ICES Advice for 2018

ICES advised that when the MSY approach is applied, catches in 2018 should be no more than 8 561 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 2017 and 2018

Hake is managed by TAC, effort control and technical measures. The agreed TAC for Southern Hake in 2017 was 10 520 t and in 2018 it is 9 258 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 as a suitable recovery target. Taking this in consideration, EU (CR 2018/1209) considers that it was appropriate to fix the Southern hake TAC on the basis of maximum sustainable yield advice. EU (CR 2018/1209, annex II-b) regulation includes effort management measures, limiting days at sea for each country. This stock was under partial landing obligation since 2016.

Technical measures applied to this stock include: (i) minimum landing size of 27 cm, (ii) protected areas, and (iii) minimum mesh size. These measures are set, depending on areas and gears, by several national regulations.

According to the Spanish Regulations progressively implemented after 2011 AAA/1307/2013, the Spanish quota is shared by individual vessels. This regulation was updated in 2015 (AAA/2534/2015) including a fishing plan for trawlers. Regulations (EU Reg. 850/98) also established a closure for trawling off the southwest coast of Portugal, between December and February.

10.2 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) rose to the total effort for each métier.

In 2017, overall landings decreased from 12 443 t in 2016 to 9 171 t in 2017. Portuguese official landings were 1 484 t, below those of 2016 (1973 t). Spanish official landings were 6 857 t in 2017 while they had been 8 063 t in 2016. Non-reported landings decreased to 763 from 2 174 t in 2016. Total discards in 2016 were 2 313 t and decreased to 1 676 t in 2017. Total catches were 10 847 t in 2017 less than the 14 756 t observed in 2016. TACs were 10 520 t in 2016, which means total catches slightly overpass the TAC.

Length distributions for 2016 landings and discards are presented in Figure 10.1. and in Table 10.2. Mean size has lately been quite stable in landings (33.4 in 2015 and 33.7 in 2017), as well as in discards (20.0, 22.0 and 22 cm in the latest 3 years). Catch lengths varied from 26.4 in 2015 to 28.3 cm in 2017.

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 and 30.3 in 2017, the historical lowest.

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 in autumn to minimize any sources of variability. They are part of the IBTS system (ICES, 2017), 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). It shows low values for biomass and abundance in the early 2000s and increases after 2004 showing the maximum historical values in 2008–10, 2012 and 2015. Values in 2016 and 2017 are near the historical mean. The Spanish ground fish survey (SpGFS-WIBTS-Q4) shows similar trend with low values for biomass and abundance in the early 2000s. These values increased after 2004 with a maximum in 2009-12 and 2015. It decreases in 2016 and 2017 although above the historical mean. 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 followed by a decrease in 2016 and 2017, all reaching values around 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 (vessels longer than 15m). All vessels in the recovery plan are required to be equipped with an e-logbook system. The standardized CPUE from the Portuguese bottom-trawl fleet targeting groundfish 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 2017). P-TR LPUE has been above the historical mean after 2007, peaking in 2015 and is about the historical mean in 2017.

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 shows 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 Figures 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 19–34 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.

P-TR (25–40 cm) showed negative residuals with a downward trend between 2005 and 2010, but has since then returned to lower residuals. 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 plot 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

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. 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 2004 with mean figures around 70 million (ranging from 40 to 120 mill); another between 2005 and 2009, with mean figures of 123 mill; and another between 2010 and 2016, around 80 mill. Recruitment in 2017 was replaced with the geometric mean of years 1989-16 (79 427 mill).

Fishing mortality increased from the beginning of the time series (F=0.36 in 1982) peaking in 1995–97 to around 1.17; declining to 0.79 in 1999 and remaining relatively stable until 2012 (F=0.82). F then progressively declined with oscillations and, reached 0.44 in 2017. The SSB was very high at the beginning of the time series with values around 45 000 t, then decreased to a minimum of 5 709 t in 1998. Since then biomass has tended to increase, reaching 20 041 in 2017.

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 2017–2012. 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. Monhn's Rho index for the last 6 years were estimated for recruitment (0.86), F (-0.24) and SSB (0.32). The recruitment figure is overestimated since last year is usually replaced with a geometric mean. Even though figures are high indicating a problem for the assessment and advice.

To better understand the causes of this pattern a retrospective analysis of the parameters estimated by the GADGET model was performed. Recruitments are quite stable in the beginning of the time series and become more variable in the recent years as it is shown in Figure 10.10. Growth parameters have also been quite stable as well as the abundance in the first year (1982) ages. The next table shows the other parameters estimated by the model as a proportion of bias compared with the last year assessment ($(100^*ParX_{yr}-ParX_{2017})/ParX_{2017}$)

Parameter	land_slp-1982-93	Land_L50_1982-93	land_slp-94+	Land_L50_94+	Land_Cadiz_1	Land_Cadiz_3	Land_Cadiz_4	Disc_1993-17_1	Disc_1993-17_2	Disc_1993-17_3	SpSurv1	SpSurv3	SpSurv4	PtSurv1	PtSurv3	PtSurv4	CdAutSurv1	CdAutSurv3	CdAutSurv4
2016	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	**-2%**	**7%**	**2%**	**-35%**	**8%**
2015	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	**-1%**	**-1%**	**2%**	**13%**	1%	**-20%**	**2%**
2014	0%	0%	**3%**	0%	0%	0%	0%	0%	-1%	0%	0%	**4%**	**-2%**	0%	**2%**	**15%**	1%	**-25%**	**-4%**
2013	0%	0%	**5%**	0%	0%	0%	0%	0%	-1%	0%	0%	**3%**	**1%**	1%	**-5%**	**32%**	-1%	**-14%**	**-22%**
2012	0%	0%	**4%**	0%	0%	0%	0%	0%	1%	0%	0%	**4%**	**-5%**	1%	**-2%**	**40%**	1%	**-29%**	**-10%**

The table identifies the parameters more sensitive to peel (subtracting one year of data before refitting the model) which are the selection of the different fleets (landings, discards and surveys). The more sensitive fleets are the 3 surveys. However these have not a direct impact on the stock dynamics since are fleets that are not contributing to the fishing mortality. Among the fleets contributing to the population dynamics there are only one parameter sensitive to peel that is "Land_slp-94+", corresponding to the slope parameter in the logistic selection to the landings from 1994 to 2017. To evaluate the impact of this parameter on the retrospective patter, this parameter was fixed with the fitted figure in 2017 (0-76) in all the peels (2016-12). The model was then refitted and the Mohn's Rho produced the following figures: 0.85 for recruitment; -0.23 for F and 0.30 for SSB. The figures are slightly lower than original but not enough to identify this parameter as relevant in the retrospective pattern observed. Further work is required to identify the causes of this pattern.

10.4 Catch options and prognosis

10.4.1 Short-term projections

Short term projections are presented in Figure 10.11 and Table 10.7. The methodology used was developed during the latest benchmark (WKSOUTH, 2014) and WKMSREF4 (2015), and is described in the Stock Annex. The 2017 recruitment figure was replaced with the geometric mean and F was scaled to the mean of the last 3 years; this is higher than the F estimated for 2017, but it is considered a more appropriate assumption given the observed retrospective pattern. This procedure is considered to improve the estimate of the hake population abundance at the start of 2018 and, therefore, to provide the most suitable basis for the calculation of catch options for 2019...

Note that mortality in GADGET is length based and F multipliers do not apply linearly, e.g. if F_{mult}=1, F is 0.64 and if F_{mult}=0.5, F is 0.31.

In 2018 the expected SSB is 23 885t. F_{sq} for the intermediate year (2018) is 0.60. Recruitment for 2017-19 is 79 427 thousands. During the intermediate year, 2018, the expected yield (landings) is 14 483 t and the SSB at the end of the year is expected to be 23 904 t. It should be noted that catches in 2018 (16 709 t) are likely overestimate as a consequence of the settings chosen for F under the retrospective pattern.

Different F multipliers applied in 2019 provide management alternatives according to different scenarios. Under F_{sq} (F_{mult}=1), F would be 0.60, the expected catch would be 10 922 t and SSB in 2020 would be 32 001 t. Under the recovery plan, decreasing F by 10% (F_{mult}=0.9), F would be 0.54, the landings in 2019 would be 13 380 t which is outside the TAC constraint range (15%). This makes the recovery plan option the one with the landings equal to 2018 TAC * 1.25 (9 278 t), with F=0.34 and SSB on 2020 of 32 426 t. With the MSY approach (F=0.25), F_{mult} would be 0.41, the yield and catch 7 220 t and 8 281 t and SSB in 2020 would be 36 104 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 1989–2016. The F_{max} estimated as 0.25 confirm the stability of F_{MSY} from year to year.

The following table shows the expected long-term figures for different reference Fs:

	F (1-3)	Yield	SSB
Fsq	0.60	13700	22581
Flow	0.17	17650	103921
Fmsy	0.25	18360	74643
Fupp	0.36	17371	48141

10.5 Biological reference points

Reference points were estimated by WKMSYRef4 (ICES 2016). MSY $B_{trigger}$ was set as a B_{pa} by ACOM (ICES, 2016).

Reference points

PA Reference points	Value	Rational
B_{lim}	8 000	Hockey stick breakpoint (8 000 t if rounded)
B_{pa}	11 100	B_{lim} * 1.4
F_{lim}	1.05	F corresponding to the slope of the hockey stick SSB-Rec relationship
F_{pa}	0.75	F_{lim} / 1.4
MSY Reference points		
F_{MSY}	0.25	
F_{MSY} lower	0.17	
F_{MSY} upper	0.36	
B_{MSY}	73 330	
MSY	18 139	
MSY $B_{trigger}$	11 100	

10.6 Comments on the assessment

Updates of the index SP-CORUTR since 2013 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 and 2009, after which it returned to values around the historical mean. Since 2015recruitment returned to values around average.

The retrospective pattern shows a trend to overestimate SSB and underestimate F.

10.7 Management considerations

The stock is in a healthy status (SSB in 2018 is 23 885 t, well above B_{pa} = 11 100 t). However, the stock continues to be overexploited (F 2017=0.44, well above F_{MSY} = 0.25), although inside precautionary limits (F_{pa}=0.75). The stock has been exploited above F_{MSY} 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. The causes of this pattern are not yet well understood.

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.

10.8 References

ICES.2017. Manual of the IBTS North Eastern Atlantic Surveys. Series of ICES Survey Protocols SISP 15. 92 pp. http://doi.org/10.17895/ices.pub.3519

10.9 Tables and Figures

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	0.47	2.6		6.14	1.82	14.57	16.4
2013	0.64	1.75	1.11	0.62		1.86	1.16	2.22	7.2	1.93	0.81	0.33	2.7	0.31	1.46	2.55	11.66	14.2
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
2017	0.69	1.51	1.71	0.27		1.60	1.08	1.43	6.86	0.91	0.57	0.24	1.48	0.07	0.76	1.68	9.17	10.8

Table 10.2 Hake Southern Stock: length compositions (thousands)

Length (cm) (4 to 100+ each 2)	Land	Disc	Catch
4	0	0	0
6	1	149	150
8	39	1164	1203
10	192	1723	1915
12	277	1811	2088
14	382	1194	1576
16	474	2049	2523
18	741	4558	5299
20	786	6587	7373
22	584	4404	4988
24	754	2456	3210
26	1238	850	2088
28	2151	311	2462
30	2372	88	2460
32	2256	50	2306
34	2107	19	2126
36	1840	19	1859
38	1112	36	1148
40	773	2	775
42	602	0	602
44	397	0	397
46	375	0	375
48	411	0	411
50	377	0	377
52	354	1	355
54	327	0	327
56	272	17	289
58	251	0	251
60	205	0	205
62	171	0	171
64	149	0	149
66	103	0	103
68	87	0	87
70	68	0	68
72	56	0	56
74	39	0	39
76	26	0	26
78	17	0	17
80	10	0	10
82	7	0	7
84	5	0	5
86	3	0	3
88	2	0	2
90	2	0	2
92	1	0	1
94	1	0	1
96	1	0	1
98	0	0	0
TOTAL	22398	27488	49886
Weight (000' tons)	9.10	1.68	10.78
SOP	9.08	1.68	10.76
SOP / NW	1.00	1.00	1.00
Mean length (cm)	34.6	19.4	26.3

*** without France landings (0.07 thousand t)**

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
2017											19.7	2.6	256.1	57.9	136.6	89

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

Data in 2014-2016 reviewed in 2018

Table 10.4 Hake Southern Stock: Spanish groundfish surveys; biomass, abundances and recruitment indices.

	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	118.5
2017	6.58	0.57	112	158.8	14.5	140	4.74	0.89	44	151.1	3.39	0.52	45	

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)	s.e. (lpue)	Effort
1985	945	21	45920				
1986	842	21	39810				
1987	695	20	34680				
1988	698	17	42180				
1989	715	16	44440	1847	45.2	3.7	40870
1990	749	17	44430	1138	41.8	3.5	27224
1991	501	12	40440	1245	37.6	4.8	33101
1992	589	15	38910	1325	35.7	3.1	37144
1993	514	12	44504	870	29.3	2.9	29709
1994	473	12	39589	789	35.5	3.9	22199
1995	831	20	41452	1026	44.4	4.2	23095
1996	722	20	35728	758	40.9	4.2	18541
1997	732	21	35211	897	47.7	5.5	18807
1998	895	27	32563	970	41.2	3.7	23532
1999	691	23	30232	1090	49.6	3.9	22000
2000	590	20	30102	1158	35.4	4.7	32710
2001	597	20	29923	1198	45.4	5.0	26371
2002	232	11	21823	965	44.9	3.3	21482
2003	274	15	18493	962	40.8	2.2	23586
2004	259	12	21112	799	41.1	2.1	19456
2005	330	16	20663	965	44.1	2.3	21876
2006	518	27	19264	908	41.1	3.0	22082
2007	621	29	21201	724	39.2	1.8	18456
2008	762	38	20212	936	47.0	2.2	19898
2009	640	40	16162	964	43.9	2.0	21977
2010	553	40	13744	727	44.0	2.1	16540
2011	538	47	11532	493	44.3	2.4	11130
2012	498	42	11887	814	51.9	2.1	15692
2013*	542	37	14736	812	49.2	2.0	16506
2014*	493	27	18060	661	48.2	2.1	13706
2015*	411	31	13309	763	60.9	2.0	12528
2016*	514	38	13718	752	46.0	1.4	16337
2017*	303	24	12449	575	43.2	1.5	13298

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	69.84	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	8.88	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	101.10	11.62	9.71	1.91
1997	1.18	6.48	80.82	10.77	8.50	2.27
1998	0.94	5.71	57.82	9.36	7.68	1.68
1999	0.79	7.41	67.04	8.69	7.17	1.52
2000	0.88	8.68	70.32	9.74	7.90	1.83
2001	0.86	8.82	49.55	9.24	7.58	1.66
2002	0.82	9.22	70.75	8.18	6.69	1.49
2003	0.84	8.99	60.08	8.21	6.74	1.46
2004	0.73	8.99	77.94	7.86	6.94	0.91
2005	0.78	9.36	127.71	10.31	8.33	1.98
2006	0.90	10.69	95.34	14.08	10.82	3.26
2007	0.96	12.53	170.45	17.44	14.93	2.50
2008	0.93	12.29	115.67	19.11	16.80	2.31
2009	0.97	14.21	106.12	22.17	19.24	2.93
2010	0.73	14.13	63.90	16.95	15.37	1.58
2011	0.83	16.93	87.09	19.01	17.06	1.95
2012	0.82	16.00	89.70	16.40	14.57	1.82
2013	0.70	14.27	66.37	13.91	11.35	2.55
2014	0.78	17.22	83.92	14.48	11.88	2.60
2015	0.69	15.48	99.51	13.84	11.55	2.29
2016	0.67	16.48	69.77	14.52	12.21	2.31
2017	0.44	20.04	79.43	10.78	9.10	1.68

Recruitment in 2017 was replaced with geo mean of years 1989-16

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

SSB 2018	BIO 2018	F 2018	Yield 2018	Catch 2018	SSB 2019	BIO 2019
23885	29247	0.60	14483	16709	23904	29098

Fmult	F 2018	Yield 2018	Catch 2018	SSB 2019	
0.00	0.00	0	0	49332	
0.10	0.06	1786	2046	46036	
0.20	0.11	3489	3998	42891	
0.30	0.17	5124	5873	39900	*F = FMSY lower*
0.40	0.23	6655	7631	37123	
0.41	0.24	6862	7869	36749	*Rec. Plan TAC constraint (-15%)*
0.44	**0.25**	**7220**	**8281**	**36104**	*MSY approach: FMSY*
0.50	0.28	8070	9258	34578	*equal TAC*
0.58	0.34	9278	10647	32426	*Rec. Plan TAC constraint (+15%)*
0.60	0.35	9517	10922	32001	
0.62	0.36	9814	11264	31475	*F = FMSY upper*
0.70	0.41	10840	12445	29665	
0.80	0.47	12094	13891	27469	
0.90	0.53	13282	15262	25408	
0.91	0.54	13380	15374	25239	*Rec. Plan: F (2019) = Fsq - 10%*
1.00	0.60	14426	16583	23439	
1.23	0.75	16793	19323	19421	*Fpa*
1.67	1.05	20401	23516	13443	*Flim*

There is a EC Recovery Plan (-10% annual F redution; +-15% TAC constrain)
Fmsy = 0.25
TAC 2017 = 9258 (-+15% [10647, 7869])
Recruitment = 79 427 t mill (gemetric mean 1989-16)

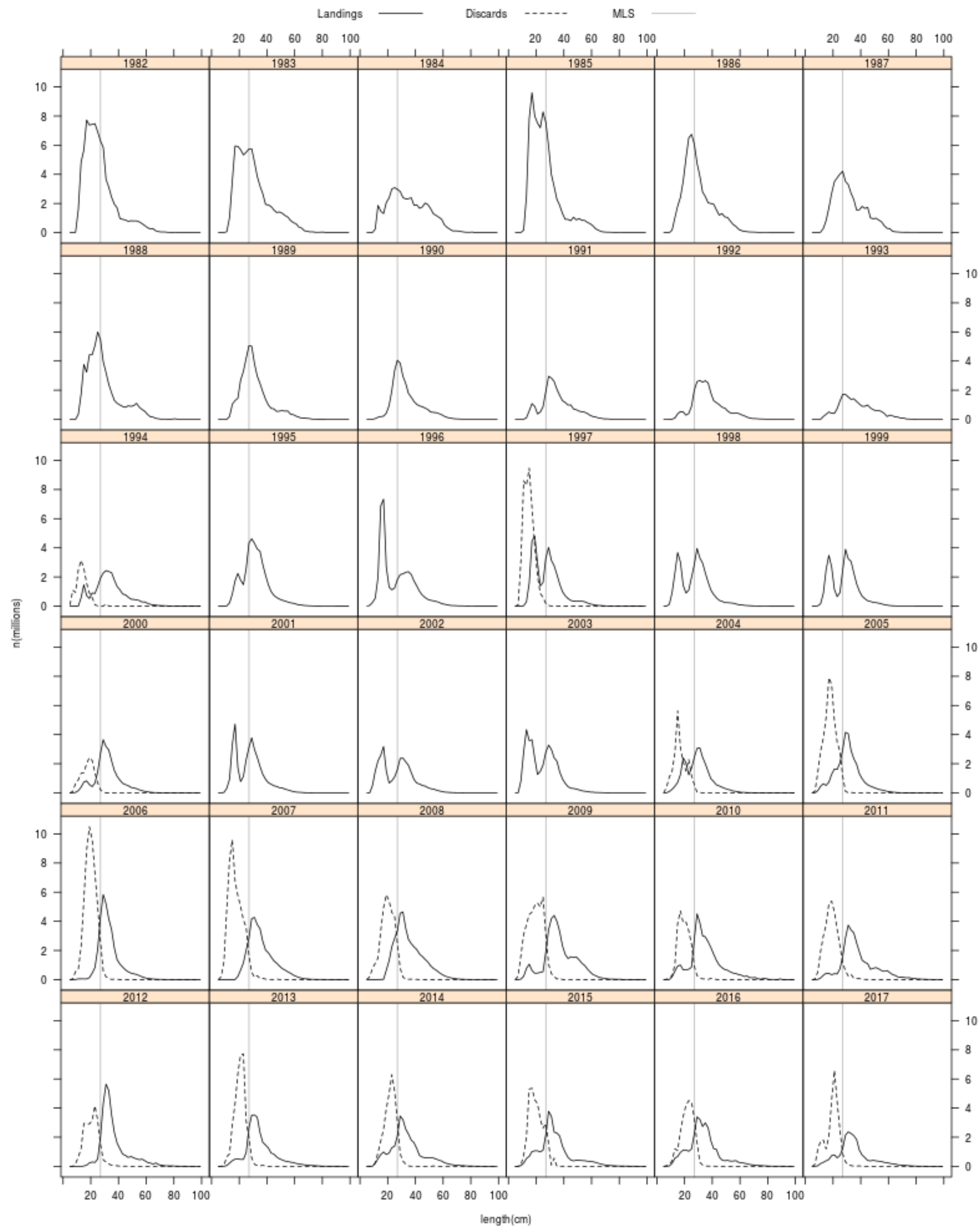


Figure 10.1.Length distribution of catches used in the assessment. Landings (1982-latest year) plus Cadiz landings from 1994–2004. Discards from 1992–latest year (dashed line). Minimum landing size (MLS) since 1992 at 27 cm.

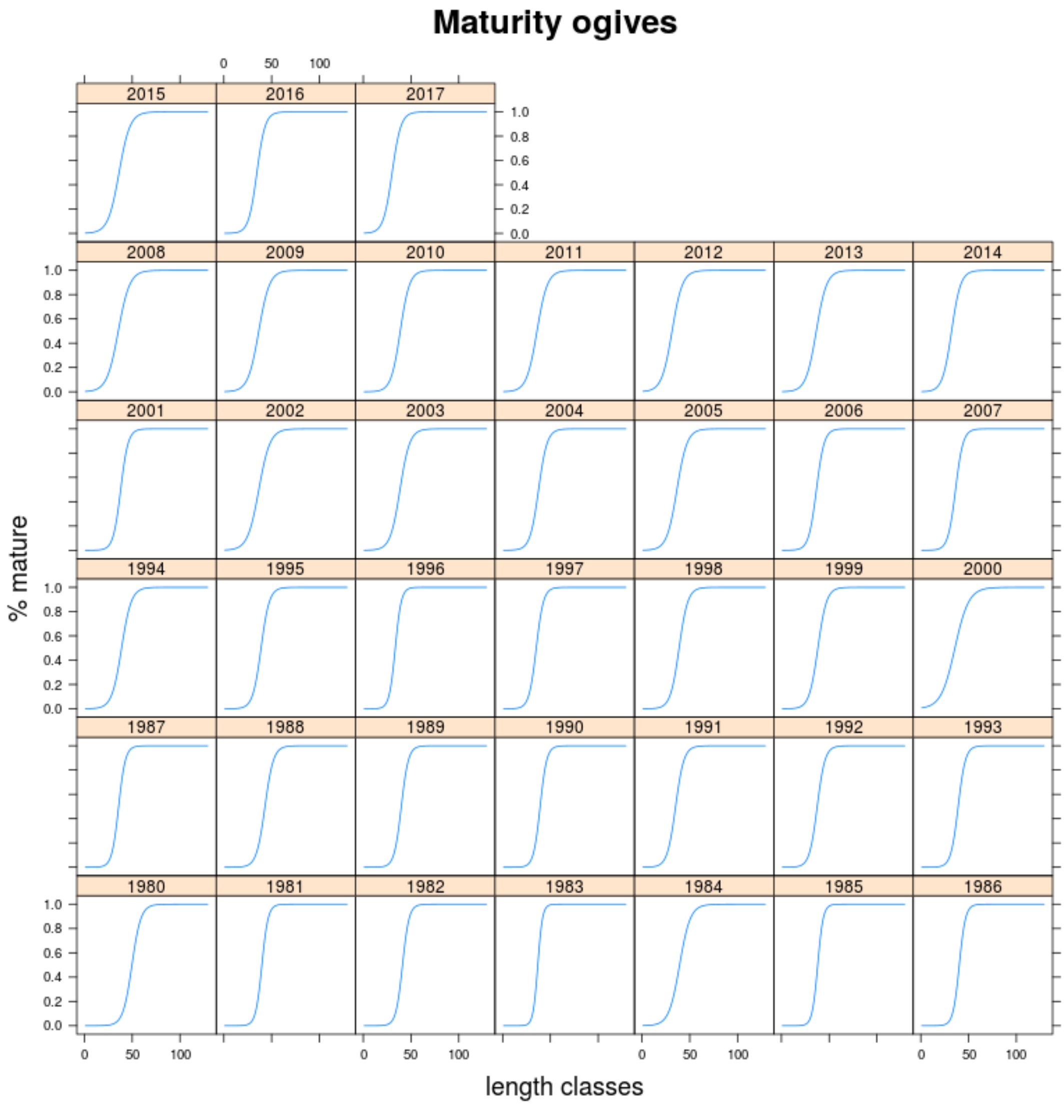


Figure 10.2. Maturity ogives from 1986 to 2016

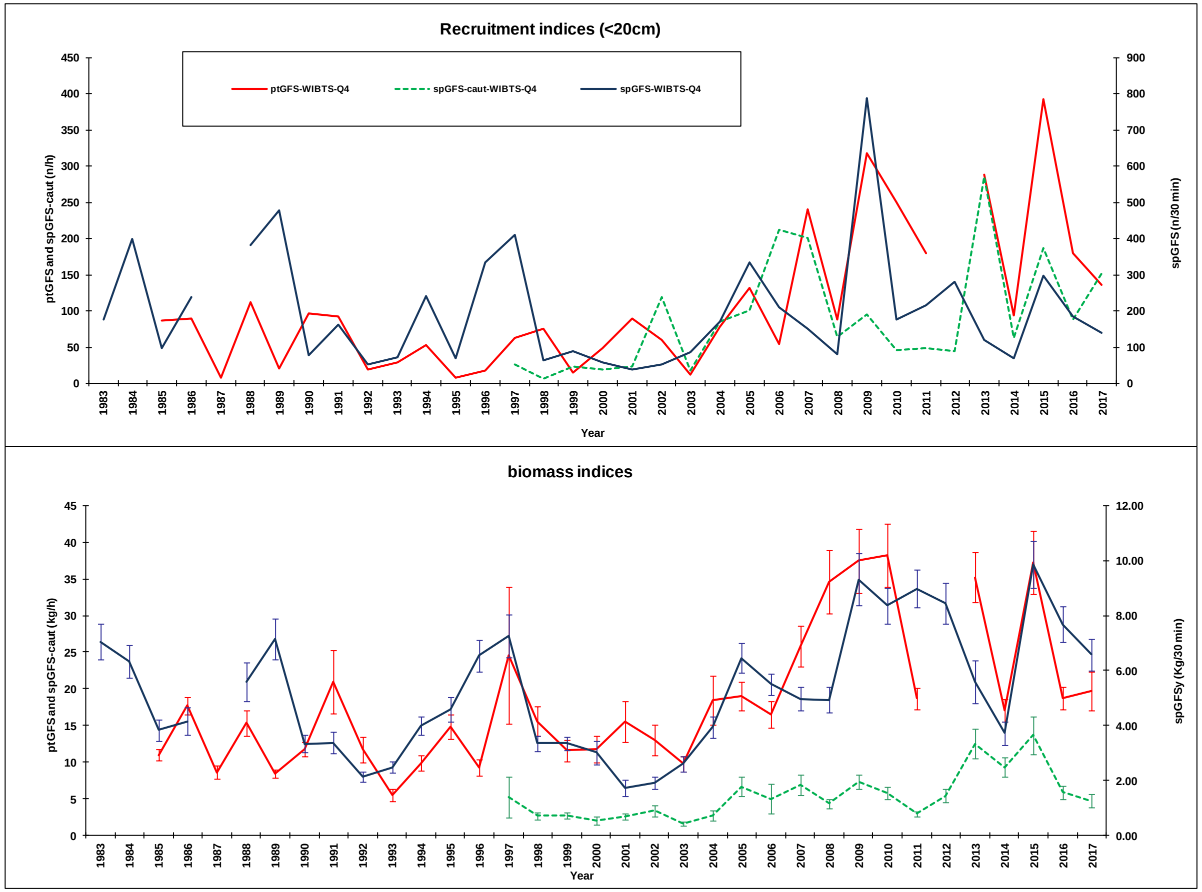


Figure 10.3. Hake Southern Stock: - Recruitment and biomass Indices from groundfish surveys. Vertical bars = 90% CI.

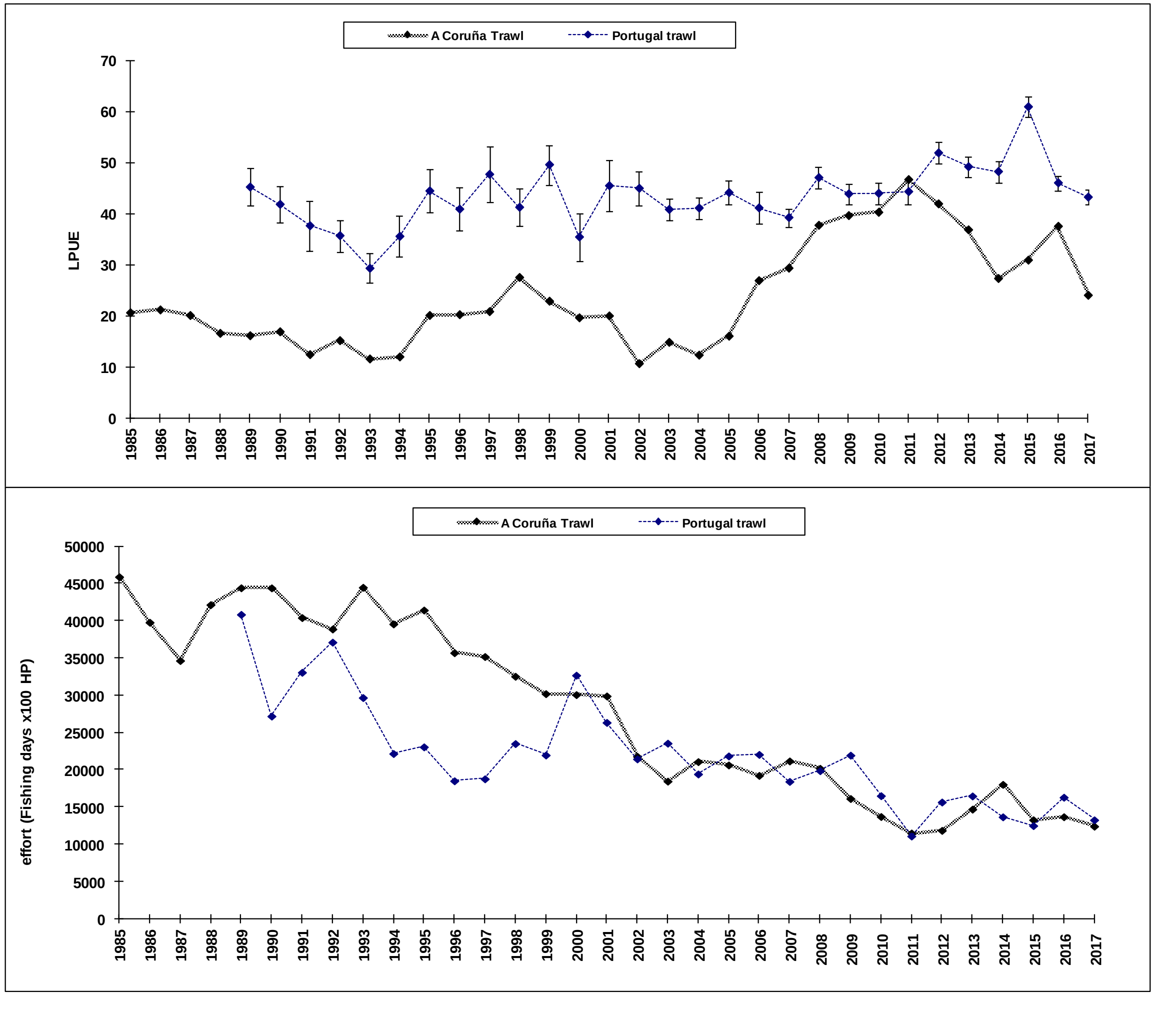


Figure 10.4. Hake Southern Stock: - lpue and fishing effort trends for trawl fleets. Vertical bars = 90% CI.

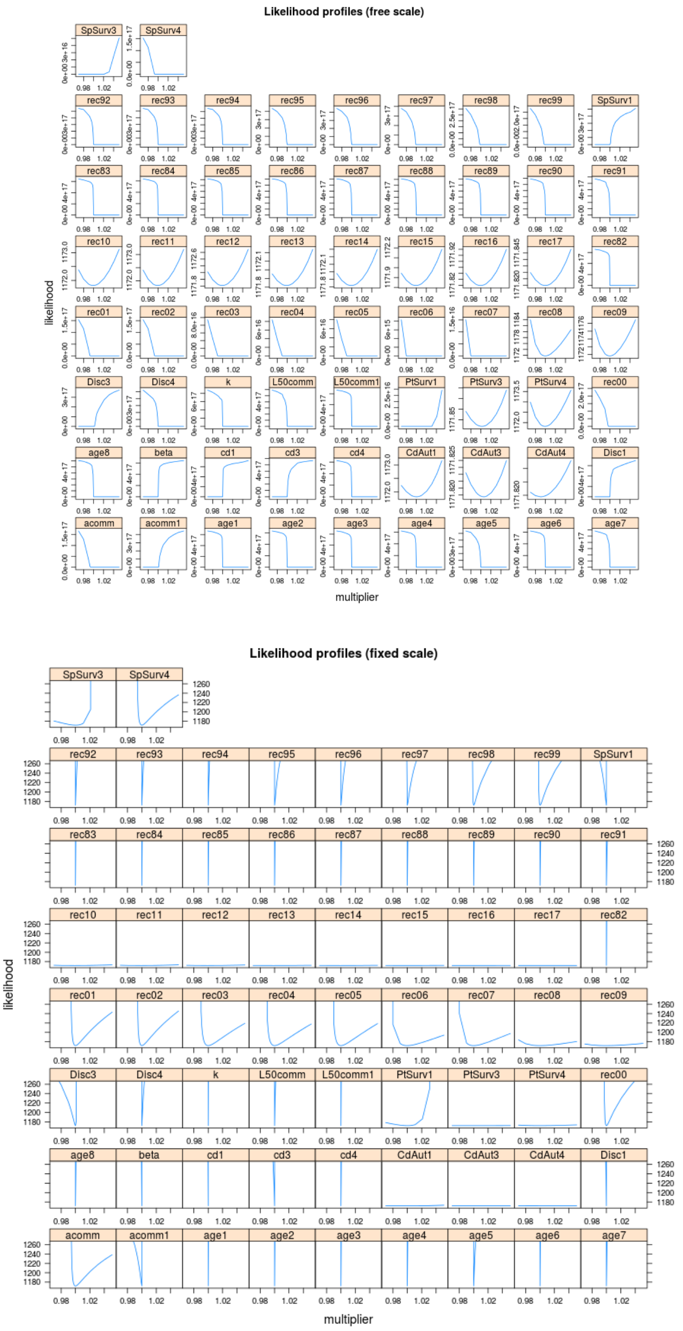


Figure 10.5. Gadget convergence with likelihood profiles. Free scaled (upper panel) and fixed scaled (lower panel)

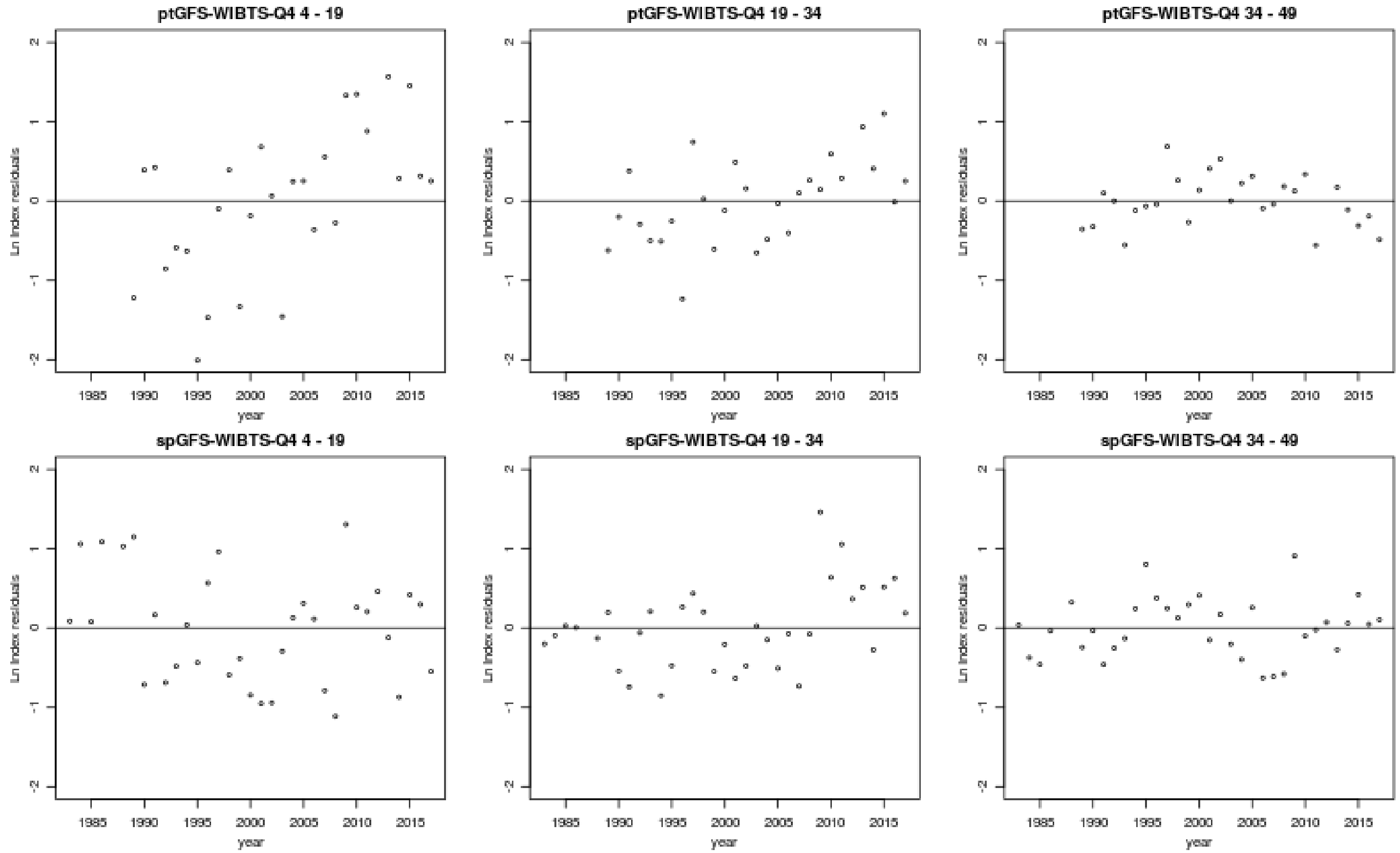
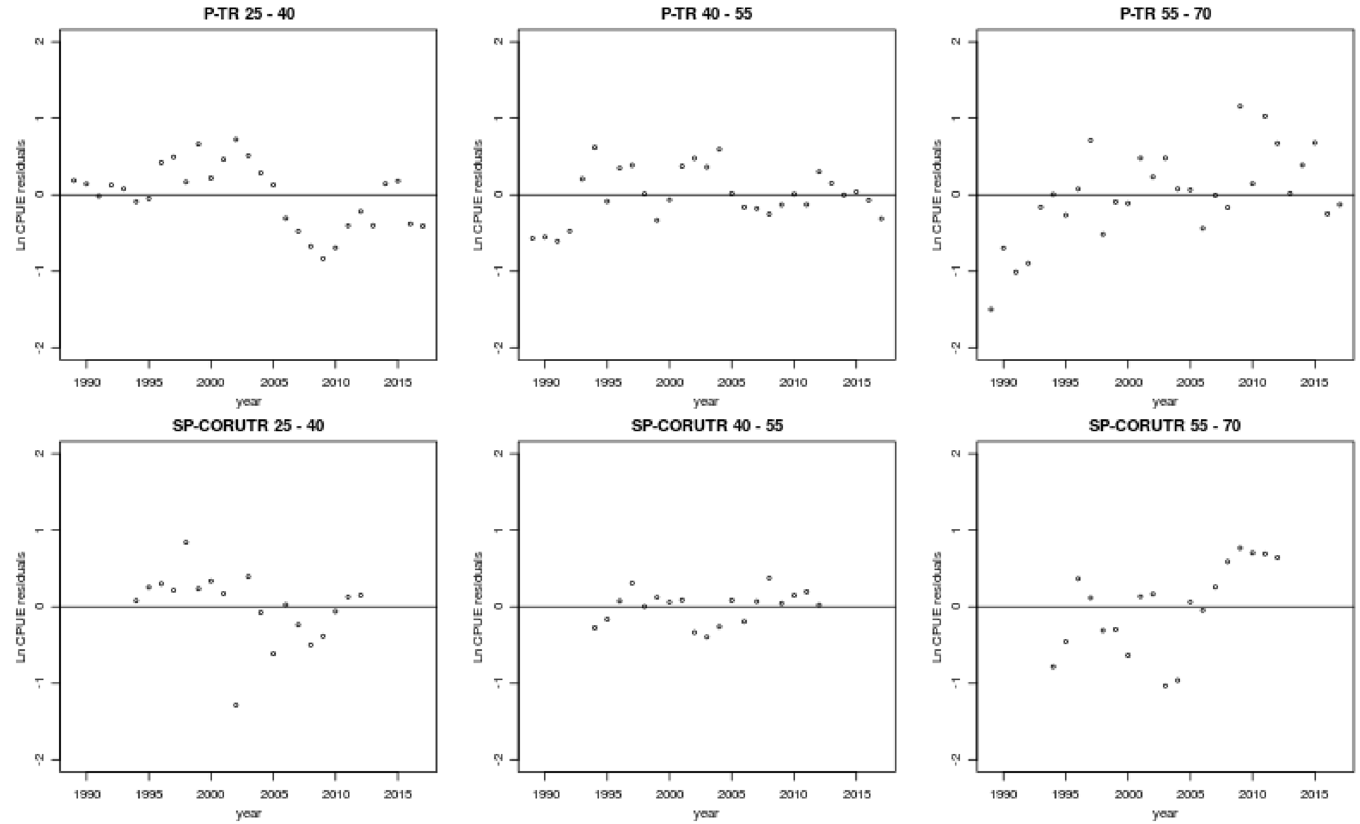
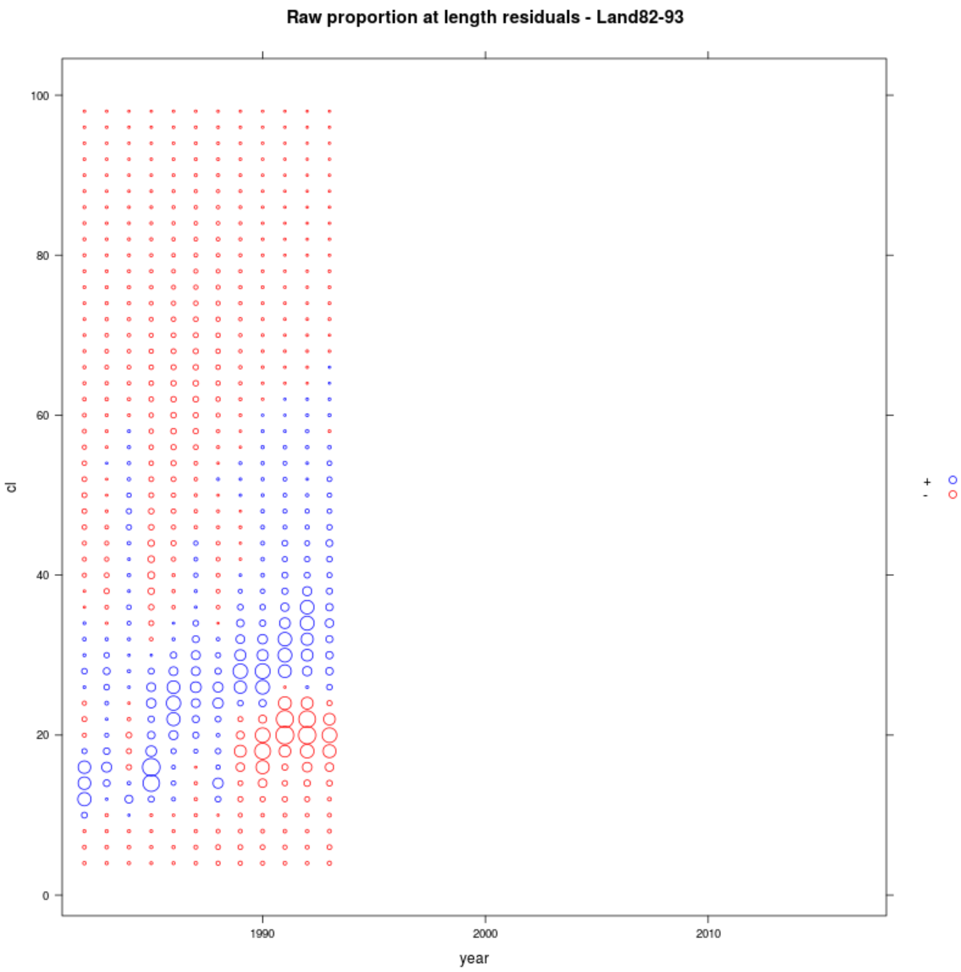


Figure 10.6 Diagnostics Residuals (10.6 a and b). Observed vs. expected length proportions (10.6 c-i))

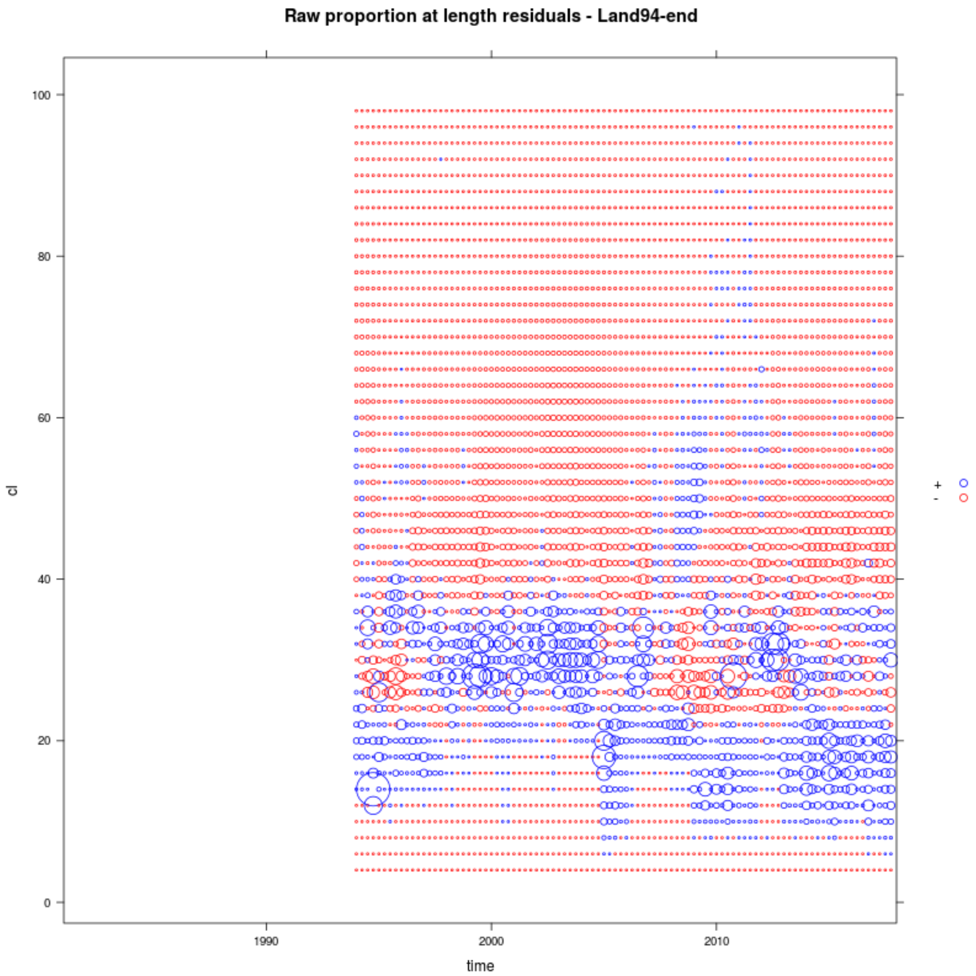
(10.6 a) Survey residuals by 15 cm groups (4–19, 19–34, 34–49 cm)



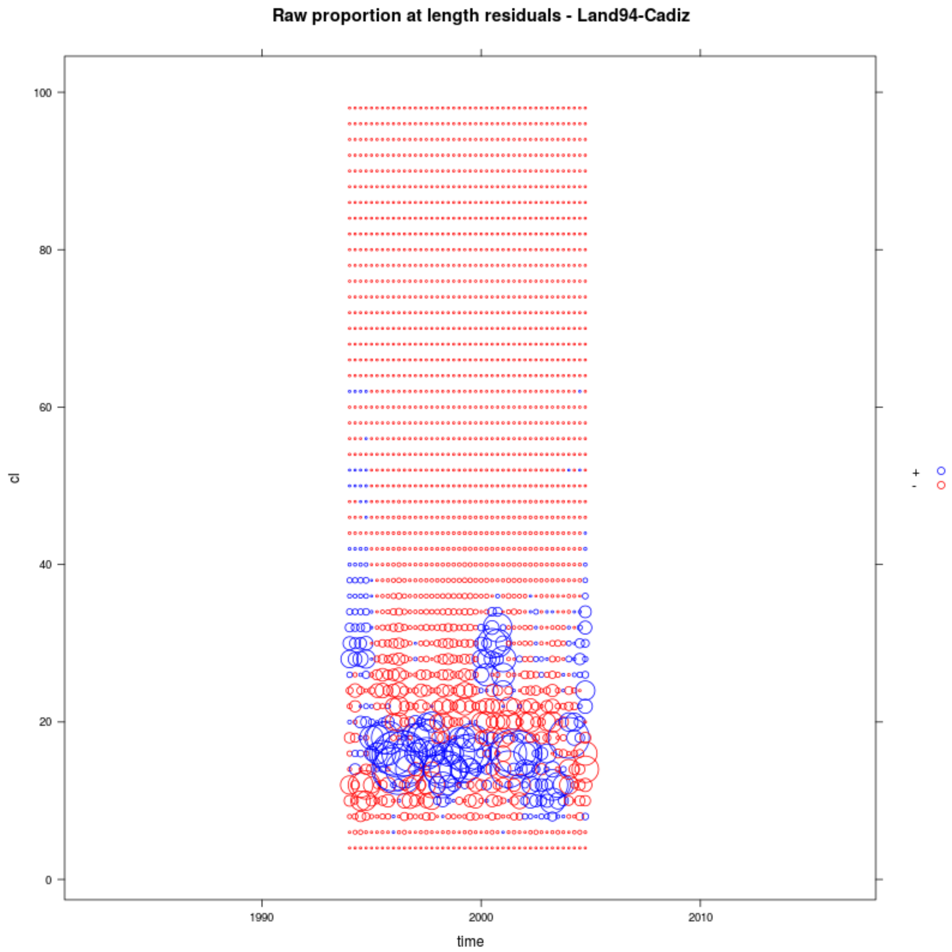
(10.6 b) Lpue residuals by 15 cm groups (25–40, 40–55, 55–70 cm)



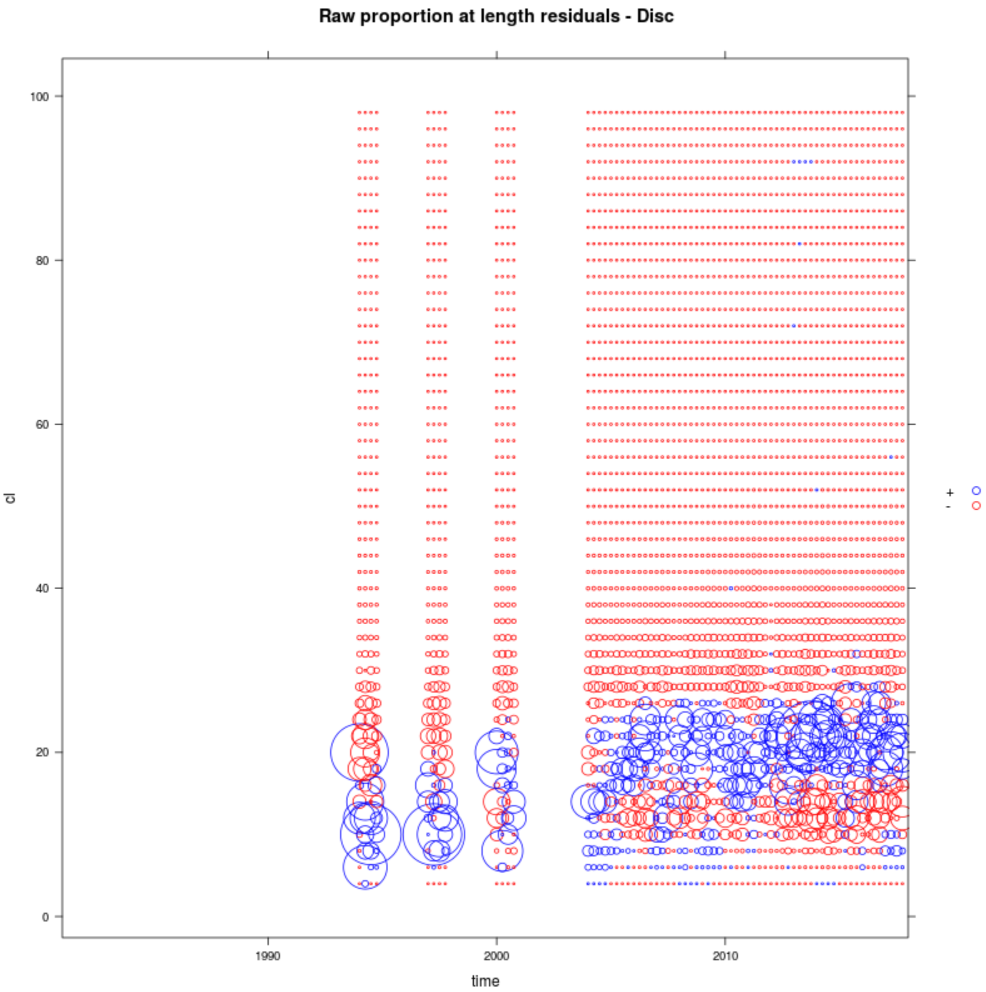
(10.6 c). Bubble plot for landings length distribution from 1982 to 1993.



