ICES WGBIE REPORT 2014

ICES ADVISORY COMMITTEE

ICES CM 2014/ACOM:11

REF. ACOM

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

7–13 May 2014

Lisbon, Portugal

ICES

International Council for the Exploration of the Sea

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Recommended format for purposes of citation:

ICES. 2014. Report of the Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE), 7–13 May 2014, Lisbon, Portugal. ICES CM 2014/ACOM:11. 714 pp.

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Executive Summary

The ICES Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE) met in Lisbon, Portugal during 7–13 May 2014. There were 23 stocks in its remit distributed from ICES Divisions IIIa to IXa though mostly distributed in Sub Areas VII, VIII and IX. There were 18 participants (of whom 2 participated by videoconference). The group was tasked with carrying out stock assessments and catch forecasts and providing a first draft of the ICES advice for 2014 for 16 stocks. 4 stocks were listed as "multiyear". For those stocks, catch information was updated. For the remaining stocks, WGBIE had to finalise a draft advice prepared by WGNEW.

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

Four stocks within the remit of the WG went through the benchmarking process in 2014. For the two southern megrim stocks, the inclusion of discards and some modifications in the assessment model settings were carried out. For northern hake, the retrospective pattern issue which arose in last year's assessment was partly addressed and for southern hake, convergence issues of the assessment model were investigated.

Three *nephrops* stocks from the Bay of Biscay and the Iberian waters are scheduled for benchmark assessments at the start of 2015. The WGBIE meeting spent some time planning this benchmark (see Annex N) together with longer term benchmarks (2016 and after, see section 1.).

A recurrent issue significantly constrained the group's ability to address the terms of reference this year. Despite an ICES datacall with a deadline of 4 weeks before the meeting, data for several stocks were only available at the start of the meeting which lead to increase in workload during the working group, as in that case, the assessments could not be carried out in National Laboratories prior to the meeting as mentioned in the ToRs. **This is an important matter of concerns for the group members**.

Section 1 of the report presents a summary by stock and discusses general issues. Section 2 provides descriptions of the relevant fishing fleets and surveys used in the assessment of the stocks. Sections 3 to 13 contain the single stock assessments. Additionally, the WG ToRs this year included a reconsideration of the reference points for northern hake (see Annex R).

1 Introduction

1.1 Terms of Reference

2013/2/ACOM11 The Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim [WGHMM], will be renamed to **Working Group for the Bay of Biscay and the Iberian waters Ecoregion** (WGBIE) chaired by Michel Bertignac (France), will meet in Lisbon, Portugal, 7–13 May 2014 to:

a) Address generic ToRs for Regional and Species Working Groups (see table below);

b) Assess the progress on the benchmark preparation of nep-2324, nep-2829 and nep-30 for 2015;

c) With reference to the recommendation of WKMSYREF2, reconsider MSY reference points for northern hake. If possible, also establish precautionary reference points. The application of updated reference points will, however, be contingent on the availability of up to date fishery data to calculate relevant values.

The assessments will be carried out on the basis of the stock annex in National Laboratories, prior to the meeting. The data to perform the assessment should be available 4 weeks before the meeting. This will be coordinated as indicated in the table below.

WGBIE will report by 24 May for the attention of ACOM. The group will report on the ACOM guidelines on reopening procedure of the advice before 14 October and will report on reopened advice before 29 October.

Fish Stock	Stock Name	Stock Coordinator	Assess. Coord. 1	Assess. Coord. 2	Advice
anp-78ab	Anglerfish (L. piscatorius) in Divisions VIIb-k and VIIIa,b	Spain	Spain	UK	Update
anb-78ab	Anglerfish (Lophius budegassa) in Divisions VIIb-k and VIIIa,b	UK	UK	Spain	Update
anb-8c9a	Anglerfish (Lophius budegassa) in Divisions VIIIc and IXa	Portugal	Portugal	Spain	Update
Anp-8c9a	Anglerfish (L. piscatorius) in Divisions VIIIc and IXa	Spain	Spain	Portugal	Update
Bss-8ab	Sea bass in Divisions VIIIa,b	France	France	none	Multyear
Bss-8c9a	Sea bass in Divisions VIIIc and IXa	France	France	none	Multyear
hke-nrtn	Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock);	Spain	Spain	none	Update
hke-soth	Hake in Division VIIIc and IXa (Southern stock);	Spain	Spain	Portugal	Update
mgb-8c9a	Megrim (Lepidorhombus boscii) in Divisions VIIIc and IXa	Spain	Spain	none	Update
mgw-8c9a	Megrim (Lepidorhombus whiffiagonis) in Divisions VIIIc and IXa	Spain	Spain	none	Update
mgw-78	Megrim (L. whiffiagonis) in Subarea VII & Divisions VIIIa,b,d,e	Spain	Spain	none	Update

sol-bisc	Sole in Divisions VIIIa,b,d (Bay of Biscay)	France	France	none	Update
ple-89a	Plaice in Subarea VIII and Division IXa	Ireland	Ireland	none	Multiyear
whg-89a	Whiting in Subarea VIII and Division IXa	Ireland	Ireland	none	Multiyear
nep-2324	Nephrops in Divisions VIIIa,b (Bay of Biscay, FU 23, 24)	France	France	none	Biennial 1st year
Nep-VIIIc					
nep-25	Nephrops in North Galicia (FU 25)	Spain	Spain	none	Biennial 1st year
nep-31	Nephrops in the Cantabrian Sea (FU 31)	Spain	Spain	none	Biennial 1st year
Nep-IXa					
nep-2627	Nephrops in West Galicia and North Portugal (FU 26-27)	Spain/ Portugal	Spain/ Portugal	Portugal/ Spain	Biennial 1st year
nep-2829	Nephrops in South-West and South Portugal (FU 28-29)	Spain/ Portugal	Spain/ Portugal	Portugal/ Spain	Biennial 1st year
nep-30	Nephrops in Gulf of Cadiz (FU 30)	Spain/ Portugal	Spain/ Portugal	Portugal/ Spain	Biennial 1st year

For the following stocks, WGBIE will finalise the draft text on ecosystem and fisheries information based on draft advice prepared by WGNEW:

Fish Stock	Stock Name	Stock Coordinator	Assess. Coord. 1	Assess. Coord. 2	Advice
gug-89a	Grey gurnard in Subarea VIII and Division IXa	Ireland	Ireland	none	WGNEW
pol-89a	Pollack in Subarea VIII and Division IXa	Spain	Spain	none	WGNEW
sol-8c9a	Sole in Divisions VIIIc and IXa	Portugal	Portugal	none	WGNEW

1.2 Summary by Stock

The stocks assessed within WGBIE are distributed from ICES Division IIIa to IXa (Figure 1.1). Figure 1.2 shows the distribution areas of the *Nephrops* Functional Units (FUs).

Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)

Hake is caught in nearly all fisheries in Subareas VII and VIII and also in some fisheries in Subareas IV and VI. Spain accounts 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 86 100 t in 2013, the highest value since 1963. In 2013, landings were well above the 2013 TAC (69 440 t).

The Northern hake emergency plan (EC 1162/2001, EC 2602/2001 and EC 494/2002) was followed by a recovery plan in 2004 (EC 811/2004). The recovery plan aims at achieving a spawning stock biomass (SSB) of 140 000 t (B_{pa}). This is to be achieved by limiting fishing mortality to F=0.25 (F_{pa}) and by allowing a maximum change in TAC between consecutive years of 15%. ICES advised in 2008 that the northern hake stock had met the SSB target in the recovery plan for two consecutive years (2006 and 2007). The recovery plan indicates that, in such a situation, a long-term management plan should be implemented. Such a plan is currently under development by the EC.

The 2013 WG carried out an update assessment (following the stock annex specifications) but an important retrospective pattern was detected along the whole historical series. The group decided to fix the growth parameters (a parameter which is estimated in the update assessment) at the values estimated during WGHMM 2011. This removed the retrospective pattern observed but he WG was of the view that, whereas the overall trends estimated by the assessment were representative of stock development, the actual rates of increase and decrease of SSB and F in the most recent years were very uncertain. The stock had a benchmark assessment in February 2014 (WKSOUTH; see also section 1.5.6). One of the main objectives of the workshop was to address the retrospective pattern. It was felt that this pattern was mainly due to changes in the size of hake caught by the majority of the fleets which the assessment model had difficulties to cope with. Most of the benchmark workshop was thus focused on obtaining the most appropriate way to account for the changes in retention and selectivity for the two most influential fleets and the group agreed that the model was an improvement in terms of taking into account the changes in stock structure and accepted the assessment model with the proviso that the model be developed and fine tuned as more data and information become available

This year, the assessment was carried out following the stock annex revised during the benchmark and although the retrospective patterns are still present, they are less important than last year and limited to the recent years. The recruitment appears to fluctuate without substantial trend over the whole series. The recruitment estimated for 2012 is the highest in the whole series (880 million).In 2013, the recruitment decreased to an average level (431 million). From high levels at the start of the series (96 000 t in 1980), the SSB has decreased steadily to a low level at the end of the 90s (25 000 t in 1998). Since that year, SSB has increased to the highest value of the series in 2012 (188 000 t) and decreased slightly in 2013. 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. They declined sharply afterwards to 0.34 in 2012 and increased up to 0.46 in 2013.

The group was requested to provide biological reference points based on the recommendations from WKMSYREF2). A specific software, similar to plotMsy and eqSim, was developed to evaluate the goodness of reference points under a risk analysis approach and values for F_{MSY}, MSY Btrigger, Blim and Bpa were proposed by the WG (see Annex R).

Details about the assessment of this stock are provided in Section 3 and Annex C.

Hake in Divisions VIIIc and IXa

Hake in Divisions VIIIc and IXa 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 2012 were 14 573 t and 19 960 in 2013. Total discards in 2012 were 1 992 and 4 082 in 2013, 25% higher than the previous maximum in the series. Total catches were 16 633 and 24 042 in 2012 and 2013, representing a 65% increase.

A Recovery Plan for southern hake and Iberian *Nephrops* was enacted in 2006 (EC 2166/2005). This plan aims to rebuild the stock to within safe biological limits, corresponding to 35 000 t of SSB (B_{pa}), driving fishing mortality to 0.27. A fishing mortality rate reduction of 10% should be applied every year, with a constraint of 15% maximum change in TAC between any two consecutive years. The regulation also includes effort management measures. The plan is in the process of being revised jointly by STECF/ICES and developing towards F_{MSY} targets, with the possible inclusion of anglerfish stocks. This is, however, work under development and no new plan has yet emerged.

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

The recruitment (age 0) is highly variable and presents two different periods: one from 1982 to 2003 with mean figures around 70 million, ranging from 40 to 120, and a recent period from 2004 to latest with a mean of 119 million ranging from 70 to 180 million. Fishing mortality increased from the beginning of the time series (F=0.36 in 1982) peaking in 1995 at 1.18; declining to 0.77 in 1999 and remaining relatively stable until 2013 (F=0.94). 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 900t in 1998. Since then biomass has continuously increased, reaching 17 800 in 2013, slightly above the 2012 figure (17 400 t)

In 2010, WGHMM proposed an F_{MSY} proxy based on the benchmark assessment and the same value was kept this year. This year, the group has made a proposal for Blim.

Details on the assessment of this stock are in Section 7 and Annex G.

Anglerfish (Lophius piscatorius and L. budegassa) in Divisions VIIb-k and VIIIa,b,d

Both species are caught on the same grounds and by the same fleets and are usually not separated by species in the landings. Anglerfish is an important component of mixed fisheries taking hake, megrim, sole, cod, plaice and *Nephrops*. Spain and France together contribute about 80% of total stock landings. The TAC for both species combined was set at 36 953 t for 2013 and at 42 496 t for 2014. Estimated landings of 36 855 t in 2013 are at the highest level over the last 10 years and the fourth highest of the time series.

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

For *L. piscatorius* the available data indicate that the biomass has been increasing as a consequence of the good recruitment observed in 2001, 2002 and 2004 and has stabilised in recent years. There is evidence of good recruitments in 2008, 2009, 2010 and 2011. 2008 and 2009 recruitments have entered the fishery giving one of the higher yields of the time series. Recruitment in 2012 and 2013, lower than previous years could have implications in the total biomass of the stock in the future.

For *L. budegassa* survey data give indication that the biomass has shown a continuous increase since the mid 2000's as a consequence of several good incoming recruitments. There is good evidence of a strong incoming recruitment from 2008. The EVHOE-WIBTS-Q4 shows evidence of a medium level of recruitment in 2010 and the last three years has recorded its historical maximum. Length frequency distributions from the two available surveys show contradictory signals for 2009, 2011 and 2012 recruitments, but the working group considers that the trend of EVHOE is more representative due to the larger coverage of the survey.

Measures should be taken to ensure good survival of recent recruitments. For both anglerfish species, data from surveys tracking recent good recruitment give scope for growth studies that should be initiated as soon as possible.

More details on the anglerfish assessment can be found in Section 4 and Annex D.

Anglerfish (L. piscatorius and L. budegassa) in Divisions VIIIc and IXa

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 2013 were 2 188 t. The combined TAC was set at 2475 t in 2013 and 2629 t in 2014

A benchmark assessment was carried out in 2012 for these stocks. Age determination problems prevent the application of an age-structured model. The two species are assessed separately, using a surplus-production model (software ASPIC), tuned with commercial LPUE series for *L. budegassa* and a length based SS3 implementation for *L. piscatorius*.

Biomass of *L. piscatorius* decreased during the 1980s and early 1990s, but has progressively increased over the last two decades to 7,107 tonnes in 2013. No biomass reference points have been determined for this stock. Fishing mortality peaked during the late 1980's but has since declined and is currently stable and close to F_{MSY} (0.19). 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 untill 2001, since then a slight recovery was observed, being in 2014 at 89% of B_{MSY}. Fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2013, fishing mortality is estimated to be below F_{MSY}.

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

More details are provided in Section 8 and Annex H.

Megrim (Lepidorhombus whiffiagonis) in Divisions VIIb-k and VIIIa,b,d

L. whiffiagonis in Div. VIIb-k and VIIIa,b,d is caught in a mixed demersal fishery catching anglerfish, hake and *Nephrops*, both as a targeted species and as valuable bycatch. The 2013 TAC was set at 19 101 t and 2014 TAC 19 101 t, including a 5% contribution of L. boscii in the landings for which stock there is no assessment. Landings in 2013 are higher than in 2012 (20%), reaching up to 15 800 t. Discarding of smaller megrim is substantial and also includes individuals above the minimum landing size of 20 cm. The discards estimate for 2013 are, 4137 t

The stock was assessed with XSA until 2006, but severe deficiencies in the input data made it impossible to continue conducting an analytical assessment. There was some improvement of the data situation in 2009, although a number of important issues remained to be resolved (see Annex P, concerning stock data problems). The stock underwent a benchmark in 2012 at which the commercial CPUE series were revised and discard data compiled for a number of important fleets. A Bayesian catch at age model was investigated but due to underlying issues with the catch at age data could only be considered to be indicative of trends in the fishery and therefore not sufficient to form the basis of projections.

In this year assessment, the use of the Bayesian statistical catch-at-age model gives very promising results and the model is able to address the heterogeneity in the Northern Megrim data in a very satisfactory way. The model fit to the data is adequate and the WG considers that the current assessment can be fully accepted and not only as indicator of trend as in the last benchmark. However, some work is still needed in order to develop the basis for short term projection and that is the reason why, in this year assessment, no projections have been carried out directly from the assessment. The development of framework for projections based on the bayesian stock assessment model will be conducted intercessionaly and made available to the WG next year. Catch, landing and discard data and survey indices do not appear to indicate the presence of important change in trends of recruitment or the overall biomass. The stock appears stable at the present level of fishing.

Details of the available data and analysis carried out during the WG are provided in Section 5 and Annex E.

Megrims (L. whiffiagonis and L. boscii) in Divisions VIIIc and IXa

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 2013 were 1342 t (of which 80% correspond to *L. whiffiagonis*), above the TAC of 1 214 t, which is set for both species combined. The agreed combined TAC for megrim and four-spot megrim in ICES Divisions VIIIc and IXa was 1214 t in 2013 and 2257 t in 2014.

The species are assessed separately, using XSA for each of them. The two species had a benchmark assessment in 2014 (WKSOUTH). For *L. whiffiagonis*, discards data were incorporated in the assessment resulting in catch numbers-at-age as input data from 1986 to 2013. New indices tuning fleet were also included. For *L. boscii*, discards data were also incorporated into the assessment and fine tuning of the model was also carried out. The stock annexes of both stocks have been updated and can be found in annex I.

For *L. whiffiagonis* the assessment indicates that fishing mortality has decreased in 2013, after the two increasing values of 2011 and 2012. The SSB values in 2007-2010 are the lowest in the series. 2011 and 2012 SSB values are significantly higher and similar to those that occurred in the nineties. SSB for 2013 shows again an increase. After a very high recruitment (at age 1) value in the series in 2010 and the followings decreases, the last year the recruitment value shows an increase.

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 2013 the SSB is estimated at 5835 t. Recruitment has fluctuated around 45 million fish during all the series. Very weak year classes are found in 1993 and 1998. The highest value occurred in 2009, while 2013 value is the lowest in the series, with 14 million fish. Estimates of fishing mortality values show two different periods: an initial one with higher values from 1989 to 1996 and, following a decrease in 1997, a second period stabilised at a lower level, with small ups and downs. From 2007, the F has been de-creasing, till 2013, when a significant increase has occurred with a value of 0.35.

Following recommendations from WKMSYREF2, proposal for references points have been made by WKSOUTH and reviewed and accepted by WGBIE.

Details of the assessments are presented in Section 9 and Annex I.

Sole in Divisions VIIIa,b (Bay of Biscay)

Bay of Biscay sole is caught in ICES Divisions VIIIa 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). Landings in 2013 were 4 234 t, whereas the TAC was 4 100 t.

In 2006 a multiannual plan for the sustainable exploitation of the stock of sole in the Bay of Biscay (EC regulation 388/2006) was established, which set the objective of bringing SSB above 13 000 t (B_{pa}) in 2008. This was to be attained by gradually reducing the fishing mortality rate (10 % annual reduction), while constraining the TAC change to a maximum of 15% between consecutive years. ICES advised in 2009 that the SSB target had been met in 2008. According to the plan, the Council should therefore decide on a long-term fishing mortality target and a rate of reduction to be applied in order to reach it. This has not yet happened although work is currently under development jointly by STECF and ICES.

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

Until last year, no recruitment indices were available for tuning the assessment. A benchmark workshop recommended the inclusion of the ORHAGO survey in order to provide such information and this inclusion was accepted in last year assessment. This year the assessment was carried out with the inclusion of the ORHAGO survey (FR-ORHAGO) has described in the stock annex.

This year, an attempt was made to update the reference points following the frame-work of WKMSYREF2. However, the group did not have enough confidence in the results to propose new reference points. This work will be carried out intersessionnaly.

Since 1984, fishing mortality has gradually increased, peaking in 2002 and decreased substantially the following two years. It increased in 2005 and, later on stabilized at around 0.42 (= Fpa). The SSB trend in earlier years increases 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 is above Bpa since 2010. 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 GM93-11 (22.7 million). However, the 2012 and 2013 values are the lowest of the series (11.1 million and 10.7 million respectively)

In previous assessment, the XSA recruitment estimate in the terminal year was considered very uncertain and was overwritten by a short GM series from 1993 to the antepenultimate assessment year. This year, the retrospective analyses show that the 2012 recruitment was well estimated and that this recruitment was confirmed to be at a low level. The group therefore considers that, with the inclusion of the ORHAGO survey, the estimate of the recruitment for last year (2013 in this year assessment) has improved compared to previous assessment and decided to keep the value estimated by the assessment model.

Details on the assessment are in Section 6 and Annex F of the report.

***Nephrops* in ICES Division VIIIa,b**

There are two Functional Units in ICES Division VIIIa,b: FU 23 (Bay of Biscay North) and FU 24 (Bay of Biscay South), see Figure 1.2. *Nephrops* in these FUs are exploited by French trawlers almost exclusively. Landings declined until 2000, from 5 900 t in 1988 to 3 100 t in 2000. After that year, they increased again to around 3 700 t, staying at that level for some time. Since 2006 landings have been around 3,300 t. In 2012 and 2013, a strong reduction of the landings occurred (2 520 t in 2012, 2 380 t in 2013). The agreed TAC for 2014 was 3 899 t (the same as for 2013).

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

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

The stock was assessed this year using XSA. Due to strong retrospective pattern, the results were considered only as indicative of stock trends. Results indicate that recruitment presents an overall decreasing trend since 2004-2005. SSB has declined since the years 2007 down to the historically lowest levels in 2012 and 2013. F shows an increase from the late 1990’s to 2005-2006 followed by a decreasing trend.

Details can be found in Section 10 and Annex J.

***Nephrops* in ICES Division VIIIc**

There are two Functional Units in Division VIIIc (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. The fishery takes place throughout the year, with the highest landings in Spring and Summer. At present, the trawl fleet comprises three main components: baca bottom trawl, high vertical opening trawl (HVO) and bottom pair trawl, of which only the baca trawl catches *Nephrops*. Landings from both FUs have declined dramatically in recent years reaching 10t in each FU in 2013, below the TAC in recent years, which has not been restrictive. The TACs were set at 74 t and 67 t for the whole Division VIIIc for 2013 and 2014, respectively.

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

FU 25 (North Galicia): Landings were reported only by Spain. Since the early 90s landings declined from about 400 t to less than 100 t in 2003. In the period 2004-2012, landings show a continuous decreasing trend down to 10 t in the last. The time series of the commercial landings shows a clear declining trend, with present values representing approximately 1% of the landings in the 70s. Discards in this functional unit remain insignificant.

FU 31 (Cantabrian Sea): landings from this FU are reported by Spain (the only participant in the fishery) and are available for the period 1983-2013. 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 to less than 10 t in the period 2009-2011. In 2012 and 2013, landings were 10 t each year.

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, as was done in 2012. The results in this year indicate an extremely low abundance level

Additional details are provided in Section 11 and Annex K of the report.

***Nephrops* in ICES Division IXa**

There are five Functional Units in Div. IXa (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 2013 from the five FUs combined were 238 t. The TAC set for the whole Division IXa was 246 t and 221 t for 2013 and 20143.

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 VIIIc, described above.

Landings are reported by Spain and minor quantities by Portugal. Spanish fleets fish in FU 26 and FU 27, whereas Portuguese artisanal fleets fish with traps in FU 27. Two periods can be distinguished in the time series of landings available 1975-2013. During

1975-1989, the mean landing was 680 t, fluctuating between 575 and 800 t ap-proximately. Since 1990 onwards there has been a marked downward trend in landings, being below 50 t from 2005 to 2011. In the two last years, landings continued to decrease down to only 3 t in 2013, the lowest value in the time series. Landings in 2013 represent less than 1% of the landings prior to 1990. Discards rates are negligible.

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

FU 28+29 (SW and S Portugal): *Nephrops* is taken by a multi-species 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 deepwater 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 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

This stock underwent an inter-benchmark protocol in 2012 with an inconclusive outcome. Considerable effort had been devoted to obtaining an appropriately standardised LPUE index from the crustacean trawl fleet, which takes into account the mixed nature of the fishery and the shifts between different target species. In addition a revised XSA was presented. Although the LPUE standardisation was considered to be appropriate the XSA assessment was not accepted as indicative of stock trends and the assessment of this stock is based on CPUE and effort trends with the overall conclusion that the stock is stable at the current rate of exploitation.

According the ICES data-limited approach, this stock is classified in the category 3.2.0. The advice is based on survey and fishery CPUE and effort trends. The standardized effort shows a consistent declining trend since 2005 reaching a historic low in 2009-2010. In the following years, the effort had a slight increase however still remaining at a low level. The fleet standardized CPUE, used as index of biomass, decreased in the period 2006-2011. The index has been increasing in recent year.

FU 30 (Gulf of Cádiz): *Nephrops* in the Gulf of Cádiz is caught in a mixed fishery by the trawl fleet. Landings are markedly seasonal with high values from April to September. Landings were reported by Spain and minor quantities by Portugal. Landings increased from 100t in the mid 90s to a higher level at the beginning of the 2000s. Landings have decreased again until 2008 and then remained around 100t from 2008 to 2012. They have dropped to 26 t in 2013. The reason for this drop is that the quota in 2012 was exceeded and the European Commission applied a sanction which will be paid in 3 years. So, the Nephrops fishery was closed almost whole 2013 and vessels could only went fishing *Nephrops* a few days in summer and winter.

According to the ICES data-limited approach, this stock is considered as category 3.2.0. FU 30 is assessed by the analysis of the LPUE series trend, as was done in 2012. Since 2010, the commercial directed *Nephrops* LPUE shows an increasing trend achieving in 2013 a high value but the *Nephrops* fishery was closed the most part of the year, which increases the uncertainty associated with the LPUE index in 2013. The signal of the abundance index in the 2013 survey is comparable to the values of higher abundance in the time series.

The five *Nephrops* FUs (assessed as 3 separate stocks) are managed jointly, with a single TAC set for the whole of Division IXa. 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 12 and Annex L.

1.3 Data available

For the first time, ICES launched a formal data call for WGBIE in 2014, in order to prepare the datasets for the working group and progress on the use of InterCatch. The data call can be found in Annex T. Catch (totals and/or age–length structured) and effort data according to species, country, area and métier were requested.

As shown in the table below not all countries managed to deliver data for all species by the deadline : around 65% of stock x country strata were uploaded (43 on 67). All data was available at the start of the meeting though permitting an update for all stocks assessed by WGBIE. Uploading the data into InterCatch was part of the data request but as a result, only few of the stocks among the 21 listed in the datacall used InterCatch as the only tool to compute the model entry files. For all other stocks, InterCatch was partly used or not used at all, the remaining data being delivered directly to each Stock Coordinators.

Stock	Country	Data provided on deadline in IC (Y/N)	Data available at the start of the meeting (Y/N)	Data uploaded in Intercatch (IC) or provided to Stock Coordinators (SC)
anb-78ab	Belgium	Y	Y	IC + SC
anb-78ab	France	N	Y	IC + SC
anb-78ab	UK EW	Y	Y	IC + SC
anb-78ab	UK Sco	Y	Y	IC + SC
anb-78ab	Ireland	Y	Y	IC + SC
anb-78ab	Spain	Y	Y	IC + SC
anp-78ab	Belgium	Y	Y	IC + SC
anp-78ab	France	N	Y	IC + SC
anp-78ab	UK EW	Y	Y	IC + SC
anp-78ab	UK Sco	Y	Y	IC + SC
anp-78ab	Ireland	Y	Y	IC + SC
anp-78ab	Spain	Y	Y	IC + SC
sol-8c9a	Spain	Y	Y	IC
sol-8c9a	Portugal	N	Y	IC
hke-nrtn	UK Sco	Y	Y	IC
hke-nrtn	Belgium	Y	Y	IC
hke-nrtn	France	N	Y	IC
hke-nrtn	Ireland	Y	Y	IC
hke-nrtn	UK EW	Y	Y	IC

hke-nrtn	Spain	Y	Y	IC
hke-nrtn	Netherlands	N	Y	IC
hke-nrtn	Sweden	Y	Y	IC
hke-nrtn	Denmark	Y	Y	IC
hke-nrtn	Norway	Y	Y	IC
hke-nrtn	Germany	Y	Y	IC
hke-nrtn	UK NI	Y	Y	IC
hke-soth	Spain	Y	Y	IC + SC
hke-soth	Portugal	Y	Y	IC + SC
hke-soth	France	N	Y	IC
mgw-78	Spain	N	Y	IC + SC
mgw-78	France	N	Y	SC
mgw-78	UK EW	Y	Y	IC + SC
mgw-77	UK NI	N	Y	IC
mgw-78	UK Sco	Y	Y	IC + SC
mgw-78	Ireland	Y	Y	IC + SC
mgw-78	Belgium	Y	Y	IC + SC
nep-9a (26-27)	Spain	N	Y	IC + SC
nep-9a (26-27)	Portugal	Y	Y	IC + SC
nep-9a (28-29)	Spain	N	Y	IC + SC
nep-9a (28-29)	Portugal	Y	Y	IC + SC
nep-9a (30)	Spain	N	Y	
nep-9a (30)	Portugal	N	Y	IC + SC
nep-8c(25)	Spain	N	Y	SC
nep-8c(31)	Spain	N	Y	SC
nep-8ab(23-24)	France	N	Y	SC
sol-bisc	France	N	Y	SC
sol-bisc	Belgium	Y	Y	IC + SC
anb-8c9a	Spain	Y	Y	IC + SC
anb-8c9a	Portugal	Y	Y	IC + SC
anp-8c9a	Spain	Y	Y	IC + SC
anp-8c9a	Portugal	Y	Y	IC + SC
mgb-8c9a	Spain	N	Y	SC
mgb-8c9a	Portugal	Y	Y	SC
mgw-8c9a	Spain	N	Y	SC
mgw-8c9a	Portugal	Y	Y	SC
ple-89a	France	N	Y	IC
ple-89a	Portugal	Y	Y	IC
ple-89a	Spain	N	Y	IC
whg-89a	France	N	Y	IC
whg-89a	Spain	Y	Y	IC
whg-89a	Belgium	Y	Y	IC
bss-8ab	France	N	Y	SC
bss-8ab	Spain	Y	Y	IC
bss-8ab	UK EW	N	Y	IC
bss-8ab	Belgium	Y	Y	IC

bss-8c9a	Spain	Y	Y	IC
bss-8c9a	Portugal	Y	Y	IC

As in previous years, data for 2014 were prepared in advance of the meeting and all revisions to data are referred to in the appropriate stock sections. However, WGBIE has again experienced significant delays and issues regarding data delivery. **This is a major matter of concerns for the working group members and, as in previous years, the assessments could not be carried out in National Laboratories prior to the meeting as mentioned in the ToRs**. This year however, data for all stocks for which an update assessment was required were available at the start of the meeting.

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

In many cases, national statistics for recent years are either not currently available officially or are of a preliminary nature. As a consequence, the official landings (http://www.ices.dk/fish/statlant.asp) provided to ICES by statistical offices are of limited relevance for the assessments.

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 VII, as well as for the *Nephrops* FUs in VIIIc and IXa, or to a combination of species in the cases of anglerfish and megrim.

Biological sampling levels by country and stock are summarised in Table 1.3.

1.4 Stock Data Problems Relevant to Data Collection

WGBIE identified the following issues for further discussion by the PGCCDBS in relation to stock data problems relevant to data collection. These are listed in the table included in Annex S of the report

1.5 Issues that arose during the WGBIE meeting

1.5.1 Revision of the MSY reference points

WGBIE was asked to address the following Terms of Reference:

ToR c) With reference to the recommendation of WKMSYREF2, reconsider MSY reference points for northern hake. If possible, also establish precautionary reference points. The application of updated reference points will, however, be contingent on the availability of up to date fishery data to calculate relevant values.

The answer to this ToR is given in annex R of the report.

1.5.2 Unallocated landings

This year, for some stocks, a bulk of landings was uploaded into Intercatch without any allocation to a specific country, metier, time or area. These "unallocated" catches were subsequently allocated to country, métier and areas in order to get the best possible assessment of the stock status. A description of the approach used to allocate theses catches is presented in each data sections of the stocks concerned.

1.5.3 Use of InterCatch by WGBIE

This year, some progress has been made by the group with regards to the use of InterCatch. One stock is using exclusively InterCatch as a tool to compute the model entry files and several stocks are partly using InterCatch in this process. A demonstration of the use of the Intercatch database for the preparation and the compilation of the data for the assessment was made by Henrik Kjems-Nielsen from the ICES secretariat. Several questions emerged from the WG on the different steps needed to download and raise assessment data. These issues were addressed during the WG.

1.5.4 Update on the Data compilation workshop on anglerfish stocks in ICES areas.

In preparation for the anglerfish data compilation workshop in November 2014, the group met by means of WebEx, once at the end of 2013 and once during March 2014, to discuss the work plan for the two species of anglerfish, *Lophius piscatorious* and *Lophius budegassa*, in the North East Atlantic. For both species, new studies, data requirements and issues where explored and a timetable for a data call was discussed.

Some of the issue explored and highlighted during the two WebEx's included data and biological problems and deficiencies outlined below;

i) Different aging methodologies used by individual countries reveal differing results, suggesting that age based model should not be an option, however growth information is still required.

ii) Whether to assess each species as a single stock rather than four smaller stock components and if the stock area should be extended to the Faroes and Iceland.

iii) The potential issue with splitting the two species as they are landed together and are split using samples from the commercial fisheries from each of the countries where sampling intensities, design and time period differ.

iv) The quality and lack of discard data.

v) The quality and lack of other biological information such as length-weight, maturity and mortality.

The next stages in the process were discussed with the main outcomes of stock coordinators putting together and discussing the work plans, issues and aligning the data requirements in preparation for the data call, provisionally scheduled for release before August 2014, and to obtain the help of the expert working group on stock ID methods (WGSIM) to identify methods and procedures to address the stock ID and boundary issue put to the group.

1.5.5 Stock annexes

This year the stock annex that was still missing (Sole in Divisions VIIIc and IXa) has been prepared and is presented as Annex Q of the WG report. Hence, all stocks assessed by this WG now have a stock annex.

1.5.6 Summary of benchmark in 2014

The benchmark workshop on hake and southern megrim (WKSOUTH, 2014) met in November 2013 and February 2014 to assess the data and benchmark the assessments of the Northern and Southern hake and the Southern stocks of megrim and four spot megrim (ICES 2014/ACOM:40). With the exception of reference points for the megrim and four spot megrim all the work on the assessment methodologies were finalised and agreed before the end of the workshops. During WebEx's after the workshop the reference point methodology for the two stocks of megrim were agreed upon with the recommendation that the expert working group WGBIE assess and evaluate the proposed reference points along with the methodology and proposed reference points for northern hake.

Northern and southern hake

Given the expansion in spatial distribution and recent changes in the size structure for hake where the commercial sampling of length distributions show an increase in the larger fish in the most recent years, recommendations were agreed to request additional data from surveys on the larger fish and survey data covering areas where the stock has expanded in to. It was also recommended that commercial sampling levels from countries which land hake need to be revisited.

Additional recommendation from the group to develop both assessment models included obtaining sex specific data to allow the models to more accurately estimate growth and better account for the proportion male-female at length.

Given the complexity of the northern stock of hake and data, and the difficulties surrounding its assessment it must be acknowledged that the assessment may still display some instabilities in coming years. Most of the benchmark workshop was focused on obtaining the most appropriate way to account for the changes in retention and selectivity for the two most influential fleets and the group agreed that the model was an improvement in terms of taking into account the changes in stock structure and accepted the assessment model with the proviso that the model be developed and fine tuned as more data and information become available.

For the southern stock of hake long run times and optimisation issues presented limitations for model exploration and the majority of the time was devoted to checking the model was consistently reaching an optimised solution. As a result, the group accepted the continuation of the methodology already used, but as with northern hake model development was recommended and the use of a two sex model introduced.

Southern megrim and four spot megrim

For southern stocks of megrim and four spot megrim the meetings were spent improving the input data and fine tuning the model and data already used for assessment purposes. A number of methodologies were presented for raising discards in years where discard sampling was not available; recommendations were agreed by the group to further develop these methodologies to give better estimates of discards for inclusion in the model. Both assessments and forecast methodologies where accepted by the group and biological reference points were discussed. Additional work on biological reference points continued after the benchmark workshop and was presented during WebEx meetings, the methodologies and results presented were accepted by the group with the expectation that the expert working group WGBIE review the results and methodologies before final acceptance.

1.5.7 Proposals for future benchmarks

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

Name	Assement status	Latest Benchmark	Benchmark next year	Planning Year +2	Further Planning	Comments
Anglerfish (Lophius budegassa) in Divisions VIIb-k and VIIIa,b,d	Update	WKFLAT 2012	No	Biology, Discards, LFD, SS3 assessment		All Anglerfish together
Anglerfish (Lophius piscatorius) in Divisions VIIb-k and VIIIa,b,d	Update	WKFLAT 2012	No	Biology, Discards, LFD, SS3 assessment		All Anglerfish together
Megrim (Lepidorhombus whiffiagonis) in Divisions VIIb-k and VIIIa,b,d	Update	WKFLAT 2012	No	Data compilation workshop to review data (discards, landings, survey).		
Nephrops in Division IXa (FU 28-29)	Biennial	IBP Nephrops 2012	2015			
Nephrops in Division IXa (FU 30)	Biennial		2015			
Nephrops in Divisions VIIIa,b (Bay of Biscay, FU 23, 24)	Biennial	IBP Nephrops 2012	2015			
Sole in Divisions VIIIa,b (Bay of Biscay)	Update	2013 (InterBenchmark)			Adding Discards, Maturity ogive, mean weight at age, Update reference points	
Anglerfish (Lophius budegassa) in Divisions VIIIc and IXa	Update	WKFLAT 2012	Yes	Biology, Discards, LFD, SS3 assessment		All Anglerfish together
Anglerfish (Lophius piscatorius) in Divisions VIIIc and IXa	Update	WKFLAT 2012	Dependant on the output of the data compilation Workshop			All Anglerfish together

1.5.7.1 Benchmark planning

The WG reviewed the situation this year and decided to go ahead with the benchmarks proposed for the start of 2015. The ICES benchmark preparation tables by stock were reviewed during the WG meeting. The WG indentified potential directions of solution to improve the assessments of those stocks without deciding yet on any preferred options. They include the use of Under Water TV surveys, length based or biomass dynamic assessment models. It was however not possible during the WG to make proposal for external experts in those area. Proposals for such experts will be put forwards by the stock coordinators by mid-June so that the selected expert can plan well in advance their participation in the benchmark. The updated tables and relevant comments regarding the 2015 benchmarks are included in Annex N ("Benchmark planning for 2015").

1.5.7.2 Longer-term benchmark planning

WGBIE is also proposing longer term benchmarks and issues that should be addressed in the next round of benchmarks have been listed, even though they are several years in the future. Several benchmarks are thus proposed :

a) For 2016, the group proposed a benchmark for all anglerfish stocks of WGBIE, preferably in conjunction with the anglerfish stocks (*Lophius piscatorius* and *L. budegassa*) in Division IIIa, Subarea IV, VI from the other ICES EWG WGCSE to address issues related to biology of the species (growth and maturity), compilation of data on discards and to develop quantitative stock assessments method.

b) For the stock of megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d the WG proposes to have a Data Compilation workshop to review the basic data (catch and survey data).

c) on longer term without precise date, the stock of Sole in the Bay of Biscay to include discards in the assessment, reconsider the maturity ogive and mean weights at age currently used, set recruitment age at age 1 (currently age 2) and to update reference points.

1.5.7.3 Presentation of a proposal from Ifremer for an ecosystem survey in the English Channel.

A presentation of a proposal from Ifremer for an ecosystem survey in the English Channel was made during the WG. The objective of the survey is to extend westwards the current CGFS (Channel Ground Fish Survey) which is carried out in October each year since 1988 in the eastern English Channel. The aim is also to move from a groundfish survey to an ecosystem sampling survey (physico-chemical environment, plankton, megabenthos, all fish, birds and marine mammals observations). The survey is expected to collect a large spectrum of data (Relative abundance, size structure, relation between size, age, maturity, stomach content and trophic level) on several species distributed in the English Channel. A first survey will be carried out autumn 2014.

The WG considers that the data collected by such survey could potentially be very useful to provide information on the ecosystem of this area and on several species for which very little information is currently available. The WG notes however that the area where this survey will take place is outside the distribution areas of the stocks the WG has to assess.

1.6 Mixed Fisheries considerations

The potential application of a mixed fisheries approach on WGBIE stocks was described in a WD presented last year to WGHMM 2013. Due to the scarce number of accepted assessments of the northern stocks, it was proposed to initially focus on southern stocks. Thus, last year the required data were collected in order to develop a mixed fisheries analysis on Iberian stocks, whose preliminary results were presented to WGMIXFISH-METH 2013. The results were also presented to this year WGBIE in a working document (Castro and Silva, 2014), which can be summarized as follows.

The developed Iberian mixed fisheries analysis consisted of a multi-stock deterministic forecast by using the Fcube method (Ulrich et al, 2011). This method requires, for the commercial data, landings and effort disaggregated by metier and fleet segment and, and for biological data, the population parameters from the stock assessments. On the one hand, the commercial data compilation has required an extra effort which was financially supported by the GEPETO project (Atlantic Area Programme, nº 2011-1/159). On the other hand, the Fcube requirements made to narrow the list of potential stocks to the following five Iberian stocks: hake (HKE), southern stock of horse mackerel (HOM9), four-pot megrim (LDB), megrim (MEG) and white anglerfish (ANK). However, other Iberian stocks could not be included due to lack of quantitative assessment (Nephrops FU25, U2627, FU2829, FU30 and FU31), lack of absolute population parameters (black anglerfish) or to show a geographic distribution greater than the Iberian waters extension (mackerel, western stock of horse mackerel or blue whiting). Finally, five management scenarios were investigated:

- **max**: The underlying assumption was that fishing stops when all quota species are fully utilised with respect to the upper limit corresponding to single stock exploitation boundary.
- **min**: The underlying assumption was that fishing stops when the catch for the first quota species meets the upper limit corresponding to single stock exploitation boundary.
- **hke**: The underlying assumption was that all fleets set their effort at the level corresponding to their hake quota share, regardless of other stocks.
- **sq_E**: The effort was set as equal to the effort in the most recently recorded year for which there are landings and discard data.
- **Ef_Mgt**: The effort in métiers using gear controlled by the EU effort management regime have their effort adjusted according to the regulation (see Council Regulation (EC) Nº 2166/2005).

Results suggest that the length assessed stocks (HKE and MON) need further revision regarding the respective single-stock forecast reproduction. Moreover the inconsistencies observed between LDB and MEG results may indicate two things: the inappropriateness to include stocks assessed separately but managed together, or/and that the small Iberian MEG stock (mgw8c9a) may be part of northern component (mgw78ab). However, as general conclusion we can say that the Fcube method properly captures the TAC-TAE relationships. In fact, the results show HKE as the choke stock, so "scenario hke" forecast multi-TACs more similar to "scenario min" than "scenario Ef_Mgt", which is based on the effort control regime related to the Iberian hake recovery plan (Figure 1.6.1).

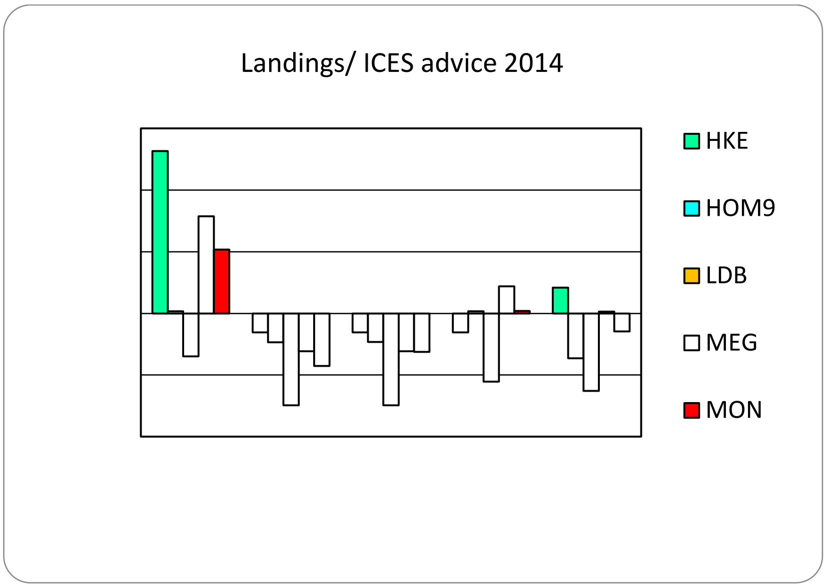


Figure 1.6.1 Plot of ratios of landings (landings expected regarding the ICES advice for 2014) by stock and Fcube scenario.

This Iberian mixed fisheries analysis was accepted by WGMIXFISH-METH as preliminary approach so that the WGMIXFISH-METH report was extended with the respective Iberian sections. In fact, the next step that has been raised is the continuation of the Iberian mixed fisheries analysis updated with results of the WGBIE 2014 assessments, in order to present the results to the WGMIXFIH-METH 2014 next October. In this sense, the developers of the Iberian mixed fisheries analysis want to emphasize the breakthrough that provides the widespread use of InterCatch in order to compile mixed fisheries commercial data, as it will avoid the extra effort made by the national laboratories last year.

Apart the formal ICES context, GEPETO project has provided the Iberian mixed fisheries data collected to the FP7 MyFish project, in which it has been planned the application of stochastic methods on Iberian mixed fisheries, particularly the FLBEIA method,

1.7 Assessment and forecast auditing process

This year WGBIE has carried out internally an audit of individual assessments and forecasts. WGBIE stocks subjected to review are shown in the Table below and the designated auditor is named on the last column. 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. No concerns were raised by the auditors by the end of the meeting. A few corrections in the figures of one stock report were made during the meeting.

Fish Stock	Stock Name	Stock Coord.	Advice	Review
anp-78ab	Anglerfish (L. piscatorius) in Divisions VIIb-k and VIIIa,b	Spain/UK	Update	Cristina Silva
anb-78ab	Anglerfish (Lophius budegassa) in Divisions VIIb-k and VIIIa,b	Spain/UK	Update	Ricardo Alpoim

anb-8c9a	Anglerfish (Lophius budegassa) in Divisions VIIIc and IXa	Portugal	Update	Ane Iriondo
anp-8c9a	Anglerfish (L. piscatorius) in Divisions VIIIc and IXa	Spain	Update	Yolanda Vila
hke-nrtn	Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock);	Spain	Update	Lisa Readdy
hke-soth	Hake in Division VIIIc and IXa (Southern stock);	Spain	Update	Eoghan Kelly
mgb-8c9a	Megrim (Lepidorhombus boscii) in Divisions VIIIc and IXa	Spain	Update	José Castro
mgw-8c9a	Megrim (Lepidorhombus whiffiagonis) in Divisions VIIIc and IXa	Spain	Update	Santiago Cerviño
mgw-78	Megrim (L. whiffiagonis) in Subarea VII & Divisions VIIIa,b,d,e	Spain	Update	Iñaki Quincoces
sol-bisc	Sole in Divisions VIIIa,b,d (Bay of Biscay)	France	Update	João Pereira
nep-2324	Nephrops in Divisions VIIIa,b (Bay of Biscay, FU 23, 24)	France	Biennial 1st year	Dorleta Garcia
nep-25	Nephrops in North Galicia (FU 25)	Spain	Biennial 1st year	Fátima Borges
nep-31	Nephrops in the Cantabrian Sea (FU 31)	Spain	Biennial 1st year	Fátima Borges
nep-2627	Nephrops in West Galicia and North Portugal (FU 26-27)	Portugal	Biennial 1st year	Esther Abad
nep-2829	Nephrops in South-West and South Portugal (FU 28-29)	Portugal	Biennial 1st year	Spyros Fifas
nep-30	Nephrops in Gulf of Cadiz (FU 30)	Spain/Portugal	Biennial 1st year	Spyros Fifas

1.8 References

Ulrich, C., Reeves, S. A., Vermard, Y., Holmes, S. J., and Vanhee, W. 2011. Reconciling single-species TACs in the North Sea demersal fisheries using the Fcube mixed-fisheries advice framework. – ICES Journal of Marine Science, 68: 1535–1547.

Garcia, D., Sanchez, S., Prellezo, R., Urtizberea, A. and M. Andres. (submmitted) FLBEIA: A toolbox to conduct Bio-Economic Impact Assessment of fisheries management strategies. Ecological Modelling.

TABLE 1.3 Biological sampling levels by stock and country. Number of fish measured and aged from landings in 2012

		Angler (L.pisc.)		Angler (L.bude.)		Megrim (L.whiff.)		Megrim (L. boscii)	Sole
		VIIb–k & VIIIa,b,d	VIIIc & IXa	VIIb–k & VIIIa,b,d	VIIIc & IXa	VIIb–k & VIIIa,b,d	VIIIc & IXa	VIIIc & IXa	VIIIa,b
Belgium	No. lengths	2971		5659					7253
	No. ages								199
	No. samples**	14		2					2
E & W (UK)	No. lengths	8661		840		8965			
	No. ages					576			
	No. samples*	97		41		69			
France	No. lengths	17091		8122					16807
	No. ages			0					1869
	No. samples*	950		608					152
Portugal	No. lengths		290		1212		324	2223	
	No. ages***		0		0		0	0	
	No. samples*		74		114		6	55	
Republic of	No. lengths	7662		3454		19216			
Ireland	No. ages	941		10		1004			
	No. samples**	121		82		101			
Spain	No. lengths	5213	6569	8332	4574	15383	5941	23196	

	No. ages		0		0	1199	1174	964	
	No. samples	100	226	102	226	99	169	152	
Denmark	No. lengths								
	No. ages								
	No. samples								
Total	No. lengths	41598	6859	26407	5786	43564	6265	25419	24060
	No. ages	941	0	10	0	2779	1174	964	2068
Total No. in international		NA	286	NA	312	NA	1185	9720	14660
landings (thousands)									
No. Measured as % of		0.3	2.4	0.2	1.9	NA	0.5	0.3	0.2
annual number caught									

*** Vessels**

**** Categories**

***** Ages, surveys**

****** Boxes/hauls (for sampling onboard)**

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

Table 1.3 (continued)

		Hake		Nephrops		
		IIIa, IV, VI, VII & VIIIa,b	VIIIc & IXa	VIIIab FU 23-24	VIIIc FU 25-31	IXa FU 26-30
Scotland (UK)	No. lengths	6636				
	No. ages					
	No. samples*	125				
E & W (UK)	No. lengths	11199				
	No. ages	658				
	No. samples*	140				
France	No. lengths			27440		
	No. Ages*****					
	No. samples****			635		
Portugal	No. lengths		23834			8396
	No. ages***					
	No. samples*		425			33
Republic of	No. lengths	5285				
Ireland	No. ages*****	0				
	No. samples*	92				
Spain	No. lengths	65444	53030		1637	1968

	No. ages					
	No. samples*	499	504		34	19
Denmark	No. lengths	13622				
	No. ages					
	No. samples*	326				
Total	No. lengths	88564	76864	27440	1637	10364
	No. ages	658	0	0	0	0
Total No. in international		NA	35547	269767	274	6114
landings (thousands)						
No. Measured as % of		NA	0.2	0.01	0.60	0.2
annual number caught						

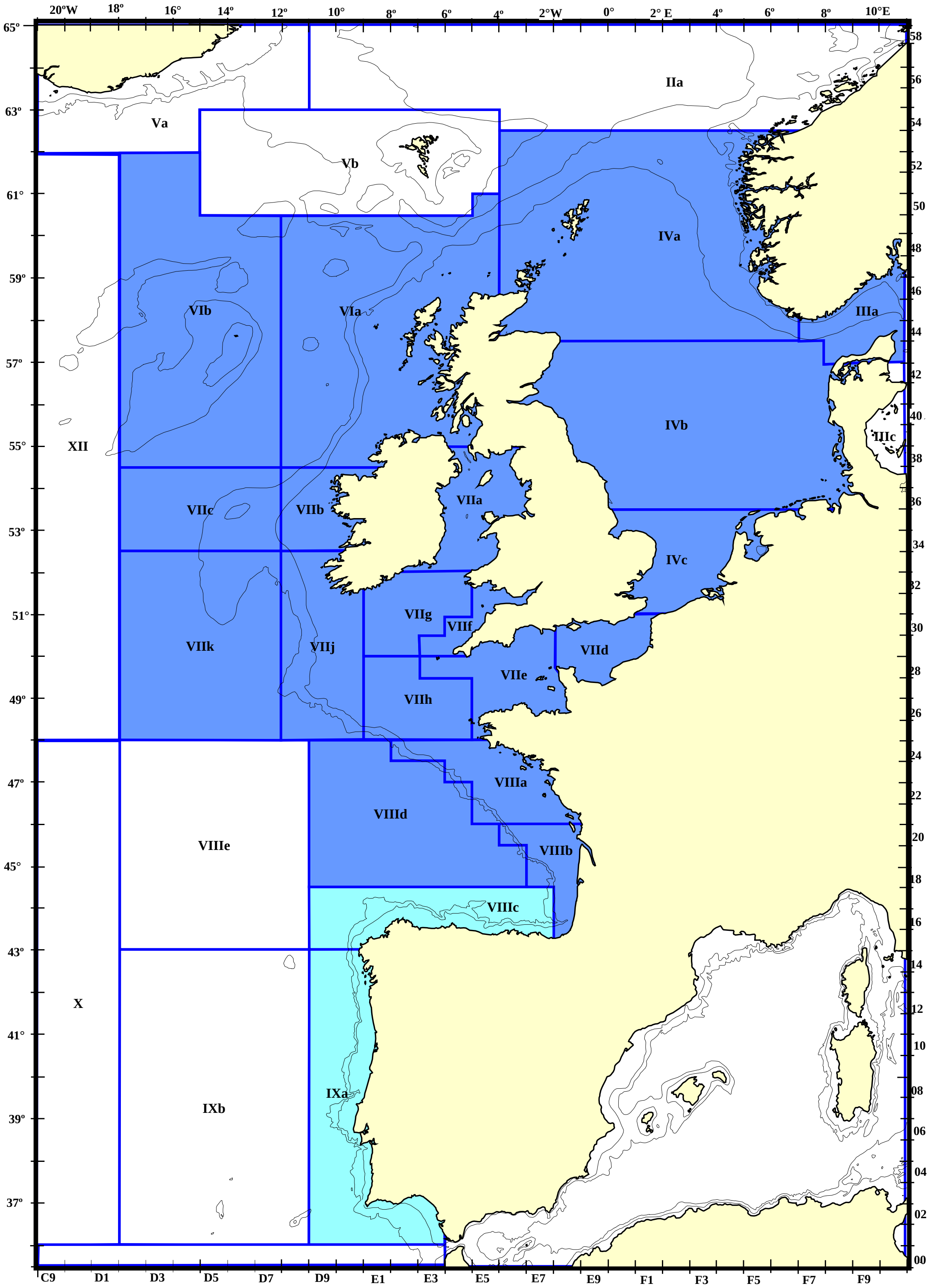


Figure 1.1. Map of ICES Divisions. Northern (IIIa, IV, VI, VII and VIIIabd) and Southern (VIIIc and IXa) Divisions with different shading.

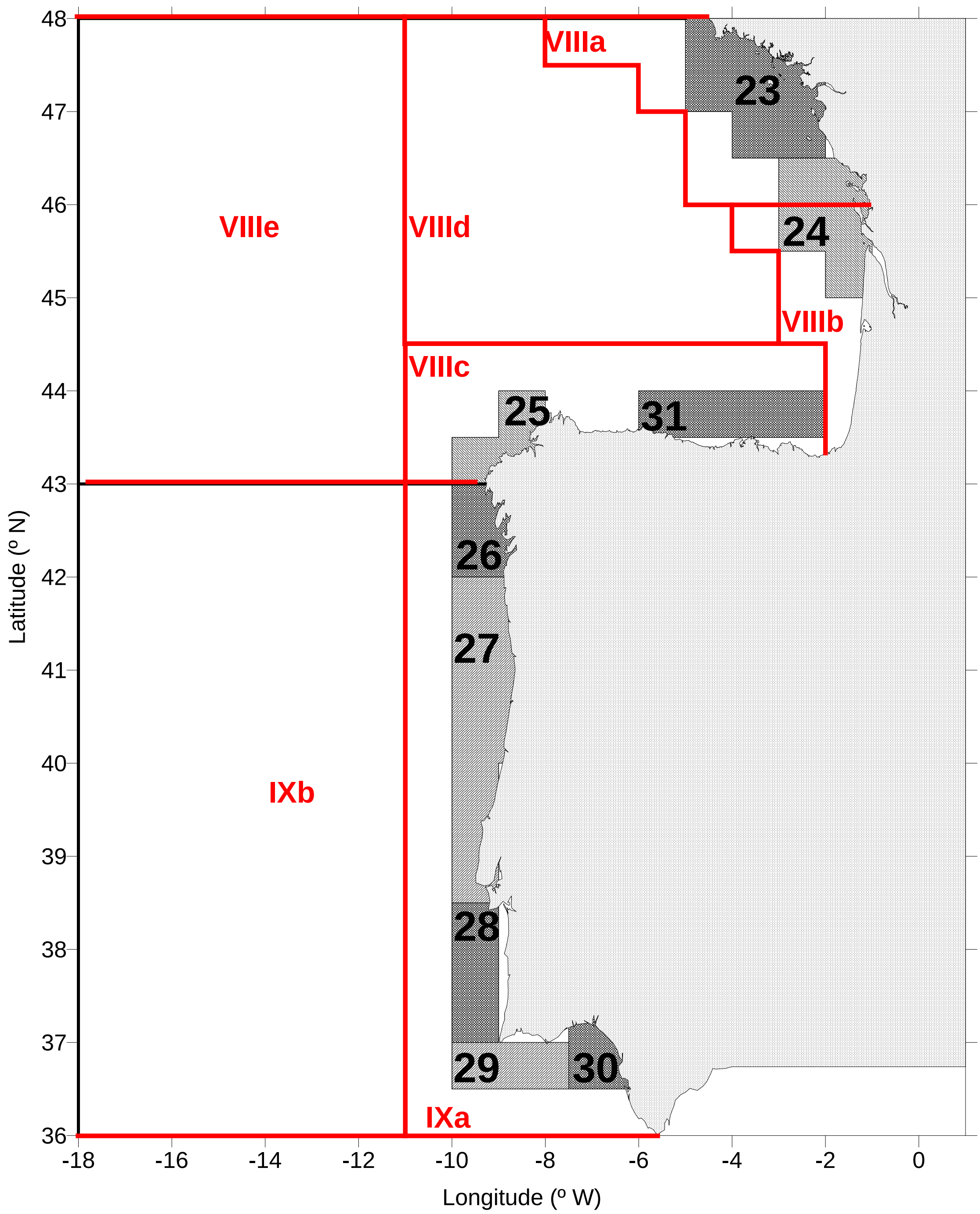


Figure 1.2. ICES Division VIII and IXa. *Nephrops* Functional Units. Division VIIIab (Management Area N): FUs 23-24. Division VIIIc (Management Area O): FUs 25 and 31. Division IXa (Management Area Q): FUs 26-30.

2 Description of Commercial Fisheries and Research Surveys

2.1 Fisheries description

This Section describes the fishery units relevant for 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 VII and Divisions VIIIa,b,d).

The fleets operating in the ICES Subarea VII and Divisions VIIIabd are used in this WG following the Fishery Units (FU) defined by the "ICES Working Group on Fisheries Units in sub-areas VII and VIII" (ICES, 1991):

Fishery Unit	Description	Sub-area
FU1	Long-line in medium to deep water	VII
FU2	Long-line in shallow water	VII
FU3	Gill nets	VII
FU4	Non-Nephrops trawling in medium to deep water	VII
FU5	Non-Nephrops trawling in shallow water	VII
FU6	Beam trawling in shallow water	VII
FU8	Nephrops trawling in medium to deep water	VII
FU9	Nephrops trawling in shallow to medium water	VIII
FU10	Trawling in shallow to medium water	VIII
FU12	Long-line in medium to deep water	VIII
FU13	Gill nets in shallow to medium water	VIII
FU14	Trawling in medium to deep water	VIII
FU15	Miscellaneous	VII & VIII
FU16	Outsiders	IIIa, IV, V & VI
FU00	French unknown	

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

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

Data for stock assessment are typically provided to stock coordinators either still according to the old FUs and the traditional tuning fleets or to the DCF métiers. In the case of discards and/or biological data, even though 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 METIER (Level 6)	DESCRIPTION	FR	IR	SP	UK
FU1	LLS_DEF	LLS_DEF_0_0_0	Set longline directed to demersal fish			X	X
FU2							
FU3	GNS_DEF	GNS_DEF_100-219_0_0	Set gillnet directed to demersal fish (100-219 mm)	X	X	X	
FU4	OTB_DEF	OTB_DEF_70-99_0_0	Bottom otter trawl directed to demersal fish (70-99 mm)		X	X	X
		OTB_DEF_100-119_0_0	Bottom otter trawl directed to demersal fish (100-119 mm)			X	X
FU5	OTB_DEF		Otter trawl directed to demersal Fish shallow water				X
FU6	TBB_DEF		Beam trawl				X
FU8	OTB_CRU						
FU9	OTB_CRU	OTB_CRU_70-99_0_0	Bottom otter trawl directed to crustaceans (70-99 mm)	X	X		X
FU10	OTB_DEF						
FU12	LLS_DEF	LLS_DEF_0_0_0	Set longline directed to demersal fish	X		X	
FU13	GNS_DEF	GNS_DEF_45-59_0_0	Set gillnet directed to demersal fish (45-59 mm)	X			
		GNS_DEF_>=100_0_0	Set gillnet directed to demersal fish (at least 100 mm)	X		X	
FU14	OTB_DEF	OTB_DEF_>=70_0_0	Bottom otter trawl directed to demersal fish (at least 70 mm)	X		X	
	OTB_MCF	OTB_MCF _>=70_0_0	Bottom otter trawl directed to mixed cephalopods and demersal fish (at least 70 mm)			X	
	OTT_DEF	OTT_DEF _>=70_0_0	Multi-rig otter trawl directed to demersal fish (at least 70 mm)	X			

FU	Fleet for InterCatch	DCF METIER (Level 6)	DESCRIPTION	FR	IR	SP	UK
	OTB_CRU	OTB_CRU _>=70_0_0	Bottom otter trawl directed to crustaceans (at least 70 mm)	X			
	OTT_CRU	OTT_CRU _>=70_0_0	Multi-rig otter trawl directed to crustaceans (at least 70 mm)	X			
	OTB_MPD	OTB_MPD _>=70_0_0	Bottom otter trawl directed to mixed pelagic and demersal fish (at least 70 mm)			X	
	PTB_DEF	PTB_DEF _>=70_0_0	Bottom pair trawl directed to demersal fish (at least 70 mm)			X	
FU15	SSC_DEF		Fly shooting seine directed to demersal fish				
FU16	OTB_DEF	OTB_DEF _100-119_0_0	Bottom otter trawl directed to demersal fish (100-119 mm)	X		X	X
	LLS_DEF	LLS_DEF _0_0_0	Set longline directed to demersal fish			X	
	SSC_DEF		Fly shooting seine directed to demersal fish				
FU00	PTM_DEF		Midwater pair trawl directed to demersal fish				

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

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

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

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

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

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

2.1.2 Atlantic Iberian Peninsula Shelf (Divisions VIIIc and IXa).

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

Country	Fishery Unit	Description
Spain	Small Gillnet	Gillnet fleet using "beta" gear (60 mm mesh size) for targeting hake in Divisions VIIIc and IXa North
	Gillnet	Gillnet fleet using "volanta" gear (90 mm mesh size) for targeting hake in Division VIIIc
		Gillnet fleet using "rasco"gear (280 mm mesh size) for targeting anglerfish in Division VIIIc
	Long Line	Long line fleet targeting a variety of species (hake, great fork beard, conger) in Division VIIIc
	Northern Artisanal	Miscellaneous fleet exploiting a variety of species in Divisions VIIIc and IXa North
	Southern Artisanal	Miscellaneous fleet exploiting a variety of species in Division IXa South (Gulf of Cádiz)
	Northern Trawl	Miscellaneous fleet operating in Divisions VIIIc and IXa North composed of bottom pair trawlers 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 IXa 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 IXa involving gillnet (80 mm mesh size), trammel (100 mm mesh size), long line and other gears. Species caught: hake, octopus, pout, horse mackerel and others
	Trawl	Trawl fleet opertaing in Portuguese waters of Division IXa copmpounded by bottom otter trawlers targeting crustaceans (55 mesh size), and bottom oter trawlers targeting different species of fish (65 mm mesh size).

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

The correspondence between Fishing Units and DCF métiers has been also compiled for the southern stocks fleets and is presented in the following table. As for the Celtic-Biscay shelf, sampling inconsistencies among biological and commercial data make the use of the DCF Level 5 preferable to introduce Iberian data in InterCatch. This re-aggregation affects the Spanish gillnet operating in the Northern Spanish waters, because the set gillnet ("*beta*") directed to hake (GNS_DEF_60-79_0_0) and the set gillnet ("volanta") also targeting hake (GNS_DEF_80-99_0_0) must be sampled together. It must taken into account that the set gillnet using more than 280 mm mesh size

(GNS_DEF_280_0_0) targets mostly anglerfish and cannot be distinguished at Level 5 (the level proposed for the InterCatch fleets) from the two gillnet métiers previously mentioned (which are directly mainly to hake). So a revision of the current InterCatch fleet proposal may be required in this case (to be decided by the WG by mid-September, as stated at the start of Section 2.1).

COUNTRY	FU	Fleet for InterCatch	METIERS (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	Trammel net directed to demersal fish (at least 100 mm)		X
	Artisanal	GNS_DEF	GNS_DEF_80-99_0_0	Set gillnet directed to demersal fish (80-99 mm)		X
Portugal		LLS_DEF	LLS_DEF_0_0_0	Set longline directed to demersal fish		X
		LLS_DWS	LLS_DWS_0_0_0	Set longline directed to deep-water species		X
	Trawl	OTB_CRU	OTB_CRU_>=55_0_0	Otter bottom trawl directed to crustaceans (at least 55 mm)		X
		OTB_DEF	OTB_DEF_60-69_0_0	Otter bottom trawl directed to demersal fish (60-69 mm)		X

2.2 Description of surveys

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

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

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

2.2.1 Spanish groundfish survey (SpGFS-WIBTS-Q4)

The SpGFS-WIBTS-Q4 covers the northern Spanish shelf comprised in ICES Division VIIIc and the northern part of IXa, including the Cantabrian Sea and off Galicia waters.

It is a bottom trawl survey that aims to collect data on the distribution, relative abundance and biology of commercial fish species such as hake, monkfish and white anglerfish, megrim, four-spot megrim, blue whiting and horse mackerel. Abundance indices are estimated by length and in some cases by age, with indices also estimated for *Nephrops*, and data collected for other demersal fish and invertebrates. The survey is ca. 120 hauls and is from 30-800 m depths, usually starts at the end of the 3rd quarter (September) and finishes in the 4th quarter.

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

The SpPGFS-WIBTS-Q4 occurs at the end of the 3rd quarter (September) and start of the 4th quarter. It is a bottom trawl survey that aims to collect data on the distribution, relative abundance and biology of commercial fish in ICES Division VIIb-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 IXa, 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. IXa) and from 20 to 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, seabream 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. IXa) and from 20 to 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 VIIfghj, and the French part of the Bay of Biscay in divisions VIIIab. 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, monkfishes and megrim) leaving at least two stations per stratum and 140 valid tows are planned every year although this number is dependent on available sea time.

2.2.8 French RESSGASC groundfish survey (RESSGASC)

The RESSGASC survey was conducted in the Bay of Biscay from 1978 to 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 VIIe-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 was it discontinued in 2004.

2.2.15 Irish groundfish survey (IGFS-WIBTS-Q4)

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

3 Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)

Type of assessment: update (stock benchmarked in 2014)., stock on observation list. **Data revisions**: Spanish Porcupine Ground Fish Survey (SpPGFS-WIBTS-Q4) from 2001 to 2013 was revised. **Review Group issues: None.**

3.1 General

3.1.1 Stock definition and ecosystem aspects

This section is described in the Stock Annex (Annex C).

3.1.2 Fishery description

The general description of the fishery is now presented in the Stock Annex.

3.1.3 Summary of ICES advice for 2012 and management for 2011 and 2012

ICES advice for 2014

ICES advises on the basis of the MSY approach that landings in 2014 should be no more than 81 846 t.

MSY approach

The stock is considered to be above any potential MSY Btrigger. Following the ICES MSY framework implies fishing mortality to be reduced to 0.27, resulting in landings of 80 447tones in 2015. This is expected to lead to an SSB of 281 012 tones in 2016.

Like the main stocks of the EU, the Northern hake stock is managed by a TAC and quotas. The TACs for recent years are presented below:

TAC (t)	2008	2009	2010	2011	2012	2013	2014
IIIa, IIIb,c,d (EC Zone)	1627	1552	1661	1661	1661	2093	2466
IIa (EC Zone), IV	1896	1808	1935	1935	1935	2438	2874
Vb (EC Zone), VI, VII, XII, XIV	30281	28879	30900	30900	30900	38938	45896
VIIIa,b,d,e	20196	19261	20609	20609	20609	25970	30610
Total Northern Stock [IIa-VIIIabd]	54000	51500	55105	55105	55105	69 440	81846

Management for 2013 and 2014

The minimum legal sizes for fish caught in Sub areas IV-VI-VII and VIII is set at 27 cm total length (30cm in Division IIIa) 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 VII and the other in Sub area VIII, where a 100 mm minimum mesh size is required for all otter-trawlers, whatever the amount of hake caught.

There are explicit management objectives for this stock under the EC Reg. No 811/2004 implementing measures for the recovery of the northern hake stock. It is aiming at increasing the quantities of mature fish to values equal to or greater than 140 000t. This is to be achieved by limiting fishing mortality to 0.25 and by allowing a maximum change in TAC between years of 15%.

According to ICES advice for 2012, due to the new perspective of historical stock trends, resulting from the new assessment, the previously defined precautionary reference points are no longer appropriate. In particular, the absolute levels of spawning biomass, fishing mortality, and recruitment have shifted to different scales. As a consequence, the TAC corresponding to the current recovery plan (EC Reg. No. 811/2004) should not be considered, because the plan uses target values based on precautionary reference points that are no longer appropriate.

The initial TAC for 2013 (55 105 t) was revised upwards (69 440 t) by the EC after 2013 assessment working group.

3.2 Data

3.2.1 Commercial catches and discards

Total landings from the Northern stock of hake by area for the period 1961-2014 as used by the WG are given in Table 3.1. They include landings from Division IIIa, Subareas IV, VI and VII, and Divisions VIIIa,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 last 3 data years, 2011, 2012 and 2013, they have increased again due to differences between official statistics and scientific estimations. The group decided to use scientific estimates to carry out the assessment. The unallocated landings were divided by metier using scientific information provided by the research institutes. Table 1 of the Stock Annex provides a historical perspective of the level of aggregation at which landings have been available to the WG.

Except for 1995, landings decreased steadily from 66 500 t in 1989 to 35 000 t in 1998. Up to 2003, landings fluctuated around 40 000 t. Since then, with the exception of 2006, landings have been increasing up to 79 700 t in 2011, the highest value since 1961. The landings in 2013, 76 700 t were well above the revised 2013 TAC (69 440 t).

The discard data sampling and data availability are presented in the Stock Annex. Table 3.2 presents discard data available to the group from 1999 to 2014. The discards have increased significantly in the last years; the total amount of observed discards in 2013 is double of those observed in 2008. The increase is general to all the fleets. It is remarkable the discards of gillnetters which did not discard before 2012 and in the last 2 years they have discards higher than 1000 tones.

3.2.2 Biological sampling

The sampling level is given in Table 1.3.

Length compositions of the 2013 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 3.3).

3.2.3 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 3.1a and b 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 three peaks in 2002, 2004, and 2008. The index obtained in 2012 reach the highest value of the series, 193% higher than previous year.

The abundance index provided by IGFS-WIBTS-Q4 follows a similar trend, so that from the 2008 peak, the abundance index obtained in 2012 achieves the higher value of the series, 268% higher than previous year index.

Both indices, EVHOE-WIBTS-Q4 and IGFS-WIBTS-Q4, suffered a significant decrease, around 65%, in 2013. Both indices are consistent over recent years.

. SpPGFS-WIBTS-Q4 survey is conducted on Porcupine's Bank since 2001. A new revised SpPGFS-WIBTS-Q4 survey index was provided this year, the revision was due to a change in the calculation methodology of the tow trawling time. The abundance index follows an increasing trend since 2003, reaching its highest value in 2009 and slightly decreases in 2010 and 2011. The abundance index in 2013 experienced a significant increase (+93%).compared to 2012. Revised and previous SpPGFS-WIBTS-Q4 indices are shown in Figure 3.2. The trend of both time series are similar but the increase in the revised one is more moderate. The comparison between the assessment results obtained in the last benchmark (ICES, 2014a) and the results obtained with the new survey are shown in Figure 3.3. The differences are almost imperceptible.

The spatial distribution of the EVHOE-WIBTS-Q4 index for hakes from 0 to 20cm is given in Figure 3.4 for the most recent years. It is apparent from this figure that inter-annual variations in abundance are different between areas (VII and VIII). In 2012, both areas display large abundance, even higher than in 2008, another year with high abundance index over recent years. In 2013, the abundance is lower than in 2012 especially in the Celtic sea.

3.2.4 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 1982-2012 are given in Table 3.5ab and Figure 3.4ab.

Since 1985, the LPUE of A Coruña trawlers operating in Subarea VII has fluctuated, with an increasing trend reaching its maximum value in 2011 and decreased sharply in the last two years. Over the same period, LPUE from Vigo trawlers operating in

Subarea VII followed a slightly decreasing trend, becoming less variable during the last 15 years. It must be taken into account that while A Coruña trawl fleet is targeting hake, the Vigo trawl fleet is directed to megrim, taking hake only as bycatch.

LPUE from Ondarroa pair trawlers operating in Divisions VIIIa,b, shows an increasing trend until 2009. The increase in LPUE in 2008 and 2009 was very high, especially in 2009. Since then the LPUE decreased, although not to the low levels of the beginning of the time series. In 2013 it increased slightly again. In 2006 the fleet experienced a decrease in effort (expressed in number of days), which corresponds to a decrease in number of vessels.

Assessment

This is an update assessment.

3.2.5 Input data

See Stock Annex (under "*Input data for SS3*").

3.2.6 Model

The Stock Synthesis 3 (SS3) assessment model (Methot and Wetzel 2013) was selected for use in this assessment. Model description and settings are presented in the Stock Annex (under "*Current assessment*" for model description and "*SS3 settings (input data and control files)*" for model settings).

3.2.7 Assessment results

Residuals of the fits to the surveys log(abundance indices) are presented in Figure 3.6. The greater part of the upward trend, until 2012, in relative abundance observed in all three contemporary trawl surveys (EVHOE-WIBTS-Q4, SpPGFS-WIBTS-Q4 and IGFS-WIBTS-Q4) has been captured by the model but there is still some residual trend apparent in the graphs. Pearson residuals of their length frequency distributions show a "fairly random" behaviour with no particular trend or lack of fit (Figure 3.6, 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 3.7 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 VII and VIII (the *others* fleet). For the Spanish trawl fleets in VII, 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 VIII, 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 VII 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 VIII, the same retention function is assumed throughout the entire assessment period (1978-present). For the other fleet both selection and retention curves are considered constant until 2002 and are allowed to vary from year to year since then. The variation is modelled using a random walk as described in the stock annex. The assessment currently assumes that the other commercial fleets do not discard fish, although this assumption should be revised as more information on discards becomes available. It is noteworthy the high amount of discards (> 1000 tonnes) of gillnetter fleet in VII and VIII in the last two years. Before 2012 the discards of this fleet were considered negligible..

The retrospective analysis (Figure 3.9) shows that for F and SSB the model results are reasonably robust to the exclusion of recent data. The patterns observed indicate a tendency to underestimate SSB and over-estimate F over the last years. The revision upwards of the SSB is especially marked in the last two years. A marked retrospective pattern is observed for recruitment in 2008, in this year recruitment is revised upwards year by year and this increase provokes the revision upwards of the SSB in final years.

F2013 (average of F-at-length over lengths 15-80 cm) was estimated at 0.42 and SSB at 166 050 t.

Summary results from SS3 are given in Table 3.5 and Figure 3.10.

3.2.8 Historic trends in biomass, fishing mortality and recruitment

For recruitment, fluctuations appear to be without substantial trend over the whole series. The recruitment in 2012 was the highest in the whole series 880 millions of individuals and in 2013 decreased to the mean level (424 million).

From high levels at the start of the series (101 000 t in 1980), the SSB has decreased steadily to a low level at the end of the 90s (24 000 t in 1998). Since that year, SSB has increased to the highest value of the series in 2012 (189 000 t) and decreased slightly in 2013.

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. They declined sharply afterwards to 0.35 in 2012 and increased up to 0.42 in 2013.

3.3 Catch options and prognosis

3.3.1 Short – Term projection

For the current projection, unscaled F is used, corresponding to F(15-80cm) = 0.38.

The recruitment used for projections in this WG is the GM calculated from 1978 to the final assessment year minus 2.

Landings in 2015 and SSB in 2016 predicted for various levels of fishing mortality in 2015 are given in Table 3.6 and Figure 3.11. Maintaining status quo F in 2015 is expected to result in an increase in landings with respect to 2014 and an increase in SSB in 2015 with respect to 2014.

3.3.2 Yield and biomass per recruit analysis

Options for long term projection are indicated in the Stock Annex.

Results of equilibrium yield and SSB per recruit are presented in Table 3.7 and Figure 3.12. The F-multiplier in Table 3.7 is with respect to status quo F (average F in the final 3 assessment years, 2010-2012). Considering the yield and SSB per recruit curves, F_{max},

$F_{0.1}$, $F_{35\%}$ and $F_{30\%}$ are respectively estimated to be 72%, 48%, 54% and 64% of status quo F. The maximum equilibrium yield per recruit is less than 4% above the equilibrium yield at $F_{sq.}$

3.4 Biological reference points

The group was requested to provide biological reference points for the stock of Northern Hake. A specific software, similar to plotMsy and eqSim (ICES, 2014b), was developed to evaluate the goodness of reference points under a risk analysis approach. Annex T gives a detailed description of the software and of its application to northern hake.

Based on the analysis carried out in Annex T, the working group proposes the following MSY and Precautionary Approach reference points:

	Type	Value	Technical basis
MSY	MSY Btrigger	46 200	Bpa
Approach	FMSY	0.27	Fmsy in the combined stock recruitment relationship (annex T)
	Blim	33 000	SSB2006 Low level of SSB followed by a sharp increase, lower level of SSB would led to lower recruitment level.
Precautionary	Bpa	46 200	1.4Blim
Approach	Flim	Not defined	
	Fpa	Not defined	

3.5 Comments on the assessment

The retrospective pattern in 2008 recruitment was somewhat corrected in last benchmark (ICES, 2014a) but this year again it has impacted on the increase in the SSB in the final part of the assessment. During the benchmark the retrospective pattern was related with the length frequency distributions of the fleets and the way they are modelled. The model tried to explain the length frequency distributions observed through an increase in the recruitment. This was partially solved giving more flexibility to the selectivity and retention curves over time. As this pattern has not disappeared, in the future, more work will be needed to understand what is driving such a retrospective pattern.. The discards of non-Spanish trawlers in VII and VIII have increased significantly in the last years. The gillnetters in VII and VIII started discarding a significant amount of hake in 2012. For both fleets, length frequency distributions have been made recently available in intercatch, so it could be advisable to include them in the model. This year, length frequency distribution of Scottish discards in *others* fleet have been made available for the first time, in annual basis. In SS3 no length frequency distribution are considered for the discards of this fleet in recent years, in future assessments it would be advisable to include this data in the model.

3.6 Management considerations

After several years of increasing trend in SSB, it has decreased in 2013 and the fishing mortality has increased. The decrease in SSB is the consequence of high fishing mortality and low recruitments in 2009-2011. However, 2012 year class was the stronger in the series and will contribute to the SSB in the short term. 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. The short-term forecasts of SSB and yield obtained this year are influenced by the low recruitments estimated for 2009-2011.

3.7 References.

Methot, R. D. and C. R. Wetzel (2013). "Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management." Fisheries Research 142: 86-99.

ICESa (2014). Report of the Bechmark Wrokshop on Southern megrim and hake (WKSOUTH). 3–7 February 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:40. Copenhaguen, Denmark.

ICESb (2014). Report of the Workshop to consider reference points for all stocks (WKMSYREF2. 8-10 January 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:47. Copenhaguen, Denmark.

Table 3.1. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock. Estimates of landings ('000 t) by area for 1961-2011.

Table 3.1. Northern Hake. Estimates of catches ('000 t) by area for 1961-2010.

	Landings (1)					Discards (2)	Catches (3)
Year	IVa+VI	VII	VIIIa,b	Unallocated	Total	Total	Total
1961	-	-	-	95.6	95.6	-	95.6
1962	-	-	-	86.3	86.3	-	86.3
1963	-	-	-	86.2	86.2	-	86.2
1964	-	-	-	76.8	76.8	-	76.8
1965	-	-	-	64.7	64.7	-	64.7
1966	-	-	-	60.9	60.9	-	60.9
1967	-	-	-	62.1	62.1	-	62.1
1968	-	-	-	62.0	62.0	-	62.0
1969	-	-	-	54.9	54.9	-	54.9
1970	-	-	-	64.9	64.9	-	64.9
1971	8.5	19.4	23.4	0	51.3	-	51.3
1972	9.4	14.9	41.2	0	65.5	-	65.5
1973	9.5	31.2	37.6	0	78.3	-	78.3
1974	9.7	28.9	34.5	0	73.1	-	73.1
1975	11.0	29.2	32.5	0	72.7	-	72.7
1976	12.9	26.7	28.5	0	68.1	-	68.1
1977	8.5	21.0	24.7	0	54.2	-	54.2
1978	8.0	20.3	24.5	-2.2	50.6	-	50.6
1979	8.7	17.6	27.2	-2.4	51.1	-	51.1
1980	9.7	22.0	28.4	-2.8	57.3	-	57.3
1981	8.8	25.6	22.3	-2.8	53.9	-	53.9
1982	5.9	25.2	26.2	-2.3	55.0	-	55.0
1983	6.2	26.3	27.1	-2.1	57.5	-	57.5
1984	9.5	33.0	22.9	-2.1	63.3	-	63.3
1985	9.2	27.5	21.0	-1.6	56.1	-	56.1
1986	7.3	27.4	23.9	-1.5	57.1	-	57.1
1987	7.8	32.9	24.7	-2.0	63.4	-	63.4
1988	8.8	30.9	26.6	-1.5	64.8	-	64.8
1989	7.4	26.9	32.0	0.2	66.5	-	66.5
1990	6.7	23.0	34.4	-4.2	60.0	-	60.0
1991	8.3	21.5	31.6	-3.4	58.1	-	58.1
1992	8.6	22.5	23.5	2.1	56.6	-	56.6
1993	8.5	20.5	19.8	3.3	52.1	-	52.1
1994	5.4	21.1	24.7	0.0	51.3	*	51.3
1995	5.3	24.1	28.1	0.1	57.6	-	57.6
1996	4.4	24.7	18.0	0.0	47.2	-	47.2
1997	3.3	18.9	20.3	-0.1	42.5	-	42.5
1998	3.2	18.7	13.1	0.0	35.1	-	35.1
1999	4.3	24.0	11.6	0.0	39.8	*	39.8
2000	4.0	26.0	12.0	0.0	42.0	*	42.0
2001	4.4	23.1	9.2	0.0	36.7	-	36.7
2002	2.9	21.2	15.9	0.0	40.1	-	40.1
2003*	3.3	25.4	14.4	0.0	43.2	1.4	44.6
2004*	4.4	27.5	14.5	0.0	46.4	2.6	49.0
2005*	5.5	26.6	14.5	0.0	46.6	4.6	51.1
2006*	6.1	24.7	10.6	0.0	41.5	1.2	42.7
2007*	7.0	27.5	10.6	0.0	45.1	2.2	47.3
2008*	10.7	22.8	14.3	0.0	47.8	3.4	51.2
2009*	13.1	25.3	20.4	0.0	58.8	11.0	69.8
2010*	14.2	33.5	25.1	0.0	72.8	12.1	84.9
2011*	18.8	18.6	16.6	25.7	79.7	13.9	93.6
2012*	22.4	22.2	16.7	13.9	75.2	14.9	90.1
2013*	16.2	28.5	19.9	12.1	76.7	15.8	92.5

(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.

Table 3.2. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Summary of discards data available (weight (t) in bold, numbers ('000) in italic)). The discards of Fleet 2 and Fleet 3 (in red) are not included in the assessment,

SS3 Fleets	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
FLEET 1	**1034**	**1530**	na	**537**	**1712**	**2010**	**5674**	**5077**	**5054**	**3495**
	10666	*17393*	na	*4526*	*21437*	*17542*	*27619*	*27954*	*26452*	*38293*
FLEET 2	**32**	**94**	**na**	**na**	**na**	**1025**	**1192**	**130**	**1142**	**2934**
	282	*629*	*na*	*na*	*na*	*6814*	*3831*	*1037*	*5101*	*16863*
FLEET 3	**1359**	**1597**	**532**	**767**	**858**	**4283**	**726**	**871**	**624**	**1475**
	39550	*37740*	*18031*	*24277*	*18245*	*68524*	*14709*	21208	*25228*	*32535*
FLEET 4	**30**	**489**	**206**	**471**	**352**	**580**	**101**	**292**	**364**	**379**
	451	*8475*	*3397*	*10002*	*7153*	*7925*	*1719*	*5036*	*5329*	*5552*
FLEET 5	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**1503**	**1256**
	na	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*4061*	*3283*
FLEET 7	**159**	**873**	**484**	**390**	**446**	**3135**	**4425**	**7533**	**6183**	**6287**
	na	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*16855*
Total Weight (t)	**2614**	**4583**	**1222**	**2165**	**3368**	**11033**	**12118**	**13903**	**14870**	**15826**
Total Number ('000)	*51724*	*64237*	*21428*	*39654*	*47488*	*101349*	*48325*	*58210*	*66171*	*113381*

Table 3.3. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Landings (L) and Length Frequency Distribution (LFD) provided in 2011.

Country		France	Ireland	Spain	UK(E+W)	Scotland	Denmark	Others
Unit	Quarter							
1 + 2	1			L+LFD	L	L		
	2			L+LFD	L	L		
	3			L+LFD	L+LFD	L+LFD		
	4			L+LFD	L	L		
3	1	L	L+LFD	L	L+LFD	L+LFD		
	2	L	L+LFD		L+LFD	L+LFD		
	3	L	L+LFD	L+LFD	L+LFD	L+LFD		
	4	L+LFD	L+LFD	L+LFD	L+LFD	L+LFD		
4 + 5 + 6	1	L+LFD	L+LFD	L+LFD		L+LFD		L
	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
8	1		L+LFD		L+LFD	L+LFD		L
	2		L+LFD		L+LFD	L+LFD		L
	3		L+LFD		L+LFD	L+LFD		L
	4		L+LFD		L+LFD	L+LFD		L
9	1	L+LFD						
	2	L+LFD						
	3	L+LFD						
	4	L+LFD						
10 + 12	1	L+LFD		L+LFD				
	2	L+LFD		L+LFD				
	3	L+LFD		L+LFD				
	4	L+LFD		L+LFD				
13	1	L+LFD		L+LFD				
	2	L+LFD		L+LFD				
	3	L+LFD		L+LFD				
	4	L+LFD		L+LFD				
14	1	L+LFD		L+LFD				
	2	L+LFD		L+LFD				L
	3	L+LFD		L+LFD				L
	4	L+LFD		L+LFD				
15	1	L+LFD	L+LFD		L+LFD	L+LFD		L
	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
16	1	L+LFD			L+LFD	L+LFD	L+LFD	L
	2	L+LFD			L+LFD	L+LFD	L+LFD	L
	3	L+LFD			L+LFD	L+LFD	L+LFD	L+LFD
	4	L+LFD			L+LFD	L+LFD	L+LFD	L
00	1							
	2							
	3							
	4							

Table 3.4.a Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,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

* Before 1988 landings and effort refer to Vigo trawl fleet only, from 1988 to 2002 to combined V

** 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

Table 3.4.b. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Effort and LPUE values of commercial fleets.

Sub-area VI

	Ondarroa trawl in VI		
Year	Landings(t)	Effort(days)	LPUE(Kg/day)
1994	164	635	259
1995	164	624	262
1996	259	695	372
1997	127	710	179
1998	89	750	118
1999	197	855	230
2000	243	763	318
2001	239	1123	213
2002	233	1234	189
2003	138	718	193
2004	306	411	743
2005	291	337	864
2006	304	368	827
2007	265	335	791
2008	451	349	1293
2009	383	380	1008
2010	580	394	1472
2011	489	339	1443
2012	902	355	2542

Sub-area VII

	A Coruña long line in VII			Celeiro long line in VII			Burela long line in VII		
Year	Landings(t)	Effort(days)	LPUE(Kg/day	Landings(t)	Effort(days)	LPUE(Kg/day)	Landings(t)	Effort(days)	LPUE(Kg/day)
1985	3577	4788	747	na	na	na	na	na	na
1986	3038	4128	736	na	na	na	na	na	na
1987	2832	4467	634	na	na	na	na	na	na
1988	3141	3766	834	na	na	na	na	na	na
1989	2631	3503	751	na	na	na	na	na	na
1990	2342	3682	636	na	na	na	na	na	na
1991	2223	3217	691	na	na	na	na	na	na
1992	2464	2627	938	na	na	na	na	na	na
1993	2797	2568	1089	na	na	na	na	na	na
1994	2319	2641	878	4062	6516	623	2278	3804	599
1995	2507	2161	1160	5209	6420	811	2905	3444	843
1996	2111	1669	1265	5988	6720	891	3245	3636	892
1997	830	900	922	4174	6144	679	2299	3540	649
1998	292	372	784	2817	4668	603	1639	3000	546
1999	323	395	817	3447	4980	692	1982	2880	688
2000	281	276	1018	3699	4440	833	2282	2928	779
2001	229	276	830	3383	3756	901	3034	3672	826
2002	214	300	712	2769	3984	695	2399	3732	643
2003	648	1188	545	3386	4404	769	2514	3636	691
2004	280	312	899	3990	4596	868	3255	3852	845
2005	199	288	691	4177	3930	1063	3074	3507	876
2006	256	312	822	4372	4560	959	3639	5184	702
2007	271	520	520	5039	5712	882	4367	6300	693
2008	233	288	810	4302	5184	830	4058	4884	831
2009	214	192	1116	4959	4624	1072	5146	4536	1135
2010	315	375	839	7630	5556	1373	9141	5736	1594
2011	443	350	1265	9672	5172	1870	10908	5988	1822
2012	217	253	858	6621	6720	985	7440	6984	1065

Sub-area VIII

	Ondarroa trawl in VIIIabd			Santander trawl in VIIIabd		
Year	Landings(t)	Effort(days)	LPUE(Kg/day)	Landings(t)	Effort	LPUE
1993	2244	5590	401	na	na	na
1994	2817	5619	501	175	640	273
1995	2069	4474	463	131	620	211
1996	944	4378	216	62	530	117
1997	2348	4286	548	65	805	81
1998	287	3002	96	95	1445	66
1999	81	2337	34	89	1830	49
2000	157	2227	70	79	1520	52
2001	341	2118	161	94	1590	59
2002	321	2107	152	252	1260	200
2003	230	2296	100	212	1405	151
2004	165	2159	76	200	995	201
2005	257	2263	114	120	596	202
2006	216	2398	90	83	636	131
2007	296	2098	141	105	1278	82
2008	543	2017	269	na	na	na
2009	741	1807	410	120	1278	94
2010	405	1358	298	69	774	89
2011	241	1384	174	45	454	99
2012	207	1384	150	25	274	91
	* From 1998 hake no more targeted			Effort (day*100 HP)		

Table 3.5. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Summary of landings and assessment results.

Table 3.5. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,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	287324	117200	79690	50551	-	50551	0.63	0.5
1979	268851	126128	99256	51096	-	51096	0.51	0.54
1980	297040	123492	100894	57265	-	57265	0.57	0.64
1981	575986	106120	85959	53918	-	53918	0.63	0.65
1982	397435	97720	69609	54994	-	54994	0.79	0.69
1983	137712	103815	67400	57507	-	57507	0.85	0.63
1984	283655	109755	80299	63286	-	63286	0.79	0.65
1985	631628	95694	76796	56099	-	56099	0.73	0.82
1986	360801	79251	57405	57092	-	57092	0.99	0.93
1987	438521	74217	42371	63369	-	63369	1.5	0.98
1988	503603	76084	45315	64823	2	64825	1.43	1.01
1989	486957	76392	44629	66473	73	66546	1.49	1.09
1990	501651	70203	41921	59954	-	59954	1.43	1.04
1991	282202	66611	40595	58129	-	58129	1.43	0.98
1992	306315	65541	38697	56617	-	56617	1.46	1.02
1993	518453	58458	37977	52144	-	52144	1.37	1.07
1994	284966	52126	29930	51259	356	51615	1.71	1.07
1995	147187	58248	29068	57621	-	57621	1.98	1.12
1996	358139	53612	34293	47210	-	47210	1.38	0.96
1997	247389	46428	29755	42465	-	42465	1.43	1.08
1998	404125	43399	23901	35060	-	35060	1.47	0.97
1999	203526	47740	27370	39814	349	40163	1.45	0.96
2000	177357	53140	30181	42026	83	42109	1.39	0.9
2001	326732	53290	35813	36675	-	36675	1.02	0.74
2002	260398	56308	37037	40107	-	40107	1.08	0.8
2003	151773	61130	37271	43162	2110	45272	1.16	0.81
2004	315697	63470	42205	46417	2552	48969	1.1	0.81
2005	212952	59203	40587	46550	4676	51226	1.15	0.94
2006	285275	55787	33144	41467	1816	43283	1.25	0.83
2007	444540	62870	39527	45028	2191	47219	1.14	0.72
2008	652117	79657	47006	47739	3248	50987	1.02	0.58
2009	189117	124194	71131	58818	9871	68689	0.83	0.49
2010	169255	191076	125542	72799	9415	82214	0.58	0.38
2011	189941	228242	188146	79628	13775	93403	0.42	0.35
2012	833725	215812	188679	75232	12225	87457	0.4	0.35
2013	423847	206884	166050	76773	11637	88410	0.46	0.42
Arith.Mean	348783	90536	62929	54144	4649	56210		
	Units	Thousands	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	

[1] Discards used in the assessment. In years with (-) discards are not available or considerent unreliable.

Table 3.6. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Catch option table.

SSB(2014)	Rec proj	F(15-80cm)	Catch(2014)	Land(2014)	SSB(2015)
161707	304198	0.38	100832	77916	225125

Fmult	Fcatch(15-80cm)	Catch(2015)	Land(2015)	Disc(2015)	SSB(2016)
0	0	0	0	0	371457
0.1	0.0376	15091	12494	2597	356509
0.2	0.0751	29542	24438	5104	342184
0.3	0.1127	43380	35855	7525	328454
0.4	0.1502	56632	46770	9862	315294
0.5	0.1878	69323	57204	12119	302680
0.6	0.2254	81476	67177	14299	290589
0.7	0.2629	93114	76711	16404	278998
0.8	0.3005	104260	85823	18436	267886
0.9	0.3381	114933	94534	20399	257233
1	0.3756	125155	102859	22296	247020
1.1	0.4132	134944	110817	24127	237227
1.2	0.4507	144318	118422	25896	227837
1.3	0.4883	153296	125691	27605	218832
1.4	0.5259	161894	132638	29256	210197
1.5	0.5634	170128	139277	30851	201917
1.6	0.601	178013	145621	32392	193975
1.7	0.6386	185565	151684	33881	186358
1.8	0.6761	192797	157478	35319	179052
1.9	0.7137	199723	163014	36709	172044
2	0.7512	206355	168303	38052	165321

Table 3.7. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,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
0.80	0.1	0.04	0.11	0.10	2.56
0.65	0.2	0.08	0.18	0.16	2.08
0.54	0.3	0.11	0.22	0.20	1.71
0.45	0.4	0.15	0.25	0.23	1.42
0.37	0.5	0.19	0.27	0.24	1.20
0.32	0.6	0.23	0.28	0.25	1.02
0.27	0.7	0.26	0.29	0.25	0.87
0.24	0.8	0.3	0.29	0.25	0.75
0.20	0.9	0.34	0.29	0.25	0.65
0.18	1	0.38	0.29	0.24	0.57
0.16	1.1	0.41	0.28	0.24	0.51
0.14	1.2	0.45	0.28	0.23	0.45
0.13	1.3	0.49	0.28	0.22	0.40
0.11	1.4	0.53	0.27	0.22	0.36
0.10	1.5	0.56	0.26	0.21	0.32
0.09	1.6	0.6	0.26	0.20	0.29
0.08	1.7	0.64	0.25	0.20	0.27
0.08	1.8	0.68	0.25	0.19	0.24
0.07	1.9	0.71	0.24	0.18	0.22
0.06	2	0.75	0.23	0.18	0.20

	SPR level	Fmult	F(15-80cm)	YPR(catch)	YPR(landings)	SSB PR
Fmax	0.27	0.72	0.27	0.29	0.25	0.85
F0.1	0.39	0.48	0.18	0.27	0.24	1.24
F35%	0.35	0.54	0.2	0.28	0.24	1.13
F30%	0.3	0.64	0.24	0.29	0.25	0.96

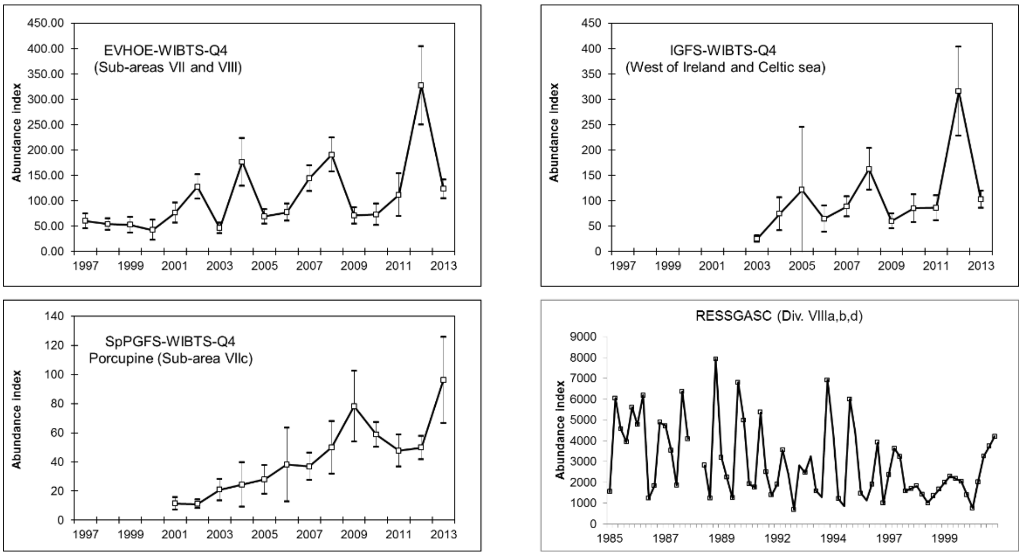


Figure 3.1. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Abundance indices from surveys.

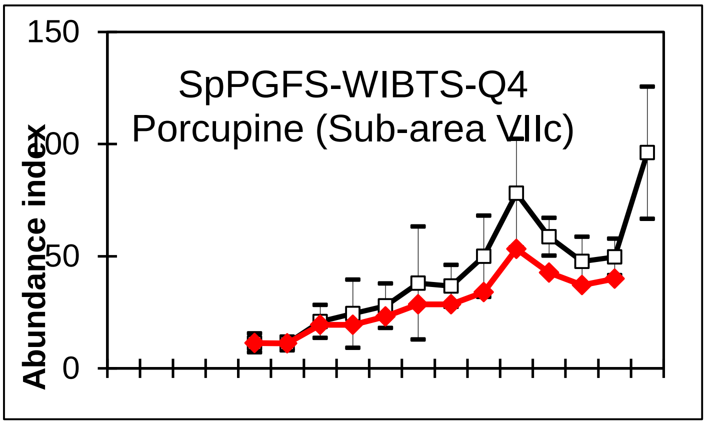


Figure 3.2. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Comparison of PORCUPINE index used until 2013 (red) and the revised index provided in 2014 (black).

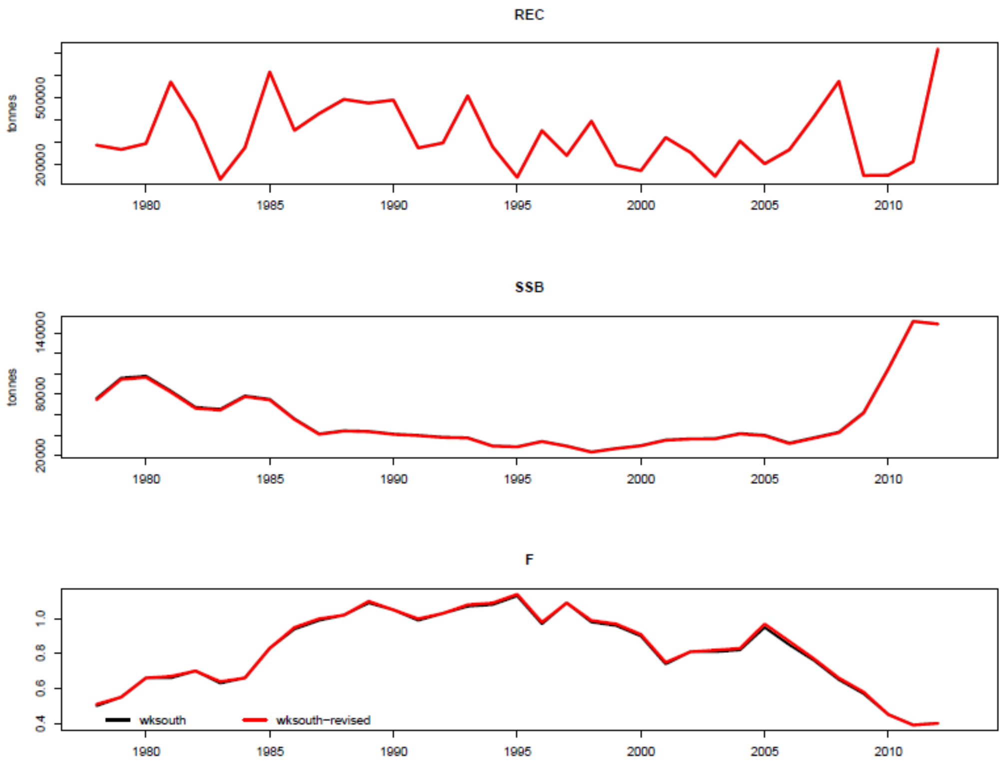


Figure 3.3. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Comparison of results of assessment carried out in WKSOUTH in 2014 and WGBIE 2014 using revised PORCUPINE survey and corrected sample size for others fleet discards.

Figure 3.4. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Spatial distribution of hake (0-20 cm) indices from EVHOE-WIBTS-Q4 survey from 2006 to 2011.

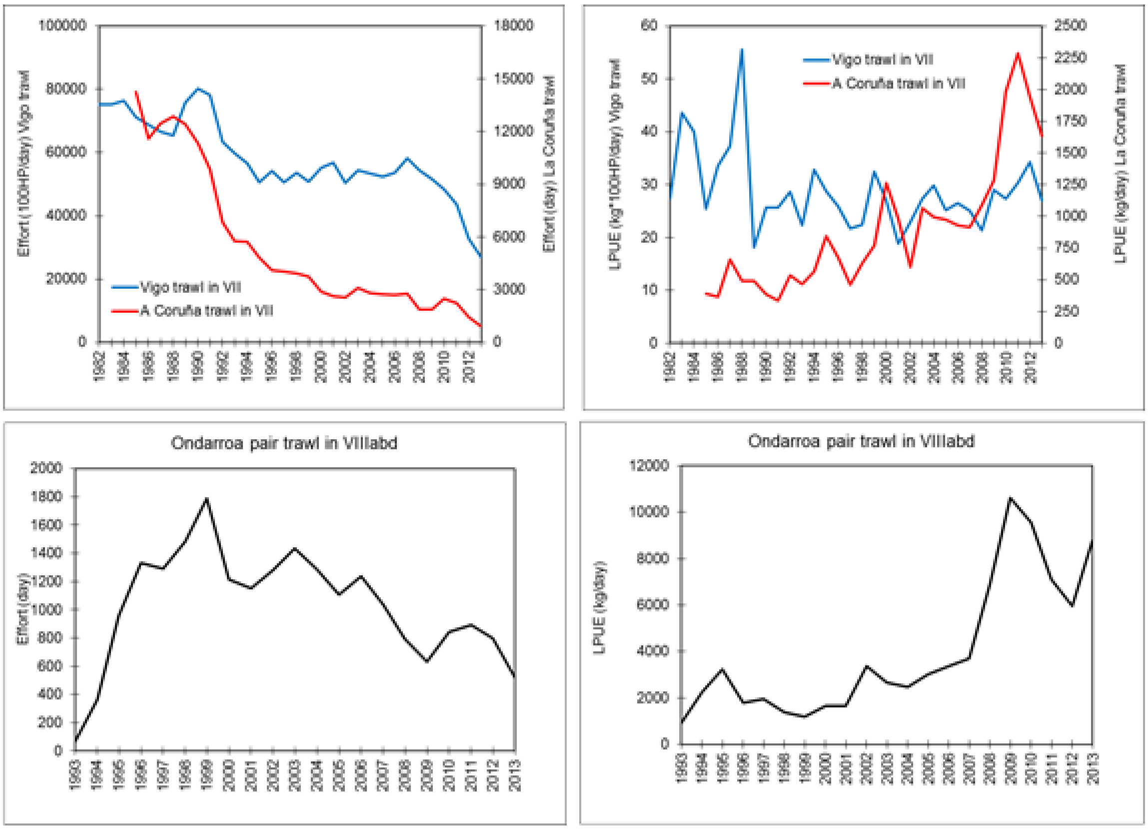


Figure 3.5a. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). LPUE and effort from commercial fleets

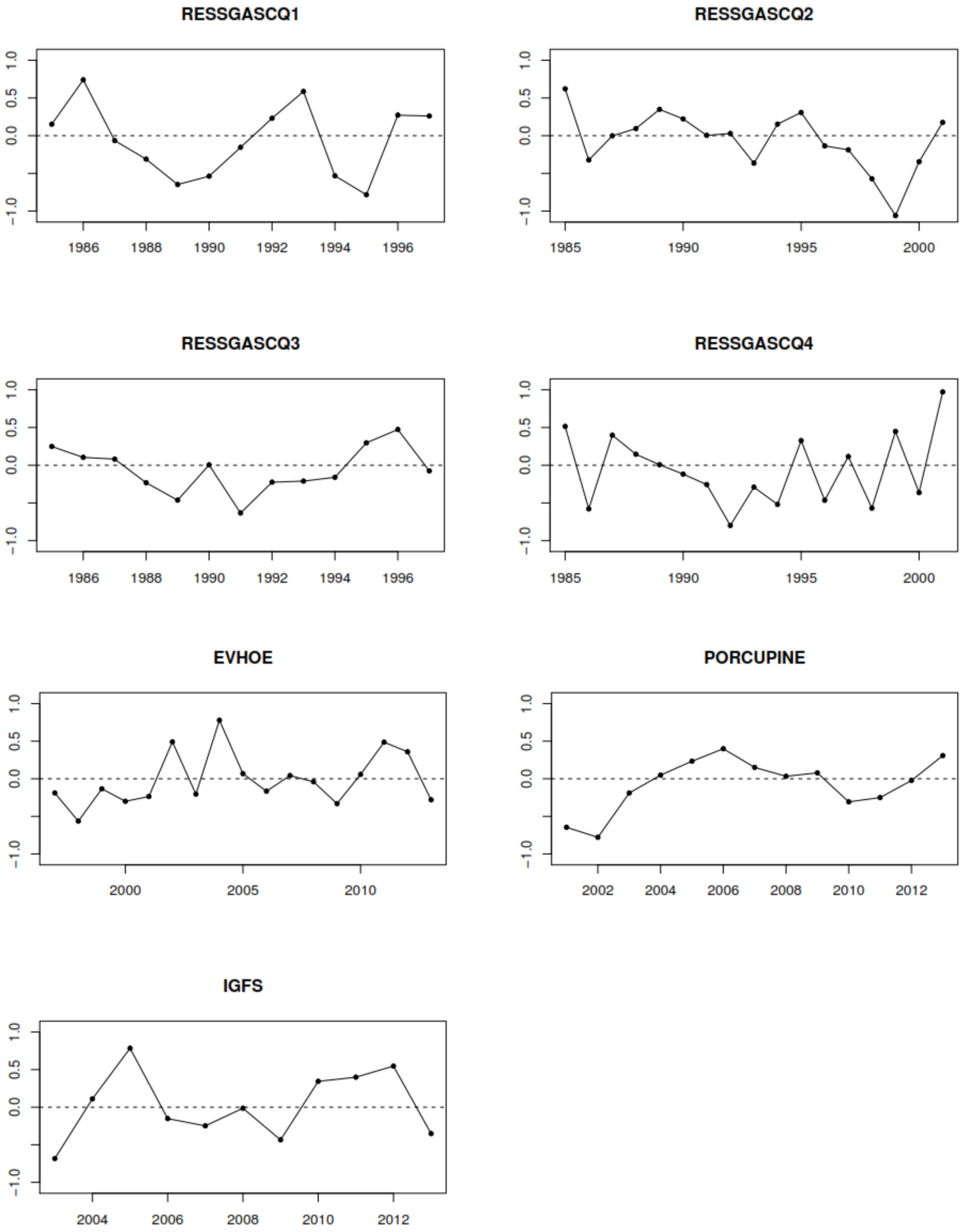


Figure 3.6. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Residuals of the fits to the surveys log(abundance indices). For RESSGASC, EVHOE, PORCUPINE and IGFS, fits are by quarter.

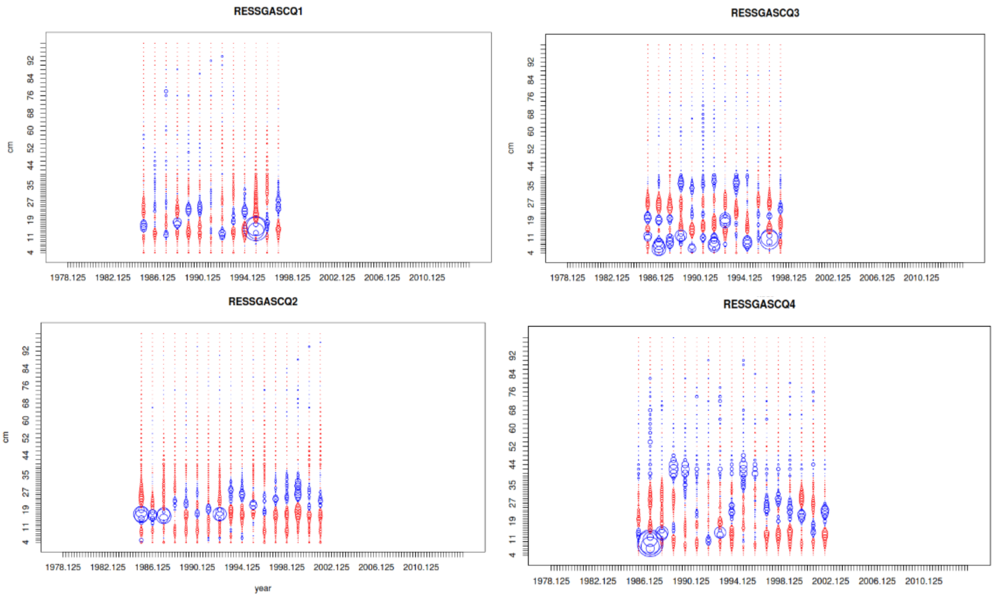


Figure 3.7. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter. Blue and red denote positive and negative residuals, respectively.

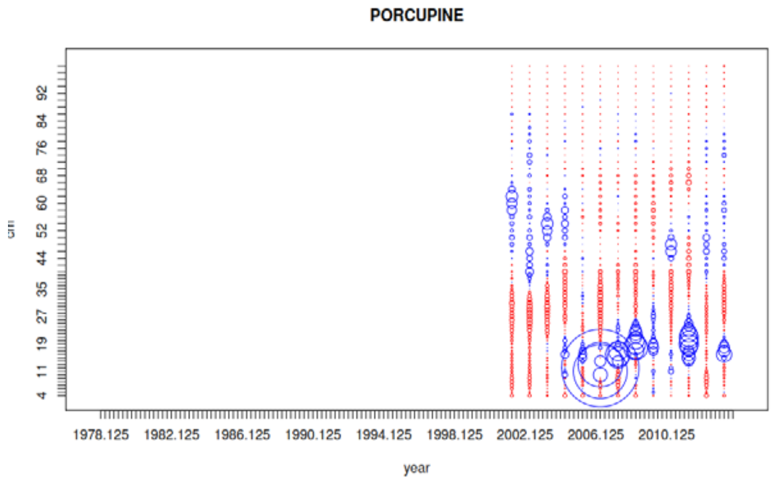


Figure 3.7 (continued). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter. Blue and red denote positive and negative residuals, respectively.

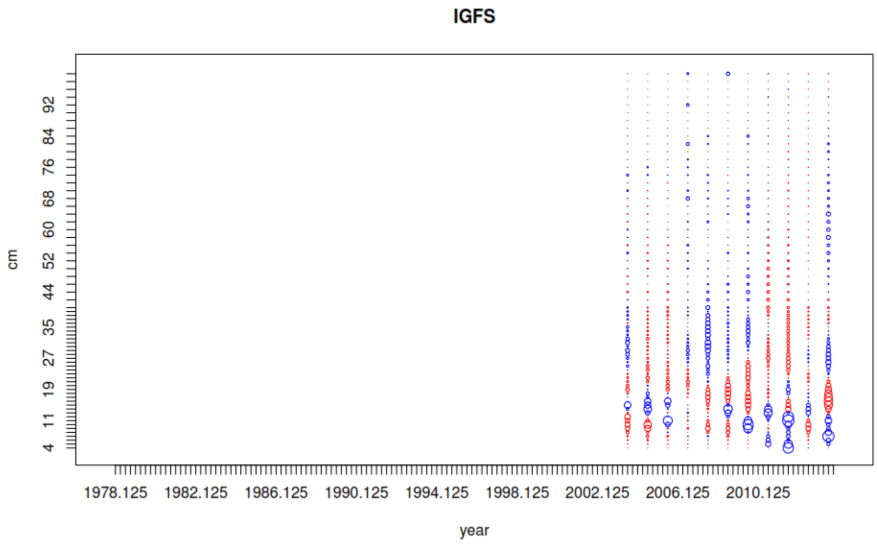


Figure 3.7 (continued). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter. Blue and red denote positive and negative residuals, respectively.

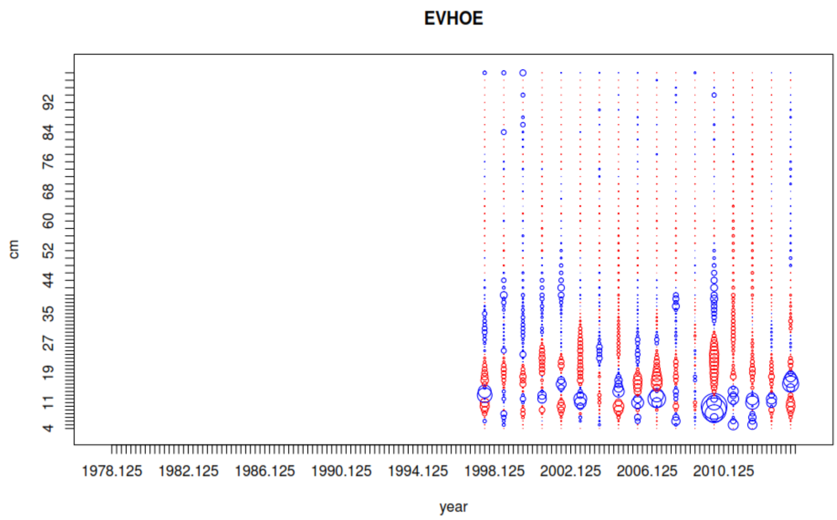


Figure 3.7. (continued) Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. Blue and red denote positive and negative residuals, respectively.

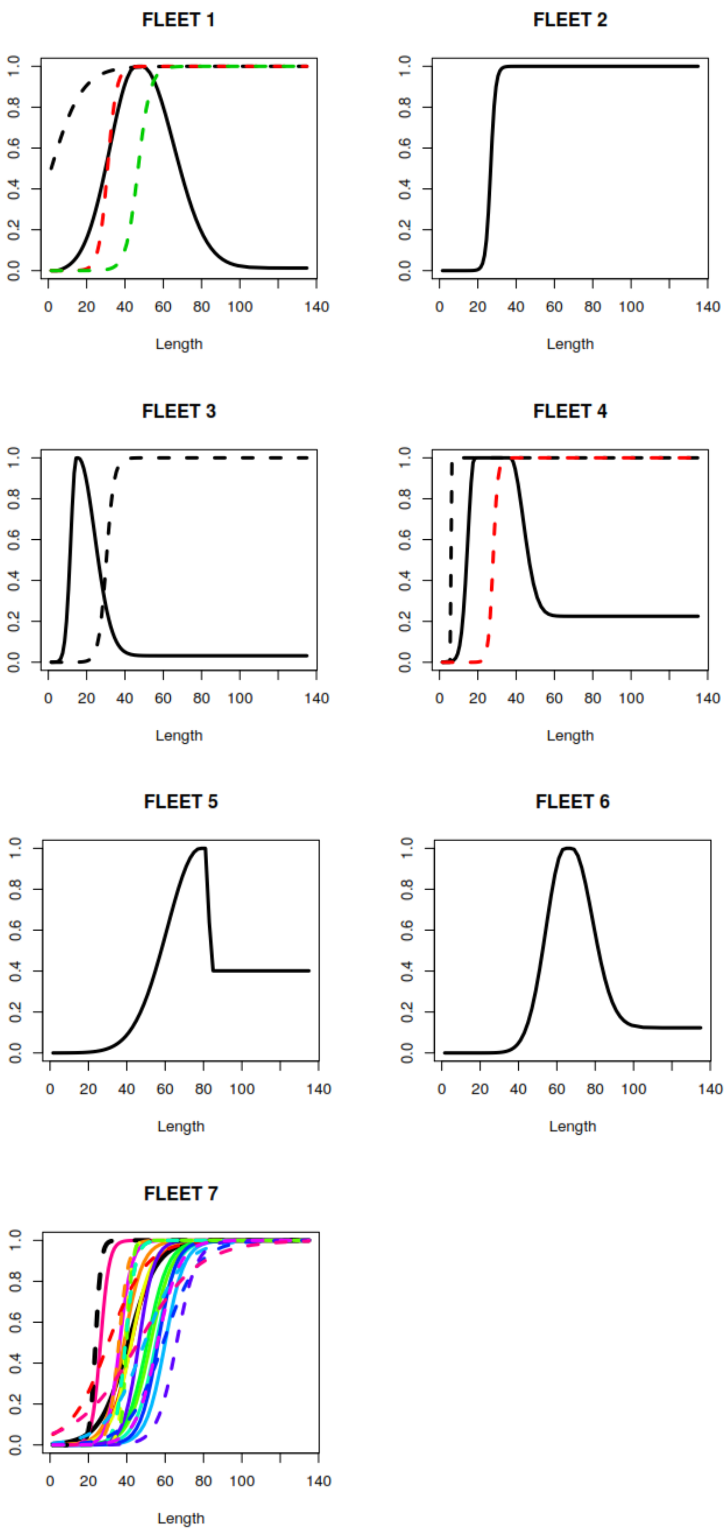


Figure 3.8. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Selection patterns (solid lines) and retention functions (dashed lines) at length by commercial fleet estimated by SS3. For FLEET1, retention functions for 1978-1997, 1998-2009 and 2010-2013 are in black, red and green respectively. For FLEET4, retention functions for 1978-1997 and 1998-2013 are in black and red respectively. For FLEET7, black lines correspond with the selection and retention functions from 1978 to 2002, the colours for the rest of the years are, 2003 (red), 2004 (orange), 2005 (yellow), 2006 (light green), 2007 (green), 2008 (light blue), 2009 (blue), 2010 (dark blue), 2011 (violet), 2012 (purple) and 2013 (pink).

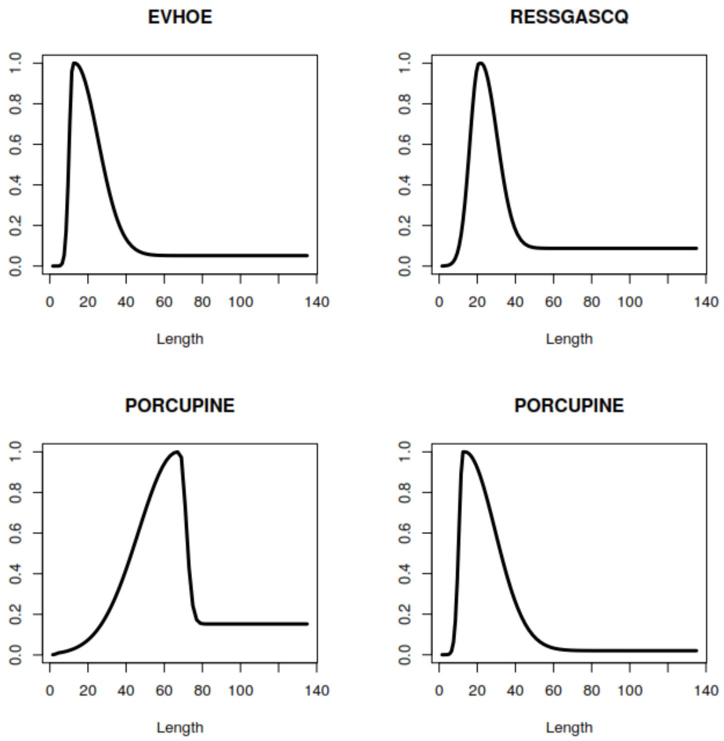


Figure 3.8 (continued). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Selection patterns at length for surveys estimated by SS3.

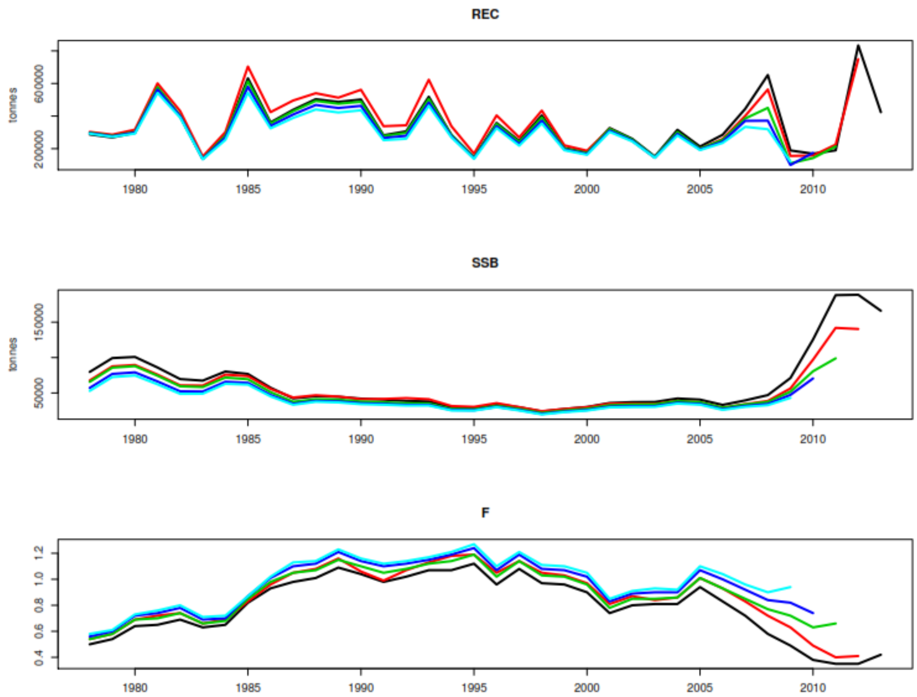


Figure 3.9. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Retrospective plot from SS3.

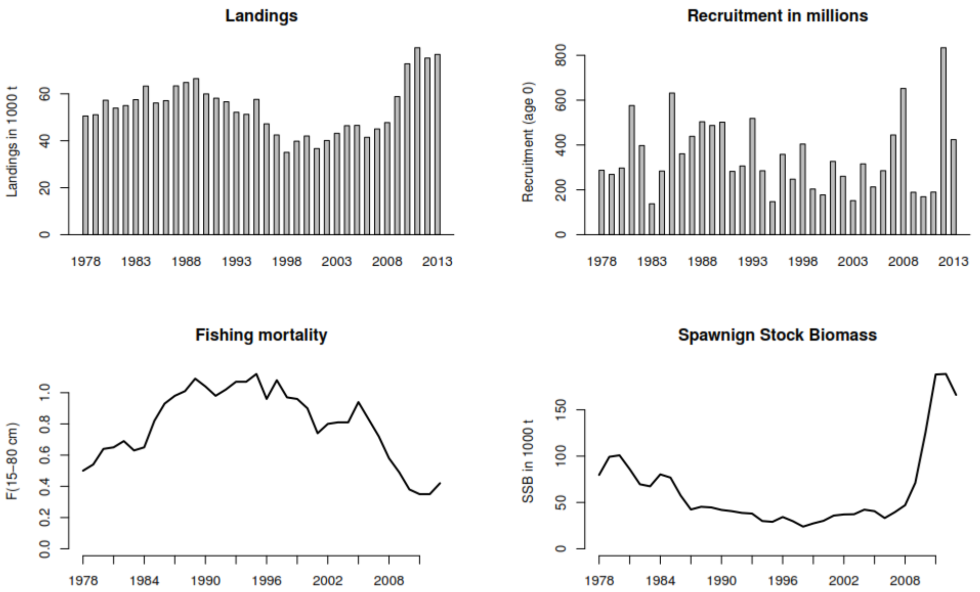


Figure 3.10. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Summary plot of stock trends.

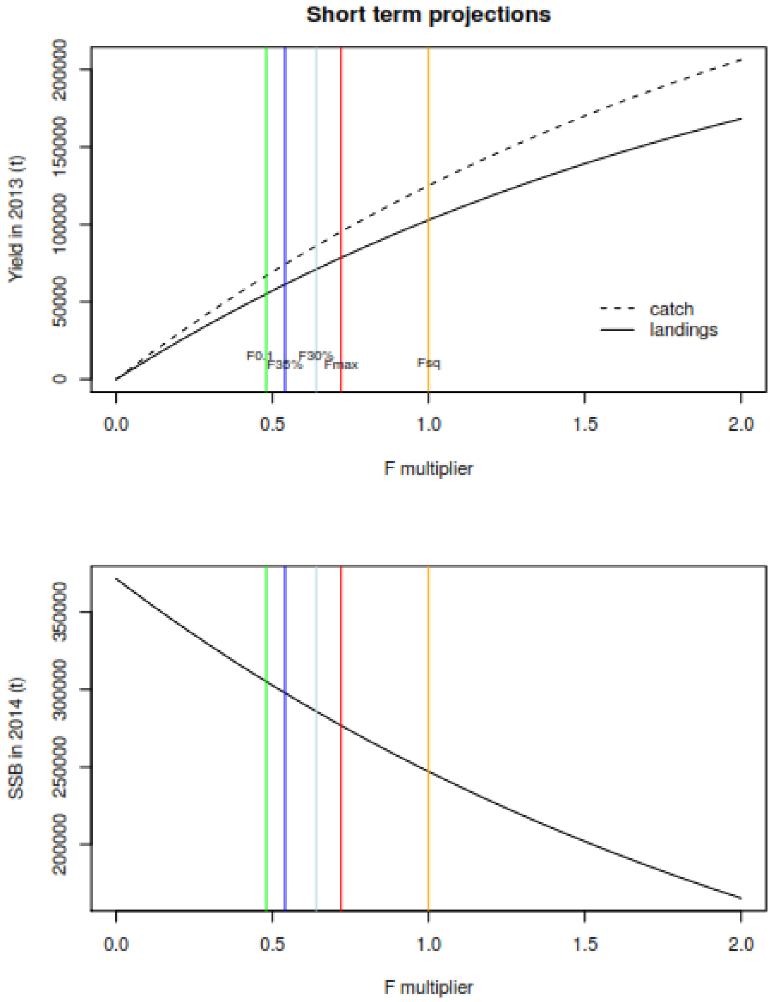


Figure 3.11. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Short term projections

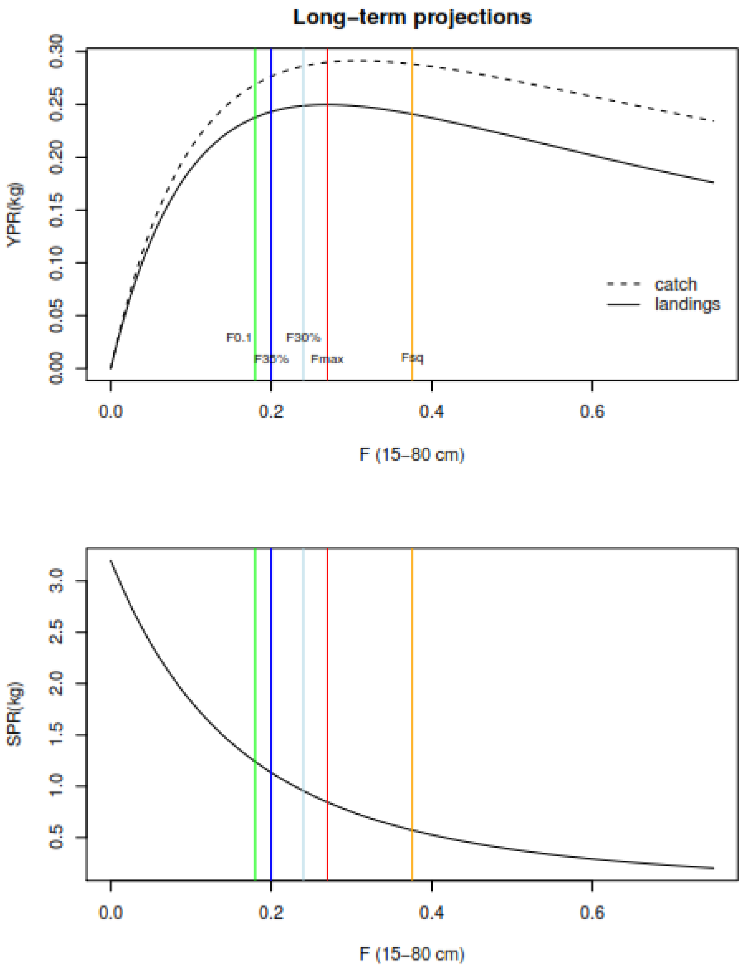


Figure 3.12. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Equilibrium yield and SSB per recruit.

4 Anglerfish (*Lophius piscatorius and Lophius budegassa*) in Divisions VIIb-k and VIIIa,b,d

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

L. piscatorius and L. budegassa:

Type of assessment in 2014: Same Advice as Last Year (SALY).

Data revisions this year: none

4.1 General

4.1.1 Summary of ICES advice for 2014 and management for 2013 and 2014

ICES advice for 2014

Effort in fisheries that catch anglerfish should not increase.

Management applicable for 2013 and 2014

The TAC applied to both species and including Division VIIa was set at 36 953 t for 2013 and at 42 496 t for 2014.

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

4.1.2 Landings

Landings have increased since 2000 and have fluctuated around 33 000 t since 2003. The landings of both species combined were estimated to be 27 926 t in 2009, 28 880 t in 2010, 28 357 t in 2011 and 36 384 t in 2012. Estimated landings of 36 855 t in 2013 are at the highest level over the last 10 years and the fourth highest of the time series (Table 4.1-1).

4.1.3 Discards

Estimation of discards has been carried out by some countries. This information shows that an increasing proportion of small fish of both species are caught and discarded. After an extensive analysis of discard data by WKFLAT 2012, discard estimates were considered not to be precise enough to be used in the assessment.

Table 4.1-1. Anglerfish in Divisions VIIb-k and VIIIa,b,d -Total landings from 1984 to 2013 – Working Group estimates

Year	VIIb-k	VIIIa,b,d	Total
1977			19 895
1978			23 445
1979			29 738
1980			38 880
1981			39 450
1982			35 285
1983			38 280
1984	28 847	7 909	36 756
1985	28 491	7 161	35 652
1986	25 987	5 897	31 883
1987	22 295	7 233	29 528
1988	22 494	5 983	28 477
1989	24 674	5 276	29 950
1990	23 434	5 950	29 384
1991	20 256	4 684	24 940
1992	17 412	3 530	20 942
1993	16 517	3 507	20 024
1994	18 023	3 841	21 864
1995	21 822	4 862	26 684
1996	24 153	6 102	30 255
1997	23 928	5 846	29 774
1998	23 295	4 876	28 171
1999	21 845	3 143	24 988
2000	18 129	2 456	20 585
2001	19 534	2 875	22 409
2002	22 648	3 571	26 220
2003	28 552	4 681	33 233
2004	29 510	5 640	35 150
2005	27 908	5 167	33 075
2006	26 795	4 823	31 618
2007	30 121	5 213	35 334
2008	26 724	5 032	31 756
2009	22 733	5 193	27 926
2010	23 338	5 542	28 880
2011	22 458	5 900	28 357
2012	27 380	9 004	36 384
2013*	25 994	10 861	36 855

* preliminar

4.2 Anglerfish *(L. piscatorius)* in Divisions VIIb-k and VIIIa,b,d

4.2.1 Data

4.2.2 Commercial Catch

The Working Group estimates of landings of *L. piscatorius* by fishery unit (defined in Section 2 of the report) are given in Table 4.2-1 *Lophius piscatorius* in Divisions VIIb-k and VIIIa,b,d - Landings in tonnes by Fishery Unit.

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

A revision of the 2011 landings provided an estimated of 20 370 t. The 2012 landing showed an increase to 26 837 t, which is the third largest recorded landings of the time series. In 2013 a slightly decrease of the landings gave a figure of 24 200 t.

4.2.2.1 Commercial LPUE

Effort and LPUE data for the three Spanish fleets and English FU6 were available in up to 2013 (Table 4.2-2 *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data and Figure 4.2-1 *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data). Fishing effort for most fleets showed a decrease until the mid 1990's. Effort remained relatively stable thereafter, from 2011 to 2013 a sharp decrease in SP-VIGO7 (41 % reduction) and SP-CORUTR7 (77 % reduction) was recorded.

All the commercial LPUE series decreased steadily until 1992. Since then, they have increased up to 2007 except for the 2 BAKA fleets. Most showed a decline in 2008. In 2009 and 2010 EW-FU06 and both BAKA fleets showed an increasing trend but SP-VIGO7 and SP-CORUTR7 showed a decreasing one. In 2011 all available fleets showed an increasing trend that continues in 2012 for all fleets with the exception of EW-FU06. In 2013 Spanish fleets showed the highest LPUE of the time series and EW-FU06 continued decreasing but being the fourth higher of the time series.

4.2.2.2 Surveys data

4.2.2.2.1 The French EVHOE-WIBTS-Q4 survey

This survey covers the highest proportion of the area of stock distribution. Standardised biomass and abundance indices are given in Figure 4.2-2 *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d- Time-series of the EVHOE-WIBTS-Q4 survey indices weight (left) and numbers (right) per 30 minutes tow from 1997 to 2013 and the length distributions in Figure 4.2-3 - *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d. Time-series of the EVHOE-WIBTS-Q4 Length distributions in Nb per 30 minutes tow from 1997 to 2013

The biomass indices show a continuous increase from 2000 to 2007 and a decrease thereafter, with the 2010 index value in between those from 2000 and 2001. In 2011 the indices were as high as the 2005 value and the 2012 value recorded the historical maximum, in 2013 the index was similar to 2011 level. Abundance in numbers shows four peaks in 2001, 2002, 2004 and to a lesser extent 2008. Since 2008 the abundance in numbers remains stable. In 2013 the abundance in number showed one of the lower levels in the 2001 – 2013 period.

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

These year classes are now still present in the recent survey catches at larger sizes and account for the higher biomass index. The length distribution in 2009 and 2010 indicates two good recruitments at the level seen in 2008, although not as strong as in 2001, 2002 and 2004. 2011 and 2012 recruitment seems to be at medium levels. 2013 recruitment is the second lower since 2001.

In Figure 4.2-4 and, Figure 4.2-5 the distribution of recruits (identified as individuals of less than 23 cm) show that contrasting with the years 2001, 2002 and 2004 where the recruits were found in both Celtic Sea and Bay of Biscay areas along the shelf, the recruits were found almost only south of the Celtic Sea and in the Bay of Biscay in 2008 and 2009. The results from 2010 to 2012 show a uniform distribution of recruits through the sampling area of the survey. 2013 shows a uniform distribution with low levels of recruitment.

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

This survey was initiated in 2001 and covers the Porcupine Bank. Standardised biomass and abundance indices are given in Figure 4.2-6 and the length distributions in Figure 4.2-7. Although covering a small area of the total stock distribution, similar pulses of recruitment are detected in 2001 and to a lower extent in the years 2002 to 2004. In 2010 a recruitment level similar to 2002-2004 was found. In 2011 the recruitment level was low and in 2012 the recruitment returned to medium values. In 2013 a revision of the indices for the period 2003-2012 was presented with no effects in the trends of the series. 2013 values are the higher of the series for both biomass and abundance indices.

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

Abundance indices in numbers per square kilometer from this survey are given in Table 4.2-3. They show the same drop as the EVHOE-WIBTS-Q4 and the SPPGFS (WIBTS-Q4) after the peak in 2004. The 2009 index showed a recovery in abundance, although it was still lower than the 2005 value. In 2010 and 2011 a value close to the 2004 maximum has been found. In 2012 a value similar to the 2009 medium level was recorded. In 2013 the value continued in medium levels but higher than in 2012. Due to the overall low numbers caught in some years the length distributions are not presented.

4.2.2.2.4 The English Fisheries Science Partnership survey.

This survey was discontinued in 2012.This survey covers a fraction of the areas VIIe, VIIf, VIIg and VIIh. Trends in biomass and abundance are not presented as more detailed analysis of trends in abundance and biomass is needed.

Length distribution of *L. piscatorius* catches are available and presented in Figure 4.2-8. Here again the high recruitment of 2004 is detected and can be easily tracked in 2005 with a mode at 25-45 cm and in 2006 with a mode at 45-60 cm, as in the EVHOE-WIBTS-Q4 survey. The pulse of recruitment observed in the EVHOE-WIBTS-Q4 survey in 2008 was also present in the FSP-ENG-MONK survey. For 2009 the highest value of the series for recruitment was recorded by the survey and the good recruitment for 2008 was tracked too. In 2010 three different modes are evident corresponding to a good recruitment and the surviving individual from 2008 and 2009 recruitments. In 2011 a similar pattern to 2010 was found with three different modes related to a good recruitment and corresponding to the good recruitments found in 2009 and 2010. In 2012 a medium level recruitment was found.

4.2.3 Conclusion

LPUE's and survey data (biomass, abundance indices and length distributions) give indication that the biomass has been increasing as a consequence of the good recruitment observed in 2001, 2002 and 2004 and has stabilised in recent years. There is evidence of good recruitments in 2008, 2009, 2010 and 2011. 2008 and 2009 recruitments have entered the fishery giving one of the higher yields of the time series. Recruitment in 2012 and 2013, lower than previous years could have implications in the total biomass of the stock in the future.

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

Preliminary information on discards shows that an increasing proportion of small fish are caught and discarded.

Measures should be taken to ensure good survival of the good incoming recruitments.

4.2.4 Comments on the assessment

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

Table 4.2-1 *Lophius piscatorius* in Divisions VIIb-k and VIIIa,b,d - Landings in tonnes by Fishery Unit.

	VIIb,c,e-k						VIIIa,b,d				
Year	Gill-Net (Unit 3+13)	Medium/Deep Trawl (Unit 4)	Shallow Trawl (Unit 5)	Beam Trawl (Unit 6)	Shallow/medium Neph.Trawl (Unit 8)	Unallocated	Neph.Trawl (Unit 9)	Shallow Trawl (Unit 10)	Medium/Deep Trawl (Unit 14)	Unallocated	TOTAL VII +VIII
1986	429	13 781	2 877	1 437	1 021	0	746	720	2 657	0	23 666
1987	560	11 414	2 900	1 520	787	0	1 035	542	3 152	0	21 909
1988	643	9 812	3 105	1 814	774	0	927	534	2 487	0	20 095
1989	781	8 448	5 259	2 998	754	0	673	444	1 772	0	21 130
1990	1 021	8 787	3 950	1 736	880	0	410	391	2 578	0	19 753
1991	1 752	7 563	2 793	1 142	752	0	284	218	1 657	0	16 160
1992	1 773	6 254	1 492	998	887	0	254	166	942	0	12 766
1993	1 742	5 776	2 125	1 258	969	0	360	278	950	0	13 458
1994	1 377	7 344	2 595	1 523	1 236	0	261	198	1 586	0	16 120
1995	1 915	8 461	3 195	1 805	1 242	0	501	429	1 954	228	19 730
1996	2 244	9 796	2 658	2 189	1 149	138	441	379	2 229	938	22 162
1997	2 538	9 225	2 945	2 031	964	39	429	376	2 045	1 068	21 660
1998	3 398	8 714	2 138	1 722	812	3	397	149	1 699	542	19 572
1999	3 162	9 037	2 369	1 409	780	19	98	116	1 259	0	18 250
2000	2 034	7 067	1 642	1 434	726	6	91	77	863	0	13 941
2001	2 002	7 880	2 293	1 978	886	17	146	76	1 402	0	16 681
2002	2 719	9 465	2 609	1 836	924	22	247	96	1 908	0	19 826
2003	3 498	12 332	2 786	1 983	974	81	470	168	2 575	0	24 865
2004	5 004	12 770	2 642	2 460	852	14	457	218	3 296	0	27 714
2005	5 154	11 556	2 400	2 388	594	7	342	165	2 936	2	25 543
2006	3 741	13 409	2 216	2 421	700	3	429	218	2 758	2	25 898
2007	4 594	14 949	2 382	2 836	660	11	286	244	3 015	0	28 977
2008	5 107	11 766	1 885	1 990	491	10	227	325	2 573	1	24 376
2009	3 957	9 938	358	1 880	48	16	221	0	2 153	275	18 844
2010	3 398	9 851	539	2 503	21	31	301	0	2 373	504	19 521
2011	2 152	8 968	548	3 019	12	1 658	231	0	2 285	1 497	20 370
2012	2 905	12 821	513	3 231	14	1 260	195	0	3 731	2 168	26 837
2013*	2 045	11 237	392	3 081	71	1 498	216	0	4 232	1 429	24 200

* preliminar

Table 4.2-2 ***L. piscatorius*** **in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data**

EFFORT	SP-VIGO7 in Sub-Area VII ('000 days*HP)	SP-CORUTR7 in Sub-Area VII ('000 days*HP)	French Benthic trawlers* Celtic Sea FU04 ('000 hrs)	French Benthic Twin Trawls Celtic Sea ('000 hrs)	French Benthic trawlers* Bay of Biscay FU14 ('000 hrs)	French Benthic Twin Trawls Bay of Biscay ('000 hrs)	EW FU06 Beam trawlers in VII ('00 days)	SP-BAKON7 (days)	SP-BAKON8 (days)
1986	6 875	9 527	418	N/A	123	N/A	N/A		
1987	6 662	10 453	349	N/A	199	N/A	N/A		
1988	6 547	10 886	334	N/A	150	N/A	N/A		
1989	7 585	10 483	378	N/A	187	N/A	N/A		
1990	8 021	9 630	380	N/A	208	N/A	N/A		
1991	7 822	8 522	380	N/A	210	N/A	N/A		
1992	6 370	5 852	331	N/A	186	N/A	100		
1993	5 988	5 001	274	N/A	159	N/A	114	1 094	5 590
1994	5 655	4 990	249	N/A	148	N/A	116	980	5 619
1995	5 070	4 403	287	N/A	174	N/A	127	1 214	4 474
1996	5 416	3 746	196	121	144	19	126	1 170	4 378
1997	5 058	3 738	178	133	133	33	126	540	4 286
1998	5 360	3 684	182	134	117	40	121	1 196	3 002
1999	5 084	3 512	110	110	83	59	115	1 384	2 337
2000	5 519	2 773	165	104	87	49	104	1 850	2 227
2001	5 678	2 356	135	133	61	66	186	1 451	2 118
2002	5 041	2 258	116	120	57	75	111	949	2 107
2003	5 437	2 597	147	136	68	81	166	1 022	2 296
2004	5 347	2 292	160	133	78	89	174	910	2 159
2005	5 246	2 120	127	137	83	121	109	544	2 263
2006	5 392	2 257	140	145	72	101	94	487	2 398
2007	5 812	2 323	149	152	48	127	97	476	2 098
2008	5 432	1 640	118	126	58	113	138	105	2 017
2009	5 155	1 626					75	0	1 807
2010	4 843	1 988					77	138	1 358
2011	4 553	1 725					82	57	1 384
2012	3 276	937					84		1 384
2013	2 683	563					146		1 185

LPUE	Vigo in Sub-Area VII (kg/days*HP)	La Coruna in Sub-Area VII (kg/days*HP)	French Benthic trawlers* Celtic Sea FU04 (kg/10 hrs)	French Benthic Twin Trawls Celtic Sea (kg/10 hrs)	French Benthic trawlers* Bay of Biscay FU14 (kg/10 hrs)	French Benthic Twin Trawls Bay of Biscay (kg/10 hrs)	EW (FU06) Beam trawlers in VII (kg/10 days)	SP-BAKON7 (kg/day)	SP-BAKON8 (kg/day)
1986	286	383	143		131				
1987	235	326	142		119				
1988	182	272	132		110				
1989	210	236	102		61				
1990	206	228	104		85				
1991	184	234	82		55				
1992	188	200	56		35		94		
1993	268	172	60		42		93	60	23
1994	289	187	111		75		81	73	44
1995	410	131	131		84		77	99	56
1996	520	212	117	159	81	113	110	130	70
1997	440	245	105	133	78	84	117	132	71
1998	451	193	95	113	60	66	111	134	66
1999	428	136	52	76	42	44	95	125	34
2000	203	182	87	73	34	45	109	186	31
2001	239	170	103	119	56	85	82	184	61
2002	469	218	138	152	69	120	123	218	72
2003	598	286	191	186	102	154	80	274	76
2004	563	249	134	188	87	172	93	249	119
2005	591	356	170	146	99	133	144	287	100
2006	568	383	183	196	108	137	175	221	89
2007	611	409	233	214	118	151	202	261	71
2008	466	542	214	190	97	122	106	171	101
2009	350	252					198		144
2010	298	454					250	217	132
2011	417	384					266	484	157
2012	599	526					235		212
2013	649	724					205		246

Table 4.2-3 - ***L. piscatorius*** **in Divisions VIIb-k and VIIIa,b,d– Abundance indices in Nb/sq Km from 2003 to 2010from the IGFS-WIBTS-Q4.**

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

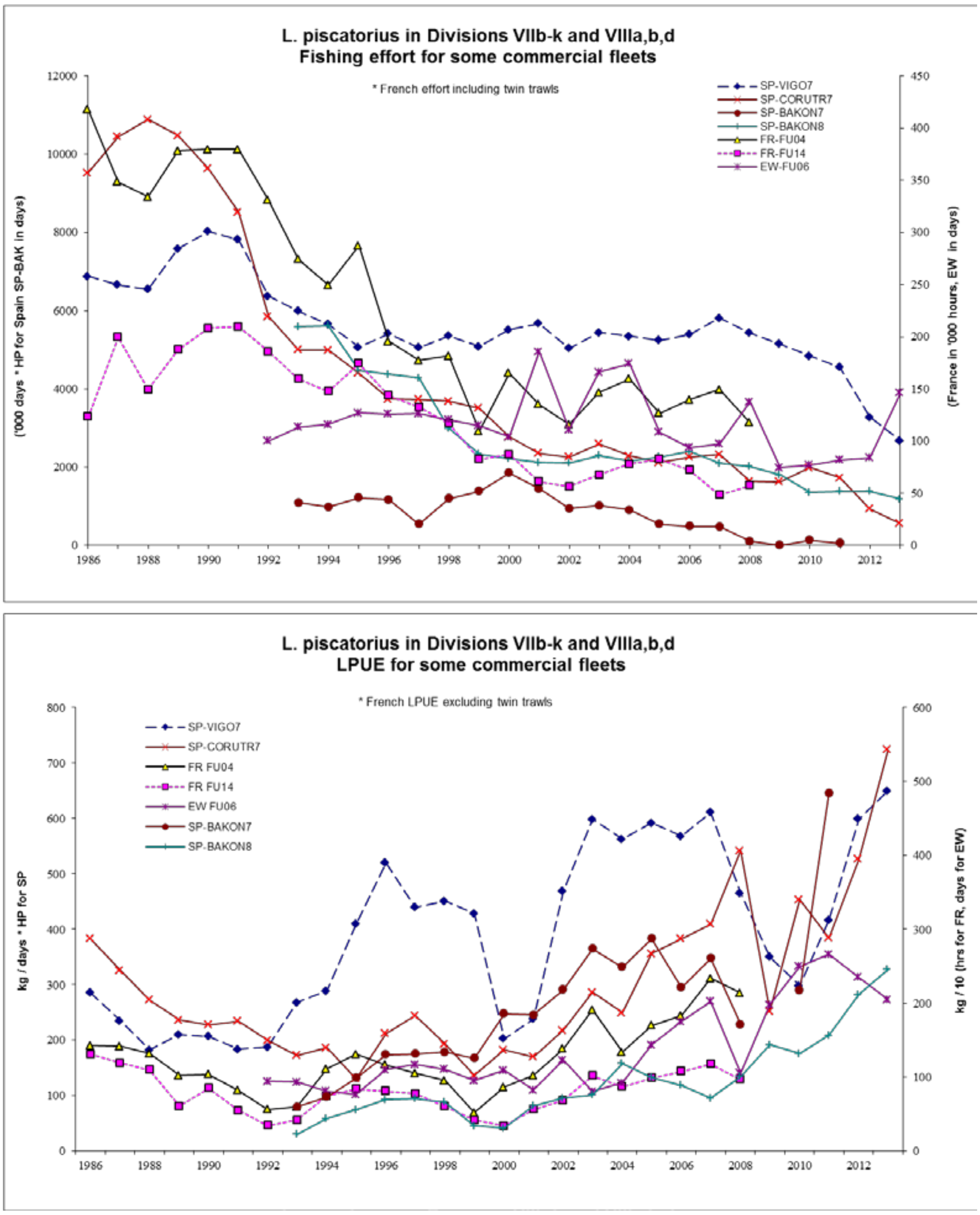


Figure 4.2-1 ***L. piscatorius*** **in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data**

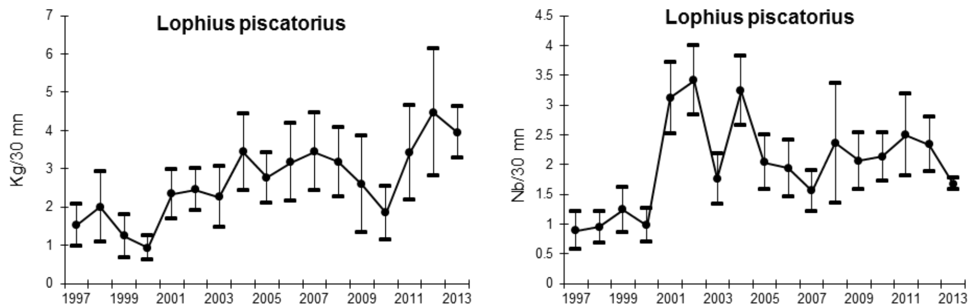


Figure 4.2-2 ***L. piscatorius*** **in Divisions VIIb-k and VIIIa,b,d- Time-series of the EVHOE-WIBTS-Q4 survey indices Kg (left) and Nb (right) per 30 minutes tow from 1997 to 2013**

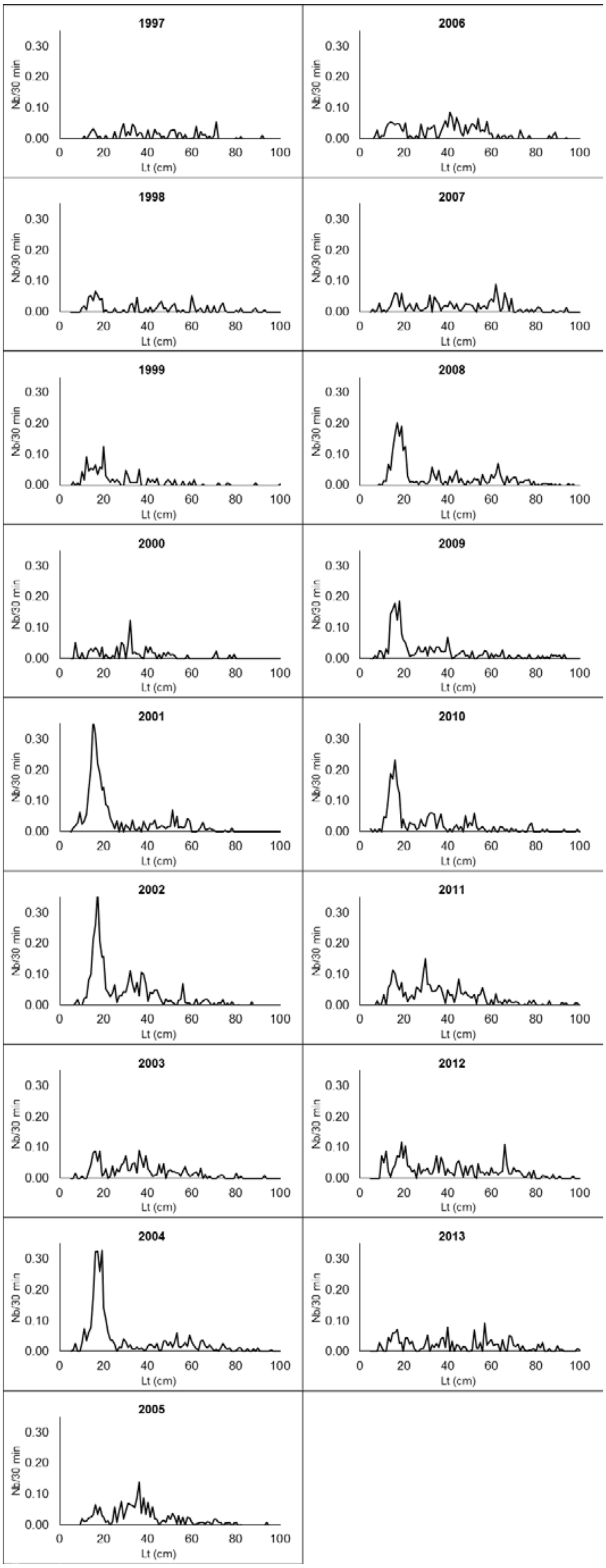


Figure 4.2-3 - *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d. Time-series of the EVHOE-WIBTS-Q4 Length distributions in Nb per 30 minutes tow from 1997 to 2013

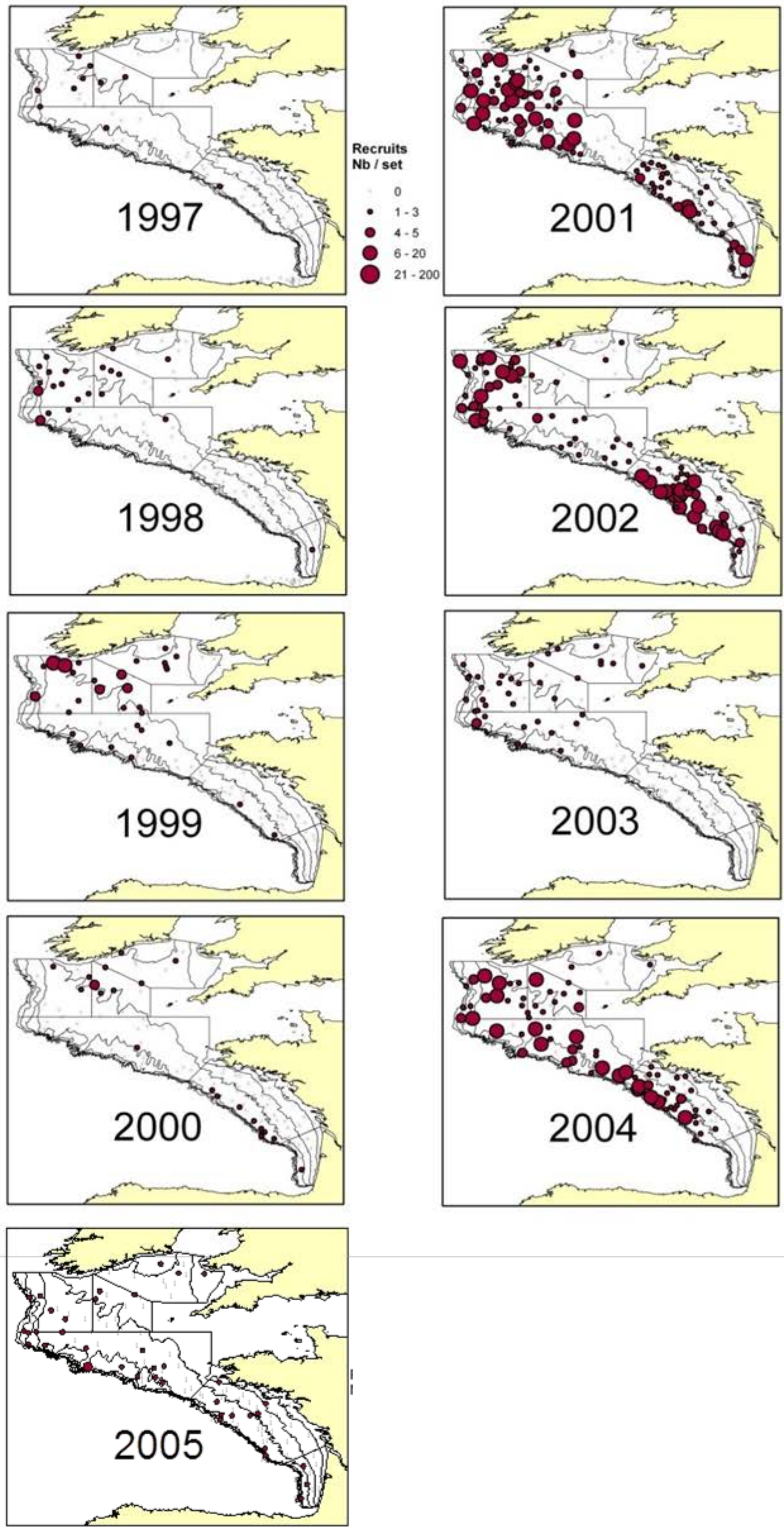


Figure 4.2-4 – *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 1997 to 2005.

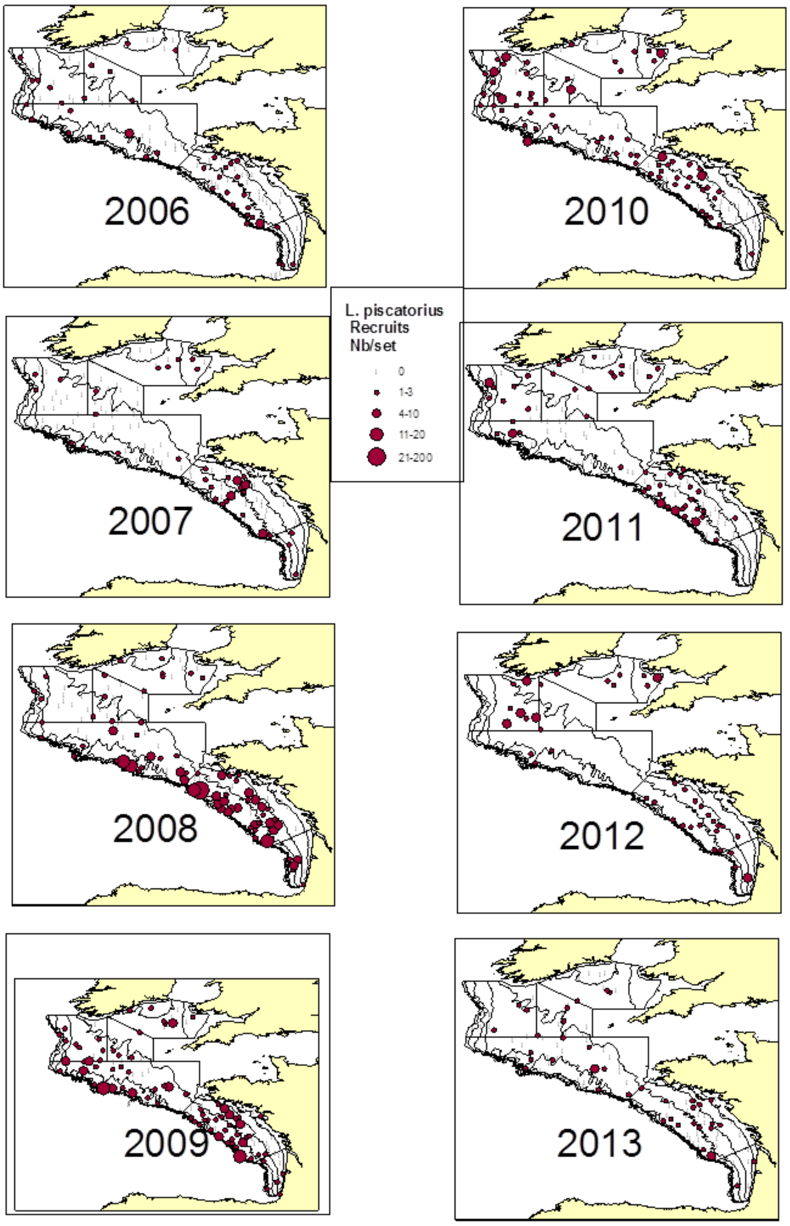


Figure 4.2-5 – L. piscatorius in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 2005 to 2013.

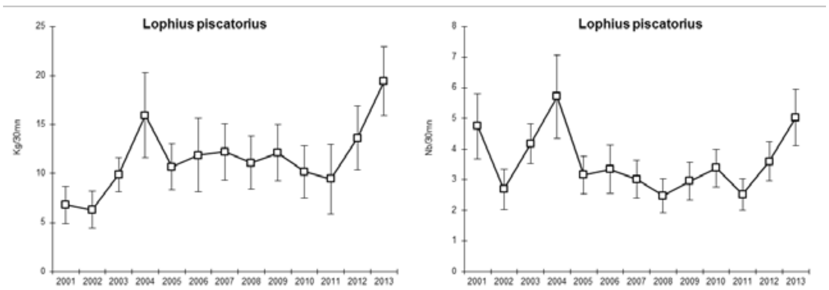


Figure 4.2-6 - *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d- Time-series of the SPPGFS (WIBTS-Q4) survey indices Kg (left) and Nb (right) per 30 minutes tow from 2001 to 2013

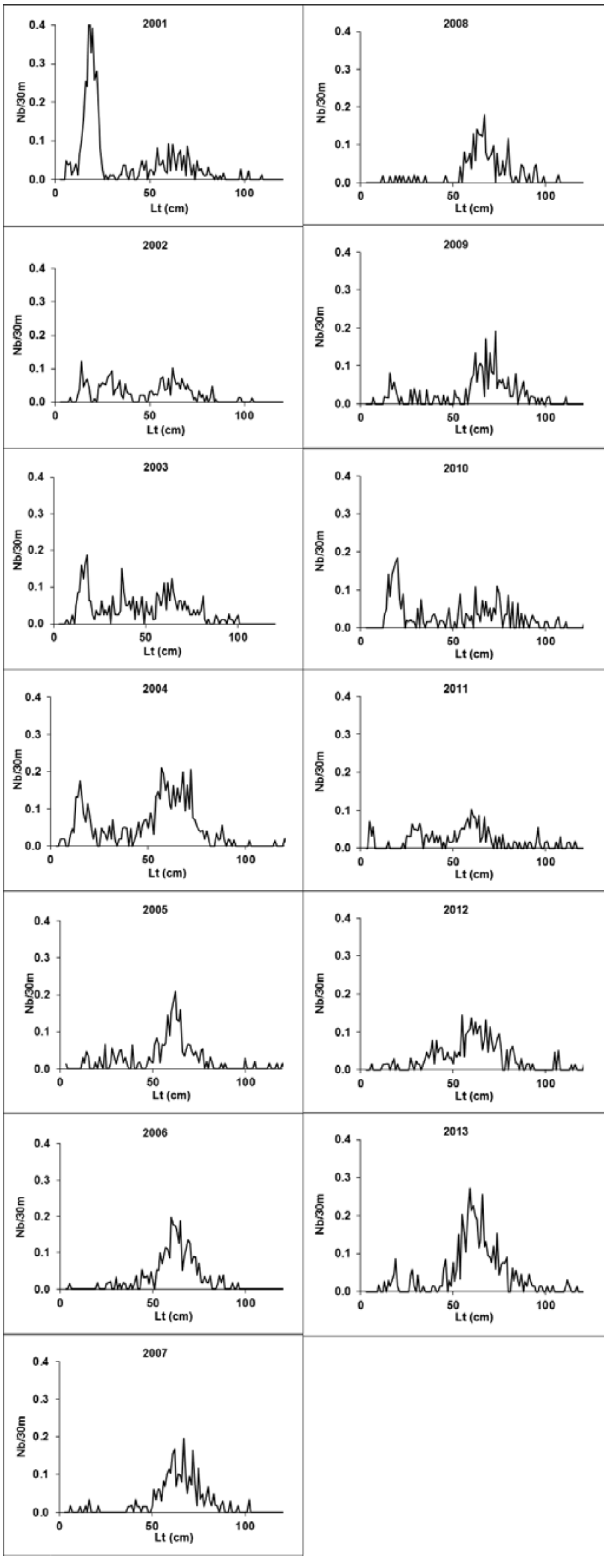


Figure 4.2-7 - ***L. piscatorius*** **in Divisions VIIb-k and VIIIa,b,d- Time-series of the SPPGFS (WIBTS-Q4) Length distributions in Nb per 30 minutes tow from 2001 to 2013**

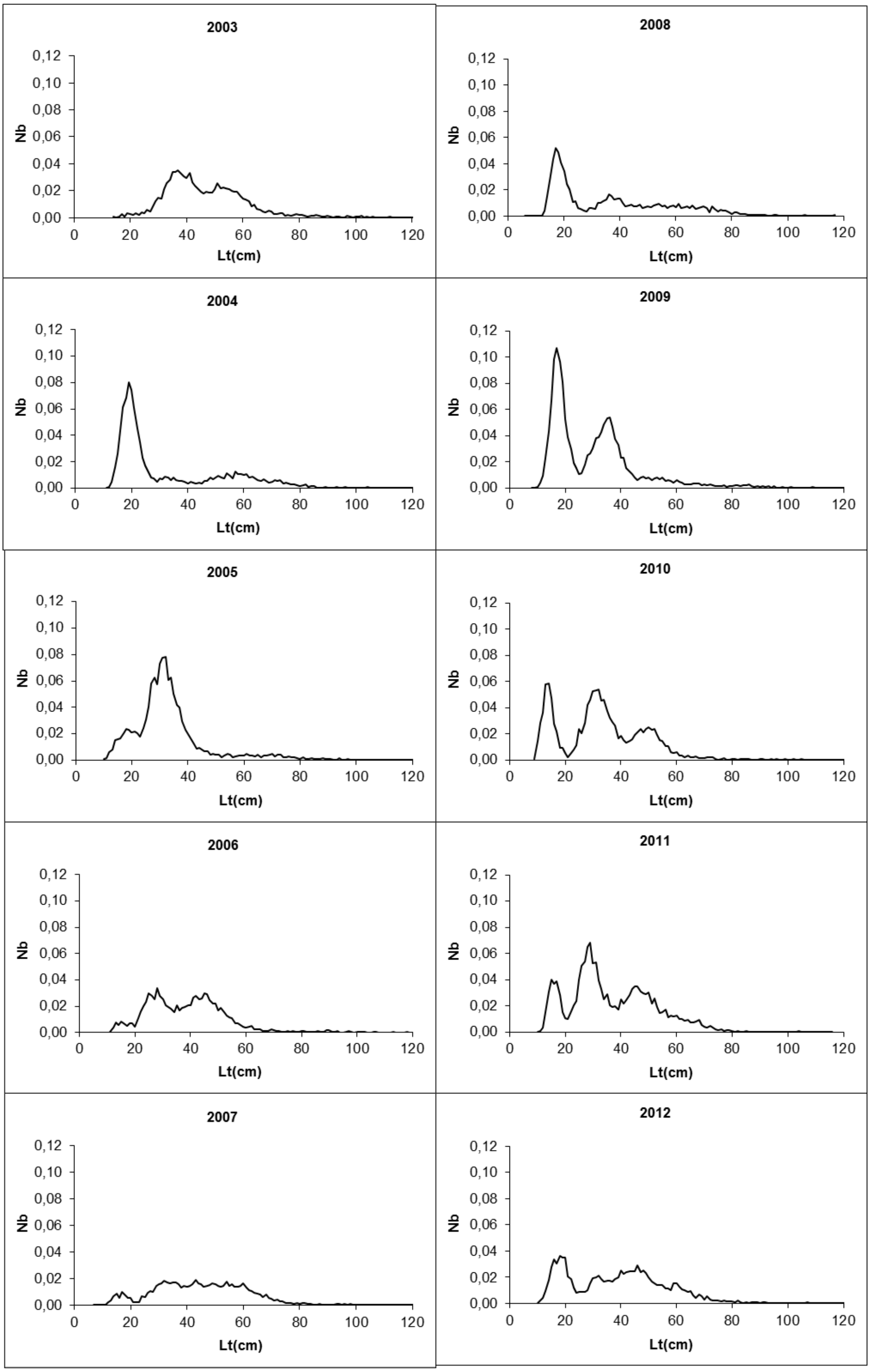


Figure 4.2-8 - *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d- Time-series of the FSP-ENG-MONK Length distributions in Nb per meter beam per hour tow from 2003 to 2012

4.3 *Anglerfish (L. budegassa)* in Divisions VIIb-k and VIIIa,b,d

4.3.1 Data

4.3.1.1 Commercial Catch

The Working Group estimates of landings of *L. budegassa* by fishery unit (defined in Section 2) are given in Table 4.3-1.

The landings have fluctuated over the studied period between 5 720 t to 9 632 t with a succession of high (1989-1992, 1996-1998 and 2003) and low values (1994, 2001 and 2006). The total estimated landings have dropped from 2003 to 2006 and since then have risen to the fourth highest of the time-series in 2010 with 9 359 t landed and the third highest in 2012. In 2013 landings of 12 655 t are the highest of the time series.

4.3.1.2 Commercial LPUE

Effort and LPUE data were available in 2013 for the three Spanish fleets, and for the English EW-FU06 (Table 4.3-2 and 4.3-1). Fishing effort for most fleets shows a decrease until the early 2000's. Effort remained relatively stable thereafter, with the exception of SP-BAKON7 which disappeared in 2009 but reappeared again in 2010 with 2008 effort levels and disappeared again in 2012. From 2011 to 2013 a sharp decrease in SP-VIGO7 (41 % reduction) and SP-CORUTR7 (77 % reduction) was recorded.

LPUEs from SP-BAKON7 show an increasing trend from 1993 to 2000. Since then LPUEs have fluctuated with increasing trends since 2006 and conflicting trends for the most recent period. The 2010 SP-CORUTR7 LPUE has a revised figure for 2010 from 93 down to 19 which is similar to its historic levels. In 2012 SP-VIGO7 showed the series maximum. In 2013 SP-CORUTR7 and SP-BAKON8 showed the series maximum and SP-VIGO7 high values again, whereas EW-FU06 showed a decreasing trend.

4.3.1.3 Surveys data

4.3.1.3.1 The French EVHOE-WIBTS-Q4 survey

This survey covers the highest proportion of the area of stock distribution. Standardised biomass and abundance indices are given in Figure 4.3-2. The biomass index shows patterns of increase and decrease over the time-series, with a continuous increase from 2005 to its maximum value in 2008 followed again by a decrease to 2003-2005 levels. The most recent year shows an increase to the second highest level of the time-series in 2012 and a intermediate level in 2013. The abundance index shows a similar pattern to reach its highest values in the time series in 2008. In 2009 and 2010 the indices returned to 2004-2005 levels, 2011 shows another increase in abundance followed with the fourth highest result of the series in 2012. In 2013 the abundance found was the highest of the series

The length distributions (Figure 4.3-3.) show that the abovementioned results correspond to strong incoming year-classes from 2004 until 2008 that can be tracked from year to year with modes between 10-17 cm for the first age group (since 2004), 18 – 32 for the second (2005, 2007 and 2008), 33-45 for the third and 50-55 for the fourth (more obvious in 2008).

For 2009 the length distribution does not show a strong signal of recruitment nor can the signal from 2008's strong recruitment be followed. 2010 shows a medium level recruitment and the last two years, 2011, 2012 and 2013 gives the strongest signals of the time series for recruits.

The localisation of juveniles (individuals less than 16 cm) caught during the survey from 1997 to 2008 show two nursery areas one in the western Celtic Sea and another in the north-western area of the Bay of Biscay (Figure 4.3-4. and Figure 4.3-5.), in 2008, juveniles are also found in more southern area of the Bay of Biscay in deeper waters. In 2010 to 2013 the normal pattern was found again with a more confined distribution in the western Celtic Sea.

4.3.1.3.2 The English Fisheries Science Partnership survey.

This survey was discontinued in 2013

This survey samples a fraction of each of the areas VIIe, VIIf, VIIg and VIIh. The survey covers a restricted area of the species distribution but the pulses of recruitment observed in the EVHOE-WIBTS-Q4 surveys are also present in the FSP-ENG-MONK survey in the following year. Length distribution of *L. budegassa* catches are available and presented in Figure 4.3-6.

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

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

4.3.1.3.3 Other surveys

The other surveys (IGFS-WIBTS-Q4 and SPPGFS (WIBTS-Q4)) are covering areas mostly outside the preferred area of distribution of the species. Therefore information is too scarce to be presented.

4.3.2 Conclusion

Survey data give indication that the biomass has shown a continuous increase since the mid 2000's as a consequence of several good incoming recruitments. There is good evidence of a strong incoming recruitment from 2008. The EVHOE-WIBTS-Q4 shows evidence of a medium level of recruitment in 2010 and the last three years has recorded its historical maximum. Length frecuency distributions from the two available surveys show contradictory signals for 2009, 2011 and 2012 recruitments, but the working group considers that the trendof EVHOE is more representative due to the larger coverage of the survey.

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

Preliminary information on discards shows that an increasing proportion of small fish are caught and discarded.

Measures should be taken to ensure good survival of recent recruitment.

4.3.3 Comments on the assessment

As for *L. piscatorius*, data from surveys tracking recent good recruitment give scope for growth studies and ageing validation that should be initiated as soon as possible. It is noted that this should be easier than for *L. piscatorius* given the length distribution observed in recent years in the EVHOE-WIBTS-Q4 survey and the last four years in the English Fisheries Science Partnership programme FSP-ENG-MONK survey.

Table 4.3-3 *Lophius budegassa* in Divisions VIIb-k and VIIIa,b,d - Landings in tonnes by Fishery Unit.

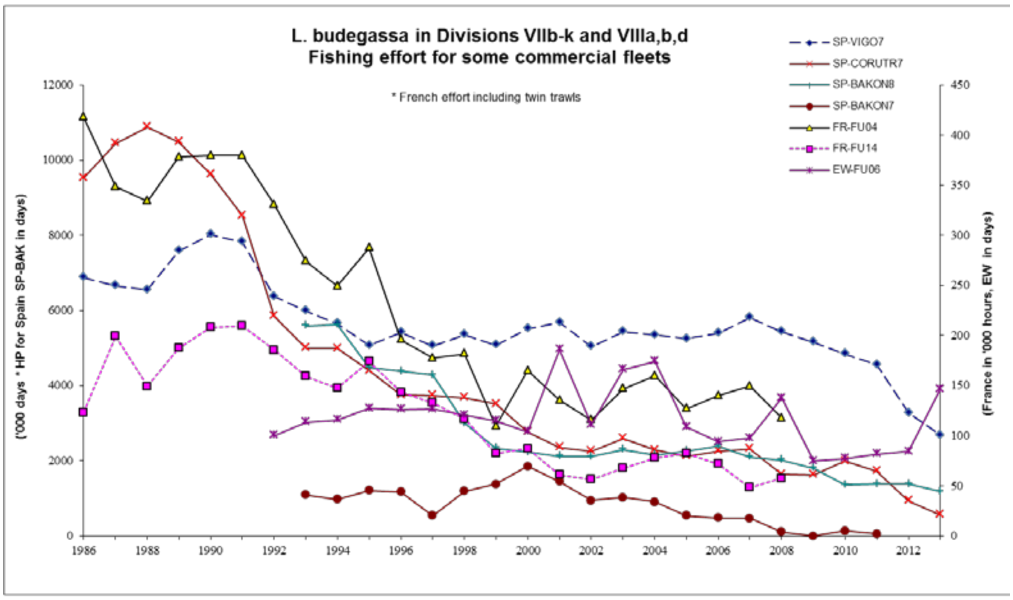
	VIIb,c,e-k						VIIIa,b,d				
		Medium/Deep	Shallow	Shallow/medium				Shallow	Medium/Deep		TOTAL
Year	Gill-Net	Trawl	Trawl	Beam Trawl	Neph.Trawl	Unallocated	Neph.Trawl	Trawl	Trawl	Unallocated	VII +VIII
	(Unit 3+13)	(Unit 4)	(Unit 5)	(Unit 6)	(Unit 8)		(Unit 9)	(Unit 10)	(Unit 14)		
1986	23	5 126	348	540	406	0	443	150	1 181	0	8 217
1987	30	3 493	696	462	434	0	483	116	1 904	0	7 619
1988	34	4 072	1 095	751	394	0	435	102	1 498	0	8 382
1989	40	4 398	976	505	515	0	446	112	1 829	0	8 820
1990	53	4 818	631	905	653	0	550	156	1 865	0	9 632
1991	0	4 416	934	397	507	0	475	117	1 933	0	8 780
1992	0	4 808	301	305	594	0	459	191	1 518	0	8 176
1993	0	3 415	429	405	399	0	433	101	1 385	0	6 566
1994	0	2 935	265	209	540	0	232	49	1 515	0	5 744
1995	10	3 963	455	159	617	0	312	62	1 286	90	6 953
1996	118	4 587	477	245	524	28	374	109	1 239	392	8 092
1997	134	4 836	602	132	474	9	313	17	1 128	471	8 114
1998	179	5 565	246	230	288	1	258	72	1 454	305	8 599
1999	18	4 311	119	282	338	0	144	76	1 450	0	6 739
2000	57	4 489	161	284	228	0	124	31	1 270	0	6 645
2001	41	3 758	107	266	306	0	121	29	1 100	0	5 728
2002	30	4 272	147	251	372	0	112	14	1 195	0	6 394
2003	92	5 748	337	342	376	5	195	26	1 248	0	8 368
2004	122	4 684	242	343	376	0	254	9	1 407	0	7 436
2005	73	4 837	162	409	329	0	235	56	1 431	0	7 532
2006	9	3 661	145	271	218	0	286	1	1 128	1	5 720
2007	92	3 874	168	306	250	0	243	0	1 424	0	6 357
2008	21	4 620	187	392	254	0	235	0	1 669	0	7 379
2009	72	5 963	24	441	36	0	354	0	2 047	145	9 082
2010	224	6 137	9	597	27	0	379	0	1 763	223	9 359
2011	172	3 562	11	591	16	1 747	378	0	1 413	96	7 988
2012	110	4 896	6	483	6	1 135	275	0	2 250	384	9 546
2013*	155	5 564	4	551	64	1 332	559	0	3 564	862	12 655

* preliminar

Table 4.3-4 *L. budegassa* in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data

EFFORT	SP-VIGO7 in Division VII ('000 days*HP)	SP-CORUTR7 in Division VII ('000 days*HP)	French Benthic trawlers* Celtic Sea FU04 ('000 hrs)	French Benthic Twin Trawls Celtic Sea ('000 hrs)	French Benthic trawlers* Bay of Biscay FU14 ('000 hrs)	French Benthic Twin Trawls Bay of Biscay ('000 hrs)	EW FU06 Beam trawlers in VII ('00 days)	SP-BAKON7 (days)	SP-BAKON8 (days)
1986	6 875	9 527	418	N/A	123	N/A	N/A		
1987	6 662	10 453	349	N/A	199	N/A	N/A		
1988	6 547	10 886	334	N/A	150	N/A	N/A		
1989	7 585	10 483	378	N/A	187	N/A	N/A		
1990	8 021	9 630	380	N/A	208	N/A	N/A		
1991	7 822	8 522	380	N/A	210	N/A	N/A		
1992	6 370	5 852	331	N/A	186	N/A	100		
1993	5 988	5 001	274	N/A	159	N/A	114	1 094	5 590
1994	5 655	4 990	249	N/A	148	N/A	116	980	5 619
1995	5 070	4 403	287	N/A	174	N/A	127	1 214	4 474
1996	5 416	3 746	196	121	144	19	126	1 170	4 378
1997	5 058	3 738	178	133	133	33	126	540	4 286
1998	5 360	3 684	182	134	117	40	121	1 196	3 002
1999	5 084	3 512	110	110	83	59	115	1 384	2 337
2000	5 519	2 773	165	104	87	49	104	1 850	2 227
2001	5 678	2 356	135	133	61	66	186	1 451	2 118
2002	5 041	2 258	116	120	57	75	111	949	2 107
2003	5 437	2 597	147	136	68	81	166	1 022	2 296
2004	5 347	2 292	160	133	78	89	174	910	2 159
2005	5 246	2 120	127	137	83	121	109	544	2 263
2006	5 392	2 257	140	145	72	101	94	487	2 398
2007	5 812	2 323	149	152	48	127	97	476	2 098
2008	5 432	1 640	118	126	58	113	138	105	2 017
2009	5 155	1 626					75	0	1 807
2010	4 843	1 988					77	138	1 358
2011	4 553	1 725					82	57	1 384
2012	3 276	937					84		1 384
2013	2 683	563					146		1 185

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



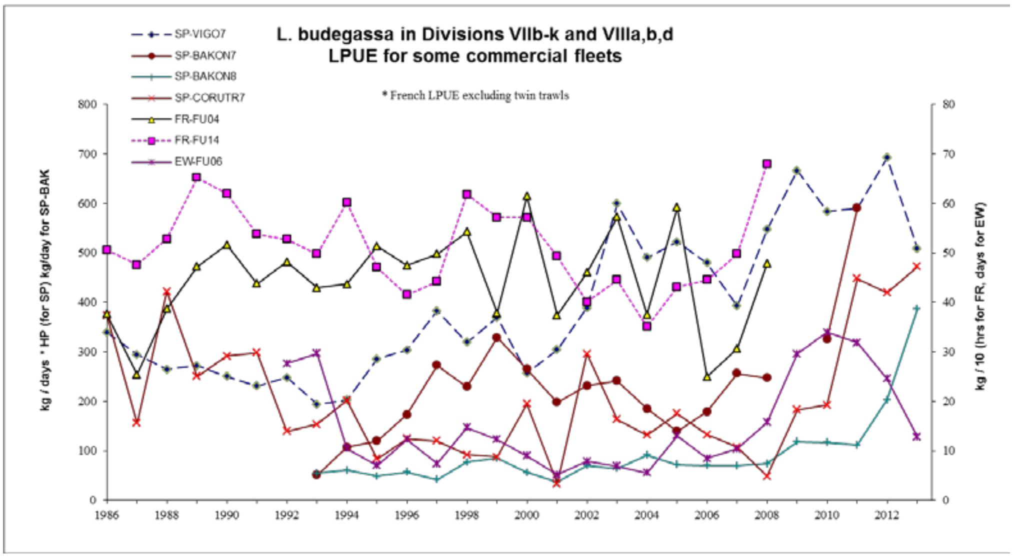


Figure 4.3-7 ***L. budegassa*** **in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data**

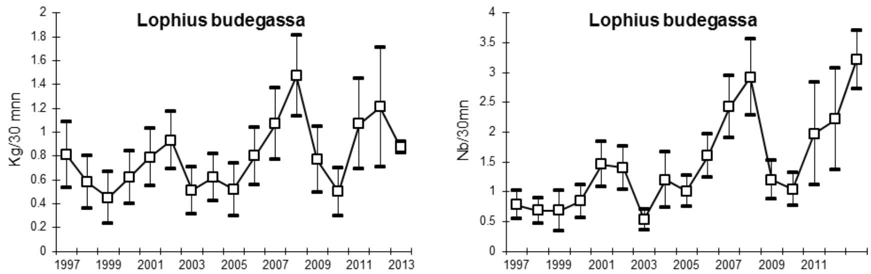


Figure 4.3-8 ***L. budegassa*** **in Divisions VIIb-k and VIIIa,b,d- Time-series of the EVHOE-WIBTS-Q4 survey's indices Kg (left) and Nb (right) per 30 minutes tow from 1997 to 2011**

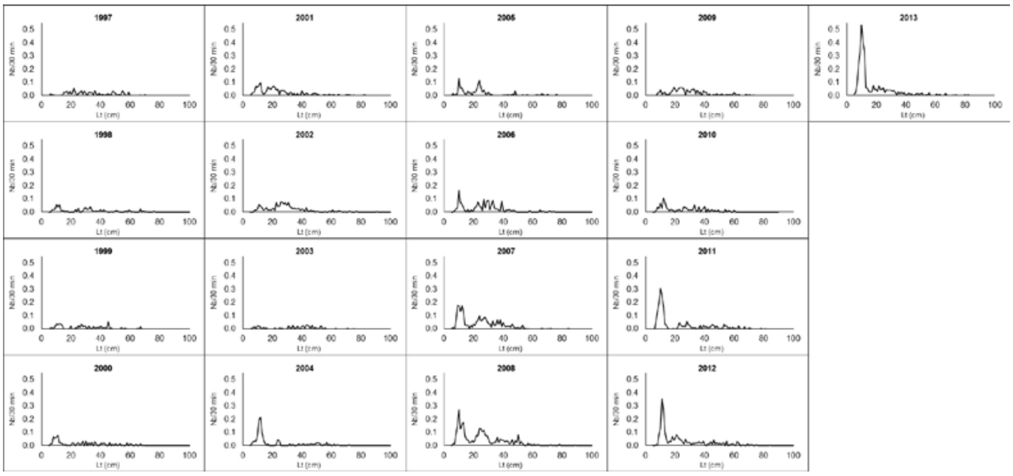


Figure 4.3-9 - ***L. budegassa*** **in Divisions VIIb-k and VIIIa,b,d- Time-series of the EVHOE-WIBTS-Q4 length distributions in Nb per 30 minutes tow from 1997 to 2011.**

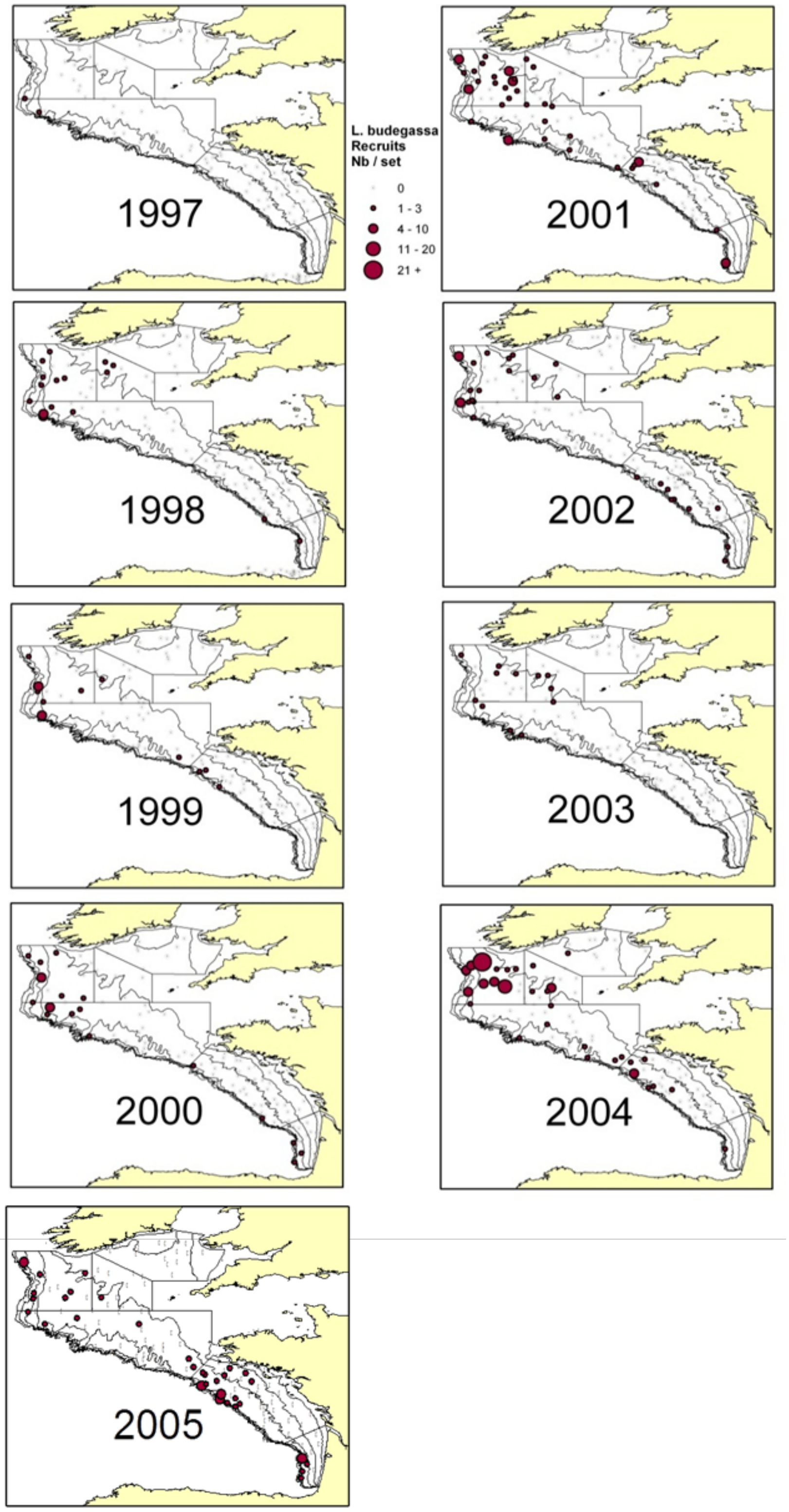


Figure 4.3-10 – *L. budegassa* in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 16 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 1997 to 2005.

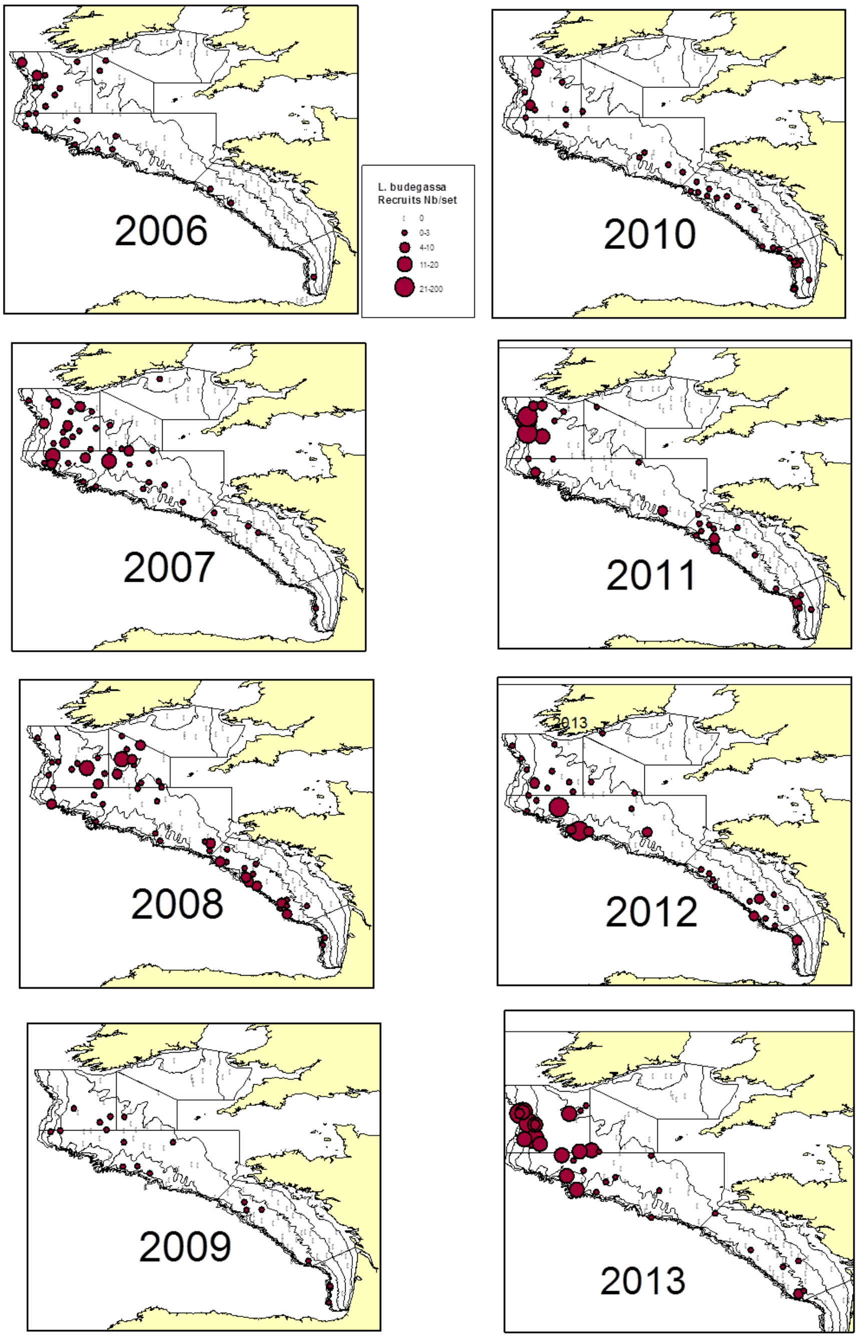


Figure 4.3-11 – *L. budegassa* in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 16 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 2006 to 2013.

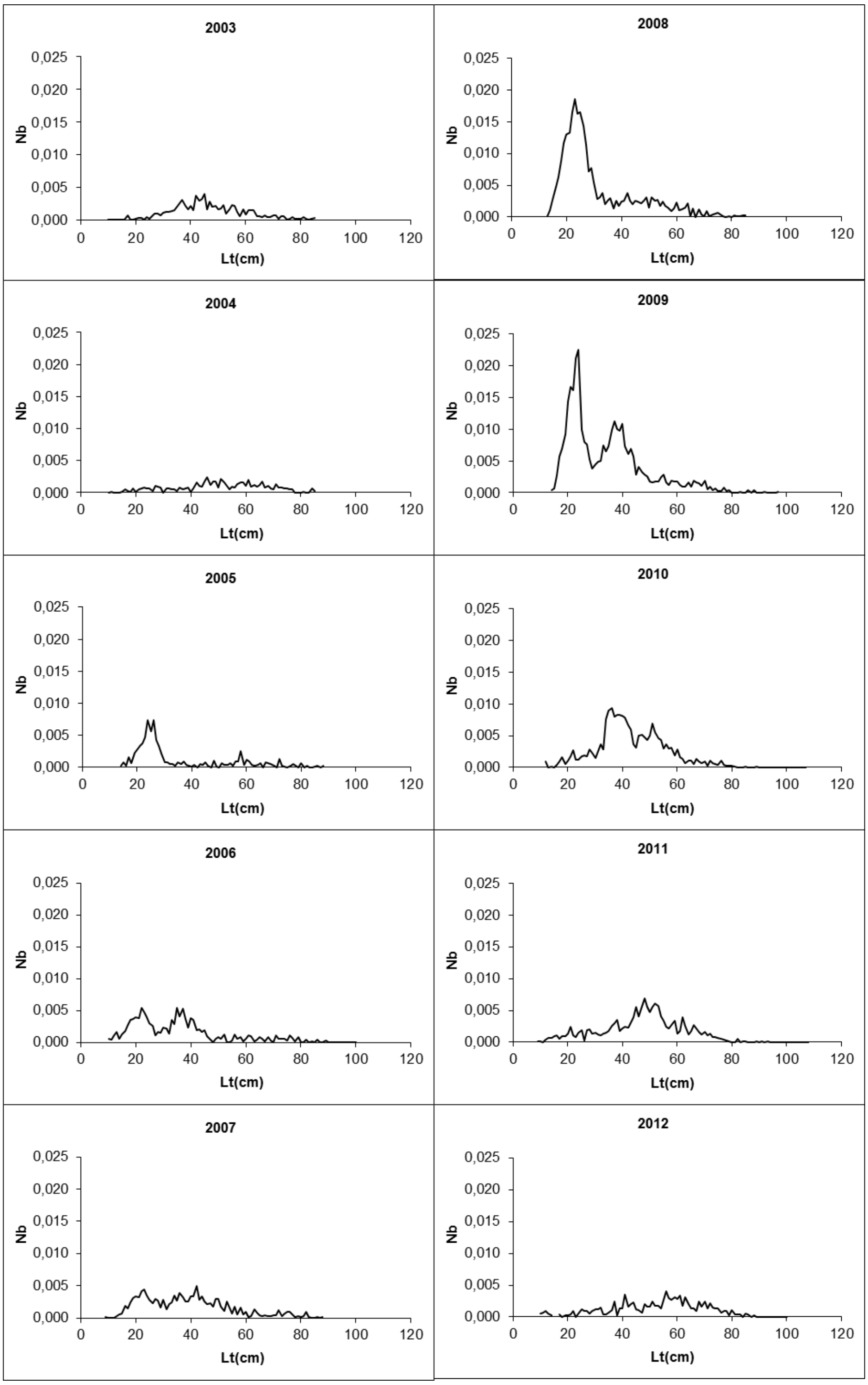


Figure 4.3-12 - ***L. budegassa*** **in Divisions VIIb-k and VIIIa,b,d- Time-series of the FSP-ENG-MONK length distributions in Nb per 30 minutes tow from 2003 to 2012.**

5 Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d

Assessment type: An Update assessment has been done for this stock. This stock was benchmarked in 2012 in WKFLAT. This type of assessment is based on survey trends in population parameters from assessment results; and a more detailed trend study on abundance of age groups from surveys and commercial fleets.

