# ICES WGHMM REPORT 2012

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# Report of the Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim (WGHMM)

10–16 May 2012

ICES Headquarters, Copenhagen

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## Contents

## Executive Summary


The ICES Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim (WGHMM) met in ICES Headquarters during May 10-16 2012. There were 21 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 3 participated part time and 3 by correspondence). The group was tasked with carrying out stock assessments and catch forecasts and providing a first draft of the ICES advice for 2013 for all stocks including 9 functional units for *Nephrops*. In addition, 5 new stocks were also added to the terms of reference in 2012.

A number of WGHMM stocks underwent the benchmark process in 2012. Anglerfish stocks (*L.piscatorius and L.budegassa*) in VIIIc, IXa and in VIIb-k, VIIIa,b,d and megrim (*L.whiffiagonis*) in VIIb-k, VIIIa,b,d were considered by WKFLAT_2012 with new assessment approaches being agreed for *L.piscatorius* in VIIIc, IXa and for megrim in VIIb-k, VIIIa,b,d. *Nephrops* FUs 23-24 and 26-27 were also considered by the Inter-Benchmark Protocol IBPNeph_2012 although no firm conclusions were reached by this group.

A number of issues significantly constrained the group's ability to address the terms of reference this year, most notably the recall of all Spanish commercial data for 2011 that had previously been supplied. Alternative 'official' data were subsequently supplied to the group but for a number of reasons these data could not be used in the assessments. This meant that for 19 of the 21 stocks no update assessment could be conducted this year. In these instances the group adopted one of two approaches depending on the status of the assessment for the stock concerned (see section 1.4.1 for further details).

Five new stocks were included in the terms of reference for 2012. Confirmation that these stocks would be included for consideration by the WGHMM was received prior to the meeting but gave little opportunity to arrange for stock co-ordinators and preparation of data prior to the meeting. Relatively little progress was made for the new stocks in 2012. The group discussed approaches for improving the information for these stocks and for integrating them more appropriately into the report next year. As last year this information is contained in an annex to the final report (Annex R).

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 12 contain the single stock assessments. Several annexes follow.

# 1 Introduction

## 1.1 Terms of Reference

2011/2/ACOM11 The **Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim** [WGHMM], Rob Scott*, UK, will meet in ICES HQ, 10–16 May 2012 to:

a ) Address generic ToRs for Fish Stock Assessment Working Groups (see table below).

b ) Assess the progress on the benchmark preparation of Megrim (*Lepidorhombus boscii*) in Divisions VIIIc and IXa and Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIIc and IXa.

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.

WGHMM will report by 23 May 2012 for the attention of ACOM.

| Fish Stock | Stock Name | Stock Coordinator | Assess. Coord. 1 | Assess. Coord. 2 | Advice |
|---|---|---|---|---|---|
| ang-78ab | Anglerfish (*Lophius budegassa* and *L. piscatorius*) in Divisions VIIb-k and VIIIa,b | Spain/France | Spain/France | France/Spain | Advice |
| ang-8c9a | Anglerfish (*Lophius budegassa* and *L. piscatorius*) in Divisions VIIIc and IXa | Spain/Portugal | Spain/Portugal | Portugal/Spain | Advice |
| hke-nrtn | Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock); | France | France | Spain | Advice |
| hke-soth | Hake in Division VIIIc and IXa (Southern stock); | Spain | Spain | Portugal | Advice |
| mgb-8c9a | Megrim (*Lepidorhombus boscii*) in Divisions VIIIc and IXa | Spain | Spain | | Advice |
| mgw-8c9a | Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIIc and IXa | Spain | Spain | | Advice |
| mgw-78 | Megrim (*L. whiffiagonis*) in Subarea VII & Divisions VIIIa,b,d,e | Spain | Spain | | Advice |
| sol-bisc | Sole in Divisions VIIIa,b,d (Bay of Biscay) | France | France | | Advice |
| nep-2324 | *Nephrops* in Divisions VIIIa,b (Bay of Biscay, FU 23, 24) | France | France | | Advice |
| nep-25 | *Nephrops* in Division VIIIc (FU 25, North Galicia) | Spain | Spain | | Biennial, 1st year |
| nep-31 | *Nephrops* in Division VIIIc (FU31, Cantabrian Sea) | Spain | Spain | | Biennial, 1st year |
| nep-2627 | *Nephrops* in Division IXa (FU 26-27 West Galicia and North Portugal) | Spain/Portugal | Spain/Portugal | Portugal/Spain | Biennial, 1st year |
| nep-2829 | *Nephrops* in Division IXa (FU 28-29 South-West and South Portugal) | Spain/Portugal | Spain/Portugal | Portugal/Spain | Biennial, 1st year |
| nep-30 | *Nephrops* in Division IXa (FU 30, | Spain/Portugal | Spain/Portugal | Portugal/Spain | Biennial, |

| | | | | | |
|---|---|---|---|---|---|
| | Gulf of Cadiz) | | | | 1st year |
| sol-8c9a | Sole in Divisions VIIIc and IXa | ? | ? | ? | Advice |
| ple-89a | Plaice in Subarea VIII and Division IXa | ? | ? | ? | Advice |
| pol-89a | Pollack in Subarea VIII and Division IXa | ? | ? | ? | Advice |
| whg-89a | Whiting in Subarea VIII and Division IXa | ? | ? | ? | Advice |
| | | ? | ? | ? | Advice |
| | | ? | ? | ? | Advice |
| gug-89a | Grey gurnard in Subarea VIII and Division IXa | ? | ? | ? | Advice |

## 1.2 Summary by Stock

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

For many of the stocks assessed by WGHMM it was not possible to produce update assessments in 2012. The stock summaries presented below will be largely unchanged from last year in those instances where the 2011 assessment has been used as the basis of stock status. These include the stocks of northern hake, northern anglerfish, southern hake, southern megrims.

***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 73 100 t in 2010, which is well above the 2010 TAC (55 105 t). The biggest increases in landings took place in 2009 and 2010, each year representing an approximate 25% increase with respect to landings in the preceding year.

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.

This stock had a benchmark assessment in February 2010 (WKROUND, ICES 2010a), where main issues tackled were the fact that growth of this species is faster than previously assumed and that ages have been overestimated in the past. As no new ageing criterion has been developed, WKROUND replaced the previous age-based assessment model (XSA) with a new one (Stock Synthesis) which permits the use of only length data and has the capability to estimate fish growth together with population dynamics and exploitation levels. Discards have also been incorporated in the new assessment, with landings and discards data entered at “fleet” level and quarterly. The benchmark assessment started in 1990, the year up to which data at this finer level of disaggregation have been recovered. Only abundance indices from research surveys (*i.e.* no commercial CPUEs) have been used for tuning.

In 2010, WGHMM updated the northern hake assessment in the Autumn using a reduced time series due to the unavailability of 2009 French landings data before that time. The reduced length of the assessed period (from year 1990) and the fact that no large fish are present in the commercial catches or survey abundance indices during this period, made the assessment uncertain, particularly in the most recent years. The WG in 2010 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 WG in 2010 accepted the assessment only as indicative of stock trends and did not present short term projections.

For the 2011 WG it was possible to recover commercial data (landings and length frequency distributions) by fleet for years 1978-1989, albeit on an annual rather than a quarterly basis. This allowed extending the assessment period back to 1978, as was the case with the previous XSA assessment. The incorporation of these earlier years has improved the model's ability to determine the degree to which levels of fishing reduced hake abundance during the mid 80s and the 90s and, thus, provides a clearer perspective of the historical stock development. While recent rates of F decrease and SSB increase remain important, recent F and SSB estimates are consistent with values estimated at the end of the 70s. The sharp increase in SSB in recent years is the direct consequence of a series of good recruitments in 2006-2008 and the high growth rate estimated by the assessment model (consistent with estimates from tagging data). Estimated SSB trends are also consistent with increasing landings and increasing CPUEs from commercial fleets and current SSB estimates are in line with the short-term projections that were deemed to be unrealistic in 2010. The retrospective analysis showed that assessment results were not overly sensitive to the exclusion of recent data. As a consequence, the WG decided to accept the assessment in 2011 as a full analytical assessment and used it as a basis to provide short-term projections and catch forecasts.

Since it was not possible to update the assessment in 2012 (see section 1.4.1) the assessment presented by the working group in 2011 has been used as the basis of stock status and an extended short term forecast, with 2 intermediate years has been used to determine catch options and management advice for 2013. The use of two intermediate years increases the uncertainty in estimates of catches and stock status produced by the forecast. Status quo F and geometric mean recruitment assumptions have been made for the intermediate years. Available survey information indicates that recruitment in 2011 has been close to the geometric mean value.

In 2010, the WG proposed an $F_{MSY}$ proxy based on the benchmark assessment. The same value was kept by the WG in 2011 and this year. If the present northern hake assessment becomes an established analytical assessment, further work on reference points should be conducted in the near future.

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. Landings in 2010 were estimated to be 15 700 t, well above the TAC (9 300 t). Total stock catch, including discards, was estimated to be 17 300 t. The TAC in 2011 was 10,695 t and in 2012 is 12,299 t.

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 2010 (WKROUND, ICES 2010a). As for northern hake, growth and age reading were main issues and WKROUND replaced the previous age-based assessment model (Bayesian statistical catch-at-age) with a new one (GADGET) which permits the use of only length data and can estimate fish growth together with population dynamics and exploitation levels. Discards and the Gulf of Cádiz area were incorporated in the benchmark assessment.

For SSB, the current assessment indicates a strong decreasing trend from the mid 1980s until the late 1990s, when the historic minimum is reached. After that, SSB shows a general increasing trend, accelerating in recent years, and reaches 18 700 t in 2010. Recruitment has been increasing strongly after 2004 with the largest estimate corresponding to year 2010, but this value needs to be confirmed in future assessments (the WG replaced this estimate by the geometric mean of recruitment estimates over years 1989-2009). F shows relatively stable values for about one decade until 2009, with a sudden drop in 2010. This is suspected to be a consequence of the reduction in Spanish landings due to the national legislation mentioned above.

It was not possible to update the assessment in 2012 (see section 1.4.1). The assessment presented by the working group in 2011 has been used as the basis of stock status and an extended short term forecast, with 2 intermediate years has been used to determine catch options and management advice for 2013. The use of two intermediate years increases the uncertainty in estimates of catches and stock status produced by the forecast. Status quo F and geometric mean recruitment assumptions have been made for the intermediate years. In addition, geometric mean recruitment has also been assumed for 2010. These assumed values contribute significantly to estimates of catches in 2013.

In 2010, WGHMM proposed an $F_{MSY}$ proxy based on the benchmark assessment and the same value was kept by the WG in 2011 and this year.

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*. The 2010 TAC for both species combined is 41 400 t and estimated landings 28,880 t. Spain and France together contribute about 80% of total stock landings. The 2011 and 2012 TACs are 40,950 t. and 38,900 t. respectively.

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 between them the whole distribution area of the stocks and with little overlap between them.

For *L. piscatorius* the available data indicate that biomass has been increasing as a consequence of very high recruitments in 2001, 2002 and 2004 and has stabilised in recent years (although with some decrease according to the French survey in the last 2 years). There is evidence of good recruitments in 2008-2010.

For *L. budegassa* survey data indicate that biomass and abundance in numbers have been continuously increasing from the mid to late 2000s, due to a sequence of strong recruitments during 2004-2008. Recruitment in 2009 appears to be low but with an improvement in 2010.

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 2010 were 2 331 t, 58% above the TAC of 1 496 t, which is set for both species combined. The combined TAC in 2011 and 2012 was 1,571 t. and 3,300 t. respectively.

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 around 7,500 tonnes. 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.

Fishing mortality of *L. budegassa* was around $F_{MSY}$ in the early 1980s, subsequently increasing to much higher levels. F has been decreasing strongly since year 2000 and has been below $F_{MSY}$ since 2009. Biomass was close to $B_{MSY}$ until the mid-late 1980s, then decreasing strongly during the period of higher fishing mortality. In parallel with the reduction in F in recent years, biomass shows a marked upwards trend since 2008, being below but close to $B_{MSY}$ in 2011.

Although the stocks are assessed separately, they are managed together. The differences in their current status make it difficult to give common advice.

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 2011 and 2012 TAC is 20 106 t. Landings in 2008 (10 853 t) corresponded to the minimum of the historical series but have increased to approximately average levels in 2010 (13 185 t). Discarding of smaller megrim is substantial and also includes individuals above the minimum landing size of 20 cm. The discards estimate for 2010, 4 406 t, is among the highest in the historical series

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.

It was not possible to update this assessment in 2012 and the assessment conducted at the benchmark meeting using data up to and including 2010 has been used as the basis of advice this year.

Fishing mortality is estimated to be higher in recent years but the absolute level cannot be determined from the current assessment. SSB has declined throughout most of the time series but has increased slightly in the most recent years. Overall the stock appears to be stable at the current level of fishing mortality.

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 2010 were 1 380 t (of which 94% correspond to *L. boscii*), above the TAC of 1 287 t, which is set for both species combined. The TAC for 2011 and 2012 is 1,094 t. and 1,214 t. respectively.

The species are assessed separately, using XSA for each of them. Update assessments were conducted this year. For *L. whiffiagonis*, a survey and two commercial LPUE series (one of which ended in 2003) are used for tuning the XSA. For *L. boscii*, the same survey and one of the commercial LPUE series (although stopped in 1999) are used for tuning.

For *L. whiffiagonis* the assessment indicates that SSB has been in general decline throughout the time series. The lowest SSB occurring in 2009, although a slight retrospective trend indicates that this value may be revised upwards in subsequent assessments. Fishing mortality has also declined since the late 1980s and is currently estimated at its lowest value and below FMSY, however, these values should be considered with caution. The reference points are considered to be preliminary and have been derived from an assessment that does not include discards.

For *L. boscii* the assessment indicates that SSB decreased progressively between 1988 and 2001, with a slight increasing trend thereafter. SSB in 2010 is estimated to be close the mean of the full time series. F has fluctuated through time but since 1998 has remained very constant at values of around 0.3. Both high and low recruitments are seen throughout the whole time series.

It was not possible to update assessments for either stock in 2012 (see section 1.4.1). Consequently the assessments conducted in 2011 using data up to and including 2010 have been used as the basis of stock status and an extended, 4 year, forecast has been used to determine catch options and management advice for 2013

There are no biological reference points defined for these stocks. The WG proposed $F_{MSY}$ values in 2010, which were maintained this year.

The differences in SSB, recruitment and F trends in the last years make it difficult to give combined advice for the two stocks. Mixed fishery considerations should be taken into account when providing management advice.

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 2011 were 4 626 t, whereas the TAC was 4 250 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.

A benchmark for this stock took place at the start of 2011, in the ICES workshop WKFLAT (ICES, 2011b). The assessment approved at the benchmark is based on XSA, as was the previous assessment. The benchmark decided to exclude the tuning series corresponding to the RESSGASC survey, as this survey was last conducted in 2002 and was no longer contributing to final population estimates. At the benchmark, two additional CPUE series from commercial fleets were incorporated for tuning. The main reason for this decision was that the two commercial series previously used for tuning (composed of appropriately chosen groups of trawlers from the ports of La Rochelle and Les Sables d'Olonne) were displaying less and less effort and it was considered that they might soon no longer be representative of stock abundance. This was considered to be the case already in this year's assessment. Hence, the assessment conducted by the WG this year is an update of the assessment approved at the benchmark, but without the inclusion of the 2010 tuning data from La Rochelle and Les Sables fleets.

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. At present, no recruitment indices are available for tuning the assessment, although a survey which started in 2007 (ORHAGO) should be useful in the near future and the benchmark workshop recommended its inclusion as soon as possible.

The benchmark kept the previous reference points, so $B_{pa}$ remains at 13 000 t. However, as a consequence of the changes introduced at the benchmark, the time series of SSB estimates was revised upwards during the 1980s and slightly downwards for recent years, with the consequence that SSB is now estimated to be a bit below $B_{pa}$ during the 1999-2010 period, although just above it in 2011. F has been at lower levels since 2003, at around $F_{pa}$ (0.42). It is estimated to be below $F_{pa}$ in 2009 and 2010. The XSA recruitment estimate in the terminal year is very uncertain and was, as usual, overwritten by a short GM series from 1993 to the antepenultimate assessment year.

An $F_{MSY}$ value of 0.26 was proposed for this stock by WGHMM in 2010 and kept this year.

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. The TAC in 2011 was 3,899 the same as for 2011.

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. Work presented to the IBP included the development of a probabilistic method to fill in the many gaps in the series of discards estimates, the inclusion of the LANGOLF survey tuning series and changes to the shrinkage settings of XSA. The working group accepted these changes but recommends that the stock undergoes a full benchmark process in the near future.

The stock is assessed using XSA and a new assessment is presented this year, although the results are considered only indicative of stock trends. The assessment indicates a reduction in F and an increase in SSB in recent years although these are considered to be poorly estimated. The stock is considered to be stable at current levels of fishing mortality. In line with recommendations from WKLIFE, a short term forecast has been conducted from which the percentage change in SSB in 2014 can be calculated for different levels of catch in 2013.

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 in 2010 from the two FUs combined were 43 t, well below the TAC of 101 t, which is set for the whole of Division VIIIc.

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).

It was not possible to update the trends of LPUE for either FU25 or FU31 this year. Consequently information is presented for years up to and including 2010.

**FU 25** (North Galicia): Landings are reported only by Spain. Since the early 1990s landings declined from about 400 t to less than 50 t. Landings in 2008-2010 are the three lowest recorded values. The LPUE from the main commercial fleet shows an overall declining trend, with some fluctuations and reaching its three lowest values in 2008-2010.

**FU 31** (Cantabrian Sea): Landings reported by Spain (the only participant in the fishery) are available for the period 1983-2010. The highest landings were recorded in 1989 and 1990. After 1996 landings have declined sharply from 129 t to less than 20 t in recent years, with only 6 and 8.5 t landed in 2009 and 2010, respectively. The LPUE data available show an increase in 2010, but this does not change the perception that the stock is at a very low abundance level.

Both FUs were assessed in 2010, with the conclusion that they were at very low abundance levels and ICES advised zero catch for 2011 and 2012. There is insufficient information available this year to change that conclusion.

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 2010 from the five FUs combined were 250 t, below the TAC of 337 t, set for the whole of Division IXa.

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. During 1975-1989 landings fluctuated between 600 and 800 t, with a strong downward trend starting from 1990. After 2004, landings have been below 50 t every year. Only 19 t were landed in 2010.

The stock was assessed in 2010, with the conclusion that it continued to be at a very low abundance level. There is insufficient information available this year to change that conclusion.

**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.

Until 1992 landings fluctuated around 480 t, subsequently falling drastically until 132 t in 1996. After that, landings increased again substantially until 2004, at which point a new decreasing trend started. Landings were 124 t in 2010, the second lowest value in the series.

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.

The working group recommends that the stock undergoes a full benchmark process in the near future.

**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 fluctuated around 100 t until year 2000, subsequently increasing to much higher levels (over 200 t). They have been decreasing again since 2006, with a big drop in 2008. Landings in 2010 were only 107 t, the lowest value for over a decade. Estimated directed effort at *Nephrops* has decreased substantially since 2005. This could be a consequence of several effort regulation measures established in very recent years and other factors such as bad weather conditions and an industry strike in 2008. Landings of rose shrimp increased in 2008, indicating a possible change in the objectives of the fishery.

The stock was assessed in 2010 via examination of directed LPUE and survey trends. The LPUE series shows an overall declining trend and ICES advised on the basis of a transition to an MSY approach to reduce landings from recent levels at a rate greater than the rate of stock decrease. No assessment was conducted this year.

It was not possible to update the trends of LPUE for either FU25 or FU31 this year. Consequently information is presented for years up to and including 2010.

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. Fine scale management of catches and effort at a geographic scale corresponding to the actual stocks would be more appropriate.

Additional details can be found in Section 12 and Annex L.

## 1.3 Data available

As in previous years, data for 2012 were prepared in advance of the meeting and all revisions to data are referred to in the appropriate stock sections. Data deficiencies have compromised the assessments conducted for some stocks. The main data problems detected by the Working Group and for which action is required are described in the "Data Problems" table included in Annex P of the WG report.

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. Specific issues relating to the provision of data to the working group arose during the meeting this year. These issues seriously affected the work that could be conducted during the meeting and are described in more detail in section 1.4.1

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 Issues that arose during the WGHMM meeting

### 1.4.1 Recall of Spanish Data

The start of the meeting was delayed slightly to allow scientists from IEO to receive an instruction, delivered via their national institute, regarding the provision of data to the working group. At 09:30 on the first day of the meeting the working group was advised that the estimates of Spanish landings submitted by IEO for 2011 could not be used by the working group. Instead, official data for Spanish landings would be provided by the national administration for fishery statistics (Secretaría General de Pesca - SGP). The instruction was that these official data should be used in the assessments and that the scientific estimates of landings in 2011 previously provided by IEO should be disregarded.

Data for Spanish landings were provided to the working group by SGP (via IEO) on Friday 11$^{th}$ May and are shown in annex T of this report. No information was available on the method by which these data had been compiled. The data were submitted at very short notice and were not made available following the usual procedures for the provision of official statistics (ie. Via STATLANT).

The group evaluated these data and quickly concluded that they were unsuitable for use in the models used to assess the stocks. In many cases the data were not disaggregated to an appropriate level to enable their inclusion in the assessment models. The level of disaggregation necessary varies between stocks but in some cases requires data at a quarterly level for the different fleet sectors operating in the fishery. In other instances the data provided were not disaggregated by species (ie. for monkfish – *L.piscatorius* and *L.budegassa* and for megrim *L.whiffiagonis* and *L.boscii*). These species are assessed separately but are managed as a combined stock. Similarly, for stocks of *Nephrops* the data were not disaggregated to functional unit level. Some concerns were raised regarding the validity of the data provided which in some instances indicated a marked reduction in landings from previous years. It was not possible to attribute these reductions in landings to any observed changes in the fishery such as a reduction in fishing effort, a marked decline in stock biomass or an increase in discard levels.

The group concluded that the landings data for 2011 provided by SGP could not be used to update the assessment models in 2012. Three stocks assessed by WGHMM (Biscay Sole, *Nephrops* FU 23-24 and *Nephrops* FU 28-29) were unaffected by the absence of Spanish landings data and could be assessed in the usual approach. Following a discussion of the available options the group adopted the following approach for those stocks affected by the unavailability of landings data in 2011.

For those stocks for which an accepted assessment was available, the assessment conducted either by the working group in 2011 or by the benchmark group in March 2012 (using data up to and including 2010) would be used as the basis of stock status and an extended short term projection with appropriate estimates used for 2011 and 2012 would be used to determine catch options and management advice for 2013.

For those stocks for which no accepted full assessment was available, information on stock trends would be provided based on commercial LPUE that excluded Spanish landings in 2011 and all available survey information. In this instance the advice would be formulated as last year but with the exception of Spanish landings information in 2011.

The approach taken to conducting a four year short term forecast is detailed in the individual stock sections of this report. A brief statement is provided at the beginning of each stock section to describe the approach taken.

### 1.4.2 Use of InterCatch by WGHMM

As for 2011, little progress has been made by the group with regards to the use of InterCatch. Last year the WG stock coordinators compiled a table indicating whether or not InterCatch has been used for their stocks and the reasons for not using it. The same table applies this year. The 2011 WG agreed to define common “InterCatch fleets” (which essentially correspond to Level 5 DCF métiers) to facilitate the use of InterCatch in future years and to promote consistency between countries and stocks.

### 1.4.3 Stock annexes

Stock annexes are available for all of the stocks currently assessed by WGHMM. No stock annexes currently exist for the new stocks that have been included in the terms of reference for 2012. Work will be conducted between now and the next working group meeting to further progress this information.

### 1.4.4 Benchmarks

The group discussed adopting a long term approach to the benchmark process and is drafting a strategy for conducting the necessary work to further develop the assessments and methods used to provide management advice. In some cases this work will span a number of years. The group is very conscious that the success of the benchmark meetings is very dependent on the amount of work that can be done beforehand. For this reason the group agreed to postpone the proposed benchmark of Megrim in VIIIc, IXa until further work could be completed.

It is proposed that the stock of Northern Hake should be considered for a benchmark in 2013.

Two stocks of *Nephrops* (FU 26-27 and FU 28-29) underwent an inter-benchmark protocol in 2012. The results of this process were largely inconclusive and no clear instructions were provided to the working group on whether the proposed revisions to the assessments should be accepted or not. The group discussed the proposed assessment revisions and drew its own conclusions, based mainly on the most pragmatic way to proceed.

The long term plans for benchmark work are currently under development. Initial proposals for the benchmark schedule and supporting information are given Annex N of this report. The group continues to update and further develop the ICES benchmark preparation tables produced previously for stocks benchmarked in 2012.

### 1.4.5 Data Tables

As requested by ICES in recent years, this year the WG stock coordinators were again asked to fill Data Tables concerning data transmitted to the WG for assessment purposes. These tables have been filled during the WG meeting and are available on the WGHMM 2012 SharePoint site, under the "Data Tables" folder

### 1.4.6 New ToRs on new species

The terms of reference for WGHMM listed several new species this year for which advice is required in 2012. The process by which new species are allocated to the working groups remains opaque and the procedures followed by WGNEW for the transfer of stocks to the area based groups appears to be inconsistent. In some cases assessments and benchmark procedures are conducted for individual stocks by WGNEW whilst in other cases stocks are passed on to area based assessment groups following minimal data collation. The allocation of the new stocks to WGHMM was subject to decisions made during WGNEW in 2012 and as a consequence WGHMM received very short notice of the additional work required. It was difficult to allocate stock co-ordinators at such short notice and as a consequence the amount of progress achieved for these stocks in 2012 has been variable.

WGHMM continues to detail the work conducted on the new stocks in annexes to the main report (see annex R of this report) with a view to developing specific stock sections for each of these stocks in 2013. Advice sheets for these stocks have also been drafted this year.

**Table 1.3 Biological sampling levels by stock and country. Number of fish measured and aged from landings in 2011**

| | | 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 | | | | | | | | 9046 |
| | No. ages | | | | | | | | 347 |
| | No. samples** | | | | | | | | 2 |
| E & W (UK) | No. lengths | 9863 | | 1615 | | 11803 | | | |
| | No. ages | | | | | 610 | | | |
| | No. samples* | 115 | | 58 | | 96 | | | |
| France | No. lengths | 16510 | | 5676 | | 19321 | | | 25617 |
| | No. ages | | | | | 1441 | | | 2084 |
| | No. samples*** | 908 | | 908 | | 3459 | | | 181 |
| Portugal | No. lengths | | 83 | | 670 | | 135 | 3057 | |
| | No. ages*** | | 0 | | 0 | | 0 | 0 | |
| | No. samples* | | 31 | | 68 | | 7 | 54 | |
| Republic of Ireland | No. lengths | 6074 | | 2827 | | 24915 | | 81 | |
| | No. Ages***** | 1120 | | 0 | | 2414 | | 0 | |
| | No. samples* | 107 | | 63 | | 96 | | 3 | |
| Spain | No. lengths | 4764 | 2775 | 10201 | 5143 | 21936 | 5334 | 22623 | |
| | No. Ages***** | 0 | 0 | 0 | 0 | 2141 | 1065 | 1090 | |
| | No. samples | 125 | 188 | 125 | 188 | 171 | 161 | 185 | |
| **Total** | **No. lengths** | **37211** | **2858** | **20319** | **5813** | **76460** | **5469** | **25761** | **34663** |
| | **No. ages** | **1120** | **0** | **0** | **0** | **5942** | **1065** | **1090** | **2431** |
| **Total No. in international landings (thousands)** | | **8139** | **493** | **7063** | **292** | **-** | **NA** | **NA** | **17340** |
| **No. Measured as % of annual number caught** | | **0.5** | **0.6** | **0.3** | **2.0** | | **NA** | **NA** | **0.2** |

* 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 | 2928 | | | | |
| | No. ages | | | | | |
| | No. samples* | 86 | | | | |
| E & W (UK) | No. lengths | 5557 | | | | |
| | No. ages | 742 | | | | |
| | No. samples* | 99 | | | | |
| France | No. lengths | 16711 | | 33458 | | |
| | No. Ages***** | 1416 | | | | |
| | No. samples*** | 450 | | 469 | | |
| Portugal | No. lengths | | 19836 | | | 4974 |
| | No. ages*** | | 0 | | | |
| | No. samples* | | 362 | | | 29 |
| Republic of Ireland | No. lengths | 9203 | | | | |
| | No. ages***** | 0 | | | | |
| | No. samples* | 95 | | | | |
| Spain | No. lengths | 61009 | 52982 | | 2016 | 4394 |
| | No. ages**** | 4265 | 0 | | | |
| | No. samples* | 262 | 530 | | 32 | 45 |
| **Total** | **No. lengths** | **95408** | **72818** | **33458** | **2016** | **9368** |
| | **No. ages** | **6423** | **0** | **0** | **0** | **0** |
| **Total No. in international landings (thousands)** | | **NA** | **NA** | **229614** | **NA** | **NA** |
| **No. Measured as % of annual number caught** | | **NA** | **NA** | **0.01** | **NA** | **NA** |

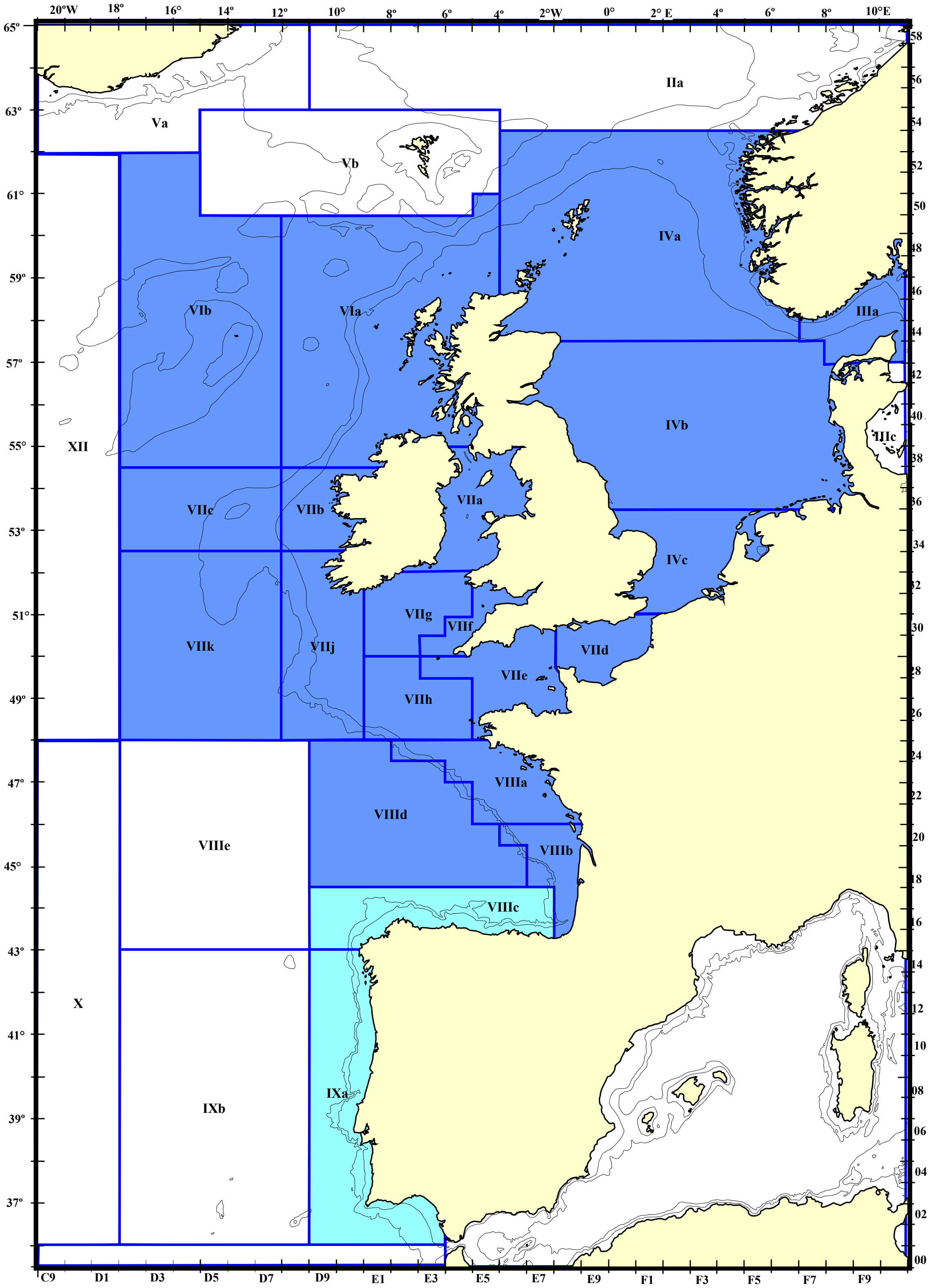



**Figure 1.1. Map of ICES Divisions. Northern (IIIa, IV, VI, VII and VIIIabd) and Southern (VIIIc and IXa) Divisions with different shading.**

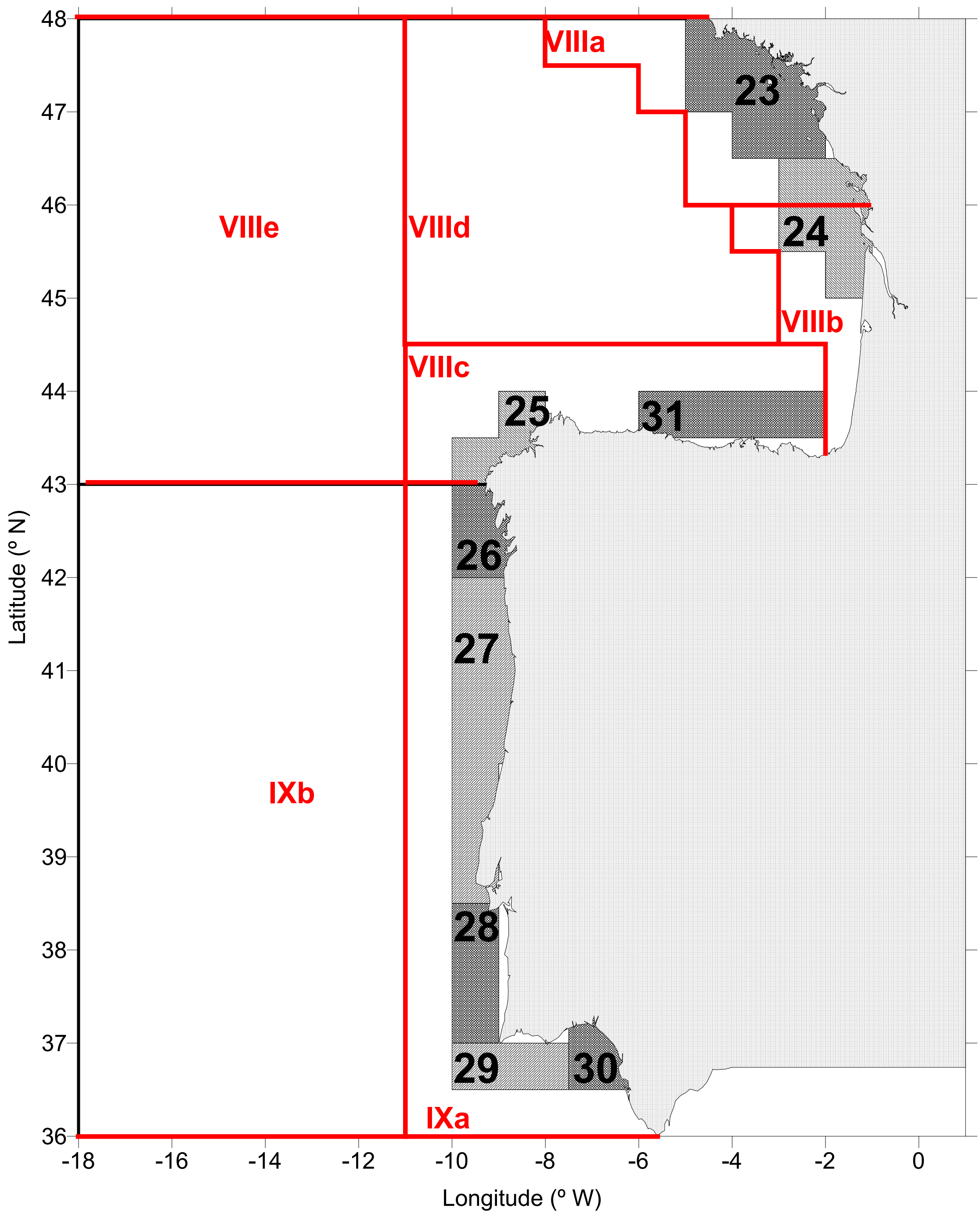



**Figure 1.2. ICES Division VIII and IXa. *Nephrops* Functional Units. Division VIIIab (Management Area N): FUs 23-24. Division VIIIc (Management Area O): FUs 25 and 31. Division IXa (Management Area Q): FUs 26-30.**

# 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 in future years, it presents the “fleets” that the WG proposes to use for data submission in InterCatch. WG members will check with the data teams and their institutions that this choice of fleets is indeed feasible for data submission.

### 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 |
| FU4 | OTB_DEF | 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 | | | |
| FU13 | GNS_DEF | 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 | |
| FU14 | OTB_MCF | OTB_MCF _>=70_0_0 | Bottom otter trawl directed to mixed cephalopods and demersal fish (at least 70 mm) | | | X | |
| FU14 | OTT_DEF | OTT_DEF _>=70_0_0 | Multi-rig otter trawl directed to demersal fish | X | | | |

| FU | Fleet for InterCatch | DCF METIER (Level 6) | DESCRIPTION | FR | IR | SP | UK |
|---|---|---|---|---|---|---|---|
| | | | (at least 70 mm) | | | | |
| | 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 |
|---|---|---|---|---|---|---|
| Spain | Gillnet | GNS_DEF | GNS_DEF_80-99_0_0 | Set gillnet directed to demersal species (80-99 mm) | X | |
| | | | 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 | |
| | Southern artisanal | LLS_DWS | LLS_DWS_0_0_0 | Set longline directed to deep-water species | X | |
| | Northern Trawl | PTB_DEF | PTB_DEF _>= 55_0_0 | Pair bottom trawl directed to demersal fish (at least 55 mm) | X | |
| | | 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 | |
| Portugal | Artisanal | GTR_DEF | GTR_DEF_>=100_0_0 | Trammel net directed to demersal fish (at least 100 mm) | | X |
| | | GNS_DEF | GNS_DEF_80-99_0_0 | Set gillnet directed to demersal fish (80-99 mm) | | X |
| | | 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 | | ----- |
| 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.

### 2.1.1 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.

### 2.2.5 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.

### 2.2.6 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.

### 2.2.7 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.

### 2.2.8 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.

### 2.2.9 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 1$^{st}$ 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.

### 2.2.10 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.

### 2.2.11 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.

### 2.2.12 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 2010), stock on observation list. It was not possible to include Spanish commercial data for 2011 in the assessment. The assessment model could not be updated this year. The assessment conducted in 2011 has been used as the basis of projections for catch options and management advice for 2013.

**Data revisions**: Landing and discards from 2007 to 2010 for the Spanish Vigo trawlers fishing in VII. This led to minor changes in the landings for those years.

**Review Group issues:** no outstanding issue. Some editorial suggestions have been addressed.

## 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 2012*

ICES advises on the basis of the transition to the MSY approach that landings in 2012 should be no more than 51 900 t.

MSY approach

The stock is considered to be above any potential MSY $B_{trigger}$. Following the ICES MSY framework implies fishing mortality to be reduced to 0.24, resulting in landings of 39 400 tonnes in 2012. This is expected to lead to an SSB of 138 000 tonnes in 2013.

Following the transition scheme towards the ICES MSY framework implies fishing mortality be reduced to 0.33 and corresponding to landing of 51 900 tonnes. This is expected to lead to an SSB of 125 000 tonnes in 2013. 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) | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| IIIa, IIIb,c,d (EC Zone) | 1323 | 1588 | 1627 | 1552 | 1661 | 1661 | 1661 |
| IIa (EC Zone), IV | 1541 | 1850 | 1896 | 1808 | 1935 | 1935 | 1935 |
| Vb (EC Zone), VI, VII, XII, XIV | 24617 | 29541 | 30281 | 28879 | 30900 | 30900 | 30900 |
| VIIIa,b,d,e | 16412 | 19701 | 20196 | 19261 | 20609 | 20609 | 20609 |
| Total Northern Stock [IIa-VIIIabd] | 43893 | 52680 | 54000 | 51500 | 55105 | 55105 | 55105 |

*Management for 2011 and 2012*

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.

## 3.2 Data

### 3.2.1 Commercial catches and discards

Total landings from the Northern stock of hake by area for the period 1961-2010 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, which are higher over the first decade (1961-1970), when the uncertainties in the fisheries statistics were high. Table 1 of the Stock Annex provides a historical perspective of the level of aggregation at which landings have been available to the WG.

Spanish data for 2011 are not included.

Spanish data in 2011 have been provided by SGP, the official national administration responsible for fishery statistics, and are presented in Annex T. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations.

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 73 100 t in 2010, the highest value since 1974 and well above the 2010 TAC (55 100 t). 2011 preliminary data seem to confirm this tendency: although still incomplete, landings excluding Spain (which is as yet unknown) have increased between 2010 and 2011 (17% increase from 30 294 to 35 504t ).

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 2011.

### 3.2.2 Biological sampling

The sampling level is given in Table 1.3.

Length compositions of the 2011 landings by Fishery Unit and quarter were provided by Ireland, France, Scotland, 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.

After two consecutive years of increases in 2001 and 2002, the abundance index provided by EVHOE-WIBTS-Q4 dropped in 2003, then showed a sharp increase in 2004 and dropped again in 2005 and 2006. The index increased again in 2007 and 2008, to reach the highest value of the series. It dropped again in 2009 and 2010 to a level close to the 2005 and 2006 levels and increased in 2011.

The abundance index provided by IGFS-WIBTS-Q4 follows a similar trend to EVHOE-WIBTS-Q4 in recent years with a decrease from 2008 to 2009-2010 and an increase in 2011.

For the SpPGFS-WIBTS-Q4 survey conducted on Porcupine's Bank since 2001, the abundance index follows an increasing trend since 2003, reaching its highest value in 2009 and decreases in 2010 and 2011.

The spatial distribution of the EVHOE-WIBTS-Q4 index for hakes from 0 to 20cm is given in Figure 3.2 for the most recent years. It is apparent from this figure that inter-annual variations in abundance are different between areas (VII and VIII).

### 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.

Due to the lack of Spanish data, it was not possible to update the effort and LPUE table and figures presented in this section. This section is thus a copy from last year report.

Effort and LPUE data for the period 1982-2010 are given in Table 3.4ab and Figure 3.3ab.

Since 1985, the LPUE of A Coruña trawlers operating in Subarea VII has fluctuated, with an increasing trend reaching its maximum value in 2010. 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.

LPUE from Ondarroa and Pasajes pair trawlers operating in Divisions VIIIa,b,d have followed similar trends and have been quite variable. Two peak values have been observed in 1995 and 2002. For Ondarroa, very large increases in LPUE have been observed in 2008 and 2009, with the largest value observed in 2009. Its LPUE remained at this high level in 2010. In 2005 both fleets experienced a decrease in effort (expressed in number of days), which corresponds to a decrease in number of vessels. This decrease has continued further for the Pasajes pair trawlers which were at a very low level of effort in 2007 (105 days only) and stopped their operations in 2008.

For the Ondarroa "Baka" trawlers fishing in Subareas VI, VII and Div. VIIIa,b,d, the Pasajes "Bou" trawlers fishing in Subarea VIII and the trawlers from Santander in VIIIa,b,d there is no marked trend in the LPUE, except for Ondarroa "Baka" trawlers in Subarea VII targeting hake and megrim until 1996 and megrim and anglerfish with lower hake LPUE since then, and Ondarroa trawl in VI which shows a increasing trend after 2003. LPUEs from Ondarroa "Baka" trawlers fishing in Div. VIIIa,b,d have been increasing since 2006.

Due to important reductions in the availability of log-book information in recent years for both French fleets from Les Sables and Lesconil, LPUE values for the years 1996 onwards have low reliability. Effort and LPUE for the period 1987-2003 are given in Table 3.4b and presented in Figure 3.3b only for the period 1987-1995.

The LPUE series of the two most important Spanish longline fleets operating in VII (Celeiro and Burela) have been rather stable over time, but both experienced a marked increased in the last 2-3 years. This same trend in also present in A Coruña longliners fishing in VII, although it is not quite as strong. It is to be noted however that for gill-netters and long liners, LPUEs expressed in kg/day may not be the most appropriate.

## 3.3 Assessment

Due to the lack of reliable Spanish landings and discards for 2011, the Working Group decided not to update the assessment.

The last assessment available was conducted during WGHMM2011 (ICES, 2011) and is used as a basis for current stock assessment and projections. Text and figures presented in the assessment results and historic trends sections below are copies from last year report.

### 3.3.1 Input data

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

### 3.3.2 Model

The Stock Synthesis 3 (SS3) assessment model (Methot, 2009) 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).

### 3.3.3 Assessment results

Residuals of the fits to the surveys log(abundance indices) are presented in Figure 3.4. The greater part of the upward trend in relative abundance observed in all three contemporary trawl surveys (EVHOE-WIBTS-Q4, SpPGFS-WIBTS-Q4 and IGFS-WIBTS-Q4) has been captured by the model 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 3.5, 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, 2010a).

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 3.6 presents selectivity (for the total catch; black lines) and retention functions by fleet (red and green lines) estimated by the model. For the Spanish trawl fleets in VII and VIII, a retention function is estimated for years 1978-1997 and another one for 1998-present. This change in retention 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. For the French trawlers targeting *Nephrops* in VIII, the same retention function is assumed throughout the entire assessment period (1978-present). 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.

The assessment model also estimates the growth rate K from a von Bertalanffy growth model (with L infinite fixed at 130 cm, in accordance with the Stock Annex). This year K is estimated at 0.177, close to last year's estimate.

The retrospective analysis (Figure 3.7) shows that for F and SSB the model results are not very sensitive to the exclusion of recent data. For 2006 and 2007, the patterns observed indicate a tendency to underestimate SSB and over-estimate F over the last years, but for more recent years (2008 to 2010), the trends in F and SSB remain fairly stable over the whole series. Some retrospective pattern is observed for recruitment but here again, the decreasing trend after 2008 is relatively well defined.

F2010 (average of F-at-length over lengths 15-80 cm) was estimated at 0.39 and SSB at 131 075 t.

Summary results from SS3 are given in Table 3.5 and Figure 3.8.

### 3.3.4 Historic trends in biomass, fishing mortality and recruitment

For recruitment, fluctuations appear to be without substantial trend over the whole series. Over the last years however, after some increase up to 454 million in 2007 (estimated to be among the highest of the series), the recruitment has decreased sharply to 100 million in 2009 (one of the lowest values of the series).

From high levels at the start of the series (102 000 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 2010 (131 000 t).

The fishing mortality is calculated as the average annual F for sizes 15–80 cm. This measure of F is nearly identical to the average F for ages 1–5. Values of F increased from values around 0.5-0.6 in the late 70s and early 80s to values around 1.0 during the 90s. They declined sharply afterwards to 0.39 in 2010.

## 3.4 Catch options and prognosis

### 3.4.1 Short – Term projection

Options for short term projection are indicated in the Stock Annex

This year, short term projections are carried out on the basis of the 2011 assessment and it is thus necessary to provide fishing mortality and recruitment values for two intermediate years (2011 and 2012)

For fishing mortality, unscaled F is used, corresponding to F(15-80cm)=0.42.

For recruitment, the Working Group decided to use information provided by available surveys in 2011 to set recruitment for 2011. For hake, among the three surveys available, the EVHOE-WIBTS-Q4, which covers the two main nursery areas, is thought to be the best suited for providing such information. A plot of recruitment estimated by the assessment model versus the EVHOE-WIBTS-Q4 index of abundance is presented in Figure 3.9. The Group is aware that the two series are not independent (the index being used, among other sources of information, to estimate recruitment) but the plot indicates a fair relationship between the two series which somehow confirms the choice of this survey as a good indicator of recruitment trend. In 2011, the EVHOE-WIBTS-Q4 index of abundance has increased from the low values observed in 2009 and 2010. It is at a level which indicates no departure from the historical levels and it was thus decided to use the GM calculated as indicated in the Stock Annex as recruitment for 2011 : i.e. GM from 1978 to the final assessment year minus 2 (295 M).

Landings in 2013 and SSB in 2014 predicted for various levels of fishing mortality in 2013 are given in Table 3.6 and Figure 3.10. Maintaining status quo F in 2013 is expected to result in a decrease in landings with respect to 2012 and a increase in SSB in 2014 with respect to 2013.

### 3.4.2 Yield and biomass per recruit analysis

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

Results of equilibrium yield and SSB per recruit are presented in Table 3.7 and Figure 3.11. The F-multiplier in Table 3.7 is with respect to status quo F (average F in the final 3 assessment years, 2008-2010). Considering the yield and SSB per recruit curves, $F_{max}$, $F_{0.1}$, $F_{35\%}$ and $F_{30\%}$ are respectively estimated to be 68%, 46%, 48% and 57% of status quo F. The maximum equilibrium yield per recruit is less than 4% above the equilibrium yield at $F_{sq.}$

## 3.5 Biological reference points

The benchmark carried out in 2010 (ICES 2010a) led to a complete re-start relative to the previous assessment which was based on age data now demonstrated to be biased. Thus, the PA reference points are no longer appropriate.

$F_{MSY}$ has been set to 0.24, the value proposed by WGHMM in 2010 based on F30% (the fishing rate that would reduce the spawning biomass per recruit to 30% of its unfished level). As can be seen in Table 3.7, F30% is still estimated equal to 0.24 in this year’s assessment.

According to the guidelines provided by WKFRAME (ICES, 2010b; ICES, 2011), for stocks fished at a level well above $F_{MSY}$ (as this is the case for northern hake), $B_{PA}$ could be used as a preliminary operational trigger point which could be revised once we get better knowledge of the biomass distribution under the condition of fishing at $F_{MSY}$. As explained above, the $B_{pa}$ value previously used for the northern hake stock is no longer appropriate and the WG is not proposing any MSY-$B_{trigger}$ this year.

| | Type | Value | Technical basis |
|---|---|---|---|
| MSY Approach | MSY $B_{trigger}$ | Not defined | |
| | $F_{MSY}$ | 0.24 | $F_{30\%SPR}$ as estimated in WGHMM 2010 |
| Precautionary Approach | $B_{lim}$ | Not defined | |
| | $B_{pa}$ | Not defined | |
| | $F_{lim}$ | Not defined | |
| | $F_{pa}$ | Not defined | |

## 3.6 Comments on the assessment

Due to the lack of reliable landing and discards data for 2011, no update assessment was carried out by this WG, which is therefore using the assessment conducted at the 2011 WGHMM.

The sharp increase in SSB in recent years is the direct consequence of a series of good recruitments in 2006-2008, low F and a high growth rate estimated by SS3 (K=0.177, consistent with the growth rate estimated from tagging data (de Pontual et al., 2009). Furthermore, the trends are consistent with increasing landings (Table 3.1) and increasing LPUEs for some fleets (Table 3.4). Finally, the retrospective analysis shows that for F and SSB the model results are not very sensitive to the exclusion of recent data and, for the recent years (2008 to 2010), the trends in F and SSB remain fairly stable over the whole series.

The assessment is now carried out with discards of several commercial fleets included. To account for the large uncertainties associated with the estimations of discards in weight, the discard data are entered in the assessment model assuming a CV of 50% (see Stock Annex). This leads, for some fleets, to low estimates of discards compared to the observations (not presented in this report but available on the WG Share-point) and, as a consequence, to projections of discards that are also very low when compared with recent observed values (as can be noticed by comparing Tables 3.6 and 3.2). Uncertainties around discards could be improved by an increased sampling level of onboard observer programme for some of the fleets that are currently sampled at a low level (non-*Nephrops* trawlers, gillnetters, longliners).

Hake otoliths are currently collected but not used in the assessment due to lack of validated ageing method. The Working Group supports any initiative that would allow the development of a validated ageing method for hake.

## 3.7 Management considerations

As in previous years, there are strong indications of an increase in SSB and decrease in fishing mortality. The increase in SSB is the consequence of several strong incoming recruitments, in particular, the 2006-2008 year classes. It must be noted however 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. As no assessment has been carried out this year, assumptions have been made on recruitment level and fishing mortality for both 2011 and 2012. The short-term forecasts of SSB and yield obtained this year are influenced by the low recruitments estimated for 2009 and 2010 and by the assumed values on recruitment and F for 2011 and 2012.

**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.**

| | Landings (1) | | | | | Discards (2) | Catches (3) |
|---|---|---|---|---|---|---|---|
| Year | IIIa, IV and VI | VII | VIIIa,b | Unallocated | Total | VIIIa,b | 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 | - | 52.9 |
| 1979 | 8.7 | 17.6 | 27.2 | -2.4 | 51.1 | - | 53.8 |
| 1980 | 9.7 | 22.0 | 28.4 | -2.8 | 57.3 | - | 60.5 |
| 1981 | 8.8 | 25.6 | 22.3 | -2.8 | 53.9 | - | 56.3 |
| 1982 | 5.9 | 25.2 | 26.2 | -2.3 | 55.0 | - | 58.1 |
| 1983 | 6.2 | 26.3 | 27.1 | -2.1 | 57.5 | - | 60.1 |
| 1984 | 9.5 | 33.0 | 22.9 | -2.1 | 63.3 | - | 65.1 |
| 1985 | 9.2 | 27.5 | 21.0 | -1.6 | 56.1 | - | 59.9 |
| 1986 | 7.3 | 27.4 | 23.9 | -1.5 | 57.1 | - | 60.1 |
| 1987 | 7.8 | 32.9 | 24.7 | -2.0 | 63.4 | - | 65.3 |
| 1988 | 8.8 | 30.9 | 26.6 | -1.5 | 64.8 | - | 66.8 |
| 1989 | 7.4 | 26.9 | 32.0 | 0.2 | 66.5 | - | 68.8 |
| 1990 | 6.7 | 23.0 | 34.4 | -4.2 | 60.0 | - | 61.5 |
| 1991 | 8.3 | 21.5 | 31.6 | -3.4 | 58.1 | - | 59.8 |
| 1992 | 8.6 | 22.5 | 23.5 | 2.1 | 56.6 | - | 58.3 |
| 1993 | 8.5 | 20.5 | 19.8 | 3.3 | 52.1 | - | 53.6 |
| 1994 | 5.4 | 21.1 | 24.7 | 0.0 | 51.3 | * | 53.1 |
| 1995 | 5.3 | 24.1 | 28.1 | 0.1 | 57.6 | - | 58.9 |
| 1996 | 4.4 | 24.7 | 18.0 | 0.0 | 47.2 | - | 48.8 |
| 1997 | 3.3 | 18.9 | 20.3 | -0.1 | 42.5 | - | 44.2 |
| 1998 | 3.2 | 18.7 | 13.1 | 0.0 | 35.1 | - | 35.9 |
| 1999 | 4.3 | 24.0 | 11.6 | 0.0 | 39.8 | * | 40.6 |
| 2000 | 4.0 | 26.0 | 12.0 | 0.0 | 42.0 | * | 42.6 |
| 2001 | 4.4 | 23.1 | 9.2 | 0.0 | 36.7 | - | 37.2 |
| 2002 | 2.9 | 21.2 | 15.9 | 0.0 | 40.1 | - | 40.4 |
| 2003 | 3.3 | 25.4 | 14.4 | 0.0 | 43.2 | * | 43.2 |
| 2004 | 4.4 | 27.5 | 14.5 | 0.0 | 46.4 | * | 46.4 |
| 2005 | 5.5 | 26.6 | 14.5 | 0.0 | 46.6 | 4.0 | 46.6 |
| 2006 | 6.1 | 24.7 | 10.6 | 0.0 | 41.5 | * | 41.5 |
| 2007 | 7.0 | 27.4 | 10.6 | 0.0 | 45.0 | 2.1 | 45.0 |
| 2008 | 10.7 | 22.8 | 14.3 | 0.0 | 47.7 | 3.5 | 47.7 |
| 2009 | 13.1 | 25.3 | 20.4 | 0.0 | 58.8 | 7.1 | 58.8 |
| 2010 | 14.2 | 33.5 | 25.1 | 0.0 | 72.8 | 6.5 | 72.8 |
| 2011(4) | 15.0 | 9.9 | 10.6 | 0.0 | 35.5 | 2.6 | 35.5 |

(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

(3) From 1978 total catches used for the Working Group.

(4) Without Spanish data

**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)).**

| Fleet/metier sampled | Corresponding Fishery Units | SS3 Fleets | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spanish Trawl in VII | FU 4 | SPTRAWL7 | NA | **83** | NA | NA | NA | **1034** | **1530** | NA | **537** | **1712** | **2010** | **5674** | NA |
| | | | NA | *759* | NA | NA | NA | *10666* | *17393* | NA | *4526* | *21437* | *17542* | *27619* | NA |
| French Nephrops trawl in VII | FU 8 | TRAWLOTH | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | **662** | **641** | NA |
| | | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | *4637* | *2031* | NA |
| French trawl in VII | FU4 | TRAWLOTH | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | **363** | **551** | **130** |
| | | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | *1493* | *1159* | *301* |
| French Nephrops trawl in VIIIabd | FU9 | FRNEP8 | **565** | **341** | **417** | **172** | **1035** | **1359** | **1597** | **532** | **767** | **858** | **4283** | **726** | **871** |
| | | | *9139* | *7421* | *6407* | *2992* | *23676* | *39550* | *37740* | *18031* | *24277* | *18245* | *68524* | *14709* | *21208* |
| French trawl in VIIIabd | FU10 | TRAWLOTH | **211** | **169** | **100** | **142** | NA | NA | NA | NA | NA | NA | **839** | **324** | **144** |
| | | | *3053* | *3013* | *1439* | *2253* | NA | NA | NA | NA | NA | NA | *9046* | *2403* | *2212* |
| Spanish trawl in VIIIabd | FU14 | SPTRAWL8 | NA | NA | NA | NA | NA | **30** | **489** | **206** | **471** | **352** | **580** | **101** | NA |
| | | | NA | NA | NA | NA | NA | *451* | *8475* | *3397* | *10002* | *7153* | *7925* | *1719* | NA |
| Irish trawl and seine in VII | FU15 | TRAWLOTH | **190** | **650** | **194** | NA | NA | **32** | **94** | * | * | * | NA | NA | NA |
| | | | *1868* | *892* | *1046* | NA | NA | *282* | *629* | * | * | * | *684* | *641* | *736* |
| UK (EW) trawl in IV and VII | FU16 + 4 + 5 | | NA | * | * | * | * | * | * | * | * | * | * | * | * |
| | | | NA | * | * | * | * | * | * | * | * | * | * | * | * |
| Spanish trawl in VI | FU16 | OTHERS | NA | NA | NA | NA | NA | NA | NA | NA | NA | **6** | **31** | **120** | NA |
| | | | NA | NA | NA | NA | NA | NA | NA | NA | NA | *11* | *36* | *146* | NA |
| French trawl in IV & VI | FU16 | 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 | *68* | *2700* |
| Danish trawl and seine | FU16 | OTHERS | **42** | **21** | **142** | **354** | **242** | **206** | **814** | **610** | **255** | **190** | **213** | **95** | **94** |
| | | | *29* | *38* | *483* | *691* | *479* | *775* | *3243* | *1084* | *849* | *642* | *508* | *234* | *275* |
| **Total Weight from sampled fleet (t)** | | | **1008** | **1264** | **854** | **668** | **1277** | **2661** | **3710** | **738** | **1775** | **3119** | **7117** | **6716** | **2648** |
| *Total Nb. from sampled fleets ('000)* | | | *14090* | *12123* | *9376* | *5935* | *24155* | *51724* | *64237* | *21428* | *38805* | *47488* | *95219* | *45067* | *26696* |

* sampled but not raised

**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 | 1 | | | L+LFD | | | | |
| | 2 | | | L+LFD | | | | |
| | 3 | | | L+LFD | | | | |
| | 4 | | | L+LFD | | | | |
| 2 | 1 | L+LFD | | | L | | | |
| | 2 | L+LFD | | | L | | | |
| | 3 | L+LFD | | | L | | | |
| | 4 | L+LFD | | | L | | | |
| 3 | 1 | L+LFD | L | L+LFD | L+LFD | | | |
| | 2 | L+LFD | L | L+LFD | L+LFD | | | |
| | 3 | L+LFD | L | L+LFD | L+LFD | | | |
| | 4 | L+LFD | L | L+LFD | L+LFD | | | |
| 4 | 1 | L+LFD | | L+LFD | L | | | |
| | 2 | L+LFD | | L+LFD | L | | | |
| | 3 | L+LFD | | L+LFD | L | | | |
| | 4 | L+LFD | | L+LFD | L | | | |
| 5 | 1 | L+LFD | L | | L+LFD | | | |
| | 2 | L+LFD | L | | L+LFD | | | |
| | 3 | L+LFD | L | | L+LFD | | | |
| | 4 | L+LFD | L | | L+LFD | | | |
| 6 | 1 | | L | | L+LFD | | | |
| | 2 | | L | | L+LFD | | | |
| | 3 | | L | | L+LFD | | | |
| | 4 | | L | | L+LFD | | | |
| 8 | 1 | L+LFD | L | | | | | |
| | 2 | L+LFD | L | | | | | |
| | 3 | L+LFD | L | | | | | |
| | 4 | L+LFD | L | | | | | |
| 9 | 1 | L+LFD | | | | | | |
| | 2 | L+LFD | | | | | | |
| | 3 | L+LFD | | | | | | |
| | 4 | L+LFD | | | | | | |
| 10 | 1 | L+LFD | | | | | | |
| | 2 | L+LFD | | | | | | |
| | 3 | L+LFD | | | | | | |
| | 4 | L+LFD | | | | | | |
| 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 | | | | |
| | 2 | | | L+LFD | | | | |
| | 3 | | | L+LFD | | | | |
| | 4 | | | L+LFD | | | | |
| 15 | 1 | | L+LFD | | | | | L |
| | 2 | | L+LFD | | | | | L |
| | 3 | | L+LFD | | | | | L |
| | 4 | | L+LFD | | | | | L |
| 16 | 1 | | L | L+LFD | L | L+LFD | L+LFD | L |
| | 2 | | L | L+LFD | L | L+LFD | L+LFD | L |
| | 3 | | L | L+LFD | L | L+LFD | L+LFD | L |
| | 4 | | L | L+LFD | L | L+LFD | L+LFD | L |
| 00 | 1 | L | | | | | | |
| | 2 | L | | | | | | |
| | 3 | L | | | | | | |
| | 4 | L | | | | | | |

**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 | 1527 | 59213 | 26 |
| 2008 | 2042 | 1872 | 1091 | 1370 | 58396 | 23 |
| 2009 | 2418 | 1884 | 1284 | 1651 | 58521 | 28 |
| 2010 | 4934 | 2484 | 1986 | 1650 | 56065 | 29 |

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

** Effort in days/100HP; LPUE in kg/(day/100HP)

**Sub-area VIII**

| | Ondarroa pair trawl in VIIIa,b,d | | | Pasajes pair trawl in VIIIa,b,d | | |
|---|---|---|---|---|---|---|
| Year | Landings(t)* | Effort(days) | LPUE(Kg/day) | Landings(t)* | Effort(days) | LPUE(Kg/day) |
| 1982 | -- | | | -- | | |
| 1983 | -- | | | -- | | |
| 1984 | -- | | | -- | | |
| 1985 | -- | | | -- | | |
| 1986 | -- | | | -- | | |
| 1987 | -- | | | -- | | |
| 1988 | -- | | | -- | | |
| 1989 | -- | | | -- | | |
| 1990 | -- | | | -- | | |
| 1991 | -- | | | -- | | |
| 1992 | -- | | | -- | | |
| 1993 | 64 | 68 | 930 | -- | | |
| 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 | | | |
| 2009 | 6716 | 633 | 10610 | | | |
| 2010 | 8056 | 844 | 9545 | | | |

* Landings of the pair trawl (two boats) * Landings of the pair trawl (two boats)

**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 |

**Sub-area VII**

| | A Coruña long line in VII | | | Celeiro long line in VII | | | Burela long line in VII | | | Ondarroa trawl in VII* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Landings(t) | Effort(days) | LPUE(Kg/day) | 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 | n/a | n/a | | n/a | n/a | | n/a | n/a | |
| 1986 | 3038 | 4128 | 736 | n/a | n/a | | n/a | n/a | | n/a | n/a | |
| 1987 | 2832 | 4467 | 634 | n/a | n/a | | n/a | n/a | | n/a | n/a | |
| 1988 | 3141 | 3766 | 834 | n/a | n/a | | n/a | n/a | | n/a | n/a | |
| 1989 | 2631 | 3503 | 751 | n/a | n/a | | n/a | n/a | | n/a | n/a | |
| 1990 | 2342 | 3682 | 636 | n/a | n/a | | n/a | n/a | | n/a | n/a | |
| 1991 | 2223 | 3217 | 691 | n/a | n/a | | n/a | n/a | | n/a | n/a | |
| 1992 | 2464 | 2627 | 938 | n/a | n/a | | n/a | n/a | | n/a | n/a | |
| 1993 | 2797 | 2568 | 1089 | n/a | n/a | | n/a | n/a | | 538 | 1094 | 492 |
| 1994 | 2319 | 2641 | 878 | 4062 | 6516 | 623 | 2278 | 3804 | 599 | 1084 | 980 | 1106 |
| 1995 | 2507 | 2161 | 1160 | 5209 | 6420 | 811 | 2905 | 3444 | 843 | 528 | 1214 | 435 |
| 1996 | 2111 | 1669 | 1265 | 5988 | 6720 | 891 | 3245 | 3636 | 892 | 291 | 1170 | 249 |
| 1997 | 830 | 900 | 922 | 4174 | 6144 | 679 | 2299 | 3540 | 649 | 109 | 540 | 202 |
| 1998 | 292 | 372 | 784 | 2817 | 4668 | 603 | 1639 | 3000 | 546 | 137 | 1196 | 115 |
| 1999 | 323 | 395 | 817 | 3447 | 4980 | 692 | 1982 | 2880 | 688 | 195 | 1384 | 141 |
| 2000 | 281 | 276 | 1018 | 3699 | 4440 | 833 | 2282 | 2928 | 779 | 249 | 1850 | 135 |
| 2001 | 229 | 276 | 830 | 3383 | 3756 | 901 | 3034 | 3672 | 826 | 164 | 1451 | 113 |
| 2002 | 214 | 300 | 712 | 2769 | 3984 | 695 | 2399 | 3732 | 643 | 195 | 949 | 206 |
| 2003 | 648 | 1188 | 545 | 3386 | 4404 | 769 | 2514 | 3636 | 691 | 112 | 1022 | 110 |
| 2004 | 280 | 312 | 899 | 3990 | 4596 | 868 | 3255 | 3852 | 845 | 111 | 910 | 122 |
| 2005 | 199 | 288 | 691 | 4177 | 3930 | 1063 | 3074 | 3507 | 876 | 76 | 544 | 140 |
| 2006 | 256 | 312 | 822 | 4372 | 4560 | 959 | 3639 | 5184 | 702 | 102 | 487 | 210 |
| 2007 | 271 | 520 | 520 | 5039 | 5712 | 882 | 4367 | 6300 | 693 | 66 | 476 | 138 |
| 2008 | 233 | 288 | 810 | 4302 | 5184 | 830 | 4058 | 4884 | 831 | 17 | 105 | 162 |
| 2009 | 214 | 192 | 1116 | 4959 | 4624 | 1072 | 5146 | 4536 | 1135 | | | |
| 2010 | 315 | 375 | 839 | 7630 | 5556 | 1373 | 9141 | 5736 | 1594 | | | |

* From 1996 hake no more targeted

| | A Coruña gillnet in VII | | | Celeiro gillnet in VII | | | Ondarroa gillnet in VII | | | Burela gillnet in VII | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Landings(t) | Effort(days) | LPUE(Kg/day) | Landings(t) | Effort(days) | LPUE(Kg/days | Landings(t) | Effort(days) | LPUE(Kg/day) | Landings(t) | Effort(days) | LPUE(Kg/day) |
| 1998 | 192 | 324 | 593 | 818 | 1572 | 520 | 34 | 73 | 462 | 238 | 444 | 536 |
| 1999 | 206 | 252 | 817 | 805 | 1068 | 754 | 50 | 58 | 869 | 451 | 444 | 1016 |
| 2000 | 237 | 204 | 1162 | 994 | 1308 | 760 | 81 | 84 | 969 | 353 | 600 | 588 |
| 2001 | 188 | 168 | 1119 | 674 | 1008 | 669 | 118 | 117 | 1007 | 215 | 252 | 852 |
| 2002 | 217 | 156 | 1388 | 631 | 912 | 692 | 189 | 132 | 1429 | 223 | 276 | 807 |
| 2003 | 126 | 192 | 656 | 454 | 660 | 688 | | | | 280 | 348 | 805 |
| 2004 | 135 | 144 | 937 | 513 | 756 | 679 | | | | 260 | 264 | 983 |
| 2005 | 326 | 300 | 1087 | 624 | 857 | 728 | | | | 228 | 230 | 992 |
| 2006 | 182 | 180 | 1011 | 497 | 924 | 537 | | | | 56 | 144 | 388 |
| 2007 | 118 | 516 | 229 | 680 | 1524 | 446 | | | | 99 | 348 | 284 |
| 2008 | 32 | 48 | 675 | 501 | 804 | 624 | | | | 115 | 228 | 503 |
| 2009 | 12 | 15 | 823 | 779 | 948 | 822 | | | | 15 | 36 | 413 |
| 2010 | 31 | 24 | 1292 | 498 | 660 | 754 | | | | | | |

**Sub-area VIII**

| | Ondarroa trawl in VIIIa,b,d* | | | Santander trawl in VIIIa,b,d | | | Avilés long line in VIIIa,b,d | | | Avilés gillnet in VIIIa,b,d | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Landings(t) | Effort(days) | LPUE(Kg/day) | Landings(t) | Effort | LPUE(Kg/days | Landings(t) | Effort(days) | LPUE(Kg/day) | Landings(t) | Effort(days) | LPUE(Kg/day) |
| 1993 | 2244 | 5590 | 401 | n/a | n/a | | n/a | n/a | | | | |
| 1994 | 2817 | 5619 | 501 | 175 | 640 | 273 | 1145 | 2340 | 489 | | | |
| 1995 | 2069 | 4474 | 463 | 131 | 620 | 211 | 1145 | 2184 | 524 | | | |
| 1996 | 944 | 4378 | 216 | 62 | 530 | 117 | 819 | 2184 | 375 | | | |
| 1997 | 2348 | 4286 | 548 | 65 | 805 | 81 | 700 | 1896 | 369 | | | |
| 1998 | 287 | 3002 | 96 | 95 | 1445 | 66 | 353 | 1044 | 338 | 218 | 780 | 279 |
| 1999 | 81 | 2337 | 34 | 89 | 1830 | 49 | 567 | 1392 | 407 | 213 | 564 | 378 |
| 2000 | 157 | 2227 | 70 | 79 | 1520 | 52 | 553 | 1344 | 411 | 219 | 492 | 445 |
| 2001 | 341 | 2118 | 161 | 94 | 1590 | 59 | 893 | 1974 | 453 | 482 | 780 | 618 |
| 2002 | 321 | 2107 | 152 | 252 | 1260 | 200 | 314 | 744 | 423 | 392 | 504 | 778 |
| 2003 | 230 | 2296 | 100 | 212 | 1405 | 151 | 513 | 828 | 620 | n/a | n/a | n/a |
| 2004 | 165 | 2159 | 76 | 200 | 995 | 201 | 592 | n/a | n/a | 885 | n/a | n/a |
| 2005 | 257 | 2263 | 114 | 120 | 596 | 202 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2006 | 216 | 2398 | 90 | 83 | 636 | 131 | 310 | 1075 | 288 | 406 | 1054 | 385 |
| 2007 | 296 | 2098 | 141 | 105 | 1278 | 82 | n/a | n/a | n/a | n/a | n/a | n/a |
| 2008 | 543 | 2017 | 269 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 2009 | 741 | 1807 | 410 | 120 | 1278 | 94 | 368 | 252 | 1461 | 1215 | 1116 | 1089 |
| 2010 | | | | 69 | 774 | 89 | 520 | n/a | | 1658 | n/a | |

* From 1998 hake no more targeted

| | Les Sables trawl in VIIIa,b,d* | | | Lesconil trawl in VIIIa* | | | Pasajes Bou trawl in VIIIabd | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Landings (t) | Effort (day)** | LPUE (Kg/day) | Landings (t) | Effort (day)** | LPUE (Kg/day) | Landings (t) | Effort* | LPUE* |
| 1982 | n/a | | | n/a | | | n/a | | |
| 1983 | n/a | | | n/a | | | n/a | | |
| 1984 | n/a | | | n/a | | | n/a | | |
| 1985 | n/a | | | n/a | | | n/a | | |
| 1986 | n/a | | | n/a | | | 2394 | 46719 | 51 |
| 1987 | 536 | 8165 | 66 | 313 | 7180 | 44 | 3423 | 50664 | 68 |
| 1988 | 658 | 9189 | 72 | 361 | 7140 | 51 | 2830 | 42160 | 67 |
| 1989 | 895 | 9192 | 97 | 426 | 5932 | 72 | 2912 | 47193 | 62 |
| 1990 | 608 | 9635 | 63 | 321 | 5510 | 58 | 3168 | 50776 | 62 |
| 1991 | 422 | 8274 | 51 | 382 | 5451 | 70 | 2775 | 47844 | 58 |
| 1992 | 166 | 6865 | 24 | 148 | 5699 | 26 | 2790 | 56228 | 50 |
| 1993 | 160 | 6827 | 23 | 244 | 5677 | 43 | 2954 | 55195 | 54 |
| 1994 | 226 | 5358 | 42 | 215 | 3830 | 56 | 2758 | 42228 | 65 |
| 1995 | 476 | 6600 | 72 | 192 | 4624 | 42 | 2800 | 32819 | 85 |
| 1996 | (153) | (4875) | (31) | (80) | (3019) | (27) | 666 | 9502 | 70 |
| 1997 | (127) | (4568) | (28) | (20) | (781) | (26) | 417 | 7085 | 59 |
| 1998 | (47) | (3309) | (14) | (15) | (597) | (24) | 217 | 3664 | 59 |
| 1999 | **(79)** | **(3163)** | **(25)** | **(14)** | **(194)** | **(73)** | -- | | |
| 2000 | **(47)** | **(1759)** | **(27)** | **(26)** | **(362)** | **(71)** | -- | | |
| 2001 | **(45)** | **(1425)** | **(32)** | **(18)** | **(298)** | **(59)** | -- | | |
| 2002 | **(46)** | **(1086)** | **(43)** | **(17)** | **(286)** | **(59)** | -- | | |
| 2003 | **(19)** | **(875)** | **(22)** | **(11)** | **(249)** | **(45)** | -- | | |
| 2004 | -- | -- | -- | -- | -- | -- | -- | | |
| 2005 | -- | -- | -- | -- | -- | -- | -- | | |

* Part of the fleet only
** (1 day = 20 fishing hours)

* Twin trawls excluded
** (1 day = 9 fishing hours)

*Effort in days/100HP;LPUE in kg/(day/100HP)

**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 | Yield/SSB | F (15-80 cm) |
|---|---|---|---|---|---|---|
| 1978 | 280631 | 116459 | 78177 | 50551 | 0.65 | 0.49 |
| 1979 | 258652 | 126414 | 99476 | 51096 | 0.51 | 0.53 |
| 1980 | 276005 | 124635 | 101917 | 57265 | 0.56 | 0.63 |
| 1981 | 538869 | 107689 | 87727 | 53918 | 0.61 | 0.64 |
| 1982 | 370360 | 98643 | 71402 | 54994 | 0.77 | 0.66 |
| 1983 | 128493 | 105040 | 68866 | 57507 | 0.84 | 0.6 |
| 1984 | 243448 | 111442 | 81881 | 63286 | 0.77 | 0.64 |
| 1985 | 550445 | 96291 | 78221 | 56099 | 0.72 | 0.79 |
| 1986 | 326490 | 78788 | 57999 | 57092 | 0.98 | 0.89 |
| 1987 | 387231 | 74529 | 42763 | 63369 | 1.48 | 0.95 |
| 1988 | 452547 | 75117 | 45644 | 64823 | 1.42 | 0.98 |
| 1989 | 433097 | 74731 | 43982 | 66473 | 1.51 | 1.06 |
| 1990 | 430813 | 69258 | 41029 | 59954 | 1.46 | 0.99 |
| 1991 | 238950 | 67117 | 40943 | 58129 | 1.42 | 0.93 |
| 1992 | 257803 | 66545 | 40131 | 56617 | 1.41 | 0.95 |
| 1993 | 467945 | 59108 | 39296 | 52144 | 1.33 | 1.01 |
| 1994 | 264551 | 52822 | 30737 | 51259 | 1.67 | 1.03 |
| 1995 | 136309 | 58978 | 30037 | 57621 | 1.92 | 1.07 |
| 1996 | 330345 | 54544 | 35188 | 47210 | 1.34 | 0.93 |
| 1997 | 229932 | 46728 | 30507 | 42465 | 1.39 | 1.03 |
| 1998 | 378378 | 44200 | 24603 | 35060 | 1.43 | 0.94 |
| 1999 | 194931 | 48612 | 28062 | 39814 | 1.42 | 0.93 |
| 2000 | 173072 | 54342 | 31083 | 42026 | 1.35 | 0.86 |
| 2001 | 317173 | 54478 | 36791 | 36675 | 1 | 0.72 |
| 2002 | 265151 | 57279 | 37888 | 40107 | 1.06 | 0.78 |
| 2003 | 145895 | 62443 | 38161 | 43162 | 1.13 | 0.78 |
| 2004 | 334983 | 65433 | 43609 | 46417 | 1.06 | 0.78 |
| 2005 | 224857 | 62059 | 42802 | 46550 | 1.09 | 0.87 |
| 2006 | 303304 | 61200 | 36530 | 41467 | 1.14 | 0.72 |
| 2007 | 454286 | 71402 | 45909 | 45098 | 0.98 | 0.61 |
| 2008 | 381687 | 92250 | 56968 | 47823 | 0.84 | 0.47 |
| 2009 | 99576 | 134346 | 85181 | 58975 | 0.69 | 0.4 |
| 2010 | 176248 | 174907 | 131075 | 73125 | 0.56 | 0.39 |
| Arith. Mean | 304620 | 80237 | 54078 | 52066 | | |
| Units | Thousands | Tonnes | Tonnes | Tonnes | | |

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

| SSB(2011) | Rec proj | F(15-80cm) | Catch(2011) | Land(2011) | |
|---|---|---|---|---|---|
| 153890 | 294822 | 0.42 | 79200 | 77390 | |
| SSB(2012) | Rec proj | F(15-80cm) | Catch(2012) | Land(2012) | SSB(2013) |
| 130541 | 294822 | 0.42 | 65897 | 63157 | 114252 |

| Fmult | F(15-80cm) | Catch(2013) | Land(2013) | Disc(2013) | SSB(2014) |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 180265 |
| 0.1 | 0.04 | 7603 | 7280 | 323 | 172793 |
| 0.2 | 0.08 | 14876 | 14238 | 638 | 165641 |
| 0.3 | 0.13 | 21833 | 20886 | 946 | 158794 |
| 0.4 | 0.17 | 28487 | 27240 | 1247 | 152239 |
| 0.5 | 0.21 | 34853 | 33311 | 1541 | 145964 |
| 0.6 | 0.25 | 40942 | 39113 | 1829 | 139955 |
| 0.7 | 0.30 | 46767 | 44657 | 2110 | 134202 |
| 0.8 | 0.34 | 52339 | 49954 | 2384 | 128694 |
| 0.9 | 0.38 | 57669 | 55016 | 2653 | 123418 |
| 1 | 0.42 | 62767 | 59852 | 2915 | 118367 |
| 1.1 | 0.46 | 67644 | 64472 | 3171 | 113529 |
| 1.2 | 0.51 | 72308 | 68887 | 3422 | 108895 |
| 1.3 | 0.55 | 76770 | 73104 | 3666 | 104457 |
| 1.4 | 0.59 | 81039 | 77133 | 3906 | 100206 |
| 1.5 | 0.63 | 85121 | 80981 | 4140 | 96133 |
| 1.6 | 0.68 | 89026 | 84657 | 4368 | 92232 |
| 1.7 | 0.72 | 92760 | 88169 | 4592 | 88495 |
| 1.8 | 0.76 | 96333 | 91522 | 4810 | 84914 |
| 1.9 | 0.80 | 99749 | 94725 | 5024 | 81483 |
| 2 | 0.85 | 103016 | 97783 | 5233 | 78196 |

**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(15-80 cm) | YPR(catch) | YPR(landings) | SSB/R |
|---|---|---|---|---|---|
| 1.00 | 0.0 | 0.00 | 0.00 | 0.00 | 3.20 |
| 0.78 | 0.1 | 0.04 | 0.11 | 0.11 | 2.51 |
| 0.62 | 0.2 | 0.08 | 0.18 | 0.18 | 1.99 |
| 0.50 | 0.3 | 0.13 | 0.23 | 0.22 | 1.61 |
| 0.41 | 0.4 | 0.17 | 0.25 | 0.25 | 1.31 |
| 0.34 | 0.5 | 0.21 | 0.27 | 0.26 | 1.08 |
| 0.28 | 0.6 | 0.25 | 0.27 | 0.27 | 0.91 |
| 0.24 | 0.7 | 0.30 | 0.28 | 0.27 | 0.76 |
| 0.20 | 0.8 | 0.34 | 0.28 | 0.27 | 0.65 |
| 0.17 | 0.9 | 0.38 | 0.27 | 0.26 | 0.56 |
| 0.15 | 1.0 | 0.42 | 0.27 | 0.26 | 0.48 |
| 0.13 | 1.1 | 0.46 | 0.26 | 0.25 | 0.42 |
| 0.12 | 1.2 | 0.51 | 0.25 | 0.24 | 0.37 |
| 0.10 | 1.3 | 0.55 | 0.25 | 0.23 | 0.33 |
| 0.09 | 1.4 | 0.59 | 0.24 | 0.23 | 0.29 |
| 0.08 | 1.5 | 0.63 | 0.23 | 0.22 | 0.26 |
| 0.07 | 1.6 | 0.68 | 0.23 | 0.21 | 0.23 |
| 0.07 | 1.7 | 0.72 | 0.22 | 0.20 | 0.21 |
| 0.06 | 1.8 | 0.76 | 0.21 | 0.20 | 0.19 |
| 0.05 | 1.9 | 0.80 | 0.20 | 0.19 | 0.17 |
| 0.05 | 2.0 | 0.85 | 0.20 | 0.18 | 0.15 |

| | SPR level | Fmult | F(15-80cm) | YPR(catch) | YPR(landings) | SSB/R |
|---|---|---|---|---|---|---|
| Fmax | 0.25 | 0.68 | 0.29 | 0.28 | 0.27 | 0.79 |
| F0.1 | 0.37 | 0.46 | 0.19 | 0.26 | 0.26 | 1.18 |
| F35% | 0.35 | 0.48 | 0.20 | 0.26 | 0.26 | 1.12 |
| F30% | 0.30 | 0.57 | 0.24 | 0.27 | 0.27 | 0.96 |

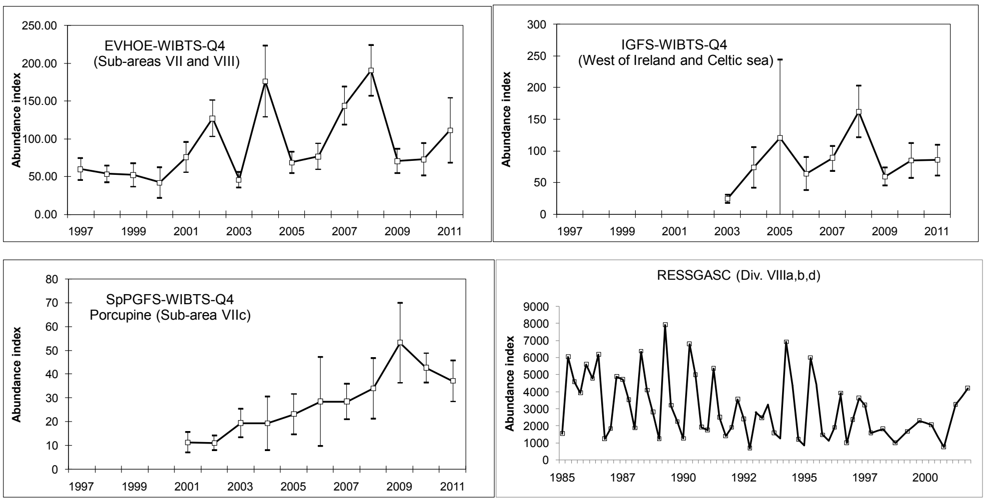



**Figure 3.1a . Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Abundance indices from surveys.**

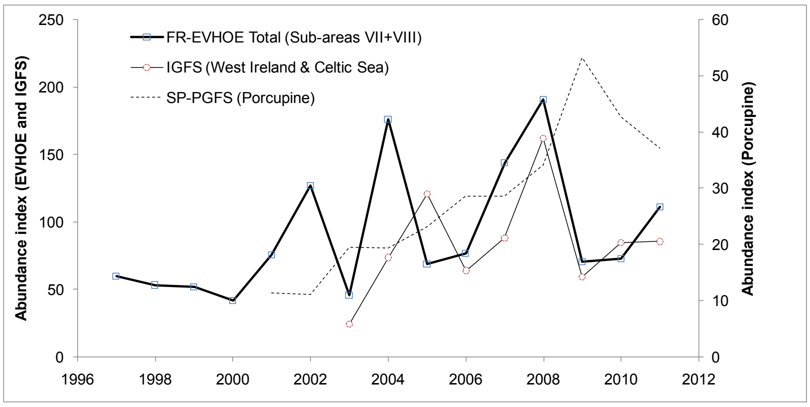



**Figure 3.1b . Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Comparison of survey indices for survey currently carried out.**

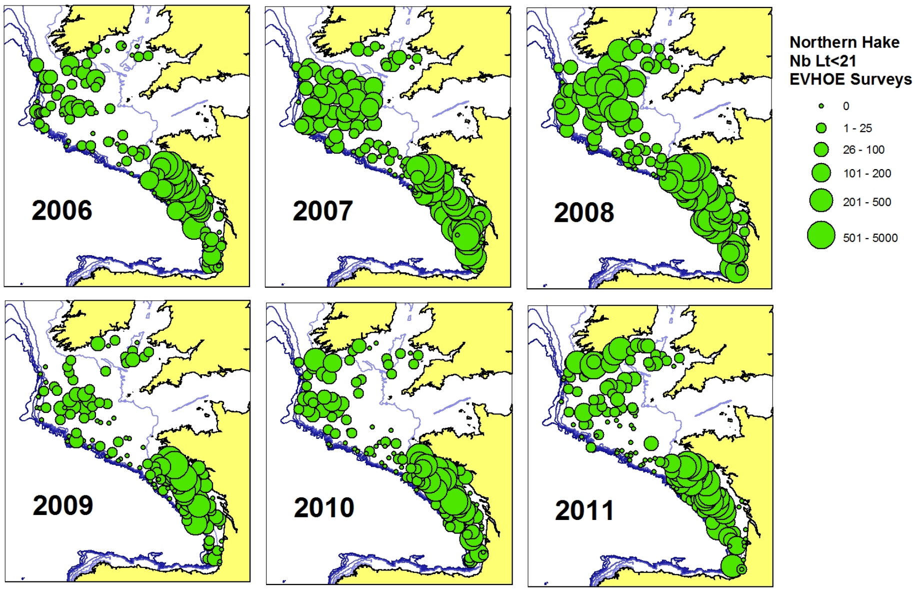



Figure 3.2. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Spatial distribution of hake (0-20 cm) indices from EVHOE-WIBTS-Q4 survey from 2006 to 2011.

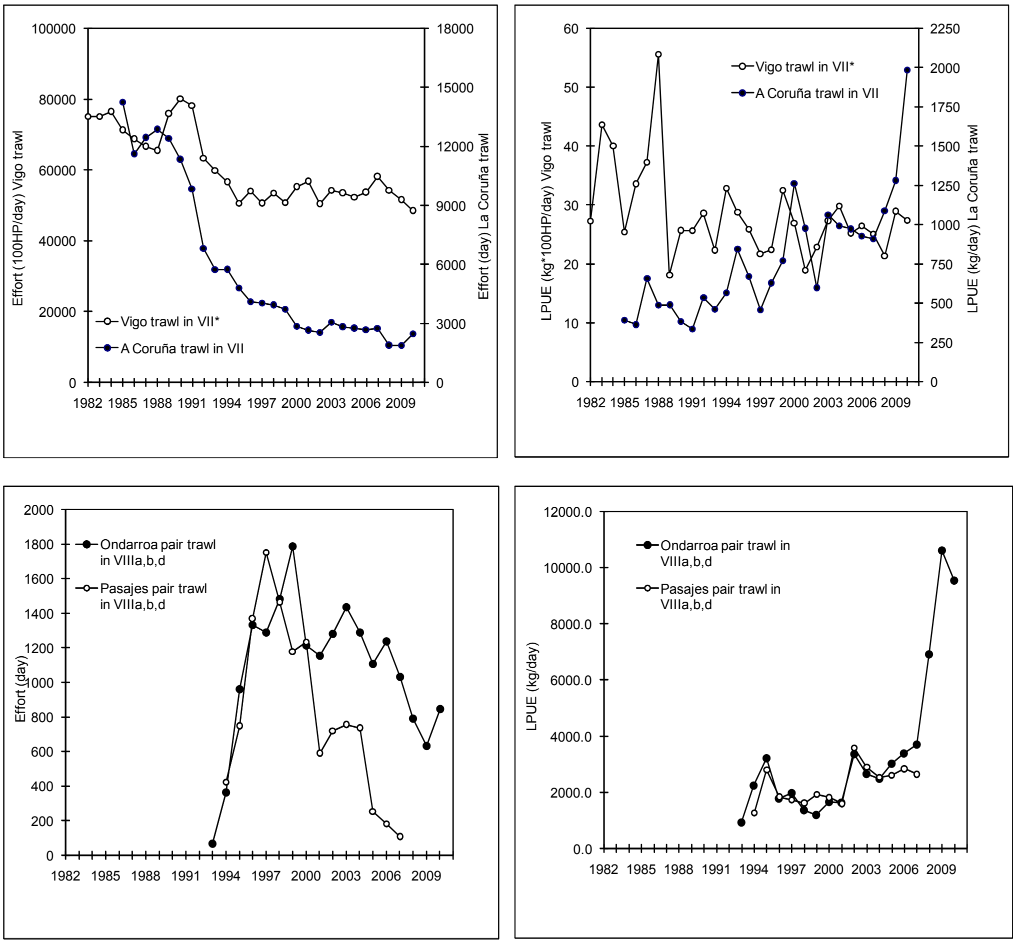



Figure 3.3a. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). LPUE and effort from commercial fleets

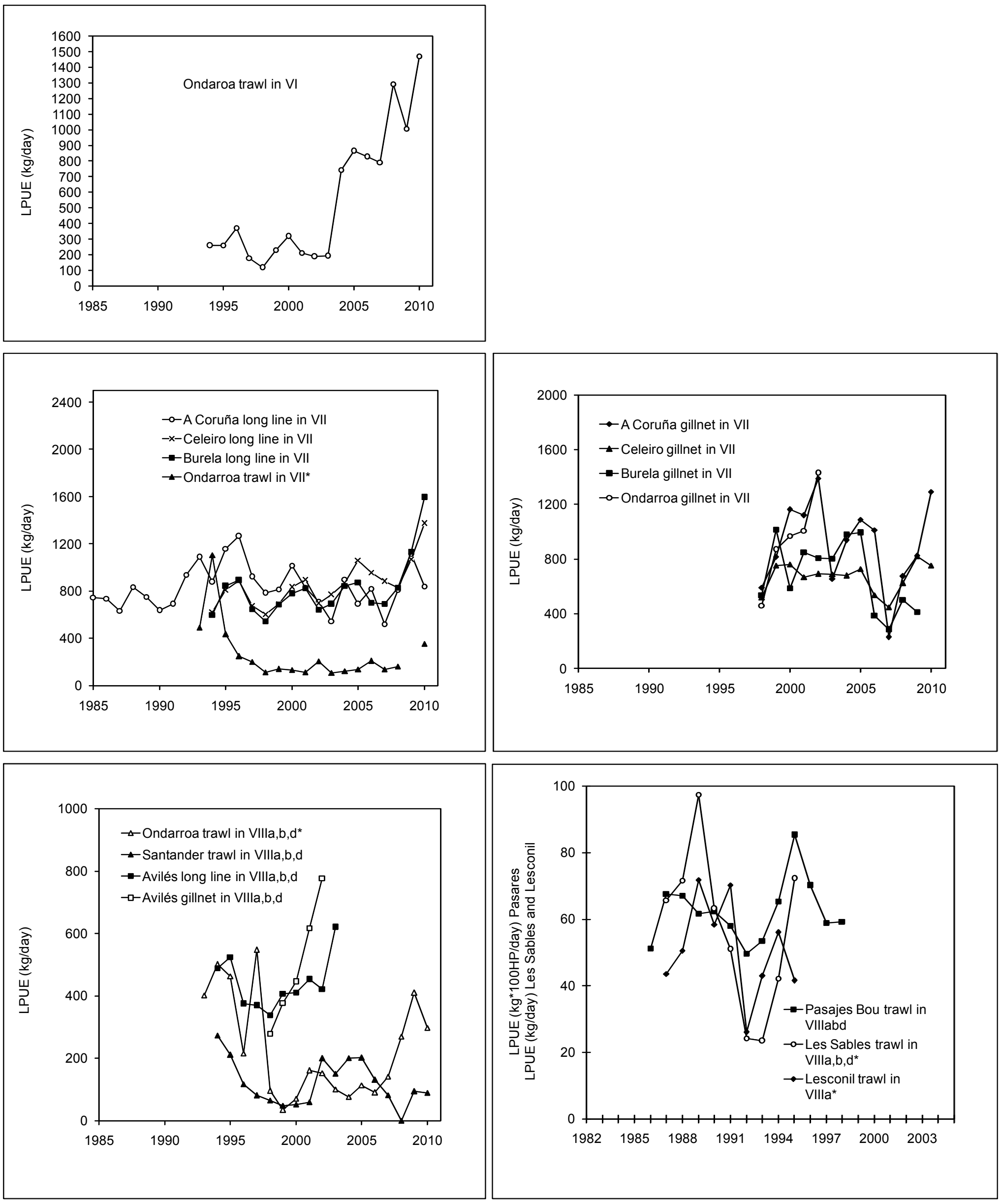



**Figure 3.3b. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). LPUE for commercial fleets.**

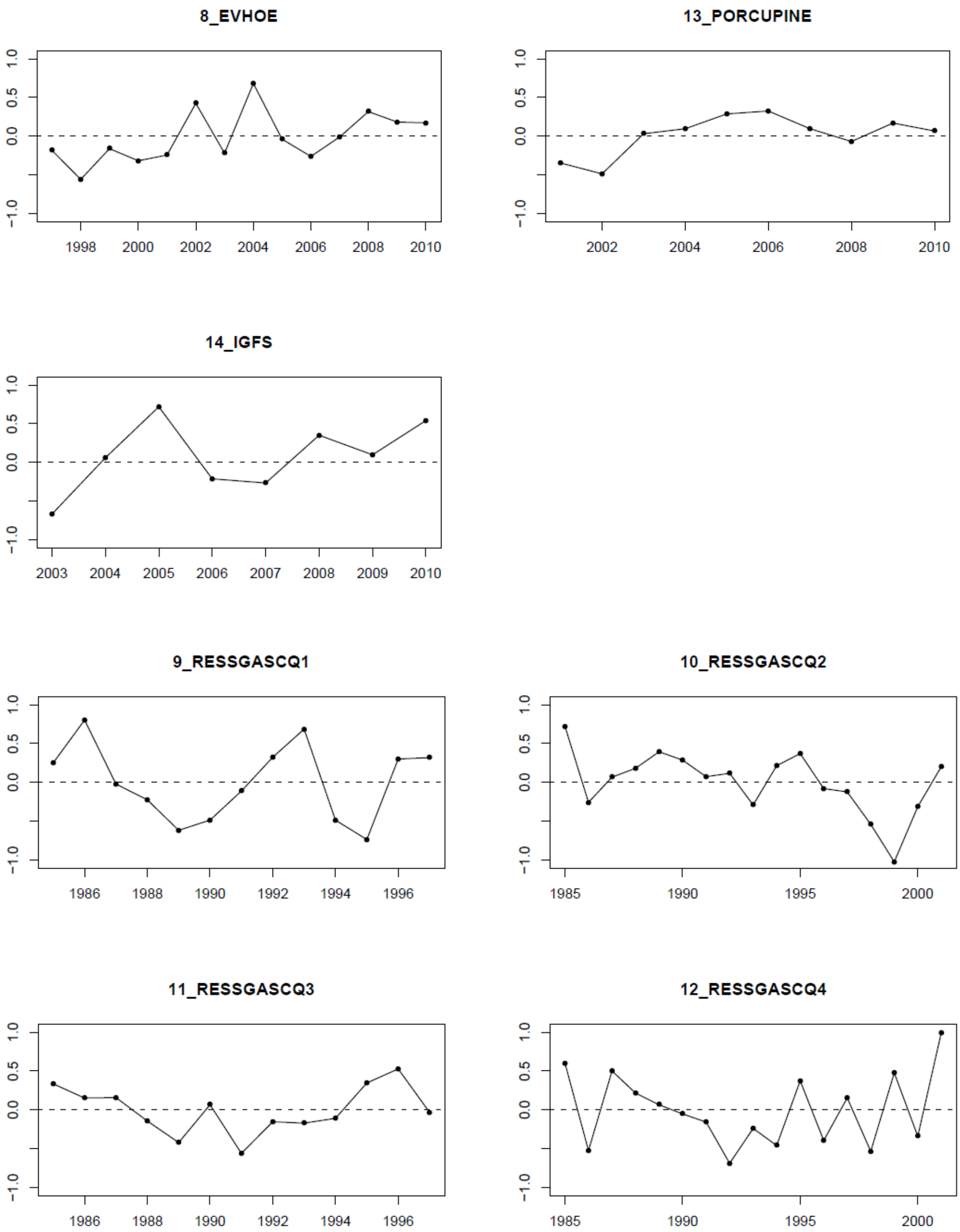
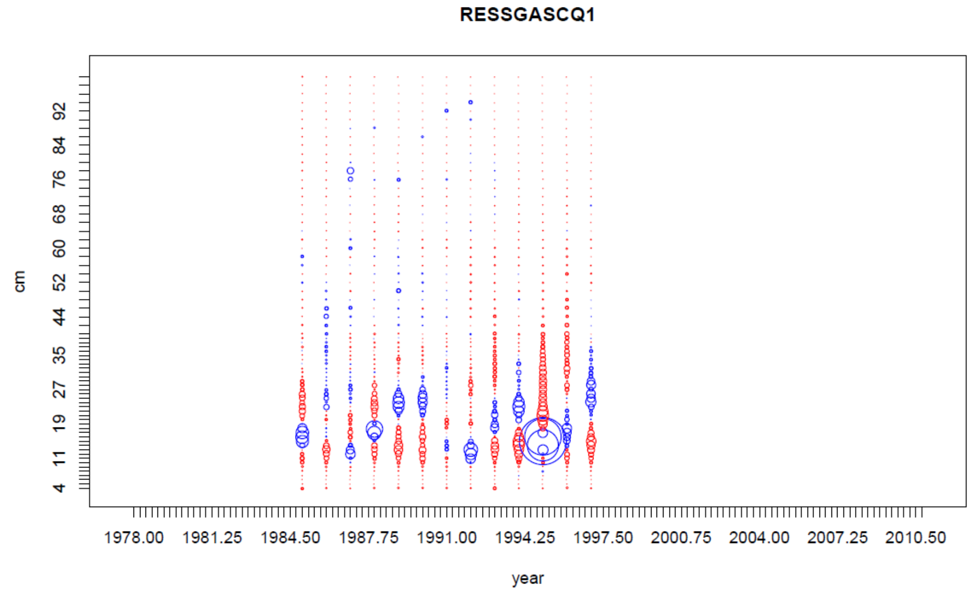



**Figure 3.4. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Residuals of the fits to the surveys log(abundance indices). For RESSGASC, fits are by quarter.**



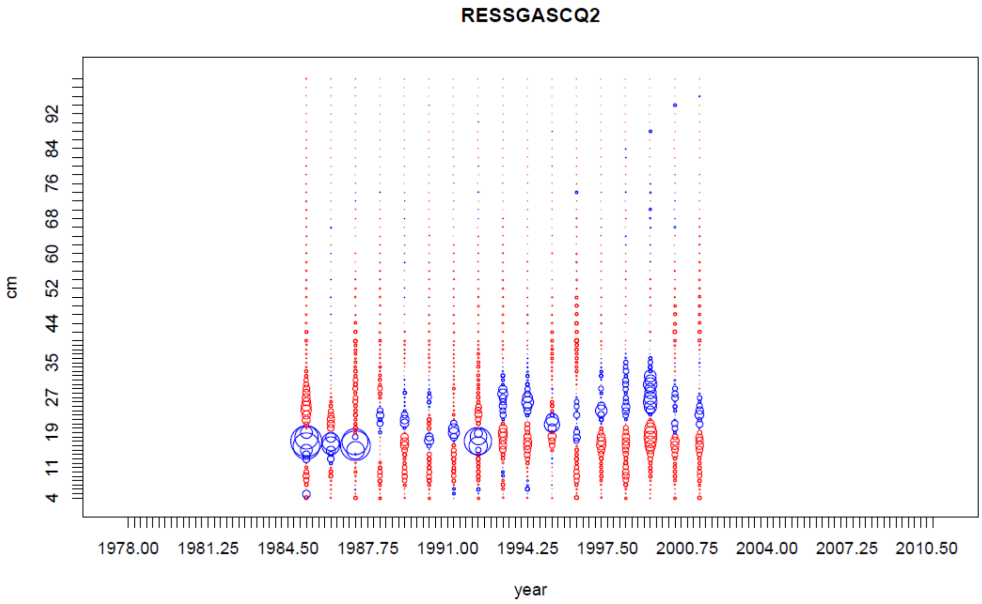




**Figure 3.5. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter. Blue and red denote positive and negative residuals, respectively.**

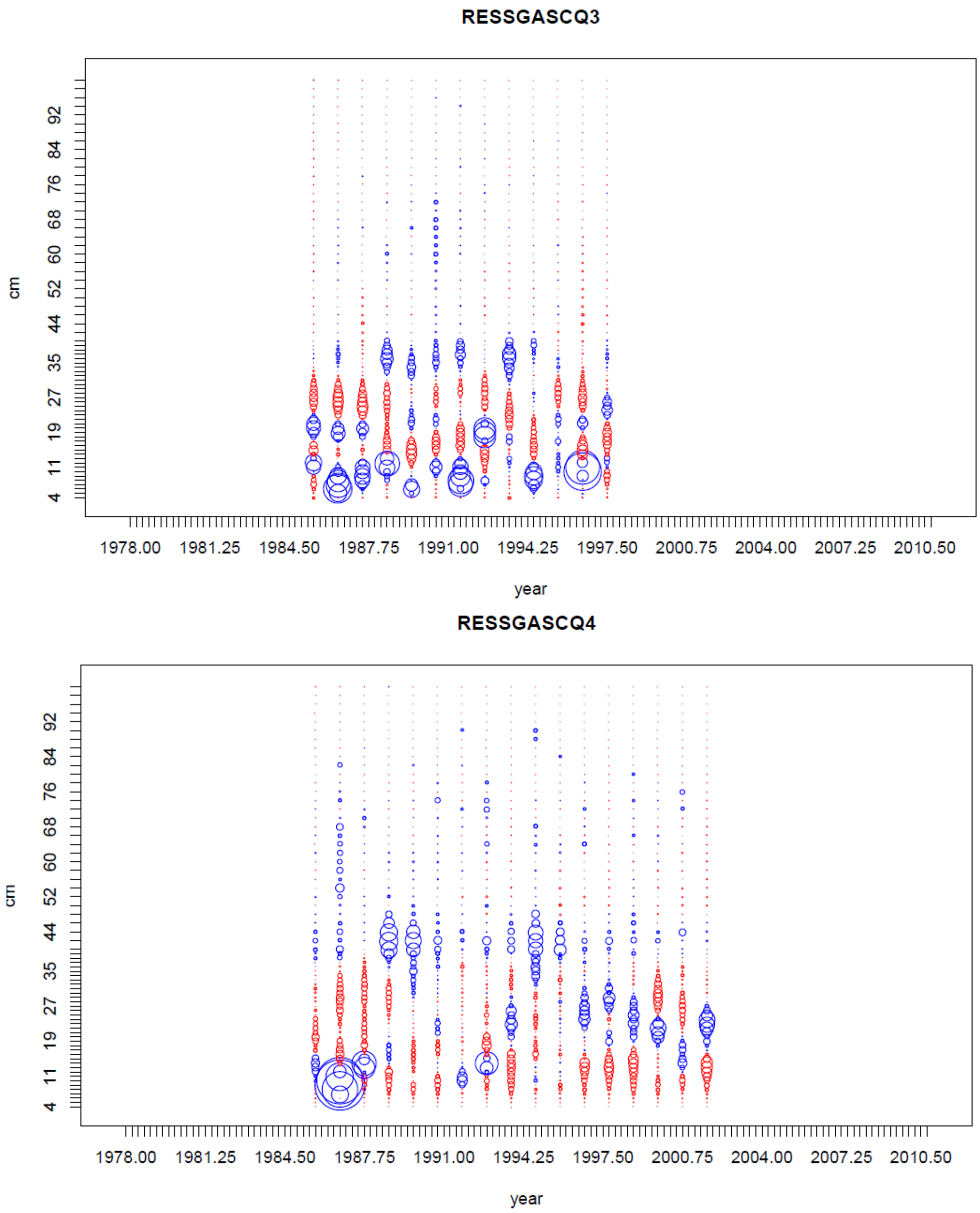



**Figure 3.5 (continued). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter. Blue and red denote positive and negative residuals, respectively.**

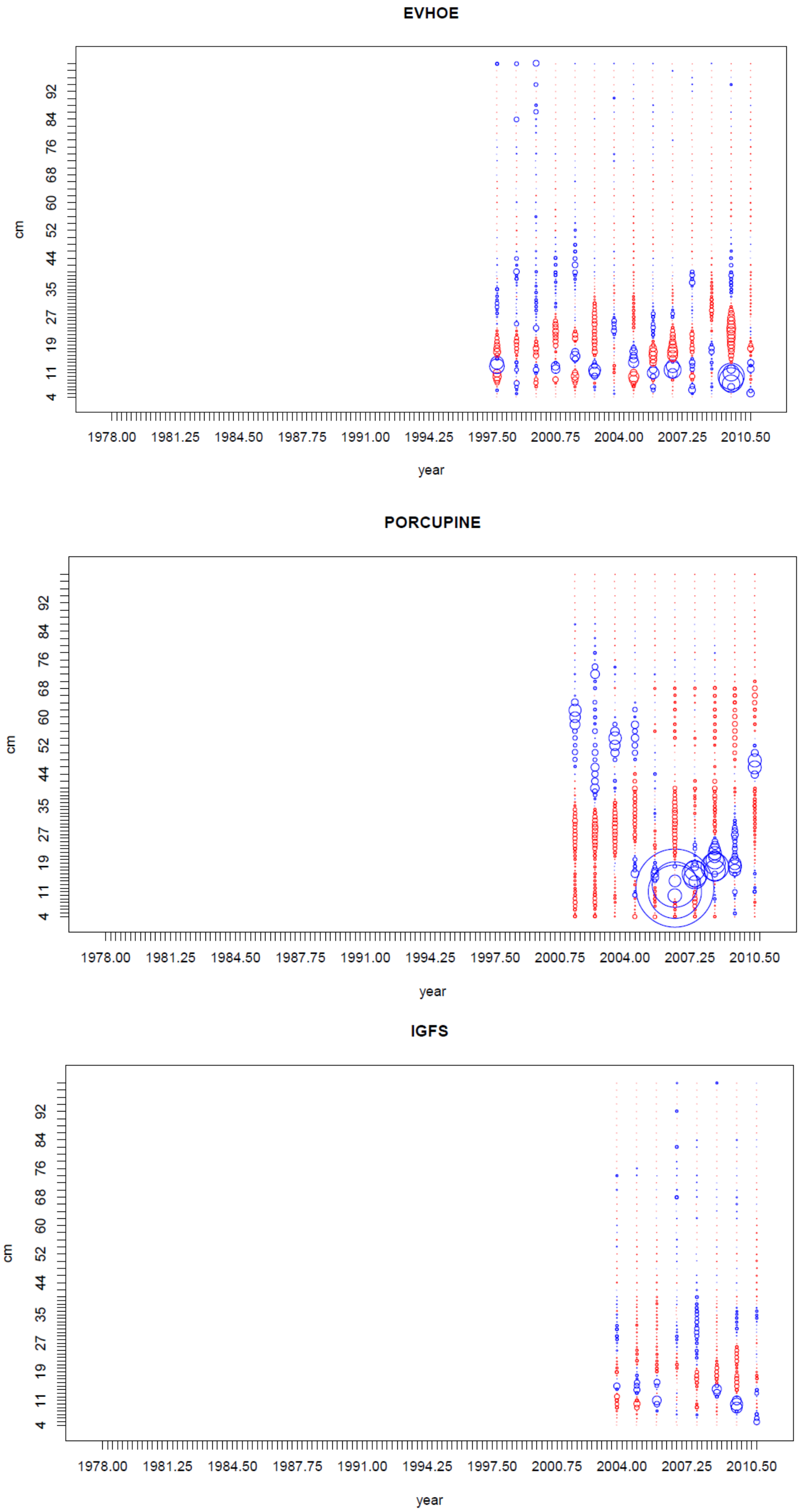



**Figure 3.5. (continued) Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Pearson residuals of the fit to the length distributions of the surveys abundance indices. Blue and red denote positive and negative residuals, respectively.**

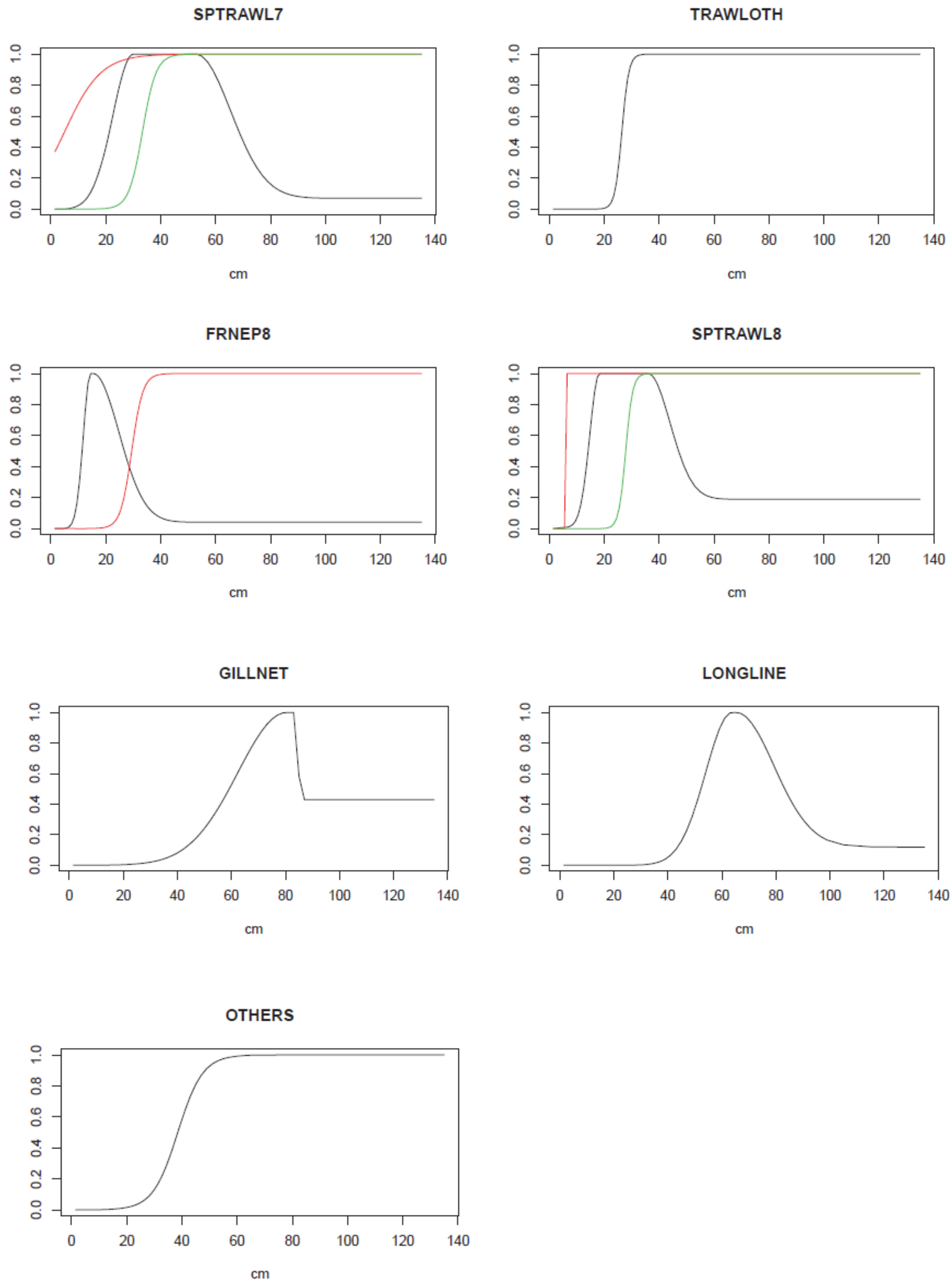



**Figure 3.6. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Selection patterns (black) and retention functions at length by commercial fleet estimated by SS3. For SPTRAWL7 and SPTRAWL8, retention functions from 1978 to 1997 are in red and retention functions after 1998 are in green. For FRNEP8, the retention function, valid for all the period (1978 to 2010), is in red.**

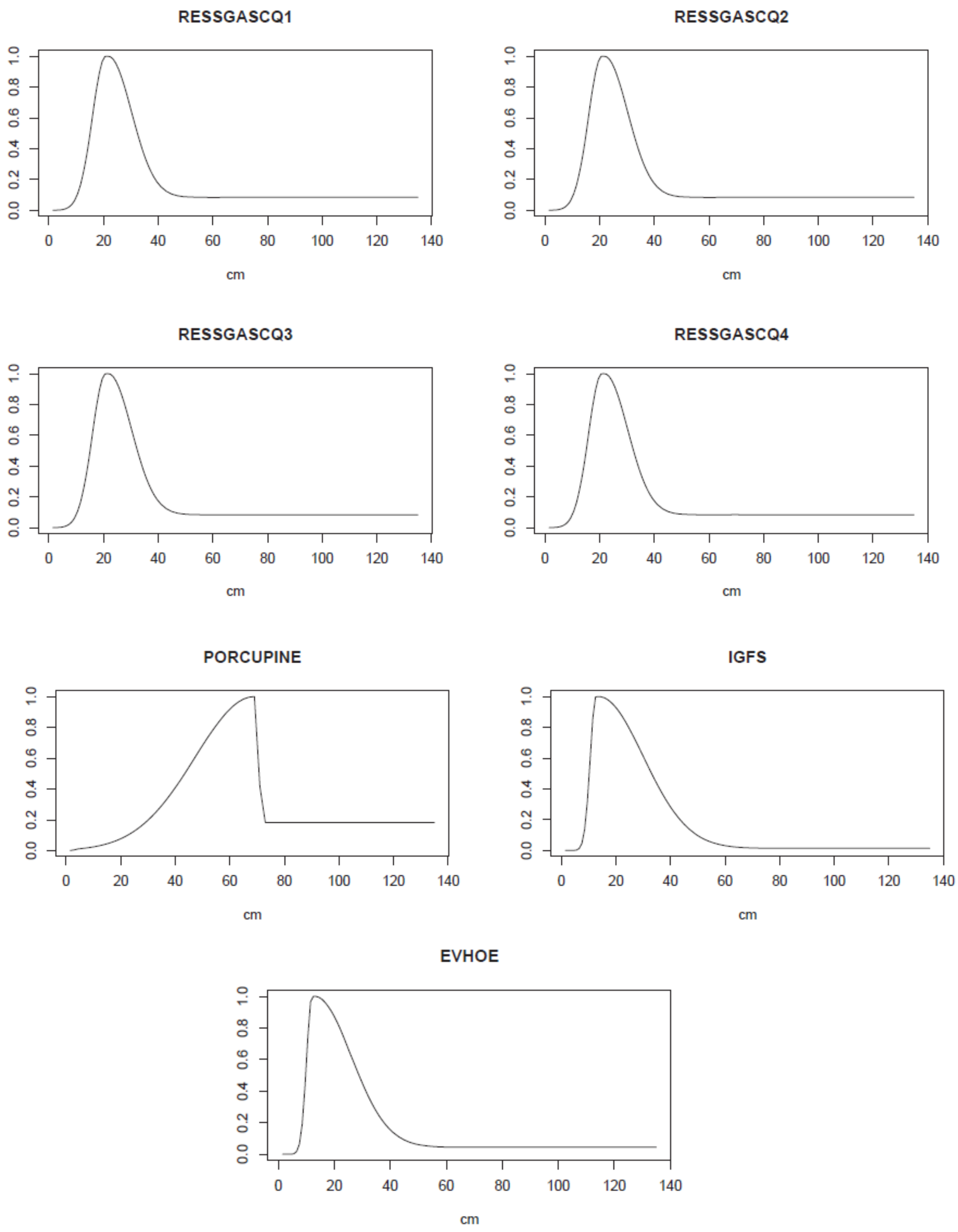



**Figure 3.6 (continued). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Selection patterns at length for surveys estimated by SS3.**

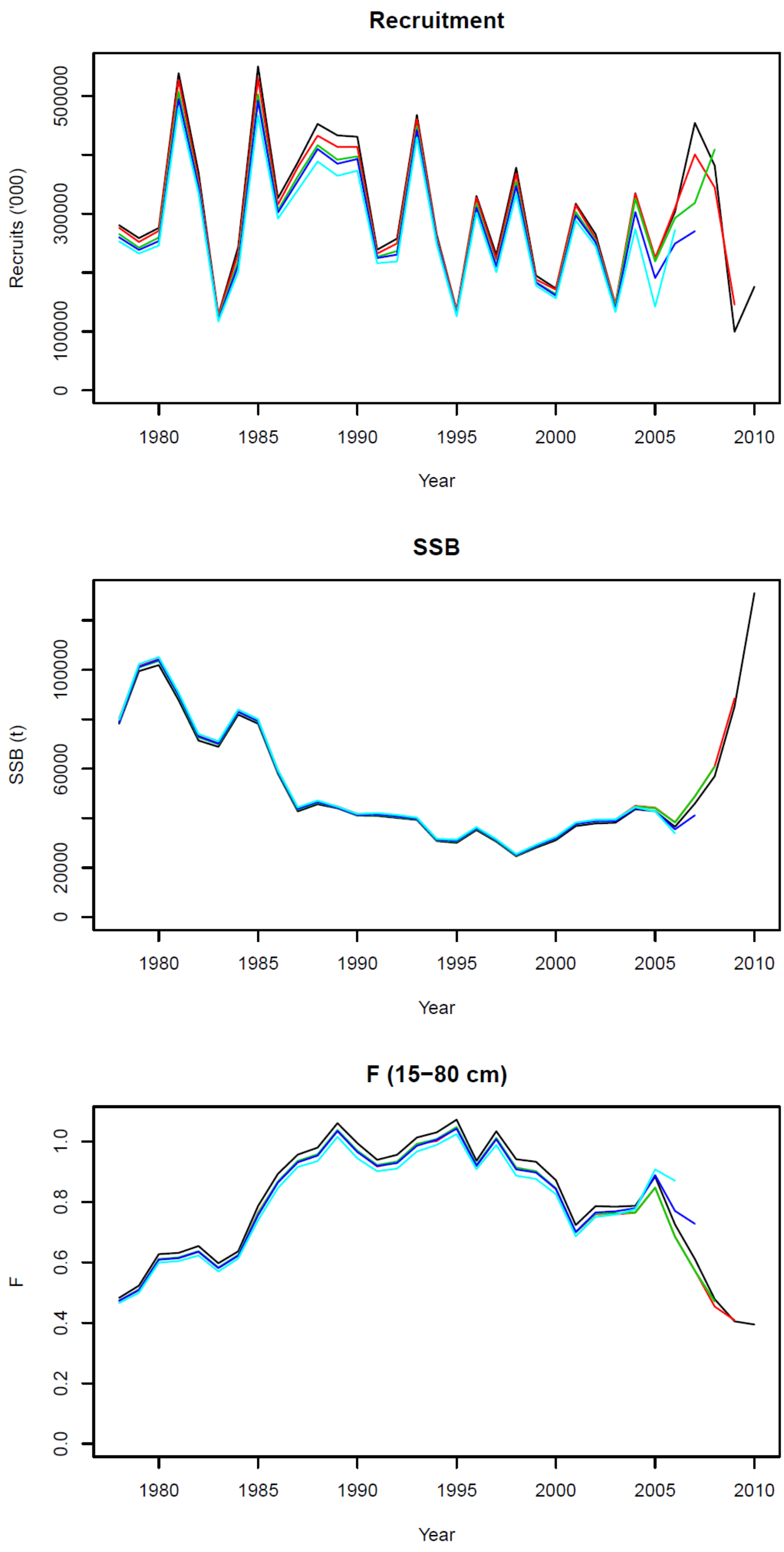



**Figure 3.7. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Retrospective plot from SS3.**

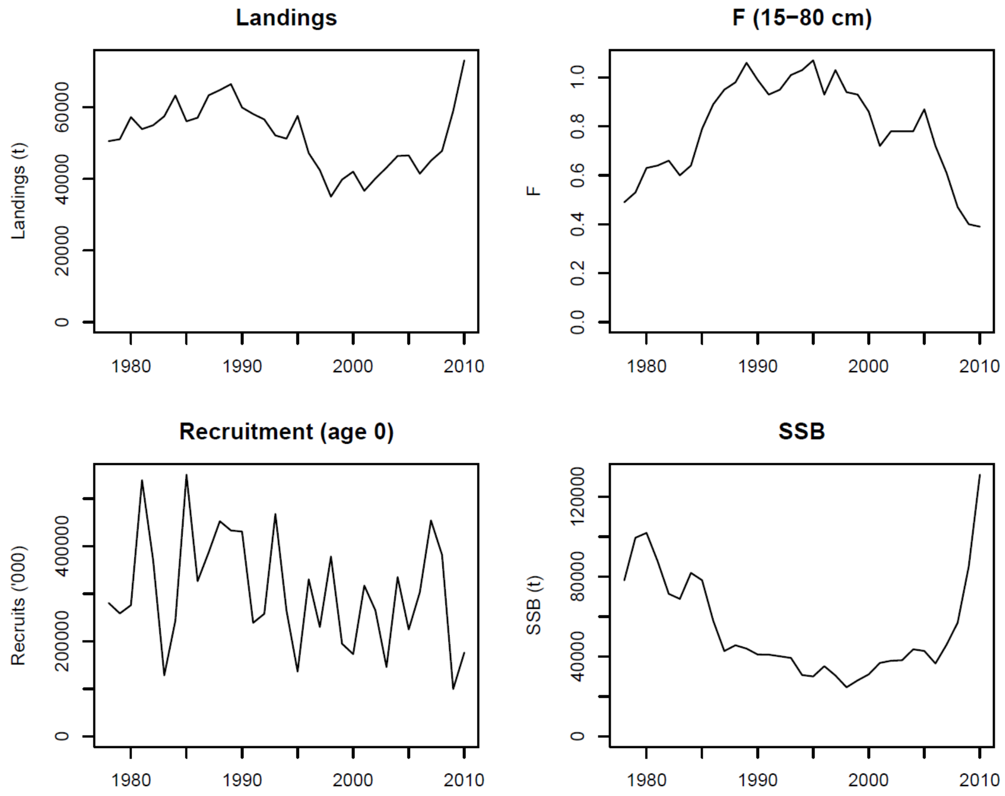



**Figure 3.8. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Summary plot of stock trends.**

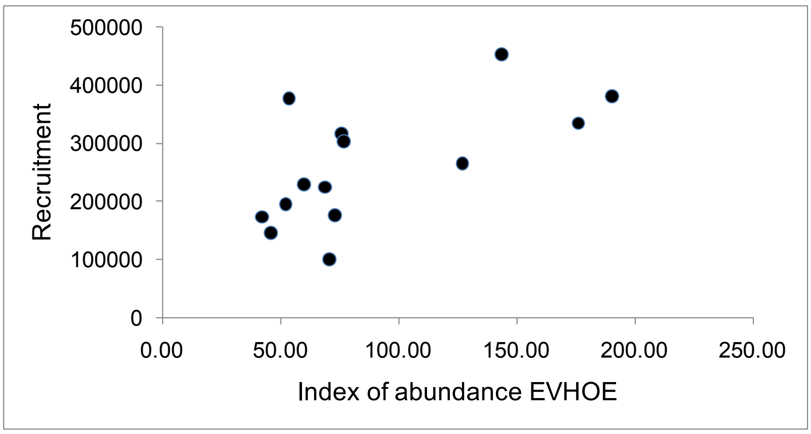



**Figure 3.9. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Recruitment vs EVHOE-WIBTS-Q4 abundance index plot.**

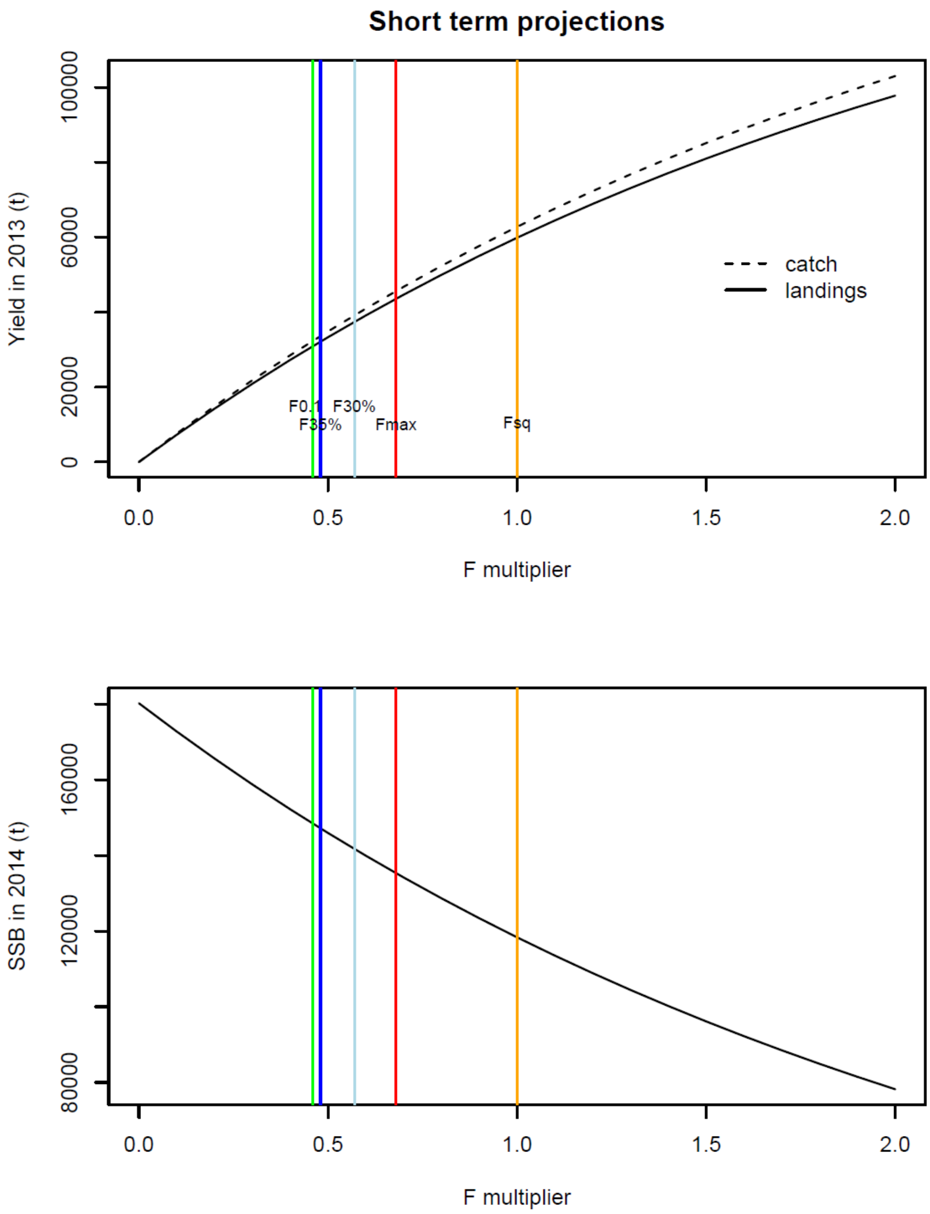



**Figure 3.10. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Short term projections**

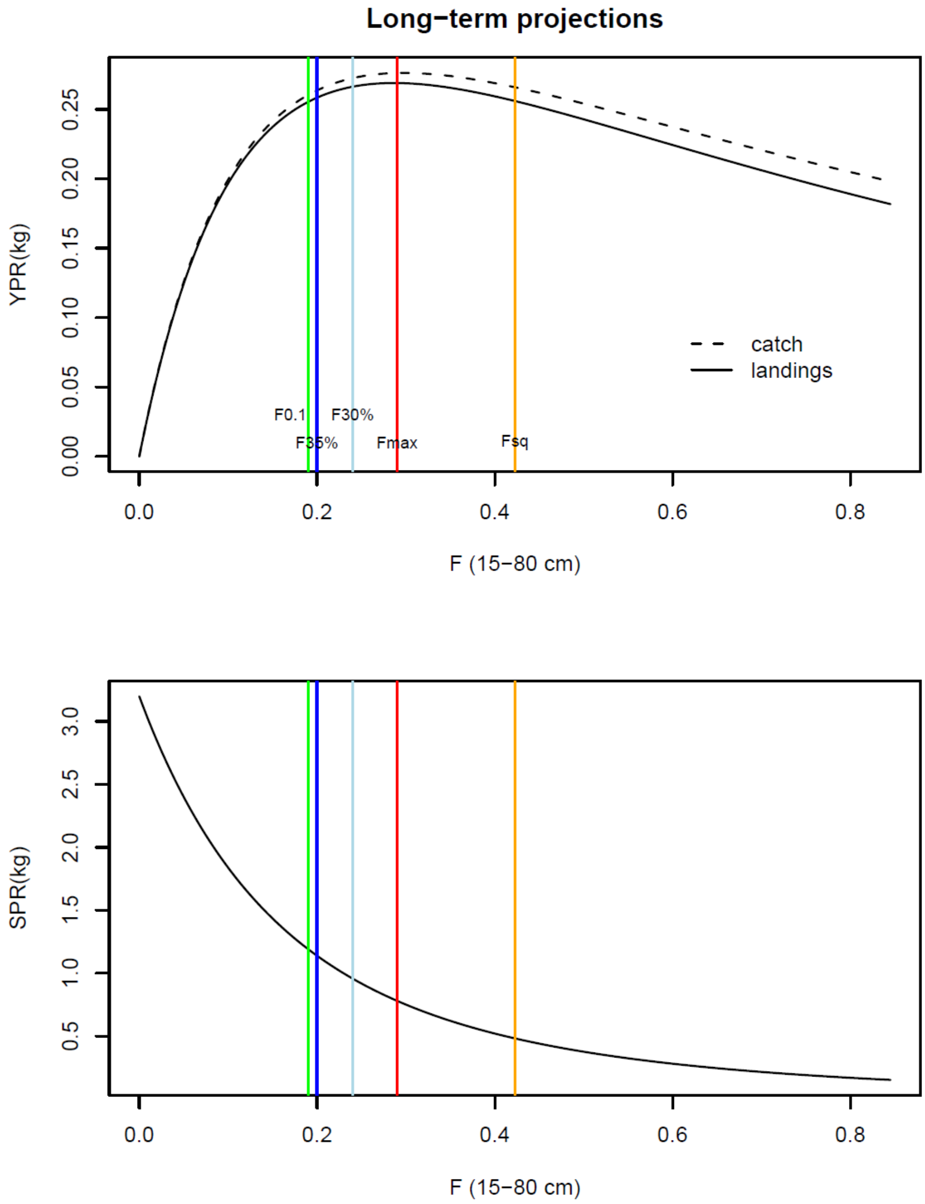



**Figure 3.11. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Equilibrium yield and SSB per recruit.**

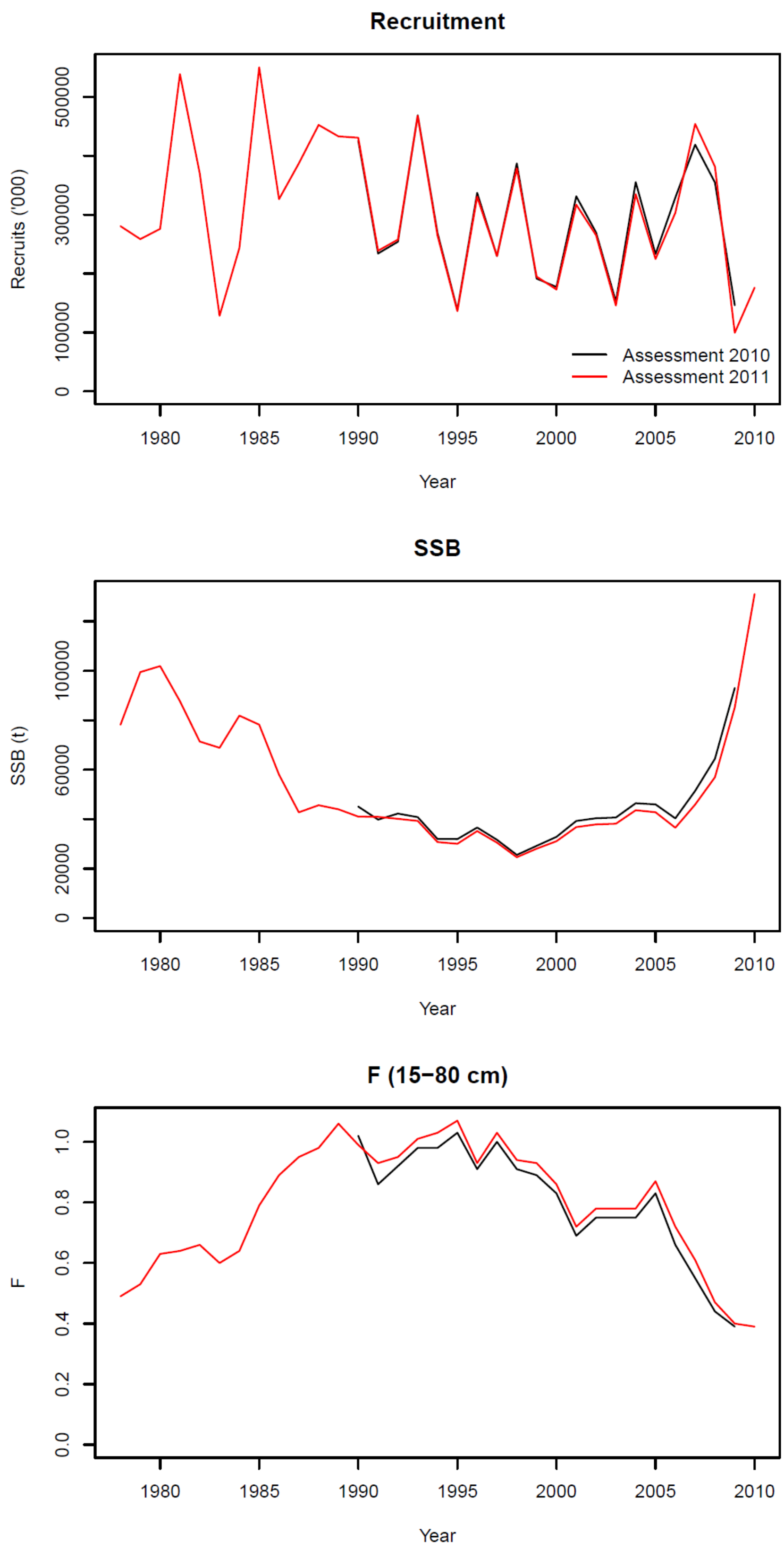



**Figure 3.12. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Comparison of results of assessment carried out in 2010 and 2011**

# 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 2012:** Same Advice as Last Year (SALY). However, it was not possible to include Spanish commercial data for 2011 in the assessment. The assessment conducted in 2011 follows the same approach as last year but omits Spanish commercial data for 2011.

**Data revisions this year:** 1989-1995, 1998, 2001, 2002, 2007-2010 landings series

**Review Group issues:**

Issues noted last year by the Review Group have not yet been addressed. A benchmark assessment for this stock is scheduled for 2012. Addressing the difficulties precluding an analytical assessment for this stock will require a substantial amount of work in advance of the next benchmark assessment.

An evaluation of the relative quality of the different tuning fleets (e.g. internal consistency of age compositions, presence of year effects, differences in trends related to different spatio-temporal patterns) should be provided. This is described for one series in the text but should be conducted in a consistent manner for all tuning series. Screening of these data using models such as SURBA would be worthwhile.

A similar analysis should also be conducted on the catch-at-age data prior to its incorporation in a stock assessment model. Anglerfish are very difficult to age. Consequently the ability to track cohorts of Anglerfish in this area may prove to be poor.

Should ageing and data difficulties continue to preclude an age-structured assessment in this area then the development of alternative methods of stock assessment is strongly encouraged (e.g. the length-based approach previously adopted for Northern shelf anglerfish). Development of survey-based methods to indicate the relative status of the stock should also be encouraged.

There is currently no accepted analytical basis for management advice. The status of the stock in relation to MSY and PA indicators is unknown.

## 4.1 General

### 4.1.1 Summary of ICES advice for 2012 and management for 2011 and 2012

*ICES advice for 2012*

Effort in fisheries that catch anglerfish should not increase.

*Management applicable for 2011 and 2012*

The TAC applied to both species and including Division VIIa was set at 40 950 t for 2011 and at 38 900 t for 2012.

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

There has been a revision of landings for the years marked in Table 4.1-1, in 2011 and after comparison with the last three years Spanish landings were considered not reliable and were not inputted into the table.

French data providers have been able to produce definitive landing estimates for 2009 and 2010 (Total or by FU) and the figures has been updated.

Landings have increased since 2000 and have fluctuated around 33 000 t since 2003. The landings of both species combined were estimated at 32 174 t in 2008, 28 455 t in 2009 and 29 686 t in 2010 (Table 4.1-1) since 2011 figures lack Spanish data and cannot be compared with previous years.

### 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.

France has provided a preliminary estimate of discards of both species for 2011. The estimated levels for 2011 as % of catch weight was 5.5% for Lophius piscatorius, 8.7% for Lophius budegassa and 6.2% for both species combined (WD09).

**Table 4.1-1. Anglerfish in Divisions VIIb-k and VIIIa,b,d -Total landings from 1984 to 2011 – Working Group estimates**

| Year | VIIb-k | VIIIa,b,d | Total |
|---|---|---|---|
| 1977 | | | 19895 |
| 1978 | | | 23445 |
| 1979 | | | 29738 |
| 1980 | | | 38880 |
| 1981 | | | 39450 |
| 1982 | | | 35285 |
| 1983 | | | 38280 |
| 1984 | 28847 | 7909 | 36756 |
| 1985 | 28491 | 7161 | 35652 |
| 1986 | 25987 | 5897 | 31883 |
| 1987 | 22295 | 7233 | 29528 |
| 1988 | 22494 | 5983 | 28477 |
| 1989* | 24674 | 5276 | 29950 |
| 1990* | 23434 | 5950 | 29384 |
| 1991* | 20256 | 4684 | 24940 |
| 1992* | 17412 | 3530 | 20942 |
| 1993* | 16517 | 3507 | 20024 |
| 1994* | 18023 | 3841 | 21864 |
| 1995* | 21822 | 4862 | 26684 |
| 1996 | 24153 | 6102 | 30255 |
| 1997 | 23928 | 5846 | 29774 |
| 1998* | 23295 | 4876 | 28171 |
| 1999 | 21845 | 3143 | 24988 |
| 2000 | 18129 | 2456 | 20585 |
| 2001* | 19534 | 2875 | 22409 |
| 2002* | 22648 | 3571 | 26220 |
| 2003 | 28552 | 4681 | 33233 |
| 2004 | 29510 | 5640 | 35150 |
| 2005 | 27908 | 5167 | 33075 |
| 2006 | 26795 | 4823 | 31618 |
| 2007* | 30121 | 5213 | 35334 |
| 2008* | 26724 | 5032 | 31756 |
| 2009* | 22733 | 5193 | 27926 |
| 2010* | 23338 | 5542 | 28880 |
| 2011** | 16844 | 5078 | 21921 |

* revised

** preliminar, no Spanish reliable data

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

### 4.2.1 Data

#### 4.2.1.1 Commercial Catch

The Working Group estimates of landings of *L. piscatorius* by fishery unit (defined in Section 2 of the report) are given in Table 4.2-1 *Lophius piscatorius* in Divisions VIIb-k and VIIIa,b,d - Landings in tonnes by Fishery Unit. Spanish data for 2011 are not included.

Spanish data in 2011 have been provided by SGP, the official notional administration responsible for fishery statistics, and are presented in Annex T. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations.

The landings have declined steadily from 23 700 t in 1986 to 12 800 t in 1992, then increased to 22 200 t in 1996 and declined to 13 900 t in 2000. The landings have increased since then reaching the maximum of the time series in 2007 (29 000 t). The 2008 value show a 16% drop at 24 300 t. In 2009 continued the decreasing trend with a 24 % drop (18 850 t) and in 2010 landings recovered to historic mean levels at 19 500 t.

#### 4.2.1.2 Commercial LPUE

Effort and LPUE data for the two Spanish fleets and English FU6 were available in 2011 (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.

All the commercial LPUE series decreased steadily until 1992. Since then, they have increased up to 2007 except for the 2 BAKA fleet. 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 a decreasing one. In 2011 all available fleets showed an increasing trend.

#### 4.2.1.3 Surveys data

##### 4.2.1.3.1 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 4.2-2 *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d- Evolution of the EVHOE-WIBTS-Q4 survey's indices Kg (left) and Nb (right) per 30 minutes tow from 1997 to 2011. and the length distributions in Figure 4.2-3 - *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d. Evolution of the EVHOE-WIBTS-Q4 Length distributions in Nb per 30 minutes tow from 1997 to 2011..

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 was as high as the 2005 historical maximum. Abundance in numbers shows four peaks in 2001, 2002, 2004 and to a lower extent in 2008. Since 2008 the abundance in numbers remain stable.

The length distribution shows that these peaks in abundance in numbers 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 identified.

These year classes are now still present in the recent survey catches at bigger sizes and account for the high 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 recruitment seems to be at medium levels.

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 for 2010 and 2011 show a uniform distribution of recruits through the sampling area of the survey.

#### 4.2.1.3.2 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.

In 2008 problems with the survey gear affected its geometry. It is very difficult to assess how these changes in gear behaviour have affected abundance indices; apparently the effect has not been dramatic in any species, though in both species of the genus *Lophius* a remarkable decrease has been found. Monkfish biomass stratified abundance index is within the limits of the survey's time series, with values close to those found in the beginning of the series, while the stratified index in number is the lowest of the time series after three years of a slight but steady decrease. The recruitment in 2008 was approximated with the number of individuals smaller than 21 cm, and results continue being poor as in the previous four years since 2005. For 2009 results were very similar to the ones from 2008 for all the parameters studied.

#### 4.2.1.3.3 The Irish Groundfish Survey (IGFS-WIBTS-Q4)

Abundance indices in Nb/sqKm 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. Due to the overall low number caught in some years the length distributions are not presented.

#### 4.2.1.3.4 The English Fisheries Science Partnership survey.

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.

### 4.2.2 Conclusion

LPUE's, survey data (biomass and abundance indices, 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.

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.

### 4.2.3 Comments on the assessment

Data from surveys tracking recent good recruitment give scope for 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) | Other | Neph.Trawl (Unit 9) | Shallow Trawl (Unit 10) | Medium/Deep Trawl (Unit 14) | Unallocated | TOTAL VII +VIII |
| 1986 | 429 | 13781 | 2877 | 1437 | 1021 | | 746 | 720 | 2657 | | 23666 |
| 1987 | 560 | 11414 | 2900 | 1520 | 787 | | 1035 | 542 | 3152 | | 21909 |
| 1988 | 643 | 9812 | 3105 | 1814 | 774 | | 927 | 534 | 2487 | | 20095 |
| 1989* | 781 | 8448 | 5259 | 2998 | 754 | | 673 | 444 | 1772 | | 21130 |
| 1990* | 1021 | 8787 | 3950 | 1736 | 880 | | 410 | 391 | 2578 | | 19753 |
| 1991* | 1752 | 7563 | 2793 | 1142 | 752 | | 284 | 218 | 1657 | | 16160 |
| 1992* | 1773 | 6254 | 1492 | 998 | 887 | | 254 | 166 | 942 | | 12766 |
| 1993* | 1742 | 5776 | 2125 | 1258 | 969 | | 360 | 278 | 950 | | 13458 |
| 1994* | 1377 | 7344 | 2595 | 1523 | 1236 | | 261 | 198 | 1586 | | 16120 |
| 1995* | 1915 | 8461 | 3195 | 1805 | 1242 | | 501 | 429 | 1954 | 228 | 19730 |
| 1996 | 2244 | 9796 | 2658 | 2189 | 1149 | 138 | 441 | 379 | 2229 | 938 | 22162 |
| 1997 | 2538 | 9225 | 2945 | 2031 | 964 | 39 | 429 | 376 | 2045 | 1068 | 21660 |
| 1998* | 3398 | 8714 | 2138 | 1722 | 812 | 3 | 397 | 149 | 1699 | 542 | 19572 |
| 1999 | 3162 | 9037 | 2369 | 1409 | 780 | 19 | 98 | 116 | 1259 | 0 | 18250 |
| 2000 | 2034 | 7067 | 1642 | 1434 | 726 | 6 | 91 | 77 | 863 | 0 | 13941 |
| 2001* | 2002 | 7880 | 2293 | 1978 | 886 | 17 | 146 | 76 | 1402 | 0 | 16681 |
| 2002* | 2719 | 9465 | 2609 | 1836 | 924 | 22 | 247 | 96 | 1908 | 0 | 19826 |
| 2003 | 3498 | 12332 | 2786 | 1983 | 974 | 81 | 470 | 168 | 2575 | 0 | 24865 |
| 2004 | 5004 | 12770 | 2642 | 2460 | 852 | 14 | 457 | 218 | 3296 | 0 | 27714 |
| 2005 | 5154 | 11556 | 2400 | 2388 | 594 | 7 | 342 | 165 | 2936 | 2 | 25543 |
| 2006 | 3741 | 13409 | 2216 | 2421 | 700 | 3 | 429 | 218 | 2758 | 2 | 25898 |
| 2007* | 4594 | 14949 | 2382 | 2836 | 660 | 11 | 286 | 244 | 3015 | 0 | 28977 |
| 2008* | 5107 | 11766 | 1885 | 1990 | 491 | 10 | 227 | 325 | 2573 | 1 | 24376 |
| 2009* | 3957 | 9938 | 358 | 1880 | 48 | 16 | 221 | 0 | 2153 | 275 | 18844 |
| 2010* | 3398 | 9851 | 539 | 2503 | 21 | 31 | 301 | 0 | 2373 | 504 | 19521 |
| 2011** | 2152 | 7785 | 548 | 3019 | 12 | 42 | 231 | 0 | 1908 | 1452 | 17149 |

* revised

** preliminar, no Spanish reliable data

**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 | 6875 | 9527 | 418 | N/A | 123 | N/A | N/A | | |
| 1987 | 6662 | 10453 | 349 | N/A | 199 | N/A | N/A | | |
| 1988 | 6547 | 10886 | 334 | N/A | 150 | N/A | N/A | | |
| 1989 | 7585 | 10483 | 378 | N/A | 187 | N/A | N/A | | |
| 1990 | 8021 | 9630 | 380 | N/A | 208 | N/A | N/A | | |
| 1991 | 7822 | 8522 | 380 | N/A | 210 | N/A | N/A | | |
| 1992 | 6370 | 5852 | 331 | N/A | 186 | N/A | 100 | | |
| 1993 | 5988 | 5001 | 274 | N/A | 159 | N/A | 114 | 1094 | 5590 |
| 1994 | 5655 | 4990 | 249 | N/A | 148 | N/A | 116 | 980 | 5619 |
| 1995 | 5070 | 4403 | 287 | N/A | 174 | N/A | 127 | 1214 | 4474 |
| 1996 | 5416 | 3746 | 196 | 121 | 144 | 19 | 126 | 1170 | 4378 |
| 1997 | 5058 | 3738 | 178 | 133 | 133 | 33 | 126 | 540 | 4286 |
| 1998 | 5360 | 3684 | 182 | 134 | 117 | 40 | 121 | 1196 | 3002 |
| 1999 | 5084 | 3512 | 110 | 110 | 83 | 59 | 115 | 1384 | 2337 |
| 2000 | 5519 | 2773 | 165 | 104 | 87 | 49 | 104 | 1850 | 2227 |
| 2001 | 5678 | 2356 | 135 | 133 | 61 | 66 | 186 | 1451 | 2118 |
| 2002 | 5041 | 2258 | 116 | 120 | 57 | 75 | 111 | 949 | 2107 |
| 2003 | 5437 | 2597 | 147 | 136 | 68 | 81 | 166 | 1022 | 2296 |
| 2004 | 5347 | 2292 | 160 | 133 | 78 | 89 | 174 | 910 | 2159 |
| 2005 | 5246 | 2120 | 127 | 137 | 83 | 121 | 109 | 544 | 2263 |
| 2006 | 5392 | 2257 | 140 | 145 | 72 | 101 | 94 | 487 | 2398 |
| 2007 | 5812 | 2323 | 149 | 152 | 48 | 127 | 97 | 476 | 2098 |
| 2008** | 5432 | 1640 | 118 | 126 | 58 | 113 | 138 | 105 | 2017 |
| 2009** | 5155 | 1626 | | | | | 75 | 0 | 1807 |
| 2010** | 4843 | 1988 | | | | | 77 | 138 | 1358 |
| 2011** | | | | | | | 82 | 57 | 1384 |

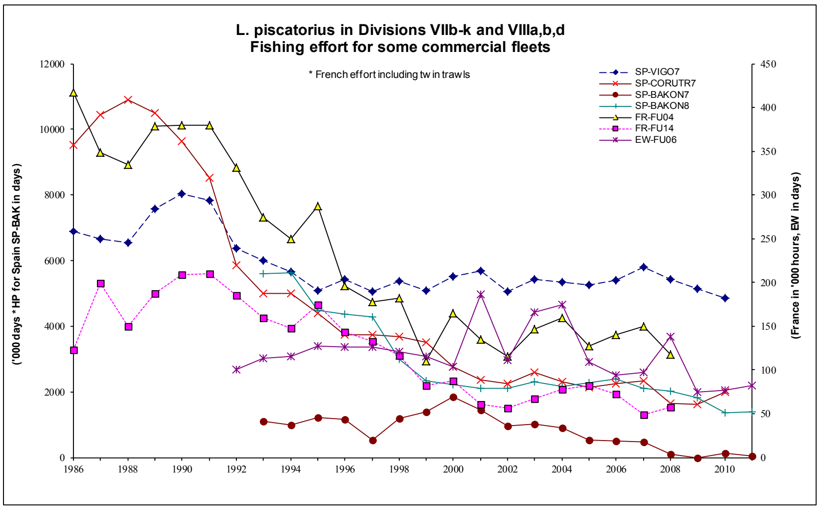
| LPUE | Vigo in Sub-Area VII (kg/days*HP) | La Coruna in Sub-Area VII (kg/days*HP) | French Benthic trawlers* Celtic Sea FU04 (kg/10 hrs) | French Benthic Twin Trawls Celtic Sea (kg/10 hrs) | French Benthic trawlers* Bay of Biscay FU14 (kg/10 hrs) | French Benthic Twin Trawls Bay of Biscay (kg/10 hrs) | 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** | | | | | | | 250 | 217 | 132 |
| 2011** | | | | | | | 266 | 484 | 157 |

* Identified twin trawls excluded

** preliminary

**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 |
|---|---|---|---|---|---|---|---|---|---|
| Nb/sqKm | 68.9 | 91.5 | 63.5 | 32.3 | 21.3 | 19.7 | 45.2 | 84.4 | 80.6 |



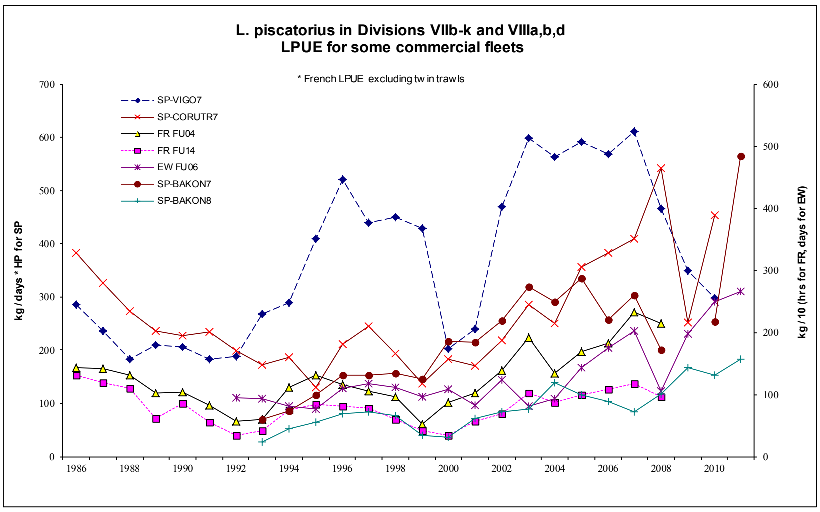




**Figure 4.2-1** ***L. piscatorius*** **in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data**

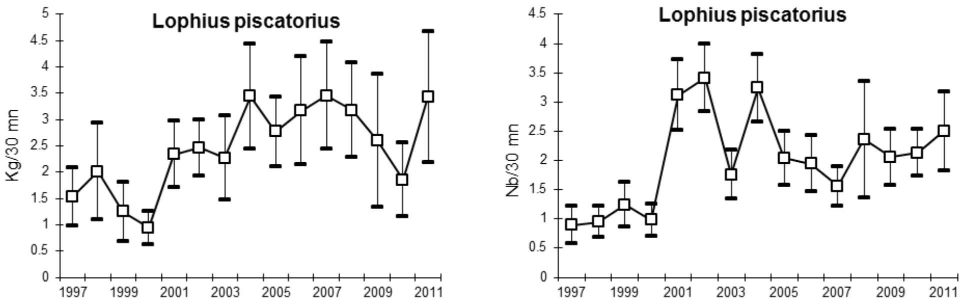



**Figure 4.2-2** ***L. piscatorius*** **in Divisions VIIb-k and VIIIa,b,d- Evolution of the EVHOE-WIBTS-Q4 survey's indices Kg (left) and Nb (right) per 30 minutes tow from 1997 to 2011.**

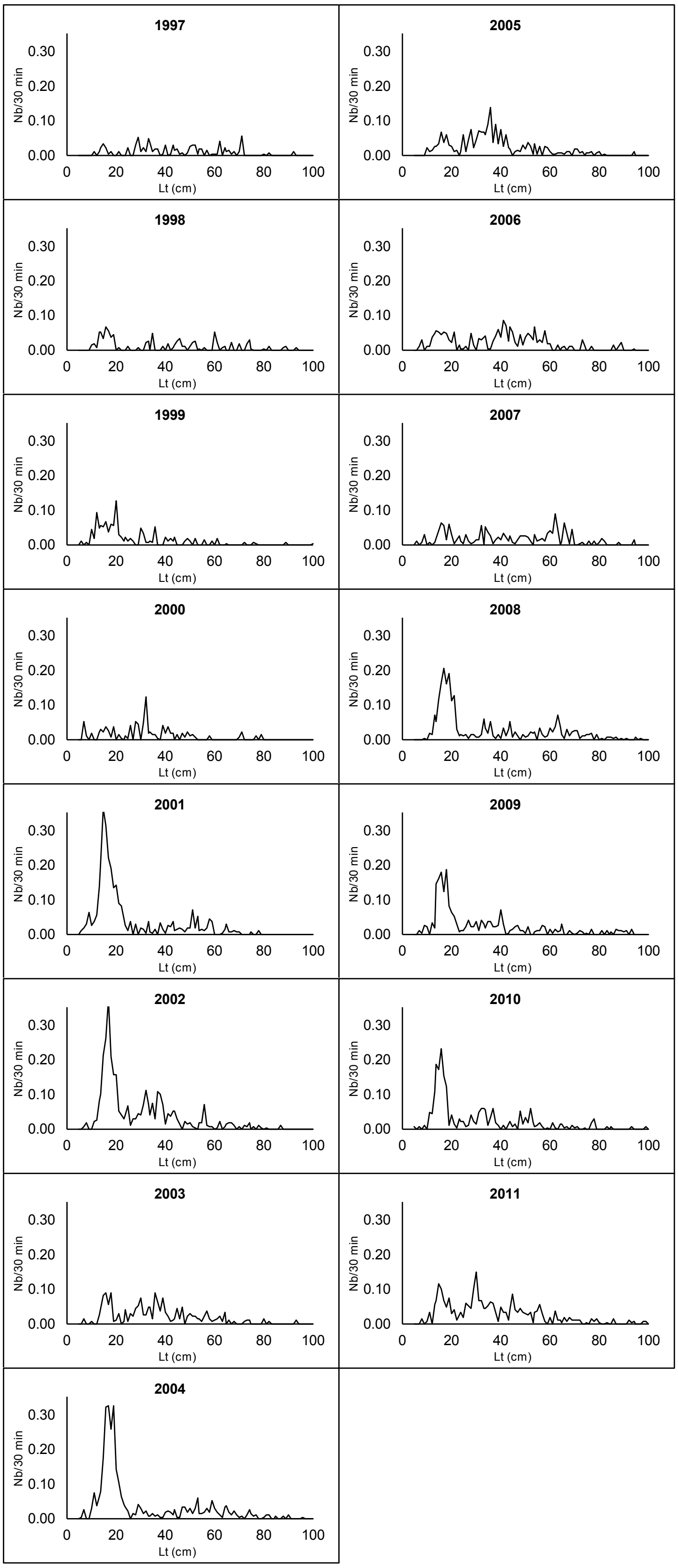



**Figure 4.2-3 - *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d. Evolution of the EVHOE-WIBTS-Q4 Length distributions in Nb per 30 minutes tow from 1997 to 2011.**

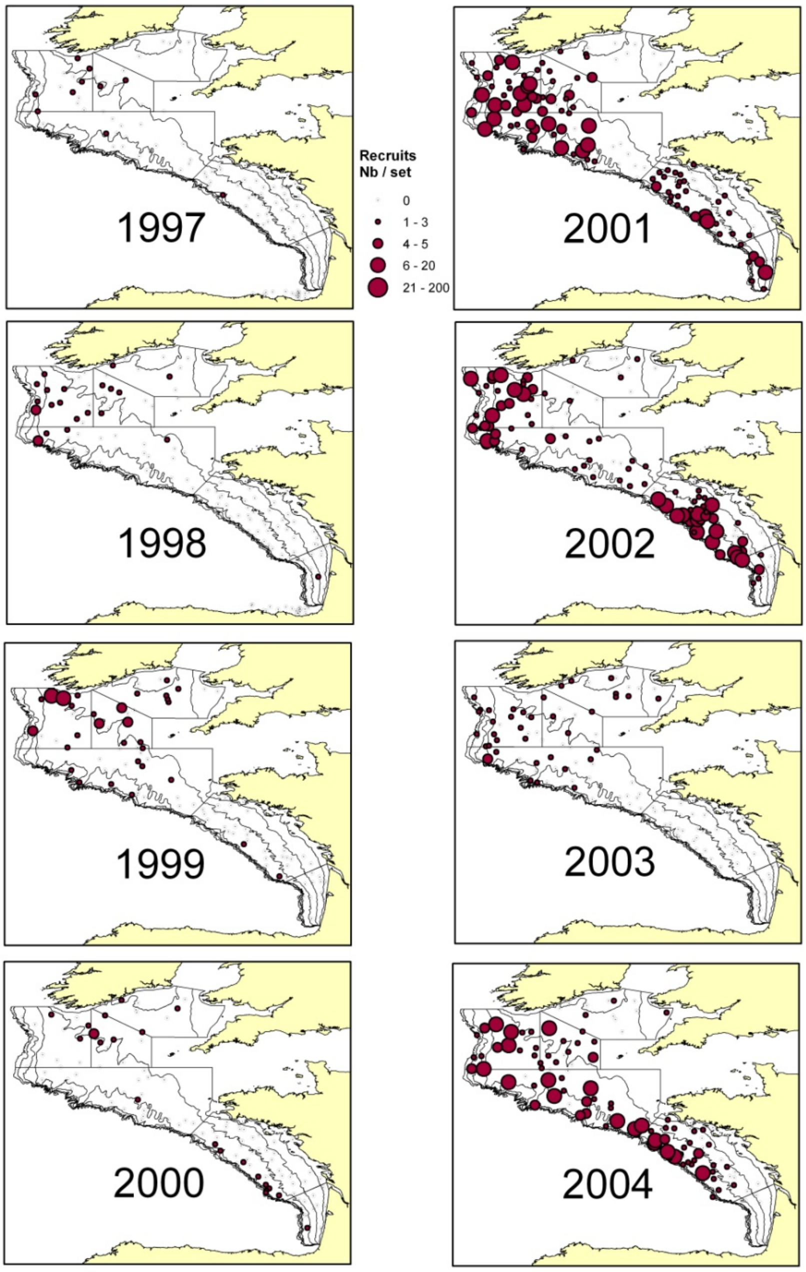



**Figure 4.2-4 – *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 1997 to 2004.**

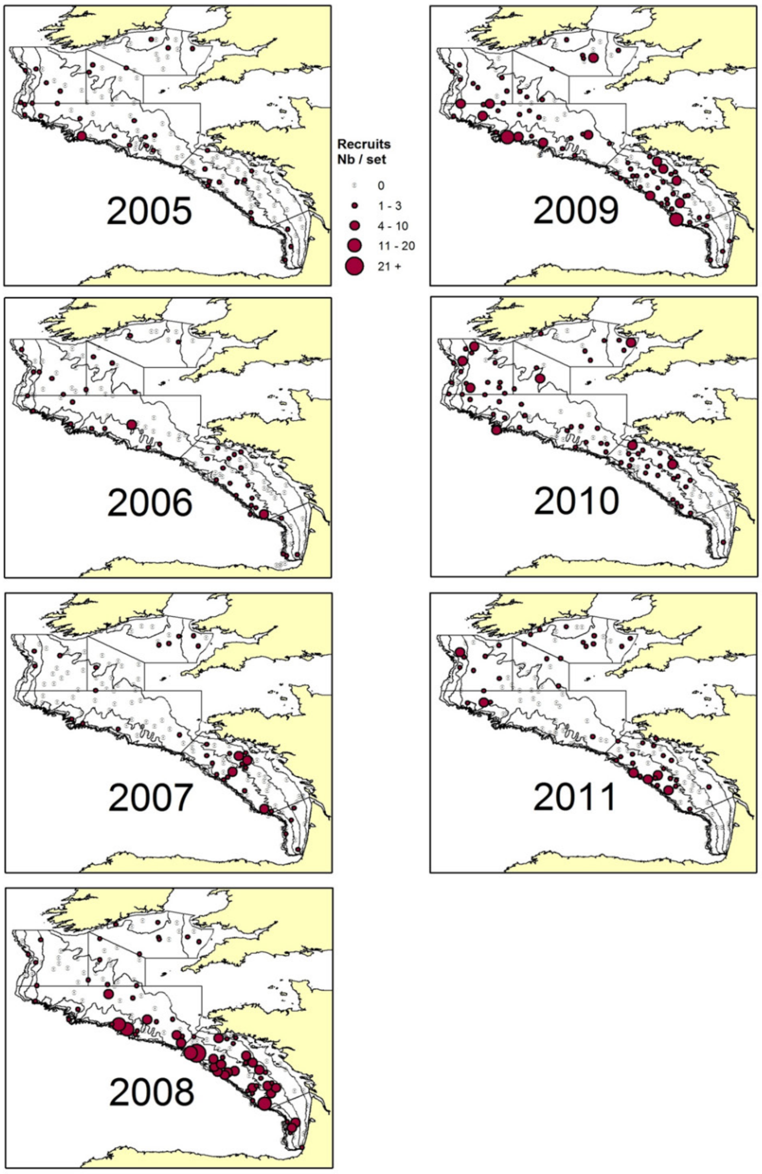



**Figure 4.2-5 – *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 2005 to 2011.**

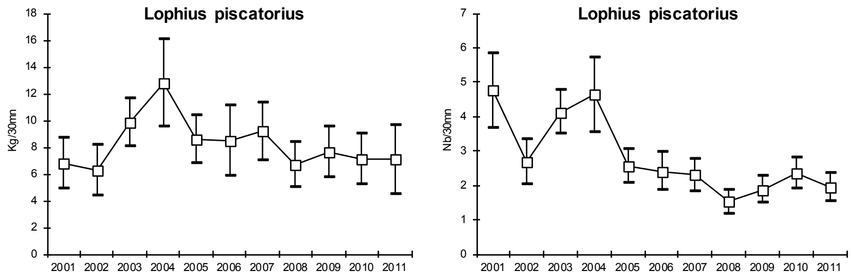



**Figure 4.2-6 -** ***L. piscatorius*** **in Divisions VIIb-k and VIIIa,b,d- Evolution of the SPPGFS (WIBTS-Q4) survey's indices Kg (left) and Nb (right) per 30 minutes tow from 2001 to 2011.**

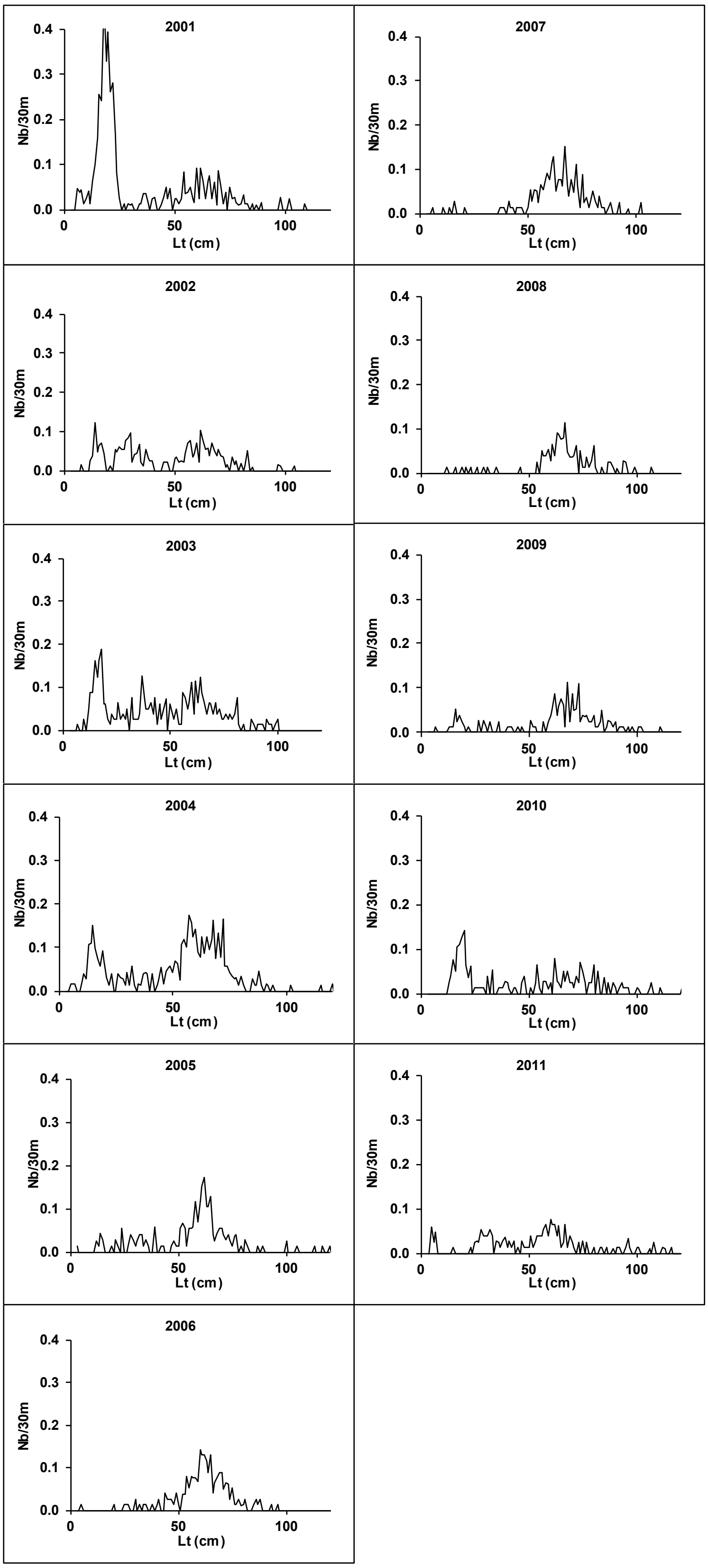



**Figure 4.2-7 -** ***L. piscatorius*** **in Divisions VIIb-k and VIIIa,b,d- Evolution of the SPPGFS (WIBTS-Q4) Length distributions in Nb per 30 minutes tow from 2001 to 2011**

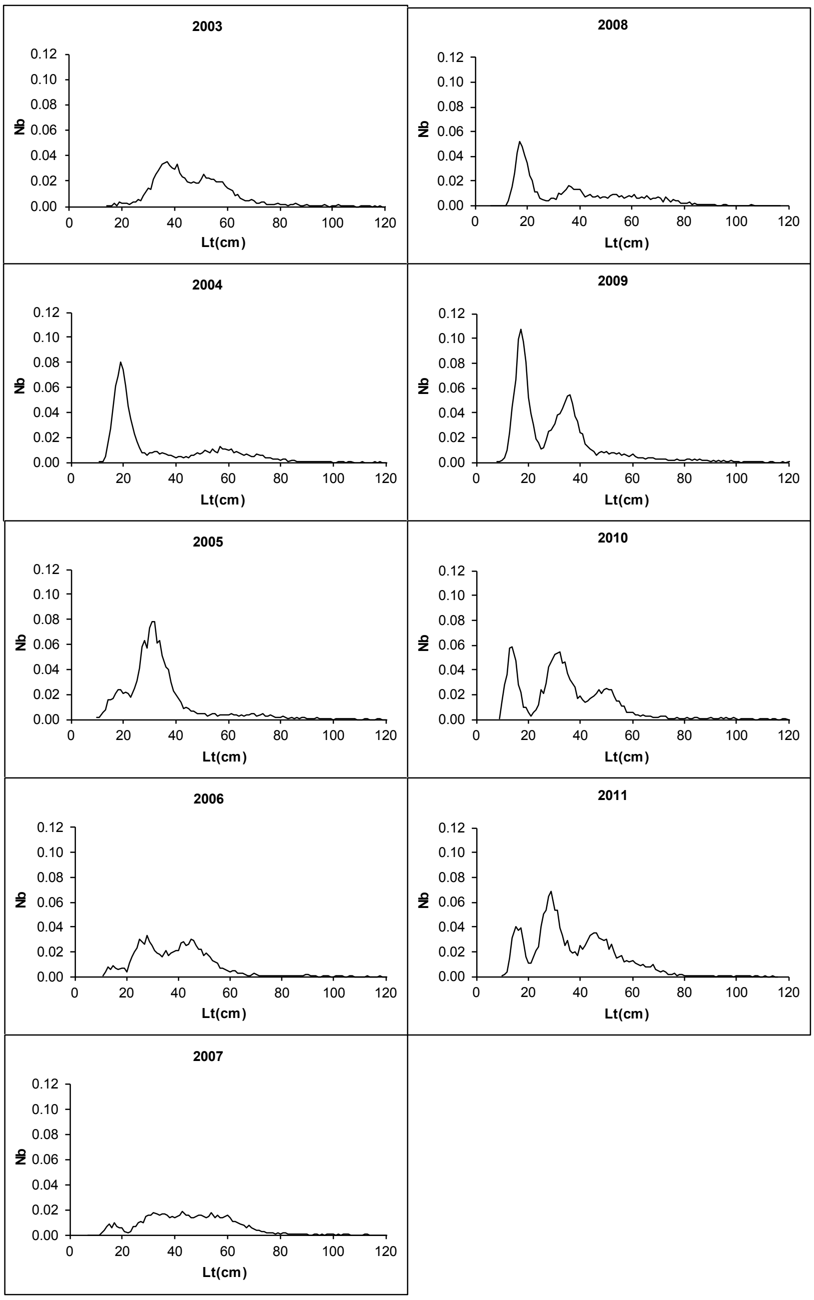



**Figure 4.2-8 - *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d- Evolution of the FSP-ENG-MONK Length distributions in Nb per meter beam per hour tow from 2003 to 2011**

## 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. Spanish data for 2011 are not included.

Spanish data in 2011 have been provided by SGP, the official notional administration responsible for fishery statistics, and are presented in Annex T. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations.

The landings have fluctuated over the studied period between 4 720 t to 9 630 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 second highest of the time-series in 2010 with 9 360 t landed.

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

#### 4.3.1.2 Commercial LPUE

Effort and LPUE data were available in 2011 for the two Spanish fleets, two French fleets and for the English EW-FU06 (table 4.3-2 and figure 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.

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. In the last three years SP- BAKON7 has shown an increasing trend, while EW-FU06 and SP-BAKON8 are stable. The 2010 SP-CORUTR7 LPUE has a revised figure from 93 down to 19 which is similar to its historic levels.

#### 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. 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.

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 most recent year, 2011, gives the strongest signal 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 (figures 4.3-4 and 4.3-5). However, in 2008, juveniles are also found in the more southern area of the Bay of Biscay in deeper waters. In 2010 and 2011 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 samples a fraction of each of the areas VIIe, VIIf, VIIg and VIIh (WD07). 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 and 2011 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 a strong recruitment signal present in the EVHOE-WIBTS-Q4 survey in a given year tends to be followed by a strong signal around 16-28 cm for this survey in the following year.

##### 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 this 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 most recent year has recorded its historical maximum. Data from the two available surveys show contradictory signals for 2009 and 2011 recruitments, however, the different recruitment ages for the surveys would suggest that the recruitment in 2009 for FSP-ENG-MONK are the recruits from the previous year of the EVHOE-WIBTS-Q4 and therefore the 2011 recruits are expected to be evident in the 2012 FSP-ENG-MONK 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 survey.

