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

5 - 11 May 2010

Bilbao, Spain

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0 Executive Summary

The ICES Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim (WGHMM) met in Bilbao (Spain) during May 5-11 2010. There are 19 stocks in its remit, distributed from ICES Division IIIa to IXa: 2 stocks of hake (Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d and Hake in Divisions VIIIc and IXa), 4 of anglerfish (*Lophius piscatorius* and *L. budegassa* in Divisions VIIb-k and VIIIa,b,d and *L. piscatorius* and *L. budegassa* in Divisions VIIIc and IXa), 3 of megrim (*Lepidorhombus whiffiagonis* in Divisions VIIb-k and VIIIa,b,d and *Lepidorhombus boscii* and *L. Whiffiagonis* in Divisions VIIIc and IXa), 1 of sole (Sole in Divisions VIIIa,b - Bay of Biscay), 2 functional units of *Nephrops* in Divisions VIIIa,b, 2 in Division VIIIc and 5 in Division IXa. There were 20 participants from 5 countries (France, Ireland, Portugal, Spain and UK). The meeting was chaired by Carmen Fernández (Spain).

The meeting was tasked with carrying out stock assessments and providing catch forecasts and a first draft of ICES advice for 2011 for all stocks in its remit. Analytical assessments using age-structured models were conducted for the southern stocks of megrim, the Bay of Biscay sole and two *Nephrops* functional units. Following the conclusions from the WKROUND benchmark workshop conducted at the beginning of 2010, the two hake stocks were assessed using models that permit the use of only length-structured data (no age data), although important uncertainties in the northern hake assessment meant that the WGHMM meeting accepted it only as indicative of stock trends. A surplus-production model, without age or length structuring, was used to assess the southern stocks of anglerfish. No analytical assessments have been provided for the northern stocks of anglerfish or megrim after 2006. For anglerfish this is mostly due to ageing problems and to an increase in discards in recent years, for which there is no reliable data. For megrim, there have been severe deficiencies in the input data, of which several still remain. The state of stocks for which no analytical assessment could be performed was inferred from examination of commercial lpue or cpue data and from survey information.

The WGHMM meeting also devoted considerable effort to proposing F_{MSY} values for the stocks, although some should be considered as preliminary and may be revised in the near future.

Section 1 of the report presents a synthesis by stock and discusses general issues. Section 2 provides descriptions of relevant fishing fleets and surveys, whereas Sections 3 to 12 contain the single stock assessments. Section 13 groups references. Several Annexes follow. Titles and abstracts of Working Documents presented to the meeting are in Annex B. Planning of preparatory work for future benchmarks is presented in Annex N. WGHMM recommendations are in Annex O and main data problems requiring action in Annex P.

1 Introduction

1.1 Terms of Reference

2009/2/ACOM11 The **Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim** [WGHMM] (Chaired by: Carmen Fernández, Spain) will meet in Bilbao (Spain), 5–11 May 2010 to:

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

The assessments will be carried out on the basis of the stock annex in National Laboratories, prior to the meeting. This will be coordinated as indicated in the table below.

Material and data relevant for the meeting must be available to the group no later than 14 days prior to the starting date.

WGHMM will report by 18 May 2010 for the attention of ACOM.

Fish Stock	**Stock Name**	**Stocks Coordinator**	**Assess. Coord. 1**	**Assess. Coord. 2**	**Perform assessment**	**Advice**
ang-78ab	Anglerfish (*Lophius budegassa* and *L. piscatorius*) in Divisions VIIb-k and VIIIa,b	Spain/France	Spain/France	France/Spain	Y	Same advice as last year
ang-8c9a	Anglerfish (*Lophius. Piscatorius* and *Lophius budegassa*) in Divisions VIIIc and IXa	Spain/Portugal	Spain/Portugal	Portugal/Spain	Y	Update
hke-nrtn	Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock);	France	France	Spain	Y	Update
hke-soth	Hake in Division VIIIc and IXa (Southern stock);	Spain	Spain	Portugal	Y	Update
mgb-8c9a	Megrim (*Lepidorhombus boscii* and *Lepidorhombus whiffiagonis*)) in Divisions VIIIc and IXa	Spain	Spain		Y	Same advice as last year
mgw-78	Megrim (*L. whiffiagonis*) in Subarea VII & Divisions VIIIa,b,d,e	Spain	Spain		Y	Same advice as last year
sol-bisc	Bay of Biscay sole	France	France		Y	Update
nep-8ab	*Nephrops* in Divisions VIIIa,b (Bay of Biscay, FU 23, 24)	France	France		Y	Update
nep-8c	*Nephrops* in Division VIIIc (FU 25, 31)	Spain	Spain		Y	Update
nep-9a	*Nephrops* in Division IXa (FU 26-30)	Spain/Portugal	Spain/Portugal	Portugal/Spain	Y	Update

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).

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. The TAC in 2009 was 51 500 t. Total stock landings in 2009 are unknown as the data provided by France are of poor quality and the WG could not use them. For the other countries, landings in 2009 are approximately 25% higher than in 2008.

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 tonnes (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 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 assessment starts 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.

No new assessment was conducted at this WG due to the absence of 2009 landings data. Hence, the assessment conducted by WKROUND, using data until 2008, was used. This assessment indicates overall increasing and decreasing trends for SSB and fishing mortality, respectively, since the late 1990s. However, 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, make the assessment uncertain, particularly in the most recent years. The WG was of the view that, whereas the overall trends estimated by the assessment are representative of stock development, the actual rates of increase and decrease of SSB and F in the most recent years are very uncertain. Short term projections using recent F values show unrealistic SSB increases. As a consequence of these big uncertainties, the WG accepted the assessment only as indicative of stock trends (with the concern just stated about the uncertainty of the actual rates in the most recent years) and decided not to present short term projections.

In order to improve the assessment, work will attempted in two main directions: recovery of commercial data (by fleet and quarter) from before 1990, and appropriate standardisation of a cpue series from a fleet catching large individuals (*e.g.* from a long-line fishery).

The previous biological reference points are not applicable in the context of the new assessment. The WG has proposed an F_{MSY} proxy based on the new assessment.

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 2009 were estimated to be 19 200 t, over twice the TAC (8 104 t). Total catch, including discards, in 2009 was estimated to be 22 400 t.

A Recovery Plan for southern hake 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. An evaluation of the recovery plan is under ICES discussion.

This 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 have been incorporated in the new assessment.

For SSB, the 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 20 100 t in 2009. Recruitment has been increasing strongly after 2004 and is estimated to be extremely large in 2009, but this value needs to be confirmed in future assessments. F shows relatively stable values in the last ten years and is equal to 0.74 in 2009.

The previous biological reference points are not applicable in the context of the new assessment. The WG has proposed an F_{MSY} proxy based on the new assessment.

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 2009 TAC for both species combined is 36 000 t. Landings in 2009 are unknown as no reliable estimates are available from France and the Spanish data are considered as preliminary. The two countries contribute about 80% of total stock landings.

Age determination problems and an increase in discards in recent years have prevented the performance of an analytical assessment since 2007. The assessment this year was based on examining commercial lpues and survey data (biomass, abundance indices and length distributions from surveys). Four surveys were 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 good recruitments in 2001, 2002 and 2004 and has stabilised in recent years. Recruitment in 2008 also appears good and there are indications of another good incoming recruitment in 2009.

For *L. budegassa* survey data indicate that biomass and abundance in numbers have been continuously increasing since the mid 2000s, due to a sequence of strong recruitments starting in 2004. Recruitment in 2008 also appears good, whereas the two relevant surveys for this species give contradictory signals regarding 2009 recruitment.

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

More details 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 not usually landed separately, for the majority of the commercial categories, and they are recorded together in the ports' statistics. Landings of both species combined in 2009 were 3 049 t, 73% above the TAC of 1 760 t, which is set for both species combined.

A benchmark assessment was carried out in 2007 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 in both cases, although the series are different for the two species.

Biomass of *L. piscatorius* has decreased during the 1980s and early 1990s, and has since remained stable at low levels, well below B_{MSY}. F has been above F_{MSY} during the whole time series, except in years 2001 and 2002. F has been decreasing for four consecutive years in a row, but it is still above F_{MSY} in 2009. Fishing mortality equal to 0 from 2011 onwards is not expected to bring the stock to B_{MSY} until 2015.

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 is below F_{MSY} in 2008 and 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 an upwards trend since 2003, although it is still below B_{MSY} in 2010. If F during 2010 remains the same as in 2009, the stock biomass is expected to be at 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 2009 TAC is 20 425 t. Landings in 2008 (11 282 t) corresponded to the minimum of the historical series. Stock landings in 2009 are unknown, due to the absence of French data. Landings in 2009 excluding France amount to 12 790 t, which is larger than total stock landings in several recent years. Discarding of smaller megrim is substantial and also includes individuals above the minimum landing size of 20 cm.

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. The situation has worsened again this year, with the absence of all commercial data from France. The present assessment is based on examining commercial cpue and survey series.

The three surveys and two commercial cpue values available for 2009 indicate a biomass increase with respect to 2008. None of the data examined appear to indicate the presence of a strong incoming recruitment. In view of the available data, the WG concluded that the stock appears to be stable at the present level of fishing. The group states strongly the importance of incorporating annual estimates of discards in the assessment, which requires receiving discards estimates corresponding to all major contributors to stock catches.

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 2009 were 1 218 t (of which 93% correspond to *L. boscii*), below the TAC of 1 430 t, which is set for both species combined.

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 at low levels since 1991, with a slow but gradually declining trend since 1997. The seven most recent years (2004-2010) correspond to the lowest SSB estimates. Recruitment has been continuously at low levels for about one decade, with the 2009 estimate being the second lowest in the series. F has been variable over time, although with generally lower values after the mid 1990s. F in 2009 has decreased for the third consecutive year, reaching the lowest value in the entire series (0.10).

For *L. boscii* the assessment indicates that SSB decreased substantially between 1988 and 2001, with a slight increasing trend from that year until 2008 and a slight decrease in 2009. F has been rather stable since the mid 1990s, at lower levels than those estimated for earlier years. Both high and low recruitments are seen throughout the whole time series.