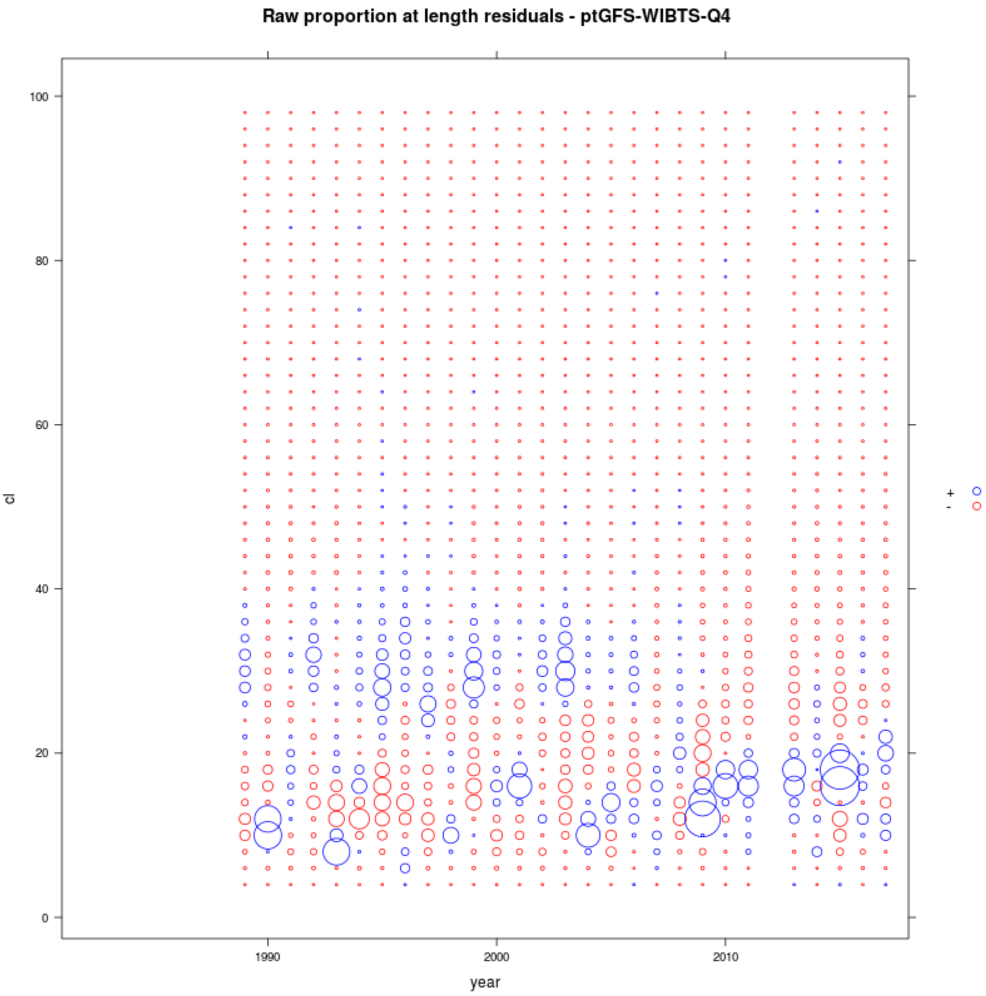
(10.6 d). Bubble plot for landings length distribution from 1994 to last year



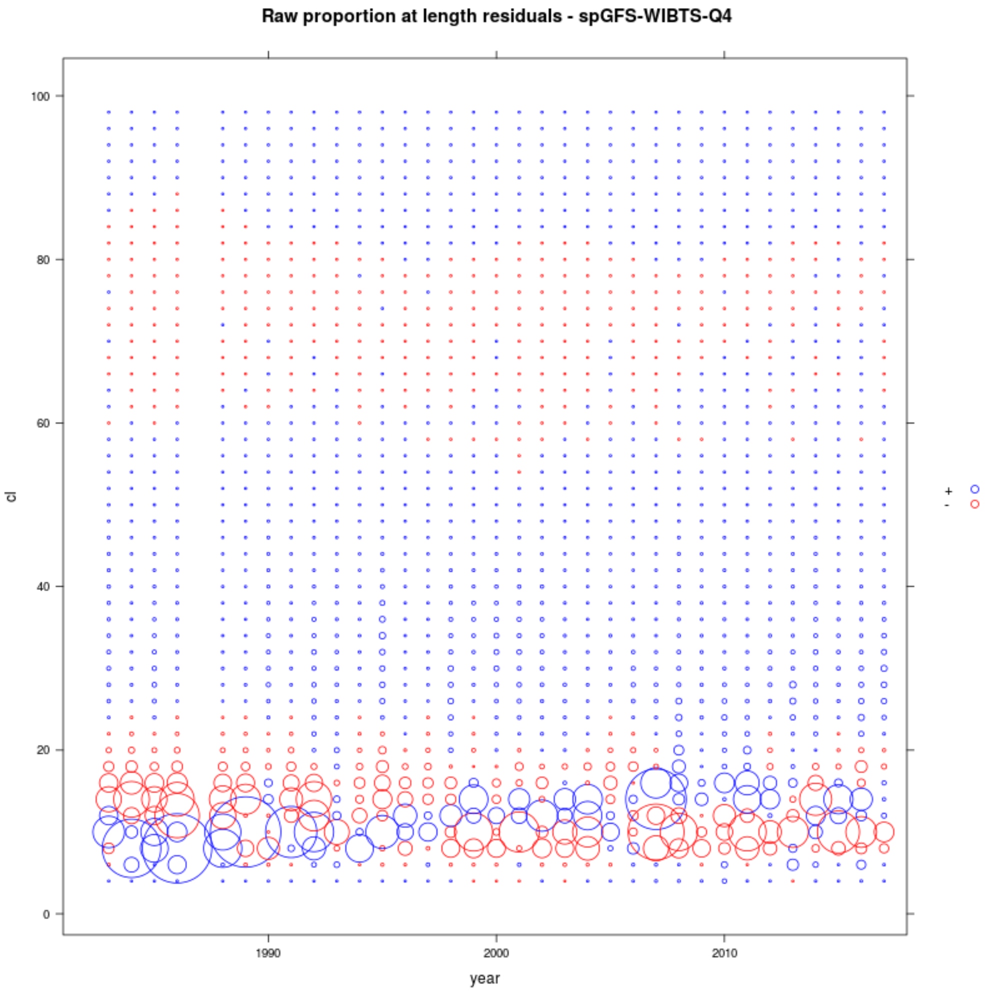
(10.6 e). Bubble plot for Cadiz landings length distribution from 1982 to 2004



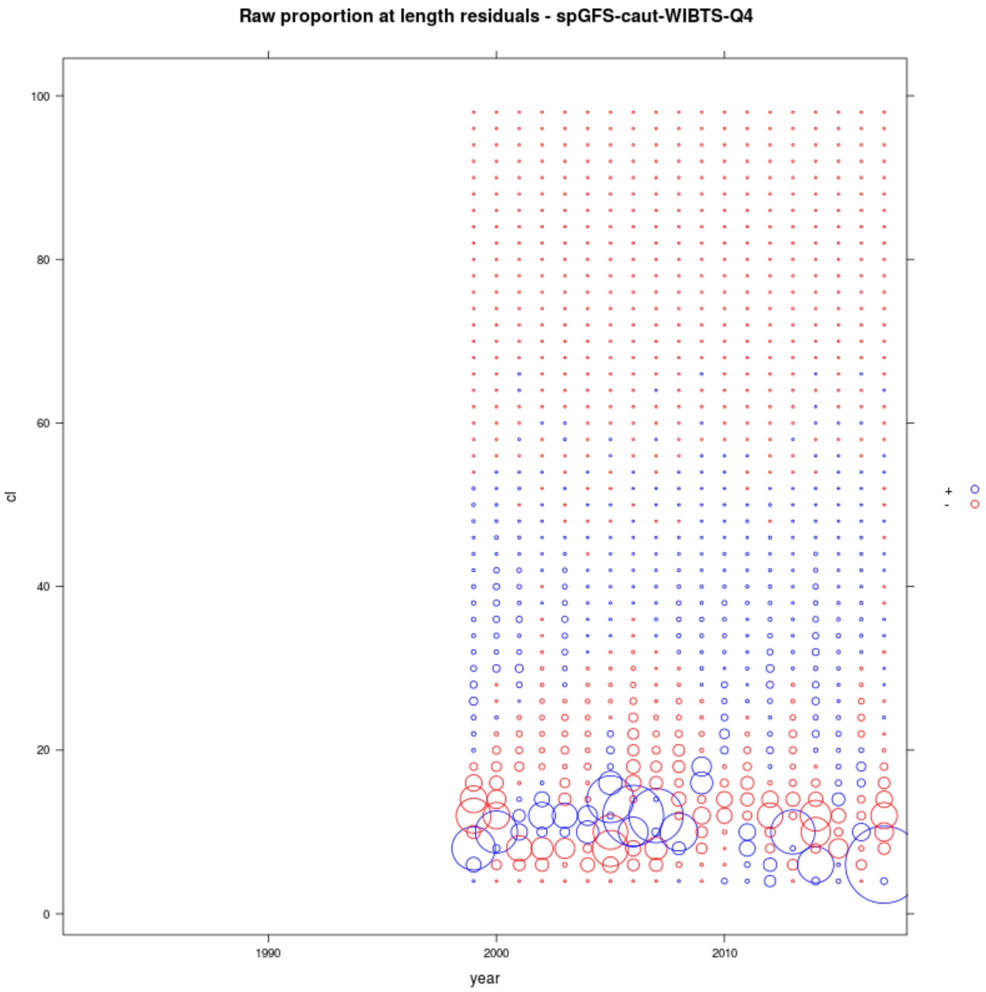
(10.6 f). Bubble plot for Discards length distribution for years 1993,97,99, 2004-end



(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)

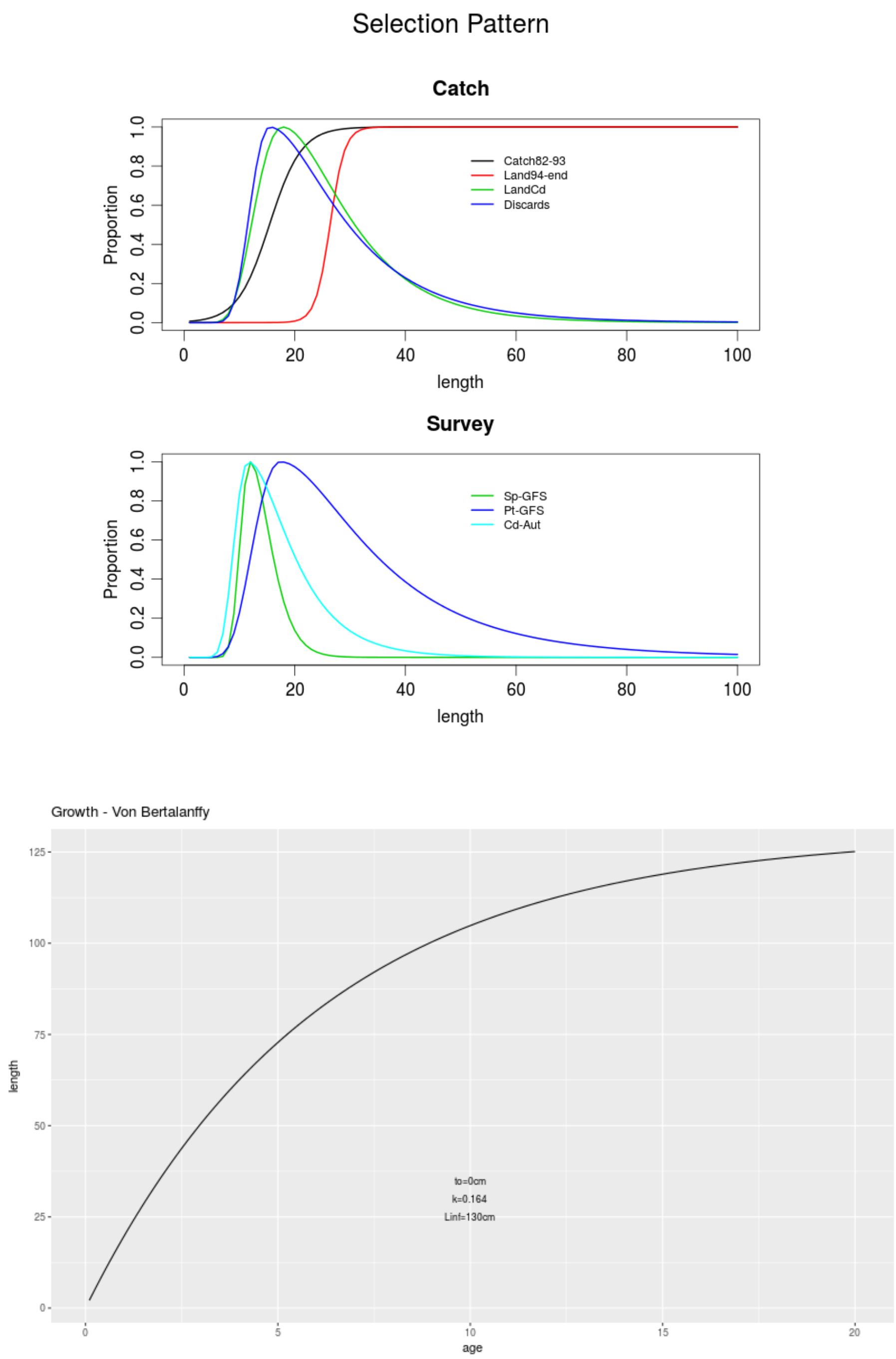


Figure 10.7. Selection pattern (upper panel) and von Bertalanffy growth with k parameter estimated by the model (lower panel)

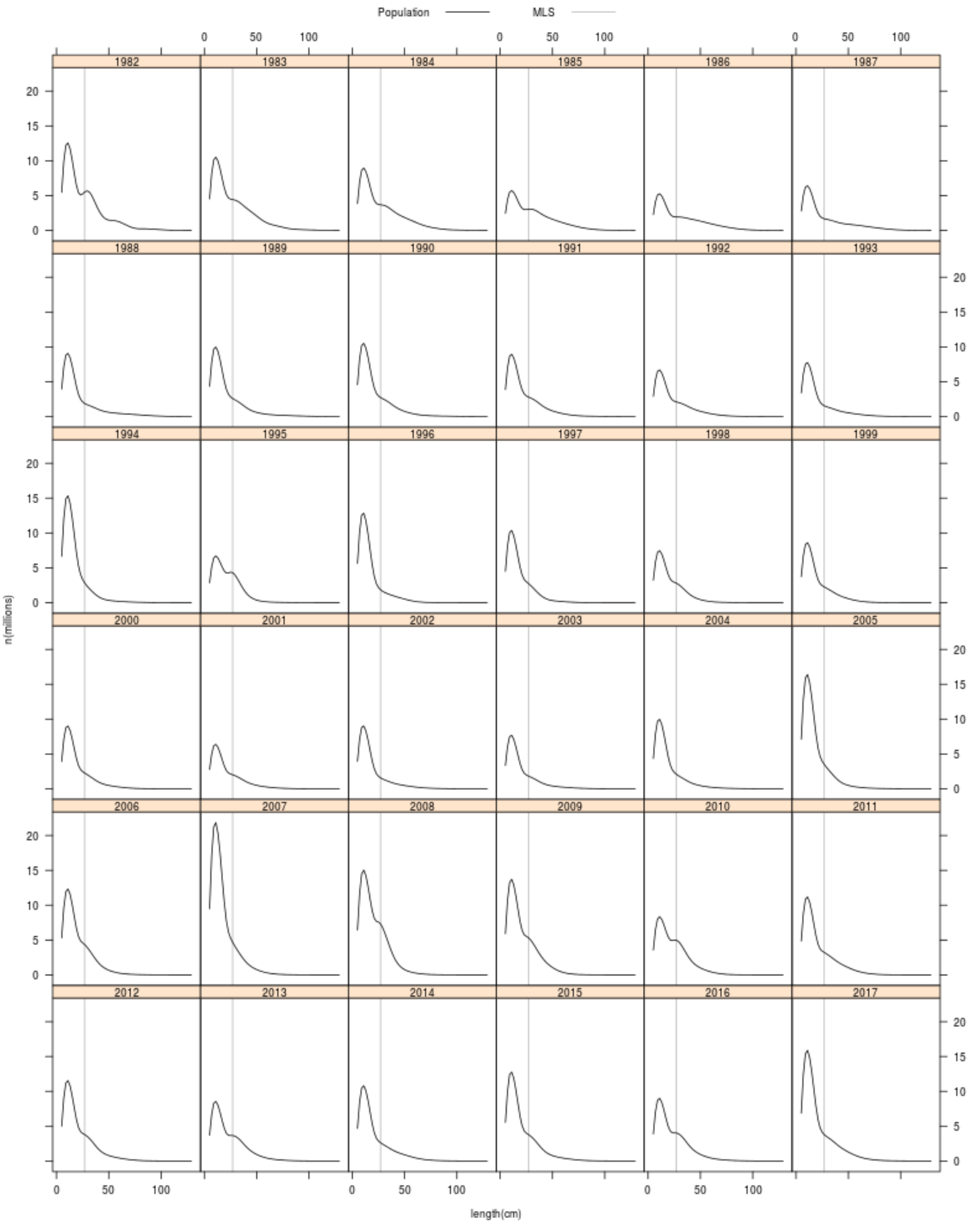


Figure 10.8. Population length distribution at the beginning of the 4th quarter

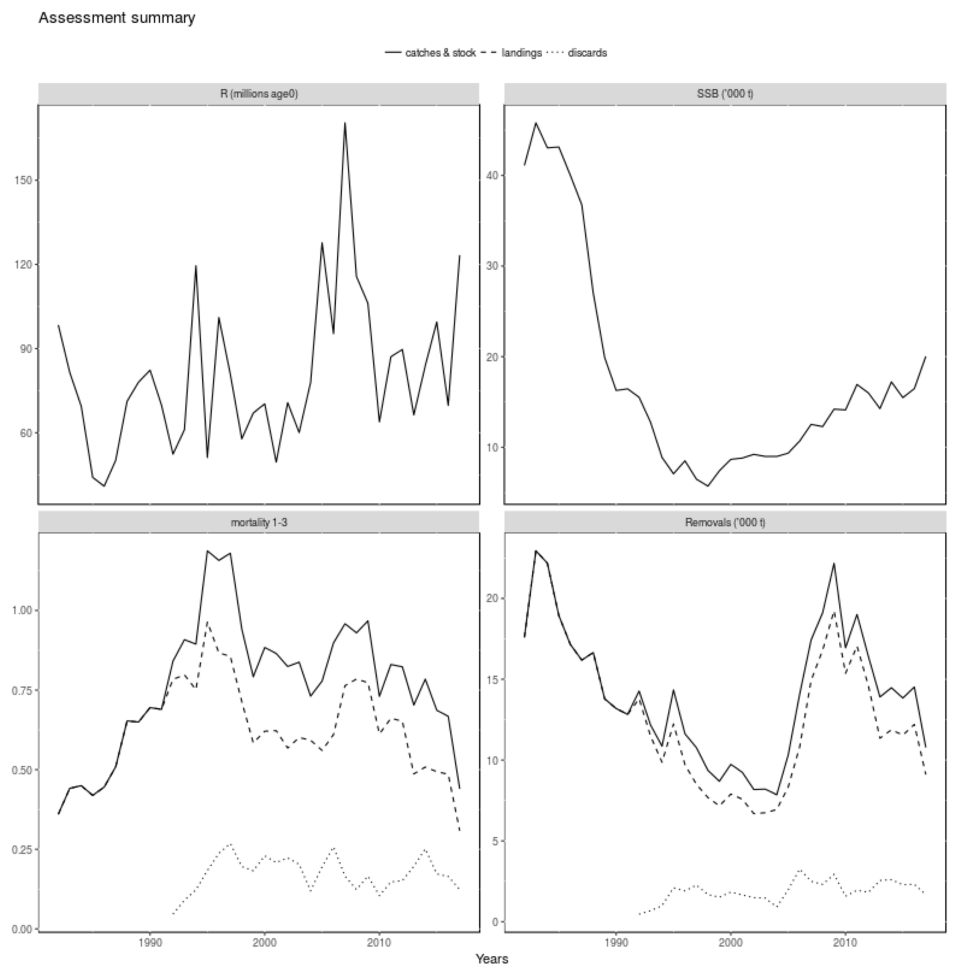


Figure 10.9. Summary plot. SSB and removals (catch, landings and discards). Fishing mortality (F) for ages 1–3.

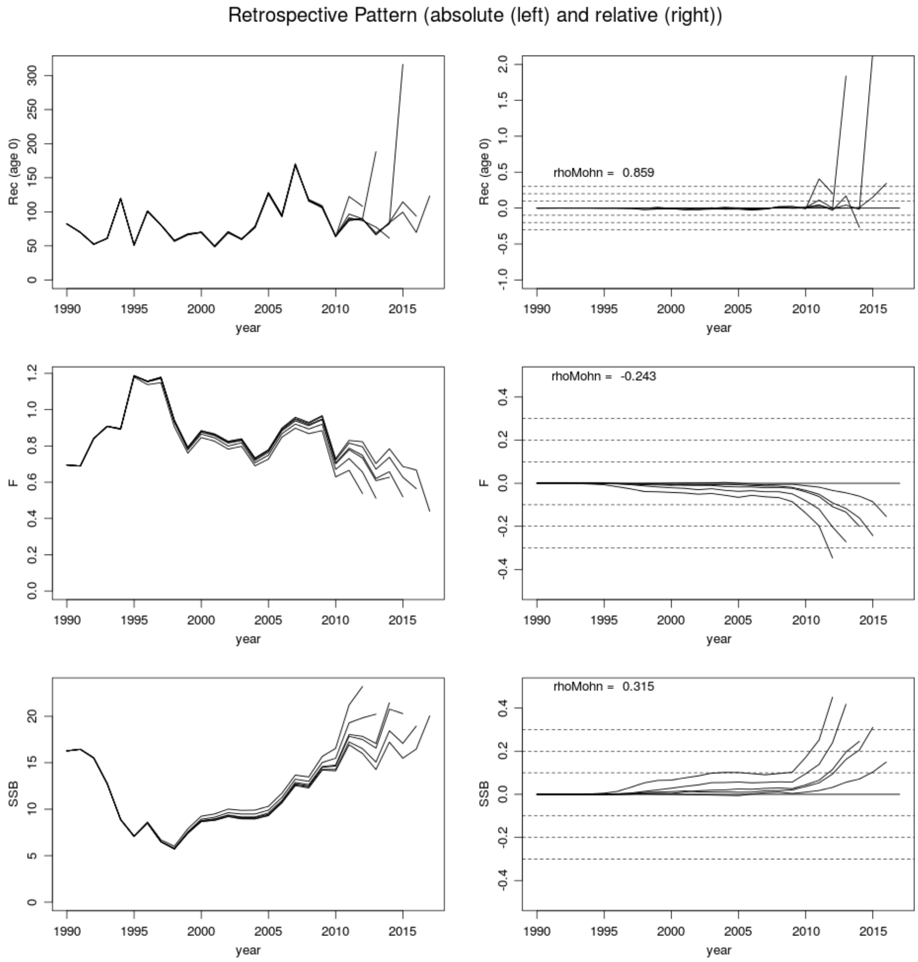


Figure 10.10. Retrospective plots (absolute and relative).

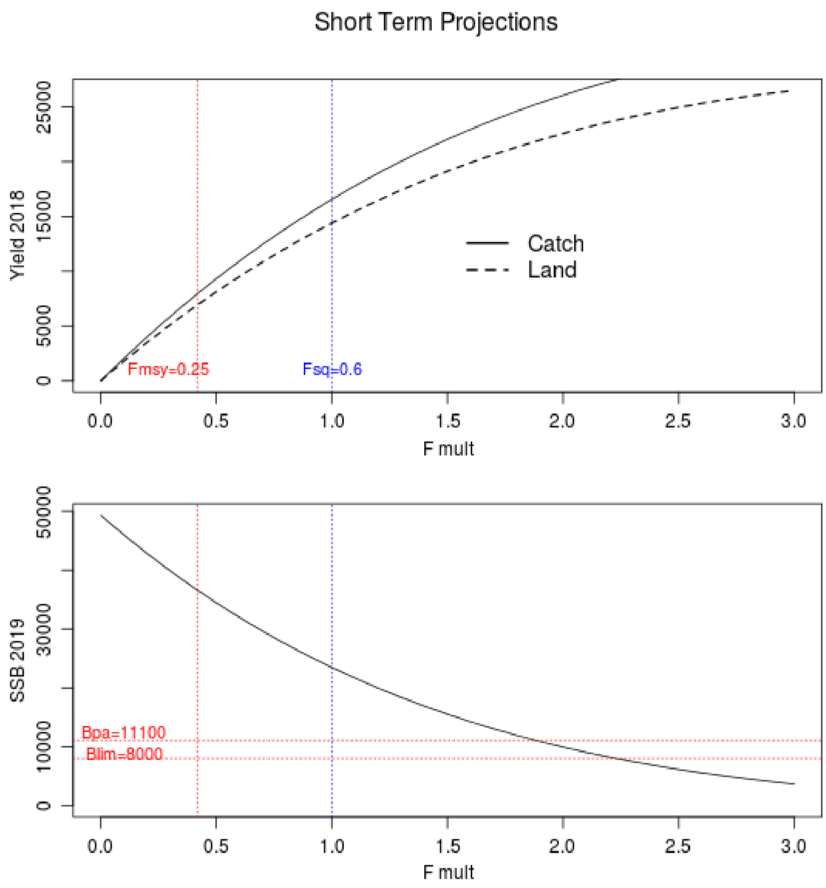


Figure 10.11. Short term projections

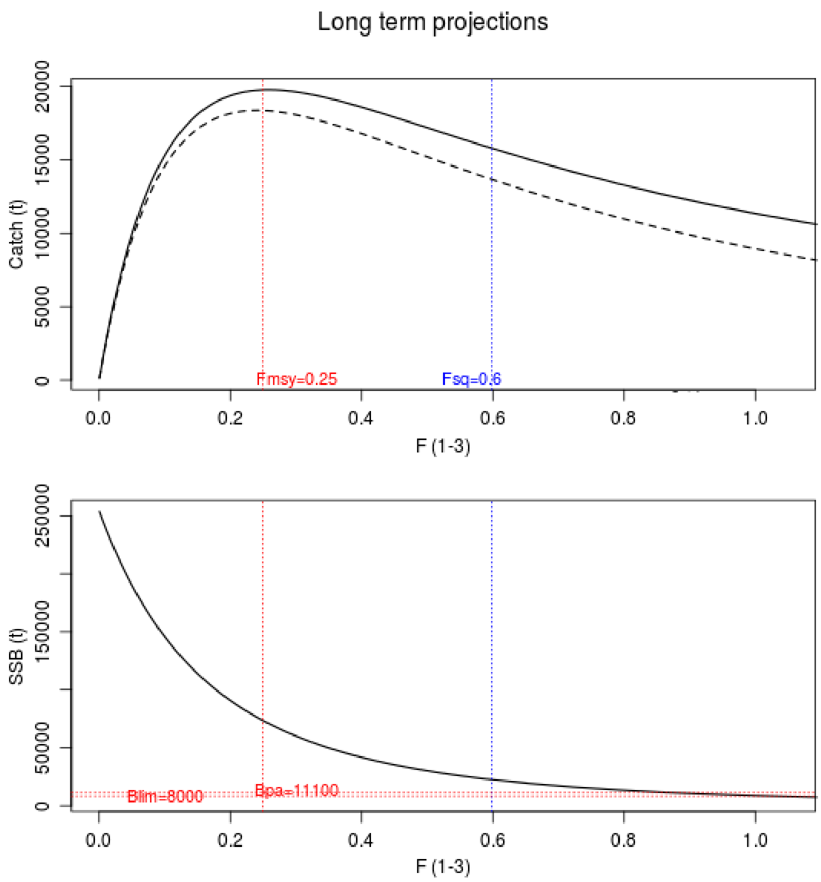


Figure 10.12. Long term yield and SSB per recruit

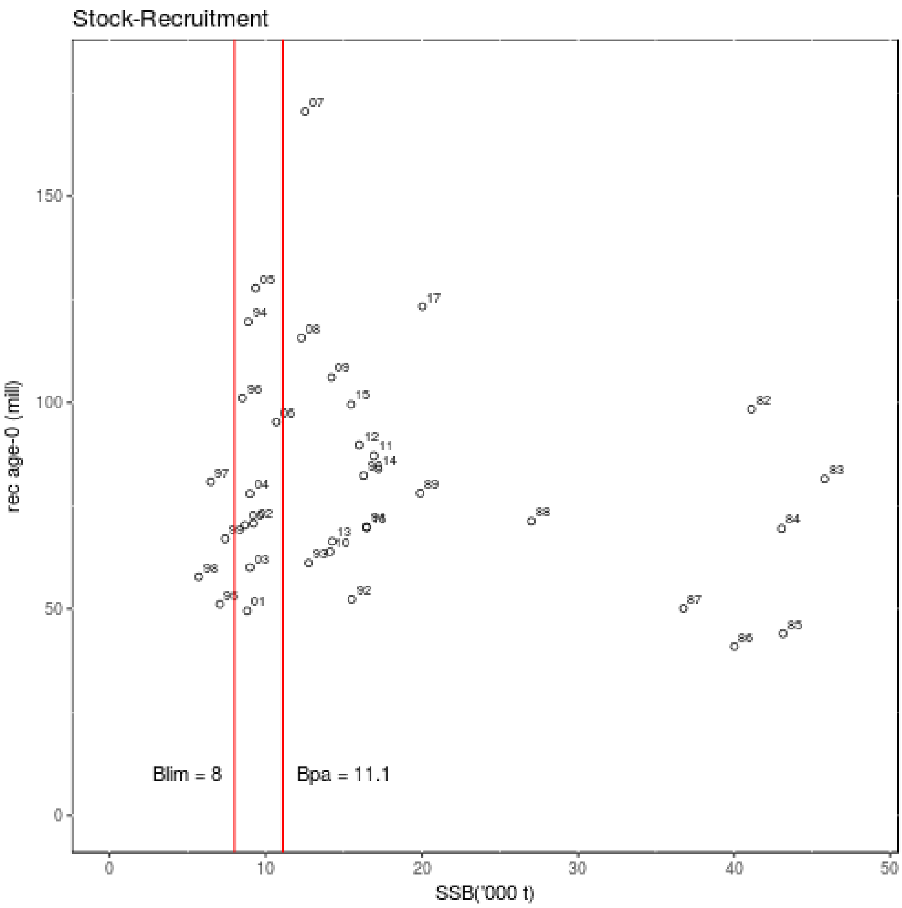


Figure 10.13. Stock-Recruitment plot

11 Nephrops (Divisions 8.a,b, FU 23-24)

Type of assessment: Update assessment

Main changes from the last assessment (WGBIE2017): No major change compared to the last year. In 2016, the stock was benchmarked and assessment based on UWTV survey conducted since 2014 was validated as analytical method. The stock was upgraded from category 3 to 1.

Previously, some changes had occurred since the IBP *Nephrops* 2012 when the stock was assessed by XSA model:

- - 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	8.a,b
Functional Units	Bay of Biscay North, 8.a (FU 23)
	Bay of Biscay South, 8.b (FU 24)

11.1 General

11.1.1 Ecosystem aspects

This section is detailed in Stock Annex.

11.1.1 Fishery description

The general features of the fishery are given in Stock Annex.

11.1.2 ICES Advice for 2018

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 2017 recommended *"… when the MSY approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of 2014-2016, catches in 2018 should be no more than 5531 tonnes. This implies landings of no more than 3614 tonnes "*.

11.1.2 Management applicable for 2017 and 2018

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

2018

Species:	Norway lobster *Nephrops norvegicus*	Zone:	8a, 8b, 8d and 8e (NEP/8ABDE.)
Spain	217		
France	3 397		
Union	3 614		
TAC	3 614		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 2017 was 4 160 t (against 3 899 t which was the TAC for years 2013-2016 before the validation of the UWTV survey as standard assessment method). For 2018, as consequence of the 2017's advice based on the validated UWTV survey 2017 the TAC was fixed at 3 614 t. In 2017, total nominal landings reached 3 412 t.

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 8.a, 8.b and 8.d."

In agreement with this, the National French Committee of Fisheries (deliberations 39/2007, 1/2008) fixed the rules of trawling activities targeting *Nephrops* in the areas 8.a, 8.b applicable from the 1st April 2008. All vessels catching more than 50 kg of *Nephrops* per day must use a selective device from at least one of the following: (1) a ventral panel of 60 mm square mesh; (2) a flexible grid or (3) a 80 mm codend mesh size. The majority of *Nephrops* directed vessels (Districts of South Brittany) chose the increase of the codend mesh size whereas the ventral squared panel was adopted by multi-purpose trawlers (mainly in harbours outside Brittany).

A licence system was adopted in 2004 and, since then, there has been a cap on the number of *Nephrops* trawlers operating in the Bay of Biscay of 250 (180 in 2018). In the beginning of 2006, the French producers' organisations adopted regulations (*e.g.* monthly quotas) which had some effects on fishing effort limitation. In 2017, some additional decisions such as spreading sails of landings over many days were taken by the producers' organisations at the aim of preventing any productivity excess and quota overshot.

11.2 Data

11.2.1 Commercial catches and discards

Total catches, landings and discards, of *Nephrops* in division 8.a,b for the period 1960–2017 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 period 2014-2016, landings increased continuously (2 807 t in 2014; 3 569 t in 2015; 4 091 t in 2016). In 2017 landings decreased by –17% (3 412 t) nevertheless under the more constraining regulations cited above. 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 0.28 and 0.46 for the overall period 1987–2017 with the historically lowest value in 2017) 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.

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 (2003-2017) reached a higher level of 2 040 t. This change in the amount of discards could be due to the restriction of individual quotas, the strength of some recruitments in the middle of 2000’s and the change in the MLS (which tends to increase the discards), although improvements in the selectivity pattern should tend to reduce the discards. The relative contribution of each of these three factors remains unknown. In 2017, 201 million individuals were estimated to have been discarded (2 390 t).

11.2.2 Biological sampling

Landings

French sampling plan at auction started in 1984, but only from 1987 onwards the data can be used on quarterly basis. Since 2003, additional database of landings was also provided by sampling routinely performed on board under the European DCF aiming for discard estimates. As the landed fraction of *Nephrops* is usually size graded the sampling plan is time and commercial category *vs.* size stratified.

During the first two quarters of 2017, the French onshore sampling program at auction was discontinued due to a planned shift in its implementation and a move towards a subcontracted program as already performed for the French on board sampling. The delay in the call for tenders disrupted the onshore sampling for six months. Compared to other onshore species, the Bay of Biscay *Nephrops* was impacted in a lesser degree because complementary sampling in the first half of the year was carried out owing to other European projects of biological parameters (such as maturity) sampling. The numbers of sampling units by quarter and for the whole year as well as the numbers of landed sampled *Nephrops* are respectively presented in Tables 11.2 and 11.3.

In order to tackle the lack of landings data in Q1 and Q2 2017 a simulation was performed and presented in the WG (WD 12) generating missing sampling units at auction from those sampled on board on the basis of stratified estimators (quarter/harbour/commercial category *vs.* size). This method was not developed for the FU23-24 Nephrops and only actually sampled units were retained for quarterly and global estimates.

Discards

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 11.4; 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 (606 trips and 1 712 hauls have been sampled over 15 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% (85% for 2016 and 88% in 2017). 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 numbers of sampling units by quarter and for the whole year and those of discarded sampled *Nephrops* are given by Table 11.5.

The length distribution of landings, discards, catches and removals are presented in Tables 11.6.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. Figure 11.3 provides yearly by sex LFDs and their CVs for landings and discards 2017.

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. 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 and 2017 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. 11.4a). Investigations on the basis of stratified statistical estimators (Table 11.7) as well as on geostatistics (Table 11.8; Fig. 11.5 and 11.6) were carried out and examined by WKNEP 2016 which validated the UWTV approach. The number of sampled stations decreased between 2016 and 2017 (from 196 validated ones to 124) because a larger area than the Central Mud Bank was covered in 2017 (Fig. 11.4b) in order to accurately limit the actual outline of the stock accordingly to recommendations of the WGNEPS 2016. Between 2016 and 2017, the total number of burrows decreased by –19% (3,373 billion in 2017 against 4,168).

The survey occurred in different seasons within year (September 2014, July 2015, May 2016 and 2017, April 2018: results not yet compiled for the WGBIE 2018) as it is constrained by the schedule time for UWTV Irish equipment and staff.

A new survey was carried out during the WGBIE 2018 meeting (end of April) 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 11.9; Figure 11.7). 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 11.7), 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 the latter period (2015: 19.5 kg/h; 2016: 19.7 kg/h; 2017: 21.9 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. In 2017, the assessment was performed on the UWTV results 2017 and on the averaged 2014–2016 LFDs and mean weights for landings and discards. Details of this assessment are provided below. The estimated *status quo* harvest rate calculated as removals 2016 divided by the UWTV estimate 2017 was equal to 7.2%.

VARIABLE	VALUE	SOURCE	NOTES
Abundance in TV assessment	3372.539	ICES (2017)	UWTV 2017 (May)
Mean weight in landings	24.708	ICES (2017)	Average 2014–2016
Mean weight in discards	11.831	ICES (2017)	Average 2014–2016
Discard rate (total)	52.55%	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)	43.70%	ICES (2017)	Average 2014–2016 (proportion by number), only applies in scenarios where discarding is allowed.

11.4 Catch options and prognosis

For 2018, 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 2018	ICES (2018)	UWTV 2018 (May)
Mean weight in landings	24.938	ICES (2018)	Average 2015–2017
Mean weight in discards	12.049	ICES (2018)	Average 2015–2017
Discard rate (total)	55.57%	ICES (2018)	Average 2015–2017 (proportion by number)
Discard survival rate	30%	ICES (2018)	Only applies in scenarios where discarding is allowed.
Dead discard rate (total)	46.70%	ICES (2018)	Average 2015–2017 (proportion by number), only applies in scenarios where discarding is allowed.

11.5 Biological reference points

A F_{MSY} 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 F_{MSY} 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 French *Nephrops* trawlers on board sampling programme avoids the use of “derived” data for missing years (13 years on 31). 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 and 2017. 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.

The particular problem of lower sampling rate for landings during the 1st and 2nd quarters 2017 due to the delay on the sampling shift between operators as explained above affected the precision of estimates (decrease of the sampling units and of measured *Nephrops* at auction) although it did not change the overall perception for the stock status (LFDs and mean weight for landings) which will be assessed after the compilation of the 2018’s UWTV results.

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. Before the 2016's benchmark workshop the industry had suggested the necessity of applying additional tuning commercial information from the southern part of fishery. Anyway, in the recent period after applying the UWTV assessment method the clear declining trend for the southern part of the Bay of Biscay is considered problematic. They emphasized the recent steep upwards change as landings increased on years 2014–2016 whereas they moderated conclusions about decrease between 2016 and 2017 as they pointed out many additional regulations aiming to control productivity of *Nephrops* trawlers and to avoid quotas overshot. They also considered the necessity to routinely continue UWTV survey on a fixed period within year.

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 suggested a stock status within safety limits. Decrease of UWTV indices between 2016 and 2017 coinciding with nominal landings could be considered cautiously although current situation will be examined reliably only after compilation of the 2018's UWTV survey data.

Table 11.1. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Estimates of catches (t) by FU for 1960-2017

Year	Landings (1) FU 23-24 (2) VIIIa,b	Landings (1) FU 23 VIIIa	Landings (1) FU 24 VIIIb	Landings (1) Unallocated (MA N)(3)	Landings (1) Total VIIIa,b used by WG	Total Discards FU 23-24 VIIIa,b		Catches Total 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	4123		9997
1989	-	4253	582	77	4835	2634		7470
1990	1	4613	359	87	4972	627		5599
1991	1	4353	401	55	4754	1213	*	5967
1992	0	5123	558	47	5681	1354		7034
1993	0	4577	532	49	5109	1007		6116
1994	0	3721	371	27	4092	741		4833
1995	0	4073	380	14	4452	706		5159
1996	0	4034	84	15	4118	495		4614
1997	2	3450	147	41	3610	805		4415
1998	2	3565	300	40	3865	1453	*	5318
1999	2	2873	337	26	3209	1148		4357
2000	0	2848	221	36	3069	1455		4523
2001	1	3421	309	22	3730	2537		6267
2002	2	3323	356	36	3679	2620		6299
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	1012	*	3532
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
2017	na	3283	129	na	3412	2387	*	5799

(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 (8.a,b). Quarterly and yearly numbers of units for the landings sampling program.**

year	Q1 auction	Q1 sea	Q1 Σ	Q2 auction	Q2 sea	Q2 Σ	Q3 auction	Q3 sea	Q3 Σ	Q4 auction	Q4 sea	Q4 Σ
2014	96	23	119	122	82	204	107	64	171	106	30	136
2015	119	37	156	119	71	190	123	70	193	114	12	126
2016	108	30	138	139	93	232	112	109	221	142	23	165
2017	26	30	56	27	36	63	63	47	110	92	19	111
Total	349	120	469	407	282	689	405	290	695	454	84	538

Table 11.3. ***Nephrops*** **in FUs 23-24 Bay of Biscay (8.a,b). Quarterly and yearly numbers of sampled landed individuals.**

YEAR	Q1			Q2			Q3			Q4		
	AUCTION	SEA	Σ	AUCTION	SEA	Σ	AUCTION	SEA	Σ	AUCTION	SEA	Σ
2014	3774	855	4629	5400	3662	9062	4957	2321	7278	4642	1115	5757
2015	5347	1488	6835	5520	2760	8280	5695	2835	8530	4905	345	5251
2016	4562	1130	5692	6367	3340	9707	4801	3751	8552	6150	765	6915
2017	951	949	1900	1191	1606	2797	2863	1259	4122	4080	670	4750
Total	14634	4422	19056	18478	11368	29846	18316	10166	28482	19777	2895	22673

Table 11.4. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Derivation and estimations of discards

1987	sampled
1988-1990	from 1987's logistic function of sorting by quarter+density of probability
1991	sampled
1992-1997	from 1991's logistic function of sorting by quarter+density of probability
1998	sampled
1999-2002	from 1998's logistic function of sorting by quarter+density of probability
since 2003	sampled

Table 11.5. *Nephrops* in FUs 23-24 Bay of Biscay (8.a,b). Quarterly and yearly discards sample program on board.

YEAR	QUARTER	SAMPLED FO	TOTAL FO	NB_TRIPS	TOTAL TRIPS	NB NEPHROPS
2014	1	7	13	4	2689	377
	2	25	91	13	5615	1146
	3	21	99	12	5274	712
	4	10	27	8	3973	436
	total	63	230	37	17551	2671
2015	1	16	28	7	2785	655
	2	36	124	14	5598	1334
	3	28	131	13	4999	747
	4	7	31	3	3480	194
	total	87	314	37	16862	2930
2016	1	16	39	7	3441	549
	2	40	119	15	6207	1168
	3	46	153	17	5443	1135
	4	15	85	8	3906	256
	total	117	396	47	18997	3108
2017	1	20	97	9	3719	516
	2	29	138	12	6139	932
	3	23	55	9	4850	793
	4	10	26	17	3498	332
	total	82	316	37	18206	2573

Table 11.6.a Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 1987-2001

Landings CL mm/Y	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**
Weights	**5397**	**5875**	**4835**	**4972**	**4754**	**5681**	**5109**	**4092**	**4452**	**4118**	**3610**	**3865**	**3209**	**3069**	**3730**

Table 11.6.b Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 2002-2017

Landings **CL mm/Y**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
10	0	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	0
12	0	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	0
14	0	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	0
16	0	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	0
18	0	14	0	25	5	4	12	0	0	0	0	0	0	0	0	6
19	0	0	14	27	0	0	0	0	0	1	0	5	0	0	0	18
20	107	87	47	82	5	4	77	37	14	22	35	31	1	16	21	24
21	925	280	249	270	70	14	191	73	75	6	25	151	74	130	138	320
22	1122	661	899	771	131	18	208	288	252	11	235	682	180	575	532	368
23	5513	1614	2194	2588	227	48	322	473	386	111	334	1002	764	1121	772	1155
24	10061	3966	5664	6511	822	188	721	1929	1238	515	1399	3162	1836	2523	1341	1787
25	12951	8164	10930	13678	2844	1201	2742	3670	3940	1803	3843	7873	4419	3478	3842	3845
26	21403	13297	13998	17811	6376	5684	6319	8258	8499	4773	7875	13242	7910	6651	7285	9264
27	19433	17614	16094	22006	12010	9439	10891	12759	14173	7520	11079	14926	12869	9702	12566	14413
28	22074	18572	15350	21879	14647	13248	12640	15732	15390	8991	11920	13260	13788	14431	16617	14546
29	16559	16843	14808	18027	14591	12516	12890	13524	15340	9602	11120	13397	14560	13726	18269	17209
30	18105	17264	14143	15570	13690	12219	10726	13271	15736	8821	9636	10296	12662	13690	16596	16695
31	9989	13345	12353	12634	11814	10698	9772	10859	12749	8253	8393	9137	11051	12456	16820	12979
32	10284	11276	10322	9907	9694	9274	8845	9310	11366	6954	7414	7116	10354	12021	13096	12950
33	7813	8253	8020	7800	8421	7859	7436	7086	8851	6175	6069	5558	6509	9882	12519	7752
34	5308	6195	6298	6537	7112	6539	6425	5985	7140	5467	4505	4123	6657	7881	8416	7638
35	4309	4653	4673	5100	5135	6529	5366	4568	5852	4541	3507	2783	4961	6122	6809	5052
36	3157	3818	3308	3369	4104	4735	3867	3697	3626	4260	2649	1978	3264	5219	6474	4829
37	2049	3075	2875	2597	3196	3839	3121	2565	3024	3648	1976	1472	2682	4511	4785	2620
38	2224	2660	2098	2380	2662	2639	2398	1871	2247	3911	1563	998	1783	3311	3342	2005
39	1559	2174	1683	1650	1956	2245	2043	1491	1630	3472	1314	936	1844	2726	2850	2176
40	1398	1936	1555	1628	1599	1711	1633	1190	1280	3296	1103	518	843	2676	1976	1294
41	764	1423	1188	1154	1171	1227	1190	878	966	2740	878	438	669	1635	1394	1020
42	632	1403	889	953	990	1111	1015	742	742	2497	635	351	412	1284	1185	779
43	640	1054	774	842	741	710	805	540	560	2157	558	320	343	883	749	585
44	432	810	707	640	633	746	706	473	509	1762	536	249	234	637	658	471
45	416	808	613	605	595	518	536	396	442	1177	478	177	206	467	708	442
46	328	535	485	415	479	373	405	307	305	1024	441	181	159	236	368	271
47	241	456	388	353	440	311	361	262	290	858	378	88	151	216	332	261
48	188	339	313	339	382	257	294	245	237	656	381	98	87	149	230	143
49	79	206	318	288	319	237	262	196	204	557	212	74	72	200	195	100
50	115	253	306	276	287	190	228	156	160	501	160	46	63	108	123	126
51	73	170	214	176	246	163	201	115	135	383	132	37	58	68	83	53
52	46	150	152	184	201	138	116	110	120	296	128	32	24	46	88	96
53	51	120	111	142	137	140	121	98	97	198	96	24	42	33	56	37
54	20	80	90	104	156	115	95	63	95	271	93	17	18	29	59	49
55	30	57	47	109	137	79	73	75	79	152	58	15	11	26	23	38
56	13	23	86	69	117	60	67	54	75	132	46	8	5	15	21	24
57	6	47	49	58	134	70	41	31	67	98	48	22	10	18	7	12
58	6	22	27	43	134	45	40	48	47	105	52	3	8	5	7	12
59	3	10	32	41	85	33	19	23	48	79	33	12	3	3	8	6
60	11	8	10	19	115	33	23	14	42	48	22	3	2	3	5	7
61	0	5	5	28	40	23	7	8	30	39	15	8	1	0	3	2
62	0	4	3	16	21	9	9	9	16	55	18	1	1	7	3	6
63	1	1	5	9	19	9	7	10	7	23	11	2	1	0	0	1
64	0	0	8	8	18	10	6	3	16	12	8	0	0	1	1	2
65	1	0	1	14	11	9	1	3	9	11	7	0	0	1	1	3
66	0	1	1	6	10	1	0	2	3	11	3	0	0	0	1	1
67	0	0	1	5	8	1	0	2	3	6	1	0	0	0	0	0
68	0	0	2	4	7	3	0	0	4	7	0	0	0	0	0	0
69	0	1	0	1	6	2	0	1	1	2	2	0	0	0	0	0
70	0	0	0	2	4	0	0	0	1	2	0	0	0	0	1	1
71	0	1	0	1	5	0	0	0	1	1	0	0	0	0	0	0
72	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0	1
73	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1
74	0	0	0	0	4	0	0	0	0	1	0	0	1	0	0	1
75	0	0	0	1	4	0	0	0	0	0	1	0	0	0	2	5
Total	**180442**	**163771**	**154405**	**179758**	**128777**	**117273**	**115274**	**123504**	**138120**	**108011**	**101424**	**114853**	**121594**	**138920**	**161371**	**143502**
Weights	**3679**	**3886**	**3571**	**3991**	**3447**	**3176**	**3030**	**2987**	**3398**	**3559**	**2520**	**2380**	**2807**	**3569**	**4091**	**3412**

Table 11.6.c Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 1987-2001.

Total Discards

CL mm/Y	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	9995	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**
Weights	**1767**	**4123**	**2634**	**627**	**1213**	**1354**	**1007**	**741**	**706**	**495**	**805**	**1453**	**1148**	**1455**	**2537**

Table 11.6.d Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 2002-2017.

Total Discards

CL mm/Y	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
10	1268	28	0	0	0	22	0	82	0	0	0	0	0	0	0	26
11	1817	0	0	94	0	171	38	135	2	0	0	0	0	0	0	0
12	2597	70	363	413	70	202	98	79	0	237	0	0	0	75	76	54
13	3696	294	1722	1085	234	122	235	177	97	596	532	0	28	184	76	111
14	5233	636	3152	3190	1138	900	389	291	83	834	665	229	101	606	327	384
15	7354	1198	5548	7287	3102	1288	189	1157	155	941	1425	870	281	1476	578	1228
16	10227	3386	6784	13528	7810	2959	1027	2315	822	1230	4544	1313	1300	2354	569	1668
17	14027	5927	8836	15094	11655	3636	1832	3059	1333	2430	4737	4179	1647	3242	2717	3697
18	18895	8078	10161	19795	16139	4590	2626	4843	2309	3630	8066	3372	2808	5073	5207	4175
19	24883	11506	17361	19522	25891	5244	6473	6485	3532	4546	8024	8730	3822	8084	9685	8517
20	31890	12142	19250	22265	39742	8735	11444	12766	5692	7227	10125	9682	6457	9246	9420	13805
21	39629	18597	25898	32409	54220	11585	15630	16772	7699	10393	12145	15281	9195	10952	12022	16601
22	24662	21416	25210	35523	69870	17930	24730	18701	11689	15161	14034	20618	11284	11324	15704	16245
23	48438	28429	26756	40041	70094	24086	27560	21693	13672	13837	12904	26287	15130	14109	18312	20400
24	39179	26501	21343	36279	55408	30615	29638	24105	16963	15551	14889	21750	14000	16820	19435	21961
25	22841	23211	20085	30222	52660	32917	28007	20736	14670	16545	10873	17823	18051	18746	22159	21886
26	17386	17357	12006	19003	38812	27376	23127	14205	11852	10047	7747	10188	11947	15874	24994	21474
27	8069	9680	6436	8498	20124	20567	10129	9188	8558	8127	4304	5439	8155	11931	17139	13660
28	4129	6187	3487	4603	10263	10365	5893	5927	5986	3201	919	2824	5026	8056	11441	11298
29	1494	2537	2115	1201	4188	4464	3225	3163	3360	2086	588	2146	2316	5771	10887	5361
30	876	1605	1901	1600	2578	2868	1923	3261	1876	2011	680	945	1672	4714	5283	5464
31	214	1326	1115	1417	1109	1316	925	1824	1274	1246	125	922	1263	2033	4343	3766
32	119	574	735	526	592	737	454	839	716	492	200	684	1482	1745	2458	2470
33	44	313	503	296	544	484	421	671	350	265	13	365	384	812	3193	814
34	21	261	385	553	411	537	1025	830	274	272	145	494	433	1108	1071	1132
35	7	176	424	260	230	265	206	332	242	174	24	233	125	147	874	1540
36	4	113	108	46	73	336	78	197	55	59	3	260	391	243	774	503
37	1	83	74	246	25	299	153	188	162	149	146	130	45	298	573	681
38	1	93	31	116	99	40	93	269	16	97	68	81	71	246	576	320
39	0	15	139	147	0	3	369	55	33	24	0	33	230	65	598	409
40	0	37	73	37	169	47	0	66	38	25	3	0	122	175	72	235
41	0	34	60	20	0	40	0	8	4	0	0	0	7	46	148	126
42	0	4	12	31	0	20	53	0	4	157	0	0	0	508	186	139
43	0	14	13	0	0	11	0	38	0	4	4	0	152	199	0	202
44	0	0	13	0	0	0	0	14	6	0	0	0	0	12	0	164
45	0	13	0	0	36	0	0	0	0	5	0	0	0	56	0	38
46	0	0	0	0	0	0	0	0	6	0	0	0	0	44	77	0
47	0	0	0	0	0	0	0	0	0	6	0	0	7	0	0	23
48	0	0	0	0	0	0	0	8	0	0	0	36	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0
50	0	0	0	0	0	11	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	0
52	0	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	0
54	0	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	23
56	0	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	0
58	0	0	0	0	0	0	39	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	0
60	0	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	0
62	0	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	0
64	0	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	0
66	0	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	0
68	0	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	0
70	0	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	0
72	0	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	0
74	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
Total	**329002**	**201841**	**222102**	**315346**	**487288**	**214788**	**198031**	**174480**	**113530**	**121603**	**117935**	**154914**	**117930**	**156400**	**200973**	**200600**
Weights	**2620**	**1977**	**1932**	**2698**	**4544**	**2411**	**2123**	**1833**	**1275**	**1263**	**1012**	**1521**	**1326**	**1822**	**2531**	**2387**

Table 11.6.e Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 1987-2001.

Total catches															
CL mm/Y	**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	299	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	4979	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	2993	3933	2991	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 11.6.f Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 2002-2017.

Total catches																
CL mm/Y	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
10	1268	28	0	0	0	22	0	82	0	0	0	0	0	0	0	26
11	1817	0	0	94	0	171	38	135	2	0	0	0	0	0	0	0
12	2597	70	363	413	70	202	98	79	0	237	0	0	0	75	76	54
13	3696	294	1722	1085	234	122	235	177	97	596	532	0	28	184	76	111
14	5233	636	3152	3190	1138	900	389	291	83	834	665	229	101	606	327	384
15	7354	1198	5548	7287	3102	1289	189	1157	155	941	1425	870	281	1476	578	1228
16	10227	3386	6784	13528	7810	2959	1027	2315	822	1230	4544	1313	1300	2354	569	1668
17	14027	5947	8843	15094	11655	3636	1832	3059	1333	2430	4737	4179	1647	3242	2717	3697
18	18895	8092	10161	19820	16144	4593	2638	4843	2309	3630	8066	3372	2808	5073	5207	4181
19	24883	11506	17376	19549	25891	5244	6473	6485	3532	4546	8024	8735	3822	8084	9685	8535
20	31997	12229	19297	22348	39747	8738	11521	12803	5706	7249	10160	9713	6458	9262	9441	13829
21	40555	18877	26146	32679	54289	11598	15820	16845	7775	10398	12170	15433	9269	11082	12160	16921
22	25784	22077	26109	36293	70001	17948	24938	18989	11941	15171	14269	21300	11464	11899	16237	16613
23	53951	30042	28950	42629	70322	24134	27882	22167	14058	13948	13238	27289	15894	15231	19084	21554
24	49240	30467	27006	42790	56230	30803	30359	26034	18202	16065	16288	24913	15836	19343	20775	23747
25	35792	31376	31015	43900	55504	34119	30750	24406	18610	18348	14716	25696	22470	22223	26001	25731
26	38790	30654	26004	36814	45189	33060	29446	22463	20352	14820	15622	23430	19857	22526	32279	30738
27	27502	27294	22530	30504	32134	30006	21020	21948	22730	15647	15383	20365	21024	21633	29705	28073
28	26203	24759	18837	26482	24909	23613	18533	21659	21375	12191	12838	16084	18814	22487	28058	25844
29	18053	19381	16923	19228	18779	16980	16115	16687	18700	11687	11708	15543	16876	19498	29156	22570
30	18981	18868	16044	17170	16268	15087	12649	16531	17612	10832	10315	11241	14334	18403	21879	22159
31	10203	14672	13469	14051	12923	12014	10697	12682	14024	9500	8518	10059	12314	14489	21163	16745
32	10403	11849	11057	10433	10286	10011	9299	10150	12082	7447	7614	7801	11836	13766	15554	15419
33	7857	8566	8523	8095	8965	8343	7857	7757	9201	6440	6082	5923	6892	10695	15712	8566
34	5329	6456	6684	7090	7524	7076	7449	6815	7414	5739	4649	4617	7091	8990	9487	8770
35	4316	4829	5097	5361	5366	6793	5573	4900	6094	4715	3531	3016	5087	6270	7683	6592
36	3161	3931	3416	3415	4177	5071	3945	3894	3681	4319	2652	2237	3654	5462	7247	5332
37	2050	3158	2949	2844	3221	4138	3273	2753	3186	3797	2122	1602	2727	4809	5358	3302
38	2225	2752	2129	2496	2760	2679	2491	2139	2263	4007	1632	1079	1854	3556	3918	2325
39	1560	2189	1822	1797	1956	2247	2412	1546	1662	3496	1314	968	2075	2791	3448	2585
40	1399	1973	1628	1665	1768	1758	1633	1257	1318	3321	1107	518	965	2851	2048	1529
41	764	1457	1248	1174	1171	1267	1190	886	971	2740	878	438	676	1681	1542	1146
42	632	1407	901	984	990	1130	1069	742	746	2654	635	351	412	1792	1370	918
43	641	1068	787	842	741	722	805	578	560	2161	563	320	495	1082	749	787
44	432	810	719	640	633	746	706	487	515	1762	536	249	234	649	658	636
45	416	821	613	605	631	518	536	396	442	1182	478	177	206	523	708	480
46	328	535	485	415	479	373	405	307	312	1024	441	181	159	280	445	271
47	241	456	388	353	440	311	361	262	290	865	378	88	158	216	332	284
48	188	339	313	339	382	257	294	254	237	656	381	134	87	149	230	143
49	79	206	318	288	319	237	262	196	204	557	212	74	72	223	195	100
50	115	253	306	276	287	201	228	156	160	501	160	46	63	108	123	126
51	73	170	214	176	246	163	201	115	135	383	132	37	58	68	83	53
52	46	150	152	184	201	138	116	110	120	296	128	32	24	46	88	96
53	51	120	111	142	137	140	121	98	97	198	96	24	42	33	56	37
54	20	80	90	104	156	115	95	63	95	271	93	17	18	29	59	49
55	30	57	47	109	137	79	73	75	79	152	58	15	11	26	23	61
56	13	23	86	69	117	60	67	54	75	132	46	8	5	15	21	24
57	6	47	49	58	134	70	41	31	67	98	48	22	10	18	7	12
58	6	22	27	43	134	45	80	48	47	105	52	3	8	5	7	12
59	3	10	32	41	85	33	19	23	48	79	33	12	3	3	8	6
60	11	8	10	19	115	33	23	14	42	48	22	3	2	3	5	7
61	0	5	5	28	40	23	7	8	30	39	15	8	1	0	3	2
62	0	4	3	16	21	9	9	9	16	55	18	1	1	7	3	6
63	1	1	5	9	19	9	7	10	7	23	11	2	1	0	0	1
64	0	0	8	8	18	10	6	3	16	12	8	0	0	1	1	2
65	1	0	1	14	11	9	1	3	9	11	7	0	0	1	1	3
66	0	1	1	6	10	1	0	2	3	11	3	0	0	0	1	1
67	0	0	1	5	8	1	0	2	3	6	1	0	0	0	0	0
68	0	0	2	4	7	3	0	0	4	7	0	0	0	0	0	0
69	0	1	0	1	6	2	0	1	1	2	2	0	0	0	0	0
70	0	0	0	2	4	0	0	0	1	2	0	0	0	0	1	1
71	0	1	0	1	5	0	0	0	1	1	0	0	0	0	0	0
72	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0	1
73	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1
74	0	0	0	0	4	0	0	0	0	1	0	0	1	0	0	1
75	0	0	0	1	4	0	0	0	0	0	1	0	0	0	2	5
Total	**509443**	**365612**	**376507**	**495103**	**616065**	**332060**	**313305**	**297984**	**251649**	**229614**	**219358**	**269767**	**239523**	**295319**	**362344**	**344102**
Weights	**6299**	**5863**	**5503**	**6689**	**7990**	**5587**	**5154**	**4820**	**4673**	**4822**	**3532**	**3900**	**4133**	**5391**	**6622**	**5799**

Table 11.6.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/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
10	0	922	52	0	0	382	139	94	130	57	928	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	269	497	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	2469	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	10185	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	1956	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**	**6679**	**5411**	**5603**	**6628**	**5814**	**4610**	**4947**	**4465**	**4173**	**4882**	**4013**	**4087**	**5506**

Table 11.6.h Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 2002-2017.