## Table 4.3-1 *Lophius budegassa* 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) | Shallow/medium Beam Trawl (Unit 6) | Neph.Trawl (Unit 8) | Other | Neph.Trawl (Unit 9) | Shallow Trawl (Unit 10) | Medium/Deep Trawl (Unit 14) | Unallocated | TOTAL VII +VIII |
| 1986 | 23 | 5126 | 348 | 540 | 406 | 0 | 443 | 150 | 1181 | 0 | 8217 |
| 1987 | 30 | 3493 | 696 | 462 | 434 | 0 | 483 | 116 | 1904 | 0 | 7619 |
| 1988 | 34 | 4072 | 1095 | 751 | 394 | 0 | 435 | 102 | 1498 | 0 | 8382 |
| 1989* | 40 | 4398 | 976 | 505 | 515 | 0 | 446 | 112 | 1829 | 0 | 8820 |
| 1990* | 53 | 4818 | 631 | 905 | 653 | 0 | 550 | 156 | 1865 | 0 | 9632 |
| 1991* | 0 | 4416 | 934 | 397 | 507 | 0 | 475 | 117 | 1933 | 0 | 8780 |
| 1992* | 0 | 4808 | 301 | 305 | 594 | 0 | 459 | 191 | 1518 | 0 | 8176 |
| 1993* | 0 | 3415 | 429 | 405 | 399 | 0 | 433 | 101 | 1385 | 0 | 6566 |
| 1994* | 0 | 2935 | 265 | 209 | 540 | 0 | 232 | 49 | 1515 | 0 | 5744 |
| 1995* | 10 | 3963 | 455 | 159 | 617 | 0 | 312 | 62 | 1286 | 90 | 6953 |
| 1996 | 118 | 4587 | 477 | 245 | 524 | 28 | 374 | 109 | 1239 | 392 | 8092 |
| 1997 | 134 | 4836 | 602 | 132 | 474 | 9 | 313 | 17 | 1128 | 471 | 8114 |
| 1998* | 179 | 5565 | 246 | 230 | 288 | 1 | 258 | 72 | 1454 | 305 | 8599 |
| 1999 | 18 | 4311 | 119 | 282 | 338 | 0 | 144 | 76 | 1450 | 0 | 6739 |
| 2000 | 57 | 4489 | 161 | 284 | 228 | 0 | 124 | 31 | 1270 | 0 | 6645 |
| 2001* | 41 | 3758 | 107 | 266 | 306 | 0 | 121 | 29 | 1100 | 0 | 5728 |
| 2002* | 30 | 4272 | 147 | 251 | 372 | 0 | 112 | 14 | 1195 | 0 | 6394 |
| 2003 | 92 | 5748 | 337 | 342 | 376 | 5 | 195 | 26 | 1248 | 0 | 8368 |
| 2004 | 122 | 4684 | 242 | 343 | 376 | 0 | 254 | 9 | 1407 | 0 | 7436 |
| 2005 | 73 | 4837 | 162 | 409 | 329 | 0 | 235 | 56 | 1431 | 0 | 7532 |
| 2006 | 9 | 3661 | 145 | 271 | 218 | 0 | 286 | 1 | 1128 | 1 | 5720 |
| 2007* | 92 | 3874 | 168 | 306 | 250 | 0 | 243 | 0 | 1424 | 0 | 6357 |
| 2008* | 21 | 4620 | 187 | 392 | 254 | 0 | 235 | 0 | 1669 | 0 | 7379 |
| 2009* | 72 | 5963 | 24 | 441 | 36 | 0 | 354 | 0 | 2047 | 145 | 9082 |
| 2010* | 224 | 6137 | 9 | 597 | 27 | 0 | 379 | 0 | 1763 | 223 | 9359 |
| 2011** | 172 | 2495 | 11 | 591 | 16 | 0 | 378 | 0 | 1065 | 44 | 4772 |

* revised
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## Table 4.3-2 *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 | 6875 | 9527 | 418 | N/A | 123 | N/A | N/A | N/A | N/A |
| 1987 | 6662 | 10453 | 349 | N/A | 199 | N/A | N/A | N/A | N/A |
| 1988 | 6547 | 10886 | 334 | N/A | 150 | N/A | N/A | N/A | N/A |
| 1989 | 7585 | 10483 | 378 | N/A | 187 | N/A | N/A | N/A | N/A |
| 1990 | 8021 | 9630 | 380 | N/A | 208 | N/A | N/A | N/A | N/A |
| 1991 | 7822 | 8522 | 380 | N/A | 210 | N/A | N/A | N/A | N/A |
| 1992 | 6370 | 5852 | 331 | N/A | 186 | N/A | 100 | N/A | N/A |
| 1993 | 5988 | 5001 | 274 | N/A | 159 | N/A | 114 | 1094 | 5590 |
| 1994 | 5655 | 4990 | 249 | N/A | 148 | N/A | 116 | 980 | 5619 |
| 1995 | 5070 | 4403 | 287 | N/A | 174 | N/A | 127 | 1214 | 4474 |
| 1996 | 5416 | 3746 | 196 | 121 | 144 | 19 | 126 | 1170 | 4378 |
| 1997 | 5058 | 3738 | 178 | 133 | 133 | 33 | 126 | 540 | 4286 |
| 1998 | 5360 | 3684 | 182 | 134 | 117 | 40 | 121 | 1196 | 3002 |
| 1999 | 5084 | 3512 | 108 | 110 | 83 | 59 | 115 | 1384 | 2337 |
| 2000 | 5519 | 2773 | 160 | 103 | 87 | 49 | 104 | 1850 | 2227 |
| 2001 | 5678 | 2356 | 127 | 133 | 60 | 66 | 186 | 1451 | 2118 |
| 2002 | 5041 | 2258 | 114 | 120 | 56 | 75 | 111 | 949 | 2107 |
| 2003 | 5437 | 2597 | 144 | 134 | 65 | 78 | 166 | 1022 | 2296 |
| 2004 | 5347 | 2292 | 155 | 129 | 75 | 88 | 174 | 910 | 2159 |
| 2005 | 5246 | 2120 | 137 | 135 | 81 | 118 | 109 | 544 | 2263 |
| 2006 | 5392 | 2257 | 140 | 145 | 72 | 101 | 94 | 487 | 2398 |
| 2007 | 5952 | 2323 | 149 | 152 | 48 | 127 | 97 | 476 | 2098 |
| 2008** | 5840 | 1640 | 118 | 126 | 58 | 113 | 138 | 105 | 2017 |
| 2009** | 5852 | 1626 | N/A | N/A | N/A | N/A | 75 | 0 | 1807 |
| 2010** | 5607 | 1988 | N/A | N/A | N/A | N/A | 77 | 138 | 1358 |
| 2011** | | | | | | | 82 | 57 | 1384 |

| 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** | | | | | | | 32 | 590 | 112 |

* Identified twin trawls excluded
** Preliminar

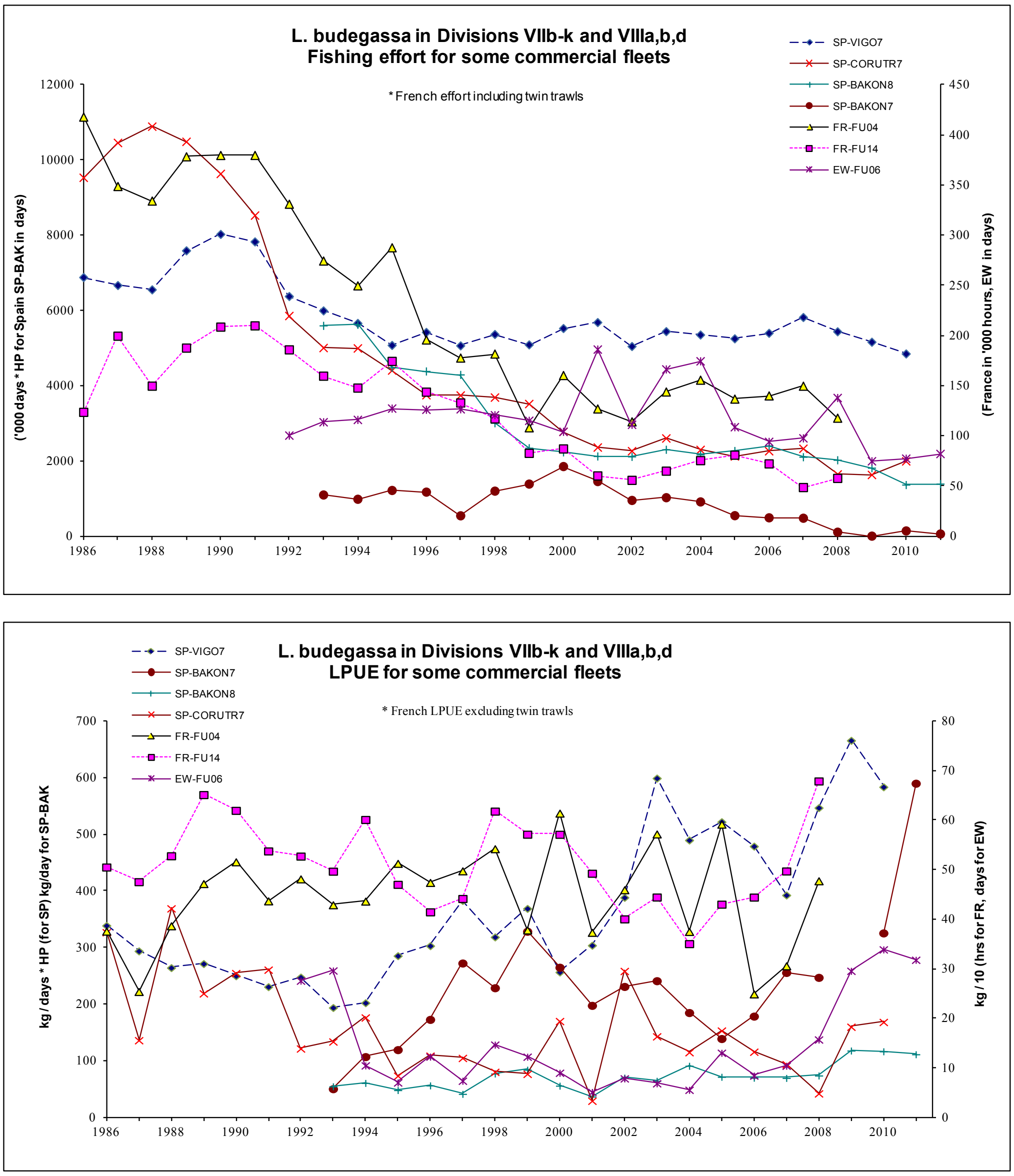



**Figure 4.3-1** ***L. budegassa*** **in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data**

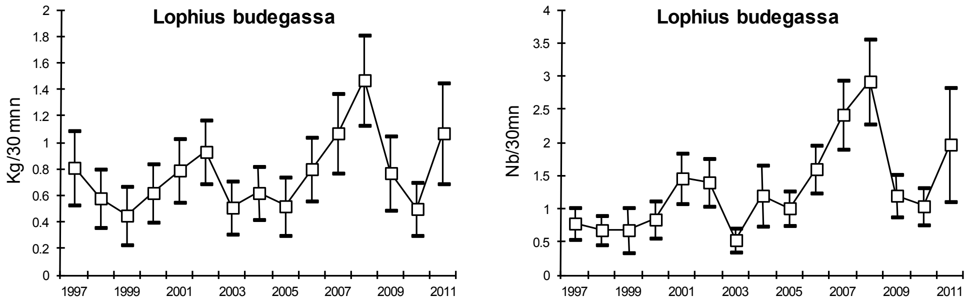



**Figure 4.3-2** ***L. budegassa*** **in Divisions VIIb-k and VIIIa,b,d- Evolution of the EVHOE-WIBTS-Q4 survey's indices Kg (left) and Nb (right) per 30 minutes tow from 1997 to 2011**

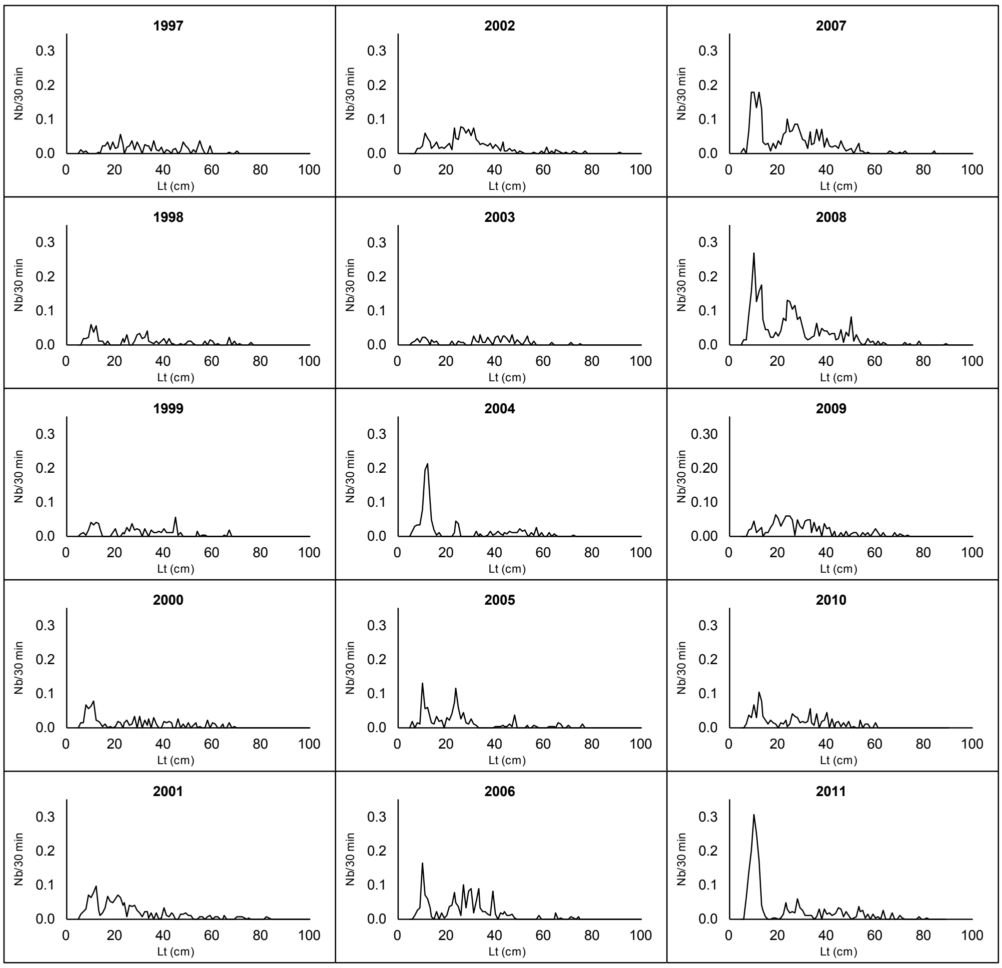



**Figure 4.3-3 - *L. budegassa* in Divisions VIIb-k and VIIIa,b,d- Evolution of the EVHOE-WIBTS-Q4 Length distributions in Nb per 30 minutes tow from 1997 to 2011.**

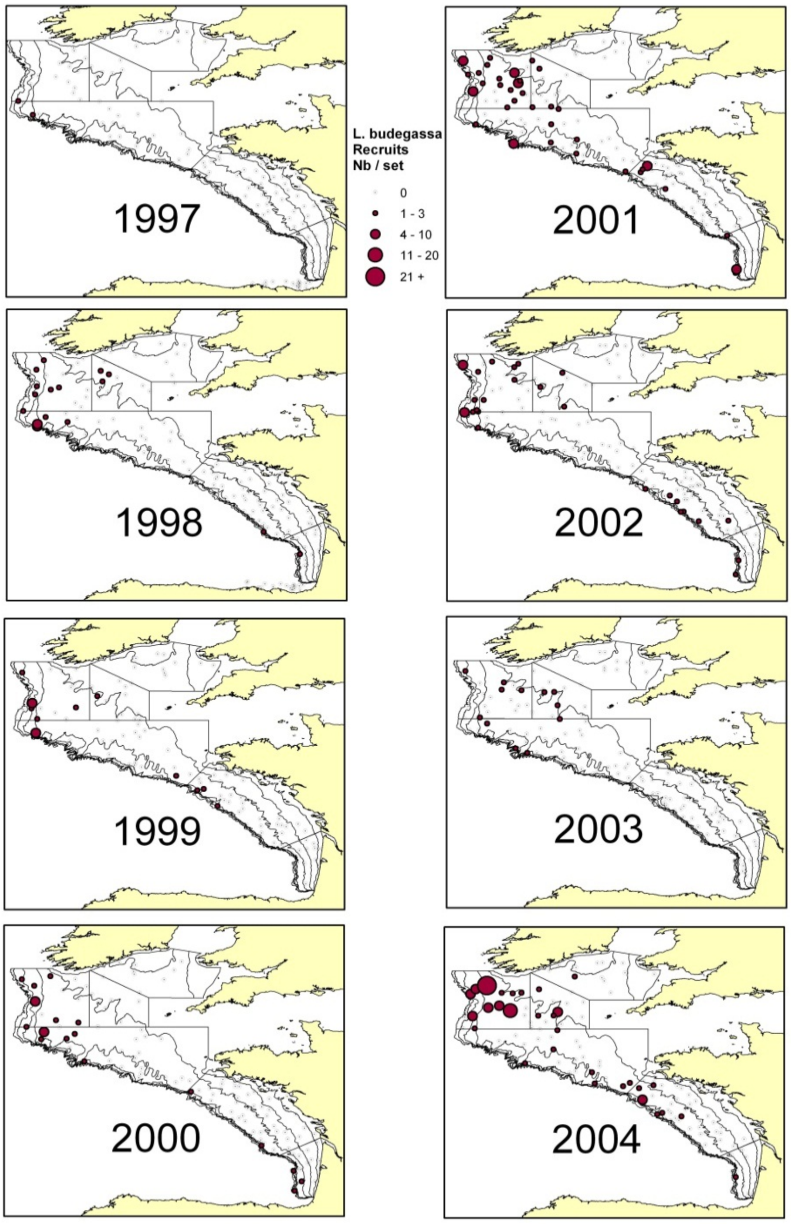



**Figure 4.3-4 –** ***L. budegassa*** **in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 16 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 1997 to 2004.**

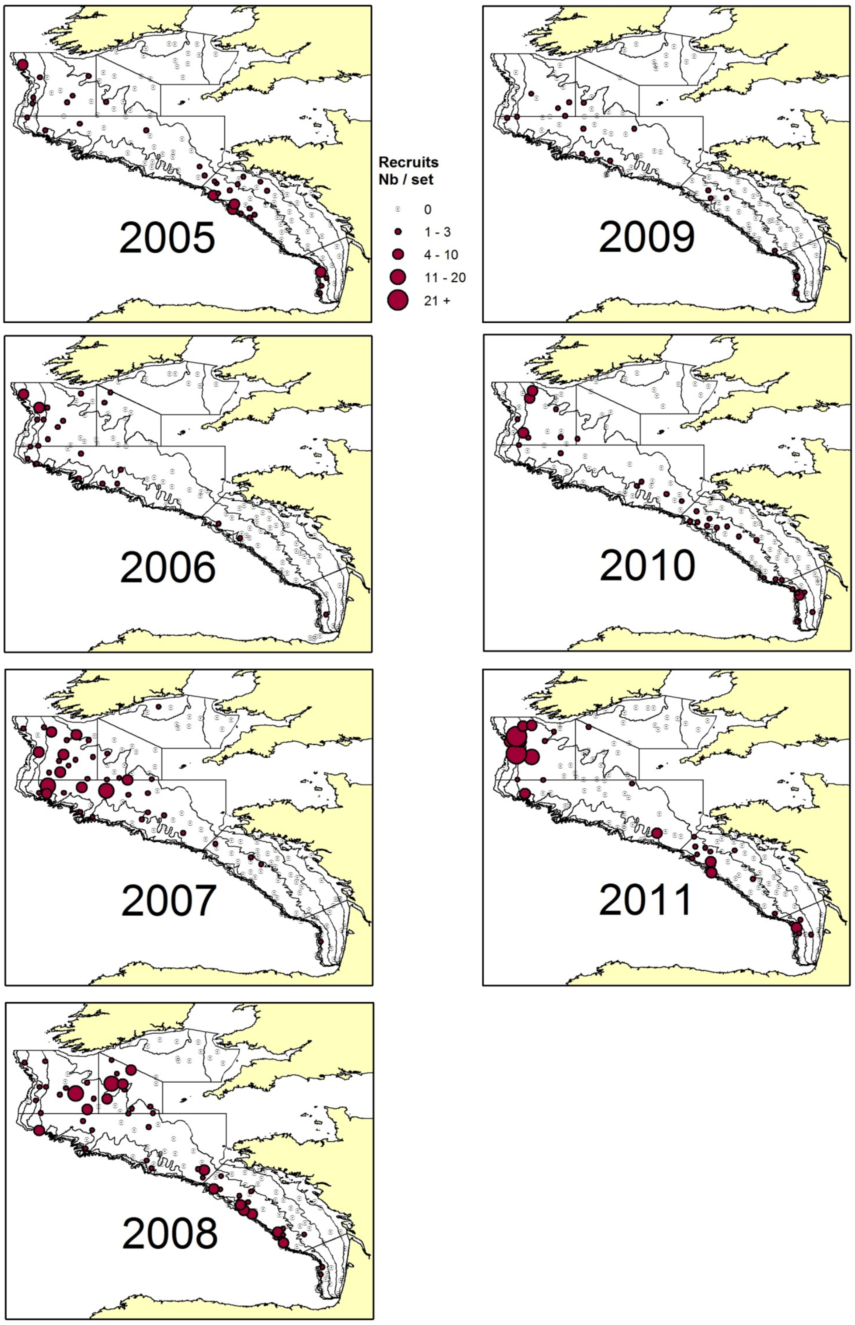



**Figure 4.3-5 – *L. budegassa* in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 16 cm) in Nb per 30m observed in the EVHOE-WIBTS-Q4 surveys from 2005 to 2011.**

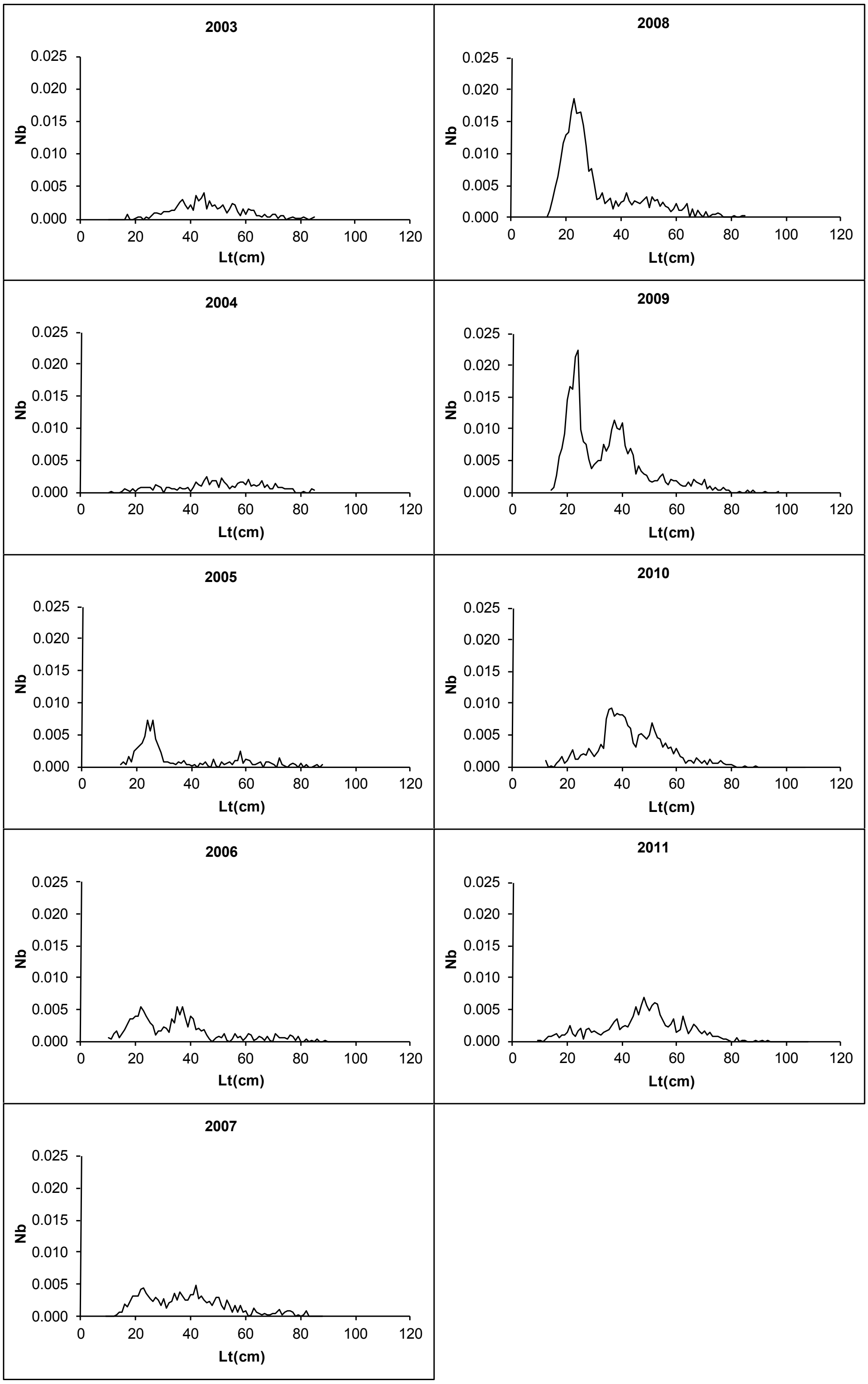



**Figure 4.3-6 - *L. budegassa* in Divisions VIIb-k and VIIIa,b,d- Evolution of the FSP-ENG-MONK Length distributions in Nb per 30 minutes tow from 2003 to 2011.**

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

**Assessment type:** This stock was benchmarked in 2012. assessment. Type of assessment is based on survey trends ( up to 2011); trends in population parameters from the Benchmark results (up to 2010); and a more detailed trend study on abundance of age groups from surveys and commercial fleets (up to 2011 and 2010, respectively).

It was not possible to include Spanish commercial data for 2011 in the assessment. The assessment model could not be updated this year. The assessment conducted in 2011 follows the same approach as last year but omits Spanish commercial data for 2011.

**Data revisions this year**: no major data revision have been carried out apart from Spain, this has been used in the benchmark progress in data.

## 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 Irish, French and UK demersal vessels. In 2010, the four countries together have reported around 98% of the total landings (Table 5.1a). Estimates of total landings (including unreported or miss-reported landings) and catches (landings + discards) as used by the Working Group up to 2010 are shown in Table 5.1b. In 2011, no data update has been carried out due to the large Spanish component (around 50%) in the landings and the lack of data from this country limiting the capability of the group to deploy any assessment.

### 5.1.2 Summary of ICES Advice for 2011 and Management applicable for 2010 and 2011

**ICES advice for 2011**

ICES provided two advice options for 2011:

On the basis of the transition to an MSY approach, catch and effort reduction should take place in 2011.

On the basis of the Precautionary approach, catch and effort should not increase in 2011.

**Management applicable for 2011 & 2012**

The 2011 and 2012 TACs were set at 20 106 t respectively, 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 1972-2011, as estimated by the WG, are given in Table 5.1.a. Spanish data for 2011 are not included.

Spanish data in 2011 have been provided by SGP, the official national administration responsible for fishery statistics, and are presented in Annex T. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations.

During Benchmark, 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 included in this revised data series.

Landings in 2010 are slightly lower than in 2009 (1%), reaching up to 13 185 t

Discard data were updated in 2011 as United Kingdom (England and Wales) and Ireland provided discard raised data. Spain did provided discards for 2011 but was not used as no raising factor (effort) was not readily available for the group. 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 2000 (Table 5.1b.) 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, United Kingdom (England and Wales), and Ireland provide discard data since 2000. Still, Spain and France does not provide this data, which led to an artificial de-crease 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** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Discard ratio (%) | 11 | 13 | 15 | 20 | 27 | 17 | 22 | 17 | 19 | 16 | 25 |

### 5.2.2 Biological sampling

Age and Length distribution provided by countries are explained in Stock annex-Meg78 (Annex 6).

**Age**

France provided ALKs and consequently completed number and weights at age up to 2011.

Spain, Ireland and UK (England and Wales) provided number at age for discards and landings up to 2011. However, Spanish data was not used.

Age distribution for landings and discards from 1987 to 2010 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 2011..Spanish length composition was standardised by total number of individuals, as lengths were provided but not raising was applied to the official landings.

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 2010 the numbers discarded of small lengths markedly increased.

### 5.2.3 Abundance indices from 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 1997–2011 are summarised in Table 5.2.3.1.

EVHOE-WIBTS-Q4 indices for age 1 showed no evident general trend. Oscillations of high and low values are present from 2002 to 2007. In 2008 indices decreased sharply with a slight increase till 2010. In 2011, the lowest value of the series is reached.

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.

An abundance index was provided for the Spanish Porcupine Ground Fish Survey (SpPGFS-WIBTS-Q4) from 2001 to 2011, and from Irish Groundfish Survey (IGFS-WIBTS-Q4) from 2003-2011. For the last three years of the data series, both surveys provide the lowest values of the age 1.

When comparing Spanish, French and Irish 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 2011, it slightly decreased. The SpPGFS-WIBTS-Q4 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 3 years of the series.

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.

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. Age group i) appear most abundant during years 2005 to 2008. In 2011, surveys show contradictory signals for different age grouping. Thus, EVHOE-WIBTS-Q4 and SpPGFS-WIBTS-Q4 Surveys identifies a positive increase for ages group ii) and iii) while for IGFS-WIBTS-Q4last year estimation is negative for all age groups

It must be noted that the areas covered by the three surveys almost do not overlap. 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 (Figure 5.2.3.3).

### 5.2.4 Commercial catch-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.

Commercial series of catch-at-age and effort data were available for three Spanish fleets in Subarea VII: A Coruña (SP-CORUTR7), Cantábrico (SP-CANTAB7) and Vigo (SP-VIGOTR7) from 1984–2010. (Figure 5.2.4.1a)

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 5.2.4.1a). 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 general level of effort in SP-CORUTR7 and SP-VIGOTR7 has decreased since 1991, stabilising the last years of the series. SP-VIGOTR7 showed a very slight increase in 2007, decreasing slightly till 2010. 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 (Figure 5.2.4.1a). 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 9 years (Figure 5.2.4.1a). Since French logbook data were only partially available since 1999, only the LPUE data can be considered.

The CPUE of SP-CORUTR7 has fluctuated until 1990, when it started decreasing, with a slight increase in 2007. In 2009, CPUE for this fleet sharply increased (Figure 5.2.4.2b). 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. The CPUE of SP-VIGOTR7, as for SP-CORUTR7, has had a sharp increase in 2009. In 2010, CPUE of SP-CORUTR7 slightly decreased. 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.

The LPUE of all French bottom trawlers fleets decreased from 1988 to 1991 and remained relatively stable until 1994 (Figure 5.2.4.2c). 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. From 1996, the demersal fleet LPUE started decreasing. No update of LPUE information for 2009 and 2010 was provided for French fleets.

The LPUE of all Irish beam trawlers fleets' oscillates up and down since 2000 to 2006 following a decreased trend. From 2007 an increase in the LPUE is observed (Figure 9.2.4.2c).

An analysis of the abundance indices of different age's groups along the whole data series for commercial fleets was carried out (Figure 5.2.4.3). 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 and 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 and 2006 to 2010 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 2010, Spanish and Irish fleets show contradictory signals for different age grouping. Whereas Spanish fleet identified a positive increase for all age groups in 2010, Irish fleet just identified that positive estimate for old fish.

### 5.2.5 Conclusions

As no precise estimates of development of the stock population structure and SSB are available, The basis for the assessment are,

- 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 (Figure 5.2.5.1)
- 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 data series.

Precise estimates of recent development of the stock population structure and SSB are not available. Spanish commercial CPUEs series give congruous trends EVHOE-WIBTS-Q4 and SpPGFS-WIBTS-Q4 survey biomass indices both show an increase in 2009 and 2010. In 2011, IGFS-WIBTS-Q4 and SpPGFS-WIBTS-Q4 coincide in the increasing trend. Discard data and survey indices do not appear to indicate the presence of either strong incoming recruitment or strong decreasing trend in 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.

The group states strongly the importance of delivering reliable Spanish and French 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.

## 5.3 Short term and medium term forecasts

No analytical assessment resulted available for this stock consequently no forecast is either provided.

## 5.4 Biological reference points

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

## 5.5 Recommendations on the procedure for assessment updates and further work

No progress can be expected if no international commitment to work com-promise for countries exploiting on data and methods to assess this stock is obtained. However it appears unlikely that time between possible future Benchmarks and Working Groups would be enough for: i) solving data availability, ii) reviewing their quality, iii) new model trials and even iv) exchange of experiences between researches working in same species but different stocks. That is why it would be recommended that:

a ) Resources could be made available for a real improvement in the assessment of this stock. A pilot project is suggested for in a depth treatment of data analysis and improvement and model selection. A detailed work plan will be presented at the RCM during September 2012.

b ) If no resources are available, interseasonal work between this WG and next working group will be focused in the improvement of the data quality.

**Table 5.1a** **Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d.**
**Nominal landings and catches (t) 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 | |
| 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 | 1850 |
| 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 | 2208 |
| 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 | 267 | 2208 |
| Total landings | 16659 | 17865 | 18927 | 17114 | 17577 | 19233 | 14370 | 15094 | 15600 | 14929 | 13684 | 15862 | 15109 | 14230 | 14345 | 13305 | 15031 | 15778 | 15987 | 15687 | 14300 | 12703 | 12000 | 13048 | 10853 | 13348 | 13185 | |
| Total discards | 2169 | 1732 | 2321 | 1705 | 1725 | 2582 | 3284 | 3282 | 2988 | 3108 | 2700 | 3206 | 3026 | 3066 | 5371 | 3297 | 1870 | 2262 | 2813 | 4008 | 5240 | 2578 | 3368 | 2703 | 2531 | 2604 | 4406 | |
| Total catches | 18828 | 19597 | 21248 | 18819 | 19302 | 21815 | 17654 | 18376 | 18588 | 18037 | 16384 | 19068 | 18135 | 17296 | 19716 | 16601 | 16901 | 18040 | 18800 | 19695 | 19539 | 15281 | 15369 | 15750 | 13384 | 15952 | 17590 | |
| 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 |

Note: UK includes data from Northern Ireland from 2009 onwards.

Table 5.1b. 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** | 13185 | 4406 | 17590 | 20106 |
| **2011 (*)** | 5983 | 1242 | 7225 | 20106 |

(1) for both megrim species and VIIa included
(*) No Spanish 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** |

**- In bold: years where discards sampling programs provided information**
- In (): years for which the length distribution of discards has been derived
**(*) Spanish discard data were provided but not used as no raising effort was available.**

**Table 5.2.2.1 Megrim (*L.whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Original Length composition by fleet (thousands) has been deployed. No raised to the total landings. No length frequencies for Belgium are available. Spanish leNgth distribution has been scaled to the total numbers.**

| Length | FRANCE | SPAIN | | IRELAND | UNITED KINGDOM | | | |
|---|---|---|---|---|---|---|---|---|
| class (cm) | ALL FISHING I | FU04:Otter trawl-me | FU14:Otter trawl-med& | ALL FISHING | FU03:Fixed nets | FU 04: Otte | FU05:Otter t | FU06:Beam trawl-all depths |
| 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | 142 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 |
| 21 | 526 | 0 | 6 | 6 | 0 | 0 | 0 | 0 |
| 22 | 4106 | 1 | 31 | 20 | 0 | 0 | 0 | 1 |
| 23 | 11472 | 4 | 65 | 44 | 0 | 0 | 0 | 1 |
| 24 | 62923 | 37 | 95 | 138 | 0 | 0 | 7 | 4 |
| 25 | 82662 | 99 | 104 | 256 | 0 | 0 | 18 | 14 |
| 26 | 95965 | 124 | 110 | 473 | 0 | 0 | 31 | 25 |
| 27 | 92568 | 122 | 91 | 722 | 0 | 0 | 43 | 35 |
| 28 | 100933 | 116 | 69 | 967 | 0 | 0 | 43 | 49 |
| 29 | 106978 | 101 | 49 | 1018 | 0 | 0 | 57 | 63 |
| 30 | 167857 | 77 | 35 | 1327 | 0 | 0 | 56 | 94 |
| 31 | 188642 | 68 | 32 | 1439 | 0 | 0 | 46 | 85 |
| 32 | 185333 | 54 | 30 | 1384 | 0 | 0 | 43 | 100 |
| 33 | 218897 | 37 | 42 | 1413 | 0 | 0 | 39 | 107 |
| 34 | 232703 | 31 | 39 | 1311 | 0 | 0 | 35 | 122 |
| 35 | 211187 | 21 | 40 | 1226 | 1 | 0 | 30 | 110 |
| 36 | 235871 | 19 | 39 | 1053 | 1 | 0 | 26 | 97 |
| 37 | 225388 | 12 | 31 | 874 | 1 | 0 | 20 | 88 |
| 38 | 218710 | 14 | 29 | 834 | 1 | 0 | 18 | 74 |
| 39 | 204272 | 11 | 22 | 615 | 1 | 0 | 18 | 67 |
| 40 | 201264 | 9 | 16 | 556 | 1 | 0 | 13 | 63 |
| 41 | 195123 | 7 | 9 | 515 | 1 | 0 | 12 | 58 |
| 42 | 189656 | 7 | 5 | 450 | 0 | 0 | 8 | 44 |
| 43 | 148582 | 5 | 4 | 292 | 1 | 0 | 5 | 47 |
| 44 | 135991 | 5 | 2 | 298 | 0 | 0 | 5 | 34 |
| 45 | 111980 | 3 | 1 | 237 | 0 | 0 | 2 | 24 |
| 46 | 85561 | 4 | 1 | 162 | 0 | 0 | 2 | 19 |
| 47 | 66201 | 2 | 1 | 139 | 0 | 0 | 1 | 14 |
| 48 | 54528 | 3 | 1 | 155 | 0 | 0 | 1 | 10 |
| 49 | 43025 | 2 | 0 | 88 | 0 | 0 | 1 | 8 |
| 50 | 30439 | 2 | 0 | 60 | 0 | 0 | 0 | 8 |
| 51 | 27443 | 1 | 0 | 44 | 0 | 0 | 0 | 6 |
| 52 | 21401 | 1 | 0 | 57 | 0 | 0 | 0 | 4 |
| 53 | 17661 | 0 | 0 | 33 | 0 | 0 | 0 | 4 |
| 54 | 9990 | 0 | 0 | 54 | 0 | 0 | 0 | 4 |
| 55 | 8761 | 0 | 0 | 42 | 0 | 0 | 0 | 3 |
| 56 | 4064 | 0 | 0 | 14 | 0 | 0 | 0 | 1 |
| 57 | 2057 | 0 | 0 | 11 | 0 | 0 | 0 | 1 |
| 58 | 434 | 0 | 0 | 9 | 0 | 0 | 0 | 1 |
| 59 | 784 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 61 | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 4002274 | | | 18338 | 11 | 0 | 579 | 1489 |

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

**Table 5.2.3.1** **Abundance Indices by kilograms and numbers by 30 minutes haul duration**

**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 | 141 | 487 | 350 | 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 | 5 |

**SP-PGFS**

| | **Effort** | **Age 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 |

**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** | 1.94 | 14.55 |
| **2008** | 2.01 | 13.34 |
| **2009** | 2.5 | 14.8 |
| **2010** | 2.57 | 15.53 |
| **2011** | 3.21 | 17.14 |

**SP-PGFS Abundance Indices by kilograms and numbers by 30 minutes haul duration**

| | **kg/30'** | **Nb/30'** |
|---|---|---|
| **2001** | 6.80 | 143.34 |
| **2002** | 6.66 | 147.00 |
| **2003** | 8.15 | 180.79 |
| **2004** | 7.45 | 167.47 |
| **2005** | 8.28 | 170.17 |
| **2006** | 6.03 | 125.37 |
| **2007** | 7.31 | 177.38 |
| **2008** | 5.99 | 109.70 |
| **2009** | 8.11 | 113.68 |
| **2010** | 8.52 | 112.56 |
| **2011** | 9.82 | 126.60 |

**IGFS Abundance Indices by numbers by 10 square kilometers**

| | |
|---|---|
| **2003** | 1227 |
| **2004** | 1926 |
| **2005** | 2254 |
| **2006** | 2039 |
| **2007** | 725 |
| **2008** | 1247 |
| **2009** | 1850 |
| **2010** | 1103 |
| **2011** | 1227 |

**Table 5.2.4.1 Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d.**
**French and Spanish CPUEs for different bottom trawler fleets.**

| | French (single and twin bottom trawls combined) CPUE (kg/h) | | | | Spanish CPUE (kg/(100day*100 hp)) | | | Irish LPUE ('000 h |
|---|---|---|---|---|---|---|---|---|
| | Benthic Bay of Bisc | Benthic Western Approa | Gadoids Western Approa | Nephrops Western Approa | A Coruña -VI | Cantábrico- V | 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 | NA | NA | NA | 13.5 |

**Figure 5.2.1.1. - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Length composition of catches for the years 1990 to 2010.**

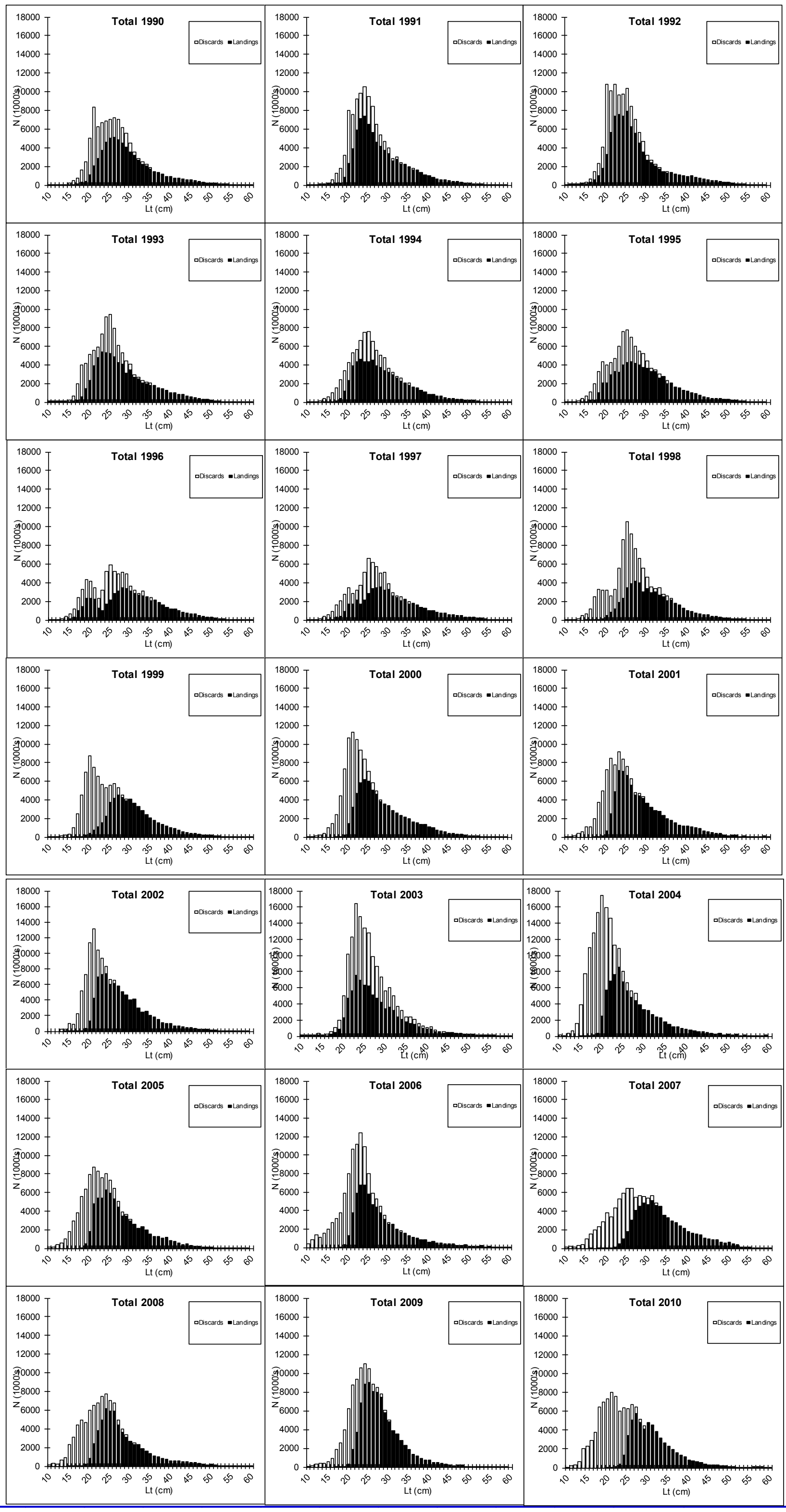


**Figure 5.2.2.1 - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Age composition of catches for the years 1990 to 2010.**

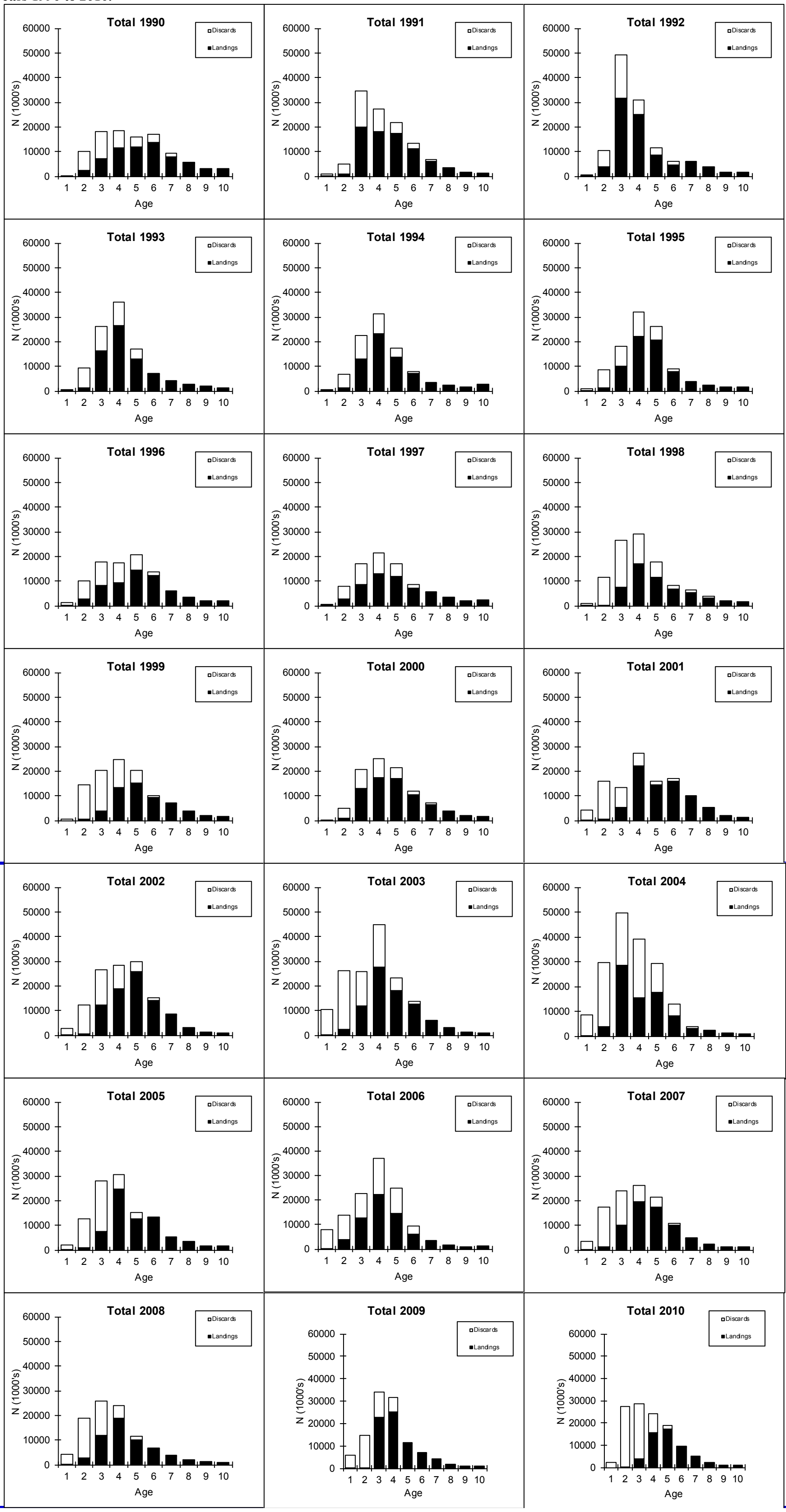


**Figure 5.2.3.1 Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Scaled Biomass Indices for EVHOE, SP-PGFS and IGFS**

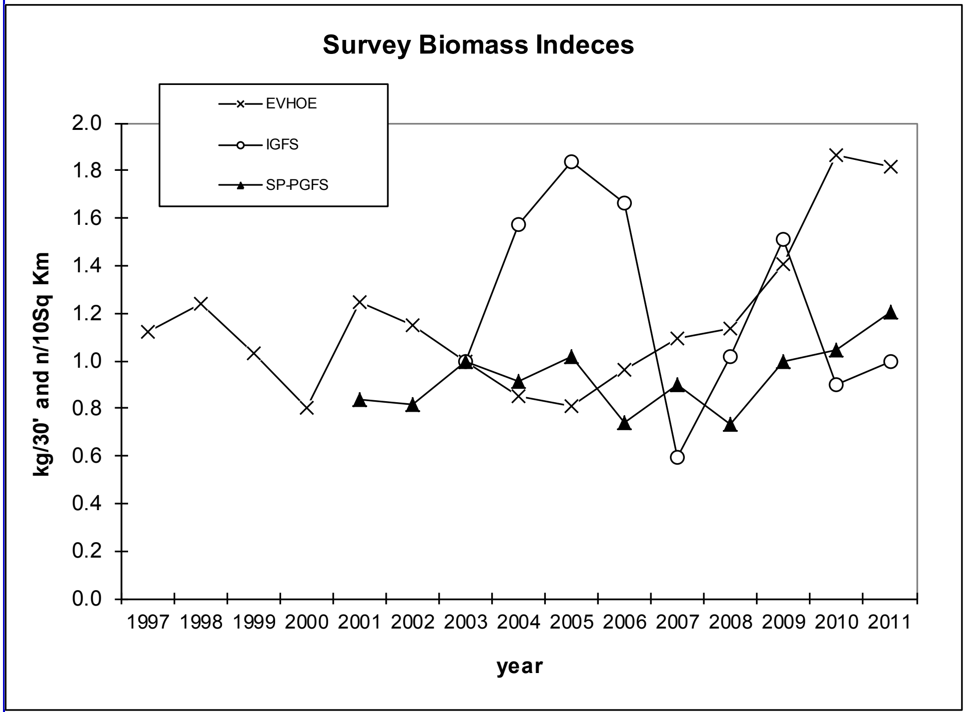
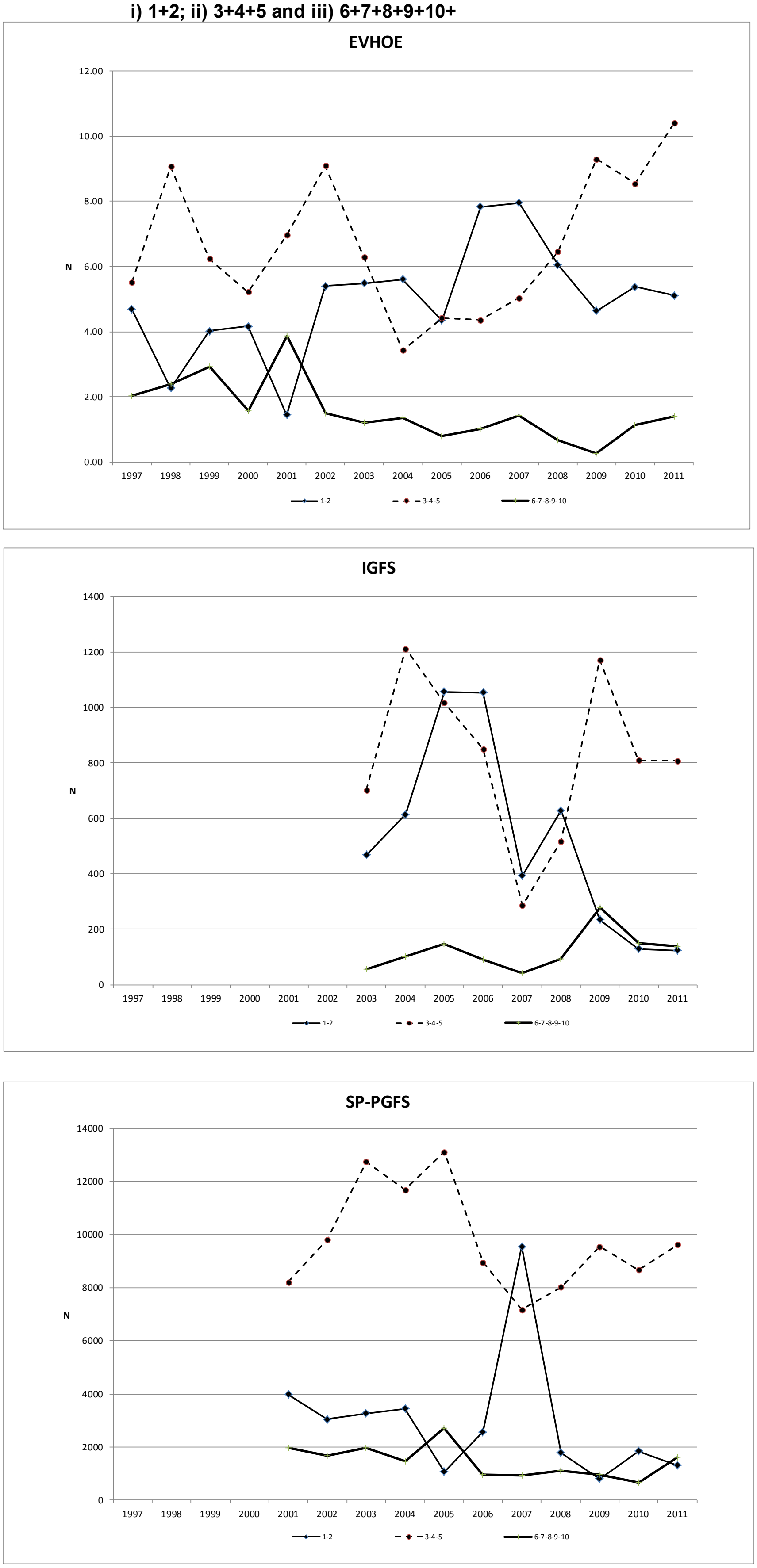


**Figure 5.2.3.2 Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Abundance Indices for EVHOE, IGFS and SP-PGFS by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+**



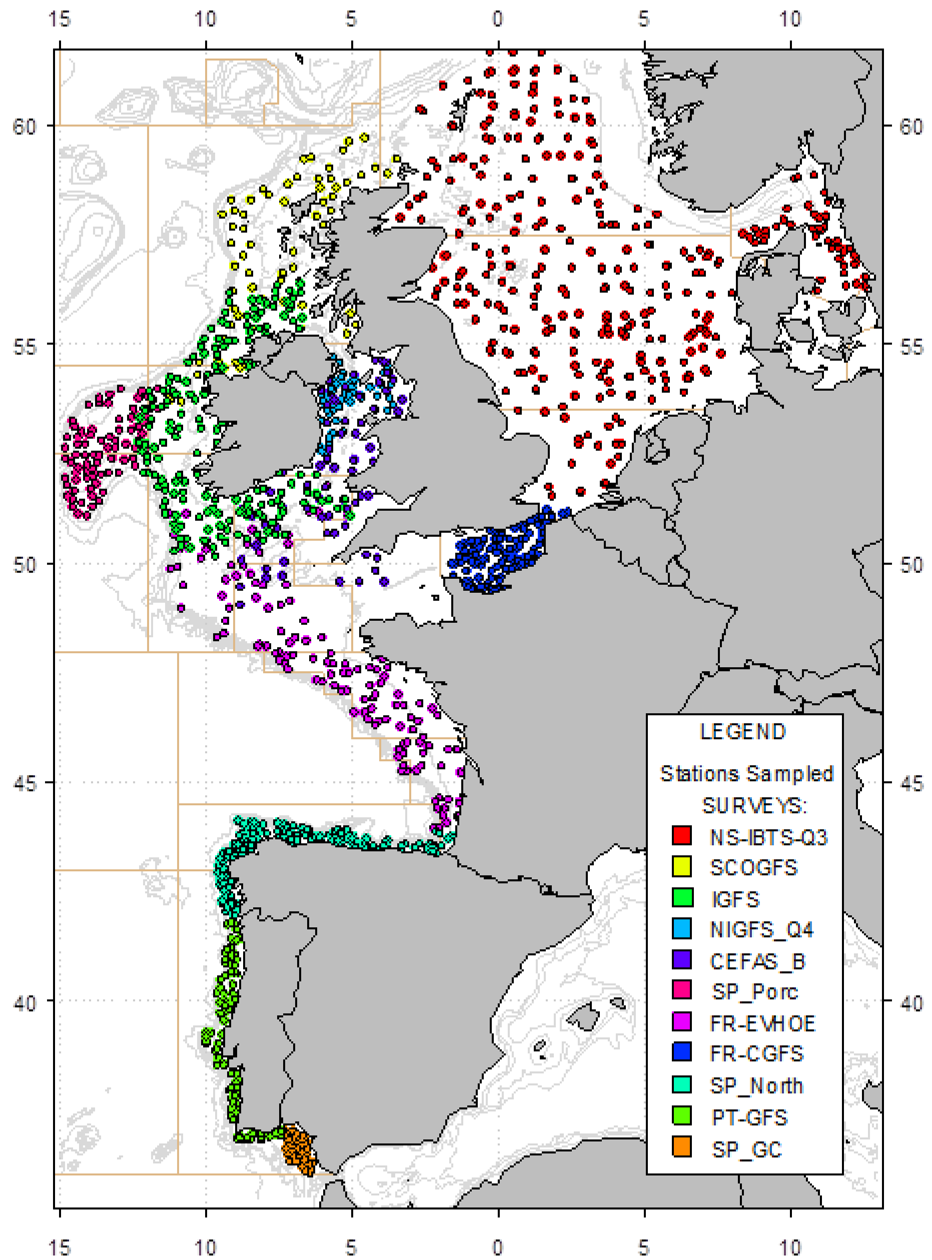



Figure 5.2.3.3. Station positions for the IBTS Surveys carried out in the Western and North Sea Area in the autumn/winter of 2008. (From IBTSWG 2009 Report). Just to be used as general location of the Surveys.

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

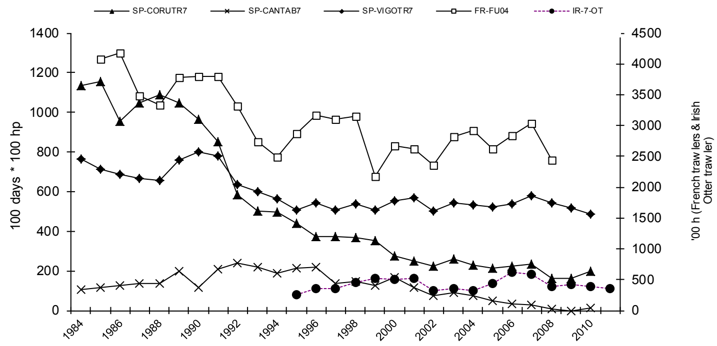



**Figure 5.2.4.1b Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d.**

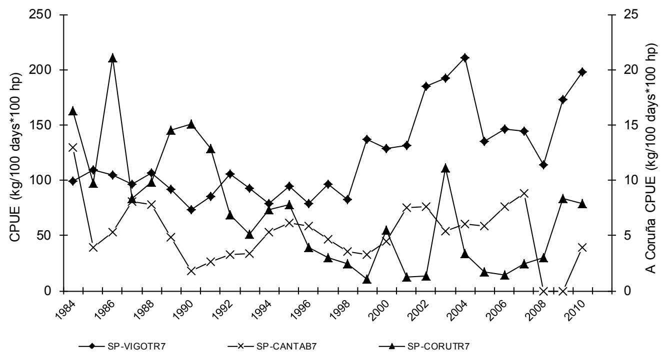



**Figure 5.2.4.1c Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d. French LPUE for different bottom trawler fleet.**

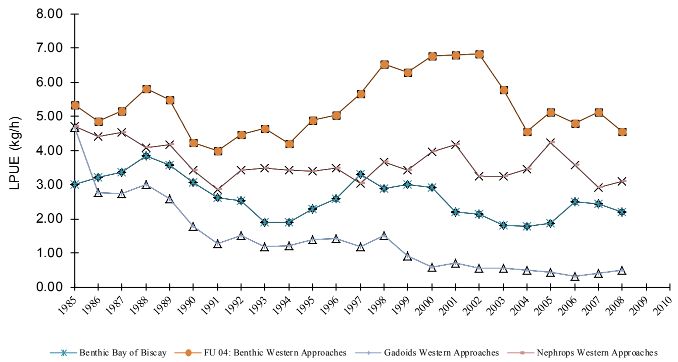



**Figure 5.2.4.1d Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d. Irish LPUE for beam trawl fleet.**

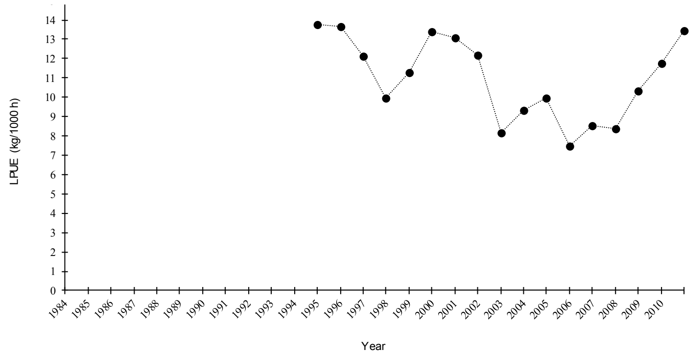
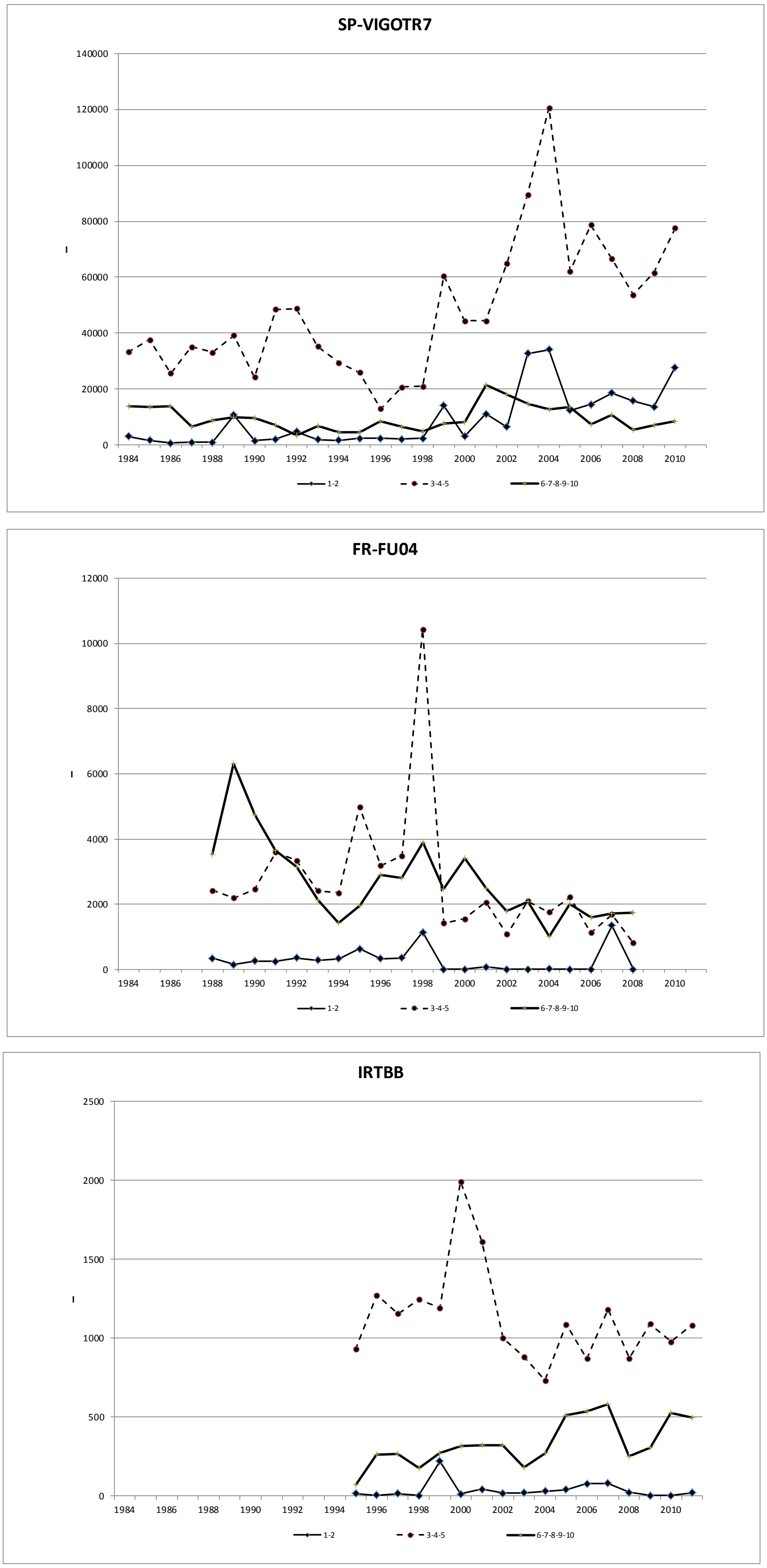


**Figure 5.2.4.3 Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Abundance Indices for SP-VIGOTR7, FR-FU04 and IRTBB by ages grouped: i) 1+2; ii) 3+4+5 and iii) 6+7+8+9+10+**



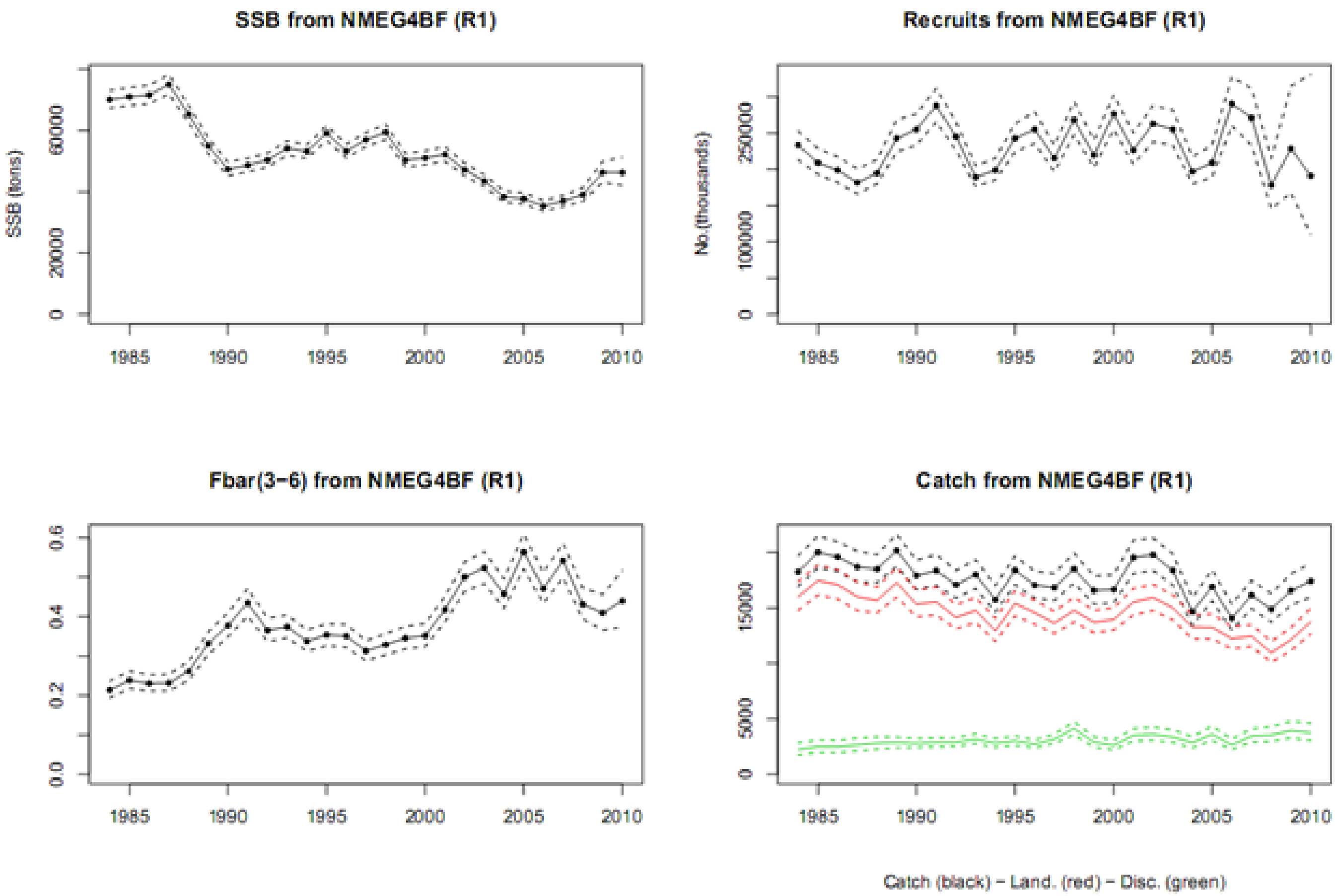



**Figure 5.2.5.1 From top to down and left to rigth, time series of SSB, recruits, mean fishing mortality of ages 3 to 6 (Fbar), catch (black), landings (red) and discards (green), as resulted during WKFLAT 2012. The solid line indicates the median and the dashed lines the 5% and 95% quantiles.**

# 6 Bay of Biscay Sole

**Type of assessment in 2012**: update.

**Data revisions this year:** Compared to last year assessment, there is only very limited change in data due to small revisions of 2010 landings and of 2010 commercial LPUE.

**Review Group issues**:

- The RG wondered for the convergence of XSA, if any runs have been done to test the sensitivity to the number of iterations run. But, XSA converge after 58 iterations without big change in the output, and the WGHMM decide to use the output XSA completely converged. (cf. text)
- For the next benchmark, the RG suggestions are to include discards, to include the ORHAGO survey time series when this is long enough and to update the maturity ogive.
- The other comments are answered all along the text.

## 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 2012 and management applicable to 2011 and 2012

#### ICES advice for 2012:

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

The advice provided for 2012:

ICES advises on the basis of the transition to the MSY approach that landings in 2012 should be no more than 4000 t.

#### Management applicable to 2011 and 2012

The sole landings in the Bay of Biscay are subject to a TAC regulation. The 2011 TAC was set at 4250 t. The 2012 TAC is the same at 4250 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. They are nearly exclusively landed in Bay of Biscay harbours. The record of the auction sales allows thus to consider that the reliability of the WG estimates is satisfactory all along the series.

The 2010 landings estimate was revised less than 1% higher to 3966 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 4000t and 4800t before falling to 3650t in 2009 and increasing to 3966 t in 2010 (Table 6.1a).

The 2011 landings figure (4626 t) is 6 % above the landings predicted by the 2011 WG at status quo mortality (4364 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 2010 split was not 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 2011 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 2011 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, was only slightly reduced. 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. The series was presented to the WKFLAT 2011 which considered that this series should be used to tune the assessment in the near future but its length is still too short to be inserted in the tuning process in the assessment. The WKFLAT 2011 highlighted that "A particular attention must be paid to the tuning series which evolve by the adding of the ORHAGO survey as soon as its series is five years long".

### 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 6.3). 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.
Some corrections of the FR-BB-IN-Q4 time series were made because of a problem in the process of the French data base building which were found recently for the boat lower than 12 meters. The result is a lower value for the FR-BB-IN-Q4 since 2006 until 2009 (Figure 6.4). For the LPUE data for 2009 and subsequent years we use data LPUE corrected in accordance with the industry.

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 (Figure 6.3). Later on, its trend was flat until 2009, but it changed to an increasing one in 2010. The 2011 LPUE is closed to the 2010 one and above the 1997-2009 values.

## 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 1984-2011.

#### 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) 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.

| 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 – 2011 | 1 – 8 | <1 % |
| Offshore otter trawlers | FR-BB-OFF-Q2 | 2000 – 2011 | 1 – 8 | <1 % |

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 showed small residuals for all fleets (Figure 6.5).

### Exploratory runs

To answer the question of the review group about XSA convergence, we did a comparison between the output of the XSA after 30 iterations (as the last assessment without convergence) and when it converges (after 58 iterations). The results are in the Figure 6.6. The graphs show very little differences between the 2 outputs. Consequently the WG decided to use the outputs of XSA when it converges.

The XSA outputs show a change in the fishing mortality pattern in the terminal year because of a large increase in fishing mortality at age 4. This is the highest value in the time series. This increase can be explained by the strength of the large 2007 year class which recruits up to age 4 and which has already caused an increase in the 2011 fishing mortality at age 3 as estimated by the 2010 WG (Figure 6.7). However, there are some doubts about the real increase in fishing mortality at age 4 in 2011 because it could be revised downwards (as is revised the fishing mortality at age 3 in 2010 by this year WG) if the 2007 year class is still underestimated. The age distribution in the forth quarter, and consequently the FR-BB-IN-Q4 commercial fleet fishing mortality estimates, are a cause of concern for this risk.

Indeed, some age misreading in the 2011 first two quarters were suspected during the WG and corrected by asking for a second age readings but this exercise could not be carried out for the 2011 last two quarters for this year assessment. Consequently, the large change of the selection pattern in 2011 must be looked circumspectly.

### Final XSA run

The final XSA was run using the same settings than in last year assessment.

| | | | 2011 XSA | | | 2012 XSA |
|---|---|---|---|---|---|---|
| Catch data range | | | 84-10 | | | 84-11 |
| 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 | 00-10 | 3-7 | FR-BB-IN-Q4 | 00-11 | 3-7 |
| | FR-BB-OFF-Q2 | 00-10 | 2-6 | FR-BB-OFF-Q2 | 00-11 | 2-6 |
| Taper | | | No | | | No |
| Ages catch dep. | | | 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 6.5 and retrospective results in Figure 6.8. There is no change in the retrospective patterns between this year and last year's assessments.

Only the fleet FR-BB-OFF-Q2 provides information on survivors at age 2. At age 3, only the fleets FR-BB-IN-Q4 and FR-BB-OFF-Q2 provide estimates, the FR-BB-IN-Q4 one being two times higher than the FR-BB-OFF-Q2 one, both with about the same weight. At age 4, the FR-BB-OFF-Q2 fleet has the highest weight with an estimate which is in the same range than the FR-BB-IN-Q4 one. FR-SABLES and FR-ROCHELLE fleets provide lower estimates with about half weight than the two other fleets. At ages 5 and higher, FR-SABLES and FR-ROCHELLE and FR-BB-OFF-Q2 provide rather close estimates but not the FR-BB-IN-Q4 which estimates are lower.

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 6.9. Fishing mortality in 2011 is estimated by XSA to have been at 0.48. Fishing mortality in 2010 is estimated at 0.39, the same value than last year WG report.

### 6.3.3 Assessment results

#### 6.3.3.1 Estimating year class abundance

The 2008 year class is estimated to be 17.5 million 2 year olds by XSA. Last year's WG XSA estimate (6 millions) was not accepted by the WG which preferred to overwrite this year class with the $GM_{93-08}$ (22.4 million) because of the lack of reliability of the XSA estimates that shows the retrospective analysis. The present value indicates that this year class strength is much lower than the 1993-2009 average ($GM_{93-09}$ = 22.6 million). This year class has the lower historical value in the stock number time series.

The 2009 year class is estimated to be at 4.1 millions 2 year olds by XSA. The WG considered that the reliability of XSA recruitment estimate in terminal year remains too low to change the usual process of overwriting it by the $GM_{93-09}$, as in previous WG assessment. The estimates are provided by only one tuning fleet and the F shrinkage mean.

The XSA estimate was consequently overwritten by a series GM from 1993 up to two years before the terminal years (2009), as in preceding assessments, since there is observed fall in stock numbers at age 2 after 1993. This $GM_{93\text{-}09}$ is also used to estimate subsequent recruitments. The WG agreed to keep this calculation of the GM to be homogeneous with the previous assessment.

Recruitment at age 2

| Year class | Thousands | Basis | Surveys | Commercial | Shrinkage |
|---|---|---|---|---|---|
| 2008 | 16457 | XSA | 0 % | 70 % | 30 % |
| 2009 | 22639 | GM(93-09) | | | |
| 2010 & subsequent | 22639 | GM(93-09) | | | |

#### 6.3.3.2 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 6.9.

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 0.4. Fishing mortality was 0.41 in 2009, 0.42 in 2010 and 0.48 in 2011.

SSB trend in earlier years increases from 12300 t in 1984 to 16 500 t in 1993, afterwards it shows a continuous decrease to 9 700 t in 2003. After a 29 % increase between 2003 and 2006, the SSB remains close to 12000 t from 2007 onwards. It is estimated to 13400 t in 2011, a bit higher (3 %) than in 2010.

The recruitment values are lower since 1993. Between 2004 and 2008 the series is stable around 18 million and the 2007 year class is the highest value since 1993, as it was expected from the available ORHAGO survey indices (Figure 6.10).

### 6.3.4 Catch options and prognosis

The exploitation pattern is the mean over the period 2009-2011 (over 2009-2010 at age 2), considering the absence of trend in F in the last three years of the assessment. This *status quo* F is estimated at 0.43.

The recruits at age 2 from 2012 to 2014 are assumed equal to $GM_{93\text{-}09}$. Stock numbers at age 3 in 2012 are derived from $GM_{93\text{-}09}$ reduced by total estimated mortality (M plus the average F at age 2 for years 2009 and 2010). Stock numbers at ages 4 and above in 2012 are the XSA survivors estimates.

Weights at age in the landings are the 2009-2011 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 2009-2011 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.

#### 6.3.4.1 Short term predictions

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

The landings forecasts is 4240 t in 2012 (TAC is set at 4250 t), 8.3 % lower than the 2011 landings (4626 t).

Assuming recruitment at $GM_{93\text{-}09}$, the SSB is predicted to increase to 14200 t in 2012 and to 14700 t in 2013, fishing at *status quo* F in 2012. It will continue to grow at *status quo* F, to reach 15000 t in 2014 (Tables 6.12 and 6.13).

The proportional contributions of recent year classes to the landings in 2013 and to the SSB in 2014 are given in Table 6.14. Year classes for which $GM_{93\text{-}09}$ recruitment has been assumed (2009 to 2012) contribute 66 % of the 2013 landings and 64 % of the 2014 SSB.

#### 6.3.4.2 Yield and Biomass Per Recruit

Results for yield and SSB per recruit, conditional on *status quo* F, are given in Table 6.15 and in Figure 6.11. The $\mathbf{F}_{sq}$ (0.43) is 28 % above $\mathbf{F}_{max}$ (0.31) and 2.7 times $\mathbf{F}_{0.1}$ (0.16). Long-term equilibrium landings and SSB (at F *status quo* and assuming GM recruitment) are estimated to be 4800 t and 16000 t respectively (Table 6.15).

### 6.3.5 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 $B_{trigger}$ | 13000 t | Bpa |
| Approach | $F_{MSY}$ | 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 |
| | $B_{lim}$ | Not defined | |
| Precautionary | $B_{pa}$ | 13 000t | The probability of reduced recruitment increases when SSB is below 13 000 t, based on the historical development of the stock. |
| Approach | $F_{lim}$ | 0.58 | Based on the historical response of the stock. |
| | $F_{pa}$ | 0.42 | $F_{lim}$ * 0.72 |

The WKFLAT 2011 decided that $F_{max}$ remains unchanged as well as $F_{MSY}$ which is set to $F_{max}$. This year the $F_{max}$ is higher than 2011 and 2010 but the WG 2012 decided to not change the $F_{msy}$ because there is some fear that the fishing pattern in 2012 could not be well estimated and could be revised by future assessments.

The basis for setting $F_{lim}$ was kept (historical response of the stock) and its value remains coherent with the historical SSB trend. Consequently, $F_{pa}$ 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.

### 6.3.6 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 but this series must be continued to allow a better estimate of the incoming recruitment. Stopping the use of fleets of La Rochelle and Les Sables tuning series leads to a lack of information at age 2, which is now only given by the Offshore Q2 new tuning fleet. Therefore the rapid incorporation of ORHAGO in the assessment will be necessary.

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 review group recommended that further work should include investigation on the monitoring of the inshore trawlers discards.

#### Consistency

The retrospective results show that the XSA recruitment estimate in terminal year is very uncertain; it was consequently overwritten with a GM estimate, as in previous WG assessments. This GM estimate has a very large 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, 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 is low for the two recent years of the assessment (Figure 6.8) but the fishing mortality increase in 2012 must be considered as uncertain because some age misreading are suspected in quarter 3 and 4.

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.

#### 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

A meeting with representatives of the fishing industry was held in France prior to the WG to present the data used by the 2012 WGHMM to assess the state of the Bay of Biscay sole stock. 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.

### 6.3.7 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 12500 t in 2006 but it remains close to

12000 t thereafter and above to 13000 t in 2010 and 2011. It is estimated to be 14200 t (above Bpa = 13000 t) in 2012 assuming $GM_{93\text{-}09}$ recruitment for 2011.

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 | 4201 | | | | 4587 | 4626** | - | - |

[1] including reported in VIII or VIIIc,d
[2] Discards = Partial estimates for the French offshore trawlers fleet
* reported in VIII
** Preliminary
*** reported as S*olea* spp (*Solea lascaris* and *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 |
|---|---|---|---|
| Shrimp trawlers | 0 | 0 | 0 |
| Inshore trawlers | 6 | 8 | 7 |
| Offshore otter trawlers | 21 | 19 | 17 |
| Offshore beam trawlers | 10 | 11 | 8 |
| Fixed nets | 63 | 61 | 67 |

Table 6.2 : Bay of Biscay Sole - 2011

French and Belgian relative length distribution of landings

| Length(cm) | France | Belgium |
|---|---|---|
| 13 | 0.00 | 0.00 |
| 14 | 0.00 | 0.00 |
| 15 | 0.00 | 0.00 |
| 16 | 0.00 | 0.00 |
| 17 | 0.00 | 0.00 |
| 18 | 0.00 | 0.00 |
| 19 | 0.00 | 0.00 |
| 20 | 0.00 | 0.00 |
| 21 | 0.02 | 0.00 |
| 22 | 0.15 | 0.01 |
| 23 | 1.50 | 0.45 |
| 24 | 4.27 | 5.64 |
| 25 | 6.33 | 11.24 |
| 26 | 8.73 | 12.36 |
| 27 | 10.97 | 13.30 |
| 28 | 11.44 | 12.13 |
| 29 | 11.91 | 8.52 |
| 30 | 12.47 | 8.55 |
| 31 | 10.22 | 5.67 |
| 32 | 6.88 | 5.48 |
| 33 | 4.42 | 4.33 |
| 34 | 2.82 | 3.14 |
| 35 | 1.85 | 2.92 |
| 36 | 1.35 | 1.85 |
| 37 | 0.94 | 1.37 |
| 38 | 0.70 | 1.15 |
| 39 | 0.69 | 0.51 |
| 40 | 0.58 | 0.66 |
| 41 | 0.44 | 0.35 |
| 42 | 0.35 | 0.20 |
| 43 | 0.26 | 0.09 |
| 44 | 0.20 | 0.02 |
| 45 | 0.16 | 0.01 |
| 46 | 0.11 | 0.03 |
| 47 | 0.08 | 0.01 |
| 48 | 0.07 | 0.00 |
| 49 | 0.05 | 0.00 |
| 50 | 0.02 | 0.00 |
| 51 | 0.00 | 0.00 |
| 52 | 0.01 | 0.00 |
| 53 | 0.00 | 0.00 |
| 54 | 0.00 | 0.00 |
| 55 | 0.00 | 0.00 |
| Total | 100.00 | 100.00 |

**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 |
|---|---|---|---|---|---|---|---|---|
| 2 | 3411 | 3976 | 3535 | 3885 | 3173 | 2860 | 2084 | 1159 |
| 3 | 5415 | 3464 | 4436 | 5181 | 4794 | 3986 | 7707 | 5007 |
| 4 | 3291 | 3738 | 2747 | 2615 | 2886 | 2233 | 3758 | 8886 |
| 5 | 917 | 2309 | 2012 | 1419 | 1353 | 1501 | 1272 | 1012 |
| 6 | 661 | 991 | 1030 | 1262 | 938 | 946 | 484 | 552 |
| 7 | 272 | 461 | 530 | 686 | 892 | 541 | 269 | 243 |
| +gp | 333 | 508 | 1537 | 946 | 1193 | 960 | 284 | 481 |
| TOTALNUM | 14300 | 15447 | 15827 | 15994 | 15229 | 13027 | 15858 | 17340 |
| TONSLAND | 4002 | 4539 | 4793 | 4363 | 4299 | 3650 | 3966 | 4626 |
| SOPCOF % | 101 | 102 | 101 | 100 | 100 | 102 | 100 | 100 |

**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* |
|---|---|---|---|---|---|---|---|---|
| Age | | | | | | | | |
| 2 | 0.19 | 0.189 | 0.195 | 0.176 | 0.174 | 0.17 | 0.179 | 0.188 |
| 3 | 0.227 | 0.226 | 0.242 | 0.225 | 0.229 | 0.215 | 0.206 | 0.222 |
| 4 | 0.29 | 0.298 | 0.282 | 0.298 | 0.287 | 0.275 | 0.272 | 0.254 |
| 5 | 0.391 | 0.367 | 0.347 | 0.326 | 0.352 | 0.317 | 0.337 | 0.349 |
| 6 | 0.493 | 0.43 | 0.42 | 0.388 | 0.392 | 0.361 | 0.414 | 0.446 |
| 7 | 0.643 | 0.468 | 0.455 | 0.419 | 0.401 | 0.447 | 0.477 | 0.526 |
| +gp | 0.81 | 0.656 | 0.533 | 0.511 | 0.519 | 0.601 | 0.768 | 0.635 |
| SOPCOFAC | 1.0104 | 1.0153 | 1.0136 | 1.0026 | 1 | 1.0158 | 1.0019 | 1.0015 |

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 | 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/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 | 5.9 | 2.2 | 3.4 | 5.4 | 4.5 | 4.5 | 465 |
| 2007 | 4.9 | 3.7 | 3.5 | 5.3 | 4.6 | 4.5 | 440 |
| 2008 | 4.0 | 3.2 | 4.1 | 5.6 | 4.6 | 4.5 | 468 |
| 2009 | 4.4 | 2.1 | 3.3 | 5.2 | na | na | na |
| 2010 | 4.6 | 3.5 | 3.6 | 5.7 | na | na | na |
| 2011 | 4.6 | 3.5 | 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 |

**Table 6.6: Sole 8ab, available tuning data (landings); SOLE VIIIa,b commercial landings (N in 10**-3) - 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 | 1412 | 4.02 | 20.77 | **11.09** | **3.30** | **0.99** | **0.34** | **0.23** | **0.08** |
| 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 | 3073 | 4.25 | 24.40 | **23.98** | **8.75** | **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 | 6457 | 21.70 | 77.32 | **25.16** | **6.25** | **4.30** | **3.62** | **2.43** | **5.64** |
| 2007 | 3707 | 2.56 | 32.29 | **15.08** | **6.81** | **3.49** | **2.89** | **0.64** | **2.06** |
| 2008 | 3577 | 0.57 | 13.74 | **15.67** | **8.49** | **2.94** | **1.65** | **1.22** | **1.22** |
| 2009 | 3600 | 2.65 | 47.67 | **14.66** | **3.35** | **1.80** | **1.53** | **0.63** | **1.37** |
| 2010 | 4151 | 1.43 | 21.03 | **32.30** | **9.12** | **2.90** | **0.90** | **0.43** | **1.02** |
| 2011 | 4333 | 1.32 | 26.53 | **23.74** | **16.96** | **1.94** | **1.82** | **0.27** | **0.49** |

**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 | 4009 | 0.00 | **13.40** | **46.06** | **6.40** | **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 | 952 | 0.00 | **0.69** | **5.00** | **1.67** | **0.53** | **0.16** | 0.10 | 0.22 |
| 2010 | 2259 | 0.00 | **1.54** | **27.14** | **7.93** | **2.15** | **0.12** | 0.03 | 0.07 |
| 2011 | 2820 | 0.00 | **1.03** | **12.81** | **24.24** | **1.44** | **0.70** | 0.36 | 1.00 |

**Table 6.7**

```
Lowestoft VPA Version 3.1

  22/05/2012  19:56

Extended Survivors Analysis

SOLE VIIIa,b

CPUE data from file tunfilt.dat

Catch data for  28 years. 1984 to 2011. Ages  2 to   8.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                   ,    year, year,  age ,  age
FR-SABLES           ,   1991, 2011,   2,     7,   .000,  1.000
FR-ROCHELLE         ,   1991, 2011,   2,     7,   .000,  1.000
FR-BB-IN-Q4         ,   2000, 2011,   3,     7,   .750,  1.000
FR-BB-OFF-Q2        ,   2000, 2011,   2,     6,   .250,   .500


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   58 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,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009,  2010,  2011

     2,  .245,  .202,  .232,  .251,  .212,  .249,  .198,  .101,  .143,  .350
     3,  .525,  .466,  .375,  .347,  .434,  .483,  .487,  .362,  .380,  .524
     4,  .805,  .442,  .419,  .427,  .452,  .437,  .482,  .390,  .607,  .888
     5, 1.001,  .412,  .290,  .516,  .381,  .395,  .376,  .440,  .357,  .286
     6,  .965,  .594,  .365,  .514,  .405,  .387,  .437,  .434,  .219,  .230
     7,  .755,  .762,  .407,  .415,  .505,  .457,  .461,  .430,  .188,  .146
```

**Table 6.7 (cont'd)**

XSA population numbers (Thousands)

| | AGE | | | | | |
|---|---|---|---|---|---|---|
| YEAR , | 2, | 3, | 4, | 5, | 6, | 7, |
| 2002 , | 2.52E+04, | 1.23E+04, | 9.38E+03, | 5.14E+03, | 2.16E+03, | 1.22E+03, |
| 2003 , | 2.46E+04, | 1.78E+04, | 6.58E+03, | 3.79E+03, | 1.71E+03, | 7.43E+02, |
| 2004 , | 1.73E+04, | 1.82E+04, | 1.01E+04, | 3.83E+03, | 2.27E+03, | 8.55E+02, |
| 2005 , | 1.88E+04, | 1.24E+04, | 1.13E+04, | 6.02E+03, | 2.59E+03, | 1.43E+03, |
| 2006 , | 1.94E+04, | 1.32E+04, | 7.94E+03, | 6.68E+03, | 3.25E+03, | 1.40E+03, |
| 2007 , | 1.85E+04, | 1.42E+04, | 7.77E+03, | 4.57E+03, | 4.13E+03, | 1.96E+03, |
| 2008 , | 1.86E+04, | 1.31E+04, | 7.93E+03, | 4.54E+03, | 2.78E+03, | 2.54E+03, |
| 2009 , | 3.14E+04, | 1.38E+04, | 7.27E+03, | 4.43E+03, | 2.82E+03, | 1.63E+03, |
| 2010 , | 1.65E+04, | 2.56E+04, | 8.68E+03, | 4.45E+03, | 2.58E+03, | 1.65E+03, |
| 2011 , | 4.13E+03, | 1.29E+04, | 1.59E+04, | 4.28E+03, | 2.82E+03, | 1.88E+03, |

Estimated population abundance at 1st Jan 2012

| | | | | | | |
|---|---|---|---|---|---|---|
| , | 0.00E+00, | 2.63E+03, | 6.92E+03, | 5.91E+03, | 2.91E+03, | 2.03E+03, |

Taper weighted geometric mean of the VPA populations:

| | | | | | | |
|---|---|---|---|---|---|---|
| , | 2.29E+04, | 1.80E+04, | 1.11E+04, | 5.96E+03, | 3.30E+03, | 1.83E+03, |

Standard error of the weighted Log(VPA populations) :

| | | | | | | |
|---|---|---|---|---|---|---|
| , | .3984, | .2350, | .2558, | .2616, | .2792, | .3902, |

1

Log catchability residuals.

Fleet : FR-SABLES

| Age , | 1991 |
|---|---|
| 2 , | -.23 |
| 3 , | .12 |
| 4 , | .15 |
| 5 , | .10 |
| 6 , | -.17 |
| 7 , | -.06 |

| Age , | 1992, | 1993, | 1994, | 1995, | 1996, | 1997, | 1998, | 1999, | 2000, | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 , | -.13, | -.38, | -.41, | -.08, | -.21, | -.12, | -.03, | -.18, | .20, | -.17 |
| 3 , | -.18, | .17, | -.10, | -.17, | -.02, | .21, | .00, | -.41, | .40, | .08 |
| 4 , | -.25, | -.07, | .38, | .16, | .03, | .02, | .45, | -.20, | .16, | -.04 |
| 5 , | -.14, | -.09, | .24, | .01, | -.10, | -.23, | .16, | .29, | -.06, | -.25 |
| 6 , | .19, | -.38, | .04, | -.24, | .25, | -.01, | -.39, | .42, | -.04, | -.20 |
| 7 , | -.15, | -.27, | .17, | .06, | .46, | -.02, | .10, | .53, | .06, | -.24 |

| Age , | 2002, | 2003, | 2004, | 2005, | 2006, | 2007, | 2008, | 2009, | 2010, | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 , | .21, | -.13, | .29, | .45, | .76, | .21, | .15, | -.22, | 99.99, | 99.99 |
| 3 , | .27, | .01, | -.29, | -.19, | -.05, | -.10, | .09, | .14, | 99.99, | 99.99 |
| 4 , | .15, | -.28, | -.19, | -.15, | -.48, | .00, | .22, | -.06, | 99.99, | 99.99 |
| 5 , | .36, | -.16, | -.47, | .22, | -.74, | .33, | .22, | .33, | 99.99, | 99.99 |
| 6 , | .38, | .05, | -.32, | .19, | -.58, | .27, | .29, | .25, | 99.99, | 99.99 |
| 7 , | .10, | .11, | -.13, | .07, | -.13, | .57, | .34, | .24, | 99.99, | 99.99 |

**Table 6.7 (cont'd)**

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

| Age , | 2, | 3, | 4, | 5, | 6, | 7 |
|---|---|---|---|---|---|---|
| Mean Log q, | -15.0770, | -14.5330, | -14.4991, | -14.6889, | -14.6891, | -14.6891, |
| S.E(Log q), | .2968, | .2003, | .2331, | .2944, | .2937, | .2631, |

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, | 4.03, | -2.854, | 30.24, | .05, | 19, | 1.01, | -15.08, |
| 3, | .97, | .152, | 14.40, | .63, | 19, | .20, | -14.53, |
| 4, | .78, | 1.598, | 13.33, | .75, | 19, | .17, | -14.50, |
| 5, | 1.01, | -.043, | 14.76, | .45, | 19, | .31, | -14.69, |
| 6, | 1.36, | -.976, | 17.08, | .30, | 19, | .40, | -14.69, |
| 7, | .74, | 2.415, | 12.69, | .83, | 19, | .16, | -14.59, |

Fleet : FR-ROCHELLE

| Age , | 1991 |
|---|---|
| 2 , | -.09 |
| 3 , | .20 |
| 4 , | .46 |
| 5 , | .48 |
| 6 , | .13 |
| 7 , | .02 |

| Age , | 1992, | 1993, | 1994, | 1995, | 1996, | 1997, | 1998, | 1999, | 2000, | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 , | -.18, | -.45, | -.39, | -.04, | .33, | -.05, | .20, | -.02, | .20, | -.23 |
| 3 , | -.03, | .00, | -.20, | -.10, | .06, | .12, | -.09, | -.48, | -.26, | -.07 |
| 4 , | .14, | -.20, | .32, | .32, | -.13, | -.06, | .49, | -.23, | -.09, | .16 |
| 5 , | .19, | -.06, | .21, | .23, | -.34, | -.34, | .02, | .19, | -.14, | -.03 |
| 6 , | .35, | -.25, | .13, | -.34, | -.10, | .00, | -.53, | .52, | -.30, | .12 |
| 7 , | .08, | -.03, | -.02, | -.07, | -.12, | -.11, | .02, | .22, | -.25, | .10 |

| Age , | 2002, | 2003, | 2004, | 2005, | 2006, | 2007, | 2008, | 2009, | 2010, | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 , | .69, | .16, | .36, | .09, | -.06, | .02, | .21, | -.74, | 99.99, | 99.99 |
| 3 , | .20, | .22, | -.09, | -.38, | -.29, | .51, | .51, | .16, | 99.99, | 99.99 |
| 4 , | -.31, | -.05, | -.24, | -.20, | -.30, | -.24, | .24, | -.09, | 99.99, | 99.99 |
| 5 , | -.04, | -.05, | -.45, | .30, | -.28, | -.28, | .17, | .22, | 99.99, | 99.99 |
| 6 , | .02, | .12, | -.18, | .43, | -.10, | -.24, | .10, | .11, | 99.99, | 99.99 |
| 7 , | -.07, | -.20, | -.03, | .20, | .01, | -.29, | .21, | .10, | 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

**Table 6.7 (cont'd)**

```
   Age ,        2,        3,        4,        5,        6,        7
 Mean Log q,  -15.0113,  -14.5743,  -14.8020,  -15.1631,  -15.2264,  -15.2264,
 S.E(Log q),     .3231,     .2684,     .2609,     .2567,     .2708,     .1458,

 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,    1.66,   -1.187,     18.27,     .16,     19,     .53,  -15.01,
  3,    1.13,    -.440,     15.17,     .42,     19,     .31,  -14.57,
  4,     .75,    1.620,     13.44,     .72,     19,     .19,  -14.80,
  5,     .82,     .975,     14.00,     .64,     19,     .21,  -15.16,
  6,    1.56,   -1.500,     19.30,     .29,     19,     .41,  -15.23,
  7,     .87,    1.622,     14.19,     .90,     19,     .12,  -15.24,
1

 Fleet : FR-BB-IN-Q4

  Age  ,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999,  2000,  2001
     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,   .20,  -.43
     4 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .38,  -.52
     5 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,   .22,  -.20
     6 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.44,   .07
     7 , 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99, 99.99,  -.19,  -.13


  Age  ,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009,  2010,  2011
     2 , No data for this fleet at this age
     3 ,   .22,   .61,   .16,  -.35,  -.16,  -.15,   .01,  -.22,  -.18,   .28
     4 ,  -.70,   .12,   .28,   .09,  -.53,   .12,   .39,  -.53,   .34,   .55
     5 ,   .01,  -.59,   .63,   .31,  -.38,   .36,   .21,  -.20,   .05,  -.41
     6 ,   .68,  -.28,   .90,   .08,   .04,   .11,   .02,  -.07,  -.85,  -.26
     7 ,   .63,   .37,   .25,  -.06,   .57,  -.59,  -.16,  -.41, -1.17, -1.84


 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,  -14.4110,  -14.9083,  -15.3218,  -15.1689,  -15.1689,
 S.E(Log q),     .3016,     .4432,     .3639,     .4635,     .7538,


 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,     .91,     .243,     13.97,     .41,     12,     .29,  -14.41,
  4,     .65,     .983,     12.86,     .43,     12,     .29,  -14.91,
  5,     .96,     .063,     15.04,     .19,     12,     .37,  -15.32,
  6,    1.18,    -.227,     16.47,     .14,     12,     .57,  -15.17,
  7,   -6.82,   -2.073,    -48.30,     .01,     12,    4.28,  -15.40,
1
```

**Table 6.7 (cont'd)**

Fleet : FR-BB-OFF-Q2

| Age | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | .27 | .31 |
| 3 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | -.47 | -.17 |
| 4 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | .36 | .23 |
| 5 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | .84 | .57 |
| 6 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | .74 | 1.21 |
| 7 | No data for this fleet at this age | | | | | | | | | |

| Age | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | .72 | .78 | .28 | .20 | -.46 | .36 | .77 | -1.75 | -1.15 | -.32 |
| 3 | .18 | .10 | .14 | -.23 | -.28 | .66 | .29 | -.14 | .07 | -.16 |
| 4 | .14 | -.02 | -.09 | -.03 | -.68 | -.46 | -.10 | -.32 | .28 | .68 |
| 5 | .89 | -.09 | -.81 | .32 | -.48 | -.92 | -.02 | -.23 | .27 | -.34 |
| 6 | 1.45 | .44 | -.44 | -.68 | .31 | .03 | -.77 | -.49 | -1.63 | -.17 |
| 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 | -15.7540 | -14.4694 | -14.7387 | -15.4562 | -15.9494 |
| S.E(Log q) | .7897 | .3035 | .3731 | .5954 | .8837 |

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 | .95 | .110 | 15.45 | .31 | 12 | .79 | -15.75 |
| 3 | 1.11 | -.237 | 15.00 | .31 | 12 | .35 | -14.47 |
| 4 | .48 | 3.086 | 11.81 | .78 | 12 | .13 | -14.74 |
| 5 | .55 | .765 | 12.30 | .22 | 12 | .33 | -15.46 |
| 6 | -8.05 | -.918 | -57.27 | .00 | 12 | 7.17 | -15.95 |

Terminal year survivor and F summaries :

Age 2 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 |
|---|---|---|---|---|---|---|---|
| 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 | 1915. | .822 | .000 | .00 | 1 | .701 | .455 |
| F shrinkage mean | 5560. | 1.50 | | | | .299 | .181 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 2633. | .73 | .58 | 2 | .798 | .350 |

**Table 6.7 (cont'd)**

Age 3 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 |
|---|---|---|---|---|---|---|---|
| FR-SABLES , | 1., | .000, | .000, | .00, | 0, | .000, | .000 |
| FR-ROCHELLE , | 1., | .000, | .000, | .00, | 0, | .000, | .000 |
| FR-BB-IN-Q4 , | 9183., | .314, | .000, | .00, | 1, | .457, | .418 |
| FR-BB-OFF-Q2 , | 5277., | .295, | .316, | 1.07, | 2, | .509, | .643 |
| F shrinkage mean , | 8850., | 1.50,,,, | | | | .034, | .431 |

Weighted prediction :

| Survivors, at end of year, | Int, s.e, | Ext, s.e, | N, | Var, Ratio, | F |
|---|---|---|---|---|---|
| 6917., | .21, | .21, | 4, | .962, | .524 |

1

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

Year class = 2007

| Fleet, | Estimated, Survivors, | Int, s.e, | Ext, s.e, | Var, Ratio, | N, | Scaled, Weights, | Estimated F |
|---|---|---|---|---|---|---|---|
| FR-SABLES , | 4726., | .304, | .000, | .00, | 1, | .169, | 1.026 |
| FR-ROCHELLE , | 2809., | .331, | .000, | .00, | 1, | .143, | 1.389 |
| FR-BB-IN-Q4 , | 6650., | .264, | .359, | 1.36, | 2, | .295, | .820 |
| FR-BB-OFF-Q2 , | 7487., | .239, | .421, | 1.76, | 3, | .365, | .756 |
| F shrinkage mean , | 13893., | 1.50,,,, | | | | .027, | .475 |

Weighted prediction :

| Survivors, at end of year, | Int, s.e, | Ext, s.e, | N, | Var, Ratio, | F |
|---|---|---|---|---|---|
| 5914., | .14, | .21, | 8, | 1.452, | .888 |

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

Year class = 2006

| Fleet, | Estimated, Survivors, | Int, s.e, | Ext, s.e, | Var, Ratio, | N, | Scaled, Weights, | Estimated F |
|---|---|---|---|---|---|---|---|
| FR-SABLES , | 3361., | .171, | .003, | .02, | 2, | .277, | .252 |
| FR-ROCHELLE , | 3468., | .213, | .026, | .12, | 2, | .176, | .245 |
| FR-BB-IN-Q4 , | 2348., | .234, | .199, | .85, | 3, | .300, | .344 |
| FR-BB-OFF-Q2 , | 2899., | .237, | .173, | .73, | 4, | .235, | .287 |
| F shrinkage mean , | 2013., | 1.50,,,, | | | | .013, | .391 |

Weighted prediction :

| Survivors, at end of year, | Int, s.e, | Ext, s.e, | N, | Var, Ratio, | F |
|---|---|---|---|---|---|
| 2912., | .11, | .08, | 12, | .734, | .286 |

1

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

**Table 6.7 (cont'd)**

```
Year class = 2005

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FR-SABLES          ,      2103.,   .144,       .069,    .48,   3,  .324,     .223
FR-ROCHELLE        ,      2267.,   .174,       .191,   1.10,   3,  .230,     .208
FR-BB-IN-Q4        ,      1761.,   .216,       .124,    .57,   4,  .264,     .261
FR-BB-OFF-Q2       ,      2085.,   .235,       .143,    .61,   5,  .173,     .225

  F shrinkage mean  ,      1144.,   1.50,,,,                          .010,     .378

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     2026.,       .09,      .06,   16,    .659,   .230

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

Year class = 2004

Fleet,                 Estimated,    Int,       Ext,    Var,    N, Scaled,  Estimated
     ,                 Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
FR-SABLES          ,      1837.,   .138,       .140,   1.02,   4,  .333,     .118
FR-ROCHELLE        ,      1880.,   .154,       .082,    .53,   4,  .302,     .116
FR-BB-IN-Q4        ,       872.,   .219,       .323,   1.47,   5,  .230,     .235
FR-BB-OFF-Q2       ,      1284.,   .242,       .359,   1.48,   5,  .125,     .165

  F shrinkage mean  ,       386.,   1.50,,,,                          .010,     .470

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,     ,   Ratio,
     1468.,       .09,      .13,   19,   1.458,   .146
```

1
1

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

| | YEAR | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AGE | | | | | | | | | | | |
| | 2 | 0.2964 | 0.3596 | 0.2569 | 0.1739 | 0.2166 | 0.2021 | 0.2648 | 0.1436 | 0.1482 | 0.0833 | 0.1097 |
| | 3 | 0.2428 | 0.3533 | 0.2705 | 0.3535 | 0.3976 | 0.4353 | 0.3823 | 0.3517 | 0.3178 | 0.353 | 0.3261 |
| | 4 | 0.3355 | 0.2718 | 0.3171 | 0.3451 | 0.4286 | 0.4247 | 0.5226 | 0.4586 | 0.4521 | 0.4955 | 0.7486 |
| | 5 | 0.3475 | 0.3714 | 0.3861 | 0.3701 | 0.3452 | 0.5872 | 0.5722 | 0.442 | 0.5557 | 0.6349 | 0.7325 |
| | 6 | 0.3192 | 0.2288 | 0.4831 | 0.4087 | 0.4196 | 0.5218 | 0.3184 | 0.4084 | 1.0771 | 0.591 | 0.7484 |
| | 7 | 0.335 | 0.2914 | 0.3966 | 0.3757 | 0.399 | 0.5131 | 0.4727 | 0.6037 | 0.8278 | 0.7801 | 0.7583 |
| | +gp | 0.335 | 0.2914 | 0.3966 | 0.3757 | 0.399 | 0.5131 | 0.4727 | 0.6037 | 0.8278 | 0.7801 | 0.7583 |
| 0 | FBAR 3- 6 | 0.3112 | 0.3063 | 0.3642 | 0.3693 | 0.3977 | 0.4923 | 0.4489 | 0.4152 | 0.6007 | 0.5186 | 0.6389 |

| | YEAR | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AGE | | | | | | | | | | | |
| | 2 | 0.1556 | 0.1141 | 0.1844 | 0.2115 | 0.1308 | 0.2727 | 0.2199 | 0.245 | 0.2017 | 0.2322 | 0.2511 |
| | 3 | 0.3267 | 0.352 | 0.5118 | 0.3958 | 0.393 | 0.478 | 0.5081 | 0.5248 | 0.4657 | 0.3752 | 0.3472 |
| | 4 | 0.6778 | 0.5241 | 0.6623 | 0.7271 | 0.6364 | 0.766 | 0.6497 | 0.8049 | 0.4416 | 0.4185 | 0.4268 |
| | 5 | 0.7126 | 0.5026 | 0.5641 | 0.5887 | 0.722 | 0.72 | 0.5787 | 1.0009 | 0.4125 | 0.2899 | 0.5158 |
| | 6 | 0.5538 | 0.7654 | 0.6655 | 0.4129 | 0.7029 | 0.5179 | 0.5313 | 0.9646 | 0.5941 | 0.3649 | 0.5135 |
| | 7 | 0.7491 | 0.9735 | 0.7302 | 0.7336 | 0.5309 | 0.4479 | 0.5155 | 0.7551 | 0.7616 | 0.4074 | 0.4146 |
| | +gp | 0.7491 | 0.9735 | 0.7302 | 0.7336 | 0.5309 | 0.4479 | 0.5155 | 0.7551 | 0.7616 | 0.4074 | 0.4146 |
| 0 | FBAR 3- 6 | 0.5677 | 0.536 | 0.6009 | 0.5311 | 0.6136 | 0.6205 | 0.5669 | 0.8238 | 0.4785 | 0.3621 | 0.4508 |

| | YEAR | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | FBAR **-** |
|---|---|---|---|---|---|---|---|---|
| | AGE | | | | | | | |
| | 2 | 0.2123 | 0.2489 | 0.198 | 0.1008 | 0.1429 | 0.3498 | 0.1978 |
| | 3 | 0.4339 | 0.4832 | 0.4869 | 0.3623 | 0.3796 | 0.5239 | 0.4219 |
| | 4 | 0.4523 | 0.4368 | 0.4819 | 0.39 | 0.607 | 0.8877 | 0.6282 |
| | 5 | 0.3807 | 0.3952 | 0.3757 | 0.4399 | 0.3571 | 0.2857 | 0.3609 |
| | 6 | 0.4046 | 0.3874 | 0.4371 | 0.4344 | 0.2193 | 0.2304 | 0.2947 |
| | 7 | 0.5053 | 0.4574 | 0.4615 | 0.4299 | 0.1875 | 0.1463 | 0.2546 |
| | +gp | 0.5053 | 0.4574 | 0.4615 | 0.4299 | 0.1875 | 0.1463 | |
| 0 | FBAR 3- 6 | 0.4179 | 0.4256 | 0.4454 | 0.4067 | 0.3908 | 0.4819 | |

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

Terminal Fs derived using XSA (With F shrinkage)

| | YEAR | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AGE | | | | | | | | | | | |
| | 2 | 24185 | 29558 | 28423 | 24984 | 26781 | 28253 | 32179 | 35858 | 35409 | 24965 | 263 |
| | 3 | 15430 | 16270 | 18667 | 19891 | 18997 | 19512 | 20886 | 22343 | 28106 | 27626 | 207 |
| | 4 | 10276 | 10952 | 10341 | 12888 | 12639 | 11551 | 11424 | 12895 | 14222 | 18507 | 175 |
| | 5 | 7285 | 6648 | 7552 | 6814 | 8258 | 7449 | 6835 | 6129 | 7375 | 8188 | 102 |
| | 6 | 4478 | 4657 | 4149 | 4644 | 4258 | 5291 | 3747 | 3490 | 3565 | 3828 | 39 |
| | 7 | 3250 | 2945 | 3352 | 2316 | 2793 | 2533 | 2841 | 2466 | 2099 | 1099 | 19 |
| | +gp | 4348 | 3023 | 3950 | 2388 | 2438 | 1301 | 2417 | 2263 | 1763 | 1365 | 13 |
| 0 | TOTAL | 69252 | 74053 | 76433 | 73924 | 76164 | 75890 | 80330 | 85443 | 92539 | 85579 | 82 |

| | YEAR | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AGE | | | | | | | | | | | |
| | 2 | 23696 | 29513 | 23726 | 22586 | 24445 | 25007 | 16935 | 25151 | 24601 | 17306 | 188 |
| | 3 | 21360 | 18351 | 23825 | 17852 | 16541 | 19407 | 17227 | 12299 | 17813 | 18194 | 124 |
| | 4 | 13573 | 13941 | 11677 | 12922 | 10874 | 10103 | 10887 | 9378 | 6584 | 10117 | 113 |
| | 5 | 7517 | 6236 | 7469 | 5448 | 5651 | 5207 | 4249 | 5144 | 3794 | 3831 | 60 |
| | 6 | 4438 | 3336 | 3413 | 3845 | 2736 | 2484 | 2293 | 2156 | 1711 | 2273 | 25 |
| | 7 | 1681 | 2308 | 1404 | 1588 | 2302 | 1226 | 1339 | 1220 | 743 | 855 | 14 |
| | +gp | 1953 | 2210 | 1768 | 2387 | 2481 | 1288 | 1263 | 851 | 490 | 1042 | 15 |
| 0 | TOTAL | 74219 | 75893 | 73282 | 66627 | 65030 | 64721 | 54194 | 56200 | 55737 | 53618 | 54 |

| | YEAR | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | GMST 84-** | AMST 84-** |
|---|---|---|---|---|---|---|---|---|---|---|
| | AGE | | | | | | | | | |
| | 2 | 19426 | 18533 | 18572 | 31353 | 16457 | (4128) | (0) | 24740 | 25254 |
| | 3 | 13249 | 14215 | 13073 | 13786 | 25649 | 12908 | (2633) | 17949 | 18389 |
| | 4 | 7938 | 7768 | 7934 | 7269 | 8682 | 15877 | 6917 | 11030 | 11367 |
| | 5 | 6680 | 4569 | 4542 | 4433 | 4453 | 4281 | 5914 | 6099 | 6290 |
| | 6 | 3254 | 4130 | 2785 | 2822 | 2584 | 2819 | 2912 | 3348 | 3473 |
| | 7 | 1405 | 1965 | 2537 | 1628 | 1654 | 1877 | 2026 | 1830 | 1971 |
| | +gp | 4054 | 2698 | 3379 | 2877 | 1743 | 3710 | 4368 | | |
| 0 | TOTAL | 56005 | 53877 | 52820 | 64168 | 61222 | 45602 | 24770 | | |

( ) age 2 replaced by GM 93-2009 = 22639
( ) age 3 replaced by GM e-(F09-10+M) 18135

**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 | FBAR 3- 6 |
|---|---|---|---|---|---|---|
| 1984 | 24185 | 14828 | 12331 | 4038 | 0.328 | 0.311 |
| 1985 | 29558 | 16077 | 13382 | 4251 | 0.318 | 0.306 |
| 1986 | 28423 | 17101 | 14504 | 4805 | 0.331 | 0.364 |
| 1987 | 24984 | 18704 | 15519 | 5086 | 0.328 | 0.369 |
| 1988 | 26781 | 18569 | 15412 | 5382 | 0.349 | 0.398 |
| 1989 | 28253 | 17855 | 14529 | 5845 | 0.402 | 0.492 |
| 1990 | 32179 | 18491 | 14907 | 5916 | 0.397 | 0.449 |
| 1991 | 35858 | 19224 | 14908 | 5569 | 0.374 | 0.415 |
| 1992 | 35409 | 20649 | 16085 | 6550 | 0.407 | 0.601 |
| 1993 | 24965 | 20026 | 16491 | 6420 | 0.389 | 0.519 |
| 1994 | 26343 | 19442 | 15988 | 7229 | 0.452 | 0.639 |
| 1995 | 23696 | 17814 | 14386 | 6205 | 0.431 | 0.568 |
| 1996 | 29513 | 17919 | 13979 | 5854 | 0.419 | 0.536 |
| 1997 | 23726 | 16628 | 13466 | 6259 | 0.465 | 0.601 |
| 1998 | 22586 | 16610 | 13394 | 6027 | 0.450 | 0.531 |
| 1999 | 24445 | 16124 | 12486 | 5249 | 0.420 | 0.614 |
| 2000 | 25007 | 15665 | 11991 | 5760 | 0.480 | 0.621 |
| 2001 | 16935 | 13156 | 10675 | 4836 | 0.453 | 0.567 |
| 2002 | 25151 | 13278 | 9845 | 5486 | 0.557 | 0.824 |
| 2003 | 24601 | 13481 | 9725 | 4108 | 0.422 | 0.479 |
| 2004 | 17306 | 14364 | 11338 | 4002 | 0.353 | 0.362 |
| 2005 | 18822 | 14756 | 11759 | 4539 | 0.386 | 0.451 |
| 2006 | 19426 | 15717 | 12529 | 4793 | 0.383 | 0.418 |
| 2007 | 18533 | 14927 | 11932 | 4363 | 0.366 | 0.426 |
| 2008 | 18572 | 14825 | 11890 | 4299 | 0.362 | 0.445 |
| 2009 | 31353 | 16098 | 11644 | 3650 | 0.314 | 0.407 |
| 2010 | 16457 | 16190 | 13038 | 3966 | 0.304 | 0.391 |
| 2011 | (4128) | 14587 | 13377 | 4626 | 0.346 | 0.482 |
| Arith. Mean | 24186 | 16540 | 13268 | 5183 | 0.3923 | 0.4851 |
| 0 Units | (Thousands) | (Tonnes) | (Tonnes) | (Tonnes) | | |
| GM 93-2009 = | 22639 | | | | | |

**Table 6.11: Multifleet prediction input data**

Sole in Bay of Biscay
Multi fleet input data

MFDP version 1a
Run: 2012_
Time and date: 19:35 22/05/2012
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input Fs are 2009-2010 means at age 2
Input Fs are 2009-2011 means at age 3 to 8
Catch and stock wts are 2009-2011 means
Recruits are 1993-2009 GM
unscaled F

2012

| Age | N | M | Mat | PF | PM | Stock Wt | F Landings | Landing WT |
|---|---|---|---|---|---|---|---|---|
| 2 | 22639 | 0.1 | 0.32 | 0 | 0 | 0.190 | 0.1219 | 0.179 |
| 3 | 18135 | 0.1 | 0.83 | 0 | 0 | 0.227 | 0.4219 | 0.214 |
| 4 | 6917 | 0.1 | 0.97 | 0 | 0 | 0.283 | 0.6282 | 0.267 |
| 5 | 5914 | 0.1 | 1 | 0 | 0 | 0.354 | 0.3609 | 0.334 |
| 6 | 2912 | 0.1 | 1 | 0 | 0 | 0.430 | 0.2947 | 0.407 |
| 7 | 2026 | 0.1 | 1 | 0 | 0 | 0.511 | 0.2546 | 0.483 |
| 8 | 4368 | 0.1 | 1 | 0 | 0 | 0.706 | 0.2546 | 0.668 |

2013

| Age | N | M | Mat | PF | PM | Stock Wt | F Landings | Landing WT |
|---|---|---|---|---|---|---|---|---|
| 2 | 22639 | 0.1 | 0.32 | 0 | 0 | 0.190 | 0.1219 | 0.179 |
| 3 | | 0.1 | 0.83 | 0 | 0 | 0.227 | 0.4219 | 0.214 |
| 4 | | 0.1 | 0.97 | 0 | 0 | 0.283 | 0.6282 | 0.267 |
| 5 | | 0.1 | 1 | 0 | 0 | 0.354 | 0.3609 | 0.334 |
| 6 | | 0.1 | 1 | 0 | 0 | 0.430 | 0.2947 | 0.407 |
| 7 | | 0.1 | 1 | 0 | 0 | 0.511 | 0.2546 | 0.483 |
| 8 | | 0.1 | 1 | 0 | 0 | 0.706 | 0.2546 | 0.668 |

2014

| Age | N | M | Mat | PF | PM | Stock Wt | F Landings | Landing WT |
|---|---|---|---|---|---|---|---|---|
| 2 | 22639 | 0.1 | 0.32 | 0 | 0 | 0.190 | 0.1219 | 0.179 |
| 3 | | 0.1 | 0.83 | 0 | 0 | 0.227 | 0.4219 | 0.214 |
| 4 | | 0.1 | 0.97 | 0 | 0 | 0.283 | 0.6282 | 0.267 |
| 5 | | 0.1 | 1 | 0 | 0 | 0.354 | 0.3609 | 0.334 |
| 6 | | 0.1 | 1 | 0 | 0 | 0.430 | 0.2947 | 0.407 |
| 7 | | 0.1 | 1 | 0 | 0 | 0.511 | 0.2546 | 0.483 |
| 8 | | 0.1 | 1 | 0 | 0 | 0.706 | 0.2546 | 0.668 |

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

MFDP version 1a
Run: 2012_
Time and date: 19:35 22/05/2012
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

**Basis**
**F(2012) = mean F(09–10) unscaled (age 2)**
**F(2012) = mean F(09–11) unscaled (age 3 to above)**
**R10–12 = GM(93–09) = 22.6 million**

**2012**

| Biomass | SSB | Landings FMult | Landings FBar | Yield |
|---|---|---|---|---|
| 17853 | 14163 | 1.0000 | 0.4264 | 4240 |

**2013**

| Biomass | SSB | Landings FMult | Landings FBar | Landing Yield | 2014 Biomass | SSB |
|---|---|---|---|---|---|---|
| 18431 | 14709 | 0.0000 | 0.0000 | 0 | 24198 | 20337 |
| . | 14709 | 0.1000 | 0.0426 | 540 | 23540 | 19695 |
| . | 14709 | 0.2000 | 0.0853 | 1059 | 22910 | 19079 |
| . | 14709 | 0.3000 | 0.1279 | 1557 | 22305 | 18489 |
| . | 14709 | 0.4000 | 0.1706 | 2035 | 21724 | 17923 |
| . | 14709 | 0.5000 | 0.2132 | 2495 | 21168 | 17380 |
| . | 14709 | 0.6000 | 0.2559 | 2936 | 20633 | 16859 |
| . | 14709 | 0.7000 | 0.2985 | 3361 | 20120 | 16359 |
| . | 14709 | 0.8000 | 0.3412 | 3770 | 19627 | 15879 |
| . | 14709 | 0.9000 | 0.3838 | 4162 | 19153 | 15419 |
| . | 14709 | 1.0000 | 0.4264 | 4540 | 18698 | 14976 |
| . | 14709 | 1.1000 | 0.4691 | 4904 | 18261 | 14551 |
| . | 14709 | 1.2000 | 0.5117 | 5255 | 17840 | 14142 |
| . | 14709 | 1.3000 | 0.5544 | 5592 | 17436 | 13750 |
| . | 14709 | 1.4000 | 0.5970 | 5917 | 17047 | 13372 |
| . | 14709 | 1.5000 | 0.6397 | 6230 | 16673 | 13009 |
| . | 14709 | 1.6000 | 0.6823 | 6532 | 16312 | 12660 |
| . | 14709 | 1.7000 | 0.7250 | 6822 | 15966 | 12324 |
| . | 14709 | 1.8000 | 0.7676 | 7103 | 15631 | 12000 |
| . | 14709 | 1.9000 | 0.8102 | 7373 | 15310 | 11689 |
| . | 14709 | 2.0000 | 0.8529 | 7634 | 15000 | 11389 |

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: 2012_
Time and date: 19:35 22/05/2012
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Year: 2012 F multiplier: 1 Fleet1 HCFba 0.4264

| Age | Landings F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 0.1219 | 2474 | 443 | 22639 | 4309 | 7244 | 1379 | 7244 | 1379 |
| 3 | 0.4219 | 5961 | 1278 | 18135 | 4123 | 15052 | 3422 | 15052 | 3422 |
| 4 | 0.6282 | 3086 | 824 | 6917 | 1958 | 6709 | 1899 | 6709 | 1899 |
| 5 | 0.3609 | 1710 | 572 | 5914 | 2094 | 5914 | 2094 | 5914 | 2094 |
| 6 | 0.2947 | 709 | 289 | 2912 | 1251 | 2912 | 1251 | 2912 | 1251 |
| 7 | 0.2546 | 434 | 210 | 2026 | 1035 | 2026 | 1035 | 2026 | 1035 |
| 8 | 0.2546 | 936 | 625 | 4368 | 3084 | 4368 | 3084 | 4368 | 3084 |
| Total | | 15311 | 4240 | 62911 | 17853 | 44226 | 14163 | 44226 | 14163 |

Year: 2013 F multiplier: 1 Fleet1 HCFba 0.4264

| Age | Landings F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 0.1219 | 2474 | 443 | 22639 | 4309 | 7244 | 1379 | 7244 | 1379 |
| 3 | 0.4219 | 5961 | 1278 | 18135 | 4123 | 15052 | 3422 | 15052 | 3422 |
| 4 | 0.6282 | 4802 | 1282 | 10761 | 3045 | 10438 | 2954 | 10438 | 2954 |
| 5 | 0.3609 | 966 | 323 | 3339 | 1182 | 3339 | 1182 | 3339 | 1182 |
| 6 | 0.2947 | 908 | 370 | 3730 | 1603 | 3730 | 1603 | 3730 | 1603 |
| 7 | 0.2546 | 421 | 203 | 1962 | 1003 | 1962 | 1003 | 1962 | 1003 |
| 8 | 0.2546 | 961 | 642 | 4485 | 3167 | 4485 | 3167 | 4485 | 3167 |
| Total | | 16493 | 4540 | 65051 | 18431 | 46251 | 14709 | 46251 | 14709 |

Year: 2014 F multiplier: 1 Fleet1 HCFba 0.4264

| Age | Landings F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 0.1219 | 2474 | 443 | 22639 | 4309 | 7244 | 1379 | 7244 | 1379 |
| 3 | 0.4219 | 5961 | 1278 | 18135 | 4123 | 15052 | 3422 | 15052 | 3422 |
| 4 | 0.6282 | 4802 | 1282 | 10761 | 3045 | 10438 | 2954 | 10438 | 2954 |
| 5 | 0.3609 | 1502 | 502 | 5195 | 1839 | 5195 | 1839 | 5195 | 1839 |
| 6 | 0.2947 | 513 | 209 | 2106 | 905 | 2106 | 905 | 2106 | 905 |
| 7 | 0.2546 | 539 | 260 | 2514 | 1284 | 2514 | 1284 | 2514 | 1284 |
| 8 | 0.2546 | 969 | 648 | 4523 | 3193 | 4523 | 3193 | 4523 | 3193 |
| Total | | 16760 | 4621 | 65872 | 18698 | 47071 | 14976 | 47071 | 14976 |

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 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| Stock No. (thousands) of 2 year-olds | 31353 | 16457 | 22639 | 22639 | 22639 | 22639 |
| Source | XSA | XSA | GM93-2009 | GM93-2009 | GM93-2009 | GM93-2009 |
| Status Quo F: | | | | | | |
| % in 2012 landings | 13.5 | 19.4 | 30.1 | 10.4 | - | - |
| % in 2013 | 8.1 | 7.1 | 28.2 | 28.1 | 9.8 | - |
| % in 2012 SSB | 14.8 | 13.4 | 24.2 | 9.7 | - | - |
| % in 2013 SSB | 10.9 | 8.0 | 20.1 | 23.3 | 9.4 | - |
| % in 2014 SSB | 8.6 | 6.0 | 12.3 | 19.7 | 22.8 | 9.2 |

GM : geometric mean recruitment

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

**a ) 2013 landings** **b ) 2014 SSB**

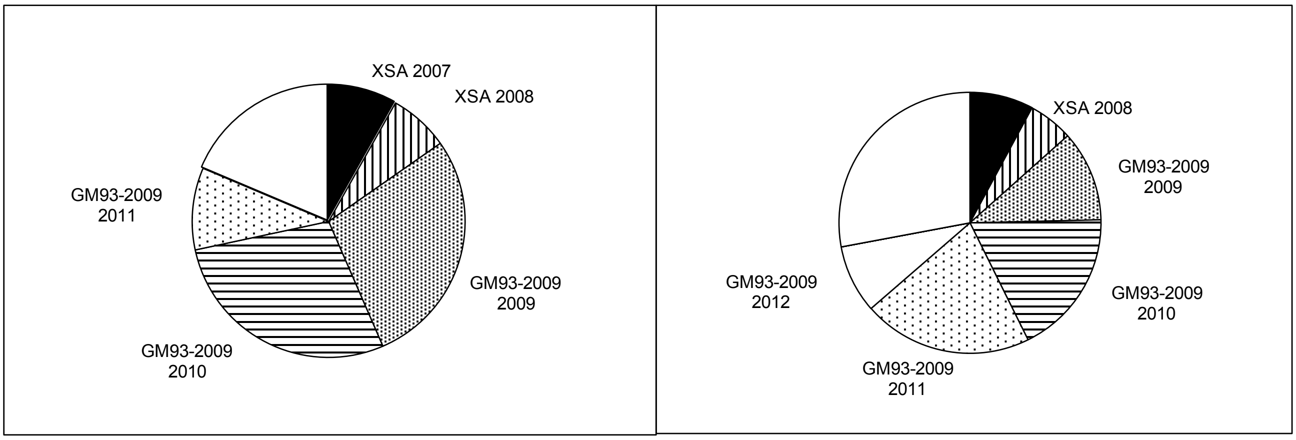


**Table 6.15a: Bay of Biscay Sole Multifleet Yield per recruit**

MFYPR version 2a
Run: 2012_unsc_
Time and date: 19:37 22/05/2012
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 | 5.5595 | 9.6499 | 5.3882 | 9.6499 | 5.3882 |
| 0.1000 | 0.0426 | 0.2323 | 0.1018 | 8.1882 | 4.0200 | 7.3329 | 3.8494 | 7.3329 | 3.8494 |
| 0.2000 | 0.0853 | 0.3813 | 0.1558 | 6.7010 | 3.0573 | 5.8489 | 2.8875 | 5.8489 | 2.8875 |
| 0.3000 | 0.1279 | 0.4837 | 0.1855 | 5.6802 | 2.4140 | 4.8310 | 2.2450 | 4.8310 | 2.2450 |
| 0.4000 | 0.1706 | 0.5575 | 0.2016 | 4.9447 | 1.9637 | 4.0985 | 1.7954 | 4.0985 | 1.7954 |
| 0.5000 | 0.2132 | 0.6128 | 0.2101 | 4.3953 | 1.6374 | 3.5518 | 1.4697 | 3.5518 | 1.4697 |
| 0.6000 | 0.2559 | 0.6554 | 0.2140 | 3.9729 | 1.3943 | 3.1322 | 1.2273 | 3.1322 | 1.2273 |
| 0.7000 | 0.2985 | 0.6890 | 0.2153 | 3.6406 | 1.2092 | 2.8026 | 1.0429 | 2.8026 | 1.0429 |
| 0.8000 | 0.3412 | 0.7159 | 0.2150 | 3.3742 | 1.0656 | 2.5388 | 0.9000 | 2.5388 | 0.9000 |
| 0.9000 | 0.3838 | 0.7380 | 0.2138 | 3.1569 | 0.9524 | 2.3240 | 0.7874 | 2.3240 | 0.7874 |
| 1.0000 | 0.4264 | 0.7563 | 0.2121 | 2.9772 | 0.8620 | 2.1468 | 0.6976 | 2.1468 | 0.6976 |
| 1.1000 | 0.4691 | 0.7717 | 0.2101 | 2.8267 | 0.7888 | 1.9987 | 0.6250 | 1.9987 | 0.6250 |
| 1.2000 | 0.5117 | 0.7847 | 0.2081 | 2.6991 | 0.7288 | 1.8734 | 0.5656 | 1.8734 | 0.5656 |
| 1.3000 | 0.5544 | 0.7960 | 0.2062 | 2.5899 | 0.6792 | 1.7665 | 0.5165 | 1.7665 | 0.5165 |
| 1.4000 | 0.5970 | 0.8057 | 0.2043 | 2.4954 | 0.6378 | 1.6743 | 0.4756 | 1.6743 | 0.4756 |
| 1.5000 | 0.6397 | 0.8142 | 0.2025 | 2.4131 | 0.6028 | 1.5941 | 0.4412 | 1.5941 | 0.4412 |
| 1.6000 | 0.6823 | 0.8218 | 0.2008 | 2.3407 | 0.5731 | 1.5238 | 0.4120 | 1.5238 | 0.4120 |
| 1.7000 | 0.7250 | 0.8284 | 0.1993 | 2.2766 | 0.5476 | 1.4618 | 0.3870 | 1.4618 | 0.3870 |
| 1.8000 | 0.7676 | 0.8344 | 0.1978 | 2.2194 | 0.5255 | 1.4067 | 0.3654 | 1.4067 | 0.3654 |
| 1.9000 | 0.8102 | 0.8398 | 0.1965 | 2.1681 | 0.5063 | 1.3573 | 0.3467 | 1.3573 | 0.3467 |
| 2.0000 | 0.8529 | 0.8447 | 0.1954 | 2.1218 | 0.4894 | 1.3129 | 0.3303 | 1.3129 | 0.3303 |

| Reference point | F multiplier | Absolute F |
|---|---|---|
| Fleet1 Landings Fbar(3-6) | 1.0000 | 0.4264 |
| FMax | 0.7228 | 0.3082 |
| F0.1 | 0.3715 | 0.1584 |
| F35%SPR | 0.3770 | 0.1608 |

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 |
| 4802 | 15793 |

GM (93-09) for recruits (age 2)
22639

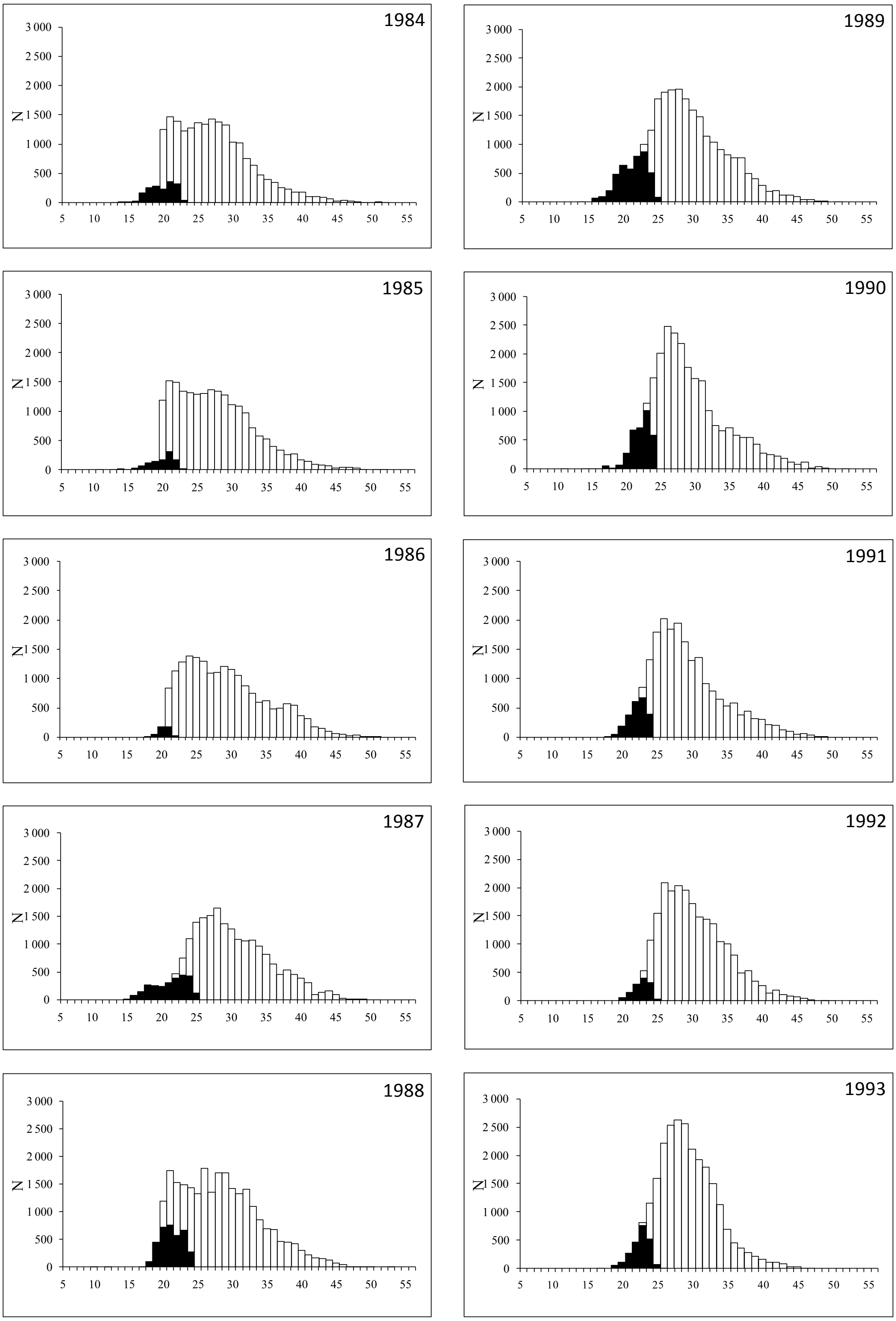



**Figure 6.1 a: Bay of Biscay sole French length distribution from 1984 to 1993**

Total French landings

Discard estimates of the French offshore trawlers fleet

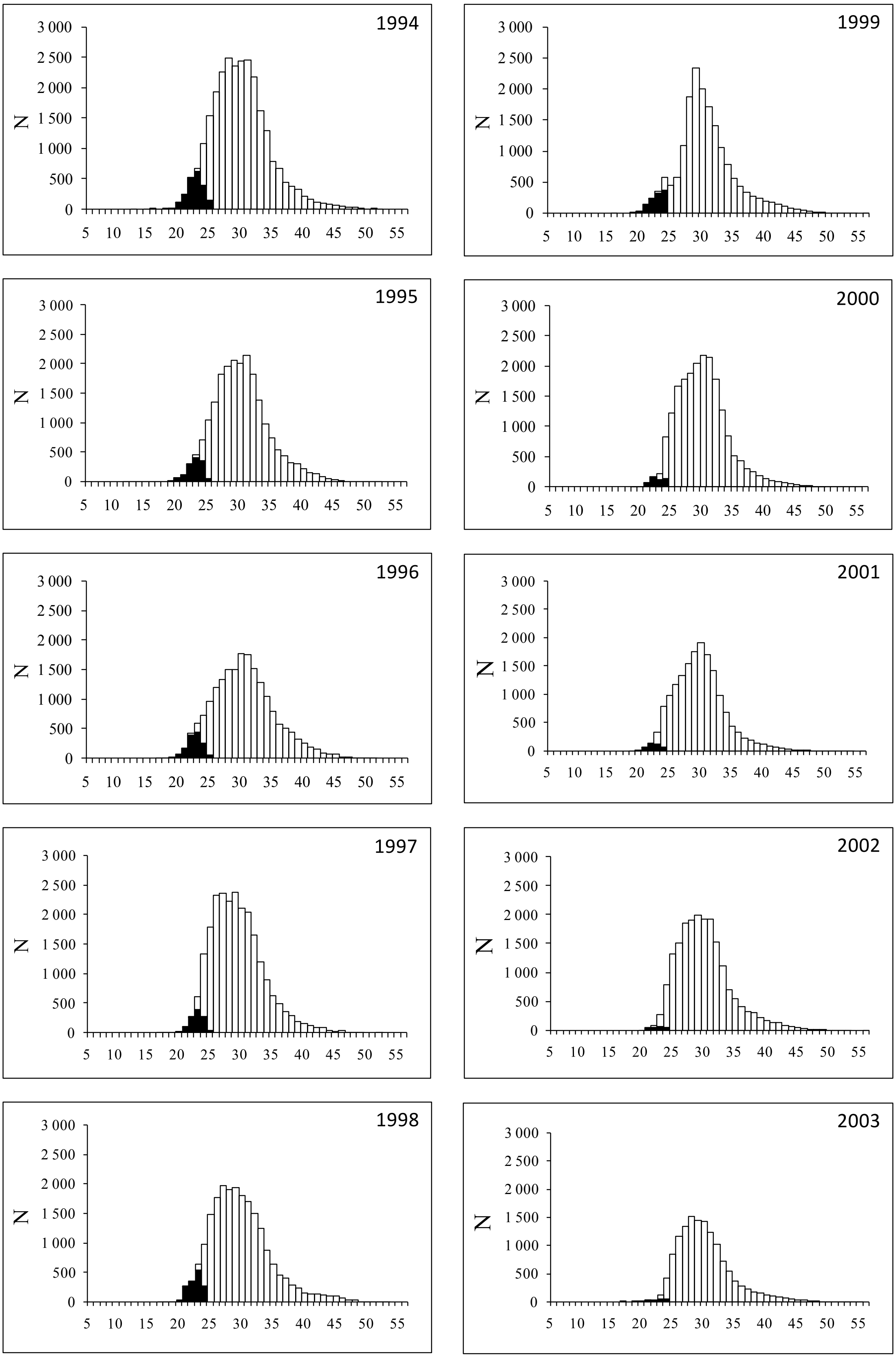



**Figure 6.1 b: Bay of Biscay sole French length distribution from 1994 to 2003**

Total French landings

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

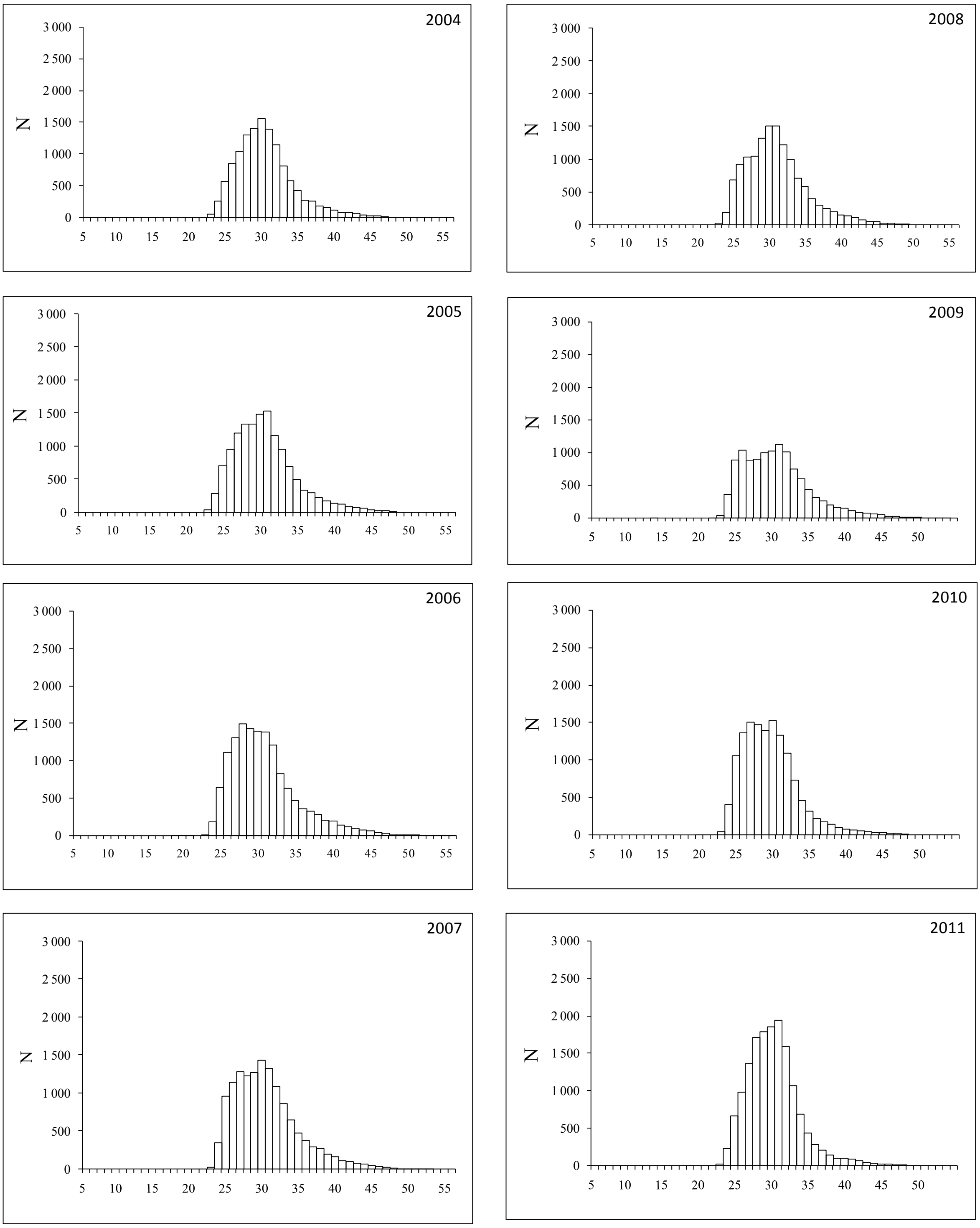



**Figure 6.1 c: Bay of Biscay sole French length distribution from 2004 to 2011**

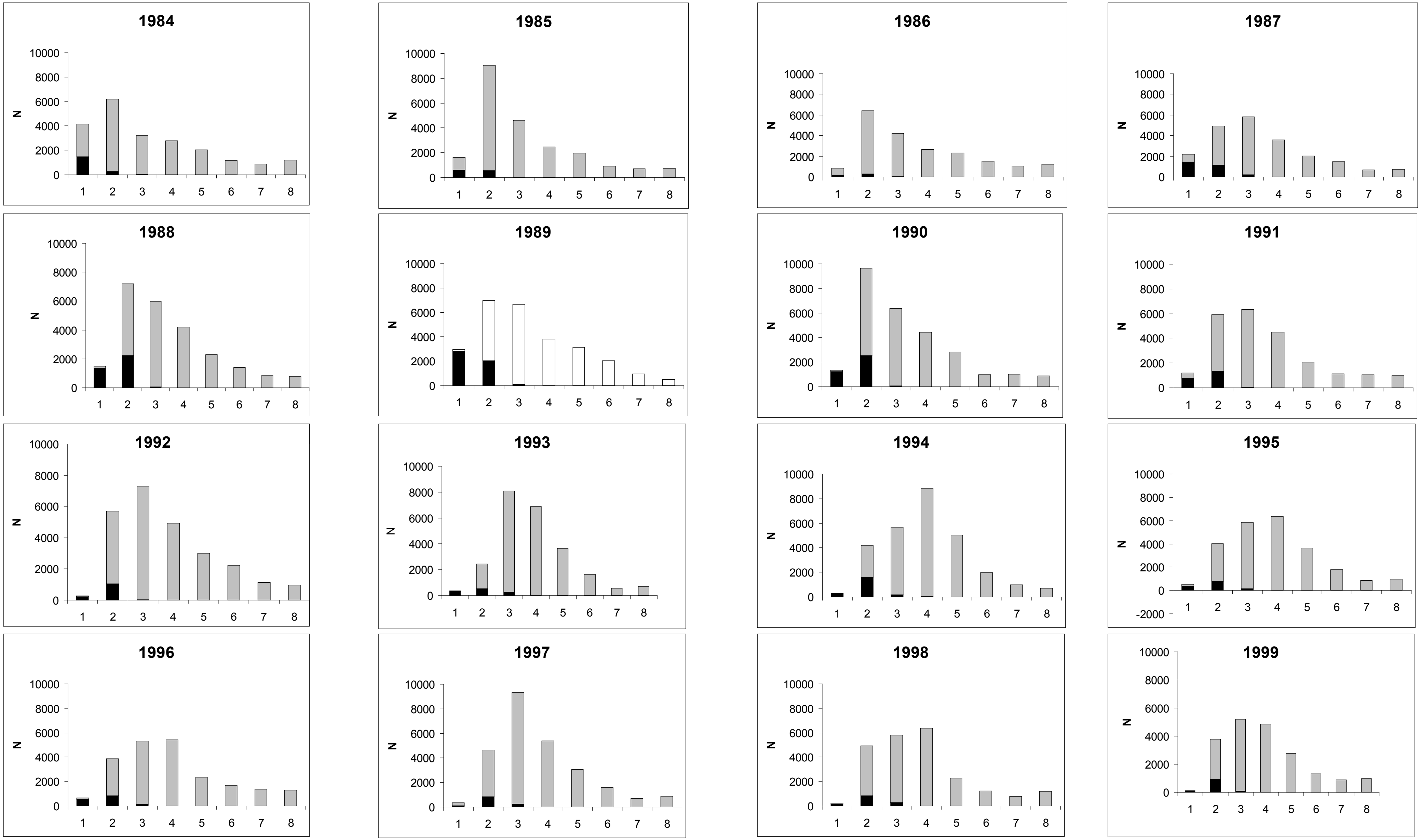



**Figure 6.2 a: Bay of Biscay sole landings and discards age distributions from 1984 to 1999 (numbers in thousands)**

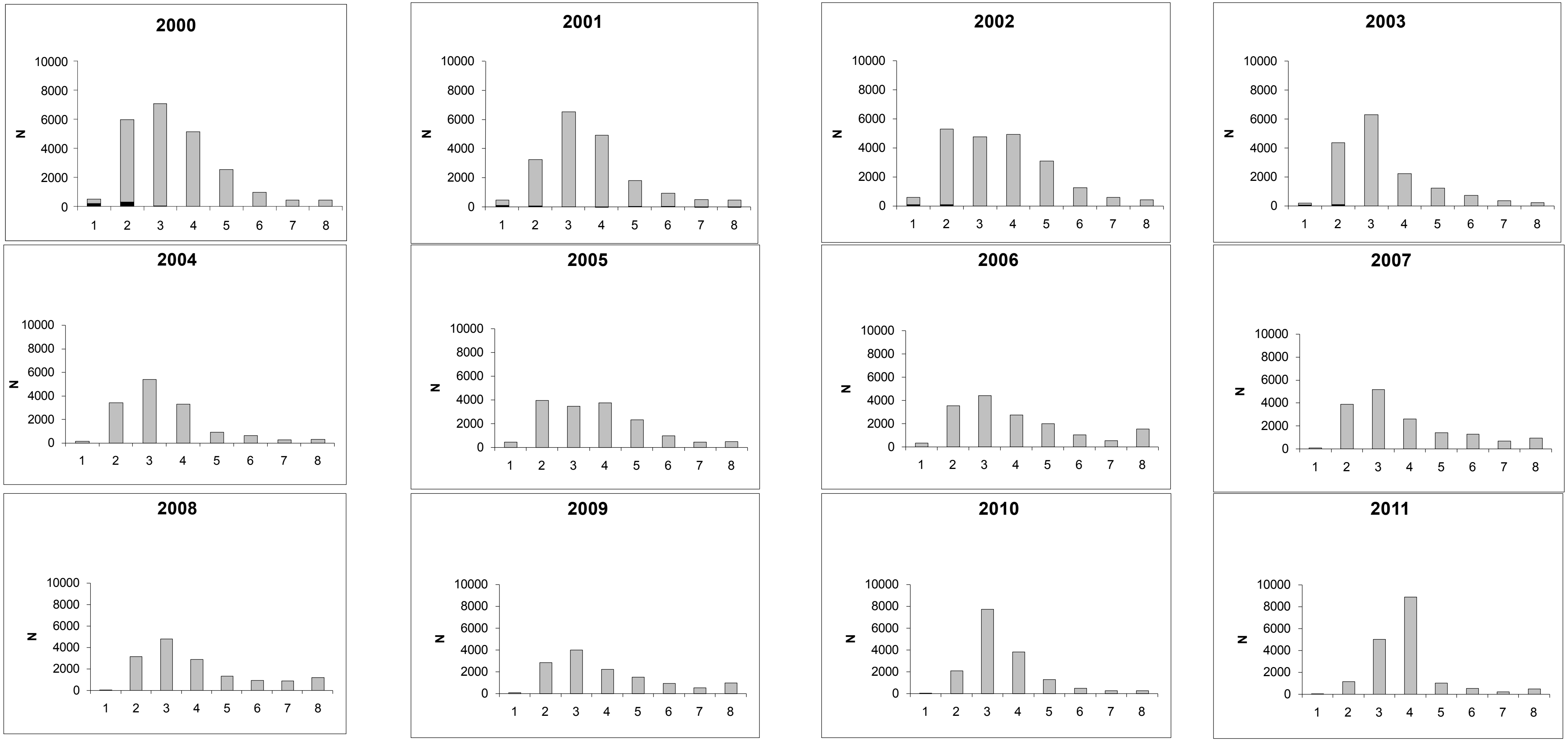



**Figure 6.2 b:** **Bay of Biscay sole landings and discards age distributions from 2000 to 2011 ; landings age distribution since 2004 (numbers in thousands)**

Total landings

Discard estimates of the French offshore trawlers fleet

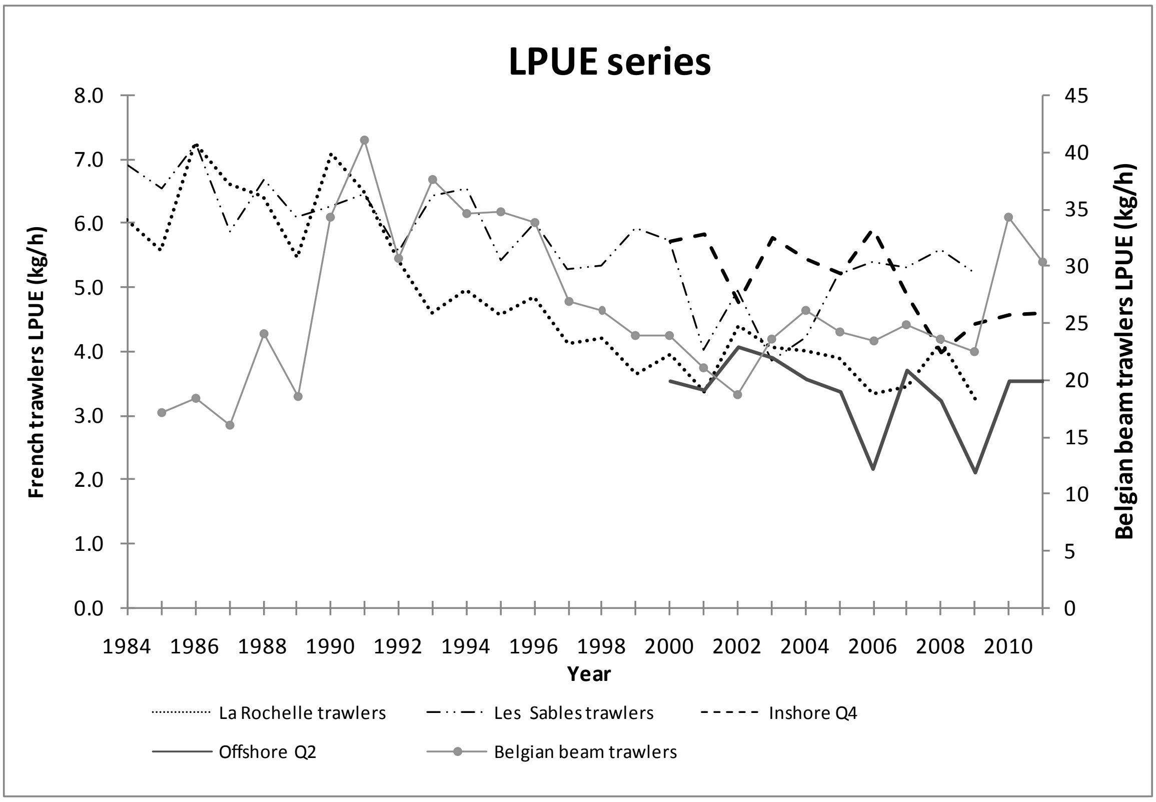



**Figure 6.3: Bay of Biscay sole (Division VIIIa,b). LPUE trends of the 4 tuning fleets**

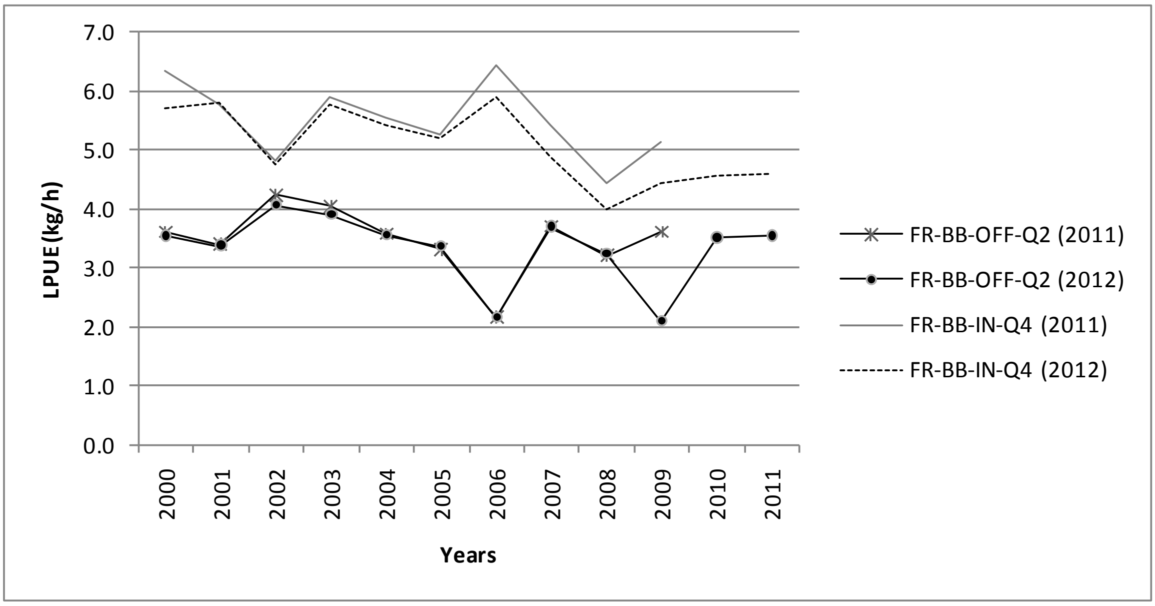



**Figure 6.4: Bay of Biscay sole (Division VIIIa,b). LPUE corrections WG 2011 / WG 2012**

## LOG CATCHABILITY RESIDUAL PLOTS (XSA)

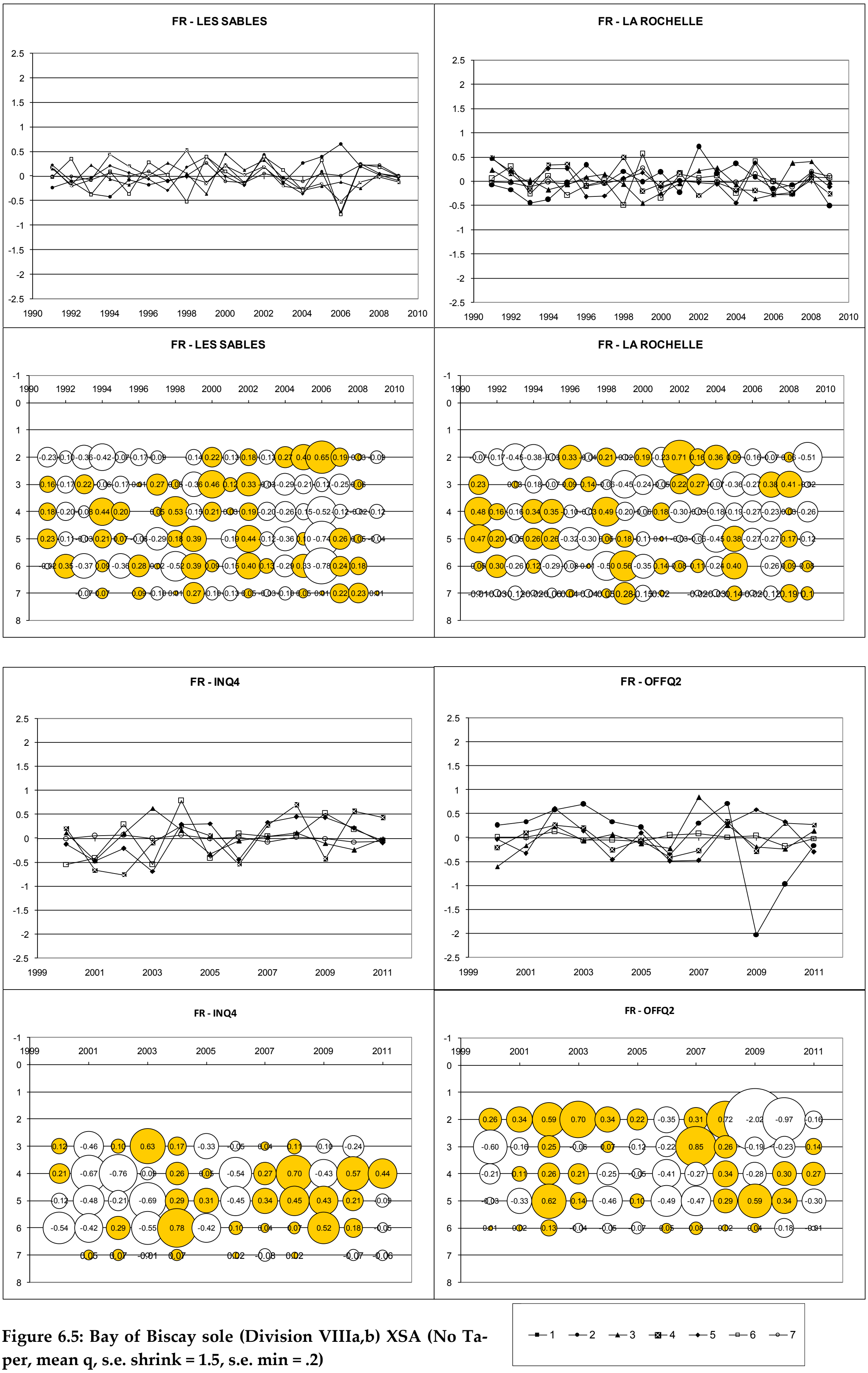



**Figure 6.5: Bay of Biscay sole (Division VIIIa,b) XSA (No Taper, mean q, s.e. shrink = 1.5, s.e. min = .2)**

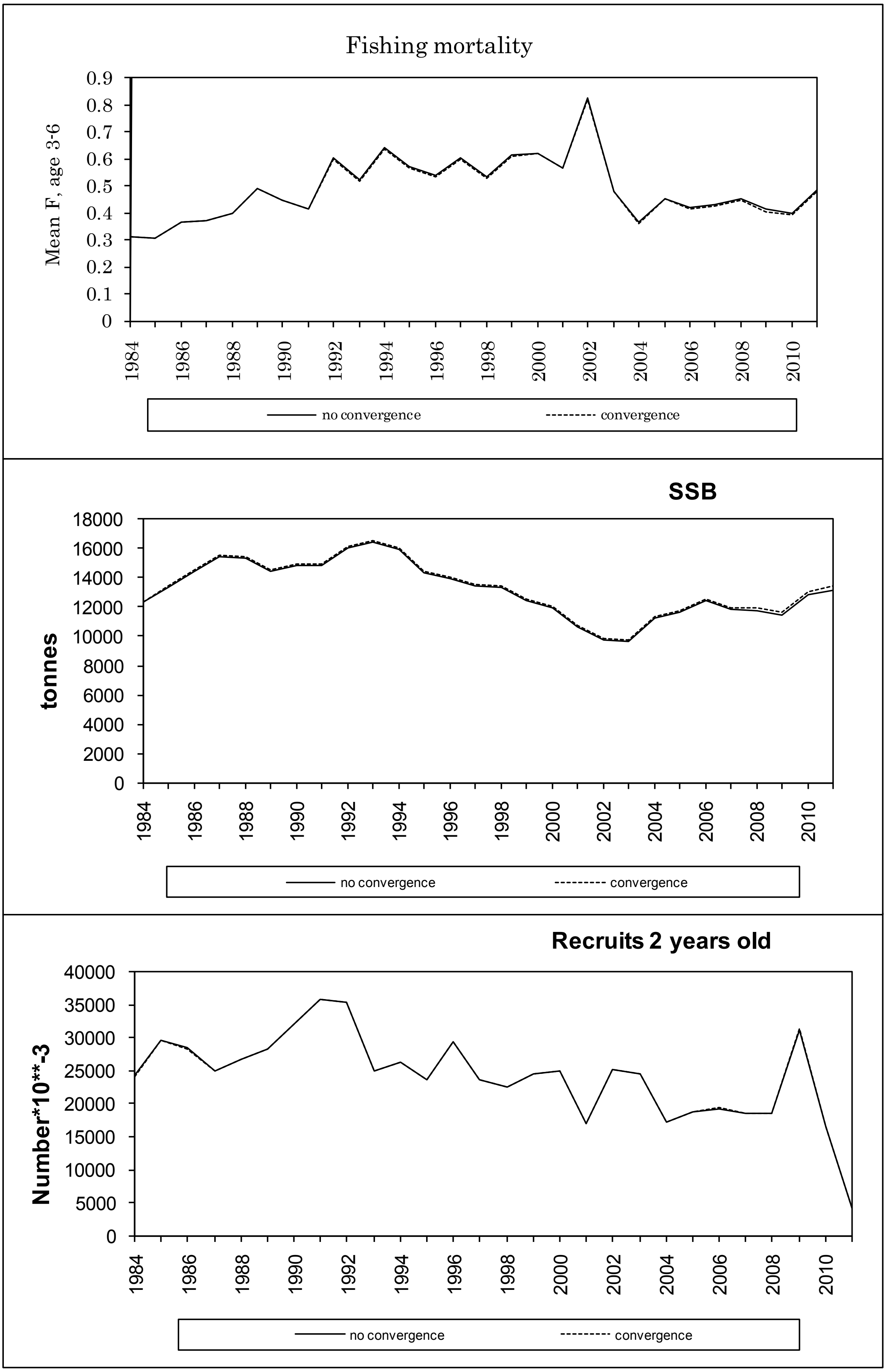



**Figure 6.6: Bay of Biscay sole (Division VIIIa,b) - WG12 / WG12 comparison of convergence**

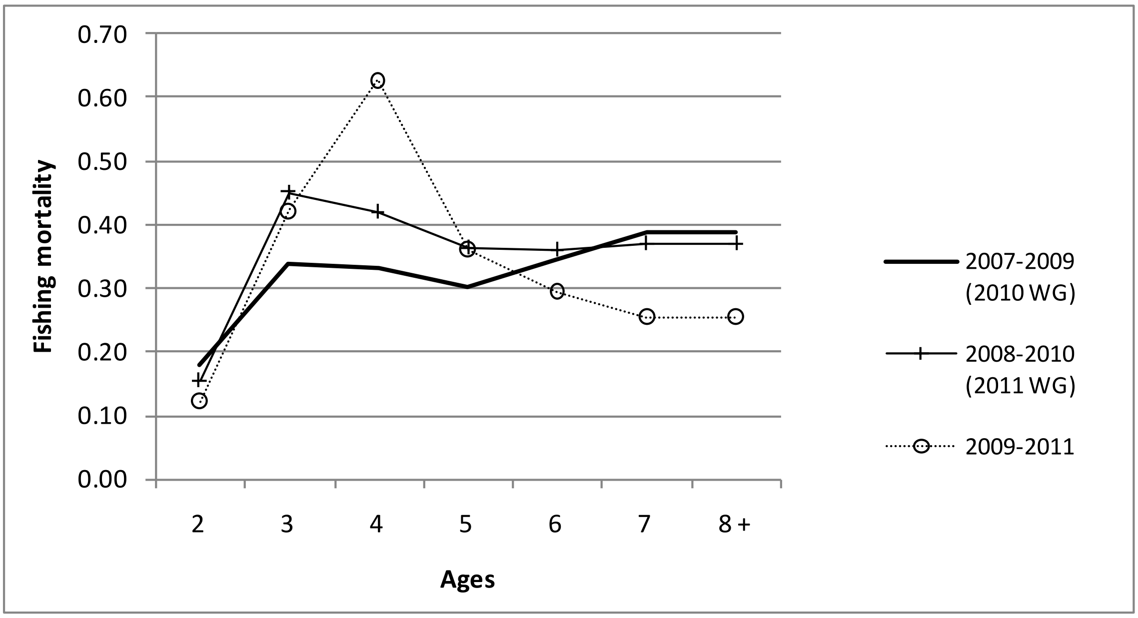



**Figure 6.7: Bay of Biscay sole (Division VIIIa,b) - Selection pattern in 2010, 2011 and 2012 (Fmean)**

F(y) = mean F((y-2) – (y-1)) age 2

F(y) = mean F((y-2) – y) age 3 to above

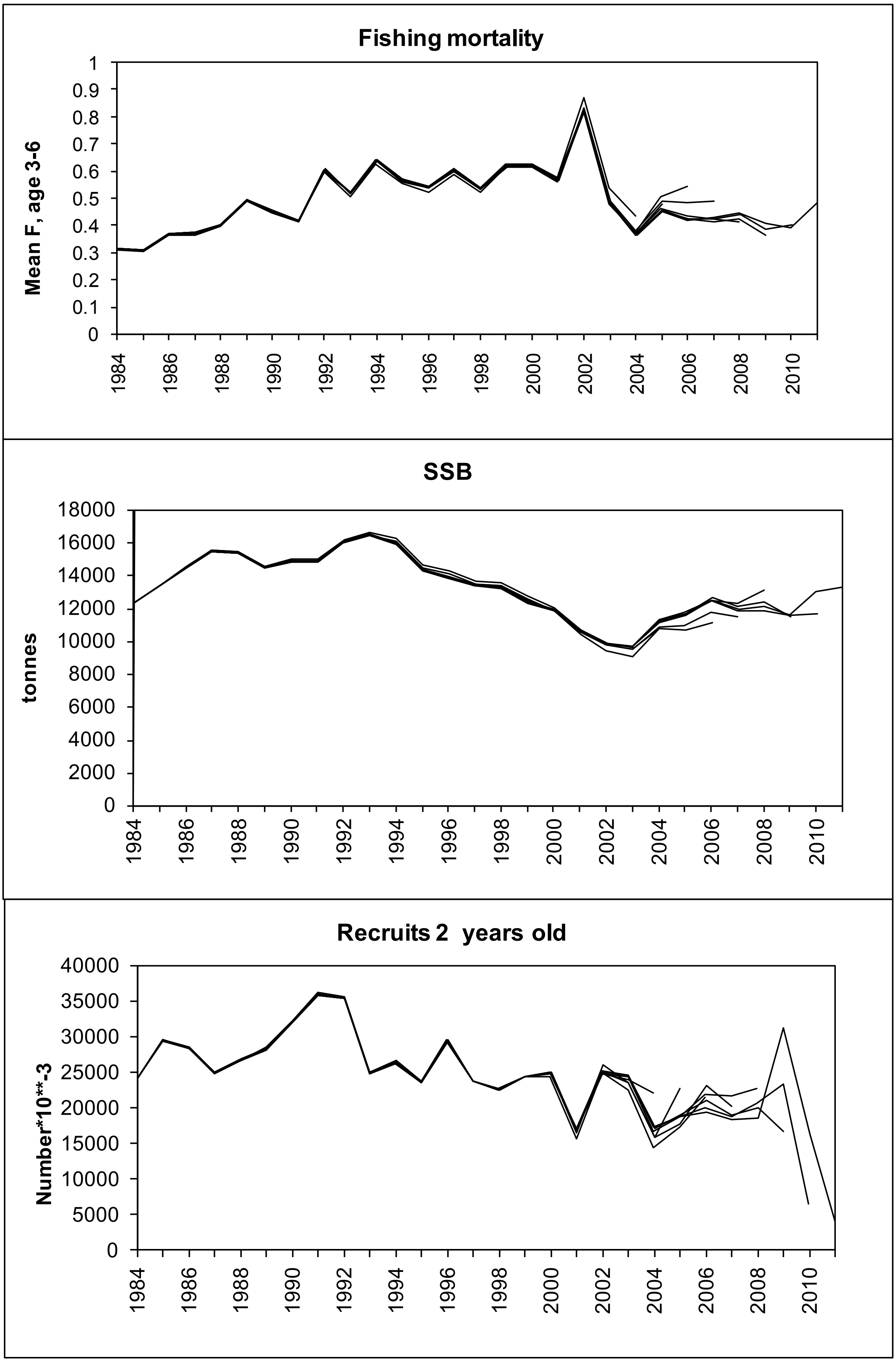



**Figure 6.8: Bay of Biscay sole (Division VIIIa,b) - Retrospective results**

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


**Figure 6.9: Sole in Division VIIIa,b (Bay of Biscay) – Trends for Landings, F, R, SSB**

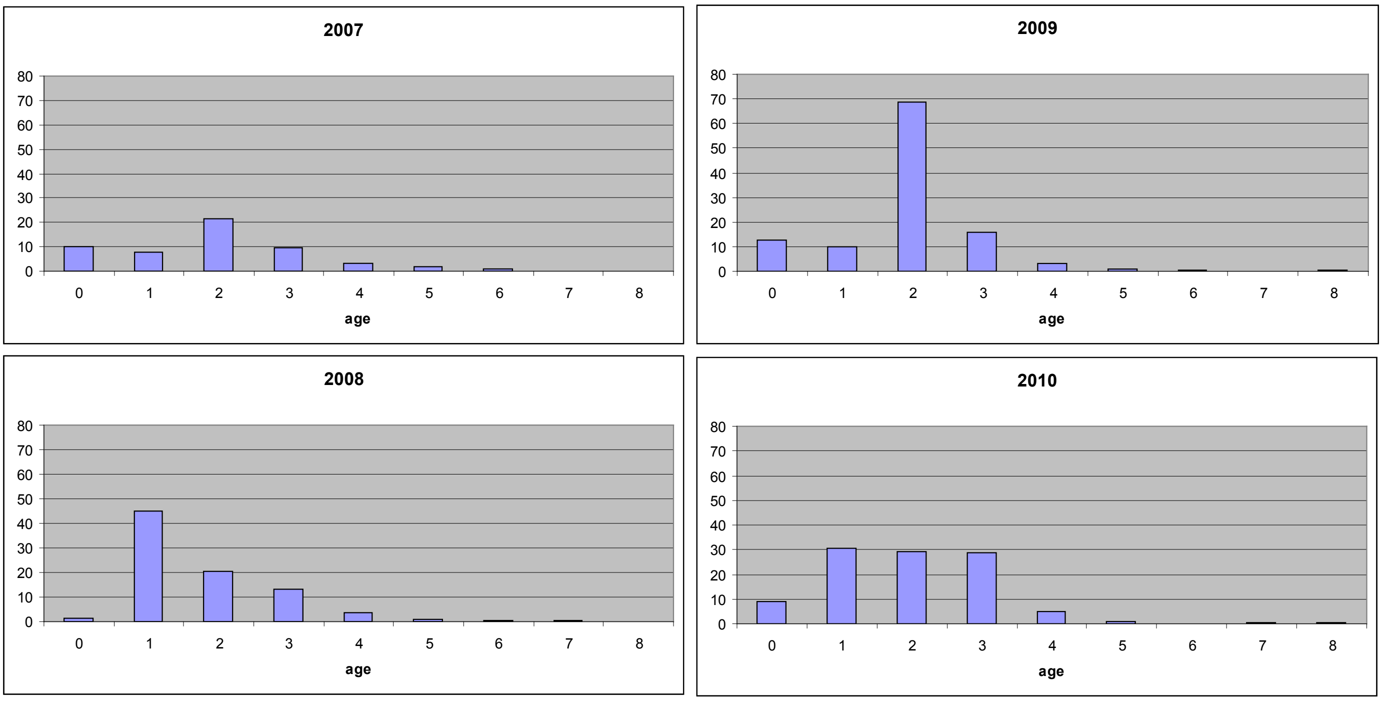
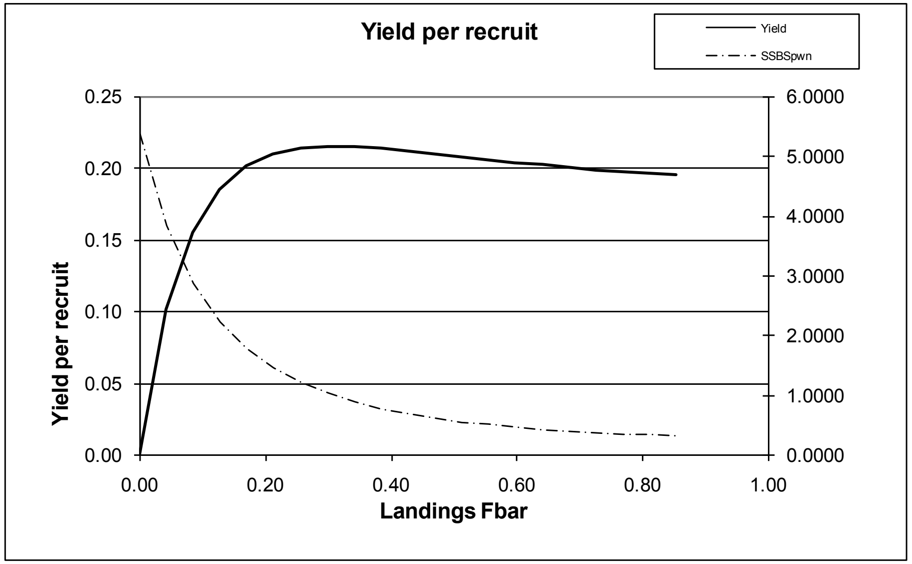
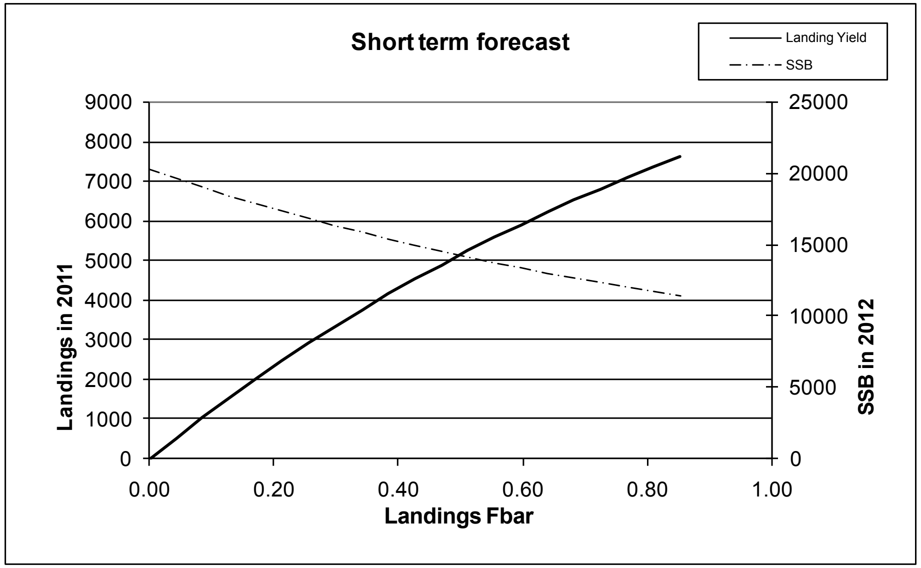



**Figure 6.10: Sole in Division VIIIa,b (Bay of Biscay) – 2007 – 2010 ORHAGO numbers at age**

**(Numbers/10 nautical miles)**




MFYPR version 2a
Run: 2012_unsc_
Time and date: 19:37 22/05/2012

| Reference point | F multiplier | Absolute F |
|---|---|---|
| Fleet1 Landings Fbar(3-6) | 1.0000 | 0.4264 |
| FMax | 0.7228 | 0.3082 |
| F0.1 | 0.3715 | 0.1584 |
| F35%SPR | 0.3770 | 0.1608 |

Weights in kilograms

MFDP version 1a
Run: 2012_
Time and date: 19:35 22/05/2012
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input units are thousands and kg - output in tonnes

**Figure 6.11: Sole in Division VIIIa,b (Bay of Biscay)**

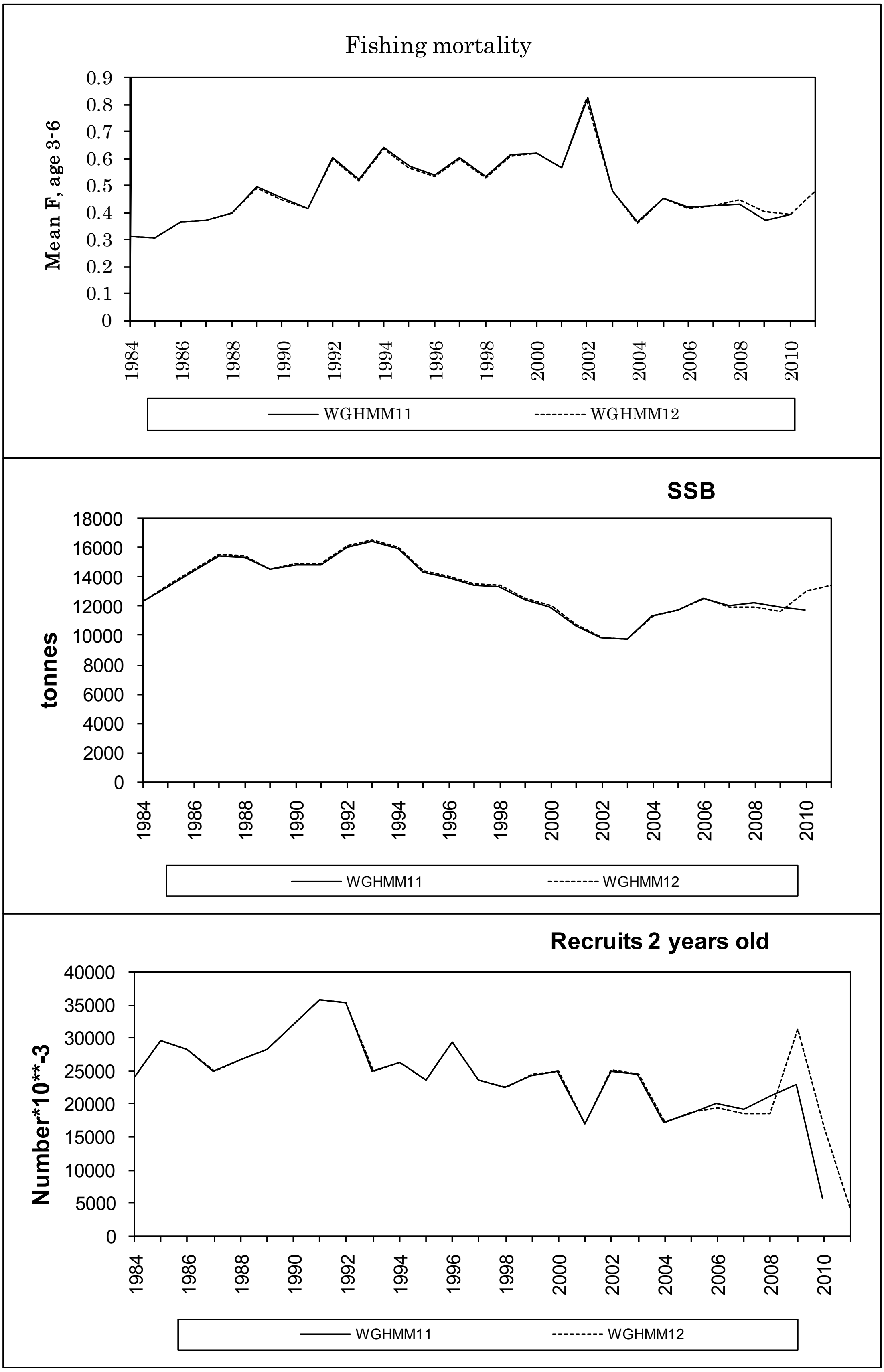



**Figure 6.12: Bay of Biscay sole (Division VIIIa,b) - WG11 / WG12 comparison**

# 7 Southern Stock of Hake

## 7.1 General

The type of assessment is “update” based on a previous benchmark assessment (WKROUND, 2010). However, it was not possible to include Spanish commercial data for 2011 in the assessment. The assessment model could not be updated this year. The assessment conducted in 2011 has been used as the basis of projections for catch options and management advice for 2013..