Data revisions this year: French 2012 landing revision has been carried out and a revised Spanish Porcupine Ground Fish Survey abundance index in ages has been used in the assessment.

5.1 General

5.1.1 Fishery description

Megrim in the Celtic Sea, west of Ireland, and in the Bay of Biscay are caught in a mixed fishery predominantly by Spanish followed by French, Irish and UK demersal vessels. In 2013, the four countries together have reported around 97% of the total landings (Table 5.1.1.1.). Estimates of total landings (including unreported or miss-reported landings) and catches (landings+discards) as used by the Working Group up to 2013 are shown in Table 5.1.1.2. In 2012, Spanish official data for years 2011 and 2012 was included.

5.1.2 Summary of ICES Advice for 2014 and Management applicable for 2013 and 2014

ICES advice for 2014

New data (landings, discards and surveys) available for this stock do not change the perception of the stock; therefore, the advice for this fishery in 2014 is the same as the advice for 2013 (see ICES, 2012a*): Based on the ICES approach for data limited stocks, ICES advises that landings should be no more than 12 000 tonnes.*

Management applicable for 2013 & 2014

The 2013 TAC was set at 19 101 t and 2014 TAC 19 101 t, including a 5% contribution of *L. boscii* in the landings for which stock there is no assessment.

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

5.2 Data

5.2.1 Commercial catches and discards

Stock catches for the period 1984-2013, as estimated by the WG, are given in Table 5.1.1.2.

Spanish data from 2011 to 2013 has been provided by SGP, the official national administration responsible for fishery statistics. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations.

During Benchmark 2012, France landing data series were reviewed from 1999 onwards and final landings were provided for 2010 and 2011. Minor revisions were made for the Irish and Spanish landings and they are included in this revised data series.

Landings in 2013 are higher than in 2012 (20%), reaching up to 15 800 t.

Discard data for 2013 for UK were preliminar. Ireland and Spain provided discard data. France did not provided discard data since 1999, as data appear to be very uncertain in relation to sampling level affecting their representatively.

Discard data available by country and the procedure to derive them are summarised in Table 5.2.1.1. The discards decrease in year 2000 can be partly explained by the reduction in the minimum landing size from 25 cm to 20 cm. Since 2000, an increasing trend in the discards has been observed. This could be explained by the MLS plus due to the large number of small fish caught until 2004. In 2005, the decrease in the number of small fish resulted in a large decrease of discards (Figure 5.2.1.1). In 2006 discards increased again around 23 %, especially in ages 4 and 5, while a decrease occurred till 2008. In 2010, discards increased in almost 40% close to levels of 2003. In 2011 and 2012, discards decreased 25% and 14% respectively but in 2013 discards increased again 43%.

In 2012, United Kingdom (England and Wales), and Ireland provide discard data since 2000. France does not provide this data, which led to an artificial decrease in the amount of total discards. The group states strongly the importance of incorporating annual estimates of discards to obtain consistent data along the whole data series. Maybe also discards could explain some possible recruitment that could not be completely registered in the catch at age matrix and LPUEs.

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

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Discard ratio (%)	11	13	15	20	27	17	22	17	19	16	25	22	19	21

5.2.2 Biological sampling

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

Age

France provided ALKs and consequently completed number and weights at age up to 2013. Spain, Ireland and UK (England and Wales) provided number at age for discards and landings up to 2013.

Age distribution for landings and discards from 1999 to 2013 are presented in Figure 5.2.2.1.

Lengths

Table 5.2.2.1 shows the available original length composition of landings by Fishing Unit in 2013. Spanish length composition was standardised by total number of individuals. The length compositions of the landings show an increase between 1990 and 1992 and, subsequently, a constant decrease until a rapid increase starting in 2000 (Figure 5.2.1.1) due to the change in MLS. Up to 2006, mean lengths stay relatively stable in the recent years with a decrease in length of discards. In 2013 increased the mean length of discarded fishes.

5.2.3 Surveys 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 1997–2013 are summarised in Table 5.2.3.1.

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

EVHOE-WIBTS-Q4 indices for age 1+2 showed no evident general trend. Oscillations of high and low values are present from 2002 to 2007. In 2007 indices decreased sharply with a slight increase till 2010. From 2010 it remains quite stable with a slight decrease in 2013 (Figure 5.2.3.2).

An abundance index in ages was provided for Irish Groundfish Survey (IGFS-WIBTS-Q4) from 2003-2013. For the last five years of the data series, the survey provides the lowest values of older ages. For the younger ages, it is quite stable in the last five years.

A revised abundance index in ages was provided for the Spanish Porcupine Ground Fish Survey (SpPGFS-WIBTS-Q4) from 2001 to 2013 due to a change in the calculation methodology of the tow trawling time. In Figure 5.2.3.2. both indices OLD SP-PGFS and NEW SP-PGFS are represented an minor changes are observed between them in the grouped ages time series.

When comparing Spanish, French and Irish survey biomass indices some contradictory signals are detected (Figure 5.2.3.1). The EVHOE-WIBTS-Q4 index decreased from 2001 until 2005 and since then has sharply increased. In 2012 and 2013, it slightly decreased. The OLD SpPGFS-WIBTS-Q4 Porcupine survey (OLD SP-PGFS) biomass index appears to fluctuate without trend, with the lowest value of the period attained in 2008. However, some concerns about the good performance of the gear in 2008 were raised and thus the 2008 index may not be entirely reliable. In 2009, these performance problems were solved and the index increased for the last 4 years of the series. The NEW SpPGFS-WIBTS-Q4 Porcupine survey (NEW SP-PGFS) shows from year 2003 a higher abundance index but maintaining similar increasing trends as the old one.

Irish Ground Fish 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 2010 a sharp decreased occurred in contradiction with the French and Spanish surveys. In 2011 a slight increase occurred in agreement with Spanish survey and in 2012 and 2013 a decreased was observed again.

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

It must be noted that the areas covered by the three surveys almost do not overlap (Figure 5.2.3.3). There is some overlap between the northern component of EVHOE-WIBTS-Q4 and the southern coverage of IGFS-WIBTS-Q4, whereas the eastern boundary of SP-PGFS essentially coincides with the western one of IGFS-WIBTS-Q4.

5.2.4 Commercial catch and effort data

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

The general level of effort is described in Figure 5.2.4.1. SP-CORUTR7 and SP-VIGOTR7 fleets have decreased sharply until 1993, since then it has been decreasing slightly. SP-VIGOTR7 showed a very slight increase in 2007, decreasing slightly till 2013. 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 three years no effort was deployed. The effort of the French benthic trawlers fleet in the Celtic Sea decreased from 1991 to 1994, then increased in 1995-1996 and decreasing again in 1999. Since then, effort has been fluctuating up and down for the last 10 years. Since French logbook data were only partially available since 1999, only the LPUE data can be considered.

Commercial series of catch-at-age and effort data were available for three Spanish fleets in Subarea VII (Figure 5.2.4.2): A Coruña (SP-CORUTR7) from 1984–2013, Cantábrico (SP-CANTAB7) from 1984–2010 as no effort has been deployed by this fleet in subarea VII during the last three years and Vigo (SP-VIGOTR7) from 1984–2013. 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 decrease again in 2012. Over the same period, SP-VIGOTR7 has remained relatively stable until 1999, when it started to increase, reaching in 2004 the historical maximum. In 2005 a sharp decrease occurred, increasing slightly again in 2006 and 2007 and a sharp increase in 2009. SP-CANTAB7 has been fluctuating up to 1999 and then a general increasing trend is observed. No LPUE value is available for this fleet in 2009, as no effort was deployed. In 2010, LPUEs increased as a result of some trips being deployed in area VII but in 2011, 2012 and 2013 no effort was deployed.

From 1985 to 2008, LPUEs from four French trawling fleets: FR-FU04, Benthic Bay of Biscay, Gadoids Western Approaches and *Nephrops* Western Approaches were available. (Table 5.2.4.1.& Figure 5.2.4.3). FR-FU04, Benthic Bay of Biscay, Gadoids Western Approaches and *Nephrops* Western Approaches were revised and new series included. However no data for 2009, 2010 and 2011 were provided as effort deployed by these fleet was considered, at the time of the analysis, unreliable. The LPUE of all French bottom trawlers fleets decreased from 1988 to 1991 and remained relatively stable until 1994 (Figure 5.2.4.3). Since then, both benthic fleets have shown increasing LPUE until 1997 and 1998. Benthic trawlers in VIIIa,b,d follow a decreasing trend while the FU04: Benthic Western Approaches remained at an increasing trend until 2002, then a sharp decreasing trend is observed till 2004. From then, LPUE has increased and remain stable for the last 3 years of the series.

The LPUE of all Irish beam trawlers fleets oscillates up and down since 2000 to 2006 following a decreasing trend. From 2007 an increase in the LPUE is observed (Figure 5.2.4.4).

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

An analysis of the abundance indices of different age groups along the whole data series for commercial fleets was carried out (Figure 5.2.4.5). Ages groups were identified as: i) age 1+age 2; ii) age 3+age 4+age 5 and iii) age 6+age 7+age 8+age 9+age 10+. For

Spanish and Irish commercial fleets, the most abundant age group was ii) at the beginning and the end of the data series. Age group i) appear more abundant than older ages (ii) during years 2003 and 2004 in the Spanish fleet. French fleets appear to land mostly old individual at the beginning of the data series, while same quantities of medium age fish (group ii) and old fish (group iii) are presented till 2008. In general a marked decrease in abundance index of old fish was observed for French fleet. In 2013, a slight decrease of numbers is observed in Spanish and Irish fleets but the proportion of age groups catches is maintained.

Based on age groups of commercial fleets, summarizing no particular LPUE changes have been observed, so no stock changes is observed.

5.3 Assessment

No analytical assessment is available for this stock since 2007 consequently no forecast is either provided. This stock was Benchmarked in 2012 and a Bayesian statistical catch-at-age model was tested. Absolute values of the assessment were not accepted by the Group due to the lack of confidence on the data and deficiencies of then available data.

This year, an update assessment has been conducted using data up to year 2013, according to the settings presented in the Stock Annex.

5.3.1 Data Exploratory Analysis

In summary, the stock catch-at-age matrix shows three periods: 1984–1989; 1990–1998 and 1999–2013.

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 results are described below. The analysis of the standardized log abundance indices revealed no special trend in EVHOE-WIBTSQ4 survey (Figure 5.3.1.1). Otherwise, in SpPGFS-WIBTS-Q4 negative values for older ages from 2007 to 2011 but positive for older ages in 2012 and 2013. 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 1999 and 2000, VIGO99 showed negative high values for ages 1 and 2 but in the last years positive values of ages 1,2 and 3. IRTBB and SpPGFS-WIBTS-Q4 were the fleets that showed more positive values for older ages from year 2010 onwards.

The time-series of catch at age (Figure 5.3.1.2) showed very low catches of ages 1–5 from 1984 to 1989. From 2004 to 2010, the catch of older ages (>6) was remarkably low, whereas catches of ages 1 and 2 increased markedly from 2003. This could be a result of an underestimation of catches of these ages (specially age 1) before this year due, most probably, 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 to almost no individuals caught at the end of the data series.

The analysis of the landings are presented since 1990 (Figure 5.3.1.3). Landings of ages 1 and 2 decreased from the beginning of the series to the last years where negative values have increased from 2009 onwards. When analyzing landings of ages older than 5, differences in the patterns were also quite apparent. In fact, the proportion of older ages in the landings decreased significantly from 2004 to 2009, as already discussed in relation to the catch.

The signal coming from the discard data showed that at the beginning of the data series discards of age 1 was low (Figure 5.3.1.4). Discards of this age increased along the data series, particularly from 2003 onwards. Ages 4, 5, and 6 appeared to be highly discarded in year 2004. From year 2010 to 2013, ages 1 to 3 appear to be highly discarded.

5.3.2 Model

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

Until last year working group, the model was fitted in a Bayesian context, using the freely available software WinBUGS (Lunn *et al*., 2009). Due to the high amount of time needed to run the model in this software (3 days to run the final assessment) which limited the possibility to make trial runs with different inputs during the working group, another freely available software JAGS (Martyn Plummer, 2007) was tested. With JAGS, the final run took 1.5 hours to run which represents a very important improvement in terms of ease of use of the assessment model during the WG. A comparison of the results of both software was done in order to check the outputs. As the results obtained where nearly the same (Figure 5.3.2.1) it was decided to used the JAGS version of the assessment model for the assessment.

The model is described in Annex E of this report and also in WKFLAT 2012 report.

5.3.3 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).

The prior settings for this run are listed in Table 5.3.3.1. and are the ones chosen in the Benchmark as the best one among the different model configurations run.

In order to be sure that the model has produced a representative sample of the posterior distribution, the MCMC chain was examined for behaviour ("convergence" properties). This was done by examining trace plots and autocorrelation plots for most parameters in the model (Figure 5.3.3.1 to Figure 5.3.3.3). The trace and autocorrelation plots showed a good behaviour in the run carried out with the model, giving support to the reliability of the outputs from the MCMC simulation conducted.

Model diagnostics plots examined were: prior-posterior plots and time series and bubble plots of the residuals. Prior-posterior distributions and residuals time series are shown in Figures 5.3.3.4 to Figures 5.3.3.5, respectively. 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 ord 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.

Time series of estimated spawning stock biomass (SSB), reference fishing mortality (Fbar), recruits and catch, landings and discards are shown in Figure 5.3.3.5. The SSB shows an overall decreasing trend from the start of the series in 1984 to 2005 with a marked increasing trend till 2013. 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 without any trend. The uncertainty around median recruitment was small until the last 3 years, when it started to increase. As expected, uncertainty in recruitment estimates is largest at the end of the time series, as those years correspond to cohorts that are still passing through the population and additional information about them will be gained in future years. The fishing mortality showed three marked periods which coincide with the data periods, 1984-1989, 1990-1998 and 1999-2013. The lowest Fbar was observed in the first period and the highest one in the year 2005. The uncertainty was small and increased slightly in the last years of the fit. Overall, the catches showed very weak decreasing trend. The landings decreased in a higher proportion than the catches and the discards showed an increasing trend. The uncertainty was small in all the years.

5.4 Retrospective pattern

Retrospective analysis was conducted for 4 years, the retrospective time series of most relevant indicators are shown in Figures 5.4.1. In terms of SSB, two groups were distinguished: one corresponding to the two shortest time series (removing the 2 and 3 final years) and a second one with the two longest time series (until 2013 and removing 1 year). The SSB estimates were very similar throughout the entire time series and there was an upward 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 downwards year by year.

5.5 Conclusions

The use of the Bayesian statistical catch-at-age model gives very promising results and the model is able to address the heterogeneity in the Northern Megrim data in a very satisfactory way. The model fit to the data is adequate and the WG considers that the current assessment can be fully accepted and not only as indicator of trend as in the last benchmark. However, some work is still needed in order to develop the basis for short term projection and that is the reason why, in this year assessment, no projections have been carried out directly from the assessment. The development of framework for projections based on the bayesian stock assessment model will be conducted intercessionaly and made available to the WG next year.

Catch, landing and discard data and survey indices do not appear to indicate the presence of important change in trends of recruitment or the overall biomass.

In the context of the current trend analysis and in view of available data, the Group concludes that the stock appears stable at the present level of fishing.

5.6 Short term and medium term forecasts

No forecast is provided.

5.7 Biological reference points

The calculation of possible reference points was not considered appropriate at this time due to the lack of analytical assessment.

5.8 Recommendations on the procedure for assessment updates and further work

It needs to be pointed out that stock data from countries should be available one month before the group starts as it was set, otherwise there is not enough time during the group to make preliminary runs to obtain the best fit of the model.

The group states strongly the importance of delivering reliable French discard data, including annual estimates of discards to explain some of the recruitment processes detected in the analysis and not completely registered in the catch at age matrix and LPUEs.

Some recommendations are done in Annex O.

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

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
France			4896	5056	5206	5452	4336	3709	4104	3640	3214	3945	4146	4333	4232	3751	4173	3645	2929	3203	2758	2787	2726	2733	2383	1316	1728	1599	2268	4489
Spain			10242	8772	9247	9482	7127	7780	7349	6526	5624	6129	5572	5472	4870	4615	6047	7575	8797	8340	7526	5841	5916	6895	5402	8062	7095	3847	3997	4827
U.K.			2048	1600	1956	1451	1380	1617	1982	2131	2309	2658	2493	2875	2492	2193	2185	1710	1787	1732	1622	1764	1509	1462	1387	1842	1810	1845	1744	2918
Ireland			1563	1561	995	2548	1381	1956	2113	2592	2420	2927	2699	1420	2621	2597	2512	2767	2413	2249	2288	2155	1751	1763	1514	1918	2283	2227	3047	3038
Belgium			178	125	173	300	147	32	52	40	117	203	199	130	129	149	115	80	62	163	106	156	99	195	167	209	261	330	609	538
Unallocated																												2074	1080	
Total landings	16659	17865	18927	17114	17577	19233	14371	15094	15600	14929	13685	15862	15109	14230	14345	13304	15032	15778	15987	15687	14300	12703	12000	13048	10853	13348	13177	11923	12745	15809
Total discards	2169	1732	2321	1705	1725	2582	3284	3282	2988	3108	2700	3206	3026	3066	5371	3297	1870	2261	2813	4008	5240	2578	3368	2703	2531	2604	4406	3340	2902	4137
Total catches	18828	19597	21248	18819	19302	21815	17655	18376	18588	18037	16385	19068	18135	17296	19716	16601	16902	18039	18800	19696	19540	15281	15369	15751	13384	15952	17583	15263	15647	19946
Agreed TAC (1)				16460	18100	18100	18100	18100	18100	21460	20330	22590	21200	25000	25000	20000	20000	16800	14900	16000	20200	21500	20400	20400	20400	20400	20106	20106	19101	19101

Table 5.1.1.2. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,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	16602	20000
2000	15031	1870	16901	20000
2001	15778	2262	18040	16800
2002	15987	2813	18800	14900
2003	15687	4008	19695	16000
2004	14300	5240	19539	20200
2005	12703	2578	15281	21500
2006	12000	3368	15369	20425
2007	13048	2703	15750	20425
2008	10853	2531	13384	20425
2009	13348	2604	15952	20425
2010	13177	4406	17583	20106
2011(*)	11923	3340	15263	20106
2012(*)	12745	2902	15647	19101
2013(*)	15809	4137	19946	19101

(1) for both megrim species and VIIa included.

(*) Spanish official data are included.

Table 5.2.1.1 Megrim (*L.whiffiagonis*) in VIIb-k and VIIIa,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	-	SP04	IR	UK
2005	-	SP05	IR	UK
2006	-	SP06	IR	UK
2007	-	SP07	IR	UK
2008	-	SP08	IR	UK
2009	-	SP09	IR	UK
2010	-	SP10	IR	UK
2011	-	SP11 (*)	IR	UK
2012	-	SP12 (*)	IR	UK
2013	-	SP13 (*)	IR	UK

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

Length	FRANCE	SPAIN		IRELAND	UNITED KINGDOM		
class (cm)	ALL FISHING UNITS	FU04: Otter trawl-med&deep VII	FU14:Otter trawl-med&deep VIIIabd	ALL FISHING UNITS	FU03:Fixed nets	FU05:Otter trawl-shallow	FU06:Beam trawl-all depths
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	1	0	0	0	0
19	0	0	0	0	0	0	0
20	2151	4	16	0	0	0	0
21		0	30	2845	0	0	0
22	4184	0	73	5843	0	0	0
23		57	194	14508	0	0	0
24	69873	590	226	37612	0	0	7802
25		2059	320	62545	29	0	7472
26	283210	3168	285	136492	44	0	44053
27		2912	247	238218	78	177	102309
28	681957	2237	242	398703	133	1011	165085
29		1845	241	500078	348	7591	263548
30	1258111	1372	193	718448	554	18945	255997
31		1024	143	805844	415	40701	197199
32	1649890	851	130	871791	476	53956	177563
33		736	106	808358	439	64807	211248
34	1446289	577	75	746208	338	69678	197897
35		408	55	572648	419	56964	178373
36	1180346	393	50	440135	279	60424	177002
37		347	41	379481	309	55172	151999
38	1156089	303	30	335921	249	48985	134060
39		282	31	283575	274	35132	94773
40	975551	254	25	276098	245	25007	79122
41		234	21	195291	336	15703	74100
42	777407	186	13	169344	280	11348	56204
43		135	11	157063	262	8183	41677
44	691521	144	10	122867	516	5425	42883
45		111	9	114661	138	2760	43512
46	509556	73	4	77020	709	1819	32621
47		63	2	67373	116	2240	26297
48	342395	46	3	42344	30	1496	25966
49		33	3	28997	142	111	12496
50	181384	19	6	21130	0	288	16290
51		10	1	14736	11	0	7208
52	86699	12	0	11076	11	0	5943
53		11	0	5428	19	292	4892
54	36552	3	0	4552	0	0	5925
55		2	0	4513	0	0	1334
56	13861	0	0	1241	0	0	1863
57		2	0	1008	0	0	135
58	6497	0	0	951	0	0	513
59		0	0	1006	0	0	0
60	87	0	0	0	0	0	0
61		0	0	0	0	0	0
62		0	0	0	0	0	0
63		0	0	0	0	0	0
64		0	0	0	0	0	0
65		0	0	0	0	0	0
66		0	0	0	0	0	0
67		0	0	0	0	0	0
68		0	0	0	0	0	0
69		0	0	0	0	0	0
70		0	0	0	0	0	0
TOTAL	11353609	20503	2837	8675954	7199	588215	2845361

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

UK-WCGFS-D — Effort in hours

	Effort	Age 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

	Effort	Age 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

	Effort	Age 1	2	3	4	5	6	7	8	9
1997	100	0.77	3.92	2.47	1.47	1.59	0.91	0.61	0.35	0.15
1998	100	1.61	0.66	4.48	3.07	1.52	0.98	0.84	0.43	0.14
1999	100	0.54	3.48	0.72	2.14	3.38	1.66	0.70	0.30	0.27
2000	100	1.38	2.79	2.64	1.35	1.22	0.73	0.40	0.28	0.14
2001	100	0.94	0.51	1.87	2.36	2.72	1.87	1.40	0.38	0.22
2002	100	3.12	2.28	4.24	3.18	1.67	0.68	0.49	0.23	0.10
2003	100	2.53	2.95	2.40	3.21	0.67	0.65	0.25	0.19	0.11
2004	100	0.97	4.64	1.70	0.96	0.77	0.66	0.33	0.25	0.12
2005	100	0.86	3.48	2.94	0.91	0.57	0.48	0.13	0.07	0.12
2006	100	2.77	5.06	3.25	0.25	0.86	0.36	0.38	0.21	0.07
2007	100	4.05	3.91	1.63	1.39	2.03	0.66	0.43	0.24	0.10
2008	100	0.54	5.52	3.72	2.05	0.69	0.38	0.22	0.06	0.01
2009	100	1.55	3.09	7.90	0.94	0.45	0.21	0.06	0.01	0.00
2010	100	2.71	2.67	2.75	4.59	1.20	0.54	0.25	0.21	0.13
2011	100	0.08	5.03	5.17	3.63	1.60	0.97	0.27	0.04	0.12
2012	100	1.26	3.89	7.87	1.89	0.94	0.78	0.66	0.08	0.03
2013	100	0.89	3.34	3.93	4.63	0.49	0.52	0.35	0.04	0.07

IGFS

	Effort	Age 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	2
2012	100	4	24	141	140	108	52	36	16	9	33
2013	100	9	31	132	93	83	58	30	10	8	22

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

	OLD	SP-PGFS								
		Age								
	Effort	0	1	2	3	4	5	6	7	8
2001	100	43	1770	2208	2842	3434	1941	1357	487	132
2002	100	6	972	2064	3068	4265	2471	1209	340	118
2003	100	12	979	2292	3997	5653	3090	1393	417	144
2004	100	6	597	2841	4524	4616	2550	932	405	126
2005	100	65	541	532	1934	6987	4183	2193	407	100
2006	100	4	1426	1144	2592	3739	2619	713	161	88
2007	100	24	3937	5613	2836	2884	1444	681	191	66
2008	100	10	189	1595	3872	2861	1282	863	197	58
2009	100	4	360	445	3584	4840	1122	605	273	86
2010	100	30	236	1604	1913	5030	1732	366	165	114
2011	100	31	328	975	2087	3274	4256	1195	265	156
2012	100	4	133	584	3177	2408	2697	2450	975	330
2013	100	5	1240	1029	1018	1407	3237	2326	1502	514

	NEW	SP-PGFS								
		Age								
	Effort	0	1	2	3	4	5	6	7	8
2001	100	43	1770	2208	2842	3434	1941	1357	487	132
2002	100	6	1069	2502	3168	3997	2237	1107	327	107
2003	100	11	1081	2913	4105	5262	2789	1284	410	129
2004	100	7	719	3457	5497	5569	3071	1125	490	153
2005	100	77	633	626	2279	8250	4959	2605	484	118
2006	100	5	1775	1443	3275	4719	3311	901	204	113
2007	100	30	4856	6989	3556	3621	1814	852	238	83
2008	100	14	260	2219	5405	4009	1806	1219	280	83
2009	100	6	534	661	5319	7096	1635	877	401	129
2010	100	39	318	2157	2557	6723	2313	494	227	157
2011	100	37	393	1174	2509	3940	5141	1452	323	189
2012	100	5	157	692	3759	2862	3207	2926	1173	402
2013	100	6	1473	1184	1174	1619	3703	2657	1730	600

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

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	11.96	167.34
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

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	1227
2012	583
2013	497

Table 5.2.4.1. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,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

(*) LPUEs, no discards available

Table 5.3.3.1. 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
$N(y,1) \sim LN(medrec,2)$	$medrec = 250000$
$N(1984,a) \sim LN(medrec$ $\exp[-(a-1)M - \sum_{j=1}^{a-1} medF(j)],2), a = 2,\dots,9$	$medrec$ 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
$f(y) \sim LN(med_f, CV_f)$	$med_f = 0.3, CV_f = 1$
$\rho \sim Uniform(0,1)$	
$r_L(1984,a) \sim LN(medr_L(a),1), a = 1,\dots,8$	$medr_L = (0.0005,0.05,1,1,1,1,1,1)$
$r_L(y,9) = r_L(y,10+) = 1$	
$r_{SPD}(1984,a) \sim LN(medr_{SPD}(a),1), a = 1,\dots,7$	$medr_{SPD} = (0.002,0.02,0.02,0.02,0.01,0.01,0.01)$
$r_{IRD}(1984,a) \sim LN(medr_{IRD}(a),1), a = 1,\dots,8$	$medr_{IRD} = (0.001,0.01,0.01,0.01,$ $0.005,0.005,0.005,0.001)$
$r_{UKD}(1984,a) \sim LN(medr_{UKD}(a),1), a = 1,\dots,8$	$medr_{UKD} = (0.00001,0.001,0.001,0.001,$ $0.001,0.001,0.001,0.001)$
$r_{OTD}(1984,a) \sim LN(medr_{OTD}(a),1), a = 1,\dots,8$	$medr_{OTD} = (0.002,0.02,0.02,0.02,$ $0.01,0.01,0.01,0.002)$
$r_{SPD}(y,7) = r_{SPD}(y,a) = r_{IRD}(y,a)$ $= r_{UKD}(y,a) = r_{OTD}(y,a) = 0,\ a = 8,9,10+$	
$\tau_C(a), \tau_L(a), a = 1,2,3; \tau_D(a), a = 1,\dots,8$	$\Gamma(4,0.345)$
$\tau_C(a), \tau_L(a), a = 4,\dots,10+$	$\Gamma(10,0.1)$
$\tau_{SPD}(a), a = 1,\dots,7; \tau_{IRD}(a), \tau_{UKD}(a), a = 1,\dots,8$	$\Gamma(4,0.345)$
$\log[q_k(a)] \sim N(\mu_{Ik}, \tau_{Ik}), a \le 8,$ index $k = 1,\dots,5$	$\mu_{Ik} = -7,\ \tau_{Ik} = 0.2$
$q_k(a) = q_k(8), a > 8,$ indices k with ages > 8	

$\tau_k(a)$, index $k = 1,...,5$	$\Gamma(4,0.345)$

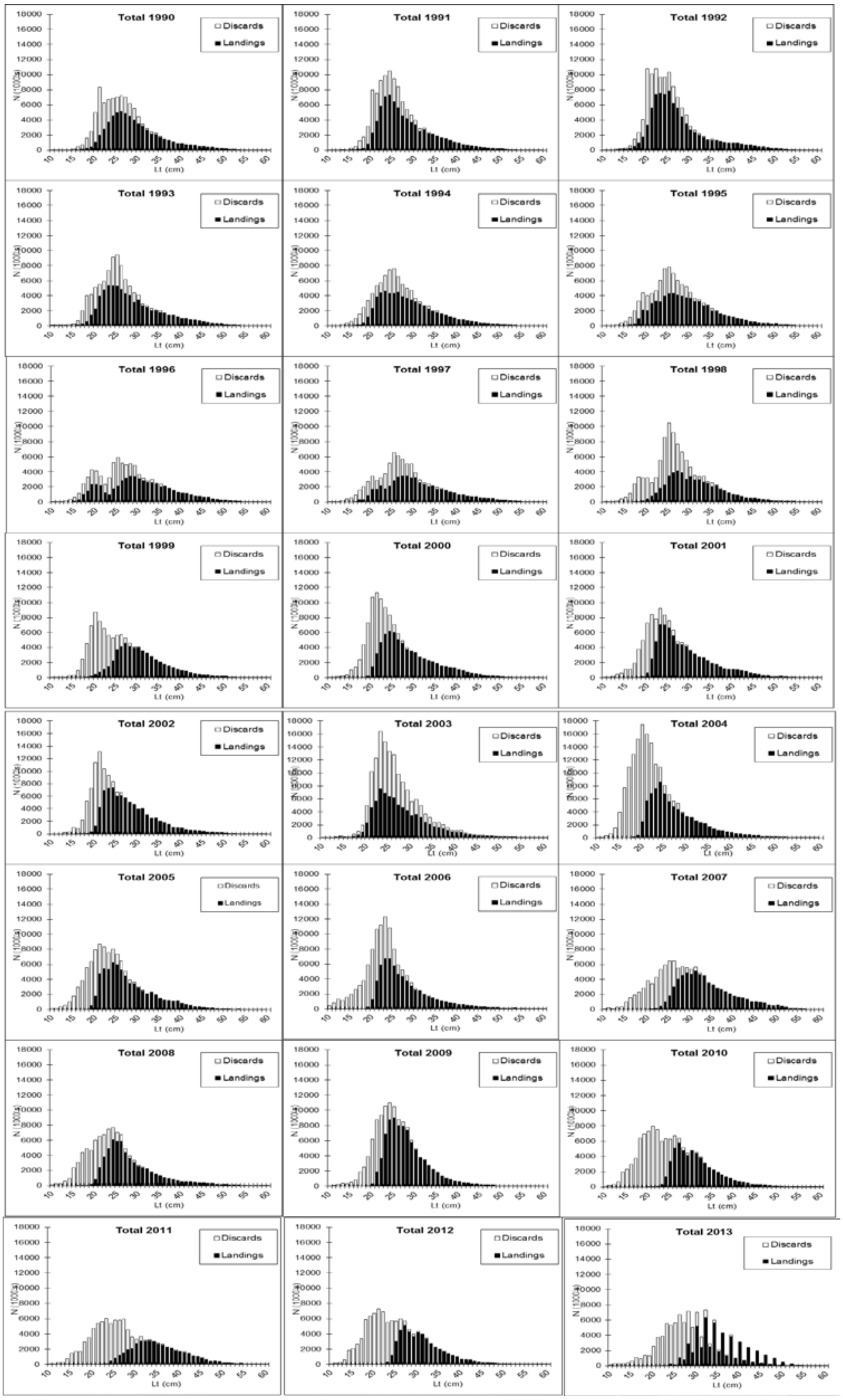


Figure 5.2.1.1. Megrim (*L.whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Length composition of catches for the years 1999 to 2012. Numbers of individuals in thousand tns.

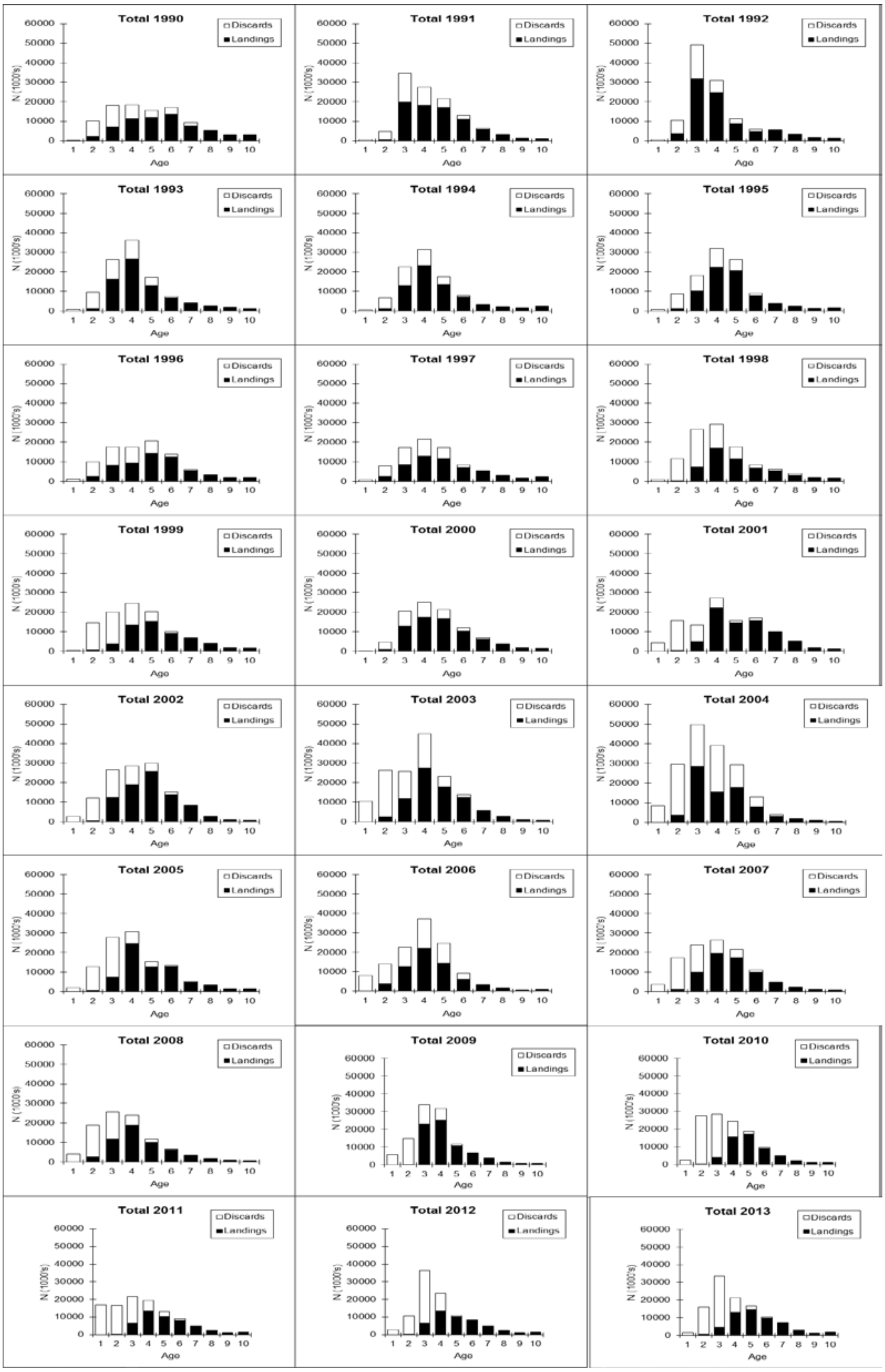


Figure 5.2.2.1. Megrim (*L.whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Age composition of catches for the years 1999 to 2012.

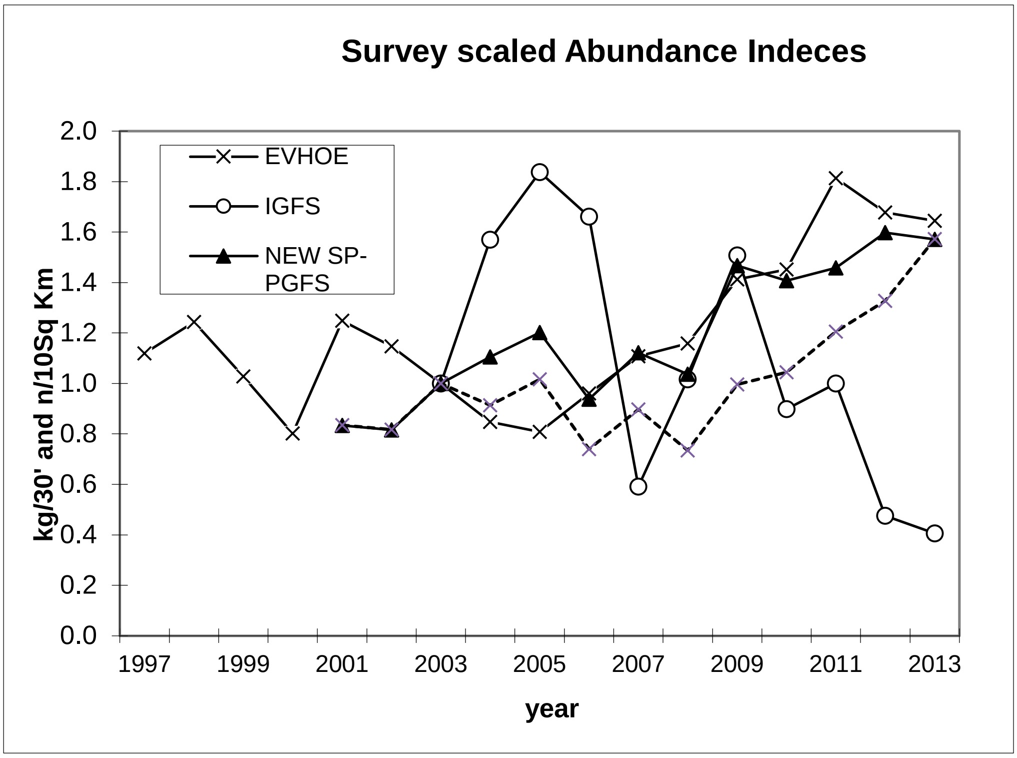


Figure 5.2.3.1. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Scaled Biomass Indices for EVHOE, NEW SP-PGFS, OLD SP-PGFS and IGFS.

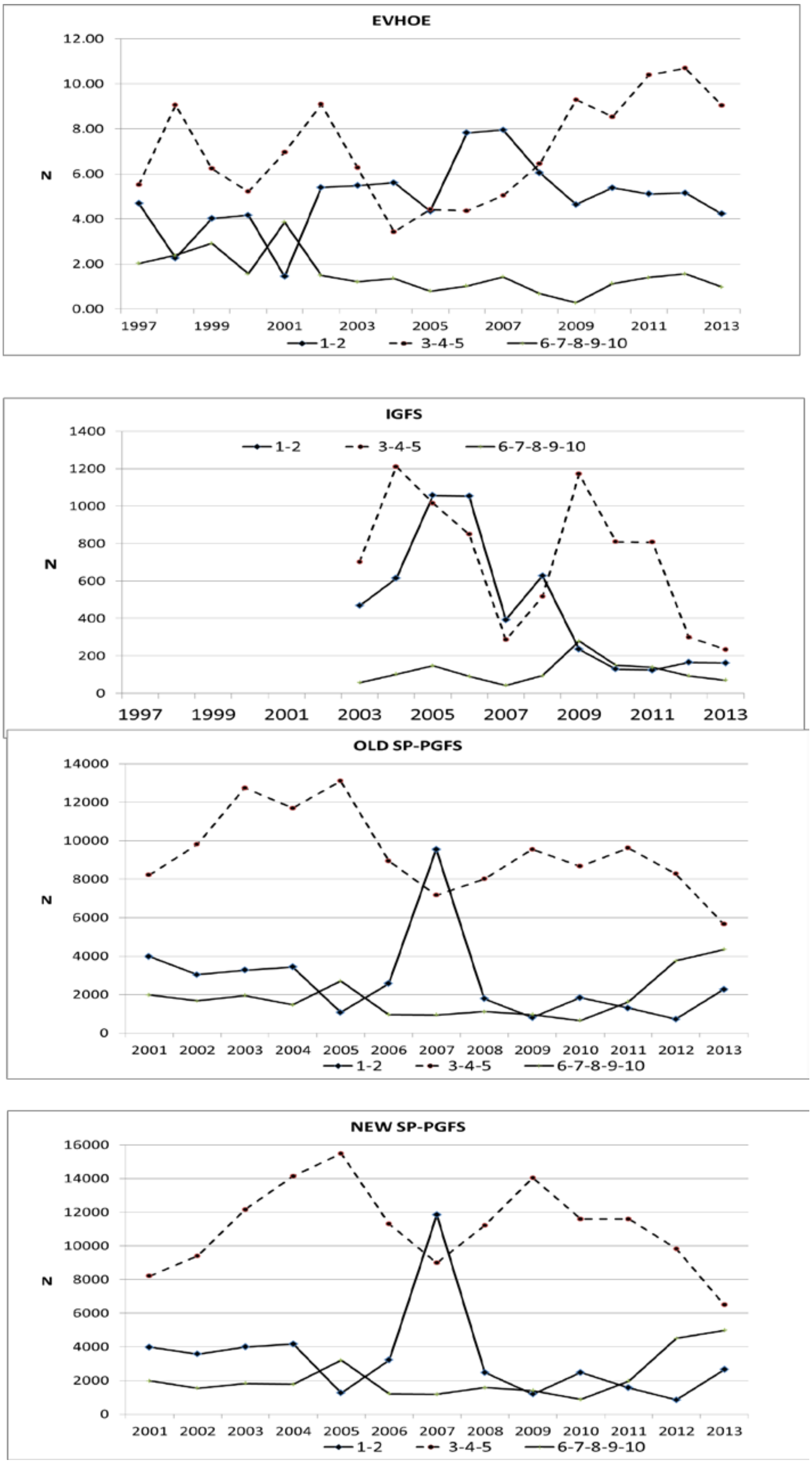


Figure 5.2.3.2. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Abundance Indices for EVHOE, IGFS and SP-PGFS by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+.

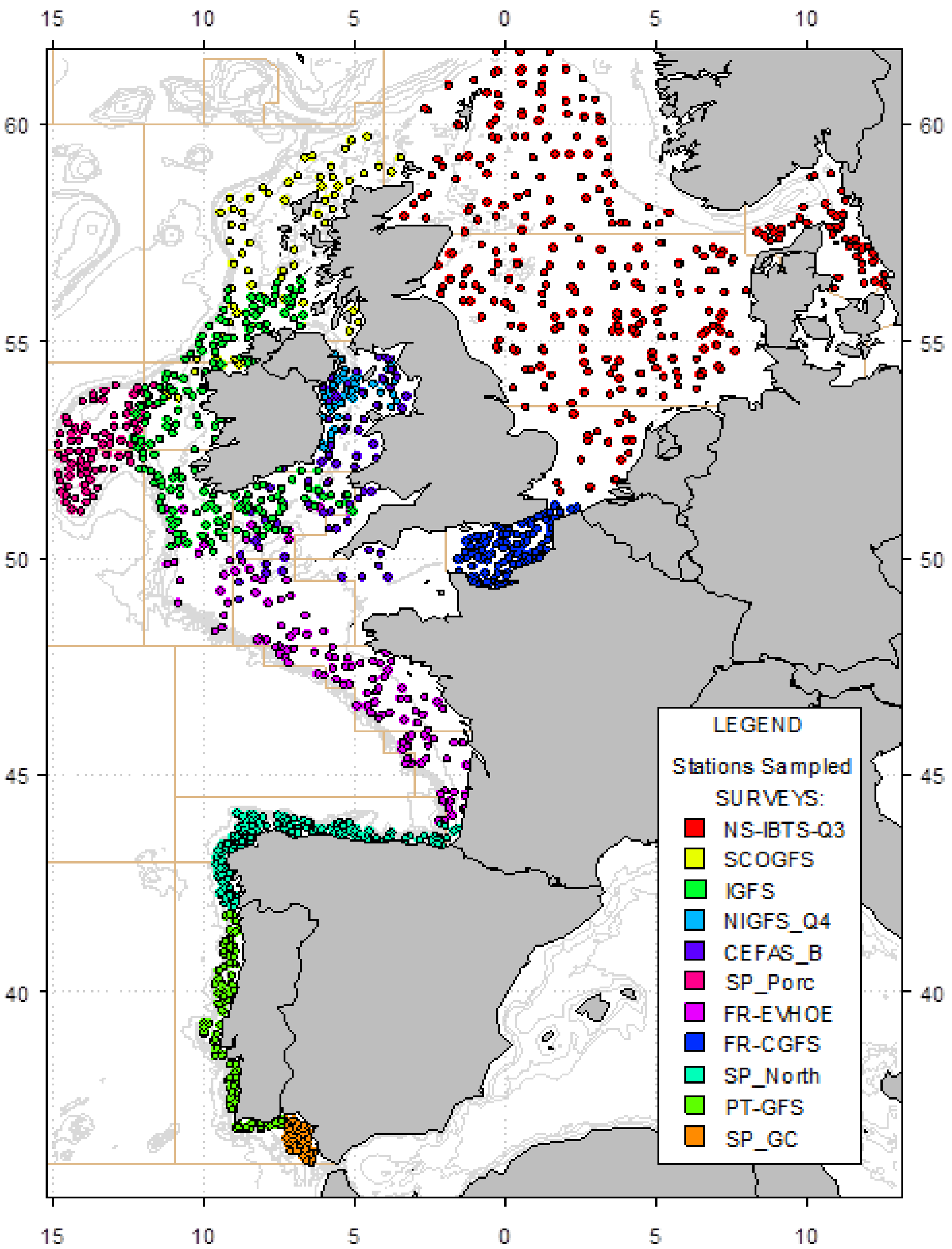


Figure 5.2.3.3. Station positions for the IBTS Surveys carried out in the Western and North Sea Area in the autumn/winter of 2008. (From IBTSWG 2009 Report). Just to be used as general location of the Surveys.

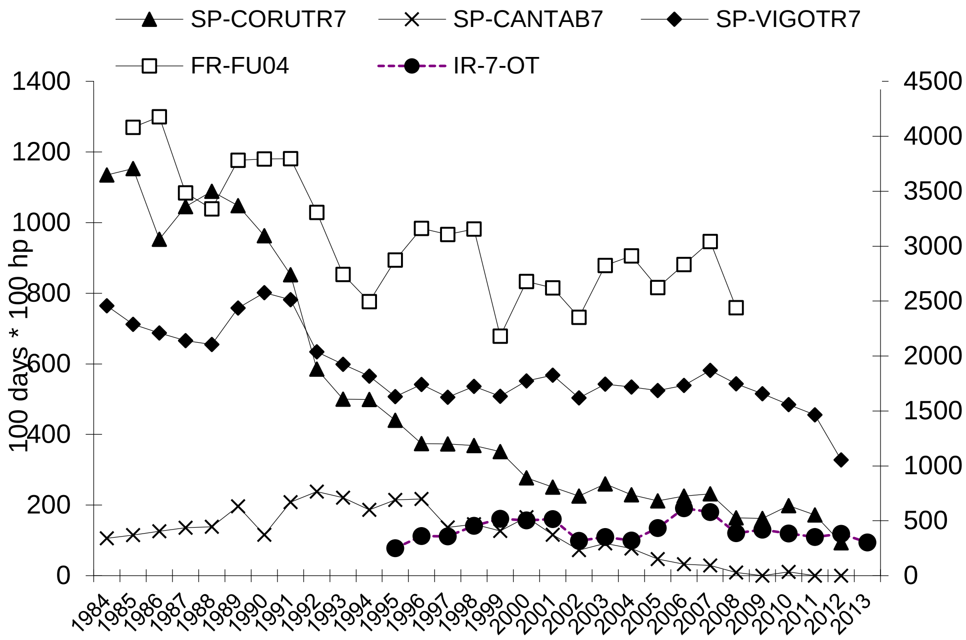


Figure 5.2.4.1. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Evolution of effort for different bottom trawler fleets.

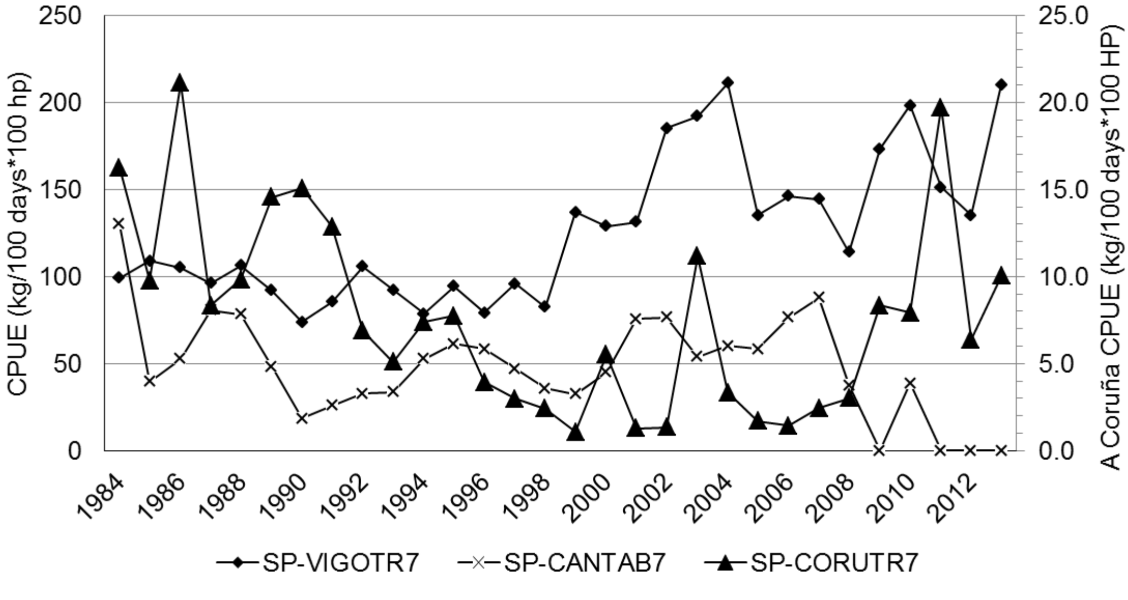


Figure 5.2.4.2. Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d. Spanish CPUE for different bottom trawler fleets.

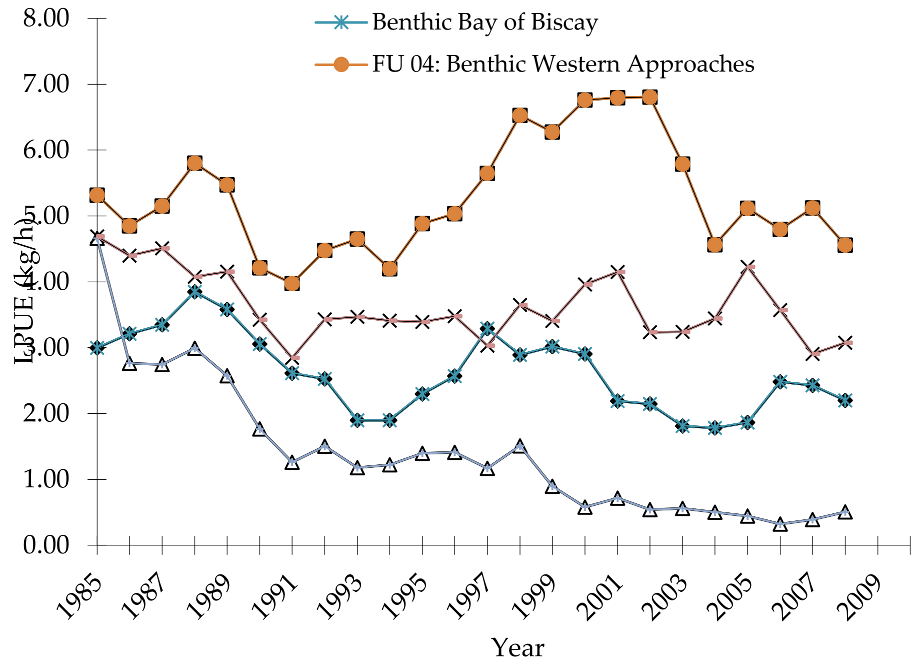


Figure 5.2.4.3. Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d. French LPUE for different bottom trawler fleet.

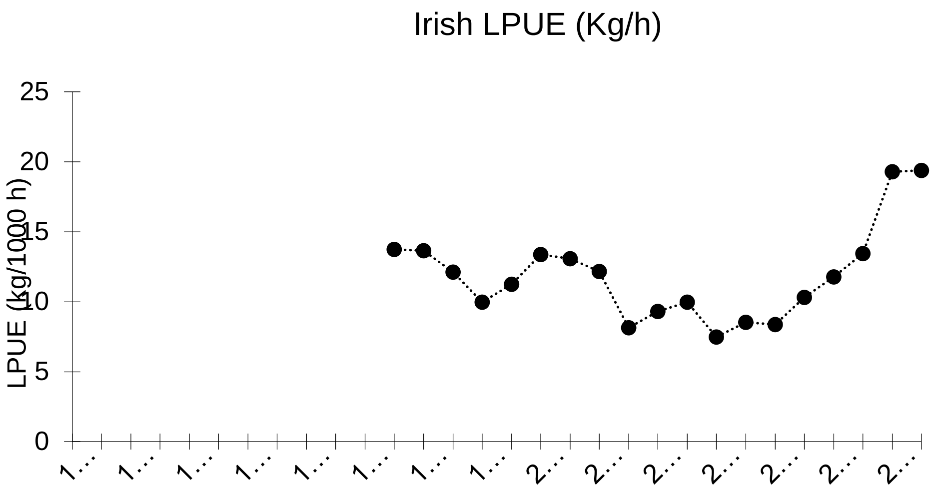


Figure 5.2.4.4. Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d. Irish LPUE for beam trawl fleet.

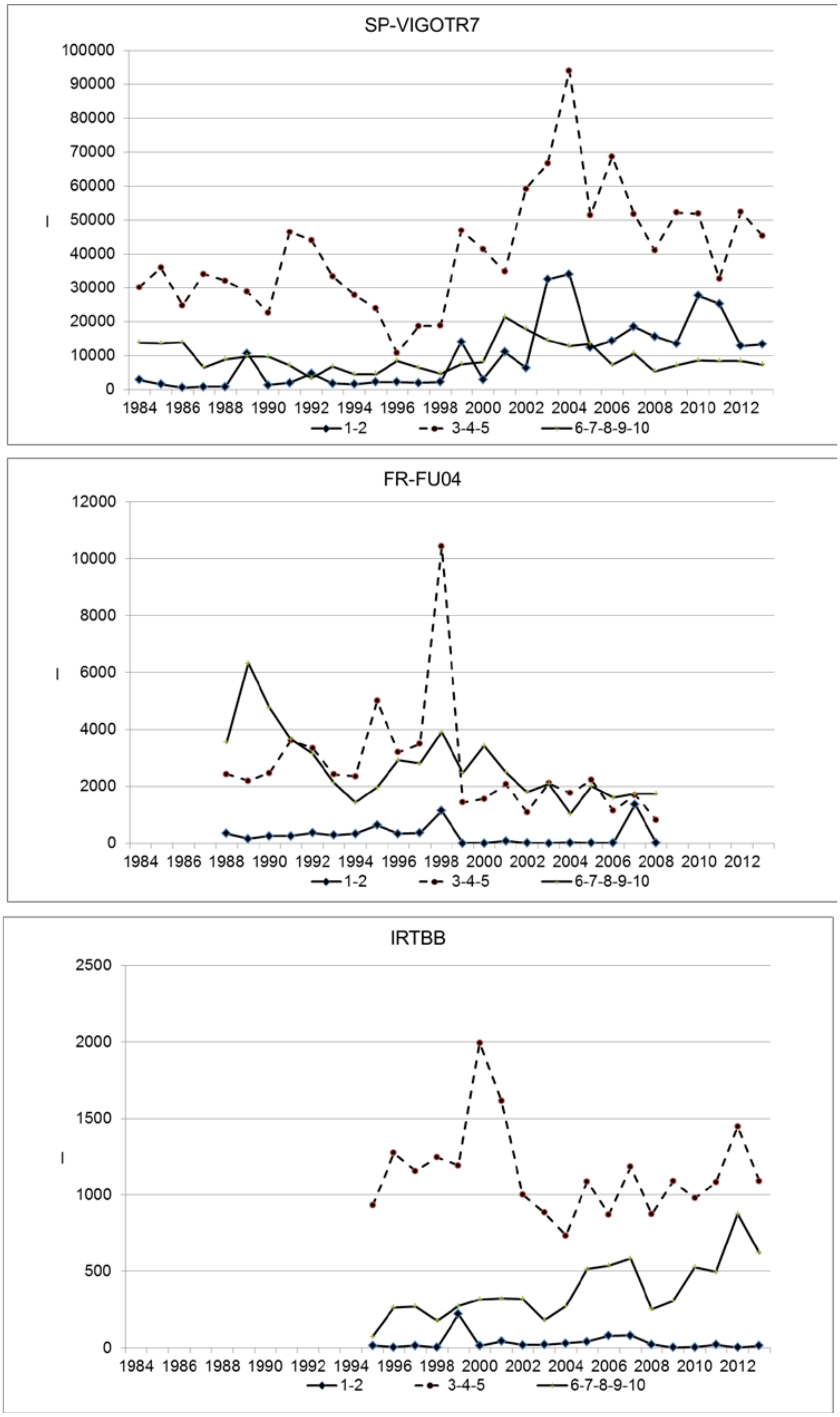


Figure 5.2.4.5. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Abundance Indices for SP-VIGOTR7, FR-FU04 and IRTBB by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+.

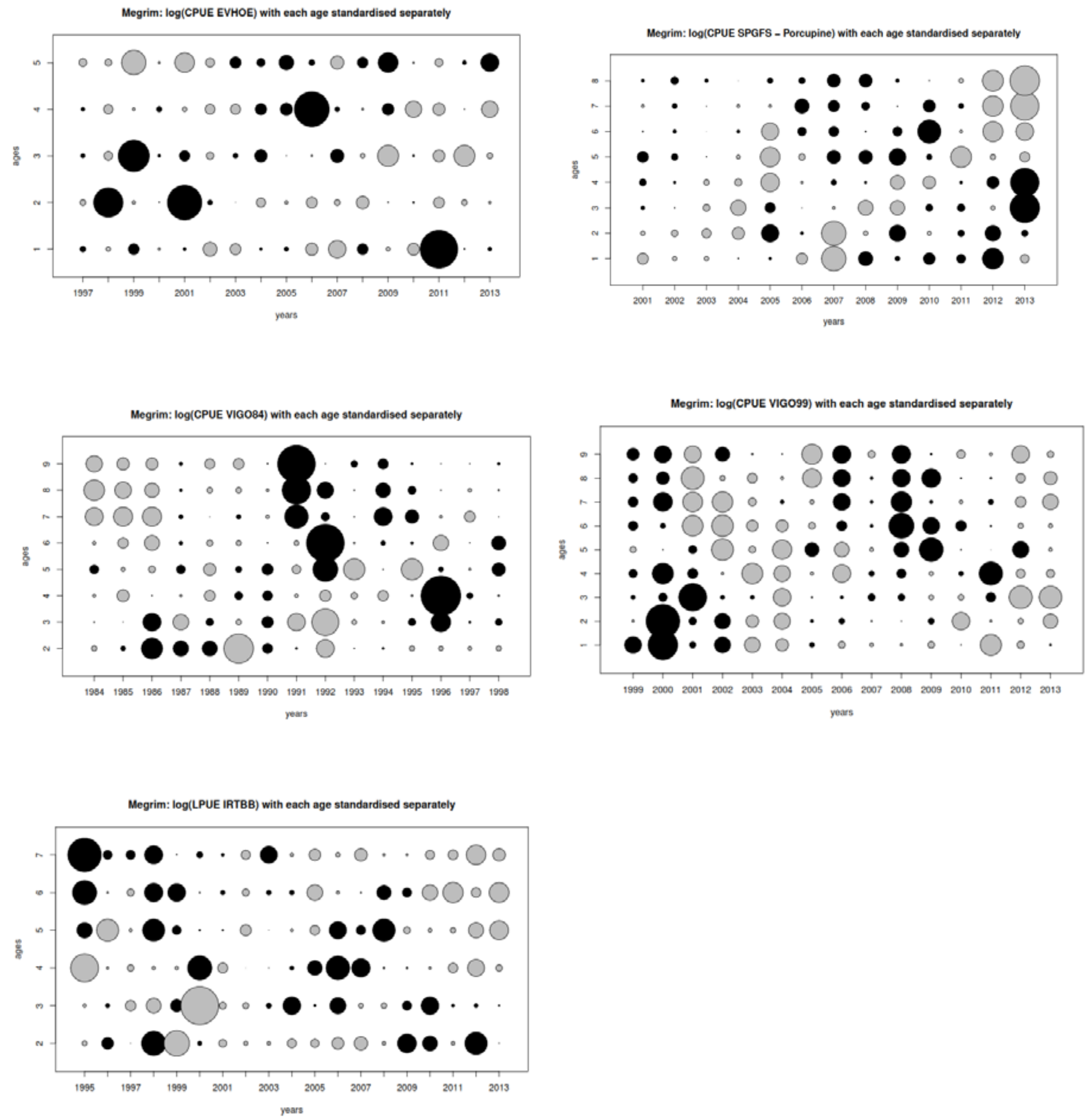


Figure 5.3.1.1. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Bubble plots of the standardized log abundance indices of the surveys and commercial fleets used as tuning fleets.

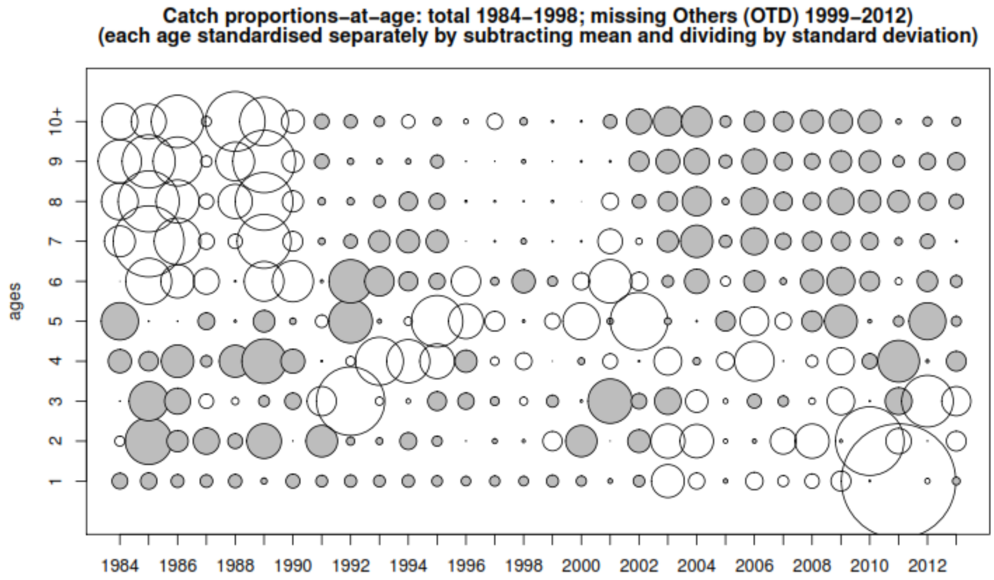


Figure 5.3.1.2. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Bubble plots for catch numbers at age from 1984 to 2013.

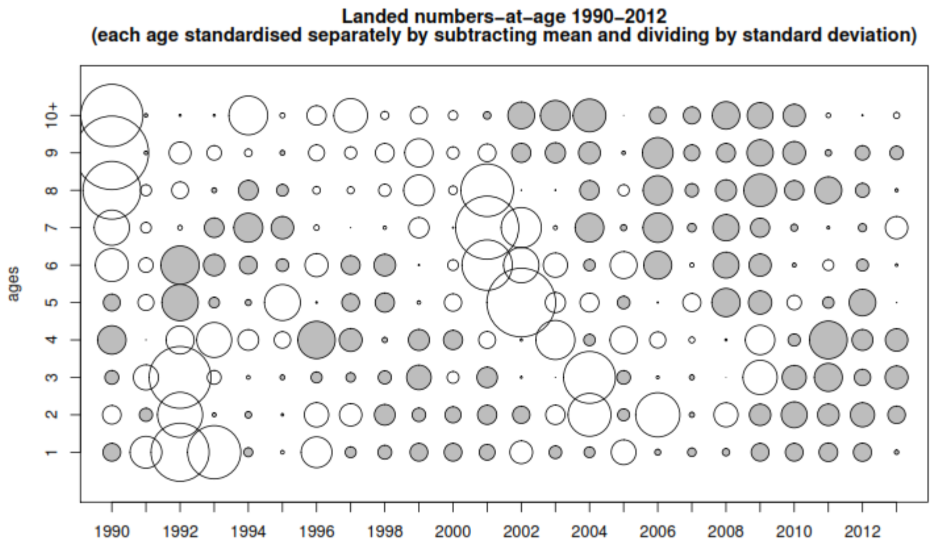


Figure 5.3.1.3. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Bubble plots for landing numbers at age from 1990 to 2013.

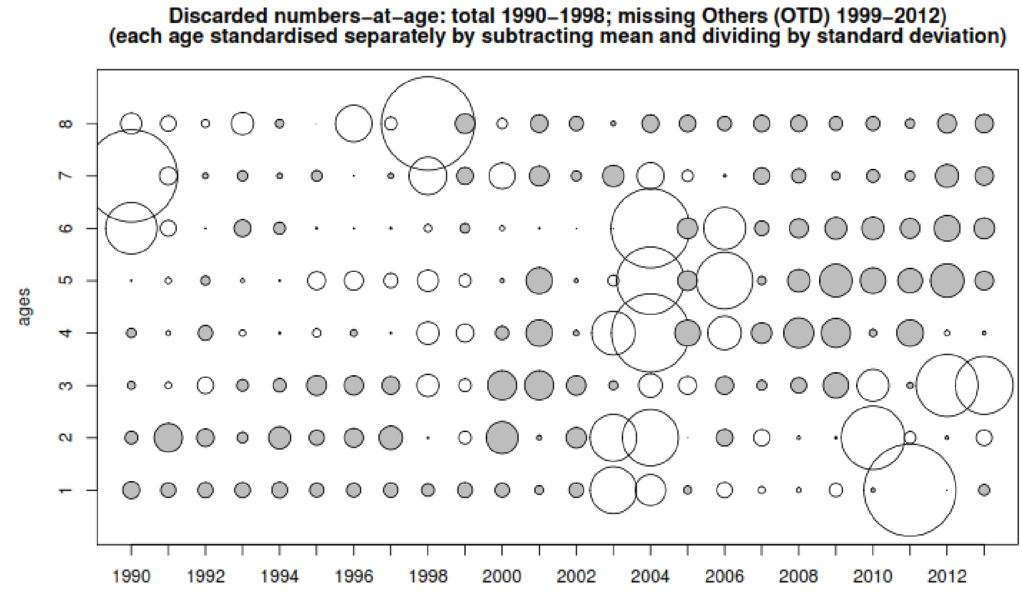
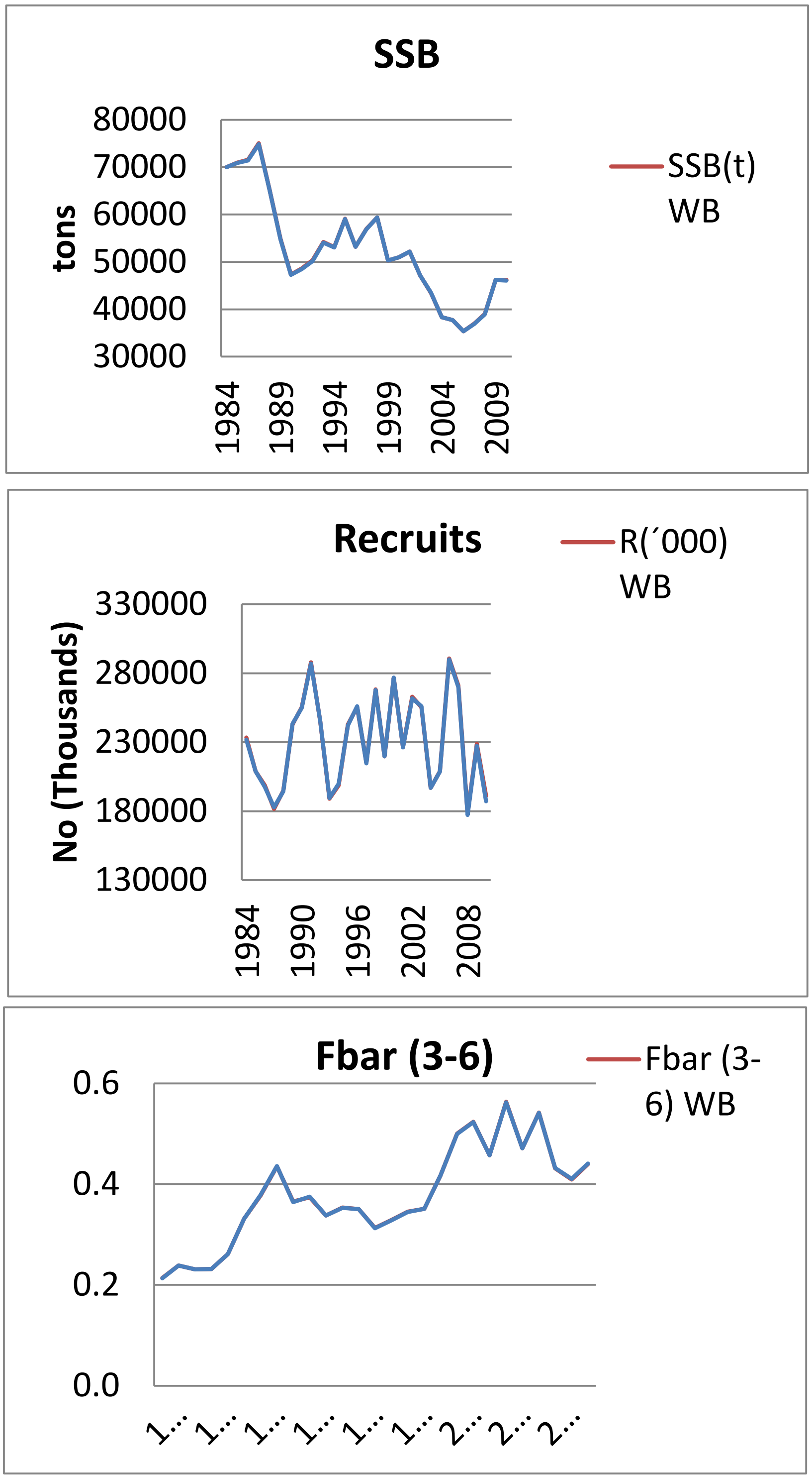


Figure 5.3.1.4. Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Bubble plots for discarded numbers at age from 1990 to 2013.



Difference	SSB(t)	R(´000)	Fbar (3-6)
Mean	0.1%	0.2%	0.0%

Figure 5.3.2.1. Comparison of the assessment results until 2010, using the different softwares WINGBUGS and JAGS.

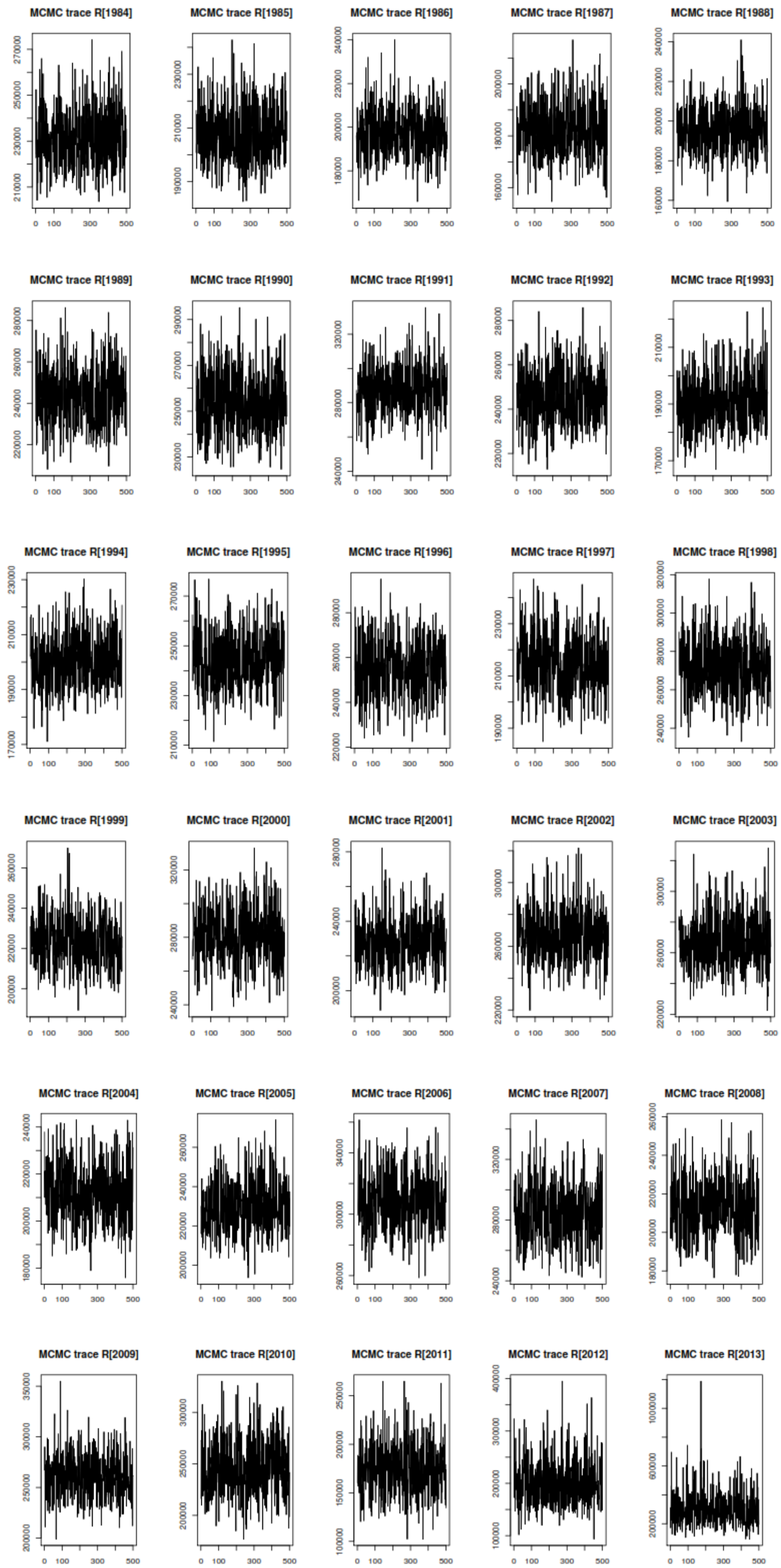


Figure 5.3.3.1. Trace plots of recruitmen draws from 1984 to 2013.

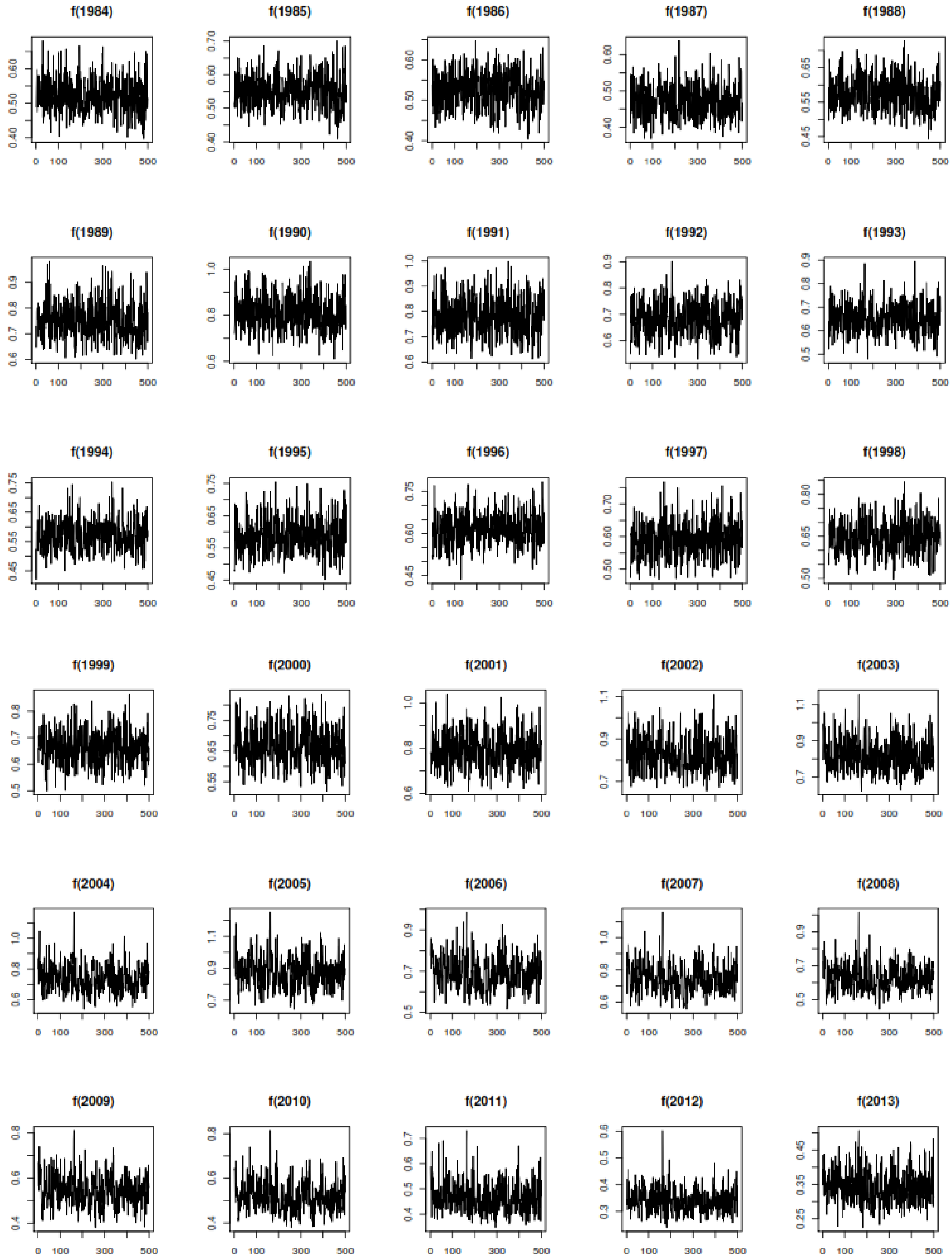


Figure 5.3.3.2. Trace plots of f(y) fishing mortality in ages 9 and 10 from 1984 to 2013.

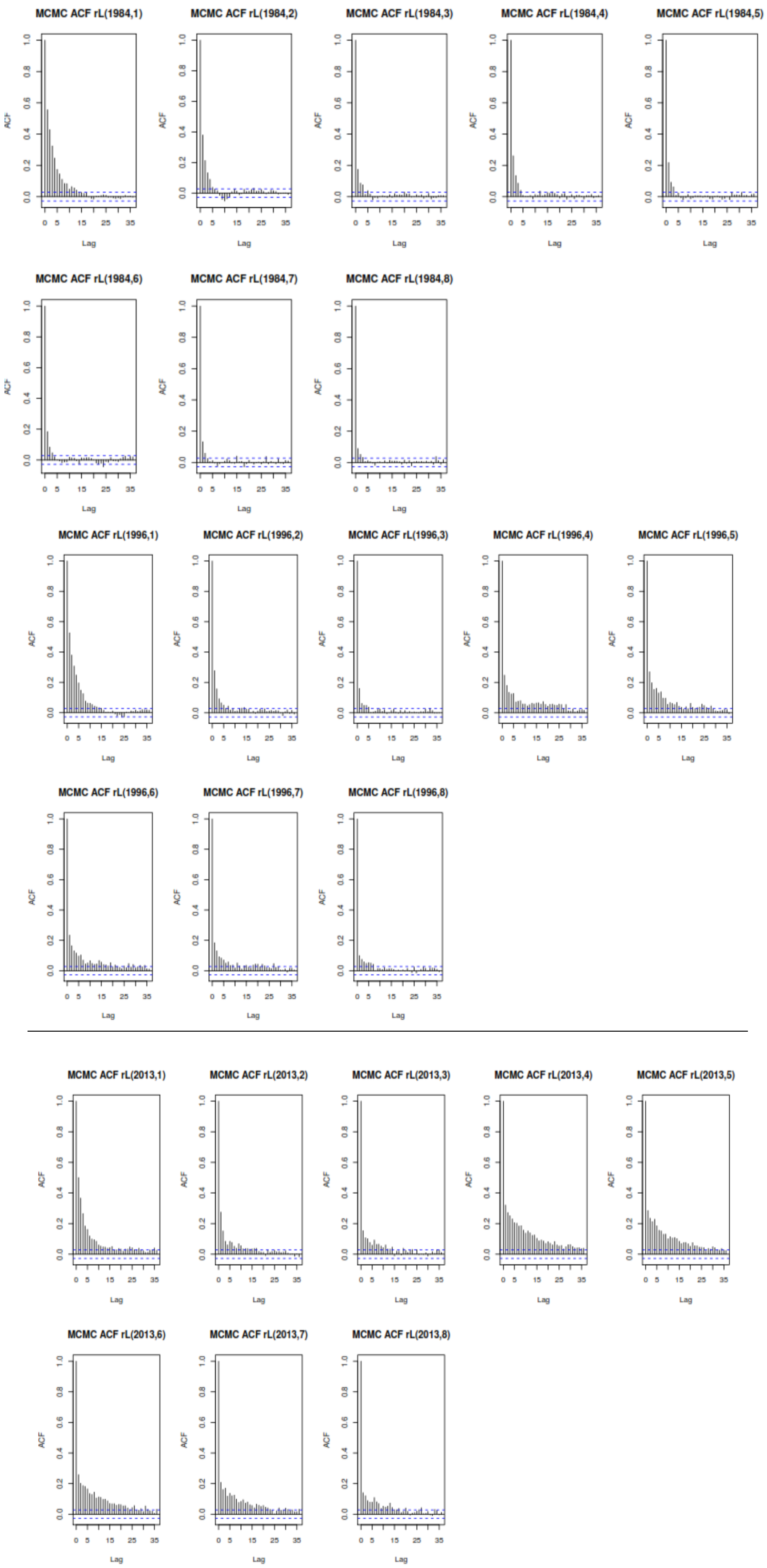


Figure 5.3.3.3. Autocorrelation plots of rL for years 1984, 1996 and 2013.

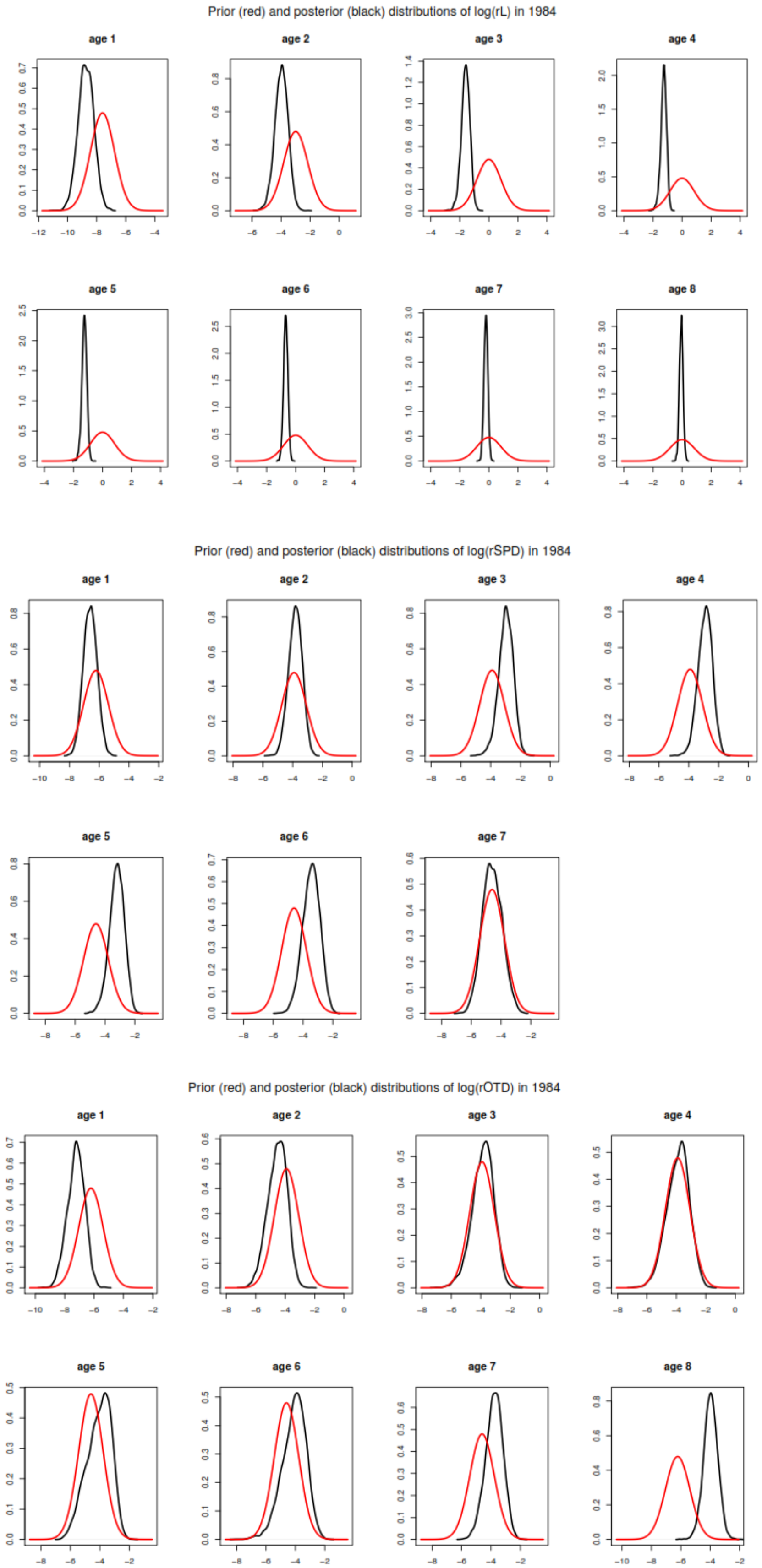


Figure 5.3.3.4. Prior (red) and posterior distribution of log (N) in 1984, log (rSPD) at age in 1984 and log (rOTD) at age in 1984.

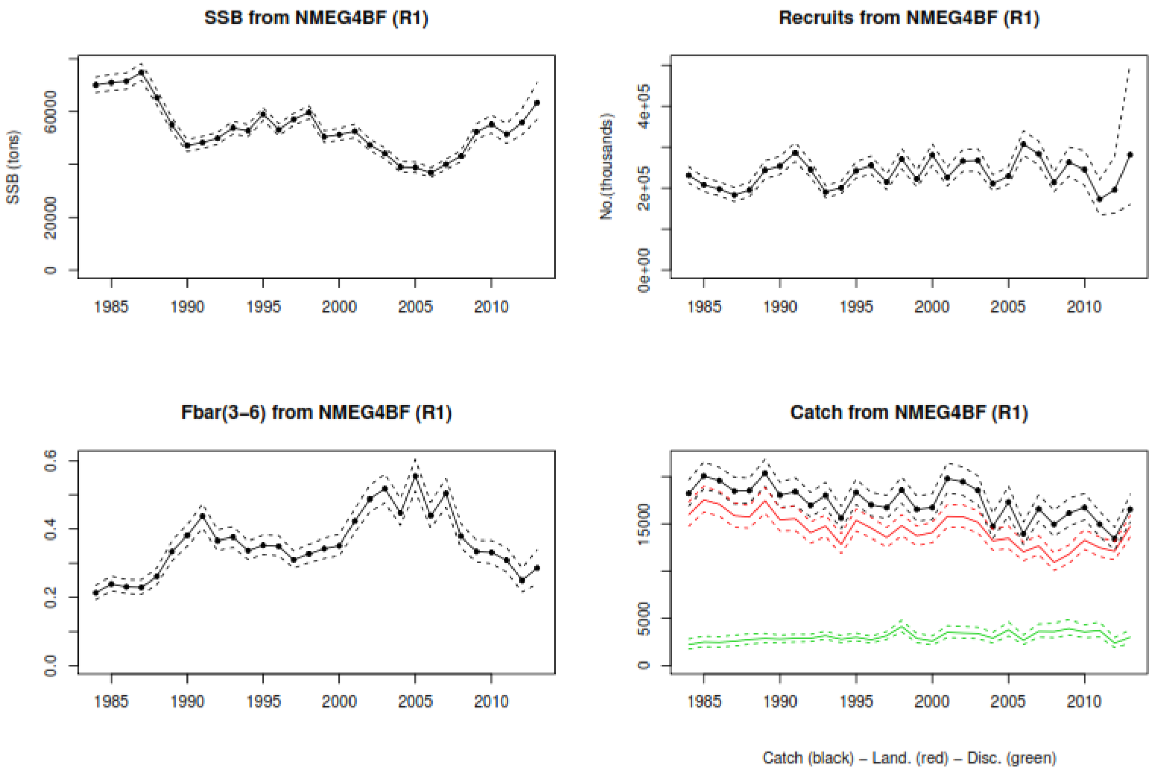


Figure 5.3.3.5. Time series of spawning stock biomass (SSB), recruits, Fbar, catch, landings and discards from 1984 to 2013. The solid dotted lines correspond with the median of the distribution and the dashed lines with 5% and 95% quantiles.

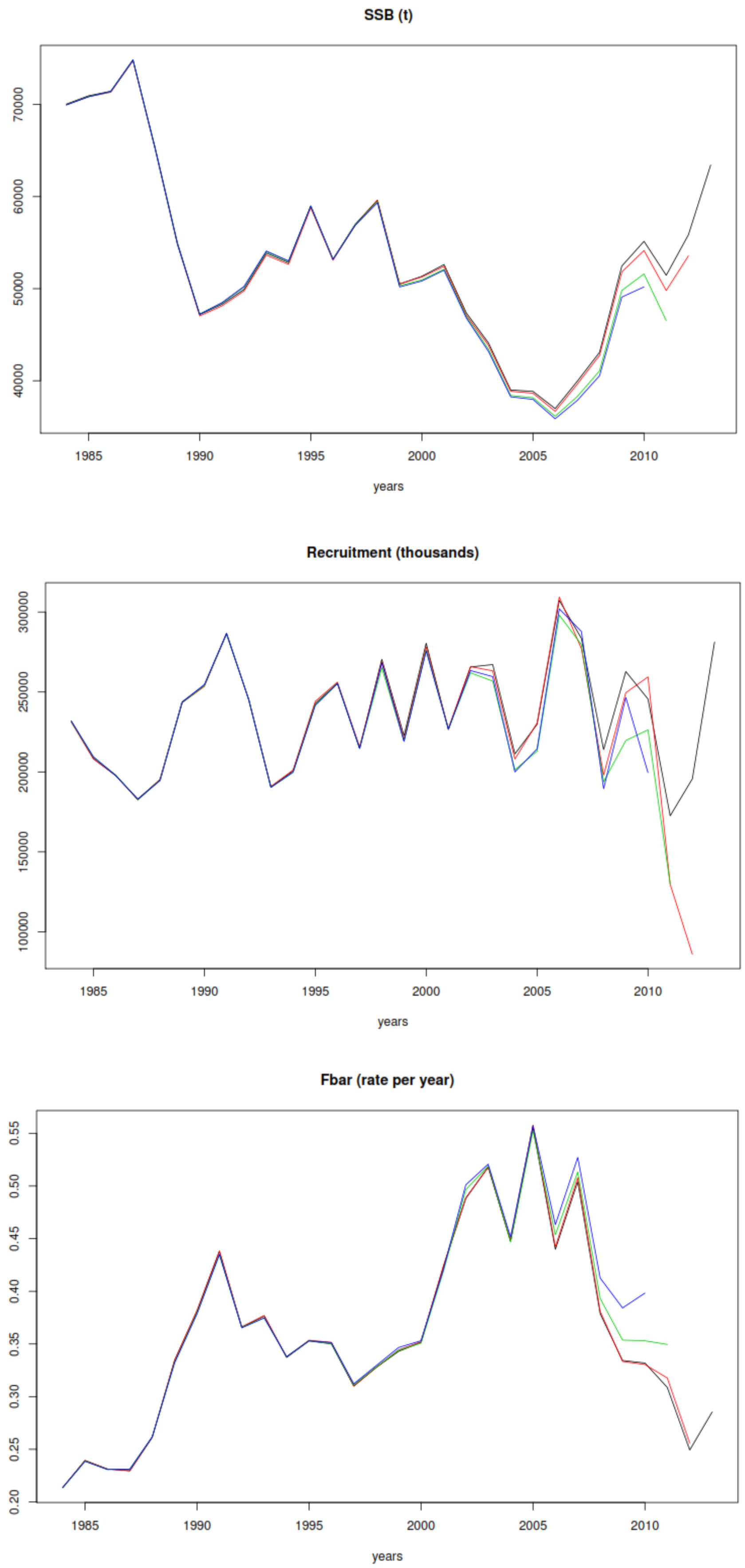


Figure 5.4.1. Time series of median SSB, recruitment and Fbar in retrospective analysis.

6 Bay of Biscay Sole

Type of assessment in 2013: update.

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

6.1 General

6.1.1 Ecosystem aspects

See Stock Annex

6.1.2 Fishery description

See Stock Annex

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

ICES advice for 2014:

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

The advice provided for 2014:

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

Management applicable to 2013 and 2014

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

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

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

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

6.2 Data

6.2.1 Commercial catches and discards

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

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

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

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

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

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

6.2.2 Biological sampling

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

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

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

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

6.2.3 Abundance indices from surveys

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

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

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

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

6.2.4 Commercial catch- effort data

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

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

The La Rochelle LPUE series (FR-ROCHELLE) shows a decreasing trend from 1990 to 2001. Later on, the series does not exhibit any trend but some up and down variations (Table 6.5.a and Figure 6.5). The Les Sables d'Olonne LPUE series (FR-SABLES) shows also a declining trend up to 2003. Thereafter, it shows a short increase in 2004-2005 but the trend is flat from 2005 onwards.

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

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

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

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

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

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

6.3 Assessment

6.3.1 Input data

See stock annex

6.3.2 Model

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

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

The year range used is 1984-2013.

Catch-at-age analysis and Data screening

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

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

Four commercial LPUE series are used in the assessment: La Rochelle offshore trawlers (FR-ROCHELLE) and Les Sables d'Olonne offshore trawlers (FR-SABLES) 1991 to 2009, the Bay of Biscay offshore trawlers in the second quarter (FR-BB-OFF-Q2) 2000 to 2012 and the Bay of Biscay inshore trawlers in the last quarter (FR-BB-IN-Q4) 2000 to last year. The data for these four tuning series are in table 6.6.

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

FLEET TYPE	ACRONYM	PERIOD	AGE RANGE	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 – 2013	1 – 8	<1 %
Offshore otter trawlers	FR-BB-OFF-Q2	2000 – 2012	1 – 8	<1 %
Beam trawler survey	FR-ORHAGO	2007 – 2013	0 – 8	0 %

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

Result of XSA runs

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

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

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

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

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

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

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

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

6.4 Estimating year class abundance

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

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

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

Recruitment at age 2

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

6.5 Historic trends in biomass, fishing mortality and recruitment

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

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

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

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

6.5.1 Catch options and prognosis

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

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

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

6.5.2 Short term predictions

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

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

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

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

6.6 Yield and Biomass Per Recruit

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

6.6.1 Biological reference points

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

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

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

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

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

EqSim

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

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

PlotMSY

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

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

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

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

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

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

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

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

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

6.6.2 Comments on the assessment

Sampling

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

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

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

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

Discarding

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

Consistency

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

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

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

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

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

Misreporting

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

Industry input

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

6.6.3 Management considerations

The assessment indicates that SSB has decreased continuously to 9700 t in 2003, since a peak in 1993 (16 500 t), has increased to 12 400 t in 2006 but it remains close to 11 700 t thereafter and since 2010 is above 13 000 t. It is estimated to be 12 750 t (below B_{pa} = 13 000 t) in 2014 assuming XSA recruitment value for 2013, but an increase is predicted by the short term prediction, and SSB is assumed to be above B_{pa} in 2015 and after.

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

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

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

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

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

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

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

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

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

Table 6.2 : Bay of Biscay Sole - 2013

French and Belgian relative length distribution of landings

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

MLS= 24 cm

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

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

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

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

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

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

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

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

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

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

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

* French offshore trawlers in other harbours than in La Rochelle and Les Sables

na : non available

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

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

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

FR - SABLES

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

FR - ROCHEL

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

FR-BB-IN-Q4

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

Table 6.6: cont'd

FR-BB-OFF-Q2

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

FR-ORHAGO

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

Table 6.7: XSA tuning diagnostic

Lowestoft VPA Version 3.1

9/05/2014 10:05

Extended Survivors Analysis

SOLE VIIIa,b

CPUE data from file tunfilt.dat

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

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

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability independent of stock size for all ages

Catchability independent of age for ages >= 6

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 3 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.500

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

Prior weighting not applied

Tuning converged after 66 iterations

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Fishing mortalities

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

1

XSA population numbers (Thousands)

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

Table 6.7: cont'd

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

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

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

Estimated population abundance at 1st Jan 2014

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

Taper weighted geometric mean of the VPA populations:

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

Standard error of the weighted Log(VPA populations) :

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

1

Log catchability residuals.

Fleet : FR-SABLES

Age	1991	1992	1993
2	-.22	-.13	-.37
3	.11	-.18	.17
4	.14	-.26	-.08
5	.09	-.15	-.10
6	-.19	.17	-.39
7	-.06	-.15	-.27

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
2	-.40	-.07	-.20	-.11	-.02	-.17	.20	-.16	.22	-.12
3	-.10	-.17	-.02	.21	.00	-.41	.40	.08	.26	.01

4	.37	.15	.02	.02	.45	-.22	.14	-.05	.14	-.29
5	.23	.00	-.11	-.24	.16	.28	-.08	-.27	.35	-.17
6	.03	-.24	.24	-.02	-.40	.42	-.04	-.22	.36	.04
7	.18	.06	.47	-.01	.11	.54	.08	-.23	.07	.09

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
2	.30	.48	.79	.24	.13	-.38	99.99	99.99	99.99	99.99
3	-.29	-.18	-.02	-.07	.11	.10	99.99	99.99	99.99	99.99
4	-.19	-.15	-.47	.04	.27	-.02	99.99	99.99	99.99	99.99
5	-.49	.23	-.74	.34	.28	.40	99.99	99.99	99.99	99.99
6	-.33	.16	-.55	.26	.32	.36	99.99	99.99	99.99	99.99
7	-.14	.07	-.15	.63	.34	.30	99.99	99.99	99.99	99.99

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

Age	2	3	4	5	6	7
Mean Log q	-15.0807	-14.5264	-14.4858	-14.6712	-14.6672	-14.6672
S.E(Log q)	.3114	.1979	.2337	.3069	.2975	.2761

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	4.93	-3.200	34.75	.04	19	1.25	-15.08
3	.98	.089	14.45	.64	19	.20	-14.53
4	.81	1.313	13.49	.73	19	.19	-14.49

Table 6.7: cont'd

5,	1.09,	-.296,	15.19,	.41,	19,	.34,	-14.67,
6,	1.38,	-1.010,	17.21,	.29,	19,	.41,	-14.67,
7,	.73,	2.329,	12.61,	.81,	19,	.17,	-14.57,

1

Fleet : FR-ROCHELLE

Age	1991	1992	1993
2	-.08	-.17	-.45
3	.20	-.04	.00
4	.45	.13	-.21
5	.47	.18	-.07
6	.12	.34	-.25
7	.01	.08	-.03

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
2	-.39	-.03	.34	-.05	.20	-.02	.20	-.22	.70	.16
3	-.21	-.11	.06	.12	-.10	-.48	-.26	-.07	.19	.23
4	.30	.31	-.14	-.07	.48	-.24	-.10	.15	-.31	-.06
5	.20	.22	-.35	-.35	.01	.19	-.16	-.05	-.06	-.06
6	.12	-.35	-.11	-.01	-.53	.52	-.30	.10	.00	.10
7	-.01	-.06	-.10	-.11	.02	.22	-.23	.11	-.09	-.22

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
2	.37	.12	-.03	.04	.19	-.90	99.99	99.99	99.99	99.99
3	-.09	-.38	-.26	.54	.54	.12	99.99	99.99	99.99	99.99
4	-.23	-.21	-.29	-.20	.29	-.06	99.99	99.99	99.99	99.99
5	-.47	.32	-.29	-.27	.23	.29	99.99	99.99	99.99	99.99
6	-.19	.41	-.07	-.25	.13	.21	99.99	99.99	99.99	99.99
7	-.04	.20	-.01	-.23	.21	.16	99.99	99.99	99.99	99.99

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

Age ,	2,	3,	4,	5,	6,	7
Mean Log q,	-15.0150,	-14.5677,	-14.7887,	-15.1453,	-15.2045,	-15.2045,
S.E(Log q),	.3454,	.2720,	.2591,	.2652,	.2727,	.1427,

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	2.16,	-1.655,	20.75,	.11,	19,	.71,	-15.01,
3,	1.16,	-.541,	15.32,	.41,	19,	.32,	-14.57,
4,	.78,	1.400,	13.59,	.71,	19,	.20,	-14.79,
5,	.87,	.677,	14.27,	.60,	19,	.23,	-15.15,
6,	1.58,	-1.511,	19.36,	.29,	19,	.42,	-15.20,
7,	.85,	1.984,	14.00,	.91,	19,	.11,	-15.21,

1

Fleet : FR-BB-IN-Q4

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

Table 6.7: cont'd

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

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

Age	3	4	5	6	7
Mean Log q	-14.4790	-14.9115	-15.1954	-15.1508	-15.1508
S.E(Log q)	.3026	.4316	.3614	.4121	.4719

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	1.09	-.281	14.92	.45	14	.34	-14.48
4	1.04	-.094	15.15	.29	14	.47	-14.91
5	.68	1.315	13.07	.59	14	.24	-15.20
6	1.04	-.085	15.41	.32	14	.44	-15.15
7	2.88	-1.768	30.36	.07	14	1.22	-15.27

1

Fleet : FR-BB-OFF-Q2

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

3	99.99	99.99	99.99	99.99	99.99	99.99	-.41	-.12	.23	.17
4	99.99	99.99	99.99	99.99	99.99	99.99	.38	.25	.16	.00
5	99.99	99.99	99.99	99.99	99.99	99.99	.78	.52	.84	-.13
6	99.99	99.99	99.99	99.99	99.99	99.99	.74	1.20	1.43	.44
7	No data for this fleet at this age									

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
2	.44	.37	-.29	.52	.89	-1.76	-1.34	-2.03	.52	99.99
3	.20	-.17	-.19	.75	.38	-.12	-.07	-.58	-.07	99.99
4	-.06	-.01	-.64	-.39	-.03	-.26	.25	.32	.01	99.99
5	-.86	.30	-.52	-.94	.01	-.21	.28	-.38	.32	99.99
6	-.44	-.70	.34	.03	-.74	-.40	-1.53	.04	-.43	99.99
7	No data for this fleet at this age									

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

Age	2	3	4	5	6
Mean Log q	-15.9013	-14.5233	-14.7571	-15.4033	-15.9348
S.E(Log q)	1.0335	.3452	.2922	.5749	.8295

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	-1.65	-1.597	.09	.03	13	1.60	-15.90
3	1.75	-1.110	18.14	.17	13	.60	-14.52
4	.64	2.270	12.74	.78	13	.16	-14.76
5	.64	.910	12.94	.37	13	.37	-15.40
6	4.38	-.670	43.24	.00	13	3.72	-15.93

Table 6.7: cont'd

1

Fleet : FR-ORHAGO

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

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

Age	2	3	4	5	6	7
Mean Log q	-9.1028	-9.3774	-9.8545	-10.6270	-11.3029	-11.3029
S.E(Log q)	.1897	.1743	.3668	.8265	1.4506	.7131

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.79	1.641	9.25	.93	7	.13	-9.10
3	1.33	-1.469	9.28	.80	7	.21	-9.38
4	1.45	-.757	10.15	.36	7	.55	-9.85
5	.43	1.399	9.45	.55	7	.33	-10.63
6	.24	2.254	8.81	.63	7	.26	-11.30
7	.32	1.487	8.69	.49	7	.21	-11.24

1

Fleet disaggregated estimates of survivors :

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

Year class = 2011

FR-SABLES

Age, 2,

Survivors, 0.,

Raw Weights, .000,

FR-ROCHELLE

Age, 2,

Survivors, 0.,

Raw Weights, .000,

FR-BB-IN-Q4

Age, 2,

Survivors, 0.,

Raw Weights, .000,

FR-BB-OFF-Q2

Age, 2,

Survivors, 0.,

Raw Weights, .000,

FR-ORHAGO

Age, 2,

Survivors, 7307.,

Raw Weights, 18.765,

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

Table 6.7: cont'd

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

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

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

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

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

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

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

Weighted prediction :

Survivors, Int, Ext, N, Var, F

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

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

1

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

Year class = 2010

FR-SABLES

Age, 3, 2,

Survivors, 0., 0.,

Raw Weights, .000, .000,

FR-ROCHELLE

Age, 3, 2,

Survivors, 0., 0.,

Raw Weights, .000, .000,

FR-BB-IN-Q4

Age, 3, 2,

Survivors, 4947., 0.,

Raw Weights, 6.566, .000,

FR-BB-OFF-Q2

Age, 3, 2,

Survivors, 0., 8618.,

Raw Weights, .000, .491,

FR-ORHAGO

Age, 3, 2,

Survivors, 5649., 4571.,

Raw Weights, 16.100, 13.729,

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FR-SABLES ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-ROCHELLE ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-BB-IN-Q4 ,	4947.,	.313,	.000,	.00,	1,	.176,	.454
FR-BB-OFF-Q2 ,	8618.,	1.072,	.000,	.00,	1,	.013,	.285
FR-ORHAGO ,	5125.,	.143,	.106,	.74,	2,	.799,	.441

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

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
5142.,	.13,	.06,	5,	.448,	.440

1

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

Year class = 2009

Table 6.7: cont'd

FR-SABLES

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

FR-ROCHELLE

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

FR-BB-IN-Q4

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

FR-BB-OFF-Q2

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

FR-ORHAGO

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

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

FR-SABLES , 1., .000, .000, .00, 0, .000, .000
FR-ROCHELLE , 1., .000, .000, .00, 0, .000, .000
FR-BB-IN-Q4 , 7822., .259, .057, .22, 2, .205, .381
FR-BB-OFF-Q2 , 5834., .340, .572, 1.68, 2, .104, .484
FR-ORHAGO , 7772., .135, .112, .83, 3, .680, .383

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

Weighted prediction :

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

1
Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 2008

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

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

FR-BB-IN-Q4
Age, 5, 4, 3, 2,
Survivors, 3795., 5958., 2030., 0.,
Raw Weights, 3.469, 1.503, 2.150, .000,

Table 6.7: cont'd

FR-BB-OFF-Q2

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

FR-ORHAGO

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

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

Weighted prediction :

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

1

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

Year class = 2007

FR-SABLES

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

FR-ROCHELLE

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

FR-BB-IN-Q4

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

FR-BB-OFF-Q2

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

FR-ORHAGO

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

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

Table 6.7: cont'd

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

Weighted prediction :

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

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

Year class = 2006

FR-SABLES

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

FR-ROCHELLE

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

FR-BB-IN-Q4

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

FR-BB-OFF-Q2

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

Table 6.7: cont'd

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

FR-ORHAGO

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

Fleet,		Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,		Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FR-SABLES	,	1639.,	.172,	.011,	.06,	2,	.140,	.148
FR-ROCHELLE	,	1692.,	.220,	.034,	.15,	2,	.084,	.144
FR-BB-IN-Q4	,	1334.,	.204,	.063,	.31,	5,	.321,	.179
FR-BB-OFF-Q2	,	1423.,	.223,	.156,	.70,	5,	.153,	.169
FR-ORHAGO	,	1584.,	.155,	.202,	1.30,	6,	.291,	.153
F shrinkage mean	,	425.,	1.50,,,,				.011,	.480

Weighted prediction :

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

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

Terminal Fs derived using XSA (With F shrinkage)

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

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

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

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

Terminal Fs derived using XSA (With F shrinkage)

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

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

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

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

Terminal Fs derived using XSA (With F shrinkage)

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

Table 6.11: Multifleet prediction input data

Sole in Bay of Biscay
Multi fleet input data

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

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

2014

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

2015

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

2016

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

Input units are thousands and kg - output in tonnes

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

MFDP version 1a	**Basis**
Run: 2014_	
Time and date: 15:35 22/05/2014	**F(2014) = mean F(11-13) unscaled (age 2 to above)**
Fbar age range (Total) : 3-6	**R14 = GM (1993 to n-2) = 22.7 million**
Fbar age range Fleet 1 : 3-6	

2014

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

2015

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

Bpa = 13000 t
Fpa = 0.42

Input units are thousands and kg - output in tonnes

Table 6.13: Bay of Biscay sole - Detailed predictions

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

Year: 2014 F multiplier: 1 Fleet1 HCFba 0.4191

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

Year: 2015 F multiplier: 1 Fleet1 HCFba 0.4191

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

Year: 2016 F multiplier: 1 Fleet1 HCFba 0.4191

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

Input units are thousands and kg - output in tonnes

Table 6.14: Stock numbers of recruits and their source for recent year classes used in predictions and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2009	2010	2011	2012	2013	2014
Stock No. (thousands) of 2 year-olds	22091	11120	10678	22699	22699	22699
Source	XSA	XSA	XSA	GM93-2011	GM93-2011	GM93-2011
Status Quo F:						
% in 2014 landings	26.0	14.3	14.6	17.5	-	-
% in 2015	11.8	9.3	12.2	32.2	16.4	-
% in 2014 SSB	19.9	10.8	11.8	11.8	-	-
% in 2015 SSB	12.3	7.0	9.1	25.9	10.9	-
% in 2016 SSB	9.2	4.4	6.0	20.1	24.2	10.2

GM : geometric mean recruitment

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

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

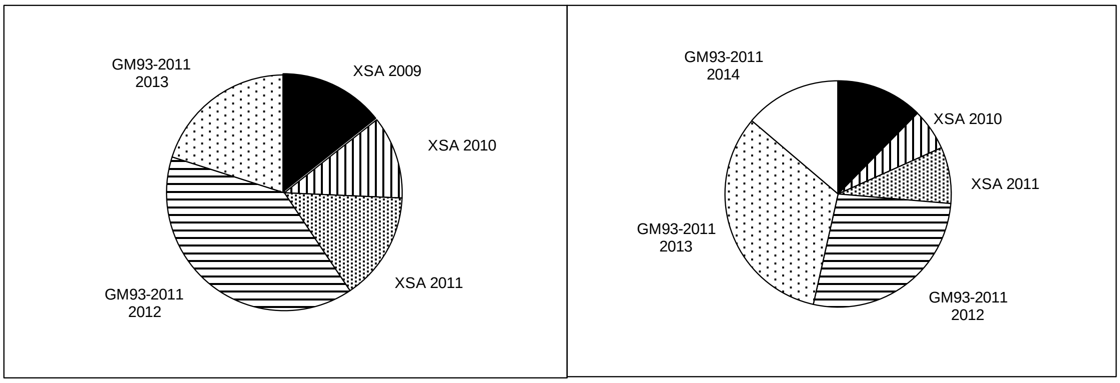


Table 6.15a: Bay of Biscay Sole Multifleet Yield per recruit

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

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

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

Weights in kilograms

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

Long-term equilibrium at F status quo

landings	SSB
Yield * GM	SSBSpwn * GM
4676	16920

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

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

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

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

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

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

a)

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

Data range (1984 to 2012)

b)

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

Data range (1984 to 2013)

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

Automatically specified weights

Ricker	Beverton-Holt	Smooth hockeystick
0.211	0.539	0.250

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

Automatically specified weights

Ricker	Beverton-Holt	Smooth hockeystick
0.082	0.473	0.445

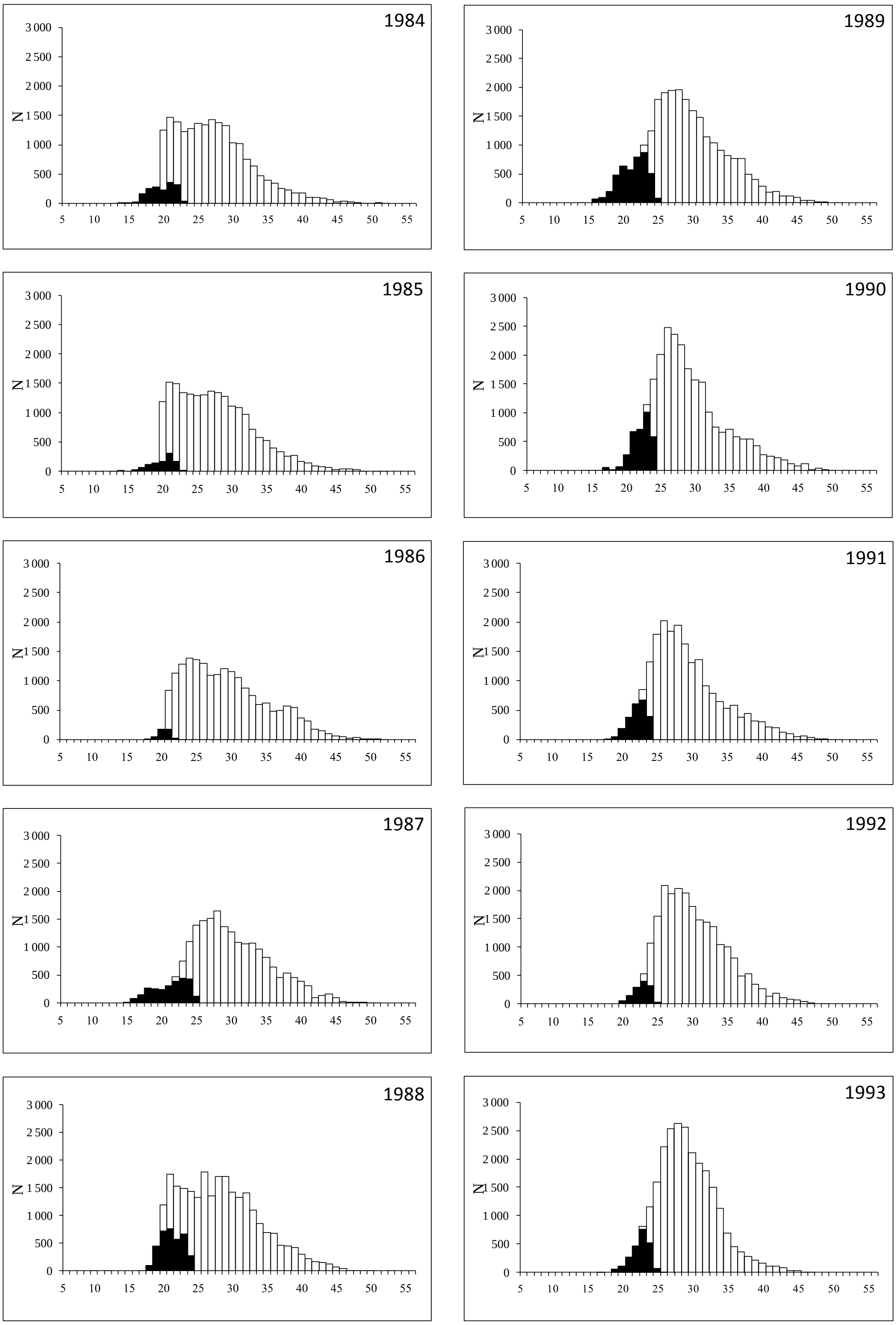


Figure 6.1 a: Bay of Biscay sole French length distribution from 1984 to 1993

Total French landings

Discard estimates of the French offshore trawlers fleet

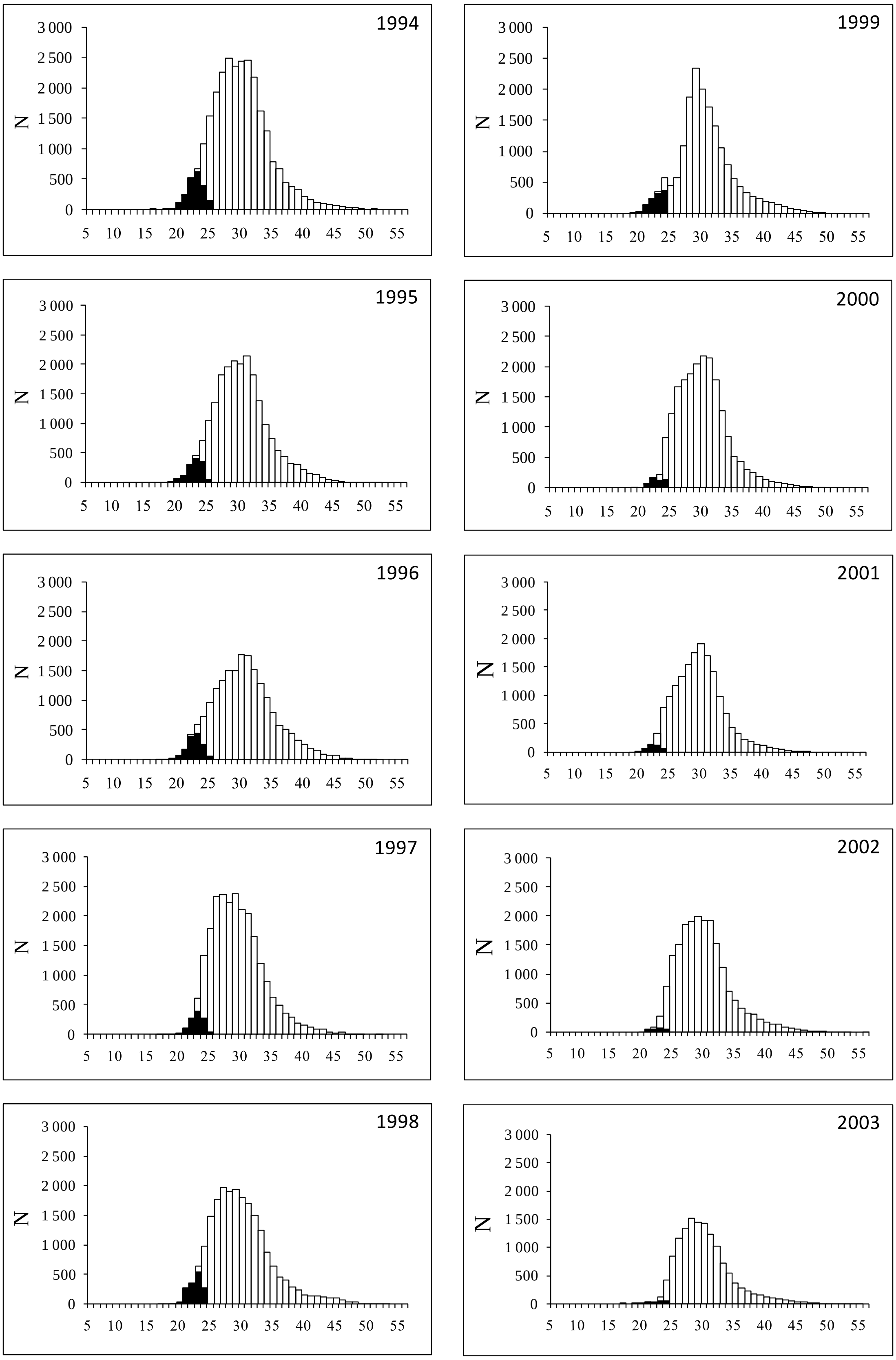


Figure 6.1 b: **Bay of Biscay sole French length distribution from 1994 to 2003**

Total French landings

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

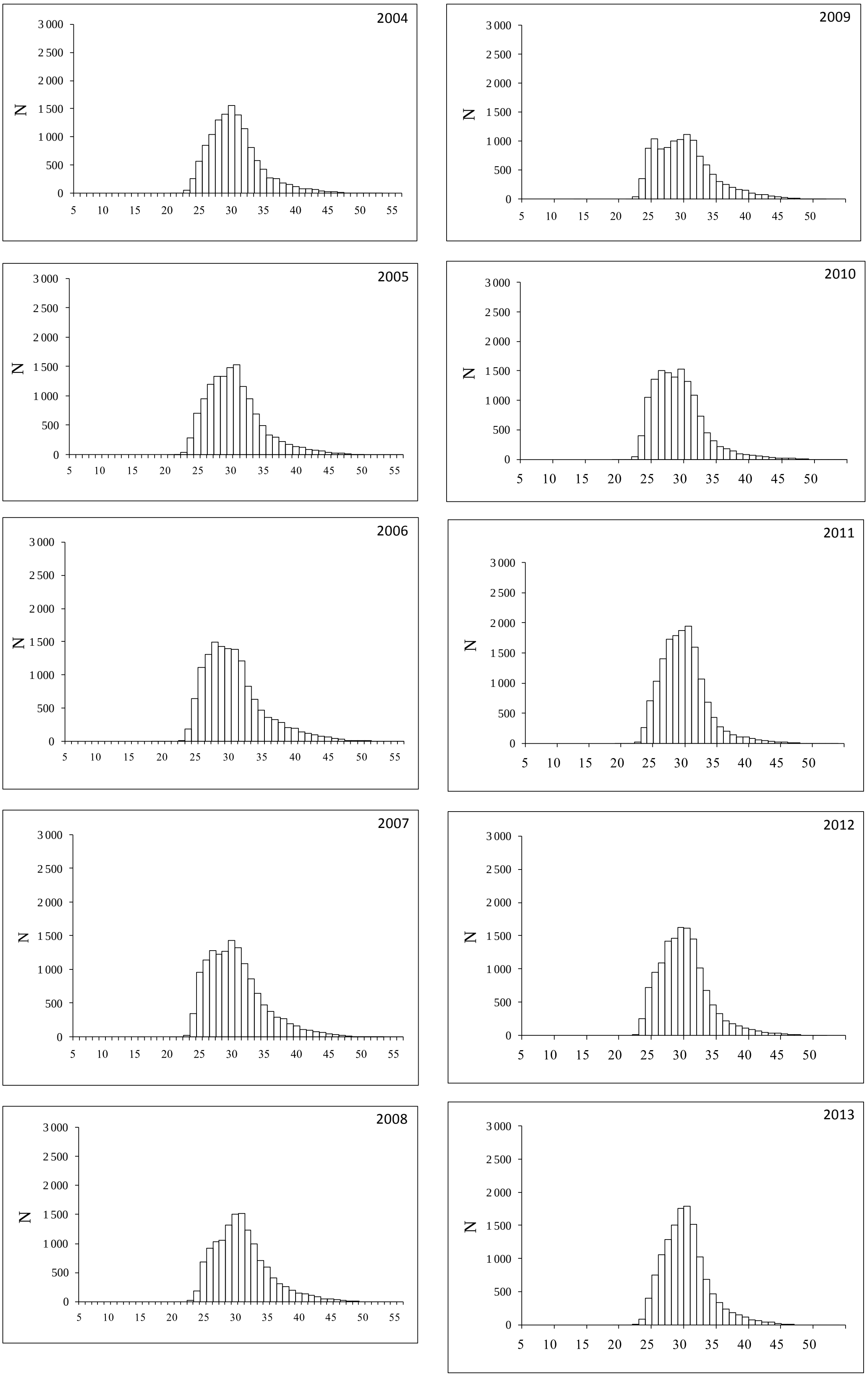
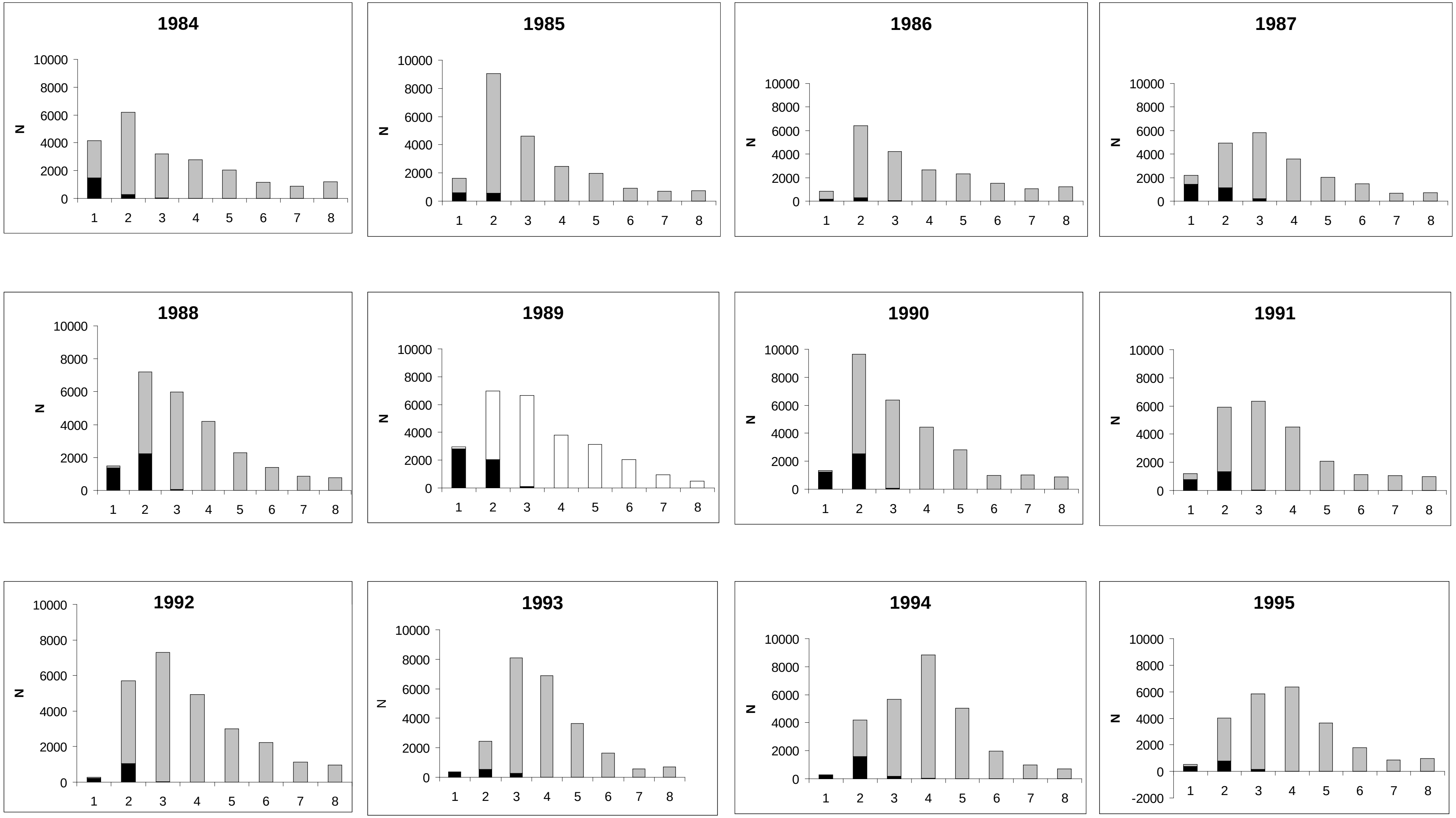


Figure 6.1 c: Bay of Biscay sole French length distribution from 2004 to 2013


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

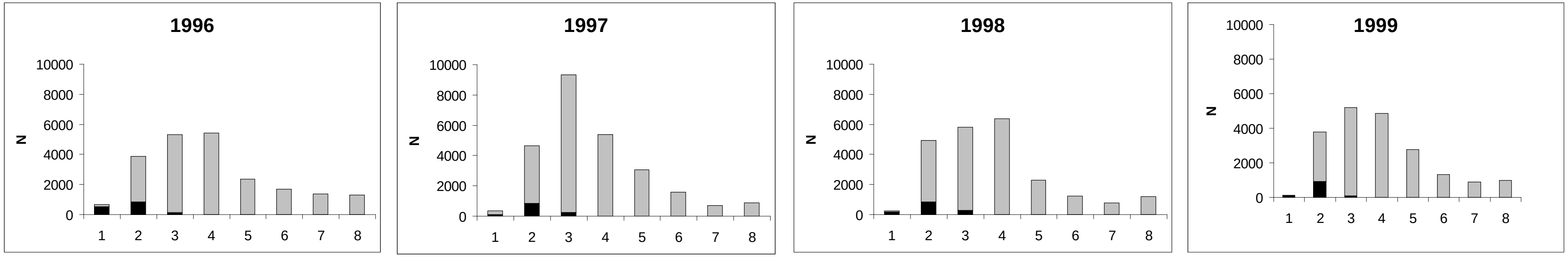
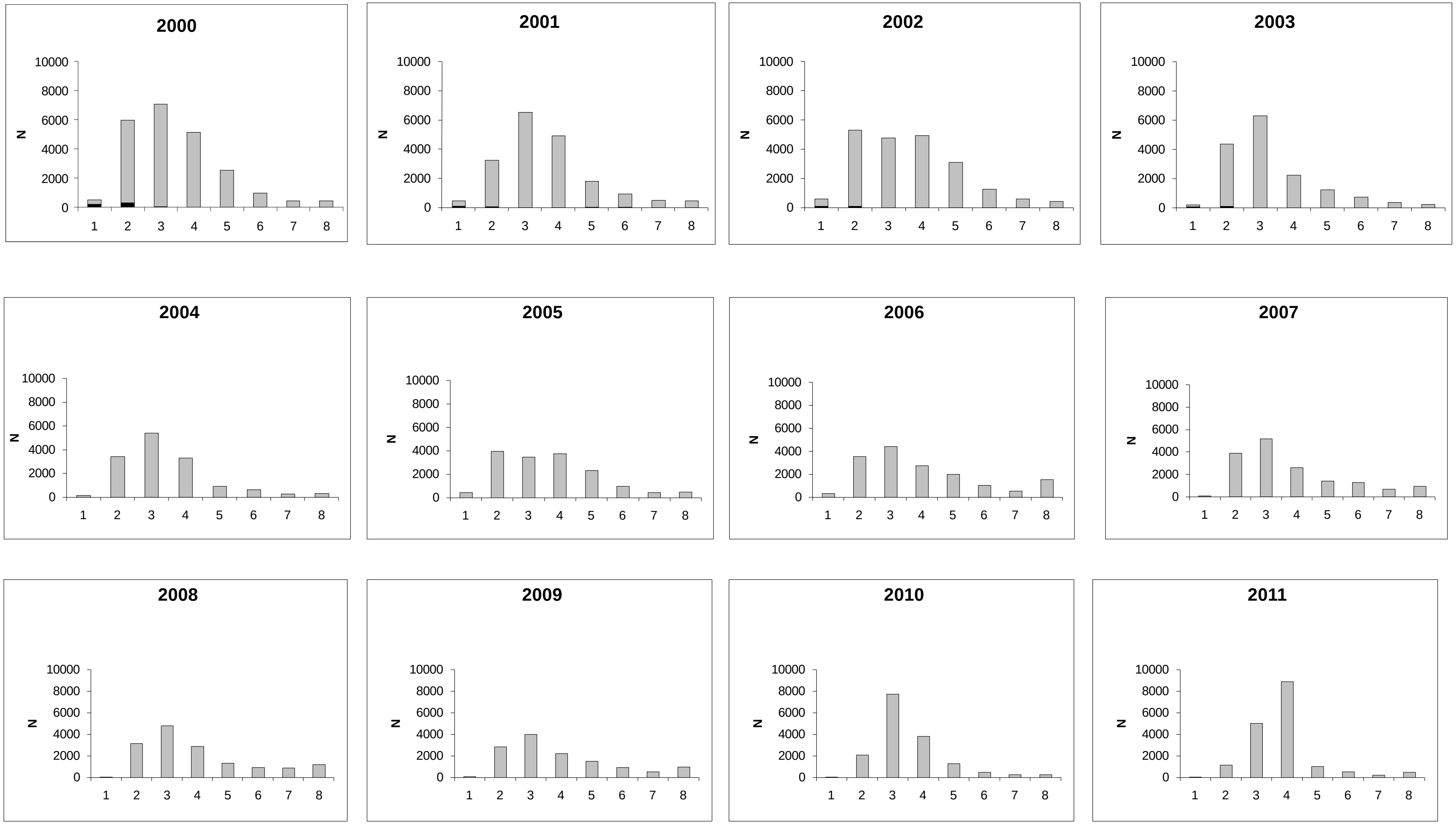


Figure 6.2 a: **Bay of Biscay sole landings and discards age distributions from 1984 to 1999 (numbers in thousands)**

Total landings
Discard estimates of the French offshore trawlers fleet


2000
2001
2002
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2011
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10000
8000
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4000
2000
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1
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7
8

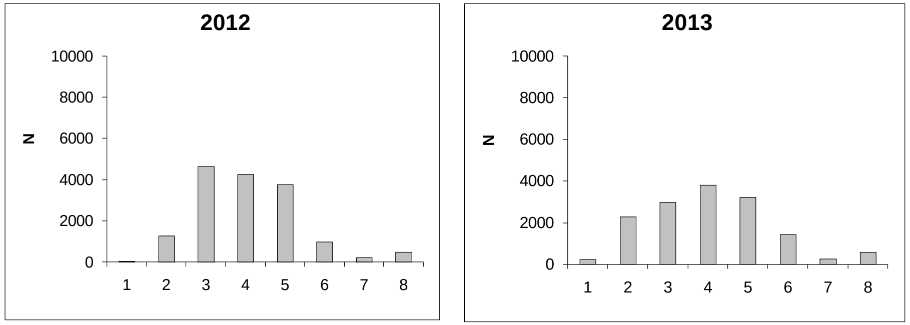


Figure 6.2 b: Bay of Biscay sole landings and discards age distributions from 2000 to 2013 ; landings age distribution since 2004 (numbers in thousands)

Total landings
Discard estimates of the French offshore trawlers fleet

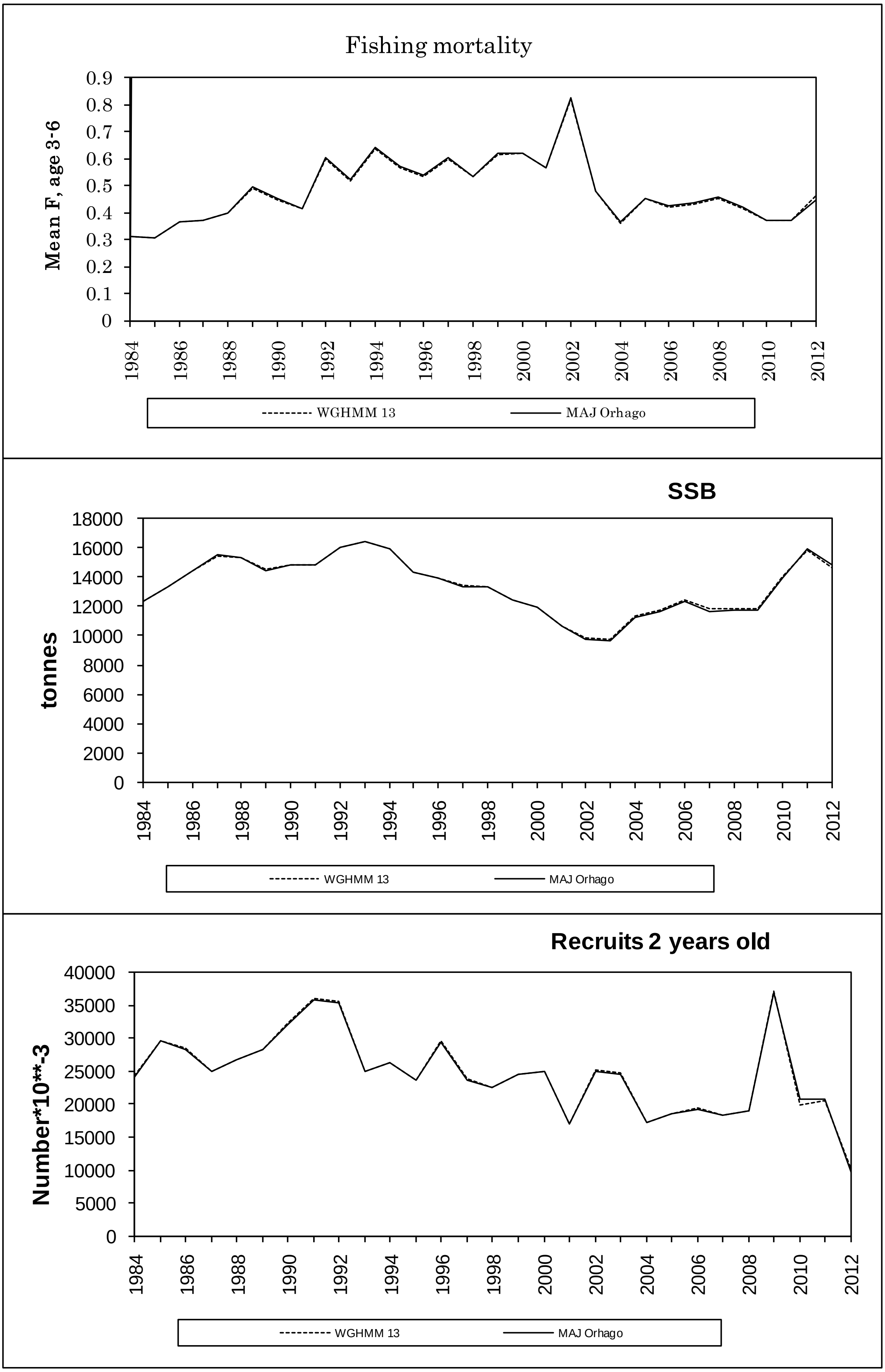


Figure 6.3: Bay of Biscay sole (Division VIIIa,b) – comparison WG13 vs WG13 with Orhago survey corrected in 2014.

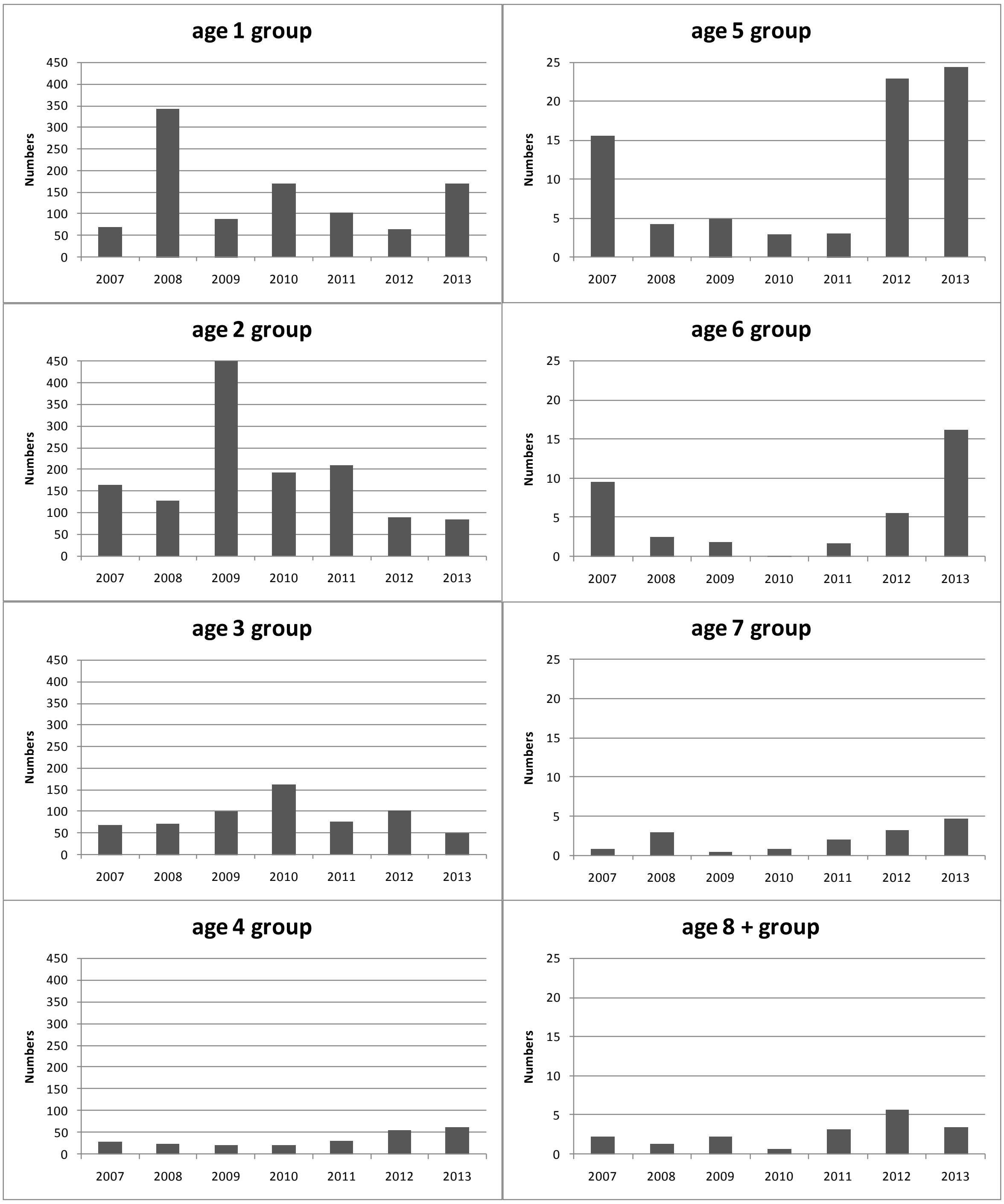


Figure 6.4: Orhago survey time series

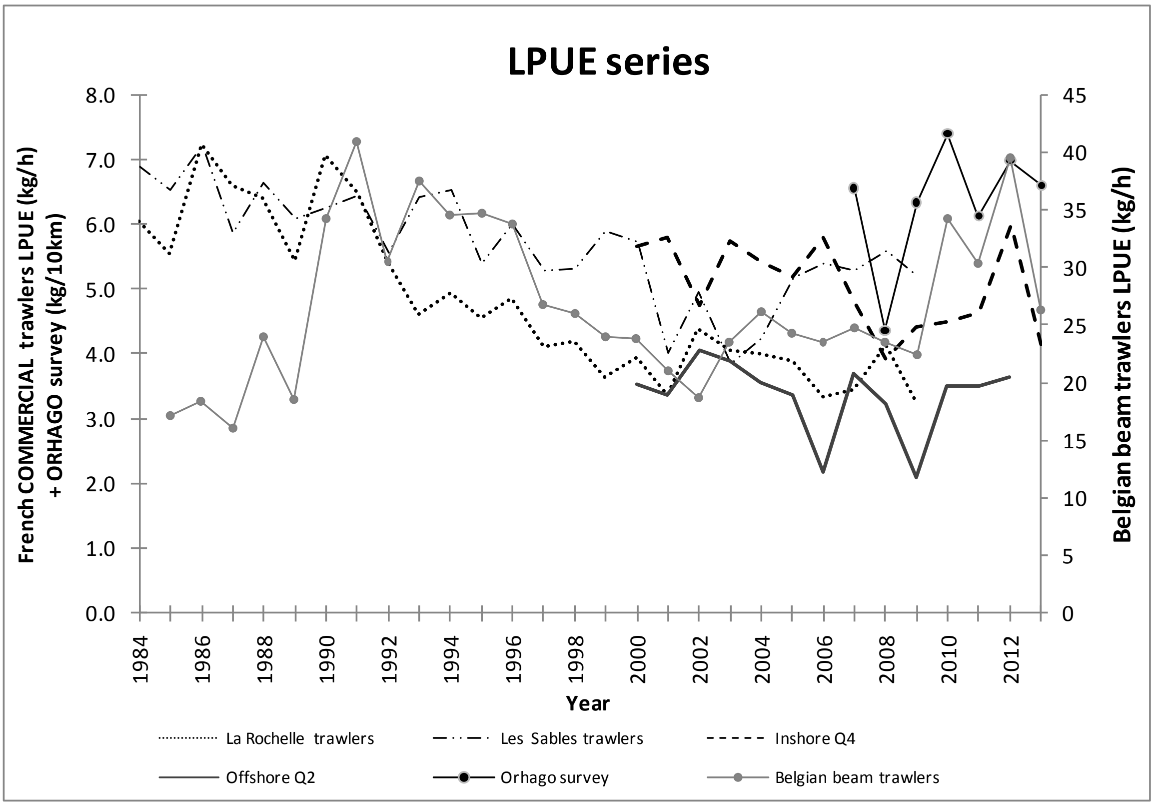
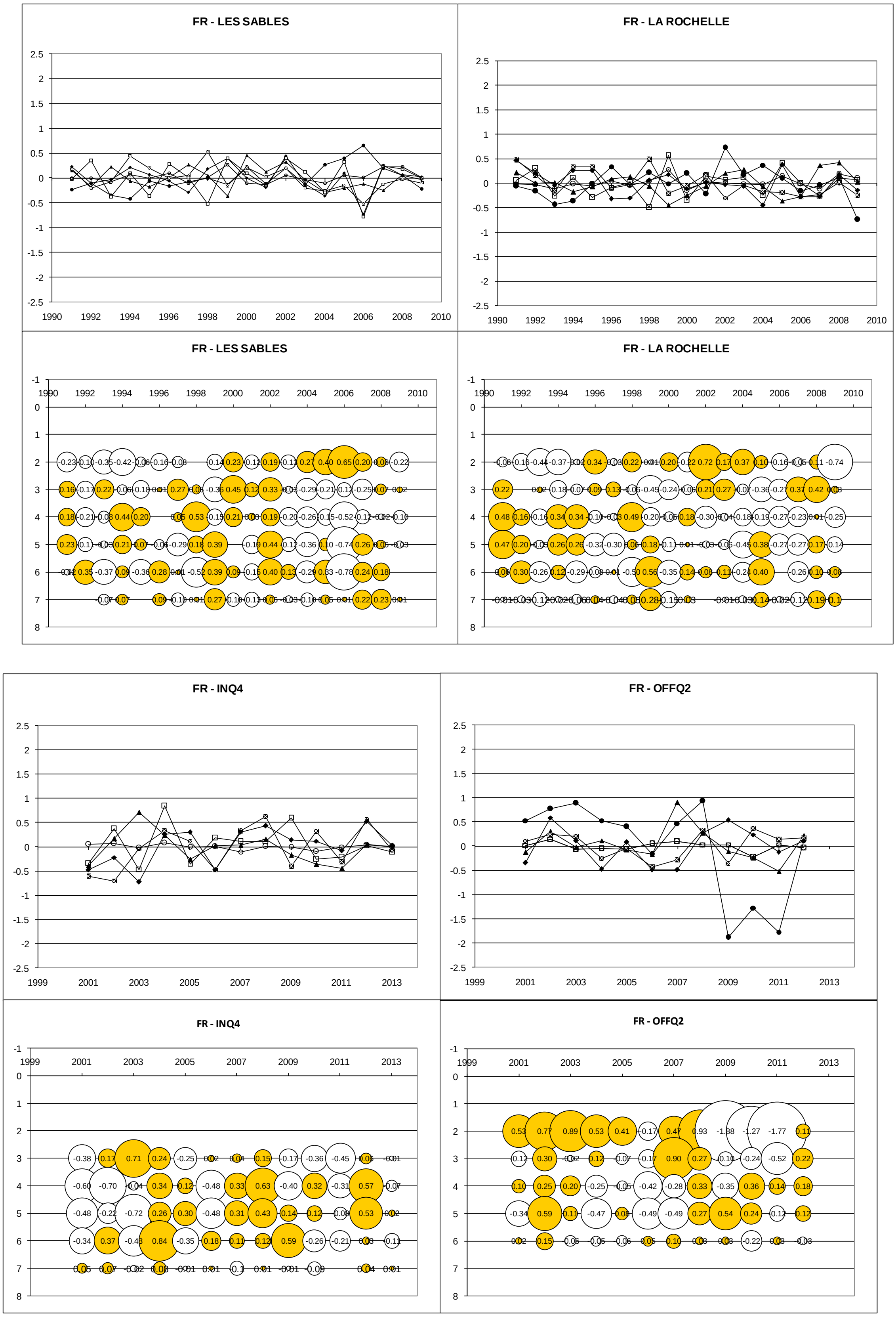


Figure 6.5: Bay of Biscay sole (Division VIIIa,b). LPUE trends of the 5 available commercial tuning fleets and CPUE of the ORHAGO survey (for sole greater than the minimum landing size, i.e. 24cm)

LOG CATCHABILITY RESIDUAL PLOTS (XSA)



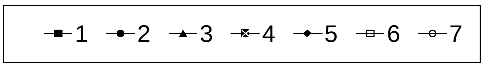
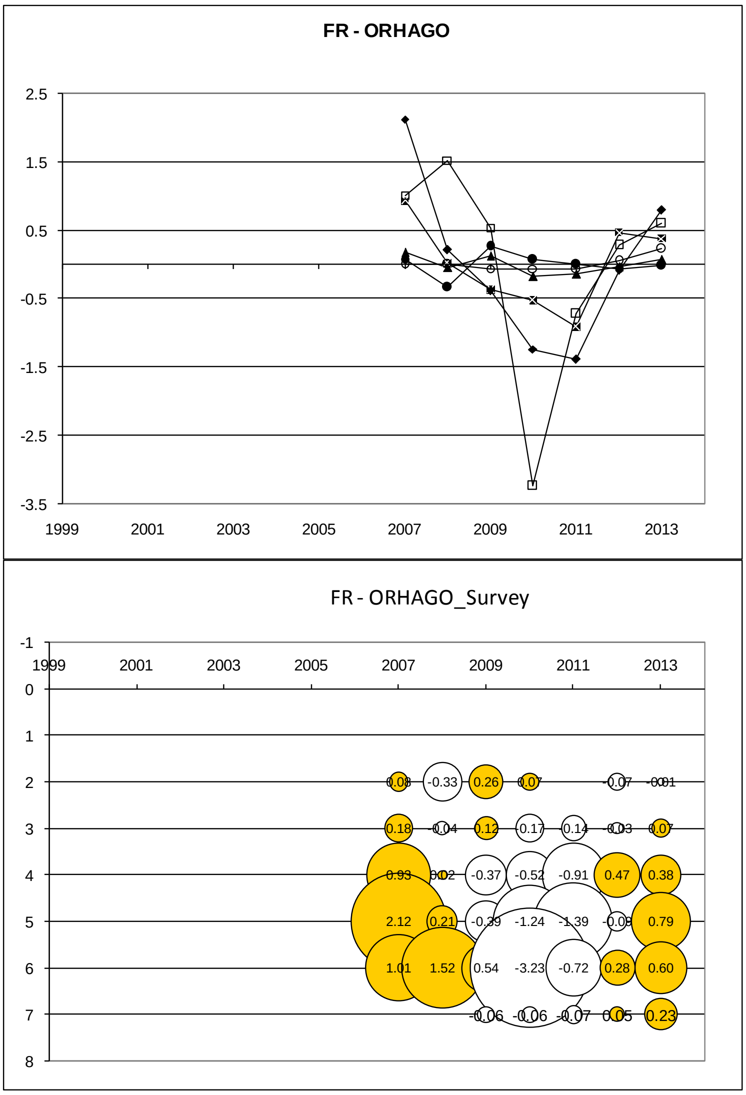


Figure 6.6a: Bay of Biscay sole (Division VIIIa,b)

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

LOG CATCHABILITY RESIDUAL PLOTS (XSA)



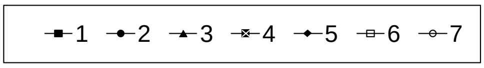


Figure 6.6b: Bay of Biscay sole (Division VIIIa,b)

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

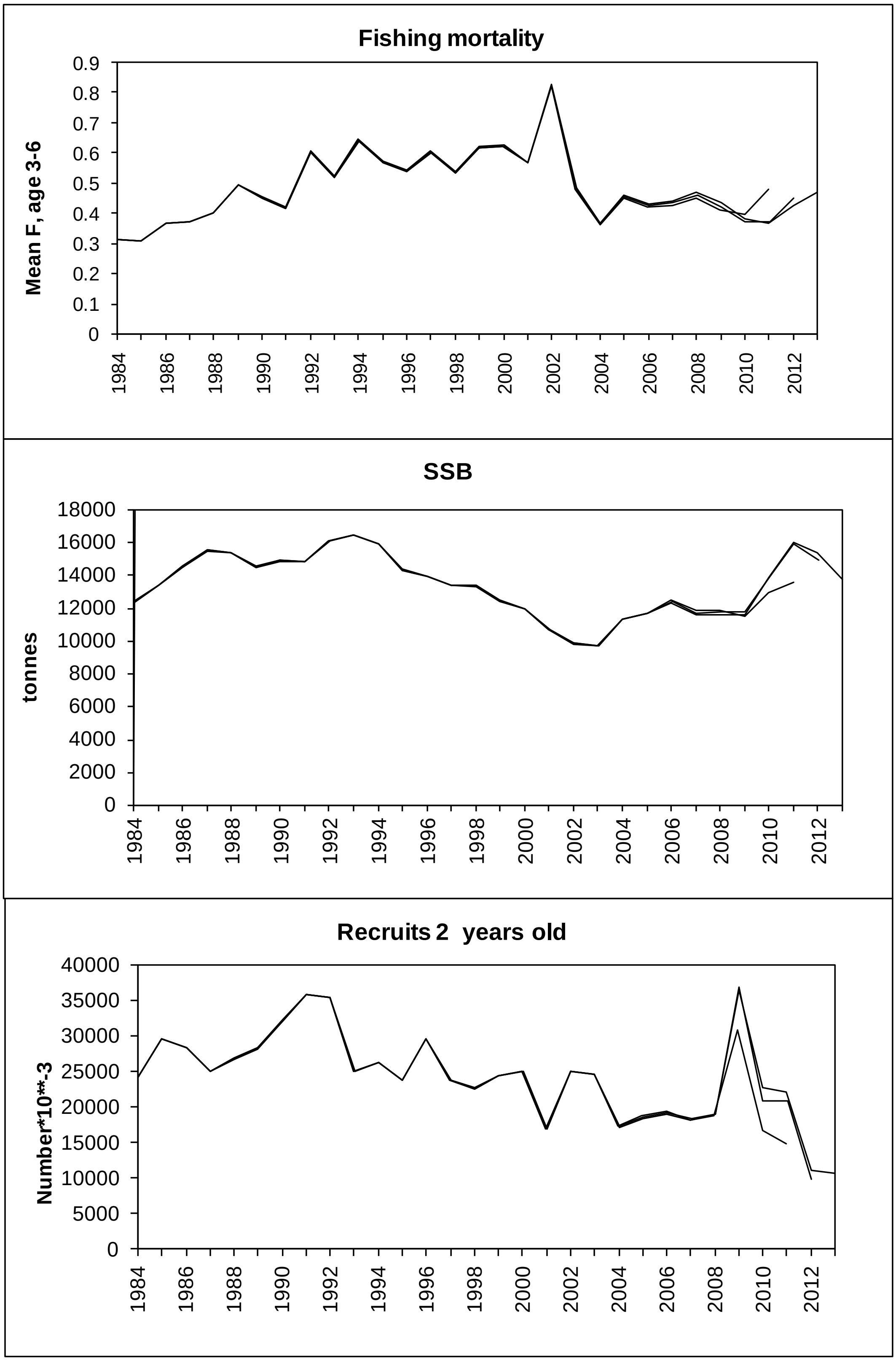
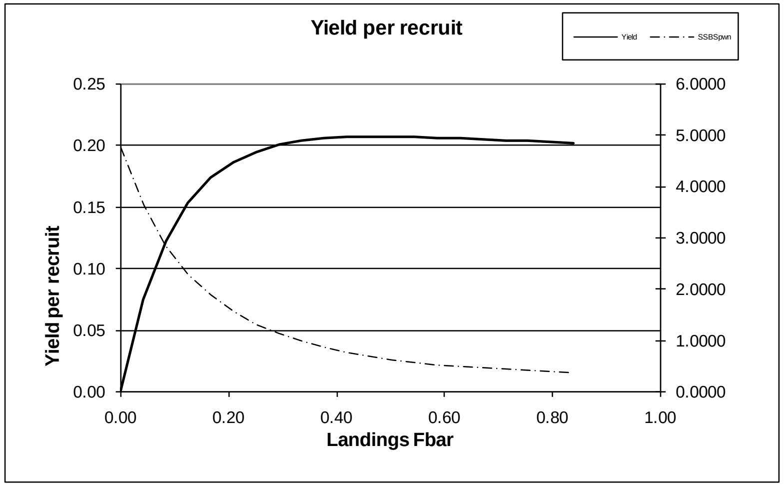
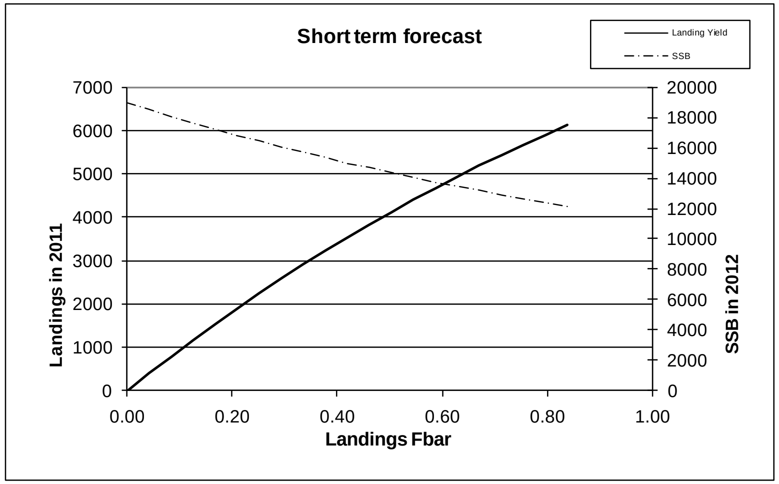


Figure 6.7: Bay of Biscay sole (Division VIIIa,b) - Retrospective results

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

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





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

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

Weights in kilograms

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

Input units are thousands and kg - output in tonnes

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

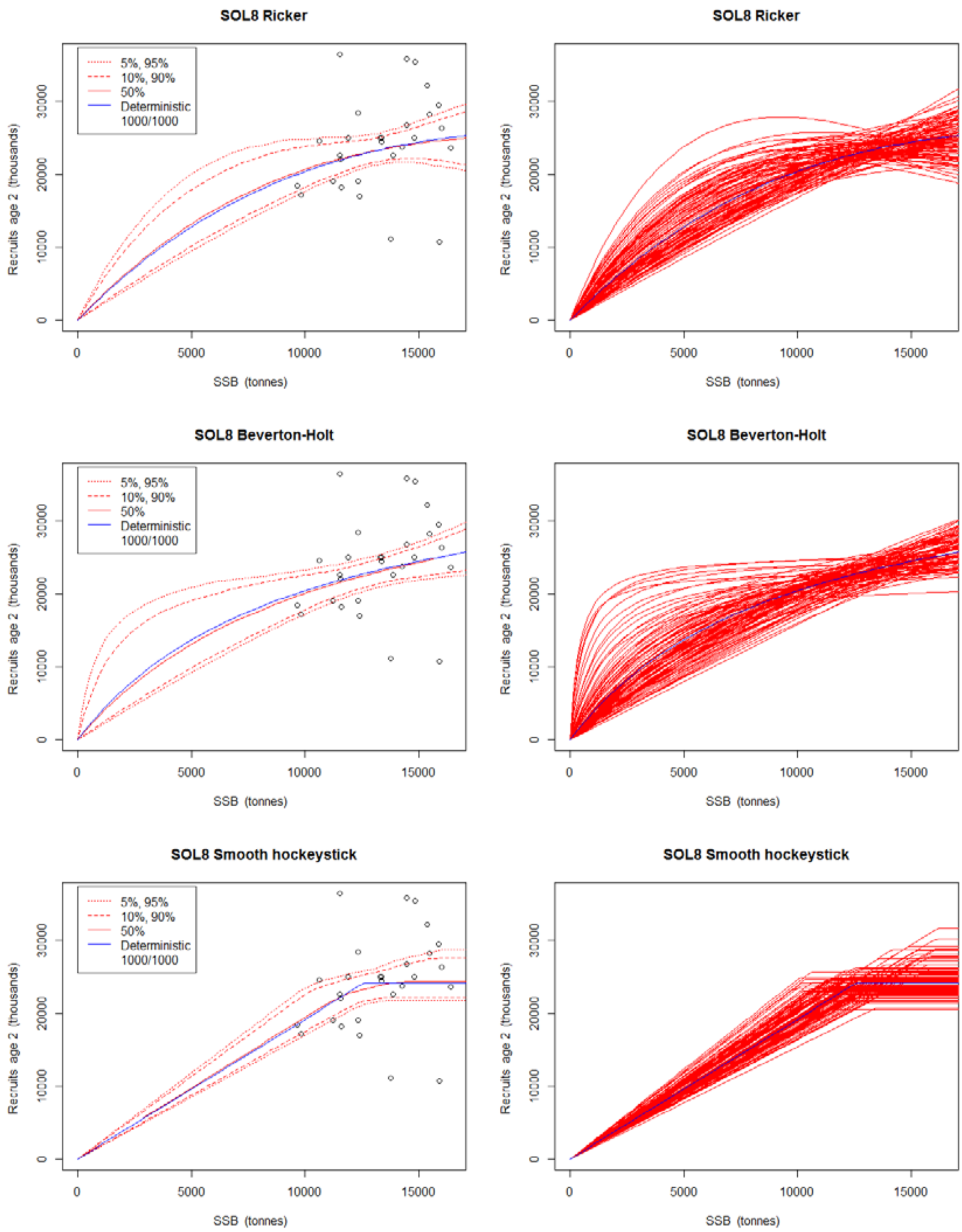


Figure 6.10: Bay of Biscay sole stock–recruit fits for Ricker (top), Beverton–Holt (middle) and smooth Hockey-stick (bottom). The left hand figures illustrate the 95th, 90th, median, 10th, and 5th percentiles from the successful MCMC samples, plotted with the assessment data points; the right hand figures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

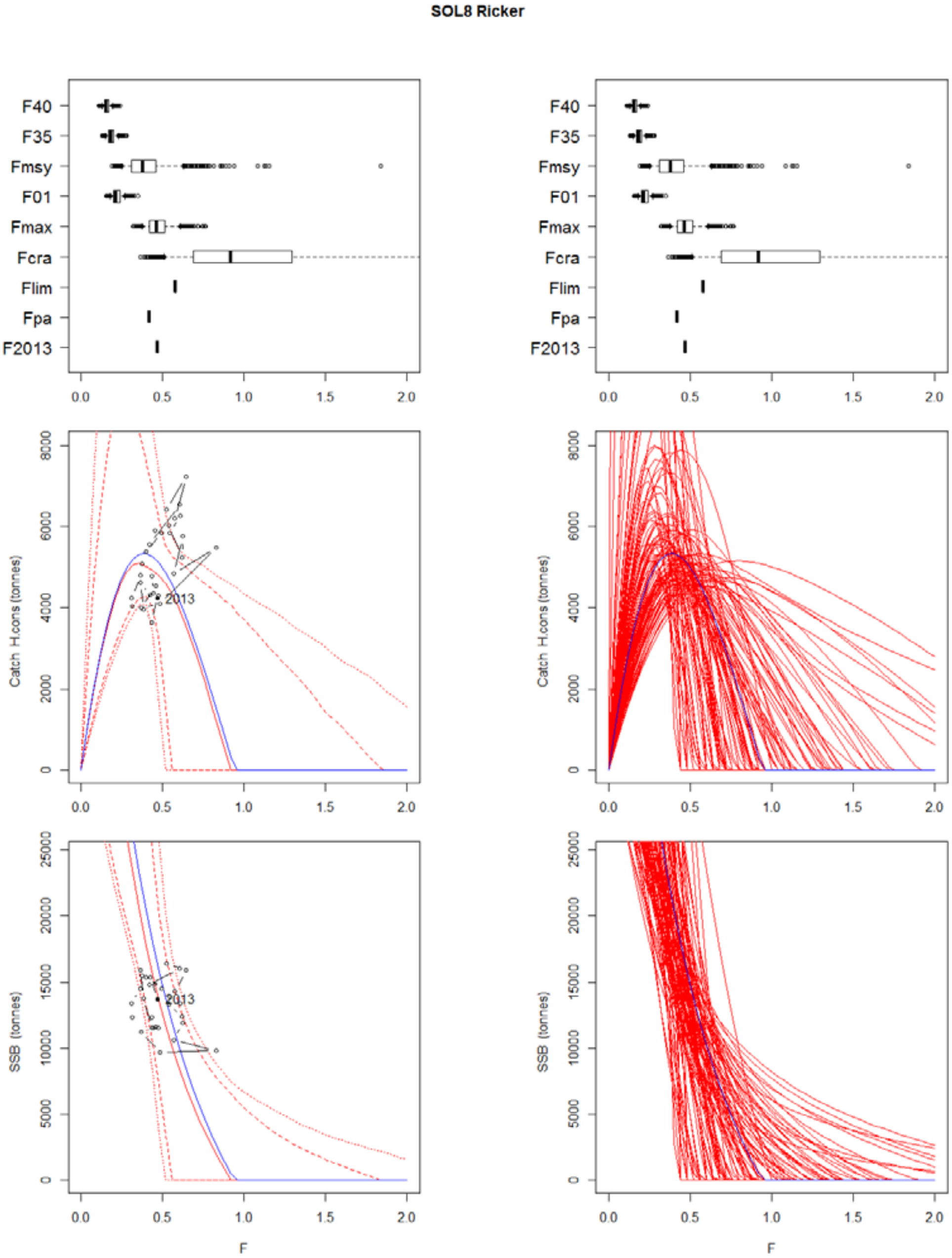


Figure 6.11: Bay of Biscay sole yield and SSB based on the Ricker stock and recruitment model estimates. Top: box plots of Fmsy and Fcrash with proxies for Fmsy based on the yield-per-recruit: Fmax, F0.1, F35% and F40% SPR also Flim, Fpa and F in the final year; middle: equilibrium landings vs. fishing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

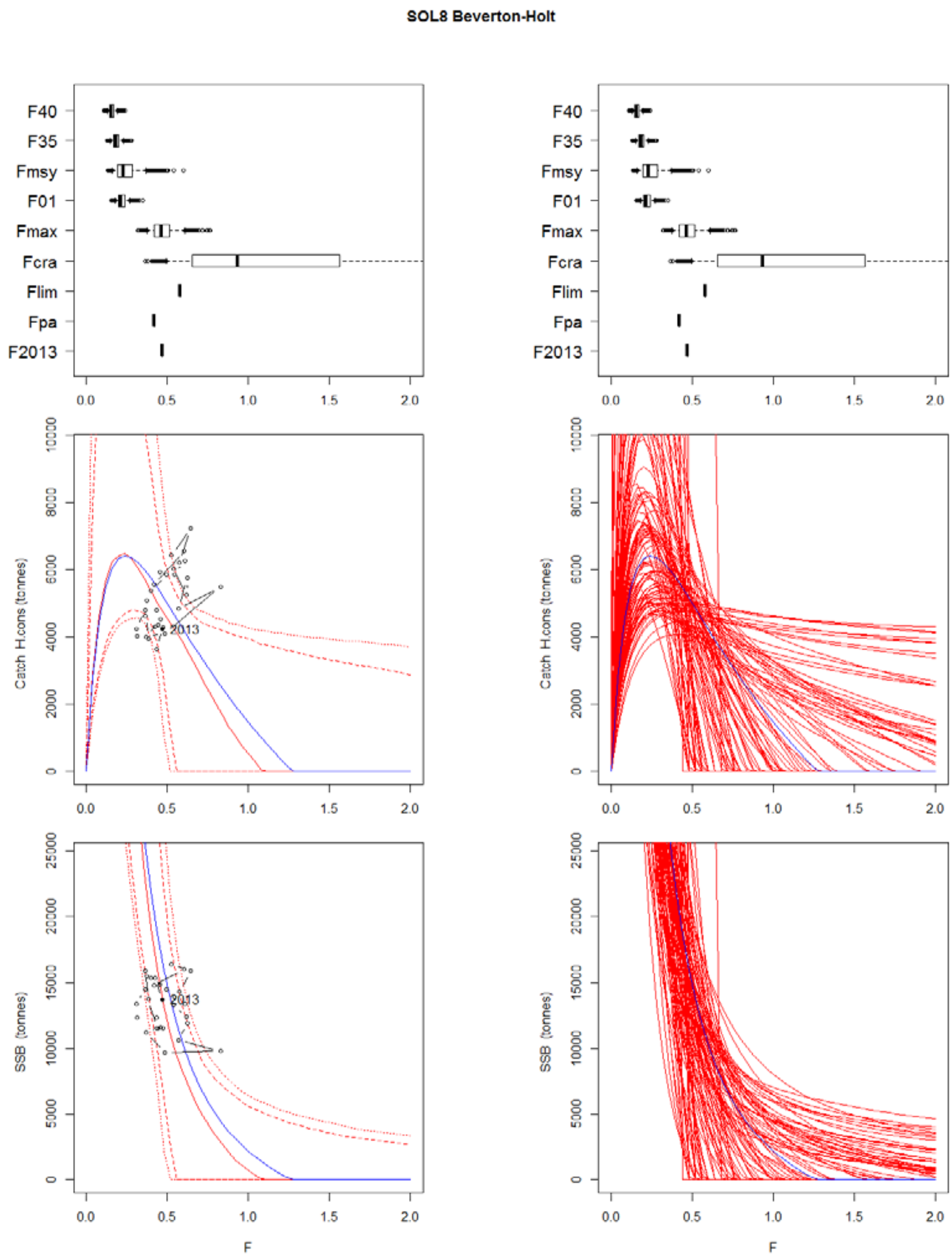


Figure 6.12: Bay of Biscay sole yield and SSB based on the Beverton–Holt stock and recruitment model estimates. Top: box plots of Fmsy and Fcrash with proxies for Fmsy based on the yield-per-recruit: Fmax, F0.1, F35% and F40% SPR also Flim, Fpa and F in the final year; middle: equilibrium landings vs.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

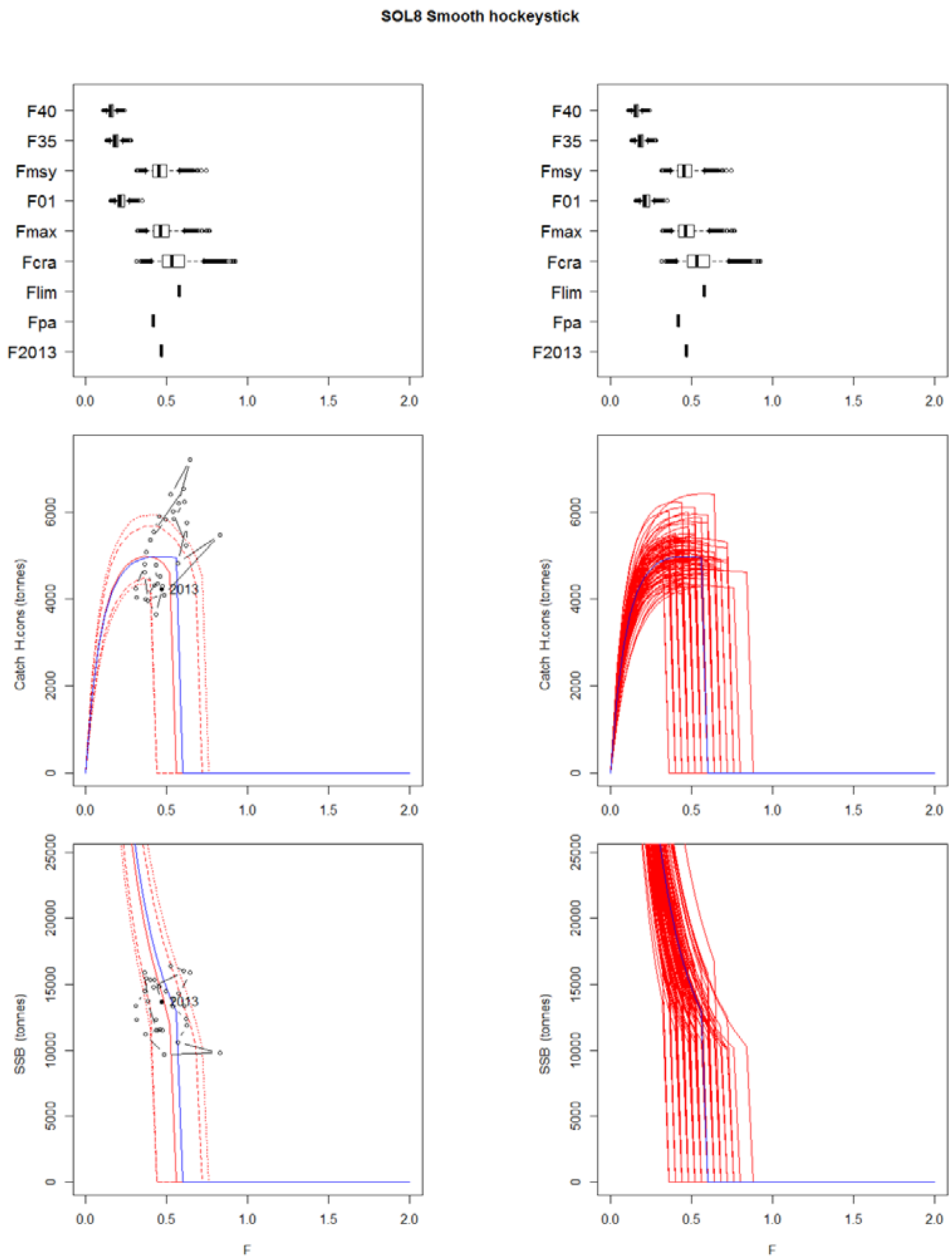


Figure 6.13: Bay of Biscay sole yield and SSB based on the Hockey-stick stock and recruitment model estimates. Top: box plots of Fmsy and Fcrash with proxies for Fmsy based on the yield-per-recruit: Fmax, F0.1, F35% and F40% SPR also Flim, Fpa and F in the final year; middle: equilibrium landings vs.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

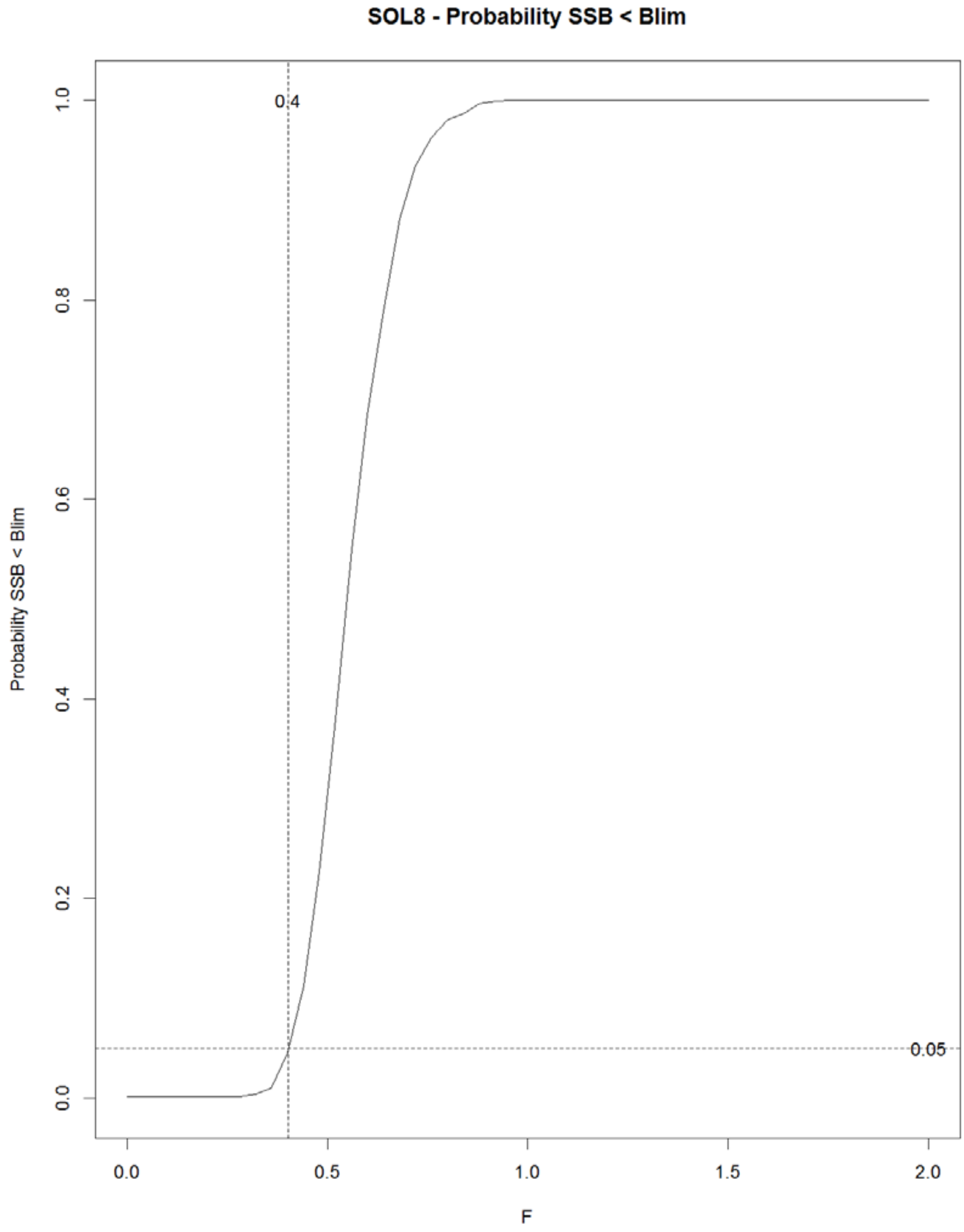


Figure 6.14: Bay of Biscay sole probability of SSB < Blim for the combined analysis weighted by model likelihood, indicating the F value coinciding with a 5% probability.

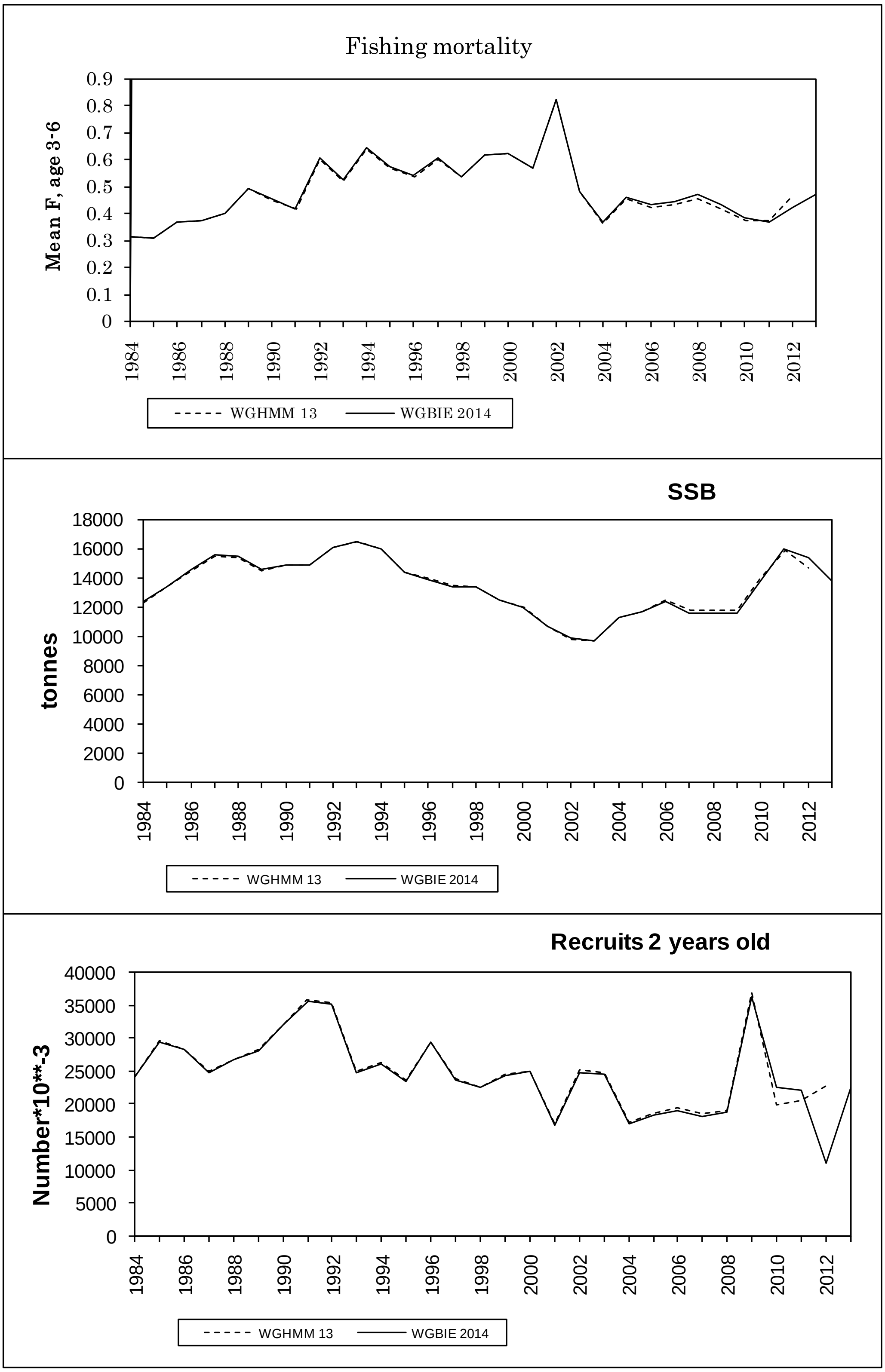


Figure 6.15: Bay of Biscay sole (Division VIIIa,b) - WG13 / WG14 comparison

7 Southern Stock of Hake

7.1 General

The type of assessment is "update" based on a previous benchmark assessment (WKSOUTH, 2014).

Long run times and optimization issues presented limitations for model exploration during the benchmark meeting. The majority of the time at the meeting was devoted to checking that the model was consistently reaching an optimised solution. As a result, WKSOUTH (2014) accepted the continuation of the methodology already used for the assessment, the projection and the reference points.

Data revisions: Portuguese discard estimates were revised for 2012 (the sample size and quality was improved from last year). The data input to the model have been corrected.

7.1.1 Fishery description

Fishery description is available in the Stock Annex (Annex G).

7.1.2 ICES advice for 2014 and Management applicable to 2013 and 2014.

ICES Advice for 2014

ICES advised, on the basis of the transition to the MSY approach, that landings in 2014 should be no more than 13 123 t.

Management Applicable for 2013 and 2014

Hake is managed by TAC, effort control and technical measures. The agreed TAC for Southern Hake in 2013 was 14 144 t and in 2014 is 16 266 t.

A Recovery Plan for southern hake was enacted in 2006 (CE 2166/2005). This plan aims to rebuild the stock to within safe biological limits by decreasing fishing mortality a maximum of 10% at year with a TAC constrain of 15%. SSB target (35 000 t) is no longer considered suitable under the new assessment model. This regulation includes effort management in addition to TAC measures, set in Reg. EU Council 39/2013 (annex II-b).

Since 2006, a 10% annual reduction of fishing days at sea was applied to all vessels, although with some exclusions. The effort from fishing trips which retain <3% hake are excluded from the regulation.

Technical measures applied to this stock include: (i) minimum landing size of 27 cm, (ii) protected areas, and (iii) minimum mesh size. These measures are set depending on areas and gears by several national regulations.

According to the Spanish Regulations in 2012 and 2013 the fishing options have been shared by quarters and individual trawlers (ARM/3158/2011 and Res. 28-12-2012 SGMAR The Portuguese regulations also established a closure for trawling off the southwest coast of Portugal between December and February.

7.2 Data

7.2.1 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 7.1. Since 2011, estimates of unallocated landings have been included in the assessment. These estimates are assumed to be the best information available at this time. However, it is recommended that the time series of unallocated landings for this stock be reviewed before next meeting.

In 2013, Portuguese landings were 2 744 t, slightly above those from 2012 (2 607 t). Spanish official landings in 2012 (5 831 t) and 2013 (7 154 t). Unallocated landings were 6 136 t in 2012 (42% of total landings) and 3 333 t in 2013 (20% of total landings). Total landings in 2012 were 14 573 t and 13 539 in 2013. Total discards in 2012 were 1 950 and 2 871 in 2013. Total catches were 16 523 and 16 410 in 2012 and 2013.

Growth, Length-weight relationship and M

An international length-weight relationship for the whole period has been used since 1999. The assessment model follows a constant von Bertalanffy model with fixed Linf = 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 7.2. L50 in 2013 is 36.5 cm, which is similar to previous years (except 2012 when it was lower) and relatively stable around 36-37 cm. There was a recommendation from WKSOUTH to incorporate Portuguese L50 data in a common estimate but due to lack of time it has not been possible to achieve this in the present assessment.

7.2.2 Abundance indices from surveys

Biomass, abundance and recruitment indices for the Portuguese and Spanish surveys respectively are presented in Table 7.3 and Table 7.4 and Figure 7.3. The Spanish (SpGFS-WIBTS-Q4 and SPGFS-caut-WIBTS-Q4) and the Portuguese (PtGFS-WIBTS-Q4) surveys are used to tune the model, by fitting the model estimates to the observed length proportions and survey trends.

The Portuguese Autumn survey (PtGFS-WIBTS-Q4) showed variable abundance indices with a minimum in 1993 and maximum in 2010. However, the 5 highest values are among the 6 latest estimates. The survey was not performed in 2012. The Spanish groundfish survey (SpGFS-WIBTS-Q4) shows low values for biomass and abundance in the early 2000s. These values increased from then, peaking to a historical maximum in 2009 and have remained stable since.

The recruitment indices of the SpGFS-WIBTS-Q4, SPGFS-caut-WIBTS-Q4 and PtGFS-WIBTS-Q4 (Figure 7.3) were highly variable in the past showing good recruitments in recent years. In 2013, PtGFS-WIBTS-Q4 and SPGFS-caut-WIBTS-Q4 are both at the respective maxima, while SpGFS-WIBTS-Q4 is lower, at around 58% of its historical mean.

In 2013 a new vessel was used for the Spanish surveys. A calibration exercise performed in 2012 suggested no significant differences for hake abundance estimates and therefore no correction was deemed necessary. The series is therefore kept continuous.

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. In 2013 more than 90% of the log-books are being completed in the electronic version. However, due to various errors, data cleaning algorithms are required and are yet to be agreed upon internally in IPMA. IPMA therefore opted to postpone estimations of CPUE until 2015 (at which time the series will also be revised backwards). The standardized CPUE from the Portuguese bottom-trawl fleet targeting roundfish had previously been routinely calculated by fitting a GLM to log-book data on landings and effort. The CPUE trend was increasing until 2010, with a peak of 43 Kg / hour (standardized series).

Spanish sales notes and Owners Associations data were compiled by IEO to estimate fleet effort until 2012 and are presented in figure 7.4 and table 7.5. Since the fleet dynamics are complex and considers temporal movements among harbours, these values are mainly valid for LPUE trends and their use to follow landings or effort trends may be done with caution. Spanish LPUE (SP-CORUTR) estimates for 2013 was considered unreliable because the effort estimation procedure was changed and no revision was yet possible. As soon as is feasible, they will be revised backwards

In 2014 the assessment therefore does not incorporate any additional effort data as compared to 2013. The two fleets included in the assessment model are SP-CORUTR and P-TR. SP-CORUTR peaks in 2011 with 47 Kg per fishing day and 100 HP. In 2012 the LPUE is the second best of the series hereto available, with 42, similar to the mean of 2008-12.

7.3 Assessment

The assessment carried out used the gadget model (length-age based) as decided by WKROUND (2010) and described on the stock annex (Annex G).

7.3.1 Model diagnostics

Likelihood profiles for each parameter estimated by the model are presented in Figure 7.5. This analysis is carried out in each parameter individually and it does not guarantee that the model found an absolute minimum. It allows checking that the minimization algorithm found a minimum. The values on the horizontal axes of the plots represent multiplicative factors with respect to the estimated parameter value. To check for convergence the minimum likelihood value must correspond to the estimated parameter value (i.e. the multiplier 1). The change in likelihood may be very large if the model gives “understocking”, i.e. if it is not able to produce enough fish to subtract the observed catches from the modelled population. Due to the distinct impact each parameter has on the likelihood value, the plots are presented scaled and unscaled. In Figure 7.5, all parameter estimates correspond to the minimum of the likelihood.

Residuals for surveys and abundance indices (SpGFS-WIBTS-Q4 and PtGFS-WIBTS-Q4) and commercial fleets (SP-CORUTR and P-TR) are presented in Fig 7.6a-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 without any trend. Regarding commercial fleets, P-TR (25-40 cm) was not available from 2011 to 2013. P-TR (25-40 cm) shows a downwards trend in more recent years. The difficulty of these indices to follow the abundance generated by the recent increase in recruitment may be due to the fact that discards are not included in the computation. Apart from this, the fits are quite consistent.

Figures 7.6 (c-i) present bubble plots of residuals for proportions at length. These proportions are grouped by 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 (7.6-d) and discards (7.6-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 once that the residuals' values are quite small (maximum ~0.3). The model takes into account the data precision when weighting the individual likelihood components (defined in Stock Annex), so data sets with larger model residuals will have less impact on the overall model fit.

7.3.2 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 7.7. 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 plot. The pattern corresponding to catches during 1982-93 shows higher relative efficiency for smaller fish (when compared with catches from 1994 onwards), which is in agreement with our assumption that before 1992 (when the minimum landing size was implemented) the importance of discards was relatively lower. The discards (1992-latest) and landings (1994-latest) selection patterns are used for projections.

Survey selection patterns are presented in the lower selection pattern panel. The Portuguese survey PtGFS-WIBTS-Q4 catches relatively larger fish than the Spanish surveys (SpGFS-WIBTS-Q4 and SPGFS-caut-WIBTS-Q4). Both Spanish surveys show a similar pattern. They are both performed with the same vessel and gear in every year, but since 2013 a new vessel has been used (without a significant impact in hake abundance estimates).

The von Bertalanffy k parameter was estimated to be 0.164, the same as in the previous assessment.

Historic trends in biomass, fishing mortality, yield and recruitment

Model estimates of abundance at length in the beginning of the 4th quarter are presented in Figure 7.8. The figure shows a general increase of small fish after 2004 that contributes to an increase of large fish in more recent years.

Table 7.6 and Figure 7.9 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.

The recruitment (age 0) is highly variable and presents two different periods: one from 1982 to 2003 with mean figures around 70 million, ranging from 40 to 120, and a recent period from 2004 to latest with a mean of 119 million ranging from 70 to 180 million. Following the technical annex, the latest recruitment was substituted with the geometric mean of years 1989-2012 (81 024 thousand). The parameter is usually poorly estimated as shown by the retrospective pattern (Fig 7.10). Fishing mortality increased from the beginning of the time series (F=0.36 in 1982) peaking in 1995 at 1.18; declining to 0.77 in 1999 and remaining relatively stable until 2009 (F=0.97). Afterwards F decreased reaching 0.59 in 2013. 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 900t in 1998. Since then biomass has continuously increased, reaching 18 900 in 2013.

Retrospective pattern for SSB, fishing mortality, yield and recruitment

Figure 7.10 presents the results of the assessments performed using the retrospective data series from 2013-2009. There is a clear trend in the retrospective pattern for recruitment, F and SSB. Recruitment shows high variability, whereas both recruitment and SSB show a tendency to be overestimated, in contrast to F which shows a tendency to be underestimated.

7.4 Catch options and prognosis

7.4.1 Short-term projections

The methodology used this year was developed during the benchmark (WKSOUTH, 2014) and described in the Stock Annex (Annex G). Results are presented in Fig. 7.11 and Table 7.7. Note that GADGET is length based and F multipliers do not apply linearly, e.g. if Fmult is 1, F is 0.59 and if Fmult=0.5 produces F is 0.28.

In 2014 the expected SSB is 24 685 t. Fsq for the intermediate year (2014) is estimated as the average of the last 3 assessment years scaled to last year (0.59). Recruitment for 2013 was not accepted because of the uncertainties shown in the retrospective analysis. Recruitment used for projections in years 2013-15 was the geometric mean of 1989-2012 (81 024 thousand)

During the intermediate year, 2014, the expected yield (landings) is 14 844 t and the SSB at the end of the year is expected to be 25 646 t.

Different F multipliers applied in 2015 provide management alternatives according to different scenarios. Under Fsq (0.59) the expected yield would be 15 017 t and SSB in 2016 would be 25 077 t. Decreasing F by 10% (0.53), the yield and SSB would be 13 844 and 27 142 t. This is inside the 15% boundaries in the recovery plan. With the MSY approach F would be 0.24, yield 7 302 t and SSB 38 829 t.

7.4.2 Yield and biomass per recruit analysis

F producing maximum landings per recruit was estimated following the Stock Annex (Annex G). This results in Fmax = 0.25 and F0.1=0.17 (Figure 7.12).

Next table shows the expected figures for different reference Fs.

	F (1-3)	Yield/R	SSB/R
Fsq	0.59	0.17	0.29
Fmax	0.24	0.23	0.96
F0.1	0.17	0.22	1.29
F35%SPR	0.21	0.23	1.10

7.5 Biological reference points

Fmax (F=0.24) is the Southern hake Fmsy proxy.

The working group proposes a Blim= 9 000 t based on Bloss. The stock recruitment plot does not show any clear sign of reduced recruitment at low SSB. However we opted to a conservative approach rejecting the 4 lowest SSB values (see Fig. 13) which gives a Bloss figure around 9 000 t.

Reference points

	Type	Value	Technical basis
MSY	MSY Btrigger	Not defined.	
approach	FMSY	0.24	Fmax (ICES, 2010).
	Blim	9 000 t	Bloss (WGBIE, 2014)
Precautionary	Bpa	Not defined.	
approach	Flim	Not defined.	
	Fpa	Not defined.	

7.6 Comments on the assessment

The assessment procedure followed the Southern hake stock annex although two indexes could not be updated (SP-CORUTR and P-TR).

Assessment results show good recruitment in recent years, but recruitment in the terminal year is considered unreliable. Surveys indicate that the latest recruitment abundance (<20 cm) is below the historical mean north of the northern Portuguese border and at the respective historical maxima to the south.

Given the lack of abundance indices for large fish at the beginning of the time series, the SSB estimates for this period may be considered with caution.

The retrospective pattern shows a trend to overestimate SSB and underestimate F.

7.7 Management considerations

An important part of landings are unallocated since 2011 (49%, 43% and again 20% in the latest year) and total catches are well above the advised TAC. Exceeding the TAC may compromise the goals of the recovery plan.

The objective of the recovery plan was to rebuild the stock within safe biological limits, meaning to reach a SSB of 35 000 t by 2015. Since the enforcement of the plan the stock historical perception has changed and this SSB figure is no longer valid. The stock recruitment plot (Fig. 7.13) does not show signs of poor recruitments at low SSB, which suggests that B_{loss} (9 000 t) could be a good candidate for B_{lim}.

There are indications of good recruitment since 2005. In 2013 the survey indices show that recruitment is the highest ever to the south of the northern Portuguese border, but below average to the north.

F in 2013 continues to be above Fmax. The stock is therefore being overexploited.

The retrospective pattern shows overestimation of SSB and underestimation of F. the impact on the advised TAC is relatively minor since both processes balance each other.

Hake is a top predator which is caught in a multispecies fishery and decisions on hake management will have an impact on the trophic chain that was not accounted for in this assessment.