Removals=Landings+dead catches (discard survival rate : 30%)

CL mm/Y	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
10	888	19	0	0	0	16	0	58	0	0	0	0	0	0	0	18
11	1272	0	0	66	0	119	27	94	1	0	0	0	0	0	0	0
12	1818	49	254	289	49	142	69	56	0	166	0	0	0	53	53	38
13	2587	206	1205	760	164	85	164	124	68	417	372	0	20	129	53	78
14	3663	445	2206	2233	797	630	272	204	58	584	466	160	71	424	229	269
15	5148	839	3883	5101	2171	902	132	810	108	658	998	609	196	1033	405	859
16	7159	2370	4749	9469	5467	2072	719	1621	575	861	3181	919	910	1648	399	1168
17	9819	4169	6193	10565	8158	2545	1282	2141	933	1701	3316	2925	1153	2270	1902	2588
18	13226	5669	7112	13882	11302	3216	1851	3390	1616	2541	5646	2360	1966	3551	3645	2929
19	17418	8055	12167	13692	18124	3671	4531	4540	2472	3183	5617	6116	2676	5659	6779	5980
20	22430	8586	13522	15668	27825	6118	8087	8973	3998	5081	7122	6809	4521	6488	6615	9688
21	28666	13298	18377	22957	38024	8123	11131	11813	5465	7281	8527	10848	6510	7797	8553	11941
22	18385	15653	18546	25636	49040	12569	17519	13379	8434	10623	10058	15114	8079	8502	11525	11739
23	39420	21514	20924	30617	49293	16909	19614	15659	9957	9797	9367	19403	11355	10998	13591	15434
24	37486	22517	20604	31906	39608	21619	21468	18803	13113	11400	11821	18387	11636	14297	14945	17159
25	28940	24412	24990	34834	39706	24243	22348	18185	14209	13385	11454	20349	17054	16600	19353	19165
26	33574	25447	22402	31113	33545	24847	22508	18202	16796	11806	13298	20373	16273	17763	24781	24296
27	25081	24390	20599	27955	26097	23835	17982	19191	20163	13209	14092	18733	18578	18053	24563	23975
28	24964	22903	17791	25101	21831	20503	16765	19881	19579	11231	12563	15237	17306	20070	24626	22455
29	17605	18619	16289	18868	17523	15641	15148	15738	17692	11061	11531	14899	16181	17766	25890	20962
30	18718	18387	15474	16690	15495	14227	12072	15553	17049	10229	10111	10957	13832	16989	20294	20519
31	10138	14274	13134	13626	12590	11619	10419	12135	13641	9126	8480	9783	11935	13879	19860	15615
32	10367	11677	10836	10276	10108	9790	9163	9898	11867	7299	7554	7595	11391	13242	14816	14678
33	7844	8472	8372	8007	8802	8197	7731	7556	9096	6361	6078	5814	6777	10451	14754	8322
34	5323	6377	6568	6924	7400	6915	7142	6566	7332	5657	4606	4469	6961	8657	9165	8430
35	4314	4776	4970	5282	5297	6714	5511	4801	6021	4663	3524	2946	5049	6225	7421	6130
36	3160	3897	3384	3401	4155	4971	3921	3835	3665	4301	2651	2159	3537	5389	7015	5181
37	2050	3133	2927	2770	3214	4048	3228	2696	3138	3753	2078	1563	2713	4720	5186	3097
38	2225	2725	2120	2461	2731	2667	2463	2059	2258	3978	1611	1055	1833	3483	3745	2229
39	1560	2184	1780	1753	1956	2246	2301	1529	1652	3489	1314	959	2006	2772	3268	2462
40	1399	1962	1606	1654	1717	1744	1633	1237	1306	3313	1106	518	929	2798	2026	1459
41	764	1447	1230	1168	1171	1255	1190	884	969	2740	878	438	674	1667	1498	1108
42	632	1406	897	975	990	1125	1053	742	745	2607	635	351	412	1640	1315	876
43	641	1064	783	842	741	718	805	567	560	2160	561	320	449	1022	749	726
44	432	810	715	640	633	746	706	483	514	1762	536	249	234	645	658	586
45	416	817	613	605	620	518	536	396	442	1181	478	177	206	506	708	468
46	328	535	485	415	479	373	405	307	310	1024	441	181	159	267	422	271
47	241	456	388	353	440	311	361	262	290	863	378	88	156	216	332	277
48	188	339	313	339	382	257	294	251	237	656	381	124	87	149	230	143
49	79	206	318	288	319	237	262	196	204	557	212	74	72	217	195	100
50	115	253	306	276	287	198	228	156	160	501	160	46	63	108	123	126
51	73	170	214	176	246	163	201	115	135	383	132	37	58	68	83	53
52	46	150	152	184	201	138	116	110	120	296	128	32	24	46	88	96
53	51	120	111	142	137	140	121	98	97	198	96	24	42	33	56	37
54	20	80	90	104	156	115	95	63	95	271	93	17	18	29	59	49
55	30	57	47	109	137	79	73	75	79	152	58	15	11	26	23	54
56	13	23	86	69	117	60	67	54	75	132	46	8	5	15	21	24
57	6	47	49	58	134	70	41	31	67	98	48	22	10	18	7	12
58	6	22	27	43	134	45	68	48	47	105	52	3	8	5	7	12
59	3	10	32	41	85	33	19	23	48	79	33	12	3	3	8	6
60	11	8	10	19	115	33	23	14	42	48	22	3	2	3	5	7
61	0	5	5	28	40	23	7	8	30	39	15	8	1	0	3	2
62	0	4	3	16	21	9	9	9	16	55	18	1	1	7	3	6
63	1	1	5	9	19	9	7	10	7	23	11	2	1	0	0	1
64	0	0	8	8	18	10	6	3	16	12	8	0	0	1	1	2
65	1	0	1	14	11	9	1	3	9	11	7	0	0	1	1	3
66	0	1	1	6	10	1	0	2	3	11	3	0	0	0	1	1
67	0	0	1	5	8	1	0	2	3	6	1	0	0	0	0	0
68	0	0	2	4	7	3	0	0	4	7	0	0	0	0	0	0
69	0	1	0	1	6	2	0	1	1	2	2	0	0	0	0	0
70	0	0	0	2	4	0	0	0	1	2	0	0	0	0	1	1
71	0	1	0	1	5	0	0	0	1	1	0	0	0	0	0	0
72	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0	1
73	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1
74	0	0	0	0	4	0	0	0	0	1	0	0	1	0	0	1
75	0	0	0	1	4	0	0	0	0	0	1	0	0	0	2	5
Total	**410743**	**305060**	**309877**	**400500**	**469879**	**267624**	**253896**	**245640**	**217590**	**193133**	**183978**	**223293**	**204145**	**248399**	**302052**	**283922**
Weights	**5513**	**5270**	**4923**	**5880**	**6627**	**4864**	**4517**	**4270**	**4290**	**4443**	**3229**	**3444**	**3735**	**4844**	**5863**	**5083**

Table 11.7. Total number of burrows (10^6), densities/m² and CVs by spatial stratum and for the Bay of Biscay. Years 2016 and 2017 after including rough sea bottom (noted RO) 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 (196 stations)				2017 (124 stations)				
	nb/m²	total burrow	CV (%)	% burrows	nb/m²	total burrow	CV (%)	% burrows	% surf
	0.320	**5167.67**	**7.84**		**0.259**	**4181.95**	**9.87**		
CB	0.258	654.41	19.84	12.66%	0.152	384.49	20.10	9.19%	15.69%
CL	0.237	272.72	20.87	5.28%	0.262	302.03	14.76	7.22%	7.13%
LI	0.283	1319.12	13.86	25.53%	0.210	978.48	14.75	23.40%	28.85%
VS	0.839	531.18	17.92	10.28%	1.147	726.44	27.94	17.37%	3.92%
VV	0.642	1728.09	14.52	33.44%	0.425	1142.76	19.82	27.33%	16.65%
RO	0.148	662.15	29.61	12.81%	0.144	647.75	34.23	15.49%	27.76%

Table 11.8. Estimation of the abundance of Nephrops burrows (10^6) by UWTV. Example of years 2014 and 2015 (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 11.9. 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
2017	520	238	21.88

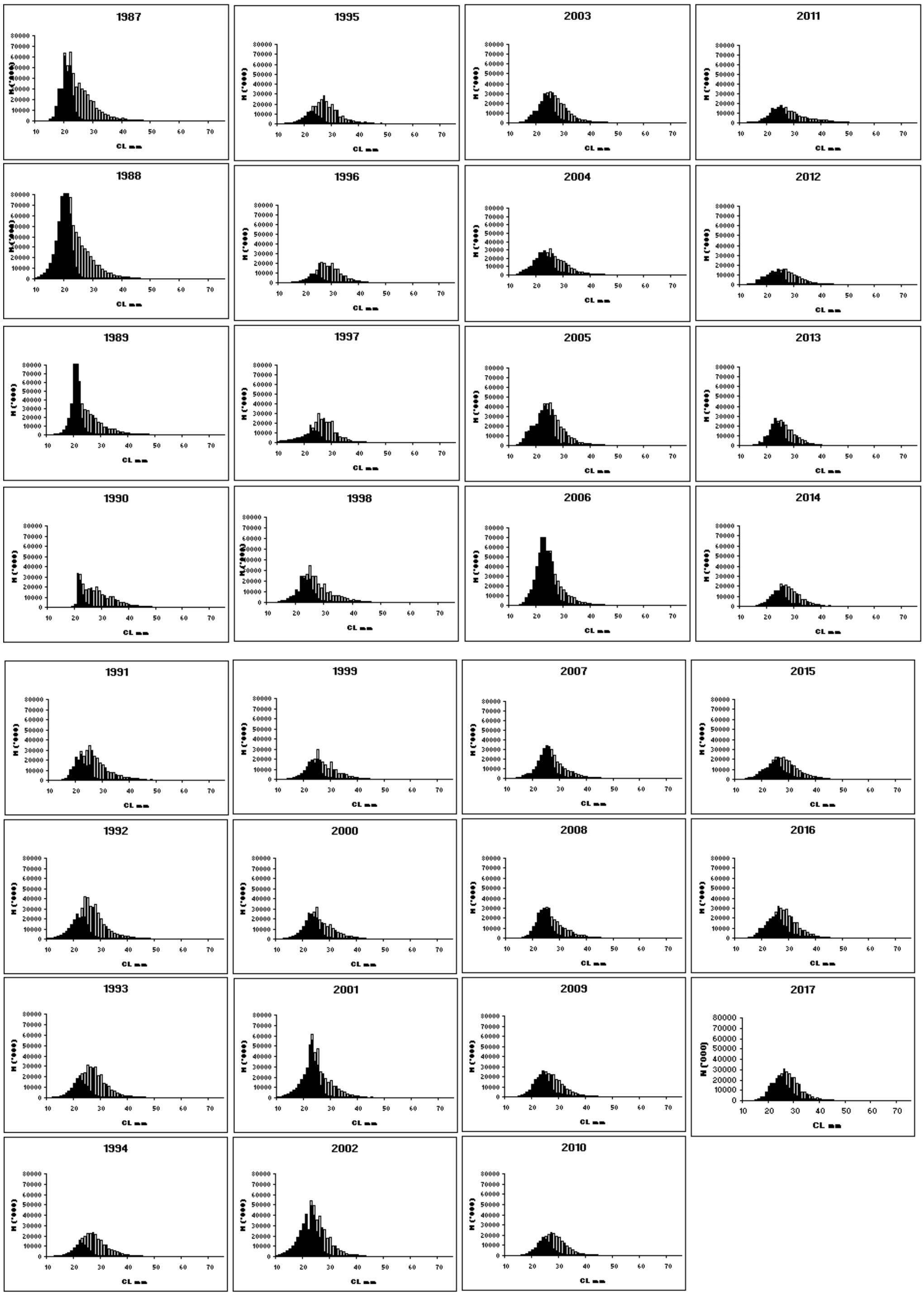
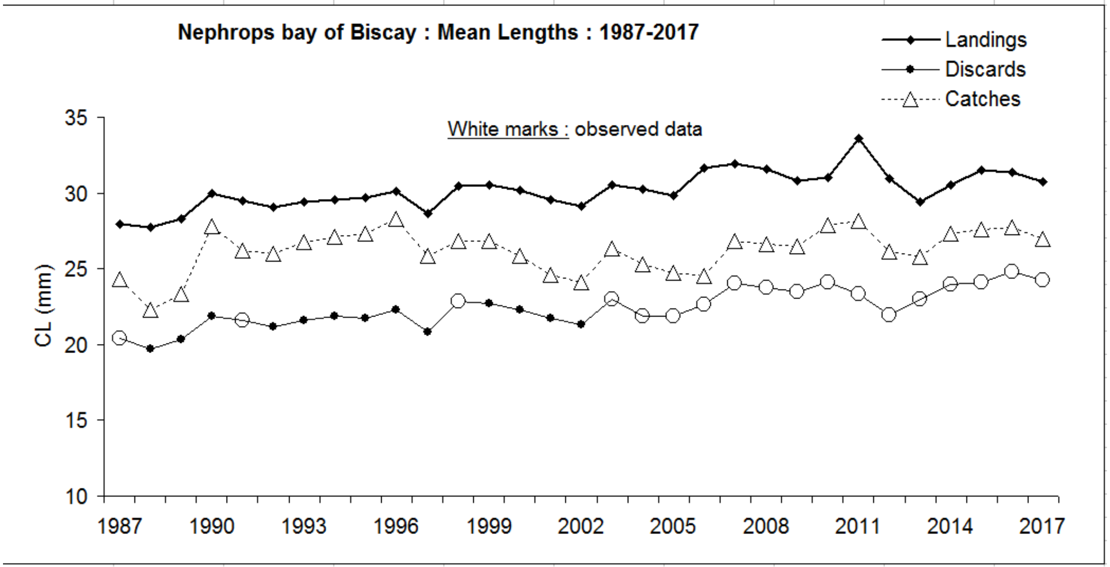
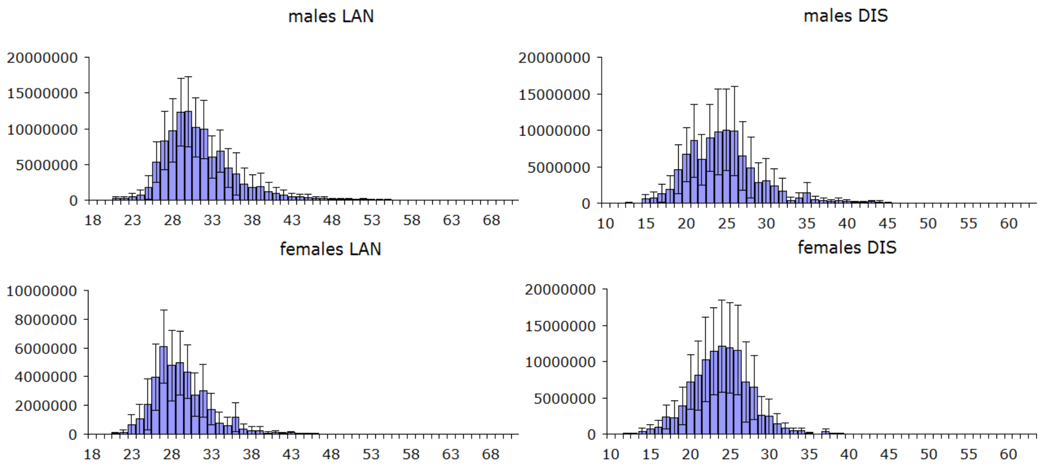


Figure 11.1. ***Nephrops*** **in FU23-24 Bay of Biscay (8.ab) catches (landings in white, discards in dark). Years 1987–2017.**

Figure 11.2. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - mean length of landings, discards and catches





CV (%) by year and sex			
		males	females
2014	LAN	13.4	19.0
	DIS	28.4	35.0
2015	LAN	10.8	14.3
	DIS	15.9	15.9
2016	LAN	13.5	13.9
	DIS	25.2	25.0
2017	LAN	18.8	24.2
	DIS	25.5	19.4

Figure 11.3. Nephrops in FU23-24 Bay of Biscay (8.ab). LFDs and confidence intervals for landings and discards 2017 by sex.

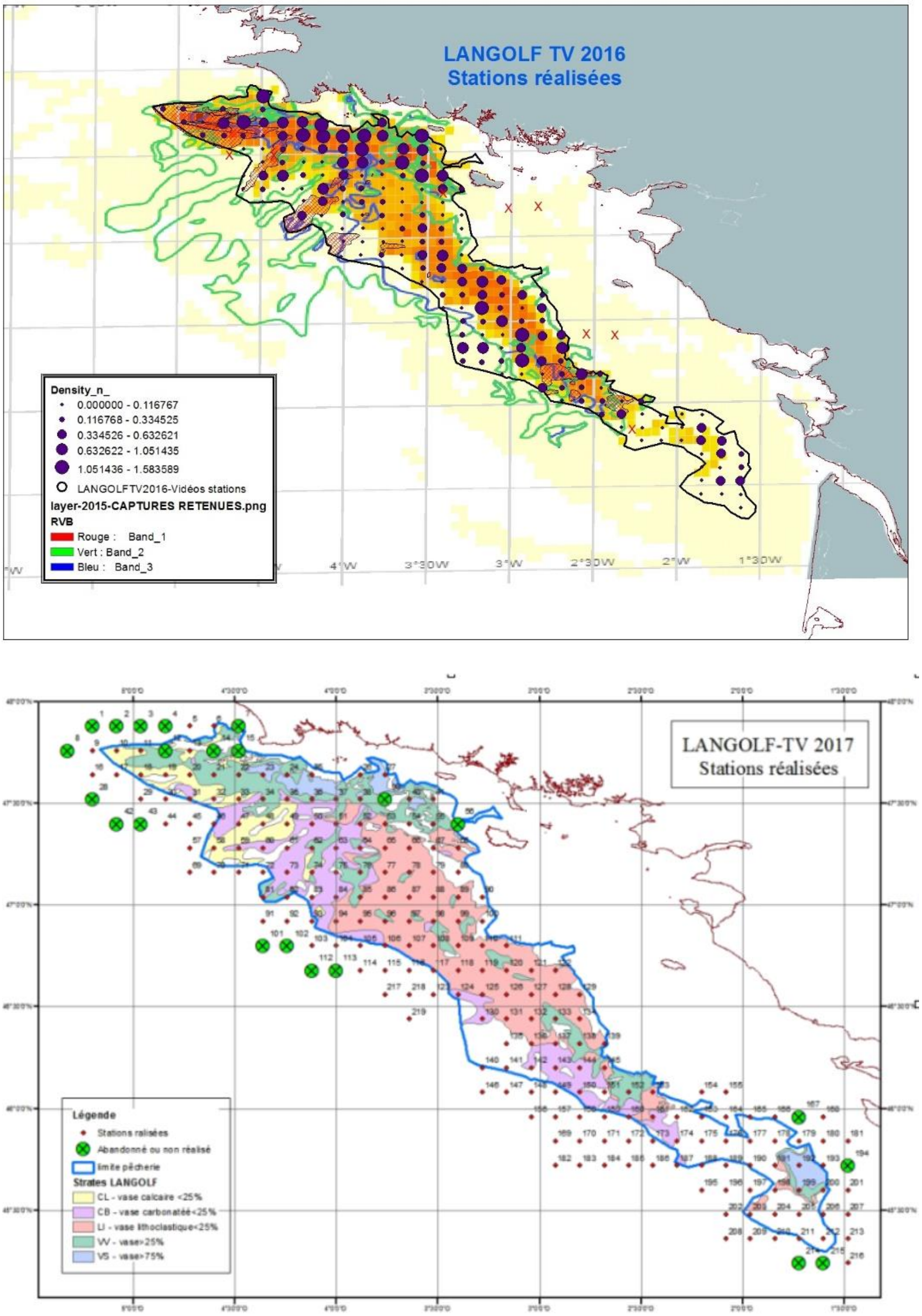


Figure 11.4. Above: systematic grid of the 2016's UWTV survey combined with VMS data (rectangles of 3 min*3 min; source: National Fisheries Direction; compilation: SIH Ifremer). Below: UWTV stations on a systematic grid for the 2017's survey with additional stations outside the edge of the Central Mud Bank.

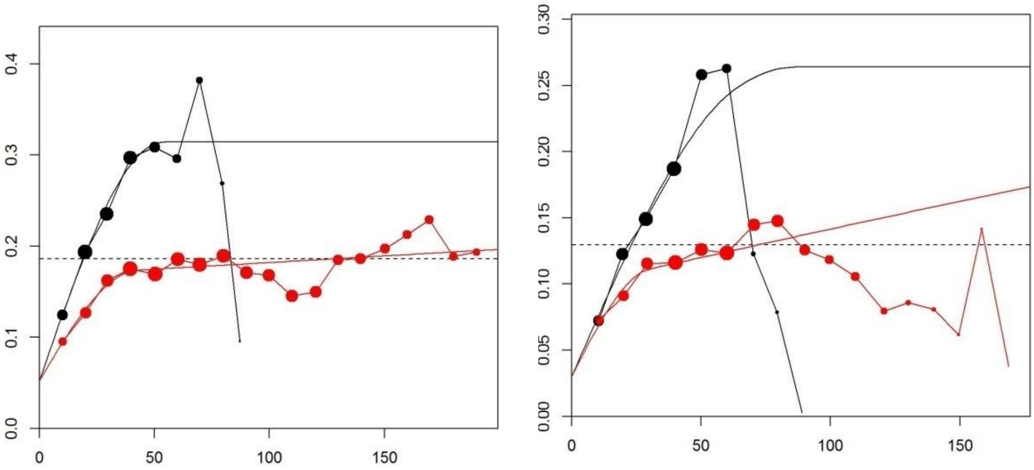


Figure 11.5. Experimental variograms (circles proportional to the number of pairs) and models (continuous curves) for the main anisotropic directions (red: NW->SE, black: SW->NE).

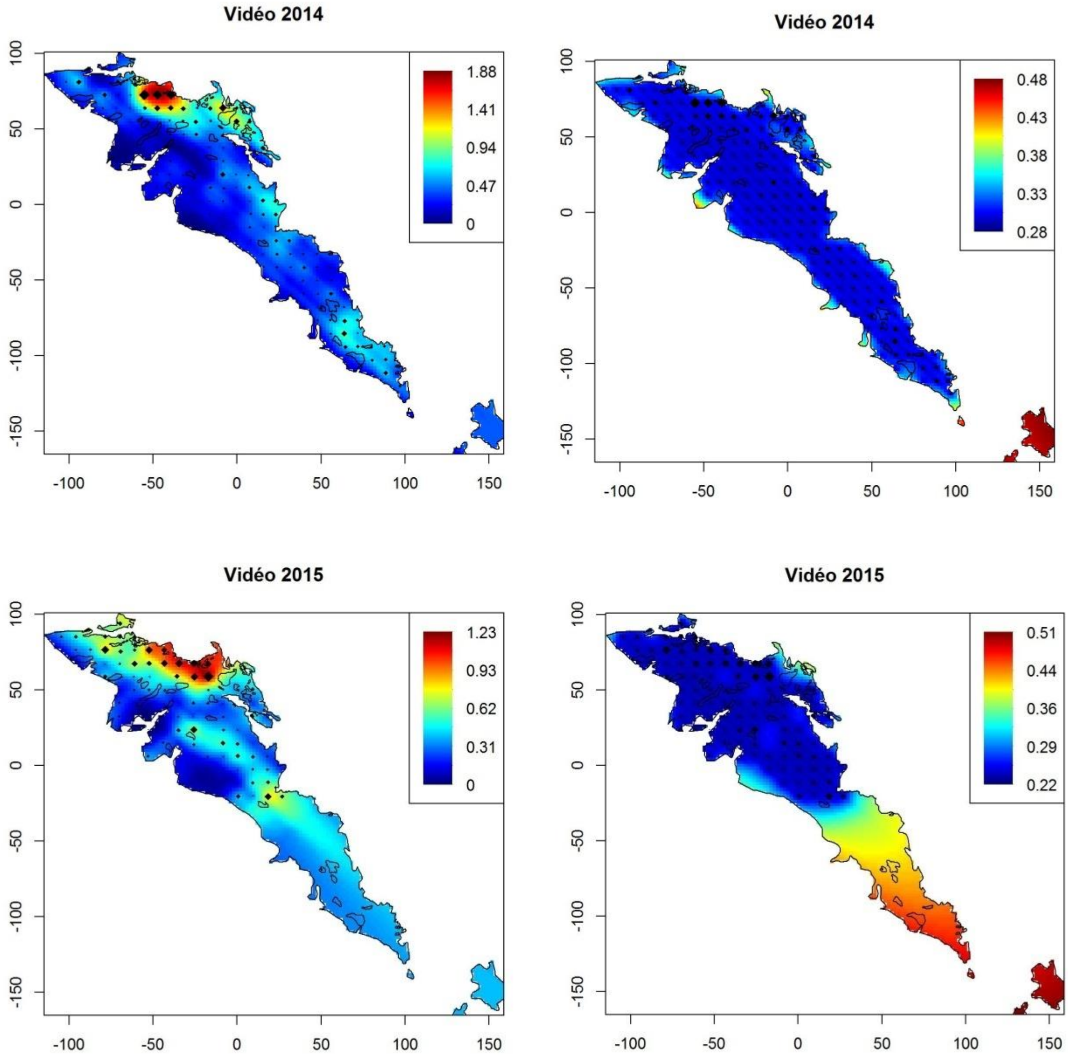


Figure 11.6. Years 2014 and 2015. Estimation of the burrows densities /m² using ordinary kriging (left column) error of kriging (right column).

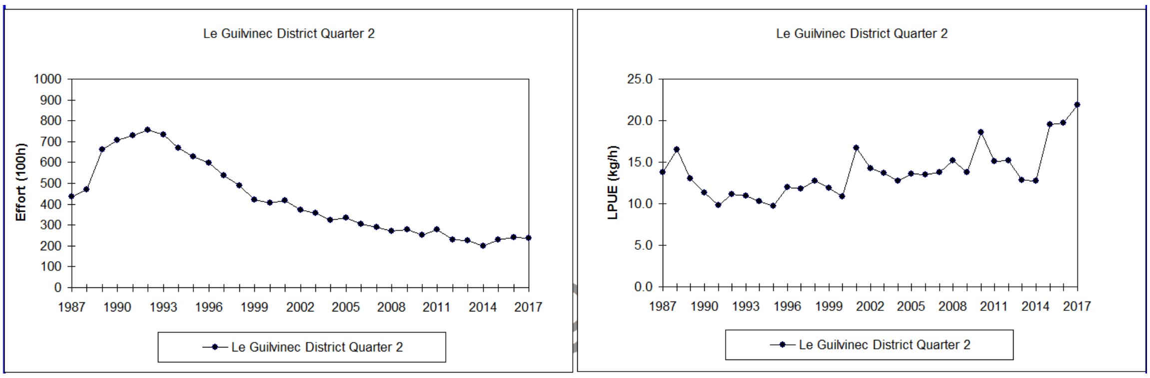


Figure 11.7. Nephrops in FUs 23-24 Bay of Biscay (8.a,b). Effort and LPUE values for standardised commercial fleets.

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 2017 and 2018

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). This plan is based on precautionary reference points for southern hake that are no longer appropriate.

A zero TAC was set for the whole of Division 8c for 2017-2019 period.

A scientific quota of 4.2 t was established for *Nephrops* in FU 25 in order to carry out an observer's program supervised by the Spanish Oceanographic Institute (IEO) in 2017 for obtain a commercial *Nephrops* abundance index.

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 estimate is considered the best information available at this time. In 2017, landings were 2 t corresponding to catches obtained from the observer's programme (CARACAS survey). Details about this survey are documented in a working document presented in this WG (WD Nº 10, Vila et al., 2018). 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 2000–2017, 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 2008–2017).

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 overall trend was observed from 2010 to 2017 (Figure 12.1.1). Mean carapace length in males was 37.7 mm CL while 38.0 mm CL for females 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 (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 that year, representing approximately 15% of fishing effort in the 70's. Effort increased from 2012 to 2014 but the overall trend since 2014 onwards is decreasing. SP-LCGOTBDEF effort was 1154 trips in 2017. 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 but it declined again in 2017.

Fishing industry presented abundance data of this stock for 2015 and 2016 in last WGBIE (ICES, 2017) based on catches and effort information obtained from two trawler vessels based in the A Coruña port. Since the fishery is closed for 2017-2019 period, any new approach of analysis and assessment of the stock trends in the next few years cannot be achieved. An observer's program (CARACAS survey) was authorized in August and September in order to obtain a commercial *Nephrops* abundance index (see WD Nº 10, Vila et al., 2018). Table below shows the *Nephrops* abundance index (CPUE) estimated in 2017 from this survey for this FU, as well as the previous CPUE series estimated from the fishing industry in 2015 and 2016.

Source	Year	Period	Directed CPUE (Kg/hour)	s.d.	Non-directed* CPUE (Kg/hour)	s.d.
ICES2017-Fishing Industry	2015	Year	6.46		0.18	
ICES2017-Fishing Industry	2016	Year	10.81		0.27	
CARACAS survey	2017	Aug-Sep	7.22	1.57	0.59	0.56

***To avoid the effect of daily variations in the catchability of *Nephrops*, which is a consequence of the changes in their behaviour, the hauls that were carried out in more than 50% of time between dusk and dawn were considered non-directed to *Nephrops*.**

This CPUE time series is still very short to describe the trend of the abundance index of *Nephrops* in FU 25. However, it would be interesting to continue this CPUE time series in the next years in order to examine it as an abundance index of *Nephrops* in a future benchmark.

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 2017 WGBIE with qualitative and quantitative information about *Nephrops*' fishery in FU25 (ICES, 2017). The WG decided that the lpue data provided, could be examined as an abundance index of *Nephrops* 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 (1975–2017), 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*.

An observer's programme supervised by the Spanish Oceanographic Institute (IEO) to obtain a commercial *Nephrops* abundance index was carried out in 2017. To do this, a scientific quota for *Nephrops* in FU 25 was authorized by EU.

Spain requested a sentinel fishery for *Nephrops* in Division 8c for 2018 (2018 WGBIE Annex 8). An ICES Special Request Advice for a sentinel fishery in *Nephrops* FU 25 for 2018 was delivered in February 2018. ICES advices that, if an UWTV survey cannot be conducted, an observer's on-board programme with a fixed effort level and supervised by a scientific institute must be carried out (ICES, 2018).

12.1.7 References

10Information regarding fishing for *Nephrops Norvegicus* (Norway lobster) in Galicia (FU 25). *In* Report of the Working Group for the Bay of Biscay and Iberian waters Ecoregion (WGBIE), 4–11 May 2017, Cádiz, Spain. ICES CM 2017/ACOM:12. 532 pp. Annex 6, Working Document No. 10.

ICES, 2018. EU request for advice on a sentinel fishery for Norway lobster (*Nephrops*) in fuctional unit 25, Division 8c. ICES Special Request Advice Bay of Biscay and the Iberian Coast Ecoregion. Published 9 February 2018 sr.2018.02. DOI: 10.17895/ices.pub.3967

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
2017	2	0	2

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 2000–2017.

Size, CL/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
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		0
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	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	0
30	85	112	105	14	46	43	25	19	10	1	9	2	2	12	3	18	37	1
31	60	129	102	26	45	56	39	36	10	1	9	3	3	2	2	11	31	1
32	127	288	198	36	60	66	55	44	15	1	18	3	3	3	2	14	49	0
33	95	319	181	51	71	87	69	69	13	3	20	5	3	5	5	25	73	1
34	219	302	272	66	70	83	62	75	16	4	27	13	2	5	7	26	97	2
35	218	265	308	85	91	98	85	90	25	5	34	25	4	18	12	47	183	6
36	158	243	259	110	98	102	88	101	31	6	30	21	4	8	16	26	153	6
37	144	285	236	123	101	88	87	105	37	9	34	23	5	9	13	22	137	4
38	113	238	185	147	98	92	80	101	35	10	26	63	3	6	13	22	193	6
39	82	192	129	130	81	69	67	86	37	10	23	45	1	15	11	12	121	6
40	134	212	186	129	96	81	64	90	47	12	20	78	8	11	13	16	180	2
41	64	115	99	81	78	61	59	73	44	12	23	61	4	7	9	11	96	2
42	73	150	117	79	63	52	49	63	38	11	23	50	3	6	8	12	59	1
43	30	103	67	65	57	47	44	59	35	12	24	52	1	15	8	10	58	2
44	48	98	109	52	39	36	32	46	29	14	22	34	3	7	7	10	38	0
45	40	68	78	46	44	34	30	42	23	13	21	24	3	7	4	6	36	0
46	20	35	65	57	35	26	26	37	22	11	22	17	1	7	5	5	18	1
47	10	22	34	42	26	20	18	30	20	14	22	13	1	2	4	5	17	1
48	17	24	35	37	23	14	17	22	16	9	17	15	0	4	2	3	13	1
49	11	18	23	27	16	13	11	16	14	8	14	17	2	3	2	3	11	1
50	13	18	24	27	19	11	14	18	10	8	13	12	0	2	2	2	13	0
51	8	16	34	20	13	7	9	11	11	6	11	7	1	2	1	2	8	0
52	8	10	18	16	12	8	8	8	9	6	8	7	0	2	1	2	6	0
53	2	15	13	11	9	6	7	7	8	7	9	4	1	2	2	2	5	0
54	5	4	4	9	7	5	4	4	6	5	7	7	0	2	1	1	4	0
55	7	7	9	6	6	5	4	3	6	6	7	6	1	1	1	1	3	0
56	2	5	6	5	5	3	9	3	4	4	4	5	0	1	1	1	2	0
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	0
60	2	1	2	2	2	2	1	1	2	3	3	3	0	0	0	0	1	0
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	44
Total weight (tonnes)	81	147	143	89	75	63	62	67	39	21	34	44	10	10	9	14	77	2
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	0.045
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	38.3

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
2017	2		1154		2.6

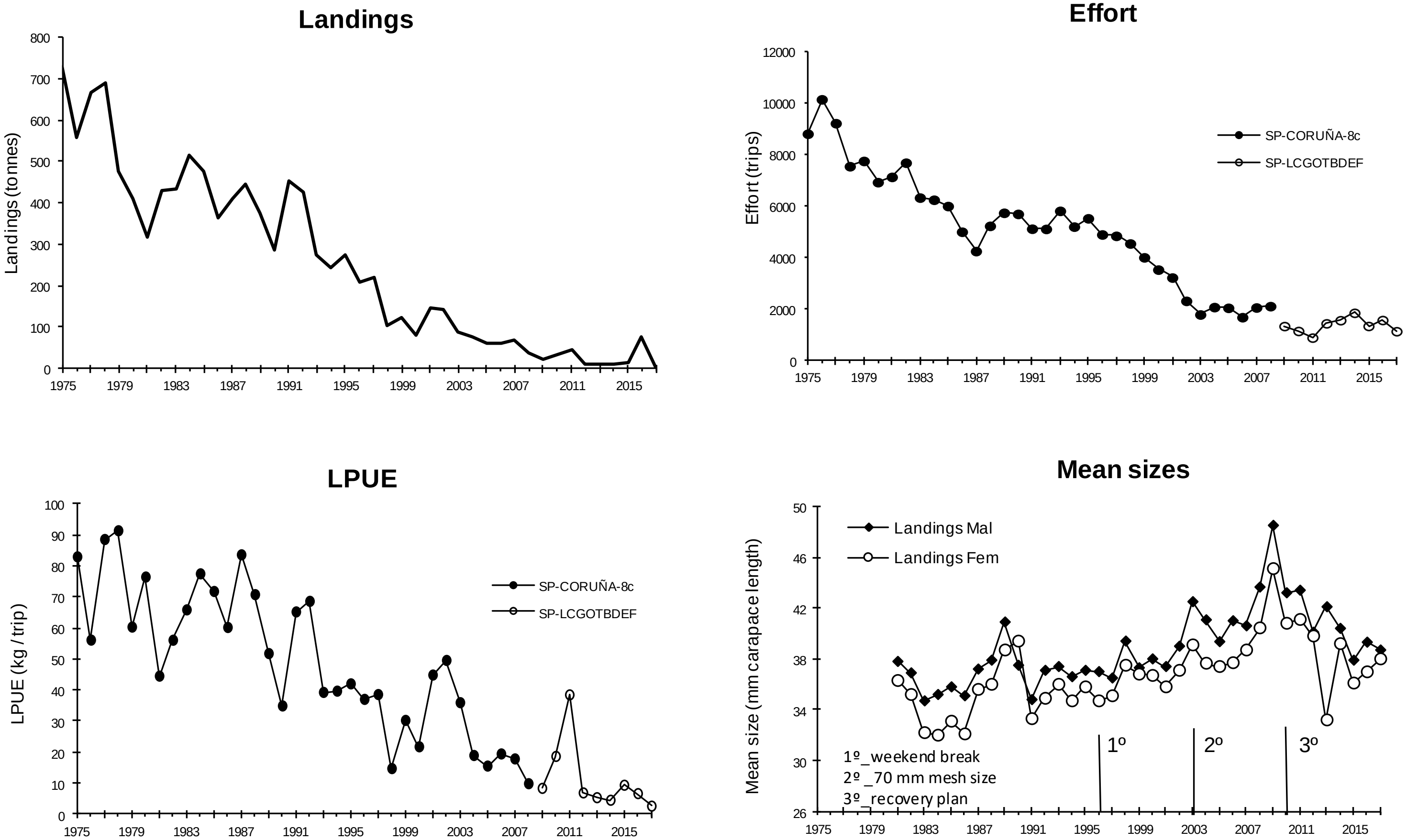


Figure 12.1.1. ***Nephrops*** **FU25, North Galicia. Long-term trends in landings, effort, lpue and mean sizes**

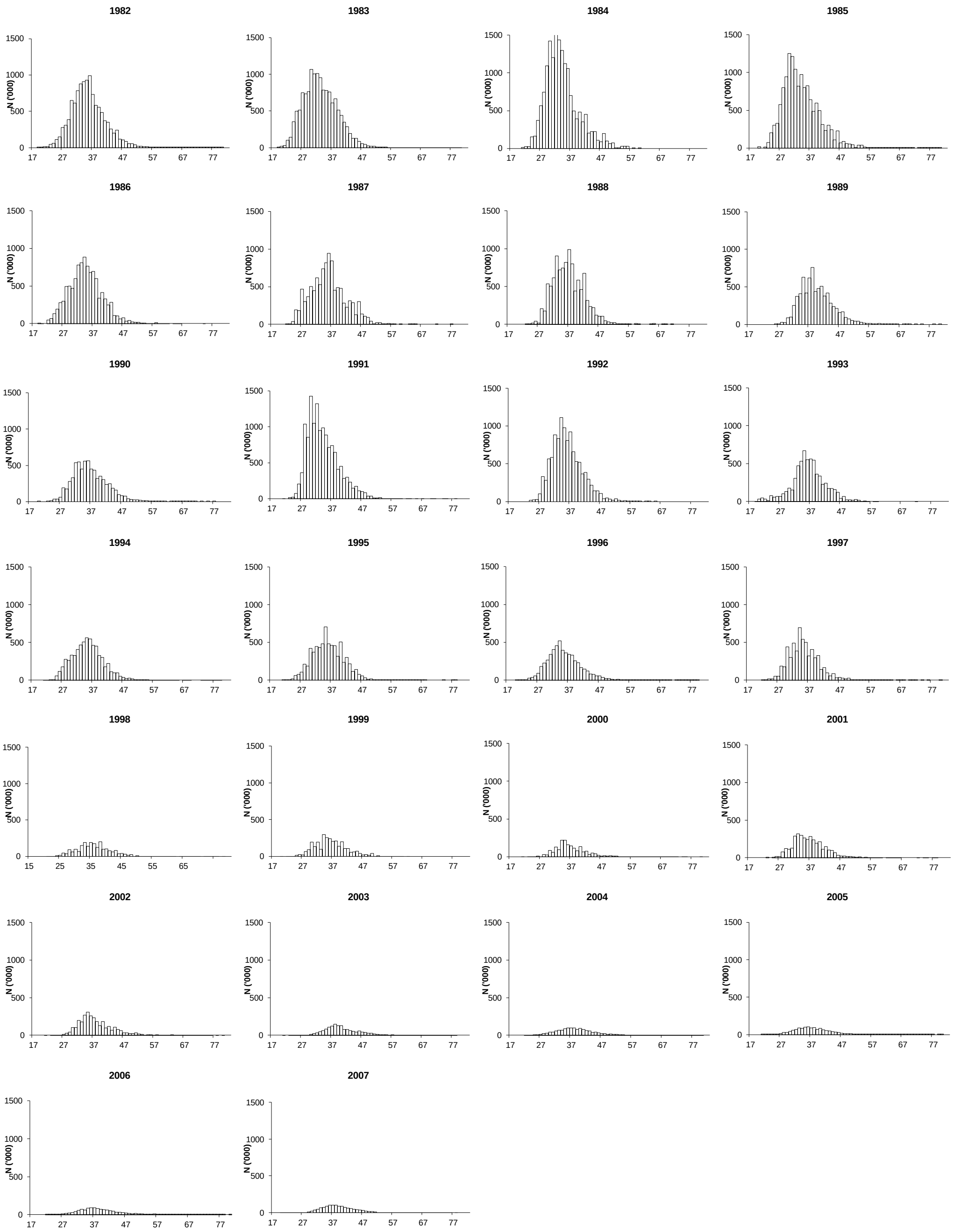


Figure 12.1.2a. *Nephrops* FU25, North Galicia. Length distributions in landings for 1982–2007 period.

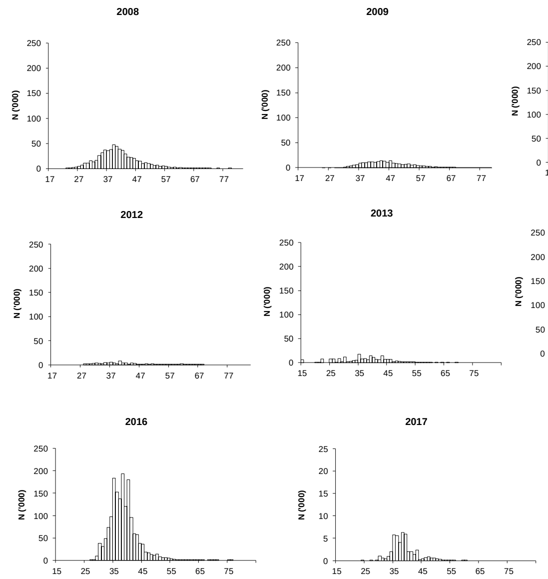


Figure 12.1.2b. *Nephrops* FU25, North Galicia. Length distributions in landings for the period 2008–2017

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 2017 and 2018

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). This plan is based on precautionary reference points for southern hake that are no longer appropriate.

A zero TAC was set for the whole of Division 8c for 2017–2019 period.

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.

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 1983–2017. 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. In 2017, landings were zero. Information on discards was sent to the WG through InterCatch. There have never been discards in this functional unit. Nevertheless, 31.4 Kg was discarded in 2017 but it was considered negligible.

12.2.2.2 Biological sampling

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 although the overall trend is increasing. Mean size in 2016 was of 52.1 mm CL for males and 45.8 mm CL for females. No length frequency distributions for both sexes were available in 2017.

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 harbours 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). An effort series including the Santander, Avilés and Gijón effort together from 2009 onwards is presented. 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. In 2017, effort was lower than the previous 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.LPUE data is not available in 2017 since zero landings were recorded.

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
2017	0	0	0

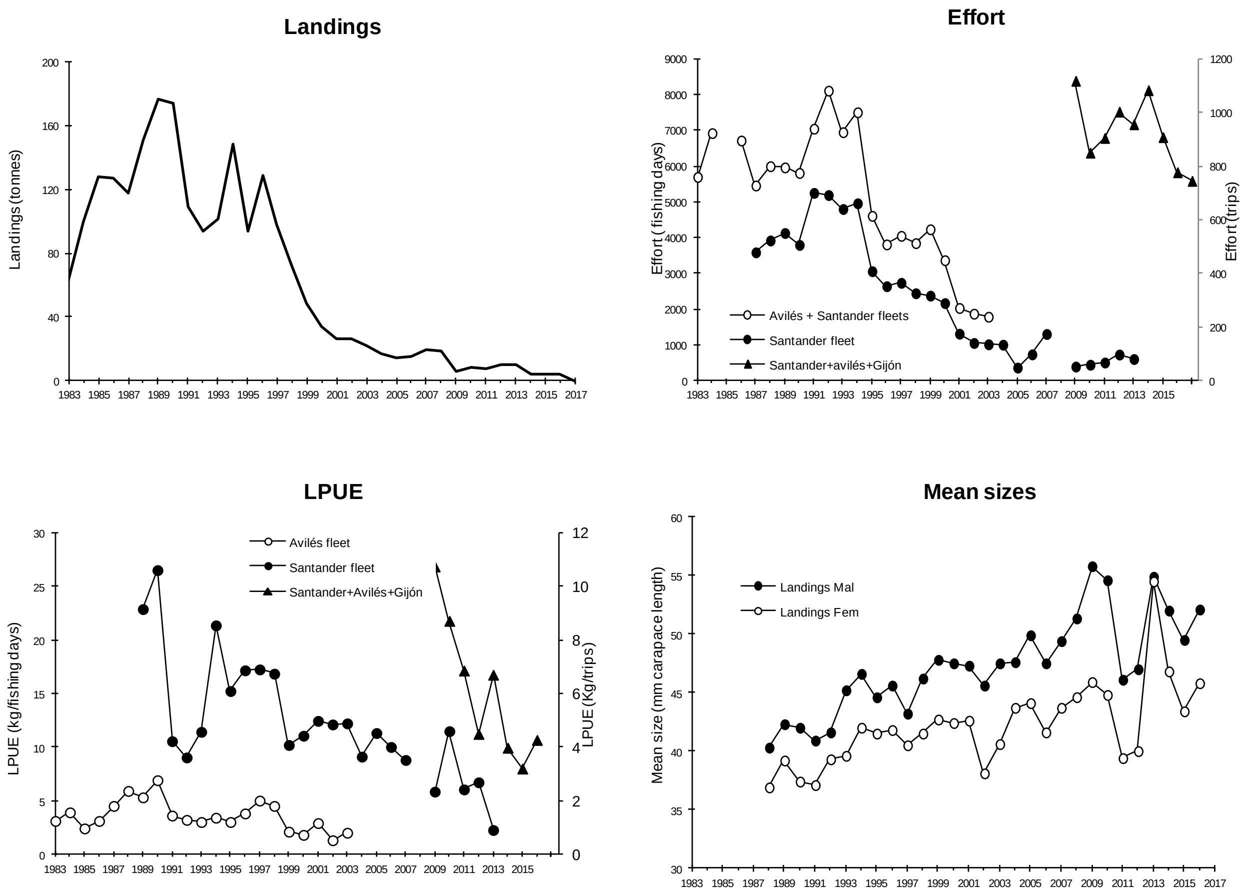


Figure 12.2.1. ***Nephrops*** **FU31, Cantabrian Sea. Long-term trends in landings, effort, lpue and mean sizes**

12.3 Summary for Division 8c

Nephrops in Division 8c 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 indicate that both stocks are in very poor condition. However, landings estimates in *Nephrops* FU25 in 2016 show a significant increase of landings. TAC in FU 25 and FU 31 was zero catch for 2017, 2018 and 2019. However, a scientific quota was only authorized for FU25 in August and September 2017 in order to get a commercial abundance index. A sentinel fishery was advised by ICES with the same objective for 2018.

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
2017	2		0	2

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 2017 and 2018

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). This plan is based on precautionary reference points for southern hake that are no longer appropriate

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.

The TAC set for the whole Division 9a was 336 t for 2017 and 381 t for 2018, 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 126 days for Spanish vessels and at 113 days for Portuguese vessels for these two years (Annex II b of Council Regulations nos. 127/2017 and 120/2018). 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 in FU 27 by the Portuguese fleet. So, estimated landings in 2016 were three times more than 2015 (6 t). In 2017, estimated landings were only 2 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

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 trend increased for males since 2014 onwards but it declined for females in 2016. 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. No length frequency distributions for both sexes were available in 2017.

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; Figure 13.1.1). 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). In 2010, LPUE downfall again and it has remained at minimum level since then. In 2017, LPUE recorded the lowest value in the time series (0.3 Kg/trip) indicating that the abundance of this FU is very poor.

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, 72/2016, 127/2017). The recovery plan target and rules have not been changed since it was implemented. This plan also includes a seasonal closure (June-August) for *Nephrops* in an area of the West Galicia (FU 26) fishing grounds, which was amended to the Council Regulation (EC) No 850/98.

A Fishing Plan for the Northwest Cantabrian ground was established in 2013 (AAA/1307/2013). This new regulation establishes an assignation of the quotas by vessel including *Nephrops.*

Table 13.1.1. ***Nephrops*** **FU26-27, West Galicia and North Portugal. Landings in tonnes by Functional Units and country.**

	Spain		Portugal	Unallocated/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
2017	<1	0	2			2

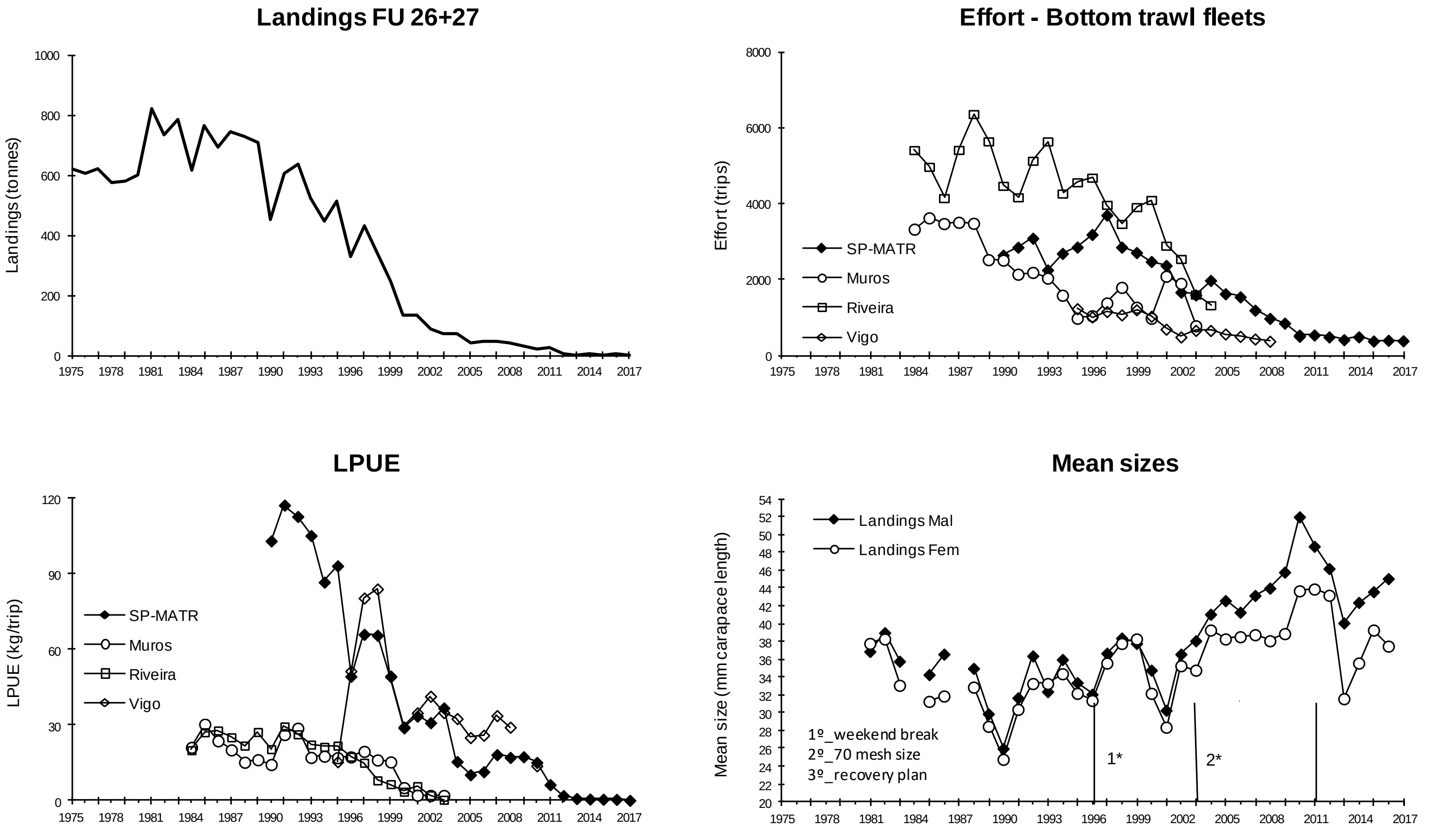
**Prior 1996, landings of Spain recorded in FU 26 include catches in FU 27

Table 13.1.2. ***Nephrops*** **FU26-27, West Galicia and North Portugal. Length compositions, mean weight (Kg) and mean size (CL, mm) in landings for the 1988-2016 period. Data no available in 2017.**

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
2017	<1	390	0.3



1* -weekend break in West Galicia, 2*- 70 mm mesh size, 3*-recovery plan

Figure 13.1.1. ***Nephrops*** **FU26-27, West Galicia and North Portugal. Long-term trends in landings, effort and mean sizes.**

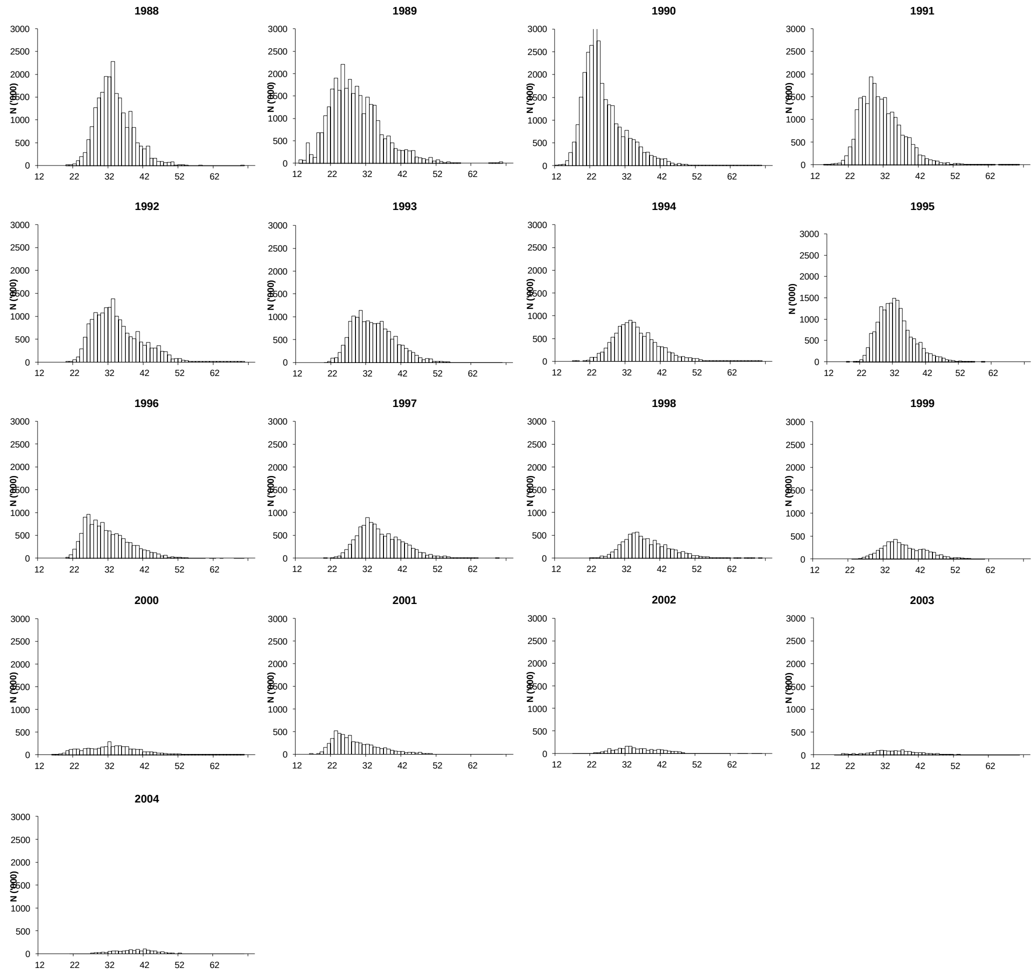


Figure 13.1.2a. *Nephrops* FU26-27. West Galicia and North Portugal. Length distributions in landings for the 1988-2004 period.