There are no biological reference points defined for these stocks. However, the WG has proposed F_{MSY} proxies this year.

The differences in SSB and recruitment 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.

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 2009 were 3 600 t, whereas the TAC was 4 390 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.

An update age-based assessment (XSA) was performed this year, using landings, indices from two surveys (ending in 2002) and two commercial fleets. Partial discard information is available from 1984 to 2003, but there are questions regarding its reliability. 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 started in 2007 should be useful in the future.

The assessment indicates that SSB has been increasing since 2004, reaching above 13 000 t (B_{pa}) in 2008, although with a slight decrease in 2009. F has been at lower levels since 2003. F has decreased in 2009 and corresponds to the lowest value in the historical series (0.33). 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} proxy has been proposed for this stock 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 5 940 t in 1988 to 3 110 t in 2000. After that year, they increased again to around 3 700 t, staying at that level for some time. There has been a decline again in the last 4 years, with landings being 3 030 t in 2009, the lowest recorded value, and below the TAC (4 104 t).

A French regulation increased the minimum landing size in 2006 and several effort and gear selectivity regulations have also been put in place in recent years. 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. Considerable effort is being put in the development of a probabilistic method to fill in the many gaps in the series of discards estimates.

The stock was assessed using XSA, after applying slicing to convert to ages the length composition data, and used 1 tuning fleet corresponding to a commercial lpue series. SSB has on the whole been stable since the start of the assessment period, with a gradual decline during the 1990s and a gradual increase since around year 2000. F has been quite stable throughout the assessment period, but has declined in the final three years, with the value in 2008 (0.38) being the lowest in the entire series. Recruitment gradually decreased until 1998 and has generally been a bit higher and more variable after that year.

No biological reference points exist for this stock. This year, the WG has proposed an F_{MSY} proxy.

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 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. 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 2009 from the two FUs combined were 27 t, well below the TAC of 112 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).

FU 25 (North Galicia): Landings were reported only by Spain. Since the early 1990s landings declined from about 400 t to less than 50 t. Landings in 2009 were 21 t, the lowest recorded value. The lpue from the main commercial fleet shows an overall declining trend, with some fluctuations and reaching its lowest value in 2009.

FU 31 (Cantabrian Sea): Landings reported by Spain (the only participant in the fishery) are available for the period 1983-2009. 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. Only 6 t were landed in 2009. The 2009 lpue value from the available commercial fleet is the lowest in the entire series.

Both FUs were assessed by examining lpue trends, with the conclusion that stock abundances are at minimum historical levels.

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 2009 from the five FUs combined were 267 t, below the TAC of 374 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 25 t were landed in 2009.

The stock was assessed by examining lpue series trends, with the conclusion that it continues to be at a very low abundance level.

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

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 122 t in 2009, the lowest value in the series.

An assessment was carried out using XSA separately for males (the predominant sex in the landings) and females. Abundance indices from a crustacean trawl survey and lpue from the crustacean trawl fishery were used for tuning. The assessment was accepted for trends only, due to uncertainties about growth and natural mortality and the fact that ages were obtained from conversion of length frequencies via slicing. Additionally, there is a strong retrospective pattern of recruitment and SSB overestimation and F underestimation in recent years.

Fishing mortality for both males and females has decreased since 2005. For males, after a declining trend in the period 1989-95, SSB increased in 1996-2002, at which point a new declining trend started. Male recruitment is at a low level after the decline observed in the period 2004-2008. Females SSB and recruitment have been more stable over the entire assessment period.

Considerable effort is being devoted to obtaining an appropriately standardised lpue index from the crustacean trawl fleet, which the WG considers very important for the improvement of this assessment.

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. Landing 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 2008 and 2009 were 120 t each year. 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 via examination of lpue and survey trends. The lpue series shows an overall declining trend, remaining stable in the last five years. The survey trend is stable since 1997, albeit with large interannual variability. The state of stock appears to be stable at recent levels of fishing, although at a lower biomass level than in the early 1990s.

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 reasonably stable within low levels. 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 2010 were prepared in advance of the meeting and all revisions to data are referred to in the appropriate stock sections. No commercial data from France was available for 2009 in relation to the stocks of northern megrim and northern anglerfish and uncertainties in the Spanish northern anglerfish data and poor quality of the French northern hake data were noted. These data deficiencies have compromised the assessments conducted for the northern stocks. Any other deficiencies in the landings data are discussed in each stock section. 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.

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 Proposals for Fmsy and Btrigger

As requested in a new ToR this year, WGHMM considered carefully the issue of trying to establish reference points F_{MSY} and $B_{trigger}$, for application of the MSY-based approach to advice by ICES. An attempt to follow the guidelines provided in the WKFRAME (ICES 2010b) report was made. Whereas these guidelines were felt to be useful in a general sense, they provided little guidance when specific choices had to be made. There was also very little time for WG members to prepare for this work, as the WKFRAME report only became available approximately one week before the WGHMM meeting started. This limited strongly the amount of analysis that could be done. For most of the stocks, the group concluded that potential candidates for F_{MSY} should be in the range of $F_{0.1}$ -- $F_{35\%}$ -- $F_{max,}$ but the basis for choosing one particular value over another within that interval was often not clear. For each stock, the subsection on Biological Reference Points includes an explanation of what was done this year with respect to proposing an F_{MSY} value and possible work to be done for next year WG. No progress was made towards defining $B_{trigger}$ as this requires more careful analysis that the group did not have time to undertake.

The fact that MSY framework for advice should be considered this year meant that even assessments originally scheduled as SALY (Same Advice as Last Year) became in reality Update assessments (as the advice provided last year was not necessarily in accordance with MSY principles). So the WG has updated all assessments and provided a first draft of the advice sheets for all stocks.

1.4.2 Use of InterCatch by WGHMM

No real progress has been made by the group with regards to the use of InterCatch after last year. As requested, the WG stock coordinators have filled a table indicating whether or not InterCatch has been used for their stocks and, in the cases where it has not been used, the reasons for not using it. This table has been forwarded to Henrik Kjems-Nielsen at the end of the meeting, as requested.

1.4.3 Stock annexes

This year stock annexes were prepared for most of the stocks that were lacking one. Stock annexes have now been completed for all *Nephrops* FUs and for the southern stocks of anglerfish. At present, only the southern megrims are without annexes, due to a shortage of personnel. These stock annexes will be ready for 2011.

1.4.4 Benchmarks

The WG considers it high priority that effort to improve stock assessments continues outside benchmarks. From the recent experience gained from the benchmark of the hake stocks, the WG considers that good evidence of progress on assessment improvement should be presented at the WG before a stock goes through a benchmark. This refers both to potential data issues and to alternative methodologies that may need to be applied. The proposed way of proceeding is that stock coordinators coordinate the presentation of Working Documents to WGHMM showing appropriate progress in advance of a potential benchmark.

The originally scheduled benchmark for the northern megrim stock for the beginning of 2011 now appears not to be feasible, given the lack of progress obtaining the required data and the low possibilities of obtaining them in the short time. Methods to deal with the missing discards data will probably be required and more time is necessary to develop them. Details are provided in Annex N (“Planning of Benchmarks”). The WG considers that it is more realistic to wait until the 2011 WGHMM meeting to evaluate whether enough progress has been made in relation to data and models development. If enough progress is made, the benchmark could then be scheduled for the beginning of 2012.

1.4.5 Section with surveys description has been included

As indicated in the 2009 WG report, a new section has been included this year providing a brief summary description of all surveys used by the WG, together with acronyms to be used consistently throughout the report and stock annexes. This is Section 2.2 of this report.

Table 1.3 **Biological sampling levels by stock and country. Number of fish measured and aged from landings in 2009**

		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								10641
	No. ages								407
	No. samples**								8
E & W (UK)	No. lengths	8350		1098		8340			
	No. ages	202		0		1194			
	No. samples*	81		58		56			
France	No. lengths								28718
	No. ages								1456
	No. samples*								270
Portugal	No. lengths		411		321		0	5539	
	No. ages***		0		0		0	0	
	No. samples*		116		89		0	111	
Republic of Ireland	No. lengths	3601		4801		4708			
	No. ages	292		471		1432			
	No. samples**	101		119		125			
Spain	No. lengths	13869	5294	10150	2528	2904	1239	14947	
	No. ages	0	0	0	0	505	642	753	
	No. samples	142	194	137	194	15	108	138	
Total	**No. lengths**	**25820**	**5705**	**16049**	**2849**	**15952**	**1239**	**20486**	**39359**
	No. ages	**494**	**0**	**471**	**0**	**3131**	**642**	**753**	**1863**
Total No. in international landings (thousands)		**NA**	**493**	**NA**	**292**	**NA**	**515**	**10210**	**12662**
No. Measured as % of annual number caught		**0.3**	**1.2**	**0.2**	**1.0**	**NA**	**0.2**	**0.2**	**0.3**

* 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	11553				
	No. ages	191				
	No. samples*	179				
E & W (UK)	No. lengths	8377				
	No. ages	436				
	No. samples*	70				
France	No. lengths	16739		31607		
	No. Ages*****	2571				
	No. samples***	259		461		
Portugal	No. lengths		19059			13324
	No. ages***		2573			
	No. samples*		199			46
Republic of Ireland	No. lengths	8688				
	No. ages*****	928				
	No. samples*	158				
Spain	No. lengths	73488	50714		4867	4681
	No. ages		0			
	No. samples*	246	446		51	67
Total	**No. lengths**	**118845**	**69773**	**31607**	**4867**	**18005**
	No. ages	**4126**	**2573**	**0**	**0**	**0**
Total No. in international landings (thousands)		**NA**	**35547**	**299913**	**277**	**8121**
No. Measured as % of annual number caught		**NA**	**0.2**	**0.01**	**1.76**	**0.2**