Table 7.1 HAKE SOUTHERN STOCK. Catch estimates (´000 t) by country and gear, 1972-2013

	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	**0.60**	**2.6**		6.14	**1.95**	**14.57**	**16.52**
2013	0.64	1.75	1.11	0.62		1.86	1.16	**2.22**	**7.2**	1.93	0.81	**0.65**	**2.7**	0.31	3.33	**2.87**	**13.54**	**16.41**

Table 7.2 HAKE SOUTHERN STOCK - length compositions (thousands) in 2013

Length (cm)	STOCK		
(4 to 100+ each 2)	Land	Disc	Catch
4	0	0	0
6	0	4	4
8	3	79	82
10	47	1280	1327
12	177	1193	1370
14	309	3451	3760
16	394	4446	4840
18	411	7215	7627
20	399	9150	9549
22	400	8773	9173
24	848	3727	4575
26	2667	2205	4872
28	4264	589	4853
30	4272	138	4410
32	3519	58	3578
34	2784	26	2810
36	2033	292	2325
38	1678	10	1687
40	1519	0	1519
42	1075	1	1076
44	874	0	874
46	709	1	710
48	651	2	653
50	527	0	527
52	430	1	431
54	390	1	391
56	340	0	340
58	311	1	312
60	234	1	235
62	198	1	199
64	159	0	159
66	113	0	113
68	104	0	104
70	81	0	81
72	67	7	74
74	51	0	51
76	36	0	36
78	31	0	31
80	18	0	18
82	10	0	11
84	12	0	12
86	9	0	9
88	3	0	3
90	3	0	3
92	5	1	6
94	2	0	2
96	1	0	1
98	1	0	1
TOTAL	32169	42653	74824
Nominal Weight (tons)	13.23	2.87	16.10
SOP	13.16	2.94	16.10
SOP / NW	1.01	0.98	1.00
Mean length (cm)	35.5	20.6	27.0

*** without France landings**

Table 7.3 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
2012											35.2	3.4	473.1	62.1	289.0	93

NO surveys in 2012

all data concerns 20 mm cod end mesh size except data marked with * which concerns 40 mm

(1) n/hour <20 cm converted to Noruega and NCT

(**) all area not covered

*** R/V Capricornio, other years R/V Noruega

Strata depth:

from 1979 to 1988 covers 20-500 m depth

from 1989 to 2004 covers 20-750 m depth

since 2005 covers 20-500 m depth

since 2002 tow duration is 30 min for autumn survey

Table 7.4 HAKE SOUTHERN STOCK - Spanish groundfish surveys; abundances and recruitment indices for total area (Mino - Bidasoa). Biomass for Cadiz surveys.

	Spanish Survey (SpGFS-WIBTS-Q4) (/30 min)						Cadiz Survey (SPGFS-caut-WIBTS-Q4) (/hour)				Cadiz Survey (SPGFS-cspr-WIBTS-Q4) (/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	285.57	5.50	0.56	40	76.5

Since 1997 new depth stratification: 70-120m, 121-200m and 201-500 m
Before 1997: 30-100m, 101-200m and 201-500 m

Table 7.6. Southern Hake Stock Assessment summary

Year	Mort (1-3)	R (million)	SSB ('000 tn)	Land ('000 tn)	Disc ('000 tn)	Catch ('000 tn)
1982	0.36	98.4	41.1	17.6		17.6
1983	0.44	81.5	45.8	22.9		22.9
1984	0.45	69.5	43.0	22.2		22.2
1985	0.42	44.1	43.1	18.9		18.9
1986	0.45	41.0	40.0	17.2		17.2
1987	0.51	50.1	36.8	16.2		16.2
1988	0.65	71.2	27.0	16.7		16.7
1989	0.65	78.1	19.9	13.8		13.8
1990	0.69	82.4	16.3	13.2		13.2
1991	0.69	69.9	16.5	12.8		12.8
1992	0.84	52.4	15.5	13.8	*0.5*	14.3
1993	0.91	61.1	12.8	11.5	*0.7*	12.2
1994	0.89	119.5	8.9	9.9	*1.0*	10.9
1995	1.18	51.2	7.1	12.2	*2.1*	14.3
1996	1.14	101.0	8.6	9.7	*1.9*	11.6
1997	1.16	80.3	6.6	8.5	*2.3*	10.8
1998	0.92	57.6	5.9	7.7	*1.7*	9.4
1999	0.77	66.5	7.7	7.2	*1.5*	8.7
2000	0.86	69.5	9.0	7.9	*1.8*	9.7
2001	0.84	49.1	9.2	7.6	*1.7*	9.2
2002	0.80	69.4	9.7	6.7	*1.5*	8.2
2003	0.82	60.1	9.4	6.7	*1.5*	8.2
2004	0.72	79.1	9.3	6.9	0.9	7.9
2005	0.75	126.1	9.7	8.3	2.0	10.3
2006	0.87	96.9	11.2	10.8	3.3	14.1
2007	0.91	158.4	13.2	14.9	2.5	17.4
2008	0.90	117.0	13.1	16.8	2.3	19.1
2009	0.97	109.4	14.4	19.2	2.9	22.2
2010	0.74	71.5	13.9	15.4	1.6	16.9
2011	0.80	108.8	16.9	17.1	1.9	19.0
2012	0.70	107.9	17.7	14.6	1.9	16.5
2013*	0.59	178.3	18.9	13.2	2.9	16.1

* Recruitment 2013 = 81 024 million (geo mean 1989-12)

Landings do not include France data presented in table 7.1

Table 7.7. Short term projections

	SSB 2014	BIO 2014	F 2014	Yield 2014	Catch 2014	SSB 2015	BIO 2015
number	24685	30583	0.59	14844	17389	25646	30953

Fmult	F 2015	Yield 2015	Catch 2015	SSB 2016	
0	0.00	0	0	52703	
0.1	0.06	1860	2141	49183	
0.20	0.11	3634	4184	45822	
0.30	0.17	5324	6133	42650	
0.40	0.23	6932	7991	39659	
0.43	0.24	7302	8417	38829	*Fmax*
0.50	0.28	8462	9759	36840	
0.60	0.34	9916	11441	34186	
0.70	0.40	11296	13040	31690	
0.80	0.47	12605	14558	29345	
0.90	0.53	13844	15997	27142	*Rec Plan*
1.00	0.59	15017	17361	25077	
1.05	0.59	15017	17361	25077	
1.10	0.66	16125	18652	23142	
1.20	0.72	17171	19872	21330	
1.30	0.79	18157	21024	19637	
1.40	0.85	19085	22111	18055	

There is a EC Recovery Plan (-10% annual F redution; +-15% TAC constrain)
Fmsy proxi = Fmax (0.24)
TAC 2014 = 16 266 (-+15% [13 826, 18 706])
Recruitment = 81 mill (geo mean 1989-12)

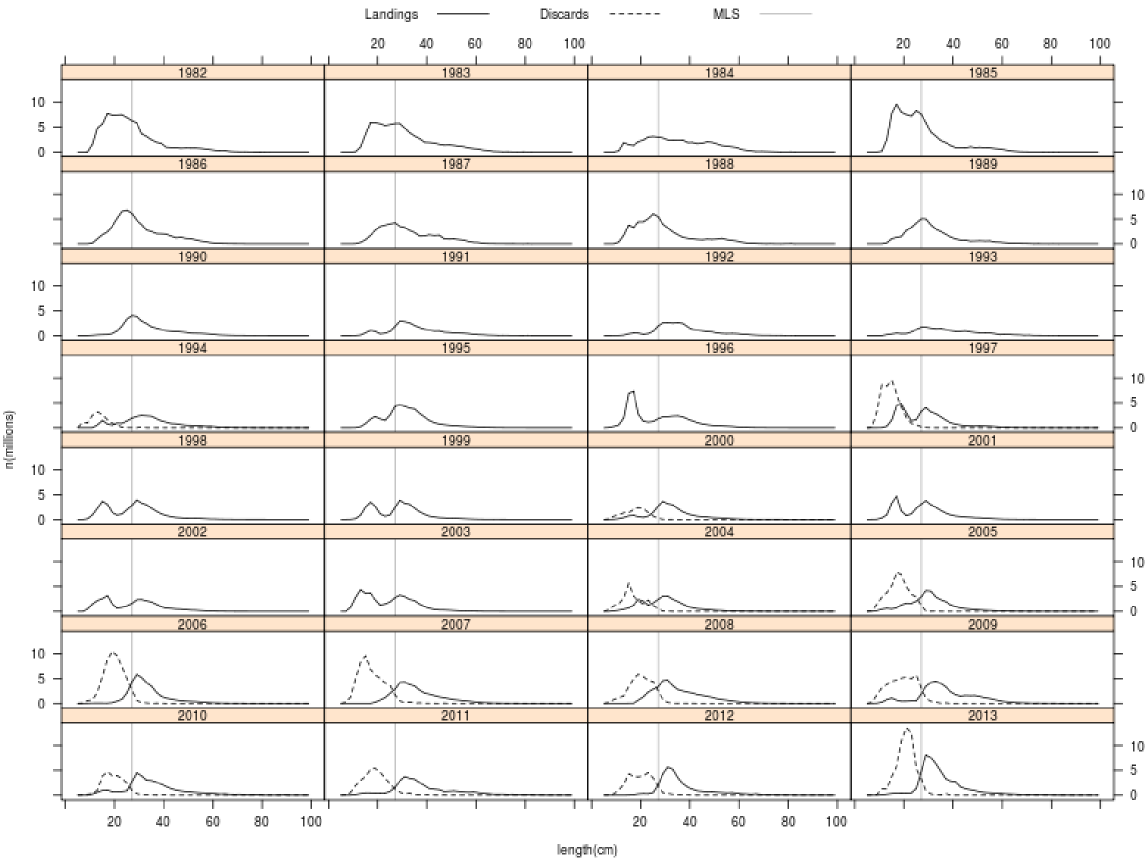


Figure 7.1. Length distribution of catches used in the assessment. Landings (1982-13). Discards from 1992-13. Minimum landing size (MLS) since 1992 at 27 cm.

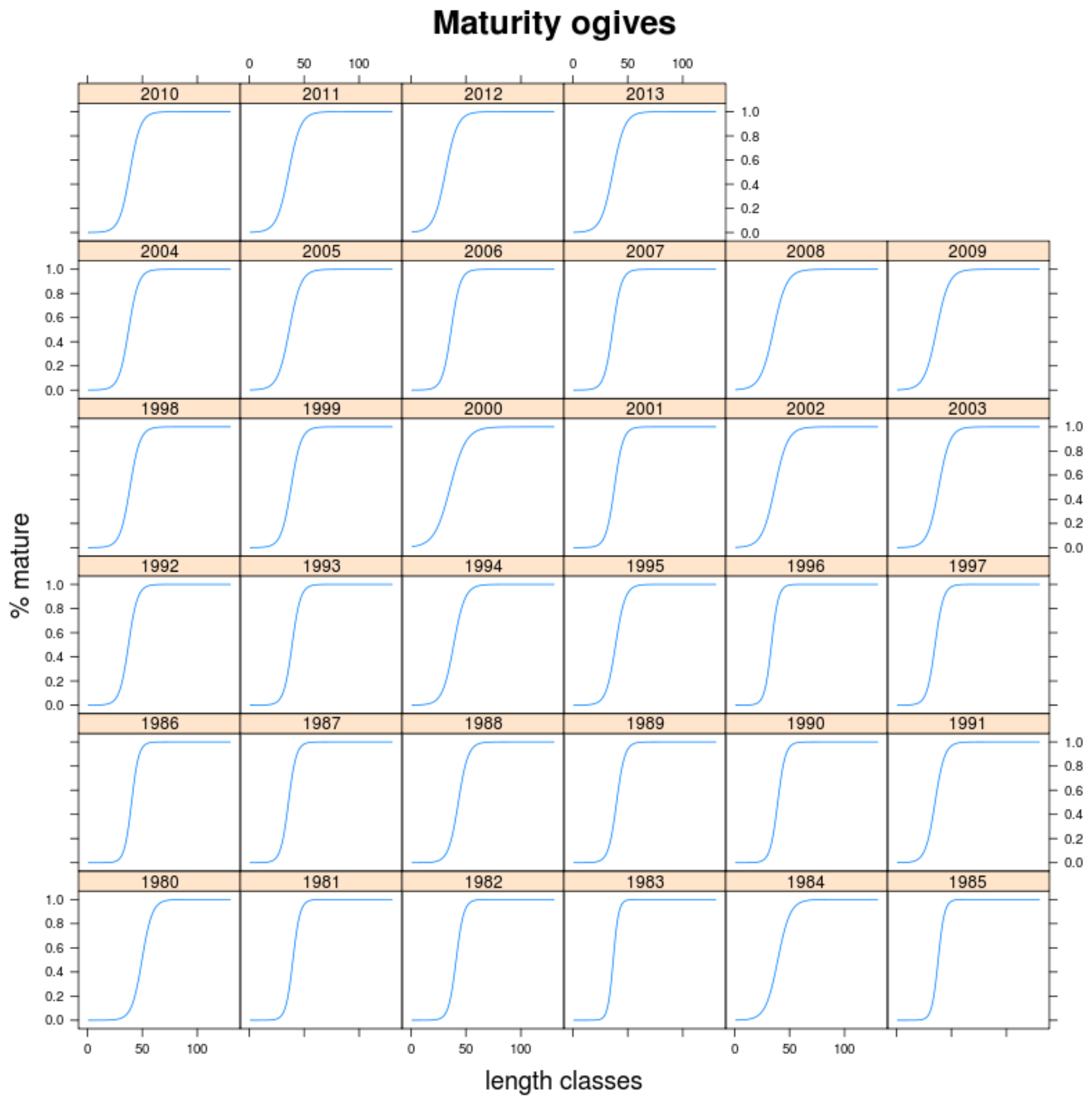


Figure 7.2 Maturity ogives from 1908 to 2013

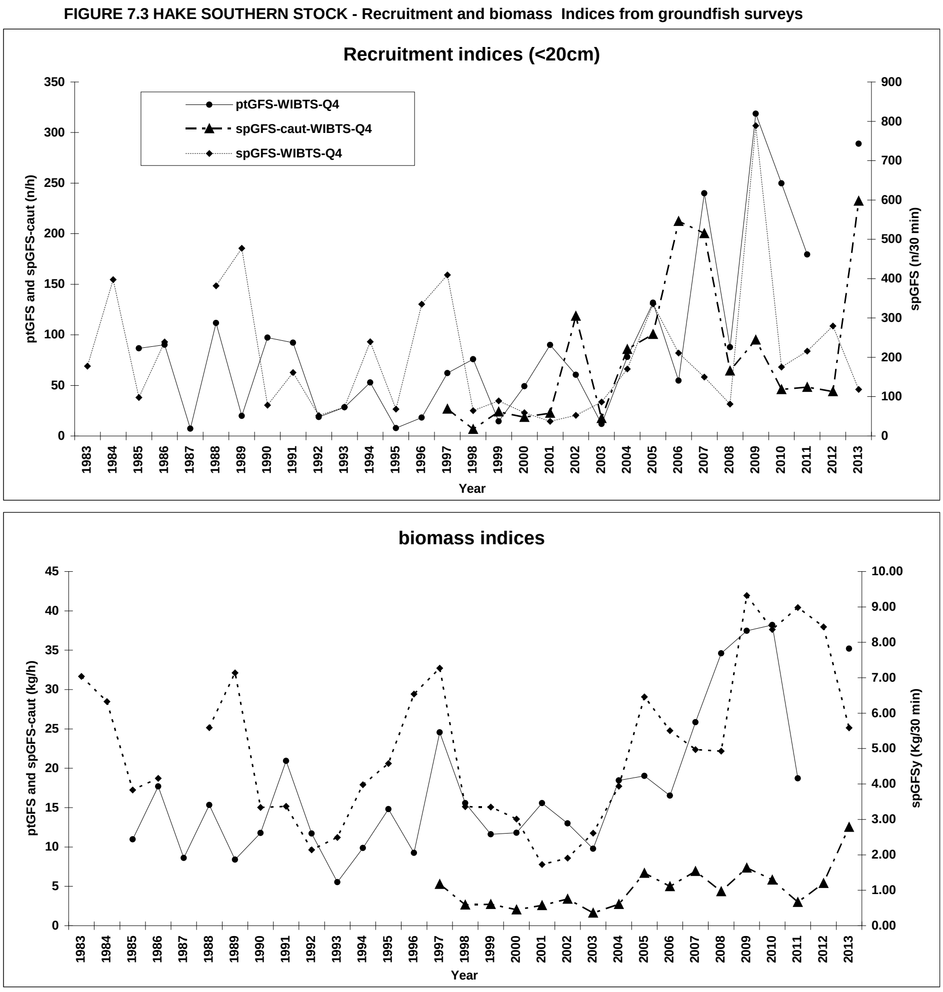
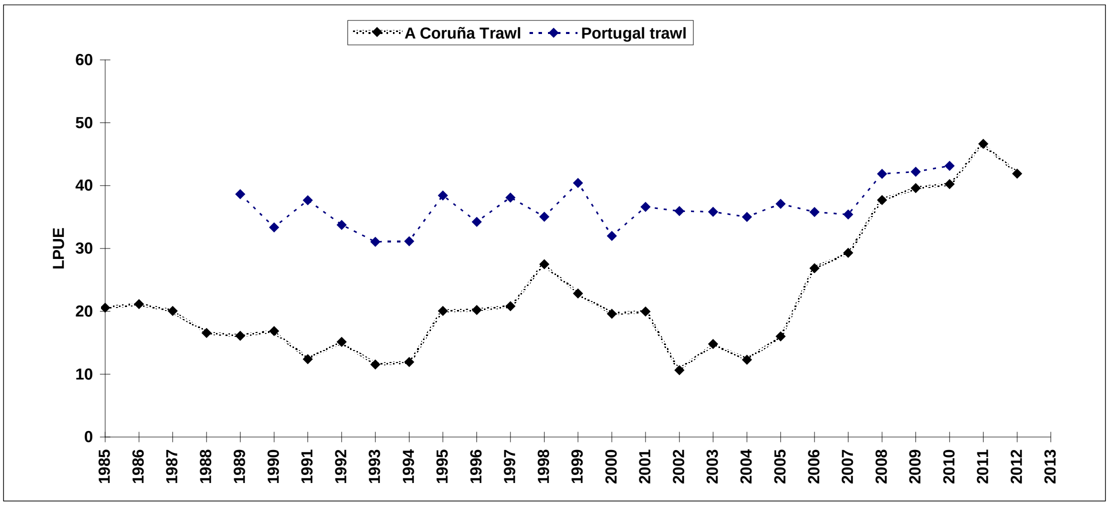


Figure 7.3 HAKE SOUTHERN STOCK - Recruitment and biomassIndices from groundfish surveys



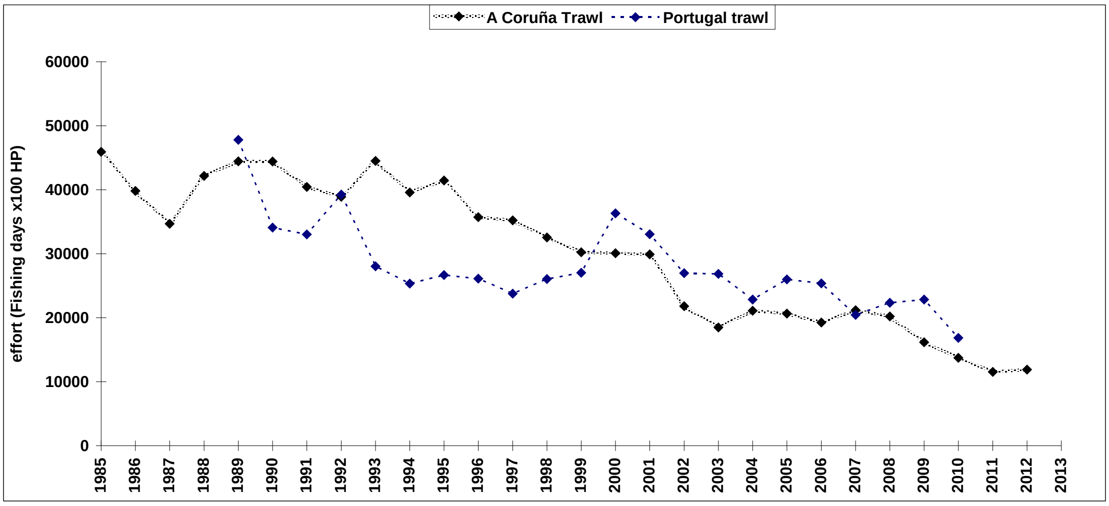


Figure 7.4 HAKE SOUTHERN STOCK- LPUE and fishing effort trends for trawl fleets

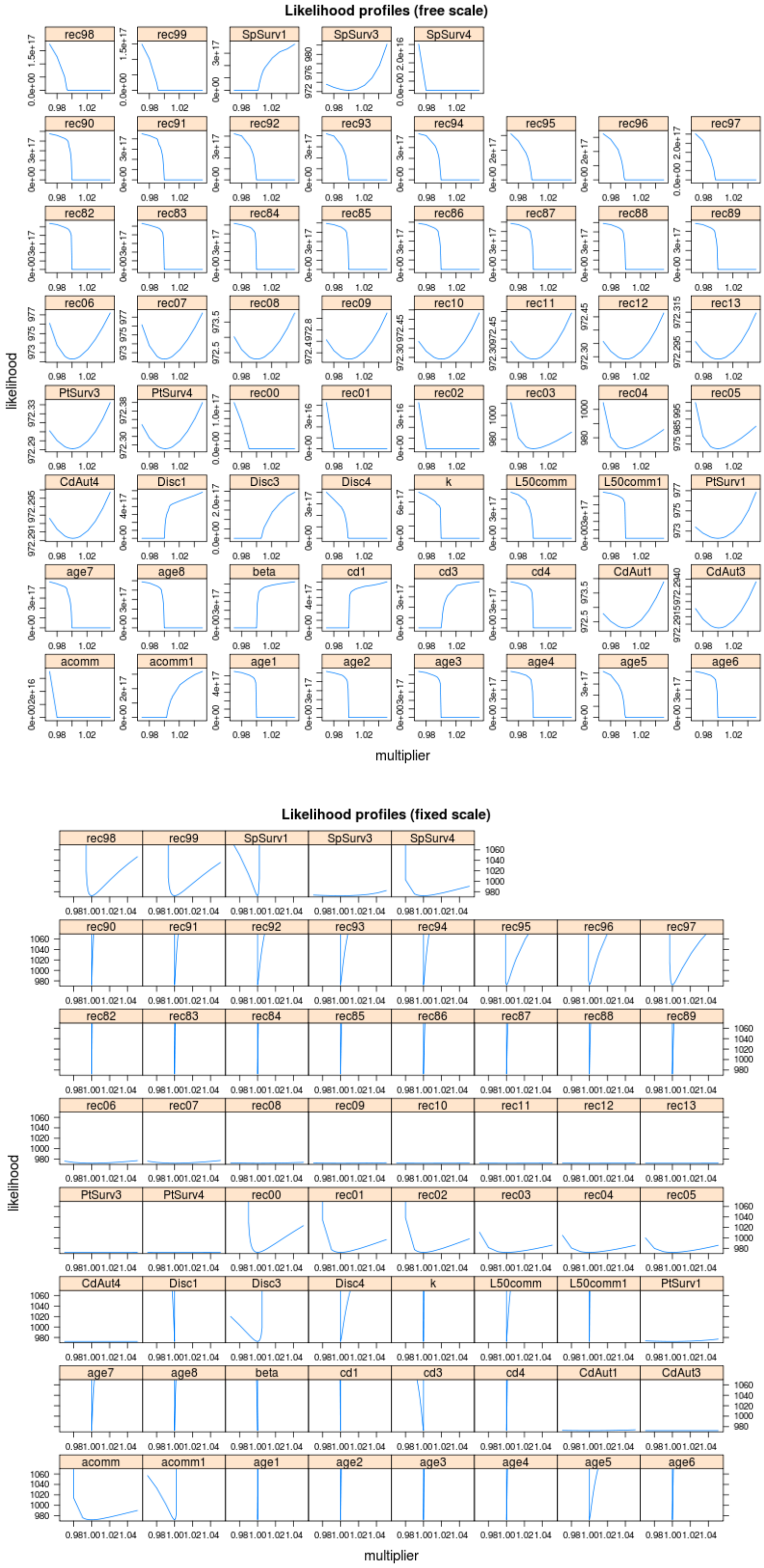
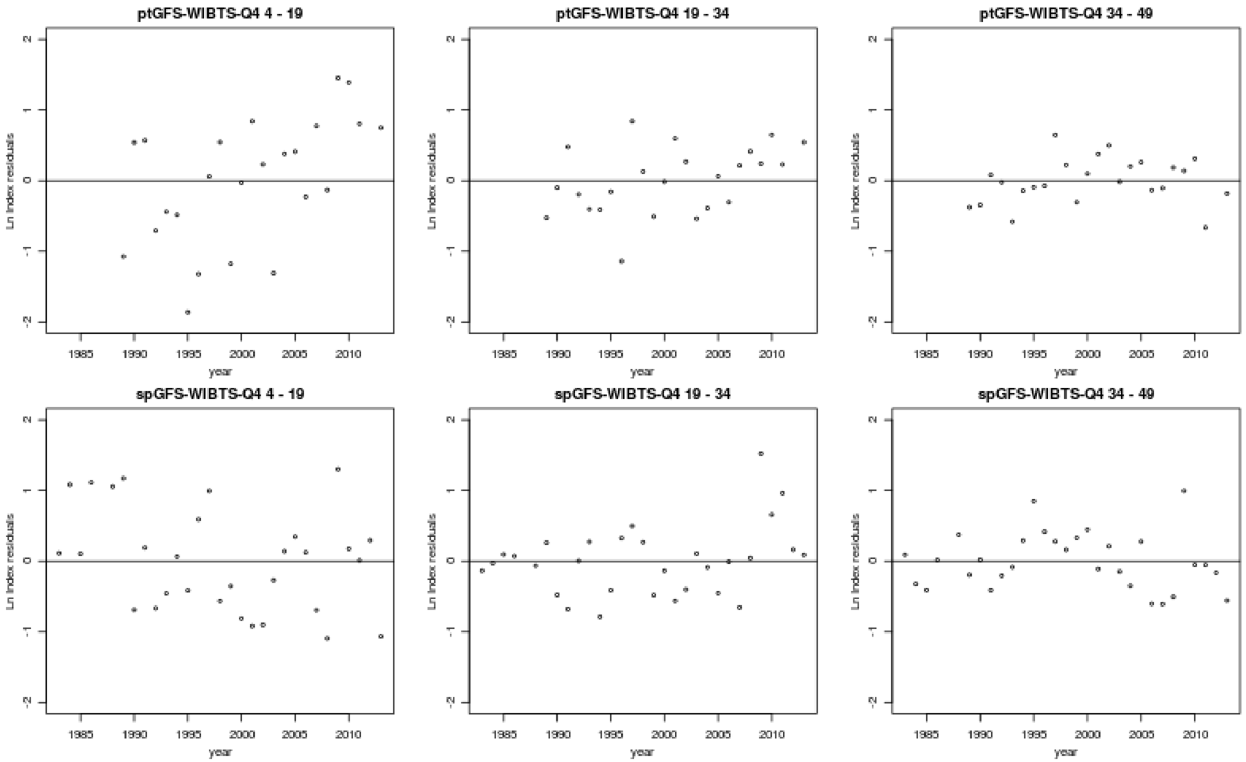
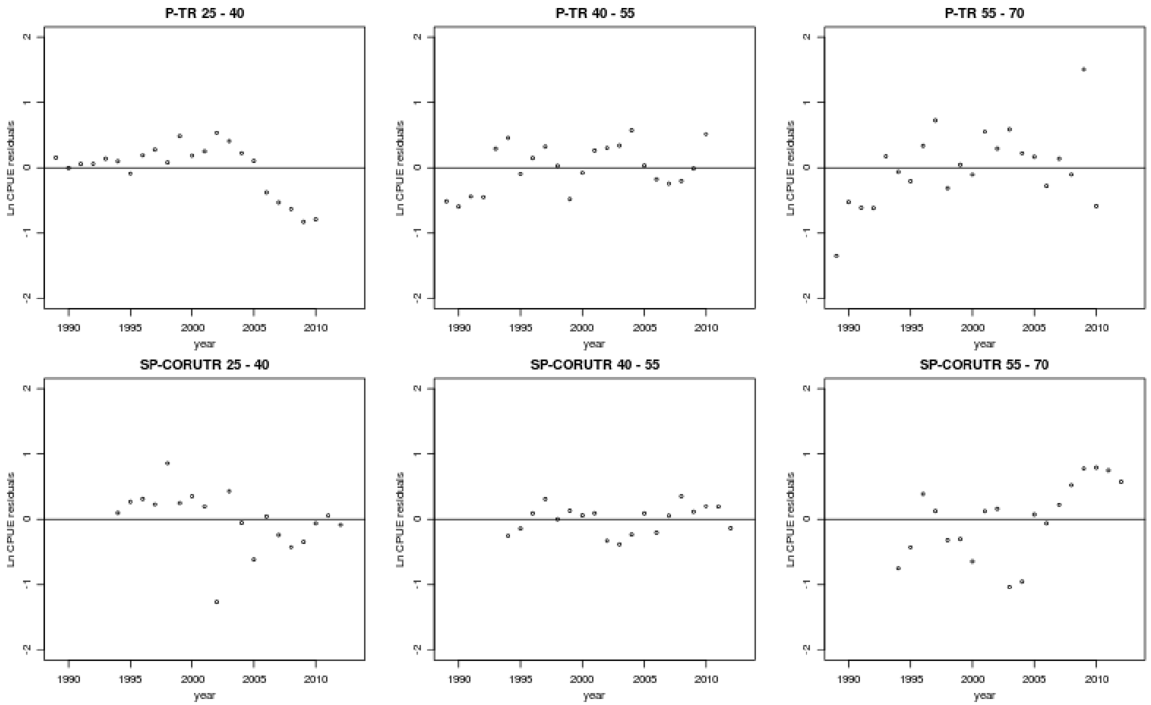


Figure 7.5. Gadget convergence with likelihood profiles. Free scaled (upper panel) and fixed scaled (lower panel)

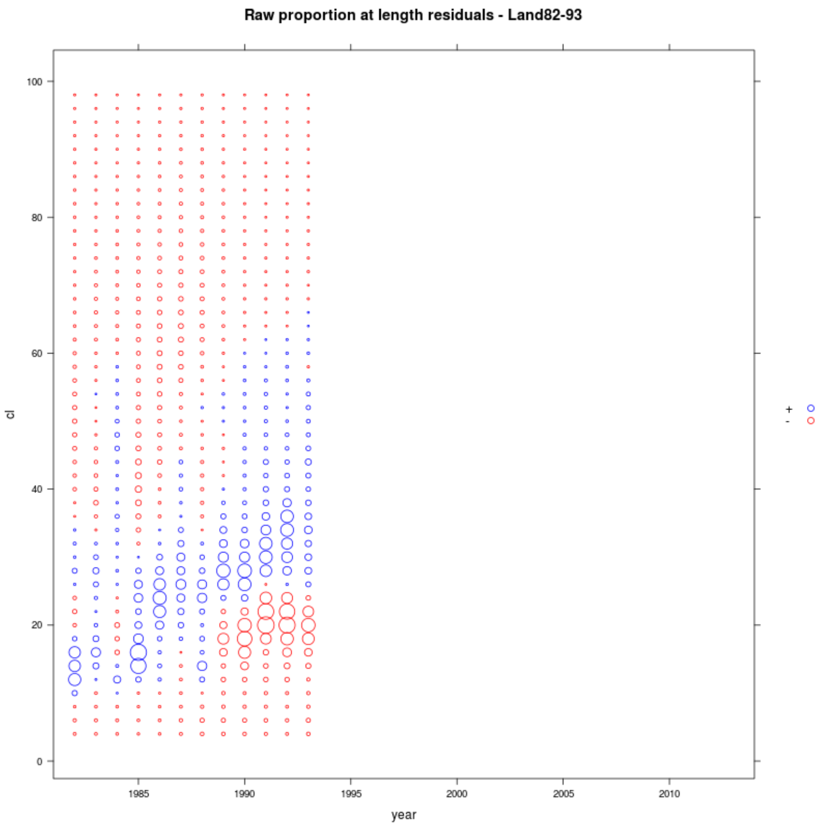
Figure 7.6 Diagnostics Residuals



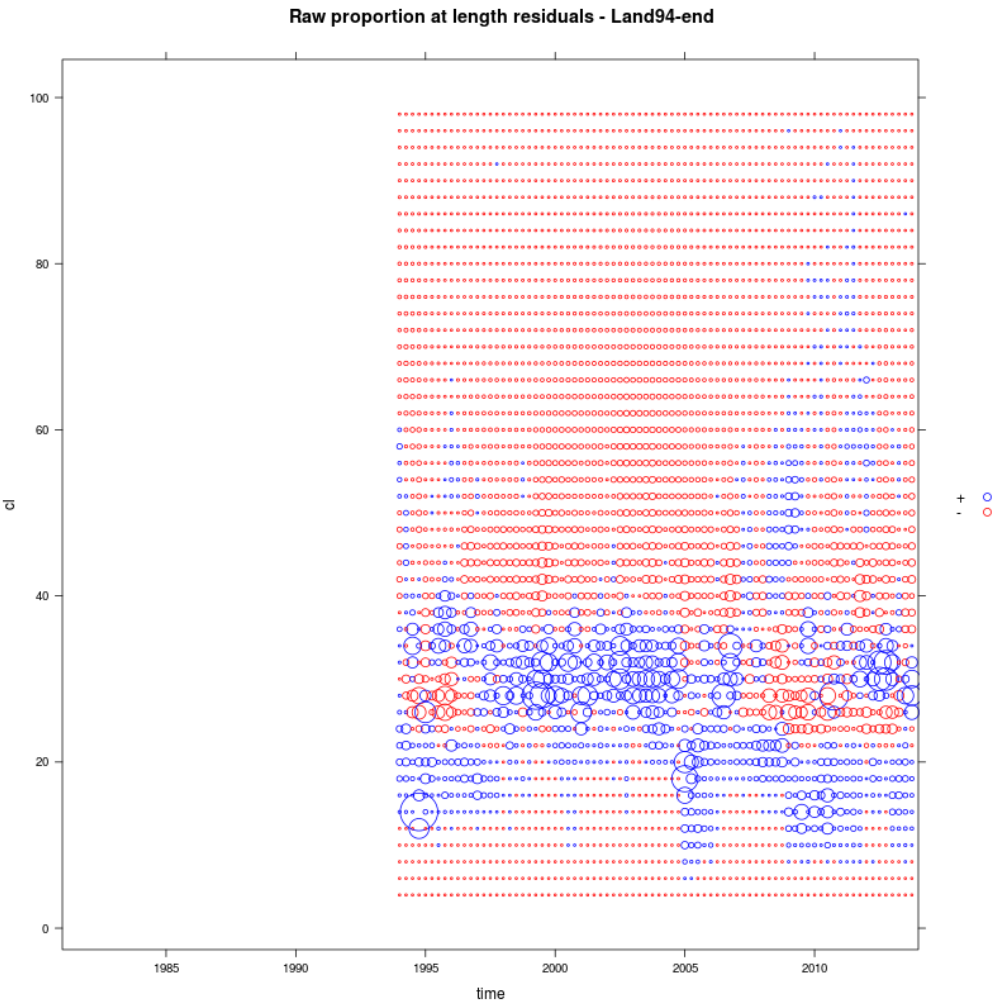
(7.6 a) Survey residuals by 15 cm groups (4-19, 19-34, 34-49 cm)



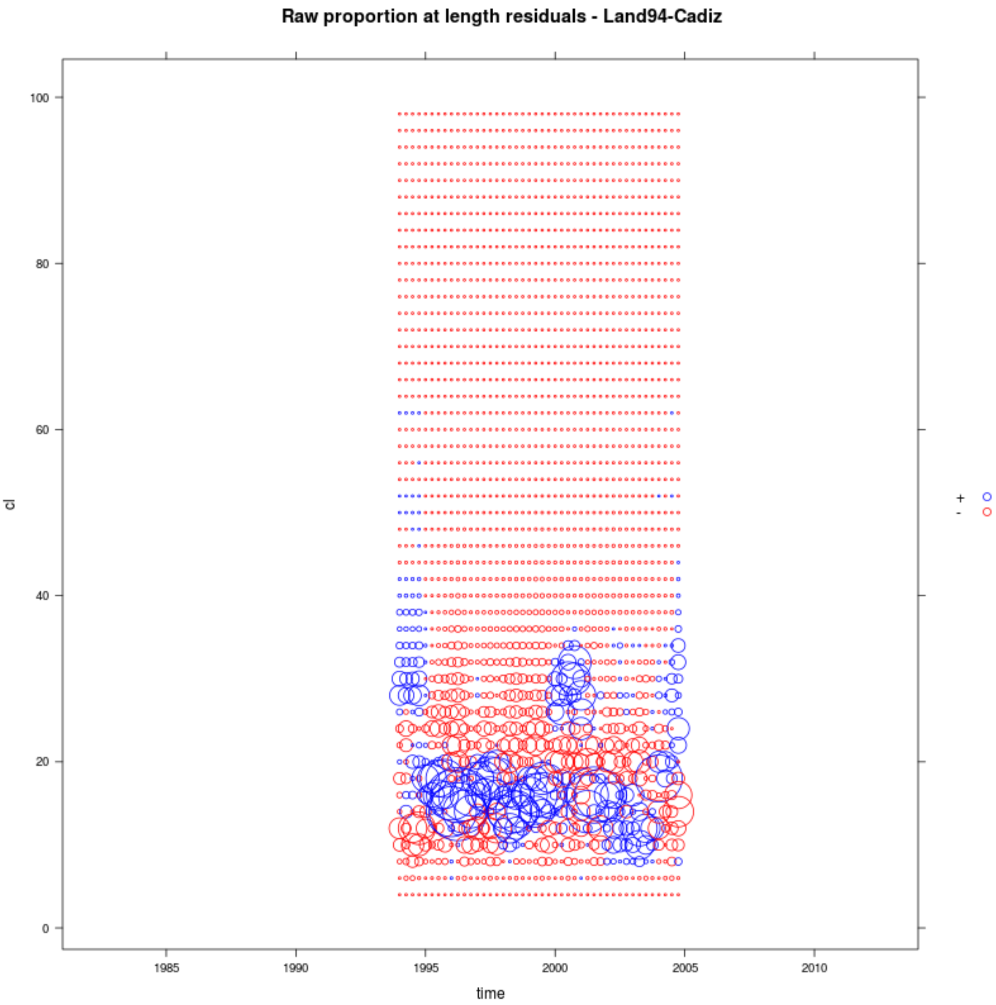
(7.6 b) LPUE residuals by 15 cm groups (25-40, 40-55, 55-70 cm)



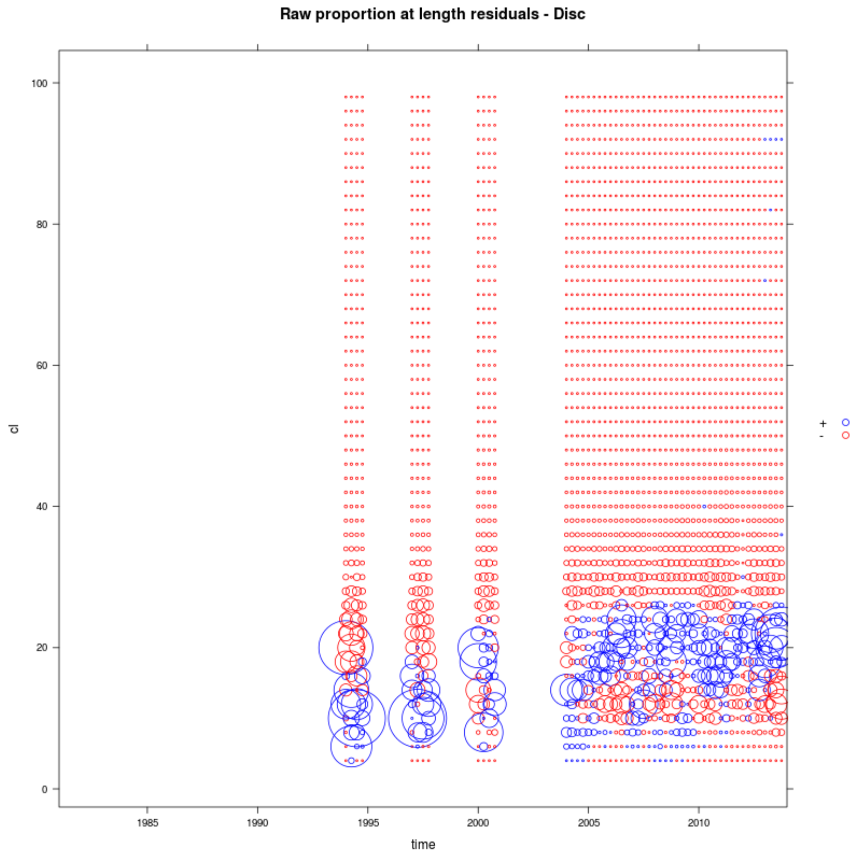
(7.6 c). Bubble plot for landings length distribution from 1982 to 1993.



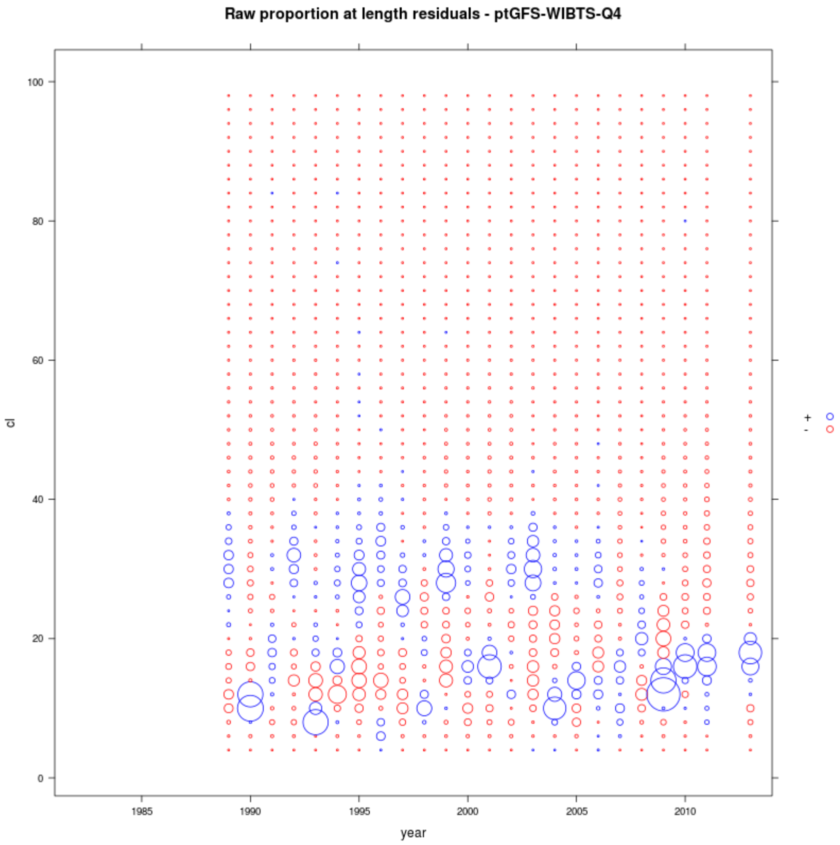
(7.6 d). Bubble plot for landings length distribution from 1994 to last year (byquarter).



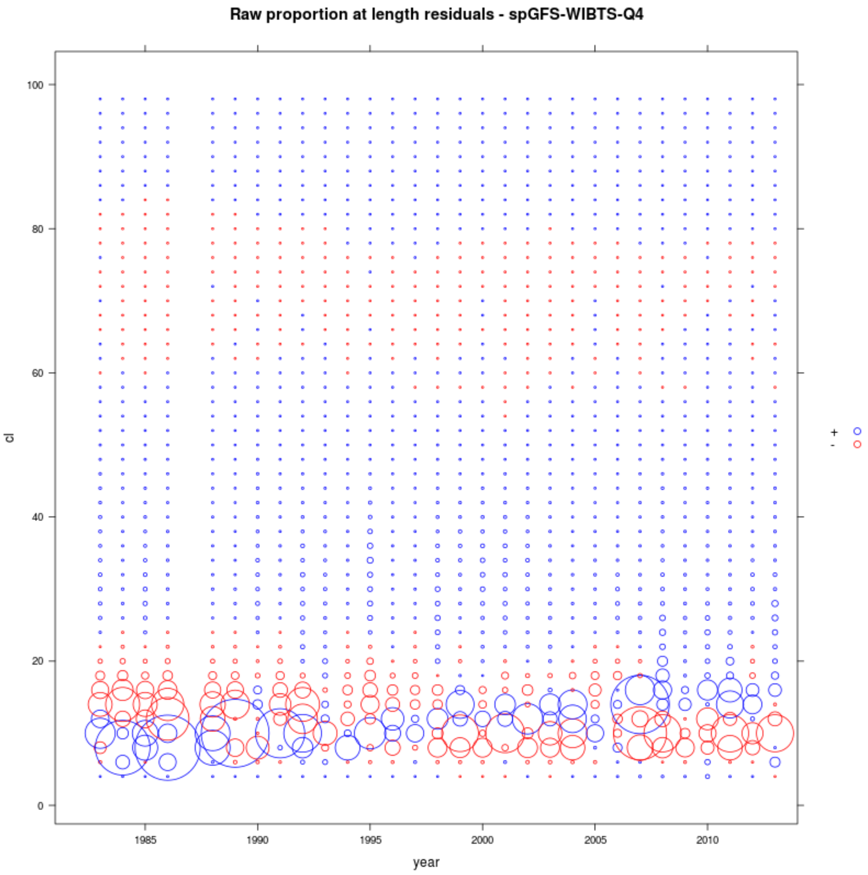
(7.6 e). Bubble plot for Cadiz landings length distribution from 1982 to 2004 (by quarter).



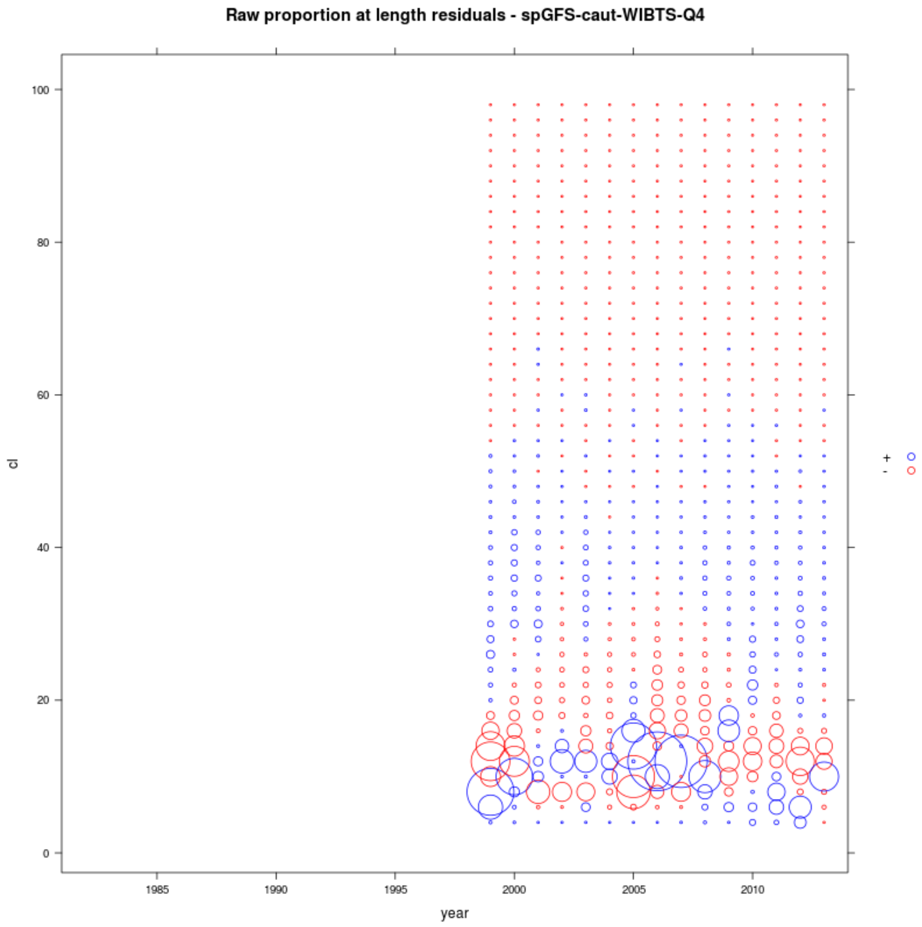
(7.6 f). Bubble plot for Discards length distribution for years 1993,97,99, 2004-2010 by quarter



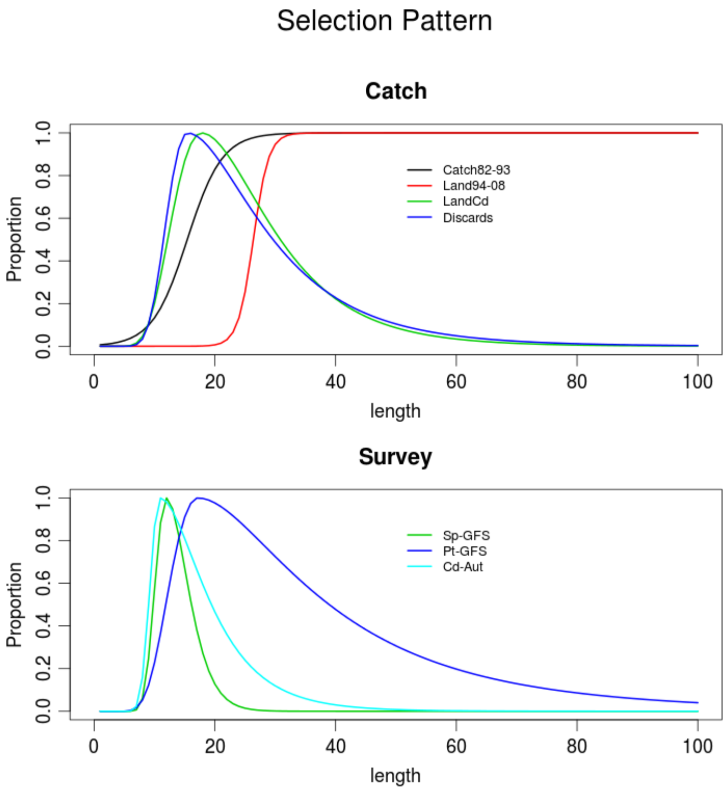
(7.6 g) Bubble plot for Portuguese demersal survey (ptGFS-WIBTS-Q4)



(7.6 h) Bubble plot for North Spain demersal survey (stGFS-WIBTS-Q4)



(7.6 i) Bubble plot for South Spain (Cadiz) demersal survey (stGFS-caut-WIBTS-Q4)



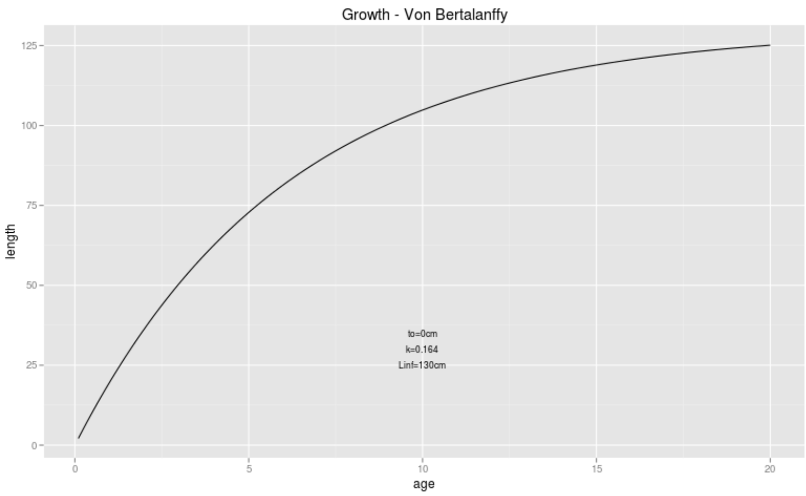


Figure 7.7. Selection pattern (upper panel) and and von Bertalanffy growth with k parameter estimated by the model (lower panel)

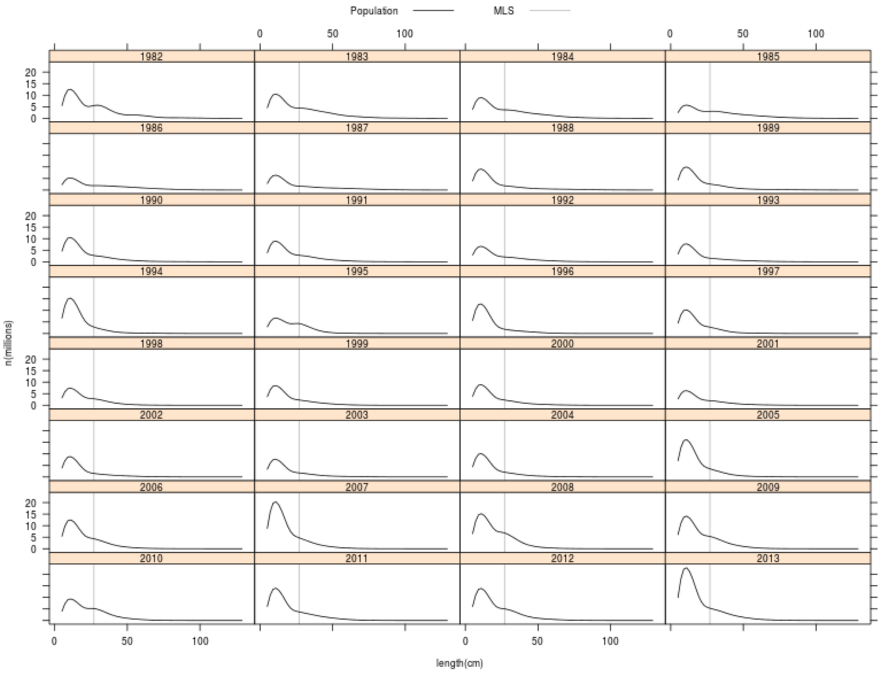


Figure 7.8. Population length distribution (4rd quarter)

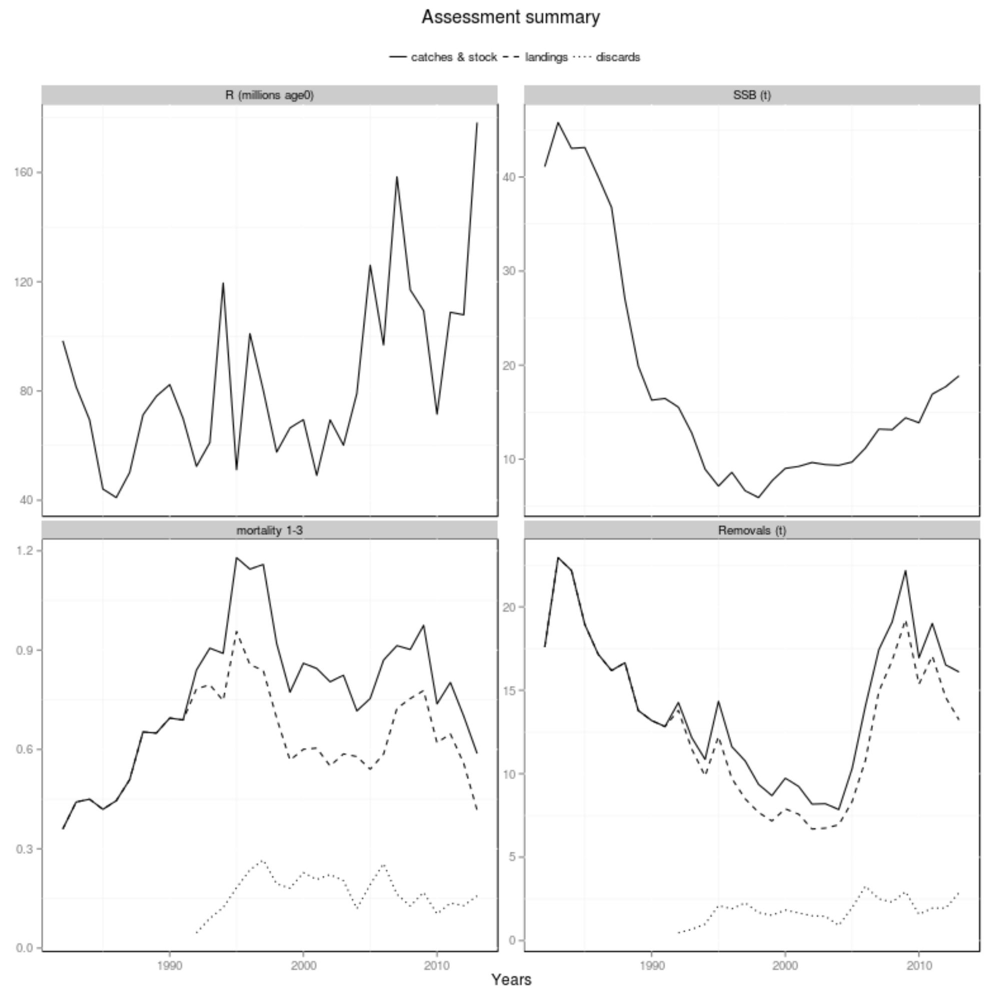


Figure 7.9. Summary plot. SSB and removals (catch, landings and discards) in '000 t. Recruitment in '000000 individuals.

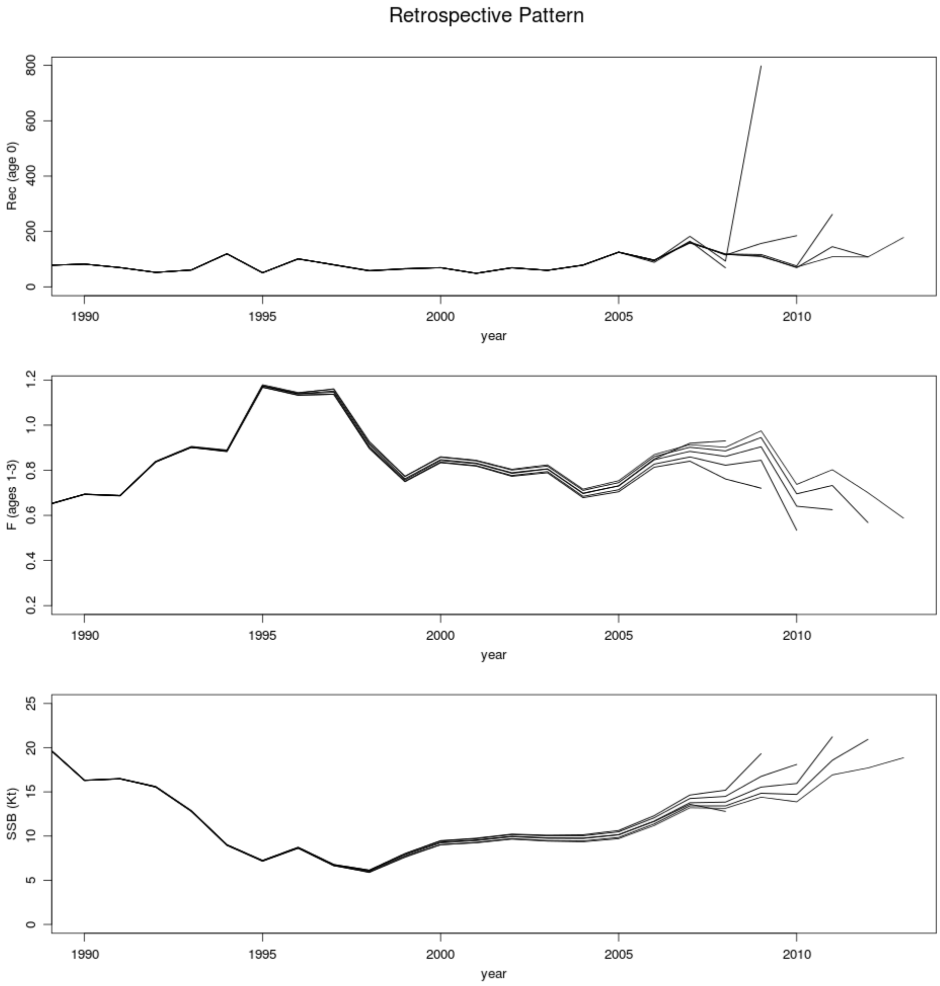


Figure 7.10. Retrospective plot

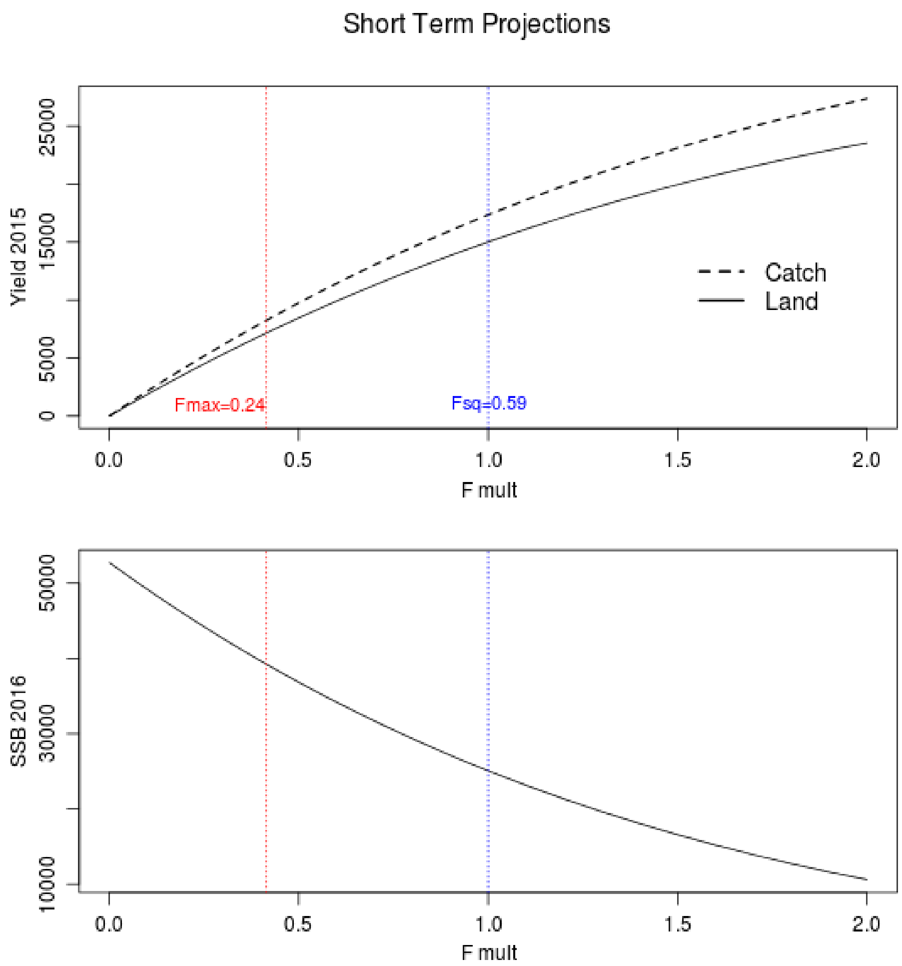


Figure 11. Short term advice

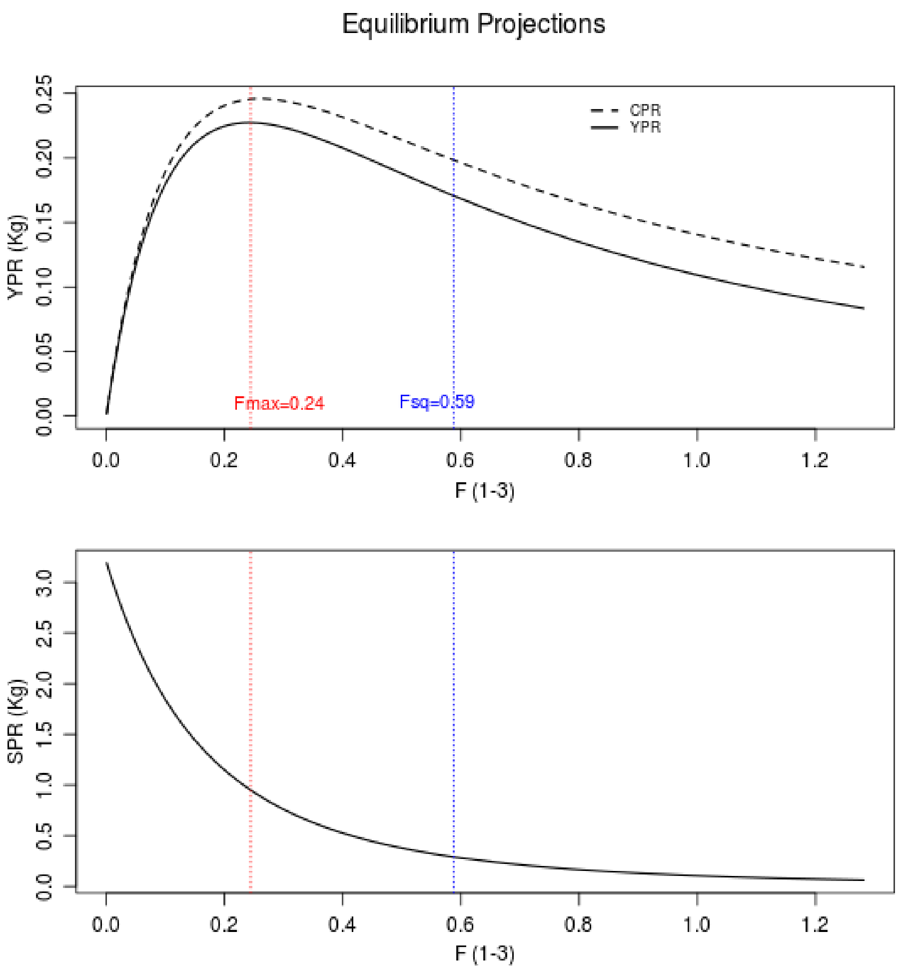


Figure 12. Long term yield and SSB per recruit

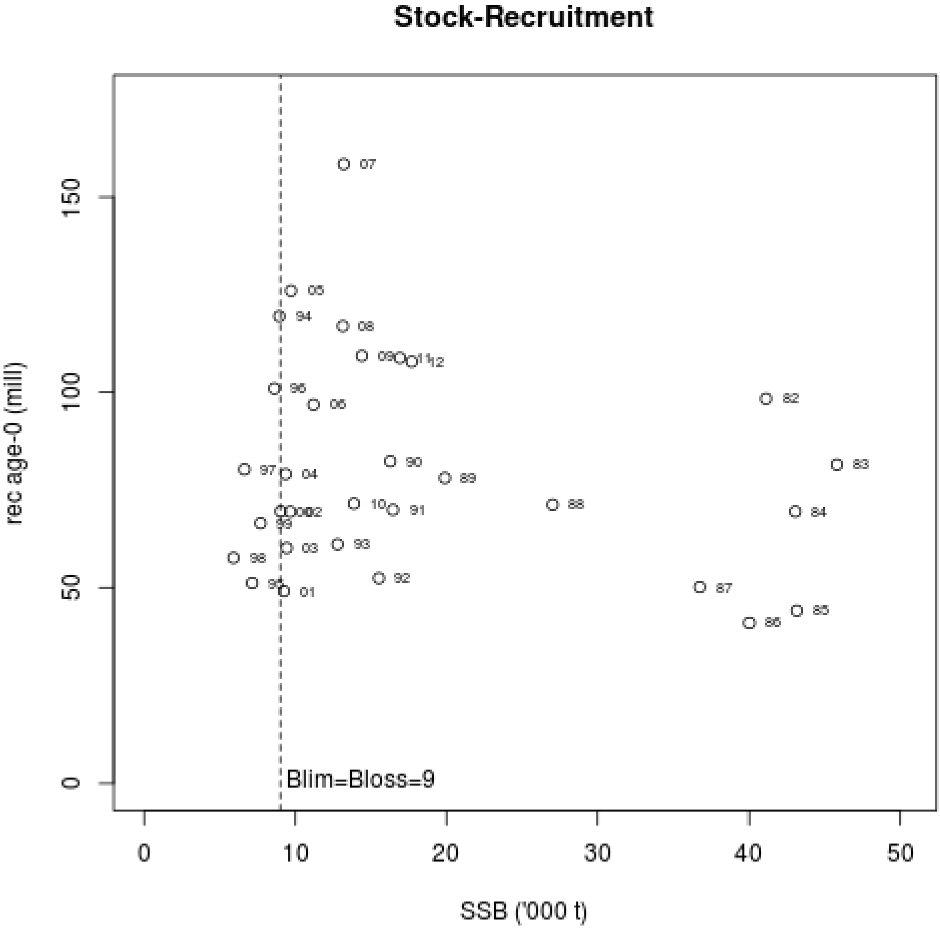


Figure 7.13 Stock-Recruitment plot.

8 Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Divisions VIIIc and IXa

L. piscatorius and L. budegassa

Type of assessment in 2014: Update (the assessment models and settings were approved in the benchmark WKFLAT-2012).

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

Data revisions this year: Portuguese LPUE series for *L. budegassa* in 2012.

8.1 General

Two species of anglerfish, *Lophius piscatorius* and *L. budegassa*, are found in ICES Divisions VIIIc and IXa. 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 VIIIc and IXa and Portuguese landings of Division IXa are derived from their relative proportions in market samples.

The benchmark assessment of anglerfish in Division VIIIc and IXa was carried out in 2012, a new assessment using Stock Synthesis (SS3) for *L. piscatorius* was approved and new settings and data were incorporate to the ASPIC model for *L. budegassa.*

The ageing estimation problems, detected in a previous benchmarck (see WGHMM2007 report) continue unsolved for *L. piscatorius* (ICES, 2012) 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*.

8.2 Summary of ICES advice for 2014 and management for 2013 and 2014

ICES advice for 2014:

As both species of anglerfish are caught in the same fisheries and are subject to a combined TAC, the same multiplicative factor for current fishing mortality is assumed for both species. The change is driven by *L. piscatorius,* as it is the species in poorest condition. Following the ICES MSY approach implies fishing mortality to be increased by 5%.

ICES advises the following landings for 2014 on the basis of the MSY approach:

L. piscatorius: less than 1476 t; L. budegassa: less than 1153 t; Combined anglerfish: less than 2629 t.

Management applicable for 2013 and 2014:

The two species are managed under a common TAC that was set at 2475 t for 2013 and 2629 t for 2014.

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.

8.3 Anglerfish (*L. piscatorius*) in Divisions VIIIc and IXa

8.3.1 General

8.3.2 Ecosystem aspects

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

8.3.3 Fishery description

L. piscatorius is mainly caught by Spanish and Portuguese bottom trawlers and gillnet fisheries. For some gillnet fishery, it is an important target species, while it is also a by catch of the trawl fishery targeting hake or crustaceans (see Stock Annex, Annex H).

The length distribution of the landings is considerably different between both fisheries, with the gillnet landings showing higher mean lengths compared to the trawl landings. Since 2001 to 2013, the Spanish landings were on average 49% from the trawl fleet (mean lengths in 2013 of 59 cm and 55 cm in Divisions VIIIc and IXa, respectively) and 51% from the gillnet fishery (mean length of 77 cm in Division VIIIc in 2013). For the same period, Portuguese landings were on average 12% from bottom trawlers (mean length of 52 cm in 2013) and 90% from the artisanal fleet (mean length of 58 cm in 2013).

8.3.4 Data

8.3.4.1 Commercial catches and discards

Total landings by country and gear for the period 1978-2013, as estimated by the WG, are given in Table 8.3.1. Spanish data for 2013 were available by metier DCF and ICES division being showed separately in the table. Since 2005 there was a decreasing trend in total landings with a minimum value of 976 t recorded in 2011. In 2012 and 2013 landings increased by 29% and 13 % respectively (see Stock Annex).

This year unallocated landings were available for the first time for this stock. The high level of unallocated landings seems not to be consistent with the time series of landings. Besides the method of calculating scientific estimates of landings has changed this year. Taking into account the above evidences the WG decided not to consider the unallocated landings for 2013 in the stock assessment and to recommend the review of the potential time series of unallocated landings for this stock.

Spanish discards estimates of *L. piscatorius* in weight and associated coefficient of variation (CV) are shown in the Table 8.3.2. For the available time series anglerfish discards represent less than 16% of Spanish trawl catches. An increase in estimated discards was observed in 2004, 2005 and 2006 in relation to previous years. The maximum value of the time series occurred in 2013 with 66 t. The Spanish gillnet fleet discards value are only available for 2013 and was estimated in 144 t.

L. piscatorius discards in the Portuguese trawl fisheries are considered negligible (Fernández & Prista, 2012; Prista *et al*., 2014).

8.3.4.2 Biological sampling

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

The sampling levels for 2013 are shown in Table 1.3. The metier 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 since 2009.

Length composition

Table 8.3.3 gives the available annual length compositions by ICES division, country and gear and adjusted length composition for total stock landings for 2013.The annual length compositions for all fleets combined for the period 1986–2013 are presented in Figure 8.3.1.

Landings in number, the mean length and mean weight in the landings between 1986 and 2013 are showed in Table 8.3.4. 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.

Biological information

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

8.3.4.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2013 are summarized in Table 8.3.5.

The abundance index from Spanish survey Sp-GFS-WIBTS-Q4 is shown in Figure 8.3.2. Since 2000 the highest abundance values were detected in 2001 and 2006, since this year a downward trend was observed. In 2011, the abundance and biomass indices decreased by 44% and 40%, respectively, relative to 2010 values. In 2013 an increase in the index in biomass and in number was observed.

8.3.4.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 8.3.6 and Figure 8.3.3 for Spanish trawlers (Division VIIIc) from the ports of Santander and Avilés since 1986, for A Coruña since 1982 and for the Portuguese trawlers (Division IXa) 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. In 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 that 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.

The A Coruña fleet index, used in the assessment as abundance index from 1982 to 2012, was not available for 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. However, due to various errors, data cleaning algorithms are required and are yet to be agreed upon internally in IPMA. IPMA therefore opted to postpone estimations of CPUE until 2015 (at which time the series will also be revised backwards).

For each fleet the proportion of the landings in the stock is also given in the table. In 2007 a data series from the artisanal fleet from the port of Cedeira in Division VIIIc was provided. This LPUE series is annually standardized to incorporate a new year data, latest available standardized series, from 1999 to 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 8.3.6, but not represented in Figure 8.3.3.

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 to 2012 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 2011.

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 to 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

8.3.5 .Assessment

A new model assessment was adopted in 2012 benchmark (WKFLAT2012). The assessment approved in the WGHMM2012 was updated with 2013 data.

8.3.5.1 Input data

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

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

8.3.5.2 Model

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

8.3.5.3 Assessment results

The model diagnosis is carried out means the analysis of residuals of abundance indices. Residual plots of the fits to the abundance indices are shown in Figure 8.3.4. Although some minor trends have been detected, as it happens for A Coruña indices from 1995 to 2000, it can be considered that the model follows trends of the abundance indices used in the model (A Coruña, Cedeira and the Spanish survey). Pearson residual plots are presented for the model fits to the length-composition data of the abundance indices (Figure 8.3.5). There were not detected specific patterns in any of the abundance indices. Some high positive residual are evident for A Coruña indices in the first and second quarter. Nevertheless, the model fits reasonably well.

The model estimates size-based selectivity functions for commercial fleets (Figure 8.3.6) and for population abundance indices (Figure 8.3.7). 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 fishes until very large individuals. The Spanish artisanal fleet is most efficient in 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 in the length range between 30 and 60 cm. This selection pattern shows strange selection over larger fish that could be an effect of an insufficient length sampling.

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

8.3.5.4 Historic trends in biomass, fishing mortality and recruitment

Table 8.3.7 and Figure 8.3.8 provide the summary of results from the assessment model and observed landings. Maximum values of recruitment are recorded at the beginning of the time series (1982, 1986 and 1987) with values over the 4 millions. Along the time series other high recruitment values were detected in 1989, 1994 and 2001. Since 2006 the recruitment has been below 1 millon until 2011. Landings steadily decreased from 3.6 Kt in 2005 to 0.98 Kt in 2011, coinciding with the decrease in F, from 0.38 in 2005 to 0.16 in 2011. Respect to 2011 landings and F increased in 2012 by 29% and 12% respectively. Since 2005 to 2012 SSB was at stable medium values around 6.5 kt, increasing to 7.1 kt in 2013.

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

In order to assess the consistency of the assessment from year to year, a retrospective analysis was carried out. It was conducted by removing one year (2013), two years (2013 and 2012), three years (2013, 2012, 2011) and four years (2013, 2012, 2011, 2010) of data while using the same model configuration (Figure 8.3.9). All the retrospective analysis runs were similar in the estimates of recruitment. Although there is some uncertainty in terminal year point estimates of recruitment no consistent bias was observed. Retrospective analysis showed minimal differences in SSB and F estimates.

There was not observed the presence of retrospective pattern being the assessment accepted for projections.

8.3.6 Catch options and prognosis

8.3.6.1 Short-term projections

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

For fishing mortality, the F *status quo* equal to 0.17, estimated as the average of fishing mortality the last three years $F_{2011\text{-}2013}$ over lengths 30-130 cm, was used for 2014. In the case of recruitment, the geometric mean of the whole period (1980-2013) was used following one of the options indicated in the Stock Annex.

Projected landings in 2015 and SSB at the beginning of 2016 for different management options in 2015 are presented in Table 8.3.8. Under F *status quo* scenario in 2015 is expected an increase in landings with respect to 2014, and an increase in SSB in 2016 with respect to 2015.

8.3.6.2 Yield and biomass per recruit analysis

The summary table of Yield and SSB per recruit analysis is given in Table 8.3.9 and in Figure 8.3.10. The F that maximizes the yield per recruit, F_{max}, is estimated in 0.29 over the Fsq (0.17) and corresponding with a level of 12% of SSB per recruit.

The $F_{0.1}$, rate of fishing mortality at which the slope of the YPR curve falls to 10% of its value at the origin, is equal to 0.19 and it is corresponding with a 24% of SSB/R. The fishing mortality of $F_{30\%}$, $_{35\%}$ and $_{40\%}$ is estimated in 0.15, 0.13 and 0.11 respectively.

The *status quo* F is below F_{max} and $F_{0.1}$, and above from any of the reference points based on SSB per recruit analysis (Figure 8.3.10).

8.3.7 Biological Reference Points of stock biomass and yield.

F_{MSY} has been set to 0.19, the value proposed by the Working Group in 2012 based on $F_{0.1}$. No proposals for MSY-Btrigger has been presented. $F_{0.1}$ is still estimated equal to 0.19 in the present assessment (Table 8.3.9).

8.3.8 Comments on the assessment

The spawning stock biomass has increased since 2011. Fishing mortality in 2013 has been estimated as the second lowest value of the whole series. An increase in landings occurred from 0.98 kt in 2011 to 1.5 kt in 2013.

8.3.8.1 Quality considerations

Alternative runs for the assessment were carried out to improve the convergence of the model. The low bound of the parameter 2 that defines the selectivity of the fishery SPART was widen.

The doubts about the unallocated landings estimates for 2013 prevent from including them into the stock assessment. If the high level of unallocated landings is confirmed for 2013 and/or previous years, the stock status could substantially differ from the current assessment results.

For 2013, the majority of both Spanish and Portuguese fleets LPUE series data came from electronic logbooks. To calculate the LPUEs, different criteria than that established for previous years must be applied. Therefore the WG decided to postpone the use of LPUEs until 2015, at which time the series will also be revised backwards.

8.3.9 Management considerations

Management considerations are describing for both anglerfish stocks in section 8.3.

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Prista, N., Fernandes, A., Pereira, J, Silva, C., Alpoim, R. and F. Borges. Discards of WGBIE species by the Portuguese bottom otter trawl operating in the ICES division IXa (2004-2013). Working Document presented at WGBIE2014.

8.4 Anglerfish (*Lophius budegassa*) in Divisions VIIIc and IXa

8.4.1 General

8.4.1.1 Ecosystem aspects

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

Fishery description

L. budegassa is caught by Spanish and Portuguese bottom trawlers and gillnet fisheries. As with L. piscatorius, it 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, Annex M).

The length distribution of the landings is considerably different between both fisheries, with the gillnet landings showing higher mean lengths compared to the trawl landings. Since 2004, the Spanish landings were on average split 86% from the trawl fleet (mean lengths in 2013 of 48 cm in both Divisions VIIIc and IXa) and 14% from the artisanal fleet (mean length of 68 cm in 2013 in Division VIIIc). Portuguese landings, for the same period, were on average split, 28 % from the trawl fleet (mean length of 43 cm in 2013) and 72% from the artisanal fleet (mean length of 56 cm in 2013).

8.4.2 Data

8.4.2.1 Commercial catches and discards

Total landings of *L. budegassa* by country and gear for the period 1978–2013, as estimated by the Working Group, are given in Table 8.4.1. See historical landings analysis in the Stock Annex. From 2002 to 2007 landings increased to 1 301 t, decreasing afterwards to levels between 770 - 800 t in 2009-2011. In 2012 catches reached 1 024 t, but in 2013 catches decreased to the levels of 2009-2011.

This year unallocated landings were available for the first time for this stock. The high level of unallocated landings seems not to be consistent with the time series of landings. Besides the method of calculating scientific estimates of landings has changed this year. Taking into account the above evidences the WG decided not to consider the unallocated landings for 2013 in the stock assessment and to recommend the review of the potential time series of unallocated landings for this stock.

Spanish trawl discards estimates of *L. budegassa* in weight and associated coefficient of variation (CV) are shown in Table 8.4.2. The estimated Spanish discards rate observed from 1994 to 2013, shows two picks, in 2006 (92 t) and 2010 (61 t), for the rest of the years discards could be considered negligible. The coefficient of variation for weight data varied from 24% to 99%.

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

8.4.2.2 Biological sampling

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

The sampling levels for 2013 are shown in Table 1.3. The metier sampling adopted in Spain and Portugal in 2013, 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, in 2012 and 2013 Portugal increased the sampling effort.

Length composition

Table 8.4.3 gives the annual length compositions by ICES division, country and gear and the adjusted length composition for total stock landings for 2013. The annual length compositions between 1986 and 2013 are presented in Figure 8.4.1.

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. Since 2008 these small fish were not observed. The total annual landings in numbers and the annual mean length and mean weight are in Table 8.4.4.

In 2005 the total number of landed individuals was low, being 9% of the maximum value (year 1987). In 2006 and 2007 the number of landed fish more than doubled the 2005 number. The number of landed fish decreased to a minimum in 2009. In 2010 and 2011 the number increased, but since then have been decreasing being in 2013 at minimum levels. The mean weight and length continued at relative high levels.

8.4.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2013 are summarized in Table 8.4.5. 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.

8.4.2.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 8.4.6 and Figure 8.4.2 for Spanish trawlers from ports of Santander, Avilés and A Coruña (all in Division VIIIc) since 1986 and for Portuguese trawlers (Division IXa) since 1989. For each fleet the proportion related to the total landings is also given in the table.

In 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.ices

For the Portuguese fleets, until 2011 most log-books were filled in paper but have thereafter been progressively replaced by e-logbooks. In 2013 more than 90% of the logbooks are being completed in the electronic version. However, due to various errors, data cleaning algorithms are required and are yet to be agreed upon internally in IPMA. IPMA therefore opted to postpone estimations of CPUE until 2015 (at which time the series will also be revised backwards). The value for 2012 of the Portuguese Trawler fleet directing to groundfish was revised.

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. Since 2010 an increase of catches were observed specially in the Portuguese fleets.

Effort trends are analysed in section 8.3.2.4.

LPUEs of Spanish Aviles and Santander fleets show high values during the second half of the 90's, while the Portuguese fleets have fluctuated. Spite the variability, from 2000 to 2005, a decreasing trend was observed for all fleets, since then a slightly increasing trend can be observed.

8.4.3 Assessment

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

8.4.3.1 Input data

At the WKFLAT2012 it was accepted, as the basis for advice, to run the ASPIC model with the following data series:

- 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: 1989-2012).
- Portuguese Trawler fleet directing to groundfish (PT.fish.tr: 1989-2012).

Due the problems described above with the 2013 LPUE data, the landings series was the only that was updated with the 2013 value.

The input data are presented in Table 8.4.7.

8.4.3.2 Model

The ASPIC (version 5.34.8) model (which implements the Schaeffer population growth model) was used for the WKFLAT 2012 assessment. Runs were performed conditioning on yield rather than on effort. The model options, the starting estimates and the minimum and maximum constraints of each parameter are indicated in the input file (Table 8.4.7).

8.4.3.3 Assessment results

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

It is suggested, by the ADGBBI (June 2013), that until the next benchmark that WG explores the sensitivity of B/Bmsy and F/Fmsy (like retrospective pattern) by keeping the *B1/K* fixed (e.g. at the current value or based on some expert judgment about the state of the stock in the beginning of the time series). Following this suggestion the *B1/K* was fixed at 0.6. This value seems reasonable but don´t have a strong scientific basis, it was also the value agreed in the benchmark for the starting guess.

Fixing *B1/K* the model became stable and is no more sensitivity to the starting guess settings of *MSY*, *K and* seed (see section 8.4.3.4 - Sensitive Analyses).

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 8.4.8, whereas Figure 8.4.3 plots observed and estimated CPUEs for each of the series used in the model. B_{2014}/B_{MSY} and F_{2013}/F_{MSY} have respectively 2.08% and 2.28% of bias and both have more than 19% relative inter-quartile ranges. Biomass in 2014 is estimated to be 89% of B_{MSY} with 95% bias-corrected confidence interval between 66% and 117%. Fishing mortality in 2013 is estimated to be 0.54 times F_{MSY} with 95% bias-corrected confidence interval between 0.38 and 91 times F_{MSY}. MSY is estimated to be 1633 t with 95% CI from 1053 t to 1819 t.

Trends in relative biomass (Figure 8.4.4) indicate a steady decrease since the beginning of the series till 2001, since then a slight recovery was observed, been in 2014 at 89% of B_{MSY}. Fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2013, fishing mortality is estimated to be below F_{MSY}.

Comparison between the 2012 benchmark, the 2013 and the 2014 update assessments are showed in Table 8.4.9 and Figure 8.4.5. Fixing B1/K at 0.60 led don´t change the trend of the previous assessments and the 2014 results are in the middle of the previous assessments.

A retrospective analysis was done taking one each time to the accepted assessment (Figure 8.4.6). Despite some retro patron in all series the model show a good stability.

8.4.3.4 Sensitive analyses

The sensitive analyses done between several settings of the model can be summarized in two steps:

- The stability of the "benchmark settings" model by changing the starting guess for *B1/K* +/-10%, +/-25% and +/-50%. (Table 8.4.10).
- The stability of the "benchmark settings" with B1/K fixed at 0.60 by changing +/- 25% the starting guess for *MSY*, *K* and the *seed* (Table 8.4. 11).

Changing the starting guess for *B1/K* +/-10%, +/-25% and +/-50% the model show some instability been difficult to choose what is the best fit.

Fixing B1/K the model stabilises and the results of changing +/- 25% the starting guess for *MSY*, *K* and the *seed* are very consistent.

8.4.4 Projections

Projections were performed based on the "benchmark settings" with B1/K fixed at 0.60 ASPIC estimates. The projected B/B_{MSY} and yield are presented in Table 8.4.12, where each column corresponds to a fishing mortality scenario. Projections were performed for F *status quo* (assumed as the average of the last 3 years - F 2011-2013), F_{MSY} and with zero catches. A set of projections were performed with the necessary F reductions to obtain 2015 yield for both anglerfish species combined corresponding to the 2014 TAC (2629 t) and +/-15% 2014 TAC. Projections using the same multiplicative factor of F_{MSY} for *L. piscatorius* in the scenario MSY approach was also performed. The reason for this projection scenario is that both *L. budegassa* and *L. piscatorius* F_{2013} are below F_{MSY}, been *L. piscatorius* F_{2013} nearest F_{MSY}, so this stock will drive the management strategy.

For *L. budegassa*, fishing mortality equal to F *status quo* in 2015 is expected to keep the stock below B_{MSY} in 2015. The biomass is expected to increase in near future under all fishing mortality scenarios examined (Table 8.4.12).

8.4.5 Biological Reference Points

WKFLAT (ICES, 2012) endorsed the basis for MSY reference points previously assumed by ICES (i.e. F_{MSY} based on the ASPIC output and a proxy for MSY Btrigger as 50% of B_{MSY} of the ASPIC output).

8.4.6 Comments on the assessment

Fixing *B1/K* the model became stable and is no more sensitivity to the starting guess settings of *MSY*, *K and* seed. The *B1/K* was fixed at 0.6, this value seems reasonable but don´t have a strong scientific basis, it was also the value agreed in the benchmark for the starting guess.

During the benchmark (WKFLAT 2012) the same model (SS3) applied to the white anglerfish was tested for the black anglerfish with some promising results but need to be tested more carefully before its application. SS3 is a length-based model so the length sampling is key information for this stock. A benchmark for this stock was considered during the WG, 2016 was mentioned as a tentative year for the benchmark but not before.

8.4.7 Quality considerations

The doubts about the unallocated landings estimates for 2013 prevent from including them into the stock assessment. If the high level of unallocated landings is confirmed for 2013 and/or previous years, the stock status could substantially differ from the current assessment results.

For 2013, the majority of both Spanish and Portuguese fleets LPUE series data came from electronic logbooks. To calculate the LPUEs, different criteria than that established for previous years must be applied. Therefore the WG decided to postpone the use of LPUEs until 2015, at which time the series will also be revised backwards.

8.4.8 Management considerations

Management considerations are in section 8.3.

8.5 Anglerfish (*L. piscatorius* and *L. budegassa*) in Divisions VIIIc and IXa

The total anglerfish (Lophius) landings are given in Table 8.5.1 by ICES division, country and fishing gear. The general trend reflects the trends described for each species, with landings increasing in the early eighties and reaching maximum in 1986 (9433 t) and 1988 (10 021 t), and decreasing after that to the minimum in 2001 (1801 t) and 2002 (1802 t). From 2002 to 2005 landings increased reaching 4541 t. Since then, landings decreased and in 2011 were the lowest of the time series with 1774 t (976 t *L. piscatorius* and 798 t *L. budegassa*).

The species proportion in the landings has changed since 1986. In the beginning of the time series (1980-1986) *L. piscatorius* represented more than 70% of the total anglerfish landings. After 1986 the proportion of *L. piscatorius* decreased and since 1999 both species had approximately the same weight in the annual landings. The mean value from 2004 to 2013 *L. piscatorius* was 68%.

The TAC (2475 t in 2013and 2629 t in 2014) is set for both species of anglerfish combined. The reported landings in 2013 were 83% of the established TAC.

The landings, effort and LPUE data series of the combined species are presented in Table 8.5.2 and Figure 8.5.1. During the late 1980s and early 1990s a decrease in LPUE is observed for all series while an increase is apparent in the middle of the 1990s. Since then, LPUE values have decreased and reached the minimum of the series in 2001 for the A Coruña fleet and in 2000 for the Portuguese fleets. Both Portuguese trawl fleets show afterwards an increasing trend till 2007 but since then a declined in LPUE was observed till 2010, while the data available for the Spanish fleets indicates stability or an increasing trend. The Portuguese fleets LPUEs show an increase in 2011. These series were not update with the 2013 value due to reasons already presented in Sections 8.3 and 8.4.

8.5.1 Assessment

The Working Group has performed assessments for each species separately (Sections 8.3 and 8.4).

8.5.2 Comments on the assessment

The benchmark assessment of anglerfish in Division VIIIc and IXa was carried out in 2012, a new assessment using Stock Synthesis (SS3) for *L. piscatorius* was approved and new settings and data were incorporate to the ASPIC model for *L. budegassa*.

The update of the assessments including data for 2013 was carried out by this WG, being the latest assessment for both anglerfish approved used to carry out the projections.

As the models used are different for each anglerfish species comments on the assessment are done for each species separately (Sections 8.3 and 8.4).

8.5.3 Biological Reference Points

Biological Reference Points are assumed differentially for each species (Sections 8.3 and 8.4).

8.5.4 Management considerations

Lophius piscatorius and *L. budegassa* are subject to a common TAC (2475 t in 2013and 2629 t in 2014), so the joint status of these species should be taken into account when formulating management advice. Combined landings in 2013 (2188 t) were 83% of the TAC. Both species of anglerfish are reported together because of their similarity but are assessed separately.

Both stocks status are based on the present updated assessment.

The *L. piscatorius* spawning stock biomass has increased since 2011. Fishing mortality in 2013 has been estimated as the second lowest value of the whole series. An increase in land-ings occurred from 0.98 kt in 2011 to 1.5 kt in 2013. Landings decreased since 2005 to 2011, and after two significant consecutive drops of 32% and 37% in 2010 and in 2011, landings increased in 2012 and 2013. Under F *status quo* scenario in 2015 is expected an increase in landings with respect to 2014, and an increase in SSB in 2016 with respect to 2015.

L. budegassa fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2013, fishing mortality was estimated to be below F_{MSY}. Trends in relative biomass indicate a steady decrease since the beginning of the series to below B_{MSY} in 2001, since then a slight recovery was observed, been in 2014 at 89% of B_{MSY}. Fishing mortality equal to F *status quo* in 2013 is expected to keep the stock below B_{MSY} in 2015. The biomass is expected to be below B_{MSY} in 2015 under all fishing mortality scenarios examined.

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 viceversa. It is necessary to take into account that a recovery plan for hake and *Nephrops* is taking place in the same area.

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

Table 8.5.1 ANGLERFISH (*L. piscatorius* and *L. budegassa*) - Divisions VIIIc and IXa.
Tonnes landed by the main fishing fleets for 1978-2013 as determined by the Working Group.

	Div. VIIIc				Div. IXa						Div. VIIIc+IXa	
	SPAIN				SPAIN			PORTUGAL				
Year	Trawl	Gillnet	Others	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL	TOTAL	Unallocated
1978	n/a	n/a		n/a	506			n/a	222	728	n/a	
1979	n/a	n/a		n/a	625			n/a	435	1 060	n/a	
1980	4 008	1 477		5 485	786			n/a	654	1 440	6 926	
1981	3 909	2 240		6 149	1 040			n/a	679	1 719	7 867	
1982	2 742	3 095		5 837	1 716			n/a	598	2 314	8 151	
1983	4 269	1 911		6 180	1 426			n/a	888	2 314	8 494	
1984	3 600	1 866		5 466	1 136			409	950	2 495	7 961	
1985	2 679	2 495		5 174	977			466	1 355	2 798	7 972	
1986	3 052	3 209		6 261	1 049			367	1 757	3 172	9 433	
1987	3 174	2 571		5 745	1 133			426	1 668	3 227	8 973	
1988	3 583	3 263		6 846	1 254			344	1 577	3 175	10 021	
1989	2 291	2 498		4 789	1 111			531	1 142	2 785	7 574	
1990	1 930	1 127		3 057	1 124			713	1 231	3 068	6 124	
1991	1 993	854		2 847	878			533	1 545	2 956	5 802	
1992	1 668	1 068		2 736	786			363	1 610	2 758	5 493	
1993	1 360	959		2 319	699			306	1 231	2 237	4 556	
1994	1 232	1 028		2 260	629			149	549	1 327	3 587	
1995	1 755	677		2 432	814			134	297	1 245	3 677	
1996	2 146	850		2 995	749			265	574	1 589	4 584	
1997	2 249	1 389		3 638	838			191	860	1 889	5 527	
1998	1 660	1 507		3 167	865			209	829	1 903	5 070	
1999	1 116	1 140		2 256	750			119	692	1 561	3 817	
2000	710	612		1 322	485			146	675	1 306	2 628	
2001	614	364		978	247			117	459	823	1 801	
2002	559	415		974	344			104	380	828	1 802	
2003	1 190	771		1 961	617			96	529	1 242	3 203	
2004	1 510	1 389		2 898	549			77	602	1 229	4 127	
2005	1 651	1 719		3 370	653			60	458	1 171	4 541	
2006	1 490	1 371		2 861	801			68	381	1 250	4 111	
2007	1 327	1 076		2 404	866			78	303	1 247	3 651	
2008	1 280	1 238		2 518	473			50	246	770	3 288	
2009	1 151	1 207		2 358	386			43	262	691	3 049	
2010	665	1 036		1 701	355			72	203	630	2 331	
2011	518	539		1 056	397			122	199	718	1 774	
2012	562	661		1 222	365			161	533	1 059	2 281	
2013	495	853	52	1 400	166	85	12	114	412	789	2 188	1 224

Table 8.3.2 ANGLERFISH (*L. piscatorius* and *L. budegassa*) - Divisions VIIIc and IXa.

Landings, effort and landings per unit effort for trawl and gillnet fisheries. For landings the percentage relative to total annual stock landings is given.

Landings (t)

Year	Div. VIIIc Avilés	%	Santander	%	A Coruña-Fleet	%	Cedeira	%
1982					2 273	28		
1983					2 255	27		
1984					2 134	27		
1985					1 387	17		
1986	564	6	537	6	1 177	12		
1987	585	7	545	6	1 291	14		
1988	526	5	418	4	1 226	12		
1989	333	4	338	4	852	11		
1990	317	5	318	5	838	14		
1991	297	5	344	6	715	12		
1992	232	4	329	6	642	12		
1993	129	3	329	7	584	13		
1994	181	5	384	11	512	14		
1995	333	9	312	8	745	20		
1996	484	11	359	8	899	20		
1997	488	9	503	9	812	15		
1998	377	7	430	8	563	11		
1999	148	4	249	7	n/a	n/a	355	9
2000	51	2	119	5	381	14	143	5
2001	35	2	82	5	n/a	n/a	92	5
2002	87	5	73	4	299	17	137	8
2003	120	4	100	3	470	15	162	5
2004	248	6	129	3	546	13	387	9
2005	332	7	66	1	725	16	436	10
2006	164	4	107	3	666	16	419	10
2007	113	3	123	3	678	19	235	6
2008	109	3	n/a	n/a	688	21	228	7
2009	74	2	43	1	464	15	187	6
2010	n/a	n/a	63	3	364	16	235	10
2011	n/a	n/a	81	n/a	290	16	61	3
2012	n/a	n/a	44	2	314	14	67	3

n/a - not available

Fishing effort

Year	Div. VIIIc [1] Avilés	[1] Santander	[1] A Coruña-Fleet	[2] Cedeira standardized 2012
1982			63 313	
1983			51 008	
1984			48 665	
1985			45 157	
1986	10 845	18 153	40 420	
1987	8 309	14 995	34 651	
1988	9 047	16 660	41 481	
1989	8 063	17 607	44 410	
1990	8 497	20 469	44 403	
1991	7 681	22 391	40 429	
1992	n/a	22 833	38 899	
1993	7 635	21 370	44 478	
1994	9 620	22 772	52 397	
1995	6 146	14 046	51 708	
1996	4 525	12 071	44 501	
1997	5 061	11 776	44 602	
1998	5 929	10 646	n/a	
1999	6 829	10 349	n/a	4 582
2000	4 453	8 779	n/a	2 981
2001	1 838	3 053	n/a	1 932
2002	2 748	3 975	28 695	2 398
2003	2 526	3 837	26 127	2 703
2004	n/a	3 776	29 540	4 677
2005	n/a	1 404	30 965	3 325
2006	n/a	2 718	32 130	3 911
2007	n/a	4 334	34 838	3 976
2008	n/a	n/a	30 024	5 133
2009	n/a	1 125	29 092	2 300
2010	n/a	1 628	22 746	1 880
2011	n/a	n/a	18 617	522
2012	n/a	n/a	21 110	n/a

[1] Fishing days per 100 HP

[2] Soaking days

n/a - not available

Table 8.3.2 cont.

	LPUE			
	Div. VIIIc			
Year	[1] Avilés	[1] Santander	[1] A Coruña-Fleet	[2] Cedeira standardized 2012
1982			35.9	
1983			44.2	
1984			43.9	
1985			30.7	
1986	52.0	29.6	29.1	
1987	70.4	36.3	37.3	
1988	58.1	25.1	29.6	
1989	41.3	19.2	19.2	
1990	37.4	15.5	18.9	
1991	38.6	15.3	17.7	
1992	n/a	14.4	16.5	
1993	16.9	15.4	13.1	
1994	18.8	16.8	9.8	
1995	54.1	22.2	14.4	
1996	106.9	29.7	20.2	
1997	96.4	42.7	18.2	
1998	63.6	40.4	n/a	
1999	21.7	24.1	n/a	77.5
2000	11.4	13.6	n/a	48.1
2001	19.1	26.9	n/a	47.8
2002	31.6	18.4	10.4	57.3
2003	47.6	26.1	18.0	59.9
2004	n/a	34.1	18.5	82.7
2005	n/a	46.9	23.4	131.1
2006	n/a	39.4	20.7	107.2
2007	n/a	28.3	19.5	59.1
2008	n/a	n/a	22.9	44.4
2009	n/a	38.2	15.9	81.2
2010	n/a	39.0	16.0	124.8
2011	n/a	n/a	15.6	117.2
2012	n/a	n/a	14.9	n/a

[1] kg/day*100HP n/a - not available

[2] kg/soaking day

	Landings (t)			
	Div. IXa			
Year	Portugal Crustacean	%	Portugal Fish	%
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989	174	2	358	5
1990	233	4	480	8
1991	174	3	359	6
1992	118	2	244	4
1993	100	2	206	5
1994	49	1	101	3
1995	44	1	90	2
1996	90	2	175	4
1997	89	2	102	2
1998	81	2	128	3
1999	44	1	75	2
2000	68	3	78	3
2001	68	4	49	3
2002	65	4	39	2
2003	43	1	53	2
2004	35	1	42	1
2005	24	1	36	1
2006	31	1	37	1
2007	41	1	38	1
2008	26	1	24	1
2009	23	1	21	1
2010	38	2	35	1
2011	63	4	58	3
2012	84	4	77	3

n/a - not available

Table 8.3.2 cont

Year	Effort Div. IXa [3] Portugal Crustacean	[4] Portugal Crustacean standardized	[3] Portugal Fish	[4] Portugal Fish standardized
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989	76	23	52	18
1990	90	20	61	17
1991	83	17	57	15
1992	71	15	49	14
1993	75	13	56	13
1994	41	8	36	10
1995	38	8	41	9
1996	64	14	54	12
1997	43	11	27	9
1998	48	11	35	10
1999	24	8	18	6
2000	42	10	19	6
2001	85	18	19	5
2002	62	10	14	4
2003	42	10	17	6
2004	21	7	14	4
2005	20	5	13	4
2006	22	5	12	4
2007	22	6	8	3
2008	14	4	5	2
2009	15	n/a	6	n/a
2010	21	n/a	14	n/a
2011	18	n/a	9	n/a
2012	56	n/a	35	n/a

[3] 1000 Hours trawling with occurrence of anglerfish
[4] 1000 Hauls
n/a - not available

Year	LPUE Div. IXa [3] Portugal Crustacean	[4] Portugal Crustacean standardized	[3] Portugal Fish	[4] Portugal Fish standardized
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989	2.3	7.7	6.9	20.3
1990	2.6	11.4	7.9	28.0
1991	2.1	10.4	6.3	23.3
1992	1.7	7.8	5.0	17.8
1993	1.3	7.5	3.7	15.8
1994	1.2	6.4	2.8	10.5
1995	1.1	5.6	2.2	9.9
1996	1.4	6.2	3.2	14.3
1997	2.1	7.8	3.8	11.6
1998	1.7	7.3	3.6	13.3
1999	1.9	5.4	4.2	13.2
2000	1.6	6.7	4.2	12.9
2001	0.8	3.7	2.6	9.8
2002	1.0	6.7	2.8	8.7
2003	1.0	4.4	3.1	9.5
2004	1.6	5.4	2.9	9.5
2005	1.2	4.7	2.7	9.7
2006	1.4	5.8	3.0	9.9
2007	1.8	6.9	4.7	12.9
2008	1.9	6.9	4.5	13.6
2009	1.5	n/a	3.3	n/a
2010	1.8	n/a	2.4	n/a
2011	3.5	n/a	6.3	n/a
2012	1.5	n/a	2.2	n/a

[3] kg/hour trawl n/a - not available
[4] kg/haul

Table 8.4.1. ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
Tonnes landed by the main fishing fleets for 1978-2013 as determined by the Working Group.

	Div. VIIIc				Div. IXa						Div. VIIIc+IXa	
	SPAIN				SPAIN			PORTUGAL				
Year	Trawl	Gillnet	Others	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL	TOTAL	Unallocated
1978	n/a	n/a		n/a	248			n/a	107	355	355	
1979	n/a	n/a		n/a	306			n/a	210	516	516	
1980	1203	207		1409	385			n/a	315	700	2110	
1981	1159	309		1468	505			n/a	327	832	2300	
1982	827	413		1240	841			n/a	288	1129	2369	
1983	1064	188		1252	699			n/a	428	1127	2379	
1984	514	176		690	558			223	458	1239	1929	
1985	366	123		489	437			254	653	1344	1833	
1986	553	585		1138	379			200	847	1425	2563	
1987	1094	888		1982	813			232	804	1849	3832	
1988	1058	1010		2068	684			188	760	1632	3700	
1989	648	351		999	764			272	542	1579	2578	
1990	491	142		633	689			387	625	1701	2334	
1991	503	76		579	559			309	716	1584	2162	
1992	451	57		508	485			287	832	1603	2111	
1993	516	292		809	627			196	596	1418	2227	
1994	542	201		743	475			79	283	837	1580	
1995	924	104		1029	615			68	131	814	1843	
1996	840	105		945	342			133	210	684	1629	
1997	800	198		998	524			81	210	815	1813	
1998	748	148		896	681			181	332	1194	2089	
1999	565	127		692	671			110	406	1187	1879	
2000	441	73		514	377			142	336	855	1369	
2001	383	69		452	190			101	269	560	1013	
2002	173	74		248	234			75	213	522	770	
2003	279	49		329	305			68	224	597	926	
2004	250	120		370	285			50	267	603	973	
2005	273	97		370	283			31	214	527	897	
2006	323	124		447	541			39	121	701	1148	
2007	372	68		440	684			66	111	861	1301	
2008	386	70		456	336			40	119	495	951	
2009	301	148		449	172			34	114	320	769	
2010	352	81		432	197			70	84	351	784	
2011	256	68		324	279			75	119	474	798	
2012	207	61		267	231			156	370	757	1024	
2013	217	77	5	300	106	7	0.1	100	258	471	770	199

n/a: not available

Table 8.4.2 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa. Weight and percentage of discards for Spanish trawl fleet.

Year	Weight (t)	CV	% Trawl Catches
1994	6.1	24.4	0.6
1995	n/a	n/a	n/a
1996	n/a	n/a	n/a
1997	21.3	35.2	1.6
1998	n/a	n/a	n/a
1999	19.7	43.7	1.6
2000	8.7	35.1	1.1
2001	n/a	n/a	n/a
2002	n/a	n/a	n/a
2003	1.1	53.6	0.2
2004	8.1	70.2	1.5
2005	13.6	45.6	2.4
2006	92.0	56.8	9.6
2007	0.3	98.8	0.0
2008	1.9	59.4	0.3
2009	29.3	53.8	5.8
2010	61.2	63.2	10.0
2011	12.4	33.2	2.3
2012	5.8	52.8	1.3
2013	22.3	n/a	6.5

n/a: not available

CV: coefficient of variation

Table 8.4.3 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
Length composition by fleet for landings in 2013 (thousands).
Ajusted Total: Ajusted to landings from fleets without length composition.

	Div. VIIIc			Div. IXa				Div. VIIIc+IXa	
	SPAIN			SPAIN	PORTUGAL				Adjusted
Length (cm)	Trawl	Gillnet	TOTAL	Trawl	Trawl	Artisanal	TOTAL	TOTAL	TOTAL
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.042	0.000	0.000	0.042	0.042	0.044
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.068	0.000	0.068	0.012	0.000	0.000	0.012	0.080	0.082
28	0.346	0.000	0.346	0.098	0.000	0.039	0.137	0.483	0.497
29	0.566	0.000	0.566	0.148	0.000	0.119	0.267	0.833	0.855
30	2.012	0.000	2.012	0.300	0.183	0.197	0.680	2.692	2.764
31	1.858	0.000	1.858	0.273	0.548	0.402	1.224	3.082	3.148
32	2.259	0.000	2.259	0.456	0.245	0.472	1.174	3.433	3.517
33	2.154	0.000	2.154	0.258	0.422	0.462	1.142	3.296	3.371
34	3.588	0.000	3.588	0.433	0.716	0.377	1.525	5.113	5.239
35	3.524	0.000	3.524	0.323	0.585	0.250	1.159	4.683	4.803
36	4.405	0.000	4.405	0.477	1.895	1.127	3.499	7.904	8.057
37	5.975	0.000	5.975	0.700	2.564	2.036	5.301	11.276	11.484
38	4.917	0.000	4.917	1.194	3.252	0.570	5.015	9.932	10.123
39	4.969	0.000	4.969	0.811	3.766	0.664	5.241	10.210	10.391
40	4.989	0.000	4.989	1.291	4.350	0.482	6.123	11.112	11.308
41	4.783	0.000	4.783	1.033	2.630	2.165	5.828	10.611	10.792
42	4.249	0.131	4.380	0.891	3.716	0.614	5.220	9.600	9.765
43	3.883	0.000	3.883	0.918	3.909	1.424	6.250	10.133	10.283
44	3.818	0.012	3.830	1.948	3.091	0.126	5.164	8.993	9.174
45	4.037	0.037	4.074	1.674	1.951	3.126	6.751	10.825	11.004
46	4.339	0.024	4.363	2.179	3.444	1.082	6.705	11.068	11.273
47	4.295	0.000	4.295	1.603	1.479	1.391	4.473	8.768	8.952
48	3.269	0.206	3.475	1.479	1.439	1.324	4.243	7.718	7.873
49	3.057	0.104	3.161	1.339	0.698	1.722	3.759	6.920	7.060
50	2.546	0.423	2.969	1.086	1.012	2.612	4.711	7.679	7.806
51	2.637	0.043	2.680	0.952	0.718	3.328	4.998	7.678	7.791
52	2.042	0.511	2.553	0.899	0.164	1.936	2.999	5.551	5.659
53	1.352	0.444	1.796	0.818	0.625	0.679	2.122	3.917	3.999
54	1.165	0.219	1.384	0.467	0.866	0.645	1.978	3.362	3.420
55	1.232	0.557	1.789	0.520	1.123	3.197	4.840	6.628	6.700
56	1.635	0.470	2.105	0.438	1.393	0.585	2.417	4.522	4.602
57	1.908	0.405	2.313	0.345	0.303	1.504	2.153	4.466	4.549
58	1.136	0.621	1.757	0.535	0.308	1.424	2.267	4.025	4.096
59	1.276	0.640	1.916	0.227	0.909	6.505	7.641	9.557	9.624
60	1.454	1.246	2.700	0.277	0.349	2.371	2.997	5.697	5.790
61	1.982	0.486	2.468	0.380	0.421	9.725	10.526	12.994	13.083
62	1.297	1.235	2.532	0.429	0.165	8.967	9.561	12.093	12.186
63	1.834	1.505	3.339	0.481	0.565	0.927	1.973	5.312	5.432
64	1.355	0.677	2.032	0.864	0.272	4.704	5.839	7.872	7.962
65	2.475	0.734	3.209	0.592	0.540	2.075	3.208	6.418	6.536
66	0.834	0.850	1.684	0.660	0.196	0.865	1.722	3.406	3.479
67	0.841	0.808	1.649	0.672	0.646	1.211	2.529	4.178	4.250
68	1.278	1.244	2.522	0.853	0.000	1.742	2.594	5.116	5.221
69	0.837	0.785	1.622	0.649	0.336	1.599	2.584	4.205	4.276
70	0.719	1.346	2.065	0.677	0.432	0.933	2.041	4.106	4.192
71	0.519	0.441	0.960	0.635	0.029	0.491	1.156	2.116	2.166
72	0.641	0.800	1.441	0.770	0.216	0.990	1.976	3.417	3.486
73	0.958	0.654	1.612	0.392	0.000	1.680	2.072	3.684	3.746
74	0.441	0.160	0.601	0.455	0.204	0.270	0.930	1.531	1.564
75	0.158	0.074	0.232	0.289	0.084	0.475	0.847	1.079	1.095
76	0.038	0.097	0.135	0.425	0.268	0.011	0.705	0.840	0.857
77	0.093	0.168	0.261	0.262	0.000	0.268	0.530	0.790	0.807
78	0.291	0.147	0.438	0.500	0.000	0.260	0.760	1.198	1.227
79	0.143	0.109	0.252	0.136	0.046	0.000	0.182	0.433	0.446
80	0.034	0.027	0.061	0.225	0.183	0.475	0.882	0.944	0.953
81	0.230	0.079	0.309	0.081	0.013	0.000	0.094	0.403	0.415
82	0.246	0.011	0.257	0.103	0.000	0.000	0.103	0.360	0.371
83	0.088	0.016	0.104	0.081	0.000	0.000	0.081	0.185	0.191
84	0.026	0.081	0.107	0.155	0.000	0.000	0.155	0.262	0.270
85	0.000	0.013	0.013	0.090	0.000	0.000	0.090	0.102	0.105
86	0.290	0.000	0.290	0.089	0.036	0.000	0.126	0.416	0.427
87	0.029	0.011	0.040	0.080	0.000	0.000	0.080	0.121	0.124
88	0.000	0.000	0.000	0.000	0.000	0.050	0.050	0.050	0.050
89	0.000	0.000	0.000	0.059	0.000	0.039	0.097	0.097	0.099
90	0.026	0.019	0.045	0.025	0.000	0.000	0.025	0.070	0.072
91	0.015	0.000	0.015	0.024	0.000	0.000	0.024	0.039	0.040
92	0.000	0.000	0.000	0.038	0.000	0.000	0.038	0.038	0.040
93	0.050	0.000	0.050	0.062	0.000	0.000	0.062	0.112	0.116
94	0.000	0.000	0.000	0.071	0.000	0.039	0.110	0.110	0.112
95	0.000	0.000	0.000	0.039	0.000	0.039	0.078	0.078	0.080
96	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
97	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
98	0.000	0.000	0.000	0.087	0.000	0.000	0.087	0.087	0.089
99	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100+			0.000	0.000	0.252	0.213	0.465	0.465	0.465
TOTAL	114	19	132	38	54	83	174	307	312
Landings (t)	217	77	295	106	100	258	463	758	771
Mean Weight (g)	1913	4147	2228	2799	1858	3108	2657	2472	2470
Mean Length (cm)	46.6	63.7	49.0	52.9	45.3	56.3	52.2	50.8	50.8
Measured weight (t)	6.0	2.2	8.2	3.6	1.2	1.4	6.1	14.3	14.3

Table 8.4.4 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
Number, mean weight and mean length of landings between 1986 and 2013.

	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	525	1518	43
2012	479	2137	49
2013	312	2470	51

Table 8.4.5 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
Abundance indices from Spanish and Portuguese surveys.

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

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 8.4.6 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
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.

Landings (t)

	Div. VIIIc									
Year	Avilés	%	Santander	%	A Coruña-Port	A Coruña-Trucks	[1]A Coruña-Fleet	%	Cedeira	%
1982					655		655	28		
1983					765		765	32		
1984					574		574	30		
1985					253		253	14		
1986	64	3	21	1	352		352	14		
1987	85	2	16	0	673		673	18		
1988	125	3	30	1	570		570	15		
1989	119	5	32	1	344		344	13		
1990	58	2	40	2	288		288	12		
1991	52	2	62	3	225		225	10		
1992	33	2	107	5	211		211	10		
1993	53	2	143	6	199		199	9		
1994	65	4	196	12	166	37	204	13		
1995	141	8	126	7	353	75	428	23		
1996	162	10	89	5	334	68	403	25		
1997	143	8	122	7	298	43	341	19		
1998	91	4	114	5	323	72	394	19		
1999	41	2	67	4	374	n/a	n/a	n/a	14	1
2000	23	2	44	3	287	6	293	21	4	<1
2001	12	1	28	3	281	n/a	n/a	n/a	6	1
2002	11	1	16	2	76	31	107	14	7	1
2003	9	1	15	2	85	43	128	14	3	<1
2004	32	3	23	2	68	40	107	11	5	1
2005	54	6	7	1	54	32	86	10	2	<1
2006	16	1	18	2	70	81	151	13	4	<1
2007	11	1	19	1	109	113	223	17	2	<1
2008	10	1	n/a	n/a	163	98	261	27	0.4	<1
2009	5	1	8	1	80	67	147	19	4	1
2010	n/a	n/a	19	2	112	87	199	25	4	1
2011	n/a	n/a	36	5	n/a	n/a	144	18	1	<1
2012	n/a	n/a	22	2	n/a	n/a	172	17	4	<1
2013	n/a	n/a	n/a	n/a	78	n/a	n/a	n/a	n/a	n/a

Fishing effort

	Div. VIIIc					
Year	[1]Avilés	[1]Santander	A Coruña-Port	A Coruña-Trucks	[1]A Coruña-Fleet	[2]Cedeira standardized 2010
1982			63313		63313	
1983			51008		51008	
1984			48665		48665	
1985			45157		45157	
1986	10845	18153	40420		40420	
1987	8309	14995	34651		34651	
1988	9047	16660	41481		41481	
1989	8063	17607	44410		44410	
1990	8497	20469	44403		44403	
1991	7681	22391	40429		40429	
1992	n/a	22833	38899		38899	
1993	7635	21370	44478		44478	
1994	9620	22772	39602	12795	52397	
1995	6146	14046	41476	10232	51708	
1996	4525	12071	35709	8791	44501	
1997	5061	11776	35494	9108	44602	
1998	5929	10646	29508	n/a	n/a	
1999	6829	10349	30131	n/a	n/a	4582
2000	4453	8779	30079	n/a	n/a	2981
2001	1838	3053	29935	n/a	n/a	1932
2002	2748	3975	21948	6747	28695	2398
2003	2526	3837	18519	7608	26127	2703
2004	n/a	3776	19198	10342	29540	4677
2005	n/a	1404	20663	10302	30965	3325
2006	n/a	2718	19264	12866	32130	3911
2007	n/a	4334	21651	13187	34838	3976
2008	n/a	n/a	20212	9812	30024	5133
2009	n/a	1125	16162	12930	29092	2300
2010	n/a	1628	13744	9003	22746	1880
2011	n/a	n/a	n/a	n/a	18617	522
2012	n/a	n/a	n/a	n/a	21110	n/a
2013	n/a	n/a	18194	n/a	21110	n/a

[1] Fishing days per 100 HP [2] Soaking days

Table 8.4.6 Cont.

	LPUE					
	Div. VIIIc					
Year	[1]Avilés	[1]Santander	A Coruña-Port	A Coruña-Trucks	[1]A Coruña-Fleet	[2]Cedeira standardized 2010
1982			10.3		10.3	
1983			15.0		15.0	
1984			11.8		11.8	
1985			5.6		5.6	
1986	5.9	1.1	8.7		8.7	
1987	10.3	1.1	19.4		19.4	
1988	13.9	1.8	13.7		13.7	
1989	14.7	1.8	7.7		7.7	
1990	6.8	1.9	6.5		6.5	
1991	6.7	2.8	5.6		5.6	
1992	n/a	4.7	5.4		5.4	
1993	7.0	6.7	4.5		4.5	
1994	6.7	8.6	4.2	2.9	3.9	
1995	23.0	9.0	8.5	7.3	8.3	
1996	35.8	7.4	9.4	7.8	9.0	
1997	28.3	10.4	8.4	4.8	7.7	
1998	15.3	10.7	10.9	n/a	10.9	
1999	5.9	6.5	12.4	n/a	12.4	3.0
2000	5.1	5.0	9.6	n/a	9.6	1.0
2001	6.7	9.3	9.4	n/a	9.4	2.3
2002	4.1	4.1	3.5	4.6	3.7	3.0
2003	3.6	4.0	4.6	5.6	4.9	0.9
2004	n/a	6.0	3.5	3.8	3.6	1.0
2005	n/a	4.9	2.6	3.1	2.8	0.5
2006	n/a	6.8	3.6	6.3	4.7	0.9
2007	n/a	4.5	5.1	8.6	6.4	0.5
2008	n/a	n/a	8.1	10.0	8.7	0.1
2009	n/a	6.8	5.0	5.2	5.1	1.7
2010	n/a	11.9	8.1	9.7	8.7	2.1
2011	n/a	n/a	n/a	n/a	7.7	1.3
2012	n/a	n/a	n/a	n/a	8.2	n/a
2013	n/a	n/a	4.3	n/a	n/a	n/a

[1] kg/days*100HP [2] kg/soaking day

Table 8.4.6 Cont.

	Landings (t)			
	Div. IXa			
Year	Portugal Crustacean	%	Portugal Fish	%
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989	89	3	183	7
1990	127	5	261	11
1991	101	5	208	10
1992	94	4	193	9
1993	64	3	132	6
1994	26	2	53	3
1995	22	1	46	2
1996	45	3	88	5
1997	38	2	43	2
1998	70	3	111	5
1999	41	2	69	4
2000	66	5	76	6
2001	59	6	42	4
2002	47	6	28	4
2003	30	3	38	4
2004	23	2	27	3
2005	12	1	19	2
2006	18	2	22	2
2007	34	3	31	2
2008	21	2	19	2
2009	18	2	16	2
2010	37	5	34	4
2011	39	5	36	5
2012	81	8	75	7
2013	52	5	48	5

	Fishing effort			
	Div. IXa			
Year	Portugal [3]Crustacean	Portugal [4]Crustacean standardized	Portugal [3]Fish	Portugal [4]Fish standardized
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989	76	23	52	18
1990	90	20	61	17
1991	83	17	57	15
1992	71	15	49	14
1993	75	13	56	13
1994	41	8	36	10
1995	38	8	41	9
1996	64	14	54	12
1997	43	11	27	9
1998	48	11	35	10
1999	24	8	18	6
2000	42	10	19	6
2001	85	18	19	5
2002	62	10	14	4
2003	42	10	17	6
2004	21	7	14	4
2005	20	5	13	4
2006	22	5	12	4
2007	22	6	8	3
2008	14	4	5	2
2009	15	n/a	6	n/a
2010	21	n/a	14	n/a
2011	18	n/a	9	n/a
2012	56	n/a	35	n/a
2013	21	n/a	48	n/a

[3] 1000 Hours trawling with occurrence of anglerfish [4] 1000 Hauls n/a - not available

Table 8.4.6 Cont.

	LPUE			
	Div. IXa			
Year	Portugal [3]Crustacean	Portugal [4]Crustacean standardized	Portugal [3]Fish	Portugal [4]Fish standardized
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989	1.17	3.9	3.51	10.4
1990	1.41	6.2	4.29	15.2
1991	1.22	6.1	3.65	13.5
1992	1.32	6.2	3.97	14.1
1993	0.85	4.8	2.37	10.1
1994	0.64	3.4	1.50	5.5
1995	0.58	2.8	1.11	5.0
1996	0.70	3.1	1.62	7.1
1997	0.88	3.3	1.60	4.9
1998	1.45	6.3	3.16	11.5
1999	1.72	5.0	3.85	12.2
2000	1.56	6.5	4.04	12.6
2001	0.69	3.2	2.27	8.5
2002	0.75	4.8	2.00	6.2
2003	0.71	3.1	2.17	6.7
2004	1.07	3.5	1.90	6.2
2005	0.63	2.4	1.38	5.0
2006	0.80	3.3	1.73	5.6
2007	1.53	5.6	3.98	10.5
2008	1.50	5.4	3.56	10.6
2009	1.14	n/a	2.65	n/a
2010	1.75	n/a	2.37	n/a
2011	2.15	n/a	3.91	n/a
2012	1.44	n/a	2.12	n/a
2013	2.42	n/a	0.84	n/a

[3] kg/hour trawl   [4] kg/haul

Table 8.4.7 ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa.
ASPIC input settings and data.

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

SPCORTR8c			PT.crust.tr		PT.fish.tr	
CC			I1		I1	
1980	-1.00E+00	2.11E+03	1980	-1.00E+00	1980	-1.00E+00
1981	-1.00E+00	2.30E+03	1981	-1.00E+00	1981	-1.00E+00
1982	1.03E+01	2.37E+03	1982	-1.00E+00	1982	-1.00E+00
1983	1.50E+01	2.38E+03	1983	-1.00E+00	1983	-1.00E+00
1984	1.18E+01	1.93E+03	1984	-1.00E+00	1984	-1.00E+00
1985	5.61E+00	1.83E+03	1985	-1.00E+00	1985	-1.00E+00
1986	8.71E+00	2.56E+03	1986	-1.00E+00	1986	-1.00E+00
1987	1.94E+01	3.83E+03	1987	-1.00E+00	1987	-1.00E+00
1988	1.37E+01	3.70E+03	1988	-1.00E+00	1988	-1.00E+00
1989	7.74E+00	2.58E+03	1989	1.17E-03	1989	3.51E-03
1990	6.49E+00	2.33E+03	1990	1.41E-03	1990	4.29E-03
1991	5.56E+00	2.16E+03	1991	1.22E-03	1991	3.65E-03
1992	5.41E+00	2.11E+03	1992	1.32E-03	1992	3.97E-03
1993	4.47E+00	2.23E+03	1993	8.53E-04	1993	2.37E-03
1994	3.89E+00	1.58E+03	1994	6.37E-04	1994	1.50E-03
1995	8.28E+00	1.84E+03	1995	5.82E-04	1995	1.11E-03
1996	9.05E+00	1.63E+03	1996	7.03E-04	1996	1.62E-03
1997	7.65E+00	1.81E+03	1997	8.79E-04	1997	1.60E-03
1998	1.09E+01	2.09E+03	1998	1.45E-03	1998	3.16E-03
1999	1.24E+01	1.88E+03	1999	1.72E-03	1999	3.85E-03
2000	9.55E+00	1.37E+03	2000	1.56E-03	2000	4.04E-03
2001	9.40E+00	1.01E+03	2001	6.86E-04	2001	2.27E-03
2002	3.74E+00	7.70E+02	2002	7.54E-04	2002	2.00E-03
2003	4.89E+00	9.26E+02	2003	7.14E-04	2003	2.17E-03
2004	3.63E+00	9.72E+02	2004	1.07E-03	2004	1.90E-03
2005	2.76E+00	8.97E+02	2005	6.34E-04	2005	1.38E-03
2006	4.69E+00	1.15E+03	2006	8.01E-04	2006	1.73E-03
2007	6.39E+00	1.30E+03	2007	1.53E-03	2007	3.98E-03
2008	8.69E+00	9.51E+02	2008	1.50E-03	2008	3.56E-03
2009	5.05E+00	7.69E+02	2009	1.14E-03	2009	2.65E-03
2010	8.75E+00	7.84E+02	2010	1.75E-03	2010	2.37E-03
2011	7.71E+00	7.98E+02	2011	2.15E-03	2011	3.91E-03
2012	8.17E+00	1.02E+03	2012	1.44E-03	2012	2.12E-03
2013	-1.00E+00	7.70E+02	2013	-1.00E+00	2013	-1.00E+00

Table 8.4.8 ANGLERFISH (L. budegassa) – Divisions VIIIc and IXa.

ASPIC results: parameter estimates, non parametric bootstrap relative bias and bias corrected confidence interval, interquartil (IQ) range and relative range. Ye(2014): equilibrium yield available in 2014; Y(Fmsy): yield availabe at Fmsy in 2014; Ye2014/MSY: equilibrium yield available in 2014 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.

	WG2014 (WKFLAT2012/Stock Annex settings), B1/K fixed at 0.60							
			Bootstrap Confidence Interval					
Parameter	Point estimates	Relative bias	Lower 80%	Higher 80%	Lower 95%	Higher 95%	IQ-Range	Relative IQ-Range
B1/K	0.60	0.00%	0.60	0.60	0.60	0.60	0.00	0.00%
K	47260	9.45%	36540	75490	32350	105800	16930	35.80%
q(1)	4.08E-04	2.47%	2.25E-04	5.90E-04	1.55E-04	7.01E-04	1.83E-04	44.90%
q(2)	6.57E-08	2.34%	3.37E-08	9.47E-08	2.25E-08	1.16E-07	3.08E-08	46.80%
q(3)	1.53E-07	2.63%	8.50E-08	2.26E-07	5.37E-08	2.74E-07	7.34E-08	48.00%
MSY	1633	-0.15%	1343	1759	1053	1819	202	12.40%
Ye(2014)	1614	-1.51%	1300	1746	1055	1797	216	13.40%
Y.(Fmsy)	801	-0.02%	787	817	780	829	16	2.00%
Bmsy	23630	9.45%	18270	37750	16180	52880	8464	35.80%
Fmsy	0.069	2.17%	0.037	0.097	0.024	0.111	0.030	43.80%
fmsy(1)	169.6	1.02%	143.3	203.3	127.1	227.4	31.07	18.30%
fmsy(2)	1052000	1.99%	866200	1278000	757500	1495000	204400	19.40%
fmsy(3)	452100	1.62%	380500	566000	347400	646000	100400	22.20%
B./Bmsy	0.89	2.08%	0.73	1.05	0.66	1.17	0.17	19.10%
F./Fmsy	0.54	2.28%	0.44	0.75	0.38	0.91	0.15	27.60%
Ye./MSY	0.99	-1.44%	0.94	1.00	0.90	1.00	0.03	2.80%
q2/q1	1.61E-04	-0.12%	1.42E-04	1.89E-04	1.33E-04	2.01E-04	2.44E-05	15.10%
q3/q1	3.75E-04	0.26%	3.28E-04	4.40E-04	3.03E-04	4.74E-04	5.94E-05	15.80%

Table 8.4.9 ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa.

Outputs	WKFLAT2012	WG2013 Benchmark Settings	WG2014 Benchmark Settings	WG2014 Bench. Set. B1/K fixed
B1/K	0.93	0.44	0.44	0.60
MSY	1375	1881	1900	1633
K	43910	58390	59360	47260
q(1)	3.09E-04	4.22E-04	4.22E-04	4.08E-04
q(2)	4.85E-08	6.78E-08	6.78E-08	6.57E-08
q(3)	1.17E-07	1.58E-07	1.58E-07	1.53E-07
TOF	1.07E+01	1.14E+01	1.14E+01	1.14E+01
mse	1.60E-01	1.57E-01	1.57E-01	1.55E-01
rmse	4.01E-01	3.96E-01	3.96E-01	3.93E-01
CI	0.5015	0.2162	0.2114	0.3080
CN	1.0000	0.9438	0.9356	1.0000
Rest	111	19	8	7
Error	0	0	0	0
r sq 1	0.181	0.165	0.165	0.169
rsq 2	0.010	0.132	0.131	0.125
rsq 3	0.052	0.029	0.028	0.031
Y.@Fmsy	1436	1300	1352	1463
Bmsy	21950	29190	29680	23630
Fmsy	0.063	0.064	0.064	0.069
B./Bmsy	1.040	0.684	0.705	0.893
F./Fmsy	0.522	0.806	0.589	0.539

B./Bmsy: By+1/Bmsy

F./Fmsy: F_{y-}/Fmsy

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

Table 8.4.10 ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa.
Sensitive analyses of the "Benchmark settings" by changing +/-10%, +/-25% and +/-50% the starting guess for *B1/K*.

				WGBIE 2014			
Variation	**-50%**	**-25%**	**-10%**	**0**	**+10%**	**+25%**	**+50%**
B1/K	**0.3**	**0.45**	**0.54**	**0.6**	**0.66**	**0.75**	**0.9**
Outputs							
B1/K	0.72	0.51	0.66	0.44	0.66	0.53	0.61
MSY	1540	1744	1581	1900	1582	1716	1619
K	42570	52470	44710	59360	44700	51160	46600
q(1)	3.96E-04	4.15E-04	4.02E-04	4.22E-04	4.02E-04	4.14E-04	4.06E-04
q(2)	6.40E-08	6.68E-08	6.50E-08	6.78E-08	6.50E-08	6.66E-08	6.55E-08
q(3)	1.49E-07	1.55E-07	1.51E-07	1.58E-07	1.51E-07	1.55E-07	1.52E-07
TOF	1.15E+01	1.13E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01
mse	1.57E-01	1.55E-01	1.57E-01	1.57E-01	1.57E-01	1.57E-01	1.57E-01
rmse	3.96E-01	3.94E-01	3.96E-01	3.96E-01	3.96E-01	3.96E-01	3.96E-01
CI	0.3833	0.2563	0.3438	0.2114	0.3438	0.2674	0.3165
CN	1.0000	1.0000	1.0000	0.9356	1.0000	1.0000	1.0000
Rest	162	10	73	8	466	7	53
Error	0	0	0	0	0	0	0
r sq 1	0.170	0.171	0.169	0.165	0.169	0.167	0.169
rsq 2	0.120	0.133	0.123	0.131	0.123	0.128	0.125
rsq 3	0.033	0.037	0.032	0.028	0.032	0.030	0.031
Y.@Fmsy	1541	1402	1501	1352	1501	1418	1472
Bmsy	21280	26240	22350	29680	22350	25580	23300
Fmsy	0.072	0.066	0.071	0.064	0.071	0.067	0.069
B./Bmsy	1.001	0.798	0.947	0.705	0.948	0.822	0.906
F./Fmsy	0.509	0.565	0.524	0.589	0.524	0.558	0.535

Table 8.4.11 ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa.
Sensitive analyses of the "Benchmark settings" with B1/K fixed at 0.60 by changing +/-25% the starting guess for *MSY*, *K* and the *seed*.

		WGBIE 2014	
Variation	-25%	0	+25%
MSY	1358	1811	2264
Low Bound	136	181	226
Hy Bound	2717	3623	4528
Outputs			
B1/K	0.60	0.60	0.60
MSY	1633	1633	1633
K	47250	47260	47250
q(1)	4.08E-04	4.08E-04	4.08E-04
q(2)	6.57E-08	6.57E-08	6.57E-08
q(3)	1.53E-07	1.53E-07	1.53E-07
TOF	1.14E+01	1.14E+01	1.14E+01
mse	1.55E-01	1.55E-01	1.55E-01
rmse	3.93E-01	3.93E-01	3.93E-01
CI	0.3080	0.3080	0.3080
CN	1.0000	1.0000	1.0000
Rest	9	7	9
Error	0	0	0
r sq 1	0.169	0.169	0.169
rsq 2	0.125	0.125	0.125
rsq 3	0.031	0.031	0.031
Y.@Fmsy	1463	1463	1464
Bmsy	23630	23630	23630
Fmsy	0.069	0.069	0.069
B./Bmsy	0.893	0.893	0.893
F./Fmsy	0.539	0.539	0.539

		WGBIE 2014	
Variation	-25%	0	+25%
K	13584	18113	22641
Low Bound	1358	1811	2264
Hy Bound	271689	362252	452815
Outputs			
B1/K	0.60	0.60	0.60
MSY	1633	1633	1633
K	47240	47260	47250
q(1)	4.08E-04	4.08E-04	4.08E-04
q(2)	6.57E-08	6.57E-08	6.57E-08
q(3)	1.53E-07	1.53E-07	1.53E-07
TOF	1.14E+01	1.14E+01	1.14E+01
mse	1.55E-01	1.55E-01	1.55E-01
rmse	3.93E-01	3.93E-01	3.93E-01
CI	0.3081	0.3080	0.3080
CN	1.0000	1.0000	1.0000
Rest	9	7	8
Error	0	0	0
r sq 1	0.169	0.169	0.169
rsq 2	0.125	0.125	0.125
rsq 3	0.031	0.031	0.031
Y.@Fmsy	1464	1463	1464
Bmsy	23620	23630	23620
Fmsy	0.069	0.069	0.069
B./Bmsy	0.893	0.893	0.893
F./Fmsy	0.539	0.539	0.539

		WGBIE 2014	
Variation	-25%	0	+25%
seed	769468	1025957	1282446
Outputs			
B1/K	0.60	0.60	0.60
MSY	1633	1633	1633
K	47250	47260	47260
q(1)	4.08E-04	4.08E-04	4.08E-04
q(2)	6.57E-08	6.57E-08	6.57E-08
q(3)	1.53E-07	1.53E-07	1.53E-07
TOF	1.14E+01	1.14E+01	1.14E+01
mse	1.55E-01	1.55E-01	1.55E-01
rmse	3.93E-01	3.93E-01	3.93E-01
CI	0.3081	0.3080	0.3080
CN	1.0000	1.0000	1.0000
Rest	7	7	7
Error	0	0	0
r sq 1	0.169	0.169	0.169
rsq 2	0.125	0.125	0.125
rsq 3	0.031	0.031	0.031
Y.@Fmsy	1463	1463	1464
Bmsy	23620	23630	23630
Fmsy	0.069	0.069	0.069
B./Bmsy	0.893	0.893	0.893
F./Fmsy	0.539	0.539	0.539

Table 8.4.12. ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.

Point estimates of B/BMSY(from 2014 to 2016) and Yield (from 2014 to 2016) for projections with F status quo (Fsq), FMSY, zero catches. Reductions to obtain yields equal to 2014 TAC, and +/- 15% 2014 TAC are also presented. The value of F2014/FMSY is equal to Fsq (mean F of 2011-2013) in all scenarios proposed. Values for F/FMSY are also given.

Fishing mortality trends in relation to F_{MSY}

year	*L. piscatorius* MSYApproach	Fsq	F_{MSY}	zero catches	-15% TAC= 2235 t	TAC=2629 t	+15% TAC = 3023 t
2014	0.63	0.63	0.63	0.63	0.63	0.63	0.63
2015	0.69	0.63	1.00	0.00	0.50	0.60	0.70
2016	0.69	0.63	1.00	0.00	0.50	0.60	0.70
2017	0.69	0.63	1.00	0.00	0.50	0.60	0.70

Biomass trends in relation to B_{MSY}

year	*L. piscatorius* MSYApproach	Fsq	F_{MSY}	zero catches	-15% TAC= 2235 t	TAC=2629 t	+15% TAC = 3023 t
2014	0.89	0.89	0.89	0.89	0.89	0.89	0.89
2015	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2016	0.95	0.95	0.93	0.99	0.96	0.95	0.95
2017	0.97	0.98	0.93	1.06	0.99	0.98	0.97
2018	0.99	1.00	0.94	1.13	1.03	1.01	0.99

Yield

year	*L. piscatorius* MSYApproach	Fsq	F_{MSY}	zero catches	-15% TAC= 2235 t	TAC=2629 t	+15% TAC = 3023 t
2014	927	927	927	927	927	927	927
2015	1050	956	1510	0	775	918	1063
2016	1077	985	1518	0	804	947	1090
2017	1102	1012	1525	0	833	975	1115

Table 8.3.1. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Tonnes landed by the main fishing fleets for 1978-2013 as determined by the Working Group.

	Div. VIIIc				Div. IXa						Div. VIIIc+IXa	
	SPAIN				SPAIN			PORTUGAL				
Year	Trawl	Gillnet	Others	TOTAL	Trawl	Gillnet	Others	Trawl	Artisanal	TOTAL	TOTAL	Unallocated
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	
1981	2 750	1 931		4 681	535				352	887	5 568	
1982	1 915	2 682		4 597	875				310	1 185	5 782	
1983	3 205	1 723		4 928	726				460	1 186	6 114	
1984	3 086	1 690		4 776	578			186	492	1 256	6 032	
1985	2 313	2 372		4 685	540			212	702	1 454	6 139	
1986	2 499	2 624		5 123	670			167	910	1 747	6 870	
1987	2 080	1 683		3 763	320			194	864	1 378	5 141	
1988	2 525	2 253		4 778	570			157	817	1 543	6 321	
1989	1 643	2 147		3 790	347			259	600	1 206	4 996	
1990	1 439	985		2 424	435			326	606	1 366	3 790	
1991	1 490	778		2 268	319			224	829	1 372	3 640	
1992	1 217	1 011		2 228	301			76	778	1 154	3 382	
1993	844	666		1 510	72			111	636	819	2 329	
1994	690	827		1 517	154			70	266	490	2 007	
1995	830	572		1 403	199			66	166	431	1 834	
1996	1 306	745		2 050	407			133	365	905	2 955	
1997	1 449	1 191		2 640	315			110	650	1 075	3 714	
1998	912	1 359		2 271	184			28	497	710	2 981	
1999	551	1 013		1 564	79			9	285	374	1 938	
2000	269	538		808	107			4	340	451	1 259	
2001	231	294		525	57			16	190	263	788	
2002	385	341		726	110			29	168	307	1 032	
2003	911	722		1 633	312			29	305	645	2 278	
2004	1 260	1 269		2 528	264			27	335	626	3 154	
2005	1 378	1 622		3 000	371			29	244	643	3 644	
2006	1 166	1 247		2 413	260			29	260	549	2 963	
2007	955	1 009		1 964	181			13	192	386	2 350	
2008	894	1 168		2 062	138			11	127	275	2 337	
2009	850	1 058		1 909	213			10	148	371	2 280	
2010	313	955		1 268	158			2	119	279	1 547	
2011	262	470		733	118			46	80	244	976	
2012	355	600		955	134			6	163	302	1 257	
2013	278	775	47	1 100	60	77	12	15	154	318	1 418	1 025

n/a: not available

Table 8.3.2. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Weight and percentage of discards for Spanish fleets.

	Trawl			Gillnet	
Year	Weight (t)	CV	% Catches	Weight (t)	% Catches
1994	20.9	34.05	2.4		
1995	n/a	n/a	n/a		
1996	n/a	n/a	n/a		
1997	5.4	68.13	0.3		
1998	n/a	n/a	n/a		
1999	0.8	71.30	0.1		
2000	5.7	33.64	1.5		
2001	n/a	n/a	n/a		
2002	n/a	n/a	n/a		
2003	25.1	54.42	2.0		
2004	48.2	32.53	3.1		
2005	44.1	30.97	2.5		
2006	43.7	48.33	3.0		
2007	17.1	28.44	1.5		
2008	4.9	56.47	0.5		
2009	20.0	26.11	3.6		
2010	11.5	36.87	2.4		
2011	22.6	19.27	5.6		
2012	62.6	43.65	11.4		
2013	65.8	n/a	16.3	143.8	14.4

n/a: not available
CV: coefficient of variation

Table 8.3.3. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.

Length composition by fleet and ajusted length composition for total landings (thousands) in 2013.
Ajusted TOTAL: ajusted to landings from fleets without length compostion.

	Div. VIIIc			Div. IXa				Div. VIIIc+IXa	
	SPAIN			SPAIN	PORTUGAL				
Length (cm)	Trawl	Gillnet	TOTAL	Trawl	Trawl	Artisanal	TOTAL	TOTAL	Ajusted TOTAL
14	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
15	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
16	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
17	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
18	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
19	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
20	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
21	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
22	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
23	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
24	0.000	0.000	0.000	0.000	0.000	0.02	0.02	0.02	0.02
25	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
26	0.000	0.000	0.000	0.011	0.000	0.00	0.01	0.01	0.02
27	0.059	0.000	0.059	0.000	0.000	0.00	0.00	0.06	0.07
28	0.000	0.000	0.000	0.178	0.000	0.00	0.18	0.18	0.24
29	0.050	0.000	0.050	0.159	0.000	0.02	0.18	0.23	0.27
30	0.228	0.000	0.228	0.088	0.000	0.00	0.09	0.32	0.39
31	0.563	0.000	0.563	0.135	0.006	0.07	0.21	0.78	0.91
32	0.634	0.000	0.634	0.298	0.000	0.04	0.33	0.97	1.16
33	1.840	0.000	1.840	0.357	0.000	0.06	0.41	2.25	2.64
34	1.062	0.000	1.062	0.310	0.059	0.45	0.82	1.89	2.16
35	1.420	0.000	1.420	0.585	0.059	0.69	1.34	2.76	3.19
36	1.713	0.000	1.713	0.365	0.234	0.46	1.06	2.77	3.16
37	1.731	0.000	1.731	0.254	0.119	0.46	0.83	2.56	2.96
38	1.180	0.000	1.180	0.716	0.612	0.59	1.91	3.09	3.41
39	1.975	0.000	1.975	0.238	0.119	0.03	0.39	2.36	2.78
40	1.629	0.000	1.629	0.504	0.178	0.28	0.96	2.59	2.96
41	1.687	0.000	1.687	0.494	0.345	0.09	0.93	2.62	2.97
42	1.316	0.000	1.316	0.610	0.119	8.74	9.47	10.78	11.10
43	1.411	0.013	1.424	0.652	0.000	0.12	0.77	2.20	2.57
44	1.569	0.013	1.582	0.482	0.000	0.51	0.99	2.57	2.90
45	0.992	0.000	0.992	0.425	0.498	0.82	1.74	2.73	3.04
46	1.120	0.024	1.144	0.859	0.000	0.64	1.50	2.65	2.99
47	1.387	0.013	1.400	0.698	1.390	0.66	2.75	4.15	4.69
48	1.435	0.016	1.451	0.410	0.038	2.76	3.21	4.66	5.01
49	2.179	0.016	2.195	0.706	0.000	0.31	1.02	3.21	3.80
50	1.523	0.099	1.622	0.454	0.000	0.12	0.58	2.20	2.57
51	1.514	0.209	1.723	0.363	0.000	0.06	0.42	2.15	2.54
52	1.768	0.145	1.913	0.522	0.315	0.15	0.99	2.90	3.39
53	1.844	0.436	2.280	0.330	0.320	0.55	1.20	3.48	3.93
54	1.895	0.464	2.359	0.524	0.000	0.00	0.52	2.88	3.39
55	1.574	0.220	1.794	0.332	0.000	9.69	10.02	11.81	12.20
56	1.418	1.033	2.451	0.406	0.000	0.00	0.41	2.86	3.24
57	1.049	0.692	1.741	0.401	0.000	0.00	0.40	2.14	2.52
58	1.652	0.853	2.505	0.365	0.000	0.09	0.45	2.96	3.40
59	1.235	0.821	2.056	0.354	0.000	0.00	0.35	2.41	2.74
60	1.829	1.636	3.465	0.182	0.000	2.78	2.96	6.43	6.92
61	1.959	2.014	3.973	0.228	0.000	0.07	0.30	4.27	4.83
62	2.076	1.838	3.914	0.277	0.000	0.02	0.30	4.21	4.75
63	1.990	2.099	4.089	0.335	0.000	0.00	0.33	4.42	5.02
64	1.523	2.921	4.444	0.409	0.000	0.00	0.41	4.85	5.46
65	2.356	3.905	6.261	0.129	0.000	0.00	0.13	6.39	7.15
66	1.601	2.482	4.083	0.280	0.000	0.00	0.28	4.36	4.89
67	1.570	2.602	4.172	0.100	0.000	0.15	0.25	4.42	4.95
68	1.426	4.201	5.627	0.122	0.000	0.22	0.34	5.97	6.66
69	1.305	3.797	5.102	0.089	0.000	0.00	0.09	5.19	5.79
70	1.329	3.947	5.276	0.015	0.038	0.29	0.34	5.62	6.21
71	1.064	4.023	5.087	0.075	0.000	0.00	0.08	5.16	5.75
72	0.965	4.328	5.293	0.131	0.000	0.00	0.13	5.42	6.01
73	1.161	4.641	5.802	0.096	0.000	0.07	0.17	5.97	6.62
74	0.429	4.263	4.692	0.187	0.000	0.61	0.79	5.49	6.01
75	0.867	4.597	5.464	0.148	0.000	0.08	0.22	5.69	6.31
76	0.772	3.353	4.125	0.036	0.000	0.15	0.18	4.31	4.76
77	1.156	3.026	4.182	0.266	0.000	0.07	0.34	4.52	5.06
78	1.568	2.744	4.312	0.092	0.038	1.22	1.35	5.66	6.16
79	1.226	2.747	3.973	0.150	0.000	0.07	0.22	4.20	4.66
80	0.948	3.209	4.157	0.239	0.000	0.22	0.46	4.61	5.14
81	0.380	1.921	2.301	0.198	0.000	1.25	1.45	3.75	4.08
82	0.735	2.401	3.136	0.172	0.000	0.07	0.24	3.38	3.74
83	0.407	2.460	2.867	0.270	0.000	0.24	0.51	3.37	3.74
84	0.928	1.658	2.586	0.249	0.000	0.26	0.51	3.10	3.46
85	0.656	1.797	2.453	0.010	0.000	0.15	0.16	2.62	2.91
86	0.731	1.832	2.563	0.292	0.092	0.15	0.53	3.09	3.44
87	0.346	1.492	1.838	0.029	0.000	0.13	0.16	2.00	2.24
88	0.286	1.789	2.075	0.219	0.000	0.91	1.13	3.20	3.51
89	1.186	1.826	3.012	0.192	0.092	0.07	0.36	3.37	3.74
90	0.218	2.098	2.316	0.047	0.277	0.16	0.49	2.80	3.10
91	0.072	1.222	1.294	0.027	0.038	0.07	0.14	1.43	1.58
92	0.220	1.229	1.449	0.148	0.000	0.07	0.22	1.67	1.86
93	0.181	1.649	1.830	0.071	0.000	0.31	0.38	2.21	2.43
94	0.274	1.123	1.397	0.105	0.000	0.24	0.34	1.74	1.92
95	0.171	1.053	1.224	0.034	0.000	0.27	0.31	1.53	1.69
96	0.205	1.276	1.481	0.092	0.038	0.02	0.15	1.63	1.83
97	0.433	1.148	1.581	0.000	0.000	0.00	0.00	1.58	1.79
98	0.058	0.858	0.916	0.056	0.061	0.00	0.12	1.03	1.13
99	0.019	1.050	1.069	0.000	0.000	0.00	0.00	1.07	1.18
100+	0.742	8.283	9.025	0.184	0.126	2.23	2.54	11.57	12.58
TOTAL	80	112	192	20	5	41	66	258	286
Tonnes	278	775	1 053	60	15	154	302	1 355	1 418
Mean Weight (g)	3 473	6 948	5 497	3 046	2 820	3 752	4 583	5 263	4 950
Mean length (cm)	58.8	77.6	69.7	55.0	51.6	57.7	56.4	66.3	66.2
Measured weight (t)	7.7	27.8	35.5	2.1	0.2	1.5	3.7	39.2	39.2

Table 8.3.4. ANGLERFISH (*L. piscatorius*). Divisions VIIIc and IXa.
Numbers, mean weight and mean length of landings between 1986 and 2013.

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	244	4 003	60
2012	273	4 602	64
2013	286	4 950	66

Table 8.3.5. ANGLERFISH (*L. piscatorius*). Divisions VIIIc and IXa.
Abundance indices from Spanish and Portuguese surveys.

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

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

Table 8.3.6. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.

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.

Landings (t)

Year	Div. VIIIc									
	Avilés	%	Santander	%	A Coruña Port	A Coruña Trucks	A Coruña Fleet	%	Cedeira	%
1982					1 618		1 618	28		
1983					1 490		1 490	24		
1984					1 560		1 560	26		
1985					1 134		1 134	18		
1986	500	7	516	8	825		825	12		
1987	500	10	529	10	618		618	12		
1988	401	6	387	6	656		656	10		
1989	214	4	305	6	508		508	10		
1990	260	7	278	7	550		550	15		
1991	245	7	281	8	491		491	13		
1992	198	6	222	7	432		432	13		
1993	76	3	186	8	385		385	17		
1994	116	6	188	9	245	63	309	15		
1995	192	10	186	10	260	57	316	17		
1996	322	11	270	9	413	83	496	17		
1997	345	9	381	10	411	59	470	13		
1998	286	10	316	11	138	30	168	6		
1999	108	6	182	9	168	n/a	n/a	n/a	342	18
2000	28	2	75	6	85	2	88	7	140	11
2001	23	3	54	7	84	n/a	n/a	n/a	87	11
2002	75	7	57	6	130	61	191	19	130	13
2003	111	5	85	4	228	115	342	15	159	7
2004	216	7	106	3	277	162	439	14	382	12
2005	278	8	59	2	391	248	639	18	434	12
2006	148	5	89	3	242	273	515	17	415	14
2007	101	4	103	4	222	233	455	19	233	10
2008	99	4	n/a	n/a	274	153	428	18	228	10
2009	69	3	35	2	165	152	317	14	183	8
2010	n/a	n/a	44	3	95	70	165	11	231	15
2011	n/a	n/a	44	5	n/a	n/a	146	15	60	6
2012	n/a	n/a	22	2	n/a	n/a	142	11	63	5
2013	n/a	n/a	n/a	n/a	111	n/a	n/a	n/a	n/a	n/a

n/a - not available

Fishing effort

Year	Div. VIIIc					
	[1] Avilés	[1] Santander	[1] A Coruña Port	[1] A Coruña Trucks	[1] A Coruña Fleet	[2] Cedeira standardized 2012
1982			63 313		63 313	
1983			51 008		51 008	
1984			48 665		48 665	
1985			45 157		45 157	
1986	10 845	18 153	40 420		40 420	
1987	8 309	14 995	34 651		34 651	
1988	9 047	16 660	41 481		41 481	
1989	8 063	17 607	44 410		44 410	
1990	8 497	20 469	44 403		44 403	
1991	7 681	22 391	40 429		40 429	
1992	n/a	22 833	38 899		38 899	
1993	7 635	21 370	44 478		44 478	
1994	9 620	22 772	39 602	12 795	52 397	
1995	6 146	14 046	41 476	10 232	51 708	
1996	4 525	12 071	35 709	8 791	44 501	
1997	5 061	11 776	35 494	9 108	44 602	
1998	5 929	10 646	29 508	n/a	n/a	
1999	6 829	10 349	30 131	n/a	n/a	4 582
2000	4 453	8 779	30 079	n/a	n/a	2 981
2001	1 838	3 053	29 935	n/a	n/a	1 932
2002	2 748	3 975	21 948	6 747	28 695	2 398
2003	2 526	3 837	18 519	7 608	26 127	2 703
2004	n/a	3 776	19 198	10 342	29 540	4 677
2005	n/a	1 404	20 663	10 302	30 965	3 325
2006	n/a	2 718	19 264	12 866	32 130	3 911
2007	n/a	4 334	21 651	13 187	34 838	3 976
2008	n/a	n/a	20 212	9 812	30 024	5 133
2009	n/a	1 125	16 162	12 930	29 092	2 300
2010	n/a	1 628	13 744	9 003	22 746	1 880
2011	n/a	n/a	n/a	n/a	18 617	522
2012	n/a	n/a	n/a	n/a	21 110	n/a
2013	n/a	n/a	18 194	n/a	n/a	n/a

[1] Fishing days per 100 HP

[2] Soaking days

n/a - not available

Table 8.3.6.(continued)

	LPUE					
	Div. VIIIc					
Year	[1] Avilés	[1] Santander	[1] A Coruña Port	[1] A Coruña Trucks	[1] A Coruña Fleet	[2] Cedeira standardized 2012
1982			25.6		25.6	
1983			29.2		29.2	
1984			32.1		32.1	
1985			25.1		25.1	
1986	46.1	28.4	20.4		20.4	
1987	60.2	35.3	17.8		17.8	
1988	44.3	23.3	15.8		15.8	
1989	26.5	17.3	11.4		11.4	
1990	30.6	13.6	12.4		12.4	
1991	31.9	12.6	12.1		12.1	
1992	n/a	9.7	11.1		11.1	
1993	9.9	8.7	8.7		8.7	
1994	12.0	8.2	6.2	5.0	5.9	
1995	31.2	13.2	6.3	5.6	6.1	
1996	71.1	22.4	11.6	9.4	11.2	
1997	68.1	32.3	11.6	6.5	10.5	
1998	48.3	29.7	4.7	n/a	4.7	
1999	15.8	17.6	5.6	n/a	5.6	74.5
2000	6.3	8.6	2.8	n/a	2.8	46.8
2001	12.5	17.6	2.8	n/a	2.8	44.8
2002	27.5	14.3	5.9	9.1	6.7	54.3
2003	44.0	22.1	12.3	15.1	13.1	59.0
2004	n/a	28.1	14.4	15.7	14.9	81.6
2005	n/a	41.9	18.9	24.1	20.6	130.4
2006	n/a	32.7	12.6	21.2	16.0	106.2
2007	n/a	23.8	10.3	17.7	13.1	58.6
2008	n/a	n/a	13.6	15.6	14.2	44.3
2009	n/a	31.3	10.2	11.8	10.9	79.5
2010	n/a	27.1	6.9	7.8	7.3	122.7
2011	n/a	n/a	n/a	n/a	7.9	115.9
2012	n/a	n/a	n/a	n/a	6.7	n/a
2013	n/a	n/a	6.1	n/a	n/a	n/a

[1] kg/day*100HP   n/a - not available

[2] kg/soaking day

Table 8.3.6.(continued)

	Landings (t)			
	Div. IXa			
Year	Portugal Crustacean	%	Portugal Fish	%
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989	85	2	175	3
1990	106	3	219	6
1991	73	2	151	4
1992	25	1	51	2
1993	36	2	75	3
1994	23	1	47	2
1995	22	1	45	2
1996	45	2	88	3
1997	51	1	59	2
1998	11	<1	17	1
1999	3	<1	6	<1
2000	2	<1	2	<1
2001	9	1	7	1
2002	18	2	11	1
2003	13	1	16	1
2004	12	<1	14	<1
2005	12	<1	17	<1
2006	13	<1	16	1
2007	7	<1	6	<1
2008	6	<1	5	<1
2009	5	<1	5	<1
2010	1	<1	1	<1
2011	24	2	22	2
2012	3	<1	3	<1
2013	8	<1	7	<1

n/a - not available

	Effort			
	Div. IXa			
Year	[3] Portugal Crustacean	[4] Portugal Crustacean standardized	[3] Portugal Fish	[4] Portugal Fish standardized
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989	76	23	52	18
1990	90	20	61	17
1991	83	17	57	15
1992	71	15	49	14
1993	75	13	56	13
1994	41	8	36	10
1995	38	8	41	9
1996	64	14	54	12
1997	43	11	27	9
1998	48	11	35	10
1999	24	8	18	6
2000	42	10	19	6
2001	85	18	19	5
2002	62	10	14	4
2003	42	10	17	6
2004	21	7	14	4
2005	20	5	13	4
2006	22	5	12	4
2007	22	6	8	3
2008	14	4	5	2
2009	15	n/a	6	n/a
2010	21	n/a	14	n/a
2011	18	n/a	9	n/a
2012	56	n/a	35	n/a
2013	21	n/a	57	n/a

[3] 1000 Hours trawling with occurrence of anglerfish

[4] 1000 Hauls

Table 8.3.6.(continued)

	LPUE			
	Div. IXa			
Year	[3] Portugal Crustacean	[4] Portugal Crustacean standardized	[3] Portugal Fish	[4] Portugal Fish standardized
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989	1.1	3.7	3.3	9.9
1990	1.2	5.2	3.6	12.8
1991	0.9	4.4	2.6	9.8
1992	0.3	1.6	1.0	3.7
1993	0.5	2.7	1.3	5.7
1994	0.6	3.0	1.3	4.9
1995	0.6	2.8	1.1	4.9
1996	0.7	3.1	1.6	7.1
1997	1.2	4.5	2.2	6.7
1998	0.2	1.0	0.5	1.8
1999	0.1	0.4	0.3	1.0
2000	0.0	0.2	0.1	0.4
2001	0.1	0.5	0.4	1.4
2002	0.3	1.9	0.8	2.4
2003	0.3	1.3	0.9	2.8
2004	0.6	1.9	1.0	3.3
2005	0.6	2.2	1.3	4.7
2006	0.6	2.4	1.3	4.2
2007	0.3	1.1	0.8	2.1
2008	0.4	1.5	1.0	2.9
2009	0.3	n/a	0.7	n/a
2010	0.0	n/a	0.1	n/a
2011	1.3	n/a	2.4	n/a
2012	0.1	n/a	0.1	n/a
2013	0.4	n/a	0.1	n/a

[3] kg/hour trawl n/a - not available

[4] kg/haul

Table 8.3.7. ANGLERFISH (*L. piscatorius*) - Division VIIIc and IXa.
Summary of the assessment results.

Year	Recruit Age0 (thousands)	Total Biomass (t)	Total SSB (t)	Landings (t)	Yield/SSB	F (30-130 cm)
1980	442	13 111	7 194	4 817	0.67	0.33
1981	1 650	14 862	9 609	5 566	0.58	0.34
1982	6 788	14 385	10 957	5 782	0.53	0.38
1983	3 025	13 447	9 990	6 113	0.61	0.52
1984	803	13 383	8 276	6 031	0.73	0.54
1985	1 677	12 805	8 139	6 139	0.75	0.55
1986	5 996	10 805	7 757	6 870	0.89	0.83
1987	4 115	7 467	4 886	5 139	1.05	0.96
1988	1 628	7 381	3 313	6 321	1.91	1.46
1989	2 979	5 783	2 516	4 995	1.99	1.20
1990	2 427	4 761	2 285	3 790	1.66	0.89
1991	926	4 655	2 136	3 640	1.70	0.87
1992	1 168	4 417	2 120	3 382	1.60	0.91
1993	1 374	3 539	1 923	2 329	1.21	0.69
1994	2 862	3 369	1 876	2 007	1.07	0.59
1995	2 190	3 906	1 962	1 835	0.94	0.39
1996	457	5 762	2 788	2 956	1.06	0.43
1997	210	6 892	3 862	3 715	0.96	0.47
1998	180	6 365	4 384	2 981	0.68	0.39
1999	475	5 453	4 352	1 939	0.45	0.30
2000	560	4 793	4 079	1 256	0.31	0.25
2001	3 112	4 530	3 794	788	0.21	0.19
2002	1 612	5 247	3 882	1 034	0.27	0.20
2003	394	7 294	4 465	2 279	0.51	0.31
2004	1 703	8 726	5 609	3 156	0.56	0.33
2005	1 122	9 048	6 612	3 646	0.55	0.38
2006	1 318	8 550	6 398	2 932	0.46	0.37
2007	553	8 163	6 056	2 349	0.39	0.32
2008	461	8 246	6 179	2 338	0.38	0.30
2009	637	8 071	6 362	2 280	0.36	0.30
2010	997	7 504	6 204	1 548	0.25	0.23
2011	1 222	7 457	6 160	976	0.16	0.16
2012	586	8 245	6 579	1 257	0.19	0.18
2013	1 803	9 094	7 106	1 419	0.20	0.18

Table 8.3.8. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Catch option table.

SSB(2014)	Rec proj	F(30-130cm)	Land(2014)	SSB(2015)
7 876	1 178	0.17	1 570	8770

Fmult	Fland (30-130cm)	Landings(2015)	SSB(2016)
0	0	0	11598
0.1	0.02	194	11408
0.2	0.03	383	11222
0.3	0.05	569	11039
0.4	0.07	752	10860
0.5	0.09	931	10684
0.6	0.1	1107	10511
0.7	0.12	1279	10342
0.8	0.14	1449	10176
0.9	0.15	1615	10013
1	0.17	1777	9853
1.1	0.19	1937	9696
1.2	0.2	2094	9542
1.3	0.22	2248	9391
1.4	0.24	2399	9243
1.5	0.26	2547	9097
1.6	0.27	2692	8954
1.7	0.29	2835	8814
1.8	0.31	2975	8677
1.9	0.32	3112	8542
2	0.34	3247	8409

Table 8.3.9. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Yield and SSB per recruit summary table.

SPR level	Fmult	F(30-130cm)	YPR(land)	SSB/R
1.00	0.0	0.00	0.00	53.73
0.87	0.1	0.02	0.42	46.53
0.75	0.2	0.03	0.77	40.40
0.66	0.3	0.05	1.05	35.17
0.57	0.4	0.07	1.29	30.69
0.50	0.5	0.09	1.48	26.86
0.44	0.6	0.10	1.64	23.56
0.39	0.7	0.12	1.77	20.73
0.34	0.8	0.14	1.87	18.30
0.30	0.9	0.15	1.96	16.19
0.27	1.0	0.17	2.03	14.37
0.24	1.1	0.19	2.08	12.80
0.21	1.2	0.20	2.12	11.43
0.19	1.3	0.22	2.15	10.24
0.17	1.4	0.24	2.17	9.20
0.15	1.5	0.26	2.18	8.30
0.14	1.6	0.27	2.19	7.50
0.13	1.7	0.29	2.19	6.80
0.12	1.8	0.31	2.19	6.19
0.11	1.9	0.32	2.19	5.65
0.10	2.0	0.34	2.18	5.17

	SPR level	Fmult	F(30-130cm)	YPR(land)	SSB/R
Fmax	0.12	1.72	0.29	2.19	6.67
F0.1	0.24	1.10	0.19	2.08	12.80
F40%	0.40	0.67	0.11	1.73	21.54
F35%	0.35	0.78	0.13	1.85	18.87
F30%	0.30	0.90	0.15	1.96	16.19

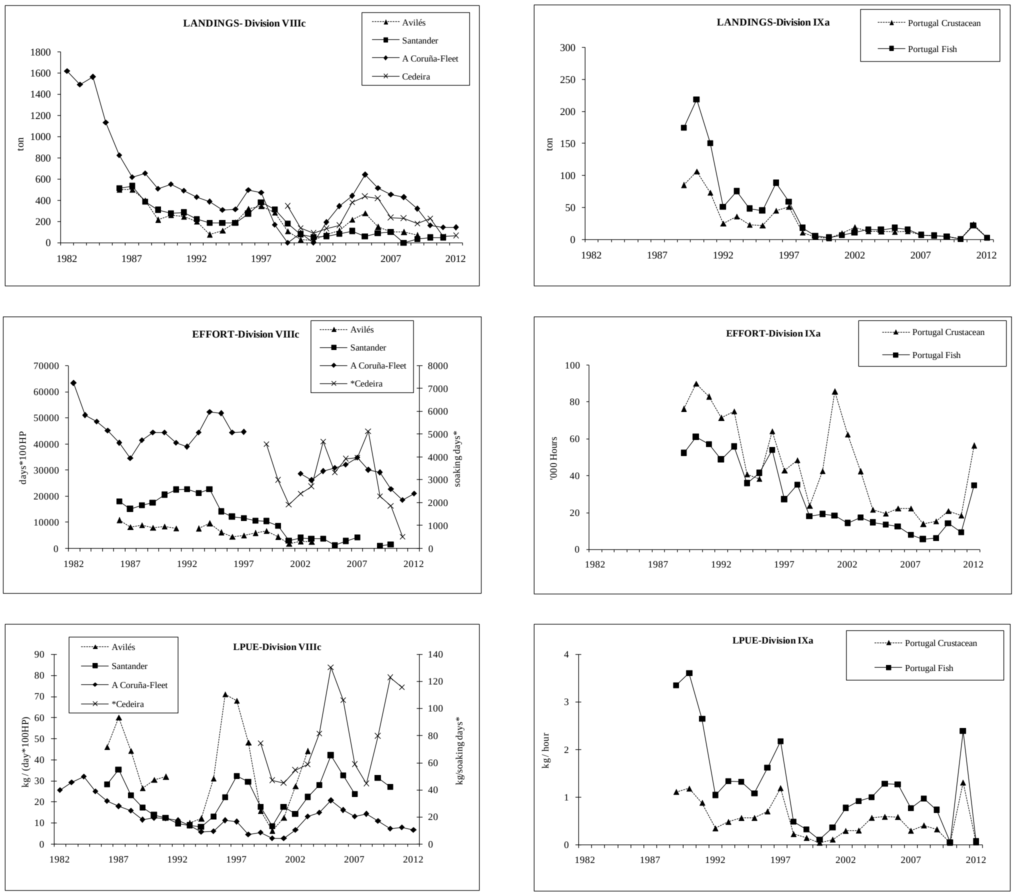


Figure 8.3.2 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa Trawl and gillnet landings, effort and LPUE data between 1982-2012

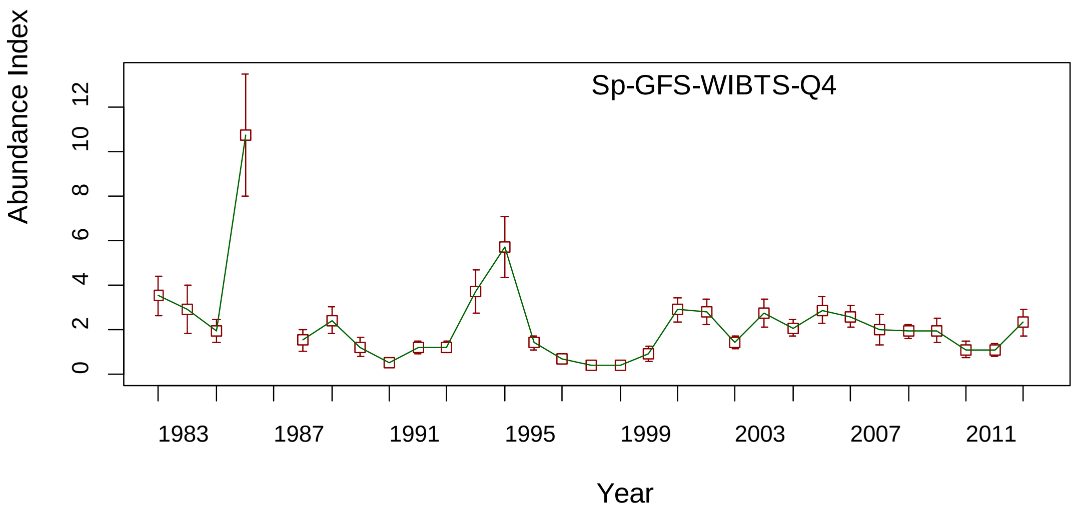


Figure 8.3.3 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Abundance index from survey Sp-GFS-WIBTS-Q4 in numbers/30 min. Bars represent 95% confidence intervals.

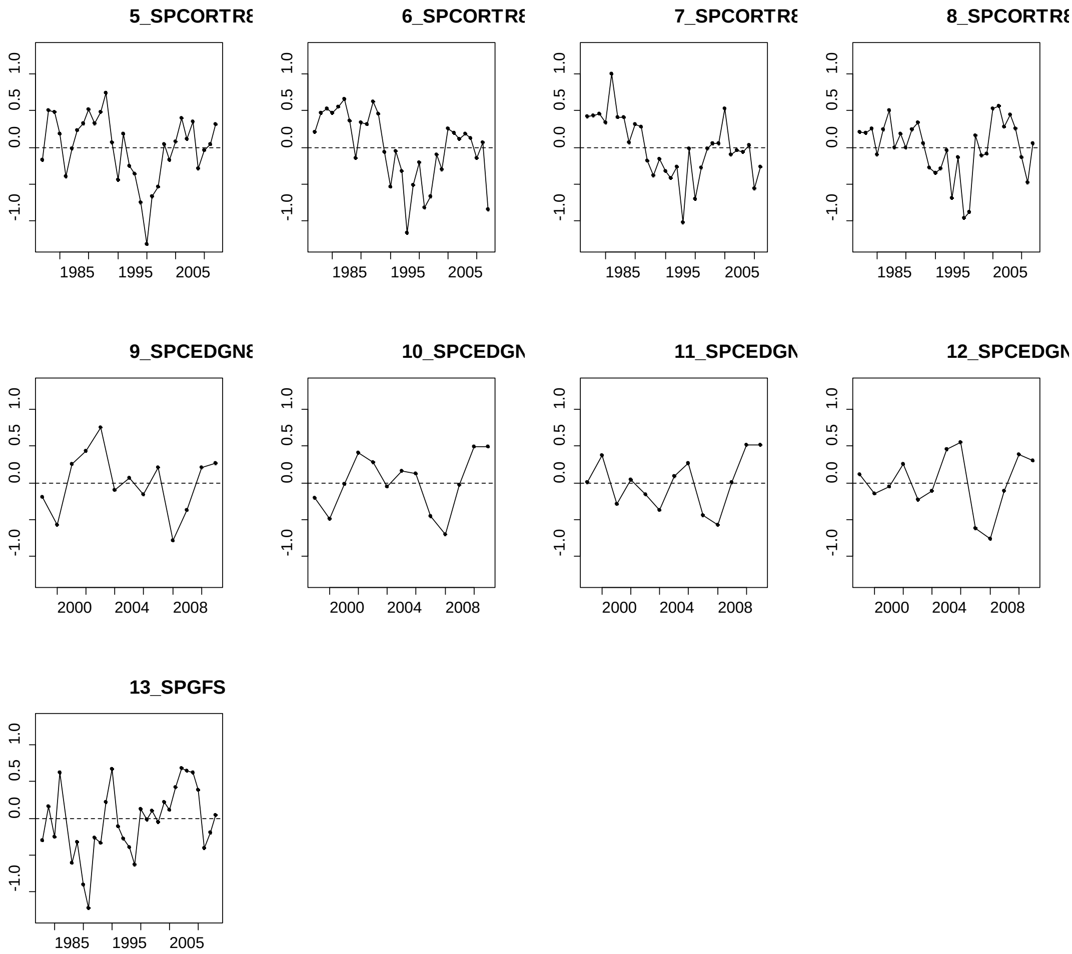


Figure 8.3.4 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Residuals of the fits to the surveys in log(abundance indices). A Coruña and Cedeira are by quarters.

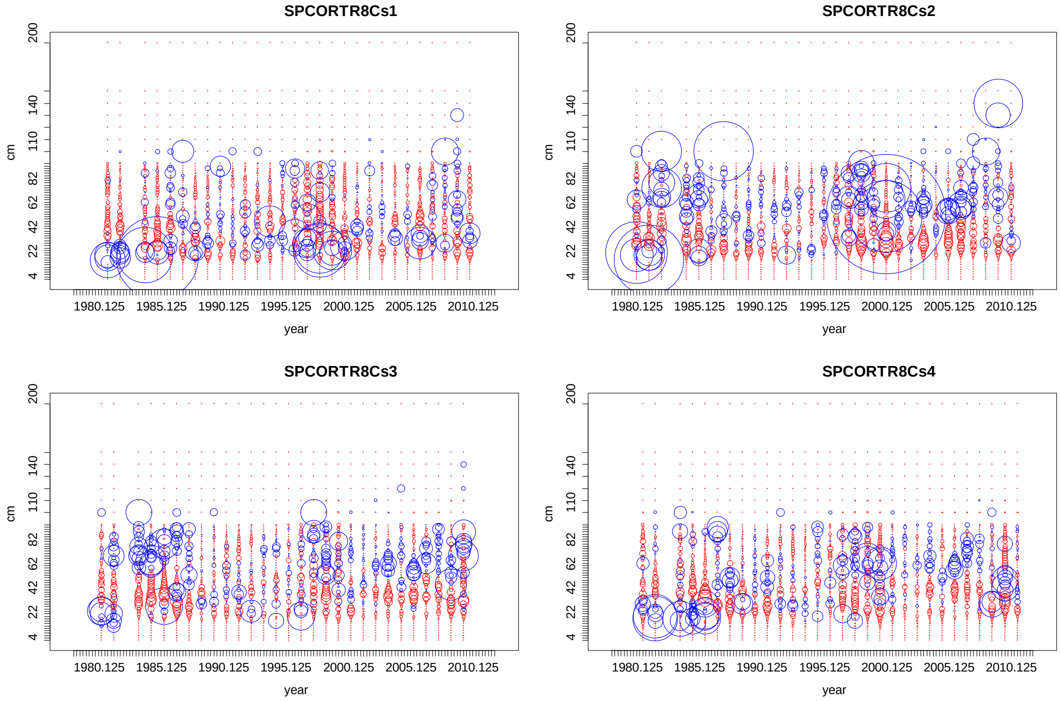


Figure 8.3.5 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Pearson residuals of the fit to the length distributions of the abundance indices. Blue=positive residuals and red=negative residuals.

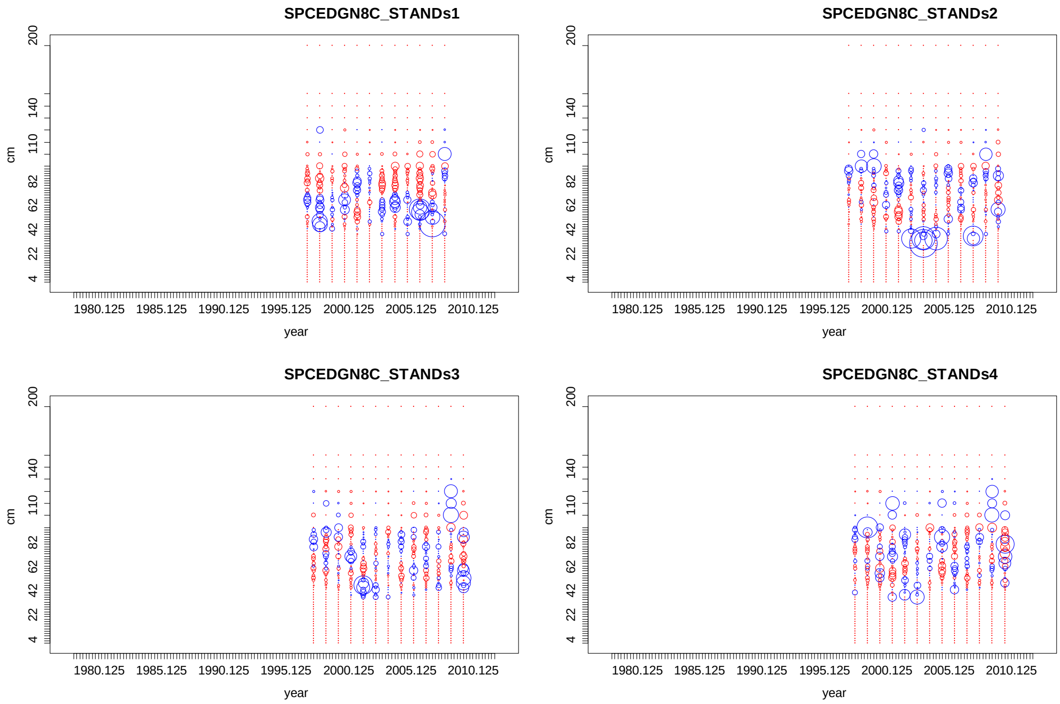


Figure 8.3.5 (continued)

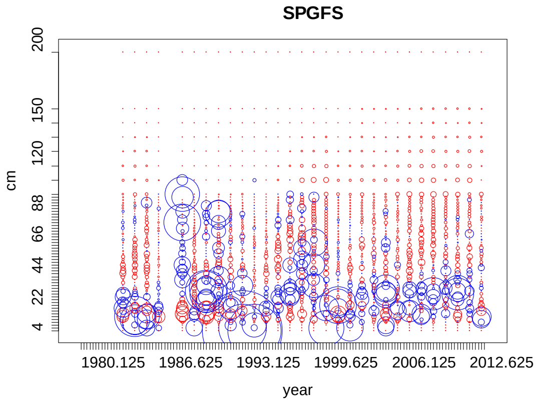


Figure 8.3.5 (continued)

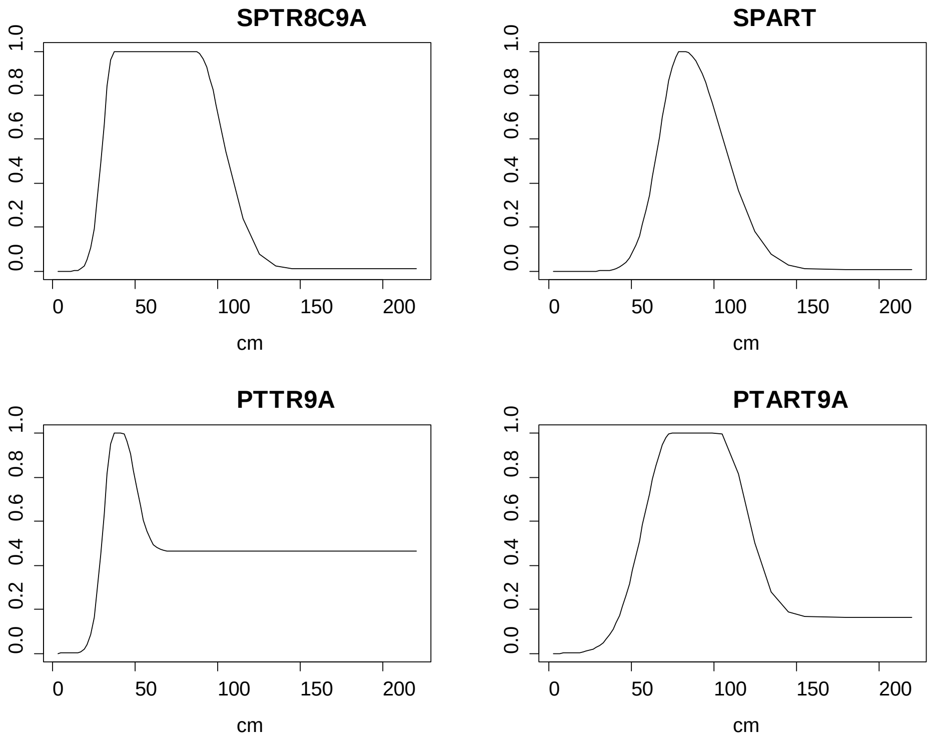


Figure 8.3.6 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Relative selection patterns at length by fishery estimated by SS3.

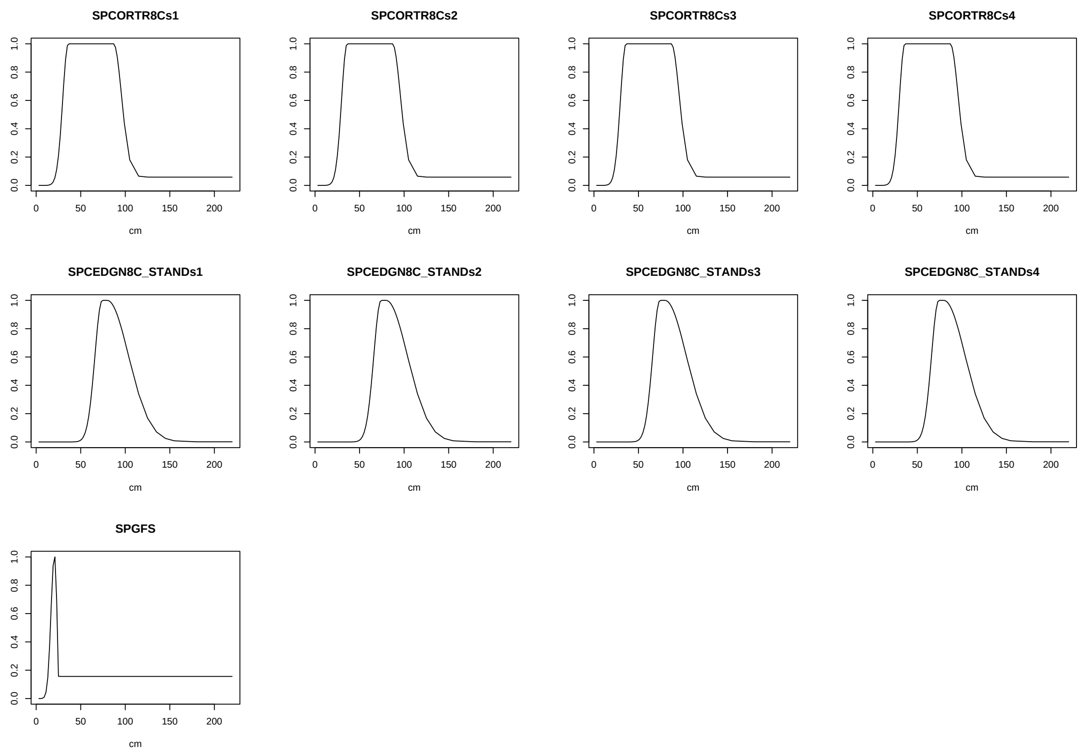


Figure 8.3.7 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Relative selection patterns at length by abundance index estimated by SS3. A Coruña and Cedeira indices are by quarter.

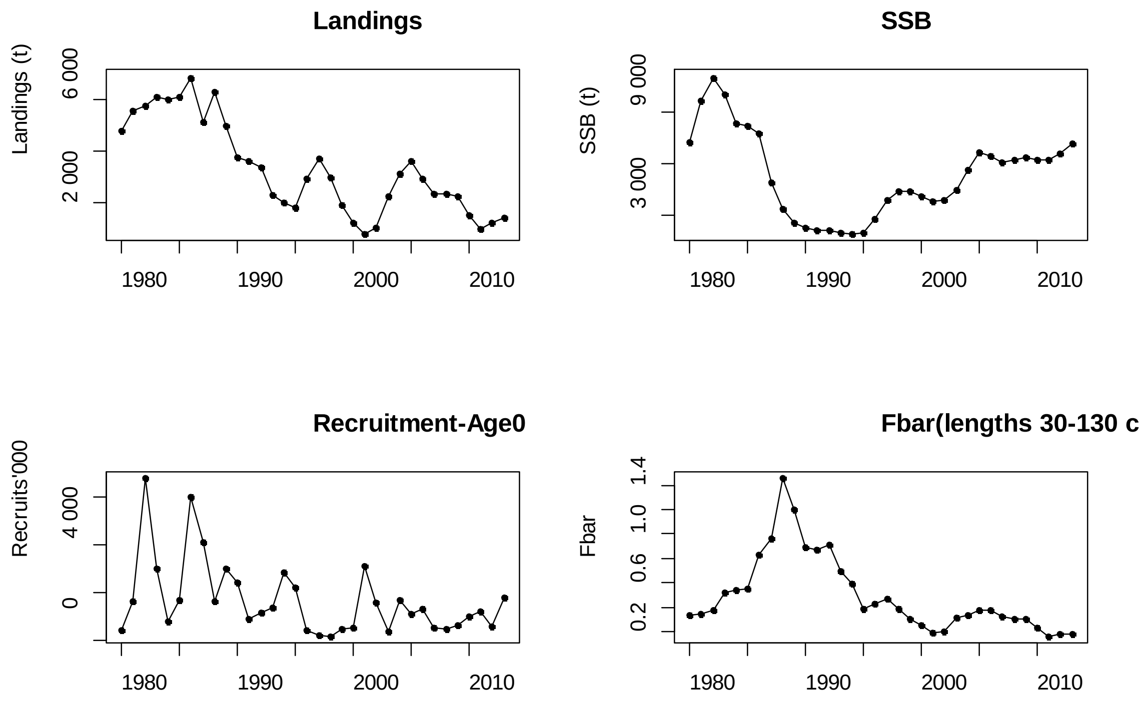


Figure 8.3.8 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Summary plots of stock trends.

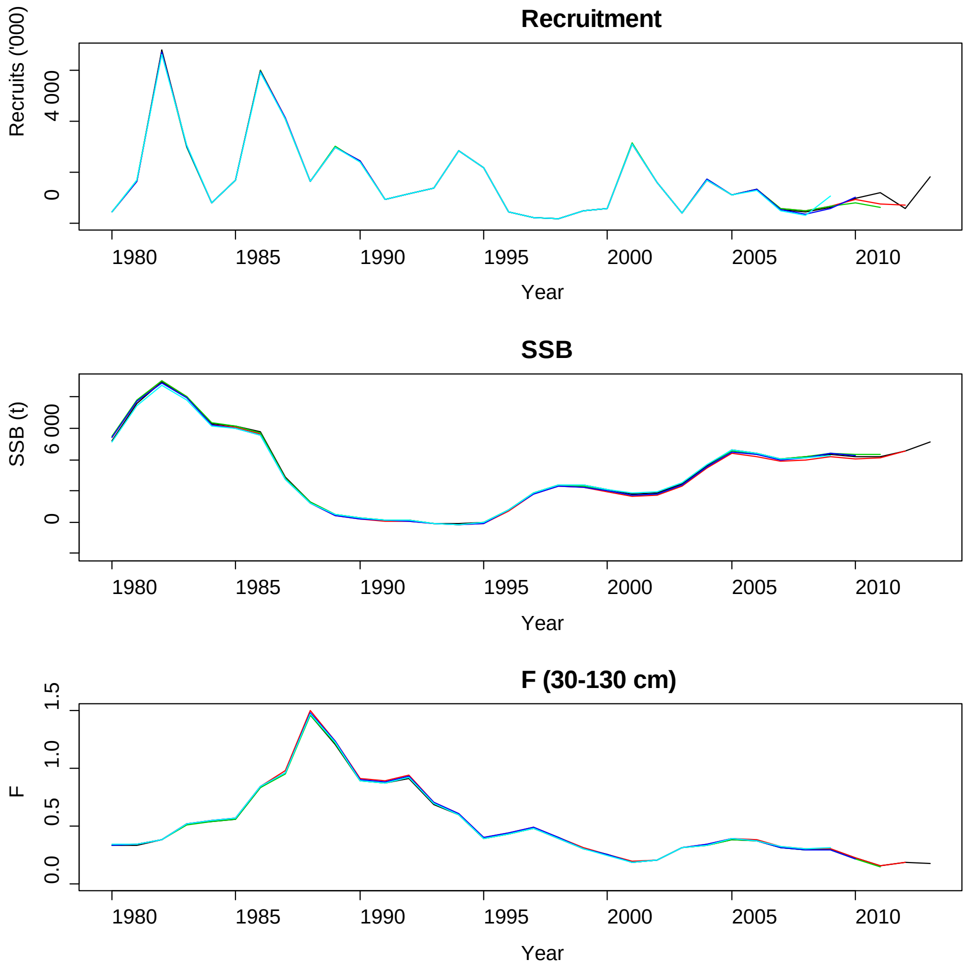


Figure 8.3.9 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Retrospective plots from SS3.

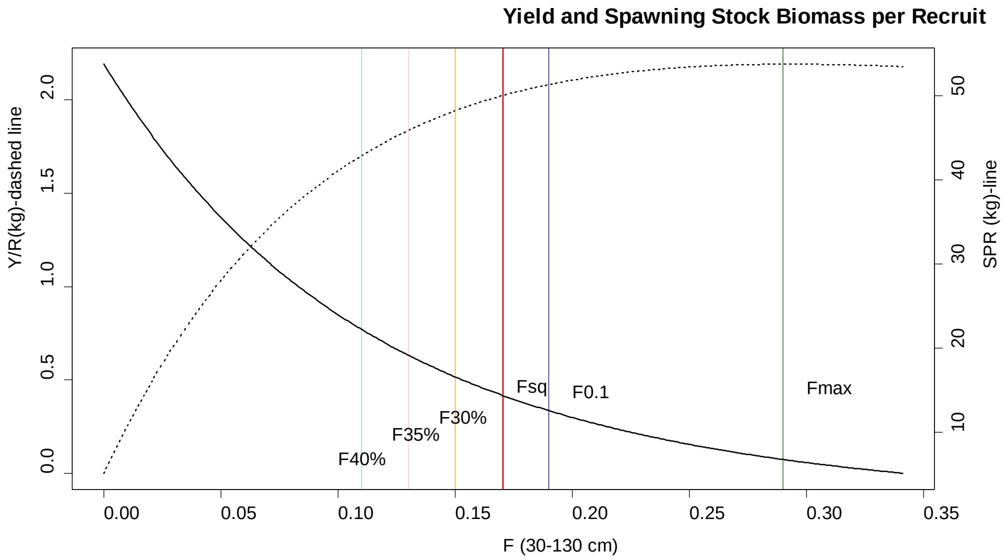


Figure 8.3.10 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Yield and SSB per recruit plot. Estimated reference points and Fsq are indicated.

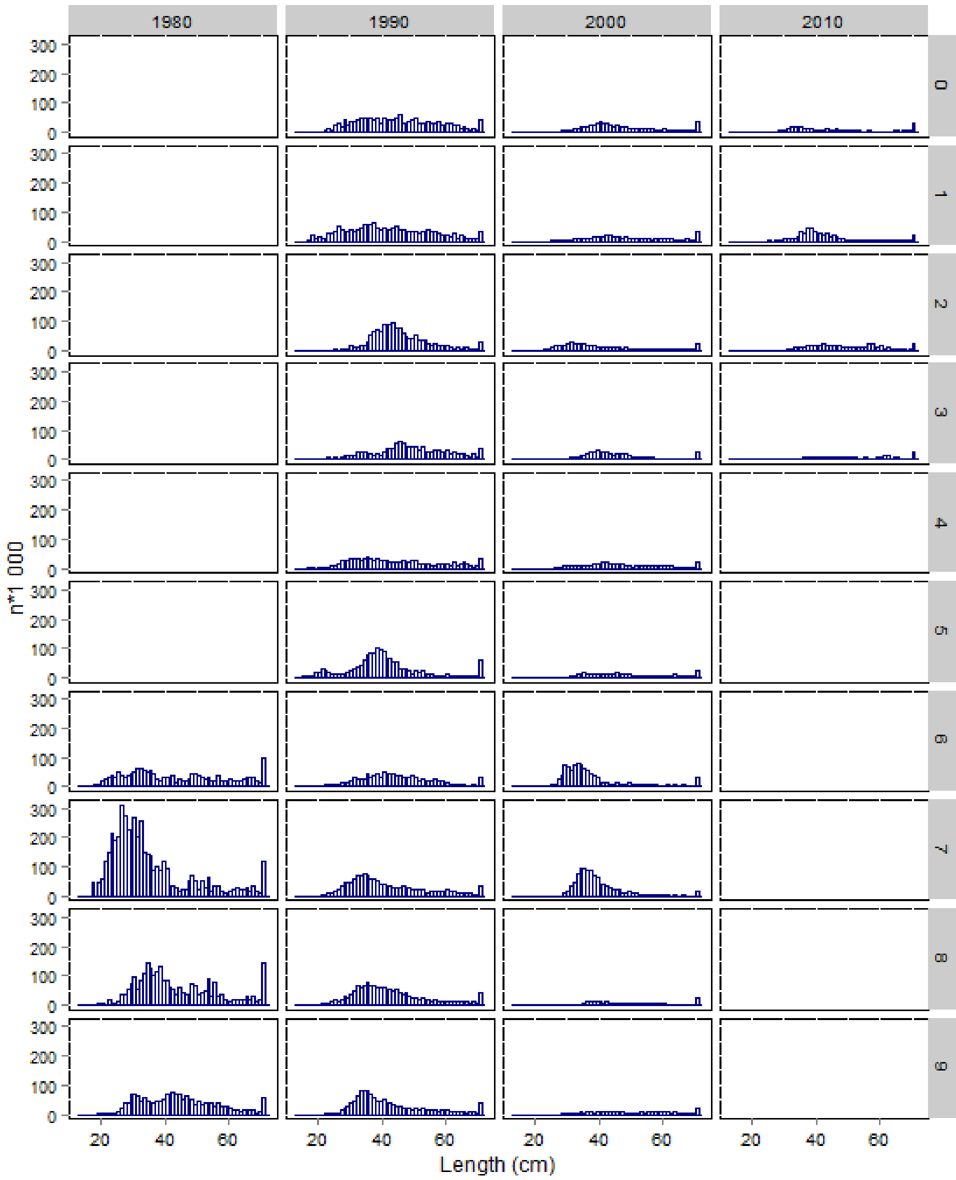


Figure 8.4.1 **ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa. Length distributions of landings (thousands for 1986 to 2013).**

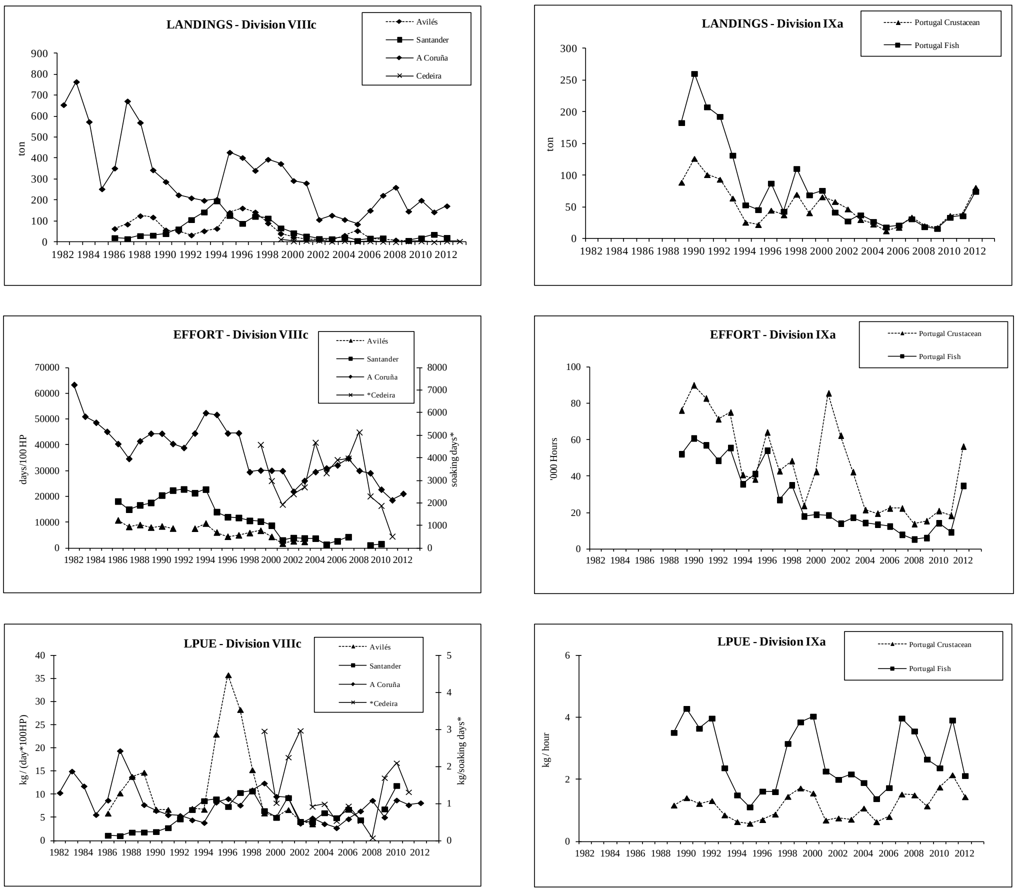


Figure 8.4.2 **ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa. Trawl and gillnet landings, effort and LPUE data between 1986-2012.**

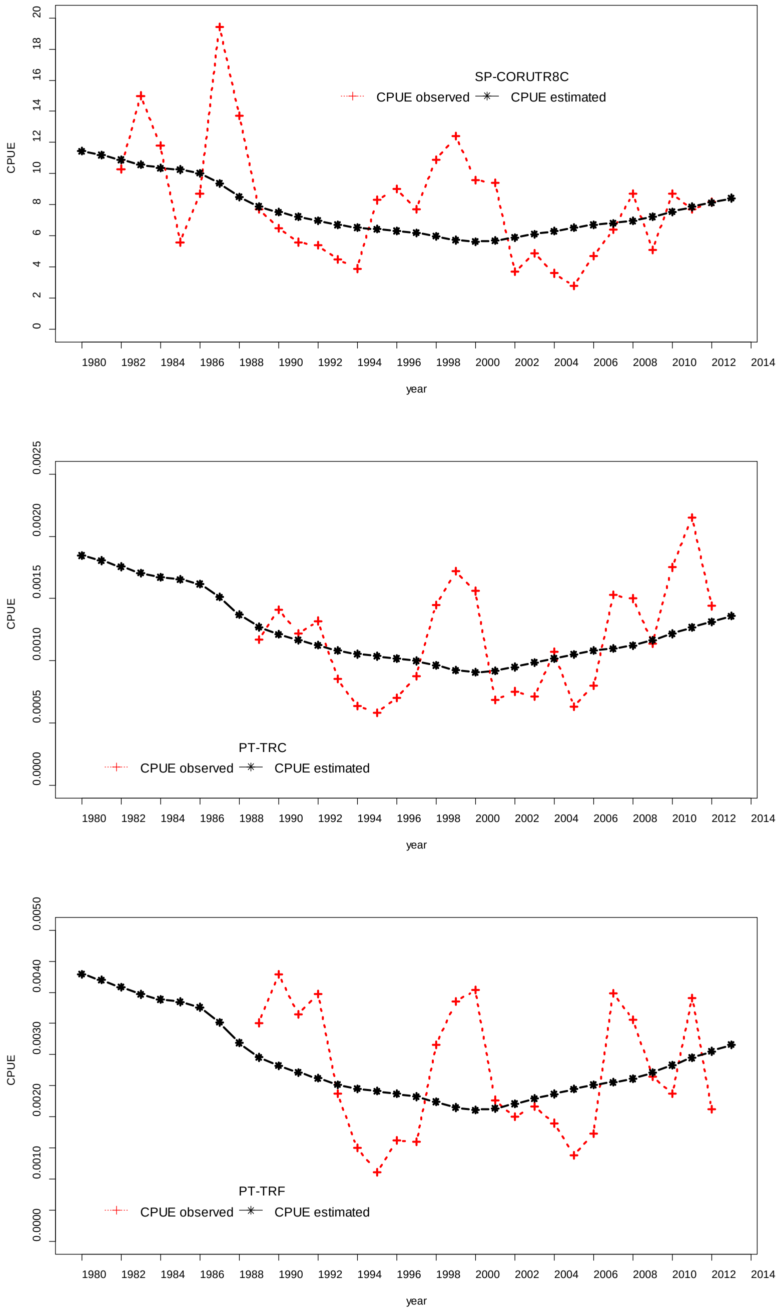


Figure 8.4.3. ANGLERFISH (*L. budegassa*)– Divisions VIIIc and IXa. Observed CPUE for the three commercial fleets and estimated values by the model.