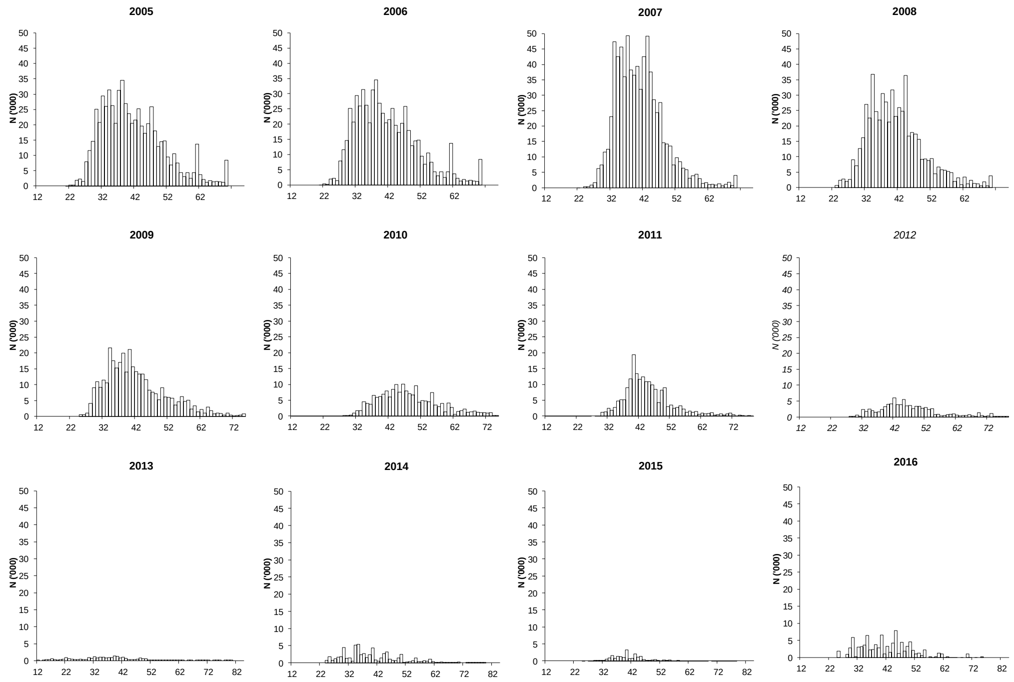


Figure 13.1.2b. ***Nephrops*** **FU26-27. West Galicia and North Portugal. Length distributions in landings for the 2005–2016 period. Data no available in 2017.**

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 2018

The advice for these stocks is biennial and valid for 2018-2019. Based on the ICES approach for data-limited stocks, ICES advised that catches in 2018 for FUs 28 and 29 should be no more than 281 tonnes.

To protect the stock in this Functional Unit, ICES advises that management area should be consistent with the assessment area. Therefore, management should be implemented at the Functional Unit level.

Management applicable for 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). This plan is based on precautionary reference points for southern hake that are no longer appropriate.

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 336 and 381 t for 2017 and 2018, 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 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 127/2017 and 120/2018). 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 1–2 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 2014-2017, 100% of the caches were into FU 28-29 definition.

Males are the dominant component in most of the years in the time series with exception for 1995 and 1996 when total female landings exceeded male landings (ICES, 2006). The male:female ratio in 2017 was 1:1.

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 2017 was at the same level as in previous years, in the months when the Norway lobster 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. Besides, 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 in this stock is biennial. The stock data were updated with the new information from 2017. As no changes were perceived in the stock information and trends, the advice issued in 2017 for 2018 and 2019 is considered still valid and there is no need of reopening the advice. Table 13.2.7 and Figure 13.2.6 with the updated results from the Mean Length Z approach (ICES, 2015) were also added to corroborate with this statement.

13.2.4 Biological reference points

Proxies of MSY reference points were reviewed in WGBIE 2017 using the methods developed in WKLIFE and WKProxy (ICES, 2015, 2016). From length-based analysis of the period 1984-2016, $F_{0.1}$ was estimated at 0.23 for males and 0.24 for females, as proxies of F_{MSY}. No proxy for B_{MSY} was identified (ICES, 2017).

13.2.5 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, 104/2015, 72/2016 and 127/2017). The recovery plan target and rules have not been changed since it was implemented. Although not revoked, the enforcement of the plan has been relaxed in the last two years.

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.

13.2.6 References

ICES, 2015. Report of the Fifth Workshop on the Development of Quantitative Assessment Methodologies based on Life-history Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE V), 5–9 October 2015, Lisbon, Portugal. ICES CM 2015/ACOM:56. 157 pp.

ICES, 2016. Report of the Workshop to consider MSY proxies for stocks in ICES category 3 and 4 stocks in Western Waters (WKProxy), 3–6 November 2015, ICES Headquarters, Copenhagen. ICES CM 2015/ACOM:61. 183 pp.

ICES, 2017. Report of the Working Group for the Bay of Biscay and Iberian Ecoregion (WGBIE), 4-11 May 2017, Cadiz, Spain. ICES CM 2017/ACOM:12, 532.

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					Total
	28***	29	28+29			
	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
2017**		26	9	241	249	275

** Preliminary values

*** Spanish landings from FU28 included in FU29

Table 13.2.2.a. FU 28-29 - Length Composition of *Nephrops* Males (1984-2017)

Landings (thousands)																	
Age/Year	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
17																	
18																	
19					4	21					0						
20			0	16	4			6	4							4	
21		17	9			84		16	37	9						3	3
22	7	5	14	15		97	9	29	96	38	9				2	0	16
23	24	7	7	8		143	5	19	55	34			8	4		5	8
24	14	40	121	209	51	272	27	53	202	42	18		17	9	8	9	20
25	109	83	115	81	97	229	116	69	181	149	34	3	23	6	16	39	13
26	250	170	137	446	128	205	182	111	263	72	68	0	36	43	32	33	58
27	282	326	170	718	208	269	149	94	185	95	77	0	54	95	81	49	85
28	374	500	289	871	399	280	337	139	506	272	157	0	56	78	65	68	44
29	439	559	341	727	456	283	415	159	462	382	95	28	38	88	65	109	148
30	412	742	328	584	442	317	695	239	725	548	187	11	68	104	160	133	87
31	277	670	389	742	457	230	813	325	755	548	231	24	92	172	129	272	111
32	373	784	680	806	446	367	866	260	670	674	383	108	151	283	289	88	161
33	339	531	213	236	428	265	702	133	345	365	149	83	70	90	95	182	92
34	389	635	609	721	656	328	785	239	451	655	270	215	159	251	269	152	160
35	478	525	590	245	664	291	755	171	296	475	224	169	147	169	118	175	100
36	378	463	519	342	572	295	449	138	399	639	221	147	78	154	166	143	158
37	528	346	322	406	424	356	465	77	351	391	107	262	172	149	167	128	162
38	496	383	606	355	571	302	479	120	378	344	179	134	113	58	85	75	106
39	353	309	361	240	326	332	611	126	348	306	95	151	62	46	47	180	81
40	447	337	323	156	366	316	829	200	248	174	144	232	83	82	83	83	96
41	247	230	316	335	164	314	797	141	243	158	93	247	78	37	53	184	102
42	371	246	507	264	215	360	628	174	246	170	168	293	85	33	167	58	91
43	199	156	198	62	102	364	335	121	242	107	127	65	31	21	43	102	47
44	194	233	422	215	128	481	553	125	371	179	150	88	42	28	69	63	86
45	165	144	233	206	93	339	324	90	220	150	87	27	22	21	34	111	61
46	148	178	189	170	72	231	228	128	167	55	79	58	21	33	38	67	85
47	129	161	140	74	76	191	202	122	191	96	68	31	38	20	34	59	88
48	176	212	149	79	85	193	121	62	178	102	78	25	15	9	24	40	55
49	89	138	104	58	43	73	92	78	111	47	47	16	20	4	13	50	37
50	91	142	50	34	53	94	58	67	69	30	50	12	9	3	33	32	65
51	66	120	63	27	34	114	59	44	50	38	29	4	6	7	14	32	34
52	64	135	66	44	38	77	33	40	35	15	46	11	16	7	31	8	53
53	45	99	32	37	23	40	19	16	29	18	22	5	6	6	11	13	18
54	73	101	35	45	22	35	27	29	50	23	18	5	8	16	19	15	31
55	20	67	25	31	22	37	30	26	29	19	9	3	4	10	8	9	19
56	20	35	14	20	16	20	30	19	5	5	11	2	4	3	6	13	19
57	10	33	5	15	12	22	7	10	6	5	11	3	7	16	8	8	19
58	13	14	8	14	11	17	14		11	4	6		5	3	5	4	13
59	7	10	3	9	4	16	5	2	9	3	10	0	5	2	3	4	10
60	3	6	3	4	3	13	2		10	8	1	1	1	4	1	1	8
61	3	1	4	4	1	5		1	3	2	1	0	1	9	1	2	14
62	3	1	2	1	2	3		1	7	5	1		2	7	1	3	6
63	1	1		1	1	4		5	0	1	0		2	3	0	2	1
64		2	0	2	1			1	3	1	2		0	4	0	1	1
65	0	0		2	2				3	1	1		0	4		0	4
66	0			0	1					1			0	4	0		1
67	0			0	0	0			6	5				6	0		
68					0	2				0	1			0	0		
69				0										0	0		0
70	0			1		0				2				0	0		0
71										0					0		
72				0		0				1					0		
73														0			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**	**2680**
Landings (t)	**292**	**353**	**315**	**277**	**249**	**318**	**351**	**345**	**304**	**232**	**139**	**98**	**65**	**74**	**88**	**116**	**117**

Table 13.2.2.a. FU 28-29 - Length Composition of *Nephrops* Males (1984-2017) (continued)

Landings Age/Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
17																	
18																	
19			0				2	0							1		
20			0		4		3	1	0	0							
21	0	2	0	0	33		5	0	0	0				0			
22	1	2	13	4	51	10	20	8	2		0	3		1			
23	3	1	3	15	32	22	31	10	4		1	0	3	1	0		8
24	5	2	11	20	107	53	53	26	29	8	0	8		1	1		4
25	6	3	40	45	120	46	65	28	30	10	1	27	8	6	5		8
26	8	11	56	126	153	75	121	32	38	8	3	37	6	7	3		23
27	24	24	87	187	206	94	111	52	63	22	6	47	27	15	8		68
28	24	48	62	205	286	144	141	60	89	14	4	37	25	12	10		109
29	53	60	147	246	330	220	189	62	83	33	5	143	55	35	27	10	149
30	74	139	248	300	533	290	297	60	129	44	5	158	84	36	71	27	324
31	92	123	188	277	573	270	256	93	116	75	22	248	82	49	112	51	293
32	274	233	325	475	757	378	295	129	135	116	32	573	217	120	138	36	345
33	139	281	248	352	437	247	246	108	80	78	21	329	109	47	96	75	207
34	224	257	264	352	574	311	327	150	94	104	52	436	276	119	162	166	277
35	173	274	275	347	333	194	252	121	76	83	31	356	155	144	263	128	295
36	163	265	195	224	263	168	256	83	59	77	34	248	191	119	202	173	138
37	167	247	234	167	293	172	224	109	57	78	64	211	145	108	191	155	145
38	99	254	197	147	226	164	265	73	58	125	69	206	216	144	179	240	82
39	109	229	174	93	175	100	173	75	61	71	39	126	95	129	125	300	71
40	159	254	215	165	152	100	188	77	63	84	44	112	162	160	139	247	114
41	130	163	163	108	129	125	163	102	53	55	49	114	113	90	117	179	86
42	195	163	168	177	152	190	198	128	105	75	68	140	171	129	142	185	101
43	181	167	172	113	118	95	82	76	38	51	45	79	64	58	85	182	64
44	173	122	121	122	176	144	90	61	51	65	43	87	89	104	127	222	94
45	140	113	103	131	140	96	83	60	25	39	19	52	42	59	92	187	108
46	144	106	76	103	117	118	71	38	25	26	15	46	81	59	62	211	75
47	120	111	75	97	113	61	60	48	25	43	18	47	89	83	61	129	53
48	80	104	83	90	66	54	65	48	23	35	12	30	67	26	28	157	18
49	79	86	59	58	52	41	38	34	24	23	12	32	53	36	48	92	32
50	93	103	94	82	69	28	42	36	20	25	11	19	59	25	58	69	41
51	71	72	65	41	40	30	37	27	17	20	15	17	37	32	56	58	27
52	88	94	73	65	45	37	48	29	32	30	24	33	47	64	70	26	46
53	41	69	58	31	22	22	21	24	13	16	9	22	18	25	45	34	38
54	54	53	57	50	24	33	27	23	19	21	24	32	36	44	48	52	46
55	34	28	46	26	12	15	10	20	12	14	15	15	16	24	60	41	38
56	29	43	29	57	14	11	8	15	13	8	25	24	20	20	43	51	30
57	37	37	25	16	9	6	6	17	11	9	25	20	15	20	27	36	22
58	23	26	21	12	9	7	7	20	7	11	45	7	12	10	14	45	5
59	15	16	13	15	8	9	5	11	4	6	19	7	8	9	16	38	12
60	15	25	16	24	12	6	3	9	7	5	13	4	10	7	10	30	10
61	9	11	8	11	8	8	4	8	4	5	7	9	7	4	4	21	4
62	10	11	15	16	8	8	3	15	8	6	22	3	1	12	4	10	5
63	4	11	11	7	7	7	1	8	4	6	7	2	4	3	3	14	2
64	9	11	8	10	10	7	1	10	6	5	17	2	3	8	3	10	2
65	6	5	4	3	10	7	1	9	2	3	9	1	1	2	1	9	2
66	5	8	3	7	3	4	2	11	1	3	5	3	2	3	2	6	3
67	4	3	5	2	2	6	1	6	1	3	3	3	1	2	1	4	2
68	1	6	6	2	3	4	0	8	0	4	3	3	1	1	0	4	1
69	3	3	2	2	2	4	1	4	1	0	2	1		1	0	8	1
70	6	2	4	3	4	5	0	4	1	0	1	3	1	1	0	3	1
71	2	2	4	1	1	3	1	2	0	0	0	1		1	0	3	1
72	2	2	4	1	3	4	0	3	1	0	1	3	0	1		2	0
73	0	1	1	1	2	2		1	0	0	1	1		1		0	0
74	0	1	1	1	3	1		1	1	0	1	1		1		0	0
75	0	1	0	0	1	1		1	1	2	0	1		0		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	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	**3602**	**4486**	**4575**	**5233**	**7036**	**4259**	**4598**	**2280**	**1822**	**1649**	**1018**	**4170**	**2928**	**2217**	**2959**	**3725**	**3632**
Landings (t)	**190**	**222**	**205**	**205**	**231**	**162**	**159**	**114**	**73**	**79**	**72**	**149**	**132**	**114**	**147**	**166**	**139**

Table 13.2.2.b. FU 28-29 - Length Composition of *Nephrops* Females (1984–2017)

Landings	(thousands)																
Age/Year	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
17																	
18					4												
19		0				35					0						
20	3	1	7		8	21				18							
21	1	1	22	3	21	102		21	9	49							3
22	8	21	30	78		88	19	11	102	63			0	13	2	5	18
23	66	21	7	31	28	135	15	69	38	21	2		0	0	4	4	6
24	79	102	118	270	153	258	38	173	164	41	22	2	11	20	15	25	49
25	228	205	104	357	163	197	138	198	203	191	73		13	20	25	27	24
26	272	284	186	684	220	282	140	436	361	111	92	1	35	102	74	94	81
27	345	491	359	902	429	326	247	418	448	235	134	0	37	77	91	76	139
28	431	523	322	1421	471	231	345	598	597	413	170	6	36	152	148	100	64
29	443	672	419	1253	516	285	491	590	514	523	269	31	45	178	114	121	171
30	422	588	381	928	499	317	575	771	599	775	326	104	50	199	199	236	152
31	487	593	418	948	482	501	639	414	736	752	427	182	95	394	168	263	131
32	485	653	700	946	766	306	859	807	617	824	558	322	198	502	376	485	283
33	613	415	406	227	527	314	596	375	430	449	283	251	53	163	116	187	153
34	618	467	654	774	813	511	734	310	369	359	353	641	209	278	298	346	235
35	562	563	447	447	460	435	519	284	287	194	246	674	184	150	112	287	193
36	469	329	316	386	489	274	243	130	267	203	237	811	142	135	166	317	225
37	505	353	400	223	206	318	189	108	333	154	147	692	267	129	171	201	213
38	383	284	330	269	265	285	207	135	251	100	128	348	151	39	48	184	85
39	274	142	211	146	288	148	216	74	176	150	66	194	67	35	59	151	92
40	171	119	80	119	132	131	230	131	147	110	114	344	120	21	89	111	79
41	58	106	55	65	128	149	73	39	68	108	77	361	63	31	64	81	66
42	50	36	133	54	43	127	210	62	69	95	73	165	111	18	84	73	67
43	30	27	21	40	28	109	58	82	26	43	23	64	29	2	34	38	41
44	17	13	47	147	27	91	77	6	46	42	43	88	90	18	71	34	49
45	14	11	27	84	19	27	41	21	40	34	13	54	36	8	22	18	23
46	7	6	5	40	14	38	31	45	25	37	11	13	15	4	28	18	38
47	5	3	3	26	9	24	16	7	12	29	7	18	23	3	23	7	52
48	4	1		71	11	29	7	15	18	15	4	15	8	2	6	9	25
49	1	0	3	17	4	9	1	17	17	23	4	1	6	7	6	4	21
50	1	0		2	6	3	1	2	32	8	17	1	2	1	6	5	10
51	0	0	3	4	3	7	2	4	4	5	0			1	2	2	10
52	1			5	5	8	1		5	6	1	1	0	1	1	3	16
53	2			2	3	1			9	6	0			0	0		6
54				4	1	1			1	1			1	0	1		5
55				0	1	1			6	2							1
56				3	0	2		5	14	5					0		3
57				0	0	1			4	1			0		0		1
58				0		0			4	1							
59				1	0	0											0
60					0				1	0							
61						1											3
62																	
63									4	1							
64																	
65																	
66																	0
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**	**2829**
Landings (t)	**169**	**156**	**150**	**232**	**171**	**151**	**174**	**134**	**165**	**145**	**97**	**174**	**67**	**62**	**72**	**95**	**84**

Table 13.2.2.b. FU 28-29 - Length Composition of *Nephrops* Females (1984-2017) (continued)

Landings

Age/Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
17			0														
18				0				0									
19			1				2	0							0		
20	0		0	0	8		4	1									
21	1	0	3	12	48	3	15	2	1			7				4	
22	0		3	10	88	14	26	12	1	0			3	1		4	
23	7	0	9	43	54	37	34	11	4	1	1		7	1	0	1	
24	7	10	19	62	135	44	53	25	22	10	1	5	7	3		2	13
25	15	11	36	101	129	55	130	23	23	11	1	8	18	10	5	19	91
26	24	15	67	211	272	113	227	38	80	12	3	17	7	10	7	19	23
27	34	34	67	266	294	152	298	73	138	20	7	40	36	17	13	46	100
28	44	107	98	336	242	179	355	81	170	26	7	51	33	23	23	44	134
29	90	127	173	395	420	392	458	123	149	51	4	130	59	60	39	57	169
30	131	237	241	406	654	321	365	145	205	67	7	164	119	80	85	219	464
31	167	195	152	334	565	305	317	129	132	99	26	330	129	99	143	149	290
32	316	296	360	530	857	510	409	252	209	145	45	397	290	203	208	307	462
33	184	467	270	433	448	272	253	182	110	91	51	195	194	105	146	214	290
34	252	429	314	400	462	341	386	177	122	140	96	297	278	202	167	325	353
35	158	470	255	324	254	249	351	187	103	120	56	165	232	188	303	362	365
36	174	351	194	222	203	162	213	103	83	144	60	138	166	153	203	193	196
37	144	302	203	178	182	142	240	121	90	119	73	98	199	151	162	203	142
38	108	300	206	151	178	152	247	134	83	106	151	76	206	148	171	125	81
39	112	213	160	113	89	173	138	123	86	95	113	46	61	121	136	112	105
40	133	186	284	136	84	114	109	125	62	80	68	46	67	145	134	130	108
41	79	110	170	82	73	129	73	95	83	65	65	37	41	66	104	82	56
42	91	80	192	122	116	112	56	75	94	52	80	35	65	90	87	112	72
43	55	87	132	70	70	44	16	30	25	28	80	33	9	27	54	59	55
44	56	57	75	66	61	46	21	24	43	40	41	27	13	40	58	48	53
45	29	51	68	66	50	35	18	28	17	25	21	10	9	17	56	25	45
46	33	40	37	51	39	54	19	14	22	19	11	10	11	17	36	28	36
47	26	25	25	44	35	23	9	26	16	18	15	11	13	18	16	14	21
48	12	24	28	37	18	11	8	20	7	12	9	5	7	5	8	3	14
49	15	19	18	24	24	7	7	13	6	7	7	6	5	7	8	5	7
50	15	26	24	20	23	7	3	13	8	7	2	6	5	4	8	14	7
51	9	22	14	13	17	11	5	11	3	6	5	6	1	3	7	4	7
52	6	19	21	13	17	7	3	7	3	4	4	9	5	4	9	8	6
53	6	10	13	8	10	2	1	8	3	2	3	5	1	3	6	0	5
54	2	2	14	7	6	9	1	8	1	2	5	5	3	8	12	2	4
55	2	3	10	4	5	1	1	3	4	0	5	2	1	3	12	2	3
56	1	3	7	6	2	1	0	3	0	0	2	1	1	6	10	1	1
57	0	2	4	2	3	1		1	0	0	1	3	2	2	4	0	1
58	1	1	1	2	0	1	0	1	1	0	4	2	0		1	0	0
59	1	0	0	1	1	1			0	0	2	0	1	1	3	0	0
60	0		0		2			1		0	2	0		2	3	1	1
61	1		0	1					0	0	1	0					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		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	**2540**	**4332**	**3969**	**5304**	**6240**	**4229**	**4871**	**2449**	**2211**	**1628**	**1138**	**2424**	**2306**	**2044**	**2446**	**2946**	**3782**
Landings (t)	**79**	**135**	**130**	**140**	**151**	**112**	**114**	**74**	**60**	**52**	**45**	**65**	**66**	**66**	**85**	**88**	**102**

Table 13.2.3. - SW and S Portugal (FUs 28-29): Effort and CPUE of Portuguese trawlers, 1994–2017.

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	90,163	1.8
1999	26	8.1	81,268	2.6
2000	27	7.4	110,765	1.8
2001	33	8.2	81,094	3.3
2002	31	11.5	68,151	5.3
2003	32	10.5	52,443	7.0
2004	23	15.0	80,241	4.7
2005	25	15.3	63,902	6.1
2006	25	11.0	47,379	6.1
2007	26	10.5	51,319	5.7
2008	27	7.0	40,421	5.5
2009	27	4.9	30,919	4.9
2010	25	5.2	30,103	4.9
2011	26	4.5	34,677	4.3
2012	21	10.2	44,111	5.2
2013	24	8.2	37,087	5.6
2014	24	7.5	34,341	5.6
2015	22	10.5	47,485	5.2
2016	22	11.5	42,445	6.7
2017*	22	11.0	46,461	5.9

* provisional; ** standardized CPUE

Table 13.2.4. - SW and S Portugal (FUs 28-29): *Nephrops* CPUEs (kg/hour) in research trawl surveys, 1994–2017.

Year	Demersal surveys CPUE (kg/hour)			Crustacean surveys	
	Summer	Autumn	Winter	Month and year of survey	CPUE (kg/hour)
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	2.7
1998	0.7	0.02	ns	Jun-98	1.4
1999	0.3	0.02	ns	Jun-99	2.5
2000	1.0	0.92	ns	Jun-00	1.6
2001	0.6	0.35	ns	Jun-01	0.8
2002	ns	0.02	ns	Jun-02	2.8
2003	ns	0.19	ns	Jun-03	2.9
2004	ns	0.51	ns	Jun-04	nr
2005	ns	0.09	0.16	Jun-05	5.3
2006	ns	0.19	0.06	Jun-06	2.8
2007	ns	0.04	0.73	Jun-07	2.9
2008	ns	0.13	0.25	Jun-08	5.4
2009	ns	0.13	ns	Jun-09	2.8
2010	ns	0.34	ns	Jun-10	8.1
2011	ns	0.11	ns	Jun-11	nc
2012	ns	ns	ns	ns	ns
2013	ns	0.64	ns	Jun-13	2.5
2014	ns	0.06	ns	Jul-14	1.0
2015	ns	0.21	ns	Jul-15	3.2
2016	ns	0.69	ns	Jun-16	4.9
2017	ns		ns	Jul-16	5.0

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, 1994-2017.

Year	Landings		Demersal surveys						Crustacean surveys	
			Summer		Autumn		Winter			
	Males	Females	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	43.7	41.6	ns	ns	38.7	36.1
2017	37.4	34.3	ns	ns	45.2	45.3	ns	ns	40.6	34.5

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			89997	120849		
year	19	21463.8	89978	99385	< 2.2e-16	17.8%
month	11	2980.1	89967	96405	< 2.2e-16	2.5%
depth.class2	2	2579.6	89965	93825	< 2.2e-16	2.1%
catdps	1	2219	89964	91607	< 2.2e-16	1.8%
cat_pnep	1	31333.3	89963	60273	< 2.2e-16	25.9%
catPRT2	2	1507.8	89961	58765	< 2.2e-16	1.2%
Total	**36**	**62083.6**				**51.4%**

AIC: 333566

Table 13.2.7 Results from the application of the Mean Length Z approach.

		Males	Females
	Input:		
	LFD period	1984–2017	1984–2017
	Effort series	1998–2017	1998–2017
	Growth:		
	Linf =	70	65
	K =	0.2	0.065
	t0 =	-0.15	-0.15
	W~L relationship:		
	a =	0.00028	0.00056
	b =	3.2229	3.0288
	External M*	0.3	0.2
Method	**Results**		
Gedamke & Hoenig	Z =	0.46	0.29
	F* =	0.16	0.09
THoG	q estimate =	0.007	0.002
	q estimate* =	0.030	0.013
	M estimate =	0.42	0.26
	F_{2017} estimate =	0.03	0.01
	F_{2017} estimate* =	0.11	0.05

*** indicates estimates with external fixed M**

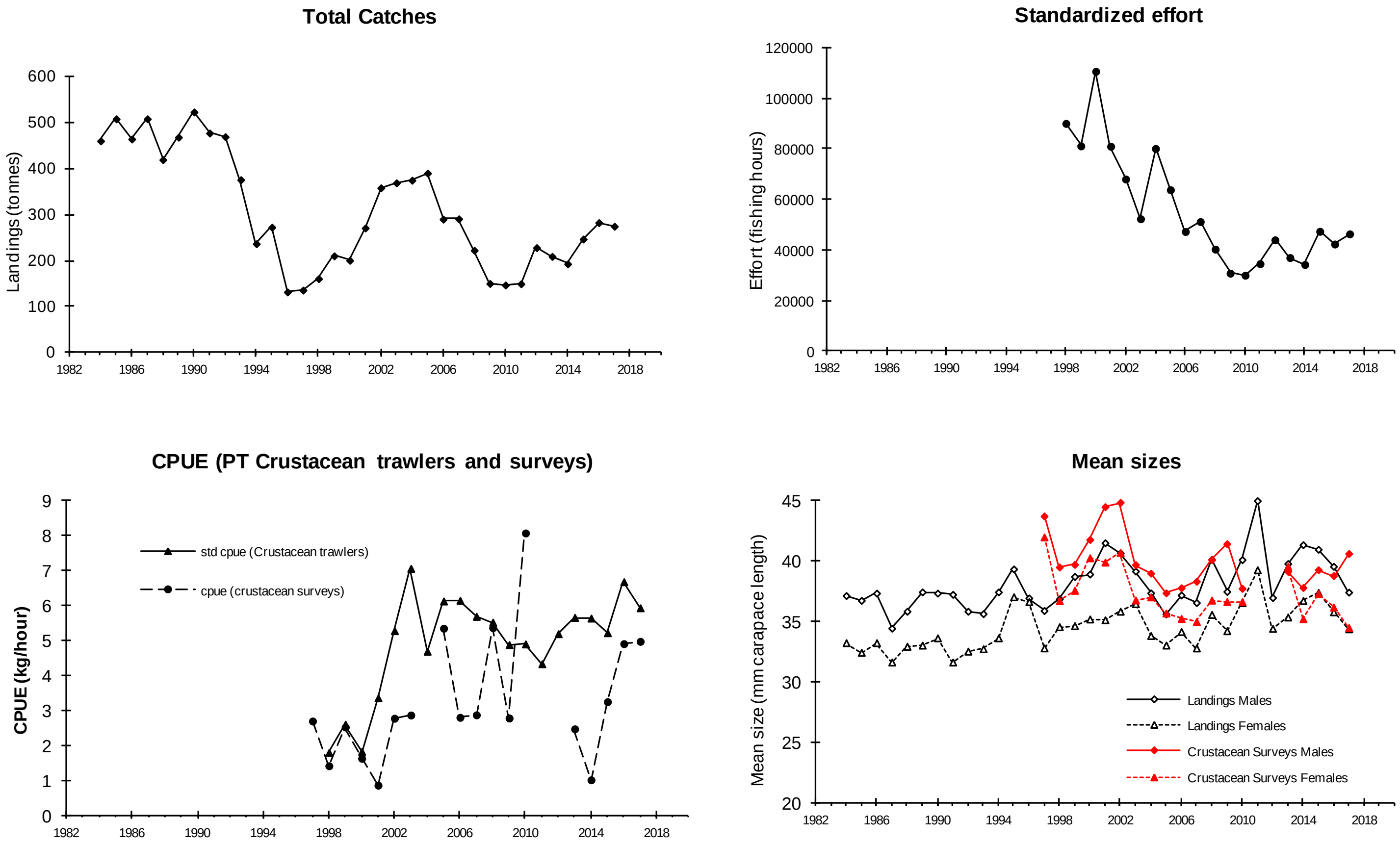


Figure 13.2.1. SW and S Portugal (FU 28+29): landings, effort, biomass indices and mean sizes of *Nephrops* in Portuguese landings and surveys. Note: Values of CPUEs and effort updated with the new CPUE standardization.

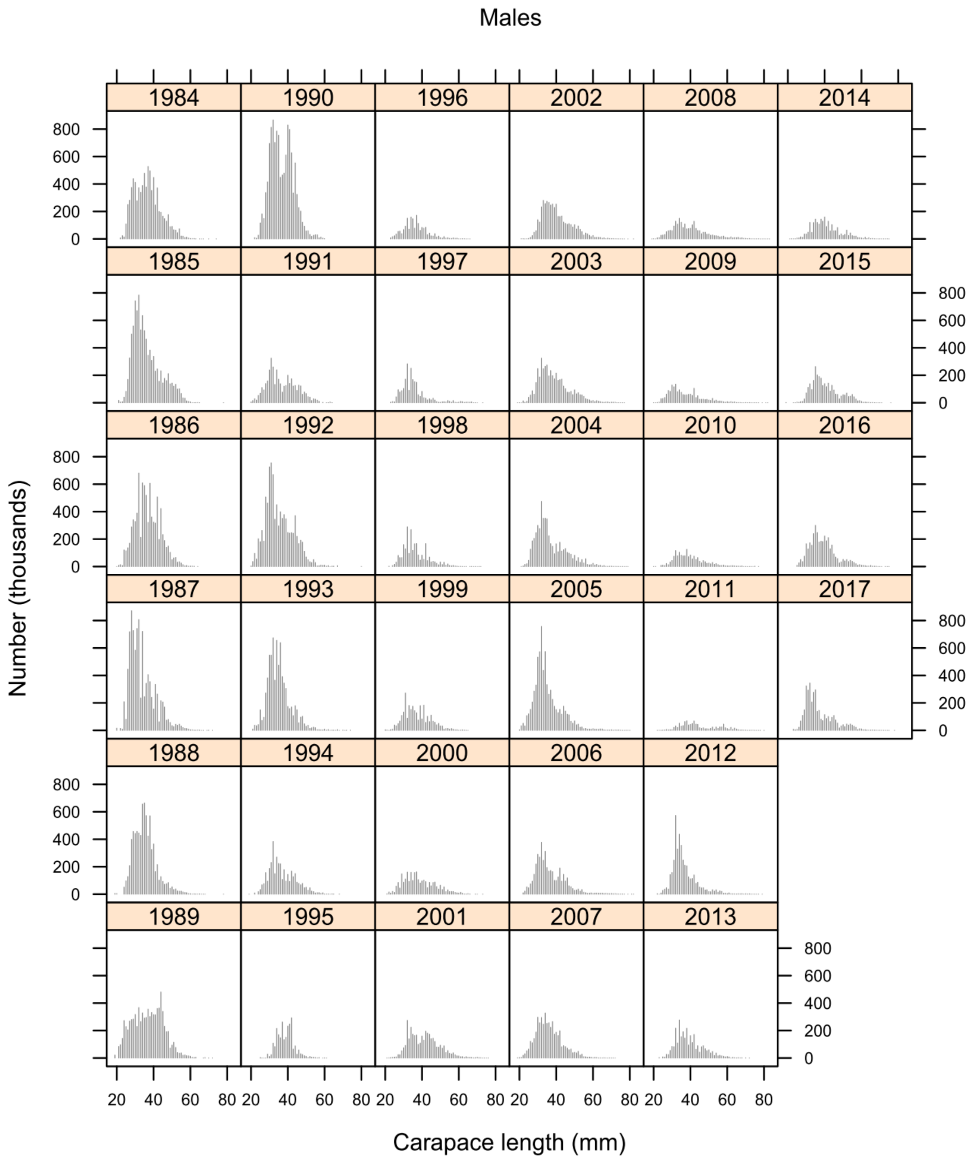


Figure 13.2.2.a. SW and S Portugal (FU 28-29) male length distributions for the period 1984–2017.

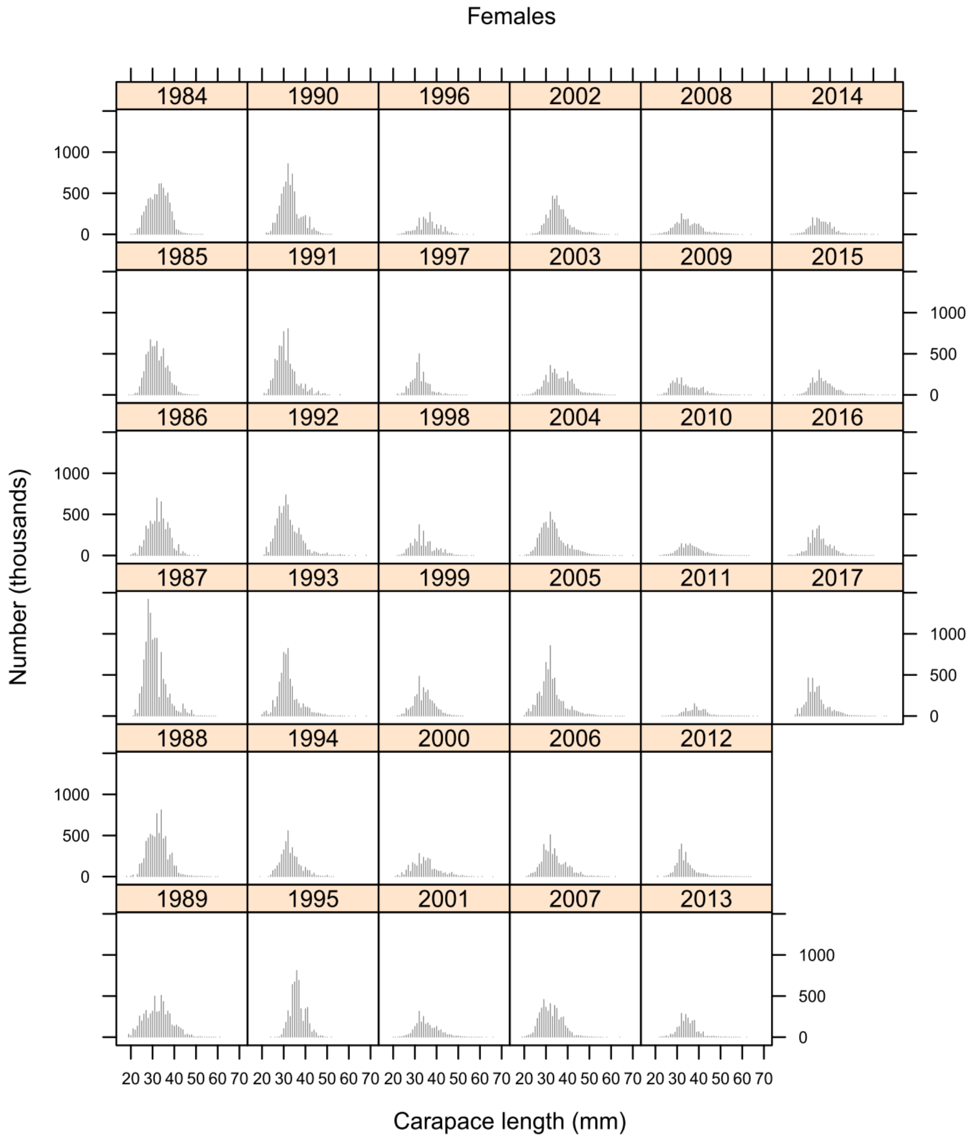


Figure 13.2.2.b. SW and S Portugal (FU 28-29) female length distributions for the period 1984–2017.

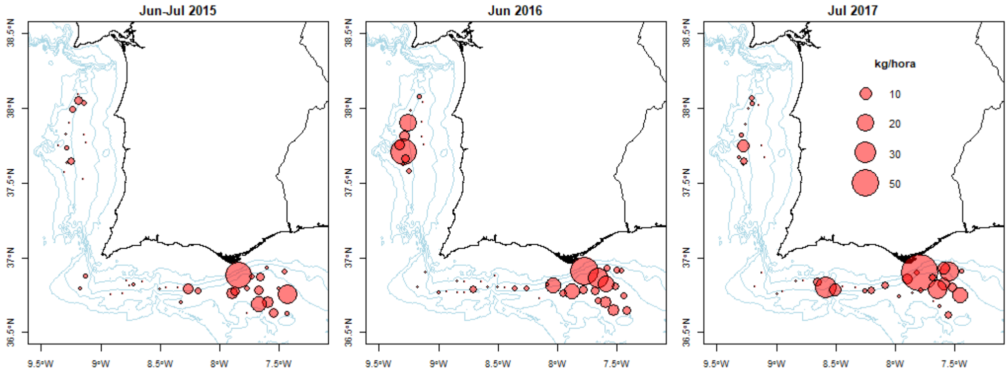


Figure 13.2.3. **Spatial distribution of *Nephrops* biomass survey index in the period 2015–2017.**

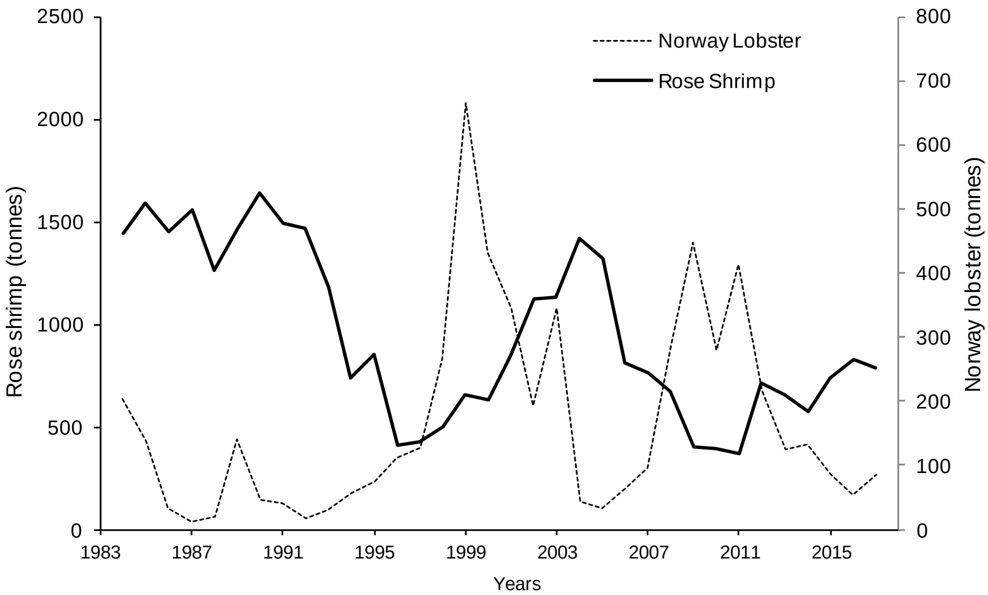


Figure 13.2.4 **FUs 28-29: Landings of the two main target species of the Crustacean Fishery in the period 1984–2017.**

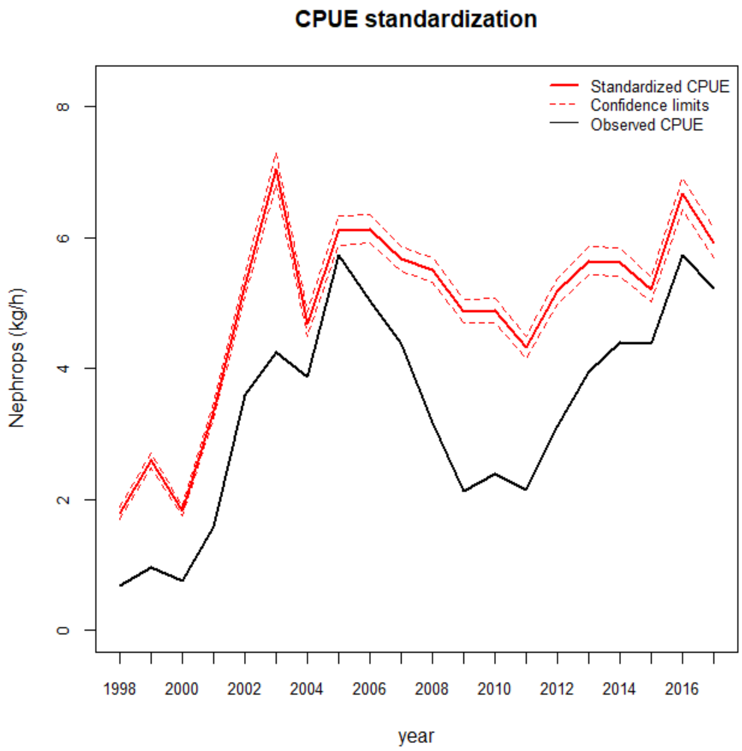


Figure 13.2.5. Comparison of standardized and observed *Nephrops* CPUE.

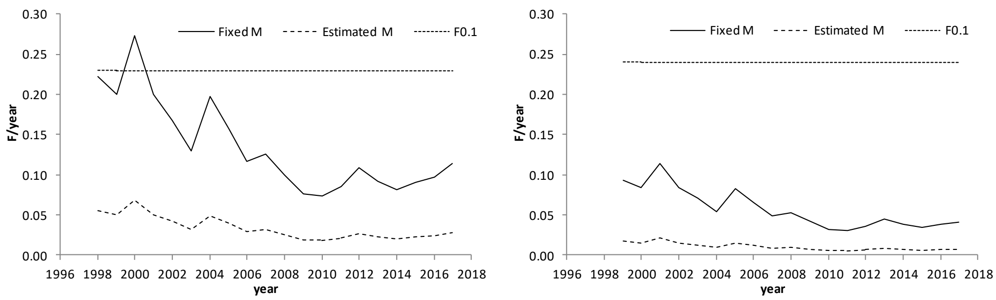


Figure 13.2.6. *Nephrops* FU 28-29. Fishing mortality from THoG model using an external fixed M or an M estimated by the model. Left panel: males, right panel: females.

13.3 *Nephrops* in FU 30 (Gulf of Cadiz)

Type of assessment:

Nephrops FU 30 was benchmarked by WKNEP 2016. UWTV Surveys based Approach was considered appropriated for providing scientific advice on the abundance of this FU but stock specific MSY harvest rate could not be derived. The basis of advice for this stock follows a category 4 approach for *Nephrops* lobster stocks.

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 2018 and Management applicable for 2017 and 2018

ICES Advice for 2018

ICES advises that when the precautionary approach is applied, catches should be no more than 100 tonnes in 2018. All catches are assumed to be landed.

To protect the stock in the functional unit (FU) 30 and to ensure that this stock is exploited sustainably, ICES advises that management should be implemented at the functional unit level.

Management applicable for 2017 and 2018

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). This recovery plan does not apply to FU 30.

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 336 t for 2017 and 381 t for 2018, 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 126 days for Spanish vessels and at 113 days for Portuguese vessels for these two years (Annex II b of Council Regulations nos. 127/2017 and 120/2018). 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 were estimated by this WG since 2016 when the concurrent sampling was satisfactory implemented. 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 13.3.5). *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) (Figure 13.3.1). TAC was limiting the fishery during this 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. In 2017, landings estimations were 140 t, 13% more than previous year (Figure 13.3.1). 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). In 2017, the percentage discarded was 2.5%. 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 2001-2017. 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, onboard 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 between 2013 and 2015 was probably influenced by the EU sanction in this period and the closure of *Nephrops* fishery in 2013.

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 both 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 but increased in males (32.2 mm CL) and decreased in females (29.5 mm CL) last year. Length frequency distribution shows an increase of smaller sizes in 2016 and 2017 (see Figure 13.3.3).

The sex-ratio as proportion of males in landings is shown in Figure 13.3.4. The proportion of males remained stable around 50% since 2009 but an increase of males was observed in 2017.

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 (about 31 g). In 2016 a decreasing of the mean weight in landings was observed up to 23.2 g. No changes were observed in mean weight in 2017 landings (23.4 g).

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) (1993-2017 time series) are shown in Table 13.3.3.

The overall abundance index trend was decreasing from 1993 to 1998, while from 1998 to 2009 the index has remained stable although fluctuating widely in some years. The lowest value in the time series were recorded in 2004 and 2012. In 2010 the deeper strata (500-700 m) were not sampled due to a reduction in number of 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 increased strongly in 2013 and 2014 (Table 13.3.3). The survey index has fluctuated since 2015 and it declined in 2017. This survey is not specifically directed to *Nephrops* and is not carried out during the main *Nephrops* fishing season but the overall abundance index shows an increasing trend since 2013 onwards (Figure 13.3.6), suggesting that the *Nephrops* abundance stock is not in bad conditions.

The length distributions of *Nephrops* obtained in the Spanish bottom trawl spring surveys (SPGF-cspr-WIBTS-Q1) during the period 2001-2017 are presented in Figure 13.3.7. In 2015 and 2016, an increase of the smaller individuals was observed but in the mean size in both sexes increased in 2017. 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 between 28.3 and 34.9 mm CL for females and 32.2 and 42.9 mm CL for males.

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). Survey in 2014 was considered exploratory but three UWTV surveys are available (2015 and 2017) and the next survey will be carried out in June 2018.

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), and SGNEPS and WGNEPS. A description of UWTV surveys carried out in FU 30 since 2014 is documented in the stock annex.

UWTV surveys results were evaluated in the Benchmark Workshop on *Nephrops* Stocks (WKNEP) in 2016 (ICES, 2016). WKNEP 2016 concluded that the UWTV survey in FU 30 is appropriate for providing scientific advice on the abundance of this stock.

The mean burrow density (adjusted to the cumulative bias) trend increased since 2015 (Table 13.3.4). *Nephrops* density was lower in 2016 (0,078 burrows/m^2) regarding to the previous year but it increased in 2017 (0.133 burrows/m^2). In general, the range of the observations was relatively high in all years (0.00-0.34 burrows/m^2 in 2015, 0.00-0.33 burrows/m^2 in 2016 and 0.00-0.53 burrows/m^2 in 2017).

The final modelled density surfaces for the time series (2015-2017) 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) increased from 298 million burrows in 2015 to 371 million burrows in 2017 with a lower value recorded in 2016 of 232 million burrow. The coefficient of variation was about 7% in 2015 and 2016 but it was higher in 2017 (CV=8.7%). Detailed results about the ISUNEPCA UWTV survey in FU 30 in 2017 are documented in a WD presented in this WG (WD Nº11, Vila et al., 2018).

In UWTV survey carried out in 2015, the number of stations and the space between them was increased in relation to 2014 (exploratory survey). However, the border was under sampled mainly in the shallower limit. In addition, an overestimation of the number of burrows may have happened. 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. However, the total number of TV stations was increased in 2017 (Table 13.3.4). Moreover, the identification of the *Nephrops* burrows was carried out for three scientist who participated in the two previous surveys and therefore with more experience. A more realistic result was obtained in 2016 and 2017 UWTV survey (Figure 13.3.9) according to the VMS information (ICES, 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.

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. Directed effort is estimated from trips with landings at least 10% *Nephrops*.

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 consequence of the sanction in 2012, the effort drop in the 2013-2015 period (mean value 283 fishing days) (Figure 13.3.1). In 2016 and 2017, fishing effort increased up to 535 fishing days in last year.

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). The increased abundance of rose shrimp in 2008 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. 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 but the commercial index declined in 2017 (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 since this date. On the other hand, LPUE in 2016 and 2017 is estimated using official landings and not the total landings estimated by the WG.

13.3.3 Assessment

This stock was benchmarked in October 2016 (ICES, 2016). The assessment is based on UWTV approach according to category 4 for *Nephrops* stocks outlined in WKNEP 2016 and using parameters in the stock annex.

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 2015–2017 period.

Variable	Value	Source	Notes
Stock abundance	Available in October 2018	ICES (2018)	UWTV survey 2018
Mean weight in landings	23.38 g	ICES (2018)	Average 2016-2017
Mean weight in discards		ICES (2018)	Not relevant
Discard proportion	0%	ICES (2018)	Negligible
Discard survival rate		ICES (2018)	Not relevant
Dead discard rate	0%	ICES (2018)	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 2018 UWTV survey. This will be presented in October 2018 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 decided 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.

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.

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. ADGNEP recommended that if stock specific MSY reference points can be estimated, *Nephrops* FU 30 will meet the requirements for category 1 assessment.

The WGBIE 2017 supports the proposal of a specific workshop before the 2018 assessment WGs but this have not been possible. This WK will be carry out in January 2019.

Several trials with the mean-length Z method were performed using the data for the period 2006-2017 and 2009-2017 during this WG. Results of the model application are inconsistent and cannot be used.

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.