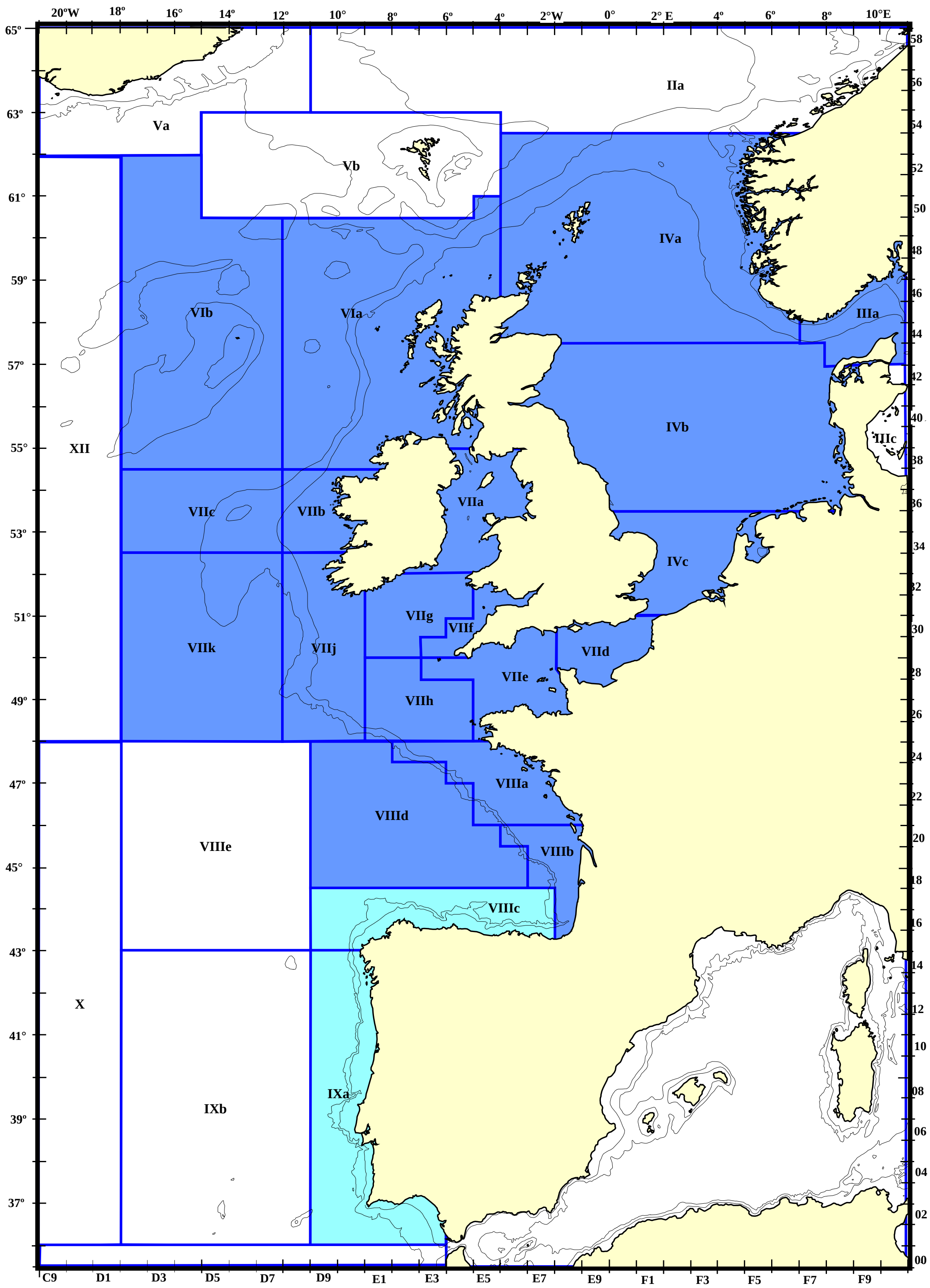


Figure 1.1. Map of ICES Divisions. Northern (IIIa, IV, VI, VII and VIIIabd) and Southern (VIIIc and IXa) Divisions with different shading.

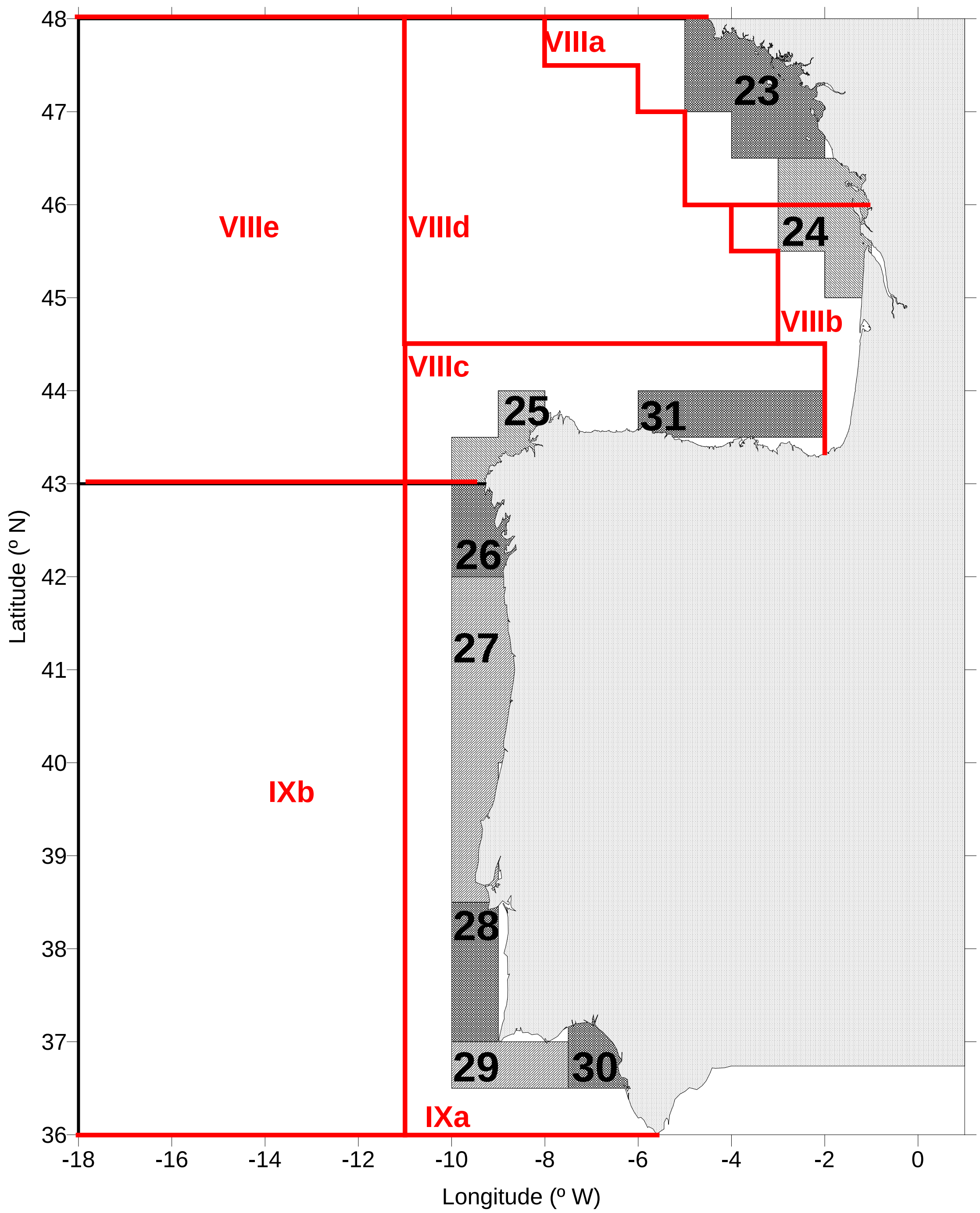


Figure 2.2. ICES Division VIII and IXa. Nephrops Functional Units

Division VIIIab (Management Area N): FUs 23-24.

Division VIIIc (Management Area O): FUs 25 and 31.

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.

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 (MS). One of the most relevant changes of this new period with respect to the last 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. This is done in the following table, which must be considered as preliminary, as it was not possible to clarify all issues relating to the activity of different countries in each métier during the WG. The table will be updated as appropriate in next year's WG. It must also be taken into account that the list of métiers considered here (corresponding to those agreed by RCM-NA in 2009) may change in relation to acronyms or regional merging in the next RCM-NA meeting, to be held in early June 2010.

FU	METIER	DESCRIPTION (mesh size in brackets)	FRANCE	IRE-LAND	SPAIN	UK
FU1	LLS_DEF_0_0_0	Set longline directed to demersal fish			X	X
FU2						
FU3	GNS_DEF_100-219_0_0	Set gillnet directed to demersal fish (100-219 mm)	X	X		
FU4	OTB_DEF_70-99_0_0	Bottom otter trawl directed to demersal fish (70-99 mm)		X	X	X
	OTB_DEF_100-119_0_0	Bottom otter trawl directed to demersal fish (100-119 mm)			X	X
FU5						
FU6						
FU8						
FU9	OTB_CRU_70-99_0_0	Bottom otter trawl directed to crustaceans (70-99 mm)	X	X		X
FU10						
FU12	LLS_DEF_0_0_0	Set longline directed to demersal fish	X		X	
FU13	GNS_DEF_45-59_0_0	Set gillnet directed to demersal fish (45-59 mm)	X			
	GNS_DEF_>=100_0_0	Set gillnet directed to demersal fish (at least 100 mm)	X		X	
FU14	OTB_MCF_>=70_0_0	Bottom otter trawl directed to mixed crustaceans and demersal fish (at least 70 mm)			X	
	OTB_DEF_>=70_0_0	Bottom otter trawl directed to demersal fish (at least 70 mm)	X		X	
	OTT_DEF_>=70_0_0	Multi-rig otter trawl directed to demersal fish (at least 70 mm)	X			
	OTB_CRU_>=70_0_0	Bottom otter trawl directed to crustaceans (at least 70 mm)	X			
	OTT_CRU_>=70_0_0	Multi-rig otter trawl directed to crustaceans (at least 70 mm)	X			
	OTB_MPD_>=70_0_0	Bottom otter trawl directed to mixed pelagic and demersal fish (at least 70 mm)			X	
	PTB_DEF_>=70_0_0	Bottom pair trawl directed to demersal fish (at least 70 mm)			X	
FU15						
FU16	OTB_DEF_100-119_0_0	Bottom otter trawl directed to demersal fish (100-119 mm)	X		X	X
	LLS_DEF_0_0_0	Set longline directed to demersal fish			X	
FU00						

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).