### 7.1.1 Fishery description

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

### 7.1.2 ICES advice for 2012 and Management applicable to 2011 and 2012

#### ICES Advice for 2012

ICES advised, on the basis of the transition to the MSY approach, that landings in 2012 should not exceed 14 300 t..

#### Management Applicable for 2011 and 2012

Hake is managed by TAC, effort control and technical measures. The agreed TAC for Southern Hake in 2011 was 10 695 t and in 2012 is 12 299 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 decreasing fishing mortality a maximum of 10% at year with a TAC constrain of 15%. SSB target (35 000 t) is not considered suitable under the new assessment model. This regulation also includes effort management in addition to TAC measures.

Since 2006, a 10% annual reduction of fishing days at sea was applied to all vessels, although with some exclusions. In 2012, vessels that landed less than 5 tonnes of hake in 2009 or 2010 are excluded.

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 for 2011 and 2012, in 2011 there will be 2 months of closure and a system to share the Spanish quota with maximum landings per quarter and fleet segment. (ARM/2296/2011, ARM/3361/2010 and ARM/1083/2011). In 2012 the fishing options have been shared among 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, a maximum of 155 days of fishing for the bottom-trawl fleet, and the division of quotas between fishing vessels.

## 7.2 Data

### 7.1.1 Commercial Catch: landings and discards

#### Catches: landings and discards

Southern Hake catches by country and gear for the period 1972-2011, as estimated by the WG, are given in Table 7.1.. Spanish data for 2011 are not included.

In 2011, Portuguese landings were 2 214 t, slightly below those from 2010 (2 341 t)

Spanish data in 2011 have been provided by SGP, the official national administration responsible for fishery statistics, and are presented in Annex T. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations.. The 2011 Spanish landings were provided to the group only on the 11th of May. Preliminary analysis suggests that the formats are not adequate to implement the technical annex defining the Southern hake model. The reasons are: (1) quarterly landings are required for the assessment model, while data were provided in an yearly basis; (2) effort in days*100CV are needed instead of days, this breaks CPUE temporal consistency, particularly for A Coruña Baka fleet, required for model tuning. Furthermore, effort data for this fleet is inconsistent among different stocks

Official Spanish landings for 2011 are 6.0 Kt, less than half the previously estimated 2010 landings (13.0 t). This strong landings reduction should be explained by additional information like effort, surveys or discards. There is no effort data in appropriate units, which would allow an analysis of changes in effort between 2010 and 2011. However, there are not any regulations suggesting a relevant effort reduction. The Spanish survey (SpGFS-WIBTS-Q4) shows a light increase in biomass, from 8.36 kg/h in 2010 to 8.98 kg/h in 2011. Proportion of Spanish discards by trip in 2010 was 10% (in weight) and 17% in 2011. This discarding increase does not explain the strong landings reduction. The absence of evidences supporting the Spanish landings reduction suggests that the change in the method to calculate the 2011 landings could be the reason.

Given the doubts about the quality of Spanish commercial data for 2011, these have not been used for assessment purposes.

Biological Sampling

The sampling levels in 2011 are summarized in Table 1.3.

#### Length Composition

Table 7.2 presents the length compositions of catches by country and gear and mean length for 2011. Length composition by fleet from Spain is presented scaled to sum 1000 since catches were not accepted for the assessment (Table 7.2). Mean size for the different fleets shows similar figures than those from 2010. Figure 7.1 shows the length distributions of landings and discards for 1982-2010.

#### Growth, Length–weight relationship and M

An international length-weight relationship for the whole period has been used since 1999 (see Stock Annex G).. 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. The maturity proportion in this assessment year is shown in Figure 7.2. 2011 figures are similar to those from previous years..

### 7.2.1 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.

Since 1989 the Portuguese Autumn survey (PtGFS-WIBTS-Q4) has shown variable abundance indices with a minimum in 1987 and maximum in 2009. Biomass in 2011 is half the one in 2010 and around the historic mean. Recruitment (<20 cm) in 2011 was lower than those from 2010 and 2009 although continues to be high, being the 4$^{th}$ highest in the series.,

The Spanish groundfish survey (SpGFS-WIBTS-Q4) shows low values for biomass and abundance in early 2000s, but abundance and biomass increases since 2004, being in 2009 at the historical maximum. In 2011 the recruitment index (<20 cm) is slightly over the historic mean. The biomass is similar to that in 2010 and well above the historic mean.

The recruitment indices of the SpGFS-WIBTS-Q4, SPGFS-caut-WIBTS-Q4 and PtGFS-WIBTS-Q4 (Figure 7.3) were relatively inconsistent in the past. However, all show the same increasing pattern in recent years with high values in 2005, 2006 and 2007, a strong drop in 2008 and an increase in 2009. In 2010, SpGFS-WIBTS-Q4 and SPGFS-caut-WIBTS-Q4 showed a drop towards mean historical figures. However PtGFS-WIBTS-Q4 keeps near the historical maximum. In 2011, SpGFS-WIBTS-Q4 and SPGFS-caut-WIBTS-Q4 keep about mean historical figures and PtGFS-WIBTS-Q4 is about two times historic means. The spatial distribution of hake recruits (individuals <20cm) in 2010 in Portugal, showed a shift in the recruitment areas similar to 2009 (IBTS, 2010, 2011). The largest recruitment areas are now located in the northwest instead of the traditional southwest area. Such change raises doubts about recruitment survival, given that oceanographic condition are different on both areas.

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.

#### Commercial catch-effort data

Effort and landings series are collected from Portuguese logbooks and compiled by IPIMAR. Spanish sales notes and Owners Associations data were compiled by IEO to estimate fleet effort until 2010 and are presented in figure 7.4 and table 7.5. Spanish commercial data for 2011 was not accepted .to update the assessment because of doubts about the quality..

The standardized CPUE from the Portuguese bottom-trawl fleet targeting roundfish has been routinely calculated by fitting a GLM to log-book data on catches and effort. This procedure is applied every year using a standard query and R script that are used to filter and analyse the data using always the same criteria in every year. However, this year the log-book data from 2011 were received just a short time before the data submission deadline, and they were retrieved from the data base using a different query than in previous years. When fitting the GLM to the whole data series, the standardized CPUE estimates showed deviations from what had been obtained in previous years. The source of these differences may be related with a different aggregation or selection of the log-book records, or with the adaptation of this year's data format to be used with the R script that fits the GLM. Given that there was not enough time to explore and correct these discrepancies, an estimate of Portuguese bottom-trawl CPUE for 2011 was not available in time for this WG meeting.

Historic effort trend have decreased for most fleets. In recent years (2007-2010) effort has also decreased (except SP-VIMATR that remains stable). In 2010 the 2 fleets used in the assessment (SP-CORUTR and P-TR) have experience a clear effort reduction. The other fleets remains stable or with a small increase.

The estimates in Table 7.5 from SP-CORUTR, SP-CORUTRP, SP-VIMATR and P-TR continue in the historic maximum in 2010. SP-CTR LPUE is over the historic mean..

## 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 were presented in Figure 7.5 for each parameter estimated by the model. 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 “understoking”, 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 from commercial fleets are presented (Fig 7.6a-b, respectively), grouped in 15 cm classes (from 4 to 49 in surveys and 25 to 70 cm in commercial fleets). Most residuals are within the range of -1 to 1. Surveys' residuals don't show any trend. SpGFS-WIBTS-Q4 (19-34 and 34-49 cm) show a larger residual in 2009. Regarding commercial fleets, P-TR (25-40 cm) and SP-CORUTR (25-40 cm) show downwards trends in recent years. This effect may be due to the difficulty of these indices to follow the abundance generated by the recent increase in recruitment, given that discards are not included in the computation of the latter, and may not be fully accounted for in the computation of the former. 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 and discards. 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). Also, the use of a logistic curve for the landings selection may contribute to such a pattern. 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.

Sensitivity to the datasets used in the assessment is presented in the next table. The table shows the estimates (in terms of recruitment in 2009 and 2010; F 2010 and SSB 2010) obtained when a particular dataset is excluded divided by those obtained when all datasets are included (noting that exclusion of a dataset means exclusion of the corresponding entire time series). The most sensitive parameter is recruitment in 2010, and the datasets with highest impact are SpGFS-WIBTS-Q4 and PtGFS-WIBTS-Q4. These two data sets have conflicting impacts on this estimate, with exclusion of the first dataset leading to a higher recruitment estimate and exclusion of the second one to a lower recruitment estimate.

| | NoPtLPUE | NoPtSurvLd | NoPtSurvTrd | NoSpLPUE | NoSpSurvLd | NoSpSurvTrd |
|---|---|---|---|---|---|---|
| R09 | 1.18 | 0.95 | 0.93 | 1.01 | 0.89 | 1.00 |
| R10 | 0.95 | 1.03 | 0.59 | 0.99 | 1.59 | 1.00 |
| F10 | 0.96 | 1.00 | 1.07 | 1.07 | 1.13 | 1.00 |
| SSB10 | 0.97 | 1.00 | 0.93 | 0.91 | 0.95 | 1.00 |

### 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 1994-2010; discards 1992-2010 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 and landings (1994-2010) 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.

The von Bertalanffy k parameter was estimated to be 0.165, the same value as last year.

#### Historic trends in biomass, fishing mortality, yield and recruitment

Model estimates of abundance at length in the beginning of the 4$^{th}$ 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.

Recruitment in 2010 is estimated to be the maximum of the series and needs to be confirmed in the future. Catches (landings and discards) dropped from 22.1 Kt in 2009 to 16.9 Kt in 2010 (excluding the 2010 French landings data), as well as F, from 0.83year-1 in 2009 to 0.52year-1 in 2010. These results are due to the implementation of new regulations to control landings in Spain during the third and fourth quarters of 2010.

SSB continues to show an increasing trend since 1998, the minimum of the series, to 18.7 Kt in 2010.

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

Figure 7.10 presents the results of the assessments performed using the data series until 2010, 2009, 2008, 2007, 2006 and 2005.

In the previous assessments SSB showed a trend to be underestimated and F to be overestimated. The present retrospective analysis does not show any particular trend in SSB or F, with 2009 and 2008 showing alternate patterns. Nevertheless, when looking only to 2009, the retrospective pattern shows a reverse direction than before, underestimating F and overestimating SSB. It will be necessary to confirm in the future if there is a shift in the retrospective pattern.

## 7.2 Catch options and prognosis

### 7.3.3 Short-term projections

The projections for 2013 were based on the past year assessment model, therefore requiring the use of two intermediate years instead of one. The methodology used for the projections is described in the Stock Annex (Annex G). The only departure from that description is the assumption that F, selectivity and recruitment in the first intermediate year are the same as those in the second intermediate year.

The assumption of recruitment for these 4 years increases the uncertainty of the forecasted 2013 yield and 2014 SSB, since abundance for ages 1-3 in 2013, which are an important part of yield and SSB, totally depends on these recruitments. A simulation exercise was performed to check the sensitivity o the recruitment assumptions on the resulting advice. Three scenarios with different recruitments for the years 2010-2013 were tested: (1) geometric mean (80.8 mill), (2) geometric mean plus 25% (101.1 mill) and geometric mean minus 25% (60.6 mill). The F in 2013 is 0.35, which is the F corresponding to the ICES MSY transition scheme. The next table shows the results of the simulations:

| | Yield 2013 | SSB 2014 | Yield change | SSB change |
|---|---|---|---|---|
| **Rec GM** | 10552 | 26186 | | |
| **Rec GM +25%** | 12182 | 31078 | +15% | +19% |
| **Rec GM -25%** | 8922 | 21296 | -15% | -19% |

The results above show that when changing the recruitment level by plus or minus 25% in the years 2010-13 the expected yield in 2012 increases or decreases 15% and the SSB in 2014 increases or decreases 19%. Given that the recruitment variability in recent years have ranged from 60 mill in 2003 to 150 mill in 2009, the impact on the expected yield may be considered relatively important. 61% of expected landings in 2013 (at F = 0.35, i.e. MSY transition) are belong to ages groups 0 to 3.

It was explored the option to use the surveys and GADGET recruitment results to improve the recruitment estimation for 2010 and 2011, however given the high variability of the surveys this option was rejected. Surveys figures for 2010 and 2011 are variable although suggest values lightly over historic means (see tables 7.3 and 7.4, and Figure 7.3)

Management options are presented in Table 7.7 and Figure 7.11. Fsq is estimated as the average of the last 3 assessments and recruitment for 2010-2013 was the geometric mean of 1989-2009 (80.8 mill).

Note that GADGET is length based and F multipliers are applied to the length exploitation pattern. This may cause some changes in F (ages 1-3) if the relative contributions of different length changes on these ages. So, the average F for the last 3 years is 0.7165; the modelled F in 2011, 2012 and 2013 (with Fmult=1) are respectively 0.7158, 0.7140 and 0.7140. This produces an apparent inconsistency (F2011=0.72 and Fsq = 0.71) caused by changes in length composition in ages 1-3.

During the first intermediate year, 2011, the expected yield (landings) will be 25.0kt and the SSB at the end of the year is expected to be 25.1kt. During the second intermediate year, 2012, the expected yield is 21.2kt and the SSB at the end of this year is 20.6 Kt..

Different F multipliers applied in 2013 provide management alternatives according to different schemes. Under Fsq (0.71) and considering a recruitment of 80.8 mill (geo mean 1989-2009), expected yield (landings) would be 17.8 Kt and SSB in 2013 would be 17.8 kt. Decreasing F by 10% (0.64), yield and SSB would be 16.5 and 17.9 Kt. With the MSY transition scheme F would be 0.35, yield 10.5 kt and SSB 11.4 Kt. If landings in 2013 correspond to a 15% increase with respect to the 2012 TAC, then 2013 landings are 14.1 kt, and SSB in 2014 is 22.1 kt. At Fmax (Fmsy proxy = 0.24) yield in 2013 would be 7.6 kt and SSB in 2014 29.5 kt.

### 7.3.4 Yield and biomass per recruit analysis

F producing maximum landings per recruit was estimated following the Stock Annex (Annex G). This results in Fmax = 0.24 and F0.1=0.17 (Figure 7.12). The same as last year.

Next table shows the expected figures for different F values. Equilibrium yield and SSB were estimated assuming recruitment is the geometric mean of 1989-2009 (80.8 mill).

| | F | YPR | SPR | Yield | SSB |
|---|---|---|---|---|---|
| **F01** | 0.17 | 0.24 | 1.24 | 19.5 | 100 |
| **F30%** | 0.23 | 0.25 | 0.93 | 20.3 | 75 |
| **Fmax** | 0.24 | 0.25 | 0.88 | 20.4 | 71 |

Fmax would drive the stock to equilibrium yields about 20.4 Kt and SSB to 71 Kt which is well above historical SSB estimates.

## 7.4 Biological reference points

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

## 7.5 Comments on the assessment

The current assessment shows a change in the retrospective pattern, with an underestimation of F and overestimation of SSB in the last year.

The table below summarises the consistency with last the  assessment made in 2010.

| | Year | WGHMM10 | WGHMM11 | % change | Comments |
|---|---|---|---|---|---|
| Fbar | 2009 | 0.74 | 0.83 | +12% | |
| SSB | 2009 | 20.1 | 17.2 | -14% | |
| R | 2009 | 901.6 | 159.7 | -465% | |

In spite of these changes the relative perspective about stock status is similar to previous years. An increase in stock size is observed, mainly due to high recruitments.

Regarding stock exploitation, there is a recent decrease in fishing mortality, from 0.83 year-1 to 0.52 year-1, reflecting the decrease in Spanish catches in 2010.

The Portuguese and Spanish groundfish survey indices have a large impact on the estimation of 2010 recruitment and, to a lesser extent, on fishing mortality and SSB.

There is a lack of calibration data in the beginning of the time series. Assessment results for those years should be considered with caution.

## 7.6 Management considerations

This year the projections have been performed with two intermediate years making the advice more sensitive to assumptions for these years. The recruitment has been substituted with a GM in 2010, which was also used for 2011, 2012 and 2013. This implies that in 2013 ages from 1 to 3 are estimated with these recruits. These ages have a large contribution to yield (61%).

There are indications of good recruitments in recent years. In 2011 the indices show that recruitment is slightly above historic means.

The retrospective pattern used to revise SSB towards higher values and F to lower values in recent years. However this pattern has changed in 2010  to corrections in the opposite direction, given more uncertainty to evaluate the reliability of F in 2011 and 2012..

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, 1972-2011**

| | SPAIN | | | | | | | | | PORTUGAL | | | | FRANCE | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **YEAR** | **ART** | **GILLNET** | **LONGLINE** | **Cd TRW** | **Pr-Bk TRW** | **PAIR TRW** | **BAKA TRW** | **DISC** | **LAND** | **ART** | **TRAWL** | **DISC** | **LAND** | **TOTAL** | **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** | - | **1.8** | **7.9** | **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** | - | **1.7** | **7.6** | **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** | - | **1.5** | **6.7** | **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** | - | **1.5** | **6.7** | **8.2** |
| **2004** | 0.45 | 0.42 | 0.13 | 1.06 | | 1.66 | 1.13 | **0.22** | **4.8** | 1.27 | 0.80 | **0.69** | **2.1** | - | **0.9** | **6.9** | **7.8** |
| **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** | - | **2.0** | **8.3** | **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** | - | **3.3** | **10.8** | **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** | - | **2.5** | **14.9** | **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** | - | **2.3** | **16.8** | **19.1** |
| **2009** | 1.36 | 2.92 | 2.10 | 0.55 | | 7.37 | 2.54 | **0.98** | **16.8** | 1.39 | 0.96 | **1.96** | **2.4** | - | **2.9** | **19.2** | **22.1** |
| **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 * | **1.6** | **15.7** | **17.3** |
| **2011**** | | | | | | | | | | 1.72 | 0.49 | **0.74** | **2.2** | | **0.7** | **2.2** | **3.0** |

*** French catches not considered in assessment model until full time series review.**

**** Spanish data provided by SGMAR are showed in annex T.**

**Table 7.2 HAKE SOUTHERN STOCK - length compositions (thousands) by gear in 2011**

| Length (cm) | PORTUGAL | | | SPAIN | | | | | | | STOCK | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Trawl | Art | Disc | Art | Cd-Trw | Ba-Trw | Pa-Trw | Gillnet | Longline | Disc | Land | Disc | Catch |
| **4** | | | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| **5** | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| **6** | | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 3 | 0 |
| **7** | | | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | 22 | 0 |
| **8** | | | 110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 110 | 110 |
| **9** | | | 362 | 0 | 3 | 0 | 0 | 0 | 0 | 3 | | 365 | 365 |
| **10** | | | 757 | 0 | 11 | 0 | 0 | 0 | 0 | 7 | | 764 | 764 |
| **11** | | | 886 | 0 | 16 | 0 | 0 | 0 | 0 | 9 | | 895 | 895 |
| **12** | | | 1125 | 0 | 31 | 0 | 0 | 0 | 0 | 23 | | 1148 | 1148 |
| **13** | | | 1012 | 0 | 41 | 0 | 0 | 0 | 0 | 27 | | 1039 | 1039 |
| **14** | | | 891 | 0 | 52 | 0 | 0 | 0 | 0 | 46 | | 937 | 937 |
| **15** | | | 1104 | 0 | 54 | 0 | 0 | 0 | 0 | 56 | | 1159 | 1159 |
| **16** | | | 1055 | 0 | 53 | 0 | 0 | 0 | 0 | 82 | | 1137 | 1137 |
| **17** | 0 | 0 | 1429 | 0 | 51 | 0 | 0 | 0 | 0 | 76 | | 1505 | 1505 |
| **18** | 0 | 0 | 1163 | 0 | 40 | 0 | 0 | 0 | 0 | 88 | | 1251 | 1251 |
| **19** | 0 | 0 | 1110 | 0 | 41 | 0 | 0 | 0 | 0 | 91 | | 1202 | 1202 |
| **20** | 0 | 0 | 811 | 0 | 48 | 1 | 0 | 0 | 0 | 101 | | 912 | 912 |
| **21** | 0 | 1 | 685 | 0 | 49 | 2 | 0 | 0 | 0 | 80 | | 765 | 765 |
| **22** | 1 | 5 | 691 | 0 | 40 | 0 | 0 | 0 | 0 | 76 | | 767 | 767 |
| **23** | 8 | 5 | 486 | 0 | 43 | 2 | 2 | 0 | 0 | 54 | | 540 | 540 |
| **24** | 15 | 28 | 538 | 0 | 47 | 2 | 6 | 0 | 0 | 53 | | 592 | 592 |
| **25** | 42 | 52 | 305 | 0 | 48 | 4 | 9 | 0 | 0 | 30 | | 335 | 335 |
| **26** | 85 | 85 | 428 | 0 | 46 | 7 | 16 | 0 | 0 | 17 | | 445 | 445 |
| **27** | 128 | 138 | 76 | 52 | 48 | 22 | 25 | 0 | 0 | 20 | | 96 | 96 |
| **28** | 161 | 203 | 26 | 62 | 38 | 39 | 39 | 0 | 0 | 24 | | 50 | 50 |
| **29** | 172 | 225 | 23 | 57 | 32 | 49 | 55 | 0 | 0 | 8 | | 31 | 31 |
| **30** | 142 | 301 | 32 | 75 | 32 | 50 | 65 | 0 | 0 | 5 | | 37 | 37 |
| **31** | 125 | 345 | 62 | 79 | 20 | 67 | 75 | 0 | 0 | 3 | | 65 | 65 |
| **32** | 85 | 333 | 44 | 74 | 18 | 75 | 66 | 0 | 0 | 6 | | 50 | 50 |
| **33** | 65 | 297 | 81 | 75 | 12 | 72 | 55 | 0 | 0 | 8 | | 89 | 89 |
| **34** | 62 | 258 | 22 | 63 | 9 | 64 | 74 | 0 | 0 | 2 | | 23 | 23 |
| **35** | 65 | 258 | 19 | 71 | 10 | 60 | 56 | 0 | 11 | 1 | | 20 | 20 |
| **36** | 63 | 183 | 13 | 57 | 7 | 51 | 58 | 0 | 0 | 2 | | 15 | 15 |
| **37** | 52 | 181 | 6 | 49 | 7 | 47 | 45 | 1 | 14 | 1 | | 7 | 7 |
| **38** | 36 | 132 | 20 | 45 | 13 | 43 | 35 | 1 | 7 | 1 | | 22 | 22 |
| **39** | 30 | 143 | 20 | 38 | 7 | 39 | 38 | 2 | 0 | 0 | | 20 | 20 |
| **40** | 21 | 117 | 20 | 27 | 5 | 34 | 25 | 6 | 14 | 0 | | 20 | 20 |
| **41** | 25 | 77 | 23 | 19 | 6 | 34 | 20 | 6 | 14 | 0 | | 23 | 23 |
| **42** | 20 | 69 | 10 | 12 | 4 | 25 | 21 | 10 | 22 | 0 | | 10 | 10 |
| **43** | 19 | 60 | 5 | 9 | 4 | 28 | 25 | 11 | 26 | 0 | | 5 | 5 |
| **44** | 14 | 58 | 0 | 6 | 4 | 26 | 25 | 14 | 13 | 0 | | 0 | 0 |
| **45** | 18 | 74 | 6 | 5 | 2 | 21 | 16 | 19 | 35 | 0 | | 6 | 6 |
| **46** | 16 | 60 | 10 | 6 | 1 | 20 | 10 | 20 | 12 | 0 | | 10 | 10 |
| **47** | 14 | 52 | 7 | 4 | 1 | 16 | 8 | 29 | 7 | 0 | | 7 | 7 |
| **48** | 14 | 40 | 0 | 6 | 1 | 13 | 9 | 37 | 34 | 0 | | 0 | 0 |
| **49** | 13 | 41 | 0 | 5 | 1 | 11 | 8 | 48 | 51 | 0 | | 0 | 0 |
| **50** | 8 | 41 | 10 | 6 | 2 | 10 | 8 | 54 | 48 | 0 | | 10 | 10 |
| **51** | 8 | 37 | 0 | 6 | 0 | 7 | 8 | 56 | 60 | 0 | | 0 | 0 |
| **52** | 10 | 35 | 0 | 7 | 0 | 7 | 6 | 56 | 65 | 0 | | 0 | 0 |
| **53** | 7 | 28 | 0 | 6 | 0 | 6 | 4 | 59 | 50 | 0 | | 0 | 0 |
| **54** | 7 | 32 | 0 | 8 | 0 | 6 | 3 | 60 | 40 | 0 | | 0 | 0 |
| **55** | 7 | 23 | 0 | 7 | 0 | 5 | 4 | 52 | 43 | 0 | | 0 | 0 |
| **56** | 5 | 23 | 0 | 7 | 0 | 5 | 3 | 61 | 33 | 0 | | 0 | 0 |
| **57** | 3 | 15 | 0 | 9 | 0 | 4 | 2 | 48 | 60 | 0 | | 0 | 0 |
| **58** | 3 | 20 | 0 | 7 | 0 | 3 | 3 | 50 | 70 | 0 | | 0 | 0 |
| **59** | 3 | 28 | 0 | 6 | 0 | 4 | 2 | 50 | 74 | 0 | | 0 | 0 |
| **60** | 8 | 19 | 0 | 5 | 0 | 3 | 3 | 41 | 52 | 0 | | 0 | 0 |
| **61** | 4 | 10 | 0 | 5 | 0 | 2 | 4 | 33 | 39 | 0 | | 0 | 0 |
| **62** | 4 | 10 | 0 | 4 | 0 | 3 | 4 | 31 | 26 | 0 | | 0 | 0 |
| **63** | 3 | 7 | 0 | 3 | 0 | 2 | 2 | 25 | 20 | 0 | | 0 | 0 |
| **64** | 2 | 27 | 0 | 3 | 0 | 2 | 4 | 20 | 22 | 0 | | 0 | 0 |
| **65** | 2 | 7 | 0 | 2 | 0 | 2 | 3 | 17 | 5 | 0 | | 0 | 0 |
| **66** | 1 | 8 | 0 | 2 | 0 | 2 | 2 | 13 | 5 | 0 | | 0 | 0 |
| **67** | 1 | 4 | 0 | 2 | 0 | 1 | 3 | 11 | 3 | 0 | | 0 | 0 |
| **68** | 1 | 5 | 0 | 2 | 0 | 1 | 3 | 11 | 4 | 0 | | 0 | 0 |
| **69** | 1 | 4 | 0 | 2 | 0 | 1 | 3 | 9 | 3 | 0 | | 0 | 0 |
| **70** | 2 | 3 | 0 | 1 | 0 | 0 | 5 | 8 | 3 | 0 | | 0 | 0 |
| **71** | 1 | 6 | 0 | 1 | 0 | 0 | 3 | 6 | 2 | 0 | | 0 | 0 |
| **72** | 1 | 3 | 0 | 1 | 0 | 0 | 4 | 4 | 1 | 0 | | 0 | 0 |
| **73** | 1 | 1 | 0 | 1 | 0 | 0 | 3 | 3 | 2 | 0 | | 0 | 0 |
| **74** | 1 | 1 | 0 | 0 | 0 | 0 | 5 | 4 | 0 | 0 | | 0 | 0 |
| **75** | 1 | 1 | 0 | 1 | 0 | 0 | 4 | 3 | 1 | 0 | | 0 | 0 |
| **76** | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 2 | 1 | 0 | | 0 | 0 |
| **77** | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | | 0 | 0 |
| **78** | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | | 0 | 0 |
| **79** | 0 | 6 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | | 0 | 0 |
| **80** | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | | 0 | 0 |
| **81** | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | | 0 | 0 |
| **82** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | | 0 | 0 |
| **83** | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | | 0 | 0 |
| **84** | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| **85** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | | 0 | 0 |
| **86** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| **87** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | 0 | 0 |
| **88** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| **89** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| **90** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | | 0 | 0 |
| **TOTAL** | 1607 | 4231 | 15514 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | | 16507 | 16482 |
| **Nominal Weight (** | 0.49 | 1.72 | 0.74 | | | | | | | | | 0.74 | 0.74 |
| **SOP** | 0.54 | 1.80 | 0.79 | | | | | | | | | 0.86 | 0.86 |
| **SOP / NW** | 0.90 | 0.96 | 0.93 | | | | | | | | | 0.86 | 0.86 |
| **Mean length (cm)** | 34.2 | 36.9 | 17.7 | 36.8 | 23.0 | 37.7 | 38.6 | 55.8 | 54.1 | 20.2 | | 17.9 | 17.9 |

**Spanish landings length distribution have not been raised to the total landings since have not been accepted to provide advice.**

**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 |

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 (Sp-GFS) (/30 min) | | | | | | Cadiz Survey (Sp-GFS-caut) (/hour) | | | | Cadiz Survey (Sp-GFS-cspr) (/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 |

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

Before 1997: 30-100m, 101-200m and 201-500 m

**Table 7.5 HAKE SOUTHERN STOCK. Landings (tonnes), Catch per unit effort and effort for trawl fleets**

| | A Coruña Trawl | | | A Coruña Pair Trawl | | | Vigo and Marín trawl [1] | | | Santander trawl | | | Cadiz trawl | | | Portugal trawl | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | Landings | Ipue * | Effort | Landings | Ipue * | Effort | Landings | Ipue * | Effort | Landings | Ipue * | Effort | Landings | Ipue *** | Effort | Landings | Ipue ** | Effort **** |
| 1985 | 945 | 21 | 45920 | 1016 | 43 | 23700 | | | | | | | | | | | | |
| 1986 | 842 | 21 | 39810 | 1009 | 39 | 25630 | | | | 218 | 12.0 | 18153 | | | | | | |
| 1987 | 695 | 20 | 34680 | 752 | 25 | 29820 | | | | 455 | 30.3 | 14995 | | | | | | |
| 1988 | 698 | 17 | 42180 | 410 | 32 | 12980 | | | | 219 | 13.1 | 16660 | | | | | | |
| 1989 | 715 | 16 | 44440 | 480 | 31 | 15240 | | | | 245 | 13.9 | 17607 | | | | 1847 | 38.6 | 47810 |
| 1990 | 749 | 17 | 44430 | 429 | 24 | 18250 | 438 | 17.5 | 25063 | 392 | 19.2 | 20469 | | | | 1138 | 33.4 | 34106 |
| 1991 | 501 | 12 | 40440 | 609 | 20 | 30530 | 368 | 12.6 | 29260 | 340 | 15.2 | 22391 | | | | 1245 | 37.7 | 33035 |
| 1992 | 589 | 15 | 38910 | 730 | 27 | 26670 | 666 | 21.4 | 31146 | 311 | 13.6 | 22833 | | | | 1325 | 33.8 | 39257 |
| 1993 | 514 | 12 | 44504 | 350 | 16 | 21349 | 290 | 13.1 | 22198 | 390 | 18.2 | 21370 | | | | 871 | 31.0 | 28053 |
| 1994 | 473 | 12 | 39589 | 319 | 15 | 20732 | 556 | 21.3 | 26115 | 296 | 13.0 | 22772 | 326 | 11.7 | 27823 | 789 | 31.1 | 25341 |
| 1995 | 831 | 20 | 41452 | 691 | 24 | 28988 | 1018 | 35.5 | 28677 | 336 | 23.9 | 14046 | 458 | 14.2 | 32194 | 1026 | 38.4 | 26690 |
| 1996 | 722 | 20 | 35728 | 249 | 14 | 17555 | 647 | 21.9 | 29480 | 274 | 22.7 | 12071 | 975 | 30.5 | 31951 | 894 | 34.2 | 26121 |
| 1997 | 732 | 21 | 35211 | 295 | 18 | 16307 | 347 | 9.2 | 37578 | 127 | 10.8 | 11776 | 880 | 27.0 | 32573 | 906 | 38.1 | 23781 |
| 1998 | 895 | 27 | 32563 | 198 | 12 | 16966 | 284 | 6.7 | 42371 | 122 | 11.4 | 10646 | 523 | 15.9 | 32824 | 913 | 35.0 | 26053 |
| 1999 | 691 | 23 | 30232 | 139 | 15 | 9322 | 402 | 10.1 | 39738 | 92 | 8.9 | 10349 | 570 | 17.4 | 32731 | 1092 | 40.4 | 27019 |
| 2000 | 590 | 20 | 30102 | 92 | 29 | 3190 | 371 | 11.0 | 33771 | 52 | 5.9 | 8779 | 584 | 19.5 | 29875 | 1162 | 32.0 | 36312 |
| 2001 | 597 | 20 | 29923 | 91 | 19 | 4873 | 293 | 8.7 | 33802 | 47 | 15.5 | 3053 | 1203 | 39.6 | 30416 | 1210 | 36.6 | 33048 |
| 2002 | 232 | 11 | 21823 | 266 | 37 | 7147 | 256 | 10.6 | 24288 | 30 | 7.6 | 3975 | 883 | 28.9 | 30526 | 970 | 36.0 | 26975 |
| 2003 | 274 | 15 | 18493 | 121 | 30 | 3988 | 397 | 17 | 23151 | 22 | 5.8 | 3837 | 1251 | 39.5 | 31643 | 962 | 35.8 | 26855 |
| 2004 | 259 | 12 | 21112 | 249 | 29 | 8582 | 259 | 23 | 11139 | 17 | 4.6 | 3776 | 1062 | 35.4 | 30029 | 800 | 35.0 | 22849 |
| 2005 | 330 | 16 | 20663 | 428 | 47 | 9025 | 286 | 29 | 9981 | 7 | 4.9 | 1404 | 885 | 27.3 | 32419 | 965 | 37.1 | 25997 |
| 2006 | 518 | 27 | 19264 | 489 | 78 | 6245 | 360 | 32 | 11128 | 24 | 9.0 | 2718 | 634 | 24.1 | 26248 | 908 | 35.8 | 25369 |
| 2007 | 621 | 29 | 21201 | 788 | 59 | 13471 | 375 | 34 | 11062 | 64 | 14.8 | 4334 | 505 | 20.7 | 24398 | 724 | 35.4 | 20447 |
| 2008 | 762 | 38 | 20212 | 631 | 70 | 8964 | 454 | 41 | 11034 | 64 | | | 529 | 27.7 | 19135 | 936 | 41.9 | 22353 |
| 2009 | 640 | 40 | 16162 | 886 | 112 | 7944 | 400 | 42 | 9468 | 31 | 27.6 | 1125 | 550 | 25.9 | 21218 | 964 | 42.2 | 22836 |
| 2010 | 553 | 40 | 13744 | 1440 | 179 | 8027 | 450 | 42 | 10672 | 15 | 15.9 | 1627 | 680 | 31.1 | 21863 | 727 | 43.1 | 16855 |
| 2011 | | | | | | | | | | | | | | | | | | |

* - Kg/fishind day x100 HP

[1] since 2004 Vigo-Marin fleet change in sampling design

** - Kg/hour (new standarized Ipue serie)

***- Kg/fishing day

**** - Standardized effort

**Portugal trawl series standarized in 2010**

**Cadiz Trawl include Ayamonte harbor in 2009. Not considered before.**

**NO CPUE DATA AVAILABLE FOR 2011**

**Table 7.6. Southern Hake Stock Assessment summary**

| Year | Mort (1-3) | R (thousands) | SSB (tn) | Land (tn) | Disc (tn) | Catch (tn) |
|---|---|---|---|---|---|---|
| **1982** | 0.359 | 97.8 | 40.5 | 17.6 | | 17.6 |
| **1983** | 0.445 | 81.9 | 44.5 | 22.9 | | 22.9 |
| **1984** | 0.453 | 69.3 | 41.5 | 22.2 | | 22.2 |
| **1985** | 0.420 | 44.8 | 41.8 | 18.9 | | 18.9 |
| **1986** | 0.442 | 41.1 | 38.9 | 17.2 | | 17.2 |
| **1987** | 0.502 | 50.1 | 36.1 | 16.2 | | 16.2 |
| **1988** | 0.644 | 68.2 | 26.5 | 16.7 | | 16.7 |
| **1989** | 0.648 | 77.9 | 19.5 | 13.8 | | 13.8 |
| **1990** | 0.694 | 82.7 | 15.8 | 13.2 | | 13.2 |
| **1991** | 0.684 | 69.6 | 16.0 | 12.8 | | 12.8 |
| **1992** | 0.821 | 51.2 | 15.2 | 13.8 | *0.5* * | 14.3 |
| **1993** | 0.871 | 61.5 | 12.8 | 11.5 | *0.7* * | 12.2 |
| **1994** | 0.855 | 117.4 | 9.2 | 9.9 | *1.0* * | 10.9 |
| **1995** | 1.143 | 50.3 | 7.6 | 12.2 | *2.1* * | 14.3 |
| **1996** | 1.104 | 105.4 | 9.0 | 9.7 | *1.9* * | 11.6 |
| **1997** | 1.101 | 76.1 | 6.9 | 8.5 | *2.3* * | 10.8 |
| **1998** | 0.872 | 59.9 | 6.4 | 7.7 | *1.7* * | 9.4 |
| **1999** | 0.731 | 65.7 | 8.2 | 7.2 | *1.5* * | 8.7 |
| **2000** | 0.811 | 68.4 | 9.7 | 7.9 | *1.8* * | 9.7 |
| **2001** | 0.799 | 49.7 | 10.0 | 7.6 | *1.7* * | 9.2 |
| **2002** | 0.753 | 69.5 | 10.4 | 6.7 | *1.5* * | 8.2 |
| **2003** | 0.768 | 60.3 | 10.3 | 6.7 | *1.5* * | 8.2 |
| **2004** | 0.659 | 78.9 | 10.4 | 6.9 | 0.9 | 7.9 |
| **2005** | 0.693 | 127.4 | 10.9 | 8.3 | 2.0 | 10.3 |
| **2006** | 0.807 | 99.5 | 12.4 | 10.8 | 3.3 | 14.1 |
| **2007** | 0.830 | 159.2 | 14.7 | 14.9 | 2.5 | 17.4 |
| **2008** | 0.803 | 120.7 | 15.1 | 16.8 | 2.3 | 19.1 |
| **2009** | 0.825 | 159.7 | 17.2 | 19.2 | 2.9 | 22.2 |
| **2010** | 0.521 | 172.1 | 18.7 | 15.4 | 1.6 | 16.9 |

* estimated from survey abundance, discards and discards/landings rate

Recruitment 2010 = 80842 mill (geo mean 1989-09)

**Table 7.7. Catch Options Table.**

| SSB 2011 | BIO 2011 | F 2011 | Yield 2011 | Catch 2011 | SSB 2012 | BIO 2012 |
|---|---|---|---|---|---|---|
| 27650 | 37987 | 0.72 | 25020 | 27206 | 25078 | 32325 |

| F 2012 | Yield 2012 | Catch 2012 | SSB 2013 | BIO 2013 |
|---|---|---|---|---|
| 0.71 | 21235 | 22901 | 20627 | 27359 |

| Fmult | F 2013 | Yield 2013 | Catch 2013 | SSB 2014 | |
|---|---|---|---|---|---|
| 0.00 | 0.00 | 0 | 0 | 37855 | |
| 0.1 | 0.07 | 2342 | 2527 | 35320 | |
| 0.20 | 0.13 | 4545 | 4907 | 32894 | |
| 0.30 | 0.20 | 6615 | 7147 | 30600 | |
| 0.36 | 0.24 | 7796 | 8425 | 29284 | *Fmsy* |
| 0.40 | 0.27 | 8557 | 9251 | 28431 | |
| 0.49 | 0.33 | 10200 | 11033 | 26584 | |
| 0.51 | 0.34 | 10454 | 11309 | 26188 | *-0.15%* |
| 0.51 | 0.35 | 10552 | 11415 | 26186 | *MSY transition scheme* |
| 0.60 | 0.41 | 12077 | 13074 | 24454 | |
| 0.62 | 0.42 | 12299 | 13314 | 24153 | *Same TAC* |
| 0.70 | 0.49 | 13665 | 14802 | 22636 | |
| 0.74 | 0.51 | 14144 | 15324 | 22074 | *+15%. EU Rec. Plan* |
| 0.80 | 0.56 | 15144 | 16416 | 20926 | |
| 0.90 | 0.64 | 16520 | 17920 | 19319 | *-10%* |
| 1.00 | 0.71 | 17795 | 19318 | 17811 | *Fsq* |
| 1.20 | 0.87 | 20066 | 21818 | 15077 | |
| 1.40 | 1.04 | 21992 | 23951 | 12690 | |
| 1.60 | 1.22 | 23605 | 25752 | 10621 | |
| 1.80 | 1.40 | 24936 | 27254 | 8838 | |
| 2.00 | 1.40 | 24936 | 27254 | 8838 | |

There is a EC Recovery Plan (-10% annual F redution; +-15% TAC constrain)
Fmsy proxi = Fmax (0.24)
TAC 2012 = 12299 (-+15% [10454-14143])
F transition (0.4*F2010+0.6Fmax) = 0.35
Recruitment = 80.8 mill (geo mean 1989-09)
Note that F in 2012 is different to F in 2011 because of nonlinearity in length based dinamcys. Fmultipliers for this two years are 1.
2013 forecast have been based on WGHMM 2011 assessment. Two intermediate years are required

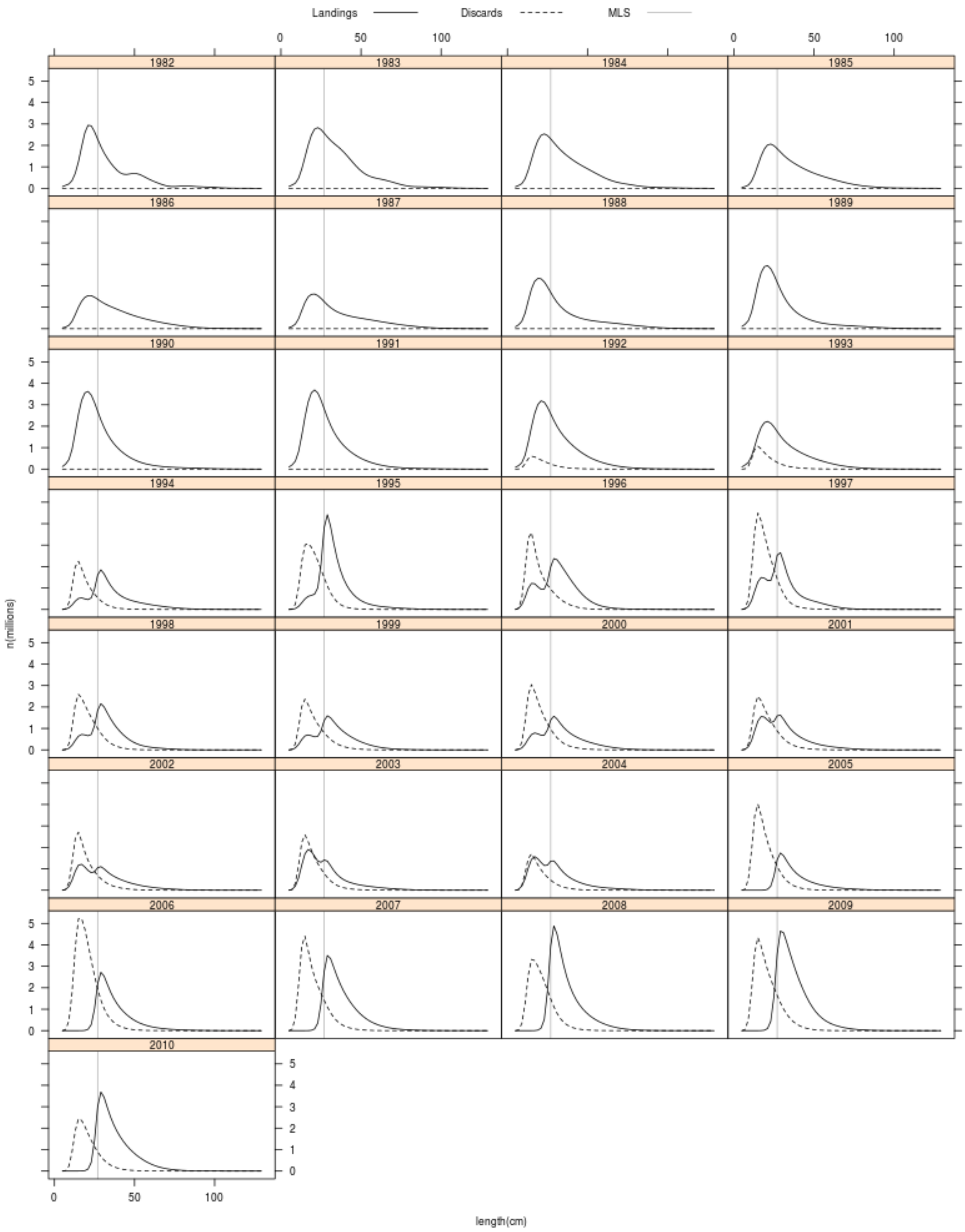



**Figure 7.1 Length distribution of catches used in the assessment. Landings (1982-10) plus Cadiz landings from 1994-2004. Discards from 1992-10. Minimum landing size (MLS) since 1992 at 27 cm.**

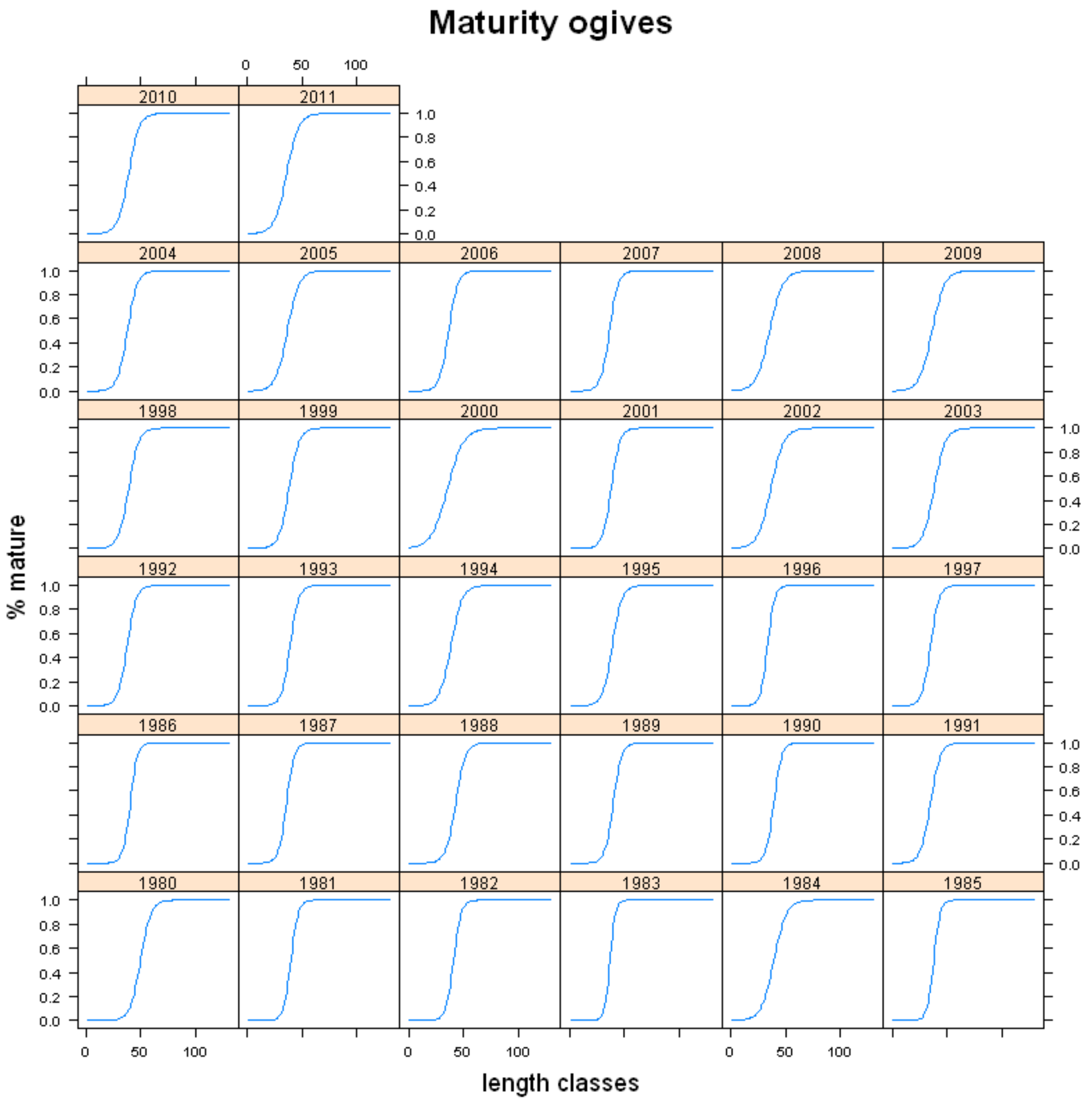



**Figure 7.2 Maturity ogive**

FIGURE 7.3 HAKE SOUTHERN STOCK - Recruitment and biomass Indices from groundfish surveys

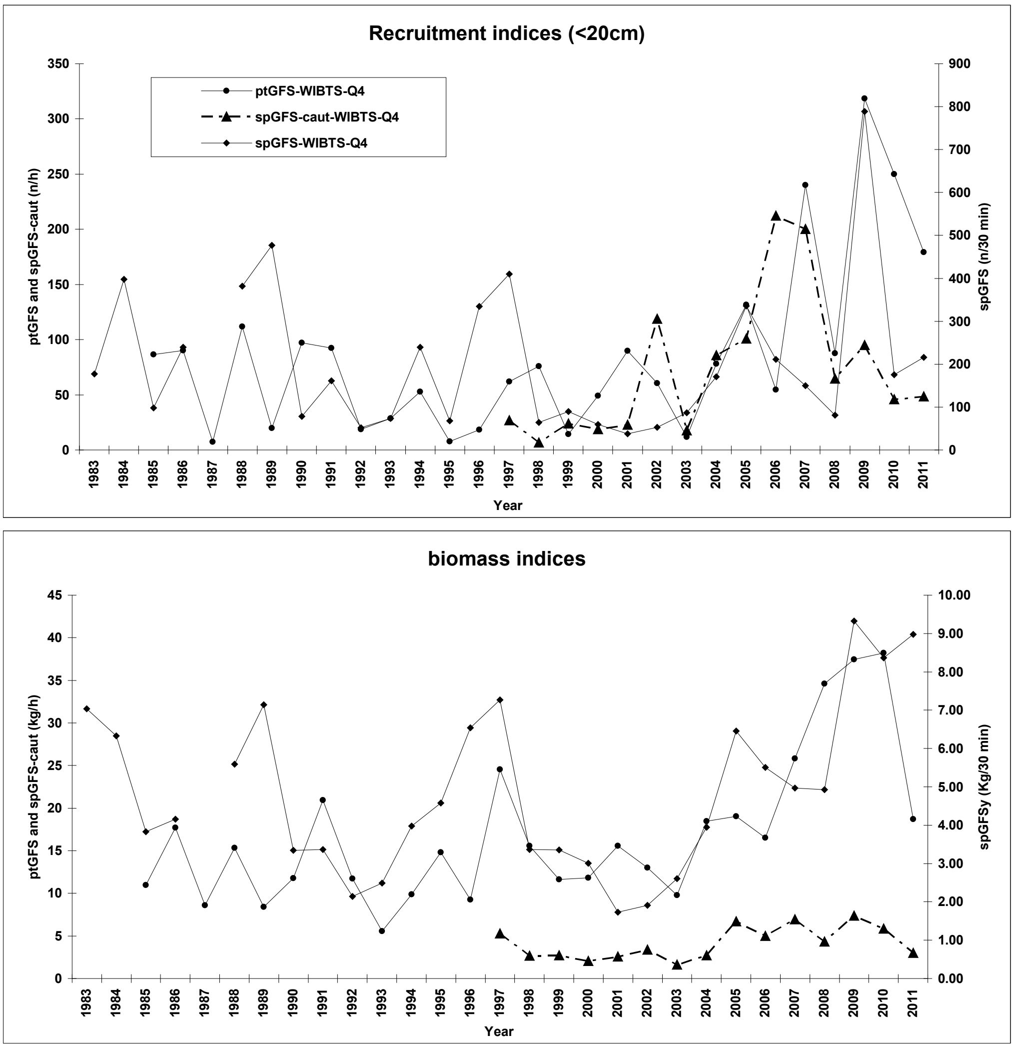
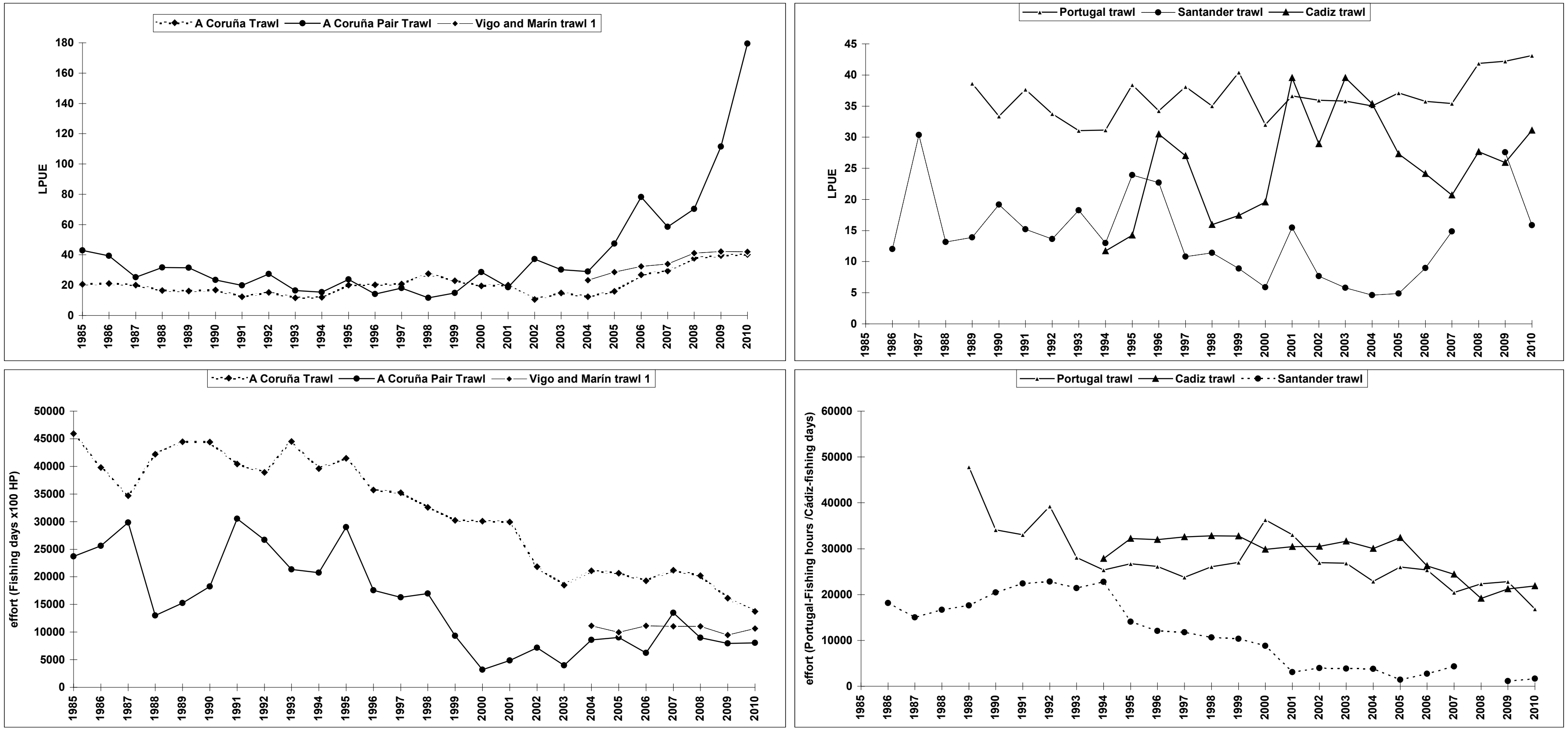


**FIGURE 7.4 HAKE SOUTHERN STOCK - LPUE and fishing effort trends for trawl fleets**



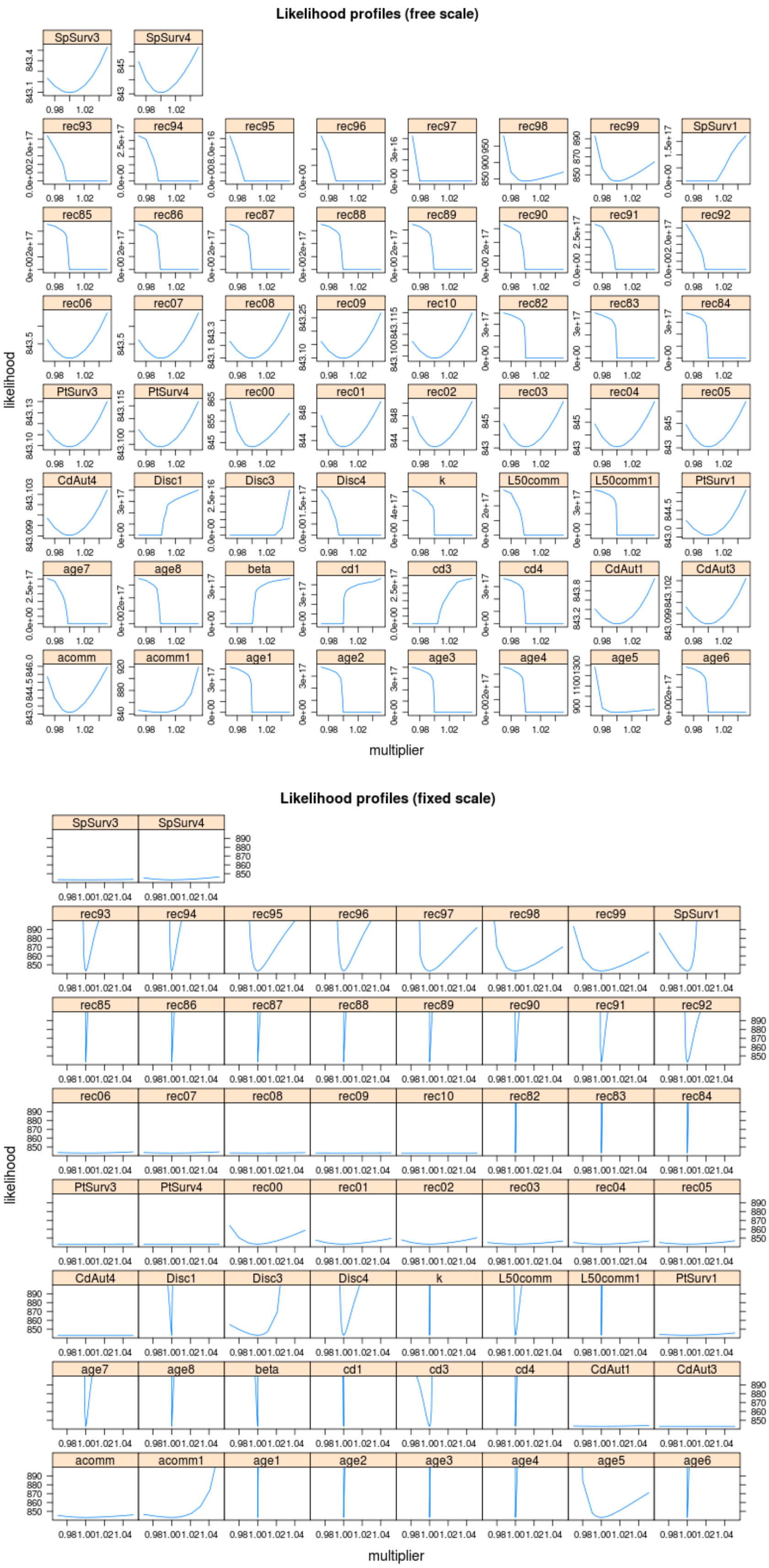
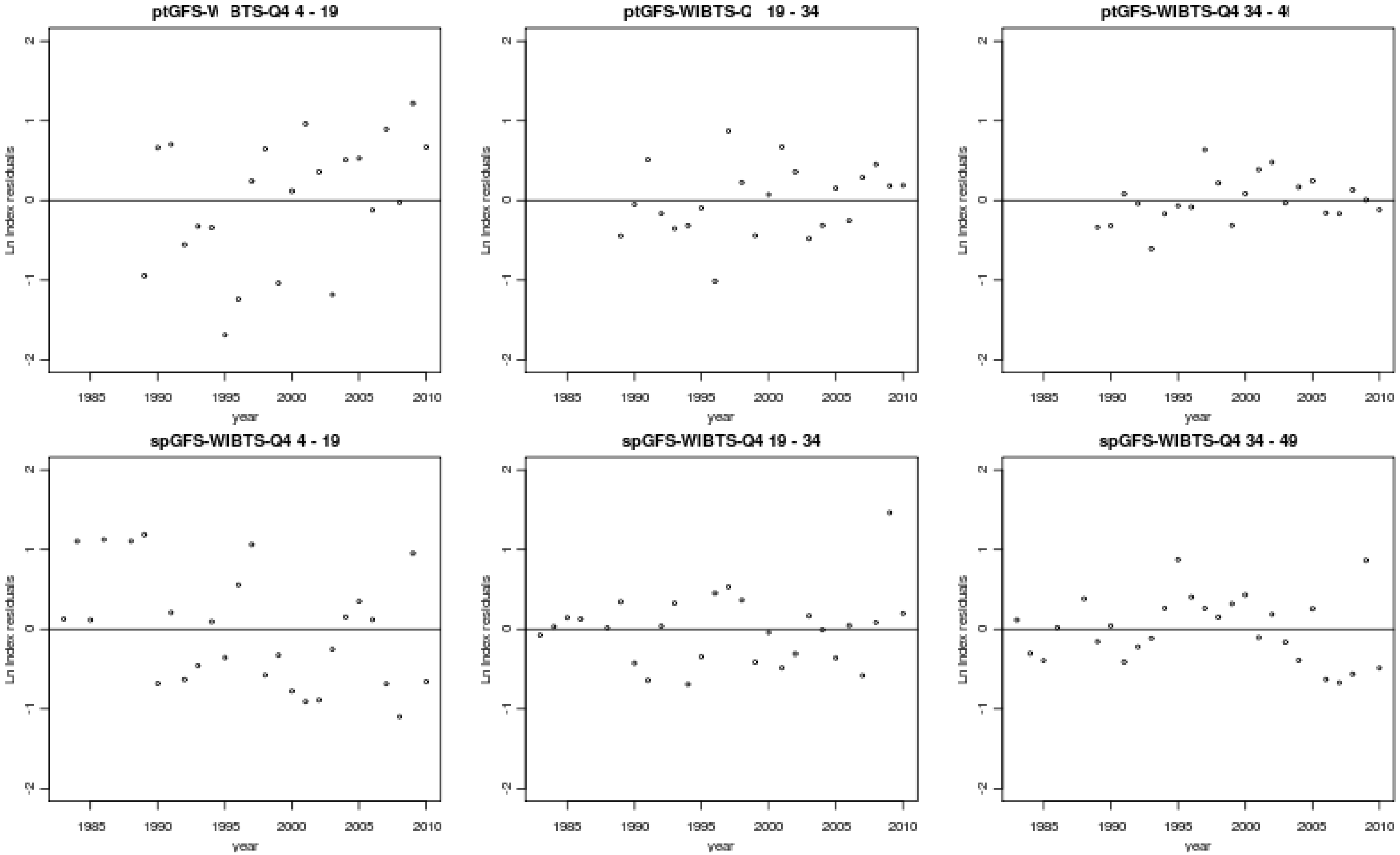
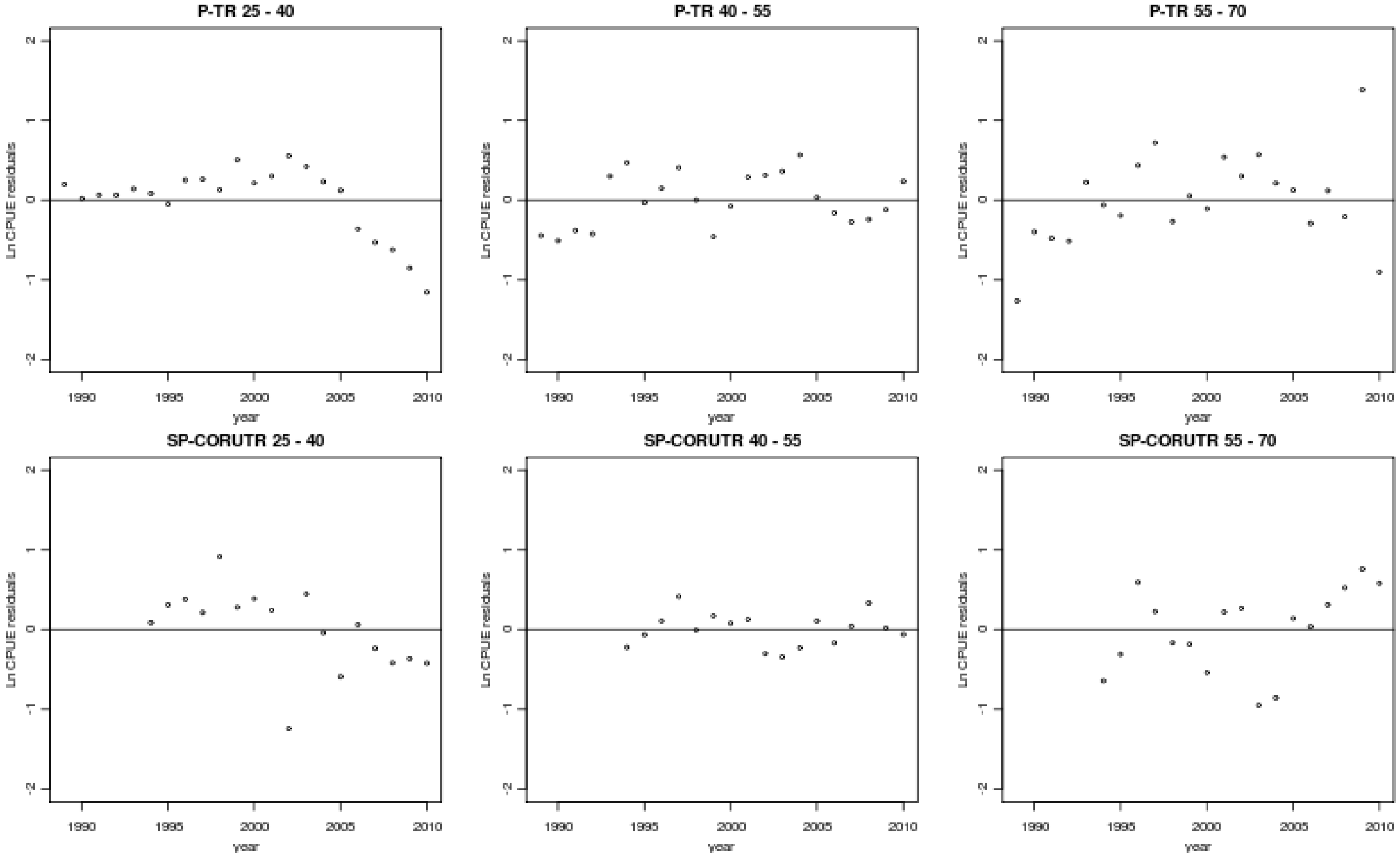



**Figure 7.5. Gadget convergence with likelihood profiles. Free scaled (upper panel) and fixed scaled (lower panel)**

**Figure 7.6 Diagnostics Residuals (a); observed vs. expected length proportions (b-h);**

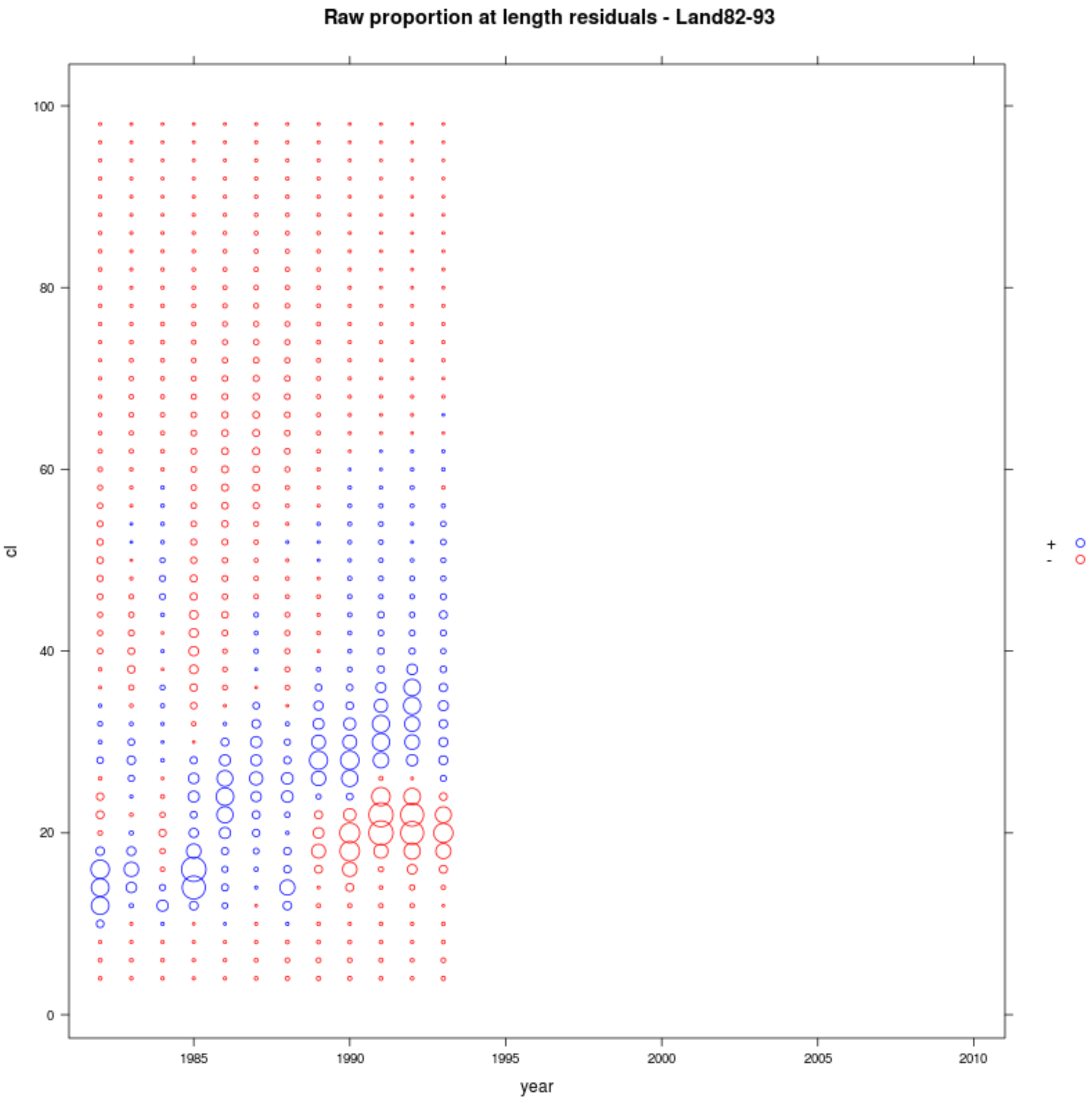


**(7.6 a) Survey residuals by 15 cm groups (4-19, 19-34, 34-49**

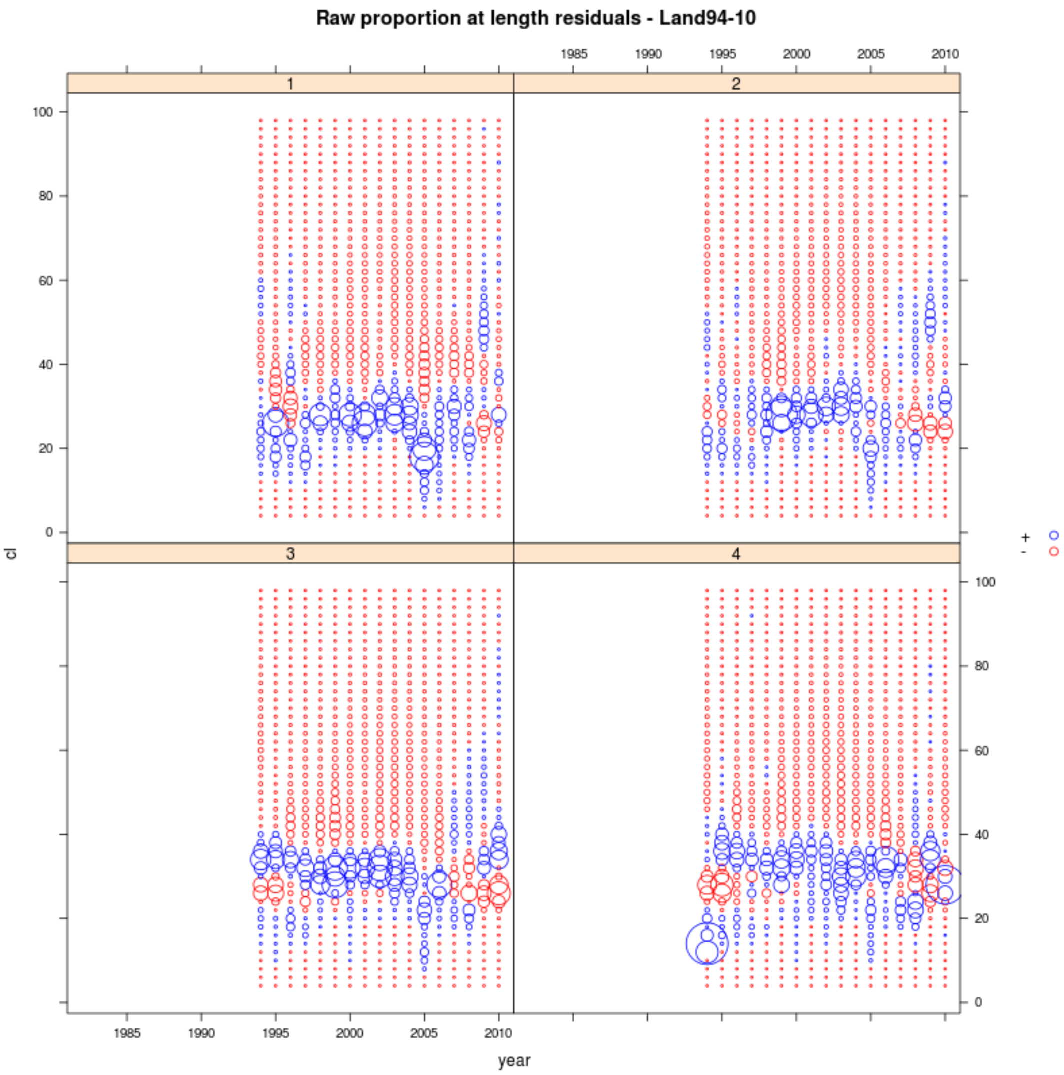



**cm)**

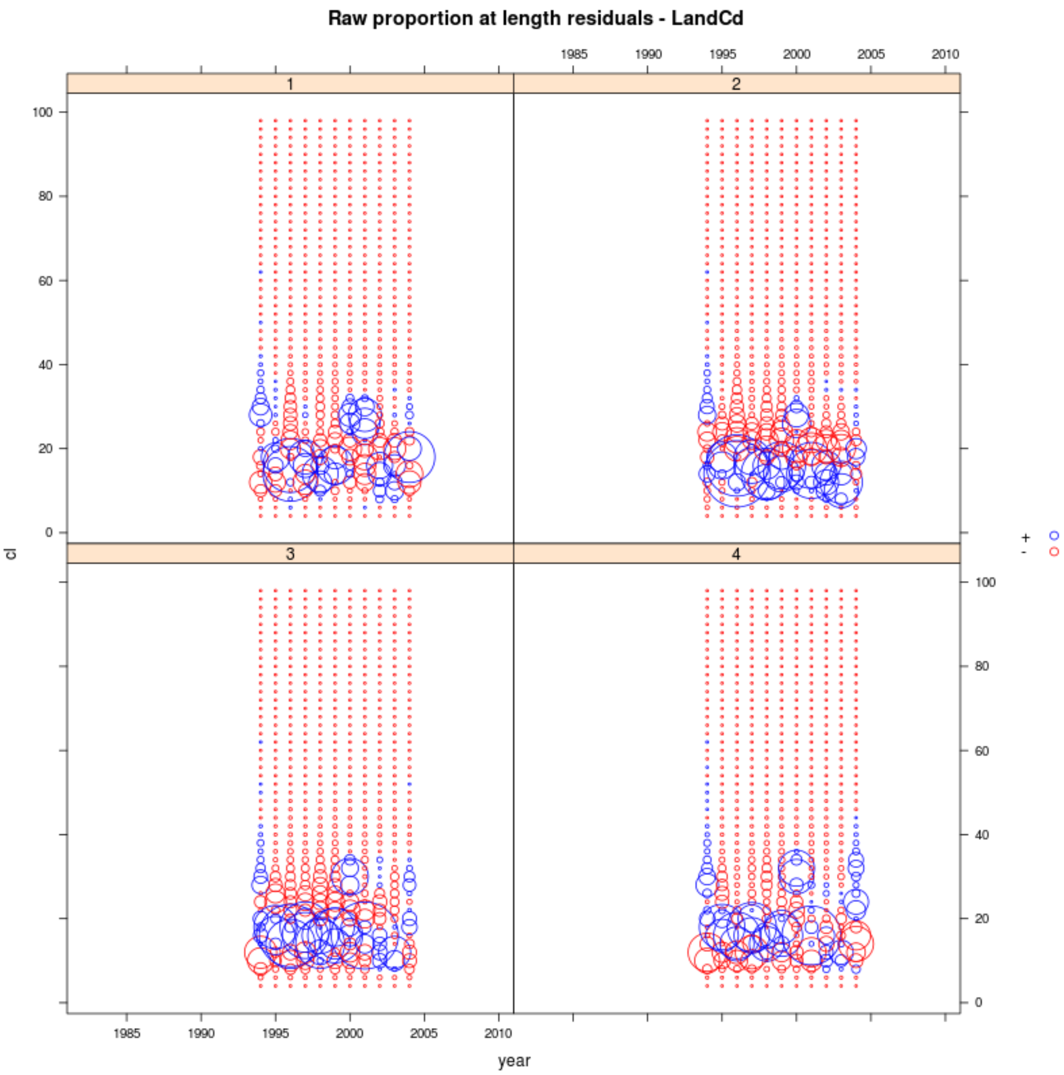
**(7.6 b) CPUE residuals by 15 cm groups (25-40, 40-55, 55-70 cm)**



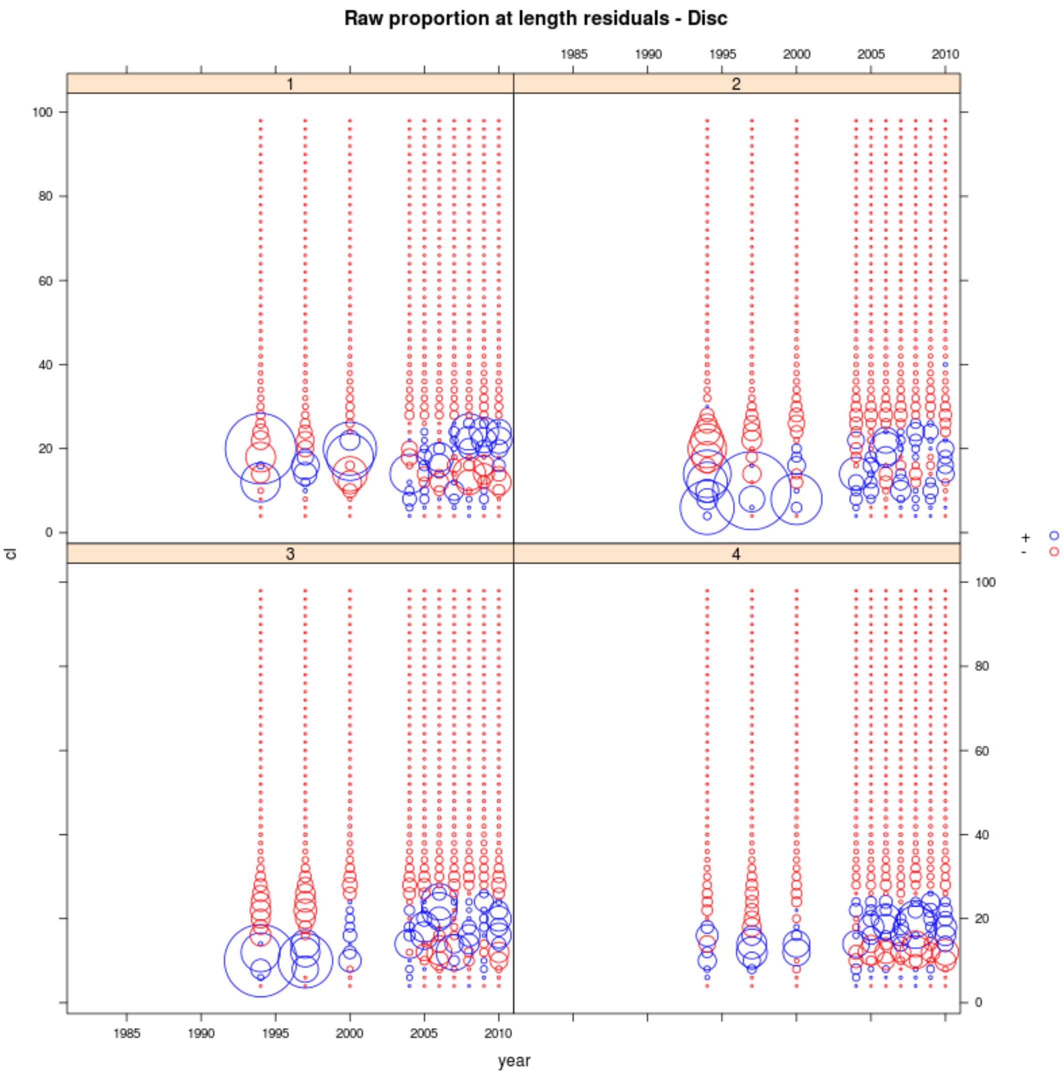

**(7.6 c). Bubble plot for landings length distribution from 1982 to 1993.**



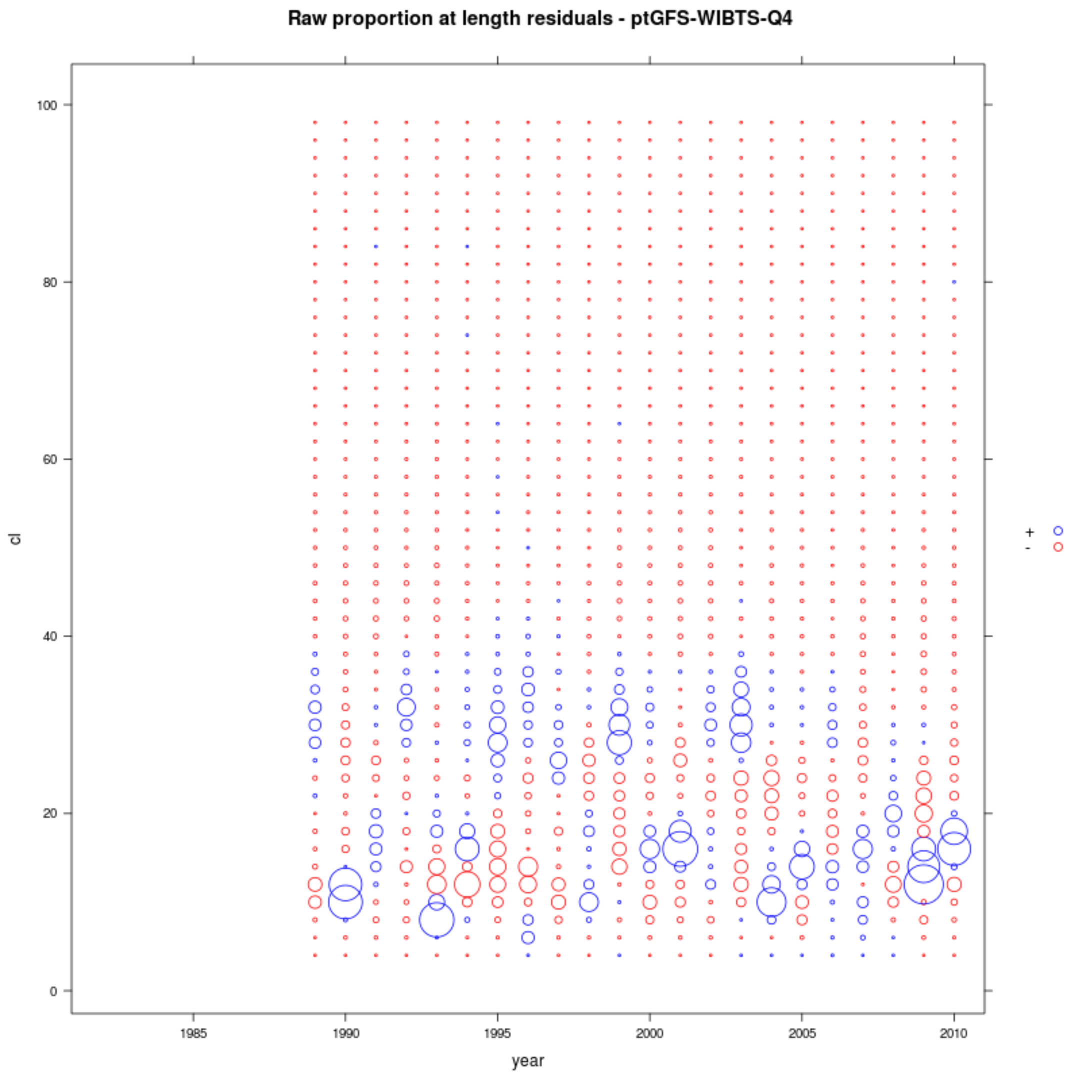

**(7.6 d). Bubble plot for landings length distribution from 1994 to 2010.**



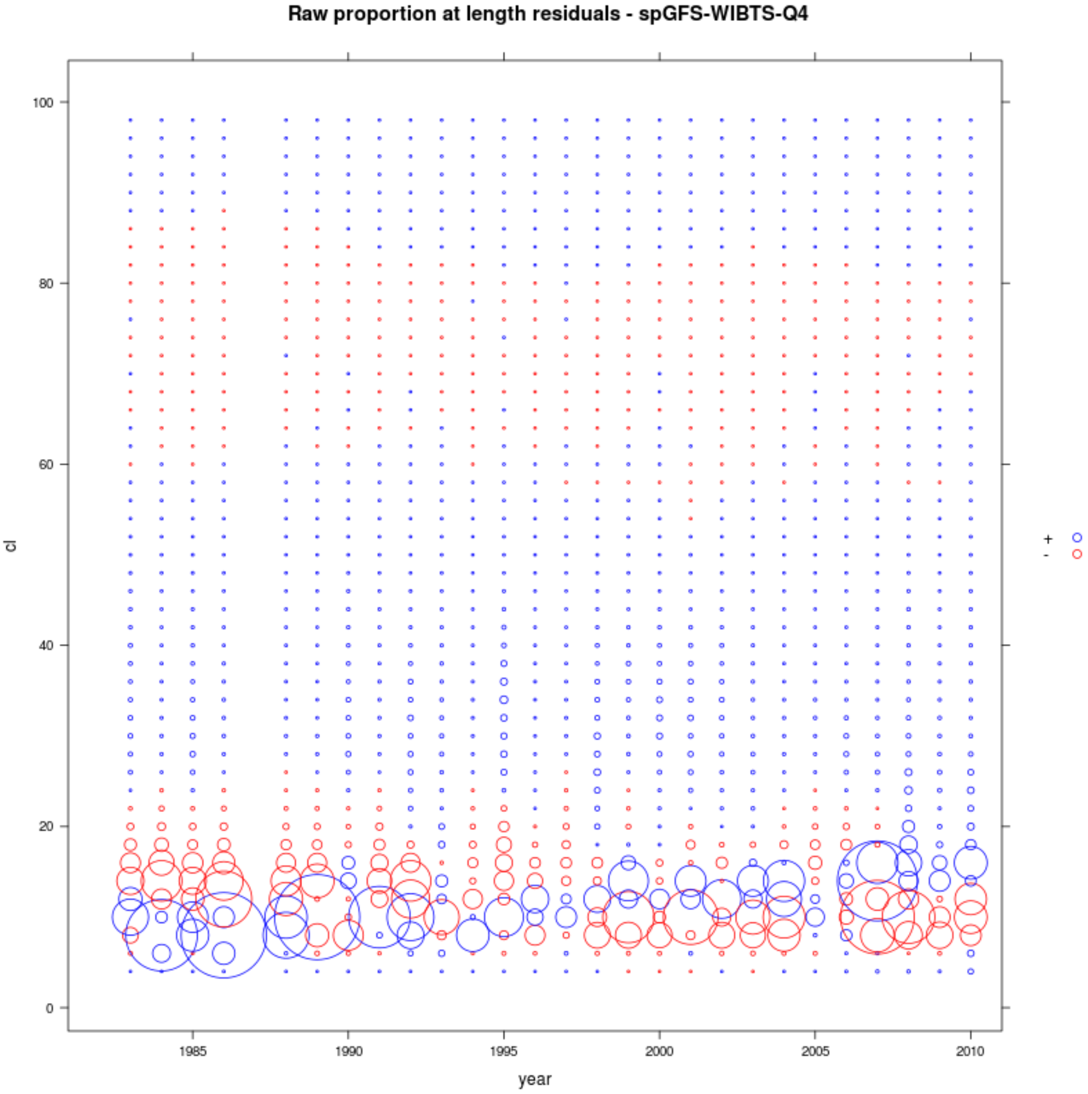

**(7.6 e). Bubble plot for Cadiz landings length distribution from 1982 to 2004.**



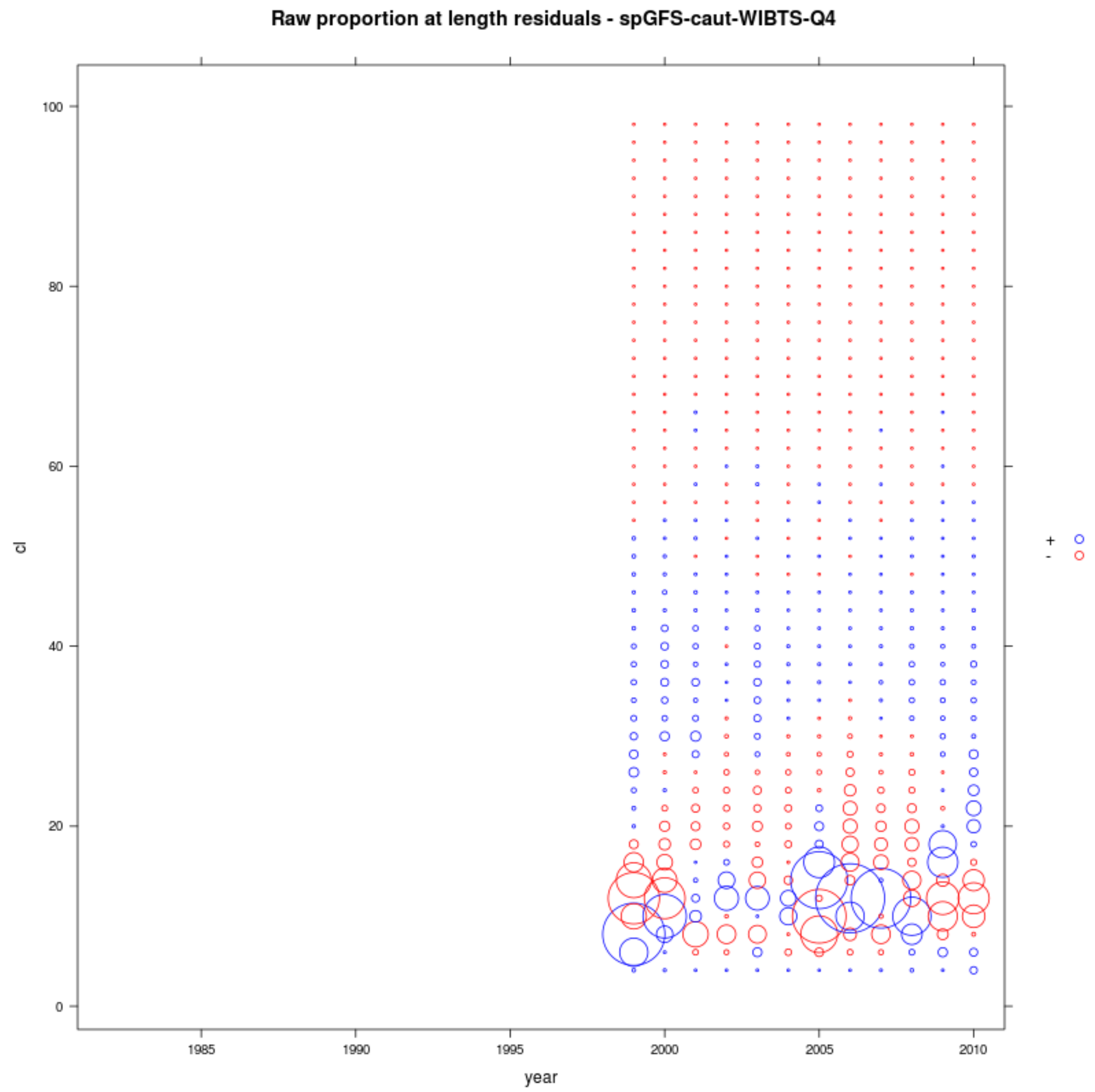

**(7.6 f). Bubble plot for Discards length distribution for years 1993,97,99, 2004-2010**




**(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)**

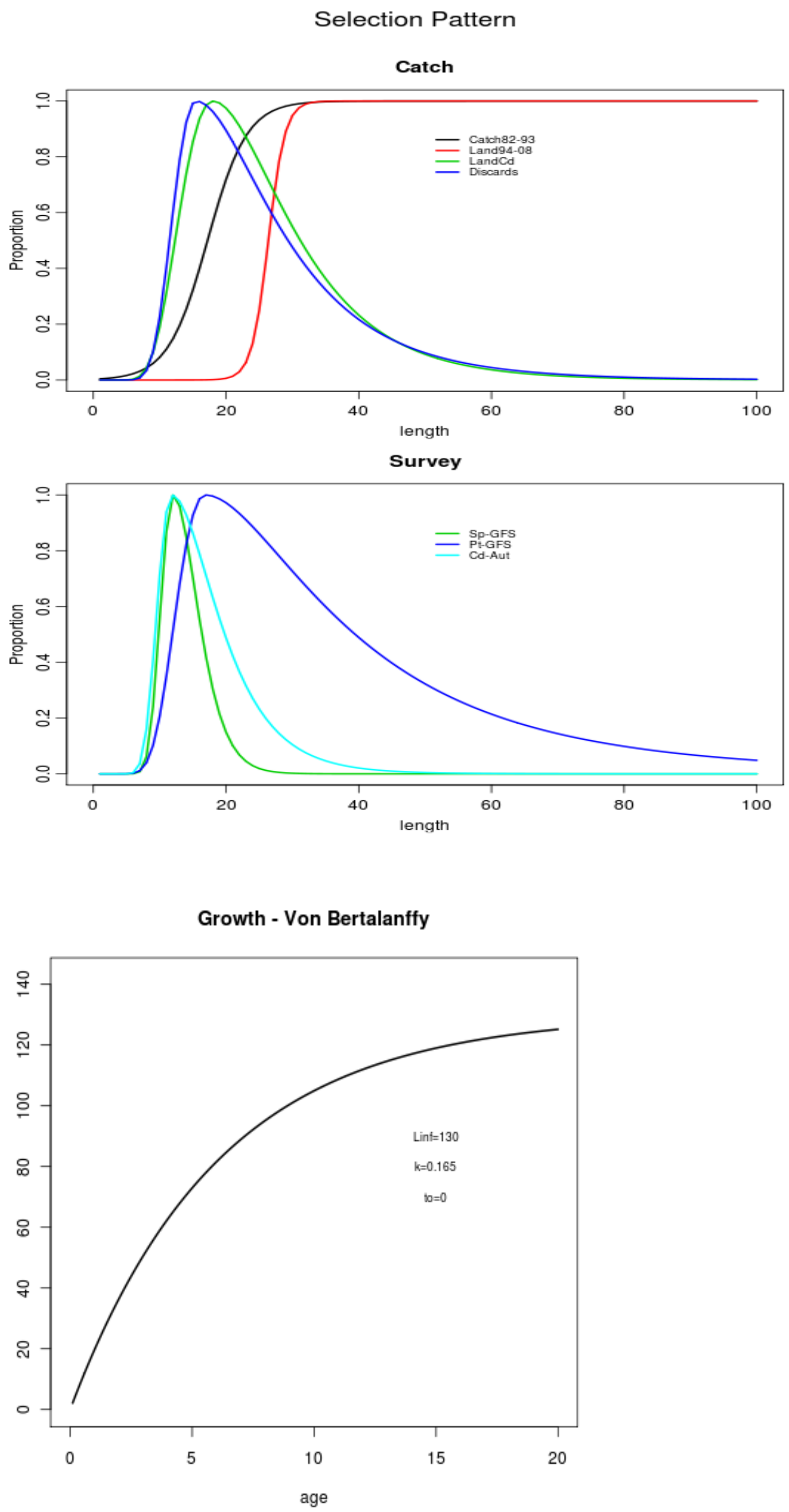



**Figure 7.7. Selection pattern (upper panel) and and von Bertalanffy growth with k parameter estimated by the model (lower panel)**

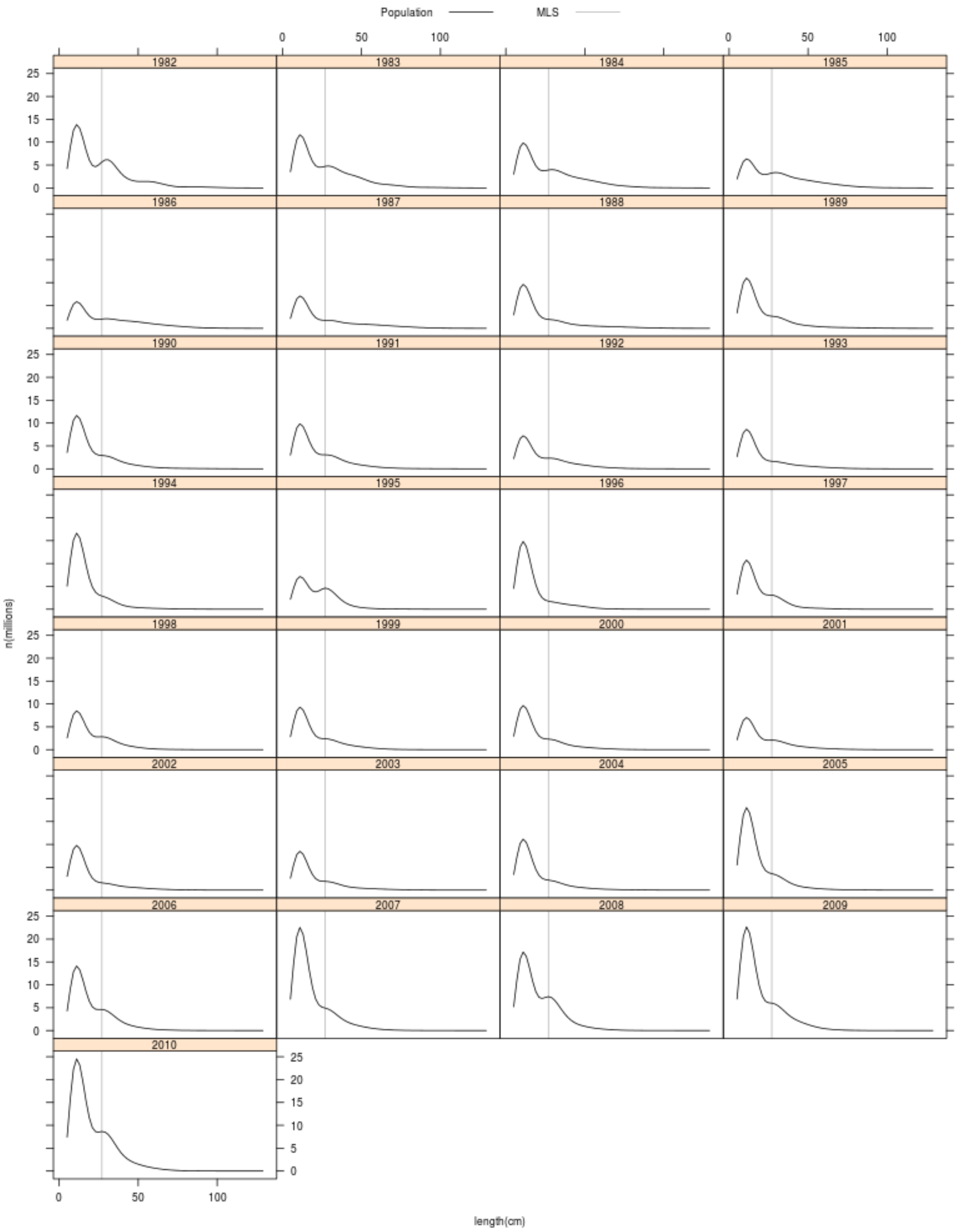



**Figure 7.8. Population length distribution.**

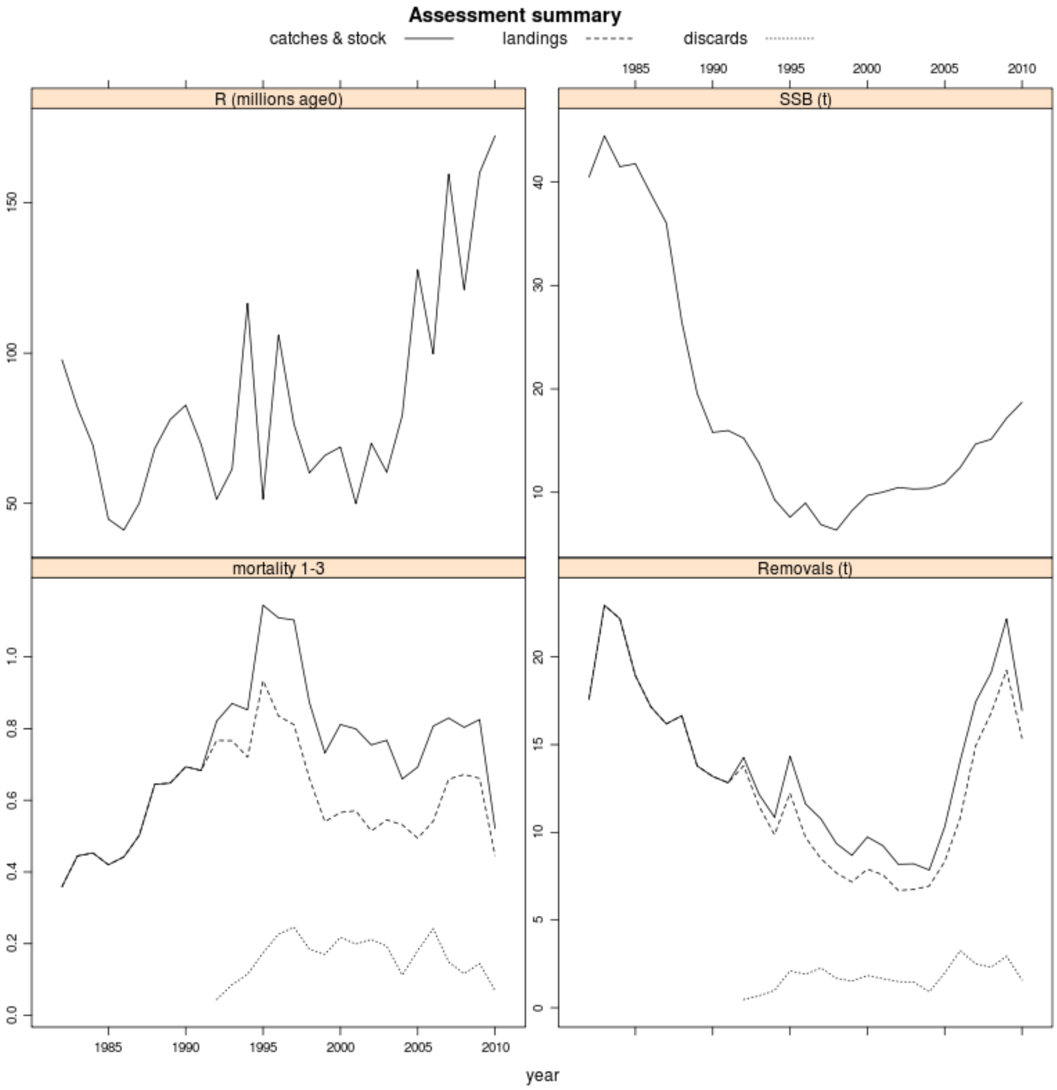
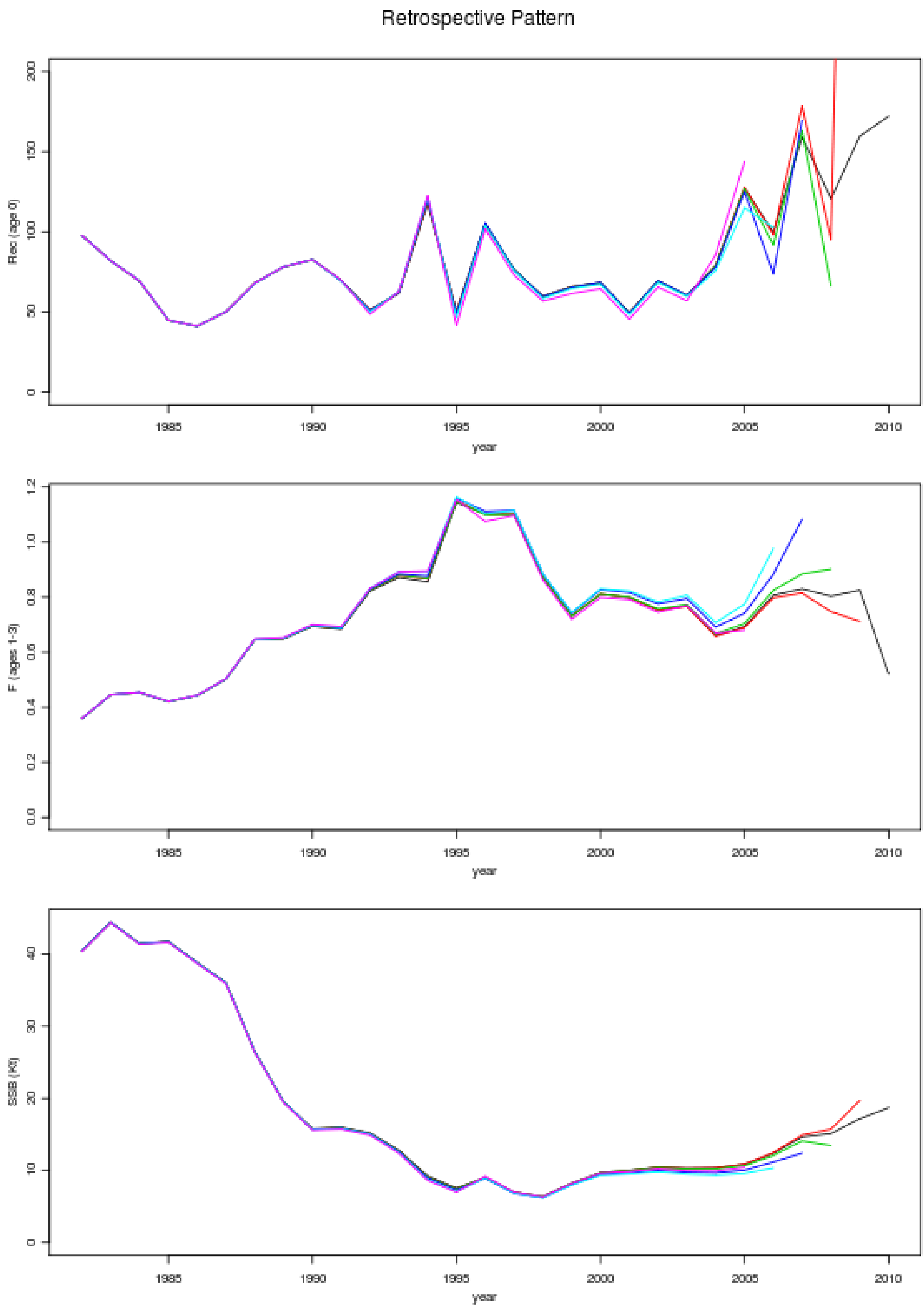



**Figure 7.9. Summary plot. SSB and removals (catch, landings and discards) in '000 t. Recruitment in '000000 individuals.**




*Note that recruitment in 2010 year assessment (upper plot red line) reaches 880 mill and Y axis was cut at 200 mill.*

**Figure 7.10. Retrospective plot**

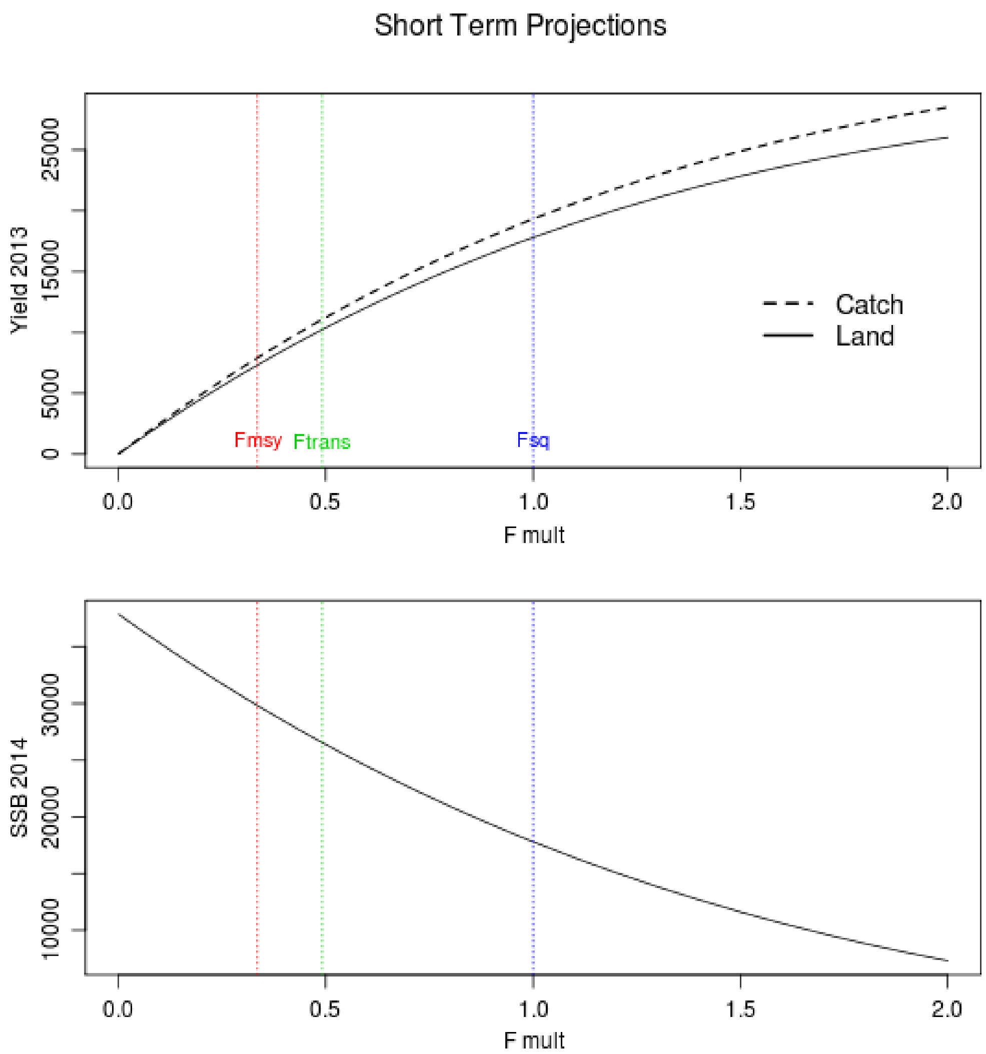



**Figure 11. Short term advice**

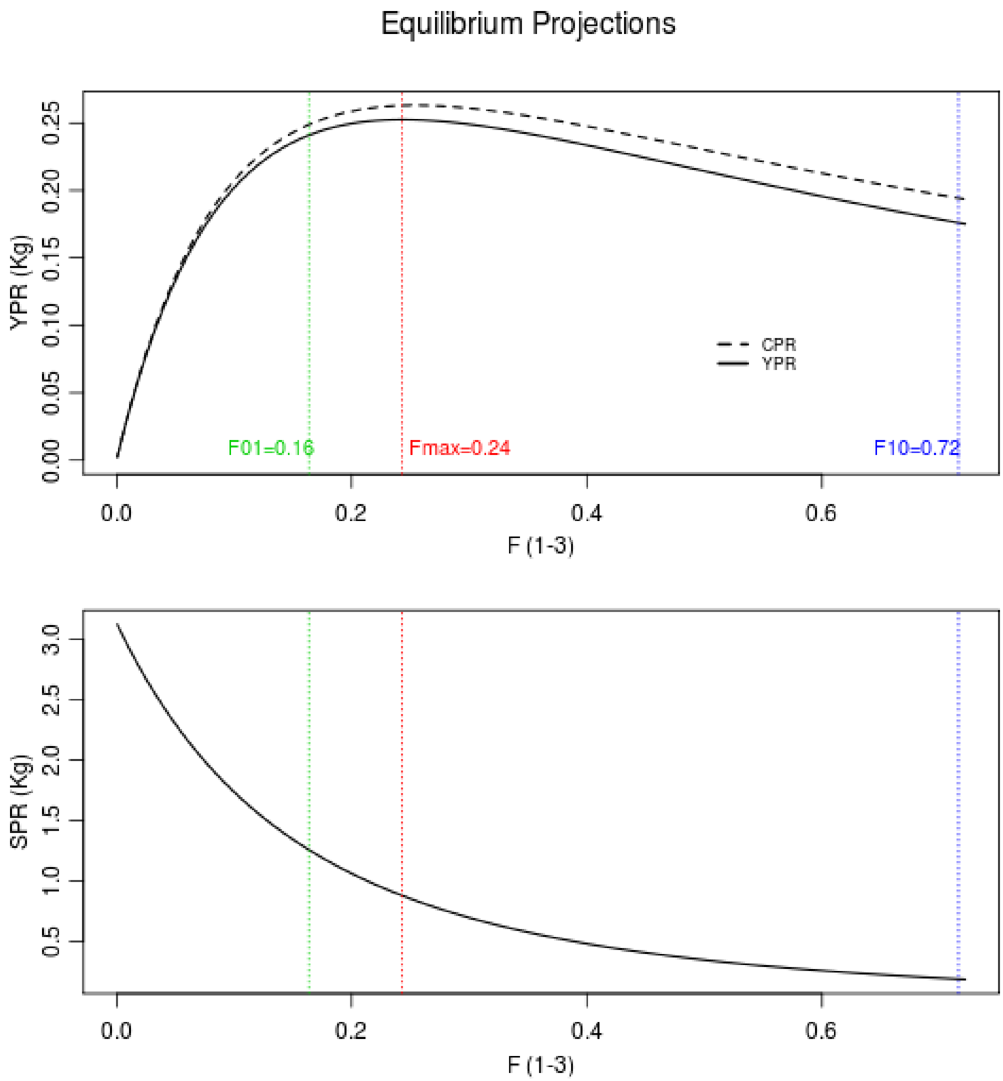



**Figure 12. Long term yield and SSB per recruit**

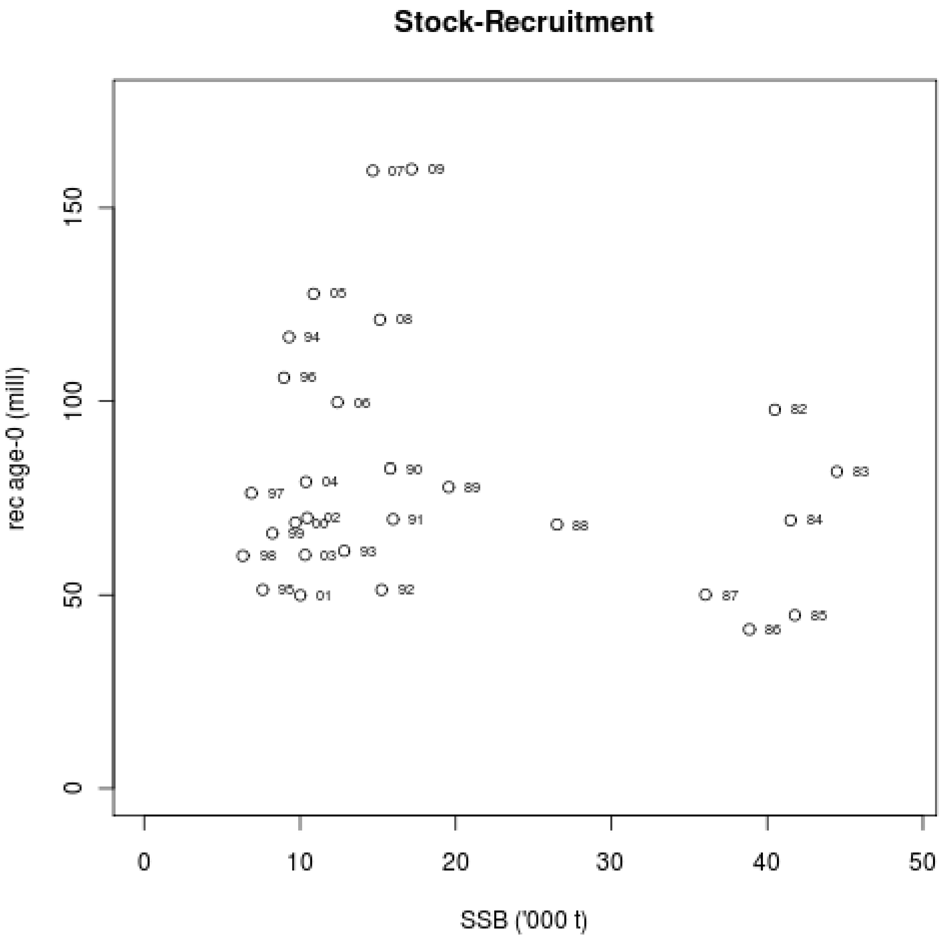



**Figure 7.13 Stock-Recruitment plot.**

# 8 Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Divisions VIIIc and IXa

*L. piscatorius and L. budegassa*

**Type of assessment in 2011:** Benchmark **(**the assessment model and settings were approved in WKFLAT-2012). However, it was not possible to include Spanish commercial data for 2011 in the assessments. The assessment models could not be updated this year. The assessments conducted in 2012 benchmark have been used as the basis of projections for catch options and management advice for 2013.

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

**Data revisions this year:** Spanish landings in 1999, 2004 and 2010 for *L. piscatorius* and in 1995, 1999, 2004 and 2010 for *L. budegassa*. A Coruña tuning fleet information for the period 1982-2010 was update for both stocks.

## 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-recapure and length composition analysis (Landa *et al*., 2008) was used in the assessment of *L. piscatorius*.

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

***ICES advice for 2012:***

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 framework implies fishing mortality to be reduced by 13%.

ICES advises the following landings for 2012 on the basis of the MSY framework approach:

*L. piscatorius*: less than 2200 t; *L. budegassa*: less than 1100 t; Combined anglerfish: less than 3300 t.

***Management applicable for 2011 and 2012:***

The two species are managed under a common TAC that was set at 1 571 t for 2011 and 3300 t for 2012.

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.

# 8.1 Anglerfish (*L. piscatorius*) in Divisions VIIIc and IXa

## 8.1.1 General

### 8.1.1.1 Ecosystem aspects

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

### 8.1.1.2 Fishery description

*L. piscatorius* is 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 2010, the Spanish landings were on average 45% from the trawl fleet (mean lengths in 2010 of 58 cm and 62 cm in Divisions VIIIc and IXa, respectively) and 55% from the gillnet fishery (mean length of 78 cm in Division VIIIc in 2010). For the same period, Portuguese landings were on average 8% from bottom trawlers (mean length of 47 cm in 2010) and 92% from the artisanal fleet (mean length of 65 cm in 2010).

## 8.1.2 Data

### 8.1.2.1 Commercial catches and discards

Total landings by country and gear for the period 1978-2011, as estimated by the WG, are given in Table 8.1.1. Spanish data for 2011 are not included. Spanish data in 2011 have been provided by Secretaría General de Pesca (SGP), the official national administration responsible for fishery statistics, and are presented in Annex T. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations. Several deficiencies in the Spanish data for 2011 prevent the use of these data to assess the stock. Landings data are not by species and the time scale is the year, being the stock evaluated by species and on a quarter time-step, Spanish data were not used for the evaluation of the stock. Portuguese landings in 2011 were 4% higher than previous year.

Spanish discards estimates of *L. piscatorius* in weight and associated coefficient of variation (CV) are shown in the Table 8.1.2. For the available time series anglerfish discards represent less than 4% 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 2004 with 48 t.

*L. piscatorius* discards in the Portuguese trawl fisheries are considered negligible (Fernández & Prista, 2012).

#### 8.1.2.2 Biological sampling

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

The sampling levels for 2011 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 8.1.3 gives the annual length compositions by ICES division, country and gear for 2011 in relative values. Length composition was presented scaled to 1000 since Spanish landings were not available. The mean length values in Division IXa for 2011 were lower than in 2010, and the mean length of total landings of the stock decreased from 71 cm in 2010 to 61 cm in 2011

The annual length compositions for all fleets combined for the period 1986–2010 are presented in Figure 8.1.1.

Landings in number, the mean length and mean weight in the landings between 1986 and 2011 are showed in Table 8.1.4. 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. 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).

#### 8.1.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2011 are summarized in Table 8.1.5. (See Stock Annex for background information).

The abundance index from Spanish survey Sp-GFS-WIBTS-Q4 is shown in Figure 8.1.2. 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

#### 8.1.2.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 8.1.6 and Figure 8.1.3 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.

Spanish data for 2011 were neither analyzed nor entered in the tables because landings were not provided by species and the effort unit differs from the time series estimated by the working group.

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 2010, is presented. Standardized effort provided for Portuguese trawl fleets (1989-2008) and their corresponding LPUEs are also given in Table 8.1.6, but not represented in Figure 8.1.3.

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 2010 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. The A Coruña fleet decreased its importance since 1986. 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. In 2009 and 2010 A Coruña and Cedeira fleet showed a decrease in effort. 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 years an important increase of Cedeira LPUE was observed. Portuguese fleets shown an important increase in 2011.

### 8.1.3 Assessment

A new model assessment was adopted in 2012 benchmark. The assessment approved in the benchmark without entered any 2011 data was used to carry out the projections.

#### 8.1.3.1 Input data

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

#### 8.1.3.2 Model

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

#### 8.1.3.3 Assessment results

The model diagnosis is carried out means the analysis of residuals of abundance indices. Residual plots of the fits to the abundance indices are shown in Figure 8.1.4. 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 8.1.5). 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 8.1.6) and for population abundance indices (Figure 8.1.7). 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 shows strange selection over the larger fish that could be an effect of an insufficient length sampling. The selection pattern for Portuguese trawl fleet is similar to Spanish trawl fleet, showing a wide range of length fully selected.

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.

##### Historic trends in biomass, fishing mortality and recruitment

Table 8.1.7 and Figure 8.1.8 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 3.9 millions. In 2010 the recruitment has increased, relative to previous years, and it is estimated in 1.0 million. Landings steadily decreased from 3.6 Kt in 2005 to 1.5 Kt in 2010, coinciding with the decrease in F, from 0.36 in 2005 to 0.20 in 2010. Since 2005 SSB is at stable medium values, being 7.7 kt in 2010.

##### 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 (2010), two years (2010 and 2009), three years (2010, 2009, 2008) and four years (2010, 2009, 2008, 2007) of data (Figure 8.1.9). The F and recruitment show a low sensitivity to the exclusion of recent years. For the base assessment, 2010, a tendency to overestimate SSB was observed at the beginning of the series and over the last years. Overall, the trends in F and SSB remain quite stable over the whole time series and no evident retrospective pattern is observed for recruitment.

### 8.1.4 Catch options and prognosis

#### 8.1.4.1 Short-term projections

Projections were performed based on benchmark assessment. Due to that the assessment data end in 2010, it was necessary to define the assumptions for two intermediate years: 2011 and 2012.

For fishing mortality, the F *status quo* equal to 0.24, estimated as the average of fishing mortality the last three years $F_{2008\text{-}2010}$ over lengths 30-130 cm, was used for 2011 and 2012. The same selectivity pattern by fleet was used for both intermediate years.

In the case of recruitment, the Working Group decided to explore the suitability of the available recruitment indicators. The Spanish survey series (Sp-GFS-WIBTS-Q4) is the only survey representative for this stock and it is considered a good recruitment indicator. A recruitment - survey index relationship was fit (Figure 8.1.10), and the recruitment interpolated from the survey abundance value in 2011 was estimated in 0.89 millions. This value is lower than the geometric mean of the whole series and, as a conservative measure the Working Group decided to use the value of the interpolation for the recruitment in 2011.The recruitment assumption used for 2012 was the geometric mean of the whole period (1982-2011) as it is indicated in the Stock Annex.

Projected landings in 2013 and SSB at the beginning of 2014 for different management options in 2013 are presented in Table 8.1.8. Under F *status quos* scenario in 2013 is expected an increase in landings with respect to 2012, and an increase in SSB in 2014 with respect to 2013.

#### 8.1.4.2 Yield and biomass per recruit analysis

The summary table of Yield and SSB per recruit analysis is given in Table 8.1.9 and in Figure 8.1.11. The F that maximizes the yield per recruit, $F_{max}$, is estimated in 0.29 over the Fsq (0.24) 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 23% of SSB/R. The fishing mortality of $F_{30\%}$, $_{35\%}$ and $_{40\%}$ is estimated in 0.15, 0.13 and 0.12 respectively.

The *status quo* F is between $F_{max}$ and $F_{0.1}$, and far away from any of the reference points based on SSB per recruit analysis (Figure 8.1.11).

### 8.1.5 Biological Reference Points

The last benchmark implied a change in the model assessment and, thus the $F_{MSY}$ value provided directly by ASPIC, the previous assessment model, is not suitable anymore. New reference point estimates based on Yield per Recruit and Spawning Stock Biomass per Recruit were analysed in wd0X. The implications of selecting a particular reference point as $F_{MSY}$ proxy were evalauted in terms of SSB and Yield. The Working Group concluded that $F_{0.1}$=0.19 offers a reasonable trade-off between of stock biomass and yield.

$F_{MSY}$ has been set to 0.19, the value proposed by the Working Group based on $F_{0.1}$.

No proposals for MSY-Btrigger has been presented.

### 8.1.6 Comments on the assessment

Because of Spanish information is not available for 2011, no update assessment was carried out by this WG, being the latest assessment for southern white anglerfish carried out at the WKFLAT 2012.

The spawning stock biomass has remained stable at medium levels since 2005. Fishing mortality decreased by 25% in 2010 relative to 2009. A steady decrease in landings has been observed from 3.6 kt in 2005 to 1.5 kt in 2010.

### 8.1.7 Management considerations

For the projections, assumptions on recruitment and fishing mortality for two intermediate years (2011 and 2012) were made. The recruitment has been substituted with an interpolation of survey index value in 2011, and by the geometric mean of the whole recruitment series in 2012. The projected estimates of SSB in 2014 and yield in 2013 are sensitive to those assumptions. The percentage of landings in 2013 that depends on the recruitment assumptions made for 2011 and 2012 is 23 %.

The survey abundance index indicates a drop in recruitment for 2011.

Other management considerations in section 8.3.

**References**

Fernández, A.C. and Prista, N. 2012. Portuguese discard data on angler◎shouthern *Lophius piscatorius* and blackbellied angler *Lophius budegassa* (2004-2010). Working document-07 presented at WKFLAT2012. ICES CM: ACOM: 46.

ICES, 2012. Report of the Anglerfish (*Lophius piscatorius*) *illicia* and otoliths exchange 2011. 61 pp.

**Table 8.1.1.** ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.

Tonnes landed by the main fishing fleets for 1978-2011 as determined by the Working Group.

| | Div. VIIIc | | | Div. IXa | | | | Div. VIIIc+IXa |
|---|---|---|---|---|---|---|---|---|
| | SPAIN | | | SPAIN | PORTUGAL | | | |
| Year | Trawl | Gillnet | TOTAL | Trawl | Trawl | Artisanal | TOTAL | TOTAL |
| 1978 | n/a | n/a | n/a | 258 | | 115 | 373 | |
| 1979 | n/a | n/a | n/a | 319 | | 225 | 544 | |
| 1980 | 2806 | 1270 | 4076 | 401 | | 339 | 740 | 4816 |
| 1981 | 2750 | 1931 | 4681 | 535 | | 352 | 887 | 5568 |
| 1982 | 1915 | 2682 | 4597 | 875 | | 310 | 1185 | 5782 |
| 1983 | 3205 | 1723 | 4928 | 726 | | 460 | 1186 | 6114 |
| 1984 | 3086 | 1690 | 4776 | 578 | 186 | 492 | 1256 | 6032 |
| 1985 | 2313 | 2372 | 4685 | 540 | 212 | 702 | 1454 | 6139 |
| 1986 | 2499 | 2624 | 5123 | 670 | 167 | 910 | 1747 | 6870 |
| 1987 | 2080 | 1683 | 3763 | 320 | 194 | 864 | 1378 | 5141 |
| 1988 | 2525 | 2253 | 4778 | 570 | 157 | 817 | 1543 | 6321 |
| 1989 | 1643 | 2147 | 3790 | 347 | 259 | 600 | 1206 | 4996 |
| 1990 | 1439 | 985 | 2424 | 435 | 326 | 606 | 1366 | 3790 |
| 1991 | 1490 | 778 | 2268 | 319 | 224 | 829 | 1372 | 3640 |
| 1992 | 1217 | 1011 | 2228 | 301 | 76 | 778 | 1154 | 3382 |
| 1993 | 844 | 666 | 1510 | 72 | 111 | 636 | 819 | 2329 |
| 1994 | 690 | 827 | 1517 | 154 | 70 | 266 | 490 | 2007 |
| 1995 | 830 | 572 | 1403 | 199 | 66 | 166 | 431 | 1834 |
| 1996 | 1306 | 745 | 2050 | 407 | 133 | 365 | 905 | 2955 |
| 1997 | 1449 | 1191 | 2640 | 315 | 110 | 650 | 1075 | 3714 |
| 1998 | 912 | 1359 | 2271 | 184 | 28 | 497 | 710 | 2981 |
| 1999 | 551 | 1013 | 1564 | 79 | 9 | 285 | 374 | 1938 |
| 2000 | 269 | 538 | 808 | 107 | 4 | 340 | 451 | 1259 |
| 2001 | 231 | 294 | 525 | 57 | 16 | 190 | 263 | 788 |
| 2002 | 385 | 341 | 726 | 110 | 29 | 168 | 307 | 1032 |
| 2003 | 911 | 722 | 1633 | 312 | 29 | 305 | 645 | 2278 |
| 2004 | 1260 | 1269 | 2528 | 264 | 27 | 335 | 626 | 3154 |
| 2005 | 1378 | 1622 | 3000 | 371 | 29 | 244 | 643 | 3644 |
| 2006 | 1166 | 1247 | 2413 | 260 | 29 | 260 | 549 | 2963 |
| 2007 | 955 | 1009 | 1964 | 181 | 13 | 192 | 386 | 2350 |
| 2008 | 894 | 1168 | 2062 | 138 | 11 | 127 | 275 | 2337 |
| 2009 | 850 | 1058 | 1909 | 213 | 10 | 148 | 371 | 2280 |
| 2010 | 313 | 955 | 1268 | 158 | 2 | 119 | 279 | 1547 |
| 2011 | n/a | n/a | n/a | n/a | 46 | 80 | n/a | n/a |

n/a: not available

**Table 8.1.2.** ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.

Weight and percentage of discards for Spanish trawl fleet.

| Year | Weight (t) | CV | % Trawl 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 |

n/a: not available

CV: coefficient of variation

**Table 8.1.3.** ANGLERFISH (*L. piscatorius* ) - Divisions VIIIc and IXa.

Length composition by fleet in 2011 (relative values in ‰).

| | Div. VIIIc | | | Div. IXa | | | | Div. VIIIc+IXa |
|---|---|---|---|---|---|---|---|---|
| | SPAIN | | | SPAIN | PORTUGAL | | | |
| Length (cm) | Trawl | Gillnet | TOTAL | Trawl | Trawl | Artisanal | TOTAL | TOTAL |
| 14 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 15 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 16 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 17 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 18 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 19 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 20 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 21 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 22 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 23 | 0.000 | 0.000 | 0.000 | 1.213 | 0.000 | 0.00 | 0.47 | 0.10 |
| 24 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 25 | 0.000 | 0.000 | 0.000 | 5.040 | 0.000 | 0.00 | 1.96 | 0.40 |
| 26 | 0.602 | 0.000 | 0.334 | 10.400 | 0.000 | 0.00 | 4.04 | 1.10 |
| 27 | 2.709 | 0.000 | 1.503 | 4.316 | 0.000 | 0.00 | 1.68 | 1.54 |
| 28 | 4.656 | 0.000 | 2.583 | 8.023 | 0.000 | 0.00 | 3.11 | 2.69 |
| 29 | 9.660 | 0.000 | 5.360 | 8.193 | 0.000 | 0.00 | 3.18 | 4.91 |
| 30 | 15.455 | 0.000 | 8.576 | 9.064 | 0.000 | 0.00 | 3.52 | 7.53 |
| 31 | 17.310 | 0.000 | 9.605 | 6.343 | 0.000 | 0.00 | 2.46 | 8.13 |
| 32 | 22.859 | 0.000 | 12.684 | 14.817 | 0.000 | 0.00 | 5.75 | 11.26 |
| 33 | 19.402 | 0.000 | 10.766 | 13.201 | 0.000 | 0.00 | 5.12 | 9.60 |
| 34 | 23.859 | 0.000 | 13.239 | 16.298 | 0.000 | 10.14 | 8.73 | 12.31 |
| 35 | 36.791 | 0.000 | 20.415 | 31.869 | 0.000 | 17.86 | 16.60 | 19.63 |
| 36 | 42.277 | 0.000 | 23.459 | 37.771 | 0.000 | 10.14 | 17.06 | 22.14 |
| 37 | 47.354 | 0.000 | 26.276 | 50.948 | 0.000 | 10.14 | 22.18 | 25.43 |
| 38 | 34.726 | 0.000 | 19.269 | 27.696 | 0.000 | 20.27 | 15.55 | 18.50 |
| 39 | 52.071 | 0.000 | 28.893 | 55.581 | 0.000 | 17.86 | 25.80 | 28.26 |
| 40 | 31.471 | 0.000 | 17.463 | 32.482 | 0.000 | 2.41 | 13.18 | 16.58 |
| 41 | 14.904 | 0.000 | 8.270 | 10.465 | 0.000 | 7.72 | 5.89 | 7.78 |
| 42 | 22.241 | 1.164 | 12.860 | 20.592 | 0.000 | 127.88 | 38.29 | 18.10 |
| 43 | 26.754 | 0.000 | 14.845 | 25.698 | 0.000 | 10.14 | 12.38 | 14.34 |
| 44 | 26.736 | 0.000 | 14.836 | 22.707 | 0.000 | 7.72 | 10.64 | 13.97 |
| 45 | 39.857 | 0.000 | 22.116 | 40.227 | 0.000 | 2.41 | 16.19 | 20.89 |
| 46 | 22.070 | 0.000 | 12.246 | 23.023 | 0.000 | 0.00 | 8.94 | 11.56 |
| 47 | 18.447 | 2.165 | 11.200 | 15.139 | 13.802 | 0.00 | 11.05 | 11.17 |
| 48 | 12.607 | 0.000 | 6.996 | 16.857 | 1.488 | 3.86 | 8.02 | 7.21 |
| 49 | 10.754 | 1.346 | 6.566 | 7.111 | 435.024 | 6.28 | 167.36 | 39.68 |
| 50 | 23.924 | 2.516 | 14.395 | 23.804 | 0.000 | 0.00 | 9.24 | 13.33 |
| 51 | 20.035 | 9.207 | 15.216 | 14.617 | 2.097 | 0.00 | 6.46 | 13.41 |
| 52 | 18.861 | 8.131 | 14.085 | 17.548 | 43.029 | 0.00 | 22.94 | 15.91 |
| 53 | 17.655 | 4.200 | 11.667 | 13.511 | 40.650 | 0.00 | 20.49 | 13.48 |
| 54 | 11.581 | 9.997 | 10.876 | 8.669 | 0.000 | 3.86 | 4.28 | 9.52 |
| 55 | 17.422 | 6.345 | 12.492 | 18.525 | 0.000 | 127.88 | 37.49 | 17.64 |
| 56 | 14.460 | 11.013 | 12.926 | 9.925 | 0.000 | 0.00 | 3.85 | 11.06 |
| 57 | 13.445 | 10.262 | 12.029 | 13.708 | 15.155 | 3.86 | 11.92 | 12.01 |
| 58 | 6.863 | 12.210 | 9.243 | 3.718 | 2.097 | 0.00 | 2.23 | 7.80 |
| 59 | 9.065 | 18.155 | 13.112 | 16.887 | 2.097 | 0.00 | 7.34 | 11.92 |
| 60 | 22.959 | 23.389 | 23.152 | 16.456 | 117.179 | 130.29 | 81.19 | 35.10 |
| 61 | 10.143 | 18.335 | 13.791 | 9.128 | 2.097 | 130.29 | 35.20 | 18.20 |
| 62 | 16.324 | 25.212 | 20.282 | 25.165 | 13.802 | 188.26 | 59.54 | 28.37 |
| 63 | 15.837 | 17.343 | 16.508 | 17.794 | 27.468 | 2.41 | 17.78 | 16.77 |
| 64 | 18.957 | 21.389 | 20.041 | 14.596 | 0.000 | 2.41 | 6.24 | 17.20 |
| 65 | 12.516 | 32.558 | 21.439 | 10.609 | 0.000 | 0.00 | 4.12 | 17.87 |
| 66 | 11.997 | 24.371 | 17.506 | 11.610 | 0.000 | 0.00 | 4.51 | 14.83 |
| 67 | 10.219 | 34.791 | 21.159 | 9.376 | 43.029 | 0.00 | 19.77 | 20.87 |
| 68 | 10.370 | 33.604 | 20.714 | 9.263 | 0.000 | 0.00 | 3.60 | 17.19 |
| 69 | 9.282 | 26.890 | 17.121 | 6.884 | 0.000 | 0.00 | 2.67 | 14.15 |
| 70 | 6.572 | 48.317 | 25.156 | 2.987 | 0.000 | 0.00 | 1.16 | 20.21 |
| 71 | 13.587 | 35.893 | 23.518 | 10.598 | 0.000 | 2.41 | 4.69 | 19.64 |
| 72 | 4.054 | 36.341 | 18.428 | 5.996 | 0.000 | 4.34 | 3.36 | 15.32 |
| 73 | 10.009 | 40.086 | 23.399 | 8.769 | 0.000 | 0.00 | 3.40 | 19.28 |
| 74 | 13.869 | 39.100 | 25.102 | 16.061 | 0.000 | 0.00 | 6.23 | 21.22 |
| 75 | 5.447 | 54.960 | 27.490 | 5.151 | 162.717 | 0.00 | 63.01 | 34.80 |
| 76 | 5.745 | 21.506 | 12.762 | 7.474 | 0.000 | 0.00 | 2.90 | 10.73 |
| 77 | 4.547 | 30.436 | 16.072 | 6.889 | 0.000 | 0.00 | 2.67 | 13.31 |
| 78 | 7.096 | 21.082 | 13.323 | 5.637 | 17.049 | 2.41 | 9.15 | 12.46 |
| 79 | 4.852 | 30.511 | 16.275 | 4.919 | 0.000 | 0.00 | 1.91 | 13.32 |
| 80 | 2.620 | 20.875 | 10.747 | 6.113 | 0.000 | 0.00 | 2.37 | 9.02 |
| 81 | 2.026 | 14.230 | 7.459 | 5.930 | 0.000 | 0.00 | 2.30 | 6.40 |
| 82 | 3.999 | 18.655 | 10.524 | 4.503 | 0.000 | 0.00 | 1.75 | 8.72 |
| 83 | 4.508 | 18.842 | 10.890 | 6.193 | 0.000 | 0.00 | 2.40 | 9.14 |
| 84 | 6.385 | 10.642 | 8.281 | 7.204 | 0.000 | 0.00 | 2.80 | 7.15 |
| 85 | 3.938 | 9.057 | 6.217 | 11.322 | 0.000 | 0.00 | 4.39 | 5.84 |
| 86 | 2.000 | 12.653 | 6.743 | 6.229 | 0.000 | 0.00 | 2.42 | 5.85 |
| 87 | 3.983 | 9.906 | 6.620 | 2.860 | 0.000 | 127.88 | 31.41 | 11.72 |
| 88 | 4.286 | 12.557 | 7.968 | 4.859 | 0.000 | 3.86 | 2.80 | 6.90 |
| 89 | 4.309 | 8.389 | 6.125 | 6.526 | 2.097 | 0.00 | 3.32 | 5.55 |
| 90 | 4.275 | 18.897 | 10.785 | 4.653 | 0.000 | 0.00 | 1.81 | 8.94 |
| 91 | 5.984 | 8.472 | 7.092 | 21.732 | 0.000 | 0.00 | 8.44 | 7.37 |
| 92 | 3.297 | 15.772 | 8.851 | 1.751 | 0.000 | 0.00 | 0.68 | 7.17 |
| 93 | 3.441 | 10.224 | 6.461 | 3.371 | 0.000 | 0.00 | 1.31 | 5.40 |
| 94 | 0.568 | 6.539 | 3.226 | 2.582 | 0.000 | 0.00 | 1.00 | 2.77 |
| 95 | 1.316 | 6.346 | 3.555 | 0.384 | 34.031 | 0.00 | 12.91 | 5.48 |
| 96 | 1.118 | 9.401 | 4.805 | 3.517 | 0.000 | 0.00 | 1.37 | 4.10 |
| 97 | 5.455 | 5.199 | 5.341 | 4.084 | 0.000 | 0.00 | 1.59 | 4.57 |
| 98 | 2.026 | 7.481 | 4.455 | 2.371 | 0.000 | 0.00 | 0.92 | 3.73 |
| 99 | 1.923 | 5.365 | 3.456 | 4.117 | 0.000 | 0.00 | 1.60 | 3.07 |
| 100+ | 9.160 | 57.677 | 30.759 | 28.356 | 25.090 | 14.96 | 23.96 | 29.36 |
| TOTAL | | | | | | | | |
| Tonnes | n/a | n/a | n/a | n/a | 46 | 80 | n/a | n/a |
| Mean Weight (g) | n/a | n/a | n/a | n/a | 2229 | 6092 | n/a | n/a |
| Mean length (cm) | 51.1 | 74.5 | 61.5 | 54.0 | 41.9 | 59.2 | 57.4 | 60.7 |
| Measured weight (t) | 9.4 | 12.8 | 22.2 | 5.8 | 0.1 | 0.2 | 6.1 | 28.3 |

n/a: not available

**Table 8.1.4.** ANGLERFISH (*L. piscatorius* ). Divisions VIIIc and IXa.

Numbers, mean weight and mean length of landings between 1986 and 2011.

| Year | Total (thousands) | Mean Weight (g) | Mean Length (cm) |
|---|---|---|---|
| 1986 | 1872 | 3670 | 61 |
| 1987 | 2806 | 1832 | 44 |
| 1988 | 2853 | 2216 | 50 |
| 1989 | 1821 | 2744 | 54 |
| 1990 | 1677 | 2261 | 49 |
| 1991 | 1657 | 2197 | 50 |
| 1992 | 1256 | 2692 | 54 |
| 1993 | 857 | 2719 | 54 |
| 1994 | 704 | 2850 | 54 |
| 1995 | 876 | 2093 | 48 |
| 1996 | 1153 | 2564 | 52 |
| 1997 | 1043 | 3560 | 60 |
| 1998 | 583 | 5113 | 68 |
| 1999 | 290 | 6674 | 71 |
| 2000 | 190 | 6885 | 72 |
| 2001 | 127 | 6189 | 64 |
| 2002 | 381 | 2766 | 50 |
| 2003 | 784 | 2907 | 54 |
| 2004 | 809 | 3456 | 61 |
| 2005 | 856 | 4259 | 63 |
| 2006 | 923 | 3211 | 58 |
| 2007 | 553 | 4251 | 62 |
| 2008 | 540 | 4327 | 63 |
| 2009 | 492 | 4630 | 64 |
| 2010 | 288 | 5569 | 71 |
| 2011 | n/a | n/a | 61 |

n/a: not available

**Table 8.1.5.** ANGLERFISH (*L. piscatorius*). 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 | | 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 | + | + |

Ysts = 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

**Table 8.1.6.** 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)

| | Div. VIIIc | | | | | | | | | | | Div. IXa | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Avilés | % | Santander | % | A Coruña-Port | A Coruña-Trucks | A Coruña-Fleet | % | Cedeira | % | | Portugal Crustacean | % | Portugal Fish | % |
| 1982 | | | | | 1618 | | 1618 | 28 | | | | | | | |
| 1983 | | | | | 1490 | | 1490 | 24 | | | | | | | |
| 1984 | | | | | 1560 | | 1560 | 26 | | | | | | | |
| 1985 | | | | | 1134 | | 1134 | 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 | | | | 85 | 2 | 175 | 3 |
| 1990 | 260 | 7 | 278 | 7 | 550 | | 550 | 15 | | | | 106 | 3 | 219 | 6 |
| 1991 | 245 | 7 | 281 | 8 | 491 | | 491 | 13 | | | | 73 | 2 | 151 | 4 |
| 1992 | 198 | 6 | 222 | 7 | 432 | | 432 | 13 | | | | 25 | 1 | 51 | 2 |
| 1993 | 76 | 3 | 186 | 8 | 385 | | 385 | 17 | | | | 36 | 2 | 75 | 3 |
| 1994 | 116 | 6 | 188 | 9 | 245 | 63 | 309 | 15 | | | | 23 | 1 | 47 | 2 |
| 1995 | 192 | 10 | 186 | 10 | 260 | 57 | 316 | 17 | | | | 22 | 1 | 45 | 2 |
| 1996 | 322 | 11 | 270 | 9 | 413 | 83 | 496 | 17 | | | | 45 | 2 | 88 | 3 |
| 1997 | 345 | 9 | 381 | 10 | 411 | 59 | 470 | 13 | | | | 51 | 1 | 59 | 2 |
| 1998 | 286 | 10 | 316 | 11 | 138 | 30 | 168 | 6 | | | | 11 | <1 | 17 | 1 |
| 1999 | 108 | 6 | 182 | 9 | 168 | n/a | n/a | n/a | 342 | 18 | | 3 | <1 | 6 | <1 |
| 2000 | 28 | 2 | 75 | 6 | 85 | 2 | 88 | 7 | 140 | 11 | | 2 | <1 | 2 | <1 |
| 2001 | 23 | 3 | 54 | 7 | 84 | n/a | n/a | n/a | 87 | 11 | | 9 | 1 | 7 | 1 |
| 2002 | 75 | 7 | 57 | 6 | 130 | 61 | 191 | 19 | 130 | 13 | | 18 | 2 | 11 | 1 |
| 2003 | 111 | 5 | 85 | 4 | 228 | 115 | 342 | 15 | 159 | 7 | | 13 | 1 | 16 | 1 |
| 2004 | 216 | 7 | 106 | 3 | 277 | 162 | 439 | 14 | 382 | 12 | | 12 | <1 | 14 | <1 |
| 2005 | 278 | 8 | 59 | 2 | 391 | 248 | 639 | 18 | 434 | 12 | | 12 | <1 | 17 | <1 |
| 2006 | 148 | 5 | 89 | 3 | 242 | 273 | 515 | 17 | 415 | 14 | | 13 | <1 | 16 | 1 |
| 2007 | 101 | 4 | 103 | 4 | 222 | 233 | 455 | 19 | 233 | 10 | | 7 | <1 | 6 | <1 |
| 2008 | 99 | 4 | n/a | n/a | 274 | 153 | 428 | 18 | 228 | 10 | | 6 | <1 | 5 | <1 |
| 2009 | 69 | 3.02 | 35 | 2 | 165 | 152 | 317 | 14 | 183 | 8 | | 5 | <1 | 5 | <1 |
| 2010 | n/a | n/a | 44 | 3 | 95 | 70 | 165 | 10 | 231 | 14 | | 1 | <1 | 1 | <1 |
| 2011 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | | 24 | n/a | 22 | n/a |

n/a - not available

Fishing effort

| | Div. VIIIc | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | [1] Avilés | [1] Santander | A Coruña-Port | A Coruña-Trucks | [1] A Coruña-Fleet | [2] Cedeira standardized 2010 | | [3] Portugal Crustacean | [4] Portugal Crustacean standardized | [3] Portugal Fish | [4] Portugal Fish standardized |
| 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 | | | 76 | 23 | 52 | 18 |
| 1990 | 8497 | 20469 | 44403 | | 44403 | | | 90 | 20 | 61 | 17 |
| 1991 | 7681 | 22391 | 40429 | | 40429 | | | 83 | 17 | 57 | 15 |
| 1992 | n/a | 22833 | 38899 | | 38899 | | | 71 | 15 | 49 | 14 |
| 1993 | 7635 | 21370 | 44478 | | 44478 | | | 75 | 13 | 56 | 13 |
| 1994 | 9620 | 22772 | 39602 | 12795 | 52397 | | | 41 | 8 | 36 | 10 |
| 1995 | 6146 | 14046 | 41476 | 10232 | 51708 | | | 38 | 8 | 41 | 9 |
| 1996 | 4525 | 12071 | 35709 | 8791 | 44501 | | | 64 | 14 | 54 | 12 |
| 1997 | 5061 | 11776 | 35494 | 9108 | 44602 | | | 43 | 11 | 27 | 9 |
| 1998 | 5929 | 10646 | 29508 | n/a | n/a | | | 48 | 11 | 35 | 10 |
| 1999 | 6829 | 10349 | 30131 | n/a | n/a | 4860 | | 24 | 8 | 18 | 6 |
| 2000 | 4453 | 8779 | 30079 | n/a | n/a | 3726 | | 42 | 10 | 19 | 6 |
| 2001 | 1838 | 3053 | 29935 | n/a | n/a | 2167 | | 85 | 18 | 19 | 5 |
| 2002 | 2748 | 3975 | 21948 | 6747 | 28695 | 2464 | | 62 | 10 | 14 | 4 |
| 2003 | 2526 | 3837 | 18519 | 7608 | 26127 | 2764 | | 42 | 10 | 17 | 6 |
| 2004 | n/a | 3776 | 19198 | 10342 | 29540 | 5696 | | 21 | 7 | 14 | 4 |
| 2005 | n/a | 1404 | 20663 | 10302 | 30965 | 3485 | | 20 | 5 | 13 | 4 |
| 2006 | n/a | 2718 | 19264 | 12866 | 32130 | 4429 | | 22 | 5 | 12 | 4 |
| 2007 | n/a | 4334 | 21651 | 13187 | 34838 | 4599 | | 22 | 6 | 8 | 3 |
| 2008 | n/a | n/a | 20212 | 9812 | 30024 | 5168 | | 14 | 4 | 5 | 2 |
| 2009 | n/a | 1125 | 16162 | 12930 | 29092 | 2299 | | 15 | n/a | 6 | n/a |
| 2010 | n/a | 1628 | 13744 | 9003 | 22746 | 1902 | | 21 | n/a | 14 | n/a |
| 2011 | n/a | n/a | n/a | n/a | n/a | n/a | | 16 | n/a | 11 | n/a |

[1] Fishing days per 100 HP  [3] 1000 Hours trawling with occurrence of anglerfish

[2] Soaking days  [4] 1000 Hauls

n/a - not available

LPUE

| | Div. VIIIc | | | | | | | Div. IXa | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | [1] Avilés | [1] Santander | [1] A Coruña-Port | [1] A Coruña-Trucks | [1] A Coruña-Fleet | [2] Cedeira standardized 2010 | | [3] Portugal Crustacean | [4] Portugal Crustacean standardized | [3] Portugal Fish | [4] Portugal Fish standardized |
| 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 | | | 1.1 | 3.7 | 3.3 | 9.9 |
| 1990 | 30.6 | 13.6 | 12.4 | | 12.4 | | | 1.2 | 5.2 | 3.6 | 12.8 |
| 1991 | 31.9 | 12.6 | 12.1 | | 12.1 | | | 0.9 | 4.4 | 2.6 | 9.8 |
| 1992 | n/a | 9.7 | 11.1 | | 11.1 | | | 0.3 | 1.6 | 1.0 | 3.7 |
| 1993 | 9.9 | 8.7 | 8.7 | | 8.7 | | | 0.5 | 2.7 | 1.3 | 5.7 |
| 1994 | 12.0 | 8.2 | 6.2 | 5.0 | 5.9 | | | 0.6 | 3.0 | 1.3 | 4.9 |
| 1995 | 31.2 | 13.2 | 6.3 | 5.6 | 6.1 | | | 0.6 | 2.8 | 1.1 | 4.9 |
| 1996 | 71.1 | 22.4 | 11.6 | 9.4 | 11.2 | | | 0.7 | 3.1 | 1.6 | 7.1 |
| 1997 | 68.1 | 32.3 | 11.6 | 6.5 | 10.5 | | | 1.2 | 4.5 | 2.2 | 6.7 |
| 1998 | 48.3 | 29.7 | 4.7 | n/a | n/a | | | 0.2 | 1.0 | 0.5 | 1.8 |
| 1999 | 15.8 | 17.6 | 5.6 | n/a | n/a | 70.3 | | 0.1 | 0.4 | 0.3 | 1.0 |
| 2000 | 6.3 | 8.6 | 2.8 | n/a | n/a | 37.4 | | 0.0 | 0.2 | 0.1 | 0.4 |
| 2001 | 12.5 | 17.6 | 2.8 | n/a | n/a | 40.0 | | 0.1 | 0.5 | 0.4 | 1.4 |
| 2002 | 27.5 | 14.3 | 5.9 | 9.1 | 6.7 | 52.8 | | 0.3 | 1.9 | 0.8 | 2.4 |
| 2003 | 44.0 | 22.1 | 12.3 | 15.1 | 13.1 | 57.7 | | 0.3 | 1.3 | 0.9 | 2.8 |
| 2004 | n/a | 28.1 | 14.4 | 15.7 | 14.9 | 67.0 | | 0.6 | 1.9 | 1.0 | 3.3 |
| 2005 | n/a | 41.9 | 18.9 | 24.1 | 20.6 | 124.4 | | 0.6 | 2.2 | 1.3 | 4.7 |
| 2006 | n/a | 32.7 | 12.6 | 21.2 | 16.0 | 93.7 | | 0.6 | 2.4 | 1.3 | 4.2 |
| 2007 | n/a | 23.8 | 10.3 | 17.7 | 13.1 | 50.7 | | 0.3 | 1.1 | 0.8 | 2.1 |
| 2008 | n/a | n/a | 13.6 | 15.6 | 14.2 | 44.0 | | 0.4 | 1.5 | 1.0 | 2.9 |
| 2009 | n/a | 31.3 | 10.2 | 11.8 | 10.9 | 79.5 | | 0.3 | n/a | 0.7 | n/a |
| 2010 | n/a | 27.1 | 6.9 | 7.8 | 7.3 | 121.3 | | 0.0 | n/a | 0.1 | n/a |
| 2011 | n/a | n/a | n/a | n/a | n/a | n/a | | 1.5 | n/a | 2.0 | n/a |

[1] kg/day*100HP  [3] kg/hour trawl  n/a - not available

[2] kg/soaking day  [4] kg/haul

**Table 8.1.7.** ANGLERFISH (*L. piscatorius* ) - Division VIIIc and IXa.
Summary of approved assessment in WKFLAT2012.

| Year | Recruit Age0 (thousands) | Total Biomass (t) | Total SSB (t) | Landings (t) | Yield/SSB | F (30-130 cm) |
|---|---|---|---|---|---|---|
| 1980 | 464 | 12527 | 6518 | 4817 | 0.74 | 0.34 |
| 1981 | 1755 | 14541 | 9147 | 5566 | 0.61 | 0.34 |
| 1982 | 6263 | 14290 | 10748 | 5782 | 0.54 | 0.37 |
| 1983 | 3113 | 13621 | 10085 | 6113 | 0.61 | 0.49 |
| 1984 | 789 | 13801 | 8723 | 6031 | 0.69 | 0.51 |
| 1985 | 1570 | 13313 | 8693 | 6139 | 0.71 | 0.53 |
| 1986 | 5733 | 11231 | 8241 | 6870 | 0.83 | 0.81 |
| 1987 | 3976 | 7736 | 5234 | 5139 | 0.98 | 0.92 |
| 1988 | 1774 | 7619 | 3644 | 6321 | 1.73 | 1.38 |
| 1989 | 2857 | 5946 | 2752 | 4995 | 1.82 | 1.16 |
| 1990 | 2386 | 4883 | 2429 | 3790 | 1.56 | 0.86 |
| 1991 | 968 | 4793 | 2295 | 3640 | 1.59 | 0.83 |
| 1992 | 1151 | 4559 | 2288 | 3382 | 1.48 | 0.87 |
| 1993 | 1343 | 3666 | 2060 | 2329 | 1.13 | 0.66 |
| 1994 | 2773 | 3507 | 2012 | 2007 | 1.00 | 0.57 |
| 1995 | 2249 | 4055 | 2116 | 1835 | 0.87 | 0.37 |
| 1996 | 507 | 5988 | 2996 | 2956 | 0.99 | 0.41 |
| 1997 | 192 | 7216 | 4136 | 3715 | 0.90 | 0.45 |
| 1998 | 184 | 6739 | 4715 | 2981 | 0.63 | 0.37 |
| 1999 | 456 | 5868 | 4740 | 1939 | 0.41 | 0.28 |
| 2000 | 543 | 5246 | 4515 | 1256 | 0.28 | 0.24 |
| 2001 | 3040 | 5016 | 4269 | 788 | 0.18 | 0.17 |
| 2002 | 1691 | 5755 | 4389 | 1034 | 0.24 | 0.19 |
| 2003 | 441 | 7940 | 5041 | 2279 | 0.45 | 0.29 |
| 2004 | 1606 | 9477 | 6273 | 3156 | 0.50 | 0.31 |
| 2005 | 1223 | 9857 | 7353 | 3646 | 0.50 | 0.36 |
| 2006 | 1340 | 9480 | 7253 | 2932 | 0.40 | 0.34 |
| 2007 | 582 | 9249 | 7029 | 2349 | 0.33 | 0.28 |
| 2008 | 357 | 9522 | 7306 | 2338 | 0.32 | 0.26 |
| 2009 | 536 | 9474 | 7652 | 2280 | 0.30 | 0.27 |
| 2010 | 1024 | 8940 | 7618 | 1548 | 0.20 | 0.20 |

**Table 8.1.8.** ANGLERFISH (*L. piscatorius* ) - Divisions VIIIc and IXa.

Catch option table.

| SSB (2011) | Recr | F (30-130cm) | Landings (2011) | |
|---|---|---|---|---|
| 7629 | 886 | 0.24 | 1651 | |
| SSB (2012) | Rec proj | F (30-130cm) | Landings (2012) | SSB (2013) |
| 7298 | 1166 | 0.24 | 1544 | 7237 |

| Fmult | Fland (30-130cm) | Landings (2013) | SSB (2014) |
|---|---|---|---|
| 0 | 0 | 0 | 9082 |
| 0.1 | 0.02 | 182 | 8899 |
| 0.2 | 0.05 | 360 | 8719 |
| 0.3 | 0.07 | 533 | 8544 |
| 0.4 | 0.1 | 702 | 8374 |
| 0.5 | 0.12 | 867 | 8207 |
| 0.6 | 0.15 | 1027 | 8045 |
| 0.7 | 0.17 | 1184 | 7886 |
| 0.8 | 0.19 | 1337 | 7731 |
| 0.9 | 0.22 | 1485 | 7580 |
| 1 | 0.24 | 1631 | 7433 |
| 1.1 | 0.27 | 1772 | 7289 |
| 1.2 | 0.29 | 1910 | 7148 |
| 1.3 | 0.32 | 2045 | 7011 |
| 1.4 | 0.34 | 2176 | 6877 |
| 1.5 | 0.36 | 2304 | 6746 |
| 1.6 | 0.39 | 2429 | 6618 |
| 1.7 | 0.41 | 2551 | 6493 |
| 1.8 | 0.44 | 2670 | 6371 |
| 1.9 | 0.46 | 2786 | 6252 |
| 2 | 0.48 | 2899 | 6136 |

**Table 8.1.9.** 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 | 56.72 |
| 0.82 | 0.1 | 0.02 | 0.55 | 46.40 |
| 0.67 | 0.2 | 0.05 | 0.97 | 38.11 |
| 0.55 | 0.3 | 0.07 | 1.29 | 31.44 |
| 0.46 | 0.4 | 0.10 | 1.54 | 26.06 |
| 0.38 | 0.5 | 0.12 | 1.73 | 21.70 |
| 0.32 | 0.6 | 0.15 | 1.86 | 18.16 |
| 0.27 | 0.7 | 0.17 | 1.96 | 15.27 |
| 0.23 | 0.8 | 0.19 | 2.03 | 12.92 |
| 0.19 | 0.9 | 0.22 | 2.08 | 10.98 |
| 0.17 | 1.0 | 0.24 | 2.11 | 9.39 |
| 0.14 | 1.1 | 0.27 | 2.13 | 8.08 |
| 0.12 | 1.2 | 0.29 | 2.13 | 6.99 |
| 0.11 | 1.3 | 0.32 | 2.13 | 6.08 |
| 0.09 | 1.4 | 0.34 | 2.11 | 5.32 |
| 0.08 | 1.5 | 0.36 | 2.10 | 4.68 |
| 0.07 | 1.6 | 0.39 | 2.08 | 4.14 |
| 0.07 | 1.7 | 0.41 | 2.06 | 3.68 |
| 0.06 | 1.8 | 0.44 | 2.03 | 3.29 |
| 0.05 | 1.9 | 0.46 | 2.01 | 2.96 |
| 0.05 | 2.0 | 0.48 | 1.98 | 2.67 |

| | SPR level | Fmult | F(30-130cm) | YPR(land) | SSB/R |
|---|---|---|---|---|---|
| Fmax | 0.12 | 1.20 | 0.29 | 2.13 | 7.04 |
| F0.1 | 0.23 | 0.78 | 0.19 | 2.02 | 13.24 |
| F40% | 0.40 | 0.48 | 0.12 | 1.68 | 22.70 |
| F35% | 0.35 | 0.55 | 0.13 | 1.79 | 20.01 |
| F30% | 0.30 | 0.64 | 0.15 | 1.90 | 17.08 |

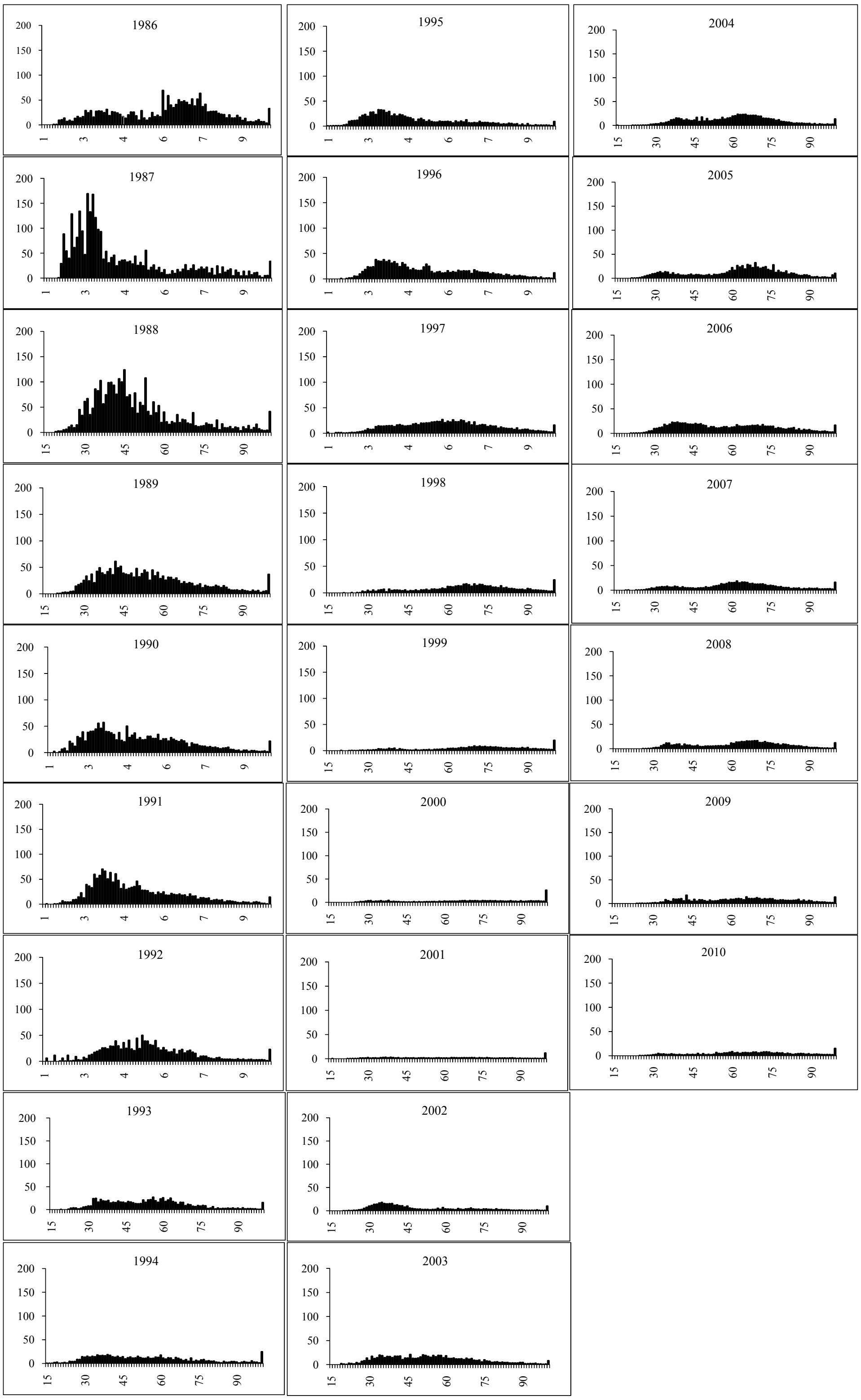



**Figure 8.1.1** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Length distributions of landings (thousands for 1986 to 2010).

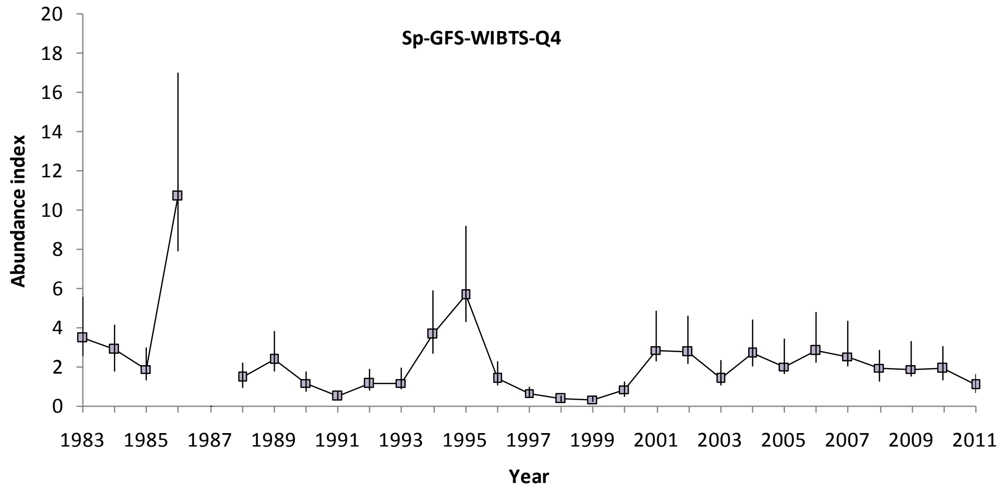



**Figure 8.1.2** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Abundance index for survey Sp-GFS-WIBTS-Q4 in numbers/30 min. Bars represent 95% confidence intervals.

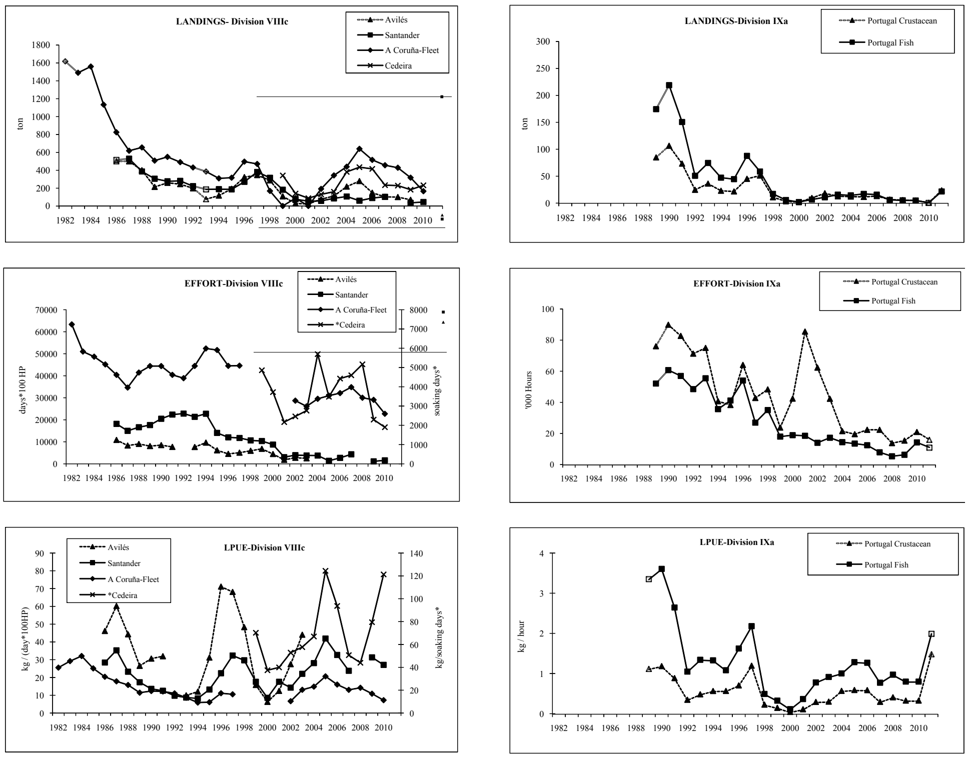



**Figure 8.1.3** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Trawl and gillnet landings, effort and LPUE data between 1986-2011.

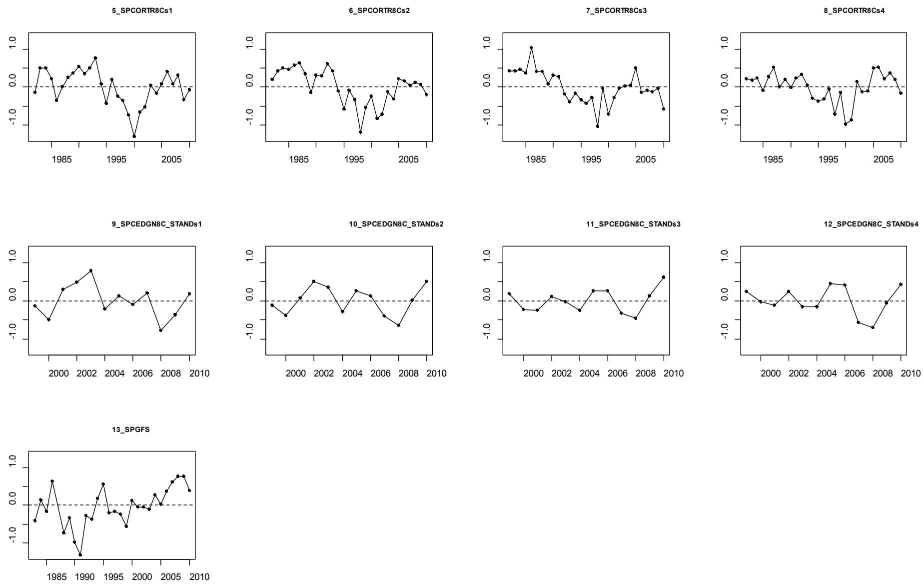
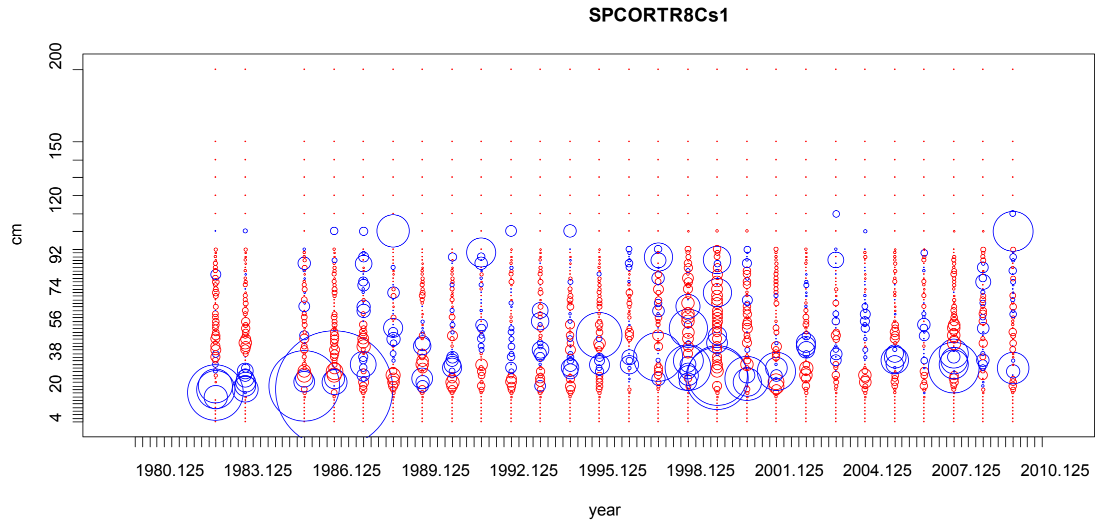



**Figure 8.1.4** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Residuals of the fits to the abundance indices in log (abundance indices). A Coruña and Cedeira are by quarter.