13.3.7 References

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Silva, L., A.C. Fariña, I. Sobrino and Y. Vila. 2006. Inconsistencies in the annual length compositions series (2001–2005) of *Nephrops* from the Gulf of Cádiz, FU 30 (ICES Division 9.a). Working document presented to the WGHMM (Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim)

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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
2017	38	<1	101	140

** 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 (2005-2017) 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
2017	24.2	29.8	2.5	3.0

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
2017	2.27	79	0.86	20	1.67	54

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	7.6
2016	58	0.0776	3000	3000	233	7.3
2017	62	0.1336	3000	3000	371	8.7

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
2017	140	24	45.5	535

*Landings, LPUE and fishing effort from fishing trips with at least 10% *Nephrops* .
** Ayamonte landings are included since 2002
*** Since 2016 Total landings were estimated by the WG

Table 13.3.6. ***Nephrops*** **FU30, Gulf of Cadiz. Summary for ISUNEPCA UWTV survey time series.**

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	%	%
2014**	0.48	0	0.48	282		0.2	31.2	NA	0	0
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
2017	5.95	0	5.95	370	63	1.6	23.4	NA	0	0
2018				***	***					

* Discards are considered negligible and are not included in the assessmet
* UWTV survey in 2014 is considered exploratory. UWTV abundance estimates is not adjusted by the cummulative bias
** UWTV abundance estimates available in autumn 2018

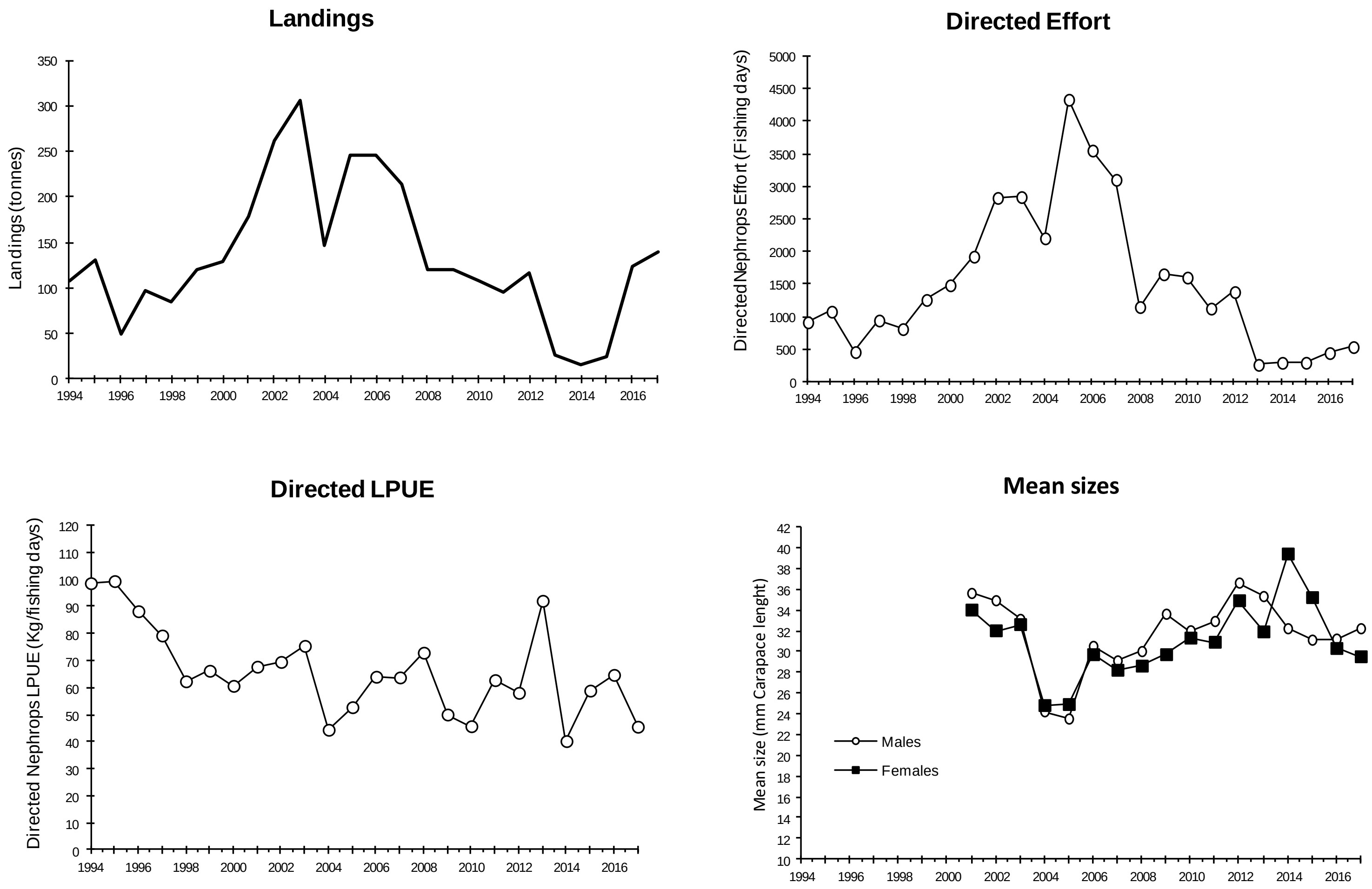


Figure 13.3.1. ***Nephrops*** **FU 30, Gulf of Cádiz. Long term trends in landings,** ***Nephrops*** **directed effort and LPUE and mean sizes.**

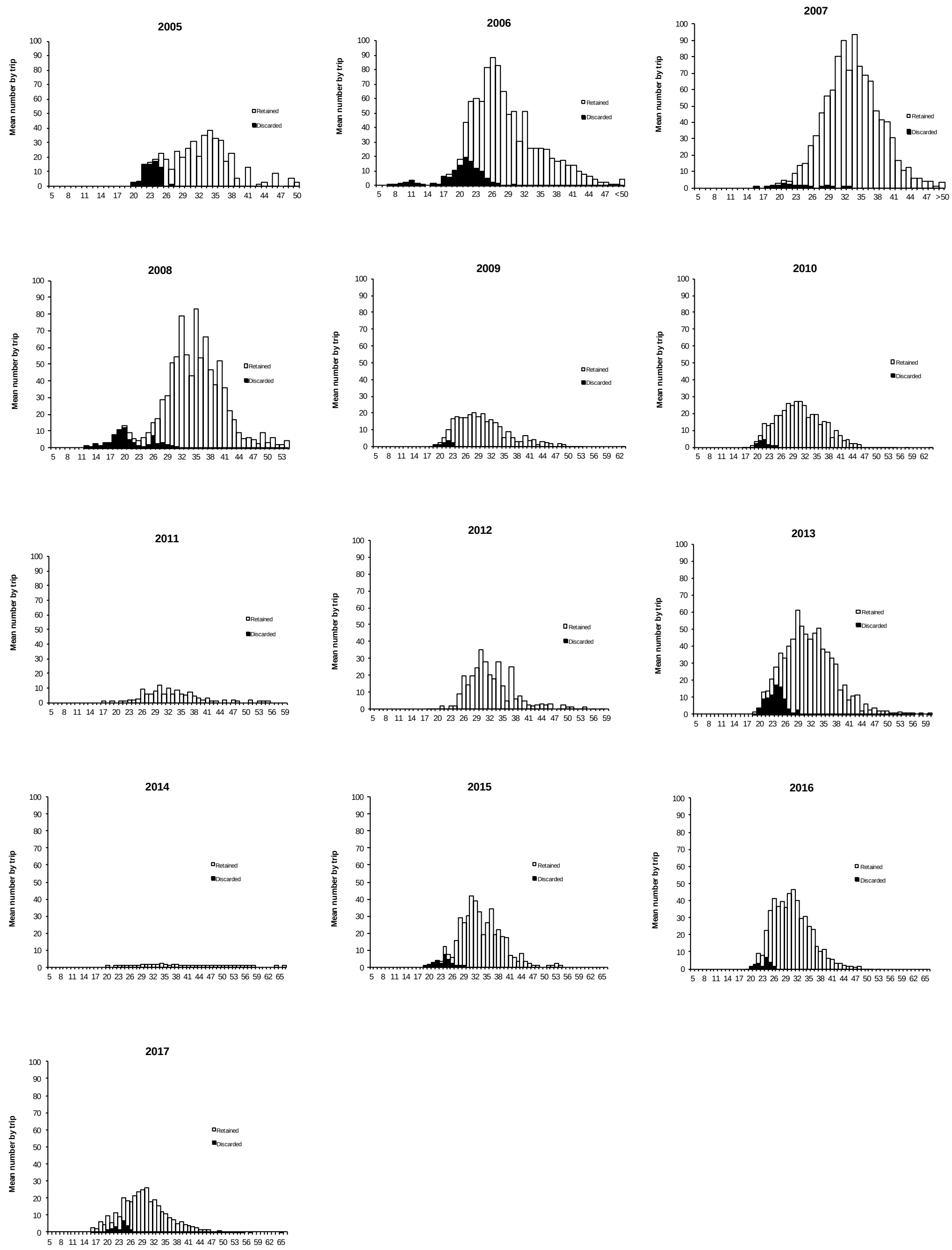


Figure 13.3.2. ***Nephrops*** **FU 30, Gulf of Cadiz. Length distribution of retained and discarded fractions** ***Nephrops*** **from discards program (2005–2017 period).**

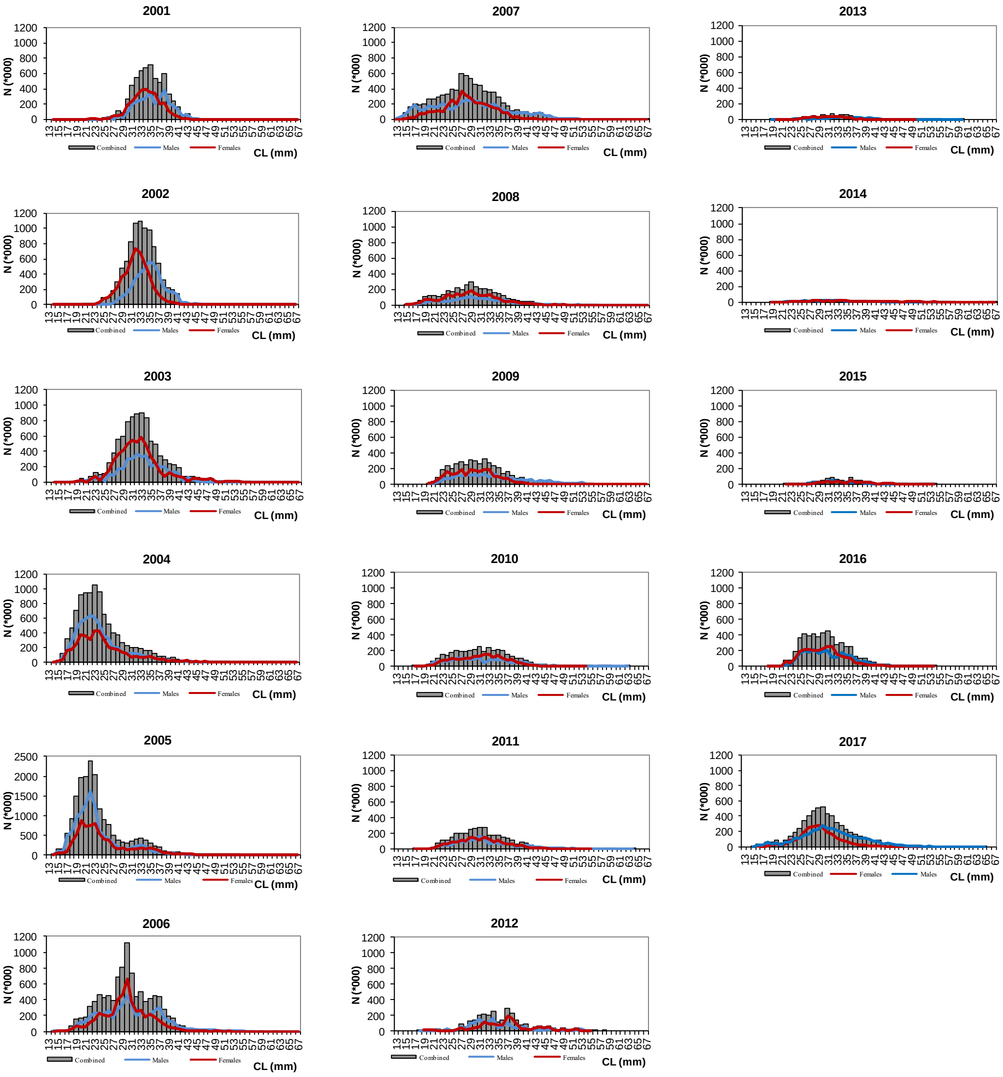


Figure 13.3.3. ***Nephrops*** **FU30, Gulf of Cádiz. Length distributions of landings for the period 2001–2017**

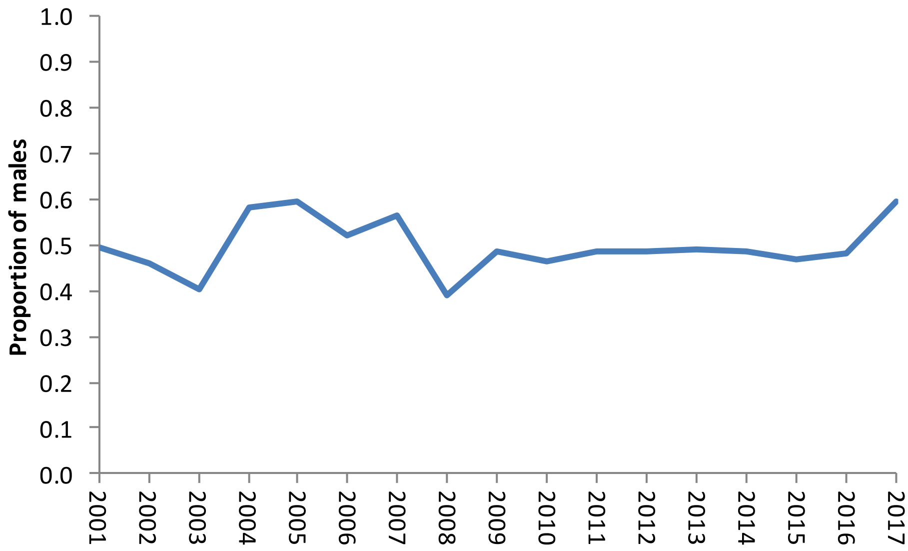


Figure 13.3.4. *Nephrops* in FU 30, Gulf of Cadiz. Proportion of males in landings in the time series.

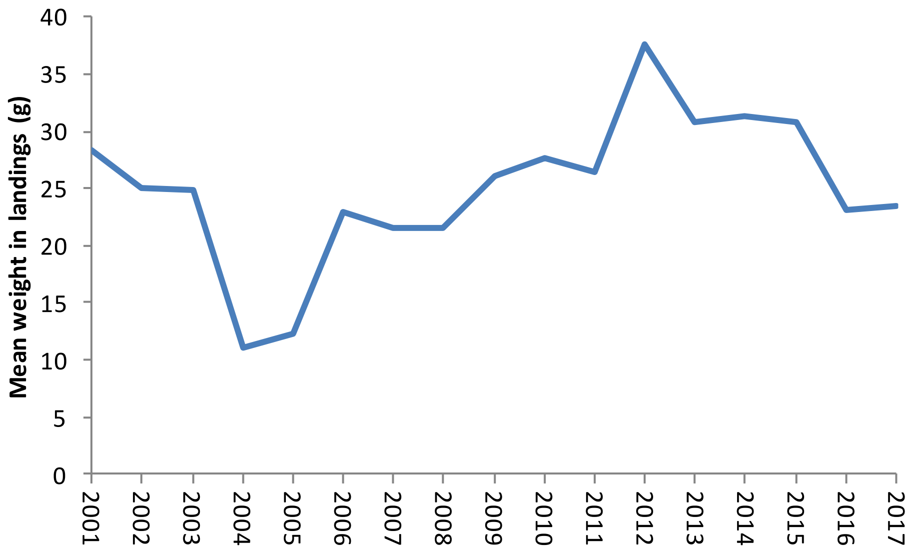
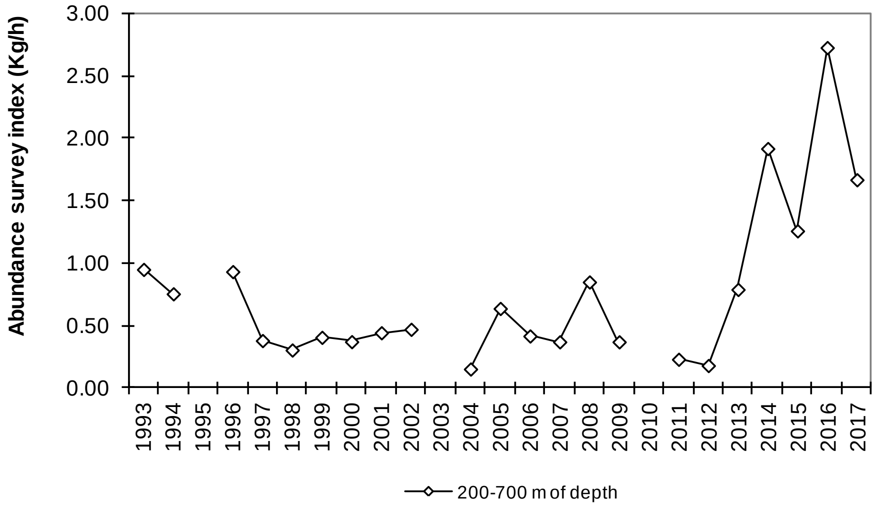


Figure 13.3.5. *Nephrops* in FU 30, Gulf of Cadiz. Mean weight trend in commercial landings.



* 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).

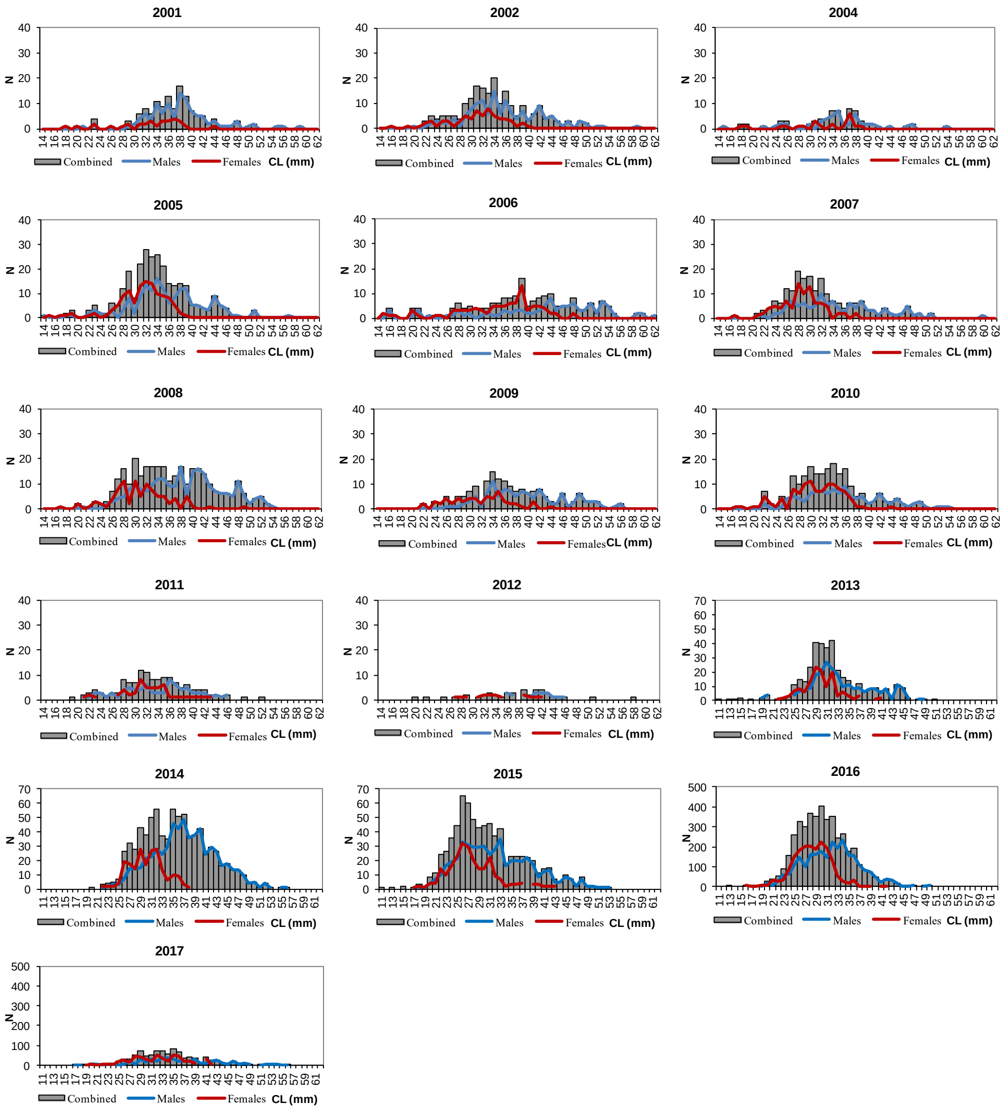


Figure 13.3.7. ***Nephrops*** **FU30, Gulf of Cádiz. Length distributions from Spanish bottom trawl surveys (SPGFS-cspr-WIBTS-Q1) for 2001–2017 period.**

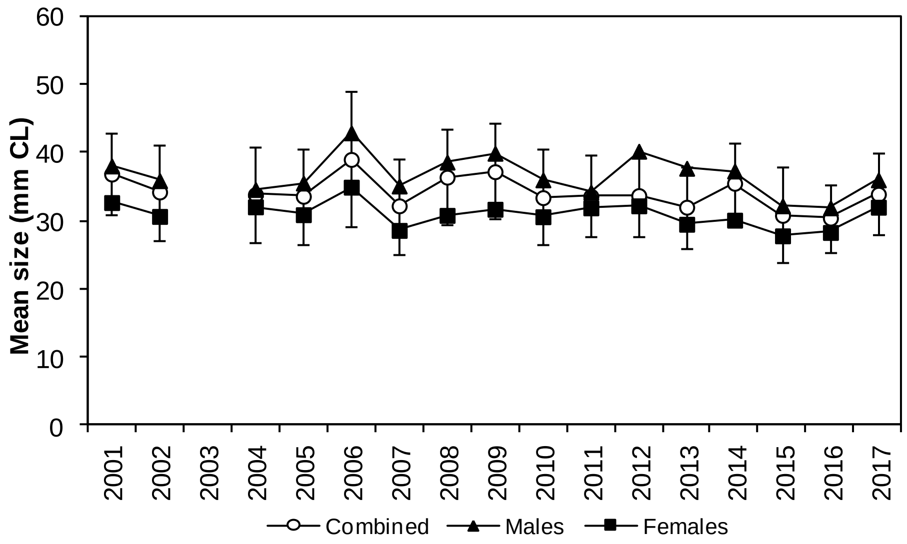


Figure 13.3.8. ***Nephrops*** **FU30, Gulf of Cádiz. Mean size in spring bottom trawl surveys (SPGFS-cspr-WIBTS-Q1) for the period 2001-2017.**

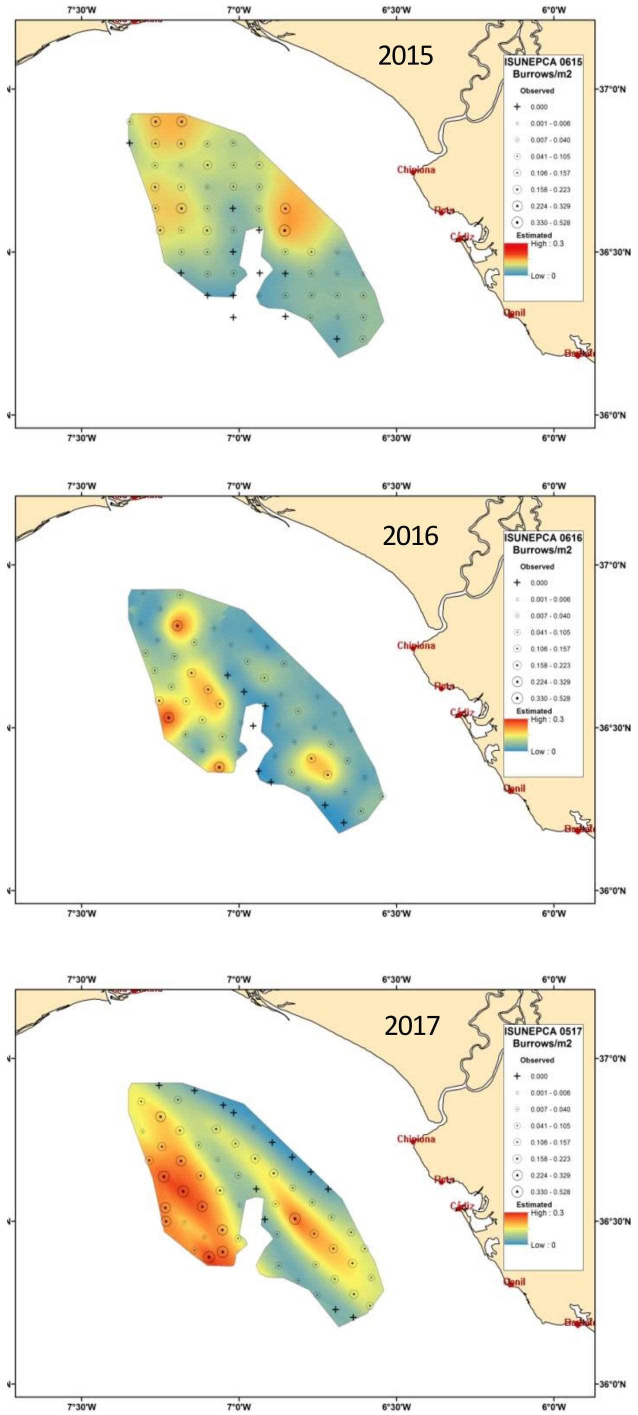


Figure 13.3.9. ***Nephrops*** **FU 30, Gulf of Cadiz. Contour plots of the krigged density estimates for the ISUNEPCA UWTV surveys time series (2015–2017).**

14 European seabass (*Dicentrarchus labrax*) in Divisions 8.a-b (Bay of Biscay North and Central)

Type of assessment: update (stock benchmarked in WKBASS 2017 and WKBASS 2018). **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 97% of international landings in 2017 (Table 14-1). Spain is responsible for 3% of the catches essentially in the area 8.b in 2017 (mainly bottom trawlers).

Table 14-1. Seabass in Division 8.a-b. Summary of official and ICES commercial landings data. UK includes England, Wales, Northern Ireland and Scotland.

Year	Belgium	France	Netherlands	Spain	UK	Total Official	Total ICES
1985	0	2477	0	0	0	2477	3420
1986	0	2606	0	0	0	2606	3549
1987	0	2474	0	0	5	2479	3417
1988	0	2274	0	0	15	2289	3217
1989	0	2201	0	0	0	2201	3144
1990	0	1678	0	0	0	1678	2621
1991	0	1774	0	17	0	1791	2734
1992	0	1752	0	14	0	1766	2709
1993	0	1595	0	14	0	1609	2552
1994	0	1708	0	17	0	1725	2668
1995	0	1549	0	0	0	1549	2492
1996	0	1459	0	0	0	1459	2402
1997	0	1415	0	0	0	1415	2358
1998	0	1261	0	27	0	1288	2231
1999	0	2081	0	11	0	11	2091
2000	0	2080	0	67	0	2147	2362
2001	0	2020	3	68	0	2091	2306
2002	0	1937	0	176	0	2113	2392
2003	0	2812	0	119	0	2931	2616
2004	0	2561	0	96	0	2657	2380
2005	0	3184	0	74	0	3258	2796
2006	0	3318	0	168	2	3488	2875
2007	1	2984	0	74	1	3060	2751
2008	0	1508	0	145	0	1653	2745
2009	1	2339	0	194	0	2534	2278
2010	0	2322	0	165	2	2489	2229
2011	1	2295	0	311	0	2607	2575
2012	0	2325				2325	2549
2013	0	2532	0		0	2532	2685
2014	0	2900	0	91	0	2991	2991
2015	0	2193	0	71	0	2264	2264
2016	0	2160	0	93	0	2253	2253
2017	0	2223	0	72	0	2295	2295

For France, lines fishery (handlines and longlines) takes place all year round, while nets, pelagic and bottom trawls fisheries take place from November to April on pre spawning and spawning grounds when seabass are aggregated. In 2017, nets represent 28% of the landings of the area, lines 33%, bottom trawl 20%, and pelagic trawl 11%. In 2017, an increase in landings for all gears except netters is observed (Figure 14-1). Netters are very dependent on weather conditions. 2017 was a poor year compared to 2014, which was exceptional.

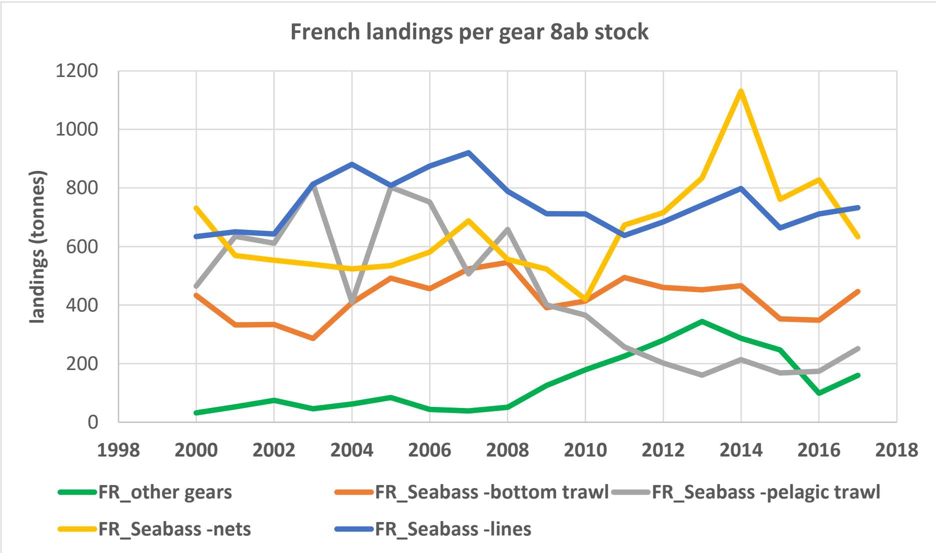


Figure 14-1. Seabass in Division 8.a-b. French landings per metier.

14.1.3 Summary of ICES advice for 2017 and management

ICES advice for 2018

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 2440 tonnes in 2018. If discard rates do not change from last year (2016), this implies commercial landings of no more than 2375 tonnes. Recreational catches cannot be quantified; therefore, total catches cannot be calculated (ICES, 2017a).

Management for 2017

Seabass are not subject to EU TACs and quotas. Under national regulation, the minimum landing size (MLS) of seabass in the Northeast Atlantic is 38 cm total length[1], a variety of national restrictions on commercial seabass fishing are also in place. These include:

- An historical landings limit of 5 t/boat/week for French and UK trawlers landing seabass (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 seabass, the landings limits have slightly changed, from 1.5t/week to 5t/week depending on season and gear used[2].

[1] https://www.legifrance.gouv.fr/eli/arrete/2016/11/24/AFSH1634591A/jo/texte
[2] *https://www.legifrance.gouv.fr/jo_pdf.do?id=JORFTEXT000032065998*

- A licensing system from 2012 in France for commercial gears targeting seabass in order to fix the level of the French commercial fishery[3]
- A MLS of 38cm (instead of 36cm) has been implemented in 2017 for commercial fisheries in the Bay of Biscay.
- 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 seabass 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 2000-2017 from a separate analysis by Ifremer of logbook and auction data (SACROIS methodology; Demaneche et al., 2010). Landings are available per metier.

iii) Spanish landings for 2007-2011 from sale notes and for 2012-2017 from official statistics

Discarding of seabass by commercial fisheries can occur where fishing takes place in areas with seabass smaller than the minimum landing size (i.e. < 38 cm). Discards rates are low (Table 14-2). In 2017 total discards percentage is estimate at 3% of the total catches with an amount of 74 t (in 2016, total discards percentage was also estimated at 3% of the total catches with an amount of 62 t).

For Spain, observer data from Spanish vessels fishing in area 8, have shown there was no seabass discards from 2003 (No information in 2017 were available on discards for this WG).

Table 14-2. Seabass in Division 8.a-b. Estimated seabass discards (tonnes) of French vessels in the Bay of Biscay.

year	discards	landings	%discards
2017	74	2223	3.22%
2016	65	2160	2.92%
2015	69	2193	3.05%

[3] *www.comite-peches.fr/wp-content/uploads/B17-2015_Bar-Cadre1.pdf*

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 seabass landings covers sampling at sea and onshore. Data are available from 2000 onwards. French length composition for 8.a-b, across time, all gear combined are presented in Figure 14-2.

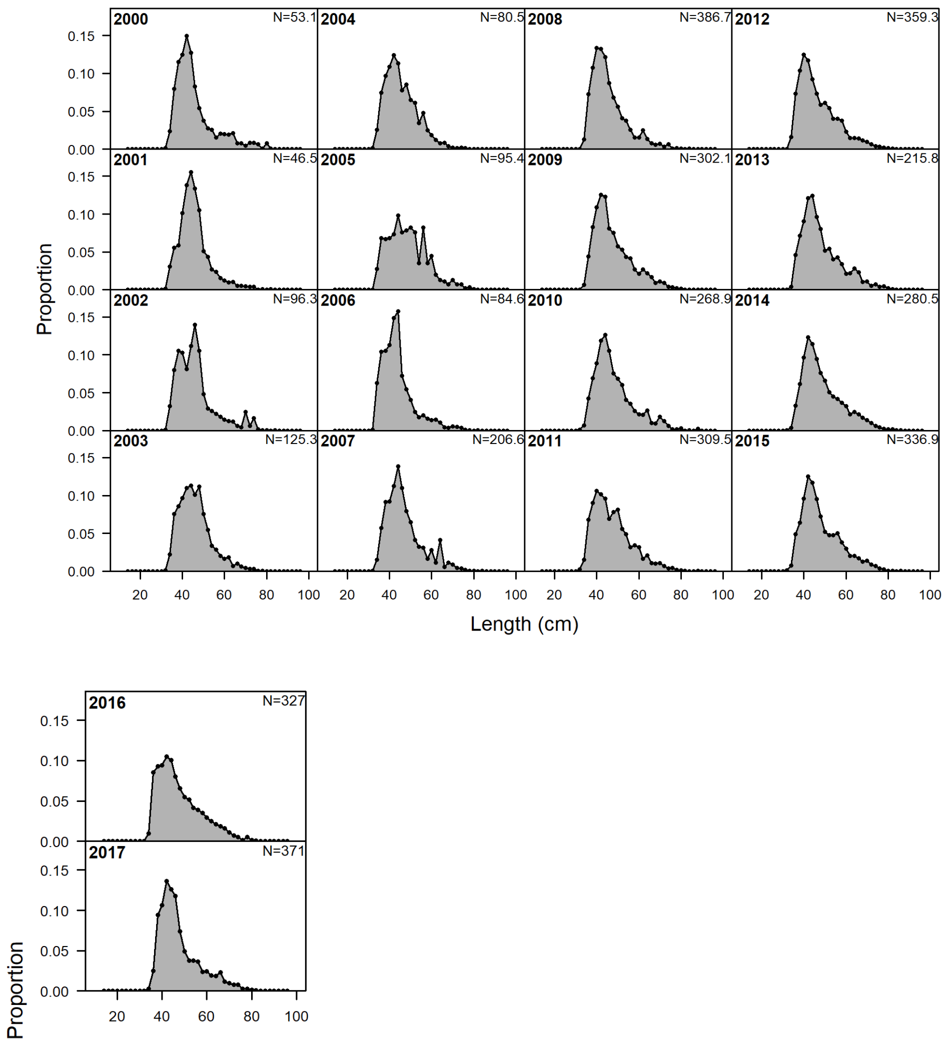


Figure 14-2. Seabass in Division 8.a-b. Length composition all French fleet combined from 2000 onwards

The French sampling programme for age compositions of seabass is based on age–length keys with fixed allocation. For the 8.a-b area, the information is available only from 2008.

WGBIE were made aware of an issue with the sampling level in Q1 and Q2 of 2017 from France (working document Quemar, Vigneau et al., 2018). Because of the lack of market sampling for length (biological and onboard sampling was unaffected), efforts were made to try and fill the deficiency in the number of samples by use of simulation techniques. Both simulated data and actual data were uploaded to InterCatch combined making it impossible to distinguish true samples from simulated ones. The simulation was based on commercial landings market categories (Figure 14-3).

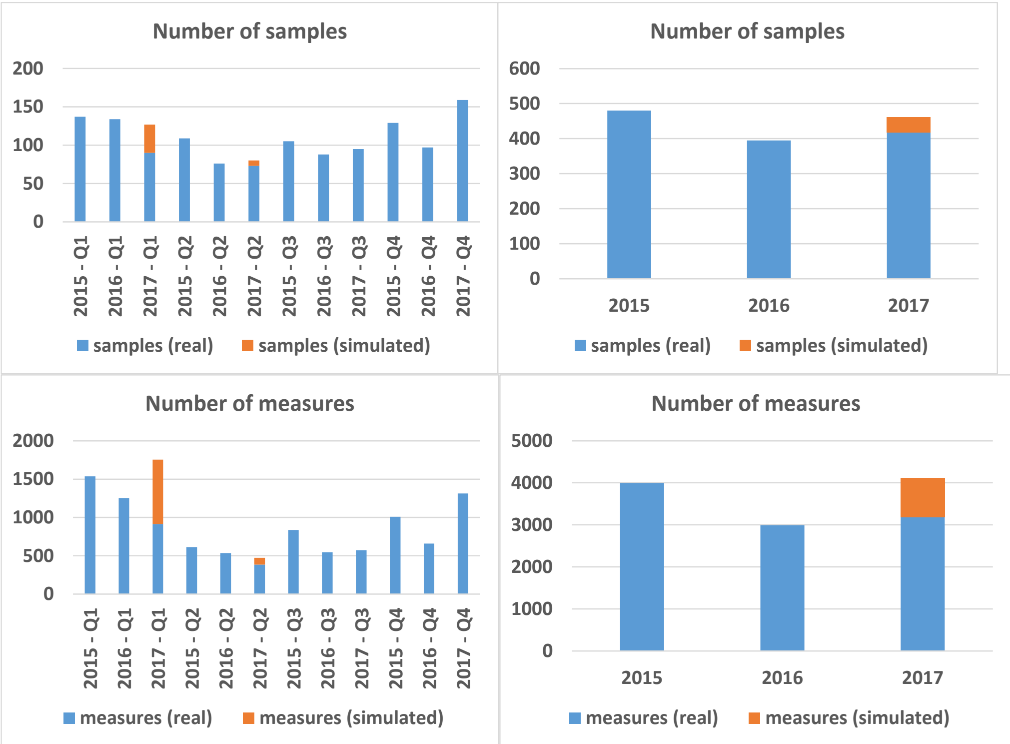


Figure 14-3. Seabass in Division 8.a-b. Numbers of seabass samples (trips) and measures (fish) simulated or not in the French sampling scheme in 2017 compared to the previous years.

14.2.2.2 Recreational fishery

The full description of the recreational catches is now presented in the Stock Annex.

Recreational fishery catches reconstructed for the whole time series

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 historical estimates of the recreational catch over the entire time series. (IBP Bass; ICES, 2014) considered more plausible to treat recreational fishing as having a more stable participation and effort over time than the commercial fishery. A decision was made during WKBASS 2018 assessment meeting to apply a constant recreational fishing mortality over time considering the same approach than used for the Northern stock. Total retained recreational catches were iteratively adjusted to obtain a constant recreational F overall years, which was derived using the catch of 1,430 t estimated in 2010.

The implementation of new management measures should have led to a reduction in fishing mortality as more and larger fish are released (Hyder et al., 2018). This means that it is not appropriate to assume constant recreational fishing mortality in the last years and thus it is necessary to re-estimate the recreational catches. This has been done using the estimated reductions generated from the assessment of the impact of different levels of bag limits and minimum landing sizes (Armstrong *et al*., 2014) in order to derive changes in recreational fishing mortality.

Also, the application of different management measures, gave a recreational mortality multiplier for 2010-2012 of 1 and of 0.684 for 2013-2016 (related to an increase in MCRS to 42 cm).

In 2017 with a 5 fish bag limit implementation, the multiplier was estimated to be unchanged. However, for 2018 with a 3 fish bag limit implementation, it was estimated to be 0.647. This was taken into account when preforming the short-term forecast. Table 14-3 compiled figures used in the assessment for the recreational fishery.

Table 14-3 : Seabass in Division 8.a-b. Time series used in SS3 for recreational and commercial fisheries.

YEAR	COMMERCIAL LANDINGS (T)	RECREATIONAL LANDINGS (T)
1985	3420	1431
1986	3549	1384
1987	3417	1350
1988	3217	1331
1989	3144	1323
1990	2621	1331
1991	2734	1342
1992	2709	1338
1993	2552	1317
1994	2668	1277
1995	2492	1215
1996	2402	1147
1997	2358	1089
1998	2231	1079
1999	2091	1124
2000	2362	1217
2001	2306	1295
2002	2392	1350
2003	2616	1380
2004	2380	1395
2005	2796	1408
2006	2875	1427
2007	2751	1448
2008	2745	1461
2009	2278	1451
2010	2229	1430
2011	2575	1392
2012	2549	1341
2013	2685	875
2014	2991	819
2015	2264	769
2016	2252	733
2017	2295	713

Recreational post released mortality (PRM)

Based on the information provided by Hyder et al. (2018), WKBASS 2018 agreed on a figure of 5% for PRM in recreational fisheries on the Northern and the Bay of Biscay seabass stocks. This estimate is based on a published German study (Lewin et al., 2018)

Recreational length compositions

The estimate of removals were recalculated for the 2010 reference year as the sum of retained and released fish with a PRM of 5%. A length composition for recreational removals for the 2010 reference year was estimated as described in working document from Hyder et al. (2018).

14.2.3 Abundance indices from surveys

Currently, there is no survey providing relative indices of adult or juvenile seabass abundance over time. A French study is undertaken from 2013 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., 2018). Abundance indices have been calculated for year 2016 and 2017 in the Loire estuary and are planned for year 2018. The study has been submitted to FEAMP for year 2019-2021, including also the Gironde estuary in order to get two abundance index for the stock Bss 8ab. The ultimate objective would be to make it sustainable through DCF from 2022.

14.2.4 Commercial landing-effort data

The full description of the LPUE is now presented in the Stock Annex and in the working document from Laurec and Drogou, 2017.

The absence of a relative index of abundance covering adult seabass has been identified as a major issue for the assessment of the seabass stock in the Bay of Biscay.

There are no scientific surveys providing sufficient data on adult seabass to develop an index of abundance for the area. Therefore, Ifremer investigated the potential for deriving an index from commercial fishery landings and effort data available since 2000. This allows the possibility to derive from French logbooks data (vessels with length > or < 10m) a LPUE index at the resolution of ICES rectangle and gear strata.

A new LPUE index was presented at WKBASS 2018. This index is obtained by modelling the zeros and non-zeros values using a delta-GLM approach. A review of the study has been done by an external expert (M. Christman) before WKBASS 2018. The reviewer recommended the new LPUE index to be used in the assessment of Bay of Biscay seabass stock.

The new LPUE index has been incorporated in the Northern and the Bay of Biscay stocks assessment models. Results updated with 2017 data are presented in Figure 14-4.

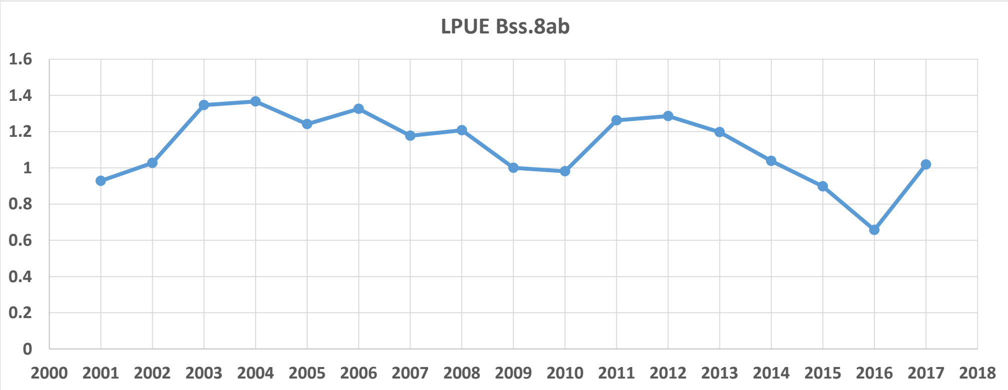


Figure 14-4. Seabass in Division 8.a-b. LPUE abundance index derived for the Bay of Biscay seabass stock.

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 seabass growth exist and have been published by Dorel (1986) and Bertignac (1987). To update these studies, seabass 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. L_{inf} 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

Seabass 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 14-5)

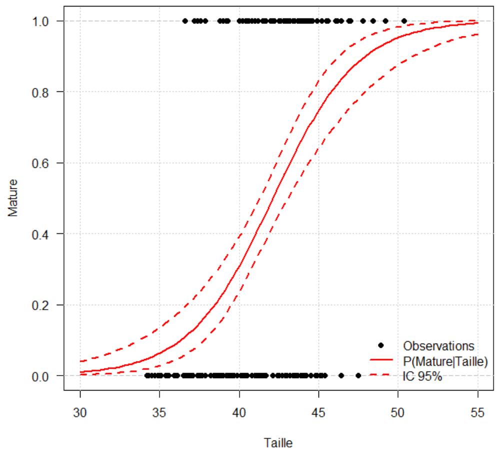


Figure 14-5. Seabass in Division 8.a-b. Maturity ogive for the Bay of Biscay seabass stock.

14.2.5.3 Natural mortality

WKBASS 2017 and WKBASS 2018 proposed to use the same value for both the Northern and the Bay of Biscay seabass stock (ICES, 2017b): Then et al. (2015) t_{max} method, as being more robust than inferences from any single study, set the natural mortality for seabass to M = 0.24.

14.3 Assessment

This is an update assessment including year 2017 from WKBASS 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 14-6 presents selectivity functions by fleet estimated by the model.

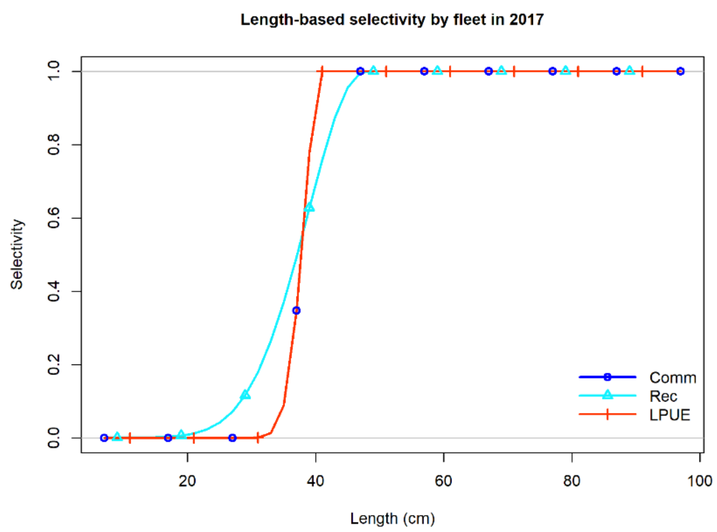


Figure 14-6. Seabass in Division 8.a-b. Selection patterns at length by commercial and recreational fleets estimated by SS3. Selection pattern for the LPUE abundance index was assumed to follow the one from the commercial fleet.

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).

Model fit for the LPUE abundance index was good (Figure 14-7). The index was useful to help the model to get the correct trend over time.

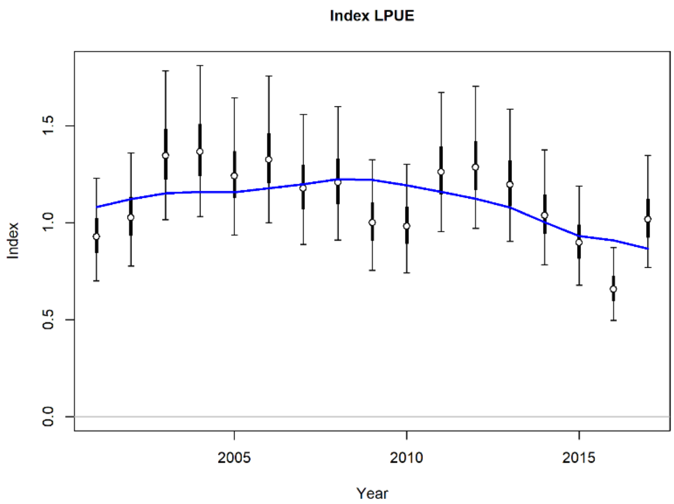
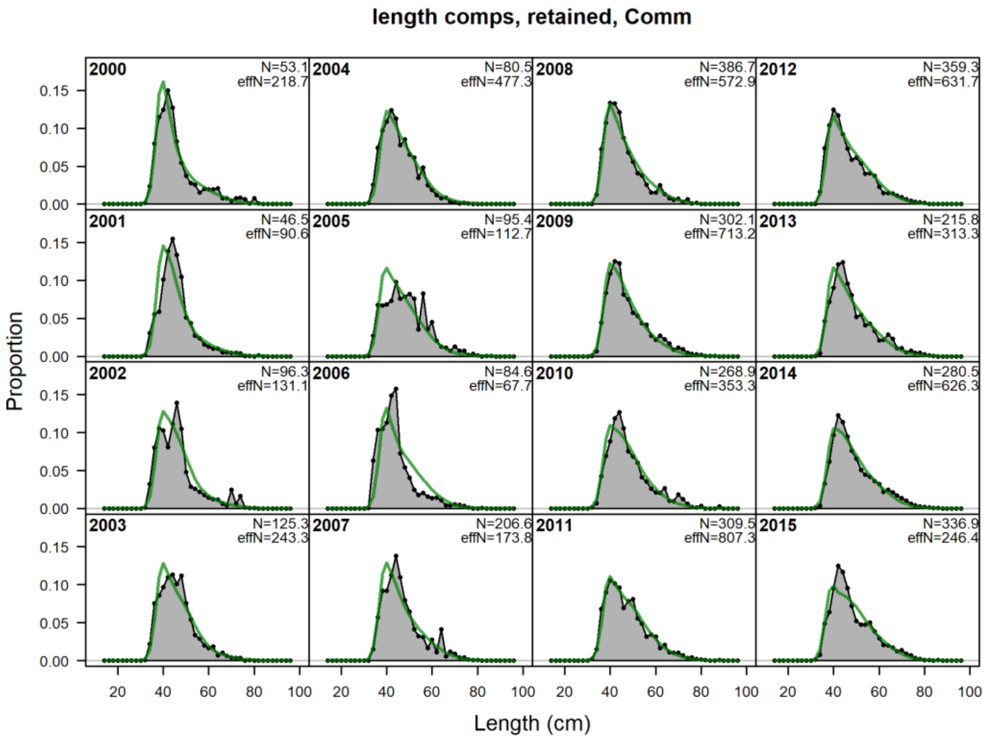


Figure 14-7. Seabass in Division 8.a-b. Fit to the LPUE abundance index.

Model fit for the commercial length composition data good (Figure 14-8)



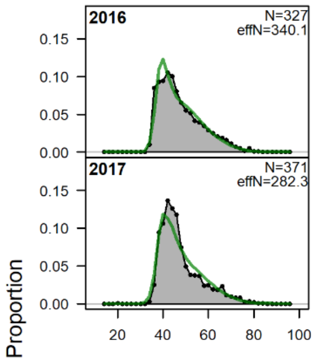
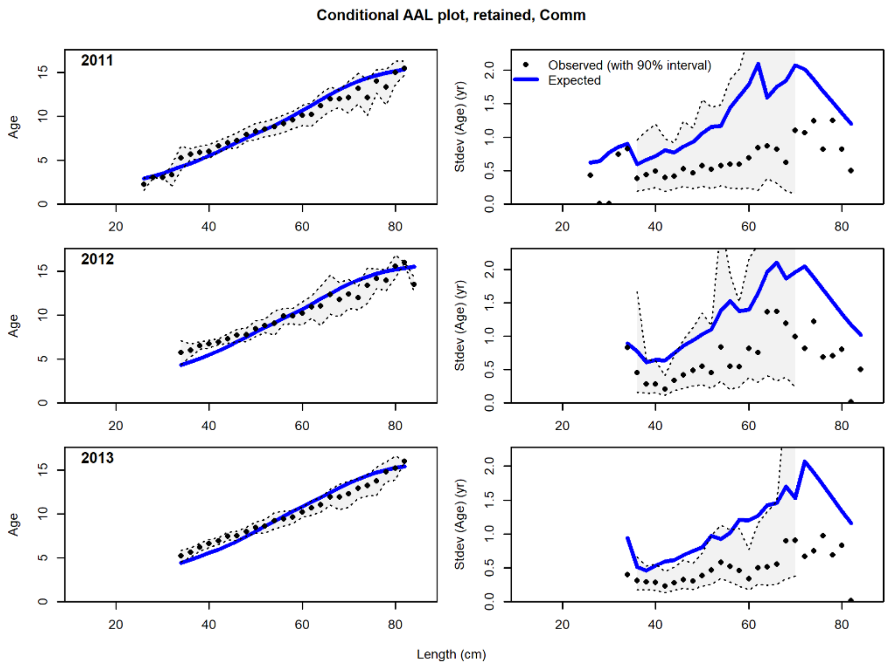
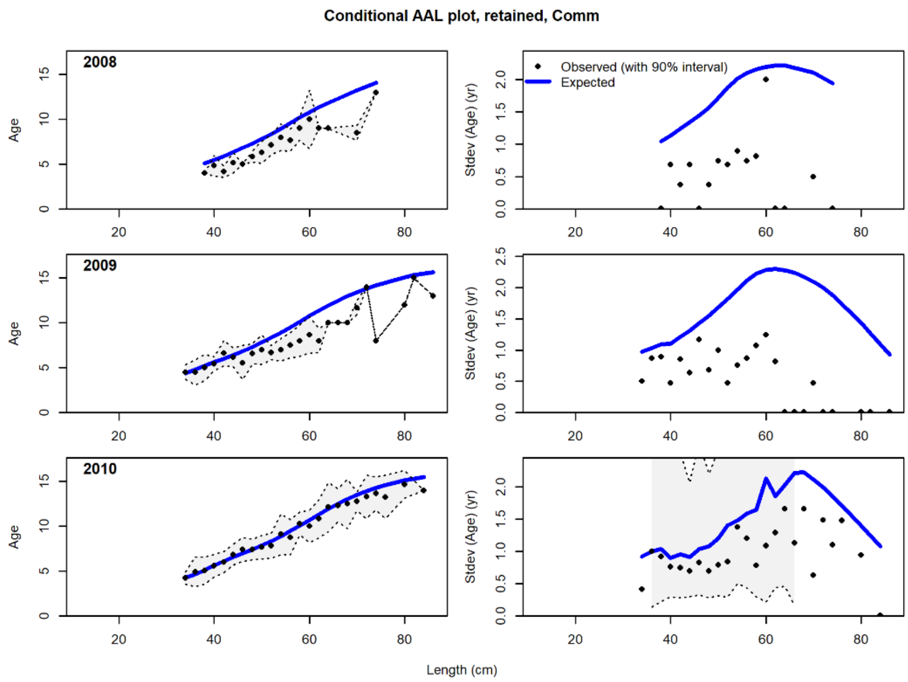


Figure 14-8. Seabass in Division 8.a-b. Final Bay of Biscay seabass stock assessment model: fit to commercial fishery length composition data.

Model fit for the aggregated fishery age-at-length composition data were good in average, but poor in standard deviation (





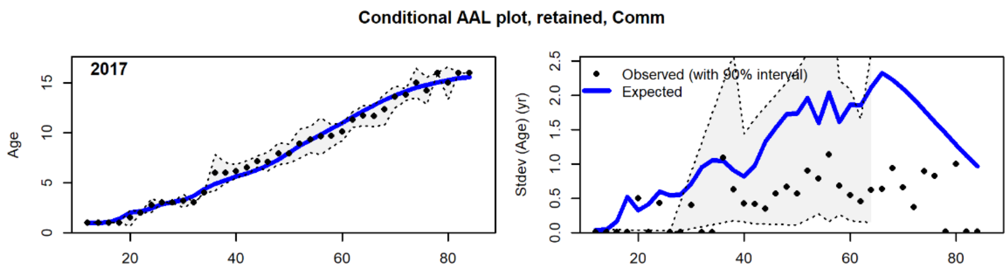
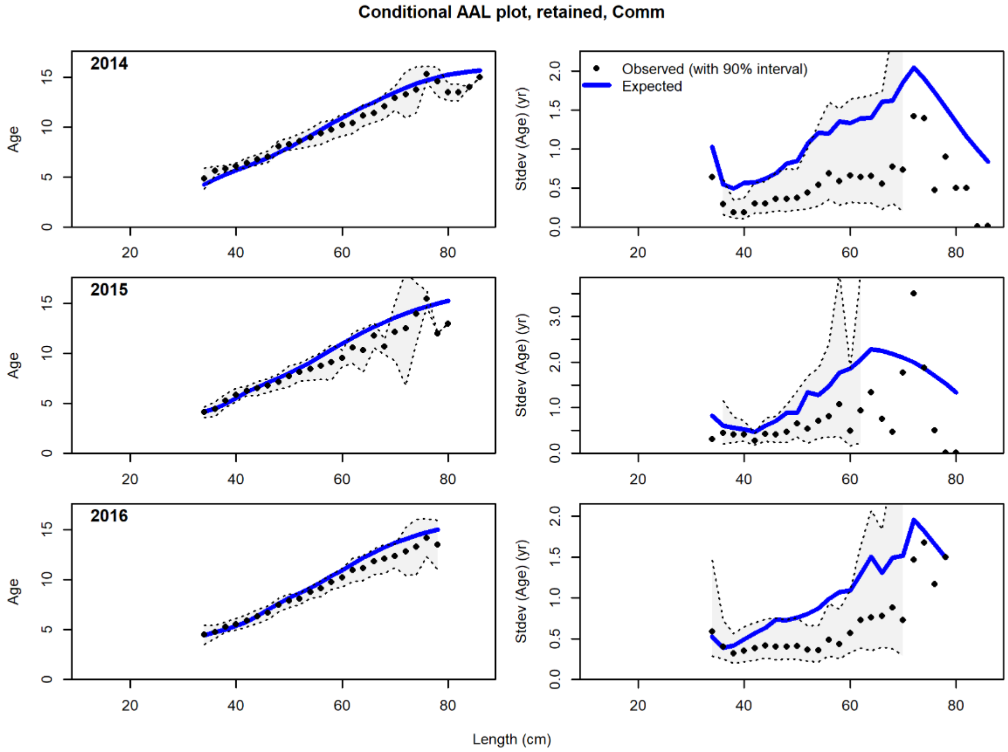


Figure 14-9 and Figure 14-10).



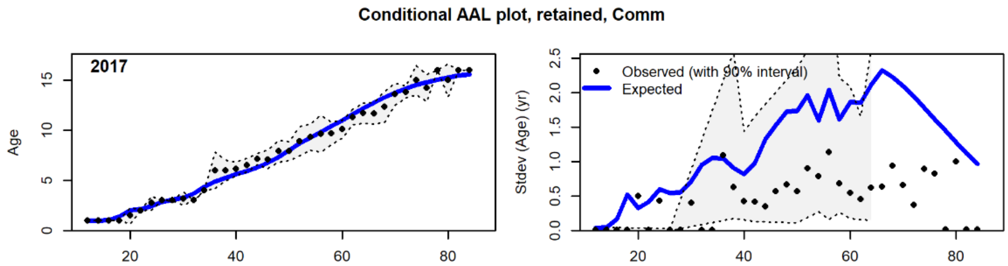


Figure 14-9. Seabass in Division 8.a-b. Final Bay of Biscay seabass stock assessment model: fit to conditional age-at-length for commercial fishery.

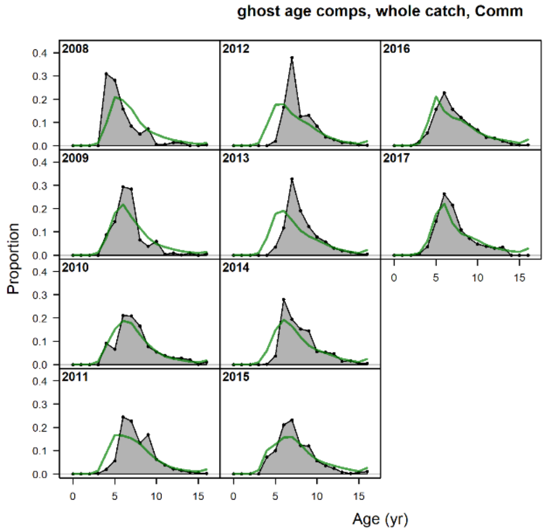


Figure 14-10. Seabass in Division 8.a-b. Final Bay of Biscay seabass stock assessment model: fit to ghost age composition data for commercial fishery

The fit were poor for first 2 years (2008 and 2009). However, for these years the sampling size was low.

Age compositions data were included in the base model as "ghost", meaning that they were not used for estimating the model likelihood. The purpose was to illustrate what the model estimated in terms of age composition data (Figure 14-10). Model and observations compared well, even though a discrepancies for some years was evident. For instance, in years 2011-2014, the model overestimated the proportion of age ≤ 5 compared to observations, or vice versa. Uncertainty in age reading or sampling bias may be considered as a potential explanation.

A retrospective analysis was conducted (Figure 14-11). Recruitment, SSB and F series showed some variability, however the stock trend is rather robust. In the last 5 years, the SSB is stable around 20,000 t showing a decreasing trend, while the F is below 0.15 and fluctuating without a trend. Recruitment was poorly estimated in recent years and showed high variability.