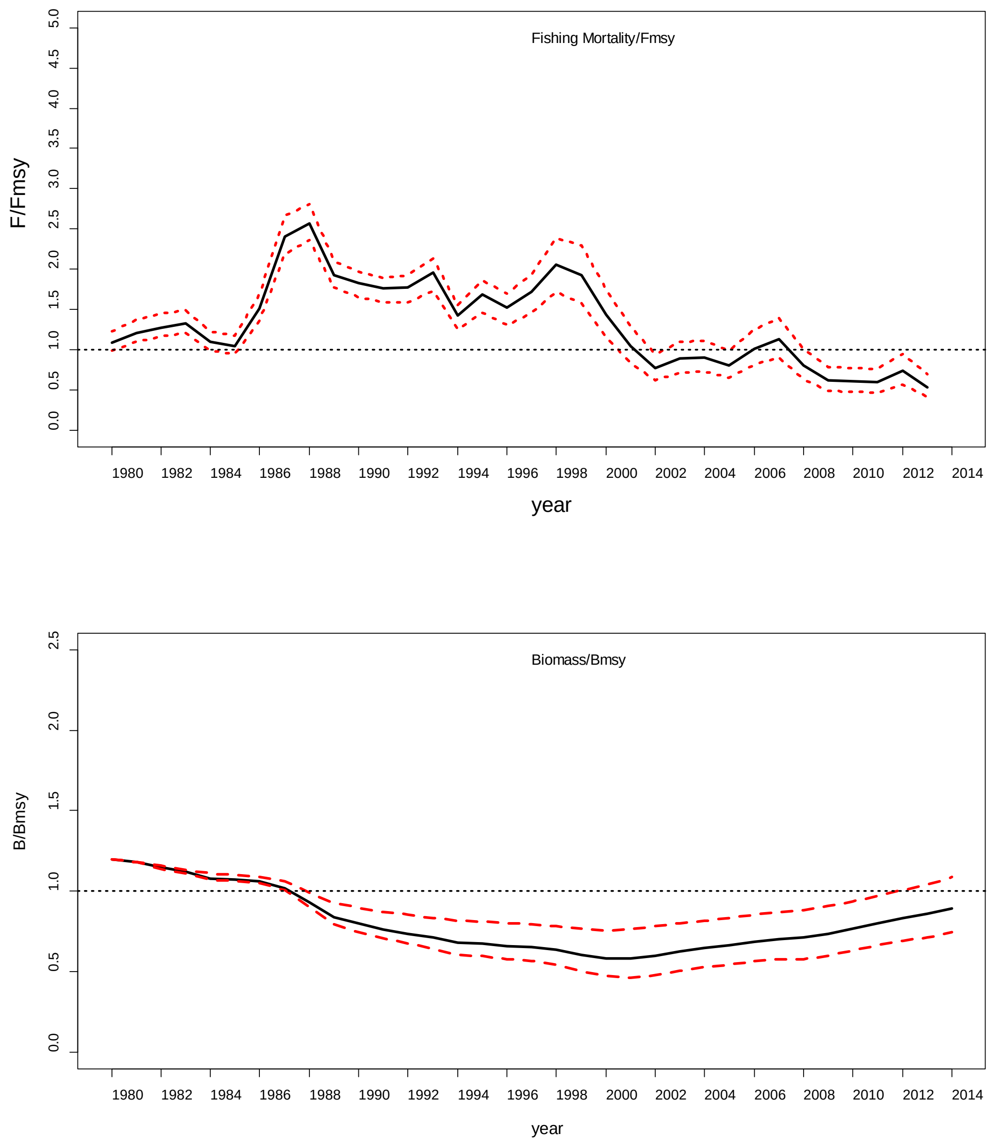
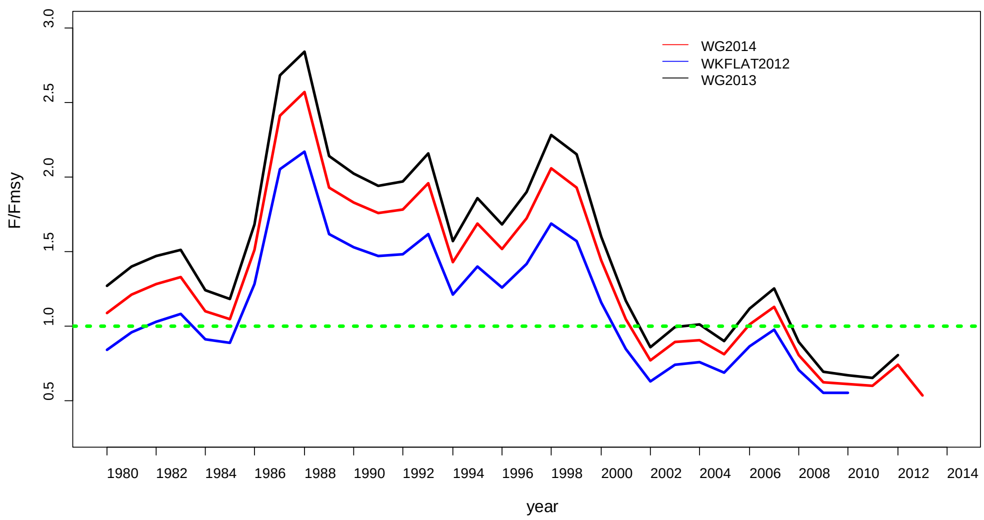


Figure 8.4.4. ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa. Confidence intervals (80%) of the F/FMSY and B/BMSY ratios.



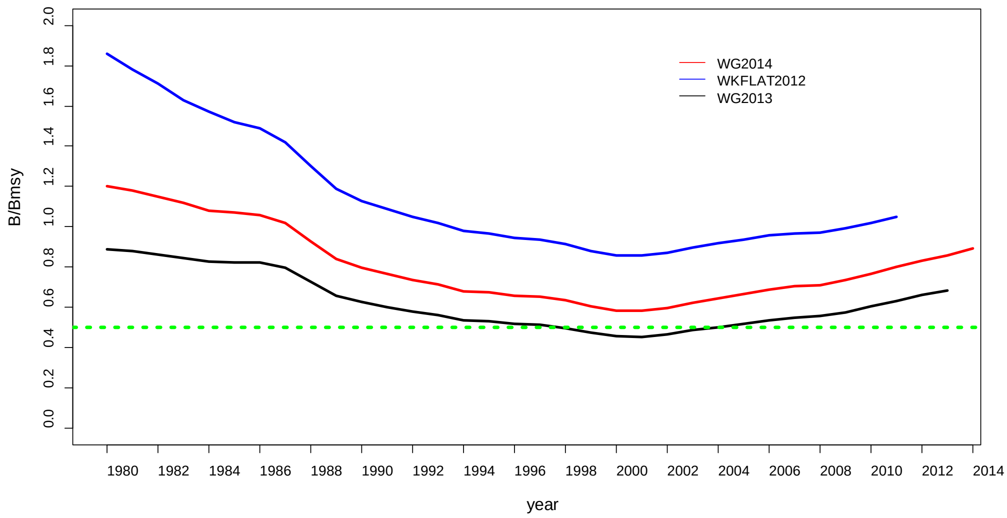
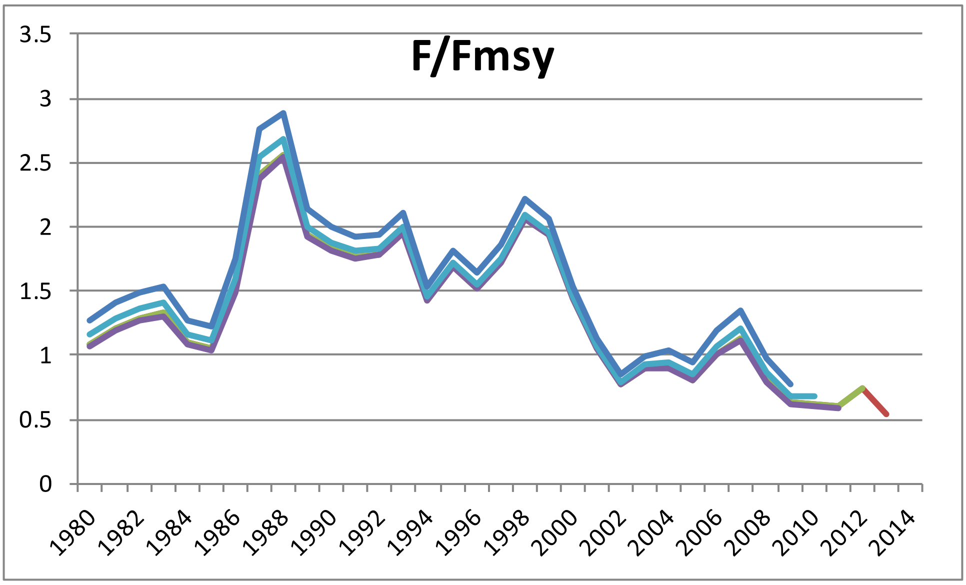


Figure 8.4.5. ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa. Trends of the F/FMSY and B/BMSY ratios from the, 2012 benchmark, 2013 and 2014 WG assessments.



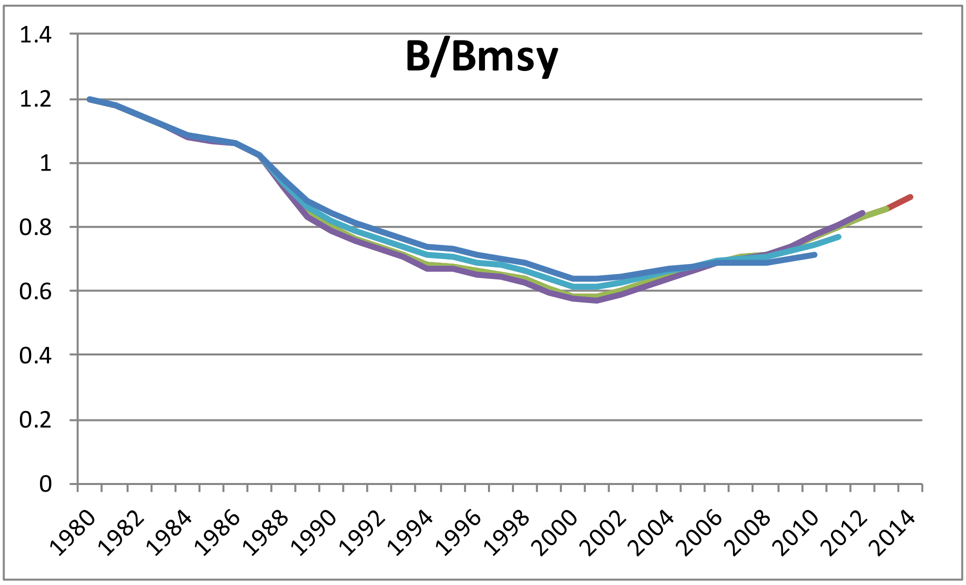


Figure 8.4.6 ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa. Retro analysis of the F/FMSY and B/BMSY ratios of 2014 WG assessment.

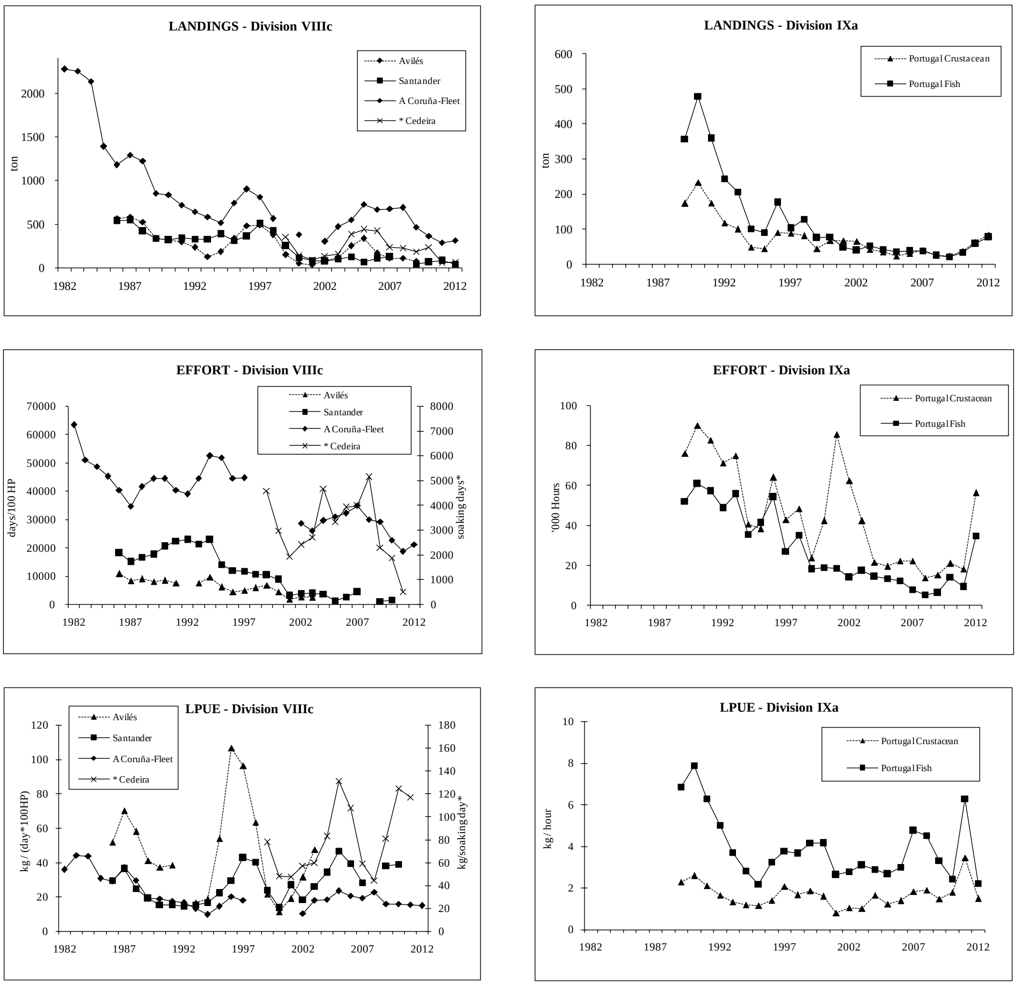


Figure 8.5.1 ANGLERFISH (*L. budegassa* and *L. piscatorius*) - Divisions VIIIc and IXa. Trawl and gillnet landings, effort and LPUE data between 1982-2012.

9 Megrims in Divisions VIIIc and IXa

Lepidorhombus whiffiagonis:

Type of assessment in 2014: Benchmark (new data and settings were approved in WKSOUTH-2014). The assessment model has been updated with 2013 data in the working group.**Data revisions this year:** Discards missing data have been estimated and the complete time series has been included in the assessment model. New tuning fleets for A Coruña port and Avilés port from 1986-2013 have been provided and included.

None

Lepidorhombus boscii:

Type of assessment in 2014: Update. Benchmark (new data and settings were approved in WKSOUTH-2014). The assessment model has been updated with 2013 data in the working group.

Data revisions this year: Discards missing data have been estimated and the complete time series has been included in the assessment model. New tuning fleets for A Coruña port and Avilés port from 1986-2013 have been provided. Only new fleet for A Coruña has been included

General

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 2013 and management for 2013 and 2014

ICES advice for 2014(as extracted from ICES Advice 2013, Book 7):

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

Following the ICES MSY approach implies fishing mortality at FMSY = 0.18, resulting in landings of no more than 1957 t in 2014. This is expected to lead to an SSB of 7012 t in 2015 for *L. boscii*. *For L. whiffiagonis*, the ICES MSY approach implies fishing mortality at 0.15, with landings of 300 t in 2014. The expected SSB in 2015 is 1168 t. ***Management applicable for 2013 and 2014:***

The agreed combined TAC for megrim and four-spot megrim in ICES Divisions VIIIc and IXa was 1214 t in 2013 and 2257 t in 2014.

9.1 Megrim (*L. whiffiagonis)* in Divisions VIIIc and IXa

9.1.1 General

See general section for both species.

9.1.2 Data

9.1.2.1 Commercial catches and discards

Working Group estimates of landings, discards and catches for the period 1986 to 2013 are given in Table 9.1.1. Estimates of catches presently include an unallocated landing category. These estimates are considered the best information available at this time. However, given that the method of calculating them has changed this year, it is recommend to review the time series of unallocated landings for this stock following the criteria used in 2013. The total estimated international landings in Divisions VIIIc and IXa for 2013 was 222 t. Landings reached a peak of 977 t in 1990, followed by a steady decline to 117 t in 2002. Some increase in landings has been observed since then, but landings have again decreased annually since 2007. The landings in 2010 were the lowest value of the entire series. 2012 and 2013 values represent important increments in the landings of the stock. Historical landings for both species combined are shown in Figure 9.1.1. In 2013, international landings are 1342 t, being a increase in relation to the previous year.

Discards estimates were available from “observers on board sampling programme” for Spain in the years displayed in Table 9.1.2(a). Discards in number represent between 10-45% of the total catch, with the exception of the year 2007 when discards have been very low and 2011 with discards extremely high. Following recommendations described in the advice sheets for both stocks, different methodologies were applied trying to reconstruct the discards time-series in years without sampling for the Benchmark WKSOUTH. An effort was made to complete the time-series back until 1986. Given the dissatisfaction with the more advanced methods applying GLMs, discard estimates from the average by period were selected by the Benchmark for filling in missing data. For the first period (1986-1999), the average of available years 1994, 1997 and 1999 were used and for the second period (2000-2012) the absence of data in 2001 and 2002 was replaced by the average of the closest years. The reason for using these two periods is the change in the Minimum landing size (MLS) in 2000 that has the potential to bring about a shift in the discarding behaviour.. Total discards are given in tons in Table 9.1.1 and in numbers at age in Table 9.1.2(b), these data are now included in the assessment model.

9.1.3 Biological sampling

Annual length compositions of total stock landings are displayed in Figure 9.1.2 for the period 1986 – 2013 and in Table 9.1.3. (a)Unallocated value is raised to total length distribution. ,. The bulk of sampled specimens corresponds to fish of 21-36 cm.

Sampling levels for both species are given in Table 1.3.

Mean lengths and mean weights in landings since 1990 are shown in Table 9.1.3(b). The mean length and mean weight values in 2014 are the highest in the historic series.

Age compositions of catches are presented in Table 9.1.4 and weights-at-age of catches in Table 9.1.5, from 1986 to 2013. These values were also used as the weights-at-age in the stock.

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

9.1.3.1 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 9.1.6. In 2012, Portuguese surveys were not conducted due to budgetary constraints of national scope turned unfeasible to repair the R/V.

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

The Spanish survey (SpGFS-WIBTS-Q4) covers the distribution area and depth strata of this species in Spanish waters (covering both VIIIc and IXa). 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. In 2011, the index increases significantly, being the highest value in the last 10 years, going to decline in 2012 and increase in 2013 again (Figure 9.1.3(a), bottom right panel). In 2013 the survey has been carried out in a new vessel and with new doors. This year the abundance indices are 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 this year in the assessment model. It is necessary to explore the reasons for these results, and if a correction factor must be applied for next survey results.

The Spanish survey recruitment indices for ages 0 and 1 indicate an extremely weak year class in 1993, followed by better recruitments, except for relatively low values for the 1997 and 1998 year classes. The 1999 year class appears to be relatively strong compared to those from previous years, but the 2000 to 2005 year classes again appear to be low. The survey indicates extremely low values at age 0 for years 2006-2008, with 2006 and 2008 being equal worst with 1993 in the historic series. In 2009, the age 0 index is the highest after 2001, whereas the age 1 index is the second lowest in the series. In 2010, there is a very important increase in age 1, being the highest value since 1996. In 2013 ages 0 is in very low level.

Catch numbers-at-age per unit effort and effort values for the Spanish survey are given in Table 9.1.7. In addition, Figure 9.1.3(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. Only the years used to tune the XSA assessment are represented. The figure indicates that the survey is quite good at tracking cohorts through time and highlights the weakness of the last few cohorts. The big age 1 index in 2010 is also detected in this figure and can be followed, present in age 2 in 2011, age 3 in 2012 and age 4 in 2013.

9.1.3.2 Commercial catch-effort data

The commercial LPUE and effort data of the Portuguese trawlers fishing in Division IXa covers the period 1988 – 2013 (Table 9.1.8 and Figure 9.1.3(a)).

The last assessments were calibrated by using two bottom otter trawl tuning fleets: A Coruña trawl (SP-CORUTR8c) for the period 1990-current year and Avilés trawl (SP-AVILESTR) for the period 1990-2003. 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. These new tuning fleets (SP-LCGOTBDEF and SP-AVSOTBDEF) were accepted to tune the assessment model. The LPUEs and effort values are given in Table 9.1.8 and Figure 9.1.3(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 2013, effort shows a high increase. The LPUE shows relatively high stable values for 1986 – 2002. Since 2003 LPUE shows lower values, is increasing since 2010 till 2012 and in 2013 a new fall can be observed.

Avilés (SP-AVSOTBDEF) effort does not present any trend throughout the whole period. The highest value occurred in 1998 and the lowest in 2001. . LPUE shows an 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 9.1.7.

Figure 9.1.3(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. Only the years used to tune the XSA are represented. The panel corresponding to A Coruña trawl fleet clearly indicates below average values since about year 2003, in 2011 and 2012 values are above average but in 2013 the values fell again.

Commercial fleets not used in the assessment to tune the model

Portuguese effort values are quite variable, except in 2001 and 2002 when they are significantly lower (Table 9.1.8 and Figure 9.1.3(a)). For the Portuguese fleets, until 2011 most log-books were filled in paper but have thereafter been progressively replaced by e-logbooks. In 2013 more than 90% of the log-books are being completed in the electronic version. However, due to various errors, data cleaning algorithms are required and are yet to be agreed upon internally in IPMA. IPMA therefore opted to postpone estimations of CPUE until 2015 (at which time the series will also be revised backwards). 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 2013 represent a decrease in relation to previous years.

9.1.4 Assessment

An update assessment was conducted, according to the Stock Annex specifications and the new settings accepted in the Benchmark. Assessment years are 1986-2013 and ages 1-7+.

9.1.4.1 Input data

It follows the Stock Annex, incorporating discards data to landed numbers-at-age and resulting in catch numbers-at-age as input data from 1986 to 2013. New indices from A Coruña (SP-LCGOTBDEF) tuning fleet and Avilés tuning fleet (SP-AVSOTBDEF) have been included. The Spanish survey (SpGFS-WIBTS-Q4) has not been updated with 2013 data for the raison mentioned before.

9.1.4.2 Model

Data screening

Figure 9.1.4(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. The top panel of Figure 9.1.4(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 4 to 7+. The high abundance of age 0 in the Spanish survey in 2009 can have influence in the high values of ages 2 and 3 in 2011 and 2012. Figure 9.1.4(a) shows discards proportion at age, being more abundant for age 1 from 2000 onwards. Before this year, discarding was higher in age 2. Visual inspection of Figures 9.1.3(b) and 9.1.3(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 trawl fleet.

Final run

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

The retrospective analysis shows a small but consistent pattern of overestimation of SSB and underestimation of F and recruitment in recent years (Figure 9.1.5).

9.1.4.3 Assessment results

Diagnostics from the XSA run are presented in Table 9.1.9 and log catchability residuals plotted in Figure 9.1.6. For all tuning fleets the magnitude of the residuals is larger for older ages. Residuals in A Coruña trawl fleet in the last years present mainly positive values. Until 1997 many of the survey residuals were negative, whereas many are positive since 1999. Since 2008, there appears to be a change towards negative survey residuals again. Several year effects are apparent in all tuning series. As has been the case in the last few years the model shows that it hasn't converged, however the differences which activate this criteria was so small (0.00049 difference) and close to zero that we have confidence that the assessment has converged.. The results presented correspond to a run of 160 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 9.1.10 and 9.1.11, respectively, and summary results presented in Table 9.1.12 and Figure 9.1.7(a).

Fishing mortality is estimated to have decreased in 2013, after the two increasing values of 2011 and 2012 that which may be explained by the increase in landings in that two years. The SSB values in 2007-2010 are the lowest in the series. 2011 and 2012 SSB values are significantly higher and similar to those that occurred in the nineties. SSB for 2013 shows again an increase. After a very high recruitment (at age 1) value in the series in 2010 and the followings decreases, the last year the recruitment value shows an increase.

Bubble plots of standardised (by subtracting the mean and dividing by the standard deviation over the years) estimated F-at-age and relative F-at-age (F-at-age divided by Fbar) are presented in Figure 9.1.7(b). The top panel of the figure indicates that fishing mortality has been lower for all ages since about year 2000. The reduction occurred earlier for ages 1 and 2, at around 1994. In terms of the relative exploitation pattern-at-age (bottom panel of the figure), the most obvious changes are the reduction for ages 1 and 2 around 1994 and the increase for age 3 soon after that. This might be related to discarding practices. There is no clear pattern over time in the age 4 selection, whereas for ages 5 and older there seems to have been an increase during the mid to late 1990's but they have since come back down to lower values. Since 2010, there appears to have been an increase of the relative exploitation towards older ages, with high values above the average for ages 5 to 7+.

9.1.4.4 Year class strength and recruitment estimations

The 2010 year class is estimated to have 6.1 million fish at 1 year of age, based on the Spanish survey (SpGFS-WITBS-Q4) (60% of weight), two commercial fleets SP-LCGOTBDEF (22% of weight) and SP-AVSOTBDEF (14% of weight) and F shrinkage (4%).

The 2011 year class is estimated to have 3.4 million individuals at 1 year of age based on the information from the Spanish survey (SpGFS-WIBTS-Q4) (47% of weight), P-shrinkage (46% of the weight) and F shrinkage (7%).

The 2012 year class is estimated to have 4.2 million fish at 1 year of age, based on P-shrinkage (84% of the weight) and F shrinkage (16%).

In accordance with the stock annex specifications, GM recruitment is computed over years 1998-2011. 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
2010	6062	XSA	460%	36%	4%
2011	3358	XSA	647%	0%	53%
2012	3274	GM (98-11)			
2013	3274	GM (98-11)			

9.1.4.5 Historic trends in biomass, fishing mortality and recruitment

From Table 9.1.12 and Figure 9.1.7, we see that SSB decreased from 2416 t in 1990 to 1080 t in 1995. From 1996 to 2003, it remained relatively stable at low levels with an average value of around 1100 t. Starting from 2004, SSB is estimated to have been even lower, 834 t in2004. The values for 2004-2010 are the lowest in the series, with SSB in 2009 (668 t) corresponding to the lowest value.. SSB values of 1597 and 1448 corresponding to years 2012 and 2013 are significant increases.

F has declined in recent years from the high levels observed prior to 1995 (Fbar, for ages 2-4, in the range of 0.29-0.50 before 1995) and the high value reached in 1998 (0.39). Fbar increased every year between 2003 and 2006 (Fbar=0.39 in 2006), but has decreased every year since then, reaching in 2010 the lowest value of the entire series at 0.08. After two years increasing, F decreases again, being 0.13 in 2013.

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. The 1994 year class is the second lowest value in the time series. Since 1998 recruitment has been continuously at low levels (recruitment in 2008 is estimated to be the lowest value of the series). In 2010 a good recruitment occurred, with a value more similar to those estimated for the previous decade. However, in 2011 and 2012, values of recruitments decreased again. In 2013 it appears to be a small increase. .

9.1.4.6 Catch Options and prognosis

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

9.1.4.7 Short-term projections

Short-term projections have been made using MFDP.

The input data for deterministic short-term predictions are shown in Table 9.1.13. The exploitation pattern used was the scaled F-at-age computed for each of the last five years and then the average of these scaled 2009-2013 years was weighted to the final year. This selection pattern was split into selection-at-age of landings and discards (corresponding to Fbar = 0.16 for landings and Fbar=0.02 for discards, being 0.17 for catches).

Because of not using 2013 value of the Spanish survey, the Working Group decided to recalculate the age group above recruitment in the input data. Age 2 for 2014 is replaced by GM90-11 reduced by total estimated mortality. This option has been included in the Stock annex.

Management options for catch prediction are in Table 9.1.14. Figure 9.1.8 shows the short-term forecast summary. The detailed output by age group assuming *status quo* F for 2014-2016 is given in Table 9.1.15 for landings and discards.

Under *status quo* F, landings in 2014 and 2015 are predicted to be 290 t and 286 t respectively, and discards 24 t in both years. SSB would decrease from the 1 341t estimated for 2014 to 1 250 t in 2015 and to 1 212 t in 2016.

The contributions of recent year classes to the predicted landings in 2015 and SSB in 2016, assuming GM_{98-11} recruitment, are presented in Table 9.1.16. The assumed GM_{98-11} age 1 recruitment for the 2014 and 2015 year classes contributes 21% to landings in 2014 and 46% to the predicted SSB at the beginning of 2015. Megrim starts to contribute strongly to SSB at 2 years of age (see maturity ogive in Table 9.1.13).

9.1.4.8 Yield and biomass per recruit analysis

The results of the yield- and SSB-per-recruit analyses are in Table 9.1.17 (see also left panel of Figure 9.1.8, which plots yield-per-recruit and SSB-per-recruit versus Fbar). Assuming s*tatus quo* exploitation Fbar = 0.16 for landings and Fbar=0.02 for discardsand GM_{98-11} for recruitment, the equilibrium yield would be around 200 t of landings and 23 t of discards with an SSB of 975 t.

9.1.5 Biological reference points

The stock-recruitment time series is plotted in Figure 9.1.9.All recruitment values since 1998 have been low, until 2010, with a very high recruitment value, followed by not so higher ones.

See Stock Annex for information about Biological reference points.

F_{MSY}=0.17 was preliminarily proposed in WGHMM 2010, corresponding to F40% as calculated in that WG.

With the inclusion of discards data in the assessment, a new estimation of Biological Reference Points has been developed during the Benchmark WKSOUTH. The software PlotMSY was employed to define the biological reference points for both stocks, following the recommendations of ICES expert groups.

The biological information needed to run this model was obtained from the assessment carried out during WKSOUTH with data up to 2012. See Stock annex for specific settings. This proposal has been updated with 2013 data to explore the reference points. Figure 9.1.10 shows the results for this update.

There were some slight changes to the (median) values of potential reference points: Fmax=0.17 (between F35%=0.15 and F30%=0.19), whereas FMSY is 0.11, 0.08, and 0.17, under Ricker, Beverton-Holt and Hockey-stick, respectively. There is, however, some increase in the value of F giving 5% long-term probability of SSB being below 650 t, based on the likelihood weighting of the three stock-recruitment functions; this F value increased to 0.19.

The Working Group accepted the updated values having reviewed the methodology and the inclusion of 2013 data.

The new proposal for BRP is:

	Type	Value	Technical basis
MSY	MSY Btrigger	910 t	default option; 1.4 Blim
Approach	FMSY	0.17	Fmax as FMSY proxy
	Blim	650 t	just above Bloss in the 2014 benchmark assessment
Precautionary	Bpa	910 t	default option; 1.4 Blim
Approach	Flim		
	Fpa		

9.1.6 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. 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 significant differences in R and F when discards are included. However, if the comparison is made with the assessment results from the Benchmark, they are quite similar except in the final trend of the last year (Figure 9.1.11)

Megrim starts to contribute strongly to SSB at 2 years of age. Around 35% of the predicted SSB in 2015 relies on year classes for which recruitment has been assumed to be $GM_{98\text{-}10}$.

9.1.7 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 by-catch in mixed fisheries generally directed to white fish. Therefore, fishing mortality of megrims could be influenced by restrictions imposed on demersal mixed fisheries, aimed at preserving and rebuilding the overexploited stocks of southern hake and *Nephrops*.

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

Working group considers that this stock could be just "the tail" of the much larger stock of megrim in ICES Subarea VII and Divisions VIIIabd. Genetic studies on 16S rDNA gene from several samples from the Atlantic area show that there is not a clear differentiation between the northern and southern stocks considered by ICES (García-Vázquez et al., 2006). This could also explain why a prolonged decrease in F was not reflected in stock increases. One suggested option is to reconsider the stock limits and the inclusion in the Northern megrim stock.

Table. 9.1.1 Megrim (*L. whiffiagonis*) in Divisions VIIIc, IXa. Landings, discards and catch (t).

	Spain landings			Portugal landing	Unallocated	Total landings	Discards	Total catch
Year	VIIIc	IXa***	Total	IXa				
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	109	3	111	34	14	159	69	228
*2012	164	3	167	18	103	288	31	319
*2013	122	6	127	11	84	222	18	240

***IXa is without Gulf of Cádiz

** Data revised in WG2010

* Official data by country and unallocated landings

Table. 9.1.2(a) Megrim (*L. whiffiagonis*) in Divisions VIIIc, IXa. 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	2010	2011*	2012	2013
Weight Ratio	0.03	0.14	0.12	0.13	0.11	0.07	0.14	0.08	0.00	0.08	0.13	0.06	0.36	0.10	0.09
CV	50.83	32.23	33.4	48.41	19.93	29.24	43.17	31.62	55.01	58.8	52.9	61.6	23.7	28.8	30.3
Number Ratio	0.10	0.38	0.34	0.45	0.26	0.16	0.28	0.21	0.01	0.20	0.36	0.27	0.75	0.36	0.25

All discard data revised in WG2011

*Data revised in WG2013

Table. 9.1.2(b) Megrim (*L. whiffiagonis*) in Divisions VIIIc, IXa. Discards in numbers at age (thousands) for Spanish trawlers

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	138	138	138	138	138	138	138	138	104	138	138	41	138	270	27
2	339	339	339	339	339	339	339	339	93	339	339	453	339	471	611
3	425	425	425	425	425	425	425	425	136	425	425	857	425	284	160
4	130	130	130	130	130	130	130	130	51	130	130	142	130	197	73
5	10	10	10	10	10	10	10	10	3	10	10	1	10	26	19
6	4	4	4	4	4	4	4	4	1	4	4	5	4	6	0
7	1	1	1	1	1	1	1	1	0	1	1	3	1	0	0

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011*	2012	2013
1	10	10	0	4	20	0	0	0	96	16	12	8	330
2	338	338	239	164	223	19	11	126	142	119	2044	808	53
3	82	82	57	28	61	108	0	86	21	6	346	85	13
4	31	31	12	6	38	115	0	8	15	1	1	41	5
5	9	9	4	5	11	28	0	5	7	2	2	2	0
6	1	1	0	3	4	13	0	2	7	0	0	1	0
7	1	1	0	2	1	4	0	0	3	1	0	1	0

Table 9.1.3(a) Megrim (*L. whiffiagonis*) Divisions VIIIc and IXa. Annual length distributions in landings in 2013.

Length (cm)	Total
10	
11	
12	
13	
14	
15	
16	
17	0.5
18	0.5
19	6.1
20	11.6
21	20.5
22	40.6
23	67.4
24	94.2
25	96.2
26	106.8
27	77.1
28	72.5
29	65.2
30	92.1
31	99.8
32	75.4
33	63.0
34	55.8
35	33.3
36	21.1
37	18.7
38	16.2
39	12.7
40	13.0
41	9.0
42	5.1
43	3.2
44	2.2
45	2.1
46	1.2
47	0.6
48	0.8
49	0.3
50+	0.2
Total	1767

Table 9.1.3(b) Megrim (*L. whiffiagonis*) Divisions VIIIc and IXa. Mean lengths and mean weights in landings since 1990

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

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mean length (cm)	26	25.7	26.1	25.3	26.2	26.7	26.6	27.6	29.4	27.6	28.2	29.4
Mean weight (g)	137	134	137	127	137	148	147	163	187	160	163	188

Table 9.1.4 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Catch numbers at age.

Catch numbers at age Numbers*10**-3

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	*2008	2009	2010	2011	2012	2013
AGE																												
1	1352	2359	3316	1099	4569	1357	1401	858	133	848	537	535	416	491	620	378	369	368	210	346	110	90	133	170	149	2051	812	360
2	2377	2728	3769	2328	2560	2777	817	2128	568	461	1911	1919	1307	524	282	387	233	299	264	276	526	161	370	111	39	801	309	138
3	798	882	1168	808	905	931	807	442	1835	384	167	1153	1335	1157	671	331	341	277	211	438	582	232	215	159	53	94	950	283
4	649	404	748	641	878	700	1130	536	552	630	289	77	891	719	526	253	95	179	247	171	276	297	153	102	112	131	171	573
5	505	293	534	505	333	647	595	361	625	245	506	367	218	448	361	221	165	80	187	156	183	142	168	80	97	139	208	79
6	202	81	182	191	377	142	78	103	330	70	148	308	329	105	83	161	81	54	102	87	110	81	60	60	81	97	109	60
+gp	194	71	130	253	558	59	68	36	119	72	81	116	149	207	161	118	37	48	72	41	36	56	35	29	43	77	145	92
TOTALNUM	6077	6818	9847	5825	10180	6613	4896	4464	4162	2710	3639	4475	4645	3651	2704	1849	1321	1305	1293	1515	1823	1059	1134	711	574	3390	2704	1585
TONSLAND	705	537	858	761	1022	655	558	421	492	258	373	408	482	386	288	194	136	149	160	166	226	155	144	95	88	228	319	240
SOPCOF %	95	95	95	99	99	100	100	101	100	101	101	100	100	101	101	100	99	101	100	98	100	100	100	101	100	101	101	101

* Data revised in WG2010 from original value presented

Table 9.1.5 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Catch weights at age (kg).

Mean weight at age

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	*2008	2009	2010	2011	2012	2013
AGE																												
1	0.041	0.046	0.043	0.045	0.040	0.035	0.031	0.031	0.039	0.051	0.041	0.033	0.032	0.033	0.037	0.039	0.038	0.047	0.048	0.051	0.057	0.061	0.033	0.031	0.037	0.026	0.027	0.039
2	0.095	0.079	0.086	0.094	0.091	0.085	0.075	0.073	0.063	0.044	0.080	0.062	0.061	0.058	0.057	0.078	0.070	0.083	0.082	0.077	0.082	0.088	0.084	0.088	0.091	0.081	0.091	0.077
3	0.113	0.086	0.098	0.114	0.121	0.102	0.116	0.102	0.099	0.087	0.081	0.095	0.095	0.084	0.089	0.085	0.111	0.115	0.109	0.108	0.110	0.110	0.118	0.135	0.116	0.132	0.135	0.130
4	0.163	0.142	0.149	0.163	0.165	0.145	0.155	0.146	0.130	0.126	0.127	0.126	0.130	0.118	0.119	0.117	0.115	0.149	0.130	0.140	0.150	0.144	0.145	0.160	0.168	0.130	0.159	0.182
5	0.215	0.175	0.191	0.223	0.206	0.173	0.209	0.194	0.150	0.164	0.164	0.140	0.154	0.159	0.161	0.148	0.162	0.194	0.157	0.164	0.174	0.197	0.187	0.189	0.203	0.191	0.168	0.234
6	0.315	0.311	0.289	0.292	0.240	0.251	0.318	0.235	0.190	0.210	0.210	0.198	0.189	0.216	0.215	0.171	0.205	0.252	0.203	0.199	0.223	0.236	0.246	0.246	0.228	0.235	0.226	0.282
+gp	0.477	0.415	0.424	0.520	0.369	0.420	0.534	0.538	0.344	0.340	0.354	0.341	0.324	0.296	0.296	0.256	0.387	0.382	0.319	0.379	0.390	0.366	0.409	0.404	0.370	0.363	0.351	0.397
SOPCOFAC	0.95	0.954	0.951	1	0.987	1.004	0.998	1.01	1	1.009	1.01	1.001	1.005	1.006	1.011	1.005	0.994	1.006	1.001	0.985	1.003	0.997	1.003	1.006	0.999	1.014	1.01	1.01

* Data revised in WG2010 from original value presented

Table 9.1.6 Megrim (*L. whiffiagonis*) Divisions VIIIc, IXa. Abundance and Recruitment indices from Portuguese and Spanish surveys.

	Biomass Index						Abundance index					Recruitment index		
	Portugal (k/h)			Spain (k/30 min)			Portugal (n/h)		Spain (n/30 min)			At age 1 Portugal (n)	At age 0 Spain (n/30 min)	At age 1 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	2.45	1983		1.88	7.72
1984				1.92	0.34	1984			28	4.57	1984		0.32	16.08
1985				0.89	0.15	1985			9	1.34	1985		0.10	2.74
1986				1.65	0.2	1986			33	6.22	1986		13.78	11.19
1987				ns		1987			ns		1987		ns	ns
1988				3.52	0.64	1988			43	8.82	1988		0.65	16.60
1989				3.13	0.5332	1989			42	7.04	1989		2.90	13.96
1990	0.08			3.08	0.86	1990			28	5.5	1990	5	0.11	9.13
1991	0.11			1.22	0.17	1991			10	1.67	1991	5	1.26	1.38
1992	0.11			1.39	0.2	1992			18	3.35	1992	8	0.01	12.03
1993	0.04			1.46	0.24	1993			15	3.23	1993	1	0.00	2.76
1994	0.05			1.02	0.2	1994			8	1.87	1994	+	0.60	0.05
1995	0.01			1.03	0.16	1995			11	1.86	1995	+	0.41	7.38
A,1996	+			1.64	0.22	A,1996			21	3.6	A,1996	+	0.45	11.26
1997	+	1.41	1.04	1.79	0.25	1997	7.22	4.82	20	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

+	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
**	Spanish Survey with different vessel (Miguel Oliver)

Table 9.1.7 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Tuning data.

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

1986	2013								
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	1.4	16.4	45.0	73.6	8.0	5.9	5.6	13.1	2013

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

1986	2013								
1	1	0	1						
1	7							Eff.	
10	408	516	428	209	182	153	92	3.9	1986
10	590	471	510	242	145	168	55	3.0	1987
10	1458	905	749	357	155	193	85	3.4	1988
10	836	514	539	253	145	174	68	3.3	1989
10	4366	949	225	173	46	50	71	3.2	1990
10	980	855	229	100	84	15	7	3.5	1991
10								2.3	1992
10	1149	1490	91	100	53	25	19	2.4	1993
10	19	176	547	135	133	51	24	4.5	1994
10	41	2	43	140	70	26	14	3.5	1995
10	135	797	14	117	259	74	62	2.3	1996
10	96	880	621	34	153	128	46	2.6	1997
10	16	309	375	233	52	69	38	5.1	1998
10	10	110	398	263	162	38	70	4.9	1999
10	29	54	239	230	146	36	53	2.5	2000
10	37	200	193	122	115	84	85	1.3	2001
10	54	158	239	65	93	53	47	2.0	2002
10	26	84	105	70	31	24	28	2.2	2003
10	53	231	208	248	193	103	60	1.6	2004
10	118	182	309	117	107	59	26	3.0	2005
10	43	182	236	120	83	46	12	2.8	2006
10	25	48	72	93	41	24	20	2.2	2007
10	5	153	85	51	49	18	16	2.0	2008
10	12	41	67	50	39	39	21	2.3	2009
10	50	45	66	160	136	121	62	2.0	2010
10	6	483	95	133	168	134	110	2.2	2011
10	0	28	118	23	29	18	28	2.6	2012
10	10	34	123	267	37	30	59	1.5	2013

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

1988	2013								
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
1	3.24	1.63	3.29	5.63	0.67	0.35	0.87	114	2013

Table 9.1.8 Megrim (*L. whiffiagonis*). LPUE data by fleet in Divisions VIIIc and IXa.

	SP-LCGOTBDEF			SP-AVSOTBDEF			Portugal trawl in IXa		
Year	Landings (t)	Effort	LPUE [1]	Landings (t)	Effort	LPUE [1]	Landings (t)	Effort	LPUE [2]
1986	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	36.0	0.40
2013	33	13.1	2.49	16	1.5	10.59	8.1	47.5	0.17

[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

Table 9.1.9. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Tuning diagnostic.

Lowestoft VPA Version 3.1

1/05/2014 21:24

Extended Survivors Analysis

Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa

CPUE data from file fleetw.txt

Catch data for 28 years. 1986 to 2013. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF	1986	2013	3	6	0	1
SP-AVSOTBDEF	1986	2013	3	6	0	1
SP-GFS	1990	2013	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 160 iterations

Total absolute residual between iterations
159 and 160 = .00049

Final year F values

Age	1	2	3	4	5	6
Iteration **	0.1004	0.0787	0.1487	0.1729	0.2913	0.4906
Iteration **	0.100	0.079	0.149	0.173	0.291	0.490

Regression weights

1.000	1.000	1.000	1.000	1.000	1.000	1	1	1	1

Fishing mortalities

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	0	0	0	0	0	0	0.016	0.468	0.311	0.1
2	0	0	0	0	0	0	0.041	0.115	0.116	0.079
3	0	0	0	0	0	0	0.068	0.13	0.195	0.149
4	0	0	0	0	0	0	0.125	0.239	0.37	0.173
5	0	0	0	0	0	0	0.188	0.226	0.742	0.291
6	0	0	0	0	0	0	0.335	0.292	0.279	0.49

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
2004	3380	2230	1470	1330	870	340
2005	2830	2580	1580	1020	865	543
2006	2290	2010	1860	901	677	567
2007	2770	1770	1170	996	488	389
2008	1620	2190	1310	746	546	271
2009	1510	1210	1460	875	472	295
2010	10100	1080	890	1050	624	314
2011	6060	8120	850	681	758	423
2012	3360	3110	5920	611	439	495
2013	4170	2010	2260	3990	346	171

Estimated population abundance at 1st Jan 2014

	0	3090	1520	1600	2750	212

Taper weighted geometric mean of the VPA populations:

	5000	3590	2320	1450	827	435

Standard error of the weighted Log(VPA populations) :

	0.6727	0.6642	0.5614	0.5122	0.4111	0.4281
1						

Log catchability residuals.

Fleet : SP-LCGOTBDEF

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	No data for this fleet at this age							
2	No data for this fleet at this age							
3	-0.49	-0.14	0.07	-0.7	-0.52	-0.53	-0.55	-0.66
4	-0.37	-0.57	-0.44	-0.15	-0.15	0.05	-0.24	-0.4
5	-0.4	-0.71	-0.4	-0.75	0.39	0.25	0.34	-0.47
6	-0.47	-0.75	-0.45	-0.48	-0.18	0.41	0.51	0.06

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.24	-0.5	-1.28	0.07	0.01	0.02	0.51	0.52	0.56	-0.26
4	0.44	-0.08	-0.43	-0.89	0.47	-0.02	0.57	0.22	-0.21	-0.25
5	1.09	-0.29	0.27	-0.08	0.45	0.1	0.32	-0.1	0.21	-0.33
6	1.36	-0.36	0.52	0.32	1.18	0.79	-0.29	-0.03	-0.36	-0.61

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.42	0.38	0.11	0.38	0.16	0.13	-0.03	0.87	1.63	0.4
4	-0.26	-0.46	0.11	0.42	0.01	-0.35	0.19	1.04	1.81	-0.09
5	-0.38	-0.68	-0.46	0.13	0.04	-0.55	0.17	0.26	1.92	-0.34
6	0.35	-0.73	-0.7	-0.24	-0.42	-0.4	0.68	0.18	0.58	0.23

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	-6.4472	-6.0338	-5.5397	-5.5397
S.E(Log q)	0.5771	0.5373	0.5714	0.5792

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	1.01	-0.029	6.44	0.48	28	0.59	-6.45
4	1.4	-1.437	5.54	0.33	28	0.74	-6.03
5	1.35	-0.961	5.13	0.23	28	0.77	-5.54
6	1.44	-1.18	5.27	0.22	28	0.83	-5.51
1							

Fleet : SP-AVSOTBDEF

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	No data for this fleet at this age							
2	No data for this fleet at this age							
3	0.52	0.4	1.13	0.61	-0.13	-0.34	99.99	-0.7
4	0.25	0.27	0.42	0.61	-0.07	-0.5	99.99	-0.41
5	0.42	0.21	0.16	-0.15	-0.6	-0.14	99.99	-0.72
6	0.81	0.97	1.11	1.05	-0.44	-1.02	99.99	-0.19

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.44	-1.53	-1.83	0.66	0.08	0.4	0.31	0.71	0.43	-0.41
4	0.13	-0.44	-0.26	-0.62	0.13	0.17	0.27	0.03	-0.06	-0.56
5	0.57	-0.15	0.49	0.29	0.08	0.2	-0.17	-0.19	-0.11	-0.67
6	0.21	0.05	0.63	0.56	0.38	0.79	-0.76	-0.23	-0.54	-1.1

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.53	0.94	0.55	-0.24	-0.22	-0.63	-0.16	0.29	-1.43	-0.39
4	0.69	0.21	0.46	0.12	-0.31	-0.57	0.45	0.75	-0.83	-0.32
5	0.63	0.01	0.06	-0.3	-0.2	-0.39	0.56	0.6	-0.46	-0.02
6	0.96	-0.17	-0.39	-0.72	-0.47	0.1	1.19	0.97	-1.12	0.59

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	-4.6237	-4.4781	-4.2034	-4.2034
S.E(Log q)	0.744	0.4349	0.3906	0.7508

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	0.87	0.599	5.04	0.44	27	0.65	-4.62
4	0.92	0.533	4.71	0.62	27	0.4	-4.48
5	0.79	1.502	4.74	0.67	27	0.3	-4.2
6	1.47	-0.943	3.15	0.14	27	1.09	-4.08
1							

Fleet : SP-GFS

Age	1986	1987	1988	1989	1990	1991	1992	1993
1	99.99	99.99	99.99	99.99	-0.12	-0.47	-0.01	0
2	99.99	99.99	99.99	99.99	0.08	-0.27	-0.57	0.02
3	99.99	99.99	99.99	99.99	0.21	-0.74	-0.32	-1.01
4 99.99		99.99	99.99	99.99	0.7	0.14	0.27	0.12
5	99.99	99.99	99.99	99.99	0.51	0.18	0.59	-0.19
6	99.99	99.99	99.99	99.99	0.73	-0.44	-0.58	-0.49

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	-1.44	-0.12	0.09	-0.01	0.06	0.23	0.78	0.17	0.5	0.31
2	-0.9	-0.87	-0.04	0.01	-0.12	0.42	0.65	0.64	0.41	0.13
3	0.3	-1.27	-1.16	0.11	0.3	0.57	0.57	0.25	0.91	0.05
4	0.11	-0.31	-0.46	-0.43	0.05	0.1	0.66	0.61	-0.53	-0.12
5	0.32	-0.06	-0.38	-0.1	0.02	0.18	0.24	0.13	0.32	-0.2
6	-0.07	-0.3	0	-0.53	0.54	1.2	-0.13	-0.56	-0.65	-1.01

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	0.18	0.49	0.16	0.37	-0.24	-0.23	-0.14	-0.2	-0.35	99.99
2 0.27		-0.02	0.26	0	0.17	-0.12	-0.38	0.19	0.01	99.99
3	0.08	0.61	0.23	0.35	0.17	0.21	-1.04	0.61	0.01	99.99
4	0	0.35	0.07	0.38	-0.24	-0.01	-0.4	-0.79	-0.27	99.99
5	-0.25	0.39	0.16	0.26	-0.12	-0.38	-0.42	-0.39	-0.8	99.99
6	0.6	-0.13	-0.12	-0.05	-0.57	-0.16	0.35	-0.21	-0.66	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	-6.8164	-6.5902	-6.3681	-6.3681
S.E(Log q)	0.6201	0.3923	0.3447	0.5439

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	0.56	2.985	7.84	0.69	23	0.44	-7.42
2	0.66	2.487	7.36	0.72	23	0.41	-7

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	0.93	0.324	6.88	0.51	23	0.59	-6.82
4 0.71		2.651	6.76	0.8	23	0.25	-6.59
5	0.74	1.84	6.45	0.71	23	0.24	-6.37
6	1.41	-1.08	6.69	0.25	23	0.74	-6.51
1							

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2012

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	1	0	0	0	0	0	0
P shrinkage mean	3590	0.66				0.836	0.087
F shrinkage mean	1427	1.5				0.164	0.206

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3086	0.61	8.04	2	13.242	0.1

Age 2 Catchability dependent on age and year class strength

Year class = 2011

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	1070	0.458	0	0	1	0.472	0.11
P shrinkage mean	2321	0.56				0.463	0.052
F shrinkage mean	1000	1.5				0.065	0.118

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1525	0.35	0.37	3	1.06	0.079

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

Year class = 2010

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	2375	0.587	0	0	1	0.224	0.102
SP-AVSOTBDEF	1079	0.758	0	0	1	0.135	0.213
SP-GFS	1503	0.315	0.103	0.33	2	0.601	0.157
F shrinkage mean	1640	1.5				0.04	0.145

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1598	0.26	0.13	5	0.49	0.149

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

Year class = 2009

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	5147	0.402	0.844	2.1	2	0.26	0.096
SP-AVSOTBDEF	1560	0.384	0.456	1.19	2	0.296	0.287
SP-GFS	2828	0.284	0.105	0.37	3	0.42	0.168
F shrinkage mean	2035	1.5				0.024	0.227

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2748	0.2	0.26	8	1.286	0.173

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

Year class = 2008

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	414	0.337	0.659	1.95	3	0.239	0.159
SP-AVSOTBDEF	165	0.281	0.29	1.03	3	0.371	0.361
SP-GFS	179	0.238	0.183	0.77	4	0.37	0.336
F shrinkage mean	166	1.5				0.02	0.358

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
212	0.16	0.21	11	1.315	0.291

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

Year class = 2007

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF	174	0.319	0.417	1.31	4	0.268	0.271
SP-AVSOTBDEF	98	0.279	0.316	1.13	4	0.296	0.441
SP-GFS	45	0.198	0.154	0.78	5	0.406	0.787
F shrinkage mean	238	1.5				0.03	0.205

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
86	0.15	0.22	14	1.434	0.49

Table 9.1.10. Megrim (*L. whiffiagonis*) Div. VIIIc and IXa. Estimates of fisihing mortality at age.

Run title : Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa

At 1/05/2014 21:26

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1986	1987	1988	1989	1990	1991	1992	1993
AGE								
1	0.1579	0.2187	0.3665	0.1196	0.4755	0.2839	0.1386	0.1954
2	0.4077	0.5474	0.6483	0.4774	0.4486	0.6014	0.2763	0.3228
3	0.3067	0.2589	0.4799	0.2729	0.3432	0.2896	0.3463	0.2361
4	0.4542	0.2509	0.3655	0.5324	0.5387	0.4891	0.6892	0.409
5	0.6376	0.3813	0.6171	0.4523	0.5908	1.0285	1.0639	0.4896
6	0.4459	0.1921	0.4342	0.4666	0.7371	0.5439	0.3073	0.5128
+gp	0.4459	0.1921	0.4342	0.4666	0.7371	0.5439	0.3073	0.5128
FBAR 2- 4	0.3895	0.3524	0.4979	0.4276	0.4435	0.46	0.4373	0.3226

Table 8 Fishing mortality (F) at age

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
1	0.0671	0.0985	0.0605	0.078	0.1043	0.2171	0.1846	0.1229	0.1456	0.1394
2	0.1918	0.3479	0.3355	0.318	0.2772	0.1853	0.1864	0.1679	0.1037	0.1685
3	0.513	0.1918	0.2035	0.3478	0.3829	0.4238	0.3834	0.3478	0.219	0.1727
4	0.5211	0.33	0.2161	0.1359	0.4987	0.3666	0.3468	0.2423	0.1576	0.1708
5	1.2717	0.4632	0.4838	0.4687	0.7	0.5059	0.3169	0.2392	0.2465	0.1931
6	1.2218	0.4325	0.5704	0.621	1.0634	0.9072	0.1614	0.227	0.1289	0.1185
+gp	1.2218	0.4325	0.5704	0.621	1.0634	0.9072	0.1614	0.227	0.1289	0.1185
FBAR 2- 4	0.4086	0.2899	0.2517	0.2673	0.3863	0.3252	0.3055	0.2527	0.1601	0.1707

Table 8 Fishing mortality (F) at age

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Fbar 11-13
AGE											
1	0.0712	0.1449	0.0546	0.0365	0.0948	0.133	0.0165	0.4683	0.3109	0.1004	0.2932
2	0.1404	0.126	0.3419	0.1057	0.2067	0.1069	0.0407	0.1154	0.1164	0.0787	0.1035
3	0.1722	0.3647	0.4246	0.2479	0.2008	0.1284	0.0681	0.1303	0.1951	0.1486	0.158
4	0.2298	0.2059	0.4135	0.4	0.257	0.1379	0.1255	0.2391	0.37	0.1728	0.2606
5	0.2714	0.2223	0.3549	0.3883	0.4153	0.2072	0.1885	0.2265	0.7419	0.2912	0.4199
6	0.4029	0.195	0.2413	0.2618	0.2809	0.2543	0.3351	0.2922	0.2789	0.4903	0.3538
+gp	0.4029	0.195	0.2413	0.2618	0.2809	0.2543	0.3351	0.2922	0.2789	0.4903	
FBAR 2- 4	0.1808	0.2322	0.3933	0.2512	0.2215	0.1244	0.0781	0.1616	0.2272	0.1334	

Table 9.1.11. Megrim (*L. whiffiagonis*) Div. VIIIc and IXa. Estimates of stocks numbers at age

Run title : Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa

At 1/05/2014 21:26

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
AGE								
1	10229	13272	11944	10774	13344	6068	11960	5342
2	7846	7152	8732	6778	7827	6791	3740	8524
3	3339	4273	3387	3739	3443	4092	3047	2323
4	1965	2012	2700	1716	2330	2000	2508	1765
5	1184	1021	1282	1534	825	1113	1004	1031
6	621	512	571	566	799	374	326	284
+gp	591	447	404	743	1166	154	282	98
TOTAL	25774	28689	29019	25850	29734	20592	22867	19367

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

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
1	2265	9987	10102	7878	4641	2781	4066	3611	3010	3126
2	3598	1734	7410	7785	5966	3423	1833	2768	2615	2131
3	5053	2432	1002	4337	4638	3702	2328	1245	1916	1930
4	1502	2477	1643	670	2508	2589	1984	1299	720	1260
5	960	730	1458	1084	479	1247	1469	1148	835	504
6	517	220	376	736	555	195	616	876	740	534
+gp	183	225	204	274	247	377	1189	639	337	473
TOTAL	14077	17805	22195	22763	19032	14314	13484	11587	10172	9958

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

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	GMst 98-11
AGE												
1	3378	2834	2288	2774	1625	1509	10081	6062	3358	4166	0	3274
2	2227	2576	2007	1773	2189	1210	1082	8119	3107	2015	3086	
3	1474	1584	1859	1168	1306	1458	890	850	5923	2265	1525	
4	1329	1016	901	996	746	875	1050	681	611	3989	1598	
5	870	865	677	488	546	472	624	758	439	346	2748	
6	340	543	567	389	271	295	314	423	495	171	212	
+gp	238	255	185	267	157	142	166	334	654	260	216	
TOTAL	9856	9672	8483	7854	6841	5961	14207	17227	14587	13211	9385	

Table 9.1.12 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Summary of landings and XSA results.

Run title : Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa

At 1/05/2014 21:26

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 1	TOTALBIO	TOTSPBIO	CATCHES	YIELD/SSB	FBAR 2- 4
1986	10229	2594	2243	705	0.3144	0.3895
1987	13272	2352	1893	537	0.2837	0.3524
1988	11944	2580	2166	858	0.3961	0.4979
1989	10774	2722	2338	761	0.3255	0.4276
1990	13344	2839	2416	1022	0.4231	0.4435
1991	6068	1848	1650	655	0.3969	0.46
1992	11960	1858	1585	558	0.3521	0.4373
1993	5342	1602	1430	421	0.2943	0.3226
1994	2265	1316	1235	492	0.3985	0.4086
1995	9987	1352	1008	258	0.256	0.2899
1996	10102	1687	1354	373	0.2754	0.2517
1997	7878	1630	1410	408	0.2894	0.2673
1998	4641	1538	1403	482	0.3435	0.3863
1999	2781	1259	1178	386	0.3276	0.3252
2000	4066	1419	1309	288	0.22	0.3055
2001	3611	1098	983	194	0.1973	0.2527
2002	3010	1010	916	136	0.1484	0.1601
2003	3126	1146	1032	149	0.1444	0.1707
2004	3378	960	834	160	0.1918	0.1808
2005	2834	1003	887	166	0.1871	0.2322
2006	2288	951	848	226	0.2664	0.3933
2007	2774	883	755	155	0.2052	0.2512
2008	1625	733	679	144	0.2121	0.2215
2009	1509	709	668	95	0.1423	0.1244
2010	10081	1011	755	88	0.1166	0.0781
2011	6062	1381	1212	228	0.1882	0.1616
2012	3358	1685	1597	319	0.1997	0.2272
2013	4166	1570	1448	240	0.1658	0.1334
Arith. Mean	6160	1526	1330	375	0.2593	0.2912
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 9.1.13. Megrim (*L. whiffiagonis*) in Division VIIIc, IXa. Prediction with management option table: Input data

MFDP version 1a
Run: MEG
Time and date: 15:20 09/05/2014
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Age	2014	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	3274	0.2	0.34	0	0	0.032	0.008	0.061	0.211	0.029
	2	2310	0.2	0.9	0	0	0.086	0.078	0.096	0.034	0.064
	3	1525	0.2	1	0	0	0.130	0.156	0.131	0.007	0.099
	4	1598	0.2	1	0	0	0.160	0.243	0.160	0.005	0.125
	5	2748	0.2	1	0	0	0.197	0.375	0.197	0.005	0.174
	6	212	0.2	1	0	0	0.243	0.449	0.244	0.005	0.175
	7	216	0.2	1	0	0	0.377	0.452	0.378	0.002	0.127

Age	2015	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	3274	0.2	0.34	0	0	0.032	0.008	0.061	0.211	0.029
	2 .		0.2	0.9	0	0	0.086	0.078	0.096	0.034	0.064
	3 .		0.2	1	0	0	0.130	0.156	0.131	0.007	0.099
	4 .		0.2	1	0	0	0.160	0.243	0.160	0.005	0.125
	5 .		0.2	1	0	0	0.197	0.375	0.197	0.005	0.174
	6 .		0.2	1	0	0	0.243	0.449	0.244	0.005	0.175
	7 .		0.2	1	0	0	0.377	0.452	0.378	0.002	0.127

Age	2016	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	3274	0.2	0.34	0	0	0.032	0.008	0.061	0.211	0.029
	2 .		0.2	0.9	0	0	0.086	0.078	0.096	0.034	0.064
	3 .		0.2	1	0	0	0.130	0.156	0.131	0.007	0.099
	4 .		0.2	1	0	0	0.160	0.243	0.160	0.005	0.125
	5 .		0.2	1	0	0	0.197	0.375	0.197	0.005	0.174
	6 .		0.2	1	0	0	0.243	0.449	0.244	0.005	0.175
	7 .		0.2	1	0	0	0.377	0.452	0.378	0.002	0.127

Input units are thousands and kg - output in tonnes

Table 9.1.14. Megrim (*L. whiffiagonis*) in Div. VIIIc and IXa catch forecast: management option table

MFDP version 1a

Run: MEG

Time and date: 15:20 09/05/2014

Fbar age range (Total) : 2-4

Fbar age range Fleet 1 : 2-4

2014		Total	Landings		Discards	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield
1430	1341	1	0.1587	290	0.0153	24

2015		Total	Landings		Discards		2015	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield	Biomass	SSB
1337	1250	0	0.0000	0	0.0000	0	1702	1610
.	1250	0.1	0.0159	33	0.0015	3	1655	1563
.	1250	0.2	0.0317	66	0.0031	5	1610	1519
.	1250	0.3	0.0476	97	0.0046	8	1566	1475
.	1250	0.4	0.0635	127	0.0061	10	1524	1434
.	1250	0.5	0.0794	156	0.0077	12	1483	1393
.	1250	0.6	0.0952	184	0.0092	15	1444	1354
.	1250	0.7	0.1111	211	0.0107	17	1406	1317
.	1250	0.8	0.1270	237	0.0123	19	1369	1280
.	1250	0.9	0.1428	262	0.0138	22	1333	1245
.	1250	1	0.1587	286	0.0153	24	1299	1212
.	1250	1.1	0.1746	310	0.0169	26	1266	1179
.	1250	1.2	0.1904	332	0.0184	28	1234	1147
.	1250	1.3	0.2063	354	0.0199	30	1203	1117
.	1250	1.4	0.2222	375	0.0215	32	1173	1087
.	1250	1.5	0.2381	396	0.0230	34	1145	1059
.	1250	1.6	0.2539	415	0.0245	36	1117	1031
.	1250	1.7	0.2698	435	0.0261	38	1090	1005
.	1250	1.8	0.2857	453	0.0276	40	1064	979
.	1250	1.9	0.3015	471	0.0291	41	1038	954
.	1250	2	0.3174	488	0.0307	43	1014	930

Input units are thousands and kg - output in tonnes

Table 9.1.15. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Single option prediction: Detail Tables.

MFDP version 1a
Run: MEG
Time and date: 15:20 09/05/2014
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2014 F multiplier: 1 Fleet1 HCFbar: 0.1587 Fleet1 DFbar: 0.0153

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0079	21	1	0.2114	565	16	3274	105	1113	36	1113	36
2	0.0776	154	15	0.0337	67	4	2310	198	2079	178	2079	178
3	0.1557	199	26	0.0073	9	1	1525	198	1525	198	1525	198
4	0.2428	313	50	0.005	6	1	1598	255	1598	255	1598	255
5	0.3754	783	154	0.005	10	2	2748	541	2748	541	2748	541
6	0.4487	70	17	0.0054	1	0	212	52	212	52	212	52
7	0.4517	72	27	0.0024	0	0	216	81	216	81	216	81
Total		1611	290		660	24	11883	1430	9491	1341	9491	1341

Year: 2015 F multiplier: 1 Fleet1 HCFbar: 0.1587 Fleet1 DFbar: 0.0153

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0079	21	1	0.2114	565	16	3274	105	1113	36	1113	36
2	0.0776	144	14	0.0337	62	4	2153	184	1937	166	1937	166
3	0.1557	221	29	0.0073	10	1	1692	219	1692	219	1692	219
4	0.2428	208	33	0.005	4	1	1061	170	1061	170	1061	170
5	0.3754	291	57	0.005	4	1	1021	201	1021	201	1021	201
6	0.4487	507	124	0.0054	6	1	1538	374	1538	374	1538	374
7	0.4517	74	28	0.0024	0	0	223	84	223	84	223	84
Total		1464	286		653	24	10961	1337	8585	1250	8585	1250

Year: 2016 F multiplier: 1 Fleet1 HCFbar: 0.1587 Fleet1 DFbar: 0.0153

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0079	21	1	0.2114	565	16	3274	105	1113	36	1113	36
2	0.0776	144	14	0.0337	62	4	2153	184	1937	166	1937	166
3	0.1557	206	27	0.0073	10	1	1577	204	1577	204	1577	204
4	0.2428	230	37	0.005	5	1	1177	188	1177	188	1177	188
5	0.3754	193	38	0.005	3	0	678	134	678	134	678	134
6	0.4487	188	46	0.0054	2	0	572	139	572	139	572	139
7	0.4517	303	115	0.0024	2	0	915	345	915	345	915	345
Total		1286	278		649	23	10345	1299	7969	1212	7969	1212

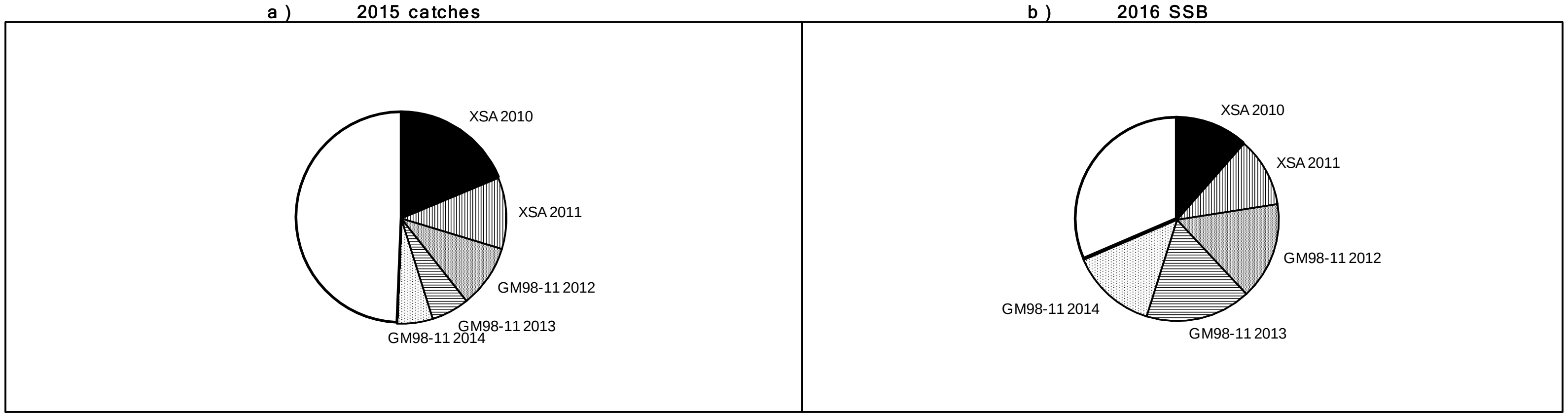
Input units are thousands and kg - output in tonnes

Table 9.1.16 **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			2010	2011	2012	2013	2014
Stock No. (thousands)			6062	3358	3274	3274	3274
of		1 year-olds					
Source			XSA	XSA	GM98-11	GM98-11	GM98-11
Status Quo F:							
% in	2014	catches	16.2	8.6	6.1	5.4	-
% in	2015		18.7	11.0	9.7	5.8	5.5
% in	2014	SSB	19.0	14.8	13.3	2.7	-
% in	2015	SSB	16.1	13.6	17.5	13.3	2.9
% in	2016	SSB	11.5	11.1	15.5	16.8	13.7

GM : geometric mean recruitment

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



XSA	XSA	GM98-11	GM98-11	GM98-11
2010	2011	2012	2013	2014

Table 9.1.17.

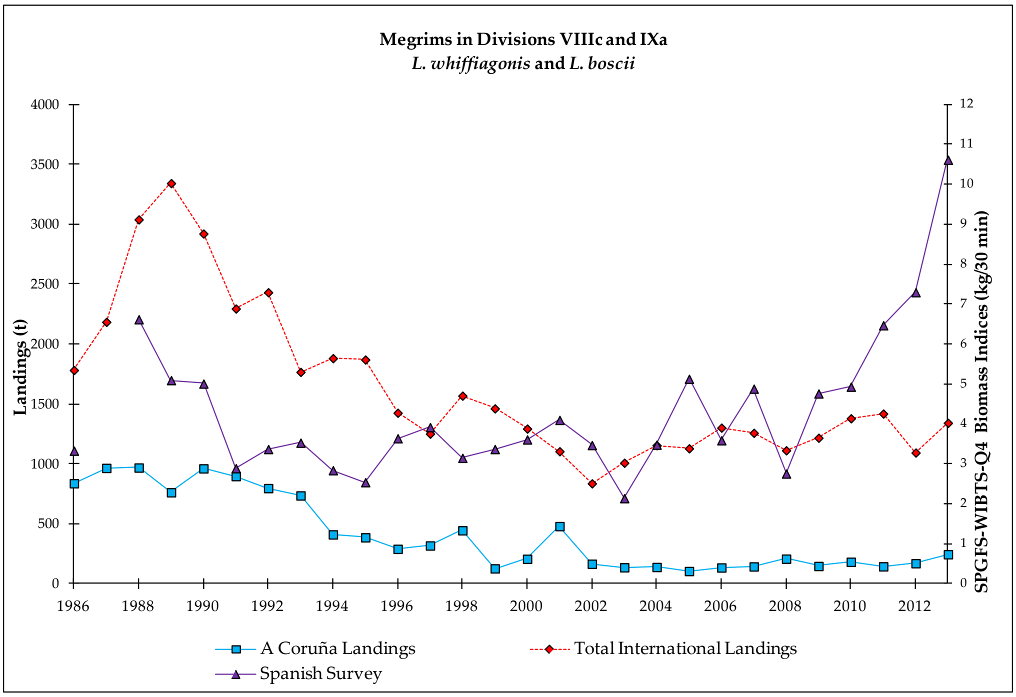
Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa, yield per recruit results.

MFYPR version 2a
Run: MEG
Time and date: 15:23 09/05/2014
Yield per results

Catch	Landings			Discards								
FMult	Fbar	CatchNos	Yield	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	1.0811	4.7748	1.053	4.7748	1.053
0.1	0.0159	0.1011	0.0274	0.0015	0.0224	0.0008	4.9002	0.876	4.1601	0.8481	4.1601	0.8481
0.2	0.0317	0.1677	0.0432	0.0031	0.0442	0.0016	4.4605	0.736	3.7221	0.7082	3.7221	0.7082
0.3	0.0476	0.2137	0.0525	0.0046	0.0653	0.0024	4.1268	0.6346	3.3902	0.6069	3.3902	0.6069
0.4	0.0635	0.2466	0.058	0.0061	0.0858	0.0031	3.8621	0.5578	3.1271	0.5303	3.1271	0.5303
0.5	0.0794	0.2705	0.061	0.0077	0.1058	0.0038	3.6449	0.4977	2.9115	0.4703	2.9115	0.4703
0.6	0.0952	0.2881	0.0625	0.0092	0.1251	0.0045	3.462	0.4495	2.7303	0.4222	2.7303	0.4222
0.7	0.1111	0.3011	0.063	0.0107	0.144	0.0052	3.305	0.4098	2.5747	0.3827	2.5747	0.3827
0.8	0.127	0.3106	0.0628	0.0123	0.1623	0.0058	3.1678	0.3767	2.4391	0.3497	2.4391	0.3497
0.9	0.1428	0.3175	0.06	0.0138	0.1801	0.0064	3.05	0.3486	2.3192	0.3218	2.3192	0.3218
1	0.1587	0.3222	0.0612	0.0153	0.1974	0.0069	2.9378	0.3245	2.212	0.2977	2.212	0.2977
1.1	0.1746	0.3253	0.0601	0.0169	0.2143	0.0075	2.8397	0.3035	2.1154	0.2769	2.1154	0.2769
1.2	0.1904	0.327	0.0589	0.0184	0.2307	0.008	2.7505	0.2851	2.0275	0.2586	2.0275	0.2586
1.3	0.2063	0.3277	0.0576	0.0199	0.2467	0.0085	2.6687	0.2688	1.9472	0.2424	1.9472	0.2424
1.4	0.2222	0.3275	0.0563	0.0215	0.2623	0.009	2.5934	0.2542	1.8732	0.228	1.8732	0.228
1.5	0.2381	0.3266	0.0549	0.023	0.2775	0.0095	2.5237	0.2412	1.8048	0.215	1.8048	0.215
1.6	0.2539	0.3251	0.0536	0.0245	0.2923	0.01	2.4589	0.2294	1.7413	0.2033	1.7413	0.2033
1.7	0.2698	0.323	0.0522	0.0261	0.3067	0.0104	2.3985	0.2186	1.6821	0.1927	1.6821	0.1927
1.8	0.2857	0.3206	0.0509	0.0276	0.3208	0.0108	2.3419	0.2088	1.6267	0.183	1.6267	0.183
1.9	0.3015	0.3178	0.0496	0.0291	0.3345	0.0113	2.2888	0.1998	1.5748	0.1741	1.5748	0.1741
2.0	0.3174	0.3147	0.0484	0.0307	0.3479	0.0117	2.2388	0.1916	1.5260	0.1659	1.526	0.1659

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1	0.1587
FMax	0.7153	0.1135
F0.1	0.4195	0.0666
F35%SPR	0.7408	0.1176

Weights in kilograms



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

Figure 9.1.1 Historical landings and biomass indices of Spanish survey of megrims (both species combined).

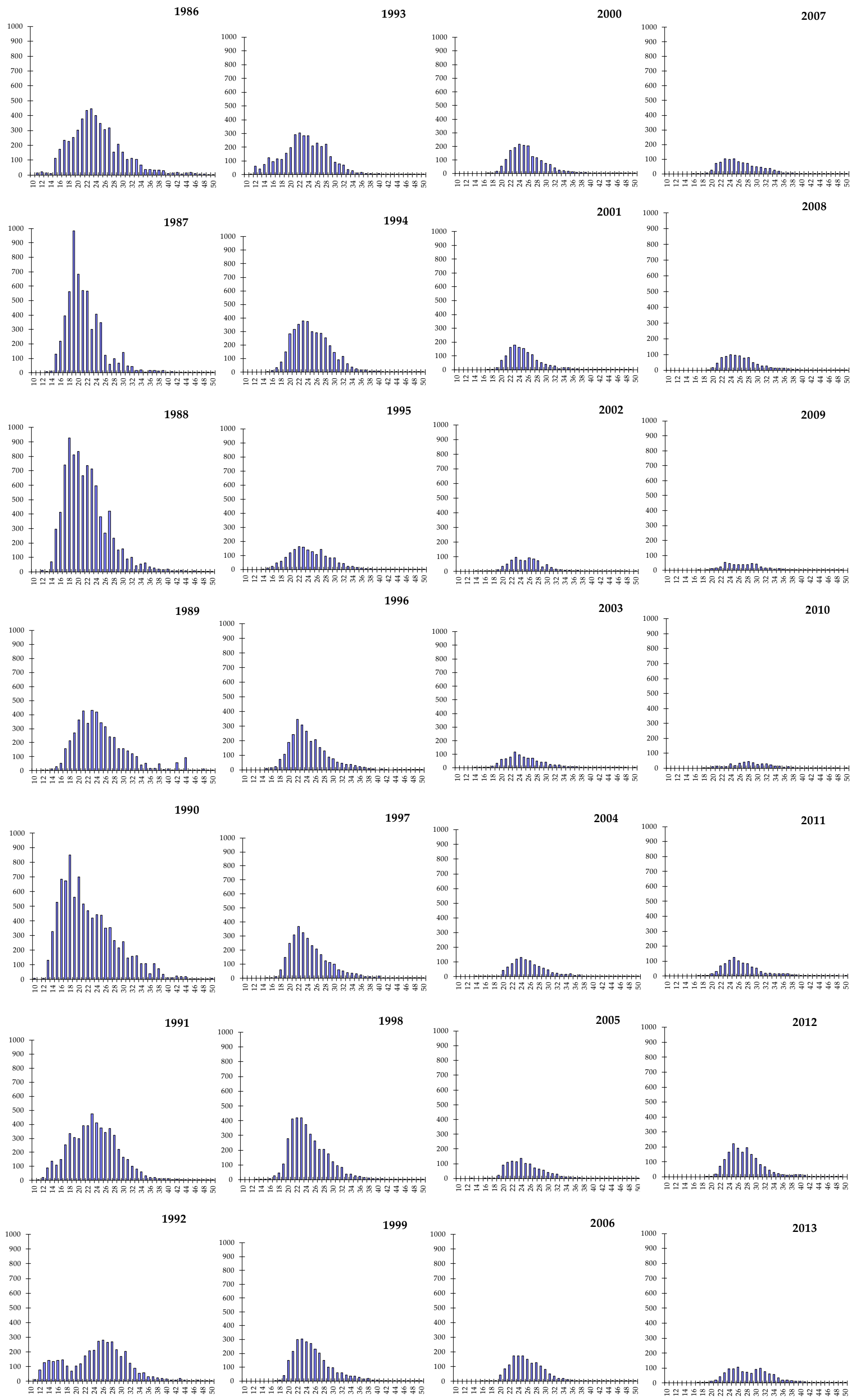
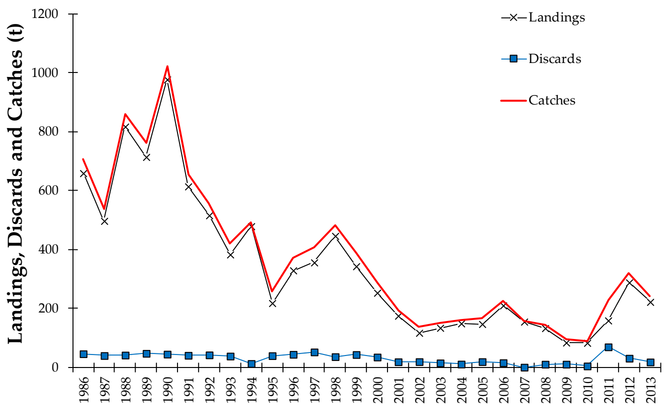
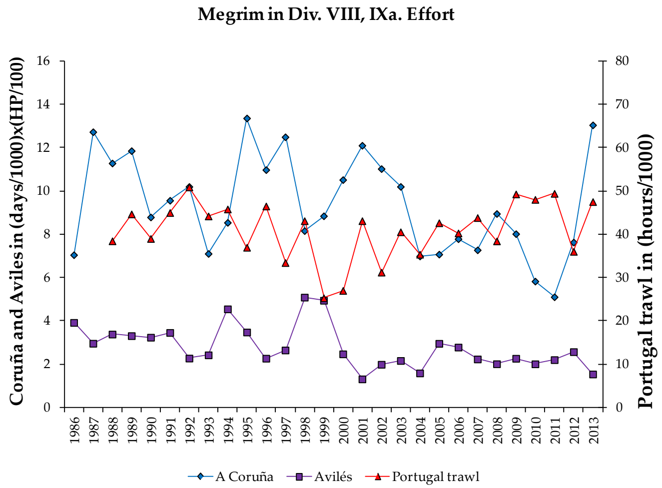
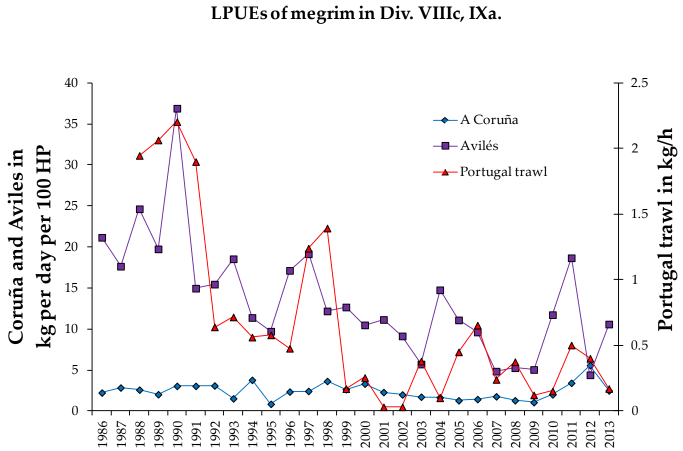
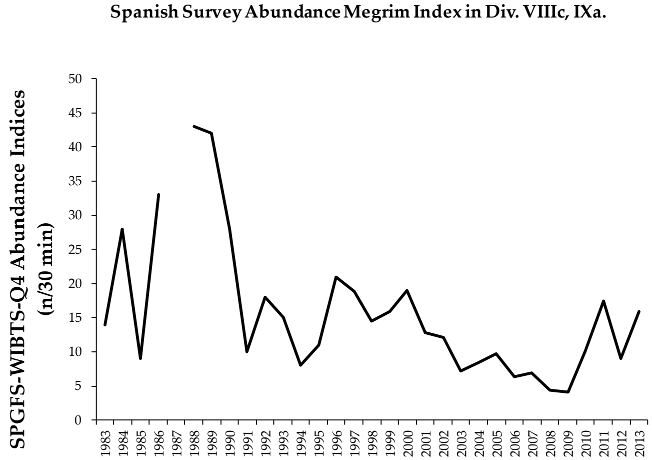


Figure 9.1.2 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Annual length compositions of landings ('000)







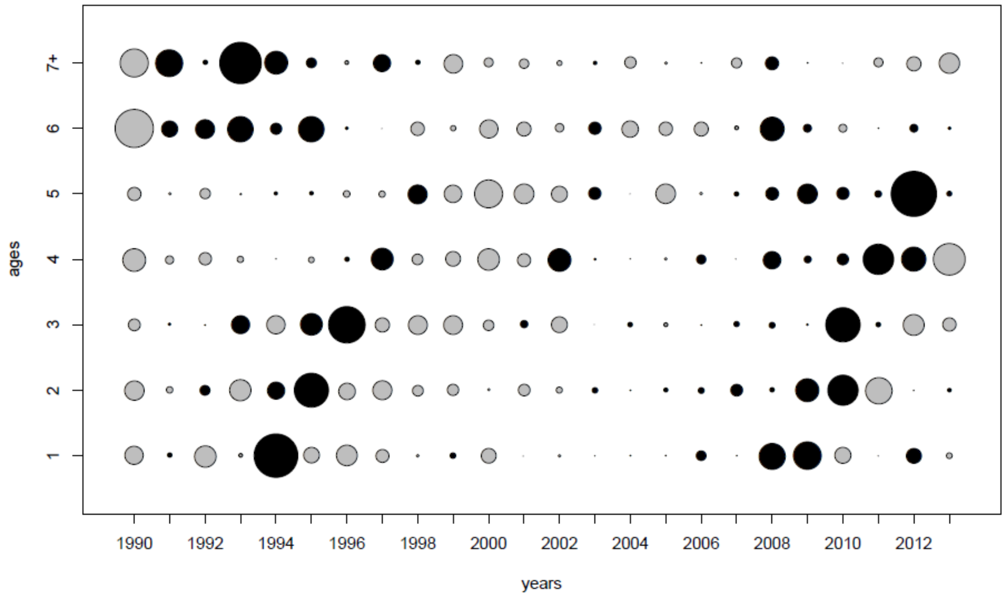


Spanish Landings of 2008 revised in WG2010 from original value presented

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

Figure 9.1.3(a) Megrim (*L.whiffiagonis*) in Divisions VIIIc, IXa. Catches (t), Efforts, LPUEs and Abundance Indices.

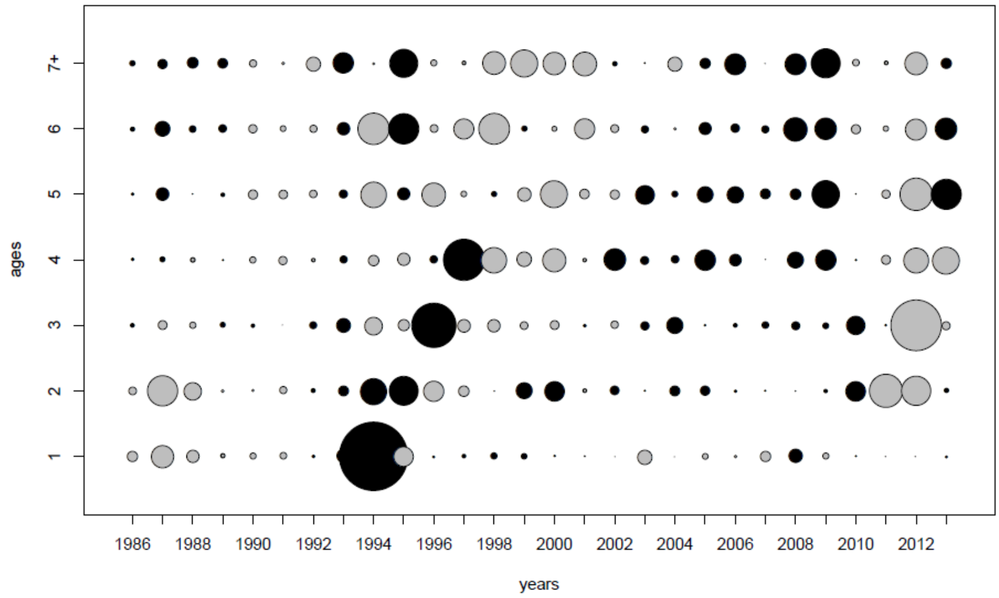
Standardized log (abundance index at age) from survey SpGFS-WIBTS-Q4 (black bubbles means <0)



* 2013 data not included in the assessment

Figure 9.1.3(b): Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa

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)

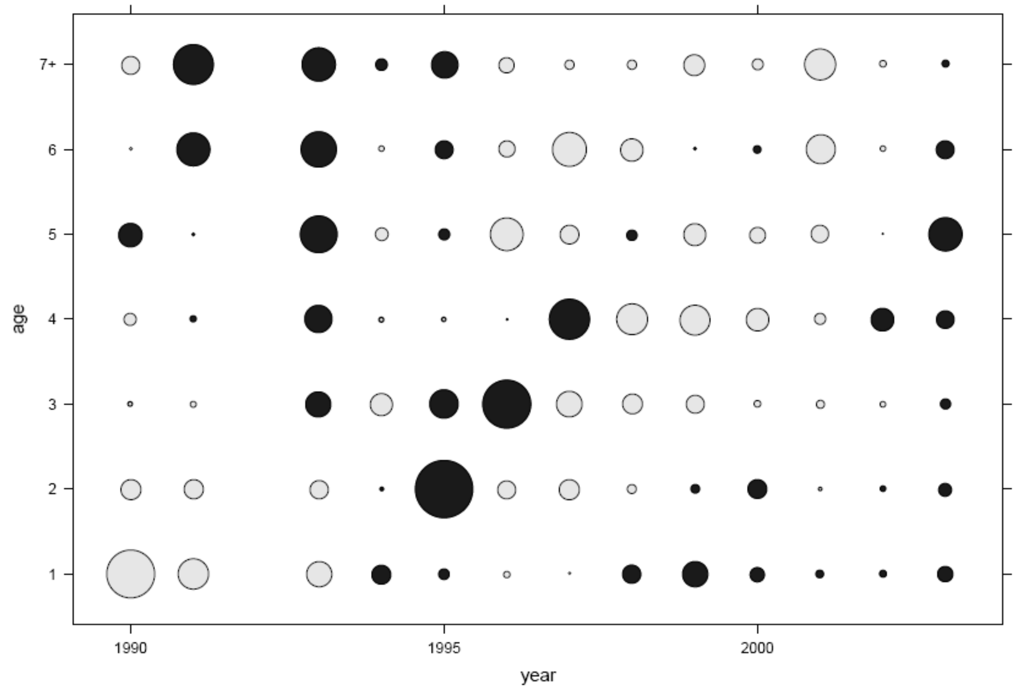
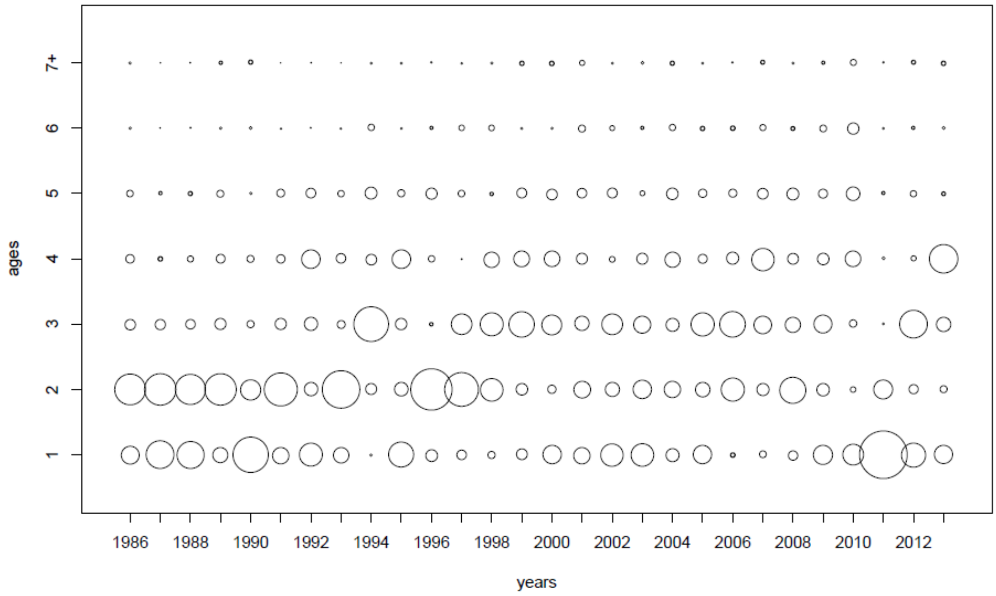


Figure 9.1.3(c): Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa

Catches proportions at age



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

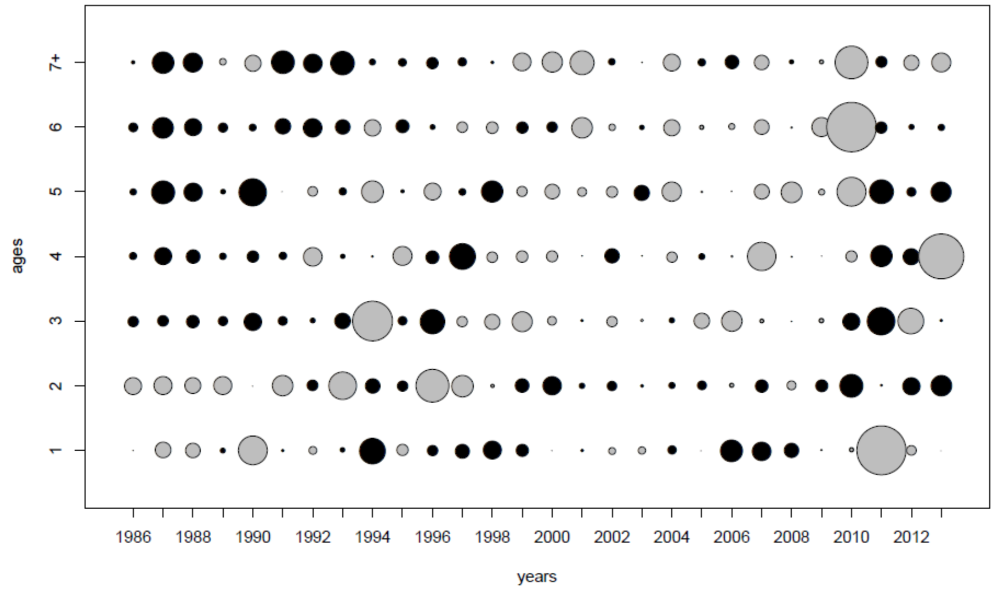
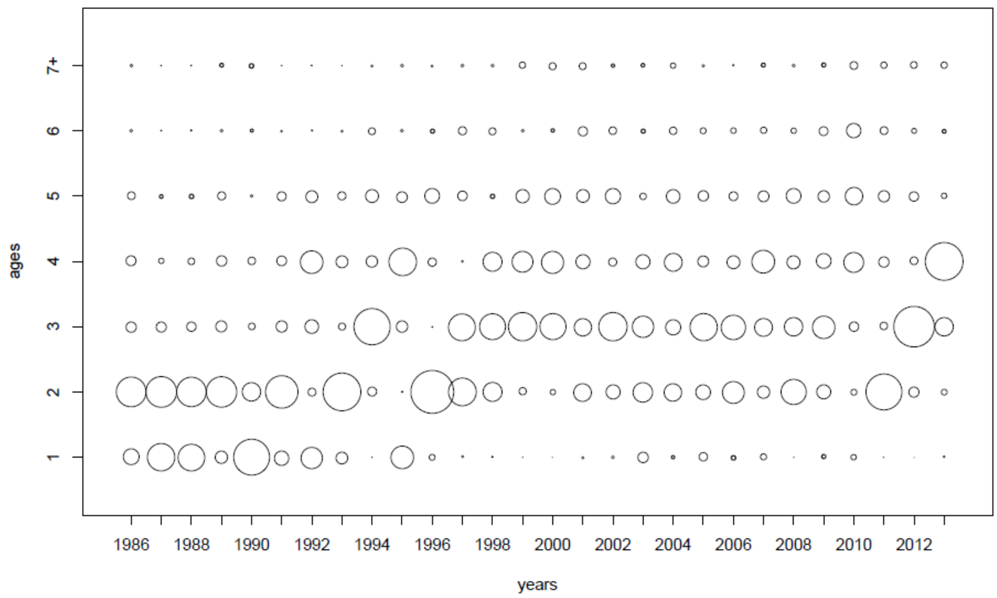


Figure 9.1.4(a). Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa.

Landings proportions at age



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

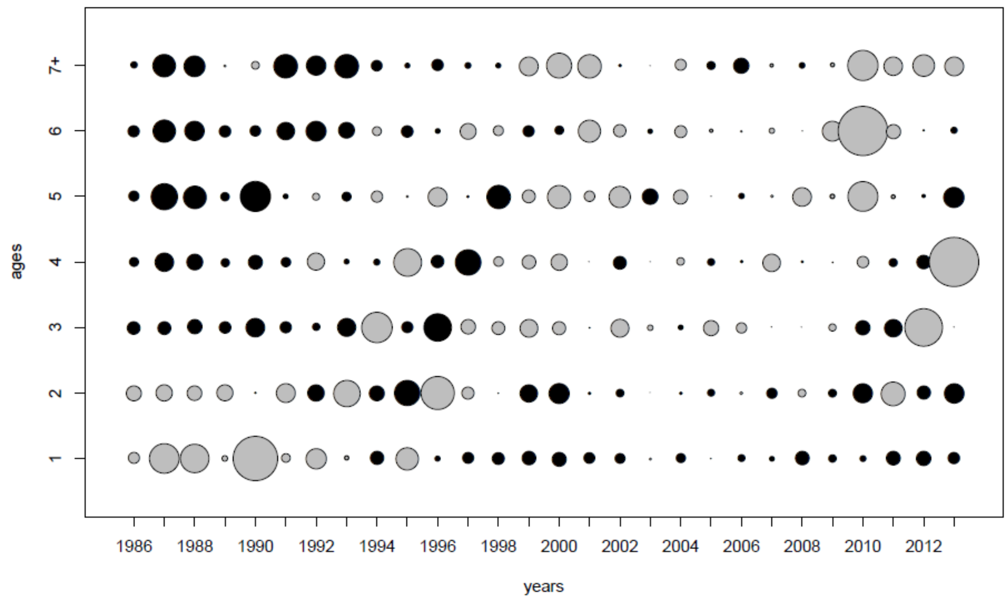
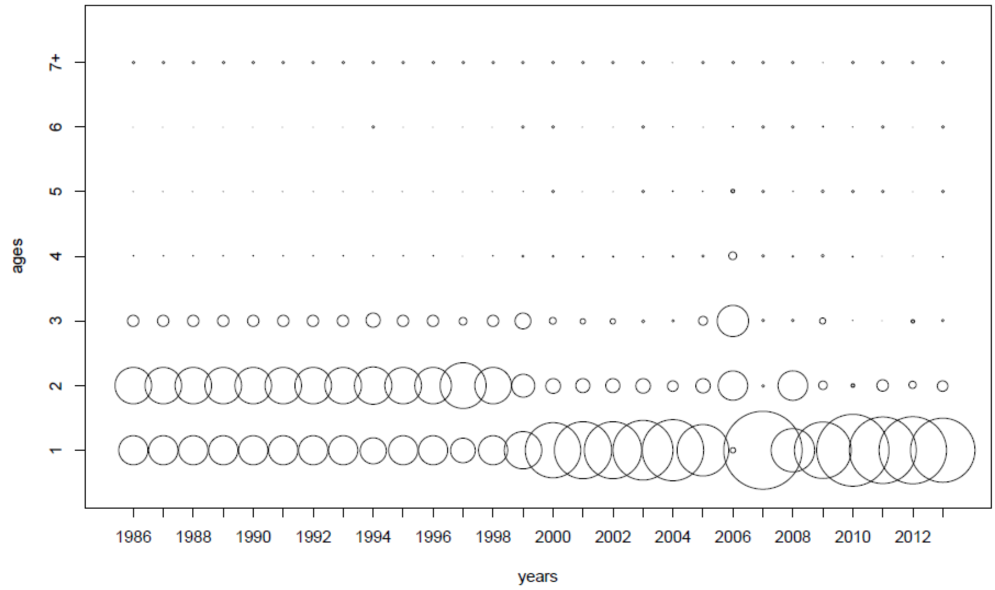


Figure 9.1.4(b). Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa.

Discards proportions at age



Standardizediscards proportions at age (black bubble means < 0)

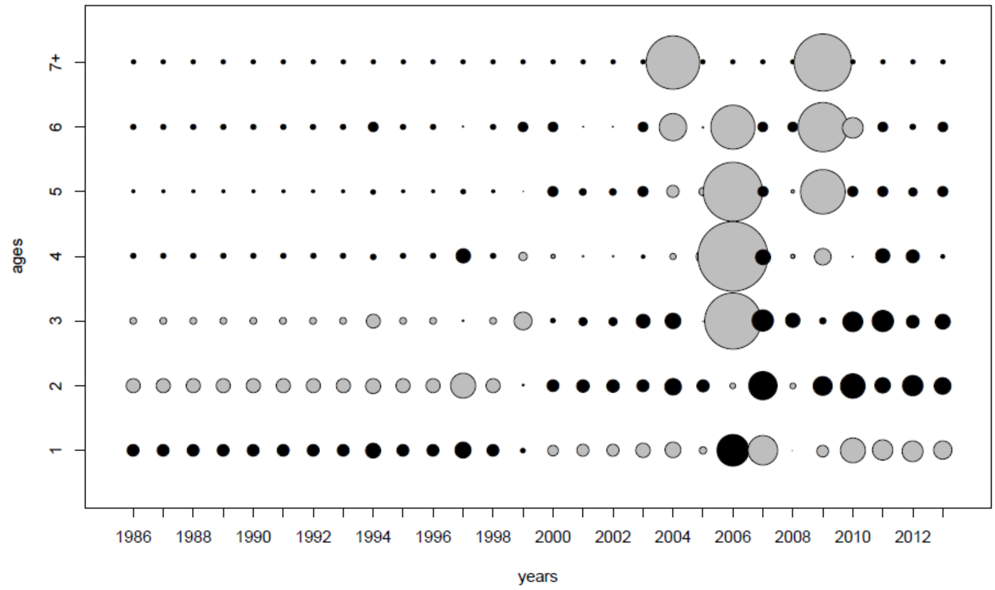


Figure 9.1.4(c). Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa.

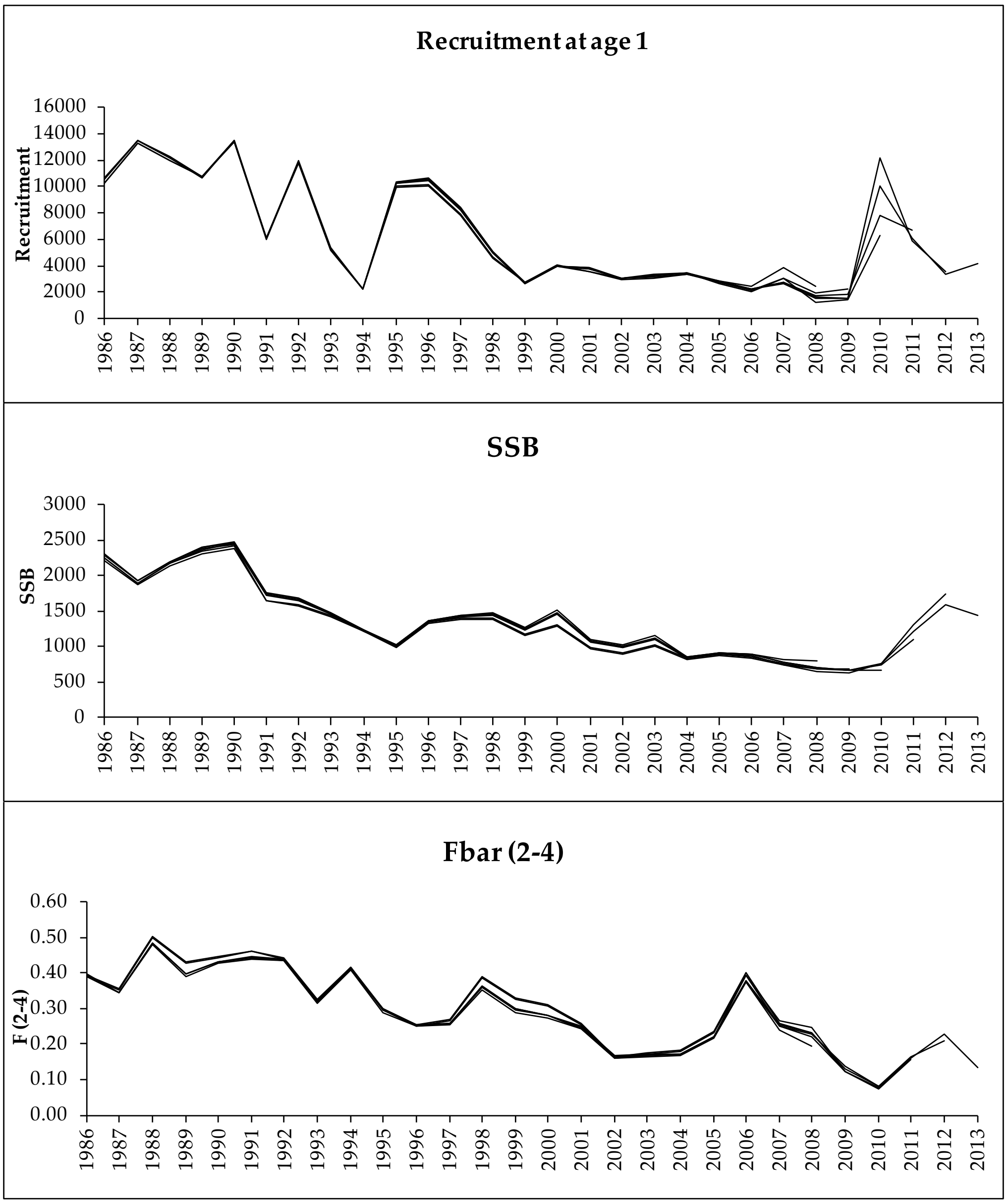


Figure 9.1.5. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Retrospective XSA

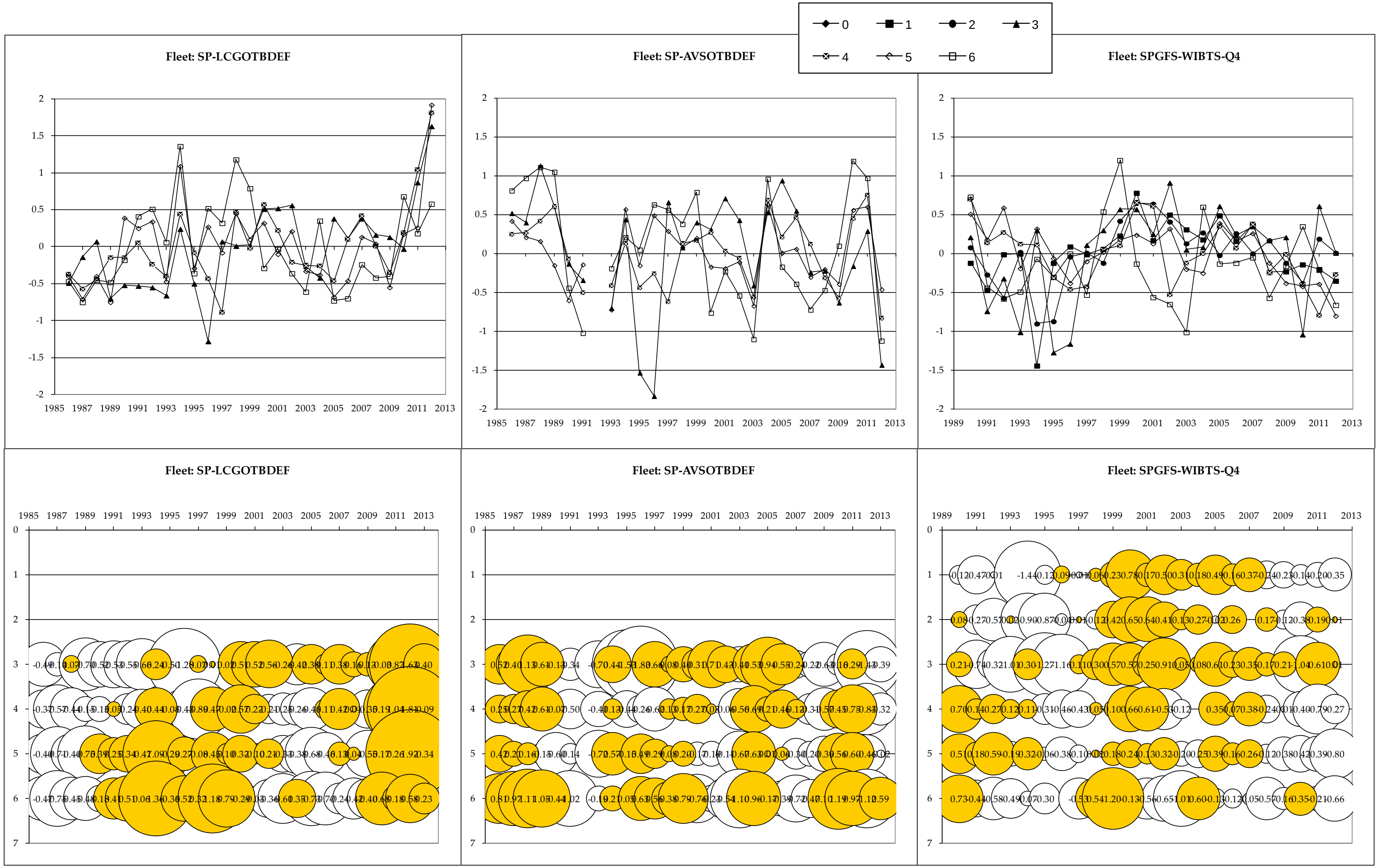


Figure 9.1.6. Megrim in Divisions VIIIc and IXa. LOG CATCHABILITY RESIDUAL PLOTS (XSA)

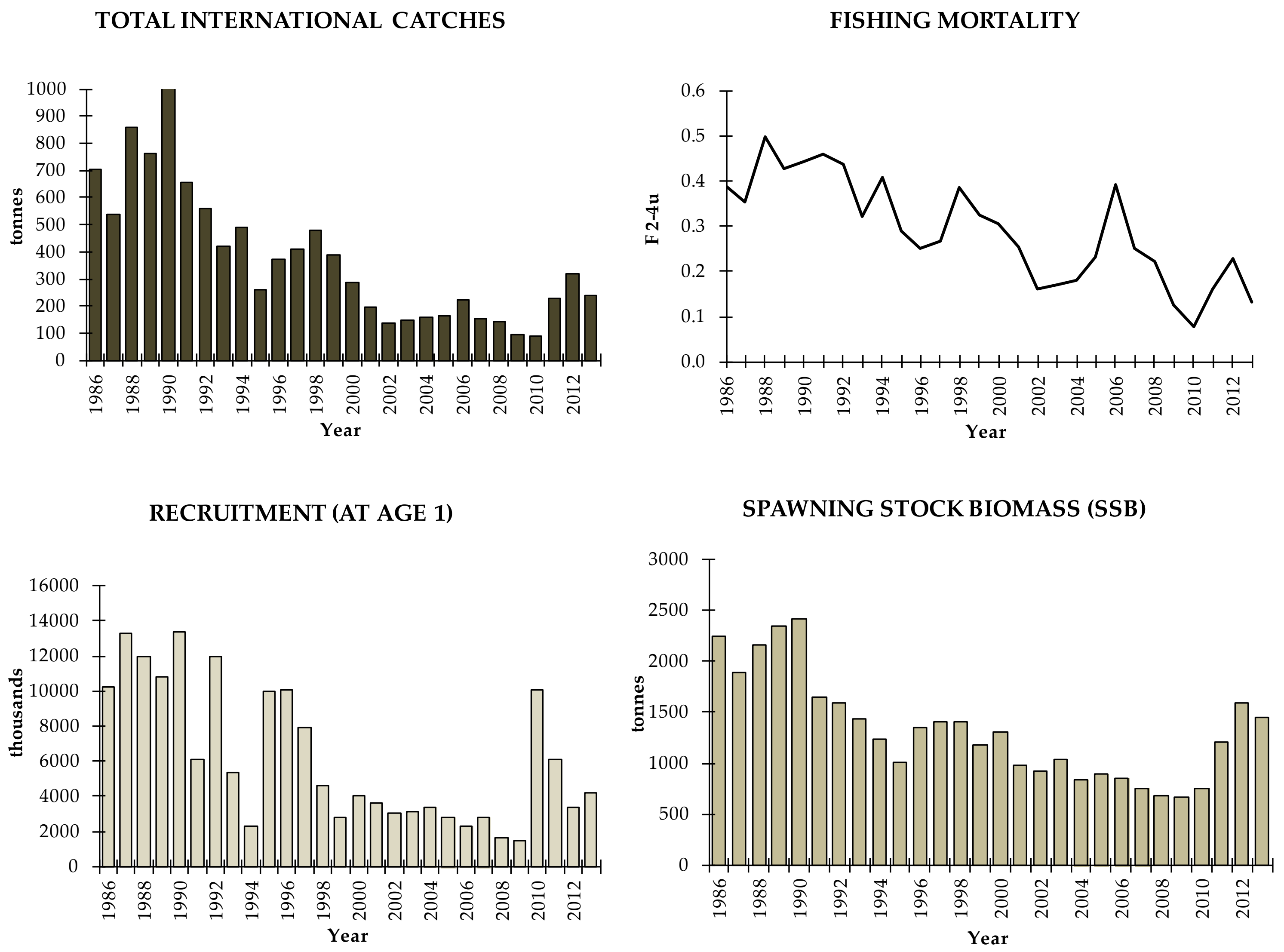
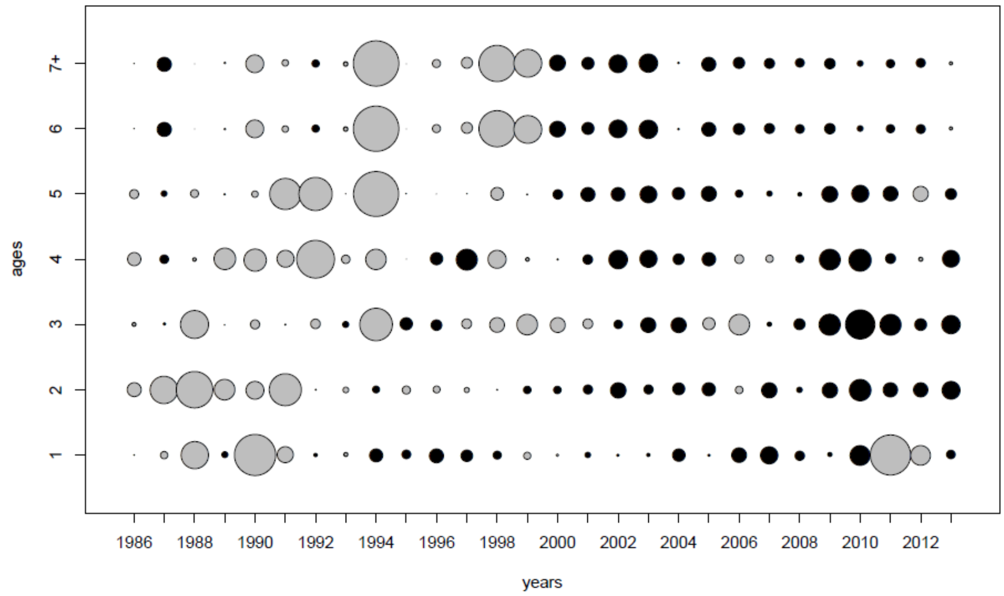


Figure 9.1.7(a) Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Stock Summary

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



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

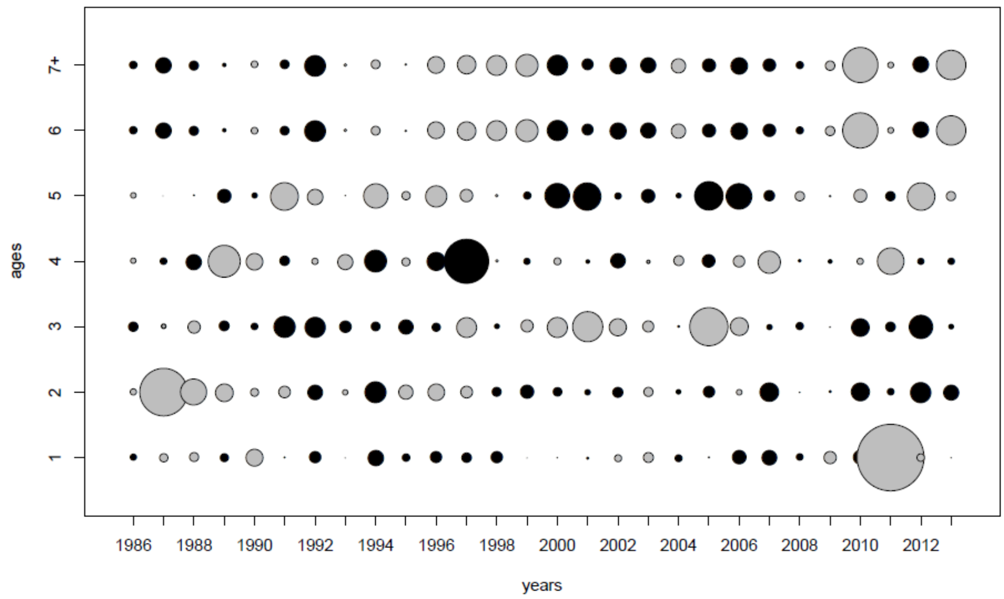
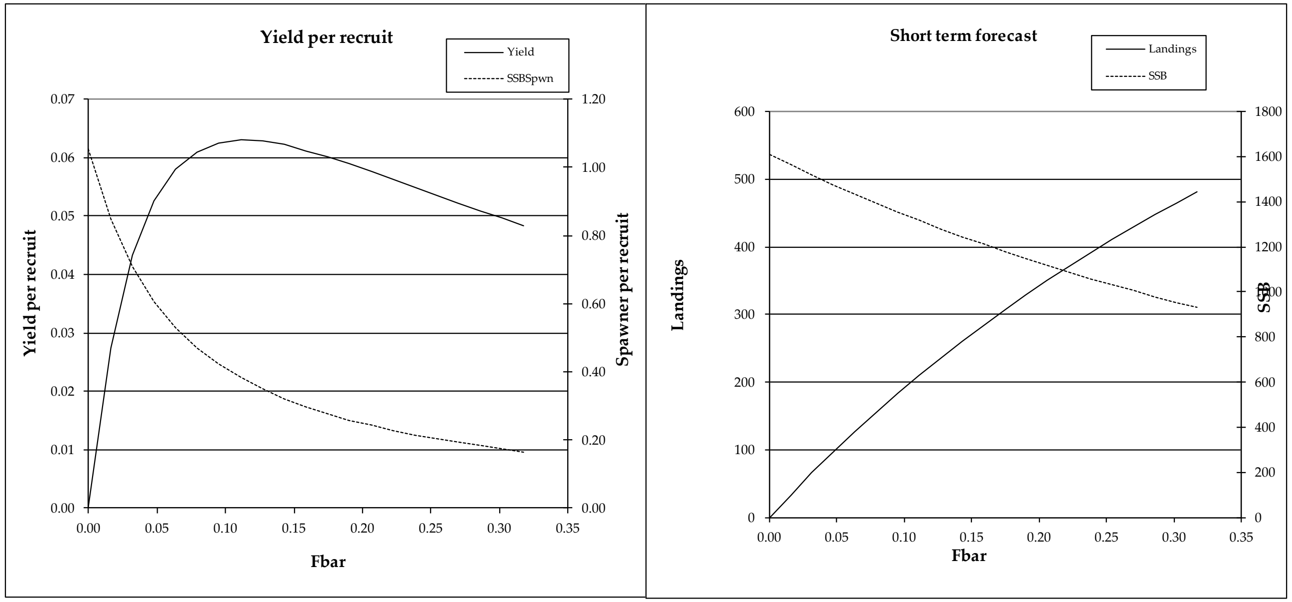


Figure 9.1.7(b): Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa



MFYPR version 2a
Run: MEG
Time and date: 15:23 09/05/2014

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1.0000	0.1587
FMax	0.7153	0.1135
F0.1	0.4195	0.0666
F35%SPR	0.7408	0.1176

MFDP version 1a
Run: MEG
Time and date: 15:20 09/05/2014
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Input units are thousands and kg - output in tonnes

Figure 9.1.8. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa, forecast summary

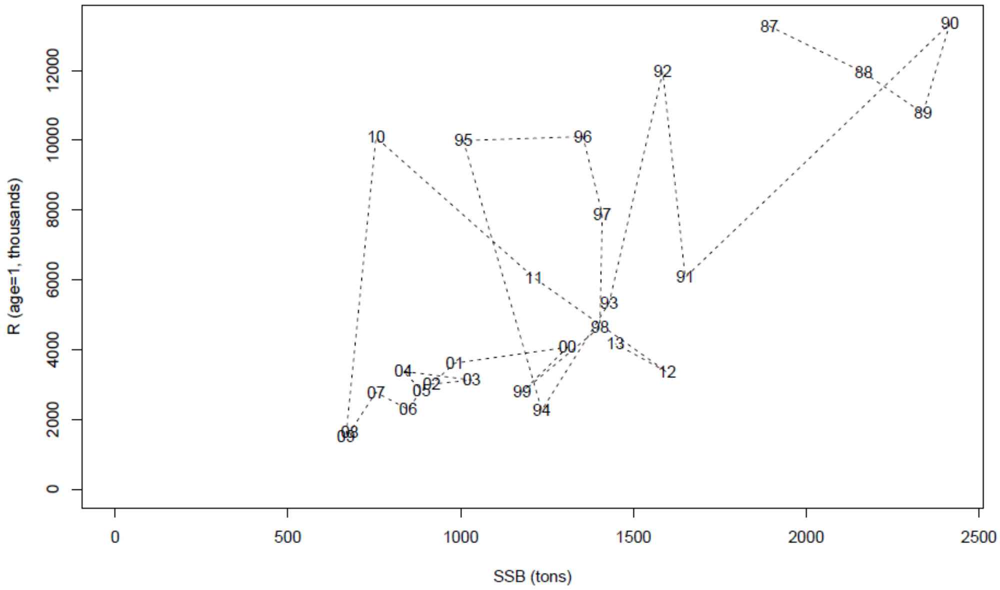


Figure 9.1.9. Megrim (L.whiffiagonis) in Divisions VIIIc and IXa. SSB-Recruitment plot. (numbers in graph, 1987-2010, are recruitment years)

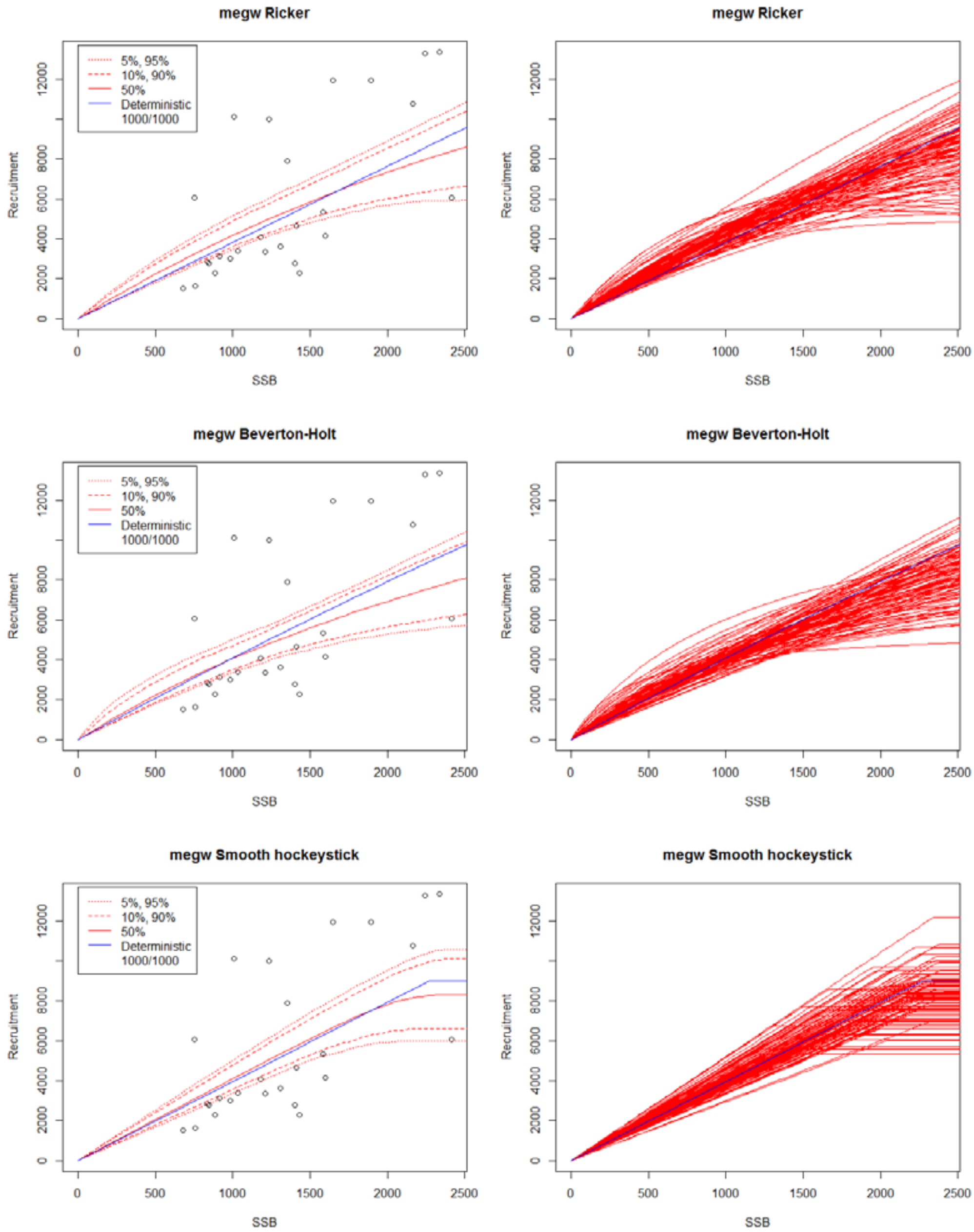


Figure 9.1.10. Megrim (*L. whiffiagonis*) in Div. VIIIc and IXa. Output from PlotMSY

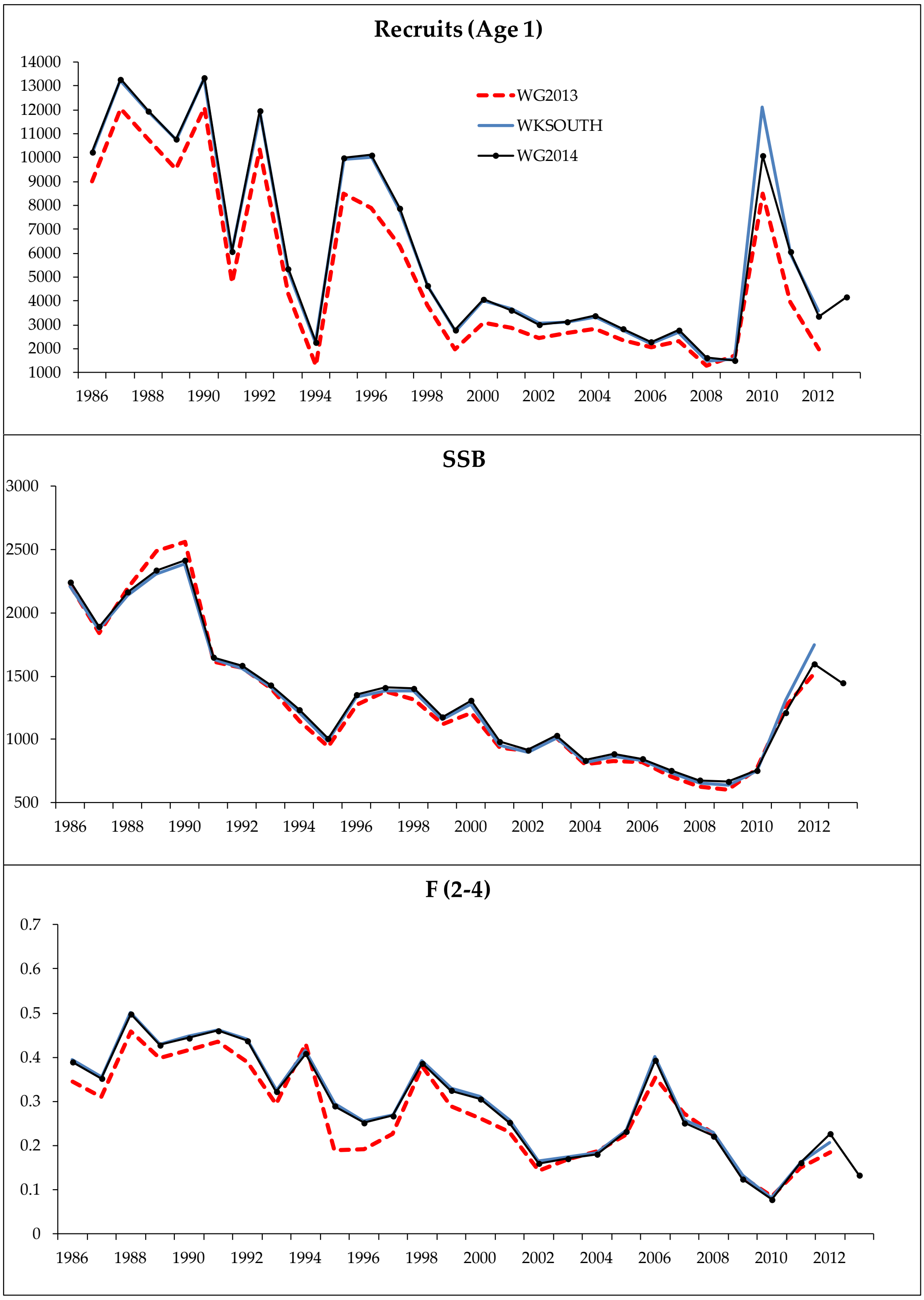


Figure 9.1.11. Megrim (*L. whiffiagonis*) in Div. VIIIc and IXa. Recruits, SSB and F estimates from WG13, WGSOUTH and WG14

9.2 Four-spot megrim (*Lepidorhombus boscii*)

9.2.1 General

See general section for both species.

9.2.2 Data

9.2.2.1 Commercial catches and discards

The WG estimates of four-spot megrim international landings, discards and catches for the period 1986 to 2013 are given in Table 9.2.1. Estimates of catches presently include an unallocated landing category. These estimates are considered the best information available at this time. However, given that the method of calculating them has changed this year, it is recommend to review the time series of unallocated landings for this stock following the criteria used in 2013. Landings reached a peak of 2629 t in 1989 and have generally declined since then to their lowest value of 720 t in 2002. There has been some increase again in the last few years. Landings in 2010 are 1297 t, the highest value after 1995. After a similar value in 2011, landings in 2012 are 806 t, a significant drop. In 2013, landings increase to 1120 t.

Discards estimates were available from "observers on board sampling programme" for Spain in the years displayed in Table 9.2.2(a). . Discard / Total Catch ratio and CV are also presented, where discards in number represent between 39-63% of the total catch. Following the ICES recommendations in the advice sheet and using the same methodology described for *L. whiffiagonis* in section 9.1.2.1, discards missing data are also estimated for *L. boscii*. . Spanish discards in numbers-at-age are shown in Table 9.2.2(b), indicating that the bulk of discards (in numbers) is for ages 1 to 3 Total discards are given in tons in Table 9.2.1

9.2.2.2 Biological sampling

Annual length compositions of total stock landings are given in Figure 9.2.1 and Table 9.2.3(a) for the period 1986-2013. Unallocated value is raised to total length distribution.

Mean length and weights in landings since 1990 are shown in the Table 9.2.3(b).

Weights-at-age of catches (given in Table 9.2.5) 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.

9.2.2.3 Abundance indices from surveys

Portuguese and Spanish survey indices are summarised in Table 9.2.6.

Two Portuguese surveys, named ``Crustacean´´ (PT-CTS(UWTV(FU28-29))) and ``October´´ (PtGFS-WIBTS-Q4), provide indices for 2013. The October survey was conducted with a different vessel and gear in 2003 and 2004. Excluding these two years, the biomass indices from this survey in 2007 and 2011 were the highest observed since 1994, whereas the value in 2010 is the second lowest in the series. In 2011, both the biomass and abundance indices from the Crustacean survey are the highest in the time series. In 2012, Portuguese Survey was not carried out due to budgetary constraints of national scope turned unfeasible to repair the R/V. In 2013 shows a low value of abundance.

Total biomass, abundance and recruitment indices from the Spanish Groundfish Survey (SpGFS-WIBTS-Q4) are also presented in Table 9.2.6. 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). This was followed by a period of higher values, with a high one in 2005. In 2013, the biomass and the abundance indices are the highest of the series. For the same raison that for *L. whiffiagonis*, survey carried out in a new vessel and with new doors, the abundance values of 2013 have not been included in the assessment models.

The recruitment index for age 0 in 2009 was very high and also in 2009. After two years in low levels, in 2012 the recruitment index shows a small increase, being lower in 2013. The high index in 2009 applies to all ages and not just the recruitment (see Table 9.2.7, which gives abundance indices by age, and Figure 9.2.2, 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). In 2012, only age 1 index is below average, whereas indices for the other ages are very high. It seems to be a "year" effect in 2013 values, probably due to the new vessel. From Figure 9.2.2, the survey appears to have been quite good at tracking cohorts, in the last ten years, good cohorts of 2005 and 2009 can be followed, specially the second one..

9.2.2.4 Commercial catch–effort data

The last assessments were calibrated by using a bottom otter trawl tuning fleet from A Coruña port, SP-CORUTR8c, for the period 1990-1999. Two new commercial tuning indices have been 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 9.1.2.4, one per port (A Coruña and Avilés), were made available for the benchmark. 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 9.2.7 and Figure 9.2.3(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 9.2.8 displays landings (in tonnes), fishing effort and LPUE for the two Spanish trawl fleets just mentioned for the period 1988-2013 and for the Portuguese trawl fleet fishing in Division IXa for the period 1988–2013 (see also Figure 9.2.3). After very high value in 2010, the LPUE of Coruña (SP-LCGOTBDEF) shows a similar value in 2013 in relation to 2012. An increase is observed in the LPUE from Avilés (SP-AVSOTBDEF) in 2013 from the last year´s low value. For the Portuguese fleets, until 2011 most log-books were filled in paper but have thereafter been progressively replaced by e-logbooks. In 2013 more than 90% of the log-books are being completed in the electronic version. However, due to various errors, data cleaning algorithms are required and are yet to be agreed upon internally in IPMA. IPMA therefore opted to postpone estimations of CPUE until 2015 (at which time the series will also be revised backwards).

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 2013, as indicated in the Stock Annex. In Figure 9.2.3(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 stabletill year 2009, when effort is declining to its lowest value in the series, reached in 2011. In 2013, the effort value is extremely high, being the second highest.

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 the second lowest in the series.

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

The LPUE series from the Avilés trawl fleet (SP-AVILESTR) shows a generally upwards trend during all the series. The value in 2013 is a big increase. . 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.

9.2.3 Assessment

An update assessment was conducted, according to the Stock Annex specifications and the new settings accepted in the Benchmark. Assessment years are 1986-2013 and ages 0-7+.

9.2.4 Model

Data screening

Figures 9.2.4(a), (b) and (c) are a bubble plots representing catch, landings and discards proportions at age. This plots clearly indicate that the bulk of the landings generally corresponds to ages 2 to 4 and the discards at ages 1-2. The bottom panel of Figures 9.2.4(a), (b) and (c) also present bubble plots corresponding to standardized catch, landings and discards proportions at age, showing that the one corresponding to landings is the best to follow cohorts.

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

Final XSA run

Settings for this year’s assessment were the same ones used in the Benchmark WKSOUTH and are detailed in the Stock Annex.

The retrospective analysis shows no particular worrying features (Figure 9.2.5). The model has a tendency to underestimate F and an overestimate SSB in the last years.

9.2.4.1 Assessment results

Diagnostics from the XSA final run are presented in Table 9.2.9 and log catchability residuals plotted in Figure 9.2.6. Diagnostics and residuals are similar to those found in the previous assessment. Many of the survey residuals are negative until the mid 1990's. After that, positive survey residuals are more abundant in this period.

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Table 9.2.10 presents the fishing mortality-at-age estimates. Fbar (=F_{2-4}) is estimated to be 0.36 in 2013, in line with the range of F values estimated for the last decade.

Population numbers-at-age estimates are presented in Table 9.2.11.

9.2.4.2 Year class strength and recruitment estimations

The 2011 year class estimate is 34 million individuals, obtained by averaging estimates coming from the Spanish survey tuning data (92% of weight)and F-shrinkage (8% weight).

The 2012 year class estimate is 54 million individuals, estimated from the Spanish survey (75% of weight)and F-shrinkage (25% weight).

The 2013 year class estimate is 15 million individuals, obtained a value from F-shrinkage (100% weight).

Following the procedure stated in the Stock Annex, the geometric mean of estimated recruitment over the years 1990-2011 has been used for computation of 2014 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
2011	38428	XSA	92%	-	8%
2012	54471	XSA	75%	-	25%
2013	42254	GM90-11		-	
2014	42254	GM90-11			

9.2.4.3 Historic trends in biomass, fishing mortality, and recruitment

Estimated fishing mortality and population numbers-at-age from the XSA run are given in Tables 9.2.10 and 9.2.11. Further results, including SSB estimates, are summarised in Table 9.2.12 and Figure 9.2.7(a).

SSB decreased gradually from 6801 t in 1989 to 3313 t in 2001, the lowest value in the series, and has since increased. In 2013 the SSB is estimated at 5835 t

Recruitment has fluctuated around 45 million fish during all the series. Very weak year classes are found in 1993 and 1998. The highest value occurred in 2009, while 2013 value is the lowest in the series, with 14 million fish.

Estimates of fishing mortality values show two different periods: an initial one with higher values from 1989 to 1996 and, following a decrease in 1997, a second period stabilised at a lower level, with small ups and downs. From 2007, the F has been decreasing, till 2013, when a significant increase has occurred with a value of 0.35..

There seems to be interannual variability in the relative fishing exploitation pattern at age (F over Fbar, see Figure 9.2.7(b), bottom panel), with alternating periods of time with higher and lower relative exploitation pattern on the older ages.

9.2.5 Catch options and prognosis

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

9.2.5.1 Short-term projections

Short-term projections have been made using MFDP software. The input data for deterministic short-term projections are given in Table 9.2.13. The exploitation pattern used was the scaled F-at-age computed for each of the last five years and then the average of these scaled 2009-2013 years was weighted to the final year. This selection pattern was split into selection-at-age of landings and discards (corresponding to Fbar = 0.18 for landings and Fbar=0.09 for discards, being 0.27 for catches).As it has been done for *L. whiffiagonis*, as the recruitment in 2013 (age 0) has been replaced by GM, age 1 in 2014 has been recalculated from GM reduced by total estimated mortality. This option has been included in the Stock annex.

Table 9.2.14 gives the management options for 2015, and their consequences in terms of projected landings and stock biomass. Figure 9.2.8 (right panel) plots short-term yield and SSB versus Fbar.

The detailed output by age group, assuming F *status quo* for 2014-2016, is given in Table 9.2.15 for landings and discards. Under this scenario, projected landings for 2014 and 2015 are 1318 and 1227 t, respectively. Projected discards for the same years are 336 and 329 t.

Under F *status quo*, projected SSB values for 2015 and 2016 are about 6043 t in 2015 and 6035 t in 2016.

The contributions of recent year classes to the projected landings and SSB are presented in Table 9.2.16 (under F *status quo*). The year classes for which GM_{90-11} recruitment is assumed contribute in a 17% to catches in 2015 and with a 39% to SSB in 2016.

9.2.5.2 Yield and biomass per recruit analysis

The analysis is conducted following the Stock Annex specifications and results presented in Table 9.2.17. The left panel of Figure 9.2.8 plots yield-per-recruit and SSB-per-recruit versus Fbar.

Under F s*tatus quo* (Fbar = 0.18 for landings and Fbar=0.09 for discards), yield-per-recruit is 0.03 kg for landings and 0.01 kg for discards and SSB-per-recruit is 0.13 kg. Assuming GM_{90-11} recruitment of 42 million, the equilibrium yield would be around 1137 t of landings and 321 t of discards, with an SSB value of 5624 t.

9.2.5.3 Biological reference points

There is no evidence of reduced recruitment at the lower SSB levels observed (Figure 9.2.9).

See Stock Annex for more information about Biological reference points.

F_{MSY}=0.18 was preliminarily proposed in WGHMM 2010, corresponding to F40% as calculated in that WG, for consistency with the rationale followed for *L. whiffiagonis*.

With the inclusion of discards data in the assessment, a new estimation of Biological Reference Points has been developed during the Benchmark WKSOUTH. The software PlotMSY was employed to define the biological reference points for both stocks, following the recommendations of ICES expert groups.

The biological information needed to run this model was obtained from the assessment carried out during WKSOUTH with data up to 2012. See Stock annex for specific settings. This proposal has been updated with 2013 data to explore the reference points. Figure 9.2.10 shows the results for this update..

There are, once again, some slight changes to the (median) values of potential reference points: F_{max}=0.17, whereas F_{MSY} was 0.20, 0.13, and 0.17, under Ricker, Beverton-Holt and Hockey-stick, respectively. Values of F below 0.33 correspond to less than 5% long-term probability of SSB being below 3300 t (B_{loss}), based on the likelihood weighting of the three stock-recruitment functions.

The Working Group accepted the updated values having reviewed the methodology and the inclusion of 2013 data.

The new proposal for BRP is:

	Type	Value	Technical basis
MSY	MSY Btrigger	4600 t	default option; 1.4 Blim
Approach	FMSY	0.17	Fmax as FMSY proxy
	Blim	3300 t	Bloss in the 2014 benchmark assessment
Precautionary	Bpa	4600 t	default option; 1.4 Blim
Approach	Flim		
	Fpa		

9.2.6 Comments on the assessment

Two commercial fleets (SP-LCGOTBDEF-1 and SP-LCGOTBDEF-2) and the Spanish survey (SpGFS-WIBTS-Q4) were used for tuning. The commercial fleet data used for tuning corresponds to ages 3 and older, which are not well represented in the survey. The Spanish survey covers a large part of the distribution area of the stock. The survey appears to have been quite good at tracking cohorts.

With the new settings, discards data and new tuning fleets, the model converges. It seems that the convergence issue is solved for this stock.

Comparison of this assessment with the one performed in 2013shows different results due to the inclusion of discards data (Figure 9.2.11) being trends the same but in a different range. F and R are higher when discards are included. However, if the comparison is made with the assessment results from the Benchmark WKSOUTH, they are quite similar except in the final trend of the last year.

9.2.7 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 between 2001 onwards, with small drops in 2009, 2011 and 2013.. Fishing at *status quo* F during 2014 and 2015 would result in some biomass increase from the 2013 value for 2014, and a similar value for 2015.

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.

9.3 Combined Forecast for Megrims (*L. whiffiagonis* and *L. boscii*)

Figure 9.3.1 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 VIIIc and IXa. Both are taken as by-catch in mixed bottom trawl fisheries. Assuming status quo F for both species in 2014 (average of estimated F over 2011-2013, corresponding to Fbar== 0.16 for landings and Fbar=0.02 for discards for *L. whiffiagonis* and Fbar = 0.18 for landings and Fbar=0.09 for discardsfor *L. boscii*), Figure 9.3.2 gives the combined predicted landings for 2015 and individual SSB for 2016, 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 2011-2013) for both species, predicted combined catches in 2015 are 1866 t and individual SSBs in 2016 are 1212 t for *L. whiffiagonis* and 6035 t for *L. boscii*.

Table 9.2.1. Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Total landings (t).

	Spain landings			Portugal landings	Unallocated	Total landings	Discards	Total catch
Year	VIIIc	IXa***	Total	IXa				
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	292.0	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	499	368	867	181	212	1260	269	1529
*2012	245	231	476	98	231	806	369	1175
*2013	345	275	619	80	420	1120	496	1616

***IXa is without Gulf of Cádiz

** Data revised in WG2010

* Official data by country and unallocated landings

Table. 9.2.2(a) Megrim (*L. boscii*) in Divisions VIIIc, IXa. 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	2010	2011*	2012	2013
Weight Ratio	0.30	0.28	0.24	0.29	0.21	0.30	0.32	0.27	0.25	0.20	0.23	0.19	0.20	0.34	0.31
CV	23.2	11.2	14.4	16.5	10.2	23.1	24.0	48.4	18.3	22.6	21.1	18.8	16.0	15.5	23.2
Number Ratio	0.50	0.63	0.59	0.61	0.47	0.55	0.55	0.42	0.47	0.42	0.39	0.62	0.50	0.60	0.59

**All discard data revised in WG2011

*Data revised in WG2013

Table. 9.2.2(b) Megrim (*L. boscii*) in Divisions VIIIc, IXa. Discards in numbers at age (thousands) for Spanish trawlers

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0	1289	1289	1289	1289	1289	1289	1289	1289	678	1289	1289	256	1289	2933	354
1	3322	3322	3322	3322	3322	3322	3322	3322	2741	3322	3322	3273	3322	3954	6148
2	4322	4322	4322	4322	4322	4322	4322	4322	4134	4322	4322	6099	4322	2734	1207
3	2211	2211	2211	2211	2211	2211	2211	2211	2710	2211	2211	2108	2211	1815	1888
4	605	605	605	605	605	605	605	605	581	605	605	146	605	1088	1218
5	94	94	94	94	94	94	94	94	189	94	94	90	94	3	171
6	20	20	20	20	20	20	20	20	55	20	20	3	20	0	12
7	4	4	4	4	4	4	4	4	11	4	4	0	4	1	2

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011*	2012	2013
0	208	208	238	33	10	1	100	202	2	2879	30	682	275
1	5673	5673	4479	6393	3515	1233	3248	2342	1525	10362	5132	5313	5499
2	1750	1750	989	3053	5482	2497	4541	2374	2490	1301	3595	2480	4379
3	1025	1025	495	693	609	1445	757	1384	1970	696	544	1057	3030
4	477	477	50	163	183	486	105	52	480	283	174	15	707
5	67	67	2	27	56	168	44	10	51	83	37	5	39
6	4	4	0		23	22	7	3	7	11	1	2	12
7	1	1			6	9	1	3		1		0	2

Table 9.2.3(a) Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa
Length compositions of landings in 2013 ('000 fish)

Length (cm)	Total
10	
11	
12	
13	
14	0.2
15	0.4
16	
17	4.2
18	20.2
19	107.1
20	393.1
21	846.0
22	1131.5
23	1535.2
24	1555.7
25	1382.5
26	939.3
27	633.3
28	362.9
29	280.8
30	184.9
31	144.8
32	65.9
33	50.3
34	26.0
35	13.1
36	9.7
37	7.9
38	7.1
39	4.6
40	3.6
41	3.0
42	1.5
43	0.9
44	1.1
45	1.2
46	1.1
47	0.6
48	
49	0.1
50+	
Total	9720

Table 9.2.3(b) Megrim (L. boscii) Divisions VIIIc and IXa. Mean lengths and mean weights in landings since 1990

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	22.7	22.7	22.9	23.5	23.6	23.6	24.1	23.7	23.7	23.9
Mean weight (g)	116	118	122	128	111	96	107	112	109	113	121	114	105	101	98	97.0	99.4	109.1	109.7	110.7	118.4	112.2	112.0	114.0

Table 9.2.4 Four-spot megrim (*L. boscii*) in Divisions VIIIc, IXa. Catch numbers at age.

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	*2008	2009	2010	2011	2012	2013
AGE																												
0	1289	1289	1289	1289	1289	1289	1289	1289	678	1289	1289	256	1289	2933	354	208	208	238	33	10	1	100	202	2	2879	30	682	275
1	3432	5605	4847	4055	4766	4482	4168	3868	2824	4743	3719	3308	3367	3992	6193	5840	5863	4846	6785	3638	1267	3257	2357	1546	10377	5144	5329	5499
2	7797	15902	14414	11462	9506	8001	6989	6656	7049	6527	6458	7343	5526	3895	1862	2888	4139	3791	5568	8004	5232	6147	3935	3136	2364	4696	3038	4982
3	5901	7284	7666	7603	4096	5539	6211	4307	7225	8349	3478	4978	6447	4596	3533	2276	3386	3368	3777	3604	5951	3390	4879	4887	3568	2841	3418	5063
4	4545	4198	5384	6514	4434	2516	5784	4404	2849	6201	4419	890	3545	4996	4000	2870	1220	1526	2602	2024	2639	2705	2204	4640	3817	3157	1577	4745
5	1226	1438	2460	3573	2405	2744	2294	1245	1801	1150	1990	1714	792	1405	2020	1937	454	501	1155	1426	1156	1909	1003	1662	2529	2858	1378	1629
6	869	589	1181	1798	1403	1048	758	655	894	602	224	1069	849	235	797	941	240	447	279	802	274	855	354	640	496	1209	891	1006
+gp	233	145	467	634	807	483	71	282	457	284	555	443	353	489	840	358	360	142	337	399	228	461	298	222	438	413	390	465
TOTALNUM	25292	36450	37708	36928	28706	26102	27564	22706	23777	29145	22132	20001	22168	22541	19599	17318	15870	14859	20536	19907	16748	18824	15232	16735	26468	20348	16703	23664
TONSLAND	1408	2021	2586	3037	2354	2129	2353	1822	1920	2058	1466	1204	1501	1442	1414	1221	1028	1067	1354	1358	1427	1396	1182	1413	1562	1529	1175	1616
SOPCOF %	100	100	100	100	100	99	103	99	100	100	100	102	100	101	100	100	100	101	101	100	101	101	101	100	101	103	101	101

* Data revised in WG2010 from original value presented

Table 9.2.5 Four-spot megrim (*L. boscii*) in Divisions VIIIc, IXa. Mean weights at age in Catchs (kg).

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	*2008	2009	2010	2011	2012	2013
AGE																												
0	0.004	0.004	0.004	0.004	0.003	0.004	0.004	0.003	0.005	0.004	0.003	0.004	0.004	0.006	0.006	0.004	0.006	0.008	0.006	0.0060	0.006	0.005	0.005	0.004	0.004	0.003	0.009	0.004
1	0.013	0.027	0.027	0.027	0.019	0.022	0.021	0.014	0.023	0.030	0.023	0.016	0.019	0.018	0.023	0.024	0.024	0.025	0.027	0.021	0.023	0.022	0.017	0.025	0.012	0.02	0.033	0.017
2	0.034	0.046	0.049	0.055	0.051	0.055	0.052	0.052	0.056	0.046	0.043	0.030	0.040	0.045	0.057	0.050	0.057	0.066	0.053	0.050	0.06	0.045	0.053	0.045	0.056	0.04	0.051	0.046
3	0.055	0.062	0.069	0.079	0.081	0.097	0.093	0.092	0.082	0.082	0.054	0.063	0.073	0.072	0.066	0.073	0.090	0.088	0.081	0.083	0.091	0.079	0.079	0.069	0.084	0.077	0.076	0.064
4	0.090	0.089	0.100	0.108	0.134	0.114	0.120	0.136	0.114	0.096	0.106	0.091	0.105	0.090	0.087	0.099	0.109	0.123	0.108	0.108	0.104	0.114	0.112	0.104	0.108	0.097	0.107	0.1
5	0.129	0.125	0.138	0.144	0.154	0.164	0.159	0.174	0.148	0.143	0.135	0.123	0.137	0.147	0.126	0.122	0.163	0.142	0.131	0.122	0.136	0.123	0.151	0.142	0.141	0.126	0.13	0.131
6	0.159	0.151	0.167	0.167	0.183	0.190	0.225	0.218	0.178	0.168	0.209	0.180	0.179	0.197	0.169	0.166	0.209	0.201	0.175	0.132	0.176	0.152	0.201	0.175	0.182	0.168	0.162	0.158
+gp	0.263	0.239	0.280	0.275	0.272	0.263	0.351	0.295	0.243	0.255	0.231	0.252	0.293	0.268	0.228	0.255	0.247	0.247	0.235	0.197	0.233	0.198	0.235	0.288	0.271	0.239	0.201	0.226
SOPCOFAC	1.001	1.002	1.003	1.000	1.001	0.993	1.028	0.989	1.002	0.996	0.999	1.017	1.003	1.009	1.001	1.001	0.999	1.013	1.007	1.004	1.007	1.011	1.006	1.001	1.010	1.035	1.007	1.010

* Data revised in WG2010 from original value presented

Table 9.2.6 Four-spot megrim (*L. boscii*) Divisions VIIIc, IXa. 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
A,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
A,B,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
A,2003	1.36	3.65	1.20	1.32	0.16
A,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

	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
A,1996			44.80	4.05
1997	31.57	15.52	43.50	3.84
1998	26.46	10.68	34.30	4.45
A,B,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
A,2003	60.80	20.97	16.90	1.54
A,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

	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
A,1996	16	3.57	20.56
1997	1	3.54	13.34
1998	+	0.27	9.57
A,B,1999	+	0.94	7.46
2000	16	1.07	13.96
2001	25	0.59	16.95
2002	1	1.04	9.95
A,2003	8	0.65	4.95
A,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

+ less than 0.04
ns no survey
A Portuguese October Survey with different vessel and gear (Capricórnio and CAR net)
B Portuguese Crustacean Survey covers partial area only with a different Vessel (Mestre Costeiro)
* Revised in WGHMM2011
** New vessel for Spanish survey (Miguel Oliver)

Table 9.2.7 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Tuning data

FLT01: SP-LCGOTBDEF-1. 1000 Days by 100 HP (thousand)

1986	2012									
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	20	100	168	105	39	2	10.2	1992
10		0	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	23	111	40	143	125	59	12.5	1997
10		0	82	420	350	98	127	62	8.2	1998
10		0	62	210	331	165	33	45	8.8	1999

FLT02: SP-LCGOTBDEF-2. 1000 Days by 100 HP (thousand)

1986	2003									
1	1	0	1							
1	7								Eff.	
10		0	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	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	72	277	665	258	140	53	13.1	2013

FLT03: SPGFS-WIBTS-Q4 (n/30 min)

1988	2012									
1	1	0.75	0.83							
0	7								Eff.	
1	2.9	25	21	7	2	1	0	0	101	1988
1	8.5	17	8	4	2	1	0	0	91	1989
1	0.4	19	13	2	3	2	1	0	120	1990
1	2.5	9	9	4	2	1	0	0	107	1991
1	2.4	35	4	4	2	1	0	0	116	1992
1	0.3	21	17	2	2	1	0	0	109	1993
1	3.5	3	11	6	1	1	0	0	118	1994
1	1.9	20	2	4	3	0	0	0	116	1995
1	3.6	21	14	1	2	2	0	0	114	1996
1	3.5	13	14	9	1	1	1	0	116	1997
1	0.3	10	10	9	4	1	1	0	114	1998
1	0.9	7	11	6	3	1	0	0	116	1999
1	1.1	14	5	5	4	2	1	1	113	2000
1	0.6	17	13	5	4	2	1	1	113	2001
1	1.0	10	13	7	2	1	0	1	110	2002
0	0.7	5	4	4	2	1	0	0	112	2003
1	1.2	21	11	6	3	1	0	0	114	2004
1	4.7	18	22	11	4	2	1	1	116	2005
1	0.6	15	13	8	3	1	1	1	115	2006
1	0.9	11	21	10	5	1	1	0	117	2007
1	0.4	8	12	8	3	1	1	0	115	2008
1	3.4	7	14	14	10	3	1	1	117	2009
1	0.6	34	17	11	7	2	1	1	114	2010
1	0.9	9	34	14	8	3	1	0	111	2011
1	1.7	12	22	31	10	3	2	1	115	2012
0	1.3	26	30	36	21	4	2	1	114	2013

Table 9.2.8 Four-spot megrim (*L. boscii*). LPUE data by fleet in Divisions VIIIc, IXa.

	SP-LCGOTBDEF			SP-AVSOTBDEF			Portugal trawl in IXa		
Year	Landings(t)	Effort	LPUE [1]	Landings(t)	Effort	LPUE [1]	Landings(t)	Effort	LPUE [2]
1986	69.0	7.1	9.8	26.5	3.9	6.8			
1987	189.8	12.7	14.9	30.7	3.0	10.4			
1988	78.6	11.3	7.0	47.3	3.4	14.0	146	38.5	3.8
1989	72.9	11.9	6.2	36.1	3.3	10.9	183	44.7	4.1
1990	68.8	8.8	7.8	63.8	3.2	19.7	164	39.0	4.2
1991	94.0	9.6	9.8	42.1	3.5	12.2	166	45.0	3.7
1992	67.2	10.2	6.6	35.2	2.3	15.5	280	50.9	5.5
1993	55.2	7.1	7.8	38.9	2.4	16.1	180	44.2	4.1
1994	90.8	8.5	10.6	63.7	4.5	14.0	146	45.8	3.2
1995	147.6	13.4	11.0	85.9	3.5	24.7	121	37.0	3.3
1996	78.7	11.0	7.2	37.1	2.3	16.4	155	46.5	3.3
1997	99.0	12.5	7.9	49.5	2.6	18.7	76	33.4	2.3
1998	117.4	8.2	14.4	56.2	5.1	11.0	83	43.1	1.9
1999	103.9	8.8	11.7	55.9	4.9	11.3	73	25.3	2.9
2000	172.3	10.5	16.4	34.1	2.5	13.8	93	27.0	3.4
2001	245.0	12.1	20.2	16.5	1.3	12.5	89	43.1	2.1
2002	143.8	11.0	13.0	22.5	2.0	11.3	97	31.2	3.1
2003	118.7	10.2	11.6	12.4	2.2	5.7	117	40.5	2.9
2004	127.3	7.0	18.2	23.5	1.6	14.8	111	35.4	3.1
2005	96.0	7.1	13.6	45.0	3.0	15.2	140	42.6	3.3
2006	123.5	7.8	15.9	32.3	2.8	11.6	149	40.3	3.7
2007*	130.5	7.3	17.9	19.9	2.2	8.9	165	43.8	3.8
2008*	196.8	9.0	22.0	14.5	2.0	7.2	146	38.4	3.8
2009	138.8	8.0	17.3	42.0	2.3	18.5	183	49.3	3.7
2010	170.7	5.8	29.3	51.1	2.0	25.4	150	48.0	3.1
2011	126.9	5.1	24.8	43.1	2.2	19.6	134	49.4	2.7
2012	127.8	7.6	16.7	11.1	2.6	4.3	78	36.0	2.2
2013	212.8	13.1	16.3	19.5	1.5	12.6	59	47.5	1.2

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

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

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

Table 9.2.9. Four-spot megrim (*L.boscii*) in Divisions VIIIc and IXa. Tuning diagnostic.

Lowestoft VPA Version 3.1

5/05/2014 13:01

Extended Survivors Analysis

Four spot megrim (L. boscii) Division VIIIc and IXa

CPUE data from file fleetb.txt

Catch data for 28 years. 1986 to 2013. Ages 0 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-LCGOTBDEF-1	1986	2013	3	6	0	1
SP-LCGOTBDEF-2	2000	2013	3	6	0	1
SP-GFS	1988	2013	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 36 iterations

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
0	0.001	0	0	0.003	0.007	0	0.081	0.001	0.014	0.021
1	0.198	0.141	0.033	0.087	0.088	0.07	0.2	0.202	0.207	0.149
2	0.322	0.378	0.31	0.218	0.144	0.162	0.145	0.131	0.176	0.306
3	0.397	0.357	0.54	0.34	0.27	0.268	0.281	0.26	0.132	0.498
4	0.594	0.384	0.484	0.506	0.387	0.446	0.348	0.431	0.225	0.274
5	0.44	0.784	0.396	0.798	0.354	0.573	0.469	0.479	0.339	0.384
6	0.493	0.632	0.327	0.577	0.323	0.403	0.331	0.43	0.266	0.446

XSA population numbers (Thousands)

	AGE						
YEAR	0	1	2	3	4	5	6
2004	3.73E+04	4.18E+04	2.24E+04	1.27E+04	6.42E+03	3.59E+03	7.92E+02
2005	5.34E+04	3.05E+04	2.81E+04	1.33E+04	7.01E+03	2.90E+03	1.89E+03
2006	5.27E+04	4.37E+04	2.17E+04	1.58E+04	7.61E+03	3.91E+03	1.08E+03
2007	3.78E+04	4.31E+04	3.46E+04	1.30E+04	7.53E+03	3.84E+03	2.16E+03
2008	3.12E+04	3.09E+04	3.24E+04	2.28E+04	7.58E+03	3.72E+03	1.42E+03
2009	7.73E+04	2.53E+04	2.31E+04	2.29E+04	1.42E+04	4.21E+03	2.13E+03
2010	4.11E+04	6.33E+04	1.93E+04	1.61E+04	1.44E+04	7.47E+03	1.95E+03
2011	3.84E+04	3.11E+04	4.24E+04	1.37E+04	9.96E+03	8.30E+03	3.82E+03
2012	5.45E+04	3.14E+04	2.08E+04	3.05E+04	8.64E+03	5.29E+03	4.21E+03
2013	1.49E+04	4.40E+04	2.09E+04	1.43E+04	2.19E+04	5.65E+03	3.09E+03

Estimated population abundance at 1st Jan 2014

0.00E+00	1.20E+04	3.10E+04	1.26E+04	7.10E+03	1.36E+04	3.15E+03

Taper weighted geometric mean of the VPA populations:

4.30E+04	3.65E+04	2.60E+04	1.61E+04	8.90E+03	3.98E+03	1.73E+03

Standard error of the weighted Log(VPA populations) :

0.3568	0.3157	0.3652	0.3763	0.4416	0.4305	0.495

Log catchability residuals.

Fleet : SP-LCGOTBDEF-1

Age	1986	1987	1988	1989	1990	1991	1992	1993
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	0.57	0.87	-0.08	-0.41	-0.76	-0.19	-0.45	-0.03
4	0.31	0.29	-0.59	-0.53	-0.19	-0.57	-0.09	0.32
5	0.09	-0.23	-0.8	-0.84	-0.18	0.43	-0.01	-0.25
6	-0.23	-0.15	-0.43	-0.25	0.1	0.74	-0.02	0.26

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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	-0.1	0.36	-0.57	-0.32	0.69	0.42	99.99	99.99	99.99	99.99
4	0.49	0.11	0.03	-0.47	0.63	0.26	99.99	99.99	99.99	99.99
5	0.52	0.78	-0.35	-0.09	0.76	0.18	99.99	99.99	99.99	99.99
6	0.62	0.9	-0.14	0.26	0.46	0.53	99.99	99.99	99.99	99.99

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	-6.7219	-5.8654	-5.4472	-5.4472
S.E(Log q)	0.502	0.414	0.5044	0.4574

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	2.056	8.04	0.66	14	0.26	-6.72
4	0.94	0.203	6.05	0.53	14	0.41	-5.87
5	-50.28	-4.634	151.18	0	14	15.8	-5.45
6	1.1	-0.368	5.04	0.51	14	0.47	-5.26
1							

Fleet : SP-LCGOTBDEF-2

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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	-0.61	0.33	-0.28	0.2
4	99.99	99.99	99.99	99.99	99.99	99.99	0	0.79	-0.46	-0.35
5	99.99	99.99	99.99	99.99	99.99	99.99	-0.23	0.99	-0.65	-0.25
6	99.99	99.99	99.99	99.99	99.99	99.99	0.13	0.18	-0.34	-0.01

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	0.41	0.09	0.5	0.16	0.15	-0.17	0.18	-0.52	-0.2	-0.24
4	0.44	-0.3	-0.15	0.18	0.26	-0.05	0.05	-0.11	0.22	-0.52
5	-0.05	0.2	-0.53	0.34	-0.09	-0.12	0.27	0.13	0.35	-0.37
6	0.19	0.02	-0.58	0.09	-0.1	-0.46	0.01	0.27	0.04	-0.35

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

Age	3	4	5	6
Mean Log q	-5.6809	-5.0489	-4.7468	-4.7468
S.E(Log q)	0.3389	0.3622	0.4242	0.2724

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	1.11	-0.39	5.25	0.51	14	0.39	-5.68
4	1.16	-0.628	4.42	0.56	14	0.43	-5.05
5	0.83	0.837	5.36	0.66	14	0.36	-4.75
6	0.87	1.126	5.18	0.85	14	0.23	-4.81
1							

Fleet : SP-GFS

Age	1986	1987	1988	1989	1990	1991	1992	1993
0	99.99	99.99	0.5	1.64	-1.03	0.25	0.26	-1.09
1	99.99	99.99	0.39	-0.12	0.11	-0.29	0.51	0.09
2	99.99	99.99	0.16	-0.33	-0.16	-0.42	-0.85	-0.15
3	99.99	99.99	-0.26	-0.8	-0.94	-0.76	-0.49	-0.65
4	99.99	99.99	-1.02	-0.57	-0.26	-0.63	-0.3	-0.57
5	99.99	99.99	-0.39	-0.53	0.31	-0.04	0.03	-0.77
6	99.99	99.99	0.04	-0.04	0.21	-0.37	0.03	0.06

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
0	0.84	0.04	1	1.32	-0.87	-0.13	-0.05	-0.69	-0.19	99.99
1	-1.13	0.24	0.04	-0.03	-0.01	0.27	0.37	0.47	-0.12	99.99
2	-0.45	-0.95	0.09	-0.23	-0.18	0.27	0.08	0.39	0.35	99.99
3	-0.49	-0.63	-0.5	0.25	-0.02	-0.03	0.25	0.66	0.5	99.99
4	-0.16	-0.37	-0.69	-0.06	0.08	-0.44	0.48	0.93	0.47	99.99
5	-0.19	-0.42	0.16	-0.1	0.45	-0.46	-0.18	1.18	-0.04	99.99
6	0.03	-0.38	0.07	-0.06	-0.03	-0.18	-0.21	-0.06	0.01	99.99

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
0	0.02	1.04	-1.03	-0.3	-0.96	0.33	-0.62	-0.28	0.01	99.99
1	0.29	0.38	-0.25	-0.46	-0.45	-0.36	0.36	-0.28	-0.02	99.99
2	0.08	0.58	0.26	0.19	-0.4	0.11	0.47	0.38	0.71	99.99
3	0.18	0.7	0.37	0.63	-0.25	0.32	0.42	0.81	0.72	99.99
4	0.2	0.35	-0.13	0.58	-0.18	0.56	0.18	0.68	0.88	99.99
5	-0.41	0.73	-0.35	0.36	-0.6	0.87	-0.14	0.01	0.53	99.99
6	-0.17	0.1	0.28	0.12	-0.04	0.34	-0.34	-0.42	0.05	99.99

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	-10.2125	-7.5653	-7.2568	-7.3457	-7.3506	-7.4714	-7.4714
S.E(Log q)	0.7732	0.3813	0.4234	0.5556	0.5325	0.4922	0.2056

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	0.48	2.145	10.46	0.43	24	0.34	-10.21
1	0.74	1.337	8.31	0.55	24	0.28	-7.57
2	1.17	-0.567	6.78	0.35	24	0.5	-7.26
3	1.49	-1.096	6.21	0.19	24	0.82	-7.35
4	1.79	-1.775	6	0.19	24	0.91	-7.35
5	1.23	-0.744	7.27	0.32	24	0.61	-7.47
6	1	-0.042	7.51	0.86	24	0.21	-7.51
1							

Terminal year survivor and F summaries :

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

Year class = 2013

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF-1	1	0	0	0	0	0	0
SP-LCGOTBDEF-2	1	0	0	0	0	0	0
SP-GFS	1	0	0	0	0	0	0
F shrinkage mean	11985	1.5				1	0.021

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
11985	1.5	0	1	0	0.021

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

Year class = 2012

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF-1	1	0	0	0	0	0	0
SP-LCGOTBDEF-2	1	0	0	0	0	0	0
SP-GFS	31424	0.789	0	0	1	0.754	0.147
F shrinkage mean	29860	1.5				0.246	0.154

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
31032	0.7	0.03	2	0.036	0.149

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

Year class = 2011

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF-1	1	0	0	0	0	0	0
SP-LCGOTBDEF-2	1	0	0	0	0	0	0
SP-GFS	11761	0.349	0.103	0.3	2	0.917	0.324
F shrinkage mean	27404	1.5				0.083	0.152

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
12616	0.34	0.19	3	0.541	0.306

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

Year class = 2010

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF-1	1	0	0	0	0	0	0
SP-LCGOTBDEF-2	5601	0.351	0	0	1	0.43	0.598
SP-GFS	8082	0.273	0.375	1.37	3	0.531	0.449
F shrinkage mean	16605	1.5				0.039	0.244

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7098	0.22	0.23	5	1.059	0.498

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

Year class = 2009

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF-1	1	0	0	0	0	0	0
SP-LCGOTBDEF-2	9464	0.257	0.16	0.63	2	0.531	0.374
SP-GFS	21267	0.247	0.086	0.35	4	0.448	0.184
F shrinkage mean	9588	1.5				0.022	0.37

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
13601	0.18	0.18	7	0.985	0.274

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

Year class = 2008

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF-1	1	0	0	0	0	0	0
SP-LCGOTBDEF-2	2572	0.225	0.229	1.01	3	0.566	0.453
SP-GFS	4206	0.227	0.301	1.32	5	0.411	0.3
F shrinkage mean	2623	1.5				0.023	0.446

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3150	0.16	0.18	9	1.126	0.384

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

Year class = 2007

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-LCGOTBDEF-1	1	0	0	0	0	0	0
SP-LCGOTBDEF-2	1444	0.193	0.162	0.84	4	0.677	0.489
SP-GFS	2066	0.22	0.185	0.84	6	0.301	0.365
F shrinkage mean	1920	1.5				0.022	0.388

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1618	0.15	0.12	11	0.767	0.446

Table 9.2.10 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Estimates of fisihing mortality at age.

Run title : Four spot megrim (L. boscii) Division VIIIc and IXa

At 5/05/2014 13:03

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1986	1987	1988	1989	1990	1991	1992	1993
AGE								
0	0.0199	0.0275	0.0251	0.0268	0.0358	0.0225	0.0242	0.0492
1	0.0638	0.1131	0.1369	0.1027	0.1308	0.1681	0.0941	0.0942
2	0.2411	0.4663	0.4719	0.5513	0.3708	0.3378	0.4287	0.2137
3	0.3766	0.3727	0.4305	0.4918	0.3872	0.385	0.4796	0.5157
4	0.7139	0.5065	0.5238	0.8172	0.6024	0.4381	0.9135	0.7615
5	0.6211	0.5152	0.6386	0.8164	0.8441	0.9802	0.9474	0.4984
6	1.024	0.7037	1.1273	1.5995	0.93	1.2231	0.8249	0.8
+gp	1.024	0.7037	1.1273	1.5995	0.93	1.2231	0.8249	0.8
FBAR 2- 4	0.4439	0.4485	0.4754	0.6201	0.4535	0.3869	0.6073	0.497

Table 8 Fishing mortality (F) at age

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
0	0.0156	0.024	0.0337	0.0093	0.0682	0.0925	0.0109	0.0061	0.0057	0.0051
1	0.1449	0.1442	0.0893	0.1136	0.1629	0.3107	0.2876	0.2489	0.2379	0.179
2	0.2483	0.5803	0.2984	0.2552	0.2817	0.2877	0.2327	0.2105	0.2806	0.2384
3	0.3796	0.5237	0.7172	0.3965	0.3737	0.4013	0.461	0.4961	0.4087	0.3885
4	0.788	0.6615	0.5886	0.3972	0.5505	0.5601	0.744	0.8703	0.5456	0.3256
5	0.8443	0.8944	0.4582	0.4776	0.755	0.439	0.4634	1.0591	0.3121	0.4525
6	0.8363	0.7797	0.4215	0.4802	0.4626	0.5254	0.4811	0.4085	0.3356	0.5807
+gp	0.8363	0.7797	0.4215	0.4802	0.4626	0.5254	0.4811	0.4085	0.3356	0.5807
FBAR 2- 4	0.4719	0.5885	0.5348	0.3497	0.402	0.4164	0.4792	0.5256	0.4116	0.3175

Table 8 Fishing mortality (F) at age

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	FBAR 11-13
AGE											
0	0.001	0.0002	0	0.0029	0.0072	0	0.0805	0.0009	0.0139	0.0205	0.0118
1	0.1976	0.1414	0.0326	0.0871	0.0882	0.0698	0.2	0.2021	0.2075	0.1487	0.1861
2	0.3218	0.3779	0.3104	0.2184	0.1443	0.1623	0.1451	0.1305	0.1762	0.3055	0.2041
3	0.3969	0.3568	0.5396	0.3397	0.2699	0.2685	0.2809	0.2604	0.1323	0.498	0.2969
4	0.5943	0.3841	0.4837	0.5061	0.3875	0.4462	0.3479	0.4315	0.2253	0.2743	0.3104
5	0.4397	0.7838	0.3955	0.7976	0.3543	0.5725	0.469	0.4788	0.3391	0.3839	0.4006
6	0.4929	0.6318	0.3274	0.5768	0.3234	0.4026	0.3308	0.4299	0.2664	0.4463	0.3809
+gp	0.4929	0.6318	0.3274	0.5768	0.3234	0.4026	0.3308	0.4299	0.2664	0.4463	
FBAR 2- 4	0.4377	0.3729	0.4446	0.3547	0.2672	0.2923	0.258	0.2741	0.1779	0.3593	

Table 9.2.11 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Estimates of stock numbers at age.

Run title : Four spot megrim (L. boscii) Division VIIIc and IXa

At 5/05/2014 13:03

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
AGE								
0	72166	52558	57480	53879	40523	64091	59510	29680
1	61392	57919	41864	45894	42946	32011	51307	47556
2	40221	47158	42348	29890	33906	30849	22153	38235
3	20781	25875	24221	21629	14100	19159	18017	11813
4	9844	11675	14594	12894	10829	7838	10674	9131
5	2929	3947	5760	7077	4663	4854	4141	3505
6	1499	1288	1931	2490	2561	1641	1491	1315
+gp	395	313	748	855	1448	740	138	558
TOTAL	209226	200733	188946	174608	150976	161183	167430	141793

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

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
0	48421	60187	43002	30511	21603	36687	36165	37609	40135	51354
1	23134	39030	48110	34041	24748	16520	27383	29289	30604	32672
2	35436	16385	27664	36024	24877	17216	9914	16816	18696	19751
3	25282	22634	7509	16806	22850	15368	10571	6432	11154	11562
4	5775	14161	10977	3001	9255	12874	8423	5458	3207	6069
5	3491	2150	5983	4989	1652	4370	6020	3277	1872	1521
6	1743	1229	720	3098	2533	636	2306	3101	930	1122
+gp	878	571	1768	1272	1044	1309	2407	1170	1386	352
TOTAL	144159	156348	145733	129741	108562	104980	103190	103152	107983	124403

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

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	GM 90-11
AGE												
0	37275	53387	52680	37805	31159	77277	41125	38428	54471	14942	0	42254
1	41830	30489	43701	43130	30862	25328	63267	31065	31435	43980	11985	
2	22364	28108	21670	34633	32365	23135	19338	42409	20780	20915	31032	
3	12741	13272	15771	13008	22793	22937	16104	13694	30473	14264	12616	
4	6418	7014	7605	7527	7583	14246	14358	9956	8641	21856	7098	
5	3588	2901	3911	3839	3715	4214	7465	8301	5295	5648	13601	
6	792	1892	1085	2156	1416	2134	1946	3824	4210	3088	3150	
+gp	948	930	896	1149	1183	734	1706	1295	1832	1415	2359	
TOTAL	125957	137993	147318	143247	131076	170007	165310	148973	157136	126108	81842	

Table 9.2.12 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Summary of landings and XSA results.

Run title : Four spot megrim (L. boscii) Division VIIIc and IXa

At 5/05/2014 13:03

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS Age 0	TOTALBIO	TOTSPBIO	CATCHES	YIELD/SSB	FBAR 2- 4
1986	72166	5203	4321	1408	0.3259	0.4439
1987	52558	7349	6073	2021	0.3328	0.4485
1988	57480	7893	6799	2586	0.3804	0.4754
1989	53879	7870	6801	3037	0.4465	0.6201
1990	40523	6841	6061	2354	0.3884	0.4535
1991	64091	6712	5836	2129	0.3648	0.3869
1992	59510	6466	5519	2353	0.4264	0.6073
1993	29680	6133	5421	1822	0.3361	0.497
1994	48421	6530	5702	1920	0.3367	0.4719
1995	60187	6040	5098	2058	0.4037	0.5885
1996	43002	5361	4543	1466	0.3227	0.5348
1997	30511	4571	4018	1204	0.2996	0.3497
1998	21603	5177	4680	1501	0.3207	0.402
1999	36687	4676	4169	1442	0.3459	0.4164
2000	36165	4540	3932	1414	0.3596	0.4792
2001	37609	3917	3313	1221	0.3686	0.5256
2002	40135	4236	3482	1028	0.2952	0.4116
2003	51354	4824	3825	1067	0.279	0.3175
2004	37275	5095	4159	1354	0.3255	0.4377
2005	53387	5012	4166	1358	0.326	0.3729
2006	52680	5779	4778	1427	0.2987	0.4446
2007	37805	5610	4736	1396	0.2948	0.3547
2008	31159	6169	5475	1182	0.2159	0.2672
2009	77277	6231	5429	1413	0.2603	0.2923
2010	41125	6779	6065	1562	0.2575	0.258
2011	38428	6451	5777	1529	0.2647	0.2741
2012	54471	7566	6382	1175	0.1841	0.1779
2013	14942	6416	5835	1616	0.2769	0.3593
Arith. Mean	45504	5909	5086	1644	0.323	0.417
Units	(Thousand:	(Tonnes)	(Tonnes)	(Tonnes)		

Table 9.2.13 Four-spot megrim (L. boscii) in Divisions VIIIc and IXa. Prediction with management option table: Input data

MFDP version 1a
Run: LDB
Time and date: 14:51 09/05/2014
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2014 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
0	42254	0.2	0	0	0	0.005	0.000	0.003	0.024	0.005
1	29815	0.2	0.55	0	0	0.021	0.001	0.033	0.180	0.021
2	31032	0.2	0.86	0	0	0.048	0.040	0.066	0.146	0.041
3	12616	0.2	0.97	0	0	0.074	0.170	0.084	0.105	0.054
4	7098	0.2	0.99	0	0	0.103	0.322	0.106	0.028	0.079
5	13601	0.2	1	0	0	0.134	0.450	0.135	0.010	0.110
6	3150	0.2	1	0	0	0.169	0.373	0.169	0.004	0.133
7	2359	0.2	1	0	0	0.245	0.376	0.245	0.001	0.101

2015 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
0	42254	0.2	0	0	0	0.005	0.000	0.003	0.024	0.005
1 .		0.2	0.55	0	0	0.021	0.001	0.033	0.180	0.021
2 .		0.2	0.86	0	0	0.048	0.040	0.066	0.146	0.041
3 .		0.2	0.97	0	0	0.074	0.170	0.084	0.105	0.054
4 .		0.2	0.99	0	0	0.103	0.322	0.106	0.028	0.079
5 .		0.2	1	0	0	0.134	0.450	0.135	0.010	0.110
6 .		0.2	1	0	0	0.169	0.373	0.169	0.004	0.133
7 .		0.2	1	0	0	0.245	0.376	0.245	0.001	0.101

2016 Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt	Exploit pattern	Weight DWt
0	42254	0.2	0	0	0	0.005	0.000	0.003	0.024	0.005
1 .		0.2	0.55	0	0	0.021	0.001	0.033	0.180	0.021
2 .		0.2	0.86	0	0	0.048	0.040	0.066	0.146	0.041
3 .		0.2	0.97	0	0	0.074	0.170	0.084	0.105	0.054
4 .		0.2	0.99	0	0	0.103	0.322	0.106	0.028	0.079
5 .		0.2	1	0	0	0.134	0.450	0.135	0.010	0.110
6 .		0.2	1	0	0	0.169	0.373	0.169	0.004	0.133
7 .		0.2	1	0	0	0.245	0.376	0.245	0.001	0.101

Input units are thousands and kg - output in tonnes

Table 9.2.14. Megrim (*L. boscii*) in Div. VIIIc and IXa catch forecast: management option table

MFDP version 1a
Run: LDB
Time and date: 14:51 09/05/2014
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

2014		Total	Landings		Discards	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield
6917	6185	1	0.1774	1318	0.0931	336

2015		Total	Landings		Discards		2015	
Biomass	SSB	FMult	FBar	Yield	FBar	Yield	Biomass	SSB
6762	6043	0	0.0000	0	0.0000	0	8735	7960
.	6043	0.1	0.0177	143	0.0093	36	8508	7739
.	6043	0.2	0.0355	280	0.0186	71	8289	7524
.	6043	0.3	0.0532	413	0.0279	106	8076	7317
.	6043	0.4	0.0709	542	0.0372	140	7870	7116
.	6043	0.5	0.0887	666	0.0465	173	7671	6921
.	6043	0.6	0.1064	786	0.0558	206	7477	6732
.	6043	0.7	0.1242	902	0.0651	237	7290	6550
.	6043	0.8	0.1419	1014	0.0745	269	7108	6373
.	6043	0.9	0.1596	1122	0.0838	299	6932	6201
.	6043	1	0.1774	1227	0.0931	329	6761	6035
.	6043	1.1	0.1951	1328	0.1024	358	6596	5874
.	6043	1.2	0.2128	1425	0.1117	387	6435	5718
.	6043	1.3	0.2306	1520	0.1210	415	6280	5567
.	6043	1.4	0.2483	1611	0.1303	442	6129	5420
.	6043	1.5	0.2661	1699	0.1396	469	5983	5278
.	6043	1.6	0.2838	1784	0.1489	496	5841	5140
.	6043	1.7	0.3015	1867	0.1582	521	5703	5007
.	6043	1.8	0.3193	1946	0.1675	547	5570	4877
.	6043	1.9	0.3370	2024	0.1768	571	5440	4752
.	6043	2	0.3547	2098	0.1861	596	5314	4630

Table 9.2.15 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Single option prediction. Detail Tables.

MFDP version 1a
Run: LDB
Time and date: 14:51 09/05/2014
Fbar age range (Total) : 2-4
Fbar age range Fleet 1 : 2-4

Year: 2014 F multiplier: 1 Fleet1 HCFbar: 0.1774 Fleet1 DFbar: 0.0931

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0244	924	4	42254	203	0	0	0	0
1	0.0005	12	0	0.1797	4457	94	29815	638	16398	351	16398	351
2	0.0401	1032	68	0.1456	3749	155	31032	1477	26688	1270	26688	1270
3	0.1697	1704	143	0.1054	1058	57	12616	934	12238	906	12238	906
4	0.3223	1759	186	0.0282	154	12	7098	733	7027	725	7027	725
5	0.4495	4476	603	0.0102	102	11	13601	1823	13601	1823	13601	1823
6	0.3732	893	151	0.0037	9	1	3150	532	3150	532	3150	532
7	0.3763	675	165	0.0005	1	0	2359	578	2359	578	2359	578
Total		10552	1318		10453	336	141925	6917	81460	6185	81460	6185

Year: 2015 F multiplier: 1 Fleet1 HCFbar: 0.1774 Fleet1 DFbar: 0.0931

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0244	924	4	42254	203	0	0	0	0
1	0.0005	14	0	0.1797	5047	107	33761	722	18568	397	18568	397
2	0.0401	678	45	0.1456	2463	102	20385	970	17531	834	17531	834
3	0.1697	2850	239	0.1054	1770	96	21101	1561	20468	1515	20468	1515
4	0.3223	1944	206	0.0282	170	13	7845	810	7766	801	7766	801
5	0.4495	1347	182	0.0102	31	3	4093	548	4093	548	4093	548
6	0.3732	1994	338	0.0037	20	3	7032	1188	7032	1188	7032	1188
7	0.3763	885	217	0.0005	1	0	3094	758	3094	758	3094	758
Total		9713	1227		10425	329	139565	6762	78553	6043	78553	6043

Year: 2016 F multiplier: 1 Fleet1 HCFbar: 0.1774 Fleet1 DFbar: 0.0931

Age	Catch F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	0.0244	924	4	42254	203	0	0	0	0
1	0.0005	14	0	0.1797	5047	107	33761	722	18568	397	18568	397
2	0.0401	768	51	0.1456	2789	115	23083	1099	19851	945	19851	945
3	0.1697	1872	157	0.1054	1163	63	13861	1026	13446	995	13446	995
4	0.3223	3252	345	0.0282	285	22	13121	1354	12990	1341	12990	1341
5	0.4495	1489	201	0.0102	34	4	4524	606	4524	606	4524	606
6	0.3732	600	102	0.0037	6	1	2116	358	2116	358	2116	358
7	0.3763	1626	399	0.0005	2	0	5687	1393	5687	1393	5687	1393
Total		9622	1254		10248	317	138408	6761	77183	6035	77183	6035

Input units are thousands and kg - output in tonnes

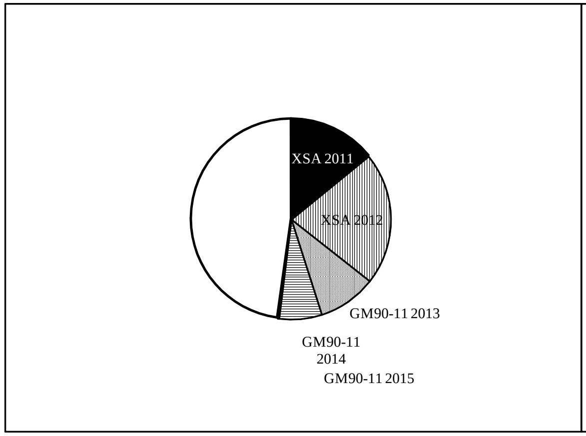
Table 9.2.16 **Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to catches and SSB (by weight) of these year classes

Year-class	2011	2012	2013	2014	2015
Stock No. (thousands of 0 year-olds	38428	54471	42254	42254	42254
Source	XSA	XSA	GM90-11	GM90-11	GM90-11
Status Quo F:					
% in 2014 catches	12.1	13.5	5.7	0.2	-
% in 2015	14.1	21.5	9.5	6.9	0.3
% in 2014 SSB	14.6	20.5	5.7	0.0	-
% in 2015 SSB	13.3	25.1	13.8	6.6	0.0
% in 2016 SSB	10.0	22.2	16.5	15.7	6.6

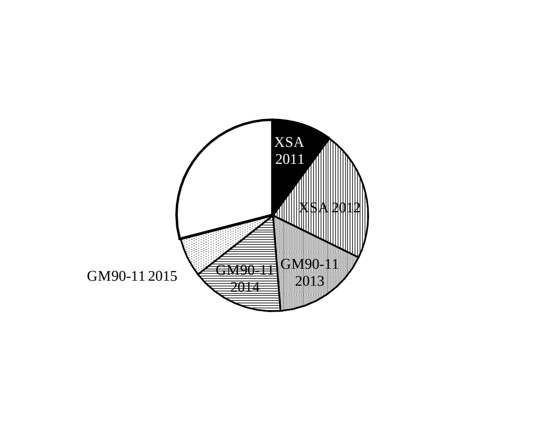
GM : geometric mean recruitment

Four-spot megrim (L. boscii) in Divisions VIIIc and IXa : Year-class % contribution to

a) 2015 catches



b) 2016 SSB



XSA	XSA	GM90-11	GM90-11	GM90-11
2011	2012	2013	2014	2015

Table 9.2.17 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Yield per recruit results.