Last year, the WG agreed on a proposal of fleet segmentation (and acronyms) for presentation of southern stocks landings in subsequent years; however, it has not been been possible to use it this year.

The correspondence between Fishing Units and métiers DCF has been also compiled for the southern stocks fleets and is presented in the following table. As for the northern stocks, the table must be considered as preliminary and will be updated as appropriate next year.

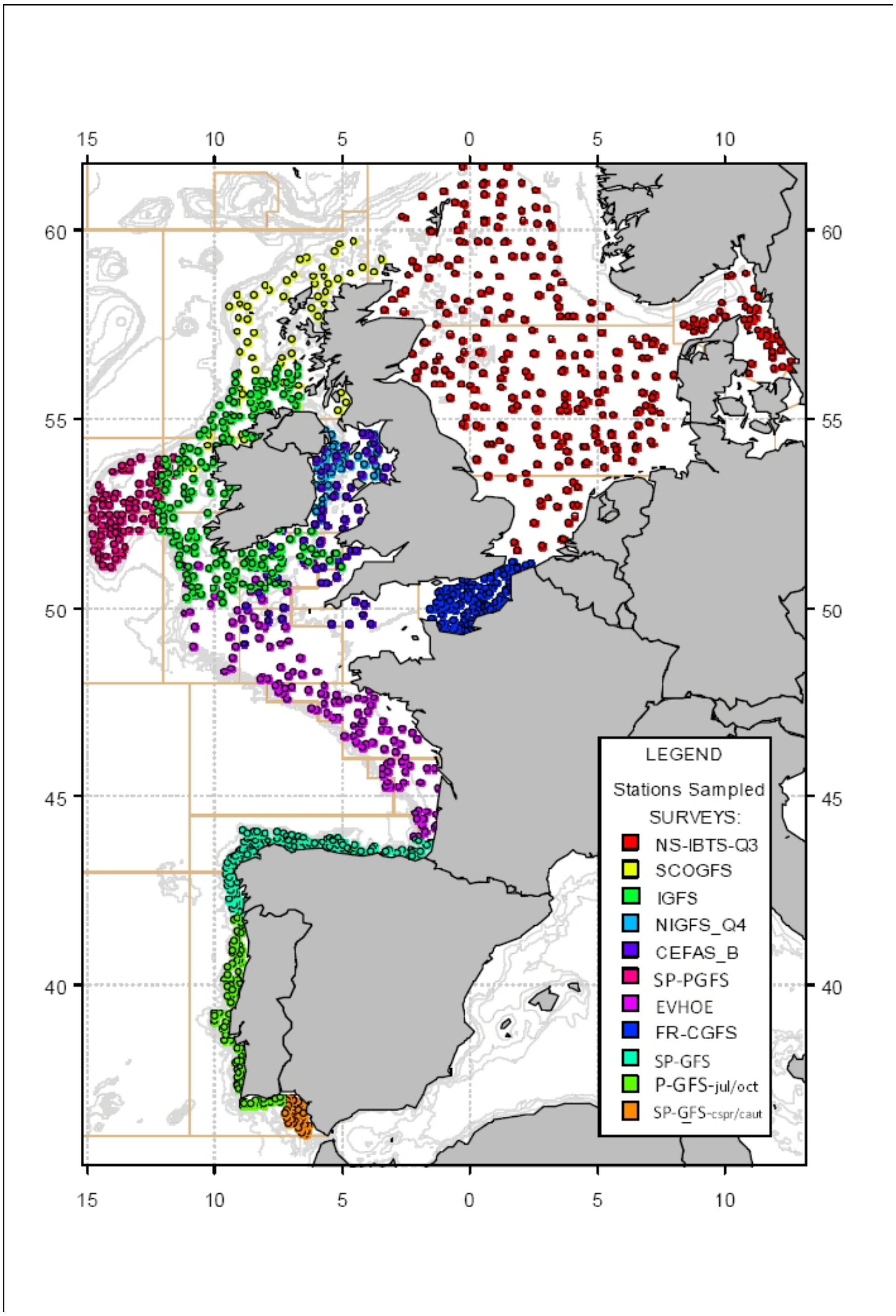
COUN-TRY	FU	METIERS	DESCRIPTION (mesh size in brackets)	SPAIN	PORTU-GAL
SPAIN	Gillnet	GNS_DEF_80-99_0_0	Set gillnet directed to demersal species (80-99 mm)	X	
		GNS_DEF_280_0_0	Set gillnet directed to demersal species (at least 280 mm)	X	
	Longline	LLS_DEF_0_0_0	Set longline directed to demersal fish	X	
	Northern Arisanal	GNS_DEF_60-79_0_0	Set gillnet directed to demersal fish (60-79 mm)	X	
	Southern artisanal	LLS_DWS_0_0_0	Set longline directed to deep-water species	X	
	Northern Trawl	PTB_DEF _> = 55_0_0	Pair bottom trawl directed to demersal fish (at least 55 mm)	X	
		OTB_DEF_>=55_0_0	Otter bottom trawl directed to demersal fish (at least 55 mm)	X	
		OTB_MPD_>=55_0_0	Otter bottom trawl directed to mixed pelagic and demersal fish (at least 55 mm)	X	
	Southern trawl	OTB_DEM_>=55_0_0	Otter bottom trawl directed to demersal species (at least 55 mm)	X	
PORTU-GAL	Artisanal	GTR_DEF_>=100_0_0	Trammel net directed to demersal fish (at least 100 mm)		X
		GNS_DEF_80-99_0_0	Set gillnet directed to demersal fish (80-99 mm)		X
		LLS_DEF_0_0_0	Set longline directed to demersal fish		X
		LLS_DWS_0_0_0	Set longline directed to deep-water species		X
	Trawl	OTB_CRU_>=55_0_0	Otter bottom trawl directed to crustaceans (at least 55 mm)		X
		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 used in the assessment of stocks by this WG. The surveys are listed in the following table.

Survey	WGHMM acronym	DCF acronym
Spanish groundfish survey – quarter 4	SP-GFS	IBTS-EA-4Q
Spanish Porcupine groundfish survey	SP-PGFS	IBTS-EA
Spanish Cadiz groundfish survey – Autumn	SP-GFS-caut	
Spanish Cadiz groundfish survey – Spring	SP-GFS-cspr	
Portuguese groundfish survey – October	P-GFS-oct	IBTS-EA-4Q
Portuguese groundfish survey – July	P-GFS-jul	
Portuguese crustacean trawl survey / Nephrops TV survey offshore Portugal	P-CTS	UWFT (FU 28-29)
Portuguese winter groundfish survey/Western IBTS 1st quarter	PESCADA-BD	
French EVHOE groundfish survey	EVHOE	IBTS-EA-4Q
French RESSGASC groundfish survey (ended in 2002)	RESSGASC	
French Bay of Biscay sole beam trawl survey	ORHAGO	
French Nephrops survey in Bay of Biscay	LANGOLF	
UK west coast groundfish survey (ended in 2004)	UK-WCGFS	
English fisheries science partnership survey	EW-FSP	
Irish groundfish survey	IGFS	IBTS-EA-4Q

The following figure, from the ICES IBTSWG 2009 report, shows the station positions for the IBTS surveys carried out in the Western and North Sea Area in autumn/winter of 2008. Many of the surveys used by WGHMM can be identified in the figure.



A brief description of each survey now follows.

2.2.1 Spanish groundfish survey (SP-GFS)

The SP-GFS 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 (SP-PGFS)

The SP-PGFS 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 (SP-GFS-cspr) and Autumn (SP-GFS-caut)

The bottom trawl surveys SP-GFS-cspr and SP-GFS-caut 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 surveys - July (P-GFS-jul) and October (P-GFS-oct)

P-GFS-oct and P-GFS-jul extend from latitude 41°20' N to 36°30' N (ICES Div. IXa) and from 20 to 500m depth. The surveys take place in Autumn and Summer, respectively. The main objectives of the surveys are 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*. The main objective of the October survey is to monitor the abundance and distribution of hake and horse mackerel recruitment. The surveys aim to carry out ca. 90 stations per year.

2.2.5 Portuguese crustacean trawl survey / Nephrops TV survey offshore Portugal (P-CTS)

The P-CTS 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, the crustacean trawl survey conducted in Functional Units 28 and 29, was combined with an experimental video sampling.

2.2.6 Portuguese winter groundfish survey/Western IBTS 1st quarter (PESCADA-BD)

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

2.2.7 French EVHOE groundfish survey

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

2.2.8 French RESSGASC groundfish survey (RESSGASC)

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

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

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

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

This survey commenced in 2006 specifically for providing abundance indices of *Nephrops* in the Bay of Biscay. It is carried out on the area of the Central Mud Bank of the Bay of Biscay (ca.11680 km^2), in the second quarter, using twin trawl, with hours of trawling around dawn and dusk.

2.2.11 UK west coast groundfish survey (UK-WCGFS)

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

2.2.12 English fisheries science partnership survey (EW-FSP)

The western anglerfish survey, part of the English fisheries science partnership programme, has been carried out every year since 2003 with 184 valid hauls in 2009. 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 sub divisions VIIe-h.

2.2.13 Irish groundfish survey (IGFS)

The IGFS 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.

Data revisions: no data revision.

Review Group issues: This year, the assessment model has changed and almost all issues raised by the review group are not valid anymore. All other issues (Comment on discard in table 3.1, comment on discard sampling program in the Stock Annex) have been addressed in the current version of the report

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 2010 and management for 2009 and 2010

ICES advice for 2010

Applying a fishing mortality of F = 0.25 as indicated in Article 5.2 of the agreed recovery plan is expected to lead to an SSB 171,200 t in 2011 (the highest SSB since 1989), with estimated landings in 2010 of 55 200 t. This implies an increase in TAC of 7%. ICES also indicates that the fishing mortality in 2008, estimated at 0.24, is above fishing mortalities that are expected to lead to high long-term yields and low risk of stock depletion (F0.1 = 0.10 and Fmax = 0.18). This indicates that long-term yield is expected to increase at fishing mortalities well below the historic values. Fishing at such a lower mortality is expected to lead to higher SSB and therefore lower the risk of observing the stock to be outside precautionary limits.