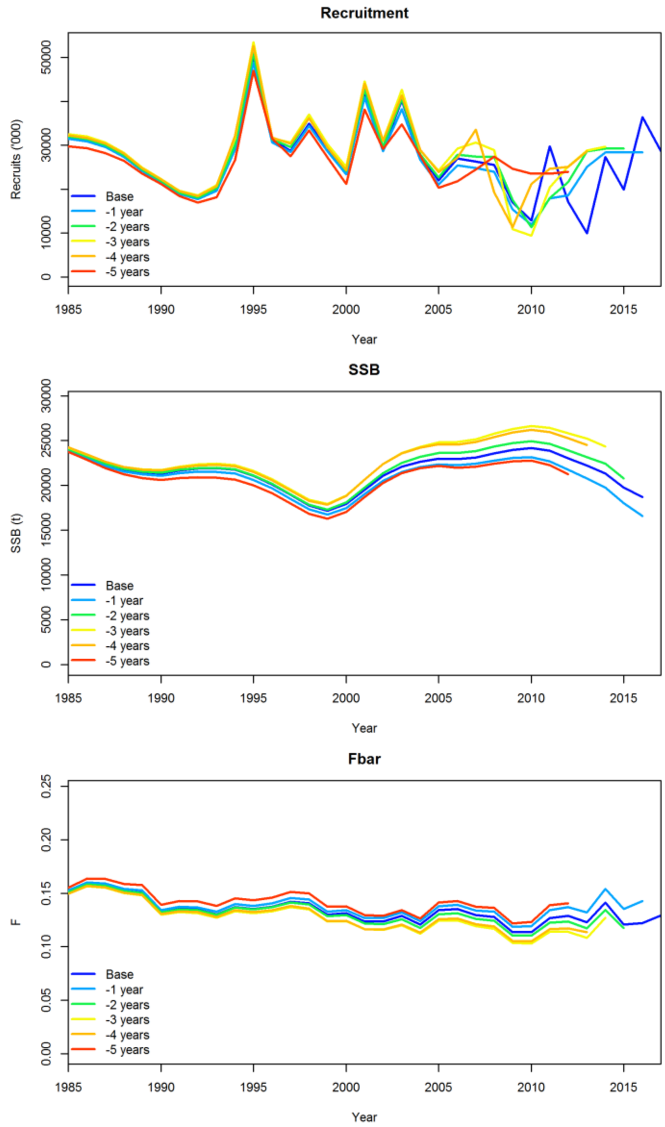


Figure 14-11. Seabass in Division 8.a-b. Retrospective plot from SS3.

14.3.5 Historic trends in biomass, fishing mortality and recruitment

Summary results from SS3 are given in Table 14-4 and Figure 14-12. The recruitment series was variable around ~30,000,000 individuals per year. Recruitment below average was observed for years 2009–2012. The SSB fluctuated around 20,000 t. A low SSB was observed just before the 2000s, and high SSB was observed around year 2010. Since then, a decreasing trend is observed. F computed for ages 4–15 showed a stable trend over the whole time series.

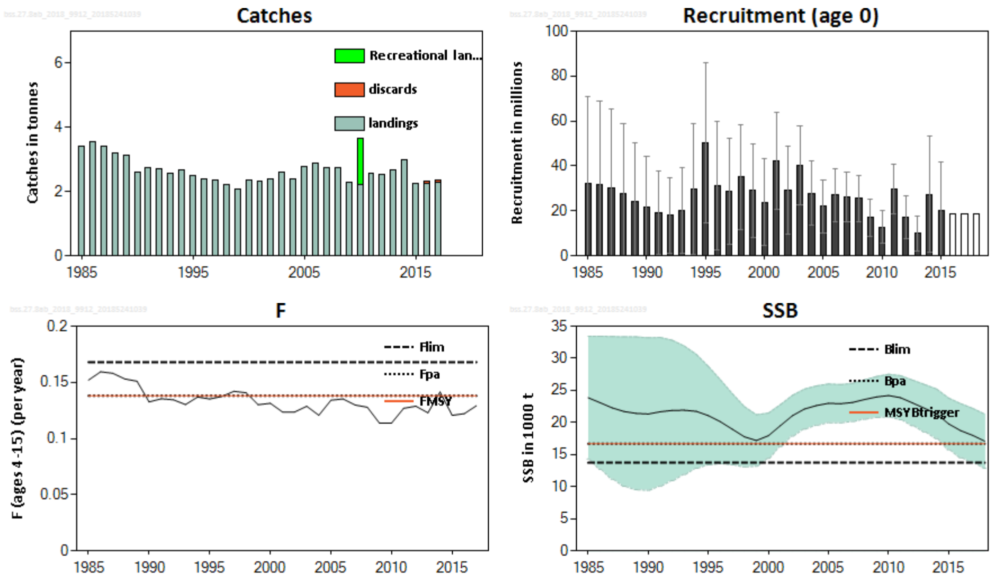


Figure 14-12. Seabass in Division 8.a-b. Summary of the assessment Bss-8ab

Table 14-4. Seabass in Division 8.a-b. Assessment summary. Weight are in tonnes.

Year	Recruitment	High	Low	SSB	High	Low	Landings	Discards	F
	Age 0								Ages 4-15
	thousands			tonnes			tonnes	tonnes	per year
1985	32004	70892	0	23860	33420	14300	3420		0.152
1986	31437	69082	0	23075	33441	12708	3549		0.159
1987	30051	65102	0	22275	33384	11166	3417		0.158
1988	27784	59005	0	21702	33344	10059	3217		0.153
1989	24396	50462	0	21423	33332	9514	3144		0.151
1990	21833	44116	0	21321	33205	9436	2621		0.133
1991	19110	37701	520	21671	33245	10097	2734		0.135
1992	17950	34918	982	21878	32809	10948	2709		0.135
1993	20005	39080	930	21910	31909	11910	2552		0.130
1994	29540	58555	524	21738	30618	12859	2668		0.137
1995	50106	85840	14372	21063	28742	13384	2492		0.135
1996	31271	59977	2564	20124	26659	13589	2402		0.137
1997	28699	52263	5134	18951	24487	13415	2358		0.142
1998	34961	58430	11493	17768	22470	13067	2231		0.141
1999	29158	49983	8333	17196	21207	13184	2091		0.130
2000	23877	43386	4367	17934	21458	14410	2362		0.131
2001	42063	63712	20414	19512	22781	16242	2306		0.124
2002	29077	48528	9626	21059	24225	17894	2392		0.124
2003	40239	57888	22589	22094	25202	18986	2616		0.129
2004	27773	42073	13474	22633	25697	19570	2380		0.121
2005	21937	33873	10002	22983	26001	19965	2796		0.134
2006	27007	38817	15197	22924	25895	19953	2875		0.135
2007	26295	37415	15175	23125	26096	20153	2751		0.130
2008	25542	35849	15234	23578	26635	20520	2745		0.128
2009	16935	25369	8500	23974	27164	20784	2278		0.114
2010	12836	20298	5374	24193	27508	20877	2229		0.114
2011	29730	40912	18549	23861	27289	20434	2575		0.127
2012	17113	26703	7524	23048	26598	19498	2549		0.129
2013	9920	17562	2277	22214	25908	18520	2685		0.123
2014	27316	53181	1451	21353	25212	17493	2991		0.141
2015	19896	41727	0	19777	23797	15758	2264		0.121
2016	18743			18723	22931	14515	2252	65	0.122
2017	18743			17990	22198	13782	2295	74	0.129
2018	18743			17094	21302	12885			
2019									
2020									
Average	25944	47184	6923	21295	27240	15349	2635	69	0.133

14.4 Biological reference points

The definition of the biological reference points relies on the arbitrary choice of a Stock – Recruitment relationship type defined by ICES (ICES, 2015, 2017c). For the Bay of Biscay seabass stock, the type 5 stock was chosen at the very end of the WKBASS 2018, but it was not discussed in a plenary and no discussion appears in the report.

The WGBIE disagreed with the WKBASS 2018 choice, and recommended the use of the type 6 for the Bay of Biscay seabass stock. Indeed, the WGBIE concluded that the Stock – Recruitment relationship of the Bay of Biscay seabass stock meets the definition of type 6 category: the stock-recruitment plot displays very little dependence between R and SSB and this is a stock with a narrow dynamic range of SSB and showing no evidence of past or present impaired recruitment. In this case, B_{loss} is defined as B_{pa} = 16 688 tonnes.

Following the recommendation of the WGBIE, a working document (section 0: Annex 2) was written detailing the computation of the biological reference points and forecasts under both type choice (i.e. either type 5 or type 6). Hereafter, the biological reference points (Table 14-5) and forecast (section 14.5) computed under type 6 choice were retained as recommended by the WGBIE 2018.

Table 14-5. Seabass in Division 8.a-b. Biological reference points computed under type 6 assumption as agreed by the WGBIE.

Framework	Reference point	Value	Technical basis
MSY approach	MSY $B_{trigger}$	16 688 t	B_{pa}
	F_{MSY}	0.138	F that maximizes median long-term yield in stochastic simulations under constant F exploitation; constrained by the requirement that $F_{MSY} \leq F_{pa}$
Precautionary approach	B_{lim}	13 735 t	B_{pa} / exp(CV * 1.645)
	B_{pa}	16 888 t	Lowest observed SSB
	F_{lim}	0.168	F that, In equilibrium gives a 50% probability of SSB>B_{lim}
	F_{pa}	0.138	F_{pa} = F_{lim} / exp(CV * 1.645)
Management plan	SSB_{mgt}	Not defined	
	F_{mgt}	Not defined	

14.5 Catch options and prognosis

14.5.1 Short-Term projection

Forecast inputs used for projections are compiled in Table 14-6. The recruitment used for projections is the geometric mean (GM) calculated from 2008 to 2014 (Table 14-7). For the short-term projection, scaled F-at-age to the average of the last 3 years (2015-2017) were used for commercial and recreational fleets (Table 14-7). Total landings forecasted for 2018 are 2718 t, with 2092 t for the commercial fishery and 626 t for the recreational fishery. SSB 2019 is forecasted to be at 15573 t, i.e. below MSY $B_{trigger}$, and between B_{pa} and B_{lim}.

Table 14-6. Seabass 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	18584	0,004	0,000	0,000	0,009	0,000	0,009	0,24
1	14618	0,020	0,000	0,000	0,044	0,000	0,051	0,24
2	11498	0,078	0,000	0,000	0,295	0,001	0,151	0,24
3	9675	0,183	0,003	0,001	0,460	0,004	0,300	0,24
4	10400	0,332	0,031	0,019	0,592	0,011	0,485	0,24
5	2879	0,519	0,167	0,066	0,726	0,020	0,690	0,24
6	3578	0,737	0,431	0,096	0,900	0,027	0,906	0,24
7	4328	0,977	0,683	0,105	1,120	0,031	1,134	0,24
8	1283	1,232	0,842	0,107	1,368	0,032	1,378	0,24
9	1149	1,494	0,923	0,108	1,628	0,033	1,633	0,24
10	1176	1,757	0,962	0,108	1,889	0,033	1,892	0,24
11	825	2,018	0,980	0,108	2,146	0,033	2,148	0,24
12	580	2,271	0,989	0,108	2,395	0,033	2,396	0,24
13	324	2,516	0,994	0,108	2,634	0,033	2,634	0,24
14	283	2,749	0,996	0,108	2,861	0,033	2,861	0,24
15	281	2,969	0,998	0,108	3,074	0,033	3,074	0,24
16	471	3,534	0,998	0,108	3,593	0,033	3,593	0,24

Age 0,1,2 over-written as follows:

2018 yc 2018 age 0 replaced by 2008–2014 LTGM (18 584 thousand);

2017 yc 2018 age 1 from SS3 survivor estimate at-age 1, 2018 * LTGM / SS3 estimate of age 0 in 2016;

2016 yc 2018 age 2 from SS3 survivor estimate at-age 2, 2018 * LTGM / SS3 estimate of age 0 in 2015.

Table 14-7. Seabass in Division 8.a-b. The basis for the catch scenarios.

VARIABLE	VALUE	NOTES
F ages 4–15 (2018)	0.124	F_{sq}; $F_{average(2015-2017)}$ scaled to 2017; commercial fishery F= 0.096; recreational fishery F=0.028 (reduced to account for 2018 management measures; $F_{recreational(2018)} = F_{recreational(2017)} * 0.945$)
SSB (2019)	15573 t	Short-term forecast
R_{age0} (2016, 2017, 2018)	18584 thousands	Geometric mean (2008-2014)
Total catch (2018)	2718 t	Fishing at F_{sq} with $F_{recreational(2018)}$ reduced
Wanted commercial catch (2018)	2092 t	Short-term forecast
Unwanted commercial catch (2018)	negligible	
Recreational Catch (2018)	626 t	Short-term forecast with management measures taken into account and full compliance assumed

Landings in 2019 and SSB in 2020 predicted for various levels of fishing mortality in 2019 are given in Table 14-8. Maintaining status quo F in 2019 is expected to result in a decrease in the total catch (from 2718 t to 2684 t) and SSB (from 15573 t to 15149 t) with respect to 2018. However, when the MSY approach is applied, total catches (commercial and recreational) in 2019 should be no more than 2793 t (with all catches assumed to be landed). The resulting SSB would reached in 2020 a level of 15066 t.

Table 14-8. Seabass in Division 8.a-b. Catch options table.

Basis	Total catch - Commercial landings and recreational removals - (2019)	Commercial landings (2019)	Recreational removals (2019)	Total F (2019)	$F_{commercial\ landings}$ (2019)	$F_{recreational}$ (2019)	SSB (2020)	% SSB change
ICES basis								
MSY approach: F=Fmsy * SSB_2019 / MSY_Btrigger	2793	2154	639	0,129	0,100	0,029	15066	-3,26
$F=F_{MSY}$_lower * SSB_2019 / MSY_Btrigger	2525	1948	578	0,116	0,090	0,026	15269	-1,95
$F=F_{MSY}$_upper * SSB_2019 / MSY_Btrigger	3586	2766	821	0,169	0,131	0,038	14467	-7,10
$F=F_{MSY}$	2980	2298	682	0,138	0,107	0,031	14925	-4,16
F=0	0	0	0	0,000	0,000	0,000	17196	10,42
$F=F_{pa}$	2988	2304	683	0,139	0,107	0,031	14919	-4,20
$F=F_{lim}$	3580	2761	819	0,168	0,130	0,038	14472	-7,07
SSB_2019 = B_{lim}	4560	3516	1044	0,220	0,170	0,050	13736	-11,80
SSB_2019 = B_{pa}	662	511	151	0,029	0,023	0,007	16688	7,16
SSB_2019 = MSY_B_{rigger}t	662	511	151	0,029	0,023	0,007	16688	7,16
F=F_2017	2684	2070	614	0,124	0,096	0,028	15149	-2,72
$F=F_{MSY}$_lower	2696	2079	617	0,124	0,096	0,028	15140	-2,78
$F=F_{MSY}$_upper	3822	2947	875	0,181	0,140	0,041	14290	-8,24

14.5.2 Yield and biomass per recruit analysis

Not performed during this WG.

14.6 Comments on the assessment

The assessment for the Bay of Biscay seabass stock shows that since 2000, the spawning stock biomass (SSB) fluctuated around 20 000 t and is currently at MSY $B_{trigger}$. A low SSB was observed just before the 2000s, and high SSB was observed around year 2010. Since then, a decreasing trend is observed. The fishing mortality (F) showed a stable trend over the whole time series and has fluctuated below F_{msy} during the period. The recruitment is variable over time, and it was observed below average for years 2009-2013. Landings are stable over time around 2 600t. Thus, extreme situations have not been explored to fully understand the dynamics of this stock. This implies that the estimation of the biological reference points whatever the chosen type of the SR relationship is uncertain. Note that no discussion took place during WGBIE 2018 about using a category 3 (instead of a category 1) based on the SS3 model outputs (i.e. the SSB), but this option could have been considered given the uncertainties on the biological reference points.

Otherwise, this assessment relies on short data time-series: length composition time series start in 2000; age-at-length time series start only in 2008 (with a proper sampling after 2010); recreational data were surveyed for only one year, 2010. In addition, there is no scientific survey for adult seabass to scale the model to an appropriate level of abundance. There is no survey on recruits either. All those elements make this assessment uncertain. In order to improve future assessments and advice for this stock, several important limitations and deficiencies in data for the Bay of Biscay seabass stock should be addressed.

1) Recruitment indices are needed for the Bay of Biscay area. Estimation of recruitment is only based on commercial landings, and it may be smooth because of ageing errors (Laurec and Drogou, 2012). A French study has been undertaken in 2013-2018 to explore the possibility of creating recruitment indices in estuarine waters. The survey delivered good results, but it needs economic support to be carried out routinely (Le Goff et al., 2017). Abundance indices have been calculated for year 2016 and 2017 in the Loire estuary and are planned for year 2018. The study has been submitted to FEAMP for year 2019-2021, including also the Gironde estuary in order to get 2 abundance index for the stock Bss 8ab. Final objective would be to make it sustainable through DCF from 2022 after having implemented and discussed it in the assessment during a benchmark.

2) Robust relative fishery-independent abundance indices are needed for adult seabass in the Bay of Biscay. The establishment of dedicated surveys on the spawning grounds could provide valuable information on trends in abundance and population structure of adult seabass as well as information on stock structure and linkages between spawning and recruitment grounds using drift model.

3) Further research is needed to better understand the spatial dynamics of seabass (mixing between stock areas; effects of site fidelity on fishery catch rates; spawning site–recruitment ground linkages; environmental influences on recruitment).

4) Assessment model should be revised according to the results of undergoing tagging and genetic programs.

5) Studies are needed to investigate the accuracy/bias in ageing and errors due to historically age sampling schemes.

6) Continued estimation of recreational catches and size compositions is needed across the stock range and information to evaluate historical trends in recreational effort and catches would be beneficial for interpreting changes in age–length compositions over time.

7) Historical catches data (1985–2000) need to be revised following the methodology used for the recent years (2000 onwards). Historical catches data need also to be disaggregated into several fishing fleets (e.g. midwater trawls, bottom trawls, nets, lines).

8) 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 seabass management.

9) 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 proportion of different gear types (especially with the large decrease in numbers of pair trawlers after 1995).

14.7 Management considerations

Seabass 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 seabass 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 seabass, 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 seabass 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 seabass. 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 seabass 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 seabass. 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 seabass. There is also a significant recreational fishing mortality in inshore waters. The importance of seabass 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.

14.8 References.

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Appendix 1: Seabass 8ab Bss 8ab Note written by WGBIE group during WGBIE 2018. 11th May 2018.

Seabass 8ab Bss 8ab

Note written by WGBIE group during WGBIE 2018. 11th May 2018

The WGBIE accepted the analytical assessment from SS3. However, a problem was detected with the reference point's calculations. Firstly, stock recruitment relationships obtained from the outputs of the SS3 were different for Type 5 and Type 6 categories. In both categories the SR relationship should be the same and the only difference is the definition of the PA reference points. However, in the SR models used in the benchmark both SR relationships were different. The SR used in Type 6 had higher mean recruitment above the breaking point, i.e., the stock was more productive and this increase in the productivity producing a higher Fmsy.

Given that the SR relationships must be the same in both categories when the PA reference points are decreased (i.e. in type 6) the Fmsy should be lower than that obtained in type 5. When the biomass reference points are less precautionary and the risk criteria are the same, the lower precaution in biomass must be compensated with a higher precaution in F.

The WGBIE members run the scripts used in the benchmark using the same output data from SS3 for both recruitment categories (Scripts and data used are placed in the SharePoint in Software folder). As expected, and in contradiction with the results from the benchmark, we obtained the same stock recruitment relationship. This relationship was the same obtained in the benchmark for type 5. Hence, we calculated the reference points for both categories using the same script used in the benchmark. The Fmsy obtained in type 5 was equal to 0.141 and in type 6 was equal to 0.138 (Table 1). The difference in Fmsy was low and it was similar to the mean fishing mortality observed in the historical series. The reference points obtained in type 5 were different to those obtained in the benchmark. Therefore, there may be some discrepancies in the overall process of producing the reference points in the benchmark and this needs to be re-evaluated in an IBP.

The WGBIE concluded that the SR relationship meets the definition of type 6 category. Furthermore, the Fmsy obtained was around the fishing mortality observed in the historical series so there was no argument to think that it is not precautionary. Hence, the WGBIE concluded that using a type 6 SR relationship for the stock agrees with the PA framework.

Appendix 2: Working document on the biological reference points and forecast options for the Bay of Biscay seabass stock

Working document on the biological reference points and forecast options for the Bay of Biscay seabass stock

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To: WGBIE members, ADGBBI, ACOM.

1 Biological reference points

1.1 Current reference points

There is no current Biological Reference Points for Seabass (*Dicentrarchus labrax*) in Divisions 8.a,b (Bay of Biscay North and Central).

1.2 Source of data

The Bay of Biscay seabass stock is intending to be a category 1 stock with an analytical assessment based on a Stock Synthesis 3 (SS3) modelling approach. Data used in the biological reference points analysis were taken from the final assessment model obtained during ICES WKBASS 2018.

1.3 Methods used for the biological reference points

All analyses were conducted with EqSim in R. The SS3 model output was converted to a FLStock object in order to run EqSim. All model and data selection setting are presented in Table 1.3.1.

Table 1.3.1 Model and data selection settings

DATA AND PARAMETERS	SETTING	COMMENTS
SSB-recruitment data	Full dataseries (years classes 1985–2016)	
Exclusion of extreme values (option extreme.trim)	No	
Trimming of R values	Yes	-3,+3 Standard deviations
Mean weights and proportion mature; natural mortality	2007–2016	

Exploitation pattern	2007–2016	
Assessment error in the advisory year. CV of F	0.212	Set ICES default value
Autocorrelation in assessment error in the advisory year	0.423	Set ICES default value

1.4 Results

1.4.1 Stock recruitment relationship

The stock-recruitment plot displays very little dependence between R and SSB (Figure 1.4.1). Based on the S/R relationship classification proposed by ICES (2017), the seabass stock can be categorised as a type 5 or a type 6 S-R plot.

For a type 5, this is a stock with no clear relationship between stock and recruitment (no apparent S-R signal), while, for a type 6, this is a stock with a narrow dynamic range of SSB and showing no evidence of past or present impaired recruitment. No B_{lim} from this data, only the PA reference point.

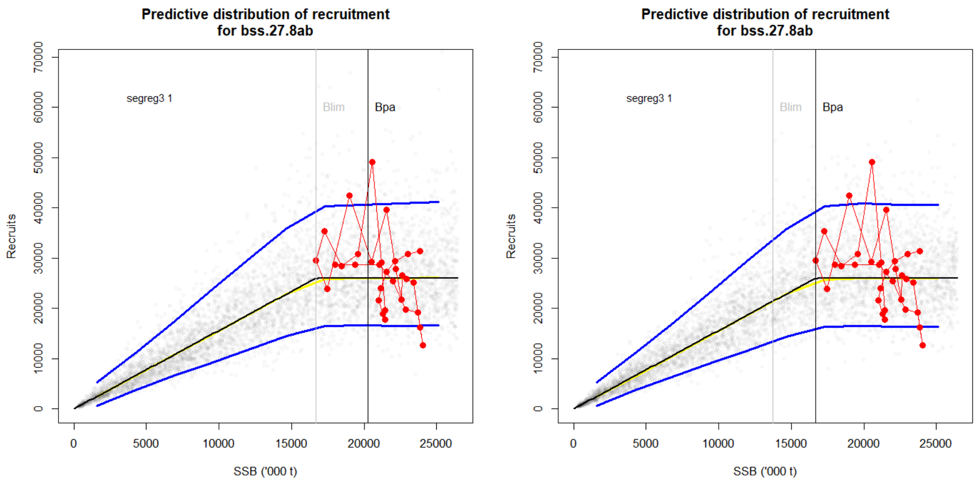

Figure 1.4.1. Stock recruitment relationship for the Bay of Biscay seabass stock with B_{lim} and B_{pa} determined following the ICES type 5 (left) or type 6 (right) stock.

For type 5 stock S-R, B_{lim} is estimated to be equal to B_{loss}. This implies a B_{lim} of 16 688 tonnes with a $B_{pa} = B_{lim} * \exp(CV \times 1.645) = 20\,275$ tonnes, with a CV = 0.118 derived from SS3 outputs (i.e. the CV of the last year SSB estimate).

For type 6 stock S-R, B_{pa} is estimated to be equal to B_{loss}. This implies a B_{pa} of 16,688 tonnes with a $B_{lim} = B_{pa} / \exp(CV \times 1.645) = 13{,}735$ tonnes, with CV = 0.118 derived from SS3 outputs.

1.4.2 Type 5 stock

1.4.2.1 Yield and SSB

F_{MSY} is estimated from the base run and taken as the peak of the median landings equilibrium yield curve. The F_{MSY} range is calculated as those F values associated with median yield that is 95% of the peak of the median yield curve.

1.4.2.2 Eqsim analysis

a) Segmented regression method, full SR time-series, without $B_{trigger}$

F_{lim} and F_{pa} was estimated using the EqSim software to run the simulation with $B_{trigger}$ set to 0 (i.e. no $B_{trigger}$ used), $F_{cv} = F_{phi} = 0$ (i.e. no assessment/advice error set for this first run) and the segmented regression as the only SR method. F_{lim} is estimated as the fishing mortality that at equilibrium from a long-term stochastic projection leads to a 50% probability of having SSB above B_{lim}. F_{lim} was estimated to be 0.159 and F_{pa} is estimated to be 0.131 based on the following equation [$F_{pa} = F_{lim}/\exp(CV * 1.645)$].

Initially, F_{MSY} is calculated as the fishing mortality that maximises median long-term yield in stochastic simulations under constant F exploitation (i.e. without MSY Btrigger). Using the same simulation method with the inclusion of assessment/advice error default values: Fcv=0.212, Fphi=0.423 from WKMSYREF4 (ICES, 2016). $F_{MSY} = 0.138$ and is thus above $F_{pa} = 0.131$, see Figure 1.4.2 and Figure 1.4.3. In such a case, F_{MSY} is reduced to F_{pa} (i.e. F_{MSY} cannot exceed F_{pa}).

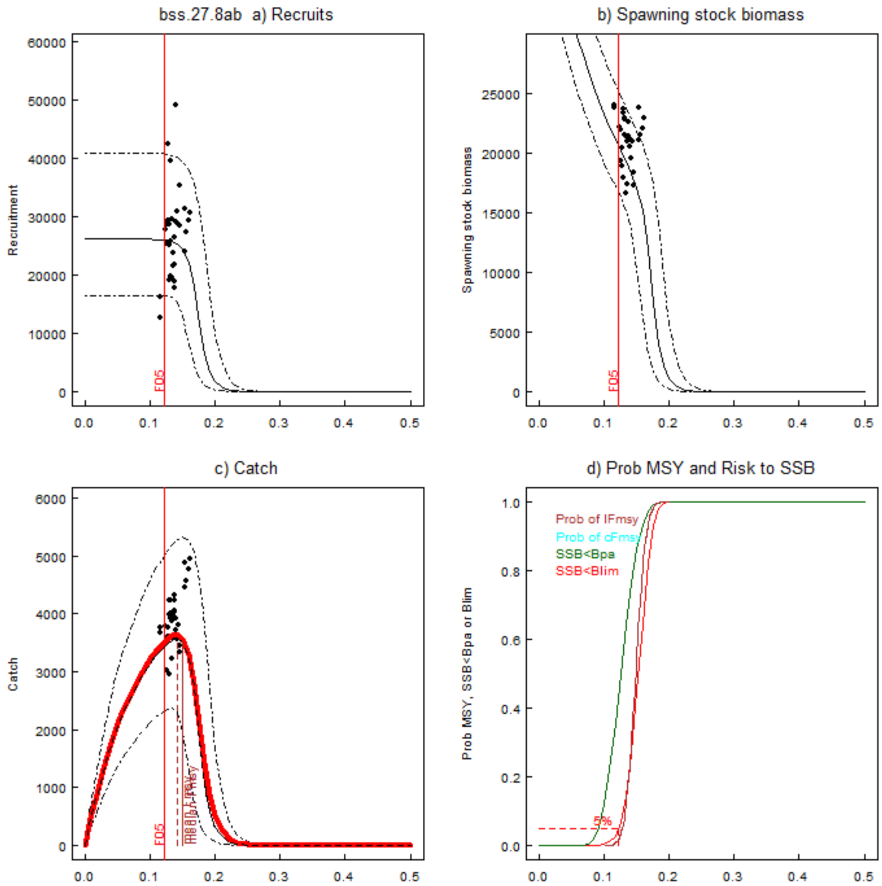

Figure 1.4.2. Eqsim summary plot without $B_{trigger}$. Panels a to c: historic values (dots) median (solid black) and 90% intervals (dotted black) recruitment, SSB and landings for exploitation at fixed values of F. Panel c also shows mean landings (red solid line). Panel d shows the probability of SSB<B_{lim} (red), SSB<B_{pa} (green) and the cumulative distribution of F_{MSY} based on yield as landings (brown).

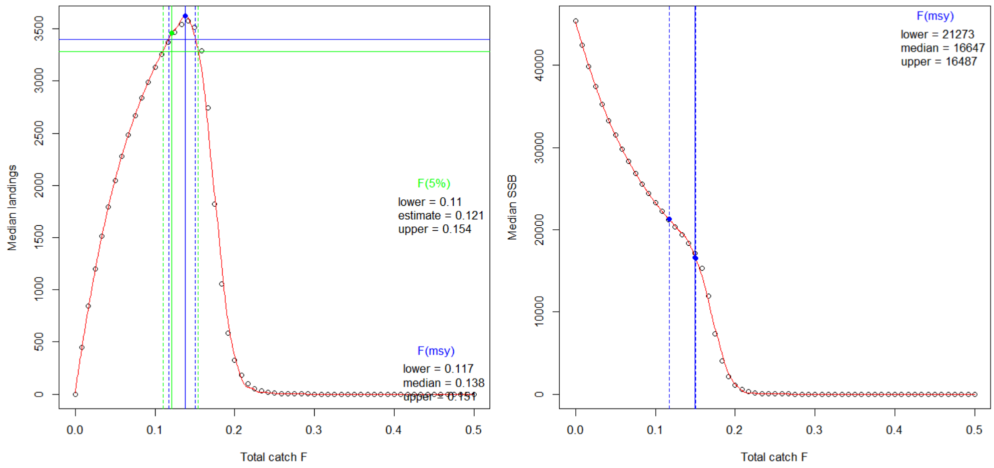

Figure 1.4.3. Left) Eqsim median landings yield curve with estimated reference points without $B_{trigger}$. Blue lines: F_{MSY} estimate (solid) and range at 95% of maximum yield (dotted). Green lines: F (5%) estimate (solid) and range at 95% of yield implied by F (5%) (Dotted). Right) Eqsim median SSB curve with estimated reference points without $B_{trigger}$. Blue dots: lower and upper SSB corresponding to lower and upper F_{MSY}.

b) Segmented regression method, full SR time-series, with $B_{trigger}$

ICES defines MSY $B_{trigger}$ as the 5th percentile of the distribution of SSB when fishing at F_{MSY}. However if the stock has not been fished at F_{MSY} for at least 5 years, as in this case, then MSY $B_{trigger}$ is set to B_{pa}.

For the final run, assessment/advice error were included using the same default values and MSY $B_{trigger}$ was set to 20 275 tonnes. As shown in Figure 1.4.4, EqSim output $F_{p.05}$ (fishing mortality that gives 5% probability of SSB below B_{lim}) equals 0.139. As F_{MSY} estimated in the first run is below $F_{p.05}$, then F_{MSY} is kept to 0.131.

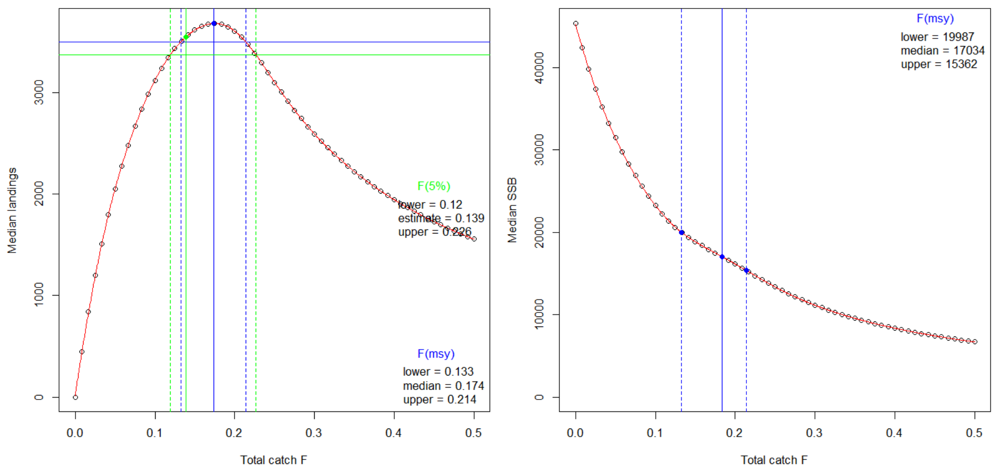

Figure 1.4.4. Eqsim median landings yield curve with estimated reference points with $B_{trigger}$. Blue lines: F_{MSY} estimate (solid) and range at 95% of maximum yield (dotted). Green lines: F (5%) estimate (solid) and range at 95% of yield implied by F (5%) (Dotted).

1.4.2.3 Proposed reference points

For the Bay of Biscay seabass stock, the proposed reference points are reported in Table 1.4.1.

Table 1.4.1. Summary table of proposed stock reference points for method Eqsim.

STOCK	**Seabass divisions 8ab**		
PA Reference points	Value	Rational	
B_{lim}	16,688 t	Lowest observed SSB	
B_{pa}	20,275 t	B_{lim} / exp(CV * 1.645)	
F_{lim}	0.159	In equilibrium gives a 50% probability of SSB>B_{lim}	
F_{pa}	0.131	F_{pa} = F_{lim} / exp(CV * 1.645)	
MSY Reference point	Value		
F_{MSY} without $B_{trigger}$	0.131	Reduced value (originally equals to 0.138)	
F_{MSY} lower without $B_{trigger}$	0.117		
F_{MSY} upper without $B_{trigger}$	0.151		
$F_{P.05}$ (5% risk to B_{lim} without $B_{trigger}$)	0.121		
F_{MSY} upper precautionary without $B_{trigger}$	0.154		
MSY $B_{trigger}$	20,275 t		
$F_{P.05}$ (5% risk to B_{lim} with $B_{trigger}$)	0.139		With WKMSYREF4 default values for assessment/advice error
F_{MSY} with $B_{trigger}$	0.131	Reduced value (originally equals to 0.174)	
F_{MSY} lower with $B_{trigger}$	0.131	Reduced value (originally equals to 0.133)	
F_{MSY} upper with $B_{trigger}$	0.131	Reduced value (originally equals to 0.214)	
F_{MSY} upper precautionary with $B_{trigger}$	0.131	Reduced value (originally equals to 0.227)	
Median SSB at F_{MSY}	20,079 t		
Median SSB lower precautionary (median at F_{MSY} upper precautionary)	14,662 t		
Median SSB upper (median at F_{MSY} lower)	20,079 t		

1.4.3 Type 6 stock

1.4.3.1 Yield and SSB

F_{MSY} is estimated from the base run and taken as the peak of the median landings equilibrium yield curve. The F_{MSY} range is calculated as those F values associated with median yield that is 95% of the peak of the median yield curve.

1.4.3.2 Eqsim analysis

a) Segmented regression method, full SR time-series, without $B_{trigger}$

F_{lim} and F_{pa} was estimated using the EqSim software to run the simulation with $B_{trigger}$ set to 0 (i.e. no $B_{trigger}$ used), F_{cv} = F_{phi} = 0 (i.e. no assessment/advice error set for this first run) and the segmented regression as the only SR method. F_{lim} is estimated as the fishing mortality that, at equilibrium from a long-term stochastic projection, leads to a 50% probability of having SSB above B_{lim}. F_{lim} was estimated to be 0.168, and F_{pa} is estimated to be 0.138 based on the following equation [$F_{pa} = F_{lim}/exp(CV * 1.645)$].

Initially, F_{MSY} is calculated as the fishing mortality that maximises median long-term yield in stochastic simulations under constant F exploitation (i.e. without MSY Btrigger). Using the same simulation method with the inclusion of assessment/advice error default values: Fcv=0.212, Fphi=0.423 from WKMSYREF4 (ICES, 2016). F_{MSY} = 0.138 and is thus not above F_{pa} = 0.138 too, see Figure 1.4.5 and Figure 1.4.6. In such a case, F_{MSY} is not reduced to F_{pa} (i.e. F_{MSY} cannot exceed F_{pa}).

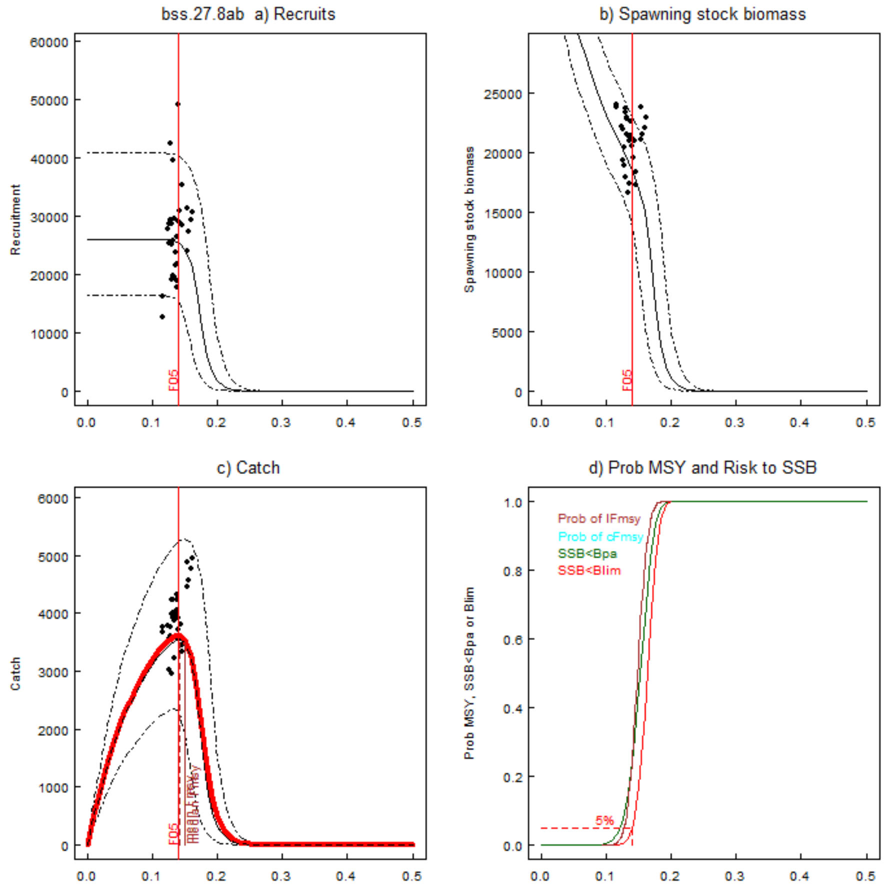

Figure 1.4.5: Eqsim summary plot without $B_{trigger}$. Panels a to c: historic values (dots) median (solid black) and 90% intervals (dotted black) recruitment, SSB and landings for exploitation at fixed values of F. Panel c also shows mean landings (red solid line). Panel d shows the probability of SSB<B_{lim} (red), SSB<B_{pa} (green) and the cumulative distribution of F_{MSY} based on yield as landings (brown).

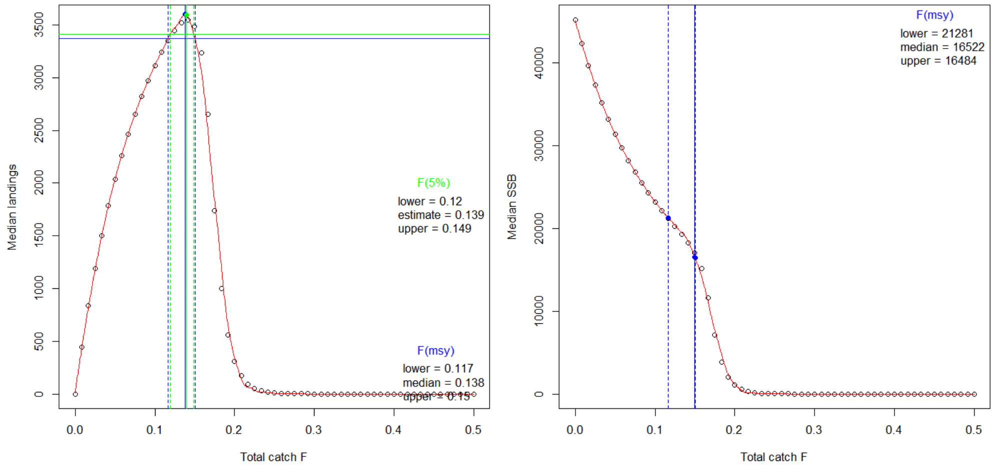

Figure 1.4.6: Left) Eqsim median landings yield curve with estimated reference points without $B_{trigger}$. Blue lines: F_{MSY} estimate (solid) and range at 95% of maximum yield (dotted). Green lines: F (5%) estimate (solid) and range at 95% of yield implied by F (5%) (Dotted). Right) Eqsim median SSB curve with estimated reference points without $B_{trigger}$. Blue dots: lower and upper SSB corresponding to lower and upper F_{MSY}.

b) Segmented regression method, full SR time-series, with $B_{trigger}$

ICES defines MSY $B_{trigger}$ as the 5th percentile of the distribution of SSB when fishing at F_{MSY}. However if the stock has not been fished at F_{MSY}, as in this case, then MSY $B_{trigger}$ is set to B_{pa}.

For this final run, assessment/advice error were included using the same default values and MSY $B_{trigger}$ was set to 16,688 tonnes. As shown in Figure 1.4.7, EqSim output $F_{p.05}$ (fishing mortality that gives 5% probability of SSB below B_{lim}) equals 0.160. As F_{MSY} estimated in the first run is below $F_{p.05}$, then F_{MSY} is kept to 0.138.

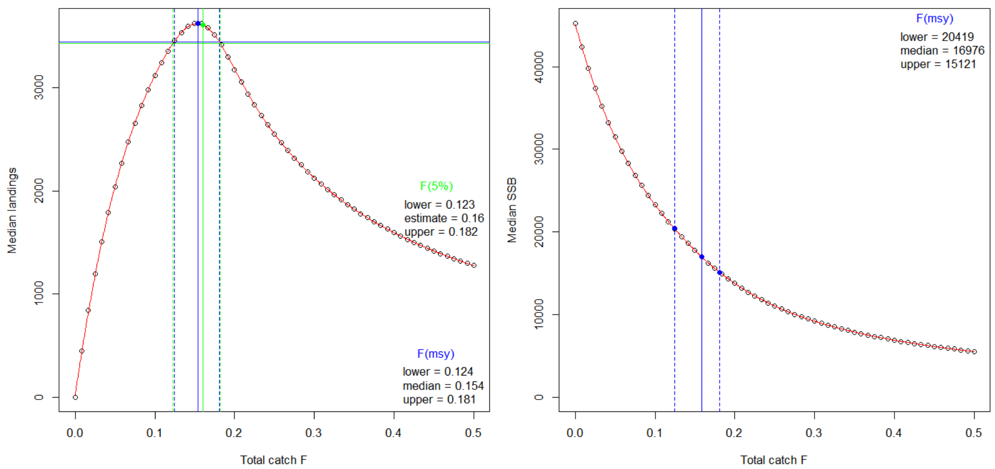

Figure 1.4.7: Eqsim median landings yield curve with estimated reference points with $B_{trigger}$. Blue lines: F_{MSY} estimate (solid) and range at 95% of maximum yield (dotted). Green lines: F (5%) estimate (solid) and range at 95% of yield implied by F (5%) (Dotted).

1.4.3.3 Proposed reference points

For the seabass in division 8ab stock, the proposed reference points are reported in the Table 1.4.2.

Table 1.4.2. Summary table of proposed stock reference points for method Eqsim.

STOCK	Seabass divisions 8ab		
PA Reference points	Value	Rational	
B_{lim}	13,735 t	Lowest observed SSB	
B_{pa}	16,688 t	B_{lim} / exp(CV * 1.645)	
F_{lim}	0.168	In equilibrium gives a 50% probability of SSB>B_{lim}	
F_{pa}	0.138	$F_{pa} = F_{lim}$ / exp(CV * 1.645)	
MSY Reference point	Value		
F_{MSY} **without** $B_{trigger}$	0.138		
F_{MSY} **lower without** $B_{trigger}$	0.117		
F_{MSY} **upper without** $B_{trigger}$	0.150		
$F_{P.05}$ **(5% risk to** B_{lim} **without** $B_{trigger}$**)**	0.139		
F_{MSY} **upper precautionary without** $B_{trigger}$	0.149		
MSY $B_{trigger}$	16,688 t	Increased value to B_{pa} (originally equals to 16,189 t)	
$F_{P.05}$ **(5% risk to** B_{lim} **with** $B_{trigger}$**)**	0.160		With WKMSYREF4 default values for assessment/advice error
F_{MSY} **with** $B_{trigger}$	0.138	Reduced value (originally equals to 0.153)	
F_{MSY} **lower with** $B_{trigger}$	0.124		
F_{MSY} **upper with** $B_{trigger}$	0.180		
F_{MSY} **upper precautionary with** $B_{trigger}$	0.182		
Median SSB at F_{MSY}	18,948 t		
Median SSB lower precautionary (median at F_{MSY} **upper precautionary)**	15,031 t		
Median SSB upper (median at F_{MSY} **lower)**	20,426 t		

1.4.4 Choice of the biological reference points

The Table 1.4.3 compiled the biological reference points according to both stock type options. Type 5 was chosen at the WKBASS 2018, but it was not discussed in a plenary. The WGBIE disagreed with the WKBASS 2018 choice, and recommended to use the type 6 for the Bay of Biscay stock.

Table 1.4.3 Summary table of proposed stock reference points depending on the type of stock.

STOCK	Seabass divisions 8ab	
PA Reference points	Type 5	Type 6
B_{lim}	16688 t	13735 t

B_{pa}	20275 t	16688 t
F_{lim}	0.159	0.168
F_{pa}	0.131	0.138
MSY Reference point		
F_{MSY} without $B_{trigger}$	0.131	0.138
F_{MSY} lower without $B_{trigger}$	0.117	0.117
F_{MSY} upper without $B_{trigger}$	0.151	0.150
$F_{P.05}$ (5% risk to B_{lim} without $B_{trigger}$)	0.121	0.139
F_{MSY} upper precautionary without $B_{trigger}$	0.154	0.149
MSY $B_{trigger}$	20275 t	16688 t
$F_{P.05}$ (5% risk to B_{lim} with $B_{trigger}$)	0.139	0.160
F_{MSY} with $B_{trigger}$	0.131	0.138
F_{MSY} lower with $B_{trigger}$	0.131	0.124
F_{MSY} upper with $B_{trigger}$	0.131	0.180
F_{MSY} upper precautionary with $B_{trigger}$	0.131	0.182
Median SSB at F_{MSY}	20079 t	18948 t
Median SSB lower precautionary (median at F_{MSY} upper precautionary)	14662 t	15031 t
Median SSB upper (median at F_{MSY} lower)	20079 t	20426 t

2 Forecasts

2.1 Source of data

The forecast used the data available at the WGBIE 2018, i.e. compared to the WKBASS 2018 run, it included the additional 2017 year.

2.2 Method used

The Table 2.2.1 summed up the basis for the catch scenarios.

Table 2.2.1 The basis for the catch scenarios.

Variable	Value	Notes
F ages 4–15 (2018)	0.124	F_{sq}; $F_{average(2015-2017)}$ scaled to 2017; commercial fishery F= 0.096; recreational fishery F=0.028 (reduced to account for 2018 management measures; $F_{recreational(2018)} = F_{recreational(2017)} * 0.945$)
SSB (2019)	15573 t	Short-term forecast
R_{age0} (2016, 2017, 2018)	18584 thousands	Geometric mean (2008-2014)
Total catch (2018)	2718 t	Fishing at F_{sq} with $F_{recreational(2018)}$ reduced
Wanted commercial catch (2018)	2092 t	Short-term forecast
Unwanted commercial catch (2018)	negligible	

Variable	Value	Notes
Recreational Catch (2018)	626 t	Short-term forecast with management measures taken into account and full compliance assumed

2.3 Results

2.3.1 Catch scenarios for type 5 stock

SSB 2019 (15573 t) below B_{lim} (16688 t). In this situation, the forecasts leads to an advice of 0 t (Table 2.3.1).

Table 2.3.1 Annual catch scenarios with type 5 stock. All weight are in tonnes.

Basis	Total catch - Commercial landings and recreational removals - (2019)	Commercial landings (2019)	Recreational removals (2019)	Total F (2019)	$F_{commercial\ landings}$ (2019)	$F_{recreational}$ (2019)	SSB (2020)	% SSB change
ICES basis								
MSY approach: F=0, as SSB_2019 < Blim	0	0	0	0,000	0,000	0,000	17196	10,42
F=Fmsy	2842	2192	650	0,131	0,102	0,030	15029	-3,49
F=0	0	0	0	0,000	0,000	0,000	17196	10,42
F=Fpa	2842	2192	650	0,131	0,102	0,030	15029	-3,49
F=Flim	3408	2628	780	0,160	0,124	0,036	14602	-6,24
SSB_2019 = Blim	662	511	151	0,029	0,023	0,007	16688	7,16
SSB_2019 = Bpa	-3978	-3071	-907	-0,160	-0,124	-0,036	20276	30,20
SSB_2019 = MSY_Btrigger	-3978	-3071	-907	-0,160	-0,124	-0,036	20276	30,20
F=F_2017	2684	2070	614	0,124	0,096	0,028	15149	-2,72
F=Fmsy_lower	2842	2192	650	0,131	0,102	0,030	15029	-3,49
F=Fmsy_upper	4452	3433	1019	0,214	0,165	0,048	13817	-11,28

Resulting stock development over time is presented in Figure 2.3.1

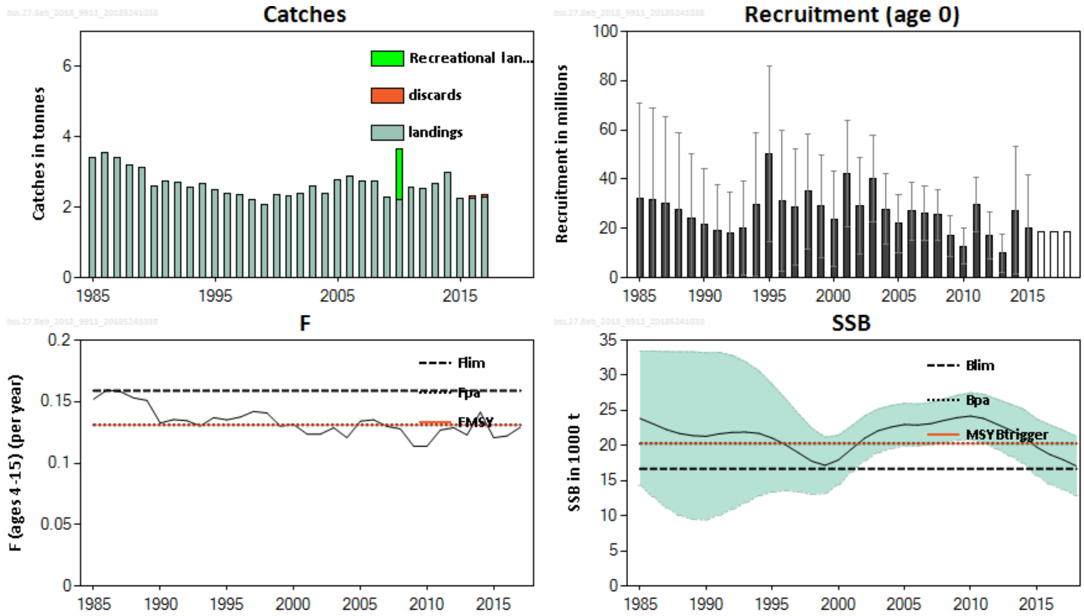

Figure 2.3.1: stock development over time-type 5 stock

2.3.2 Catch scenarios for type 6 stock

For this type, we have B_{lim} (13735 t) < SSB_2019 (15573 t) < MSY_Btrigger (16688 t). So ICES advice basis is Fmsy*SSB_2019/MSY_Btrigger. Type 6 stock offered under the ICES precautionary approach some catch opportunities coherent with the past series (Table 2.3.2).

Table 2.3.2 Annual catch scenarios with type 6 stock. All weight are in tonnes.

Basis	Total catch - Commercial landings and recreational removals - (2019)	Commercial landings (2019)	Recreational removals (2019)	Total F (2019)	$F_{commercial\ landings}$ (2019)	$F_{recreational}$ (2019)	SSB (2020)	% SSB change
ICES basis								
MSY approach: F=Fmsy * SSB_2019 / MSY_Btrigger	2793	2154	639	0,129	0,100	0,029	15066	-3,26
F=Fmsy_lower * SSB_2019 / MSY_Btrigger	2525	1948	578	0,116	0,090	0,026	15269	-1,95
F=Fmsy_upper * SSB_2019 / MSY_Btrigger	3586	2766	821	0,169	0,131	0,038	14467	-7,10
F=Fmsy	2980	2298	682	0,138	0,107	0,031	14925	-4,16
F=0	0	0	0	0,000	0,000	0,000	17196	10,42
F=Fpa	2988	2304	683	0,139	0,107	0,031	14919	-4,20
F=Flim	3580	2761	819	0,168	0,130	0,038	14472	-7,07
SSB_2019 = Blim	4560	3516	1044	0,220	0,170	0,050	13736	-11,80
SSB_2019 = Bpa	662	511	151	0,029	0,023	0,007	16688	7,16
SSB_2019 = MSY_Btrigger	662	511	151	0,029	0,023	0,007	16688	7,16
F=F_2017	2684	2070	614	0,124	0,096	0,028	15149	-2,72

F=Fmsy_lower	2696	2079	617	0,124	0,096	0,028	15140	-2,78
F=Fmsy_upper	3822	2947	875	0,181	0,140	0,041	14290	-8,24

Resulting stock development over time is presented in Figure 2.3.2.

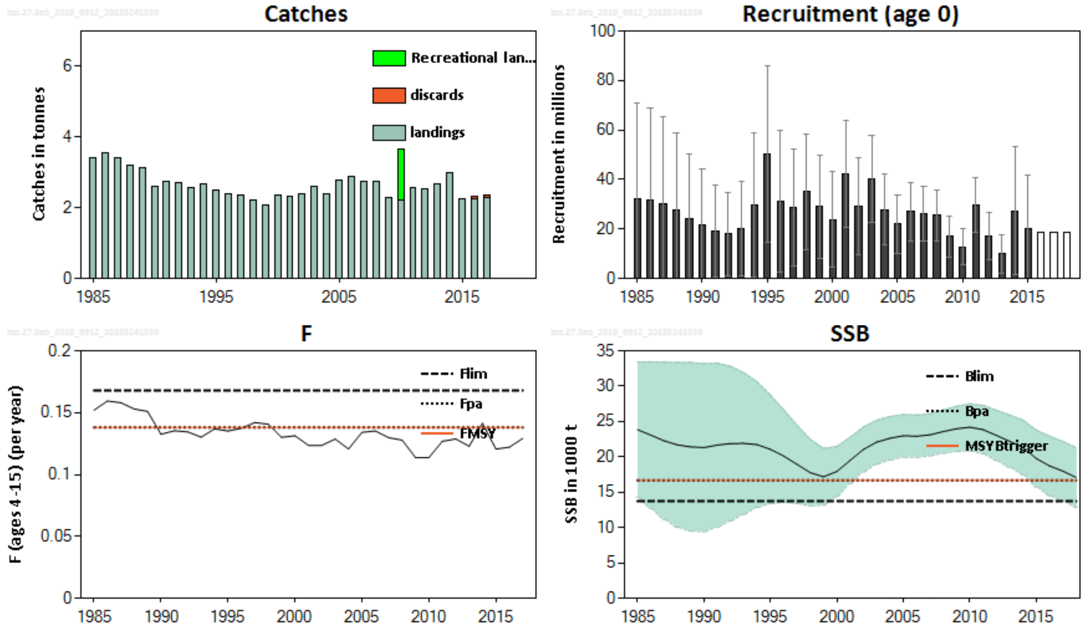

Figure 2.3.2 : stock development over time-type 6 stock

3 Conclusion

The definition of the biological reference points relies on the arbitrary choice of a Stock – Recruitment relationship type. For the Bay of Biscay seabass stock, the type 5 stock was chosen at the very end of the WKBASS 2018, but it was not discussed in a plenary and no discussion appears in the report.

The WGBIE disagreed with the WKBASS 2018 choice, and recommended the use of the type 6 for the Bay of Biscay stock. Indeed, the WGBIE concluded that the SR relationship meets the definition of type 6 category. Furthermore, the Fmsy obtained was around the fishing mortality observed in the historical series so there was no argument to think that it is not precautionary. Hence, the WGBIE concluded that using a type 6 SR relationship for the stock agrees with the PA framework. On further consideration, as stock assessors of the bss.8ab, we totally agree. The WGBIE conclusions still holds with the revised results of this working document: type 6 fits with the narrow dynamic of the Bay of Biscay seabass stock (Figure 3.1.1).