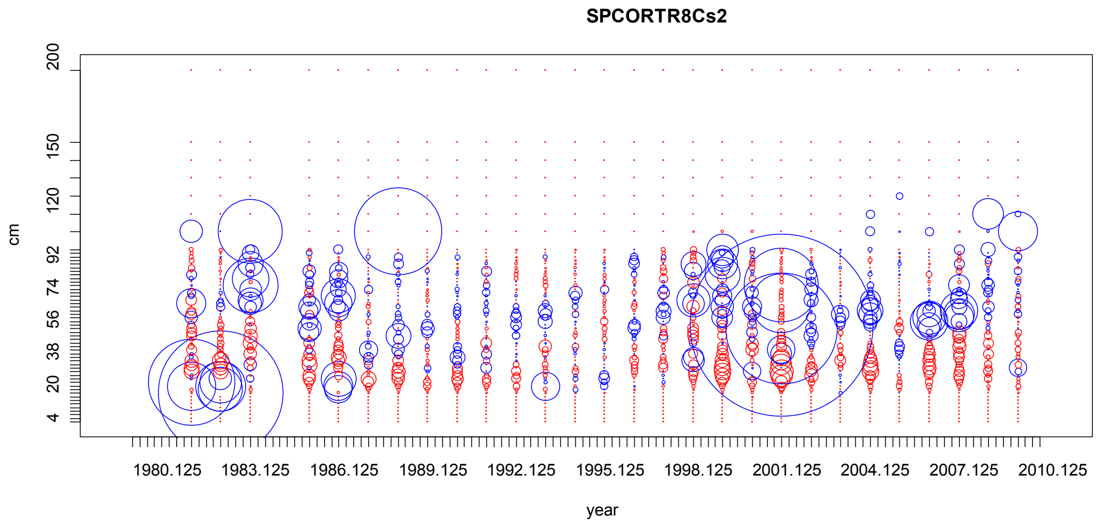
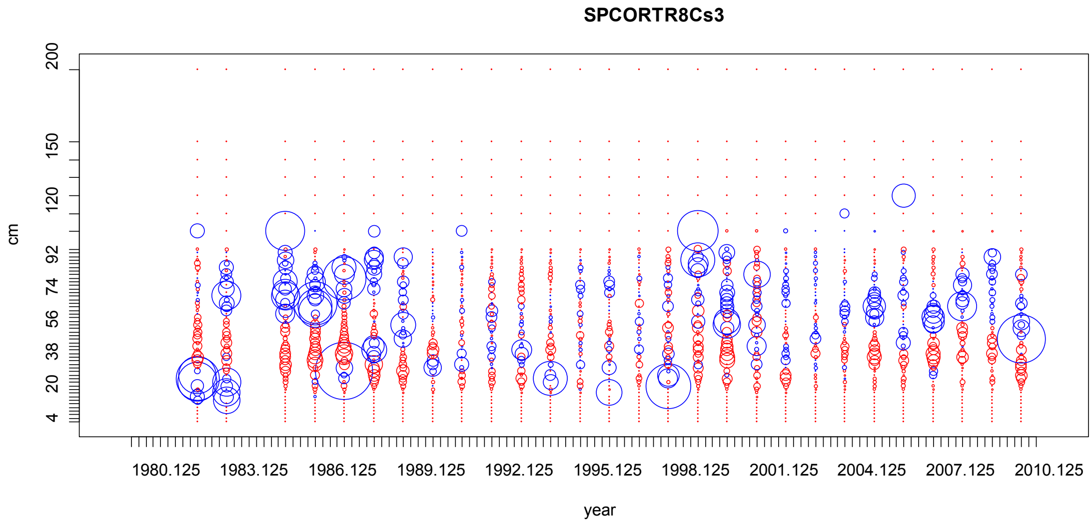




**Figure 8.1.5** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Pearson residuals for assessment estimates of length data by abundance index. Blue=positive residuals; red=negative residuals.



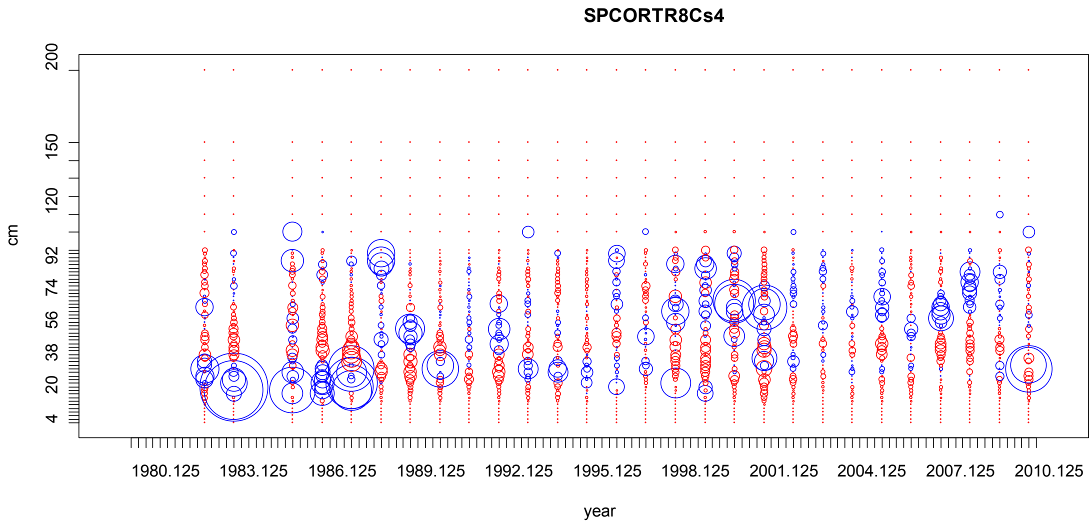
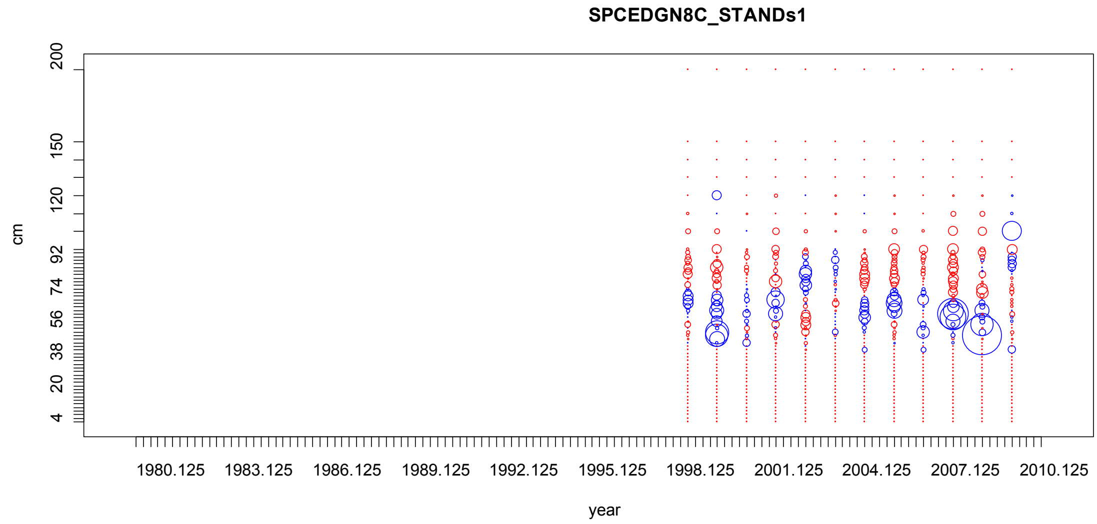




**Figure 8.1.5 (continued)**



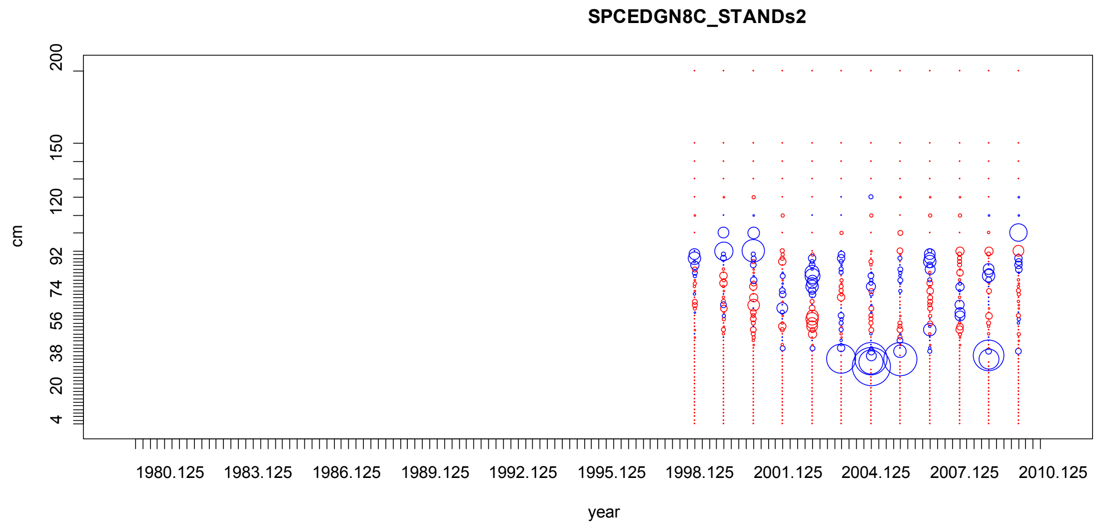
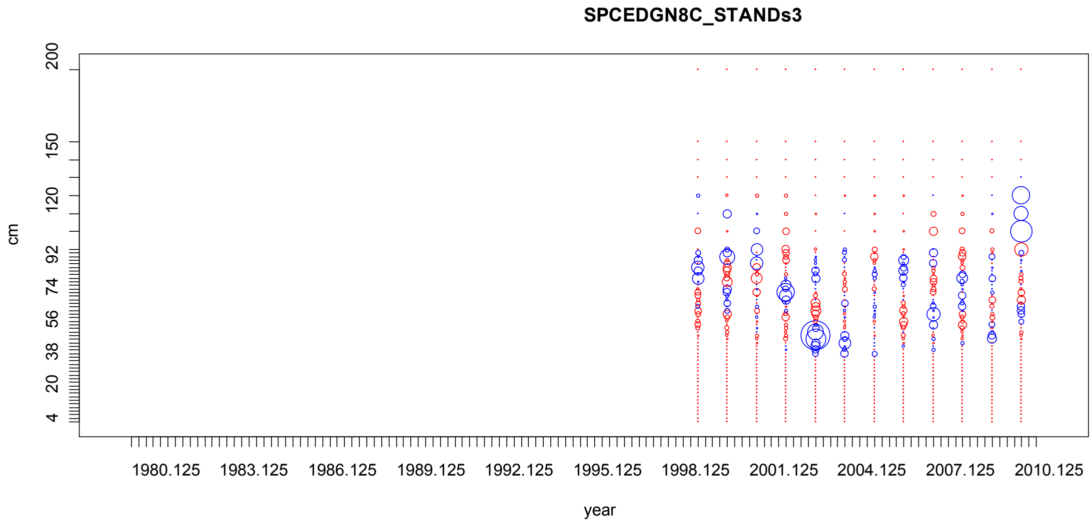




**Figure 8.1.5 (continued)**



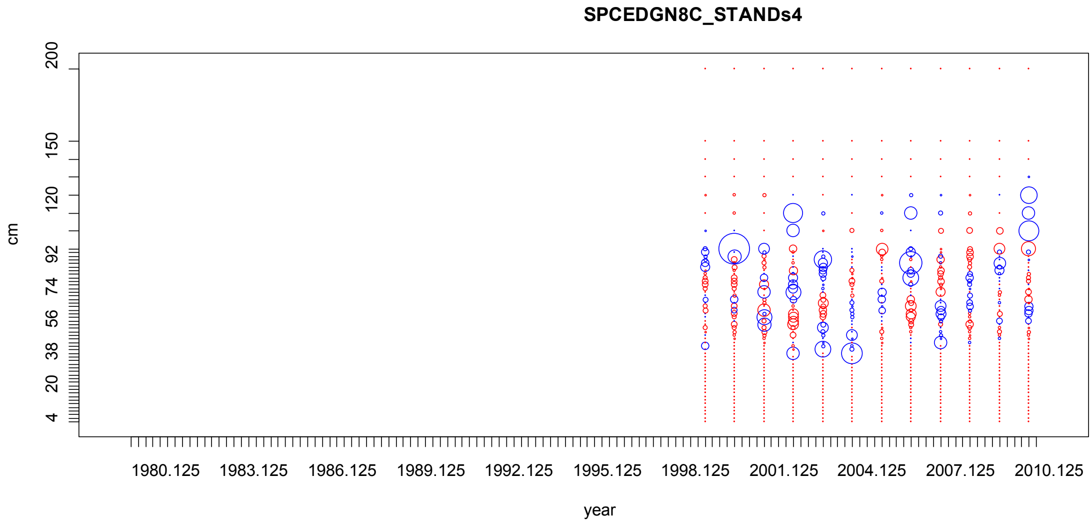




**Figure 8.1.5 (continued)**

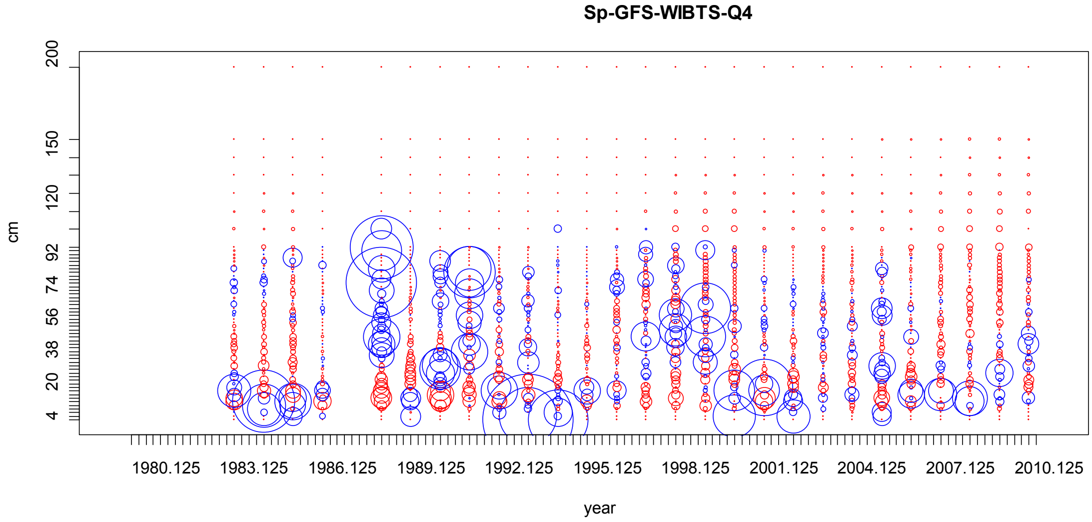



**Figure 8.1.5 (continued)**

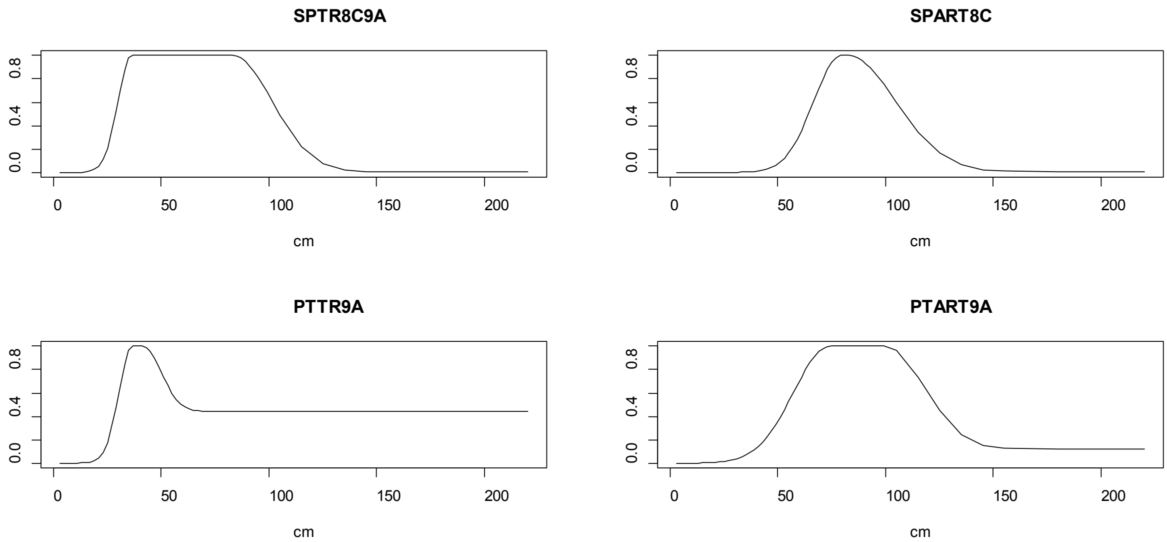



**Figure 8.1.6** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Relative selection patterns at length by fishery estimated by SS3.

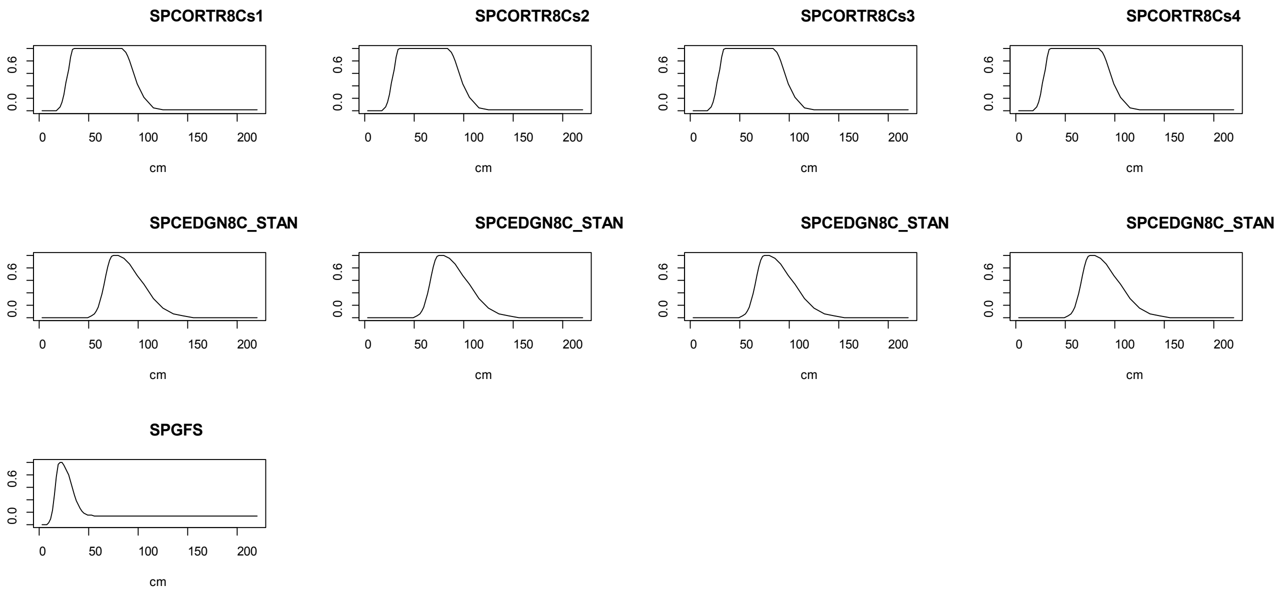



**Figure 8.1.7** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Relative selection patterns at length by abundance index estimated by SS3. A Coruña and Cedeira indices are by quarter.

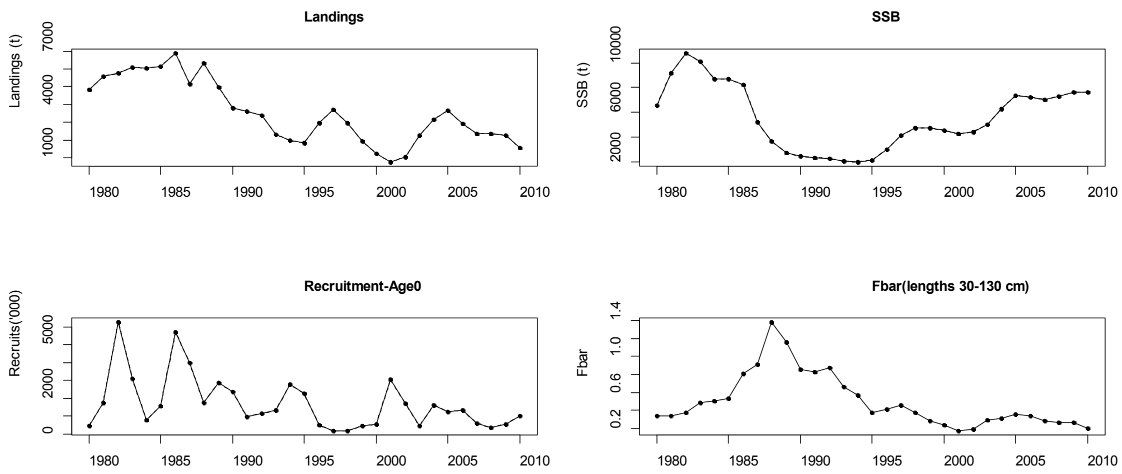



**Figure 8.1.8** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Summary plots of stock trends.

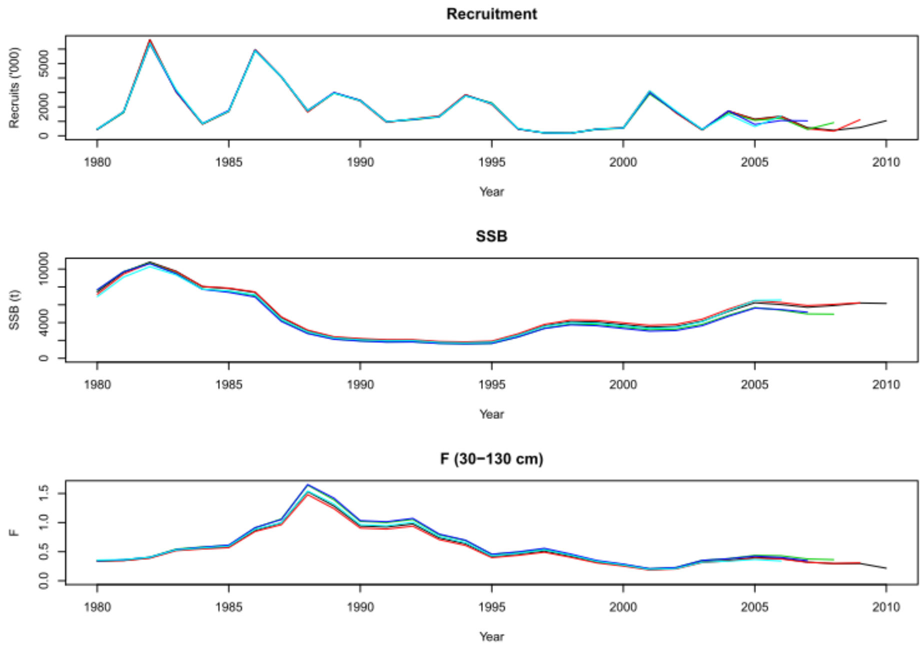



**Figure 8.1.9** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Retrospective plots from SS3.

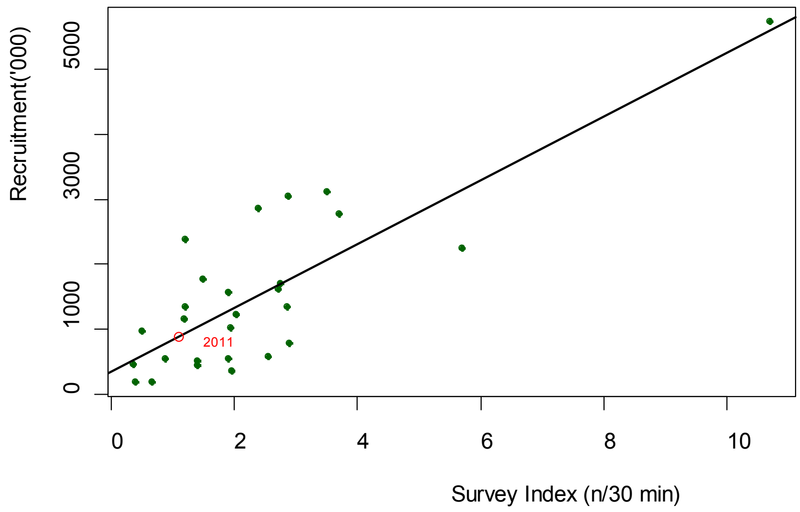



**Figure 8.1.10** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Recruitment and survey abundance index (Sp-GFS-WIBTS-Q4) relationship. The interpolation for survey index in 2011 is indicated.

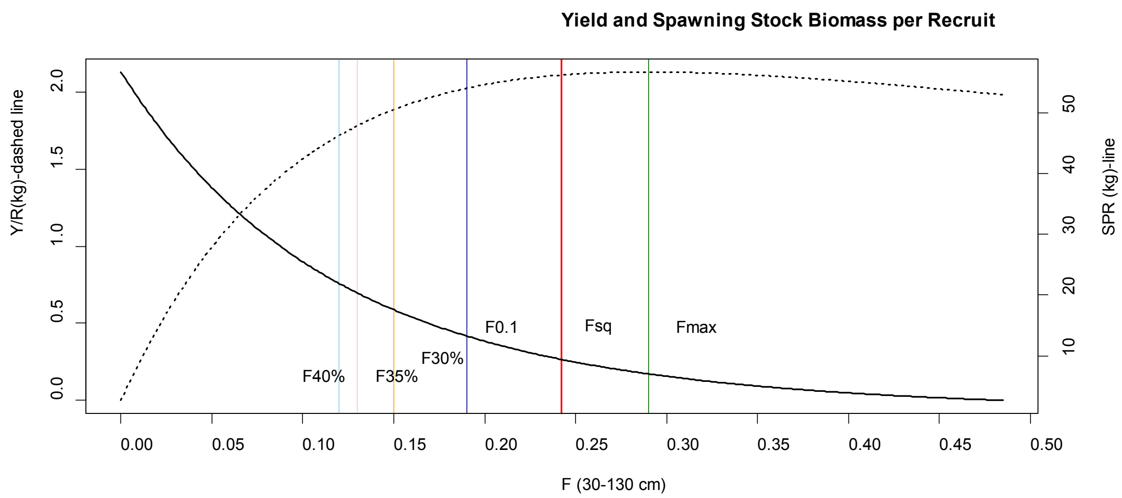



**Figure 8.1.11** **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Yield and SSB per recruit plot. Estimated reference points and Fsq are indicated.

# 8.2 Anglerfish (*Lophius budegassa*) in Divisions VIIIc and IXa

## 8.2.1 General

### 8.2.1.1 Ecosystem aspects

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

### 8.2.1.2 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).

The length distribution of the landings is considerably different between both fisheries, with the gillnet landings showing higher mean lengths compared to the trawl landings. From 2001 to 2010, the Spanish landings were on average split 87% from the trawl fleet and 13% from the artisanal fleet. Spanish landings data spited by species are not available for 2011, but from the sampling in 2011 the back anglerfish observed mean lengths of the trawl fishery were 41.7 and 42.8 cm in Divisions VIIIc and IXa respectively and mean length of the artisanal fishery was 63 cm in Division VIIIc. Since 2002 Portuguese landings were on average split, 27 % from the trawl fleet (mean length of 40.4 cm in 2011) and 73% from the artisanal fleet (mean length of 44.3 cm in 2011).

## 8.2.2 Data

### 8.2.2.1 Commercial catches and discards

Total landings of *L. budegassa* by country and gear for the period 1978–2011, as estimated by the Working Group, are given in Table 8.2.1. Spanish data in 2011 have been provided by Secretaría General de Pesca (SGP), the official national administration responsible for fishery statistics, and are presented in Annex T In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations. Several deficiencies in the Spanish data for 2011 prevent the use of these data to assess the stock. Landings data are not by species, Spanish data were not used for the evaluation of the stock. Portuguese landings in 2011 were 25% higher than previous year. See historical landings analysis in the Stock Annex. From 2002 to 2007 landings increased to 1 301 t, decreasing afterwards to 784 t in 2010. Total landings for back anglerfish in 2011 are not available.

Spanish trawl discards estimates of *L. budegassa* in weight and associated coefficient of variation (CV) are shown in Table 8.2.2. An increase in estimated discards rate was observed from 2004 to 2006, Spanish discards decreased to negligible values in 2007 and 2008 but since 2009 increased again, being 61 t in 2010. The maximum value of the time series occurred in 2006 with 92 t. 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 2004-2011 period (WDxx). The maximum occurrence of discards in the trawl fleet targeting fish was 2% (sampling effort varies between 83 and 194 hauls per year). The maximum occurrence of discards in the trawl fleet targeting crustaceans was 8% (sampling effort varies between 30 and 111 hauls per year). Because the estimation algorithm, used for hake in the WD, may be sensitive to a large frequency of zeros in the samples and a reasonable number of observations is required for accurate length frequency estimation of annual fleet discards, estimates of discards have not been calculated for the moment. *L. budegassa* discards in the Portuguese trawl fisheries seem to be negligible.

#### 8.2.2.2 Biological sampling

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

The sampling levels for 2011 are shown in Table 1.3. The metier sampling adopted in Spain and Portugal in 2011, 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 since 2009.

##### Length composition

Table 8.2.3 gives the annual length compositions by ICES division, country and gear for 2011 in relative values. Length composition was presented scaled to 1000 since Spanish landings were not available. Mean length for the Portuguese artisanal fleet decrease considerably in 2011 (from 63 cm in 2010 to 44.3 cm in 2011).

The annual length compositions between 1986 and 2010 are presented (in absolute values) in Figure 8.2.1.

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, except in 2010 when some increase was observed. The total annual landings in numbers and the annual mean length and mean weight are in Table 8.2.4.

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. Since then, the number of landed fish decreased to a minimum in 2009. In 2010 the number increased, while mean weight and length continued at high levels. Total number of landed individuals is not available for 2011.

#### 8.2.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2011 are summarized in Table 8.2.5. 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.

#### 8.2.2.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 8.2.6 and Figure 8.2.2 for Spanish trawlers from ports of Santander, Aviles and A Coruña (all in Division VIIIc) since 1986 and for Portuguese trawlers (Division IXa) since 1989. For each fleet the proportion of the landings in the stock is also given in the table.

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. In 2010 the observed landings showed a lightly increase.

Effort trends are analysed in section 8.1.2.4.

LPUEs of all Spanish fleets show high values during the second half of the 90's, while the Portuguese fleets have fluctuated. From 2002 to 2005 LPUE's have remained relatively stable at low values for all fleets. Since then an increasing or stable trend was observed in most of the fleets.

### 8.2.3 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). Due to the lack of data for 2011, the assessment model could not be updated this meeting, the assessment approved in the benchmark without entered any 2011 data was used to carry out the projections.

#### 8.2.3.1 Input data

A revised series from the Spanish fleet 'A Coruña' was available at WKFLAT2012, This series is the longest of the potential tuning series and represents the bulk of the fishery and it was concluded that it should be included in the modelling. 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.

The input data are presented in Table 8.2.7.

#### 8.2.3.2 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 8.2.7).

#### 8.2.3.3 Assessment results

The correlation coefficient between input fleets is acceptable but the r square between observed and fitted CPUE values are low (see Annex M). Point estimates and bias-corrected bootstrap confidence intervals for parameters are presented in Table 8.2.8, whereas Figure 8.2.3 plots observed and estimated CPUEs for each of the series used in the model. $B_{2011}/B_{MSY}$ and $F_{2010}/F_{MSY}$ have respectively -3.28% and 8.56% of bias and both have around 40% relative inter-quartile ranges. Biomass in 2011 is estimated to be 105% of $B_{MSY}$ with 95% bias-corrected confidence interval between 32% and 157%. Fishing mortality in 2010 is estimated to be 0.55 times $F_{MSY}$ with 95% bias-corrected confidence interval between 0.27 and 1.37 times $F_{MSY}$. MSY is estimated to be 1375 t with 95% CI from 184 t to 1699 t. More detailed results can be found in Annex M.

Trends in relative biomass (Figure 8.2.4) indicate a steady decrease since the beginning of the series to below $B_{MSY}$ in 2001, since then a slight recovery was observed and in 2011 the biomass is just above $B_{MSY}$. Fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2010, fishing mortality is estimated to be below $F_{MSY}$.

Comparison between the previews assessments (2007-2011) and the benchmark 2012 assessment are showed in Table 8.2.9 and Figure 8.2.5. The historic perspective of the stock is very different from the previous model, due to the inclusion of the series "A Coruna" that gives more information of the catches and also covers more time since it goes back in time further.

### 8.2.4 Projections

Projections were performed based on the ASPIC estimates. The projected B/$B_{MSY}$ and yield are presented in Table 8.2.10, where each column corresponds to a fishing mortality scenario. Projections were performed for F *status quo* (assumed as the average of the last 3 years - F 2008-2010), $F_{MSY}$, with zero catches. A set of projections were performed with the necessary F reductions to obtain 2013 yield for both anglerfish species combined corresponding to the 2012 TAC (3 300 t) and +/-15% 2011 TAC. Projections using the same multiplicative factor of F *status quo* for *L. piscatorius* in the scenarios MSY Framework and MSY transition were also performed. The reason for this projection scenario is that *L. piscatorius* is the species in poorest condition, so it will likely drive the advice for both anglerfish species combined.

For *L. budegassa*, fishing mortality equal to F *status quo* in 2013 is expected to keep the stock above $B_{MSY}$ in 2014. The biomass is expected to be above $B_{MSY}$ in 2014 under all fishing mortality scenarios examined (Table 8.2.10).

### 8.2.5 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).

### 8.2.6 Comments on the assessment

With the inclusion of the Spanish "A Coruña" series the assessment improved related to preview considerations but still show some week points such as high 80% confidence intervals, contributing to uncertainty in the assessment results.

The stability of the aspic model (particularly in the retro) is still a major issue (WKFLAT2012).

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 should be considered in two or three years (see Annex N which gives the benchmark preparation plan).

### 8.2.7 Management considerations

Management considerations are in section 8.3.

**Table 8.2.1.** ANGLERFISH (*L. budegassa* ) - Divisions VIIIc and IXa.
Tonnes landed by the main fishing fleets for 1978-2011 as determined by the Working Group.

| | Div. VIIIc | | | Div. IXa | | | | Div. VIIIc+IXa |
|---|---|---|---|---|---|---|---|---|
| | SPAIN | | | SPAIN | PORTUGAL | | | |
| Year | Trawl | Gillnet | TOTAL | Trawl | Trawl | Artisanal | TOTAL | TOTAL |
| 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 | n/a | n/a | n/a | n/a | 75 | 119 | n/a | n/a |

n/a: not available

**Table 8.2.2** 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 |

n/a: not available

CV: coefficient of variation

**Table 8.2.3** ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
Relative length composition by fleet in 2011 (‰).

| | Div. VIIIc | | | Div. IXa | | | | Div. VIIIc+IXa |
|---|---|---|---|---|---|---|---|---|
| | SPAIN | | | SPAIN | PORTUGAL | | | |
| Length (cm) | Trawl | Gillnet | TOTAL | Trawl | Trawl | Artisanal | TOTAL | TOTAL |
| 20 | 0.00 | 0.00 | 0.00 | 0.23 | 0.00 | 0.00 | 0.10 | 0.05 |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | 0.00 | 0.00 | 0.00 | 0.24 | 0.00 | 0.00 | 0.11 | 0.05 |
| 25 | 0.90 | 0.00 | 0.82 | 0.61 | 18.96 | 0.00 | 4.79 | 2.83 |
| 26 | 0.27 | 0.00 | 0.25 | 1.70 | 0.00 | 0.00 | 0.76 | 0.51 |
| 27 | 1.36 | 0.00 | 1.24 | 1.80 | 2.06 | 0.00 | 1.29 | 1.27 |
| 28 | 4.08 | 0.00 | 3.73 | 5.25 | 0.00 | 0.00 | 2.34 | 3.03 |
| 29 | 8.64 | 0.00 | 7.89 | 9.79 | 0.00 | 0.00 | 4.37 | 6.11 |
| 30 | 19.34 | 0.00 | 17.66 | 18.05 | 18.96 | 0.00 | 12.57 | 15.09 |
| 31 | 20.29 | 0.00 | 18.54 | 14.15 | 12.83 | 0.19 | 9.43 | 13.94 |
| 32 | 26.79 | 0.00 | 24.47 | 22.29 | 11.11 | 0.58 | 12.78 | 18.56 |
| 33 | 29.94 | 0.00 | 27.35 | 25.46 | 15.47 | 1.92 | 15.65 | 21.44 |
| 34 | 32.42 | 0.00 | 29.61 | 25.94 | 86.68 | 2.31 | 32.95 | 31.30 |
| 35 | 59.41 | 0.00 | 54.27 | 50.86 | 114.98 | 110.95 | 85.09 | 69.84 |
| 36 | 73.69 | 0.00 | 67.31 | 71.14 | 36.49 | 5.03 | 42.03 | 54.53 |
| 37 | 94.34 | 0.00 | 86.17 | 109.68 | 66.88 | 18.21 | 70.63 | 78.32 |
| 38 | 89.84 | 0.00 | 82.06 | 86.67 | 124.52 | 32.82 | 78.69 | 80.36 |
| 39 | 67.68 | 0.00 | 61.82 | 67.59 | 78.21 | 35.37 | 59.95 | 60.88 |
| 40 | 61.10 | 0.00 | 55.81 | 58.26 | 70.86 | 24.40 | 50.58 | 53.16 |
| 41 | 41.17 | 0.00 | 37.61 | 43.58 | 44.08 | 142.14 | 74.80 | 56.40 |
| 42 | 41.77 | 0.00 | 38.15 | 41.30 | 35.80 | 37.12 | 38.67 | 38.41 |
| 43 | 49.41 | 0.00 | 45.14 | 45.96 | 23.69 | 147.92 | 72.83 | 59.13 |
| 44 | 35.32 | 0.00 | 32.27 | 30.43 | 27.51 | 47.57 | 35.14 | 33.72 |
| 45 | 29.04 | 0.00 | 26.53 | 23.26 | 35.29 | 144.39 | 64.35 | 45.64 |
| 46 | 27.74 | 14.79 | 26.62 | 24.20 | 24.97 | 72.73 | 39.70 | 33.23 |
| 47 | 16.13 | 0.00 | 14.73 | 17.14 | 15.27 | 40.62 | 24.10 | 19.47 |
| 48 | 20.07 | 4.01 | 18.68 | 20.92 | 22.23 | 19.11 | 20.66 | 19.68 |
| 49 | 10.92 | 10.00 | 10.84 | 11.19 | 6.89 | 4.30 | 7.99 | 9.40 |
| 50 | 9.21 | 16.69 | 9.85 | 13.01 | 9.42 | 12.30 | 11.93 | 10.90 |
| 51 | 9.05 | 31.13 | 10.96 | 11.23 | 13.61 | 11.81 | 11.98 | 11.48 |
| 52 | 8.77 | 3.27 | 8.29 | 10.92 | 8.33 | 6.00 | 8.75 | 8.53 |
| 53 | 8.16 | 26.78 | 9.77 | 9.11 | 3.07 | 3.91 | 6.03 | 7.88 |
| 54 | 7.70 | 33.66 | 9.94 | 11.97 | 17.82 | 0.00 | 9.59 | 9.76 |
| 55 | 4.63 | 23.09 | 6.23 | 5.32 | 2.52 | 1.94 | 3.59 | 4.89 |
| 56 | 7.40 | 28.34 | 9.21 | 6.74 | 7.86 | 0.00 | 4.88 | 7.02 |
| 57 | 3.83 | 26.43 | 5.79 | 3.01 | 2.13 | 14.17 | 6.32 | 6.06 |
| 58 | 3.98 | 22.90 | 5.62 | 4.12 | 0.00 | 0.00 | 1.84 | 3.71 |
| 59 | 4.53 | 35.66 | 7.22 | 5.13 | 0.00 | 0.00 | 2.29 | 4.73 |
| 60 | 8.68 | 91.12 | 15.81 | 8.32 | 2.52 | 0.00 | 4.31 | 10.00 |
| 61 | 4.59 | 21.67 | 6.06 | 5.12 | 0.00 | 0.00 | 2.28 | 4.15 |
| 62 | 6.42 | 71.26 | 12.03 | 6.24 | 0.00 | 0.00 | 2.79 | 7.36 |
| 63 | 4.35 | 36.60 | 7.14 | 5.04 | 2.01 | 0.00 | 2.72 | 4.91 |
| 64 | 4.58 | 33.06 | 7.04 | 4.50 | 0.00 | 13.98 | 6.42 | 6.73 |
| 65 | 2.11 | 62.87 | 7.37 | 0.62 | 0.00 | 0.00 | 0.28 | 3.79 |
| 66 | 3.35 | 63.14 | 8.53 | 3.47 | 0.67 | 0.00 | 1.71 | 5.08 |
| 67 | 3.71 | 62.81 | 8.82 | 4.29 | 1.34 | 1.94 | 2.84 | 5.80 |
| 68 | 4.54 | 35.08 | 7.19 | 4.00 | 7.35 | 15.92 | 8.56 | 7.88 |
| 69 | 2.92 | 37.22 | 5.89 | 2.96 | 12.26 | 0.19 | 4.30 | 5.09 |
| 70 | 4.97 | 44.24 | 8.37 | 5.90 | 0.00 | 4.27 | 3.98 | 6.15 |
| 71 | 3.01 | 27.03 | 5.09 | 3.39 | 0.67 | 0.00 | 1.67 | 3.36 |
| 72 | 3.57 | 36.37 | 6.41 | 4.26 | 0.67 | 1.94 | 2.68 | 4.52 |
| 73 | 2.68 | 25.65 | 4.67 | 3.39 | 2.66 | 0.00 | 2.15 | 3.40 |
| 74 | 2.34 | 16.01 | 3.52 | 3.49 | 1.85 | 1.94 | 2.61 | 3.06 |
| 75 | 2.64 | 15.81 | 3.78 | 3.80 | 0.67 | 2.14 | 2.53 | 3.15 |
| 76 | 1.72 | 13.72 | 2.76 | 1.89 | 0.67 | 0.00 | 1.00 | 1.87 |
| 77 | 1.04 | 0.00 | 0.95 | 2.08 | 0.00 | 13.98 | 5.34 | 3.17 |
| 78 | 1.58 | 11.96 | 2.48 | 1.87 | 0.00 | 3.91 | 2.07 | 2.27 |
| 79 | 0.87 | 5.09 | 1.23 | 1.89 | 0.67 | 0.00 | 1.00 | 1.12 |
| 80 | 0.72 | 5.12 | 1.10 | 2.36 | 0.00 | 0.00 | 1.05 | 1.08 |
| 81 | 0.10 | 0.00 | 0.09 | 0.75 | 0.00 | 0.00 | 0.34 | 0.22 |
| 82 | 0.00 | 4.01 | 0.35 | 0.85 | 3.40 | 0.00 | 1.19 | 0.77 |
| 83 | 0.00 | 0.00 | 0.00 | 1.05 | 0.00 | 0.00 | 0.47 | 0.24 |
| 84 | 0.11 | 0.00 | 0.10 | 1.40 | 0.00 | 1.94 | 1.24 | 0.67 |
| 85 | 0.15 | 0.00 | 0.14 | 0.93 | 0.00 | 0.00 | 0.41 | 0.28 |
| 86 | 0.16 | 0.00 | 0.15 | 0.56 | 0.00 | 0.00 | 0.25 | 0.20 |
| 87 | 0.11 | 0.00 | 0.10 | 0.27 | 1.19 | 0.00 | 0.40 | 0.25 |
| 88 | 0.05 | 0.00 | 0.05 | 1.13 | 0.00 | 0.00 | 0.50 | 0.28 |
| 89 | 0.00 | 0.00 | 0.00 | 1.68 | 1.05 | 0.00 | 1.00 | 0.51 |
| 90 | 0.00 | 0.00 | 0.00 | 0.92 | 0.00 | 0.00 | 0.41 | 0.21 |
| 91 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.22 | 0.11 |
| 92 | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.06 | 0.03 |
| 93 | 0.00 | 0.00 | 0.00 | 1.62 | 0.67 | 0.00 | 0.88 | 0.45 |
| 94 | 0.00 | 0.00 | 0.00 | 0.58 | 0.00 | 0.00 | 0.26 | 0.13 |
| 95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 96 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.22 | 0.11 |
| 97 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 98 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 99 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 100+ | 0.00 | 3.43 | 0.30 | 0.00 | 1.19 | 0.00 | 0.28 | 0.29 |
| TOTAL | 1000.00 | 1000.00 | 1000.00 | 1000.00 | 1000.00 | 1000.00 | 1000.00 | 1000.00 |
| Landings (t) | n/a | n/a | n/a | n/a | 75 | 119 | n/a | n/a |
| Mean Weight (g) | n/a | n/a | n/a | n/a | 1299 | 1545 | n/a | n/a |
| Mean Length (cm) | 41.7 | 63.0 | 43.5 | 42.8 | 40.4 | 44.3 | 42.7 | 43.1 |
| Measured weight (t) | 7.9 | 10.0 | 17.9 | 9.3 | 0.6 | 0.4 | 1.0 | 18.9 |

**Table 8.2.4** ANGLERFISH (*L. budegassa* ) - Divisions VIIIc and IXa.
Number, mean weight and mean length of landings between 1986 and 2011.

| | 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 | n/a | n/a | n/a |

n/a: not available

**Table 8.2.5** 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 |

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

**Table 8.2.6** 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 | | | | | | | | | | Div. IXa | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Avilés | % | Santander | % | A Coruña-Port | A Coruña-Trucks | [1]A Coruña-Fleet | % | Cedeira | % | Portugal Crustacean | % | Portugal Fish | % |
| 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 | | | 89 | 3 | 183 | 7 |
| 1990 | 58 | 2 | 40 | 2 | 288 | | 288 | 12 | | | 127 | 5 | 261 | 11 |
| 1991 | 52 | 2 | 62 | 3 | 225 | | 225 | 10 | | | 101 | 5 | 208 | 10 |
| 1992 | 33 | 2 | 107 | 5 | 211 | | 211 | 10 | | | 94 | 4 | 193 | 9 |
| 1993 | 53 | 2 | 143 | 6 | 199 | | 199 | 9 | | | 64 | 3 | 132 | 6 |
| 1994 | 65 | 4 | 196 | 12 | 166 | 37 | 204 | 13 | | | 26 | 2 | 53 | 3 |
| 1995 | 141 | 8 | 126 | 7 | 353 | 75 | 428 | 23 | | | 22 | 1 | 46 | 2 |
| 1996 | 162 | 10 | 89 | 5 | 334 | 68 | 403 | 25 | | | 45 | 3 | 88 | 5 |
| 1997 | 143 | 8 | 122 | 7 | 298 | 43 | 341 | 19 | | | 38 | 2 | 43 | 2 |
| 1998 | 91 | 4 | 114 | 5 | 323 | 72 | 394 | 19 | | | 70 | 3 | 111 | 5 |
| 1999 | 41 | 2 | 67 | 4 | 374 | n/a | n/a | n/a | 14 | 1 | 41 | 2 | 69 | 4 |
| 2000 | 23 | 2 | 44 | 3 | 287 | 6 | 293 | 21 | 4 | <1 | 66 | 5 | 76 | 6 |
| 2001 | 12 | 1 | 28 | 3 | 281 | n/a | n/a | n/a | 6 | 1 | 59 | 6 | 42 | 4 |
| 2002 | 11 | 1 | 16 | 2 | 76 | 31 | 107 | 14 | 7 | 1 | 47 | 6 | 28 | 4 |
| 2003 | 9 | 1 | 15 | 2 | 85 | 43 | 128 | 14 | 3 | <1 | 30 | 3 | 38 | 4 |
| 2004 | 32 | 3 | 23 | 2 | 68 | 40 | 107 | 11 | 5 | 1 | 23 | 2 | 27 | 3 |
| 2005 | 54 | 6 | 7 | 1 | 54 | 32 | 86 | 10 | 2 | <1 | 12 | 1 | 19 | 2 |
| 2006 | 16 | 1 | 18 | 2 | 70 | 81 | 151 | 13 | 4 | <1 | 18 | 2 | 22 | 2 |
| 2007 | 11 | 1 | 19 | 1 | 109 | 113 | 223 | 17 | 2 | <1 | 34 | 3 | 31 | 2 |
| 2008 | 10 | 1 | n/a | n/a | 163 | 98 | 261 | 27 | 0.4 | <1 | 21 | 2 | 19 | 2 |
| 2009 | 5 | 1 | 8 | 1 | 80 | 67 | 147 | 19 | 4 | 1 | 18 | 2 | 16 | 2 |
| 2010 | n/a | n/a | 19 | 2 | 112 | 87 | 199 | 25 | 4 | 1 | 37 | 5 | 34 | 4 |
| 2011 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 39 | n/a | 36 | n/a |

Fishing effort

| | Div. VIIIc | | | | | | Div. IXa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | [1]Avilés | [1]Santander | A Coruña-Port | A Coruña-Trucks | [1]A Coruña-Fleet | [2]Cedeira standardized 2010 | Portugal [3]Crustacean | Portugal [4]Crustacean standardized | Portugal [3]Fish | Portugal [4]Fish standardized |
| 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 | | 76 | 23 | 52 | 18 |
| 1990 | 8497 | 20469 | 44403 | | 44403 | | 90 | 20 | 61 | 17 |
| 1991 | 7681 | 22391 | 40429 | | 40429 | | 83 | 17 | 57 | 15 |
| 1992 | n/a | 22833 | 38899 | | 38899 | | 71 | 15 | 49 | 14 |
| 1993 | 7635 | 21370 | 44478 | | 44478 | | 75 | 13 | 56 | 13 |
| 1994 | 9620 | 22772 | 39602 | 12795 | 52397 | | 41 | 8 | 36 | 10 |
| 1995 | 6146 | 14046 | 41476 | 10232 | 51708 | | 38 | 8 | 41 | 9 |
| 1996 | 4525 | 12071 | 35709 | 8791 | 44501 | | 64 | 14 | 54 | 12 |
| 1997 | 5061 | 11776 | 35494 | 9108 | 44602 | | 43 | 11 | 27 | 9 |
| 1998 | 5929 | 10646 | 29508 | n/a | n/a | | 48 | 11 | 35 | 10 |
| 1999 | 6829 | 10349 | 30131 | n/a | n/a | 4860 | 24 | 8 | 18 | 6 |
| 2000 | 4453 | 8779 | 30079 | n/a | n/a | 3726 | 42 | 10 | 19 | 6 |
| 2001 | 1838 | 3053 | 29935 | n/a | n/a | 2167 | 85 | 18 | 19 | 5 |
| 2002 | 2748 | 3975 | 21948 | 6747 | 28695 | 2464 | 62 | 10 | 14 | 4 |
| 2003 | 2526 | 3837 | 18519 | 7608 | 26127 | 2764 | 42 | 10 | 17 | 6 |
| 2004 | n/a | 3776 | 19198 | 10342 | 29540 | 5696 | 21 | 7 | 14 | 4 |
| 2005 | n/a | 1404 | 20663 | 10302 | 30965 | 3485 | 20 | 5 | 13 | 4 |
| 2006 | n/a | 2718 | 19264 | 12866 | 32130 | 4429 | 22 | 5 | 12 | 4 |
| 2007 | n/a | 4334 | 21651 | 13187 | 34838 | 4599 | 22 | 6 | 8 | 3 |
| 2008 | n/a | n/a | 20212 | 9812 | 30024 | 5168 | 14 | 4 | 5 | 2 |
| 2009 | n/a | 1125 | 16162 | 12930 | 29092 | 2299 | 15 | n/a | 6 | n/a |
| 2010 | n/a | 1628 | 13744 | 9003 | 22746 | 1902 | 21 | n/a | 14 | n/a |
| 2011 | n/a | n/a | n/a | n/a | n/a | n/a | 16 | | 11 | |

[1] Fishing days per 100 HP  [3] 1000 Hours trawling with occurrence of anglerfish
[2] Soaking days  [4] 1000 Hauls
n/a - not available

LPUE

| | Div. VIIIc | | | | | | Div. IXa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | [1]Avilés | [1]Santander | A Coruña-Port | A Coruña-Trucks | [1]A Coruña-Fleet | [2]Cedeira standardized 2010 | Portugal [3]Crustacean | Portugal [4]Crustacean standardized | Portugal [3]Fish | Portugal [4]Fish standardized |
| 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 | | 1.17 | 3.9 | 3.51 | 10.4 |
| 1990 | 6.8 | 1.9 | 6.5 | | 6.5 | | 1.41 | 6.2 | 4.29 | 15.2 |
| 1991 | 6.7 | 2.8 | 5.6 | | 5.6 | | 1.22 | 6.1 | 3.65 | 13.5 |
| 1992 | n/a | 4.7 | 5.4 | | 5.4 | | 1.32 | 6.2 | 3.97 | 14.1 |
| 1993 | 7.0 | 6.7 | 4.5 | | 4.5 | | 0.85 | 4.8 | 2.37 | 10.1 |
| 1994 | 6.7 | 8.6 | 4.2 | 2.9 | 3.9 | | 0.64 | 3.4 | 1.50 | 5.5 |
| 1995 | 23.0 | 9.0 | 8.5 | 7.3 | 8.3 | | 0.58 | 2.8 | 1.11 | 5.0 |
| 1996 | 35.8 | 7.4 | 9.4 | 7.8 | 9.0 | | 0.70 | 3.1 | 1.62 | 7.1 |
| 1997 | 28.3 | 10.4 | 8.4 | 4.8 | 7.7 | | 0.88 | 3.3 | 1.60 | 4.9 |
| 1998 | 15.3 | 10.7 | 10.9 | n/a | n/a | | 1.45 | 6.3 | 3.16 | 11.5 |
| 1999 | 5.9 | 6.5 | 12.4 | n/a | n/a | 2.8 | 1.72 | 5.0 | 3.85 | 12.2 |
| 2000 | 5.1 | 5.0 | 9.6 | n/a | n/a | 1.1 | 1.56 | 6.5 | 4.04 | 12.6 |
| 2001 | 6.7 | 9.3 | 9.4 | n/a | n/a | 2.7 | 0.69 | 3.2 | 2.27 | 8.5 |
| 2002 | 4.1 | 4.1 | 3.5 | 4.6 | 3.7 | 2.9 | 0.75 | 4.8 | 2.00 | 6.2 |
| 2003 | 3.6 | 4.0 | 4.6 | 5.6 | 4.9 | 0.9 | 0.71 | 3.1 | 2.17 | 6.7 |
| 2004 | n/a | 6.0 | 3.5 | 3.8 | 3.6 | 0.9 | 1.07 | 3.5 | 1.90 | 6.2 |
| 2005 | n/a | 4.9 | 2.6 | 3.1 | 2.8 | 0.7 | 0.63 | 2.4 | 1.38 | 5.0 |
| 2006 | n/a | 6.8 | 3.6 | 6.3 | 4.7 | 0.9 | 0.80 | 3.3 | 1.73 | 5.6 |
| 2007 | n/a | 4.5 | 5.1 | 8.6 | 6.4 | 0.5 | 1.53 | 5.6 | 3.98 | 10.5 |
| 2008 | n/a | n/a | 8.1 | 10.0 | 8.7 | 0.1 | 1.50 | 5.4 | 3.56 | 10.6 |
| 2009 | n/a | 6.8 | 5.0 | 5.2 | 5.1 | 1.7 | 1.14 | n/a | 2.65 | n/a |
| 2010 | n/a | 11.9 | 8.1 | 9.7 | 8.7 | 2.1 | 1.75 | n/a | 2.37 | n/a |
| 2011 | n/a | n/a | n/a | n/a | n/a | n/a | 2.44 | n/a | 3.27 | n/a |

[1] kg/days*100HP  [3] kg/hour trawl
[2] kg/soaking day  [4] kg/haul

**Table 8.2.7** 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
31 ## 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 | 5.60E+00 | 1.83E+03 | 1985 | -1.00E+00 | 1985 | -1.00E+00 |
| 1986 | 8.70E+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 | 7.70E+00 | 2.58E+03 | 1989 | 1.17E-03 | 1989 | 3.51E-03 |
| 1990 | 6.50E+00 | 2.33E+03 | 1990 | 1.41E-03 | 1990 | 4.29E-03 |
| 1991 | 5.60E+00 | 2.16E+03 | 1991 | 1.22E-03 | 1991 | 3.65E-03 |
| 1992 | 5.40E+00 | 2.11E+03 | 1992 | 1.32E-03 | 1992 | 3.97E-03 |
| 1993 | 4.50E+00 | 2.23E+03 | 1993 | 8.53E-04 | 1993 | 2.37E-03 |
| 1994 | 3.90E+00 | 1.58E+03 | 1994 | 6.37E-04 | 1994 | 1.50E-03 |
| 1995 | 8.30E+00 | 1.84E+03 | 1995 | 5.82E-04 | 1995 | 1.11E-03 |
| 1996 | 9.00E+00 | 1.63E+03 | 1996 | 7.03E-04 | 1996 | 1.62E-03 |
| 1997 | 7.70E+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 | 9.60E+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 | 3.70E+00 | 7.70E+02 | 2002 | 7.54E-04 | 2002 | 2.00E-03 |
| 2003 | 4.90E+00 | 9.26E+02 | 2003 | 7.14E-04 | 2003 | 2.17E-03 |
| 2004 | 3.60E+00 | 9.72E+02 | 2004 | 1.07E-03 | 2004 | 1.90E-03 |
| 2005 | 2.80E+00 | 8.97E+02 | 2005 | 6.34E-04 | 2005 | 1.38E-03 |
| 2006 | 4.70E+00 | 1.15E+03 | 2006 | 8.01E-04 | 2006 | 1.73E-03 |
| 2007 | 6.40E+00 | 1.30E+03 | 2007 | 1.53E-03 | 2007 | 3.98E-03 |
| 2008 | 8.70E+00 | 9.51E+02 | 2008 | 1.50E-03 | 2008 | 3.56E-03 |
| 2009 | 5.10E+00 | 7.69E+02 | 2009 | 1.14E-03 | 2009 | 2.65E-03 |
| 2010 | 8.70E+00 | 7.84E+02 | 2010 | 1.75E-03 | 2010 | 2.37E-03 |

**Table 8.2.8** 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(2011): equilibrium yield available in 2011; Y(Fmsy): yield availabe at Fmsy in 2011; Ye2011/MSY: equilibrium yield available in 2011 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.

| | WG2012/WKFLAT2012 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Bootstrap Confidence Interval | | | | | | |
| | Point | | Lower | Higher | Lower | Higher | | | Relative |
| Parameter | estimates | Relative bias | 80% | 80% | 95% | 95% | | IQ-Range | IQ-Range |
| B1/K | 0.93 | -3.46% | 0.22 | 1.08 | 0.18 | 1.18 | | 0.64 | 69.20% |
| K | 43910 | 30.68% | 30540 | 95400 | 26970 | 197000 | | 27730 | 63.20% |
| | | | | | | | | | |
| q(1) | 3.09E-04 | 11.50% | 1.34E-04 | 5.07E-04 | 6.52E-05 | 6.12E-04 | | 1.96E-04 | 63.30% |
| q(2) | 4.85E-08 | 13.49% | 2.02E-08 | 8.23E-08 | 1.06E-08 | 1.03E-07 | | 3.29E-08 | 67.80% |
| q(3) | 1.17E-07 | 13.42% | 4.98E-08 | 2.01E-07 | 2.67E-08 | 2.44E-07 | | 8.02E-08 | 68.80% |
| | | | | | | | | | |
| MSY | 1375 | 13.07% | 527 | 1517 | 184 | 1699 | | 456 | 33.20% |
| Ye(2011) | 1372 | -0.31% | 1070 | 1611 | 664 | 1859 | | 232 | 16.90% |
| Y.(Fmsy) | 804 | 0.41% | 789 | 825 | 782 | 839 | | 18 | 2.30% |
| | | | | | | | | | |
| Bmsy | 21950 | 30.68% | 15270 | 47700 | 13490 | 98520 | | 13860 | 63.20% |
| Fmsy | 0.063 | 10.10% | 0.017 | 0.093 | 0.008 | 0.110 | | 0.041 | 65.00% |
| | | | | | | | | | |
| fmsy(1) | 202.6 | 3.46% | 141.8 | 308 | 98.96 | 417.3 | | 78.91 | 39.00% |
| fmsy(2) | 1291000 | 3.19% | 919100 | 2042000 | 686300 | 3071000 | | 560100 | 43.40% |
| fmsy(3) | 537700 | 3.34% | 382000 | 861300 | 288300 | 1220000 | | 232900 | 43.30% |
| | | | | | | | | | |
| B./Bmsy | 1.05 | -3.28% | 0.58 | 1.39 | 0.32 | 1.57 | | 0.39 | 37.00% |
| F./Fmsy | 0.55 | 8.56% | 0.37 | 0.87 | 0.27 | 1.37 | | 0.23 | 42.20% |
| Ye./MSY | 1.00 | -9.43% | 1.00 | 1.00 | 0.99 | 1.00 | | 0.00 | 0.00% |
| | | | | | | | | | |
| q2/q1 | 1.57E-04 | 1.42% | 1.34E-04 | 1.80E-04 | 1.26E-04 | 1.95E-04 | | 2.46E-05 | 15.70% |
| q3/q1 | 3.77E-04 | 1.43% | 3.17E-04 | 4.39E-04 | 2.94E-04 | 4.79E-04 | | 6.13E-05 | 16.30% |

**Table 8.2.9** ANGLERFISH (*L. budegassa* ) – Divisions VIIIc and IXa
Comparasion of parameter estimates between WGHMM 2011 and WKFLAT 2012 assessments

| Parameter | Assessment year | |
|---|---|---|
| point | WGHMM | WKFLAT |
| estimates | 2011 | 2012 |
| B1/K | 0.40 | 0.93 |
| K | 11700 | 43910 |
| MSY | 2515 | 1375 |
| Y.@Fmsy | 1013 | 1436 |
| Bmsy | 5850 | 21950 |
| Fmsy | 0.430 | 0.063 |
| B./Bmsy | 0.91 | 1.04 |
| F./Fmsy | 0.39 | 0.52 |

B./Bmsy: $B_{2011}$/Bmsy for 2011.

F../Fmsy: $F_{2010}$/Fmsy for 2011.

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

**Table 8.2.10.** ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.

Point estimates of B/BMSY(from 2011 to 2013) and Yield (from 2011 to 2013) for projections with F status quo (Fsq), FMSY, zero catches. Reductions to obtain yields equal to 2012 TAC, and +/- 15% 2012 TAC are also presented. The value of F2011/FMSY and F2012/FMSY is equal to Fsq (mean F of 2008-2010) in all scenarios proposed. Values for F/FMSY are also given.

**Fishing mortality trends in relation to $F_{MSY}$**

| year | *L. piscatorius* MSYFramework | *L. piscatorius* MSYTransition | Fsq | $F_{MSY}$ | zero catches | -15% TAC= 2805 t | TAC=3300 t | +15% TAC = 3795 t |
|---|---|---|---|---|---|---|---|---|
| 2011 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| 2012 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| 2013 | 0.48 | 0.49 | 0.60 | 1.00 | 0.00 | 0.64 | 0.76 | 0.89 |

**Biomass trends in relation to $B_{MSY}$**

| year | *L. piscatorius* MSYFramework | *L. piscatorius* MSYTransition | Fsq | $F_{MSY}$ | zero catches | reduction 67.45 % | reduction 61.45 % | reduction 55.37 % |
|---|---|---|---|---|---|---|---|---|
| 2011 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 |
| 2012 | 1.07 | 1.07 | 1.07 | 1.07 | 1.07 | 1.07 | 1.07 | 1.07 |
| 2013 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 |
| 2014 | 1.12 | 1.12 | 1.11 | 1.08 | 1.15 | 1.11 | 1.10 | 1.09 |

**Yield**

| year | *L. piscatorius* MSYFramework | *L. piscatorius* MSYTransition | Fsq | $F_{MSY}$ | zero catches | reduction 67.45 % | reduction 61.45 % | reduction 55.37 % |
|---|---|---|---|---|---|---|---|---|
| 2011 | 878.4 | 878.4 | 878.4 | 878.4 | 878.4 | 878.4 | 878.4 | 878.4 |
| 2012 | 896.6 | 896.6 | 896.6 | 896.6 | 896.6 | 896.6 | 896.6 | 896.6 |
| 2013 | 729.4 | 737.7 | 910.4 | 1494.0 | 0.0 | 959.6 | 1147.0 | 1341.0 |

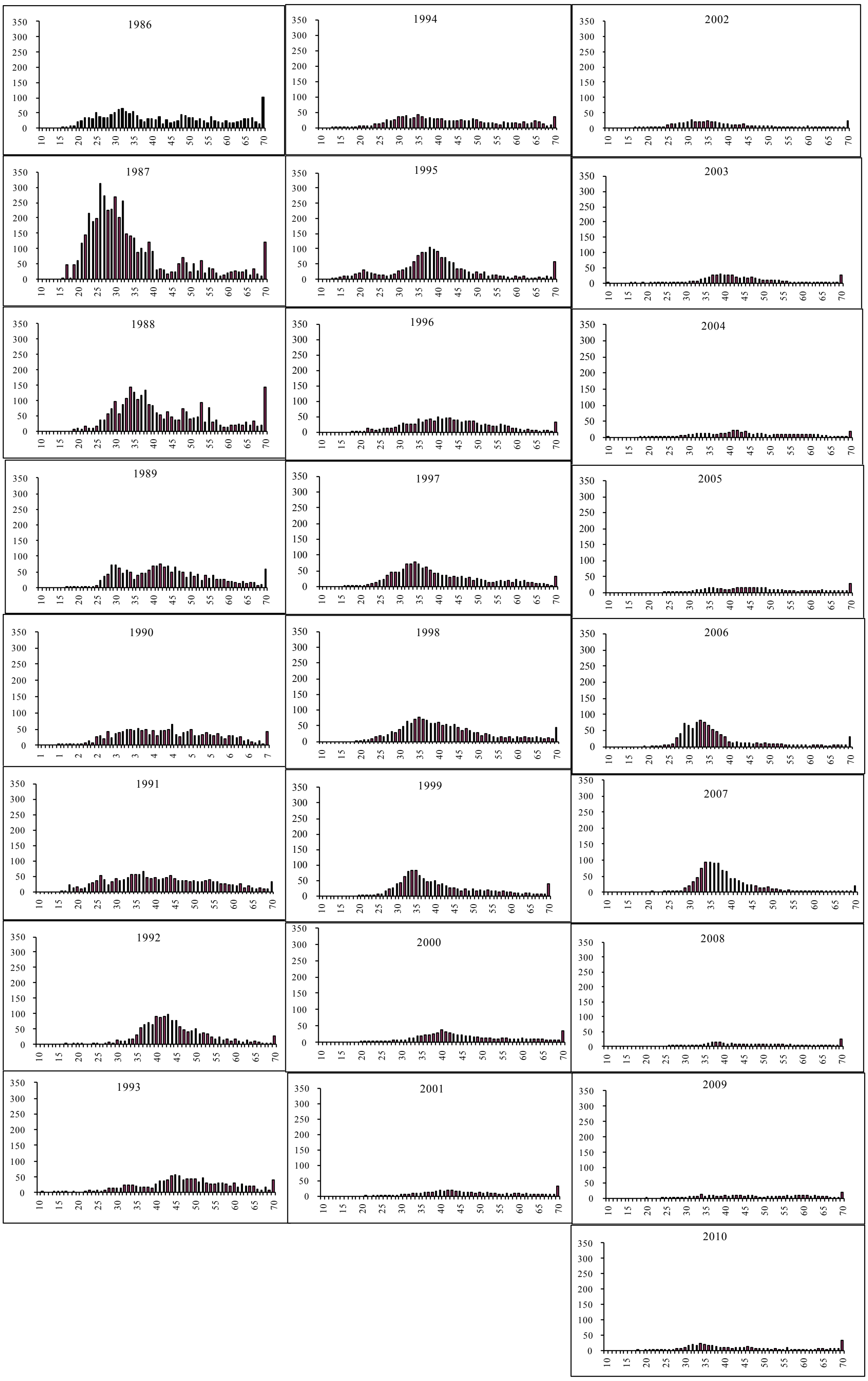



**Figure 8.2.1** **ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa. Length distributions of landings (thousands for 1986 to 2010).**

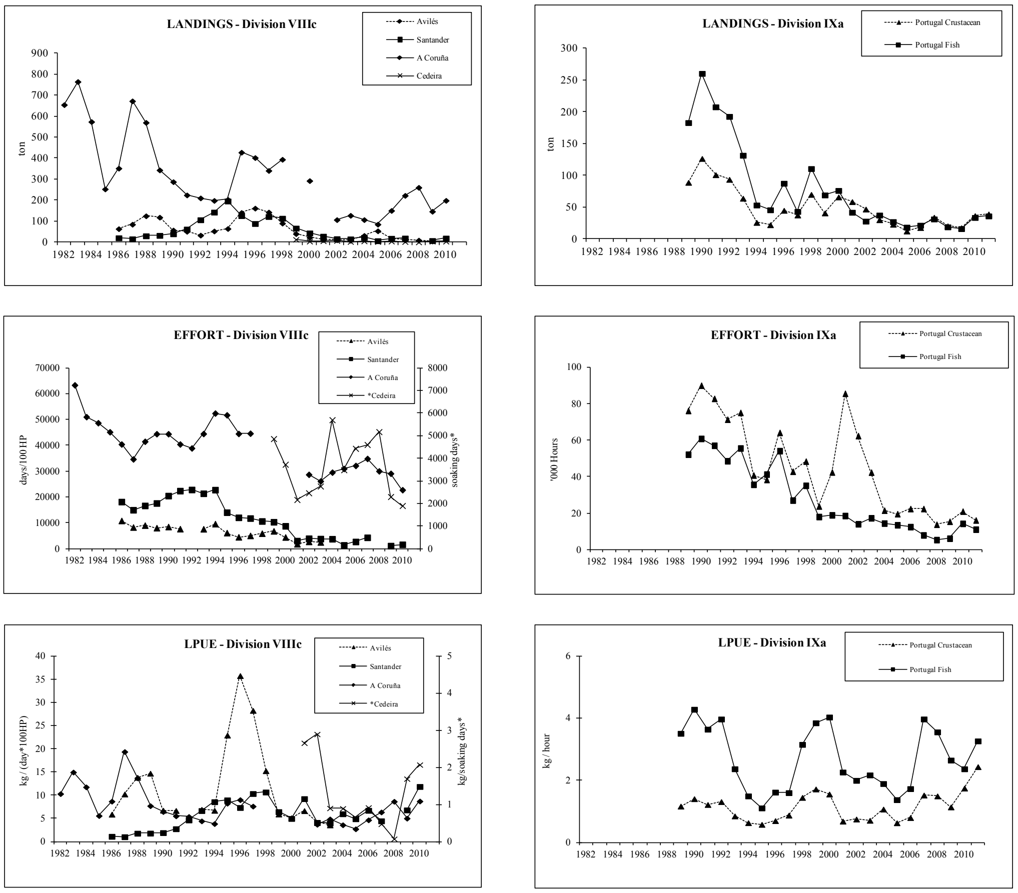



**Figure 8.2.2** **ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.**
**Trawl and gillnet landings, effort and LPUE data between 1986-2011.**

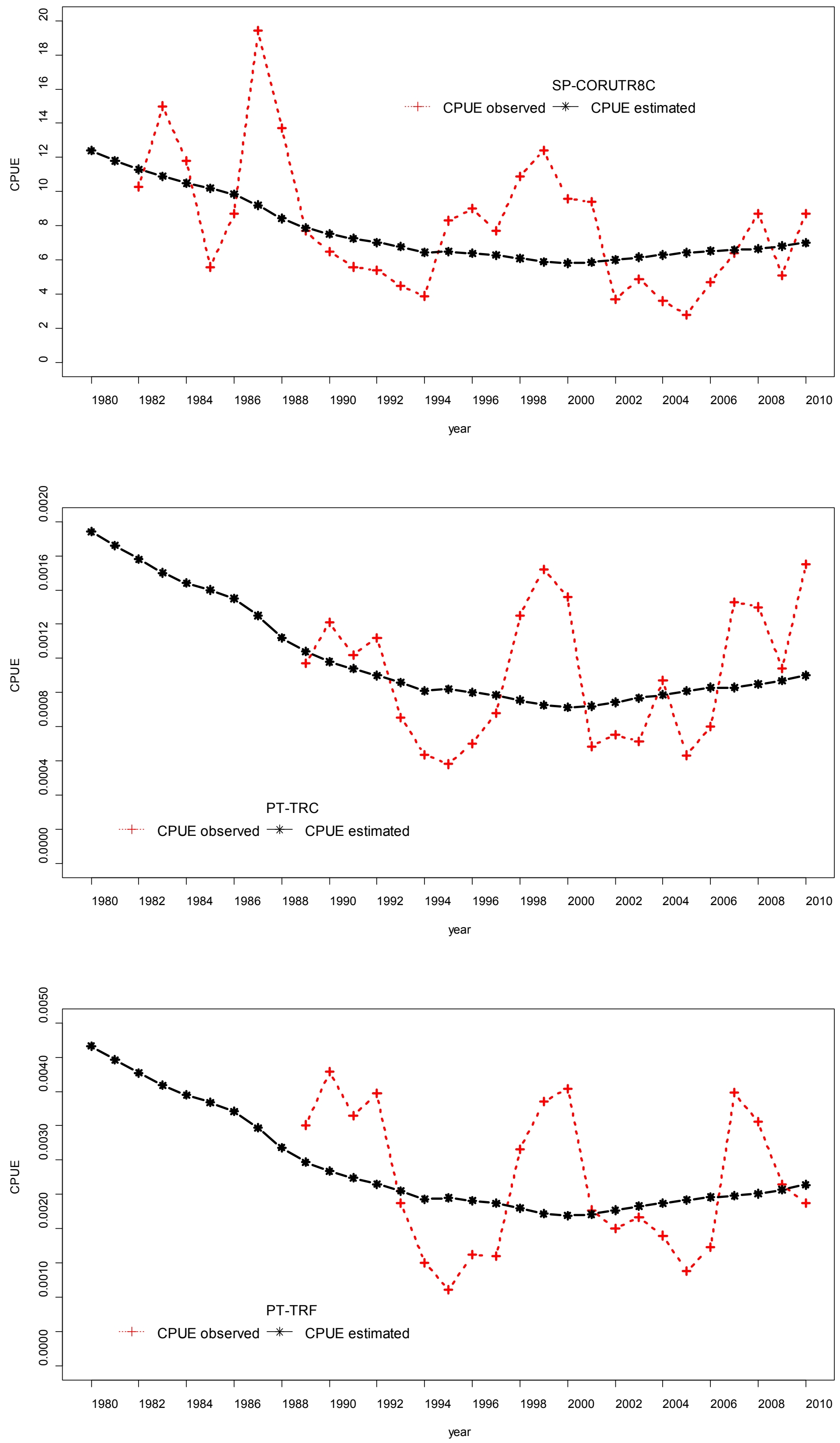
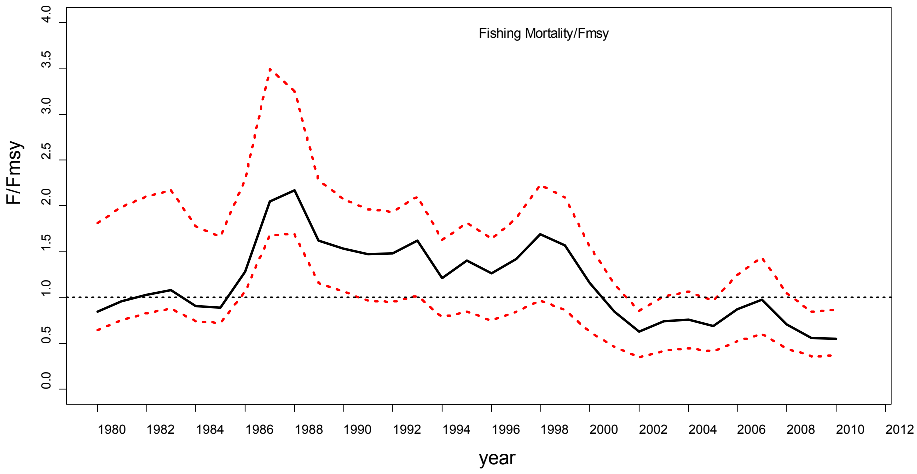



**Figure 8.2.3. ANGLERFISH (*L. budegassa*)– Divisions VIIIc and IXa. Observed CPUE for the three commercial fleets and estimated values by the model.**



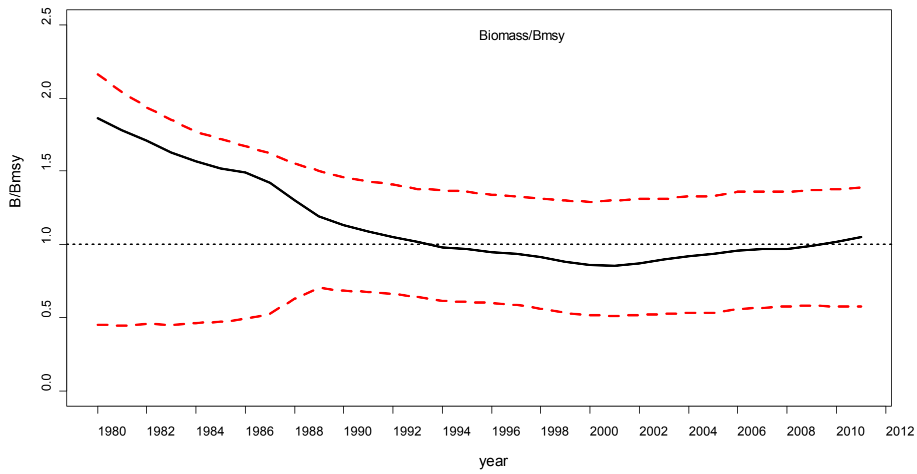
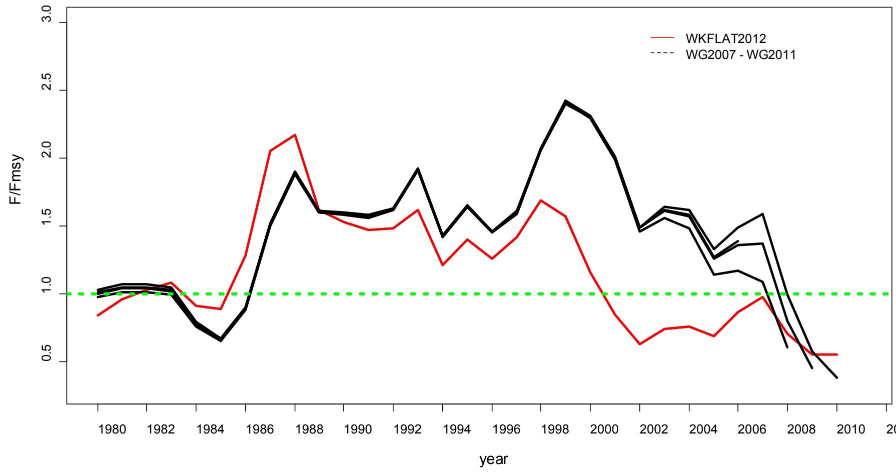




**Figure 8.2.4. ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa. Confidence intervals (80%) of the F/FMSY and B/BMSY ratios.**



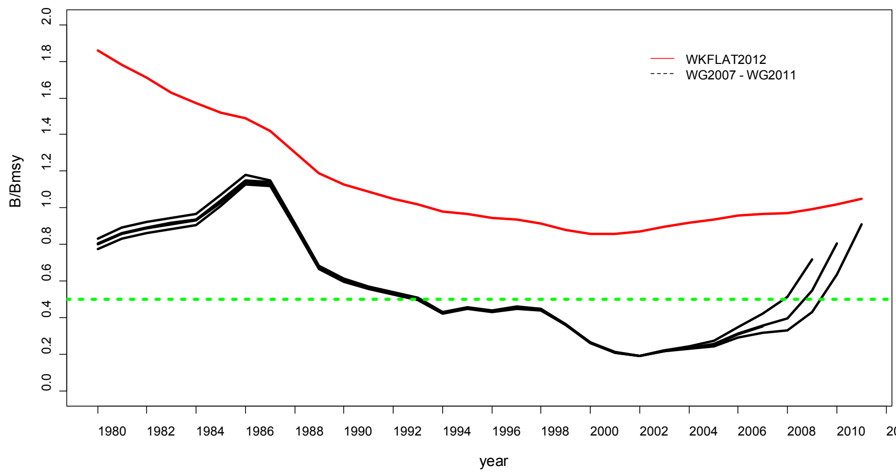




**Figure 8.2.5. ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa. Trends of the F/FMSY and B/BMSY ratios from the 2007 – 2011 WG assessments and 2012 benchmark assessment.**

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

The total anglerfish (Lophius) landings are given in Table 8.3.1 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 (9 433 t) and 1988 (10 021 t), and decreasing after that to the minimum of the time series in 2001 (1 801 t) and 2002 (1 802 t). From 2002 to 2005 landings increased reaching 4 541 t. Since then, landings decreased and in 2010 were 2331 t (1 547 t *L. piscatorius* and 784 t *L. budegassa*) in 2010.

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. Since 2002, *L. piscatorius* again gained more importance and represents 68% of the 2010 landings.

The TAC (1 571 t in 2011 and 3 300 t in 2012) is set for both species of anglerfish combined. Landings in 2010 were 1.57 times the established TAC.

The landings, effort and LPUE data series of the combined species are presented in Table 8.3.2 and Figure 8.3.1. 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.

### 8.3.1 Assessment

The Working Group has performed assessments for each species separately (Sections 8.1 and 8.2).

### 8.3.2 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*.

Because of Spanish information is not available for 2011, no update assessment was carried out by this WG, being the latest assessment for both anglerfish approved at the WKFLAT 2012 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 8.1 and 8.2).

### 8.3.3 Biological Reference Points

Biological Reference Points are assumed differentially for each species (Sections 8.1 and 8.2).

### 8.3.4 Management considerations

*Lophius piscatorius* and *L. budegassa* are subject to a common TAC (1 571 t in 2011 and 3 300 t in 2012), so the joint status of these species should be taken into account when formulating management advice. Combined landings in 2010 (2 331 t) were 1.48 times the TAC. Both species of anglerfish are reported together because of their similarity but are assessed separately.

Both stocks status are based on the assessments done in the benchmark in March 2012 and does not included data for 2011.

*L. piscatorius* fishing mortality has decreased since 2005, and for 2010 fishing mortality was estimated to be 26% lower than in 2009. SSB has been increasing since 1994 it remained stable from 2009 to 2010. Landings decreased from 2005 to 2010, a drop of 32% was observed from 2009 to 2010. Under F *status quo* scenario in 2013 is expected an increase in landings with respect to 2012, and an increase in SSB in 2014 with respect to 2013. The survey abundance index indicates a drop in recruitment for 2011 (other management considerations in Section 8.1.).

*L. budegassa* fishing mortality has decreased since 1999 and is in 2010 below $F_{MSY}$. Biomass has increased since 2002, and is presently just above $B_{MSY}$. Fishing mortality equal to F *status quo* in 2013 is expected to keep the stock above $B_{MSY}$ in 2014. The biomass is expected to be above $B_{MSY}$ in 2014 under all fishing mortality scenarios examined (Section 8.2).

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 8.3.1** ANGLERFISH (*L. piscatorius* and *L. budegassa*) - Divisions VIIIc and IXa.
Tonnes landed by the main fishing fleets for 1978-2011 as determined by the Working Group.

| | Div. VIIIc | | | Div. IXa | | | | Div. VIIIc+IXa |
|---|---|---|---|---|---|---|---|---|
| | SPAIN | | | SPAIN | PORTUGAL | | | |
| Year | Trawl | Gillnet | TOTAL | Trawl | Trawl | Artisanal | TOTAL | TOTAL |
| 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 | 1060 | n/a |
| 1980 | 4008 | 1477 | 5485 | 786 | n/a | 654 | 1440 | 6926 |
| 1981 | 3909 | 2240 | 6149 | 1040 | n/a | 679 | 1719 | 7867 |
| 1982 | 2742 | 3095 | 5837 | 1716 | n/a | 598 | 2314 | 8151 |
| 1983 | 4269 | 1911 | 6180 | 1426 | n/a | 888 | 2314 | 8494 |
| 1984 | 3600 | 1866 | 5466 | 1136 | 409 | 950 | 2495 | 7961 |
| 1985 | 2679 | 2495 | 5174 | 977 | 466 | 1355 | 2798 | 7972 |
| 1986 | 3052 | 3209 | 6261 | 1049 | 367 | 1757 | 3172 | 9433 |
| 1987 | 3174 | 2571 | 5745 | 1133 | 426 | 1668 | 3227 | 8973 |
| 1988 | 3583 | 3263 | 6846 | 1254 | 344 | 1577 | 3175 | 10021 |
| 1989 | 2291 | 2498 | 4789 | 1111 | 531 | 1142 | 2785 | 7574 |
| 1990 | 1930 | 1127 | 3057 | 1124 | 713 | 1231 | 3068 | 6124 |
| 1991 | 1993 | 854 | 2847 | 878 | 533 | 1545 | 2956 | 5802 |
| 1992 | 1668 | 1068 | 2736 | 786 | 363 | 1610 | 2758 | 5493 |
| 1993 | 1360 | 959 | 2319 | 699 | 306 | 1231 | 2237 | 4556 |
| 1994 | 1232 | 1028 | 2260 | 629 | 149 | 549 | 1327 | 3587 |
| 1995 | 1755 | 677 | 2432 | 814 | 134 | 297 | 1245 | 3677 |
| 1996 | 2146 | 850 | 2995 | 749 | 265 | 574 | 1589 | 4584 |
| 1997 | 2249 | 1389 | 3638 | 838 | 191 | 860 | 1889 | 5527 |
| 1998 | 1660 | 1507 | 3167 | 865 | 209 | 829 | 1903 | 5070 |
| 1999 | 1116 | 1140 | 2256 | 750 | 119 | 692 | 1561 | 3817 |
| 2000 | 710 | 612 | 1322 | 485 | 146 | 675 | 1306 | 2628 |
| 2001 | 614 | 364 | 978 | 247 | 117 | 459 | 823 | 1801 |
| 2002 | 559 | 415 | 974 | 344 | 104 | 380 | 828 | 1802 |
| 2003 | 1190 | 771 | 1961 | 617 | 96 | 529 | 1242 | 3203 |
| 2004 | 1510 | 1389 | 2898 | 549 | 77 | 602 | 1229 | 4127 |
| 2005 | 1651 | 1719 | 3370 | 653 | 60 | 458 | 1171 | 4541 |
| 2006 | 1490 | 1371 | 2861 | 801 | 68 | 381 | 1250 | 4111 |
| 2007 | 1327 | 1076 | 2404 | 866 | 78 | 303 | 1247 | 3651 |
| 2008 | 1280 | 1238 | 2518 | 473 | 50 | 246 | 770 | 3288 |
| 2009 | 1151 | 1207 | 2358 | 386 | 43 | 262 | 691 | 3049 |
| 2010 | 665 | 1036 | 1701 | 355 | 72 | 203 | 630 | 2331 |
| 2011 | n/a | n/a | n/a | n/a | 122 | 199 | n/a | n/a |

n/a: not available

**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)

| | Div. VIIIc | | | | | | | | Div. IXa | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Avilés | % | Santander | % | A Coruña-Fleet | % | Cedeira | % | Portugal Crustacean | % | Portugal Fish | % |
| 1982 | | | | | 2273 | 28 | | | | | | |
| 1983 | | | | | 2255 | 27 | | | | | | |
| 1984 | | | | | 2134 | 27 | | | | | | |
| 1985 | | | | | 1387 | 17 | | | | | | |
| 1986 | 564 | 6 | 537 | 6 | 1177 | 12 | | | | | | |
| 1987 | 585 | 7 | 545 | 6 | 1291 | 14 | | | | | | |
| 1988 | 526 | 5 | 418 | 4 | 1226 | 12 | | | | | | |
| 1989 | 333 | 4 | 338 | 4 | 852 | 11 | | | 174 | 2 | 358 | 5 |
| 1990 | 317 | 5 | 318 | 5 | 838 | 14 | | | 233 | 4 | 480 | 8 |
| 1991 | 297 | 5 | 344 | 6 | 715 | 12 | | | 174 | 3 | 359 | 6 |
| 1992 | 232 | 4 | 329 | 6 | 642 | 12 | | | 118 | 2 | 244 | 4 |
| 1993 | 129 | 3 | 329 | 7 | 584 | 13 | | | 100 | 2 | 206 | 5 |
| 1994 | 181 | 5 | 384 | 11 | 512 | 14 | | | 49 | 1 | 101 | 3 |
| 1995 | 333 | 9 | 312 | 8 | 745 | 20 | | | 44 | 1 | 90 | 2 |
| 1996 | 484 | 11 | 359 | 8 | 899 | 20 | | | 90 | 2 | 175 | 4 |
| 1997 | 488 | 9 | 503 | 9 | 812 | 15 | | | 89 | 2 | 102 | 2 |
| 1998 | 377 | 7 | 430 | 8 | 563 | 11 | | | 81 | 2 | 128 | 3 |
| 1999 | 148 | 4 | 249 | 7 | n/a | n/a | 355 | 9 | 44 | 1 | 75 | 2 |
| 2000 | 51 | 2 | 119 | 5 | 381 | 14 | 143 | 5 | 68 | 3 | 78 | 3 |
| 2001 | 35 | 2 | 82 | 5 | n/a | n/a | 92 | 5 | 68 | 4 | 49 | 3 |
| 2002 | 87 | 5 | 73 | 4 | 299 | 17 | 137 | 8 | 65 | 4 | 39 | 2 |
| 2003 | 120 | 4 | 100 | 3 | 470 | 15 | 162 | 5 | 43 | 1 | 53 | 2 |
| 2004 | 248 | 6 | 129 | 3 | 546 | 13 | 387 | 9 | 35 | 1 | 42 | 1 |
| 2005 | 332 | 7 | 66 | 1 | 725 | 16 | 436 | 10 | 24 | 1 | 36 | 1 |
| 2006 | 164 | 4 | 107 | 3 | 666 | 16 | 419 | 10 | 31 | 1 | 37 | 1 |
| 2007 | 113 | 3 | 123 | 3 | 678 | 19 | 235 | 6 | 47 | 1 | 38 | 1 |
| 2008 | 109 | 3 | n/a | n/a | 688 | 21 | 228 | 7 | 26 | 1 | 24 | 1 |
| 2009 | 74 | 2 | 43 | 1 | 464 | 15 | 228 | 7 | 23 | 1 | 21 | 1 |
| 2010 | n/a | n/a | 63 | 3 | 364 | 16 | 235 | 10 | 38 | 2 | 35 | 1 |
| 2011 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 63 | n/a | 58 | n/a |

Fishing effort

| | Div. VIIIc | | | | Div. IXa | | | |
|---|---|---|---|---|---|---|---|---|
| Year | [1] Avilés | [1] Santander | [1] A Coruña-Fleet | [2] Cedeira standardized 2010 | [3] Portugal Crustacean | [4] Portugal Crustacean standardized | [3] Portugal Fish | [4] Portugal Fish standardized |
| 1982 | | | 63313 | | | | | |
| 1983 | | | 51008 | | | | | |
| 1984 | | | 48665 | | | | | |
| 1985 | | | 45157 | | | | | |
| 1986 | 10845 | 18153 | 40420 | | | | | |
| 1987 | 8309 | 14995 | 34651 | | | | | |
| 1988 | 9047 | 16660 | 41481 | | | | | |
| 1989 | 8063 | 17607 | 44410 | | 76 | 23 | 52 | 18 |
| 1990 | 8497 | 20469 | 44403 | | 90 | 20 | 61 | 17 |
| 1991 | 7681 | 22391 | 40429 | | 83 | 17 | 57 | 15 |
| 1992 | n/a | 22833 | 38899 | | 71 | 15 | 49 | 14 |
| 1993 | 7635 | 21370 | 44478 | | 75 | 13 | 56 | 13 |
| 1994 | 9620 | 22772 | 52397 | | 41 | 8 | 36 | 10 |
| 1995 | 6146 | 14046 | 51708 | | 38 | 8 | 41 | 9 |
| 1996 | 4525 | 12071 | 44501 | | 64 | 14 | 54 | 12 |
| 1997 | 5061 | 11776 | 44602 | | 43 | 11 | 27 | 9 |
| 1998 | 5929 | 10646 | n/a | | 48 | 11 | 35 | 10 |
| 1999 | 6829 | 10349 | n/a | 4860 | 24 | 8 | 18 | 6 |
| 2000 | 4453 | 8779 | n/a | 3726 | 42 | 10 | 19 | 6 |
| 2001 | 1838 | 3053 | n/a | 2167 | 85 | 18 | 19 | 5 |
| 2002 | 2748 | 3975 | 28695 | 2464 | 62 | 10 | 14 | 4 |
| 2003 | 2526 | 3837 | 26127 | 2764 | 42 | 10 | 17 | 6 |
| 2004 | n/a | 3776 | 29540 | 5696 | 21 | 7 | 14 | 4 |
| 2005 | n/a | 1404 | 30965 | 3485 | 20 | 5 | 13 | 4 |
| 2006 | n/a | 2718 | 32130 | 4429 | 22 | 5 | 12 | 4 |
| 2007 | n/a | 4334 | 34838 | 4599 | 22 | 6 | 8 | 3 |
| 2008 | n/a | n/a | 30024 | 5168 | 14 | 4 | 5 | 2 |
| 2009 | n/a | 1125 | 29092 | 2299 | 15 | n/a | 6 | n/a |
| 2010 | n/a | 1628 | 22746 | 1902 | 21 | n/a | 14 | n/a |
| 2011 | n/a | n/a | n/a | n/a | 16 | n/a | 11 | n/a |

[1] Fishing days per 100 HP
[2] Soaking days
[3] 1000 Hours trawling with occurrence of anglerfish
[4] 1000 Hauls
n/a - not available

LPUE

| | Div. VIIIc | | | | Div. IXa | | | |
|---|---|---|---|---|---|---|---|---|
| Year | [1] Avilés | [1] Santander | [1] A Coruña-Fleet | [2] Cedeira standardized 2010 | [3] Portugal Crustacean | [4] Portugal Crustacean standardized | [3] Portugal Fish | [4] Portugal Fish standardized |
| 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 | | 2.3 | 7.7 | 6.9 | 20.3 |
| 1990 | 37.4 | 15.5 | 18.9 | | 2.6 | 11.4 | 7.9 | 28.0 |
| 1991 | 38.6 | 15.3 | 17.7 | | 2.1 | 10.4 | 6.3 | 23.3 |
| 1992 | n/a | 14.4 | 16.5 | | 1.7 | 7.8 | 5.0 | 17.8 |
| 1993 | 16.9 | 15.4 | 13.1 | | 1.3 | 7.5 | 3.7 | 15.8 |
| 1994 | 18.8 | 16.8 | 9.8 | | 1.2 | 6.4 | 2.8 | 10.5 |
| 1995 | 54.1 | 22.2 | 14.4 | | 1.1 | 5.6 | 2.2 | 9.9 |
| 1996 | 106.9 | 29.7 | 20.2 | | 1.4 | 6.2 | 3.2 | 14.3 |
| 1997 | 96.4 | 42.7 | 18.2 | | 2.1 | 7.8 | 3.8 | 11.6 |
| 1998 | 63.6 | 40.4 | n/a | | 1.7 | 7.3 | 3.6 | 13.3 |
| 1999 | 21.7 | 24.1 | n/a | 73.1 | 1.9 | 5.4 | 4.2 | 13.2 |
| 2000 | 11.4 | 13.6 | n/a | 38.5 | 1.6 | 6.7 | 4.2 | 12.9 |
| 2001 | 19.1 | 26.9 | n/a | 42.6 | 0.8 | 3.7 | 2.6 | 9.8 |
| 2002 | 31.6 | 18.4 | 10.4 | 55.7 | 1.0 | 6.7 | 2.8 | 8.7 |
| 2003 | 47.6 | 26.1 | 18.0 | 58.6 | 1.0 | 4.4 | 3.1 | 9.5 |
| 2004 | n/a | 34.1 | 18.5 | 67.9 | 1.6 | 5.4 | 2.9 | 9.5 |
| 2005 | n/a | 46.9 | 23.4 | 125.1 | 1.2 | 4.7 | 2.7 | 9.7 |
| 2006 | n/a | 39.4 | 20.7 | 94.7 | 1.4 | 5.8 | 3.0 | 9.9 |
| 2007 | n/a | 28.3 | 19.5 | 51.1 | 2.1 | 8.0 | 4.7 | 12.9 |
| 2008 | n/a | n/a | 22.9 | 44.1 | 1.9 | 6.9 | 4.5 | 13.6 |
| 2009 | n/a | 38.2 | 15.9 | 99.2 | 1.5 | n/a | 3.4 | n/a |
| 2010 | n/a | 39.0 | 16.0 | 123.4 | 1.8 | n/a | 2.4 | n/a |
| 2011 | n/a | n/a | n/a | n/a | 3.9 | n/a | 5.3 | n/a |

[1] kg/day*100HP
[2] kg/soaking day
[3] kg/hour trawl
[4] kg/haul
n/a - not available

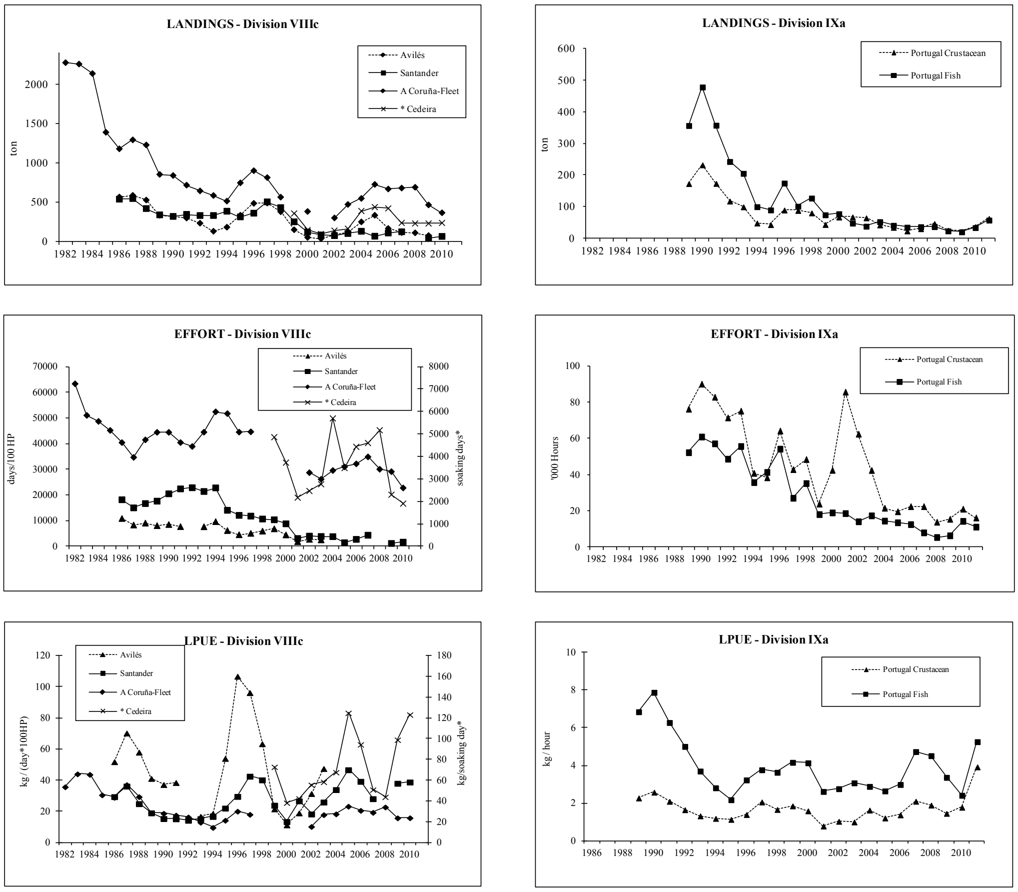



**Figure 8.3.1** ANGLERFISH (*L. budegassa* and *L. piscatorius*) - Divisions VIIIc and IXa. Trawl and gillnet landings, effort and LPUE data between 1986-2011.

# 9 Megrims in Divisions VIIIc and IXa

***Lepidorhombus whiffiagonis:***

**Type of assessment in 2011**: Update. However, it was not possible to include Spanish landings data for 2011 in the assessment. The assessment model could not be updated this year. The assessment conducted in 2011 has been used as the basis of projections for catch options and management advice for 2013.

**Data revisions this year:** None.

**Review Group issues for *L.whiffiagonis***: Following recommendations from RG in 2010, the following actions were taken:

1 ) Legend in 9.1.3 has been changed.

***Lepidorhombus boscii:***

**Type of assessment in 2011**: Update. However, it was not possible to include Spanish landings data for 2011 in the assessment. The assessment model could not be updated this year. The assessment conducted in 2011 has been used as the basis of projections for catch options and management advice for 2013.

**Data revisions this year:** None.

**Review Group issues for *L. boscii***: None.

## 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 2012 and management for 2011 and 2012

***ICES advice for 2012*** (as extracted from ICES Advice 2011, Book 7):

Following the ICES MSY framework implies fishing mortality to be reduced to 0.08 for *L. whiffiagonis* and to 0.18 for *L. boscii*. For *L. whiffiagonis* this results in landings of 100 t in 2012 and expected SSB of 1190 t in 2013. For *L. boscii* this results in landings of 760 t in 2012 and expected SSB of 5300 t in 2013. This corresponds to 860 t of landings in 2012 for both species combined. As both species of megrim (*L.whiffiagonis* and *L.boscii*) are caught in the same fisheries and are subject to a combined TAC, the same proportional reduction from current fishing mortality is assumed for both species. The reduction necessary for *L.boscii* to reach $F_{MSY}$ is applied, as it is the species whose current fishing levels are further from $F_{MSY}$.

***Management applicable for 2010 and 2011:***

The agreed combined TAC for megrim and four-spot megrim in ICES Divisions VIIIc and IXa was 1094 t in 2011 and 1214 in 2012.

## 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

Spanish data in 2011 have been provided by SGP, the official national administration responsible for fishery statistics, and are presented in Annex T. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations.

Working Group estimates of landings for the period 1986 to 2011 are given in Table 9.1.1. The total estimated international landings in Divisions VIIIc and IXa for 2010 was 83 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 represent the lowest value of the entire series. Historical landings for both species combined are shown in Figure 9.1.1. In 2011, Portuguese landings are 34 t, being a significant increase in relation to previous years. The 2011 data provided for Spanish landings were no disaggregated by species, they were referred to Genre level. The group concluded that they were unsuitable for use in the model describe in the Stock annex. .

Discards estimates are available 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. Discards data are not used in this assessment because of the lack of data in several years of the series. Discard/Total Catch ratio and estimated CV are shown in the same table. In Table 9.1.2(b), the available series of years with Spanish discards in numbers-at-age for *L. whiffiagonis* are presented. With the exception of 1994, 1997 and 2006, discarded numbers are largest at age 1. In 2011, sampling discards has been done, however raising to total landings is not possible due to reasons previously mention.

#### 9.1.2.2 Biological sampling

Annual length compositions of total stock landings are displayed in Figure 9.1.2 for the period 1986 – 2010. No length composition of landings is provided for 2011 because it was not possible to raise to total landings. However, annual length distribution in samplings for 2011, in relative numbers, is presented in Table 9.1.3. (a). The bulk of sampled specimens corresponds to fish of 20-35 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 2010 are the highest in the historic series. 2011 values are similar to those in 2009.

Age compositions of landings are presented in Table 9.1.4 and weights-at-age of landings in Table 9.1.5, from 1986 to 2010. 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.

#### 9.1.2.3 Abundance indices from surveys

Two Portuguese (PtGFS-WIBTS-Q4, also called "October" survey, and PT-CTS (UWTV (FU 28-29)), also called "Crustacean" survey) and one Spanish (SpGFS-WIBTS-Q4) survey indices are summarised in Table 9.1.6.

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 (Figure 9.1.3(a), bottom right panel).

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 2011 age 1 value is not so high as last year and age 0 is null.

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, presenting age 2 in 2011, the highest value of the entire series.

#### 9.1.2.4 Commercial catch-effort data

Due to the same reasons as in landings data (no disaggregation into species) and different effort units provided, LPUE for Spanish commercial fleets cannot be presented for 2011.

Fishing effort and LPUE data were available for the period 1986 - 2010 for the Spanish trawlers from A Coruña (SP-CORUTR8c) fishing in Division VIIIc. The commercial LPUE and effort data of the Portuguese trawlers fishing in Division IXa covers the period 1988 – 2011 (Table 9.1.8 and Figure 9.1.3(a)). No effort information from the Avilés fleet (SP-AVILESTR) fishing in Division VIIIc is available after 2003.

### Commercial fleets used in the assessment to tune the model

Before 1993, A Coruña (SP-CORUTR8c) effort was generally stable, with a decreasing trend observed after that year. The 2010 effort value is the lowest in the series. The

LPUE shows relatively high stable values for 1986 – 1992. Since 1998 LPUE has declined, but has increased in 2010.

Avilés (SP-AVILESTR) effort has decreased throughout the whole period to a very low level in 2003. LPUE shows an increasing trend between 1986 and 1990, with a sharp decrease in 1991. Since then, it has had a further upward and downward fluctuation, with a peak in 1997, reaching its lowest value in 2003. No effort data are available for this fleet after 2003.

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.

#### Commercial fleets not used in the assessment to tune the model

Portuguese effort values are quite variable, except in 1999 and 2000 when they are significantly lower (Table 9.1.8 and Figure 9.1.3(a)). 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 2011 is the second highest value during the last decade.

### 9.1.3 Assessment

Due to the lack of reliable Spanish landings for 2011, the Working Group decided not to update the assessment.

The last assessment available was conducted during WGHMM2011 (ICES, 2011) and is used as a basis for current stock assessment and projections. Text, tables and figures presented in the assessment results are the same as in the last year report.

#### 9.1.3.1 Input data

#### 9.1.3.2 See Stock Annex.Model

#### Data screening

The top panel of Figure 9.1.4 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+. 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. These figures also indicate a certain degree of agreement between the three tuning indices.

### Final run

XSA model was selected for use in this assessment. Model description and settings are the same used last year and are detailed in the Stock Annex.

The retrospective analysis shows a small but consistent pattern of overestimation of recruitment and SSB and underestimation of F in recent years (Figure 9.1.5).

#### 9.1.3.3 Assessment results

As has been the case in the last few years, there were convergence problems with the XSA run. The results presented correspond to a run of 30 iterations, as increasing the number of iterations led to larger total absolute residuals value between iterations.

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. The sign of ages 5 and 6 residuals from the SP-CORUTR8c commercial fleet changed from positive to negative at around year 2000. Until 1996 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.

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 dropped considerably in 2009 and 2010, after the local peak reached in 2006, which may be explained by the relatively high landings in that year. The SSB values in 2007-2010 are the lowest in the series. After the second lowest recruitment (at age 1) in the series in 2009, this year presents a high recruitment value similar to those that occurred in the late nineties.

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, which are not accounted for in the current assessment, which is based just on landings. 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. In 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+.

#### 9.1.3.4 Year class strength and recruitment estimations

The 2008 year class is estimated to have 1.2 million individuals at 1 year of age based on the information from the Spanish survey (SpGFS-WIBTS-Q4) (61% of weight) and one commercial fleet (SP-CORUTR8c) (19% of weight). P-shrinkage and F-shrinkage contributed 18% and 2% of the weight, respectively. The estimate from the run in the 2010 Working Group was 1.6 million at one year of age.

The 2009 year class is estimated to have 5.3 million fish at 1 year of age, based on the Spanish survey (SpGFS-WIBTS-Q4) (72% of weight), P-shrinkage (23% of the weight) and F shrinkage (5%).

In accordance with the stock annex specifications, GM recruitment is computed over years 1998-2008. 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 |
|---|---|---|---|---|---|
| 2007 | 1491 | XSA | 41% | 44% | 15% |
| 2008 | 1234 | XSA | 60% | 19% | 21% |
| 2009 | 5338 | XSA | 73% | | 27% |
| 2010 | 2504 | GM $_{(98\text{-}08)}$ | | | |

#### 9.1.3.5 Historic trends in biomass, fishing mortality and recruitment

From Table 9.1.12 and Figure 9.1.7, we see that SSB decreased from 2576 t in 1990 to 935 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, below 900 t in every year. The values for 2004-2010 are the lowest in the series, with SSB in 2009 (650 t) corresponding to the lowest value. In 2010 the SSB value is 717 t, still very low.

F has declined in recent years from the high levels observed prior to 1995 (Fbar, for ages 2-4, in the range of 0.29-0.45 before 1995) and the high value reached in 1998 (0.38). Fbar increased every year between 2003 and 2006 (Fbar=0.34 in 2006), but has decreased every year since then, reaching in 2010 the lowest value of the entire series at 0.08.

Recruitment (at age 1) varies substantially throughout the time series, but shows a general decline from the high levels seen until the 1991 year class. The 1993 year class is the lowest value in the time series. Since 1998 recruitment has been continuously at low levels (recruitment in 2009 is estimated to be the second lowest value of the series). However, in 2010 a good recruitment appears to have occurred, with a value more similar to those estimated for the previous decade.

#### 9.1.3.6 Catch Options and prognosis

Stock projections were calculated according to the settings specified in the Stock Annex. This year, short term projections are carried out on the basis of the 2011 assessment and it is thus necessary to provide fishing mortality and recruitment values for two intermediate years (2011 and 2012).

#### 9.1.3.7 Short-term projections

Short-term projections have been made using R software v. 2.14.2 and FLR packages: FLcore v. 2.5.0, FLash v. 2.5.0 and FLAssess v.2.5.0. Script code is included in the Stock annex.

The input data for deterministic short-term predictions are shown in Table 9.1.13. The exploitation pattern used was the unscaled average of 2008-2010 (corresponding to Fbar = 0.14, F *status quo*). For recruitment in 2011, the Working Group decided to explore information provided by available survey in 2011. Two options were considered, to use the result of fitting a linear regression model between recruitment and abundance index for age 1 of SpGFS-WIBTS-Q4 or to use the GM(98-08) of historic recruitments. Both values are very similar, fitted value is 2521 and GM(98-08) is 2504. The Working Group has decided to use the GM to be according with the Stock Annex indications.

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 2011-2014 is given in Table 9.1.15.

Under *status quo* F, landings in 2012 and 20133 are predicted to be 158 t and 174 t respectively. SSB would increase from the 1067t estimated for 2012 to 1125 t in 2013 and to 1139 t in 2014.

The contributions of recent year classes to the predicted landings in 2013 and SSB in 2014, assuming $GM_{98-08}$ recruitment, are presented in Table 9.1.16. The assumed $GM_{98-08}$ age 1 recruitment for the 2010, 2011 and 2012 year classes contributes 22% to landings in 2013 and 46% to the predicted SSB at the beginning of 2014. Megrim starts to contribute strongly to SSB at 2 years of age (see maturity ogive in Table 9.1.13).

#### 9.1.3.8 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 *status quo* exploitation (Fbar = 0.14) and $GM_{98-08}$ for recruitment, the equilibrium yield would be around 187 t with an SSB of 1112 t.

### 9.1.4 Biological reference points

The stock-recruitment time series is plotted in Figure 9.1.9. Most of the high recruitment values are at the beginning, and the first four correspond to years in which a combined ALK was used. Ignoring the first 4 years, both low and high recruitments have been estimated. However, all recruitment values since 1998 have been low, with the only exception of 2010.

See Stock Annex for information about Biological reference points.

WGHMM 2010 was asked to provide an $F_{MSY}$ value for this stock. Possible proxies considered for $F_{MSY}$ were in the range of $F_{max}$, F0.1 and F35% and F40%. $F_{max}$ is not well defined for this stock, as the yield-per-recruit curve generally shows a very flat top.

In order to establish a proxy, a rough exercise including discards was conducted in WGHMM 2010 (see description and results in the Stock Annex). The following sensitivity table also complemented the discards exercise and has been updated in this WG:

| | WG2005 | WG2006 | WG2007 | WG2008 | WG2009 | WG2010 | WG2011 |
|---|---|---|---|---|---|---|---|
| FMax | 0.35 | 0.36 | 0.38 | 0.39 | 0.37 | 0.32 | 0.24 |
| F0.1 | 0.15 | 0.16 | 0.16 | 0.18 | 0.17 | 0.14 | 0.10 |
| F35% | 0.21 | 0.22 | 0.22 | 0.23 | 0.22 | 0.21 | 0.18 |
| F40% | | | | | | 0.17 | 0.14 |

$F_{MSY}$=0.17 was preliminarily proposed in WGHMM 2010, corresponding to F40% as calculated in that WG. Even though all biological reference points have been estimated to be lower in WG2011, it seems precipitate to change the 0.17 value proposed as $F_{MSY}$ last year. However, this $F_{MSY}$ value should still be considered as preliminary and is likely to be revised as further work continues on this assessment (particularly when including discards information and developing an assessment model providing uncertainty estimates).

### 9.1.5 Comments on the assessment

Due to the aggregation level of Spanish landings data for 2011, no update assessment was carried out by this WG, which is therefore using the assessment conducted at the 2011 WGHMM. Next comments correspond to last year assessment.

The inclusion of discards in the assessment would be likely to have an influence in the perception of the state of the stock. With the exception of years 2007 for which we get much lower discard estimates, discards in number represent between 10-45% of the total catch and they are thought to be important for younger ages. It is therefore recommended to continue with the collection of discards data to provide annual estimates with a view to incorporate them in the assessment soon.

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 2 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 very similar trends for F, recruitment and SSB (Figure 9.1.10).

The assessment indicates that SSB has been at lower levels since 1991, with a slow but gradually declining trend since 1997. The last years (2004-2010) correspond to the lowest SSB estimates, although SSB is expected to increase during 2010. Both high and low recruitments have been observed during the period of low SSB (recruitments since 1992), although all recruitments between 1998 and 2009 have been low, with the second lowest value in the whole time series in 2009. The 2010 recruitment estimate is considerably higher than in previous years.

Megrim starts to contribute strongly to SSB at 2 years of age. Around 30% of the predicted SSB in 2013 relies on year classes for which recruitment has been assumed to be $GM_{98-08}$. Additionally, the good 2010 recruitment estimate is contributing strongly to the predicted increase in SSB between 2010 and 2013.

### 9.1.6 Management considerations.

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

**Table. 9.1.1 Megrim (*L. whiffiagonis*) in Divisions VIIIc, IXa. Total landings (t).**

| | Spain | | | Portugal | Total |
|---|---|---|---|---|---|
| Year | VIIIc | IXa | Total | IXa | VIIIc, IXa |
| 1986 | 508 | 98 | 606 | 53 | 659 |
| 1987 | 404 | 46 | 450 | 47 | 497 |
| 1988 | 657 | 59 | 716 | 101 | 817 |
| 1989 | 533 | 45 | 578 | 136 | 714 |
| 1990 | 841 | 25 | 866 | 111 | 977 |
| 1991 | 494 | 16 | 510 | 104 | 614 |
| 1992 | 474 | 5 | 479 | 37 | 516 |
| 1993 | 338 | 7 | 345 | 38 | 383 |
| 1994 | 440 | 8 | 448 | 31 | 479 |
| 1995 | 173 | 20 | 193 | 25 | 218 |
| 1996 | 283 | 21 | 305 | 24 | 329 |
| 1997 | 298 | 12 | 310 | 46 | 356 |
| 1998 | 372 | 8 | 380 | 66 | 446 |
| 1999 | 332 | 4 | 336 | 7 | 343 |
| 2000 | 238 | 5 | 243 | 10 | 253 |
| 2001 | 167 | 2 | 169 | 5 | 175 |
| 2002 | 112 | 3 | 115 | 3 | 117 |
| 2003 | 113 | 3 | 116 | 17 | 134 |
| 2004 | 142 | 1 | 144 | 5 | 149 |
| 2005 | 120 | 1 | 121 | 26 | 147 |
| 2006 | 173 | 2 | 175 | 35 | 210 |
| 2007 | 139 | 2 | 141 | 14 | 155 |
| *2008 | 114 | 2 | 116 | 17 | 133 |
| 2009 | 74 | 2 | 77 | 7 | 84 |
| 2010 | 66 | 8 | 74 | 10 | 83 |
| 2011 | n/a | n/a | n/a | 34 | n/a |

**Table. 9.1.2(a) Megrim (*L. whiffiagonis*) in Divisions VIIIc, IXa. Discard/Total Catch ratio and estimated CV for Spain**

| Year | 1994 | 1997 | 1999 | 2000 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | *2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | n/a |
| 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 | n/a |
| 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 | n/a |

**All discard data revised in WG2011

* Sampling discards has been done in 2011, however raising to total landings is not possible.

**Table. 9.1.2(b) Megrim (*L. whiffiagonis*) in Divisions VIIIc, IXa. Discards in numbers at age (thousands) for Spanish trawlers**

| | 1994 | 1997 | 1999 | 2000 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | *2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 104 | 41 | 270 | 27 | 0 | 4 | 20 | 0 | 0 | 0 | 96 | 16 | n/a |
| 1 | 93 | 453 | 471 | 611 | 239 | 164 | 223 | 19 | 11 | 126 | 142 | 119 | n/a |
| 2 | 136 | 857 | 284 | 160 | 57 | 28 | 61 | 108 | 0 | 86 | 21 | 6 | n/a |
| 3 | 51 | 142 | 197 | 73 | 12 | 6 | 38 | 115 | | 8 | 15 | 1 | n/a |
| 4 | 3 | 1 | 26 | 19 | 4 | 5 | 11 | 28 | | 5 | 7 | 2 | n/a |
| 5 | 1 | 5 | 6 | | 0 | 3 | 4 | 13 | | 2 | 7 | 0 | n/a |
| 6 | | 3 | | | | 2 | 1 | 4 | | 0 | 3 | 1 | n/a |
| 7 | | | | | | 1 | 0 | 0 | | | 1 | 0 | n/a |

**Table 9.1.3(a) Megrim (*L. whiffiagonis*) Divisions VIIIc and IXa. Annual length distributions in samplings in 2011. Relative numbers scaled to 1000..**

| Length (cm) | Div. VIIIc | Div. IXa | Total |
|---|---|---|---|
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | 1.0 | 2.4 | 1.5 |
| 18 | 1.5 | 2.3 | 1.7 |
| 19 | 2.3 | 2.1 | 2.2 |
| 20 | 15.2 | 15.3 | 15.3 |
| 21 | 32.2 | 29.2 | 31.2 |
| 22 | 67.7 | 68.9 | 68.1 |
| 23 | 83.2 | 81.1 | 82.5 |
| 24 | 102.7 | 113.9 | 106.5 |
| 25 | 116.0 | 144.7 | 125.8 |
| 26 | 94.8 | 113.9 | 101.4 |
| 27 | 84.7 | 97.3 | 89.1 |
| 28 | 80.9 | 90.6 | 84.2 |
| 29 | 64.8 | 57.2 | 62.2 |
| 30 | 57.3 | 42.7 | 52.2 |
| 31 | 35.1 | 27.9 | 32.6 |
| 32 | 20.5 | 15.0 | 18.6 |
| 33 | 21.9 | 14.0 | 19.2 |
| 34 | 19.9 | 13.1 | 17.6 |
| 35 | 18.5 | 13.3 | 16.7 |
| 36 | 16.5 | 12.0 | 14.9 |
| 37 | 16.6 | 10.4 | 14.4 |
| 38 | 9.7 | 7.0 | 8.8 |
| 39 | 8.5 | 6.4 | 7.8 |
| 40 | 7.3 | 4.8 | 6.5 |
| 41 | 6.6 | 4.4 | 5.8 |
| 42 | 5.0 | 3.2 | 4.4 |
| 43 | 3.4 | 2.7 | 3.1 |
| 44 | 2.5 | 1.6 | 2.2 |
| 45 | 1.9 | 1.4 | 1.7 |
| 46 | 1.3 | 0.8 | 1.1 |
| 47 | 0.4 | 0.3 | 0.4 |
| 48 | 0.1 | 0.1 | 0.1 |
| 49 | | | |
| 50+ | 0.1 | 0.1 | 0.1 |

**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 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | *2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Mean length (cm) | 22.3 | 23.5 | 24.6 | 23.4 | 25.1 | 24.7 | 24.6 | 24.6 | 24.7 | 25.3 | 25.8 | 25.1 | 26 | 25.7 | 26.1 | 25.3 | 26.2 | 26.7 | 26.6 | 27.6 | 29.4 | 27.6 |
| Mean weight (g) | 105 | 108 | 129 | 108 | 124 | 121 | 120 | 118 | 119 | 127 | 134 | 124 | 137 | 134 | 137 | 127 | 137 | 148 | 147 | 163 | 187 | 160 |

**All data recalculated in WGHMM

* Mean length and mean weight in samplings

## Table 9.1.4 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Landed 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (*)0 | (15) | (0) | (0) | (0) | (8) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | n/a |
| 1 | 1013 | 2020 | 2977 | 760 | 4230 | 1018 | 1062 | 519 | 40 | 509 | 198 | 82 | 77 | 20 | 9 | 40 | 31 | 129 | 46 | 123 | 91 | 79 | 7 | 28 | 30 | n/a |
| 2 | 1952 | 2303 | 3344 | 1903 | 2135 | 2352 | 392 | 1703 | 432 | 36 | 1486 | 1062 | 882 | 240 | 122 | 305 | 151 | 242 | 236 | 215 | 418 | 161 | 284 | 90 | 33 | n/a |
| 3 | 668 | 752 | 1038 | 678 | 775 | 801 | 677 | 312 | 1784 | 254 | 37 | 1011 | 1205 | 960 | 598 | 300 | 310 | 265 | 205 | 401 | 467 | 232 | 207 | 144 | 52 | n/a |
| 4 | 639 | 394 | 738 | 631 | 868 | 690 | 1120 | 526 | 549 | 620 | 279 | 76 | 881 | 693 | 507 | 244 | 86 | 175 | 242 | 160 | 248 | 297 | 148 | 95 | 110 | n/a |
| 5 | 501 | 289 | 530 | 501 | 329 | 643 | 591 | 357 | 624 | 241 | 502 | 362 | 214 | 442 | 361 | 220 | 164 | 80 | 184 | 152 | 170 | 142 | 166 | 73 | 97 | n/a |
| 6 | 201 | 80 | 181 | 190 | 376 | 141 | 77 | 102 | 330 | 69 | 147 | 305 | 328 | 105 | 83 | 160 | 80 | 54 | 100 | 86 | 106 | 81 | 60 | 57 | 80 | n/a |
| +gp | 194 | 71 | 130 | 253 | 558 | 59 | 68 | 36 | 119 | 72 | 81 | 116 | 149 | 207 | 161 | 118 | 37 | 48 | 71 | 41 | 36 | 56 | 35 | 28 | 43 | n/a |
| TOTALNUM | 5168 | 5909 | 8938 | 4916 | 9271 | 5704 | 3987 | 3555 | 3878 | 1801 | 2733 | 3014 | 3735 | 2667 | 1841 | 1387 | 860 | 993 | 1084 | 1177 | 1536 | 1048 | 907 | 515 | 445 | n/a |
| TONSLAND | 659 | 497 | 817 | 714 | 977 | 614 | 516 | 383 | 479 | 218 | 329 | 356 | 446 | 343 | 253 | 175 | 117 | 134 | 149 | 147 | 210 | 155 | 133 | 84 | 83 | n/a |
| SOPCOF % | 95 | 95 | 95 | 99 | 99 | 100 | 100 | 100 | 100 | 101 | 102 | 100 | 101 | 101 | 101 | 101 | 100 | 101 | 100 | 98 | 100 | 100 | 100 | 100 | 100 | n/a |

(*) Age 0 was not used in the assessment.
* Data revised in WG2010 from original value presented

## Table 9.1.5 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Landed 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 0.045 | 0.049 | 0.045 | 0.051 | 0.041 | 0.039 | 0.034 | 0.036 | 0.046 | 0.06 | 0.054 | 0.056 | 0.046 | 0.056 | 0.056 | 0.058 | 0.058 | 0.056 | 0.0623 | 0.0610 | 0.0633 | 0.0652 | 0.0587 | 0.0648 | 0.0617 | n/a |
| 2 | 0.102 | 0.084 | 0.09 | 0.102 | 0.098 | 0.091 | 0.095 | 0.08 | 0.069 | 0.071 | 0.088 | 0.083 | 0.07 | 0.07 | 0.072 | 0.085 | 0.082 | 0.089 | 0.0850 | 0.0798 | 0.0917 | 0.0884 | 0.0915 | 0.0906 | 0.0938 | n/a |
| 3 | 0.121 | 0.092 | 0.103 | 0.122 | 0.129 | 0.108 | 0.125 | 0.117 | 0.1 | 0.102 | 0.121 | 0.102 | 0.099 | 0.089 | 0.094 | 0.088 | 0.115 | 0.116 | 0.1094 | 0.1105 | 0.1228 | 0.1095 | 0.119 | 0.1345 | 0.1168 | n/a |
| 4 | 0.164 | 0.143 | 0.15 | 0.164 | 0.166 | 0.146 | 0.155 | 0.147 | 0.13 | 0.127 | 0.128 | 0.126 | 0.13 | 0.119 | 0.121 | 0.118 | 0.119 | 0.15 | 0.1297 | 0.1426 | 0.1589 | 0.144 | 0.1467 | 0.1603 | 0.1684 | n/a |
| 5 | 0.216 | 0.176 | 0.191 | 0.224 | 0.207 | 0.173 | 0.209 | 0.195 | 0.15 | 0.165 | 0.164 | 0.141 | 0.155 | 0.16 | 0.161 | 0.148 | 0.162 | 0.194 | 0.1574 | 0.1647 | 0.1816 | 0.1971 | 0.188 | 0.1881 | 0.2029 | n/a |
| 6 | 0.316 | 0.314 | 0.29 | 0.293 | 0.241 | 0.252 | 0.321 | 0.237 | 0.19 | 0.212 | 0.211 | 0.199 | 0.189 | 0.216 | 0.215 | 0.172 | 0.206 | 0.252 | 0.2038 | 0.1994 | 0.228 | 0.236 | 0.2465 | 0.2492 | 0.2277 | n/a |
| +gp | 0.477 | 0.415 | 0.424 | 0.52 | 0.369 | 0.42 | 0.534 | 0.538 | 0.344 | 0.34 | 0.354 | 0.341 | 0.324 | 0.296 | 0.296 | 0.256 | 0.388 | 0.382 | 0.3197 | 0.3801 | 0.3925 | 0.3657 | 0.4091 | 0.408 | 0.3706 | n/a |
| SOPCOFAC | 0.9488 | 0.9495 | 0.9485 | 0.9937 | 0.9855 | 1.0024 | 0.9998 | 1.0029 | 1.0007 | 1.0064 | 1.0197 | 0.998 | 1.0078 | 1.0073 | 1.0101 | 1.0073 | 0.996 | 1.0059 | 1.0018 | 0.9837 | 0.9999 | 0.9991 | 0.9996 | 1.0009 | 0.9955 | n/a |

* 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 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | At age 1 | At age 0 | At age 1 |
| | Portugal (k/h) | | | Spain (k/30 min) | | | Portugal (n/h) | | Spain (n/30 min) | | | Portugal (n) | Spain (n/30 min) | |
| | October | Crustaceans | s.e | Mean | s.e. | | Crustaceans | s.e. | Mean | s.e. | | October | | |
| 1983 | | | | 0.96 | 0.14 | 1983 | | | 14 | 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 |

\+ 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

**Table 9.1.7 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Tuning data.**

**FLT01: SP-CORUTR8c. 1000 Days by 100 HP (thousand) (*)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1986 | 2011 | | | | | | | | |
| 1 | 1 | 0 | 1 | | | | | | |
| 1 | 7 | | | | | | | Eff. | |
| 10 | 34.4 | 91.2 | 37.7 | 45.2 | 38.7 | 14.8 | 8.5 | 39.8 | 1986 |
| 10 | 242.1 | 187.3 | 62.2 | 32.6 | 25.9 | 9.2 | 7.5 | 34.7 | 1987 |
| 10 | 67.8 | 215.4 | 75.8 | 71.3 | 54.0 | 19.0 | 9.5 | 42.2 | 1988 |
| 10 | 12.6 | 87.8 | 36.3 | 46.6 | 35.8 | 13.1 | 8.8 | 44.4 | 1989 |
| 10 | 22.1 | 80.4 | 48.6 | 81.3 | 34.5 | 36.3 | 36.5 | 44.4 | 1990 |
| 10 | 13.1 | 107.9 | 47.0 | 59.7 | 61.9 | 15.1 | 5.4 | 40.4 | 1991 |
| 10 | 5.7 | 23.7 | 66.6 | 144.5 | 91.3 | 11.8 | 10.0 | 38.9 | 1992 |
| 10 | 0.2 | 42.5 | 20.4 | 49.2 | 37.8 | 9.7 | 1.6 | 44.5 | 1993 |
| 10 | 0.0 | 3.5 | 52.5 | 28.8 | 42.2 | 30.1 | 6.3 | 39.6 | 1994 |
| 10 | 51.1 | 3.2 | 15.4 | 33.6 | 12.1 | 3.3 | 2.3 | 41.5 | 1995 |
| 10 | 1.2 | 54.7 | 2.7 | 17.6 | 46.7 | 14.7 | 8.6 | 35.7 | 1996 |
| 10 | 0.9 | 32.6 | 49.7 | 5.0 | 25.4 | 23.6 | 8.1 | 35.2 | 1997 |
| 10 | 0.5 | 15.3 | 42.5 | 52.9 | 15.0 | 30.9 | 13.9 | 32.6 | 1998 |
| 10 | 0.7 | 7.9 | 40.4 | 42.5 | 35.0 | 9.7 | 19.5 | 30.2 | 1999 |
| 10 | 1.2 | 5.5 | 36.8 | 50.8 | 48.6 | 12.3 | 14.4 | 30.1 | 2000 |
| 10 | 1.9 | 18.3 | 18.4 | 22.1 | 23.7 | 19.3 | 13.5 | 29.9 | 2001 |
| 10 | 1.7 | 10.6 | 35.9 | 9.9 | 27.1 | 14.3 | 5.6 | 21.8 | 2002 |
| 10 | 20.2 | 15.0 | 15.6 | 15.7 | 9.5 | 7.8 | 6.7 | 18.5 | 2003 |
| 10 | 1.4 | 7.5 | 8.5 | 12.8 | 12.1 | 9.0 | 8.4 | 21.1 | 2004 |
| 10 | 3.9 | 8.4 | 18.6 | 8.5 | 9.1 | 5.6 | 3.8 | 20.7 | 2005 |
| 10 | 2.2 | 11.6 | 16.1 | 11.3 | 8.6 | 6.2 | 2.5 | 19.3 | 2006 |
| 10 | 7.8 | 11.7 | 13.2 | 16.9 | 10.2 | 6.1 | 4.9 | 21.2 | 2007 |
| 10 | 0.1 | 14.2 | 13.1 | 9.7 | 10.6 | 3.6 | 2.4 | 20.2 | 2008 |
| 10 | 4.2 | 12.0 | 15.7 | 8.8 | 6.1 | 4.1 | 2.0 | 16.2 | 2009 |
| 10 | 1.1 | 4.8 | 8.3 | 17.4 | 16.8 | 12.4 | 7.0 | 13.7 | 2010 |
| n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 2011 |

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

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1986 | 2003 | | | | | | | | |
| 1 | 1 | 0 | 1 | | | | | | |
| 1 | 7 | | | | | | | Eff. | |
| 10 | 251 | 317 | 263 | 128 | 112 | 94 | 56 | 10.8 | 1986 |
| 10 | 410 | 327 | 355 | 168 | 101 | 117 | 39 | 8.3 | 1987 |
| 10 | 1177 | 731 | 605 | 288 | 125 | 156 | 69 | 9.0 | 1988 |
| 10 | 750 | 461 | 484 | 227 | 130 | 156 | 61 | 8.1 | 1989 |
| 10 | 3704 | 805 | 191 | 147 | 39 | 42 | 60 | 8.5 | 1990 |
| 10 | 870 | 759 | 203 | 89 | 74 | 13 | 7 | 7.7 | 1991 |
| 10 | | | | | | | | 0.0 | 1992 |
| 10 | 544 | 705 | 43 | 47 | 25 | 12 | 9 | 7.6 | 1993 |
| 10 | 17 | 154 | 479 | 119 | 116 | 45 | 21 | 9.6 | 1994 |
| 10 | 34 | 2 | 36 | 117 | 58 | 22 | 12 | 6.1 | 1995 |
| 10 | 117 | 689 | 12 | 101 | 223 | 64 | 54 | 4.5 | 1996 |
| 10 | 88 | 812 | 573 | 31 | 141 | 118 | 43 | 4.7 | 1997 |
| 10 | 18 | 349 | 424 | 263 | 59 | 79 | 43 | 5.4 | 1998 |
| 10 | 10 | 105 | 382 | 252 | 156 | 36 | 67 | 6.8 | 1999 |
| 10 | 25 | 48 | 210 | 201 | 128 | 31 | 46 | 4.5 | 2000 |
| 10 | 43 | 234 | 226 | 142 | 135 | 98 | 100 | 1.8 | 2001 |
| 10 | 46 | 132 | 199 | 54 | 78 | 45 | 39 | 2.7 | 2002 |
| 10 | 23 | 76 | 95 | 63 | 28 | 22 | 25 | 2.5 | 2003 |

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

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1988 | 2011 | | | | | | | | |
| 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 | 127 | 2010 |
| 1 | 1.94 | 12.47 | 1.32 | 0.30 | 0.63 | 0.40 | 0.39 | 122 | 2011 |

**Age 1 excluded in this year assessment for SP-CORUTR8c and SP-AVILESTR fleets.**

**Table 9.1.8 Megrim (*L. whiffiagonis*). LPUE data by fleet in Divisions VIIIc and IXa.**

| | A Coruña Trawl in VIIIc | | | Avilés Trawl in VIIIc | | | Portugal trawl in IXa | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Landings (t) | Effort | LPUE [1] | Landings (t) | Effort | LPUE [1] | Landings (t) | Effort | LPUE [2] |
| 1986 | 156 | 39.8 | 3.92 | 141 | 10.8 | 13.04 | | | |
| 1987 | 155 | 34.7 | 4.47 | 102 | 8.3 | 12.23 | | | |
| 1988 | 263 | 42.2 | 6.24 | 180 | 9.0 | 19.94 | 74.9 | 38.5 | 1.95 |
| 1989 | 196 | 44.4 | 4.41 | 143 | 8.1 | 17.75 | 92.2 | 44.7 | 2.06 |
| 1990 | 270 | 44.4 | 6.08 | 266 | 8.5 | 31.33 | 86.0 | 39.0 | 2.20 |
| 1991 | 211 | 40.4 | 5.22 | 102 | 7.7 | 13.28 | 85.5 | 45.0 | 1.90 |
| 1992 | 255 | 38.9 | 6.55 | 56 | n/a | | 32.6 | 50.9 | 0.64 |
| 1993 | 121 | 44.5 | 2.72 | 67 | 7.6 | 8.76 | 31.7 | 44.2 | 0.72 |
| 1994 | 108 | 39.6 | 2.73 | 96 | 9.6 | 9.95 | 25.8 | 45.8 | 0.56 |
| 1995 | 28 | 41.5 | 0.67 | 50 | 6.1 | 8.16 | 21.4 | 37.0 | 0.58 |
| 1996 | 72 | 35.7 | 2.01 | 67 | 4.5 | 14.72 | 22.2 | 46.5 | 0.48 |
| 1997 | 75 | 35.2 | 2.12 | 83 | 4.7 | 17.70 | 41.5 | 33.4 | 1.24 |
| 1998 | 90 | 32.6 | 2.78 | 74 | 5.4 | 13.78 | 60.1 | 43.1 | 1.39 |
| 1999 | 73 | 30.2 | 2.40 | 83 | 6.8 | 12.21 | 4.3 | 25.3 | 0.17 |
| 2000 | 79 | 30.1 | 2.63 | 41 | 4.5 | 9.26 | 6.9 | 27.0 | 0.25 |
| 2001 | 49 | 29.9 | 1.65 | 24 | 1.8 | 13.01 | 1.3 | 43.1 | 0.03 |
| 2002* | 36 | 21.8 | 1.66 | 21 | 2.7 | 7.78 | 1.0 | 31.2 | 0.03 |
| 2003* | 25 | 18.5 | 1.36 | 13 | 2.5 | 5.06 | 15.3 | 40.5 | 0.38 |
| 2004 | 22 | 21.1 | 1.06 | 27 | n/a | | 3.4 | 35.4 | 0.10 |
| 2005 | 18 | 20.7 | 0.88 | 35 | n/a | | 19.0 | 42.6 | 0.45 |
| 2006 | 18 | 19.3 | 0.94 | 29 | n/a | | 26.3 | 40.3 | 0.65 |
| 2007** | 23 | 21.2 | 1.10 | 12 | n/a | | 10.5 | 43.8 | 0.24 |
| 2008** | 17 | 20.2 | 0.82 | 11 | n/a | | 14.4 | 38.4 | 0.37 |
| 2009 | 12 | 16.2 | 0.76 | 12 | n/a | | 6.0 | 49.3 | 0.12 |
| 2010 | 19 | 13.7 | 1.37 | 25 | n/a | | 7.3 | 48.0 | 0.15 |
| 2011 | n/a | n/a | n/a | 32 | n/a | | 24.8 | 49.4 | 0.50 |

[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

28/04/2011 12:22

Extended Survivors Analysis

Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa

CPUE data from file fleetw.txt

Catch data for 25 years. 1986 to 2010. Ages 1 to 7.

| Fleet | First year | Last year | First age | Last age | Alpha | Beta |
|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1990 | 2010 | 2 | 6 | 0 | 1 |
| SP-AVILESTR | 1990 | 2010 | 2 | 6 | 0 | 1 |
| SpGFS-WIBTS-Q4 | 1990 | 2010 | 1 | 6 | 0.75 | 0.83 |

Time series weights :

Tapered time weighting not applied

Catchability analysis :

Catchability dependent on stock size for ages < 5

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

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 30 iterations

Total absolute residual between iterations
29 and 30 = .00680

Final year F values

| Age | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Iteration 29 | 0.0063 | 0.0379 | 0.0653 | 0.1256 | 0.2208 | 0.3454 |
| Iteration 30 | 0.0062 | 0.0377 | 0.065 | 0.125 | 0.2188 | 0.3417 |

Regression weights

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Fishing mortalities

| Age | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.016 | 0.014 | 0.054 | 0.018 | 0.059 | 0.05 | 0.034 | 0.005 | 0.025 | 0.006 |
| 2 | 0.143 | 0.076 | 0.149 | 0.133 | 0.109 | 0.288 | 0.117 | 0.166 | 0.085 | 0.038 |
| 3 | 0.311 | 0.212 | 0.186 | 0.182 | 0.348 | 0.364 | 0.257 | 0.217 | 0.119 | 0.065 |
| 4 | 0.224 | 0.137 | 0.177 | 0.259 | 0.211 | 0.379 | 0.417 | 0.259 | 0.146 | 0.125 |
| 5 | 0.253 | 0.231 | 0.182 | 0.287 | 0.258 | 0.363 | 0.39 | 0.435 | 0.196 | 0.219 |
| 6 | 0.3 | 0.137 | 0.111 | 0.364 | 0.21 | 0.288 | 0.293 | 0.282 | 0.259 | 0.342 |

XSA population numbers (Thousands)

| YEAR \ AGE | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 2001 | 2.82E+03 | 2.53E+03 | 1.24E+03 | 1.34E+03 | 1.09E+03 | 6.83E+02 |
| 2002 | 2.40E+03 | 2.27E+03 | 1.80E+03 | 7.44E+02 | 8.78E+02 | 6.92E+02 |
| 2003 | 2.70E+03 | 1.93E+03 | 1.72E+03 | 1.19E+03 | 5.31E+02 | 5.70E+02 |
| 2004 | 2.87E+03 | 2.10E+03 | 1.36E+03 | 1.17E+03 | 8.16E+02 | 3.63E+02 |
| 2005 | 2.39E+03 | 2.31E+03 | 1.50E+03 | 9.31E+02 | 7.40E+02 | 5.02E+02 |
| 2006 | 2.06E+03 | 1.85E+03 | 1.69E+03 | 8.68E+02 | 6.18E+02 | 4.68E+02 |
| 2007 | 2.59E+03 | 1.61E+03 | 1.13E+03 | 9.63E+02 | 4.86E+02 | 3.52E+02 |
| 2008 | 1.49E+03 | 2.05E+03 | 1.17E+03 | 7.18E+02 | 5.20E+02 | 2.70E+02 |
| 2009 | 1.23E+03 | 1.21E+03 | 1.42E+03 | 7.71E+02 | 4.54E+02 | 2.76E+02 |
| 2010 | 5340 | 985 | 913 | 1030 | 546 | 305 |

Estimated population abundance at 1st Jan 2011

| | | | | | |
|---|---|---|---|---|---|
| 0 | 4360 | 780 | 704 | 751 | 362 |

Taper weighted geometric mean of the VPA populations:

| | | | | | |
|---|---|---|---|---|---|
| 4120 | 3150 | 2180 | 1420 | 835 | 416 |

Standard error of the weighted Log(VPA populations) :

| | | | | | |
|---|---|---|---|---|---|
| 0.7296 | 0.6846 | 0.5324 | 0.4547 | 0.375 | 0.4142 |

Log catchability residuals.

Fleet : SP-CORUTR8c

| Age | 1990 |
|---|---|
| 1 | No data for this fleet at this age |
| 2 | 0.42 |
| 3 | 0.06 |
| 4 | 0.12 |
| 5 | 0.47 |
| 6 | 0.28 |

| Age | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | No data for this fleet at this age | | | | | | | | | |
| 2 | 0.85 | 0.27 | -0.15 | -1.19 | -0.22 | 0.36 | -0.2 | -0.59 | -0.64 | -0.29 |
| 3 | -0.14 | 0.43 | -0.12 | -0.11 | -0.32 | -0.63 | -0.08 | -0.22 | -0.06 | 0.24 |
| 4 | 0.1 | 0.38 | 0.13 | 0.1 | -0.26 | -0.22 | -0.06 | -0.09 | -0.22 | 0.04 |
| 5 | 0.93 | 1.42 | 0.31 | 0.84 | -0.38 | 0.21 | 0.03 | 0.36 | 0.21 | 0.32 |
| 6 | 0.4 | 0.19 | 0.17 | 1.09 | -0.53 | 0.32 | 0.83 | 1.47 | 1.12 | -0.22 |

| Age | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | No data for this fleet at this age | | | | | | | | | |
| 2 | 0.22 | -0.12 | 0.34 | -0.28 | -0.3 | 0.24 | 0.32 | 0.24 | 0.61 | 0.1 |
| 3 | 0.36 | 0.43 | -0.13 | -0.32 | 0.19 | -0.03 | 0.2 | 0.15 | 0.05 | 0.03 |
| 4 | -0.06 | 0.1 | -0.13 | -0.2 | -0.19 | 0.07 | 0.18 | 0.15 | 0.01 | 0.05 |
| 5 | -0.33 | 0 | -0.56 | -0.71 | -0.91 | -0.73 | -0.31 | -0.32 | -0.84 | -0.01 |
| 6 | -0.05 | -0.44 | -0.87 | -0.15 | -1.02 | -0.82 | -0.55 | -0.82 | -0.71 | 0.33 |

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

| Age | 5 | 6 |
|---|---|---|
| Mean Log q | -5.5765 | -5.5765 |
| S.E(Log q) | 0.6147 | 0.718 |

Regression statistics :

Ages with q dependent on year class strength

| Age | Slope | t-value | Intercept | RSquare | No Pts | Reg s.e | Mean Log q |
|---|---|---|---|---|---|---|---|
| 2 | 0.77 | 1.362 | 7.47 | 0.65 | 21 | 0.48 | -7.34 |
| 3 | 0.71 | 2.552 | 6.88 | 0.8 | 21 | 0.27 | -6.59 |
| 4 | 0.51 | 5.817 | 6.63 | 0.88 | 21 | 0.17 | -6.1 |

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 |
|---|---|---|---|---|---|---|---|
| 5 | 0.52 | 2.607 | 6.09 | 0.61 | 21 | 0.28 | -5.58 |
| 6 | 1.13 | -0.298 | 5.52 | 0.22 | 21 | 0.83 | -5.58 |
| 1 | | | | | | | |

Fleet : SP-AVILESTR

| Age | 1990 |
|---|---|
| 1 | No data for this fleet at this age |
| 2 | -0.09 |
| 3 | -0.19 |
| 4 | -0.1 |
| 5 | -0.65 |
| 6 | -0.8 |

| Age | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | No data for this fleet at this age | | | | | | | | | |
| 2 | 0.07 | 99.99 | -0.2 | 0.08 | -0.62 | -0.06 | 0.02 | -0.13 | -0.12 | 0.17 |
| 3 | -0.34 | 99.99 | -0.63 | 0.11 | -0.74 | -0.38 | 0.29 | 0.08 | 0.22 | 0.23 |
| 4 | -0.36 | 99.99 | -0.72 | 0.25 | -0.22 | 0.01 | -0.09 | 0.36 | 0.3 | 0.28 |
| 5 | -0.12 | 99.99 | -1.34 | 0.62 | -0.04 | 0.67 | 0.51 | 0.49 | 0.47 | 0.05 |
| 6 | -0.98 | 99.99 | -0.86 | 0.26 | 0.12 | 0.83 | 1.2 | 1.16 | 1.21 | -0.52 |

| Age | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | No data for this fleet at this age | | | | | | | | | |
| 2 | 0.41 | 0.27 | 0.22 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| 3 | 0.9 | 0.43 | 0.02 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| 4 | 0.34 | 0.14 | -0.2 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| 5 | 0.19 | -0.16 | -0.7 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| 6 | 0.36 | -0.52 | -1.06 | 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 | 5 | 6 |
|---|---|---|
| Mean Log q | -4.3429 | -4.3429 |
| S.E(Log q) | 0.6019 | 0.8736 |

Regression statistics :

Ages with q dependent on year class strength

| Age | Slope | t-value | Intercept | RSquare | No Pts | Reg s.e | Mean Log q |
|---|---|---|---|---|---|---|---|
| 2 | 0.4 | 4.994 | 6.9 | 0.86 | 13 | 0.27 | -5.04 |
| 3 | 0.59 | 1.579 | 6.02 | 0.58 | 13 | 0.47 | -4.8 |
| 4 | 0.77 | 0.999 | 5.31 | 0.64 | 13 | 0.34 | -4.72 |

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 |
|---|---|---|---|---|---|---|---|
| 5 | 0.83 | 0.373 | 4.77 | 0.29 | 13 | 0.52 | -4.34 |
| 6 | 2.79 | -1.331 | 1.18 | 0.05 | 13 | 2.36 | -4.31 |

Fleet : SpGFS-WIBTS-Q4

| Age | 1990 |
|---|---|
| 1 | -0.31 |
| 2 | 0.02 |
| 3 | 0.04 |
| 4 | 0.27 |
| 5 | 0.36 |
| 6 | 0.18 |

| Age | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | -0.45 | -0.14 | -0.02 | -0.98 | -0.23 | 0.06 | -0.08 | -0.02 | 0.24 | 0.71 |
| 2 | -0.3 | -0.48 | 0.01 | -0.79 | -0.52 | -0.05 | 0.05 | -0.11 | 0.36 | 0.6 |
| 3 | -0.74 | -0.33 | -0.76 | 0.15 | -0.92 | -0.64 | -0.02 | 0.16 | 0.35 | 0.37 |
| 4 | -0.1 | -0.05 | -0.06 | 0.04 | -0.28 | -0.33 | -0.11 | -0.11 | -0.05 | 0.33 |
| 5 | 0.03 | 0.4 | -0.32 | 0.24 | -0.06 | -0.16 | -0.03 | 0.04 | 0.23 | 0.33 |
| 6 | -0.6 | -0.74 | -0.71 | -0.16 | -0.34 | 0.12 | 0.13 | 1.21 | 1.52 | -0.01 |

| Age | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.15 | 0.44 | 0.19 | 0.1 | 0.39 | 0.06 | 0.21 | -0.35 | -0.22 | 0.22 |
| 2 | 0.6 | 0.43 | 0.13 | 0.23 | -0.01 | 0.23 | 0.03 | 0.12 | -0.19 | -0.34 |
| 3 | 0.25 | 0.76 | 0.14 | 0.19 | 0.54 | 0.23 | 0.4 | 0.31 | 0.22 | -0.69 |
| 4 | 0.32 | -0.34 | -0.1 | 0.06 | 0.33 | 0.09 | 0.31 | -0.06 | 0.15 | -0.29 |
| 5 | 0.04 | 0.1 | -0.41 | -0.32 | 0.43 | 0.11 | 0.11 | -0.21 | -0.5 | -0.41 |
| 6 | -0.41 | -0.73 | -1.23 | 0.36 | -0.19 | -0.04 | -0.08 | -0.71 | -0.24 | 0.23 |

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

| Age | 5 | 6 |
|---|---|---|
| Mean Log q | -6.2192 | -6.2192 |
| S.E(Log q) | 0.2817 | 0.6485 |

Regression statistics :

Ages with q dependent on year class strength

| Age | Slope | t-value | Intercept | RSquare | No Pts | Reg s.e | Mean Log q |
|---|---|---|---|---|---|---|---|
| 1 | 0.53 | 3.802 | 7.65 | 0.77 | 21 | 0.37 | -7.2 |
| 2 | 0.64 | 2.834 | 7.29 | 0.76 | 21 | 0.37 | -6.94 |
| 3 | 0.78 | 1.02 | 6.96 | 0.54 | 21 | 0.49 | -6.79 |
| 4 | 0.72 | 2.454 | 6.67 | 0.8 | 21 | 0.23 | -6.47 |

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 |
|---|---|---|---|---|---|---|---|
| 5 | 0.74 | 2.024 | 6.33 | 0.76 | 21 | 0.19 | -6.22 |
| 6 | 1.6 | -1.131 | 6.54 | 0.16 | 21 | 1.01 | -6.34 |

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2009

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SP-AVILESTR | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SpGFS-WIBTS-Q4 | 5414 | 0.384 | 0 | 0 | 1 | 0.723 | 0.005 |
| P shrinkage mean | 3148 | 0.68 | | | | 0.229 | 0.009 |
| F shrinkage mean | 768 | 1.5 | | | | 0.048 | 0.035 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 4357 | 0.33 | 0.35 | 3 | 1.08 | 0.006 |

Age 2 Catchability dependent on age and year class strength

Year class = 2008

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 860 | 0.51 | 0 | 0 | 1 | 0.191 | 0.034 |
| SP-AVILESTR | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SpGFS-WIBTS-Q4 | 587 | 0.285 | 0.059 | 0.21 | 2 | 0.604 | 0.05 |
| P shrinkage mean | 2177 | 0.53 | | | | 0.182 | 0.014 |
| F shrinkage mean | 180 | 1.5 | | | | 0.023 | 0.154 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 780 | 0.22 | 0.29 | 5 | 1.291 | 0.038 |

Age 3 Catchability dependent on age and year class strength

Year class = 2007

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 826 | 0.249 | 0.248 | 1 | 2 | 0.435 | 0.055 |
| SP-AVILESTR | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SpGFS-WIBTS-Q4 | 489 | 0.25 | 0.134 | 0.54 | 3 | 0.411 | 0.092 |
| P shrinkage mean | 1423 | 0.45 | | | | 0.141 | 0.033 |
| F shrinkage mean | 157 | 1.5 | | | | 0.013 | 0.262 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 704 | 0.16 | 0.19 | 7 | 1.159 | 0.065 |

Age 4 Catchability dependent on age and year class strength

Year class = 2006

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 799 | 0.155 | 0.037 | 0.24 | 3 | 0.496 | 0.117 |
| SP-AVILESTR | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SpGFS-WIBTS-Q4 | 687 | 0.169 | 0.137 | 0.81 | 4 | 0.397 | 0.135 |
| P shrinkage mean | 835 | 0.38 | | | | 0.101 | 0.113 |
| F shrinkage mean | 303 | 1.5 | | | | 0.006 | 0.284 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 751 | 0.11 | 0.07 | 9 | 0.608 | 0.125 |

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

Year class = 2005

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 382 | 0.151 | 0.055 | 0.36 | 4 | 0.474 | 0.207 |
| SP-AVILESTR | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SpGFS-WIBTS-Q4 | 347 | 0.147 | 0.129 | 0.88 | 5 | 0.518 | 0.225 |
| F shrinkage mean | 224 | 1.5 | | | | 0.007 | 0.33 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 362 | 0.11 | 0.07 | 10 | 0.656 | 0.219 |

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

Year class = 2004

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 197 | 0.151 | 0.136 | 0.91 | 5 | 0.473 | 0.312 |
| SP-AVILESTR | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SpGFS-WIBTS-Q4 | 162 | 0.149 | 0.146 | 0.98 | 6 | 0.516 | 0.37 |
| F shrinkage mean | 494 | 1.5 | | | | 0.011 | 0.137 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 180 | 0.11 | 0.1 | 12 | 0.948 | 0.342 |

**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 28/04/2011 12:26

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

| YEAR | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| AGE | | | | | |
| 1 | 0.1322 | 0.2042 | 0.3638 | 0.092 | 0.4875 |
| 2 | 0.3307 | 0.4982 | 0.6125 | 0.4195 | 0.4015 |
| 3 | 0.2487 | 0.2039 | 0.4393 | 0.2348 | 0.3001 |
| 4 | 0.453 | 0.2274 | 0.3162 | 0.5269 | 0.5341 |
| 5 | 0.7989 | 0.3805 | 0.544 | 0.3687 | 0.5829 |
| 6 | 0.5047 | 0.2726 | 0.4373 | 0.3806 | 0.5255 |
| +gp | 0.5047 | 0.2726 | 0.4373 | 0.3806 | 0.5255 |
| FBAR 2- 4 | 0.3441 | 0.3098 | 0.456 | 0.3937 | 0.4119 |

Table 8 Fishing mortality (F) at age

| YEAR | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | |
| 1 | 0.2712 | 0.1217 | 0.1465 | 0.0354 | 0.0691 | 0.0285 | 0.0145 | 0.0224 | 0.0109 | 0.0032 |
| 2 | 0.5564 | 0.1584 | 0.2923 | 0.1748 | 0.0404 | 0.2943 | 0.2103 | 0.2126 | 0.0902 | 0.0853 |
| 3 | 0.2567 | 0.3034 | 0.1826 | 0.5699 | 0.1476 | 0.0532 | 0.3346 | 0.392 | 0.3781 | 0.3388 |
| 4 | 0.479 | 0.6928 | 0.41 | 0.563 | 0.3946 | 0.24 | 0.1473 | 0.5497 | 0.4112 | 0.3516 |
| 5 | 1.0179 | 1.0294 | 0.4927 | 1.3256 | 0.5197 | 0.6508 | 0.5618 | 0.7894 | 0.5961 | 0.3909 |
| 6 | 0.5347 | 0.2991 | 0.4769 | 1.2693 | 0.4674 | 0.7089 | 1.1412 | 1.7969 | 1.2743 | 0.2069 |
| +gp | 0.5347 | 0.2991 | 0.4769 | 1.2693 | 0.4674 | 0.7089 | 1.1412 | 1.7969 | 1.2743 | 0.2069 |
| FBAR 2- 4 | 0.4307 | 0.3849 | 0.295 | 0.4359 | 0.1942 | 0.1958 | 0.2307 | 0.3848 | 0.2932 | 0.2586 |

Table 8 Fishing mortality (F) at age

| YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | FBAR 08-10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | |
| 1 | 0.0158 | 0.0144 | 0.0542 | 0.0179 | 0.0585 | 0.0499 | 0.0342 | 0.0052 | 0.0254 | 0.0062 | 0.0123 |
| 2 | 0.1429 | 0.0763 | 0.1489 | 0.1329 | 0.1088 | 0.288 | 0.1173 | 0.166 | 0.0854 | 0.0377 | 0.0964 |
| 3 | 0.3111 | 0.2116 | 0.1863 | 0.1816 | 0.3485 | 0.3637 | 0.2565 | 0.2174 | 0.1186 | 0.065 | 0.1337 |
| 4 | 0.2244 | 0.1367 | 0.1773 | 0.2593 | 0.2105 | 0.3793 | 0.4165 | 0.2586 | 0.1463 | 0.125 | 0.1766 |
| 5 | 0.2527 | 0.2313 | 0.182 | 0.2866 | 0.2576 | 0.3626 | 0.3895 | 0.435 | 0.1958 | 0.2188 | 0.2832 |
| 6 | 0.2997 | 0.1366 | 0.1106 | 0.3635 | 0.21 | 0.288 | 0.2934 | 0.2821 | 0.2595 | 0.3417 | 0.2944 |
| +gp | 0.2997 | 0.1366 | 0.1106 | 0.3635 | 0.21 | 0.288 | 0.2934 | 0.2821 | 0.2595 | 0.3417 | |
| FBAR 2- 4 | 0.2261 | 0.1415 | 0.1708 | 0.1913 | 0.2226 | 0.3437 | 0.2634 | 0.214 | 0.1168 | 0.0759 | |

**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 28/04/2011 12:26

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 |
|---|---|---|---|---|---|
| AGE | | | | | |
| 1 | 9042 | 12089 | 10788 | 9555 | 12115 |
| 2 | 7661 | 6487 | 8069 | 6138 | 7135 |
| 3 | 3353 | 4506 | 3227 | 3581 | 3304 |
| 4 | 1939 | 2141 | 3009 | 1703 | 2318 |
| 5 | 1006 | 1009 | 1396 | 1795 | 823 |
| 6 | 561 | 371 | 565 | 663 | 1017 |
| +gp | 536 | 327 | 402 | 876 | 1493 |
| TOTAL | 24097 | 26928 | 27455 | 24312 | 28206 |

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

| YEAR | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | |
| 1 | 4737 | 10243 | 4209 | 1271 | 8430 | 7779 | 6308 | 3840 | 2037 | 3102 |
| 2 | 6092 | 2957 | 7426 | 2976 | 1004 | 6442 | 6189 | 5090 | 3074 | 1650 |
| 3 | 3910 | 2859 | 2066 | 4539 | 2046 | 790 | 3929 | 4107 | 3370 | 2300 |
| 4 | 2004 | 2476 | 1728 | 1409 | 2102 | 1445 | 613 | 2302 | 2272 | 1890 |
| 5 | 1113 | 1016 | 1014 | 939 | 657 | 1160 | 931 | 433 | 1088 | 1233 |
| 6 | 376 | 329 | 297 | 507 | 204 | 320 | 495 | 435 | 161 | 491 |
| +gp | 156 | 289 | 104 | 179 | 211 | 174 | 185 | 192 | 311 | 947 |
| TOTAL | 18387 | 20170 | 16844 | 11821 | 14655 | 18109 | 18651 | 16399 | 12312 | 11612 |

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

| YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | GMST 98-08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | |
| 1 | 2819 | 2396 | 2703 | 2867 | 2391 | 2065 | 2593 | 1491 | 1234 | 5338 | 0 | 2504 |
| 2 | 2531 | 2272 | 1934 | 2096 | 2305 | 1846 | 1608 | 2052 | 1215 | 985 | 4357 | |
| 3 | 1240 | 1796 | 1723 | 1364 | 1502 | 1693 | 1133 | 1171 | 1423 | 913 | 780 | |
| 4 | 1342 | 744 | 1190 | 1171 | 931 | 868 | 963 | 718 | 771 | 1035 | 704 | |
| 5 | 1089 | 878 | 531 | 816 | 740 | 618 | 486 | 520 | 454 | 546 | 751 | |
| 6 | 683 | 692 | 570 | 363 | 502 | 468 | 352 | 270 | 276 | 305 | 362 | |
| +gp | 500 | 319 | 505 | 255 | 238 | 158 | 242 | 156 | 135 | 163 | 275 | |
| TOTAL | 10204 | 9097 | 9156 | 8932 | 8609 | 7716 | 7378 | 6378 | 5506 | 9285 | 7229 | |

**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 28/04/2011 12:26

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

| | RECRUITS Age 1 | TOTALBIO | TOTSPBIO | LANDINGS | YIELD/SSB | FBAR 2- 4 |
|---|---|---|---|---|---|---|
| 1986 | 9042 | 2562 | 2215 | 659 | 0.2975 | 0.3441 |
| 1987 | 12089 | 2287 | 1842 | 497 | 0.2698 | 0.3098 |
| 1988 | 10788 | 2596 | 2203 | 817 | 0.3708 | 0.456 |
| 1989 | 9555 | 2882 | 2498 | 714 | 0.2859 | 0.3937 |
| 1990 | 12115 | 2973 | 2576 | 977 | 0.3793 | 0.4119 |
| 1991 | 4737 | 1807 | 1629 | 614 | 0.3769 | 0.4307 |
| 1992 | 10243 | 1843 | 1585 | 516 | 0.3256 | 0.3849 |
| 1993 | 4209 | 1565 | 1406 | 383 | 0.2724 | 0.295 |
| 1994 | 1271 | 1200 | 1141 | 479 | 0.42 | 0.4359 |
| 1995 | 8430 | 1276 | 935 | 218 | 0.2331 | 0.1942 |
| 1996 | 7779 | 1587 | 1253 | 329 | 0.2626 | 0.1958 |
| 1997 | 6308 | 1638 | 1353 | 356 | 0.2631 | 0.2307 |
| 1998 | 3840 | 1450 | 1298 | 446 | 0.3436 | 0.3848 |
| 1999 | 2037 | 1200 | 1103 | 343 | 0.3108 | 0.2932 |
| 2000 | 3102 | 1322 | 1195 | 253 | 0.2117 | 0.2586 |
| 2001 | 2819 | 1053 | 923 | 175 | 0.1895 | 0.2261 |
| 2002 | 2396 | 1029 | 919 | 117 | 0.1274 | 0.1415 |
| 2003 | 2703 | 1142 | 1024 | 134 | 0.1308 | 0.1708 |
| 2004 | 2867 | 941 | 806 | 149 | 0.185 | 0.1913 |
| 2005 | 2391 | 941 | 826 | 147 | 0.1779 | 0.2226 |
| 2006 | 2065 | 927 | 824 | 210 | 0.255 | 0.3437 |
| 2007 | 2593 | 841 | 716 | 155 | 0.2166 | 0.2634 |
| 2008 | 1491 | 748 | 672 | 133 | 0.198 | 0.214 |
| 2009 | 1234 | 714 | 650 | 84 | 0.1292 | 0.1168 |
| 2010 | 5338 | 943 | 717 | 83 | 0.1158 | 0.0759 |
| Arith. Mean | 5258 | 1499 | 1292 | 360 | 0.2539 | 0.2794 |
| Units | (Thousands) | (Tonnes) | (Tonnes) | (Tonnes) | | |

**Table 9.1.13. Megrim (*L. whiffiagonis*) in Division VIIIc, IXa. Prediction with management option table: Input data**

Fbar age range: 2-4

2011

| Age | Stock size | Natural mortality | Maturity ogive | Prop. of F bef. Spaw. | Prop. of M bef. Spaw. | Weight in Stock | Exploit pattern | Weight CWt |
|---|---|---|---|---|---|---|---|---|
| 1 | 2504 | 0.2 | 0.34 | 0 | 0 | 0.062 | 0.012 | 0.062 |
| 2 | 4357 | 0.2 | 0.9 | 0 | 0 | 0.092 | 0.096 | 0.092 |
| 3 | 780 | 0.2 | 1 | 0 | 0 | 0.123 | 0.134 | 0.123 |
| 4 | 704 | 0.2 | 1 | 0 | 0 | 0.158 | 0.177 | 0.158 |
| 5 | 751 | 0.2 | 1 | 0 | 0 | 0.193 | 0.283 | 0.193 |
| 6 | 362 | 0.2 | 1 | 0 | 0 | 0.241 | 0.294 | 0.241 |
| 7 | 275 | 0.2 | 1 | 0 | 0 | 0.396 | 0.294 | 0.396 |

2012

| Age | Stock size | Natural mortality | Maturity ogive | Prop. of F bef. Spaw. | Prop. of M bef. Spaw. | Weight in Stock | Exploit pattern | Weight CWt |
|---|---|---|---|---|---|---|---|---|
| 1 | 2504 | 0.2 | 0.34 | 0 | 0 | 0.062 | 0.012 | 0.062 |
| 2 | | 0.2 | 0.9 | 0 | 0 | 0.092 | 0.096 | 0.092 |
| 3 | | 0.2 | 1 | 0 | 0 | 0.123 | 0.134 | 0.123 |
| 4 | | 0.2 | 1 | 0 | 0 | 0.158 | 0.177 | 0.158 |
| 5 | | 0.2 | 1 | 0 | 0 | 0.193 | 0.283 | 0.193 |
| 6 | | 0.2 | 1 | 0 | 0 | 0.241 | 0.294 | 0.241 |
| 7 | | 0.2 | 1 | 0 | 0 | 0.396 | 0.294 | 0.396 |

2013

| Age | Stock size | Natural mortality | Maturity ogive | Prop. of F bef. Spaw. | Prop. of M bef. Spaw. | Weight in Stock | Exploit pattern | Weight CWt |
|---|---|---|---|---|---|---|---|---|
| 1 | 2504 | 0.2 | 0.34 | 0 | 0 | 0.062 | 0.012 | 0.062 |
| 2 | . | 0.2 | 0.9 | 0 | 0 | 0.092 | 0.096 | 0.092 |
| 3 | . | 0.2 | 1 | 0 | 0 | 0.123 | 0.134 | 0.123 |
| 4 | . | 0.2 | 1 | 0 | 0 | 0.158 | 0.177 | 0.158 |
| 5 | . | 0.2 | 1 | 0 | 0 | 0.193 | 0.283 | 0.193 |
| 6 | . | 0.2 | 1 | 0 | 0 | 0.241 | 0.294 | 0.241 |
| 7 | . | 0.2 | 1 | 0 | 0 | 0.396 | 0.294 | 0.396 |

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 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2504 | 0.2 | 0.34 | 0 | 0 | 0.062 | 0.012 | 0.062 |
| 2 | . | 0.2 | 0.9 | 0 | 0 | 0.092 | 0.096 | 0.092 |
| 3 | . | 0.2 | 1 | 0 | 0 | 0.123 | 0.134 | 0.123 |
| 4 | . | 0.2 | 1 | 0 | 0 | 0.158 | 0.177 | 0.158 |
| 5 | . | 0.2 | 1 | 0 | 0 | 0.193 | 0.283 | 0.193 |
| 6 | . | 0.2 | 1 | 0 | 0 | 0.241 | 0.294 | 0.241 |
| 7 | . | 0.2 | 1 | 0 | 0 | 0.396 | 0.294 | 0.396 |

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**

Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa

Fbar age range: 2-4

| 2012 | | | | |
|---|---|---|---|---|
| Biomass | SSB | FMult | FBar | Landings |
| 1188 | 1067 | 1 | 0.1356 | 158 |

| 2013 | | | | | 2014 | |
|---|---|---|---|---|---|---|
| Biomass | SSB | FMult | FBar | Landings | Biomass | SSB |
| 1246 | 1125 | 0 | 0 | 0 | 1450 | 1330 |
| . | 1125 | 0.1 | 0.0136 | 19 | 1429 | 1309 |
| . | 1125 | 0.2 | 0.0271 | 38 | 1409 | 1288 |
| . | 1125 | 0.3 | 0.0407 | 56 | 1389 | 1268 |
| . | 1125 | 0.4 | 0.0542 | 74 | 1369 | 1248 |
| . | 1125 | 0.5 | 0.0678 | 91 | 1350 | 1229 |
| . | 1125 | 0.6 | 0.0814 | 108 | 1331 | 1210 |
| . | 1125 | 0.7 | 0.0949 | 125 | 1312 | 1192 |
| . | 1125 | 0.8 | 0.1085 | 142 | 1294 | 1174 |
| . | 1125 | 0.9 | 0.122 | 158 | 1277 | 1156 |
| . | 1125 | 1 | 0.1356 | 174 | 1259 | 1139 |
| | 1125 | 1.1 | 0.1492 | 189 | 1242 | 1122 |
| | 1125 | 1.2 | 0.1627 | 204 | 1226 | 1105 |
| | 1125 | 1.3 | 0.1763 | 219 | 1209 | 1089 |
| | 1125 | 1.4 | 0.1898 | 234 | 1193 | 1073 |
| | 1125 | 1.5 | 0.2034 | 248 | 1178 | 1057 |
| | 1125 | 1.6 | 0.217 | 262 | 1162 | 1042 |
| | 1125 | 1.7 | 0.2305 | 275 | 1147 | 1027 |
| | 1125 | 1.8 | 0.2441 | 289 | 1133 | 1012 |
| | 1125 | 1.9 | 0.2576 | 302 | 1118 | 998 |
| | 1125 | 2 | 0.2712 | 315 | 1104 | 984 |

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.**

Fbar age range: 2-4

| Year: | 2011 | F multiplier: | 1 | Fbar: | 0.1356 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Age | F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
| 1 | 0.012 | 28 | 2 | 2504 | 155 | 851 | 53 | 851 | 53 |
| 2 | 0.096 | 363 | 33 | 4357 | 401 | 3921 | 361 | 3921 | 361 |
| 3 | 0.134 | 89 | 11 | 780 | 96 | 780 | 96 | 780 | 96 |
| 4 | 0.177 | 104 | 16 | 704 | 112 | 704 | 112 | 704 | 112 |
| 5 | 0.283 | 169 | 33 | 751 | 145 | 751 | 145 | 751 | 145 |
| 6 | 0.294 | 84 | 20 | 362 | 87 | 362 | 87 | 362 | 87 |
| 7 | 0.294 | 64 | 25 | 275 | 109 | 275 | 109 | 275 | 109 |
| Total | | 900 | 141 | 9733 | 1104 | 7645 | 962 | 7645 | 962 |

| Year: | 2012 | F multiplier: | 1 | Fbar: | 0.1356 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Age | F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
| 1 | 0.012 | 28 | 2 | 2504 | 155 | 851 | 53 | 851 | 53 |
| 2 | 0.096 | 169 | 16 | 2025 | 186 | 1823 | 168 | 1823 | 168 |
| 3 | 0.134 | 368 | 45 | 3239 | 400 | 3239 | 400 | 3239 | 400 |
| 4 | 0.177 | 82 | 13 | 559 | 89 | 559 | 89 | 559 | 89 |
| 5 | 0.283 | 109 | 21 | 483 | 93 | 483 | 93 | 483 | 93 |
| 6 | 0.294 | 108 | 26 | 463 | 112 | 463 | 112 | 463 | 112 |
| 7 | 0.294 | 90 | 36 | 389 | 154 | 389 | 154 | 389 | 154 |
| Total | | 954 | 158 | 9662 | 1188 | 7807 | 1067 | 7807 | 1067 |

| Year: | 2013 | F multiplier: | 1 | Fbar: | 0.1356 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Age | F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
| 1 | 0.012 | 28 | 2 | 2504 | 155 | 851 | 53 | 851 | 53 |
| 2 | 0.096 | 169 | 16 | 2025 | 186 | 1823 | 168 | 1823 | 168 |
| 3 | 0.134 | 171 | 21 | 1506 | 186 | 1506 | 186 | 1506 | 186 |
| 4 | 0.177 | 342 | 54 | 2320 | 368 | 2320 | 368 | 2320 | 368 |
| 5 | 0.283 | 86 | 17 | 383 | 74 | 383 | 74 | 383 | 74 |
| 6 | 0.294 | 69 | 17 | 298 | 72 | 298 | 72 | 298 | 72 |
| 7 | 0.294 | 121 | 48 | 519 | 206 | 519 | 206 | 519 | 206 |
| Total | | 985 | 174 | 9556 | 1246 | 7701 | 1125 | 7701 | 1125 |

| Year: | 2014 | F multiplier: | 1 | Fbar: | 0.1356 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Age | F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
| 1 | 0.012 | 28 | 2 | 2504 | 155 | 851 | 53 | 851 | 53 |
| 2 | 0.096 | 169 | 16 | 2025 | 186 | 1823 | 168 | 1823 | 168 |
| 3 | 0.134 | 171 | 21 | 1506 | 186 | 1506 | 186 | 1506 | 186 |
| 4 | 0.177 | 159 | 25 | 1078 | 171 | 1078 | 171 | 1078 | 171 |
| 5 | 0.283 | 358 | 69 | 1592 | 307 | 1592 | 307 | 1592 | 307 |
| 6 | 0.294 | 55 | 13 | 236 | 57 | 236 | 57 | 236 | 57 |
| 7 | 0.294 | 116 | 46 | 498 | 197 | 498 | 197 | 498 | 197 |
| Total | | 1055 | 192 | 9440 | 1259 | 7585 | 1139 | 7585 | 1139 |

Input units are thousands and kg - output in tonnes

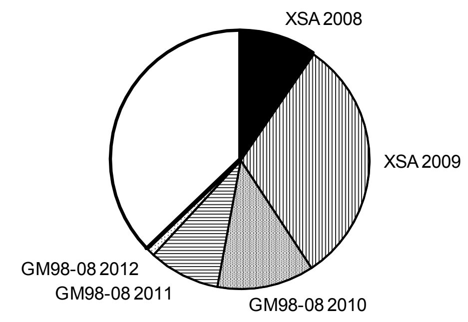
Table 9.1.16 Megrim (L. whiffiagonis) in Divisions VIIIc and IXa
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

| Year-class | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| Stock No. (thousands) of 1 year-olds | 1234 | 5338 | 2504 | 2504 | 2504 |
| Source | XSA | XSA | GM98-08 | GM98-08 | GM98-08 |
| Status Quo F: | | | | | |
| % in 2012 landings | 8.2 | 28.7 | 9.8 | 1.1 | - |
| % in 2013 | 9.6 | 31.2 | 12.2 | 8.9 | 1.0 |
| % in 2012 SSB | 8.3 | 37.5 | 15.7 | 4.9 | - |
| % in 2013 SSB | 6.6 | 32.7 | 16.5 | 14.9 | 4.7 |
| % in 2014 SSB | 5.0 | 27.0 | 15.0 | 16.3 | 14.7 |

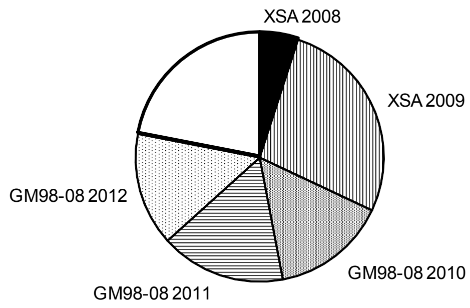
GM : geometric mean recruitment

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

a ) 2013 landings




b ) 2014 SSB




| XSA 2008 | XSA 2009 | GM98-08 2010 | GM98-08 2011 | GM98-08 2012 |
|---|---|---|---|---|

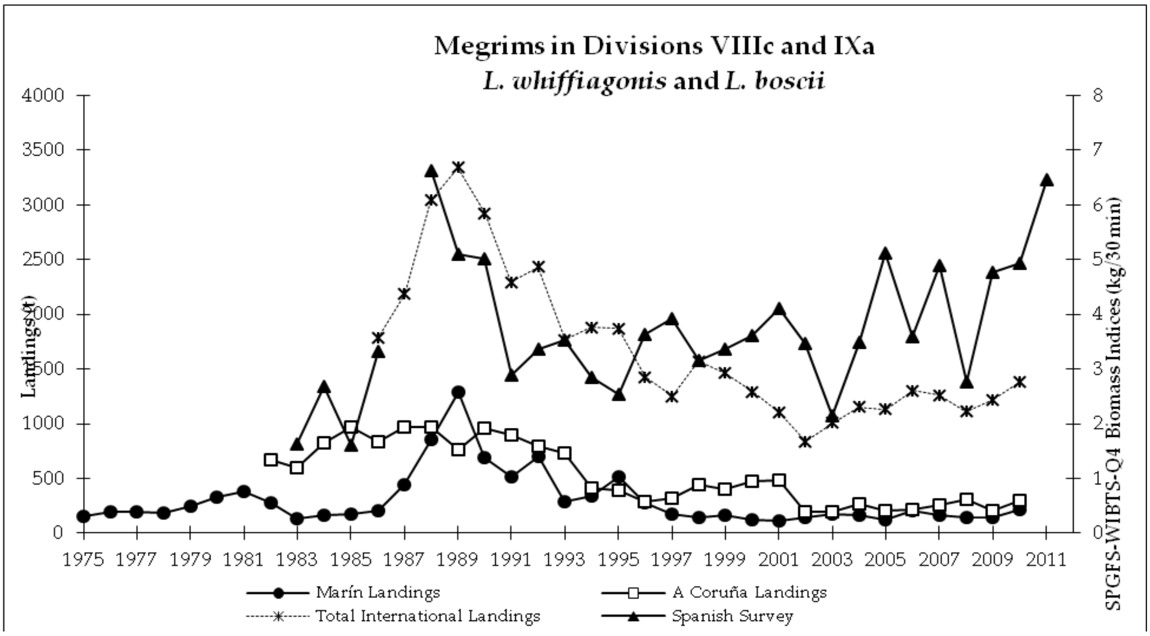
**Table 9.1.17. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa, yield per recruit results.**