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)	2004	2005	2006	2007	2008	2009	2010
IIIa, IIIb,c,d (EC Zone)	1178	1284	1323	1588	1627	1552	1661
IIa (EC Zone), IV	1373	1496	1541	1850	1896	1808	1935
Vb (EC Zone), VI, VII, XII, XIV	21926	23888	24617	29541	30281	28879	30900
VIIIa,b,d,e	14623	15932	16412	19701	20196	19261	20609
Total Northern Stock [IIa-VIIIabd]	39100	42600	43893	52680	54000	51500	55105

Management for 2009 and 2010

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, the northern hake SSB for 2009 is estimated to be above the recovery plan target (140 000 t). Article 3 of the recovery plan prescribes that a management plan should be implemented when the target is reached in two consecutive years and ICES considers that SSB has been approximately 140 000 t in the last two years. Such a plan is under development by the EC.

3.2 Data

3.2.1 Commercial catches and discards

Total landings from the Northern stock of hake by area for the period 1961-2009 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.

The 2009 landing data provided by France is of poor quality and the Working Group considered that it could not be used in this assessment.

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 and with the exception of 2006, landings have been increasing up to 47 822 t in 2008. 2009 preliminary data seem to confirm this tendency: although still incomplete, landings from all countries (excluding France, which is as yet unknown) have increased between 2008 and 2009 (22% increase for Spain, which is the main contributor to the landings, 27% for all countries).

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 2009.

3.2.2 Biological sampling

The sampling level is given in Table 1.3.

Length compositions of the 2009 landings by Fishery Unit and quarter were provided by Ireland, Spain, Scotland, UK(E&W) and Denmark (annual).

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 survey conducted in the Bay of Biscay and in Celtic Sea with a new design since 1997, the SP-PGFS survey conducted on the Porcupine Bank since 2001, and the Irish Groundfish Survey (IGFS) 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 3.1 presents 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.

After two consecutive years of increases in 2001 and 2002, the abundance index provided by EVHOE 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 to a level close to the 2005 and 2006 levels.

The abundance index provided by IGFS follows a similar trend to EVHOE in recent years with a sharp decrease from 2008 to 2009.

For the SP-PGFS survey conducted on Porcupine's Bank since 2001, the abundance index follows an increasing trend since 2003, reaching its highest value in 2009.

The spatial distribution of the EVHOE index for hakes from 0 to 20cm is given in Figure 3.2. In 1999, the Erika shipwreck limited the spatial coverage of this survey in the Bay of Biscay. 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.

Effort and LPUE data for the period 1982-2009 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 2009. 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. In 2005, both fleets have 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, the longliners from A Coruña, Celeiro and Burela in VII, the longliners from Avilés in VIIIa,b,d 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.

LPUE values of Spanish gill-netters that started to fish hake in Subareas VII and VIII in 1998 present in general an increasing trend in both sea areas until 2002. 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 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 French landings for 2009, the Working Group decided not to update the assessment.

The last assessment available was conducted during the Benchmark workshop WKROUND (ICES, 2010) and is used as a basis for current stock assessment and projections.

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

Fits to the surveys abundance indices are presented in Figure 3.4 (note that the horizontal axes in the figures take into account the time of the year when the surveys are conducted: *e.g.* a survey happening in quarter 4 is displayed very close to the following year on the horizontal axis of the figure. This can be confusing and shall be rectified in next year's report). The upward trend in relative abundance observed in all three contemporary trawl surveys (EVHOE, SP-PGFS and IGFS) has been captured by the model. Residuals of their length frequency distributions show a "fairly random" behavior with no particular trend or lack of fit (Figure 3.5, where open and close circles denote positive and negative residuals, respectively). Residuals of the length frequency distributions of commercial fleets (not presented in this report) show some patterns, as mentioned in the benchmark report (ICES, 2010a).

The assessment model includes estimation of size-based selectivity functions which partition the total catch into discarded and retained portions. Figure 3.6 presents selectivity (for the total catch) and retention functions by fleet estimated by the model.

Sensitivity of model results to exclusion of recent data is expected because of the relatively short survey tuning index time-series, the recent increases in the survey indices and the small number of ages in the stock. The patterns demonstrated in Figure 3.7 indicate that current estimates have some uncertainty and a tendency to underestimate SSB and over-estimate F in the most recent years.

F2008 (average of F-at-length over lengths 15-80 cm) was estimated at 0.45 and SSB at 64 947 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, some increase in recruitment is observed with 2008 recruitment estimated to be among the highest of the series (441 million).

The level of spawning-stock biomass averaged 37 000 t during 1990–2006, then increased to near 65 000 t in 2008 in line with the good incoming recruitments of recent years.

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 averaged near 1.0 during the 1990s and declined sharply to 0.45 in 2008.

Because spawning biomass during 1990–2008 varied over a narrow and low range, it is not feasible to observe a relationship between recruitment and spawning biomass.

3.4 Catch options and prognosis

3.4.1 Short – Term projection

Because of:

a) the important uncertainties associated with this assessment and, in particular, with the strength of recent trends (rates of SSB increase and F decrease in the final assessment years)

b) the clearly unrealistic rate of SSB increase obtained from the short term projections under status-quo F conducted by WKROUND (ICES, 2010a). See Figure 3.8.

The Working Group decided not to conduct short term projections.

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 based are presented in Table 3.6 and Figure 3.9. The F-multiplier in Table 3.6 is with respect to the average F in the final 3 assessment years (2006-2008).

3.5 Biological reference points

This assessment represents a complete restart 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.

The timeseries of spawning biomass and recruitment does not have sufficient contrast to allow direct estimation of Fmsy. Reference points of F0.1, F35%, F30% and Fmax were calculated within the SS3 assessment model to provide a range of potential proxies for Fmsy. Fx% is the fishing rate that would reduce spawning biomass per recruit to x% of its unfished level.

Fmax (=0.29) would be a potential candidate for Fmsy, as the yield-per-recruit curve has a well-defined maximum and discards are incorporated in the assessment and taken into account in the yield-per-recruit computation. Moreover, SSB during the historic period has been capable of increasing under high fishing pressure, suggesting a productive stock. However, an F value of 0.29 corresponds approximately to F24%, whereas the guidelines provided by WKFRAME (ICES, 2010b) suggest that F values larger than F30% might lead to recruitment overfishing. WKFRAME further indicated that values around F35% should be robust Fmsy proxies against stock-recruitment functions and recruitment variability. Taking all this into account and the specific aspects of the northern hake stock, this Working Group has suggested that a fishing mortality in the range F35% - Fmax (i.e. 0.20 – 0.29) should be selected as Fmsy. If a single value is to be chosen within that range, F30%=0.24 could be a suitable candidate.

	Type	Value	Technical basis
MSY Approach	MSY $B_{trigger}$	Not defined	
	F_{MSY}	0.20-0.29 or 0.24	Between F35% and Fmax or F30%
Precautionary Approach	B_{lim}	Not defined	
	B_{pa}	Not defined	
	F_{lim}	Not defined	
	F_{pa}	Not defined	

3.6 Comments on the assessment

The northern hake assessment has been completely revised during the WKROUND benchmark workshop (ICES, 2010a). The new assessment has shifted to a length-based approach using the Stock Synthesis assessment model. This approach allows direct use of the quarterly length–composition data and explicit modeling of a retention process that partitions total catch into discarded and retained portions. No age data are used in the new assessment.

Due to the poor quality of the French data for 2009 (landings and discards in weight), no update assessment was carried out by this WG, which is therefore using the assessment conducted at the WKROUND benchmark workshop.

The assessment is found to be limited in its ability to precisely estimate current stock abundance and mortality because the modeled time period, 1990–2008, does not exhibit strong contrasts in the available data. Furthermore, over that period, little information is available on large fish as a very small proportion of fish larger than 60 cm is observed in the data since 1990 (landings and surveys). All this leads to large uncertainties associated with the main population parameters (SSB, F and recruitment), particularly in the most recent years, which propagate into the short-term forecast as shown in the stock trends presented during WKROUND (see also Figure 3.8).

The recent increasing trends in recruitment and SSB and the decreasing trend in F estimated by SS3 are considered to be representative of recent development of the stock in overall terms. These trends are consistent with increasing landings (Table 3.1) and increasing LPUEs and decreasing effort of some of the main fleets catching hake (Table 3.3). The Working Group considered, however, that the rate of increase and decrease of those trends remains uncertain.

As a consequence, the Working Group accepted the assessment as only indicative of trends (with the concern stated above that the uncertain rates of increase and decrease) and decided not to carry out short term projection.

Future work should attempt to extend the modeled time period back to about 1960 to improve the model's ability to determine the degree to which historical levels of fishing reduced hake abundance. The downward trend during the 1980s in the catch of larger hake should provide information regarding the level of fishing mortality that caused this decline. Incorporating tuning information about large fish would help stabilize the SSB estimates.

3.7 Management considerations

The change of assessment model has modified the historical perspective of the stock. The modeled time-period now starts in 1990, at the end of the sharp decrease in SSB estimated in previous assessments.

As in previous years, there are strong indications of an increase in SSB and decrease in fishing mortality, although the rates of increase and decrease are uncertain.

Table 3.1. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**
Estimates of catches ('000 t) by area for 1961-2009.