For illustration purpose, the stock – recruitment relationships of the Bay of Biscay seabass stock and the Northern seabass stock (both assessed at WKBASS 2018) have been displayed in Figure 3.1.1. Both relationships are very different. The Northern seabass stock was categorised as type 5 stock in the WKBASS 2018 report, while the Bay of Biscay seabass stock fits with a type 6 stock.

It is worse noting that the biological reference points run under type 6 choice for the WGBIE 2018 were revised for this working document. The mean recruitment above the breaking point is now the same whatever the choice of the type.

All R scripts and data used to produce this working document are available on the SharePoint of the WGBIE 2018 under the section "data/bss.8ab".

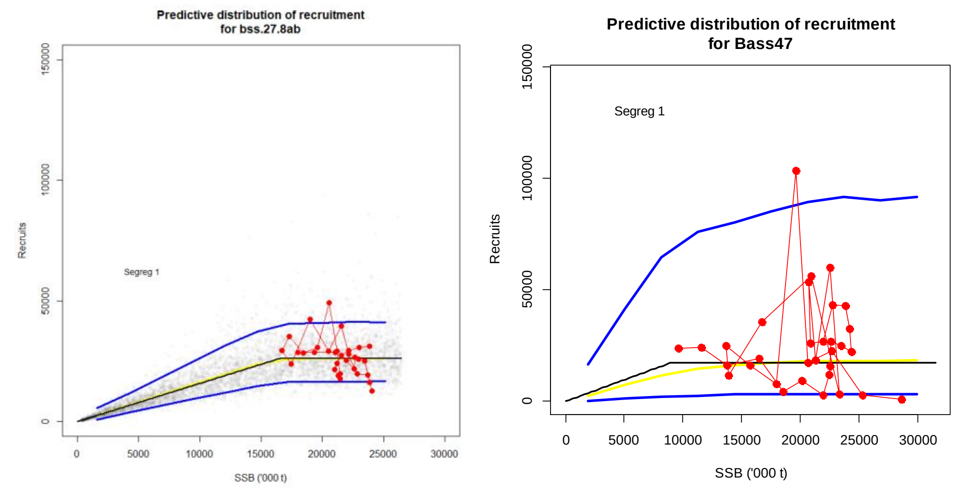

Figure 3.1.1. Stock recruitment relationship for the Bay of Biscay seabass stock (left) and for the Northern Seabass stock (right) (also assessed during WKBASS 2018).

15 European seabass (*Dicentrarchus labrax*) in Division 8c, 9a

15.1 ICES advice applicable

"ICES advises that when the precautionary approach is applied, commercial catches in each of the years 2018 and 2019 should be no more than 478 tonnes. 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

Sea 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. 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 areas that could form management units for this stock (ICES, 2012).

The stock identity was assumed to be: Northern (ICES areas 4.b-c, 7.a,d-h); Southern Ireland and Western Scotland (ICES areas 6.a, 7.b and 7.j); Biscay (ICES areas 8.a-b); Portugal & Northern Spain (ICES areas 8.c & 9.a) (Figure 1). Since then, stock identity has not changed (ICES, 2017), but research on population structure are under progress.

Two large tagging programmes are underway that will provide significant information on the movements of sea bass in the end of 2017, 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 at 10 locations in the Channel and Bay of Biscay. So far, 414 tags have been returned (January 2018) and the movements of individual fish are being reconstructed. Cefas and Ifremer are working together to compare geolocation algorithms. Behavioural and genetic studies of sea bass 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. Genetic studies have also been reported by Museum d'Histoire Naturelle (France) in the Gen Stock project ended in May 2018.

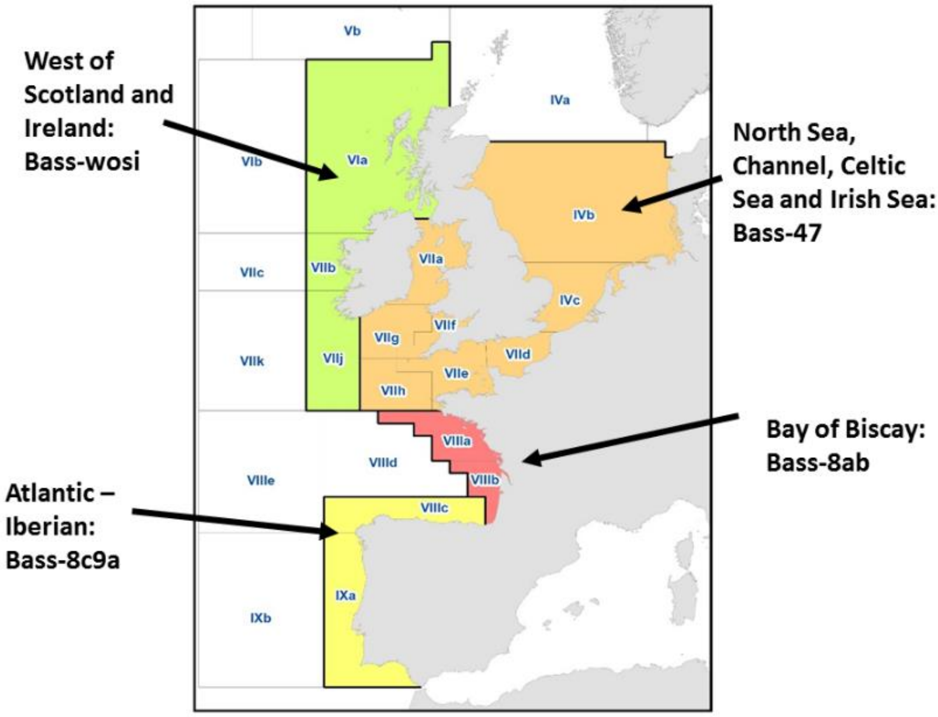

Figure 1. Main spawning and nursery areas. Spawning areas sloping downwards from left to right; Nursery areas sloping downwards from right to left. (from Casey and Pereiro, 1995)

A further study has been done using stable isotope 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 have been provided for the benchmark workshop for sea bass WKBASS led in February 2018.

15.2.2 Management applicable to 2017

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 2018

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 952 tonnes in 2017. 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 2016, in 2017, in the all area, Portuguese and Spanish landings stable (respectively 598 tonnes and 354 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 (171 tonnes and 183 tonnes). Landings per country are given in Figure 15-1, 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.

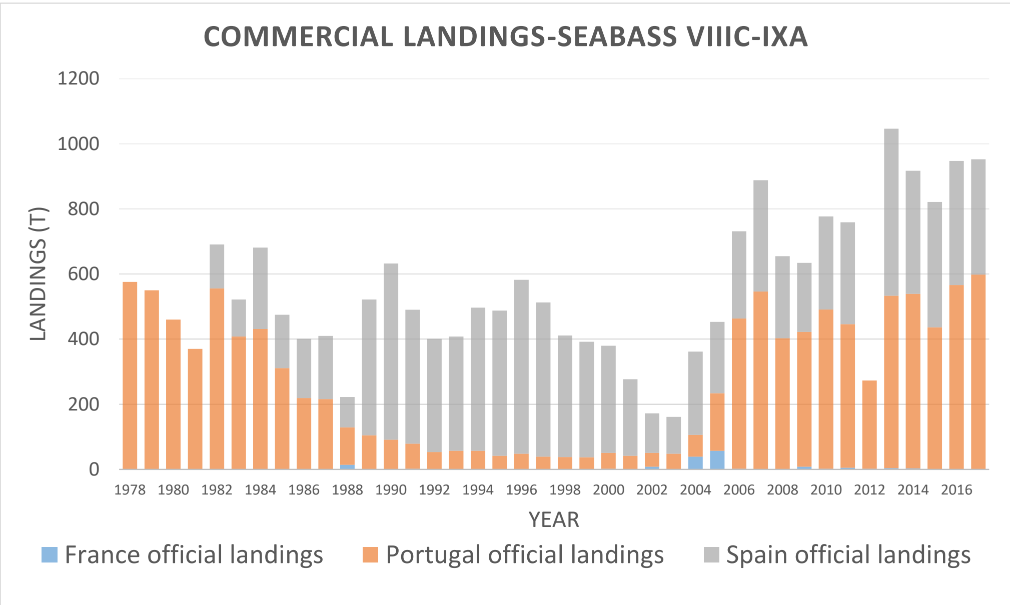

Figure 15-1: commercial landings per country in area 27.7.9a and 27.7.8c (source: intercatch)

15.3.2 Commercial length composition data

Quarterly length composition are available in the 9.a area (source intercatch) for Portuguese fleet (MIS_MIS_0_0_0) in 2016 and 2017 and presented yearly in Figure 15-2 and for Spanish fleet in 2017 (only LLS_DEF_0_0_0) presented in Figure 15-3.

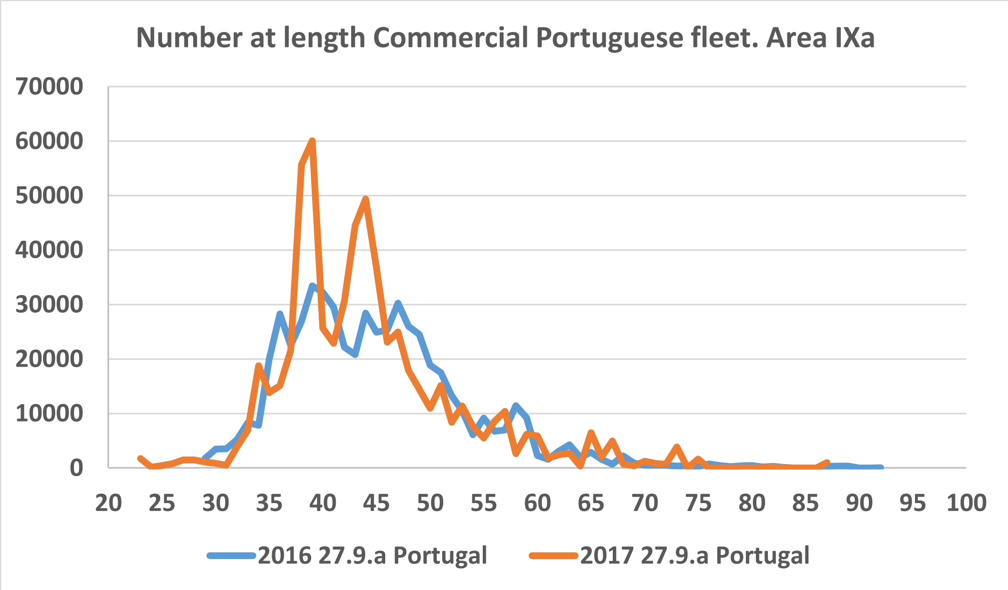

Figure 15-2 : commercial length composition in 2016 and 2017 for Portuguese fleet landings (source: intercatch)

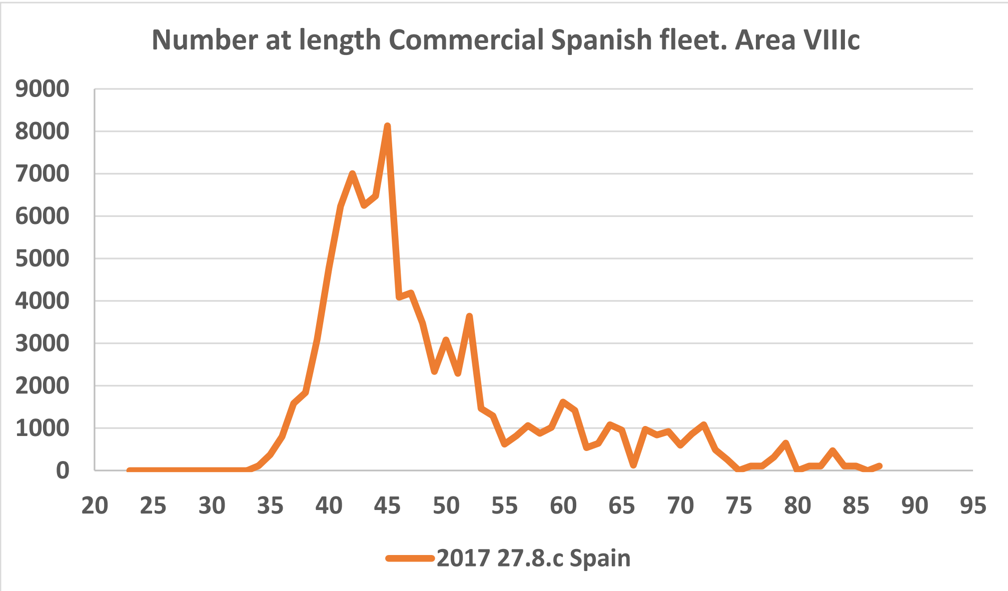

Figure 15-3: commercial length composition in 2017 for Spanish fleet landings (source: intercatch)

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 15-4)

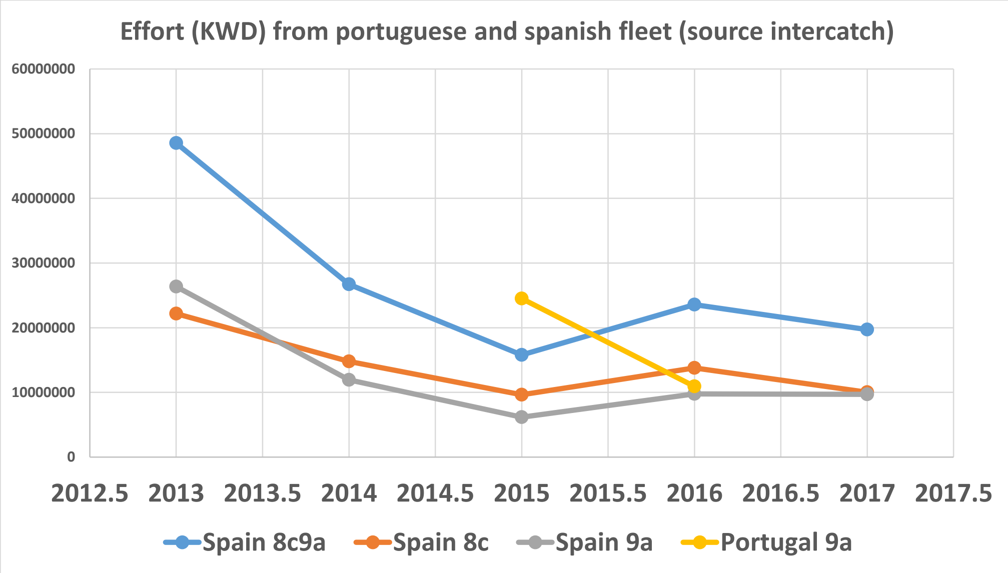

Figure 15-4: Effort (KWD) for Spanish and Portuguese fleet in 8c 9a area (source: intercatch)

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 analysed. It was concluded that post surveys assured a full coverage of the target population, but showed very low response rates. Telephone surveys presented the highest response rates, but lower coverage of the target population. E-mail surveys had a low coverage and a low response rate, but it was the cheapest method, and allowed the largest sample size. All surveys methods were affected by recall bias. Recommendations are made about how to improve the surveys (increasing coverage, reducing non-response, and recall bias) to set up a routine cost-effective monitoring program for Basque recreational fisheries. Results show that estimated sea bass recreational catches are comparable to commercial catches, which emphasize the relevance of sampling recreational fishing on a routine basis and including this information into the stock assessment and management processes.

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. (Source: AZTIs estimation under Data Collection Framework). Further details can be found in WGRFS 2017 report.

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.

Advice for 2018 and 2019: 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 478 tonnes in each of the years 2018 and 2019.

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=478 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 2018 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 analysed 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.

15.7 References

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15.8 Tables

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
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

COUNTRY	FRANCE OFFICIAL LANDINGS	PORTUGAL OFFICIAL LANDINGS	SPAIN OFFICIAL LANDINGS	TOTAL OFFICIAL LANDINGS	TOTAL ICES ESTIMATES***
2015	0	436	385	821	821
2016	1	565	381	947	947
2017		598	354	952	952

*** 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	landings 2017
Portugal	total IXa	565	598
	MIS_MIS_0_0_0	565	598
	total VIIIc	0	0
	Total Portugal	565	598
Spain	total IXa	165	171
	GNS_DEF_60-79_0_0	8	8
	GNS_DEF_80-99_0_0	0	0
	GTR_DEF_60-79_0_0	50	45
	LHM_DEF_0_0_0	3	3
	LLS_DEF_0_0_0	86	85
	MIS_MIS_0_0_0_HC	12	3
	OTB_DEF_>=55_0_0	0	0
	OTB_MCD_>=55_0_0	0	0
	PS_SPF_0_0_0	6	25.03
	total VIIIc	215	183
	FPO_CRU_0_0_0_all	0	
	GNS_DEF_>=100_0_0	0	0
	GNS_DEF_60-79_0_0	7	11
	GNS_DEF_80-99_0_0	3	1
	GTR_DEF_60-79_0_0	38	26
	LHM_DEF_0_0_0	2	0
	LLS_DEF_0_0_0	139	130
	MIS_MIS_0_0_0	0	3
	MIS_MIS_0_0_0_HC	3	
	OTB_DEF_>=55_0_0	0	0.29
	OTB_MPD_>=55_0_0	1	0.25
	PS_SPF_0_0_0	21	12.81
	PTB_MPD_>=55_0_0	0	

16 Plaice (*Pleuronectes platessa*) in Subarea 8 and Division 9.a

Plaice (*Pleuronectes platessa*) are caught as a bycatch by various fleets and gear types covering small-scale artisanal and trawl fisheries. Portugal and France are the main participants in this fishery with Spain playing a minor role. Present fishery statistics are considered to be preliminary as there are concerns about the reliability of the French data from 2008–09. 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, 2016 and 2017 catches, which were in the order of 11%, 2% and 5% of the French catches in these years. 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 8 and Division 9.a: official landings by country in tonnes

Year	Belgium	France	Portugal	Spain	Total
1994		365	33	1	399
1995		319		12	331
1996		248		14	262
1997		255		3	258
1998		219		6	225
1999	1			3	4
2000	15	193		22	230
2001		201		22	223
2002	1	167		11	179
2003	1	217	1	4	223
2004		229	163	7	399
2005	4	186	1	33	224
2006	2	248	1	4	253
2007	5	214	41	4	264
2008	2	98	89	4	193
2009	2	134	101	9	246
2010	1	200	112	12	325
2011	2	208	64	8	282
2012	3	183	62	3	251
2013	0	147	44	5	196
2014	1	164	51	6	220
2015	2	141	45	5	193
2016	1	121	47	4	173
2017*	1	98	33	2	134

Table 16.2: Plaice in Subarea 8 and Division 9a: Catches submitted to intercatch (tonnes).

Catch category	Country	Gear	2014	2015	2016	2017
Discards	France	Nets	-	10	3	4
		Other	-	2	0	0
		Trawl	-	4	0	1
	Spain	Nets	0	-	-	-
		Trawl	0	-	-	-
	Portugal	Trawl		0*	0*	0*
Discards Total			0	15	3	5
Landings	Belgium	Other	1	2	1	1
	France	Nets	42	46	48	42
		Other	38	21	12	24
		Trawl	82	74	62	33
	Portugal	Other	47	44	47	33
	Spain	Nets	4	3	3	1
		Other	1	1	1	0
		Trawl	1	1	1	1
Landings Total			217	193	174	135
Catch Total			217	208	177	140
Official Landings			220	193	173	134

*** Not in IC, submitted to AC**

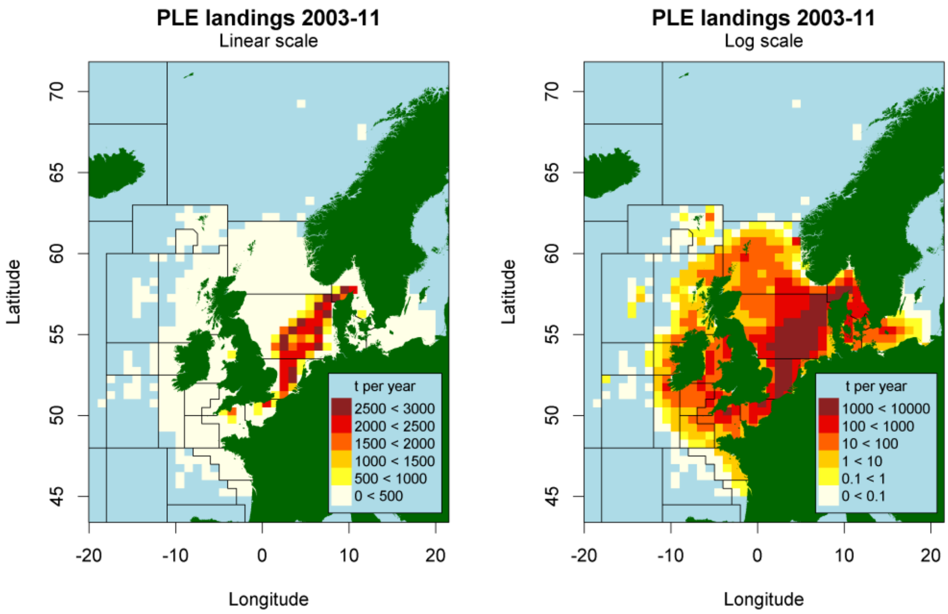

Figure 16.1: International landings of Plaice by statistical rectangle from 2003–2011

17 Pollack (*Pollachius pollachius*) 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 10 years, France was responsible for 75% 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 metier from 2000 to 2014 is available from ROMELIGO project (WD 05, ICES, 2018). Data from this Project could be used to complete the official information available for this stock and will be requested from the responsible of the project. Recreational catches may be considerable and have not been quantified.

Discard estimates are available for the last 3 years for the main fleets (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 between the 3% and 11% of their catches in 2017and 2016 respectively; those represented the 1% and 5% of the commercial catches of the stock. ROMELIGO project could provide a time series of discard values for this stock.

In 2015 ICES advised that commercial landings should be no more than 1414 tonnes in each of the years 2016 and 2017. In 2017 ICES advised that commercial landings should be no more than 1131 tonnes in each of the years 2018 and 2019.

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 (2017 preliminary). The ICES estimate is based on a correction of mixed species (whiting and pollack) landings records in the Portuguese landings from 9a. Shaded values come from ICES/FAO historical data base.

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	n/a	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
2017*	0	128	1219	0	95	38	1480	1	1481

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. Shaded values come from ICES/FAO historical data base.

	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
2017	596	100	486	37	123	91	9	38	0	0	1480

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
2017	18.6	0	0	0	0	0

18 Whiting (*Merlangius merlangus*) in Subarea 8 and Division 9.a

Whiting (*Merlangius merlangus*) are caught in mixed demersal fisheries primarily by France and Spain (Table 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 18.1. Note that the official corrected figures for 2015 were not available for the WG. Therefore the group will apply these percentage splits to the official landings from 2004. The 2015 values will be updated with the new official landings in time for the 2017 EWG.

Whiting has never been recorded in Spanish discards and is negligible in Portuguese discards. However there are indications that there is considerable discarding by the French fleet. The discards reported by France are 33% for 2015 and 25% for 2016 and 2017 total French catch weight (Table 18.2).

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 18.1 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 18.2; Very High Vertical Opening gear, VHVO). Traditionally, this fleet obtains the most important whiting Basque catches and its fishing effort can be quantified with accuracy along all the period. However it has to be noted that the whiting is not the main target for this 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 18.1: Whiting in Subarea 8 and Division 9a: official landings in tonnes. The ICES estimate is based on a correction of mixed species (whiting and pollack) landings records in the Portuguese landings from 9a.

YEAR	BELGIUM	FRANCE	PORTUGAL	SPAIN	TOTAL	UNALLOC	ICES EST
1994		3496	15	136	3647	0	3647
1995		2645	2	1	2648	0	2648
1996		1544	4	13	1561	0	1561
1997		1895	3	47	1945	0	1945
1998		1750	3	105	1858	0	1858
1999			1	211	212	0	212
2000	2	1106	2	338	1448	0	1448
2001	3	1989	1	288	2281	0	2281
2002	3	1970	1	230	2204	0	2204
2003	1	2275	4	171	2451	0	2451
2004		1965	77	249	2291	-70	2221
2005	3	1662	2	416	2083	-2	2081
2006	2	1420	7	433	1862	-6	1856
2007	4	1617	107	296	2024	-104	1920
2008	1	772	98	187	1058	-93	965
2009	2	1303	114	54	1473	-111	1362
2010	3	2234	114	101	2452	-110	2342
2011	1	2029	105	108	2243	-102	2141
2012	3	1791	90	110	1994	-87	1907
2013	1	1943	95	55	2094	-93	2001
2014	1	1579	65	55	1700	-49	1651
2015	2	2138	38	56	2234	-35	2199
2016	1	2441	20	40	2502	23	2525
2017*	0	1871	18	20	1909	16	1925

*** Preliminary**

Table 18.2 Whiting in Subarea 8 and Division 9a: landings submitted to intercatch (tonnes).

CATCH CAT	COUNTRY	GEAR	2014	2015	2016	2017
Landings	France	Lines	0*	539	807	675
		Nets	113*	234	419	282
		Other	561*	412	491	182
		Trawl	465*	955	736	748
	Portugal	Other	0	31**	0	16
		Trawl	0	2**	0	1
	Spain	Other	1	0	1	0
		Traw;	53	55	71	20
	Other	Other	1	2	1	0
	Total	land	1194	2231**	2525	1925
ICES best estimate of the landings			1651	2199	2525	1925
Discards	France	Lines	-	10	8	1
		Nets	-	141	282	221
		Other	-	313	294	310
		Trawl	-	597	245	86
	Total	dis	-	1060	828	618

*** probably incomplete (total France official landings: 1579)**

**** no correction for whiting/pollack species misidentification**

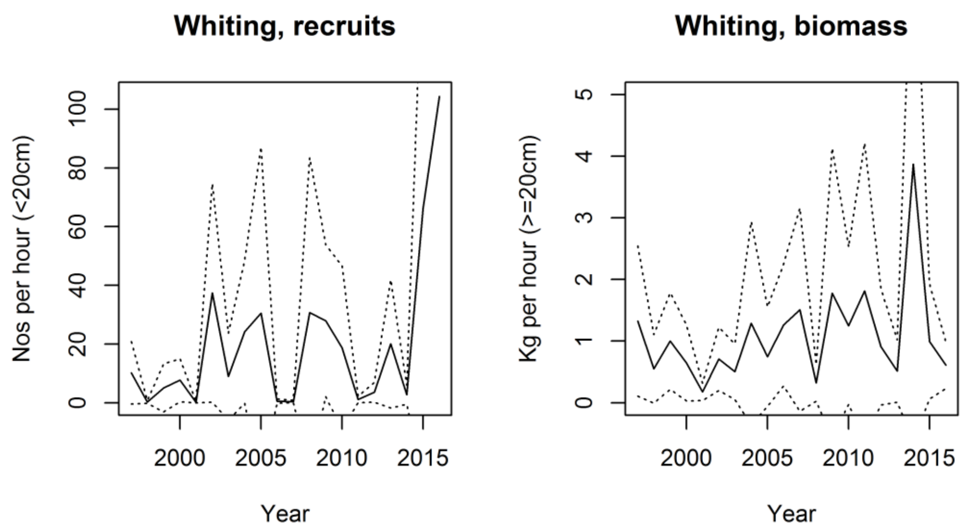

Figure 18.1. EVHOE-WIBTS-Q4 survey indices of recruitment (left) and biomass (right).

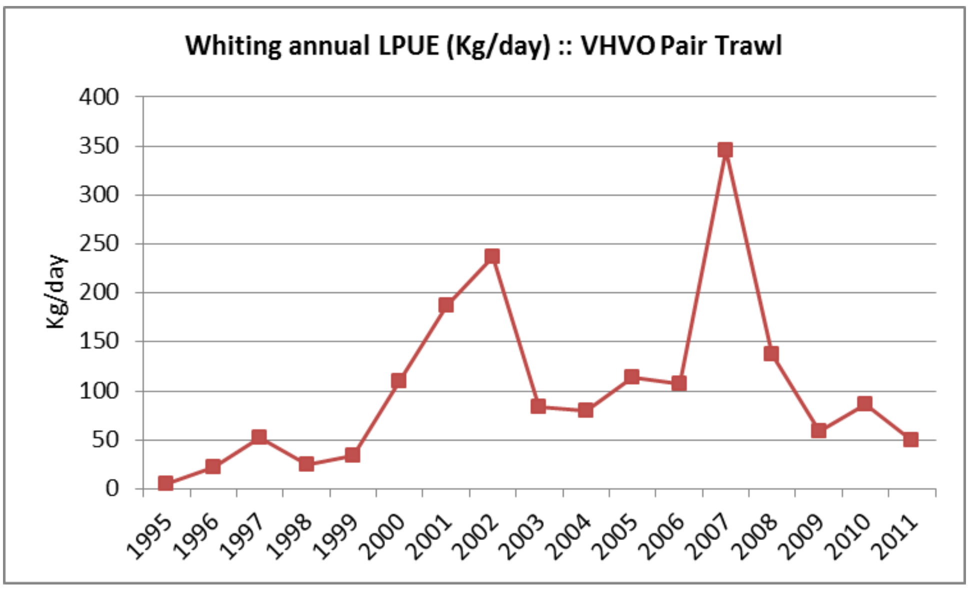

Figure 18.2. Whiting landings per unit effort (LPUEs in kg/day), by year, for basque pair bottom trawl fleet fishing in Divisions 8.a,b,d, in the period 1995–2011.

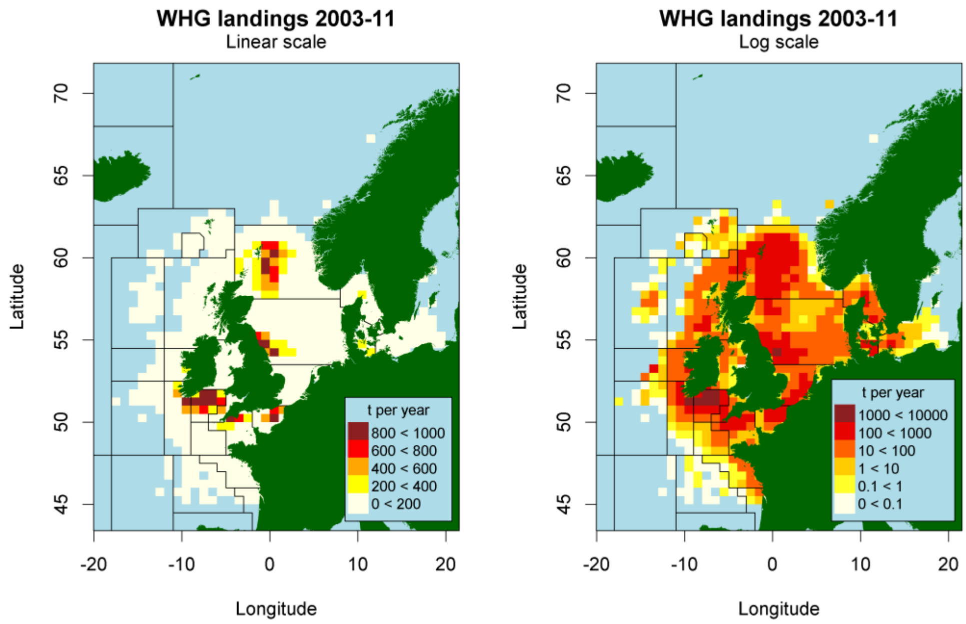

Figure 18.3: International landings of Whiting by statistical rectangle from 2003–2011

Annex 1: List of participants

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

3 –10 May 2018

ICES HQ, Copenhagen, Denmark

MEMBER	DEPT/INSTITUTE	EMAIL	COUNTRY
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Annex 2: Recommendations

Recommendation	For follow up by:
The EWG noted reference point estimation is sensitive to strong retrospective bias in both the recent and historical part of a biomass and fishing mortality timeseries and recommends that this be reviewed with respect to the periodicity of updating reference points.	ICES Secretariat (WKMSYREF#)
The EWG note that new practices are used in the French nephrops fishery to reduce discard mortality and recommends that the results of survivability of such methods be reviewed for inclusion in future assessments. Coordination of survivability research its validity and how that feeds into advice.	ICES Secretariat
Recent research on the conversion of hake eggs to spawning biomass from the Spanish component of the trienial egg survey showed good correspondance with the assessment and the EWG would like the processing and reporting of hake eggs to be included in the ToRs of WGMEGS and the trienial mackerel and horse mackerel survey.	ICES Secretariat / WGMEGS
The project conducted by France (ROMELIGO) provided useful information for pollack and whiting and the EWG aggreed that the collection and disemination of such data to ICES should continue in the future to assist in the development of an assessment for these species.	ICES Secretariat / national labs
The expert group noted that some of the stocks have reference points which give catches that are considered outside the expected range to assess fully their impact on the stock. In the interim the EWG proposed that incremental changes to FMSY was more precautionary but recommends that reference points obtained from SPiCT and Harvest ratio calculation is further reviewed along with the methods, if appropriate, of implementing incremental changes.	ICES Secretariate (WKLife# / WKMSYREF#)
The EWG requests that working documents be submitted for review to the EWG no later than the data submision deadline and that working documents be provided if national labs submit revisions to survey data, catch data or have changed raising/sampling methodologies. This will provide the working group with the necessary background to compile a history and audit trail of these changes and make better informed choices.	ICES Secretariat / ACOM / national labs

Annex 3: Terms of Reference for 2019

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

2019/2/ACOMXX The **Working Group for the Bay of Biscay and Iberian waters Ecoregion** [WGBIE], chaired by TBC (), will meet in IPMA, Lisbon, Portugal (tbc), 2–9 May 2019 (tbc) to:

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

b) Review and evaluate the potential for assessing FU29 and FU30 as one stock;

c) Review and assess the progress on the benchmark preparation of hake 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 5 April 2019 (tbc) according to the Data Call 2019.

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
anb-8c9a	Southern black anglerfish (*Lophius budegassa*) in divisions 8.c, 9.a	May 2018	**anb-8c9a_SA**
ank.27.78abd	Black-bellied anglerfish (*Lophius budegassa*) in divisions 7.b–k, 8.a,b,d (west and southwest of Ireland, Bay of Biscay)	May 2018	**ank.27.78abd_SA**
bss.27.8ab	European sea bass (*Dicentrarchus labrax*) in Subarea 8.a,b,d (Bay of Biscay)	May 2018	**bss.27.8ab_SA**
bss-8c9aA	European sea bass (*Dicentrarchus labrax*) in Subarea 8.c, 9.a	May 2013	**bss-8c9a_SA**
gug-89a	Grey gurnard (*Eutrigla gurnardus*) in Subarea 8 and Division 9.a	May 2014	**gug-89a_SA**
hke-nrtn	Hake in Division 3.a, subareas 4, 6 and 7 and divisions 8.a,b,d, Northern Stock	May 2016	**hke-nrtn_SA**
hke-soth	Hake (*Merlucciusmerluccius*) in Divisions 8.c and 9.a, Southern stock	May 2017	**hke-soth_SA**
ldb.27.7b-k.8abd	Four spot megrim (*Lepidorhombus boscii*) in divisions 7.b-k and 8.a,b,d	May 2017	**ldb.27.7b-k.8abd_SA**
ldb.27.8c9a	Four spot megrim (*Lepidorhombus boscii*), divisions 8.c, 9.a	May 2018	**lbd.27.8c9a_SA**
meg.27.7.b-k8.abd	Megrim (*Lepidorhombus whiffiagonis*) in divisions 7.b-k and 8.a,b,d	May 2018	**meg.27.7b-k8abd_SA**
meg.27.8c9a	Megrim (*Lepidorhombus whiffiagonis*) in divisions 8.c and 9.a	May 2018	meg.27.8c9a_SA
mon.27.78abd	White anglerfish (*Lophius piscatorius*) in divisions 7.b–k, 8.a–b, and 8.d	May 2018	mon.27.78abd
mon.27.8c9a	White anglerfish (*Lophius piscatorius*) in divisions 8.c, 9.a	May 2018	**mon.27.8c9a_SA**
nep-2324	Nephrops in Division 8.a,b, FU 23–24-	October 2016	nep-2324_SA
nep-25	Nephrops Division 8.c, FU 25 (North Galicia)	May 2016	nep-25_SA
nep-2627	Nephrops Division 9.a, FUs 26–27 (West Galician and North Portugal)	May 2016	nep-2627_SA
nep-2829	Nephrops in Division 9.a, FU 28–29 (Southwest and South Portugal)	May 2016	nep-2829_SA
nep-30	Nephrops in Division 9.a, FU 30 (Gulf of Cadiz)	October 2016	nep-30_SA
nep-31	Nephrops in Division 8.c, FU 31 (Cantabrian Sea)	May 2016	nep-31_SA

Stock ID	Stock name	Last updated	Link
ple-89a	Plaice (*Pleuronectes platessa*) in Subarea 8 and Division 9.a (Bay of Biscay and Atlantic Iberian waters)	May 2016	ple-89a_SA
pol-27.89a	Pollack (*Pollachius pollachius*) in Subarea 8 and Division 9a (Bay of Biscay and Atlantic Iberian waters)	May 2017	pol-27.89a_SA
sol.27.8ab	Sole (*Solea solea)* in Division 8.a,b (northern and cen-tral Bay of Biscay)	May 2016	sol.27.8ab
sol-8c9a	Sole (*Solea spp*.) in divisions 8.c and 9.a (Cantabrian Sea and Atlantic Iberian waters)	May 2016	sol-8c9a_SA
whg-89a	Whiting (*Merlangius merlangus*) in Subarea 8 and Division 9.a (Bay of Biscay and Atlantic Iberian waters)	May 2016	whg-89a_SA

Annex 5: Benchmark planning

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	Stock identity working group
CPUEs	Little information on abundance of large fish. Only one CPUE available	Incorporation of CPUE from commercial fleets catching adults Explore potential use of egg survey data for estimating biomass.	Catch and Effort data of available fleets. Ask national DB (Sp and Pt)	Experts on standardize LPUE Paula Alvarez (AZTI)

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
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. Predation by cetaceans too Growth Annual length-weight	Explore life history methods to support new parameters figures (Linf, k, M, etc) Multispecies model combined with life history	Explore literature about life history in other hakes. Tagging data (France) Some progress made and can be explored. Hake and anglerfish (EASME micorchemistry EU programme, AHA project) France/Ireland/Spain/Norway which includes microchemistry will conclude in 3 years.	
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 Consistent database from Spain so some progress made. From Portugal this has not progressed as far.	Biology/reproduction experts (Maria Sainza, Ana Costa, Rosario Dominguez)
Retro bias issue	Sensitivity of assessment to explore reason for the bias retrospective pattern in SSB and F	Explore sensitivity, identify sensible parameters and check changes in likelihoods	No data needed	

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 Unravelling the dynamics of a multi-gear fleet – Inputs for fisheries assessment and management under the Common Fisheries Policy

Teresa Moura, António Fernandes, Ricardo Alpoim, Manuela Azevedo

Effective species management requires good knowledge on vessel dynamics, either at a stock basis or through the establishment of multiannual management plans as advisable under the new European Common Fisheries Policy (CFP). Achieving such knowledge on Portuguese multi-gear fisheries is challenging given the large number of species caught and the different management measures applied to potential target species. The latter ranges from no input or output controls to output controls based on individual vessel quotas (IVQ). To provide accurate regional knowledge to the CFP, the dynamics of vessels involved in the trammel net fishery targeting anglerfish *(Lophius* spp.) was characterised based on on-board sampling data and logbook reports. The selected vessels were very dynamic, and were found to target other species such as hake (*Merluccius merluccius),* John Dory (Zeus faber) and octopus (Octopus vulgaris). Anglerfish landing trends can be explained by changes in abundance, quota availability and shifts/changes in fishing effort. Overall, the dynamics of these vessels varied with area of exploitation, IVQ value and anglerfish total allowable catch (TAC). These results show the influence of different management systems in the dynamics of vessels and the advantage of an IVQ management system, where fishers can spatially and temporally allocate effort. Results also highlight a fishing effort shift towards unregulated species in face of IVQ or TAC restrictions. WD 02 Preliminary results from length frequency analysis of *Lophiuspiscatorius*in divisions 7.b-k, 8.a-b and 8.d.

WD 02 Results on *Merluccius (*hake), *Lophius budegassa* (black anglerfish) and *Lophius piscatorius* (white anglerfish), *Lepidorhombus boscii* (four-spot megrim) and *Lepidorhombus whiffiagonis* (megrim) from the Spanish Ground Fish Survey on the Porcupine bank (NE Atlantic)

S. Ruiz-Pico, M. Blanco, O. Fernández-Zapico, F. Velasco & F. Baldó

This working document presents the results of *Merluccius* (hake), *Lophius budegassa* (black anglerfish), *Lophius piscatorius* (white anglerfish), *Lepidorhombus boscii* (four-spot megrim) and *Lepidorhombus whiffiagonis* (megrim) caught on the Porcupine Spanish Groundfish Survey (SP-PORC-Q3) in 2017. Biomass, abundance, distribution and length frequency were analysed. Biomass indices of these target species remained similar in 2017 than the previous year. A remarkable abundance of specimens of M. merluccius from 18 to 30 cm were found.

WD 03 Results of most relevant commercial species captured in the bottom trawl surveys on the Northern Spanish Shelf.

M. Blanco, O. Fernández-Zapico, S. Ruiz-Pico, A. Punzón, I. Preciado, F. Velasco

This working document presents the results of the most relevant commercial species captured in the Spanish Groundfish Survey on Northern Spanish shelf in 2017. Biomass, distribution and length distributions are analysed for European hake (Merluccius merluccius), four-spot megrim (*Lepidorhombus boscii*), megrim (*Lepidorhombus whiffiagonis*), black anglerfish (*Lophius budegassa*), white anglerfish (*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 important abundance and poor recruitment, though there is a small signal of recruitment around Cape Peñas. Northern megrim presented the highest abundance in all the time series maintaining a 3 year trend but the recruitment decreased. Both species of angler showed poor abundances, reaching very low values within the historical series, especially L. *piscatorius*. Recruitment of both species was absent in the entire shelf surveyed. Norway lobster keeps on being at very low values in all the Cantabrian and Galician shelves, even lower than the previous year. Moreover, larger sizes have been reduced. Results of some very scarce species assessed within the WGBIE are also presented, namely sole, seabass, whiting and pollack.

WD 04 Is hake egg production a good proxy of SSB for Hake?

P. Álvarez and D. Garcia

The Triennial Mackerel and Horse mackerel egg surveys collect plankton samples covering the Northeast Atlantic waters from Portugal to Northern Scotland and from January to July. The purpose of this program is to estimate the biomass of mackerel and horse mackerel populations using the ichthyoplankton method. In the area of the Bay of Biscay, AZTI -since 1995- identifies also hake eggs within their routine plankton analysis process. The aim of this working document is to research the utility of ichthyoplankton indices as a complementary information to detect hake biomass variability. This Working Document presents the results of Stage I eggs abundance transformed into egg production from 1995 to 2016 in March and April which is considered the peak of spawning of hake in this area.

The agreement between the historical biomass trend estimated by the assessment model of this stock and the egg indices estimated here is fairly good. Therefore, the ichthyoplankton method can be considered a good tool to detect hake biomass variability and could be use in the assessment model as an abundance indices. The egg index confirms the high increase in the SSB of Hake in the last 10 years.

WD 05 ROMELIGO : Improvement of the fishery knowledge of striped red mullet,whiting and pollack of the Bay of Biscay (Pollack)

Jean-Pierre Léauté, Nathalie Caill-Milly, Muriel Lissardy

Whiting (*Merlangius merlangus*), stripped red mullet (*mullus surmuletus*) 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 surveys, 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, Nathalie Caill-Milly, Muriel Lissardy

Whiting (*Merlangius merlangus*), stripped red mullet (*mullus surmuletus*) 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 surveys, etc.) or data to be collected (biological parameters).

WD 07 Maturity parameters of the megrim (*Lepidorhombus whiffiagonis*) and the four spot megrim (*L. boscii*) stocks in Atlantic Iberian waters (Div. 8.c-9.a) and in Celtic Seas and northern Bay of Biscay (Div. 7.b-k, 8.abd)

Domínguez-Petit, R., Landa, J., Fernández, J.C., Gutierrez, P., Abad, E., García, B. & Santos, M.B.

Iberian waters (ICES Div. 8.c-9.a) and Celtic Seas and northern Bay of Biscay (ICES Div. 7.b-k,8.abd) currently used in the stock assessment are based on macroscopic observations and were estimated in 1998. This study presents updated maturity ogives and parameters by length and age in Div. 8.c-9.a2 (Galician waters and Cantabrian Sea), and in Div. 7.b-k, 8.abd (Celtic Sea, West and South of Ireland) by specie and sex and for both sexes combined based on a more robust microscopic methodology A total of 620 individuals were sampled, 254 in 8.c-9.a2 and 366 in 7.b-k, in 2017 on board the commercial vessels and research surveys. *L. whiffiagonis* in 8.c-9.a2 showed a L50 for both sexes combined of 17.5 cm and anA50 of 2 years, while in 7.b-k, 8.abd were 20.5 cm and 2.8 years, respectively. On the other hand, L. boscii in 8.c-9.a2 showed a L50 and an A50 for both sexes combined of 13.8 cm and 1.9 years, respectively, while in 7.b-k, 8.abd were 16.4 cm and 2.3 years respectively. Maturity parameters for L. boscii in 7.b-k, 8.abd are presented for the first time. Results showed that maturity is reached at slightly larger lengths and older ages in the northernmost stock (7.b-k, 8.abd) in both species than in the southernmost stock (8.c, 9.a). Besides, males of both species mature at significantly smaller lengths and younger ages than females. The L50 and A50 values obtained in the present study were comparable to those from previous study based on microscopic methodology and covering a similar fish length range.

WD 08 Definition of trawl metiers operating in ICES Div. 8abd: Length structure of hake landings and discards of Spanish otter and pair bottom trawlers (2015-17)

Mikel Basterretxea, Marina Santurtún, Luis Arregi

In this working document, a detailed updated definition of the métiers is provided from 2015 to 2017. The description of the Management Units includes:

1) Characteristics of the fishery and its activity

2) Catches and discards estimates

3) Length structure from 2015 to 2017

4) Reasons for discarding

5) Other relevant information

A reference period of 3 years (2015-2016-2017) is used to show the variability in catches. When no 2017 data is available, this is the case of some discards and landing estimates of some otter trawl metiers, the closest year with data available is used (i.e. 2016). Landings were obtained from the official 2017 data call to deliver to ICES assessment groups. Discards were obtained from estimates calculated by AZTI following the methodologies agreed in ICES.

Along 2017, 85% of the trips deployed by the otter trawls in the Bay of Biscay practiced OTB_DEF>70 targeting demersal species. Otter trawler trips targeting a mixed pelagic and demersal fish accounts for 7% of the total number of trips of the otter trawl fleet in the Bay of Biscay. Just 4% of the total number of trips were deployed by vessels prosecuting a mixed fishery on cephalopods and demersal species (OTB_MCF) and small pelagic fish (OTB_SPF).

WD 09 Definition of trawl metiers operating in ICES Div. 8abd: Length structure of hake landings and discards of Spanish otter and pair bottom trawlers (2013-15) and (2015-2017)

Mikel Basterretxea, Marina Santurtún, Luis Arregi

WD 10 Abundance indices data collection for Nephrops FU 25 (North Galicia) in 2017 and 2018

Vila, Y., Sampedro, P. , Fariña, C. and González-Herráiz, I.

Last assessment for *Nephrops* FU 25 (Division 8c) in 2016 indicated an extremely low abundance level and a zero TAC was established for 2017, 2018 and 2019. Get new fishery data and commercial abundance indices is impossible with the closed FU 25 *Nephrops* fishery. Moreover, there are not appropriate abundance indices from scientific survey. Therefore, any new approach of analysis and assessment of the stock trends in the next few years cannot be achieved.

A scientific quota for *Nephrops* in FU 25 was authorized in 2017 and an observer's programme supervised by the Spanish Oceanographic Institute (IEO) was carried out in August and September in order to obtain a commercial abundance index. CARACAS survey covered the highest *Nephrops* density area within the FU 25. Two commercial vessels with a regulatory gear (70 mm mesh) were used for the survey. An observer was also on board during these fishing days. A total 14 trips (7 for each vessel) targeting *Nephrops* were undertaken during this survey, where 10 trips were two-days long and 4 trips were one-day long. In the total trips, and 79 hauls ranging to 180 and 530 m of depth were carried out.

In the whole of the survey, the retained *Nephrops* catch represents 15% in the total directed hauls. Discard rate was less than 0.1%, so the discard of this species is considered null. The total *Nephrops* catch obtained by the two vessels was 2 070 Kg, with an average yield of 86 Kg/fishing day. The overall catch trend for both vessels was declining during the survey, from early August to the end of September. Results are consistent with the seasonal cycle of *Nephrops* in the area, which is very pronounced between May and August, with an abundance peak in June or July *Nephrops.* CPUE in hauls directed to this specie for the whole period was 7.2 Kg/hour.

A total of 7 266 individuals were measured (4 112 females and 3 154 males). Females were higher in number, being the sex-ratio for the population 57.2% of females. Mean size was 39.8 mm and 41.7 mm for females and males, respectively.

Spain requested a sentinel fishery for *Nephrops* in Division 8c for 2018. An ICES Special Request Advice for a sentinel fishery in *Nephrops* FU 25 for 2018 was delivered in February 2018. ICES advices that, if an UWTV survey cannot be conducted, an observer's on-board programme with a fixed effort level and supervised by a scientific institute must be carried out.

WD 11 GULF OF CADIZ Nephrops Grounds (FU 30) ISUNEPCA 2017 UWTV Survey and catch options for 2018

Vila, Y., Burgos, C. , Soriano, M. , Farias, C. , Rueda, J.L, Gallardo-Núñez, M. and Mateo, A.

The Spanish Oceanographic Institute (IEO) carried out the fourth *Nephrops* UWTV survey on the Gulf of Cadiz fishing grounds in 2017, although UWTV survey in 2014 was considerate only exploratory. This survey was multidisciplinary in nature and the specific objectives were 1) To obtain estimates of *Nephrops* burrows densities; 2) To confirm the boundaries of the *Nephrops* area distribution; 3) To obtain estimates of macrobenthic species and the occurrence of trawl marks, 4) To collect oceanographic data using a sledge mounted CTD. This working document details the methodology and results of ISUNECPA UWTV survey in 2017 which were used in the last advice carried out in October 2017.

The *Nephrops* density ranged between 0 and 0.53 burrows/m^2 and the average burrow density was 0.13 burrows/m^2. The highest densities were observed in the west part of the area. The visibility at depths lower than 200 m was poor generating a high uncertainty in the *Nephrops* burrows identification. The information obtained from the beam trawl activity indicated absence of *Nephrops* in hauls carried out at this depth. So, stations located at the edge of the surveyed area were considered as stations with zero *Nephrops* density in the geostatistic analysis.

Other burrowing species detected in the beam trawl hauls that co-occur with *Nephrops* were mainly *Munida* sp., *Goneplax rhomboides*, *Monodaeus couchii* and *Macropipus tuberculatus*, being the squat lobster burrows the ones that created the highest confusion in the identification and quantification of *Nephrops* burrows.

The number of stations used in the geostatistic analysis was higher than the previous years. The abundance estimate derived from the krigged burrow surface (and adjusted for the cumulative bias) was 371 million burrows with a CV of 8.7% in 2017. The stock abundance is estimated to have increased more than 50% in 2017. The spatial pattern of burrow density is consistent in last two years.

ISUNEPCA UWTV surveys is an excellent platform for obtain information on the benthic habitats and the monitoring of benthic macro fauna of the sedimentary areas in the circa littoral zone deep, on the impact of fishing activity on the bottom, as well as information of environmental variables. These results are being exploited yet and only preliminary results are present in this WD. This information could be useful in the monitoring programs within the Marine Strategy Framework Directive.

WD 12 Estimation of quarterly length distribution of landings in the context of a 6-months disruption in the French on-shore sampling. Working Document to ICES/WGBIE 2018

Thibaud Quemar, Joel Vigneau, Laurent Dubroca

At the end of 2016, the French on-shore sampling program was discontinued, due to a planned shift in its implementation, and a move towards a subcontracted program as is the French at-sea sampling. The fisheries institute Ifremer and the French authority prepared the move well in advance, but a final delay in the call for tenders disrupted the on-shore sampling for 6 months. The situation as from the 1st of July 2017 is now that the French on-shore and at-sea programs are part of the same call for tenders, run by the French authority and prepared together with Ifremer, where Ifremer develops the sampling plans and associated tools, validates and stores the data in its database and realises the estimation and provision of the data to end users. The action of sampling on the ground is now entirely conducted by subcontractors. In order to mitigate the consequences of the disruption for assessment working group, two processes were initiated. At first, an urgent resumption of the on-shore program by Ifremer staff was planned for the second quarter with a minimal sampling allocation and designed to collect information for those stocks most reliant on the on-shore sampling. Eventually, the situation for 2017 is a lack of on-shore sampling in the French continental harbours in the first quarter, about 30% of the plan for quarter 2 and a fully-fledged program in quarters 3 and 4 as part of the new program. The second phase of the mitigation was a study to investigate the potential use of the size grading of the fish in the French auctions. Given that the at-sea program provides annually about 300000 individual measurements in the retained fraction, and that the vast majority of the fish sold in auction are size graded, the idea was to investigate (1) the reliance of the length frequency distribution on the on-shore program and (2) the possibility to borrow former samples for a given stock if a stability of the length frequency of each of its size grades is proven. It is to be recalled that France always makes use of the two sources of length sampling for the landings, viz. at-sea retained fraction and on-shore, for the preparation of data for assessment working groups, thus the 2017 disruption of the on-shore will often result in a lowering of the number of samples with different orders of magnitude depending on the stocks. This study will further form the basis of a renewed approach in France for deriving length distribution of the stocks based on a better complementary of the at-sea and on-shore sampling and the use of auctions size grades. The working document is specially designed for the stock assessors of ICES assessment working groups, and contains the description of the methods used supported by a detailed case study. In annex, a synthesis is given for all stocks which have received some compensation for missing information. It is then up to each stock assessor to ponder the importance and relevance of the proposed compensation and make the choice to go for this estimation or borrow a length/age frequency from another source in Intercatch.

WD 13 Reference points for black anglerfish in areas 27.78abd.

Hans Gerritsen.

This document follows the ICES Technical Guidelines for setting reference points for stocks in category 3 and 4 (2018; https://doi.org/10.17895/ices.pub.3977). Black anglerfish were benchmarked at WKAnglerfish in 2018 but no new assessment method or reference points could be agreed.

WD 14 Maturity-at-age estimates for Irish Demersal Stocks in 6.a, 7.a and 7.bgj between 2004–2017.

Dara-Jane Moore and Hans Gerritsen.

This document provides maturity-at-age estimates for stocks assessed by the WGCSE and WGBIE. All data are obtained on surveys and commercial sampling carried out by the Marine Institute.

Annex 7: French Simulated data

WGBIE were made aware of an issue with the sampling level in Q1 and Q2 of 2017 from France (WD12). Because of the lack of market sampling for length (biological and onoard sampling was unaffected), efforts were made to try and fill the deficiency in the number of samples by use of simulation techniques. Both simulated data and actual data were uploaded to InterCatch combined making it impossible to distinguish true samples from simulated ones. Due to the timing in notifying the working group it was not possible to assess the impact of such simulated data on the assessment and the group recommended that sensitivities with and without the simulated data are carried out.

The simulation was based on commercial landings market categories.

Annex 8: Summary of ACOM WCBBI minutes on ank.27.8c9a assessment and advice

The ACOM Web Conference on the advice for the Bay of Biscay and Iberian Waters (WCBBI) met on Monday 25 June 2018. They reviewed the assessments and advice for all stocks in this area to be published on 29 June 2018. At this web conference, ACOM decided to reject the recently benchmarked category 1 assessment of ank.27.8c9a based on the proposal to use the lower 95%CI of F_{MSY} rather than the F_{MSY} point estimate as the fishing pressure reference point, and consequently, what implications this has for our confidence in the assessment itself. The WGBIE, WKAngler 2018, and ADGBBI were consulted on this decision via the Secretariat. Each provided substantive feedback on the issue to ACOM.

It was decided by ACOM via the ACOM Forum throughout the week (25–29 June) to:

1) Use the SPiCT assessment results as relative to the mean of the time series.

2) Use the SPiCT reference points as proxy reference points, as indicated in the ICES guidance for category 3 and 4 assessments and reference points.

3) Present the advice as a category 3.2 stock with proxy reference points.

Black-bellied anglerfish in divisions 8.c and 9.a. Reference points, values, and their technical basis.