MFYPR version 2a
Run: meg
Time and date: 15:59 30/04/2011
Yield per results

| FMult | Fbar | CatchNos | Yield | StockNos | Biomass | SpwnNosJan | SSBJan | SpwnNosSpwn | SSBSpwn |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.0000 | 0.0000 | 0.0000 | 5.5167 | 1.1400 | 4.7748 | 1.0917 | 4.7748 | 1.0917 |
| 0.1 | 0.0136 | 0.0796 | 0.0212 | 5.1200 | 0.9960 | 4.3783 | 0.9477 | 4.3783 | 0.9477 |
| 0.2 | 0.0271 | 0.1419 | 0.0362 | 4.8103 | 0.8858 | 4.0686 | 0.8376 | 4.0686 | 0.8376 |
| 0.3 | 0.0407 | 0.1920 | 0.0470 | 4.5609 | 0.7991 | 3.8193 | 0.7508 | 3.8193 | 0.7508 |
| 0.4 | 0.0542 | 0.2334 | 0.0550 | 4.3551 | 0.7292 | 3.6136 | 0.6809 | 3.6136 | 0.6809 |
| 0.5 | 0.0678 | 0.2683 | 0.0610 | 4.1820 | 0.6717 | 3.4406 | 0.6235 | 3.4406 | 0.6235 |
| 0.6 | 0.0813 | 0.2982 | 0.0654 | 4.0339 | 0.6238 | 3.2927 | 0.5756 | 3.2927 | 0.5756 |
| 0.7 | 0.0949 | 0.3241 | 0.0688 | 3.9055 | 0.5833 | 3.1644 | 0.5350 | 3.1644 | 0.5350 |
| 0.8 | 0.1084 | 0.3469 | 0.0713 | 3.7929 | 0.5486 | 3.0518 | 0.5004 | 3.0518 | 0.5004 |
| 0.9 | 0.1220 | 0.3671 | 0.0732 | 3.6930 | 0.5186 | 2.9520 | 0.4704 | 2.9520 | 0.4704 |
| 1 | 0.1356 | 0.3852 | 0.0746 | 3.6037 | 0.4924 | 2.8628 | 0.4442 | 2.8628 | 0.4442 |
| 1.1 | 0.1491 | 0.4015 | 0.0757 | 3.5231 | 0.4694 | 2.7824 | 0.4213 | 2.7824 | 0.4213 |
| 1.2 | 0.1627 | 0.4163 | 0.0764 | 3.4501 | 0.4491 | 2.7094 | 0.4009 | 2.7094 | 0.4009 |
| 1.3 | 0.1762 | 0.4299 | 0.0770 | 3.3833 | 0.4310 | 2.6428 | 0.3828 | 2.6428 | 0.3828 |
| 1.4 | 0.1898 | 0.4423 | 0.0773 | 3.3221 | 0.4147 | 2.5816 | 0.3666 | 2.5816 | 0.3666 |
| 1.5 | 0.2033 | 0.4538 | 0.0776 | 3.2656 | 0.4001 | 2.5252 | 0.3520 | 2.5252 | 0.3520 |
| 1.6 | 0.2169 | 0.4645 | 0.0777 | 3.2132 | 0.3869 | 2.4729 | 0.3387 | 2.4729 | 0.3387 |
| 1.7 | 0.2304 | 0.4744 | 0.0778 | 3.1645 | 0.3748 | 2.4243 | 0.3267 | 2.4243 | 0.3267 |
| 1.8 | 0.2440 | 0.4837 | 0.0778 | 3.1190 | 0.3638 | 2.3789 | 0.3157 | 2.3789 | 0.3157 |
| 1.9 | 0.2576 | 0.4924 | 0.0777 | 3.0763 | 0.3537 | 2.3364 | 0.3056 | 2.3364 | 0.3056 |
| 2 | 0.2711 | 0.5006 | 0.0777 | 3.0363 | 0.3444 | 2.2964 | 0.2963 | 2.2964 | 0.2963 |

| Reference point | F multiplier | Absolute F |
|---|---|---|
| Fbar(2-4) | 1 | 0.1356 |
| FMax | 1.7481 | 0.237 |
| F0.1 | 0.7483 | 0.1014 |
| F35%SPR | 1.3042 | 0.1768 |
| Flow | 0.6765 | 0.0917 |
| Fmed | 1.5438 | 0.2093 |
| Fhigh | 7.1072 | 0.9634 |

Weights in kilograms




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

** Data not available in 2011 for Marín, A Coruña and Total International landings.

**Figure 9.1.1 Historical landings and biomass indices of Spanish survey of megrims (both species combined).**

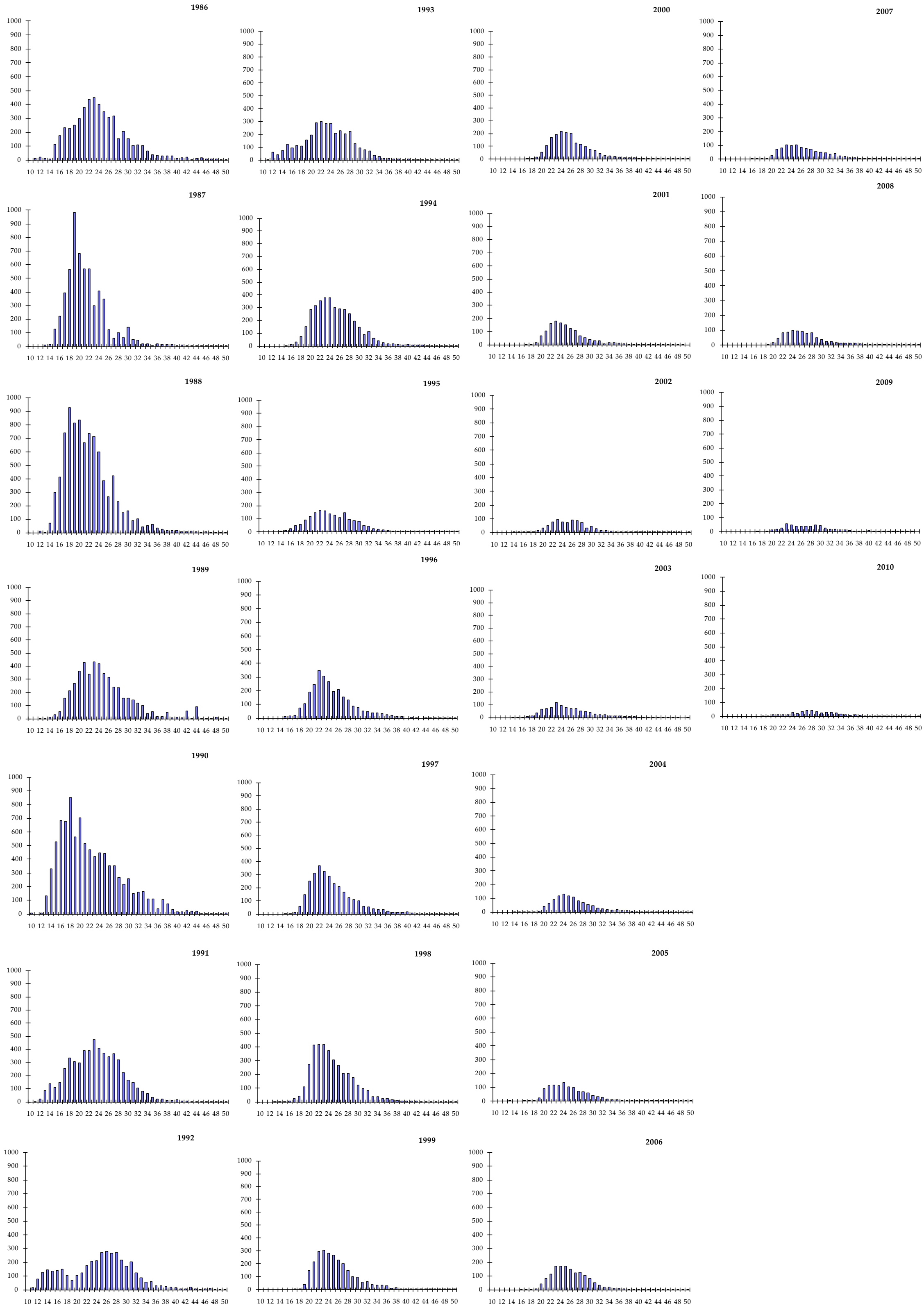
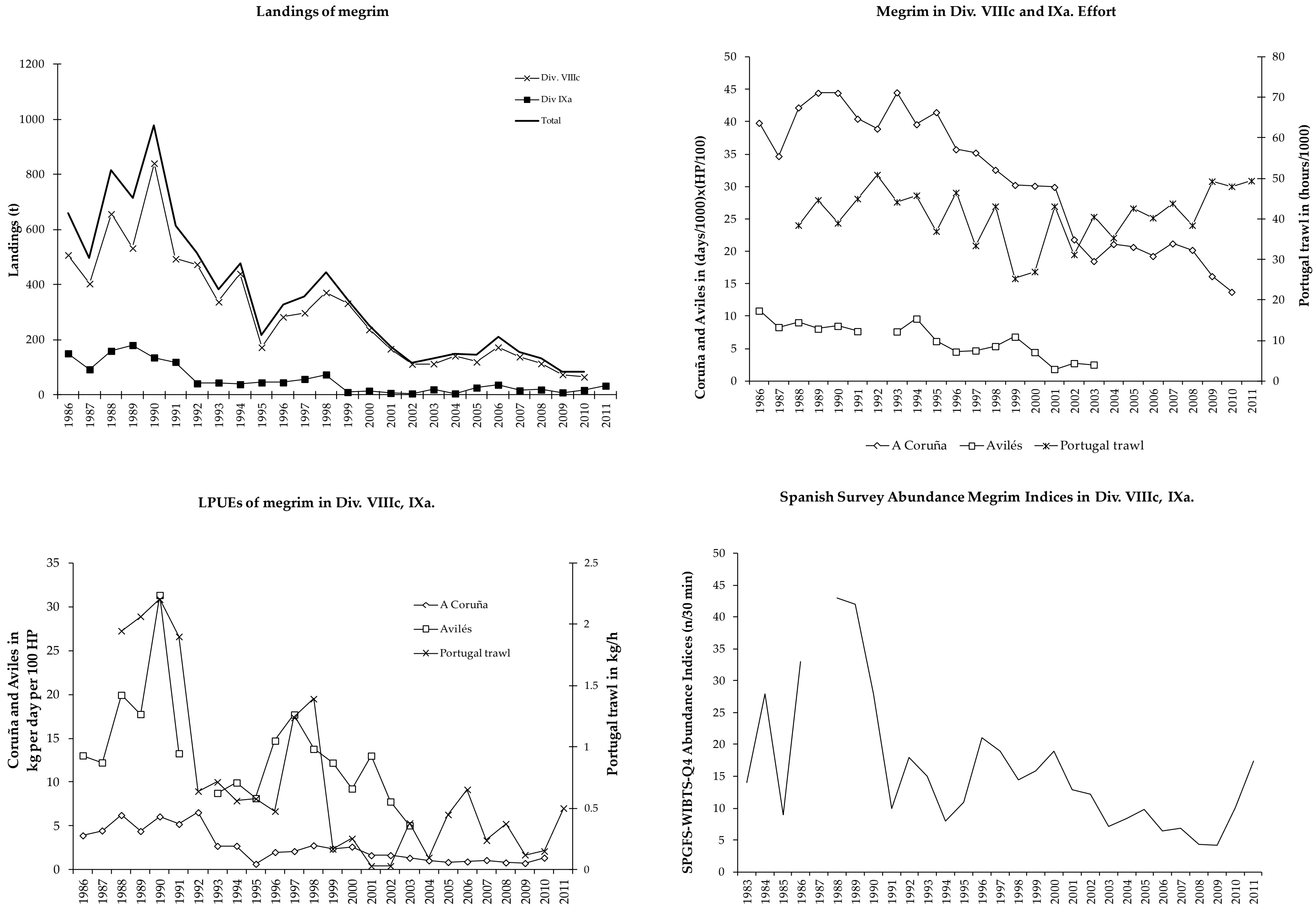



**Figure 9.1.2 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Annual length compositions of landings ('000)**




Spanish Landings of 2008 revised in WG2010 from original value presented

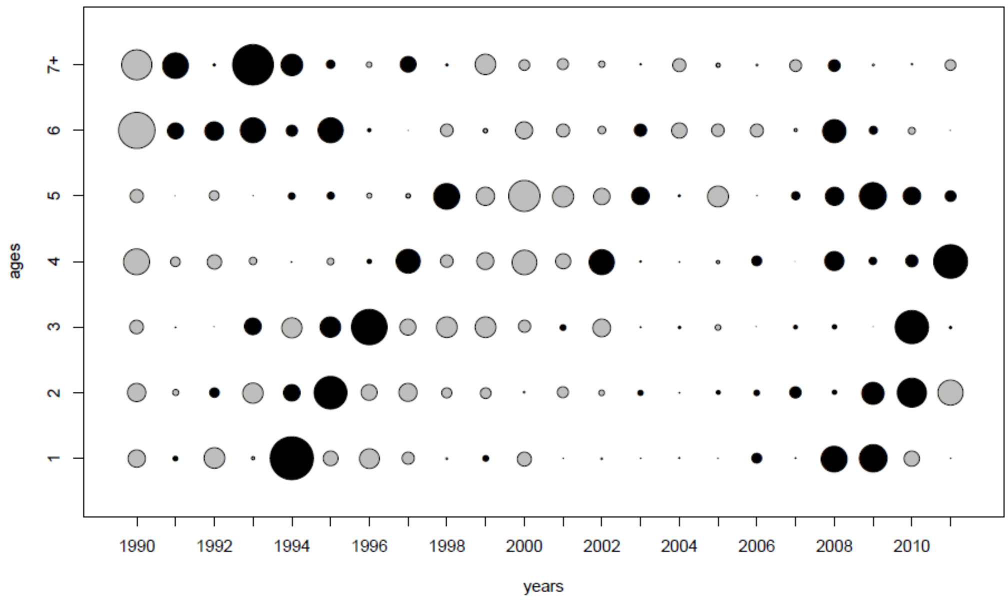
* Portuguese Trawl Effort of 2007 and 2008 revised in WG2010 from original value presented

** Data in 2011 for landings in Division IXa corresponds only to Portuguese landings.

**Figure 9.1.3(a) Megrim (*L.whiffiagonis*) in Divisions VIIIc, IXa. Landings (t), Efforts, LPUEs and Abundance Indices.**

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

**(black bubbles means <0)**

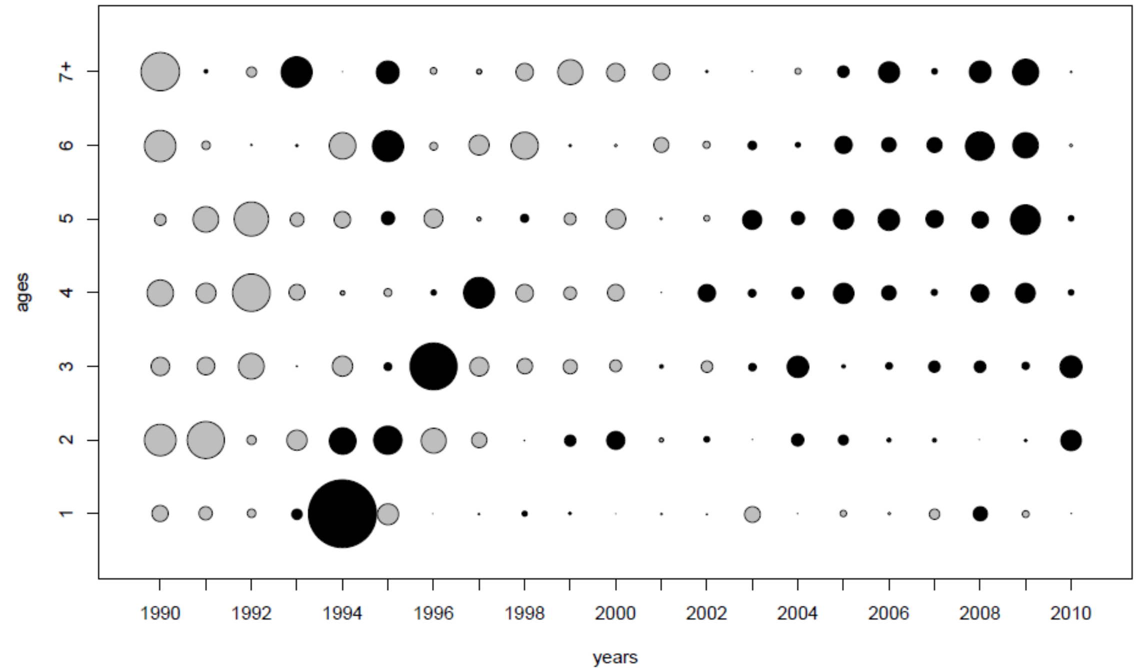



* 2011 data not included in the assessment

**Figure 9.1.3(b): Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa**

**Standardized log (abundance index at age) from A Coruña VIIIc trawl fleet**

**(black bubble means < 0)**




**Standardized log (abundance index at age) from Avilés VIIIc trawl fleet**

**(black bubble means < 0)**

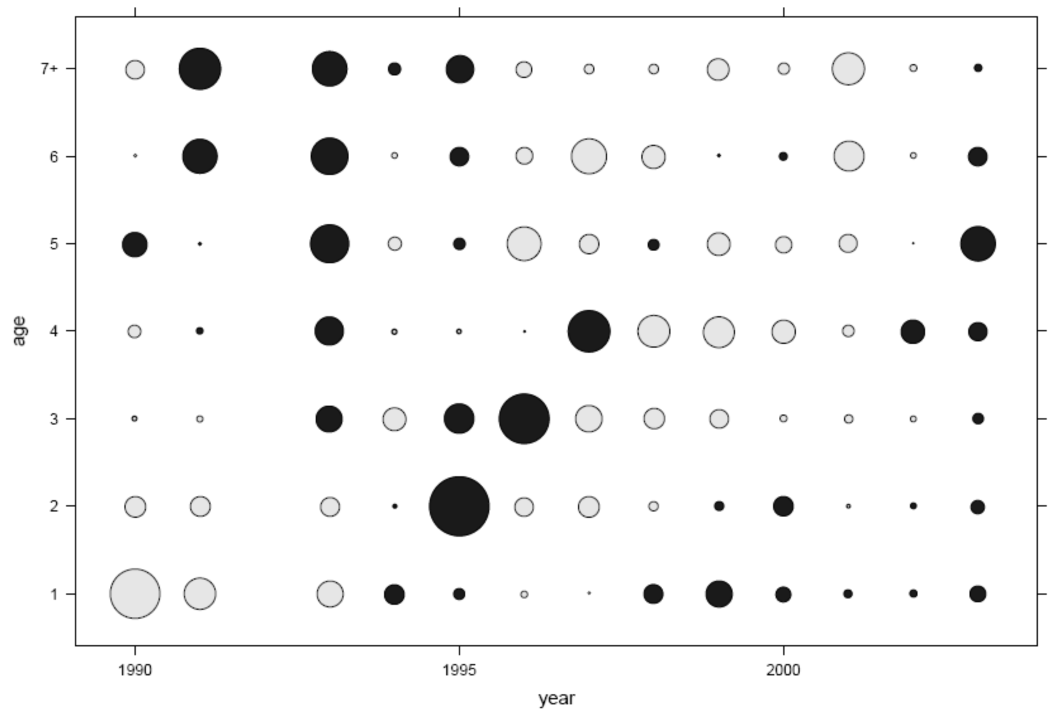
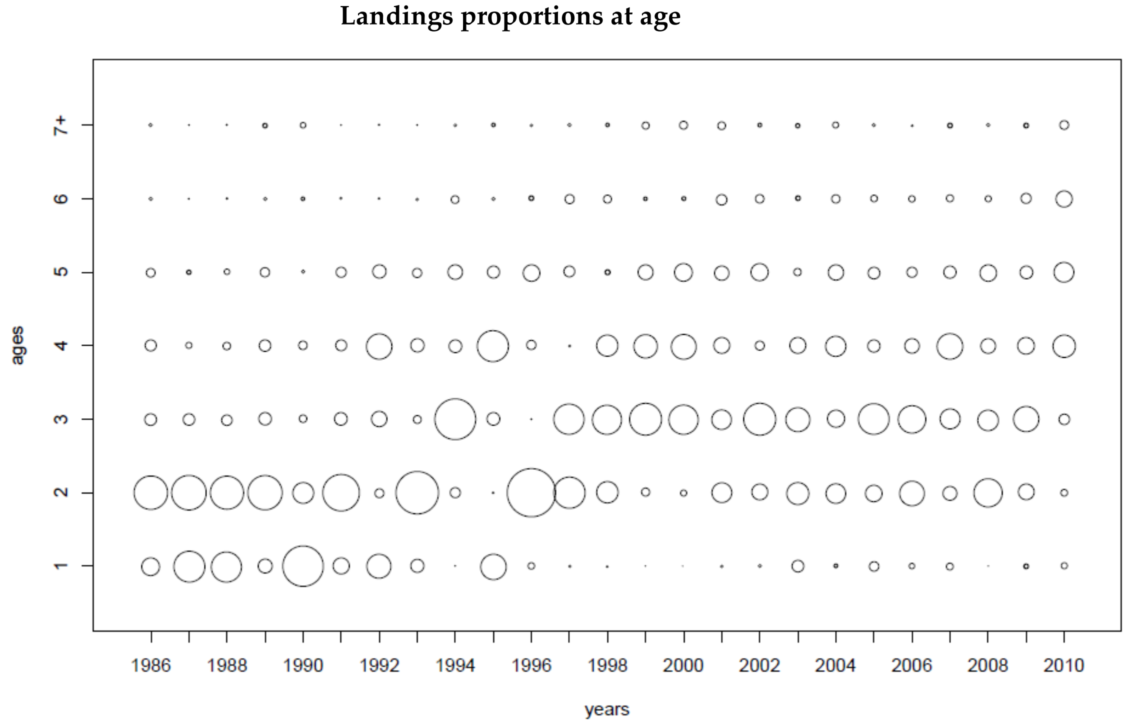



**Figure 9.1.3(c): Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa**



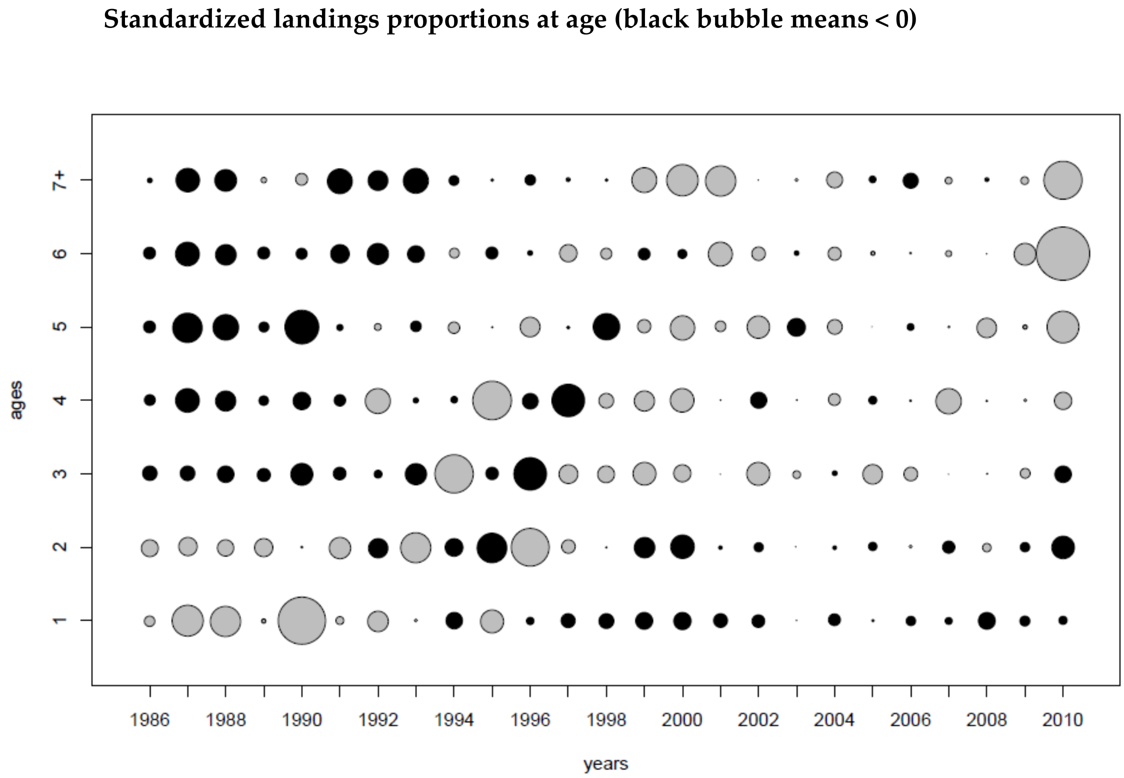




**Figure 9.1.4. Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa.**

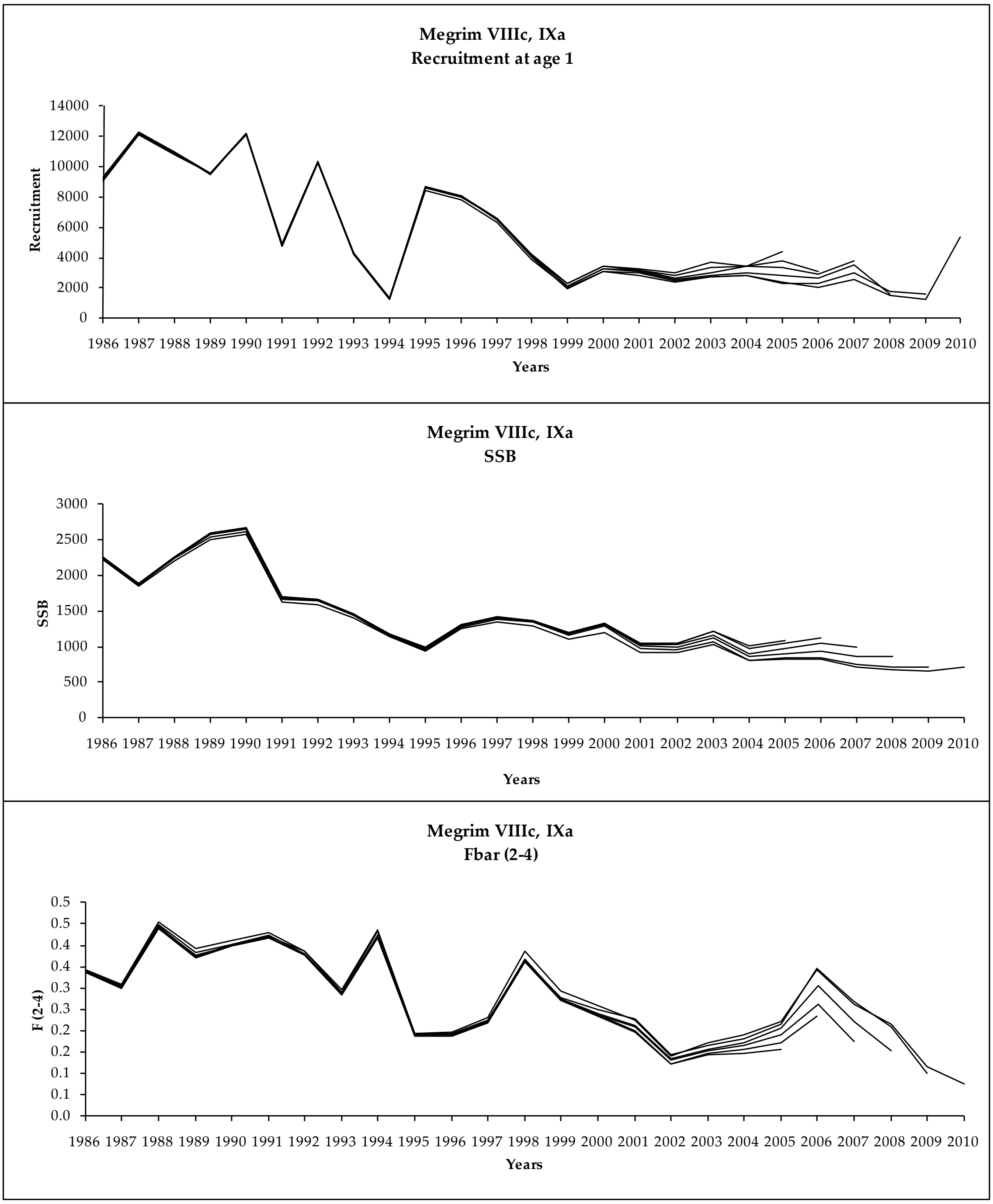



**Figure 9.1.5. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Retrospective XSA**

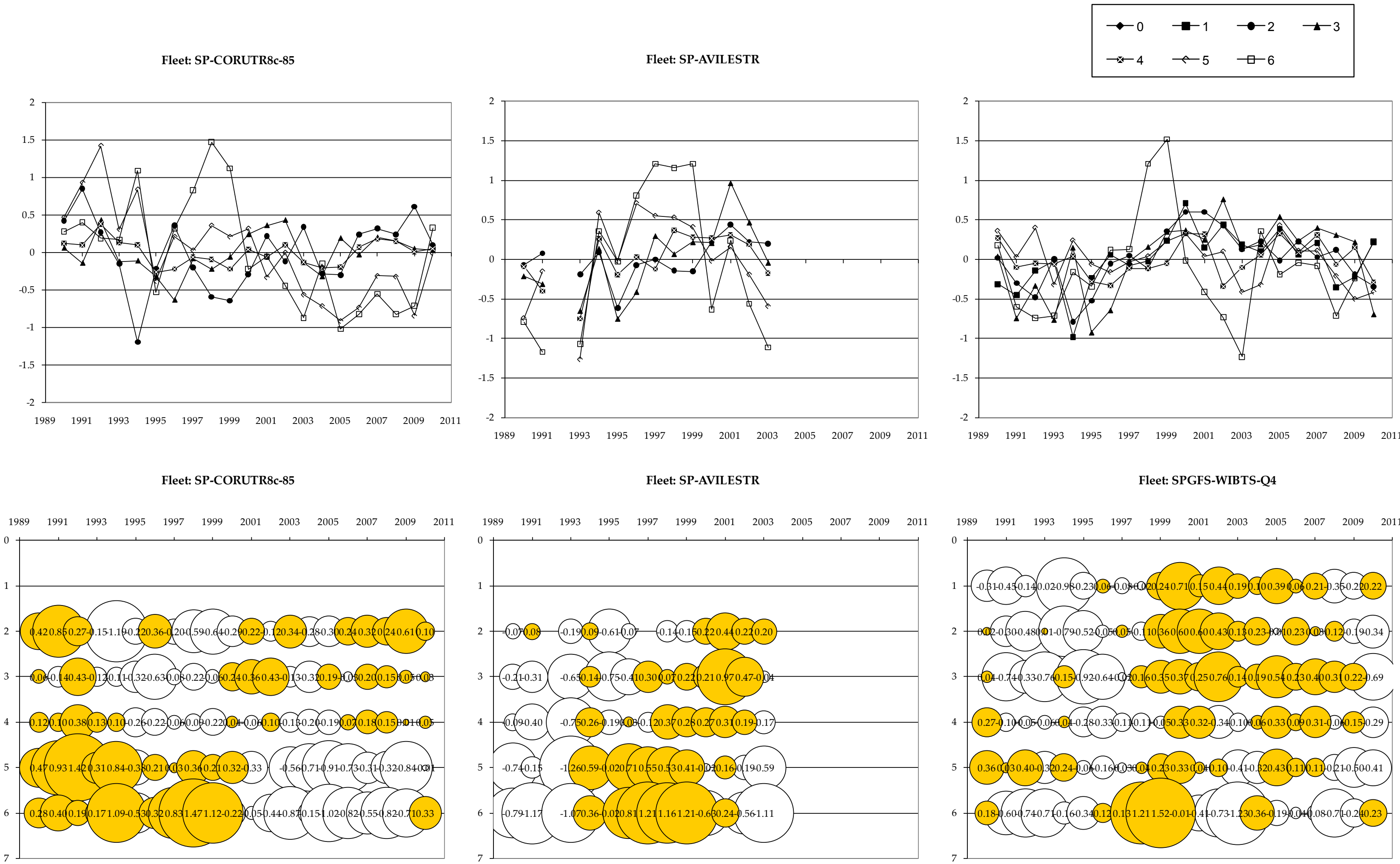



**Figure 9.1.6. Megrim in Divisions VIIIc and IXa. LOG CATCHABILITY RESIDUAL PLOTS (XSA)**

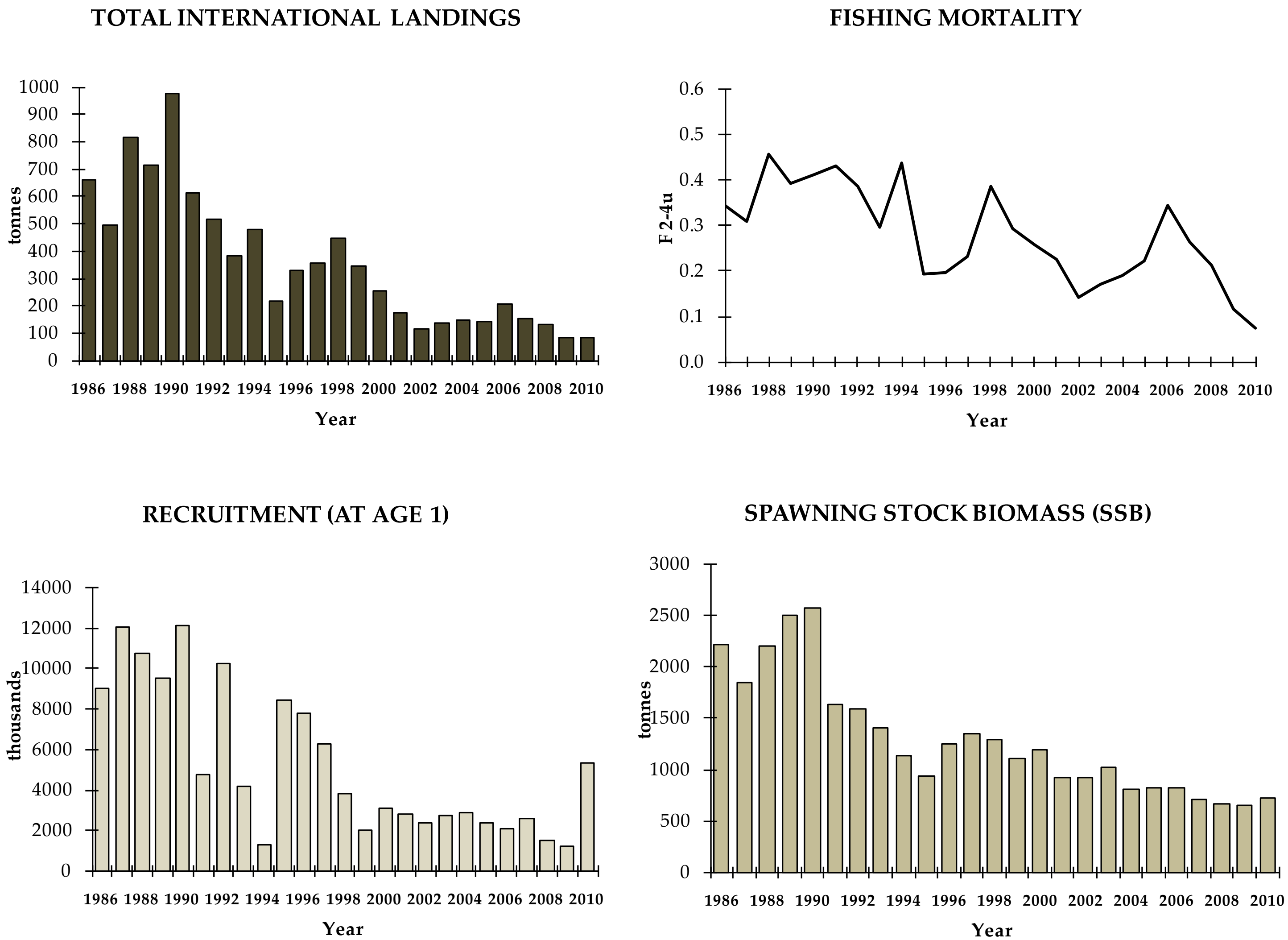
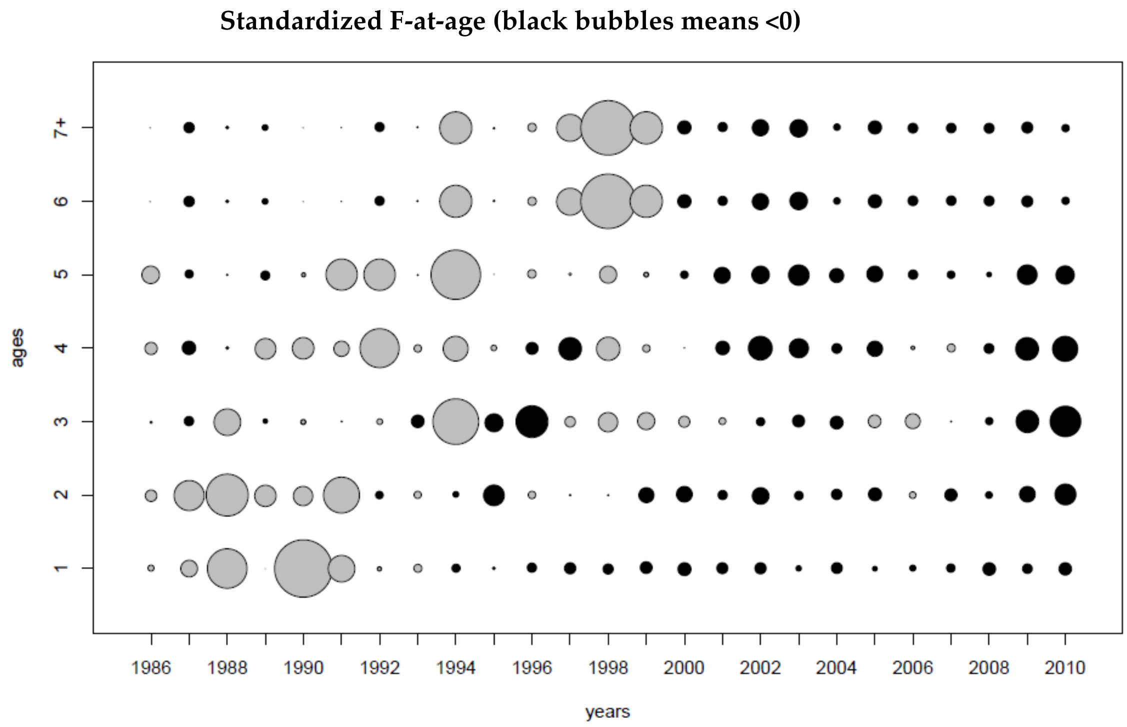



**Figure 9.1.7(a) Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Stock Summary**



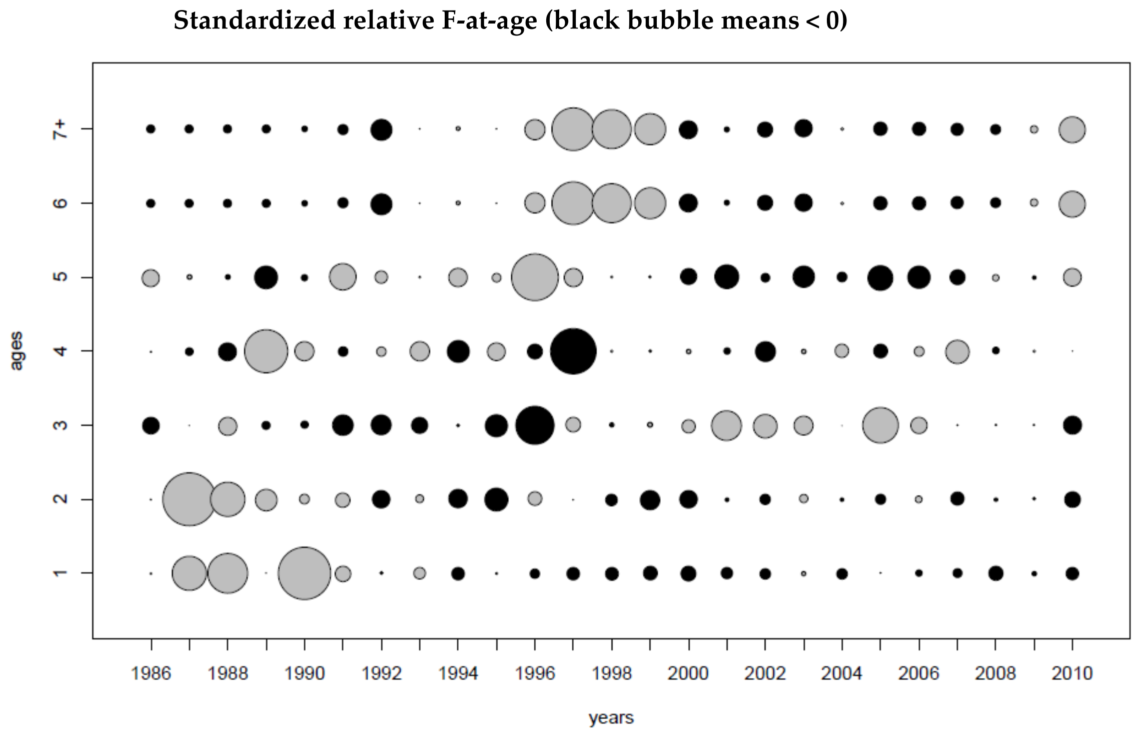
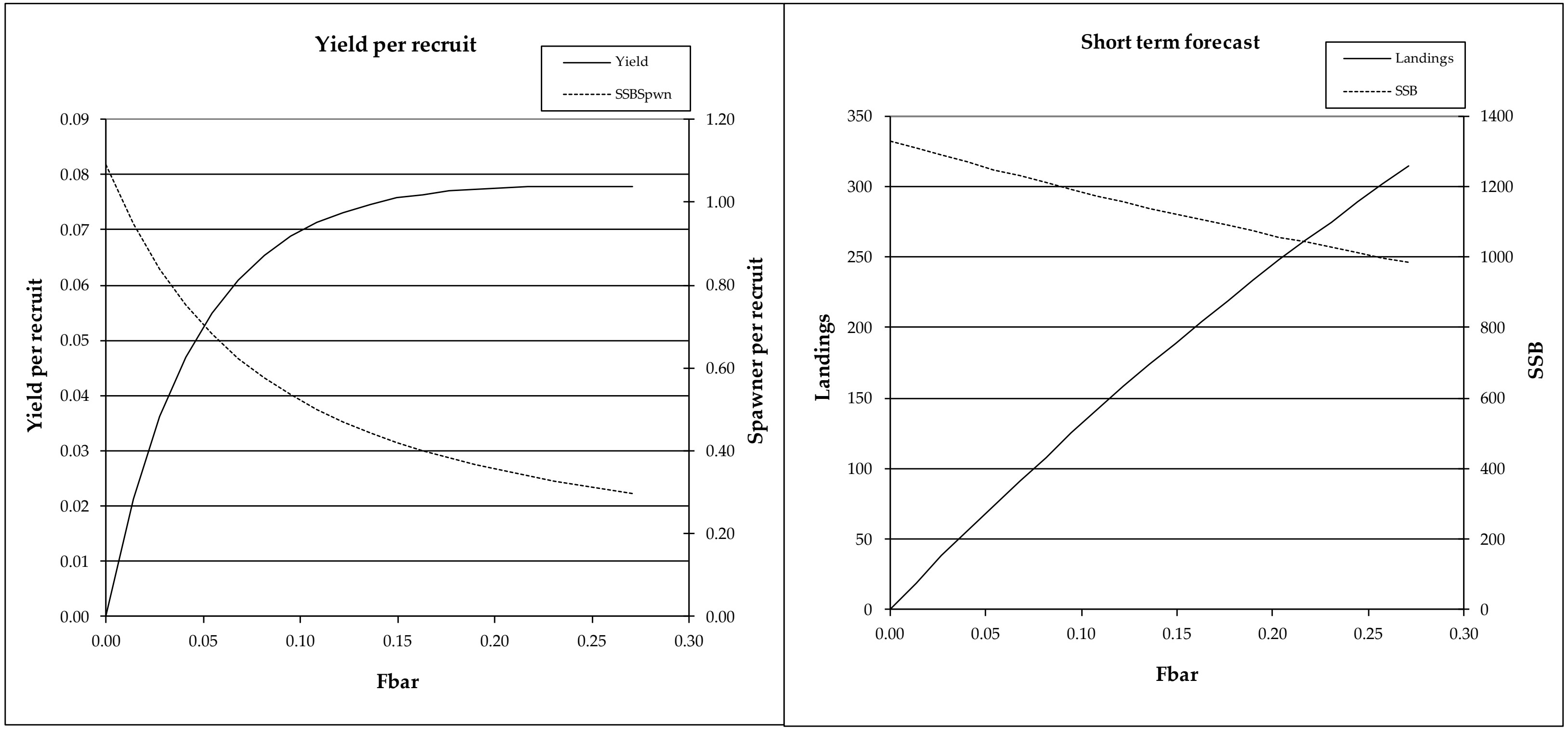




**Figure 9.1.7(b): Megrim (*L. whiffiagonis*) in Divisions VIIIc & IXa**




MFYPR version 2a
Run: meg
Time and date: 12:59 30/04/2011

| Reference point | F multiplier | Absolute F |
|---|---|---|
| Fbar(2-4) | 1.0000 | 0.1356 |
| FMax | 1.7481 | 0.2370 |
| F0.1 | 0.7483 | 0.1014 |
| F35%SPR | 1.3042 | 0.1768 |
| Flow | 0.6765 | 0.0917 |
| Fmed | 1.5438 | 0.2093 |
| Fhigh | 7.1072 | 0.9634 |

Weights in kilograms

Fbar age range: 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**

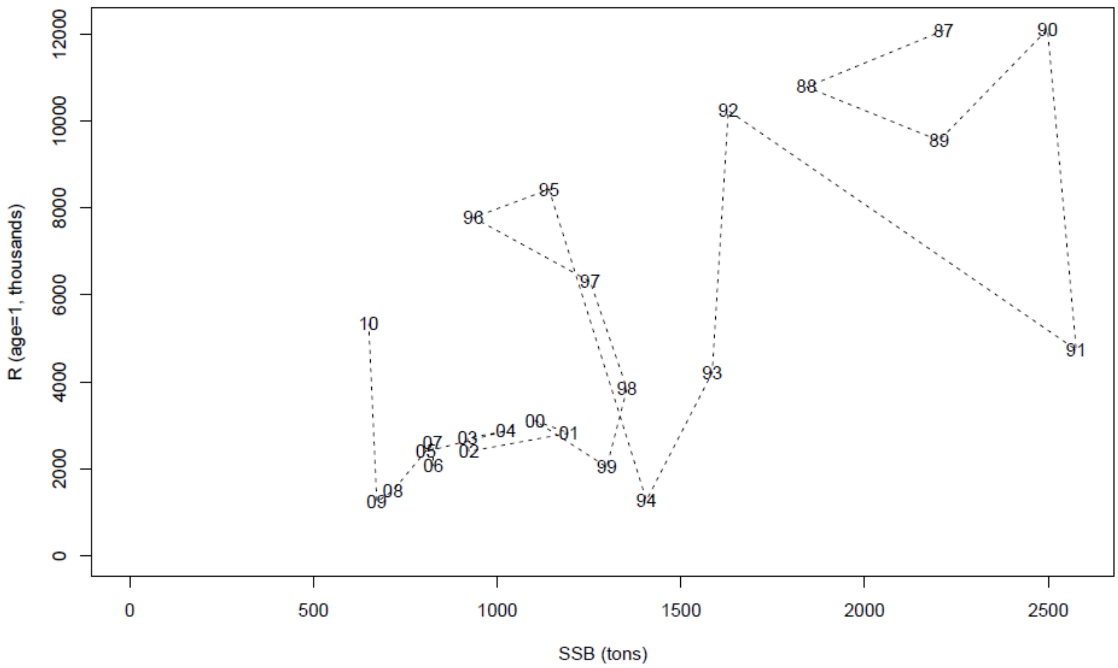



**Figure 9.1.9. Megrim (*L.whiffiagonis*) in Divisions VIIIc and IXa. SSB-Recruitment plot.**

**(numbers in graph, 1987-2010, are recruitment years)**

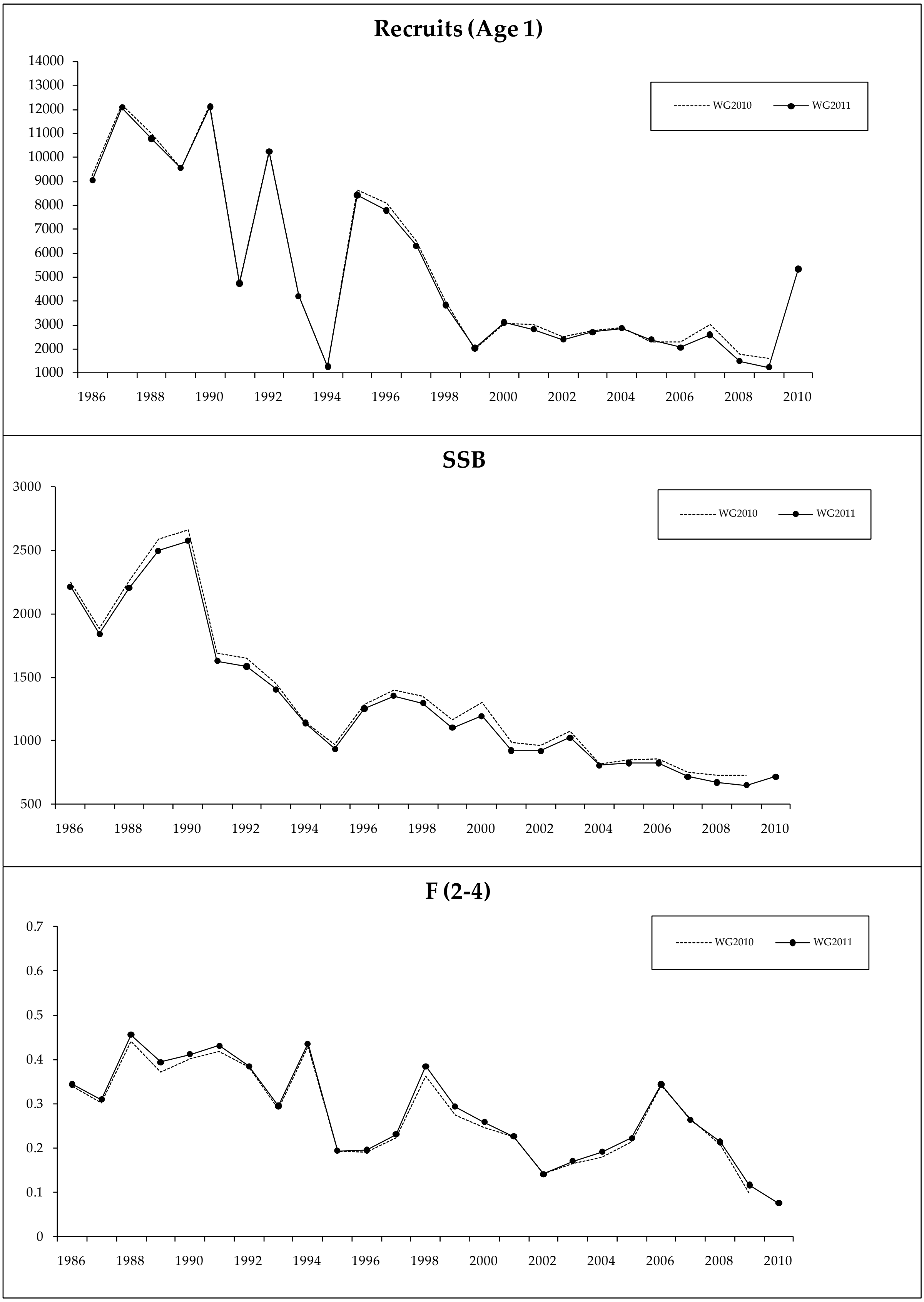



**Figure 9.1.10. Megrim (*L. whiffiagonis*) in Div. VIIIc and IXa. Recruits, SSB and F estimates from WG10 and WG11**

## 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

Spanish data in 2011 have been provided by SGP, the official national administration responsible for fishery statistics, and are presented in Annex T. In previous years catches have been estimated by the WG based on IEO and AZTI scientific estimations.

The estimates of four-spot megrim international landings for the period 1986 to 2010 used by the WG are given in Table 9.2.1. 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. Landings in 2011 only for Portugal are 181 t, a similar value as last year.

The 2011 data provided for Spanish landings were no disaggregated by species, they were referred to Genre level. The group concluded that they were unsuitable for use in the model describe in the Stock annex.

Discards estimates are available for Spanish trawlers in some years. Annual discards of four-spot megrim are estimated to be from around 190 t to 520 t along the whole time series. Discard / Total Catch ratio and CV are presented in Table 9.2.2(a), where discards in number represent between 39-63% of the total catch. Discards are not incorporated in this assessment due to the lack of data in some years of the series but a working document (WD06) describing the application of a Bayesian model incorporating discards has been presented to be considered as a possible alternative assessment model. 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. In 2011, sampling discards has been done, however raising to total landings is not possible due to reasons previously mentioned.

#### 9.2.2.2 Biological sampling

Annual length compositions of total stock landings are given in Figure 9.2.1 for the period 1986-2010. No length composition of landings is provided for 2011 because it was not possible to raise to total landings. But as has been done with *L. whiffiagonis*, annual length distribution in samplings for 2011, in relative numbers, are presented in Table 9.2.3. (a). The sampling levels for both species are given in Table 1.3.

Mean length and weights in landings since 1990 are shown in the Table 9.2.3(b).

Due to very low landings in the age 0 group over the whole period (see Table 9.2.4), the values of these landings were replaced by zeros in the assessment.

Weights-at-age of landings (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 2010. The October survey was conducted with a different vessel and gear in 2003 and 2004. Excluding these two years, the biomass indeces 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.

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 2011, the biomass index is the highest of the series and the abundance index the second highest. The recruitment index for age 1 in 2010 was the highest of the series, in 2011 this value presents a decrese. The very high index in 2005 applies to all ages and not just the recruitment ages (see Table 9.2.7, which gives abundance indices by age, and the top panel of 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 2011, only age 0 and age 1 indeces are below average, whereas indices for ages older than 2 are very high. From Figure 9.2.2, the survey appears to have been quite good at tracking cohorts through time until about 2002, whereas the signal seems more blurred in recent years.

#### 9.2.2.4 Commercial catch–effort data

Due to the same reasons as in landings data (no disaggregation into species) and different effort units provided, LPUE for Spanish commercial fleets can not be presented for 2011.

Landed numbers-at-age per unit effort and effort data were available for commercial Spanish trawl fleets based in A Coruña (SP-CORUTR8c, for years 1986-2010) and Avilés (SP-AVILESTR, for years 1986–2003), fishing in ICES Division VIIIc (see Table 9.2.7). 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 1988-2010 and for the Portuguese trawl fleet fishing in Division IXa for the period 1988–2011 (see also Figure 9.2.3). The LPUE of A Coruña presents a very high value in 2010, similar to those at the beginning of the series.

### *Commercial fleets used in the assessment to tune the model*

A Coruña trawl fleet (SP-CORUTR8c) was used for tuning, considering only values until 1999, as indicated in the Stock Annex. The effort of this fleet had been generally stable until year 1993, after which a steady declined started. A low effort value was reached in 2003, when restrictions imposed on fishing activity due to the Prestige oil spill influenced effort. A stable period followed this value till year 2008, when effort is declining again to its lowest value in the series, reached in 2010.

### *Commercial fleets not used in the assessment to tune the model*

The effort of the Avilés trawl fleet (SP-AVILESTR) decreased along the whole period, reaching very low levels in the last years of the available data 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 until 1995 and a decreasing one from then. The LPUE of the Portuguese trawl fleet has generally declined since 1992, with an increase in recent years.

## 9.2.3 Assessment

Due to the lack of reliable Spanish landings for 2011, the Working Group decided not to update the assessment.

### 9.2.3.1 The last assessment available was conducted during WGHMM2011 (ICES, 2011) and is used as a basis for current stock assessment and projections. Text, tables and figures presented in the assessment results are the same as in the last year report. Input data

See Stock Annex.

As in previous years, due to the very low and irregular landings of age 0 individuals, values corresponding to age 0 in the catch-at-age matrix (displayed in Table 9.2.4) were replaced by zeros.

#### Model

### *Data screening*

Figure 9.2.4 is a bubble plot representing catch proportions at age, clearly indicating that the bulk of the landings generally corresponds to ages 2 to 4. The bottom panel of Figure 9.2.4 is another bubble plot corresponding to standardized catch proportions at age, indicating that age composition of landings in 2010 is fairly typical of what has been observed in recent years.

Very weak cohorts corresponding to year classes of 1993 and 1998 can be clearly identified from the standardized catch proportions at age matrix and good cohorts corresponding to year classes of 1991, 1992, 1995 and 2005 can also be tracked (bottom panel of Figure 9.2.4).

### *Final XSA run*

Settings for this year's assessment were the same ones used in the last assessment and are detailed in the Stock Annex.

The retrospective analysis shows no particular worrying features (Figure 9.2.5).

#### 9.2.3.2 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. Note that because of the taper weighting used (tricubic over 20 years), tuning (and, therefore, residuals) starts in year 1991. 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 obtained for many ages in 2001, 2005, 2007, 2009 and 2010, in line with the high values registered by the survey in those years. Mostly negative residuals are obtained for the survey indices in 2006 and 2008. The fact that in many recent years survey residuals are either positive or negative for most ages may be indicative of year effects in the survey.

Since the commercial fleet data are stopped in 1999, they do not intervene directly in the estimates of survivors at the end of 2010. Hence, survivor estimates are given by the survey and P-shrinkage for ages 0 to 2, and only by the survey for ages 3 to 6. F-shrinkage gets very low weight, due to the large s.e. value set for it (1.5).

Table 9.2.10 presents the fishing mortality-at-age estimates. Fbar ($=F_{2\text{-}4}$) is estimated to be 0.34 in 2010, 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.

#### 9.2.3.3 Year class strength and recruitment estimations

The 2008 year class estimate is 20 million individuals, obtained by averaging estimates coming from the Spanish survey tuning data (73% of weight), P-shrinkage (25% weight) and F-shrinkage (2% weight).

The 2009 year class estimate is 35 million individuals, estimated from the Spanish survey (55% of weight), P-shrinkage (43% weight) and F-shrinkage (2% weight).

The 2010 year class estimate is 22 million individuals, obtained by averaging a lower value coming from the Spanish survey (43% weight) and a higher one from P-shrinkage (57% weight).

Following the procedure stated in the Stock Annex, the geometric mean of estimated recruitment over the years 1990-2008 has been used for computation of 2011 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 |
|---|---|---|---|---|---|
| 2008 | 20385 | XSA | 73% | - | 27% |
| 2009 | 34771 | XSA | 55% | - | 46% |
| 2010 | 21810 | XSA | 43% | - | 57% |
| 2011 | 24016 | $GM_{90\text{-}08}$ | | | |

#### 9.2.3.4 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 8038 t in 1988 to 3260 t in 2001, the lowest value in the series, and has since experienced some increase. The 2008 SSB is estimated to be 5103 t, the highest value after 1994. SSB is a bit lower in 2010, with an estimated value of 4797 t.

Recruitment has fluctuated around 25 million fish from 1990 to 2002, with the exception of the very weak 1993 and 1998 year classes. In 2003, 2005 and 2009 recruitment has been above this level.

Estimates of fishing mortality values show two different periods: an initial one with higher values from 1989 to 1995 and, following a sharp decrease in 1997, a second period stabilised at a lower level, with small ups and downs. The value of 0.34 in 2010 represents some increase in relation to recent years

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.

### 9.2.4 Catch options and prognosis

Projection settings follow the Stock Annex specifications. This year, short term projections are carried out on the basis of the 2011 assessment and it is thus necessary to provide fishing mortality and recruitment values for two intermediate years (2011 and 2012). The exploitation pattern used (F *status quo*) was the unscaled average of 2008-2010, which gives an Fbar value of 0.29.

#### 9.2.4.1 Short-term projections

Short-term projections have been made using R software v. 2.14.2 and FLR packages: FLcore v. 2.5.0, FLash v. 2.5.0 and FLAssess v.2.5.0. Script code is included in the Stock annex.

The input data for deterministic short-term projections are given in Table 9.2.13. For recruitment in 2011, the Working Group decided to explore information provided by available survey in 2011. Two options were considered, to use the result of fitting a linear regression model between recruitment and abundance index for age 1 of SpGFS-WIBTS-Q4 or to use the GM(90-08) of historic recruitments. Both values are very similar, fitted value is 23401 and GM(90-08) is 24016. As for *L. whiffiagonis*, the Working Group has decided to use the GM to be according with the Stock Annex indications.

Table 9.2.14 gives the management options for 2013, 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 2011-2014, is given in Table 9.2.15. Under this scenario, projected landings for 2012 and 2013 are 1135 and 1174 t, respectively.

Under F *status quo*, projected SSB values for 2012 and 2013 are about 4092 t in 2012 and 4851 t in 2013 and decrease to 4772 in 2014.

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 $GM_{90\text{-}08}$ recruitment is assumed contribute in a 7% to landings in 2013 and 50% to SSB in 2014.

#### 9.2.4.2 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 *status quo* (Fbar=0.29), yield-per-recruit is 0.046 kg and SSB-per-recruit is 0.195 kg. Assuming $GM_{90\text{-}08}$ recruitment of 24 million, the equilibrium yield would be around 1105 t with an SSB value of 4680 t.

#### 9.2.4.3 Biological reference points

Stock-recruitment data from before 1990 are not considered reliable. For the remaining years there is no evidence of reduced recruitment at the lower SSB levels observed (Figure 9.2.9). At present, there is no new information to define biomass reference points $B_{lim}$ and $B_{pa}$ for this stock.

See Stock Annex for more information about Biological reference points.

In previous Working Groups, reference points were not proposed because of the interannual variability detected in the relative exploitation pattern-at-age. However, WGHMM 2010 was asked to provide an $F_{MSY}$ value for this stock. Possible proxies considered for $F_{MSY}$ were in the range of Fmax, F0.1 and F35% and F40%. Fmax is not well defined for this stock, as the yield-per-recruit curve generally shows a very flat top.

In order to establish a proxy, a rough exercise to assess the impact of discards was conducted in WGHMM 2010 (see description and results in the stock annex). The following sensitivity table also complemented the discards exercise and has been updated in this WG:

| | WG2005 | WG2006 | WG2007 | WG2008 | WG2009 | WG2010 | WG2011 |
|---|---|---|---|---|---|---|---|
| Fmax | 0.63 | 0.48 | 0.55 | 0.57 | 0.62 | 0.39 | 0.37 |
| F0.1 | 0.27 | 0.17 | 0.18 | 0.14 | 0.18 | 0.14 | 0.15 |
| F35percent | 0.31 | 0.26 | 0.27 | 0.25 | 0.28 | 0.24 | 0.24 |
| F40percent | | | | | | 0.18 | 0.19 |

$F_{MSY}$=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*. The value of F40% remains very similar this year, so this WG sees no reason to change the 0.18 value proposed as $F_{MSY}$ last year. However, this $F_{MSY}$ value should still be considered as preliminary and is likely to be revised as further work continues on this assessment (particularly when including discards information and developing an assessment model providing uncertainty estimates).

### 9.2.5 Comments on the assessment

Due to the aggregation level of Spanish landings data for 2011, no update assessment was carried out by this WG, which is therefore using the assessment conducted at the 2011 WGHMM. Next comments correspond to last year assessment.

One commercial fleet (SP-CORUTR8c) 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. Only data up to year 1999 were used, as the increasing use of HVO trawl gear (targeting horse mackerel and with very few four-spot megrim catches) in the traditional Baca trawl fishery in recent years makes it difficult to compare effort values from recent years with those from earlier years. 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 through time until about 2002, but the signal seems more blurred in recent years.

Comparison of this assessment with the one performed last year shows similar results for the common years (Figure 9.2.10).

Four-spot megrim starts to contribute strongly to SSB at 2 years of age, with 28% of the predicted SSB in 2013 relying on year classes with recruitment assumed to be given by $GM_{90-08}$.

The fact that discards data are not used in the assessment of this stock may modify the perception of its state. Discards data were not used in this assessment because of the lack of data in some years of the series. Discards in number represent between 39-63% of the total catch. Including discards would produce a more real picture of fishing exploitation and stock dynamics. It could also have an impact on biological reference points and predictions.

### 9.2.6 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 and 2008, with some drop in 2009 and a slight increase again in 2010. Fishing at *status quo* F (Fbar=0.29) during 2011 and 2012 would result in some biomass increase from the 2010 value.

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 2011 and 2012 (average of estimated F over 2008-2010, corresponding to Fbar=0.14 for *L. whiffiagonis* and Fbar=0.29 for *L. boscii*), Figure 9.3.2 gives the combined predicted landings for 2013 and individual SSB for 2014, 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 2008-2010) for both species, predicted combined landings in 2013 are 1348 t and individual SSBs in 2014 are 1139 t for *L. whiffiagonis* and 4772 t for *L. boscii*.

**Table 9.2.1. Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Total landings (t).**

| | Spain | | | Portugal | Total |
|---|---|---|---|---|---|
| Year | VIIIc | IXa | Total | IXa | VIIIc IXa |
| 1986 | 799 | 197 | 996 | 128 | 1124 |
| 1987 | 995 | 586 | 1581 | 107 | 1688 |
| 1988 | 917 | 1099 | 2016 | 207 | 2223 |
| 1989 | 805 | 1548 | 2353 | 276 | 2629 |
| 1990 | 927 | 798 | 1725 | 220 | 1945 |
| 1991 | 841 | 634 | 1475 | 207 | 1682 |
| 1992 | 654 | 938 | 1592 | 324 | 1916 |
| 1993 | 744 | 419 | 1163 | 221 | 1384 |
| 1994 | 665 | 561 | 1227 | 176 | 1403 |
| 1995 | 685 | 826 | 1512 | 141 | 1652 |
| 1996 | 480 | 448 | 928 | 170 | 1098 |
| 1997 | 505 | 289 | 794 | 101 | 896 |
| 1998 | 725 | 284 | 1010 | 113 | 1123 |
| 1999 | 713 | 298 | 1011 | 114 | 1125 |
| 2000 | 674 | 225 | 899 | 142 | 1041 |
| 2001 | 629 | 177 | 807 | 124 | 931 |
| 2002 | 343 | 247 | 590 | 130 | 720 |
| 2003 | 393 | 314 | 707 | 169 | 876 |
| 2004 | 534 | 295 | 829 | 177 | 1006 |
| 2005 | 473 | 321 | 794 | 189 | 983 |
| 2006 | 542 | 348 | 891 | 201 | 1092 |
| 2007 | 591 | 295 | 886 | 218 | 1104 |
| *2008 | 546 | 262 | 808 | 172 | 980 |
| 2009 | 577 | 342 | 919 | 215 | 1134 |
| 2010 | 616 | 484 | 1100 | 197 | 1297 |
| 2011 | n/a | n/a | n/a | 181 | n/a |

* Data revised in WG2010 from original value presented

**Table. 9.2.2(a) Megrim (*L. boscii*) in Divisions VIIIc, IXa. Discard/Total Catch ratio and estimated CV for Spain**

| Year | 1994 | 1997 | 1999 | 2000 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | *2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | n/a |
| 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 | n/a |
| 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 | n/a |

**All discard data revised in WG2011

* Sampling discards has been done in 2011, however raising to total landings is not possible.

**Table. 9.2.2(b) Megrim (*L. boscii*) in Divisions VIIIc, IXa. Discards in numbers at age (thousands) for Spanish trawlers**

| | 1994 | 1997 | 1999 | 2000 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | *2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 678 | 256 | 2933 | 354 | 238 | 33 | 10 | 1 | 100 | 202 | 2 | 2879 | n/a |
| 1 | 2741 | 3273 | 3954 | 6148 | 4479 | 6393 | 3515 | 1233 | 3248 | 2342 | 1525 | 10362 | n/a |
| 2 | 4134 | 6099 | 2734 | 1207 | 989 | 3053 | 5482 | 2497 | 4541 | 2374 | 2490 | 1301 | n/a |
| 3 | 2710 | 2108 | 1815 | 1888 | 495 | 693 | 609 | 1445 | 757 | 1384 | 1970 | 696 | n/a |
| 4 | 581 | 146 | 1088 | 1218 | 50 | 163 | 183 | 486 | 105 | 52 | 480 | 283 | n/a |
| 5 | 189 | 90 | 3 | 171 | 2 | 27 | 56 | 168 | 44 | 10 | 51 | 83 | n/a |
| 6 | 55 | 3 | 0 | 12 | 0 | | 23 | 22 | 7 | 3 | 7 | 11 | n/a |
| 7 | 11 | 0 | 1 | 2 | | | 6 | 9 | 1 | 3 | | 1 | |
| 8 | 0 | | | | | | 1 | | | | | | |
| 9 | 0 | | | | | | 1 | | | | | | |
| 10 | | | | | | | | | | | | | |

**Table 9.2.3(a) Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Annual length distributions in samplings in 2011. Relative numbers scaled to 1000**

| | Spain | | Portugal | | Total | | |
|---|---|---|---|---|---|---|---|
| Length (cm) | Div. VIIIc | Div. IXa | Trawler | Artisanal | Spain | Portugal | Total |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | 0.4 | | | 0.4 | 0.4 |
| 13 | | | 0.6 | | | 0.6 | 0.6 |
| 14 | | | | | | | |
| 15 | | | | | | | |
| 16 | 1.9 | 1.5 | | | 3.4 | | 3.4 |
| 17 | 11.6 | 9.9 | 3.3 | | 21.5 | 3.3 | 24.8 |
| 18 | 27.7 | 24.5 | 7.1 | | 52.3 | 7.1 | 59.4 |
| 19 | 66.6 | 63.9 | 32.7 | | 130.4 | 32.7 | 163.1 |
| 20 | 136.9 | 139.0 | 61.9 | 8.4 | 275.9 | 70.3 | 346.2 |
| 21 | 132.2 | 147.0 | 98.8 | 32.1 | 279.1 | 130.9 | 410.0 |
| 22 | 121.7 | 140.8 | 143.2 | 11.0 | 262.4 | 154.2 | 416.6 |
| 23 | 98.8 | 111.1 | 113.7 | 27.0 | 209.9 | 140.8 | 350.7 |
| 24 | 97.5 | 91.8 | 129.7 | 87.7 | 189.3 | 217.4 | 406.7 |
| 25 | 86.4 | 68.4 | 98.5 | 100.4 | 154.8 | 198.9 | 353.7 |
| 26 | 66.7 | 58.5 | 121.1 | 261.7 | 125.1 | 382.8 | 507.9 |
| 27 | 48.3 | 43.8 | 59.2 | 158.0 | 92.1 | 217.1 | 309.2 |
| 28 | 38.9 | 34.0 | 31.0 | 156.9 | 72.9 | 187.8 | 260.8 |
| 29 | 25.1 | 23.7 | 37.5 | 98.9 | 48.8 | 136.4 | 185.2 |
| 30 | 17.3 | 16.7 | 35.2 | 18.9 | 34.0 | 54.2 | 88.2 |
| 31 | 10.2 | 10.7 | 15.9 | 18.9 | 21.0 | 34.8 | 55.8 |
| 32 | 5.2 | 5.9 | 4.5 | 20.1 | 11.1 | 24.6 | 35.7 |
| 33 | 3.3 | 3.6 | 1.7 | | 6.8 | 1.7 | 8.6 |
| 34 | 1.5 | 1.8 | 0.7 | | 3.3 | 0.7 | 4.0 |
| 35 | 0.8 | 1.0 | 0.3 | | 1.8 | 0.3 | 2.1 |
| 36 | 0.4 | 0.9 | 0.5 | | 1.3 | 0.5 | 1.8 |
| 37 | 0.2 | 0.4 | 1.0 | | 0.6 | 1.0 | 1.6 |
| 38 | 0.2 | 0.3 | 0.6 | | 0.6 | 0.6 | 1.2 |
| 39 | 0.1 | 0.2 | 0.5 | | 0.3 | 0.5 | 0.8 |
| 40 | 0.2 | 0.2 | 0.2 | | 0.4 | 0.2 | 0.6 |
| 41 | 0.1 | 0.1 | 0.2 | | 0.2 | 0.2 | 0.4 |
| 42 | 0.1 | 0.1 | | | 0.2 | | 0.2 |
| 43 | 0.0 | 0.1 | | | 0.1 | | 0.1 |
| 44 | 0.0 | 0.0 | | | 0.1 | | 0.1 |
| 45 | 0.1 | 0.1 | | | 0.2 | | 0.2 |
| 46 | 0.0 | 0.0 | | | 0.1 | | 0.1 |
| 47 | | | | | | | |
| 48 | 0.0 | 0.0 | | | 0.0 | | 0.0 |
| 49 | | | | | | | |
| 50+ | | | | | | | |

**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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

* Mean length and mean weight in samplings

**Table 9.2.4 Four-spot megrim (*L. boscii*) in Divisions VIIIc, IXa. Landed 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (*)0 | (4) | (1) | (9) | (2) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | n/a |
| 1 | 110 | 2283 | 1525 | 733 | 1444 | 1160 | 846 | 546 | 83 | 1421 | 397 | 35 | 45 | 38 | 45 | 167 | 190 | 367 | 392 | 123 | 34 | 9 | 15 | 21 | 15 | n/a |
| 2 | 3475 | 11580 | 10092 | 7140 | 5184 | 3679 | 2667 | 2334 | 2915 | 2205 | 2136 | 1244 | 1204 | 1161 | 655 | 1138 | 2389 | 2802 | 2515 | 2522 | 2735 | 1606 | 1561 | 646 | 1063 | n/a |
| 3 | 3690 | 5073 | 5455 | 5392 | 1885 | 3328 | 4000 | 2096 | 4515 | 6138 | 1267 | 2870 | 4236 | 2781 | 1645 | 1251 | 2361 | 2873 | 3084 | 2995 | 4506 | 2633 | 3495 | 2917 | 2872 | n/a |
| 4 | 3940 | 3593 | 4779 | 5909 | 3829 | 1911 | 5179 | 3799 | 2268 | 5596 | 3814 | 744 | 2940 | 3908 | 2782 | 2393 | 743 | 1476 | 2439 | 1841 | 2153 | 2600 | 2152 | 4160 | 3534 | n/a |
| 5 | 1132 | 1344 | 2366 | 3479 | 2311 | 2650 | 2200 | 1151 | 1612 | 1056 | 1896 | 1624 | 698 | 1402 | 1849 | 1870 | 387 | 499 | 1128 | 1370 | 988 | 1865 | 993 | 1611 | 2446 | n/a |
| 6 | 849 | 569 | 1161 | 1778 | 1383 | 1028 | 738 | 635 | 839 | 582 | 204 | 1066 | 829 | 235 | 785 | 937 | 236 | 447 | 279 | 779 | 252 | 848 | 351 | 633 | 485 | n/a |
| +gp | 229 | 141 | 463 | 630 | 803 | 479 | 67 | 278 | 446 | 280 | 551 | 443 | 349 | 488 | 838 | 357 | 359 | 142 | 337 | 393 | 219 | 460 | 295 | 222 | 437 | n/a |
| TOTALNUM | 13425 | 24583 | 25841 | 25061 | 16839 | 14235 | 15694 | 10839 | 12678 | 17278 | 10265 | 8026 | 10301 | 10013 | 8599 | 8149 | 6665 | 8606 | 10174 | 10023 | 10887 | 10021 | 8861 | 10210 | 10852 | n/a |
| TONSLAND | 1124 | 1688 | 2223 | 2629 | 1945 | 1682 | 1916 | 1384 | 1403 | 1652 | 1098 | 896 | 1123 | 1125 | 1041 | 931 | 720 | 876 | 1006 | 983 | 1092 | 1104 | 980 | 1134 | 1297 | n/a |
| SOPCOF % | 100 | 100 | 100 | 100 | 100 | 99 | 103 | 99 | 100 | 97 | 100 | 102 | 100 | 101 | 101 | 101 | 100 | 101 | 101 | 101 | 101 | 101 | 101 | 100 | 101 | n/a |

(*) Age 0 was not used in the assessment.

* 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 landings (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 0.022 | 0.036 | 0.039 | 0.043 | 0.028 | 0.033 | 0.032 | 0.023 | 0.033 | 0.043 | 0.038 | 0.032 | 0.033 | 0.036 | 0.035 | 0.042 | 0.042 | 0.043 | 0.040 | 0.049 | 0.034 | 0.041 | 0.044 | 0.034 | 0.033 | n/a |
| 2 | 0.046 | 0.053 | 0.057 | 0.066 | 0.065 | 0.073 | 0.073 | 0.074 | 0.069 | 0.066 | 0.062 | 0.056 | 0.063 | 0.070 | 0.080 | 0.069 | 0.071 | 0.071 | 0.066 | 0.060 | 0.07 | 0.067 | 0.076 | 0.061 | 0.073 | n/a |
| 3 | 0.065 | 0.071 | 0.079 | 0.090 | 0.106 | 0.117 | 0.110 | 0.118 | 0.092 | 0.092 | 0.074 | 0.080 | 0.086 | 0.090 | 0.086 | 0.091 | 0.103 | 0.094 | 0.086 | 0.087 | 0.094 | 0.088 | 0.091 | 0.081 | 0.091 | n/a |
| 4 | 0.095 | 0.094 | 0.104 | 0.112 | 0.141 | 0.125 | 0.125 | 0.143 | 0.121 | 0.100 | 0.112 | 0.097 | 0.112 | 0.101 | 0.100 | 0.106 | 0.128 | 0.125 | 0.111 | 0.111 | 0.107 | 0.116 | 0.113 | 0.108 | 0.11 | n/a |
| 5 | 0.132 | 0.127 | 0.139 | 0.145 | 0.156 | 0.166 | 0.161 | 0.178 | 0.153 | 0.146 | 0.137 | 0.126 | 0.142 | 0.147 | 0.132 | 0.123 | 0.170 | 0.142 | 0.132 | 0.123 | 0.138 | 0.124 | 0.151 | 0.143 | 0.142 | n/a |
| 6 | 0.160 | 0.152 | 0.168 | 0.167 | 0.184 | 0.191 | 0.226 | 0.220 | 0.181 | 0.169 | 0.213 | 0.180 | 0.180 | 0.197 | 0.170 | 0.166 | 0.210 | 0.201 | 0.175 | 0.133 | 0.179 | 0.153 | 0.201 | 0.175 | 0.183 | n/a |
| +gp | 0.265 | 0.242 | 0.281 | 0.276 | 0.273 | 0.264 | 0.359 | 0.297 | 0.245 | 0.256 | 0.232 | 0.252 | 0.294 | 0.268 | 0.228 | 0.255 | 0.247 | 0.247 | 0.235 | 0.198 | 0.236 | 0.198 | 0.235 | 0.288 | 0.271 | n/a |
| SOPCOFAC | 1.0015 | 1.0017 | 1.0028 | 1.0015 | 0.9968 | 0.9907 | 1.0339 | 0.9865 | 1.0011 | 0.9719 | 0.9987 | 1.0174 | 1.0010 | 1.0128 | 1.0091 | 1.0072 | 0.9999 | 1.0115 | 1.0115 | 1.0111 | 1.0114 | 1.0097 | 1.01 | 1.0029 | 1.0111 | n/a |

* 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 |

**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 |

**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 |

+ 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

**Table 9.2.7 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Tuning data**

**FLT01: SP-CORUTR8c. 1000 Days by 100 HP (thousand)(*)** 1986 2010

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 1 | | | | | | | |
| 1 | 7 | | | | | | | | Eff. | |
| 10 | | 16.1 | 481.7 | 526.6 | 641.7 | 191.7 | 131.9 | 28.4 | 39.8 | 1986 |
| 10 | | 463.7 | 1870.3 | 671.2 | 430.3 | 170.6 | 77.8 | 23.9 | 34.7 | 1987 |
| 10 | | 59.5 | 528.9 | 354.0 | 360.9 | 203.8 | 106.2 | 45.5 | 42.2 | 1988 |
| 10 | | 17.8 | 204.7 | 189.2 | 257.9 | 201.4 | 116.9 | 48.4 | 44.4 | 1989 |
| 10 | | 8.6 | 195.7 | 114.0 | 328.2 | 197.5 | 137.6 | 72.5 | 44.4 | 1990 |
| 10 | | 17.8 | 154.5 | 251.2 | 161.1 | 327.5 | 138.4 | 70.5 | 40.4 | 1991 |
| 10 | | 0.8 | 38.8 | 199.2 | 334.7 | 209.8 | 77.6 | 4.6 | 38.9 | 1992 |
| 10 | | 0.2 | 60.7 | 162.9 | 377.3 | 140.9 | 77.5 | 27.4 | 44.5 | 1993 |
| 10 | | 0.0 | 44.7 | 149.5 | 121.8 | 112.2 | 62.4 | 33.3 | 39.6 | 1994 |
| 10 | | 0.9 | 25.8 | 217.6 | 236.1 | 96.9 | 65.3 | 18.8 | 41.5 | 1995 |
| 10 | | 0.7 | 28.3 | 29.0 | 189.7 | 113.4 | 17.1 | 43.8 | 35.7 | 1996 |
| 10 | | 0.3 | 19.7 | 97.0 | 34.9 | 124.8 | 109.4 | 51.4 | 35.2 | 1997 |
| 10 | | 0.2 | 61.9 | 318.9 | 265.2 | 74.5 | 96.3 | 47.0 | 32.6 | 1998 |
| 10 | | 0.3 | 56.6 | 191.4 | 302.2 | 150.9 | 29.8 | 40.7 | 30.2 | 1999 |
| 10 | | 0.3 | 55.6 | 113.4 | 275.1 | 239.2 | 129.5 | 121.0 | 30.1 | 2000 |
| 10 | | 10.1 | 105.3 | 155.9 | 338.3 | 310.6 | 172.5 | 58.8 | 29.9 | 2001 |
| 10 | | 5.9 | 103.5 | 176.7 | 75.2 | 54.3 | 36.9 | 57.7 | 21.8 | 2002 |
| 10 | | 15.2 | 224.4 | 283.4 | 167.0 | 58.8 | 52.0 | 17.5 | 18.5 | 2003 |
| 10 | | 18.2 | 214.5 | 311.3 | 276.7 | 137.6 | 37.8 | 51.1 | 21.1 | 2004 |
| 10 | | 7.0 | 167.1 | 257.9 | 170.0 | 131.9 | 76.9 | 46.1 | 20.7 | 2005 |
| 10 | | 4.5 | 235.7 | 404.5 | 197.2 | 97.6 | 26.7 | 26.0 | 19.3 | 2006 |
| 10 | | 1.1 | 159.3 | 246.0 | 253.4 | 181.7 | 87.2 | 50.0 | 21.2 | 2007 |
| 10 | | 1.7 | 203.0 | 471.3 | 311.7 | 147.4 | 56.8 | 52.2 | 20.2 | 2008 |
| 10 | | 5.9 | 101.4 | 365.5 | 446.5 | 157.9 | 61.0 | 23.4 | 16.2 | 2009 |
| 10 | | 0.0 | 99.8 | 356.1 | 509.2 | 422.3 | 90.7 | 72.2 | 13.7 | 2010 |
| 10 | | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | 2011 |

**FLT02: SP-AVILESTR. 1000 Days by 100 HP (thousand) (*)** 1986 2003

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 1 | | | | | | | |
| 1 | 7 | | | | | | | | Eff. | |
| 10 | | 1.8 | 135.5 | 130.9 | 110.7 | 38.7 | 33.2 | 16.6 | 10.8 | 1986 |
| 10 | | 7.2 | 149.2 | 151.6 | 195.0 | 105.9 | 48.1 | 7.2 | 8.3 | 1987 |
| 10 | | 295.1 | 1099.8 | 357.0 | 187.9 | 63.0 | 28.7 | 21.0 | 9.0 | 1988 |
| 10 | | 121.5 | 623.8 | 276.6 | 165.0 | 76.9 | 39.7 | 21.1 | 8.1 | 1989 |
| 10 | | 963.9 | 1591.1 | 204.8 | 180.1 | 97.7 | 37.7 | 28.2 | 8.5 | 1990 |
| 10 | | 717.4 | 699.1 | 214.8 | 101.5 | 98.9 | 36.5 | 26.0 | 7.7 | 1991 |
| 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1992 |
| 10 | | 470.2 | 637.9 | 150.6 | 153.2 | 21.0 | 11.8 | 5.2 | 7.6 | 1993 |
| 10 | | 26.0 | 670.5 | 642.4 | 175.7 | 81.1 | 33.3 | 19.8 | 9.6 | 1994 |
| 10 | | 292.1 | 324.2 | 896.1 | 961.7 | 128.5 | 64.5 | 17.1 | 6.1 | 1995 |
| 10 | | 16.4 | 300.7 | 199.2 | 568.4 | 251.1 | 18.0 | 54.5 | 4.5 | 1996 |
| 10 | | 0.7 | 249.7 | 710.0 | 207.0 | 344.8 | 157.3 | 53.4 | 4.7 | 1997 |
| 10 | | 0.5 | 120.9 | 474.2 | 347.9 | 74.5 | 91.4 | 23.4 | 5.4 | 1998 |
| 10 | | 1.7 | 140.0 | 306.2 | 422.0 | 121.2 | 17.9 | 23.6 | 6.8 | 1999 |
| 10 | | 3.3 | 79.6 | 351.0 | 536.0 | 217.7 | 50.9 | 54.6 | 4.5 | 2000 |
| 10 | | 30.1 | 224.8 | 270.7 | 469.2 | 251.2 | 132.8 | 47.1 | 1.8 | 2001 |
| 10 | | 4.1 | 260.6 | 348.8 | 155.1 | 84.9 | 30.6 | 37.3 | 2.7 | 2002 |
| 10 | | 2.6 | 119.8 | 159.0 | 87.8 | 32.3 | 29.3 | 10.3 | 2.5 | 2003 |

**FLT03: SPGFS-WIBTS-Q4 (n/30 min)** 1988 2010

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0.75 | 0.83 | | | | | | | |
| 0 | 7 | | | | | | | | Eff. | |
| 1 | 2.9 | 24.6 | 20.6 | 7.3 | 1.9 | 1.1 | 0.4 | 0.3 | 101 | 1988 |
| 1 | 8.5 | 16.7 | 8.4 | 3.6 | 2.1 | 1.1 | 0.3 | 0.1 | 91 | 1989 |
| 1 | 0.4 | 19.1 | 13.0 | 2.2 | 2.8 | 1.6 | 0.7 | 0.4 | 120 | 1990 |
| 1 | 2.5 | 9.3 | 9.3 | 3.7 | 1.6 | 1.0 | 0.2 | 0.1 | 107 | 1991 |
| 1 | 2.4 | 35.0 | 4.1 | 4.1 | 2.1 | 1.0 | 0.4 | 0.0 | 116 | 1992 |
| 1 | 0.3 | 21.4 | 16.7 | 2.3 | 1.5 | 0.5 | 0.4 | 0.2 | 109 | 1993 |
| 1 | 3.5 | 2.9 | 11.2 | 6.3 | 1.5 | 0.7 | 0.4 | 0.4 | 118 | 1994 |
| 1 | 1.9 | 19.6 | 2.4 | 4.4 | 3.2 | 0.3 | 0.2 | 0.2 | 116 | 1995 |
| 1 | 3.6 | 20.6 | 14.4 | 1.4 | 1.9 | 2.4 | 0.3 | 0.3 | 114 | 1996 |
| 1 | 3.5 | 13.3 | 14.0 | 8.7 | 1.1 | 1.5 | 1.0 | 0.3 | 116 | 1997 |
| 1 | 0.3 | 9.6 | 10.0 | 9.2 | 3.6 | 0.7 | 0.8 | 0.3 | 114 | 1998 |
| 1 | 0.9 | 7.5 | 10.9 | 6.0 | 2.9 | 1.0 | 0.2 | 0.3 | 116 | 1999 |
| 1 | 1.1 | 14.0 | 5.4 | 5.2 | 4.1 | 1.7 | 0.6 | 0.9 | 113 | 2000 |
| 1 | 0.6 | 17.0 | 12.7 | 4.7 | 3.8 | 2.2 | 1.0 | 0.7 | 113 | 2001 |
| 1 | 1.0 | 10.0 | 12.7 | 7.4 | 1.8 | 0.7 | 0.3 | 0.6 | 110 | 2002 |
| 1 | 0.7 | 5.0 | 4.1 | 4.1 | 1.7 | 0.6 | 0.5 | 0.3 | 112 | 2003 |
| 1 | 1.2 | 21.1 | 11.3 | 6.1 | 2.7 | 0.8 | 0.2 | 0.5 | 114 | 2004 |
| 1 | 4.7 | 17.7 | 22.4 | 11.2 | 4.0 | 1.6 | 0.6 | 0.7 | 116 | 2005 |
| 1 | 0.6 | 14.7 | 13.3 | 8.2 | 2.5 | 1.0 | 0.5 | 0.6 | 115 | 2006 |
| 1 | 0.9 | 11.3 | 21.3 | 10.2 | 4.9 | 1.4 | 0.7 | 0.3 | 117 | 2007 |
| 1 | 0.4 | 8.1 | 11.7 | 7.9 | 2.6 | 0.8 | 0.5 | 0.3 | 115 | 2008 |
| 1 | 3.4 | 7.4 | 13.6 | 14.1 | 9.6 | 3.1 | 1.1 | 0.5 | 117 | 2009 |
| 1 | 0.6 | 34.2 | 16.6 | 10.8 | 7.2 | 2.2 | 0.5 | 0.6 | 127 | 2010 |
| 1 | 0.9 | 8.9 | 33.8 | 13.8 | 7.7 | 2.8 | 0.9 | 0.5 | 122 | 2011 |

**Table 9.2.8 Four-spot megrim (*L. boscii*). LPUE data by fleet in Divisions VIIIc, IXa.**

| | A Coruña Trawl in VIIIc | | | Avilés Trawl in VIIIc | | | Portugal trawl in IXa | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Landings(t) | Effort | LPUE [1] | Landings(t) | Effort | LPUE [1] | Landings(t) | Effort | LPUE [2] |
| 1986 | 682 | 39.8 | 17.1 | 45 | 10.8 | 4.1 | | | |
| 1987 | 811 | 34.7 | 23.4 | 60 | 8.3 | 7.2 | | | |
| 1988 | 706 | 42.2 | 16.7 | 102 | 9.0 | 11.3 | 146 | 38.5 | 3.8 |
| 1989 | 593 | 44.4 | 13.3 | 79 | 8.1 | 9.8 | 183 | 44.7 | 4.1 |
| 1990 | 692 | 44.4 | 15.6 | 142 | 8.5 | 16.8 | 164 | 39.0 | 4.2 |
| 1991 | 680 | 40.4 | 16.8 | 83 | 7.7 | 10.9 | 166 | 45.0 | 3.7 |
| 1992 | 542 | 38.9 | 13.9 | 56 | na | | 280 | 50.9 | 5.5 |
| 1993 | 615 | 44.5 | 13.8 | 58 | 7.6 | 7.6 | 180 | 44.2 | 4.1 |
| 1994 | 303 | 39.6 | 7.7 | 118 | 9.6 | 12.3 | 146 | 45.8 | 3.2 |
| 1995 | 359 | 41.5 | 8.7 | 127 | 6.1 | 20.7 | 121 | 37.0 | 3.3 |
| 1996 | 219 | 35.7 | 6.1 | 64 | 4.5 | 14.1 | 155 | 46.5 | 3.3 |
| 1997 | 244 | 35.2 | 6.9 | 81 | 4.7 | 17.3 | 76 | 33.4 | 2.3 |
| 1998 | 355 | 32.6 | 10.9 | 67 | 5.4 | 12.5 | 83 | 43.1 | 1.9 |
| 1999 | 324 | 30.2 | 10.7 | 74 | 6.8 | 10.8 | 73 | 25.3 | 2.9 |
| 2000 | 389 | 30.1 | 12.9 | 54 | 4.5 | 12.1 | 93 | 27.0 | 3.4 |
| 2001 | 431 | 29.9 | 14.4 | 27 | 1.8 | 14.6 | 89 | 43.1 | 2.1 |
| 2002 | 234 | 21.8 | 10.7 | 26 | 2.7 | 9.5 | 97 | 31.2 | 3.1 |
| 2003 | 168 | 18.5 | 9.1 | 13 | 2.5 | 5.0 | 117 | 40.5 | 2.9 |
| 2004 | 241 | 21.1 | 11.4 | 27 | n/a | | 111 | 35.4 | 3.1 |
| 2005 | 189 | 20.7 | 9.1 | 48 | n/a | | 140 | 42.6 | 3.3 |
| 2006 | 198 | 19.3 | 10.3 | 35 | n/a | | 149 | 40.3 | 3.7 |
| 2007* | 232 | 21.2 | 10.9 | 22 | n/a | | 165 | 43.8 | 3.8 |
| 2008* | 288 | 20.2 | 14.3 | 15 | n/a | | 146 | 38.4 | 3.8 |
| 2009 | 195 | 16.2 | 12.1 | 44 | n/a | | 183 | 49.3 | 3.7 |
| 2010 | 276 | 13.7 | 20.1 | 54 | n/a | | 150 | 48.0 | 3.1 |
| 2011 | n/a | n/a | n/a | n/a | n/a | | 134 | 49.4 | 2.7 |

[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

28/04/2011 13:51

Extended Survivors Analysis

Four spot megrim (L. boscii) Division VIIIc and IXa

CPUE data from file fleetb.txt

Catch data for 25 years. 1986 to 2010. Ages 0 to 7.

| Fleet | First year | Last year | First age | Last age | Alpha | Beta |
|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1986 | 1999 | 3 | 6 | 0 | 1 |
| SPGFS-WIBTS-Q4 | 1988 | 2010 | 0 | 6 | 0.75 | 0.83 |

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

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 = .300

Prior weighting not applied

Tuning had not converged after 40 iterations

Total absolute residual between iterations
39 and 40 = .00049

Final year F values

| Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Iteration 39 | 0 | 0.0006 | 0.09 | 0.3204 | 0.6183 | 0.5879 | 0.4616 |
| Iteration 40 | 0 | 0.0006 | 0.09 | 0.3204 | 0.6186 | 0.5878 | 0.4615 |

1

Regression weights

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.751 | 0.82 | 0.877 | 0.921 | 0.954 | 0.976 | 0.99 | 0.997 | 1 | 1 |

Fishing mortalities

| Age | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0.009 | 0.01 | 0.02 | 0.017 | 0.007 | 0.001 | 0 | 0.001 | 0.001 | 0.001 |
| 2 | 0.1 | 0.181 | 0.206 | 0.181 | 0.147 | 0.201 | 0.075 | 0.099 | 0.049 | 0.09 |
| 3 | 0.366 | 0.308 | 0.345 | 0.369 | 0.34 | 0.423 | 0.304 | 0.233 | 0.271 | 0.32 |
| 4 | 0.611 | 0.387 | 0.323 | 0.557 | 0.393 | 0.44 | 0.463 | 0.437 | 0.482 | 0.619 |
| 5 | 1.073 | 0.182 | 0.49 | 0.439 | 0.716 | 0.379 | 0.878 | 0.322 | 0.696 | 0.588 |
| 6 | 0.567 | 0.352 | 0.331 | 0.564 | 0.625 | 0.268 | 0.66 | 0.39 | 0.35 | 0.461 |

XSA population numbers (Thousands)

| | AGE | | | | | | |
|---|---|---|---|---|---|---|---|
| YEAR | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 2001 | 2.50E+04 | 1.96E+04 | 1.33E+04 | 4.51E+03 | 5.79E+03 | 3.14E+03 | 2.39E+03 |
| 2002 | 2.56E+04 | 2.05E+04 | 1.59E+04 | 9.84E+03 | 2.56E+03 | 2.57E+03 | 8.80E+02 |
| 2003 | 3.10E+04 | 2.09E+04 | 1.66E+04 | 1.09E+04 | 5.92E+03 | 1.42E+03 | 1.76E+03 |
| 2004 | 2.49E+04 | 2.54E+04 | 1.68E+04 | 1.11E+04 | 6.31E+03 | 3.51E+03 | 7.15E+02 |
| 2005 | 3.65E+04 | 2.04E+04 | 2.04E+04 | 1.15E+04 | 6.26E+03 | 2.96E+03 | 1.85E+03 |
| 2006 | 2.73E+04 | 2.99E+04 | 1.66E+04 | 1.44E+04 | 6.69E+03 | 3.46E+03 | 1.18E+03 |
| 2007 | 2.22E+04 | 2.24E+04 | 2.44E+04 | 1.11E+04 | 7.75E+03 | 3.53E+03 | 1.94E+03 |
| 2008 | 2.04E+04 | 1.82E+04 | 1.83E+04 | 1.86E+04 | 6.72E+03 | 3.99E+03 | 1.20E+03 |
| 2009 | 3.48E+04 | 1.67E+04 | 1.49E+04 | 1.36E+04 | 1.20E+04 | 3.55E+03 | 2.37E+03 |
| 2010 | 2.18E+04 | 2.85E+04 | 1.36E+04 | 1.16E+04 | 8.47E+03 | 6.08E+03 | 1.45E+03 |

Estimated population abundance at 1st Jan 2011

| | | | | | | |
|---|---|---|---|---|---|---|
| 0.00E+00 | 1.79E+04 | 2.33E+04 | 1.02E+04 | 6.88E+03 | 3.73E+03 | 2.77E+03 |

Taper weighted geometric mean of the VPA populations:

| | | | | | | |
|---|---|---|---|---|---|---|
| 2.46E+04 | 2.01E+04 | 1.58E+04 | 1.14E+04 | 6.72E+03 | 3.31E+03 | 1.43E+03 |

Standard error of the weighted Log(VPA populations) :

| | | | | | | |
|---|---|---|---|---|---|---|
| 0.2944 | 0.3168 | 0.3205 | 0.3616 | 0.4044 | 0.3929 | 0.4611 |

1

Log catchability residuals.

Fleet : SP-CORUTR8c

| Age | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| 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 |
| 4 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| 5 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| 6 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |

| Age | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 0.24 | 0.17 | 0.49 | -0.53 | 0.14 | -0.63 | -0.49 | 0.4 | 0.3 | 99.99 |
| 4 | -0.19 | 0.48 | 0.76 | 0.13 | -0.15 | -0.17 | -0.66 | 0.32 | 0.18 | 99.99 |
| 5 | 0.73 | 0.37 | 0.06 | 0.09 | 0.22 | -0.59 | -0.28 | 0.39 | 0.04 | 99.99 |
| 6 | 0.28 | 0.32 | 0.32 | 0.05 | 0.26 | -0.29 | 0.11 | 0.22 | 0.37 | 99.99 |

| Age | | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | -6.4571 | -5.6741 | -5.221 | -5.221 |
| S.E(Log q) | 0.59 | 0.509 | 0.4424 | 0.3716 |

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 | 0.68 | 0.19 | 7.41 | 0.75 | 9 | 1.08 | -6.46 |
| 4 | 0.67 | 0.321 | 6.72 | 0.89 | 9 | 0.77 | -5.67 |
| 5 | 2.46 | -0.611 | 1.14 | 0.6 | 9 | 1.65 | -5.22 |
| 6 | 1 | -0.004 | 5.04 | 0.91 | 9 | 0.89 | -5.05 |
| 1 | | | | | | | |

Fleet : SPGFS-WIBTS-Q4 ☻

| Age | | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|
| | 0 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| | 1 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| | 2 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| | 3 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| | 4 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| | 5 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |
| | 6 | 99.99 | 99.99 | 99.99 | 99.99 | 99.99 |

| Age | | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | -0.13 | -0.08 | 0.04 | 0.42 | -0.06 | 0.66 | 0.89 | 0.24 | 0.12 | 0 |
| | 1 | -0.13 | 0.38 | -0.01 | -0.72 | 0.25 | 0.08 | 0.06 | -0.02 | 0.41 | 0.25 |
| | 2 | -0.58 | -0.91 | -0.31 | -0.64 | -0.9 | -0.01 | -0.33 | -0.28 | 0.06 | 0 |
| | 3 | -1.11 | -0.8 | -0.88 | -0.82 | -0.93 | -0.74 | -0.02 | -0.26 | -0.28 | -0.22 |
| | 4 | -0.99 | -0.6 | -0.79 | -0.36 | -0.59 | -0.89 | -0.27 | -0.11 | -0.58 | 0.21 |
| | 5 | -0.27 | -0.27 | -0.92 | -0.22 | -0.39 | 0.15 | -0.08 | 0.4 | -0.41 | -0.1 |
| | 6 | -1.59 | -0.29 | -0.41 | -0.17 | -0.3 | 0.16 | 0.03 | 0.1 | -0.14 | -0.02 |

| Age | | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | -0.34 | -0.08 | 99.99 | 0.02 | 0.34 | -0.43 | -0.02 | -0.38 | 0.21 | -0.16 |
| | 1 | 0.25 | -0.3 | 99.99 | 0.21 | 0.25 | -0.31 | -0.27 | -0.37 | -0.38 | 0.54 |
| | 2 | 0.13 | 0.02 | 99.99 | -0.16 | 0.33 | 0.04 | 0.05 | -0.28 | 0.05 | 0.38 |
| | 3 | 0.45 | 0.09 | 99.99 | -0.16 | 0.37 | -0.09 | 0.29 | -0.53 | 0.39 | 0.32 |
| | 4 | 0.32 | 0.23 | 99.99 | -0.16 | 0.12 | -0.38 | 0.17 | -0.36 | 0.41 | 0.58 |
| | 5 | 1.06 | -0.63 | 99.99 | -0.55 | 0.49 | -0.41 | 0.34 | -0.87 | 0.97 | -0.01 |
| | 6 | 0.16 | -0.09 | 99.99 | -0.18 | -0.05 | -0.02 | 0.12 | 0.01 | 0.02 | -0.11 |

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 | -6.8848 | -7.0068 | -7.3022 | -7.3022 |
| S.E(Log q) | 0.3863 | 0.3924 | 0.6207 | 0.1212 |

Regression statistics :

Ages with q dependent on year class strength

| Age | Slope | t-value | Intercept | RSquare | No Pts | Reg s.e | Mean Log q |
|---|---|---|---|---|---|---|---|
| 0 | 0.51 | 1.365 | 9.97 | 0.46 | 19 | 0.34 | -9.86 |
| 1 | 0.95 | 0.155 | 7.3 | 0.49 | 19 | 0.36 | -7.15 |
| 2 | 1.05 | -0.214 | 6.69 | 0.63 | 19 | 0.27 | -6.85 |

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 | 1.51 | -1.064 | 5.62 | 0.32 | 19 | 0.58 | -6.88 |
| 4 | 1.01 | -0.046 | 6.98 | 0.53 | 19 | 0.42 | -7.01 |
| 5 | 1.33 | -0.385 | 7.02 | 0.13 | 19 | 0.86 | -7.3 |
| 6 | 0.88 | 1.965 | 7.32 | 0.97 | 19 | 0.09 | -7.32 |
| 1 | | | | | | | |

Terminal year survivor and F summaries :

Age 0 Catchability dependent on age and year class strength

Year class = 2010

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SPGFS-WIBTS-Q4 | 15243 | 0.363 | 0 | 0 | 1 | 0.432 | 0 |
| P shrinkage mean | 20141 | 0.32 | | | | 0.568 | 0 |
| F shrinkage mean | 0 | 1.5 | | | | 0 | 0 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 17855 | 0.24 | 0.21 | 2 | 0.879 | 0 |

Age 1 Catchability dependent on age and year class strength

Year class = 2009

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SPGFS-WIBTS-Q4 | 33326 | 0.286 | 0.161 | 0.56 | 2 | 0.546 | 0 |
| P shrinkage mean | 15770 | 0.32 | | | | 0.435 | 0.001 |
| F shrinkage mean | 6330 | 1.5 | | | | 0.02 | 0.002 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 23296 | 0.21 | 0.32 | 4 | 1.527 | 0.001 |

Age 2 Catchability dependent on age and year class strength

Year class = 2008

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SPGFS-WIBTS-Q4 | 9886 | 0.203 | 0.266 | 1.31 | 3 | 0.733 | 0.093 |
| P shrinkage mean | 11375 | 0.36 | | | | 0.252 | 0.081 |
| F shrinkage mean | 7915 | 1.5 | | | | 0.015 | 0.115 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 10209 | 0.18 | 0.17 | 5 | 0.941 | 0.09 |

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

Year class = 2007

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SPGFS-WIBTS-Q4 | 6877 | 0.178 | 0.13 | 0.73 | 4 | 0.98 | 0.321 |
| F shrinkage mean | 6989 | 1.5 | | | | 0.02 | 0.316 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 6879 | 0.18 | 0.11 | 5 | 0.627 | 0.32 |

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

Year class = 2006

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SPGFS-WIBTS-Q4 | 3687 | 0.165 | 0.202 | 1.22 | 5 | 0.972 | 0.625 |
| F shrinkage mean | 5686 | 1.5 | | | | 0.028 | 0.446 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 3732 | 0.17 | 0.18 | 6 | 1.09 | 0.619 |

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

Year class = 2005

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SPGFS-WIBTS-Q4 | 2770 | 0.167 | 0.145 | 0.87 | 6 | 0.961 | 0.587 |
| F shrinkage mean | 2672 | 1.5 | | | | 0.039 | 0.603 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 2766 | 0.17 | 0.13 | 7 | 0.762 | 0.588 |

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

Year class = 2004

| Fleet | Estimated Survivors | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| SP-CORUTR8c | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| SPGFS-WIBTS-Q4 | 752 | 0.18 | 0.118 | 0.65 | 7 | 0.967 | 0.46 |
| F shrinkage mean | 655 | 1.5 | | | | 0.033 | 0.513 |

Weighted prediction :

| Survivors at end of year | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 749 | 0.18 | 0.11 | 8 | 0.594 | 0.461 |

**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 28/04/2011 13:52

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

| YEAR | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| AGE | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0.0024 | 0.0596 | 0.0624 | 0.0263 | 0.0594 |
| 2 | 0.1158 | 0.3782 | 0.403 | 0.4595 | 0.2615 |
| 3 | 0.2104 | 0.2471 | 0.3071 | 0.3913 | 0.2083 |
| 4 | 0.4273 | 0.3265 | 0.3895 | 0.6457 | 0.5369 |
| 5 | 0.3317 | 0.2512 | 0.3719 | 0.5506 | 0.5681 |
| 6 | 0.3251 | 0.2764 | 0.3585 | 0.5335 | 0.4409 |
| +gp | 0.3251 | 0.2764 | 0.3585 | 0.5335 | 0.4409 |
| FBAR 2- 4 | 0.2512 | 0.3173 | 0.3665 | 0.4988 | 0.3356 |

Table 8 Fishing mortality (F) at age

| YEAR | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0.078 | 0.0274 | 0.0191 | 0.0093 | 0.0691 | 0.0158 | 0.0021 | 0.0033 | 0.0055 | 0.0031 |
| 2 | 0.2113 | 0.2584 | 0.0983 | 0.1341 | 0.362 | 0.1408 | 0.0628 | 0.0904 | 0.1118 | 0.1234 |
| 3 | 0.2671 | 0.3746 | 0.3327 | 0.2797 | 0.4607 | 0.3655 | 0.2852 | 0.3141 | 0.3105 | 0.229 |
| 4 | 0.338 | 0.8719 | 0.7489 | 0.7373 | 0.6706 | 0.5873 | 0.3805 | 0.5327 | 0.5377 | 0.5886 |
| 5 | 0.9181 | 0.8335 | 0.4744 | 0.8621 | 0.9678 | 0.5032 | 0.5371 | 0.7562 | 0.5273 | 0.5301 |
| 6 | 0.5371 | 0.7169 | 0.6139 | 0.7774 | 0.9247 | 0.4863 | 0.5962 | 0.5858 | 0.6251 | 0.644 |
| +gp | 0.5371 | 0.7169 | 0.6139 | 0.7774 | 0.9247 | 0.4863 | 0.5962 | 0.5858 | 0.6251 | 0.644 |
| FBAR 2- 4 | 0.2721 | 0.5016 | 0.3933 | 0.3837 | 0.4978 | 0.3645 | 0.2428 | 0.3124 | 0.32 | 0.3136 |

Table 8 Fishing mortality (F) at age

| YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | FBAR 08-10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0.0094 | 0.0103 | 0.0196 | 0.0172 | 0.0067 | 0.0013 | 0.0004 | 0.0009 | 0.0014 | 0.0006 | 0.001 |
| 2 | 0.0996 | 0.1811 | 0.2064 | 0.1809 | 0.1467 | 0.2011 | 0.0754 | 0.0991 | 0.0493 | 0.09 | 0.0794 |
| 3 | 0.366 | 0.3083 | 0.3449 | 0.3685 | 0.3402 | 0.4228 | 0.3036 | 0.2335 | 0.2714 | 0.3204 | 0.2751 |
| 4 | 0.6109 | 0.3865 | 0.3226 | 0.5569 | 0.3929 | 0.4398 | 0.4634 | 0.4371 | 0.4818 | 0.6186 | 0.5125 |
| 5 | 1.0728 | 0.1819 | 0.4895 | 0.439 | 0.7161 | 0.379 | 0.8781 | 0.3216 | 0.6958 | 0.5878 | 0.5351 |
| 6 | 0.5669 | 0.3517 | 0.3306 | 0.5644 | 0.6253 | 0.268 | 0.66 | 0.3905 | 0.35 | 0.4615 | 0.4006 |
| +gp | 0.5669 | 0.3517 | 0.3306 | 0.5644 | 0.6253 | 0.268 | 0.66 | 0.3905 | 0.35 | 0.4615 | |
| FBAR 2- 4 | 0.3588 | 0.292 | 0.2913 | 0.3688 | 0.2933 | 0.3545 | 0.2808 | 0.2566 | 0.2675 | 0.343 | |

**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 28/04/2011
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Terminal Fs derived using XSA (With F shrinkage)

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

| YEAR | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|
| AGE | | | | | |
| 0 | 53249 | 34015 | 38131 | 33796 | 20878 |
| 1 | 49762 | 43597 | 27849 | 31219 | 27670 |
| 2 | 35113 | 40642 | 33628 | 21421 | 24897 |
| 3 | 21489 | 25604 | 22797 | 18401 | 11077 |
| 4 | 12523 | 14255 | 16373 | 13728 | 10186 |
| 5 | 4431 | 6688 | 8420 | 9080 | 5893 |
| 6 | 3381 | 2604 | 4259 | 4753 | 4287 |
| +gp | 905 | 641 | 1686 | 1666 | 2467 |
| TOTAL | 180853 | 168044 | 153142 | 134065 | 107355 |

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

| YEAR | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | |
| 0 | 42252 | 39025 | 12081 | 28729 | 34229 | 23014 | 18163 | 9351 | 19859 | 23998 |
| 1 | 17094 | 34593 | 31951 | 9891 | 23521 | 28025 | 18842 | 14871 | 7656 | 16259 |
| 2 | 21348 | 12945 | 27557 | 25665 | 8023 | 17972 | 22585 | 15395 | 12134 | 6234 |
| 3 | 15693 | 14149 | 8186 | 20450 | 18375 | 4574 | 12781 | 17366 | 11515 | 8884 |
| 4 | 7364 | 9837 | 7965 | 4805 | 12657 | 9490 | 2598 | 7868 | 10385 | 6911 |
| 5 | 4875 | 4300 | 3368 | 3084 | 1882 | 5300 | 4319 | 1454 | 3781 | 4966 |
| 6 | 2734 | 1594 | 1530 | 1716 | 1066 | 585 | 2623 | 2067 | 559 | 1827 |
| +gp | 1261 | 143 | 662 | 899 | 504 | 1566 | 1078 | 860 | 1147 | 1927 |
| TOTAL | 112620 | 116585 | 93298 | 95238 | 100259 | 90525 | 82990 | 69230 | 67036 | 71006 |

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

| YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | GMST 90-08 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | |
| 0 | 25023 | 25556 | 31005 | 24925 | 36496 | 27302 | 22180 | 20385 | 34771 | 21810 | 0 | 24016 |
| 1 | 19648 | 20487 | 20923 | 25385 | 20407 | 29880 | 22353 | 18160 | 16690 | 28468 | 17855 | |
| 2 | 13271 | 15935 | 16602 | 16798 | 20428 | 16596 | 24433 | 18293 | 14854 | 13645 | 23296 | |
| 3 | 4511 | 9836 | 10885 | 11057 | 11478 | 14443 | 11113 | 18551 | 13565 | 11577 | 10209 | |
| 4 | 5785 | 2561 | 5917 | 6312 | 6262 | 6687 | 7748 | 6716 | 12026 | 8466 | 6879 | |
| 5 | 3141 | 2571 | 1425 | 3509 | 2961 | 3461 | 3527 | 3991 | 3552 | 6082 | 3732 | |
| 6 | 2393 | 880 | 1755 | 715 | 1852 | 1185 | 1940 | 1200 | 2369 | 1450 | 2766 | |
| +gp | 902 | 1328 | 554 | 854 | 923 | 1023 | 1039 | 1000 | 825 | 1294 | 1417 | |
| TOTAL | 74674 | 79154 | 89064 | 89554 | 100807 | 100578 | 94333 | 88296 | 98651 | 92793 | 66154 | |

**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 28/04/2011 13:52

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

| | RECRUITS Age 0 | TOTALBIO | TOTSPBIO | LANDINGS | YIELD/SSB | FBAR 2- 4 |
|---|---|---|---|---|---|---|
| 1986 | 53249 | 6822 | 5890 | 1124 | 0.1908 | 0.2512 |
| 1987 | 34015 | 8384 | 7206 | 1688 | 0.2343 | 0.3173 |
| 1988 | 38131 | 8981 | 8038 | 2223 | 0.2766 | 0.3665 |
| 1989 | 33796 | 8622 | 7653 | 2629 | 0.3435 | 0.4988 |
| 1990 | 20878 | 7427 | 6760 | 1945 | 0.2877 | 0.3356 |
| 1991 | 42252 | 6670 | 6007 | 1682 | 0.28 | 0.2721 |
| 1992 | 39025 | 6059 | 5252 | 1916 | 0.3648 | 0.5016 |
| 1993 | 12081 | 6036 | 5355 | 1384 | 0.2585 | 0.3933 |
| 1994 | 28729 | 5649 | 5106 | 1403 | 0.2748 | 0.3837 |
| 1995 | 34229 | 5184 | 4489 | 1652 | 0.368 | 0.4978 |
| 1996 | 23014 | 4841 | 4139 | 1098 | 0.2653 | 0.3645 |
| 1997 | 18163 | 4485 | 3949 | 896 | 0.2269 | 0.2428 |
| 1998 | 9351 | 4695 | 4256 | 1123 | 0.2638 | 0.3124 |
| 1999 | 19859 | 4263 | 3899 | 1125 | 0.2885 | 0.32 |
| 2000 | 23998 | 4024 | 3573 | 1041 | 0.2914 | 0.3136 |
| 2001 | 25023 | 3853 | 3260 | 931 | 0.2856 | 0.3588 |
| 2002 | 25556 | 4385 | 3703 | 720 | 0.1944 | 0.292 |
| 2003 | 31005 | 4657 | 3925 | 876 | 0.2232 | 0.2913 |
| 2004 | 24925 | 4614 | 3917 | 1006 | 0.2568 | 0.3688 |
| 2005 | 36496 | 4822 | 4054 | 983 | 0.2425 | 0.2933 |
| 2006 | 27302 | 5237 | 4514 | 1092 | 0.2419 | 0.3545 |
| 2007 | 22180 | 5437 | 4690 | 1104 | 0.2354 | 0.2808 |
| 2008 | 20385 | 5776 | 5103 | 980 | 0.192 | 0.2566 |
| 2009 | 34771 | 5101 | 4603 | 1134 | 0.2464 | 0.2675 |
| 2010 | 21810 | 5509 | 4797 | 1297 | 0.2704 | 0.343 |
| Arith. Mean | 28009 | 5661 | 4965 | 1322 | 0.2641 | 0.3391 |
| Units | (Thousands) | (Tonnes) | (Tonnes) | (Tonnes) | | |

**Table 9.2.13 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa.**

**Prediction with management option table: Input data**

Fbar age range: 2-4

| 2011 Age | Stock size | Natural mortality | Maturity ogive | Prop. of F bef. Spaw. | Prop. of M bef. Spaw. | Weight in Stock | Exploit pattern | Weight CWt |
|---|---|---|---|---|---|---|---|---|
| 0 | 24016 | 0.2 | 0 | 0 | 0 | 0.003 | 0.000 | 0.003 |
| 1 | 17855 | 0.2 | 0.55 | 0 | 0 | 0.037 | 0.001 | 0.037 |
| 2 | 23296 | 0.2 | 0.86 | 0 | 0 | 0.070 | 0.079 | 0.070 |
| 3 | 10209 | 0.2 | 0.97 | 0 | 0 | 0.088 | 0.275 | 0.088 |
| 4 | 6879 | 0.2 | 0.99 | 0 | 0 | 0.110 | 0.513 | 0.110 |
| 5 | 3732 | 0.2 | 1 | 0 | 0 | 0.145 | 0.535 | 0.145 |
| 6 | 2766 | 0.2 | 1 | 0 | 0 | 0.186 | 0.401 | 0.186 |
| 7 | 1417 | 0.2 | 1 | 0 | 0 | 0.265 | 0.401 | 0.265 |

| 2012 Age | Stock size | Natural mortality | Maturity ogive | Prop. of F bef. Spaw. | Prop. of M bef. Spaw. | Weight in Stock | Exploit pattern | Weight CWt |
|---|---|---|---|---|---|---|---|---|
| 0 | 24016 | 0.2 | 0 | 0 | 0 | 0.003 | 0.000 | 0.003 |
| 1 | | 0.2 | 0.55 | 0 | 0 | 0.037 | 0.001 | 0.037 |
| 2 | | 0.2 | 0.86 | 0 | 0 | 0.070 | 0.079 | 0.070 |
| 3 | | 0.2 | 0.97 | 0 | 0 | 0.088 | 0.275 | 0.088 |
| 4 | | 0.2 | 0.99 | 0 | 0 | 0.110 | 0.513 | 0.110 |
| 5 | | 0.2 | 1 | 0 | 0 | 0.145 | 0.535 | 0.145 |
| 6 | | 0.2 | 1 | 0 | 0 | 0.186 | 0.401 | 0.186 |
| 7 | | 0.2 | 1 | 0 | 0 | 0.265 | 0.401 | 0.265 |

| 2013 Age | Stock size | Natural mortality | Maturity ogive | Prop. of F bef. Spaw. | Prop. of M bef. Spaw. | Weight in Stock | Exploit pattern | Weight CWt |
|---|---|---|---|---|---|---|---|---|
| 0 | 24016 | 0.2 | 0 | 0 | 0 | 0.003 | 0.000 | 0.003 |
| 1 | | 0.2 | 0.55 | 0 | 0 | 0.037 | 0.001 | 0.037 |
| 2 | | 0.2 | 0.86 | 0 | 0 | 0.070 | 0.079 | 0.070 |
| 3 | | 0.2 | 0.97 | 0 | 0 | 0.088 | 0.275 | 0.088 |
| 4 | | 0.2 | 0.99 | 0 | 0 | 0.110 | 0.513 | 0.110 |
| 5 | | 0.2 | 1 | 0 | 0 | 0.145 | 0.535 | 0.145 |
| 6 | | 0.2 | 1 | 0 | 0 | 0.186 | 0.401 | 0.186 |
| 7 | | 0.2 | 1 | 0 | 0 | 0.265 | 0.401 | 0.265 |

| 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 |
|---|---|---|---|---|---|---|---|---|
| 0 | 24016 | 0.2 | 0 | 0 | 0 | 0.003 | 0.000 | 0.003 |
| 1 | | 0.2 | 0.55 | 0 | 0 | 0.037 | 0.001 | 0.037 |
| 2 | | 0.2 | 0.86 | 0 | 0 | 0.070 | 0.079 | 0.070 |
| 3 | | 0.2 | 0.97 | 0 | 0 | 0.088 | 0.275 | 0.088 |
| 4 | | 0.2 | 0.99 | 0 | 0 | 0.110 | 0.513 | 0.110 |
| 5 | | 0.2 | 1 | 0 | 0 | 0.145 | 0.535 | 0.145 |
| 6 | | 0.2 | 1 | 0 | 0 | 0.186 | 0.401 | 0.186 |
| 7 | | 0.2 | 1 | 0 | 0 | 0.265 | 0.401 | 0.265 |

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**

Fbar age range: 2-4

| 2012 | | | | |
|---|---|---|---|---|
| **Biomass** | **SSB** | **FMult** | **FBar** | **Landings** |
| 5506 | 4902 | 1 | 0.289 | 1135 |

| 2013 | | | | | 2014 | |
|---|---|---|---|---|---|---|
| **Biomass** | **SSB** | **FMult** | **FBar** | **Landings** | **Biomass** | **SSB** |
| 5457 | 4851 | 0 | 0 | 0 | 6701 | 6091 |
| . | 4851 | 0.1 | 0.0289 | 140 | 6542 | 5932 |
| . | 4851 | 0.2 | 0.0578 | 274 | 6389 | 5781 |
| . | 4851 | 0.3 | 0.0867 | 403 | 6243 | 5635 |
| . | 4851 | 0.4 | 0.1156 | 527 | 6103 | 5496 |
| . | 4851 | 0.5 | 0.1445 | 646 | 5969 | 5362 |
| . | 4851 | 0.6 | 0.1734 | 760 | 5840 | 5234 |
| . | 4851 | 0.7 | 0.2023 | 870 | 5717 | 5111 |
| . | 4851 | 0.8 | 0.2312 | 976 | 5599 | 4993 |
| . | 4851 | 0.9 | 0.2601 | 1077 | 5485 | 4880 |
| . | 4851 | 1 | 0.289 | 1174 | 5376 | 4772 |
| . | 4851 | 1.1 | 0.3179 | 1268 | 5272 | 4667 |
| . | 4851 | 1.2 | 0.3468 | 1358 | 5171 | 4567 |
| . | 4851 | 1.3 | 0.3757 | 1445 | 5075 | 4472 |
| . | 4851 | 1.4 | 0.4046 | 1528 | 4982 | 4379 |
| . | 4851 | 1.5 | 0.4335 | 1609 | 4893 | 4291 |
| . | 4851 | 1.6 | 0.4624 | 1686 | 4808 | 4206 |
| . | 4851 | 1.7 | 0.4913 | 1760 | 4726 | 4124 |
| . | 4851 | 1.8 | 0.5202 | 1832 | 4647 | 4046 |
| . | 4851 | 1.9 | 0.5491 | 1901 | 4571 | 3970 |
| . | 4851 | 2 | 0.578 | 1967 | 4498 | 3898 |

Input units are thousands and kg - output in tonnes

**Table 9.2.15 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Single option prediction. Detail Tables.**

Fbar age range: 2-4

Year: 2011 F multiplier: 1 Fbar: 0.289

| Age | F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 24016 | 80 | 0 | 0 | 0 | 0 |
| 1 | 0.0010 | 16 | 1 | 17855 | 661 | 9820 | 363 | 9820 | 363 |
| 2 | 0.0795 | 1615 | 113 | 23296 | 1631 | 20035 | 1402 | 20035 | 1402 |
| 3 | 0.2751 | 2236 | 196 | 10209 | 895 | 9903 | 868 | 9903 | 868 |
| 4 | 0.5125 | 2521 | 278 | 6879 | 759 | 6810 | 751 | 6810 | 751 |
| 5 | 0.5351 | 1414 | 206 | 3732 | 542 | 3732 | 542 | 3732 | 542 |
| 6 | 0.4007 | 833 | 155 | 2766 | 515 | 2766 | 515 | 2766 | 515 |
| 7 | 0.4007 | 427 | 113 | 1417 | 375 | 1417 | 375 | 1417 | 375 |
| Total | | 9062 | 1062 | 90170 | 5458 | 54483 | 4818 | 54483 | 4818 |

Year: 2012 F multiplier: 1 Fbar: 0.289

| Age | F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 24016 | 80 | 0 | 0 | 0 | 0 |
| 1 | 0.0010 | 17 | 1 | 19663 | 728 | 10815 | 400 | 10815 | 400 |
| 2 | 0.0795 | 1012 | 71 | 14604 | 1022 | 12560 | 879 | 12560 | 879 |
| 3 | 0.2751 | 3857 | 338 | 17616 | 1544 | 17088 | 1498 | 17088 | 1498 |
| 4 | 0.5125 | 2327 | 257 | 6348 | 700 | 6285 | 693 | 6285 | 693 |
| 5 | 0.5351 | 1278 | 186 | 3374 | 490 | 3374 | 490 | 3374 | 490 |
| 6 | 0.4007 | 539 | 100 | 1789 | 333 | 1789 | 333 | 1789 | 333 |
| 7 | 0.4007 | 691 | 183 | 2294 | 607 | 2294 | 607 | 2294 | 607 |
| Total | | 9722 | 1135 | 89704 | 5506 | 54204 | 4902 | 54204 | 4902 |

Year: 2013 F multiplier: 1 Fbar: 0.289

| Age | F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 24016 | 80 | 0 | 0 | 0 | 0 |
| 1 | 0.0010 | 17 | 1 | 19663 | 728 | 10815 | 400 | 10815 | 400 |
| 2 | 0.0795 | 1115 | 78 | 16083 | 1126 | 13831 | 968 | 13831 | 968 |
| 3 | 0.2751 | 2418 | 212 | 11044 | 968 | 10712 | 939 | 10712 | 939 |
| 4 | 0.5125 | 4015 | 443 | 10954 | 1209 | 10845 | 1197 | 10845 | 1197 |
| 5 | 0.5351 | 1180 | 171 | 3113 | 452 | 3113 | 452 | 3113 | 452 |
| 6 | 0.4007 | 487 | 91 | 1618 | 301 | 1618 | 301 | 1618 | 301 |
| 7 | 0.4007 | 675 | 179 | 2240 | 593 | 2240 | 593 | 2240 | 593 |
| Total | | 9907 | 1174 | 88730 | 5457 | 53174 | 4851 | 53174 | 4851 |

Year: 2014 F multiplier: 1 Fbar: 0.289

| Age | F | CatchNos | Yield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 24016 | 80 | 0 | 0 | 0 | 0 |
| 1 | 0.0010 | 17 | 1 | 19663 | 728 | 10815 | 400 | 10815 | 400 |
| 2 | 0.0795 | 1115 | 78 | 16083 | 1126 | 13831 | 968 | 13831 | 968 |
| 3 | 0.2751 | 2663 | 233 | 12162 | 1066 | 11797 | 1034 | 11797 | 1034 |
| 4 | 0.5125 | 2517 | 278 | 6867 | 758 | 6799 | 750 | 6799 | 750 |
| 5 | 0.5351 | 2035 | 296 | 5372 | 781 | 5372 | 781 | 5372 | 781 |
| 6 | 0.4007 | 450 | 84 | 1493 | 278 | 1493 | 278 | 1493 | 278 |
| 7 | 0.4007 | 637 | 169 | 2116 | 560 | 2116 | 560 | 2116 | 560 |
| Total | | 9434 | 1138 | 87771 | 5376 | 52222 | 4772 | 52222 | 4772 |

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 landings and SSB (by weight) of these year classes**

| Year-class | | | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|
| Stock No. (thousands) | | | 34771 | 21810 | 24016 | 24016 | 24016 |
| of | 0 year-olds | | | | | | |
| Source | | | XSA | XSA | GM90-08 | GM90-08 | GM90-08 |
| Status Quo F: | | | | | | | |
| % in | 2012 | landings | 29.8 | 6.2 | 0.1 | 0.0 | - |
| % in | 2013 | | 37.7 | 18.1 | 6.6 | 0.1 | 0.0 |
| % in | 2012 | SSB | 30.6 | 17.9 | 8.2 | 0.0 | - |
| % in | 2013 | SSB | 24.7 | 19.4 | 20.0 | 8.2 | 0.0 |
| % in | 2014 | SSB | 16.4 | 15.7 | 21.7 | 20.3 | 8.4 |

GM : geometric mean recruitment

**Four-spot megrim (L. boscii) in Divisions VIIIc and IXa : Year-class % contribution to**

**a ) 2013 landings** **b ) 2014 SSB**

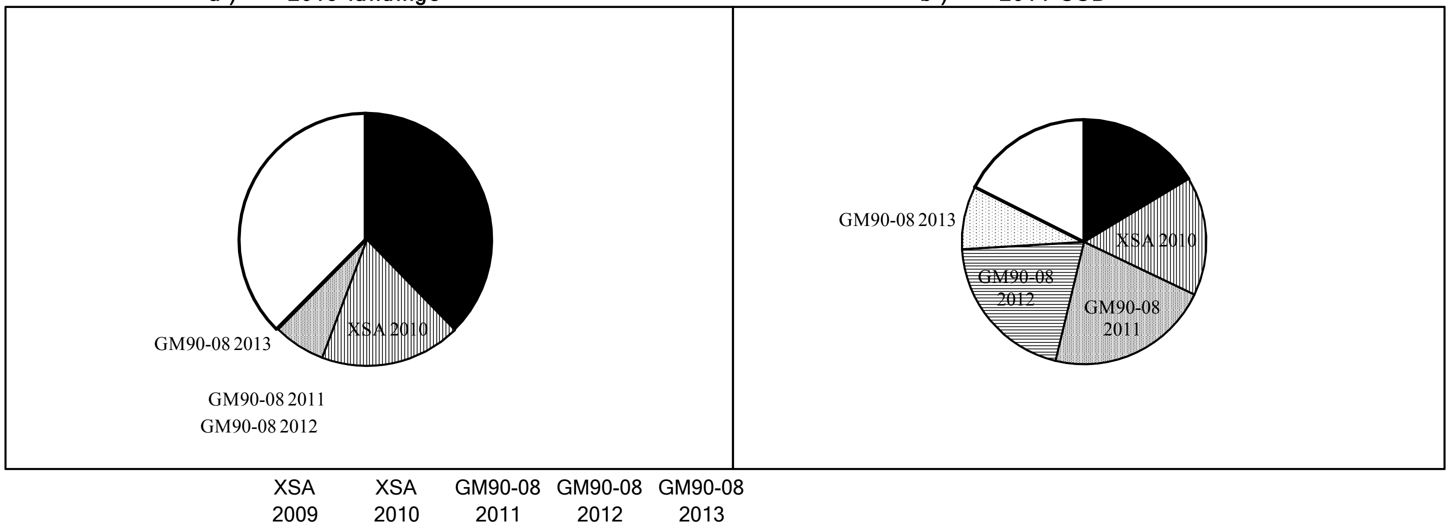


**Table 9.2.17 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Yield per recruit results.**

MFYPR version 2a
Run: ldb
Time and date: 13:02 30/04/2011
Yield per results

| FMult | Fbar | CatchNos | Yield | StockNos | Biomass | SpwnNosJan | SSBJan | SpwnNosSpwn | SSBSpwn |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 5.5167 | 0.6479 | 4.0334 | 0.6224 | 4.0334 | 0.6224 |
| 0.1 | 0.0289 | 0.0976 | 0.0168 | 5.0308 | 0.5292 | 3.5479 | 0.5038 | 3.5479 | 0.5038 |
| 0.2 | 0.0578 | 0.1665 | 0.0272 | 4.6879 | 0.4476 | 3.2052 | 0.4222 | 3.2052 | 0.4222 |
| 0.3 | 0.0867 | 0.2178 | 0.0338 | 4.4336 | 0.3888 | 2.9512 | 0.3634 | 2.9512 | 0.3634 |
| 0.4 | 0.1156 | 0.2573 | 0.038 | 4.238 | 0.3448 | 2.7559 | 0.3194 | 2.7559 | 0.3194 |
| 0.5 | 0.1445 | 0.2886 | 0.0409 | 4.0831 | 0.311 | 2.6013 | 0.2857 | 2.6013 | 0.2857 |
| 0.6 | 0.1734 | 0.3141 | 0.0427 | 3.9575 | 0.2844 | 2.476 | 0.2591 | 2.476 | 0.2591 |
| 0.7 | 0.2023 | 0.3352 | 0.0439 | 3.8537 | 0.2632 | 2.3724 | 0.2379 | 2.3724 | 0.2379 |
| 0.8 | 0.2312 | 0.353 | 0.0447 | 3.7665 | 0.2459 | 2.2855 | 0.2206 | 2.2855 | 0.2206 |
| 0.9 | 0.2601 | 0.3682 | 0.0453 | 3.6922 | 0.2316 | 2.2114 | 0.2064 | 2.2114 | 0.2064 |
| 1 | 0.289 | 0.3814 | 0.05 | 3.6281 | 0.2197 | 2.1476 | 0.19 | 2.1476 | 0.1945 |
| 1.1 | 0.3179 | 0.3929 | 0.0457 | 3.5722 | 0.2096 | 2.0919 | 0.1844 | 2.0919 | 0.1844 |
| 1.2 | 0.3468 | 0.403 | 0.0458 | 3.5229 | 0.201 | 2.0429 | 0.1758 | 2.0429 | 0.1758 |
| 1.3 | 0.3757 | 0.4121 | 0.0458 | 3.4792 | 0.1936 | 1.9994 | 0.1684 | 1.9994 | 0.1684 |
| 1.4 | 0.4046 | 0.4202 | 0.0458 | 3.4401 | 0.1871 | 1.9605 | 0.162 | 1.9605 | 0.162 |
| 1.5 | 0.4335 | 0.4275 | 0.0458 | 3.4048 | 0.1815 | 1.9254 | 0.1564 | 1.9254 | 0.1564 |
| 1.6 | 0.4624 | 0.4342 | 0.0457 | 3.3728 | 0.1765 | 1.8936 | 0.1515 | 1.8936 | 0.1515 |
| 1.7 | 0.4913 | 0.4403 | 0.0456 | 3.3436 | 0.1721 | 1.8647 | 0.1471 | 1.8647 | 0.1471 |
| 1.8 | 0.5202 | 0.4459 | 0.0456 | 3.3168 | 0.1682 | 1.8381 | 0.1431 | 1.8381 | 0.1431 |
| 1.9 | 0.5491 | 0.4511 | 0.0455 | 3.2921 | 0.1646 | 1.8136 | 0.1396 | 1.8136 | 0.1396 |
| 2 | 0.578 | 0.4559 | 0.0454 | 3.2693 | 0.1614 | 1.791 | 0.1364 | 1.791 | 0.1364 |

| Reference point | F multiplier | Absolute F |
|---|---|---|
| Fbar(2-4) | 1 | 0.289 |
| FMax | 1.2917 | 0.3733 |
| F0.1 | 0.5128 | 0.1482 |
| F35%SPR | 0.8182 | 0.2365 |
| Flow | 0.4729 | 0.1367 |
| Fmed | 1.1733 | 0.3391 |
| Fhigh | 2.317 | 0.6697 |

Weights in kilograms

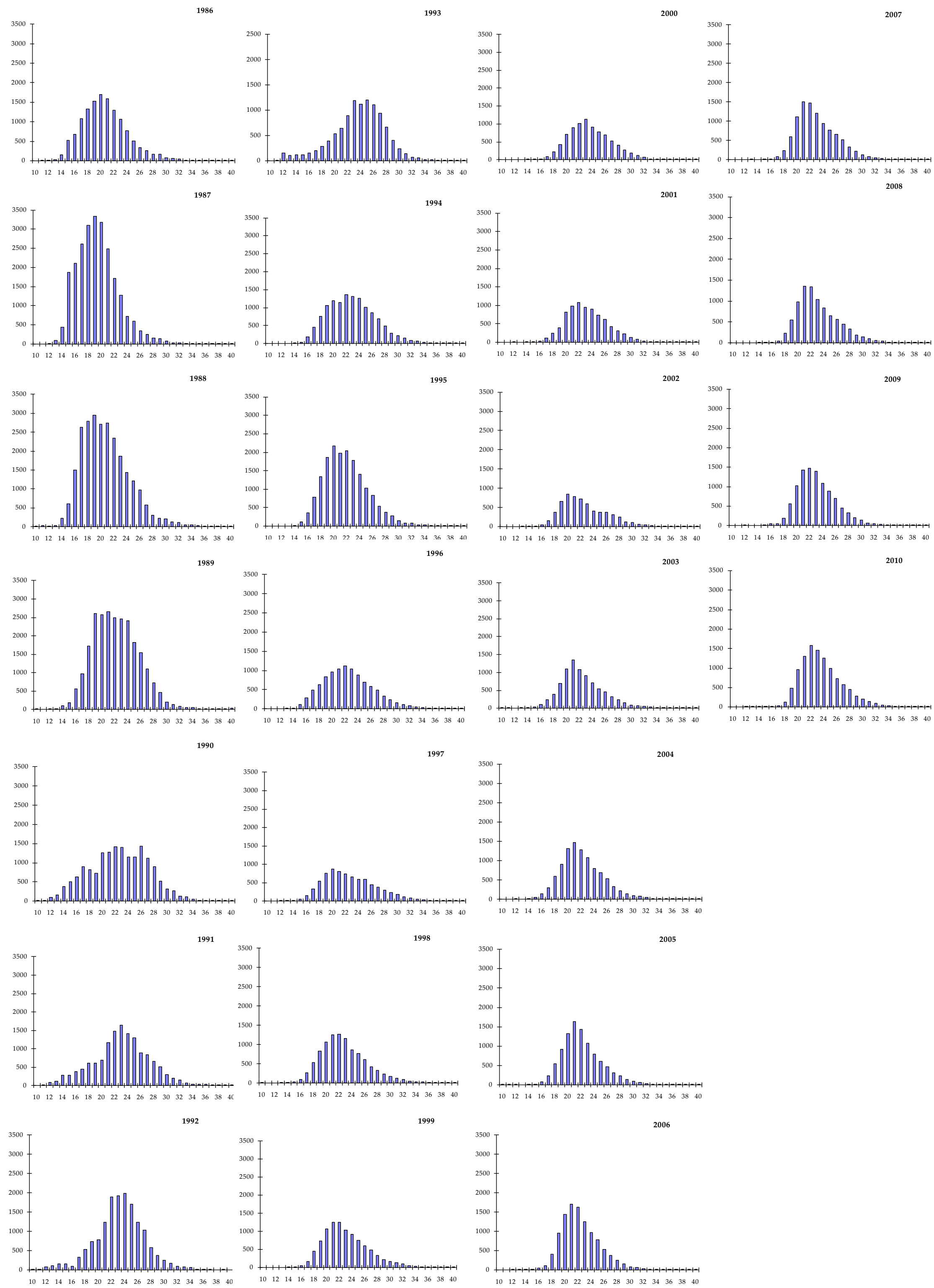
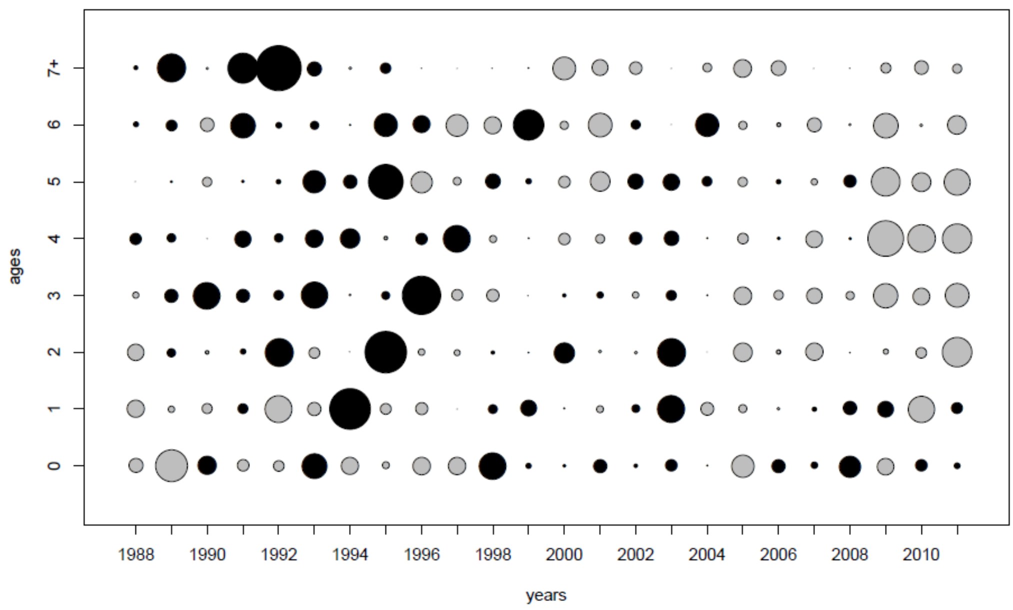


**Figure 9.2.1 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Annual length compositions of landings ('000)**

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

**(black bubble means < 0)**




**Standardized log(abundance index at age) from A Coruña VIIIc trawl fleet**

**(black bubble means < 0)**

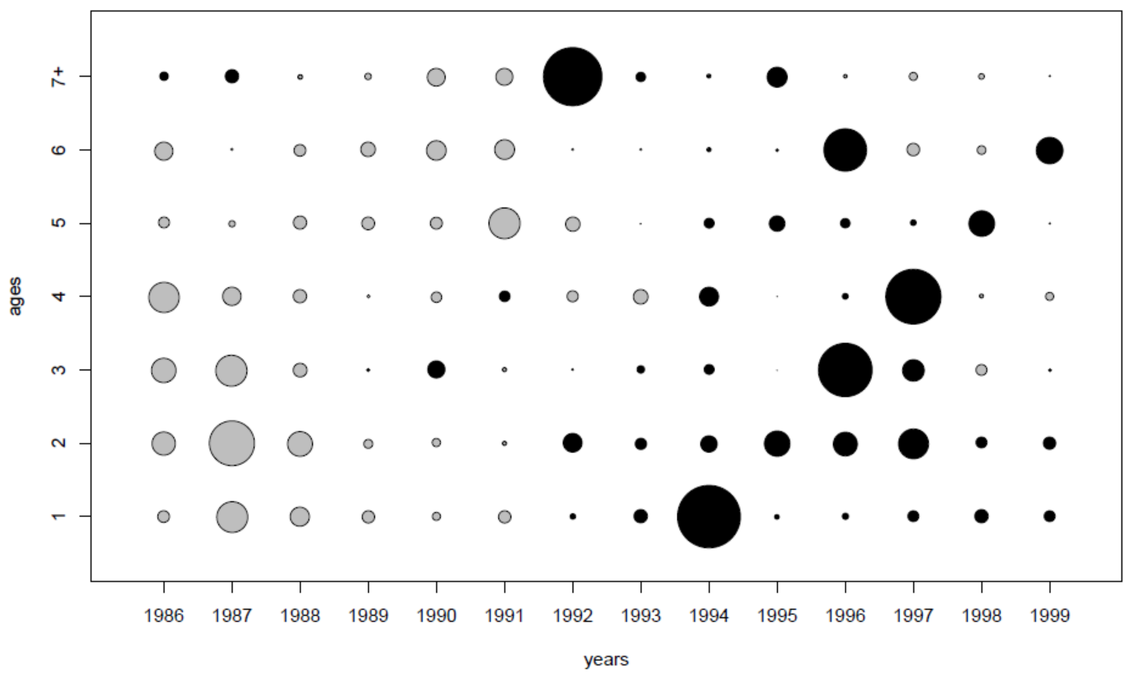
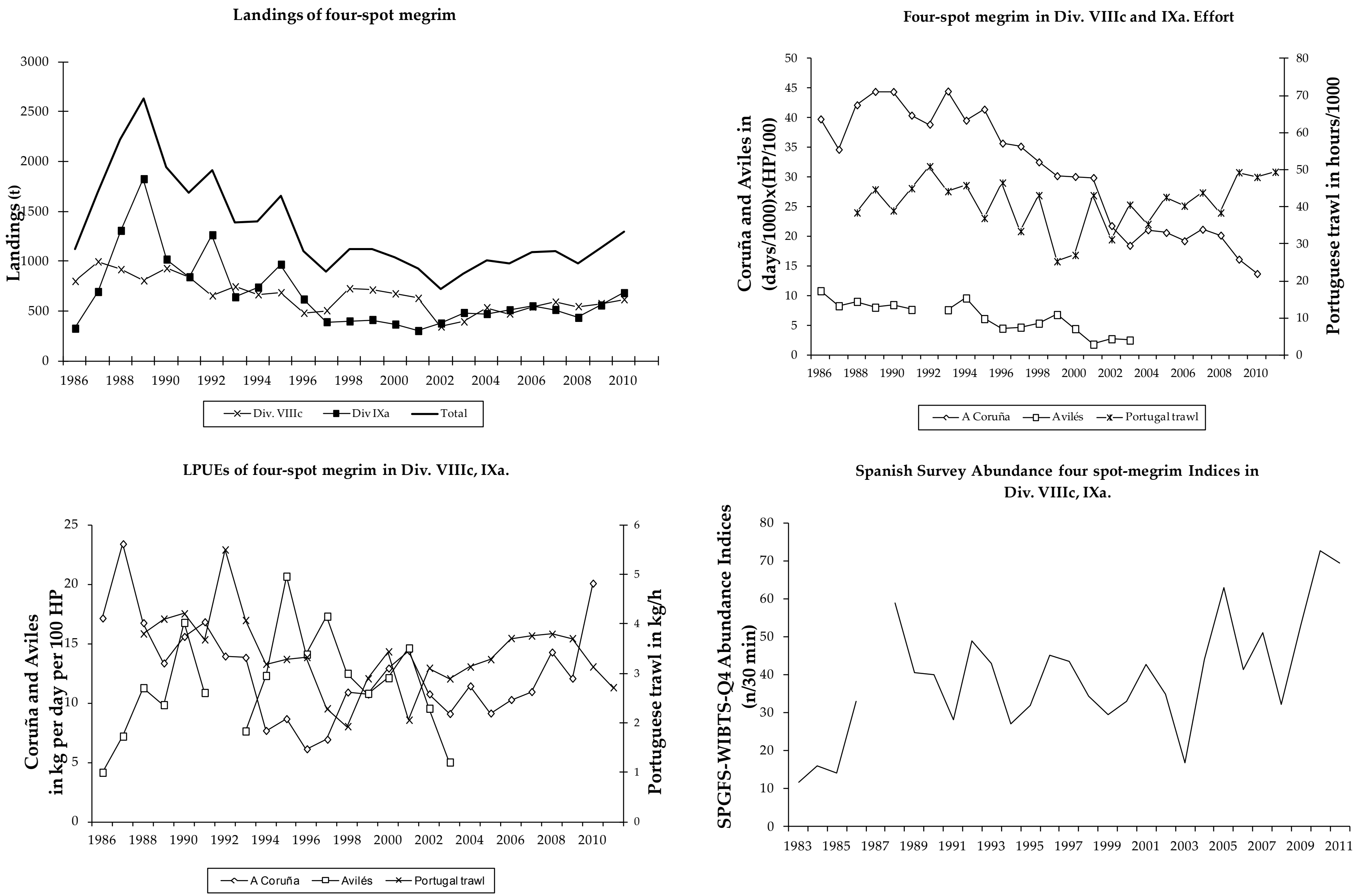



**Figure 9.2.2: Four-spot megrim (*L. boscii*) in Divisions VIIIc&IXa**




* Data not available in 2011 for Avilés, A Coruña and International landings.

**Figure 9.2.3 Four-spot megrim (*L.boscii*) in Divisions VIIIc and IXa. Landings (t), Efforts, LPUEs and Abundance Indices.**

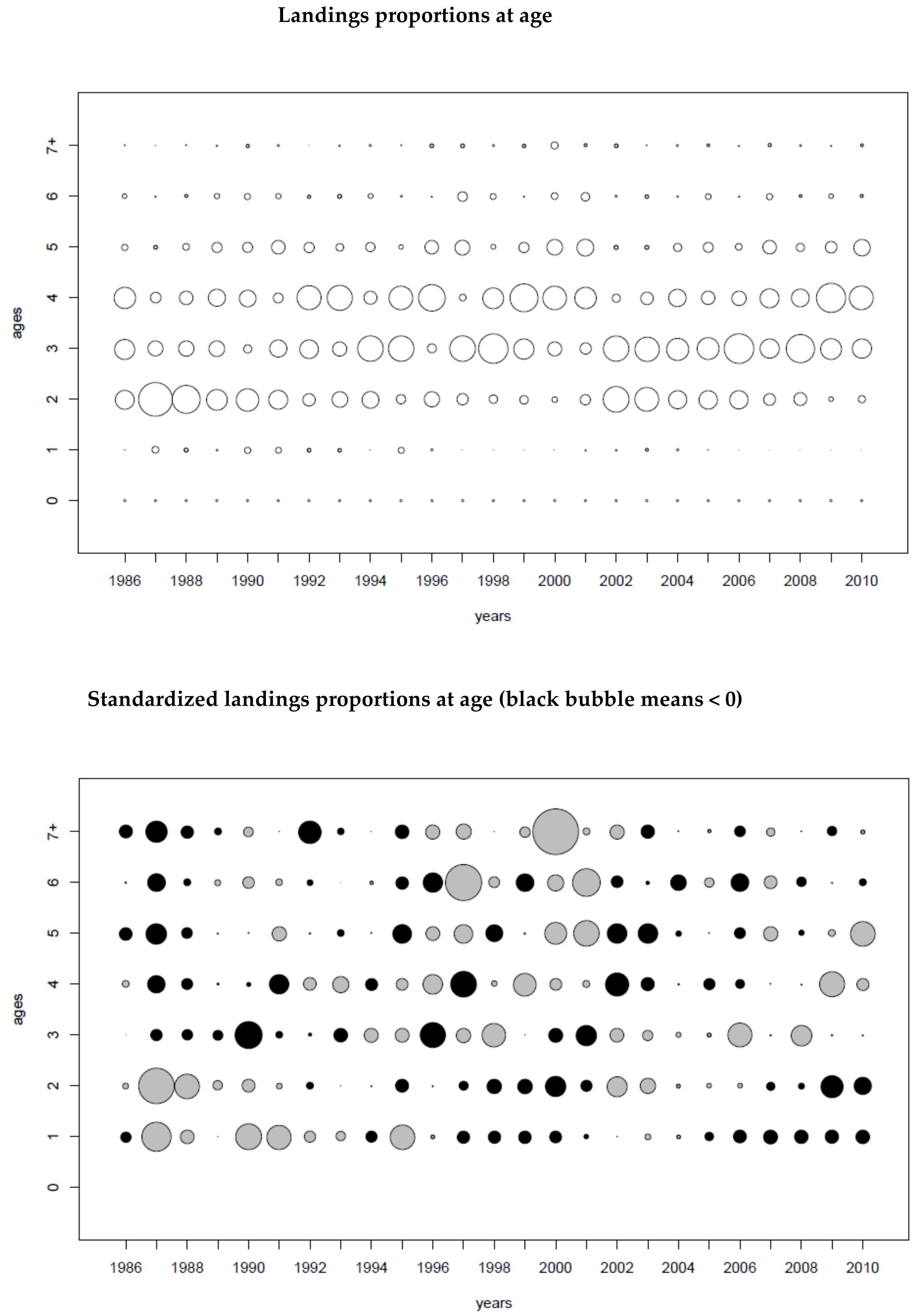



**Figure 9.2.4. Four-spot megrim (*L. boscii*) in Divisions VIIIc & IXa.**

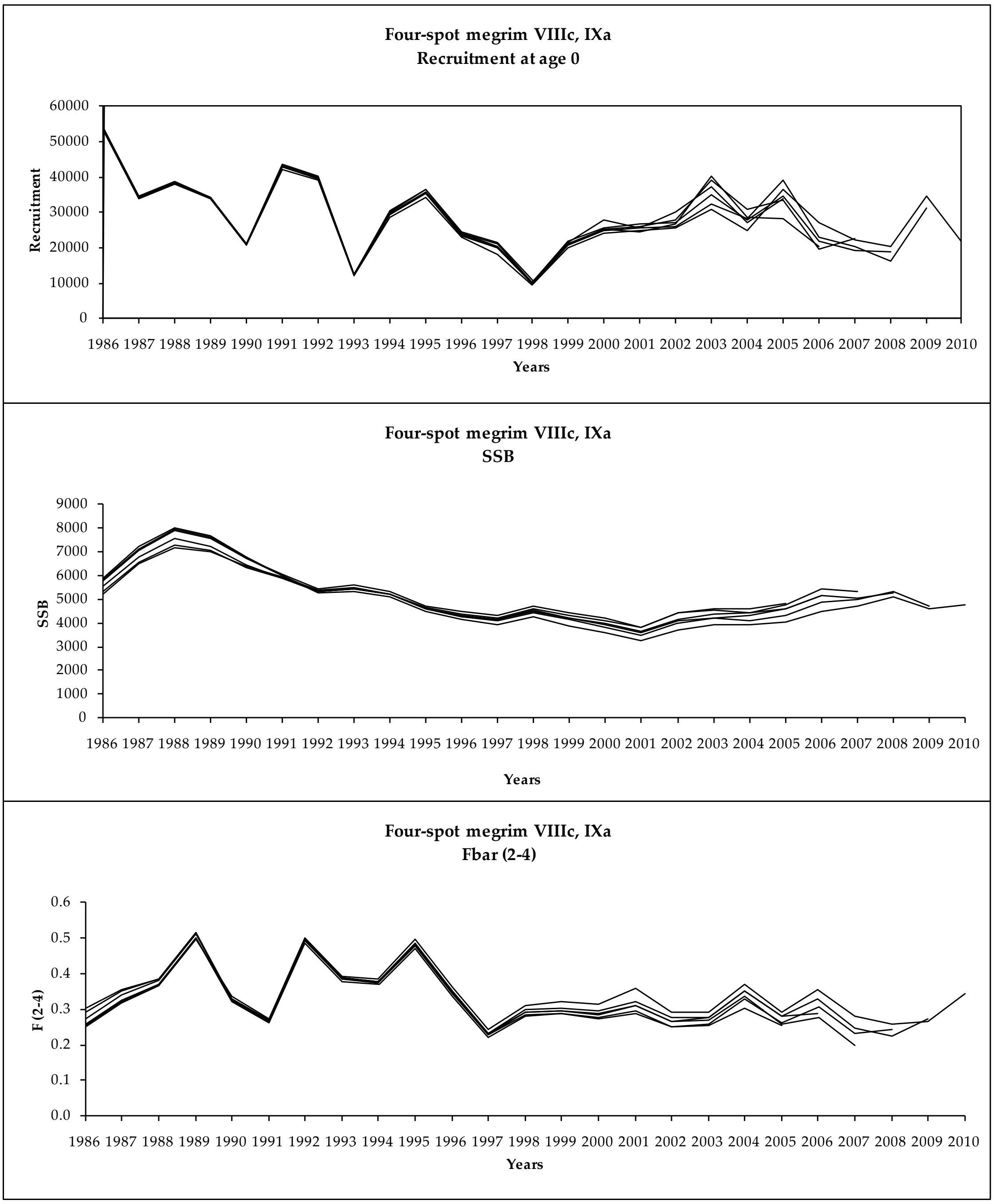



**Figure 9.2.5. Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Retrospective XSA**

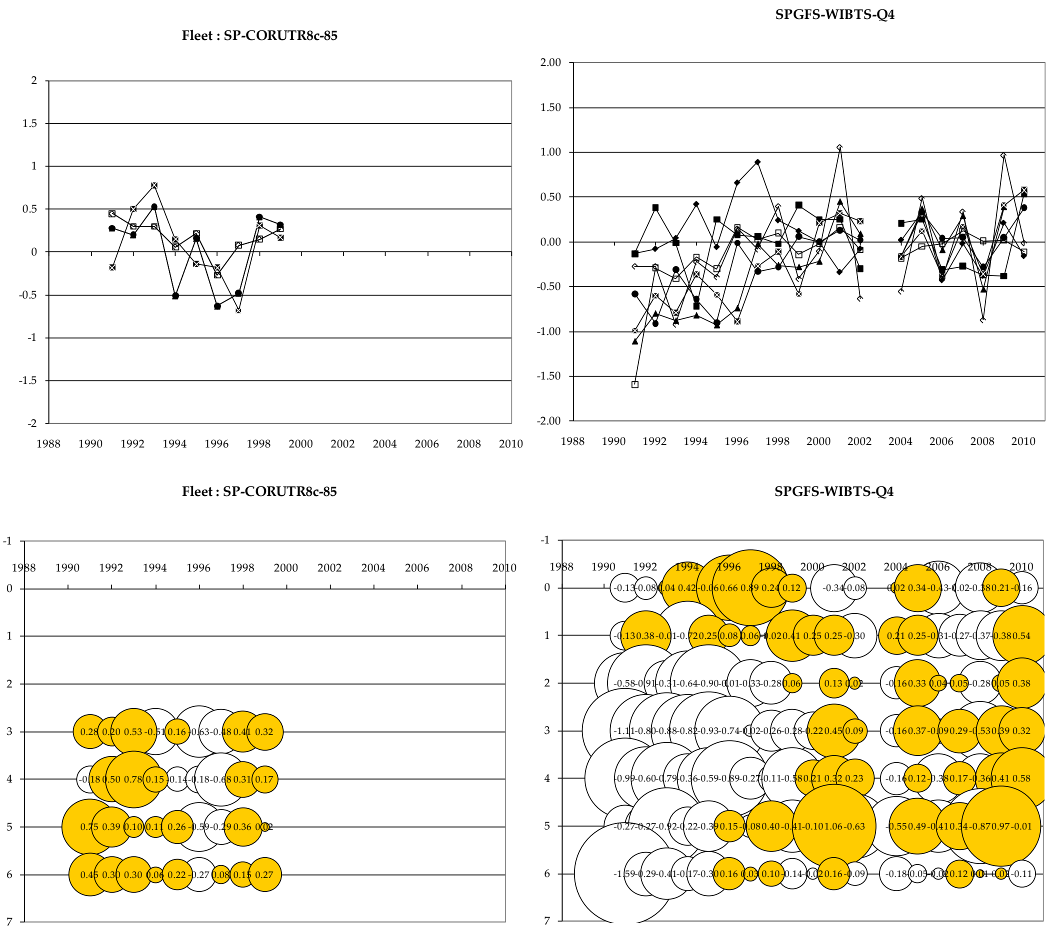



**Figure 9.2.6. Four spot megrim (*L. boscii*) in Divisions VIIIc and IXa. LOG CATCHABILITY RESIDUAL PLOTS (XSA)**

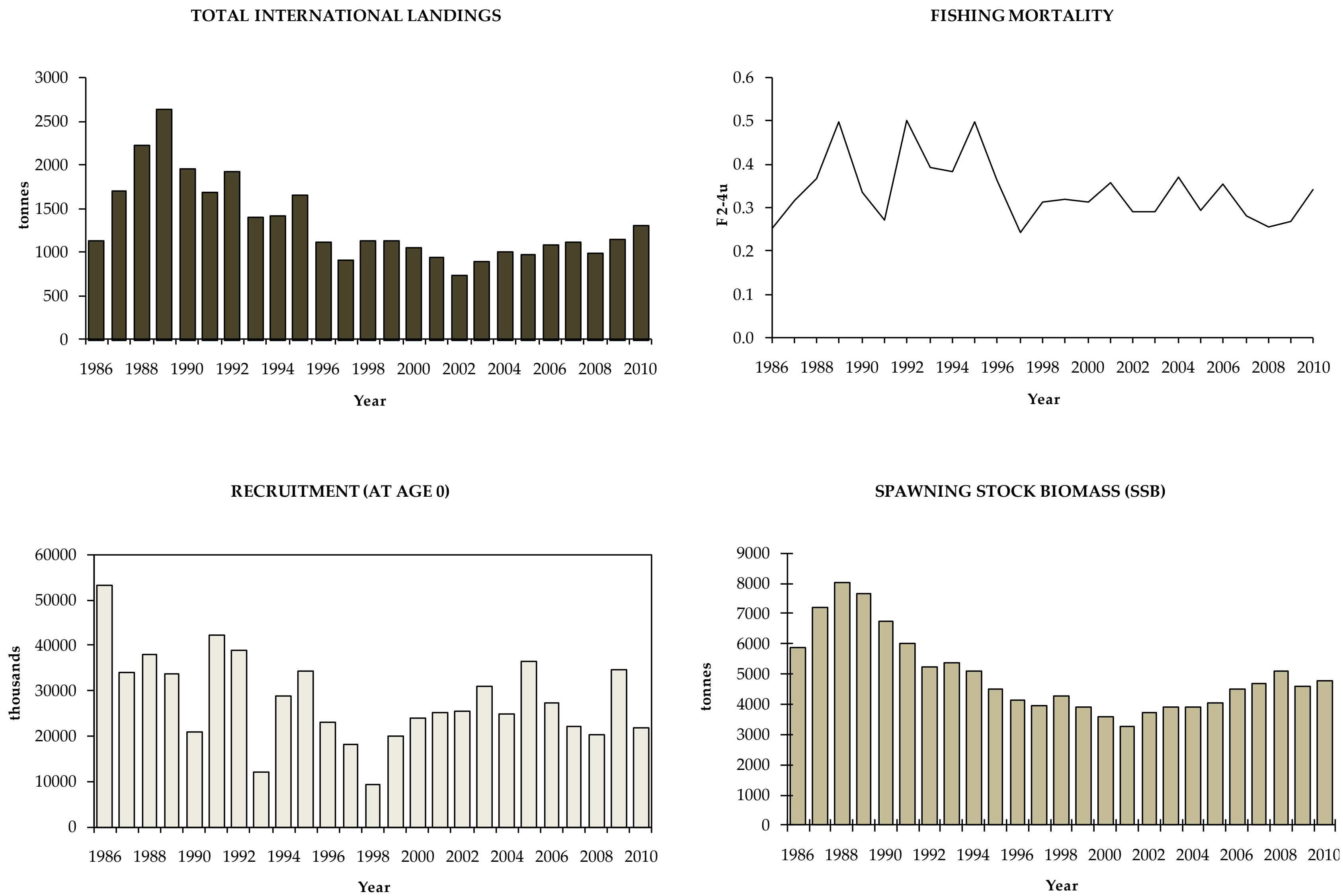
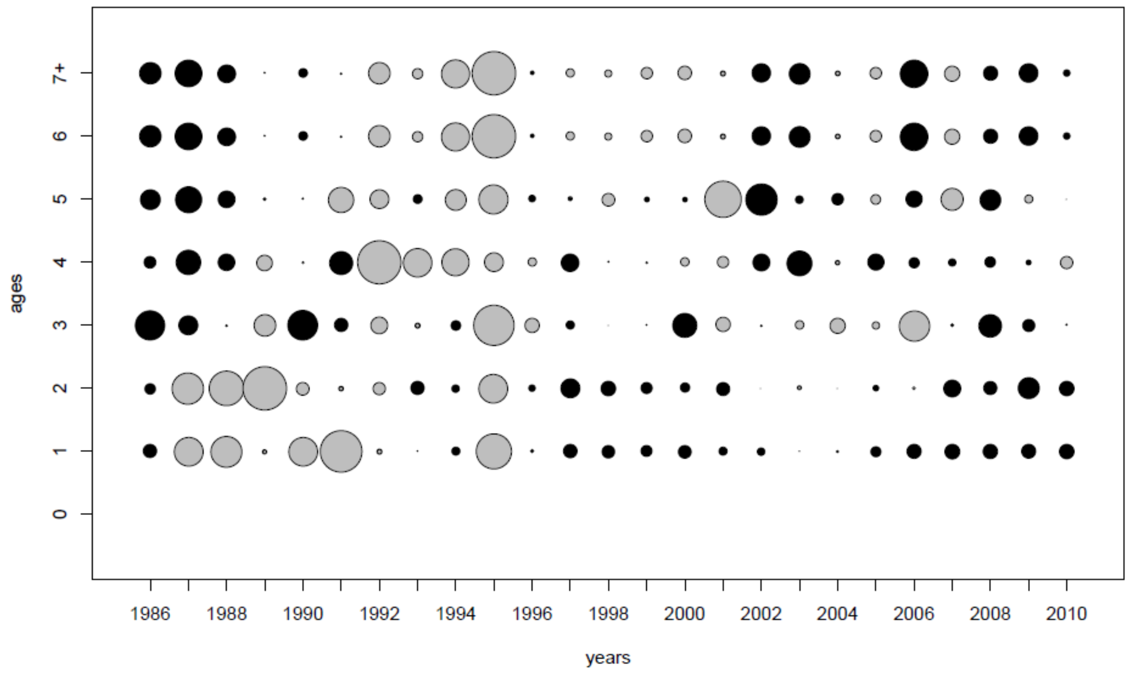


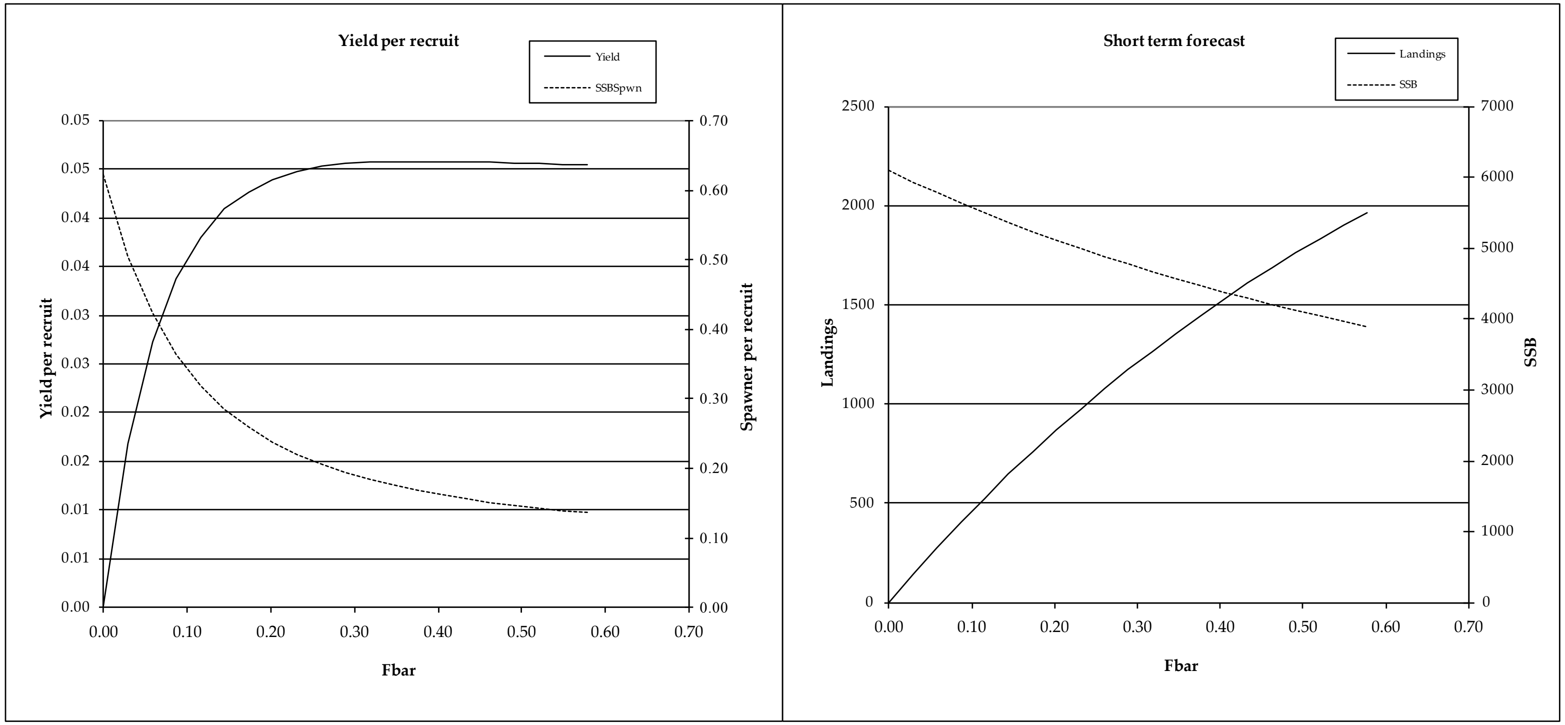

**Figure 9.2.7(a). Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Stock Summary**

**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: 13:02 30/04/2011

| Reference point | F multiplier | Absolute F |
|---|---|---|
| Fbar(2-4) | 1.0000 | 0.2890 |
| FMax | 1.2917 | 0.3733 |
| F0.1 | 0.5128 | 0.1482 |
| F35%SPR | 0.8182 | 0.2365 |
| Flow | 0.4729 | 0.1367 |
| Fmed | 1.1733 | 0.3391 |
| Fhigh | 2.3170 | 0.6697 |

Weights in kilograms

Run: ldb
Four spot megrim (L. boscii) Division VIIIc and IXa

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**

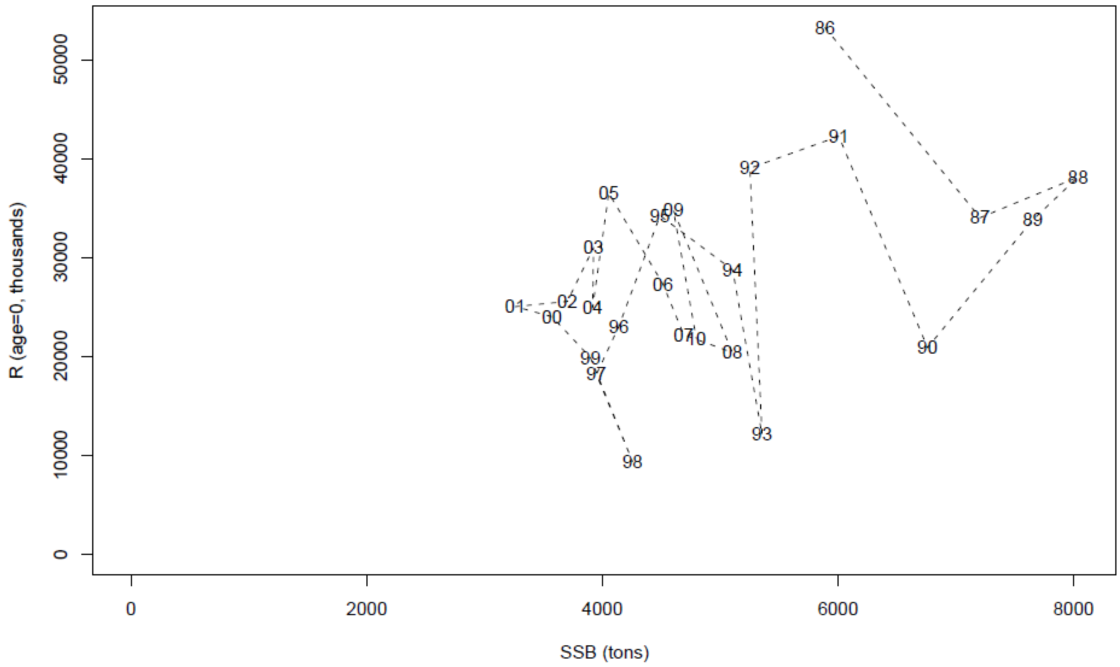



**Figure 9.2.9. Four spot megrim (*L.boscii*) in Divisions VIIIc and IXa. SSB-Recruitment plot.**

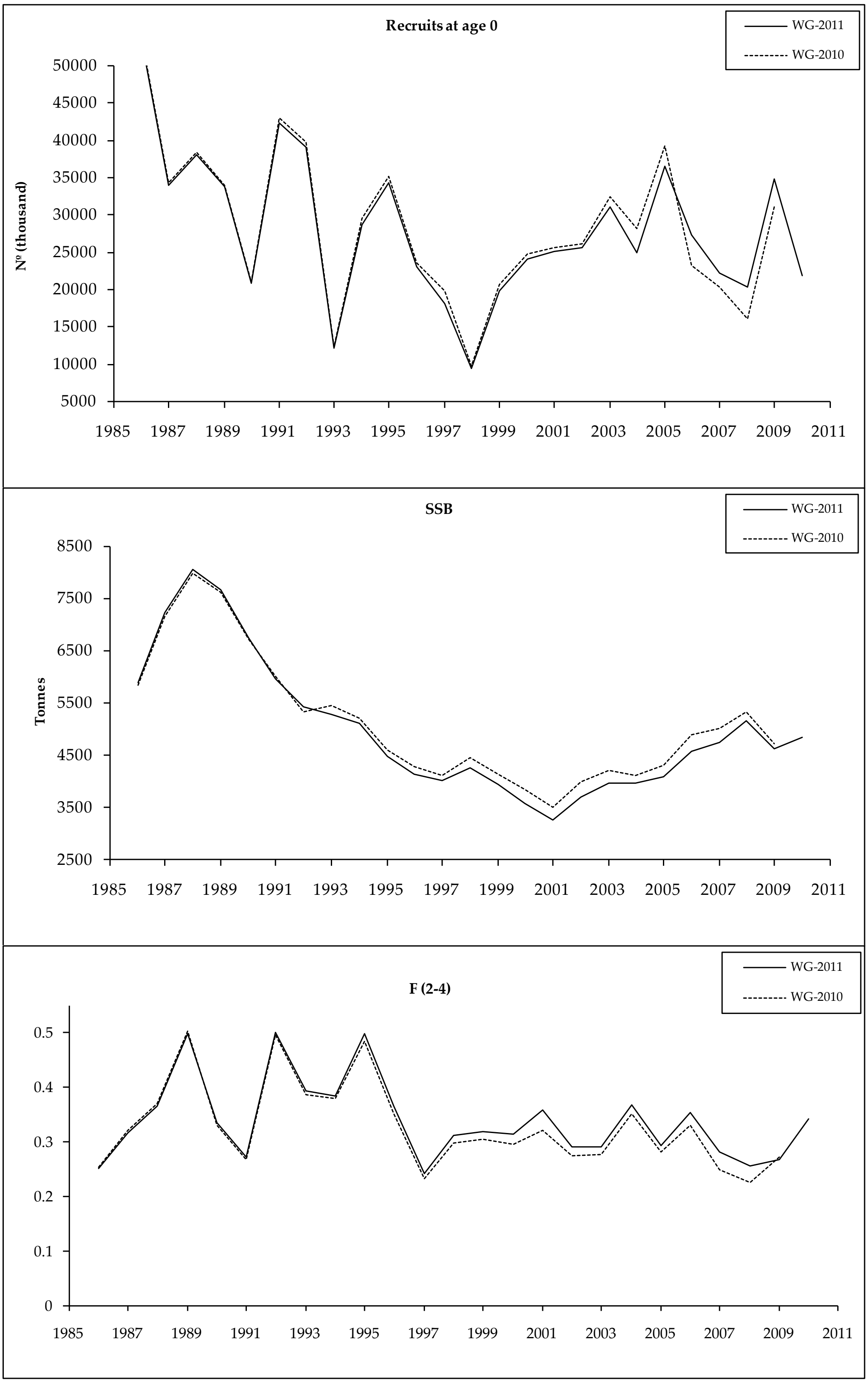



**Figure 9.2.10. Four-spot megrim (*L. boscii*) Recruits, SSB and Fs from WG10 and WG11**

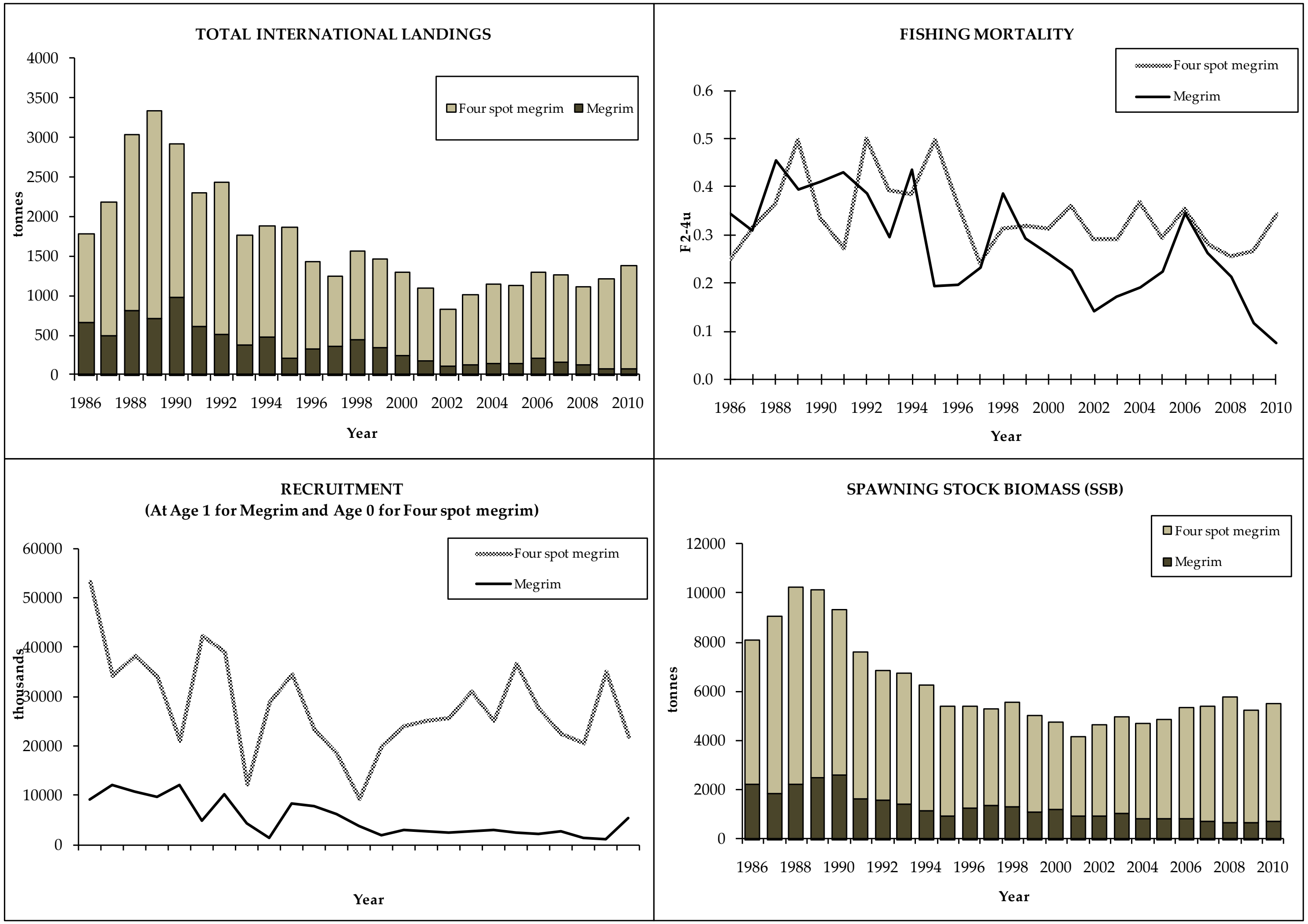



**Figure 9.3.1. Stock trends for both stocks. Megrin and Four-spot megrim in Divisions VIIIc and IXa.**

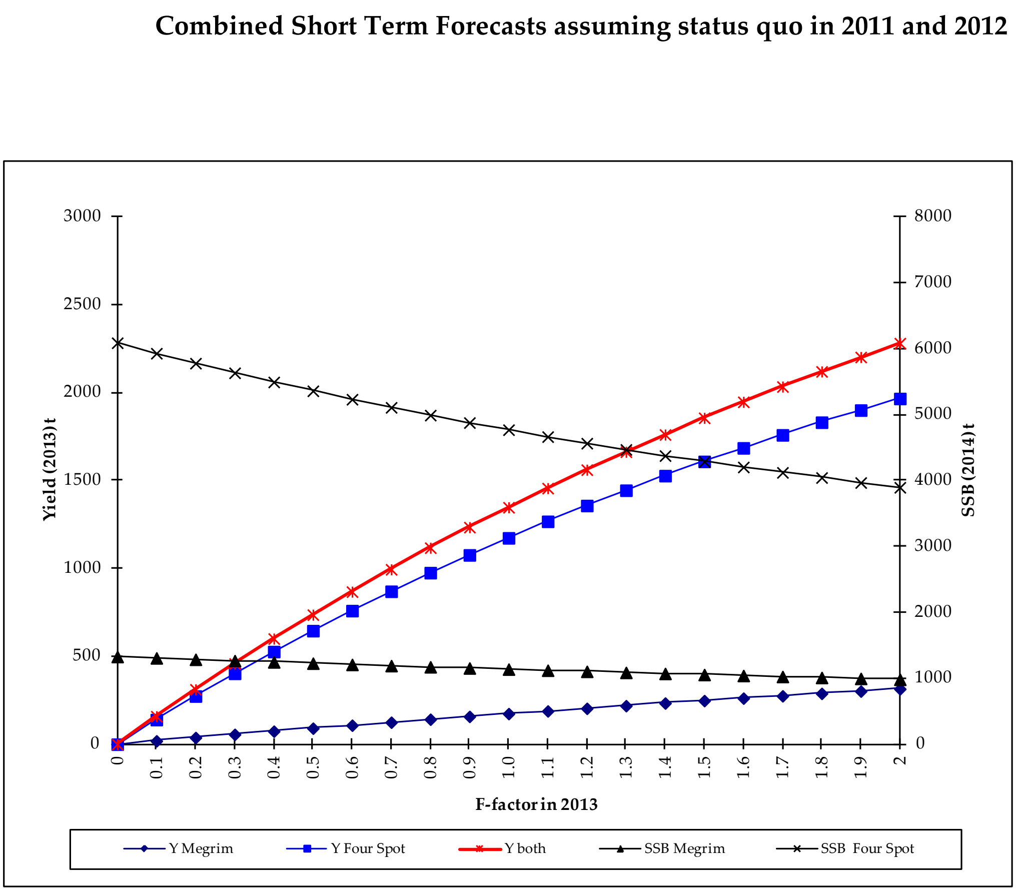



**Figure 9.3.2. Megrims (*L. whiffiagonis and L. boscii*) in Divisions VIIIc and IXa.**

# 10 *Nephrops* (Divisions VIII ab, FU 23-24)

Type of assessment update assessment

*Main changes from the last assessment (WGHMM 2010):*

- *Methodology for discard derivation (probabilistic approach replaced the proportional one).*
- *Scientific times 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 2012

*Exploitation boundaries in relation to precautionary considerations*: The advice given in 2010 for this *Nephrops* stock is biennial and valid for 2011 and 2012 (see ICES, 2010). This year ICES adopts the transition to the MSY approach as basis for advice, which corresponds to reducing catch.