						Discards (2)	Catches (3)
Year	IVa+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	-3.3	49.5	2.4	51.9
1979	8.7	17.6	27.2	-2.4	51.1	2.7	53.8
1980	9.7	22.0	28.4	-3.6	56.5	3.2	59.7
1981	8.8	25.6	22.3	-2.8	53.9	2.3	56.3
1982	5.9	25.2	26.2	-2.3	55.0	3.1	58.1
1983	6.2	26.3	27.1	-2.1	57.5	2.6	60.1
1984	9.5	33.0	22.9	-2.1	63.3	1.9	65.1
1985	9.2	27.5	21.0	-1.6	56.1	3.8	59.9
1986	7.3	27.4	23.9	-1.5	57.1	3.0	60.1
1987	7.8	32.9	24.7	-2.0	63.4	2.0	65.3
1988	8.8	30.9	26.6	-1.5	64.8	2.0	66.8
1989	7.4	26.9	32.0	0.2	66.5	2.3	68.8
1990	6.7	23.0	34.4	0.2	64.3	1.5	65.8
1991	8.3	21.5	31.6	-9.1	52.4	1.7	54.1
1992	8.6	22.5	23.5	2.1	56.6	1.7	58.3
1993	8.5	20.5	19.8	3.3	52.1	1.5	53.6
1994	5.4	21.1	24.7	0	51.3	1.9	53.1
1995	5.3	24.1	28.1	0	57.6	1.2	58.9
1996	4.4	24.7	18.0	0	47.2	1.5	48.8
1997	3.3	18.9	20.3	0	42.6	1.8	44.4
1998	3.2	18.7	13.1	0	35.0	0.8	35.8
1999	4.3	24.0	11.6	0	39.8	0.8	40.6
2000	4.0	26.0	12.0	0	42.0	0.6	42.6
2001	4.4	23.1	9.2	0	36.7	0.5	37.2
2002	2.9	21.2	15.9	0	40.1	0.3	40.4
2003*	3.3	25.4	14.4	0	43.2	-	43.2
2004*	4.4	27.5	14.5	0	46.4	-	46.4
2005*	5.5	26.6	14.5	0	46.6	-	46.6
2006*	6.1	24.7	10.6	0	41.5	-	41.5
2007*	7.0	27.5	10.6	0	45.1	-	45.1
2008*	10.7	22.8	14.3	0	47.8	-	47.8
2009*(4)	10.6	20.6	11.6	0	42.8	-	42.8

(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. Includes Divisions IIIa, IVb,c from 1976.
There are some unallocated landings (moreover for the period 1961-1970).
(2) Discards have been estimated from 1978 and only for Divisions VIIIa,b.
(3) From 1978 total catches used for the Working Group.
(4) Without French data
(*) inadequate discards estimates

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

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 2009

Country								
Unit	Quarter	France	Ireland	Spain	UK(E+W)	Scotland	Denmark	Others
1	1			L+LFD				
	2			L+LFD				
	3			L+LFD				
	4			L+LFD				
2	1	Not Used			L			
	2	Not Used			L			
	3	Not Used			L			
	4	Not Used			L			
3	1	Not Used	L	L+LFD	L+LFD			
	2	Not Used	L	L+LFD	L+LFD			
	3	Not Used	L	L+LFD	L+LFD			
	4	Not Used	L	L+LFD	L+LFD			
4	1	Not Used		L+LFD	L+LFD			
	2	Not Used		L+LFD	L+LFD			
	3	Not Used		L+LFD	L+LFD			
	4	Not Used		L+LFD	L+LFD			
5	1	Not Used	L		L+LFD			
	2	Not Used	L		L+LFD			
	3	Not Used	L		L+LFD			
	4	Not Used	L		L+LFD			
6	1		L		L+LFD			
	2		L		L+LFD			
	3		L		L+LFD			
	4		L		L+LFD			
8	1	Not Used	L					
	2	Not Used	L					
	3	Not Used	L					
	4	Not Used	L					
9	1	Not Used						
	2	Not Used						
	3	Not Used						
	4	Not Used						
10	1	Not Used						
	2	Not Used						
	3	Not Used						
	4	Not Used						
12	1	Not Used		L+LFD				
	2	Not Used		L+LFD				
	3	Not Used		L+LFD				
	4	Not Used		L+LFD				
13	1	Not Used		L+LFD				
	2	Not Used		L+LFD				
	3	Not Used		L+LFD				
	4	Not Used		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	Not Used	L	L+LFD	L	L+LFD	L+LFD	L
	2	Not Used	L	L+LFD	L	L+LFD	L+LFD	L
	3	Not Used	L	L+LFD	L	L+LFD	L+LFD	L
	4	Not Used	L	L+LFD	L	L+LFD	L+LFD	L
00	1	Not Used						
	2	Not Used						
	3	Not Used						
	4	Not Used						

**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

* Before 1988 landings and effort refer to Vigo trawl fleet only, from 1988 to 2002 to combined Vigo+Marín trawl fleet
** Effort in days/100HP; LPUE in kg/(day/100HP)

Sub-area VIII

	Ondarroa pair trawl in 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	10611			

* 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			

* 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

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

* 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 catches and SS3 results

Year	Recruit Age 0	Total Biomass	Total SSB	Landings	Yield/SSB	F (15-80 cm)
1990	459198	72233	43779	64287	1.47	1.06
1991	253796	65002	38873	52375	1.35	0.89
1992	272843	68137	41172	56617	1.38	0.95
1993	491977	60322	39870	52144	1.31	1.01
1994	278821	54230	31220	51259	1.64	1.01
1995	141831	60746	31080	57621	1.85	1.06
1996	350960	55832	35998	47210	1.31	0.93
1997	241938	47651	31064	42465	1.37	1.02
1998	405834	45264	25016	35060	1.4	0.93
1999	201058	50060	28690	39814	1.39	0.92
2000	181368	56289	32168	42026	1.31	0.85
2001	339635	56461	38358	36675	0.96	0.71
2002	277032	59350	39416	40107	1.02	0.77
2003	155990	64850	39689	43162	1.09	0.76
2004	369014	68164	45553	46417	1.02	0.77
2005	235442	65615	45246	46550	1.03	0.83
2006	331558	66452	39948	41467	1.04	0.67
2007	353792	78930	51639	45098	0.87	0.55
2008	441262	100088	64947	47823	0.74	0.45
Arith. Mean	304387	62930	39143	46746		
Units	Thousands	Tonnes	Tonnes	Tonnes		

Table 3.6. 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
0.733	0.1	0.06	0.129	0.127	2.297
0.55	0.2	0.11	0.202	0.199	1.724
0.421	0.3	0.17	0.241	0.237	1.321
0.329	0.4	0.22	0.261	0.255	1.032
0.262	0.5	0.28	0.269	0.262	0.821
0.212	0.6	0.33	0.269	0.261	0.663
0.173	0.7	0.39	0.265	0.256	0.544
0.144	0.8	0.44	0.259	0.249	0.451
0.121	0.9	0.5	0.251	0.24	0.379
0.103	1	0.56	0.243	0.23	0.322
0.088	1.1	0.61	0.234	0.221	0.276
0.076	1.2	0.67	0.225	0.211	0.238
0.066	1.3	0.72	0.217	0.202	0.207
0.058	1.4	0.78	0.208	0.193	0.182
0.051	1.5	0.83	0.2	0.184	0.16
0.045	1.6	0.89	0.193	0.176	0.141
0.04	1.7	0.94	0.185	0.168	0.126
0.036	1.8	1	0.179	0.16	0.113
0.032	1.9	1.06	0.172	0.153	0.101
0.029	2	1.11	0.166	0.146	0.091

	SPR level	Fmult	F(15-80 cm)
Fmax	0.24	0.53	0.29
F0.1	0.36	0.36	0.2
F35%	0.35	0.37	0.21

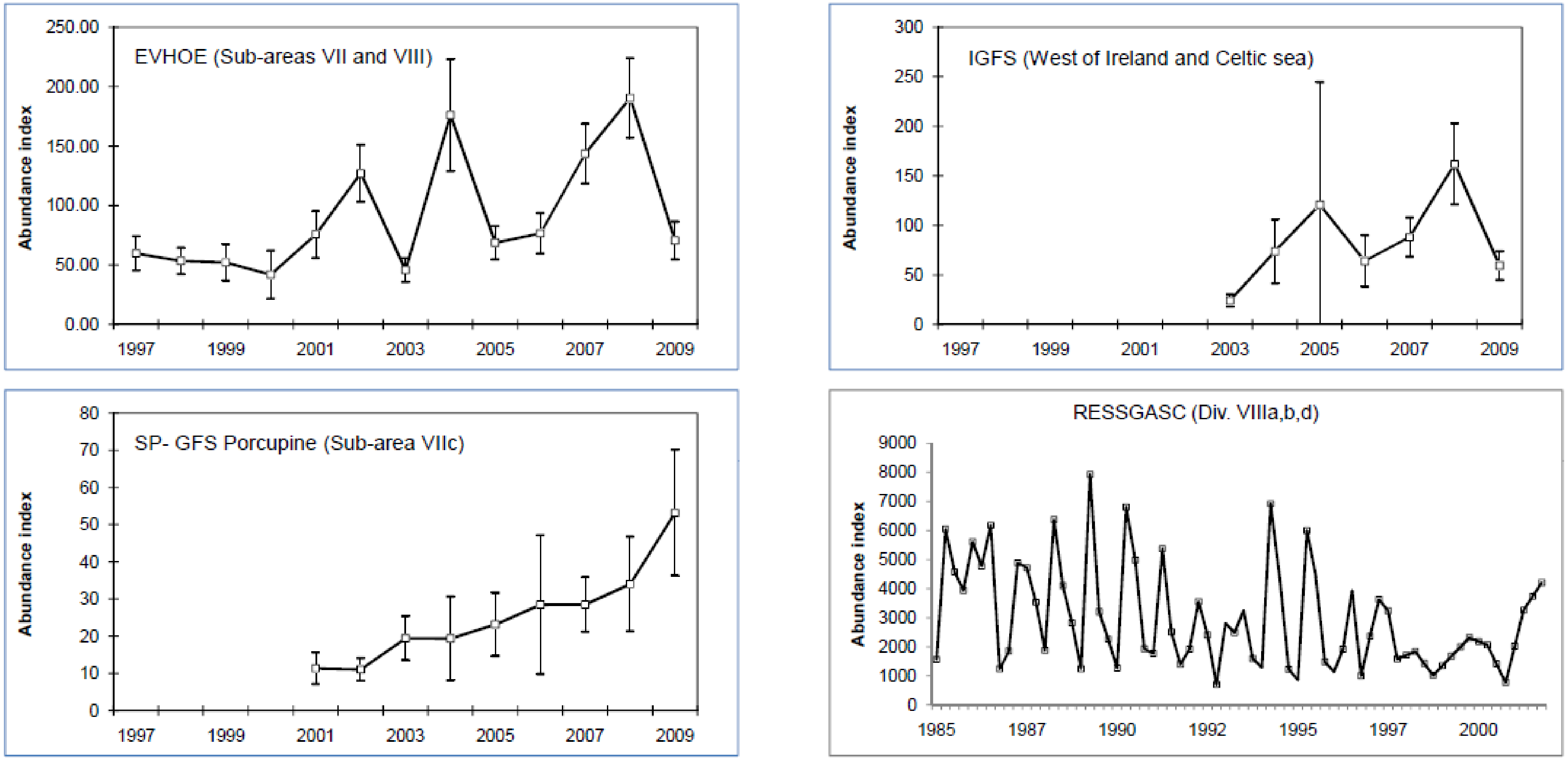


Figure 3.1 Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Abundance indices from surveys