Framework	Reference point	Relative value	Technical basis	Source
MSY approach	MSY $B_{trigger\ proxy}$	0.5 × $B_{MSY\ proxy}$ = 0.25 × K*	Relative value. B_{MSY} proxy is estimated directly from the assessment model and changes when the assessment is updated.	ICES (2018a)
	$F_{MSY\ proxy}$	r/2*	Relative value. The F_{MSY} proxy is estimated directly from the assessment model and changes when the assessment is updated.	ICES (2018a)
Precautionary approach	$B_{lim\ proxy}$	0.3 × $B_{MSY\ proxy}$*	Relative value (equilibrium yield at this biomass is 50% of the MSY proxy).	ICES (2018a)
	B_{pa}	Not defined		
	$F_{lim\ proxy}$	1.7 × $F_{MSY\ proxy}$*	Relative value (the F that drives the stock to the proxy of B_{lim}).	ICES (2018a)
	F_{pa}	Not defined		
Management plan	SSB_{mgt}	Not applicable		
	F_{mgt}	Not applicable		
	MAP MSY $B_{trigger}$	0.5 × $B_{MSY\ proxy}$ = 0.25 × K*	MSY $B_{trigger\ proxy}$	
	MAP B_{lim}	0.3 × $B_{MSY\ proxy}$ *	$B_{lim\ proxy}$	
	MAP F_{MSY}	r/2*	$F_{MSY\ proxy}$	
	MAP range F_{lower}	0.78 $F_{MSY\ proxy}$	Consistent with ranges resulting in no more than 5% reduction in long-term	

Framework	Reference point	Relative value	Technical basis	Source
			yield compared with the MSY (ICES, 2016a).	
	MAP range F_{upper}	$F_{MSY\ proxy}$ (F_{2018} × 3.631)	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with the MSY (ICES, 2016a).	

*** Fishing mortality is estimated only in relation to the $F_{MSY\ proxy}$ and total stock biomass is estimated only in relation to the $B_{MSY\ proxy}$. K is the carrying capacity and r is the intrinsic biomass growth rate.**

See the published advice for further details.

Going forward, the WGBIE is asked to make further investigations into the biology of the stock and behaviour of the fishery to gain a deeper understanding of how the model output and reference points is consistent with our knowledge of this stock.

Annex 9: Spain request for a *Nephrops* 8c sentinel fishery

Request code (client): 1709_nephrops8c

Background: A zero TAC was established for 8c *Nephrops* (Cantabrian Sea, North of Spain) for 2017, 2018 and 2019. In the 2017 ICES WGBIE in May, the Spanish fishing industry provided Functional Unit 25 *Nephrops* (NW Spain) CPUEs of 2015 and 2016 with certain signs of improvement. WGBIE stated that these data could be taken into account in the future if the time series were extended. In summer 2017 Spain carried out an 8c *Nephrops* sentinel fishery to collect new information about the state of the Functional Unit and obtain a new point in the CPUE time series. This fishery was made with an observers programme supervised by the Spanish Institute of Oceanography (IEO).

Request: ICES is requested to

- assess a level of catches that would minimise impact on the stock but would be sufficient to allow collection of LPUE data for potential use as an abundance index
- suggest any specific conditions that should apply to the fishery, and data collected, in order for it to be useful in an abundance index context – i.e. trips, timeframe, geographical area, etc.

Answer to some WGBIE comments

Advice process

- Spain asked permission to DG MARE to carry out a *Nephrops* 8c sentinel fishery in 2018.
- DGMARE requested advice about it to ICES. This request was announced on 21st November 2017.
- On November 30th the Special Request Advice was provided to ICES by a stock assessor and transmitted to the ICES Working Group for the Bay of Biscay and the Iberian Waters Ecoregion, from which some comments were incorporated to the Advice.
- A document from the Spanish Ministry was sent to ICES on December 1st. This document has two parts, one is a long paragraph made by the Ministry where it proposes to force the use of a mesh size of 70 mm in the area and to carry out a new sentinel fishery with observers on board for which ask for a special quota of 24 tons. The second part is the report made by the IEO about the *Nephrops* 8c sentinel fishery carried out in 2017.
- The reception of this document did not involve the modification of the ICES Special Request Advice since the 2017 sentinel fishery report data were already one of the basis of the Advice.
- On December 1st there were more comments from the ICES WGBIE that were not included in the Advice because there was not a consensus.

Comments not incorporated into the advice

1) *"The overall trend of LPUE shows high variability but an overall declining trend to its lowest level of 4.5 Kg/trip in 2014. I think we need to be much more precautionary than the special request response states given where the stock is estimated to be now along and a decline in overall landings with a TAC that doesn't appear limiting."*

The problem is that the introduction of the ITQs in 2012 distributed the total 8c *Nephrops* TAC between all the 8c trawlers, pair trawlers and pelagic trawlers included that do not fish *Nephrops* and do not change ITQ with others. This provoked that *Nephrops* ITQ for the bottom trawlers that normally fished *Nephrops* were tiny (from 767 kg/vessel/annual in 2012 to 434 kg/vessel/annual in 2016, see the WD the Spanish fishing industry presented in the 2017 WGBIE). Due to this, official landings (coming from logbooks) are not very credible since 2012 and CPUEs estimates are done with official landings. The LPUE from the 2017 observer programme supervised by the IEO in FU 25 was 86 kg/day at sea (see page 8 of the re-port sent by the Ministry). According to this if a vessel has an annual ITQ of 434 kg, in 5 days at sea consumes the annual quota**. We have to take into account that the sentinel fishery proposed for 2018 would be carried out only in the FU 25 area that was prospected in the observers programme in 2017, since is the only area where there are reliable data and those data do not discourage the tonnage proposed for the sentinel fishery.**

The official LPUEs before the introduction of the ITQs were 18.6 and 38.4 kg/trip in 2010 and 2011 respectively. With the introduction of the ITQs this value falls a 82% (from 38.4 kg/trip in 2011 to 6.8 kg/trip in 2012) and remains in those levels since then. The LPUEs from the 2017 observer programme supervised by the IEO in FU 25 were 158.37 kg/trip in August and 128.85 kg/trip in September, far from the official LPUEs since 2012 around 6 kg/trip.

2) *"The landings in the last few years from the trawls have been between 10 and 14 tonnes, which is around the suggested advised catch range for the sentinel fishery (7.6 and 12.6 tonnes), this could be viewed as opening the fishery to normal practices. Also, given that landings have been around the advised sentinel fishery catch range in the recent period with an associated fishing pressure of below proxy reference point the stock remains below any proxy biomass reference points with no clear indication of recovery (table 7.3.25.1 from the 2016 advice)."*

See previous comments about official landings reliability. The scientific landings in 2016 were 77 t.

3) *"I think the LPUE used to provide an overall tonnage for the sentinel fishery needs careful consideration so that it's not too limiting but precautionary enough to minimise its impact on the stock and recovery is not impeded, I also think that the number of trips needed should to be revisited and that 10 per month is possible too excessive."*

The LPUE used to provide an overall tonnage for the sentinel fishery was obtained in an observer on board programme supervised by the IEO with all guarantees and carried out in August and September, when the CPUEs are lower than in other months in this FU (see Special Request Advice). The number of trips is based in the 2017 observers programme, 9 trips were made in the month of August with an average CPUE of 158.37 kg/trip and a standard deviation of 60 (CV=0.38). 10 trips are proposed with the aim of diminishing this coefficient of variation. As it was commented the sentinel fishery would be carried out only in the area of FU25 that was prospected in 2017 and with reliable data, not in the whole stock. The Advice has been done with this premise.

4) *"These 10 t might be viewed as an extra catch and the opening of the fishery to normal practices or a reward for fishing when the TAC was previously set to 0 tonnes. As far as I understood, in these FUs, Nephrops should only be caught as by-catch, but the survey information considered target and non-targeted trips. A research sampling program with observers on board of specific vessel(s) (or research trips made with a fishing vessel) could be appropriate, and a number of fishing trips can be defined for this program. More difficult is to set a quota for this."*

The questions of the Special Request were:

1) *Describe what to do to in order to obtain a quality 2018 abundance index to ex-tend the time series started in 2015:*

Observer programme in the FU25 previously prospected area is proposed as the one carried out in 2017.

2) How much tonnage should DGMARE allow to obtain that 2018 abundance index:

A figure (10 t) is calculated with the data collected under the supervision of the IEO in 2017. The figure seems very high comparing with the 2013–2015 official landings but these landings are not credible.

This 10 t might not be viewed as an extra catch and the opening of the fishery to normal practices or a reward for fishing when the TAC was previously set to 0 tonnes by no means. 2016 scientific landings were 77 tonnes and this 10 tonnes only could be fished within the 2018 observer programme in a specific area of FU 25 following certain conditions under the IEO direct supervision conditions (see Special Request Advice and Ministry report) which is very far from the normal practices.

The information considered target and not-targeted trips because was collected in an observer programme to see the real LPUE of *Nephrops* in that area to calculate an abundance index in that area. The programme did not pretend to replicate the behaviour of the fleet that practices a mixed fishery, *Nephrops* data from this fleet do not reflect a proper *Nephrops* LPUE (see *Nephrops* LPUEs in WGBIE report versus 2017 observers programme LPUEs).

How the quota has been set is described in the Special Request Advice.

5) "10 trips/month seems to me a large sampling effort, but our colleagues from IEO would know better. I believe that the trips to be sampled are in addition to the current DCF observers' programme."

See point 3 answer. The observer programme to estimate FU 25 *Nephrops* abundance index carried out in 2017 and the one proposed for 2018 are apart from the current DCF observers' programme. This two programmes were design specifically for *Nephrops* and this could not be done in the DCF observers' programme because *Nephrops* fishery has been very low in the last years and the DCF observers' programme must give answer to the main fisheries when the budget is limited. Moreover the DCF programme was mainly design for discard estimations and *Nephrops* is not discarded in Spain.

A 9.1: Report from the Spanish institute of oceanographic: abundance index follow up survey for *Nephrops* in Functional Unit 25 (North Galicia) on board commercial vessels (Caracas, survey at sea for Norway lobster)

MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE

CIGALA
Nephrops norvegicus

DECEMBER 2017

LOBSTER FUNCTIONAL UNIT 25

Advancing in the knowledge of the stock.

In relation to this stock it is necessary to be able to carry out data collection surveys focused on the FU 25. This year, a survey has been carried out using two commercial vessels; this survey has shown that the yields per unit of effort are greater than those that have been observed previously. The historical data series for this species is short and its improvement would contribute to a better knowledge of the stock for the future benchmark foreseen to be discussed in a year and a half. This would result in an improvement both in stock knowledge and stock assessment, in order to verify trends that aim to improve the biological status and take the corresponding management decisions based on the best scientific knowledge as established by the CFP. As a commitment, ***it is proposed to propose a specific management plan*** *to force fishing with 70 mm mesh. These campaigns would be carried out with commercial fishing vessels with observers on board. It is necessary that the catches obtained in these campaigns can be commercialized to guarantee the collection of information and avoid economic losses to the participating sector. REQUEST: A quota of 24 tons is requested, half of the quota for Spain in 2016. This would be the sufficient quota, according to the data of the historical series presented, feasible to guarantee the monitoring of the stock.*

SUMMARY

REPORT FROM THE SPANISH INSTITUTE OF OCEANOGRAPHIC: ABUNDANCE INDEX FOLLOW UP SURVEY FOR NEPHROPS IN FUNCTINAL UNIT 25 (NORTH GALICIA) ON BOARD COMMERCIAL VESSELS (CARACAS, SURVEY AT SEA FOR NORWAY LOBSTER)

MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE

Secretaría General de Pesca

MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE

CIGALA

Nephrops norvegicus

DECEMBER 2017

LOBSTER FUNCTIONAL UNIT 25

Advancing in the knowledge of the stock.

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MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE

Secretaría General de Pesca

SURVEY REPORT

Survey at sea for follow-up on Indices of abundance of Norway lobster in functional unit (FU) 25 of Northern Galicia in commercial vessels (survey abundance Norway lobster CARACAS)

September 2017

María Paz Sampedro

Antonio Celso Fariña.

Spanish Institute of Oceanography. A Coruña.

Introduction and background

The landings of Norway lobster of the 25 functional unit (FU25) have experienced a steady decline since 1975 until 2014. This fact has motivated the scientific recommendation of the ICES for the management of the stock was zero TAC, which was also established in the rule-power of the EU (Reg. EU 2017/127). As a result, the Norway lobster fishery was closed for the three-year period 2017-2019.

Since 2007, the evaluation of the exploitation status in the FU25 has been based on the trend of commercial trends (catches per unit effort). In the Working Group "Working Group for the Bay of Biscay and Iberian Waters Ecoregion" (WGBIE2017), which includes the evaluation of that stock, the fisheries sector presented the stock data abundance for the years 2015 and 2016 (ICES, 2017). These data were based on caches and effort information from two trawling vessels with base port in A Coruña. Part of their trips are targeted to Norway lobster in the FU25. Abundance indices provided by the sector were considered relevant to the knowledge of the stock status, and given that there are no indices from scientific surveys for the Norway lobster in the Northwestern Cantabrico fishery. So the ICES recommended to continue with the historical series of commercial rates which will allow tracking the stock status and the possibility of carrying out a future assessment of the stock.

Get new fishery data and commercial abundance indices to follow this recommendation is impossible with the closed FU25 lobster fishery, committing any new approach of analysis and assessment of the stock trends in the next few years. Therefore, and demands of the fishing industry, was asked to the General Secretariat of Fisheries (SGP) the possibility of carrying out a survey for the monitoring of fishing activity, restricted to the data obtaining and with fishing vessels used for the calculation of abundance indices submitted to the WGBIE2017. The survey was authorized by the SGP (see annex I).

The survey was designed, not to interfere with the normal fishing operations and a scientific observer on board of that vessels lead to Norway lobster in the FU25 for obtaining data and fishery indices.

Survey objectives

The main objective of this survey was to obtain an index of abundance of the FU25 Norway lobster population in 2017 and continue the time series of commercial CPUEs initiated by 2015 by the fisheries sector. As secondary objectives we considered to obtain the size composition and the proportion of sexes in catches. We used that as indicators of stock status and reproductive potential, respective, as well as other fisheries data concerning associated species, discards, etc.

Participants

In addition to the authors of the report, other persons have participated in logistics, execution and coordination of the survey:

-Antonio Duarte, observant scientist on board.

-Alfredo Villar, owner of the vessel "Ana Isabel".

-Ramón Fernández, owner and captain of the vessel"Burelés".

-Juan Carlos Corrás, Manager of the Shipowners Association of Galicia "Pescagalicia – Arpega – O Barco" vessels.

-Torcuato Teixeira, Secretary of the Association of owners of fishing vessels of Galicia "Pescagalicia – Arpega – O Barco".

Methods

Study area

Within the geographical area corresponding to the Norway Lobster FU25 (statistical rectangles of the ICES: 15E0-E1 and 16E1), the area of fishing for this survey was restricted to fishing grounds situated- in the Northwest of A Coruña, between 200 and 500 m deep and delimited by the meridians Prior and Sisargas. In this zone Higher densities fishing grounds are located for the specie, and named as Pozo de Sisargas, Ppozo de Baldayo, playa Nova y Pozo de Prior (Figure 1).

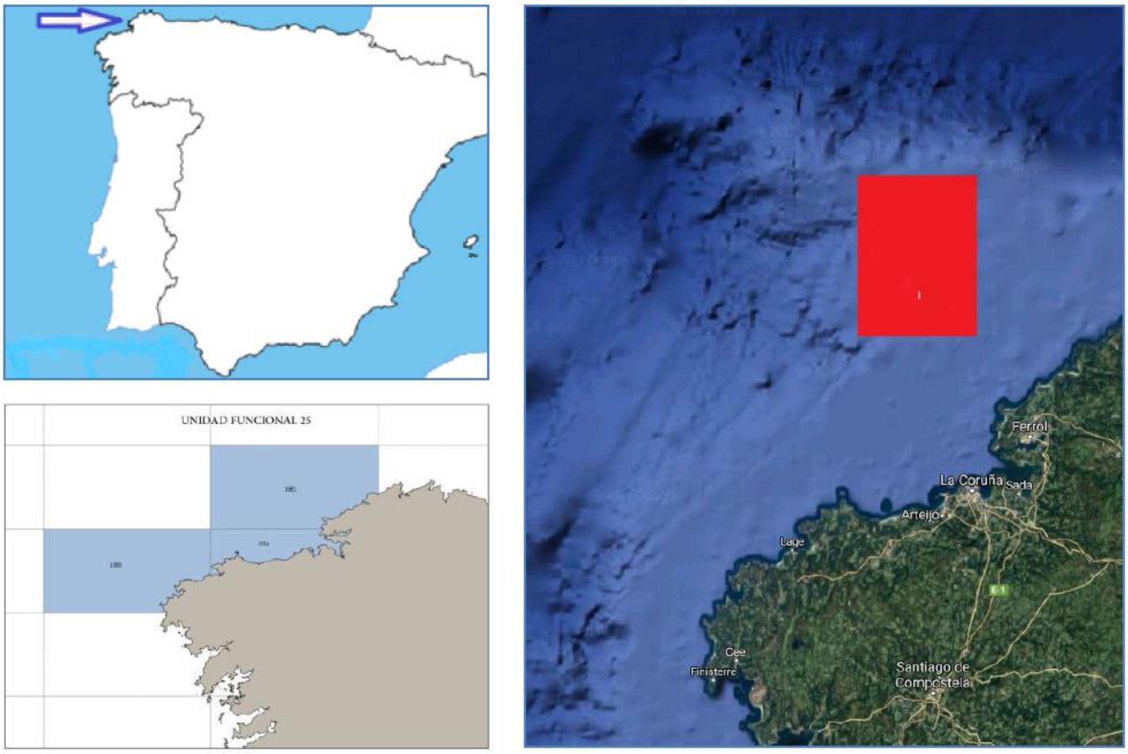


Figure 1. Location of the FU25, in the northeast of Galicia, and of the study area represented as a red rectangle.

Vessels

The survey was planned for the monitoring of trips and LANCES targeted to bottom fisheries and Norway lobster in two fishing vessels "Burelés" and "Anne Lisbeth", between August 10 and September 30, 2017. The two vessels have their port base in A coruña, and registered as trawlers in Cantabrian Sea and Northwest (table 1).

The fishing days targeted to Norway lobster had to take the observer on board, and were distributed evenly between both vessels, corresponding roughly and alternatively, two days per week and vessel in the period. Altogether, they were monitored 24 fishing days that were targeting Norway lobster hauls.

The calendar of the executed days of observation was as follows:

-"Bureles": 10, 11, 16, 17, 22, 23 and 31 August, and 1, 14, 15, 19 and 20 September.

-'Ana Isabel': 14, 15, 24, 25, 29 and 30 August and 7, 8, 12, 13, 21 and 22 September.

Table 1. Information and specifications of vessels participating in the survey.

	BURELÉS	ANA ISABEL
MATRÍCULA	FE-2-1-97	VI-5-8-00
MODALIDAD - CENSO	Arrastre Fondo Cantábrico NW	Arrastre de Fondo Cantábrico NW
ARQUEO GT	223.61	219.02
ARQUEO TRB	149.9	149
ESLORA TOTAL	28 m	28 m
POTENCIA	625 cv	320 cv
ARTE	Arrastre con puertas	Arrastre con puertas
TAMAÑO MALLA	70 mm	70 mm

Trips and LANCES

During the survey, the development of the trips, schedules and sets of followed the normal commercial schemes in the bottom trawling fishery for Norway lobster. There have had not intervention in the usual procedures of commercial fishing, or fishing, so that fishery indices obtained are comparable with the previously provided by the sector. Because of the distance of the fishing grounds to based port, trips usually take two days, as opposed to nearby fishing grounds, where bottom trawling vessels fishing trips tend to have 1 day in duration.

Similarly, bottom trawling gear was constantly used in each of the vessel was the usual, with the regulatory 70 mm mesh.

The Norway lobster is a specie that has daily and seasonal variations in its catchability which are a reflection of changes in their behavior. At depths greater than 200 m, the animals are retracted in their burrows during hours of low-light (Chapman, 1980). To avoid the effect of daily variations in the availability of the Norway lobster in the catchability of species (Aguzzi et al. 2003), sets that passed by more than 50% of its duration between dusk and Dawn were considered non-targdeted hauls sets to Norway lobster. Twenty-five of the monitored hauls sets were classified as not intended for Norway lobster, being the remaining 54 hauls you launch led to the capture of Norway lobster.

The duration of each haul was calculated as the elapsed time in hours between the time in art making firm on the bottom and the beginning of the toning. Unity of effort used to calculate catch per unit of effort (CPUE) was trawling time. A weekly value of Norway lobster CPUE was calculated for each and both vessels together to analyze the temporal evolution in the period of the campaign. Cigala campaign CPUE value was calculated by averaging the weekly values of CPUE.

Observation Methodology and data collection

During trips targeting Nephrops, the observer followed established working protocols, which consisted, as indicated below, in:

- Recompilation of general data about trips and fishing oparations or hauls in each of them, including their characteristics (geographical position, depth) and fishing (hours) effort.

-For each fishing haul, quantitative data about total catch by species, both landed and discarded.

-For the Norway lobster, random sampling of sizes (length of Shell to mm bottom) by sex in each haul, proportion of sexes and ovate females.

-For other commercial species (hake and megrims), and according to availability, size of the catch sampling.

Complementary to the observer data, the logbooks were available for each monitored trip, and sales notes.

Database and data analysis

All documentation and data collected by the observer and relating to fisheries monitoring survey were include in a database. This database is available in the Oceanographic Centre of A Coruña. The catch data analysis was performed based on the information of the observer, matched entirety with Logbooks. (Variation less than 0.002% by weight).

The composition size for each Norway lobster haul was determined by the weighting of survey carried out on board by the observer, using the relationship length-weight for males and females in Farina (1984).

Results

Monitored trips

The trips monitored during this survey were developed between August 10 and September 22, 2017. The result was a total of 14 trips (7 trips for each fishing vessels). Of these trips, 10 were 2 days and one 4 for only 1 day.

In the total trips, there were 79 hauls between 180 and 530 m deep, 54 of them targeting Nephrops and 25 not specifically targeting this species (conducted at night). All of them in areas of fishing of the 25 functional unit (Figure 1)

For more details about the dates of the trips, individual characteristics of the hauls made and catches by haul, you can consult the summary in annex II.

Total catches and Norway lobster catches

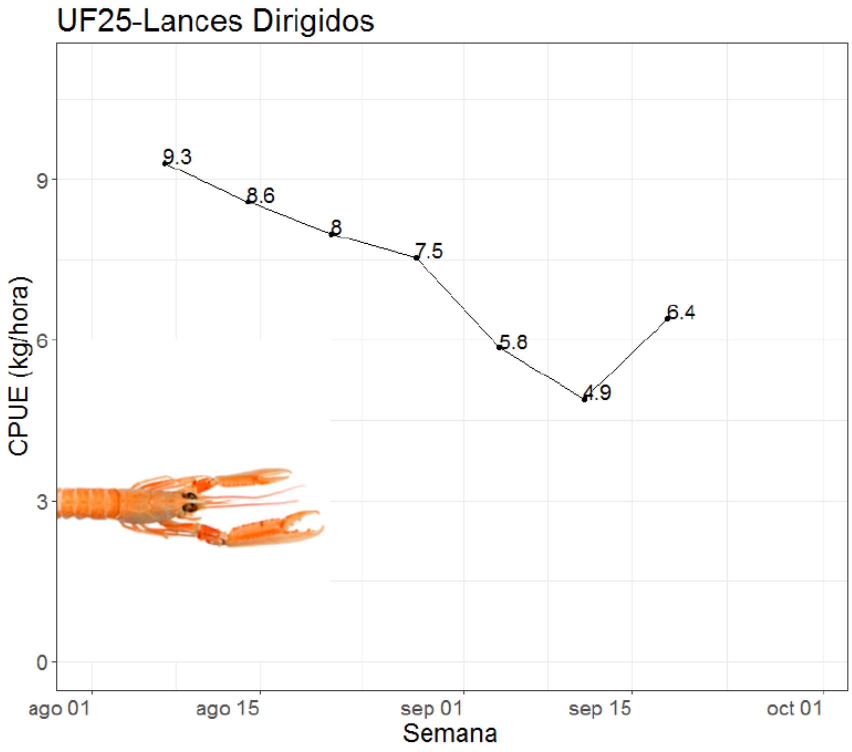
A total of 55.070 Kg of different species were catched (fish, crustaceans and molluscs) in the 79 hauls, being retained 31% of the catch (17 024 kg) and the rest (38. 046 kg) discarded.

The total catch of lobster made by two vessels in the monitored tides was 2070 kg, an average for the species of 86 kg per day at sea. During the period only one animal was discarded due to its size (less than 25 mm in shell length). The discard rate was lower than the 0.1 ‰, which is considered the discard of the species is almost nil and that the retained catch is equivalent to the total catch.

CPUE, catch per unit of effort, of Norway lobster

Norway lobster catch varied weekly, with a maximum yield of 9.3 kg/hour in the second week of August that decreased to 4.9 in mid-September. In non-directed hauls, the CPUE also weekly decreased from 1.3 kg/hour in August to be zero in September (Figure 2).

On average, the CPUE of lobster during the campaign tracking in 2017 was 7.2 kg/h, with 1.57 standard deviation (table 2).



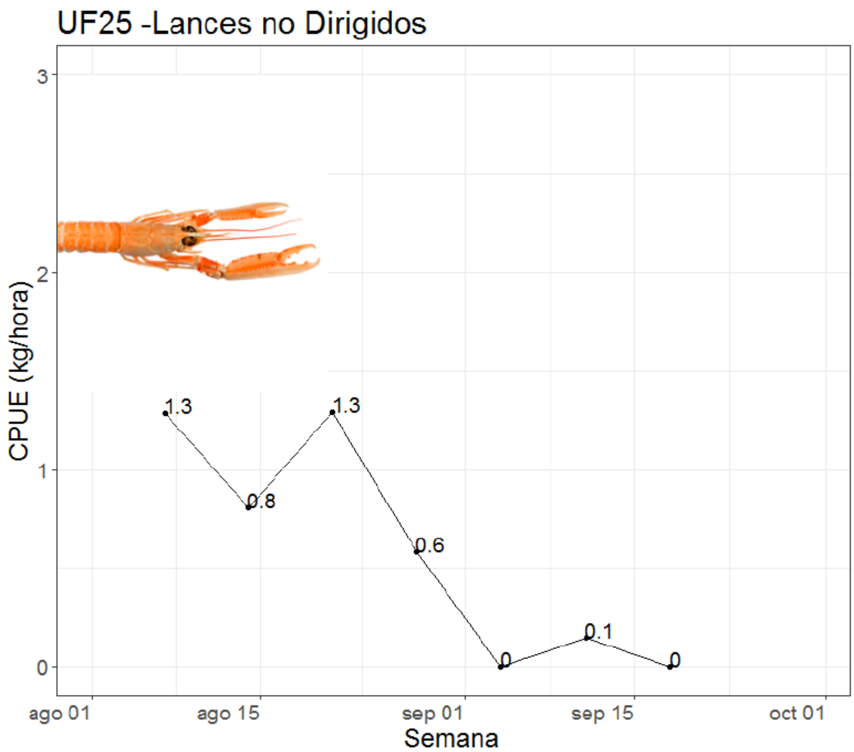


Figure 2. Weekly evolution of CPUE in weight for Norway lobster in hauls targeted Nephrops (above) and hauls non-directed (below) (August and September 2017).

Small differences between the 2 vessels in the weekly CPUE were observed (Figure 3). Thus, the general trend for both series is the decline of the catch throughout the follow-up period, from early August to end of September.

Data per vessel of the CPUE of Norway lobster in hauls targeted Norway lobster for the whole period were 7.1 and 7.4 kg/hour for the "Ana Isabel" and the "Bureles", respectively

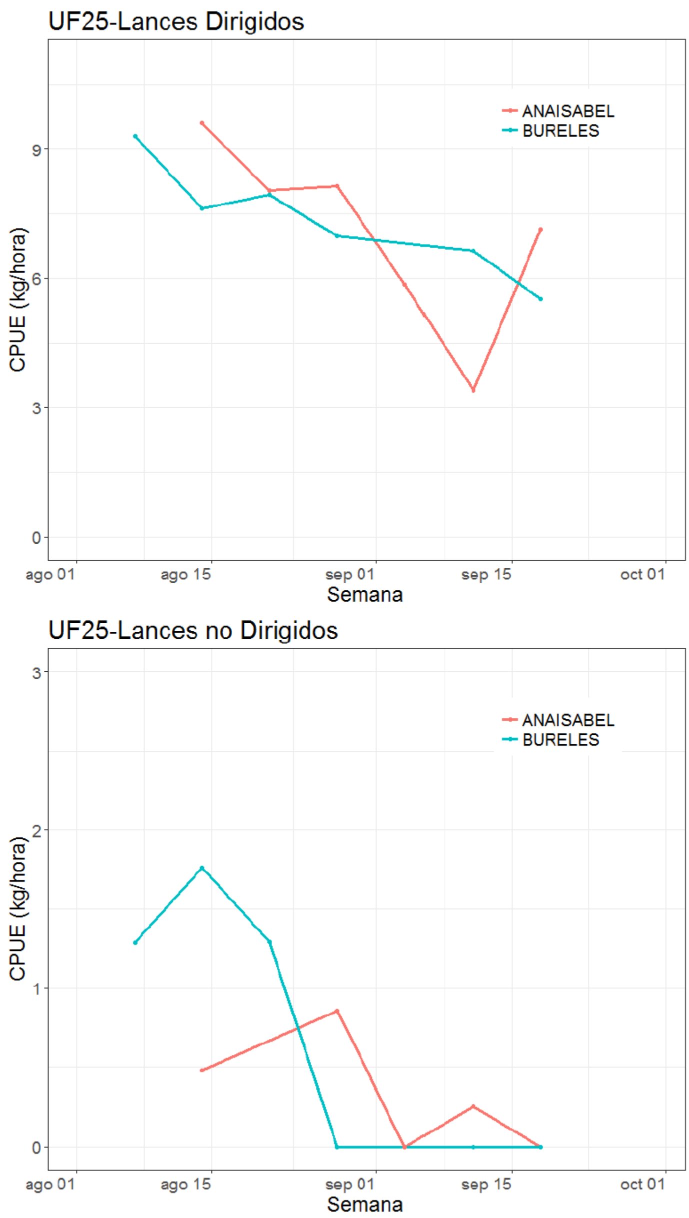


Figure 3. Weekly evolution of CPUE for Norway lobster for each of the vessel. The top graph shows the CPUEs of hauls targetes to Norway and lower the CPUEs of hauls non-directed (August and September 2017).

Table 2. Average CPUE of Norway lobster and its standard deviation (s.d.) during the period on the FU 25

Period	Catches	CPUE (Kg/hour)	sd
August-September 2017	Targeted	7.2	1.57
	Non-targeted	0.6	0.56

Composition of size and sex ratio of the catch of Norway lobster

The average of the length (LC, mm) and sex was registered for 7 266 animals, resulting 4 112 females and 3 154 males. The females were dominant in number, being the sexratio of the females in the population of 57.2%.

Female animal's sizes ranged from 22 to 69 mm of LC, and the males between 25 and 75 mm. Averages sizes 39.8 for females and to 41.7 mm CL for males (Figure 4).38% of females were with eggs. The smaller registered for females carrying eggs was 31 mm of LC.

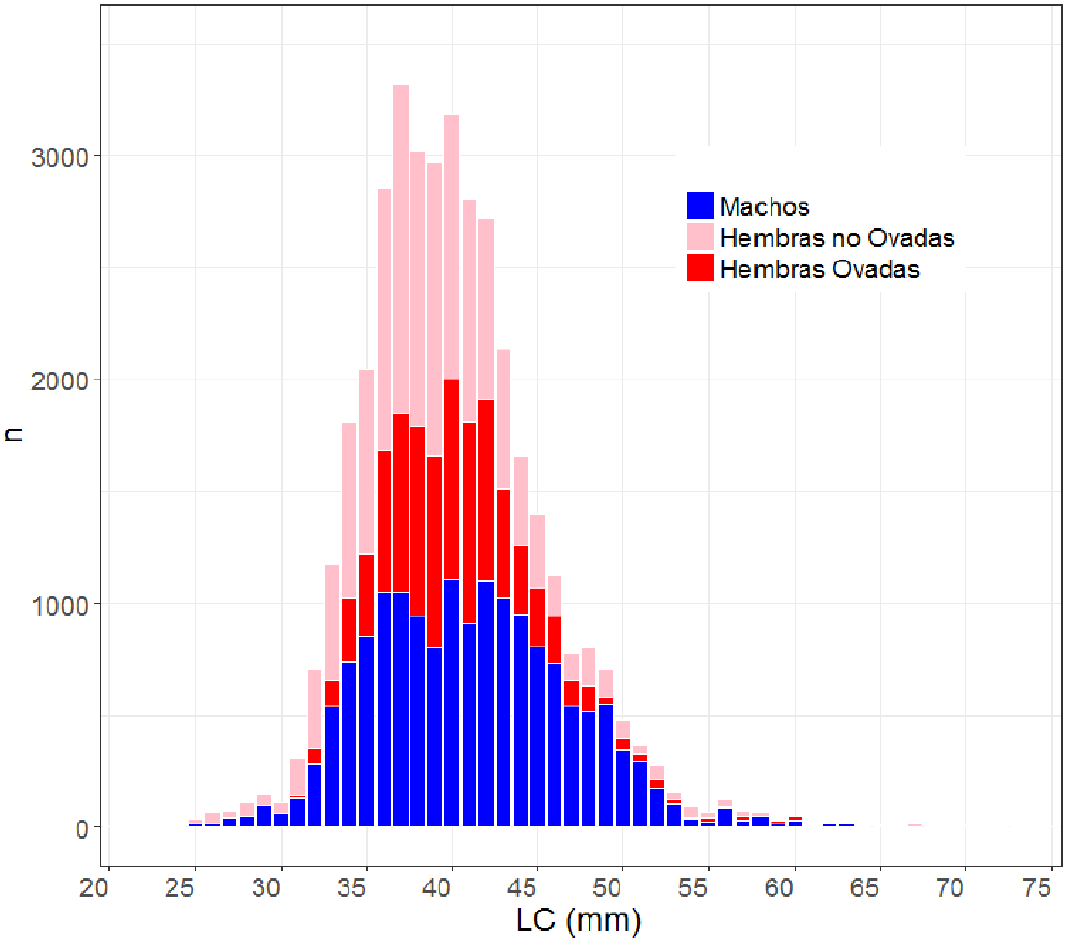


Figure 4. Size composition of the total catch for males, females without egg ("HEMBRAS NO OVADAS") and females with eggs ("HEMBRAS OVADAS").

Weight of Norway lobster in the catch composition.

In the set of monitored trips, representation in weight of the catch of Norway lobster from the retained catch was 15% in targeted hauls and 1% in non-directed hauls (table 3).

Table 3. Percentage of Norway lobster on the catch retained by weight.

% RETAINED CATCHES		
WEEK	**TARGETED**	**NON-TARGETED**
07/08/2017	33.1	2.8
14/08/2017	18.1	2.4
21/08/2017	20.8	3.5
28/08/2017	17.1	2.0
04/09/2017	6.1	0.0
11/09/2017	9.1	0.5
18/09/2017	12.8	0.0
SURVEY	14.8	1.3

The Norway lobster represented between 6 and 33% of the retained weight in bottom trawling hauls targeting this specie. The highest values were recorded in the first week of the survey (August), while lower values (table 3) were obtained in September. These results are consistent with the seasonal cycle of the specie in the area, very marked between May and August, which peak abundance s usually in June or July (Farina, 1996). In August-September the incubation cycle begins (Fariña et al., 1999), and the females with eggs are confined in their burrows, resulting in less accessible

CPUE species associated

Although the lobster was the target species of the study, data concerning other associated species were collected.

For all the survey hauls, both night and day, we stimated the retained catches per effort unit and the discard catchs per effort unit (table 4) (RPUE). The species with higher yields in the survey were blue whiting (*Micromesistius poutassou*), megrims (*Lepidorhombus spp*.), Norway lobster (*Nephrops norvegicus*) and hake (*Merluccius merluccius*) with 21.4, 6.1, 5.5 and 5.0 kg per hour, respectively. Therefore, in these fishing grounds, the Norway lobster resulted the 3rd specie in relative importance by weight. Discarded species include patexo (Poly-bius henslowii) and spiders (Munida spp.) with average values greater than 40 kg/hour.

Table 4. Catch per unit of effort (RPUE) retained and discarded per unit of effort (DPUE) the main species for total operations of the campaign, sets day and night fishing. The Norway lobster RPUE appears shaded.

Grupo/Especie		
Nombre común	**Nombre científico**	**RPUE (kg/hora)**
Bacaladilla	*Micromesistius poutassou*	21.4
Gallos	*Lepidorhombus* spp	6.1
Cigala	*Nephrops norvegicus*	5.5
Merluza	*Merluccius merluccius*	5.0
Juliana	*Lophius piscatorius*	1.7
Rape	*Lophius budegassa*	1.2
Pintarroja	*Scyliorhinus canicula*	1.2
Pota	*Illex coindetii*	1.0
Jurel	*Trachurus trachurus*	0.6
Cabra	*Helicolenus dactylopterus*	0.6
Pulpo cabezón	*Eledone cirrhosa*	0.5
Potarro	*Todarodes sagittatus*	0.1
Bertorella	*Phycis blennoides*	0.1
Congrio	*Conger conger*	0.1
Rubios	*Triglidae*	0.1

Grupo/Especie		
Nombre común	**Nombre científico**	**DPUE (kg/hora)**
Patexo	*Polybius henslowii*	56.4
Munidas	*Munida* spp	43.4
Marujito	*Gadiculus argenteus*	0.3
Holoturias	Holoturia	0.3
Zapatas	*Galeus* spp	0.3
Quimera	*Chimaera monstrosa*	0.2
Patata de mar	*Actinauge richardi*	0.1
Atún	*Thunnus thynnus*	0.1
Negrito	*Etmopterus spinax*	0.1
-	*Bathynectes maravigna*	0.1

Final considerations

From this survey data we have estimated and an index for of abundance of Norway lobster in the FU25 for the year 2017 which is depicted in table 5 along with the historical series previously available.

The results provide relevant information about the FU25, an index of abundance and the size and sex of the population that, along with previous historical series, composition, would allow monitoring of this population and a future assessment of the stock state.

Table 5. Historical series available for the FU25 commercial CPUE.

Origen	Year	Period	Target CPUE (Kg/hour)	s.d.	Non-Target CPUE (Kg/hour)	s.d.
ICES2017-fishing sector	2015	Annual	6.46		0.18	
ICES2017-fishing sector	2016	Annual	10.81		0.27	
This survey	2017	August-September	7.22	1.57	0.59	0.56

The commercial serie is still very short to describe a trend. For this reason, It would be interesting to continue this Norway Lobster CPUE data series in the next years, in order to conclude any trends and explore possibilities for fishing and management of the area. Although this is a complex task in itself, by the established zero quota for Norway lobster, it would be the only possibility for the fishery data and discuss with direct information possibilities of production of these fishing grounds.

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Reglamento (UE) 2017/127 del Consejo de 20 de enero de 2017, por el que se establecen, para 2017, las posibilidades de pesca para determinadas poblaciones y grupos de poblaciones de peces, aplicables en aguas de la Unión y, en el caso de los buques pesqueros de la Unión, en determinadas aguas no pertenecientes a la Unión (DOUEL 24 de 28.1.2017).

MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE

SECRETARIA GENERAL DE PESCA

DIRECCION GENERAL DE ORDENACION PESQUERA SUBDIRECCION GENERAL DE CONTROL E INSPECCION

F A X

DE:	SUBDIRECCION GENERAL DE CONTROL E INSPECCIÓN
A:	IEO – CENTRO OCEANOGRÁFICO DE A CORUÑA (fax: 981 229 077) DIRECCIÓN ÁREA FUNCIONAL DE AGRICULTURA Y PESCA DE A CORUÑA SUB. GRAL. DE PROTECCIÓN DE LOS RECURSOS PESQUEROS SUB. GRAL. DE CALADERO NACIONAL Y AGUAS COMUNITARIAS
ASUNTO:	CAMPAÑA IEO - INDICES DE CIGALA EN FU-25 GALICIA NORTE (CARACAS)
S/REF:	N/REF: 158 TMS/JAF
FECHA:	08 de agosto de 2017
NUMERO PAGINAS INCLUYENDO PORTADA: 2	

En el marco del estudio del IEO en relación a una campaña sobre el índice de población de cigala en la Unidad Funcional (FU) 25, se autoriza a los buques pesqueros **"BURELES"**, **"FE-2-1-97"**, **Código U.E.: ESP000023450** y **"ANA ISABEL"**, **"VI-5-8-00"**, **Código U.E.: ESP000024668** a realizar, esta campaña.

La presente autorización queda subordinada a las siguientes condiciones:

- **Arte de pesca autorizado:** Arrastre de fondo, según Anexo I del Reglamento (CE) nº 850/98 del Consejo de 30 de marzo de 1998.
- **Periodo de validez de la autorización:** 2 mareas por buque/semana del 10 de agosto al 30 de septiembre de lunes a viernes. Total de mareas 24 (12 por buque).
- **Zona de actividad:** Aguas situadas entre los 200 y 500 metros de profundidad dentro de los rectángulos estadísticos 15E0, 15E1 y 16E1 correspondientes al Caladero Nacional del CNW (CIEM VIIIc).
- **Especies objetivo:** Cigala. Con posibilidad de estudio de otras especies secundarias (gallo, rape, merluza, etc). El **tope** de capturas de **cigala** será de **4.252 kg** para la totalidad de la campaña.

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28071 MADRID
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FAX: 913471512

Anexo I *cont*

- La comunicación de capturas en el DEA deberá realizarse mediante la declaración de capturas, y se deberá indicar en el apartado de comentarios de ese mensaje, "campaña científica". También se comunicarán los desembarques consignando especies y kg descargados en esas mareas de la forma habitual.

- Las capturas se deberán desembarcar en el puerto de A Coruña, puerto habitual de descarga de estos pesqueros, permitiendo su comercialización, excepto ejemplares de tamaño inferior al reglamentario.

- Deberá disponer del sistema de localización de buques (caja azul) en correcto funcionamiento.

- Deberá encontrarse a bordo personal del IEO los días efectivos de investigación y solo se considerarán esos días dentro de la presente autorización.

- Se deberá cumplir con todo lo establecido por el Reglamento (CE) nº 1224/2009 del Consejo, de 20 de noviembre de 2009, por el que se establece un régimen comunitario de control.

- A fin de poder conocer los días concretos de actividad, será necesario comunicar a esta Subdirección General (inspecpm@mapama.es) con al menos 24h de antelación el día o días a llevar a cabo dicha actividad.

La presente autorización se concede exclusivamente para el ámbito de la actividad pesquera y, por tanto, está condicionado al cumplimiento de la normativa en materia de seguridad y demás aspectos de la navegación que exige la Dirección General de la Marina Mercante.

La Subdirectora General de Control e Inspección

TML

Teresa Molina Schmid

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Anexo II

Tabla. Fecha y hora de inicio, duración, produndidad y captura total en peso, captura retenida y captura de cigala de todos los lances realizados durante el estudio.

LANCE	FECHA_HORA INICIO	DURACIÓN (hh:min)	PROFUNDIDAD FIRME (m)	PROFUNDIDAD VIRADO (m)	CAPTURA TOTAL (kg)	CAPTURA RETENIDA (kg)	CAPTURA CIGALA (kg)
1	10/08/2017 7:00	6:11	457	373	158	143	32.0
2	10/08/2017 15:36	5:45	380	388	104	89	37.0
3	10/08/2017 22:10	4:00	402	313	136	131	4.0
4	11/08/2017 3:00	3:00	300	298	200	196	5.0
5	11/08/2017 7:00	5:10	386	373	195	164	65.0
6	11/08/2017 13:05	4:50	366	380	219	218	70.0
7	14/08/2017 4:00	3:39	274	293	129	114	3.0
8	14/08/2017 8:30	6:09	338	366	317	293	60.0
9	14/08/2017 15:24	6:28	369	347	405	384	60.0
10	14/08/2017 23:20	3:55	291	256	145	137	1.0
11	15/08/2017 4:20	2:51	263	287	129	114	1.0
12	15/08/2017 8:08	6:32	316	338	368	342	82.0
13	15/08/2017 15:33	6:10	331	347	620	583	41.0
14	16/08/2017 6:45	5:55	357	315	183	163	61.0
15	16/08/2017 13:30	4:10	276	336	165	145	56.0
16	16/08/2017 18:30	4:10	338	304	174	158	16.0
17	17/08/2017 7:05	4:05	391	320	124	112	18.0
18	17/08/2017 12:20	4:00	313	344	352	151	21.2
19	17/08/2017 16:55	4:00	322	300	116	116	28.3
20	17/08/2017 21:45	3:35	304	304	140	114	6.3
21	22/08/2017 8:02	5:23	439	411	139	110	50.0
22	22/08/2017 14:25	6:00	439	446	124	111	57.5
23	22/08/2017 21:25	4:15	439	441	265	223	8.5
24	23/08/2017 2:35	4:05	433	437	94	82	2.3
25	23/08/2017 7:30	5:05	362	384	104	74	47.0
26	23/08/2017 13:40	4:40	443	439	71	63	30.0
27	23/08/2017 19:10	4:30	439	393	181	124	19.0
28	24/08/2017 7:10	5:15	457	457	470	450	52.0
29	24/08/2017 13:20	10:45	512	494	421	402	48.0
30	25/08/2017 7:30	5:24	457	457	394	358	50.0
31	25/08/2017 13:40	4:30	421	439	320	291	58.0
32	29/08/2017 8:10	4:00	369	320	573	534	60.0
33	29/08/2017 12:51	7:49	329	324	575	459	40.0
34	29/08/2017 21:40	4:30	307	417	4126	120	0.0
35	30/08/2017 2:55	4:22	408	311	1598	97	0.0
36	30/08/2017 8:10	4:30	329	362	205	171	40.0
37	30/08/2017 13:40	4:50	384	311	226	173	32.0
38	30/08/2017 19:10	4:00	315	384	262	176	11.0
39	31/08/2017 8:00	4:10	388	318	414	91	30.8
40	31/08/2017 13:00	4:10	318	388	474	137	26.5

Tabla. *cont.*

LANCE	FECHA HORA INICIO	DURACIÓN (hh:min)	PROFUNDIDAD FIRME (m)	PROFUNDIDAD VIRADO (m)	CAPTURA TOTAL (kg)	CAPTURA RETENIDA (kg)	CAPTURA CIGALA (kg)
41	31/08/2017 18:10	4:00	373	307	480	62	19.3
42	31/08/2017 23:10	3:00	302	408	348	43	0.0
43	01/09/2017 3:10	3:05	436	430	240	111	0.0
44	01/09/2017 7:50	4:35	371	357	209	109	32.5
45	01/09/2017 13:15	4:55	353	433	271	162	43.3
46	07/09/2017 7:25	5:15	448	384	522	308	40.0
47	07/09/2017 13:40	5:50	443	384	921	545	35.0
48	07/09/2017 20:18	4:00	430	530	291	226	0.0
49	07/09/2017 1:20	3:39	475	475	223	158	0.0
50	08/09/2017 6:10	5:30	402	402	1081	907	26.0
51	08/09/2017 12:23	4:37	457	311	326	270	23.0
52	12/09/2017 6:50	5:20	315	311	743	619	30.0
53	12/09/2017 12:55	5:05	322	338	631	483	18.0
54	12/09/2017 18:40	4:15	320	311	252	149	8.0
55	12/09/2017 23:40	3:48	285	230	160	84	0.0
56	13/09/2017 4:07	3:50	247	311	284	160	0.0
57	13/09/2017 8:55	4:14	304	320	627	366	19.0
58	13/09/2017 14:10	4:55	342	326	1808	168	6.0
59	14/09/2017 19:55	4:06	280	187	180	171	3.0
60	14/09/2017 7:50	5:50	355	318	821	276	35.0
61	14/09/2017 14:30	5:40	326	351	168	133	37.5
62	14/09/2017 21:10	4:15	309	278	5213	59	0.0
63	14/09/2017 2:20	4:20	274	335	4883	139	0.0
64	15/09/2017 7:40	4:30	358	318	622	90	36.5
65	15/09/2017 13:00	4:25	326	368	1148	96	26.8
66	19/09/2017 6:10	5:30	289	311	2258	155	32.5
67	19/09/2017 12:30	4:10	315	336	1044	22	13.5
68	19/09/2017 17:40	3:50	333	313	1617	98	16.0
69	19/09/2017 22:25	3:15	329	439	675	60	0.0
70	20/09/2017 2:40	4:00	448	320	1174	134	0.0
71	20/09/2017 7:40	8:00	311	373	1339	281	56.5
72	20/09/2017 16:25	4:45	368	336	1093	184	18.0
73	21/09/2017 4:50	3:35	274	366	594	161	0.0
74	21/09/2017 9:00	5:40	366	322	1858	449	48.5
75	21/09/2017 15:30	5:50	320	311	1567	458	34.0
76	21/09/2017 22:00	4:25	252	216	1015	109	0.0
77	22/09/2017 3:10	3:45	227	326	1057	248	0.0
78	22/09/2017 8:10	4:40	366	357	957	349	38.0
79	22/09/2017 13:00	4:35	357	417	959	344	43.5

A 9.2: Reviewers' Comments

Reviewer Comments

The request relates to *Nephrops* fisheries in Div. 8c, which contains two *Nephrops* functional units – North Galicia (FU25) and Cantabrian Sea (FU31). The request asks ICES to respond to two issues; firstly, to assess the level of catches for an 8c sentinel fishery that would "minimise impact on the stock" but allow sufficient data to be collected to maintain the integrity of the CPUE time series, and secondly, to suggest conditions that should be applied to ensure the usefulness of the data collection scheme.

The advice summary states that to allow collection of sufficient CPUE data, a TAC of 3-5t is required. It goes on to propose specific conditions for data collection (4 trips/month sampled between May and September, operating in the same area as the 2017 observer programme). The advice notes that landings from Div. 8c have declined consistently since 1989, with a zero catch recommendation being given since 2002, and a TAC of zero being set for 2017–2019.

The elaboration of the advice states that "there are no discards in this functional unit". The table at the end of the working document presented to WGBIE shows considerable discarding of fish on hauls observed during 2017, and so "there are no *Nephrops* discards in this fishery" would be a more accurate statement.

The methods used to arrive at the catch advice follow a four-step process. Firstly, the number of trips required to provide a catch rate with an appropriately precise CV was calculated by resampling observed hauls collected in 2017. Secondly, the time period when observer data should be collected is determined by examining historic monthly trends in CPUE. Figure 2 shows the monthly distributions of the CPUEs from FU25 over the period 1980 – 2008. This period covers a time over which catch rates declined by 86%. It would be interesting to know whether the pattern holds at the very low densities we are currently seeing and to see equivalent data from 2009–2016. In step three, the CPUE's seen during the sampling in August and September 2017 are raised on the basis of the ratio of the historically observed catch rates in these months to the rates seen in May, June and July. Again, these scaling factors are based on historic data, and it would be interesting to see whether they remain valid for the current stock. Finally, the catch required to support the requisite number of observer trips is derived by multiplying catch rates by trip. The methods used to calculate the monitoring TAC seem a reasonable approach.

While these calculations address the areas of the request relating to collection of data, they do not directly consider the minimisation of impacts on the stock specified in part one of the request. As the trajectory of the stock has been one of long term decline, we can assume that *status quo* levels of fishing pressure are not sustainable. While the 3-5t catch recommendation is a reduction from the 12t seen in recent years, I note that the most recent unreported landings given by the working group were approximately seven times greater than official figures, and as such, the prospect of any open fishery on the stock leaves open the possibility of continued overexploitation. *Nephrops* has an extensively documented history of fishery independent survey techniques, and advising the setting of a TAC for a stock in a parlous state is questionable, in the context of ICES' advisory framework.

The advice does not make any specific mention of sampling or catches from FU31, merely stating that "*observers programme in 2018 will be applicable only to the prospected area (fishing grounds at the North West of A Coruña, NW Spain), since currently there are no evidence of changes in the Nephrops populations of the remaining 8c fishing grounds*". According to the working group report, between 1990–2016, annual landings have declined from over 170t to 4t, and a strong decline in CPUE is shown in the various series presented. I would say that the change in the *Nephrops* stock status in this functional unit is at least as concerning as that seen in FU25, and, whatever the arguments on the wisdom of allowing fishing of the stock, to develop a sampling strategy for *Nephrops* in Div. 8c which does not take this area into account seems like a significant omission.

A 9.3: ADGNEPH8c Minutes

30–31 January 2018, by correspondence

The Advice Drafting Group met by correspondence on 30-31 January 2018to respond to the EU request for advice on a sentinel fishery for N*ephrops* in FU25 in Division 8.c requested by Spain. The list of participants is in Table 1.

The Chair welcomed the participants and provided some background to the request. In addition to the draft advice sheet, documents available to the ADG included the draft report from the expert group, other background documents as well as two reviews of the work which had been requested. Following the initial reviews, some additional work was required and the advice release was postponed from December 2017 to February 2018. Following the additional work, one of the initial reviewer examined the updated version and provided comments.

The request included two questions pertaining to

- Assess a level of catches that would minimise impact on the stock but would be sufficient to allow collection of LPUE data for potential use as an abundance index
- Suggest any specific conditions that should apply to the fishery, and data collected, in order for it to be useful in an abundance index context – i.e. trips, timeframe, geographical area, etc.

Discussion:

There was general discussion and concern regarding the request for a sentinel fishery noting that the current advice from ICES is for catches of zero tonnes. Participants agreed that the advice would be provided but that the advice document should also refer to the zero advice from ICES. It was also noted that fishery independent approaches that do not require that *Nephrops* be captured are available to monitor abundance (e.g. UWTV surveys). Other fishery independent bottom trawl surveys which would catch few *Nephrops* could also be conducted. It was explained that resources are currently not available in Spain to conduct such surveys.

There was discussion about the CPUE calculation using catch per trip as trips are not uniform (have a variable number of days, hauls and haul duration) resulting in different effort (hours) expended in a given trip. In that regard, kg/hour may be a more representative measure. Given that there can be differences between vessels which have different power or due to the month of the year, the standardization would also require a statistical model (GLM or other). As such the unit of CPUE to be used along with standardization approaches should be examined in conducting such surveys. These analyses would need to be examined during a benchmark. The advice on the catch level for the sentinel surveys is based on a number of trips necessary to achieve a level of precision for the calculated CPUE. Noting that the sentinel fishery is designed to take place in a specific part of FU25 (thought to be the main distribution area), the ADG also concluded that another issue that would need to be examined in a benchmark is whether this CPUE index can be considered as a representative index for the stock as a whole for assessment and advice purposes.

It was suggested that a coefficient of variation (CV) around the mean kg/trip of less than 30% (with 90% probability) would be an acceptable level of precision and comparable to that of 2017. Using this rationale and based on a simulation with replacement using the 2017 data, this CV could be attained by conducting 5 trips per month. It was noted that, given the variation introduced in the calculation of catch/trip because the number of hauls and haul duration during a trip were variable, the CV of an abundance index calculated using kg/hour and additional standardization through a statistical model would likely be lower. In the advice sheet, it was decided that the graph that illustrates probabilities and the CV based on the simulation of various number of trips per month should replace the graph that was originally incorporated.

Based on these results, the draft advice and report submitted to the ADG therefore recommended that 5 trips be conducted per month. However, the expert group that conducted the analysis recommended that the sentinel fishery take place from May to September, the 5 months with the highest CPUE and when *Nephrops* are outside of their burrows. Given that the monthly CPUE pattern is considered to be consistent from year to year, that the work in 2017 was conducted during the months of August and September and that the status of the stock is very low, the ADG considered that an abundance index based on these two months (10 trips in total) should be adequate to derive an index of the change in the abundance of *Nephrops* and to the extent possible minimize catches and therefore the impact on the stock. Therefore, the advice produced by the ADG recommended that the work take place during the months of August and September. The calculation of the level of catch implied by these trips followed the calculation initially provided for these months by the expert group with a 15% addition to the estimated catch to account for any increase in catch rates.

The ADG also discussed the conditions to be applied to the sentinel fishery noting that standardization of the work and of the data afterwards is desirable. Consequently, the same vessels and gears used in the 2017 work should be maintained as constant as possible and if vessel replacements need to be made, the new vessels should be comparable to the one being replaced. A list of variables to be contained in the data set which would allow standardization was suggested. The ADG also accepted the recommendation that the work should be overseen by a research institute however, it was considered that this should be kept general and that a specific organization (i.e. Spanish Oceanographic Institute (IEO) should not be named in the advice.

Aside from these major points, a number of typographical and editorial changes were made.

Table 1: List of participants to ADGNEPH8c

MEMBER	DEPT/INSTITUTE	EMAIL	FUNCTION
Ghislain Chouinard	International Council for the Exploration of the Sea	ghislain@ices.dk	Chair
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Sarah Kraak	Thünen Institute Baltic Sea Fisheries Germany	sarah.kraak@thuenen.de	Member
Lisa Readdy	Centre for Environment, Fisheries and Aquaculture Science (Cefas) Lowestoft, UK	lisa.readdy@cefas.co.uk	WGBIE chair
Cristina Silva	IPMA Portugal	csilva@ipma.pt	Member
Alain Biseau*	Ifremer Lorient Station, France	abiseau@ifremer.fr	Member
Francisco Velasco	Instituto Español de Oceanografía Centro Oceanográfico de Santander, Spain	francisco.velasco@ieo.es	Member