### 10.1.4 Management applicable for 2011 and 2012

| 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 2012 was 3 899 t (the same as for 2011) whereas the ICES recommendation was to reduce catch In 2011, total nominal landings reached 3 560 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 vessels (Districts of South Brittany) chose the increase of the codend mesh size, but the ventral squared panel was also adopted (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 (220 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 1960-2011 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), but slightly decreased compared with previous years (3 173 in 2007, 3 430 t in 2006 and 3 689 t in 2005). In 2010 and 2011, total landings increased (3 398 t and 3 559 t respectively). The 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 1987-2011). 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 early 2000's, but this trend was not confirmed in recent years because of a less typical seasonal fishing profile affecting sex ratio and because of the MLS increase (December 2005) and, moreover, because of the new selectivity regulations (April 2008). For removals, the increasing trend of sex ratio has remained for recent years: the discarded proportion has been higher since the early 2000's mainly after the adoption of larger MLS before the new selectivity regulations. The discard rate has been reduced for the last two years, however it should be induced by lower level of recent recruited year classes

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 1 550 t whereas discard estimates of the recent sampled years (2003-2011) reached a higher level of 2 230 t. This change in the amount of discards could be due to the restriction of individual quotas (notably applied since 2006), the strength of the recent recruitments 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 2011, 122 million individuals were estimated to have been discarded (1 260 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 interdependence 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 (Table 10.3) after conversion of the size composition to an age one. The WGHMM 2012 chose the probabilistic method: 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 (372 trips and 1 140 hauls have been sampled over 9 years). The analytical investigations, estimates and variances, are provided in the Stock Annex. In spite of improvements in agreement between logbook declarations and auction hall sales (89% of landings were cross-validated item by item between sales and logbooks in 2007, but this percentage dropped in 2008 up to 69% and increased for years 2009-2011: 79%, 82% and 90% respectively), the total number of trips is usually not well known and needs to be estimated. 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: in 2011, 21 trips (on 54) and 83 hauls (on 209) are provided from the southern part of the fishery.

The length distribution of landings, discards, catches and removals are presented in Tables 10.4.a-d 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: 2$^{nd}$ 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 for the WGHMM 2012.

#### 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 10.8; Figure 10.4). Effort increased from 1987 to 1992, but there has been a decreasing trend since then. In 2010, the lowest fishing effort for the whole period was observed, but a slight increase occurred in 2011. 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 are reasonably stable, 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 decreased in 2011 (-19%: 15.1 kg/h) even if the value for 2011 remains one of the highest for the time series.

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, amost 100% in the northern part of the fishery) and also the number of vessels using rock-hopper gear. 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 10.9) 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 10.5.

The male and female removal length distributions for the time series 1987-2011 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 10.6 and Figure 10.3.

Removal weights-at-age are averages weighted by numbers-at-age for each sex (Table 10.7).

#### 10.3.1 Model

Analysis carried out during the IBP *Nephrops* 2012 on the basis of the CSA model (Collie-Sissenwine Analysis adapted by Mesnil, 2003) provided not realistic results as regards the relative stability for SSB and F for this stock. Hence, as in previous years, XSA was used by the WG to assess the history of the stock dynamics. A "combined sex" assessment was performed.

**Data screening**

As in WGHMM 2008, 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 10.10). 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 2$^{nd}$ 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 WG 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 2006-2011) has been included for tuning.

The settings used in the final run (Stock Annex) are different from those of past assessments: (1) two tuning fleets were included (commercial GV-Q2 for the period 1987-2011, scientific LANGOLF for the period 2006-2011); (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 10.9.

### 10.3.2 Assessment results

The diagnostics from the final XSA are given in Table 10.11.

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 since the adoption of the probabilistic approach for discard derivation, nevertheless some year effects remain significant. The high residuals for age 1 should suggest to modify the age for recruitment to age 2 as the age group 1 is never reliably observed by any biological sampling but this option was not yet investigated by benchmark..

The retrospective analysis shows a tendency to overestimate SSB and underestimate F in recent years with divergence of retro-calculated values (Figure 10.6). Recruitments are well estimated until 2006, then the pattern is more noisy for the last years even if the overall trend of retrospective curves seems to emphasize a relative downwards trend for recruitment after 2005.

### 10.3.3 Year-class strength and recruitment estimations

- The 2007 year class is now estimated at 565 million.
- The 2008 year class is now estimated at 505 million.

These two recruitments were respectively estimated by the WGHMM 2010 at 516 and 716 million, but under different XSA input (tuning data, discard derivation method, shrinkage for XSA).

- The 2009 and 2010 year classes were estimated to be 528 and 405 million respectively.

| Year class (recruitment at age 1) | Million | Basis |
|---|---|---|
| **2007** | 565 | XSA |
| **2008** | 505 | XSA |
| **2009** | 528 | XSA |
| **2010** | 405 | XSA |

#### 10.3.4 Historic trends in biomass, fishing mortality and recruitment

Tables 10.12 and 10.13 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 10.14 and Figure 10.7.

$F_{bar}$ presented some fluctuations in the beginning of the 90's and a gradual decrease until the middle of 2000's (although $F_{bar}$ increased steeply in 2005-2006 up to 0.64-0.67 maximum level of the recent years) and declined onwards to 0.40 in 2011. The reduction of the fishing effort since 2005 (-17% for the tuning time series; Table 10.8, Figure 10.4) may have been introduced by recent restrictions on the fishing time allowed (prohibition of trawling during week-ends) and on the total and by vessel landings (quarterly and individual quotas imposed by the French producer's organisations).

The average $F_{bar}$ across the reference period (1987-2011) is 0.57.

SSB decreased by 25% in the 90's (from 9 800 t in 1990 to the historical minimum level of 7 360 t in 2000), but since 2000 there has been a gradual increase. There is no significant increasing or decreasing trend for SSB during the whole time series 1987-2009. Recruitment shows a decreasing trend from 1987 (1 294 million) to 1998 (484 million). An increase was observed during the early 2000's with an average (GM) recruitment value of 752 million for the years 2000-2005 which is higher than the average value (655 million) of the overall time series. This is due to the year classes 1999, 2003 and 2004: it is noticeable that the year class 1999 occurred in the stock before the yearly conducted sampling onboard and its positive signal for recruitment was not detected by the previously applied approach for discard derivation.

## 10.4 Catch options and prognosis

Short-term projections and yield per recruit analysis are also presented.

#### 10.4.1 Short-term projections

Input data for the catch predictions are given in Table 10.15.

The exploitation patterns for the projection are based on the unscaled average Fs-at-age in the years 2009-2011 ($F_{2\text{-}5}$=0.44). GM over 1987-2010 (655 million) was used for age 1 from 2012 onwards. Mean weights-at-age for dead discards and landings were taken as the discard and landing averages for 2009-2011 respectively.

Tables 10.16, 10.17 and Figure 10.8 give the short-term yield and SSB forecasts.

Assuming *status quo* F, landings are predicted to remain stable between 2011 and 2012 (from 3 560 t to 3 610 t in 2012), but they should be reduced in 2013 (3 390 t) and grow up in 2014 (3 600 t). SSB is predicted to be equal to 10 710 t in 2012 and to slightly decline in 2013 (10 020 t) and grow up afterwards (10 690 t in 2014). All these values are higher than the long-term arithmetic mean of the time series (8 820 t). The year classes for which recruitments were assumed using GM have marginal contribution in the landings for 2013, but 34% in the SSB for 2014 (Table 10.18).

It should be pointed out that the predicted landings under *status quo* F for 2012 (3 610 t) are lower than the 3 899 t TAC 2012 for FU23-24.

#### 10.4.2 Yield and biomass per recruit analysis

Results of equilibrium landings and SSB/R are given in Table 10.19 and Figure 10.8. In the Y/R curve based on landings only, $F_{max}$ (0.20) is estimated to be at 60% of the reference F. $F_{0.1}$ and $F_{35\%SPR}$ also calculated on landings only are estimated to be 0.13 and 0.16 respectively (38% and 48% of the *status quo* F).

Under the current exploitation pattern, the predicted long-term yield gains upon a reduction of F to $F_{max}$ would be around 9% and SSB per recruit would increase up to 70% whereas a reduction of F to $F_{35\%SPR}$ would produce an increase of Y/R up to 6.5% and of SSB/R of 105%.

### 10.5 Biological reference points

As usually for *Nephrops* stocks in the Bay of Biscay, $F_{max}$ is well defined. Moreover, variations on annual recruitment are weak, thus, mean R is a good proxy over the whole time series. $F_{35\%SPR}$ is a less pertinent proxy for $F_{MSY}$ as there is no evidence of SSB/R relationship and SSB remains stable at intermediate levels during the overall period. $F_{max}$ is proposed as $F_{MSY}$ proxy.

### 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 25). Since 2009, there has been a substantial 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 and should allow better detection of any signal of recruitment strength.

### 10.7 Information from the fishing industry

There were different meetings between the French fishing industry and scientists during the investigations of the IBP *Nephrops* 2012 and prior to the WGHMM 2012. The industry has not provided any additional quantitative information, but they supported information on landings and fishing effort compiled by the WG. The partnership commented on the application of one tuning series involved in the northern part of the fishery and its extrapolation to the southern one. They underlined the heterogeneous feature of the whole area of the stock and encouraged the integration of the scientific independent tuning series provided from the survey LANGOLF which covers the whole Bay of Biscay. Moreover, they emphasized the necessity of applying additional tuning commercial information on the southern part of fishery. The perception of the stock trends by the industry generally reflects the signals given by the data used during the recent assessments of the stock.

### 10.8 Management considerations

It is intended to propose management based on proxy $F_{MSY}$. Recruitment level in the early 2000's (2000, 2004 and 2005) was probably higher than the historical average values, but it remains uncertain and contributes significantly to uncertainty of catches in the short-term.

The impact of the use of selective devices for *Nephrops* since 2008 is not completely obvious. It is currently premature to conclude the effectiveness of the regulation while the new devices are not tested under various recruitment ranges.

The license system in operation since 2004 and the restrictions applied by the Producers' Organisations since 2006 should increase the regulation of inputs by limiting the fishing time.

**Table 10.1. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Estimates of catches (t) by FU for 1960-2011**

| | 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 |

(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 |

**Table 10.3. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Age composition of the Removals according to 2 ways of discard derivation (investigations of IBP Nephrops 2012 - years 1987-2010)**

*in bold: years with sampling onboard*

| Table 1 | Catch numbers at age | | | Numbers*10**-3 | | Proportional derivation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAF | **1987** | 1988 | 1989 | 1990 | **1991** | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | **1998** |
| AGE | | | | | | | | | | | | |
| 1 | **25573** | 28369 | 20440 | 17328 | **10216** | 14817 | 13493 | 9110 | 7988 | 8004 | 8583 | **7670** |
| 2 | **259864** | 295370 | 217967 | 163050 | **133523** | 173781 | 145439 | 107113 | 107827 | 93154 | 110729 | **99003** |
| 3 | **127252** | 129866 | 96257 | 82735 | **102945** | 138382 | 118472 | 99389 | 107835 | 94429 | 99009 | **89911** |
| 4 | **42274** | 48477 | 37800 | 51193 | **46712** | 55403 | 51864 | 44117 | 43904 | 44882 | 42158 | **39688** |
| 5 | **12918** | 15384 | 13177 | 19558 | **17025** | 19611 | 19775 | 12974 | 17060 | 17315 | 11931 | **15353** |
| 6 | **4528** | 5170 | 6298 | 8334 | **7318** | 6818 | 8182 | 4335 | 6222 | 6196 | 4512 | **7294** |
| 7 | **1908** | 2145 | 3141 | 3654 | **2807** | 2646 | 3975 | 2130 | 2469 | 2787 | 1591 | **3862** |
| 8 | **936** | 1068 | 1463 | 1548 | **1324** | 1293 | 1917 | 1003 | 932 | 1019 | 757 | **1914** |
| +gp | **1493** | 1528 | 2948 | 1514 | **1611** | 2042 | 2756 | 1778 | 1497 | 1376 | 800 | **2550** |
| 0 TOTA | **476745** | 527377 | 399490 | 348914 | **323482** | 414794 | 365872 | 281949 | 295733 | 269161 | 280070 | **267245** |
| TONSI | **6634** | 7211 | 5857 | 5868 | **5603** | 6789 | 6093 | 4834 | 5213 | 4822 | 4344 | **4882** |
| SOPC( | 101 | 100 | 101 | 99 | 100 | 99 | 100 | 99 | 99 | 100 | 99 | 100 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAF | 1999 | 2000 | 2001 | 2002 | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| AGE | | | | | | | | | | | | |
| 1 | 6036 | 6458 | 8051 | 9303 | **11262** | **22461** | **36233** | **23117** | **8306** | **3699** | **7000** | **2646** |
| 2 | 77413 | 82164 | 111944 | 115574 | **111159** | **126755** | **174554** | **258625** | **87844** | **99973** | **88777** | **55131** |
| 3 | 74298 | 73448 | 95922 | 118923 | **106678** | **91306** | **123868** | **122494** | **102757** | **84444** | **87616** | **90439** |
| 4 | 35997 | 35006 | 37879 | 38594 | **46787** | **39032** | **39169** | **40547** | **44633** | **40961** | **40786** | **45967** |
| 5 | 15463 | 13786 | 15550 | 10841 | **17689** | **17075** | **14221** | **13085** | **13150** | **14108** | **12696** | **14320** |
| 6 | 5392 | 5291 | 6545 | 4100 | **5841** | **6834** | **6416** | **5286** | **5302** | **5836** | **4830** | **4877** |
| 7 | 2665 | 2306 | 2900 | 1400 | **2444** | **2986** | **2723** | **2769** | **2444** | **2221** | **1859** | **1870** |
| 8 | 1266 | 1192 | 1824 | 953 | **1368** | **1365** | **1329** | **1491** | **1241** | **1245** | **907** | **951** |
| +gp | 1621 | 1470 | 1636 | 993 | **1832** | **2063** | **1987** | **2466** | **1948** | **1410** | **1169** | **1389** |
| 0 TOTA | 220150 | 221121 | 282251 | 300679 | **305060** | **309877** | **400499** | **469879** | **267624** | **253896** | **245640** | **217590** |
| TONSI | 4033 | 3918 | 4788 | 4831 | **5270** | **4923** | **5880** | **6627** | **4864** | **4517** | **4270** | **4290** |
| SOPC( | 101 | 100 | 101 | 101 | 99 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 | | | | | | | | | | | | |

| Table 1 | Catch numbers at age | | | Numbers*10**-3 | | Probabilistic derivation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAF | **1987** | 1988 | 1989 | 1990 | **1991** | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | **1998** |
| AGE | | | | | | | | | | | | |
| 1 | **25573** | 88445 | 21713 | 211 | **10216** | 20512 | 10918 | 6961 | 7844 | 3844 | 17607 | **7670** |
| 2 | **259864** | 512688 | 344604 | 99768 | **133523** | 149786 | 110252 | 78001 | 73728 | 49190 | 82857 | **99003** |
| 3 | **127252** | 130442 | 96674 | 82961 | **102945** | 138297 | 118115 | 99427 | 108049 | 94113 | 99966 | **89911** |
| 4 | **42274** | 48505 | 37816 | 51213 | **46712** | 55336 | 51804 | 44057 | 43834 | 44866 | 42169 | **39688** |
| 5 | **12918** | 15385 | 13178 | 19558 | **17025** | 19606 | 19775 | 12973 | 17063 | 17325 | 11927 | **15353** |
| 6 | **4528** | 5170 | 6298 | 8334 | **7318** | 6820 | 8184 | 4337 | 6224 | 6198 | 4514 | **7294** |
| 7 | **1908** | 2145 | 3141 | 3654 | **2807** | 2647 | 3975 | 2130 | 2469 | 2787 | 1592 | **3862** |
| 8 | **936** | 1068 | 1463 | 1548 | **1324** | 1293 | 1917 | 1003 | 932 | 1019 | 757 | **1914** |
| +gp | **1493** | 1528 | 2948 | 1514 | **1611** | 2042 | 2756 | 1778 | 1497 | 1376 | 800 | **2550** |
| 0 TOTA | **476745** | 805376 | 527834 | 268762 | **323482** | 396340 | 327696 | 250666 | 261640 | 220716 | 262190 | **267245** |
| TONSI | **6634** | 8760 | 6679 | 5411 | **5603** | 6628 | 5814 | 4610 | 4947 | 4465 | 4173 | **4882** |
| SOPC( | 101 | 102 | 100 | 100 | 100 | 99 | 100 | 100 | 100 | 101 | 101 | 100 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAF | 1999 | 2000 | 2001 | 2002 | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| AGE | | | | | | | | | | | | |
| 1 | 5982 | 10127 | 27929 | 39737 | **11262** | **22461** | **36233** | **23117** | **8306** | **3699** | **7000** | **2646** |
| 2 | 80238 | 106636 | 197366 | 192207 | **111159** | **126755** | **174554** | **258625** | **87844** | **99973** | **88777** | **55131** |
| 3 | 73105 | 72251 | 95812 | 122382 | **106678** | **91306** | **123868** | **122494** | **102757** | **84444** | **87616** | **90439** |
| 4 | 35750 | 34911 | 37510 | 38490 | **46787** | **39032** | **39169** | **40547** | **44633** | **40961** | **40786** | **45967** |
| 5 | 15253 | 13588 | 15264 | 10558 | **17689** | **17075** | **14221** | **13085** | **13150** | **14108** | **12696** | **14320** |
| 6 | 5328 | 5232 | 6460 | 4023 | **5841** | **6834** | **6416** | **5286** | **5302** | **5836** | **4830** | **4877** |
| 7 | 2667 | 2307 | 2901 | 1401 | **2444** | **2986** | **2723** | **2769** | **2444** | **2221** | **1859** | **1870** |
| 8 | 1266 | 1192 | 1825 | 953 | **1368** | **1365** | **1329** | **1491** | **1241** | **1245** | **907** | **951** |
| +gp | 1621 | 1470 | 1636 | 993 | **1832** | **2063** | **1987** | **2466** | **1948** | **1410** | **1169** | **1389** |
| 0 TOTA | 221208 | 247714 | 386702 | 410743 | **305060** | **309877** | **400499** | **469879** | **267624** | **253896** | **245640** | **217590** |
| TONSI | 4013 | 4087 | 5506 | 5513 | **5270** | **4923** | **5880** | **6627** | **4864** | **4517** | **4270** | **4290** |
| SOPC( | 101 | 100 | 99 | 100 | 99 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 | | | | | | | | | | | | |

Table 10.4.a Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 1987-2011

Tab_10_4_Length_Dist.xls

| Landings<br>CL mm/Y | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 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 |
| 11 | 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 |
| 12 | 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 |
| 13 | 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 |
| 14 | 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 |
| 15 | 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 |
| 16 | 0 | 158 | 59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 149 | 230 | 77 | 12 | 35 | 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 331 | 553 | 131 | 64 | 30 | 0 | 0 | 31 | 20 | 0 | 0 | 0 | 0 | 14 | 13 | 0 | 14 | 0 | 25 | 5 | 4 | 12 | 0 | 0 | 0 |
| 19 | 1296 | 1886 | 901 | 48 | 79 | 138 | 0 | 72 | 61 | 0 | 0 | 0 | 0 | 11 | 38 | 0 | 0 | 14 | 27 | 0 | 0 | 0 | 0 | 0 | 1 |
| 20 | 3129 | 4227 | 2791 | 529 | 474 | 450 | 464 | 206 | 341 | 48 | 448 | 25 | 72 | 116 | 284 | 107 | 87 | 47 | 82 | 5 | 4 | 77 | 37 | 14 | 22 |
| 21 | 6476 | 8882 | 7039 | 1947 | 1572 | 1595 | 1285 | 482 | 1573 | 414 | 1313 | 288 | 219 | 433 | 643 | 925 | 280 | 249 | 270 | 70 | 14 | 191 | 73 | 75 | 6 |
| 22 | 13501 | 16050 | 12971 | 5913 | 4733 | 3948 | 3878 | 2824 | 2395 | 1311 | 2799 | 985 | 849 | 1015 | 2116 | 1122 | 661 | 899 | 771 | 131 | 18 | 208 | 288 | 252 | 11 |
| 23 | 21337 | 25374 | 18073 | 10910 | 7854 | 9701 | 7398 | 5366 | 5523 | 2799 | 4638 | 3171 | 1888 | 2531 | 6261 | 5513 | 1614 | 2194 | 2588 | 227 | 48 | 322 | 473 | 386 | 111 |
| 24 | 24339 | 33950 | 21960 | 13293 | 15521 | 20948 | 11949 | 9650 | 8731 | 6071 | 10005 | 6484 | 4032 | 5462 | 8915 | 10061 | 3966 | 5664 | 6511 | 822 | 188 | 721 | 1929 | 1238 | 515 |
| 25 | 32476 | 36294 | 25650 | 16440 | 19747 | 27876 | 21011 | 15079 | 14348 | 13239 | 19837 | 13980 | 10717 | 11357 | 17106 | 12951 | 8164 | 10930 | 13678 | 2844 | 1201 | 2742 | 3670 | 3940 | 1803 |
| 26 | 29670 | 29808 | 22747 | 18205 | 22106 | 26617 | 23732 | 18312 | 19769 | 16779 | 19380 | 13535 | 10590 | 10212 | 13745 | 21403 | 13297 | 13998 | 17811 | 6376 | 5684 | 6319 | 8258 | 8499 | 4773 |
| 27 | 28086 | 28380 | 22091 | 16109 | 21900 | 28410 | 26044 | 21181 | 25126 | 18384 | 22823 | 16602 | 12724 | 11528 | 17098 | 19433 | 17614 | 16094 | 22006 | 12010 | 9439 | 10891 | 12759 | 14173 | 7520 |
| 28 | 24925 | 26017 | 19087 | 19595 | 21214 | 32091 | 27580 | 20488 | 20914 | 15744 | 19466 | 14432 | 12058 | 12639 | 15835 | 22074 | 18572 | 15350 | 21879 | 14647 | 13248 | 12640 | 15732 | 15390 | 8991 |
| 29 | 18703 | 20920 | 14227 | 16250 | 17138 | 24760 | 20627 | 16527 | 15909 | 16332 | 20878 | 11832 | 9448 | 11473 | 13779 | 16559 | 16843 | 14808 | 18027 | 14591 | 12516 | 12890 | 13524 | 15340 | 9602 |
| 30 | 18407 | 17862 | 13688 | 12055 | 14762 | 19828 | 21414 | 15903 | 19164 | 20214 | 21487 | 16335 | 16187 | 13888 | 16168 | 18105 | 17264 | 14143 | 15570 | 13690 | 12219 | 10726 | 13271 | 15736 | 8821 |
| 31 | 11419 | 13156 | 9037 | 11088 | 12408 | 14281 | 13452 | 11207 | 13333 | 14009 | 9791 | 8539 | 9209 | 9828 | 11316 | 9989 | 13345 | 12353 | 12634 | 11814 | 10698 | 9772 | 10859 | 12749 | 8253 |
| 32 | 10185 | 12822 | 8410 | 8540 | 8635 | 12786 | 12711 | 11490 | 13667 | 14392 | 9622 | 9237 | 9745 | 8936 | 11335 | 10284 | 11276 | 10322 | 9907 | 9694 | 9274 | 8845 | 9310 | 11366 | 6954 |
| 33 | 8528 | 8848 | 7127 | 10649 | 7273 | 9297 | 11369 | 7022 | 7117 | 8576 | 6334 | 5947 | 6000 | 6333 | 8250 | 7813 | 8253 | 8020 | 7800 | 8421 | 7859 | 7436 | 7086 | 8851 | 6175 |
| 34 | 5926 | 7812 | 6967 | 10543 | 7987 | 7318 | 7355 | 6684 | 7584 | 6524 | 4816 | 6619 | 5910 | 5225 | 6185 | 5308 | 6195 | 6298 | 6537 | 7112 | 6539 | 6425 | 5985 | 7140 | 5467 |
| 35 | 5763 | 5935 | 6214 | 7637 | 5425 | 5928 | 6307 | 5646 | 4677 | 6578 | 4737 | 6700 | 5267 | 4895 | 5213 | 4309 | 4653 | 4673 | 5100 | 5135 | 6529 | 5366 | 4568 | 5852 | 4541 |
| 36 | 4033 | 5064 | 4532 | 6274 | 4979 | 4998 | 4608 | 4337 | 3709 | 4133 | 2568 | 5308 | 4291 | 3242 | 4037 | 3157 | 3818 | 3308 | 3369 | 4104 | 4735 | 3867 | 3697 | 3626 | 4260 |
| 37 | 4024 | 3754 | 3545 | 4841 | 4541 | 4195 | 4089 | 3752 | 3496 | 4226 | 2135 | 4722 | 3230 | 2946 | 2901 | 2049 | 3075 | 2875 | 2597 | 3196 | 3839 | 3121 | 2565 | 3024 | 3648 |
| 38 | 3131 | 3106 | 3193 | 4966 | 2993 | 3933 | 2991 | 2771 | 2879 | 2788 | 1142 | 3527 | 2588 | 2687 | 2369 | 2224 | 2660 | 2098 | 2380 | 2662 | 2639 | 2398 | 1871 | 2247 | 3911 |
| 39 | 2151 | 2778 | 2154 | 3339 | 2869 | 2987 | 2290 | 1841 | 1746 | 1596 | 927 | 2169 | 2186 | 2027 | 2297 | 1559 | 2174 | 1683 | 1650 | 1956 | 2245 | 2043 | 1491 | 1630 | 3472 |
| 40 | 2425 | 2159 | 2175 | 2766 | 2414 | 2574 | 2206 | 1738 | 2015 | 1956 | 982 | 3084 | 2353 | 1862 | 1908 | 1398 | 1936 | 1555 | 1628 | 1599 | 1711 | 1633 | 1190 | 1280 | 3296 |
| 41 | 1375 | 1753 | 1461 | 1951 | 2076 | 1546 | 1452 | 1150 | 1123 | 1250 | 520 | 1558 | 1362 | 1020 | 941 | 764 | 1423 | 1188 | 1154 | 1171 | 1227 | 1190 | 878 | 966 | 2740 |
| 42 | 1350 | 1542 | 1130 | 1668 | 1662 | 1599 | 1111 | 1118 | 1558 | 1142 | 508 | 1490 | 1124 | 797 | 863 | 632 | 1403 | 889 | 953 | 990 | 1111 | 1015 | 742 | 742 | 2497 |
| 43 | 1150 | 1209 | 1087 | 1908 | 1495 | 1348 | 1069 | 687 | 1039 | 610 | 370 | 1049 | 761 | 534 | 530 | 640 | 1054 | 774 | 842 | 741 | 710 | 805 | 540 | 560 | 2157 |
| 44 | 965 | 704 | 1192 | 1401 | 1089 | 1050 | 745 | 500 | 915 | 414 | 219 | 748 | 708 | 413 | 383 | 432 | 810 | 707 | 640 | 633 | 746 | 706 | 473 | 509 | 1762 |
| 45 | 641 | 581 | 1194 | 955 | 1058 | 766 | 684 | 550 | 700 | 464 | 253 | 902 | 429 | 421 | 523 | 416 | 808 | 613 | 605 | 595 | 518 | 536 | 396 | 442 | 1177 |
| 46 | 645 | 689 | 669 | 713 | 666 | 734 | 584 | 353 | 460 | 374 | 135 | 525 | 424 | 248 | 294 | 328 | 535 | 485 | 415 | 479 | 373 | 405 | 307 | 305 | 1024 |
| 47 | 509 | 391 | 641 | 715 | 431 | 567 | 417 | 407 | 437 | 397 | 140 | 327 | 276 | 213 | 368 | 241 | 456 | 388 | 353 | 440 | 311 | 361 | 262 | 290 | 858 |
| 48 | 343 | 333 | 526 | 863 | 636 | 588 | 456 | 270 | 494 | 264 | 92 | 382 | 104 | 205 | 188 | 188 | 339 | 313 | 339 | 382 | 257 | 294 | 245 | 237 | 656 |
| 49 | 290 | 254 | 378 | 470 | 377 | 263 | 145 | 178 | 254 | 205 | 57 | 132 | 151 | 177 | 183 | 79 | 206 | 318 | 288 | 319 | 237 | 262 | 196 | 204 | 557 |
| 50 | 319 | 216 | 351 | 230 | 263 | 256 | 238 | 273 | 255 | 179 | 76 | 154 | 159 | 154 | 160 | 115 | 253 | 306 | 276 | 287 | 190 | 228 | 156 | 160 | 501 |
| 51 | 135 | 241 | 240 | 181 | 210 | 107 | 126 | 156 | 214 | 123 | 38 | 191 | 58 | 109 | 135 | 73 | 170 | 214 | 176 | 246 | 163 | 201 | 115 | 135 | 383 |
| 52 | 192 | 48 | 180 | 335 | 180 | 159 | 202 | 107 | 175 | 77 | 30 | 115 | 93 | 85 | 102 | 46 | 150 | 152 | 184 | 201 | 138 | 116 | 110 | 120 | 296 |
| 53 | 137 | 70 | 150 | 121 | 124 | 111 | 55 | 136 | 91 | 84 | 26 | 156 | 23 | 133 | 82 | 51 | 120 | 111 | 142 | 137 | 140 | 121 | 98 | 97 | 198 |
| 54 | 111 | 112 | 218 | 99 | 189 | 94 | 120 | 77 | 55 | 75 | 11 | 93 | 11 | 63 | 40 | 20 | 80 | 90 | 104 | 156 | 115 | 95 | 63 | 95 | 271 |
| 55 | 76 | 85 | 187 | 53 | 63 | 61 | 128 | 66 | 91 | 53 | 9 | 114 | 16 | 75 | 53 | 30 | 57 | 47 | 109 | 137 | 79 | 73 | 75 | 79 | 152 |
| 56 | 111 | 41 | 123 | 26 | 28 | 66 | 50 | 49 | 47 | 62 | 12 | 7 | 5 | 18 | 24 | 13 | 23 | 86 | 69 | 117 | 60 | 67 | 54 | 75 | 132 |
| 57 | 74 | 39 | 116 | 43 | 34 | 61 | 72 | 36 | 77 | 48 | 8 | 31 | 14 | 20 | 46 | 6 | 47 | 49 | 58 | 134 | 70 | 41 | 31 | 67 | 98 |
| 58 | 39 | 65 | 70 | 2 | 11 | 68 | 58 | 47 | 88 | 48 | 9 | 14 | 5 | 16 | 29 | 6 | 22 | 27 | 43 | 134 | 45 | 40 | 48 | 47 | 105 |
| 59 | 32 | 60 | 36 | 13 | 17 | 28 | 13 | 31 | 36 | 30 | 8 | 10 | 2 | 7 | 26 | 3 | 10 | 32 | 41 | 85 | 33 | 19 | 23 | 48 | 79 |
| 60 | 21 | 7 | 30 | 5 | 24 | 7 | 54 | 26 | 32 | 9 | 5 | 8 | 4 | 2 | 21 | 11 | 8 | 10 | 19 | 115 | 33 | 23 | 14 | 42 | 48 |
| 61 | 21 | 15 | 15 | 4 | 11 | 0 | 25 | 12 | 4 | 4 | 0 | 0 | 3 | 8 | 7 | 0 | 5 | 5 | 28 | 40 | 23 | 7 | 8 | 30 | 39 |
| 62 | 0 | 0 | 21 | 10 | 0 | 44 | 3 | 8 | 0 | 9 | 1 | 10 | 0 | 1 | 2 | 0 | 4 | 3 | 16 | 21 | 9 | 9 | 9 | 16 | 55 |
| 63 | 19 | 13 | 10 | 0 | 3 | 28 | 0 | 5 | 20 | 4 | 5 | 4 | 0 | 0 | 5 | 1 | 1 | 5 | 9 | 19 | 9 | 7 | 10 | 7 | 23 |
| 64 | 0 | 7 | 0 | 0 | 0 | 14 | 7 | 10 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 8 | 8 | 18 | 10 | 6 | 3 | 16 | 12 |
| 65 | 8 | 0 | 4 | 0 | 0 | 0 | 30 | 16 | 4 | 0 | 0 | 4 | 2 | 1 | 0 | 1 | 0 | 1 | 14 | 11 | 9 | 1 | 3 | 9 | 11 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 20 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 6 | 10 | 1 | 0 | 2 | 3 | 11 |
| 67 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 8 | 1 | 0 | 2 | 3 | 6 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | 4 | 7 | 3 | 0 | 0 | 4 | 7 |
| 69 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 6 | 2 | 0 | 1 | 1 | 2 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 1 | 2 |
| 71 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 5 | 0 | 0 | 0 | 1 | 1 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 |
| 73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 |
| 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 |
| Total | 288974 | 324498 | 244875 | 213779 | 217338 | 274286 | 240638 | 188879 | 202294 | 182041 | 188694 | 161549 | 135304 | 133383 | 172819 | 180442 | 163771 | 154405 | 179758 | 128777 | 117273 | 115274 | 123504 | 138120 | 108011 |
| Weights | 5397 | 5875 | 4835 | 4972 | 4754 | 5681 | 5109 | 4092 | 4452 | 4118 | 3610 | 3865 | 3209 | 3069 | 3730 | 3679 | 3886 | 3571 | 3991 | 3447 | 3176 | 3030 | 2987 | 3398 | 3559 |

Table 10.4.b Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 1987-2011.

Tab_10_4_Length_Dist.xls

Total Discards

| CL mm/Y | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0 | 1318 | 75 | 0 | 0 | 546 | 199 | 134 | 185 | 82 | 1325 | 0 | 93 | 186 | 950 | 1268 | 28 | 0 | 0 | 0 | 22 | 0 | 82 | 0 | 0 |
| 11 | 0 | 2152 | 152 | 0 | 114 | 807 | 313 | 208 | 279 | 125 | 1611 | 85 | 150 | 291 | 1341 | 1817 | 0 | 0 | 94 | 0 | 171 | 38 | 135 | 2 | 0 |
| 12 | 0 | 3508 | 308 | 0 | 0 | 1190 | 491 | 323 | 419 | 191 | 1952 | 128 | 240 | 455 | 1890 | 2597 | 70 | 363 | 413 | 70 | 202 | 98 | 79 | 0 | 237 |
| 13 | 0 | 5695 | 624 | 1 | 93 | 1749 | 768 | 501 | 627 | 291 | 2354 | 162 | 384 | 710 | 2654 | 3696 | 294 | 1722 | 1085 | 234 | 122 | 235 | 177 | 97 | 596 |
| 14 | 78 | 9194 | 1261 | 2 | 258 | 2556 | 1198 | 774 | 936 | 441 | 2823 | 660 | 613 | 1104 | 3713 | 5233 | 636 | 3152 | 3190 | 1138 | 900 | 389 | 291 | 83 | 834 |
| 15 | 2074 | 14706 | 2539 | 7 | 1249 | 3708 | 1858 | 1189 | 1388 | 666 | 3364 | 1741 | 977 | 1710 | 5164 | 7354 | 1198 | 5548 | 7287 | 3102 | 1288 | 189 | 1157 | 155 | 941 |
| 16 | 3974 | 23183 | 5074 | 22 | 2240 | 5320 | 2854 | 1811 | 2040 | 999 | 3980 | 1861 | 1548 | 2631 | 7126 | 10227 | 3386 | 6784 | 13528 | 7810 | 2959 | 1027 | 2315 | 822 | 1230 |
| 17 | 13577 | 35760 | 9995 | 71 | 4638 | 7521 | 4326 | 2727 | 2961 | 1484 | 4671 | 3527 | 2433 | 4008 | 9732 | 14027 | 5927 | 8836 | 15094 | 11655 | 3636 | 1832 | 3059 | 1333 | 2430 |
| 18 | 29288 | 53448 | 19148 | 235 | 10619 | 10421 | 6429 | 4034 | 4221 | 2171 | 5432 | 5003 | 3776 | 6016 | 13110 | 18895 | 8078 | 10161 | 19795 | 16139 | 4590 | 2626 | 4843 | 2309 | 3630 |
| 19 | 28370 | 76547 | 34910 | 766 | 12852 | 14070 | 9295 | 5825 | 5877 | 3114 | 6254 | 5991 | 5753 | 8843 | 17354 | 24883 | 11506 | 17361 | 19522 | 25891 | 5244 | 6473 | 6485 | 3532 | 4546 |
| 20 | 60253 | 230038 | 153497 | 2426 | 22797 | 18408 | 12961 | 8143 | 7938 | 4347 | 7125 | 12091 | 8534 | 12628 | 22483 | 31890 | 12142 | 19250 | 22265 | 39742 | 8735 | 11444 | 12766 | 5692 | 7227 |
| 21 | 45446 | 129602 | 100993 | 31048 | 18043 | 23225 | 17283 | 10932 | 10337 | 5862 | 8028 | 9973 | 12205 | 17372 | 28397 | 39629 | 18597 | 25898 | 32409 | 54220 | 11585 | 15630 | 16772 | 7699 | 10393 |
| 22 | 51268 | 61144 | 47652 | 26066 | 24289 | 17350 | 17709 | 13186 | 9925 | 7591 | 14964 | 23278 | 16667 | 25140 | 49505 | 24662 | 21416 | 25210 | 35523 | 69870 | 17930 | 24730 | 18701 | 11689 | 15161 |
| 23 | 23074 | 25627 | 17991 | 11687 | 15611 | 20991 | 15746 | 11862 | 12053 | 6558 | 10661 | 21641 | 17635 | 22623 | 54819 | 48438 | 28429 | 26756 | 40041 | 70094 | 24086 | 27560 | 21693 | 13672 | 13837 |
| 24 | 7213 | 10004 | 6496 | 3836 | 13741 | 20860 | 12123 | 10225 | 9074 | 6765 | 10758 | 19750 | 15698 | 21146 | 34491 | 39179 | 26501 | 21343 | 36279 | 55408 | 30615 | 29638 | 24105 | 16963 | 15551 |
| 25 | 2686 | 3535 | 2479 | 1516 | 14722 | 13478 | 10054 | 7645 | 7037 | 6720 | 10252 | 20487 | 18666 | 20177 | 30416 | 22841 | 23211 | 20085 | 30222 | 52660 | 32917 | 28007 | 20736 | 14670 | 16545 |
| 26 | 672 | 1008 | 694 | 570 | 7131 | 6137 | 5513 | 4390 | 4741 | 4030 | 4720 | 10676 | 8465 | 8496 | 11137 | 17386 | 17357 | 12006 | 19003 | 38812 | 27376 | 23127 | 14205 | 11852 | 10047 |
| 27 | 270 | 335 | 240 | 181 | 1711 | 3200 | 2863 | 2452 | 2817 | 2088 | 2639 | 7502 | 4774 | 4780 | 6340 | 8069 | 9680 | 6436 | 8498 | 20124 | 20567 | 10129 | 9188 | 8558 | 8127 |
| 28 | 0 | 117 | 70 | 78 | 999 | 1759 | 1449 | 1143 | 1117 | 874 | 1096 | 3019 | 2202 | 2630 | 2658 | 4129 | 6187 | 3487 | 4603 | 10263 | 10365 | 5893 | 5927 | 5986 | 3201 |
| 29 | 0 | 32 | 20 | 25 | 138 | 654 | 517 | 434 | 415 | 431 | 584 | 1357 | 813 | 1245 | 1183 | 1494 | 2537 | 2115 | 1201 | 4188 | 4464 | 3225 | 3163 | 3360 | 2086 |
| 30 | 0 | 10 | 7 | 7 | 291 | 256 | 268 | 208 | 249 | 263 | 287 | 686 | 695 | 679 | 665 | 876 | 1605 | 1901 | 1600 | 2578 | 2868 | 1923 | 3261 | 1876 | 2011 |
| 31 | 0 | 3 | 2 | 2 | 97 | 94 | 84 | 69 | 84 | 89 | 64 | 129 | 208 | 273 | 226 | 214 | 1326 | 1115 | 1417 | 1109 | 1316 | 925 | 1824 | 1274 | 1246 |
| 32 | 0 | 1 | 1 | 1 | 0 | 39 | 40 | 34 | 42 | 45 | 30 | 481 | 115 | 112 | 114 | 119 | 574 | 735 | 526 | 592 | 737 | 454 | 839 | 716 | 492 |
| 33 | 0 | 0 | 0 | 0 | 0 | 14 | 18 | 11 | 11 | 13 | 10 | 231 | 38 | 40 | 47 | 44 | 313 | 503 | 296 | 544 | 484 | 421 | 671 | 350 | 265 |
| 34 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 5 | 6 | 5 | 4 | 151 | 20 | 17 | 20 | 21 | 261 | 385 | 553 | 411 | 537 | 1025 | 830 | 274 | 272 |
| 35 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 | 2 | 2 | 88 | 10 | 8 | 7 | 7 | 176 | 424 | 260 | 230 | 265 | 206 | 332 | 242 | 174 |
| 36 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 48 | 5 | 3 | 4 | 4 | 113 | 108 | 46 | 73 | 336 | 78 | 197 | 55 | 59 |
| 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 74 | 2 | 2 | 1 | 1 | 83 | 74 | 246 | 25 | 299 | 153 | 188 | 162 | 149 |
| 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 | 1 | 1 | 1 | 1 | 93 | 31 | 116 | 99 | 40 | 93 | 269 | 16 | 97 |
| 39 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36 | 0 | 0 | 1 | 0 | 15 | 139 | 147 | 0 | 3 | 369 | 55 | 33 | 24 |
| 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57 | 0 | 0 | 0 | 0 | 37 | 73 | 37 | 169 | 47 | 0 | 66 | 38 | 25 |
| 41 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 | 60 | 20 | 0 | 40 | 0 | 8 | 4 | 0 |
| 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 12 | 31 | 0 | 20 | 53 | 0 | 4 | 157 |
| 43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 14 | 13 | 0 | 0 | 11 | 0 | 38 | 0 | 4 |
| 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 14 | 6 | 0 |
| 45 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 36 | 0 | 0 | 0 | 0 | 5 |
| 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 |
| 47 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 |
| 49 | 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 |
| 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 |
| 51 | 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 |
| 52 | 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 |
| 53 | 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 |
| 54 | 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 |
| 55 | 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 |
| 56 | 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 |
| 57 | 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 |
| 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 0 | 0 | 0 |
| 59 | 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 |
| 60 | 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 |
| 61 | 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 |
| 62 | 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 |
| 63 | 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 |
| 64 | 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 |
| 65 | 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 |
| 66 | 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 |
| 67 | 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 |
| 68 | 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 |
| 69 | 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 |
| 70 | 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 |
| 71 | 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 |
| 72 | 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 |
| 73 | 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 |
| 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 |
| 75 | 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 | 268244 | 686969 | 404228 | 78546 | 151634 | 174362 | 124368 | 88267 | 84780 | 55250 | 104994 | 150995 | 122720 | 163330 | 305547 | 329002 | 201841 | 222102 | 315346 | 487288 | 214788 | 198031 | 174480 | 113530 | 121603 |
| Weights | 1767 | 4123 | 2634 | 627 | 1213 | 1354 | 1007 | 741 | 706 | 495 | 805 | 1453 | 1148 | 1455 | 2537 | 2620 | 1977 | 1932 | 2698 | 4544 | 2411 | 2123 | 1833 | 1275 | 1263 |

**Table 10.4.c Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 1987-2011.**

Tab_10_4_Length_Dist.xls

**Total catches**

| CL mm/Y | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0 | 1318 | 75 | 0 | 0 | 546 | 199 | 134 | 185 | 82 | 1325 | 0 | 93 | 186 | 950 | 1268 | 28 | 0 | 0 | 0 | 22 | 0 | 82 | 0 | 0 |
| 11 | 0 | 2152 | 152 | 0 | 114 | 807 | 313 | 208 | 279 | 125 | 1611 | 85 | 150 | 291 | 1341 | 1817 | 0 | 0 | 94 | 0 | 171 | 38 | 135 | 2 | 0 |
| 12 | 0 | 3508 | 308 | 0 | 0 | 1190 | 491 | 323 | 419 | 191 | 1952 | 128 | 240 | 455 | 1890 | 2597 | 70 | 363 | 413 | 70 | 202 | 98 | 79 | 0 | 237 |
| 13 | 0 | 5695 | 624 | 1 | 93 | 1749 | 768 | 501 | 627 | 291 | 2354 | 162 | 384 | 710 | 2654 | 3696 | 294 | 1722 | 1085 | 234 | 122 | 235 | 177 | 97 | 596 |
| 14 | 78 | 9194 | 1261 | 2 | 258 | 2556 | 1198 | 774 | 936 | 441 | 2823 | 660 | 613 | 1104 | 3713 | 5233 | 636 | 3152 | 3190 | 1138 | 900 | 389 | 291 | 83 | 834 |
| 15 | 2074 | 14706 | 2539 | 7 | 1249 | 3708 | 1858 | 1189 | 1388 | 666 | 3378 | 1741 | 977 | 1710 | 5164 | 7354 | 1198 | 5548 | 7287 | 3102 | 1289 | 189 | 1157 | 155 | 941 |
| 16 | 3974 | 23341 | 5134 | 22 | 2240 | 5320 | 2854 | 1811 | 2040 | 999 | 3994 | 1861 | 1548 | 2631 | 7126 | 10227 | 3386 | 6784 | 13528 | 7810 | 2959 | 1027 | 2315 | 822 | 1230 |
| 17 | 13727 | 35990 | 10072 | 83 | 4673 | 7583 | 4326 | 2727 | 2961 | 1484 | 4671 | 3527 | 2433 | 4008 | 9732 | 14027 | 5947 | 8843 | 15094 | 11655 | 3636 | 1832 | 3059 | 1333 | 2430 |
| 18 | 29620 | 54001 | 19279 | 299 | 10649 | 10421 | 6429 | 4065 | 4241 | 2171 | 5432 | 5003 | 3776 | 6031 | 13122 | 18895 | 8092 | 10161 | 19820 | 16144 | 4593 | 2638 | 4843 | 2309 | 3630 |
| 19 | 29666 | 78433 | 35810 | 814 | 12931 | 14209 | 9295 | 5897 | 5938 | 3114 | 6254 | 5991 | 5753 | 8854 | 17392 | 24883 | 11506 | 17376 | 19549 | 25891 | 5244 | 6473 | 6485 | 3532 | 4546 |
| 20 | 63382 | 234265 | 156289 | 2955 | 23271 | 18858 | 13425 | 8348 | 8279 | 4394 | 7573 | 12116 | 8605 | 12744 | 22767 | 31997 | 12229 | 19297 | 22348 | 39747 | 8738 | 11521 | 12803 | 5706 | 7249 |
| 21 | 51922 | 138484 | 108031 | 32996 | 19615 | 24820 | 18569 | 11413 | 11910 | 6276 | 9341 | 10260 | 12424 | 17805 | 29040 | 40555 | 18877 | 26146 | 32679 | 54289 | 11598 | 15820 | 16845 | 7775 | 10398 |
| 22 | 64770 | 77194 | 60622 | 31979 | 29023 | 21298 | 21587 | 16010 | 12320 | 8902 | 17764 | 24263 | 17516 | 26155 | 51621 | 25784 | 22077 | 26109 | 36293 | 70001 | 17948 | 24938 | 18989 | 11941 | 15171 |
| 23 | 44411 | 51001 | 36064 | 22597 | 23464 | 30692 | 23143 | 17227 | 17576 | 9357 | 15299 | 24812 | 19523 | 25155 | 61081 | 53951 | 30042 | 28950 | 42629 | 70322 | 24134 | 27882 | 22167 | 14058 | 13948 |
| 24 | 31551 | 43954 | 28456 | 17129 | 29262 | 41808 | 24072 | 19876 | 17805 | 12836 | 20763 | 26235 | 19730 | 26608 | 43406 | 49240 | 30467 | 27006 | 42790 | 56230 | 30803 | 30359 | 26034 | 18202 | 16065 |
| 25 | 35162 | 39829 | 28130 | 17956 | 34469 | 41355 | 31065 | 22724 | 21385 | 19960 | 30089 | 34467 | 29383 | 31534 | 47522 | 35792 | 31376 | 31015 | 43900 | 55504 | 34119 | 30750 | 24406 | 18610 | 18348 |
| 26 | 30342 | 30817 | 23441 | 18775 | 29237 | 32754 | 29245 | 22702 | 24510 | 20810 | 24100 | 24211 | 19056 | 18708 | 24882 | 38790 | 30654 | 26004 | 36814 | 45189 | 33060 | 29446 | 22463 | 20352 | 14820 |
| 27 | 28357 | 28715 | 22331 | 16290 | 23611 | 31610 | 28907 | 23633 | 27943 | 20472 | 25462 | 24104 | 17498 | 16307 | 23438 | 27502 | 27294 | 22530 | 30504 | 32134 | 30006 | 21020 | 21948 | 22730 | 15647 |
| 28 | 24925 | 26134 | 19157 | 19672 | 22213 | 33851 | 29028 | 21631 | 22031 | 16618 | 20563 | 17450 | 14261 | 15269 | 18493 | 26203 | 24759 | 18837 | 26482 | 24909 | 23613 | 18533 | 21659 | 21375 | 12191 |
| 29 | 18703 | 20952 | 14247 | 16275 | 17276 | 25413 | 21145 | 16961 | 16324 | 16763 | 21463 | 13189 | 10261 | 12718 | 14962 | 18053 | 19381 | 16923 | 19228 | 18779 | 16980 | 16115 | 16687 | 18700 | 11687 |
| 30 | 18407 | 17871 | 13696 | 12061 | 15053 | 20084 | 21682 | 16111 | 19413 | 20478 | 21774 | 17021 | 16882 | 14567 | 16833 | 18981 | 18868 | 16044 | 17170 | 16268 | 15087 | 12649 | 16531 | 17612 | 10832 |
| 31 | 11419 | 13159 | 9038 | 11090 | 12505 | 14375 | 13535 | 11276 | 13418 | 14098 | 9856 | 8668 | 9417 | 10102 | 11542 | 10203 | 14672 | 13469 | 14051 | 12923 | 12014 | 10697 | 12682 | 14024 | 9500 |
| 32 | 10185 | 12823 | 8410 | 8541 | 8635 | 12825 | 12751 | 11524 | 13710 | 14436 | 9652 | 9718 | 9860 | 9048 | 11448 | 10403 | 11849 | 11057 | 10433 | 10286 | 10011 | 9299 | 10150 | 12082 | 7447 |
| 33 | 8528 | 8848 | 7128 | 10650 | 7273 | 9311 | 11387 | 7033 | 7128 | 8589 | 6344 | 6178 | 6038 | 6373 | 8297 | 7857 | 8566 | 8523 | 8095 | 8965 | 8343 | 7857 | 7757 | 9201 | 6440 |
| 34 | 5926 | 7812 | 6967 | 10543 | 7987 | 7324 | 7361 | 6688 | 7590 | 6529 | 4820 | 6770 | 5930 | 5242 | 6204 | 5329 | 6456 | 6684 | 7090 | 7524 | 7076 | 7449 | 6815 | 7414 | 5739 |
| 35 | 5763 | 5935 | 6214 | 7637 | 5425 | 5931 | 6309 | 5648 | 4678 | 6580 | 4739 | 6787 | 5277 | 4903 | 5220 | 4316 | 4829 | 5097 | 5361 | 5366 | 6793 | 5573 | 4900 | 6094 | 4715 |
| 36 | 4033 | 5064 | 4532 | 6274 | 4979 | 4999 | 4609 | 4338 | 3709 | 4134 | 2568 | 5356 | 4295 | 3245 | 4041 | 3161 | 3931 | 3416 | 3415 | 4177 | 5071 | 3945 | 3894 | 3681 | 4319 |
| 37 | 4024 | 3754 | 3545 | 4841 | 4541 | 4195 | 4089 | 3753 | 3496 | 4227 | 2135 | 4796 | 3232 | 2947 | 2903 | 2050 | 3158 | 2949 | 2844 | 3221 | 4138 | 3273 | 2753 | 3186 | 3797 |
| 38 | 3131 | 3106 | 3193 | 4966 | 2993 | 3933 | 2991 | 2771 | 2879 | 2788 | 1142 | 3571 | 2589 | 2688 | 2370 | 2225 | 2752 | 2129 | 2496 | 2760 | 2679 | 2491 | 2139 | 2263 | 4007 |
| 39 | 2151 | 2778 | 2154 | 3339 | 2869 | 2987 | 2290 | 1841 | 1746 | 1596 | 927 | 2205 | 2186 | 2027 | 2298 | 1560 | 2189 | 1822 | 1797 | 1956 | 2247 | 2412 | 1546 | 1662 | 3496 |
| 40 | 2425 | 2159 | 2175 | 2766 | 2414 | 2574 | 2206 | 1738 | 2015 | 1956 | 982 | 3140 | 2353 | 1862 | 1908 | 1399 | 1973 | 1628 | 1665 | 1768 | 1758 | 1633 | 1257 | 1318 | 3321 |
| 41 | 1375 | 1753 | 1461 | 1951 | 2076 | 1546 | 1452 | 1150 | 1123 | 1250 | 520 | 1558 | 1363 | 1020 | 941 | 764 | 1457 | 1248 | 1174 | 1171 | 1267 | 1190 | 886 | 971 | 2740 |
| 42 | 1350 | 1542 | 1130 | 1668 | 1662 | 1599 | 1111 | 1118 | 1558 | 1142 | 508 | 1490 | 1124 | 797 | 863 | 632 | 1407 | 901 | 984 | 990 | 1130 | 1069 | 742 | 746 | 2654 |
| 43 | 1150 | 1209 | 1087 | 1908 | 1495 | 1348 | 1069 | 687 | 1039 | 610 | 370 | 1055 | 762 | 534 | 530 | 641 | 1068 | 787 | 842 | 741 | 722 | 805 | 578 | 560 | 2161 |
| 44 | 965 | 704 | 1192 | 1401 | 1089 | 1050 | 745 | 500 | 915 | 414 | 219 | 778 | 708 | 413 | 383 | 432 | 810 | 719 | 640 | 633 | 746 | 706 | 487 | 515 | 1762 |
| 45 | 641 | 581 | 1194 | 955 | 1058 | 766 | 684 | 550 | 700 | 464 | 253 | 904 | 429 | 421 | 523 | 416 | 821 | 613 | 605 | 631 | 518 | 536 | 396 | 442 | 1182 |
| 46 | 645 | 689 | 669 | 713 | 666 | 734 | 584 | 353 | 460 | 374 | 135 | 525 | 424 | 248 | 294 | 328 | 535 | 485 | 415 | 479 | 373 | 405 | 307 | 312 | 1024 |
| 47 | 509 | 391 | 641 | 715 | 431 | 567 | 417 | 407 | 437 | 397 | 140 | 327 | 276 | 213 | 368 | 241 | 456 | 388 | 353 | 440 | 311 | 361 | 262 | 290 | 865 |
| 48 | 343 | 333 | 526 | 863 | 636 | 588 | 456 | 270 | 494 | 264 | 92 | 382 | 104 | 205 | 188 | 188 | 339 | 313 | 339 | 382 | 257 | 294 | 254 | 237 | 656 |
| 49 | 290 | 254 | 378 | 470 | 377 | 263 | 145 | 178 | 254 | 205 | 57 | 132 | 151 | 177 | 183 | 79 | 206 | 318 | 288 | 319 | 237 | 262 | 196 | 204 | 557 |
| 50 | 319 | 216 | 351 | 230 | 263 | 256 | 238 | 273 | 255 | 179 | 76 | 154 | 159 | 154 | 160 | 115 | 253 | 306 | 276 | 287 | 201 | 228 | 156 | 160 | 501 |
| 51 | 135 | 241 | 240 | 181 | 210 | 107 | 126 | 156 | 214 | 123 | 38 | 191 | 58 | 109 | 135 | 73 | 170 | 214 | 176 | 246 | 163 | 201 | 115 | 135 | 383 |
| 52 | 192 | 48 | 180 | 335 | 180 | 159 | 202 | 107 | 175 | 77 | 30 | 115 | 93 | 85 | 102 | 46 | 150 | 152 | 184 | 201 | 138 | 116 | 110 | 120 | 296 |
| 53 | 137 | 70 | 150 | 121 | 124 | 111 | 55 | 136 | 91 | 84 | 26 | 156 | 23 | 133 | 82 | 51 | 120 | 111 | 142 | 137 | 140 | 121 | 98 | 97 | 198 |
| 54 | 111 | 112 | 218 | 99 | 189 | 94 | 120 | 77 | 55 | 75 | 11 | 93 | 11 | 63 | 40 | 20 | 80 | 90 | 104 | 156 | 115 | 95 | 63 | 95 | 271 |
| 55 | 76 | 85 | 187 | 53 | 63 | 61 | 128 | 66 | 91 | 53 | 9 | 114 | 16 | 75 | 53 | 30 | 57 | 47 | 109 | 137 | 79 | 73 | 75 | 79 | 152 |
| 56 | 111 | 41 | 123 | 26 | 28 | 66 | 50 | 49 | 47 | 62 | 12 | 7 | 5 | 18 | 24 | 13 | 23 | 86 | 69 | 117 | 60 | 67 | 54 | 75 | 132 |
| 57 | 74 | 39 | 116 | 43 | 34 | 61 | 72 | 36 | 77 | 48 | 8 | 31 | 14 | 20 | 46 | 6 | 47 | 49 | 58 | 134 | 70 | 41 | 31 | 67 | 98 |
| 58 | 39 | 65 | 70 | 2 | 11 | 68 | 58 | 47 | 88 | 48 | 9 | 14 | 5 | 16 | 29 | 6 | 22 | 27 | 43 | 134 | 45 | 80 | 48 | 47 | 105 |
| 59 | 32 | 60 | 36 | 13 | 17 | 28 | 13 | 31 | 36 | 30 | 8 | 10 | 2 | 7 | 26 | 3 | 10 | 32 | 41 | 85 | 33 | 19 | 23 | 48 | 79 |
| 60 | 21 | 7 | 30 | 5 | 24 | 7 | 54 | 26 | 32 | 9 | 5 | 8 | 4 | 2 | 21 | 11 | 8 | 10 | 19 | 115 | 33 | 23 | 14 | 42 | 48 |
| 61 | 21 | 15 | 15 | 4 | 11 | 0 | 25 | 12 | 4 | 4 | 0 | 0 | 3 | 8 | 7 | 0 | 5 | 5 | 28 | 40 | 23 | 7 | 8 | 30 | 39 |
| 62 | 0 | 0 | 21 | 10 | 0 | 44 | 3 | 8 | 0 | 9 | 1 | 10 | 0 | 1 | 2 | 0 | 4 | 3 | 16 | 21 | 9 | 9 | 9 | 16 | 55 |
| 63 | 19 | 13 | 10 | 0 | 3 | 28 | 0 | 5 | 20 | 4 | 5 | 4 | 0 | 0 | 5 | 1 | 1 | 5 | 9 | 19 | 9 | 7 | 10 | 7 | 23 |
| 64 | 0 | 7 | 0 | 0 | 0 | 14 | 7 | 10 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 8 | 8 | 18 | 10 | 6 | 3 | 16 | 12 |
| 65 | 8 | 0 | 4 | 0 | 0 | 0 | 30 | 16 | 4 | 0 | 0 | 4 | 2 | 1 | 0 | 1 | 0 | 1 | 14 | 11 | 9 | 1 | 3 | 9 | 11 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 20 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 6 | 10 | 1 | 0 | 2 | 3 | 11 |
| 67 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 8 | 1 | 0 | 2 | 3 | 6 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | 4 | 7 | 3 | 0 | 0 | 4 | 7 |
| 69 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 6 | 2 | 0 | 1 | 1 | 2 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 1 | 2 |
| 71 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 5 | 0 | 0 | 0 | 1 | 1 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 |
| 73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 |
| 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **557218** | **1011467** | **649102** | **292325** | **368972** | **448648** | **365006** | **277146** | **287074** | **237291** | **293688** | **312544** | **258025** | **296713** | **478366** | **509443** | **365612** | **376507** | **495103** | **616065** | **332060** | **313305** | **297984** | **251649** | **229614** |
| **Weights** | **7164** | **9997** | **7470** | **5599** | **5967** | **7034** | **6116** | **4833** | **5159** | **4614** | **4415** | **5318** | **4357** | **4523** | **6267** | **6299** | **5863** | **5503** | **6689** | **7990** | **5587** | **5154** | **4820** | **4673** | **4822** |

**Table 10.4.d Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 1987-2011.**

Tab_10_4_Length_Dist.xls

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 |

| CL mm/Y | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 665 | 888 | 19 | 0 | 0 | 0 | 16 | 0 | 58 | 0 | 0 |
| 11 | 939 | 1272 | 0 | 0 | 66 | 0 | 119 | 27 | 94 | 1 | 0 |
| 12 | 1323 | 1818 | 49 | 254 | 289 | 49 | 142 | 69 | 56 | 0 | 166 |
| 13 | 1858 | 2587 | 206 | 1205 | 760 | 164 | 85 | 164 | 124 | 68 | 417 |
| 14 | 2599 | 3663 | 445 | 2206 | 2233 | 797 | 630 | 272 | 204 | 58 | 584 |
| 15 | 3615 | 5148 | 839 | 3883 | 5101 | 2171 | 902 | 132 | 810 | 108 | 658 |
| 16 | 4988 | 7159 | 2370 | 4749 | 9469 | 5467 | 2072 | 719 | 1621 | 575 | 861 |
| 17 | 6812 | 9819 | 4169 | 6193 | 10565 | 8158 | 2545 | 1282 | 2141 | 933 | 1701 |
| 18 | 9190 | 13226 | 5669 | 7112 | 13882 | 11302 | 3216 | 1851 | 3390 | 1616 | 2541 |
| 19 | 12186 | 17418 | 8055 | 12167 | 13692 | 18124 | 3671 | 4531 | 4540 | 2472 | 3183 |
| 20 | 16022 | 22430 | 8586 | 13522 | 15668 | 27825 | 6118 | 8087 | 8973 | 3998 | 5081 |
| 21 | 20521 | 28666 | 13298 | 18377 | 22957 | 38024 | 8123 | 11131 | 11813 | 5465 | 7281 |
| 22 | 36769 | 18385 | 15653 | 18546 | 25636 | 49040 | 12569 | 17519 | 13379 | 8434 | 10623 |
| 23 | 44635 | 39420 | 21514 | 20924 | 30617 | 49293 | 16909 | 19614 | 15659 | 9957 | 9797 |
| 24 | 33059 | 37486 | 22517 | 20604 | 31906 | 39608 | 21619 | 21468 | 18803 | 13113 | 11400 |
| 25 | 38397 | 28940 | 24412 | 24990 | 34834 | 39706 | 24243 | 22348 | 18185 | 14209 | 13385 |
| 26 | 21541 | 33574 | 25447 | 22402 | 31113 | 33545 | 24847 | 22508 | 18202 | 16796 | 11806 |
| 27 | 21536 | 25081 | 24390 | 20599 | 27955 | 26097 | 23835 | 17982 | 19191 | 20163 | 13209 |
| 28 | 17695 | 24964 | 22903 | 17791 | 25101 | 21831 | 20503 | 16765 | 19881 | 19579 | 11231 |
| 29 | 14607 | 17605 | 18619 | 16289 | 18868 | 17523 | 15641 | 15148 | 15738 | 17692 | 11061 |
| 30 | 16633 | 18718 | 18387 | 15474 | 16690 | 15495 | 14227 | 12072 | 15553 | 17049 | 10229 |
| 31 | 11475 | 10138 | 14274 | 13134 | 13626 | 12590 | 11619 | 10419 | 12135 | 13641 | 9126 |
| 32 | 11414 | 10367 | 11677 | 10836 | 10276 | 10108 | 9790 | 9163 | 9898 | 11867 | 7299 |
| 33 | 8283 | 7844 | 8472 | 8372 | 8007 | 8802 | 8197 | 7731 | 7556 | 9096 | 6361 |
| 34 | 6198 | 5323 | 6377 | 6568 | 6924 | 7400 | 6915 | 7142 | 6566 | 7332 | 5657 |
| 35 | 5218 | 4314 | 4776 | 4970 | 5282 | 5297 | 6714 | 5511 | 4801 | 6021 | 4663 |
| 36 | 4040 | 3160 | 3897 | 3384 | 3401 | 4155 | 4971 | 3921 | 3835 | 3665 | 4301 |
| 37 | 2902 | 2050 | 3133 | 2927 | 2770 | 3214 | 4048 | 3228 | 2696 | 3138 | 3753 |
| 38 | 2370 | 2225 | 2725 | 2120 | 2461 | 2731 | 2667 | 2463 | 2059 | 2258 | 3978 |
| 39 | 2298 | 1560 | 2184 | 1780 | 1753 | 1956 | 2246 | 2301 | 1529 | 1652 | 3489 |
| 40 | 1908 | 1399 | 1962 | 1606 | 1654 | 1717 | 1744 | 1633 | 1237 | 1306 | 3313 |
| 41 | 941 | 764 | 1447 | 1230 | 1168 | 1171 | 1255 | 1190 | 884 | 969 | 2740 |
| 42 | 863 | 632 | 1406 | 897 | 975 | 990 | 1125 | 1053 | 742 | 745 | 2607 |
| 43 | 530 | 641 | 1064 | 783 | 842 | 741 | 718 | 805 | 567 | 560 | 2160 |
| 44 | 383 | 432 | 810 | 715 | 640 | 633 | 746 | 706 | 483 | 514 | 1762 |
| 45 | 523 | 416 | 817 | 613 | 605 | 620 | 518 | 536 | 396 | 442 | 1181 |
| 46 | 294 | 328 | 535 | 485 | 415 | 479 | 373 | 405 | 307 | 310 | 1024 |
| 47 | 368 | 241 | 456 | 388 | 353 | 440 | 311 | 361 | 262 | 290 | 863 |
| 48 | 188 | 188 | 339 | 313 | 339 | 382 | 257 | 294 | 251 | 237 | 656 |
| 49 | 183 | 79 | 206 | 318 | 288 | 319 | 237 | 262 | 196 | 204 | 557 |
| 50 | 160 | 115 | 253 | 306 | 276 | 287 | 198 | 228 | 156 | 160 | 501 |
| 51 | 135 | 73 | 170 | 214 | 176 | 246 | 163 | 201 | 115 | 135 | 383 |
| 52 | 102 | 46 | 150 | 152 | 184 | 201 | 138 | 116 | 110 | 120 | 296 |
| 53 | 82 | 51 | 120 | 111 | 142 | 137 | 140 | 121 | 98 | 97 | 198 |
| 54 | 40 | 20 | 80 | 90 | 104 | 156 | 115 | 95 | 63 | 95 | 271 |
| 55 | 53 | 30 | 57 | 47 | 109 | 137 | 79 | 73 | 75 | 79 | 152 |
| 56 | 24 | 13 | 23 | 86 | 69 | 117 | 60 | 67 | 54 | 75 | 132 |
| 57 | 46 | 6 | 47 | 49 | 58 | 134 | 70 | 41 | 31 | 67 | 98 |
| 58 | 29 | 6 | 22 | 27 | 43 | 134 | 45 | 68 | 48 | 47 | 105 |
| 59 | 26 | 3 | 10 | 32 | 41 | 85 | 33 | 19 | 23 | 48 | 79 |
| 60 | 21 | 11 | 8 | 10 | 19 | 115 | 33 | 23 | 14 | 42 | 48 |
| 61 | 7 | 0 | 5 | 5 | 28 | 40 | 23 | 7 | 8 | 30 | 39 |
| 62 | 2 | 0 | 4 | 3 | 16 | 21 | 9 | 9 | 9 | 16 | 55 |
| 63 | 5 | 1 | 1 | 5 | 9 | 19 | 9 | 7 | 10 | 7 | 23 |
| 64 | 0 | 0 | 0 | 8 | 8 | 18 | 10 | 6 | 3 | 16 | 12 |
| 65 | 0 | 1 | 0 | 1 | 14 | 11 | 9 | 1 | 3 | 9 | 11 |
| 66 | 0 | 0 | 1 | 1 | 6 | 10 | 1 | 0 | 2 | 3 | 11 |
| 67 | 0 | 0 | 0 | 1 | 5 | 8 | 1 | 0 | 2 | 3 | 6 |
| 68 | 0 | 0 | 0 | 2 | 4 | 7 | 3 | 0 | 0 | 4 | 7 |
| 69 | 0 | 0 | 1 | 0 | 1 | 6 | 2 | 0 | 1 | 1 | 2 |
| 70 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 1 | 2 |
| 71 | 0 | 0 | 1 | 0 | 1 | 5 | 0 | 0 | 0 | 1 | 1 |
| 72 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 |
| 73 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 1 |
| 75 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 |
| Total | 386702 | 410743 | 305060 | 309877 | 400500 | 469879 | 267624 | 253896 | 245640 | 217590 | 193133 |
| Weights | 5506 | 5513 | 5270 | 4923 | 5880 | 6627 | 4864 | 4517 | 4270 | 4290 | 4443 |

### Table 10.5. 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 10.6. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Age composition of the Removals

Table 1 Catch numbers at age Numbers*10**-3

| YEAF | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | | |
| 1 | 25573 | 88445 | 21713 | 211 | 10216 | 20512 | 10918 | 6961 | 7844 | 3844 | 17607 | 7670 | 5982 |
| 2 | 259864 | 512688 | 344604 | 99768 | 133523 | 149786 | 110252 | 78001 | 73728 | 49190 | 82857 | 99003 | 80238 |
| 3 | 127252 | 130442 | 96674 | 82961 | 102945 | 138297 | 118115 | 99427 | 108049 | 94113 | 99966 | 89911 | 73105 |
| 4 | 42274 | 48505 | 37816 | 51213 | 46712 | 55336 | 51804 | 44057 | 43834 | 44866 | 42169 | 39688 | 35750 |
| 5 | 12918 | 15385 | 13178 | 19558 | 17025 | 19606 | 19775 | 12973 | 17063 | 17325 | 11927 | 15353 | 15253 |
| 6 | 4528 | 5170 | 6298 | 8334 | 7318 | 6820 | 8184 | 4337 | 6224 | 6198 | 4514 | 7294 | 5328 |
| 7 | 1908 | 2145 | 3141 | 3654 | 2807 | 2647 | 3975 | 2130 | 2469 | 2787 | 1592 | 3862 | 2667 |
| 8 | 936 | 1068 | 1463 | 1548 | 1324 | 1293 | 1917 | 1003 | 932 | 1019 | 757 | 1914 | 1266 |
| +gp | 1493 | 1528 | 2948 | 1514 | 1611 | 2042 | 2756 | 1778 | 1497 | 1376 | 800 | 2550 | 1621 |
| 0 TOTA | 476745 | 805376 | 527834 | 268762 | 323482 | 396340 | 327696 | 250666 | 261640 | 220716 | 262190 | 267245 | 221208 |
| TONSI | 6634 | 8760 | 6679 | 5411 | 5603 | 6628 | 5814 | 4610 | 4947 | 4465 | 4173 | 4882 | 4013 |
| SOPC( | 101 | 102 | 100 | 100 | 100 | 99 | 100 | 100 | 100 | 101 | 101 | 100 | 101 |

| YEAF | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | |
| 1 | 10127 | 27929 | 39737 | 11262 | 22461 | 36233 | 23117 | 8306 | 3699 | 7000 | 2646 | 5806 |
| 2 | 106636 | 197366 | 192207 | 111159 | 126755 | 174554 | 258625 | 87844 | 99973 | 88777 | 55131 | 58622 |
| 3 | 72251 | 95812 | 122382 | 106678 | 91306 | 123868 | 122494 | 102757 | 84444 | 87616 | 90439 | 59083 |
| 4 | 34911 | 37510 | 38490 | 46787 | 39032 | 39169 | 40547 | 44633 | 40961 | 40786 | 45967 | 33392 |
| 5 | 13588 | 15264 | 10558 | 17689 | 17075 | 14221 | 13085 | 13150 | 14108 | 12696 | 14320 | 19374 |
| 6 | 5232 | 6460 | 4023 | 5841 | 6834 | 6416 | 5286 | 5302 | 5836 | 4830 | 4877 | 8178 |
| 7 | 2307 | 2901 | 1401 | 2444 | 2986 | 2723 | 2769 | 2444 | 2221 | 1859 | 1870 | 3591 |
| 8 | 1192 | 1825 | 953 | 1368 | 1365 | 1329 | 1491 | 1241 | 1245 | 907 | 951 | 1842 |
| +gp | 1470 | 1636 | 993 | 1832 | 2063 | 1987 | 2466 | 1948 | 1410 | 1169 | 1389 | 3246 |
| 0 TOTA | 247714 | 386702 | 410743 | 305060 | 309877 | 400499 | 469879 | 267624 | 253896 | 245640 | 217590 | 193133 |
| TONSI | 4087 | 5506 | 5513 | 5270 | 4923 | 5880 | 6627 | 4864 | 4517 | 4270 | 4290 | 4443 |
| SOPC( | 100 | 99 | 100 | 99 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1 | | | | | | | | | | | | |

**Table 10.7. 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| +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 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 |

| YEAR | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | |
| 1 | 0.003 | 0.003 | 0.003 | 0.0036 | 0.003 | 0.0036 | 0.0035 | 0.0035 | 0.0036 | 0.0035 | 0.004 | 0.003 |
| 2 | 0.009 | 0.009 | 0.0085 | 0.009 | 0.0085 | 0.009 | 0.0085 | 0.0095 | 0.009 | 0.009 | 0.009 | 0.009 |
| 3 | 0.0165 | 0.0166 | 0.0165 | 0.0169 | 0.0166 | 0.016 | 0.0165 | 0.0163 | 0.0163 | 0.017 | 0.0171 | 0.0167 |
| 4 | 0.0262 | 0.0258 | 0.0256 | 0.0254 | 0.0252 | 0.0259 | 0.0269 | 0.027 | 0.0268 | 0.0259 | 0.0262 | 0.0277 |
| 5 | 0.0356 | 0.0336 | 0.0358 | 0.0352 | 0.0328 | 0.0351 | 0.0368 | 0.0379 | 0.037 | 0.0342 | 0.0339 | 0.0427 |
| 6 | 0.0416 | 0.041 | 0.0463 | 0.05 | 0.0429 | 0.0447 | 0.0476 | 0.0461 | 0.0453 | 0.0437 | 0.0446 | 0.0575 |
| 7 | 0.0503 | 0.0497 | 0.0538 | 0.0584 | 0.057 | 0.0575 | 0.0592 | 0.0534 | 0.0607 | 0.0567 | 0.0573 | 0.069 |
| 8 | 0.0594 | 0.0527 | 0.0533 | 0.0641 | 0.0653 | 0.0673 | 0.0705 | 0.0667 | 0.0676 | 0.0686 | 0.0693 | 0.0766 |
| +gp | 0.0719 | 0.0736 | 0.0696 | 0.0714 | 0.0762 | 0.0836 | 0.1028 | 0.083 | 0.0859 | 0.087 | 0.0982 | 0.0885 |
| 0 SOPC | 0.9991 | 0.9908 | 0.9993 | 0.9927 | 1.0019 | 0.9973 | 0.9971 | 1.0006 | 1.0006 | 0.9968 | 1.0047 | 1.0029 |
| 1 | | | | | | | | | | | | |

**Table 10.8.** 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 |

**Table 10.9. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Tune data**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| bay | of | biscay | TUNE | DATA | : | EFFORT | 100HRS | | |
| 102 | | | | | | | | | |
| FLEET | QGV | Q2 | | | | | | | |
| 1987 | 2011 | | | | | | | | |
| 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 |
| FLEET | LANGOLF | | | | | | | | |
| 2006 | 2011 | | | | | | | | |
| 1 | 1 | 0.33333 | 0.41667 | | | | | | |
| 1 | 9 | | | | | | | | |
| 11676.7199 | 1364.7 | 19063 | 24095 | 10826.1 | 4128.6 | 1971.3 | 827.6 | 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 |

**Table 10.10. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Separable analysis**

At 11/05/2012 15:32
Separable analysis
from 1987 to 2011 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 282.500 and
final sum of squared residuals is 37.791 after 77 iterations

Matrix of Residuals

| Years | 1987/88 | 1988/89 | 1989/90 | 1990/91 |
|---|---|---|---|---|
| Ages | | | | |
| 1/ 2 | -0.518 | 0.956 | 1.095 | -3.927 |
| 2/ 3 | 0.483 | 1.316 | 1.395 | -0.189 |
| 3/ 4 | 0.074 | 0.202 | -0.05 | -0.26 |
| 4/ 5 | -0.083 | 0.055 | -0.229 | 0.064 |
| 5/ 6 | 0.048 | -0.132 | -0.218 | 0.169 |
| 6/ 7 | -0.061 | -0.469 | -0.078 | 0.332 |
| 7/ 8 | -0.036 | -0.387 | 0.276 | 0.451 |
| | | | | |
| TOT | 0 | 0 | 0 | 0 |
| WTS | 0.001 | 0.001 | 0.001 | 0.001 |

| Years | 1991/92 | 1992/93 | 1993/94 | 1994/95 | 1995/96 | 1996/97 | 1997/98 | 1998/99 | 1999/** | 2000/** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/ 2 | -0.136 | 0.903 | 0.179 | 0.224 | 0.652 | -0.839 | 0.989 | 0.038 | -0.425 | -0.271 |
| 2/ 3 | -0.186 | 0.08 | -0.491 | -0.42 | -0.461 | -1.158 | -0.022 | -0.002 | -0.108 | 0.112 |
| 3/ 4 | -0.217 | 0.118 | -0.346 | 0.052 | -0.031 | -0.342 | 0.33 | -0.076 | -0.15 | -0.013 |
| 4/ 5 | -0.168 | -0.025 | -0.159 | -0.018 | -0.182 | -0.033 | 0.218 | -0.248 | -0.128 | -0.034 |
| 5/ 6 | 0.107 | 0.059 | 0.223 | -0.012 | 0.133 | 0.215 | -0.089 | 0.083 | 0.195 | 0.105 |
| 6/ 7 | 0.27 | -0.208 | 0.119 | -0.125 | -0.014 | 0.289 | -0.369 | 0.091 | 0.019 | 0.011 |
| 7/ 8 | 0.218 | -0.239 | 0.351 | 0.329 | 0.259 | 0.432 | -0.522 | 0.395 | 0.181 | -0.158 |
| | | | | | | | | | | |
| **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 | 2001/** | 2002/** | 2003/** | 2004/** | 2005/** | 2006/** | 2007/** | 2008/** | 2009/** | 2010/** | TOT | WTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1/ 2** | 0.249 | 1.607 | 0.083 | 0.423 | 0.46 | 1.039 | -0.042 | -0.851 | 0.309 | -0.457 | 0 | 0.104 |
| 2/ 3 | -0.056 | 0.56 | -0.002 | -0.217 | 0.067 | 0.605 | -0.179 | -0.179 | -0.238 | -0.008 | 0.001 | 0.203 |
| 3/ 4 | -0.34 | 0.27 | 0.116 | -0.092 | 0.128 | -0.002 | 0.027 | -0.249 | -0.212 | 0.438 | 0 | 0.515 |
| 4/ 5 | -0.197 | -0.114 | -0.081 | -0.129 | -0.094 | -0.092 | 0.051 | -0.02 | -0.03 | 0.092 | 0 | 1 |
| 5/ 6 | 0.109 | -0.084 | 0.092 | 0.074 | 0.034 | -0.086 | -0.068 | 0.094 | 0.079 | -0.021 | 0 | 0.972 |
| 6/ 7 | 0.367 | -0.121 | -0.127 | 0.078 | -0.053 | -0.157 | 0.046 | 0.22 | 0.119 | -0.229 | 0 | 0.523 |
| 7/ 8 | 0.152 | -0.406 | -0.025 | 0.159 | -0.098 | 0.069 | 0.045 | 0.169 | 0.039 | -0.325 | 0 | 0.396 |
| | | | | | | | | | | | | |
| TOT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.621 | |
| WTS | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 1 | 1 | 1 | 1 | 1 | | |

Fishing Mortalities (F)

| | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| F-values | 0.5604 | 0.5649 | 0.4695 | 0.5387 | 0.566 |

| | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|
| F-values | 0.6218 | 0.7316 | 0.5224 | 0.5874 | 0.6034 | 0.4598 | 0.5895 | 0.5361 | 0.5197 | 0.6723 |

| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| F-values | 0.4906 | 0.5794 | 0.6051 | 0.6153 | 0.5925 | 0.5317 | 0.5089 | 0.4209 | 0.3568 | 0.4 |

Selection-at-age (S)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| S-values | 0.0351 | 0.6755 | 1.1961 | 1.2374 | 1 | 0.9203 | 0.8644 | 1 |

1

**Table 10.10. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Separable analysis**

At 11/05/2012 15:32
Separable analysis
from 1987 to 2011 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 282.500 and
final sum of squared residuals is 37.791 after 77 iterations

Traditional vpa Terminal populations from weighted Separable populations

Fishing mortality residuals

| YEAR | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| AGE | | | | | |
| 1 | 0.0039 | 0.0822 | 0.0229 | -0.0186 | -0.0033 |
| 2 | 0.2073 | 0.6115 | 0.4927 | -0.0793 | -0.0461 |
| 3 | 0.0463 | 0.072 | -0.0033 | -0.1342 | -0.0876 |
| 4 | -0.0589 | 0.0198 | -0.0435 | 0.0407 | -0.047 |
| 5 | -0.0514 | -0.0289 | -0.0092 | 0.0991 | 0.014 |
| 6 | -0.0726 | -0.1018 | 0.0352 | 0.1446 | 0.04 |
| 7 | -0.0118 | -0.0737 | 0.1119 | 0.1189 | 0.0035 |
| 8 | -0.0045 | 0.0035 | 0.1254 | 0.0213 | -0.1032 |

Fishing mortality residuals

| YEAR | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | |
| 1 | 0.0164 | -0.0036 | -0.0032 | -0.0023 | -0.0124 | 0.0241 | -0.0018 | -0.0071 | -0.0036 | 0.0203 |
| 2 | -0.0225 | -0.1654 | -0.1124 | -0.1527 | -0.2387 | -0.018 | -0.0286 | -0.0518 | -0.0213 | 0.0276 |
| 3 | 0.036 | -0.1718 | -0.0078 | -0.0243 | -0.1019 | 0.12 | -0.0455 | -0.0719 | -0.0591 | -0.187 |
| 4 | 0.0333 | -0.0674 | 0.0249 | -0.0675 | -0.0191 | 0.1111 | -0.0631 | -0.0151 | -0.0086 | -0.1347 |
| 5 | 0.0645 | 0.1004 | 0.0293 | 0.0591 | 0.0388 | -0.0021 | 0.0193 | 0.0945 | 0.0703 | 0.0147 |
| 6 | -0.0532 | 0.0776 | -0.0215 | 0.0629 | -0.0026 | -0.0621 | 0.0633 | -0.0241 | 0.013 | 0.0546 |
| 7 | -0.1063 | 0.0753 | 0.0201 | 0.0462 | 0.1245 | -0.1168 | 0.1346 | 0.0338 | -0.0437 | 0.018 |
| 8 | -0.1488 | -0.0412 | -0.1134 | -0.1736 | -0.105 | -0.0762 | 0.0959 | -0.0547 | -0.0576 | 0.0305 |
| 1 | | | | | | | | | | |

Run title : bay of biscay M+F WG 2006 t0=0 9+

At 11/05/2012 15:32

Traditional vpa Terminal populations from weighted Separable populations

Fishing mortality residuals

| YEAR | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | |
| 1 | 0.0616 | -0.0007 | 0.0128 | 0.0271 | 0.0248 | -0.004 | -0.0102 | 0.0046 | -0.0034 | 0 |
| 2 | 0.1983 | -0.0239 | -0.0543 | 0.0302 | 0.2416 | -0.0877 | -0.071 | -0.0016 | -0.0091 | 0.0454 |
| 3 | 0.1153 | 0.0205 | -0.0721 | 0.0489 | 0.0201 | 0.0037 | -0.1082 | -0.055 | 0.147 | -0.0207 |
| 4 | -0.026 | -0.0241 | -0.0762 | -0.0573 | -0.036 | 0.0396 | -0.0158 | -0.0054 | 0.0381 | -0.0356 |
| 5 | -0.0347 | 0.0451 | 0.0277 | -0.0186 | -0.0136 | 0.0149 | 0.0201 | -0.0073 | 0.007 | 0.0058 |
| 6 | -0.0417 | -0.0061 | 0.0066 | -0.0102 | -0.0505 | 0.0355 | 0.067 | -0.0199 | -0.0363 | 0.0199 |
| 7 | -0.11 | 0.0006 | 0.0836 | -0.0412 | 0.0196 | 0.0186 | 0.0247 | -0.0203 | -0.0584 | 0.04 |
| 8 | -0.0637 | 0.0365 | 0.0219 | 0.0315 | -0.0047 | -0.0141 | 0.0033 | -0.0485 | -0.0427 | 0.0432 |
| 1 | | | | | | | | | | |

Tab 10_11_XSA tuning diagn.xls 30/05/2012

## Table 10.11. Nephrops in Fus 23-24 Bay of Biscay (VIIIa,b) - XSA tuning diagnostics

Lowestoft VPA Version 3.1

11/05/2012 15:32

Extended Survivors Analysis

bay of biscay M+F WG 2012 t0=0 9+

CPUE data from file TUNEFF.DAT

Catch data for 25 years. 1987 to 2011. Ages 1 to 9.

| Fleet | First year | Last year | First age | Last age | Alpha | Beta |
|---|---|---|---|---|---|---|
| FLEET QGV | 1987 | 2011 | 1 | 8 | 0.25 | 0.5 |
| FLEET LAN | 2006 | 2011 | 1 | 8 | 0.333 | 0.417 |

Time series weights :

Tapered time weighting applied
Power = 3 over 25 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 30 iterations

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Regression weights

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.866 | 0.905 | 0.936 | 0.959 | 0.976 | 0.988 | 0.995 | 0.998 | 1 | 1 |

Fishing mortalities

| Age | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.078 | 0.019 | 0.034 | 0.049 | 0.047 | 0.016 | 0.008 | 0.016 | 0.006 | 0.017 |
| 2 | 0.53 | 0.367 | 0.354 | 0.449 | 0.657 | 0.284 | 0.297 | 0.286 | 0.191 | 0.193 |
| 3 | 0.706 | 0.714 | 0.652 | 0.791 | 0.742 | 0.665 | 0.537 | 0.51 | 0.586 | 0.353 |
| 4 | 0.576 | 0.698 | 0.672 | 0.707 | 0.706 | 0.723 | 0.661 | 0.581 | 0.594 | 0.475 |
| 5 | 0.444 | 0.616 | 0.64 | 0.595 | 0.581 | 0.558 | 0.563 | 0.466 | 0.439 | 0.579 |
| 6 | 0.393 | 0.506 | 0.549 | 0.567 | 0.492 | 0.528 | 0.555 | 0.404 | 0.346 | 0.518 |
| 7 | 0.319 | 0.472 | 0.566 | 0.468 | 0.549 | 0.473 | 0.469 | 0.361 | 0.284 | 0.497 |
| 8 | 0.38 | 0.638 | 0.566 | 0.571 | 0.545 | 0.547 | 0.504 | 0.377 | 0.337 | 0.538 |

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XSA population numbers (Thousands)

| YEAR \ AGE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 2002 | 614000 | 543000 | 274000 | 99600 | 33400 | 14000 | 5810 | 3420 |
| 2003 | 680000 | 421000 | 237000 | 106000 | 43600 | 16700 | 7370 | 3290 |
| 2004 | 783000 | 494000 | 216000 | 90300 | 40900 | 18300 | 7830 | 3580 |
| 2005 | 884000 | 560000 | 257000 | 87600 | 35900 | 16800 | 8250 | 3460 |
| 2006 | 584000 | 624000 | 265000 | 90700 | 33600 | 15400 | 7420 | 4020 |
| 2007 | 619000 | 413000 | 240000 | 98300 | 34800 | 14600 | 7350 | 3340 |
| 2008 | 565000 | 452000 | 230000 | 96000 | 37100 | 15500 | 6720 | 3560 |
| 2009 | 506000 | 415000 | 249000 | 105000 | 38600 | 16500 | 6950 | 3280 |
| 2010 | 528000 | 368000 | 231000 | 116000 | 45700 | 18900 | 8560 | 3770 |
| 2011 | 4.06E+05 | 3.89E+05 | 2.25E+05 | 1.00E+05 | 5.00E+04 | 2.29E+04 | 1.04E+04 | 5.02E+03 |

Estimated population abundance at 1st Jan 2012

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.00E+00 | 2.96E+05 | 2.37E+05 | 1.23E+05 | 4.86E+04 | 2.18E+04 | 1.06E+04 | 4.93E+03 |

Taper weighted geometric mean of the VPA populations:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6.06E+05 | 4.49E+05 | 2.35E+05 | 9.65E+04 | 3.84E+04 | 1.65E+04 | 7.44E+03 | 3.43E+03 |

Standard error of the weighted Log(VPA populations) :

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.2125 | 0.1824 | 0.0994 | 0.0909 | 0.1182 | 0.1276 | 0.1548 | 0.2061 |

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Tab 10_11_XSA tuning diagn.xls 30/05/2012

Log catchability residuals.

Fleet : FLEET QGV Q2

| Age | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| 1 | 0.22 | 3.03 | 0.32 | -4.63 | -0.97 |
| 2 | 0.33 | 0.68 | 0.17 | -1.1 | -0.53 |
| 3 | -0.16 | 0.1 | -0.4 | -0.68 | -0.62 |
| 4 | -0.31 | -0.1 | -0.56 | -0.41 | -0.48 |
| 5 | -0.42 | -0.33 | -0.46 | -0.38 | -0.47 |
| 6 | -0.5 | -0.4 | -0.14 | -0.05 | -0.49 |
| 7 | -0.3 | -0.47 | -0.04 | -0.07 | -0.41 |
| 8 | -0.2 | -0.04 | -0.16 | -0.05 | -0.32 |

| Age | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.81 | 0.02 | 0.16 | 0.31 | -1.49 | 0.97 | -0.65 | -0.84 | -0.57 | -0.19 |
| 2 | -0.3 | -0.6 | -0.76 | -0.53 | -1.48 | -0.26 | -0.02 | -0.19 | 0.11 | 0.09 |
| 3 | -0.45 | -0.52 | -0.33 | -0.41 | -0.38 | -0.03 | -0.14 | -0.09 | -0.26 | 0.06 |
| 4 | -0.44 | -0.44 | -0.35 | -0.63 | -0.18 | -0.07 | -0.19 | -0.04 | -0.12 | 0.28 |
| 5 | -0.32 | -0.2 | -0.55 | -0.45 | -0.06 | -0.24 | -0.15 | 0 | -0.02 | 0.4 |
| 6 | -0.4 | 0.17 | -0.43 | -0.32 | -0.03 | -0.32 | 0.02 | -0.2 | -0.11 | 0.55 |
| 7 | -0.66 | 0.18 | -0.18 | -0.27 | 0.23 | -0.45 | 0.16 | 0.06 | -0.41 | 0.29 |
| 8 | -0.36 | 0.16 | -0.05 | -0.09 | 0.26 | 0.07 | 0.33 | 0.07 | 0.03 | 0.36 |

| Age | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.88 | -0.76 | 0.45 | 0.49 | 1.01 | -0.93 | -0.44 | 0.15 | -0.53 | -0.12 |
| 2 | 1.07 | -0.06 | 0.01 | 0.21 | 0.65 | -0.16 | 0.29 | -0.1 | 0.09 | -0.18 |
| 3 | 0.23 | 0.04 | -0.09 | 0.03 | 0.29 | 0.21 | 0.23 | 0.05 | 0.45 | -0.28 |
| 4 | -0.21 | 0.03 | 0.02 | 0.04 | 0.12 | 0.21 | 0.35 | 0.14 | 0.3 | -0.23 |
| 5 | -0.22 | 0.02 | 0.14 | 0.04 | 0.07 | -0.03 | 0.33 | 0.03 | 0.13 | -0.01 |
| 6 | -0.28 | -0.15 | 0.11 | 0.16 | 0.01 | 0.04 | 0.39 | -0.01 | -0.02 | 0.04 |
| 7 | -0.46 | -0.11 | 0.16 | -0.04 | 0.12 | -0.13 | 0.02 | -0.14 | -0.35 | 0.01 |
| 8 | -0.05 | 0.14 | 0.13 | 0.01 | 0.15 | -0.07 | 0.06 | -0.11 | -0.14 | 0.16 |

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 | -12.6329 | -9.4398 | -8.6204 | -8.3185 | -8.3136 | -8.3914 | -8.3914 | -8.3914 |
| S.E(Log q) | 1.0353 | 0.4838 | 0.2598 | 0.244 | 0.2126 | 0.2377 | 0.253 | 0.1669 |

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 | 0.77 | 0.221 | 12.79 | 0.07 | 25 | 0.83 | -12.63 |
| 2 | 0.4 | 2.499 | 11.59 | 0.57 | 25 | 0.16 | -9.44 |
| 3 | 0.59 | 1.012 | 10.17 | 0.32 | 25 | 0.15 | -8.62 |
| 4 | 1.1 | -0.125 | 7.99 | 0.1 | 25 | 0.28 | -8.32 |
| 5 | 0.9 | 0.217 | 8.53 | 0.28 | 25 | 0.2 | -8.31 |
| 6 | 0.87 | 0.298 | 8.57 | 0.28 | 25 | 0.21 | -8.39 |
| 7 | 0.73 | 0.875 | 8.59 | 0.45 | 25 | 0.18 | -8.47 |
| 8 | 0.77 | 1.526 | 8.29 | 0.78 | 25 | 0.11 | -8.33 |
| 1 | | | | | | | |

Fleet : FLEET LANGOLF

| Age | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 99.99 | 99.99 | 99.99 | 99.99 | -0.33 | -1.46 | 0.68 | 0.88 | 0.04 | 0.17 |
| 2 | 99.99 | 99.99 | 99.99 | 99.99 | -0.81 | 0.07 | -0.1 | -0.2 | 0.46 | 0.57 |
| 3 | 99.99 | 99.99 | 99.99 | 99.99 | -0.54 | 0.47 | -0.23 | -0.38 | 0.33 | 0.33 |
| 4 | 99.99 | 99.99 | 99.99 | 99.99 | -0.56 | 0.49 | 0.18 | -0.22 | 0.12 | -0.01 |
| 5 | 99.99 | 99.99 | 99.99 | 99.99 | -0.58 | 0.52 | 0.5 | -0.11 | 0.03 | -0.36 |
| 6 | 99.99 | 99.99 | 99.99 | 99.99 | -0.58 | 0.32 | 0.68 | 0.09 | 0.09 | -0.6 |
| 7 | 99.99 | 99.99 | 99.99 | 99.99 | -0.7 | 0.11 | 0.76 | 0.08 | -0.01 | -0.99 |
| 8 | 99.99 | 99.99 | 99.99 | 99.99 | -1.02 | 0.09 | 0.6 | 0.21 | 0.19 | -1.35 |

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

Tab 10_11_XSA tuning diagn.xls 30/05/2012

| Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Mean Log q | -14.9652 | -11.6852 | -10.8535 | -10.5681 | -10.5738 | -10.5616 | -10.5616 | -10.5616 |
| S.E(Log q) | 0.8352 | 0.4979 | 0.4304 | 0.3615 | 0.4443 | 0.5037 | 0.645 | 0.8128 |

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 | -0.59 | -1.101 | 12.12 | 0.11 | 6 | 0.48 | -14.97 |
| 2 | -0.7 | -4.557 | 13.89 | 0.65 | 6 | 0.16 | -11.69 |
| 3 | -0.25 | -1.963 | 12.77 | 0.38 | 6 | 0.09 | -10.85 |
| 4 | 0.44 | 0.612 | 11.1 | 0.23 | 6 | 0.17 | -10.57 |
| 5 | 3.02 | -0.482 | 10.55 | 0.01 | 6 | 1.46 | -10.57 |
| 6 | -1.68 | -1.253 | 8.38 | 0.05 | 6 | 0.8 | -10.56 |
| 7 | -0.53 | -2.226 | 8.05 | 0.36 | 6 | 0.25 | -10.68 |
| 8 | -0.31 | -3.205 | 7.45 | 0.6 | 6 | 0.14 | -10.77 |
| 1 | | | | | | | |

Terminal year survivor and F summaries :

## Age 1 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 | 262542 | 1.069 | 0 | 0 | 1 | 0.28 | 0.019 |
| FLEET LAN | 348893 | 0.903 | 0 | 0 | 1 | 0.394 | 0.014 |
| F shrinkage | 266506 | 1 | | | | 0.326 | 0.019 |

Weighted prediction :

| Survivors at end of yea | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 295066 | 0.57 | 0.1 | 3 | 0.179 | 0.017 |

1

Age 2 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 | 186560 | 0.453 | 0.134 | 0.3 | 2 | 0.453 | 0.241 |
| FLEET LAN | 364827 | 0.462 | 0.233 | 0.5 | 2 | 0.434 | 0.13 |
| F shrinkage | 121804 | 1 | | | | 0.113 | 0.347 |

Weighted prediction :

| Survivors at end of yea | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 237356 | 0.31 | 0.22 | 5 | 0.719 | 0.193 |

Age 3 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 | 102726 | 0.251 | 0.118 | 0.47 | 3 | 0.606 | 0.41 |
| FLEET LAN | 191073 | 0.329 | 0.121 | 0.37 | 3 | 0.338 | 0.241 |
| F shrinkage | 61374 | 1 | | | | 0.057 | 0.615 |

Weighted prediction :

| Survivors at end of yea | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 123078 | 0.2 | 0.15 | 7 | 0.78 | 0.353 |

1

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

Year class = 2007

| Fleet | Est Sur | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| FLEET QGV | 48189 | 0.203 | 0.182 | 0.89 | 4 | 0.604 | 0.477 |
| FLEET LAN | 52240 | 0.268 | 0.125 | 0.47 | 4 | 0.346 | 0.447 |
| F shrinkage | 31468 | 1 | | | | 0.05 | 0.661 |

Weighted prediction :

| Survivors at end of yea | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 48505 | 0.16 | 0.1 | 9 | 0.648 | 0.475 |

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

Year class = 2006

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| Fleet | Est Sur | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| FLEET QGV | 23904 | 0.181 | 0.086 | 0.48 | 5 | 0.641 | 0.54 |
| FLEET LAN | 17682 | 0.251 | 0.153 | 0.61 | 5 | 0.308 | 0.676 |
| F shrinkage | 24645 | 1 | | | | 0.052 | 0.527 |

Weighted prediction :

| Survivors at end of yea | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 21820 | 0.15 | 0.08 | 11 | 0.553 | 0.579 |

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

Year class = 2005

| Fleet | Est Sur | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| FLEET QGV | 11734 | 0.166 | 0.043 | 0.26 | 6 | 0.681 | 0.479 |
| FLEET LAN | 8176 | 0.246 | 0.116 | 0.47 | 6 | 0.274 | 0.633 |
| F shrinkage | 12045 | 1 | | | | 0.045 | 0.469 |

Weighted prediction :

| Survivors at end of yea | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 10639 | 0.14 | 0.07 | 13 | 0.468 | 0.518 |

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

Year class = 2004

| Fleet | Est Sur | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| FLEET QGV | 5180 | 0.158 | 0.049 | 0.31 | 7 | 0.732 | 0.477 |
| FLEET LAN | 4044 | 0.26 | 0.218 | 0.84 | 6 | 0.225 | 0.579 |
| F shrinkage | 5877 | 1 | | | | 0.043 | 0.431 |

Weighted prediction :

| Survivors at end of yea | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 4926 | 0.14 | 0.08 | 14 | 0.561 | 0.497 |

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Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 2003

| Fleet | Est Sur | Int s.e | Ext s.e | Var Ratio | N | Scaled Weights | Estimated F |
|---|---|---|---|---|---|---|---|
| FLEET QGV | 2322 | 0.151 | 0.092 | 0.61 | 8 | 0.779 | 0.531 |
| FLEET LAN | 2062 | 0.28 | 0.289 | 1.03 | 6 | 0.177 | 0.581 |
| F shrinkage | 2577 | 1 | | | | 0.044 | 0.489 |

Weighted prediction :

| Survivors at end of yea | Int s.e | Ext s.e | N | Var Ratio | F |
|---|---|---|---|---|---|
| 2284 | 0.13 | 0.09 | 15 | 0.695 | 0.538 |

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FLEET QGV Q2

CPUE adjusted to start of year

| YEAR | AGE 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1987 | 5.267547 | 74.41841 | 42.49063 | 17.55052 | 5.694216 | 1.981498 | 0.9380479 | 0.4478805 |
| 1988 | 71.53881 | 146.5716 | 54.96114 | 22.74905 | 6.956219 | 2.444616 | 1.031671 | 0.5837626 |
| 1989 | 2.955532 | 66.9245 | 30.67801 | 13.98031 | 5.804332 | 3.35314 | 1.734543 | 0.7248173 |
| 1990 | 0.02339708 | 12.32442 | 21.12837 | 18.08899 | 7.542186 | 3.790709 | 1.641301 | 0.7352993 |
| 1991 | 0.9007813 | 25.57177 | 25.18095 | 16.10546 | 6.36132 | 2.479276 | 0.9469324 | 0.4617439 |
| 1992 | 4.688205 | 31.1709 | 32.99364 | 17.53708 | 7.510055 | 2.617672 | 0.8655325 | 0.3867488 |
| 1993 | 1.945403 | 19.93814 | 28.21853 | 16.03389 | 7.704162 | 4.132607 | 2.023543 | 0.9157928 |
| 1994 | 2.081038 | 15.7605 | 31.58435 | 17.41184 | 4.797366 | 1.855957 | 0.9121598 | 0.4931199 |
| 1995 | 2.277151 | 18.68967 | 29.63088 | 13.2346 | 6.233215 | 2.489763 | 1.021647 | 0.3841572 |
| 1996 | 0.3809025 | 6.695055 | 28.46029 | 19.79809 | 9.305427 | 3.532751 | 1.776361 | 0.7170786 |
| 1997 | 4.512613 | 23.32709 | 40.70604 | 21.93552 | 6.934271 | 2.677512 | 1.00796 | 0.5827048 |
| 1998 | 0.8203135 | 29.06072 | 32.97415 | 18.86018 | 8.085238 | 4.071076 | 2.304337 | 1.274752 |
| 1999 | 0.855004 | 23.09259 | 31.73459 | 19.79886 | 9.163821 | 3.003676 | 1.736275 | 0.8036921 |
| 2000 | 1.516911 | 39.34495 | 26.65301 | 18.41554 | 8.253763 | 3.202235 | 1.200735 | 0.7654471 |
| 2001 | 2.06275 | 51.98301 | 45.12228 | 27.67246 | 12.91713 | 5.822306 | 2.324537 | 1.357049 |
| 2002 | 35.78599 | 125.5355 | 62.3766 | 19.7226 | 6.540539 | 2.392768 | 0.8324474 | 0.7404269 |
| 2003 | 1.038142 | 31.33418 | 44.66809 | 26.58549 | 10.88515 | 3.26464 | 1.503801 | 0.8576679 |
| 2004 | 4.017258 | 39.65697 | 35.58658 | 22.56398 | 11.59334 | 4.643005 | 2.092798 | 0.9281405 |
| 2005 | 4.713203 | 54.81448 | 47.79846 | 22.24786 | 9.122307 | 4.486905 | 1.804287 | 0.7961482 |
| 2006 | 5.213412 | 95.01579 | 63.74207 | 24.8344 | 8.845188 | 3.516116 | 1.891958 | 1.055647 |
| 2007 | 0.7939382 | 27.84725 | 53.14106 | 29.71087 | 8.295065 | 3.442115 | 1.466916 | 0.7050224 |
| 2008 | 1.189895 | 47.85504 | 52.18509 | 33.13666 | 12.70794 | 5.185668 | 1.562543 | 0.868716 |
| 2009 | 1.913981 | 29.82857 | 47.10995 | 29.31649 | 9.792176 | 3.703228 | 1.363453 | 0.6625636 |
| 2010 | 1.009169 | 31.84641 | 65.15798 | 38.43501 | 12.74222 | 4.195118 | 1.371031 | 0.7460082 |
| 2011 | 1.175886 | 25.70068 | 30.63507 | 19.39472 | 12.1251 | 5.417659 | 2.373963 | 1.342849 |

1

Tab 10_11_XSA tuning diagn.xls 30/05/2012

FLEET LANGOLF

CPUE adjusted to start of year

| | AGE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 2006 | 0.1331137 | 2.336588 | 2.992558 | 1.326792 | 0.48285 | 0.2229169 | 0.09562868 | 0.03774119 |
| 2007 | 0.04578092 | 3.719959 | 7.411126 | 4.13977 | 1.494346 | 0.5196247 | 0.2132334 | 0.09439761 |
| 2008 | 0.352206 | 3.437799 | 3.531384 | 2.966988 | 1.561089 | 0.7915076 | 0.3727037 | 0.1677507 |
| 2009 | 0.3854618 | 2.852903 | 3.297636 | 2.160965 | 0.882014 | 0.4685161 | 0.1958227 | 0.1050305 |
| 2010 | 0.1734968 | 4.893504 | 6.242124 | 3.358552 | 1.207077 | 0.5328332 | 0.2190478 | 0.1182579 |
| 2011 | 0.1516914 | 5.773412 | 6.073874 | 2.540317 | 0.8910836 | 0.3269793 | 0.0995091 | 0.0336848 |
| 1 | | | | | | | | |

**Table 10.12. 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 11/05/2012 15:33

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 | 0.1015 | 0.0392 | 0.0003 | 0.0165 | 0.038 | 0.0219 | 0.015 | 0.018 | 0.0087 | 0.0397 | 0.0186 | 0.0116 |
| 2 | 0.5918 | 1.0108 | 0.8252 | 0.2848 | 0.3356 | 0.3981 | 0.3295 | 0.2403 | 0.2426 | 0.167 | 0.2917 | 0.3676 | 0.308 |
| 3 | 0.737 | 0.7625 | 0.5689 | 0.5216 | 0.5935 | 0.7847 | 0.7085 | 0.6225 | 0.6839 | 0.619 | 0.6662 | 0.6614 | 0.5654 |
| 4 | 0.6665 | 0.7621 | 0.5546 | 0.7367 | 0.6833 | 0.8193 | 0.8515 | 0.6807 | 0.6712 | 0.7409 | 0.6794 | 0.659 | 0.6513 |
| 5 | 0.5362 | 0.5847 | 0.5086 | 0.6777 | 0.6252 | 0.7516 | 0.8728 | 0.5654 | 0.6635 | 0.6645 | 0.4696 | 0.6064 | 0.6168 |
| 6 | 0.4391 | 0.4535 | 0.5406 | 0.773 | 0.6268 | 0.5921 | 0.9176 | 0.4984 | 0.6316 | 0.5784 | 0.3793 | 0.636 | 0.4645 |
| 7 | 0.4885 | 0.4085 | 0.5936 | 0.7639 | 0.7018 | 0.5188 | 0.9276 | 0.698 | 0.6393 | 0.7059 | 0.2987 | 0.7065 | 0.54 |
| 8 | 0.5806 | 0.6029 | 0.5832 | 0.7195 | 0.7628 | 0.9209 | 1.0004 | 0.684 | 0.837 | 0.6427 | 0.443 | 0.771 | 0.5663 |
| +gp | 0.5806 | 0.6029 | 0.5832 | 0.7195 | 0.7628 | 0.9209 | 1.0004 | 0.684 | 0.837 | 0.6427 | 0.443 | 0.771 | 0.5663 |
| 0 FBAR 2- 5 | 0.6329 | 0.78 | 0.6143 | 0.5552 | 0.5594 | 0.6884 | 0.6906 | 0.5272 | 0.5653 | 0.5478 | 0.5267 | 0.5736 | 0.5354 |

| YEAR | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | FBAR **-* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | | |
| 1 | 0.0144 | 0.0433 | 0.0782 | 0.0194 | 0.0339 | 0.0488 | 0.0471 | 0.0157 | 0.0076 | 0.0162 | 0.0058 | 0.0168 | 0.013 |
| 2 | 0.328 | 0.4821 | 0.5297 | 0.3668 | 0.354 | 0.4492 | 0.6568 | 0.2839 | 0.2973 | 0.2857 | 0.1914 | 0.1927 | 0.2233 |
| 3 | 0.5579 | 0.6147 | 0.7046 | 0.7139 | 0.6525 | 0.7909 | 0.742 | 0.6651 | 0.5369 | 0.5099 | 0.5862 | 0.3532 | 0.4831 |
| 4 | 0.6275 | 0.6891 | 0.5762 | 0.6976 | 0.6724 | 0.707 | 0.7064 | 0.723 | 0.6606 | 0.5812 | 0.5943 | 0.4747 | 0.5501 |
| 5 | 0.5942 | 0.6735 | 0.444 | 0.6158 | 0.6401 | 0.5954 | 0.5815 | 0.5579 | 0.563 | 0.466 | 0.439 | 0.5786 | 0.4946 |
| 6 | 0.4711 | 0.684 | 0.3934 | 0.5059 | 0.5486 | 0.5668 | 0.4916 | 0.5282 | 0.5545 | 0.4039 | 0.3464 | 0.5178 | 0.4227 |
| 7 | 0.3985 | 0.5594 | 0.3194 | 0.4717 | 0.566 | 0.4683 | 0.5493 | 0.4731 | 0.4688 | 0.3611 | 0.2842 | 0.4967 | 0.3807 |
| 8 | 0.5295 | 0.6877 | 0.3803 | 0.6385 | 0.566 | 0.5707 | 0.5446 | 0.5468 | 0.5036 | 0.3766 | 0.3366 | 0.5376 | 0.4169 |
| +gp | 0.5295 | 0.6877 | 0.3803 | 0.6385 | 0.566 | 0.5707 | 0.5446 | 0.5468 | 0.5036 | 0.3766 | 0.3366 | 0.5376 | |
| 0 FBAR 2- 5 | 0.5269 | 0.6149 | 0.5636 | 0.5985 | 0.5798 | 0.6356 | 0.6717 | 0.5575 | 0.5145 | 0.4607 | 0.4527 | 0.3998 | |
| 1 | | | | | | | | | | | | | |

**Table 10.13. 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 11/05/2012 15:33

Terminal Fs derived using XSA (With F shrinkage)

Table 10 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 | 1293821 | 1064649 | 656571 | 734798 | 727229 | 639730 | 585404 | 544774 | 510676 | 518083 | 525247 | 483616 | 605022 |
| 2 | 675923 | 936475 | 712586 | 467711 | 544170 | 529951 | 456269 | 424281 | 397588 | 371567 | 380497 | 373957 | 351669 |
| 3 | 276523 | 277069 | 252483 | 231294 | 260617 | 288207 | 263675 | 243118 | 247179 | 231082 | 232926 | 210563 | 191822 |
| 4 | 98461 | 103057 | 100667 | 111320 | 106919 | 112121 | 102409 | 101114 | 101596 | 97150 | 96912 | 93183 | 84641 |
| 5 | 35268 | 39375 | 37456 | 45026 | 41501 | 42046 | 38486 | 34039 | 39868 | 40440 | 36067 | 38262 | 37546 |
| 6 | 14438 | 16067 | 17088 | 17541 | 17806 | 17296 | 15443 | 12521 | 15061 | 15991 | 16205 | 17563 | 16249 |
| 7 | 5595 | 7249 | 7950 | 7751 | 6306 | 7409 | 7451 | 4804 | 5924 | 6237 | 6985 | 8637 | 7242 |
| 8 | 2408 | 2673 | 3752 | 3420 | 2812 | 2434 | 3435 | 2295 | 1862 | 2435 | 2398 | 4035 | 3319 |
| +gp | 3785 | 3767 | 7450 | 3287 | 3359 | 3763 | 4827 | 3999 | 2933 | 3236 | 2504 | 5279 | 4188 |
| 0 TOTAL | 2406222 | 2450382 | 1796003 | 1622148 | 1710721 | 1642957 | 1477399 | 1370945 | 1322687 | 1286220 | 1299740 | 1235095 | 1301697 |

| YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | GMST 87- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | | |
| 1 | 765531 | 613883 | 679821 | 782658 | 884475 | 584301 | 619329 | 564502 | 504542 | 527500 | 405041 | 0 | 661700 |
| 2 | 599470 | 543081 | 420574 | 493930 | 560474 | 624050 | 412964 | 451661 | 415009 | 367749 | 388504 | 295066 | 488750 |
| 3 | 236446 | 274224 | 236890 | 215893 | 256814 | 264970 | 239707 | 230323 | 248551 | 231035 | 224984 | 237356 | 242213 |
| 4 | 85350 | 99591 | 105565 | 90347 | 87561 | 90694 | 98258 | 96002 | 104854 | 116251 | 100118 | 123078 | 97627 |
| 5 | 35293 | 33368 | 43594 | 40924 | 35917 | 33626 | 34850 | 37135 | 38618 | 45667 | 49970 | 48505 | 37829 |
| 6 | 14776 | 14016 | 16670 | 18340 | 16804 | 15422 | 14641 | 15536 | 16470 | 18872 | 22928 | 21820 | 15930 |
| 7 | 7673 | 5806 | 7365 | 7828 | 8253 | 7425 | 7346 | 6723 | 6949 | 8565 | 10394 | 10639 | 7018 |
| 8 | 4158 | 3415 | 3286 | 3579 | 3462 | 4024 | 3339 | 3565 | 3277 | 3772 | 5020 | 4926 | 3095 |
| +gp | 3665 | 3518 | 4331 | 5331 | 5104 | 6562 | 5168 | 3985 | 4178 | 5454 | 8724 | 6253 | |
| 0 TOTAL | 1752362 | 1590902 | 1518095 | 1658833 | 1858863 | 1631073 | 1435601 | 1409431 | 1342449 | 1324865 | 1215685 | 747645 | |
| 1 | | | | | | | | | | | | | |

**Table 10.14.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 | TOTALBIO | TOTSPBIO | REMOVALS | LANDINGS | DISCARDS | YIELD/SSE | FBAR 2- 5 |
|---|---|---|---|---|---|---|---|---|
| | Age 1 | | | | | | | |
| 1987 | 1293821 | 21051 | 9348 | 6634 | 5397 | 1767 | 0.7096 | 0.6329 |
| 1988 | 1064649 | 20550 | 9630 | 8760 | 5875 | 4122 | 0.9097 | 0.7800 |
| 1989 | 656571 | 18603 | 9616 | 6679 | 4835 | 2634 | 0.6946 | 0.6143 |
| 1990 | 734798 | 17933 | 9801 | 5411 | 4972 | 628 | 0.5520 | 0.5552 |
| 1991 | 727229 | 18351 | 9482 | 5603 | 4754 | 1213 | 0.5909 | 0.5594 |
| 1992 | 639730 | 17821 | 9915 | 6628 | 5681 | 1354 | 0.6685 | 0.6884 |
| 1993 | 585404 | 15631 | 8694 | 5814 | 5109 | 1007 | 0.6687 | 0.6906 |
| 1994 | 544774 | 14916 | 8430 | 4610 | 4092 | 740 | 0.5469 | 0.5272 |
| 1995 | 510676 | 14923 | 8763 | 4947 | 4452 | 707 | 0.5645 | 0.5653 |
| 1996 | 518083 | 14316 | 8305 | 4465 | 4118 | 495 | 0.5377 | 0.5478 |
| 1997 | 525247 | 13484 | 7535 | 4173 | 3610 | 804 | 0.5539 | 0.5267 |
| 1998 | 483616 | 14369 | 8394 | 4882 | 3865 | 1453 | 0.5816 | 0.5736 |
| 1999 | 605022 | 13273 | 7502 | 4013 | 3209 | 1148 | 0.5349 | 0.5354 |
| 2000 | 820967 | 14596 | 7356 | 4087 | 3069 | 1455 | 0.5556 | 0.5269 |
| 2001 | 765531 | 16481 | 7808 | 5506 | 3730 | 2538 | 0.7052 | 0.6149 |
| 2002 | 613883 | 16115 | 8526 | 5513 | 3679 | 2620 | 0.6466 | 0.5636 |
| 2003 | 679821 | 16235 | 9002 | 5270 | 3886 | 1978 | 0.5854 | 0.5985 |
| 2004 | 782658 | 15622 | 8180 | 4923 | 3571 | 1931 | 0.6019 | 0.5798 |
| 2005 | 884475 | 17751 | 8496 | 5880 | 3991 | 2699 | 0.6921 | 0.6356 |
| 2006 | 584301 | 17531 | 9088 | 6627 | 3447 | 4543 | 0.7292 | 0.6717 |
| 2007 | 619329 | 15691 | 8623 | 4864 | 3176 | 2411 | 0.5641 | 0.5575 |
| 2008 | 564502 | 15493 | 8458 | 4517 | 3030 | 2124 | 0.5340 | 0.5145 |
| 2009 | 504542 | 15465 | 8908 | 4270 | 2987 | 1833 | 0.4794 | 0.4607 |
| 2010 | 527500 | 16094 | 9686 | 4290 | 3398 | 1275 | 0.4429 | 0.4527 |
| 2011 | 405041 | 16568 | 10917 | 4443 | 3559 | 1263 | 0.4070 | 0.3998 |
| Arith. | | | | | | | | |
| Mean | 665687 | 16355 | 8819 | 5312 | 4060 | 1790 | 0.6023 | 0.5749 |
| Units | (Thousands | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) | (Tonnes) | | |

**Table 10.15 Nephrops in Fus 23-24 bay of Biscay (VIIIa,b) Prediction with management option table: Input data**

| 2012 | Landings | | Dead Discards | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age | Exploitation pattern | Weight in landings | Exploitation pattern | Weight in discards | Stock size | Natural Mortality | Maturity ogive | Prop. of F bef. spaw. | Prop. of M bef. spaw. | Weight in stock |
| 1 | 0.0000 | 0.000 | 0.0129 | 0.004 | 655480 | 0.30 | 0 | 0 | 0 | 0.004 |
| 2 | 0.0143 | 0.011 | 0.2089 | 0.009 | 295066 | 0.30 | 0 | 0 | 0 | 0.009 |
| 3 | 0.3424 | 0.018 | 0.1407 | 0.014 | 237356 | 0.25 | 0.75 | 0 | 0 | 0.017 |
| 4 | 0.5053 | 0.027 | 0.0447 | 0.023 | 123078 | 0.25 | 1 | 0 | 0 | 0.027 |
| 5 | 0.4742 | 0.037 | 0.0204 | 0.028 | 48505 | 0.25 | 1 | 0 | 0 | 0.037 |
| 6 | 0.4124 | 0.049 | 0.0103 | 0.036 | 21820 | 0.25 | 1 | 0 | 0 | 0.049 |
| 7 | 0.3732 | 0.061 | 0.0075 | 0.040 | 10639 | 0.25 | 1 | 0 | 0 | 0.061 |
| 8 | 0.4113 | 0.072 | 0.0056 | 0.050 | 4926 | 0.25 | 1 | 0 | 0 | 0.072 |
| 9+ | 0.4127 | 0.092 | 0.0043 | 0.047 | 6253 | 0.25 | 1 | 0 | 0 | 0.091 |
| Unit | - | Kilograms | - | Kilograms | Thousands | - | - | - | - | Kilograms |

| 2013 | Landings | | Dead Discards | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age | Exploitation pattern | Weight in landings | Exploitation pattern | Weight in discards | Stock size | Natural Mortality | Maturity ogive | Prop. of F bef. spaw. | Prop. of M bef. spaw. | Weight in stock |
| 1 | 0.0000 | 0.000 | 0.0129 | 0.004 | 655480 | 0.30 | 0 | 0 | 0 | 0.004 |
| 2 | 0.0143 | 0.011 | 0.2089 | 0.009 | | 0.30 | 0 | 0 | 0 | 0.009 |
| 3 | 0.3424 | 0.018 | 0.1407 | 0.014 | | 0.25 | 0.75 | 0 | 0 | 0.017 |
| 4 | 0.5053 | 0.027 | 0.0447 | 0.023 | | 0.25 | 1 | 0 | 0 | 0.027 |
| 5 | 0.4742 | 0.037 | 0.0204 | 0.028 | | 0.25 | 1 | 0 | 0 | 0.037 |
| 6 | 0.4124 | 0.049 | 0.0103 | 0.036 | | 0.25 | 1 | 0 | 0 | 0.049 |
| 7 | 0.3732 | 0.061 | 0.0075 | 0.040 | | 0.25 | 1 | 0 | 0 | 0.061 |
| 8 | 0.4113 | 0.072 | 0.0056 | 0.050 | | 0.25 | 1 | 0 | 0 | 0.072 |
| 9+ | 0.4127 | 0.092 | 0.0043 | 0.047 | | 0.25 | 1 | 0 | 0 | 0.091 |
| Unit | - | Kilograms | - | Kilograms | Thousands | - | - | - | - | Kilograms |

| 2014 | Landings | | Dead Discards | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age | Exploitation pattern | Weight in landings | Exploitation pattern | Weight in discards | Stock size | Natural Mortality | Maturity ogive | Prop. of F bef. spaw. | Prop. of M bef. spaw. | Weight in stock |
| 1 | 0.0000 | 0.000 | 0.0129 | 0.004 | 655480 | 0.30 | 0 | 0 | 0 | 0.004 |
| 2 | 0.0143 | 0.011 | 0.2089 | 0.009 | | 0.30 | 0 | 0 | 0 | 0.009 |
| 3 | 0.3424 | 0.018 | 0.1407 | 0.014 | | 0.25 | 0.75 | 0 | 0 | 0.017 |
| 4 | 0.5053 | 0.027 | 0.0447 | 0.023 | | 0.25 | 1 | 0 | 0 | 0.027 |
| 5 | 0.4742 | 0.037 | 0.0204 | 0.028 | | 0.25 | 1 | 0 | 0 | 0.037 |
| 6 | 0.4124 | 0.049 | 0.0103 | 0.036 | | 0.25 | 1 | 0 | 0 | 0.049 |
| 7 | 0.3732 | 0.061 | 0.0075 | 0.040 | | 0.25 | 1 | 0 | 0 | 0.061 |
| 8 | 0.4113 | 0.072 | 0.0056 | 0.050 | | 0.25 | 1 | 0 | 0 | 0.072 |
| 9+ | 0.4127 | 0.092 | 0.0043 | 0.047 | | 0.25 | 1 | 0 | 0 | 0.091 |
| Unit | - | Kilograms | - | Kilograms | Thousands | - | - | - | - | Kilograms |

**Table 10.16 Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - Catch predictions with management option table**

| Year: 2012 | | | | | | |
|---|---|---|---|---|---|---|
| | Landings | | Dead Discards | | | |
| F Factor | Reference F | Landings in weight | Reference F | Discards in weight | Stock Biomass | Sp. Stock Biomass |
| 1.0 | 0.3341 | 3610 | 0.1037 | 915 | 16666 | 10712 |

| Year: 2013 | | | | | | | Year: 2014 | |
|---|---|---|---|---|---|---|---|---|
| | Landings | | Dead Discards | | | | | |
| F Factor | Reference F | landings in weight | Reference F | Discards in weight | Stock Biomass | Sp. Stock Biomass | Stock Biomass | Sp. Stock Biomass |
| 0.0 | 0.0000 | 0 | 0.0000 | 0 | 17372 | 10023 | 24197 | 16030 |
| 0.1 | 0.0334 | 414 | 0.0104 | 124 | | | 23510 | 15381 |
| 0.2 | 0.0668 | 808 | 0.0207 | 245 | | | 22852 | 14761 |
| 0.3 | 0.1002 | 1185 | 0.0311 | 362 | | | 22222 | 14169 |
| 0.4 | 0.1336 | 1545 | 0.0415 | 476 | | | 21619 | 13602 |
| 0.5 | 0.1671 | 1889 | 0.0519 | 586 | | | 21041 | 13060 |
| 0.6 | 0.2005 | 2217 | 0.0622 | 693 | | | 20488 | 12542 |
| 0.7 | 0.2339 | 2530 | 0.0726 | 797 | | | 19958 | 12047 |
| 0.8 | 0.2673 | 2829 | 0.0830 | 898 | | | 19450 | 11573 |
| 0.9 | 0.3007 | 3115 | 0.0933 | 997 | | | 18963 | 11119 |
| 1.0 | 0.3341 | 3388 | 0.1037 | 1092 | | | 18496 | 10685 |
| 1.1 | 0.3675 | 3648 | 0.1141 | 1185 | | | 18049 | 10270 |
| 1.2 | 0.4009 | 3898 | 0.1244 | 1275 | | | 17620 | 9873 |
| 1.3 | 0.4343 | 4136 | 0.1348 | 1363 | | | 17209 | 9492 |
| 1.4 | 0.4677 | 4363 | 0.1452 | 1448 | | | 16814 | 9128 |
| 1.5 | 0.5012 | 4580 | 0.1556 | 1531 | | | 16436 | 8780 |
| 1.6 | 0.5346 | 4788 | 0.1659 | 1612 | | | 16073 | 8446 |
| 1.7 | 0.5680 | 4987 | 0.1763 | 1691 | | | 15724 | 8126 |
| 1.8 | 0.6014 | 5177 | 0.1867 | 1767 | | | 15390 | 7820 |
| 1.9 | 0.6348 | 5358 | 0.1970 | 1842 | | | 15069 | 7527 |
| 2.0 | 0.6682 | 5532 | 0.2074 | 1914 | | | 14760 | 7245 |

**Table 10.17 Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - Detailed tables**

MFDP version 1a
Run: LANG
Time and date: 12:17 13/05/2012
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

Year: 2012 F

| Age | Total F | CatchNos | Yield | DF | DCatchNos | DYield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0.0129 | 7279 | 27 | 655480 | 2294 | 0 | 0 | 0 | 0 |
| 2 | 0.0143 | 3292 | 36 | 0.2089 | 48001 | 432 | 295066 | 2656 | 0 | 0 | 0 | 0 |
| 3 | 0.3424 | 57603 | 1035 | 0.1407 | 23667 | 339 | 237356 | 4019 | 178017 | 3014 | 178017 | 3014 |
| 4 | 0.5053 | 42810 | 1152 | 0.0447 | 3790 | 87 | 123078 | 3274 | 123078 | 3274 | 123078 | 3274 |
| 5 | 0.4742 | 16219 | 606 | 0.0204 | 697 | 20 | 48505 | 1791 | 48505 | 1791 | 48505 | 1791 |
| 6 | 0.4124 | 6550 | 320 | 0.0103 | 163 | 6 | 21820 | 1060 | 21820 | 1060 | 21820 | 1060 |
| 7 | 0.3732 | 2945 | 181 | 0.0075 | 59 | 2 | 10639 | 649 | 10639 | 649 | 10639 | 649 |
| 8 | 0.4113 | 1479 | 106 | 0.0056 | 20 | 1 | 4926 | 352 | 4926 | 352 | 4926 | 352 |
| 9 | 0.4127 | 1883 | 173 | 0.0043 | 19 | 1 | 6253 | 570 | 6253 | 570 | 6253 | 570 |
| Total | | 132781 | 3610 | | 83696 | 915 | 1403123 | 16666 | 393238 | 10712 | 393238 | 10712 |

Year: 2013 F

| Age | Total F | CatchNos | Yield | DF | DCatchNos | DYield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0.0129 | 7279 | 27 | 655480 | 2294 | 0 | 0 | 0 | 0 |
| 2 | 0.0143 | 5349 | 59 | 0.2089 | 77980 | 702 | 479351 | 4314 | 0 | 0 | 0 | 0 |
| 3 | 0.3424 | 42434 | 763 | 0.1407 | 17434 | 250 | 174851 | 2961 | 131138 | 2221 | 131138 | 2221 |
| 4 | 0.5053 | 39663 | 1067 | 0.0447 | 3511 | 81 | 114030 | 3033 | 114030 | 3033 | 114030 | 3033 |
| 5 | 0.4742 | 18491 | 690 | 0.0204 | 795 | 22 | 55299 | 2042 | 55299 | 2042 | 55299 | 2042 |
| 6 | 0.4124 | 6916 | 338 | 0.0103 | 173 | 6 | 23038 | 1120 | 23038 | 1120 | 23038 | 1120 |
| 7 | 0.3732 | 3082 | 189 | 0.0075 | 62 | 2 | 11135 | 679 | 11135 | 679 | 11135 | 679 |
| 8 | 0.4113 | 1700 | 122 | 0.0056 | 23 | 1 | 5662 | 405 | 5662 | 405 | 5662 | 405 |
| 9 | 0.4127 | 1728 | 159 | 0.0043 | 18 | 1 | 5738 | 523 | 5738 | 523 | 5738 | 523 |
| Total | | 119362 | 3388 | | 107275 | 1092 | 1524584 | 17372 | 346040 | 10023 | 346040 | 10023 |

Year: 2014 F

| Age | Total F | CatchNos | Yield | DF | DCatchNos | DYield | StockNos | Biomass | SSNos(Jan) | SSB(Jan) | SSNos(ST) | SSB(ST) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0.0129 | 7279 | 27 | 655480 | 2294 | 0 | 0 | 0 | 0 |
| 2 | 0.0143 | 5349 | 59 | 0.2089 | 77980 | 702 | 479351 | 4314 | 0 | 0 | 0 | 0 |
| 3 | 0.3424 | 68936 | 1239 | 0.1407 | 28323 | 406 | 284055 | 4810 | 213041 | 3607 | 213041 | 3607 |
| 4 | 0.5053 | 29218 | 786 | 0.0447 | 2587 | 59 | 84001 | 2234 | 84001 | 2234 | 84001 | 2234 |
| 5 | 0.4742 | 17131 | 640 | 0.0204 | 736 | 21 | 51234 | 1892 | 51234 | 1892 | 51234 | 1892 |
| 6 | 0.4124 | 7885 | 386 | 0.0103 | 197 | 7 | 26265 | 1276 | 26265 | 1276 | 26265 | 1276 |
| 7 | 0.3732 | 3254 | 200 | 0.0075 | 65 | 3 | 11757 | 717 | 11757 | 717 | 11757 | 717 |
| 8 | 0.4113 | 1779 | 128 | 0.0056 | 24 | 1 | 5927 | 424 | 5927 | 424 | 5927 | 424 |
| 9 | 0.4127 | 1762 | 162 | 0.0043 | 18 | 1 | 5852 | 534 | 5852 | 534 | 5852 | 534 |
| Total | | 135314 | 3599 | | 117210 | 1226 | 1603920 | 18496 | 398076 | 10685 | 398076 | 10685 |

Input units are thousands and kg - output in tonnes

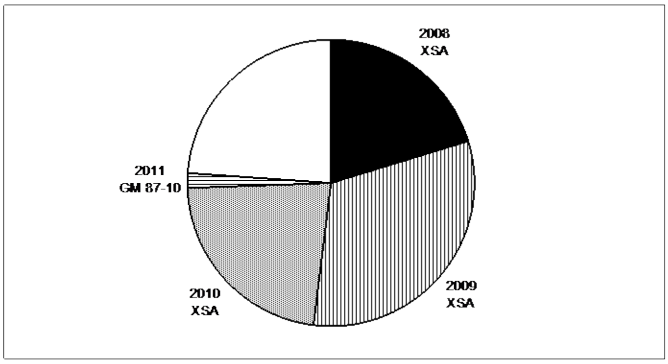
**Table 10. 18** **Nephrops in FUs 23-24 bay of Biscay males and females combined**
**Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes**

| Year-class | | | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| Stock No. (thousands) of 1 year-olds | | | 504542 | 527500 | 405041 | 655480 | 655480 |
| Source | | | XSA | XSA | XSA | GM 87-10 | GM 87-10 |
| Status Quo F: | | | | | | | |
| % in | 2012 | landings | 31.9 | 28.7 | 1.0 | 0.0 | - |
| % in | 2013 | | 20.4 | 31.5 | 22.5 | 1.7 | 0.0 |
| % in | 2012 | SSB | 30.6 | 28.1 | 0.0 | 0.0 | - |
| % in | 2013 | SSB | 20.4 | 30.3 | 22.2 | 0.0 | 0.0 |
| % in | 2014 | SSB | 11.9 | 17.7 | 20.9 | 33.8 | 0.0 |

GM : geometric mean recruitment

**Nephrops in FUs 23-24 bay of Biscay males and females combined : Year-class % contribution to**

a) 2013 landings




b) 2014 SSB

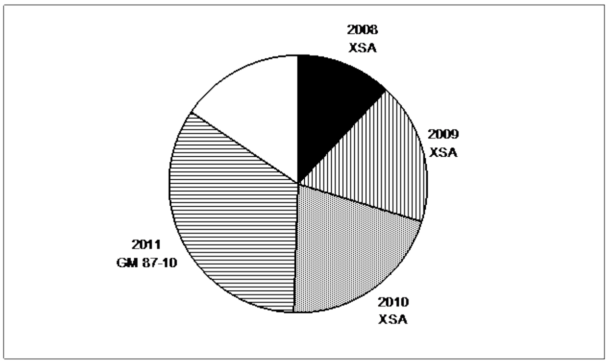



**Table 10.19 Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) : Yield per recruit summary table**

MFYPR version 2a
Run: lang
Time and date: 12:18 13/05/2012
Yield per results

| FMult | Landings LandingsFbar | LandingsNos | LandingsYield | DeadDiscards DeadDiscardsFbar | DeadDiscardsNos | DeadDiscardsYield | StockNos | Biomass | SpwnNosJan |
|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 4.2219 | 0.1298 | 2.3439 |
| 0.1 | 0.0334 | 0.0763 | 0.0034 | 0.0104 | 0.0233 | 0.0003 | 3.8271 | 0.1026 | 1.9533 |
| 0.2 | 0.0668 | 0.1285 | 0.0053 | 0.0207 | 0.0451 | 0.0005 | 3.5352 | 0.0836 | 1.6654 |
| 0.3 | 0.1002 | 0.1650 | 0.0064 | 0.0311 | 0.0656 | 0.0008 | 3.3113 | 0.0700 | 1.4456 |
| 0.4 | 0.1336 | 0.1909 | 0.0069 | 0.0415 | 0.0849 | 0.0010 | 3.1346 | 0.0598 | 1.2728 |
| 0.5 | 0.1670 | 0.2094 | 0.0072 | 0.0518 | 0.1031 | 0.0012 | 2.9919 | 0.0521 | 1.1339 |
| 0.6 | 0.2004 | 0.2225 | 0.0073 | 0.0622 | 0.1204 | 0.0013 | 2.8744 | 0.0461 | 1.0202 |
| 0.7 | 0.2338 | 0.2316 | 0.0072 | 0.0726 | 0.1368 | 0.0015 | 2.7760 | 0.0414 | 0.9255 |
| 0.8 | 0.2672 | 0.2379 | 0.0071 | 0.0829 | 0.1524 | 0.0017 | 2.6924 | 0.0376 | 0.8457 |
| 0.9 | 0.3007 | 0.2418 | 0.0069 | 0.0933 | 0.1673 | 0.0018 | 2.6206 | 0.0345 | 0.7775 |
| 1.0 | 0.3341 | 0.2441 | 0.0067 | 0.1037 | 0.1816 | 0.0019 | 2.5583 | 0.0320 | 0.7186 |
| 1.1 | 0.3675 | 0.2450 | 0.0066 | 0.1141 | 0.1952 | 0.0021 | 2.5036 | 0.0299 | 0.6674 |
| 1.2 | 0.4009 | 0.2450 | 0.0064 | 0.1244 | 0.2082 | 0.0022 | 2.4552 | 0.0281 | 0.6224 |
| 1.3 | 0.4343 | 0.2441 | 0.0062 | 0.1348 | 0.2207 | 0.0023 | 2.4120 | 0.0265 | 0.5826 |
| 1.4 | 0.4677 | 0.2426 | 0.0060 | 0.1452 | 0.2328 | 0.0024 | 2.3733 | 0.0252 | 0.5472 |
| 1.5 | 0.5011 | 0.2406 | 0.0058 | 0.1555 | 0.2443 | 0.0025 | 2.3383 | 0.0241 | 0.5154 |
| 1.6 | 0.5345 | 0.2382 | 0.0056 | 0.1659 | 0.2554 | 0.0026 | 2.3065 | 0.0231 | 0.4868 |
| 1.7 | 0.5679 | 0.2356 | 0.0054 | 0.1763 | 0.2661 | 0.0027 | 2.2774 | 0.0222 | 0.4609 |
| 1.8 | 0.6013 | 0.2327 | 0.0053 | 0.1866 | 0.2765 | 0.0028 | 2.2507 | 0.0214 | 0.4373 |
| 1.9 | 0.6347 | 0.2296 | 0.0051 | 0.1970 | 0.2864 | 0.0029 | 2.2261 | 0.0207 | 0.4157 |
| 2.0 | 0.6681 | 0.2264 | 0.0050 | 0.2074 | 0.2960 | 0.0029 | 2.2033 | 0.0201 | 0.3959 |

| Reference point | F multiplier | Absolute F |
|---|---|---|
| Fleet1 Landings Fb | 1.0000 | 0.3341 |
| FMax | 0.5982 | 0.1998 |
| F0.1 | 0.3778 | 0.1262 |
| F35%SPR | 0.4836 | 0.1616 |

Weights in kilograms
* based on landings

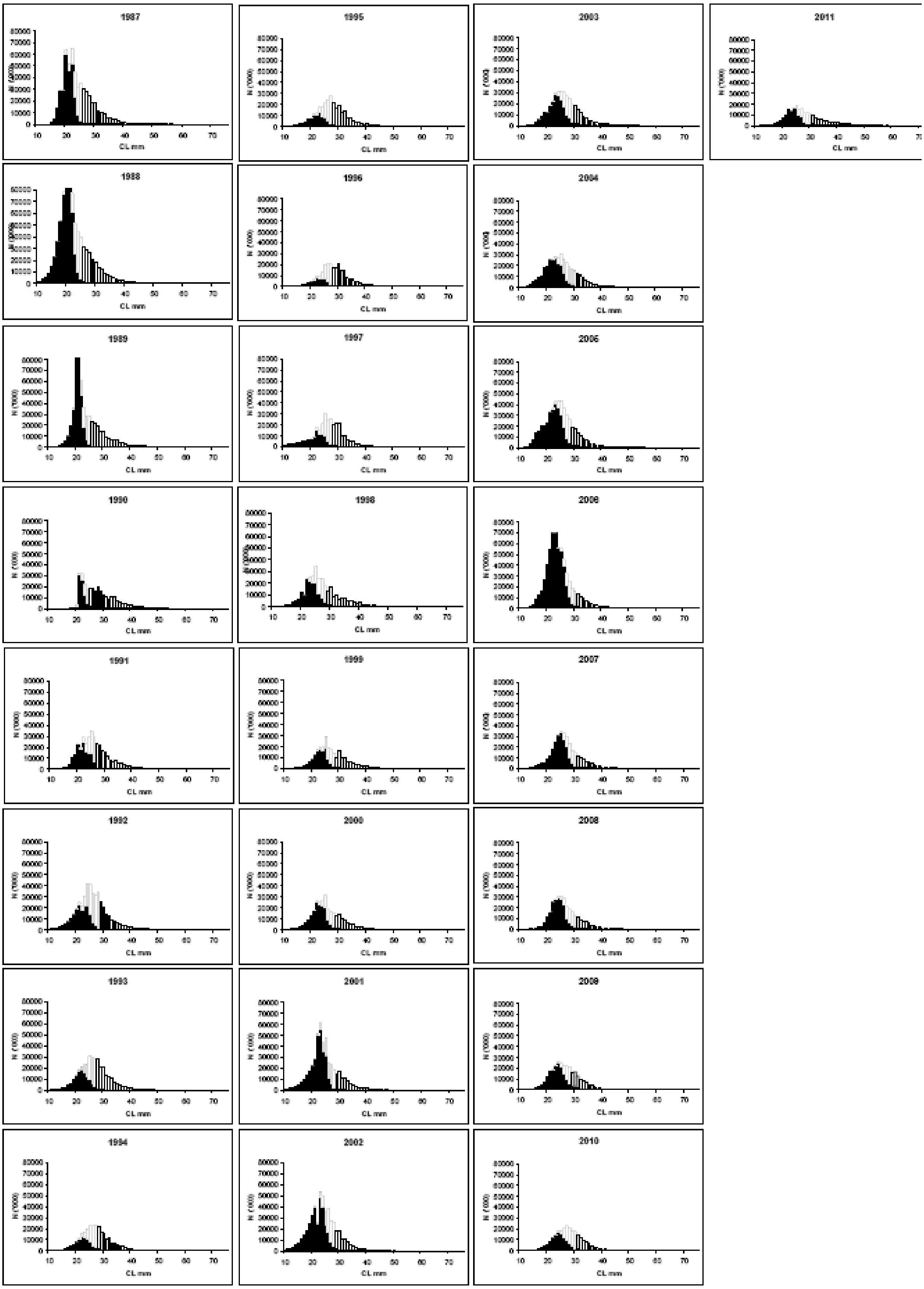
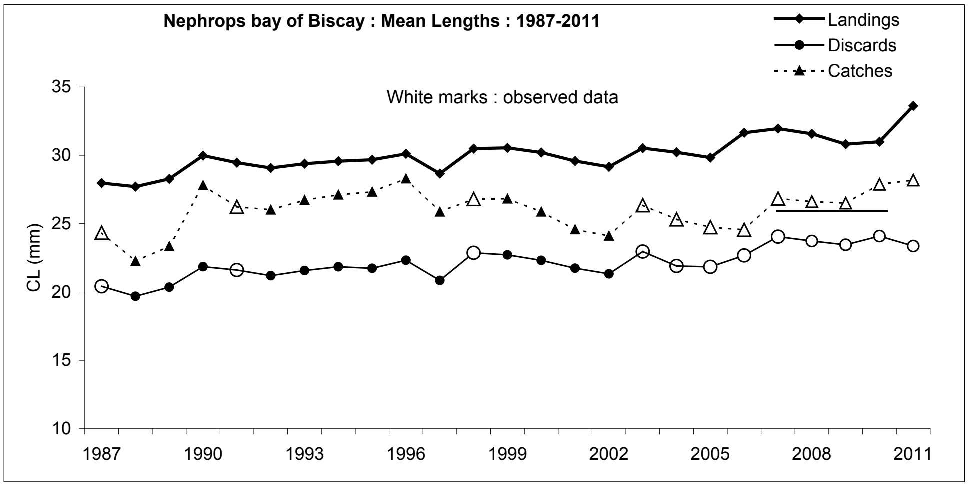
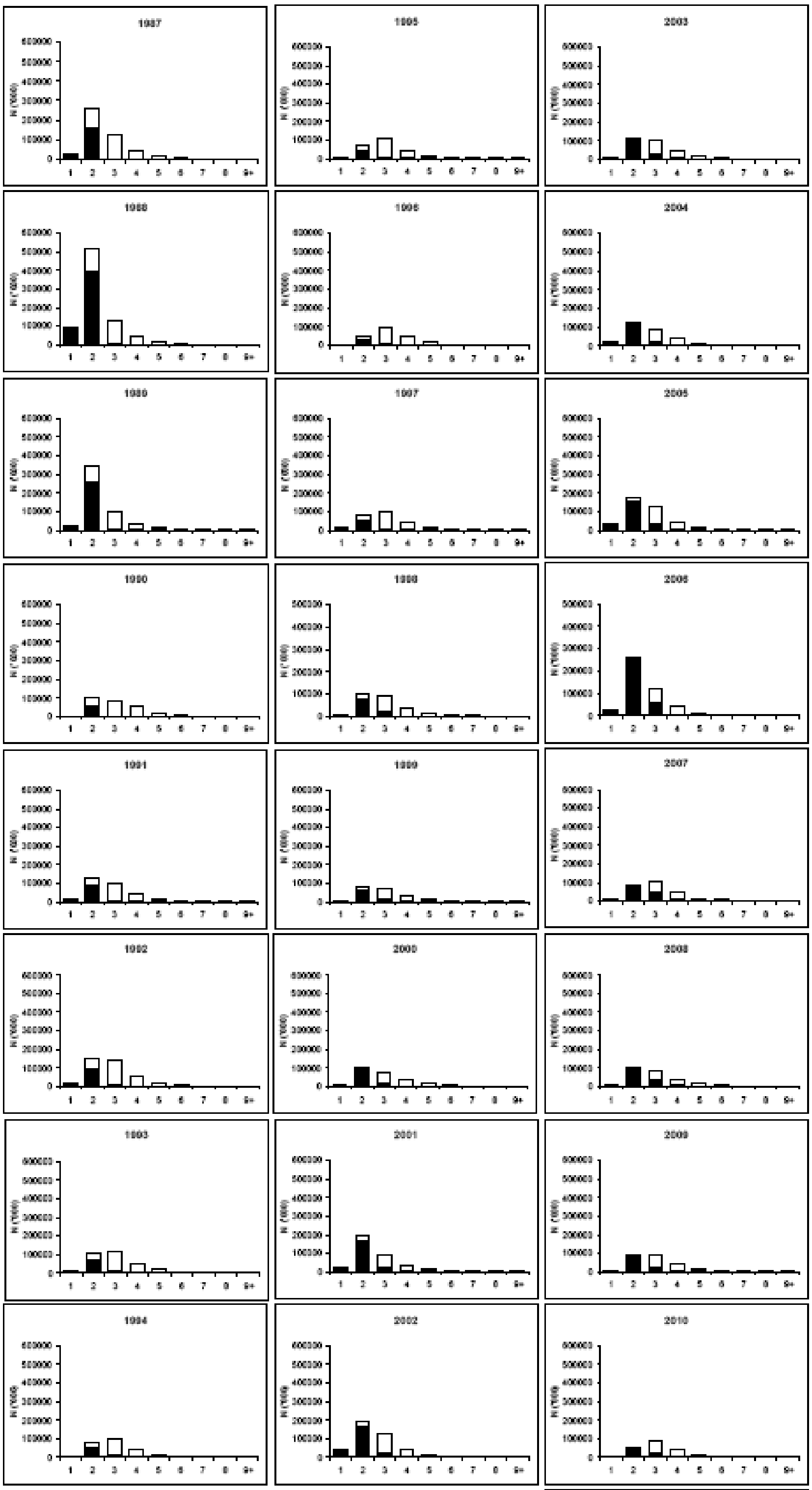


**Figure 10.1.** Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) catches (landings in white and discards in black) length distributions in 1987-2011.

**Figure 10.2. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - mean length of landings, discards and catches**





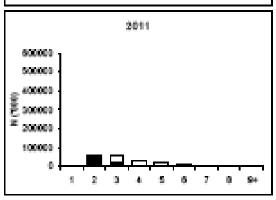


**Figure 10.3** Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) catches (landings in white and dead discards in black; mortality of discards equal to .70) age distributions in 1987-2011.

**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**

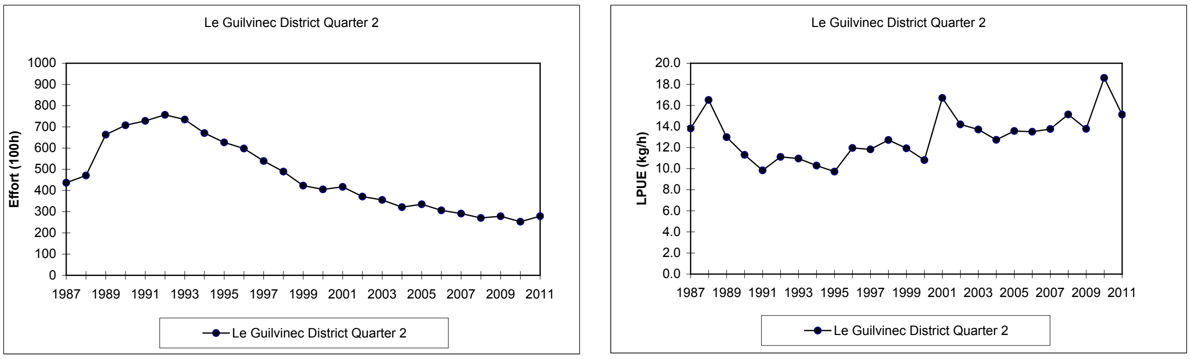



Figure 10.5 Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b)

LOG CATCHABILITY RESIDUAL PLOTS (XSA)

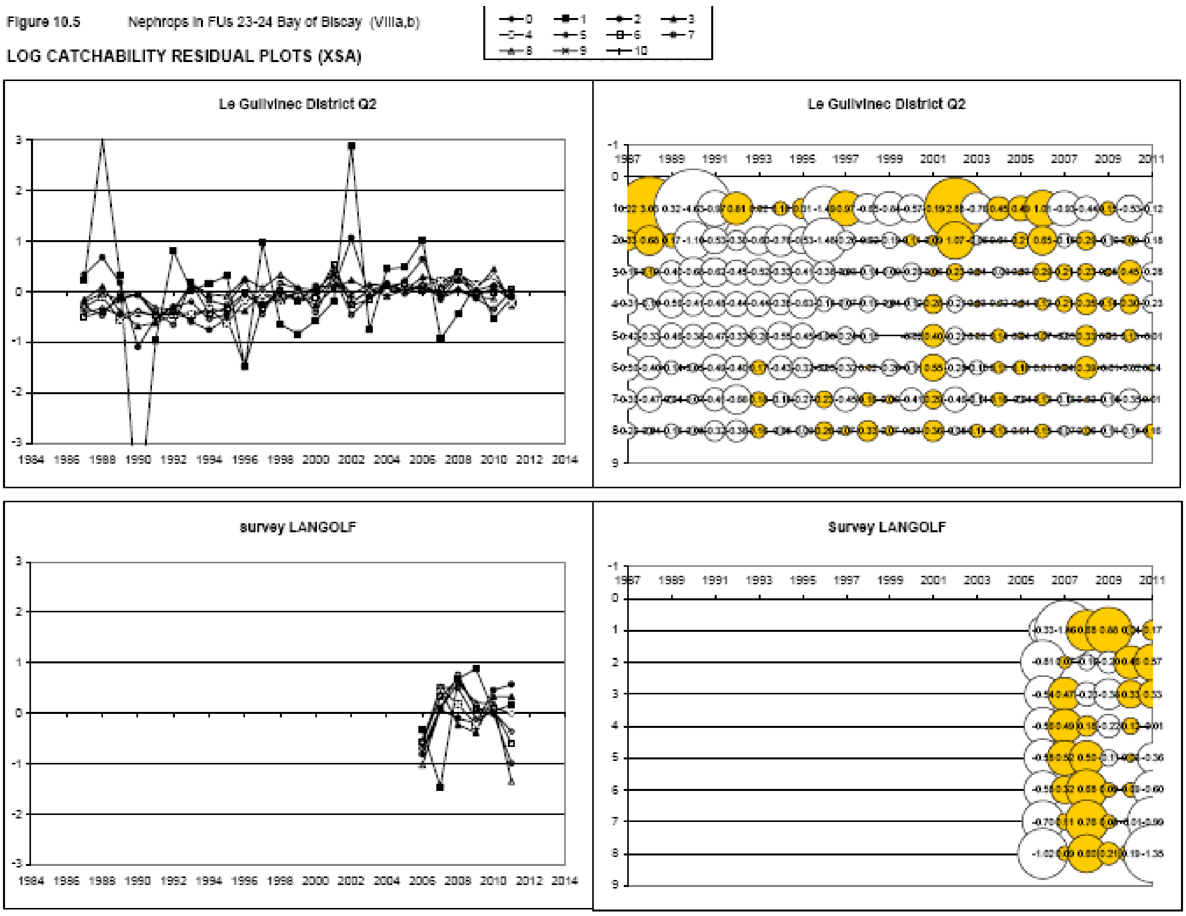


Figure 10.6. Retrospective analysis (Nephrops Bay of Biscay FU 23-24)

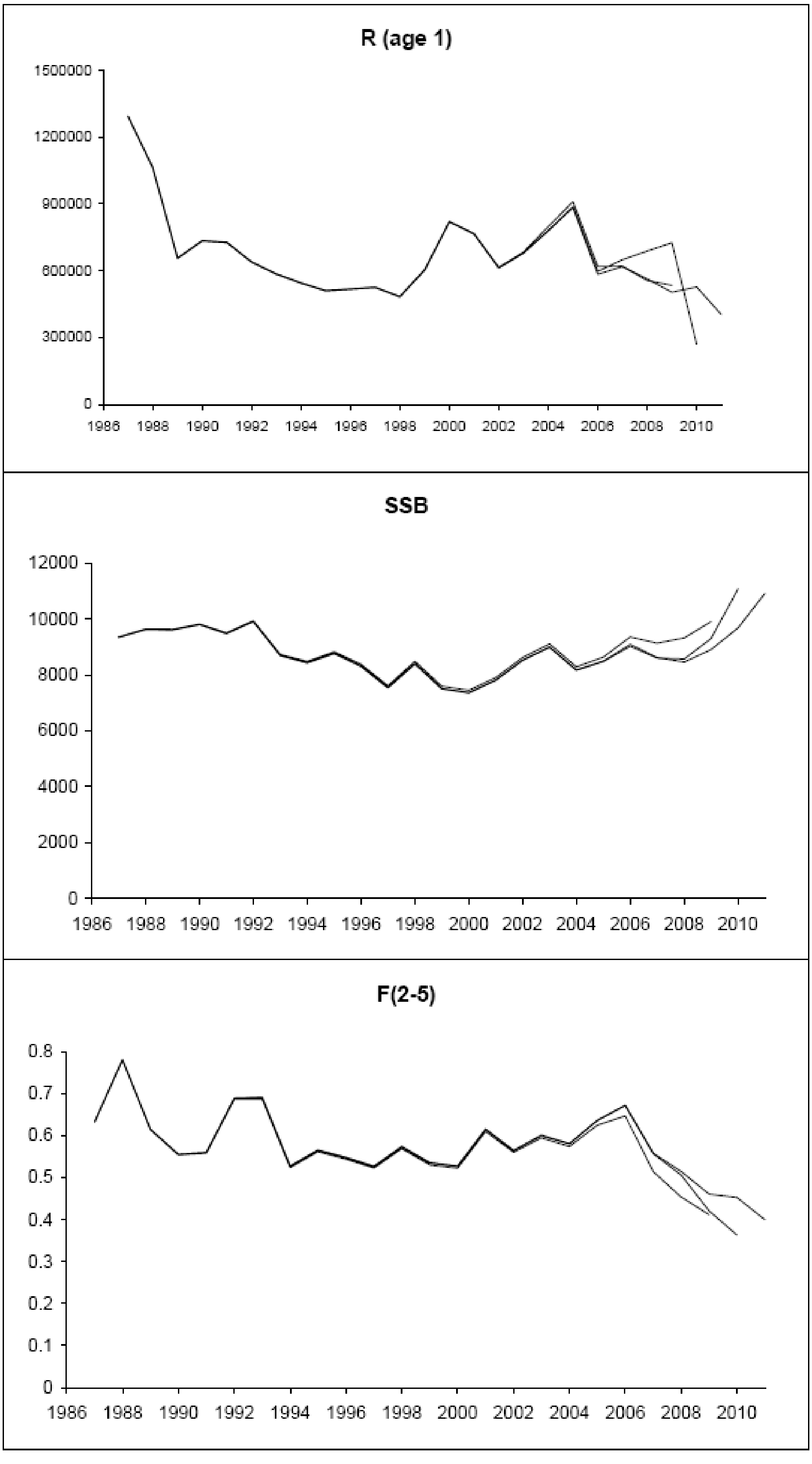
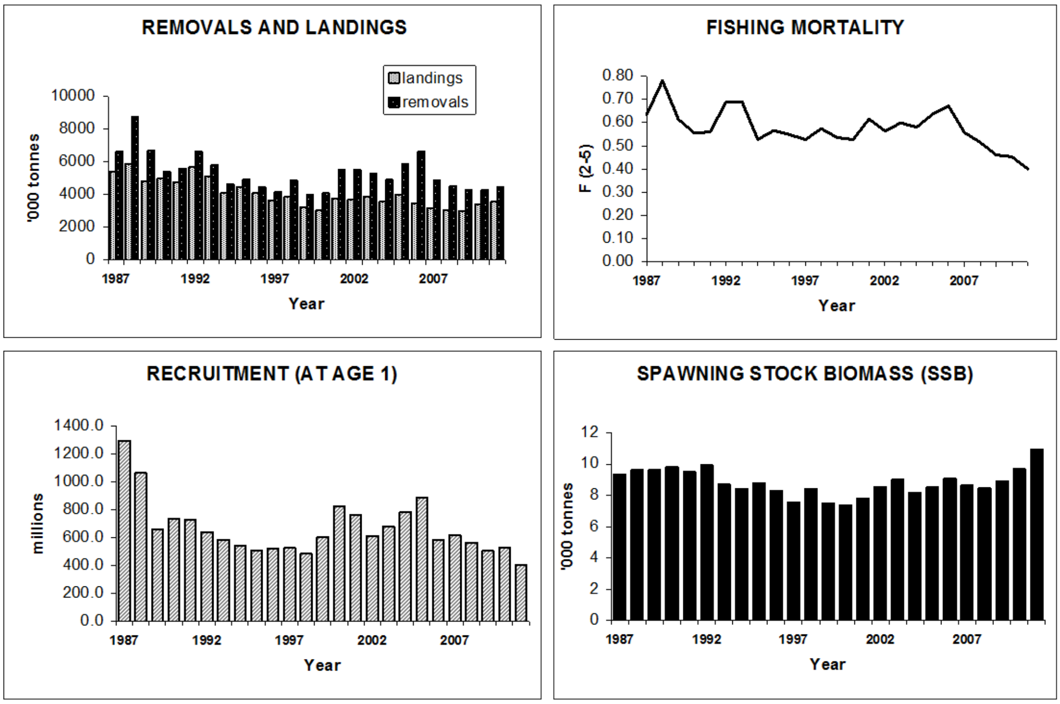


**Figure 10.7.**Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Historical trends in biomass, fishing mortality and recruitment



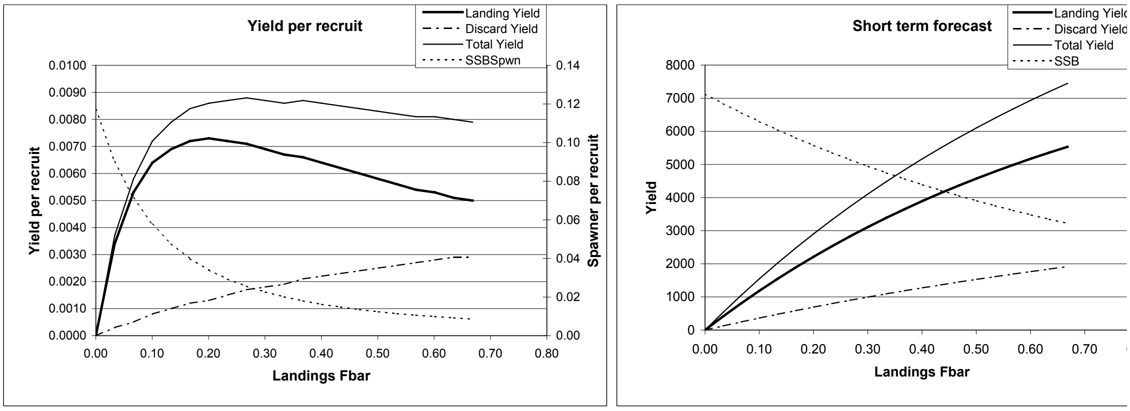




**Figure 10.8. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Short term and long term predictions**

Run: lang
Time and date: 12:18 13/05/2012

| Reference point | F multiplie | Absolute F |
|---|---|---|
| Fleet1 Landings Fbar(2-5) | 1.0000 | 0.3341 |
| FMax | 0.5982 | 0.1998 |
| F0.1 | 0.3778 | 0.1262 |
| F35%SPR | 0.4836 | 0.1616 |

Weights in kilograms

MFDP version 1a
Run: LANG
Time and date: 12:17 13/05/2012
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

Input units are thousands and kg - output in tonnes

# 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)

Type of assessment: the assessment is based on LPUE and mean size trends. However, it was not possible to include Spanish commercial data for 2011 in the assessment. The trend could not be updated this year. Thus the 1975-2010 LPUE time series has been used.

### 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 2012 and management applicable to 2011 and 2012

*ICES advice for 2012*

The advice for these *Nephrops* stocks is biennial and valid for 2011 and 2012.

Given the depleted state of FU 25 it is not relevant to provide MSY based advice. The new data (landings and lpue) available do not change the perception of FU 25 status, and give no reason to change the advice given in 2010 *Given the very low state of the stock, ICES repeats its advice of a zero catch for the stock in FU 25.*

To protect the stock in this Functional Unit, management should be implemented at the Functional Unit level.

*Management applicable to 2011 and 2012*

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 91 t and 82 t were set for the whole of Division VIIIc for 2011 and 2012, respectively.

### 11.1.2 Data

#### 11.1.2.1 Commercial catches and discards

Stock landings for the period 1975-2010, as estimated by the WG, are given in Table 11.2.1. Spanish data for 2011 are not included.

Spanish data in 2011 have been provided by Secretaría General de Pesca (SGP), the official national administration responsible for fishery statistics, and are presented in Annex XX for the whole of the Division VIIIc. Preliminary analysis shows that the formats are not adequate as data were not provided by FU and some assumptions have to be taken for the allocation of the landings. Therefore, the respective value for

FU25 could not properly extract. In previous years landings have been estimated by the WG based on IEO scientific estimations.

Landings were reported only by Spain. Since the early 90s working group estimates landings declined from about 400 t to less than 50 t in recent years. There was slight increase to 143 t in 2002, despite of the fishery being virtually closed during November and December, due to the "Prestige" oil spill off Galicia in November 2002. Landings declined again to 89 t in 2003, when the fishery remained partially closed from January to April 2003. The estimates of landings in 2009 were 21 t, the lowest value recorded during the time series. An small increment of landings was recorded in 2010, reaching a value of 34 t. The time series of the commercial landings (Figure 11.1.1) shows a clear declining trend, with present values representing approximately 6% 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.

The monthly sampling programme of the landings from this FU is considered to be at a sufficient level of intensity to produce reliable length compositions of the landings.

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 1981-2010 (see also Figure 11.1.2). Since data from the SGP were not accepted for the assessment; the 2011 length distribution samplings, sampled and provided by IEO, could not be raised to 2011 landings, and are thus given as relative values scaled to 1000 individuals.

Mean sizes in the landings in the last decade, 2000-2011, varied between 38.0 and 43.4 mm CL for the males and between 36.7 and 41.1 mm CL for the females. The maximum value was recorder in 2009, reaching 48.5 and 45.1 mm CL for males and females, respectively (Figure 11.1.1). 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 can reflect a continuous low level of recruitment during the last period of the series. In 2010, the mean size decreased in both sexes to the 2008 level, and it remained stable in 2011 (about 43 mm CL for males and 41 mm CL for females).

#### 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 1986-2010 (Table 11.1.3 and Figure 11.1.1). In 2011, Spanish landings were not accepted by WG and the respective LPUE could not be estimated. Landings and fishing effort are required by harbour and metier, and beside different effort units were provided in order to derive LPUE estimates consistent with the previous LPUE time series. This fleet accounted for more than 80% of the *Nephrops* landings from FU 25 up to 2003, diminishing afterwards but still account for a large proportion of the landings.

The overall trend in fishing effort is decreasing, with recent effort being approximately half the level in 2000. The long time series of effort (1975-2010) (Figure 11.1.1) shows a marked decrease between 1976 and 1987, and then effort remained quite stable (fluctuating around 5000 trips per year) until 1995. Since then, fishing effort decreased to 1700 trips in 2006, with a slight increase in 2007 and 2008. In 2009, fishing effort shows a progressive decrease, recording about 1300 trips in 2010. 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 overall landings.

LPUE shows an overall decreasing trend (Figure 11.1.1). After a period of quite variable LPUE until 1993, 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, the fishing effort increases to 15.6 kg/trip.

### 11.1.3 Assessment

Last assessment for *Nephrops* FU25, carried out in 2010, was based on the analysis of LPUE and mean size trends. As the time series could not be updated until 2011, this year assessment was conducted by using the available LPUE time series (1975-2010).

### 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 of a strong decline. Landings have dramatically decreased since the beginning of the series, giving a reduction around 92% for recent years.

*Nephrops* is managed by TAC and technical measures. The TAC for the whole of Division VIIIc was 101 t in 2010 and 91 t in 2011. Landings of *Nephrops* from Division VIIIc (FU 25 and FU 31) in 2010 were 42 t, 41% 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).

**Table 11.1.1.** ***Nephrops*** **FU25, North Galicia. Landings in tonnes.**

| Year | Trawl |
|---|---|
| 1975 | 731 |
| 1976 | 559 |
| 1977 | 667 |
| 1978 | 690 |
| 1979 | 475 |
| 1980 | 412 |
| 1981 | 318 |
| 1982 | 431 |
| 1983 | 433 |
| 1984 | 515 |
| 1985 | 477 |
| 1986 | 364 |
| 1987 | 412 |
| 1988 | 445 |
| 1989 | 376 |
| 1990 | 285 |
| 1991 | 453 |
| 1992 | 428 |
| 1993 | 274 |
| 1994 | 245 |
| 1995 | 273 |
| 1996 | 209 |
| 1997 | 219 |
| 1998 | 103 |
| 1999 | 124 |
| 2000 | 81 |
| 2001 | 147 |
| 2002 | 143 |
| 2003 | 89 |
| 2004 | 75 |
| 2005 | 63 |
| 2006 | 62 |
| 2007 | 67 |
| 2008 | 39 |
| 2009 | 21 |
| 2010 | 34 |
| 2011 | na |

**Table 11.1.2.** ***Nephrops*** **FU25, North Galicia. Length compositions of landings of landings, mean weight (Kg) and mean lenght (CL, mm) for the period 1982-2011. In 2011, length composition of sampling is showed in relative numbers scaled to 1000 individuals.**

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 1 | 8 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 1 | 17 | 0 | 16 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 34 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | 7 | 31 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 49 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 10 | 99 | 20 | 8 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 1 | 7 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 23 | 41 | 143 | 18 | 68 | 68 | 6 | 4 | 0 | 5 | 15 | 0 | 15 | 10 | 6 | 6 | 7 | 1 | 1 | 0 | 10 | 2 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 24 | 53 | 350 | 138 | 198 | 136 | 38 | 1 | 0 | 8 | 20 | 13 | 80 | 10 | 19 | 29 | 16 | 2 | 5 | 2 | 0 | 2 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| 25 | 105 | 496 | 150 | 300 | 192 | 191 | 16 | 0 | 30 | 71 | 19 | 57 | 60 | 64 | 38 | 18 | 6 | 15 | 7 | 10 | 2 | 0 | 7 | 5 | 2 | 1 | 1 | 0 | 0 | 0 |
| 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 | 0 | 0 |
| 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 | 1 |
| 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 | 0 | 2 | 1 |
| 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 | 3 |
| 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 |
| 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 | 5 |
| 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 | 5 |
| 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 | 7 |
| 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 | 20 |
| 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 | 38 |
| 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 | 33 |
| 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 | 36 |
| 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 | 97 |
| 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 | 70 |
| 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 | 120 |
| 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 | 94 |
| 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 | 78 |
| 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 | 80 |
| 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 | 53 |
| 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 | 37 |
| 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 | 26 |
| 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 | 20 |
| 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 | 23 |
| 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 | 26 |
| 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 | 19 |
| 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 | 11 |
| 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 | 11 |
| 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 | 7 |
| 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 | 11 |
| 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 | 9 |
| 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 | 8 |
| 57 | 4 | 1 | 0 | 6 | 0 | 7 | 4 | 8 | 5 | 3 | 0 | 0 | 5 | 1 | 2 | 1 | 0 | 2 | 3 | 0 | 5 | 7 | 4 | 3 | 4 | 2 | 5 | 3 | 5 | 6 |
| 58 | 1 | 3 | 1 | 0 | 11 | 8 | 0 | 5 | 1 | 3 | 0 | 0 | 2 | 1 | 5 | 0 | 1 | 2 | 4 | 1 | 9 | 4 | 4 | 3 | 2 | 2 | 4 | 3 | 3 | 7 |
| 59 | 3 | 2 | 0 | 2 | 1 | 0 | 10 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 5 | 0 | 1 | 0 | 0 | 1 | 4 | 5 | 3 | 2 | 1 | 1 | 3 | 3 | 2 | 2 |
| 60 | 2 | 2 | 1 | 1 | 0 | 3 | 2 | 8 | 1 | 0 | 1 | 0 | 0 | 1 | 3 | 1 | 1 | 0 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 3 | 3 | 5 |
| 61 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 4 | 2 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 2 | 0 | 1 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 4 |
| 62 | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 1 | 7 | 1 | 1 | 2 | 1 | 9 |
| 63 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 10 | 0 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 2 |
| 64 | 2 | 0 | 0 | 3 | 0 | 1 | 2 | 3 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 6 | 0 | 1 | 1 | 0 | 3 |
| 65 | 1 | 0 | 0 | 0 | 0 | 1 | 12 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 2 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 66 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 2 |
| 67 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 2 |
| 68 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 3 |
| 69 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 70 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| 71 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 6 | 0 | 0 | 1 | 0 | 0 |
| 72 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 6 | 0 | 0 | 1 | 0 | 1 |
| 73 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| 74 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 75 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 76 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 77 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 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 | 1000 |
| 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 | |
| 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 | |
| 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 |

**Table 11.1.3.** ***Nephrops*** **FU25, North Galicia. Fishing effort and LPUE for SP-CORUTR8c fleet.**

| | SP-CORUTR8c | | |
|---|---|---|---|
| Year | 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 | na | na | na |

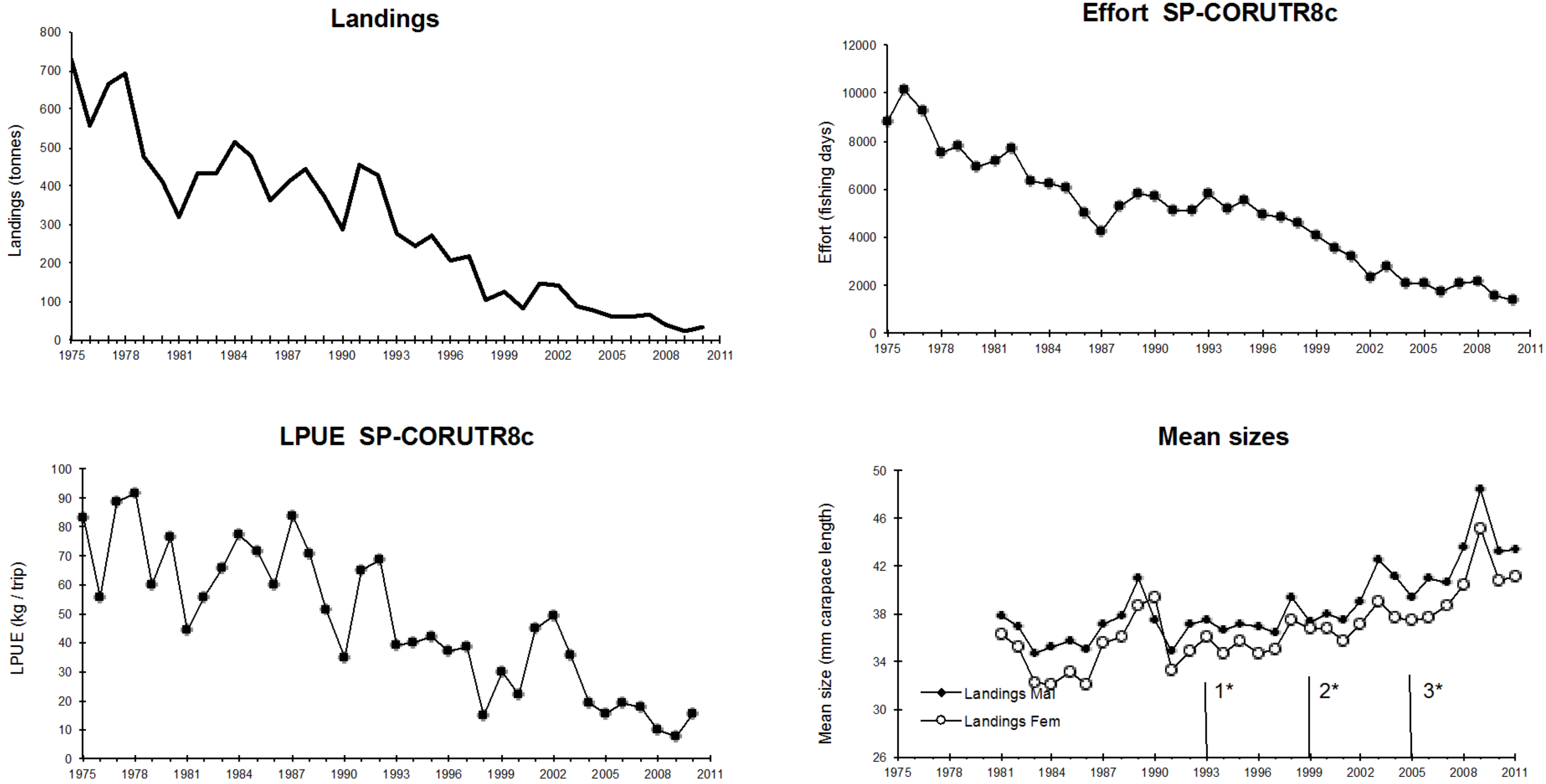



**Figure 11.1.1.** ***Nephrops*** **FU25, North Galicia. Long-term trends in landings, effort, LPUE and mean sizes.**

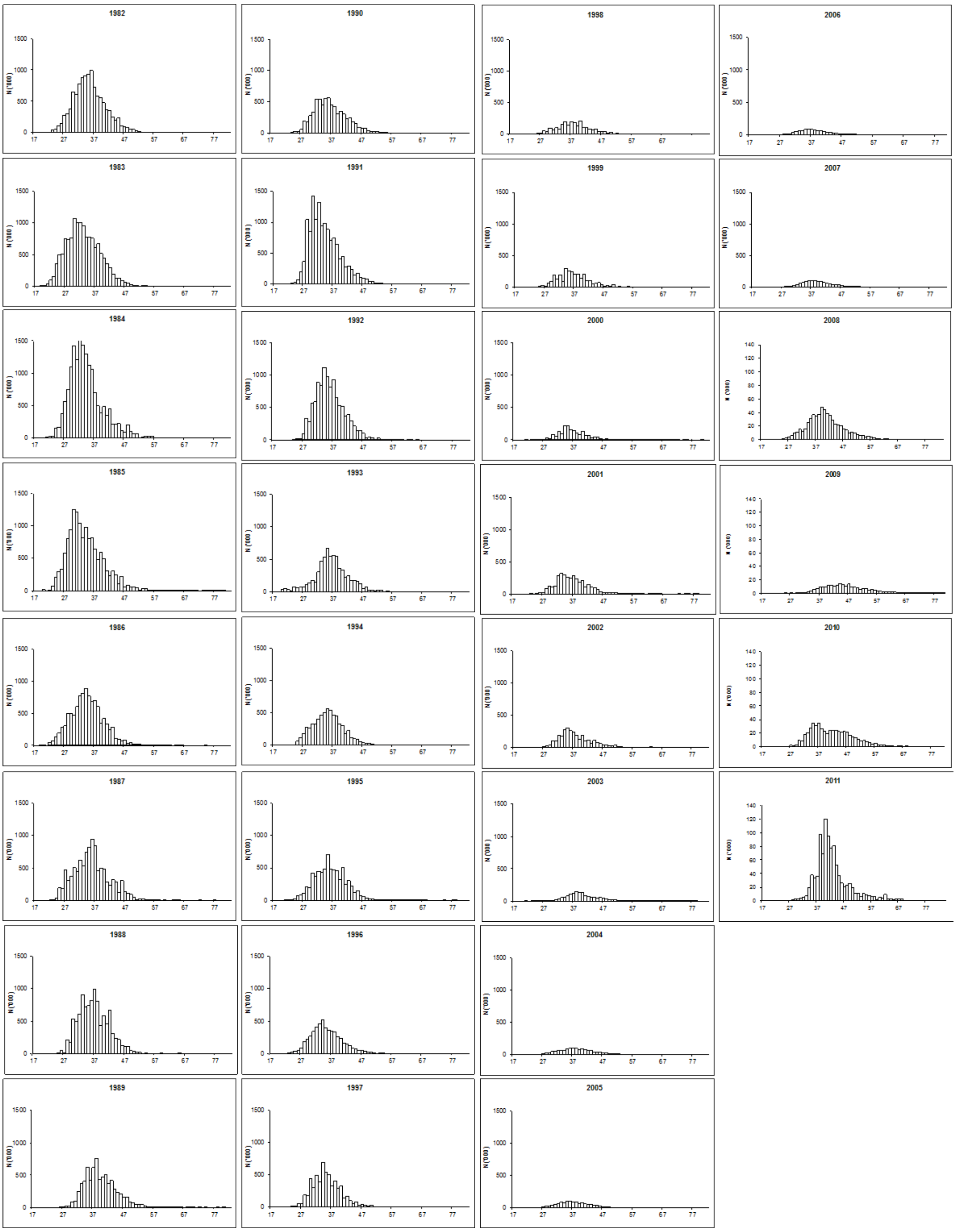



**Figure 11.1.2.** ***Nephrops*** **FU25, North Galicia. Length distributions in landings for the period 1982-2011. In 2011, length distribution in sampling is showed in relative numbers scaled to 1000 individuals. Y-axis has been changed since 2008 onwards.**

## 11.2 *Nephrops* FU 31 (Cantabrian Sea)

Type of assessment: the assessment is based on LPUE and mean size trends. However, it was not possible to include Spanish commercial data for 2011 in the assessment. The trend could not be updated this year. Thus the 1983-2010 LPUE time series has been used.