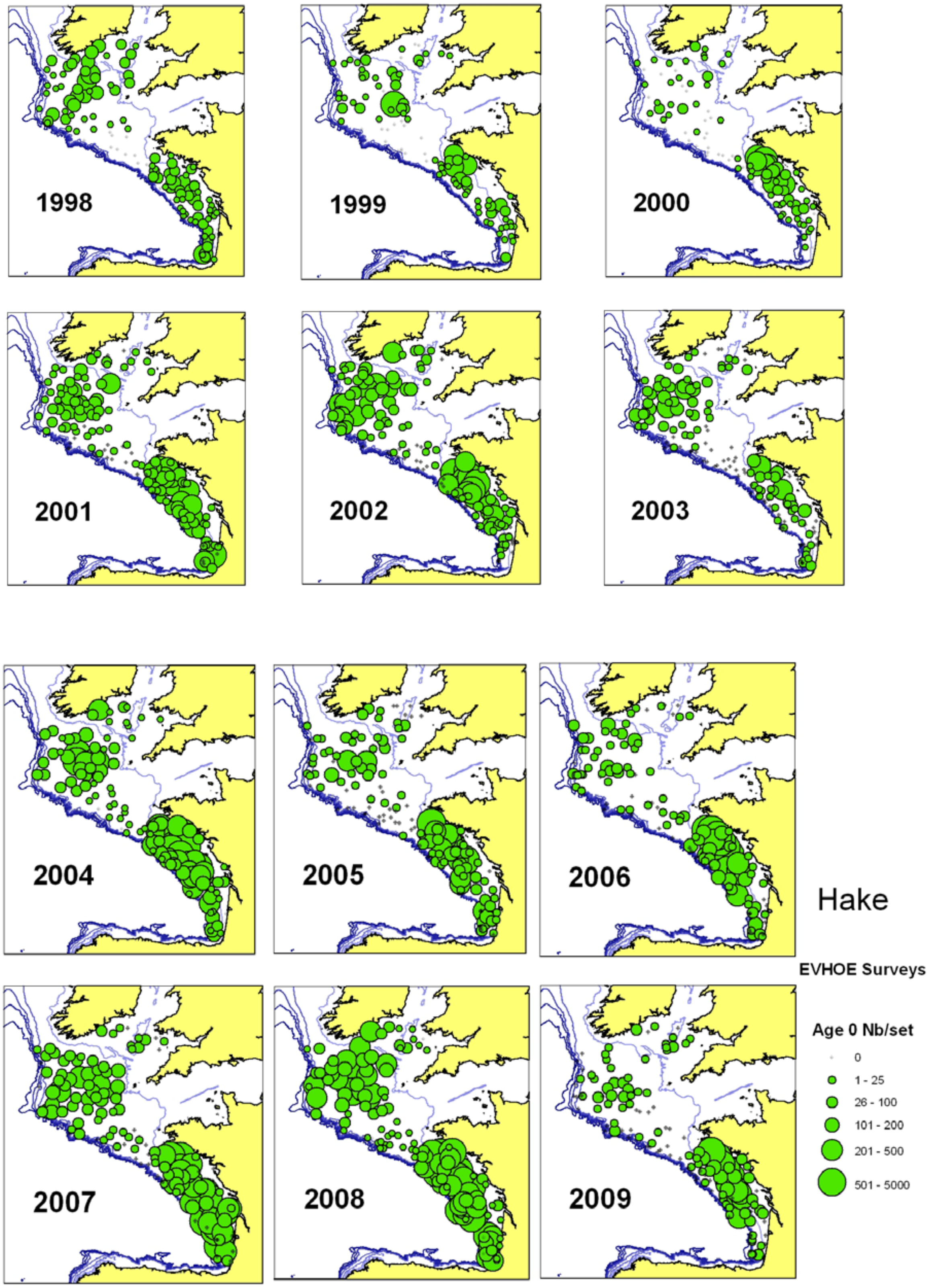


Figure 3.2 . Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Spatial distribution of hake (0-20cm) indices from FR-EVHOES survey from 1998 to 2009

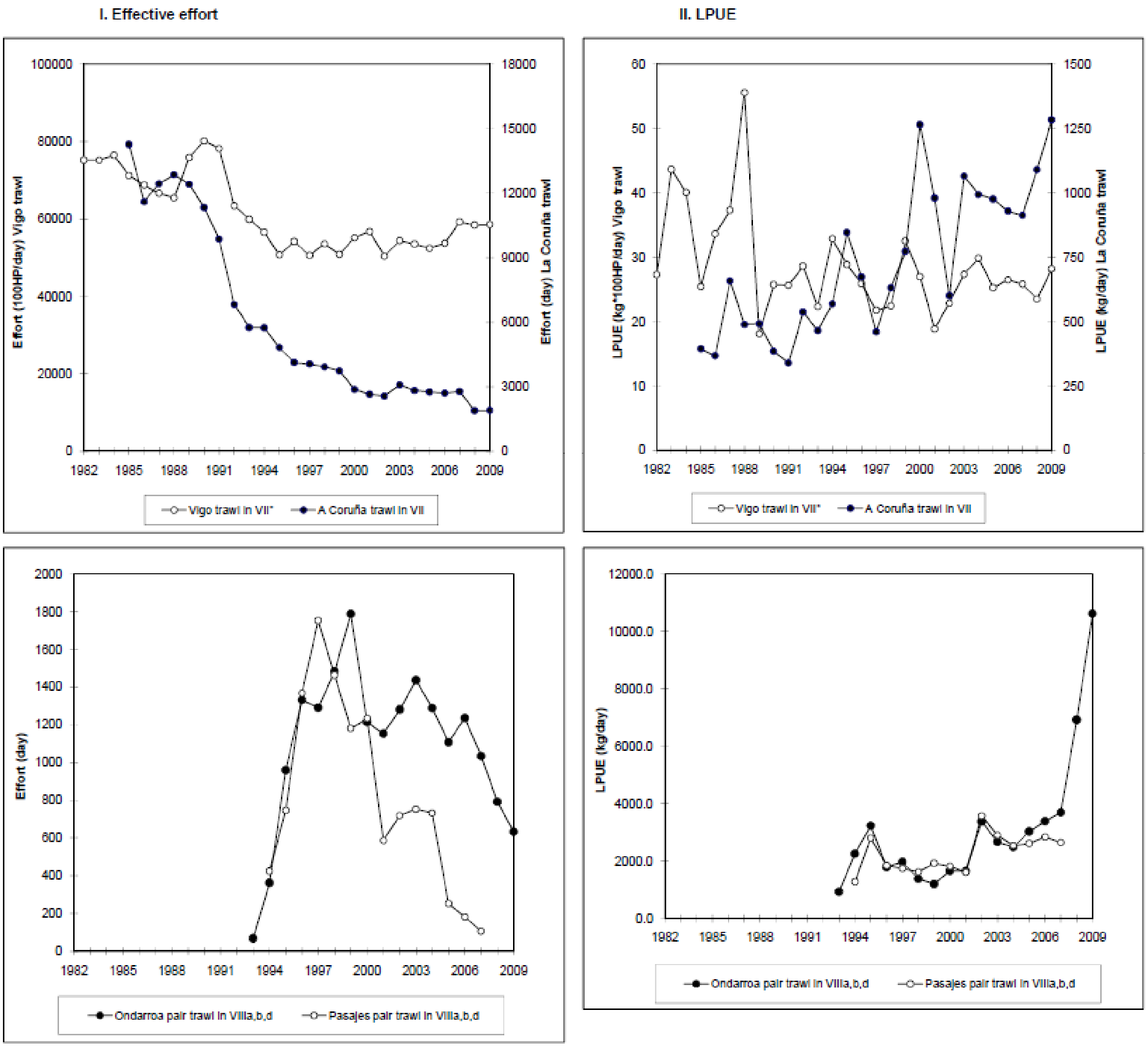


Figure 3.3a Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)