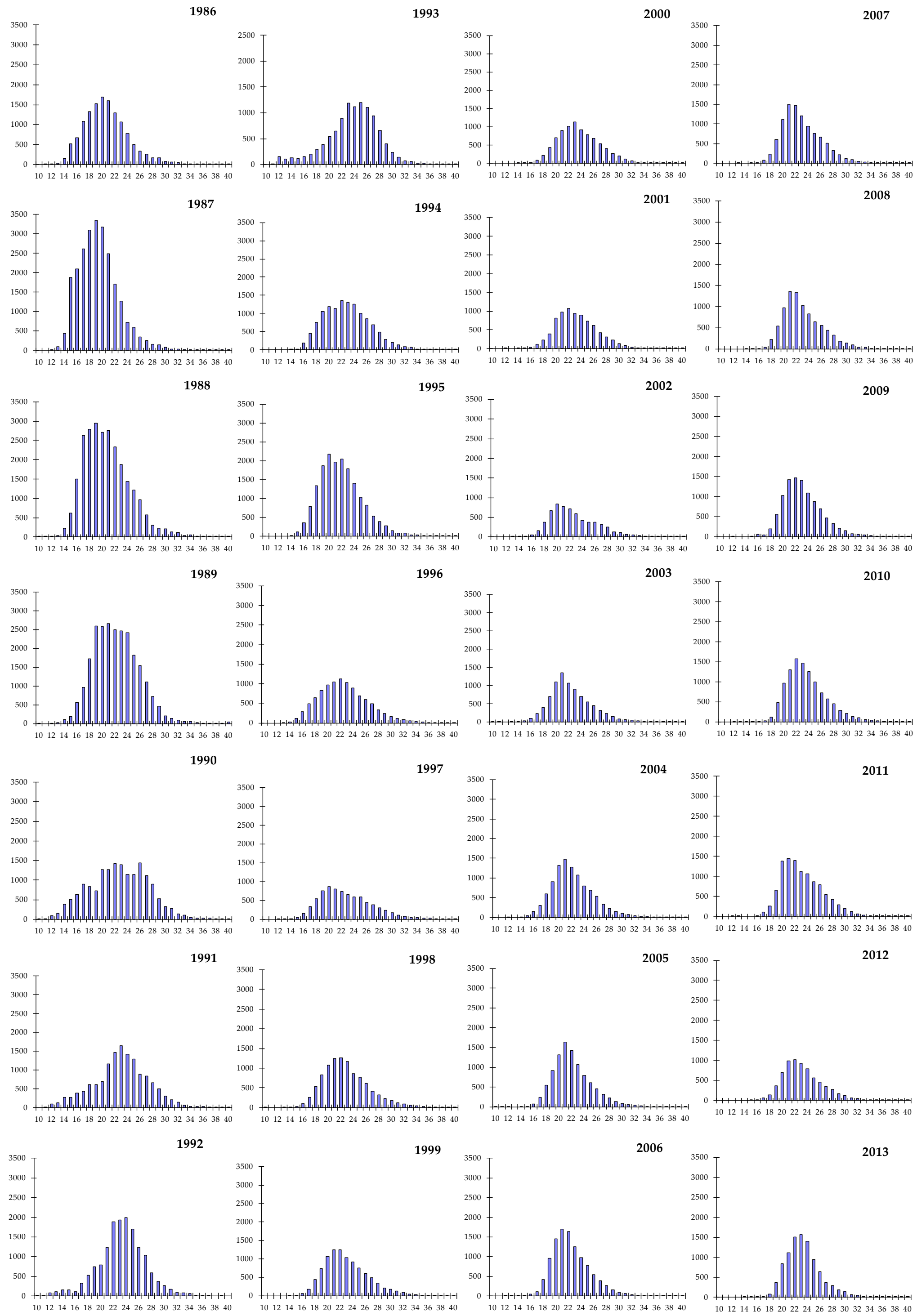
MFYPR version 2a
Run: LDB
Time and date: 14:55 09/05/2014
Yield per results

Catch	Landings			Discards								
FMult	Fbar	CatchNos	Yield	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	0	0	0	5.5167	0.5747	4.0334	0.5559	4.0334	0.5559
0.1	0.0177	0.0768	0.0133	0.0093	0.0304	0.001	4.9825	0.4617	3.503	0.4431	3.503	0.4431
0.2	0.0355	0.1267	0.021	0.0186	0.0593	0.002	4.5909	0.3824	3.115	0.364	3.115	0.364
0.3	0.0532	0.1598	0.0254	0.0279	0.0866	0.0029	4.2904	0.3243	2.818	0.306	2.818	0.306
0.4	0.0709	0.1819	0.0277	0.0372	0.1127	0.0037	4.0515	0.2802	2.5827	0.2621	2.5827	0.2621
0.5	0.0887	0.1965	0.0288	0.0465	0.1374	0.0045	3.8564	0.2459	2.391	0.228	2.391	0.228
0.6	0.1064	0.2059	0.0292	0.0558	0.161	0.0052	3.6935	0.2186	2.2314	0.2008	2.2314	0.2008
0.7	0.1242	0.2115	0.029	0.0651	0.1834	0.0059	3.5549	0.1965	2.0961	0.1789	2.0961	0.1789
0.8	0.1419	0.2144	0.0284	0.0745	0.2048	0.0065	3.4353	0.1783	1.9796	0.1608	1.9796	0.1608
0.9	0.1596	0.2152	0.03	0.0838	0.2252	0.0071	3.33	0.1632	1.8781	0.1458	1.8781	0.1458
1	0.1774	0.2145	0.0269	0.0931	0.2447	0.0076	3.238	0.1503	1.7886	0.1331	1.7886	0.1331
1.1	0.1951	0.2127	0.026	0.1024	0.2633	0.0081	3.1554	0.1394	1.7089	0.1223	1.7089	0.1223
1.2	0.2128	0.2101	0.025	0.1117	0.2811	0.0085	3.081	0.13	1.6374	0.113	1.6374	0.113
1.3	0.2306	0.2069	0.0241	0.121	0.2981	0.009	3.0135	0.1217	1.5728	0.105	1.5728	0.105
1.4	0.2483	0.2032	0.0232	0.1303	0.3144	0.0094	2.9519	0.1146	1.5141	0.0979	1.5141	0.0979
1.5	0.2661	0.1991	0.0223	0.1396	0.33	0.0098	2.8954	0.1082	1.4604	0.0917	1.4604	0.0917
1.6	0.2838	0.1948	0.0214	0.1489	0.3449	0.0101	2.8433	0.1025	1.411	0.0861	1.411	0.0861
1.7	0.3015	0.1904	0.0205	0.1582	0.3593	0.0104	2.795	0.0975	1.3654	0.0812	1.3654	0.0812
1.8	0.3193	0.1859	0.0197	0.1675	0.373	0.0107	2.7501	0.0929	1.3231	0.0768	1.3231	0.0768
1.9	0.337	0.1813	0.0189	0.1768	0.3862	0.011	2.7082	0.0888	1.2837	0.0728	1.2837	0.0728
2.0	0.3547	0.1767	0.0182	0.1861	0.3989	0.0113	2.6690	0.0851	1.2470	0.0691	1.247	0.0691

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(2-4)	1	0.1774
FMax	0.605	0.1073
F0.1	0.3927	0.0697
F35%SPR	0.6266	0.1111

Weights in kilograms

Figure 9.2.1 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Annual length compositions of landings ('000)



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

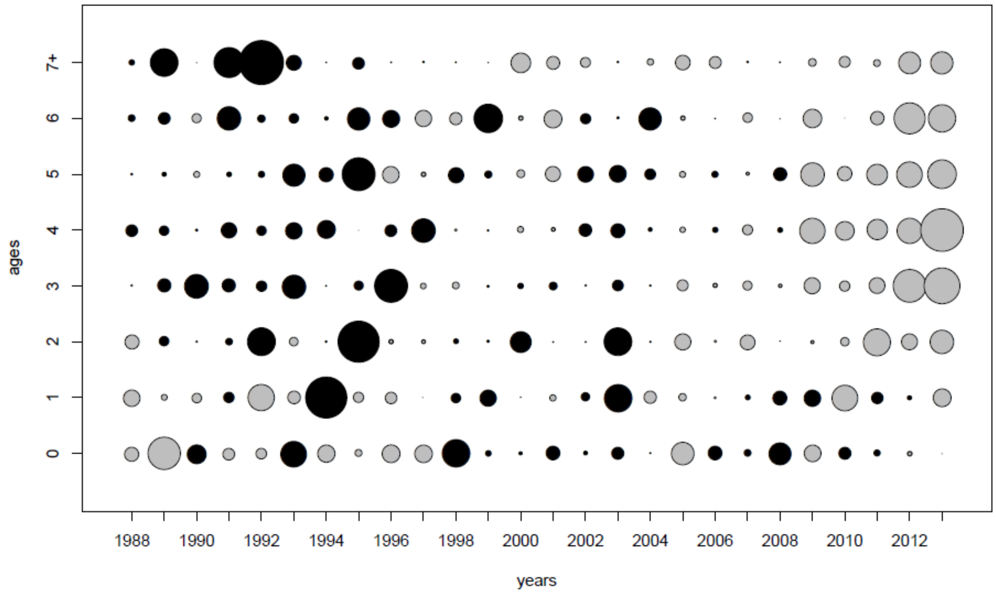


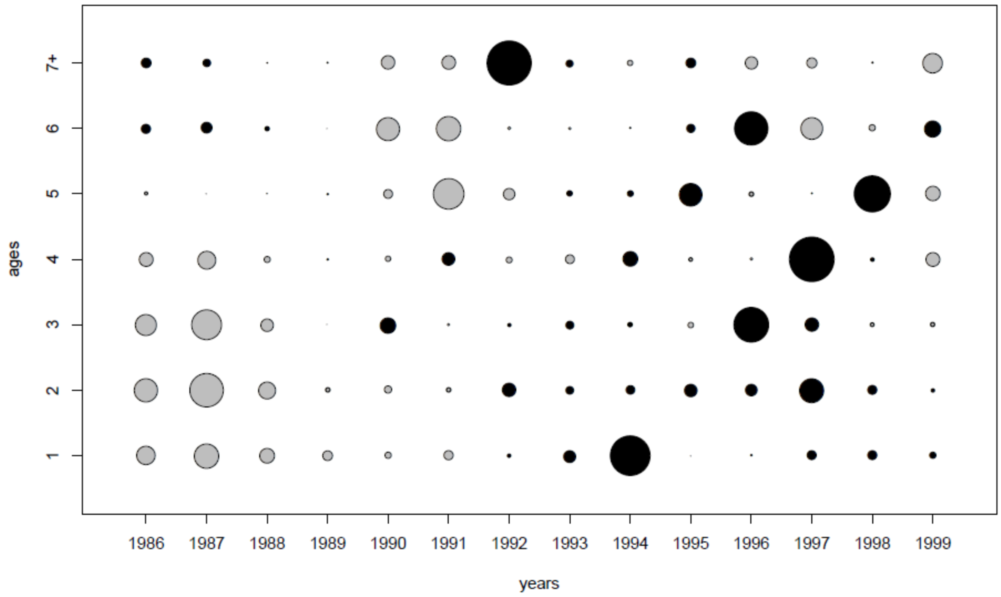
Figure 9.2.2: Four-spot megrim (*L. boscii*) in Divisions VIIIc&IXa

* 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 9.2.3 Four-spot megrim (*L.boscii*) in Divisions VIIIc and IXa. 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)

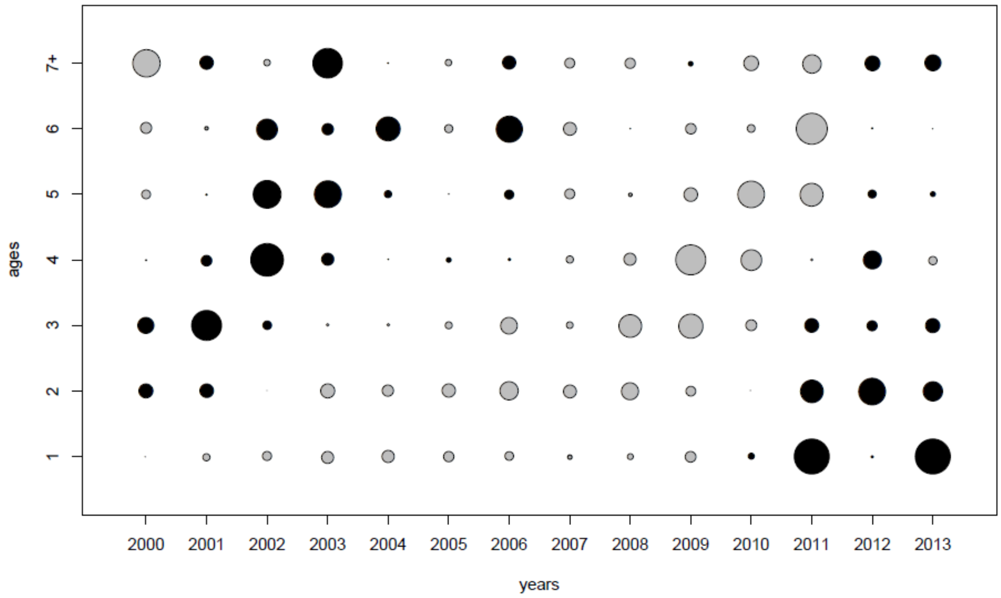
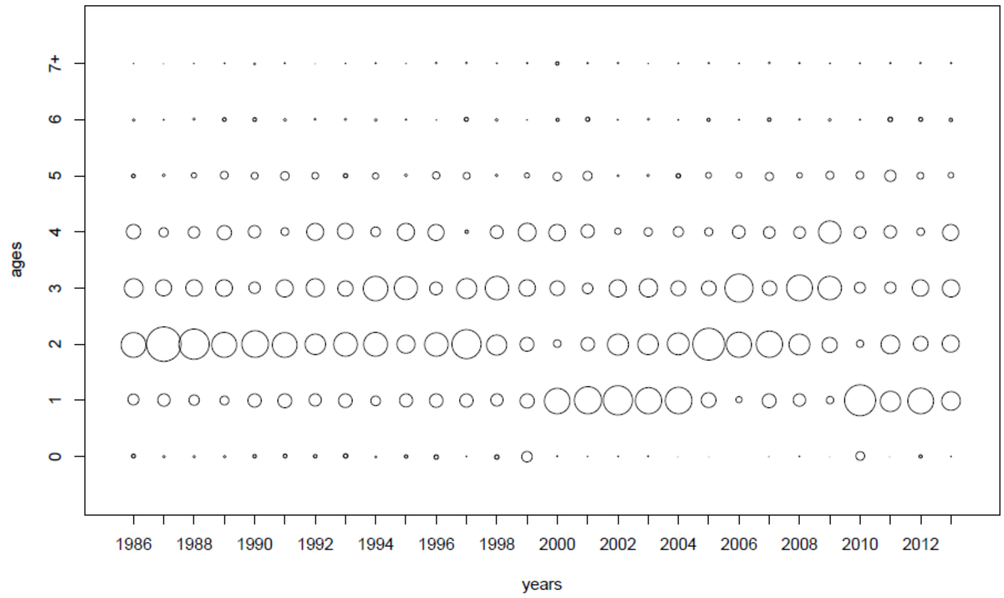


Figure 9.2.3(b): Four-spot megrim (*L. boscii*) in Divisions VIIIc&IXa

Catches proportions at age



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

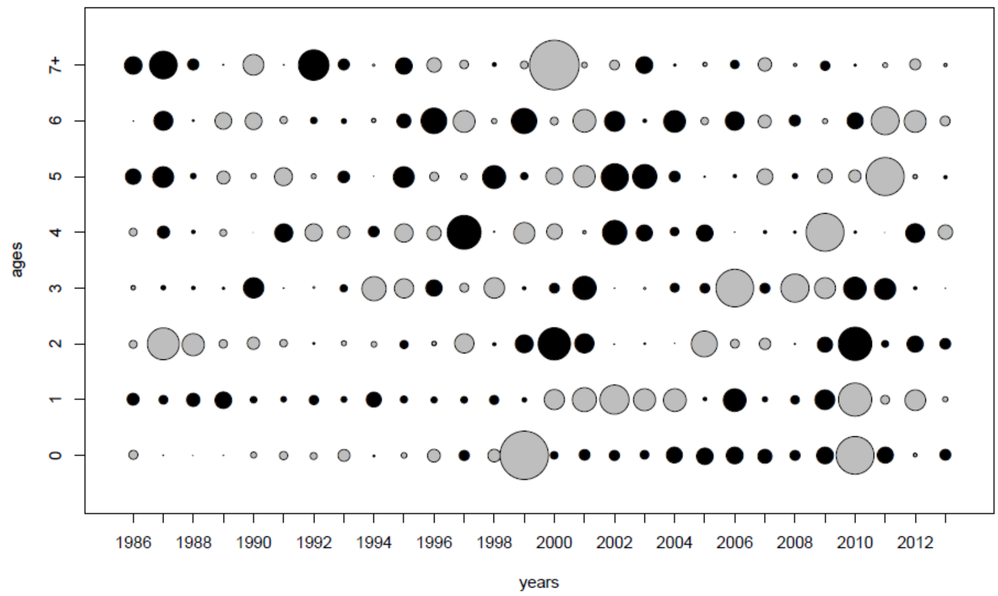
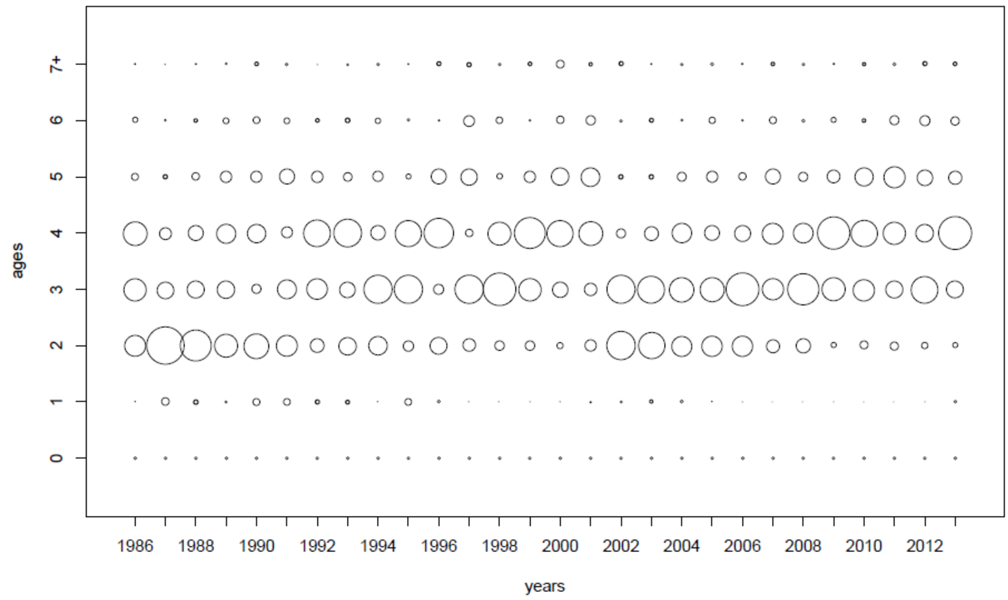


Figure 9.2.4(a). Four-spot megrim (*L. boscii*) in Divisions VIIIc & IXa.

Landings proportions at age



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

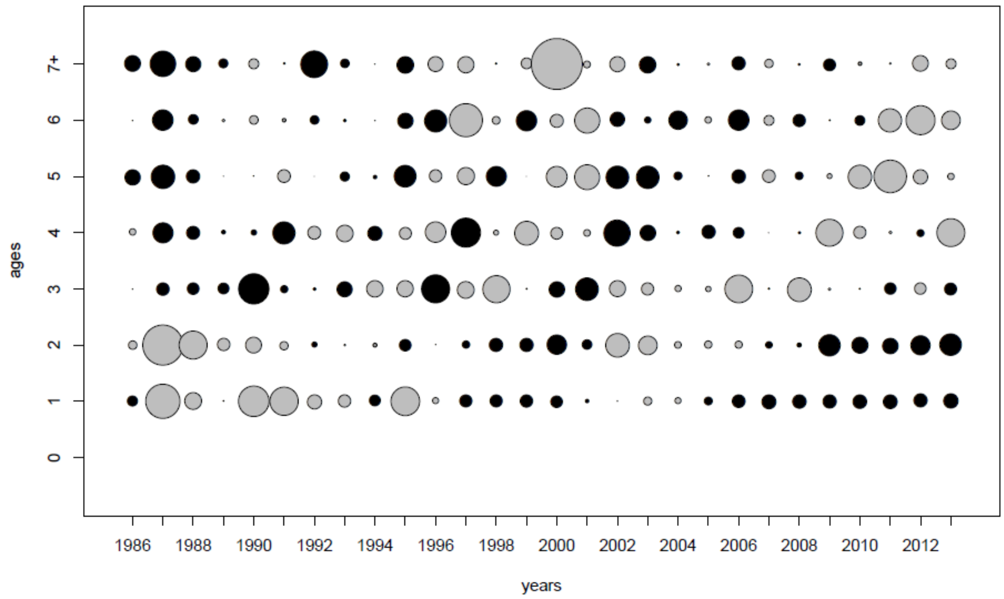
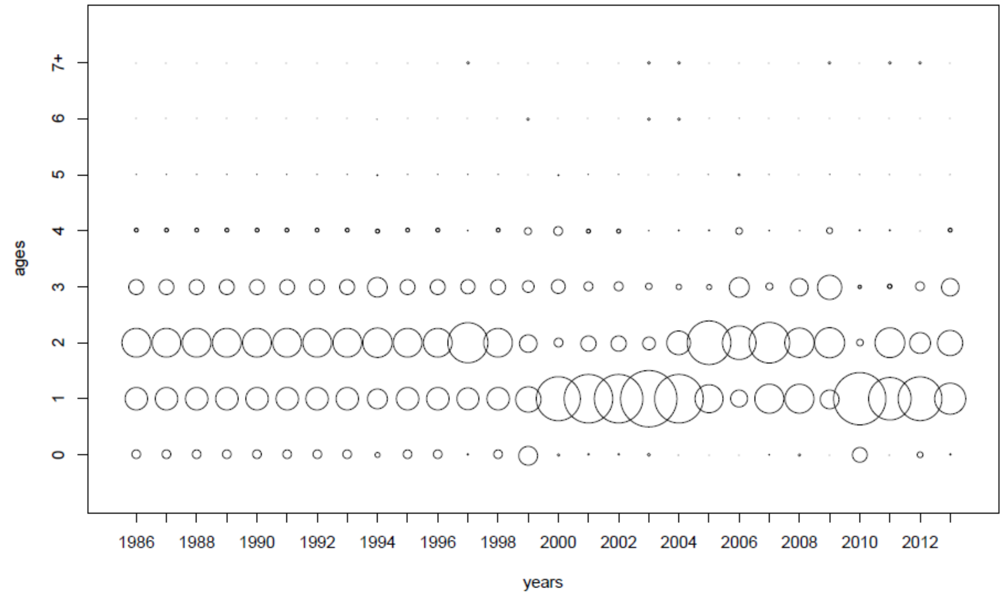


Figure 9.2.4(b). Four-spot megrim (*L. boscii*) in Divisions VIIIc & IXa.

Discards proportions at age



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

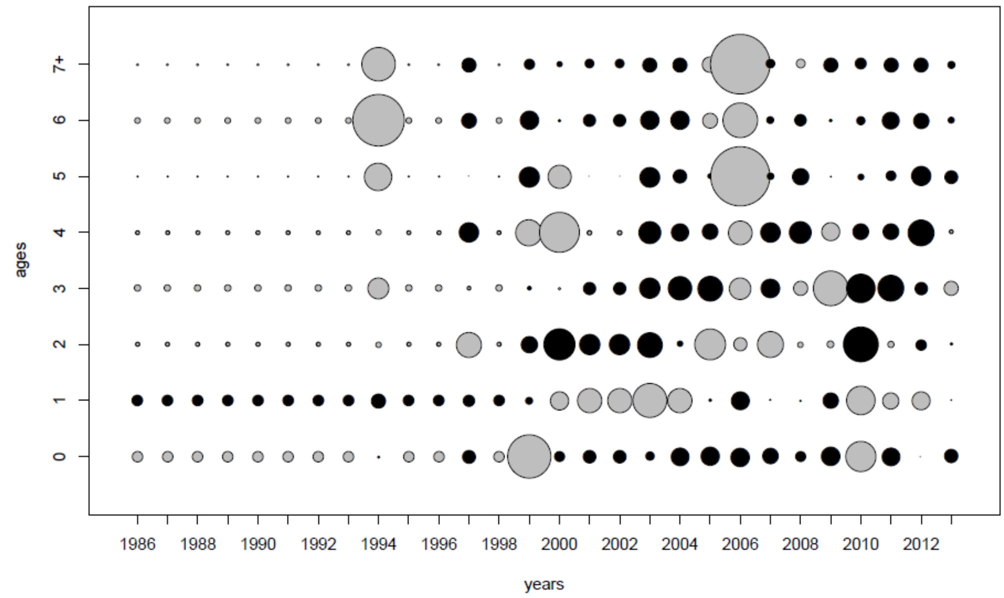


Figure 9.2.4(c). Four-spot megrim (*L. boscii*) in Divisions VIIIc & IXa.

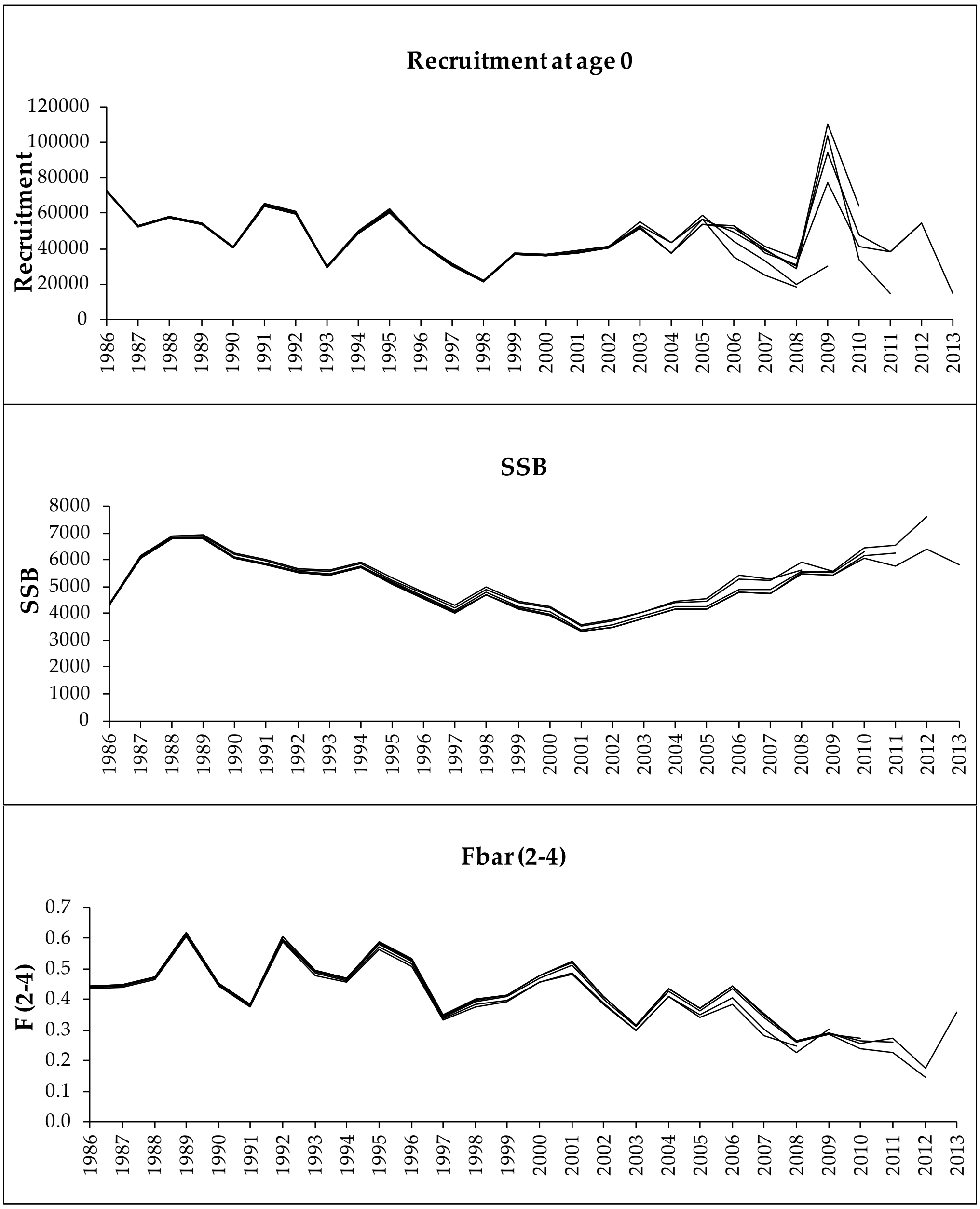


Figure 9.2.5. Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Retrospective XSA

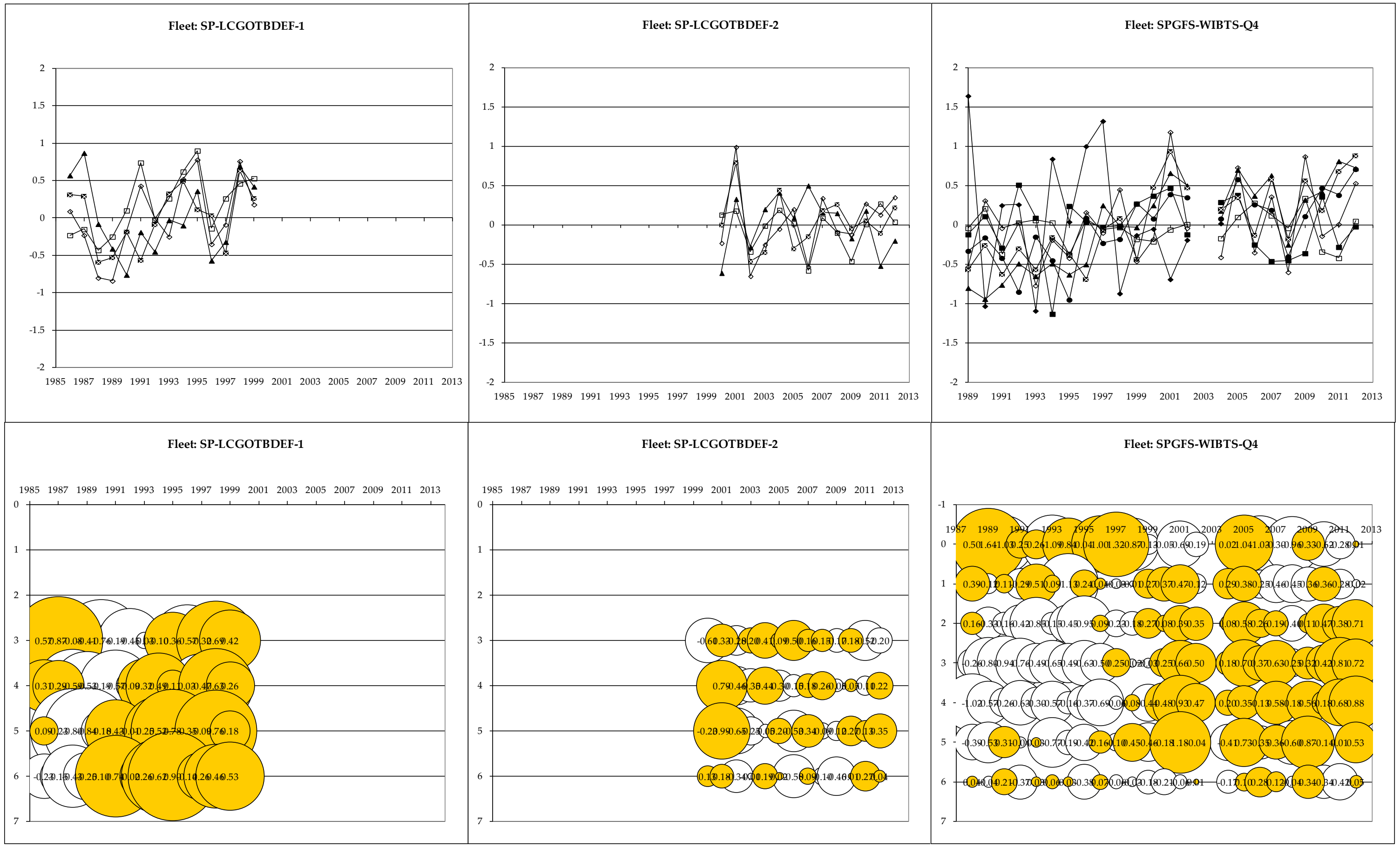


Figure 9.2.6. Four spot megrim (*L. boscii*) in Divisions VIIIc and IXa. LOG CATCHABILITY RESIDUAL PLOTS (XSA)

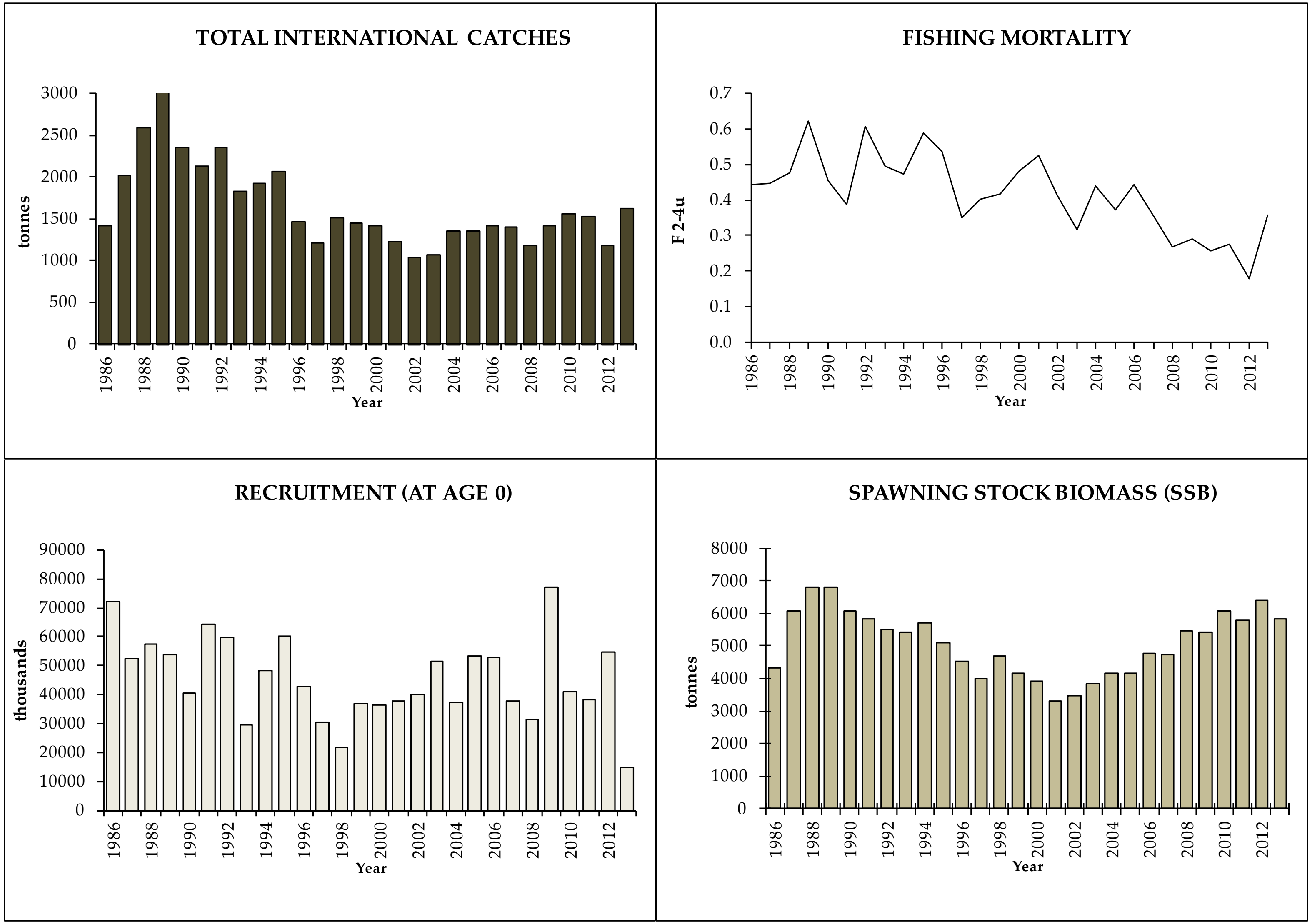
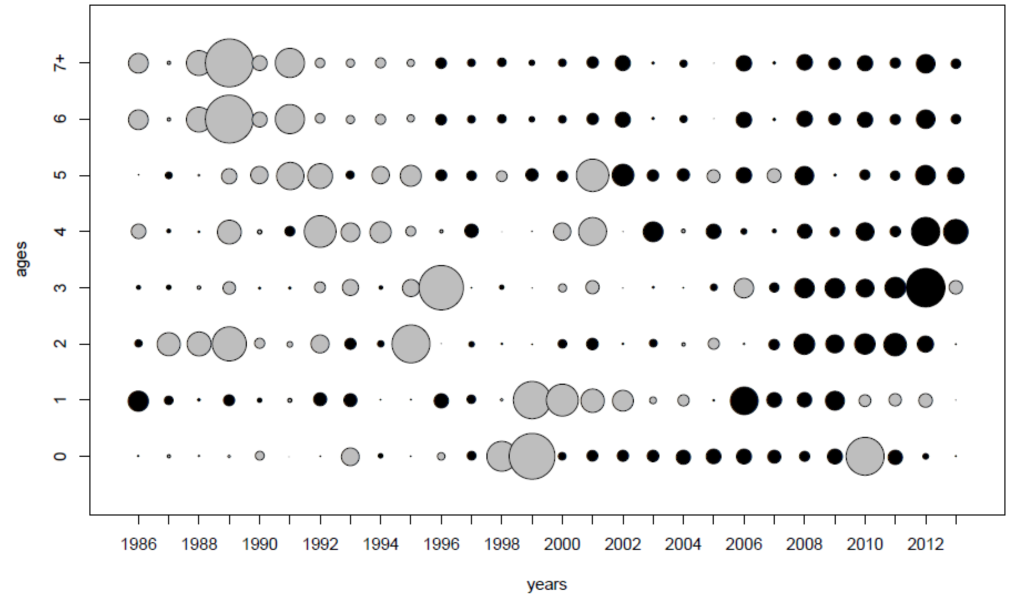


Figure 9.2.7(a). Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Stock Summary

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



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

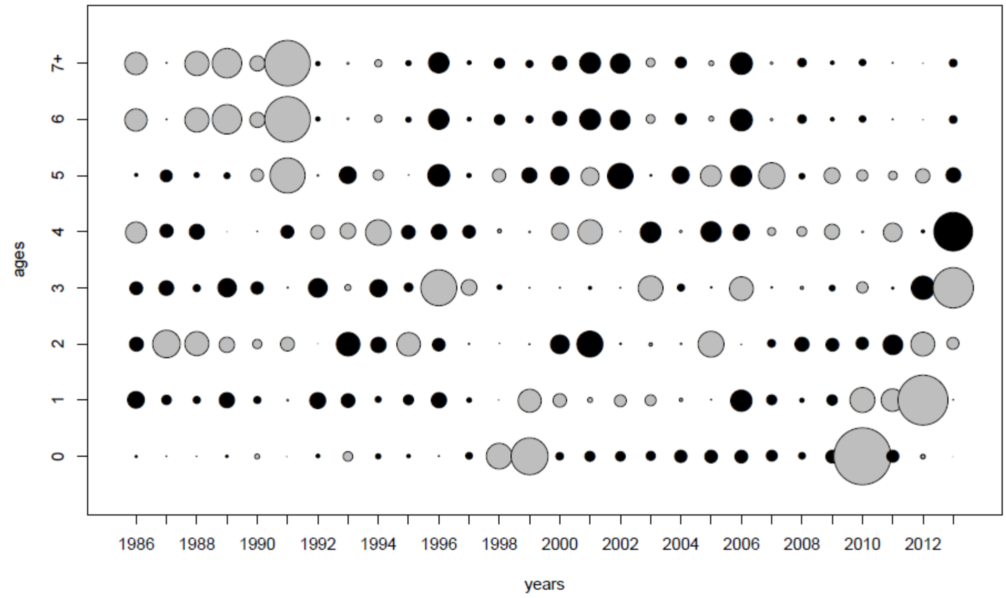
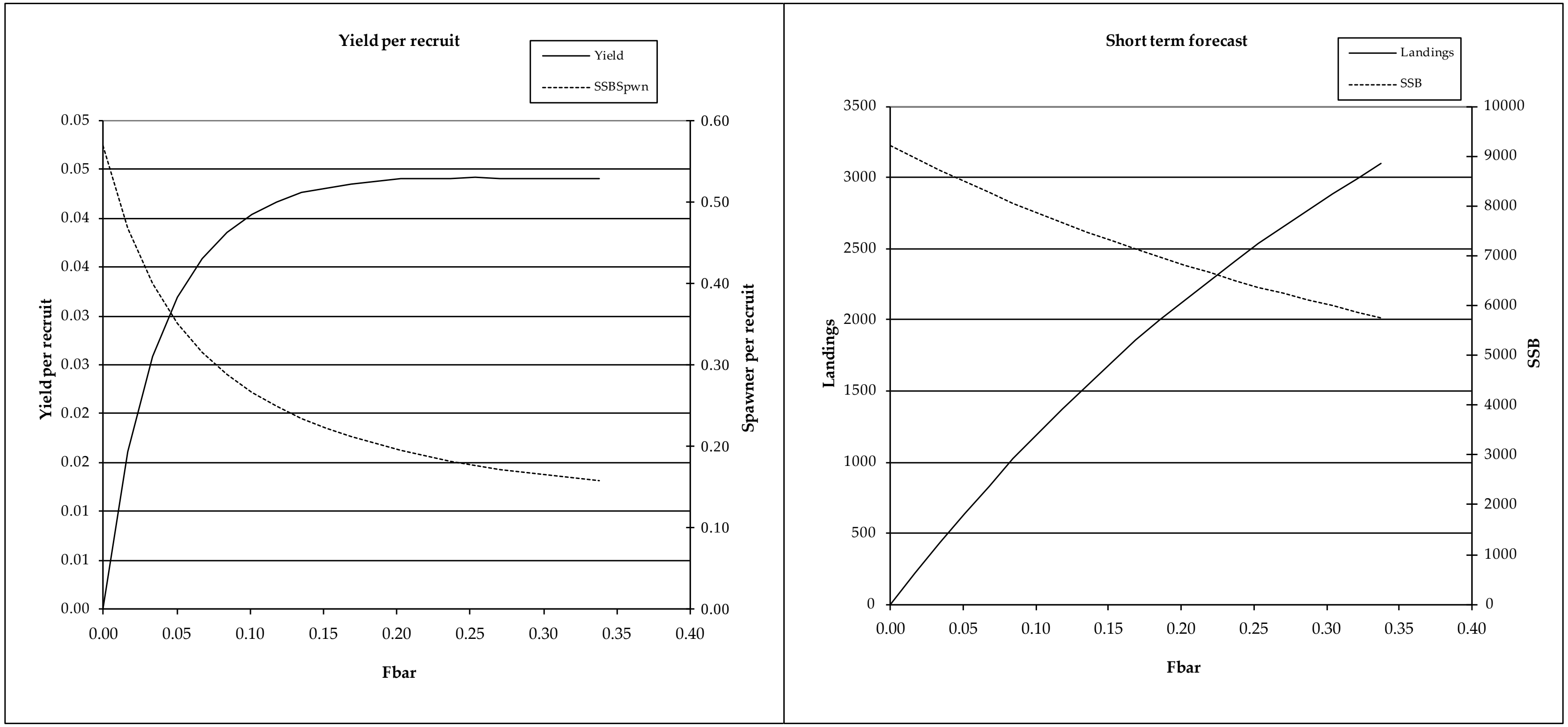


Figure 9.2.7(b): Four-spot megrim (*L. boscii*) in Divisions VIIIc&IXa



MFYPR version 2a
Run: LDB
Time and date: 21:27 07/05/2013

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.1689
FMax	1.5194	0.2566
F0.1	0.5129	0.0866
F35%SPR	1.1408	0.1927

MFDP version 1a
Run: LDB
Four spot megrim (L. boscii) Division VIIIc and IXa
Time and date: 20:44 07/05/2013
Fbar age range: 2-4

Input units are thousands and kg - output in tonnes

Figure 9.2.8. Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Forecast summary

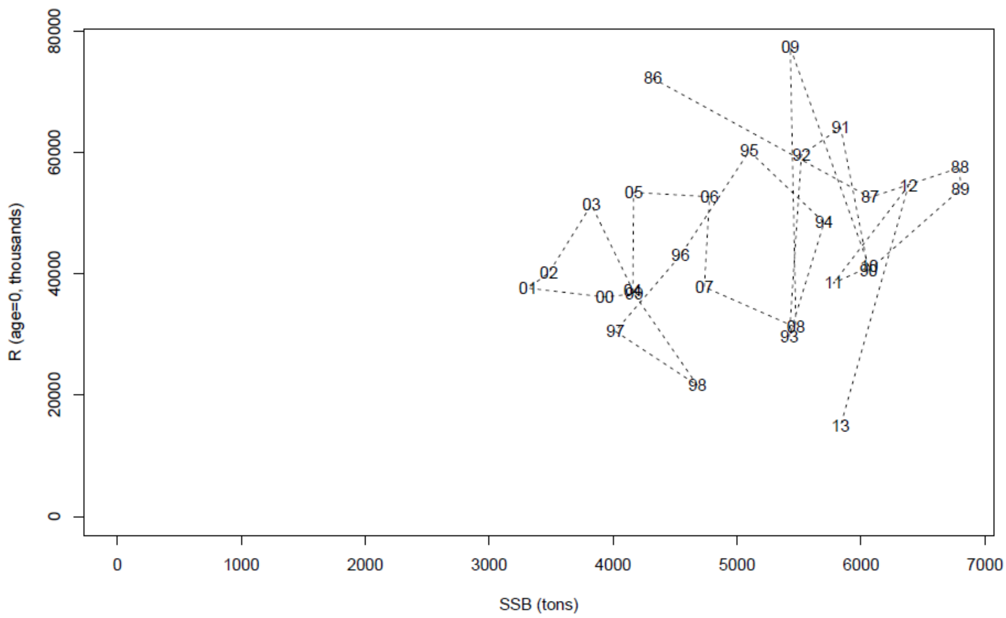


Figure 9.2.9. Four spot megrim (*L.boscii*) in Divisions VIIIc and IXa. SSB-Recruitment plot.

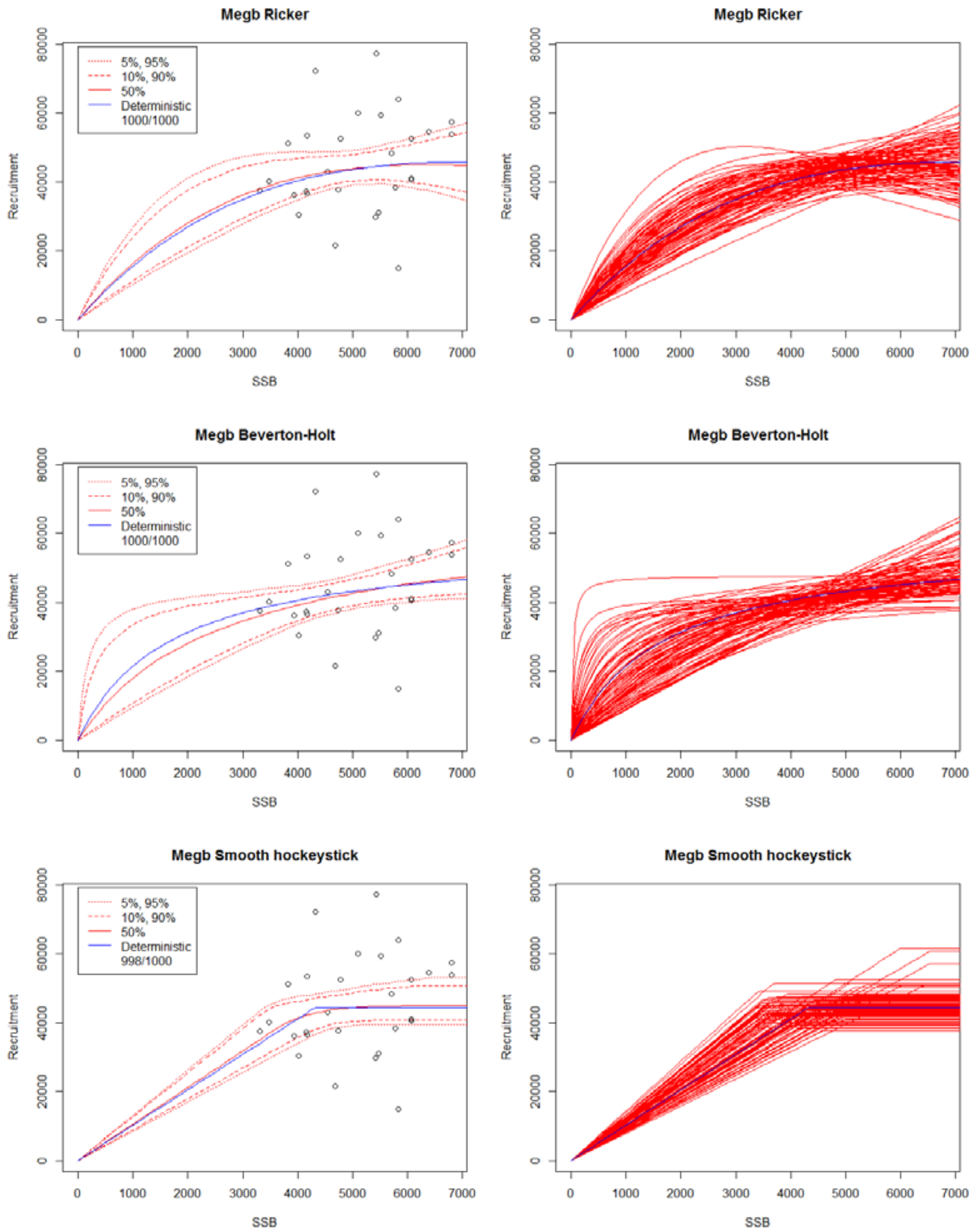


Figure 9.2.10. Four-spot megrim (*L. boscii*). Outputs from PlotMSY.

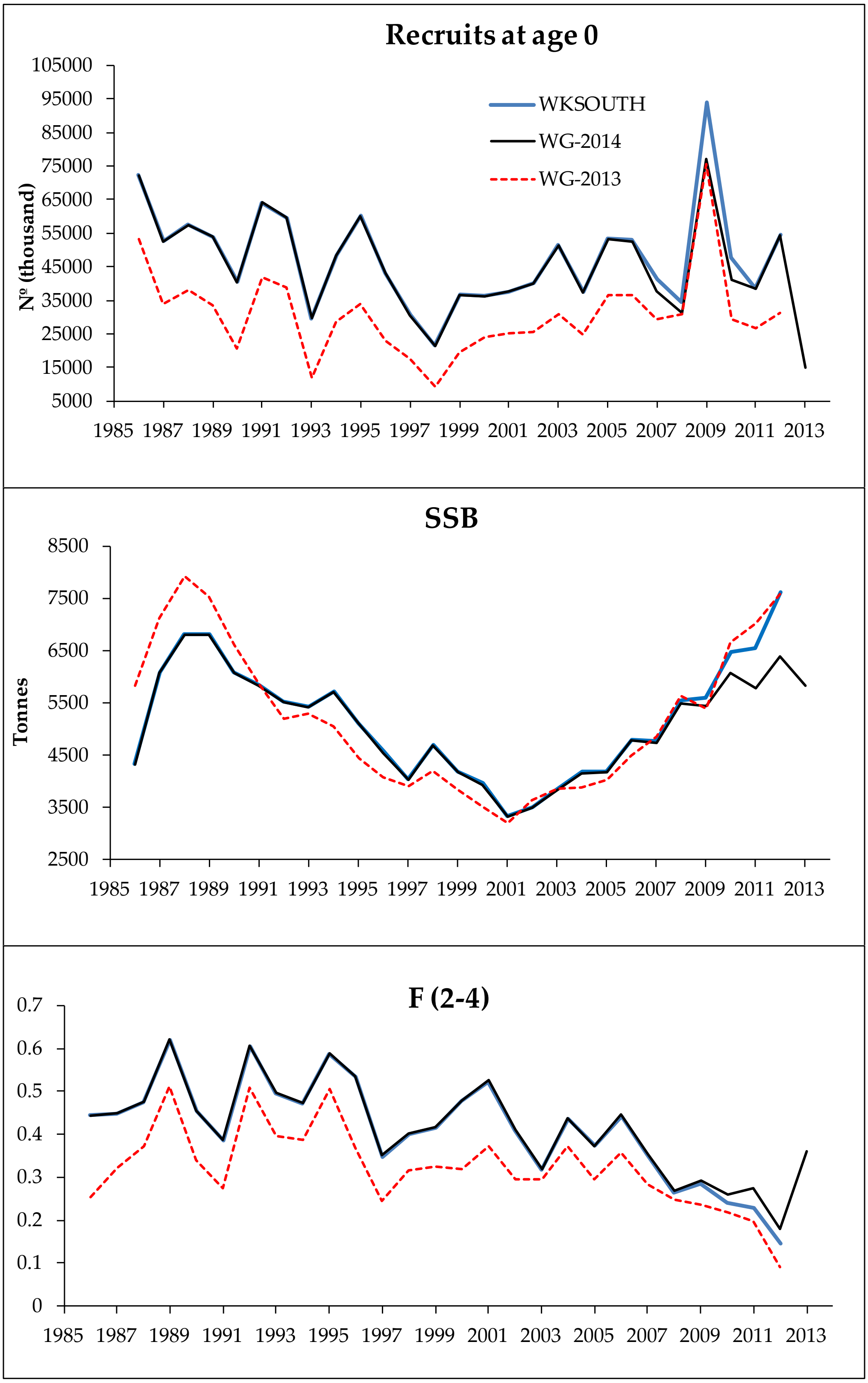


Figure 9.2.11. Four-spot megrim (*L. boscii*). Recruits, SSB and Fs from WG13, WKSOUTH and WG14

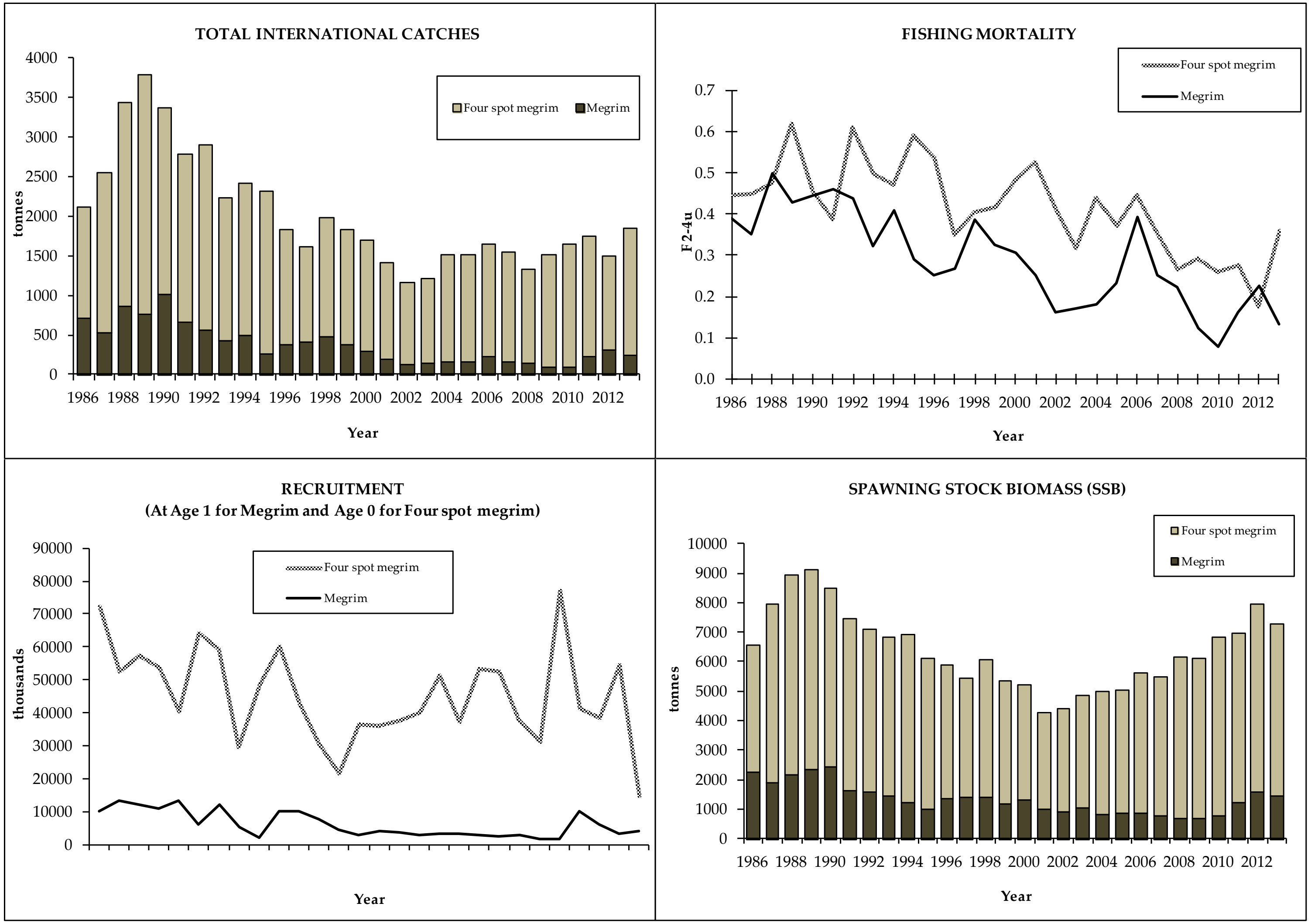


Figure 9.3.1. Stock trends for both stocks. Megrin and Four-spot megrim in Divisions VIIIc and IXa.

Combined Short Term Forecasts assuming status quo in 2014 and 2015

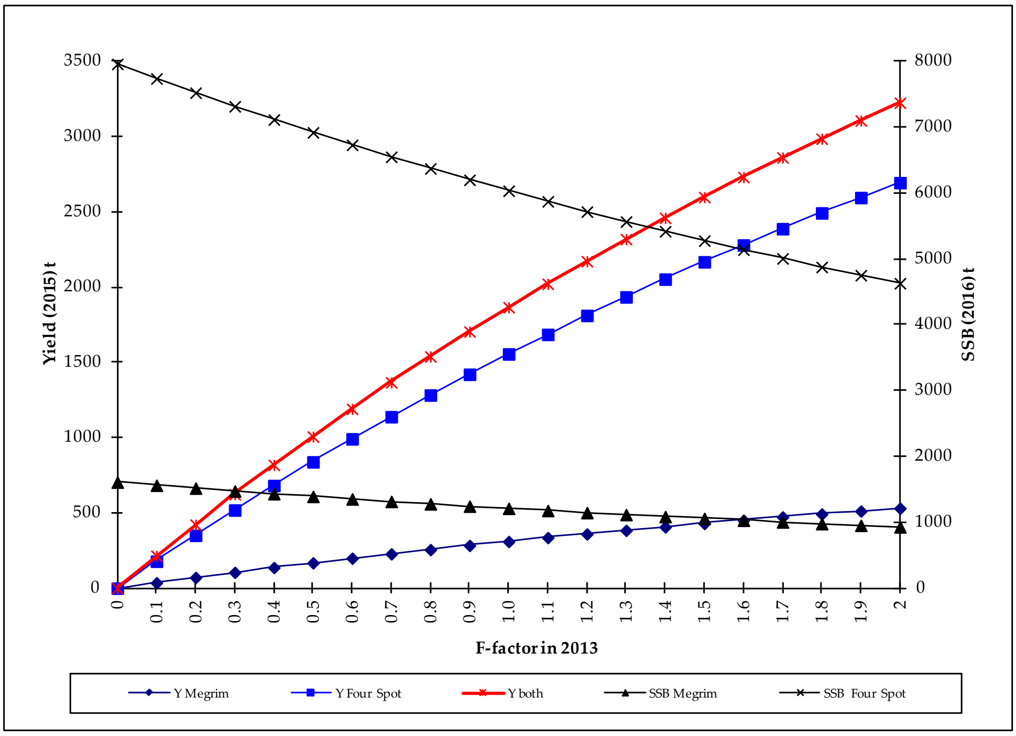


Figure 9.3.2. Megrims (*L. whiffiagonis and L. boscii*) in Divisions VIIIc and IXa.

10 Nephrops (Divisions VIII ab, FU 23-24)

Type of assessment: update assessment

Main changes from the last assessment (former WGHMM 2012):

No relevant. Previously, some changes occurred since the IBP Nephrops 2012:

- *Methodology for discard derivation (probabilistic approach replaced the proportional one).*
- *Scientific time series provided by the survey LANGOLF included in the tuning data.*

ICES description VIIIa,b

Functional Units Bay of Biscay North, VIII a (FU 23)

Bay of Biscay South, VIII b (FU 24)

10.1 General

10.1.1 Ecosystem aspects

This section is detailed in Stock Annex.

10.1.2 Fishery description

The general features of the fishery are given in Stock Annex.

10.1.3 ICES Advice for 2014

New data (landings and abundance indices) available for this stock did not change the perception of the stock; therefore, the advice for this fishery in 2014 was the same as the advice for 2013 (see ICES, 2012): *Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 3 200 tonnes.*

10.1.4 Management applicable for 2013 and 2014

Species:	Norway lobster *Nephrops norvegicus*	Zone:	VIIIa, VIIIb, VIIId and VIIIe (NEP/8ABDE.)
Spain	234		
France	3 665		
Union	3 899		
TAC	3 899		Analytical TAC

The *Nephrops* fishery is managed by TAC [articles 3, 4, 5(2) of Regulation (EC) No 847/96] along with technical measures. The agreed TAC for 2014 was 3 899 t (the same as for 2013) whereas the ICES recommendation was to reduce catch. In 2013, total nominal landings reached 2 380 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 VIIIa, VIIIb and VIIId.*"

In agreement with this, the National French Committee of Fisheries (deliberations 39/2007, 1/2008) fixed the rules of trawling activities targeting *Nephrops* in the areas VIIIa, VIIIb applicable from the 1st April 2008. All vessels catching more than 50 kg of *Nephrops* per day must use a selective device from at least one of the following: (1) a ventral panel of 60 mm square mesh; (2) a flexible grid or (3) a 80 mm codend mesh size. The majority of *Nephrops* directed vessels (Districts of South Brittany) chose the increase of the codend mesh size whereas the ventral squared panel was adopted by multi-purpose trawlers (mainly in harbours outside Brittany).

A licence system was adopted in 2004 and, since then, there has been a cap on the number of *Nephrops* trawlers operating in the Bay of Biscay of 250 (200 in 2011). In the beginning of 2006, the French producers' organisations adopted new additional regulations such as monthly quotas which had some effects on fishing effort limitation.

10.2 Data

10.2.1 Commercial catches and discards

Total catches, landings and discards, of *Nephrops* in division VIIIa,b for the period 1960-2013 are given in Table 10.1.

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). In 2012 and 2013, a strong reduction of the landings occurred (2 520 t in 2012, 2 380 t in 2013). Landings since 2008 have been reached under the new selectivity regulations.

Males usually predominate in the landings (sex ratio, defined as number of females divided by total, fluctuates between 0.31 and 0.46 for the overall period 1987-2013) and in a lesser degree in the removals (sexio ratio in the range 0.35-0.49). Females are less accessible in winter because of burrowing and, also, they have a lower growth rate. The female proportion in landings slightly increased up to the late 1990’s/early 2000's, but this trend was not confirmed in recent years probably because of the MLS increase (December 2005) and, moreover, because of the new selectivity regulations (April 2008).

Discards represent most of the catches of the smallest individuals as indicated by the available data (Figure 10.1). The average weight of discards per year in the period up to early 2000's (not routinely sampled) is about 1 540 t whereas discard estimates of the recent sampled years (2003-2013) reached a higher level of 2 110 t. This change in the amount of discards could be due to the restriction of individual quotas (notably applied since 2006), the strength of some recruitments in the middle of 2000's and the change in the MLS (which tends to increase the discards), although the change in the selectivity should tend to reduce the discards. The relative contribution of each of these three factors remains unknown. In 2013, 155 million individuals were estimated to have been discarded (1 520 t).

10.2.2 Biological sampling

Discard data by sampling on board are available for 1987, 1991, 1998 and from 2003. For the intermediate years up to 2002, since the former WGNEPH, numbers discarded at length were derived by the "proportional method" calculating discards by sex for years with no sampling onboard 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 10.2; see Stock Annex) and compared with the previous discard derivation. The probabilistic calculation provides wider variations on number of removals for age group 1 and 2 after conversion of the size composition to an age one. 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 onboard and assuming symmetrical densities of probability for yearly LFDs as tested on years with sampling onboard before MLS change (up to 2005).

Since 2003, discards have been estimated from sampling catch programmes on board *Nephrops* trawlers (451 trips and 1 339 hauls have been sampled over 11 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 2007-2013 the percentage of cross-validation item by item between logbooks and sales was comprised in a wide range of 69 to 90% (83% for 2013). Therefore, the total number of trips is usually not well known and needs to be estimated under assumptions. This can be done using the number of auction hall sales, when boats conduct daily trips, which is the case in the northern part of the fishery, but not in the southern one. Discard sampling from the southern part of the fishery was carried out only once in the past (2005), but the sampling plan has been routinely applied since 2010.

The length distribution of landings, discards, catches and removals are presented in Tables 10.3.a-h and in Figure 10.1. 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 10.2.

10.2.3 Abundance indices from surveys

For many years, abundance indices were not available for this stock. A survey specifically designed to evaluate abundance indices of *Nephrops* commenced in 2006 (with the most appropriate season: 2nd quarter, hours of trawling: around dawn and dusk and fishing gear: twin trawl). This survey (called LANGOLF; see Stock Annex) occurs once a year in May and its sampling design is stratified using sedimentary strata. Therefore, as regards the investigations carried out during the IBP *Nephrops* 2012, its results for abundance indices are included in the assessment. It should be noted that the time series provided by this survey risks to be shortly interrupted for financial constraints (the survey was not conducted in May 2014).

10.2.4 Commercial catch-effort data.

Commercial fleets used in the assessment to tune the model

Up to 1998, the majority of the vessels were not obliged to keep logbooks because of their size and fishing forms were established by inquiries. Since 1999, logbooks became compulsory for all vessels longer than 10 m. The available 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 are available for the overall time series (Table 10.7; Figure 10.4). Effort increased from 1987 to 1992, but there has been a decreasing trend since then. In 2012 and 2013, 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 "Le Guilvinec district" 2nd Quarter *Nephrops* fleet were reasonably stable for a long period, fluctuating around a long-term average of 13.1 kg/hour (Figure 10.4), with three pics values occurring in 1988, 2001 and 2010. LPUE increased steeply between 2009 and 2010 (+35%: from 13.8 kg/h to 18.6 kg/h maximum of the historical series), then strongly decreased in 2011 (-19%: 15.1 kg/h), remained stable in 2012 (15.2 kg/h) and steeply declined in 2013 (-15%: 12.8 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 onboard 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.

Annual age compositions for the "Le Guilvinec district" 2nd Quarter tuning series (Table 10.8) were obtained by using the ratios of Quarter 2-fleet-landings to Total-Quarter 2-landings.

10.3 Assessment

Biological parameters used in this year's assessment (growth parameters, length-weight relationships, natural mortality rates, discard survival rates, etc.) are provided in Table 10.4.

The male and female removal length distributions for the time series 1987-2013 were split into 9 'age groups' (the oldest age group being a plus group). The removals-at-age for each sex were summed and are presented in Table 10.5 and Figure 10.3.

Removal weights-at-age are averages weighted by numbers-at-age for each sex (Table 10.6).

10.3.1 Model

During the IBP *Nephrops* 2012, analysis carried out on the basis of the CSA model (Collie-Sissenwine Analysis) provided results as regards the relative stability for SSB and F for this stock. Hence, as in previous years, XSA sex combined was used by the WG to assess the history of the stock dynamics.

Data screening

A separable VPA was carried out to screen the removals-at-age data set using a terminal F of 0.4 at age 5 and a terminal S of 1 (Table 10.9). The results show that the residuals are generally low and do not follow any systematic pattern.

Since 2005, removals at age per unit effort for "Le Guilvinec district 2nd Quarter" have been used to tune the VPA. In the WGNEPH 2004, the tuning data were associated with a second tuning fleet covering the other harbours and districts of the Bay of Biscay for the same reference period (trip duration of this second fleet longer than one day). In 2005, the WGHMM decided to remove this second fleet from the tuning data because the estimation of its fishing effort could not be expressed by the number of sales at auction as for the GV-Q2 tuning fleet. Therefore, it was necessary to estimate it on the basis of logbook data which are of poor quality as explained previously. Since 2012, the dataset given by the scientific survey LANGOLF (years 2006-2013) has been included for tuning.

The settings used in the final run (Stock Annex) are different from those of assessments before 2012: (1) two tuning fleets were included (commercial GV-Q2 for the period 1987-2013, scientific LANGOLF for the period 2006-2013); (2) modification of the shrinkage level for XSA (1.0 instead of 1.5 previously as performed during IBP *Nephrops* 2012) . Tuning data are in Table 10.8.

10.3.2 XSA results

The diagnostics from the final XSA are given in Table 10.10. Tables 10.11 and 10.12 provide respectively F at age and stock numbers at age estimated by XSA. A full summary of the XSA estimated series is presented in Table 10.13 and Figure 10.7.

Log-catchability residuals resulting from XSA for the tuning fleet are presented in Figure 10.5. They are high in 1988 and 2002, low in 1990 for the age group 1. The overall pattern seems to be improved mainly for the intermediate years since the adoption of the probabilistic approach for discard derivation, nevertheless some year effects remain significant either for the GV-Q2 commercial fleet or for the LANGOLF survey. High residuals are estimated for age 1 in the assessment. None of the data used in this assessment (catches, survey, tuning commercial fleet) provide information on age 1 which should suggest to modify the age for recruitment from age 1 to age 2.

The retrospective analysis indicates a very strong retrospective pattern for recruitment, SSB and F (Figure 10.6). The quality of the signal seems to be deteriorated comparatively to the middle of 2000’s. Additional XSA run with no LANGOLF survey series (abnormal high value of the indices 2012; Fig. 10.8.a-c) provided similar patterns.

Recruitment presents an overall decreasing trend since 2004-2005.

SSB has declined since the years 2007 (correlation coefficient for SSB vs. year of –0.852 throughout the period 2007-2013) down to the historically lowest levels in 2012 and 2013 (Table 10.13; Figure 10.7). The retrospective pattern leads to downward revision in SSB in recent years.

Fbar (age 2-5) shows an increase from the late 1990's to 2005-2006. The apparently low level of Fbar in 2013 has to be cautiously considered as the XSA assessment performed on *Nephrops* stocks usually provides under-estimated value for the last year's F which is systematically revised upwards a year later.

10.3.3 Conclusions on the assessment

In 2012, the Review Group rejected the XSA assessment due to the strong retrospective pattern. This year, the WG also rejects the assessment for the same reasons and decides to use the assessment as indicative of trends in abundance.

The WG notes that several indicators seem to confirm the general decreasing trend in abundance in recent years obtained from the stock assessment:

- <u>Commercial tuning fleet's LPUEs</u>: in spite of a global stability for almost two decades since the beginning of the time series, this index decreases for the recent four years (-31% between 2010 and 2013).
- <u>*Nephrops* mean sizes</u>: whereas the mean size in landings and removals as illustrated by Figure 10.2 does not show significant trend for recent years, it should be underlined that mean sizes (CL, in mm) provided by LANGOLF survey decline in the period 2007-2013 (Figure 10.8.d; correlation coefficient of CL vs. year equal to -0.951). This pattern is motonotic if the particular year 2006 is not included: the survey was conducted in April instead of May, therefore it is suspected that male growth and female proportion were biased in 2006.

10.4 Catch options and prognosis

As XSA assessment was rejected by the WG, short-term projections and yield per recruit analysis were not carried out.

10.5 Biological reference points

In previous assessments, F_{max} was proposed as a satisfactory F_{MSY} proxy for the stock although the low quality of the signal provided by this year's assessment suggests to define new biological reference points (benchmark workshop in 2015).

10.6 Comments on the assessment

The continuation of the French *Nephrops* trawlers onboard sampling programme will avoid the use of "derived" data for missing years (13 years on 27). Since 2009, there has been a improvement of the sampling design as many trips were sampled in the Southern part of the fishery. Derivation based on probabilistic approach should improve diagnostic although the inadequacy of the XSA and the divergence of the retrospective pattern for recent years requires to apply alternative length-based assessment methods.

10.7 Information from the fishing industry

The industry has not provided any additional quantitative information, but they supported information on decrease of landings. The partnership underlined the heterogeneous feature of the whole area of the stock and commented on the application of one tuning series involved in the northern part of the fishery and its extrapolation to the southern one. They emphasized the necessity of applying additional tuning commercial information on the southern part of fishery. Since 2012, they have been aware of the downwards trend for the stock, moreover they considered the unfavourable context induced by the future interruption of the LANGOLF series and they investigated the realistic character to replace the trawl survey by an UWTV one. For 2013, industry pointed out the impact on *Nephrops* trawling caused by a temporarily closed area located in the Northern part of the central mud bank which should explain a proportion of the decrease of LPUEs between 2012 and 2013.

10.8 Management considerations

Recruitment level in the early 2000's was probably higher than the historical average values, but remains uncertain. It seems to to have decreased since the second half of 2000’s.

Trends provided by several indices (commercial LPUEs, mean sizes from survey) are consistent with trends in abundance estimated by the assessment.

Table 10.1. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Estimates of catches (t) by FU for 1960-2013

	Landings (1)					Total Discards		Catches
Year	FU 23-24 (2)	FU 23	FU 24	Unallocated (MA N)(3)	Total VIIIa,b	FU 23-24		Total
	VIIIa,b	VIIIa	VIIIb		used by WG	VIIIa,b		VIIIa,b
1960	3524	-	-	-	3524	-		3524
1961	3607	-	-	-	3607	-		3607
1962	3042	-	-	-	3042	-		3042
1963	4040	-	-	-	4040	-		4040
1964	4596	-	-	-	4596	-		4596
1965	3441	-	-	-	3441	-		3441
1966	3857	-	-	-	3857	-		3857
1967	3245	-	-	-	3245	-		3245
1968	3859	-	-	-	3859	-		3859
1969	4810	-	-	-	4810	-		4810
1970	5454	-	-	-	5454	-		5454
1971	3990	-	-	-	3990	-		3990
1972	5525	-	-	-	5525	-		5525
1973	7040	-	-	-	7040	-		7040
1974	7100	-	-	-	7100	-		7100
1975	-	6460	322	-	6782	-		6782
1976	-	6012	300	-	6312	-		6312
1977	-	5069	222	-	5291	-		5291
1978	-	4554	162	-	4716	-		4716
1979	-	4758	36	-	4794	-		4794
1980	-	6036	71	-	6107	-		6107
1981	-	5908	182	-	6090	-		6090
1982	-	4392	298	-	4690	-		4690
1983	-	5566	342	-	5908	-		5908
1984	-	4485	198	-	4683	-		4683
1985	-	4281	312	-	4593	-		4593
1986	-	3968	367	99	4335	-		4335
1987	-	4937	460	64	5397	1767	*	7164
1988	-	5281	594	69	5875	4138		10013
1989	-	4253	582	77	4835	3007		7842
1990	1	4613	359	87	4972	644		5616
1991	1	4353	401	55	4754	1213	*	5967
1992	0	5123	558	47	5681	1217		6897
1993	0	4577	532	49	5109	974		6084
1994	0	3721	371	27	4092	717		4809
1995	0	4073	380	14	4452	687		5139
1996	0	4034	84	15	4118	487		4606
1997	2	3450	147	41	3610	914		4523
1998	2	3565	300	40	3865	1453	*	5318
1999	2	2873	337	26	3209	1092		4301
2000	0	2848	221	36	3069	1337		4406
2001	1	3421	309	22	3730	2628		6358
2002	2	3323	356	36	3679	2535		6214
2003	1	3564	322	49	3886	1977	*	5863
2004	na	3223	348	5	3571	1932	*	5503
2005	na	3619	372	na	3991	2698	*	6689
2006	na	3026	420	na	3447	4544	*	7990
2007	na	2881	292	na	3176	2411	*	5587
2008	na	2774	256	na	3030	2123	*	5154
2009	na	2816	212	na	2987	1833	*	4820
2010	na	3153	245	na	3398	1275	*	4673
2011	na	3240	319	na	3559	1263	*	4822
2012	na	2290	230	na	2520	1013	*	3533
2013	na	2195	185	na	2380	1521	*	3900

(1) WG estimates
(2) landings from VIIIa and VIIIb aggregated until 1974
(3) outside FU 23-24

Table 10.2. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Derivation and estimations of discards

1987	sampled
1988	from 1987's logistic function of sorting by quarter+density of probability
1989	from 1987's logistic function of sorting by quarter+density of probability
1990	from 1987's logistic function of sorting by quarter+density of probability
1991	sampled
1992	from 1991's logistic function of sorting by quarter+density of probability
1993	from 1991's logistic function of sorting by quarter+density of probability
1994	from 1991's logistic function of sorting by quarter+density of probability
1995	from 1991's logistic function of sorting by quarter+density of probability
1996	from 1991's logistic function of sorting by quarter+density of probability
1997	from 1991's logistic function of sorting by quarter+density of probability
1998	sampled
1999	from 1998's logistic function of sorting by quarter+density of probability
2000	from 1998's logistic function of sorting by quarter+density of probability
2001	from 1998's logistic function of sorting by quarter+density of probability
2002	from 1998's logistic function of sorting by quarter+density of probability
2003	sampled
2004	sampled
2005	sampled
2006	sampled
2007	sampled
2008	sampled
2009	sampled
2010	sampled
2011	sampled
2012	sampled
2013	sampled

Table 10.3.a Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 1987-2000

Landings CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	14	0	0	0
16	0	158	59	0	0	0	0	0	0	0	14	0	0	0
17	149	230	77	12	35	62	0	0	0	0	0	0	0	0
18	331	553	131	64	30	0	0	31	20	0	0	0	0	14
19	1296	1886	901	48	79	138	0	72	61	0	0	0	0	11
20	3129	4227	2791	529	474	450	464	206	341	48	448	25	72	116
21	6476	8882	7039	1947	1572	1595	1285	482	1573	414	1313	288	219	433
22	13501	16050	12971	5913	4733	3948	3878	2824	2395	1311	2799	985	849	1015
23	21337	25374	18073	10910	7854	9701	7398	5366	5523	2799	4638	3171	1888	2531
24	24339	33950	21960	13293	15521	20948	11949	9650	8731	6071	10005	6484	4032	5462
25	32476	36294	25650	16440	19747	27876	21011	15079	14348	13239	19837	13980	10717	11357
26	29670	29808	22747	18205	22106	26617	23732	18312	19769	16779	19380	13535	10590	10212
27	28086	28380	22091	16109	21900	28410	26044	21181	25126	18384	22823	16602	12724	11528
28	24925	26017	19087	19595	21214	32091	27580	20488	20914	15744	19466	14432	12058	12639
29	18703	20920	14227	16250	17138	24760	20627	16527	15909	16332	20878	11832	9448	11473
30	18407	17862	13688	12055	14762	19828	21414	15903	19164	20214	21487	16335	16187	13888
31	11419	13156	9037	11088	12408	14281	13452	11207	13333	14009	9791	8539	9209	9828
32	10185	12822	8410	8540	8635	12786	12711	11490	13667	14392	9622	9237	9745	8936
33	8528	8848	7127	10649	7273	9297	11369	7022	7117	8576	6334	5947	6000	6333
34	5926	7812	6967	10543	7987	7318	7355	6684	7584	6524	4816	6619	5910	5225
35	5763	5935	6214	7637	5425	5928	6307	5646	4677	6578	4737	6700	5267	4895
36	4033	5064	4532	6274	4979	4998	4608	4337	3709	4133	2568	5308	4291	3242
37	4024	3754	3545	4841	4541	4195	4089	3752	3496	4226	2135	4722	3230	2946
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3527	2588	2687
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2169	2186	2027
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3084	2353	1862
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1362	1020
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1049	761	534
44	965	704	1192	1401	1089	1050	745	500	915	414	219	748	708	413
45	641	581	1194	955	1058	766	684	550	700	464	253	902	429	421
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**288974**	**324498**	**244875**	**213779**	**217338**	**274286**	**240638**	**188879**	**202294**	**182041**	**188694**	**161549**	**135304**	**133383**
Weights	**5397**	**5875**	**4835**	**4972**	**4754**	**5681**	**5109**	**4092**	**4452**	**4118**	**3610**	**3865**	**3209**	**3069**

Table 10.3.b Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 2001-2013

Landings CL mm/Y	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
10	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
12	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
14	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
16	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	20	7	0	0	0	0	0	0	0	0	0
18	13	0	14	0	25	5	4	12	0	0	0	0	0
19	38	0	0	14	27	0	0	0	0	0	1	0	5
20	284	107	87	47	82	5	4	77	37	14	22	35	31
21	643	925	280	249	270	70	14	191	73	75	6	25	151
22	2116	1122	661	899	771	131	18	208	288	252	11	235	682
23	6261	5513	1614	2194	2588	227	48	322	473	386	111	334	1002
24	8915	10061	3966	5664	6511	822	188	721	1929	1238	515	1399	3162
25	17106	12951	8164	10930	13678	2844	1201	2742	3670	3940	1803	3843	7873
26	13745	21403	13297	13998	17811	6376	5684	6319	8258	8499	4773	7875	13242
27	17098	19433	17614	16094	22006	12010	9439	10891	12759	14173	7520	11079	14926
28	15835	22074	18572	15350	21879	14647	13248	12640	15732	15390	8991	11920	13260
29	13779	16559	16843	14808	18027	14591	12516	12890	13524	15340	9602	11120	13397
30	16168	18105	17264	14143	15570	13690	12219	10726	13271	15736	8821	9636	10296
31	11316	9989	13345	12353	12634	11814	10698	9772	10859	12749	8253	8393	9137
32	11335	10284	11276	10322	9907	9694	9274	8845	9310	11366	6954	7414	7116
33	8250	7813	8253	8020	7800	8421	7859	7436	7086	8851	6175	6069	5558
34	6185	5308	6195	6298	6537	7112	6539	6425	5985	7140	5467	4505	4123
35	5213	4309	4653	4673	5100	5135	6529	5366	4568	5852	4541	3507	2783
36	4037	3157	3818	3308	3369	4104	4735	3867	3697	3626	4260	2649	1978
37	2901	2049	3075	2875	2597	3196	3839	3121	2565	3024	3648	1976	1472
38	2369	2224	2660	2098	2380	2662	2639	2398	1871	2247	3911	1563	998
39	2297	1559	2174	1683	1650	1956	2245	2043	1491	1630	3472	1314	936
40	1908	1398	1936	1555	1628	1599	1711	1633	1190	1280	3296	1103	518
41	941	764	1423	1188	1154	1171	1227	1190	878	966	2740	878	438
42	863	632	1403	889	953	990	1111	1015	742	742	2497	635	351
43	530	640	1054	774	842	741	710	805	540	560	2157	558	320
44	383	432	810	707	640	633	746	706	473	509	1762	536	249
45	523	416	808	613	605	595	518	536	396	442	1177	478	177
46	294	328	535	485	415	479	373	405	307	305	1024	441	181
47	368	241	456	388	353	440	311	361	262	290	858	378	88
48	188	188	339	313	339	382	257	294	245	237	656	381	98
49	183	79	206	318	288	319	237	262	196	204	557	212	74
50	160	115	253	306	276	287	190	228	156	160	501	160	46
51	135	73	170	214	176	246	163	201	115	135	383	132	37
52	102	46	150	152	184	201	138	116	110	120	296	128	32
53	82	51	120	111	142	137	140	121	98	97	198	96	24
54	40	20	80	90	104	156	115	95	63	95	271	93	17
55	53	30	57	47	109	137	79	73	75	79	152	58	15
56	24	13	23	86	69	117	60	67	54	75	132	46	8
57	46	6	47	49	58	134	70	41	31	67	98	48	22
58	29	6	22	27	43	134	45	40	48	47	105	52	3
59	26	3	10	32	41	85	33	19	23	48	79	33	12
60	21	11	8	10	19	115	33	23	14	42	48	22	3
61	7	0	5	5	28	40	23	7	8	30	39	15	8
62	2	0	4	3	16	21	9	9	9	16	55	18	1
63	5	1	1	5	9	19	9	7	10	7	23	11	2
64	0	0	0	8	8	18	10	6	3	16	12	8	0
65	0	1	0	1	14	11	9	1	3	9	11	7	0
66	0	0	1	1	6	10	1	0	2	3	11	3	0
67	0	0	0	1	5	8	1	0	2	3	6	1	0
68	0	0	0	2	4	7	3	0	0	4	7	0	0
69	0	0	1	0	1	6	2	0	1	1	2	2	0
70	0	0	0	0	2	4	0	0	0	1	2	0	0
71	0	0	1	0	1	5	0	0	0	1	1	0	0
72	0	0	0	0	1	5	0	0	0	0	0	0	0
73	0	0	0	0	0	2	1	0	0	0	0	0	0
74	0	0	0	0	0	4	0	0	0	0	1	0	0
75	0	0	0	0	1	4	0	0	0	0	0	1	0
Total	**172819**	**180442**	**163771**	**154405**	**179758**	**128777**	**117273**	**115274**	**123504**	**138120**	**108011**	**101424**	**114853**
Weights	**3730**	**3679**	**3886**	**3571**	**3991**	**3447**	**3176**	**3030**	**2987**	**3398**	**3559**	**2520**	**2380**

Table 10.3.c Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 1987-2000.

Total Discards

CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10	0	1318	75	0	0	546	199	134	185	82	1325	0	93	186
11	0	2152	152	0	114	807	313	208	279	125	1611	85	150	291
12	0	3508	308	0	0	1190	491	323	419	191	1952	128	240	455
13	0	5695	624	1	93	1749	768	501	627	291	2354	162	384	710
14	78	9194	1261	2	258	2556	1198	774	936	441	2823	660	613	1104
15	2074	14706	2539	7	1249	3708	1858	1189	1388	666	3364	1741	977	1710
16	3974	23183	5074	22	2240	5320	2854	1811	2040	999	3980	1861	1548	2631
17	13577	35760	9995	71	4638	7521	4326	2727	2961	1484	4671	3527	2433	4008
18	29288	53448	19148	235	10619	10421	6429	4034	4221	2171	5432	5003	3776	6016
19	28370	76547	34910	766	12852	14070	9295	5825	5877	3114	6254	5991	5753	8843
20	60253	230038	153497	2426	22797	18408	12961	8143	7938	4347	7125	12091	8534	12628
21	45446	129602	100993	31048	18043	23225	17283	10932	10337	5862	8028	9973	12205	17372
22	51268	61144	47652	26066	24289	17350	17709	13186	9925	7591	14964	23278	16667	25140
23	23074	25627	17991	11687	15611	20991	15746	11862	12053	6558	10661	21641	17635	22623
24	7213	10004	6496	3836	13741	20860	12123	10225	9074	6765	10758	19750	15698	21146
25	2686	3535	2479	1516	14722	13478	10054	7645	7037	6720	10252	20487	18666	20177
26	672	1008	694	570	7131	6137	5513	4390	4741	4030	4720	10676	8465	8496
27	270	335	240	181	1711	3200	2863	2452	2817	2088	2639	7502	4774	4780
28	0	117	70	78	999	1759	1449	1143	1117	874	1096	3019	2202	2630
29	0	32	20	25	138	654	517	434	415	431	584	1357	813	1245
30	0	10	7	7	291	256	268	208	249	263	287	686	695	679
31	0	3	2	2	97	94	84	69	84	89	64	129	208	273
32	0	1	1	1	0	39	40	34	42	45	30	481	115	112
33	0	0	0	0	0	14	18	11	11	13	10	231	38	40
34	0	0	0	0	0	6	6	5	6	5	4	151	20	17
35	0	0	0	0	0	2	2	2	2	2	2	88	10	8
36	0	0	0	0	0	1	1	1	1	1	0	48	5	3
37	0	0	0	0	0	0	0	0	0	0	0	74	2	2
38	0	0	0	0	0	0	0	0	0	0	0	44	1	1
39	0	0	0	0	0	0	0	0	0	0	0	36	0	0
40	0	0	0	0	0	0	0	0	0	0	0	57	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	6	0	0
44	0	0	0	0	0	0	0	0	0	0	0	30	0	0
45	0	0	0	0	0	0	0	0	0	0	0	2	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**268244**	**686969**	**404228**	**78546**	**151634**	**174362**	**124368**	**88267**	**84780**	**55250**	**104994**	**150995**	**122720**	**163330**
Weights	**1767**	**4123**	**2634**	**627**	**1213**	**1354**	**1007**	**741**	**706**	**495**	**805**	**1453**	**1148**	**1455**

Table 10.3.d Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 2001-2013.

Total Discards

CL mm/Y	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
10	950	1268	28	0	0	0	22	0	82	0	0	0	0
11	1341	1817	0	0	94	0	171	38	135	2	0	0	0
12	1890	2597	70	363	413	70	202	98	79	0	237	0	0
13	2654	3696	294	1722	1085	234	122	235	177	97	596	532	0
14	3713	5233	636	3152	3190	1138	900	389	291	83	834	665	229
15	5164	7354	1198	5548	7287	3102	1288	189	1157	155	941	1425	870
16	7126	10227	3386	6784	13528	7810	2959	1027	2315	822	1230	4544	1313
17	9732	14027	5927	8836	15094	11655	3636	1832	3059	1333	2430	4737	4179
18	13110	18895	8078	10161	19795	16139	4590	2626	4843	2309	3630	8066	3372
19	17354	24883	11506	17361	19522	25891	5244	6473	6485	3532	4546	8024	8730
20	22483	31890	12142	19250	22265	39742	8735	11444	12766	5692	7227	10125	9682
21	28397	39629	18597	25898	32409	54220	11585	15630	16772	7699	10393	12145	15281
22	49505	24662	21416	25210	35523	69870	17930	24730	18701	11689	15161	14034	20618
23	54819	48438	28429	26756	40041	70094	24086	27560	21693	13672	13837	12904	26287
24	34491	39179	26501	21343	36279	55408	30615	29638	24105	16963	15551	14889	21750
25	30416	22841	23211	20085	30222	52660	32917	28007	20736	14670	16545	10873	17823
26	11137	17386	17357	12006	19003	38812	27376	23127	14205	11852	10047	7747	10188
27	6340	8069	9680	6436	8498	20124	20567	10129	9188	8558	8127	4304	5439
28	2658	4129	6187	3487	4603	10263	10365	5893	5927	5986	3201	919	2824
29	1183	1494	2537	2115	1201	4188	4464	3225	3163	3360	2086	588	2146
30	665	876	1605	1901	1600	2578	2868	1923	3261	1876	2011	680	945
31	226	214	1326	1115	1417	1109	1316	925	1824	1274	1246	125	922
32	114	119	574	735	526	592	737	454	839	716	492	200	684
33	47	44	313	503	296	544	484	421	671	350	265	13	365
34	20	21	261	385	553	411	537	1025	830	274	272	145	494
35	7	7	176	424	260	230	265	206	332	242	174	24	233
36	4	4	113	108	46	73	336	78	197	55	59	3	260
37	1	1	83	74	246	25	299	153	188	162	149	146	130
38	1	1	93	31	116	99	40	93	269	16	97	68	81
39	1	0	15	139	147	0	3	369	55	33	24	0	33
40	0	0	37	73	37	169	47	0	66	38	25	3	0
41	0	0	34	60	20	0	40	0	8	4	0	0	0
42	0	0	4	12	31	0	20	53	0	4	157	0	0
43	0	0	14	13	0	0	11	0	38	0	4	4	0
44	0	0	0	13	0	0	0	0	14	6	0	0	0
45	0	0	13	0	0	36	0	0	0	0	5	0	0
46	0	0	0	0	0	0	0	0	0	6	0	0	0
47	0	0	0	0	0	0	0	0	0	0	6	0	0
48	0	0	0	0	0	0	0	0	8	0	0	0	36
49	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	11	0	0	0	0	0	0
51	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
53	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
55	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
57	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	39	0	0	0	0	0
59	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
61	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
63	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
65	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
67	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
69	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
71	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
73	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
75	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**305547**	**329002**	**201841**	**222102**	**315346**	**487288**	**214788**	**198031**	**174480**	**113530**	**121603**	**117935**	**154914**
Weights	**2537**	**2620**	**1977**	**1932**	**2698**	**4544**	**2411**	**2123**	**1833**	**1275**	**1263**	**1012**	**1521**

Table 10.3.e Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 1987-2000.

Total catches

CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10	0	1318	75	0	0	546	199	134	185	82	1325	0	93	186
11	0	2152	152	0	114	807	313	208	279	125	1611	85	150	291
12	0	3508	308	0	0	1190	491	323	419	191	1952	128	240	455
13	0	5695	624	1	93	1749	768	501	627	291	2354	162	384	710
14	78	9194	1261	2	258	2556	1198	774	936	441	2823	660	613	1104
15	2074	14706	2539	7	1249	3708	1858	1189	1388	666	3378	1741	977	1710
16	3974	23341	5134	22	2240	5320	2854	1811	2040	999	3994	1861	1548	2631
17	13727	35990	10072	83	4673	7583	4326	2727	2961	1484	4671	3527	2433	4008
18	29620	54001	19279	299	10649	10421	6429	4065	4241	2171	5432	5003	3776	6031
19	29666	78433	35810	814	12931	14209	9295	5897	5938	3114	6254	5991	5753	8854
20	63382	234265	156289	2955	23271	18858	13425	8348	8279	4394	7573	12116	8605	12744
21	51922	138484	108031	32996	19615	24820	18569	11413	11910	6276	9341	10260	12424	17805
22	64770	77194	60622	31979	29023	21298	21587	16010	12320	8902	17764	24263	17516	26155
23	44411	51001	36064	22597	23464	30692	23143	17227	17576	9357	15299	24812	19523	25155
24	31551	43954	28456	17129	29262	41808	24072	19876	17805	12836	20763	26235	19730	26608
25	35162	39829	28130	17956	34469	41355	31065	22724	21385	19960	30089	34467	29383	31534
26	30342	30817	23441	18775	29237	32754	29245	22702	24510	20810	24100	24211	19056	18708
27	28357	28715	22331	16290	23611	31610	28907	23633	27943	20472	25462	24104	17498	16307
28	24925	26134	19157	19672	22213	33851	29028	21631	22031	16618	20563	17450	14261	15269
29	18703	20952	14247	16275	17276	25413	21145	16961	16324	16763	21463	13189	10261	12718
30	18407	17871	13696	12061	15053	20084	21682	16111	19413	20478	21774	17021	16882	14567
31	11419	13159	9038	11090	12505	14375	13535	11276	13418	14098	9856	8668	9417	10102
32	10185	12823	8410	8541	8635	12825	12751	11524	13710	14436	9652	9718	9860	9048
33	8528	8848	7128	10650	7273	9311	11387	7033	7128	8589	6344	6178	6038	6373
34	5926	7812	6967	10543	7987	7324	7361	6688	7590	6529	4820	6770	5930	5242
35	5763	5935	6214	7637	5425	5931	6309	5648	4678	6580	4739	6787	5277	4903
36	4033	5064	4532	6274	4979	4999	4609	4338	3709	4134	2568	5356	4295	3245
37	4024	3754	3545	4841	4541	4195	4089	3753	3496	4227	2135	4796	3232	2947
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3571	2589	2688
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2205	2186	2027
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3140	2353	1862
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1363	1020
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1055	762	534
44	965	704	1192	1401	1089	1050	745	500	915	414	219	778	708	413
45	641	581	1194	955	1058	766	684	550	700	464	253	904	429	421
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**557218**	**1011467**	**649102**	**292325**	**368972**	**448648**	**365006**	**277146**	**287074**	**237291**	**293688**	**312544**	**258025**	**296713**
Weights	**7164**	**9997**	**7470**	**5599**	**5967**	**7034**	**6116**	**4833**	**5159**	**4614**	**4415**	**5318**	**4357**	**4523**

Table 10.3.f Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 2001-2013.

Total catches

CL mm/Y	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
10	950	1268	28	0	0	0	22	0	82	0	0	0	0
11	1341	1817	0	0	94	0	171	38	135	2	0	0	0
12	1890	2597	70	363	413	70	202	98	79	0	237	0	0
13	2654	3696	294	1722	1085	234	122	235	177	97	596	532	0
14	3713	5233	636	3152	3190	1138	900	389	291	83	834	665	229
15	5164	7354	1198	5548	7287	3102	1289	189	1157	155	941	1425	870
16	7126	10227	3386	6784	13528	7810	2959	1027	2315	822	1230	4544	1313
17	9732	14027	5947	8843	15094	11655	3636	1832	3059	1333	2430	4737	4179
18	13122	18895	8092	10161	19820	16144	4593	2638	4843	2309	3630	8066	3372
19	17392	24883	11506	17376	19549	25891	5244	6473	6485	3532	4546	8024	8735
20	22767	31997	12229	19297	22348	39747	8738	11521	12803	5706	7249	10160	9713
21	29040	40555	18877	26146	32679	54289	11598	15820	16845	7775	10398	12170	15433
22	51621	25784	22077	26109	36293	70001	17948	24938	18989	11941	15171	14269	21300
23	61081	53951	30042	28950	42629	70322	24134	27882	22167	14058	13948	13238	27289
24	43406	49240	30467	27006	42790	56230	30803	30359	26034	18202	16065	16288	24913
25	47522	35792	31376	31015	43900	55504	34119	30750	24406	18610	18348	14716	25696
26	24882	38790	30654	26004	36814	45189	33060	29446	22463	20352	14820	15622	23430
27	23438	27502	27294	22530	30504	32134	30006	21020	21948	22730	15647	15383	20365
28	18493	26203	24759	18837	26482	24909	23613	18533	21659	21375	12191	12838	16084
29	14962	18053	19381	16923	19228	18779	16980	16115	16687	18700	11687	11708	15543
30	16833	18981	18868	16044	17170	16268	15087	12649	16531	17612	10832	10315	11241
31	11542	10203	14672	13469	14051	12923	12014	10697	12682	14024	9500	8518	10059
32	11448	10403	11849	11057	10433	10286	10011	9299	10150	12082	7447	7614	7801
33	8297	7857	8566	8523	8095	8965	8343	7857	7757	9201	6440	6082	5923
34	6204	5329	6456	6684	7090	7524	7076	7449	6815	7414	5739	4649	4617
35	5220	4316	4829	5097	5361	5366	6793	5573	4900	6094	4715	3531	3016
36	4041	3161	3931	3416	3415	4177	5071	3945	3894	3681	4319	2652	2237
37	2903	2050	3158	2949	2844	3221	4138	3273	2753	3186	3797	2122	1602
38	2370	2225	2752	2129	2496	2760	2679	2491	2139	2263	4007	1632	1079
39	2298	1560	2189	1822	1797	1956	2247	2412	1546	1662	3496	1314	968
40	1908	1399	1973	1628	1665	1768	1758	1633	1257	1318	3321	1107	518
41	941	764	1457	1248	1174	1171	1267	1190	886	971	2740	878	438
42	863	632	1407	901	984	990	1130	1069	742	746	2654	635	351
43	530	641	1068	787	842	741	722	805	578	560	2161	563	320
44	383	432	810	719	640	633	746	706	487	515	1762	536	249
45	523	416	821	613	605	631	518	536	396	442	1182	478	177
46	294	328	535	485	415	479	373	405	307	312	1024	441	181
47	368	241	456	388	353	440	311	361	262	290	865	378	88
48	188	188	339	313	339	382	257	294	254	237	656	381	134
49	183	79	206	318	288	319	237	262	196	204	557	212	74
50	160	115	253	306	276	287	201	228	156	160	501	160	46
51	135	73	170	214	176	246	163	201	115	135	383	132	37
52	102	46	150	152	184	201	138	116	110	120	296	128	32
53	82	51	120	111	142	137	140	121	98	97	198	96	24
54	40	20	80	90	104	156	115	95	63	95	271	93	17
55	53	30	57	47	109	137	79	73	75	79	152	58	15
56	24	13	23	86	69	117	60	67	54	75	132	46	8
57	46	6	47	49	58	134	70	41	31	67	98	48	22
58	29	6	22	27	43	134	45	80	48	47	105	52	3
59	26	3	10	32	41	85	33	19	23	48	79	33	12
60	21	11	8	10	19	115	33	23	14	42	48	22	3
61	7	0	5	5	28	40	23	7	8	30	39	15	8
62	2	0	4	3	16	21	9	9	9	16	55	18	1
63	5	1	1	5	9	19	9	7	10	7	23	11	2
64	0	0	0	8	8	18	10	6	3	16	12	8	0
65	0	1	0	1	14	11	9	1	3	9	11	7	0
66	0	0	1	1	6	10	1	0	2	3	11	3	0
67	0	0	0	1	5	8	1	0	2	3	6	1	0
68	0	0	0	2	4	7	3	0	0	4	7	0	0
69	0	0	1	0	1	6	2	0	1	1	2	2	0
70	0	0	0	0	2	4	0	0	0	1	2	0	0
71	0	0	1	0	1	5	0	0	0	1	1	0	0
72	0	0	0	0	1	5	0	0	0	0	0	0	0
73	0	0	0	0	0	2	1	0	0	0	0	0	0
74	0	0	0	0	0	4	0	0	0	0	1	0	0
75	0	0	0	0	1	4	0	0	0	0	0	1	0
Total	**478366**	**509443**	**365612**	**376507**	**495103**	**616065**	**332060**	**313305**	**297984**	**251649**	**229614**	**219358**	**269767**
Weights	**6267**	**6299**	**5863**	**5503**	**6689**	**7990**	**5587**	**5154**	**4820**	**4673**	**4822**	**3532**	**3900**

Table 10.3.g Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 1987-2000.

Removals=Landings+dead catches (discard survival rate : 30%)

CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
10	0	922	52	0	0	382	139	94	130	57	928	0	65	130
11	0	1507	106	0	80	565	219	146	195	88	1128	60	105	204
12	0	2455	216	0	0	833	344	226	293	134	1366	89	168	319
13	0	3987	437	0	65	1224	538	351	439	203	1648	114	269	497
14	55	6436	883	1	181	1789	839	542	655	309	1976	462	429	773
15	1452	10294	1777	5	875	2595	1301	832	972	466	2369	1219	684	1197
16	2782	16386	3611	15	1568	3724	1998	1268	1428	699	2800	1302	1084	1842
17	9654	25262	7074	62	3282	5326	3028	1909	2072	1039	3270	2469	1703	2806
18	20833	37967	13534	229	7464	7294	4500	2855	2974	1520	3802	3502	2643	4226
19	21155	55469	25338	584	9075	9987	6507	4150	4175	2180	4378	4194	4027	6201
20	45306	165254	110239	2228	16432	13336	9537	5906	5898	3090	5436	8489	6045	8956
21	38288	99604	77733	23681	14202	17852	13384	8134	8809	4518	6933	7269	8763	12593
22	49389	58851	46327	24159	21736	16093	16274	12054	9343	6624	13274	17280	12516	18613
23	37489	43313	30667	19090	18781	24395	18420	13669	13960	7390	12101	18320	14232	18368
24	29387	40953	26507	15979	25139	35550	20435	16808	15083	10807	17535	20310	15021	20264
25	34356	38768	27386	17501	30052	37311	28048	20431	19274	17944	27014	28321	23783	25481
26	30141	30514	23233	18604	27098	30913	27591	21385	23088	19601	22684	21008	16516	16159
27	28276	28615	22259	16236	23098	30650	28048	22897	27098	19846	24670	21853	16066	14873
28	24925	26099	19136	19649	21914	33323	28594	21288	21696	16356	20234	16545	13600	14480
29	18703	20942	14241	16268	17235	25217	20989	16831	16199	16633	21287	12782	10017	12345
30	18407	17868	13693	12059	14965	20008	21602	16049	19338	20399	21688	16815	16674	14363
31	11419	13158	9038	11089	12476	14347	13510	11255	13392	14072	9836	8629	9354	10020
32	10185	12823	8410	8541	8635	12813	12739	11514	13697	14423	9643	9574	9826	9014
33	8528	8848	7128	10649	7273	9306	11382	7030	7124	8585	6341	6109	6027	6361
34	5926	7812	6967	10543	7987	7322	7360	6687	7588	6527	4819	6725	5924	5237
35	5763	5935	6214	7637	5425	5930	6309	5647	4678	6580	4738	6761	5274	4901
36	4033	5064	4532	6274	4979	4999	4609	4338	3709	4133	2568	5341	4294	3244
37	4024	3754	3545	4841	4541	4195	4089	3753	3496	4226	2135	4774	3231	2947
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3558	2589	2688
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2195	2186	2027
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3123	2353	1862
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1363	1020
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1053	761	534
44	965	704	1192	1401	1089	1050	745	500	915	414	219	769	708	413
45	641	581	1194	955	1058	766	684	550	700	464	253	904	429	421
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**476745**	**805376**	**527834**	**268762**	**323482**	**396340**	**327696**	**250666**	**261640**	**220716**	**262190**	**267245**	**221208**	**247714**
Weights	**6634**	**8760**	**6679**	**5411**	**5603**	**6628**	**5814**	**4610**	**4947**	**4465**	**4173**	**4882**	**4013**	**4087**

Table 10.3.h Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 2001-2013.

Removals=Landings+dead catches (discard survival rate : 30%)

CL mm/Y	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
10	665	888	19	0	0	0	16	0	58	0	0	0	0
11	939	1272	0	0	66	0	119	27	94	1	0	0	0
12	1323	1818	49	254	289	49	142	69	56	0	166	0	0
13	1858	2587	206	1205	760	164	85	164	124	68	417	372	0
14	2599	3663	445	2206	2233	797	630	272	204	58	584	466	160
15	3615	5148	839	3883	5101	2171	902	132	810	108	658	998	609
16	4988	7159	2370	4749	9469	5467	2072	719	1621	575	861	3181	919
17	6812	9819	4169	6193	10565	8158	2545	1282	2141	933	1701	3316	2925
18	9190	13226	5669	7112	13882	11302	3216	1851	3390	1616	2541	5646	2360
19	12186	17418	8055	12167	13692	18124	3671	4531	4540	2472	3183	5617	6116
20	16022	22430	8586	13522	15668	27825	6118	8087	8973	3998	5081	7122	6809
21	20521	28666	13298	18377	22957	38024	8123	11131	11813	5465	7281	8527	10848
22	36769	18385	15653	18546	25636	49040	12569	17519	13379	8434	10623	10058	15114
23	44635	39420	21514	20924	30617	49293	16909	19614	15659	9957	9797	9367	19403
24	33059	37486	22517	20604	31906	39608	21619	21468	18803	13113	11400	11821	18387
25	38397	28940	24412	24990	34834	39706	24243	22348	18185	14209	13385	11454	20349
26	21541	33574	25447	22402	31113	33545	24847	22508	18202	16796	11806	13298	20373
27	21536	25081	24390	20599	27955	26097	23835	17982	19191	20163	13209	14092	18733
28	17695	24964	22903	17791	25101	21831	20503	16765	19881	19579	11231	12563	15237
29	14607	17605	18619	16289	18868	17523	15641	15148	15738	17692	11061	11531	14899
30	16633	18718	18387	15474	16690	15495	14227	12072	15553	17049	10229	10111	10957
31	11475	10138	14274	13134	13626	12590	11619	10419	12135	13641	9126	8480	9783
32	11414	10367	11677	10836	10276	10108	9790	9163	9898	11867	7299	7554	7595
33	8283	7844	8472	8372	8007	8802	8197	7731	7556	9096	6361	6078	5814
34	6198	5323	6377	6568	6924	7400	6915	7142	6566	7332	5657	4606	4469
35	5218	4314	4776	4970	5282	5297	6714	5511	4801	6021	4663	3524	2946
36	4040	3160	3897	3384	3401	4155	4971	3921	3835	3665	4301	2651	2159
37	2902	2050	3133	2927	2770	3214	4048	3228	2696	3138	3753	2078	1563
38	2370	2225	2725	2120	2461	2731	2667	2463	2059	2258	3978	1611	1055
39	2298	1560	2184	1780	1753	1956	2246	2301	1529	1652	3489	1314	959
40	1908	1399	1962	1606	1654	1717	1744	1633	1237	1306	3313	1106	518
41	941	764	1447	1230	1168	1171	1255	1190	884	969	2740	878	438
42	863	632	1406	897	975	990	1125	1053	742	745	2607	635	351
43	530	641	1064	783	842	741	718	805	567	560	2160	561	320
44	383	432	810	715	640	633	746	706	483	514	1762	536	249
45	523	416	817	613	605	620	518	536	396	442	1181	478	177
46	294	328	535	485	415	479	373	405	307	310	1024	441	181
47	368	241	456	388	353	440	311	361	262	290	863	378	88
48	188	188	339	313	339	382	257	294	251	237	656	381	124
49	183	79	206	318	288	319	237	262	196	204	557	212	74
50	160	115	253	306	276	287	198	228	156	160	501	160	46
51	135	73	170	214	176	246	163	201	115	135	383	132	37
52	102	46	150	152	184	201	138	116	110	120	296	128	32
53	82	51	120	111	142	137	140	121	98	97	198	96	24
54	40	20	80	90	104	156	115	95	63	95	271	93	17
55	53	30	57	47	109	137	79	73	75	79	152	58	15
56	24	13	23	86	69	117	60	67	54	75	132	46	8
57	46	6	47	49	58	134	70	41	31	67	98	48	22
58	29	6	22	27	43	134	45	68	48	47	105	52	3
59	26	3	10	32	41	85	33	19	23	48	79	33	12
60	21	11	8	10	19	115	33	23	14	42	48	22	3
61	7	0	5	5	28	40	23	7	8	30	39	15	8
62	2	0	4	3	16	21	9	9	9	16	55	18	1
63	5	1	1	5	9	19	9	7	10	7	23	11	2
64	0	0	0	8	8	18	10	6	3	16	12	8	0
65	0	1	0	1	14	11	9	1	3	9	11	7	0
66	0	0	1	1	6	10	1	0	2	3	11	3	0
67	0	0	0	1	5	8	1	0	2	3	6	1	0
68	0	0	0	2	4	7	3	0	0	4	7	0	0
69	0	0	1	0	1	6	2	0	1	1	2	2	0
70	0	0	0	0	2	4	0	0	0	1	2	0	0
71	0	0	1	0	1	5	0	0	0	1	1	0	0
72	0	0	0	0	1	5	0	0	0	0	0	0	0
73	0	0	0	0	0	2	1	0	0	0	0	0	0
74	0	0	0	0	0	4	0	0	0	0	1	0	0
75	0	0	0	0	1	4	0	0	0	0	0	1	0
Total	**386702**	**410743**	**305060**	**309877**	**400500**	**469879**	**267624**	**253896**	**245640**	**217590**	**193133**	**183978**	**223293**
Weights	**5506**	**5513**	**5270**	**4923**	**5880**	**6627**	**4864**	**4517**	**4270**	**4290**	**4443**	**3229**	**3444**

Table 10.4. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Input data and parameters.

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	0.30	Gueguen and Charuau, 1975
MALES		
Growth - K	0.140	after Conan and Morizur, 1979 ; plus unpublished data
Growth - L(inf)	76	"
Natural mortality - M	0.3	Morizur, 1982
Size at maturity (knife-edged)	26.3 mm CL	unpublished data (WKNEPH 2006)
Length/weight - a	0.00039	Conan, 1978
Length/weight - b	3.180	"
FEMALES		
Immature Growth		
Growth - K	0.140	after Conan and Morizur, 1979 ;Verdois et al., 2001
Growth - L(inf)	76	"
Natural mortality - M	0.3	Morizur, 1982
Size at maturity	25 mm CL	Morizur, 1982
Mature Growth		
Growth - K	0.110	after Conan and Morizur, 1979 ;Verdois et al., 2001
Growth - L(inf)	56	"
Natural mortality - M	0.2	based on Morizur, 1982 ; assuming lower rate for mature females
Length/weight - a	0.00081	Conan, 1978
Length/weight - b	2.970	"

Table 10.5. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Age composition of the Removals

Table 1 Catch numbers at age Numbers*10**-3

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
AGE														
1	25573	88445	21713	211	10216	20512	10918	6961	7844	3844	17607	7670	5982	10127
2	259864	512688	344604	99768	133523	149786	110252	78001	73728	49191	82857	99003	80238	106636
3	127252	130442	96674	82961	102945	138297	118115	99427	108049	94113	99966	89911	73105	72251
4	42274	48505	37816	51213	46712	55336	51804	44057	43834	44866	42169	39688	35750	34911
5	12918	15385	13178	19558	17025	19606	19775	12973	17063	17325	11927	15353	15253	13588
6	4528	5170	6298	8334	7318	6820	8184	4337	6224	6198	4514	7294	5328	5232
7	1908	2145	3141	3654	2807	2647	3975	2130	2469	2787	1592	3862	2667	2307
8	936	1068	1463	1548	1324	1293	1917	1003	932	1019	757	1914	1266	1192
+gp	1493	1528	2948	1514	1611	2042	2756	1778	1497	1376	800	2550	1621	1470
0 TOTAL	476745	805376	527834	268762	323482	396340	327696	250666	261640	220717	262190	267245	221208	247714
TONSL	6634	8760	6679	5411	5603	6628	5814	4610	4947	4465	4173	4882	4013	4087
SOPC	101	102	100	100	100	99	100	100	100	101	101	100	101	100

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AGE													
1	27929	39737	11262	22461	36233	23117	8306	3699	7000	2646	5806	11485	5931
2	197366	192207	111159	126755	174554	258625	87844	99973	88777	55131	58622	64309	93517
3	95812	122382	106678	91306	123868	122494	102757	84444	87616	90439	59083	60854	86304
4	37510	38490	46787	39032	39169	40547	44633	40961	40786	45967	33392	27134	27094
5	15264	10558	17689	17075	14221	13085	13150	14108	12696	14320	19374	10307	5949
6	6460	4023	5841	6834	6416	5286	5302	5836	4830	4877	8178	4645	2335
7	2901	1401	2444	2986	2723	2769	2444	2221	1859	1870	3591	2419	976
8	1825	953	1368	1365	1329	1491	1241	1245	907	951	1842	1098	537
+gp	1636	993	1832	2063	1987	2466	1948	1410	1169	1389	3246	1727	651
0 TOTAL	386702	410743	305060	309877	400499	469879	267624	253896	245640	217590	193133	183978	223293
TONSL	5506	5513	5270	4923	5880	6627	4864	4517	4270	4290	4443	3229	3444
SOPC	99	100	99	100	100	100	100	100	100	100	100	100	100
1													

Table 10.6. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Removals weight at age

Table 2 Catch weights at age (kg)

	YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	AGE														
	1	0.004	0.003	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003	0.0036	0.003	0.003
	2	0.008	0.007	0.0075	0.009	0.009	0.009	0.009	0.009	0.009	0.0094	0.009	0.009	0.009	0.009
	3	0.0162	0.0169	0.0161	0.017	0.0163	0.0169	0.0163	0.017	0.017	0.0167	0.0163	0.0165	0.0165	0.0165
	4	0.0279	0.0267	0.028	0.0282	0.0268	0.0257	0.0251	0.0267	0.0261	0.0266	0.0241	0.027	0.0266	0.0262
	5	0.0421	0.0402	0.0393	0.0401	0.0397	0.0377	0.0333	0.0377	0.0363	0.0346	0.0305	0.0382	0.0362	0.0356
	6	0.0583	0.0526	0.0521	0.052	0.0513	0.0512	0.0433	0.0471	0.0485	0.0428	0.0388	0.0456	0.0453	0.0416
	7	0.0686	0.0607	0.0634	0.0661	0.064	0.0618	0.0497	0.0584	0.0621	0.0529	0.0477	0.048	0.0483	0.0503
	8	0.079	0.064	0.0688	0.0718	0.0732	0.0596	0.0586	0.0662	0.0764	0.0641	0.0523	0.0585	0.0534	0.0594
	+gp	0.0901	0.0869	0.0838	0.0722	0.0775	0.0814	0.0784	0.0812	0.0926	0.0793	0.0657	0.068	0.0607	0.0719
0	SOPC	1.0098	1.0216	1	0.9959	0.996	0.9946	1.0042	0.9984	0.9989	1.009	1.0053	1.0038	1.0068	0.9991

	YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	AGE													
	1	0.003	0.003	0.0036	0.003	0.0036	0.0035	0.0035	0.0036	0.0035	0.004	0.003	0.0036	0.004
	2	0.009	0.0085	0.009	0.0085	0.009	0.0085	0.0095	0.009	0.009	0.009	0.009	0.0085	0.009
	3	0.0166	0.0165	0.0169	0.0166	0.016	0.0165	0.0163	0.0163	0.017	0.0171	0.0167	0.017	0.0168
	4	0.0258	0.0256	0.0254	0.0252	0.0259	0.0269	0.027	0.0268	0.0259	0.0262	0.0277	0.0259	0.0261
	5	0.0336	0.0358	0.0352	0.0328	0.0351	0.0368	0.0379	0.037	0.0342	0.0339	0.0427	0.0337	0.0344
	6	0.041	0.0463	0.05	0.0429	0.0447	0.0476	0.0461	0.0453	0.0437	0.0446	0.0575	0.0467	0.044
	7	0.0497	0.0538	0.0584	0.057	0.0575	0.0592	0.0534	0.0607	0.0567	0.0573	0.069	0.0568	0.05
	8	0.0527	0.0533	0.0641	0.0653	0.0673	0.0705	0.0667	0.0676	0.0686	0.0693	0.0766	0.0649	0.055
	+gp	0.0736	0.0696	0.0714	0.0762	0.0836	0.1028	0.083	0.0859	0.087	0.0982	0.0885	0.0814	0.0732
0	SOPC	0.9908	0.9993	0.9927	1.0019	0.9973	0.9971	1.0006	1.0006	0.9968	1.0047	1.0029	0.9968	0.9966
	1													

Table 10.7. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b). Effort and LPUE values of commercial fleets used in the assessment to tune the model.
Sub-area VIII a,b

	Le Guilvinec District Quarter 2		
Year	Landings(t)	Effort(100h)	LPUE(Kg/h)
1987	603	437	13.8
1988	777	471	16.5
1989	862	664	13.0
1990	801	708	11.3
1991	717	728	9.8
1992	841	757	11.1
1993	805	735	11.0
1994	690	671	10.3
1995	609	627	9.7
1996	715	598	12.0
1997	638	539	11.8
1998	622	489	12.7
1999	505	423	11.9
2000	438	405	10.8
2001	697	417	16.7
2002	527	371	14.2
2003	487	355	13.7
2004	410	321	12.7
2005	455	335	13.6
2006	414	306	13.5
2007	401	291	13.8
2008	410	271	15.1
2009	384	279	13.8
2010	471	253	18.6
2011	422	279	15.1
2012	348	229	15.2
2013	288	224	12.8

Table 10.8. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Tune data

bay	of	biscay	TUNE	DATA	:	EFFORT	100HRS		
102									
FLEET	QGV	Q2							
1987	2013								
1	1	0.25	0.5						
1	9								
436.7	2038.3	23308.9	12847.9	5447.0	1854.7	669.1	311.0	143.5	166.3
470.6	28972.6	42380.8	17741.0	7344.1	2398.1	884.8	379.7	199.9	292.7
663.5	1727.3	29214.9	14998.7	6871.6	2902.0	1656.7	840.3	352.5	789.3
707.8	14.8	7011.7	11214.6	8866.1	3778.3	1833.2	796.4	362.7	370.8
728.2	582.7	14687.8	13389.3	8283.4	3342.9	1302.1	483.7	230.6	225.7
756.6	3125.8	18175.2	16982.2	8911.9	3913.1	1446.9	491.6	189.3	242.4
734.7	1267.1	11580.2	14507.3	7818.7	3727.3	1966.6	959.4	422.7	653.8
670.6	1240.4	8637.2	15300.1	8255.0	2373.7	941.4	429.7	233.5	445.1
626.9	1267.4	9566.6	13117.2	5886.3	2780.2	1123.7	459.8	160.7	292.5
597.9	202.9	3361.8	12308.4	8184.4	3957.1	1551.0	743.9	307.4	371.3
539.0	2142.0	10080.5	15595.2	8362.9	2857.5	1141.0	442.6	242.5	228.2
489.2	356.2	11080.9	11486.1	6575.5	2874.3	1431.5	789.4	426.4	527.2
422.9	321.8	7782.5	9902.4	5984.5	2805.5	973.0	546.9	250.7	253.2
405.2	546.4	12609.8	7990.1	5380.1	2441.3	991.4	381.9	231.9	255.5
417.1	756.6	16194.9	13633.8	8133.8	3818.8	1714.6	716.9	399.1	294.8
371.3	11536.0	34213.5	16231.3	5382.2	1874.6	698.8	249.9	217.3	181.6
355.4	327.4	8682.6	11086.4	6638.4	2801.6	875.2	408.3	218.9	301.6
321.5	1139.8	9987.1	8173.1	5144.0	2674.8	1108.2	496.3	220.1	301.7
335.3	1387.2	13899.7	10879.5	5223.3	2232.1	1109.6	462.8	196.6	292.4
306.3	1402.3	20375.5	13492.2	5326.3	1986.9	816.6	430.1	240.4	364.8
291.2	205.4	6519.2	11001.9	6020.5	1786.9	749.7	326.1	152.5	230.7
270.7	287.1	10365.2	10534.4	6389.4	2540.6	1040.0	323.5	175.5	170.0
278.8	474.1	6682.7	9893.1	5995.8	2090.1	808.9	302.6	146.2	178.8
253.0	227.7	6705.2	12069.1	7097.9	2492.7	849.4	284.1	151.6	190.3
279	291.4	5964.5	6823.3	4129.1	2483.8	1135.1	501.3	279.3	481.6
229.23	1196.2	5851.6	7587.8	4443.7	1745.2	719.3	344.3	150	236.5
224.46	431.7	5957.3	9329.1	3441.6	847.9	343.8	124.6	70.4	112.5
FLEET	LANGOLF								
2006	2013								
1	2	0.33333	0.41667						
1	9								
11676.7199	1364.7	19063	24106.3	10826.1	4139.9	1973.9	830.6	327.2	408.4
11676.7199	474.9	34898.9	61416.4	33569.6	12890.8	4532.6	1898.8	817.7	888.2
11676.7199	3664.6	32090.2	30703.4	24628.3	13440.8	6836.5	3324.2	1476.8	780.2
11676.7199	3997.7	26746	28962.7	18479.3	7874.9	4281.6	1818.5	969.7	914.6
11676.7199	1806.4	47527.6	53278.8	28579.6	10886.8	4975.3	2093.6	1108.3	657.3
11676.7199	1572.9	56044.7	56570.8	22607.3	7627.4	2863.3	878.3	292.8	149.6
11676.7199	3807.7	69756.7	86085.6	39205.8	12976.9	4403.2	1767	649.6	695.3
11676.7199	2487.9	34371.4	34787.7	13938.5	5244.9	2023.1	843.1	409.8	453.2

Table 10.9. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Separable analysis

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Separable analysis
from 1987 to 2013 on ages 1 to 8
with Terminal F of .400 on age 5 and Terminal S of 1.000

Initial sum of squared residuals was 305.962 and
final sum of squared residuals is 44.983 after 108 iterations

Matrix of Residuals

Years / Ages	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
1/ 2	-0.312	1.146	1.284	-3.728	0.068	1.129
2/ 3	0.852	1.674	1.74	0.175	0.184	0.473
3/ 4	0.277	0.4	0.136	-0.06	-0.014	0.333
4/ 5	-0.036	0.101	-0.186	0.111	-0.125	0.018
5/ 6	-0.075	-0.256	-0.338	0.047	-0.02	-0.073
6/ 7	-0.178	-0.587	-0.191	0.217	0.149	-0.334
7/ 8	-0.167	-0.518	0.148	0.32	0.082	-0.38
TOT	0	0	0	0	0	0
WTS	0.001	0.001	0.001	0.001	0.001	0.001

Years	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/**	2000/**	2001/**	2002/**
1/ 2	0.384	0.425	0.863	-0.65	1.186	0.238	-0.232	-0.057	0.445	1.806
2/ 3	-0.098	-0.059	-0.085	-0.796	0.326	0.368	0.249	0.482	0.322	0.915
3/ 4	-0.123	0.247	0.175	-0.14	0.515	0.129	0.047	0.186	-0.127	0.461
4/ 5	-0.114	0.024	-0.138	0.01	0.259	-0.202	-0.082	0.009	-0.153	-0.07
5/ 6	0.084	-0.136	0.005	0.086	-0.209	-0.043	0.073	-0.018	-0.026	-0.204
6/ 7	-0.012	-0.243	-0.135	0.167	-0.484	-0.028	-0.096	-0.106	0.24	-0.235
7/ 8	0.206	0.196	0.123	0.296	-0.652	0.261	0.051	-0.291	0.011	-0.536
TOT	0	0	0	0	0	0	0	0	0	0
WTS	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Years	2003/**	2004/**	2005/**	2006/**	2007/**	2008/**	2009/**	2010/**	2011/**	2012/**	TOT	WTS
1/ 2	0.293	0.639	0.684	1.264	0.194	-0.602	0.568	-0.13	0.093	0.064	0	0.105
2/ 3	0.374	0.164	0.453	0.984	0.192	0.192	0.119	0.365	-0.091	-0.594	0	0.192
3/ 4	0.323	0.115	0.338	0.199	0.216	-0.066	-0.046	0.595	-0.168	-0.319	0	0.463
4/ 5	-0.036	-0.087	-0.051	-0.053	0.087	0.013	-0.001	0.118	-0.149	0.019	0	1
5/ 6	-0.034	-0.056	-0.096	-0.215	-0.195	-0.03	-0.039	-0.13	0.167	0.034	0	0.901
6/ 7	-0.246	-0.045	-0.174	-0.278	-0.07	0.108	0.015	-0.32	0.03	0.169	0	0.51
7/ 8	-0.159	0.021	-0.235	-0.067	-0.088	0.04	-0.084	-0.442	0.179	0.309	0	0.382
TOT	0	0	0	0	0	0	0	0	0	0	13.124	
WTS	0.001	0.001	0.001	0.001	0.001	1	1	1	1	1		

Fishing Mortalities (F)

	1987	1988	1989	1990	1991	1992	1993
F-values	0.6941	0.7031	0.5827	0.6623	0.6934	0.7587	0.9003

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
F-values	0.6471	0.7264	0.7517	0.5714	0.7282	0.6632	0.6401	0.8311	0.6072	0.7145

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
F-values	0.7506	0.7725	0.763	0.7099	0.7184	0.6456	0.6095	0.8366	0.7031	0.4

Selection-at-age (S)

	1	2	3	4	5	6	7	8
S-values	0.0168	0.3742	0.8691	1.0823	1	0.9245	0.8721	1

1

Run title : bay of biscay M+F WG 2006 t0=0 9+

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Traditional vpa Terminal populations from weighted Separable populations

Fishing mortality residuals

YEAR	1987	1988	1989	1990	1991	1992	1993
AGE							
1	0.012	0.0907	0.0299	-0.0108	0.0051	0.0257	0.0071
2	0.3313	0.738	0.5989	0.0392	0.0794	0.1175	-0.0044
3	0.1267	0.1495	0.0615	-0.0569	-0.0049	0.1312	-0.0673
4	-0.0906	-0.0146	-0.0757	0.0137	-0.0772	0.0041	-0.1104
5	-0.1469	-0.1267	-0.0901	0.014	-0.0765	-0.0308	-0.0143
6	-0.1483	-0.1801	-0.0108	0.1105	-0.0158	-0.123	0.0175
7	-0.0576	-0.1221	0.1199	0.1479	0.0104	-0.1438	0.0886
8	-0.0083	0.0357	0.2198	0.1389	-0.0074	-0.0618	0.0805

Fishing mortality residuals

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE										
1	0.0044	0.0062	-0.0038	0.031	0.0068	0.0007	0.0039	0.0301	0.0696	0.0079
2	0.0011	-0.025	-0.1104	0.0818	0.1013	0.0656	0.0945	0.1752	0.3073	0.1061
3	0.0662	0.0595	-0.0226	0.1853	0.0382	0.0033	0.016	-0.0922	0.1865	0.1047
4	-0.0064	-0.1035	-0.0587	0.0844	-0.0985	-0.0478	-0.0373	-0.1795	-0.0539	-0.0564
5	-0.0605	-0.0369	-0.0649	-0.0822	-0.0798	0.0105	-0.0127	-0.099	-0.1245	-0.0449
6	-0.08	0.0031	-0.0721	-0.1244	0.007	-0.0894	-0.0393	-0.0104	-0.1035	-0.081
7	0.0331	0.0491	0.1481	-0.1606	0.1464	0.0341	-0.0755	0.0157	-0.1467	-0.0222
8	-0.0404	-0.1122	-0.0215	-0.0047	0.2204	0.0295	0.0228	0.1468	0.0163	0.1516
1										

Run title : bay of biscay M+F WG 2006 t0=0 9+

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Traditional vpa Terminal populations from weighted Separable populations

Fishing mortality residuals

YEAR	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AGE										
1	0.0222	0.0374	0.0369	0.0051	-0.0032	0.0128	-0.0026	-0.0032	0.0005	0
2	0.0807	0.1697	0.3879	0.0352	0.0548	0.099	0.0629	-0.0531	-0.0844	-0.0038
3	0.0169	0.1423	0.105	0.0849	-0.0398	0.0183	0.2484	-0.0841	-0.0926	0.0749
4	-0.1169	-0.0938	-0.0737	0.0095	-0.0426	-0.0224	0.0888	-0.0895	-0.0043	0.059
5	-0.0744	-0.1365	-0.1222	-0.0785	-0.0668	-0.0776	-0.0356	0.0816	-0.0075	-0.0131
6	-0.053	-0.0854	-0.1521	-0.0264	0.0307	-0.0778	-0.0889	0.0602	-0.0228	-0.0212
7	0.0668	-0.0579	-0.0023	-0.0421	0.0117	-0.0325	-0.1177	0.1145	0.0715	-0.0782
8	0.1347	0.1481	0.141	0.0671	-0.0066	-0.0132	0.0052	0.1871	0.0349	-0.0686

Table 10.10. Nephrops in Fus 23-24 Bay of Biscay (VIIIa,b) - XSA tuning diagnostics

Lowestoft VPA Version 3.1

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Extended Survivors Analysis

bay of biscay M+F WG 2006 t0=0 9+

CPUE data from file tuneff.dat

Catch data for 27 years. 1987 to 2013. Ages 1 to 9.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLEET□QGV	1987	2013	1	8	0.25	0.5
FLEET□LAN(	2006	2013	1	8	0.333	0.417

Time series weights :

Tapered time weighting applied
Power = 3 over 27 years

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 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = 1.000

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 26 iterations

1

Regression weights

0.893	0.924	0.949	0.967	0.981	0.99	0.996	0.999	1	1

Fishing mortalities

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	0.034	0.049	0.049	0.017	0.009	0.023	0.008	0.012	0.022	0.012
2	0.356	0.454	0.67	0.3	0.326	0.337	0.283	0.257	0.206	0.274
3	0.659	0.801	0.757	0.691	0.586	0.587	0.77	0.618	0.512	0.519
4	0.686	0.722	0.725	0.753	0.712	0.681	0.773	0.798	0.703	0.482
5	0.663	0.619	0.604	0.586	0.609	0.533	0.58	0.998	0.661	0.338
6	0.589	0.605	0.525	0.566	0.606	0.46	0.427	0.858	0.749	0.318
7	0.62	0.528	0.617	0.528	0.526	0.416	0.343	0.699	0.726	0.358
8	0.666	0.676	0.672	0.675	0.607	0.451	0.415	0.729	0.507	0.363

1

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8
2004	776000	491000	214000	89100	39900	17400	7320	3180
2005	873000	556000	255000	86400	34900	16000	7520	3070
2006	558000	616000	262000	89100	32700	14700	6820	3450
2007	574000	393000	233000	95600	33600	13900	6750	2870
2008	491000	418000	216000	91100	35000	14600	6150	3100
2009	359000	361000	223000	93600	34800	14800	6180	2830
2010	408000	260000	191000	96700	36900	15900	7300	3170
2011	548000	300000	145000	68800	34800	16100	8090	4030
2012	626000	401000	172000	60900	24100	9980	5310	3130
2013	5.66E+05	4.54E+05	2.42E+05	8.02E+04	2.35E+04	9.71E+03	3.67E+03	2.00E+03

Estimated population abundance at 1st Jan 2014

0.00E+00	4.14E+05	2.56E+05	1.12E+05	3.86E+04	1.30E+04	5.50E+03	2.00E+03

Taper weighted geometric mean of the VPA populations:

5.81E+05	4.21E+05	2.18E+05	8.80E+04	3.41E+04	1.44E+04	6.45E+03	2.96E+03

Standard error of the weighted Log(VPA populations) :

1	0.2348	0.2343	0.1663	0.1416	0.1575	0.1662	0.1993	0.1959

Log catchability residuals.

Fleet : FLEET□QGV□Q2□□□□□□□

Age	1987	1988	1989	1990	1991	1992	1993
1	0.11	2.91	0.21	-4.74	-1.08	0.7	-0.09
2	0.26	0.61	0.1	-1.17	-0.59	-0.36	-0.66
3	-0.27	-0.02	-0.51	-0.79	-0.73	-0.56	-0.63
4	-0.43	-0.22	-0.68	-0.52	-0.6	-0.56	-0.55
5	-0.52	-0.43	-0.57	-0.48	-0.57	-0.42	-0.3
6	-0.62	-0.52	-0.26	-0.17	-0.6	-0.51	0.06
7	-0.42	-0.58	-0.15	-0.18	-0.53	-0.77	0.09
8	-0.32	-0.16	-0.27	-0.15	-0.42	-0.46	0.09

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1	0.05	0.2	-1.6	0.86	-0.76	-0.95	-0.68	-0.3	2.77	-0.87
2	-0.82	-0.58	-1.54	-0.32	-0.08	-0.25	0.05	0.03	1.01	-0.12
3	-0.44	-0.52	-0.49	-0.14	-0.25	-0.19	-0.36	-0.05	0.13	-0.06
4	-0.46	-0.73	-0.29	-0.18	-0.29	-0.15	-0.22	0.18	-0.31	-0.07
5	-0.64	-0.54	-0.15	-0.33	-0.23	-0.08	-0.1	0.32	-0.3	-0.06
6	-0.52	-0.41	-0.11	-0.4	-0.06	-0.28	-0.18	0.48	-0.35	-0.22
7	-0.27	-0.34	0.17	-0.51	0.11	0.01	-0.46	0.26	-0.49	-0.14
8	-0.1	-0.14	0.25	0.07	0.32	0.07	0.04	0.37	-0.01	0.17

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	0.35	0.39	0.94	-0.97	-0.41	0.38	-0.39	-0.53	0.94	0.04
2	-0.05	0.15	0.6	-0.17	0.31	-0.01	0.4	0.03	-0.1	-0.16
3	-0.19	-0.07	0.19	0.13	0.2	0.07	0.59	0.14	0.24	0.13
4	-0.08	-0.06	0.02	0.13	0.3	0.17	0.44	0.14	0.5	-0.09
5	0.07	-0.04	0	-0.09	0.3	0.05	0.28	0.4	0.48	-0.31
6	0.05	0.1	-0.06	-0.03	0.34	-0.01	0.05	0.4	0.57	-0.28
7	0.13	-0.05	0.1	-0.15	0.01	-0.13	-0.29	0.21	0.46	-0.31
8	0.16	0.05	0.22	0	0.11	-0.07	-0.06	0.33	0.07	-0.27

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

Age	1	2	3	4	5	6	7	8
Mean Log q	-12.5186	-9.3754	-8.5064	-8.1995	-8.203	-8.2651	-8.2651	-8.2651
S.E(Log q)	0.9888	0.457	0.2841	0.291	0.2872	0.3033	0.2859	0.1933

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	0.86	0.15	12.63	0.07	27	0.88	-12.52
2	0.69	0.892	10.49	0.37	27	0.32	-9.38
3	1.79	-1.007	5.5	0.1	27	0.51	-8.51
4	******	-2.098	******	0	27	177.18	-8.2
5	1.31	-0.496	7.5	0.15	27	0.39	-8.2
6	1.26	-0.432	7.92	0.16	27	0.39	-8.27
7	0.77	0.807	8.43	0.48	27	0.22	-8.34
8	0.61	3.802	8.12	0.87	27	0.08	-8.19
1							

Fleet : FLEET□LANGOLF□□□□□□□

Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	99.99	99.99	-0.47	-1.57	0.63	1.04	0.11	-0.32	0.43	0.1
2	99.99	99.99	-1.01	-0.09	-0.23	-0.26	0.62	0.63	0.54	-0.26
3	99.99	99.99	-0.77	0.25	-0.4	-0.49	0.34	0.62	0.83	-0.41
4	99.99	99.99	-0.78	0.29	0.02	-0.31	0.13	0.24	0.88	-0.51
5	99.99	99.99	-0.78	0.32	0.33	-0.23	0.05	-0.09	0.68	-0.31
6	99.99	99.99	-0.72	0.18	0.56	0.02	0.08	-0.32	0.55	-0.36
7	99.99	99.99	-0.79	0.02	0.67	0.02	-0.03	-0.87	0.26	-0.25
8	99.99	99.99	-1.02	0.08	0.57	0.18	0.19	-1.26	-0.3	-0.36

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

Age	1	2	3	4	5	6	7	8
Mean Log q	-14.7778	-11.4679	-10.6005	-10.33	-10.3292	-10.3579	-10.3579	-10.3579
S.E(Log q)	0.7944	0.5709	0.5885	0.5205	0.4533	0.4463	0.5279	0.6813

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
1	-0.84	-1.498	11.75	0.1	8	0.62	-14.78
2	-1.13	-4.038	14.45	0.38	8	0.36	-11.47
3	-0.67	-3.643	13.33	0.45	8	0.23	-10.6
4	-1.6	-1.535	12.93	0.06	8	0.76	-10.33
5	1.65	-0.378	10.31	0.05	8	0.8	-10.33
6	1.53	-0.384	10.81	0.08	8	0.73	-10.36
7	2.3	-0.678	12.76	0.04	8	1.22	-10.48
8	-4.33	-1.04	-3.17	0.01	8	2.72	-10.6
1							

Terminal year survivor and F summaries :

Terminal year survivor and F summaries :

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

Year class = 2012

Fleet	Est Sur	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEET□QGV	432450	1.019	0	0	1	0.285	0.012
FLEET□LAN	458847	0.843	0	0	1	0.416	0.011
F shrinkage	344765	1				0.299	0.015

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
414164	0.54	0.1	3	0.189	0.012

1
Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 2011

Fleet	Est Sur	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEET□QGV	264359	0.428	0.416	0.97	2	0.502	0.266
FLEET□LAN	248149	0.492	0.328	0.67	2	0.377	0.281
F shrinkage	244665	1				0.121	0.284

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
255716	0.31	0.18	5	0.581	0.274

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

Year class = 2010

Fleet	Est Sur	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEET□QGV	116579	0.247	0.114	0.46	3	0.672	0.503
FLEET□LAN	107846	0.389	0.319	0.82	3	0.255	0.534
F shrinkage	88322	1				0.073	0.622

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
112005	0.21	0.11	7	0.543	0.519

1
Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 2009

Fleet	Est Sur	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEET□QGV	39462	0.199	0.092	0.46	4	0.709	0.474
FLEET□LAN	41329	0.336	0.344	1.03	4	0.234	0.457
F shrinkage	21710	1				0.057	0.743

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
38566	0.17	0.12	9	0.725	0.482

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

Year class = 2008

Fleet	Est Sur	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEET□QGV	13133	0.186	0.181	0.97	5	0.7	0.336
FLEET□LAN	15149	0.314	0.277	0.88	5	0.252	0.298

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

Year class = 2007

Fleet	Esti Sur	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEET□QGV	5771	0.185	0.159	0.86	6	0.682	0.305
FLEET□LAN	5640	0.301	0.209	0.7	6	0.272	0.311
F shrinkage	2362	1				0.046	0.627

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
5502	0.16	0.12	13	0.783	0.318

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

Year class = 2006

Fleet	Esti Sur	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEET□QGV	2061	0.191	0.164	0.86	7	0.709	0.349
FLEET□LAN	2056	0.318	0.158	0.5	7	0.239	0.35
F shrinkage	1181	1				0.052	0.548

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2001	0.16	0.11	15	0.663	0.358

1

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 2005

Fleet	Esti Sur	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEET□QGV	1130	0.181	0.127	0.7	8	0.759	0.35
FLEET□LAN	953	0.327	0.105	0.32	8	0.189	0.403
F shrinkage	943	1				0.052	0.407

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1084	0.16	0.08	17	0.511	0.363

1

FLEET□QGV□Q2□□□□□□□

CPUE adjusted to start of year

YEAR	AGE 1	2	3	4	5	6	7	8
1987	5.267578	74.4344	42.49872	17.55914	5.700369	1.983435	0.9389031	0.4482539
1988	71.54044	146.6344	54.99136	22.75855	6.961819	2.448285	1.033108	0.5849051
1989	2.955614	66.94457	30.69397	13.99104	5.807359	3.357528	1.740363	0.7272134
1990	0.02339709	12.32735	21.13614	18.11263	7.555396	3.796489	1.647225	0.7411969
1991	0.9007966	25.57966	25.20054	16.11975	6.375264	2.487027	0.9496822	0.4653776
1992	4.688424	31.18672	33.03605	17.57581	7.525181	2.627737	0.869534	0.3901677
1993	1.945464	19.94786	28.26347	16.0851	7.747051	4.156527	2.050781	0.934402
1994	2.08109	15.76671	31.63169	17.46551	4.817985	1.867674	0.921273	0.5045325
1995	2.277234	18.69843	29.68443	13.27581	6.270366	2.512007	1.036808	0.3947407
1996	0.380908	6.697555	28.51334	19.87804	9.362123	3.567587	1.812672	0.7388079
1997	4.512944	23.34036	40.79914	22.02238	6.966851	2.693324	1.016054	0.5966938
1998	0.8203437	29.08493	33.04365	18.94377	8.140301	4.117479	2.350257	1.324132
1999	0.8550263	23.10916	31.80008	19.87877	9.236979	3.030931	1.767744	0.829706
2000	1.516941	39.37957	26.70697	18.49301	8.311215	3.236619	1.215547	0.7904481
2001	2.062881	52.02761	45.24312	27.80356	13.03135	5.914147	2.376821	1.411522
2002	35.79101	125.6671	62.52015	19.81325	6.575924	2.414167	0.842842	0.7596893
2003	1.038185	31.35999	44.78716	26.70885	10.98434	3.297808	1.529678	0.8957936
2004	4.017676	39.69288	35.67462	22.6784	11.69135	4.712722	2.135428	0.9632035
2005	4.714353	54.91144	47.9738	22.36725	9.200854	4.550202	1.844759	0.8276858
2006	5.217855	95.46811	64.08765	25.0085	8.920687	3.560344	1.939811	1.106499
2007	0.7943121	28.0182	53.64845	30.04544	8.383202	3.490057	1.497079	0.7392295
2008	1.190403	48.36359	53.1397	33.77318	12.92741	5.285464	1.595937	0.8921673
2009	1.918744	30.39921	48.4838	30.42149	10.03857	3.781352	1.391828	0.6811212
2010	1.009815	32.94927	69.7397	41.06606	13.42574	4.321897	1.401404	0.768021
2011	1.173953	26.32562	33.80428	21.85919	14.15815	6.145689	2.558876	1.441728
2012	5.885492	30.84364	43.99135	27.64519	10.69078	4.55246	2.160652	0.8677516
2013	2.161653	32.8825	55.36544	20.15109	4.70559	1.893736	0.6966301	0.3942418
1								

FLEET□LANGOLF□□□□□□□

CPUE adjusted to start of year

YEAR	AGE 1	2	3	4	5	6	7	8
2006	0.1332277	2.347846	3.010397	1.336206	0.4883479	0.2260453	0.09842835	0.03957919
2007	0.04580257	3.742965	7.48271	4.186967	1.510388	0.5269346	0.2176593	0.09902812
2008	0.3523569	3.474612	3.596642	3.024654	1.588333	0.8068992	0.3807438	0.1743524
2009	0.386425	2.907902	3.394775	2.24333	0.9044179	0.4784849	0.1999307	0.1079969
2010	0.1736082	5.064118	6.686318	3.591234	1.272457	0.5490652	0.223935	0.121775
2011	0.1514411	5.914725	6.708272	2.866905	1.042591	0.3714678	0.1073453	0.03619348
2012	0.3678716	7.222459	9.811079	4.798306	1.563578	0.5483505	0.2181688	0.07387135
2013	0.2395262	3.649736	3.974082	1.570765	0.55998	0.2143747	0.09068868	0.04415269
1								

Table 10.11. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b). Estimates of Fishimg mortality at age

Run title : bay of biscay M+F WG 2012 t0=0 9+

At 7/05/2014 17:29

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE													
1	0.0232	0.1016	0.0393	0.0003	0.0165	0.0381	0.022	0.015	0.0181	0.0087	0.0399	0.0187	0.0116
2	0.5924	1.0119	0.826	0.2854	0.3364	0.3994	0.3308	0.2413	0.2439	0.168	0.2932	0.3698	0.3099
3	0.7375	0.7639	0.5703	0.5226	0.5956	0.7882	0.7128	0.6266	0.6887	0.624	0.6723	0.6671	0.5709
4	0.6679	0.7633	0.5566	0.7402	0.6857	0.8253	0.8601	0.689	0.6796	0.7518	0.69	0.6709	0.6621
5	0.5391	0.5869	0.51	0.6824	0.6311	0.7571	0.8879	0.5769	0.6796	0.6809	0.4822	0.6247	0.6382
6	0.4417	0.4576	0.5441	0.7771	0.6353	0.6025	0.9333	0.5154	0.6557	0.6048	0.3951	0.6666	0.4888
7	0.4909	0.4122	0.6027	0.7737	0.7097	0.5312	0.9639	0.7248	0.679	0.7606	0.3202	0.7598	0.5885
8	0.5829	0.6081	0.5921	0.7411	0.784	0.9448	1.055	0.7459	0.9106	0.7234	0.5069	0.8738	0.6522
+gp	0.5829	0.6081	0.5921	0.7411	0.784	0.9448	1.055	0.7459	0.9106	0.7234	0.5069	0.8738	0.6522
0 FBAR 2- 5	0.6342	0.7815	0.6158	0.5577	0.5622	0.6925	0.6979	0.5335	0.573	0.5562	0.5344	0.5831	0.5453

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AGE													
1	0.0435	0.0786	0.0195	0.0342	0.0494	0.0493	0.017	0.0088	0.0229	0.0076	0.0124	0.0215	0.0122
2	0.4844	0.5325	0.3691	0.3565	0.4539	0.6696	0.3003	0.3257	0.3367	0.2828	0.2573	0.2063	0.2737
3	0.6219	0.7108	0.7211	0.6591	0.8008	0.7566	0.6907	0.5858	0.5874	0.7698	0.6184	0.5125	0.5188
4	0.7019	0.5885	0.7101	0.6861	0.7215	0.7253	0.7533	0.712	0.6811	0.7732	0.7977	0.7028	0.4824
5	0.6973	0.4585	0.6403	0.6629	0.6186	0.6044	0.5864	0.6092	0.533	0.5799	0.998	0.661	0.3382
6	0.7263	0.4174	0.5331	0.5888	0.6046	0.5253	0.5655	0.6059	0.4601	0.4265	0.8585	0.7492	0.3181
7	0.6194	0.3527	0.5176	0.6204	0.5281	0.6167	0.5279	0.5258	0.4165	0.3431	0.6991	0.7263	0.3581
8	0.7941	0.4494	0.756	0.6661	0.6756	0.6715	0.6747	0.6067	0.4509	0.4148	0.7294	0.5066	0.3625
+gp	0.7941	0.4494	0.756	0.6661	0.6756	0.6715	0.6747	0.6067	0.4509	0.4148	0.7294	0.5066	0.3625
0 FBAR 2- 5	0.6264	0.5726	0.6101	0.5911	0.6487	0.689	0.5827	0.5582	0.5346	0.6014	0.6679	0.5207	0.4033
1													

Table 10.12. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Estimates of stocks number at age

Run title : bay of biscay M+F WG 2012 t0=0 9+

At 7/05/2014 17:29

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE													
1	1292981	1064041	655345	733274	725238	637670	583182	542325	507938	515776	522716	481094	601403
2	675438	935853	712135	466803	543041	528476	454743	422635	395773	369538	378788	372082	349801
3	276393	276710	252022	230960	259945	287370	262582	241987	245959	229738	231422	209297	190433
4	98323	102955	100387	110960	106659	111597	101757	100263	100716	96201	95866	92012	83655
5	35124	39268	37377	44808	41221	41843	38078	33531	39205	39754	35327	37446	36634
6	14370	15955	17005	17480	17637	17078	15285	12204	14666	15475	15671	16987	15614
7	5573	7195	7863	7686	6258	7277	7282	4681	5677	5929	6582	8221	6793
8	2401	2657	3711	3352	2761	2397	3332	2163	1766	2242	2158	3722	2995
+gp	3774	3743	7366	3221	3297	3704	4677	3764	2778	2975	2251	4860	3772
0 TOTAL	2404377	2448375	1793210	1618544	1706057	1637412	1470918	1363553	1314478	1277628	1290781	1225721	1291100

YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
AGE													
1	611060	676024	776371	873063	557899	573664	491330	359092	408347	547844	625951	565952	0
2	540895	418482	491118	555817	615595	393404	417831	360802	259997	300233	400856	453831	414164
3	272574	235271	214344	254730	261519	233444	215833	223490	190878	145159	171962	241610	255716
4	98044	104280	89087	86354	89071	95571	91124	93569	96733	68844	60910	80220	112005
5	32529	42389	39924	34935	32686	33586	35042	34819	36878	34770	24147	23491	38566
6	13360	16017	17402	16024	14657	13909	14552	14840	15913	16083	9981	9710	13045
7	5341	6854	7319	7522	6818	6751	6153	6183	7295	8090	5308	3675	5502
8	2985	2923	3181	3065	3455	2866	3101	2833	3175	4032	3131	2000	2001
+gp	3070	3844	4729	4510	5620	4424	3459	3606	4584	6979	4860	2402	2386
0 TOTAL	1579857	1506084	1643474	1836020	1587320	1357619	1278425	1099235	1023801	1132034	1307106	1382891	843384
1													

Table 10.13.Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b). Summary of Catches and XSA results

Run title : bay of biscay M+F WG 2012 t0=0 9+

Table 16 Summary (without SOP correction)

	RECR Age 1	TOTALBIO	TOTSPBIO	REMOVALS	LANDINGS	DISCARDS	YIELD/SSE	FBAR 2- 5
1987	1292981	21025	9330	6634	5397	1767	0.7110	0.6342
1988	1064041	20518	9606	8760	5875	4122	0.9120	0.7815
1989	655345	18557	9580	6679	4835	2634	0.6972	0.6158
1990	733274	17877	9761	5411	4972	628	0.5543	0.5577
1991	725238	18283	9436	5603	4754	1213	0.5938	0.5622
1992	637670	17740	9856	6628	5681	1354	0.6725	0.6925
1993	583182	15530	8618	5814	5109	1007	0.6746	0.6979
1994	542325	14783	8324	4610	4092	740	0.5539	0.5335
1995	507938	14775	8644	4947	4452	707	0.5723	0.5730
1996	515776	14148	8168	4465	4118	495	0.5467	0.5562
1997	522716	13320	7400	4173	3610	804	0.5640	0.5344
1998	481094	14166	8222	4882	3865	1453	0.5938	0.5831
1999	601403	13070	7332	4013	3209	1148	0.5473	0.5453
2000	817960	14378	7177	4087	3069	1455	0.5695	0.5364
2001	762582	16265	7629	5506	3730	2538	0.7217	0.6264
2002	611060	15881	8326	5513	3679	2620	0.6622	0.5726
2003	676024	15980	8786	5270	3886	1978	0.5998	0.6101
2004	776371	15348	7955	4923	3571	1931	0.6189	0.5911
2005	873063	17416	8252	5880	3991	2699	0.7126	0.6487
2006	557899	17022	8758	6627	3447	4543	0.7567	0.6890
2007	573664	14964	8267	4864	3176	2411	0.5884	0.5827
2008	491330	14325	7917	4517	3030	2124	0.5705	0.5582
2009	359092	13425	7971	4270	2987	1833	0.5357	0.5346
2010	408347	12820	8030	4290	3398	1275	0.5342	0.6014
2011	547844	12571	7619	4443	3559	1263	0.5831	0.6679
2012	625951	12342	5950	3229	2520	1013	0.5426	0.5207
2013	565952	14206	6843	3444	2380	1520	0.5033	0.4033
Arith. Mean	648523	15583	8287	5166	3940	1751	0.6182	0.5930
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)		

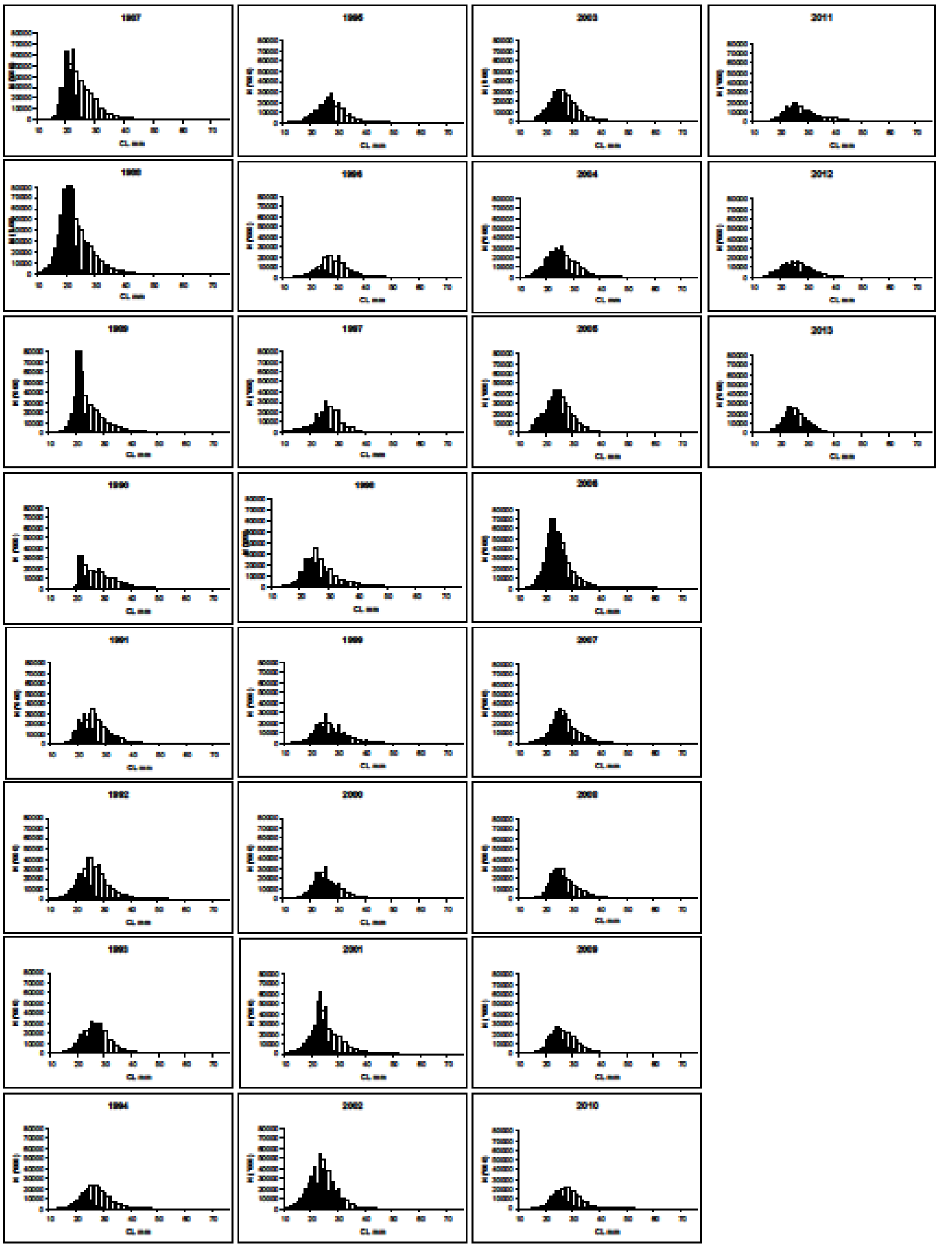
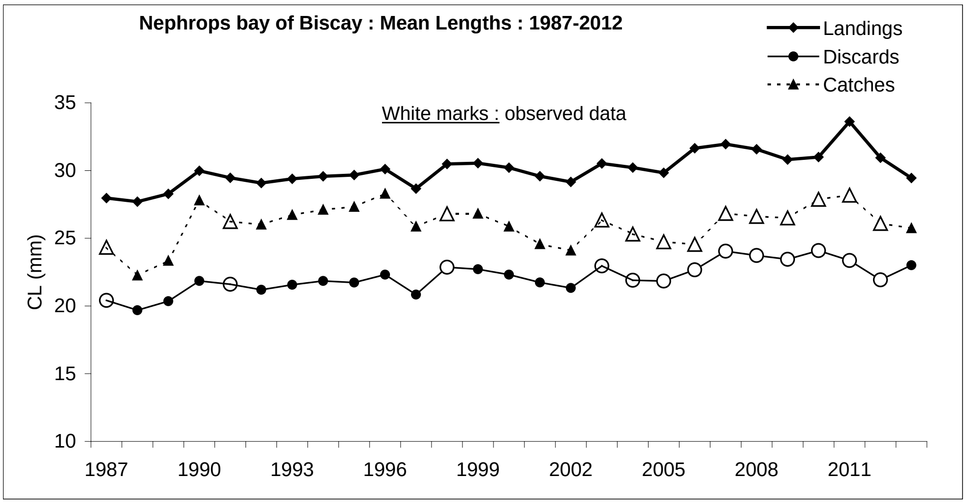


Figure 10.1. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) catches (landings in white and discards in black) length distributions in 1987-2013.

Figure 10.2. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - mean length of landings, discards and catches



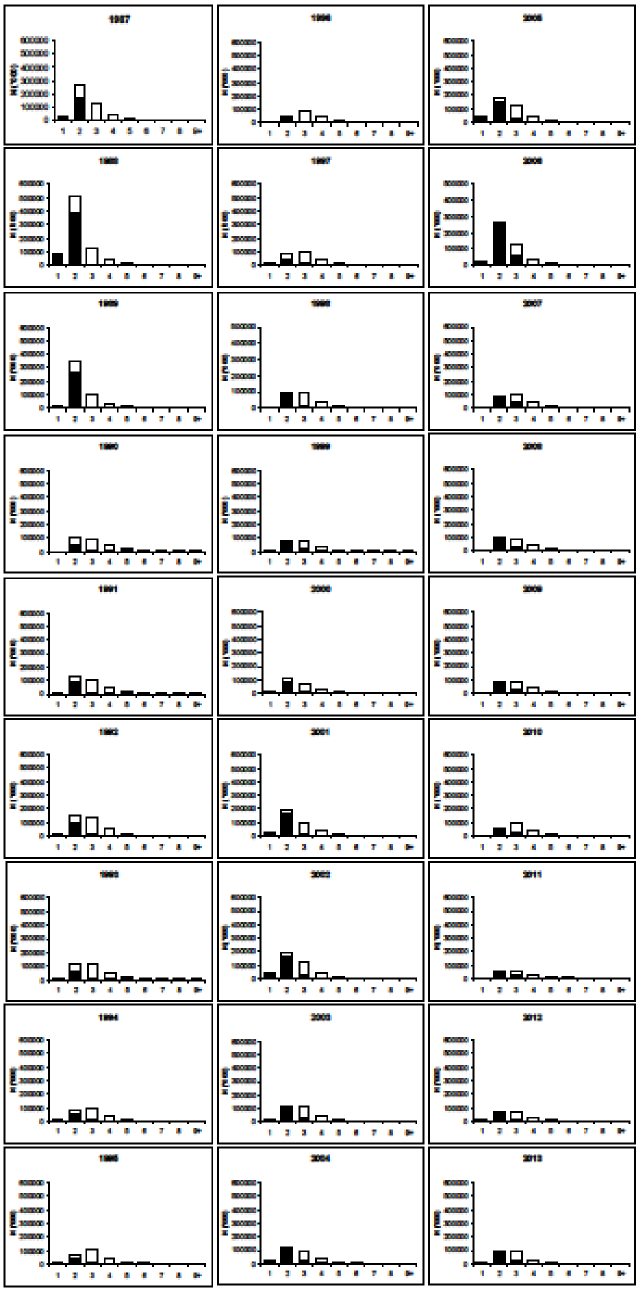
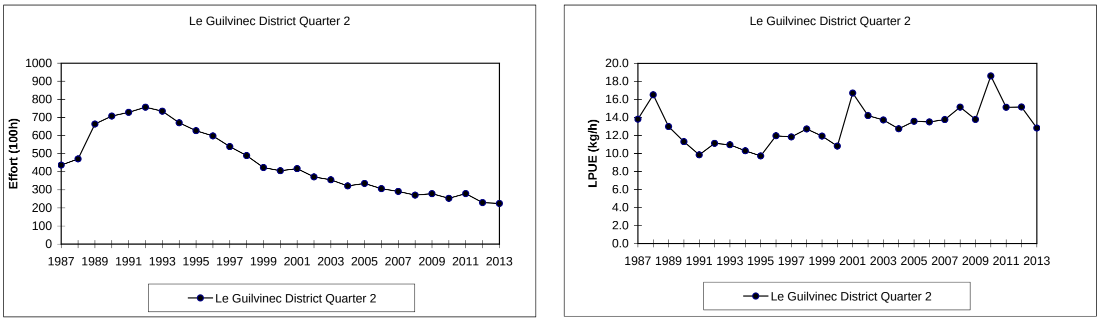


Figure 10.3 Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) catches (landings in white and dead discards in black; mortality of discard age distributions in 1987-2013.

Figure 10.4. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - Effort and LPUE values of commercial fleets used in the assessment to tune the model.

I. Effort **II. LPUE**



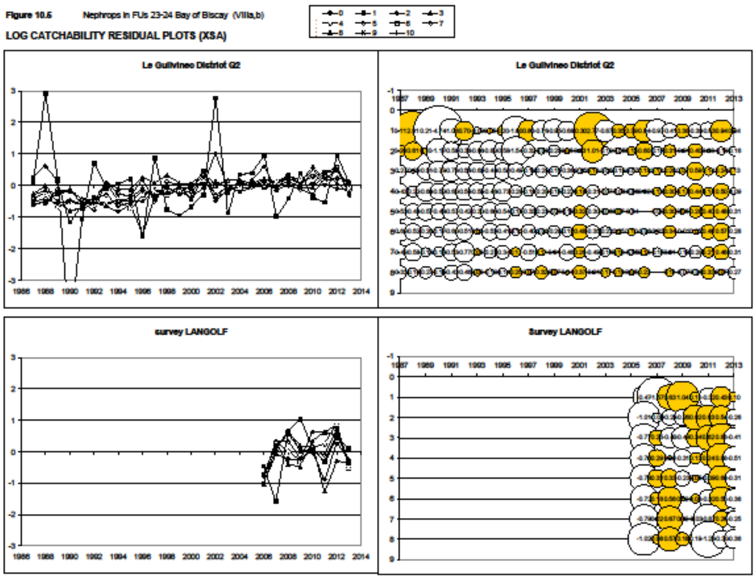


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Figure 10.6. Retrospective analysis (Nephrops Bay of Biscay FU 23-24)

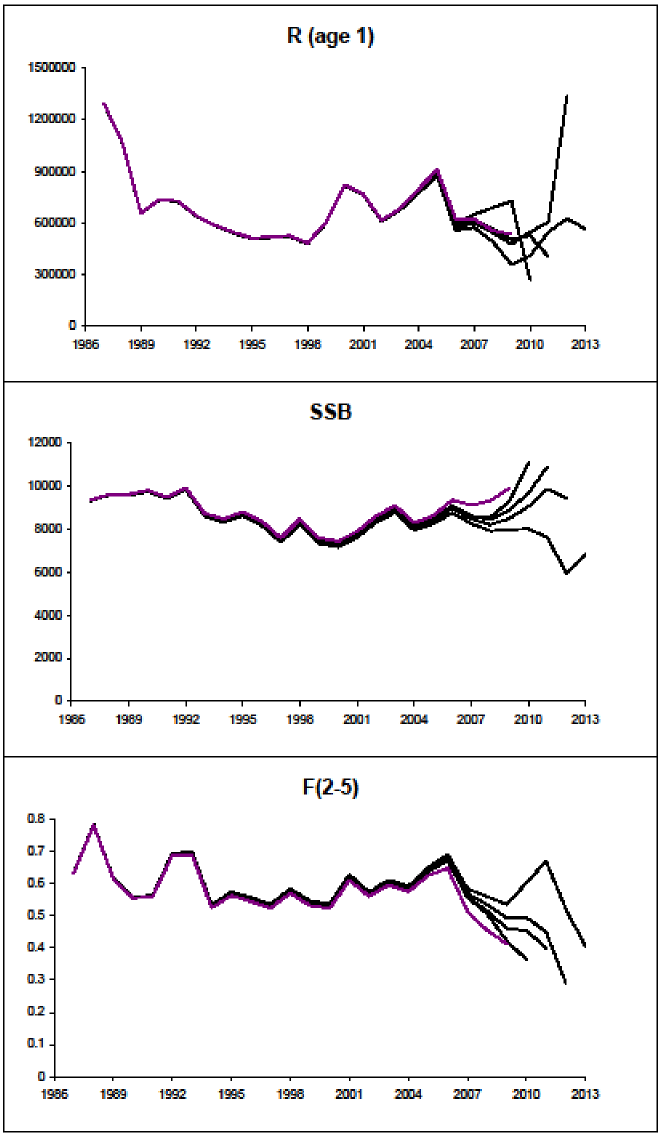
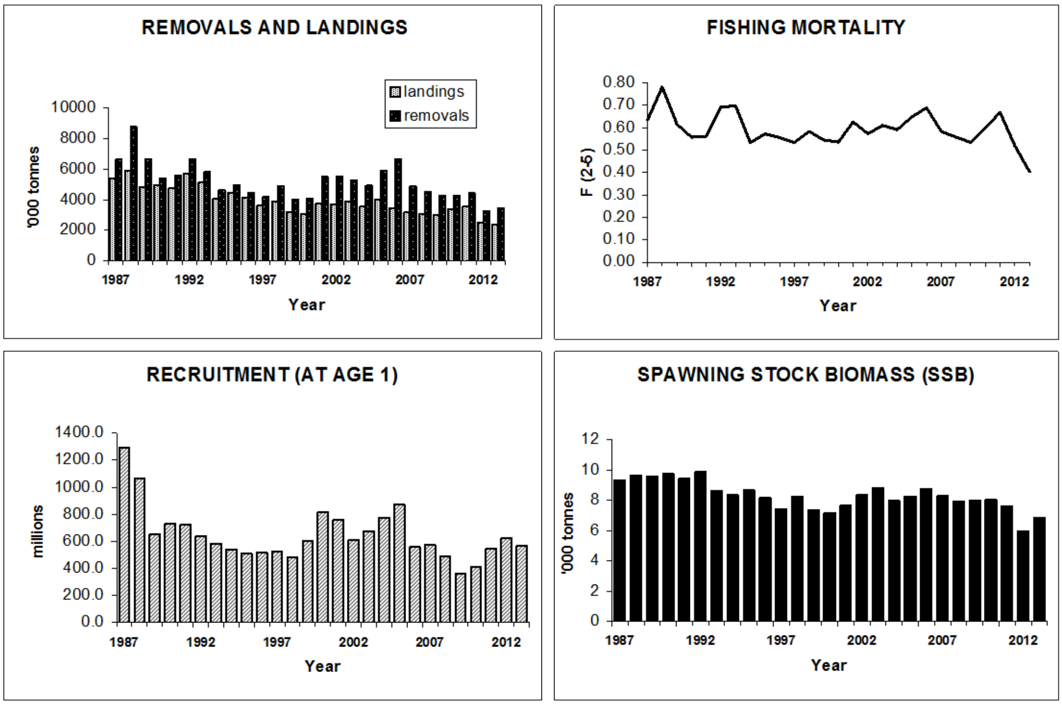


Figure 10.7. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Historical trends in biomass, fishing mortality and recruitment



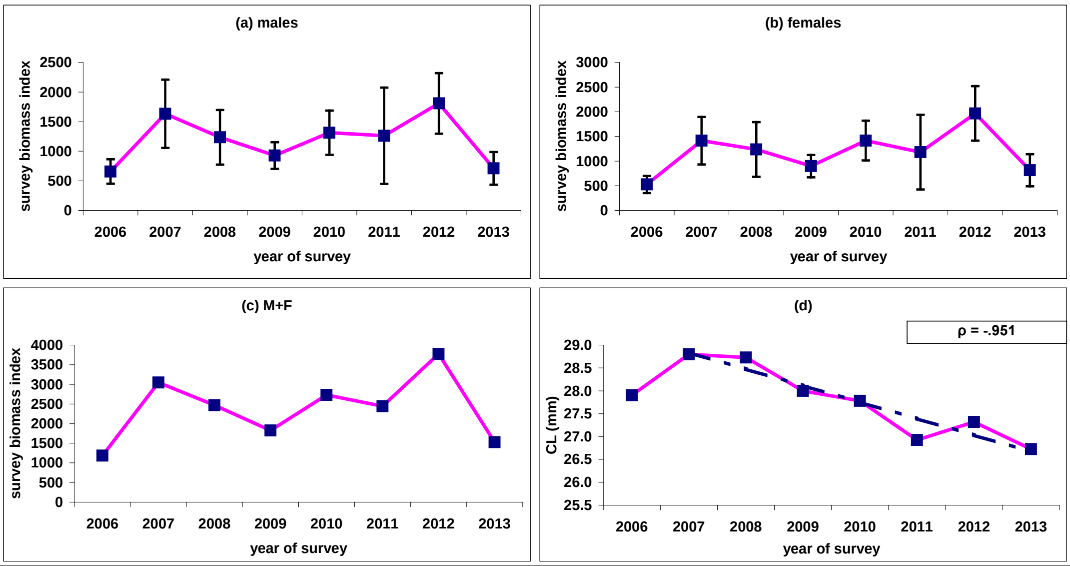


Figure 10.8. Biomass survey LANGOLF indices (a) males; (b) females, (c) sex combined, (d) mean sizes (CL, mm) sex combined.

11 *Nephrops* in Division VIIIc

The ICES Division VIIIc includes two *Nephrops* Functional Units: FU 25, North Galicia and FU 31, Cantabrian Sea.

11.1 *Nephrops* FU 25 (North Galicia)

11.1.1 General

11.1.1.1 Ecosystem aspects

See Annex K

11.1.1.2 Fishery description

See Annex K

11.1.1.3 Summary of ICES Advice for 2013 and management applicable to 2013 and 2014

ICES advice for 2013

The advice for these *Nephrops* stocks is biennial and valid for 2013 and 2014.

ICES advises on the basis of the precautionary considerations that catches should be zero.

To protect the stock in this Functional Unit, management should be implemented at the Functional Unit level.

Management applicable to 2013 and 2014

A recovery plan for southern hake and Iberian *Nephrops* stocks has been in force since the end of January 2006. The aim of the recovery plan is to rebuild the stocks within 10 years, with a reduction of 10% in F relatively to the previous year and the TAC set accordingly (Council Regulation (EC) No. 2166/2005). TACs of 74 t and 67 t were set for the whole of Division VIIIc for 2013 and 2014, respectively.

11.1.2 Data

11.1.2.1 Commercial catches and discards

In previous years landings have been estimated by the WG based on IEO scientific estimations. The information was compiled by IEO from sale sheets and Owners Associations where the *Nephrops* landings allocation was carried out based on landing port criteria. Since 2011, the Spanish Authority for Fisheries (Secretaría General de Pesca, SGP) who is also the National authority for the Data Collection Framework, established a new policy and general approach in the provision of official data on catches and fishing effort. So, *Nephrops* landings since 2011 are official landings.

Unlike the IEO scientific estimates, official landings are derived from logbooks. This source of information allows the landings disaggregation by ICES statistical rectangles. *Nephrops* catches recorded into statistical rectangles outside of the FUs in Division VIIIc were allocated to the closest rectangles in each FU. At the moment it is not possible to quantify the impact this allocation may have on the estimation of landings by FU. This issue will be further investigated in the near future.

Landings were reported only by Spain. Since the early 90s landings declined from about 400 t to less than 100 t in 2003. In the period 2004-2012, landings show a continuous decreasing trend up to 10 t in the last year (Table 11.1.1). The time series of the commercial landings (Figure 11.1.1) shows a clear declining trend, with present values representing approximately 1% of the landings in the 70s. Discards in this functional unit remain insignificant.

11.1.2.2 Biological sampling

Length frequencies by sex of the *Nephrops* landings are collected as a rule on a monthly basis. The sampling levels are showed in Table 1.3.

Annual length compositions for males and females combined, mean size and mean weight in the landings are given in Table 11.1.2 for the period 1981-2013 (see also Figure 11.1.2).

Mean sizes in the landings shows a decreasing trend in the time series. In the last decade, 2003-2013, mean size ranged between 39.4 and 48.5 mm CL for males and between 33.2 and 45.1 mm CL for females. The maximum value was recorder in 2009, reaching 48.5 and 45.1 mm CL for males and females, respectively. However, a slight reduction of the mean size was observed from 2010 to 2012 (Figure 11.1.1). In 2013, the mean size in females went down to 33.2 mm but it increases in males, reaching 42.1 mm of carapace length. Since 1982, several regulations were applied to the bottom trawl fishery (i.e. closed areas, fishing plans, changes in mesh sizes from 40 mm to the 70 mm, etc.), but discarding practices and fishing grounds for *Nephrops* remain basically unchanged. This suggests that the overall increasing trend of mean sizes may reflect a continuous low level of recruitment during the last period of the series.

11.1.2.3 Commercial catch-effort data

Fishing effort and LPUE data were available for the A Coruña trawl fleet (SP-CORUTR8c) for the period 1986-2013 (Table 11.1.3 and Figure 11.1.1).The long time series of effort (1975-2013) (Figure 11.1.1) shows a continuous decreasing trend. The lowest effort was observed in 2011, representing approximately 15% of fishing effort in the 70's. In 2012 and 2013, effort increased slightly but it remains at very low level. Effort of the bottom trawl in this fishery is directed primarily at a set of demersal and bottom species, with *Nephrops* making only a small contribution to the whole landings.

The overall trend of LPUE is declining too(Figure 11.1.1). 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 and further declined, mainly in 2008 and 2009 when the lowest values of the time series were recorded (9.9 kg/trip and 7.3 kg/trip, respectively). In 2010 and 2011, the LPUE increases but it decreased again in 2012 and 2013. LPUE in 2013 is the lowest value recorded in the time series (4.4 Kg/trip).

11.1.3 Assessment

According to the ICES data-limited approach, this stock is considered as category 3.1.4 (ICES, 2012). FU 25 is assessed by the analysis of the LPUE series trend, as was done in 2012. The results in this year indicate an extremely low abundance level.

11.1.4 Biological reference points

There are no reference points defined for this stock.

11.1.5 Management Considerations

Nephrops is taken as by catch in the mixed bottom fishery. The overall trend in landings of *Nephrops* from the North Galicia (FU25) is strongly declining. Landings have dramatically decreased since the beginning of the series (1975-2013), representing less 1% of the landings.

Nephrops is managed by TAC and technical measures. The TAC for the whole of Division VIIIc was 74 t in 2013 and 67 t in 2014. Landings of *Nephrops* from Division VIIIc (FU 25 and FU 31) in 2013 were 20 t, less than 30% of the TAC.

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).

11.2 *Nephrops* FU 31 (Cantabrian Sea)

11.2.1 General

11.2.1.1 Ecosystem aspects

See Annex K

11.2.1.2 Fishery description

See Annex K

11.2.1.3 Summary of ICES Advice for 2013 and management applicable to 2013 and 2014

ICES advice for 2013

The advice for these *Nephrops* stocks is biennial and valid for 2012 and 2013.

ICES advises on the basis of the precautionary considerations that catches should be zero.

To protect the stock in this Functional Unit, management should be implemented at the Functional Unit level.

Management applicable to 2013 and 2014

TACs of 74 and 67 t were set for the whole of Division VIIIc for 2013 and 2014, respectively. A fishing effort limitation is also applicable in accordance with the southern hake and *Nephrops* recovery plan.

11.2.2 Data

11.2.2.1 Commercial catches and discards

In previous years, landings have been estimated by the WG based on IEO scientific estimations. The information was compiled by IEO from sale sheets and Owners Associations where the *Nephrops* landings allocation was carried out based on landing port criteria. Since 2011, the Spanish Authority for Fisheries (Secretaría General de

Pesca, SGP) who is also the National authority for the Data Collection Framework established a new policy and general approach in the provision of official data on catches and fishing effort. So, *Nephrops* landings since 2011 are official landings.

Unlike the IEO scientific estimates, official landings are derived from logbooks. This source of information allows the landings disaggregation by ICES statistical rectangles. *Nephrops* catches recorded into statistical rectangles outside of the FUs in Division IXa were allocated to the clo rectangles in each FU. At the moment it is not possible to quantify the impact this allocation may have on the estimation of landings by FU. This issue will be further investigated in the near future.

Nephrops landings from FU 31 are reported by Spain (the only participant in the fishery) (Table 11.2.1 and Figure 11.2.1) and are available for the period 1983-2013. 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 to less than 10 t in the period 2009-2011. In 2012 and 2013, landings were 10 t each year.

11.2.2.1.1 Biological sampling

Length frequencies by sex of *Nephrops* landings were collected by the biological sampling programme. The sampling levels are shown in Table 1.3.

Mean size of males and females in the landings fluctuated during 1988-2013 (Figure 11.2.1). Data show a general increasing trend for both sexes to 2009 (Figure 11.2.1), where it was recorded the highest values (males with 55.8 mm and females with 45.9 mm CL). In 2011 and 2012, the mean carapace length decreased slightly in relation to the previous year, similar to the levels observed in 2002 but increased in 2012 and 2013. Mean size in 2013 was around 54 mm of carapace length in both sexes.

11.2.2.1.2 Commercial catch-effort data

The fishing effort and LPUE data series includes three bottom trawl fleets operating in the Cantabrian Sea with home harbors in Avilés, Santander and Gijón. However, only the Santander data series include the whole time series. Santander effort and LPUE from 2011 to 2013 are presented in this WG**.**

The available 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 11.2.1) 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. Effort in 2013 was around 600 fishing days (Figure 11.2.1).

The Santander LPUE series shows fluctuations around the general downward trend (Figure 11.2.1). The LPUE reached the lowest value of the time series in 2009. In 2010, the Santander LPUE increased in almost 50% respect the previous year but a sharply fall was recorded in 2011 onward. In 2013, Santander LPUE was only 2.3 Kg/fishing days.

11.2.3 Assessment

According to the ICES data-limited approach, this stock is considered as category 3.1.4 (ICES, 2012). FU 31 is assessed by the analysis of the LPUE series trend, as was done in 2012. The results this year indicate an extremely abundance level.

11.2.4 Management considerations

A recovery plan for southern hake and Atlantic Iberian *Nephrops* stocks including a fishing effort reduction was implemented and enforced in 2006.

11.3 Summary for Division VIIIc

Nephrops in Division VIIIc includes two FUs (North Galicia, FU 25 and Cantabrian Sea, FU 31). Table 11.3.1 shows the landings in Division VIIIc. Landings from both FUs have declined dramatically in recent years. Landings in Division VIIIc were below the TAC in recent years, and therefore the TAC has not been restrictive.

The very low levels of landings from FU 25 and FU 31 and the decreasing LPUE trends to 2013 indicate that both stocks are in very poor condition.

A recovery plan for southern hake and Atlantic Iberian *Nephrops* stocks was approved in December 2005 (Council Regulation (EC) No 2166/2005) and implemented since January 2006. This recovery plan includes a procedure for setting the TACs for *Nephrops* stocks, complemented by a system of fishing effort limitation (a reduction of 10% in the fishing mortality rate in the year of its application as compared with the fishing mortality rate estimated for the preceding year, within the limits of ±15% of the preceding year TAC). ICES has not evaluated the recovery plan.

Table 11.1.1. *Nephrops* FU25, North Galicia. Landings in tonnes.

Year	Trawl	Unallocated	Total FU
1975	731		731
1976	559		559
1977	667		667
1978	690		690
1979	475		475
1980	412		412
1981	318		318
1982	431		431
1983	433		433
1984	515		515
1985	477		477
1986	364		364
1987	412		412
1988	445		445
1989	376		376
1990	285		285
1991	453		453
1992	428		428
1993	274		274
1994	245		245
1995	273		273
1996	209		209
1997	219		219
1998	103		103
1999	124		124
2000	81		81
2001	147		147
2002	143		143
2003	89		89
2004	75		75
2005	63		63
2006	62		62
2007	67		67
2008	39		39
2009	21		21
2010	34		34
2011	44		44
2012	10	11	21
2013	10		10

Table 11.1.2. ***Nephrops*** **FU25, North Galicia. Length compositions of landings of landings, mean weight (Kg) and mean length (CL, mm) for the period 1982-2013.**

Size, CL/Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
15																																6
16																																
17																																
18																																
19	1	8			6							5																0	0			
20	1	17		16	1				2			34			1			0								0		0	0			0
21	7	31	9							1		49	1	0	2				0		1	0		0		0		0	0			0
22	10	99	20	8	50	0						32	1	7	5	5		0					1	1	0	1		0	0			8
23	41	143	18	68	68	6	4		5	15		15	10	6	6	7	1	1	0	10	2	0	1	1	1	1		0	0			
24	53	350	138	198	136	38	1		8	20	13	80	10	19	29	16	2	5	2		2	1	2	2	1	1	0	0	0			
25	105	496	150	300	192	191	16		30	71	19	57	60	64	38	18	6	15	7	10	2	0	7	5	2	1	1	0	0			8
26	142	511	342	326	279	185	42	1	30	203	26	70	118	77	56	53	12	26	9	19	5	2	7	8	3	5	1		0			8
27	275	748	519	575	299	467	17	2	59	359	102	71	179	108	91	49	16	21	5	20	14	3	12	13	9	4	3	0	2	0		0
28	303	731	686	799	495	302	208	23	186	1038	331	105	281	213	179	186	47	67	32	79	30	2	26	25	15	8	4		2	1	2	9
29	382	761	1004	943	500	365	175	21	174	850	280	134	262	189	225	178	38	91	24	125	43	5	28	25	18	11	6	0	2	2	1	2
30	648	1068	1307	1253	470	505	535	84	278	1426	563	176	335	424	266	441	92	194	85	112	105	14	46	43	25	19	10	1	9	2	2	12
31	611	1004	1108	1215	602	446	504	95	329	1047	584	152	330	370	342	303	65	136	60	129	102	26	45	56	39	36	10	1	9	3	3	2
32	782	1009	1581	1045	779	618	613	248	535	1319	883	308	410	444	404	492	99	197	127	288	198	36	60	66	55	44	15	1	18	3	3	3
33	874	956	1323	817	812	526	906	369	547	946	831	472	471	433	454	387	69	100	95	319	181	51	71	87	69	69	13	3	20	5	3	5
34	906	782	1193	975	886	741	719	406	448	981	1114	533	507	480	520	695	152	300	219	302	272	66	70	83	62	75	16	4	27	13	2	5
35	927	777	1032	797	764	820	745	625	555	883	976	670	564	707	396	543	193	258	218	265	308	85	91	98	85	90	25	5	34	25	4	18
36	991	756	972	823	682	945	820	414	563	709	809	549	547	480	360	500	139	241	158	243	259	110	98	102	88	101	31	6	30	21	4	8
37	728	610	643	637	694	845	989	618	447	738	923	563	462	462	341	323	192	208	144	285	236	123	101	88	87	105	37	9	34	23	5	9
38	582	667	456	484	600	453	799	757	429	641	656	546	454	459	329	407	178	211	113	238	185	147	98	92	80	101	35	10	26	63	3	6
39	553	513	360	593	341	491	438	433	315	404	528	362	330	315	257	299	123	138	82	192	129	130	81	69	67	86	37	10	23	45	1	15
40	480	438	442	494	416	478	582	477	348	449	517	336	301	507	233	326	203	202	134	212	186	129	96	81	64	90	47	12	20	78	8	11
41	368	348	323	307	329	283	461	507	304	279	365	230	178	239	166	141	101	110	64	115	99	81	78	61	59	73	44	12	23	61	4	7
42	347	286	412	230	251	226	673	375	235	295	386	243	222	300	145	166	106	106	73	150	117	79	63	52	49	63	38	11	23	50	3	6
43	250	194	187	301	283	312	314	417	244	230	296	175	113	219	122	98	81	58	30	103	67	65	57	47	44	59	35	12	24	52	1	15
44	193	124	202	239	108	286	236	280	181	146	214	173	99	116	82	57	65	61	48	98	109	52	39	36	32	46	29	14	22	34	3	7
45	238	125	205	104	102	125	219	236	157	170	138	158	99	142	74	84	82	72	40	68	78	46	44	34	30	42	23	13	21	24	3	7
46	111	87	97	223	64	302	123	209	93	109	138	124	52	74	55	31	35	42	20	35	65	57	35	26	26	37	22	11	22	17	1	7
47	100	56	79	65	80	136	104	156	78	97	104	43	38	56	55	37	41	23	10	22	34	42	26	20	18	30	20	14	22	13	1	2
48	81	44	181	85	31	108	106	163	71	79	34	69	25	30	37	26	31	26	17	24	35	37	23	14	17	22	16	9	17	15	0	4
49	48	23	89	52	42	93	44	90	36	32	45	23	29	12	21	16	16	16	11	18	23	27	16	13	11	16	14	8	14	17	2	3
50	48	17	56	48	25	41	30	71	26	34	31	25	18	16	21	28	28	41	13	18	24	27	19	11	14	18	10	8	13	12	0	2
51	32	16	64	41	17	9	23	49	22	10	16	17	8	8	12	3	5	6	8	16	34	20	13	7	9	11	11	6	11	7	1	2
52	16	6	3	4	20	19	20	41	24	9	33	26	11	6	6	5	9	9	8	10	18	16	12	8	8	8	9	6	8	7	0	2
53	12	9	6	34	8	21	5	41	18	13	14	20	10	6	11	4	4	4	2	15	13	11	9	6	7	7	8	7	9	4	1	2
54	9	6	25	33	8	1	7	26	8	4	5	2	7	4	7	3	3	5	5	4	4	9	7	5	4	4	6	5	7	7	0	2
55	8	6	25	7	4	3	5	13	9	1	12	10	7	3	5	5	3	7	7	7	9	6	6	5	4	3	6	6	7	6	1	1
56	3	3	25	5	0	10	3	9	2	3	2	2	4	2	3	0	2	4	2	5	6	5	5	3	9	3	4	4	4	5	0	1
57	4	1		6	0	7	4	8	5	3	0		5	1	2	1	0	2	3	0	5	7	4	3	4	2	5	3	5	4	0	0
58	1	3	1	0	11	8		5	1	3	0	0	2	1	5	0	1	2	4	1	9	4	4	3	2	2	4	3	3	4	0	1
59	3	2		2	1		10	2	2	1	0	0	1	1	5	0	1	0	0	1	4	5	3	2	1	1	3	3	2	1	0	1
60	2	2	1	1	0	3	2	8	1	0	1		0	1	3	1	1	0	2	1	2	2	2	2	1	1	2	3	3	3	0	0
61	0	2		1	0			4	2				1	1	2	0	0		2		1	1	3	1	1	1	2	1	1	3	1	
62	3	2		1	0			2		1	1		0	1	3	0	0	0	0	0	3	3	2	1	7	1	1	2	1	6	0	1
63	1	1		1		1		1	0	0	0		1	1	1	2	0		0	0	10	0	2	1	1	1	1	2	1	1	0	
64	2	0		3	0	1	2	3	1				0	1	1	0	0		0	0	0	1	2	1	6	0	1	1	0	2	0	0
65	1	0		0	0	1	12	1	0	2	1		0	0	4				0	0	4	1	2	1	1	0	1	1	1	1	0	
66	0	1		1	0			1	1					0	1	1	0		0	0	1	2	1	1	0	0	1	1	1	1	0	0
67	1	2		0					1	1			0	0	0	1	0		0		2	1	1	1	1	0	1	1	0	2	0	
68	0	1		1			2	0	1				0	0	1	0	0		0		0	1	1	1	0	0	1	1	1	2	0	
69	1	0		1			2	1	1				0		1		0		0		0	2	1	1	0	0	1	1	0	0	0	0
70	0	1		1				0	0	0					1	0	1		1		2	1	1	1	0	0	0	1	0	0	0	
71	1	1		0			2		1	0						0	0		0		0	1	2	0	6	0	0	1	0		0	
72	1	0				1		0				0			0	0	0		0	0	0	1	1	0	6	0	0	1	0	0	0	
73	0	1		1					1				0		0						0	1	1	1	0	0	0	1	0	0	0	
74	0	1		0	0			1		0			0	0	1	1	0		0	0	1	0	1	0	0	0		0	0	0	0	
75	0	1		1					0	0			1		1		0		0	0	0	1	0	0	0	0		0			0	
76	1	1		0									0		1	0	0				0	0	0	0	0	0	0	0			0	
77	0	0		0		1			0				1	0	0		0			0		0	0	0	0			0			0	
78	0	2		1				1		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	
80	1	0		0				0								0	0		0		0		0	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	1887	3561	3041	1540	1421	1314	1147	1298	612	235	528	650	66	206
Total weight (tonnes)	431	432	515	477	363	411	444	376	281	452	427	274	246	273	209	219	103	124	81	147	143	89	75	63	62	67	39	21	34	44	10	10
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	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
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	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

Table 11.1.3. *Nephrops* FU 25: North Galicia. Fishing effort and LPUE for SP-CORTR8c fleet.

Year	SP-CORUTR8c Landings (t)	Effort (trips)	LPUE (kg/trip)
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	17,6
2008	21	2128	9,9
2009	11	1552	7,3
2010	22	1386	15,6
2011	44	1095	33.6
2012	10	1307	11.7
2013	10	1582	4.4

Table 11.1.2. ***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

Table 11.3.1. *Nephrops* in division VIIIc. Landings by FU (tonnes).

Year	FU 25	FU 31	Unallocated	DIVISION VIIIc
1975	731			731
1976	559			559
1977	667			667
1978	690			690
1979	475			475
1980	412			412
1981	318			318
1982	431			431
1983	433	63		496
1984	515	100		615
1985	477	128		605
1986	364	127		491
1987	412	118		530
1988	445	151		596
1989	376	177		553
1990	285	174		459
1991	453	109		562
1992	428	94		522
1993	274	101		375
1994	245	148		393
1995	273	94		367
1996	209	129		338
1997	219	98		317
1998	103	72		175
1999	124	48		172
2000	81	34		115
2001	147	27		174
2002	143	26		169
2003	89	22		111
2004	75	17		92
2005	63	14		77
2006	62	15		77
2007	67	19		86
2008	39	19		58
2009	21	6		27
2010	34	8		42
2011	44	7		51
2012	10	10	11	31
2013	10	10		20

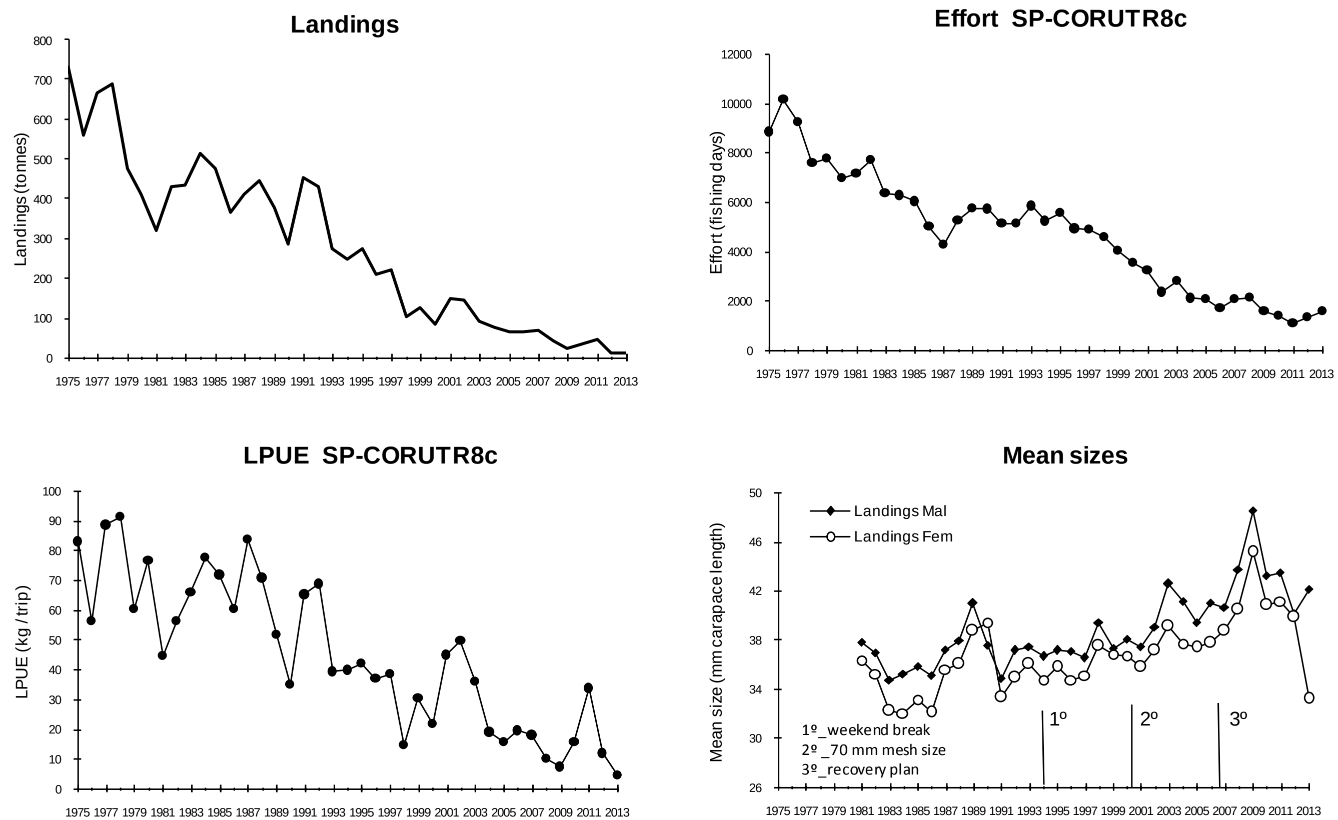


Figure 11.1.1. ***Nephrops*** **FU25, North Galicia. Long-term trends in landings, effort, LPUE and mean sizes**

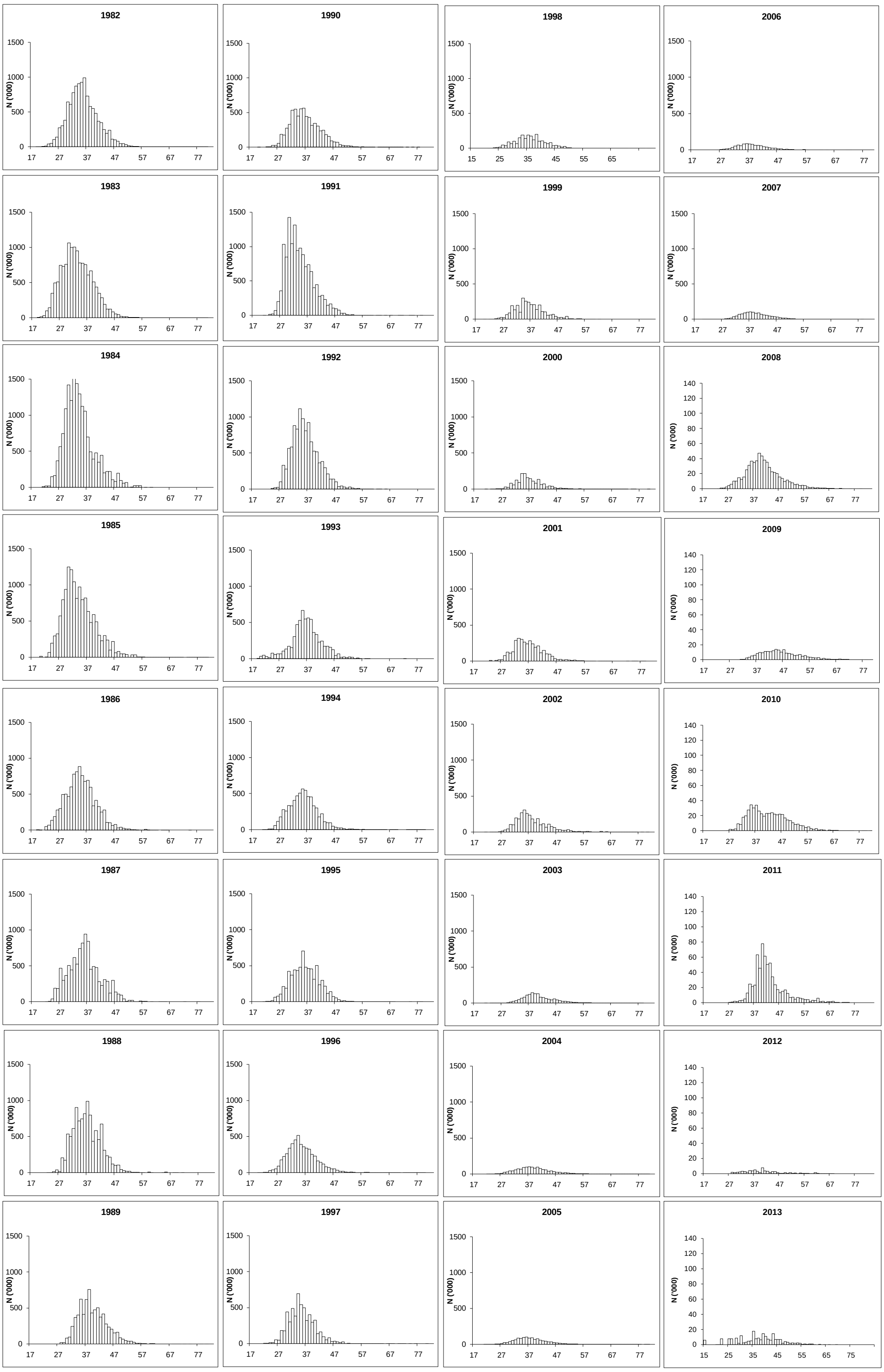


Figure 11.1.2. ***Nephrops*** **FU25, North Galicia. Length distributions in landings for the period 1982-2013. Y-axe scale has been change from 2008**

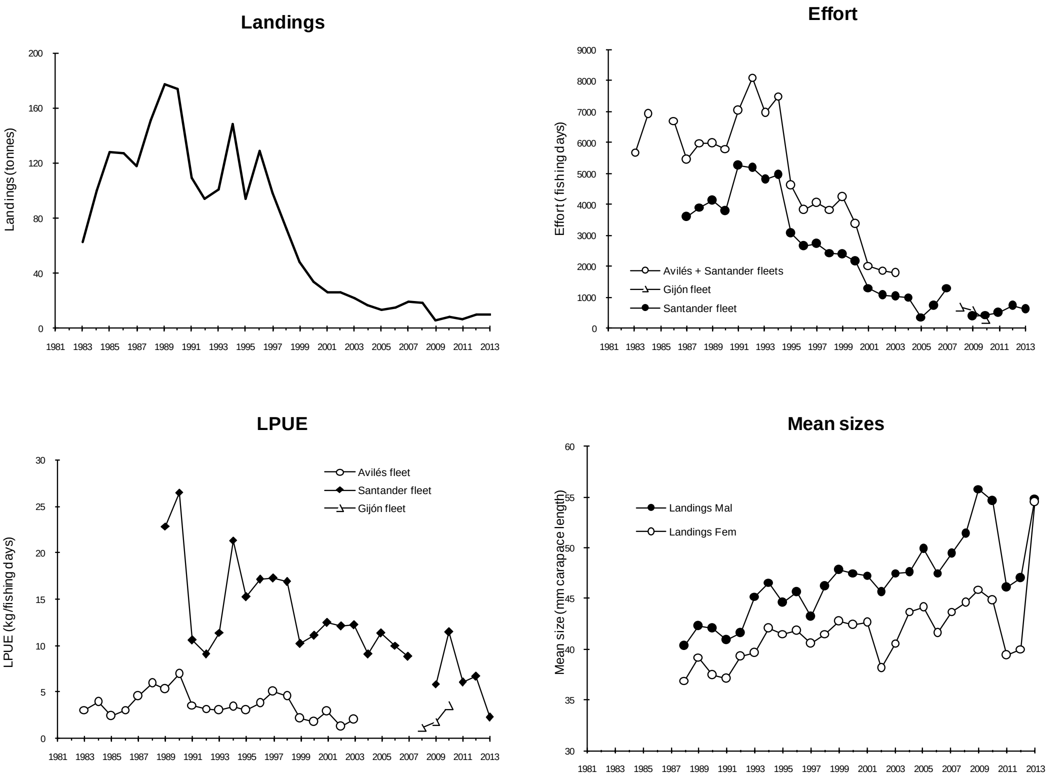


Figure 11.1.2. ***Nephrops*** **FU31, Cantabrian Sea. Long-term trends in landings, effort, LPUE and mean sizes.**

12 *Nephrops* in Division IXa

The ICES Division IXa has five *Nephrops* Functional Units: FU 26, West Galicia; FU 27 North Portugal; FU 28, Alentejo, Southwest Portugal; FU 29, Algarve, South Portugal and FU 30, Gulf of Cádiz.

12.1 *Nephrops* FU 26–27, West Galicia and North Portugal (Division IXa)

12.1.1 General

12.1.1.1 Ecosystem aspects

See Annex L

12.1.1.2 Fishery description

See Annex L

12.1.2 Summary of ICES Advice for 2013 and management applicable to 2013 and 2014

ICES advice for 2013

The advice for these *Nephrops* stocks is biennial and valid for 2013 and 2014.

ICES advises on the basis of the precautionary considerations that catches should be zero

To protect the stock in this Functional Unit, management should be implemented at the Functional Unit level.

Management applicable to 2013 and 2014

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

In order to reduce F on *Nephrops* stocks in this Division even further, a seasonal ban was introduced in the trawl and creel fishery for two boxes, located in FU 26 and 28, in the peak of the *Nephrops* fishing season. These boxes are closed for *Nephrops* fishing in June–August and in May–August, respectively.

ICES has not evaluated the current recovery plan for *Nephrops* in relation to the precautionary approach.

The TAC set for the whole Division IXa was 246 t and 221 t for 2013 and 2014, respectively, and the maximum number of fishing days per vessel was fixed at 141 and 127 days for Spanish vessels and at 140 and 126 days for Portuguese vessels for these two years (Annex IIb of Council Regulations nos. 30/2013 and 43/2014). The number of fishing days included in these regulations is not applicable to the Gulf of Cadiz (FU 30), which has a different regime.

12.1.3 Data

12.1.3.1.1 Commercial catches and discards

In previous years landings have been estimated by the WG based on IEO scientific estimations. The information was compiled by IEO from sale sheets and Owners Associations where the *Nephrops* landings allocation was carried out based on landing port criteria. Since 2011, the Spanish Authority for Fisheries (Secretaría General de Pesca, SGP) who is also the National authority for the Data Collection Framework, established a new policy and general approach in the provision of official data on catches and fishing effort. So, *Nephrops* landings since 2011 are official landings.

Unlike the IEO scientific estimates, official landings are derived from logbooks. This source of information allows the landings disaggregation by ICES statistical rectangles. *Nephrops* catches into statistical rectangles outside of the FUs in Division IXa were allocated the closest statistical rectangles in each FU. At the moment it is not possible to quantify the impact this allocation may have on the estimation of landings by FU. This issue will be further investigated in the near future.

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 it can be considerate as by-catch but 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, in recent years 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 1975-2013 (Figure 12.1.1). During 1975-1989, the mean landing was 680 t, fluctuating between 575 and 800 t approximately. Since 1990 onwards there has been a marked downward trend in landings, being below 50 t from 2005 to 2011. In two last years, landings continued decreasing up to only 3 t in 2013, the lowest value in the time series. Landings in 2013 represent less than 1% of the landings prior to 1990. .Discards rates are negligible.

Total Portuguese landings from FU 27 have decreased from almost 100 t in 1988 to just 1 t in 2012 and 2013.

12.1.3.1.2 Biological sampling

Length frequencies by sex of the *Nephrops* landings are collected monthly. The sampling levels are shown in Table 1.3.

Mean size for both sexes shows an increasing trend from 2001 to 2010 with the highest value recorded in 2010 (52.0 mm CL in males and 43.7 mm CL in females) (Figure 12.1.1). From 2011 and 2013, mean carapace length declined in both sexes. Annual length compositions for males and females combined, mean size and mean weight in landings for the period 1988-2013 are given in Table 12.1.2 and Figure 12.1.2.