### 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 2012 and management applicable to 2011 and 2012

*ICES advice for 2012*

The advice for these *Nephrops* stocks is biennial and valid for 2011 and 2012.

Given the depleted state of FU 31 it is not relevant to provide MSY based advice.The new data (landings and lpue) available do not change the perception of FU 31 status, and give no reason to change the advice given in 2010 *Given the very low state of the stock, ICES repeats its advice of a zero catch for the stock in FU 31*.

To protect the stock in this Functional Unit, management should be implemented at the Functional Unit level.

*Management applicable to 2011 and 2012*

TACs of 91 and 82 t were set for the whole of Division VIIIc for 2011 and 2012, 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

Stock landings for the period 1983-2010, as estimated by the WG, are given in Table 11.2.1. Spanish data for 2011 are not included.

Spanish data in 2011 have been provided by the Secretaría General de Pesca (SGP), the official national administration responsible for fishery statistics, and are presented in Annex XX for the whole of the Division VIIIc. Preliminary analysis shows that the formats are not adequate as data were not provided by FU and some assumptions have to be taken for the allocation of the landings. Therefore, the respective value for FU31 could not be properly extracted. In previous years landings have been estimated by the WG based on IEO scientific estimations.

*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 1983-2011. 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 recent years. In 2010, landings decreased to 9 t.

#### 11.2.2.2 Biological sampling

Length frequencies by sex of *Nephrops* landings were collected by the biological sampling programme. The sampling levels are shown in Table 1.3.

Mean size of males and females in the landings fluctuated during 1988-2011 (Figure 11.2.1). Since data from the SGP were not accepted for the assessment; the 2011 length distribution samplings, sampled and provided by IEO, could not be raised to 2011 landings, and are thus given as relative values scaled to 1000 individuals. Data show a general increasing trend for both sexes to 2010 (Figure 11.2.1), with the highest values in 2009 (males with 55.8 mm and females with 45.9 mm CL). In 2011, the mean carapace length was 46.1 mm and 39.4 mm in males and females, respectively.

#### 11.2.2.3 Commercial catch-effort data

The fishing effort data series includes two bottom trawl fleets operating in the Cantabrian Sea with home harbors in Avilés and Santander. However, fishing effort data from Avilés is not available since 2004 and from the fleet of Santander was not available in 2008. In 2011, Spanish landings were not accepted and the respective LPUE could not be estimated. Furthermore, landings and fishing effort are required by harbour and metier, in order to derive LPUE estimates consistent with the previous LPUE time series. 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*. In 2007 fishing effort increased to 1304 fishing days but it declined again to values about 400 fishing days in 2009 and 2010. Information about fishing effort from the Gijon fleet is presented since 2008 (Figure 11.2.1). The fishing effort from this fleet is low level with a decreasing trend with a value of 289 fishing days in 2010.

The LPUE data series (no data available in 2008 and 2011) shows fluctuations around the general downward trend. The LPUE corresponding to Santander fleet (Figure 11.2.1), reached the lowest value of the time series in 2009. In 2010, the Santander and Gijon LPUE increased in almost 50% respect the previous year.

### 11.2.3 Assessment

Last assessment for *Nephrops* FU31, carried out in 2010, was based on the analysis of LPUE and mean size trends. As the time series could not be updated until 2011, this year assessment was conducted by using the available LPUE time series (1983-2010).

### 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. The fishing effort data available for the Santander fleet showed an increase in 2006 and 2007 (no data is available for 2008), but with a great decrease in 2009, which has continued in 2010.

**Table 11.2.1. *Nephrops* FU31, Cantabrian Sea. Landings in tonnes.**

| Year | Trawl | Creel | Total |
|---|---|---|---|
| 1983 | 63 | | 63 |
| 1984 | 100 | | 100 |
| 1985 | 128 | | 128 |
| 1986 | 127 | | 127 |
| 1987 | 118 | | 118 |
| 1988 | 151 | | 151 |
| 1989 | 177 | | 177 |
| 1990 | 174 | | 174 |
| 1991 | 105 | 4 | 109 |
| 1992 | 92 | 2 | 94 |
| 1993 | 95 | 6 | 101 |
| 1994 | 146 | 2 | 148 |
| 1995 | 90 | 4 | 94 |
| 1996 | 120 | 9 | 129 |
| 1997 | 97 | 1 | 98 |
| 1998 | 69 | 3 | 72 |
| 1999 | 46 | 2 | 48 |
| 2000 | 33 | 1 | 34 |
| 2001 | 26 | 1 | 27 |
| 2002 | 25 | 1 | 26 |
| 2003 | 21 | 1 | 22 |
| 2004 | 17 | 0 | 17 |
| 2005 | 14 | 0 | 14 |
| 2006 | 15 | 0 | 15 |
| 2007 | 19 | 0 | 19 |
| 2008 | 19 | 0 | 19 |
| 2009 | 6 | 0 | 6 |
| 2010 | 8 | 0 | 9 |
| 2011 | na | na | na |

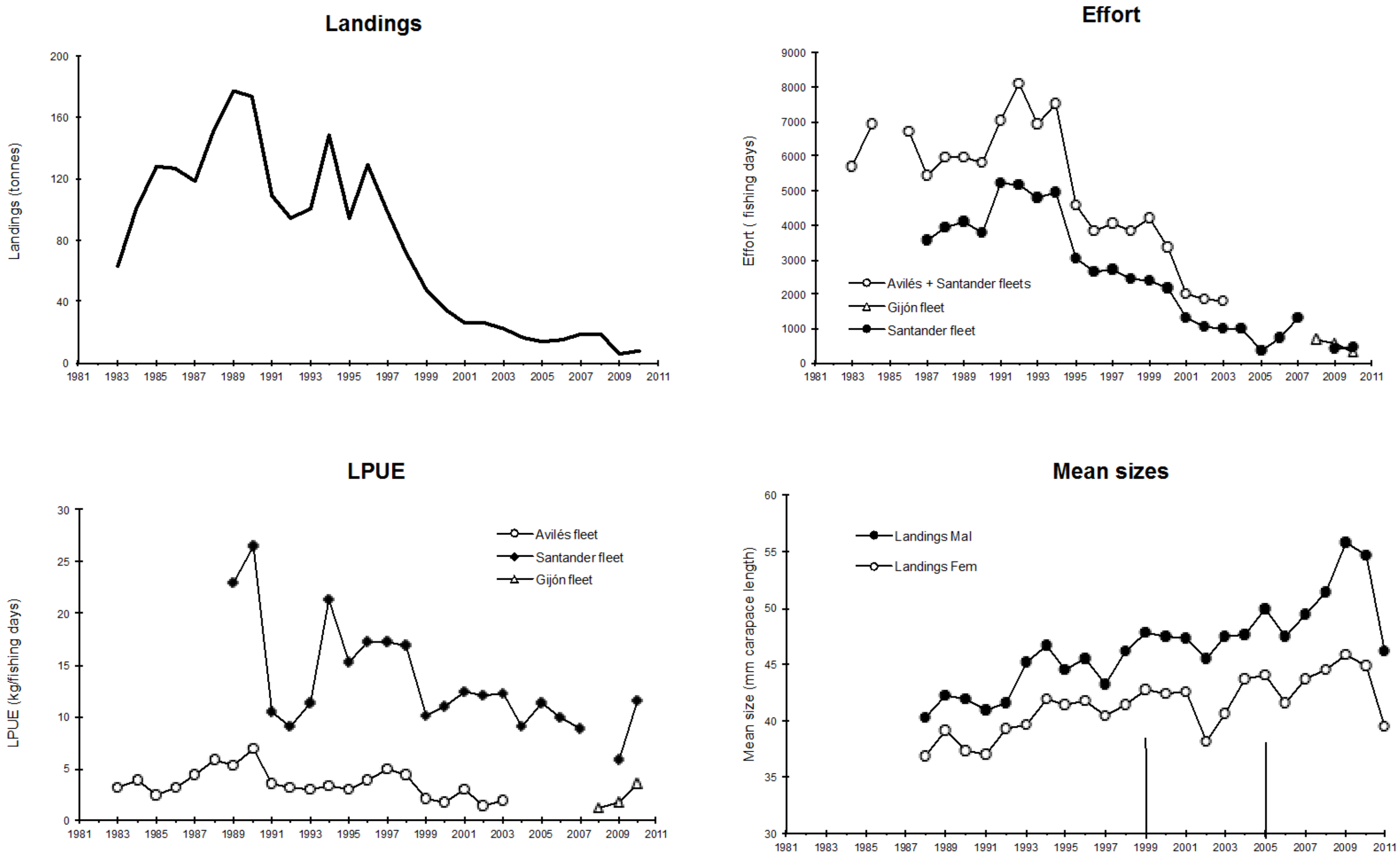



**Figure 11.2.1. Table 11.1.2.** ***Nephrops*** **FU31, Cantabrian Sea. Long-term trends in landings, effort, LPUE and mean sizes.**

## 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. gives the landings in Division VIIIc. Spanish data for 2011 were not accepted for the assessment. The 2011 Spanish landings were provided to the group only on the 11th of May by SGP, and are presented in Annex XX for the whole Division VIIIc, since they were not disaggregated by FU. On the other hand, landings and fishing effort are required by harbour and metier, in order to derive LPUE estimates consistent with the previous LPUE time series. 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 2010 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 11.3.1.** ***Nephrops*** **Division VIIIc.**
**Landings in tonnes by FU and Division VIIIc.**

| Year | FU 25 | FU 31 | 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 | na | na | na |

# 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)

Type of assessment: the assessment is based on LPUEs and mean size trends. However, it was not possible to include Spanish commercial data for 2011 in the assessment. The trend could not be updated this year. Thus the 1984-2010 LPUE time series has been used.

### 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 2012 and management applicable to 2011 and 2012

*ICES advice for 2012*

The advice for these *Nephrops* stocks is biennial and valid for 2011 and 2012.

Given the depleted state of the FU it is not relevant to provide MSY based advice. The new data (landings and lpue) available do not change the perception of FU 26-27 status, and give no reason to change the previous advice of zero catch.

To protect the stock in this Functional Unit, management should be implemented at the Functional Unit level.

*Management applicable to 2011 and 2012*

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 303 and 273 t for 2011 and 2012, respectively, and the maximum number of fishing days per vessel was fixed at 158 and 150 days for Spanish vessels and at 172 and 155 days for Portuguese vessels for these two years (Annex IIb of Council Regulations nos. 57/2011 and 57/2012). 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 Commercial catches and discards

Stock landings for the period 1975-2010, as estimated by the WG, are given in Table 12.1.1. Spanish data for 2011 are not included.

Spanish data in 2011 have been provided by the Secretaría General de Pesca (SGP), the official national administration responsible for fishery statistics, and are presented in Annex XX for the whole of the Division VIIIc. Preliminary analysis shows that the formats are not adequate as data were not provided by FU and some assumptions have to be taken for the allocation of the landings. Therefore, the respective value for FU26 y 27 could not properly extract. In previous years landings have been estimated by the WG based on IEO scientific estimations.

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 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, landings from FU27 were higher than FU26 in 2010. 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 1975-2010 (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 present. In 2010, landings recorded the lowest value in the time series (21 t), representing less than 3 % of the landings prior to 1990. Considering functional units separately, landings from FU26 decreased 13 t in 2010 respect to the respect previous year while in FU27 landings increased 9 t. Fishery statistics for the period 1975-2010 are considered to be reliable since the landings data were extracted from the sale sheets. Discards rates are very low, due to the high value of the species.

Total Portuguese landings from FU 27 have decreased from almost 100 t in 1988 to just 4 t in 2011.

#### 12.1.3.2 Biological sampling

Length frequencies by sex of the *Nephrops* landings are collected monthly. The sampling levels are shown in Table 1.3.

The length frequency distributions were obtained by sampling the commercial landings at the Spanish ports of Marin and Vigo. The monthly sampling programme of the *Nephrops* landings from the FU 26 is considered to be at a sufficient level of intensity to produce reliable length compositions.

Annual length compositions for males and females combined, mean size and mean weight in landings for the period 1988-2010 are given in Table 12.1.2 and Figure 12.1.2. Given that data from the SGP were not accepted for the assessment; the length distribution obtained from the sampling program from IEO could not be raised to total landings in 2011. However, length composition has been given as relative values scaled to 1000 individuals (Table 12.1.2 and Figure 12.1.2).

#### 12.1.3.3 Commercial catch–effort data

Fishing effort and LPUE estimates are available for Marin trawl fleet (SP-MATR) for the period 1990-2010 (Table 12.1.3). The 2011 Spanish data were not accepted and so the LPUE could not be estimated. Landings and fishing effort are required by harbour and métier and were provided for Vigo and Marin combined; besides, units of fishing effort are required in trips instead of fishing days, in order to derive LPUE estimates consistent with the previous LPUE time series.

The overall trend for the LPUE of SP-MATR is decreasing, with some stability in the 2007-2009 period around 17.5 Kg/trip. In 2010, LPUE dropped to 5 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

Last assessment for *Nephrops* FU26-27, carried out in 2010, was based on the analysis of LPUE and mean size trends. As the time series could not be updated until 2011, this year assessment was conducted by using the available LPUE time series (1990-2010).

### 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 3% of the average landings in the early period of the time series (1975-1992). Fishing effort in FU26-27 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.

**Tabla 12.1.1. *Nephrops* FU26-27, West Galicia and North Portugal. Landings in tonnes by Functional Units and country.**

| | Spain | | Portugal | Total |
|---|---|---|---|---|
| Year | FU 26* | FU 27 | FU 27 | 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 | na | na | 4 | na |

**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 1988-2011 period. In 2011, length composition in sampling is showed in relative number scaled to 1000 individuals.**

| Size, CL/Year | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | 0 | 71 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 0 | 69 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | 0 | 451 | 110 | 2 | 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 | 128 | 518 | 17 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 3 |
| 18 | 0 | 683 | 898 | 25 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 16 |
| 19 | 0 | 679 | 1502 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 |
| 20 | 27 | 1057 | 2044 | 97 | 6 | 5 | 10 | 7 | 25 | 3 | 0 | 0 | 86 |
| 21 | 27 | 1260 | 2489 | 199 | 12 | 24 | 19 | 8 | 78 | 0 | 0 | 0 | 119 |
| 22 | 39 | 1657 | 2642 | 398 | 48 | 99 | 84 | 47 | 202 | 12 | 1 | 0 | 129 |
| 23 | 109 | 1901 | 3063 | 568 | 103 | 99 | 77 | 151 | 373 | 26 | 6 | 0 | 127 |
| 24 | 198 | 1626 | 2736 | 1216 | 284 | 222 | 169 | 338 | 550 | 46 | 7 | 3 | 93 |
| 25 | 290 | 2212 | 1802 | 1477 | 541 | 381 | 199 | 672 | 906 | 113 | 45 | 15 | 134 |
| 26 | 574 | 1675 | 1451 | 1516 | 829 | 542 | 289 | 709 | 960 | 184 | 40 | 43 | 145 |
| 27 | 854 | 1878 | 1333 | 1351 | 926 | 904 | 409 | 933 | 746 | 306 | 80 | 68 | 129 |
| 28 | 1272 | 1560 | 1319 | 1940 | 1079 | 1017 | 524 | 1298 | 842 | 402 | 138 | 109 | 123 |
| 29 | 1487 | 1716 | 913 | 1797 | 1023 | 987 | 613 | 1223 | 706 | 489 | 191 | 134 | 143 |
| 30 | 1615 | 1510 | 845 | 1501 | 1069 | 1140 | 767 | 1371 | 792 | 681 | 295 | 195 | 172 |
| 31 | 1960 | 1106 | 632 | 1450 | 1180 | 890 | 802 | 1378 | 609 | 719 | 359 | 239 | 182 |
| 32 | 1951 | 1472 | 772 | 1484 | 1197 | 912 | 847 | 1491 | 601 | 888 | 411 | 292 | 285 |
| 33 | 2288 | 1313 | 601 | 1126 | 1378 | 878 | 898 | 1444 | 517 | 780 | 525 | 377 | 176 |
| 34 | 1581 | 1299 | 572 | 1160 | 1001 | 849 | 853 | 1255 | 542 | 745 | 551 | 376 | 192 |
| 35 | 1487 | 952 | 518 | 1044 | 915 | 855 | 745 | 963 | 506 | 637 | 569 | 432 | 200 |
| 36 | 1161 | 634 | 407 | 879 | 776 | 901 | 611 | 744 | 433 | 527 | 484 | 360 | 176 |
| 37 | 838 | 545 | 284 | 651 | 627 | 736 | 546 | 580 | 348 | 484 | 417 | 321 | 175 |
| 38 | 1196 | 608 | 294 | 616 | 545 | 682 | 621 | 542 | 346 | 534 | 425 | 308 | 128 |
| 39 | 837 | 451 | 226 | 600 | 505 | 510 | 475 | 425 | 285 | 406 | 292 | 240 | 128 |
| 40 | 501 | 325 | 199 | 450 | 666 | 573 | 412 | 455 | 284 | 466 | 393 | 218 | 115 |
| 41 | 428 | 288 | 165 | 375 | 431 | 385 | 321 | 321 | 213 | 399 | 312 | 182 | 112 |
| 42 | 367 | 287 | 144 | 220 | 362 | 375 | 314 | 214 | 182 | 360 | 249 | 210 | 66 |
| 43 | 433 | 296 | 156 | 203 | 425 | 307 | 293 | 188 | 165 | 325 | 292 | 219 | 64 |
| 44 | 164 | 277 | 87 | 136 | 301 | 251 | 200 | 152 | 127 | 290 | 207 | 193 | 61 |
| 45 | 165 | 286 | 58 | 110 | 303 | 219 | 178 | 125 | 118 | 218 | 196 | 162 | 58 |
| 46 | 96 | 135 | 23 | 90 | 350 | 153 | 129 | 116 | 94 | 191 | 178 | 152 | 40 |
| 47 | 94 | 117 | 45 | 82 | 228 | 104 | 92 | 84 | 56 | 123 | 120 | 84 | 38 |
| 48 | 71 | 100 | 25 | 49 | 222 | 58 | 96 | 55 | 70 | 117 | 147 | 96 | 23 |
| 49 | 73 | 76 | 29 | 42 | 148 | 84 | 71 | 46 | 23 | 60 | 105 | 64 | 21 |
| 50 | 83 | 127 | 14 | 46 | 63 | 81 | 69 | 29 | 31 | 81 | 95 | 54 | 17 |
| 51 | 15 | 48 | 9 | 14 | 71 | 27 | 59 | 13 | 21 | 43 | 59 | 21 | 17 |
| 52 | 20 | 75 | 14 | 33 | 71 | 21 | 59 | 18 | 22 | 43 | 55 | 30 | 18 |
| 53 | 23 | 34 | 13 | 26 | 34 | 20 | 28 | 6 | 13 | 30 | 37 | 33 | 5 |
| 54 | 14 | 10 | 11 | 23 | 23 | 14 | 12 | 6 | 15 | 42 | 28 | 27 | 8 |
| 55 | 6 | 27 | 1 | 6 | 13 | 17 | 12 | 1 | 9 | 25 | 26 | 12 | 6 |
| 56 | 6 | 9 | 1 | 5 | 5 | 10 | 5 | 1 | 9 | 14 | 14 | 14 | 7 |
| 57 | 10 | 5 | 1 | 2 | 6 | 5 | 10 | 0 | 4 | 8 | 12 | 6 | 5 |
| 58 | 11 | 5 | 1 | 4 | 6 | 5 | 14 | 0 | 3 | 6 | 11 | 5 | 4 |
| 59 | 7 | 0 | 4 | 0 | 7 | 2 | 7 | 0 | 0 | 2 | 1 | 5 | 3 |
| 60 | 2 | 0 | 2 | 0 | 4 | 3 | 3 | 0 | 0 | 1 | 2 | 3 | 2 |
| 61 | 4 | 0 | 1 | 0 | 3 | 2 | 12 | 0 | 0 | 0 | 2 | 0 | 3 |
| 62 | 2 | 0 | 1 | 0 | 1 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 1 |
| 63 | 1 | 0 | 1 | 0 | 3 | 0 | 5 | 0 | 0 | 1 | 0 | 0 | 3 |
| 64 | 2 | 0 | 1 | 0 | 3 | 1 | 4 | 0 | 0 | 0 | 1 | 0 | 2 |
| 65 | 2 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 |
| 66 | 3 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 2 |
| 67 | 2 | 4 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 3 |
| 68 | 2 | 11 | 1 | 0 | 2 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 2 |
| 69 | 1 | 4 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 70 | 12 | 25 | 1 | 2 | 12 | 6 | 8 | 0 | 1 | 0 | 3 | 0 | 11 |
| 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 |
| 76 | 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 |
| 78 | 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 |
| 80 | 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 |
| 82 | 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 |
| 84 | 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 |
| Total weight (t) | 727 | 708 | 450 | 603 | 636 | 522 | 448 | 511 | 331 | 432 | 344 | 246 | 132 |
| 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 |
| 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 |

| Size, CL/Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 19 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | 52 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 151 | 3 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | 236 | 3 | 27 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 22 | 348 | 11 | 11 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 23 | 518 | 16 | 31 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 24 | 466 | 22 | 17 | 1 | 2 | 1 | 0 | 2 | 0 | 0 | 0 |
| 25 | 441 | 35 | 28 | 1 | 2 | 1 | 0 | 3 | 1 | 0 | 1 |
| 26 | 365 | 56 | 22 | 7 | 2 | 2 | 1 | 2 | 1 | 0 | 0 |
| 27 | 419 | 106 | 40 | 18 | 8 | 5 | 2 | 3 | 1 | 0 | 0 |
| 28 | 274 | 74 | 46 | 23 | 12 | 8 | 6 | 9 | 4 | 0 | 0 |
| 29 | 266 | 86 | 60 | 20 | 15 | 13 | 7 | 7 | 9 | 0 | 2 |
| 30 | 252 | 118 | 90 | 31 | 25 | 20 | 12 | 13 | 11 | 0 | 8 |
| 31 | 209 | 105 | 102 | 27 | 21 | 21 | 13 | 16 | 9 | 1 | 10 |
| 32 | 220 | 160 | 95 | 49 | 29 | 35 | 23 | 27 | 11 | 2 | 19 |
| 33 | 201 | 167 | 84 | 56 | 26 | 40 | 47 | 23 | 11 | 2 | 12 |
| 34 | 156 | 131 | 83 | 56 | 31 | 51 | 43 | 37 | 22 | 5 | 15 |
| 35 | 148 | 96 | 91 | 53 | 26 | 48 | 46 | 25 | 18 | 4 | 25 |
| 36 | 120 | 110 | 85 | 56 | 21 | 42 | 36 | 22 | 15 | 4 | 22 |
| 37 | 143 | 106 | 111 | 70 | 31 | 51 | 49 | 31 | 17 | 7 | 17 |
| 38 | 110 | 76 | 72 | 86 | 35 | 61 | 38 | 28 | 20 | 6 | 26 |
| 39 | 85 | 95 | 79 | 65 | 27 | 43 | 36 | 21 | 14 | 6 | 49 |
| 40 | 65 | 76 | 60 | 90 | 24 | 55 | 39 | 32 | 21 | 7 | 63 |
| 41 | 58 | 88 | 48 | 60 | 21 | 40 | 32 | 23 | 16 | 8 | 48 |
| 42 | 57 | 81 | 54 | 101 | 22 | 47 | 43 | 26 | 14 | 6 | 48 |
| 43 | 36 | 76 | 47 | 73 | 25 | 38 | 49 | 25 | 13 | 9 | 48 |
| 44 | 44 | 52 | 33 | 62 | 20 | 32 | 38 | 36 | 13 | 10 | 45 |
| 45 | 42 | 44 | 34 | 56 | 17 | 18 | 29 | 17 | 12 | 8 | 53 |
| 46 | 28 | 49 | 26 | 29 | 20 | 18 | 24 | 18 | 8 | 10 | 55 |
| 47 | 47 | 42 | 31 | 38 | 26 | 18 | 28 | 17 | 8 | 8 | 47 |
| 48 | 18 | 22 | 13 | 28 | 18 | 12 | 15 | 16 | 7 | 7 | 30 |
| 49 | 16 | 15 | 16 | 18 | 13 | 11 | 14 | 9 | 5 | 7 | 40 |
| 50 | 12 | 12 | 15 | 16 | 15 | 13 | 14 | 9 | 9 | 10 | 60 |
| 51 | 6 | 7 | 15 | 7 | 15 | 7 | 7 | 9 | 6 | 4 | 23 |
| 52 | 6 | 7 | 10 | 12 | 10 | 8 | 10 | 9 | 6 | 5 | 24 |
| 53 | 5 | 6 | 10 | 5 | 7 | 6 | 8 | 4 | 6 | 5 | 22 |
| 54 | 3 | 2 | 8 | 4 | 11 | 10 | 6 | 7 | 4 | 5 | 19 |
| 55 | 7 | 3 | 4 | 5 | 8 | 3 | 6 | 6 | 5 | 7 | 22 |
| 56 | 4 | 3 | 5 | 3 | 4 | 2 | 3 | 6 | 6 | 4 | 20 |
| 57 | 3 | 3 | 2 | 2 | 3 | 2 | 4 | 5 | 5 | 3 | 10 |
| 58 | 5 | 4 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 4 | 10 |
| 59 | 3 | 0 | 1 | 4 | 3 | 1 | 3 | 2 | 2 | 1 | 11 |
| 60 | 2 | 2 | 2 | 7 | 4 | 2 | 1 | 3 | 3 | 4 | 12 |
| 61 | 2 | 0 | 2 | 1 | 14 | 1 | 2 | 1 | 1 | 3 | 6 |
| 62 | 5 | 0 | 2 | 2 | 4 | 2 | 1 | 3 | 2 | 1 | 5 |
| 63 | 3 | 0 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 7 |
| 64 | 2 | 0 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 8 |
| 65 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 10 |
| 66 | 2 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 3 |
| 67 | 1 | 0 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 4 |
| 68 | 1 | 0 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 7 |
| 69 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 3 |
| 70 | 1 | 1 | 5 | 4 | 8 | 1 | 1 | 4 | 1 | 1 | 6 |
| 71 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 9 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 |
| 73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 77 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 81 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 83 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total number (thousand) | 5712 | 2169 | 1666 | 1257 | 638 | 800 | 752 | 569 | 355 | 191 | 1000 |
| Total weight (t) | 132 | 87 | 72 | 70 | 42 | 44 | 46 | 36 | 25 | 19 | |
| Mean weight (kg) | 0,023 | 0,040 | 0,043 | 0,056 | 0,066 | 0,057 | 0,061 | 0,063 | 0,071 | 0,099 | |
| CL Mean length (mm) | 29,5 | 36,0 | 36,2 | 40,2 | 42,0 | 40,0 | 41,3 | 41,5 | 42,6 | 48,4 | 46,5 |

**Table 12.1.2.** ***Nephrops*** **FU26-27, West Galicia and North Portugal. Fishing effort and LPUE for SP-MATR fleet.**

| | | SP-MATR | |
|---|---|---|---|
| Year | Landings (t) | trips | LPUE (kg/trip) |
| 1994 | 234 | 2692 | 113.9 |
| 1995 | 267 | 2859 | 93.3 |
| 1996 | 158 | 3191 | 49.5 |
| 1997 | 245 | 3702 | 66.3 |
| 1998 | 188 | 2857 | 66.0 |
| 1999 | 134 | 2714 | 49.5 |
| 2000 | 72 | 2479 | 28.9 |
| 2001 | 80 | 2374 | 33.6 |
| 2002 | 52 | 1671 | 31.2 |
| 2003 | 59 | 1597 | 24.0 |
| 2004 | 31 | 1980 | 19.3 |
| 2005 | 17 | 1629 | 10.3 |
| 2006 | 18 | 1547 | 11.9 |
| 2007 | 22 | 1196 | 18.0 |
| 2008 | 17 | 980 | 17.3 |
| 2009 | 15 | 854 | 17.4 |
| 2010 | 5 | 867 | 5.3 |
| 2011 | na | na | na |

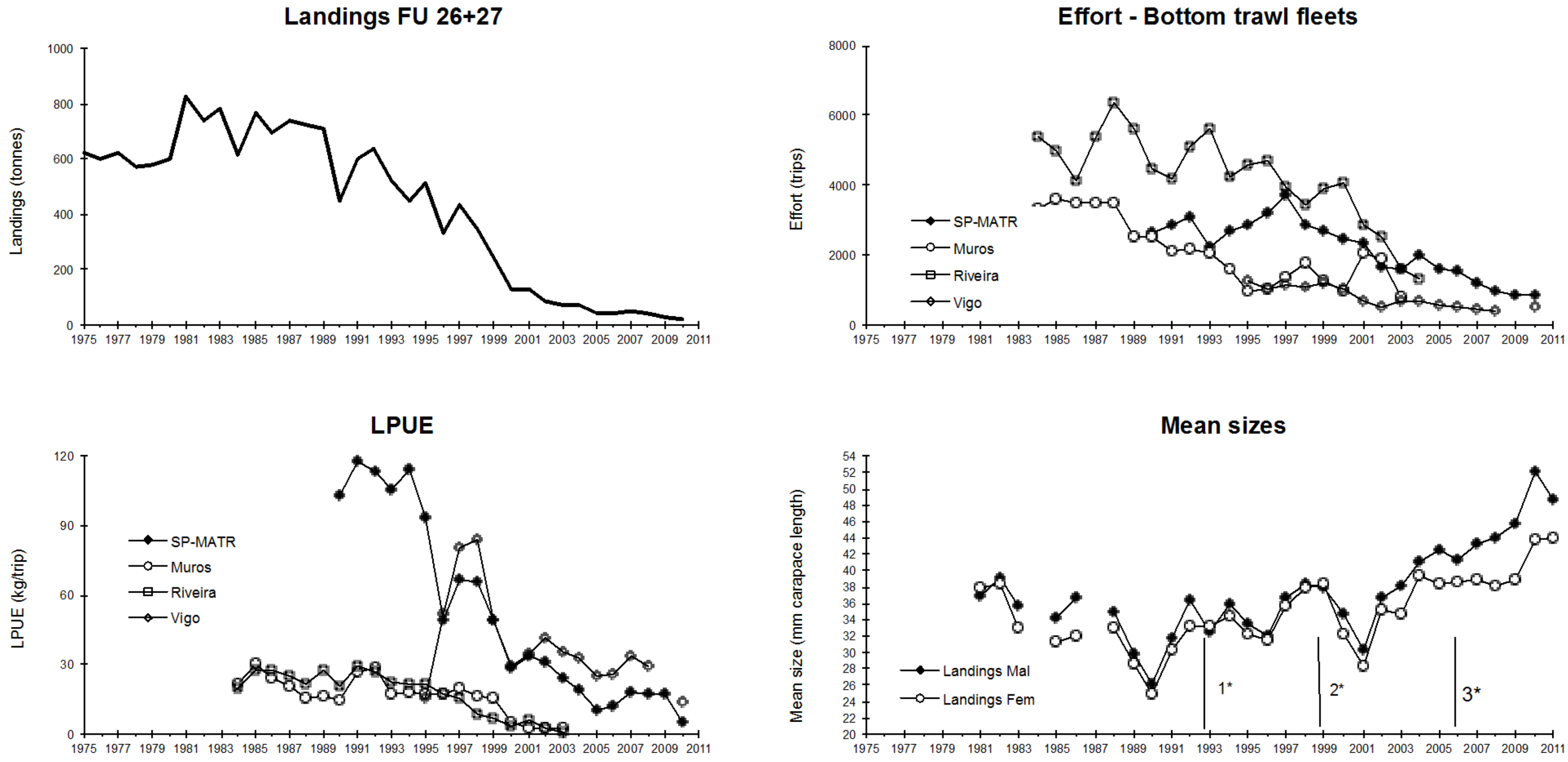



**Figure 12.1.1.** ***Nephrops*** **FU26-27, West Galicia and North Portugal. Long-term trends in landings, effort and mean sizes.**

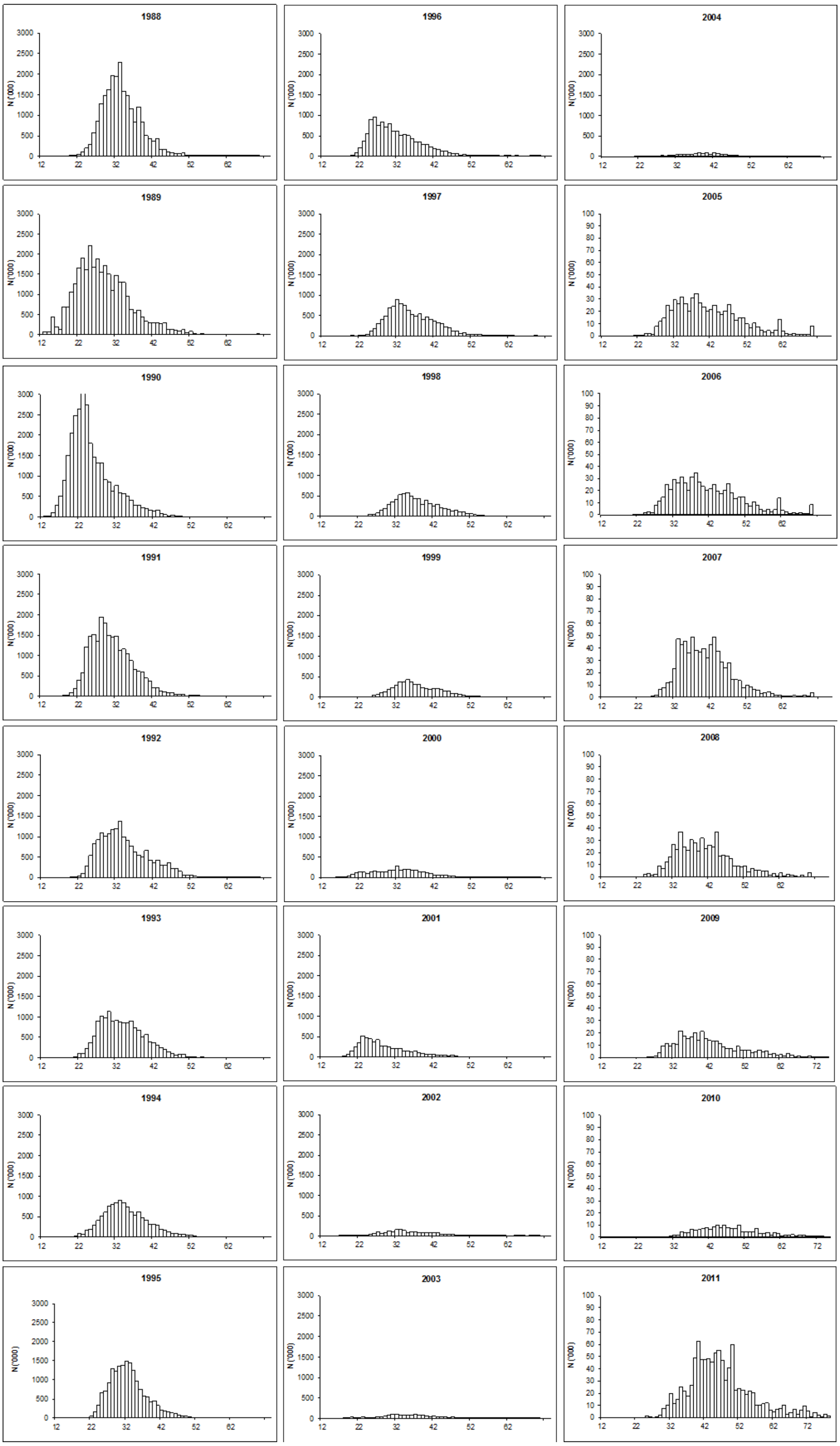



**Figure 12.1.2.** ***Nephrops*** **FU26-27. West Galicia and North Portugal. Lenght distributions in landings for 1988-2011 period. In 2011, length distribution in sampling is showed in relative numbers scaled to 1000 individuals. Y-axis scale has been changed from 2005 to 2011.**

## 12.2 FU 28 – 29 (SW and S Portugal)

### 12.2.1 General

### 12.2.2 Ecosystem aspects

See the Stock Annex (in Annex L of WG report)

### 12.2.3 Fishery description

See the Stock Annex (in Annex L of WG report)

### 12.2.4 ICES Advice for 2011 and Management applicable for 2011 and 2012

*ICES Advice for 2012*

The advice for these stocks is biennial and valid for 2011 and 2012. Management should be implemented at the Functional Unit level.

The stock trend is stable and the exploitation status is unknown. According to ICES MSY approach, catches should be reduced from recent levels. According to PA approach, catches should not exceed the recent average catch (2007-2009), corresponding to landings of 190 t.

*Management applicable for 2011 and 2012*

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 303 and 273 t for 2011 and 2012, respectively, and the maximum number of fishing days per vessel was fixed at 158 and 150 days for Spanish vessels and at 172 and 155 days for Portuguese vessels for these two years (Annex IIb of Council Regulations nos. 57/2011 and 57/2012). 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.

### 12.2.5 Data

#### 12.2.5.1 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 of Portuguese trawl landings in 2009-2010 was approximately at the same level (≈132 t), slightly decreasing in 2011 (117 t).

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 last eight years male to female sex-ratio has been close to 1.5:1.

Information on discards and the raising procedure are presented in Prista and Fernandes, 2012 (WD xx). The frequency of *Nephrops* occurrence in discards samples is very low. Discards are negligible in this fishery and mostly due to quality. In 2011, only 14 individuals were present in the discard samples.

#### 12.2.5.2 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 2011 was at the same level as in the years before. 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 12.2.1a-b and Figures 12.2.2a-b. The number of samples and measured individuals are presented in Table 1.3.

#### 12.2.5.3 Abundance indices from surveys

Over the past decade, several groundfish (PtGFS-WIBTS-Q4) and crustacean trawl surveys (PT-CTS UWTV FU 28-29) were carried out in FUs 28 and 29. Table 12.2.3 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 should provide a better estimation of the abundance for the first ages. There is 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, The R/V "NORUEGA" is reaching the limit of her lifetime and must be replaced. No CPUE index is presented for this year.

The distribution of survey indices (Figure 12.2.3) are in very good agreement with the fishery CPUE spatial distribution. The correlation between the annual CPUE from the fishery and the annual biomass index from the Crustacean survey is high. The values for the years 2010 and 2011 have to be corrected to be comparable with former years.

In 2005 and 2007, some experiments to collect UWTV images from the *Nephrops* fishing grounds were made with a camera hanged from the trawl headline. In 2008, the images collected from 9 stations in FU 28 with the same procedure looked very promising. In 2009 survey, a two-beam laser pointer was attached to the camera and UWTV images were recorded from 58 of the 65 stations. The trawling speed and the turbidity were the main problems affecting the clarity of the image and the high variation of the height of the camera to the ground resulted in a variable field of view. 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).

#### 12.2.5.4 Mean sizes

Mean carapace length (CL) data for males and females in the landings and surveys are presented for the period 1994-2011 (Table 12.2.4). 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.

#### 12.2.5.5 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, 2010x). 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 2006-2009, the landings of rose shrimp increased showing a change in the objectives of the fishery (Figure 12.2.4).

The effort is estimated using the CPUE of the fleet. If the CPUE of *Nephrops* decreased due to a change in target species (and consequently, fishing grounds), the effort might be overestimated.

The model of CPUE standardization used until 2010 never explained more than 20% of the variability (ICES, 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). This WD was also presented and discussed in this WG (WD xx).

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 were removed from the model.

The following factors were retained in the final model, with the following levels (updated to include 2011 data):

- year: 1998 – 2011
- 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 x).

Figure 12.2.5 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 2010 estimate, 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 from 240 days in the year 2006 to 216 in 2007, 194 in 2008, 175 in 2009, 158 days in 2010 and 172 days in 2011 (Council Regulations (EC) No 51/2006, 41/2007, 40/2008, 43/2009, 53/2010 and 57/2011). 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 12.2.2 and Figure 12.2.1), with an exceptional drop in 2003. After 2005, the effort presents a decreasing trend until 2009. Effort has been stable at a low level in last three years. 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). Despite the effort decline, the *Nephrops* standardized CPUE presents a decreasing trend since 2006, and the values of the last three-year period are below the 1998-2011 average.

### 12.2.6 Assessment

These FUs has been assessed using XSA, but the results have been accepted only for trends analysis.

The WD presented to IBP *Nephrops* 2012 has shown the effects of the new standardization model on the XSA diagnostics, performed with the same settings as before. There was an improvement on the residual and retrospective pattern. IBP *Nephrops* 2012 had not come to conclusions at the deadline set in the Terms of Reference (31st March), but noted that:

- the tuning fleet data have been significantly improved;
- different XSA model settings have been looked into and it seems that an F shrinkage of 1, together with making Catchability independent for ages > 4 would be a promising option;
- problems remain as the assessment does not believe the P-CTS (trawl survey) index, and tuning indices themselves have no internal consistency.

Since the benchmark was not finalized no new method was put forward for the working group.

The WG considered that XSA shall be abandoned and other methods be tried. No analytical assessment was performed and the advice will be based on survey and fishery CPUE and effort trends.

### 12.2.7 Short-term Projections

No projections were performed.

### 12.2.8 Biological reference points

No biological reference points are defined for these stocks.

Biological reference points were estimated on the basis of the Yield per Recruit curve and presented in ICES, 2011. However, as no analytical assessment was carried out, it is not possible to assess the stock status in this regard.

### 12.2.9 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 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). The number of allowed fishing days are set in each year regulations (Council Regulations (EC) Nos. 51/2006, 41/2007, 40/2008, 43/2009, 53/2010 and 57/2011).

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 last agreement was signed in 2003 for the next 10-year period. Under this agreement a number of trawlers are licensed to fish crustaceans in Portuguese waters. No information on catches/landings is currently available for these vessels.

**Table 12.2.1.** ***Nephrops*** **in South-West and South Portugal (FU 28-29). Total landings per country (tonnes).**

| Years | FU 28 | FU 29 | FU 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** | | | 16 | 117 | 133 | 133 |

**Table 12.2.2. - SW and S Portugal (FUs 28-29): Effort and CPUE of Portuguese trawlers, 1994-2011 (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 | 5.5 | | |
| 1998 | 25 | 6.4 | 40,808 | 3.9 |
| 1999 | 29 | 7.3 | 41,414 | 5.1 |
| 2000 | 33 | 6.1 | 55,043 | 3.6 |
| 2001 | 33 | 8.2 | 83,840 | 3.2 |
| 2002 | 34 | 10.5 | 71,018 | 5.0 |
| 2003 | 35 | 9.6 | 50,955 | 6.6 |
| 2004 | 33 | 10.4 | 73,593 | 4.7 |
| 2005 | 32 | 11.9 | 64,669 | 5.9 |
| 2006 | 30 | 9.1 | 46,576 | 5.9 |
| 2007 | 30 | 9.1 | 49,527 | 5.5 |
| 2008 | 30 | 6.3 | 34,948 | 5.4 |
| 2009 | 30 | 4.4 | 28,495 | 4.7 |
| 2010 | 26 | 5.0 | 28,074 | 4.7 |
| 2011* | 26 | 4.5 | 27,917 | 4.2 |

* provisional

**Table 12.2.3. - SW and S Portugal (FUs 28-29): *Nephrops* CPUEs (kg/hour) in research trawl surveys, 1994-2011.**

| Year | Demersal surveys | | | Crustacean surveys | |
|---|---|---|---|---|---|
| | CPUE (kg/hour) | | | Month and year of survey | CPUE (kg/hour) |
| | Summer | Autumn | Winter | | |
| 1994 | ns | 0.40 | ns | May-94 | 2.3 |
| 1995 | 1.3 | 0.26 | ns | No surveys 1995-96 | |
| 1996 | ns | 0.03 | ns | | |
| 1997 | 0.7 | 0.06 | ns | Jun-97 | 2.6 |
| 1998 | 0.7 | 0.02 | ns | Jun-98 | 1.2 |
| 1999 | 0.3 | 0.02 | ns | Jun-99 | 2.5 |
| 2000 | 1.0 | 0.92 | ns | Jun-00 | 1.6 |
| 2001 | 0.6 | 0.35 | ns | Jun-01 | 0.8 |
| 2002 | ns | 0.02 | ns | Jun-02 | 2.4 |
| 2003 | ns | 0.19 | ns | Jun-03 | 2.6 |
| 2004 | ns | 0.51 | ns | Jun-04 | nr |
| 2005 | ns | 0.09 | 0.16 | Jun-05 | 4.7 |
| 2006 | ns | 0.19 | 0.06 | Jun-06 | 2.4 |
| 2007 | ns | 0.04 | 0.73 | Jun-07 | 2.8 |
| 2008 | ns | 0.13 | 0.25 | Jun-08 | 4.0 |
| 2009 | ns | 0.13 | ns | Jun-09 | 2.0 |
| 2010 | ns | 0.34 | ns | Jun-10 | 6.8 |
| 2011 | ns | 0.11 | ns | Jun-11 | nc |

ns = no survey nr = not reliable nc = whole area not covered

**Table 12.2.4. - SW and S Portugal (FUs 28-29): Mean sizes (mm CL) of male and female Nephrops in Portuguese landings and surveys, 1994-2011.**

| Year | Landings | | Demersal surveys | | | | | | Crustacean surveys | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Males | Females | Summer | | Autumn | | Winter | | Males | Females |
| | | | Males | Females | Males | Females | Males | Females | | |
| 1994 | 37.4 | 33.6 | ns | ns | 39.0 | 33.6 | ns | ns | ns | ns |
| 1995 | 39.3 | 37.0 | 42.1 | 35.6 | 42.0 | 34.9 | ns | ns | ns | ns |
| 1996 | 36.9 | 36.6 | ns | ns | 38.6 | 32.2 | ns | ns | ns | ns |
| 1997 | 35.9 | 32.8 | 40.4 | 36.9 | 39.1 | 31.7 | ns | ns | 43.7 | 41.9 |
| 1998 | 36.8 | 34.5 | 36.0 | 33.9 | 40.6 | 35.9 | ns | ns | 39.5 | 36.7 |
| 1999 | 38.7 | 34.6 | 45.1 | 40.4 | 43.8 | 32.8 | ns | ns | 39.7 | 37.5 |
| 2000 | 38.9 | 35.2 | 40.8 | 37.1 | 39.0 | 35.1 | ns | ns | 41.7 | 40.2 |
| 2001 | 41.6 | 36.1 | 40.5 | 34.5 | 47.2 | 41.6 | ns | ns | 44.5 | 39.9 |
| 2002 | 40.7 | 36.2 | na | na | 35.0 | 39.0 | ns | ns | 44.8 | 40.7 |
| 2003 | 39.1 | 36.4 | ns | ns | 37.5 | 32.3 | ns | ns | 39.7 | 36.7 |
| 2004 | 37.3 | 33.8 | ns | ns | 36.7 | 31.3 | ns | ns | 39.0 | 37.0 |
| 2005 | 35.6 | 33.0 | ns | ns | 40.6 | 39.1 | 40.6 | 40.9 | 37.3 | 35.7 |
| 2006 | 37.2 | 34.1 | ns | ns | 36.1 | 32.8 | 31.7 | 35.0 | 37.7 | 35.2 |
| 2007 | 36.5 | 32.8 | ns | ns | 42.0 | 38.5 | 39.0 | 36.2 | 38.3 | 35.0 |
| 2008 | 40.1 | 35.5 | ns | ns | 43.2 | 41.4 | 46.7 | 40.6 | 40.1 | 36.7 |
| 2009 | 37.4 | 34.2 | ns | ns | 45.3 | 39.8 | ns | ns | 41.4 | 36.6 |
| 2010 | 40.1 | 36.5 | ns | ns | 39.7 | 33.7 | ns | ns | 37.7 | 36.6 |
| 2011 | 45.0 | 39.2 | ns | ns | 43.1 | 40.0 | ns | ns | nc | nc |

ns = no survey nr = not reliable nc = whole area not covered

**Table 12.2.1.a. FU 28-29 - Length Composition of Nephrops Males (1984-2011)**

Landings (thousands)

| Age/Year | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **17** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **18** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **19** | | | | | 4 | 21 | | | | | 0 | | | | | | | | | 0 | | | | 2 | 0 | | | |
| **20** | | | 0 | 16 | 4 | | | 6 | 4 | | | | | | | 4 | | | | 0 | | 4 | | 3 | 1 | 0 | 0 | |
| **21** | | 17 | 9 | | | 84 | | 16 | 37 | 9 | | | | | | 3 | 3 | 0 | 2 | 0 | 0 | 33 | | 5 | 0 | 0 | 0 | |
| **22** | 7 | 5 | 14 | 15 | | 97 | 9 | 29 | 96 | 38 | 9 | | | | 2 | 0 | 16 | 1 | 2 | 13 | 4 | 51 | 10 | 20 | 8 | 2 | | 0 |
| **23** | 24 | 7 | 7 | 8 | | 143 | 5 | 19 | 55 | 34 | | | 8 | 4 | | 5 | 8 | 3 | 1 | 3 | 15 | 32 | 22 | 31 | 10 | 4 | | 1 |
| **24** | 14 | 40 | 121 | 209 | 51 | 272 | 27 | 53 | 202 | 42 | 18 | | 17 | 9 | 8 | 9 | 20 | 5 | 2 | 11 | 20 | 107 | 53 | 53 | 26 | 29 | 8 | 0 |
| **25** | 109 | 83 | 115 | 81 | 97 | 229 | 116 | 69 | 181 | 149 | 34 | 3 | 23 | 6 | 16 | 39 | 13 | 6 | 3 | 40 | 45 | 120 | 46 | 65 | 28 | 30 | 10 | 1 |
| **26** | 250 | 170 | 137 | 446 | 128 | 205 | 182 | 111 | 263 | 72 | 68 | 0 | 36 | 43 | 32 | 33 | 58 | 8 | 11 | 56 | 126 | 153 | 75 | 121 | 32 | 38 | 8 | 3 |
| **27** | 282 | 326 | 170 | 718 | 208 | 269 | 149 | 94 | 185 | 95 | 77 | 0 | 54 | 95 | 81 | 49 | 85 | 24 | 24 | 87 | 187 | 206 | 94 | 111 | 52 | 63 | 22 | 6 |
| **28** | 374 | 500 | 289 | 871 | 399 | 280 | 337 | 139 | 506 | 272 | 157 | 0 | 56 | 78 | 65 | 68 | 44 | 24 | 48 | 62 | 205 | 286 | 144 | 141 | 60 | 89 | 14 | 4 |
| **29** | 439 | 559 | 341 | 727 | 456 | 283 | 415 | 159 | 462 | 382 | 95 | 28 | 38 | 88 | 65 | 109 | 148 | 53 | 60 | 147 | 246 | 330 | 220 | 189 | 62 | 83 | 33 | 5 |
| **30** | 412 | 742 | 328 | 584 | 442 | 317 | 695 | 239 | 725 | 548 | 187 | 11 | 68 | 104 | 160 | 133 | 87 | 74 | 139 | 248 | 300 | 533 | 290 | 297 | 60 | 129 | 44 | 5 |
| **31** | 277 | 670 | 389 | 742 | 457 | 230 | 813 | 325 | 755 | 548 | 231 | 24 | 92 | 172 | 129 | 272 | 111 | 92 | 123 | 188 | 277 | 573 | 270 | 256 | 93 | 116 | 75 | 22 |
| **32** | 373 | 784 | 680 | 806 | 446 | 367 | 866 | 260 | 670 | 674 | 383 | 108 | 151 | 283 | 289 | 88 | 161 | 274 | 233 | 325 | 475 | 757 | 378 | 295 | 129 | 135 | 116 | 32 |
| **33** | 339 | 531 | 213 | 236 | 428 | 265 | 702 | 133 | 345 | 365 | 149 | 83 | 70 | 90 | 95 | 182 | 92 | 139 | 281 | 248 | 352 | 437 | 247 | 246 | 108 | 80 | 78 | 21 |
| **34** | 389 | 635 | 609 | 721 | 656 | 328 | 785 | 239 | 451 | 655 | 270 | 215 | 159 | 251 | 269 | 152 | 160 | 224 | 257 | 264 | 352 | 574 | 311 | 327 | 150 | 94 | 104 | 52 |
| **35** | 478 | 525 | 590 | 245 | 664 | 291 | 755 | 171 | 296 | 475 | 224 | 169 | 147 | 169 | 118 | 175 | 100 | 173 | 274 | 275 | 347 | 333 | 194 | 252 | 121 | 76 | 83 | 31 |
| **36** | 378 | 463 | 519 | 342 | 572 | 295 | 449 | 138 | 399 | 639 | 221 | 147 | 78 | 154 | 166 | 143 | 158 | 163 | 265 | 195 | 224 | 263 | 168 | 256 | 83 | 59 | 77 | 34 |
| **37** | 528 | 346 | 322 | 406 | 424 | 356 | 465 | 77 | 351 | 391 | 107 | 262 | 172 | 149 | 167 | 128 | 162 | 167 | 247 | 234 | 167 | 293 | 172 | 224 | 109 | 57 | 78 | 64 |
| **38** | 496 | 383 | 606 | 355 | 571 | 302 | 479 | 120 | 378 | 344 | 179 | 134 | 113 | 58 | 85 | 75 | 106 | 99 | 254 | 197 | 147 | 226 | 164 | 265 | 73 | 58 | 125 | 69 |
| **39** | 353 | 309 | 361 | 240 | 326 | 332 | 611 | 126 | 348 | 306 | 95 | 151 | 62 | 46 | 47 | 180 | 81 | 109 | 229 | 174 | 93 | 175 | 100 | 173 | 75 | 61 | 71 | 39 |
| **40** | 447 | 337 | 323 | 156 | 366 | 316 | 829 | 200 | 248 | 174 | 144 | 232 | 83 | 82 | 83 | 83 | 96 | 159 | 254 | 215 | 165 | 152 | 100 | 188 | 77 | 63 | 84 | 44 |
| **41** | 247 | 230 | 316 | 335 | 164 | 314 | 797 | 141 | 243 | 158 | 93 | 247 | 78 | 37 | 53 | 184 | 102 | 130 | 163 | 163 | 108 | 129 | 125 | 163 | 102 | 53 | 55 | 49 |
| **42** | 371 | 246 | 507 | 264 | 215 | 360 | 628 | 174 | 246 | 170 | 168 | 293 | 85 | 33 | 167 | 58 | 91 | 195 | 163 | 168 | 177 | 152 | 190 | 198 | 128 | 105 | 75 | 68 |
| **43** | 199 | 156 | 198 | 62 | 102 | 364 | 335 | 121 | 242 | 107 | 127 | 65 | 31 | 21 | 43 | 102 | 47 | 181 | 167 | 172 | 113 | 118 | 95 | 82 | 76 | 38 | 51 | 45 |
| **44** | 194 | 233 | 422 | 215 | 128 | 481 | 553 | 125 | 371 | 179 | 150 | 88 | 42 | 28 | 69 | 63 | 86 | 173 | 122 | 121 | 122 | 176 | 144 | 90 | 61 | 51 | 65 | 43 |
| **45** | 165 | 144 | 233 | 206 | 93 | 339 | 324 | 90 | 220 | 150 | 87 | 27 | 22 | 21 | 34 | 111 | 61 | 140 | 113 | 103 | 131 | 140 | 96 | 83 | 60 | 25 | 39 | 19 |
| **46** | 148 | 178 | 189 | 170 | 72 | 231 | 228 | 128 | 167 | 55 | 79 | 58 | 21 | 33 | 38 | 67 | 85 | 144 | 106 | 76 | 103 | 117 | 118 | 71 | 38 | 25 | 26 | 15 |
| **47** | 129 | 161 | 140 | 74 | 76 | 191 | 202 | 122 | 191 | 96 | 68 | 31 | 38 | 20 | 34 | 59 | 88 | 120 | 111 | 75 | 97 | 113 | 61 | 60 | 48 | 25 | 43 | 18 |
| **48** | 176 | 212 | 149 | 79 | 85 | 193 | 121 | 62 | 178 | 102 | 78 | 25 | 15 | 9 | 24 | 40 | 55 | 80 | 104 | 83 | 90 | 66 | 54 | 65 | 48 | 23 | 35 | 12 |
| **49** | 89 | 138 | 104 | 58 | 43 | 73 | 92 | 78 | 111 | 47 | 47 | 16 | 20 | 4 | 13 | 50 | 37 | 79 | 86 | 59 | 58 | 52 | 41 | 38 | 34 | 24 | 23 | 12 |
| **50** | 91 | 142 | 50 | 34 | 53 | 94 | 58 | 67 | 69 | 30 | 50 | 12 | 9 | 3 | 33 | 32 | 65 | 93 | 103 | 94 | 82 | 69 | 28 | 42 | 36 | 20 | 25 | 11 |
| **51** | 66 | 120 | 63 | 27 | 34 | 114 | 59 | 44 | 50 | 38 | 29 | 4 | 6 | 7 | 14 | 32 | 34 | 71 | 72 | 65 | 41 | 40 | 30 | 37 | 27 | 17 | 20 | 15 |
| **52** | 64 | 135 | 66 | 44 | 38 | 77 | 33 | 40 | 35 | 15 | 46 | 11 | 16 | 7 | 31 | 8 | 53 | 88 | 94 | 73 | 65 | 45 | 37 | 48 | 29 | 32 | 30 | 24 |
| **53** | 45 | 99 | 32 | 37 | 23 | 40 | 19 | 16 | 29 | 18 | 22 | 5 | 6 | 6 | 11 | 13 | 18 | 41 | 69 | 58 | 31 | 22 | 22 | 21 | 24 | 13 | 16 | 9 |
| **54** | 73 | 101 | 35 | 45 | 22 | 35 | 27 | 29 | 50 | 23 | 18 | 5 | 8 | 16 | 19 | 15 | 31 | 54 | 53 | 57 | 50 | 24 | 33 | 27 | 23 | 19 | 21 | 24 |
| **55** | 20 | 67 | 25 | 31 | 22 | 37 | 30 | 26 | 29 | 19 | 9 | 3 | 4 | 10 | 8 | 9 | 19 | 34 | 28 | 46 | 26 | 12 | 15 | 10 | 20 | 12 | 14 | 15 |
| **56** | 20 | 35 | 14 | 20 | 16 | 20 | 30 | 19 | 5 | 5 | 11 | 2 | 4 | 3 | 6 | 13 | 19 | 29 | 43 | 29 | 57 | 14 | 11 | 8 | 15 | 13 | 8 | 25 |
| **57** | 10 | 33 | 5 | 15 | 12 | 22 | 7 | 10 | 6 | 5 | 11 | 3 | 7 | 16 | 8 | 8 | 19 | 37 | 37 | 25 | 16 | 9 | 6 | 6 | 17 | 11 | 9 | 25 |
| **58** | 13 | 14 | 8 | 14 | 11 | 17 | 14 | | 11 | 4 | 6 | | 5 | 3 | 5 | 4 | 13 | 23 | 26 | 21 | 12 | 9 | 7 | 7 | 20 | 7 | 11 | 45 |
| **59** | 7 | 10 | 3 | 9 | 4 | 16 | 5 | 2 | 9 | 3 | 10 | 0 | 5 | 2 | 3 | 4 | 10 | 15 | 16 | 13 | 15 | 8 | 9 | 5 | 11 | 4 | 6 | 19 |
| **60** | 3 | 6 | 3 | 4 | 3 | 13 | 2 | | 10 | 8 | 1 | 1 | 1 | 4 | 1 | 1 | 8 | 15 | 25 | 16 | 24 | 12 | 6 | 3 | 9 | 7 | 5 | 13 |
| **61** | 3 | 1 | 4 | 4 | 1 | 5 | | 1 | 3 | 2 | 1 | 0 | 1 | 9 | 1 | 2 | 14 | 9 | 11 | 8 | 11 | 8 | 8 | 4 | 8 | 4 | 5 | 7 |
| **62** | 3 | 1 | 2 | 1 | 2 | 3 | | 1 | 7 | 5 | 1 | | 2 | 7 | 1 | 3 | 6 | 10 | 11 | 15 | 16 | 8 | 8 | 3 | 15 | 8 | 6 | 22 |
| **63** | 1 | 1 | | 1 | 1 | 4 | | 5 | 0 | 1 | 0 | | 2 | 3 | 0 | 2 | 1 | 4 | 11 | 11 | 7 | 7 | 7 | 1 | 8 | 4 | 6 | 7 |
| **64** | | 2 | 0 | 2 | 1 | | | 1 | 3 | 1 | 2 | | 0 | 4 | 0 | 1 | 1 | 9 | 11 | 8 | 10 | 10 | 7 | 1 | 10 | 6 | 5 | 17 |
| **65** | 0 | 0 | | 2 | 2 | | | | 3 | 1 | 1 | | 0 | 4 | | 0 | 4 | 6 | 5 | 4 | 3 | 10 | 7 | 1 | 9 | 2 | 3 | 9 |
| **66** | 0 | | | 0 | 1 | | | | | 1 | | | 0 | 4 | 0 | | 1 | 5 | 8 | 3 | 7 | 3 | 4 | 2 | 11 | 1 | 3 | 5 |
| **67** | 0 | | | 0 | 0 | 0 | | | 6 | 5 | | | | 6 | 0 | | | 4 | 3 | 5 | 2 | 2 | 6 | 1 | 6 | 1 | 3 | 3 |
| **68** | | | | | 0 | 2 | | | | 0 | 1 | | | 0 | 0 | | | 1 | 6 | 6 | 2 | 3 | 4 | 0 | 8 | 0 | 4 | 3 |
| **69** | | | | 0 | | | | | | | | | | 0 | 0 | | 0 | 3 | 3 | 2 | 2 | 2 | 4 | 1 | 4 | 1 | 0 | 2 |
| **70** | 0 | | | 1 | | 0 | | | | 2 | | | | 0 | 0 | | 0 | 6 | 2 | 4 | 3 | 4 | 5 | 0 | 4 | 1 | 0 | 1 |
| **71** | | | | | | | | | | 0 | | | | | 0 | | | 2 | 2 | 4 | 1 | 1 | 3 | 1 | 2 | 0 | 0 | 0 |
| **72** | | | | 0 | | 0 | | | | 1 | | | | | 0 | | | 2 | 2 | 4 | 1 | 3 | 4 | 0 | 3 | 1 | 0 | 1 |
| **73** | | | | | | | | | | | | | | 0 | | | 0 | 0 | 1 | 1 | 1 | 2 | 2 | | 1 | 0 | 0 | 1 |
| **74** | 0 | | | | | | | | | 1 | | | | | | | | 0 | 1 | 1 | 1 | 3 | 1 | | 1 | 1 | 0 | 1 |
| **75** | | | | | | | | | | | | | | | | | | 0 | 1 | 0 | 0 | 1 | 1 | | 1 | 1 | 2 | 0 |
| **76** | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 1 | | 1 | 0 | | 0 |
| **77** | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 1 | | 1 | 0 | 0 | 0 |
| **78** | | 0 | | | 0 | | | | | | | | | | | | | | | | 0 | 1 | | | 0 | | | 0 |
| **79** | | | | | | | | | | | | | | | | | | | 0 | | 0 | 1 | 0 | | 0 | 0 | | |
| **80** | | | | | | | | | 0 | | | | | | | | | | | | | 0 | | | 0 | | | 0 |
| **81** | | | | | | | | | | | | | | | | | | | | | | | 0 | | 0 | 0 | | |
| **82** | | | | | | | | | | | | | | | | | | | 0 | | | | 0 | | 0 | 0 | | |
| **83** | | | | | | | | | | | | | | | | | | | | | | | | | 0 | | | |
| **Total** | **8106** | **9897** | **8709** | **9679** | **7925** | **8329** | **12255** | **4023** | **9249** | **7463** | **3766** | **2466** | **1854** | **2200** | **2491** | **2811** | **2680** | **3602** | **4486** | **4575** | **5233** | **7036** | **4259** | **4598** | **2280** | **1822** | **1649** | **1018** |
| **Landings (t)** | **292** | **353** | **315** | **277** | **249** | **318** | **351** | **345** | **304** | **232** | **139** | **98** | **65** | **74** | **88** | **116** | **117** | **190** | **222** | **205** | **205** | **231** | **162** | **159** | **114** | **73** | **79** | **72** |

**Table 12.2.1.b. FU 28-29 - Length Composition of Nephrops Females (1984-2011)**

Landings (thousands)

| Age/Year | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | | | | | | | | | | | | | | | | | | | | 0 | | | | | | | | |
| 18 | | | | | 4 | | | | | | | | | | | | | | | | 0 | | | | 0 | | | |
| 19 | | 0 | | | | 35 | | | | | 0 | | | | | | | | | 1 | | | | 2 | 0 | | | |
| 20 | 3 | 1 | 7 | | 8 | 21 | | | | 18 | | | | | | | | 0 | | 0 | 0 | 8 | | 4 | 1 | | | |
| 21 | 1 | 1 | 22 | 3 | 21 | 102 | | 21 | 9 | 49 | | | | | | | 3 | 1 | 0 | 3 | 12 | 48 | 3 | 15 | 2 | 1 | | |
| 22 | 8 | 21 | 30 | 78 | | 88 | 19 | 11 | 102 | 63 | | | 0 | 13 | 2 | 5 | 18 | 0 | | 3 | 10 | 88 | 14 | 26 | 12 | 1 | 0 | |
| 23 | 66 | 21 | 7 | 31 | 28 | 135 | 15 | 69 | 38 | 21 | 2 | | 0 | 0 | 4 | 4 | 6 | 7 | 0 | 9 | 43 | 54 | 37 | 34 | 11 | 4 | 1 | 1 |
| 24 | 79 | 102 | 118 | 270 | 153 | 258 | 38 | 173 | 164 | 41 | 22 | 2 | 11 | 20 | 15 | 25 | 49 | 7 | 10 | 19 | 62 | 135 | 44 | 53 | 25 | 22 | 10 | 1 |
| 25 | 228 | 205 | 104 | 357 | 163 | 197 | 138 | 198 | 203 | 191 | 73 | | 13 | 20 | 25 | 27 | 24 | 15 | 11 | 36 | 101 | 129 | 55 | 130 | 23 | 23 | 11 | 1 |
| 26 | 272 | 284 | 186 | 684 | 220 | 282 | 140 | 436 | 361 | 111 | 92 | 1 | 35 | 102 | 74 | 94 | 81 | 24 | 15 | 67 | 211 | 272 | 113 | 227 | 38 | 80 | 12 | 3 |
| 27 | 345 | 491 | 359 | 902 | 429 | 326 | 247 | 418 | 448 | 235 | 134 | 0 | 37 | 77 | 91 | 76 | 139 | 34 | 34 | 67 | 266 | 294 | 152 | 298 | 73 | 138 | 20 | 7 |
| 28 | 431 | 523 | 322 | 1421 | 471 | 231 | 345 | 598 | 597 | 413 | 170 | 6 | 36 | 152 | 148 | 100 | 64 | 44 | 107 | 98 | 336 | 242 | 179 | 355 | 81 | 170 | 26 | 7 |
| 29 | 443 | 672 | 419 | 1253 | 516 | 285 | 491 | 590 | 514 | 523 | 269 | 31 | 45 | 178 | 114 | 121 | 171 | 90 | 127 | 173 | 395 | 420 | 392 | 458 | 123 | 149 | 51 | 4 |
| 30 | 422 | 588 | 381 | 928 | 499 | 317 | 575 | 771 | 599 | 775 | 326 | 104 | 50 | 199 | 199 | 236 | 152 | 131 | 237 | 241 | 406 | 654 | 321 | 365 | 145 | 205 | 67 | 7 |
| 31 | 487 | 593 | 418 | 948 | 482 | 501 | 639 | 414 | 736 | 752 | 427 | 182 | 95 | 394 | 168 | 263 | 131 | 167 | 195 | 152 | 334 | 565 | 305 | 317 | 129 | 132 | 99 | 26 |
| 32 | 485 | 653 | 700 | 946 | 766 | 306 | 859 | 807 | 617 | 824 | 558 | 322 | 198 | 502 | 376 | 485 | 283 | 316 | 296 | 360 | 530 | 857 | 510 | 409 | 252 | 209 | 145 | 45 |
| 33 | 613 | 415 | 406 | 227 | 527 | 314 | 596 | 375 | 430 | 449 | 283 | 251 | 53 | 163 | 116 | 187 | 153 | 184 | 467 | 270 | 433 | 448 | 272 | 253 | 182 | 110 | 91 | 51 |
| 34 | 618 | 467 | 654 | 774 | 813 | 511 | 734 | 310 | 369 | 359 | 353 | 641 | 209 | 278 | 298 | 346 | 235 | 252 | 429 | 314 | 400 | 462 | 341 | 386 | 177 | 122 | 140 | 96 |
| 35 | 562 | 563 | 447 | 447 | 460 | 435 | 519 | 284 | 287 | 194 | 246 | 674 | 184 | 150 | 112 | 287 | 193 | 158 | 470 | 255 | 324 | 254 | 249 | 351 | 187 | 103 | 120 | 56 |
| 36 | 469 | 329 | 316 | 386 | 489 | 274 | 243 | 130 | 267 | 203 | 237 | 811 | 142 | 135 | 166 | 317 | 225 | 174 | 351 | 194 | 222 | 203 | 162 | 213 | 103 | 83 | 144 | 60 |
| 37 | 505 | 353 | 400 | 223 | 206 | 318 | 189 | 108 | 333 | 154 | 147 | 692 | 267 | 129 | 171 | 201 | 213 | 144 | 302 | 203 | 178 | 182 | 142 | 240 | 121 | 90 | 119 | 73 |
| 38 | 383 | 284 | 330 | 269 | 265 | 285 | 207 | 135 | 251 | 100 | 128 | 348 | 151 | 39 | 48 | 184 | 85 | 108 | 300 | 206 | 151 | 178 | 152 | 247 | 134 | 83 | 106 | 151 |
| 39 | 274 | 142 | 211 | 146 | 288 | 148 | 216 | 74 | 176 | 150 | 66 | 194 | 67 | 35 | 59 | 151 | 92 | 112 | 213 | 160 | 113 | 89 | 173 | 138 | 123 | 86 | 95 | 113 |
| 40 | 171 | 119 | 80 | 119 | 132 | 131 | 230 | 131 | 147 | 110 | 114 | 344 | 120 | 21 | 89 | 111 | 79 | 133 | 186 | 284 | 136 | 84 | 114 | 109 | 125 | 62 | 80 | 68 |
| 41 | 58 | 106 | 55 | 65 | 128 | 149 | 73 | 39 | 68 | 108 | 77 | 361 | 63 | 31 | 64 | 81 | 66 | 79 | 110 | 170 | 82 | 73 | 129 | 73 | 95 | 83 | 65 | 65 |
| 42 | 50 | 36 | 133 | 54 | 43 | 127 | 210 | 62 | 69 | 95 | 73 | 165 | 111 | 18 | 84 | 73 | 67 | 91 | 80 | 192 | 122 | 116 | 112 | 56 | 75 | 94 | 52 | 80 |
| 43 | 30 | 27 | 21 | 40 | 28 | 109 | 58 | 82 | 26 | 43 | 23 | 64 | 29 | 2 | 34 | 38 | 41 | 55 | 87 | 132 | 70 | 70 | 44 | 16 | 30 | 25 | 28 | 80 |
| 44 | 17 | 13 | 47 | 147 | 27 | 91 | 77 | 6 | 46 | 42 | 43 | 88 | 90 | 18 | 71 | 34 | 49 | 56 | 57 | 75 | 66 | 61 | 46 | 21 | 24 | 43 | 40 | 41 |
| 45 | 14 | 11 | 27 | 84 | 19 | 27 | 41 | 21 | 40 | 34 | 13 | 54 | 36 | 8 | 22 | 18 | 23 | 29 | 51 | 68 | 66 | 50 | 35 | 18 | 28 | 17 | 25 | 21 |
| 46 | 7 | 6 | 5 | 40 | 14 | 38 | 31 | 45 | 25 | 37 | 11 | 13 | 15 | 4 | 28 | 18 | 38 | 33 | 40 | 37 | 51 | 39 | 54 | 19 | 14 | 22 | 19 | 11 |
| 47 | 5 | 3 | 3 | 26 | 9 | 24 | 16 | 7 | 12 | 29 | 7 | 18 | 23 | 3 | 23 | 7 | 52 | 26 | 25 | 25 | 44 | 35 | 23 | 9 | 26 | 16 | 18 | 15 |
| 48 | 4 | 1 | | 71 | 11 | 29 | 7 | 15 | 18 | 15 | 4 | 15 | 8 | 2 | 6 | 9 | 25 | 12 | 24 | 28 | 37 | 18 | 11 | 8 | 20 | 7 | 12 | 9 |
| 49 | 1 | 0 | 3 | 17 | 4 | 9 | 1 | 17 | 17 | 23 | 4 | 1 | 6 | 7 | 6 | 4 | 21 | 15 | 19 | 18 | 24 | 24 | 7 | 7 | 13 | 6 | 7 | 7 |
| 50 | 1 | 0 | | 2 | 6 | 3 | 1 | 2 | 32 | 8 | 17 | 1 | 2 | 1 | 6 | 5 | 10 | 15 | 26 | 24 | 20 | 23 | 7 | 3 | 13 | 8 | 7 | 2 |
| 51 | 0 | 0 | 3 | 4 | 3 | 7 | 2 | 4 | 4 | 5 | 0 | | | 1 | 2 | 2 | 10 | 9 | 22 | 14 | 13 | 17 | 11 | 5 | 11 | 3 | 6 | 5 |
| 52 | 1 | | | 5 | 5 | 8 | 1 | | 5 | 6 | 1 | 1 | 0 | 1 | 1 | 3 | 16 | 6 | 19 | 21 | 13 | 17 | 7 | 3 | 7 | 3 | 4 | 4 |
| 53 | 2 | | | 2 | 3 | 1 | | | 9 | 6 | 0 | | | 0 | 0 | | 6 | 6 | 10 | 13 | 8 | 10 | 2 | 1 | 8 | 3 | 2 | 3 |
| 54 | | | | 4 | 1 | 1 | | | 1 | 1 | | | 1 | 0 | 1 | | 5 | 2 | 2 | 14 | 7 | 6 | 9 | 1 | 8 | 1 | 2 | 5 |
| 55 | | | | 0 | 1 | 1 | | | 6 | 2 | | | | | | | 1 | 2 | 3 | 10 | 4 | 5 | 1 | 1 | 3 | 4 | 0 | 5 |
| 56 | | | | 3 | 0 | 2 | | 5 | 14 | 5 | | | | | 0 | | 3 | 1 | 3 | 7 | 6 | 2 | 1 | 0 | 3 | 0 | 0 | 2 |
| 57 | | | | 0 | 0 | 1 | | | 4 | 1 | | | 0 | | 0 | | 1 | 0 | 2 | 4 | 2 | 3 | 1 | | 1 | 0 | 0 | 1 |
| 58 | | | | 0 | | 0 | | | 4 | 1 | | | | | | | | 1 | 1 | 1 | 2 | 0 | 1 | 0 | 1 | 1 | 0 | 4 |
| 59 | | | | 1 | 0 | 0 | | | | | | | | | | | 0 | 1 | 0 | 0 | 1 | 1 | 1 | | | 0 | 0 | 2 |
| 60 | | | | | 0 | | | | 1 | 0 | | | | | | | | 0 | | 0 | | 2 | | | 1 | | 0 | 2 |
| 61 | | | | | | 1 | | | | | | | | | | | 3 | 1 | | 0 | 1 | | | | | 0 | 0 | 1 |
| 62 | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 1 | 0 | | | | 0 | 0 |
| 63 | | | | | | | | | 4 | 1 | | | | | | | | 0 | 0 | | | 0 | | | | 0 | 0 | 2 |
| 64 | | | | | | | | | | | | | | | | | | | | | 1 | 0 | | 0 | 0 | 0 | | |
| 65 | | | | | | | | | | | | | | | | | | | | | 0 | 0 | | | | | | 0 |
| 66 | | | | | | | | | | | | | | | | | 0 | 0 | | | | 0 | | | | | | |
| 67 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 68 | | | | | | | | | 4 | 1 | | | | | | | | | | | | | | | | | | |
| 69 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 70 | | | | | | | | | | | | | | | | | | | | | 0 | | | | | 0 | | |
| 71 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 72 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 73 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 74 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 75 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 76 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 77 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 78 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 79 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 81 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 82 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 83 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Total** | **7052** | **7032** | **6218** | **10978** | **7243** | **6126** | **6962** | **6358** | **7059** | **6198** | **3920** | **5385** | **2095** | **2702** | **2621** | **3509** | **2829** | **2540** | **4332** | **3969** | **5304** | **6240** | **4229** | **4871** | **2449** | **2211** | **1628** | **1138** |
| **Landings (t)** | **169** | **156** | **150** | **232** | **171** | **151** | **174** | **134** | **165** | **145** | **97** | **174** | **67** | **62** | **72** | **95** | **84** | **79** | **135** | **130** | **140** | **151** | **112** | **114** | **74** | **60** | **52** | **45** |

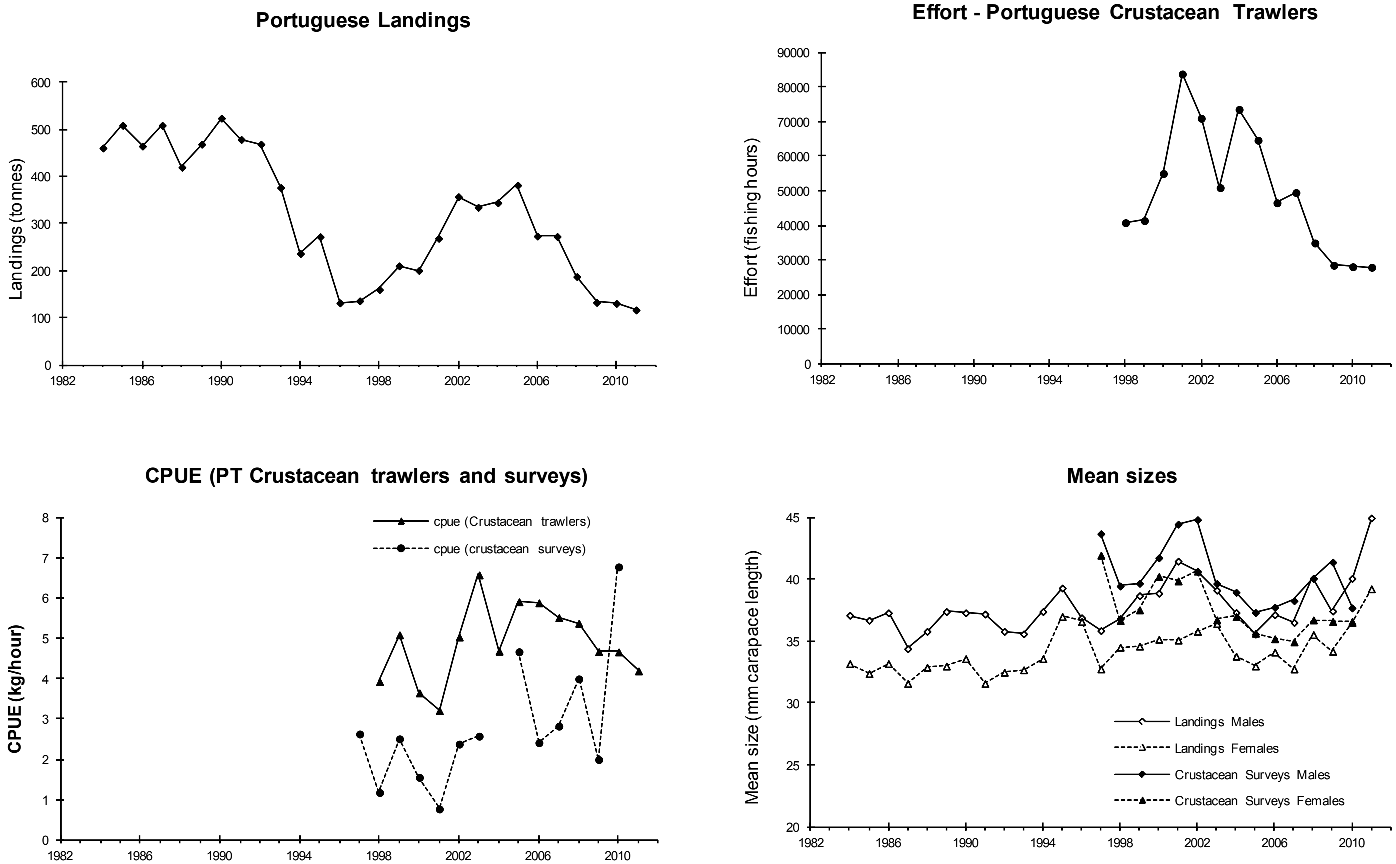



**Figure 12.2.1.** **SW and S Portugal (FU 28+29): landings, effort, biomass indices and mean sizes of *Nephrops* in Portuguese landings and surveys. Note: Values of CPUEs and effort updated with the new CPUE standardization.**

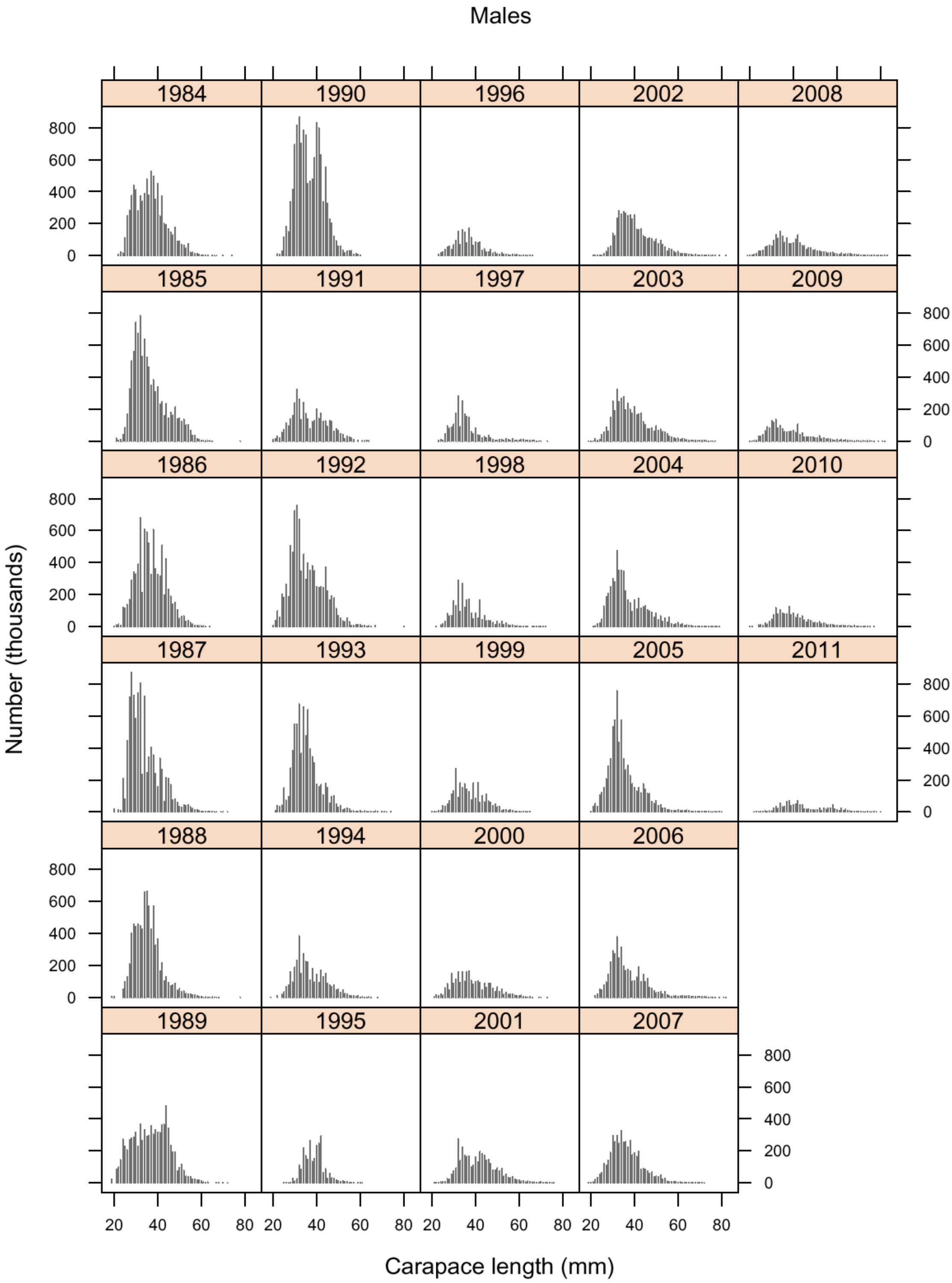



**Figure 12.2.2.a. SW and S Portugal (FU 28-29) male length distributions for the period 1984-2011.**

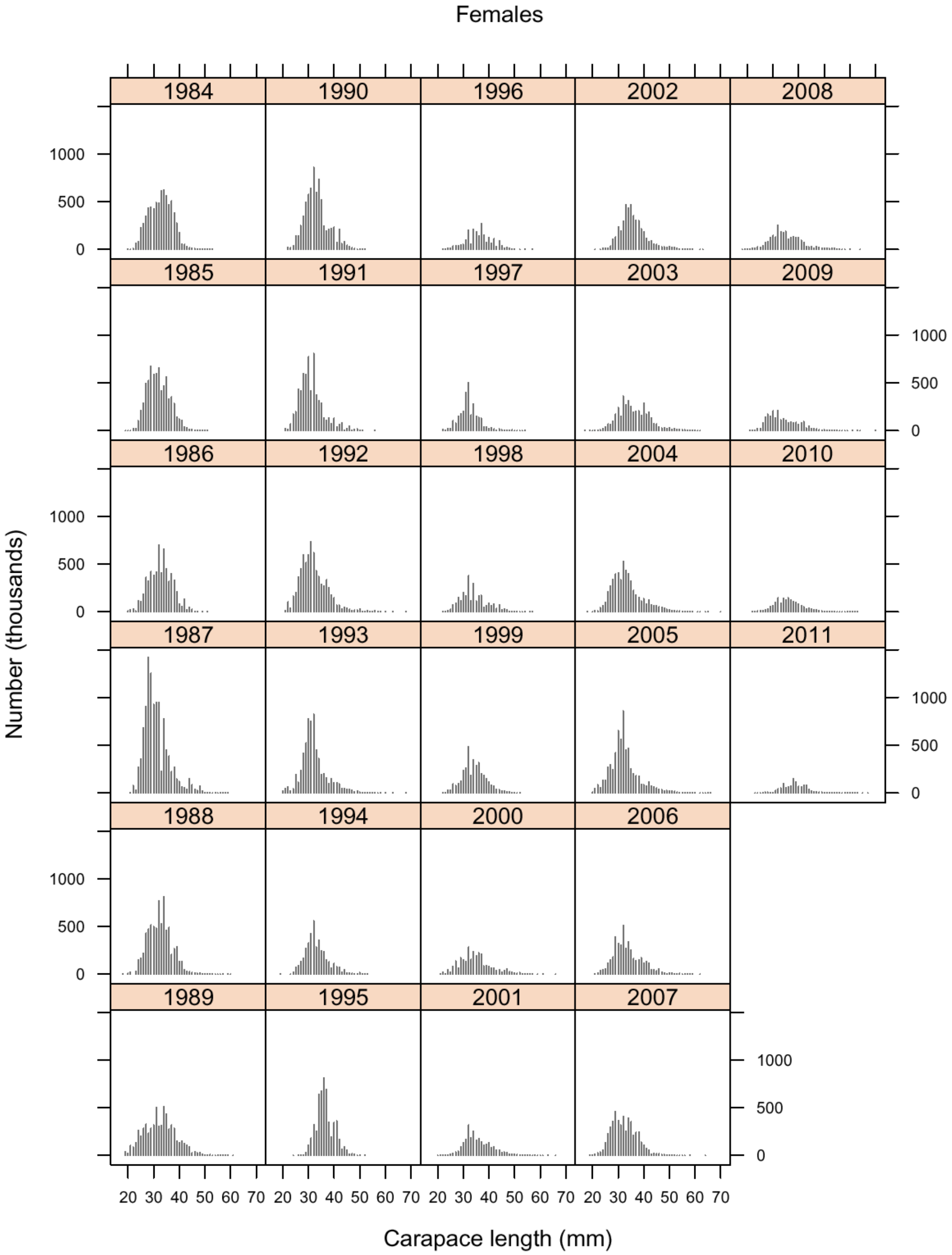



**Figure 12.2.2.b. SW and S Portugal (FU 28-29) female length distributions for the period 1984-2011.**

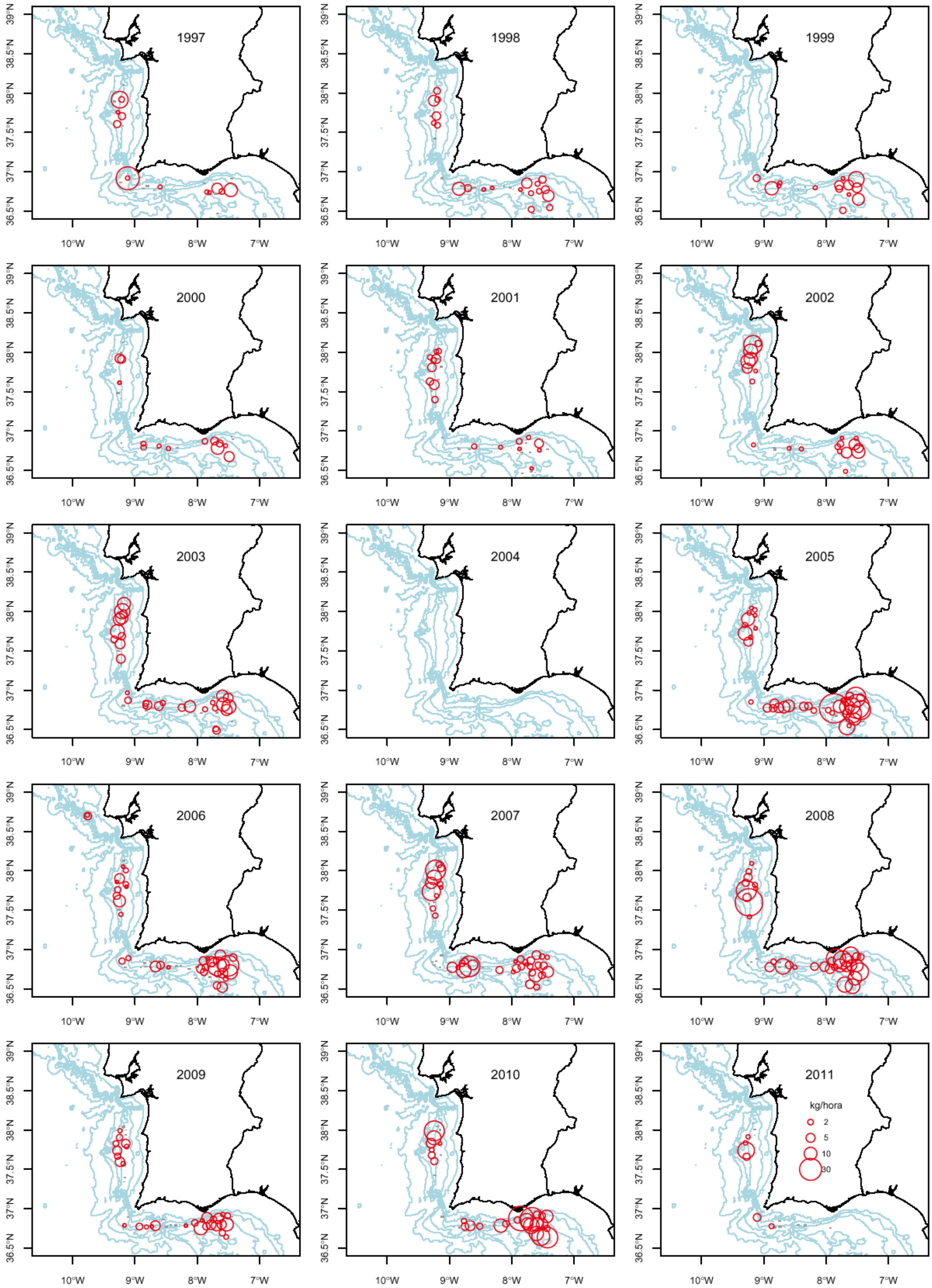



**Figure 12.2.3.** **Spatial distribution of *Nephrops* biomass survey index in the period 1997-2011. The 2011 survey was not completed and the distribution area not entirely covered.**

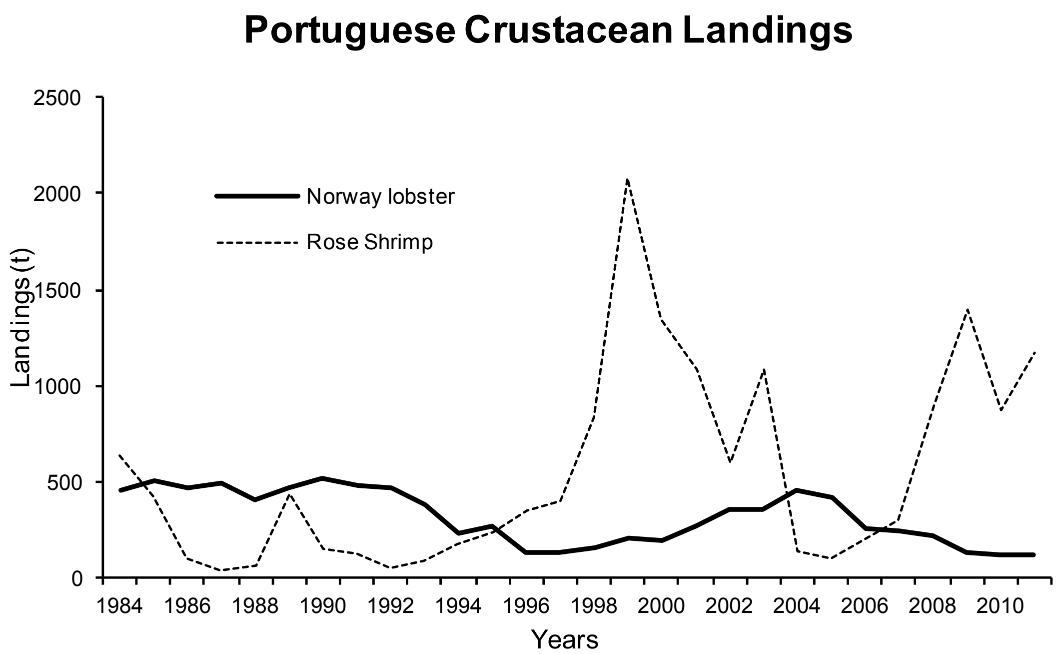



**Figure 12.2.4 FUs 28-29: Portuguese Crustacean Landings in the period 1984-2011.**

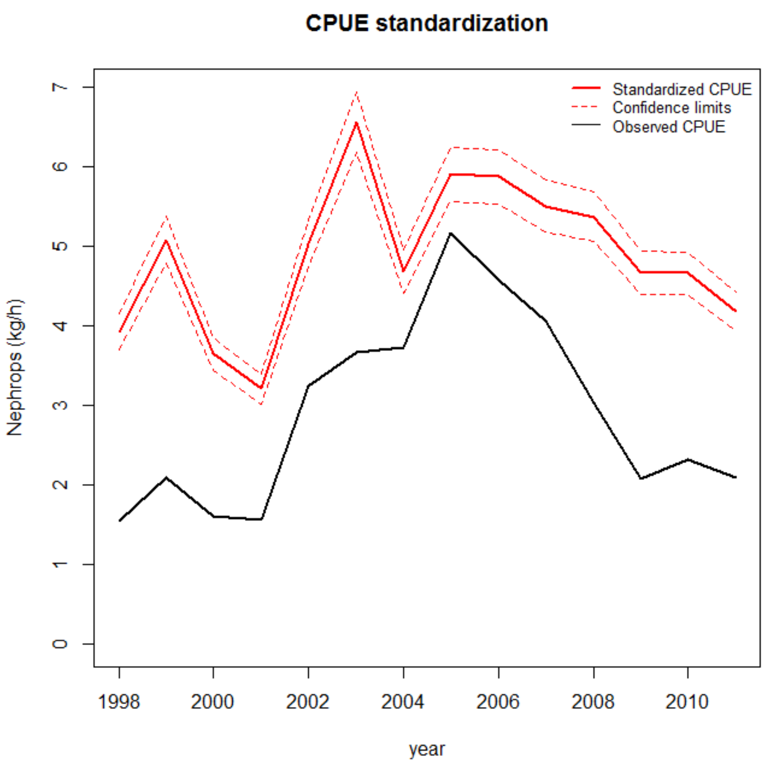



**Figure 12.2.5. Comparison of standardized and observed *Nephrops* CPUE.**

## 12.3 *Nephrops* in FU 30 (Gulf of Cadiz)

Type of assessment: the assessment is based on LPUE and mean size trends. However, it was not possible to include Spanish commercial data for 2011 in the assessment. The trend could not be updated this year. Thus the 1994-2010 LPUE time series has been used.

### 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 2012 and Management applicable for 2011 and 2012

*ICES Advice for 2012*

The advice for these *Nephrops* stocks is biennial and valid for 2011 and 2012. MSY Approach and Precautionary Approach were given in the Advice for 2011.

The long-term trend of lpue is declining and the exploitation status is unknown. Following the ICES MSY framework, it is recommended to reduce catch from recent levels at a rate greater than the rate of the stock decrease. ICES cannot quantify the rate of reduction required. According to PA, recent lpue suggest that the stock is stable at a low level and it is recommended not to increase catch above the recent average (150 t).

To protect the stock in this Functional Unit, management should be implemented at the Functional Unit level.

*Management applicable for 2011 and 2012*

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 latest Fishing Plan (ARM/2457/2010) is being applied since September 2010 and will last for 2 years. This plan reduces the length of the closed fishing season to 45 days, between 24$^{th}$ September and 7$^{th}$ November, plus 5 additional days to be selected by the ship owner during the duration of this Plan.

New regulations have been established since 2008 by the Regional Administration with the aim of distributing the fishing effort throughout the year by controlling the days and time when the Gulf of Cadiz bottom trawl fleet can enter or leave fishing ports. In 2011, a continuous period from Monday 3 am to Thursday 9 pm during May-August has been established (Resolution 24$^{th}$ September 2010, BOJA nº 209), increasing the fishing hours during this period.

The TAC set for the whole Division IXa was 303 t for 2011 and 273 t for 2012.

### 12.3.2 Data

The sampling level for the species is given in Table 1.3.

#### 12.3.2.1 Commercial catch and discard

Stock landings for the period 1994-2010, as estimated by the WG, are given in Table 12.3.1. Spanish data for 2011 are not included.

Spanish data in 2011 have been provided by the Secretaría General de Pesca (SGP), the official national administration responsible for fishery statistics, and are presented in Annex XX for the whole of the Division VIIIc. Preliminary analysis shows that the formats are not adequate as data were not provided by FU and some assumptions have to be taken for the allocation of the landings. In previous years landings have been estimated by the WG based on IEO scientific estimations.

Landings in this FU are reported by Spain and also minor quantities by Portugal. Since 2007 a significant increase in *Nephrops* landings estimates has been observed in Ayamonte port, which is located in the mouth of the Guadiana River. Landings from this port have been taken into account from Working Group 2010 onwards. This port accounted for more than 30% of the total FU30 landings in last four years, becoming the most important *Nephrops* landing port of the Gulf of Cádiz, with Isla Cristina port. Previously, the landings in Ayamonte port were minimal, with the fleet landing in nearby ports. Due to the recent importance of this port, since WGHMM in 2010, its landings 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).

Along the time series, *Nephrops* landings trends in FU30 have remained unchanged after the incorporation of Ayamonte information from 2002. However, the landings levels of this port have increased particularly from 2007 although it has remained stable around 36 t in 2009 and 2010 (Table 12.3.1). Total landings 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). Since 2006 landings have declined to around 107 t in 2010.

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 any trips carried out for sampling the *Nephrops* discard proportion in 2011. 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

Figure 12.3.3 shows the annual landings length distribution for males, females and both sexes combined during the period 2001-2011. Due data from the SGP were not accepted for the assessment; the length distribution samplings could not be raised to landings in 2011. However, length composition has been given as relative values scaled to 1000 individuals 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 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. From 2009 a concurrent sampling is carried out, as required by the new DCR (Reg. EC 1343/2007. Mean size of males, females and sexes combined of *Nephrops* landings from 2001 to 2011 are shown in Figure 12.3.4. The mean sizes in 2009 increased slightly in 10% respect the previous year and have remained stable since then.

#### 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 2012 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 this Working Group, the survey index in 2011 and 1012 are given. Abundance index trend shows a declining trend since 2005, representing less 70% in 2012. This survey is not specifically directed to *Nephrops* and it is not carried out during the main *Nephrops* fishing season but shows a similar trend to the commercial LPUE in most of the time series.

The length distributions of *Nephrops* obtained in the Spanish bottom trawl spring surveys (SPGF-cspr-WIBTS-Q1) during the period 2001-2012 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 2011 Spanish data were not accepted by the WG. *Nephrops* directed effort is required instead of total effort from the bottom trawl fleet and so the LPUE could not be estimated.

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 with only a slight decrease from 2009 to 2010 of 50 fishing days.

LPUE obtained from the directed effort shows a gradual decrease from 1994 to 1998. After 1998, the trend slightly increases until 2003. In 2004, the LPUE decreases to the lowest value recorded (44.3 Kg/fishing day). LPUE then increased until 2008 around 60%. 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).

The overall LPUE trend is quite similar to the abundance survey index in the stratum of 200-700 m from 1996 to 2002 (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. A decrease in the abundance index of the spring survey was observed in 2011 and 2012.

### 12.3.3 Assessment

Given the inconsistencies in the length compositions from 2001 to 2005 and the absence of additional information, an analytical assessment of this FU was not carried out.

The results of an ASPIC model (Prager, 1994; 2004) were presented in the ICES Workshop on Iberian mixed fisheries management plan evaluation of Southern hake, *Nephrops* and anglerfish in November 2010 (ICES CM 2010/ACOM:63). These results were in agreement with the conclusions of WGHMM 2010. However, the WG didn't consider that ASPIC results could be used as a basis to conduct stock projections as assumptions had to be made on same parameter. This fact could influence the results strongly.

Last assessment for *Nephrops* FU 30, carried out in 2010, was based on the analysis of LPUE and mean size trends. As the time series could not be updated until 2011, this year assessment was conducted by using the available LPUE time series (1994-2010).

### 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.

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). The first of these Fishing Plans (which started in October 2004 and lasted for 1 year) restricted the maximum number of fishing hours per day to 18, which could have an effect on *Nephrops* directed effort, because vessels may not have enough time to access the traditional *Nephrops* fishing grounds, which are deep and are located far from the coast. However, the Fishing Plans that followed from the end of 2005 onwards imposed this maximum number of fishing hours per day only as an annual average. All the Fishing Plans establish a continuous period of 56 hours per week without fishing and a single landing event per vessel per day. Since the first Fishing Plan in 2004 a closed fishing season with a gradual increase in the number of days has been implemented (45, 60, and 90 days per year). The Fishing plan ARM/2515/2009, established 21 out 90 days of close fishing season in winter 2010 (from 16th January to 22nd January and from 16th February to 14th February). The latest Fishing Plan (ARM/2457/2010) is being applied since September 2010 and will last for 2 years. This plan reduces the length of the closed fishing season to 45 days, between 24th September and 7th 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. However, from 2006 to 2010, total fleet effort and *Nephrops* directed effort decreased, even though the closed seasons were established outside the main *Nephrops* fishing months. As a proxy for *Nephrops* directed effort, the set of trips for which *Nephrops* represents at least 10% of the landed weight is used. All Fishing Plans starting from the one in 2007 state that by the end of the Fishing Plan, the fishing capacity of the Gulf of Cadiz bottom trawl fleet must have been reduced by 6% on a permanent basis. 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.

New regulations were recently 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 establishes 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. However, the *Nephrops* directed fishing and landings decreased sharply in 2008 and remained at similar low levels in 2009 and 2010. 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.

**Table 12.3.1.** ***Nephrops*** **FU30, Gulf of Cadiz: Landings in tonnes.**

| | FU 30 | | | | |
|---|---|---|---|---|---|
| | Spain Trawl | | | Portugal | Total |
| Year | Without Ayamonte Port | Ayamonte Port | Total Spain | All gears | |
| 1994 | 108 | | 108 | | 108 |
| 1995 | 131 | | 131 | | 131 |
| 1996 | 49 | | 49 | | 49 |
| 1997 | 97 | | 97 | | 97 |
| 1998 | 85 | | 85 | | 85 |
| 1999 | 120 | | 120 | | 120 |
| 2000 | 129 | | 129 | | 129 |
| 2001 | 178 | | 178 | | 178 |
| 2002 | 247 | 15 | 262 | | 262 |
| 2003 | 281 | 22 | 303 | 4 | 307 |
| 2004 | 130 | 13 | 143 | 4 | 147 |
| 2005 | 232 | 11 | 243 | 3 | 246 |
| 2006 | 225 | 17 | 242 | 4 | 246 |
| 2007 | 177 | 34 | 211 | 4 | 215 |
| 2008 | 77 | 40 | 117 | 3 | 120 |
| 2009 | 81 | 36 | 117 | 2 | 119 |
| 2010 | 70 | 36 | 106 | 1 | 107 |
| 2011 | na | na | na | 3 | na |

**Table 12.3.2.** ***Nephrops*** **FU30, Gulf of Cádiz: Mean carapace length of the discarded and retained fraction of** ***Nephrops*****, and percentage of discarded (2005-2011) 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 | 0.0 | 100 | 0.0 | 0.0 |

**Table 12.3.3.** ***Nephrops*** **FU30, Gulf of Cádiz. Abundance index from Spanish bottom trawl spring surveys (SPGFS-cspr-WIBTS-Q1).**

| Year | 200-500 meters | | 500-700 meters | | 200-700 meters | |
|---|---|---|---|---|---|---|
| | Kg/60' | Nb/60' | Kg/60' | Nb/60' | Kg/60' | Nb/60' |
| 1993 | 0.76 | 19 | 1.15 | 34 | 0.95 | 26 |
| 1994 | 1.22 | 31 | 0.60 | 8 | 0.94 | 21 |
| 1995 | 0.55 | 8 | ** | ** | na | na |
| 1996 | 0.56 | 10 | 1.32 | 29 | 0.93 | 19 |
| 1997 | 0.08 | 2 | 0.69 | 23 | 0.38 | 12 |
| 1998 | 0.39 | 16 | 0.22 | 7 | 0.30 | 11 |
| 1999 | 0.49 | 15 | 0.28 | 7 | 0.40 | 12 |
| 2000 | 0.22 | 7 | 0.57 | 15 | 0.37 | 10 |
| 2001 | 0.32 | 8 | 0.60 | 14 | 0.44 | 11 |
| 2002 | 0.48 | 17 | 0.44 | 11 | 0.47 | 14 |
| 2003 | ns | ns | ns | ns | ns | ns |
| 2004 | 0.15 | 5 | 0.14 | 4 | 0.15 | 5 |
| 2005 | 0.54 | 18 | 0.75 | 25 | 0.63 | 21 |
| 2006 | 0.23 | 6 | 0.65 | 20 | 0.41 | 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 | 0.34 | 11 | 0.08 | 2 | 0.23 | 7 |
| 2012 | 0.15 | 4 | 0.21 | 4 | 0.18 | 4 |

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 | 88.4 | 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** | na | na | na | na |

*Landings, LPUE and fishing effort from fishing trips with at least 10% *Nephrops*.

** Ayamonte landings are included since 2002

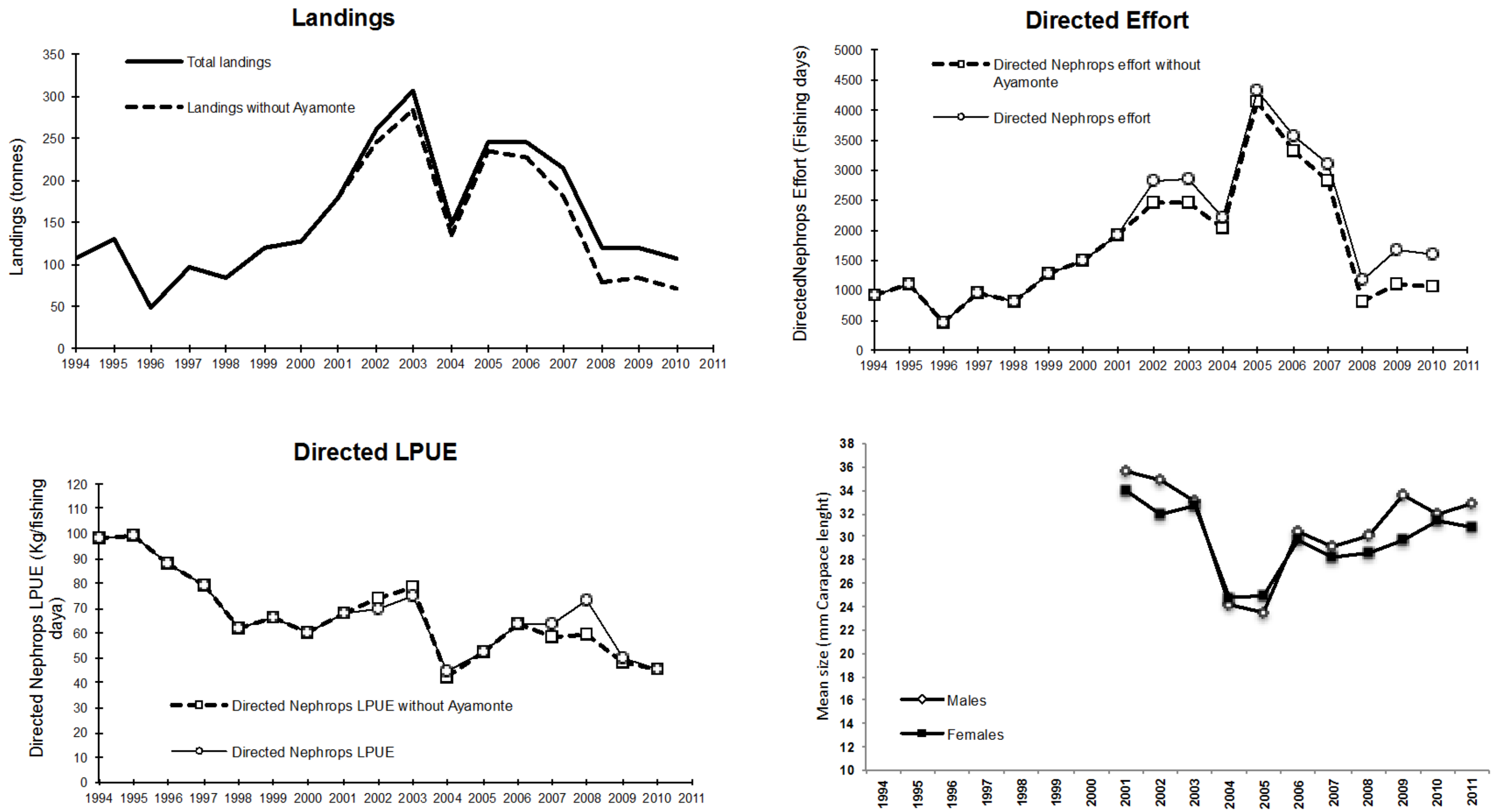



**Figure 12.3.1.** ***Nephrops*** **FU 30, Gulf of Cádiz. Long term trends in landings,** ***Nephrops*** **directed effort and LPUE and mean sizes.**

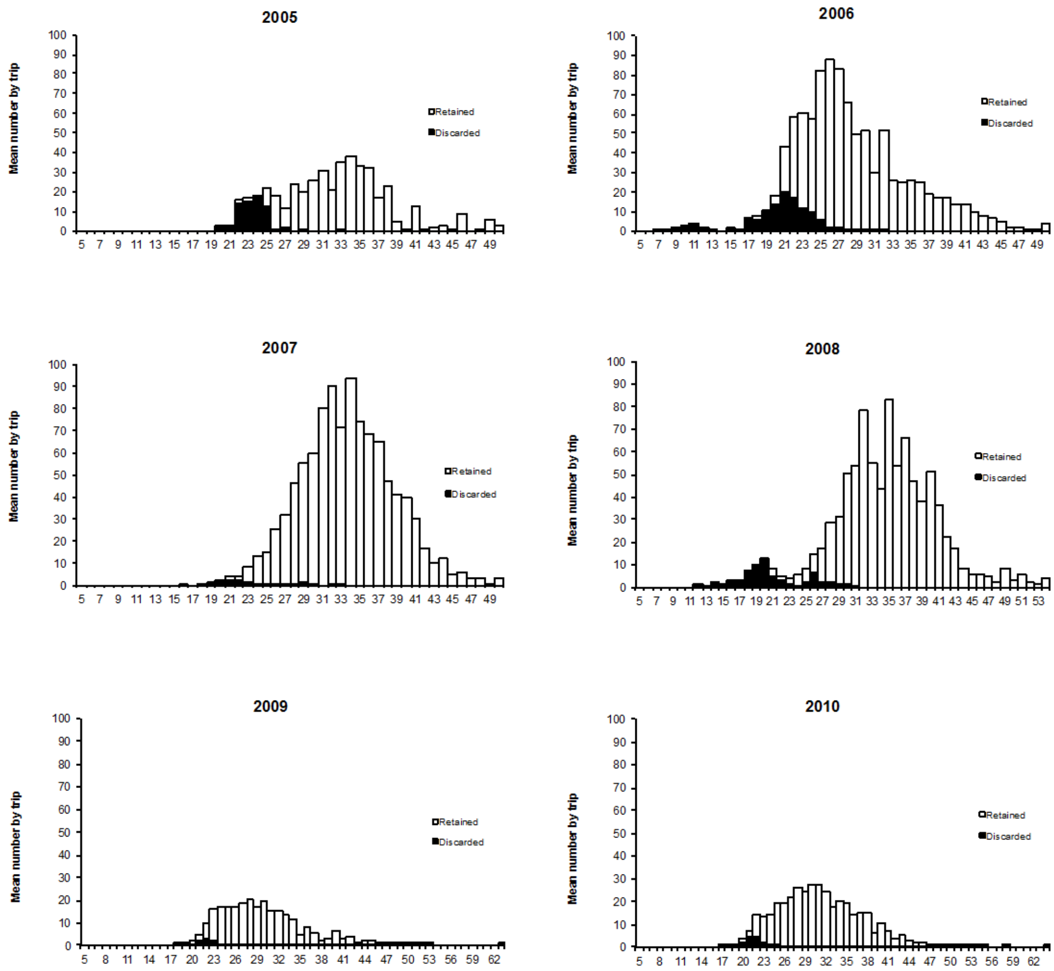



**Figure 12.3.2.** ***Nephrops*** **FU 30, Gulf of Cádiz. Length distribution of retained and discarded fractions** ***Nephrops*** **from discards program (2005-2010 period).**

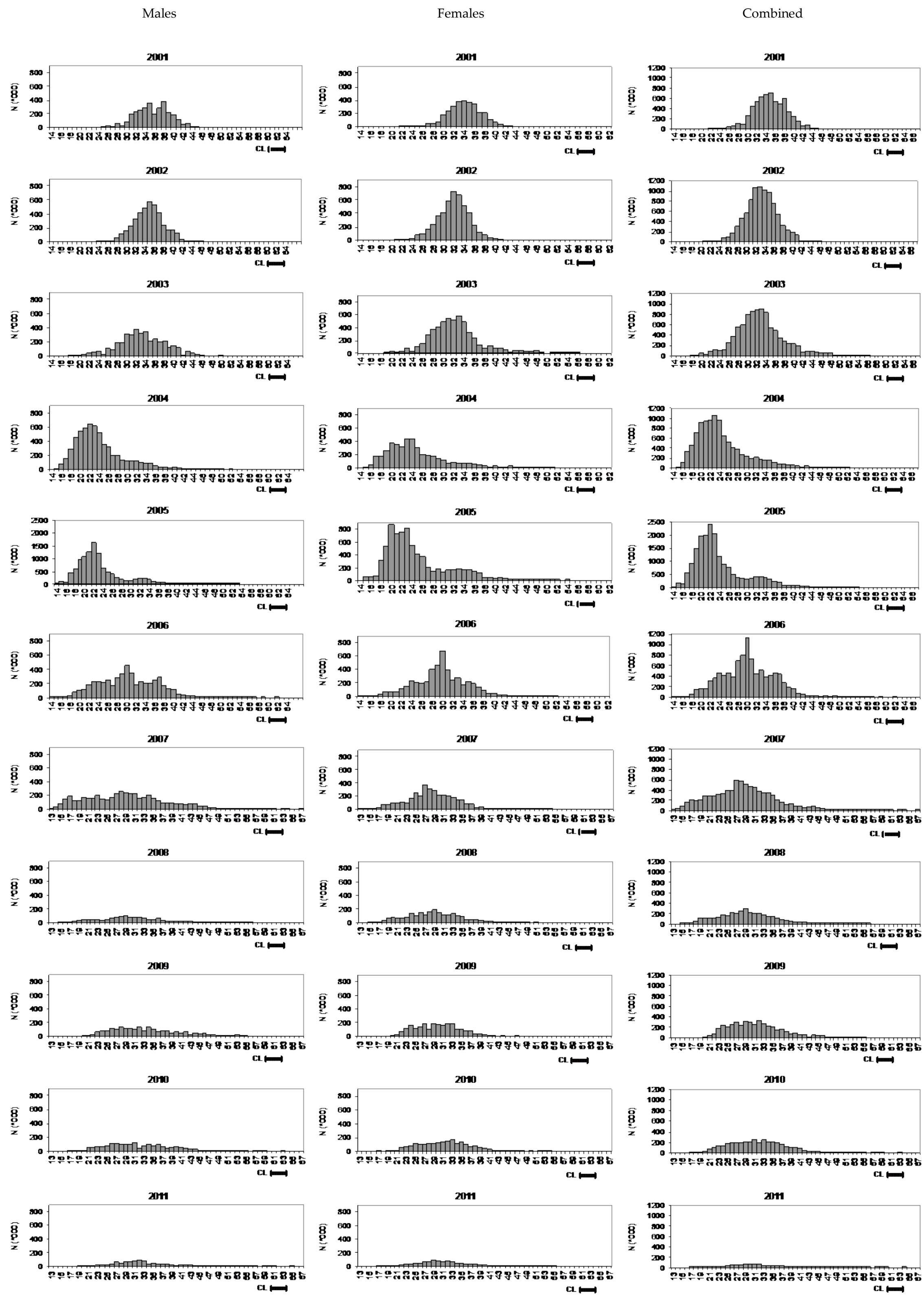
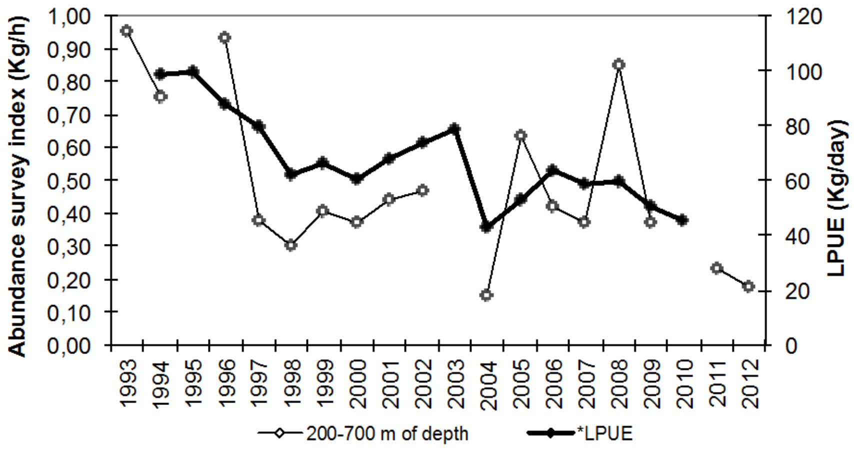



**Figure 12.3.3.** ***Nephrops*** **FU30, Gulf of Cádiz. Length distributions of landings for the period 2001-2011. In 2011, length distributions in sampling is showed in relative numbers scaled to 1000 individuals.**




* 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.**

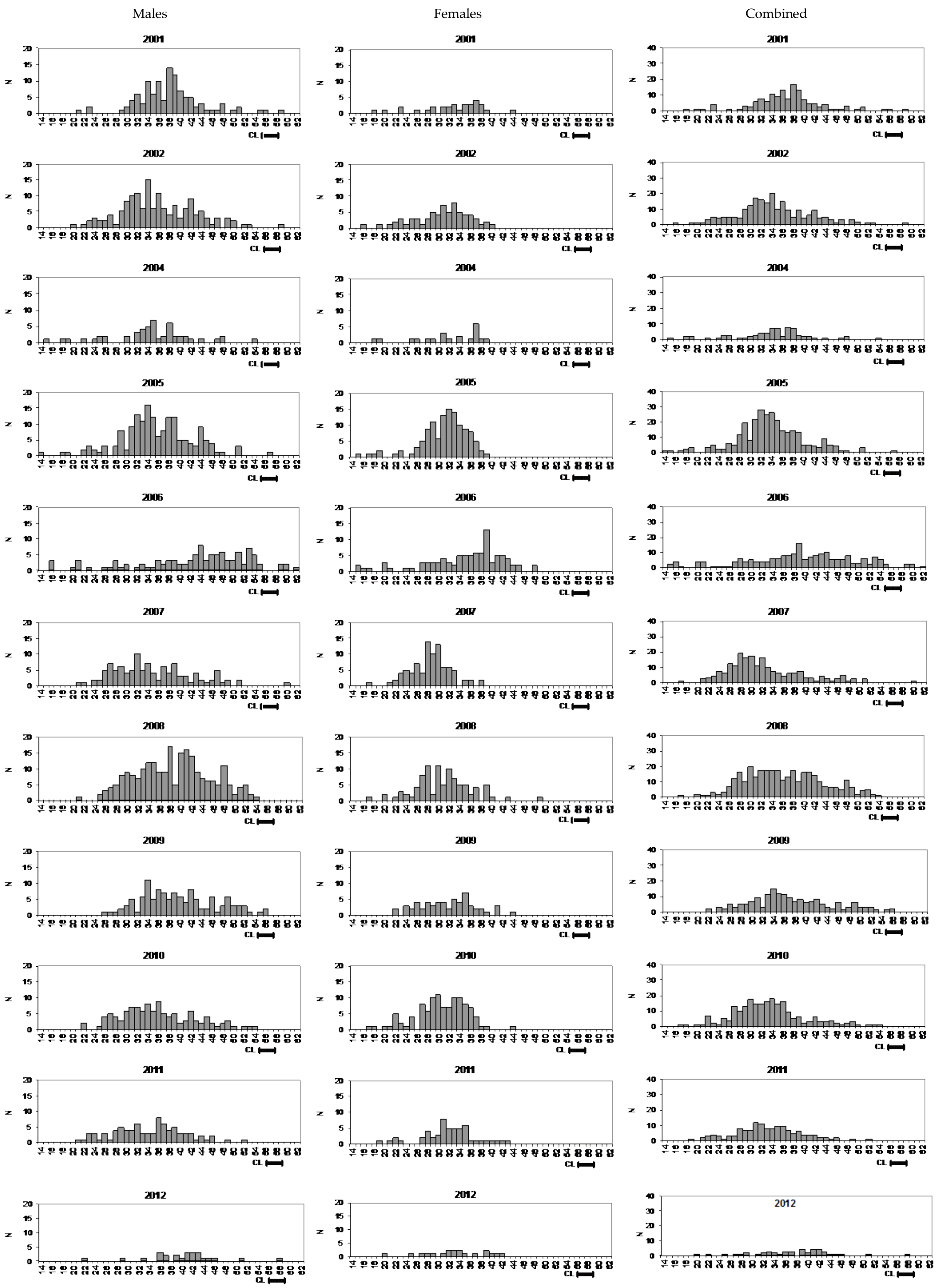



**Figure 12.3.5.** ***Nephrops*** **FU30, Gulf of Cádiz. Length distributions from Spanish bottom trawl surveys (SPGFS-cspr-WIBTS-Q1) for 2001-2012 period.**

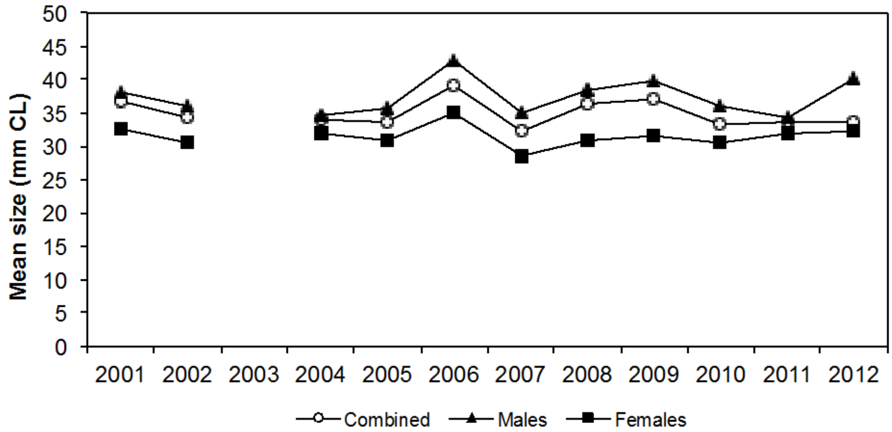



**Figure 12.3.6.** ***Nephrops*** **FU30, Gulf of Cádiz. Mean size in spring bottom trawl surveys (SPGFS-cspr-WIBTS-Q1) for the period 2001-2012.**

## 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 2008, 2009 and 2010, the landings were below the TAC (-12% -29% and -26%, respectively, see Tables 12.4.1 and 12.2.2). Spanish data for 2011 are not included. The 2011 Spanish landings were provided to the group only on the 11th of May by SGP, and are presented in Annex XX for the whole Division IXa, since data were not disaggregated by FU. On the other hand, landings and fishing effort are required by harbour and *metier* in order to derive LPUE estimates consistent with the previous LPUE time series.

The northernmost stocks (FUs 26-27) continue to be at very low abundance levels. The southern stocks (FUs 28-29 and FU 30) remain low despite some increase in a earlier period. In these FUs, part of the multispecies fleet effort was directed to rose shrimp, reducing the pressure on *Nephrops*.

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. Fine scale management of catches and/or effort at a geographic scale that corresponds to the *Nephrops* stock distribution should be implemented.

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, 12$^{th}$ January 2006) closes the crustacean fishery in FUs 28-29 in January every year. Also, a closed season of 50 days was established between September and November 2010 and 2011 (ARM/2457/2010) 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.

New regulations have been established since 2008 by the Regional Administration with the aim of distributing the fishing effort throughout the year by controlling the days and times when the Gulf of Cadiz bottom trawl fleet can enter or leave fishing ports (Resolution 23$^{th}$ November 2009, BOJA nº 235). In 2011, a continued period from Monday 3 am to Thursday 9 pm during May-August has been established (Resolution 24$^{th}$ September 2010, BOJA nº 209), increasing the fishing hours during this period.

**Table 12.4.1. 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 | Total | | Spain | Spain | Portugal | | | | Portugal | Spain | | |
| Year | Trawl | Trawl | | Artisanal | Trawl | Total | Trawl | | | Trawl | Trawl | Artisanal | Trawl | Total | | Unalloc | 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 | 0 | 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 | 0 | 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 | 0 | 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 | 0 | 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** | | na | na | 2 | 2 | 4 | na | na | na | | | 16 | 117 | 133 | 133 | 3 | na | na | na |

* Prior 1996, landings of Spain recorded in FU 26 include catches in FU 27

** Preliminary values

## Table 12.4.2. 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 | na |
| 2012 | 273 | |

## Annex A – List of participants

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### 10 – 16 May 2012

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## Annex B - Working Documents

Fourteen working documents were presented at WGHMM 2012 covering various issues relevant to the work of the group, from surveys to responses to recommendations. Abstracts of these papers are presented below. The full documents can be obtained by request to the ICES Secretariat.

### The use of VMS data for the standardization of *Nephrops* CPUE from the Portuguese Crustacean Trawl Fishery

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The Portuguese crustacean fishery takes place off the south and southwest coasts of Portuguese continental waters (ICES Division IXa – Functional Units FU 28 and 29). The fishery is conducted by 30 trawlers, which are in average 25 meters of overall length and 411 kW of engine power. This fleet accounts for 93% of deep crustacean landings from Portuguese continental waters. There are two main target species in this fishery, the deepwater rose shrimp (*Parapenaeus longirostris*) and the Norway lobster (*Nephrops norvegicus*), sharing partly the same grounds. Although their areas of distribution overlap at depths 200–500m, rose shrimp highest yields occur at depths below 400m whereas highest catch rates of Norway lobster are between 500–600m. Due to the high market value of rose shrimp and to the fact that its fishing grounds are closer to the coast, in periods of high abundance of rose shrimp the vessels spend less effort on Norway lobster. The aim of this working document is to discuss what improvements can be introduced in the *Nephrops* CPUE standardization model using the VMS information.

### The use of spatial information to improve the *Nephrops* standardisation model used in FU 28 and 29 stock assessment.

*Cristina Silva*

*INRB/L-IPIMAR, Portugal.*

The Portuguese crustacean trawl fishery takes place off the southwest (FU 28) and south (FU29) coasts of the Portuguese continental waters (ICES Division IXa). There are two main target species in this fishery, the deepwater rose shrimp (*Parapenaeus longirostris*) and the Norway lobster (*Nephrops norvegicus*), sharing partly the same grounds. In the last two working groups, a trial to standardize the *Nephrops* CPUE (in kg/day) was carried out using General Linear Models (GLM), but the final model never explained more than 20% of the variability. Considering the behaviour of the fleet in periods of high abundance of rose shrimp, new variables related to the daily catches of this species and the proportion of *Nephrops* in the total daily catch were incorporated in the new model presented in this working document. A stock assessment with XSA was performed (for males and females) with the new series of standardized *Nephrops* CPUE to evaluate the effects on the catchability residuals and the retrospective patterns.

**Simulation testing of Harvest Control Rules for Northern Stock of Hake.**

*Dorleta Garcia, Marina Santurtún, Enrique de Cárdenas*

*Fundación AZTI, Spain.*

Northern stock of Hake is under recovery plan since 2004. During this time the assessment model used to evaluate the stock has changed and it has led to a change in the perception of its status. Hence, the reference points used to define the recovery plan are no longer valid.

Thus an efficient management of the stock demands to move forward defining and evaluating new reference points and multiannual management plan for the stock. In this sense we present a preliminary work where the reference points defined in 2011 by the assessment working group are evaluated together with the ICES MSY harvest control rule and a constant TAC strategy. The reference points are compared with a strategy where fishing mortality is maintained in the 2010 level. The simulations suggest that any of the reference points defined by the assessment working group would lead to a sustainable management of the stock and that maintaining fishing mortality at 2011 level would be sustainable but would lead to very variable stock indicators. The model used, FLBEIA, demonstrates to be a valid tool to carry out evaluations of possible multiannual plans for this stock, and would allow, in the future, introducing other stocks to take into account mixed fisheries considerations.

**Update on Portuguese bottom otter trawl discards data (WGHMM species).**

*Numo Prista, Ana Cláudia Fernandes,*

*IPIMAR – INRB I.P., Portugal.*

We compile the information available on the discards of WGHMM species (Anglerfish, Lophius piscatorius ; Blackbellied angler, Lophius budegassa; Hake, Merluccius merluccius; Four-spot megrim, Lepidorhombus boscii; Megrim, Lepidorhombus whi-agonis; Sole, Solea solea; Norway lobster, Nephrops norvegicus; Plaice, Pleuronectes platessa; Pollock, Pollachius pollachius; Whiting, Merlangius merlangus; and Grey Gurnard, Eutrigla gurnardus) produced by Portuguese vessels operating with bottom otter trawl (OTB) within the Portuguese reaches of ICES Division IXa. The data was collected by the Portuguese on-board sampling programme (EU DCR/NP) in 2011. A description is presented of the on-board sampling programme, estimation algorithms, and data quality assurance procedures. Results are provided for two fisheries: the crustacean fishery (OTB_CRU) and the demersal fish fishery (OTB_DEF). The frequency of occurrence of most WGHMM species (except hake) was low with discards of commons sole, pollock, withing, blackbellied anglers, anglerfish, grey gurnards, and megrims being null or negligible. In 2011, hake discards by the Portuguese trawl fleet operating within the Portuguese reaches of ICES Division IXa were estimated to be 169 tonnes (CV: ) and 570 tonnes (CV: ) in the OTB_CRU and OTB_DEF fisheries, respectively.

**Notes on the basque fishery on Whiting (*Merlangius merlangus*), Plaice (*Pleuronectes platessa*), Pollack (*Pollachius pollachius*), Sole (*Solea solea*) and Grey gurnard (*Eutrigla gurnardus*) in the Bay of Biscay and Cantabrian waters in the last decade.**

*Lucia Zarauz, Jon Ruiz, Estanis Mugerza, Marina Santurtún and Iñaki Artetxe*

*Fundación AZTI, Spain.*

Under ICES request, countries and laboratories involved in the working group assessing Hake, Monk and Megrim (WGHMM) were asked to include a number of new stocks under consideration for which Institutions might have available data. These stocks were: Plaice in the Bay of Biscay and Iberian coast (ple-89a); Pollack in the Bay of Biscay and Iberian coast (Pol-89a); Sole in the Iberian coast (sol-8c9a); Whiting in the Bay of Biscay and Iberian coast (whg-89a) and Grey gurnard in the Bay of Biscay and Cantabrian Waters.

All data to be reviewed and collated was referred to Subarea VIII (VIII abd & c) and IX a. The only exception was sole, which covers only VIIIc (i.e. not the whole of VIII) and IXa. Data to be collected was defined as: landings; discards; data from research surveys or other sources of data potentially leading to stock abundance indices and biological data.

It might be that for most of these stocks very little data are available. However, it is of interest to know if they are not available (e.g. the species does not appear in the landings (i.e. not caught by the fleet), or they are caught by the fleet but no information is collected. Thus, the identification of the lack of data is interesting, if applicable, suggesting possible improvement in the sampling.

During 2011, AZTI continued monitoring all species caught in Basque fisheries fishery in the Basque Country (Spain) in relation to the monthly landings and fishing effort by sea area and gear. In this way, compilation and updating of the basic information on species such us those required in this exercise (i.e. whiting (*Merlangius merlangius*); plaice (*Pleuronectes platessa*), pollack (*Pollachius pollachius*), sole (*Solea solea*) ), is updated every year since 1994. This is, landings and landings per unit effort made by the Spanish fleets, when landed at the Basque Country ports are computed.

Grey gurnard (*Eutrigla gurnardus*) is landed together with streaked gurnard (*Chelidonichthys lastoviza*), Longfin gurnard (*Chelidonichthys obscurus*), Piper gurnard (*Trigla lyra*), and Tub gurnard (*Chelidonichthys lucerna*) with the generic name of "Gurnards". At present it is not possible to estimate the proportion of each species in the group, and therefore Grey gurnard landings information is not available and is not included in this report.

**Mixed-fisheries advice for ICES WGHMM stocks.**

*José Castro and Marina Santurtún*

*Instituto Español de Oceanografía, AZTI-Tecnaliea, Spain.*

This WD summarizes the state of the art regarding mixed-fisheries advice in WGHMM, since one of its tasks this year was to discuss the extension of the mixed-fisheries approach in WGHMM stocks and areas. After reviewing the development of the mixed-fisheries approach in other areas and also the characteristics of the current mixed-fisheries forecast methodology (Fcube), it is concluded that the first step should be focused on the WGHMM Southern stocks, which are exploited in Iberian Peninsula waters (ICES Div. VIIIc and IXa). Most of them present accepted assessment, providing the biological parameters required by Fcube. Making assumptions for those stocks without analytical assessment, up to twelve stocks could be included, *i.e.* 5 stocks of demersal fish (Southern stocks of hake, megrim, 4-spot megrim, white and black anglerfish) and 7 Functional Units of *Nephrops* (FU25-31).

**Western Anglerfish 2003-2011.**

*Lisa Readdy, Jon Ashworth, Peter Randall*

*Cefas, UK.*

During the months of September, October and November 2011, the beam trawlers *Billy Rowney* and *Twilight III* carried out the ninth FSP survey of anglerfish off the SW coast of England, repeating the surveys of 2003–2010. Megrim remains the most abundant of the eight commercially important species caught, followed by anglerfish (*L. piscatorius*) and lemon sole. Catch rates, combined discarded and retained, for the less common anglerfish (*L. budegassa*) and hake have been declining since 2009.

The index of monkfish (*L. piscatorius*) abundance peaked in 2005 and 2009 remaining stable at around the 2009 figure; biomass has remained fairly stable over the time-series with peaks in 2003, 2007 and 2011. The indices of the less common monkfish (*L. budegassa*) abundance and biomass steadily rose to a peak in 2008, followed by a declining trend since.

**French standardized CPUE for Monkfish and Megrim.**

*Jocelyn Le Baut*

*IFREMER, France.*

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**Preliminary estimates of discards in the French fishery in 2011 for Monkfish.**

*J. C. Mahé*

*IFREMER, France.*

Onboard observation of catches (landings and discards) in the French fishery has started in 2003. However, for Anglerfish, the sampling level and the quality has been low (misidentification of species or only reporting to the genus level). Things have improved since and preliminary analysis of the 2011 data have been done using the COST package. They are presented here.

**Maturity-at-age estimates for Irish Demersal Stocks in Via and VIIabgj 2004-11.**

*Hans Gerritsen,*

*Marine Institute, Ireland.*

This document provides maturity-at-age estimates for stocks assessed by the WGCSE and WGHMM. All data are obtained on surveys and commercial sampling carried out by the Marine Institute.

**Irish megrim (Lepidorhombus whiffiagonis, Walbaum) discards in VIIb-k - Evaluation of raising methods and derivation of a revised series.**

*Hans Gerritsen,*

*Marine Institute, Ireland.*

**Biological information and data for sole in the Portuguese continental coast.**

*Teresa Moura, Ana Moreno, Marina Dias, Manuela Azevedo*

*IPIMAR, Portugal.*

This working document presents Portuguese data for Solea solea (sole) landed in ICES division IXa. It includes information on total landings and on port sampling/landing numbers at length (under the DCF), and clarifies some aspects of the fisheries, landing, biological and survey data. A brief description of general aspects of this species in the Portuguese continental coast is also presented.

**What sex ratios at length tell us about growth in sex size dimorphic species?**

*Santiago Cerviño*

*Instituto Español de Oceanografía – C.O. de Vigo*

Sex size dimorphism (SSD) refers to the different body size in adult sexes. This process is driven by changes in growth imposed by reproductive energy allocation. Differences in growth after maturity produce different patterns in sex proportions al length in the population. If these patterns are the consequences of changes in life history parameters, it should be expected that this data (sex ratios) have relevant info on life history. Along this work we first explore how changes in life history parameters may drive to observed sex ratios; second we explore how this data may be used to estimate life history parameters and finally we discuss how this information may be useful for stock assessment purposes. Our results suggest that this valuable, accurate and chip information may play an important role to model and assess dimorphic species.

**Reference Points for southern white anglerfish stock: Potential $F_{MSY}$ proxies.**

*Paz Sampedro*

*Instituto Español de Oceanografía, Spain*

After changing the assessment model for southern white anglerfish, from an ASPIC model to a SS3 length based assessment, new reference point (RP) in terms of fishing mortality needs to be set. The stock-recruitment relationship did not follow a parametric model, so alternative proxies of $F_{MSY}$ based on the new model assessment outputs. The most studied RP based on yield per recruit curve (Fmax, $F_{0.1}$) and spawning biomass per recruit ($F_{30\%}$, $F_{35\%}$, $F_{40\%}$) were estimated. The implications of adopting a particular $F_{MSY}$ proxy were analysed in terms of SSB and yield in stochastic long-term projections. The simulation studies suggested that F0.1 (=0.19) is a reasonable $F_{MSY}$ proxy for southern white anglerfish.

# Annex C Stock Annex Northern Stock of Hake

Quality Handbook Stock Annex C

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: | Assessment of Southern Shelf Stocks of Hake, Monk and Megrim |
| Date: | May 2011 |
| Revised by | Michel Bertignac |

## 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.

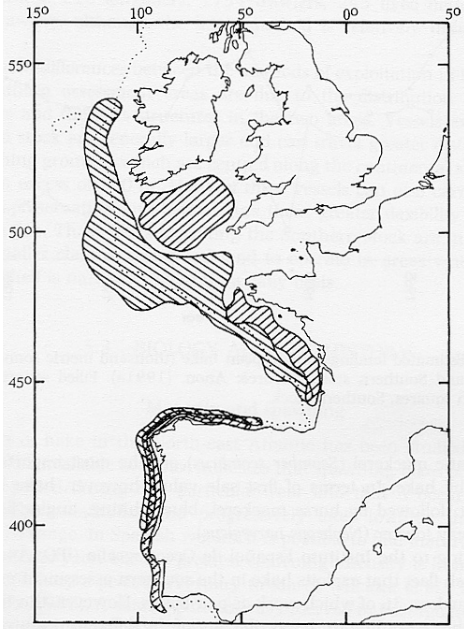


**Figure 1. Main spawning and nursery areas. Spawning areas sloping downwards from left to right; Nursery areas sloping downwards from right to left. (from Casey and Pereiro, 1995)**

## 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 60%) followed by France (around 25%), 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. Independently of these regulations, some Spanish fleets stopped their activity during some weeks in June 2008 to protest against the increase of petrol prices.

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.

# B. Data

## B.1. Commercial catch

### B.1.1. Landings

The Spanish landings data are based on sales notes and Owners Associations data compiled by IEO; and Basque Country sales notes and Ship Owners data compiled by AZTI. 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 |

### 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%.

Discards are available for Danish trawlers and seiners fishing in Subarea IV from 1995 to 2004 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 and for 2004 and 2005 (values from 32 to 650 t, not raised after 2005) and for UK-EW 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 2008. In Subarea VII, an increase in estimated discards rate was observed from 2003 to 2008 when compared with previous years. Discards were estimated to vary from very small amounts to more than 1000 t in 2003–2005 and over 2000 t in 2008. 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).**

**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)**

| Fleet/metier sampled | Corresponding Fishery Units | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spanish Trawl in VII | FU 4 | NA | **137** | NA | NA | NA | **1241** | **1740** | NA | **778** | **2339** | **2033** |
| | | NA | *800* | NA | NA | NA | *12497* | *19831* | NA | *6646* | *28615* | *16375* |
| French Nephrops trawl in VIIIabd | FU9 | **565** | **341** | **417** | **172** | **1035** | **1359** | **1597** | **532** | **767** | **858** | NA |
| | | *9139* | *7421* | *6407* | *2992* | *23676* | *39550* | *37740* | *18031* | *24277* | *18245* | NA |
| French trawl in VIIIabd | FU10 | **211** | **169** | **100** | **142** | NA | NA | NA | NA | NA | NA | NA |
| | | *3053* | *3013* | *1439* | *2253* | NA | NA | NA | NA | NA | NA | NA |
| Spanish trawl in VIIIabd | FU14 | NA | NA | NA | NA | NA | **30** | **489** | **206** | **471** | **352** | **557** |
| | | NA | NA | NA | NA | NA | *451* | *8475* | *3397* | *10002* | *7153* | *7530* |
| Irish trawl and seine in VII | FU15 | **190** | **650** | **194** | NA | NA | **32** | **94** | * | * | * | NA |
| | | *1868* | *892* | *1046* | NA | NA | 282 | *629* | * | * | * | *684* |
| UK (EW) trawl in IV and VII | FU16 + 4 + 5 | NA | * | * | * | * | * | * | * | * | * | * |
| | | NA | * | * | * | * | * | * | * | * | * | * |
| Spanish trawl in VI | FU16 | NA | NA | NA | NA | NA | NA | NA | NA | NA | **6** | **31** |
| | | NA | NA | NA | NA | NA | NA | NA | NA | NA | *11* | *36* |
| Danish trawl and seine | FU16 | **42** | **21** | **142** | **354** | **242** | **206** | **814** | **610** | **255** | **190** | **213** |
| | | *29* | *38* | *483* | *691* | *479* | *775* | NA | NA | *849* | *642* | *508* |
| **Total Weight from sampled fleet (t)** | | **1008** | **1319** | **854** | **668** | **1277** | **2868** | **3920** | **738** | **2016** | **3745** | **2277** |
| *Total Number from sampled fleets ('000)* | | *14090* | *12164* | *9376* | *5935* | *24155* | *53555* | *66675* | *21428* | *40925* | *54666* | *17603* |

* sampled but not raised

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.

## 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) recently 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), have recently proved that growth underestimation was not a regional issue. Besides, Ifremer sustained a large tagging effort in the Bay of Biscay from 2004 to 2007 which allowed confirming both the relevance of the fast growth hypothesis and the issues of the otolith-based age estimation current methodology. 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. Conversion from length-to-age using an age–length key and the use of an assessment model relying on a catch-at-age matrix and abundance indices at age as was done until 2008 becomes then problematic. This leads the Working Group to consider the use of a length-based stock 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).

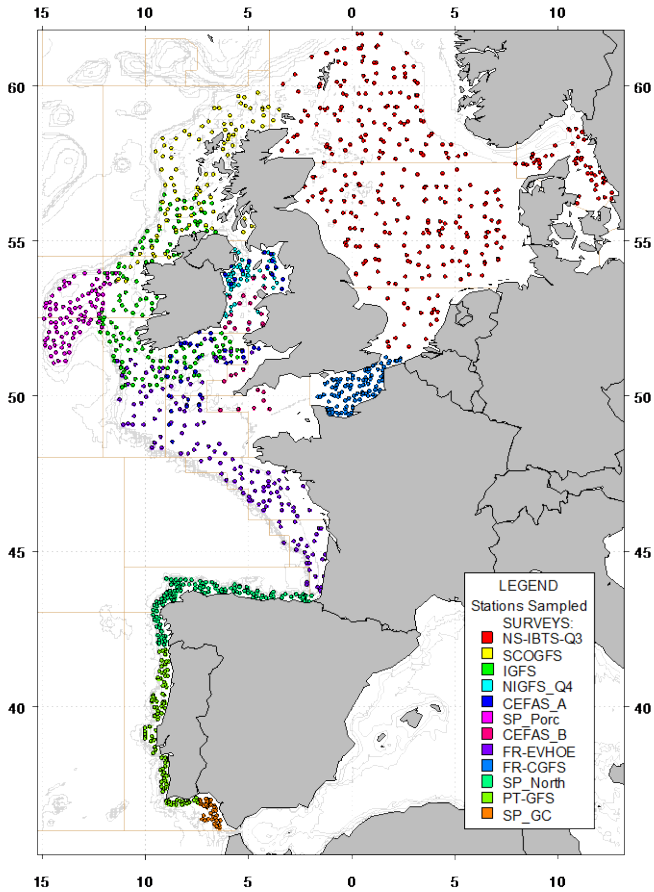


**Figure 2. Map of East Atlantic groundfish surveys: stratification and trawling positions. FR-EVHOE correspond to EVHOE-WIBTS-Q4, SP Porc corresponds to SPPGFS-WIBTS-Q4 and IGFS corresponds to IGFS-WIBTS-Q4.**

Abundance indices are available from the following research-vessel surveys:

*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)

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.

b ) 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.

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.

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.

### B.5. Other relevant data

## C. Historical stock development

Model currently used: Stock Synthesis 3 (SS3), (Methot, 2005).

Software used: Stock Synthesis V3.10, 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)<br>Quarterly: 1990-2010(LFD+tonnage) | 1994, 1999, 2000, 2003–2008 (LFD + Weight) |
| FRNEP8 | French trawl targeting *Nephrops* in VIII | 09 | Yearly : 1978-1989 (tonnage)<br>Yearly : 1985-1989 (LFD)<br>Quarterly : 1990-2010 (LFD+tonnage) | 2003–2008<br>(LFD + Weight) |
| SPTRAWL8 | Spanish trawl in VIII | 14 | Yearly : 1978-1989 (LFD+tonnage)<br>Quarterly: 1990-2010(LFD+tonnage) | 2005–2008<br>(LFD + Weight) |
| TRAWLOTH | All other trawl | 05 + 06 + 08 + 10 | Yearly : 1978-1989 (LFD+tonnage)<br>Quarterly: 1990-2010 (LFD+tonnage) | |
| GILLNET | Gillnet all countries | 03 + 13 | Yearly : 1978-1989 (LFD+tonnage)<br>Quarterly: 1990-2010 (LFD+tonnage) | |
| LONGLINE | Longline all countries | 01 + 02 + 12 | Yearly : 1978-1989 (LFD+tonnage)<br>Quarterly: 1990-2010 (LFD+tonnage) | |
| OTHERS | Everything else all countries | 15 + 16 + 00 | Yearly : 1978-1989 (LFD+tonnage)<br>Quarterly: 1990-2010 (LFD+tonnage) | |

*** 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. The remaining 4 fisheries (TRAWLOTH, GILLNET, LONGLINE, OTHERS) 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<br>1998–2001 | 1, 2 ,3 and 4<br>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 (1980–1989) 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: Linf=130 cm, K and mean length-at-age 0.75 estimated. 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 1985.

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.

Retention patterns for fisheries with discards: length-logistic with asymptotic retention = 1 in all cases, and unknown L50 and slope. For SPTRAWL7 and SPTRAWL8, two different patterns of retention over time are assumed, one for years 1990–1997 and the another one from 1998 onwards.

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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.

## D. Short-term projection

- Model used: length and age-based.
- Software used: Forecast module in SS3.
- 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: Forecast module in SS3
- 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 $B_{trigger}$ | | | | not defined |
| $F_{MSY}$ | | | | 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 |

## H. Other issues

None.

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# Annex D Stock Annex– Anglerfish in Divisions VIIb–k and VIIIa,b,d

| Quality Handbook | Stock Annex D |
|---|---|

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 | WGHMM, Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim |
| 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 |
| 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 |

| | 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 |
| 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 |
| 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 |
| 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 piscato-rius - 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 |
| 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 piscato-rius - 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 |
| 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 |

| | 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 |
| 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 |
| 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 |
| 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 |

| | 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** |
| 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 |
| 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. piscato-rius 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 |
| 2006 | 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 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** |
| 2007 | IRL-FU04+FU05/Q | IRL-FU04+FU05/Q | Total LDs and species ratio used | FU05+FU06 LDs raised to FU03 tonnage100 % 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 |
| 2008 | IRL-FU04+FU05/Q | IRL-FU04+FU05/Q | Total LDs and species ratio used | FU05+FU06 LDs raised to FU03 tonnage100 % 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 tonnage100 % 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-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 |
| 2010 | IRL-FU04+FU05/Q | IRL-FU04+FU05/Q | Total LDs and species ratio used | FU05+FU06 LDs raised to FU03 tonnage100 % 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-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

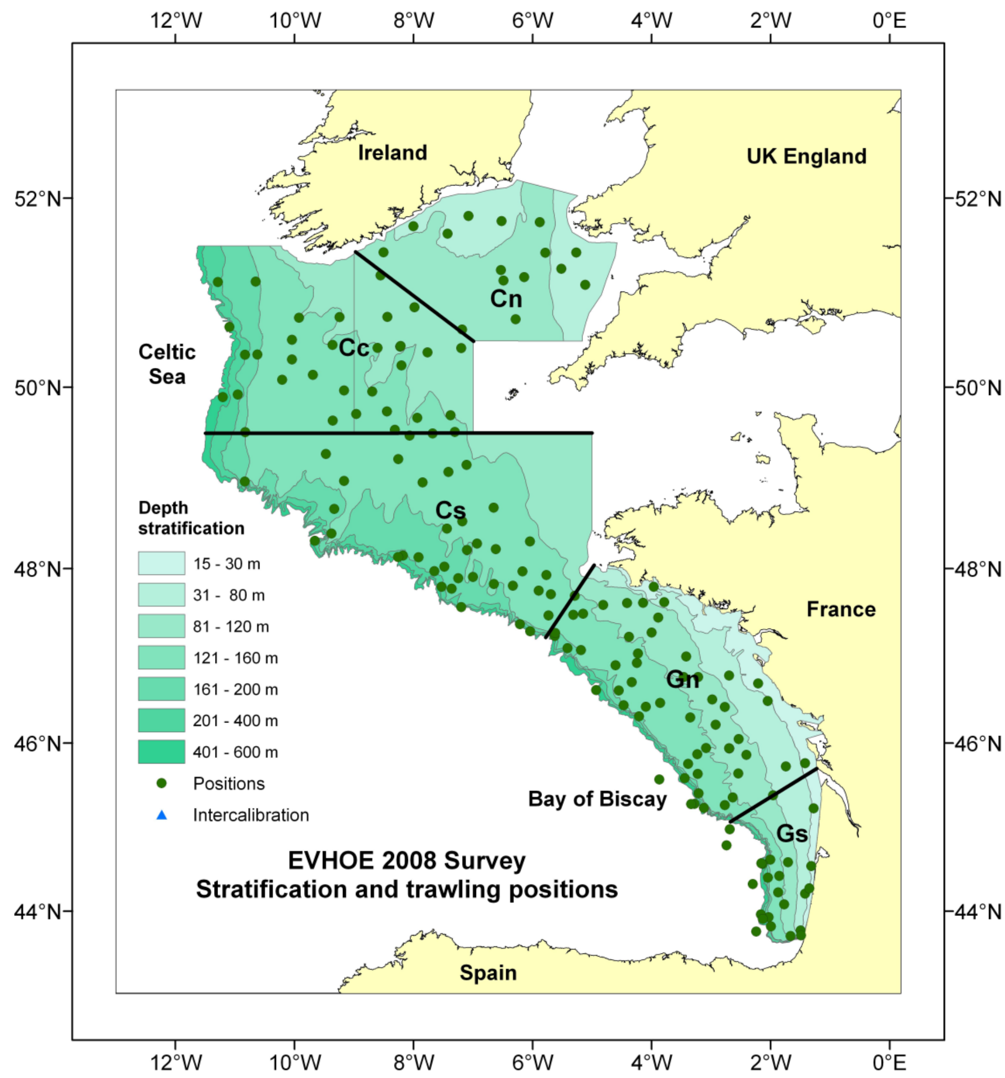
In 2007, WGHMM rejected the XSA age based assessments of both species because of data quality (increased discards not incorporated) and ageing problems clearly identified. Therefore there is no age based data used to assess the stocks. Only length distributions of landings and survey indices are used.

## 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

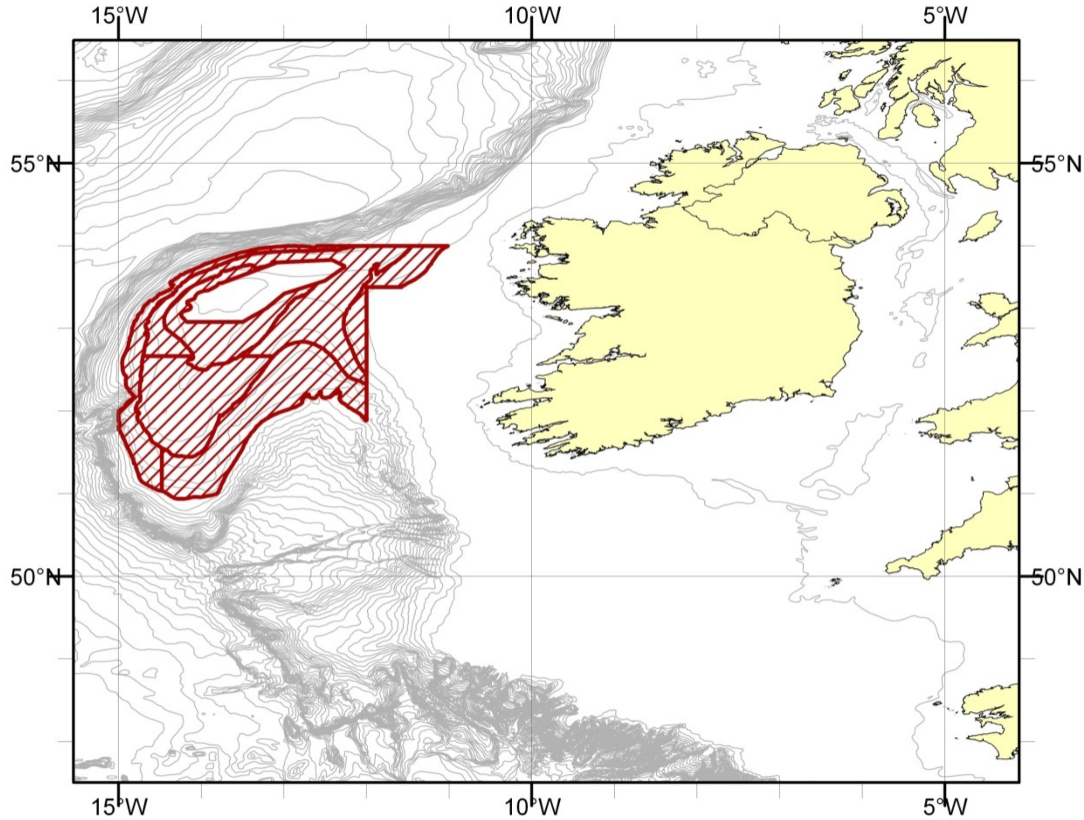
This survey covers the largest proportion of the area of stock distribution. It started in 1997.




**Map of Survey Stations completed by the EVHOE Survey in 2008.**

### The Spanish Porcupine Groundfish Survey (SP-PGFS)

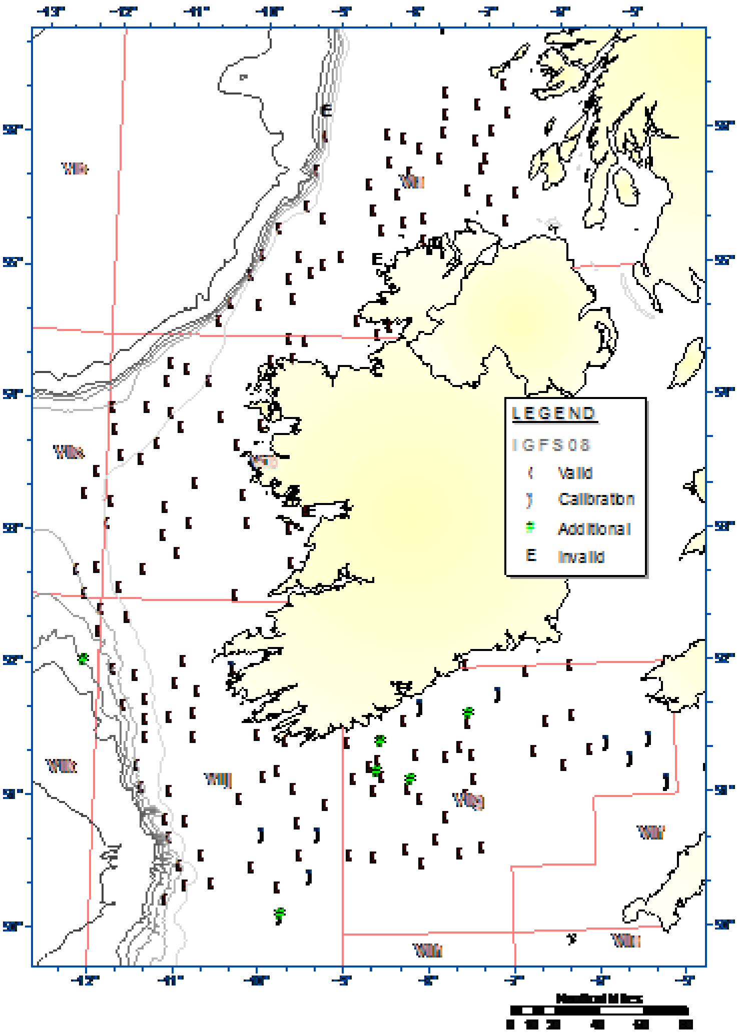
This survey was initiated in 2001 and covers the Porcupine Bank.




**Map of area covered by the Porcupine Groundfish Survey.**

### The Irish Groundfish Survey (IR-IGFS)

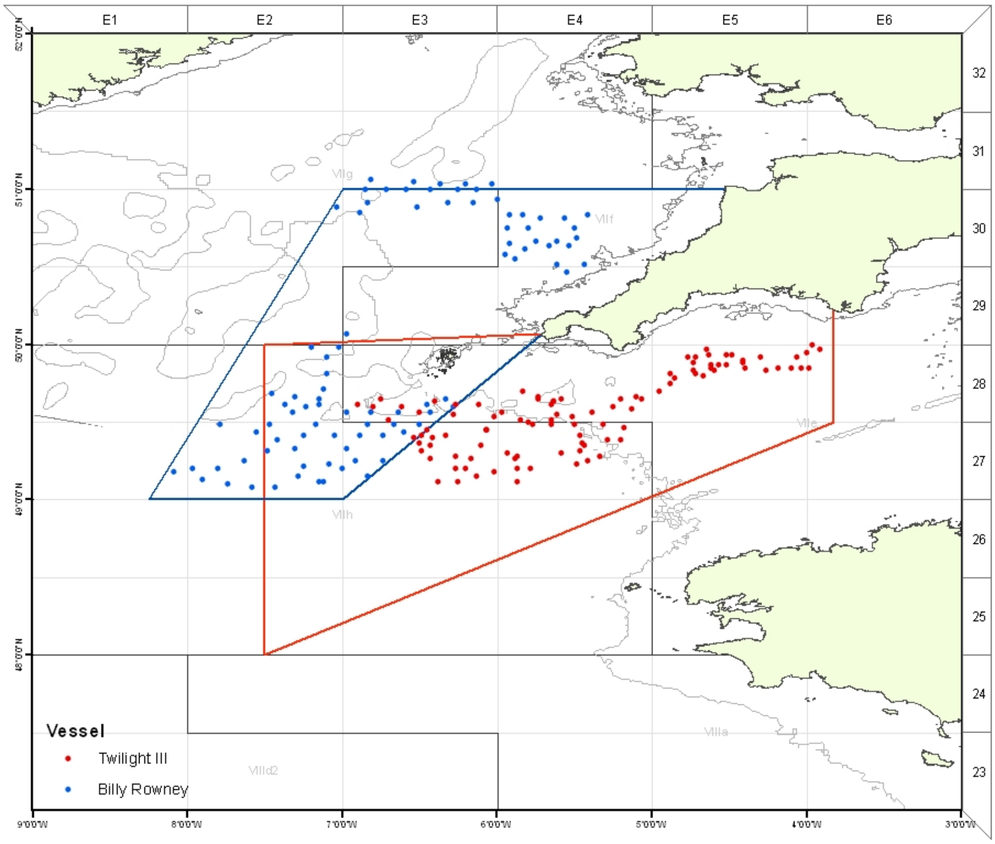
This survey was initiated in 2003 and covers areas around Ireland.




**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.

## I. References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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 Annex E

Stock specific documentation of standard assessment procedures used by ICES.

| | |
|---|---|
| Stock | Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIb–k and VIIIa,b,d |
| Working Group | WGHMM (Working Group on Hake Monk and Megrim from the Southern Waters) |
| Date | Updated March 2012: WKFLAT 2012 |
| Revised by | Marina Santurtún |

## 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).<br>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 |
| 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 |

| | France | | Ireland | | Spain | | UK | |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 Subarea 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).

*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 $y=1,...,Y$ and ages as $a=1,...,A+$, 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 $y \geq 2$:

$$N(y,a) = N(y-1,a-1)\exp[-Z(y-1,a-1)] \text{, if } 2 \leq a \leq A-1 \quad (1)$$

$$N(y,A+) = N(y-1,A-1)\exp[-Z(y-1,A-1)] + N(y-1,A+)\exp[-Z(y-1,A+)] \quad (2)$$

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:

$$F(y,a) = F_L(y,a) + \sum_{j=1}^{J} F_{D,j}(y,a) \text{ ,} \quad (3)$$

where $F_L(y,a)$ and $F_{D,j}(y,a), j=1,...,J$ 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:

$$F_L(y,a) = f(y)r_L(y,a) \text{, } F_{D,j}(y,a) = f(y)r_{D,j}(y,a), j=1,...,J \text{ ,} \quad (4)$$

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 $j=1,...,J$ 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:

$$r_L(y,a) \sim LN\left(r_L(y-1,a), CV_{rcond}\right), \tag{5}$$

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 $j=1,\ldots,J$, 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 $(\log[f(1)],\ldots,\log[f(Y)])$ *a priori*, with the same mean and variance in all years and correlation $\rho^n$ 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:

$$f(y) \sim LN\left(med_f, CV_f\right), \tag{6}$$

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 $\rho$ 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:

$$\log[C^{\text{obs}}(y,a)] \sim N\left(\log[\hat{C}(y,a)], \tau_C(a)\right), \tag{7}$$

where $C^{\text{obs}}(y,a)$ is the observed and

$$\hat{C}(y,a) = N(y,a)\{1-\exp[-Z(y,a)]\}F(y,a)/Z(y,a) \tag{8}$$

the model estimated catch numbers-at-age. For the landed numbers-at-age (years 1990–present):

$$\log[L^{\text{obs}}(y,a)] \sim N\left(\log[\hat{L}(y,a)], \tau_L(a)\right), \tag{9}$$

where $L^{\text{obs}}(y,a)$ is the observed and

$$\hat{L}(y,a) = N(y,a)\{1-\exp[-Z(y,a)]\}F_L(y,a)/Z(y,a) \tag{10}$$

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:

$$r_{OTD}(y,a) = r_{OTD}(y-1,a)\left[OTLW(y)/LW(y)\right]/\left[OTLW(y-1)/LW(y-1)\right] \tag{11}$$

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 $\tau_{D,j}(a)$, $j=1,...,J$ (discarded numbers-at-age for fleet $j=1,...,J$), 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 $\tau$ 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 $\tau$ 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 $\tau$ 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 $\tau$, 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 $\tau$. 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 $r_{OTD}(y,a)$ 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 | $B_{LIM}$ is not defined. | $B_{pa}$ be set at 55 000 t. |
| | $F_{LIM}$ is 0.44. | $F_{pa}$ be set at 0.30. |
| Target reference points | | $F_y$ is not defined. |

#### *Technical basis*

| | |
|---|---|
| $B_{LIM}$ = Not defined. | $B_{pa} = B_{loss}$. There is no evidence of reduced recruitment at the lowest biomass observed and $B_{pa}$ was therefore set equal to the lowest observed SSB. |
| $F_{LIM}$ = Floss. | $F_{pa} = F_{med}$; this implies a less than 45% probability that (SSBMT< $B_{pa}$). |

#### *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 Annex F

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: | May 2011 |
| 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).

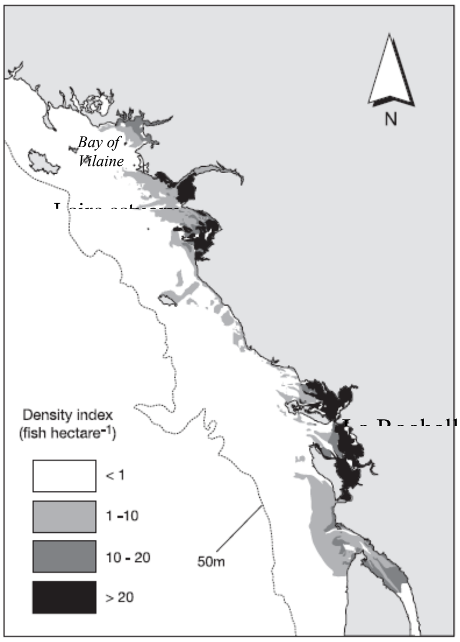



**Figure 1: Fitted 0-group sole density (number of fish per hectare) in the Bay of Biscay (Le Pape et *al.*, 2003a).**

## 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.

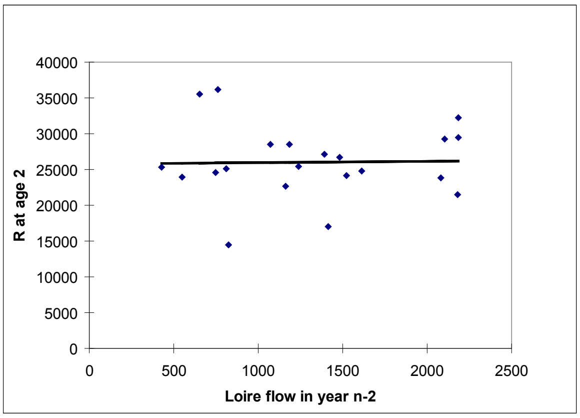
Catches have increased continuously since the beginning of the 1980s, until a maximum was reached in 1994 (7 400 t). They have decreased afterwards to 3600-4800t in 2003-2010. The year 2009 is the lower and the year 2011 is the higher since 2006 (4600 t).

### 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).

<u>Discards estimates of the French offshore trawlers provided by the RESSGASC surveys from 1987 to 2003:</u>

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 quarter 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

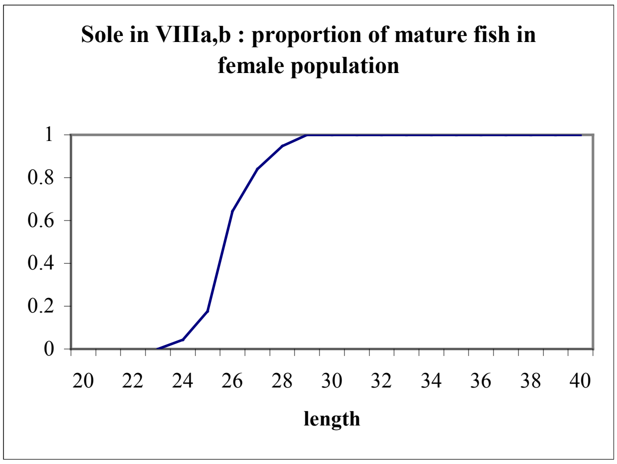
French mean weights at age are estimated using quarterly length-weight relationships in which weight are gutted weight multiplicated by the fresh/gutted transformation coefficient of French landing. This latter was changed from 1.11 to 1.04 in 2007. The French mean weights at age in catches are consequently 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.

<u>ORHAGO survey</u>

The ORHAGO survey was launch 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. The inclusion of this survey in the assessment was examined by the 2011 WKFLAT who concluded that this series is not long enough to be included in the assessment in 2011 but that possibility should be examined by the WGHMM when the series is more than five years long.

### 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: Lowesstoft 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 2012 |
|---|---|
| Catch data range | 84- last year |
| Catch age range | 2-8+ |
| Sables d'Olonne offshore trawlers fleets tuning fleet (FR – SABLES) | 1991 - 2009<br>2-7 |
| La Rochelle offshore trawlers fleets tuning fleet (FR – ROCHELLE) | 1991 - 2009<br>2-7 |
| Bay of Biscay offshore trawlers in the second quarter tuning fleet (FR-BB-OFF-Q2) | 2000 - last year<br>2-6 |
| Bay of Biscay inshore trawlers in the fourth quarter tuning fleet (FR-BB-IN-Q4) | 2000 - last year<br>3-7 |
| 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.

| WG year XSA | 1998 XSA | 1999 & 2000 XSA | 2001 XSA | 2002 XSA | 2003 XSA | 2004 XSA | 2005 XSA | 2006 XSA | 2007 XSA | 2008 XSA | 2009 XSA | 2010 XSA | 2011 XSA | 2012 XSA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Catch data range | 1984-1997 | 1984-1998 | 1984-2000 | 1984-2001 | 1984-2002 | 1984-2003 | 1984-2004 | 1984-2005 | 1984-2006 | 1984-2007 | 1984-2008 | 1984-2009 | 1984-2010 | 1984-2011 |
| Age range in catch data | 1-8+ | 1-8+ | 1-8+ | 1-8+ | 1-8+ | 2-8+ | 2-8+ | 2-8+ | 2-8+ | 2-8+ | 2-8+ | 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 | 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 |
| 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 | 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 |
| FR – ROCHELLE1 | Not used | Not used | Not used | Not used | Not used | 84-92 2-7 | Removed | Removed | Removed | Removed | Removed | Removed | Removed | Removed |
| FR – ROCHELLE2 | Not used | Not used | Not used | Not used | Not used | 93-03 2-7 | Removed | Removed | Removed | Removed | Removed | Removed | Removed | Removed |
| FR – OTHER | Not used | Not used | Not used | Not used | Not used | Not used | 95-04 2-7 | Removed | **REMOVED** | **REMOVED** | **REMOVED** | **REMOVED** | **REMOVED** | **REMOVED** |
| FR – RESSGASC-S | 88-97 1-7 | 89-98 1-7 | removed | removed | removed | removed | **REMOVED** | Removed | 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 | 87-02 2-6 | 87-02 2-6 | 87-02 2-6 | 87-02 2-6 | Removed | Removed |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FR – RESSGASC-S 3 | Not used | Not used | 87-97 2-6 | removed | removed | removed | Removed | Removed | Removed | 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 | 87-02 2-6 | 87-02 2-6 | 87-02 2-6 | 87-02 2-6 | Removed | Removed |
| FR-BB-IN-Q4 | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | 00-10 3-7 | 00-11 3-7 |
| FR-BB-OFF-Q2 | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | Not used | 00-10 2-6 | 00-11 2-6 |
| Taper | No | No | Yes | Yes | **YES** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** | **NO** |
| Tuning range | 10 | 10 | 17 | 18 | **19** | **20** | **14** | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| Ages catch dep. Stock size | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Q plateau | 6 | 6 | 6 | 6 | 6 | 6 | 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 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Year range | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| age range | 3 | 3 | 3 | 3 | 3 | 3 | 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 | 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 | 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 are 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 Approach | MSY $B_{trigger}$ | 13 000 t | $B_{pa}$ (provisional estimate. MSY $B_{trigger}$ to be re-evaluated). |
| | $F_{MSY}$ | 0.26 | $F_{max}$ (as estimated by WGHMM 2010) because no stock-recruitment relationship, limited variations of recruitment, Fishing mortality pattern known with low uncertainty |
| Precautionary Approach | $B_{lim}$ | Not defined | |
| | $B_{pa}$ | 13 000 t | The probability of reduced recruitment increases when SSB is below 13 000 t, based on the historical development of the stock. |
| | $F_{lim}$ | 0.58 | Based on the historical response of the stock. |
| | $F_{pa}$ | 0.42 | $F_{lim}$ * 0.72 |

*(unchanged since: 2010)*

## H. Other Issues

None

## I. References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# Annex G: Stock Annex Southern Hake

**Quality Handbook** **ANNEX: G – Southern Hake**

Stock specific documentation of standard assessment procedures used by ICES.

| | |
|---|---|
| Stock | Southern hake (Division VIIIc IXa) |
| Working Group: | WGHMM (WKROUND2010) |
| Date: | February 2010.( revised May 2011) |
| Revised by | Santiago Cerviño, Ernesto Jardim and Daniel Howell |

## 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), 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) and in the Mediterranean ones between 25 and 40 cm (Alheit and Pitcher, 1995; García-Rodríguez and Esteban, 1995; Ungaro *et al*., 2001). Besides, temporal fluctuations in size at maturity within the population have been also observed what probably reflects 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 (Solemdal, 1997; Trippel *et al*., 1997). 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. 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 values produces a high natural mortality in younger ages. An age-length assessment with GADGET taken into account cannibalism was presented in 2009 WGHMM (WD 7). Natural mortality estimation for ages 0 and 1 are substantial reaching values about 1 for age 0 and 0.5 for age 1. Projections show differences in recovery trajectories when compared with a model without cannibalism.

## 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.

All landings since 1994 were reviewed and computed by quarter. From 1982 to 1993 annual landings were split by quarters assuming the same quarter distribution than in 1994.

Landings from the Gulf of Cadiz were compiled and included on the assessment by quarter, following the same procedure as for other landings.

The length distributions of landings were also computed by quarter after 1994. For the previous period 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 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 (see Southern hake WD 2).

Both series of discarded weights were rebuilt back to 1992 based on the relations between (i) discards and surveys, and (ii) discards and landings (see Southern hake WD 4), with the aim of integrating them in assessment models.

## B.2. Biological

The sampling of commercial landings is carried out by the Fisheries Institutes involved in the fishery assessment (AZTI, IEO and IPIMAR) 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.

An international length-weight relationship for the whole period has been used since 1999 (a=0.00000659, b=3.01721).

Age information (otoliths) are collected by IEO, AZTI and IPIMAR and ages determined based on the recommendations of WKAEH (WKAEH, 2009). 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 (re-estimated by the model every year) is used. The growth parameters were decided based on (i) tagging data collected for the north stock in French coast (there is no information to assume a different growth (see point A.1), and (ii) k estimates by the assessment models carried out during the Benchmark WK.

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.

Maturity proportions-at-length was estimated with sexes combined from IEO sampling. Data available from IPIMAR 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 years 1982 to 2010. There are relevant changes in yearly maturity (Dominguez *et al*., 2007).

## 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).

The **Portuguese July groundfish** (**P-GFS-jul)** survey has not been conducted since 2002.

A new survey, the **Portuguese February groundfish (ptGFS-WIBTS-Q1)**, and has been carried out since 2005, with the aim of covering hake's spawning season.

## B.4. Commercial CPUE

Effort series are collected from Portuguese logbooks and compiled by IPIMAR, and from Spanish sales notes and Owners Associations data and compiled by IEO.

Landings, LPUE and effort are available for Coruña trawl (SP-CORUTR), Coruña pair trawl (SP-CORUTRP), Vigo/Marin trawl (SP-VIMATR), Santander trawl (SP-SANTR), Cadiz Trawl and Portuguese trawl (P-TR) fleets. Tuning data table (below) shows details about these surveys as well as which of them are used in the assessment model.

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. A working document presented to the benchmark documents the procedure (Southern hake WD 1).

## B.5. Other relevant data

Tagging data from IFREMER have been used to help estimating Bertalanffy's growth parameters.

# C. Historical Stock Development

Until 2009 this stock was assessed with VPA models based on ages estimated from ALK. Since 2010, based on the decisions of the Benchmark a GADGET model 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 $\beta$, 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 preditor) is modelled so that either the total catch in each area and time interval is specified, or this the catch per timestep 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 algorithims 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 fllets (1982-93 and 1994-08) 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 added to landings fleet from 2005-08. Discards from 1992-08 follows a Andersen function. The same function was used for Spanish survey, Cádiz survey and Portuguese survey. The surveys, on the other hand is modelled as fleet with constant effort and a nonparametric selection pattern that is estimated for three 15 cm length groups.

*Data used for the assessment are described below:*

| **description** | **period** | **by quarter** | **area** | **Likelihood component** |
|---|---|---|---|---|
| *Length distribution of landings* | 1994-2010 | YES | Iberia | Land1.ldist |
| *Length distribution of landings* | 1982-1993 | NO | Iberia | Land.ldist |
| *Length distribution of landings in Cadiz* | 1994-2010 | YES | Gulf of Cadiz | cdLand.ldist |
| *Length distribution of Spanish GFS* | 1982-2010 | - | North Spain | SpDem.ldist |
| *Length distribution of Spanish GFS* | 1989-2010 | - | Portugal | PtDem.ldist |
| *Length distribution of Spanish GFS in Cadiz* | 1990-2010 | - | Gulf of Cadiz | CdAut.ldist |
| *Length distribution of discards* | 1994, 1998, 1999, 2004-2010 | YES | Iberia | Disc.ldist |
| *Abundace index of Spanish GFS of 4-19 cm individuals* | 1982-2010 | - | North Spain | SpIndex15cm.1 |
| *Abundace index of Spanish GFS of 20-35 cm individuals* | 1982-2010 | - | North Spain | SpIndex15cm.2 |
| *Abundace index of Spanish GFS of 36-51 cm individuals* | 1982-2010 | - | North Spain | SpIndex15cm.3 |
| *Abundace index of Portuguese GFS of 4-19 cm individuals* | 1989-2010 | - | Portugal | PtIndex15cm.1 |
| *Abundace index of Portuguese GFS of 20-35 cm individuals* | 1989-2010 | - | Portugal | PtIndex15cm.2 |
| *Abundace index of Portuguese* | 1989-2010 | - | Portugal | PtIndex15cm.3 |

| | | | | |
|---|---|---|---|---|
| *GFS of 36-51 cm individuals* | | | | |
| *Abundace index of Spanish trawlers from A Coruña of 25-39 cm individuals* | 1994-2010 | YES | North Spain | SpCPUE15cm.1 |
| *Abundace index of Spanish trawlers from A Coruña of 40-54 cm individuals* | 1994-2010 | YES | North Spain | SpCPUE15cm.2 |
| *Abundace index of Spanish trawlers from A Coruña of 55-70 cm individuals* | 1994-2010 | YES | North Spain | SpCPUE15cm.3 |
| *Standardized abundace index of Portuguese trawlers of 25-39 cm individuals* | 1989-2010 | YES | Portugal | PtCPUE15cm.1 |
| *Standardized index of Portuguese trawlers of 40-54 cm individuals* | 1989-2010 | YES | Portugal | PtCPUE15cm.2 |
| *Standardized index of Portuguese trawlers of 55-70 cm individuals* | 1989-2010 | YES | 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** | **Relative contribution** |
|---|---|---|---|---|---|---|
| *Land1.ldist* | 0.66 | 44 | 2 | 1 | 133.2 | 0.2 |
| *Land.ldist* | 0.91 | 72 | 3 | 0.9 | 213.9 | 0.32 |
| *cdLand.ldist* | 2.5 | 52 | 2 | 0.1 | 4.2 | 0.01 |
| *SpDem.ldist* | 0.87 | 27 | 4 | 0.5 | 62.3 | 0.09 |
| *PtDem.ldist* | 0.39 | 24 | 4 | 0.4 | 99 | 0.15 |
| *CdAut.ldist* | 0.38 | 10 | 4 | 0.1 | 10.4 | 0.02 |
| *Disc.ldist* | 1.04 | 36 | 1 | 0.9 | 31.2 | 0.05 |
| *SpIndex15cm.1* | 4.84 | 9 | 4 | 0.5 | 3.7 | 0.01 |
| *SpIndex15cm.2* | 0.98 | 9 | 4 | 0.5 | 18.3 | 0.03 |
| *SpIndex15cm.3* | 1.2 | 9 | 4 | 0.5 | 15 | 0.02 |
| *PtIndex15cm.1* | 3.75 | 8 | 4 | 0.4 | 3.4 | 0.01 |
| *PtIndex15cm.2* | 1.34 | 8 | 4 | 0.4 | 9.5 | 0.01 |
| *PtIndex15cm.3* | 0.52 | 8 | 4 | 0.4 | 24.5 | 0.04 |
| *SpCPUE15cm.1* | 2.37 | 5 | 2 | 0.5 | 2.1 | <0.01 |
| *SpCPUE15cm.2* | 0.23 | 5 | 2 | 0.5 | 21.5 | 0.03 |
| *SpCPUE15cm.3* | 1.55 | 5 | 2 | 0.5 | 3.2 | 0.01 |
| *PtCPUE15cm.1* | 0.46 | 6.67 | 2 | 0.4 | 11.6 | 0.02 |
| *PtCPUE15cm.2* | 1.39 | 6.67 | 2 | 0.4 | 3.8 | 0.01 |
| *PtCPUE15cm.3* | 0.76 | 6.67 | 2 | 0.4 | 7 | 0.01 |

The parameters estimated are:

- The number of fish by age when simulation starts. (ages 1 to 8) .8 params
- Recruitment each year. (1982 to 2010). 27 params

- The growth rate (k) of the von Bertalanffy growth model.
- Parameter $\beta$ of the beta-binomial distribution .
- The ratio between recruitment in the first and second quarter.
- The selection pattern of:
    - the commercial catches (1982-93). 2 params
    - Landings (1994-2010) . 2 params
    - Cadiz landings (1982-2004) . 3 params
    - Discards (1992-10) . 3 params
    - Spanish Survey . 3 params
    - Portugese Survey . 3 params
    - Cadiz autumn Survey . 3 params
- Catchability of :
    - Spanish Survey (3 groups from 4 cm by 15 cm) .3 params
    - Portugese Survey . (3 groups from 4 cm by 15 cm) .3 params
    - Spanish CPUE (3 groups from 25 cm by 15 cm) .3 params
    - Portugese CPUE (3 groups from 25 cm by 15 cm) .3 params

71 parameters in total

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 anneling 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 fit were analysed with the following **diagnostics**:

- Profiled likelihood plots. To analize convergence and problematic parameters.
- Plot comparing observed and modeled proportions in fleets (catches, landings or discards). To analize how estimated population abundance and explotation 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: 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, landing fleet with a logistic selection pattern, and discards fleet with a 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 * 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: 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 2100

Software used: GADGET (script: 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 (asimetric) 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 (WKROUND, 2010) considers that ICES should be flexible in allowing model improvements during the Assessment Working Groups and on an inter-sessional basis. ICES should therefore ensure that resources are in place to evaluate these improvements.

In the line of previous paragraph it is worth mention that change in projection was caused by a misinterpretation regarding the way GADGET makes projections that drove to wrong results. The definition the 8 F multipliers instead of just 4 (one for each quarter) allows to a correct balance of discards and landings. Using the mean of last 3 years allows avoiding excessive weight of a unexpected data (quarter/fleet).

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# Annex H Stock Annex Southern white anglerfish (*Lophius piscatorius*) (*Divisions VIIIc, IXa)*

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|---|---|
| Quality Handbook | Stock Annex H |

Stock specific documentation of standard assessment procedures used by ICES.

| | |
|---|---|
| Stock | Southern white anglerfish (Divisions VIIIc, IXa) |
| Working Group: | Assessment of Southern Shelf Stocks of Hake, Monk and Megrim |
| Date: | 22/05/2012 |
| Revised by | Paz Sampedro (WGHMM2012) |

## 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 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 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 83% 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 2003–2010 period the catches were between

2300 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, 17% from trawlers and 83% 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, 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

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 marrecapture 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 2006 to 2010.

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 1548 t in 2010.

#### 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 2010. 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, 2012), 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):

$$W = 2.70\times10^{-5}\cdot L^{2.839}$$

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 2010. 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 1982–2010. 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 13% 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 1999–2010. Data provided for Cedeira gillnets comprise quarterly standardized effort (in soaking days), landings and length composition of landings. This fleet represents an average of 10% of international catches of white anglerfish since 1999.

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 1989–2010. 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 1989–2010. 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, 2012).

#### *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: 1980–2010.

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 2010 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 2010. It is entered as four separate indices, one index per quarter.
- Cedeira gillnetters (SPCEDGN8C): Quarterly lpue in weight from 1999 to 2010. It is entered as four separate indices, one index per quarter.
- Spanish Groundfish Survey (SPGFS): Abundance index in numbers from 1983 to 2010, 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: 1986–2010, 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: 1986–2010, 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: 1986–2010, 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: 1986–2010, 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: 1982–2010, quarterly basis. Gaps are presented in years 1982, 1984, 1985 and 1986.
- SPCEDGN8C: 1999–2010, quarterly basis.
- SPGFS: length composition for fourth quarter, from 1983–2010. 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 2011 is presented in Table 1.

**Table 1. History of southern white anglerfish assessment from 2007 to 2011.**

| WG | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| 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) |
| Software | ASPIC (v. 5.16) | No updated | ASPIC (v. 5.16) | ASPIC (v. 5.34) | ASPIC (v. 5.34.9) |
| Catch data range | 1980–2006 | | 1980–2008 | 1980–2009 | 1980–2010 |
| Cpue Series 1 (years) | SP-CORUTR8c (1986–2006) | | SP-CORUTR8c (1986–2008) | SP-CORUTR8c (1986–2009) | SP-CORUTR8c (1986–2010) |
| Index of Biomass (years) | SP-CEDGNS8c (1999–2006) | | SP-CEDGNS8c (1999–2008) | SP-CEDGNS8c (1999–2009) | SP-CEDGNS8c (1999–2010) |
| Error Type | Condition on yield | | Condition on yield | Condition on yield | Condition on yield |
| Number of bootstrap | 500 | | 500 | 1000 | 1000 |
| Maximum F | 8.0 (y-1) | | 8.0 (y-1) | 8.0 (y-1) | 8.0 (y-1) |
| Statistical weight B1/K | 1 | | 1 | 1 | 1 |
| Statistical weight for fisheries | 1,1 | | 1,1 | 1,1 | 1,1 |
| B1-ratio (starting guess) | 0.5 | | 0.5 | 0.5 | 0.5 |
| MSY (starting guess) | 5000 t | | 5000 t | 5000 t | 5000 t |
| K (starting guess) | 50 000 t | | 50 000 t | 50 000 t | 50 000 t |
| 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) |

| WG | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| 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*)

Quality Handbook Stock Annex I

Stock specific documentation of standard assessment procedures used by ICES.

| | |
|---|---|
| Stock: | Southern megrims (Divisions VIIIc, IXa) |
| Working Group: | Working Group on the Assessment of Southern Shelf of Hake, Monk and Megrim Stocks (WGHMM) |
| Last Update: | May 2012 |

## 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. Fishing practices of some Spanish trawl fleets have changed in recent years, now focusing more on species such as horse mackerel, blue whiting, or mackerel, and not taking megrim in the catch.

Since the early 1990´s the Spanish trawl fleet has diversified its gear, introducing a new trawl gear which targets primarily horse mackerel and does not catch megrim. This gear, named High Vertical Opening (HVO or "jurelera") trawl, affects catches of *L. boscii* more than those of *L. whiffiagonis*, because it operates mainly in the distribution area of the former species. The increasing use of pair trawlers, for which the vast majority of catch is blue whiting (and also catch mackerel as a seasonal fishery, Castro *et al*, 2011), and HVO ("jurelera") gear in trawlers, has reduced the effort on megrim species in recent years.

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 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. 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.

Discards data are not yet used in this assessment due to the lack of data in some years of the series. 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.

## B.2 Biological

### Landing 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 and 2004 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 based in A Coruña port (SP-CORUTR8c) and fishing in Division VIIIc since 1986, Spanish trawlers based in Avilés port (SP-AVILESTR) and fishing in Division VIIIc for the period 1986-2003, 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-CORUTR8c: 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. In 2003, restrictions imposed on fishing activity due to the Prestige oil spill had an influence on effort.
- SP-AVILESTR: 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. No data are available for this fleet after 2003.

Commercial fleets used in the assessment of *L.boscii* to tune the model

- SP-CORUTR8c: 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. Due to the increased use of HVO ("jurelera") gear (which catches very little megrim) by this fleet, estimated LPUE values for recent years are not directly comparable with those from earlier years. This affects *L.boscii* more than *L.whiffiagonis* because the HVO gear is used mostly in more southern areas, where *L.whiffiagonis* abundance is very low. Hence, only LPUE values up to year 1999 from this tuning fleet are used in the assessment in the assessment of *L.boscii*.

# C. Historical stock development: Assessment Methods and Settings

These stocks have been assessed with Extended Survivors Analysis (XSA), (Shepherd, 1992), since 1992.

Software used: VPA95 Lowestoft suite.

The input settings of the assessment model and data used in recent years are shown in the next table:

| **WG YEAR** | **2007** | | **2008** | | **2009** | | **2010** | | **2011** | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model | XSA | | XSA | | XSA | | XSA | | XSA | |
| Software | 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* |
| Catch data range | 1986-2006 | 1986-2006 | 1986-2007 | 1986-2007 | 1986-2008 | 1986-2008 | 1986-2009 | 1986-2009 | 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+ |
| SP-CORUTR8c | 1990-2006 Ages 2-6 | 1986-1999 Ages 3-6 | 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 |
| 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 |
| SpGFS-WIBTS-Q4 survey | 1990-2006 Ages 1-6 | 1988-2006 (2003 not included) Ages 0-6 | 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 |
| 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 |
| Tuning range | 17 | 21 | 18 | 22 | 19 | 23 | 20 | 24 | 21 | 25 |
| 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 |
| Q plateau | 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 |
| Shrinkage year range | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Shrinkage age range | 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 |
| F bar range | 2-4 | 2-4 | 2-4 | 2-4 | 2-4 | 2-4 | 2-4 | 2-4 | 2-4 | 2-4 |

## D. Short term projection

Common settings for *L. whiffiagonis* and *L. boscii* for deterministic short-term predictions:

- Model used: Age structured.
- Software used: MFDP prediction with management option table and yield per recruit routines.
- Natural mortality: 0.2.
- 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 last three years.
- Weight-at-age in the catch: Average weight of the three last years.
- Exploitation pattern: Average of the three last years (normally unscaled although, when appropriately justified, it could be scaled to the final year).
- Intermediate year assumptions: status quo F

Specific settings for *L. whiffiagonis*:

- Initial stock size for projections. Taken from the XSA survivors for age 2 and older.
- Stock recruitment model used: None. Recruitment at age 1 assumed equal in all projection years (GM from 1998 to final assessment year minus 2).

Specific settings *L. boscii* for deterministic short-term predictions are:

- Initial stock size for projections. Taken from the XSA survivors for age 1 and older.
- Stock recruitment model used: None. Recruitment at age 0 assumed equal in all projection years (GM from 1990 to final assessment year minus 2).

Estimates of recruitment for years 1986 to 1989 are always excluded for these stocks because age compositions in those years are based on a combined ALK instead of annual ones. Estimates of recruitment for years 1990-1997 are excluded in *L. whiffiagonis* too because this stock has consistently displayed lower recruitment levels after 1997. The range of years may be revised by the WG in the future, if felt appropriate.

## E. Medium term projections

Medium term projections are not conducted for these stocks.

## 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: MFYPR.

## G. Biological reference points

The table below shows a summary of the precautionary reference points proposed for *L. whiffiagonis* in the past. It shows that there are no precautionary reference points defined for this stock.

| | ACFM 1998 | WG 2000 | ACFM 2000 | WG 2002 | ACFM 2002 |
|---|---|---|---|---|---|
| Flim | Not defined | Not defined | Not defined | Not defined | Not defined |
| Fpa | No proposal | No proposal | Not adopted | No proposal | Not adopted |
| Blim | 900 t (Bloss,=B95 WG98) | | Not defined | | |
| Bpa | 1 500 t (Blim × 1.64) | 900 t (Bloss,=B95 WG98) | Not adopted | 1 500 t (stock history) | Not adopted |

In the WGHMM 2010 meeting, as part of the new ICES MSY framework, possible proxies were considered for $F_{msy}$ in the range of $F_{max}$, F0.1, F35% and F40%. $F_{max}$ is not well defined for this stock, as the yield-per-recruit curve shows a very flat top. It was noted that there has been some variability in these values throughout the years. Furthermore, taking into account that the assessment of this stock and yield-per-recruit calculation ignore the fact that discards exist, a rough sensitivity exercise was conducted in WG2010 taking discards into consideration in an approximate way. The following table compares the results that were obtained from the original analysis (ignoring discards, left side of the table) and the sensitivity exercise (with some assumed landed proportions and increased F on younger ages, right side of the table):

| | Original analysis | | | Sensitivity exercise with discards | | |
|---|---|---|---|---|---|---|
| WG2010 | Fbar | Y_p_R | SSB_p_R | Fbar | Y_p_R | SSB_p_R |
| Fmax | 0.32 | 0.08 | 0.29 | 0.20 | 0.05 | 0.37 |
| F0.1 | 0.14 | 0.07 | 0.48 | 0.13 | 0.05 | 0.50 |
| F35% | 0.21 | 0.07 | 0.38 | 0.19 | 0.05 | 0.38 |
| F40% | 0.17 | 0.07 | 0.43 | 0.16 | 0.05 | 0.43 |

Fmax would seem to be particularly affected by whether or not discards are taken into consideration. The F0.1, F35% and F40% values are affected to a much lesser extent.

F40%=0.17 was proposed by WGHMM 2010 as a provisional Fmsy proxy for the *L.whiffiagonis* stock. This proposal should be considered as preliminary and may be revised as further work on this stock assessment, including the incorporation of discards, takes place.

The table below summarises the history of precautionary reference points for *L. boscii* and shows that such points are not defined for this stock either.

| | ACFM 1998 | WG-1999 | WG-2000 | ACFM 2000 | WG-2002 | ACFM 2003 | WG-2003 |
|---|---|---|---|---|---|---|---|
| Flim | 0.25 (Floss WG98) | No proposal | 0.40 (Floss) | | Not defined | | |
| Fpa | 0.20 (Flim e-1.645*σ) | No proposal | 0.30 (Flim e-1.645*σ) | Not adopted | 0.31 (Fmed ) | Not adopted | No proposal |
| Blim | 3 400 t (Bloss,=B96 WG98) | 4 700 t (Bloss=B96 WG99) | | | Not defined | | |
| Bpa | 5 000 t (Blim × 1.4) | 6 500 t | 4 700 t (Bloss,=B95) | Not adopted | 5 000 t (Bloss=B95) | Not adopted | No proposal |

In previous Working Groups, reference points were not proposed because of the interannual variability detected in the relative exploitation pattern-at-age. This variability is still occurring. Nevertheless, an attempt was made during WGHMM 2010 to examine possible $F_{msy}$ candidates for this stock. The possible proxies considered for

$F_{msy}$ were the same as for the other megrim species. There has also been some variability in the values throughout the years. Additionally, the same rough sensitive exercise to assumed discards was performed with the following results:

| | Original analysis | | | Sensitivity exercise with discards | | |
|---|---|---|---|---|---|---|
| WG2010 | Fbar | Y_p_R | SSB_p_R | Fbar | Y_p_R | SSB_p_R |
| Fmax | 0.39 | 0.05 | 0.16 | 0.21 | 0.03 | 0.21 |
| F01 | 0.14 | 0.04 | 0.27 | 0.13 | 0.03 | 0.28 |
| F35% | 0.24 | 0.04 | 0.21 | 0.21 | 0.03 | 0.21 |
| F40% | 0.18 | 0.04 | 0.23 | 0.17 | 0.03 | 0.23 |

Fmax would seem to be greatly affected by whether or not discards are taken into consideration. The F0.1, F35% and F40% values are much less affected.

F40%=0.18 was proposed by WGHMM 2010 as provisional $F_{msy}$ proxy for *L. boscii*, consistently with the choice made for *L.whiffiagonis*. This proposal should be considered preliminary and may be revised as further work on this stock assessment, including the incorporation of discards, takes place.

## H. Other Issues

None.

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Short term projections code for *L. whiffiagonis*:

```
library(FLCore)
library(FLAssess)
library(FLash)

# set path to the directory with the input files
path <- 'D:/'
#path <- 'C:/ICES/WGHMM/wghmm_2012/data/megrim 8c9a/whiffiagonis/'

# read in the stock files and the tuning files
meg <- readFLStock(paste(path, 'indexw.txt', sep=''), no.discards=T)
tun <- readFLIndices(paste(path, 'fleetw_2012.txt', sep=''))

# set the fbar age range and set the plus group to 7
range(meg)[c("minfbar","maxfbar")] <- c(2,4)
meg <- setPlusGroup(meg, 7)

# read in the stock assessment results
stock.n(meg) <- trim(readVPAFile(paste(path, 'Nw.txt', sep='')),
year=1986:2010)
harvest(meg) <- trim(readVPAFile(paste(path, 'Fw.txt', sep='')),
year=1986:2010)
units(harvest(meg)) <- 'f'

# create stock recruitment object
meg.srr <- sr(as.FLSR(meg, model='geomean'))

# overwrite geometric mean parameter with correct value for years 1998 - 2008
gm.rec <- round(exp(mean(log(trim(rec(meg),year=1998:2008)))),0)
params(meg.srr)['a'] <- gm.rec

# short term forecast
nyrs    <- 4
meg.stf <- stf(meg,nyrs)

# to get round survivors issues due to non-convergence of XSA
stock.n(meg.stf)[,'2011'] <- c(gm.rec, 4357, 780,704,751,362,275)
catch.n(meg.stf)[,'2011'] <- har-
vest(meg.stf)[,'2011']/Z(meg.stf)[,'2011']*stock.n(meg.stf)[,'2011']*(1-exp(-
Z(meg.stf)[,'2011']))
landings.n(meg.stf)[,'2011'] <- catch.n(meg.stf)[,'2011']

# Last years forecast
# set up the control object to project forward from 2012 instead of 2011
fwdCtrl <- fwdControl(data.frame(year=2012:2013, val=rep(0.1356,nyrs-2),
quantity=rep('f',nyrs-2)))
meg.fwd <- fwd(meg.stf, fwdCtrl, sr=meg.srr)

# management options table
fsq <- 0.1356
Fmultipliers <- seq(0, 2, by=0.1)
landings.mo <- NULL; tsb.mo <- NULL; ssb.mo <- NULL
for(fmult in Fmultipliers){
  fwdCtrl <- fwdControl(data.frame(year=2012:2013, val=rep(fsq*fmult,2),
quantity=c('f','f')))
  meg.fwd <- fwd(meg.stf, fwdCtrl, sr=meg.srr)
  landings.mo <- c(landings.mo, landings(meg.fwd)[,'2012'])
  tsb.mo      <- c(tsb.mo, tsb(meg.fwd)[,'2013'])
  ssb.mo      <- c(ssb.mo, ssb(meg.fwd)[,'2013'])
}

# output the values for the table
section1 <- data.frame(Biomass=round(c(tsb(meg.fwd)[,'2011']),0),
                       SSB    =round(c(ssb(meg.fwd)[,'2011']),0),
                       Fmult  =1,
                       FBar   =fsq,
```

```
                       Landings=round(c(landings(meg.fwd)[,'2011']),0))


section2 <- data.frame(Biomass
=round(rep(c(tsb(meg.fwd)[,'2012']),length(Fmultipliers)),0),
                       SSB
=round(rep(c(ssb(meg.fwd)[,'2012']),length(Fmultipliers)),0),
                       Fmult   =Fmultipliers,
                       FBar    =round(fsq * Fmultipliers,4),
                       Landings=round(landings.mo,0),
                       Biomass =round(tsb.mo,0),
                       SSB     =round(ssb.mo,0))
2011
section1
2012
section2

# This years forecast
# set up the control object to project forward until 2014
fwdCtrl <- fwdControl(data.frame(year=2012:2014, val=rep(0.1356,nyrs-1),
quantity=rep('f',nyrs-1)))

# regression of recruitment on survey rec values
#survey.rec <- c(catch.n(tun[['SP-GFS']])['1', ac(1990:2008)])
#assess.rec <- c(stock.n(meg)['1',ac(1990:2008)])
#rec.lm     <- lm(assess.rec~survey.rec)
#rec.pred   <- predict(rec.lm, newdata=list(survey.rec=catch.n(tun[['SP-
GFS']])['1','2011']))

#change recruitment assumptions in 2011
stock.n(meg.stf)['1','2011'] <- gm.rec  #rec.pred
meg.fwd2 <- fwd(meg.stf, fwdCtrl, sr=meg.srr)


# management options table - this year
# management options table
fsq <- 0.1356
Fmultipliers <- seq(0, 2, by=0.1)
landings.mo <- NULL; tsb.mo <- NULL; ssb.mo <- NULL
for(fmult in Fmultipliers){
  fwdCtrl <- fwdControl(data.frame(year=2012:2014,
val=c(fsq,fsq*fmult,fsq*fmult), quantity=c('f','f','f')))
  meg.fwd3    <- fwd(meg.stf, fwdCtrl, sr=meg.srr)
  landings.mo <- c(landings.mo, landings(meg.fwd3)[,'2013'])
  tsb.mo      <- c(tsb.mo, tsb(meg.fwd3)[,'2014'])
  ssb.mo      <- c(ssb.mo, ssb(meg.fwd3)[,'2014'])
}


section1b <- data.frame(Biomass=round(c(tsb(meg.fwd2)[,'2012']),0),
                        SSB    =round(c(ssb(meg.fwd2)[,'2012']),0),
                        Fmult  =1,
                        FBar   =fsq,
                        Landings=round(c(landings(meg.fwd2)[,'2012']),0))

section2b <- data.frame(Biomass
=round(rep(c(tsb(meg.fwd2)[,'2013']),length(Fmultipliers)),0),
                       SSB
=round(rep(c(ssb(meg.fwd2)[,'2013']),length(Fmultipliers)),0),
                       Fmult   =Fmultipliers,
                       FBar    =round(fsq * Fmultipliers,4),
                       Landings=round(landings.mo,0),
                       Biomass =round(tsb.mo,0),
                       SSB     =round(ssb.mo,0))
section1a <- section1
section1b
section2b
```

Short term projections code for *L. boscii*:

```
library(FLCore)
library(FLAssess)
library(FLash)

# set path to the directory with the input files
path <- 'D:/'

# read in the stock files and the tuning files
ldb <- readFLStock(paste(path, 'indexb.txt', sep=''), no.discards=T)
tunb <- readFLIndices(paste(path, 'fleetb_2012.txt', sep=''))

# set the fbar age range and set the plus group to 7
range(ldb)[c("minfbar","maxfbar")] <- c(2,4)
ldb <- setPlusGroup(ldb, 7)

# read in the stock assessment results
stock.n(ldb) <- trim(readVPAFile(paste(path, 'Nb.txt', sep='')),
year=1986:2010)
harvest(ldb) <- trim(readVPAFile(paste(path, 'Fb.txt', sep='')),
year=1986:2010)
units(harvest(ldb)) <- 'f'

# create stock recruitment object
ldb.srr <- sr(as.FLSR(ldb, model='geomean'))

# overwrite geometric mean parameter with correct value for years 1990 - 2008
gm.rec <- round(exp(mean(log(trim(rec(ldb),year=1990:2008)))),0)
params(ldb.srr)['a'] <- gm.rec

# short term forecast
nyrs    <- 4
ldb.stf <- stf(ldb,nyrs)

# to get round survivors issues due to non-convergence of XSA
stock.n(ldb.stf)[,'2011'] <- c(gm.rec, 17855,23296,10209,6879,3732,2766,1417)
catch.n(ldb.stf)[,'2011'] <- har-
vest(ldb.stf)[,'2011']/Z(ldb.stf)[,'2011']*stock.n(ldb.stf)[,'2011']*(1-exp(-
Z(ldb.stf)[,'2011']))
landings.n(ldb.stf)[,'2011'] <- catch.n(ldb.stf)[,'2011']

# Last years forecast
# set up the control object to project forward from 2012 instead of 2011
fwdCtrl <- fwdControl(data.frame(year=2012:2013, val=rep(0.289,nyrs-2), quan-
tity=rep('f',nyrs-2)))
ldb.fwd <- fwd(ldb.stf, fwdCtrl, sr=ldb.srr)

# management options table
fsq <- 0.289
Fmultipliers <- seq(0, 2, by=0.1)
landings.mo <- NULL; tsb.mo <- NULL; ssb.mo <- NULL
for(fmult in Fmultipliers){
  fwdCtrl <- fwdControl(data.frame(year=2012:2013, val=rep(fsq*fmult,2),
quantity=c('f','f')))
  ldb.fwd <- fwd(ldb.stf, fwdCtrl, sr=ldb.srr)
  landings.mo <- c(landings.mo, landings(ldb.fwd)[,'2012'])
  tsb.mo      <- c(tsb.mo, tsb(ldb.fwd)[,'2013'])
  ssb.mo      <- c(ssb.mo, ssb(ldb.fwd)[,'2013'])
}

# output the values for the table
section1 <- data.frame(Biomass=round(c(tsb(ldb.fwd)[,'2011']),0),
                       SSB    =round(c(ssb(ldb.fwd)[,'2011']),0),
                       Fmult  =1,
                       FBar   =fsq,
                       Landings=round(c(landings(ldb.fwd)[,'2011']),0))
```

```
section2 <- data.frame(Biomass
=round(rep(c(tsb(ldb.fwd)[,'2012']),length(Fmultipliers)),0),
                       SSB
=round(rep(c(ssb(ldb.fwd)[,'2012']),length(Fmultipliers)),0),
                       Fmult   =Fmultipliers,
                       FBar    =round(fsq * Fmultipliers,4),
                       Landings=round(landings.mo,0),
                       Biomass =round(tsb.mo,0),
                       SSB     =round(ssb.mo,0))
2011
section1
2012
section2

# This year forecast
# set up the control object to project forward until 2014
fwdCtrl <- fwdControl(data.frame(year=2012:2014, val=rep(0.289,nyrs-1), quan-
tity=rep('f',nyrs-1)))

# regression of recruitment on survey rec values
survey.rec <- c(catch.n(tunb[['SP-GFS']])['0', ac(1990:2008)])
assess.rec <- c(stock.n(ldb)['0',ac(1990:2008)])
rec.lm     <- lm(assess.rec~survey.rec)
rec.pred   <- predict(rec.lm, newdata=list(survey.rec=catch.n(tunb[['SP-
GFS']])['0','2011']))

#change recruitment assumptions in 2011
stock.n(ldb.stf)['0','2011'] <- gm.rec  #rec.pred
ldb.fwd2 <- fwd(ldb.stf, fwdCtrl, sr=ldb.srr)


# management options table - this year
# management options table
fsq <- 0.289
Fmultipliers <- seq(0, 2, by=0.1)
landings.mo <- NULL; tsb.mo <- NULL; ssb.mo <- NULL
for(fmult in Fmultipliers){
  fwdCtrl <- fwdControl(data.frame(year=2012:2014,
val=c(fsq,fsq*fmult,fsq*fmult), quantity=c('f','f','f')))
  ldb.fwd3    <- fwd(ldb.stf, fwdCtrl, sr=ldb.srr)
  landings.mo <- c(landings.mo, landings(ldb.fwd3)[,'2013'])
  tsb.mo      <- c(tsb.mo, tsb(ldb.fwd3)[,'2014'])
  ssb.mo      <- c(ssb.mo, ssb(ldb.fwd3)[,'2014'])
}


section1b <- data.frame(Biomass=round(c(tsb(ldb.fwd2)[,'2012']),0),
                        SSB    =round(c(ssb(ldb.fwd2)[,'2012']),0),
                        Fmult  =1,
                        FBar   =fsq,
                        Landings=round(c(landings(ldb.fwd2)[,'2012']),0))

section2b <- data.frame(Biomass
=round(rep(c(tsb(ldb.fwd2)[,'2013']),length(Fmultipliers)),0),
                       SSB
=round(rep(c(ssb(ldb.fwd2)[,'2013']),length(Fmultipliers)),0),
                       Fmult   =Fmultipliers,
                       FBar    =round(fsq * Fmultipliers,4),
                       Landings=round(landings.mo,0),
                       Biomass =round(tsb.mo,0),
                       SSB     =round(ssb.mo,0))
section1a <- section1
section1b
section2b
```

# Annex J Stock Annex Bay of Biscay *Nephrops* (FU 23-24)

Quality Handbook Stock Annex J

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: | Assessment of Southern Shelf Stocks of Hake, Monk and Megrim |
| 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 2$^{nd}$ and 3$^{rd}$ 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.

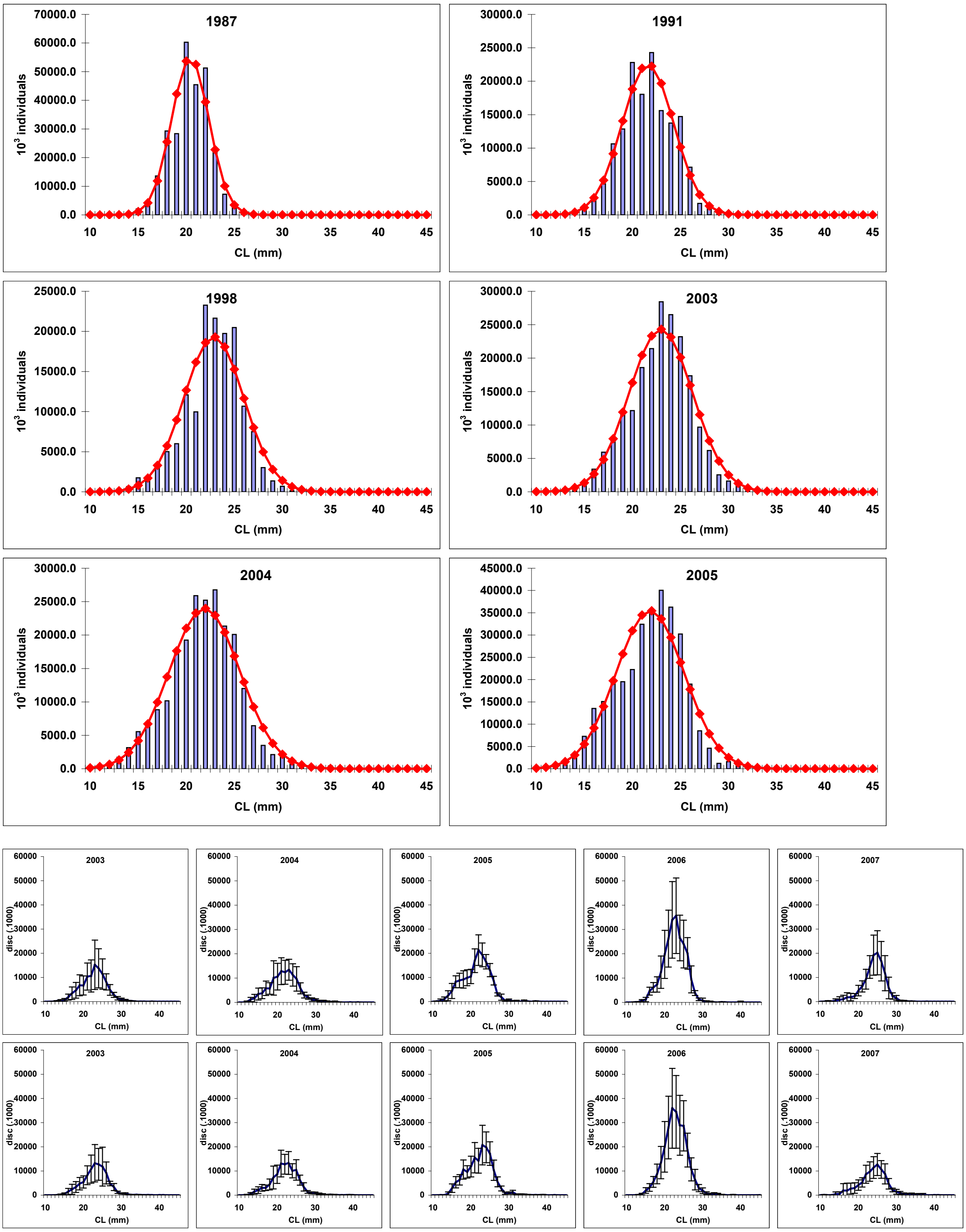


*Figure 2.* **Years 2003-2007. Distribution of length frequencies (CL in mm) and confidence intervals (confidence level 1-$\alpha$=0.95) for discards estimated by sampling. Data by sex (females above, males below).**

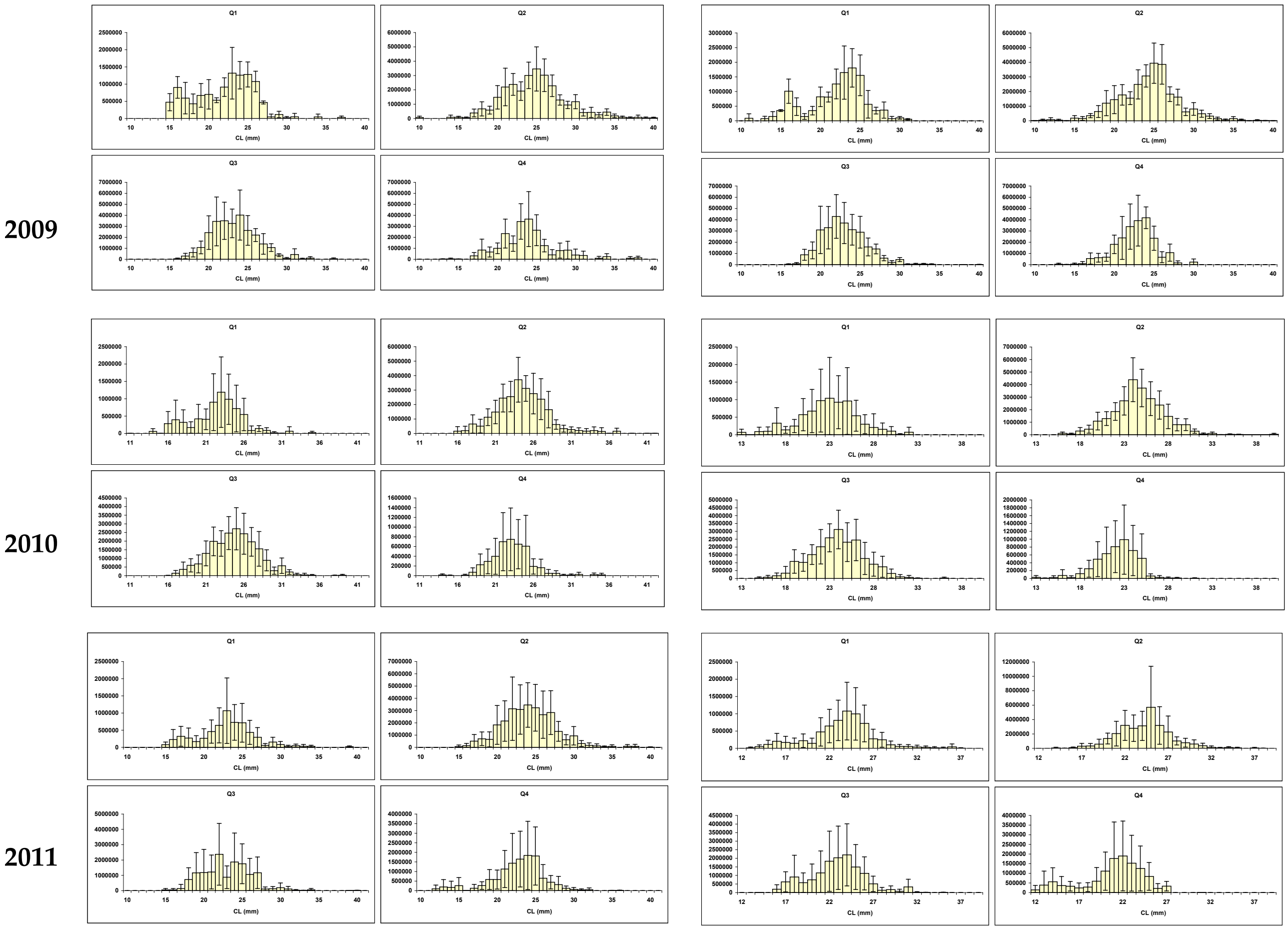


***Figure 3.* Distribution of length frequencies (CL in mm) for discards 2009-2011 and confidence intervals (confidence level 1-$\alpha$=0.95). Data by sex (males left, females right).**

## 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*** |

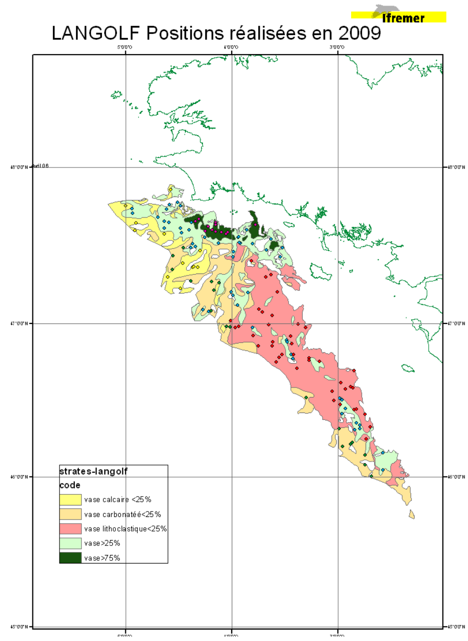


*Figure 4*. ***Nephrops* of the Bay of Biscay (FU 23-24). The Central Mud Bank, the five spatial strata and the distribution of sampling units for 2009's survey.**

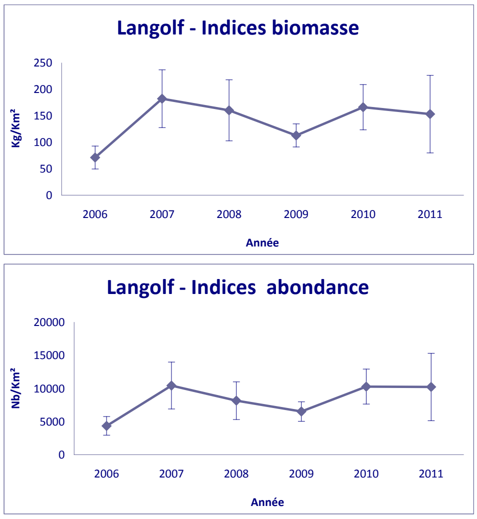


*Figure 5*. ***Nephrops* of the Bay of Biscay (FU 23-24). LANGOLF survey 2006-2011. Global indices for biomass and abundance and confidence intervals ($\alpha$=0.05).**

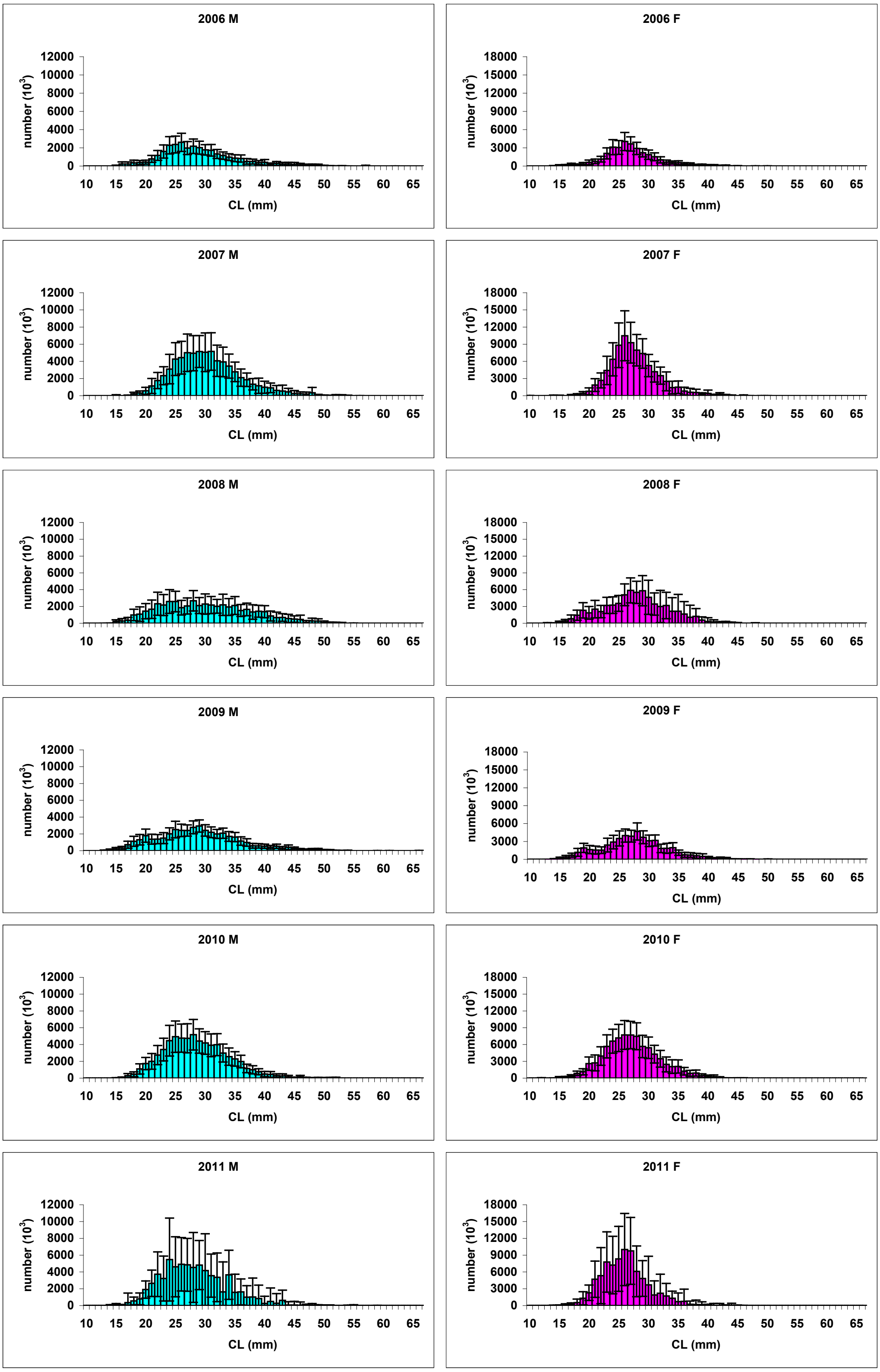


*Figure 6. Nephrops* **of the Bay of Biscay (FU 23-24). LANGOLF survey 2006-2011. LFDs by sex and confidence intervals ($\alpha$=0.05).**

## 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

[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 [9]

and

SR = 2.32 + 3.21 * Ts [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∞=76, K=0.14; mature females: L∞=56, K=0.11

| age | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9+ |
|---|---|---|---|---|---|---|---|---|---|---|
| Size (CL mm) | males | 10 | 19 | 26 | 33 | 38 | 43 | 48 | 51 | 54 |
| | 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 90$^{th}$ 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 ($F_{2-5}$=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 ($F_{2-5}$ = 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.

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**Trenkel V.M., Rochet M.J., 2002.** Towards a theory for discarding behaviour. *ICES CM 2002/V:03* Conan, G.Y., 1978. Average growth curves and life history in a *Nephrops* population from northern bay of Biscay. ICES CM 1978/K:21.

# Annex K Stock Annex North Galicia (Division VIIIc, FU 25)

Quality Handbook ANNEX: K

Stock specific documentation of standard assessment procedures used by ICES.

| | |
|---|---|
| Stock | North Galicia (Division VIIIc, FU 25). |
| Working Group: | WGHMM |
| Date: | 05 May 2010 |
| Revised by | Yolanda Vila and Luis Silva |

## 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 |
| 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<br>SP-CORUTR-8c | Assessment Years<br>1982-2005 | Assessment Ages<br>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.

## 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.

Fariña, A.C., 1996. Megafauna de la plataforma continental y talud superior de Galicia. Biología de la cigala *Nephrops norvegicus*. Doctoral Thesis. Universidad da Coruña. 297 pp.

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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.

STECF, 2003. Report of the STECF meeting on Hake Technical Measures. Lisbon, 27-31. October, 2003

# Annex K Stock Annex Cantabrian Sea (Division VIIIc, FU 31)

Stock specific documentation of standard assessment procedures used by ICES.

| | |
|---|---|
| Stock | Cantabrian Sea (Division VIIIc, FU 31). |
| Working Group: | WGHMM |
| Date: | 05 May 2010 |
| Revised by | Yolanda Vila and Luis Silva |

## 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).

## 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.

# Annex L Stock Annex West Galicia and North Portugal (Division IXa, FU 26-27)

| | |
|---|---|
| Quality Handbook | ANNEX: L |

Stock specific documentation of standard assessment procedures used by ICES.

| | |
|---|---|
| Stock | North Galicia (Division VIIIc, FU 25). |
| Working Group: | WGHMM |
| Date: | 05 May 2010 |
| Revised by | Yolanda Vila and Luis Silva |

## 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<br>SP-MATR | Assessment Years<br>1994-2005 | Assessment Ages<br>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.

## 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.

ICES, 2006. Report of the Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim. ICES CM 2006/ACFM:01

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# Annex L Stock Annex Gulf of Cadiz (Division IXa, FU 30)

Quality Handbook ANNEX: L

Stock specific documentation of standard assessment procedures used by ICES.

| | |
|---|---|
| Stock | Gulf of Cadiz (Division IXa, FU 30). |
| Working Group: | WGHMM |
| Date: | 05 May 2010 |
| 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 |
| 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 |
| Growth - L(inf) | 58 | LC max from Gulf of Cadiz landings |
| Natural mortality - M | 0.2 | Fernández et al. (1986) |
| Length/weight - a | 0.00043 | Fariña (1984) |
| Length/weight - b | 3.160 | Fariña (1984) |

Given the inconsistencies in the length compositions from 2001-2005 and the absence of additional information, assessment of this FU has not been carried out so far.

## 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

Díaz del Río, V., L.M. Fernández-Salas, J. Gil, F. Ramos and M.P. Jiménez, 2006. Gulf of Cádiz Regional Ecosystem. *Working document presented to the WGRED (ICES Working Group for Regional Ecosystem Description).*

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# Stock Annex M: 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: | 22/04/2012 |
| Revised by | Ricardo Alpoim (WKFLAT2012) |

## 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 83 % 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 2003-2010 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, 17 % from trawlers and 83 % 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 4$^{th}$ 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 marrecapture 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 4$^{th}$ quarters since then. The Portuguese landings were relatively stable during the first two years, but have decreased substantially from 2006 to 2010.

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 a new minimum in 2010 of 751 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):

$$W= 2.11x10^{-5} \cdot L^{2.9198}$$

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 2010. 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. 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 1982-2010. 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 13% 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 1999-2010. Data provided for Cedeira gillnets comprise quarterly standardized effort (in soaking days), landings and length composition of landings. This fleet represents an average of 5% 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 1989-2010. 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.

PT-TRC9A

Portuguese trawlers targeting crustacean: years 1989-2010. 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: 1980-2010

CPUE Series 1 (years): PT-TRC9a (1989-2010)

CPUE Series 2 (years): PT-TRF9a (1989-2010)

Index of Biomass (years): SPCORTR8c (1982-2010)

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. The history of black anglerfish assessment from 2007 to 2011 is presented in Table 1.

**Table 1. History of southern black anglerfish assessment from 2007 to 2011.**

| WG | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| 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) |
| Software | ASPIC (v. 5.16) | No updated | ASPIC (v. 5.24) | ASPIC (v. 5.34) | ASPIC (v. 5.34.9) |
| Catch data range | 1980-2006 | | 1980-2008 | 1980-2009 | 1980-2010 |
| CPUE Series 1 (years) | PT-TRF9a (1989-2006) | | PT-TRF9a (1989-2008) | PT-TRF9a (1989-2009) | PT-TRF9a (1989-2010) |
| CPUE Series 2 (years) | | | | | |
| Index of Biomass (years) | PT-TRC9a (1989-2006) | | PT-TRC9a (1989-2008) | PT-TRC9a (1989-2009) | PT-TRC9a (1989-2010) |
| Error Type | Condition on yield | | Condition on yield | Condition on yield | Condition on yield |
| Number of bootstrap | 500 | | 500 | 1000 | 1000 |
| Maximum F | 8.0 (y-1) | | 8.0 (y-1) | 8.0 (y-1) | 8.0 (y-1) |
| Statistical weight B1/K | 1 | | 1 | 1 | 1 |
| Statistical weight for fisheries | 1,1 | | 1,1 | 1,1 | 1,1 |
| B1-ratio (starting guess) | 0.5 | | 0.5 | 0.5 | 0.5 |
| MSY (starting guess) | 3000 t | | 3000 t | 3000 t | 3000 t |
| K (starting guess) | 20 000 t | | 20 000 t | 20 000 t | 20 000 t |
| q1 (starting guess) | 1d-5 | | 1d-5 | 1d-5 | 1d-5 |
| q2 (starting guess) | 1d-4 | | 1d-4 | 1d-4 | 1d-4 |
| Estimated parameter | 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) |
| Min and Max K | 5000 (t) -500000 (t) | | 5000 (t) - 112000 (t) | 5000 (t) -100000 (t) | 5000 (t) -100000 (t) |
| Random Number Seed | 1964185 | | 1964185 | 1964185 | 1964185 |

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# Annex N – Benchmark Planning

**Benchmark Planning for 2013**

No stocks within the remit of WGHMM are scheduled to be benchmarked at the start of 2013. It had initially been proposed that the stocks of Megrim in Divisions VIIIc and IXa should be considered for benchmark in 2013, however, the group considered that insufficient work could be completed in time and proposes instead that these stocks are considered by WKFLAT in 2014.

WGHMM continues to take a long term approach to planning and implementing the benchmark process and has begun drafting work schedules for stocks to be considered for benchmark in 2014. This process is ongoing and will continue during the inter-sessional period. Information is presented below for a number of stocks using the standard issues lists for benchmark planning.

| **Stock** | **L. piscatorius and L. budegassa in VII VIIIabd** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Iñaki Quincoces (L.piscatorius) Jean-Claude Mahé (L.budegassa) | iquincoces@azti.es<br><br>Jean.Claude.Mahe@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? | Person in charge | Date | External expertise needed at benchmark type of expertise / proposed names |
| Basic data | Revised data from France for 2009 and 2010 | Strong request from ICES to France providing the data | All the French data to be collected for this stock under DCF | Jean Claude Mahé* | 1ST WEEK OF OCTOBER 2011 | NO |
| Tuning series | No standardized commercial tuning data is available | Standardization of commercial tuning data by lengths | Raw data from logbooks and the length distributions for that fleet. Data should be available from member states | RUBEN ROA (BAKON7 & 8) IEO(PAZ* ESTHER*, CARMEN* VIGO fleet) | END OF OCTOBER | NO |
| Discards | Enforcement of laws about minimum landing weight (0.5 kg) changed totally the retention ogive and the landings length distribution. | Try to reconstruct the length distribution of specimens bellow 0.5 kg in the catch or remove the historical data of fish below 0.5 kg from the catch matrix | Discard estimates from all the involved countries | 2000-2010 DISCARD DATA LD.<br><br>IEO(DISCARD TEAM)<br><br>2006-2010 (FRANCE)<br><br>ENGLAND RISED DATA | END OF OCTOBER. | NO |

| Stock | **L. piscatorius and L. budegassa in VII VIIIabd** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Iñaki Quincoces (L.piscatorius) Jean-Claude Mahé (L.budegassa) | iquincoces@azti.es<br><br>Jean.Claude.Mahe@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? | Person in charge | Date | External expertise needed at benchmark type of expertise / proposed names |
| Biological Parameters | Split of the landings between both species of anglerfish not known for some countries and suspect of not being correctly done some years due to differences between species proportion among different countries fishing the same grounds. | Have the historical detailed information on methods used by each country.<br>Historically apply the split between species from the best identified method/country/fleet (i.e. the proportions in landings of countries splitting the species due to market reasons…). | Available directly from historic data or from Member States | Jean Claude Mahé and Iñaki Quincoces | WHEN ALL LD AVAILABLE | NO |
| | Sex ratio and maturity of anglerfish only from an European project done in 1996-98 | Compilation of the data collected under DCF and analysis for new sex-ratio and maturity parameters (COST) | Raw data from DCF, | Jorge Landa, Sally Songer. Jean-Claude Mahé Helen McCormick (TO PROVIDE DATA) LENGTH BASED * ANALYSIS Iñaki Quincoces | OCTOBER | NO |

| **Stock** | **L. piscatorius and L. budegassa in VII VIIIabd** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Iñaki Quincoces (L.piscatorius) Jean-Claude Mahé (L.budegassa) | iquincoces@azti.es<br><br>Jean.Claude.Mahe@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? | Person in charge | Date | External expertise needed at benchmark type of expertise / proposed names |
| | Growth pattern unknown or poorly known | Research on anglerfishes growth pattern. Could come from tag/recapture experiments, analysis of length distributions from surveys. | Workshop to be conducted by ICES in 2011. Results are not likely to be applicable to a benchmark in 2012 due to time constraints. | From EVHOE survey starting model for K and Linf for budegassa; from literature for piscatorius JCM* | | NO |
| Assessment method | It depends on data available. If all the data with the needed length distributions is available a length structured model could be used. If only landings data and some tuning series are available a production model could be used. | All the above plus exploratory analysis from stock coordinators | | Jean Claude Mahé, Iñaki Quincoces Carmen Fernandez, Lisa Readdy | NOVEMBER | EXPERT FOR SS3 (RICHARD METHOT) OR IF GOING FOR A DATA POOR METHOD AN EXPERT ON PRODUCTION MODELS (????) |

| **Stock** | **Southern Anglerfish (L. piscatorius)** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Paz Sampedro | paz.sampedro@co.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? | Person in charge | Date | External expertise needed at benchmark type of expertise / proposed names |
| Tuning series | 1.The two tuning series used in the last assessment are commercial CPUEs. No research survey series used.<br><br>2.Due to the introduction of a new fishing gear (jurelera) targeting pelagic species by the fleet SPCORUTR8C, the representativeness of its CPUE series for tuning the assessment could be affected. | 1. Analysis of the time series of Spanish Grounfish Survey Index. To check wether the Survey signal is clear enough to incorporate it into the assessment as a tuning series.<br><br>2. To investigate/eliminate the effect of jurelera in this tuning series by applying appropriate standardized methods (GLM, GAMs). | 1. Data are available.<br><br>2. Spanish Data Team should be asked for the availability of the detailed data (trip by trip) to use as inputs in the standardized models. | Paz<br><br>Paz will check if it is possible | Completed | |
| Discards | Discard data are only available for one of the main fishing fleets: Spanish Trawl (1994-2009). The discards time series has some missing years (1995, 1996,1998, 2001, 2002). The length compositions of discards have large uncertainty. | To estimate the discard pattern for Spanish Trawl Fishery. To analyse the variability of the pattern along the period used in the assessment. | Part of this work is already done by the Spanish Discard Team. It is necessary to confirm with this team that no changes in the discard pattern have happened in the last three years. | Paz will check if it is possible. | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Stock** | **Southern Anglerfish (L. piscatorius)** | | | | | |
| Stock coordinator | Paz Sampedro | paz.sampedro@co.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? | Person in charge | Date | External expertise needed at benchmark type of expertise / proposed names |
| Biological Parameters | 1. The ageing criteria proposed in 2007 was rejected at the assessment working group (WGHMM) due to its inconsistencies.<br><br>2. An updated and reliable maturity model is needed. | 1. To investigate a model of growth based on different information sources, including mark-recaptured data.<br><br>2. To investigate a maturity model, for both sexes combined, based on recent commercial samplings and survey data. | 1. Information is available from published studies.<br><br>2. Information is available from DCF (Data Collection Framework). | Jorge Landa, Ricardo | Completed<br><br>October | |
| Assessment method | Current assessment model is a production model (ASPIC) which Does not make full use of the data and information available. | To develop a size based model (using Stock Synthesis 3), where the available information requested in the previous sections would be used. | Stock Synthesis was developed by Richard Methot (NOAA Fisheries). | Paz, Carmen | For the benchmark | Richard Methot (if he is not available, then another expert scientist on Stock Synthesis, possibly suggested by Richard Methot). |
| Biological Reference Points | $F_{MSY}$ from ASPIC outputs was proposed as a reference point by WGHMM in 2010. No Btrigger has been defined. | Revision of the biological reference points previously defined. | Results from new model assessment would be employed. | Paz | For the benchmark | |

| **Stock** | **Southern Anglerfish (L. budegassa)** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Ricardo Alpoim | ralpoim@ipimar.pt | | | | |
| Issue | Problem/Aim | Work needed /<br>possible direction of solution | Data needed to be able to do this: are these available / where should these come from? | Person in charge | Date | External expertise needed at benchmark<br>type of expertise / proposed names |
| Tuning series | 1.The two tuning series used in the last assessment are commercial CPUEs. No research survey series used.<br><br>2.Anglerfish is not a main target species of the Portuguese surveys. | 1. To investigate these tuning series by applying standardization methods.<br><br>2. Data from the Portuguese surveys are being compiled and will be presented to the WGHMM 2011. Analysis of the time series of Survey Index. To check whether the Survey signal is clear enough to be incorporated into the assessment as tuning series. | 1.1. Data are available.<br><br>1.2. Spanish Data Team should be asked for the availability of the detailed data (trip by trip) to use as inputs in the standardized models. | 1.Paz for Spanish tuning fleets<br>Ricardo for Portuguese fleets<br><br>2.Ricardo will check if it is possible | October<br>October | |

| **Stock** | **Southern Anglerfish (L. budegassa)** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Ricardo Alpoim | ralpoim@ipimar.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? | Person in charge | Date | External expertise needed at benchmark type of expertise / proposed names |
| Discards | 1.Discard data are only available for one of the main fishing fleets: Spanish Trawl (1994-2009). The discards time series has some missing years (1995, 1996,1998, 2001, 2002). The length compositions of discards have a large uncertainty.<br><br>2.Portuguese discard data have not been presented to the WGHMM. They are being compiled and will be presented to the WGHMM 2011. | 1 .To estimate the discard pattern for Spanish Trawl Fishery. To analyse the variability of the pattern along the period used in the assessment.<br><br>2. Portuguese discard data are being compiled and will be presented to the WGHMM 2011. | 1. Part of this work is already done by the Spanish Discard Team. It is necessary to confirm with this team that no changes in the discard pattern have happened in the last three years. | 1.Paz will check if it is possible.<br><br>2.Ricardo will check the possible use of the data presented in the WGHMM 2011 | For the benchmark | |

| **Stock** | **Southern Anglerfish (L. budegassa)** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Ricardo Alpoim | ralpoim@ipimar.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? | Person in charge | Date | External expertise needed at benchmark type of expertise / proposed names |
| Biological Parameters | 1. The ageing criteria proposed in 2007 was rejected at the assessment working group (WGHMM) due to its inconsistencies.<br><br>2. An updated and reliable maturity model is needed. | 1. No solution available for the time being<br><br>2. To investigate a maturity model, for both sexes combined, based on recent commercial samplings and survey data (if there are any). | 2. Information is available from DCF (Data Collection Framework). | Jorge Landa, Ricardo | Completed<br><br>October | |

| **Stock** | **Southern Anglerfish (L. budegassa)** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Ricardo Alpoim | ralpoim@ipimar.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? | Person in charge | Date | External expertise needed at benchmark type of expertise / proposed names |
| Assessment method | Current assessment model is a production model (ASPIC) which does not make full use of the data and information available. | There are no plans at this stage to develop a new assessment model for this stock. If Stock Syntehis (which is being tryied for the L.piscatorius benchmark) works well for L. piscatorius, it might be attempted for L.budegassa at some future time. New information will be available during the WGHMM 2011. | | Ricardo, Paz | For the benchmark | |
| Biological Reference Points | $F_{MSY}$ from ASPIC outputs was proposed as a reference point by WGHMM in 2010 . No Btrigger has been defined. | 1. Revision of the biological reference points previously defined. | | Ricardo | For the benchmark | |

| **Stock** | **Meg78** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Marina Santurtun<br>Ane Iriondo | msanturtun@azti.es;<br>airiondo@azti.es | | | | |
| Issue | Problem/Aim | Work needed /<br>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<br>type of expertise / proposed names | Deadline | Responsible person |
| Tuning series | LPUE data series stopped in 2006 because of patterns in different areas and major changes in the fleet structure over time.<br><br>Trends in log-catchabilities residuals are still to be investigated as no Irish Otter trawl fleet was revised. | Ireland: Revised tunning fleet catches. | Yes, data should be available at Marine Institute.<br>Analysis of Data from Marine Institute. | No needed<br><br>(-RAC involvement: Basic data comes from the Irish Industry. Maybe qualitative information , as for example , technological creeping can be given by Industry.) | End of October | Colm Lordan (MI) |

| **Stock** | **Meg78** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Marina Santurtun<br>Ane Iriondo | msanturtun@azti.es;<br>airiondo@azti.es | | | | |
| Issue | Problem/Aim | Work needed /<br>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<br>type of expertise / proposed names | Deadline | Responsible person |
| | No segmentation of the main commercial fleets used in the assessment has been carried out | France: The FU04 (CPUEs and Effort)series is updated every year. However, no data of numbers at age are available since 2001.<br><br>Also, maybe this Fishing Unit data is not the most appropriate level of aggregation. An effort should be made to segment FU04 to to the level 5 or 6 of the Nantes Matrix (Fishery and or Metier). The detailed segmentation is theoretically available for 2009 but reliability has to be checked by France. | France: Data should be available at IFREMER. Segmentation on the main commercial fleets used in the assessment will be revised and, if appropriated, will then be applied. | No need<br><br>(- RAC involvement: Maybe RAC members could help with qualitative knowledge for further segmentation that could be carry out in this FU04 used for tuning.) | ‘ | |
| | Vigo Fleet revision of tunning series | Spain | | | End of October | Esther Abad*, Paz Sampedro* and Carmen Fernandez* (IEO) |

| **Stock** | **Meg78** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Marina Santurtun<br>Ane Iriondo | msanturtun@azti.es;<br>airiondo@azti.es | | | | |
| Issue | Problem/Aim | Work needed /<br>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<br>type of expertise / proposed names | Deadline | Responsible person |
| Discards | It is considered that a main problem with megrim assessment is the lack of discard data (biomass, length distributions and age composition ).<br><br>Underestimation of the international catch matrix occurs as some main countries (mostly France) involved in the fishery do not provide discard data. The lack of consistency of the catch series (which could cause great bias in assessment) is also a result of only one country (Spain) providing discard data since 1999<br><br>No data other than Spanish and Irish data series have been provided for the assessment in 2010.<br><br>From United Kingdom only sampling data were available. | France: to provide discard data available since 1999.<br><br>United Kingdom: to provide discad data raised to the total of the fleet. Methodology to be used: Application of recommendations of WS Discards (Charlotte Lund, 2003) and future WS on discards (2009) | Yes . Data should be available at IFREMER.<br><br>Yes. Data should be available at CEFAS. | No need<br><br>(- RAC incolvement: Basically, I think that RACs can not help much as data should be available at the Fisheries Institutes. It will be maybe good to remember the importance of a good (number of samples and sample size). This is, maybe RAC member could facilitate sampling on board to get discard data which are really important for this stock) | End of October | Lisa Readdy* (CEFAS) |

| **Stock** | **Meg78** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Marina Santurtun<br>Ane Iriondo | msanturtun@azti.es;<br>airiondo@azti.es | | | | |
| Issue | Problem/Aim | Work needed /<br>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<br>type of expertise / proposed names | Deadline | Responsible person |
| Landing | In 2010, France did not provide LANDINGS to the group. | Official deadline is October 2010. France should provide this BASIC data a.s.a.p. | Yes, landing data should be available already (by October every year) and provided by IFREMER | No need | 1st week of October | Jean Claude * |
| Biological Parameters | France: No ALK and consequently age composition of landings and weigth at age is provided to the WGHMM routinely<br><br>(Maturity Ogive: to be reviewed as for Anglers) | Strong request for providing these data for IFREMER (Member State). | I do not know about availability. Should be at IFREMER (Age data Weigth at age) | No need<br><br>(- RAC incolvement: Basically, I think that RACs can not help much as data should be available or worked out at the Fisheries Institutes). | June, July<br><br>End of October | Jean –Claude Mahé (IFREMER) *<br><br>(Marina Santurtún *: to contact IEO (Jorge Landa) : Person to be identified in IFREMER)) |

| **Stock** | **Meg78** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Marina Santurtun<br>Ane Iriondo | msanturtun@azti.es; airiondo@azti.es | | | | |
| Issue | Problem/Aim | Work needed /<br>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<br>type of expertise / proposed names | Deadline | Responsible person |
| Assessment method | If discard data are not provided to the group, then experts on megrim should look for other solutions to overcome data deficiencies | If discard data are not provided, there is a need to reconstruct discards data series to fill the gaps. The solutions considered were:<br>o Age based models – XSA after reconstructing the discard data series using selectivity functions applied to the catches distribution.<br>o Age based models that allow for some missing discards data . Recent developments on analysis of fisheries data created the opportunity to use models that allow for missing discards data, as well as other uncertainties in the data. This situation requires previous practices to be developed in agreement, like forecasts, biological reference points, advice, etc.<br>o Assessment without discards will be attempted although data series will be shorter due to inability to recover landing and discard data series disaggregated before 1990. | Different methodologies to be used by AZTI as Megrim Coordinator. | If XSA (Chris Darby)<br><br>If Bayesian model (Andre Punt, Samu Mantyniemi, Richard Hillary). | November (decision on model) | Marina Santurtún** (possibility of checking whether we go first a Bayesian model, would depend on work load of modellers at AZTI (Leire Ibaibarriaga and Dorleta Garcia) |

| **Stock** | **Meg78** | | | | | |
|---|---|---|---|---|---|---|
| Stock coordinator | Marina Santurtun<br>Ane Iriondo | msanturtun@azti.es; airiondo@azti.es | | | | |
| Issue | Problem/Aim | Work needed /<br>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<br>type of expertise / proposed names | Deadline | Responsible person |
| Biological Reference Points | No defined | If new assessment success ➔ recalculate them | | No need | | |
| | | | | | | |

| **Stock** | **FU 23-24 Nephrops (Bay of Biscay)** | | | |
|---|---|---|---|---|
| Stock coordinator | Spyros Fifas | Spyros.Fifas@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 |
| Tuning series | There is currently only one commercial tuning fleet (GV-Q2). The aim is to add tuning time series provided by LANOLF survey, but the time series available in the beginning of 2012 will be short and cannot yet be integrated in the benchmark WG. | Compilation and addition of data (Autumn 2011) which should be collected during next survey (May 2011). | Available (end 2011) | |
| Discards | The routinely carried out sampling plan onboard since 2003 does not cover many previous years (13 on 24 of the overall time series). The aim is to validate probabilistic approach for discard derivation applied on the missing data. | Ready | Available | |
| Biological Parameters | Maturity has to be analysed on the basis of data on ogives collected on the period 2004-2010. | Compilation of data provided from samples 2009 and 2010. | Available | For ICES experts see Workshop WKNEPH January 2006. |
| Assessment method | Alternative methods such as CSA have to be investigated. | ??? | | |
| Biological Reference Points | ??? | | | |
| | | | | |

| **Stock** | **Nephrops FU 28-29** | | | |
|---|---|---|---|---|
| Stock coordinator | Cristina Silva | csilva@ipimar.pt | | |
| Issue | Problem/Aim | Work needed /<br>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<br>type of expertise / proposed names |
| Tuning series | Problem: 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*.<br>Non-standardized CPUE series for *Nephrops* as the main cause for the retrospective pattern in the assessment.<br>Aim: An improvement of the retrospective pattern to levels accepted in assessment of other ICES stocks. | Standardization of the commercial CPUE (taking into account the behaviour of the fleet in targeting one or the other species) to estimate *Nephrops* target effort. | Logbook data. Time series since 1988 with information on the main species caught on a daily basis will be used. Depth and fishing grounds information from VMS data, if available, will also be used. | Expertise on statistical modelling (GLM, Delta model) and CPUE standardization.<br>Proposed name: Ruben Roa (AZTI Tecnalia) |
| Discards | Discarding is minimal in this fishery. Not an issue | | | |
| Biological Parameters | Growth parameters and natural mortality estimated in 1990 and not reviewed. Attempts to include a joint tagging program for several Nephrops FUs in DCF not successful due to high costs. | | | |

| **Stock** | **Nephrops FU 28-29** | | | |
|---|---|---|---|---|
| Stock coordinator | Cristina Silva | csilva@ipimar.pt | | |
| Issue | Problem/Aim | Work needed /<br>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<br>type of expertise / proposed names |
| Assessment method | XSA (with FLR) is currently applied separately for males and females in these FUs. Lengths are converted into ages by slicing using the growth parameters.<br>Problem: Taking into consideration the retrospective pattern, assessment results have only been accepted as indicative of trends. Exploitation status is unknown due to the high uncertainty in point estimates for recent years.<br>Aim: An accepted assessment, BRPs estimated and catch forecasts as basis for ICES advice. | | | |
| Biological Reference Points | | | | |
| | | | | |

| **Stock** | **Bay of Biscay Sole** | |
|---|---|---|
| Stock coordinator | Name: Muriel Lissardy | Email: muriel.lissardy@ifremer.fr |
| Stock assessor | Name: Muriel Lissardy / Gérard Biais | Email: gerard.biais@ifremer.fr |
| Data contact | Name: Muriel Lissardy | Email: muriel.lissardy@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 quantified[1] | | | | Steve Flatman or Willy Vanhee or Chris Darby |
| | | | | |
| | | | | |
| | | | | |
| Survey | The absence of survey indices is of concern as it results in a large uncertainty on the estimates of recent recruitments | Investigation to add the orahgo survey now too long enough | Data available from France | |

[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 quantified[1] | | | | Steve Flatman or Willy Vanhee or Chris Darby |
| | | | | |
| | | | | |
| | | | | |
| Tuning series | estimating well the abundance all along the year | proposal of a new trawler tuning series in another quarter than the second or the fourth | Catch and Effort data of fleets (Available from France) | |
| Discards | Discards of some fleets not yet included | Raising of samples available, Incorporation into the assessment model | Discards data (Available from France/Belgian) | |
| Biological Parameters | Update maturity ogive, reflect the changes in maturity at age that could result from changes in growth | Try to update the maturity ogive with data available | Maturity ogive in the beginning of the year | |
| Biological Reference Points | practice of using different fresh / gutted transformation coefficients for catch and stock to be able to compare with the estimated PA values for SSB | Investigation to change the reference point | | |

| **Stock** | **Northern Hake** | |
|---|---|---|
| Stock coordinator | Name: Bertignac Michel | Email:michel.bertignac@ifremer.fr |
| Stock assessor | Name: : Bertignac Michel / Castro José | Email:michel.bertignac@ifremer.fr<br>Email: jose.castro@vi.ieo.es |
| Data contact | Name: : Bertignac Michel | Email: michel.bertignac@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 quantified[2] | Additional M - predator relations | | | |
| | Prey relations | | | |
| | Ecosystem drivers | | | |
| | *Other ecosystem parameters that may need to be explored?* | | | |
| | | | | |

[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 quantified[2] | Additional M - predator relations | | | |
| | Prey relations | | | |
| | Ecosystem drivers | | | |
| | *Other ecosystem parameters that may need to be explored?* | | | |
| | | | | |
| Tuning series | Little information on abundance of large fish | Incorporation of CPUE from commercial fleets catching adults (Longline/Gillnet) | Catch and Effort data of fleets (Available from Spain-France) | |
| Discards | Discards of some fleets not yet included (SS3 fleets : OTHERTRAWL and OTHERS ) | Raising of samples available, Incorporation into the assessment model | Discards data (Available from France/Denmark/Ireland/UK) | |
| Biological Parameters | Setting of M | Sensitivity of assessment to M, choice of M | No data needed | **Rick Methot/Jim Ianelli** |
| | | | | |
| Assessment method | Sensitivity of assessment, poor convergence. | Sensitivity analysis on parameter settings and hypothesis (i.e. selectivity functions) and on error distribution hypothesis. | No data needed | **Rick Methot/Jim Ianelli** |
| | | | | |

| **Issue** | **Problem/Aim** | **Work needed / possible direction of solution** | **Data needed to be able to do this: are these available / where should these come from?** | **External expertise needed at benchmark type of expertise / proposed names** |
|---|---|---|---|---|
| (New) data to be Considered and/or quantified[2] | Additional M - predator relations | | | |
| | Prey relations | | | |
| | Ecosystem drivers | | | |
| | *Other ecosystem parameters that may need to be explored?* | | | |
| | | | | |
| Biological Reference Points | Revision of reference points due to extension of data series and expected improvement of the assessment during benchmark | | | **Rick Methot/Jim Ianelli** |
| | | | | |

**Proposal for 2014 Southern hake benchmark. Date is conditioned to interseasonal work presented in WGHMM 2013**

| **Stock** | **Southern Hake** | |
|---|---|---|
| Stock coordinator | Name Santiago Cerviño | Email: santiago.cervino@vi.ieo.es |
| Stock assessor | Name: Santiago Cerviño and Alberto Muirta | Email: santiago.cervino@vi.ieo.es<br>Email: amurta@ipimar.pt |
| Data contact | Name: Santiago Cerviño and Alberto Murta | Email: santiago.cervino@vi.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** |
|---|---|---|---|---|
| Catches | Catches in the past (before 1982) | Direct implementation on the model. | Ask national DB (Sp and Pt) | |
| CPUEs | Little information on abundance of large fish, particularly in the past | Incorporation of CPUE from commercial fleets catching adults | Catch and Effort data of available fleets.<br>Ask national DB (Sp and Pt) | |
| Fleets | Current model does not split fleets. This makes difficult fitting of length distributions | Explore the impact of different fleet configuration. To group or not to group! | Length distribution by fleet.<br>They are already available. | |

| **Issue** | **Problem/Aim** | **Work needed / possible direction of solution** | **Data needed to be able to do this: are these available / where should these come from?** | **External expertise needed at benchmark type of expertise / proposed names** |
|---|---|---|---|---|
| Biological Parameters (growth and mortality) | Hake is sex dimorphic specie. Accounting for differences on growth, maturity and mortality by sex. | Split model by sex.<br>Explore the option to implement a new likelihood in GADET with sex ratio at length<br>Explore life history invariants to support new parameters (Linf, k, M, etc) | Sex ratio at length. It is already available<br>Explore literature about life history in other hakes. | GADGET expert: Daniel Howell (daniel.howell@imr.no) |
| Reproductive potential | Males and females together may cause bias in reproductive potential estimation. Consider reproductive potential. | Move to a female SSB.<br>Explore eggs production at length | Sex ratios, female maturity and egg production by length class.<br>Data already available | GADGET expert: Daniel Howell |
| Trophic relationships | Hake is an active cannibal species having a great impact on M at younger classes. | Develop the process into GADGET. Most of the work in done although the fit is not good. | Stomach content, trophic information.<br>Already available. | GADGET expert: Daniel Howell |
| Recruitment | Current models assume recruitment happens in first and second quarters although hake spawns all the year. | Extend the model to recruitment in all quarters. | | GADGET expert: Daniel Howell |

## Annex O – Recommendations

| Recommendation | For follow up by: |
| --- | --- |
| 1. A new ToR for WGMIXFISH 2013 is proposed:<br>*ToR x) Compilation and analysis of stock data from Iberian waters (ICES Div. VIIIc&IXa) for Fcube provisional application. Identification of following steps needed to accomplish a mixed-fisheries approach in Iberian waters.*<br>Further details are available in Annex S of this report | WGMIXFISH |
| 2. The working group does not propose the benchmarking of southern Megrimin 2013 as previously planned. Further work is required in order that sufficient material can be submitted to a full benchmark process. | ICES Secretariat / ACOM |
| 3. Inter-benchmark protocols for some stocks have had limited success and have failed to provide clear instructions to the working group. The working group considers that minor changes to existing assessments can be considered by IBPs but that major changes to assessments should be reviewed at full benchmark meetings | ICES Secretariat / ACOM |
| 4. Given the very high workload this WG already has and the decreasing number of participants, ToRs must be given well in advance of the meeting, so that the WG members and participating institutions can plan work and attendance. The WG considers that ToRs should be given with no less than 5 months notice. | ICES Secretariat / ACOM |
| 5. To avoid late delivery of data, which compromises the quality of the assessments for which the WG is responsible, a deadline for data submission should be included as part of the meeting's ToRs. WG members felt that approximately 4 weeks prior to the meeting start was appropriate. | ICES Secretariat / ACOM / PGCCDBS |

# Annex P: Collaboration with RACs to address data deficiencies

In January WKDDRAC agreed that collaboration between ICES and RACs was important to address the data deficiencies that currently undermine the quantity and quality of assessments (ICES, 2011). This first meeting defined the problem and types of data deficiencies and data needs, identified existing initiatives, discussed the need to involve key stakeholders, and explored the range of possible remedial measures. During the second coordination meeting on data deficiency among scientists, the industry and administrations (ICES WKDDRAC2), stocks without analytical assessments, due to data deficiencies, were identified in each RAC area, in order to prioritise stocks of immediate concern based on the benchmarking schedule and stakeholders views. Where possible the nature of the data problems, the groups (scientists, Member State fisheries authorities or fisheries stakeholders) with principal responsibility for resolving specific problems and potential remedial actions were listed.

The meeting concluded a number of points in order to strength assessments of WGHMM stocks with data deficiencies, which are summarized as follows:

- Strong communications between scientists, fisheries managers and fisheries stakeholders is required to address:
    - Changing **fishing patterns** and fishing strategies. This is a prerequisite to reintegrate some CPUE into assessments.
    - Upcoming **benchmarks**. Here, the "pedigree" matrix tool can be a useful focal point for dialogue between stock coordinators and industry.
    - Accurate recording of **landings**. This is the backbone for most stock assessments, perceived as a key uncertainty by scientists.
- Industry cooperation with DCF by:
    - Applying **self-sampling programmes**.
    - Developing fully documented fisheries ("**reference fleets**") and, where appropriate, sentinel fisheries. For this, RACs and Member States promotion of fisheries and science partnership is requested.
    - By cooperating on **tagging studies**.

Under this collaboration framework opened by ICES, SWWRAC and NWWRAC have contacted WGHMM to recall issues identified during the second workshop in data deficiencies. Both RACs have summarised in detail data deficiencies in stocks comprised under WGHMM. The WG acknowledge this new push in moving forward with the recommendations identified above. Regarding the way in how to formalise this dialogue, the use of already existing structures were found the most convenient (*i.e.* ICES WGs, Benchmarks, RAC Focus groups): establishing *ad hoc* groups with clear objectives, calendars and always with a long term view.

In this sense, **RACs are encourage to contact stock coordinators** to precisely comment on data needs and issues of interest and propose agreed working agenda in which reachable objectives should be clearly identified.

## Annex Q – WGHMM Proposed ToRs for next meeting

The **Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim** [WGHMM], will meet in IPIMAR, Lisbon, May 2013 to:

a ) Address generic ToRs for Fish Stock Assessment Working Groups (see table below).

b ) Assess the progress on the benchmark preparation of Megrim (*Lepidorhombus boscii*) in Divisions VIIIc and IXa and Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIIc and IXa.

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.

| Fish Stock | Stock Name | Stock Coordinator | Assess. Coord. 1 | Assess. Coord. 2 | Advice |
|---|---|---|---|---|---|
| ang-78ab | Anglerfish (*Lophius budegassa* and *L. piscatorius*) in Divisions VIIb-k and VIIIa,b | Spain/France | Spain/France | France/Spain | Advice |
| ang-8c9a | Anglerfish (*Lophius budegassa* and *L. piscatorius*) in Divisions VIIIc and IXa | Spain/Portugal | Spain/Portugal | Portugal/Spain | Advice |
| hke-nrtn | Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock); | France | France | Spain | Advice |
| hke-soth | Hake in Division VIIIc and IXa (Southern stock); | Spain | Spain | Portugal | Advice |
| mgb-8c9a | Megrim (*Lepidorhombus boscii*) in Divisions VIIIc and IXa | Spain | Spain | | Advice |
| mgw-8c9a | Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIIc and IXa | Spain | Spain | | Advice |
| mgw-78 | Megrim (*L. whiffiagonis*) in Subarea VII & Divisions VIIIa,b,d,e | Spain | Spain | | Advice |
| sol-bisc | Sole in Divisions VIIIa,b,d (Bay of Biscay) | France | France | | Advice |
| sol-8c9a | Sole in Divisions VIIIc and IXa | ? | ? | ? | Advice |
| ple-89a | Plaice in Subarea VIII and Division IXa | ? | ? | ? | Advice |
| pol-89a | Pollack in Subarea VIII and Division IXa | ? | ? | ? | Advice |
| whg-89a | Whiting in Subarea VIII and Division IXa | ? | ? | ? | Advice |
| gug-89a | Grey gurnard in Subarea VIII and Division IXa | ? | ? | ? | Advice |

# Annex R: New Species

## Area/species-specific Issues:

### Plaice in Bay of Biscay and Iberian coast (ple-89a):

#### Species identification:

This species is *Pleuronectes platessa,* however because of morphological similarities with flounder (*Platichthys flesus*) they are often confounded at sales auction in Portugal and both commonly landed as plaice.

#### Annual landings (tonnes) by country during last decade:

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Spain | 27.3 | 24.4 | 11.5 | 22.9 | 72.8 | 13.1 | 8.8 | 6.8 | 17.2 | 19.2 | NA |
| Basque | - | - | - | - | - | - | - | - | - | - | - |
| UK | 0.1 | - | - | - | - | - | 0.1 | - | 0.2 | - | - |
| Portugal | - | - | - | 216 | 175 | 99 | 91 | 90 | 101 | 112 | 107 |
| France | 67 | 72 | 72 | 104 | 130 | 175 | 154 | 109 | - | - | - |
| Ireland | - | - | - | - | - | - | - | - | - | - | - |

Note: Spain (mostly from IXa), Portugal (IXa), France (VIIIabd), UK (England and Wales) (VIIIabd),

#### Annual landings (tonnes) by gear during last decade:

| Spain | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Small scale | 26.3 | 23.7 | 11.2 | 22.1 | 72.3 | 12.8 | 7.8 | 6 | 16.7 | 18.3 | NA |
| Trawl | 1 | 0.7 | 0.3 | 0.2 | 0.4 | 0.2 | 0.8 | 0.8 | 0.3 | 0.3 | NA |
| Others | 0 | 0 | 0 | 0.4 | 0.1 | 0.1 | 0.2 | 0.1 | 0.2 | 0.6 | NA |

| Portugal | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | - | - | - | 4.2 | 0.6 | 0.2 | 0.9 | 1 | 0.9 | 0.6 | 0.2 |
| Polyvalent | - | - | - | 211.9 | 174.5 | 98.9 | 90.2 | 88.5 | 100.1 | 111.6 | 106.4 |
| Seiners | - | - | - | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| France | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 50 | 50 | 46 | 67 | 87 | 109 | 109 | 66 | - | - | - |
| Nets | 15 | 22 | 25 | 34 | 41 | 64 | 43 | 42 | - | - | - |
| Lines | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | - | - |
| Other | 2 | 0 | 1 | 3 | 2 | 2 | 2 | 1 | - | - | - |

#### Potential abundance indices:

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. Commercial indices were not available either but exploration of logbook data may produce useful information.

### Biological data:

None

## Pollack in Bay of Biscay and Iberian coast (pol-89a):

### Species identification:

This species is *Pollachius pollachius*, but there is some mixing in Portuguese markets with whiting (*Merlangius merlangus*) due to use of common names. However the information available suggests that most Portuguese landings are pollack.

### Annual landings (tonnes) by country during last decade:

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Spain | 253 | 187 | 211 | 305 | 288 | 319 | 333 | 405 | 274 | 422 | NA |
| Basque | 12 | 35 | 25 | 23 | 39 | 28 | 20 | 22 | 14 | 11 | 24 |
| UK | 0 | 0 | 0.5 | - | 0 | 171 | 62 | 64 | 41 | 44 | 26 |
| Portugal | - | - | - | 17 | 8 | 7 | 5 | 33 | 3 | 2 | 2 |
| France | 544 | 572 | 840 | 754 | 684 | 895 | 1028 | 970 | 1125 | - | - |
| Ireland | - | - | - | - | - | - | - | 0.1 | - | - | - |

Note: Spain (mostly from VIIIc and IXa), Portugal (IXa), France: (VIIIabd), UK (England and Wales) (VIIIa), Ireland (VIIId)

### Annual landings (tonnes) by gear during last decade:

| Spain | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Longlines | 31 | 26 | 31 | 47 | 90 | 48 | 72 | 147 | 101 | 167 | NA |
| Gillnets | 53 | 28 | 35 | 36 | 36 | 29 | 51 | 95 | 76 | 162 | NA |
| Others | 169 | 134 | 146 | 222 | 161 | 243 | 210 | 163 | 97 | 93 | NA |

| Portugal | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | - | - | - | 0.1 | 0.6 | 0.3 | 0.1 | 0 | 0.5 | 0.1 | 0.3 |
| Polyvalent | - | - | - | 16.5 | 7.8 | 6.7 | 4.5 | 33.3 | 2.4 | 1.7 | 1.2 |
| Seiners | - | - | - | 0 | 0 | 0 | 0.3 | 0 | 0 | 0 | 0 |

| France | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 173 | 202 | 151 | 205 | 294 | 311 | 263 | 224 | - | - | - |
| Nets | 358 | 570 | 542 | 378 | 498 | 565 | 557 | 679 | - | - | - |
| Lines | 36 | 65 | 57 | 95 | 92 | 133 | 138 | 217 | - | - | - |
| Other | 5 | 3 | 4 | 6 | 11 | 19 | 12 | 5 | - | - | - |

### Potential abundance indices:

Survey indices (abundance and biomass) and bathymetric distribution are available from Spanish surveys in Cantabrian Sea and off Galicia. Pollack was observed in 1983 and regularly from 2004 onwards. Biomass and abundance indicies were greatest in 2009 and bathymetric distribution ranged between 0-150m with maximum abundance between 100-150m. Commercial abundance indices were not available but exploration of logbook data may produce useful information.

### Biological data:

In 2011, Spain collected information for *Pollachius pollachius,* under the multiannual Community programme 2011-2013. UK took length samples during scientific surveys up until 2001. Currently, UK under the DCF is undertaking sampling from fixed net fishery although this mostly covers VIIe-h as most of area VIII landings are made into France.

## Sole in the Iberian coast (sol-8c9a):

### Species identification:

This species is reported as *Solea solea* although it is likely to be composed of 3 species (*Solea solea*, *Solea senegalensis* and *Pegusa lascaris*) which are landed, marketed and recorded together. In the Portuguese ports those species are landed mixed under three different commercial designations. IPIMAR reports that *Solea solea* comprised 34% on average of Sole landings between 2004 and 2011 (see Working Document).

### Annual landings (tonnes)by country during last decade:

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Spain | 304 | 322 | 245 | 264 | 229 | 204 | 185 | 177 | 231 | 244 | NA |
| Basque | 7 | 6 | 5 | 4 | 15 | 3 | 10 | 12 | 10 | 11 | 11 |
| UK | - | - | 0.03 | - | 0.00 | - | 0.01 | 0.01 | 0.00 | - | - |
| Portugal | - | - | - | 880 | 1116 | 833 | 658 | 750 | 865 | 1007 | 1133 |
| France | - | - | - | - | - | - | - | - | - | - | - |
| Ireland | - | - | 0.035 | 0.021 | - | - | - | - | 0.009 | - | - |

Spain (mostly from IXa), Portugal (VIIIc, IXa), UK (England and Wales) (VIIIabd), Ireland (VIIId)

### Annual landings (tonnes) by gear during last decade:

| Spain | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 190 | 215 | 176 | 133 | 112 | 98 | 68 | 53 | 77 | 108 | NA |
| Others | 114 | 107 | 70 | 131 | 117 | 106 | 117 | 123 | 154 | 136 | NA |

| Portugal | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | - | - | - | 27 | 28 | 23 | 37 | 39 | 35 | 36 | 58 |
| Polyvalent | - | - | - | 850 | 1084 | 797 | 615 | 709 | 826 | 964 | 1071 |
| Seiners | - | - | - | 3 | 5 | 13 | 6 | 2 | 4 | 8 | 5 |

### Annual discards (kg) by country during last decade:

| | **2000** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Spain Discards** | 0 | 0 | 0 | 1006 | 0 | 0 | 311 | 255 | 0 | NA |

### Potential abundance indices:

Survey indices (abundance and biomass) and bathymetric distribution are available from the Spanish and Portuguese surveys. However, research surveys do not catch sole in sufficient quantity to serve as abundance indices. Commercial indices were not available either but exploration of logbook data may produce useful information.

**Biological data:**

IPIMAR have length, weight, sex ratio and maturity information (see Working Document).

## Whiting in the Bay of Biscay and Iberian coast (whg-89a):

### Species identification:

This species is *Merlangius merlangus*. However there are some species identification issues with pollack.

### Annual landings (tonnes) by country during last decade:

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Spain | 0.4 | 1.7 | 2.2 | 0.5 | 0.1 | 1.6 | 1.1 | 0.2 | 0.6 | 1.0 | NA |
| Basque | 365 | 511 | 229 | 184 | 219 | 201 | 492 | 153 | 52 | 122 | 123 |
| UK | - | - | 0.01 | - | - | 0.01 | 0.00 | - | 0.07 | - | - |
| Portugal | - | - | - | 75 | 77 | 107 | 107 | 97 | 111 | 112 | 102 |
| France | 890 | 890 | 724 | 703 | 1035 | 978 | 1272 | 800 | - | - | - |
| Ireland | - | - | 0.1 | - | - | - | - | 1.2 | - | - | - |

Spain (mostly from VIIIabd), Portugal (VIIIc); France (VIIIabd), England and Wales (VIIIabd) Ireland (VIIId)

### Annual landings (tonnes) by gear during last decade:

| Spain | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 0.2 | 0.3 | 1.2 | 0 | 0 | 0.1 | 0.7 | 0.1 | 0.4 | 0.8 | NA |
| Longlines | 0.1 | 1.1 | 0.6 | 0.1 | 0 | 0 | 0.4 | 0 | 0 | 0.1 | NA |
| Others | 0.1 | 0.2 | 0.4 | 0.3 | 0.1 | 1.5 | 0 | 0.1 | 0.2 | 0.1 | NA |

| Basque | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 37 | 31 | 44 | 21 | 62 | 47 | 85 | 40 | 14 | 29 | 77 |
| Long line | 0 | 1 | 2 | 2 | 2 | 2 | 3 | 4 | 1 | 0 | 1 |
| Pair trawl | 326 | 474 | 183 | 161 | 154 | 152 | 394 | 108 | 37 | 73 | 45 |
| Gillnets | 2 | 4 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 |

| Portugal | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | - | - | - | 12.1 | 7 | 4.1 | 10.7 | 5.2 | 7.1 | 5.1 | 6.2 |
| Polyvalent | - | - | - | 62.7 | 69.7 | 102.9 | 95.3 | 91.7 | 103.5 | 106.4 | 95.6 |
| Seiners | - | - | - | 0 | 0 | 0.1 | 0.6 | 0.1 | 0 | 0 | 0 |

| France | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | 637 | 493 | 355 | 425 | 598 | 474 | 528 | 306 | - | - | - |
| Nets | 69 | 135 | 109 | 86 | 122 | 179 | 146 | 162 | - | - | - |
| Lines | 28 | 7 | 13 | 105 | 149 | 201 | 370 | 253 | - | - | - |
| Other | 156 | 255 | 247 | 87 | 166 | 124 | 228 | 79 | - | - | - |

#### Potential abundance indices:

Biomass and abundance indices are available from the French EVHOE-WIBTS-Q4 survey for the Bay of Biscay area from 1987 to 2011, with the exclusion of 1993 and 1996. Abundance indices by age are available since 1997:

| EVHOE | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Kg/30 mins | 0.2 | 1.5 | 0.8 | 2.5 | 1.3 | 1.1 | 2 | 1.4 | 3.4 | 2.4 | 1.5 |
| No/30 mins | 1.3 | 34.6 | 14.8 | 40.2 | 28.4 | 6.3 | 7.1 | 42.1 | 50.5 | 35.8 | 9.2 |

AZTI have compiled whiting LPUE in Div. VIIIabd based on landings from the Basque country fleet, which constitute 99% of the Spanish landings in that sea area. The pair bottom trawl fleet working in Div. VIIIabd, has been selected to provide information on whiting landings per unit effort (LPUE) and on the abundance trends in the period 1995-2011:

| | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Landings (t)** | 326 | 474 | 183 | 161 | 154 | 152 | 394 | 108 | 37 | 73 | 45 |
| **Effort (day)** | 1740 | 2000 | 2190 | 2021 | 1359 | 1418 | 1139 | 791 | 633 | 844 | 893 |
| **LPUE (t/day)** | 0.33 | 0.47 | 0.18 | 0.16 | 0.15 | 0.15 | 0.39 | 0.11 | 0.04 | 0.07 | 0.04 |

**Biological data:**

France has recorded whiting ages since 1997 from survey samples.

### Grey Gurnard in the Bay of Biscay and Iberian coast (gug-8abd):

#### Species identification:

This species is *Eutrigla gurnardus.* However there are likely to be species identification issues with other species such as red gurnard (*Chelidonichthys cuculus*) and others.

#### Annual landings (tonnes) by country during last decade:

Only Portugal provided landings statistics for Grey Gurnard. Average landings from 2004-2011 were 1.5t but no landings were declared in 2011. Note: These landings may be composed of several different species of Gurnard.

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spain | - | - | - | - | - | - | - | - | - | - | - | - |
| Basque | - | - | - | - | - | - | - | - | - | - | - | - |
| UK | - | - | - | - | - | - | - | - | - | - | - | - |
| Portugal | - | - | - | - | 0.0 | 0.0 | 0.0 | 3.3 | 8.1 | 0.2 | 0.4 | 0.0 |
| France | - | - | - | - | - | - | - | - | - | - | - | - |
| Ireland | - | - | - | - | - | - | - | - | - | - | - | - |

#### Annual landings (tonnes) by gear during last decade:

| Portugal | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Trawl | - | - | - | - | 0 | 0 | 0 | 2.2 | 4.2 | 0 | 0 | 0 |
| Polyvalent | - | - | - | - | 0 | 0 | 0 | 1.1 | 3.9 | 0.2 | 0.4 | 0 |
| Seiners | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### Potential abundance indices:

Abundance indices (numbers per hour) were calculated for the Portuguese Ground Fish Survey however the species was not observed in 2010 and 2011 (see Working Document). 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). Commercial indices were not available but exploration of logbook data may produce useful information.

| | 2005 | | | 2006 | | | 2007 | | | 2008 | | | 2009 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | N | SW | S | N | SW | S | N | SW | S | N | SW | S | N | SW | S |
| 20-100m | 0.08 | 0.77 | 4.5 | 0.09 | - | - | 0.17 | - | 0.3 | 0.12 | - | - | 0.57 | - | - |
| 101-200m | 0.66 | 0.41 | - | 0.15 | - | - | 3.3 | - | - | - | - | - | - | - | - |
| 201-500m | 0.74 | 1.18 | 4.5 | 0.24 | - | - | 3.47 | - | 0.3 | 0.12 | - | - | 0.57 | - | - |

### Biological data:

Biological information was available from the Portuguese Ground Fish Survey (see Working Document). Length distribution ranged from 11 to 28cm, with mean length close to the length at first maturity (19,3cm; Fishbase).

## Annex S Mixed-fisheries forecast for WGHMM stocks

The WGHMM was asked to discuss the extension of the mixed-fisheries approach to their respective stocks and areas. In order to determine how the WGHMM can progress on mixed-fisheries advice for future years, a WD (WDxx, Castro and Santurtun, 2012) was presented to summarize the state of the art and the most practical measures needed to be taken. To the plenary, at which this matter was discussed, was also invited the WGMIXFISH chairman, in order to determine how this work could be developed within the approach currently developed at ICES. After discussion, a number of measures were agreed:

First of all, due to the lack of accepted assessment for Northern stocks, it was found more convenient to focus the first steps on Southern stocks, those exploited in Iberian Peninsula waters (ICES Div. VIIIc and IXa), *i.e.* five stocks of demersal fish (Southern stocks of hake, megrim, 4-spot megrim, white and black anglerfish) and 7 Functional Units of *Nephrops* (FU25-31).

From the methodological point of view, Fcube, the method currently used to perform mixed-fisheries forecast in ICES, maintains a close relationship with the respective single-stock assessments developed for each individual stock. This dependence requires that these single-stock assessment models are implemented in FLR, the meta-software were Fcube is implemented. Except both megrims and nep-2829, which are assessed by XSA, the rest of stocks are assessed by non-FLR methods (SS3, GADGET and ASPIC). Next August 2012 and in the context of the WGMIXFISH, a workshop on Fcube methodological issues will be hold. However dates were found too early in time to address all the challenges of extending the mixed-fisheries approach to the Iberian stocks.

For these reasons, it has been decided, as a first step, to focus on the compilation of the Fcube input data needed, *i.e.* catch and effort disaggregated by DCF métier for the mentioned stocks. These data will be compiled by the respective national institutes (from Portugal and Spain) throughout this year, so that they can be delivered at the WGMIXFISH 2013 meeting. Here, they will be presented and analyzed together with the WGMIXFISH experts, with the aim to determine the following steps that could be addressed to accomplish with the mixed-fisheries approach in ICES.

Summarizing, a new ToR for WGMIXFISH 2013 is proposed:

*ToR x) Compilation and analysis of stock data from Iberian waters (ICES Div. VIIIc&IXa) for Fcube provisional application. Identification of following steps needed to accomplish with mixed-fisheries approach in Iberian waters.*

## Annex T: Spanish landings data provided to WGHMM by SGP

**Table 1. Spanish landings data provided to WGHMM by SGP**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ZONA | | | | | | | | |
| STOCK | AGRUP_A | Datos | | CORUÑA | ESTADO MIEMBRO | | PAIS_VAS | SANTANDER | | VIGO Y MA | Total general |
| ANF/07. | ART | Suma de PESO_VIVO(TN) | | | | | | | | 0.18 | 0.18 |
| | | Suma de DIAS | | | | | | | | 1.00 | 1.00 |
| | | Suma de LPUE (KG/DIA) | | | | | | | | 180.00 | 180.00 |
| | BAKA TRW | Suma de PESO_VIVO(TN) | | 389.05 | 885.35 | | 7.07 | | | 908.22 | 2,189.69 |
| | | Suma de DIAS | | 243.00 | 191.00 | | 5.00 | | | 430.00 | 869.00 |
| | | Suma de LPUE (KG/DIA) | | 1,601.04 | 4,635.34 | | 1,414.11 | | | 2,112.13 | 2,519.78 |
| | GILLNET | Suma de PESO_VIVO(TN) | | 3.26 | 0.21 | | | 0.76 | | 0.27 | 4.51 |
| | | Suma de DIAS | | 27.00 | 6.00 | | | 2.00 | | 2.00 | 37.00 |
| | | Suma de LPUE (KG/DIA) | | 120.81 | 35.79 | | | 380.64 | | 135.70 | 121.87 |
| | LONGLINE | Suma de PESO_VIVO(TN) | | 0.27 | 2.63 | | | | | | 2.91 |
| | | Suma de DIAS | | 14.00 | 2.00 | | | | | | 16.00 |
| | | Suma de LPUE (KG/DIA) | | 19.52 | 1,316.65 | | | | | | 181.66 |
| Suma de PESO_VIVO(TN) ANF/07. | | | | 392.59 | 888.20 | | 7.07 | 0.76 | | 908.67 | 2,197.29 |
| Suma de DIAS ANF/07. | | | | 284.00 | 199.00 | | 5.00 | 2.00 | | 433.00 | 923.00 |
| Suma de LPUE (KG/DIA) ANF/07. | | | | 1,382.35 | 4,463.31 | | 1,414.11 | 380.64 | | 2,098.54 | 2,380.59 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ZONA | | | | | | | |
| STOCK | AGRUP_A | Datos | | CORUÑA | ESTADO MIEMBRO | | PAIS_VAS | SANTANDER | | | Total general |
| ANF/8ABD | ART | Suma de PESO_VIVO(TN) | | | | | 9.99 | | | | 9.99 |
| | | Suma de DIAS | | | | | 6.00 | | | | 6.00 |
| | | Suma de LPUE (KG/DIA) | | | | | 1,664.81 | | | | 1,664.81 |
| | BAKA TRW | Suma de PESO_VIVO(TN) | | 4.65 | 80.28 | | 471.55 | 182.28 | | | 738.77 |
| | | Suma de DIAS | | 5.00 | 29.00 | | 307.00 | 118.00 | | | 459.00 |
| | | Suma de LPUE (KG/DIA) | | 930.98 | 2,768.32 | | 1,536.00 | 1,544.74 | | | 1,609.52 |
| | GILLNET | Suma de PESO_VIVO(TN) | | 6.48 | 0.43 | | 19.78 | 17.66 | | | 44.35 |
| | | Suma de DIAS | | 83.00 | 9.00 | | 21.00 | 69.00 | | | 182.00 |
| | | Suma de LPUE (KG/DIA) | | 78.04 | 47.72 | | 942.07 | 255.98 | | | 243.70 |
| | LONGLINE | Suma de PESO_VIVO(TN) | | 0.02 | | | 9.37 | | | | 9.39 |
| | | Suma de DIAS | | 10.00 | | | 2.00 | | | | 12.00 |
| | | Suma de LPUE (KG/DIA) | | 2.20 | | | 4,686.18 | | | | 782.86 |
| | PAIR TRW | Suma de PESO_VIVO(TN) | | | 0.59 | | 66.11 | | | | 66.70 |
| | | Suma de DIAS | | | 3.00 | | 130.00 | | | | 133.00 |
| | | Suma de LPUE (KG/DIA) | | | 195.09 | | 508.56 | | | | 501.49 |
| Suma de PESO_VIVO(TN) ANF/8ABDE. | | | | 11.15 | 81.30 | | 576.81 | 199.94 | | | 869.20 |
| Suma de DIAS ANF/8ABDE. | | | | 98.00 | 41.00 | | 466.00 | 187.00 | | | 792.00 |
| Suma de LPUE (KG/DIA) ANF/8ABDE. | | | | 113.81 | 1,982.83 | | 1,237.79 | 1,069.21 | | | 1,097.48 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ZONA | | | | | | | | |
| STOCK | AGRUP_A | Datos | CADIZ | CORUÑA | ESTADO M | NULL | PAIS_VAS | SANTAND | TERCER PA | VIGO Y MA | Total general |
| ANF/8C34 | ART | Suma de PESO_VIVO(TN) | 2.67 | 2.64 | | | 5.05 | 2.59 | | 0.99 | 13.94 |
| | | Suma de DIAS | 15.00 | 60.00 | | | 10.00 | 36.00 | | 77.00 | 198.00 |
| | | Suma de LPUE (KG/DIA) | 178.13 | 44.03 | | | 505.46 | 71.90 | | 12.80 | 70.42 |
| | BAKA TRW | Suma de PESO_VIVO(TN) | 65.14 | 279.76 | 2.30 | 0.03 | 52.24 | 147.80 | 0.02 | 191.78 | 739.06 |
| | | Suma de DIAS | 1,194.00 | 742.00 | 2.00 | 1.00 | 27.00 | 211.00 | 1.00 | 245.00 | 2,423.00 |
| | | Suma de LPUE (KG/DIA) | 54.56 | 377.03 | 1,148.92 | 29.00 | 1,934.63 | 700.46 | 22.42 | 782.77 | 305.02 |
| | GILLNET | Suma de PESO_VIVO(TN) | 1.10 | 273.67 | | | 126.33 | 188.22 | | 36.72 | 626.03 |
| | | Suma de DIAS | 45.00 | 1,406.00 | | | 166.00 | 625.00 | | 486.00 | 2,728.00 |
| | | Suma de LPUE (KG/DIA) | 24.35 | 194.65 | | | 761.01 | 301.15 | | 75.55 | 229.48 |
| | LONGLINE | Suma de PESO_VIVO(TN) | 0.12 | 0.43 | | | 0.51 | 2.27 | | | 3.33 |
| | | Suma de DIAS | 4.00 | 96.00 | | | 24.00 | 81.00 | | | 205.00 |
| | | Suma de LPUE (KG/DIA) | 30.75 | 4.44 | | | 21.05 | 28.06 | | | 16.23 |
| | PAIR TRW | Suma de PESO_VIVO(TN) | | 34.74 | | | 14.04 | 10.14 | | | 58.92 |
| | | Suma de DIAS | | 312.00 | | | 54.00 | 63.00 | | | 429.00 |
| | | Suma de LPUE (KG/DIA) | | 111.35 | | | 259.98 | 161.03 | | | 137.35 |
| Suma de PESO_VIVO(TN) ANF/8C3411 | | | 69.03 | 591.24 | 2.30 | 0.03 | 198.16 | 351.02 | 0.02 | 229.48 | 1,441.28 |
| Suma de DIAS ANF/8C3411 | | | 1,258.00 | 2,616.00 | 2.00 | 1.00 | 281.00 | 1,016.00 | 1.00 | 808.00 | 5,983.00 |
| Suma de LPUE (KG/DIA) ANF/8C3411 | | | 54.87 | 226.01 | 1,148.92 | 29.00 | 705.20 | 345.49 | 22.42 | 284.01 | 240.90 |

**Table 1 cont.**

| | | | ZONA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STOCK | AGRUP_A | Datos | | CORUÑA | ESTADO MIEM | NULL | PAIS_VASCO | SANTANDER | | VIGO Y MA | Total general |
| HKE/5712 | ART | Suma de PESO_VIVO(TN) | | | 14.06 | | | | | 0.27 | 14.3337 |
| | | Suma de DIAS | | | 1.00 | | | | | 1.00 | 2 |
| | | Suma de LPUE (KG/DIA) | | | 14,063.70 | | | | | 270.00 | 7166.85 |
| | BAKA TRW | Suma de PESO_VIVO(TN) | | 1,162.90 | 1,021.04 | | 40.88 | | | 282.01 | 2506.823544 |
| | | Suma de DIAS | | 320.00 | 279.00 | | 9.00 | | | 810.00 | 1418 |
| | | Suma de LPUE (KG/DIA) | | 3,634.06 | 3,659.63 | | 4,541.87 | | | 348.16 | 1767.858635 |
| | GILLNET | Suma de PESO_VIVO(TN) | | 253.07 | 67.96 | | | 53.14 | | 0.25 | 374.4235326 |
| | | Suma de DIAS | | 47.00 | 6.00 | | | 2.00 | | 2.00 | 57 |
| | | Suma de LPUE (KG/DIA) | | 5,384.46 | 11,327.24 | | | 26,569.27 | | 125.99 | 6568.833905 |
| | LONGLINE | Suma de PESO_VIVO(TN) | | 4,152.10 | 5,835.08 | 18.86 | 50.15 | 14.98 | | 82.77 | 10153.93859 |
| | | Suma de DIAS | | 748.00 | 391.00 | 2.00 | 8.00 | 18.00 | | 4.00 | 1171 |
| | | Suma de LPUE (KG/DIA) | | 5,550.94 | 14,923.48 | 9,428.78 | 6,269.28 | 832.19 | | 20,691.63 | 8671.168733 |
| Suma de PESO_VIVO(TN) HKE/571214 | | | | 5,568.07 | 6,938.14 | 18.86 | 91.03 | 68.12 | | 365.30 | 13049.51936 |
| Suma de DIAS HKE/571214 | | | | 1,115.00 | 677.00 | 2.00 | 17.00 | 20.00 | | 817.00 | 2648 |
| Suma de LPUE (KG/DIA) HKE/571214 | | | | 4,993.79 | 10,248.37 | 9,428.78 | 5,354.77 | 3,405.90 | | 447.12 | 4928.066225 |

| | | | ZONA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STOCK | AGRUP_A | Datos | | CORUÑA | ESTADO MIEMBRO | | PAIS_VASCO | SANTANDER | | | Total general |
| HKE/8ABD | ART | Suma de PESO_VIVO(TN) | | 21.14533 | | | 3.66855 | | | | 24.81388 |
| | | Suma de DIAS | | 1.00 | | | 1.00 | | | | 2.00 |
| | | Suma de LPUE (KG/DIA) | | 21,145.33 | | | 3,668.55 | | | | 12,406.94 |
| | BAKA TRW | Suma de PESO_VIVO(TN) | | 0.83 | 26.76 | | 195.36 | 68.24 | | | 291.19 |
| | | Suma de DIAS | | 2.00 | 64.00 | | 357.00 | 184.00 | | | 607.00 |
| | | Suma de LPUE (KG/DIA) | | 415.70 | 418.12 | | 547.23 | 370.89 | | | 479.73 |
| | GILLNET | Suma de PESO_VIVO(TN) | | 651.93 | 177.89 | | 4.93 | 668.99 | | | 1,503.74 |
| | | Suma de DIAS | | 144.00 | 14.00 | | 16.00 | 112.00 | | | 286.00 |
| | | Suma de LPUE (KG/DIA) | | 4,527.31 | 12,706.55 | | 308.09 | 5,973.08 | | | 5,257.83 |
| | LONGLINE | Suma de PESO_VIVO(TN) | | 1,549.80 | 50.95 | | 152.26 | 329.74 | | | 2,082.75 |
| | | Suma de DIAS | | 370.00 | 12.00 | | 71.00 | 102.00 | | | 555.00 |
| | | Suma de LPUE (KG/DIA) | | 4,188.66 | 4,245.68 | | 2,144.44 | 3,232.73 | | | 3,752.70 |
| | PAIR TRW | Suma de PESO_VIVO(TN) | | | 47.07 | | 2,436.69 | | | | 2,483.76 |
| | | Suma de DIAS | | | 3.00 | | 238.00 | | | | 241.00 |
| | | Suma de LPUE (KG/DIA) | | | 15,688.85 | | 10,238.20 | | | | 10,306.05 |
| Suma de PESO_VIVO(TN) HKE/8ABDE. | | | | 2,223.71 | 302.67 | | 2,792.91 | 1,066.97 | | | 6,386.25 |
| Suma de DIAS HKE/8ABDE. | | | | 517.00 | 93.00 | | 683.00 | 398.00 | | | 1,691.00 |
| Suma de LPUE (KG/DIA) HKE/8ABDE. | | | | 4,301.19 | 3,254.47 | | 4,089.18 | 2,680.82 | | | 3,776.61 |

| | | | ZONA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STOCK | AGRUP_A | Datos | CADIZ | CORUÑA | ESTADO MIEM | NULL | PAIS_VASCO | SANTAND | TERCER PA | VIGO Y MA | Total general |
| HKE/8C34 | ART | Suma de PESO_VIVO(TN) | 7.9218 | 3.6918595 | | 0.075 | 1.266 | 1.892392 | | 7.380913 | 22.2279645 |
| | | Suma de DIAS | 129 | 82 | | 1 | 7 | 49 | | 209 | 477 |
| | | Suma de LPUE (KG/DIA) | 61.41 | 45.02 | | 75.00 | 180.86 | 38.62024 | | 35.31537 | 46.59950629 |
| | BAKA TRW | Suma de PESO_VIVO(TN) | 490.89 | 731.08 | 0.31 | 0.16 | 25.21 | 120.097 | 0.09802 | 489.2193 | 1857.06155 |
| | | Suma de DIAS | 2,835.00 | 1,158.00 | 2.00 | 2.00 | 36.00 | 359 | 2 | 457 | 4851 |
| | | Suma de LPUE (KG/DIA) | 173.15 | 631.33 | 156.51 | 81.00 | 700.23 | 334.532 | 49.01 | 1070.502 | 382.8203566 |
| | GILLNET | Suma de PESO_VIVO(TN) | 32.60 | 902.43 | | | 95.62 | 232.0463 | | 87.13644 | 1349.828996 |
| | | Suma de DIAS | 470.00 | 2,930.00 | | | 297.00 | 958 | | 975 | 5630 |
| | | Suma de LPUE (KG/DIA) | 69.35 | 308.00 | | | 321.94 | 242.2195 | | 89.37071 | 239.7564824 |
| | LONGLINE | Suma de PESO_VIVO(TN) | 0.11 | 443.36 | | 0.06 | 85.45 | 231.5558 | | 2.06375 | 762.5977848 |
| | | Suma de DIAS | 5.00 | 1,037.00 | | 1.00 | 106.00 | 579 | | 11 | 1739 |
| | | Suma de LPUE (KG/DIA) | 21.40 | 427.54 | | 60.00 | 806.16 | 399.9237 | | 187.6136 | 438.5266158 |
| | PAIR TRW | Suma de PESO_VIVO(TN) | | 1,361.10 | | | 576.04 | 61.41696 | | 0.12 | 1998.677989 |
| | | Suma de DIAS | | 777.00 | | | 94.00 | 132 | | 1 | 1004 |
| | | Suma de LPUE (KG/DIA) | | 1,751.73 | | | 6,128.12 | 465.28 | | 120 | 1990.715128 |
| Suma de PESO_VIVO(TN) HKE/8C3411 | | | 531.51 | 3,441.66 | 0.31 | 0.30 | 783.59 | 647.0085 | 0.09802 | 585.9204 | 5990.394284 |
| Suma de DIAS HKE/8C3411 | | | 3,439.00 | 5,984.00 | 2.00 | 4.00 | 540.00 | 2077 | 2 | 1653 | 13701 |
| Suma de LPUE (KG/DIA) HKE/8C3411 | | | 154.55 | 575.14 | 156.51 | 74.25 | 1,451.09 | 311.5111 | 49.01 | 354.4588 | 437.2231432 |

**Table 1 cont.**

| | | | ZONA | | | | | |
|---|---|---|---|---|---|---|---|---|
| STOCK | AGRUP_A | Datos | CORUÑA | ESTADO MIEMBRO | PAIS_VASCO | SANTANDER | VIGO Y MARIN | Total general |
| LEZ/07. | ART | Suma de PESO_VIVO(TN) | | | | | 4.79 | 4.79 |
| | | Suma de DIAS | | | | | 1.00 | 1.00 |
| | | Suma de LPUE (KG/DIA) | | | | | 4,790.00 | 4,790.00 |
| | BAKA TRW | Suma de PESO_VIVO(TN) | 566.37 | 992.00 | 4.61 | | 2,010.28 | 3,573.26 |
| | | Suma de DIAS | 99.00 | 93.00 | 1.00 | | 177.00 | 370.00 |
| | | Suma de LPUE (KG/DIA) | 5,720.88 | 10,666.67 | 4,613.12 | | 11,357.53 | 9,657.47 |
| | GILLNET | Suma de PESO_VIVO(TN) | 1.83 | 0.06 | | 0.27 | 3.07 | 5.23 |
| | | Suma de DIAS | 20.00 | 2.00 | | 1.00 | 2.00 | 25.00 |
| | | Suma de LPUE (KG/DIA) | 91.32 | 29.68 | | 271.28 | 1,537.31 | 209.27 |
| | LONGLINE | Suma de PESO_VIVO(TN) | | 2.46 | | | | 2.46 |
| | | Suma de DIAS | | 1.00 | | | | 1.00 |
| | | Suma de LPUE (KG/DIA) | | 2,461.04 | | | | 2,461.04 |
| Suma de PESO_VIVO(TN) LEZ/07. | | | 568.19 | 994.52 | 4.61 | 0.27 | 2,018.15 | 3,585.75 |
| Suma de DIAS LEZ/07. | | | 119.00 | 96.00 | 1.00 | 1.00 | 180.00 | 397.00 |
| Suma de LPUE (KG/DIA) LEZ/07. | | | 4,774.73 | 10,359.59 | 4,613.12 | 271.28 | 11,211.93 | 9,032.11 |

| | | | ZONA | | | | |
|---|---|---|---|---|---|---|---|
| STOCK | AGRUP_A | Datos | CORUÑA | ESTADO MIEMBRO | PAIS_VASCO | SANTANDER | Total general |
| LEZ/8ABD | ART | Suma de PESO_VIVO(TN) | 0.02 | | | | 0.02 |
| | | Suma de DIAS | 1.00 | | | | 1.00 |
| | | Suma de LPUE (KG/DIA) | 23.32 | | | | 23.32 |
| | BAKA TRW | Suma de PESO_VIVO(TN) | 5.20 | 84.27 | 188.96 | 125.77 | 404.20 |
| | | Suma de DIAS | 5.00 | 9.00 | 113.00 | 36.00 | 163.00 |
| | | Suma de LPUE (KG/DIA) | 1,039.13 | 9,363.58 | 1,672.22 | 3,493.64 | 2,479.75 |
| | GILLNET | Suma de PESO_VIVO(TN) | 5.51 | 0.25 | 0.69 | 19.76 | 26.21 |
| | | Suma de DIAS | 41.00 | 2.00 | 2.00 | 25.00 | 70.00 |
| | | Suma de LPUE (KG/DIA) | 134.31 | 127.11 | 343.93 | 790.29 | 374.37 |
| | LONGLINE | Suma de PESO_VIVO(TN) | | | 0.62 | | 0.62 |
| | | Suma de DIAS | | | 1.00 | | 1.00 |
| | | Suma de LPUE (KG/DIA) | | | 623.28 | | 623.28 |
| | PAIR TRW | Suma de PESO_VIVO(TN) | | | 11.40 | | 11.40 |
| | | Suma de DIAS | | | 42.00 | | 42.00 |
| | | Suma de LPUE (KG/DIA) | | | 271.39 | | 271.39 |
| Suma de PESO_VIVO(TN) LEZ/8ABDE. | | | 10.73 | 84.53 | 201.67 | 145.53 | 442.45 |
| Suma de DIAS LEZ/8ABDE. | | | 47.00 | 11.00 | 158.00 | 61.00 | 277.00 |
| Suma de LPUE (KG/DIA) LEZ/8ABDE. | | | 228.20 | 7,684.22 | 1,276.39 | 2,385.71 | 1,597.29 |

| | | | ZONA | | | | |
|---|---|---|---|---|---|---|---|
| STOCK | AGRUP_A | Datos | CORUÑA | PAIS_VASCO | SANTANDER | VIGO Y MARI | Total general |
| NEP/08C. | ART | Suma de PESO_VIVO(TN) | 0.18 | 0.25 | 0.40 | | 0.82 |
| | | Suma de DIAS | 3.00 | 2.00 | 6.00 | | 11.00 |
| | | Suma de LPUE (KG/DIA) | 59.33 | 124.50 | 66.00 | | 74.82 |
| | BAKA TRW | Suma de PESO_VIVO(TN) | 42.06 | 1.60 | 6.02 | 0.16 | 49.84 |
| | | Suma de DIAS | 151.00 | 16.00 | 61.00 | 4.00 | 232.00 |
| | | Suma de LPUE (KG/DIA) | 278.56 | 99.91 | 98.63 | 40.63 | 214.83 |
| | GILLNET | Suma de PESO_VIVO(TN) | 0.01 | | 0.07 | | 0.07 |
| | | Suma de DIAS | 4.00 | | 1.00 | | 5.00 |
| | | Suma de LPUE (KG/DIA) | 1.30 | | 67.00 | | 14.44 |
| | LONGLINE | Suma de PESO_VIVO(TN) | | 0.06 | | | 0.06 |
| | | Suma de DIAS | | 3.00 | | | 3.00 |
| | | Suma de LPUE (KG/DIA) | | 19.67 | | | 19.67 |
| | PAIR TRW | Suma de PESO_VIVO(TN) | | | 0.14 | | 0.14 |
| | | Suma de DIAS | | | 5.00 | | 5.00 |
| | | Suma de LPUE (KG/DIA) | | | 27.47 | | 27.47 |
| Suma de PESO_VIVO(TN) NEP/08C. | | | 42.25 | 1.91 | 6.62 | 0.16 | 50.93 |

**Table 1 cont.**

| | | | ZONA | | | | |
|---|---|---|---|---|---|---|---|
| STOCK | AGRUP_A | Datos | CADIZ | CORUÑA | VIGO Y MARIN | Total general | |
| NEP/9/341 | ART | Suma de PESO_VIVO(TN) | 0.24 | | | 0.24 | |
| | | Suma de DIAS | 3.00 | | | 3.00 | |
| | | Suma de LPUE (KG/DIA) | 79.33 | | | 79.33 | |
| | BAKA TRW | Suma de PESO_VIVO(TN) | 112.97 | 4.70 | 11.21 | 128.88 | |
| | | Suma de DIAS | 327.00 | 29.00 | 75.00 | 431.00 | |
| | | Suma de LPUE (KG/DIA) | 345.46 | 162.17 | 149.43 | 299.02 | |
| | LONGLINE | Suma de PESO_VIVO(TN) | 0.09 | | | 0.09 | |
| | | Suma de DIAS | 3.00 | | | 3.00 | |
| | | Suma de LPUE (KG/DIA) | 31.00 | | | 31.00 | |
| Suma de PESO_VIVO(TN) NEP/9/3411 | | | 113.30 | 4.70 | 11.21 | 129.21 | |
| Suma de DIAS NEP/9/3411 | | | 333.00 | 29.00 | 75.00 | 437.00 | |
| Suma de LPUE (KG/DIA) NEP/9/3411 | | | 340.23 | 162.17 | 149.43 | 295.67 | |

## Annex U – Review Group Technical Minutes

Bay of Biscay and Iberian Seas Review Group, 4-8 June 2012 (by correspondence)

| | |
|---|---|
| Reviewers: | Thomas Brunel, Netherlands (chair) |
| | Hans Lassen, Denmark |
| | Marie Storr-Paulsen, Denmark |
| Chair WG: | Robert Scott,UK |
| Secretariat: | Cristina Morgado ICES |

**General**

The Review Group considered the following stocks:

## Anglerfish (Lophius piscatorius and Lophius budegassa) in Divisions VIIIc and IXa

- Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock);
- Hake in Division VIIIc and IXa (Southern stock);
- Megrim (*Lepidorhombus boscii* and *Lepidorhombus whiffiagonis*) in Divisions VIIIc and IXa
- Bay of Biscay sole
- *Nephrops* in Divisions VIIIa,b (Bay of Biscay, FU 23, 24)
- *Nephrops* in Division VIIIc (FU 25, 31)
- *Nephrops* in Division IXa (FU 26-30)

The review group was also asked to give its opinion on the Annex R: ToRs on New species (presenting the data available, mainly catch by country and by gear time on plaice and whiting in 8-9a and sole in 8c9a). The RG didn't have any specific comment to report on this annex.

The review group acknowledged and commended the intense effort by the working group to produce the report. The report was generally well written, well-structured and well presented. Stock annexes were presented for all the stocks.

The WGHMM met under unusual circumstances this year: The scientists from Spain (IEO) were instructed to use the "official" Spanish landings for 2011 in the assessment, provided by the Spanish administration for fisheries statistics and while the WG was in session. This dataset was to replace the scientific estimates for 2011 Spanish landings, submitted in advance to the WG by IEO. The WG examined this new source of data and concluded that it could not be used in the assessments for a variety of reasons. Consequently it was impossible to update the assessments of anglerfish, hake and megrim stocks, as well as *Nephrops* in division VIIIc. For these stocks, the catch options for 2013 were produced based on the 2011 assessment. The implication are discussed in detail in a specific section of the review report, and in the section referring to each of the stocks concerned.

Apart from this general issue, many of the assessments did not include discards data (southern anglerfish and megrim, sole). Some stocks have a high discarding rate (e.g. southern four-spot megrim) and not including the discards greatly compromises the quality of the assessment. The WG is concerned about this problem and investigates alternative ways to better include the available discards data.

In some cases, the assessments suffer from a lack of tuning series. Survey information is lacking for Bay of Biscay sole and for the northern part of the Northern hake stock distribution. For Bay of Biscay sole, a new survey index should be incorporated in the assessment next year. The 2 main commercial LPUE tuning series for this stock were interrupted in 2009, due to a declining activity of the fleets, while commercial LPUE used in the assessment of Southern anglerfish (L. budegassa) are not representative of the entire stock distribution.

Notwithstanding these issues the review group found that the WGHMM 2012 report was of good quality. No major errors were noticed in the assessments, and no substantial deviations from the stock annex were found. The review group considers that this report provides the necessary information, given the circumstances, for giving advice for the exploitation of these stocks. WGHMM should, time permitting, have provided a more detailed analysis of the difference between the official Spanish data and the scientific estimates but as the instructions to use the official data only became known during the WG session there was very little time to prepare such analyses.

**Issues related to the Spanish catch data for 2011 and implications for assessment and forecast**

The problem with the Spanish data is described in section 1.4 of the WGHMM report and is relevant for a number of stocks including some *Nephrops* stocks, anglerfish, megrim and hake. The problem relates to the commercial statistics while information from surveys and length distributions in the commercial fisheries from 2011 were available. The WGHMM text states for stocks that are affected "Spanish data in 2011 have been provided by the Secretaría General de Pesca (SGP), the official national administration responsible for fishery statistics, and are presented in Annex T. Preliminary analysis shows that the formats are not adequate and some assumptions have to be taken for the allocation of the landings (*Nephrops*). In previous years catches have been estimated by the WG based on IEO [for some stocks] and AZTI scientific estimations."

It is difficult to judge the issue based on the information that is provided and it would have been desirable if an overview of the influence of the Spanish data by stock based on past catch share had been presented. A simple indicator is the Spanish share of the total catch and whether LPUE data from Spanish fisheries have been used in the assessments, e.g. for tuning or judging trends. For northern hake the catch statistics is not broken down by country, which in this case would have been helpful.

There are three problems that are discussed separately below

<u>Question 1</u>: Does the Spanish commercial catch and landing data influence the assessment results, forecast and advice significantly? Is the forecast procedure the best possible and are the forecasts useful in formulating advice?

WGHMM notes that "Three stocks assessed by WGHMM (Biscay Sole, *Nephrops* FU 23-24 and *Nephrops* FU 28-29) were unaffected by the absence of Spanish landings data and could be assessed in the usual approach". This leaves Northern and southern hake, Anglerfish, Megrims, *Nephrops* FU26-27 and FU 30 as affected. Concerning the *Nephrops* FU28-29 the report comments "Portugal and Spain have bilateral agreements for fishing in each other waters. The last agreement was signed in 2003 for the next 10-year period. Under this agreement a number of trawlers are licensed to fish crustaceans in Portuguese waters. No information on catches/landings is currently available for these vessels." It is therefore uncertain whether the *Nephrops* FU 28-29 are among the affected stocks or not.

Table 1 (this annex) summarizes some key indicators in addressing this question for hake, anglerfish and megrim. The assessments would clearly be influenced with about 50% or more of the catch being taken by Spain.

The forecast method that WGHMM has adopted includes two intermediate years and uses a Fsq assumption about these years combined with a Geometric mean recruitment assumption, i.e. an extension of the standard forecast procedure.

The contribution of the year-classes for which an assumed recruitment was used to the yield in 2013 (Fsq scenario) is variable among stocks (table 1), and depends on the magnitude of the total mortality (conditioning the rate of decrease of last estimated year-classes with time). For megrim and anglerfish, less than 25% of the yield in 2013 is composed of year-classes with an assumed recruitment. The values for hake are higher due to the high natural mortality (M=0.4) , especially for the southern stock (62%), meaning that the forecast does not provide a good basis for a projection.

The RG group appreciates that these percentages were calculated by the WG, but regrets that no comparison with the usual situation – when assumption are required for only one intermediate year- was carried out.

For some stocks there were indications of changes in recruitment in 2011 from surveys. For white anglerfish, (L. Pisc.) this information was used to predict the 2011 recruitment instead of using a GM assumption. However, the predicted value was judged very uncertain by the RG. For Northern hake, megrim and 4 spotted megrim, a similar analysis has been done which showed that 2011 recruitments predicted from the survey indices were not significantly different from the GM values, which were used in the end. Therefore, for these stocks, the RG considers that the WG has based its assumptions on the best available information. For the Southern hake, information from surveys about the 2011 recruitment was conflicting and the GM assumption had to be used without assessing its validity.

**Table 1: Selected key indicators for judging the suitability of the WGHMM adopted forecast procedure.**

**Source: Eurostat and WGHMM**

| Stock | Species | Areas | 2010 Total Catch '000 t | Spain (%) | Fsq(08-10) | LPUE from Spanish fleets | Recruitment survey (trend from 2010 to 2011) | % of the 2013 catch based on assumed rct |
|---|---|---|---|---|---|---|---|---|
| Northern Hake | Merluccius merluccius | IIIa, V, VI VII VIIIa,b,d | 55.2 (WG estimate 72.8) | 42% | 0.42 (stable) | Y | EVHOE, increased in 2011, back to long term average level | *35%* (R2011-13=GM) |
| Southern hake | Merluccius merluccius | VIIIc and IXa | 17.3 | 81% | 0.71 (dropped from 0.8 to 0.5 in 2010) | Y | PTGFS (decreasing) and SPGFS, (increasing), both indicating average R | 62% (R2010-13=GM) |
| Anglerfish | L. piscatorius | VIIIc and IXa | 1.5 | 92% | 0.24 (decreased from 0.28 to 0.2 in 2010) | Y | Abundance decreased by 44% in 2011 (SPGFS) | 23% (R2011 predicted based on survey index) |
| Anglerfish | L. budegassa | VIIIc and IXa | 0.8 | 55% | 0.60 (stable) | Y | Surplus production model, no assumption on R need for the predictions. | |
| Megrim | L. whiffiagonis | VIIIc and IXa | 0.83 | 90% | 0.14 (declining trend) | Y | SPGFS : strong R2010, average R2011 | 22% (R2011-13 = GM) |
| Megrim | L. boscii | VIIIc and IXa | 1.3 | 84% | 0.29 | Y | SPGFS : R2011 average | 7% (R2011-13=GM) |

Question 2: Is the assessments based on best data available (available to the WG or existing)

The RG does not think that this question can be answered by the reviewers who have no detailed insight in the underlying data issues. Reading the WGHMM report one can have a distinct feeling that the answer is not trivial and that a significant amount of work is lying ahead to sort out the issues. It is worth to note that the landings deviates significantly from the WG estimate in previous years (for hake 55.2 kt (Official) against 72.8 kt (WG)) The same order of differences exist also in earlier years. WGHMM comments "Some concerns were raised regarding the validity of the data provided which in some instances indicated a marked reduction in landings from previous years. It was not possible to attribute these reductions in landings to any observed changes in the fishery such as a reduction in fishing effort, a marked decline in stock biomass or an increase in discard levels."'

One should reflect about the implications of this difference between the scientific estimate and the official statistics. If the science estimate is the better this difference suggests that there is insufficient control of the fishery.

Question 3: Is the process with a national dictate on which data to use acceptable to ICES?

ICES is being dictated by a national authority to use a particular set of data. Such a procedure is not consistent with "best scientific practice" and with ICES role as an independent advisor.

Also, the process is in conflict with a long established ICES policy where the scientists work within the Assessment WGs in personal capacity and are free to disagree with the data that have been provided and use alternative data instead.

## White Anglerfish (L. piscatorius) in Divisions VIIIc and IXa (report section 8.1)

1) **Assessment type:** Benchmark (WKFLAT 2012). Assessment could not be updated during the working group due to lack of appropriate commercial Spanish data for 2011, The assessment conducted in 2012 benchmark (not including any 2011 data) has been used as the basis of projections for catch options and management advice for 2013.
2) **Assessment**: analytical
3) **Forecast**: presented
4) **Assessment model**: SS3– tuning by 1 survey Sp-GFS-WIBTS-Q4+ 2 commercial LPUE series
5) **Consistency**: Last year's assessment was accepted – the 2012 benchmark assessment was not updated due to Spanish commercial data were not broken down in details that allowed the inclusion of these data in the assessment model.
6) **Stock status**: stock exploited at F higher than the Fmsy proxy (0.19)
7) **Man. Plan.**: No information on a management pla**n**
8) **Projections:** The assessments conducted in 2012 benchmark have been used as the basis of projections for catch options and management advice for 2013.
.

## General comments

The WG found several deficiencies in the commercial Spanish data for 2011 that prevented the WG to use these data to assess the stock. The official Spanish catches, were not given by species, and not a the temporal resolution required by the assessment model, Also the Spanish effort data for 2011 could not be used as the effort unit differs from the time series estimated by the working group. This follows that no updated catch data or commercial LPUE has been available for the WG.

In the short-term forecast the recruitment value for the first intermediate year (2011) was predicted from a linear regression model between the historical time series of recruitment and survey index. This is not a standard procedure as a geometric mean is normally used. The total abundance of fish caught half hour trawled seems to have been used as a recruitment index, with no reference to any specific length-class range. This needs some justification since one can expect that several year-classes are represented in the catch from the survey. Furthermore the regression appears to be strongly driven by one strong year class, and there is a large uncertainty around the R2011 predicted from this linear model (R2011=885 [-667 ; 2437], calculated by the review group). However, in a situation were no new catch data is available to conduct the assessment it seems like a better solution to use a recruitment for 2011 based on survey data than to use a long term mean.

For R2012, the geometric mean over the years 1982-2011 is used. The procedure described in the stock annex is the following : *"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"*. There seem to be a change in the level of recruitment pre and post 1990.

The proportion of the landing in 2013 represented by the year-classes for which prediction or assumption on recruitment were made is however reasonably low (23%) compared to other stocks.

There are some concerns on the stock status for 2011, as the mean length of total landings of the stock decreased from 71 cm in 2010 to 61 cm in 2011 and the abundance and biomass indices from the Spanish survey decreased by 44% and 40%, respectively, relative to 2010 values. However, Portuguese fleets shown an increase in LPUE in 2011, Portuguese fleet data are not used in the final assessment.

## Technical comments

- Retrospective pattern for SSB, fishing mortality, yield and recruitment (page 5). It is in the text stated that there is a tendency to overestimate SSB in the beginning of the series and over the last years. This is not obvious from figure 8.1.9 were the first year has a very small overestimation of SSB but in the two following years there is an underestimation of SSB. However a consistent overestimation of recruitment is evident although there is stated that no retrospective pattern is evident for recruitment.
- It is not clear how recruitment is defined (length interval) in the stock annex.
- It is very hard to compare the Portuguese LPUE with the Spanish LUPE as no consistency plot between fleet are presented. It is therefore not clear if the increase in the less important Portuguese fleet would correspond to an increase in the Spanish fleet.
- Table 1 in the stock annex has not included the settings for the 2012 assessment

- Need to show some comparison with previous assessment to have an idea of the change in the historical perception of the stock due to the new assessment method.

**Editorial comments**

First line assessment in 2011 – should say 2012

Table 8.1.2. There is no comment on the 2011 data should say N/A

Length composition use the last data point in 2011 (61 cm) and not the one from 2010

Improve the readability of the figures 8.1.8 and 8.1.9 (summary plots and retro analysis)

**Advice**

The first line in the advice stated that the combined total landings should be no higher than 2100 t. However this was a typing mistake the value should be 2000 (have been addressed)

In the outlook table for 2013 the value of the Fmsy transition was calculated slightly wrong the correct value should be 0.194 and not 0.2. However then the two values are so similar 0.19 for the Fmsy and 0.194 for the MSY transition the transition should be removed (have been addressed).

**Conclusions**

No new assessment has been performed during the working group and the results from the 2012 benchmark assessment (based on data up to 2010) are used to make the projections. The method used to produce the 4 year forecast is arguable and introduces a lot of uncertainty (especially predicting R2011 from the survey index). However, given the limited weight of these assumption on the forecasted yield in 2013, the RG considers that the assessment and forecast presented can be used to provide the advice for this stock.

## Black Anglerfish (L. budegassa) in Divisions VIIIc and IXa (report section 8.2)

1) **Assessment type:** Benchmark (WKFLAT 2012). Assessment could not be updated during the working group due to lack of appropriate commercial Spanish data for 2011, The assessments conducted in 2012 benchmark have been used as the basis of projections for catch options and management advice for 2013.
2) **Assessment**: non-equilibrium biomass production (ASPIC)
3) **Forecast**: the forecasts, based on data including 2010 and therefore estimating the stock size at the beginning of 2011, are considered too uncertain to be useful in an advisory context
4) **Assessment model**: ASPIC (v. 5.34.9)– fitted by two Portuguese Lpue Series(1 (years): PT-TRC9a (1989–2010) Cpue Series 2 (years): PT-TRF9a (1989–2010)) and one Spanish (SPCORTR8c (1982–2010))
5) **Consistency**: Last year's assessment was accepted – the 2012 benchmark assessment was not updated due to Spanish commercial data were not broken down in details that allowed the inclusion of these data in the assessment

model. The new assessment gives very different parameters compared to the last accepted assessment (Bmsy *4 and Fmsy /6.25)

6) **Stock status**: Biomass in 2011 is estimated to be 105% of $B_{MSY}$. Fishing mortality in 2010 is estimated to be 0.55 times $F_{MSY}$

7) **Man. Plan.**: 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. No particular management plan for anglerfish.

8) **Projections:** The assessments conducted in 2012 benchmark have been used as the basis of projections for catch options and management advice for 2013. However, projections not considered useful in an advisory context. .

**General comments**

About 80% of the landings are taken by Spanish vessels (WKFLAT 2012) and the Spanish landings for 2011 were not given by species and anyhow not considered reliable. Also the Spanish effort data for 2011 could not be used as the effort unit differs from the time series estimated by the working group. For these reasons, the assessment presented in the report and used for the predictions is the one from the WKFLAT 2012 benchmark assessment, and don't include any 2011 data. Portuguese landings in 2011 were 25% higher than previous year

Discard estimates not precise enough to be used in the assessment but shows that an increasing proportion of small fish are caught and discarded.

ASPIC model is of doubtful quality (Benchmark 2012 WKFLAT) The new settings and inclusion of new data during the benchmark result in a substantial improvement in terms of model uncertainty (reduction of the confidence interval of all estimated parameters). However, the assessment of L. budegassa is still not satisfactory based on ASPIC which obviously does not catch the dynamics of the stock. But there is also little information available and the survey is clearly not very useful as commented by the WG. The new assessment give also a very different perception of the stock (carrying capacity and B msy multiplied by 4, Fmsy revised from 0.43 to 0.06). The perception of stock status is less dramatically changed, and both the old and new assessment give a Bcurrent/Bmsy close to 1 and a Fcurrent/Fmsy<1.

**Technical comments**

1 ) The difference between the catch composition in the Spanish and Portuguese fisheries should be explored.

2 ) It is hard to compare the Portuguese LPUE with the Spanish LUPE as no consistency plot between fleet are presented. It is therefore not clear if the increase in the less important Portuguese fleet would correspond to an increase in the Spanish fleet.

3 ) There is a lack of summary table showing F, SSB and R – data is only present in a figure very nice with a comparison between the former and the present assessment, however an explanation for the very large discrepancy would be nice.

4 ) Although the statement "The stability of the aspic model (particularly in the retro) is still a major issue (WKFLAT2012)" was in the report there was

no retrospective figure included (only a comparison with previous assessments,)?

5 ) The lack of 2011 data should have been further explored

6 ) The section 8.2.3.3 (assessment results) : We could not find the annex M were most of the assessment results seem to be given. The text refers to B 2011, it should be B 2010.

**Editorial comments**

- The editorial comments on graphs for L. piscatorius apply also to L. Budegassa
- Still read parts in the text
- Stock annex could not be found in the sharepoint
- First line assessment in 2011 – should say 2012
- Section 8.2.2.4 "For each fleet the proportion of the landings in the stock is also given in the table. " the sentence should probably say "For each fleet the length proportion in the landings are given in table XX" - they are not sampling the stock, but the landings.
- Page 208. "LPUEs of all Spanish fleets show high values during the second half of the 90's", this is not avious from figure 8.2.2. Value for two fleets seems very much on average and high for Aviles. The next sentence "From 2002 to 2005 LPUE's have remained relatively stable at low values for all fleets" the 2002 value seems to be record high for the Cedeira fleet and not on a low stable level.
- Page 208 "biomass (Figure 8.2.4) indicate a steady decrease since the beginning of the series to below $B_{MSY}$ in 2001", however, according to the figure the biomass decreased below Bmsy in 1995 untill 2008.

**Advice**

7 ) Wrong number in the first line for the total advice – has been addressed

8 ) Advice should be for the two stocks together.

9 ) The text in section 8.3 is suggests that it is safe to increase or perhaps maintain the current TAC of L. budegassa. However, based on L. piscatorius, the concerns based on the 2011 TAC plus the inevitable increase in uncertainty because of the lack of the 2011 Spanish data makes this assessment questionable.

10 ) The overwriting concern in formulating the advice should be for L. piscatorius. L. budegassa can be largely ignored for which there is no particular signs of problems. For L. piscatorius there are signs suggesting restricting the fishery further (primarily low survey results) would be prudent.

**Conclusions**

No new assessment has been performed during the working group and the results from the 2012 benchmark assessment (based on data up to 2010) are used to make the projections. Given the quality of the assessment, it is questionable whether or not whether the projections from this model should be used for formulating the advice. Advice to be based on L. piscatorius.

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

1 ) **Assessment type :** no new assessment in 2012. The 2011 update assessment has been used as a basis for projections for catch option and advice. Stock on observation list.
2 ) **Assessment**: Accepted. . However because of problems with Spanish 2011 commercial data, the level catch level for 2011 is not known
3 ) **Forecast**: Accepted the projections for 2013 were based on the 2011 assessment, therefore requiring making assumption on recruitment and F for two intermediate years instead of one.
4 ) **Assessment model**: Stock Synthesis 3 (Methot, 2009) length-based, tuned by 4 surveys (RESSGASC, EVHOE, SP-GFS and IGFS)
5 ) **Consistency**: assessment rejected in 2010 and accepted in 2011 (after improvement of the 2009 data and extension of the time series back to 1978 instead of 1990).
6 ) **Stock status**: (in 2010, based on the 2011 assessment) F above Fmsy (0.24) despite substantial decrease in the recent years. Strong increase in SSB (2010 value is the highest of the time series), no biomass reference point available. High recruitments in 2006-2008, signs of very low recruitments in 2009-2.010. The status of the stock in the beginning of 2013 is not assessed
7 ) **Man. Plan.**: recovery plan agreed by EU in 2004 : SSB above 140 000t to be achieved by limiting fishing mortality to 0.25 and allowing a maximum change in TAC between years of 15%.

Plan is not evaluated by ICES. This plan was based on the former (before 2010 benchmark) assessment, for which the order of magnitude of F and SSB were different from the new assessment.

**General comments**

This section was clearly presented and well explained. Most of the text is unchanged compared to last year's report, owing to the fact that no new assessment was carried out this year.

Spanish landing data for 2011 are not included. Spanish data for 2011 have been provided by SGP, the official national administration responsible for fishery statistics, and are presented in Annex T. In previous years catches have been estimated by the WGHMM based on IEO and AZTI scientific estimations. These estimates were not provided for 2011. In previous years, these scientific estimates are significantly higher than the official statistics (in 2010 55.2 kt total official landings against the WG estimate of 72.8 kt). The difference should be investigated in detail and both procedures reviewed.

A four year forecast was run to produce a catch option table for 2013. The first year in the projection (2011) is calculated as in last year's forecast (status-quo F and recruitment equal to long-term GM). Information from the EVHOE-WIBTS-Q4 suggest that the 2011 recruitment is average, which supports the choice of a GM. The same assumptions were used for the second intermediate year, 2012.

It would have been useful to see the contribution of each year classes to the SSB2014 and Catch2013 to assess the weight of the assumption made on the 2011 and 2012 recruitments on the predictions. (a value of 35% of the 2013 yield is given in the draft advice sheet but there is no basis for that in the report).

It is suggested that the advice is not based on these projections as they do not convey the basic message that the accuracy is less than in an ordinary year.

**Advice sheet**

Values provided in the Outlook table do not match with the values from the report (table 3.6). However it is suggested that the entire section is deleted.

**Technical comments**

Input data appear to be correct and suitable.

*Stock annex*

Only minor changes

*WG report*

There is some inconsistency in the way the intermediate year recruitment was calculated compared to last year's assessment. In last year's assessment, it was decided to use the GM over the whole period (1978-2010) instead of the period 1978 until 2008 (assessment years -2, as it is stated in the stock annex). This year, the GM was calculated as explained in the stock annex, i.e. excluding the 2009 and 2010 recruitments.

This had very little influence on the results of the projections (less than 1% difference in SSB2013) but the method should be chosen once and for all.

**Conclusions**

The assessment (from 2011 WGHMM) was conducted with no deviation from the stock annex. The forecast is based on assumptions made for two intermediate years, which increases the uncertainty on the projected values for 2013 and 2014.

## Southern Hake in Divisions VIIIc and IXa(report section 7)

1 ) **Assessment type:** no new assessment in 2012. The 2011 update assessment has been used as a basis for projections for catch option and advice.
2 ) **Assessment**: analytical
3 ) **Forecast**: presented, the projections for 2013 were based on the 2011 assessment, therefore requiring making assumption on recruitment and F for two intermediate years instead of one.
4 ) **Assessment model**: gadget model – tuning by 2 commercial + 3 surveys (inclusive discards)
5 ) **Consistency**: no new assessment. Last year's (2011) assessment accepted. There was a 12% upward and 14% downward revision of the 2009 F and SSB estimates compare to the previous year's assessment. Recruitment estimate for the last year in the assessment highly uncertain and replaced by the long term average.
6 ) **Stock status**: (in 2010, based on the 2011 assessment) Existing PA reference points are no longer valid. No biomass reference points are defined for this stock, but F has been above the proposed Fmsy proxy (Fmax) and Fpa for the entire time series. Suggested Fmsy-candidate = Fmax = 0.24. Fpa = 0.40. R uncertain, seem to be high recent years.

7 ) **Man. Plan.**: A recovery plan agreed by EU in 2005, and enforced since 2006. SSB above 35 000 t by 2016 and to reduce fishing mortality to 0.27. The main elements in the plan are a 10% annual reduction in F and a 15% constraint on TAC change between years. Plan is **not** evaluated by ICES.

**General comments**

The section is well structured and easy to follow, but the wording could be improved. Most of the text is unchanged compared to last year's report, owing to the fact that no new assessment was carried out this year.

It was not possible to include Spanish commercial data for 2011 in the assessment (both landing data and effort) and furthermore it was not possible to update the Portuguese bottom trawl CPUE including the 2011 data..

The 2010 recruitment has been substituted with a GM, which was also used for 2011, 2012 and 2013 in the forecast. This implies that in the year for which the advice is given, 2013, ages from 1 to 3 are estimated based on these assumed recruitment. These ages have a large contribution to yield (62% for the MSY transition option, F2013=0.35). This high dependency of the values forecasted for 2013 and 2014 to the assumptions made increases the uncertainty in the forecast compared to normal years.

Furthermore, given the recent drop in F (2010), the assumption of Fsq, using a three year mean, may not be appropriate.

There are indications of good recruitments in recent years. In 2011 the indices show that recruitment is slightly above historic means.

**Technical comments**

Section 7.2.1 abundance indices from surveys :

- why is the Portuguese survey not considered further back than 1989 when the table 7.3 shows value back to 1980 and in the figure 7.3. the data are shown back to 1985.
- Next sentence comment on the biomass in 2011 is only about half of the level in 2010. As the rest of the sentence is about abundance maybe it should be the drop in abundance that should be mentioned.
- In the same section, the comment about the spatial distribution of the recruits and its implication of recruitment survival is unclear. Do we have to understand that most of those fish <20cm in the northwestern area will probably not recruit given that oceanographic conditions are not suitable? Besides, it should be made clearer that the text refers to the 2009 (and 2010) YC sampled in the 2010 (and 2011) survey.

There should be a comment, explanation on the retrospective analysis of recruits that in recent years have shown very large pattern (-463%).

It would be beneficial to have some comments on the discrepancy between agreed TAC and landings. In the last 3 years

Different naming (short names) of the tuning fleets in the text and the figures

Table 7.6. there should be a footnote (**) next to the 2010 recruitment estimate to make clear that this value was considered too uncertain and replaced by the GM, as stated under the table (it was done this way in last year's report). The term mortality

as a header for the second column is confusing, as it suggest that the table shows Z=M+F, use F1-3 instead.

**Editorial comments**

Retrospective pattern scaling on recruitment should be changed to include the total range.

Maturity ogive (page 141).. The sentence “2011 figures are similar to those from previous years..” is rather unclear and should probably state that “the proportion of mature individuals in 2011 were similar to those in the previous years”.

Page 142. “The estimates in Table 7.5 from SP-CORUTR, SP-CORUTRP, SP-VIMATR and P-TR continue in the historic maximum in 2010.” Is a very unclear sentence which estimate are you referring to LUPE, landings or effort. Maybe an sentence like “historic high LPUE have been reached in latest years for SP-CORUTR, SP-CORUTRP, SP-VIMATR and P-TR”

Section on short term forecast :

the status quo fishing mortality is defined in the text as “Fsq is estimated as the average of the last 3 assessments”. It would be more accurate to say “average of the estimated fishing mortality for the last 3 years in the 2011 assessment”.

In presenting the different options for 2013 :

Fsq gives a SSB2013 of 20.6kt, not 17.8kt as stated in the text. SSB2014 would be 17.8k.

-10% in F : SSB2014 would be 19.3kt, not 17.9kt

At Fmsy : yield 2013 is 7.8kt not 7.6kt.

Section management considerations,: 3rd paragraph : the statement on the reliability of F2011 and F2012 is a bit unclear. Do we have to understand that since there is no consistent pattern in the retro analysis (as there used to be) we don’t know whether the last estimated F (2010) is an over or underestimate, and hence we are less sure about the reliability of the Fsq value used for the intermediate year? I would say that if instead of the consant over (or under) estimation we have random deviations, then it is safer to use the 3 year average.

Page 155, table 7.2, footnote needs to be rephrased.

**Advice**

There is inconsistency in the SSB values from 2012 in the advice outlook sheet and in the report. It should be 25.1 and not 27.6 and HC landings (2011) = is not 25.20 but 25.0. this was corrected prior to the ADG.

**Conclusions**

The assessment and the forecast have been performed correctly, and can be used as a basis to provide the advice. However, it should be noted that the forecasted yield and stock size for 2013 and 2014 are very dependent on the GM assumption made for recruitments 2011-2013 and on the Fsq assumption for 2011 and 2012..

## Sole in Divisions VIIIa,b (Bay of Biscay) (report Section 6).

1 ) Assessment type: update
2 ) Assessment: age analytical (XSA)
3 ) Forecast: presented
4 ) Assessment model: XSA – tuning by 4 CPUE fleets: 2 for the period 1991-2009 (FR-SABLES and FR-ROCHELLE) and 2 for the period 2000-2011 (FR-BB-IN-Q4 and FR-BB-OFF-Q2). No survey fleets used for tuning.
5 ) Consistency: assessment carried out according to stock annex, and with the same setting and data sources as last year. F2010 unchanged and SSB 2010 revised upwards by 14%. R2010 revised upward by 184% (but last year's estimate replaced by GM), and R2009 revised upward by (35%).
6 ) Stock status: SSB has been fluctuating somewhat below Bpa (= MSY Btrigger) for the last 12 years, but has increased over the last 2 years and is currently estimated to have been slightly above Bpa in 2010 and 2011. Fpa has been slightly below / around Fpa for the last 5 years, but has increased in 2011. Recruitment in 2009 it estimated to be very high, recruitment 2010 is considered low and there is insufficient information to correctly estimate the 2011recruitment (XSA estimate of 4 million, replaced by the GM of 22 million).
7 ) Man. Plan.: Multi-annual plan agreed 2006: SSB above 13 000 t by 2008. The main elements in the plan are a 10% annual reduction in F and a 15% constraint on TAC change between years. In 2009, ICES estimated that this objective had been reached. Plan is not evaluated by ICES. First phase biomass target for 2008 has been reached and the plan should enter its second phase, requiring a choice of long term target as well as on the rules to reach it.

**General comments**

This was generally easy to follow and clearly described but a number of inaccuracies have been found in several places.

The RG appreciates that EG has followed its recommendation to investigate the implications of XSA not converging after 30 iterations (but converging after 58 iterations) and acknowledges that the difference in the output of the model are marginal.

The assessment is currently not using any survey index. A new survey has started in 2007 to overcome this lack. During the last benchmark (2011), the survey was too short to be included in the assessment, but WKFLAT (2011) recommended to consider the inclusion of the survey as soon the series is 5 years long. Despite the survey being carried out for the 5$^{th}$ time in 2011, the survey data had not been worked out by the time of the 2012 WGHMM and the inclusion of the 2011 survey index in the assessment could not be explored.

The survey index for ages 1 and 2 seems to reflect quite well the strength of incoming recruitment, and the abundance index of 1 year olds in 2010, suggested that the 2011 recruitment (2 years old) could be intermediate between the low 2008 and 2010 recruitments and the large 2009 recruitment. This is in contradiction with the very low R2011 estimated by XSA. However since the plot for the 2011 survey index is missing from the figure 6.10 (same figure as 2011 report), it is not possible to confirm that the expected size of the R2011 is intermediate between R2009 and R2010.

**Technical comments**

**Report section**

Sec 6.2.1 and table 6.1 : why is there such a large discrepancy between the official and the WG landings. In most of the years the difference is minimal, and the WG ladings figure is higher than the official landings. However in 2009 and 2010 the WG landings are more than 20% lower than the official landings. Why would the official statistics overestimate the true landings?

Sec 6.2.3 : the time series from the ORHAGO survey is now 5 years long.

Sec 6.3.2 / Exploratory runs :

In the second paragraph, it should be "201<u>0</u> fishing mortality at age 3 as estimated by the 201<u>1</u> WG" (dates are inverted in the report).

It is however not correct to say that the fishing mortality at age pattern has changed for the terminal year, as the change occurred already in 2010, (high F at age 4 in 2010, see figure 1 from the review group report, note that this figure is different from the figure 6.7 of the working group report which shows this pattern averaged over three consecutive years).

Section 6.3.3.1 :

The 2007 year-class is estimated at 16.5 million fish, not 17.5.

This section is confusing and should be rephrased :

"In the 2011 assessment, the 2010 recruitment estimate (6 million age 2 fish) was replaced by the GM93-08 because of the lack of reliability of the recruitment estimated from XSA, as illustrated by the retrospective analysis. The 2010 recruitment is estimated to be 16.5 million age 2 fish in the 2012 assessment, which is an historical low value, well below the long-term average (GM93-09=22.6 million)".

The alternating use of year class and recruitment in this section is confusing.

Section 6.3.3.2 :

Second paragraph : F2010 is not 0.42 but 0.39 (according to table 6.10).

Third paragraph : it would be more accurate to talk about an increase in the last two years (than saying that SSB remained close to 12 000t from 2007 onwards).

Section 6.3.6 / consistency :

figure 6.12 should be referred to in this section (this figure is currently not introduced in the text of WG report) instead of the retrospective analysis, and some quantification of the revision (e.g % change) in the values of SSB; R and F 2010 have to be given.

It should be also noticed that not only the recruitment of the terminal year (2010) has been revised, but also the year before (2009) which is the 2011 assessment was estimated to be averaged, but is now estimated to be very large.

**Stock annex**:

Only slightly modified compared to the 2011 annex

**Advice sheet** :

Number were checked and no error found

**Conclusions**

The assessment and the forecast have been performed correctly, and can be used as a basis to provide the advice. However, it should be noted that the forecasted yield and stock size are very dependent (70%) on the GM assumption made for recruitments 2011-2013.

Future benchmark suggestions:

Estimate and include discards.

Add the ORHEGO survey time series when this is long enough

Use annually varying maturity ogives

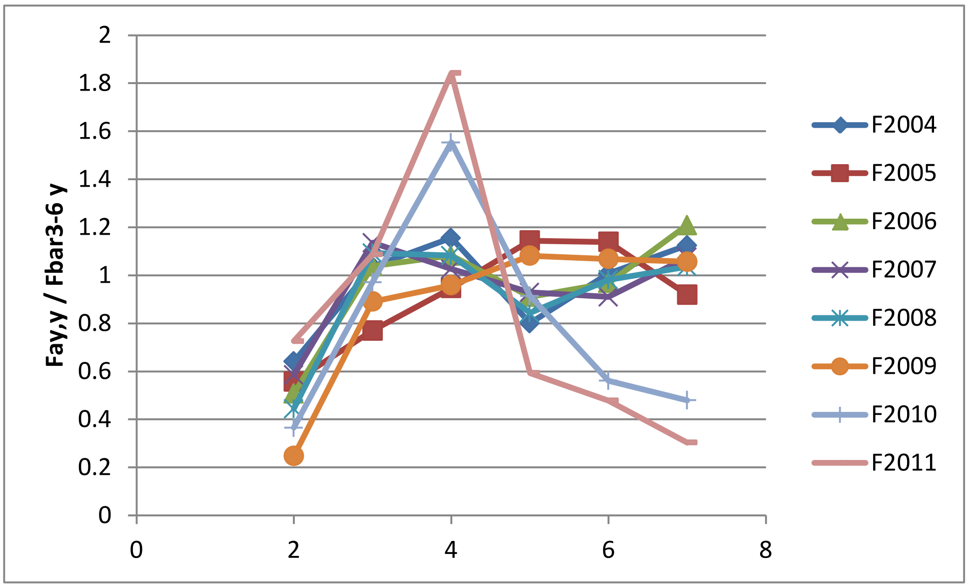


**Figure 1 : mortality at age pattern (Fa,y divided by Fbar3-6,y) calculated from the XSA 2012.**

## Nephrops in divisions VIIIa,b (Bay of Biscay, FU 23-24) (report section10)

1) **Assessment type:** update (but with changes compared to previous update assessment, see below)
2) **Assessment**: accepted
3) **Forecast**: presented
4) **Assessment model**: XSA with slicing of length distribution of catch (combined sexes including discards) + tuning by 1 LPUE fleet+1 survey index (LANGOLF)
5) **Consistency**: previous assessment (2010) accepted, this assessment was the continuation of the benchmark processes initiated during IBS *Nephrops* 2012 and was accepted.
6) **Stock status**: No agreed biological reference points. Conclude that spawning biomass has been relatively stable over the entire period (between 8 000 and 10 000 t) but increased recently until nearly 11 000t in 2011. The fishing mortality has been decreasing in the recent period and was 0.4 in 2011, but remains above all potential candidates FMSY (Fmax=0.19).
7) **Man. Plan.**: No specific management objectives are known to ICES. FU managed by TAC (not reached in 2010 and 2011), minimum landing size and mesh size regulation.

**General comments**

This section was generally well structured, documented and easy to read, but the wording could be improved.

The assessment is age based, for a species that cannot (easily) be aged. This requires conversion of length frequency distribution into age frequency distribution. This is done by a slicing program (L2AGE) assuming a time invariant growth (von Bertalanffy model). The growth parameters used (K and Linf for males and females and for juveniles and adults) were estimated in the late 1970s. Is there any indication, from more recent studies, that those parameters have not significantly changed over the last 3 decades? Furthermore, since there is a “strong yearly variability in the size at functional maturity” (stock annex), and since maturity and growth are two related traits, some interannual variability in growth should be also expected. A simulation study could be carried out to assess the implication for the assessment of using a constant growth hypothesis when growth is actually variable.

This year, an improved procedure for discards estimation for the years with no discard sampling has been applied which improved the quality of the catch-at-age data. A new survey was also incorporated in the assessment. Time series for this survey should be given in the report section not in the stock annex. There was not preliminary analysis of the suitability of the survey index (e.g. internal consistency) and it was not discussed whether the inclusion of the survey effectively improved the assessment. A more critical analysis of the survey (data suitability, fit in the XSA) should be carried out during the next WGHMM.

**Technical comments**

Section 10.3.2 : there is no comment about the residuals for the survey, included for the first time in the assessment this year. Those residuals seem to be quite correlated between age-classes, and also show some temporal patterns. What are the implication of this about the usefulness of this survey in the new assessment?

Given the large residuals at age 1, the retrospective pattern for recruit estimates and the fact that the selection at age 1 is low (0.0351, separable analysis), do we really have enough information to estimate the recruitment in the terminal assessment year? Shouldn't it be replaced by a GM as in other assessments?

Table 10.11 XSA tuning diagnostics barely readable.

**Stock annex :**

Not fully updated by the time of the review.

The date used to compute SSB, 1st of January, is based on the fact that recruitment is assumed to take place at this time of the year. But should SSB be calculated at the time when it gives the best proxy of the stock reproductive potential, i.e. at the time of hatching of the eggs.

**Advice :**

No outlook for 2013 presented.

**Conclusion**

The RG considers that the assessment and forecast were correctly conducted and that they can be used as the basis to formulate advice for this stock.

## Nephrops in divisions VIIIc (FU 25,31)

1 ) Assessment type: update
2 ) Assessment: no new assessment
3 ) Forecast:no new forecast
4 ) Assessment model: analysis of trends in LPUE
5 ) Consistency: last year's assessment was done following the same approach that 2 years before.
6 ) Stock status: very low state of the stock (for the two functional units).
7 ) Man. Plan.: landings have been below the TAC in recent years. A recovery plan has been agreed by the EC in 2006 (Council Regulation (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. ICES has not evaluated the current recovery plan for *Nephrops* in relation to the precautionary approach or the MSY framework. Since 2006 there has been an annual reduction of fishing days by 10% in response to the recovery plan which has also not been evaluated by ICES.

**General comments**

No updated LPUE time series due to the Spanish data problem (data not disaggregated to the appropriate precision level).

## Nephrops in Division IXa (FU 26-30) (Report section 12)

1 ) Assessment type: update
2 ) Assessment: no new assessment for FU26-27 and FU 30. Assessment for FU 28-29 updated.
3 ) Forecast:no new forecast
4 ) Assessment model: FU 26 and 27 , FU 28 and 29 , FU 30: trends in LPUE and survey.
5 ) Consistency: no new assessment for FU 26-27 and FU 30. XSA assessment was abandoned and an analysis of trends in survey, LPUE and effort was presented.
6 ) Stock status: No agreed biological reference points.
7 ) - FU 26 and 27 stocks are at an extremely low level. Increase in mean sizes, probably due to progressive recruitment failure.
8 ) - FU 28 and 29
9 ) - FU 30 – the trends in the time series are difficult to interpret
10 ) Man. Plan.: TAC is spread over all function units and does not limit any of the fisheries. A recovery plan has been agreed by the EC in 2006 (Council Regulation (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. ICES has not evaluated the current recovery plan for *Nephrops* in relation to the precautionary approach or the MSY framework. Seasonal closed boxes in FU 28, closed seasons in FU30 plus other regional limitations on fishing effort

**General comments**

The findings can be summarised as follows

1. The text does not discuss if the overall level of the Spanish catches are reliable or not. This is a major issue for e.g. the hake data from the same source and partly from the same fisheries.
2. The trend assessment is of little use with the lack of Spanish data.
3. The FU28-29 assessment which is analytical is very difficult to follow and there are as indicated in the comments in the text apparent inconsistencies in the text.

**Advice basis**

For FU26-27 the stock is depleted and there does not seem to be any information that suggest that the stock status has changed. The advice of a closure should remain

For FU 28-29 it is difficult to see that there is any basis for an advice for 2013.

For FU 30 (G Cadiz) the advice should be based on the survey information which suggests a continued decline. The rate is about halving the stock in about 15 years or about 5% annually. The decrease in the fishery, i.e. the TAC should be higher.

## Megrim (L.whiffiagonis) in Divisions VIIIc and IXa (report section 9.1)

1 ) **Assessment type:** update, however the assessment could not be updated this year due to lack of Spanish commercial data. The assessment conducted in 2011 has been used as the basis of projections for catch options and management advice for 2013

2 ) **Assessment**: analytical,

3 ) **Forecast**: Two year forecast. Forecast table linked to the L. boscii in VIIIc and IXa.

4 ) **Assessment model**: XSA– tuning by 2 commercial + 1 survey

5 ) **Consistency**: Last years assessment accepted, No new assessment this year

6 ) **Stock status**: (in 2010) a preliminary Fmsy at 0.17 (F40%) and F is estimated to have been below this value since 2009.

**7 ) Man. Plan.**: 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 megrims are taken in these mixed trawl fisheries, these stocks are also affected by the recovery plan effort limitation. No particular management plan for megrims. No specific management objectives are known to ICES

**General comments**

The majority of the catches are taken by Spanish trawlers. The WG found several deficiencies in the commercial Spanish data for 2011 that prevent the WG to use these data to assess the stock. Also the Spanish effort data for 2011 could not be used as the effort unit differs from the time series estimated by the working group. This follows that no updated catch data or commercial CPUE has been available for the WG.

Discards estimates are available for Spain. Discards in number represent between 10-45% of the total catch. Discards data are not yet used in this assessment due to the lack of data in some years of the series.

The Spanish survey recruitment index showed a very high value in 2010 (age 1). An increase of the same amplitude is found in the LPUE from Portuguese trawlers in 2011. This suggest that the 2010 recruitment (2009YC) is good, which is supported by the high recruitment estimated by XSA for 2010. This recruitment estimate is used, and not replaced by a GM for the forecast.

In the short-term forecast the recruitment value for 2011 was derived from a geometric mean, however the survey index after a linear fitting with historic recruitment data was explored and gave similar results.

There is a strong declining trend in the fishing mortality since 2006. The projections have been based on a Fsq (3y mean) which therefore overestimates the real F for the intermediate year.

**Technical comments**

Well made standard XSA assessment

**Editorial comments**

First page : should be type of assessment in 2012 not 2011

Internal and external consistency plots between the surveys and commercial tuning fleet would be beneficial as well as for the catch matrix.

Figure 9.1.5. Strange Y-axis with double numbers – maybe 1 more decimal would help

**Conclusions**

The indications are that four spotted megrim (L. boscii) is the more heavily exploited stock for which exploitation is above Fmsy (prel). Hence the advice should be based on considerations based on that four spotted megrim (l. boscii) while megrim (L. whiffiagonis) can largely be ignored. The survey appears to be quite good at tracking cohorts through time *for L. whiffiagonis*.

## Four spotted Megrim (L. boscii) in Divisions VIIIc and IXa) (report section 9.2)

1 ) **Assessment type:** update, however the assessment could not be updated this year due to lack of Spanish commercial data. The assessment conducted in 2011 has been used as the basis of projections for catch options and management advice for 2013
2 ) **Assessment**: analytical
3 ) **Forecast**: presented
4 ) **Assessment model**: XSA– tuning by 1 commercial + 1 survey
5 ) **Consistency**: Last year's assessment accepted, no new assessment.
6 ) **Stock status**: (in 2010) no reference points for this stock. F is above thea preliminary Fmsy at 0.18.
7 ) **Man. Plan.**: No specific management objectives are known to ICES

**General comments**

The section is well structured and easy to follow. It would be beneficial with more figures showing the consistency of the surveys and commercial tuning fleet.

The WG found several deficiencies in the commercial Spanish data for 2011 that prevent the WG to use these data to assess the stock. Also the Spanish effort data for 2011 could not be used as the effort unit differs from the time series estimated by the working group. This follows that no updated catch data or commercial CPUE has been available for the WG.

In the short-term forecast the recruitment value for 2011 was derived from a geometric mean, however the survey index after a linear fitting with historic recruitment data was explored and gave similar results. The WG decided to use the GM to be according with the Stock Annex indications in the final assessment.

**Technical comments**

The input data for this stock does not seem to be very strong, and should not form the basis of a short term advice. There is a very high discard rate between 39-63% (with the highest level recorded in 2010) of the total catch not included in the assessment. The survey appears to have been quite good at tracking cohorts through time until about 2002, but the signal seems more blurred in recent years and the 1. commercial tuning fleet included in the final run is not contributing to the survivors in the XSA analysis for any age groups.

1 commercial tuning fleet is included in the assessment for age 3-6, however the last year in the tuning series is 1999 and the weighting of this fleet is 0 for all age groups in the diagnostic. It is therefore not contributing at all to the final calculations in XSA and can be removed.

**Editorial stuff**

First page Type of assessment in 2011, should be type of assessment in 2012.

Section 9.2.4.1 SSB in 2012= 4902 and not 4092 as stated in the text.

**Advice**

The advice sheet is reflecting the same results as in the WG report.

**Conclusions**

It is stated in the report that the survey is not following the cohorts very well after 2002. This indicate that the stock duo not, at present, have any good tuning fleet. There should be put some effort into establish a new commercial tuning fleet and re-analyze the Portuguese survey to see if there is some information in that.

The RG believes that the input data for this stock is of a rather bad quality (discards are substantial and not included) and provides a poor basis for advice.

Internal and external consistency plots between the surveys and commercial tuning fleet would be beneficial as well as for the catch matrix.