12.1.3.2 Commercial catch–effort data

Fishing effort and LPUE estimates are available for Marin trawl fleet (SP-MATR) for the period 1990-2013 (Table 12.1.3). Fishing effort and LPUE from 2011 to 2013 are presented in this WG.

The overall trend for the LPUE of SP-MATR is decreasing, with some stability in the 2007-2009 periods although at very low level (17.5 Kg/trip). From 2010 to 2012, LPUE downfall again to the lowest values recorded in the time series (2 Kg/trip, approximately). In 2013, LPUE increase in relation to previous years but continue a very low level (5.7 Kg/trip).

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 12.1.1 for complementary information.

12.1.4 Assessment

According to the ICES data-limited approach, this stock is considered as category 3.1.4 (ICES, 2012). These FU 26-27 are assessed by the analysis of the LPUE series trend, as was done in 2012. Results this year indicate an extremely low abundance level.

12.1.5 Biological reference points

There are no reference points defined for this stock.

12.1.6 Management Considerations

Nephrops is taken as by catch 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 procedure for setting the TACs for *Nephrops* stocks, complemented by a system of fishing effort limitation (i.e. 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). This plan also includes a seasonal closure (June-August) for *Nephrops* in an area of the West Galicia (FU 26) fishing grounds.

12.2 FU 28 – 29 (SW and S Portugal)

12.2.1 General

12.2.1.1 Ecosystem aspects

See the Stock Annex (in Annex L of WG report)

12.2.1.2 Fishery description

See the Stock Annex (in Annex L of WG report)

12.2.1.3 ICES Advice for 2013 and Management applicable for 2013 and 2014

ICES Advice for 2013

The advice for these stocks is biennial and valid for 2013 and 2014. Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 110 tonnes. Management should be implemented at the Functional Unit level.

Management applicable for 2013 and 2014

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

In order to reduce F on *Nephrops* stocks in Division IXa 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. These boxes are closed for *Nephrops* fishing in June–August and in May–August, respectively.

ICES has not evaluated the current recovery plan for *Nephrops* in relation to the precautionary approach.

The TAC set for the whole Division IXa was 246 and 221 t for 2013 and 2014, respectively, and the maximum number of fishing days per vessel was fixed at 141 and 127 days for Spanish vessels and at 140 and 126 days for Portuguese vessels for these two years (Annex IIb of Council Regulations 39/2013 and 43/2014). 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.

12.2.2 Data

12.2.2.1 Commercial catches and discards

Table 12.2.1 and Figure 12.2.1 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.

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. *Nephrops* catches recorded in statistical rectangles outside the FUs in Division IXa were allocated to the closest rectangles in each FU. At the moment it is not possible to quantify the impact this allocation may have on the estimation of landings by FU. This issue will be further investigated in the near future.

Males are the dominant component in all landings with exception for 1995 and 1996 when total female landings exceeded male landings (ICES, 2006). For the period 2002-2011 male to female sex-ratio has been close to 1.5:1. The years 2012 and 2013 present a ratio of 2.3:1.

Information on discards and the raising procedure are presented in Prista et al, 2014 (WD 4, this EG). 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%).

12.2.2.2 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 2013 was at the same level as in previous years, from February to September, the months in which fishing was open. The sampling data are raised to the total landings by market category, vessel and month.

The length compositions of the landings are presented in Tables 12.2.2a-b and Figures 12.2.2a-b. The number of samples and measured individuals are presented in Table 1.3.

12.2.2.3 Abundance 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 12.2.4 and Figure 12.2.1 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 abundance 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) (Figure 12.2.3). 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. A review of this information will have to be carried out for the benchmark in 2015, limiting the surveyed area to the fishing area based on VMS data.

As shown in ICES (2012x), the distribution of survey indices is in very good agreement with the fishery CPUE spatial distribution. The correlation between the average annual CPUE from the fishery and the biomass index from the Crustacean survey until 2009 is also high. The values from recent years were not taken into account due to the R/V operation problems already referred.

In 2005 and 2007, some experiments to collect UWTV images from the *Nephrops* fishing grounds were made with a camera hanged from the trawl headline. In 2008, the images collected from 9 stations in FU 28 with the same procedure looked very promising. In 2009 survey, a two-beam laser pointer was attached to the camera and UWTV images were recorded from 58 of the 65 stations. The trawling speed and the turbidity were the main problems affecting the clarity of the image and the high variation of the height of the camera to the ground resulted in a variable field of view. In 2010 and 2011, no images were collected due to technical problems of the research vessel. It is not guaranteed that this method can be used for abundance estimation (information presented to SGNEPS 2012 – Study Group of *Nephrops* Surveys (ICES, 2012).

12.2.2.4 Mean sizes

Mean carapace length (CL) data for males and females in the landings and surveys are presented for the period 1994-2013 (Table 12.2.5). Figure 12.2.1 shows the mean CL trends since 1984. The mean sizes of males and females have fluctuated along the period with no apparent trend.

12.2.2.5 Commercial catch-effort data

A standardization of the CPUE series was presented to WGHMM in 2008 (ICES, 2008, Silva, C. – WD 25) applying the generalized linear models (GLMs). The data used for this standardization were the crustacean logbooks for the period 1988-2007. The factors retained for the final model (year, month and vessel category) were those which contribute more than 1% to the overall variance. The model explains 17% to 19% of the variability, when using the CPUE in kg/day or kg/haul respectively.

Until 2010, this model was updated each year with the addition of new data.

The issue of effort estimation using standardized CPUE from GLMs or other methods taking into account the flexibility of the fleet in relation to target species was further developed in the WGHMM 2010 (ICES, 2010x) and during WKSHAKE2 (ICES, 2010y). Crustacean vessels are targeting two main species, rose shrimp and Norway lobster, which have different market value. Depending on their abundance/availability, the effort is directed at one species or the other. In 2006, the landings of rose shrimp start to increase showing a change in the objectives of the fishery (Figure 12.2.3).

The effort is estimated using the CPUE of the fleet. If the CPUE of *Nephrops* decreased due to a change in target species (and consequently, fishing grounds), the effort might be overestimated.

The model of CPUE standardization used until 2010 never explained more than 20% of the variability (ICES, 2010x). The explanatory variables used were *year*, *month* and *vessel-category*. Considering the behaviour of the fleet in periods of high abundance of rose shrimp, new variables related to the catches of this species and the proportion of *Nephrops* in the total catch were incorporated. As the distributions of rose shrimp and *Nephrops* are fishing ground and depth dependent, the availability and use of VMS data could improve the standardization model, as suggested in Silva and Afonso-Dias, 2011 (WD to WKCPUEFFORT).

Taking all this into account, new variables as the fishing depth, the catches of rose shrimp and the proportion of *Nephrops* in the total crustacean catches were incorporated in the new model for CPUE standardization and presented to IBP *Nephrops* 2012 (Inter-Benchmark Protocol for *Nephrops* 2012, ICES, 2012).

The IBP *Nephrops* did not come to a conclusion about the stock assessment method but the WG has agreed to use this new CPUE standardization for the trends based assessment and standardized effort estimation.

However, as VMS data are only available since 1998, the use of this method has shortened the length of the time series. In the models presented before, the CPUE was expressed in kg/day and the time series started in 1988. The CPUE in the new model is expressed in kg/hour, the time series starts 10 years later but the estimation of CPUE is based on more reliable effort data.

The overall analysis of the geo-referenced catches confirms the general preference of rose shrimp and *Nephrops* for grounds shallower and deeper than 400 m, respectively. These data also confirm that, in years of higher abundance of rose shrimp, a greater effort is allocated to depths shallower than 400 m. In what concerns the distribution of the fishing effort between the two Functional Units, FU29 represents in average 83% of the total effort. However, the fishing areas (FUs) were found not significantly different and therefore removed from the model.

The factors and levels retained in the final model and updated to include 2011-2013 data:

- year: 1998 – 2013
- month: 1 – 12
- depth interval: [100, 400[, [400, 800[, [800, 1500]
- log catch of rose shrimp: [0, 2[, [2, 5]
- proportion of *Nephrops* in the total catch of crustaceans: [0, 0.25[, [0.25, 1]
- and vessel category: A (standard), B and C. These two categories correspond to vessels less or more productive than the standard type.

The choice of the final model was based on the highest value of explained variance and the smallest AIC. The model explains 47% of the total variability, with the proportion of *Nephrops* in the crustacean catches as the most important factor (Table 12.2.6).

Figure 12.2.4 shows the annual observed CPUE and the estimates from the model, considering the depth interval class [400, 800[, log catch of rose shrimp class [0, 2[, the category of proportion of *Nephrops* [0.25, 1] and vessel category A as the reference factors for *Nephrops* target CPUE.

The correlation found between the CPUE series derived from the model presented here and the biomass indices from the Crustacean surveys (not considering the estimates after 2009, for the reasons explained before) is high and gives confidence that CPUE is reflecting the abundance of *Nephrops* in FU 28 and 29.

The 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 initiated 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 IXa, 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). As a result of these measures, the nominal effort in 2006 to 2011 corresponds to 11 months each year.

In the period 1999-2001, standardized fishing effort increased substantially, remaining high until 2004-2005 (Table 12.2.3 and Figure 12.2.1), with an exceptional drop in 2003. After 2005, the effort presents a decreasing trend until 2009. The effort decline may be related to the effort management measures but also to effort shift to rose shrimp, which presented a large increase in abundance and landings in the period 2007-2011 (Figure 12.2.4).

The standardized effort increased in 2012 due to a higher catch from Portuguese fleet and to the provision of Spanish catches in this year. As stated in section 12.2.2.1, Spanish vessels are licensed for crustaceans in these FUs under a bilateral agreement since 2004, but no official data were available prior to 2011. In 2013, due to the lower availability of rose shrimp and the increase in abundance of Norway lobster, the Portuguese quota was fished until September and the Portuguese crustacean fleet had to stop the operation or to target other crustacean species, resulting in effort reduction. In regard to the Spanish fleet, the number of fishing days has 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.

12.2.3 Assessment

The advice is based on survey and fishery CPUE and effort trends. According the ICES data-limited approach, this stock is classified in the category 3.2.0 (ICES, 2012).

The standardized effort shows a consistent declining trend since 2005 reaching a historic low in 2009-2010. In the following years, the effort had a slight increase however still remaining at a low level.

The fleet standardized CPUE, used as index of biomass, decreased in the period 2006-2011 reversing the downward trend in recent years. Due to the technical problems recorded in the operation of the research vessel, which affected the crustacean survey series in the period 2010-2013, the trend of the survey index was not used,

12.2.3.1 Short-term Projections

No projections were performed.

12.2.3.2 Biological reference points

No biological reference points are defined for these stocks.

Biological reference points estimated on the basis of the Yield per Recruit curve were presented in ICES (2011).

12.2.4 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 and 43/2014). The recovery plan target and rules have not been changed since it was implemented.

Besides the recovery plan, the Council Regulation (EC) No 850/98 was amended with the introduction of two boxes in Division IXa, 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).

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 and 2015. 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.

12.3 *Nephrops* in FU 30 (Gulf of Cadiz)

12.3.1 General

12.3.1.1 Ecosystem aspects

See Annex L

12.3.1.2 Fishery description

See Annex L

12.3.1.3 ICES Advice for 2013 and Management applicable for 2013 and 2014

ICES Advice for 2013

The advice for these *Nephrops* stocks is biennial and valid for 2013 and 2014.

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 90 tonnes.

To protect the stock in this Functional Unit, management should be implemented at the Functional Unit level.

Management applicable for 2013 and 2014

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

An increase of mesh size to 55 mm was established since September of 2009 (Orden ARM/2515/2009) for the bottom trawl fleet.

The TAC set for the whole Division IXa was 246 t for 2013 and 221 t for 2014, respectively, and the maximum number of fishing days per vessel was fixed at 141 and 127 days for Spanish vessels and at 140 and 126 days for Portuguese vessels for these two years (Annex IIb of Council Regulations nos. 39/2013 and 43/2014). The number of fishing days included in these regulations is not applicable to the Gulf of Cadiz (FU 30), which has a different regime.

12.3.2 Data

12.3.2.1 Commercial catch and discard

In previous years landings have been estimated by the WG based on IEO scientific estimations. The information was compiled by IEO from sale sheets and Owners Associations and the *Nephrops* landings allocation was carried out based on landing port criteria. Since 2011, the Spanish Authority for Fisheries (Secretaría General de Pesca, SGP) who is also the National authority for the Data Collection Framework, established a new policy and general approach in the provision of official data on catches and fishing effort. So, *Nephrops* landings since 2011 are official landings.

Unlike the IEO scientific estimates, official landings are derived from logbooks. This source of information allows the landings disaggregation by ICES statistical rectangles. *Nephrops* catches recorded into statistical rectangles outside of the FUs in Division IXa were allocated to the clo rectangles in each FU. At the moment it is not possible to quantify the impact this allocation may have on the estimation of landings by FU. This issue will be further investigated in the near future.

Landings in this FU are reported by Spain and also minor quantities by Portugal. Since WGHMM in 2010, *Nephrops* landings in Ayamonte port have been incorporated in the Gulf of Cadiz time series of landings, as well as directed effort and LPUE from 2002 (Tables 12.3.1 and 12.3.4).

Nephrops total landings in FU 30 decreased from 108 t in 1994 to 49 t in 1996, the lowest value recorded. 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 2006-2012 periods, landings remained relatively stable around 100 t but fell to 26 t in 2013. The reason for this drop is that the quota in 2012 was exceeded and the European Commission applied a sanction which will be paid in 3 years. So, the *Nephrops* fishery was closed almost whole 2013 and vessels could only went fishing *Nephrops* a few days in summer and winter.

The discarding rate of *Nephrops* in this fishery fluctuates annually but is always low (Table 12.3.2). In 2010, the percentage of discarded *Nephrops* by weight was half of the previous year, with a value of 1.3% of discarded *Nephrops*. No *Nephrops* discards were recorded in 2011 and 2012 but about a 3% was discarded in 2013. Figure 12.3.2 shows the estimated length frequency distributions of the discarded and retained *Nephrops* by trip. The mean carapace length has fluctuated along the period with no apparent trend.

12.3.2.2 Biological sampling

The sampling level for the species is given in Table 1.3.

Figure 12.3.3 shows the annual landings length distribution for males, females and both sexes combined during the period 2001-2013. 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 samplings are 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 in 2011 and 2012 The number of monthly sampling in 2013 was influenced by the closure of *Nephrops* fishery.

Mean size of males and females in *Nephrops* landings in the period 2001-2013 are shown in Figure 12.3.1. The mean sizes show a slight increasing trend from 2006 to 2012. In 2013,, a decline of the mean size was observed in both sexes.

12.3.2.3 Abundance indices from surveys

The biomass and the abundance indices of *Nephrops* by depth strata, estimated from the Spanish bottom trawl spring surveys (SPGF-cspr-WIBTS-Q1) carried out from 1993 to 2013 are shown in Table 12.3.3.

In the time series two different periods can be observed. From 1993 to 1998 the overall abundance index trend was decreasing, while from 1998 onwards the index has remained stable although fluctuating widely in some years, except in 2004, which value was the lowest in the time series (Figure 12.3.5). In 2010 the deeper strata (500-700 m) were not sampled due to a reduction in the days of the survey, as a consequence of adverse weather conditions. Therefore, only the abundance index for the strata 200-500 m is available for 2010 (Table 12.3.3) and its value is similar to the corresponding strata in previous year. In 2011 and 2012 the abundance index decreased. Abundance index trend shows a declining trend since 2005, representing, a reduction of 28% in 2012. In 2013, a strong increase was observed, recording a value similar to the average of the four first years in the time series (Table 12.3.3). This survey is not specifically directed to *Nephrops* and is not carried out during the main *Nephrops* fishing season but it shows a similar trend to the commercial LPUE.

The length distributions of *Nephrops* obtained in the Spanish bottom trawl spring surveys (SPGF-cspr-WIBTS-Q1) during the period 2001-2013 are presented in Figure 12.3.6. The time series of *Nephrops* mean sizes for males, females and combined sexes obtained in these surveys are shown in Figure 12.3.7. No apparent trends are observed. Mean size ranged between 34.6 and 42.9 mm CL for males and between 28.6 and 34.9 mm CL for females.

12.3.2.4 Commercial catch– Effort data

Figure 12.3.1 and Table 12.3.4 show directed *Nephrops* effort estimates and LPUE series modified after the incorporation of data from Ayamonte port since 2002.

The directed fishing effort trend is clearly increasing from 1994 to 2005, and after that the trend is declining to 2008 (1150 fishing days). The maximum of the series was reached in 2005 with a value of 4336 fishing days. In 2009, directed effort increased by more than 500 fishing days with respect to the previous year and it remained stable in 2010. The directed fishing effort declined in 2011 although in 2012 was slightly higher than in the previous year. The closure *Nephrops* fishery resulted in a decrease of the fishing effort in 2013 (262 fishing days) (Figure 12.3.1).

LPUE obtained from the directed effort shows a gradual decrease from 1994 to 1998. After 1998, the trend slightly increases until 2003. In 2004, the LPUE decreases to the lowest value recorded (44.3 Kg/fishing day). LPUE then increased until 2008 around 60%. The incorporation of the Ayamonte data caused an increase of the directed LPUE mainly in 2008 (Figure 12.3.1). Since 2008 LPUE have declined to 50 Kg/fishing day in 2009 and 45.5 Kg/fishing day in 2010 (about 30% less with respect to 2008). Since 2010, LPUE shows an increasing trend with a high rise in 2013. LPUE in 2013 must be taken with caution as it does not cover the whole year due of the closure of the *Nephrops* fishery the most part of the year (Figure 12.3.1).

The overall LPUE trend is quite similar to the abundance survey index in the stratum of 200-700 m from 1996 to 2013 (no survey was carried out in 2003) despite the survey index had fluctuated in some years (Figure 12.3.4). The lowest values were detected in 2004 in both series. In 2008, the abundance survey index was well above the commercial LPUE, however, the abundance index drop in 2009 agrees with the commercial LPUE. This fact may be explaining for the increases of the rose shrimp abundance in 2008. The increased abundance of rose shrimp is believed to have led to a change in the objectives of the fishery, as rose shrimp achieves a higher market value and its fishing grounds are easier to reach because they are shallower (90-380 m) and closer to the coast. No abundance index data are available in the deeper strata sampled by Spanish bottom trawl spring surveys (SPGF-cspr-WIBTS-Q1) in 2010. In 2011 and 2012, an increase of the directed commercial LPUE was observed but differently, the abundance index of spring survey decreased. In 2013, the survey abundance index indicates an increase of the *Nephrops* abundance in FU 30 being in agreement with the rise of the commercial LPUE (Figure 12.3.5).

12.3.3 Assessment

According to the ICES data-limited approach, this stock is considered as category 3.2.0 (ICES, 2012). FU 30 is assessed by the analysis of the LPUE series trend, as was done in 2012. Since 2010, the commercial directed *Nephrops* LPUE shows an increasing trend achieving in 2013 a high value but the *Nephrops* fishery was closed the most part of the year, which increases the uncertainty associated with the LPUE index in 2013. The signal of the abundance index in the 2013 survey is comparable to the values of higher abundance in the time series.

12.3.4 Biological reference points

No reference points are defined for this stock.

12.3.5 Management considerations

Nephrops fishery is taken in mixed bottom trawl fisheries; therefore HCRs applied to other species will affect this stock.

In 2013, *Nephrops* fishery was closed the most part of the year because the quota in 2012 was exceeded and a sanction for the European Commission was applied which it will be paid in 3 years.

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.

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 control the days and time when the Gulf of Cadiz bottom trawl fleet can enter or leave fishing ports. Although the regulations vary among them, they generally allow 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.

12.4 Summary for Division IXa

ICES Division IXa includes five FUs, which are managed together. The TAC is set for the whole Division. In the period 2008-2011, the landings were below the TAC (see Tables 12.1 and 12.2.). In 2012, landings of FUs 28-29 and 30 increased and surpassed the TAC. In 2013, the landings were at the TAC level. Due to the over quota catch in 2013, a sanction was applied to the Spanish vessels and the number of fishing days was reduced. In regard to the Portuguese fleet, the quota was reached in 9 months and the fishing for *Nephrops* was closed.

The northernmost stocks (FUs 26-27) continue to be at very low abundance levels. The southern stocks (FUs 28-29 and FU 30) present an increase in the biomass index (LPUE series) in recent years. In these FUs, part of the multispecies fleet effort is directed at rose shrimp.

The practice of managing three distinctive *Nephrops* stocks by a joint TAC may lead to unbalanced exploitation of the individual stocks. This is particularly true for this Division where the state of the individual stocks is quite different. The implementation of fine scale management of catches and/or effort at a geographic scale corresponding to the *Nephrops* stock distribution has been advised.

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 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). By derogation, a different method of effort management method is applied to the Gulf of Cadiz (Article 8, §3).

The Council Regulation (EC) No 850/98 was also amended with the introduction of two boxes, in FU 26 and the other in FU 28. These boxes are closed for *Nephrops* fishing for three and four months respectively, during the peak of the fishing season (May-August) (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*.

A Portuguese regulation (Portaria no. 43, 12th January 2006) closes the crustacean fishery in FUs 28-29 in January every year. Also, a closed season of 45 days was established between September and November 2013 (AAA/627/2013) in the Gulf of Cadiz (FU30) bottom trawl fleet by Spanish Administration.

No evaluation of the impact of these closures on the *Nephrops* stocks in FUs 28–29 and FU 30 has been carried out.

Since 2008, the Andalucía Regional Administration has set regulations with the aim of distributing the fishing effort throughout the year by establishing the days and times when the Gulf of Cadiz bottom trawl fleet can enter or leave fishing ports (Resolution 23th November 2009, BOJA nº 235).

Tabla 12.1.1. *Nephrops* FU26-27, West Galicia and North Portugal. Landings in tonnes by Functional Units and country.

	Spain		Portugal	Unallocated	Total
Year	FU 26**	FU 27	FU 27	FU27	FU 26-27
1975	622				622
1976	603				603
1977	620				620
1978	575				575
1979	580				580
1980	599				599
1981	823				823
1982	736				736
1983	786				786
1984	604		14		618
1985	750		15		765
1986	657		37		694
1987	671		71		742
1988	631		96		727
1989	620		88		708
1990	401		48		449
1991	549		54		603
1992	584		52		636
1993	472		50		522
1994	426		22		448
1995	501		10		511
1996	264	50	17		331
1997	359	68	6		433
1998	295	42	8		345
1999	194	48	6		248
2000	102	21	9		132
2001	105	21	6		132
2002	59	24	4		87
2003	39	26	8		73
2004	38	24	9		71
2005	16	16	11		43
2006	15	17	12		44
2007	20	17	10		47
2008	17	12	13		42
2009	16	5	10		31
2010	3	14	4		21
2011	8	8	4	7	27
2012	3	4	1		8
2013	1	<1	1		2

**Prior 1996, landings of Spain recorded in FU 26 include catches in FU 27

Table 12.1.2. ***Nephrops*** **FU26-27, West Galicia and North Portugal. Length compositions, mean weight (Kg) and mean size (CL, mm) in landings for the 1988-2013 period.**

Size, CL/Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table 12.1.2. ***Nephrops*** **FU26-27, West Galicia and North Portugal. Fishing effort and LPUE for SP-MATR fleet.**

Year	Landings (t)	SP-MATR 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	2	715	2,5
2011	3	788	3,2
2012	1	914	0,9
2013	2	410	5,7

Table 12.2.1. *Nephrops* in South-West and South Portugal (FU 28-29). Total landings per country (tonnes).

Years	28	29	28+29			Total
	Spain	Spain	Portugal			
	Trawl	Trawl	Artisanal	Trawl	Total	
1975	137	1510		34	34	1681
1976	132	1752		30	30	1914
1977	95	1764		15	15	1874
1978	120	1979		45	45	2144
1979	96	1532		102	102	1730
1980	193	1300		147	147	1640
1981	270	1033		128	128	1431
1982	130	1177		86	86	1393
1983				244	244	244
1984				461	461	461
1985				509	509	509
1986				465	465	465
1987			11	498	509	509
1988			15	405	420	420
1989			6	463	469	469
1990			4	520	524	524
1991			5	473	478	478
1992			1	469	470	470
1993			1	376	377	377
1994				237	237	237
1995			1	272	273	273
1996			4	128	132	132
1997			2	134	136	136
1998			2	159	161	161
1999			5	206	211	211
2000			4	197	201	201
2001			2	269	271	271
2002			1	358	359	359
2003			35	335	370	370
2004			31	345	375	375
2005			31	360	391	391
2006			17	274	291	291
2007			18	274	291	291
2008			35	188	223	223
2009			17	133	151	151
2010			16	131	147	147
2011		17	16	117	133	150
2012		14	3	211	214	228
2013		10	1	198	199	209

Table 12.2.3. - SW and S Portugal (FUs 28-29): Effort and CPUE of Portuguese trawlers, 1994-2012 (standardized/revised).

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	5.4		
1998	25	6.4	39,226	4.1
1999	29	7.3	39,308	5.4
2000	33	6.1	52,564	3.8
2001	33	8.2	82,359	3.3
2002	34	10.5	69,929	5.1
2003	35	9.6	55,126	6.7
2004	33	10.4	80,286	4.7
2005	32	11.9	65,776	5.9
2006	30	9.1	48,607	6.0
2007	30	9.1	52,051	5.6
2008	30	6.3	40,127	5.5
2009	30	4.4	30,779	4.9
2010	26	5.0	30,709	4.8
2011	26	4.5	34,535	4.3
2012	21	10.2	43,875	5.2
2013*	24	8.2	37,684	5.6

* provisional

Table 12.2.4. - SW and S Portugal (FUs 28-29): *Nephrops* CPUEs (kg/hour) in research trawl surveys, 1994-2012.

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	2.6
1998	0.7	0.02	ns	Jun-98	1.2
1999	0.3	0.02	ns	Jun-99	2.5
2000	1.0	0.92	ns	Jun-00	1.6
2001	0.6	0.35	ns	Jun-01	0.8
2002	ns	0.02	ns	Jun-02	2.4
2003	ns	0.19	ns	Jun-03	2.6
2004	ns	0.51	ns	Jun-04	nr
2005	ns	0.09	0.16	Jun-05	4.7
2006	ns	0.19	0.06	Jun-06	2.4
2007	ns	0.04	0.73	Jun-07	2.8
2008	ns	0.13	0.25	Jun-08	4.0
2009	ns	0.13	ns	Jun-09	2.0
2010	ns	0.34	ns	Jun-10	6.8
2011	ns	0.11	ns	Jun-11	nc
2012	ns	ns	ns	ns	ns
2013	ns		ns	Jun-13	2.2

ns = no survey nr = not reliable nc = whole area not covered

Table 12.2.5. - SW and S Portugal (FUs 28-29): Mean sizes (mm CL) of male and female Nephrops in Portuguese landings and surveys, 1994-2012.

Year	Landings		Demersal surveys Summer		Demersal surveys Autumn		Demersal surveys Winter		Crustacean surveys	
	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			ns	ns	39.1	39.5

ns = no survey nr = not reliable nc = whole area not covered

Table 12.2.6 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			72722	83994		
year	15	9173.5	72707	74821	< 2.2e-16	10.9%
month	11	2562.6	72696	72258	< 2.2e-16	3.1%
depth.class2	2	1984.1	72694	70274	< 2.2e-16	2.4%
catdps	1	3028.6	72693	67246	< 2.2e-16	3.6%
cat_pnep	1	21413.7	72692	45832	< 2.2e-16	25.5%
catPRT2	2	1175.7	72690	44656	< 2.2e-16	1.4%
Total	**32**	**39338.2**				**46.8%**

AIC: 257790

Table 12.2.2.a. FU 28-29 - Length Composition of Nephrops Males (1984-2013)

Landings	(thousands)														
Age/Year	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
17															
18															
19					4	21					0				
20			0	16	4			6	4						
21		17	9			84		16	37	9					
22	7	5	14	15		97	9	29	96	38	9				2
23	24	7	7	8		143	5	19	55	34			8	4	
24	14	40	121	209	51	272	27	53	202	42	18		17	9	8
25	109	83	115	81	97	229	116	69	181	149	34	3	23	6	16
26	250	170	137	446	128	205	182	111	263	72	68	0	36	43	32
27	282	326	170	718	208	269	149	94	185	95	77	0	54	95	81
28	374	500	289	871	399	280	337	139	506	272	157	0	56	78	65
29	439	559	341	727	456	283	415	159	462	382	95	28	38	88	65
30	412	742	328	584	442	317	695	239	725	548	187	11	68	104	160
31	277	670	389	742	457	230	813	325	755	548	231	24	92	172	129
32	373	784	680	806	446	367	866	260	670	674	383	108	151	283	289
33	339	531	213	236	428	265	702	133	345	365	149	83	70	90	95
34	389	635	609	721	656	328	785	239	451	655	270	215	159	251	269
35	478	525	590	245	664	291	755	171	296	475	224	169	147	169	118
36	378	463	519	342	572	295	449	138	399	639	221	147	78	154	166
37	528	346	322	406	424	356	465	77	351	391	107	262	172	149	167
38	496	383	606	355	571	302	479	120	378	344	179	134	113	58	85
39	353	309	361	240	326	332	611	126	348	306	95	151	62	46	47
40	447	337	323	156	366	316	829	200	248	174	144	232	83	82	83
41	247	230	316	335	164	314	797	141	243	158	93	247	78	37	53
42	371	246	507	264	215	360	628	174	246	170	168	293	85	33	167
43	199	156	198	62	102	364	335	121	242	107	127	65	31	21	43
44	194	233	422	215	128	481	553	125	371	179	150	88	42	28	69
45	165	144	233	206	93	339	324	90	220	150	87	27	22	21	34
46	148	178	189	170	72	231	228	128	167	55	79	58	21	33	38
47	129	161	140	74	76	191	202	122	191	96	68	31	38	20	34
48	176	212	149	79	85	193	121	62	178	102	78	25	15	9	24
49	89	138	104	58	43	73	92	78	111	47	47	16	20	4	13
50	91	142	50	34	53	94	58	67	69	30	50	12	9	3	33
51	66	120	63	27	34	114	59	44	50	38	29	4	6	7	14
52	64	135	66	44	38	77	33	40	35	15	46	11	16	7	31
53	45	99	32	37	23	40	19	16	29	18	22	5	6	6	11
54	73	101	35	45	22	35	27	29	50	23	18	5	8	16	19
55	20	67	25	31	22	37	30	26	29	19	9	3	4	10	8
56	20	35	14	20	16	20	30	19	5	5	11	2	4	3	6
57	10	33	5	15	12	22	7	10	6	5	11	3	7	16	8
58	13	14	8	14	11	17	14		11	4	6		5	3	5
59	7	10	3	9	4	16	5	2	9	3	10	0	5	2	3
60	3	6	3	4	3	13	2		10	8	1	1	1	4	1
61	3	1	4	4	1	5		1	3	2	1	0	1	9	1
62	3	1	2	1	2	3		1	7	5	1		2	7	1
63	1	1		1	1	4		5	0	1	0		2	3	0
64		2	0	2	1			1	3	1	2		0	4	0
65	0	0		2	2				3	1	1		0	4	
66	0			0	1					1			0	4	0
67	0			0	0	0			6	5				6	0
68					0	2				0	1			0	0
69				0										0	0
70	0			1		0				2				0	0
71										0					0
72				0		0				1					0
73														0	
74	0									1					
75															
76															
77															
78		0			0										
79															
80									0						
81															
82															
83															
Total	**8106**	**9897**	**8709**	**9679**	**7925**	**8329**	**12255**	**4023**	**9249**	**7463**	**3766**	**2466**	**1854**	**2200**	**2491**
Landings (t)	**292**	**353**	**315**	**277**	**249**	**318**	**351**	**345**	**304**	**232**	**139**	**98**	**65**	**74**	**88**

Table 12.2.2.a. FU 28-29 - Length Composition of Nephrops Males (1984-2013)

Landings

Age/Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
17															
18															
19					0				2	0					
20	4				0		4		3	1	0	0			
21	3	3	0	2	0	0	33		5	0	0	0			
22	0	16	1	2	13	4	51	10	20	8	2		0	3	
23	5	8	3	1	3	15	32	22	31	10	4		1	0	3
24	9	20	5	2	11	20	107	53	53	26	29	8	0	8	
25	39	13	6	3	40	45	120	46	65	28	30	10	1	27	8
26	33	58	8	11	56	126	153	75	121	32	38	8	3	37	6
27	49	85	24	24	87	187	206	94	111	52	63	22	6	47	27
28	68	44	24	48	62	205	286	144	141	60	89	14	4	37	25
29	109	148	53	60	147	246	330	220	189	62	83	33	5	143	55
30	133	87	74	139	248	300	533	290	297	60	129	44	5	158	84
31	272	111	92	123	188	277	573	270	256	93	116	75	22	248	82
32	88	161	274	233	325	475	757	378	295	129	135	116	32	573	217
33	182	92	139	281	248	352	437	247	246	108	80	78	21	329	109
34	152	160	224	257	264	352	574	311	327	150	94	104	52	436	276
35	175	100	173	274	275	347	333	194	252	121	76	83	31	356	155
36	143	158	163	265	195	224	263	168	256	83	59	77	34	248	191
37	128	162	167	247	234	167	293	172	224	109	57	78	64	211	145
38	75	106	99	254	197	147	226	164	265	73	58	125	69	206	216
39	180	81	109	229	174	93	175	100	173	75	61	71	39	126	95
40	83	96	159	254	215	165	152	100	188	77	63	84	44	112	162
41	184	102	130	163	163	108	129	125	163	102	53	55	49	114	113
42	58	91	195	163	168	177	152	190	198	128	105	75	68	140	171
43	102	47	181	167	172	113	118	95	82	76	38	51	45	79	64
44	63	86	173	122	121	122	176	144	90	61	51	65	43	87	89
45	111	61	140	113	103	131	140	96	83	60	25	39	19	52	42
46	67	85	144	106	76	103	117	118	71	38	25	26	15	46	81
47	59	88	120	111	75	97	113	61	60	48	25	43	18	47	89
48	40	55	80	104	83	90	66	54	65	48	23	35	12	30	67
49	50	37	79	86	59	58	52	41	38	34	24	23	12	32	53
50	32	65	93	103	94	82	69	28	42	36	20	25	11	19	59
51	32	34	71	72	65	41	40	30	37	27	17	20	15	17	37
52	8	53	88	94	73	65	45	37	48	29	32	30	24	33	47
53	13	18	41	69	58	31	22	22	21	24	13	16	9	22	18
54	15	31	54	53	57	50	24	33	27	23	19	21	24	32	36
55	9	19	34	28	46	26	12	15	10	20	12	14	15	15	16
56	13	19	29	43	29	57	14	11	8	15	13	8	25	24	20
57	8	19	37	37	25	16	9	6	6	17	11	9	25	20	15
58	4	13	23	26	21	12	9	7	7	20	7	11	45	7	12
59	4	10	15	16	13	15	8	9	5	11	4	6	19	7	8
60	1	8	15	25	16	24	12	6	3	9	7	5	13	4	10
61	2	14	9	11	8	11	8	8	4	8	4	5	7	9	7
62	3	6	10	11	15	16	8	8	3	15	8	6	22	3	1
63	2	1	4	11	11	7	7	7	1	8	4	6	7	2	4
64	1	1	9	11	8	10	10	7	1	10	6	5	17	2	3
65	0	4	6	5	4	3	10	7	1	9	2	3	9	1	1
66		1	5	8	3	7	3	4	2	11	1	3	5	3	2
67			4	3	5	2	2	6	1	6	1	3	3	3	1
68			1	6	6	2	3	4	0	8	0	4	3	3	1
69		0	3	3	2	2	2	4	1	4	1	0	2	1	
70		0	6	2	4	3	4	5	0	4	1	0	1	3	1
71			2	2	4	1	1	3	1	2	0	0	0	1	
72			2	2	4	1	3	4	0	3	1	0	1	3	0
73		0	0	1	1	1	2	2		1	0	0	1	1	
74			0	1	1	1	3	1		1	1	0	1	1	
75			0	1	0	0	1	1		1	1	2	0	1	
76			0	0	0	0	0	1		1	0		0	0	
77				0	0	0	0	1		1	0	0	0	0	
78						0	1			0			0		
79				0		0	1	0		0	0			0	
80							0			0			0		
81								0		0	0				
82				0				0		0	0				
83										0					
Total	**2811**	**2680**	**3602**	**4486**	**4575**	**5233**	**7036**	**4259**	**4598**	**2280**	**1822**	**1649**	**1018**	**4170**	**2928**
Landings (t)	**116**	**117**	**190**	**222**	**205**	**205**	**231**	**162**	**159**	**114**	**73**	**79**	**72**	**149**	**132**

Table 12.2.2.b. FU 28-29 - Length Composition of Nephrops Females (1984-2012)

Landings (thousands)

Age/Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
17															
18					4										
19		0				35					0				
20	3	1	7		8	21				18					
21	1	1	22	3	21	102		21	9	49					
22	8	21	30	78		88	19	11	102	63			0	13	2
23	66	21	7	31	28	135	15	69	38	21	2		0	0	4
24	79	102	118	270	153	258	38	173	164	41	22	2	11	20	15
25	228	205	104	357	163	197	138	198	203	191	73		13	20	25
26	272	284	186	684	220	282	140	436	361	111	92	1	35	102	74
27	345	491	359	902	429	326	247	418	448	235	134	0	37	77	91
28	431	523	322	1421	471	231	345	598	597	413	170	6	36	152	148
29	443	672	419	1253	516	285	491	590	514	523	269	31	45	178	114
30	422	588	381	928	499	317	575	771	599	775	326	104	50	199	199
31	487	593	418	948	482	501	639	414	736	752	427	182	95	394	168
32	485	653	700	946	766	306	859	807	617	824	558	322	198	502	376
33	613	415	406	227	527	314	596	375	430	449	283	251	53	163	116
34	618	467	654	774	813	511	734	310	369	359	353	641	209	278	298
35	562	563	447	447	460	435	519	284	287	194	246	674	184	150	112
36	469	329	316	386	489	274	243	130	267	203	237	811	142	135	166
37	505	353	400	223	206	318	189	108	333	154	147	692	267	129	171
38	383	284	330	269	265	285	207	135	251	100	128	348	151	39	48
39	274	142	211	146	288	148	216	74	176	150	66	194	67	35	59
40	171	119	80	119	132	131	230	131	147	110	114	344	120	21	89
41	58	106	55	65	128	149	73	39	68	108	77	361	63	31	64
42	50	36	133	54	43	127	210	62	69	95	73	165	111	18	84
43	30	27	21	40	28	109	58	82	26	43	23	64	29	2	34
44	17	13	47	147	27	91	77	6	46	42	43	88	90	18	71
45	14	11	27	84	19	27	41	21	40	34	13	54	36	8	22
46	7	6	5	40	14	38	31	45	25	37	11	13	15	4	28
47	5	3	3	26	9	24	16	7	12	29	7	18	23	3	23
48	4	1		71	11	29	7	15	18	15	4	15	8	2	6
49	1	0	3	17	4	9	1	17	17	23	4	1	6	7	6
50	1	0		2	6	3	1	2	32	8	17	1	2	1	6
51	0	0	3	4	3	7	2	4	4	5	0			1	2
52	1			5	5	8	1		5	6	1	1	0	1	1
53	2			2	3	1			9	6	0			0	0
54				4	1	1			1	1			1	0	1
55				0	1	1			6	2					
56				3	0	2		5	14	5					0
57				0	0	1			4	1			0		0
58				0		0			4	1					
59				1	0	0									
60					0				1	0					
61						1									
62															
63									4	1					
64															
65															
66															
67															
68									4	1					
69															
70															
71															
72															
73															
74															
75															
76															
77															
78															
79															
80															
81															
82															
83															
Total	**7052**	**7032**	**6218**	**10978**	**7243**	**6126**	**6962**	**6358**	**7059**	**6198**	**3920**	**5385**	**2095**	**2702**	**2621**
Landings (t)	**169**	**156**	**150**	**232**	**171**	**151**	**174**	**134**	**165**	**145**	**97**	**174**	**67**	**62**	**72**

Table 12.2.2.b. FU 28-29 - Length Composition of Nephrops Females (1984-2012)

Landings															
Age/Year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
17					0										
18						0				0					
19					1				2	0					
20			0		0	0	8		4	1					
21		3	1	0	3	12	48	3	15	2	1			7	
22	5	18	0		3	10	88	14	26	12	1	0			3
23	4	6	7	0	9	43	54	37	34	11	4	1	1		7
24	25	49	7	10	19	62	135	44	53	25	22	10	1	5	7
25	27	24	15	11	36	101	129	55	130	23	23	11	1	8	18
26	94	81	24	15	67	211	272	113	227	38	80	12	3	17	7
27	76	139	34	34	67	266	294	152	298	73	138	20	7	40	36
28	100	64	44	107	98	336	242	179	355	81	170	26	7	51	33
29	121	171	90	127	173	395	420	392	458	123	149	51	4	130	59
30	236	152	131	237	241	406	654	321	365	145	205	67	7	164	119
31	263	131	167	195	152	334	565	305	317	129	132	99	26	330	129
32	485	283	316	296	360	530	857	510	409	252	209	145	45	397	290
33	187	153	184	467	270	433	448	272	253	182	110	91	51	195	194
34	346	235	252	429	314	400	462	341	386	177	122	140	96	297	278
35	287	193	158	470	255	324	254	249	351	187	103	120	56	165	232
36	317	225	174	351	194	222	203	162	213	103	83	144	60	138	166
37	201	213	144	302	203	178	182	142	240	121	90	119	73	98	199
38	184	85	108	300	206	151	178	152	247	134	83	106	151	76	206
39	151	92	112	213	160	113	89	173	138	123	86	95	113	46	61
40	111	79	133	186	284	136	84	114	109	125	62	80	68	46	67
41	81	66	79	110	170	82	73	129	73	95	83	65	65	37	41
42	73	67	91	80	192	122	116	112	56	75	94	52	80	35	65
43	38	41	55	87	132	70	70	44	16	30	25	28	80	33	9
44	34	49	56	57	75	66	61	46	21	24	43	40	41	27	13
45	18	23	29	51	68	66	50	35	18	28	17	25	21	10	9
46	18	38	33	40	37	51	39	54	19	14	22	19	11	10	11
47	7	52	26	25	25	44	35	23	9	26	16	18	15	11	13
48	9	25	12	24	28	37	18	11	8	20	7	12	9	5	7
49	4	21	15	19	18	24	24	7	7	13	6	7	7	6	5
50	5	10	15	26	24	20	23	7	3	13	8	7	2	6	5
51	2	10	9	22	14	13	17	11	5	11	3	6	5	6	1
52	3	16	6	19	21	13	17	7	3	7	3	4	4	9	5
53		6	6	10	13	8	10	2	1	8	3	2	3	5	1
54		5	2	2	14	7	6	9	1	8	1	2	5	5	3
55		1	2	3	10	4	5	1	1	3	4	0	5	2	1
56		3	1	3	7	6	2	1	0	3	0	0	2	1	1
57		1	0	2	4	2	3	1		1	0	0	1	3	2
58			1	1	1	2	0	1	0	1	1	0	4	2	0
59		0	1	0	0	1	1	1			0	0	2	0	1
60			0		0		2			1		0	2	0	
61		3	1		0	1					0	0	1	0	
62				0	0	0	1	0				0	0	0	0
63			0	0			0				0	0	2	0	
64						1	0		0	0	0			0	
65						0	0						0		
66		0	0				0								
67													0		
68															
69															
70						0					0				
71															
72															
73															
74															
75															
76															
77															
78															
79															
80															
81															
82															
83															
Total	**3509**	**2829**	**2540**	**4332**	**3969**	**5304**	**6240**	**4229**	**4871**	**2449**	**2211**	**1628**	**1138**	**2424**	**2306**
Landings (t)	**95**	**84**	**79**	**135**	**130**	**140**	**151**	**112**	**114**	**74**	**60**	**52**	**45**	**65**	**66**

Table 12.3.1. *Nephrops* FU30, Gulf of Cadiz: Landings in tonnes.

Year	Spain**	Portugal	Total
1994	108		108
1995	131		131
1996	49		49
1997	97		97
1998	85		85
1999	120		120
2000	129		129
2001	178		178
2002	262		262
2003	303	4	307
2004	143	4	147
2005	243	3	246
2006	242	4	246
2007	211	4	215
2008	117	3	120
2009	117	2	119
2010	106	1	107
2011	93	3	96
2012	115	1	116
2013	26	<1	26

** Ayamonte landings are included since 2002

Table 12.3.2. ***Nephrops*** **FU30, Gulf of Cadiz: Mean carapace length of the discarded and retained fraction of** ***Nephrops*****, and percentage of discarded (2005-2013) 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

Table 12.3.3. ***Nephrops*** **FU30, Gulf of Cádiz. 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

ns = no survey

**= no sampled

Table 12.3.4. ***Nephrops*** **FU30, Gulf of Cádiz. Total landings and landings, LPUE and effort at the bottom trawl fleet making fishing trips with at least 10%** ***Nephrops*** **catches.**

Year	**Total landings (t)	*Landings (t)	*LPUE (kg/day)	*Effort (Fishing days)
1994	108	90	98.6	915
1995	131	107	99.4	1079
1996	49	40	88.2	458
1997	97	75	79.2	943
1998	85	51	62.3	811
1999	120	83	66.2	1259
2000	129	90	60.6	1484
2001	178	130	67.7	1924
2002	262	196	69.4	2827
2003	307	214	75.4	2840
2004	147	98	44.3	2206
2005	246	228	52.7	4336
2006	246	227	64.0	3555
2007	215	198	63.7	3105
2008	120	84	72.9	1150
2009	119	83	50.0	1653
2010	107	73	45.5	1603
2011	97	62	54.6	1135
2012	116	80	58.0	1380
2013	26	24	92.1	262

*Landings, LPUE and fishing effort from fishing trips with at least 10% *Nephrops*.

** Ayamonte landings are included since 2002

Table 12.1. Total recorded landings in Division IXa

	Division IXa - Management Area Q																			
	FU 26+27 West Galicia + North Portugal										FU 28+29 SW+S Portugal						FU 30 Gulf Cadiz			Q Total
	26*			27						Total	28***	29	28+29			Total	30		Total	
	Portugal	Spain	Total	Portugal			Spain	alloca	Total		Spain	Spain	Portugal				Portugal	Spain		
Year	Trawl	Trawl		Artisanal	Trawl	Total	Trawl				Trawl	Trawl	Artisanal	Trawl	Total		Artisanal	Trawl		
1975		622	622							622	137	1510		34	34	1681				2303
1976		603	603							603	132	1752		30	30	1914				2517
1977		620	620							620	95	1764		15	15	1874				2494
1978		575	575							575	120	1979		45	45	2144				2719
1979		580	580							580	96	1532		102	102	1730				2310
1980		599	599							599	193	1300		147	147	1640				2239
1981		823	823							823	270	1033		128	128	1431				2254
1982		736	736							736	130	1177		86	86	1393				2129
1983		786	786							786				244	244	244				1030
1984		604	604		14	14			14	618				461	461	461				1079
1985		750	750	4	11	15			15	765				509	509	509		257	257	1531
1986		657	657	9	28	37			37	694				465	465	465		221	221	1380
1987		671	671	19	52	71			71	742			11	498	509	509		302	302	1553
1988		631	631	41	55	96			96	727			15	405	420	420		139	139	1286
1989		620	620	22	66	88			88	708			6	463	469	469		174	174	1351
1990		401	401	17	31	48			48	449			4	520	524	524		220	220	1193
1991		549	549	14	40	54			54	603			5	473	478	478		226	226	1307
1992		584	584	15	37	52			52	636			1	469	470	470		243	243	1349
1993		472	472	14	36	50			50	522			1	376	377	377		160	160	1059
1994		426	426	8	14	22			22	448				237	237	237		108	108	793
1995		501	501	1	9	10			10	511			1	272	273	273		131	131	915
1996		264	264		17	17	50		67	331			4	128	132	132		49	49	512
1997		359	359		6	6	68		74	433			2	134	136	136		97	97	666
1998		295	295		8	8	42		50	345			2	159	161	161		85	85	591
1999		194	194	5	<1	6	48		54	248			5	206	211	211		120	120	578
2000		102	102	8	1	9	21		30	132			4	197	201	201		129	129	462
2001		105	105	4	2	6	21		27	132			2	269	271	271		178	178	582
2002		59	59	4	<1	4	24		28	87			1	358	359	359		262	262	708
2003		39	39	7	1	8	26		34	73			35	335	370	370	4	303	307	749
2004		38	38	8	<1	9	24		33	71			31	345	375	375	4	143	147	593
2005		16	16	10	1	11	16		27	43			31	360	391	391	3	243	246	679
2006		15	15	12	<1	12	17		29	44			17	274	291	291	4	242	245	580
2007		20	20	8	1	10	17		27	47			18	274	291	291	4	211	214	552
2008		17	17	7	6	13	12		25	42			35	188	223	223	3	117	120	384
2009		16	16	4	6	10	5		15	31			17	133	151	151	2	117	119	300
2010		3	3	2	2	4	14		19	21			16	131	147	147	1	106	107	275
2011		8	8	2	2	4	8	7	20	27		17	16	117	133	150	3	93	96	273
2012		3	3	1	<1	1	4		6	8	<1	14	3	211	214	229	1	115	116	353
2013**		1	1	1	<1	1	<1		1	3		10	1	198	199	209	<1	26	26	238

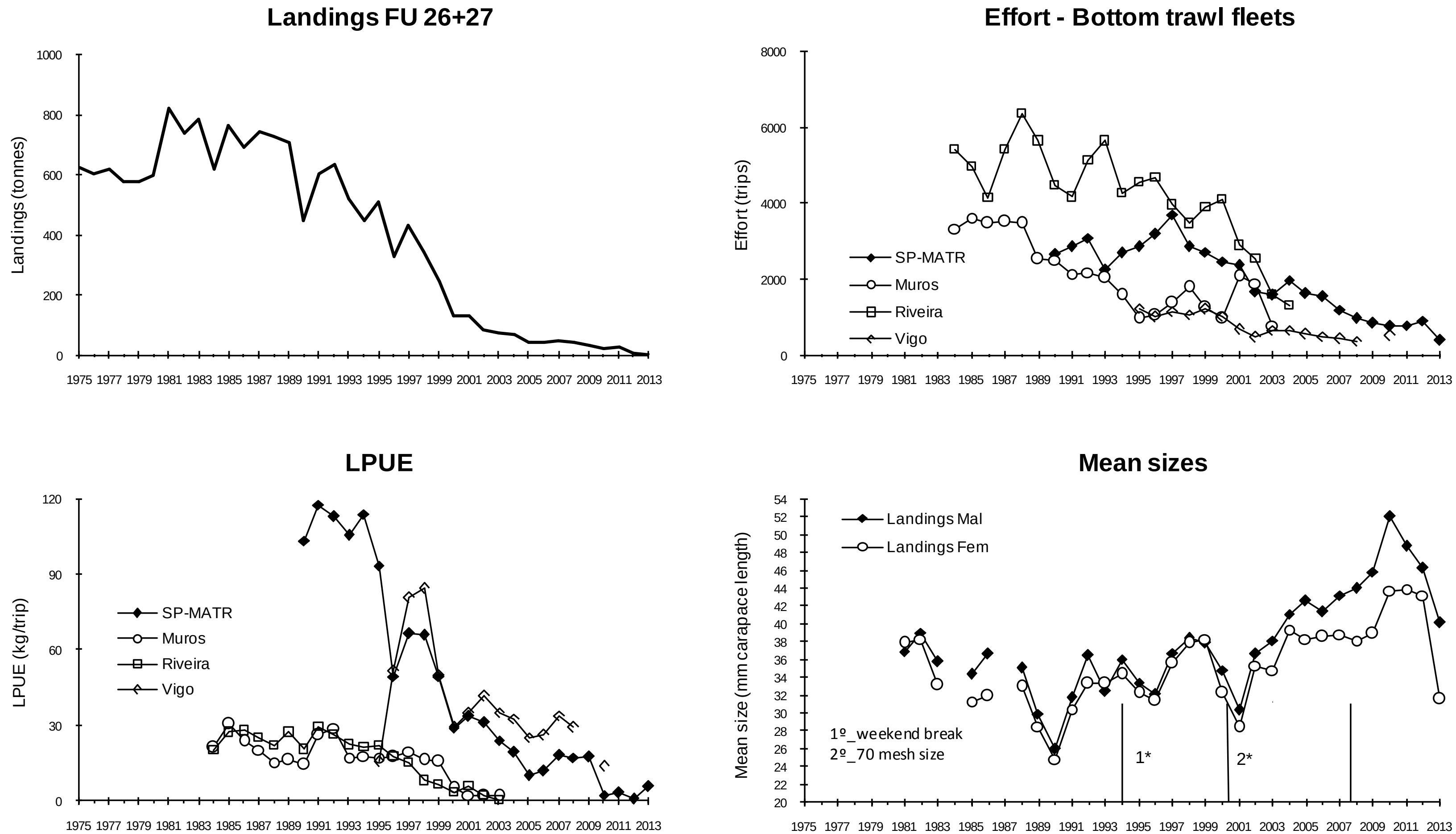
* Prior 1996, landings of Spain recorded in FU 26 include catches in FU 27

** Preliminary values

*** Spanish landings from FU28 included in FU29

Table 12.2. Division IXa. TAC and recorded landings

Year	TAC (tonnes)	Total Landings (tonnes)
1995	2500	915
1996	2500	512
1997	2500	666
1998	2500	591
1999	2000	578
2000	1500	462
2001	1200	582
2002	800	693
2003	600	718
2004	600	593
2005	540	690
2006	486	580
2007	437	552
2008	415	384
2009	374	300
2010	337	275
2011	303	273
2012	273	353
2013	246	238
2014	221	



1* -weekend break in West Galicia, 2*- 70 mm mesh size, 3*-recovery plan

Figure 12.1.1. ***Nephrops*** **FU26-27, West Galicia and North Portugal. Long-term trends in landings, effort and mean sizes.**

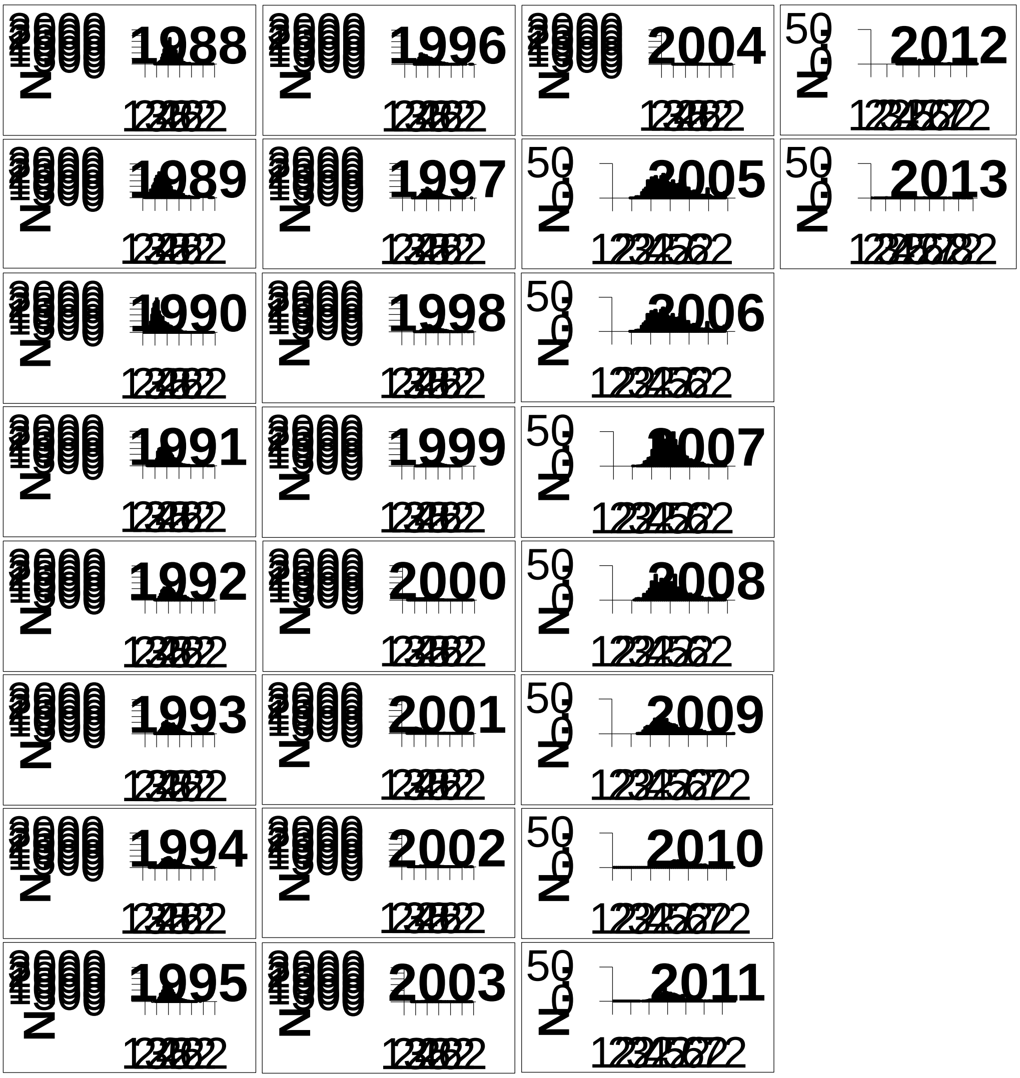


Figure 12.1.2. ***Nephrops*** **FU26-27. West Galicia and North Portugal. Length distributions in landings for the 1988-2013 period. Y-axis scale has been changed.**

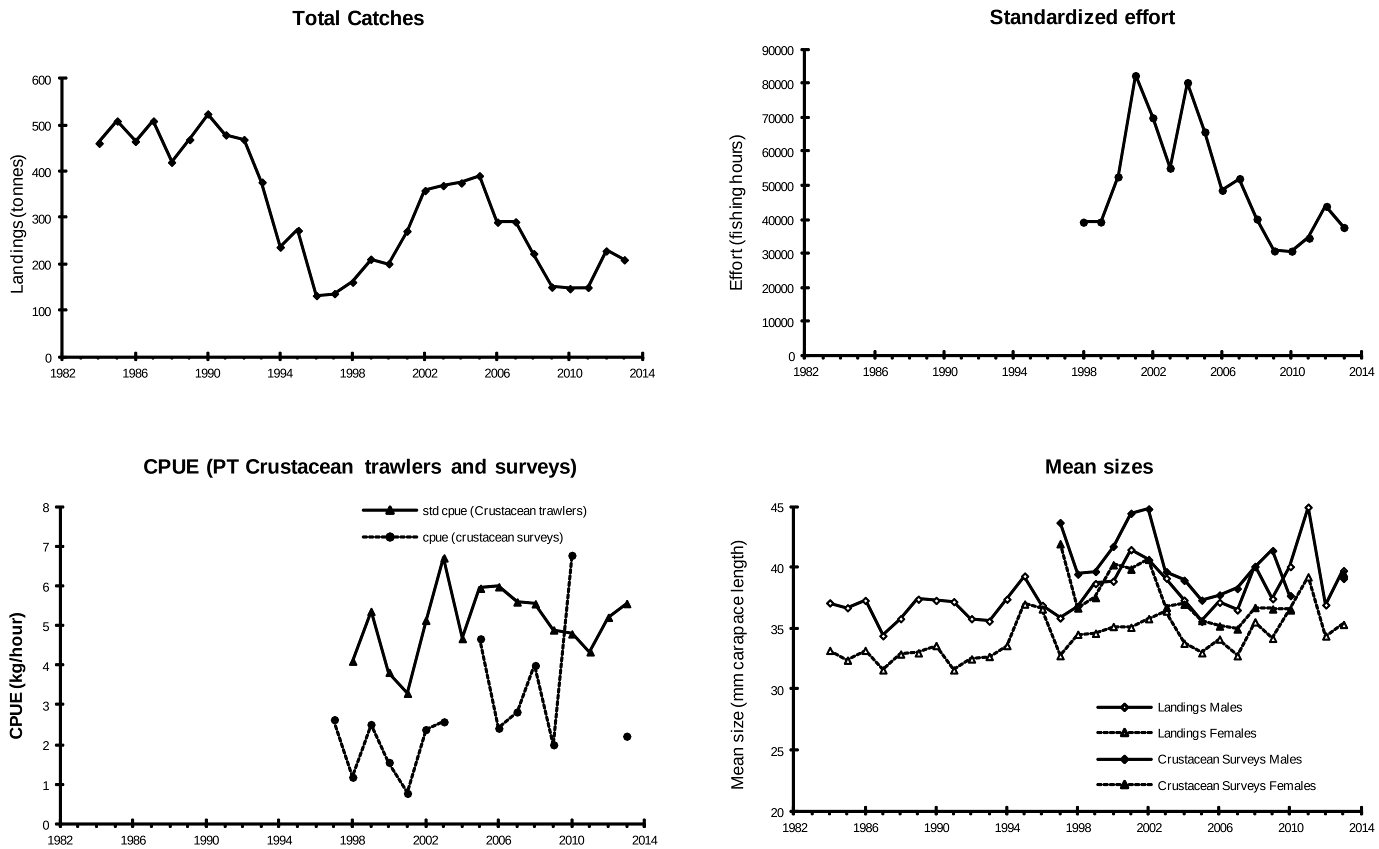


Figure 12.2.1. SW and S Portugal (FU 28+29): landings, effort, biomass indices and mean sizes of *Nephrops* in Portuguese landings and surveys. Note: Values of CPUEs and effort updated with the new CPUE standardization.

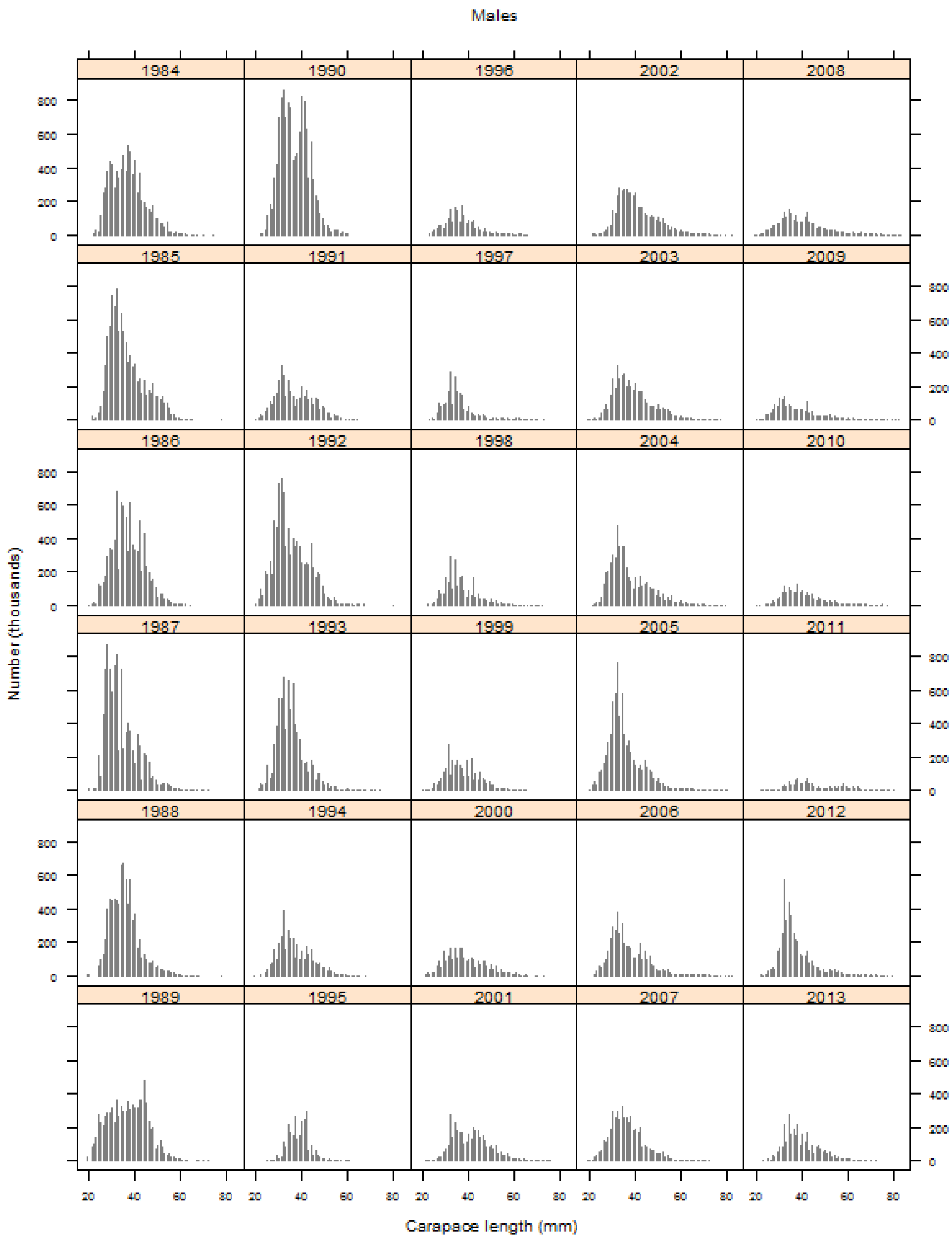


Figure 12.2.2.a. SW and S Portugal (FU 28-29) male length distributions for the period 1984-2013.

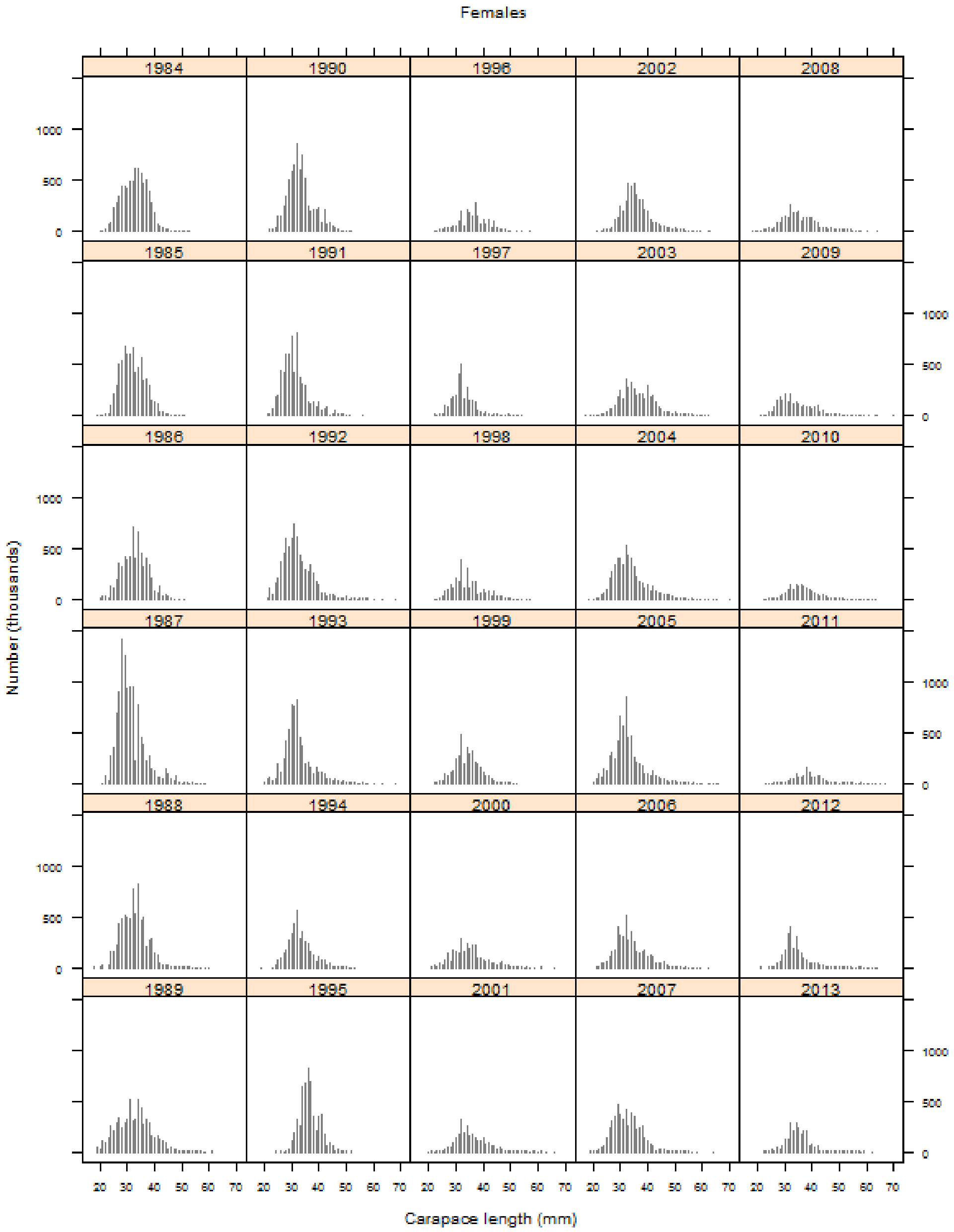


Figure 12.2.2.b. SW and S Portugal (FU 28-29) female length distributions for the period 1984-2013.

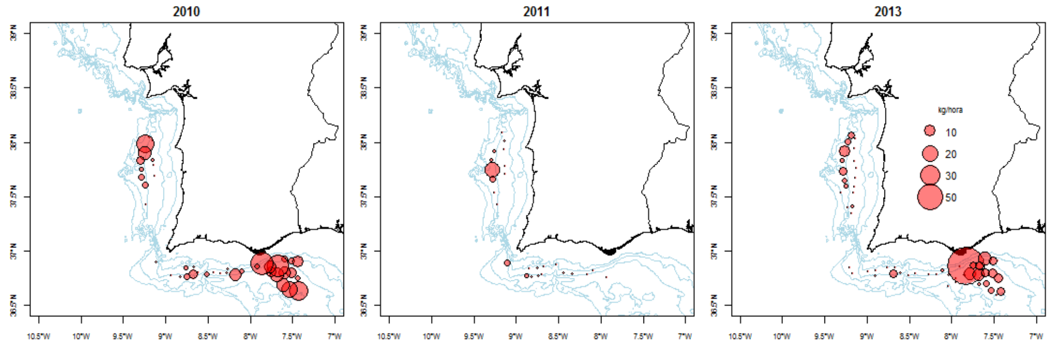


Figure 12.2.3. Spatial distribution of *Nephrops* biomass survey index in the period 2010-2013. The 2011 survey was not completed and the distribution area not entirely covered.

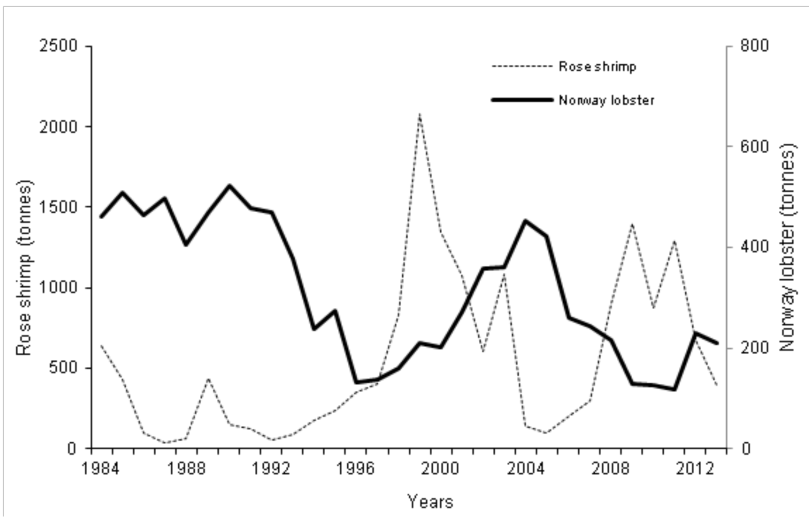


Figure 12.2.4 FUs 28-29: Portuguese Crustacean Landings in the period 1984-2011.

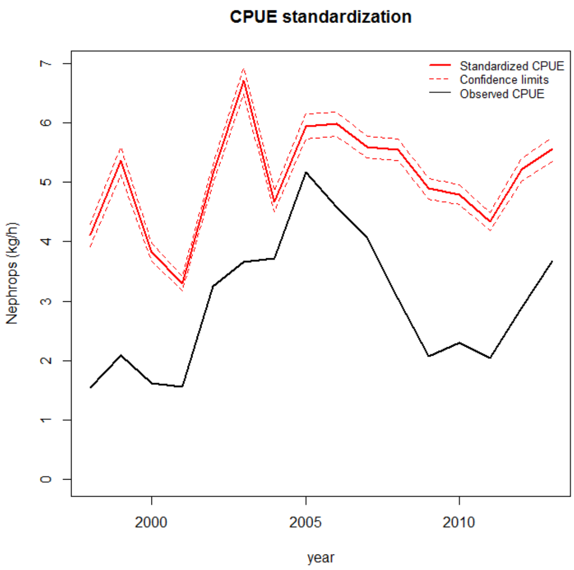


Figure 12.2.5. Comparison of standardized and observed *Nephrops* CPUE.

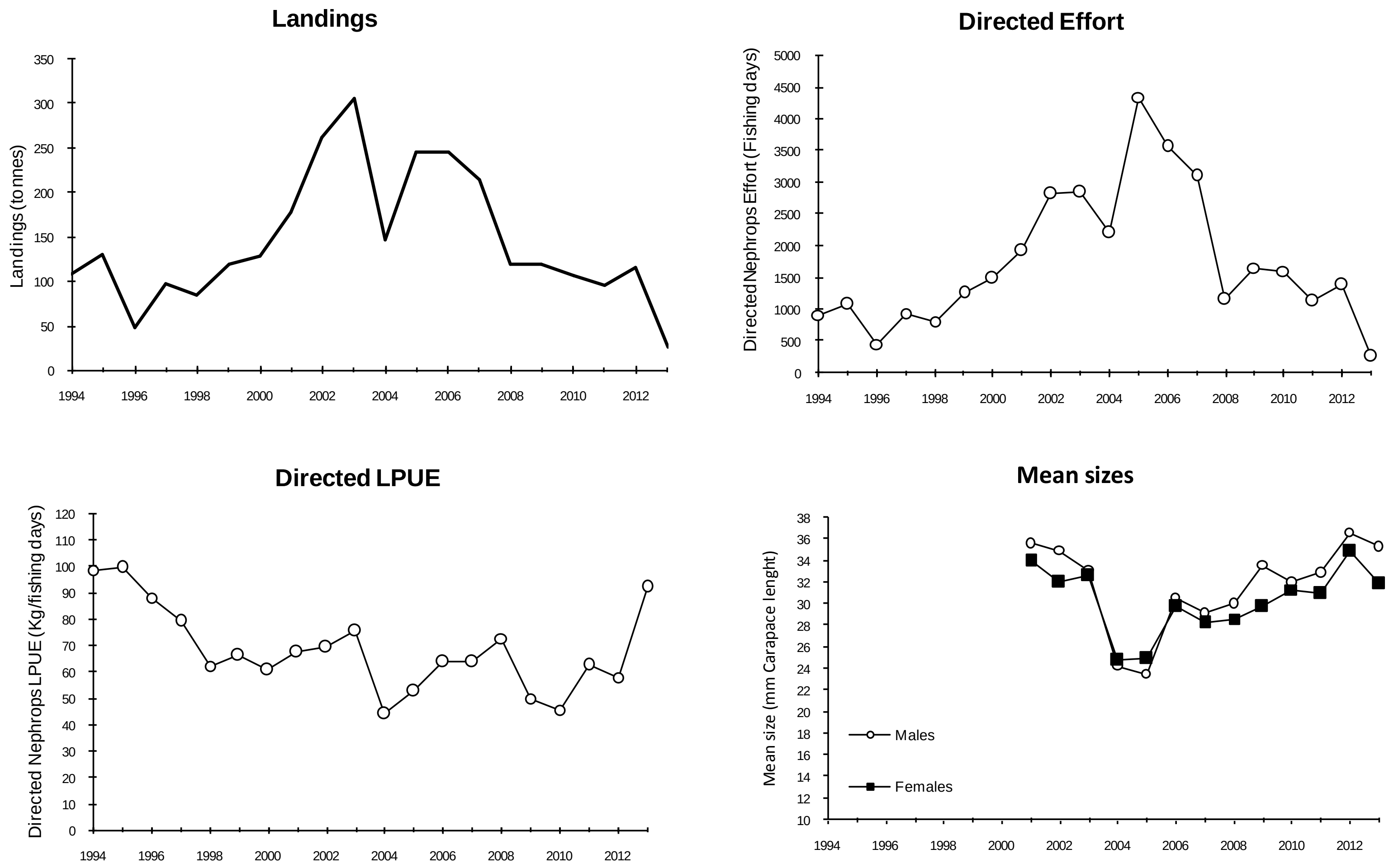


Figure 12.3.1. ***Nephrops*** **FU 30, Gulf of Cádiz. Long term trends in landings,** ***Nephrops*** **directed effort and LPUE and mean sizes.**

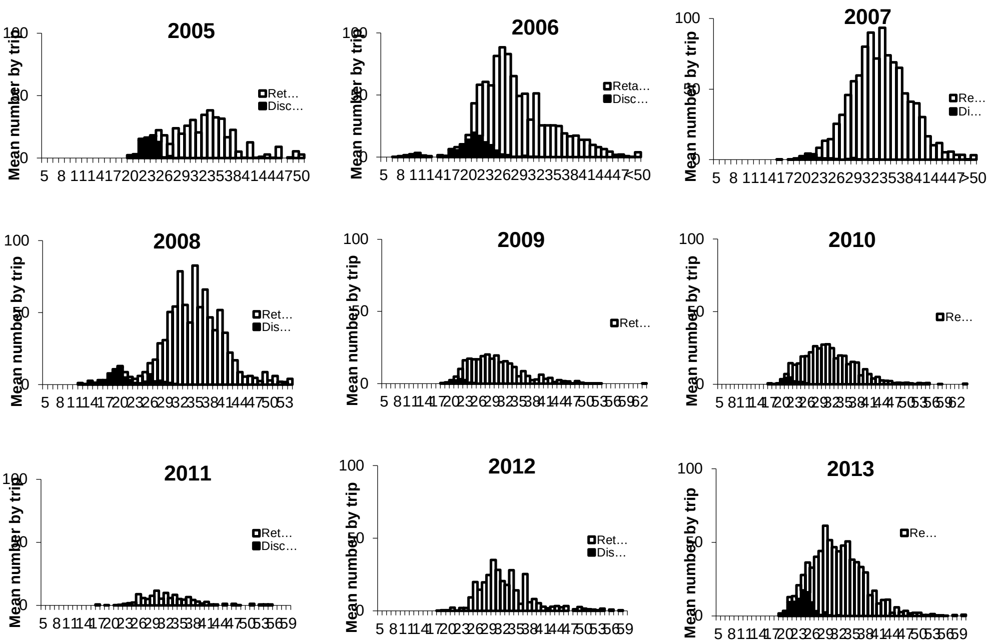


Figure 12.3.2. ***Nephrops*** **FU 30, Gulf of Cadiz. Length distribution of retained and discarded fractions** ***Nephrops*** **from discards program (2005-2013 period).**

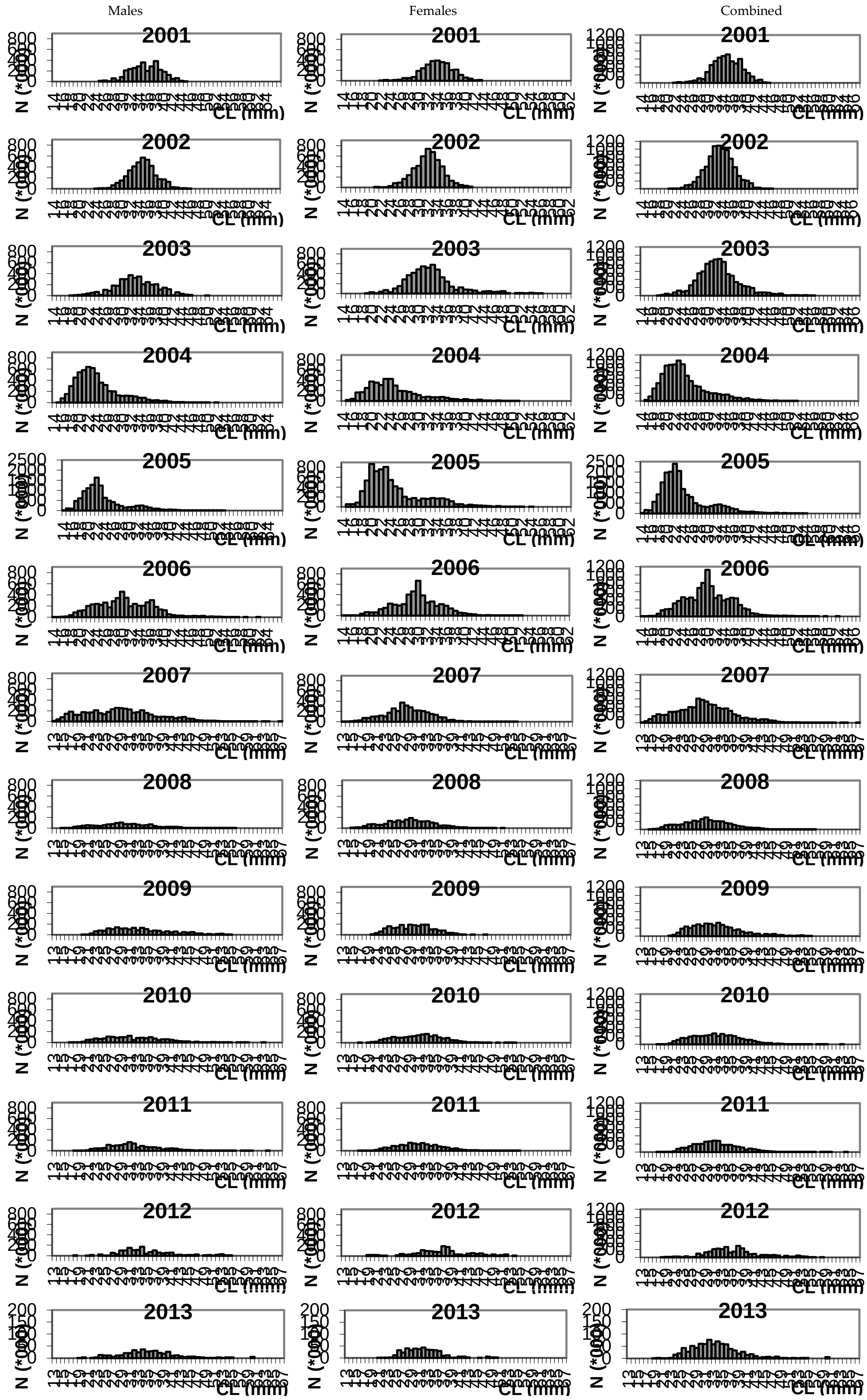
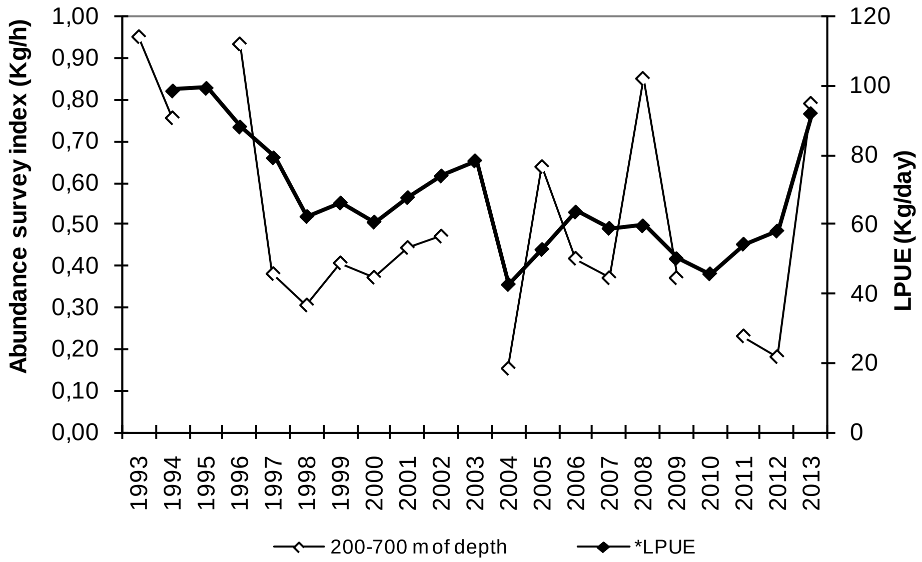


Figure 12.3.3. ***Nephrops*** **FU30, Gulf of Cádiz. Length distributions of landings for the period 2001-2013. Y-axis scale has been changed in 2013.**



* 1995 and 2010: strata 500-700 m no sampled

** 2003: no survey

Figure 12.3.4. ***Nephrops*** **FU30, Gulf of Cádiz, Abundance index from Spanish bottom trawl spring surveys (SPGFS-cspr-WIBT-Q1) and commercial directed** ***Nephrops*** **LPUE from the bottom trawl fleet.**

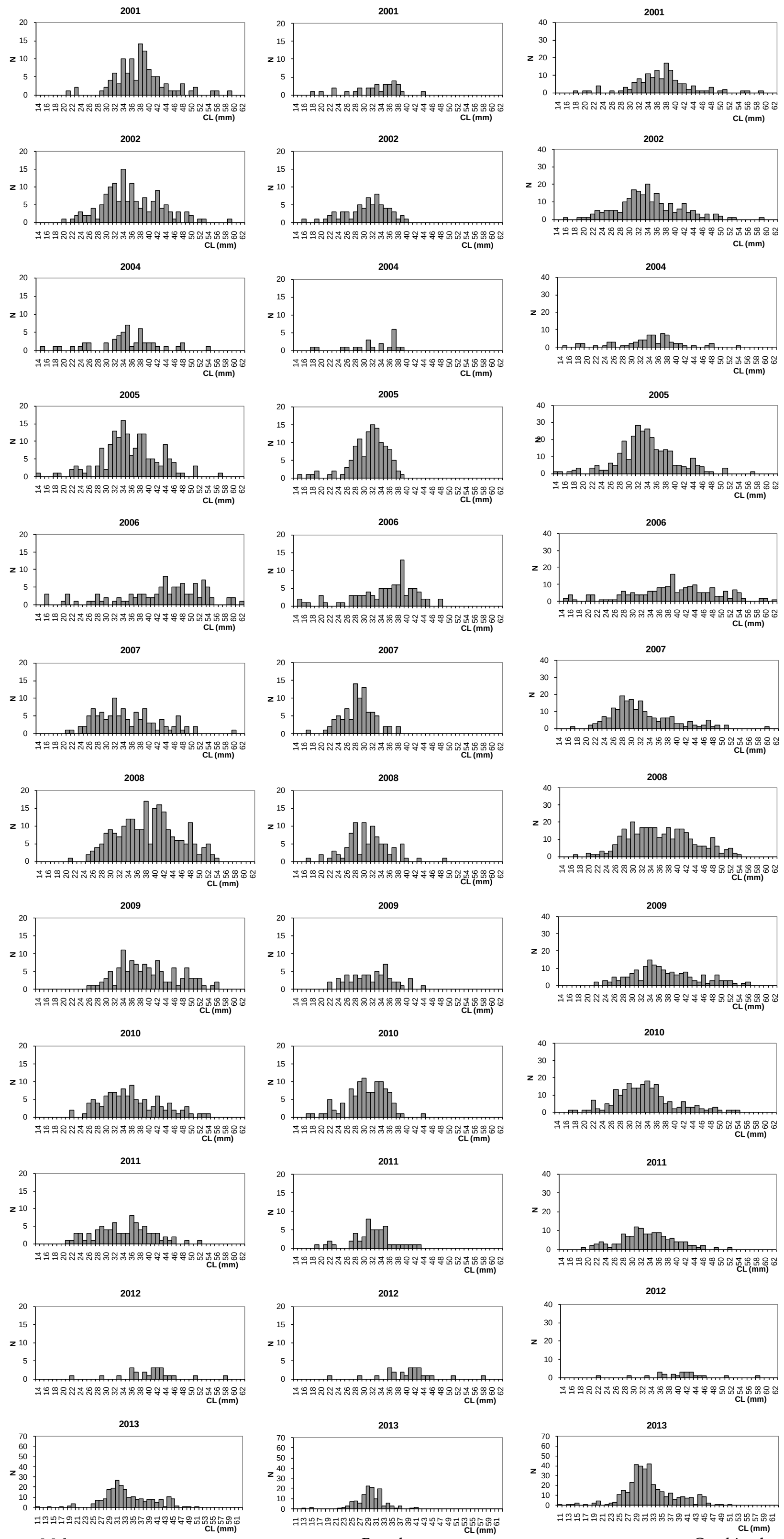


Figure 12.3.5. ***Nephrops*** **FU30, Gulf of Cádiz. Length distributions from Spanish bottom trawl surveys (SPGFS-cspr-WIBTS-Q1) for 2001-2013 period. Y-axis scale has been changed in 2013.**

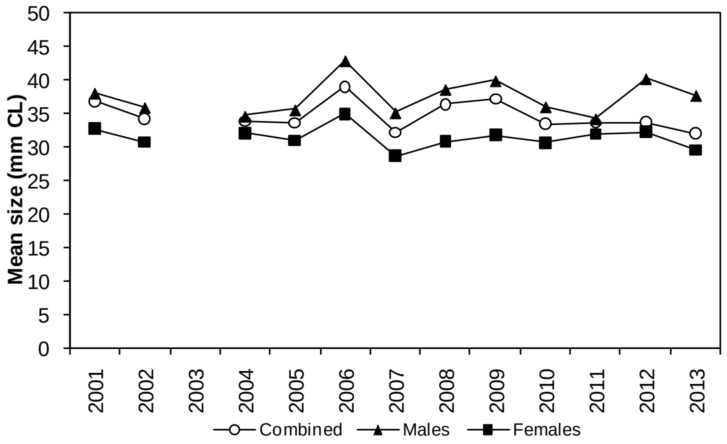


Figure 12.3.6. ***Nephrops*** **FU30, Gulf of Cádiz. Mean size in spring bottom trawl surveys (SPGFS-cspr-WIBTS-Q1) for the period 2001-2013.**

13 New Species

13.1 European Seabass in Division VIIIa,b

13.1.1 Stock ID and sub-stock structure

Bass Dicentrarchus labrax is a widely distributed species in northeast Atlantic shelf waters with a range from southern Norway, through the North Sea, the Irish Sea, the Bay of Biscay, the Mediterranean and the Black Sea to North-west Africa. The species is at the northern limits of its range around the British Isles and southern Scandinavia. Stock identity of European seabass was reviewed by WGNEW 2012 and further considered at ICES IBP-NEW 2012.

13.1.2 Recommendations for stock identity

The IBP New 2012 reports that it is clear that further studies are needed on sea bass stock identity, using conventional and electronic tagging, genetics and other individual and population markers (e.g. otolith microchemistry and shape), together with data on spawning distribution, larval transport and VMS data for vessels tracking migrating sea bass shoals, to con-firm and quantify the exchange rate of sea bass between sea areas that could form management units for this stock.

In the absence of new information the pragmatic view of WGNEW2013 is to continue to assume the presence of discrete sea bass stocks off southern Ireland and in the Bay of Biscay / IXa. It should be discussed in WGHMM 2014 for this component.

The pragmatic view of IBP-NEW 2012 was to structure the baseline stock assessments into four units:

<u>Assessment area 1</u>. Sea bass in ICES areas IVbc, VIId, VIIe,h and VIa,f&g (lack of clear genetic evidence; concentration of area IV bass fisheries in the southern North Sea; seasonal movements of bass across ICES Divisions). This is a relatively data-rich area with data on fishery landings and length/age composition by fleet; discards estimates; growth and maturity parameters; juvenile surveys, fishery LPUE trends.

<u>Assessment area 2</u>. Sea bass in Biscay (ICES Sub area VIIIa,b). Available data are fishery landings, with length compositions from 2000; discards from 2009; some fishery LPUE.

<u>Assessment area 3</u>. Sea bass in VIIIc and IXa (landings, effort, discards)

<u>Assessment area 4.</u> Sea bass in Irish coastal waters (VIa, VIIb, VIIj). Available data: Recreational fishery catch rates; no commercial fishery operating.

Fishery landings of sea bass are extremely small in Irish coastal waters of VIIa and VIIg and the stock assessment for assessment area 1will not reflect the sea bass populations around the Irish coast, which may be more strongly affiliated to the population in area 4 off southern, western and northern Ireland.

Tagging shows movements of sea bass between VIIIa and southern parts of VIIh/VIIe. A sensitivity analysis of the stock assessment for sea bass includes a combined IV, VII and VIII assessment (assessment areas 1 & 2 excluding Irish populations for which there are no commercial fisheries).

13.1.3 Fisheries data

13.1.3.1.1 Commercial landings data

Sea bass in the Bay of Biscay, are targeted by France (more than 90% of international landings) by line fisheries which take place mainly from July to October and by pelagic trawlers, nets and in a mixed bottom trawl fisheries from November to April on pre spawning and spawning grounds when seabass is aggregated. In 2013 nets represent 33% of the landings of the area, lines (handlines+longlines) 29%, bottom trawl 18%, and pelagic trawl 6% (but It has to be note that pelagic trawlers were used from 2000 to 2008 to catch around 25% of the landings of the area decreasing to 9 (the pelagic fishery take place at present essentially in the Channel). In parallel a decrease of landings for liners is also observed from 2007.

An increase in the landings of danish seine is observed from 2009. In 2013 it represents 8% of the landings (37 tons in 2010 and 204t in 2013)

In France, the market value seabass depends greatly on how its caught, giving added value to certain metiers as liners: according to auction, mean price of seabass sold by liners was 14.92€ per kg in 2009 compared with €5.99 per kg for pelagic trawl, 8.21€ per Kg for Bottom trawlers and 8.92€ per Kg for nets, reflecting differences in volume landed and fish condition.

Spain is responsible for 6% of the catches of the area (VIIIb essentially) in 2013, mainly with bottom otter trawlers. Discarding is thought to be low because of the high value of the fish; some discards could occurred due to individual quota limitations but are not quantified.Spanish bass landings from Division VIIIa,b,d have increased to around 20 tons in the 90's to around 150 tons in the middle of the 2000's, then to 317 tons in 2011. UK landings from this area are very low, usually inferior to 5 tons per year. Recreational fisheries are an important part of the total removals but these are not accurately quantified. Table 1 presents official and ices landings.

Table 1: Sea bass in the VIIIab area. ICES and official landings (tons).

VIIIab	Belgium	France	France	Netherlands	Spain	Spain	UK(Eng+Wales+N.Irl+Scotland)
Source	official stats	official stats	Ices stats	official stats	official stats	Ices stats	official stats
1978	0	1146	1146	0	0		0
1979	0	1132	1132	0	0		0
1980	0	1086	1086	0	0		0
1981	0			0	0		0
1982	0			0	0		0
1983	0	1363	1363	0	0		0
1984	0	2886	2886	0	0		0
1985	0	2477	2477	0	0		0
1986	0	2606	2606	0	0		0
1987	0	2474	2474	0	0		5
1988	0	2274	2274	0	0		15
1989	0	2201	2201	0	0		0
1990	0	1678	1678	0	0		0

1991	0	1774	1774	0	17		0
1992	0	1752	1752	0	14		0
1993	0	1595	1595	0	14		0
1994	0	1708	1708	0	17		0
1995	0	1549	1549	0	0		0
1996	0	1459	1459	0	0		0
1997	0	1415	1415	0	0		0
1998	0	1261	1261	0	27		0
1999	0	0	2080	0	11		0
2000	0	2080	2295	0	67		0
2001	0	2020	2238	3	68		0
2002	0	1937	2216	0	176		0
2003	0	2812	2497	0	119		0
2004	0	2561	2284	0	96		0
2005	0	3184	2722	0	74		0
2006	0	3318	2707	0	168		2
2007	1	2984	2677	0	74	90	1
2008	0	1508	2600	0	145		0
2009	1	2339	2152	0	194	126	0
2010	0	2322	2089	0	165	140	2
2011	1	2295	2297	0	311	278	0
2012	0	2325	2348	0		201	
2013	0		2532*	0		153	0

***Provisionnal**

13.1.4 Commercial discards

13.1.4.1 France

Discarding of sea bass by commercial fisheries can occur where fishing takes place in areas with bass smaller than the minimum landing size (36cm in most European countries), and where mesh sizes <100mm are in use. For 2009 it's estimated to be 44 tons, for 2010 44 tons, for 2011 20 tons, for 2012 37 tons and for 2013 68 tons (Table 2).

Table 13.1.4.1

year	Area	foCatEu5	Catches (t)	Landings (t)	Discards (t)	ratio (%)
2013	27.8.a	GTR_DEF	113	111 [106-113]	1,9 [0,0 -6,1]	1,7 [0-5,4]
2013	27.8.a	LLS_DEF	209	208 [207-209]	0,4 [0,0-1,3]	0,2 [0,0-0,6]
2013	27.8.a	OTB_CEP	63	10 [2-21]	53,4 [39,8-64,9]	84,8 [68,7-96,9]
2013	27.8.a	OTB_DEF	125	125 [125-125]	0,0 [0,0-0,0]	0,0 [0,0-0,0]
2013	27.8.a	SDN_DEF	167	167 [167-167]	0,0 [0,0-0,0]	0,0 [0,0-0,0]
2013	27.8.b	GNS_DEF	51	49 [46-51]	1,8 [0,4-4,6]	3,5 [0,9-8,8]
2013	27.8.b	GTR_DEF	411	402 [390-411]	9,2 [2,7-19,9]	2,3 [0,7-4,8]
2013	27.8.b	LLS_DEF	59	58 [56-59]	0,9 [0,2-2,2]	1,5 [0,4-3,8]
2013	27.8.b	OTB_CEP	8	8 [8-8]	0,0 [0,0-0,0]	0,0 [0,0-0,0]
2013	27.8.b	SDN_DEF	12	12 [12-12]	0,0 [0,0-0,0]	0,0 [0,0-0,0]

13.1.4.2 Spain

Observer data from Spanish vessels fishing in Areas VIII, have shown there was no seabass discard from 2003. No information in 2013 were available on discards for WGBIE.

Recreational catches

Recreational marine fishery surveys in Europe are still at an early stage in development (ICES WGRFS 2012). A french study targeting sea bass was conducted between 2009 and 2011 in VIIIa, VIIIb, VIIe, VIIh, VIId, Ivc. Estimates of sea bass catches were obtained from a panel of 121 recreational fishermen recruited during a random digit dialling screening survey of 15 000 households in the targeted districts (Atlantic and Chanel). The estimated recreational catch of bass in the Bay of Biscay and in the Channel was 3,170t of which 2,350t was kept and 830t released. The precision of the the combined Biscay & Channel estimate is relatively low (CV =-26%; note that the figure of 51% given in IBP-NEW 2012 was incorrect). This makes the confidence interval at 95% of the average (3170t) to [1554t;4786t].

13.1.5 Appropriate Reference Points (MSY)

IBP-NEW 2012 was not in a position to develop MSY reference points for seabass based on the SS3 runs. Further work is needed to develop biological reference points.

13.1.6 Future Research and data requirements

There are several important limitations to knowledge of sea bass populations, and deficiencies in data, that should be addressed in order to improve the assessments and advice for sea bass in the NE Atlantic. IBP-NEW2012 and WGNEW 2013 make the following recommendations:

Robust relative abundance indices are needed for adult bass in all areas. Their absence is a major deficiency which will reduce the accuracy of the assessment and the ability to make meaningful forecasts. The establishment of dedicated surveys on spawning grounds could provide valuable information on trends in abundance and population structure of adult bass as well as providing material for investigating stock structure and linkages with recruitment grounds.

Recruitment indices are needed for a wider geographic range including the Celtic/Irish Sea and Biscay areas.

Further research is needed to better understand the spatial dynamics of sea bass (mixing between ICES areas; effects of site fidelity on fishery impacts; spawning site – recruitment ground linkages; environmental influences)

Studies are needed to investigate the accuracy/bias in ageing, and errors due to age sampling schemes historically

Continued estimation of recreational catches is needed across the stock range, and information to evaluate historical trends in recreational effort and catches would be beneficial for interpreting changes in age-length compositions over time.

13.2 European Seabass Division VIIIc and IXa

13.2.1 Fisheries data

13.2.1.1 Commercial landings data

Landings series are given in Table 13.2.1 and are derived from :

i) Official statistics recorded in the Fishstat database since around the mid-1970s.

ii) Spanish landings for 2007-2011 from sale notes

iii) Portuguese estimated landings from 1986 to 2011 including distinction between Dicentrarchus labrax and punctatus.

Spanish and Portuguese vessels represent almost of the total annual landings in the area IXa and VIIIc. Commercial landings represent 1046 tons in 2013. A peak of landings is observed in the early 90's and in 2013, reaching more than 1000 tons, and lowest landings (637 tons) have been observed in 2004. Artisanal fisheries are mainly observed in this area. In 2013, in the all area, landings were equivalent between Spain and Portugal. However Landings from Portugal are only from the IXa area, while the Spanish landings are distributed equally between the two zones IXa and VIIIc.

Fishery management regulations

Seabass are not subject to EU TACs and quotas. Under EU regulation, the MLS of sea bass in the Northeast Atlantic is 36 cm total length (EC regulation 850/98). A variety of national restrictions on commercial fishing for each metier also apply to sea bass. 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.

Discards estimates

Portugal: Sea bass discards are recorded by the DCF on-board sampling programme. 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 2003-2013 periods.

Recreational catches

Recreational marine fishery surveys in Europe are still at an early stage in development (ICES WGRFS 2012).

Table 13.2.1: Sea bass in the IX and VIIIc 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

Country	France official landings	Portugal official landings	Spain official landings	Total official landings	Total ICES estimates***
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

*** Preliminary**

****-Official landings have been extracted from the Ices Official Catch Statistics Web page (15May 2013) for "BSS" and area VIIIc, IXa and IX (IX has been retained for Portuguese statistics because reported as IXa 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)**

13.3 Grey gurnard in Subarea VIII and Division IXa

Grey gurnard are caught as bycatch in mixed demersal fisheries and it is thought that the greater part of the catch is discarded. Therefore, landings are unlikely to be a good indicator of total removals. The official catch statistics are incomplete and are often not separated by species. A working document presented in 2013 described that of the 400t of gurnard landed into Portugal from Division IXa in 2012 only 0.5% was composed of grey gurnard. This species was also very rarely observed in discard observations and consequently discard estimates were not calculated at the fleet level for the Portuguese fleet. Spanish trawl discards from VIIIc and IXa were found to have declined in recent years to a stable level of ~80t. French discard data were being compiled and will be available for next year. In general the low abundance of this species in VIII and IXa means that the landings and discards are negligible in comparison to other species of gurnard.

This stock from is currently ranked as a Data Limited Stock in category 6.2 as greater part of the catch is discarded; however, all the stocks covered by the current DCF sampling programme have been proposed to be upgraded to category 4, because of the availability of biological information. Therefore, survey abundance indices, length frequency distributions, and other biological information is required from the respective National laboratories.

Portuguese and French surveys (PtGFS-WIBTS-Q4 and EVHOE-WIBTS-Q4) have provided biomass indices but values are very low and the species was not observed in the latter survey during recent years. Commercial abundance indices were also unavailable.

Biological information from DCF sampling could improve the assessment of this stock. However, the scarcity of this species in the Bay of Biscay and Iberian Peninsula negates the development of an alternative assessment. As this species is at the southern extent of its range in the Bay of Biscay and Iberian Peninsula (Table 13.3.1) perhaps merging of the northern and southern stocks would provide the best opportunity to improve the assessment.

Table 13.3.1: Grey gurnard in Subarea VIII and Division IXa. official landings in tonnes. Note: Figures may be unreliable due to inconsistent species split

Year	VIIIa	VIIIb	VIIIc	VIIId	VIIIe	IX a	Total
1993	19	34		-	-	.	53
1994	17	16		-	-	.	33
1995	31	10		-	-	.	41
1996	32	11		-	-	.	43
1997	43	12		-	-	.	55
1998	46	8		-	-	.	54
1999	0	1		.	.	.	1
2000	34	6		0.5	1	.	41
2001	26	11		-	-	.	37
2002	25	5		-	-	-	30
2003	40	7		-	-	-	47
2004	53	10		-	-	1	64
2005	43	16		-	-	-	59
2006	53	21		-	-	-	74
2007	54	16		-	.	4	74
2008	4	4		.	.	8	16
2009	60.5	39		.	.	0.5	100
2010	99	55		1	.	-	155
2011	119	49	0	2	0	0	170

Year	VIIIa	VIIIb	VIIIc	VIIId	VIIIe	IX a	Total
2012	109	54	0	3	0	0	166
2013	109	65	0	1	0	0	175

13.4 Plaice in Subarea VIII and Division IXa

Plaice is caught as a bycatch by various fleets and gear types covering small-scale artisanal and trawl fisheries. Portugal and France are the major 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.

Plaice was not recorded by either the Spanish or Portuguese discards observation programs.

This stock from is currently ranked as a Data Limited Stock in category 5.2 as only landings data are available; however, all the stocks covered by the current DCF sampling programme have been proposed to be upgraded to category 4, because of the availability of biological information. Therefore, survey abundance indices, length frequency distributions, and other biological information is required from the respective National laboratories.

Plaice was not present in sufficient numbers to provide survey abundance indices and no commercial indices were available. Other approaches should be considered in order to obtain fishery independent information.

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 a new assessment is developed. As this species is at the southern extent of its range in the Bay of Biscay and Iberian Peninsula (Table 13.4.1 and Figure 13.4.1) perhaps merging of the northern and southern stocks would provide the best opportunity to improve the assessment.

Table 13.4.1: Plaice in Subarea VIII and Division IXa. official landings in tonnes.

Year	VIIIa	VIIIb	VIIIc	VIIId	VIIIe	IX a	Total
1993	329	25	2	1		1	358
1994	334	31	34	0		0	399
1995	293	26	12	0		0	331
1996	223	26	14	0		0	263
1997	236	21	3	1		1	260
1998	199	21	6	0		1	226
1999	0	2	3	0		1	5
2000	173	36	17	1		5	232
2001	182	21	13	1		9	225
2002	148	21	10	0		0	179
2003	202	11	4	5		1	223
2004	215	13	5	3		165	400
2005	166	21	13	4		20	224
2006	222	24	2	2		3	253
2007	203	16.5	2	0		43	265

Year	VIIIa	VIIIb	VIIIc	VIIId	VIIIe	IX a	Total
2008	96.5	4	3	0		90	194
2009	124.5	12	5	0		105.5	247
2010	183	16	5	2		119	325
2011	198	10	4	2	0	68	282
2012	178	7	2	1	0	63	251
2013	135	11	0	1	0	44	191

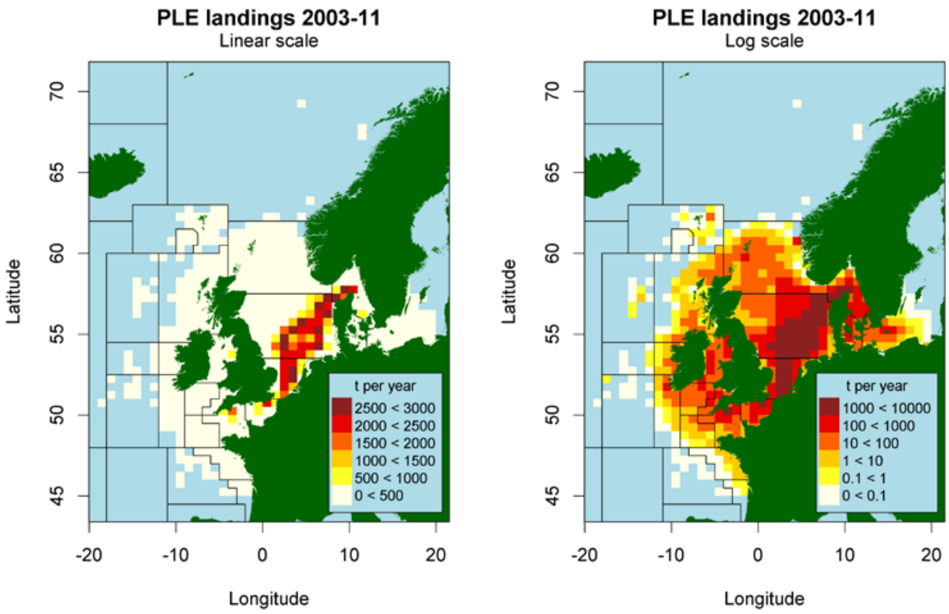


Figure 13.4.1: International landings of Plaice by statistical rectangle from 2003-2011

13.5 Whiting in Subarea VIII and Division IXa

France and Spain are the main participants in this fishery although France has not recorded landings since 2008 (Table 13.8.1). 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 Pollack (*Pollachius pollachius*). Whiting has never been recorded in Spanish discards and is negligible in Portuguese discards. The lack of discards makes it reasonable to assume that landings can be taken as a proxy of catches.

This stock from is currently ranked as a Data Limited Stock in category 5.2 as there is information on landings only; however, all the stocks covered by the current DCF sampling programme have been proposed to be upgrade to category 4, because of the availability of biological information. Therefore, survey abundance indices, length frequency distributions, and other biological information is required from the respective National laboratories.

Whiting are present in the French EVHOE-WIBTS-Q4 survey from the Bay of Biscay. Adults were not sufficient in number to serve as an SSB indicator but it may provide an index of recruitment. Commercial abundance index is available from Spanish pair trawl fleet in VIIIabd although it has declined to negligible levels in recent years.

Compilation of biological information from DCF sampling could improve the assessment of this stock. However, as this species is at the southern extent of its range in the Bay of Biscay and Iberian Peninsula (Table 13.8.1 and Figure 13.8.1) perhaps merging of the northern and southern stocks would provide the best opportunity to improve the assessment.

Table 13.8.1: Whiting in Subarea VIII and Division IXa. official landings in tonnes.

Year	VIIIa	VIIIb	VIIIc	VIIId	VIIIe	IX a	Total
1993	2375	699	7	12	-	0	3093
1994	2771	851	21	3	1	0	3647
1995	2077	560	2	10	-	0	2649
1996	1271	273	17	1	-	0	1562
1997	1647	292	6	3	-	0	1947
1998	1527	301	3	30	-	0	1861
1999	72	130	11	0	.	0	213
2000	1049	389	10	1	1	0	1449
2001	1721	527	24	3	6	0	2281
2002	1699	484	9	6	5	0	2203
2003	2057	381	4	7	-	3	2452
2004	1687	390	136	2	-	76	2291
2005	1425	649	1	6	-	2	2083
2006	1091	739	6	3.5	-	2	1842
2007	1029	871	1	2.5	2	107	2013
2008	532	425	1	4	.	98	1060
2009	1008	342	3	4	.	116	1473
2010	1863	462	4	9	.	114	2452
2011	1647	477	2	9	0	108	2243
2012	1466	427	2	12	0	88	1995
2013	1590	340	1	4	0	94	2028

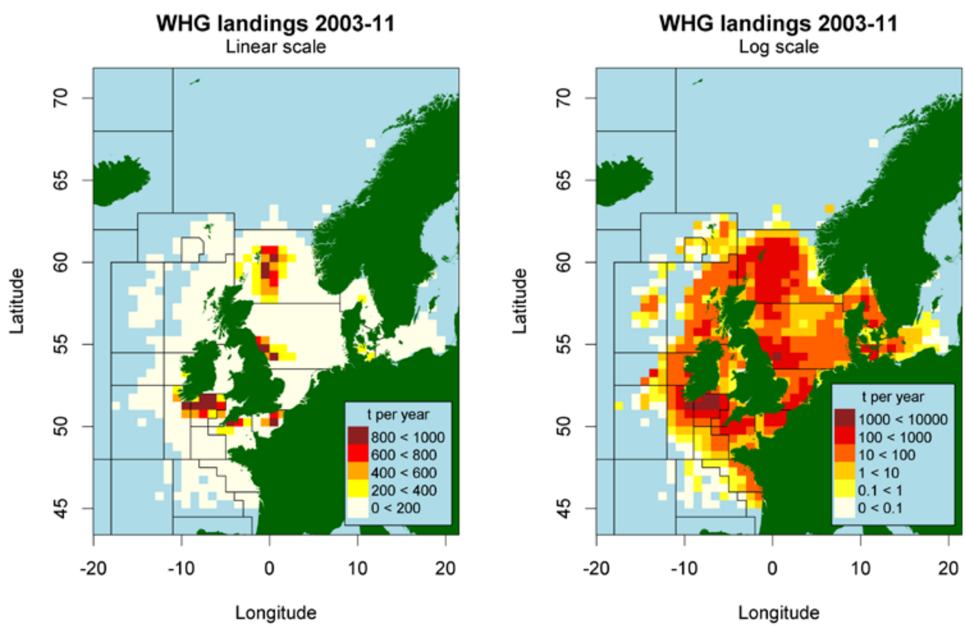


Figure 13.8.1: International landings of Whiting by statistical rectangle from 2003-2011

Annex A – List of participants

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

7 – 13 May 2014

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Annex B – Working Documents

Three working documents were presented at WGBIE 2014 covering various issues relevant to the work of the group. Abstracts of these papers are presented below. The full documents can be obtained by request to the ICES Secretariat.

WD1: Mixed fisheries forecasts for Iberian stocks

José Castro (IEO, Spain) and Cristina Silva (IPMA, Portugal)

Abstract

A multi-stock deterministic forecast prediction method using F cube has been applied to the North Sea single species advice for demersal fish and Nephrops since 2010 (WGMIXFISH). This paper applies this methodology to Iberian mixed fisheries. Fcube requirements are population parameters by stock: N, F, M, weight and maturity ogive. Also commercial data disaggregated by métier and fleet segment in order to better parameterize technical interactions. Various management scenarios were investigated and the results suggest that the length assessed stocks (HKE and MON) need further revision and that the inconsistency between LDB and MEG may indicate that mgw8c9a may be part of mgw78ab. Other advantages are that Fcube provides TAC-TAE relationships and use of Intercatch can speed up data compilation. It is recommended that the current management plan must include other stocks and better match TAC and TAE measures. Further work is needed to update the deterministic Fcube analysis with WGBIE2014 and WGHANSA2014 results (WGMIXFISH2014) and to investigate other stochastic approaches (GEPETO data were provided to MyFish project in order to apply the FLBEIA method).

WD 2: Grey Gurnard: Portuguese data for Division IXa (update)

Diana Feijó and Alberto Rocha (IPMA, Portugal)

Abstract

In Portugal, there is little information about the presence of Grey gurnard (*Eutrigla gurnardus*). Gurnards are usually landed without species discrimination, making it difficult to assess the fish stock. Data concerning Gurnards landings were collected in DCF sampling program, between 2009 and 2013. In landing ports, random trips were selected and gurnards were sampled for species composition and biological data are collected. This document summarizes the resulting information about Grey Gurnard in Portugal.

WD 3: Discards of WGBIE species by the Portuguese bottom otter trawl operating in ICES Division XIa (2004–2013)

Nuno Prista, Ana Cláudia Fernandes, João Pereira, Cristina Silva, Ricardo Alpoim and Fátima Borges

Abstract

We compile the information available on the discards of WGBIE stocks (blackbellied angler, *Lophius budegassa*; anglerfish, *Lophius piscatorius*; grey gurnard, *Eutrigla gurnardus*; European hake, *Merluccius merluccius*; megrim, *Lepidorhombus whiffagonis*; four-spot megrim, *Lepidorhombus boscii*; common sole, *Solea solea*; plaice, *Pleuronectes platessa*; pollack, *Pollachius pollachius*; whiting, *Merlangius merlangus*; and Norway lobster,

Nephrops norvegicus) produced by Portuguese vessels operating with bottom otter trawl (OTB) in Portuguese ICES Division IXa and update 2012-2013 data with electronic logbook data. The data was collected by the Portuguese on-board sampling programme (EU DCR/NP) between 2004 and 2013. We describe the on-board sampling programme, estimation algorithms and data quality assurance procedures and provide updated results for two fisheries: the crustacean bottom otter trawl fishery (OTB_CRU) and the demersal bottom otter trawl fishery (OTB_DEF). The low frequency of occurrence and number of specimens discarded in most species indicated feet discards are null or negligible for assessment purposes. That was the case of blackbellied angler, plaice, pollock, whiting, grey gurnards, megrims, anglerfish and common sole and, to a lesser extent, four-spot megrim and Norway lobster. On the contrary, the European hake frequency of occurrence in hauls sampled annually across the 2004-2013 period was 42 to 85% in the OTB_CRU fishery and in 62 to 89% in the OTB_DEF fishery. Total European hake discards in the OTB_CRU fishery in 2012 and 2013 were 242 tonnes and 126 tonnes, respectively. Total European hake discards in the OTB_DEF fishery in 2012 and 2013 were 356 tonnes and 526 tonnes, respectively. Hake discards were mostly composed of specimens smaller than the minimum landing size (27 cm) but by-catch limits motivated the discard of some larger individuals caught in the OTB_CRU fishery.

Annex C – Stock Annex: Northern Stock of Hake

Stock Annex	**Stock specific documentation of standard assessment procedures used by ICES.**
Stock	Northern Stock of Hake (Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d)
Working Group:	WGBIE – Working Group on Bay of Biscay and Iberian Ecosystems
Date:	February 2014
Revised by	Dorleta Garcia

A. General

A.1. Stock definition

European hake (*Merluccius merluccius*) is widely distributed over the Northeast Atlantic shelf, from Norway to Mauritania, with a larger density from the British Islands to the south of Spain (Casey and Pereiro, 1995) and in the Mediterranean and Black sea. Although, as demonstrated by genetic studies (Plá and Roldán, 1994; Roldán *et al.*, 1998), there is no evidence of multiple populations in the Northeast Atlantic, ICES assumes since the end of the 1970s two different stock units: the so called Northern stock, in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d, and the Southern stock in Divisions VIIIc and IXa, along the Spanish and Portuguese coasts. The main argument for this choice was that the Cap Breton canyon (close to the border between the Southern part of Division VIIIb and the more Eastern part of Division VIIIc, i.e. approximately between the French and Spanish borders) could be considered as a geographical boundary limiting exchanges between the two populations.

Hake spawn from February through to July along the shelf edge, the main areas extending from the north of the Bay of Biscay to the south and west of Ireland (Figure 1). After a pelagic life, 0-group hakes reach the bottom in depths of more than 200 m, then moving to shallower water with a muddy seabed (75–120 m) by September. There are two major nursery areas: in the Bay of Biscay and off southern Ireland.

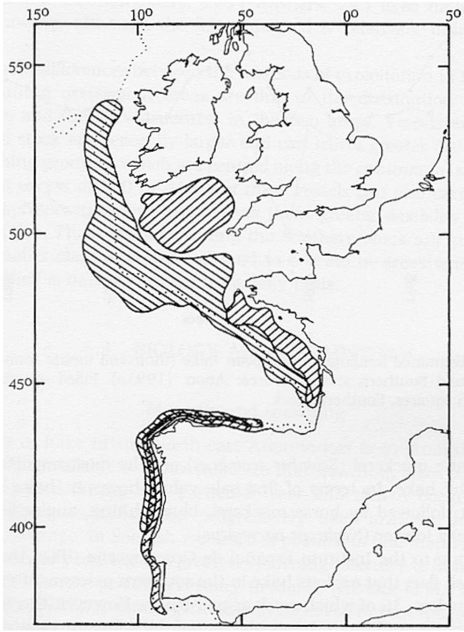

Figure 1. Main spawning and nursery areas. Spawning areas sloping downwards from left to right; Nursery areas sloping downwards from right to left. (from Casey and Pereiro, 1995)

A.2. Fishery

A set of different Fishery Units (FU) has been defined by the ICES Working Group on Fisheries Units in Sub-areas VII and VIII in 1985, in order to study the fishing activity related to demersal species (ICES, 1991a). To take into account the hake catches from other areas, a new Fishery Unit was introduced at the beginning of the nineties (FU 16: Outsiders). This Fishery Unit was created on the basis of combination between mixed areas and mixed gears (trawl, seine, longline, and gillnet). The current FU are defined as follows:

Fishery Unit	Description	Sub-area
FU1	Long-line in medium to deep water	VII
FU2	Long-line in shallow water	VII
FU3	Gillnets	VII
FU4	Non-Nephrops trawling in medium to deep water	VII
FU5	Non-Nephrops trawling in shallow water	VII
FU6	Beam trawling in shallow water	VII
FU8	Nephrops trawling in medium to deep water	VII
FU9	Nephrops trawling in shallow to medium water	VIII
FU10	Trawling in shallow to medium water	VIII
FU12	Long-line in medium to deep water	VIII
FU13	Gillnets in shallow to medium water	VIII
FU14	Trawling in medium to deep water	VIII
FU15	Miscellaneous	VII & VIII
FU16	Outsiders	IIIa, IV, V & VI
FU00	French unknown	

The main part of the fishery is currently conducted in six Fishery Units, three of them from Subarea VII: FU 4, FU 1 and FU 3, two from Subarea VIII: FU 13 and FU 14 and one in Subareas IIIa, IV, V and VI : FU16.

From the information reported to the Working Group, Spain accounted in recent years for the main part of the landings (around 43%) followed by France (around 29%), UK, Denmark, Ireland, Norway, Belgium, Netherlands, Germany, and Sweden contributing to the remaining.

The minimum landing size for fish caught in Subareas IV, VI, VII and VIII is set at 27 cm total length (30 cm in Division IIIa).

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 weight of marine organisms retained on board. This measure did not apply to vessels less than 12 m in length and which return to port within 24 hours of their most recent departure.

Two areas have been defined, one in Subarea VII and the other in Subarea VIII, where a 100 mm minimum mesh size is required for all otter trawlers, whatever the amount of hake caught.

Council Regulation (EC) No. 1954/2003 established measures for the management of fishing effort in a biologically sensitive area in Subareas VIIb, VIIj, VIIg, and VIIh. Effort exerted within the biologically sensitive area by the vessels of each EU Member State may not exceed their average annual effort (calculated over the period 1998–2002).

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 biomass to values equal to or greater than 140 000 t. 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 in 2007, the northern hake stock has met the SSB target in the recovery plan of 140 000 t for two consecutive years (2006 and 2007). Article 3 of the recovery plan indicates that, in such a situation, a management plan should be implemented.

An annual one-month fishing activity stop has been implemented by the Spanish administration since 2004. In 2008, a specific national regulation established a 90-days stop to be distributed from August 2008 to December 2009.

In Subarea VIII, for 2006, 2007 and 2008, otter trawlers using a square mesh panel are allowed to use 70 mm mesh size in the area, mentioned above, where 100 mm minimum mesh size is required for all otter trawlers. (EC Reg. No. 51/2006; EC Reg. 41/2007).

Furthermore, there was a ban on gillnets in Divisions VIa,b and VIIb,c,j,k fishing at more than 200 m of depth (EC Reg. No 51/2006) during the first semester of 2006.

A.3. Ecosystem aspects

Although a comprehensive study on the role of hake in its ecosystem has not yet been carried out, some partial studies are available. Hake belongs to a very extended and diverse community of commercial species including megrim, anglerfish, *Nephrops*, sole, sea bass, ling, blue ling, greater forkbeard, tusk, whiting, blue whiting, *Trachurus* spp, conger, pout, cephalopods (octopus, *Loligidae*, *Ommastrephidae* and cuttlefish), and rays. The relative importance of these species in the hake fishery varies largely in relation to the different gears, sea areas, and countries involved.

Hake is preyed upon by sharks and other fish. Cannibalism on juveniles by adults is also quoted. Adults feed on fish (mainly on blue whiting and other gadoids, sardine, anchovy, and other small pelagic fish); juvenile hake prey mainly upon planktonic crustaceans (above all euphausids, copepods, and amphipods).

Ecological factors or environmental conditions impacting on hake population dynamics are not taken into account at present in the assessment or in the management. However, synchronous changes have been observed in hake recruitment success and several global, regional and local parameters, which suggest that environmental conditions may be influential for hake (Goikoetxea and Irigoien, 2013). An ecological regime shift occurred in the Northeast Atlantic shelf system in 1988/89, which was detected at global scale (NAO, Gulf Stream and Northern Hemisphere temperature anomaly), as well as regionally (climatology of the Northeast Atlantic and copepod variability in the Celtic Sea). The region went from a period of cool temperatures and relatively weak wind (1978-1989) to a period of warmer temperatures and stronger westerly winds (1990-2006). Given the synchronous stepwise increase in hake recruitment success, it was concluded that the environment shifted to a regime that was favourable for northern hake. Early life stages of hake were found to benefit from a warming trend (either through the widening of the optimal environmental window or/and higher growth rates). In addition, coastward transport avoided vulnerable stages from their dispersion to oceanic areas and helped in their transport from spawning areas to nursery grounds (Goikoetxea, 2011). Other previous studies also highlighted the influence of environmental parameters such as water temperature and wind-driven transport on northern hake stock (Fernandes et al., 2010; Álvarez et al., 2001).

B. Data

In 2013 a data call was run by ICES in order to obtain more precise data on discards since 2003. Discard and Landing data was uploaded into Intercatch by most of the countries that exploit the stock. The dissagregation level varied by contry and year, from season, metier and length dissagregation level to total landings or discards by year.

B.1. Commercial catch B.1.1. Landings

Until 2010, the Spanish landings data were based on sales notes and Owners Associations records compiled by the National laboratories (IEO and AZTI). From 2011, the Spanish data are derived from official statistics provided by the Spanish Fishery Administration derived from logbook and sale notes. French landings data are based on logbook and auction hall sales.

From 1978 to 1989, landings in weight are available by year, gear (trawl, gillnets and longline), country (UK, France and Spain) and ICES Divisions (Division IVa + Sub-Area VI, Division VII and Divisions VIII a+b). From 1990 to present, for most of the years, landings in weight by FUs and countries are available on a quarterly basis. In 1992, only data from Spain is available by FU and on a quarterly basis (Table 1).

Table 1. Landings-in-weight (and their level of aggregation) available to the Working Group.

	1978 to 1989	1990–1991	1992	1993 to Present
By Gear, Country and ICES Divisions	X			
By FU		X	X	X
By year	X		X	
By quarter		X	X*	X

*** For Spain only**

From 1978 to 1989, length–frequency distributions are available by year, gear, country and ICES Divisions. From 1990 to present, length compositions of the landings are not available for all Fishery Units, quarters and countries. Only the main FUs/Countries are sampled. Table 2 presents, as an example, the length distributions available for 2008.

Table 2. Length–frequency distributions provided to the Working Group in 2008.

FU	France	Ireland	Spain	UK(EW)	Scotland	Danemark
01			Quarterly			
03	Quarterly		Quarterly	Quarterly		
04			Quarterly	Quarterly		
05	Quarterly			Quarterly		
06				Quarterly		
09	Quarterly					
10	Quarterly					
12	Quarterly		Quarterly			
13	Quarterly		Quarterly			
14			Quarterly			
15		Quarterly				
16			Quarterly		Quarterly	Yearly

In 2014 the length frecuency distribution, from 2003 to 2012, of the landings outside area VI and VII (the landings of OTHERS fleet in SS3) was recalculated using the data in Intercatch. The allocation schemes to dissagregate unsampled data (data without length infortion) in Intercatch were defined by year taken into account the area, season and gear.

B.1.2. Discards

Until 2002, the only discards series available and used by the WG were those of the French artisanal and coastal trawl fisheries in the Bay of Biscay, estimated on the basis of the length compositions obtained during FR-RESSGASC surveys. The RESSGASC survey used for their estimation ended in 2002.

EU countries are now required under the EU Data Collection regulation to collect data on discards.

A new sampling programme of discards in the French *Nephrops* trawlers fishery of the Bay of Biscay started in June 2002. Estimates obtained by this programme (see Table 3 below) were significantly different (by a factor 2 to 10) from previous estimates for that fishery (estimates are from 532 t in 2006 to 1597 t in 2005). Such discrepancies could be explained by changes in the sampling, changes in the discarding practices, variations in the abundance of small fish or by a combination of the three. The CVs associated with these estimates are around 20%. A huge amount of discards (~1500 t) was estimated for French Gillnetters in 2012. The discards estimates on this fleet were negligible in previous years.

Discards are available for Danish trawlers, seiners and gillnetters fishing in Subarea IV from 1995 to 2012 and for gillnetters from 1995 to 2008. Their values are quite variable from year to year from 100 to 800 t.

Additional information on discards was available for the Irish otter trawlers fishery in Subareas VI and VII from 1999 to 2001, for 2004 and 2005 and for 2009 to 2012 (values from 32 to 700 t, between 2006 and 2008 the discards were not raised because they were not available at the requested metier level). UK-EW discards were only available from 2000 to 2008 (raised only to the trip level).

Estimates of discards for the Spanish trawl fleets operating in the ICES Subarea VII and Divisions VIIIabd are available for 1988, 1989, 1994, from 1999 to 2001 and from 2003 to 2012. In Subarea VII, a significant increase in estimated discards rate was observed from 2010 to 2012 when compared with previous years. Discards were estimated to vary from very small amounts to more than 1000 t in 2003–2005 and over 5000 t since 2010. CVs were highly variable from 20% to more than 100%. Fixed gears were also sampled in order to design the Spanish Discards Sampling Programme, but no relevant discards were observed (Pérez *et al*., 1996).

Table 3. Summary of discards data available (weight (t) in bold, numbers ('000) in italic), those in red are included into the assessment model.

Fleet/metier	SS3 Fleet	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
French	GILLNET	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1503
		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4061
Spanish	SPTRAWL7	NA	83	NA	NA	NA	1034	1530	NA	537	1712	2010	5674	5077	5054
		NA	759	NA	NA	NA	10666	17393	NA	4526	21437	17542	27619	27954	26452
French	TRAWLOTH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	662	641	NA	NA
		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4637	2031	NA	NA
French trawl	TRAWLOTH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	363	551	130	304
		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1493	1159	301	3037
French	FRNEP8	565	341	417	172	1035	1359	1597	532	767	858	4283	726	871	624
		9139	7421	6407	2992	23676	39550	37740	18031	24277	18245	68524	14709	21208	25228
French trawl in VIIIabd	TRAWLOTH	211	169	100	142	NA	NA	NA	NA	NA	NA	*	*	*	*
		3053	3013	1439	2253	NA	NA	NA	NA	NA	NA	*	*	*	*
Spanish trawl in	SPTRAWL8	NA	NA	NA	NA	NA	30	489	206	471	352	580	101	292	364
		NA	NA	NA	NA	NA	451	8475	3397	10002	7153	7925	1719	5036	5329
Irish trawl and seine in	TRAWLOTH	190	650	194	NA	NA	32	94	*	*	*	720	559	419	497
		1868	892	1046	NA	NA	282	629	*	*	*	684	641	736	2064
UK (EW) trawl in IV	OTHERS	NA	*	*	*	*	*	*	*	*	*	*	*	*	*
		NA	*	*	*	*	*	*	*	*	*	*	*	*	*
Spanish trawl in VI	OTHERS	NA	NA	NA	NA	NA	NA	NA	NA	NA	6	31	120	NA	NA
		NA	NA	NA	NA	NA	NA	NA	NA	NA	11	36	146	NA	NA
French trawl in IV & VI	OTHERS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	47	1409	NA
		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	68	2700	NA
Danish trawl, seines ang	OTHERS	42	21	142	354	348	127	605	426	236	203	422	581	162	300
		29	38	483	691	479	775	NA	NA	849	642	508	234	275	NA
Scottish		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2604	3709	6895	5667
Irish		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	68	88	207	136
Others		NA	NA	NA	NA	9	32	268	58	153	242	40	45	268	79
		1008	1182	854	668	1392	2614	4583	1222	2164	3373	11121	12842	15730	14528
		14090	11364	9376	5935	24155	51724	64237	21428	39654	47488	96712	31138	34027	36882

* sampled but not raised

(1) French trawl discards in 2012 not dissgregated by area

During the 2003 assessment, the Working Group noted that, although some improvement in discard data availability had been observed (number of fleets sampled and area coverage), sampling does not cover all fleets contributing to hake catches and discard rates of several fleets are simply not known. Furthermore, when data are available, it was not possible to incorporate them into the assessment in a consistent way. As reconstructing an historical series was found problematic, discard estimates were removed from the full time-series of catch data. From 2003 to 2008, the assessment was thus conducted on landings only. After 2008 Working Group assessment, discards estimates from several sampled fleets were used in the assessment. This includes the French *Nephrops* trawl in VIIIabd discards data from 2003 to present, the Spanish trawl in VII in 1994, 1999, 2000, 2003 to present and the Spanish trawl in VIII abd from 2005 to present. Since 2010 the stock is assessed using SS3 and discard data is partly included into the model.

B.2. Biological

Mean weight-at-length are estimated from a fixed length–weight relationship (W(g)= 0.00513*L(cm)^3.074; ICES, 1991b).

The parameters of the time invariant logistic maturity ogive, for both sexes combined are: L_{50} = 42.85 cm and slope = - 0.2 (ICES, 2010b WD8).

Conventional tagging of European hake (de Pontual et al., 2003) opened new avenues for a better understanding of the species biology and population dynamic which have remained controversial for decades (see e.g. Belloc, 1935; Hickling, 1933). The first tagging results provided evidence of substantial growth underestimation (by a factor ~2) due to age overestimation, (de Pontual et al., 2006), thus challenging the internationally agreed age estimation method. More tagging efforts, both off the Northwest Iberian Peninsula (Piñeiro et al., 2007) and the Mediterranean Sea (Mellon-Duval et al., 2010), proved that growth underestimation was not a regional issue. More recent recaptures of tagged fishes have confirmed the growth estimated previously (de Pontual et al., 2013). An ICES workshop (ICES , 2010a) confirmed that the previous internationally agreed ageing method is neither accurate nor precise and provides overestimation of age. A replacement ageing method with sufficient precision and accuracy is currently not available. Thus, in the benchmark assessment in 2010 (ICES, 2010b) the working group started to evaluate the stock using a length based assessment model. .

In the absence of a direct estimate of natural mortality, a constant value of 0.4 was assumed for all age classes and years. It must be noted that this is a larger value than the one used in assessments conducted until 2008 where M was set to a value of 0.2. The rationale for this higher value is that if hake growths about two times faster, the hake longevity is reduced by about a half (from age ~20 to ~10), thus impacting on natural mortality (Hewitt and Hoening, 2005).

B.3. Surveys

Several research-vessel surveys cover part of the geographical distribution of the Northern hake stock (Figure 2).

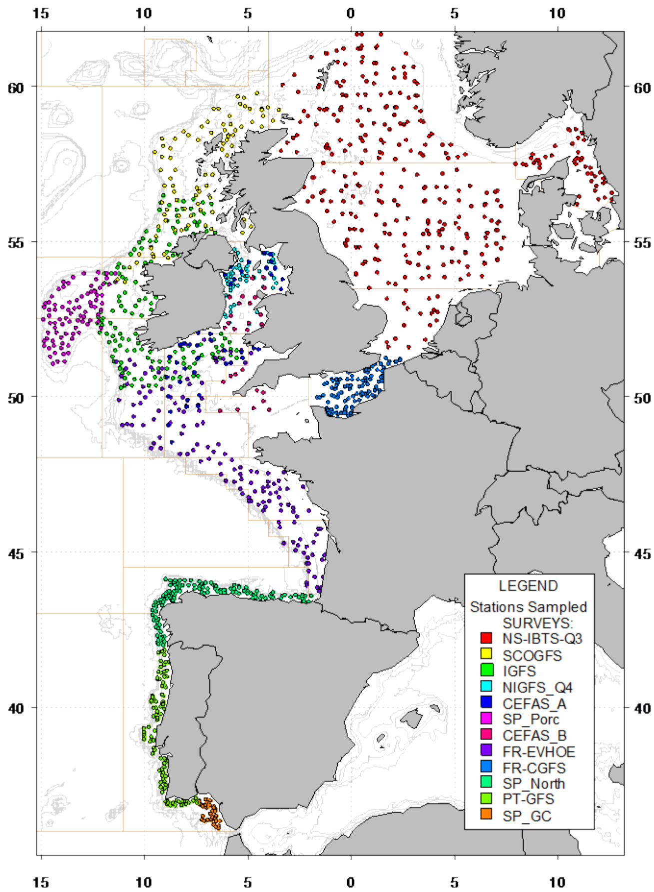

Figure 2. Map of East Atlantic groundfish surveys: stratification and trawling positions. FR-EVHOE correspond to EVHOE-WIBTS-Q4, SP Porc corresponds to SPPGFS-WIBTS-Q4 and IGFS corresponds to IGFS-WIBTS-Q4.

Abundance indices used in the SS3 assessment:

French Evhoe groundfish survey (EVHOE-WIBTS-Q4): years 1997–present. The survey occurs in autumn. The survey uses a GOV trawl with a 20 mm codend liner. It covers the shelf of both the Bay of Biscay and the Celtic Sea.

French Ressgasc groundfish survey (RESSGASC): years 1978 to 2002. Over the years 1978–1997 the RESSGASC surveys were conducted with quarterly periodicity. They were conducted twice a year after that (in spring and autumn). Survey data prior to 1987 have been excluded, because there was a change of vessel at that time. Weather conditions encountered by RESSGASC in 2002 gives to this index a poor reliability and it was decided not to use it. The survey uses a 25 m "Vendéen type" bottom trawl. It covers the Bay of Biscay. The survey ended in 2002.

Spanish Porcupine groundfish survey (SPPGFS-WIBTS-Q4): years 2001 to present. The area covered by this survey is the Porcupine bank extending from longitude 12° W to 15° W and from latitude 51° N to 54° N, covering depths between 180 and 800 m. The cruises are carried out every year in September on board R/V "Vizconde de Eza", a stern trawler of 53 m and 1800 Kw. Numbers-at-age for this abundance index are estimated from otoliths collected during the survey.

Irish Groundfish Surveys (IGFS-WIBTS-Q4): years 2003 to present. This survey is conducted on board the *R.V. Celtic Explorer* in autumn in the west of Ireland and the Celtic sea. The survey uses GOV 36/47 (Grande Ouverture Verticale).

Abundance indices not used in the SS3 assessment:

UK WCGFS survey (UK-WCGFS): years 1988 to 2004. This survey was conducted in March in the Celtic sea. It does not include the 0-age group. Numbers-at-age for this abundance index are estimated from length compositions using a mixed distribution by statistical method. The survey ended in 2004.

B.4. Commercial CPUE

Commercial cpues indices provided to the ICES Working Group are not used in the current SS3 assessment. Landings-per-unit-effort time-series are available from the following fleets:

a) Trawlers from A Coruña and Vigo fishing in Sub-area VII (SP-CORUTR7 and SP-VIGOTR7), pairtrawlers from Ondarroa and Pasajes fishing in Sub-area VIII (SP-PAIRT-ON8 and SP-PAIRT-PA8)

b) The A Coruña trawler fleet, targeting mainly hake, operates in deeper waters close to the slope in Division VIIb-c, j–k, while the trawler fleet from Vigo, targeting megrim, works in shallower waters in Division VIIj–h and catch hake as bycatch. Both pairtrawler fleets from Ondarroa and Pasajes are targeting hake in the Bay of Biscay.

c) Ondarroa "Baka" trawlers fishing in Subareas VI, VII and Division VIIIa,b,d, Pasajes "Bou" trawlers fishing in Subarea VIII, longliners from A Coruña, Celeiro and Burela fishing in VII, longliners from Avilés in VIIIa,b,d and trawlers from Santander in VIIIa,b,d.

d) Lpue values of Spanish gillnetters that started to fish hake in Subareas VII and VIII in 1998 are also provided. It is to be noted that only a small number of ships are involved in the gillnet fishery which makes lpues very sensitive to small changes in the number of trips. It is also noted that for gillnetters and longliners, lpues expressed in kg/day may not be the most appropriate.

e) Lpue data from two French fleets (Les Sables and Lesconil) fishing in Divisions VIIIa,b,d are also available from Logbooks. Due to important reductions in the availability of logbook information in recent years for both fleets, lpue values for the years 1996 onwards have low reliability. No data have been provided for those two fleets after 2003.

f) Lpue from Spanish Longliners is available since 2014 Benchmark. This LPUE corresponds with the most important Spanish longline fleet operating in ICES Subarea VII (A Coruña, Celeiro and Burela ports) and it provides an abundance index for large individuals. The time series starts in 1995, first year with sampling for quarterly length frequency distributions (LFD). Altough effort is measured in number of days it is considered appropriate because the fishing tactic of the fleet have been quite homogeneous over the period covered, without changes due to technological improvements or new management measures. It was tested in the assessment during 2014 benchmark; however it was considered that a deeper analysis of its suitability was necessary in order to use it as an abundance index.

C. Assessment: data and method

Model currently used: Stock Synthesis 3 (SS3), (Methot, 2013).

Software used: Stock Synthesis V3.24f, Richard Methot, NOAA Fisheries Seattle, WA.

Recent assessments and sensitivity analysis carried out.

An attempt to use a non-equilibrium surplus production model (ASPIC) was carried out in the 2004 WG (ICES, 2005) and preliminary fits of a length based stock assessment model have been presented in 2007 and 2008.

In the 1998 WG it was found that the SSB estimates for 1985–1987 were very sensitive to the q plateau options between age 5, 6, and 7 (which is the last true age). To reduce this effect, it was decided to extend the ten years window to a twelve-year period in order to tune to the longest available and well behaved fleet dataseries. In the 1999 and 2000 assessments, SSB estimates for 1985–1987 were still sensitive to the extent of the tuning period, and the longest (13 years and 14 years respectively) provided the best pattern for these years, whereas other estimates were very similar for other years. In 2001 assessment, it was decided to use the whole tuning data available and a taper time weighting to reduce the influence of the older years. At that time, this choice did not change radically the estimates of trends in F and SSB and those settings were maintained in 2002 to 2003 assessments.

In 2004, the group investigated again the influence of the taper time weighting and runs were conducted without taper and compared with the base-case run using a tricubic taper over a 20 year period. While the group agreed on the rationale behind the use of a taper to down-weight the years for which we may have less confidence, it expressed concerns over the large influence the use of this option has on the perception of the stock dynamics and the inability of the model to account, in a satisfactory manner, for uncertainty in the data.

Due to uncertainties in hake aging, in 2005, 2006 and 2007, the group also conducted a sensitivity analysis using a simulated ALK assuming a faster growth. In each of these years, several runs were thus conducted (An Update from the previous year and a Simulated ALK, see below).

In WGHMM 2007, an update runs from 2006 has been carried out and the SPPGFS-WIBTS-Q4 survey was added to the surveys used to tune the model.

WKROUND 2010 (ICES, 2010b) reviewed the uses of the Stock Synthesis assessment model.

Current assessment

The assessment is a length-based approach using the Stock Synthesis assessment model. This approach allows direct use of the quarterly length composition data and explicit modelling of a retention process that partitions total catch into discarded and retained portions.

The underlying population can be partitioned in time to include as many seasons within a year as required. This is important where temporal aspects of biology (like growth in the case of hake), or fishing activity dictate finer than annual-level representation, however all the basic input data must then be partitioned to the level of the underlying dynamics.

Recruitment is based on a Beverton–Holt function parameterized to include the equilibrium level of unexploited recruitment (R0) and the steepness (h) parameter, describing the fraction of the unexploited recruits produced at 20% of the equilibrium spawning biomass level. Annual deviations can be estimated for any portion of the modelled time period (or the whole period), and the expected recruitments are bias-corrected to reflect the level of variability (sigmaR, an input quantity) allowed in these deviations.

Growth is described through a von Bertalanffy growth curve with the distribution of lengths for a given age assumed to be normally distributed. The CV of these distributions is structured to include two parameters which can be estimated or fixed, defining the spread of lengths at a young and old age with a linear interpolation between. In addition to growth, the relationships between weight and length, fecundity and length as well as maturity-at-length are all generalized to allow parameters to be estimated or fixed, temporally invariant or not. All model parameters can vary over time either as a function of annual deviations about a mean level, user defined 'blocks' of years in which the parameters differ or a combination of the two.

All model expectations for comparison with data are generated as observations from a 'fleet', either a fishery or a survey/index of abundance. Each fleet has unique characteristics defining relative selectivity across age or size, and can be structured to remove catch or collect observations at a particular time of the year or season. All fleets may be considered completely independent, or parameters may be shared among fleets where appropriate via 'mirroring'.

A suite of selectivity curves including logistic-based shapes of up to eight parameters, power functions and nonparametric forms can be explored through relatively simple modification of the input files.

The kinds of data that model expectations can be fit to include: absolute or relative abundance, length–frequency distributions, age frequency distributions (either total or conditional by length), length-at-age, body weight, and proportion discard. Each of these can be from the retained, discarded or total removals by a specific fleet. Each source has an error distribution (either normal, lognormal or multinomial) associated with it, described by either an input sample size or standard deviation.

Input data for SS3

The overall fishery prosecuting the northern stock of hake has been categorized into 7 "fleets", 4 of which use trawl gears, whereas the remaining three use gillnet, longline and a combination of several gears (Table 4). They are based on a combination of the Fishery Units described above. For each fleet, estimates of landings in weight and length–frequency distributions are available. For some fleet only, discards in weight and length–frequency distribution are used.

Table 4. Fleets characteristics and data available for SS3 (Length–Frequency distribution (LFD) and weight of landings and discards).

Fleets	Description	FU	Landings (quarterly)	Discards (quarterly)
SPTRAWL7*	Spanish trawl in VII	04	Yearly : 1978-1989 (LFD+tonnage) Quarterly: 1990-2012 (LFD+tonnage)	1994, 1999, 2000, 2003–2008 (LFD + Weight)
FRNEP8	French trawl targeting Nephrops in VIII	09	Yearly : 1978-1989 (tonnage) Yearly : 1985-1989 (LFD) Quarterly : 1990-2012 (LFD+tonnage)	2003–2008 (LFD + Weight)
SPTRAWL8	Spanish trawl in VIII	14	Yearly : 1978-1989 (LFD+tonnage) Quarterly: 1990-2012 (LFD+tonnage)	2005–2008 (LFD + Weight)
TRAWLOTH	All other trawl	05 + 06 + 08 + 10	Yearly : 1978-1989 (LFD+tonnage) Quarterly: 1990-2012 (LFD+tonnage)	
GILLNET	Gillnet all countries	03 + 13	Yearly : 1978-1989 (LFD+tonnage) Quarterly: 1990-2012 (LFD+tonnage)	
LONGLINE	Longline all countries	01 + 02 + 12	Yearly : 1978-1989 (LFD+tonnage) Quarterly: 1990-2012 (LFD+tonnage)	
OTHERS	Everything else all countries	15 + 16 + 00	Yearly : 1978-1989 (LFD+tonnage) Quarterly: 1990-2012 (LFD+tonnage)	2003-2012 (Weight) 2003-2008 (Weight+LFD)

*** FU04 (and consequently SPTRAWL7) landings and discards contain small amount from area VI as, in some cases, the sampling programme does not allow to make the distinction between area VII and VI.**

For the two Spanish trawl fisheries, it is thought that discarding became much more substantial starting from 1998. For the French *Nephrops* fishery, discarding is thought to have occurred already from 1990. For the OTHERS fleet, since 2009 the discards are mainly formed by Scottish discards for which LFD are not available. The retention and selection of OTHERS fleet is thought to vary yearly because it is formed by a mixed of gears and countries. The remaining 3 fisheries (TRAWLOTH, GILLNET, LONGLINE) are assumed not to discard any fish.

Several surveys provide relative abundance indices of abundance and length distributions (Table 5).

Table 5. List of surveys used in SS3.

Surveys	Area	Years	Quarter
EVHOE-WIBTS-Q4	Bay of Biscay and Celtic Sea	1997–(y*-1)	4
RESSGASC	Bay of Biscay	1990–1997 1998–2001	1, 2 ,3 and 4 2 and 4
SPPGFS-WIBTS-Q4	Porcupine Bank	2001–(y*-1)	3
IGFS-WIBTS-Q4	North, West and South of Ireland	2003–(y*-1)	4

* y = assessment year

No commercial fleet tuning data are used.

SS3 settings (input data and control files):

Years: 1978 to present, 1 area, 4 seasons, both sexes combined.

Length Frequency Distribution are available on a yearly basis from 1978 to 1989 and on a quarterly basis from 1990 to present. No age data are used.

Initial equilibrium catch: annual average of ten years (1978–1982) for each fishery.

Variability for landings, discards and survey abundance indices are entered as standard deviation in log-scale, as follows:

Landings (tonnes): 10% variability

Discards (tonnes): 50% variability

Survey abundance indices: variability externally estimated. As the latter represents only the surveys internal variability, extra variability was added (increment to CV in SS3 control file) according to how representative each survey was felt to be of stock abundance (i.e. the area coverage of the survey as compared to the spatial distribution of the stock). Surveys' CV were increased by 0.1 (EVHOE-WIBTS-Q4), 0.2 (RESSGASC, IGFS-WIBTS-Q4), 0.3 (SPPGFS-WIBTS-Q4).

Length compositions were assigned the following sampling sizes in the SS3 input data file, on the basis of how representative they were felt to be[1]:

Landings: 125 for all fleets, except SPTRAWL7 for which 50 was used for 1990-1997 and 200 was used from 1998 onwards

Discards: 50 for SPTRAWL7 and SPTRAWL8, 80 for FRNEP8

Surveys: 125

The following multipliers were subsequently applied to the latter sample sizes in the SS3 control file:

[1] The log-likelihood for the fit to length composition observations from fishery or survey source, is defined according to a multinomial error structure. The absolute value of the sample size (which may be many thousands of fish measured) should not be interpreted literally. The input sample size scales the variance of the data. The recommended maximum level for the sample size was 400 in Fournier and Archibald (1982). In many recent synthesis applications, a value of 200 has been used (which produces an expected coefficient of variation (CV) of approximately 20% (Methot, 2000)

Landings and discards: 0.5 for all fleets, except LONGLINE to which a factor of 1 was applied

Surveys: 1 (EVHOE-WIBTS-Q4), 0.525 (RESSGASC, IGFS-WIBTS-Q4), 0.35 (SPPGFS-WIBTS-Q4)

M=0.4.

Von Bertalanffy growth function is fixed: Linf=130 cm, K = 0.177319 and mean length-at-age 0.75 = 15.8392. Linf was chosen in 2010 bechmark (ICES, 2010b) and K and and mean length-at-age 0.75 were fixed and chosen in 2014 bechmark using the estimates obtained in 2011 assessment (ICES, 2011). Same growth parameters apply to all fish (across morphs, years, etc)

Maturity ogive: length-based logistic, externally estimated and assumed constant over time

Recruitment allocation for Quarter 2 to 3 estimated with respect to Quarter 1. Quarter 2 allocation is time-varying, with annual deviates. Quarter 4 allocation set to 0.

Beverton–Holt stock–recruitment relationship: steepness h=0.999, sigma_R=0.4, R0 estimated.

Recruitment deviations starting in 1970.

F estimation method = 2 (F by fishery and quarter treated as unknown parameters)

Surveys catchabilities constant over time.

RESSGASC survey entered as 4 separate surveys (1 per quarter). Catchabilities are quarter-specific but all quarters use the same selectivity-at-length.

Selectivity only length-based (no age selectivity considered)

Selectivity-at-length uses Pattern 24 (double normal function, with 6 parameters) for fleets SPTRAWL7, FRNEP8, SPTRAWL8, GILLNET, LONGLINE and all surveys. TRAWLOTH and OTHERS use Pattern 1 (logistic function, with 2 parameters). When Pattern 24 is used, parameter P5 is not used except for SPTRAWL7 and SPTRAWL8.[2]

Selectivity-at-length constant over all years and for all fleets expect for OTHERS. The selectivity of OTHERS fleets varies yearly since 2003. The variation is modeled using a random walk with standard deviation equal to 5 for L50% parameter and equal to 1 for the slope.

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[2] The choice of selection pattern was carried out during the 2010 Benchmark (WKROUND 2010) following the following procedure: A preliminary set of model runs indicated that results were sensitive to the degree of flexibility allowed in the shape of the fishery selectivity-at-length patterns. If all fleets are allowed to be dome-shaped, the model cannot unambiguously determine the degree to which large fish exist but are never caught, vs. a result in which these large fish have reduced abundance but remain catchable. Three approaches were used to resolve this issue. First, examination of size composition data from the 1980s indicated that the percentage of large fish in the catch was much higher during the early 1980s and declined to a much lower level by 1990. This indicated that the old fish are catchable when they exist. Second, model runs were conducted with a profile on fixed levels for the degree of domed selectivity for selected fleets. These runs confirmed that the best fit to the size composition data occurred with the maximum domed pattern but the biomass increased to unrealistically high levels when the pattern was fully domed. Third, the overall average size composition of each contemporary fleet was examined and it was found that two fleets, “other trawls in VII and VIII” and “others”, had the lowest slope of the right hand side of the length composition. These two fleets were assigned an asymptotic selectivity pattern (two parameter logistic function) and all other fleets were modelled with the flexible double normal pattern. This change stabilized model performance.

Retention patterns for fisheries with discards: length-logistic with asymptotic retention = 1 in all cases, and unknown L50 and slope. For SPTRAWL7 three different patterns of retention over time are assumed, one for years 1990–1997, a second one for years 1998-2009 and a third one from 2010 . For SPTRAWL8, two different patterns of retention over time are assumed, one for years 1990–1997 and the another one from 1998 onwards.For OTHERS, the retention is the same for years 1978-2002 and it varies yearly since 2003. The variation is modeled using a random walk with standard deviation equal to 5 for both parameters L50% and the slope.

D. Short-Term Projection

- Model used: length and age-based.
- Software used: R script based on SS3 hake stock dynamics.
- Initial stock size. Taken from the SS3 in the last assessment year.
- Natural mortality: Set to 0.4 for all ages in all years.
- Growth model: Von Bertalanffy model, with parameters estimated in the assessment model.
- Maturity-at-length: The same ogive as in the assessment is used for all years.
- Weight-at-length in the stock and in the catch: The same length–weight relationship as in the assessment model.
- Exploitation pattern: Average of the final 3 assessment years (with the possibility of scaling to final year F).
- Intermediate year assumptions: *status quo* F
- Stock–recruitment model used: Beverton–Holt Stock Recruitment relationship estimated in the assessment, with deviances chosen so that recruitment in the projection years approximately matches the geometric mean of estimated recruitment from 1990 until the final assessment year minus 2.

E. Medium-Term Projections

No medium-term projections are conducted for this stock.

F. Long-Term Projections

Model used: yield and biomass-per-recruit over a range of F values.

Software used: R script based on SS3 hake stock dynamics.

Selectivity pattern: Average of final 3 assessment years.

Stock and catch weights-at-length: Same length–weight relationship as in the assessment model

Maturity: Fixed maturity ogive as used in assessment

G. Biological Reference Points

	WG 1998	ACFM 1998	ACFM 2003	ACOM 2010
MSY Btrigger				not defined
FMSY				0.24
Flim	No proposal	0.28 (= Floss WG 98)	0.35 (= Floss WG 03)	not defined

Fpa	No proposal	0.20 (= Flim*e-1.645*0.2)	0.25 (= Flim*e-1.645*0.2)	not defined
Blim	No proposal	120 000 t (~ Bloss= B94)	100 000 t (~ Bloss= B94)	not defined
Bpa	119 000 t (=Bloss= B94)	165 000 t (= Blim*e1.645*0.2)	140 000 t (= Blim*e1.645*0.2)	not defined

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Annex D – Stock Annex: Anglerfish in Divisions VIIb–k and VIIIa,b,d

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	Anglerfish (*L. piscatorius and L. budegassa*) in Divisions VIIb–k and VIIIa,b,d
Working Group	WGBIE – Working Group on Bay of Biscay and Iberian Ecosystems
Date	13 March 2012 (WKFLAT, 2012)
Revised by	Iñaki Quincoces, and Lisa Readdy

A. General

A.1. Stock definition

ICES assumes since the end of the 1970s three different stocks for assessment and management purposes: Anglerfish in Division IIa (Norwegian Sea), Division IIIa (Kattegat and Skagerrak), Subarea IV (North Sea), and Subarea VI (West of Scotland and Rockall) (*Lophius piscatorius* and *L. budegassa*); Anglerfish in Divisions VIIb–k and VIIIa,b,d (*L. piscatorius* and *L. budegassa*) and Anglerfish in Divisions VIIIc and IXa (*L. piscatorius* and *L. budegassa*). These stock definitions apply for both anglerfish species White anglerfish (*L. piscatorius*) and Black anglerfish (*L. budegassa*). In Divisions VIIb–k and VIIIa,b,d, the two species are assessed separately but advised as a single stock since the EU gives a unique TAC for both species.

A.2. Fishery

Anglerfish are an important component of mixed fisheries taking hake, megrim, sole, cod, plaice, and *Nephrops*. A trawl fishery by Spanish and French vessels developed in the Celtic Sea and Bay of Biscay in the 1970s, and overall annual landings may have attained 35 000–40 000 t by the early 1980s. Landings decreased between 1981 and 1993 and since 2000, landings show an increasing trend. France and Spain together still report more than 75% of the total landings of both species combined. The remainder is taken by the UK and Ireland (around 10% each) and Belgium (less than 5%). Otter trawls (the main gear used by French, Spanish, and Irish vessels) currently take about 80% of the total landings of *L. piscatorius*, while around 60% of UK landings are by beam trawlers and gillnetters. Over 95% of total international landings of *L. budegassa* are taken by otter trawlers. There has been an expansion of the French gillnet fishery since the early 1990s in the Celtic Sea and in the north of the Bay of Biscay, mainly by vessels landing in Spain and fishing in medium to deep waters. Otter trawling in medium and deep water in ICES Subarea VII appears to have declined, although the increasing use of twin trawls by French vessels may have increased significantly the overall efficiency of the French fleet.

A.3. Ecosystem aspects

Lophius piscatorius is a Northeastern Atlantic species, with a distribution area from Norway (Barents Sea) to the Straits of Gibraltar (and including the Mediterranean and the Black Sea). *Lophius budegassa* has a more southern distribution from the British islands and Ireland to Senegal (including the Mediterranean and the Black Sea). Though the Working Group assesses two different stocks for each species (VIIIc, IXa stock and VIIb–k, VIIIabd), the boundaries are not based on biological criteria. Recent studies were carried out in genetic and morphometric analysis (GESSAN, 2002; Duarte *et al*., 2004; Fariña *et al*., 2004).

The spawning of the *Lophius* species is very particular, with eggs extruded in a buoyant, gelatinous ribbon that may measure more than 10 m (Afonso-Dias and Hislop, 1996; Hislop *et al*., 2001; Quincoces *et al*., 2002). This particular spawning results in a highly clumped distribution of eggs and newly emerged larvae (Hislop *et al*., 2001) and favourable or unfavourable ecosystem conditions can therefore have important impacts on the recruitment.

B. Data

The particularity of the data gathering processes for anglerfish species is that, except in Spain, anglerfishes are sold without any species distinction. The overall catch per species is estimated from the species ratio observed in the biological sampling.

Biological sampling is carried out by the countries contributing most catches, but assumptions about species proportion have to be made for countries reporting raw tonnages for species combined. The amount of tonnage with no biological sampling for species composition has been much reduced since the early 2000s and in 2007 these represented less than 8% of the total *Lophius* landings. In some countries however, anglerfish are landed as tails only and conversion factors have to be used to estimate total length, which still may introduce errors.

Data are supplied from databases maintained by national Government Departments and research institutions. The figures used in assessment are considered as the best available data at the Working Group time of the year. From year to year, and before the Working Group, small revisions of data could occur. In that case, revised data are explained and incorporated into the historical dataseries for assessment.

Data are supplied on electronic files to a stock coordinator nominated by the ICES Hake Monk and Megrim (formerly Southern Self Demersal Stocks) Working Group, who compiles the international landings, discards and catch-at-age data, and maintains the time-series of such data with the amendments proposed by countries.

B.1. Commercial catch

Landings data are supplied from databases maintained by national Government Departments and research institutions. Countries providing landings data by quarter and ICES division are Spain, France, Ireland United Kingdom and Belgium.

The derivation used to compute the landings by fishery units and by species is given in the following table.

Anglerfish in Divisions VIIb–k and VIIIa,b,d; Derivation of the historical length compositions, by fishery unit for *L. piscatorius* and *L. budegassa*, in Divisions VIIb–k and in VIIIa,b,d.

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
1986	FR-FU04/Q, IR-FU04 annual tonnage/4	FR-FU05/Q, IR-FU04 annual tonnage/4	FR-FU04+SP-FU04/Q BE annual tonnage/4	?	FR-FU04+SP-FU04/Q EW-FU04 annual tonnage/4	FR-FU05/Q EW-FU05 annual tonnage/4	FR-FU04+SP-FU04/Q EW-FU06 annual tonnage/4	-	-		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
1987	FR-FU04/Q, IR-FU04 annual tonnage/4	FR-FU05/Q, IR-FU04 annual tonnage/4	FR-FU04+SP-FU04/Q BE annual tonnage/4	?	FR-FU04+SP-FU04/Q EW-FU04 annual tonnage/4	FR-FU05/Q EW-FU05 annual tonnage/4	FR-FU04+SP-FU04/Q EW-FU06 annual tonnage/4	-	-		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
1988	FR-FU04/Q, IR-FU04 annual tonnage/4	FR-FU05/Q, IR-FU04 annual tonnage/4	FR-FU04+SP-FU04/Q BE annual tonnage/4	?	FR-FU04+SP-FU04/Q EW-FU04 annual tonnage/4	FR-FU05/Q EW-FU05 annual tonnage/4	FR-FU04+SP-FU04/Q EW-FU06 annual tonnage/4	-	-		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
1989	FR-FU04/Q, IR-FU04 annual tonnage/4	FR-FU05/Q, IR-FU04 annual tonnage/4	FR-FU04+SP-FU04/Q BE annual tonnage/4	?	FR-FU04+SP-FU04/Q EW-FU04 annual tonnage/4	FR-FU05/Q EW-FU05 annual tonnage/4	FR-FU04+SP-FU04/Q EW-FU06 quarterly tonnages	-	-		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
1990	FR-FU04/Q, IR-FU04 annual tonnage/4	IR-FU05-annual LD	FR-FU04+SP-FU04/Q BE annual tonnage/4	?	FR-FU04+SP-FU04/Q EW-FU04 annual tonnage/4	FR-FU05/Q EW-FU05 annual tonnage/4	FR-FU04+SP-FU04/Q EW-FU06 quarterly tonnages	-	-		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
1991	IRL-FU04/Q	IRL-FU05/Q	FR-FU04+SP-FU04/Q BE annual tonnage/4	FR-FU03/Q, EW-FU03 annual tonnage/4	FR-FU04+SP-FU04/Q EW-FU04 annual tonnage/4	EW-FU05/Q	EW-FU06/Q	-	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
1992	FR-FU04+SP-FU04/Q, IR-FU04 quarterly tonnages	FR-FU05/Q+EW-FU05, IR-FU05 quarterly tonnages	FR-FU04+SP-FU04/Q BE annual tonnage/4	FR-FU03/Q, EW-FU03 annual tonnage/4	FR-FU04+SP-FU04/Q EW-FU04 quarterly tonnages	EW-FU05/Q	EW-FU06/Q	-	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
1993	FR-FU04+SP-FU04/Q, IR-FU04 quarterly tonnages	FR-FU05/Q+EW-FU05, IR-FU05 quarterly tonnages	FR-FU04+SP-FU04/Q BE quarterly tonnages	FR-FU03/Q, EW-FU03 annual tonnage/4	FR-FU04+SP-FU04/Q EW-FU04 quarterly tonnages	EW-FU05/Q	EW-FU06/Q	-	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
1994	IRL-FU04/Q	FR-FU05/Q+EW-FU05, IR-FU05 quarterly tonnages	FR-FU04+SP-FU04/Q BE quarterly tonnages	FR-FU03/Q, EW-FU03 annual tonnage/4	FR-FU04+SP-FU04/Q EW-FU04 quarterly tonnages	EW-FU05/Q	EW-FU06/Q	-	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
1995	FR-FU04+SP-FU04/Q, IR-FU04 quarterly tonnages	FR-FU05/Q+EW-FU05, IR-FU05 quarterly tonnages	EW-FU06/Q/Q BE quarterly tonnages	EW-FU03	FR-FU04+SP-FU04/Q EW-FU04 quarterly tonnages	EW-FU05/Q	EW-FU06/Q	-	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	Total LDs raised to FR species split	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
1996	IRL-FU04/Q	FR-FU05/Q+EW-FU05, IR-FU05 quarterly tonnages	EW-FU06/Q/Q BE quarterly tonnages	FR-FU03 + EW-FU03 quarterly tonnages 95% allocated to piscatorius - all countries quarterly LDs raised to these tonnages	FR-FU04+SP-FU04/Q EW-FU04 quarterly tonnages	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03 + EW-FU03 quarterly tonnages 95% allocated to piscatorius - all countries quarterly LDs raised to these tonnages		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	Total LDs raised to FR species split	SP-FU04/Q	SP-FU14/Q

Country/FU																					
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
1997	IRL-FU04/Q		EW-FU06/Q/Q BE quarterly tonnages	FR-FU03 + EW-FU03 quarterly tonnages 95% allocated to piscatorius - all countries quarterly LDs raised to these tonnages	FR-FU04+SP-FU04/Q EW-FU04 quarterly tonnages	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03 + EW-FU03 quarterly tonnages 95% allocated to piscatorius - all countries quarterly LDs raised to these tonnages		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	Total LDs raised to FR species split	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
1998	IRL-FU04/Q	FR-FU05/Q+EW-FU05, IR-FU05 quarterly tonnages	EW-FU06/Q/Q BE quarterly tonnages	FR-FU03/Q, EW-FU03 quarterly tonnage	FR-FU04+SP-FU04/Q EW-FU04 quarterly tonnages	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	Total LDs raised to EW species split	SP-FU04/Q	SP-FU14/Q
1999	Total LDs and species ratio used	Total LDs and species ratio used	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 tonnage, EW 2000 FU03 species ratio	FU05+FU06 LDs raised to FU04 tonnage , EW 2000 FU04 species ratio	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q

Country/FU																					
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
2000	Total LDs and species ratio used	Total LDs and species ratio used	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 tonnage, EW 2000 FU03 species ratio	FU05+FU06 LDs raised to FU04 tonnage , EW 2000 FU04 species ratio	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
2001	Total LDs and species ratio used	Total LDs and species ratio used	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 tonnage, EW 2000 FU03 species ratio	FU05+FU06 LDs raised to FU04 tonnage , EW 2000 FU04 species ratio	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
2002	Total LDs and species ratio used	Total LDs and species ratio used	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 tonnage, EW 2000 FU03 species ratio	FU05+FU06 LDs raised to EW-FU04 quarterly tonnages per species	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
2003	Total LDs and species ratio used	Total LDs and species ratio used	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 tonnage, EW 2000 FU03 species ratio	FU05+FU06 LDs raised to EW-FU04 Q2 species split used for tonnage	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
2004	IRL-FU04+FU05/Q	IRL-FU04+FU05/Q	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 tonnage, EW 2000 FU03 species ratio	FU05+FU06 LDs raised to EW-FU04 quarterly tonnages per species	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
2005	IRL-FU04+FU05/Q	IRL-FU04+FU05/Q	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 ton-nage100 % L. piscatorius assumed	FU05+FU06 LDs raised to EW-FU04 2004 species ratio used except for Q2 (species ratio provided)	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
2006	IRL-FU04+FU05/Q	IRL-FU04+FU05/Q	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 ton-nage100 % L. piscatorius assumed	FU05+FU06 LDs raised to EW-FU04 2004 species ratio used except for Q2 (species ratio provided)	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
2007	IRL-FU04+FU05/Q	IRL-FU04+FU05/Q	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 ton-nage100 % L. piscatorius assumed	FU05+FU06 LDs raised to EW-FU04 2004 species ratio used	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
2008	IRL-FU04+FU05/Q	IRL-FU04+FU05/Q	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 ton-nage100 % L. piscatorius assumed	FU05+FU06 LDs raised to EW-FU04 2004 species ratio used	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	FR-FU03/Q		FR-FU04/Q	FR-FU05/Q	FR-FU08/Q		FR-FU09/Q	FR-FU10/Q	FR-FU14/Q	-	SP-FU04/Q	SP-FU14/Q
2009	IRL-FU04+FU05/Q	IRL-FU04+FU05/Q	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 ton-nage100 % L. piscato-rius assumed	FU05+FU06 LDs raised to EW-FU04 2004 species ratio used	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	-	FR-GNS_DEF_7/Q	FR-OTB_DEF_7/Q	-	FR-OTB_CRU_7/Q	FR-GNS_DEF_8/Q	FR-OTB_CRU_8/Q	-	FR-GNS_DEF_8/Q	-	SP-FU04/Q	SP-FU14/Q

Country/FU																				
Year	IR-FU04	IR-FU05	BE-FU06	EW-FU03	EW-FU04	EW-FU05	EW-FU06	EW-Other	FR-FU03 + FU13	FR-FU03	FR-FU04	FR-FU05	FR-FU08	FR-FU13	FR-FU09	FR-FU10	FR-FU14	FR-unallocated	SP-FU04	SP-FU14
2010	IRL-FU04+FU05/Q	IRL-FU04+FU05/Q	Total LDs and species ratio used	FU05+FU06 LDs raised to FU03 ton-nage100 % L. piscato-rius assumed	FU05+FU06 LDs raised to EW-FU04 2004 species ratio used	EW-FU05/Q	EW-FU06/Q	Total LDs raised to EW species split	-	FR-GNS_DEF_7/Q	FR-OTB_DEF_7/Q	-	FR-OTB_CRU_7/Q	FR-GNS_DEF_8/Q	FR-OTB_CRU_8/Q	-	FR-GNS_DEF_8/Q	-	SP-FU04/Q	SP-FU14/Q

***Discards:* preliminary information is available but not used due to uncertainties in adequacy of raising methodologies used.**

B.2. Biological

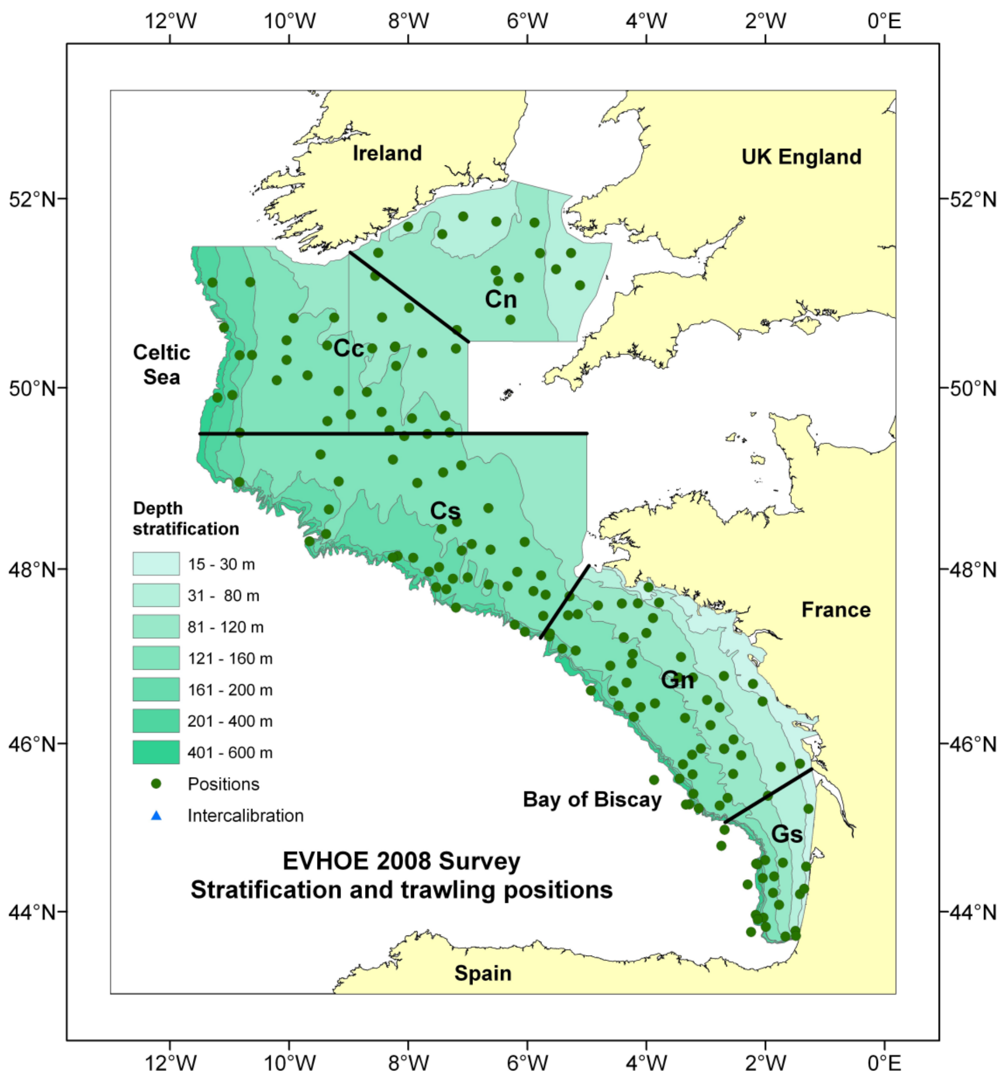
In 2007, WGHMM rejected the XSA age based assessments of both species because of data quality (increased discards not incorporated) and ageing problems clearly identified. Therefore there is no age based data used to assess the stocks. Only length distributions of landings and survey indices are used.

B.3. Surveys

For the first three surveys presented, a full description can be found on the ICES DATRAS website: http://datras.ices.dk/Home/Descriptions.aspx.

The French FR-EVHOE survey

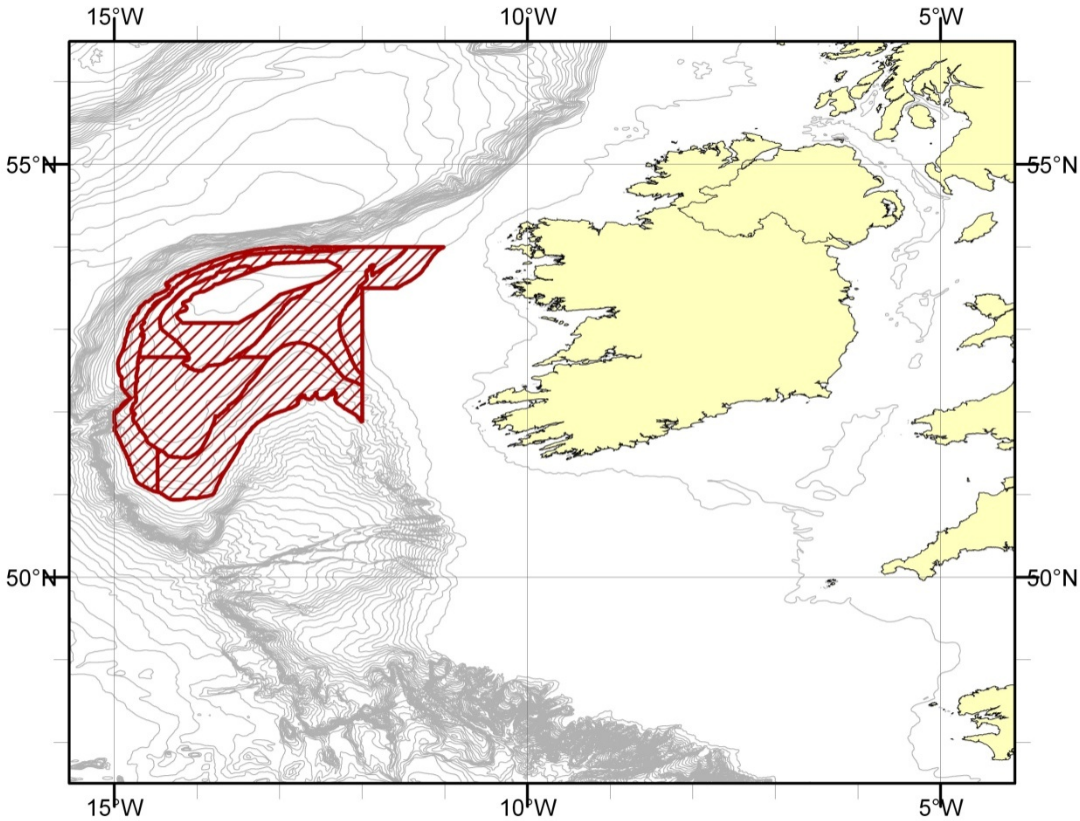
This survey covers the largest proportion of the area of stock distribution. It started in 1997.



Map of Survey Stations completed by the EVHOE Survey in 2008.

The Spanish Porcupine Groundfish Survey (SP-PGFS)

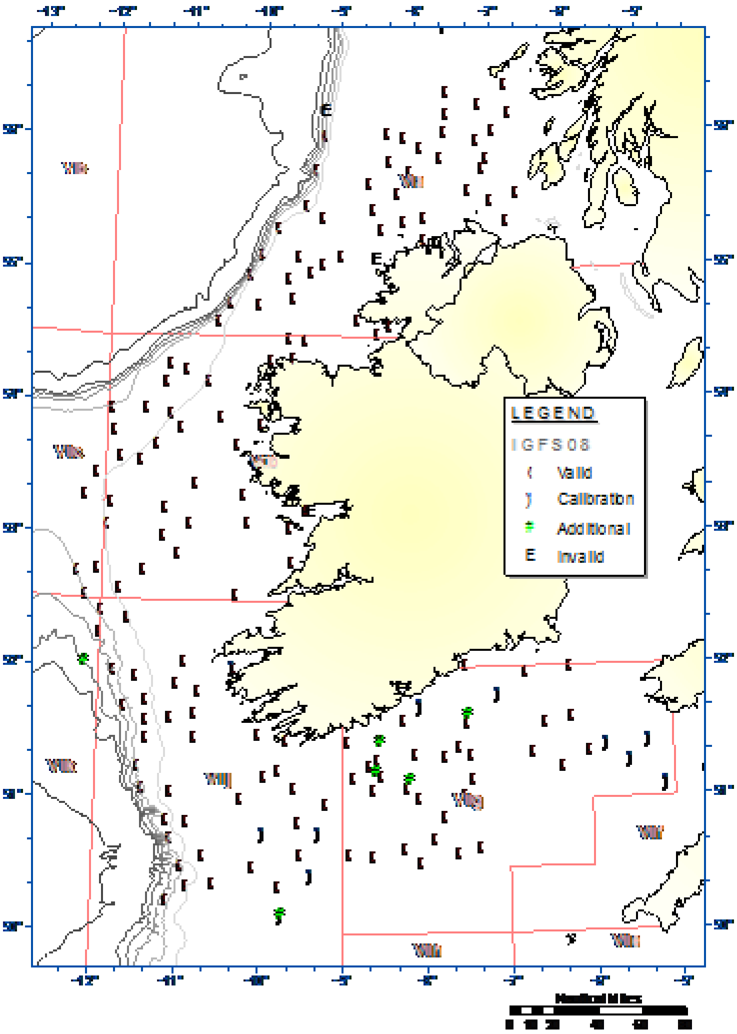
This survey was initiated in 2001 and covers the Porcupine Bank.



Map of area covered by the Porcupine Groundfish Survey.

The Irish Groundfish Survey (IR-IGFS)

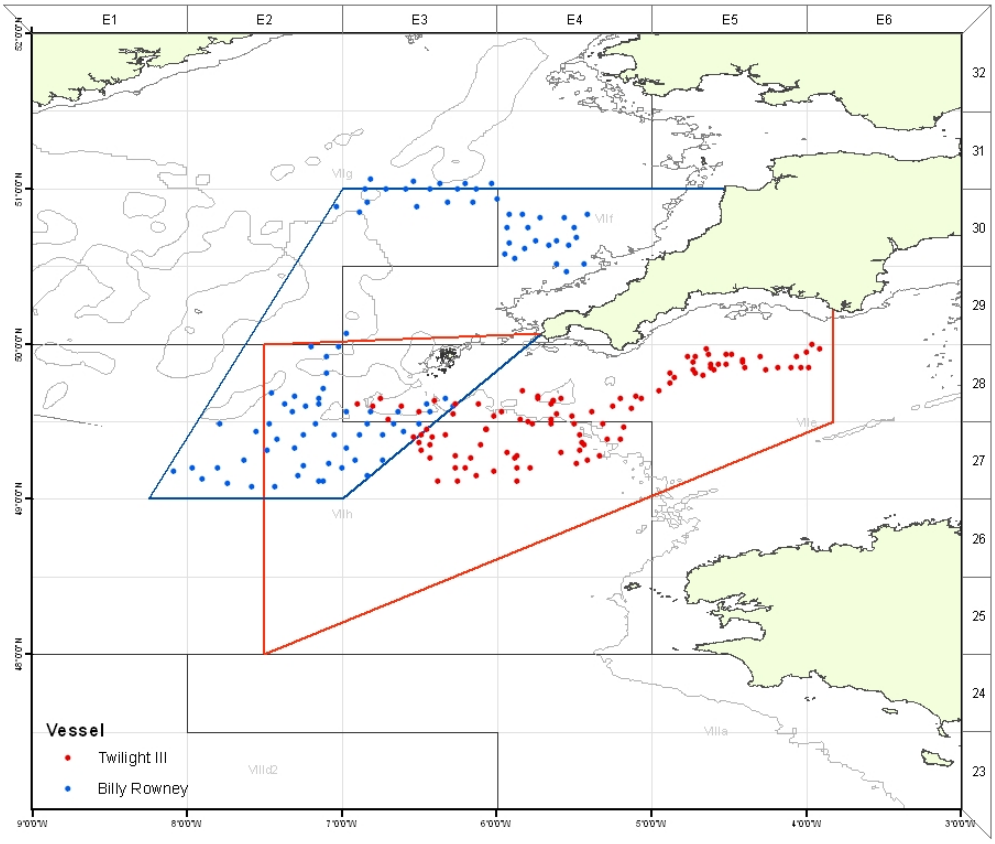
This survey was initiated in 2003 and covers areas around Ireland.



Map of Survey Stations completed by the Irish Groundfish Survey in 2008. Valid = red circles; Invalid = crosses; Intercalibration = blue squares; intercalibration and additional stations not valid for IBTS survey indices = green triangles.

The English Fisheries Science Partnership survey

This survey traverses Areas VIIe–h and started in 2003.



Map of Survey Stations completed by the EW-FSP Survey in 2011.

A full description of the survey can be found in Section 2.2.12 of the WGHMM 2011 report.

B.4. Commercial cpue

Effort and lpue data are available for four Spanish trawl fleets (SP-VIGO7, SP-CORUTR7, SP-BAKON7 and SP_BAKON8). The French data for the FR-FU04 and FR-FU14 are also provided. Finally UK provides effort and lpue data for EW-FU06.

B.5. Other relevant data

C. Assessment: data and method

The assessments of the two species (WG 2011) are based on the analysis of lpues (SP-VIGO7 , SP-CORUTR7, SP-BAKON7, SP-BAKON8, FR-FU04, FR-FU14 and EW-FU06), surveys indices (FR-EVHOE since 1997, SP-PGFS since 2001, IR-IGFS since 2003 and the EW-FSP since 2003 and length distributions from landings and surveys.

D. Short-term projection

E. Medium-term projections

F. Long-term projections

G. Biological reference points

There are precautionary reference points defined for these stocks. However, considering the underestimation of growth that is now obvious for both species, the reference points from earlier assessments are no longer valid. Reference points will have to be redefined based on an approved analytical assessment.

H. Other issues

H.1. Historic development

The analytical assessment was rejected in 2007 and advice was based on analysis of lpues, length frequencies of landings and survey data. In 2008, no new advice was delivered as the information available was considered too weak to provide any advice. The advice given for 2008 was also applicable until 2011. The stocks were reviewed in 2012 by the WKFLAT 2012 not founding an acceptable method for providing analytical assessment and recommended to continue using the analysis of trends for providing non analytical assessment.

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Quincoces, I. 2002. Crecimiento y reproducción de las especies *Lophius budegassa* Spinola1807, y *Lophius piscatorius* Linneo 1758, del Golfo de Vizcaya. PhD Thesis. Basque Country University. 276pp.

Annex E Stock Annex-Megrim (Lepidorhombus whiffiagonis) in Divisions VIIb-k and VIIIa,b,d

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIb–k and VIIIa,b,d
Working Group	WGBIE (Working Group on Bay of Biscay and the Iberian Waters Ecoregion)
Date	Updated May 2014: WGBIE 2014
Revised by	Ane Iriondo

A. General

A.1. Stock definition

Since the end of the 1970s ICES has assumed three different stocks for assessment and management purposes: megrim in ICES Subarea VI, megrim in Divisions VIIb–k and VIIIa,b,d and megrim in Divisions VIIIc and IXa. The stock under this Annex is called northern Megrim and defined as megrim in Divisions VIIb–k and VIIIa,b,d.

A.2. Fishery

Megrim in the Celtic Sea, west of Ireland, and in the Bay of Biscay are caught predominantly by Spanish and French vessels, which together have reported more than 65% of the total landings, and by Irish and UK demersal trawlers.

French benthic trawlers operating in the Celtic Sea and targeting benthic and demersal species catch megrim as a bycatch.

Spanish fleets catch megrim targeting them and in mixed fisheries for hake, anglerfish, *Nephrops* and others. Otter trawlers account for the majority of Spanish landings from Subarea VII, the remainder, very low quantities, being taken by netters prosecuting a mixed fishery for anglerfish, hake and megrim on the shelf edge around the 200 m contour to the south and west of Ireland. The catches made by otter trawlers from the port of Vigo comprise around 50% of the total catches.

Most UK landings of megrim are made by beam trawlers fishing in ICES Divisions VIIe,f,g,h.

Irish megrim landings are largely made by multi-purpose vessels fishing in Divisions VIIb,c,g for gadoids as well as plaice, sole and anglerfish.

Countries	ICES area	% landings (based on 2011 landings data)	Fisheries
Spain	Divisions VIIb,c,e–k and VIIIa,b,d	54%	Otter trawls targeting mixed groups of species (hake, anglerfish, Nephrops and other). Netters targeting also mixed species (anglerfish, hake and megrim)
France	Subarea VII	13%	Benthic trawlers targeting benthic and demersal species
Ireland	Divisions VIIb,c,g	17%	Multipurpose vessels targeting gadoids, plaice, sole and anglerfish
UK (England and Wales)	ICES Divisions VIIe,f,g,h	14%	Beam trawlers
Belgium	Divisions VIIb,c,e–k and VIIIa,b,d	2%	Beam trawlers
UK (Northern Ireland)	Divisions VIIb,c,e–k	0.04%	Multipurpose trawlers

A.3. Ecosystem aspects

There are two megrim species in the Northeastern Atlantic: megrim (*Lepidorhombus whiffiagonis*) and four spot megrim (*Lepidorhombus boscii*).

Megrim (*L.whiffiagonis*, Walbaum, 1792) is a pleuronectiform fish distributed from the Faroe Islands to Mauritania (from 70°N to 26°N) and the Mediterranean Sea, at depths ranging from 50 to 800 metres but more precisely around 100–300 metres (Aubin-Ottenheimer, 1986).

Four spot megrim (*L. boscii,* Risso 1810) is distributed from the Faroe Islands (63°N) to Cape Bojador and all around the Mediterranean Sea. It is found between 150–650 m, but mostly between 200–600 m.

Although, there does not appear to be evidence of multiple populations in the Northeast Atlantic, since the end of the 1970s ICES has assumed three different stocks for assessment and management purposes: megrim in Subarea VI, megrim in Divisions VIIb,c,e–k and VIIIa,b,d and megrim in Divisions VIIIc and IXa.

Spawning period of these species goes from January to March. Megrim spawning peak occurs in February (VIIIa,b,d) and March (VII) along the shelf edge. Males reach the first maturity at a lower length and age than females. For both sexes combined, fifty percent of the individuals mature at about 20 cm and about 2.5 year old (BIOSDEF, 1998; Santurtún *et al.*, 2000). Their eggs are spherical, pelagic, with a furrow (stria) in the internal part of the membrane and with a fat globule.

Megrim is a demersal species of small-medium size with a maximum size about 60 cm. It is believed that it has a medium-large lifespan, with a maximum age of about 14–15 years. It lives mainly in muddy bottoms, showing a gradual expansion in bathymetric distribution throughout their lifetimes, where mature males and juveniles tend to occupy deep waters, immature females shallower waters and, during the very short period when females are mature, the dynamics remain unclear.

The Bay of Biscay and Iberian shelf are considered as a single biogeographic ecotone (a zone of transition between two different ecosystems) where southern species at the northern edge of their range meet northern species at the southern edge of their range as well as for some other Mediterranean species. Since species at the edge of their range may react faster to climate changes, this area is of particular interest in accounting for effects of climate change scenarios, for instance, in the foodweb models (BECAUSE, 2004).

Megrim belongs to a very extended and diverse community of commercial species and it is caught in mixed fisheries by different gears and in different sea areas. Some of the commercial species that exist in the same ecosystem are hake and anglerfish, however many other species are also found. From the northern to southern areas of the extent of the stock these species include: Octopus, *Rajidae*, *Ommastrephidae*, *Nephrops norvegicus*, *Phycis blennoides*, *Molva molva*, *Pollachius virens*, *Trisopterus* spp (mainly *Trisopterus luscus*), *Trachurus* spp, *Sepia officinalis*, Loligidae, *Micromesistius poutassou*, *Merlangius merlangus*, *Scyliorhynus canicula* and *Pollachius pollachius*.

Demersal fish prey on megrim. Megrims are very voracious predators. Prey species include flatfish, sprat, sandeels, dragonets, gobies, haddock, whiting, pout and several squid species.

Adult megrim feed on small bottom dwelling fish, cephalopods and small benthic crustaceans; juvenile megrim feed on small fish and detritivore crustaceans inhabiting deep-lying muddy bottoms (Rodriguez-Marín and Olaso, 1993).

It is believed that megrim movements are more aggregation and disaggregation movements in the same area instead of highly migratory movements between areas (Perez, pers. comm.).

Although a comprehensive study on the role of megrim in the ecosystem of the complete sea area distribution has not been carried out, some general studies are available.

Fisheries modify ecosystems through more impacts on the target resource itself, the species associated to or dependent on it (predators or preys), on the tropic relationships within the ecosystem in which the fishery operates, and on the habitat.

At present, both the multi species aspect of the fishery and the ecological factors or environmental conditions affecting megrim population dynamics are not taken into account in assessment and management. This is due to the lack of knowledge of these issues.

B. Data

Data are supplied from databases maintained by national Government Departments and research institutions. The figures used in assessment are considered as the best available data at the Working Group time of the year. From year to year, and before the Working Group, small revisions of data could occur. In that case, revised data are explained and incorporated into the historical dataseries for assessment.

Data are supplied on electronic files to a stock coordinator nominated by the ICES Hake, Monk and Megrim (formerly Southern Self Demersal Stocks) Working Group, who compiles the international landings, discards and catch-at-age data, and maintains the time-series of such data with the amendments proposed by countries.

B.1. Commercial catch

Landings data are supplied from databases maintained by national Government Departments and research institutions. Countries providing landing data by quarter and ICES division are Spain, France, Ireland, United Kingdom and Belgium.

B.2. Discard data

In many fisheries, discards constitute a major contribution to fishing mortality in younger ages of commercial species. However, relatively few assessments in ICES stock working groups take discards into consideration. This happens mostly due to the long time-series needed (not available for all the fleets involved in the exploitation of most stocks) but also to the large amount of research effort needed to obtain this kind of information (Alverson *et al*., 1994; Kulka, 1999). The knowledge of discards and their use in stock assessment may also contribute, in cooperation with the industry, to refine fishing and management strategies (Kulka, 1999).

Spain started sampling discards on board commercial vessels in 1988, more specifically the Spanish trawl fleet operating in Subareas VI and VII was firstly target. During 1994, discard sampling was undertaken for other fleets (longliner (EC Project: Pem/93/005)). Sampling discards continued during 1999, 2000 for IV, VII, VIII and IX (EC Project: 98/095) and in 2001, partly just for cephalopods and during the first and last quarter of the year (Bellido *et al*., 2003; Santurtun *et al*., 2004). Since 2002 and under the National Sampling Programs, Spain continues sampling discards on board commercial fleets.

Until 2003, the standard procedure used for calculation of the Spanish discards estimators was based on a haul basis as described by Trenkel (2001). However, although these procedures were applied, there was not an estimate of the error and variance in every step of the analysis. Errors were only estimated on a haul basis.

From 2003 onwards and following the recommendation of the Workshop on Discard Sampling Methodology and Raising Procedures held in Charlottenlund (Denmark) in 2003 (Anon, 2003), general guidelines on appropriate sampling strategies and methodologies were described and then, the primary sampling unit was defined as the fishing trip instead of haul.

Discard data available by country and the procedure to derivate them are summarised in Table B.2.1.

From 2000 to 2001 a reduction in the minimum legal size (MLS), from 25 to 20 cm took place.

Since using the French discards from the 1991 survey to obtain estimates for 1999 and subsequent years was considered unreliable, only the Spanish data were used for these years, applied only to the Spanish fleets. This has led to an artificial decrease in the amount of total discards, since no estimates for French fleets were available.

The lack of discards data was considered the main problem with megrim assessment. This fact resulted in an underestimation of the international catch matrix occurs as some main countries (mostly France) involved in the fishery have not provide discard data. The lack of consistency of the catch series, which could cause great bias in assessment, was also a result of only one country (Spain) providing discard data since 1999.

During the WKFLAT (2012): In 2012, Spain, United Kingdom (England and Wales) and Ireland provide discard data since 2000. Still France does not provide these data, which led to an artificial decrease in the amount of total discards. Discard data deficiencies were partly overcome as United Kingdom (England and Wales) provided discard raised data from 2000 to 2010. Irish discard data were revised and updated and a new dataseries was provided since 1995. Spain provided some minor revised values of discards. France did not provided discard data since 1999, as data appear to be very uncertain in relation to sampling level affecting their representatively.

Table B.2.1. Megrim (*L.whiffiagonis*) in VIIb–k and VIIIa,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	-	SP04	IR	UK
2005	-	SP05	IR	UK
2006	-	SP06	IR	UK
2007	-	SP07	IR	UK
2008	-	SP08	IR	UK
2009	-	SP09	IR	UK
2009	-	SP10	IR	UK

- In bold: years where discards sampling programs provided information.

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

B.3. Biological

Quarterly/annually length/age composition data are supplied from databases maintained by national Government Departments and research institutions. These figures are used as the best available data to carry out the assessment.

France has provided quarterly length distribution by fishery unit and by sex since 1984. For 2002, 2003, 2004 and 2006 French data (length distributions, catch-at-age by FU and ALKs) were not available for the assessment. In 2005 and 2006, length distributions, catch-at-age data by quarter and sex were available. In 2007 and 2008, annual length distributions by sexes were provided. For 2010, no French data were provided to the group. In 2012 (ICES, 2012) France provided revised ALKs and consequently completed number and weights-at-age since 1999.

Annual length compositions of landings are available by country and fishery unit, for the period 1984–1990 by sex. Since 1991, annual length composition has been available for sexes combined for most countries except for France. Since 1999, the length compositions have been available on a quarterly or semestral basis. For Spain, data are available for sexes combined, except in 1993, when data were presented for separate sexes and on an annual basis. As in previous years, derivations were used to provide length compositions where no data other than weights of landings were available.

No ALKs were available for the period 1984–1986, and age compositions for these years were derived from a combined-sex ALK based on age readings from 1987 to 1990.

Quarterly ALKs for separate sexes were available for UK (E&W). Combined Annual ALKs were applied to their length distributions. Annual age composition of discards and semestral for landings per fleet, based on semestral ALKs for both sexes combined, were available and applied from Spain in Subarea VII and in Divisions VIIIa,b,d. Annual age composition of discards was available based on annual ALKs for both sexes combined were available and applied to Irish and UK (England and Wales) discards. Quarterly age compositions for sexes combined were available for Irish catches for Divisions VIIb,c,e–k.

The following table gives the source of length frequencies and ages for Northern Megrim:

	France		Ireland		Spain		UK	
	Length distribution	ALK	Length distribution	ALK	Length distribution	ALK	Length distribution	ALK
1984–1990	Quarter, by sex	(1984–1986) Synthetic ALKs using age reading from 1987–1990	Annual, by sex	(1984–1986) Synthetic ALKs using age reading from 1987–1990	Annual, by sex	(1984–1986) Synthetic ALKs using age reading from 1987–1990	Annual by sex	(1984–1986) Synthetic ALKs using age reading from 1987–1990
1991	Quarter, by sex	Quarter, combined	Annual, combined	Quarter, by sexes	Annual, combined	Semestral, combined	Annual, combined	Quarter, combined
1992	Quarter, by sex	Quarter, combined	Annual, combined	Quarter, by sexes	Annual, combined	Semestral, combined	Annual, combined	Quarter, combined
1993	Quarter, by sex	Quarter, combined	Annual, combined	Quarter, by sexes	Annual, by sexes	Semestral, combined	Annual, combined	Quarter, combined

	France		Ireland		Spain		UK	
1994	Quarter, by sex	Quarter, combined	Annual, combined	Quarter, by sexes	Annual, combined	Semestral, combined	Annual, combined	Quarter, combined
1995	Quarter, by sex	Quarter, combined	Annual, combined	Quarter, by sexes	Annual, combined	Semestral, combined	Annual, combined	Quarter, combined
1996	Quarter, by sex	Quarter, combined	Annual, combined	Quarter, by sexes	Annual, combined	Semestral, combined	Annual, combined	Quarter, combined
1997	Quarter, by sex	Quarter, combined	Annual, combined	Quarter, by sexes	Annual, combined	Semestral, combined	Annual, combined	Quarter, combined
1998	Quarter, by sex	Quarter, combined	Annual, combined	Quarter, by sexes	Annual, combined	Semestral, combined	Annual, combined	Quarter, combined
1999	Quarter, by sex	Quarter, combined	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2000	Quarter, by sex	Quarter, combined	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2001	Quarter, by sex	Quarter, combined	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2002	NA	NA	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2003	NA	NA	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2004	NA	NA	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2005	Quarter, by sex	Quarter, by sex	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2006	Quarter, by sex	Quarter, by sex	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes

	France		Ireland		Spain		UK	
2007	Annual, by sex	NA	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2008	Annual, by sex	NA	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2009	Quarter, by sex	Quarter, by sex	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes
2010	Quarter, by sex	Quarter, by sex	Quarter, combined	Quarter, combined	Semestral, combined	Semestral, combined	Quarter, combined	Quarter, by sexes

A fixed natural mortality of 0.2 is used for all age groups and all years both in the assessment and the forecast.

The maturity ogive, obtained by macroscopy, for sexes combined calculated for Sub-area VII (BIOSDEF, 1998), has been applied every year. It is as follows:

Age	0	1	2	3	4	5	6+
Maturity	0.00	0.04	0.21	0.60	0.90	0.98	1.00

As in previous years, SSB is computed at the start of each year, and the proportions of M and F before spawning were set to zero.

B.4 Surveys

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–present are available.

An abundance index was provided for the Spanish Porcupine Ground Fish Survey from 2001 to 2010. 2009 data have been incorporated in this update assessment.

Irish Ground Fish Survey (IGFS-WIBTS-Q4) is also from 2003 to present.

Surveys available for the assessment:

Type	Name	Year range	Age range	Used in the assessment
UK Survey Deep Water	UK-WCGFS-D	1987–2004	1–10+	No
UK Survey Shallow Water	UK-WCGFS-S	1987–2004	1–10+	No
French EVHOE Survey	EVHOE-WIBTS-Q4	1997–present	1–9	Yes
Spanish Porcupine Ground Fish Survey	SpPGFS-WBIT-Q4	2001–present	0–10+	Yes
Irish Ground Fish Survey	IGFS-WIBTS-Q4	2003–present	0–10+	No

It must be noted that area covered by the three current surveys does not overlap, just the northern component of EVHOE-WIBTS-Q4 and the southern coverage of IGFS-WIBTS-Q4. (Map B.3).

B.5 Commercial cpue

Commercial series of fleet-disaggregated catch-at-age and associated effort data were available for three Spanish fleets in Subarea VII (A Coruña (SP-CORUTR7) and Cantábrico (SP-CANTAB7) from 1986 to 2009, and Vigo (SP-VIGOTR7) 1984–2009. From 1985 to 2008, lpue s from four French trawling fleets: FR-FU04, Benthic Bay of Biscay, Gadoids Western Approaches and *Nephrops* Western Approaches are available.

In 2012, during the WKFLAT (ICES, 2012), 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 80–89 mm, larger mesh sizes are disused since 2006. No update for the French lpues series has been provided to the WKFLAT 2012 for 2009 and 2010 as effort deployed by these fleets was considered, at the time of the analysis, unreliable.

B.6 Other relevant data

The group reiterates the importance of incorporating estimates of discards from all main countries involved in the Northern Megrim fishery, specifically France, to obtain consistent data along the whole dataseries and also to detect possible recruitment processes that are not completely registered in the catch-at-age matrix and lpue.

C. Assessment: data and methods

In 2012, and during the WKFLAT (ICES, 2012), a Bayesian statistical catch-at-age model (described below in 'Model used in Benchmark 2012'**) s**howed promising results and seemed to be able to deal with the heterogeneity in the Megrim in Divisions VIIb–k and VIIIa,b,d data.. The model fit to the data was adequate. However, a lack of confidence in the data used made it impossible to accept the absolute values of model results. The lack of confidence in the data also makes it impossible to believe the results of any other model that could be applied to these data. Thus, no precise estimates of development of the stock population structure and SSB are available. The basis for the assessment should be then,

- The analysis of trends of Survey and Commercial Indices.
- For a more detailed analysis, which could be masked by the pooling ages in the above indices, qualitative results of the statistical catch-at-age Bayesian model will be scrutinised.
- A revision of the abundance of the ages of each of the fleets will be analysing by means of grouping ages (Group i: ages 1 + 2; Group ii: ages 3, 4, and 5 and Group iii: ages 6, 7 8, 9 and 10+). The objective is to discern for any possible change in abundance in young, intermediate and old ages along the dataseries.

Summary of the data used for the Benchmark 2012

Catch, landings and discard numbers-at-age data that were used to carry out the assessment:

i) From 1984 to 1990, international catches-at-age.

ii) From 1990 to present, total international landings-at-age (separately from discards).

iii) From 1990 to 1998 total international discards at age (separately from landings).

Discards in this period were originally available just for two countries: France and Spain. Total international discards from 1990 to 1998 were calculated raising the Spanish and French discards based on the international landings. However, the discard raising method used (which came from many years ago) has not been exactly clarified.

iv) For 1999, only Spanish and Irish discards-at-age are available. From 2000 onwards, discards-at-age are available for Ireland, Spain and UK. There was no information for France, Belgium and Northern Ireland. The main part of the missing discards is supposed to correspond to France, as the contribution of the other two nations to the stock landings is very small. France did not provide discards estimates due to the low sampling levels and major problems in the raising procedure.

In summary, the stock catch-at-age matrix shows inconsistencies in the data available for each identified different period: 1984–1989; 1990–1998 and 1999–2010.

The table below summarizes the information of the tuning fleets used.

FLEET	ACRONYMS	PERIOD	AGE RANGE	Landings %
Spanish Survey	SpPGFS-WIBTS-Q4	2001–assessment year-1	1–8	-
French Survey	EVHOE-WIBTS-Q4	1997–assessment year-1	1–9	-
French Benthic Western approaches	FR-FU04	1985–2008	2–9	5%
Spanish Vigo Trawl VII	VIGO84	1984–1998	2–9	37%
	VIGO99	1999–assessment year-1	2–9	47%
Irish Beam trawlers VII	IRTBB	1995–assessment year-1	2–9	3%

Model used in Benchmark 2012

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 fitted in a Bayesian context, using the freely available software WinBUGS (Lunn *et al*., 2009).

Software change in WGBIE 2014

Until last year working group, the model was fitted in a Bayesian context, using the freely available software WinBUGS (Lunn *et al*., 2009). Due to the high amount of time needed to run the model in this software (3 days to run the final assessment) and the low effectiveness that it implicates to make trial runs with different inputs during the group, another freely available software JAGS (Martyn Plummer, 2007) was tested. In JAGS software the final run took 1.5 hours to run. A comparison of the results of both software was done in order to check the outputs. As the results obtained where nearly the same (Figure 5.3.2.1) it was decided to used JAGS software for the assessment.

Population dynamics

$N(y,a)$ denotes the number of fish of age a at the beginning of year y. In this general model description, the assessment years are labelled as $y = 1,\ldots,Y$ and ages as $a = 1,\ldots, A+$, where A–1 is the last true age and the A+ group consists of fish aged A or older. For the megrim stock, the first assessment year is 1984 and the age plus group corresponds to 10+.

Population dynamics follow the usual equations for closed populations. For $y \geq 2$:

$$N(y,a) = N(y-1,a-1)\exp[-Z(y-1,a-1)] \text{, if } 2 \leq a \leq A-1 \quad (1)$$

$$N(y,A+) = N(y-1,A-1)\exp[-Z(y-1,A-1)] + N(y-1,A+)\exp[-Z(y-1,A+)]$$
(2)

where $Z(y,a) = F(y,a) + M$ and $F(y,a)$ and M are the rates of fishing and natural mortality, respectively. $M = 0.2$ is assumed for all ages and years. Annual recruitment of megrim (at age 1), $N(y,1)$, and numbers-at-age in the initial assessment year, $N(1,a)$, are unknown parameters.

Modelling $F(y,a)$ taking account of discards

The rate of fishing mortality is decomposed into disjoint terms as follows:

$$F(y,a) = F_L(y,a) + \sum_{j=1}^{J} F_{D,j}(y,a) \quad , \quad (3)$$

where $F_L(y,a)$ and $F_{D,j}(y,a),\ j = 1,\ldots, J$ relate to the total stock landings and discards from each of the J fleets fishing the stock, respectively. The fleets used for the megrim stock correspond to the countries fishing it and are: Spain, Ireland, United Kingdom and Others, where "Others" comprises France together with countries with minor stock catches. The reason for having France grouped together with countries with minor catches is the lack of French discards data, which makes treating France as a separate fleet unrealistic. However, given the volume of catch that France takes from this stock, it would make sense to have France as a separate fleet in the model if those data become available.

The terms making up the fishing mortality are modelled as follows:

$$F_L(y,a) = f(y)r_L(y,a), \quad F_{D,j}(y,a) = f(y)r_{D,j}(y,a),\ j = 1,\dots,J, \qquad (4)$$

where $f(y)$ is an overall annual factor relating to total fishing effort on the stock and $r_L(y,a)$ and $r_{D,j}(y,a)$ for $j = 1,\dots,J$ determine the exploitation pattern or, in other words, the distribution of *F* among ages and among landings and discards of different fleets. All factors in formulation (4) are positive and for identifiability, $r_L(y,a)$ is set to 1 for an age chosen arbitrarily (this was set as age 9 in the megrim model implementation, an age for which discards are assumed to be 0, i.e. $r_{D,j}(y,9) = 0$ for all fleets; therefore, $f(y)$ is interpreted as the total fishing mortality-at-age 9). Each of the $r(y,a)$ factors, whether it corresponds to landings or discards, is assumed to have the same values for ages *A*–1 and *A*+ , so that the fishing mortality of the + group is the same as the fishing mortality of the last true age.

A Normal random walk for $\log[r_L(y,a)]$ is assumed for each age separately. In original (non-logged) scale, this means:

$$r_L(y,a) \sim LN\left(r_L(y-1,a), CV_{rcond}\right), \qquad (5)$$

where the log-Normal (LN) distribution is parametrized using the median (first parameter) and coefficient of variation (second parameter). As megrim discarding is believed to have increased over the assessment period, the non-stationary random walk model in Equation (5) is considered appropriate. For each age, the value in the first year of the assessment period, $r_L(1,a)$, is an unknown parameter, whereas CV_{rcond} has been fixed at 20% (the value 10% was also explored in some model runs). The same modelling procedure is applied to $r_{D,j}(y,a)$, separately for each age and fleet $j = 1,\dots,J$, where the values in the first assessment year, $r_{D,j}(1,a)$, are unknown parameters and CV_{rcond} is fixed at the same value as for $r_L(y,a)$.

The annual factor $f(y)$ [Equation (4)] common to all components of *F* is also unknown. As $f(y)$ is expected to vary slowly in time with no particular trend *a priori*, a stationary process with time autocorrelation seems appropriate. This is modelled as a multivariate Normal distribution for $(\log[f(1)],\dots,\log[f(Y)])$ *a priori*, with the same mean and variance in all years and correlation ρ^n between $\log[f(y)]$ values that are n years apart. The resulting marginal prior distribution in original (non-logged) scale every year is log-Normal:

$$f(y) \sim LN\left(med_f, CV_f\right), \qquad (6)$$

with median and CV denoted as med_f and CV_f, respectively. Considering only non-negative correlations, the extreme $\rho = 0$ corresponds to independence between $f(y)$

values over time, whereas $\rho = 1$ leads to the same $f(y)$ value in all years. The values med_f and CV_f are fixed and ρ is treated as unknown.

Observation equations for commercial catch, landings and/or discards data in numbers-at-age

The commercial catch data for the megrim stock have different levels of aggregation depending on the year. Three main time periods can be distinguished in terms of data availability and how they are used in the assessment: (1) years 1984–1989: stock catch numbers-at-age in all years, without any disaggregation into landings and discards or by fleet; (2) years 1990–1998: stock landed numbers-at-age and stock discarded numbers-at-age in all years, without any disaggregation by fleet; (3) years 1999–present: stock landed numbers-at-age in all years and discarded numbers-at-age disaggregated by fleet for the fleets mentioned earlier, i.e. Spain, Ireland, UK (missing in 1999) and Others (but all years missing). The fact that discards of the Others fleet (composed of France and countries with minor stock catches) are not available means that the stock discards data from 1999 to present are incomplete.

Each of these sources of information is assigned its own observation equations, with a separate equation for each age. For the catch numbers-at-age (years 1984–1989), these are:

$$\log[C^{\text{obs}}(y,a)] \sim N\left(\log[\hat{C}(y,a)], \tau_C(a)\right), \qquad (7)$$

where $C^{\text{obs}}(y,a)$ is the observed and

$$\hat{C}(y,a) = N(y,a)\{1-\exp[-Z(y,a)]\}F(y,a)/Z(y,a) \qquad (8)$$

the model estimated catch numbers-at-age. For the landed numbers-at-age (years 1990–present):

$$\log[L^{\text{obs}}(y,a)] \sim N\left(\log[\hat{L}(y,a)], \tau_L(a)\right), \qquad (9)$$

where $L^{\text{obs}}(y,a)$ is the observed and

$$\hat{L}(y,a) = N(y,a)\{1-\exp[-Z(y,a)]\}F_L(y,a)/Z(y,a) \qquad (10)$$

the model-estimated landed numbers-at-age, obtained by applying the Baranov catch equation and using the landings component of *F*. The observation equations for discarded numbers-at-age for the stock total (years 1990–1998) or by fleet (years 1999–present) are defined in a similar fashion as Equations (9) and (10), considering the appropriate component of the fishing mortality, i.e. replacing $F_L(y,a)$ by $F_{SPD}(y,a)$ (Spanish discards), $F_{IRD}(y,a)$ (Irish discards), $F_{UKD}(y,a)$ (UK discards) and $F_D(y,a) = F_{SPD}(y,a) + F_{IRD}(y,a) + F_{UKD}(y,a) + F_{OTD}(y,a)$ (total stock discards). There are no observation equations involving $F_{OTD}(y,a)$ alone, given that discards of the Others fleets are missing in all years from 1999 to present. This means that information for fitting the $F_{OTD}(y,a)$ component of the total fishing mortality is very indirect as this component of fishing mortality only in the observation equations for total stock catch-at-age during 1984–1989 and total stock discards-at-age during 1990–1998. In preliminary trial runs of this models it became apparent that it was not possible to get sensible estimates of $F_{OTD}(y,a)$ for years 1999 and onwards. To circumvent this difficulty it was decided to fix the evolution of $r_{OTD}(y,a)$ from 1999 according to the formula:

$$r_{OTD}(y,a) = r_{OTD}(y-1,a)\left[OTLW(y)/LW(y)\right]/\left[OTLW(y-1)/LW(y-1)\right] \quad (11)$$

where $LW(y)$ and $OTLW(y)$ denote the total stock landings in weight and the landings of the Others fleet in weight in year y, which are both known. The idea here is to say that the discarding pattern-at-age of the Others fleet has not changed since 1998 and that its change in overall level (with the same change in level for all ages) between years can be approximated by the change in overall landings of this fleet with respect to total stock landings. Clearly, this assumption can be debated, but it was the most reasonable way found to constrain the model to produce sensible fits. If discards data become available for the Others fleet, it would be recommendable to remove this assumption from the model and let $r_{OTD}(y,a)$ continue to evolve in time as a random walk (in log-scale) after 1998 too, as originally modelled.

The precision (inverse of variance) parameters of the observation equations, namely, $\tau_C(a)$ (catch numbers-at-age), $\tau_L(a)$ (landed numbers-at-age), $\tau_D(a)$ (discarded numbers-at-age) and $\tau_{D,j}(a)$, $j=1,\ldots,J$ (discarded numbers-at-age for fleet $j=1,\ldots,J$), reflect the precision of the catch, landings and discards data and are treated as unknown and estimated when fitting the assessment model. In setting prior distributions for these parameters, the well-known relationship between the precision τ of a Normal prior distribution for the log of a variable and the CV of the corresponding log-Normal distribution for the original variable (in non-log scale) will be used. This relationship is as follows: if $\log(X) \sim N(\mu,\tau)$, where τ denotes precision (inverse of variance), then $CV(X) = [\exp(1/\tau)-1]^{1/2}$.

Observation equations for relative indices of stock abundance

Relative indices of abundance-at-age may be obtained from research surveys or correspond to values of catch per unit of effort of commercial fleets. Let $I_k^{\text{obs}}(y,a)$ denote the index corresponding to series k, which relates to a certain time portion of the year $[\alpha_k, \beta_k] \subseteq [0,1]$. For each year and age for which the index is available, the following observation equation is assumed:

$$\log[I_k^{\text{obs}}(y,a)] \sim N\left(\log\left[q_k(a)N(y,a)\frac{\exp[-\alpha_k Z(y,a)] - \exp[-\beta_k Z(y,a)]}{(\beta_k - \alpha_k)Z(y,a)}\right], \tau_k(a)\right) \quad (12)$$

The mean of the Normal distribution is the logarithm of the product of the average stock abundance during the period of the year to which the index relates and the catchability $q_k(a)$, which is unknown. The index precision, $\tau_k(a)$, is considered unknown for all indices explored in the assessment. As explained above, the relationship between the precision of a Normal distribution for the log of a variable and the CV of the corresponding log-Normal distribution for the variable in original scale will be used when setting prior distributions for the precision parameters.

Data, priors, and computational method

Catch numbers-at-age data correspond to: total stock catch (years 1984–1989), total stock landings (1990–present), total stock discards (1990–1998), Spanish discards (1999–present), Irish discards (1999–present), UK discards (2000–present, with year 1999 missing). Discards of Others (France and countries with minor stock catches) from 1999–present are missing in all years. Catch and landings correspond to ages 1–10+. Discards of ages 8 and older are minimal and assumed to be exactly 0 for ease of modelling (except for Spain, for which the very low number of discards from age 7 make it more convenient to assume that discards are 0 already from age 7).

After considering various potential abundance indices available at the benchmark, with the corresponding ranges of available ages, the ones finally explored within the assessment model correspond to the following indices, years and ages: EVHOE-WIBTS-Q4 survey (1997–present, ages 1–5), Porcupine survey (2001–present, ages 1–8), Vigo bottom-trawl cpue (split into two parts: 1984–1998, ages 2–9; 1999–present, ages 1–9; this splitting was done because of the strong increase in cpue shown by this fleet around the late 1990s and early 2000s, which, after exploration, was considered much more likely to be caused by an increase in catchability rather than be reflective of a strong increase in megrim abundance) and Irish beam trawl lpue (1995–present, ages 2–7).

In a Bayesian context, all unknown parameters are assigned prior distributions, which are meant to reflect the knowledge available before observing the data. The prior distributions considered are centred at values deemed reasonable according to current knowledge of the stock and the fishery while trying to ensure they are not too narrow, so as not to influence unduly the assessment results. Table 9.9.1.1 lists all the prior choices made for the final run. The parameters of the Gamma prior distribution for the precisions of all observation equations (the τ parameters towards the bottom of Table 9.9.1.1), were chosen using the well-known statistical fact that if $\log(X) \sim N(\mu,\tau)$, then $CV(X) = [\exp(1/\tau) - 1]^{1/2}$, as already mentioned, because it seems easier to think in terms of CVs of the observations than to think in terms of the inverse variance in logarithmic scale. With a $\Gamma(4,0.345)$ prior distribution on τ, the resulting prior distribution for the *CV*s of the observations in original (non-logged) scale has median 0.31 and (0.20, 0.61) as the 95% central probability interval. These values become 0.10 and (0.08, 0.15), when a $\Gamma(10,0.1)$ prior distribution is used for τ. The prior distributions for the exploitation pattern parameters in the first assessment year ($y = 1$, which corresponds to 1984) reflect the idea that discards were very low at that time. When setting the prior distribution for these parameters, it is useful to remember that $r_L(y,9) = r_L(y,10+) = 1$ has been set, so that all other selection-at-age parameters for landings and discards should be interpreted as departures from the fishing exploitation at ages 9 and 10+.

Model fitting was done using MCMC to simulate the posterior distribution (Gilks *et al.*, 1996, provide an accessible introduction to MCMC). This was programmed in the free software WinBUGS and run from R (R Development Core Team, 2009) using the

R2WinBUGS package (Sturtz *et al*., 2005). MCMC simulates the posterior distribution with each draw depending on the one immediately preceding it. As a consequence of this dependence, many iterations are typically needed to obtain a representative sample from the posterior distribution, particularly when this is highly dimensional and strong correlations between some of its dimensions exist. The results for the main runs conducted during the benchmark are based mostly on chains of 48 000 iterations. The first 8000 were discarded to eliminate the effect of start-up values, and 5000 equally spaced iterations out of the other 40 000 iterations were kept. This was considered enough to provide a good representation of the posterior distribution. Running time was approximately 24 h on a standard desktop PC.

Sensitivity analysis

In order to find an adequate fit of the model to the data and to test the sensitivity of the results to different model settings more than 30 model configurations were tested before and during the benchmark workshop. First, several models were run until sensible results were obtained, at which point the fine tuning of the model and detailed analysis started.

In a first sensible run, bimodal posterior densities were obtained for some variables, which suggested non convergence of the model, and the rL parameters in ages 1 and experienced a sharp decrease in the first years of the assessment period (1984 to approximately 1987), which did not appear realistic. This suggested that the prior assumed for the values of these parameters in 1984 was centred at unrealistically high values and that the model was using the random walk feature (for the logarithm of these parameters) to move these parameters to a more appropriate range of values early in the time-series. Thus, in a following run, the length of the MCMC chains was increased (to deal with the convergence issues) and the values of medF (used to set the prior median of population abundances-at-age in 1984, see Table 9.9.1.1) and prior median for rL in 1984 for ages 1 and 2 were changed (decreased) to correct for the behaviour displayed by rL at the beginning of the time-series. It was also observed that the estimated OTD discards of age 5 increased enormously after 1999, which did not make any sense. It was checked that the problem with the estimated OTD discards of age 5 was not a problem of convergence, several alternative model settings were tried in an attempt to solve this extremely unrealistic result, and finally, it could only be solved by modelling *rOTD (y,a)* from 1999 as was indicated in equation (11). In the results it was also observed that the prior CV of the catch and landings for ages 1 and 2 was too low in relation to the posterior results, so the prior median was increased from 10% to 30% in order to have a prior distribution which was not completely at odds with what the data indicated. In later runs it was also assumed that the precision in landings from 1990 to 2010 was equal to the precision in catch from 1984 to 1989. The reason was that, in principle, in the first period there was no incentive to discard or misreport data, so there was, in principle, no reason to expect a lower quality of the 1984–1989 catch data than of the 1990–2010 landings data.

To deal with the high increase in OTD discards of age 5 two structural changes to the model were tried. In the first change it was assumed that OTD discarding pattern-at-age had not changed since 1998, and the changes in overall level (with the same change in level for all ages) between years were treated as unknown parameters and estimated by the model based on the available data. This still resulted in very unrealistic estimates of OTD discards in recent years, with very large increases, propagating the problem previously detected just for age 5 to all the ages. The second approach to deal with this problem was the same as the first one (i.e. it was assumed that OTD discarding pattern-at-age had not changed since 1998) but the changes in overall level (with the same change in level for all ages) between years were approximated by the changes in overall landings of the OTD fleet with respect to total stock landings in the same years (see equation (11)). This gave sensible results and the assumption was used in all following runs.

Using the later configuration of the model several runs were tested using different sets of abundance indices. In the light of the results and the exploratory data analysis it was decided to use as abundance indices: EVHOE survey, SPGFS Porcupine survey, IRTBB lpue and VIGO cpue divided into two dataseries (VIGO84 and VIGO99). The VIGO cpue time-series was split to account for the change in catchability around 1999, for which there is now fairly clear support. The ages used in EVHOE and IRGFS indices were reduced to ages 1–5 and 2–7, respectively, which are the ages for which the exploratory plots showed some degree of cohort tracking. Besides, the prior median and CV of f(y) were also changed which did not have high influence on the results.

The CV of the random walk of rL, rIRD, rOTD, rSPD and rUKD, was treated as an unknown parameter in the first configurations, but later it was set at a fixed value. Two alternative values were tested for the CV of the random walk, 10% and 20%, the results were very similar, but the option of 20% was chosen because it gave slightly better results. Using the abundance indices listed in the previous paragraph, different configurations were tested and the one described above was selected. This run was selected as possible proposal for the assessment and is the run whose detailed prior settings are described in Table 9.9.1.1. However several more runs were conducted to test for sensibility of the model selected.

The sensitivity of the model to the prior distribution of recruitment was tested and the results obtained did not vary between runs. Due to the high decrease in the abundance of age 6 and older age groups and the increased difficulty of tracking cohorts at those ages suggested by the data, the model was run using a plus group age at 6. Two configurations were tried: one using abundance indices up to age 5 and the second one using them up to age 6+. The MCMC algorithm for these runs was very slow, they took longer than two and four days, respectively, but the results were congruent with those obtained using the 10+ age. The slowness of the MCMC algorithm with a 6+ group was also a sign that the configuration with ten age groups was better. In another two alternative runs, the assumption of constant f(y) across years was tested. This is not a sensible assumption, but it was tested in an attempt to shed light on the high fishing mortalities obtained for older age groups, particularly in later years. Within the constraints imposed by the assumption itself, the results were coherent with what was observed previously.

D. Short-term projection

No short-term projection was proposed by WKFLAT, considering that the assessment model should only be used as indicative of trends.

E. Medium-term projections

No medium-term projections are proposed for this stock.

F. Long-term Projections (until 2006)

No medium-term projections are proposed for this stock.

G. Biological reference points

Benchmark 2012: The calculation of possible reference points was not considered appropriate at this time due to the lack of analytical analysis.

H. Other issues

H.1. Historical development

Starting from 2007, no analytical assessment has been carried out. Assessment is based on discard data (Spanish dataseries and "preliminary" discard data from UK, and IR), catch-at-age data, survey indices and commercial cpues and lpues dataseries of the commercial fleets described in Section B5.

Model used until 2006: XSA. Information on XSA options in the past is provided as background for stock coordinator and reviewers.

Software used: VPA95 Lowestoft suite

Model Options chosen (until 2006):

Age recruitment	1
Taper	Yes (tricubic) – 20
Plus group	10
Tuning range	All
Ages catch dep. Stock size	No
Q plateau	8
F shrinkage se	1.5
year range	5
age range	3

Input data types and characteristics (in 2006 XSA):

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1984–2005	1–10+	Yes
Canum	Catch-at-age in numbers	1984–2005	1–10+	Yes
Weca	Weight-at-age in the commercial catch	1984–2005	1–10+	Yes
West	Weight-at-age of the spawning stock at spawning time.	1984–2005	1–10+	Yes
Mprop	Proportion of natural mortality before spawning	1984–2005	1–10+	NO
Fprop	Proportion of fishing mortality before spawning	1984–2005	1–10+	NO
Matprop	Proportion mature at age	1984–2005	1–10+	NO
Natmor	Natural mortality	1984–2005	1–10+	NO

Tuning data (in 2006 XSA):

Type	Name	Year range	Age range
Commercial Tuning fleet	SP – VIGOTR7	1984–2005	2–9
Commercial Tuning fleet	FR – FU04	1988–2001	4–9
Survey	UK-WCGFS-D	1993–2004	2–3
Survey	FR – EVHOES	1997–2005	1–9

Short-term forecast until 2006

- Model used: Age structured
- Software used: MFDP prediction with management option table and yield-per-recruit routines. MLA suite (WGFRANSW) used for sensitivity analysis and probability profiles.
- Initial stock size. Taken from the XSA for age 1 and older. The recruitment-at-age 1 in the last data year is estimated as a short-term GM (1987 onwards).
- Natural mortality: Set to 0.2 for all ages in all years.
- Maturity: The same ogive as in the assessment is used for all years.
- F and M before spawning: Set to 0 for all ages in all years.
- Weight-at-age in the stock: average stock weights for last three years.
- Weight-at-age in the catch: Average weight of the three last years.
- Exploitation pattern: Average of the three last years. Discard F's, are held constant while landings F's are varied in the management option table.
- Intermediate year assumptions: *status quo* F
- Stock–recruitment model used: None, non-parametric bootstrap for the whole period.
- Procedures used for splitting projected catches: vectors in each of the last three years of the assessment are multiplied by the proportion landed or discarded at age to give partial Fs for landings and discards. The vectors of partial Fs are then averaged over the last three years to give the forecast values.

Long-term projection until 2006

- Model used: yield and biomass per recruit over a range of F values that may reflect fixed or variable discard F's.
- Software used: MFY or MLA
- Maturity: Fixed maturity ogive as used in assessment.
- Stock and catch weights-at-age: mean of last three years
- Exploitation pattern: mean F array from last three years of assessment (to reflect recent selection patterns).

Procedures used for splitting projected catches: Catches are not split

Reference points prior to 2012

	ICES considers that:	ICES proposed that:
Limit reference points	BLIM is not defined.	Bpa be set at 55 000 t.
	FLIM is 0.44.	Fpa be set at 0.30.
Target reference points		Fy is not defined.

Technical basis

BLIM = Not defined.	Bpa = Bloss. There is no evidence of reduced recruitment at the lowest biomass observed and Bpa was therefore set equal to the lowest observed SSB.
FLIM = Floss.	Fpa= Fmed; this implies a less than 45% probability that (SSBMT< Bpa).

2008 Review group issues

There is a serious shortage of basic information for this stock due to severe deficiencies in the data (lack of updates, gaps in time-series, few data on discards, limited survey information). There are conflicting signals on stock trends both from surveys and lpue data, and it will require considerable effort to provide a reliable assessment for this stock.

Data deficiencies in 2008

1) Limited discards data available: Only Spanish discard data are used. Some preliminary, not raised, discard data supplied from UK. Ireland raised discard data are provided. No French discard data are delivered.

2) Limited survey information, particularly on the strength of the incoming year classes: French EVHOE survey data should be provided.

3) Conflicting trends in commercial tuning data: a complete review of the commercial cpues from Ireland is needed. Update cpues of the French tuning-series.

4) Segmentation on the main commercial fleets used in the assessment should be revised and, if appropriated, applied.

Data improvement in 2009

1) Limited discards data available: French discard data are still not available. UK "preliminary" unraised data were delivered. Spain and Ireland provided raised estimations of discards.

2) Substantial improvement in survey information. The EVHOE index-series by age has been updated and revised.

3) Revision of Commercial cpue series. The Irish Otter trawl tuning fleet has not yet been revised. French Fleets have been all updated and revised.

4) No new fleet segmentation of tuning fleet dataseries has been proposed and consequently no new data have been handled in.

2009 Review group issues

- "severe deficiencies in the data" for this stock. There appears to be an ongoing effort to update and revise data for this stock. The lack of discard data from all countries involved in the fishery is of particular concern, as it is likely that the international catch of this stock is underestimated. Only one country has provided discard data since 1999 (Spain) and this is the only time-series incorporated in the assessment.

- Additionally, concern was expressed that survey indices conflict in their depiction of trends in biomass over time. Specifically, the Irish groundfish survey indicated much higher biomass levels in 2004–2006 than the French and Spanish groundfish surveys. Furthermore, commercial catch-effort data show different trends for the fishery in recent years. Lpue from the French fishing fleet appears to be stable since 2005, whereas the cpue of the Spanish fleet indicates an increasing trend since 2005, with a decrease in 2008.
- This stock is targeted as part of a mixed fishery (hake, megrim, sole, cod, plaice, and *Nephrops*), but this was not noted in the 2009 report. Ecosystem information was not considered in examination of stock trends.

Data deficiencies in 2009

In 2010, quality has even decreased.

- No estimation for catches for this stock are delivered this year as France has not provided landing data.
- Limited discards: Lack of discards data for all countries and years continues to be a major problem for this stock. No data other than Spanish and Irish dataseries have been provided for the assessment. Only sampling data from United Kingdom were available.
- Commercial tuning data for four French fleets have not been updated. The Irish Otter trawl lpues series has not been revised for the time of the meeting.
- No segmentation of the main commercial fleets used in the assessment has been carried out.

Improvement of 2010 data

The above data deficiencies should be corrected for the preparation and development of a successful benchmark planned in the 1st quarter of 2010.

Data improvement during the Benchmark 2012

i) 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 80–89 mm, larger mesh sizes are disused since 2006.

ii) France provided revised ALKs and consequently completed number and weights-at-age since 1999.

iii) Spain, United Kingdom (England and Wales) and Ireland provide discard data since 2000.

iv) Irish discard data were revised and updated and a new dataseries was provided since 1995.

v) Spain provided some minor revised values of discards.

vi) Some minor revisions were carried out for SP-VIGOTR7 due to the incorporation of catches previously not recorded.

Data deficiencies after Benchmark 2012

i) France did not provided discard data since 1999, as data appear to be very uncertain in relation to sampling level affecting their representatively.

ii) No update for the French lpues series has been provided to the Benchmark group for 2009 and 2010 as effort deployed by this fleet was considered, at the time of the analysis, unreliable.

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Annex F - Stock Annex Bay of Biscay Sole

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	Sole (division VIIIab)
Working Group:	Assessment of Southern Shelf Stocks of Hake, Monk and Megrim
Date:	WGHMM 2013
Revised by:	M. Lissardy

A General

A.1 Stock definition

The Bay of Biscay sole stock extends on shelf that lies along Atlantic French coast from the Spanish boarder to the West point of Brittany. This shelf forms a geographical unit, being narrow at its two extreme parts, particularly in the south. As sole is chiefly present at less than 150 m, this geography of the living area gives some supports to the absence or only limited exchanges with other southern or northern stocks. However, a tagging experiment carried out in 1992 on two nursery areas has shown that fish may move from southern coast of Brittany to the Iroise sea, in the West of Brittany (KoutsiKopoulos et *al*., 1993).

Several spawning grounds are known at depth from 30 to 100 m , from south to north (Arbault et *al*., 1986) :

- in the north of Cap Breton, off the Landes coast,
- between Arcachon and the Gironde estuary,
- in front of La Rochelle,
- in front of the Loire estuary,
- in several but limited areas off the southern coast of Brittany.

Nursery grounds are located in the coastal waters, in bays (Pertuis d'Antioche, Pertuis Breton, Baie de Bourgneuf) and estuaries (Gironde, Loire, Vilaine) (Le Pape et *al*., 2003a).

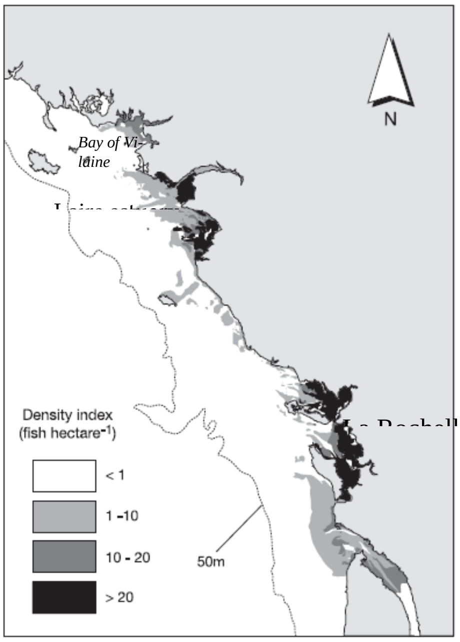


Figure 1: Fitted 0-group sole density (number of fish per hectare) in the Bay of Biscay (Le Pape et *al.*, 2003a).

A.2 Fishery

The French fleet is the major participant in the Bay of Biscay sole fishery with landings being about 90% of the total official international landings over the historical series. Most of the remaining part is usually landed by the Belgian fleet.

The fishery is largely a fixed net fishery directed on sole, particularly in the first term on the year. The other component is a French and Belgian trawl fishery. The French trawlers are otter trawlers with mixed species catches (sole, cuttlefish, squid, hake, pout, whiting….). The Belgium trawlers are beam trawlers directed at sole, but monk is an important part of its catch. The French coastal boats of these two fisheries have a larger proportion of young fish in their catch than offshore boats. These boats less than 12 m long contribute to the landings by about one third from 2000 onwards. Sole is a major resource for all these boats, given the price of this species on the market. Although the species is taken throughout the year, the catch of coastal netters is less important in autumn, those of coastal trawlers in winter and those of offshore French boats are heaviest in the first quarter.

Otter trawling predominated until the late 1980s, including a small-mesh shrimp fishery which decreased markedly in the beginning of the 1990s. The fixed fishery begun in the 1980s and it have expanded in the 1990 to account for two third to three quarters of the French landings in the beginning of 2000s. The beam trawl effort increased also rapidly and continuously in the 1990s. It has decreased after 1999 until 2004 but it has returned to its previous 2001-2002 level in 2006-2007. In 2010 it had increased until 11 % (his max until 1999) On the opposite, the otter trawl effort shows a decreasing trend until 1999 but it is stable since then.

Catches have increased continuously since the beginning of the 1980s, until a maximum was reached in 1994 (7 400 t). They have decreased afterwards to 3600-4800t in 2003-2010. The year 2009 is the lower and the year 2011 is the higher since 2006 (4600 t).

A.3 Ecosystem aspects

The quality and the extent of the nursery grounds have likely a major effect in the dynamic of sole recruitment. Studies in Vilaine bay showed a significant positive relationship between the fluvial discharges in winter-spring and the size of the nursery (Le Pape et *al.*, 2003b). The extent of the river plume influences both the larval supply and the size and biotic capacity of habitats in estuarine nursery grounds and determines the number of juveniles produced.

The WGSSDS looked at the possibility of such effect for the whole Bay of Biscay stock at it 2006 meeting. The relationship between recruitment and river flows was investigated using the Loire river flow in the first half of the year which is considered to be a representative index of the water discharge influences on nursery areas in the Bay of Biscay. Unfortunately, no relationship can be seen between this index and the recruitment at age 2 (Figure 2). The environmental effect is likely to be more complex at the Bay of Biscay scale.

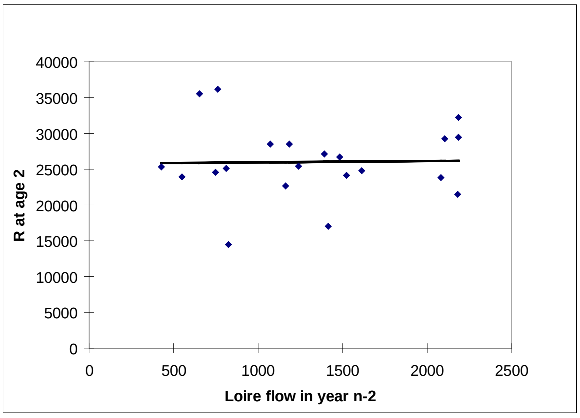


Figure 2: relationship between recruitment at age 2 (as estimated by WGSSDS in 2006) and mean Loire flow in first half year

B. Data

B.1 Commercial Catch

B.1.1 Discards estimates

Discard data are not included in the assessment because the available discards estimates are limited and, furthermore, may be biased (see thereafter).

<u>Discards data collected within the DCF regulation framework:</u>

These observations have shown that discards of beam trawlers and gillnetters are generally low but that the inshore trawlers fleet may have occasionally high discards of sole. Unfortunately, they are difficult to estimate because the effort data of inshore trawlers are not precise enough to allow estimating them by relevant areas. However, if one considers the discards have probably been high in 2009 because the 2007 year class seems to have been above the mean according to the ORHAGO survey, and if on uses the observed ratio of discards on landings of the inshore trawler fleet in 2009, which is likely to be an overestimate because the observed trips were mainly in nursery areas, the discards of the inshore trawlers are no more than 5 % of the landings in number.

The French fishing industry agreed with the data used in the assessment but suggested that the use of the discards might improve the assessment because the development of high-grading in some areas. The discards data are available since 2010 but total discards cannot be estimated because we have not an historical series (lack of data between 2004 and 2009).

Discards estimates of the French offshore trawlers provided by the RESSGASC surveys from 1987 to 2003:

Discards estimates of the French offshore trawlers were provided by the French trawl surveys FR-RESSGASC-S from 1987 to 2002. These surveys were carried out each quarter until 1997 and in the second and last quarter from 1998 to 2002.

In 2002, this survey was discontinued because the discards estimates that it provides were estimated to depend on the following questionable assumptions:

1) Trawls of the Gwen Drez R/S and the offshore trawlers have the same selectivity,

2) Gwen Drez R/S operate in the same area and in the same conditions than the offshore trawlers during the quarter (up to 1997) or the semester of the survey (quarter 4 year n + quarter 1 year n+1 for November survey year n; quarter 2 and 3 for may survey).

These discards estimates are been included several years in the assessments. They have represented about 1 to 3 % of the total catches from 1991 to 2003 and less than 0.5% since in 2002 and 2003. Given their low contribution to the total catch and the uncertainty due to the assumptions on which they are based, they have been no longer used in the assessment, as recommended by ACFM, since 2005.

Their estimation method may be finding in the annexes appended to the 2005 and 2006 WGSSDS reports or in the WGHMM stock annexes from 2007 to 2010 (Bay of Biscay sole stock was moved from WGSSDS to WGHMM in 2007)

B.1.2 Landing numbers at length

The quarterly French sampling for length compositions is by gear (trawl or fixed net) and boat length (below or over 12 m long). The contributions of each of these components of the French fleet to the landings are estimated by quarter from logbook data, assuming that the landings associated with logbooks are representative of the whole landings. In 2000-2002, surveys on fishing activities by month have provided a likely less biased estimate of landing split by gear than logbooks, which are filled in only by a part of the fleet (50-60% of the landings in 2000-2002). As logbooks are often recorded in the file with delay, the percentage of landings associated with logbook may be well below preceding years, particularly in the last quarter. In that case, the process is to use logbooks to get a landing split in the last year if it is close to the mean over the three preceding years otherwise the quarterly mean over the three preceding years is used.

B.1.3 Catch number at age

Age reading method

From 1984 to 2008, the ages in the French landings have been determined by reading otoliths which have been burnt and manually cut. From 1996 onwards, the ages in Belgian landings begun to be determined by reading the age on thin slices of otolith.

In 2005, the ages in French landings begun to be also determined by using this latter method which is the more commonly used for sole age reading. However, in order to estimate the effect of the change in age reading method, from 2005 to 2008 the age reading of French sampled fishes were carried out using the two methods. One otolith was burnt and the second was collected to get thin slices.

Two catch and weight at age 1984-2008 time series can thus be used to carry out two assessments, the set of data differing one from the other in the four terminal years. A comparison of these two assessments was presented to the 2010 WGHMM. It shows only limited differences in the outputs. Consequently, the French catch and weight at age were revised from 2005 onwards at the 2010 WGHMM to use the 2005-2009 data set provided by age reading on otolith slices, which is now the unique age reading method for the Bay of Biscay sole stock.

ALKs use to get catch at age estimates

Age compositions of the French landings and discards (up to 2003) are estimated using quarterly ALKs. Up to 1998, it is only FR-RESSGASC-S surveys ALKs. From the second half of the 1998 year and up to 2002, the first and third quarters ALKs are obtained from commercial landings samples. In 2003, commercial landing samples are completed by fish caught during a survey which was planned to design gear and methodology for the future survey ORHAGO aiming at a sole abundance index series in the Bay of Biscay. In 2004 and 2005, only market samples are used. From 2006 onwards, market samples are mainly used but the ORHAGO survey series provides age estimates at length for a large part of the landing length distribution in the last quarter of the year. Another survey (Langolf) can provide also some fish in the second quarter. Market samples are used to complete these ALKs for the upper part of the distribution.

Prior to 1994, the age composition of French offshore trawler catches is raised to include Belgian landings. In 1994 and 1995, FR-RESSGASC-S ALKs are applied to Belgian length distributions. From 1996 ahead, catch numbers at age of the Belgian fleet are estimated with Belgian ALKs. French and Belgian age composition are added before being raised to the total international catch except in 2001 where the Belgian age compositions were raised to the total of Belgian and Dutch landings.

B.2 Biological

Weights at Age

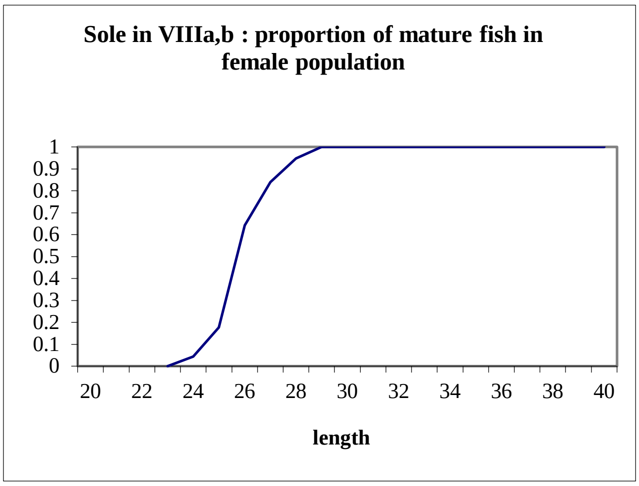
French mean weights at age are estimated using quarterly length-weight relationships in which weight are gutted weight multiplicated by the fresh/gutted transformation coefficient of French landing. This latter was changed from 1.11 to 1.04 in 2007. The French mean weights at age in catches are consequently estimated with a fresh/gutted transformation coefficient which is 1.11 up to 2006 and 1.04 from 2007 onwards.

Belgian mean weights at age are straight estimates. International mean weights at age are French-Belgian quarterly weighted mean weights.

Stock weights are set to the catch weights but always using the old fresh/gutted transformation coefficient of French landing (1.11) to have the predicted spawning biomass comparable to the biomass reference point of the management plan (Bpa as estimated in 2006 using mean weights in the stock which were mean weights in the catches).

Maturity ogive

In assessments up to the 2000 Working Group, a knife-edge maturity was used, assuming a full maturity at age 3.



During the 4 first months in 2000, the maturity at length and at age was observed on 296 female fish, 112 being between 24 cm and 28 cm long, which is the observed length range for maturity occurrence of sole in Bay of Biscay. The sampling was assumed to be at random within a length class of 1 cm. The maturity ogive was then estimated applying a maturity/age/length key thus obtained to the length distribution of the first quarter in 2000.

The maturity at age was so estimated to be:

Age	≤ 1	2	3	4	≥ 5
Mature	0	0.32	0.83	0.97	1

Natural Mortality

Natural mortality is assumed to be 0.1 for all age groups and all years.

B.3 Surveys

RESSGASC surveys

Quarterly RESSGASC survey series are available from 1987 to 2002 but it worth noting that these surveys were carried out to provide hake discard estimates and consequently not well designed for providing sole abundance indices. Each quarter from 1987 to 1998, and thereafter each second and fourth quarter of the year, the survey aimed to catch as commercial fishing boats in the same areas. These series were disrupted in 2003. They have been withdrawn from the assessment by the 2011 WKFLAT because they no longer contribute to the estimates of the terminal population numbers.

ORHAGO survey

The ORHAGO survey was launched in 2007. The fishing gear is a beam trawl with 40 mm codend. This survey is carried out in November-December in order to have a good catchability of sole at the age 1. The sampling plan is systematic. 50 hauls are distributed in 10' latitude by 10' longitude rectangles all over the sole habitat in the Bay of

Biscay. The haul positions are kept unchanged from year to year. This beam trawl survey is coordinated by the WGBEAM to which the results are reported each year since its beginning.

At the 2013 meeting of the WGBEAM 2013, several CPUE series were compared to investigate the effect of missing values for some stations in some years (0 to 20 %, depending on the year and the day fishing period) and whether fishing at night might provide a better abundance index. The WGBEAM concluded from that analysis that the CPUE times-series based on all the reference stations and on hauls carried out by daylight can be retained to provide a survey abundance index for the Bay of Biscay sole stock. An interim benchmark by correspondence was held consecutively. It agrees the inclusion of the ORHAGO survey time-series in the tuning fleets of the Bay of Biscay sole assessment, considering the need of an independent tuning index, the length of the time-series (6 years) and its ability to track year class strength in following years.

The ORHAGO survey time-series was consequently included in the assessment at the WGHMM 2013.

B.4 Commercial CPUE

Four commercial CPUE series are used in the assessment: La Rochelle offshore trawlers (FR-ROCHELLE), Les Sables d'Olonne offshore trawlers (FR-SABLES), the Bay of Biscay offshore trawlers in the second quarter (FR-BB-OFF-Q2) and the Bay of Biscay inshore trawlers in the last quarter (FR-BB-IN-Q4).

These series are provided by boats which are selected to form homogeneous groups and to limit year to year changes in fleet compositions. The following methods were adopted:

- The La Rochelle and the Les Sables d'Olonne offshore trawler fleets are two fixed groups of fishing boats. These fleets were first included in the tuning fleets at the 2005 WGSSDS. They were formed by boats which have landed sole either in La Rochelle (or near La Rochelle) or in Les Sables and for which CPUE data (with sole and *Nephrops* percentage in catches thresholds indicated thereafter) are available for a minimum number of years (10 from 1984 or 7 from 1995 to 2004). The criterion of skippers having declared to have looked for sole in 2003-2004 (IFREMER annual activities survey) was added to avoid inclusion of boats fishing sole sporadically. The La Rochelle vessels are 14 to 20 meters long and the Les Sables vessels are 12 to 23 meters long.
- The Bay of Biscay offshore trawler fleet in the second quarter and the Bay of Biscay inshore trawler fleet in the fourth quarter are formed by fishing boats which have caught sole in Bay of Biscay and for which CPUE data (with sole and *Nephrops* percentage in catches thresholds indicated thereafter) are available for five years over the ten last years. Furthermore, to limit effect of changes in fishing area, the CPUE were calculated by selecting the statistical rectangles which have provided a CPUE for more than 5 years from 2000 onwards. After the selection of rectangles, we keep the fishing boats which have caught sole for five years over the ten last years. These tuning series were first included in the tuning process at the 2011 WKFLAT. They were added to the tuning series because the decrease in number of trawlers in La Rochelle or Les Sables fleets due to the decommissioning measures or the change in gear. The inshore vessels are 10 to 12 meters long and the offshore vessels are 14 to 18 meters long.

To take into account changes in fishing areas due to change in targeting species, a minimum percentage of sole in total landing of a trip (data from 1984 to 1998) or of a day (from 1999 onwards) was selected to avoid effects of a shift in target species from sole to cephalopods in recent years. This percentage has been set to 10 % in 2005 for selecting relevant fishing periods for the La Rochelle and Les Sables tuning fleets. It resulted from the advice of fishermen given at a meeting. For defining new tuning fleets in 2011, it was necessary to reduce this percentage to 6 % for increasing the number of available data. This requirement is due to the choice to carry out the work on a more reduced time period than previously (quarter instead of year) and to pay attention to the spatial distribution of effort.

A second threshold was fixed on the percentage of *Nephrops* in total landing (below or equal to 10%) to avoid the inclusion of trips or days during which a large part of effort is devoted to this species.

The effort is in hours. It is not corrected for horse power (H x 100 kW) because this correction is considered introducing more noise, because of the quality of the measurement of horse power, than any improvement in fleets which are constructed to be homogeneous and with limited change in composition over the time period.

Because of the decreasing on the numbers of vessels for Les Sables and the large decreasing on the fishing effort for La Rochelle for 2010, the WGHMM decision is to withdraw the 2010 CPUE value for the Les Sables and La Rochelle.

C. Assessment: Data and method

Model used: XSA

Software used: Lowestoft VPA program

The XSA settings to be used were set by the WKFLAT 2011 and revised by the WGHMM are given in the following text table.

	WGHMM 2013
Catch data range	84- last year
Catch age range	2-8+
Sables d'Olonne offshore trawlers fleets tuning fleet (FR – SABLES)	1991 – 2009 2-7
La Rochelle offshore trawlers fleets tuning fleet (FR – ROCHELLE)	1991 – 2009 2-7
Bay of Biscay offshore trawlers in the second quarter tuning fleet (FR-BB-OFF-Q2)	2000 – last year 2-6
Bay of Biscay inshore trawlers in the fourth quarter tuning fleet (FR-BB-IN-Q4)	2000 – last year 3-7
Bay of Biscay beam trawler survey in the fourth quarter (FR-ORHAGO)	2007 – last year 2-8
Taper	No
Ages catch dep. Stock size	No
Q plateau	6
F shrinkage se	1.5
Year range	5
age range	3
Fleet se threshold	0.2

F bar range	3-6

Historical review of changes in XSA settings (see text table thereafter):

Age range in the assessment was changed from 0-8+ to 1-8+ in 1998, and to 2-8+ in 2004. In both cases, this change is largely due to the uncertainties in discards estimates.

Because French 1999 catches were not available at the 2000 WG, the 2000 XSA was identical to the 1999 XSA.

The age range of F bar was change from 2-6 to 3-6 at the 2004 WG because the age 2 is not fully recruited. This age range was turned back to 2-6 by ACFM because its implication on reference points. The Review Group asked nevertheless to investigate changing it again to 3-6 in 2005 and ACFM accepted the change to 3-6 in 2006.

Because of the lack of place in the page, the table is in two parts

WG year XSA	1998 XSA	1999 & 2000 XSA	2001 XSA	2002 XSA	2003 XSA	2004 XSA	2005 XSA	2006 XSA
Catch data range	1984 - 1997	1984 - 1998	1984-2000	1984-2001	1984-2002	1984-2003	1984-2004	1984-2005
Age range in catch data	1-8+	1-8+	1-8+	1-8+	1-8+	2-8+	2-8+	2-8+
FR – SABLES	88-97 1-7	89-98 1-7	84-00 2-7	84-01 2-7	84-02 2-7	84-03 2-7	91-04 revised 2-7	91-05 2-7
FR – ROCHELLE	88-97 1-7	89-98 1-7	84-00 2-7	84-01 2-7	84-02 2-7	removed	95-04 revised 2-7	91-05 corrected 2-7
FR – ROCHELLE 1	Not used	Not used	Not used	Not used	Not used	84-92 2-7	Removed	Removed
FR – ROCHELLE 2	Not used	Not used	Not used	Not used	Not used	93-03 2-7	Removed	Removed
FR – OTHER	Not used	Not used	Not used	Not used	Not used	Not used	95-04 2-7	Removed
FR – RESSGASC-S	88-97 1-7	89-98 1-7	removed	removed	removed	removed	Removed	Removed
FR – RESSGASC-S 2	Not used	Not used	87-00 2-6	87-01 2-6	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6
FR – RESSGASC-S 3	Not used	Not used	87-97 2-6	removed	removed	removed	Removed	Removed
FR – RESSGASC-S 4	Not used	Not used	87-00 1-6	87-01 1-6	87-02 1-6	87-02 2-6	87-02	87-02 2-6
FR-BB-IN-Q4	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
FR-BB-OFF-Q2	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
FR-ORHAGO	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
Taper	No	No	Yes	Yes	Yes	No	No	No
Tuning range	10	10	17	18	19	20	14	15
Ages catch dep. Stock size	No	No	No	No	No	No	No	No
Q plateau	6	6	6	6	6	6	6	6

F shrinkage se	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.5
Year range	5	5	5	5	5	5	5	5
age range	3	3	3	3	3	3	3	3
Fleet se threshold	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
F bar range	2-6	2-6	2-6	2-6	2-6	3-6	2-6	3-6

WG year XSA	2007 XSA	2008 XSA	2009 XSA	2010 XSA	2011 XSA	2012 XSA	2013 XSA
Catch data range	1984-2006	1984-2007	1984-2008	1984-2009	1984-2010	1984-2011	1984-2012
Age range in catch data	2-8+	2-8+	2-8+	2-8+	2-8+	2-8+	2-8+
FR – SABLES	91-06 corrected 2-7	91-07 2-7	91-08 2-7	91-09 2-7	91-09 2-7	91-09 2-7	91-09 2-7
FR – ROCHELLE	91-06 corrected 2-7	91-07 2-7	91-08 2-7	91-09 2-7	91-09 2-7	91-09 2-7	91-09 2-7
FR – ROCHELLE 1	Removed	Removed	Removed	Removed	Removed	Removed	Removed
FR – ROCHELLE 2	Removed	Removed	Removed	Removed	Removed	Removed	Removed
FR – OTHER	Removed	Removed	Removed	Removed	Removed	Removed	Removed
FR – RESSGASC-S	Removed	Removed	Removed	Removed	Removed	Removed	Removed
FR – RESSGASC-S 2	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	Removed	Removed	Removed
FR – RESSGASC-S 3	Removed	Removed	Removed	Removed	Removed	Removed	Removed
FR – RESSGASC-S 4	87-02 2-6	87-02 2-6	87-02 2-6	87-02 2-6	Removed	Removed	Removed
FR-BB-IN-Q4	Not used	Not used	Not used	Not used	00-10 3-7	00-11 3-7	00-12 3-7
FR-BB-OFF-Q2	Not used	Not used	Not used	Not used	00-10 2-6	00-11 2-6	00-12 2-6
FR-ORHAGO	Not used	Not used	Not used	Not used	Not used	Not used	07-12 2-8
Taper	No	No	No	No	No	No	No
Tuning range	16	17	18	19	20	21	22

Ages catch dep. Stock size	No	No	No	No	No	No	No
Q plateau	6	6	6	6	6	6	6
F shrinkage se	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Year range	5	5	5	5	5	5	5
age range	3	3	3	3	3	3	3
Fleet se threshold	0.2	0.2	0.2	0.2	0.2	0.2	0.2
F bar range	3-6	3-6	3-6	3-6	3-6	3-6	3-6

D. Short term projection

Model used: Age structured deterministic projection

Software used: MFDP

Inputs

Initial stock size:

- Recruitment is the geometric mean of recruitment values XSA over 1993 to three years before the assessment year (short mean because recruitment values are lower since 1993) if the XSA last year recruitment is considered poorly estimated according to the retrospective pattern.
- Recruitment is XSA last year recruitment if this latter one is considered to be accurately estimated according to the retrospective pattern.
- Age group above recruitment is derived from the GM.

Natural mortality: Set to 0.1 for all ages in all years

Maturity: Same ogive used for all years (given in section B.2)

F and M before spawning: None

Weight at age:

- Weights at age in the landings are the unweighted means over the last 3 years 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 unweighted means over the last 3 years using the old fresh/gutted transformation coefficient of French landing (1.11). The predicted spawning biomass is consequently comparable to the precautionary biomass reference point (Bpa) set before the change in fresh/gutted transformation coefficient of the French landing.

Exploitation pattern:

- Fishing mortality at recruiting age is the arithmetic mean over the 2 years before the terminal year if the XSA recruitment estimate is overwritten by a GM.
- Fishing mortalities above recruiting age is the arithmetic mean over the 3 last years of the assessment
- Unscaled if no trend is detected,
- Scaled to the last year's Fbar if a trend is detected.

Intermediate year assumptions:

Status quo F except if there is some information about the possibility that the TAC may be limiting.

F. Yield and biomass per recruit / long term projections

Yield per recruit calculations are conducted using the same input values as those used for the short term forecasts.

G. Biological reference points

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

(unchanged since: 2010)

H. Other Issues

None

I. References

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Annex G – Stock Annex Southern Stock of Hake

Stock Annex	Stock specific documentation of standard assessment procedures used by ICES.
Stock:	Southern Stock of Hake (Division VIIIc and IXa)
Working Group:	Working Group for the Bay of Biscay and Iberian Waters Ecoregion (WGBIE)
Date:	1 April 2014
Revised by	WKSOUTH2014

A. General

A.1. Stock definition

Southern hake stock comprises the Atlantic coast of Iberian Peninsula corresponding with the ICES divisions VIIIc and IXa. The Northern limit is in the Spanish – French boundary and the Southern one in Gibraltar Strait. These boundaries were defined based on management considerations without biological basis.

Atlantic and Mediterranean European hake are usually considered as different stocks due to the differences in biology (i.e. growth rate or spawning season) of the populations in both areas. In the North Eastern Atlantic, there is no clear evidence of the existence of multiple hake populations, although Roldán *et al.* (1998) based on genetic studies states that "*the data (…) indicate that the population structure within the Atlantic is more complex than the discrete northern and southern stocks proposed by ICES*". It is likely that there is a degree of transfer between the Southern and Northern hake stocks, and recent studies on population genetics support that (Balado *et al*., 2003; Pita *et al*., 2010; Pita *et al*., 2011), however there is at present a lack of data to quantify the amount of migrations between stocks.

A.2. Fishery

Hake in divisions VIIIc and IXa is caught in a mixed fishery by the Spanish and Portuguese fleets (trawls, gillnetters, longliners and artisanal fleets).

The Spanish trawl fleet is quite homogeneous and uses mainly two gears, pair trawl and bottom trawl. The percentage of hake present in the landings is small as there are other important target species (i.e. anglerfishes, megrims, Norway lobster, blue whiting, horse mackerel and mackerel). During recent years there has been an increase in Spanish trawlers using a new High Vertical Opening gear towed by single vessels and targeting the pelagic species listed above. In contrast, the artisanal fleet is very heterogeneous and uses a wide variety of gears; traps, large and small gillnet, long lines, etc. The trawl fleet landings length composition, since the implementation of the minimum landing size in 1991, has a mode around 29-31 cm depending on the year. Artisanal fleets target different components of the stock depending on the gear used. Small gillnets catch smaller fish than gillnets and long lines, which target mainly large fish and have length composition with a mode above 50 cm. Hake is an important component of the catch for these fleets mainly due to the high prices that reaches in the Iberian markets.

Hake is caught by the Portuguese fleet in the trawl and artisanal mixed fisheries together with other fish species and crustaceans. These include horse mackerel, anglerfish, megrim, mackerel, Spanish mackerel, blue whiting, red shrimp (*Aristeus antennatus*), rose shrimp (*Parapenaeus longirostris*) and Norway lobster. The trawl fleet comprises two distinct components - the trawl fleet catching demersal fish (70 mm mesh size) and the trawl fleet targeting crustaceans (55 mm mesh size). The fleet targeting fish species operates along the entire Portuguese coast at depths between 100 and 200 m. The trawl fleet targeting crustaceans operates mainly in the southwest and south in deeper waters, from 100 to 750 m. The most important fishing harbours from Northern Portugal are: Matosinhos, Aveiro and Figueira Foz, from Central Portugal are: Nazaré, Lisboa and Sines and Southern Portugal are: Portimão and Vila Real Santo António. The artisanal fleet lands hake mainly in the fishing harbours of the Centre. The main fishing harbours are Póvoa do Varzim (North), Sesimbra (Centre) and Olhão (South). Landings recorded by month show that the majority of the hake landings occur from May until October for both fleets.

A.3. Ecosystem aspects

European hake presents indeterminate fecundity and asynchronous development of the oocytes (Andreu, 1956; Murua *et al.*, 1998; Domínguez-Petit, 2007). It is a serial or batch spawner (Murua *et al.*, 1996). Duration of spawning season at the population level may differ between areas (Pérez and Pereiro, 1985; Alheit and Pitcher, 1995; Ungaro *et al.*, 2001; Domínguez-Petit, 2007); but a latitudinal gradient exists such that the latest peaks of spawning occur in higher latitudes. In general, adults breed when water temperatures reach 10º or 12ºC, changing their bathymetric distribution depending on the region they are in and the local current pattern, releasing eggs at depths from 50 to 150m (Murua *et al.*, 1996; 1998; Alheit and Pitcher, 1995). In general males mature earlier than females. Size at maturity is determined by density-dependent factors like abundance or age/length population structure and density independent factors like environmental conditions or fishing pressure (Domínguez *et al.*, 2008). L50 varies between areas; in the Atlantic populations is between 40-47 cm (Lucio *et al.*, 2002; Piñeiro and Saínza, 2003; Domínguez-Petit, 2007). Besides, temporal fluctuations in size at maturity within the population have been also observed what could reflect changes in growth rate (Domínguez *et al.*, 2008). Changes in maturity parameters affect stock reproductive potential, because smaller and younger females have different reproductive attributes than larger and older individuals (Trippel *et al.*, 1997; Mehault et al., 2010). Maternal physiological status, spawning experience (recruit or repeat spawners) or food rations during gametogenesis are all known to alter fecundity, egg and larval quality, as well as duration of the spawning season (Hislop *et al.*, 1978; Kjesbu *et al.*, 1991; Trippel, 1999; Marteinsdottir and Begg, 2002). Change in stock structure entails a compensatory response of age/size at maturity because depletion of large fish can be compensated by increased egg production by young fish (Trippel, 1995).

Hake recruitment indices have been related to environmental factors (Sanchez and Gil, 2000). High recruitments occur during intermediate oceanographic scenarios and decreasing recruitment is observed in extreme situations. In Galicia and the Cantabrian Sea, generally moderate environmental factors such as weak Poleward Currents, moderate upwelling and good mesoscale activity close to the shelf lead to strong recruitments. Hake recruitment leads to well-defined patches of juveniles, found in localized areas of the continental shelf. These concentrations vary in density according to the strength of the year-class, although they remain generally stable in size and spatial location. These authors have related the year-on-year repetition of the spatial patterns to environmental conditions. In the eastern, progressively narrowing, shelf of the Cantabrian Sea, years during which there is massive inflow of the eastward shelf-edge current produce low recruitment indices, due to larvae and pre-recruits being transported away from spawning areas to the open ocean.

In Portuguese continental waters the abundance of small individuals is higher between autumn and early spring. In the Southwest main concentrations occur at 200-300 m depth, while in the South they are mainly distributed at coastal waters. In the North of Portugal recruits are more abundant between 100-200 m water depths. These different depth-areas associations may be related with the feeding habits of the recruits, since the zooplankton biomass is relatively higher at those areas.

Hake is a highly ichthyophagous species with euphausiids although decapod prawns are an important part of its diet for smaller hake (> 20 cm). In Galicia and the Cantabrian Sea hake is one of the apex predators in the demersal community, occupying together with anglerfish one of the highest trophic levels (Velasco *et al.*, 2003). Its diet at >30 cm is mainly composed of blue whiting, while other species such as horse mackerel and clupeids are only important in shallow waters and in smaller individuals that also feed on other small fishes. Along the Portuguese coast the diet of hake is mainly composed of crustaceans (particularly decapods) and fish. The main food items include blue whiting, sardine, snipefish, decapods and mysids. Cannibalism in the diet of hake is highly variable depending on predator size, alternative prey abundance, year or season. Cannibalism in stomach content observations ranged from 0 to 30% of total volume, with mean values about 5%; this produces a high natural mortality in younger ages.

B. Data

B.1. Commercial catch

Landings

The landings data used in the Southern Hake assessment are based on: (i) Portuguese sales notes compiled by the National Fisheries and Aquaculture Directorate; (ii) Spanish sales notes and owners associations data compiled by IEO; and (iii) Basque Country sales notes and Ship Owners data compiled by AZTI. Since 2011 Spanish landings are submitted by the national authority, which is a different procedure from the past scientific estimations. Scientific landings estimates are presented as UNALLOCATED

From 1982 to 1993 only annual landings for Spain were available. The length distributions of landings were computed by quarter after 1994. Raising procedures are performed at the national labs before submitting the data. For the period before 1994, it was assumed that the existing annual length distribution was caught in the middle of the year.

Discards

A Spanish Discard Sampling Programme is being carried out in Divisions VIIIc and IXa North since 1993. The series provides information on discarded catch in weight and number and length distributions for Southern hake. Spanish sampling was carried out in 1994, 1997, 1999-2000 and from 2003 onwards. The number of trips sampled by the Spanish program was distributed by three trawl fleets: Baca otter trawl, Pair trawl and HVO (High Vertical Opening) trawl. Total discards were estimated raising sampling with effort. This series was revised and computed by quarter from 2004 onwards.

The Portuguese Discard Sampling Programme started in 2003 (second semester) and is based on a quasi-random sampling of co-operative commercial vessels. Two trawl fleets are sampled in this programme: Crustacean Trawl and Fish Trawl fleets. The discards estimation method was revised to take into account fishing hours as auxiliary variable and include outlier analysis.

Both series of discarded weights were rebuilt back to 1992 based on the relationships between discards and surveys, and discards and landings (ICES, 2010), with the aim of integrating them in assessment models.

B.2. Biological

A full revision of hake ecology was performed by Murua (2010). The sampling of commercial landings is carried out by the Fisheries Institutes involved in the fishery assessment (AZTI, IEO and IPMA) since 1982, except in the Gulf of Cadiz were length distribution are available only since 1994. The length composition sampling design follows a multistage stratified random scheme by quarter, harbour and gear.

After 2010, the gear sampling was substituted by a metier sampling. Raising procedure in every sampled vessel is performed by weight category and then extended to total catch in every month, harbour and gear (or metier after 2010). If there was any gap in the sampling procedure this was covered with the available information from the same quarter. Previous to 1994, only annual length distributions were available.

An international length-weight relationship for combined sexes for the whole period has been used since 1999 (a=0.00000659, b=3.01721).

Age information (otoliths) are collected by IEO, AZTI and IPMA. However, due to doubts on growth patterns and unstable ageing criteria, a von Bertalanffy growth model with t0=0, Linf=130 cm and k~0.16 (where k is re-estimated by the stock assessment model every year) is used. The Linf parameter value was chosen based on tagging data collected for the northern stock on the French coast and k estimates by the assessment models carried out during the Benchmark (ICES, 2010)

Natural mortality was assumed to be 0.4 year-1, instead of the past 0.2. The rationale is that if hake growths about two times faster, the hake longevity is reduced around half (from age ~20 to ~10). Hewit and Hoening (2005) estimate a relationship among longevity and M that produces a figure around 0.4. This value was set equal for all ages and years.

Maturity proportions-at-length was estimated with sexes combined from IEO sampling. Data available from IPMA and AZTI since 2004 were not considered due to inconsistencies with the IEO data. Maturity at length used to estimate population mature biomass was estimated with a logistic function (outside GADGET model) for all the years.

Hake is a dimorphic species where males mature at smaller size than females and also attain smaller asymptotic size (Cerviño, in press, Murua, 2010).

B.3. Surveys

The **Spanish October** groundfish (spGFS-WIBTS-Q4) survey uses a stratified random sampling design with half hour hauls and covers the northwest area of Spain from Portugal to France during September/October since 1983 (except 1987).

Two ground fish surveys are carried out annually in the **Gulf of Cadiz - in March**, from 1994, and in **November (spGFS-caut-WIBTS-Q4)**, from 1997. A stratified random sampling design with 5 bathymetric strata, covering depths between 15 and 700 m, is used in this area, with one hour hauls. Hake otoliths have been collected since 2000.

The **Portuguese October groundfish (ptGFS-WIBTS-Q4)** has been carried out in Portuguese continental waters since 1979 on board the RV "Noruega" and RV "Capricórnio". Recent work on calibration of these vessels showed a higher catchability of Capricórnio, in particular at lower sizes, as a consequence these years were calibrated. The main objective of this survey is to estimate hake's abundance indices to be used in stock assessment (Anon., 2008). A stratified sampling design was used from 1989 until 2004. In 2005 a new hybrid random-systematic sampling design was introduced, composed by a regular grid with a set of additional random locations (Jardim and Ribeiro Jr., 2007; Jardim and Ribeiro Jr., 2008). The tow duration was 60 minutes until 2001 and reduced to 30 minutes for the subsequent years, based on results of an experiment showing no significant differences in the mean abundance and length distribution between the two tow durations (Cardador personal communication, 2007)..

B.4. Commercial CPUE

Effort series are collected from Portuguese logbooks and compiled by IPMA, and from Spanish sales notes and Owners Associations data and compiled by IEO.

Landings, LPUE and effort are available for A Coruña trawl (SP-CORUTR) and Portuguese trawl (P-TR) fleets.

The CPUE series (1989-2008) of Portuguese trawlers is standardized using a GLM model with Gamma residuals, a "log" link function and explanatory variables year, zone, engine power, metier, percentage of hake in the catch, level of total catch and level of fishing effort.

Tuning data table (Table 1) shows details about these surveys and LPUEs as well as their use in the assessment model.

C. Historical Stock Development

Until 2008 this stock was assessed with XSA models based on ages estimated from ALK. In 2009 a Bayesian VPA was introduced. Since 2010, based on the decisions of the Benchmark a length based model with GADGET was introduced.

C.1. Description of gadget

Gadget is a shorthand for the "Globally applicable Area Disaggregated General Ecosystem Toolbox", which is a statistical model of marine ecosystems. Gadget (previously known as BORMICON and Fleksibest). Gadget is an age-length structured forward-simulation model, coupled with an extensive set of data comparison and optimisation routines. Processes are generally modelled as dependent on length, but age is tracked in the models, and data can be compared on either a length and/or age scale. The model is designed as a multi-area, multi-area, multi-fleet model, capable of including predation and mixed fisheries issues; however it can also be used on a single species basis. Gadget models can be both very data- and computationally- intensive, with optimisation in particular taking a large amount of time. Worked examples, a detailed manual and further information on Gadget can be found on www.hafro.is/gadget. In addition the structure of the model is described in Begley and Howell (2004), and a formal mathematical description is given in Frøysa *et al.* (2002).

Gadget is distinguished from many stock assessment models used within ICES (such as XSA) in that Gadget is a forward simulation model, and is structured be both age and length. It therefore requires direct modelling of growth within the model. An important consequence of using a forward simulation model is that the plus groups (in both age and length) should be chosen to be large enough that they contain few fish, and the exact choice of plus group does not have a significant impact on the model.

Setup of a gadget run

There is a separation of model and data within Gadget. The simulation model runs with defined functional forms and parameter values, and produces a modelled population, with modelled surveys and catches. These surveys and catches are compared against the available data to produce a weighted likelihood score. Optimisation routines then attempt to find the best set of parameter values Growth is modelled by calculating the mean growth for fish in each length group for each time step, using a parametric growth function. In the hake model a Von Bertanlanffy function has been employed to calculate this mean growth. The actual growth of fish in a given length cell is then modelled by imposing a beta-binomial distribution around this mean growth. This allows for the fish to grow by varying amounts, while preserving the calculated mean. The beta-binomial is described in Stefansson (2001). The beta-binomial distribution is constrained by the mean (which comes from the calculated mean growth), the maximum number of length cells a fish can grow in a given time step (which is set based on expert judgement about the maximum plausible growth), and a parameter β, which is estimated within the model. In addition to the spread of growth from the beta-binomial distribution, there is a minimum to this spread due by discretisation of the length distribution.

Catches

All catches within the model are calculated on length, with the fleets having size-based catchability. This imposes a size-based mortality, which can affect mean weight and length at age in the population (Kvamme 2005). A fleet (or other predictor) is modelled so that either the total catch in each area and time interval is specified, or this catch per time step is estimated. In the hake assessment described here the commercial catch and the discards are set (in kg per quarter), and the surveys are modelled as fleets with small total landings. The total catch for each fleet for each quarter is then allocated among the different length categories of the stock according to their abundance and the catchability of that size class in that fleet.

Likelihood Data

A significant advantage of using an age-length structured model is that the modelled output can be compared directly against a wide variety of different data sources. It is not necessary to convert length into age data before comparisons. Gadget can use various types of data that can be included in the objective function. Length distributions, age length keys, survey indices by length or age, CPUE data, mean length and/or weight at age, tagging data and stomach content data can all be used. Importantly this ability to handle length date directly means that the model can be used for stocks such as hake where age data is sparse or considered unreliable. Length data can be used directly for model comparison. The model is able to combine a wide selection of the available data by using a maximum likelihood approach to find the best fit to a weighted sum of the datsets.

Optimisation

The model has two alternative optimising algorithims linked to it, a wide area search simulated annealing Corona *et al*. (1987) and a local search Hooke and Jeeves algorithim HookeJeeves1961. Simulated annealing is more robust than Hooke and Jeeves and can find a global optima where there are multiple optima but needs about 2-3 times the order of magnitude number of iterations than the Hooke and Jeeves algorithim. The model is able to use both in a single run optimisation, attempting to utilize the strengths of both. Simulated annealing is used first to attempt to reach the general area of a solution, followed by Hooke and Jeeves to rapidly home in on the local solution. This procedure is repeated several times to attempt to avoid converging to a local optimum. The algorithms are not gradient-based, and there is therefore no requirement on the likelihood surface being smooth. Consequently neither of the two algorithms returns estimates of the Hessian.

Likelihood weighting

The total objective function to be minimised is a weighted sum of the different components. Selection of the weights is based on expert knowledge about the quality of the data and the space-time coverage of each data set, and the internal variance of the data set. An internal weight based on individual adjustments of the model (var) is used to reflect the variability of the data set. This was done by optimising the model to each data set in turn, and inverting the resulting objective score to use as a weight for that data set. This has the effect of assigning high weights to low variance data sets, and low weights to low variance ones. It also normalizes the weighted contribution of the different data sets. These weights were then adjusted to account for the length of the data series, the coverage of the area inhabited by the stock, and an expert judgement about the relative quality of the different data. The final column (% weight) in the table below gives the final weighted contribution of each data set to the optimised objective function.

Finding these weights is a lengthy procedure, but it does not generally need to be repeated for each assessment. Rather, the current weights can be used for several years. The weighted contribution of the data sets in a new assessment should be computed, and compared against the previous year. Provided the relative contributions are similar then the model results should be comparable between years.

C.2. Settings for the hake assessment

Population is defined by 1cm length groups, from 1-130 cm and the year is divided into four quarters. The age range is 0 to 15 years, with the oldest age treated as a plus group. Recruitment happens in the first and second quarter. The length at recruitment is estimated and mean growth is assumed to follow the von Bertalanffy growth function with Linf=130 and k estimated by the model.

An international length-weight relationship for the whole period has been used since 1999 (a=0.00000659, b=3.01721).

Natural mortality was assumed to be 0.4 $year^{-1}$

The commercial landings are modelled as two different fleets (1982-93 and 1994-present) with a selection pattern described by a logistic function. Cadiz data is modeled as an independent fleet from 1982-04 (andersen function, see gadget manual for more information) and it was added to landings fleet from 2005-08. Discards from 1992-present follows an Andersen function. The same function was used for Spanish survey, Cádiz survey and Portuguese survey. The surveys, on the other hand are modelled as fleet with constant effort and a nonparametric selection pattern that is estimated for three 15 cm length groups.

Table 1. Data used for the assessment are described below:

description	period	area	Likelihood component
Length distribution of landings	1994-lastYear	Iberia	Land1.ldist
Length distribution of landings	1982-1993	Iberia	Land.ldist
Length distribution of landings in Cadiz	1994-lastYear	Gulf of Cadiz	cdLand.ldist
Length distribution of Spanish GFS	1982-lastYear	North Spain	SpDem.ldist
Length distribution of Spanish GFS	1989-lastYear	Portugal	PtDem.ldist
Length distribution of Spanish GFS in Cadiz	1990-lastYear	Gulf of Cadiz	CdAut.ldist
Length distribution of discards	1994, 1998, 1999, 2004-lastYear	Iberia	Disc.ldist
Abundace index of Spanish GFS of 4-19 cm individuals	1982-lastYear	North Spain	SpIndex15cm.1
Abundace index of Spanish GFS of 20-35 cm individuals	1982-lastYear	North Spain	SpIndex15cm.2
Abundace index of Spanish GFS of 36-51 cm individuals	1982-lastYear	North Spain	SpIndex15cm.3

Abundace index of Portuguese GFS of 4-19 cm individuals	1989-2011	Portugal	PtIndex15cm.1
Abundace index of Portuguese GFS of 20-35 cm individuals	1989-2011	Portugal	PtIndex15cm.2
Abundace index of Portuguese GFS of 36-51 cm individuals	1989-2011	Portugal	PtIndex15cm.3
Abundace index of Spanish trawlers from A Coruña of 25-39 cm individuals	1994-lastYear	North Spain	SpCPUE15cm.1
Abundace index of Spanish trawlers from A Coruña of 40-54 cm individuals	1994-lastYear	North Spain	SpCPUE15cm.2
Abundace index of Spanish trawlers from A Coruña of 55-70 cm individuals	1994-lastYear	North Spain	SpCPUE15cm.3
Standardized abundace index of Portuguese trawlers of 25-39 cm individuals	1989-2010	Portugal	PtCPUE15cm.1
Standardized index of Portuguese trawlers of 40-54 cm individuals	1989-2010	Portugal	PtCPUE15cm.2
Standardized index of Portuguese trawlers of 55-70 cm individuals	1989-2010	Portugal	PtCPUE15cm.3

Description of the likelihood components weighting procedure and relative contribution to the final total likelihood (Note that relative contribution may change from year to year depending on the new data used to fit the model):

Likelihood component	var	quarters	quality	area	Multiplicative Weight
Land1.ldist	0.66	44	2	1	133.2
Land.ldist	0.91	72	3	0.9	213.9
cdLand.ldist	2.5	52	2	0.1	4.2
SpDem.ldist	0.87	27	4	0.5	62.3
PtDem.ldist	0.39	24	4	0.4	99
CdAut.ldist	0.38	10	4	0.1	10.4
Disc.ldist	1.04	36	1	0.9	31.2
SpIndex15cm.1	4.84	9	4	0.5	3.7
SpIndex15cm.2	0.98	9	4	0.5	18.3
SpIndex15cm.3	1.2	9	4	0.5	15
PtIndex15cm.1	3.75	8	4	0.4	3.4
PtIndex15cm.2	1.34	8	4	0.4	9.5
PtIndex15cm.3	0.52	8	4	0.4	24.5
SpCPUE15cm.1	2.37	5	2	0.5	2.1
SpCPUE15cm.2	0.23	5	2	0.5	21.5

SpCPUE15cm.3	1.55	5	2	0.5	3.2
PtCPUE15cm.1	0.46	6.67	2	0.4	11.6
PtCPUE15cm.2	1.39	6.67	2	0.4	3.8
PtCPUE15cm.3	0.76	6.67	2	0.4	7

The parameters estimated are:

- The number of fish by age when simulation starts. (ages 1 to 8) .
- Recruitment each year. (1982 to present).
- The growth rate (k) of the von Bertalanffy growth model.
- Parameter β of the beta-binomial distribution.
- The selection pattern of:
  - Commercial catches (1982-93). 2 params
  - Landings (1994-present). 2 params
  - Cadiz landings (1982-2004). 3 params
  - Discards (1992-present . 3 params
  - Spanish Survey . 3 params
  - Portuguese Survey . 3 params
  - Cadiz autumn Survey . 3 params
- Catchability of :
  - Spanish Survey (3 groups from 4 cm by 15 cm) .3 params
  - Portuguese Survey . (3 groups from 4 cm by 15 cm) .3 params
  - Spanish CPUE (3 groups from 25 cm by 15 cm) .3 params
  - Portuguese CPUE (3 groups from 25 cm by 15 cm) .3 params

The estimation can be difficult because of some or groups of parameters are correlated and therefore the possibility of multiple optima cannot be excluded. The optimisation was started with simulated annealing to make the results less sensitive to the initial (starting) values and then the optimisation was changed to Hooke and Jeeves when the 'optimum' was approached. Multiple optimisation cycles were conducted to ensure that the model had converged to an optimum, and to provide opportunities to escape convergence to a local optimum.

The model fits were analysed with the following **diagnostics**:

- Profiled likelihood plots. To analyze convergence in problematic parameters.
- Plot comparing observed and modeled length proportions in fleets (catches, landings or discards). To analyze how estimated population abundance and exploitation pattern fits observed proportions.
- Plot for residuals in catchability models. To analyze precision and bias in abundance trends.

D. Short-Term Projection

Model used: Age-length forward projection

Software used*:* GADGET (script: model/hke.predict.st.sh)

Initial stock size: estimates at the final of the assessment period estimated by the gadget model, with recruitment replaced by geometric mean (1989-Y-1), if last year recruitment estimate rejected by the group.

Maturity: arithmetic mean of last 3 years

F and M before spawning: NA

Weight at age in the stock: modeled in GADGET with VB parameters and length weight relationship

Weight at age in the catch: modeled in GADGET with VB parameters and length weight relationship

Exploitation pattern:

GADGET is a length-age based forward projection model, structured by quarter for southern hake. Two different "fleets" are used for projections, landings fleet with a logistic selection pattern, and discards fleet with an Andersen selection pattern. Although each fleet has a constant selection pattern function, the level of exploitation can be distinct by quarter. 8 F multipliers are required for projections (2 "fleets" (landings and discards) * 4 quarters), which are computed by averaging the last 3 years by quarter and fleet.

Intermediate year assumptions: If there is a trend in mean F of last 3 years the multipliers are scaled to last year's F bar (ages 1-3), so that a single scaling factor is applied to all quarters. Otherwise the multipliers are not scaled (script: /scripts/scripts.prj/multF.r).

Stock recruitment model used: geometric mean of years 89 to last year minus one.

Procedures used for splitting projected catches: driven by the selection patterns estimated by gadget for each "fleet" (landings and discards).

E. Medium-Term Projections

NA

F. Long-Term Projections

F multipliers are set in the way described for short term projections.

Model used: Age-length forward projection until 2050

Software used*:* GADGET (script: model/hke.predict.lt.sh)

Maturity: arithmetic mean of last 3 years

F and M before spawning: NA

Weight at age in the stock: modelled in GADGET with VB parameters and length weight relationship

Weight at age in the catch: modelled in GADGET with VB parameters and length weight relationship

Exploitation pattern:

Landings: logistic selection parameters estimated by GADGET.

Discards: Andersen (asymmetric) selection parameters estimated by GADGET.

Stock recruitment model used: geometric mean of years 89 to last year minus one.

Procedures used for splitting projected catches: driven by different selection functions (logistic for landings, Andersen for discards) and provide by GADGET.

G. Biological Reference Points

F max (= 0.24) was set as a proxy for Fmsy

No other BRPs set.

H. Other Issues and further work

It should be noted that new assessment model have been developed to avoid the reliance on age-based data. This new model is considered to be an improvement on the previous method given the problems related to age data described previously. However both are new, complex, and significantly different from the previous models. It is therefore likely that refinements and updates will be required over the coming years to both models and further consideration given to the data used. The panel (WKSOUTH, 2014) considers that ICES should be flexible in allowing model improvements during the Assessment Working Groups and on an inter-seasonal basis. ICES should therefore ensure that resources are in place to evaluate these improvements.

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Annex H – Stock Annex Southern white anglerfish (*Lophius piscatorius*) (Divisions VIIIc, IXa)

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	Southern white anglerfish (Divisions VIIIc, IXa)
Working Group:	Assessment for the Bay of Biscay and the Iberian Waters Ecoregion
Date:	16/05/2014
Revised by:	Paz Sampedro (WGBIE2014)

A. General

A.1 Stock definition

The two species of anglerfish (the white, *Lophius piscatorius*, and the black, *L. budegassa*) are Northeastern Atlantic species; however black anglerfish has a more southerly distribution. White anglerfish is distributed from Norway (Barents Sea) to the Strait of Gibraltar (and including the Mediterranean and the Black Sea) and black anglerfish from the British Isles to Senegal (including the Mediterranean and the Black Sea). Anglerfish occur in a wide range of depths, from shallow waters to at least 1000 m. Information about spawning areas and seasonality is scarce, therefore the stock structure remains unclear. This lack of information is due to their particular spawning behaviour. Anglerfish eggs and larvae are rarely caught in scientific surveys.

ICES gives advice for the management of several anglerfish spp. stocks in European waters: one stock on the Northern Shelf area, that includes anglerfish from the Northern Shelf, Division IIIa, Subarea IV and Subarea VI, and Norwegian Sea, Division IIa, and the stocks on the Southern Shelf area, one in Divisions VIIb–k and VIIIa,b and d and the Southern stocks in Divisions VIIIc and IXa. The stock under this Annex is called Southern White Anglerfish and is defined as white anglerfish in Divisions VIIIc and IXa. The boundaries of anglerfish in Divisions VIIb–k and VIIIa,b and d and Southern Anglerfish stocks were established for management purposes and they are not based on biological or genetic evidences (GESSAN, 2002; Duarte *et al*., 2004; Fariña *et al*., 2004).

Although the stock assessment is carried out separately for each species, white and black anglerfish are caught and landed together, due to that, the advice is given for individual and the combined species. There is a unique TAC for both species.

A.2 Fishery

Anglerfish in ICES Divisions VIIIc and IXa is exploited by Spanish and Portuguese vessels, since 2000 the Spanish landings being more than 81% for both anglerfish total reported landings. International catches for these two stocks have increased since the beginning of the 1980s, until a maximum was reached in 1988 (10 021 t). They have decreased to 1801 t–1802 t in 2001–2002. In the 2005–2011 period the catches were between 1774 t and 4500 t. Both species are caught on the same grounds by the same fleets and are marked together.

White and black anglerfish are caught together by Spanish and Portuguese bottom trawlers and gillnet fisheries. Spanish and Portuguese bottom trawlers are mixed fisheries. The Spanish bottom-trawl fleet predominantly targets hake, megrim, Norway lobster and anglerfish. Since 2003 the alternative use of a trawl gear with High Vertical Opening (HVO) has taken place in higher proportion relative to previous years. This gear targets horse mackerel and mackerel with very few anglerfish catches. Since 2002, the Spanish landings were on average 61% from the trawl fleet and 39% from the gillnet fishery. The Spanish gillnet fishery can use different artisanal gears, but most catches come from "Rasco" that is a specific gear targeting anglerfish.

Anglerfish are caught by Portuguese fleets in trawl and artisanal mixed fisheries. Portuguese landings were on average, from 2002, 19% from trawlers and 81% from artisanal fisheries. The trawl fleet has two components, the trawl fleet targeting demersal fish and trawl fleet targeting crustaceans. Since 2005, Portuguese combined species landings were TAC constrained and very low landings were registered during the 4th quarter since then.

Discarding in white anglerfish is considered low for the trawl fishery, based on estimated data for Spanish trawl fleet (ICES, 2011) and information from Portuguese trawl fleet (ICES, 2012a).

Each year, the European Union sets a combined TAC and quota for white and black anglerfish. There is no minimum landing size for anglerfish, but in order to ensure marketing standards a minimum landing weight of 500 g was fixed in 1996 by the Council Regulation (EC) No.2406/96.

As part of the Recovery Plan for the Southern hake and Iberian *Nephrops* stocks (Council Regulation (EC) No.2166/2005), in force since January of 2006, the fishing effort regulations are affecting the Spanish and Portuguese mixed trawl fisheries. As anglerfish are taken in these mixed trawl fisheries, these stocks are also affected by the recovery plan effort limitation.

A.3 Ecosystem aspects

White anglerfish is a benthic species that occur on muddy to gravelly bottoms. It attains a maximum size of around 163 cm corresponding to a weight of approximately 51 kg. Historically white anglerfish has been considered a slow growing species, with a late maturation (Duarte *et al.*, 2001). Nevertheless, new evidences from mar-recapture experiments indicate that the anglerfish growth could be faster (Landa *et al.*, 2008).

The ovarian structure of anglerfish differs from most other teleosts. It consists of very long ribbons of a gelatinous matrix, within individual mature eggs floating in separate chambers (Afonso-Dias and Hislop, 1996). The spawning of the *Lophius* species is very particular, with eggs extruded in a buoyant, gelatinous ribbon that may measure more than 10 m and contain more than a million eggs (Afonso-Dias and Hislop, 1996; Hislop *et al.*, 2001; Quincoces, 2002). Eggs and larvae drift with ocean currents and juveniles settle on the seabed when they reach a length of 5–12 cm. This particular spawning leads to highly clumped distributions of eggs and newly emerged larvae (Hislop *et al.*, 2001) and favourable or unfavourable ecosystem conditions can therefore have major impacts on recruitment.

Due to their particular reproduction aspects (that shows a high parental investment in the offspring) the population dynamics of these species is expected to be highly sensitive to external biological/ecosystem factors.

Vertical displacements of immature and mature white anglerfish from the seabed to the near surface have been recorded in the Northeast Atlantic (Hislop *et al*., 2001) and are suggested to be related to spawning or feeding.

Improvement of knowledge regarding growth, spawning behaviour, migratory behaviour and juvenile drift are essential to present and future assessment and management of both Southern Anglerfish stocks.

B. Data

B.1 Commercial catch

Landings data are provided by National Government and research institutions of Spain and Portugal. Quarterly landings by country, gear and ICES Division are available from 1978. There were unrecorded landings in Division VIIIc between 1978 and 1979, and it was not possible to obtain the total landings in those years. Portuguese landings were TAC constrained since 2005. Very low landings have been registered during the 4th quarters since then. The Portuguese landings were relatively stable during the first two years, but have decreased substantially from 2004 to 2010. In the last three years Portuguese landings were in the lower levels of the series.

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 VIIIc and IXa and Portuguese landings of Division IXa are derived from their relative proportions in market samples.

For white anglerfish the maximum landing of the available series was recorded in 1986 at 6870 t. After that, a general decline to 788 t in 2001 was observed, reaching the minimum of the available series. From 2002 to 2005 landings increased reaching 3644 t. Since 2005 landings have slowly decreased to 976 t in 2011.

Discards

Since 1994 a Spanish Discard Sampling Programme is being carried out for trawl fleets operating in the ICES Divisions VIIIc and IXa. However, the time-series is not complete and years with discard data are 1994, 1997, 1999, 2000 and from 2003 to 2012. The raising procedure used to estimate discards was based on effort. The Portuguese Discard Sampling Programme recorded anglerfish data from 2004. The frequency of occurrence of white anglerfish in discard samples is very low and its discard is considered negligible.

B.2 Biological

Landing numbers-at-length

Since 2009 the quarterly Spanish and Portuguese sampling for length compositions is by métier and ICES Division. Length data from sampled vessels are summed and the resulting length composition is applied to the quarterly landings of the corresponding métier and ICES Division. The sampled length compositions were raised for each country and SOP corrected to total landings on a quarterly or half yearly basis (when the sampling levels by quarter were low). The average lengths of trawl caught anglerfish are lower compared to the artisanal fleets.

Catch numbers-at-age

No catch numbers-at-age are provided to the Working Group. At the WGHMM 2007 meeting (ICES, 2007), age–length keys, based on *illicia* readings, were used to obtain catch number-at-age for each species. The exploratory analysis of estimates indicated that the biased age reading criterion does not allow following cohorts along years in either of the two species. The last research about white anglerfish ageing, *White Anglerfish Illicia and Otoliths Exchange 2011* (ICES, 2012b), highlighted that neither *illicia* nor otolith age readings have been validated and, in the case of *illicia* studies, the agreement among readers and the precision were not acceptable. Therefore it was concluded that the available age reading criteria for white anglerfish southern stock is not valid to build an ALK.

Growth curve

The most recent study about white anglerfish growth in Atlantic integrates results for different growth researches (tag–recapture study, length–frequency of catches, and microstructure analysis of hard parts) (Landa *et al*., 2008). A von Bertalanffy growth curve fitted to all data provided the parameter values $L_{inf} = 140$ cm and $K = 0.11$. This growth rate is faster than estimated recently using *illicia* for age estimation.

Maturity-at-length

Different estimates of maturity ogive based on macroscopic maturity staging are available for white anglerfish (Duarte *et al*., 2001; Landa *et al*., 2012). In these studies the difficulty of finding mature females in the field resulted in samplings with low coverage of mature individuals. Besides, the inadequacy in same instances of the macroscopic examination to determine maturity stage, let it to consider a maturity ogive of white anglerfish from other areas. The available study was carried out in ICES Divisions VIIIabd and determined microscopically the maturity stage (Quincoces, 2002). The parameters of maturity ogive are 50% maturity at 61.84 cm and a slope at 0.1001.

Natural mortality

No specific studies about natural mortality of white anglerfish were available. However, taking into consideration its growth rate and the high size that can attain, a constant annual instantaneous natural mortality rate (M) of 0.2 yr^{-1}, for all ages and years, is assumed.

Length–weight relationship

The weight at length relationship was calculated using data from an international project with a sampling that spatially covered a high proportion of the stock and which number of samples (BIOSDEF, 1998):

$W = 2.70 \times 10^{-5} \cdot L^{2.839}$

where W = weight in kilograms and L = length in centimetres.

B.3 Surveys

SpGFS-WIBTS-Q4

The Spanish Groundfish Survey aims to collect data on the distribution and relative abundance, and biological information of commercial fish in ICES Divisions VIIIc and Northern IXa. Since 1983 it is annually carried out in fourth quarter (September/October) of the years, except for 1987. Time-series of abundance indices, in weight and in number, and correspondent length composition are available for both anglerfish species. The full time-series of this survey is used in the assessment of white anglerfish since 2012.

PtGFS-WIBTS-Q4

Portuguese Autumn Groundfish Survey has been carried out in Portuguese continental waters since 1979 in the fourth quarter of the years. Abundance indices for both anglerfish species are available from 1989 to 2011. The abundance values detected by this survey are very low for the whole time-series, being insignificant for some years.

This survey is not used in the assessment of white anglerfish.

B.4 Commercial cpue

Six commercial series of landing-effort are available to the WG. Four of them are Spanish fleets in the ICES Division VIIIc and two Portuguese fleets in the ICES Division IXa. The Portuguese trawl fleet was split into fish trawlers and crustacean trawlers (WD12, Duarte *et al*., 2007 in ICES, 2007) according to the fleet segmentation proposed by the IBERMIX project (WD06, Castro *et al*., 2007 in ICES, 2007).

SP-CORTR8C

A Coruña trawl fleet fishing in Division VIIIc is available for years 1982–2012. Data provided for A Coruña trawlers comprise quarterly effort (fishing days per 100 horse power), landings and length composition of landings. This fleet represents an average of 15% of international catches of white anglerfish along the time-series. A standardized series from 1994 to 2006 is also available for this fleet with annual effort data (in fishing days) and annual lpue.

Data from this commercial lpue series has been used in the white anglerfish assessment since 2007.

SP-CEDGNS8C

Cedeira gillnet fleet fishing in Division VIIIc is available for years 1999–2011. Data provided for Cedeira gillnets comprise quarterly standardized effort (in soaking days), landings and length composition of landings. This fleet represents an average of 11% of international catches of white anglerfish since 1999. 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 since 2012 it is no longer recorded.

Data from this commercial lpue series has been used in the white anglerfish assessment since 2007.

Other available commercial series of lpues that have never been employed in the assessment are

PT-TRF9A

Portuguese trawlers targeting fish: years 1989–2012. Data provided for Portuguese trawlers targeting fish comprise quarterly effort (1000 hours trawling with occurrence of anglerfish), landings and length composition of landings. This fleet represents an average of 1% of international catches of white anglerfish along the time-series. A standardized series from 1989 to 2008 is also available for this fleet with annual effort data (in 1000 hauls) and annual lpue.

PT-TRC9A

Portuguese trawlers targeting crustacean: years 1989–2012. Data provided for Portuguese trawlers targeting fish comprise quarterly effort (1000 hours trawling with occurrence of anglerfish), landings and length composition of landings. This fleet represents an average of 1% of international catches of white anglerfish along the time-series. A standardized series from 1989 to 2008 is also available for this fleet with annual effort data (in 1000 hauls) and annual lpue.

SP-AVITR8C

Avilés trawl fleet fishing in Division VIIIc is available for years 1986–2003. Data provided for Avilés trawlers comprise quarterly effort (fishing days per 100 horse power), landings and length composition of landings. This fleet represents an average of 6% of international catches of white anglerfish along the time-series. The effort-series was interrupted in 2003.

SP-SANTR8C

Santander trawl fleet fishing in Division VIIIc is available for years: years 1986–2010. Data provided for Santander trawlers comprise quarterly effort (fishing days per 100 horse power), landings and length composition of landings. This fleet represents an average of 7% of international catches of white anglerfish along the time-series. Effort data for 2008 was not provided to the WG.

C. Assessment: data and method

Until 2011 white anglerfish stock was assessed with a non-equilibrium production model (ASPIC software). Results from growth studies provide a growth pattern for this stock allowing the application of a length-based assessment model. Stock Synthesis is was considered a suitable model to assess this stock by WKFLAT (ICES, 2012a).

Model

Model used: Stock Synthesis 3 (SS3) (Methot, 2000)

Software used: Stock Synthesis v3.23b (Methot, 2011)

Stock Synthesis 3 (SS3) is an integrated assessment model. SS3 has been used for stock assessment all around the world. The area of highest used is on the US Pacific Coast. SS3 is coded in C++ using Auto-Differentiation Model Builder (http://www.admb-project.org) and available from the NOAA Fisheries Toolbox (http://nft.nefsc.noaa.gov/SS3.html). SS3 has three main characteristics that differentiate it from classical assessment models:

- SS model structure allows for building of simple to complex models depending upon the data available. It is capable to build models with age and/or length structure and spatial structure.
- It is capable to use different sources of information.
- All parameters have a set of controls to allow prior constraints, time-varying flexibility, and linkages to environmental data.

The overall SS3 model is subdivided into three submodels. The first submodel simulates the population dynamics, where the basic abundance, mortality and growth functions create a synthetic representation of the true population. The second submodel is the observation submodel. This contains the processes and filters designed to derive expected values for the various types of data. The last submodel is the statistical that quantifies the magnitude of the difference between observed and expected data and employs an algorithm to find the set of parameters that maximizes the goodness-of-fit.

The SS3 model developed for white anglerfish during the WKFLAT 2012 has been designed for a particular set of data and specifications. White anglerfish is harvested by four fleets, and two commercial lpue series and one fishery-independent survey provide information about relative abundance. No discard information is considered.

Length composition data are available from both the fisheries and surveys. No age information is available for this stock.

Input data

Years: 1980–2013.

Model structure:

- Temporal unit: quarterly based data (landings, lpue and length–frequency) were used in SS3 calculations.
- Spatial structure: One area.
- Sex: Both sexes combined.

Fleet definition:

Four *fleets* were defined attending to the gear type and country:

- Spanish trawlers in ICES Division VIIIc-IXa (SPTR8C9A)
- Spanish artisanal in ICES Division VIIIc (SPART8C)
- Portuguese trawlers in ICES Division IXa (PTTR9A)
- Portuguese artisanal in ICES Division IXa (PTART9A)

Landed catches:

Quarterly landings entered the model as biomass (in weight) for the four fleets. Landings data for January 1980 to December 2013 were used to conduct the stock assessment of white anglerfish.

From 1980 to 1988 quarterly landings were estimated using the average proportion for the further five years (1989–1993) by fleet. In the case of SPART8C quarterly landings were estimated from 1980 to 1993 using the average proportion for the further five years (1994–1998).

Abundance indices:

- A Coruña trawlers (SPCORTR8C): Quarterly lpue in weight from 1982 to 2012. It is entered as four separate indices, one index per quarter.
- Cedeira gillnetters (SPCEDGN8C): Quarterly lpue in weight from 1999 to 2011. It is entered as four separate indices, one index per quarter.
- Spanish Groundfish Survey (SPGFS): Abundance index in numbers from 1983 to 2013, except for 1987.

Length composition of data:

The length bin was set by 2 cm, from 4 to 100 cm, by 10 cm from 100 to 160 cm and by 40 cm from 160 to 200 cm. Length composition for the four fishing fleets and the three abundance indices were used. The available length data and their disaggregated level differ among fleets:

Length composition of Fleets:

- SPTR8C9A: 1986–2013, quarterly basis. From 1986 to 1988 quarterly length proportions were estimated from an annual proportion using the Data Super-Period approach available in SS3.

- SPART8C: 1986–2013, quarterly basis. From 1986 to 1994 quarterly length proportions were estimated from an annual proportion using the Data Super-Period approach available in SS3.
- PTTR9A: 1986–2009, quarterly basis. From 1986 to 1988 quarterly length proportions were estimated from an annual proportion using the Data Super-Period approach presented in SS3.
- PTART9A: 1986–2009, quarterly basis. From 1986 to 1988 quarterly length proportions were estimated from an annual proportion using the Data Super-Period approach present in SS3.

Length composition of Abundance Indices:

- SPCORTR8C: 1982–2012, quarterly basis. Gaps are presented in years 1982, 1984, 1985 and 1986.
- SPCEDGN8C: 1999–2011, quarterly basis.
- SPGFS: length composition for fourth quarter, from 1983–2013. 1987 length composition is missing.

Model assumptions and parameters

- Natural mortality: M=0.2 for all ages and years.
- Growth: von Bertalanffy function: K=0.11 fixed, L_{max} and mean length-at-age 0.75 are estimated.
- Maturity ogive: length-based logistic, L_{50}=61.84 and slope=-0.1001, constant over time.
- Weight-at-length: a=2.70×10-5 b=2.839, not estimated.
- Recruitment allocation in Quarter 3.
- Stock–recruitment relationship: Beverton–Holt model: steepness h=0.999, sigmaR=0.4, R0 estimated.
- Selectivity: For all fleets selectivity was only length-based and was modelled as a double normal function. Selectivity varies among fleets, but is assumed to be time-invariant.

D. Short-term projection

Model used: Stock Synthesis 3.

Software used: *ad hoc* R code.

Initial stock size: SS3 outputs in the last assessment year.

Natural mortality: Set to 0.2 for all ages in all years.

Growth model: von Bertalanffy function, with parameters estimated in the assessment model.

Maturity-at-length: The same ogive as in the assessment is used for all years.

Weight-at-length in the stock and in the catch: The same length–weight relationship as in the assessment model

Exploitation pattern: Average of the final three assessment years (with the possibility of scaling to final year F).

Intermediate year assumptions: *status quo* F.

Recruitment: geometric mean of estimated recruitment from 1980 until the final assessment year. If trends in recruitment become evident a shorter range of years could be selected.

E. Medium-term projections

No medium-term projections are conducted for white anglerfish stock.

F. Yield and biomass per recruit/long-term projections

Yield per recruit calculations are conducted using the same input values as those used for the short term forecasts.

Model used: yield and biomass-per-recruit over a range of F values.

Software used: *ad hoc* R code.

G. Biological reference points

The new assessment methodology developed for white anglerfish in WKFLAT 2012 provides the technical basis to set reference points for this stock. In the WGHMM 2012 possible proxies for F_{MSY} were considered among Fmax, $F_{0.1}$, $F_{30\%}$, $F_{35\%}$ and $F_{40\%}$.

The following table shows the estimates that were obtained from yield and SSB per recruit analysis:

	Fbar	Y/R	SSB/R
Fmax	0.29	2.13	7.04
F0.1	0.19	2.02	13.24
F40%	0.12	1.68	22.70
F35%	0.13	1.79	20.01
F30%	0.15	1.90	17.08

$F_{0.1}$=0.19 was set by the WGHMM2012 as proxy of F_{MSY}.

H. Other issues

H.1 Historical development of assessment

Southern Anglerfish stocks were assessed for the first time in the 1990 ICES WG meeting. Different assessment trials were performed during the subsequent eight years but analytical assessments indicated unrealistic results. The database (both biological and fisheries data) were improved along these years trying to apply an analytical assessment model. Since 1998 a non-equilibrium surplus production model ASPIC (Prager, 1994) was applied to each stock or to the combined stock data. These stock assessments were accepted by the ACFM and used to provide management advice. The assessment of white anglerfish as a separate stock has been carried out continuously from 2007. The history of white anglerfish assessment from 2007 to 2013 is presented in Table 1.

Table 1. History of southern white anglerfish assessment from 2007 to 2013.

WG	2007	2008	2009	2010	2011		2012	2013
Assessment Model	Non-equilibrium Surplus production model (Prager, 1994a)	No updated	Non-equilibrium Surplus production model (Prager, 1994a)	Non-equilibrium Surplus production model (Prager, 1994a)	Non-equilibrium Surplus production model (Prager, 1994a)	Assessment Model Model Structure	Stock Synthesis 3 (Methot, 2000) Length based Quarterly based data	Stock Synthesis 3 (Methot, 2000) Length based Quarterly based data
Software	ASPIC (v. 5.16)	No updated	ASPIC (v. 5.16)	ASPIC (v. 5.34)	ASPIC (v. 5.34.9)	Software	SS3v23b	SS3v23b
Catch data range	1980–2006		1980–2008	1980–2009	1980–2010	Catch data range Fleets	1980-2010 SPTR8C9A SPART8C PTTR9A PTART9A	1980-2012 SPTR8C9A SPART8C PTTR9A PTART9A
Cpue Series 1 (years)	SP-CORUTR8c (1986–2006)		SP-CORUTR8c (1986–2008)	SP-CORUTR8c (1986–2009)	SP-CORUTR8c (1986–2010)	Abundance Index 1 (by quarter)	SPCORUTR8c (1982-2010)	SPCORUTR8c (1982-2012)
Index of Biomass (years)	SP-CEDGNS8c (1999–2006)		SP-CEDGNS8c (1999–2008)	SP-CEDGNS8c (1999–2009)	SP-CEDGNS8c (1999–2010)	Abundance Index 2 (by quarter)	SPCEDGN8C (1999-2010)	SPCEDGN8C (1999-2011)
Error Type	Condition on yield		Condition on yield	Condition on yield	Condition on yield	Abundance Index 3 (4rd quarter)	SPGFS (1983-2010)	SPGFS (1983-2012)
Number of bootstrap	500		500	1000	1000	Natural mortality	M=0.2 for all ages and years	M=0.2 for all ages and years
Maximum F	8.0 (y-1)		8.0 (y-1)	8.0 (y-1)	8.0 (y-1)	Growth	von Bertalanffy K=0.11 fixed Lmax estimated	von Bertalanffy K=0.11 fixed Lmax estimated
Statistical weight B1/K	1		1	1	1	Maturity ogive	length-based logistic L50=61.84 slope=-0.1001	length-based logistic L50=61.84 slope=-0.1001
Statistical weight for fisheries	1,1		1,1	1,1	1,1	Weight-at-length	a=2.70×10-5 b=2.839	a=2.70×10-5 b=2.839

WG	2007	2008	2009	2010	2011		2012	2013
B1-ratio (starting guess)	0.5		0.5	0.5	0.5	Recruitment allocation	Quarter 3	Quarter 3
MSY (starting guess)	5000 t		5000 t	5000 t	5000 t	Stock-Recruitment	Beverton–Holt model h=0.999 sigmaR=0.4 R0 estimated	Beverton–Holt model h=0.999 sigmaR=0.4 R0 estimated
K (starting guess)	50 000 t		50 000 t	50 000 t	50 000 t	Selectivity	All fleets: length-based double normal function Varies among fleets Time-invariant	All fleets: length-based double normal function Varies among fleets Time-invariant
q1 (starting guess)	1d-5		1d-5	1d-5	1d-5			
q2 (starting guess)	1d-6		1d-6	1d-6	1d-6			
Estimated parameter	All		All	All	All			
Min and Max allowable MSY	2000 (t) – 10 000 (t)		2000 (t)– 10 000 (t)	2000 (t)– 11 500 (t)	2000 (t)– 11 500 (t)			
Min and Max K	5000 (t)– 500 000 (t)		5000 (t)– 100 000 (t)	5000 (t)– 112 000 (t)	5000 (t) – 112 000 (t)			
Random Number Seed	1 964 185		1 964 185	1 964 185	1 964 185			

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Annex I – Stock Annex: Southern megrims (*L. whiffiagonis* and *L. boscii*)

Stock Annex	Stock specific documentation of standard assessment procedures used by ICES.
Stock:	Southern megrims (Division VIIIc, IXa)
Working Group:	Working Group for the Bay of Biscay and Iberian Waters Ecoregion (WGBIE)
Date:	13 May 2014
Revised by:	WGBIE2014

A. General

A.1. Stock definition

The genus Lepidorhombus is represented in eastern Atlantic waters by two species, megrim (*L. whiffiagonis*) and four-spot megrim (*L. boscii*). Three stocks of megrims are assessed by ICES: megrim in ICES Subareas IV and VI, megrim in Divisions VIIb-k and VIIIa,b,d and megrim in Divisions VIIIc and IXa. Although the boundaries of the stocks were established only for management purposes, recent genetic studies have proved the existence of at least two populations within the Atlantic Ocean for both species. While *L. boscii* populations match the stocks defined, *L. whiffiagonis* needs more detailed studies to refine the boundaries, although in principle would also overlap with the current structure (Danancher and García-Vázquez, 2009).

The stocks under this Annex are called Southern Megrims and include both megrim species in Divisions VIIIc and IXa. Megrim (*L. whiffiagonis*) is in both ICES Divisions (VIIIc and IXa), with its highest abundance in Division VIIIc. Four-spot megrim (*L. boscii*) is distributed in both ICES Divisions (VIIIc and IXa), being more southerly present than megrim (Sánchez *et al*., 2002). There is a certain bathymetric segregation between the two species of megrim. *L. boscii* has a preferential depth range of 100 to 450 m and *L. whiffiagonis* of 50 to 300 m (Sanchez *et al*, 1998).

A.2. Fishery

Management of megrim is both by TAC and technical measures. The two species (*L. whiffiagonis* and *L. boscii*) are managed under a common TAC. They are caught and recorded together in the landings statistics. It is impossible to manage each species separately under a common TAC. The spatial distribution of the two stocks shows some differences that could be utilized for separate management of the two stocks.

The minimum mesh size for towed gears ranges between 55 and 70 mm, depending on catch species composition. Minimum landing size for the two species changed from 25 to 20 cm in year 2000 (Council Regulation EC 850/98).

Both megrim species are included in the landings from ICES Divisions VIIIc and IXa. The percentage of megrim (*L. whiffiagonis*) in landings of both species by weight was between 12% and 37% over the whole period for which data are available, being mostly above 20% until year 2000 and mostly below 20% since that year.

No landings data are available for these stocks before 1986, although some Spanish harbours have longer landings series. Total international landings increased sharply from 1986 to 1989, when they reached 3340 t, and then showed a continuous declining trend until their lowest level of 840 t in 2002. There has been some increase in landings since that year, being 1380 t in 2010, the maximum value of the last decade.

Both species of megrim are taken as by-catch in the mixed bottom trawl fisheries targeting "white fish" by Portuguese and Spanish fleets, and also in small quantities by the Portuguese artisanal fleet. The majority of the catches are taken by Spanish trawlers.

Since the early 1990´s the Spanish bottom trawl fleet has diversified its fishing strategy, introducing a new trawl gear which targets primarily pelagic species (as horse mackerel and mackerel) (Punzón *et al*, 2010; Castro *et al*, 2011). This gear, named "jurelera", affects catches of *L. boscii* more than those of *L. whiffiagonis*, probably due to differences between the distribution area of both species. Also, the fishing ban for all trawlers in grounds within 100 m depth (RD 1441/1999, 10 sept) may affect in the proportion of both species in catches due to their different bathymetric distribution.

The Prestige oil spill in the northwest Spanish coast (November 2002) prompted a redistribution of fishing effort, particularly in the Galician area. Some regulation measures, such as spatial and seasonal closures, were adopted in order to minimise the oil spill impact on fisheries. Some trawl fleets display lower effort in 2003 in relation to later years (Abad *et al*, 2010).

Horse mackerel, Atlantic mackerel, blue whiting, anglerfish, hake, megrim, different cephalopods and *Nephrops* account for a high percentage (around 90%) of all retained species in this multispecies trawl fishery (Castro *et al*, 2011). A great number of species are caught as by-catch.

Discards are important, particularly for younger ages of both megrim species. Around 10-65% of the individuals caught are discarded by trawlers (Pérez *et al*, 2011). Lack of commercial interest, variations in market price, fish size (MLS or market size), storage capacity as well as distance to home port are the main reasons for discarding. Artisanal fleets catch few megrims and discards of all species in these fleets are very low.

Megrims have been affected by the Recovery Plan for the Southern hake and Iberian *Nephrops* stocks (Council Regulation EC 2166/2005), since January of 2006, with the fishing effort limitation measurements in the Spanish and Portuguese mixed trawl fisheries.

A.3. Ecosystem aspects

The Iberian Region along the eastern Atlantic shelf (Divisions VIIIc and IXa) is an upwelling area with high productivity, especially along the Portuguese and Galician coasts; upwelling takes place during late spring and summer (Álvarez-Salgado *et al*., 2002; Serrano *et al*., 2008). The region is characterized by a large number of commercial and non-commercial fish species caught for human consumption.

Many flatfish species show a gradual offshore movement of juveniles as they grow. This might indicate that habitat quality for flatfish is size-dependent. Another common pattern is the annual micro- and macroscale movements and migrations between spawning, feeding and wintering areas (Gibson 1994). Also, most flatfishes are associated with finer sediments, rather than with hard substrata because burying themselves provides some protection from predators and reduces the use of energy (van der Veer *et al*., 1990, 2000; Beverton and Iles 1992; Bailey 1994; Wennhage and Pihl 2001).

Previous studies on megrim species show that they generally occurred outside zones with hydrographical instabilities that foster the vertical interchange of organic matter (Sánchez and Gil, 1995) and disappear at the mouth of the most important rivers (Sánchez *et al*., 2001). Both species appear to show a gradual expansion in their bathymetric distribution throughout their lifetimes, with the larger individuals tending to occupy shallower waters than the juveniles. Bearing in mind that the two species have similar characteristics, a certain degree of interspecific competition may be assumed (Sanchez *et al*, 1998).

Juveniles of these species feed mostly on detritivore crustaceans inhabiting deep-lying muddy bottoms. Adult *L. boscii* feeds mainly on crustaceans inhabiting muddy surfaces (Rodriguez-Marín and Olaso, 1993; Rodriguez-Marín, 2002) as opposed to *L. whiffiagonis*, which are more ichthyophagous and where rates of crustacean in diet decrease with fish size (Rodriguez-Marín, 2002). None of the two species represent an important part of the diet for the main fish predators in the area. However, Velasco (IEO, Santander, Spain, pers. comm.) observed that they are occasionally present in stomach contents of hake, anglerfish and rays.

The spawning period of these species is short. Mature males can be found from November to March and mature females from December to March, but spawning peaks in March. In southern areas megrims spawn from January to April (BIOSDEF, 1998; study contract 95/038).

The growth rate also varies (Landa *et al*, 1996; Landa, 1999), growth is quicker in the southern area for both species but the maximum length attained is smaller than in the north. The maximum age for megrim also varies with latitude. In Subarea VII the maximum age of megrim is 14 years, this decreases to 12 years in Divisions VIIIc and IXa (BIOSDEF, 1998; Landa et. al, 2000). The maximum age for four-spot megrim in Divisions VIIIc and IXa is 11 years (Landa *et al*, 2002, Landa, pers. com.).

B. Data

B.1. Commercial catch

Landings

Landings data are provided by National Government and research institutions of Spain and Portugal. The available series began in 1986.

The proportions of each megrim species in Portuguese and Spanish landings are estimated using the relative abundances of the two species of megrim in the sampled landings.

For *L. whiffiagonis*, landings present an increase for a few years at the beginning of the time series and a general declining trend since then. In 2011 and 2012 landings are increasing. For *L. boscii,* landings present the same increase at the beginning of the time series; after that, they have generally declined to their lowest value in 2002 and, since then, the general trend is to increase smoothly.

Discards

Discards estimates are available for Spanish trawlers in some years and are used in this assessment, where discards are missing, mainly in the historic data these have been estimated using the mean of the time-series for each age. A discarding sampling programme runs regularly since the establishment of the European Data Collection Programme in 2003. Before this year, Spanish discards data are available only for 1994, 1997, 1999 and 2000. The raising procedure used to estimate Spanish discards for the sampled years was based on effort.

In order to include discards data in the assessment, discards estimates from the average by period have been used for imputing missing data. For the first period (1986-1999), the average of available years 1994, 1997 and 1999 were used and for the second period (2000-2012) the absence of data in 2001 and 2002 was replaced by the average of the closest years. The raison of using these two periods is the change of the Minimum landing size (MLS) in 2000 that could bring a shift in the discarding behaviour. The whole time series of discards have been added to the landings data to calculate catch data.

B.2. Biological

Landings numbers at length

Annual length compositions of total landings for *L. whiffiagonis* and *L. boscii* are available since 1986.

For *L. whiffiagonis*, length distributions were available for both Spanish and Portuguese landings until 1998, when Portuguese length frequency data were mainly based on samples from Aveiro. Due to the uncertainties of this port since 1999, Spanish length distributions were raised to the total international landings for all subsequent years. Portuguese landings only represent 10% of the total landings on average.

For *L. boscii*, length distributions are available for Spanish and Portuguese landings since 1986 and 1998, respectively.

There has been a strong decrease in landings of fish under 15 cm in length since 1994 and under 20 cm in recent years for both species. This change probably results from stricter enforcement of the minimum landing size and a mesh size increase regulation in year 2000.

Catch numbers at age

Age compositions of landings are based on annual Spanish ALKs since 1990, whereas a survey ALK from 1986 combined with an annual ALK from 1990 was applied to years 1986-1989. Landings weights-at-age are also used as the weights-at-age in the stock. The following parameter values were used in the length-weight relationship (BIOSDEF, 1998):

	L. whiffiagonis	L. boscii
a	0.006488	0.00431
b	3.0114	3.1904

Natural mortality is set to 0.2 and assumed constant over all ages and years. This is the same value used for *L. whiffiagonis* in Divisions VIIb-k and VIIIabd.

The sex combined maturity ogive (BIOSDEF, 1998) is assumed constant over time, with the following proportions of fish mature at each age:

Age	0	1	2	3	4	5+
L. whiffiagonis	0	0.34	0.90	1	1	1
L. boscii	0	0.55	0.86	0.97	0.99	1

B.3. Surveys

The Portuguese October groundfish survey (PtGFS-WIBTS-Q4) and the Portuguese Crustacean survey (PT-CTS (UWTV (FU 28-29))) and one Spanish groundfish survey (SpGFS-WIBTS-Q4) series are available since 1990, 1997 and 1983, respectively.

It should be taken into consideration that during years 1996, 1999, 2003, 2004 and 2012 the October Portuguese survey was carried out with a different vessel and gear from the one used in the rest of the series. The Crustacean survey was performed with different vessels in different years and covers a partial area; in 2004 it had many operational problems.

For these reasons and because indices from these surveys are not considered to be representative of megrim abundance, due to the very low catch rates, only the Spanish survey (SpGFS-WIBTS-Q4) is used in the assessment of the two species. The survey covers the distribution area and depth strata of these species in Spanish waters (covering both VIIIc and IXa). The survey appears to be quite good at tracking cohorts through time *for L. whiffiagonis*. For *L. boscii*, the survey signal is also clear until 2002, whereas it seems more blurred in recent years.

B.4. Commercial CPUE

LPUE and Fishing Effort data are available for the following fleets: Spanish trawlers targeting demersal fish based in A Coruña port (SP-LCGOTBDEF) and in Avilés port (SP-AVSOTBDEF) fishing in Division VIIIc since 1986 and Portuguese trawlers fishing in Division IXa since 1988. Effort from the Portuguese fleet is estimated from a sample of logbooks from sea trips where megrim occurred in the catch.

Commercial fleets used in the assessment of L.whiffiagonis to tune the model

SP-LCGOTBDEF: This fleet contributed with data of effort (fishing days per 100 horse power), LPUE (as kg per fishing day per 100 horse power) and length composition of landings.

SP-AVSOTBDEF: This fleet contributed with data of effort (fishing days per 100 horse power), LPUE (as kg per fishing day per 100 horse power) and length composition of landings.

Commercial fleets used in the assessment of L.boscii to tune the model

SP-LCGOTBDEF: This fleet contributed with data of effort (fishing days per 100 horse power), LPUE (as kg per fishing day per 100 horse power) and length composition of landings. Because of trends in the residuals, this fleet has been split in two periods, 1986-1999 (SP-LCGOTBDEF-1) and 2000-current year (SP-LCGOTBDEF-2).

B.5. Other relevant data

C. Assessment: data and method

Model used: Extended Survivors Analysis (XSA), (Shepherd, 1992)

Software used: VPA95 Lowestoft suite.

Model Options chosen *L. whiffiagonis*:

Input data types and characteristics

Type	Name	Year range	Age range	Variable from year to year
Caton	Catch in tonnes	1986- present	1-7+	Yes
Canum	Catch at age in numbers	1986- present	1-7+	Yes
Weca	Weight at age in the commercial catch	1986- present	1-7+	Yes
West	Weight at age of the spawning stock at spawning time.	1986-present	1-7+	Yes
Mprop	Proportion of natural mortality before spawning	1986-present	1-7+	No
Fprop	Proportion of fishing mortality before spawning	1986-present	1-7+	No
Matprop	Proportion mature at age	1986-present	1-7+	No
Natmor	Natural mortality	1986-present	1-7+	No

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1	SP-LCGOTBDEF	1986-present	3-6
Tuning fleet 2	SP-AVSOTBDEF	1986-present	3-6
Tuning survey 1	SpGFS-WIBTS-Q4	1986-present	1-6

Model options:

Type	Setting
Taper	No
Tuning range	
Ages catch dep. on stock size	1-2
Q plateau	5
F shrinkage s.e.	1.5
Shrinkage year range	5
Shrinkage age range	3
Fleet s.e.threshold	0.2
F bar range	2-4

Model Options chosen *L. boscii*:

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year
Caton	Catch in tonnes	1986- present	0-7+	Yes
Canum	Catch at age in numbers	1986- present	0-7+	Yes

Weca	Weight at age in the commercial catch	1986- present	0-7+	Yes
West	Weight at age of the spawning stock at spawning time.	1986-present	0-7+	Yes
Mprop	Proportion of natural mortality before spawning	1986-present	0-7+	No
Fprop	Proportion of fishing mortality before spawning	1986-present	0-7+	No
Matprop	Proportion mature at age	1986-present	0-7+	No
Natmor	Natural mortality	1986-present	0-7+	No

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1	SP-LCGOTBDEF1	1986-1999	3-6
Tuning fleet 2	SP-LCGOTBDEF2	2000-present	3-6
Tuning survey 1	SpGFS-WIBTS-Q4	1988-present	0-6

Model options:

Type	Setting
Taper	No
Tuning range	
Ages catch dep. on stock size	Independant
Q plateau	5
F shrinkage s.e.	1.5
Shrinkage year range	5
Shrinkage age range	3
Fleet s.e.threshold	0.3
F bar range	2-4

D. Short-Term Projection

L. whiffiagonis

Model used: Age structured

Software used: MFDP prediction with management option table and yield per recruit routines.

Initial stock size: Taken from the XSA survivors.

- Recruitment-at-age 1 assumed equal in all projection years (GM from 1998 to final assessment year minus 2).
- If if the XSA last year recruitment is considered poorly estimated, age 2 is replaced by GM90-11 reduced by total estimated mortality.

Maturity: Average maturity ogive for the last three years

F and M before spawning: Set to 0 for all ages in all years.

Weight at age in the stock: Average stock weights for the last five years or an appropriate number of years selected by the working group.

Weight at age in the catch: Average of the last five years or an appropriate number of years selected by the working group.

Exploitation pattern: Scale F-at-age within each year, then average the scaled last five years weighted to the final year or an appropriate number of years selected by the working group.

Intermediate year assumptions: Average Fbar for the last three years (normally unscaled although, when appropriately justified, it could be scaled to the final year).

Stock recruitment model used: None.

Procedures used for splitting projected catches: Forecast catch numbers-at-age are divided into landings and discards (at age) based on the proportions given as inputs to the projection software; the software does it automatically. These proportions were taken (for each age) to be those corresponding to the observed aver-age of the most recent 5 years.

L. boscii

Model used: Age structured

Software used*:* MFDP prediction with management option table and yield per recruit routines.

Initial stock size: Taken from the XSA survivors.

- Recruitment-at-age 0 assumed equal in all projection years (GM from 1990 to final assessment year minus 2).
- If if the XSA last year recruitment is considered poorly estimated, age 1 is replaced by GM90-11 reduced by total estimated mortality.

Maturity: Average maturity ogive for the last three years

F and M before spawning: Set to 0 for all ages in all years.

Weight at age in the stock: Average stock weights for the last five years or an appropriate number of years selected by the working group.

Weight at age in the catch: Average of the last five years or an appropriate number of years selected by the working group.

Exploitation pattern: Scale F-at-age within each year, then average the scaled last five years weighted to the final year or an appropriate number of years selected by the working group.

Intermediate year assumptions: Average Fbar for the last three years (normally unscaled although, when appropriately justified, it could be scaled to the final year).

Stock recruitment model used: Stock recruitment model used: None. Recruitment-at-age 0 assumed equal in all projection years (GM from 1990 to final assessment year minus 2).

Procedures used for splitting projected catches: Forecast catch numbers-at-age are divided into landings and discards (at age) based on the proportions given as inputs to the projection software; the software does it automatically. These proportions were taken (for each age) to be those corresponding to the observed aver-age of the most recent 5 years.

E. Medium-Term Projections

Medium term projections are not conducted for these stocks.

F. Long-Term Projections

Model used: yield and biomass per recruit over a range of F values.

Software used: MFYPR.

Yield per recruit calculations are conducted using the same input values as those used for the short term forecasts.

G. Biological Reference Points

During the 2014 benchmark workshop, the softwares PlotMSY and EqSim were employed to explore poten-tial biological reference points for both stocks, following the recommendations of ICES workshop WKM-SYREF2.

The biological information needed to run the models was obtained from the assessment.

Weight at age in the stock: Average stock weights for the last five years.

Weight at age in the landings and in the discards: Average of the last five years.

Selection-at-age: (i.e. F(a)/F(2-4)) for the total catch was computed for each of the last 5 years and the geo-metric mean (by age) then taken over these years. This selection pattern was subsequently split into selec-tion-at-age of landings and discards based on the (5-year average) proportion landed-at-age. The use of geometric mean instead of arithmetic mean for selection-at-age is in order to reduce the effect of large spikes that occur occasionally in the selection-at-age estimates, due to the variability of the discards data, and which would distort the results of the reference points computation.

Natural mortality and proportion mature-at-age were assumed constant over time (as in the assessment).

Uncertainty around each of the input variables for the reference point calculation was introduced either by calculating CVs for subsequent stochastic drawing (for the PlotMSY software) or by bootstrapping (for the EqSim software) based on the values corresponding to the assessment assumptions (in the case of weight, M and proportion mature at age) or assessment results (in the case of selection at age) for the last 5 years.

WGBIE2014 accepted the updated values having reviewed the methodology and the inclusion of 2013 data.

L. whiffiagonis

	Type	Value	Technical basis
MSY	MSY Btrigger	910 t	default option; 1.4 Blim
Approach	FMSY	0.17	Fmax as FMSY proxy
	Blim	650 t	provisional reference point; just above Bloss in the 2014 benchmark assessment
Precautionary	Bpa	910 t	default option; 1.4 Blim

Approach	Flim		
	Fpa		

L. boscii

	Type	Value	Technical basis
MSY	MSY Btrigger	4600 t	default option; Bpa
Approach	FMSY	0.17	Fmax as FMSY proxy
	Blim	3300 t	provisional reference point; Bloss in the 2014 benchmark assessment
Precautionary	Bpa	4600 t	default option;1.4 Blim
Approach	Flim		
	Fpa		

H. Other Issues

H.1. Historical overview of previous assessment methods

WG YEAR	2008		2009		2010		2011		2012		2013	
Model	XSA		XSA		XSA		XSA		XSA		XSA	
Software	VPA95 Lowestoft suite		VPA95 Lowestoft suite		VPA95 Lowestoft suite		VPA95 Lowestoft suite		VPA95 Lowestoft suite		VPA95 Lowestoft suite	
Stock	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii
Catch data range	1986-2007	1986-2007	1986-2008	1986-2008	1986-2009	1986-2009	1986-2010	1986-2010	1986-2010	1986-2010	1986-2010	1986-2010
Age range in catch data	1-7+	0-7+	1-7+	0-7+	1-7+	0-7+	1-7+	0-7+	1-7+	0-7+	1-7+	0-7+
SP-CORUTR8c	1990-2007 Ages 2-6	1986-1999 Ages 3-6	1990-2008 Ages 2-6	1986-1999 Ages 3-6	1990-2009 Ages 2-6	1986-1999 Ages 3-6	1990-2010 Ages 2-6	1986-1999 Ages 3-6	1990-2010 Ages 2-6	1986-1999 Ages 3-6	1990-2010 Ages 2-6	1986-1999 Ages 3-6
SP-AVILESTR	1990-2003 Ages 2-6	Not used	1990-2003 Ages 2-6	Not used	1990-2003 Ages 2-6	Not used	1990-2003 Ages 2-6	Not used	1990-2003 Ages 2-6	Not used	1990-2003 Ages 2-6	Not used
SpGFS-WIBTS-Q4 survey	1990-2007 Ages 1-6	1988-2007 (2003 not included) Ages 0-6	1990-2008 Ages 1-6	1988-2008 (2003 not included) Ages 0-6	1990-2009 Ages 1-6	1988-2009 (2003 not included) Ages 0-6	1990-2010 Ages 1-6	1988-2010 (2003 not included) Ages 0-6	1990-2010 Ages 1-6	1988-2010 (2003 not included) Ages 0-6	1990-2010 Ages 1-6	1988-2010 (2003 not included) Ages 0-6
Taper	No	Tricubic over 20 years	No	Tricubic over 20 years	No	Tricubic over 20 years	No	Tricubic over 20 years	No	Tricubic over 20 years	No	Tricubic over 20 years
Tuning range	18	22	19	23	20	24	21	25	21	25	21	25

WG YEAR	2008		2009		2010		2011		2012		2013	
Model	XSA		XSA		XSA		XSA		XSA		XSA	
Software	VPA95 Lowestoft suite		VPA95 Lowestoft suite		VPA95 Lowestoft suite		VPA95 Lowestoft suite		VPA95 Lowestoft suite		VPA95 Lowestoft suite	
Stock	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii	L.whiffiagonis	L.boscii
Ages catch dep. stock size	1-4	0-2	1-4	0-2	1-4	0-2	1-4	0-2	1-4	0-2	1-4	0-2
Q plateau	5	5	5	5	5	5	5	5	5	5	5	5
F shrinkage s.e.	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Shrinkage year range	5	5	5	5	5	5	5	5	5	5	5	5
Shrinkage age range	3	3	3	3	3	3	3	3	3	3	3	3
Fleet s.e. threshold	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3
F bar range	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4	2-4

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Annex J – Stock Annex Bay of Biscay *Nephrops* (FU 23-24)

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	Bay of Biscay *Nephrops* (Division VIIIa,b), FU 23-24, Management Area N
Working Group:	Working Group for the Bay of Biscay and Iberian Waters Ecoregion (WGBIE)
Date:	May 2011

A. General

A.1. Stock definition

Nephrops are distributed in North East Atlantic, from Iceland to South Portugal, in the North Sea and also in the Mediterranean sea, particularly in the western part. *Nephrops* live on 15–800m deep grounds, on muddy substrata. The distribution of this species is more determined by ground type and sea temperature than depth. *Nephrops* live in burrows dug in the mud. It leaves this burrow during low light periods (at dawn and dusk) to look for food. It can be caught in high quantities during this active time. *Nephrops* are sedentary. However they can move short distances if adverse factors modify its habitat, like mud disturbance by storms or other mechanical action on the sea bottom.

In the Bay of Biscay, *Nephrops* grounds correspond to muddy areas: the first one, which is the largest one, is in Division VIIIa and is called "la grande vasière", the second one in Division VIIIb is called "vasière de la Gironde". The overall area extends for around 12000 km² of surface.

A.2. Fishery

Nephrops in FUs 23-24 are almost exclusively exploited by French trawlers which have decreased notably throughout the recent fifteen years after conflicts of 1993-1994 and according to different decommissioning schemes.

The general features of the *Nephrops* fishery, as described in the 2003 *Nephrops* Working Group report (ICES, 2003) are still valid, but some can now be updated thanks to more precise information collected on vessel activity and economic results. These showed that:

- about 274 boats are currently involved in the Bay of Biscay *Nephrops* fishery spending an average of 180 days at sea in 2011 (139 vessels landed more than 10 t, among them 129 came from the harbours of the Northern part of the fishery).
- the typical Bay of Biscay trawler is 15 m long, with an engine power of 235 kW and a mean age of 19 years, (2005 data)
- the typical crew consists of three members.

In 2003, these vessels generated a total turnover of 82 million €. The contribution of *Nephrops* in the turnover is estimated to be 40% on average, but varies strongly from one boat to another. This percentage remained stable during recent years (2007-2011). For 45% of the vessels, more than half of the turnover is from *Nephrops*, and this proportion is even higher in the Northern part of the fishery (Southern Brittany). 67% of the *Nephrops* trawlers and at least 64% of associated employment are concentrated in Southern Brittany. As stated, the importance of *Nephrops* fishing varies between vessels: for 72% of them it is the principal activity, 12% are part-time *Nephrops* trawlers, 10% fish for *Nephrops* between 3 and 6 months each year and for 6% of the vessels it is a marginal activity (reference to the situation in 2003). Other métiers practised by these boats are finfish directed bottom trawling (48% of the fleet) and pelagic trawling (2%).

The intensity of *Nephrops* directed fishing varies during the year: 67% of the total landings take place between April and August, and low quantities are landed in January.

The *Nephrops* fishery is managed by TAC along with technical measures. The agreed TAC for 2008 was 4320 t whereas the ICES recommendation was 3600 t on the basis of 2006's advice as there was no ACFM review in 2007. In 2007, total nominal landings reached 3180 t. In 2009, a TAC of 4104 t was allowed whereas the ICES recommendation was 3400 t *i.e.* average landings from years 2005-2007. In 2010, the TAC was fixed at 3899 t and the total landings reached 3400 t. In 2011, the TAC remained unchanged whereas the French landings were 3560 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 last year (see report WGHMM 2007).

A mesh change was implemented in 2000 and the minimum codend mesh size in the Bay of Biscay is 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, it should be noted that *Nephrops* trawlers were allowed to fish in the hake box with the current mesh size of 70 mm once they have adopted a square mesh panel of 100 mm. This derogation was maintained in 2008.

As annotated in the Official Journal of the European Union (p.4, art. 27): "*In order to ensure sustainable exploitation of the hake and Norway lobster stock and to reduce discards, the use of the latest developments as regards selective gears should be permitted in ICES zones VIIIa, VIIIb and VIIId.*"

In agreement with this, the National French Committee of Fisheries (deliberations 39/2007, 1/2008) fixed the rules of trawling activities targeting *Nephrops* in the whole areas VIIIa, VIIIb applicable from the 1st April 2008. All vessels catching more than 50 kg of *Nephrops* per day must use a selective device from at least one of the following: (1) a ventral panel of 60 mm square mesh; (2) a flexible grid and (3) an 80 mm codend mesh size.

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. In the beginning of 2006, the French producers' organisations adopted new additional regulations such as monthly quotas which had some effects on fishing effort limitation.

A.3. Ecosystem aspects

Nephrops are omnivorous but polychetes, crustaceans, molluscs and echinoderms are its favourite prey. *Nephrops* grow by successive moults like all crustaceans, when renewing their carapace. Mating takes place just after the females moult. Eggs are fertilized when they are laid and they attach under the female abdomen. Berried *Nephrops* stay most of the time in their burrows. Egg loss is significant during incubation. When they hatch larvae are pelagic for one month, then after metamorphosis the small *Nephrops* settle on the sea bed.

In the Bay of Biscay, *Nephrops* of both sexes moult twice a year, before sexual maturity length is reached. Then when they are mature, females moult once a year, but males go on moulting twice a year.

Males are sexually mature when they are about 6.5 cm long (20 mm CL) and two years old, females when they are about 8 cm long (24 mm CL) and two and a half years old. Incubation takes 7 months in the Bay of Biscay. Egg number increase according to size (a 7-8 cm long female has a mean egg number around 650, a 9 cm long 800 eggs, a 15 cm long 4000 eggs).

The Bay of Biscay *Nephrops* fishery has a major impact on the Northern Stock of Hake, because the *Nephrops* fishing grounds are on a hake nursery. Hake discards are very important. By-catch of other species is not as large.

B. Data

B.1. Commercial catch

Nearly all the landings from FUs 23-24 are taken by French trawlers. In recent years, small landings are reported by Belgium from rectangles inside the FUs, and by Spain from rectangles outside the FUs but inside the MA.

Generally speaking, males predominate in the landings but sex ratio analysis shows that up to the early 2000's the proportion of females in the landings had slightly increased reaching 45% of the total (2004). The sex ratio in landings sloped down in recent years (since 2008) and was equal to 0.31 in 2011: that should be the consequence of the MLS change (1st Dec. 2005) and, moreover, of the new selectivity regulations (1st April 2008) approving the increase of the caught fraction of males because of their higher growth.

Discard data are available for 1987, 1991, 1998 and have been collected again since June 2002. The numbers discarded at length for the intermediate years up to 2002 were derived and discards since 2003 have been estimated by a sample mean estimator from on board sampling programme.

- In previous assessments (until WGHMM 2010),

Discards represent most of the catches of the 2 younger ages groups (group 1 and 2) as indicated by the available data. The average weight of discards per year on the period 1987-2002 (before DCF; only 3 years were sampled onboard as explained above) was about 1 550 tonnes whereas discards since 2003 have reached a higher level (2 230 t).

B.2. Biological sampling and methodology

B.2.1. Generalities

Landings: French sampling plan at auction started in 1984, but only since 1987 the data can be used on quarterly basis. Since 2003, additional database of landings was also provided by sampling routinely performed onboard under the European DCR (Data Collection Regulation) aiming for discard estimates.

Discards: Discard data acquired by sampling on board are available for 1987, 1991, 1998 and since 2003 (Fig. 1). For recent years, discards have been estimated from sampling catches programme on board *Nephrops* trawlers (372 trips and 1140 hauls have been sampled over period 2003-2011). Discards for sampled fishing trips are estimated by ratio estimator using the total landings as auxiliary variable (Talidec *et al.*, 2005). Discard sampling from the southern part of the fishery was carried out only once in the past (2005), thus, the poor set of available data cannot yet be included in the stock assessment.

For intermediate years up to 2002 with no sampling onboard, numbers discarded at length were derived in the following way:

- the estimates for 1987-90 from the data collected during the 1987 discard sampling programme;
- those for 1991-96 from the 1991 sampling programme; and
- those for 1997, 1999-2003 from the 1998 sampling programme.

The derivation method uses ratios at each length between discards and total numbers landed for the two sexes combined.

B.2.2. Exploratory runs based on probabilistic concepts

Applying discard data from 'sampled' to 'non-sampled' years bears the risk of inconsistency between the different data sets because it induces an inter-dependence between years and also prevents detection of any signal on recruitment strength. Hence, WG investigated additional exploratory runs based on different approaches of derivation of discards for missing years.

In order to eliminate dependence between years due to derivation of missing years from common datasets, WG carried out additional runs based on logistic derivation (*i.e.* simulation of the hand-sorting of marketable sizes) of discard length frequencies from those of landings year by year.

B.2.3. Methodology

Overall scheme of this methodology is provided below. At present, this methodology is used only for exploratory runs, with the intention of using it for the main assessment after it has been tested in a benchmark.

B.2.3.1. Sampled years

The overall programme is based on a stratified random sampling. Discards are estimated for each sampled fishing trip and raised by multiplying by the total number of fishing trip in the stratum. The total number of trips is usually not known, its estimate can be done using the number of auction hall sales in the case of trips of short duration (1 day); that is the case for "Le Guilvinec" district, but not for the Southern part of the fishery. Estimates and variances are provided by haul, trip or segment (*i.e.* fleet or district). As there is only one sample collected during each fishing operation, the within-FO variance is estimated by assuming a fixed total sample size, only the species composition and the length frequency being variable. The variance of the observed quantity in each category is estimated by assuming a hyper-geometric distribution.

The ratio between discards and an auxiliary variable was afterwards estimated. The ratio-estimate is more accurate than the simple estimate only if the correlation of discards with the auxiliary variable is larger than half the ratio of the coefficients of variation: ϱ>CV(auxiliary var.)/(2*CV(discards)) (Cochran, 1977). Total landings were taken into account as auxiliary variable. The ratio of discards over landings by trip is calculated and is then raised using total landings.

B.2.3.2. Missing years

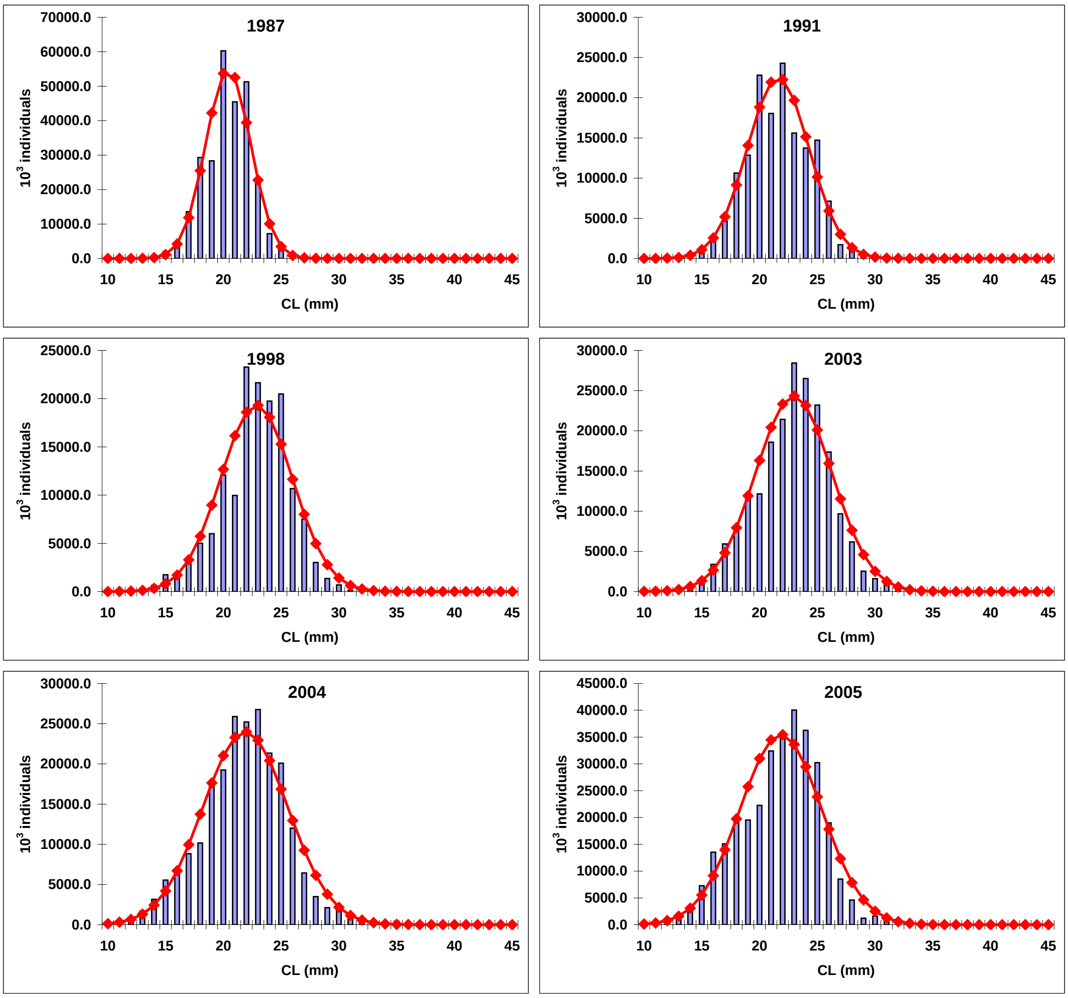
The integration of a set of independent variables (recruitment strength, density of probability of discards, regulations, market considerations) to extrapolate reliable discard rate from sampled to missing years was already considered by ICES. Indeed, the available common dataset (six years while the years after the MLS change *i.e.* 2006 and 2007 are excluded) reveals strong correlation for the relationship mean size of discards *vs.* mean size of landings (after log-log transformation) either on quarterly data (mainly for 2nd and 3rd quarters representing the major part of catches) or on the whole year datasets (R^2=0.96). This conclusion is valid on both separated sexes or on combined data. Even if year 1987 is removed from the regression, the R^2 remains high (0.90).

A new approach based on probabilistic concepts and on relationships between mean sizes of landings and of discards was performed by ICES. The main concepts of the derivation (back-calculation) are summarized as (Fig. 2):

1) The first step involves applying hand-sorting selection of retained catches which is explained by s-shaped (logistic) function *vs.* size. As statistically tested (Fifas *et al.*, 2006), the hand-sorting function is stable within-quarter for given parameters of the exploitation pattern (if mesh size and MLS remain constant within period). The overall time series was divided into three periods (years 1987-1990, 1988-1990 and 1992-1997).

2) The second step consists in removing undersized individuals unusual in landings which can generate unreliably extreme values of discards due to sampling problems (very high CV of landings for the extreme size classes). Hence, size classes less than a tested threshold (1% of cumulative landings) were eliminated. This calculation process retains only a part of the initial hand-sorting generated distributions of discards mainly the decreasing part of discarded individuals.

3) The third step allows the generation of missing size classes by applying a probability density function which can be symmetrical in regards to the overall symmetry of DLF of discards (Fig. 1; Table XXX). The whole calculation is based on multiple maximum likelihood function. Relationship as between mean sizes of landings and of discards is also included in the final fitting.



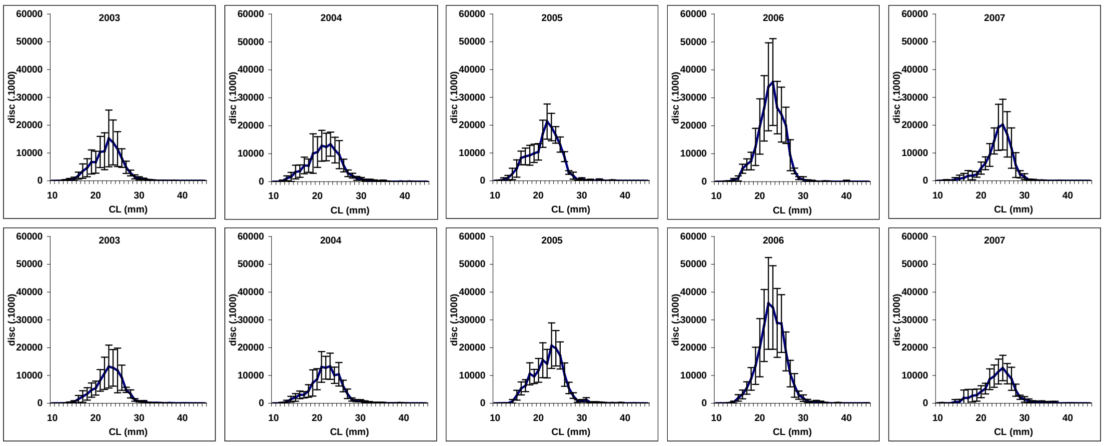


Figure 2. **Years 2003-2007. Distribution of length frequencies (CL in mm) and confidence intervals (confidence level 1-α=0.95) for discards estimated by sampling. Data by sex (females above, males below).**

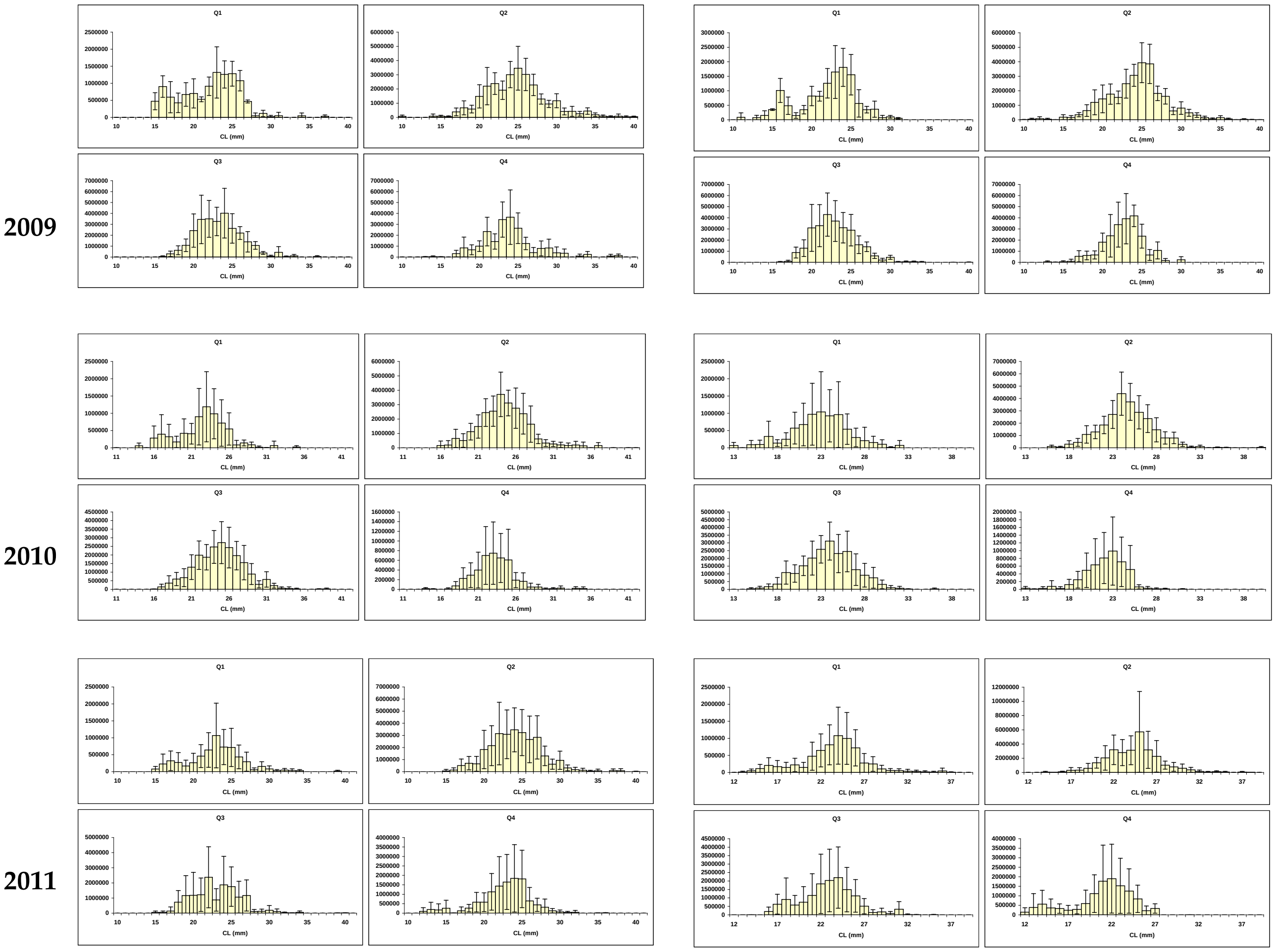


Figure 3. **Distribution of length frequencies (CL in mm) for discards 2009-2011 and confidence intervals (confidence level 1-α=0.95). Data by sex (males left, females right).**

B.3. Surveys

A survey called LANGOLF specifically designed to evaluate abundance indices of *Nephrops* in the Bay of Biscay commenced in 2006 (with the most appropriate season: 2nd quarter, hours of trawling: around dawn and dusk and fishing gear: twin trawl). This survey can provide an independent tuning dataset in addition to the commercial tuning fleet (GV-Q2; see below) considered for the whole historical series since 1987. Until 2011, these data were not included as indices for the stock assessment because of the short time series. As regards IBP *Nephrops* 2012, the abundance indices provided by the survey were included at the aim of VPA tuning.

This survey is carried out by twin trawling on the area of the Central Mud Bank of the Bay of Biscay (≈ 11680 km²). The whole area was divided to five sedimentary strata according to the mud composition of sediment and to its origin (Figure 3). The five strata are defined as:

(1) 25% mud and silt stratum (noted VV)

(2) 75% mud and silt stratum (noted VS)

(3) Lithoclastic mud<25% stratum (noted LI)

(4) Carbonated mud<25% stratum (noted CB)

(5) Calcareous mud<25% stratum (noted CL)

Using either sampling onboard for commercial vessels or VMS available data, it is possible to calculate distribution of the fishing effort for the *Nephrops* trawling fleet by stratum and by District (Table 1). The provided values are averaged on years 2003-2005. These values are used in combination with strata surfaces to allocate survey effort by stratum.

Table 1. Distribution (%) of the fishing effort of the Nephrops trawling fleet by sedimentary stratum and by District (GV=Le Guilvinec; CC+LO=Concarneau and Lorient; S=Southern Districts i.e. outside Brittany).

stratum	GV	CC+LO	S	Total
VS	4.43	4.89	2.80	12.12
VV	18.90	26.09	9.09	54.08
CL	9.10	0.00	0.00	9.10
LI	0.00	11.42	8.39	19.80
CB	3.50	0.00	1.40	4.90
	35.93	42.40	21.67	100.00

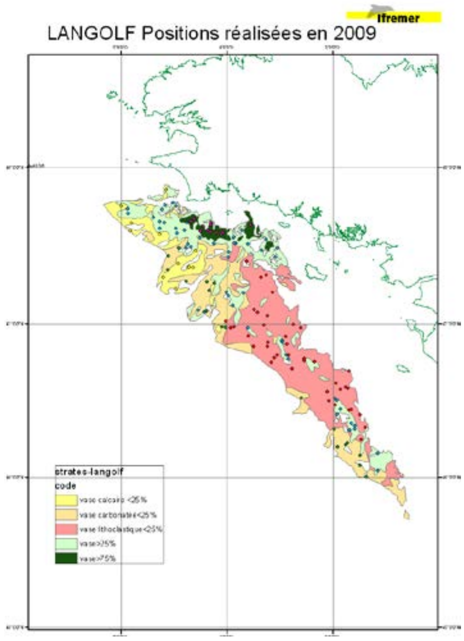


Figure 4. ***Nephrops*** **of the Bay of Biscay (FU 23-24). The Central Mud Bank, the five spatial strata and the distribution of sampling units for 2009's survey.**

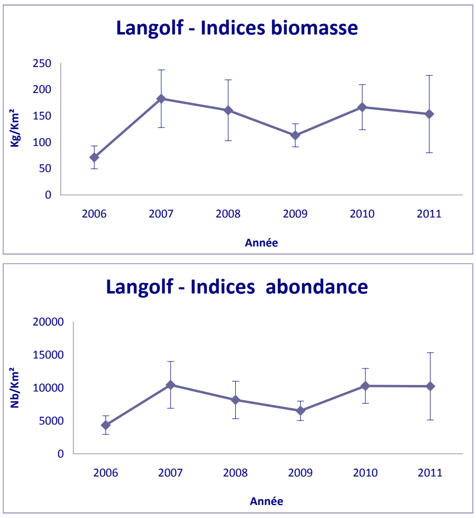


Figure 5. ***Nephrops*** **of the Bay of Biscay (FU 23-24). LANGOLF survey 2006-2011. Global indices for biomass and abundance and confidence intervals (**α**=0.05).**

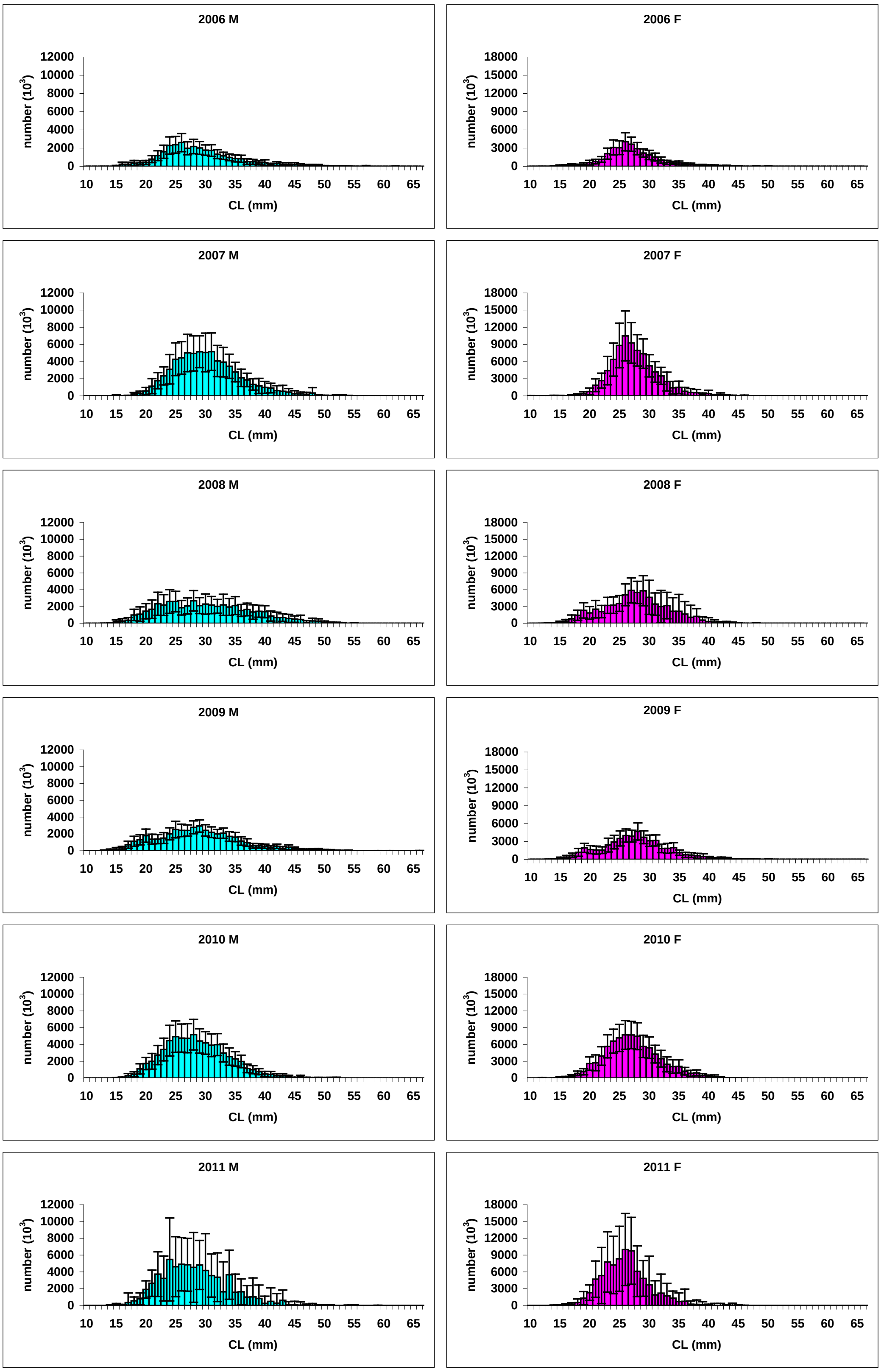


Figure 6. Nephrops **of the Bay of Biscay (FU 23-24). LANGOLF survey 2006-2011. LFDs by sex and confidence intervals (*α*=0.05).**

B.4. Commercial CPUE

Commercial fleets used in the assessment to tune the model

The logbook regulation is not particularly well enforced in the Bay of Biscay. Very few skippers regularly fill in their logbooks (in 2003 for example, skippers of 209 out of a total of 266 *Nephrops* trawlers had filled in their logbook for at least one trip, and 108 for between one and fifty trips). Only 16% of the 2004 auction sales could be linked to logbook data.

Up to 1998, the majority of the vessels were not compelled to keep logbooks, and fishing forms were established by inquiries. Since 1999 when logbooks became compulsory for all vessels >10 m, no more inquiries have been carried out to fill in these forms, the consequence being a severe degradation in the quality of the effort data.

The available log-books cannot be considered as representative of the whole fishery, and estimates which used to be calculated in the past are no longer used (as they take into account trips with more than 10% of *Nephrops* in value). The current assessment uses the work done in 2004 to define a better effort index as follows:

The fleet which is chosen to calculate the effort index is that of the "Le Guilvinec District", which groups four ports specialised in *Nephrops* trawling: 40% of the total *Nephrops* trawlers are from those ports. The reference period considered is the second quarter. This is the period of maximum availability of *Nephrops* (as females leave gradually burrows) and the period during which all boats target *Nephrops*, as opposed to the autumn and winter period when a (variable) proportion of the fleet prefers to target finfish for part of the trip. In the area covered by the Le Guilvinec fleets, fishing trips typically are daily, so the number of sales is equal to the number of trips[1]. The numbers of sales are available from the auction halls database. Fishing hours per trip vary seasonally: from 9 hours from April to October, to 6 hours in the remaining months. The overall effort index was then obtained by summing monthly products of fishing time by number of sales. The "Le Guilvinec District" effort series thus obtained is consistent with the data available before 1999, and is used to calculate LPUEs with landings data from the auction halls.

Because of changes in fishing gear and gear efficiency during the period, the number of hours trawling as such is not appropriate to quantify effort and to calculate LPUEs. In the 1990's, the number of boats using twin-trawls has increased together with that using rockhoppers. Gear efficiency has gone up, but its effect on fishing effort as a whole is difficult to quantify since twin-trawling is not always recorded in the fisheries statistics. An inquiry amongst fishermen has been performed in the frame of the EU project "TECTAC and data processing is in progress to build a time series on gear characteristics and other technical improvements (e.g. GPS). This should allow a better appreciation of 'real' effort.

Other available commercial fleets not used in last assessment to tune the VPA model

None

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[1] A fraction of Le Guilvinec trawlers (mainly located at the harbour of Loctudy) correspond to a different profile of exploitation from that of traditional vessels which can be used to tune XSA. The typical daily trip for this category consists on longer fishing time than the traditional one. The daily catchability for *Nephrops* is maximised around dawn and dusk. Then, this fraction of trawlers was removed from the tuning fleet.

B.5. Other relevant data

B.5.1. Selectivity pattern of *Nephrops* trawls

B.5.1.1. Existing selection model

Nephrops selection data were collated by ICES WGFTFB in 1995. These have been used to produce a model relating L50 and SR [=deviation of selection=2*ln(3)/(L75-L25)] to mesh size, twine thickness and open meshes round the circumference of the codend.

$$L50 = 28.12 + 0.447 * MS - 4.87 * Ts - 0.095 * MR \quad [9]$$

and

$$SR = 2.32 + 3.21 * Ts \quad [10]$$

where MS is mesh size in mm, Ts is equivalent nominal single twine thickness mm and MR is number of open meshes round codend circumference. For double twine with thickness Td, it is assumed that a single twine with the same total twine cross-section is equivalent, i.e. Ts = SQRT(2 * Td * Td). The formulae for L50 and SR should be used with caution and only within the range of codend designs used to derive them. They may be derived using only hauls exhibiting length-related selection.

For the *Nephrops* trawlers of the Bay of Biscay, the selectivity parameters are given below (Table 2) [all polyethylene material; SF=selection factor=L50/MS]:

Table 2. FU23-24 *Nephrops* stock (Bay of Biscay). Selectivity parameters (see draft report WKNEPH, Jan. 06; ICES,CM1995/B:2).

MS (mm)	55	70	80	70	80	100
thickness (mm)	4	4	4	4	4	4
double	N	Y	Y	N	N	Y
Ts	4	5.6569	5.6569	4.0000	4.0000	5.6569
nb meshes codend	100	100	100	100	100	100
L50	23.7250	22.3611	26.8311	30.4300	34.9000	35.7711
SR	15.1600	20.4785	20.4785	15.1600	15.1600	20.4785
SF	0.4314	0.3194	0.3354	0.4347	0.4363	0.3577

C. Historical Stock Development

Model used: XSA.

Software used: Lowestoft VPA suite v. 3.1 (Darby and Flatman, 1994).

Up to the 2003 assessment, tuning data were estimates of *Nephrops* directed effort based on information on the landings composition and the number of hours fished per voyage, averaged on an annual basis.

Discards for sampled fishing trips are raised by multiplying the total number of fishing trips. This total number of trips is usually not known and needs to be estimated, which can be done using the number of auction hall sales, if boats do daily trips, which is the case in the northern part of the fishery, but not in the southern part. Discards from the southern part of the fishery have not yet been sampled, so in order to obtain an estimate for the whole fishery we used the following ratio of total number of sales to number of sales in the southern part.

Then raised discards of the northern part were multiplied by this ratio. The catch sampling programme in 2005 included trips in the southern part of the fishery. So improvements in discard estimation were expected for future years. Nevertheless, the extension of the sampling design in the Southern part of the fishery could not be routinely applied every year.

Removals at length are obtained by adding up landings and "dead discards" since a discard mean survival rate of 30% is applied to discards.

The L2AGE slicing program allocates length classes into age groups, using von Bertalanffy growth parameters. The ages obtained are not absolute but relative ones (age groups). This slicing is applied to length distributions by sex and these age distributions are summed to obtain a "sex combined" age distribution.

The natural mortality both sexes combined is assumed to be 0.3 for age groups 1 and 2, then 0.25 for other age groups.

Since 2006 the WG has introduced some modifications of the maturity parameters by sex. Maturity of males is explained by the first size of functional maturity (26 mm CL on data collected in 2004; a strong yearly variability of the size of functional maturity was pointed out: Jégou, 2007). Previously, maturity of females was assumed to be knife-edged whereas now it is described by an s-shaped curve (logistic model with L50 of 21-24 mm CL which is not significantly different to the value already used by WG *i.e.* 25 mm CL).

The growth parameters, the natural mortality and the maturity ogive by sex and combined are the following (as applied since WGHMM 2006):

Table 3. Usual input parameters (maturity, growth rate, natural mortality) for performing XSA on FU23-24 Nephrops stock.

Males and immature females: $L\infty=76$, $K=0.14$; mature females: $L\infty=56$, $K=0.11$										
age		1	2	3	4	5	6	7	8	9+
Size	males	10	19	26	33	38	43	48	51	54
(CL mm)	females	10	19	26	29	32	34	36	38	40
M	Males	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	females	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	combined	0.3	0.3	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Maturity	Males	0	0	1	1	1	1	1	1	1
	females	0	0	0.5	1	1	1	1	1	1
	combined	0	0	0.75	1	1	1	1	1	1

Recruitment is assumed to occur at the 1st January and SSB is calculated at this date.

For the 2004 assessment as explained above a new tuning series was built (a) by choosing another reference fleet (the "Le Guilvinec district") and another reference period (the second quarter, which is much more indicative of the actual directedness of the fleet towards *Nephrops*) and (b) by adding a second tuning fleet covering the other ports of the Bay of Biscay, with selected *Nephrops* directed trips in the second quarter too.

This second tuning fleet has not been included since WGHMM 2005, because it is based on log book data whose quality is poor for this fishery.

So only the tuning fleet of "Le Guilvinec District" was kept to carry out the assessment. Annual age compositions were obtained by using the ratios of Quarter 2-fleet-landings to Total-quarter 2-landings.

Recent input data types and model options chosen are detailed in the following table:

Fleets	2006 XSA		2007 XSA		2008 XSA	
FR -Q2 -QGV	1987-2005	Ages 1-9+	1987-2006	Ages 1-9+	1987-2007	Ages 1-9+
Taper	Yes (3 over whole time series)		Yes (3 over whole time series)		Yes (3 over whole time series)	
Tuning range	Full		Full		Full	
Age catchability dependent of stock size	No		No		No	
q plateau	6		6		6	
F shrinkage se	1.5		1.5		1.5	
year range of shrinkage	5		5		5	
age range of shrinkage	5		5		5	

Note: no assessment was performed in 2009.

D. Short-Term Projections

Short-term projections are performed using MFDP and MFYPR procedures. In the particular case of the Bay of Biscay *Nephrops*, it is necessary to prepare data prior to the execution of the modules. Matrix containing numbers of removals by year and by age is computed using MFREP executable (available in ICES libraries) aiming to split into two matrices involving in landings and discards and the same procedure is carried out on matrix of F at age.

Apart from 2009 when no assessment was performed on the stock, short-term projections were provided on annual basis since the incorporation of the stock in the WGHMM (2005). Input for projections carried out for the five last years are commented below.

2006: In the assessment, recruitment 2005 was replaced by GM(87-04)=679 million. This GM value was input in projections for recruitments from 2006 onwards. Unscaled Fbar was calculated on years 2003-2005 (F=0.49).

2007: In the assessment, recruitment for 2005 was replaced by R2004 (=1006 million) because the WG adopted arguments for strong recruitment value for this year, but rejected the extremely high value provided by XSA. Two additional runs were also carried out with R2005 replaced either by GM(87-04)=672 million or by 90th percentile of the series 1987-2004 *i.e.* 860 million. Recruitment 2006 was replaced by GM(87-04) which was also used in projections for recruitments from 2007 onwards. The exploitation patterns for the projection are based on the unscaled average Fs-at-age in the years 2004-2006 ($F_{2\text{-}5}$ =0.48). These were then split into landings and dead discards F, based on the scaled values of F discards at age estimated in 2006 because the exploitation pattern was modified due to the MLS change.

2008: In the assessment, recruitments 2006 and 2007 were replaced by GM(87-05)=683 million which was also be input in projections for recruitments from 2008 onwards.

The exploitation patterns for the projection are based on the unscaled average Fs-at-age in the years 2005-2007 ($F_{2\text{-}5} = 0.53$). As for 2007, these were then split into landings and dead discards F, based on the scaled values of F discards at age estimated in 2006 and 2007 because the exploitation pattern was modified due to the MLS change.

2010: All recruitments estimated by XSA (1987-2009) were accepted by WG, but GM for projections was calculated after excluding R2009 (=722 million) which may not represent the overall historical trend for recruitment level (even if LANGOLF signal seems to agree with relatively high recruitment for this year; the confirmation should be given in the future while this survey will be included as tuning time series). Unscaled Fbar was calculated on years 2007-2009 (F=0.43).

E. Medium-Term Projections

No analysis was carried out.

F. Biological Reference Points

There is no reference point for this stock and without any further information the Group decided not to propose any this year.

G. Other Issues

None.

H. References

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Annex K – Stock Annex Cantabrian Sea (Division VIIIc FU 31)

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	Cantabrian Sea (Division VIIIc, FU 31).
Working Group:	WGBIE
Date:	07 May 2014 (update)
Revised by	Yolanda Vila

A. General

A.1. Stock definition

Nephrops stock from FU 31 extends in two main patches located in the central and in the easternmost Cantabrian Sea respectively.

A.2. Fishery

The description of these fisheries was updated and reported in STECF (2003). Mackerel and horse mackerel contribute 80% of the landed species by the baca bottom trawl fleet in the Cantabrian Sea, while hake and *Nephrops* together represent only 1% of the total landings by this fleet. Other trawl components operating in the Cantabrian Sea (namely HVO trawl and pair trawl) do not catch *Nephrops*.

Nephrops is managed in the area by an annual TAC (applying to the whole of ICES Division VIIIc) and technical measures. European Union regulations establish 20 mm carapace length (CL) as a minimum landing size. A recovery plan for southern hake and Atlantic Iberian *Nephrops* stocks was implemented and enforced since 2006 (EC, 2166/2005). 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.

A.3. Ecosystem aspects

Nephrops is a burrowing species and occurs on muddy sea bed on the continental shelf and upper slope. The distribution of *Nephrops* in this area is limited to depths ranging from 90-600 m in a patch work configuration where the substrate is suitable. It distribution is more determined by ground type and sea temperature than depth. They are sedentary but they can leave this burrow to look for food and for the reproduction.

After reaching sexual maturity, males molts more frequently than females, consequently growing faster. Mating takes place just after the females molt. Eggs are fertilized when they are laid and they attach under the female abdomen. Berried *Nephrops* stay most of the time in their burrows. Egg loss is significant during incubation. When they hatch larvae are pelagic for one month, then after metamorphosis the small *Nephrops* settle on the sea bed. The emergence patterns of the *Nephrops* females during the incubation period results in a different exploitation pattern for each sex.

Nephrops are omnivorous but polychetes, crustaceans, molluscs and echinoderms are its favourite prey. There are not reports on *Nephrops*' predators in the area.

B. Data

B.1. Commercial catch

Landings

Landings were reported only by Spain and they are available for the period 1983-2009. Data used in FU 31 are based on Spanish sales notes and Owners Associations data compiled by IEO.

Discard

Nephrops discards are negligible in this fishery.

B.2. Biological

Annual length frequencies by sex of *Nephrops* landings are collected by the sampling program since 1988. The sampling data of Aviles and Santander fleet are raised to the total landings by market category and month.

B.3. Surveys

Abundance indices of *Nephrops* FU 31 are derived from the Spanish groundfish survey (SP-GFS) carried out to collect information on abundance of demersal species. The survey uses a stratified random sampling design with half hour hauls and covers the northwest area of Spain, from Portugal to France, during September/October since 1983 (except 1987). Data for 2003 are not considered reliable. The information is not taken into account due to the surveys are not designed for *Nephrops.*

B.4. Commercial CPUE

Landings per unit effort data series correspond to two bottom trawl fleets operating in the Cantabrian Sea with home ports in Aviles and Santander. No effort information for Aviles is available after 2003. In 2008 and 2009 fishing effort data are not available for Santander either.

B.5. Other relevant data

C. Historical Stock Development

At present, no assessment is carried out in this working group. The low levels of landings and fishing effort are insufficient to carry out an adequate assessment. The last analytical assessment of FU31 was conducted in 2002 (ICES, 2002).

Since 2012, the advice for this stock was based on fishery LPUE and effort trend, according to the ICES data-limited approach (ICES, 2012). This stock is classified in the category 3.1.4. of Data Limited Stocks (DSL), stocks with extremely low biomass.

D. Short-Term Projection

Not used.

E. Medium-Term Projections

Not used.

F. Long-Term Projections

Not used.

G. Biological Reference Points

There are no biological references points defined for this stock.

H. Other Issues

I. References

ICES, 2002. Report of the Working Group on *Nephrops* stocks. ICES CM 2002/ACFM: 15.

STECF, 2003. Report of the STECF meeting on Hake Technical Measures. Lisbon, 27-31. October, 2003.

ICES, 2012. ICES implementation of advice for Data-limited stocks in 2012. ICES CM 2012/ACOM 68

Annex K - Stock Annex North Galicia (Division VIIIc FU 25)

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	North Galicia (Division VIIIc, FU 25).
Working Group:	WGBIE
Date:	7 May 2014 (update)
Revised by	Yolanda Vila

A. General

A.1. Stock definition

Nephrops stock from FU 25 stretches along the Atlantic area off the northwest Spanish coast, located between Cap Finisterre and the Bay of Ribadeo.

A.2. Fishery

Nephrops is caught in the mixed bottom trawl fishery in the North and Northwest Iberian Atlantic. The fishery takes place throughout the year, with the highest landings in Spring and Summer. The overall decline of some bottom commercial species in the area has influenced the fishing strategies. The bottom fisheries have targeted a variety of species, including hake, anglerfish, megrim, horse mackerel and mackerel. At present, the trawl fleet comprises three main components: baca bottom trawl, high vertical opening trawl (HVO) and bottom pair trawl (STECF, 2003). Only the baca trawl catches *Nephrops*. Trawl vessels can change the gear from year to year and, consequently, the target species and fishing effort applied vary. The increasing use of pair trawlers and HVO (fishing for mackerel and horse mackerel) that do not catch *Nephrops* has reduced the fishing effort on the species in recent years.

The *Prestige* oil spill off the northwest Spanish coast (November 2002) resulted in the adoption of several temporary regulations to minimize the impact on the fisheries, such as spatial and seasonal closure for fishing fleets. The fishery remained partially closed from January to April 2003.This caused a reduction in fishing effort of the trawl fleet from November 2002 to June 2003.

Nephrops is managed by an annual TAC (applying to the whole of ICES Division VIIIc) and technical measures. European Union regulations establish 20 mm carapace length (CL) as a minimum landing size. Few animals are caught under size. Although *Nephrops* represents less than 2% of the total weight landed by the bottom trawl fishery (Fariña, 1996), the species is a very valuable component of the landings.

A recovery plan for southern hake and Atlantic Iberian Nephrops stocks was implemented and enforced since 2006 (EC, 2166/2005). 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.

A.3. Ecosystem aspects

This geographical area is characterized by episodic upwelling of North Atlantic Central Water during summer.

Nephrops is a burrowing species and occurs on muddy sea bed on the continental shelf and upper slope. The distribution of *Nephrops* in this area is limited to depths ranging from 90-600 m in a patch work configuration where the substrate is suitable. Its distribution is more determined by ground type and sea temperature than by depth. *Nephrops* are sedentary but they can leave their burrows in search of food and for reproduction.

After reaching sexual maturity, males molt more frequently than females, consequently growing faster. Mating takes place just after the females molt. Eggs are fertilized when they are laid and they attach under the female abdomen. Berried *Nephrops* stay most of the time inside their burrows. Larvae are pelagic for one month after hatching, then after metamorphosis the small *Nephrops* settle on the sea bed. The emergence patterns of the *Nephrops* females during the incubation period results in a different exploitation pattern for each sex.

Nephrops are omnivorous, but polychetes, crustaceans, molluscs and echinoderms are their favourite preys. There are not reports on *Nephrops*' predators in the area.

B. Data

B.1. Commercial catch

Landings

Landings are reported only by Spain, with the data based on Spanish sales notes and Owners Associations data compiled by IEO. Fisheries statistics are believed to be reliable. However, during the periods 1998-2001 and 2004-2008 the information sources failed and landings data were obtained from the biological sampling programme, instead of directly from the sale sheets, which makes the quality of estimates more questionable.

Discard

Nephrops discards are negligible in this fishery. Generally, only soft and damaged individuals are discarded (Pérez et al., 1996) and the information is obtained via the onboard discard sampling programme.

B.2. Biological

Annual length compositions of the commercial landings of *Nephrops* for both males and females are available since 1980 for the A Coruña trawl fleet. The sampling data are raised to the total landings by market category and month. Starting from 2009 concurrent sampling is carried out, as required by the new DCR (Reg. EC 1343/2007). With the new sampling strategy, five fishing trips of the bottom trawl *metier* are sampled per month at the auction market in A Coruña port. Information on discards is not taken into account in the estimation of the total catch length distribution due to the low level of discards.

B.3. Surveys

Abundance indices of *Nephrops* FU 25 are derived from the Spanish groundfish survey SP-GFS carried out to collect information on abundance of demersal species. The survey uses a stratified random sampling design with half hour hauls and covers the northwest area of Spain, from Portugal to France, during September/October since 1983 (except 1987). Data for 2003 are not considered reliable. The information is not taken into account because the surveys are not designed for *Nephrops*.

B.4. Commercial CPUE

Fishing effort and LPUE data are available for A Coruña trawl fleet (SP-CORUTR8c). The fishing effort corresponds to the bottom trawl fleet that fish in a mixed fishery for demersal species (not specifically directed to *Nephrops*). Fishing effort and LPUE data starting from 1999 exclude the fishing trips that operate with HVO, as this gear (which catches mostly mackerel and horse mackerel) does not catch *Nephrops.*

B.5. Other relevant data

C. Historical Stock Development

Nephrops FU 25 has been regularly assessed since 1990 (ICES, 1990). The last analytical assessment was carried out by the WGHMM in 2006 (ICES, 2006). XSA was applied, using "catch-at age" data generated by the slicing of length distributions employing the L2AGE program. This procedure, introduced in the 1991 *Nephrops* WG, uses von Bertalanffy growth parameters to determine limits between age classes. The use of slicing to convert length compositions into age compositions is controversial, especially for older age groups (3 and older). An assessment for both sexes combined was carried out, although slicing was applied by sex and the results combined to obtain a single catch-at-age matrix for both sexes.

The 2006 XSA assessment was calibrated using data from a single commercial LPUE series, where the definition of fishing effort was based on nominal effort. The results were only accepted as indicative of stock trends.

Model used (until 2006): XSA

Software used: Lowestoft VPA Suite (VPA95.exe), Retvpa02.exe

Input data types and characteristics:

Parameter	Value	Source
Discard survival	NA	Not applicable _ Few discards (<1% on average)
MALES		
Growth-K	0.160	(ICES, 1994)
Grouth-L(inf)	70	"
Natural mortality-M	0.2	"
Lenght/weight-a	0.00043	(Fariña, 1984)
Lenght/weight-b	3.160	"
FEMALES		
Inmature Growth		
Growth-K	0.160	(ICES, 1994)
Growth-L(inf)	70	"

Natural mortality-M	0.2	“
Size at maturity (mm CL)	28	(Fariña, 1996)
Mature Growth		
Growth-K	0.080	(ICES, 1994)
Grouth-L(inf)	60	“
Natural mortality-M	0.2	Assumed from Morizur (1982)
Lenght/weight-a	0.00043	(Fariña, 1984)
Lenght/weight-b	3.160	“

XSA run:

Males+Females	**2006 WGHMM**	
Tuning Fleets used	Assessment Years	Assessment Ages
SP-CORUTR-8c	1982-2005	2 - 9
First age for normal catchability independent analysis	All ages independent	
First age at which q is considered independent of age	7	
Taper	Tricube over 20 yrs	
F shrinkage (SE for mean F)	1.5	
F Shrinkage	Final 5 yrs	3 oldest ages
Minimum Log SE for terminal population estimates	0.3	
Fbar (age)	4 - 7	
Recruitment Age	2	

No improvements in relation to the methodological assessment have been achieved after 2006 and the WG has not attempted any further analytical assessment for this stock. The time series of fisheries data are updated annually and LPUE series used to depict the stock trend.

Since 2012, the advice for this stock was based on fishery LPUE and effort trend, according to the ICES data-limited approach (ICES, 2012). This stock is classified in the category 3.1.4. of Data Limited Stocks (DSL): stocks with extremely low biomass.

D. Short-Term Projection

Not used.

E. Medium-Term Projections

Not used.

F. Long-Term Projections

Not used.

G. Biological Reference Points

There are no biological references points defined for this stock.

H. Other Issues

I. References

Fariña, A.C., 1984. Informe de la Campaña "Sisargas83". Inf. Tec. Inst. Esp. Oceanogr., no 25.

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ICES, 2012. ICES implementation of advice for Data-limited stocks in 2012. ICES CM 2012/ACOM 68.

Annex L - Stock Annex Nephrops FU 26-27

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	West Galician and North Portugal (Division IXa, FU 26-27).
Working Group:	WGBIE
Date:	07 May 2014 (update)
Revised by	Yolanda Vila

A. General

A.1. Stock definition

The *Nephrops* stock from FU 26 extends along the Atlantic area off the northwestern Spanish coast, south of Cape Finisterre, whereas FU 27 covers the Atlantic area off northern Portugal.

A.2. Fishery

Nephrops is caught in a mixed bottom trawl fishery, which takes place throughout the year, with the highest *Nephrops* landings in Spring and Summer. The overall decline of some bottom commercial species in the area has influenced the fishing strategies of the trawl fleets in terms of gear modalities and target species. Targeted species include hake, anglerfish, megrim, horse mackerel, mackerel and a variety of other fish and cephalopods.

The bottom trawl fleet comprises three main components: baca trawl, high vertical opening trawl (HVO) and pair trawl, each targeting different species. Only the baca trawl catches *Nephrops*. The description of these fisheries was updated and reported in STECF (2003). Trawl vessels can change gear from year to year and, consequently, target species and fishing effort applied vary. The increasing use of pair trawlers and HVO (fishing for mackerel and horse mackerel) that do not catch *Nephrops,* has reduced fishing effort on the species in recent years.

The *Prestige* oil spill off the northwest Spanish coast (November 2002) resulted in the adoption of several temporary regulations to minimize the impact on the fisheries, such as spatial and seasonal closure for fishing fleets. The fishery remained partially closed from January to April 2003, causing a reduction in fishing effort.

Nephrops is managed by an annual TAC (applying to the whole of ICES Division IXa) and technical measures. European Union regulations establish 20 mm carapace length (CL) as a minimum landing size. Few animals are caught under size. Although *Nephrops* represents less than 2% of the total weight landed by the bottom trawl fishery (Fariña, 1996), the species is a very valuable component of the landings.

A Recovery Plan for southern hake and Atlantic Iberian *Nephrops* stocks was implemented and enforced since 2006 (EC 2166/2005). 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.

A.3. Ecosystem aspects

Nephrops is a burrowing species and occurs on muddy sea bed on the continental shelf and upper slope. The distribution of *Nephrops* in this area is limited to depths ranging from 90-500 m. Main patch configurations are evident in shallower waters (80-140 m) in the west coast of Galicia. The distribution of *Nephrops* is more determined by ground type and sea temperature than depth. They are sedentary but they can leave their burrows to look for food and for reproduction purposes.

After reaching sexual maturity, males molt more frequently than females, consequently growing faster. Mating takes place just after the females molt. Eggs are fertilized when they are laid and they attach under the female abdomen. Berried *Nephrops* stay most of the time in their burrows. Larvae are pelagic for one month after hatching, then after metamorphosis the small *Nephrops* settle on the sea bed. The emergence patterns of females during the incubation period results in a different exploitation pattern for each sex.

Nephrops are omnivorous but polychetes, crustaceans, molluscs and echinoderms are their favourite preys. There are not reports on *Nephrops*' predators in the area.

B. Data

B.1. Commercial catch

Landings

Landings are reported by Spain and minor quantities by Portugal. The catches are taken by Spanish fleets fishing on the Galicia (FU 26) and North Portugal (FU 27) fishing grounds and by the Portuguese artisanal fleet fishing with traps in FU 27. Prior to 1996 no distinction was made between the two FUs and, therefore, the Spanish landings for that early period are given for the two FUs together. The Spanish data used are based on Spanish sales notes and Owners Associations data compiled by IEO. Landings data are available since 1975 although landings by sex are only available from 1988 onwards.

Discard

Nephrops discards are negligible in this fishery. Generally, only soft and damaged individuals are discarded (Pérez et al., 1996) and the information is obtained via the onboard discard sampling programme.

B.2. Biological

Length frequencies by sex of the *Nephrops* landings are collected monthly by the biological sampling programme since 1988. The sampling data from the Marín and Vigo fleets are raised to the total landings by market category and month. Starting from 2009 concurrent sampling is carried out, as required by the new DCR (Reg. EC 1343/2007). With the new sampling strategy, fishing trips of the bottom trawl *metier* are sampled at the auction markets of Riveira (FU 26), Marin (FU 26) and Vigo (FU 27) ports, with 3, 4 and 2 sampling events per month, respectively. Information on discards is not taken into account in the estimation of the total catch length distribution due to the low level of discards.

B.3. Surveys

Abundance indices of *Nephrops* FU 26 are derived from the Spanish groundfish survey SP-GFS carried out to collect information on abundance of demersal species. The survey uses a stratified random sampling design with half hour hauls and covers the northwest area of Spain, from Portugal to France, during September/October since 1983 (except 1987). Data for 2003 are not considered reliable. The information is not taken into account due to the surveys are not designed for *Nephrops*.

B.4. Commercial CPUE

Fishing effort and an LPUE data series are available for Marín trawl fleet (SP-MATR) starting from 1994. This fleet accounts for more than 40% of the landings from these FUs. Time series of fishing effort and LPUE of the bottom trawl fleets with home ports of Muros (1984-2003), Riveira (1984-2004) and Vigo (1995-present) are also available.

B.5. Other relevant data

C. Historical Stock Development

The species has been regularly assessed since 1990 (ICES, 1990). The last analytical assessment for this FU was carried out by the WGHMM in 2006 (ICES, 2006). XSA was used with "catch-at age" data generated by slicing length distributions employing the L2AGE program. This procedure, introduced at the 1991 *Nephrops* WG, uses von Bertalanffy growth parameters to determine limits between age classes. The use of slicing to convert length compositions into age composition is controversial, especially for older age groups (3 and older). An assessment with combined sexes was carried out, although the slicing was applied for each sex separately and the resulting catch-at-age matrices by sex added up for the assessment. Prior to 2005 an assessment by sex was carried out but the WG proposed to carry out an assessment for both sexes combined, considering the advantages for management.

The 2006 assessment was calibrated using data from a single commercial LPUE series, where the definition of fishing effort was based on nominal effort. The results were accepted only as indicative of stock trends and not used for projections.

Model used (until 2006): XSA

Software used: Lowestoft VPA Suite (VPA95.exe), Retvpa02.exe

Input data types and characteristics

Parameter	Value	Source
Discards survival	NA	Not applicable-Few discards (<1% on average)
MALES		
Growth-K	0.150	(Fernandez et al., 1986)
Grouth-L(inf)	80	"
Natural mortality-M	0.2	"
Lenght/weight-a	0.00043	(Fariña, 1984)
Lenght/weight-b	3.160	"
FEMALES		
Inmature Growth		
Growth-K	0.160	(ICES, 1994)
Growth-L(inf)	70	"

Natural mortality-M	0.2	"
Size at maturity (mm CL)	26	(Fariña, 1996)
Mature Growth		
Growth-K	0.080	(ICES, 1994)
Grouth-L(inf)	65	"
Natural mortality-M	0.2	"
Lenght/weight-a	0.00043	(Fariña, 1984)
Lenght/weight-b	3.160	"

XSA run:

Males+Females	2006 WGHMM	
Tuning Fleets used	Assessment Years	Assessment Ages
SP-MATR	1994-2005	2 - 9
First age for normal catchability independent analysis	All ages independent	
First age at which q is considered independent of age	6	
Taper	Tricube over 20 yrs	
F shrinkage (SE for mean F)	1.5	
F Shrinkage	Final 5 yrs	3 oldest ages
Minimum Log SE for terminal population estimates	0.3	
Fbar (age)	3 - 7	
Recruitment Age	2	

After 2006, no improvements in relation to a methodological assessment were achieved and the WG did not attempt any further analytical assessment for this stock. The time series of fisheries data are updated every year and LPUE series used to depict the stock trends.

Since 2012, the advice for this stock was based on fishery LPUE and effort trend, according to the ICES data-limited approach (ICES, 2012). This stock is classified in the category 3.1.4. of Data Limited Stocks (DSL): stocks with extremely low biomass.

D. Short-Term Projection

Not used.

E. Medium-Term Projections

Not used.

F. Long-Term Projections

Not used.

G. Biological Reference Points

There are no biological references points defined for this stock.

H. Other Issues

I. References

Fariña, A.C., 1984. Informe de la Campaña "Sisargas83". Inf. Tec. Inst. Esp. Oceanogr., no 25.

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ICES, 1990. Report of the Working Group on *Nephrops* stocks. ICES CM 1990/Assess:16

ICES, 1994. Report of the Working Group on *Nephrops* and *Pandalus* stocks. ICES CM 1994/Assess: 12.

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Pérez, N., Pereda, P., Uriarte, A., Trujillo, V., Olaso, I. and Lens, S., 1996. Descartes de la flota española en el área del ICES. Datos y Resúm. Inst. Esp. Oceanogr., 2: 142 pp.

ICES, 2012. ICES implementation of advice for Data-limited stocks in 2012. ICES CM 2012/ACOM 68.

Annex L – Stock Annex Nephrops FU 28-29

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	Southwest and South Portugal (Division IXa, FUs 28-29)
Working Group:	WGBIE
Date:	12 May 2014 (updated)
Revised by	Cristina Silva

A. General

A.1. Stock definition

The Norway lobster (*Nephrops norvegicus*) is distributed along the continental slope off the southwest and south Portuguese coast, at depths ranging from 200 to 800 m. Its distribution is limited to muddy sediments, and requires sediment with a silt and clay content of between 10–100% to excavate its burrows, and this means that the distribution of suitable sediment defines the species distribution. Although FUs 28 and 29 are different stocklets, landings records are not differentiated and they are assessed together.

A.2. Fishery

The fishery in FUs 28 and 29 is mainly conducted by Portugal. For the last 25 years, this species has been a very important resource for the demersal trawl fisheries operating in the region. With exception of the years when the abundance of pink shrimp (*Parapenaeus longirostris*) is extremely high, *Nephrops* constitutes the main target species of the majority of the crustacean trawl fleet, and is not generally caught as by-catch of other fleets.

The Portuguese trawl fleet comprises two components, namely the trawl fleet fishing for fish and the trawl fleet fishing for crustaceans. The trawl fleet fishing for fish operates off the entire coast while the trawl fleet directed to crustaceans operates mainly in the Southwest and South Portugal, in deep waters, where crustaceans are more abundant. The fish trawlers are licensed to use a mesh size >= 65 mm and the crustacean trawlers are licensed for two different mesh sizes, 55 mm for catching shrimp and >= 70 mm for Norway lobster. Demersal fish trawlers that regularly land *Nephrops*, do in fact target this resource, which in terms of overall profit, represents a significant additional income.

The number of trawlers targeting crustaceans has been fixed at 35 since the early 1990s. However, since the late 1990s, some vessels have been replaced by new ones, better equipped and with a more powerful engine. In 2008, the number of licensed fish trawlers was 69 with an average of 645 HP, 182 GRT and 26 m of overall length, whereas the number of crustacean trawlers was 30, with an average of 562 HP, 177 GRT and 25 m of overall length.

There are two main target species in the crustacean fishery, which are the Norway lobster and the deepwater rose shrimp. These two species have a different but overlapping depth distribution. Rose shrimp occurs from 100 to 350 meters of depth whereas Norway lobster is distributed from 200 to 800 meters. The number of fishing trips directed to one species or to the other depends on the abundance of these species each year. The number of fishing trips directed to *Nephrops* increased in 2004-2005, dropping again in recent years.

The fishery takes place throughout the year, with the highest landings usually being made in the spring and summer.

A Recovery Plan for the southern hake and Iberian *Nephrops* stocks has been in force since the end of January 2006 (Council Regulation (EC) No. 2166/2005). 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. In order to reduce fishing mortality on *Nephrops* stocks in this area even further, the Recovery Plan introduced a seasonal ban in the trawl and creel fishery in a box, located in FU 28, for four months in the peak of the *Nephrops* fishing season (May – August).

Every year, the TAC and the number of fishing days per vessel is regulated.

A Portuguese national regulation (Portaria no. 1142/2004, 13th September 2004) enforced a complete closure of the deepwater crustacean trawl fishery in January–February 2005 and established a ban on *Nephrops* fishing from 15 September to 15 October. The ban in September–October was already implemented in 2004. This regulation was revoked in January 2006 after the implementation of the Recovery Plan, keeping only one month of closure of the crustacean fishery in January (Portaria no. 43/2006, 12th January 2006). Although these periods do not correspond to the main fishing season for Nephrops, these measures resulted in a reduction of effort.

The minimum landing size (MLS) for *Nephrops norvegicus* is 20 mm of carapace length (CL) or 70 mm of total length (TL). Discards are negligible and are mainly related to quality (broken or soft shells).

The main by-catch species are blue whiting, hake and anglerfish.

A.3. Ecosystem aspects

The Norway lobster (*Nephrops norvegicus*) is distributed along the southwest and south Portuguese coast, at depths ranging from 200 to 800 m. Its distribution along the continental slope is patchy and high abundance areas have been clearly identified.

Differences in the length composition of catches originating from FU28 (SW Portugal) and those originating from FU29 (S Portugal) were observed during the surveys. At present there is no scientific evidence to separate these stocks and consider them two sub-populations. Further work in this area is needed to improve our knowledge about this stock.

Another topic that should be further investigated, is the possible interaction between the stocks found in FU29 and FU30 (Cadiz). Exchanges between the two populations are likely to occur since there are no known physical/geographical constraints limiting this exchange. Aiming for a better understanding of the *Nephrops* population dynamics, tagging experiments and genetic studies would provide valuable information, which would help to support the issues dealt with during the assessment working groups.

Norway lobster is a benthic species that attains a maximum size of around 80mm (CL) corresponding to a weight of approximately 400g. Lobsters spawn from August through to November off the shelf edge in deep waters. After spawning, females carry the eggs for a 3 to 4 month period after which the larvae hatch and become pelagic free swimmers. Larvae move freely in the water column for a short time period before settling into the mud grounds. Females reach the first maturity at 30 mm and males around 28 mm of carapace length (CL) (ICES, 2006).

A comprehensive study into the role of Norway lobsters in the ecosystem has not yet been carried out. It would be particularly useful to have such information, as *Nephrops* is known to be part of an extended and dynamic community of highly valuable commercial species.

B. Data

B.1. Commercial catch

Up to 1992 the estimated landings from FUs 28 and 29 have fluctuated between 450 and 530 t, with a long-term average of about 480 t. Between 1990 and 1996, the landings fell drastically to 132 t. From 1997 to 2005 landings have increased to levels observed during the early 1990s but decreased again in recent years.

Males are the dominant component in all landings with exception of 1995 and 1996 when total female landings exceeded male landings (ICES, 2006a). Male to female sex-ratio has been close to 1.5:1.

A discard sampling program onboard the Portuguese crustacean trawlers started in 2004. Discards of *Nephrops* are considered negligible in this fishery and mostly due to quality.

B.2. Biological

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. The sampling data are raised to the total landings by market category, vessel and month. Information on discards is not taken into account in the estimation of the total catch length distributions due to the low level of discards and the lack of defined raising procedures. However, the length distribution of discards confirms the idea that *Nephrops* is not rejected because of its MLS (20 mm of CL) but mainly due to quality problems.

Mean weights-at-age for this stock are estimated from fixed weight-length.

A natural mortality rate of 0.3 was assumed for all age classes and years for males and immature females, with a value of 0.2 for mature females based in Morizur (1982). The lower value for mature females reflects the reduced burrow emergence while ovigerous and hence an assumed reduction in predation.

The size at maturity for females was recalculated at ICES-WKNEPH 2006 to be 30 mm being the same as used in assessments prior to 2008 (ICES, 2006). An asymmetrical log-log relationship was used to estimate the maturity ogive and L_{50}.

A segmented regression was used to estimate the size at maturity for males as the breakpoint in the growth relationship between the appendix masculina and the carapace length. The value estimated for FU 29 was 28.4 mm of CL (ICES, 2006).

Growth parameters were estimated using the Bhattacharya method and tagging experiments (Figueiredo, 1989).

Several factors were considered to potentially affect survival, including duration of the tow and season, and biological characteristics of the individuals (e.g. size, sex and ovigerous condition). Survival was only affected by season (increased mortality in warm months). A global estimate of survival of released lobsters, taking into consideration survival and proportion of the catches for each season, was 35% (Castro *et al.*, 2003)

Summary:

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	0.35	
MALES		
Growth - K	0.200	Portuguese data (Bhattacharya method) ; tagging (ICES, 1990a)
Growth - L(inf)	70	"
Natural mortality - M	0.3	Figueiredo (1989)
Size at maturity (mm CL)	28.4	ICES (2006)
Length/weight - a	0.00028	Figueiredo (pers. comm., 1986)
Length/weight - b	3.2229	"
FEMALES		
Immature Growth		
Growth - K	0.200	Portuguese data (Bhattacharya method) ; tagging (ICES, 1990a)
Growth - L(inf)	70	"
Natural mortality - M	0.3	Figueiredo (1989)
Size at maturity (mm CL)	30	ICES (1994)
Mature Growth		
Growth - K	0.065	Portuguese data (Bhattacharya method) ; tagging (ICES, 1990a)
Growth - L(inf)	65	"
Natural mortality - M	0.2	Figueiredo (1989)
Length/weight - a	0.00056	Figueiredo (pers. comm., 1986)
Length/weight - b	3.0288	"

B.3. Surveys

The Portuguese crustacean surveys started in 1981. The surveys were carried out with the research vessels «Mestre Costeiro» and «Noruega» and the main areas covered were the southwest coast (Alentejo or FU 28) and the south coast (Algarve or FU 29). The main objectives were 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).

In 1997, a stratified sampling design was adopted, based on the design for the demersal resources. The sectors and depth strata were the same used for the groundfish surveys, from 200 to 750 meters in the southwest coast and from 100 to 750 meters in the south coast. The number of hauls in each stratum was dependent on *Nephrops* and rose shrimp abundance variance, with a minimum of 2 stations per stratum. The average total number of stations in the period 1997-2004 was 60. These surveys were carried out in May-July and had a total duration of 20 days.

Since 2005, sampling was based on a regular grid superimposed on the area of *Nephrops* distribution. This sampling procedure allows a more powerful use of data, especially considering the use of geostatistical tools. The total duration of the survey was the same (20 days) and the haul duration had to be reduced from 60 to 30 minutes in order to cover all the rectangles (77) of the grid.

Sediment samples have been collected since 2005 with the aim to study the characteristics of the *Nephrops* fishing grounds.

In 2008, the crustacean trawl survey conducted in Functional Units 28 and 29, was combined with an experimental video sampling. The collection of images was limited to 10 stations in FU 28.

A SeaCorder, composed of an MD4000 high resolution colour camera, an MP4 video recorder and a 30 Gb hard drive, was hung at the central point of the headline, pointing forward onto the sea floor with an angle of 45 degrees, approximately (ICES, 2007). A 2-beam laser pointer is attached to the SeaCorder, for measuring purposes (estimation of the width of view and *Nephrops* and burrows sizes).

The collection of video footage was routinely carried out in each trawl station was routinely carried in 2009. This methodology is being evaluated to see if the data can be used for biomass estimation, length distribution and *Nephrops* catchability by the trawl gear (ICES, 2009).

The observation of the collected footages shows that the trawling speed and the turbidity were the main problems affecting the clarity of the image and that 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 (ICES, 2012a).

B.4. Commercial CPUE

A standardization of the CPUE series was presented to WGHMM in 2008 (Silva, C. – WD 25) and reviewed in 2009, applying the generalized linear models (GLMs). The data used for this standardization were the crustacean logbooks for the period 1988-2008. The factors retained for the final model (year, month and vessel category) were those which contribute more than 1% to the overall variance. The model explains 17% to 19% of the variabilility, when using the CPUE in kg/day or kg/haul respectively. The CPUE series was standardised and the effort estimated correspondingly.

The issue of effort estimation using standardized CPUE from GLMs or other methods taking into account the flexibility of the fleet in relation to target species was further developed in the WGHMM 2010 (ICES, 2010a) and during WKSHAKE2 (ICES, 2010b). Crustacean vessels are targeting two main species, rose shrimp and Norway lobster, which have different market value. Depending on their abundance/availability, the effort is directed at one species or the other.

The model of CPUE standardization used until 2010 never explained more than 20% of the variability (ICES, 2010a). The explanatory variables used were *year*, *month* and *vessel-category*. Considering the behaviour of the fleet in periods of high abundance of rose shrimp, new variables related to the catches of this species and the proportion of *Nephrops* in the total catch were incorporated. As the distributions of rose shrimp and *Nephrops* are fishing ground and depth dependent, the availability and use of VMS data were suggested to improve the standardization model (Silva and Afonso-Dias, 2011, WD to WKCPUEFFORT).

Taking all this into account, new variables as the fishing depth, the catches of rose shrimp and the proportion of *Nephrops* in the total crustacean catches were incorporated in the new model for CPUE standardization and presented to IBP *Nephrops* 2012 (Inter-Benchmark Protocol for *Nephrops* 2012).

The IBP *Nephrops* (ICES, 2012b) did not come to a conclusion about the stock assessment method but the WG has agreed to use this new CPUE standardization for the trends based assessment and standardized effort estimation.

VMS data are only available since 1998 and the use of this method has shortened the length of the time series. In the models presented before, the CPUE was expressed in kg/day and the time series started in 1988. The CPUE in the new model is expressed in kg/hour, the time series starts 10 years later but the estimation of CPUE is based on more reliable effort data.

The overall analysis of the geo-referenced catches confirmed the general preference of rose shrimp and *Nephrops* for grounds shallower and deeper than 400 m, respectively. These data also confirmed that, in years of higher abundance of rose shrimp, a greater effort is allocated to depths shallower than 400 m. In what concerns the distribution of the fishing effort between the two Functional Units, FU29 represents in average 83% of the total effort. However, the FUs were found not significantly different and therefore removed from the model.

The factors and levels retained in the final model presented to IBP 2012 were updated to include 2011 and 2012 data:

- year: 1998 – 2012
- month: 1 – 12
- depth interval: [100, 400[, [400, 800[, [800, 1500]
- log catch of rose shrimp: [0, 2[, [2, 5]
- proportion of *Nephrops* in the total catch of crustaceans: [0, 0.25[, [0.25, 1]
- and vessel category: A (standard), B and C. These two categories correspond to vessels less or more productive than the standard type.

The choice of the final model was based on the highest value of explained variance and the smallest AIC. The model explains 47% of the total variability, with the proportion of *Nephrops* in the crustacean catches as the most important factor.

The depth interval class [400, 800[, the log catch of rose shrimp class [0, 2[, the category of proportion of *Nephrops* [0.25, 1] and the vessel category A are used as the reference factors for *Nephrops* target CPUE.

B.5. Other relevant data

C. Historical Stock Development

In the past, LCA assessments were carried out for males and females separately over a 3-year reference period, in which the stock was considered to be in a steady state. The steady state assumption was questioned due to the decrease of the stock and this method was abandoned (ICES, 2002).

Software used: Lba99g.exe

Age structured XSA assessments have been carried out recently for *Nephrops*, males and females separately (ICES, 2008), with two tuning fleets: the crustacean fleet and the crustacean survey. The results were considered unreliable for several reasons most importantly, growth and natural mortality assumptions and the use of age-converted groups by slicing. However, the results have been taken as indicative of stock trends.

Software used:

- For conversion of the length compositions in ages with slicing: L2AGE4.exe
- XSA: Lowestoft VPA Suite (VPA95.exe), Retvpa02.exe, FLR package

Males	2006 – 2010 WGHMM	
Tuning Fleets used (First - Last year ; Ages used)	Period	Ages
P-TR: Crustacean Trawl Fleet	1988-2005	2 - 7
P-CTS: Crustacean Trawl Survey	1997-2005	2 - 7
First age for normal catchability independent analysis	All ages independent	
First age at which q is considered independent of age	6	
Taper time weight applied?	Tricube over 20 yrs	
F shrinkage (SE for mean F)	1.5	
F Shrinkage	Final 5 yrs	3 oldest ages
Minimum Log SE for terminal population estimates	0.3	
Fbar (age)	2 - 7	
Recruitment Age	2	

Females	2006 – 2010 WGHMM	
Tuning Fleets used (First - Last year ; Ages used)	Period	Ages
P-TR: Crustacean Trawl Fleet	1988-2005	2 – 12
P-CTS: Crustacean Trawl Survey	1997-2005	2 – 5
First age for normal catchability independent analysis	All ages independent	
First age at which q is considered independent of age	11	
Taper time weight applied?	Tricube over 20 yrs	
F shrinkage (SE for mean F)	1.5	
F Shrinkage	Final 5 yrs	5 oldest ages
Minimum Log SE for terminal population estimates	0.3	
Fbar (age)	4 – 10	
Recruitment Age	2	

Other indicators, such as CPUE from the fleet, abundance index from crustacean trawl survey and mean sizes in landings and in surveys have also been used when analysing trends.

These FUs were assessed using XSA until 2010, but the results were only accepted for trends analysis.

IBP Nephrops 2012 had not come to conclusions at the deadline set in the Terms of Reference (31st March), but noted that, although there were some significant improvements in the tuning fleet data and different XSA model settings have been looked into, there were still some problems of internal consistency (ICES, 2012b).

In 2012, WGHMM considered that XSA shall be abandoned and other methods be tried. Since this year, the advice for these stocks was based on survey and fishery CPUE and effort trends, according to the ICES data-limited approach (ICES, 2012c).

This stock is classified in the category 3.2.0 of Data-Limited Stocks (DLS), stocks that have survey data on abundance or cpue over time, but there is no survey-based proxy for *MSY $B_{trigger}$* and *F* values or proxies are not known.

D. Short-Term Projection

Not used

E. Medium-Term Projections

Not used

F. Long-Term Projections

Not used

G. Biological Reference Points

There are no biological reference points defined for this stock.

H. Other Issues

I. References

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Annex L – Stock Annex Nephrops FU 30

Quality Handbook	Stock specific documentation of standard assessment procedures used by ICES.
Stock	Gulf of Cadiz (Division IXa, FU 30).
Working Group:	WGBIE
Date:	07 May 2014 (update)
Revised by	Yolanda Vila and Luis Silva

A. General

A.1. Stock definition

The *Nephrops* stock from FU30 comprises the Spanish waters of the Gulf of Cadiz, defined as the Spanish Suratlantic Region. The western limit of the stock is at the Portuguese border, on the Guadiana River estuary, whereas the eastern border is at the Gibraltar Strait. The Gibraltar Strait separates the Gulf of Cadiz from the Mediterranean Sea and is considered a natural border. On the other hand, the Guadiana River does not seem to be a real boundary for splitting possibly different populations (FUs 29 and 30). This stock limit was decided mainly on management considerations, without any clear biological basis. Possible differences and exchange rates across FUs 29 and 30 should be studied. Tagging experiments and genetic studies could provide valuable information in this respect.

Within FU 30, *Nephrops* grounds correspond to muddy and sandy areas ranging between 200 to 700 m depth. High fishing effort is particularly carried out around 500 m (Ramos et al., 1996).

A.2. Fishery

Nephrops in FU 30 is exploited mostly by Spanish trawlers. The bottom trawl fleet of the Gulf of Cadiz is characterized by the multispecifity of its landings (Sobrino, 1994; Jiménez, 2002; 2004). The fleet operates mainly from four coastal localities: Isla Cristina, Sanlúcar de Barrameda, Puerto de Santa María and Huelva. Huelva was the most important *Nephrops* landing port until 2002, but landings from Isla Cristina and Puerto de Santa María became larger than Huelva landings from that year onwards (Vila et al., 2005). Recent information from the Port of Ayamonte shows that *Nephrops* landings at this port represent 31% of the total *Nephrops* landings from the bottom trawl fleet in FU 30. Ayamonte and Isla Cristina were the main *Nephrops* landing ports in 2009. Landings are clearly seasonal with high values from April to September (Jiménez, 2002). *Nephrops* represents 1.5% of the total trawl landings from the area.

Two main *métiers* were identified among the trawlers in the past (STECF, 2003). The most common group normally fish in shallow waters (30-100 m) with a mixture of target species (sparids, cephalopods, wedge sole, hake and horse mackerel). The other group operates between 90 and 500 m of depth, targeting mainly blue whiting, shrimp, horse mackerel, hake and Norway lobster.

A fleet conversion developed by the public administration at the end of the 1990s homogenized considerably this fleet regarding its technical characteristics and fishing capacity. Jiménez et al. (2004) observed a direct relationship between the capacity of vessel mobility and the bathymetric situation of the fishing. After the fleet conversion, a larger number of vessels could access the more remote and deeper fishing grounds, resulting in an increase of *Nephrops* directed effort and landings from 2000 to 2004. At present, *Nephrops* and the others target species of the Gulf of Cádiz bottom trawl fleet are landed by a unique and highly multispecific *metier*, due to recent changes in the abundance of target species and fleet regulations (see WGHMM 2007 report Section 2).

Different Fishing Plans have been established since 2004 in order to reduce the fishing effort of the bottom trawl fleet in the Gulf of Cádiz (ORDENES APA/3423/2004, APA/2858/2005, APA/2883/2006, APA/2801/2007). The current Fishing Plan (ORDENES ARM/2515/2009, ARM/58/2010) runs from September 2009 until September 2010. The plans generally restrict daily fishing hours, establish two days per week of no fishing and a single landing event per vessel per day. The reduction of daily fishing hours has a direct effect on *Nephrops* directed effort because the trawl fleet does not have enough time to access the *Nephrops* fishing grounds, which are located far away from the fishing port. Furthermore, the plan establishes a closed fishing season of 90 days distributed in two periods. The first period took place last year between September 25-November 23 2009, and the second period was established between January 22-February 14 2010).

The effects of the closed seasons on *Nephrops* population have not yet been evaluated. However, from 2006 onwards, total fleet effort and directed effort decreased even though the closed season was established outside of the main fishing season. Since 2008, the directed fishing effort and the landings of *Nephrops* are much lower. The increment of the abundance of rose shrimp (*Parapenaeus longirostris*) has led a change in the objectives of the fishery. This fact, together with the bad weather conditions during 2008 and the remoteness of the *Nephrops* fishing grounds, probably has an influence on this reduction.

Nephrops is managed in the area by an annual TAC (applying to the whole of ICES Division IXa) and technical measures. The European Union regulations establish 20 mm carapace length (CL) as a minimum landing size. Few animals are caught under size.

For the bottom trawl fleet, the Gulf of Cadiz area has different regulations from the rest of statistical subdivisions in the North Eastern Atlantic, allowing the use of smaller mesh sizes (40 mm). Nevertheless, an increase of mesh size to 55 mm or more was indefinitely implemented in the last Fishing Plan in order to reduce discards of individuals below the minimum landing size.

There is a Recovery Plan for the southern stock of hake and Iberian stocks of *Nephrops* (EC 2166/2005). Effort limitation measures indicated in the Recovery Plan (and specifically defined in Annex IIb of the annual EC regulation setting TACs) do not affect the Gulf of Cádiz.

A.3. Ecosystem aspects

Nephrops is a burrowing species and inhabits muddy sea beds on the continental shelf and upper slopes. Its distribution is more determined by ground type and sea temperature than depth. In this area, it is distributed between 200 and 800 m of depth in a patchwork configuration where the substrate is suitable. *Nephrops* are sedentary but they can leave their burrows to look for food and for reproduction.

After reaching sexual maturity, males molt more frequently than females, consequently growing faster. Mating takes place just after the females molt. Eggs are fertilized when they are laid and they attach under the female abdomen. Berried *Nephrops* stay most of the time in their burrows. Larvae are pelagic for one month after hatching, then after metamorphosis the small *Nephrops* settle on the sea bed. The emergence pattern of the *Nephrops* females during the incubation period results in a different exploitation pattern for each sex. The spawning season occur in summer, mature females are observed in spring and summer while berried females appear starting from August (Vila et al., 2005). Females remain in their burrows during the autumn and winter.

Nephrops are omnivorous, but polychetes, crustaceans, molluscs and echinoderms are their favourite preys.

Further work in this area is needed to improve our knowledge about this stock. The information on the specific *Nephrops* biology from this area is still scarce.

A comprehensive study into the role of Norway lobsters in the ecosystem would be particularly useful since a habitat of special interest has been observed in deeper waters of the Gulf of Cádiz (OSPAR, 2004). Methane-enriched fluid expelled through a submarine mound, probably formed as a mud volcano in this area, maintains a highly sensitive ecosystem (Díaz del Río et al., 2006).

B. Data

B.1. Commercial catch

Landings

Landings are reported by Spain and also minor quantities by Portugal. Spanish data are based on sales notes and Owners Associations data compiled by IEO.

Discard

An annual Spanish Discard Sampling Programme under the EU DCR has been carried out in FU 30 since 2005. Until 2008, fishing trips in the bottom trawl *metier* were sampled by observers onboard during the *Nephrops* fishing season (Summer). The number of fishing trips sampled by year ranged between 20 and 30. Based on the new DCR, the discard sampling scheme covers the whole year since 2009 (Reg. EC 1343/2007). The 22 total annual number of sampled fishing trips in the bottom trawl *metier* was distributed among the quarters, with 5, 6, 6 and 5 sampled trips in quarters 1 to 4, respectively. The series provides information on discarded catch in weight and number and length distributions.

B.2. Biological

Annual length compositions of the commercial landings of *Nephrops* for both males and females are available since 2001. The sampling followed a multistage stratified random scheme by month in the port of Huelva for the period 2001-2005. These data were raised to the total landings from FU 30. Inconsistencies were found in this series (Silva *et al*., 2006), due to the fact that not all commercial categories were sampled before 2004. In 2006, a new sampling scheme was introduced, which included sampling in other ports (Isla Cristina, El Puerto de Santa María and Sanlúcar de Barrameda) and excluded the port of Huelva because the landings in this port have decreased. The sampling data were raised to the total landings by market category, port, month and area.

Starting from 2009 concurrent sampling is carried out, as required by the new DCR (Reg. EC 1343/2007). With the new sampling strategy, six fishing trips of the bottom trawl *metier* are sampled per month onboard vessels from the main landings ports in the Gulf of Cadiz, in order to ensure the widest geographical coverage. At least two fishing trips per month correspond to the deepest strata, where the *Nephrops* fishing grounds in this FU are located.

Information on discards is not taken into account in the estimation of the total catch length distribution due to the low level of discards.

No new information on biological parameters is available since 2004 (Vila *et al*., 2005). Carapace length (CL) and total weight (W) relationships were $W=0.0004*CL^{3.1018}$ for males, $W=0.0007*CL^{2.9657}$ for females and $W=0.0006*CL^{3.0237}$ for both sexes. Females' carapace length at first maturity was 29.4 mm. A histology study on female gonads is presently taking place, in order to compare macro and micro maturity scales. This study could improve the estimates of size at first maturity in this sex. Additionally, measurements of appendix masculine are being carried out with the aim of obtaining the size of onset of sexual maturity in males, following the methodology of McQuaid et al. (2006). Biological studies should continue in *Nephrops* from the Gulf of Cadiz.

B.3. Surveys

Two ground fish surveys are carried out annually in the Gulf of Cadiz in March (SP-GFS-cspr, since 1994) and November (SP-GFS-caut, since 1997). A stratified random sampling design with five bathymetric strata, covering depths between 15 and 700 m, is used, with one hour hauls.

Neither of these surveys are carried out during the main fishing period of *Nephrops* (April-September). Berried females are hidden in their burrows in autumn, so only the index from the March survey is considered potentially representative of stock abundance.

B.4. Commercial CPUE

Effort data used in the Gulf of Cadiz are based on Spanish sales notes and Owners Associations data compiled by IEO.

The estimate of *Nephrops* directed effort corresponds to daily fishing trips for which *Nephrops* represent at least 10% of the total landings in weight.

B.5. Other relevant data

C. Historical Stock Development

An LCA assessment of *Nephrops* of the Gulf of Cadiz (FU 30) was attempted in 2004 for the first time, in the ICES WGNEPH (ICES 2004). The input parameters used are presented in the table below. Given the uncertainties about input parameters, this assessment was considered as preliminary. Also, the steady state assumptions required for LCA assessment are questionable due to the observed trends in landings and effort.

Model used (in 2004): LCA

Software used: Lba

Input data types and characteristics:

PARAMETERS	VALUE	SOURCE
Discard Survival	NA	Not aplicable - few discards (< 1 % on average)
MALES		
Length range (mm)	18-50	Landings (2001-2003)
Growth - K	0.160	From FU 25 k value
Growth - L(inf)	60	Lmax from Gulf of Cadiz surveys
Natural mortality - M	0.2	Fernández et al. (1986)
Length/weight - a	0.00043	Fariña (1984)
Length/weight - b	3.160	Fariña (1984)
FEMALES		
Immature Growth		
Growth - K	0.160	From FU 25 k value
Growth - L(inf)	60	L max from Gulf of Cadiz surveys From Gulf of Cadiz surveys
Natural mortality - M	0.2	Fernández et al. (1986)
Size at maturity	28	Average from FU 25 and FU 26-27 values
FEMALES		
Mature Growth		
Length range (mm)	18-56	Landings (2001-2003)
Growth - K	0.090	Average from FU 25 and FU 26-27 Average from FU 25 and FU 26-27 values
Growth - L(inf)	58 60	LC max from Gulf of Cadiz landings From Gulf of Cádiz landings length distribution From Gulf of Cádiz landings length distribution From Gulf of Cadiz surveys

Natural mortality - M	0.2	Fernández et al. (1986)
Length/weight - a	0.00043	Fariña (1984)
Length/weight - b	3.160	Fariña (1984)

No analytical assessment have been carried out for this stock. The advice was based on fishery LPUE and effort trends. Abundance survey index is to take account supporting the fishery information of the data.

Since 2012, the advice for this stock was based on fishery LPUE and effort trend, according to the ICES data-limited approach (ICES, 2012). This stock is classified in the category 3.2.0. of Data Limited Stocks (DSL), stocks that have survey data on abundance or cpue over time, but there is no survey-based proxy for *MSY* $B_{trigger}$ and *F* values or proxies are not known.

D. Short-Term Projection

Not used.

E. Medium-Term Projections

Not used.

F. Long-Term Projections

Not used.

G. Biological Reference Points

There are no biological references points defined for this stock.

H. Other Issues

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Annex M - Stock Annex Southern black anglerfish (Lophius budegassa) (Divisions VIIIc, IXa)

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Southern black anglerfish (Divisions VIIIc, IXa)
Date:	23/05/2013
Revised by	Ricardo Alpoim (WGHMM2013)

A General

A.1 Stock definition

The two species of anglerfish (the white, *Lophius piscatorius,* and the black, *L. budegassa*) are North Eastern Atlantic species, however black anglerfish has a more southerly distribution. White anglerfish is distributed from Norway (Barents Sea) to the Straits of Gibraltar (and including the Mediterranean and the Black Sea) and black anglerfish from the British Isles to Senegal (including the Mediterranean and the Black Sea). Anglerfish occur in a wide range of depths, from shallow waters to at least 1000 m. Information about spawning areas and seasonality is scarce, therefore the stock structure remains unclear. This lack of information is due to their particular spawning behaviour. Anglerfish eggs and larvae are rarely caught in scientific surveys.

ICES gives advice for the management of several anglerfish spp. stocks in European waters: one stock on the Northern Shelf area, that includes anglerfish from the Northern Shelf–Division IIIa, Subarea IV and Subarea VI, and Norwegian Sea–Division IIa, and the stocks on the Southern Shelf area, one in Divisions VIIb-k and VIIIa,b and d and the Southern stocks in Divisions VIIIc and IXa. The stock under this Annex is called Southern Black Anglerfish and is defined as black anglerfish in Divisions VIIIc and IXa. The boundaries of anglerfish in Divisions VIIb-k and VIIIa,b and d and Southern Anglerfish stocks were established for management purposes and they are not based on biological or genetic evidences (GESSAN, 2002; Duarte *et al*., 2004; Fariña *et al*., 2004).

Although the stock assessment is carried out separately for each species, white and black anglerfish are caught and landed together, due to that, the advice is given for individual and the combined species. There is a unique TAC for both species.

A.2 Fishery

Anglerfish in ICES Divisions VIIIc and IXa are exploited by Spanish and Portuguese vessels, since 2000 the Spanish landings being more than 81 % for both anglerfish total reported landings. International catches for this stock have increased since the beginning of the 1980s, until a maximum was reached in 1988 (10 021 t). They have decreased to 1 801 t - 1 802 t in 2001-2002. In the 2003-2011 period the catches were between 2 300 t and 4 500 t. Both species are caught on the same grounds by the same fleets and are marked together.

White and black anglerfish are caught together by Spanish and Portuguese bottom trawlers and gillnet fisheries. Spanish and Portuguese bottom trawlers are mixed fisheries. The Spanish bottom trawl fleet predominantly targets hake, megrim, Norway lobster and anglerfish. Since 2003 the alternative use of a trawl gear with High Vertical

Opening (HVO) has taken place in higher proportion relative to previous years. This gear targets horse mackerel and mackerel with very few anglerfish catches. Since 2002, the Spanish landings were on average 61 % from the trawl fleet and 39 % from the gillnet fishery. The Spanish gillnet fishery can use different artisanal gears, but most catches come from “Rasco” that is a specific gear targeting anglerfish.

Anglerfish are caught by Portuguese fleets in trawl and artisanal mixed fisheries. Portuguese landings were on average, from 2002, 19 % from trawlers and 81 % from artisanal fisheries. The trawl fleet has two components, the trawl fleet targeting demersal fish and trawl fleet targeting crustaceans. Since 2005, Portuguese combined species landings were TAC constrained and very low landings were registered during the 4th quarter since then.

Discarding in black anglerfish is considered low for the trawl fishery, based on estimated data for Spanish trawl fleet (ICES, 2011) and information from Portuguese trawl fleet (ICES, 2012).

Each year, the European Union sets a combined TAC and quota for white and black anglerfish. There is no minimum landing size for anglerfish, but in order to ensure marketing standards a minimum landing weight of 500 g was fixed in 1996 by the Council Regulation (EC) No.2406/96.

As part of the Recovery Plan for the Southern hake and Iberian *Nephrops* stocks (Council Regulation (EC) No.2166/2005), in force since January of 2006, the fishing effort regulations are affecting the Spanish and Portuguese mixed trawl fisheries. As anglerfish are taken in these mixed trawl fisheries, these stocks are also affected by the recovery plan effort limitation.

A.3 Ecosystem aspects

Black anglerfish is a benthic species that occur on muddy to gravelly bottoms. It attains a maximum size of around 93 cm corresponding to a weight of approximately 12 kg. Historically black anglerfish has been considered a slow growing species, with a late maturation (Duarte *et al*., 2001). Nevertheless, new evidences from mar-recapture experiments indicate that the anglerfish growth could be faster (Landa *et al*., 2008).

The ovarian structure of anglerfish differs from most other teleosts. It consists of very long ribbons of a gelatinous matrix, within individual mature eggs floating in separate chambers (Afonso-Dias and Hislop, 1996). The spawning of the *Lophius* species is very particular, with eggs extruded in a buoyant, gelatinous ribbon that may measure more than 10 m and contain more than a million eggs (Afonso-Dias and Hislop, 1996; Hislop *et al*., 2001 and Quincoces, 2002). Eggs and larvae drift with ocean currents and juveniles settle on the seabed when they reach a length of 5-12 cm. This particular spawning leads to highly clumped distributions of eggs and newly emerged larvae (Hislop *et al*., 2001) and favourable or unfavourable ecosystem conditions can therefore have major impacts on recruitment.

Due to their particular reproduction aspects (that shows a high parental investment in the offspring) the population dynamics of these species is expected to be highly sensitive to external biological/ecosystem factors.

Vertical displacements of immature and mature white anglerfish from the seabed to the near surface have been recorded in the Northeast Atlantic (Hislop *et al*., 2001) and are suggested to be related to spawning or feeding.

Improvement of knowledge regarding growth, spawning behaviour, migratory behaviour and juvenile drift are essential to present and future assessment and management of both Southern Anglerfish stocks.

B. Data

B.1 Commercial Catch

Landings data are provided by National Government and research institutions of Spain and Portugal. Quarterly landings by country, gear and ICES Division are available from 1978. There were unrecorded landings in Division VIIIc between 1978 and 1979, and it was not possible to obtain the total landings in those years. Portuguese landings were TAC constrained since 2005. Very low landings have been registered during the 4th quarters since then. The Portuguese landings were relatively stable during the first two years, but have decreased substantially from 2006 to 2010. In 2011 and 2012 Portuguese landings have increased by 16 and 116% respectively.

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 VIIIc and IXa and Portuguese landings of Division IXa are derived from their relative proportions in market samples.

After 1980, black anglerfish landings increased and reached a peak of 3 832 t in 1987. Since then, landings decreased and reached a minimum in 2002 of 770 t. From 2002 to 2007 landings increased to 1 301 t, decreasing afterwards to near 790 t in 2010 and 2011, but in 2012 catches reached 1 024 t.

Discards

Since 1994 a Spanish Discard Sampling Programme is being carried out for trawl fleets operating in the ICES Divisions VIIIc and IXa. However, the time series is not complete and years with discard data are 1994, 1997, 1999, 2000 and from 2003 to 2009. The raising procedure used to estimate discards was based on effort. The Portuguese Discard Sampling Programme recorded anglerfish data from 2004. The frequency of occurrence of black anglerfish in discard samples is very low and their discard is considered negligible.

B.2 Biological

Landing numbers at length

Since 2009 the quarterly Spanish and Portuguese sampling for length compositions is by metier and ICES Division. Length data from sampled vessels are summed and the resulting length composition is applied to the quarterly landings of the corresponding metier and ICES Division. The sampled length compositions were raised for each country and SOP corrected to total landings on a quarterly or half yearly basis (when the sampling levels by quarter were low). The average lengths of trawl caught anglerfish are lower compared to the artisanal fleets.

Catch numbers at age

No catch numbers at age are provided to the Working Group. At the WGHMM 2007 meeting (ICES, 2007), age length keys, based on *illicia* readings, were used to obtain catch number at age for each species. The exploratory analysis of estimates indicated that the biased age reading criterion does not allow following cohorts along years in either of the two species. The last research about white anglerfish ageing, *White Anglerfish Illicia and Otoliths Exchange 2011* (ICES, 2012), highlighted that neither *illicia* or otolith age readings have not been validated and, in the case of *illicia* studies, the agreement among readers and the precision were not acceptable. Therefore it was concluded that the available age reading criteria for white anglerfish southern stock is not valid to build an ALK.

Growth curve

An agreed growth model is not available for black anglerfish *in* Divisions VIIIc, IXa.

Maturity-at-length

Different estimates of maturity ogive at length are available for *Lophius bugegassa* (Duarte *et al*., 2001, Quincoces, 2002, Landa *et al*., 2012). The last study (Landa *et al*., 2012) indicates, for ICES Div. VIIIc-IXa, a sex ratio of 1:1.01 (50.30% of females) and L50 values of 46.95 cm for combined sexes, 40.97 cm for males and 62.44 cm for females. These values of sex ratio and L50 are within the range given for this species in previous studies.

Natural mortality

Trial assessment, in the past, of the black anglerfish stock used a natural mortality rate of 0.15 yr-1. This value was adopted for all ages and years in the absence of any direct estimates.

Length-weight relationship

The weight at length relationship was calculated using data from an international project with a sampling that spatially covered a high proportion of the stock and which number of samples (BIOSDEF, 1998):

$W = 2.11 \times 10^{-5} \cdot L^{2.9198}$

where W = weight in kilograms and L = length in centimetres.

B.3 Surveys

SpGFS-WIBTS-Q4

The Spanish Groundfish Survey aims to collect data on the distribution and relative abundance, and biological information of commercial fish in ICES Divisions VIIIc and Northern IXa. Since 1983 it is annually carried out in fourth quarter (September/October) of the years, except for 1987. Time series of abundance indices, in weight and in number, and correspondent length composition are available for both anglerfish species.

This survey is not used in the actual assessment of black anglerfish.

PtGFS-WIBTS-Q4

Portuguese Autumn Groundfish Survey has been carried out in Portuguese continental waters since 1979 in the fourth quarter of the years. Abundance indices for both anglerfish species are available from 1989 to 2011. This survey was not performed in 2012. The abundance values detected by this survey are very low for the whole time series, being insignificant for some years.

This survey is not used in the actual assessment of black anglerfish.

PtGFS-WIBTS-Q1

Portuguese Winter Groundfish Survey has been carried out in Portuguese continental waters from 2005 till 2008 in the first quarter. Time series of abundance indices, in weight and in number, and correspondent length composition are available for both anglerfish species. The abundance values detected by this survey are very low for the whole time series.

This survey is not used in the actual assessment of black anglerfish.

PT CTS

Portuguese Crustacean Survey has been carried out in south of the Portuguese coast since 1997 in the second quarter. This survey was not performed in 2012. Time series of abundance indices, in weight and in number, and correspondent length composition are available for both anglerfish species. This survey detects better anglerfish (especially *L. budegassa*) but the area cover is very small compared with the anglerfish stocks distribution.

This survey is not used in the actual assessment of black anglerfish.

PtGFS (Summer)

Portuguese Summer Groundfish Survey has been carried out in Portuguese continental waters from 1990 till 2001 (except 1994, 1996) in the third quarter. Time series of abundance indices, in weight and in number, and correspondent length composition are available for both anglerfish species. The abundance values detected by this survey are very low for the whole time series, being insignificant for some years.

This survey is not used in the actual assessment of black anglerfish.

Portuguese deepwater fish survey

Portuguese deepwater fish Survey has been carried out in Portuguese continental waters from 1997 till 2002. No indices are available only raw data.

This survey is not used in the actual assessment of black anglerfish**.**

B.4 Commercial CPUE

Six commercial series of landing-effort are available to the WG. Four of them are Spanish fleets in the ICES Division VIIIc and two Portuguese fleets in the ICES Division IXa. The Portuguese trawl fleet was split into fish trawlers and crustacean trawlers (WD12, Duarte *et al*., 2007 in ICES, 2007) according to the fleet segmentation proposed by the IBERMIX project (WD06, Castro *et al*., 2007 in ICES, 2007).

SP-CORTR8C

A Coruña trawl fleet fishing in Division VIIIc is available for years 1982-2012. Data provided for A Coruña trawlers comprise quarterly effort (fishing days per 100 horse power), landings and length composition of landings. This fleet represents an average of 18% of international catches of black anglerfish along the time series. A standardized series from 1994 to 2006 is also available for this fleet with annual effort data (in fishing days) and annual LPUE.

It was agreed (WKFLAT 2012) to use the data from this commercial LPUE series in the black anglerfish assessment.

SP-CEDGNS8C

Cedeira gillnet fleet fishing in Division VIIIc is available for years 1999-2011. Data provided for Cedeira gillnets comprise quarterly standardized effort (in soaking days), landings and length composition of landings. This fleet represents an average of 1% of international catches of black anglerfish since 1999.

Information from this commercial series is not used in the actual assessment of black anglerfish.

PT-TRF9A

Portuguese trawlers targeting fish: years 1989-2012. Data provided for Portuguese trawlers targeting fish comprise quarterly effort (1000 hours trawling with occurrence of anglerfish), landings and length composition of landings. This fleet represents an average of 5% of international catches of black anglerfish along the time series. A standardized series from 1989 to 2008 is also available for this fleet with annual effort data (in 1000 hauls) and annual LPUE.

Data from this commercial LPUE has been used in the black anglerfish assessment since 2007.

PT-TRC9A

Portuguese trawlers targeting crustacean: years 1989-2012. Data provided for Portuguese trawlers targeting fish comprise quarterly effort (1000 hours trawling with occurrence of anglerfish), landings and length composition of landings. This fleet represents an average of 3% of international catches of black anglerfish along the time series. A standardized series from 1989 to 2008 is also available for this fleet with annual effort data (in 1000 hauls) and annual LPUE.

Data from this commercial LPUE has been used in the black anglerfish assessment since 2007.

Other available commercial series of LPUEs that have never been employed in the assessment are:

SP-AVITR8C

Avilés trawl fleet fishing in Division VIIIc is available for years 1986-2003. Data provided for Avilés trawlers comprise quarterly effort (fishing days per 100 horse power), landings and length composition of landings. This fleet represents an average 3% of international catches of black anglerfish along the time series. The effort series was interrupted in 2003.

SP-SANTR8C

Santander trawl fleet fishing in Division VIIIc is available for years: years 1986-2010. Data provided for Santander trawlers comprise quarterly effort (fishing days per 100 horse power), landings and length composition of landings. This fleet represents an average of 3% of international catches of black anglerfish along the time series. Effort data for 2008 was not provided to the WG.

C. Assessment Methods and Settings

Until 2011 black anglerfish stock was assessed with a non-equilibrium production model (ASPIC software).

A revised series from the Spanish fleet 'A Coruña' was available at WKFLAT2012, historical survey series data, discard data and other commercial LPUE series. The 'A Coruña' series is the longest of the potential tuning series and represents the bulk of the fishery and it was concluded that this series should be included in the modelling. At WKFLAT2012 three potential models were applied to the data: a Bayesian surplus production model, SS3, and numerous formulations of ASPIC. The SS3 showed promise but it was determined that more exploration would be required before the model could be accepted as the basis for advice. A new formulation of ASPIC which included 3 tuning indices (A Coruña, Portuguese Trawler fleet directing to crustaceans, Portuguese Trawler fleet directing to groundfish) was presented which tracks the central trend in the indices and is more stable than previous assessment. This was accepted as the basis for advice.

Model, input data and settings:

Assessment Model: Non-equilibrium Surplus production model (Prager, 1994; 2004)

Software: ASPIC (v. 5.34.9)

Stock: black anglerfish (*L.budegassa*)

Catch data range: 1980-2012

CPUE Series 1 (years): PT-TRC9a (1989-2012)

CPUE Series 2 (years): PT-TRF9a (1989-2012)

Index of Biomass (years): SPCORTR8c (1982-2012)

Error Type: Condition on yield

Number of bootstrap: 1000

Maximum F: 8.0 (y-1)

Statistical weight B1/K: 1

Statistical weight for fisheries: 8.59E-01; 1.20E+00; 9.81E-01

B1-ratio (starting guess) : 0.6

MSY (starting guess): 1.81126E+03 t

K (starting guess): 1.81126E+04 t

q1 (starting guess): 8.2523E-04

q2 (starting guess): 1.1196E-07

q3 (starting guess): 2.7279E-07

Estimated parameter: All

Min and Max allowable MSY: 1.81126E+02 (t); 3.62252E+03 (t)

Min and Max K: 1.81126E+03 (t); 3.62252E+05 (t)

Random Number Seed: 1025957

D. Short term projection

Model: ASPIC projections (Prager, 1994).

Software: ASPICP

Stock forecasts should use the average of the last 3 years fishing mortality with the possibility of projecting with fishing mortality estimated in the final year depending on trends.

Projections are performed based on ASPIC estimates. Projections are performed for the following scenarios,:

- Reduction of F in the first year from 10% to 50 %.
- F sq (status quo)
- F_{MSY}
- Zero catches

TAC, - 15% TAC and + 15% TAC

E. Medium term projections

No medium term projections are conducted for black anglerfish stock.

F. Yield and biomass per recruit / long term projections

None

G. Biological reference points

WKFLAT (ICES, 2012) endorsed the basis for MSY reference points previously assumed by ICES (i.e. Fmsy based on the ASPIC output and a proxy for MSY Btrigger as 50% of Bmsy of the ASPIC output).

H. Other Issues

H.1. Historical Development of Assessment

Southern Anglerfish stocks were assessed for the first time in the 1990 ICES WG meeting. Different assessment trials were performed during the subsequent 8 years but analytical assessments indicated unrealistic results. The data base (both biological and fisheries data) were improved along these years trying to apply an analytical assessment model. Since 1998 a non-equilibrium surplus production model ASPIC (Prager, 1994) was applied to each stock or to the combined stock data. These stock assessments were accepted by the ACFM and used to provide management advice. The assessment of black anglerfish as a separate stock has been carried out continuously from 2007. In 2012 during the benchmark (WKFLAT2012) it was agreed to include a third series in the assessment. The history of black anglerfish assessment from 2007 to 2012 is presented in Table 1.

Table 1. History of southern black anglerfish assessment from 2007 to 2012.

WG	2007	2008	2009	2010	2011	2012
Assessment Model	Non-equilibrium Surplus production model (Prager, 1994a)	No updated	Non-equilibrium Surplus production model (Prager, 1994a)	Non-equilibrium Surplus production model (Prager, 1994a)	Non-equilibrium Surplus production model (Prager, 1994a)	Non-equilibrium Surplus production model (Prager, 1994a)
Software	ASPIC (v. 5.16)	No updated	ASPIC (v. 5.24)	ASPIC (v. 5.34)	ASPIC (v. 5.34.9)	ASPIC (v. 5.34.9)
Catch data range	1980-2006		1980-2008	1980-2009	1980-2010	1980-2010
CPUE Series 1 (years)	PT-TRF9a (1989-2006)		PT-TRF9a (1989-2008)	PT-TRF9a (1989-2009)	PT-TRF9a (1989-2010)	PT-TRC9a (1989-2010)
CPUE Series 2 (years)						PT-TRF9a (1989-2010)
Index of Biomass (years)	PT-TRC9a (1989-2006)		PT-TRC9a (1989-2008)	PT-TRC9a (1989-2009)	PT-TRC9a (1989-2010)	SPCORTR8c (1982-2010)
Error Type	Condition on yield		Condition on yield	Condition on yield	Condition on yield	Condition on yield
Number of bootstrap	500		500	1000	1000	1000
Maximum F	8.0 (y-1)		8.0 (y-1)	8.0 (y-1)	8.0 (y-1)	8.0 (y-1)
Statistical weight B1/K	1		1	1	1	1
Statistical weight for fisheries	1,1		1,1	1,1	1,1	8.59E-01, 1.20E+00, 9.81E-01
B1-ratio (starting guess)	0.5		0.5	0.5	0.5	0.6
MSY (starting guess)	3000 t		3000 t	3000 t	3000 t	1811.26 t
K (starting guess)	20 000 t		20 000 t	20 000 t	20 000 t	18 112.6 t
q1 (starting guess)	1d-5		1d-5	1d-5	1d-5	8.2523E-04
q2 (starting guess)	1d-4		1d-4	1d-4	1d-4	1.1196E-07
q3 (starting guess)						2.7279E-07

Estimated parameter	All	All	All	All	All
Min and Max allowable MSY	2000 (t) -10000 (t)	2000 (t) -11500 (t)	2000 (t) -10000 (t)	2000 (t) -10000 (t)	181.126 (t) -3622.52 (t)
Min and Max K	5000 (t) -500000 (t)	5000 (t) - 112000 (t)	5000 (t) -100000 (t)	5000 (t) -100000 (t)	1811.26 (t) -362252 (t)
Random Number Seed	1964185	1964185	1964185	1964185	1025957

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Annex N: Benchmark Planning

Benchmark information per stock

To be filled in by the stock coordinator (send to Barbara@ices.dk)

Stock	**Nephrops FU 23-24**	
Stock coordinator	Name: Spyros Fifas	Email:Spyros.Fifas@ifremer.fr
Stock assessor	Name: Spyros Fifas	Email: Spyros.Fifas@ifremer.fr
Data contact	Name: Spyros Fifas, Michèle Salaun	Email: Spyros.Fifas@ifremer.fr, Michele.salaun@ifremer.fr

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified1	Necessity to explore relationship between abundance of hake in the central mud bank of the Bay of Biscay and recruitment level for Nephrops (competition ?)	Spatially structure models	Data provided from LANGOLF survey (series 2006-2013)+DCF sampling onboard (since 2003)	
Tuning series	Commercial tuning fleet (district of Le Guilvinec 2nd quarter, years 1987-2013)+twin trawl survey LANGOLF (years 1987-2013), probably not carried out from 2014 onwards	Investigation aiming to include another tuning series corresponding to the Southern part (outside Brittany) of the fishery	Data provided by fishing industry representative	
Discards	DCF sampling plan covering period since 2003+sparse years (1987,1991,1998). Aim of validation of the discard derivation method applied on missing years (already examined by IBP Nephrops 2012)	Additional investigations have to be undertaken on the actual impact of selectivity devices adopted since 1st April 2008 (not enough data for the moment)	DCF samples since 2003	
Biological Parameters	Validation of discard survival rate either as used by WGHMM (WGBIE) for the whole historical series or as updated by recent experiments (higher value of the survival rate)	Spatial variability of maturity ogives (GLMs vs. compacity of the sediment, depth, etc.)	Maturity database as filled in since 2004-2005	

[1] Include all issues that you think may be relevant, even if you do not have the specific expertise at hand.If need be, the Secretariat will facilitate finding the necessary expertise to fill in the topic. There may be items in this list that result in ‘action points for future work’ rather than being implemented in the assessment in one benchmark.

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified1	Necessity to explore relationship between abundance of hake in the central mud bank of the Bay of Biscay and recruitment level for Nephrops (competition ?)	Spatially structure models	Data provided from LANGOLF survey (series 2006-2013)+DCF sampling onboard (since 2003)	
Assessment method	The IBP 2012 concluded the inadequancy of the CSA (Collie-Sissenwine analysis) because of unlikely variability of predicted SSB and recruitment indices. The XSA assessment was retained although it should be replaced by alternative approaches (length structured models?) or by UWTV survey (nevertheless, this method limits unibiased investigations only on the adult component of Nephrops stocks)			
Biological Reference Points	N/A			

Benchmark information per stock

To be filled in by the stock coordinator (send to Barbara@ices.dk)

Stock	**Nephrops FU 28-29**	
Stock coordinator	Name: Cristina Silva	Email: csilva@ipma.pt
Stock assessor	Name: Cristina Silva	Email: csilva@ipma.pt
Data contact	Name: Cristina Silva	Email: csilva@ipma.pt

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified2	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Total Catch	Only landings from Portuguese fleet are available -> unaccounted mortality Possible separation by Functional Unit?	Review and estimate total catch and total effort	Historical data from Spanish Fleet in these FUs (landings, logbook data) Spatial data (VMS) Portuguese data available	
Tuning series	Fishery targeting 2 main species of crustaceans, deepwater rose shrimp and Norway lobster, sharing only partly the same grounds. In periods of high abundance of rose shrimp the vessels spend less effort on Nephrops. Crustacean trawl survey	Standardized CPUE series for Nephrops related to area/depth, other species dependency Estimate abundance/biomass for fishing areas	All data available: Logbooks, VMS data Crustacean survey series	
Discards	Discarding is minimal in this fishery. Not an issue			

[2] Include all issues that you think may be relevant, even if you do not have the specific expertise at hand.If need be, the Secretariat will facilitate finding the necessary expertise to fill in the topic. There may be items in this list that result in ‘action points for future work’ rather than being implemented in the assessment in one benchmark.

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified2	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Biological Parameters	Growth parameters and natural mortality estimated by tagging in 1990. Attempts to include a joint tagging program for several Nephrops FUs in DCF not successful due to high costs.			
Assessment method	No analytical assessment approved. XSA, used until 2011, accepted only for trends. The use of standardized CPUE has reduced the residuals in catchability and the retrospective pattern but problems of internal consistency remain (IBP, 2012)	Explore: Length based assessments with different methods (LCA, SS3, ...) Age based assessments using slicing (for comparison) A number of approaches, including trawl surveys, length composition information, and basic fishery data such as landings and effort.	Data available: Landings (partial – missing Spanish data) CPUE Survey indices Length distribution Maturity Weight-length relationship Spatial distribution	Helen Dobby/Richard Methot/Jim Ianelli
Biological Reference Points	No BRPs adopted	BRPs (Y/R) or proxies depending on the assessment approach		

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified2	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Management issues	Crustacean fishery directed at rose shrimp and Norway lobster. Norway lobster is the 2nd target species, its importance increases in periods of low abundance of rose shrimp. Recovery Plan for Southern Hake and Iberian Nephrops stocks since 2006. No objectives defined for Nephrops in this plan. 10% reduction in F for Southern Hake resulted in 10% reductions in TAC and effort for Nephrops every year.	Understand the fisheries dynamics and the dependence from rose shrimp. Unlink Nephrops management from Southern Hake recovery. Set management objectives for Nephrops, taking into account the characteristics of the crustacean fishery.		

Benchmark information per stock

To be filled in by the stock coordinator (send to Barbara@ices.dk)

Stock	Nephrops FU 30	
Stock coordinator	Name: Yolanda Vila	Email: yolanda.vila@cd.ieo.es
Stock assessor	Name: Yolanda Vila	Email: yolanda.vila@cd.ieo.es
Data contact	Name: Yolanda Vila	Email: yolanda.vila@cd.ieo.es

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified3	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Tuning series	- Metier highly multiespecific. Directed effort estimated from trips with at least 10% Nephrops landings. - Trawl survey_ARSA_(SPGF-cspr-WIBTS-Q1) but it is directed to demersal species in general and not to Nephrops	- VMS and logbooks analysis. - UWTV survey. A proposal for to carry out a UWTV survey in 2014 has been submitted to national request cofounded from FEP (Fondos Europeo de Pesca). However, this survey is not assured.	VMS are needed and they should be supplied by the Spanish Administration (Secretaría General de Pesca, SGP)	
Discards	Discarding is minimal in this fishery. Not an issue			

[3] Include all issues that you think may be relevant, even if you do not have the specific expertise at hand. If need be, the Secretariat will facilitate finding the necessary expertise to fill in the topic. There may be items in this list that result in 'action points for future work' rather than being implemented in the assessment in one benchmark.

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified3	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			
Biological Parameters	There is no information about growth parameters and natural mortality. Maturity ogives are available from 2004, 2009, 2010 and 2011.		Biological parameters information of others FU	
Assessment method	No analytical assessment	Explore: Length based assessments with different methods (LCA, SS3, GADGET...) A number of approaches, including trawl surveys, length composition information, and basic fishery data such as landings and effort.	Data available: Landings CPUE Trawl Survey indices Length distribution Maturity Weight-length relationship	
Biological Reference Points	N/A			

Issue	Problem/Aim	Work needed / possible direction of solution	Data needed to be able to do this: are these available / where should these come from?	External expertise needed at benchmark type of expertise / proposed names
(New) data to be Considered and/or quantified3	Additional M - predator relations			
	Prey relations			
	Ecosystem drivers			
	Other ecosystem parameters that may need to be explored?			

Annex O – Recommendations

Recommendation	For follow up by:
1. The EWG notices that several of the new stocks assessed this year have negligible catches and that there are distributed mainly in more northerly areas. This includes the stocks of Grey gurnard in Subarea VIII and Division IXa [gug-89a] and Plaice (Pleuronectes platessa) in Subarea VIII and Division IXa [ple-89a], whiting and pollack. The scientific effort required to provide coverage of these less abundant stocks in the southern area could be more useful if applied to current stocks in the EWG.	ACOM Leadership / WG on Stock Identification
2. The EWG considers that the stock of Megrim (Lepidorhombus whiffiagonis) in VIIIc and IXa is probably a southern extension of the northern stock (Megrim (Lepidorhombus whiffiagonis) in VII and VIIIabd) and that a joint assessment of those two stocks could be envisaged. The WG recommends that the limits of the two stocks be reconsidered. This could be carried out during an interim benchmark (IBP). The working group considers that the same recommendation also applies to the southern and northern stocks of Hake. Feedback from the WG on Stock Identification is needed to facilitate benchmark planning for this.	WG on Stock Identification / ACOM Leadership
2.. The EWG notes that hake otoliths are currently collected but not used in the assessment due to lack of a validated ageing method. The EWG further notes that the current sampling level may be too high in relation with the current data needs. The EWG recommends that the utility of the current sampling level be evaluated.	ICES Secretariat / ACOM PGCCDBS
4. The EWG recommends that ICES have a workshop to develop a decision framework (indicators) for the frequency of updating the advice.	ACOM / ICES Secretariat

Annex P: Term of Reference for 2015

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

2015/2/ACOM11 The Working Working Group for the Bay of Biscay and Iberian waters Ecoregion [WGBIE], chaired by Michel Bertignac (France), will meet in [Spain?], 6–12 May 2015 to:

a) Address generic ToRs for Regional and Species Working Groups (see table below);

b) Assess the progress on the benchmark preparation of [???];

The assessments will be carried out on the basis of the stock annex in National Laboratories, prior to the meeting. The data to perform the assessment should be available 4 weeks before the meeting. This will be coordinated as indicated in the table below.

WGBIE will report by [?? May] for the attention of ACOM. The group will report on the ACOM guidelines on reopening procedure of the advice before 14 October and will report on reopened advice before 29 October.

Fish Stock	Stock Name	Stock Coordinator	Assess. Coord. 1	Assess. Coord. 2	Advice
anp-78ab	Anglerfish (L. piscatorius) in Divisions VIIb-k and VIIIa,b	Spain	Spain	UK	Update
anb-78ab	Anglerfish (Lophius budegassa) in Divisions VIIb-k and VIIIa,b	UK	UK	Spain	Update
anb-8c9a	Anglerfish (Lophius budegassa) in Divisions VIIIc and IXa	Portugal	Portugal	Spain	Update
Anp-8c9a	Anglerfish (L. piscatorius) in Divisions VIIIc and IXa	Spain	Spain	Portugal	Update
Bss-8ab	Sea bass in Divisions VIIIa,b	France	France	none	Multiyear
Bss-8c9a	Sea bass in Divisions VIIIc and IXa	France	France	none	Multiyear
hke-nrtn	Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock);	Spain	Spain	none	Update
hke-soth	Hake in Division VIIIc and IXa (Southern stock);	Spain	Spain	Portugal	Update
mgb-8c9a	Megrim (Lepidorhombus boscii) in Divisions VIIIc and IXa	Spain	Spain	none	Update
mgw-8c9a	Megrim (Lepidorhombus whiffiagonis) in Divisions VIIIc and IXa	Spain	Spain	none	Update
mgw-78	Megrim (L. whiffiagonis) in Subarea VII & Divisions VIIIa,b,d,e	Spain	Spain	none	Update
sol-bisc	Sole in Divisions VIIIa,b,d (Bay of Biscay)	France	France	none	Update
ple-89a	Plaice in Subarea VIII and Division IXa	Ireland	Ireland	none	Multiyear
whg-89a	Whiting in Subarea VIII and Division IXa	Ireland	Ireland	none	Multiyear

nep-2324	Nephrops in Divisions VIIIa,b (Bay of Biscay, FU 23, 24)	France	France	none	Biennial 2st year
nep-25	Nephrops in North Galicia (FU 25)	Spain	Spain	none	Biennial 2st year
nep-31	Nephrops in the Cantabrian Sea (FU 31)	Spain	Spain	none	Biennial 2st year
nep-2627	Nephrops in West Galicia and North Portugal (FU 26-27)	Spain/Portugal	Spain/ Portugal	Portugal/ Spain	Biennial 2st year
nep-2829	Nephrops in South-West and South Portugal (FU 28-29)	Spain/Portugal	Spain/ Portugal	Portugal/ Spain	Biennial 2st year
nep-30	Nephrops in Gulf of Cadiz (FU 30)	Spain/Portugal	Spain/ Portugal	Portugal/ Spain	Biennial 2st year
gug-89a	Grey gurnard in Subarea VIII and Division IXa	Ireland	Ireland	none	Multiyear
pol-89a	Pollack in Subarea VIII and Division IXa	Spain	Spain	none	Multiyear
sol-8c9a	Sole in Divisions VIIIc and IXa	Portugal	Portugal	none	Multiyear

Annex Q – Stock Annexes for New Species

Stock Annex: European sea bass (*Dicentrarchus labrax*) in subarea VIIIa, VIIIb, VIIId (Bay of Biscay)

Stock specific documentation of standard assessment procedures used by ICES.

Stock	European sea bass (*Dicentrarchus labrax*) in subarea VIIIa,VIIIb, VIIId (Bay of Biscay)
Working Group:	WGBIE
Date:	May 2013
Revised by	Mickael Drogou, May 2013 (stock annex developed by IBPNEW 2012, retaining only information for BSS-8ab and WGNEW 2013)

A. General

Seabass for the 8ab area is considered in 2012 as data poor species, in category 5.2.0

A.1. Stock definition

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.

Stock structure of sea bass in the Atlantic has been reviewed by WGNEW 2012 and IBP-NEW 2012 based on evidence from genetics studies, tagging studies, distribution of commercial catches and similarities in stock trends between areas, drawing also on extensive information contained in previous WGNEW and ICES SGBASS reports.

IBP-NEW considers that stock structure remains uncertain, and recommends further studies on seabass 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 bass shoals, to confirm and quantify the exchange rate of seabass between sea areas that could form management units for this stock. Such information is critical to support development of models to describe the spatial dynamic of the species under environmental drivers (eg. temperature and food). Such a modelling work is being carried out in France in the framework of a PhD study (R. Lopez).

The pragmatic view of IBP-NEW 2012 is to structure the baseline stock assessments into four units:

- Assessment area 1. Sea bass in ICES areas IVbc, VIId, VIIe,h and VIa,f&g (lack of clear genetic evidence; concentration of area IV bass fisheries in the southern North Sea; seasonal movements of bass across ICES Divisions). Relatively data-rich area with data on fishery landings and length/age composition; discards estimates and lengths; growth and maturity parameters; juvenile surveys, fishery LPUE trends.

- Assessment area 2. Sea bass in Biscay (ICES Sub area VIIIa,b). Available data are fishery landings, with length compositions from 2000; discards from 2009; some fishery LPUE.
- Assessment area 3. Sea bass in VIIIc and IXa (landings, effort)
- Assessment area 4. Sea bass in Irish coastal waters (VIa, VIIb, VIIj). Available data: Recreational fishery catch rates; no commercial fishery operating.

Fishery landings of sea bass are extremely small in Irish coastal waters of VIIa and VIIg and the stock assessment for assessment area 1will not reflect the sea bass populations around the Irish coast, which may be more strongly affiliated to the population in area 4 off southern, western and Northern Ireland.

A.2. Fishery

General description

Sea bass in the Bay of Biscay, are targeted by France (more than 90% of international landings) by line fisheries which take place mainly from July to October and by pelagic trawlers, nets and in a mixed bottom trawl fisheries from November to April on pre spawning and spawning grounds when seabass is aggregated (Figure 1). In 2012 nets represent 31% of the landings of the area, lines (handlines+longlines) 29%, bottom trawl 20%, and pelagic trawl 9% (but It has to be note that pelagic trawlers were used from 2000 to 2008 to catch around 25% of the landings of the area decreasing to 9 (the pelagic fishery take place at present essentially in the Channel). In parallel a decrease of landings for liners is also observed from 2007.

In France, the market value seabass depends greatly on how its caught, giving added value to certain metiers as liners: according to auction, mean price of seabass sold by liners was 14.92€ per kg in 2009 compared with €5.99 per kg for pelagic trawl, 8.21€ per Kg for Bottom trawlers and 8.92€ per Kg for nets, reflecting differences in volume landed and fish condition.

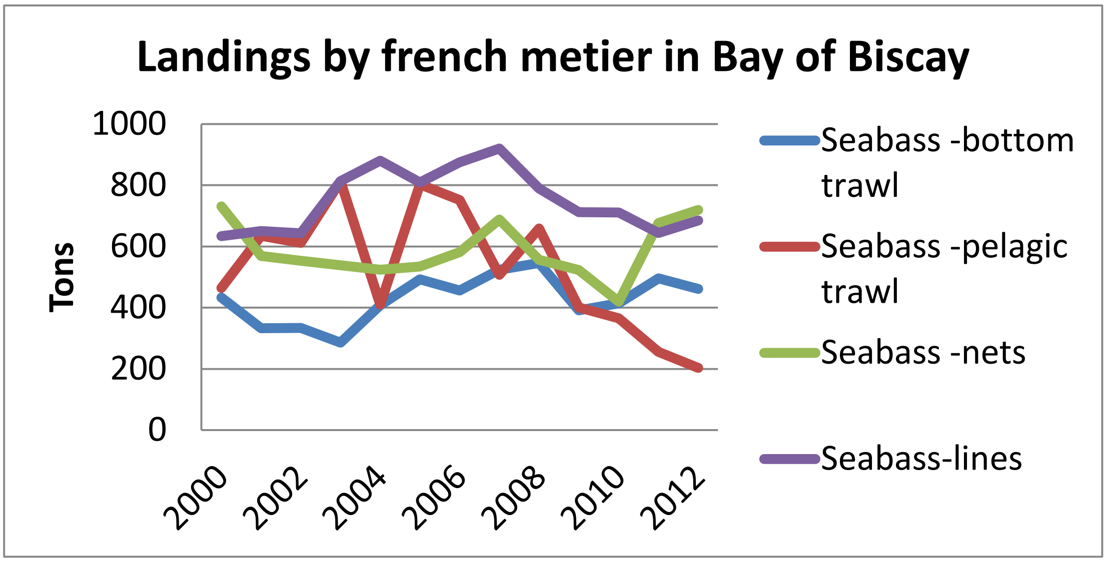

Figure 1 : landings by french fleet in the Bay of Biscay from 2000

Spain is responsible for around 10% of the catches, mainly with bottom otter trawlers. Discarding is thought to be low because of the high value of the fish; some discards could occurred due to individual quota limitations but are not quantified.. Spanish bass landings from Division VIIIa,b,d have increased to around 20 tons in the 90's to around 150 tons in the middle of the 2000's, then to 317 tons in 2011. Spanish commercial landings by gear type are shown in Figure 10.4. UK landings from this area are very low, usually inferior to 5 tons per year. Recreational fisheries are an important part of the total removals but these are not accurately quantified

Seabass are a popular target for recreational fishing in Europe, particularly for angling in the UK, Ireland and France, and increasingly in parts of southern Norway, the Netherlands and Belgium. Relatively little historical data are available on recreational fisheries although several European countries are now carrying out surveys to meet the requirements of the EU Data Collection Framework and for other purposes (ICES WKSMRF 2009, PGRFS 2010 & 2011, WGRFS 2012; Herfault *et al*, 2010, Rocklin et al, 2012 in prep, Van der Hammen & De Graaf, 2012).

Fishery management regulations

Seabass are not subject to EU TACs and quotas. Commercial vessels catching bass within cod recovery zones are subject to days-at-sea limits according to gear, mesh and species composition. Under EU regulation, the MLS of bass in the Northeast Atlantic is 36 cm total length, and there is effectively a banned range for enmeshing nets of 70 - 89 mm stretched mesh in Regions 1 and 2 of Community waters[1]. A variety of national restrictions on commercial bass fishing are also in place. These include:

- a landings limit of 5 t/boat/week for all French trawlers landing bass;
- a licensing system from 2012 in France for commercial gears targeting sea bass.
- voluntary closed season from February to mid-March for long-line and handline bass fisheries in Brittany; France
- A minimum size landing of 42cm for recreationnal fisheries since 2013 in France.

Depending on country, measures affecting recreational fisheries include minimum landing sizes, restrictions on sale of catch, gear restrictions.

A.3. Ecosystem aspects

Temperature appears to be a major driver for bass production and distribution (Pawson, 1992). Reynolds *et al*. (2003) observed a positive relationship between annual seawater temperature during the development phases of eggs and larvae of sea bass and the timing and (possibly) abundance of post-larval recruitment to nursery areas. In addition, early growth is related to summer temperature and survival of 0-groups through the first winter is affected by body size (and fat reserves) and water temperature (Lancaster 1991; Pawson 1992). prolonged periods of temperatures below 5 - 6°C

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[1] Region 1: All waters which lie to the north and west of a line running from a point at latitude 48 ºN, longitude 18 °W; thence due north to latitude 60 °N; thence due east to longitude 5 °W; thence due north to latitude 60 °30'N; thence due east to longitude 4 °W; thence due north to latitude 64 °N; thence due east to the coast of Norway.

Region 2: All waters situated north of latitude 48 °N, but excluding the waters in Region 1 and ICES Divisions IIIb, IIIc and IIId.

may lead to high levels of mortality in 0-groups in estuaries during cold winters. As a result, any SSB–recruit relationships may be obscured by temperature effects (Pawson *et al.*, 2007a).

Recruitment of sea bass is highly variable, and the fisheries have often in the past been dominated by individual very strong year classes or have been negatively affected by periods of very poor recruitment. Expansion of sea bass populations in the North Sea in the 1990s coincided with a period of ocean warming as well as the growth of the very strong 1989 year class.

B. Data

B.1. Commercial catch

B1.1 Landings data

Data available

Landings series for use are available from three sources:

i) Official statistics recorded in the Fishstat database since around the mid 1980s.

ii) French landings for 2000-2012 from a separate analysis by Ifremer of log-book and auction data.

iii) Spanish landings for 2007-2011 from sale notes

French vessels take around 90% of the total annual landings in the area VIIIa and VIIIb with a a fishery including nets, bottom trawlers, pelagic trawlers (and also Danish seiners since 2010 in small proportion) who essentially operate during quarter 1 and 4 (prespawning and spawning season) and lines who operate essentially during quarter 3 and 4. Declines are observed in landings from 1984 to 1999 but are certainly due to poor statistics, which are more reliable since 2000.

Spanish bass landings from Division VIIIa,b,d have increased to around 20 tons in the 90's to around 150 tons in the middle of the 2000's, then to 317 tons in 2011. UK landings from this area are very low, usually inferior to 5 tons per year.

Quality of official landings data

The official landings data for sea bass available to WGNEW 2013 are subject to several uncertainties that can affect the accuracy of assessments:

- Incomplete reporting of landings in the 1970s and early 1980s when the fisheries were developing;
- Poor reporting accuracy for small vessels that do not supply EU logbooks.

From 1999 onwards, French landings data from FishStat are replaced by more accurate figures from a separate analysis of logbook and auction data carried out by Ifremer, in which landings have been correctly allocated to fishing ground. The time series for each component fishing ground therefore has a step change around 2000

B1.2 Discards estimates

French Data

Survey design and analysis

The French sampling schemes also utilise vessel-list sampling frames and random selection of vessels within strata defined by area and fleet sector. From the activity calendars of French vessels for year n-1, vessels are grouped by the métiers practiced. Thus, a vessel may belong to multiple groups if practicing several metiers in the period. If the metier has to be sampled in priority No. 1, the vessel to be boarded is chosen randomly within this group of vessels. The observer then chooses to go onboard for a trip. During the trip, the fishing operations corresponding to metier No. 1 are sampled. Optionally, if the vessel practices several metier during the trip, fishing operation of the metier No 2 will also be sampled if the metier No.2 is included in the annual sampling plan. If the metier is not part of the plan, it is requested to sample at least one fishing operation of this metier in the trip. (complete document on sampling protocol in French :http://sih.ifremer.fr/content/download/5587/40495/file/Manuel_OBSMER_V2_2_2012.pdf)

Data coverage and quality

France

Discards data are only available for French fleets from 2009 onwards. Length frequencies are available. Discarding of sea bass by commercial fisheries can occur where fishing takes place in areas with bass smaller than the minimum landing size (36cm in most European countries), and where mesh sizes <100mm are in use. For 2009, .discard are estimated to 44 tons, for 2010 44 tons, for,2011 20 tons and 2012 37 tons. Precision is low at current sampling rates weighting and raising of France discards estimates was carried out using COST tools, which have limited flexibility to match raising procedures to the sampling stratification, including where vessels are stratified by LOA. There is therefore a large potential for bias in the discards estimates. However discard rates are low in general in the fishery.

Spain

Observer data from Spanish vessels fishing in Areas VIII, have shown there was no seabass discard from 2003.

B1.3 Recreational catches

Recreational marine fishery surveys in Europe are still at an early stage in development (ICES WKSMRF 2009; PGRFS 2010 & 2011; WGRFS 2012). The following information was available to WGNEW 2012.

France

A study targeting sea bass was conducted between 2009 and 2011 in VIIIa, VIIIb, VIIe, VIIh, VIId, Ivc. Estimates of sea bass catches were obtained from a panel of 121 recreational fishermen recruited during a random digit dialling screening survey of 15 000 households in the targeted districts (Atlantic and Chanel). The estimated recreational catch of bass in the Bay of Biscay and in the Channel was 3,170t of which 2,350t was kept and 830t released. The precision of the the combined Biscay & Channel estimate is relatively low (CV =-26%; note that the figure of 51% given in IBP-NEW 2012 was incorrect). This makes the confidence interval at 95% of the average (3170t) to [1554t;4786t].

Increasing the panel from 121 to 210 fishermen would be expected to improve precision to 20% and increasing this panel to 500 would improve precision to 13%.

Around 60% of the recreational catch estimate was from Bay of Biscay. The main gears used, in order of total catch, were fishing rod with artificial lure, fishing rod with bait, hand line, long line, net and spear fishing. Approximately 80% of the recreational catch was taken by sea angling (rod and line or handline).

Spain

A recreational boat fishing survey was performed in the Basque Country to estimate the total catch of the target species of this fishery. Fishermen were asked about their catches in 2009, and 555 surveys were collected. Sea bass catch data were modeled with a two-step GLM, using type of boat and total boat length as covariables. The results were extrapolated to the total number of boats using an updated census. The estimated catch for seabass was in 2009 was 8183 Kg, with an associated standard error of 149 Kg. It is important to note that this estimation refers only to the fishing performed from boats. In order to estimate total recreational catches of sea bass, anglers fishing from coast and spear fishers need to be included in the survey. In 2012 a pilot study financed by the Data Collection Framework (DCF) was taking place in order to estimate total sea bass catches (taking into account all types of recreational fishing), and it is expected that the results if this study will increase significantly the estimated sea bass catch. Results were not available for WGNEW2013.

Quality of recreational catch estimates

Recreational catch estimates from surveys (numbers or tonnes caught per year) are not yet available as time series. The estimates for France are characterised by relatively poor precision. The 2012 ICES Working Group on Recreational Fisheries initiated the development of data quality indicators for recreational fishery survey estimates, however sources and potential magnitude of bias in available estimates were not provided to WGNEW 2013.

Scorecard on data quality

Data quality is evaluated in relation to precision (relative standard errors or proxies for effective sample size) and critical forms of bias (e.g. coverage of surveys; biases in fishery catch data, natural mortality rate). Where possible, sensitivity analyses are conducted to evaluate the effect of these biases on the assessment results. WGNEW 2012 (udated in WGNEW 2013, Figure 10.15, Figure 10.16, Figure 10.17, Figure 10.18) highlighted blocks of national data using traffic lights colours to indicate potential quality issues, but IBP-NEW 2012 and WGNEW 2013 did not have time to conduct the detailed evaluation of biases in data quality required by the ICES scorecard

B.2. Biological sampling

B2.1 Length and age compositions of landed and discarded fish in commercial fisheries.

Length and age compositions of sea bass landings were available to WGNEW & IBP-NEW 2012.

Length and age compositions of commercial landings

Length compositions of sea bass landings, are only available from sampling in France from 2000 in the Bay of Biscay, area VIIIa and VIIIb. Shorter time series of length compositions were supplied by Spain for Areas VIII for bottom trawlers in 2010 and 2011.

Effective sample sizes for length and age compositions

The effective sample size for annual estimates of length or age composition lie between the number of trips sampled and the number of fish measured or aged, due to cluster sampling effects. Effective sample sizes have not been computed yet for sampling data for seabass. In the meantime, numbers of fishing trips sampled for length or age could be used as an annual measure of relative precision of data sets

Sampling methods and analysis

France

The French sampling programme for length compositions of sea bass covers sampling at sea and on shore. Since 2009, both sampling types are first based on metiers composition and their relative importance per fishing harbours and month. Both are also designed to sample the whole catch following a concurrent sampling of species, potentially leading to low sea bass sample size. In order to complement this effort, specific sampling for sea bass at the market is added at times and harbours when higher landings are occurring, especially from metiers targeting sea bass. The sampling frame is based on the main harbours, gear types (or grouping of metiers) and month and is available to all samplers on a dedicated website. Real time follow-up of the plan, refusal rates and their reasons, time taken to sample, all this information is also available from the website, together with sampling protocol (in French :

http://sih.ifremer.fr/content/download/5587/40495/file/Manuel_OBSMER_V2_2_2012.pdf). Before 2009, only market specific sampling was in place, and the sampling plan was designed and followed by the stock coordinator. The French sampling programme for age compositions of sea bass is based on age-length keys with fixed allocation. For the VIIeh area, quarterly French landings at auctions are sampled in order to collect five scales (from 2000 to 2008) or three scales (from 2009) by length class (cm). For the VIIIab area the information is available only from 2010. For other areas the information is not available. All length samples are populated in a central data base (Harmonie) and regular extracts are available in the COST format. Raising the data to the population is done using COST tools and a special forum for discussing the outcomes of the analysis is held every year in March, in order to gather all stock coordinators and prepare the datasets for the assessment working groups.

Data coverage and quality

Sampling has been very variable between areas and gears, with greatest consistency between years in the neighbouring stock unit in VIIIa,b. There has been a general increase in numbers of trips sampled for length since 2009 (see assessment report).

The statistical design of fishery sampling schemes has undergone change in recent years in France, following recommendations from ICES workshops on sampling survey design, with a move towards more representative sampling across trips within fleet segments. This can result in sampling more trips that have small catches of bass, and is one reason for the increase in numbers of sampled trips with bass since 2009 in France which does not imply an increase of the proportion in numbers of fish measured per trip.

Length and age compositions

Length compositions are supplied by France since 2000 for VIIIab, disaggregated by seven gear types: bottom trawl, pelagic pair trawl, nets, handlines, longlines purseiners and danish seiners from 2012. French sampling rates for length compositions have been very variable between area, gear and year strata. Sampling has also been very variable between areas and gears, with greatest consistency between years in VIIIa,b. There has been a general increase in numbers of trips sampled for length since 2009. An attempt of building a catch at age matrix is proposed in WGNEW 2013 but should be discussed and analysed to conclude that the use or not. If such is the case, because of age validation (see below) a 9 or 10+ group should be adopted. The matrix has been built on the assumption that stock delimitation for seabass is still uncertain, and with scales sampling from 2000 to 2005 from coastal fisheries of Audierne (boundary between VIIIa and VIIeh), with sampling from 2006 and 2007 from in shore and off shore fisheries in VIIeh, and with sampling from 2008 to 2011 from the all Bay of Biscay.

Spanish landings of *Dicentrarchus labrax*, which is not a target species for any Spanish fleet, were not sampled for length structure before the implementation of concurrent sampling in 2009. Length information is scarce for most part of the Spanish metiers. For this reason length structure is presented only for bottom trawl activity in the Bay of Biscay in 2010 and 2011 where enough individuals have been sampled to allow an adequate extrapolation..

Accuracy and validation of age estimates

Age-reading consistency

Consistency in age reading of sea bass between four operators in Cefas and Ifremer was examined during a limited exchange of otolith and scale images between laboratories in 2011, organised by the ICES Planning Group on Commercial Catches, Discards and Biological Sampling (Mahé et al. 2012). A total of 155 fish of 17 -74 cm was sampled on board French research vessels during two international surveys. The precision of ageing was similar for scales and otoliths. The coefficient of variation of age readings for individual fish was around 12% implying a standard deviation of +/- 1 year for a 10-year-old fish, with relatively few fish having identical readings by all four operators. However it was noted by the operators that photographic images were more difficult to evaluate than original age material, which was likely to have a negative effect on the consistency of ageing. These results provide no indication of the validity of ages, only the consistency between operators, and cannot indicate data quality in earlier years when different operators provided the age data. A more extensive age exchange is to be carried out in 2012.

Age validation

WGNEW was not aware of specific studies to validate absolute ages of seabass derived from otolith or scale readings. Strong and weak year classes can be followed clearly to over 20 years of age in UK sample data although it is not known to what extent the elevated numbers of sampled fish in immediately adjacent year classes is a true reflection of year class strength or a consequence of age errors discussed in the previous section. Year class tracking is less clear in the younger ages 3 – 5 although this will be affected by gear selectivity and changes in fish behaviour.

Sea bass show relatively broad length-at-age distributions, and it has been noted in French data (Laurec et al. 2012 WD to IBP-NEW) that the length-at-age distributions can have unusual patterns including some multiple modes that could indicate age errors. This will result in some smoothing of age data across neighbouring year classes. In the UK data, unusual patterns in length-at-age distributions for some younger ages appear related more to effects of minimum landing size on data from the fishery.

Inclusion of age error parameters in Stock Synthesis model

CV's for ageing error by age class can be input to Stock Synthesis. Based on the ICES sea bass scale exchange in 2002, the CVs of ~12% can be specified as increasing values per age class to give a standard error of ~1 year per age class.

Commercial discards

France

Discarding of sea bass by commercial fisheries can occur where fishing takes place in areas with bass smaller than the minimum landing size (36cm in most European countries), and where mesh sizes <100mm are in use. For 2009, .it's estimated to 44 tons, for 2010 44 tons, for,2011 20 tons and 2012 37 tons.

Spain

Observer data from Spanish vessels fishing in Areas VIII, have shown there was no seabass discard from 2003.

Quality of discards estimates

Precision is low at current sampling rates weighting and raising of France discards estimates was carried out using COST tools, which have limited flexibility to match raising procedures to the sampling stratification, including where vessels are stratified by LOA. There is therefore a large potential for bias in the discards estimates. However discard rates are low in general in the fishery..

B2.2 Growth parameters

For area VIIIa,b no specific growth curve is available yet, especially because af the lack of information on youngest age which are needed to calibrate the growth curve. IBPNew 2012 discussed this section but because of the difference in environmental condition between the Channel and Bay of Biscay, further studies are needed to present a robust growth curve in this area.

Growth is relatively slow and the species is long-lived (up to 30 years of age). In the Channel, maturity is attained at 4 - 7 years, which is around 35 cm for males and 42 cm for females (Pawson and Pickett 1996). Nevertheless, although bass is an eurythermic species (registered tolerance from 5-33o C) maximal somatic growth occurs around 22-24oC (Vinagre et al. 2012), thus contributing to pronounced latitudinal gradients in length at age and daily growth rates. Values from Pawson and Picket could thus be revised downwards to the North area in the Bay of Biscay (and in Iberian waters).

B2.3 Maturity

Available data are from samples from all around the coast of England and Walesans are discussed in the IBPNew 2012 report. Nos specific data from The Bay of Biscay are available.

B2.4 Larval dispersal, nursery grounds and recruitment

Bass larvae resulting from offshore spawning move steadily inshore towards the coast as they grow and, when they reach a specific developmental stage at around 11 - 15 mm in length (at 30 - 50 days old), it is thought that they respond to an environmental cue and actively swim into estuarine nursery habitats (Jennings and Pawson, 1992). From June onwards, 0-group bass in excess of 15 mm long are found almost exclusively in creeks, estuaries, backwaters, and shallow bays all along the southeast, south, and west coasts of England and Wales, where they remain through their first and second years, after which they migrate to over-wintering areas in deeper water, returning to the larger estuaries in summer. Several studies indicate the existence of similar bass nursery areas in bays and estuaries on the French coasts of the Channel and Bay of Biscay and southern Ireland.

During the winter, juvenile bass move into deeper channels or into open water, and return in spring to the larger estuaries and shallow bays on the open coast, where they remain for the next 2-3 years.

On the south and west coasts of the UK, juvenile bass emigrate from these nursery areas at around 36 cm TL (age 3 - 6 years, depending on growth rate), often dispersing well outside the 'home' range, and not necessarily recruiting to their specific parent spawning stock (Pawson *et al.*, 1987; Pickett and Pawson., 2004). It appears that there is substantial mixing of bass at this stage throughout large parts of the populations' distribution range. When they reach 4 or 5 years of age their movements become more wide-ranging and they eventually adopt the adult feeding/spawning migration patterns (Pawson et al., 1994).

B2.5 Natural mortality M

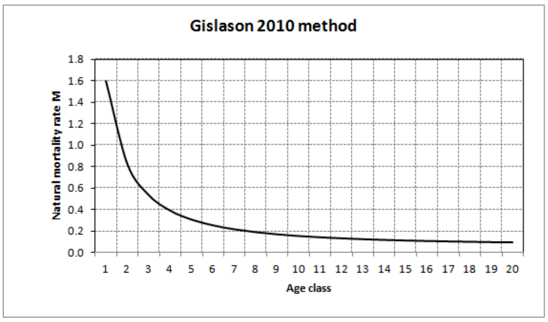
A variety of methods are given in the literature relating natural mortality rate M to life history parameters such as von Bertalanffy growth parameters k and Linf (asymptotic length), length or age at 50% maturity and apparent longevity particularly in an unexploited or very lightly exploited population. These methods were applied to the following sea bass life history parameters by Armstrong (2012):

There are no direct estimates of natural mortality available for Northeast Atlantic sea bass. Predation up to around age 4 will be in and near estuaries and bays. As with other fish species it is expected that M will be relatively high at the youngest ages, particularly given the slow growth rate in sea bass. For the benchmark assessment WGNEW 2012 proposes the compilation of life-history based inferences in the general value of M, based on maximum observed age, VB growth parameters, age at maturity and age of cohort biomass peak in relation to maturity. Age composition data from France since 2000 and the UK since 1985 indicate maximum recorded ages from 22 (French data) to 28 (UK data). The probability of encountering very old sea bass is partly a function of the interaction of year class strength and sampling rates, as well as mortality, however the occurrence of sea bass to almost 30 years of age suggests low rates of mortality.

The probability of encountering very old bass is partly a function of the interaction of year class strength and sampling rates, as well as mortality, however the occurrence of seabass to almost 30 years of age suggests low rates of mortality. The observed maximum age of 28 years in sea bass samples in the UK was recorded in the early 1980s, following a period of relatively low fishery landings. Age compositions of recreational fishery caught bass in southern Ireland, presented by stakeholders at IBP-NEW 2012, also show ages up to 26 years. This stock has been subject to a commercial fishery ban for many years.

Inferences on natural mortality rates are given below:

Source	Formulation	Combined sex M		
Hoenig 1983	variety of taxa ln(M) = 1.44-0.982*ln(tmax);	0.160		
	teleosts ln(M) = 1.46-1.01*ln(tmax)	**0.149**		
Alverson and Carney 1975	M = 3k/(exp(0.38*tmax*k)-1)	**0.161**		
Pauly 1980	M=exp(-0.0152+0.6543*ln(k)-0.279*ln(Linf,cm)+0.4634*lnT(oC))	0.196	temperature C	12
		0.211		14
		0.224		16
Ralston 1987	M=0.0189+2.06*k	**0.219**		
Beverton 1992	M=3k/(exp(*am* *k)-1) am = age at 50% maturity	0.369	female *am* ; comb sex k	
		0.614	male *am* , comb sex k	
Jensen (1997)	M=1.5K	**0.146**		
Gislason 2010	M = exp(0.55-1.61*Ln(L) + 1.44* Ln (Linf)+ Ln(K))	**Age class**	Length	M
		1	13.1	1.599
		2	19.7	0.827
		3	25.7	0.539
		4	31.1	0.395
		5	36.1	0.312
		6	40.5	0.258
		7	44.6	0.221
		8	48.3	0.195
		9	51.6	0.175
		10	54.7	0.159
		11	57.5	0.147
		12	60.0	0.138
		13	62.2	0.130
		14	64.3	0.123
		15	66.2	0.117
		16	67.9	0.113
		17	69.4	0.109
		18	70.8	0.105
		19	72.1	0.102
		20	73.2	0.100



The inferred values of M, with the exception of the Beverton method, are in the range 0.15 – 0.22. The average of the Gislason estimates for ages 3 – 20 is 0.19.

A variety of methods are given in the literature relating natural mortality rate M to life history parameters such as von Bertalanffy growth parameters k and Linf (asymptotic length), length or age at 50% maturity and apparent longevity particularly in an unexploited or very lightly exploited population. The probability of encountering very old bass is partly a function of the interaction of year class strength and sampling rates, as well as mortality, however the occurrence of seabass to almost 30 years of age suggests low rates of mortality. The observed maximum age of 28 years in sea bass samples in the UK was recorded in the early 1980s, following a period of relatively low fishery landings. Age compositions of recreational fishery caught bass in southern Ireland, presented by stakeholders at IBP-NEW 2012, also show ages up to 26 years (Fig. B2-3). This stock has been subject to a commercial fishery ban for many years.

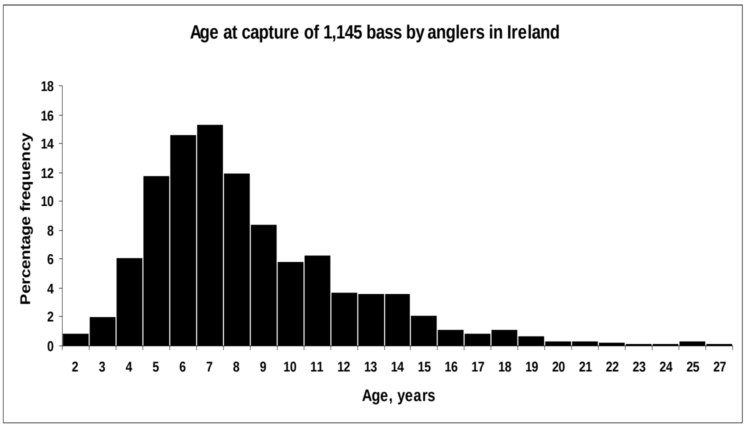


Fig. B2-3. Age composition of bass from samples collected from recreational catches in southern Ireland (data courtesy Ed Fahy, IBP-NEW 2012 meeting).

Inferences on sea bass natural mortality based on some life history models in the literature are given in IBP-NEW 2012 benchmark assessment section. The inferred values of M, with the exception of the Beverton method, are in the range 0.15 – 0.22 (Armstrong, 2012).

Hooking mortality, and mortality of discarded bass from commercial vessels

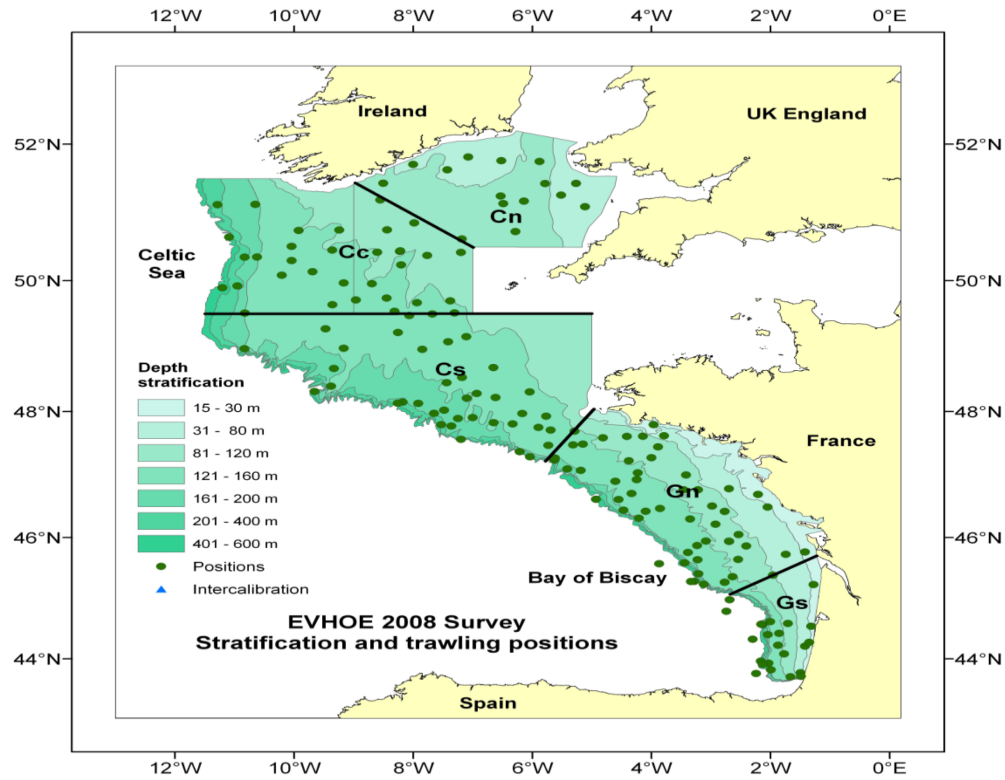
The NMFS in the US has in the past used an average hooking mortality of 9% for striped bass, estimated by Diodati and Richards 1996. Striped bass are very similar to European sea bass in terms of morphology, habitats and angling methods. A literature review of hooking mortality for a range of species compiled by the Massachusetts Division of Marine Fisheries included a total of 40 different experiments by 16 different authors where striped bass hooking mortality was estimated over two or more days (Gary A. Nelson, Massachusetts Division of Marine Fisheries, pers. comm.) The mean hooking mortality rate was 0.19 (standard deviation 0.19). Direct experiments are needed on European seabass to estimate hooking mortality for conditions and angling methods typical of European fisheries.

A fraction of sea bass discarded from commercial line vessels and netters may survive depending on the extent of injury or stress. This will affect the calculation of fishing mortality reference points that are conditional on selectivity patterns. Trawl-caught undersized bass are less likely to survive. Unfortunately no estimates of survival rates of commercial bass discards is available.

B.3. Surveys

France : Evhoe survey

Seabass are caught in small numbers in the French Evhoe trawl survey, which extends to the shelf edge in Subareas VII and VIII but also extends into coastal areas of the Bay of Biscay and the Celtic Sea where bass may be caught (cf the station map). Less than 10% of the stations have bass catches in most years. A mean of 0.5 seabass per trawl has been recorded from 1987. Abundance indices are calculated as stratified means.



.Fig. B 3-2. Station positions for French Evhoe bottom-trawl survey.

Spain

Information of Dicentrachus labrax catches in the series of research surveys conducted by the IEO since 1983 showed there are a very few seabass caught.

B.4. Commercial LPUE

France

IBP-NEW2012 evaluated a range of commercial fishery LPUE series for French and UK fleets operating in Areas IV and VII, including the LPUE trends for participants in the Cefas voluntary logbook scheme. A methodology on french bottom trawlers has been tested from auctions sales in area VII, IV and VIIIab : time series have been calculated for bottom trawlers <18m, which don't target seabass. French and UK (>10m) trawlers in areas IVb,c, VIId and VIIef could have been compared, and it shows very similar LPUE trends. With some exceptions (e.g. trawlers in VIId), UK >10m vessels tend to show different LPUE trends to 10m and under vessels. For the VIIIa and VIIIb, there is unlikely no possible comparison for the french results with other countries or other data set, and so will not be used at present.

Spain

LPUE data for Spanish fleets operating in ICES areas VI-VIII and landing into Basque Country ports were provided to WGNEW in 2005, and the best indicator of sea bass abundance trends (LPUE) in the period 1994 - 2004 was considered to be from vessels of the 'baka' otter trawl fleet working in Div. VIIIa,b,d and landing into the Basque port of Ondarroa. Data for later years were not available to WGNEW. Landings and effort data were provided to WGNEW by Spain, though not in the form of LPUE indices.

B.5. Other relevant data

None

C. Assessment: data and method

This chapter refers to the work done during IBPNew2012 for the Bay of Biscay Area

Length cohort analysis for Bay of Biscay

Little information on sea bass biology and data on exploitation are available for areas VIIIab: there are no growth parameter estimates, ALKs are only available for 2008-2010 and no abundance indices (either survey or commercial fishery based) are readily available. It is thus not possible to carry out an assessment comparable to the one developed for area IV and VII.

An exploratory analysis of the length frequency data was carried out using a length cohort analysis (Jones, 1984) applied to the pooled-gears length frequency distributions from French fleets fishing in the Bay of Biscay. The main difficulty with length-cohort analysis is that its application requires estimates or assumptions about the underlying growth rates (Linf and K), and the choice of input growth parameters can critically influence the results obtained (Jones, 1990). As no growth parameters estimates are readily available for Bay of Biscay sea bass, two sets of values were used for comparison : i) a set of estimates obtained from area IV and VII and used in the stock assessment described above (Linf=85cm and K=0.09) and ii) a set of parameters obtained during the IBP-NEW 2012 from fitting a VB growth model to length-age data collected in the Bay of Biscay in 2009 and 2010 (Linf=95cm and K=0.10). The estimates of F at length and N at initial length were then used to calculate equilibrium yield under a series of fishing mortality levels using a length based Thompson and Bell model.

Results clearly show the strong impact of assumptions on growth parameters on equilibrium yields which makes the use of this method very problematic with the limited biological knowledge available. Furthermore, this method relies on strong assumptions which may not be met in the case of seabass, namely that length composition data are sampled from a stock at equilibrium, with no variation in exploitation over time and no variation in year-class strength. This underlines, for this area, the critical need for data (biological and fishery related) to be able to carry out an analytical assessment of the stock, either as a separate stock or in a joint assessment with the more northern areas.

Inclusion of Bay of Biscay data in Stock Synthesis model

Runs 1A and 1B, the length only and age-length models for IVb,c and VIIa,d,e,f,g,h, were re-run to include a seventh fleet representing the French fleet in the Bay of Biscay. Length compositions for this fleet are provided for the years 2000 onwards. Tuning data for the Bay of Biscay are not included.

Inclusion of Bay of Biscay data scales up the SSB and recruitment compared with SS3 runs 1A and 1B. Although a trend of increasing F is shown, the rate of increase is lower than in IV&VII and terminal F is much lower.

A potential problem with this simple extension of the SS3 model is the possibility for different growth patterns in the warmer waters of the Bay of Biscay, affecting the fit of the length-based model. The absence of any age composition data precludes a direct evaluation of year class variations, and it is therefore not possible to evaluate how well the Solent and Thames recruit surveys match recruitment patterns in the Bay of Biscay population.

Conclusions regarding Bay of Biscay area (IBP New 2012)

Further analysis of growth rates are needed to allow any interpretation of length composition data for this area. Inclusion of Bay of Biscay data in the SS3 model assumes that there is a single biological stock, a hypothesis which can neither be confirmed or disproved with current knowledge. Relative abundance indices for pre-recruit and recruited sea bass are also needed for this area. IBP-NEW 2013 considers that no assessment can at present be performed for sea bass in the Bay of Biscay.

Implications of missing recreational catches in assessment model

Recreational catch estimates for sea bass are currently available for only 2010, and only for France and the Netherlands. Data for surveys in the UK in 2012 are not yet available. For France and Netherlands, the combined estimates of recreational fishery removals for 2010, including an assumed hooking mortality of 20% for released fish, is 1,115t:

	All Areas IV – VIII			Areas IV & VII only				
	kept	released	CV	Proportion in IV&VII	kept	released	hooking mortality for releases	total removed
France 2010	2350	830	0.51	0.4	940	332	20%	1006
Netherlands 2010	96	65	0.31	1	96	65	20%	109
Total								1115

These removals would represent 19% of a combined fishery removal of 5,850t in 2010 (1,115t recreational + 4,736 t commercial), although this percentage will be imprecise due to the large CVs for the recreational catch estimates (for France, the CV for areas IV and VII will be larger than 0.51 as only 40% of the catch estimate is for this area). The addition of recreational catches from the UK, Belgium and other countries would increase this percentage, but addition of commercial discards weights for all international fleets would reduce the percentage. Estimates of discards weights of sea bass in areas IV&VII in 2010 for UK trawls and nets, and French fleets, are around 200t. These figures exclude discards from other national fleets or UK fleets not sampled. Retained catches of sea bass by UK sea angers were estimated in the late 1980s and early 1990s to be around 400 t per year (Dunn et al 1989; Dunn and Potten 1994), although these estimates are of unknown accuracy. It is possible, therefore, that recreational fisheries could potentially account for around 20% of the fishing mortality in recent years. It is not possible to evaluate how the recreational fishing mortality rate may have altered over time, and how this would affect the fit of the model, including initial depletion rate. Further work is needed to consider how to handle recreational data (recent estimates and missing historical data) in assessments and advice for sea bass.

Short term projections

Short term projections were not carried out, although the scenario of increasing F, declining SSB and very poor recruitment since 2008 would lead to an expectation of further SSB decline. Procedures for carrying out trends-only projections should be developed at WGNEW 2013.

Appropriate Reference Points (MSY)

IBP-NEW 2012 was not in a position to develop MSY reference points for seabass based on the SS3 runs. Further work is needed at WGNEW 2013 to develop biological reference points.

Model used: Stock Synthesis 3 (SS3) (Methot, 2010)

Software used: Stock synthesis v3.23b (Methot, 2011)

The development of a seabass assessment model by IBP-NEW 2012 was built on experiences from application of the statistical, fleet-based separable model developed by Pawson et al (2007a) and updated by ICES WGNEW (Kupschus et al. 2008). The Pawson et al model was fitted only using UK age compositions for trawls, midwater trawls, nets and lines, separately for areas IVbc, VIId, VIIeh and VIIafg, and was intended mainly to estimate fleet selection patterns. Although it excluded any tuning data, the recruitment series for each sea area closely resembled the Solent survey indices and to an extent the shorter Thames series, and was able to provide coherent selection patterns by fleet.

The IBP-NEW 2012 assessment required a modelling framework capable of handling a mixture of age and length data for fisheries, including data for French fleets that had length composition data but no age composition data, and for which the length data were available only since the 2000s. The Stock Synthesis (SS) assessment model was chosen, primarily for its highly flexible statistical model framework allowing the building of simple to complex models using a mix of data compositions available. This model is written in ADMB (www.admb-project.org), is forward simulating and available at the NOAA toolbox: http://nft.nefsc.noaa.gov/SS3.html. For European sea bass a range of assessment models were built using Stock Synthesis 3 (SS3) version 3.29b to integrate the mix of fisheries and survey data available (fleet-based landings; landings age or length compositions and discards length compositions for variable combinations of fleets and years; three surveys providing recruitment indices) and biological information from recent research on growth rates, maturity and mortality.

Two basic model structures were explored, with the same specifications where possible:

1. Age and length model – Including age compositions for the four UK fleets and combined length compositions for the French fleets.
2. Length only model – Including only the length compositon data for all fishery fleets.

Input data

Years: 1985-2010

Model structure:

- Temporal unit: annual based data (landings, lpue, age-frequency and length-frequency)
- Spatial structure: One area
- Sex: Both sexes combined

Fleet definition:

Six fleets were defined as the gear for UK vessles, France and Other:

- UK trawl
- UK midwater trawl

- UK nets
- UK lines
- French fleets (combined)
- Other (Other countries and Other UK fleets combined)

Landed catches:

Annual landings in tonnes from 1985 to 2010 for the six fleets from ICES sub-divisions IVb and c, VIIa, d-h were used in the assessment.

Abundance indices:

Ten abundance indices were defined for each age up to 4 years for different areas and time period.

- Spring Solent survey in ICES sub-division VIId covering ages 2 to 4 for years 1985 to 2009
- Autumn Solent survey in ICES sub-division VIId covering ages 2 to 4 for years 1986 to 2009
- Autumn/Winter Thames survey ICES sub-division IVc covering ages 0 to 3 for years 1997 to 2009

Age composition of data for age-length model:

The age bins were set at 0 to 11 with a plus group for ages 12 and over. Age compositions for four fishing fleets were used. The available age data and their disaggregated level differ among fleets:

- UK trawl – Annual total numbers and mean weight in kilograms for 1985 to 2010 were used in the age-length model.
- UK midwater trawl – Annual total number and mean weight in kilograms for 1985 to 2010 were used in the age-length model. Gaps in the time-series were present, for years 1986, 1990, 1993, 1997 and 2006.
- UK nets - Annual total numbers and mean weight in kilograms for 1985 to 2010 were used in the age-length model.
- UK lines - Annual total numbers and mean weight in kilograms for 1985 to 2010 were used in the age-length model.

Length composition of data:

The length bin was set from 4 to 100 cm by 2 cm intervals. Length compositions for five fishing fleets were used. The available length data and their disaggregated level differ among fleets:

- UK trawl – Annual total numbers for 1985 to 2010 were used in the length only model.
- UK midwater trawl – Annual total numbers for 1985 to 2010 were used in the length only model.
- UK nets – Annual total numbers for 1985 to 2010 were used in the length only model.
- UK lines – Annual total numbers for 1985 to 2010 were used in the length only model.

- French all fleets combined – Annual total numbers for 2000 to 2010 were used in both the age-length and length only model.

Model assumptions and parameters

Characteristic	Settings
Starting year	1985
Ending year	2010
Equilibrium catch for starting year	Mean landings by fleet: 1980-1984
Number of areas	1
Number of seasons	1
Number of fishing fleets	6
Number of surveys (recruit surveys)	3 surveys, modelled as 10 single-age fleets at ages 0 – 4
Individual growth	Von Bertalanffy, parameters fixed, combined sex
Number of estimated parameters	48
Population characteristics	
Maximum age	30
Genders	1
Population length bins	4 - 100, 2 cm bins
Ages for summary total biomass	0 –12+
Data characteristics	
Data length bins (for length structured fleets)	14 – 94, 2 cm bins
Data age bins (for age structured fleets)	0 – 12+
Minimum age for growth model	0 [age 2 for age-length model]
Maximum age for growth model	30
Maturity	Logistic 2-parameter – females; L50 = 40.65cm
Fishery characteristics	
Fishery timing	-1 (whole year)
Fishing mortality method	Hybrid
Maximum F	2.9
Fleet 1: UK Trawl selectivity	Asymptotic
Fleet 2: UK Midwater trawl selectivity	Asymptotic
Fleet 3: UK Nets selectivity	Asymptotic (dome shaped forsensitivity run)
Fleet 4: UK Lines selectivity	Asymptotic
Fleet 5: Combined French fleet selectivity	Asymptotic
Survey characteristics	
Solent spring survey timing (yr)	0.42
Solent autumn survey timing (yr)	0.83
Thames survey timing (yr)	0.75
Catchabilities (all surveys)	Analytical solution
Survey selectivities	[all survey data entered as single ages; sel = 1]
Fixed biological characteristics	

Natural mortality	0.2
Beverton-Holt steepness	0.999
Recruitment variability (σR)	0.9
Weight-length coefficient	0.00001296
Weight-length exponent	2.969
Maturity inflection (L50%)	40.649 cm
Maturity slope	-0.33349
Length at age Amin	5.78 cm
Length at Amax	80.26 cm
Von Bertalanffy k	0.09699
Von Bertalanffy Linf	84.55 cm
Von Bertalanffy t0	-0.730 yr
Std. Deviation length at age (cm)	SD = 0.1166 * age + 3.5609

D. Other Issues

D.1. Historical overview of previous assessment methods

No previous methods for international data.

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Stock Annex: European sea bass (*Dicentrarchus labrax*) in subarea VIIIc, IXa

Stock specific documentation of standard assessment procedures used by ICES.

Stock	European sea bass (*Dicentrarchus labrax*) in subarea VIIIc, IXa
Working Group:	WGBIE
Date:	May 2013
Revised by	Mickael Drogou, May 2013 (stock annex developed by IBPNEW 2012, retaining only information forBSS-8c9a and WGNEW 2013)

A General

Seabass for the 8ab area is considered in 2012 as data poor species, in category 5.2.0

A.1. Stock definition

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.

Stock structure of sea bass in the Atlantic has been reviewed by WGNEW 2012 and IBP-NEW 2012 based on evidence from genetics studies, tagging studies, distribution of commercial catches and similarities in stock trends between areas, drawing also on extensive information contained in previous WGNEW and ICES SGBASS reports.

IBP-NEW considers that stock structure remains uncertain, and recommends further studies on seabass 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 bass shoals, to confirm and quantify the exchange rate of seabass between sea areas that could form management units for this stock. Such information is critical to support development of models to describe the spatial dynamic of the species under environmental drivers (eg. temperature and food). Such a modelling work is being carried out in France in the framework of a PhD study (R. Lopez).

The pragmatic view of IBP-NEW 2012 is to structure the baseline stock assessments into four units:

- Assessment area 1. Sea bass in ICES areas IVbc, VIId, VIIe,h and VIa,f&g (lack of clear genetic evidence; concentration of area IV bass fisheries in the southern North Sea; seasonal movements of bass across ICES Divisions). Relatively data-rich area with data on fishery landings and length/age composition; discards estimates and lengths; growth and maturity parameters; juvenile surveys, fishery LPUE trends.
- Assessment area 2. Sea bass in Biscay (ICES Sub area VIIIa,b). Available data are fishery landings, with length compositions from 2000; discards from 2009; some fishery LPUE.
- Assessment area 3. Sea bass in VIIIc and IXa (landings, effort,discards)

- Assessment area 4. Sea bass in Irish coastal waters (VIa, VIIb, VIIj). Available data: Recreational fishery catch rates; no commercial fishery operating.

Fishery landings of sea bass are extremely small in Irish coastal waters of VIIa and VIIg and the stock assessment for assessment area 1will not reflect the sea bass populations around the Irish coast, which may be more strongly affiliated to the population in area 4 off southern, western and Northern Ireland.

A.2. Fishery

General description

Spanish and Portugese vessels represent almost of the total annual landings in the area IXa and VIIIc. Commercial landings represent 772 tons in 2011. A peak of landings is observed in the early 90's reaching more than 1000 tons, and lowest landings (637 tons) have been observed in 2004. Artisanal fisheries are mainly observed in this area. Off Portugal, estimated total landings of sea bass (hereafter refers only to European sea bass) average 421 tons for the period 1986-2012. Landings had a maximum of 610 tons in 1989, followed by a slight decrease and another increase to a second maximum of 633 tons in 2006. Most landings come from the polyvalent mixed fishery (80-99%) using mostly gill nets (GNS_DEF_80-99_0_0), trammel nets (GTR_DEF_>=100_0_0) and long-line or hand-line (LLS_DEF_0_0_0). The landings by purse seiners and trawlers represent a small amount.

Relatively little historical data are available on recreational fisheries although several European countries are now carrying out surveys to meet the requirements of the EU Data Collection Framework and for other purposes (ICES WKSMRF 2009, PGRFS 2010 & 2011, WGRFS 2012; Herfault *et al*, 2010, Rocklin et al, 2012 in prep, Van der Hammen & De Graaf, 2012).

Fishery management regulations

Seabass are not subject to EU TACs and quotas. Under EU regulation, the MLS of sea bass in the Northeast Atlantic is 36 cm total length (EC regulation 850/98). A variety of national restrictions on commercial fishing for each metier also apply to sea bass. 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.

A.3. Ecosystem aspects

This section comes from the IBPNew report and refers to UK studies.

Temperature appears to be a major driver for bass production and distribution (Pawson, 1992). Reynolds *et al*. (2003) observed a positive relationship between annual seawater temperature during the development phases of eggs and larvae of sea bass and the timing and (possibly) abundance of post-larval recruitment to nursery areas. In addition, early growth is related to summer temperature and survival of 0-groups through the first winter is affected by body size (and fat reserves) and water temperature (Lancaster 1991; Pawson 1992). prolonged periods of temperatures below 5 - 6°C may lead to high levels of mortality in 0-groups in estuaries during cold winters. As a result, any SSB–recruit relationships may be obscured by temperature effects (Pawson *et al*., 2007a).

Recruitment of sea bass is highly variable, and the fisheries have often in the past been dominated by individual very strong year classes or have been negatively affected by periods of very poor recruitment. Expansion of sea bass populations in the North Sea in the 1990s coincided with a period of ocean warming as well as the growth of the very strong 1989 year class.

B. Data

B.1. Commercial catch

B1.1 Landings data

Data available

Landings series 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) Portugese estimated landings from 1986 to 2011 including distinction between Dicentrarchus labrax and punctatus.

Spanish and Portugese vessels represent almost of the total annual landings in the area IXa and VIIIc. Commercial landings represent 772 tons in 2011. A peak of landings is observed in the early 90's reaching more than 1000 tons, and lowest landings (637 tons) have been observed in 2004.. Artisanal fisheries are mainly observed in this area. Off Portugal, estimated total landings of sea bass (hereafter refers only to European sea bass) average 421 tons for the period 1986-2012. Landings had a maximum of 610 tons in 1989, followed by a slight decrease and another increase to a second maximum of 633 tons in 2006. Most landings come from the polyvalent mixed fishery (80-99%) using mostly gill nets (GNS_DEF_80-99_0_0), trammel nets (GTR_DEF_>=100_0_0) and longline or hand-line (LLS_DEF_0_0_0). The landings by purse seiners and trawlers represent a small amount.

Quality of official landings data

The official landings data for sea bass available to WGNEW 2013 are subject to several uncertainties that can affect the accuracy of assessments:

- Incomplete reporting of landings in the 1970s and early 1980s when the fisheries were developing;
- Poor reporting accuracy for small vessels that do not supply EU logbooks.

Portugal: With the regulations introduced with the DCF, landings by species are now more accurate, especially since 2006. Additionally, market sampling enabled the estimation of the remaining misidentification and correction of total landings by species. Official landings underestimate total catch to an unknown degree. Landings series for use in the assessment are available from the Portuguese official statistics since 1986. Landings of sea bass from the ICES division IXa are reported in three categories: the European sea bass (Dicentrarchus labrax, FAO code BSS), the spotted sea bass (Dicentrarchus punctatus, FAO code PSU) and also a mix of the above two species under the category Dicentrarchus sp. (FAO code BSE). From DCF market sampling it was possible to estimate that the spotted sea bass represents only ca. 2.5% of sea bass species total landings, and produce a time series of corrected landings for Dicentrarchus labrax.

Spain : Landings from the sales notes are detailed for the 2007-2011 period. This source of information was chosen as the accuracy of the landings for D. labrax improves with respect to logbook data. Main reason seems to be the role of small scale fisheries that do not have to supply logbooks data.

B1.2 Discards estimates

Portugal: Sea bass discards are recorded by the DCF on-board sampling programme. 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 2003-2011 periods.

Quality of discards estimates

Portugal. As sampling is targeted at all species, annual coverage of the sea bass catches is relatively limited. The low numbers of sea bass in retained catches show that the Portuguese on-board sampling is not covering the sea bass fishing area. Nevertheless, the species is of high value and discards are probably negligible.

B1.3 Recreational catches

Recreational marine fishery surveys in Europe are still at an early stage in development (ICES WGRFS 2012).

Spain

A recreational boat fishing survey was performed in the Basque Country to estimate the total catch of the target species of this fishery. Fishermen were asked about their catches in 2009, and 555 surveys were collected. Sea bass catch data were modeled with a two-step GLM, using type of boat and total boat length as covariables. The results were extrapolated to the total number of boats using an updated census. The estimated catch for seabass was in 2009 was 8183 Kg, with an associated standard error of 149 Kg. It is important to note that this estimation refers only to the fishing performed from boats. In order to estimate total recreational catches of sea bass, anglers fishing from coast and spear fishers need to be included in the survey. In 2012 a pilot study financed by the Data Collection Framework (DCF) was taking place in order to estimate total sea bass catches (taking into account all types of recreational fishing), and it is expected that the results if this study will increase significantly the estimated sea bass catch. Results were not available for WGNEW2013.

Portugal

It is recognized that a pilot study on recreational fishing of sea-bass should be carried out in order to determine the importance of this fishery in Portugal, whether it is necessary to monitor it regularly and if so how the monitoring could be carried out. Recreational fishery data have not been collected due to lack of resources and weak administrative information available. A pilot study addressed to the maritime touristic operators was implemented in 2010 in order to obtain the quantities of sea bass catches. The results of this study revealed very low quantities of sea bass catches (DCF, 2012).

Quality of recreational catch estimates

Recreational catch estimates from surveys (numbers or tonnes caught per year) are not yet available as time series. The estimates for France are characterised by relatively poor precision. The 2012 ICES Working Group on Recreational Fisheries initiated the development of data quality indicators for recreational fishery survey estimates, however sources and potential magnitude of bias in available estimates were not provided to WGNEW 2013.

B.2. Biological

B2.1 Length and age compositions of landed and discarded fish in commercial fisheries.

Portugal : In Portugal, quarterly length compositions of sea bass landings from division IXa are available from DCF concurrent sampling since 2009 for the polyvalent fleet. The number of animals sampled is small, N=2229 for the 4 years (2009 to 2012) and concerned only the area IXa. The sample rate (trips sampled per tonne landed) was around 0.2 in 2009, 2010 and 2011. Most specimens measured were landed from trammel nets (GTR_DEF_>=100_0_0), gill nets (GNS_DEF_80-99_0_0), and long-line (LLS_DEF_0_0_0). The quarterly length compositions show that recruitment to the fishery is seasonal starting during the second quarter of the year. Length compositions derived from fisheries with the two main gear types show that the fisheries with gill nets and trammel nets catch smaller animals (mean = 48 cm) of a narrow length range, mainly animals between 40 and 55 cm (80%); whereas the line fishery catches animals bigger animals (mean = 51 cm) and of a wider size range. There is no significant trend in the mean length of sea bass over the 4 years period analysed. No age sampling is available

Spain : No data available from Spain for the VIIIc, IXa area

B2.2 Biological parameters and other research in Iberian waters: weights, maturities, growth

This section provides biological parameters, discussed in a Portuguese Working Document for the ICES Working Group on Assessment of New MoU Species by Ana Moreno and Yorgos Stratoudakis (2013).

Spawning season

Bass spawning is limited within the 9-17o C water temperature range and has a latitudinal gradient in the Atlantic coast of Europe, with season placed progressively later in the year in more northerly latitudes (April-June off Ireland; February-May in the English Channel and eastern Celtic Sea; January-March in the Bay of Biscay and October-January in the Gulf of Cadiz). Based on back-calculated birthdates of juveniles caught in 4 Portuguese estuaries, Vinagre et al (2009) support the above latitudinal trend; successful spawning in SW Portugal seems to concentrate from December to February, becoming progressively later (January to April or February to April) as moving towards estuaries in NW Portugal, although temperature seasonality is not the trigger for this local pattern. An earlier study by Sobral et al (2000) identifies February as the main spawning month for bass off the Ria de Aveiro (NW Portugal), based on the macroscopic staging of gonads from fish caught by "majoieiras" (small bits of old trammel nets fixed perpendicularly on the beach at low tide).

Spawning grounds and seasonal migrations

Off western Portugal (where temperature is not a limiting factor for the definition of potential spawning habitat and continental shelf is narrow), there is no evidence of inshore-offshore migrations (sea bass is almost exclusively caught in the inner shelf and often at depths <10 m), and there is evidence of spawning at very shallow waters (Sobral et al 2000 and blog reports by recreational line fishers operating from land). Additionally, there is evidence of large pre-spawning and spawning aggregations found inshore, as verified by the occasional purse seine sets with up to 3-4 t of sea bass in the catch.

Ontogenetic movements

Off Portugal, there is evidence that juvenile bass colonize transition waters during the summer and stay there for at least the first year (Gordo 1989; Cabral and Costa 2001). Although fish in the second year of life and even third have been found within such protected and semi-enclosed systems, no mature fish have ever been registered there, whereas there is little known on the movements of bass while at sea.

Growth

Off Portugal, there are mean length at age data only for younger age groups (usually from studies with immature fish in estuaries and rias), appointing to intermediate sizes at age between the lower values in more northerly area and higher values in the Mediterranean and Atlantic Moroccan coast (Gordo 1989; Cabral and Costa 2001).

Maturation

In the northern range of the species distribution area, maturity is attained at around 4 - 7 years, which is around 35 cm for males and 42 cm for females. No information is available from Portugal. Nevertheless, Chavanne et al (2008) report from aquaculture experience that males complete maturation in the second year and females in the third (although recognize maturation as a problem for production only for fish reared for more than 3 years); it is thus likely that first maturation off Portugal occurs at intermediate ages between those reported from wild populations at the northern limit of the distribution and those from aquaculture.

B.3. Surveys

Portugal

No sea bass are caught in the Portuguese trawl survey cruises. Nevertheless, juvenile sea bass are regularly caught in surveys within estuaries (e.g. Gordo 1989; Cabral and Costa 2001). Monitoring efforts under the Water Framework Directive (e.g. Ramos et al 2012) could thus be used also to construct series of sea bass recruitment indices, at least in the main nurseries for the species in Portugal (Vasconcelos et al 2008), at no additional cost.

Spain

Information of Dicentrachus labrax catches in the series of research surveys conducted by the IEO since 1983 is showed in Table 10.12. There are also a very few seabass caught.

B.4. Commercial LPUE

Spain

LPUE data for Spanish fleets operating in ICES areas VI-VIII and landing into Basque Country ports were provided to WGNEW in 2005, and the best indicator of sea bass abundance trends (LPUE) in the period 1994 - 2004 was considered to be from vessels of the 'baka' otter trawl fleet working in Div. VIIIa,b,d and landing into the Basque port of Ondarroa. Data for later years were not available to WGNEW. Landings and effort data were provided to WGNEW by Spain, though not in the form of LPUE indices.

Portugal

Commercial catch-effort data was analysed for the Portuguese polyvalent fishery for the years 1995 to 2011 from auction daily landings data. The unit of effort is given as the number of trips that deliver sea bass. There is no apparent trend in the sea bass LPUE for the period analysed, but the unit of measure is probably not reflecting sea bass abundance (Figure 10.14)

Quality of data : Sea bass are a by-catch in most polyvalent fisheries and catchability may drift due to changes in species targeting, areas fished and vessel fishing power. On the other hand, the unit of effort given as the number of trips that deliver sea bass is probably meaningless to reveal abundance

B.5. Other relevant data

None

C. Assessment: data and method

Data do not allow to conduct an assessment.

D. Short-Term Projection

None

E. Medium-Term Projections

None

F. Long-Term Projections

None

G. Biological Reference Points

None

H. Other Issues

None

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Stock Annex: Grey gurnard in Subarea VIII and Division IXa

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Grey Gurnard in Subarea VIII and Division IXa
Working Group:	Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE)
Date:	May 2014
Revised by	Eoghan Kelly WGBIE

A. General

A.1. Stock definition

Grey gurnard (*Eutrigla gurnardus*) occurs in the Eastern Atlantic from Iceland, Norway, southern Baltic and North Sea to southern Morocco and Madeira. It is also found in the Mediterranean and Black Seas. The species is more abundant in the North Sea and less so in the Channel, the Celtic Sea and in the Bay of Biscay. It can be found at depths ranging from 10 to 340m though less often below 150m. This species grows up to 60 cm though usually reaching 30 cm, with 19.3 cm as the length at first maturity (Fishbase).

No studies are known of the stock ID of grey gurnard and individual behaviour does not militate to maintain the population in a single stock. WGNEW concluded that in the absence of specific information on stock structure, the ICES ecoregions (North Sea including VIId, Celtic Seas and South European Atlantic) are to be used as minimum level of disaggregation for the definition of stock units (ICES, 2012). This is an interim solution until more information is available on the stock.

A.2. Fishery

In the past, gurnards were often not sorted by species when landed and reported into one generic category of "gurnards". In recent years the official statistics seem to improve gradually, however, catch statistics are incomplete for several years. Grey gurnard is mainly taken as a by-catch in mixed demersal fisheries for flatfish and roundfish. However, the market is limited and the larger part of the catch appears to be discarded. Owing to the low commercial value of this species, landings data will usually not reflect the actual catches very well.

In South European Atlantic (VIII and IX), official landings have fluctuated at low level and were on average 63 t since 2000 (ICES, 2012). In North Portugal, Rocha (2007, 2008) determined the composition and proportion of Triglidae landings in artisanal fleet and Feijó et al. (2008) studied the mixture of Triglidae species in the trawl fleet. This work revealed that grey gurnard may represent as little as 0.5% of all gurnard landings and it is the tub gurnard (*Chelidonichthys lucerna*) that is the most valuable and frequently landed species of gurnard.

The Portuguese discard observer program in the period 2004-2011, recorded grey gurnard in less than 3% of the hauls sampled in the demersal fish bottom trawl fleet. For the crustacean bottom trawl fleet there was no occurrence of Grey gurnard in this period. Discarding of grey gurnard by Spanish trawl fleet has declined from 500 to 80t in recent years.

A.3. Ecosystem aspects

Grey gurnard is most common on sandy bottoms, but also on mud, shell and rocky bottoms. Juveniles feed on a variety of small crustaceans. The diet of older specimens consists mainly of larger crustaceans and small fish. Spawning takes place in spring and summer. There do not seem to be clear nursery areas.

B. Data

B.1. Commercial catch

Landings data are incomplete and issues with speciation makes commercial data difficult to interpret. Grey gurnard is taken as a by-catch in mixed demersal fisheries for flatfish and roundfish and it is thought that the larger part of the catch is discarded.

B.2. Biological

Biological information was available from the Portuguese Ground Fish Survey. Length distribution ranged from 11 to 28cm, with mean length close to the length at first maturity (19.3cm). Studies in the Baie de Douarnenez (Brittany) have shown that the length at which 50% of males and females were mature were 29.4 and 31.2 cm, respectively (Baron, 1985a, 1985b).

Biological sampling of gurnards was carried out on a fornightly basis in Northern Portugal during 2007. From 1965 Gurnards collected, 56 specimens of *Eutrigla gurnardus* (2.8%) were randomly sampled from bottom trawler landings. Total length, total weight, eviscerated weight and gonad weight were recorded in addition to information on sex and maturity of each specimen. Length-based maturity ogives were generated. Otoliths were also collected.

Between 2009 and 2012 the Portuguese port sampling program collected data from 947 fishing trips. Grey gurnards were observed in gill and trammel nets and in trawlers, normally mixed with other gurnards like tub, red, longfin, piper and streaked gurnards. The presence of grey gurnard occurred during all year, without remarkable seasonal variation. A bi-modal distribution (24cm and 29cm) was observed and specimens smaller than 19cm were not present. Although smaller individuals may be discarded at sea. Despite bibliography information indicating a maximum size of ~60cm, individuals greater than 46cm were not observed in these samples.

B.3. Surveys

Biological data on grey gurnard were compiled from Portuguese Ground Fish Survey (PtGFS-WIBTS) for 2007 and 2008. This survey covered the whole Portuguese continental coast, within depths ranging from 20 to 500m. Despite the low abundance the species was seen in the 20-100m and the 101-200m depth range, mainly in North zone (Caminha to Lisbon). The species was not observed in the 2010 or 2011 survey. Biomass indices were also available from EVHOE-WIBTS-Q4 in the Bay of Biscay but values were very low (<0.4Kg/30min).

B.4. Commercial CPUE

Commercial indices were not available but exploration of logbook data may produce useful information.

B.5. Other relevant data

No information.

C. Assessment: data and method

For data-limited stocks where landings are negligible compared with discards (Category 6) ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current exploitation is appropriate. For this stock, ICES advises that catches should decrease by 20% in relation to the average catch of the last three years.

D. Short-Term Projection

E. Medium-Term Projections

F. Long-Term Projections

G. Biological Reference Points

H. Other Issues

I. References

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Stock Annex: Plaice in Subarea VIII and Division IXa

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Plaice in Subarea VIII and Divisiion IXa
Working Group:	Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE)
Date:	May 2014
Revised by	Eoghan Kelly WGBIE

A. General

A.1. Stock definition

The stock unit definition of plaice (*Pleuronectes platessa*) in this area is not clear. WGNEW concluded that in the absence of specific information on stock structure, the ICES ecoregions (North Sea including VIId, Celtic Seas and South European Atlantic) are to be used as minimum level of disaggregation for the definition of stock units (ICES, 2012). This is an interim solution until more information is available on the stock.

A.2. Fishery

Plaice is caught as a bycatch by various fleets and gear types covering small-scale artisanal and trawl fisheries. Portugal and France are the major participants in this fishery averaging 124 and 110 tons respectively between 2001 and 2011. French landings increased to 183t in 2012. Average Spanish landings are around 22 tons but there were no data available in 2011.

A.3. Ecosystem aspects

No information.

B. Data

B.1. Commercial catch

Fishery statistics are currently being compiled. At present, only official landings are available, which are considered to be preliminary for the purpose of stock assessment. There are concerns about the reliability of the 2008-2009 French data. There are speciation issues with flounder (*Platichthys flesus*) and they are often confounded at sales auction in Portugal. Landings statistics need to be quality-assured and confirmed for the region.

B.2. Biological

No information.

B.3. Surveys

Plaice was not present in the Spanish and Portuguese research surveys and not caught in sufficient quantities in the French survey in the Bay of Biscay to serve as an abundance index.

B.4. Commercial CPUE

Commercial indices were not available but exploration of logbook data may produce useful information.

B.5. Other relevant data

No information.

C. Assessment: data and method

For stocks where reliable catch data are available including biological information (Category 4) ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current exploitation is appropriate for the stock. For this stock, ICES advises that catches should decrease by 20% in relation to the average catch of the last three years.

D. Short-Term Projection

E. Medium-Term Projections

F. Long-Term Projections

G. Biological Reference Points

H. Other Issues

I. References

ICES. 2012. Report of the Working Group on Assessment of New MoU Species (WGNEW), 5 - 9 March 2012, . ICES CM 2012/ACOM:20. 258 pp.

Stock Annex: Sole in subdivisions VIIIc and IXa

Stock Annex	Stock specific documentation of standard assessment procedures used by ICES.
Stock	Sole in Subdivisions VIIc and IXa
Working Group:	Working Group for the Bay of Biscay and Iberian Waters Ecoregion WGBIE
Date:	05/2014
Revised by	Maria de Fatima Borges WGBIE

A. General

A.1. Stock definition

Solea Solea is a widely distributed species in Northeast Atlantic shelf waters with a range from southern Norway including North Sea and western Baltic and Mediterranean Sea, to the Northwest of Africa inhabiting sandy and muddy bottoms at depths near to 100 and 200 meters (Quero *et al.*, 1986). At present there is no information on stock unit definition for sole in ICES subdivision VIIIc and IXa. It was considered that in the absence on specific information on stock structure, the Subdivisions VIIIc and IXa may be used as a management unit.

A.2. Fishery

Portugal and Spain are the main participants in this area fisheries. Figure 1 illustrates *Solea* species *(Solea solea, Solea senegalensis and Pegusa lascaris*) landings by Divisions VIIIc and IXa. In Portugal there is evidence of market *solea* species misclassification which means *solea solea* Portuguese official landings might not correspond only to this species but be mixed with *Solea senegalensis* and *Pegusa lascaris.* In Portugal trammel nets are the most used métier to catch soles with about 90% of the total landings.

Based on DCF harbour length sampling data it was possible to separate the soles complex using scientifically identified proportions of each species: *Solea solea*, *S. senegalensis* and *Pegusa lascaris*, and this was estimated for the landings in Portugal (Division IXa) . This analysis revealed that solea senegalensis constitutes the highest proportion of the landings followed by *Pegusa lascaris* and that *Solea solea* has the least contribution to the landings, as indicated in Figure 2 (Borges, *et al.*,(2014). The group recommends these proportions estimated from DCF sampling be applied to correct the official catches by species.

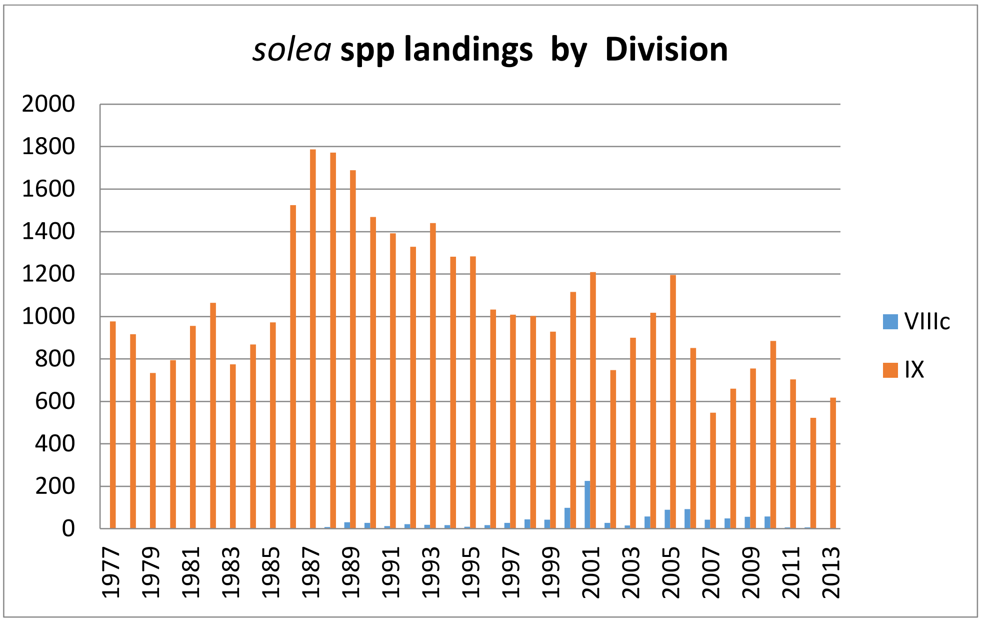

Figure 1 Sole in Divisions VIIIc and IXa. Official landings of solea spp: *Solea solea, Pegusa Lascaris and solea senegalensis*, by division (in tonnes).

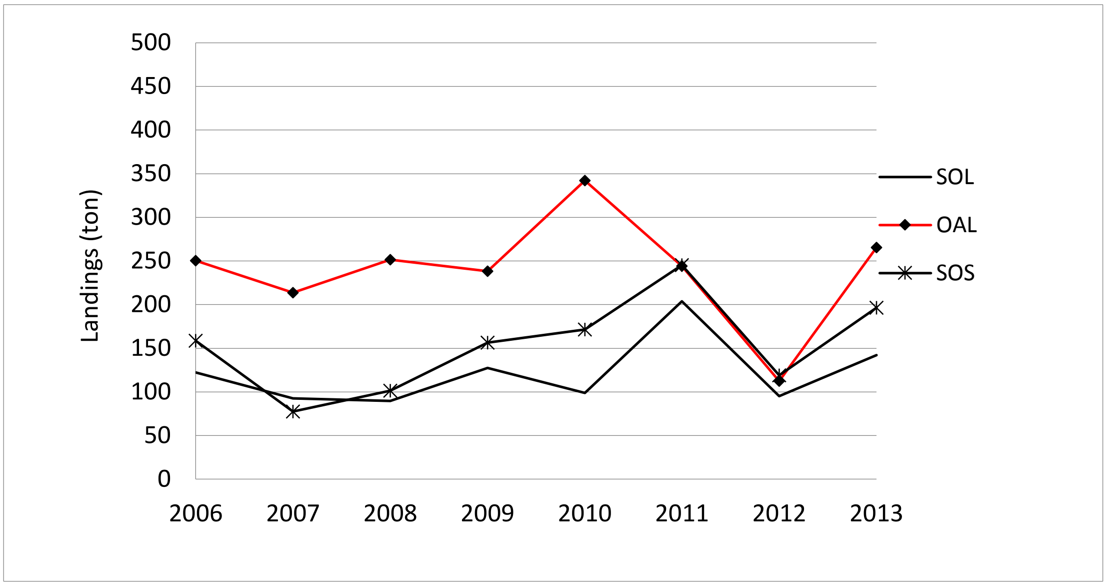

Figure 2. Estimated landings of Solea solea (SOL), Solea senegalensis (OAL) and Pegusa lascaris (SOS) for Div. IXa (Portugal)

A.3. Ecosystem aspects

Sole (*Solea solea*) spawning takes place in winter/early spring and varies with latitude starting earlier in the south. Larvae migrate to estuaries where juveniles concentrate until they reach approximately 2 years of age and move to deeper waters. 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 nursery ground. (Cabral and Costa, 1999).

B. Data

B.1. Commercial catch

In Portugal *Solea solea* (SOL) is caught together with and other similar species *Solea senegalensis* (OAL) and *Pegusa lascaris* (SOS) and there are evidences of misreporting sole (*Solea solea*) with the other two species. Landings length compositions for *Solea solea* are presented for the Portuguese area (Figure x.2) (Borges, *et al*, 2014). Based on the DCF discard sampling in Portugal discards for Sole (*Solea solea*) only occur in negligible small amounts due to the minimum landing size or damaged specimens (Prista, *et al*, 2014)

B.2. Biological

Recent growth studies based on *S. solea* otolith readings in the Portuguese coast indicate L_{inf} 52.1cm (females) and 45.7cm (males) while 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 in comparison with the northern European coasts. *Solea solea* maturity ogives by sex, length-weight relationship, sex-ratio by length based on harbour DCF sampling were presented in 2012 for IXa division (Jardim, *et al*, 2011).

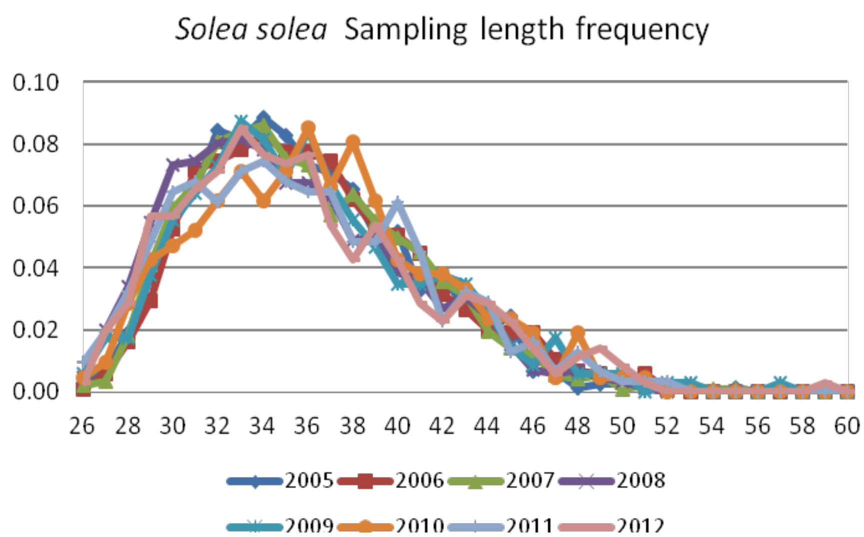

Figure 3- Division IXa (Portugal. *Solea solea* sampling length frequency from all métiers harbour sampling DCF-IPMA

B.3. Surveys

Solea solea is rarely caught in the existing Portuguese bottom trawl research surveys (Autumn BTS, Jardim *et al*, 2011). This species may be found along the Portuguese coast mainly from very shallow waters and estuaries up to 100 m depth. To monitor sole species a dedicated independent research survey is necessary.

B.4. Commercial CPUE

Commercial indices were not available but exploration of logbook data may produce useful information.

B.5. Other relevant data

C. Assessment: data and method

For data limited stocks without information on abundance or exploitation (Category 5) ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicationg that the current exploitation is appropriate for the stock. For this stock, ICES advises that catches should decrease by 20% in relation to the average catch of the last three years.

D. Short-Term Projection

E. Medium-Term Projections

F. Long-Term Projections

G. Biological Reference Points

H. Other Issues

References

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Stock Annex: Whiting in Subarea VIII and Division IXa

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Whiting in Subarea VIII and Division IXa
Working Group:	Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE)
Date:	May 2014
Revised by	Eoghan Kelly WGBIE

A. General

A.1. Stock definition

The stock unit definition of whiting (*Merlangius merlangus*) in this area is not clear and Atlantic Iberian waters (Division IXa) represent the southern limits of the distribution of the species. WGNEW concluded that in the absence of specific information on stock structure, the ICES ecoregions (North Sea including VIId, Celtic Seas and South European Atlantic) are to be used as minimum level of disaggregation for the definition of stock units (ICES, 2012). This is an interim solution until more information is available on the stock.

A.2. Fishery

France and Spain are the main participants in this fishery although France has not recorded landings since 2008 and there were no Spanish data available for 2011. Landings are primarily made by trawlers although France recorded substantial landings by long lines prior to 2009.

A.3. Ecosystem aspects

No information.

B. Data

B.1. Commercial catch

Fishery statistics are currently being compiled. At present, only official landings are available, which are considered to be preliminary for the purpose of stock assessment. There are concerns about the reliability of the 2008-2009 French data. There may be species identification issues in landings with Pollack (*Pollachius pollachius*). Landings statistics need to be quality-assured and confirmed for the region.

B.2. Biological

Atlantic Iberian waters (Division IXa) represent the southern limits of the distribution of the species.

B.3. Surveys

Whiting are present in the French EVHOE-WIBTS-Q4 survey for the Bay of Biscay area from 1987, with the exclusion of 1993 and 1996. Age information is available since 1997. Survey information could provide information on recruitment but catches of adult whiting are not in sufficient quantity to serve as an SSB indicator. Other approaches should be initiated to obtain fishery-independent information on total stock biomass.

B.4. Commercial CPUE

AZTI have compiled whiting LPUE in Div. VIIIabd based on landings from the pair trawl fleet, which constitute 99% of the Spanish landings in that area. Landings and effort by this fleet have both declined from mid 2000s and LPUE has declined from 0.39 t/day in 2007 to 0.04 t/day in 2011.

B.5. Other relevant data

No information.

C. Assessment: data and method

For stocks where reliable catch data are available including biological information (Category 4) ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current exploitation is appropriate for the stock. For this stock, ICES advises that catches should decrease by 20% in relation to the average catch of the last three years.

D. Short-Term Projection

E. Medium-Term Projections

F. Long-Term Projections

G. Biological Reference Points

H. Other Issues

I. References

ICES. 2012. Report of the Working Group on Assessment of New MoU Species (WGNEW), 5 - 9 March 2012, . ICES CM 2012/ACOM:20. 258 pp.

Annex R Northern Hake Stock Reference Points in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)

1.1 The model

Specific software for northern hake was developed in R (R Development Core Team 2013) and Winbugs (Lunn, Spielgelhalter et al. 2009) to include uncertainty in the calculation of reference points and to evaluate the reference points under a risk analysis framework. The software is similar to the eqSim and plotMSY R libraries presented in the ICES workshop WKMSYREF2 (ICES, 2014b).

EqSim and PlotMSY could not be applied because both these softwares are for age-structured population dynamics models with an annual time step, and the northern hake assessment model is not of that form. Similar to EqSim, the specific software developed for northern hake conducts a long-term projection using age-structured population dynamics, with annual stochasticity in recruitment (recruitment drawn from fitted stock-recruit curves and incorporating annual stochastic deviations; time auto-correlation in the annual deviations is also allowed). Multiple replicates (simulations) are performed in the long-term projection, giving rise to the long-term stochastic equilibrium distribution, corresponding to the final projection year. Fmsy is the F value that maximises long-term yield (with yield understood as the landed portion of the catch).

The performance of the ICES MSY HCR (which reduces F linearly from Fmsy towards 0 when SSB < MSY Btrigger) was examined following the WKMSYREF2 guidelines. Assessment/advice error in F was incorporated in the long-term projection (via an AR(1) process on ln(F)), and the long-term Probability(SSB < Blim) evaluated. The HCR is considered precautionary if this probability is < 5%.

The main differences the developed software presents with respect to EqSim are that:

- It uses seasonal time steps.
- Recruitment (derived from SSB on January 1st) enters the population in 3 of the 4 seasons (first 3 quarters of the year).
- Selection pattern of the fishery and F (Fbar 15-80 cm) are season-dependent, to account for the different amounts of fishing pressure exerted by different fleets in different seasons.
- The stock recruitment relationships are estimated under a bayesian approach using winbugs.
- It does not include stochasticity in biological parameters (M, weight and maturity at age). However, it is noted that these parameters are treated as fixed in the hake stock assessment, and if EqSim would have been applied, it would most likely also have treated these parameters as fixed (as EqSim resamples them from assessment model inputs or outputs, by default).
- Input data for BRP calculations is taken directly from the SS3 (Method, 2013) assessment output.

Two possible definitions of Fmsy are considered (as in EqSim):

1. For each replicate, find the value of F that maximises long-term equilibrium yield for that replicate; this gives Fmsy for that particular replicate. Fmsy can then be defined as the median of the Fmsy values across the replicates, denoted here as Fmsy1.
2. For each value of F considered (i.e. the grid of F values used in the BRP computation), find the average long-term yield (long-term equilibrium yield averaged across replicates) for that F. Fmsy is defined as the value of F for which average long-term yield is maximum, denoted here as Fmsy2.

The software was applied to the assessment results presented in Section 5.

1.2 Stock Recruitment

The stock recruitment fits obtained are shown in Figure R.1. The red points represent the observed stock-recruitment pairs and the black lines, the 5%, 50% and 95% percentiles of the fitted SR curves. Four stock-recruitment relationship were fit, Beverton and Holt, Hockey Stick, Ricker, and a mixture of the three referred to here as the 'Combined' stock recruitment relationship. The breakpoint in the Hockey stick model is constrained to be above the lowest observed SSB. In the 'Combined' model 1/3 prior probability was assigned to each of the three SR functions (Beverton and Holt, Hockey Stick and Ricker) and the parameters (9 parameters, i.e. 3 per SR model type) as well as the posterior probabilities of the three SR models were estimated. In the MCMC chain for the Combined model, the sampler moves from model to model depending on the updated posterior probabilities of each of the three SR models, which depend on the goodness of the fit of the SR models to the SR data. The resulting posterior probabilities were 0.69 for Hockey Stick, 0.23 for Beverton and Holt and 0.08 for Ricker (hence, the data gave most weight to Hockey Stick). The breakpoint in the Hockey Stick model is around 48 000 tonnes. The Ricker curve shows a decreasing trend for SSB levels above 100 000 tonnes. The Combined curve is similar to the Hockey stick curve, as expected given that posterior weights are highest for the Hockey stick SR model; the width of the probability intervals in the Combined model increases with biomass level. The probability intervals are quite narrow in all the cases, but it is noted that Figure R.1 depicts the intervals for the SR curves (i.e. the figure is not showing predictive intervals, which would also take into account departures of observed recruitment from fitted curves). Except for the Hockey stick relationship, the higher the SSB the wider the probability interval.

1.3 Fishing mortality reference points.

Uncertainty in the fishery selection pattern was incorporated based on random draws from the estimates in the final 5 assessment years; 500 replicates were used. For Fmsy computation, the stock is projected 60 years into the future, treating values in year 60 as long-term equilibrium. As indicated in Section 4.3 of the WKMSYREF2 report, this initial calculation of Fmsy is based on a constant F (without Btrigger) and does not include assessment/advice error.

Fishing mortality reference points obtained using yield per recruit analysis are shown in Figure R.2. .

Stochastic Yield per recruit and %SPR curves are shown in Figure R.3. Yield per recruit for Fmax and F30% is similar and slightly lower for F0.1 and Fsq (F status-quo, taken as the average F of the last 3 assessment years). The probability interval of yield per recruit is very right skewed and it increases from the origin (i.e. when F=0) until it reaches the maximum yield per recruit value around F = 0.27. The probability interval in the %SPR curve is very narrow. %SPR for F0.1 is around 40%, for Fmax around 26%, and for Fsq it decreases below 20%.

The probability distribution of Fmsy, its median Fmsy1 (first definition of Fmsy), and Fmsy2 (second definition of Fmsy) for each of the four stock recruitment relationships are shown in Figure R.4. For each SR model, the values Fmsy1 and Fmsy2 are very similar (see rows corresponding to Fmsy1 and Fmsy2 in Table R.2). However, Fmsy1 and Fmsy2 for the Ricker SR model are almost double the values for the rest of the models.

Following the guidelines from WKMSYREF2 (ICES, 2014b) Fmsy is selected based on the Combined stock recruitment model. The value 0.27 (between Fmsy1 and Fmsy2) was selected by the working group as Fmsy for the stock (pending the check for precautionary considerations of the ICES MSY HCR; Section 1.5 below). It is well below Fmsy1 and Fmsy2 for the Ricker model, it is very close to the Fmsy1 and Fmsy2 for the rest of the models, and it is equal to Fmax.

1.4 Biomass reference points.

The biomass reference points agreed by the working group are shown in the table below. Blim was defined as the SSB in 2006, one of the lowest observed biomasses (the sixth lowest) in the historical series. Bpa was defined as 1.4 times Blim, and MSY Btrigger set equal to Bpa, which is the default approach used by many ICES stocks.

Biomass Indicator	Rationale	tonnes
Blim	B[2006]	33 000
Bpa	1.4*Blim	46 200
Btrigger	Bpa	46 200

The default approach to select Blim for ICES assessed stocks is the breakpoint of the Hockey Stick relationship. In this case the breakpoint is around 48 000 tones. This value was considered too high to be considered as Blim for the northern hake stock, most of the SSB values fall below this point (see Table R.3) and the stock has been able to increase strongly from these lower biomasses even with high fishing mortality. Table R.3 shows the SSB and recruitment pairs ordered from the lowest to the highest SSB. Taking Blim as the lowest observed SSB in the historic period (SSB[1998] = 24 Kt) is a common approach used in many ICES stocks with no clear evidence of impaired recruitment within the range of observed SSBs, but this point was considered very risky and uncertain by the group, so it was decided to take Blim above this point. SSB[2006] is 25% higher than the lowest observed SSB, and for all the SSBs below it, except for the lowest one, the corresponding recruitment is lower than that observed in 2006. Besides, starting from the biomass in 2006, the stock experienced a sharp increase until 2012. Figure R.5 shows for each SSB level, the mean recruitment for SSBs lower than it, a running mean. The first values are highly influenced by the good 1998 recruitment, above the historical mean. The running mean reaches the minimum for SSB[2006] and afterwards it starts an increasing trend until SSB[1986]. For SSBs above SSB[2006], the running mean settles slightly below the mean recruitment. Thus, the recruitment for SSBs higher than SSB in 2006 is, on average, higher than the recruitment for lower SSB. For the reasons explained above, the working group concluded that SSB[2006] was a better option for Blim than the lowest observed SSB or the breakpoint of the Hockey Stick model,.

1.5 ICES MSY Harvest Control Rule evaluation.

After selecting biomass reference points the ICES MSY HCR (which reduces F from Fmsy linearly towards 0 when SSB < MSY Btrigger) was tested using long term simulations. Following Section 4.3 of the WKMSYREF2 report, the objective is to evaluate whether the Fmsy value initially selected for northern hake (Fmsy=0.27) corresponds to a long-term Probability(SSB < Blim) < 0.05, when applied in the context of the ICES MSY HCR. As noted before, the stock was projected for 60 years and 500 replicates, using quarterly time steps and applying the ICES MSY HCR in each projection year.

The projection was done including several uncertainties as proposed by WKMSYREF2 (ICES, 2014), namely:

- Uncertainty in selectivity at age: the historical selectivities are bootstrapped over the last five years.
- Recruitment is drawn stochastically with autocorrelation on an annual basis (rho = 0.5).
- Error in F was added using an autoregressive process of first order (AR(1) on ln(F)). Both time autocorrelation and standard deviation of marginal distribution were set equal to 0.3.

The summary of the simulation results are shown in Figure R.6 and Table R.2 (rows labelled “F5% risk to Blim” and “F5% risk to Bpa”). The long-term probability of SSB being below Blim or Bpa using Fmsy1 or Fmsy2 for all the stock recruitment relationships was well below 5%. Table R.2 shows the fishing mortality levels for which Probability(SSB<Blim) = 5% and Probability(SSB<Bpa) = 5% are reached for each of the stock recruitment models; these F values are all > 0.3. In the Combined model the 5% cutpoint for Blim is at F=0.48 (F=0.32 for Bpa).

WKMSYREF2 defines a harvest control rules as precautionary when the long term probability of SSB being below Blim is lower than 5%. According to this definition, the proposed Fmsy = 0.27 (between Fmsy1 and Fmsy2 in the Combined model), is precautionary for any of the stock-recruitment models tested.

1.6 References.

ICES. 2014d. Report of the Workshop to consider reference points for all stocks (WKMSYREF2. 8-10 January 2014, Copenhagen, Denmark. ICES CM 2014/ACOM:47.

Lunn, D., D. Spielgelhalter, et al. (2009). "The BUGS project: Evolution, critique, and future directions." Statistics in Medicine **28**: 3049-3067.

R Development Core Team (2013). R: A Language and Environment for Statistical Computing. Vienna, Austria.

Table R.1. Yield Per Recruit reference points.

	F(15-80cm)	%SPR
Fsq	0.38	0.18
Fmax	0.27	0.26
F0.1	0.17	0.39
F30%	0.23	0.30

Table R.2 Fmsy1 and Fmsy2 reference points (calculated based on a constant F and without assessment/advice error); fishing mortality levels corresponding to long-term Probability(SSB < Blim) = 5% and Probability(SSB<Bpa) = 5% (these F values correspond to the constant F for SSB > MSY Btrigger in an HCR that reduces F linearly to 0 when SSB < MSY Btrigger; they have been calculated incorporating assessment/advice error in F). The corresponding %SPR value for each F is also displayed.

	Indicator	F(15-80cm)	%SPR
Beverton & Holt	Fmsy1	0.24	0.29
	Fmsy2	0.25	0.29
	F5% risk to Blim	>0.76	-
	F5% risk to Bpa	0.63	0.09
Hockey Stick	Fmsy1	0.27	0.26
	Fmsy2	0.27	0.26
	F5% risk to Blim	0.44	0.15
	F5% risk to Bpa	0.31	0.23
Ricker	Fmsy	0.54	0.11
	FmaxEY	0.54	0.11
	F5% risk to Blim	>0.76	-
	F5% risk to Bpa	0.65	0.09
Combined	Fmsy1	0.26	0.27
	Fmsy2	0.28	0.25
	F5% risk to Blim	0.48	0.13
	F5% risk to Bpa	0.32	0.22

Table R 3. SSB-recruitment pairs ordered from lowest to highest SSB.

Year	SSB	Recruitment
1998	23901	404125
1999	27370	203526
1995	29068	147187
1997	29755	247389
1994	29930	284966
2000	30181	177357
2006	33144	285275
1996	34293	358139
2001	35813	326732
2002	37037	260398
2003	37271	151773
1993	37977	518453
1992	38697	306315
2007	39527	444540
2005	40587	212952
1991	40595	282202
1990	41921	501651
2004	42205	315697
1987	42371	438521
1989	44629	486957
1988	45315	503603
2008	47006	652117
1986	57405	360801
1983	67400	137712
1982	69609	397435
2009	71131	189117
1985	76796	631628
1978	79690	287324
1984	80299	283655
1981	85959	575986
1979	99256	268851
1980	100894	297040
2010	125542	169255
2013	166050	423847
2011	188146	189941
2012	188679	833725

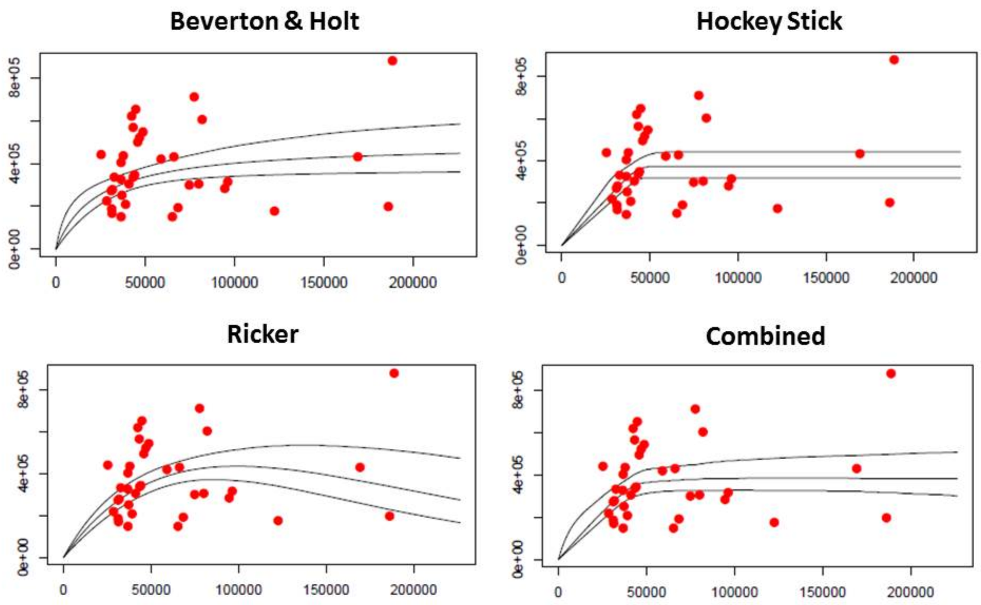


Figure R.1 Observed Stock Recruitment pairs (red points) and the 5%, 50% and 95% percentiles (black lines) for the four stock recruitment models tested (intervals are for fitted SR curves, i.e. not predictive intervals).

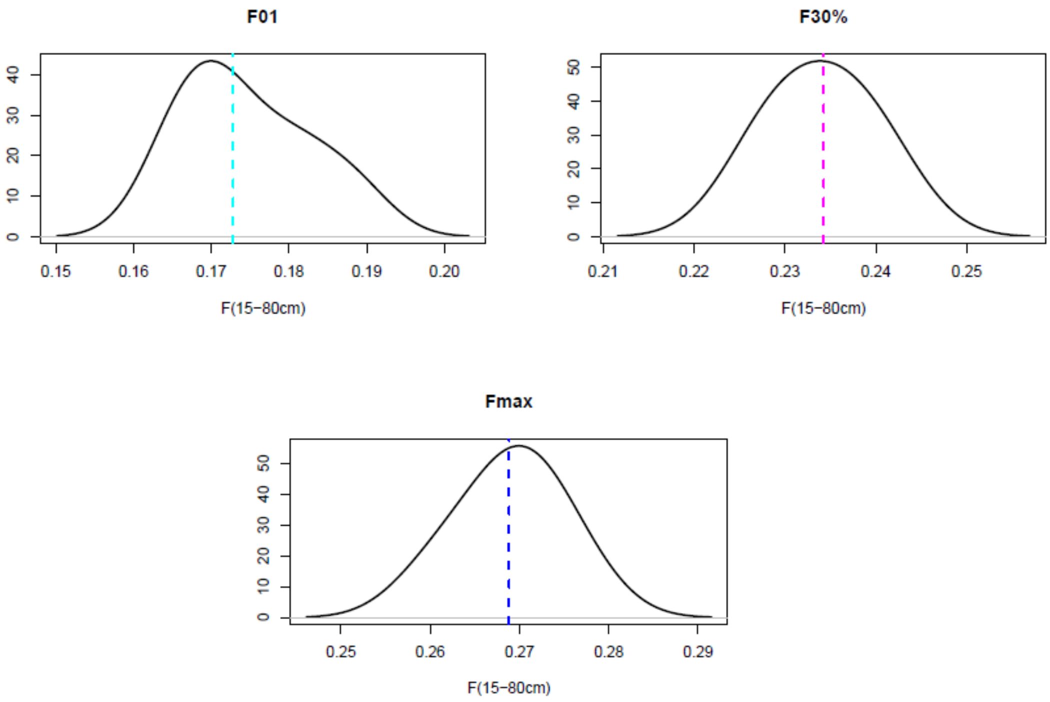


Figure R.2 Density distributions for F01, F30% and Fmax. The vertical dashed lines indicate the median value of the distributions.

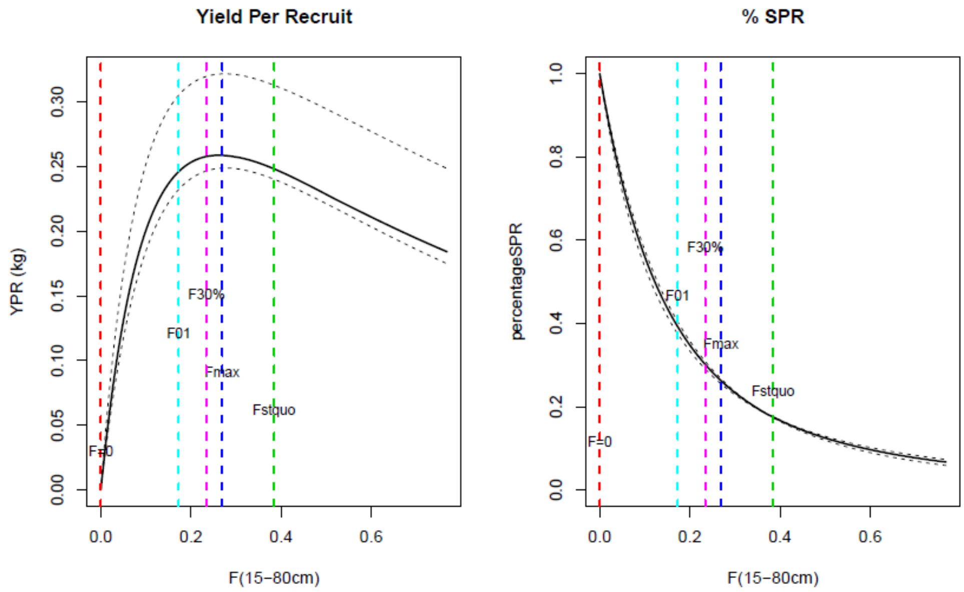


Figure R.3 Yield per recruit and % SPR curves. The solid black line is the median and the dashed black lines the 5% and 95% percentiles. The vertical dashed lines correspond with F = 0 (red) and the median values of F01 (light blue), F30% (pink), Fmax (dark blue) and Fsq (green).

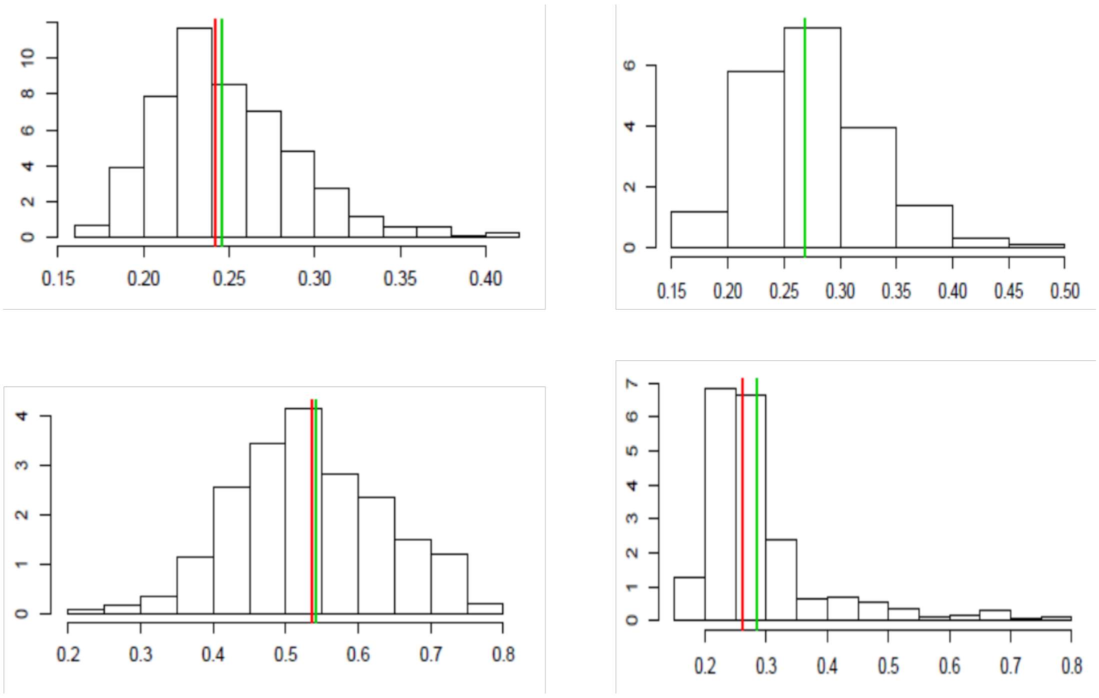


Figure R.4 Fmsy distributions for the four stock recruitment models considered. Beverton-Holt (top left), Hockey-Stick (top right), Ricker (bottom left), Combined (bottom right). Vertical lines correspond to Fmsy1 (red) and Fmsy2 (green); both lines overlap in the Hockey-Stick graph.

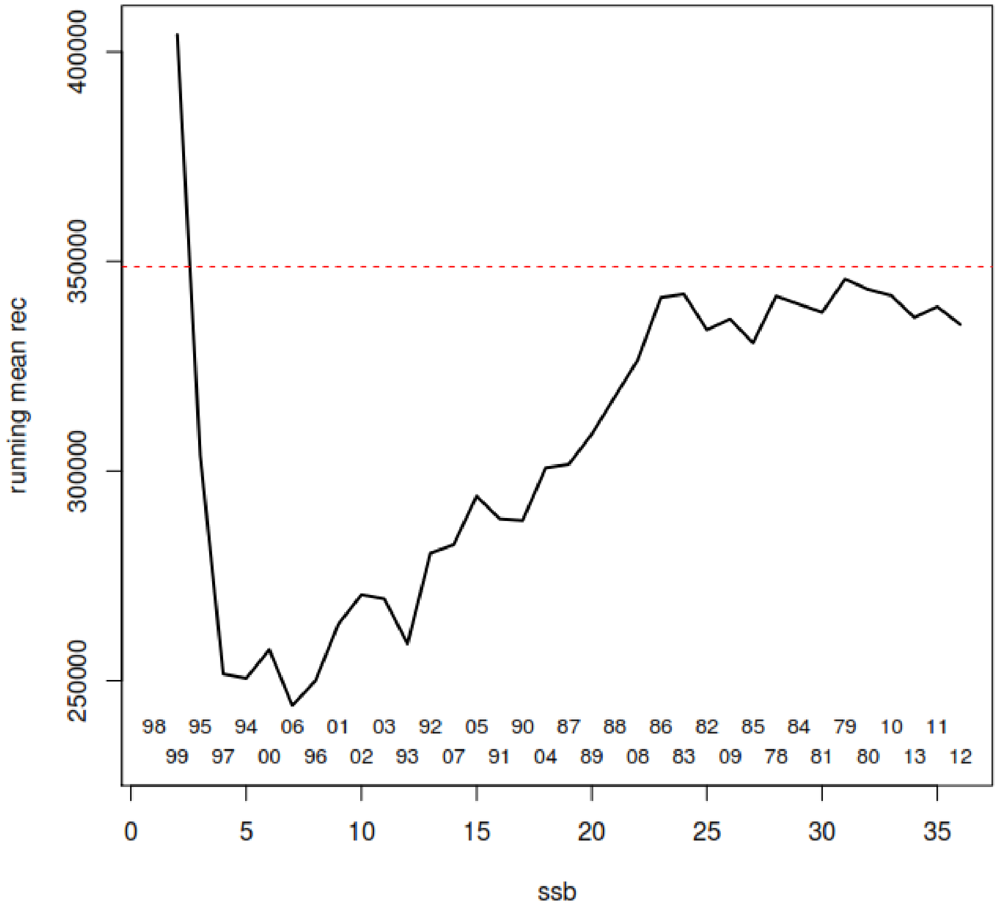
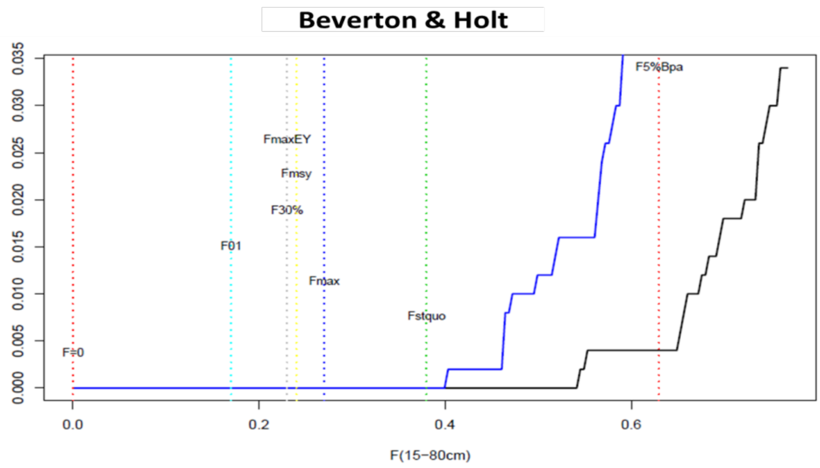
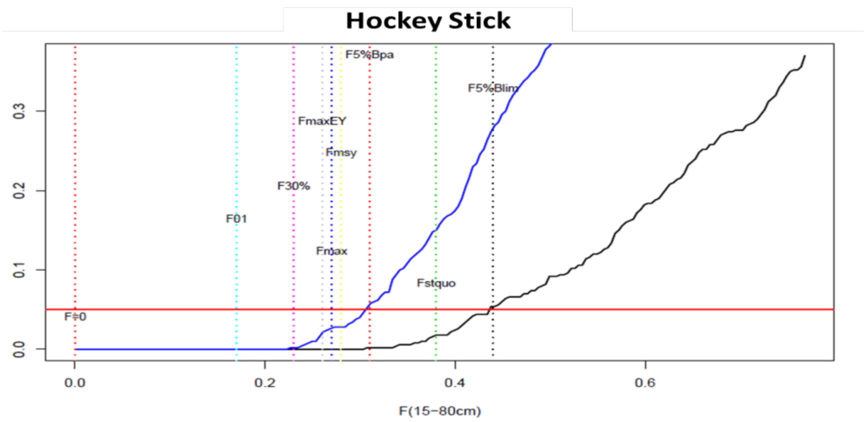
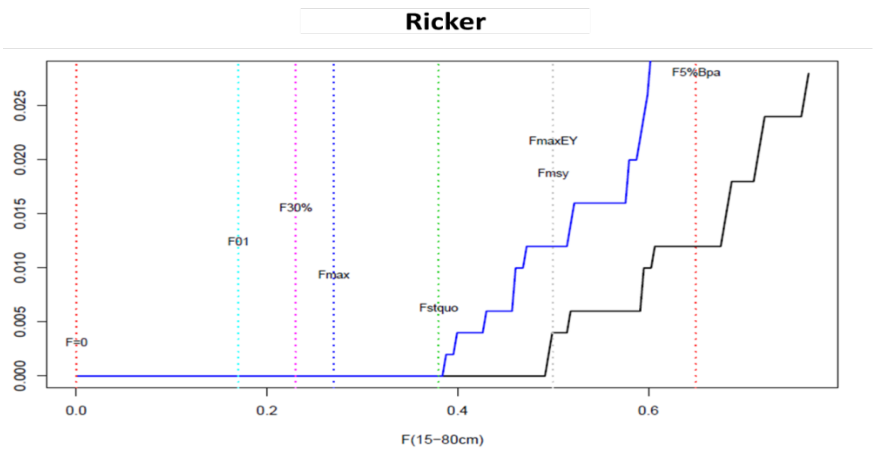


Figure R.5 Running means of recruitment for SSB values below the corresponding SSB. The horizontal line indicates historical mean recruitment. The numbers in the bottom of the graph indicate the corresponding year.


Beverton & Holt
F5%Bpa
FmaxEY
Fmsy
F30%
F01
Fmax
Fstquo
F=0
F(15-80cm)


Hockey Stick
F5%Bpa
F5%Blim
FmaxEY
Fmsy
F30%
F01
Fmax
Fstquo
F=0
F(15-80cm)


Ricker
F5%Bpa
FmaxEY
Fmsy
F30%
F01
Fmax
Fstquo
F=0
F(15-80cm)

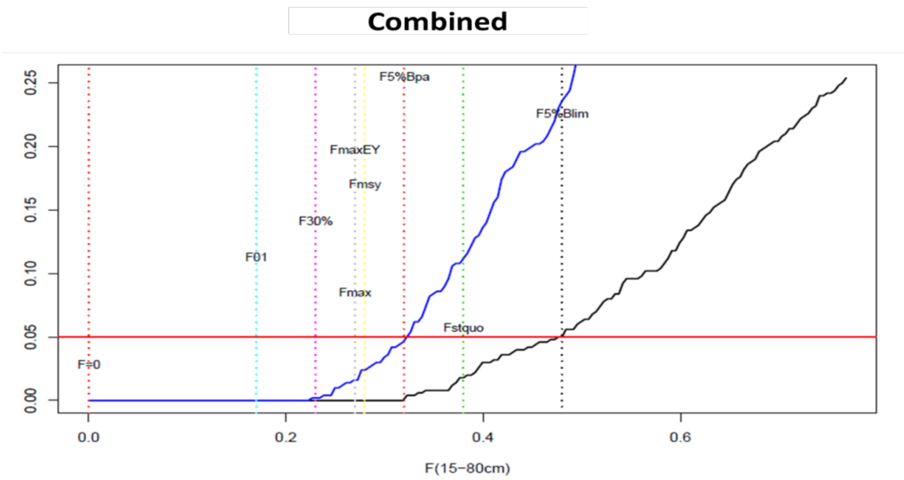


Figure R.6 Long-term probability of SSB being below Blim (black solid line) or Bpa (blue solid line) for an HCR with constant F when SSB > MSY Btrigger and a linear reduction in F towards 0 when SSB < MSY Btrigger. Horizontal red line indicates 5% probability (note different scaling of vertical axis in the different panels). Vertical dashed lines indicate different HCRs, with each HCR corresponding to a different constant value of F for SSB above MSY Btrigger: median value of F0.1 (light blue), F30% (pink), Fmax (blue), Fmsy1 (yellow), Fmsy2 (grey), Fstquo (green), the F value leading to 5% probability of SSB<Blim (black), and the F value leading to 5% probability of SSB<Bpa (red). Fmsy1 and Fmsy2 in these graphs differ slightly from those reported in Table R.2 because the ones here were calculated considering assessment/advice errors in F and an HCR that reduces F when SSB < MSY Btrigger; the differences, however, are very minor.

Annex S Stock Data Problems Relevant to Data Collection – WGBIE

Stock Data Problems Relevant to Data Collection – WGBIE

Stock	Data Problem	How to be addressed in	By who[1]
Stock name	Data problem identification	Description of data problem and recommend solution	Who should take care of the recommended solution and who should be notified on this data issue.
Meg 7 & 8abd	Discards availability	Lack of discard data from the French fleets.	Ask the DPMA to supply these data as soon as possible (at least one month before WG(May)
Sol-bisc	Maturity ogive need to be updated	Need to have sole under the MLS = 24 cm	Provide a campaign to collect small soles in the beginning of the year

[1] Recommendations on surveys for be addressed by the SCICOM Steering Group on Ecosystem Surveys, Science and Technology (SSGESST)

Data call: Data submission for stocks assessed in the ICES Working Group Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE), formerly WGHMM

Rationale

ICES provides fisheries advice to competent authorities for the species assessed by the Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE), and this advice is provided on the basis of the best available survey and commercial data. Additional ICES Working Groups, including WKLIFE and WGMIXFISH-METH will also use the data to further develop fish stock assessment methods for the production of advice for WGBIE stocks.

Scope of call

ICES Countries are requested to supply landings, discards, biological sample and effort data from 2013. This information should be provided by métier, as listed in Annex 1. The list of species and areas for which data should be prepared is given in Table 1, Table 2 and Annex 6. If 2013 data for the Northern hake stock in the Subarea IV and IIIa were already submitted in the North Sea data call, issued by ICES on 3 February 2014, there is no need to re-submit.

Table1. List of species, InterCatch species code, and the ICES areas for which data are requested.

	Common name for species	***Scientific name for species***	***InterCatch Code***	***Data requested from areas***
1	Anglerfish	*Lophius piscatorius*	*MON*	Divisions VIIb,c,d,e,f,g,h,j,k, VIIIa,b,c and IXa
2	Black-bellied anglerfish	*Lophius budegassa*	*ANK*	Divisions VIIb,c,d,e,f,g,h,j,k, VIIIa,b,c and IXa
3	Sea bass	*Dicentrarchus labrax*	*BSS*	Divisions VIIIa,b,c and IXa
4	Hake	*Merluccius merluccius*	HKE	Division IIa, IIIa, Subareas IV, VI and VII, Divisions VIIIa,b,c,d, and IXa
5	Four-spot megrim	*Lepidorhombus boscii*	*LDB*	Divisions VIIIc and IXa
6	Megrim	*Lepidorhombus whiffiagonis*	*MEG*	Divisions VIIIa,b,c,d,e, IXa, and VIIb,c,d,e,f,g,h,j,k
7	Common sole	*Solea spp.*	SOL	Divisions VIIIa,b,d
8	Plaice	*Pleuronectes platessa*	PLE	Subarea VIII and Division IXa
9	Whiting	*Merlangius merlangus*	*WHG*	Subarea VIII and Division IXa
10	Norway lobster	*Nephrops norvegicus*	NEP	Divisions VIIIa,b (FU 23, 24), Division VIIIc (FU 25, 31), and Division IXa (FU 26-27, 28-29, 30)

Table 2. List of areas for which data are requested for upload to InterCatch. Data should be uploaded at the division level. See Appendix 6 for *Nephrops areas.* If division-level upload is not possible, please contact: Michel Bertignac Michel.Bertignac@ifremer.fr , Chair of WGBIE. If there are any problems with uploading data to InterCatch please contact Henrik Kjems-Nielsen Henrik.Kjems-Nielsen@ices.dk.

Area	***InterCatch Area code***	***InterCatch Area type***
Norwegian Sea	IIa	Division
Skagerrak and Kattegat	IIIa	Division
North Sea	IV	Sub area
Faroe Grounds	*Vb*	*Division*
West of Scotland and Rockall	VI	Sub area
Celtic Sea and Channel	VII	Sub area
West of Ireland	VIIb	Division
Porcupine Bank	VIIc	Division
Eastern Channel	VIId	Division
Western Channel	VIIe	Division
Bristol Channel	VIIf	Division
Celtic Sea North	VIIg	Division
Celtic Sea South	VIIh	Division
Southwest of Ireland - East	VIIj	Division
Southwest of Ireland - West	VIIk	Division
Bay of Biscay, north	VIIIa	Division
Bay of Biscay, south	VIIIb	Division
Cantabrian Sea	VIIIc	Division
Bay of Biscay, offshore	VIIId	Division
West Bay of Biscay	VIIIe	Division
Portuguese Waters - East	IXa	Division
Portuguese Waters - West	IXb	Division

Deadline

The deadline to deliver the data is 10 April 2014.

Data to be reported

Landings, discards, sample and effort data from 2013 according to one or more of the metiers listed in Annex 1. If corrections for earlier years need to be made, a full new set of data for the respective species may need to be uploaded as well. Please inform the ICES WG chair if this is needed (see contacts below).

Format to report

The InterCatch format should be used, please see the 'InterCatch Exchange Manual' on the ICES website for InterCatch at http://www.ices.dk/marine-data/data-portals/Pages/InterCatch.aspx .

How to report

The InterCatch formatted national data should be imported into InterCatch, which is available at this link: https://intercatch.ices.dk/Login.aspx.

Metiers

The metiers used in this data call are at level 6 (including mesh size range and selectivity device) and they are available in InterCatch. If a needed metier is not available in InterCatch, please contact: Michel Bertignac Michel.Bertignac@ifremer.fr, Chair of WGBIE.

The metier_tag entries in the annexed tables closely follow the naming convention used for the EU Data Collection Framework (DCF). Below is an explanation of the metier tag elements; an underscore separates each of the elements.

Metier tag elements:

1. GEAR TYPE (gear types available under the DCF are shown in Appendix 1. Data can be aggregated over more than one category but in this case the most significant gear type is entered. The aggregations assumed in forming Annex 1 are also shown in Appendix 1 and Appendix 2).
2. METIER CODE (code conforming to target assemblage code of DCF) see Appendix 3. Data can be aggregated over more than one category but in this case the most significant metier code is entered.
3. MESH SIZE RANGE (mesh size ranges available under the DCF). Data can be aggregated over more than one category but in this case the most significant mesh size range is entered. If, for that gear type, data have been aggregated over all ranges used by a nation, an additional (to the DCF) entry "all" can be used.
4. SELECTIVITY DEVICE (types of selectivity device available under the DCF) see Appendix 4.
5. SELECTIVITY DEVICE MESH SIZE (the actual mesh size of any selectivity device is entered).
6. VESSEL LENGTH CLASS (Member states have indicated national sampling scheme designs do not take account of vessel lengths. Therefore only the non-standard entry of "all" is currently provided for in InterCatch).

OTB_CRU_>=70_0_0_all

Bottom otter trawl_directed to crustaceans_(at least 70 mm)_with no selectivity device_no selectivity device mesh size_all vessel length classes

Figure 1. Explanation of the metier tag elements; an underscore separates each of the elements.

Country and area codes

Country codes are provided in Appendix 5. Country and area are supplied to InterCatch separately. To reduce the number of entries required in InterCatch, data are requested according to the areas shown in Appendix 6 and not according to finer spatial resolutions.

Issues of note

It is requested to fill in the following length sampling information fields for both landing and discard samples:

- Number samples of length, field: NumSamplesLngt
- Number length measured, field: NumLngtMeas

DemHC and DemIBC (as used in previous years) must be coded as MIS_MIS_0_0_0_HC and MIS_MIS_0_0_0_IBC, respectively.

When uploading to InterCatch the year used is the data year, which must be entered as four digits, “2013”.

If discard data are unavailable there should be no entry for discards. A value of zero should only be entered when zero discards were observed.

Effort Data

Effort is required in kWdays for all species and areas. Effort is recorded in position 11 of the InterCatch header information.

Aggregations

If national data are aggregated over several DCF level 6 categories, the métier tag corresponding to the most significant category is chosen e.g., a mobile gear with mesh sizes covering 70-119 mm (combining 70-99 and 100-119) but 70-99 mm is most significant – code 70-99.

Exceptions to this general rule are cases where data have been aggregated over all mesh size ranges within the national fleet. In these instances the tag “all” can be entered.

In addition, Member states have indicated national sampling scheme designs do not take account of vessel lengths and therefore only the non-standard entry of “all” is currently provided for in InterCatch against vessel length. The option has been left open for length category specific métier tags to be added in future years if nations begin to sample and raise data independently for different length categories.

Conversions to InterCatch Format

A description of the InterCatch Exchange format can be downloaded at the InterCatch information webpage under: http://www.ices.dk/marine-data/data-portals/Pages/InterCatch.aspx.

A two page overview of the fields in the InterCatch commercial catch format can be found at the same page, again under ‘Manuals’ (just below the InterCatch Exchange format manual). From this page the valid codes can be seen.

To ease the process of converting the national data into the InterCatch format Andrew Campbell from Ireland has made a conversion tool ‘InterCatchFileMaker’, which converts data manually entered in the ‘Exchange format spreadsheet’ into a file in the InterCatch format. The conversion tool ‘InterCatchFileMaker’ can be downloaded at the InterCatch information page under ‘Program to convert to InterCatch file format’. The download includes a spreadsheet in which the landings and sampling data can be placed; the converter then converts the data in the spreadsheet into the InterCatch format.

For InterCatch related questions contact: Henrik Kjems-Nielsen Henrik.Kjems-Nielsen@ices.dk .

Supporting Documentation

Once data have been submitted to InterCatch, a process of fill-ins will be undertaken by the respective stock coordinators for entries containing only bulk weight of landings and/or discards. To aid this process, countries are requested to complete a documentation file (EXCEL spreadsheet) in a format like that shown in Appendix 8.

The documentation spreadsheet should be submitted electronically to Michel Bertignac Michel.Bertignac@ifremer.fr, Chair of WGBIE.

Appendix 1. Gear coding (as defined under the DCF). Codes made available in the WGBIE data call are shown in the left column and are based on information from countries fishing in the respective areas about significant fishing gears. If a code is missing, please contact Michel Bertignac Michel.Bertignac@ifremer.fr, Chair of WGBIE. If there are any problems with uploading data to InterCatch please contact Henrik Kjems-Nielsen Henrik.Kjems-Nielsen@ices.dk .

Code available in this data call	DCF code	Type of gear
LLS	TBB	Beam trawl
OTB	OTB	Bottom otter trawl
	OTT	Multi-rig otter trawl
	PTB	Bottom pair trawl
	OTM	Midwater otter trawl
	PTM	Midwater pair trawl
SSC	SSC	Fly shooting (Scottish) seine
	SPR	Pair seine
	PS	Purse seine
SDN	SDN	Anchored seine
	SB, SV	Beach and boat seine
GNS	GNS	Set gillnet
	GND	Driftnet
GTR	GTR	Trammel net
LLS	LHP	Pole lines
	LHM	Hand lines
	LLS	Set longlines
FPO	FPO	Pots and Traps
MIS	FYK	Fyke nets
	FPN	Stationary uncovered pound nets
	DRB	Boat dredge
	HMD	Mechanised/ Suction dredge
	OTH	Other

Appendix 2. Gear coding (as defined under the DCF). Codes currently available in the WGBIE data call. If a code is missing, please contact Michel Bertignac Michel.Bertignac@ifremer.fr, Chair of WGBIE. If there are any problems with uploading data to InterCatch please contact Henrik Kjems-Nielsen Henrik.Kjems-Nielsen@ices.dk .

Métier Level 6	Description
DRB_MOL_0_0_0_all	Boat dredge, molluscs, no selectivity devise, all vessels
FPO_CRU_0_0_0_all	Pots and Traps, Crustaceans, no selectivity device, all vessels
GN_DEF_100-109_0_0_all	Gill nets, demersal fish, mesh size 100-109mm, no selectivity device, all vessels
GNS_DEF_>=100_0_0	Set gillnet, Demersal fish, mesh size more than 100mm, no selectivity device
GNS_DEF_>=220_0_0_all	Set gillnet, Demersal fish, mesh size more than 220mm, no selectivity device, all vessels
GNS_DEF_>=220_0_0_all_FDF	Set gillnet, Demersal fish, mesh size >=220mm, no selectivity device, all vessels, Fully Documented Fisheries
GNS_DEF_100-119_0_0_all	Set gillnet, Demersal fish, mesh size 100-119mm, no selectivity device, all vessels
GNS_DEF_100-219_0_0	Set gillnet directed to demersal fish (100-219 mm)
GNS_DEF_10-30_0_0_all	Set gillnet, Demersal fish, mesh size 10-30mm, no selectivity device, all vessels
GNS_DEF_120-219_0_0_all	Set gillnet, Demersal fish, mesh size 120-219mm, no selectivity device, all vessels
GNS_DEF_120-219_0_0_all_FDF	Set Gillnet, Demersal Fish, Mesh size 120-219, All Vessels, No grid selectivity, Fully Documented Fisheries
GNS_DEF_45-59_0_0	Set gillnet directed to demersal fish (45-59 mm)
GNS_DEF_60-79_0_0	Set gillnet, Demersal fish, mesh size 60-79 mm, no selectivity device
GNS_DEF_80-99_0_0	Set gillnet directed to demersal fish (80-99 mm)
GNS_DEF_all_0_0_all	Set gillnet, Demersal fish, all mesh sizes, no selectivity device, all vessels
GTR_DEF_60-79_0_0	Trammel nets, Demersal fish, mesh size 60-79mm, no selectivity device
GTR_DEF_all_0_0_all	Trammel nets, Demersal fish, all mesh sizes, no selectivity device, all vessels

LHM_DEF_0_0_0 LLS_DEF_0_0_0	Hand lines directed to demersal fish Set longline directed to demersal fish
LLS_DEF_0_0_0_all	Set longlines, Demersal fish, mesh size not specified, no selectivity device, all vessels.
LLS_FIF_0_0_0_all	Set longlines, Finfish, no selectivity device, all vessels
MIS_DEF_all_0_0_all	Demersal fisheries, Demersal fish, mesh size any, no selectivity device, all vessels
MIS_MIS_0_0_0_IBC	Demersal fisheries - Miscellaneous Industrial bycatch
MIS_MIS_All_0_0_All	Demersal fisheries - Miscellaneous
OTB_CRU _>=70_0_0	Bottom otter trawl directed to crustaceans (at least 70 mm)
OTB_CRU_100-119_0_0_all	Otter trawl, Crustaceans, mesh size 100-119, no selectivity device, all vessels
OTB_CRU_32-69_0_0_all	Otter trawl, Crustaceans and Demersal fish, mesh size 32-69, no selectivity device, all vessels
OTB_CRU_32-69_2_22_all	Otter trawl, Crustaceans, mesh size 32-69, selectivity device - grid 22mm, all vessels
OTB_CRU_70-89_2_35_all	Otter trawl, Crustaceans, mesh size 70-89, selectivity device - grid 35mm, all vessels
OTB_CRU_70-99_0_0	Bottom otter trawl directed to crustaceans (70-99 mm)
OTB_CRU_70-99_0_0_all	Otter trawl, Crustaceans and Demersal fish, mesh size 70-99, no selectivity device, all vessels
OTB_CRU_90-119_0_0_all	Otter trawl, Crustaceans and Demersal fish, mesh size 90-119, no selectivity device, all vessels
OTB_CRU_90-119_0_0_all_FDF	Bottom otter trawl, Crustaceans, mesh Size 90-119, Selectivity Device - none, All vessel types, Fully Documented Fisheries
OTB_CRU_All_0_0_All	Bottom otter trawl, Crustaceans, all mesh sizes, no selectivity devise, all vessel types
OTB_DEF _100-119_0_0	Bottom otter trawl directed to demersal fish (100-119 mm)
OTB_DEF_>=120_0_0_all	Otter trawl, Demersal fish and Crustaceans, mesh size more than 120mm, no selectivity device, all vessels
OTB_DEF_>=120_0_0_all_FDF	Bottom otter trawl, Demersal fish, Mesh Size 120 or greater, Selectivity Device - none, All vessel types, Fully Documented Fisheries

OTB_DEF_>=55_0_0	Bottom otter trawl directed to demersal fish (at least 55 mm)
OTB_DEF_>=70_0_0	Bottom otter trawler targeting demersal fish with a mesh size > 70 mm
OTB_DEF_100-119_0_0_all	Bottom otter trawler targeting demersal fish with a mesh size 100-119 mm
OTB_DEF_70-99_0_0	Bottom otter trawl directed to demersal fish (70-99 mm)
OTB_DEF_All_0_0_All	Bottom otter trawl directed to demersal fish, all mesh sizes, no selectivity devise
OTB_MCD_>=55_0_0	Otter trawl, Mixed crustaceans and demersal fish, mesh size more than 55mm, no selectivity device.
OTB_MCF_>=70_0_0	Otter trawler targeting cephalopods and fish
OTB_MOL_70-99_0_0_all	Otter trawl, Molluscs, mesh size 70-99mm, no selectivity device, all vessels
OTB_MPD _>=70_0_0	Bottom otter trawl directed to mixed pelagic and demersal fish (at least 70 mm)
OTB_MPD_>=55_0_0	Bottom otter trawl directed to pelagic and demersal fish (at least 55 mm)
OTB_SPF_32-69_0_0_all	Otter Bottom trawl, Small pelagic fish, 32-69 mm, no selectivity devise, all vessels
OTM_DEF_100-119_0_0_all	Midwater otter trawl, Demersal species, mesh size 100-119mm, no selectivity device, all vessels
OTM_DEF_32-54_0_0_all	Midwater otter trawl, Demersal species, mesh size 32-54mm, no selectivity device, all vessels
OTM_DEF_55-69_0_0_all	Midwater otter trawl, Demersal species, mesh size 55-69mm, no selectivity device, all vessels
OTM_DEF_70-99_0_0_all	Midwater otter trawl, Demersal species, mesh size 70-99mm, no selectivity device, all vessels
OTM_DEF_80-89_0_0_all	Midwater otter trawl, Demersal species, mesh size 80-89mm, no selectivity device, all vessels
OTT_CRU _>=70_0_0	Multi-rig otter trawl directed to crustaceans (at least 70 mm)
OTT_DEF _>=70_0_0	Multi-rig otter trawl directed to demersal fish (at least 70 mm)
OTT_DEF_>=120_0_0_all	Multi-rig otter trawl, demersal fish, mesh size more than 120mm, no selectivity device, all vessels
OTT_DEF_100-119_0_0_all	Multi-rig otter trawl, demersal fish, mesh size 100-119mm, no selectivity device, all vessels

OTT_DEF_16-31_0_0_all	Multi-rig otter trawl, demersal fish, mesh size 16-31mm, no selectivity device, all vessels
OTT_DEF_80-89_0_0_all	Multi-rig otter trawl, demersal fish, mesh size 80-89mm, no selectivity device, all vessels
OTT_DEF_90-99_0_0_all	Multi-rig otter trawl, demersal fish, mesh size 90-99mm, no selectivity device, all vessels
PS_SPF_0_0_0	Purse seine, Small pelagic fish, no selectivity device.
PTB_DEF _>=70_0_0	Bottom pair trawl directed to demersal fish (at least 70 mm)
PTB_DEF_>=120_0_0_all	Pair bottom trawl, demersal fish, mesh size more than 120mm, no selectivity device, all vessels
PTB_DEF_>=70_0_0	Pair bottom trawler targeting demersal fish
PTB_DEF_80-89_0_0_all	Pair bottom trawl, demersal fish, mesh size 80-89mm, no selectivity device, all vessels
PTB_MPD_>=55_0_0	Bottom pair trawl directed to mixed pelagic and demersal fish (at least 55 mm)
PTM_DEF_90-104_0_0	Midwater pair trawl, demersal fish, mesh size 90-104 mm, no selectivity device
SDN_DEF_>=120_0_0_all	Anchored seine, Demersal fish, mesh size more than 120mm, no selectivity device, all vessels
SDN_DEF_>=120_0_0_all_FDF	Anchored Seine, Demersal Fish, Mesh Size 120 or above, Selectivity Device - none, All vessels, Fully Documented Fisheries
SSC_DEF_>=120_0_0_all	Fly shooting seine, Demersal fish, mesh size more than 120mm, no selectivity device, all vessels
SSC_DEF_>=120_0_0_all_FDF	Fly shooting seine, Demersal Fish, Mesh Size 120 or greater, Selectivity Device - none, All vessels, Fully Documented Fisheries
SSC_DEF_100-119_0_0_all	Fly shooting seine, Demersal fish, mesh size 100-119mm, no selectivity device, all vessels.
SSC_DEF_80-89_0_0_all	Fly shooting seine, Demersal fish, mesh size 80-89mm, no selectivity device, all vessels.
SSC_DEF_All_0_0_All	Fly shooting seine, , Demersal fish, all mesh sizes, no selectivity, all vessels
TBB_CRU_16-31_0_0_all	Beam trawl, Crustaceans, mesh size 16-31mm, no selectivity device, all vessels
TBB_DEF_<16_0_0_all	Beam trawl, Demersal fish, mesh size 16mm or less, no selectivity device, all vessels
TBB_DEF_>=120_0_0_all	Beam trawl, Demersal fish, mesh size more than 120, no selectivity device, all vessels

TBB_DEF_100-119_0_0_all	Beam Trawl, mesh size 100-119mm
TBB_DEF_70-99_0_0_all	Beam trawl, Demersal fish, mesh size 70-99, no selectivity device, all vessels
TBB_DEF_90-99_0_0_all	Beam trawl, Demersal fish, mesh size 90-99, no selectivity device, all vessels
TBB_DEF_all_0_0_all	Beam trawl, Demersal fish, all mesh sizes, no selectivity, all vessels

Appendix 3. Target assemblage (métier code) codes permitted under the DCF.

Code	Definition
DEF	Demersal fish
CRU	Crustaceans
SPF	Small pelagic fish
LPF	Large pelagic fish
MOL	Molluscs
DWS	Deep-water species
FIF	Finfish
CEP	Cephalopods
CAT	Catadromous
GLE	Glass eel
MPD	Mixed pelagic and demersal fish
MDD	Mixed demersal and deep-water species
MCD	Mixed crustaceans and demersal fish
MCF	Mixed cephalopods and demersal fish

Appendix 4. Selectivity devices are defined under the DCF according to this table.

Description	Code
None mounted	0
Exit window/selection panel	1
Grid	2
Unknown	3

Appendix 5. Country codes as used by InterCatch.

BE	Belgium	JE	UK (Channel Island Jersey)
CA	Canada	LT	Lithuania
DE	Germany	LV	Latvia
DK	Denmark	NL	Netherlands
EE	Estonia	NO	Norway
ES	Spain	PL	Poland
FI	Finland	PT	Portugal
FO	Faroe Islands	RU	Russia
FR	France	SE	Sweden
GG	UK (Channel Island Guernsey)	UK	United Kingdom
GL	Greenland	UKE	UK (England)
IE	Ireland	UKN	UK(Northern Ireland)
IM	UK (Isle of Man)	UKS	UK(Scotland)
IS	Iceland	US	United States
IT	Italy		

Appendix 6. Area coding for *Nephrops* as used in InterCatch for this data call.

Corresponding Area units for finish	Nephrops only			
	Functional Unit (FU)	InterCatch Code	InterCatch Area type code	ICES Rectangles
Divisions VIIIa and VIIIb	FU23-24	VIII2324	Div	21E6, 21E7, 22E5, 22E6, 23E5
Division VIIIc	FU25	VIIIc25	SubDiv	15E0, 15E1, 16E1
	FU31	VIIIc31	SubDiv	16E4, 16E5, 16E6, 16E7,
Division IXa	FU26-27	IXa26 IXa27	SubDiv	09E0, 10E0, 11E0, 12E0,
	FU28-29	IXa2829	SubDiv	02E0, 03E0, 04E0
	FU30	IXa30	SubDiv	02E2, 02E3, 03E2, 03E3

Appendix 7. Species for inclusion in this data call.

	COMMON SPECIES NAME	*CODE*	*SCIENTIFIC SPECIES NAME*
1	*Anglerfish*	*MON*	*Lophius piscatorius*
2	*Black-bellied Anglerfish*	*ANK*	*Lophius budegassa*
3	*Sea bass*	*BSS*	*Dicentrarchus labrax*
4	*Hake*	*HKE*	*Merluccius merluccius*
5	*Four-spot megrim*	*LDB*	*Lepidorhombus boscii*
6	*Megrim*	*MEG*	*Lepidorhombus whiffiagonis*
7	*Common sole*	*SOL*	*Solea spp.*
8	*Plaice*	*PLE*	*Pleuronectes platessa*
9	*Whiting*	*WHG*	*Merlangius merlangus*
10	*Norway lobster*	*NEP*	*Nephrops norvegicus*

Appendix 8. The documentation spreadsheet – an example of how to describe specific DCF categories contributing to supra-métiers uploaded to InterCatch. This spreadsheet is to be created

by the data provider and supplied to Michel Bertignac Michel.Bertignac@ifremer.fr, Chair of WGBIE once data uploads are completed.

Metier code WGMIXFISH	Area	Vessel length classes	Gear types	Mesh size range	Description
OTB_CRU_70-99_0_0_all	4	<10 10<12 12<18 18<24 24<40 >=40	OTB OTT PTB SSC	70-99	Bottom trawls with mesh size >=70 & < 100 mm. No distinction between gear with or without selective devices. Notes NEP7 - majority of vessels 18<24 length with use of OTT gear. NEP8 & NEP9 - majority of vessels 12<18 length.
OTB_DEF_>=120_0_0_all	4	<10 10<12 12<18 18<24 24<40 >=40	OTB OTT PTB SSC	100-119 >=120	Bottom trawls with mesh size >=100mm. No distinction between gear with or without selective devices.
FPO_CRU_0_0_0_all	4	<10 10<12 12<18 18<24 24<40 >=40	FPO	na	Creels There are very small amounts of creel landings - no sampling. Mostly <10m vessels