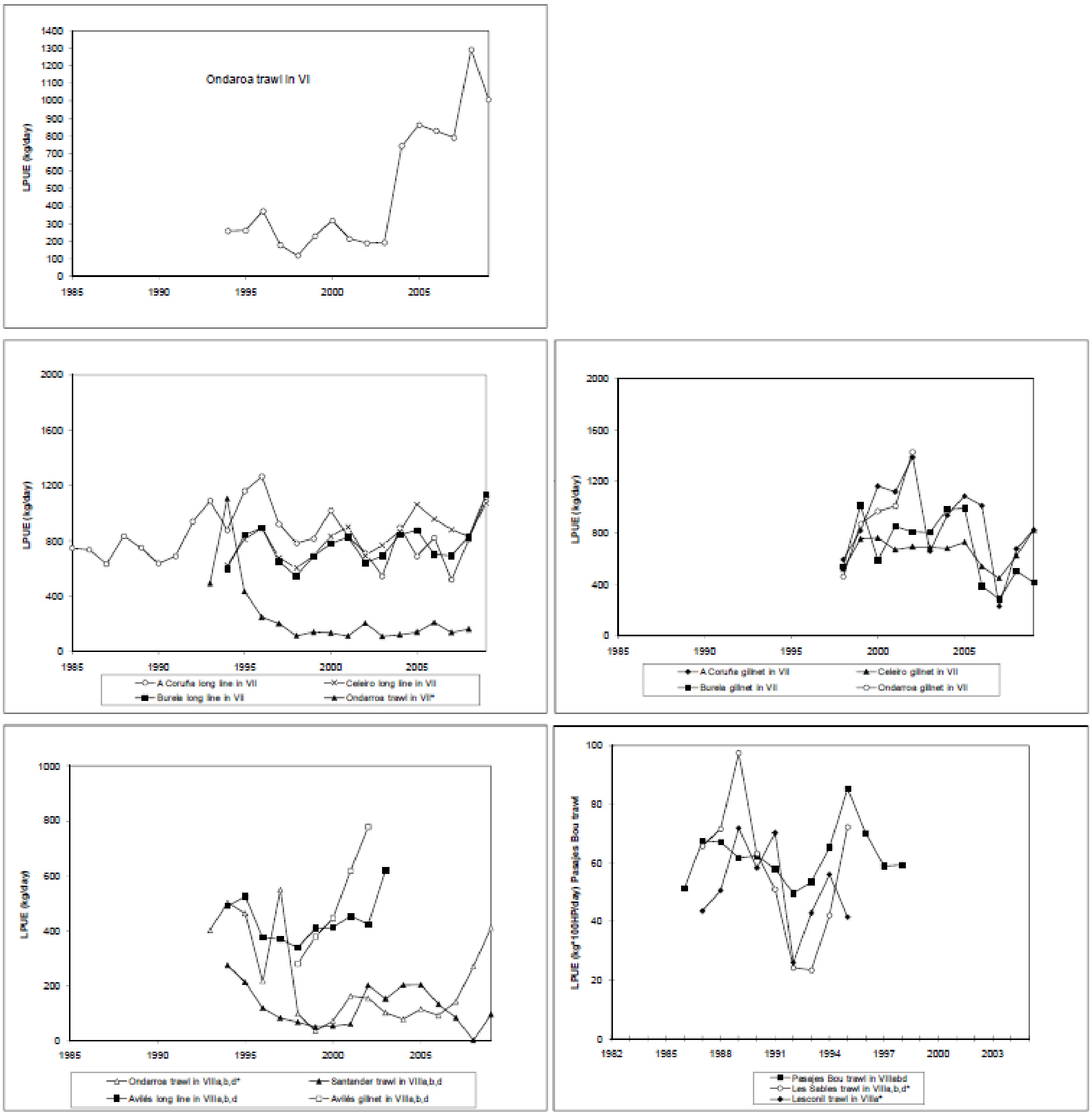


Figure 3.3b. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)

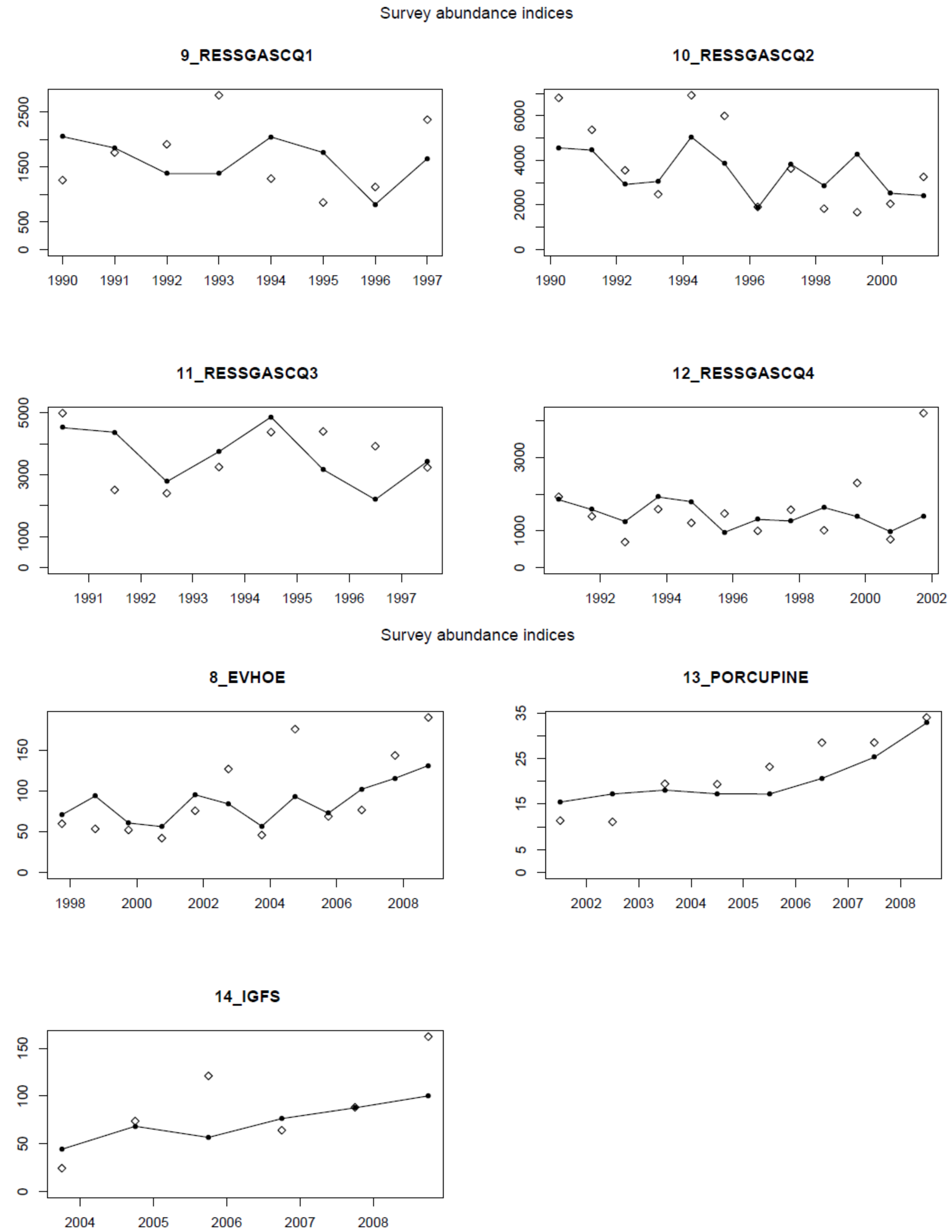
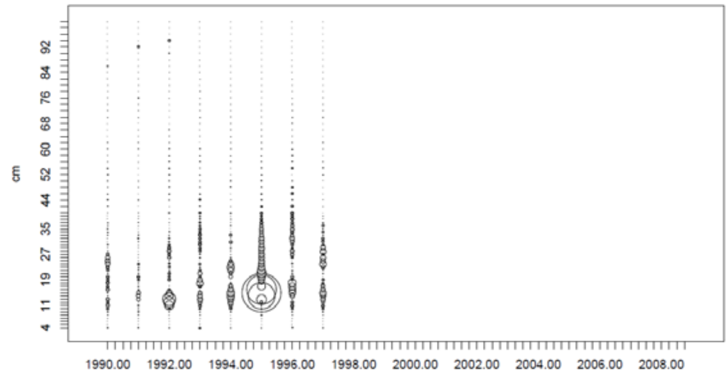
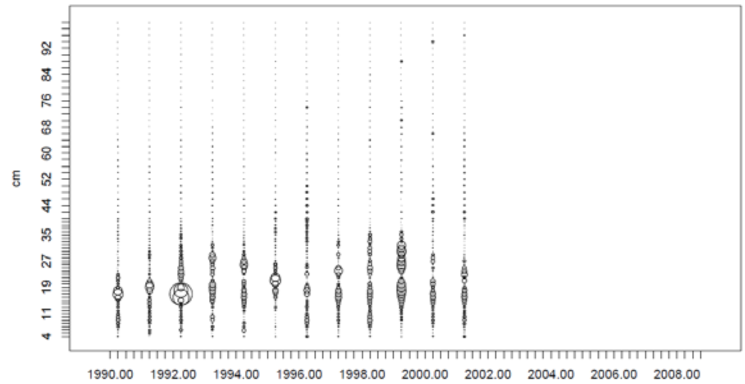


Figure 3.4 Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Fits to the surveys abundance indices, for RESSGASC, fits are by quarter.

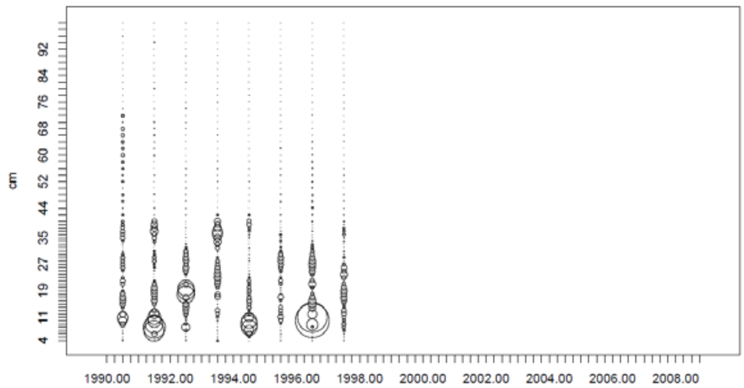
RESSGASCQ1



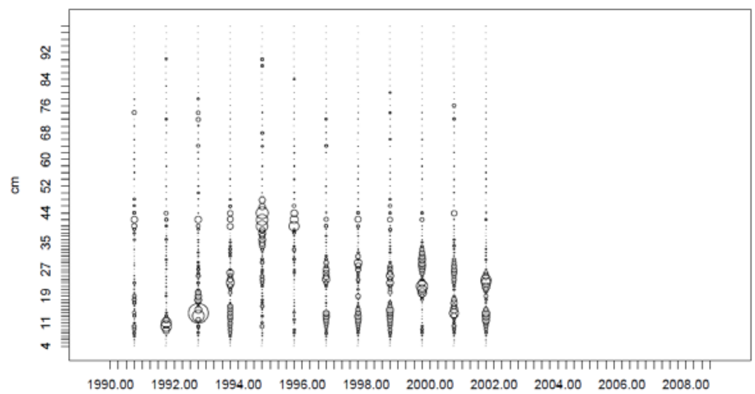
RESSGASCQ2



RESSGASCQ3



RESSGASCQ4



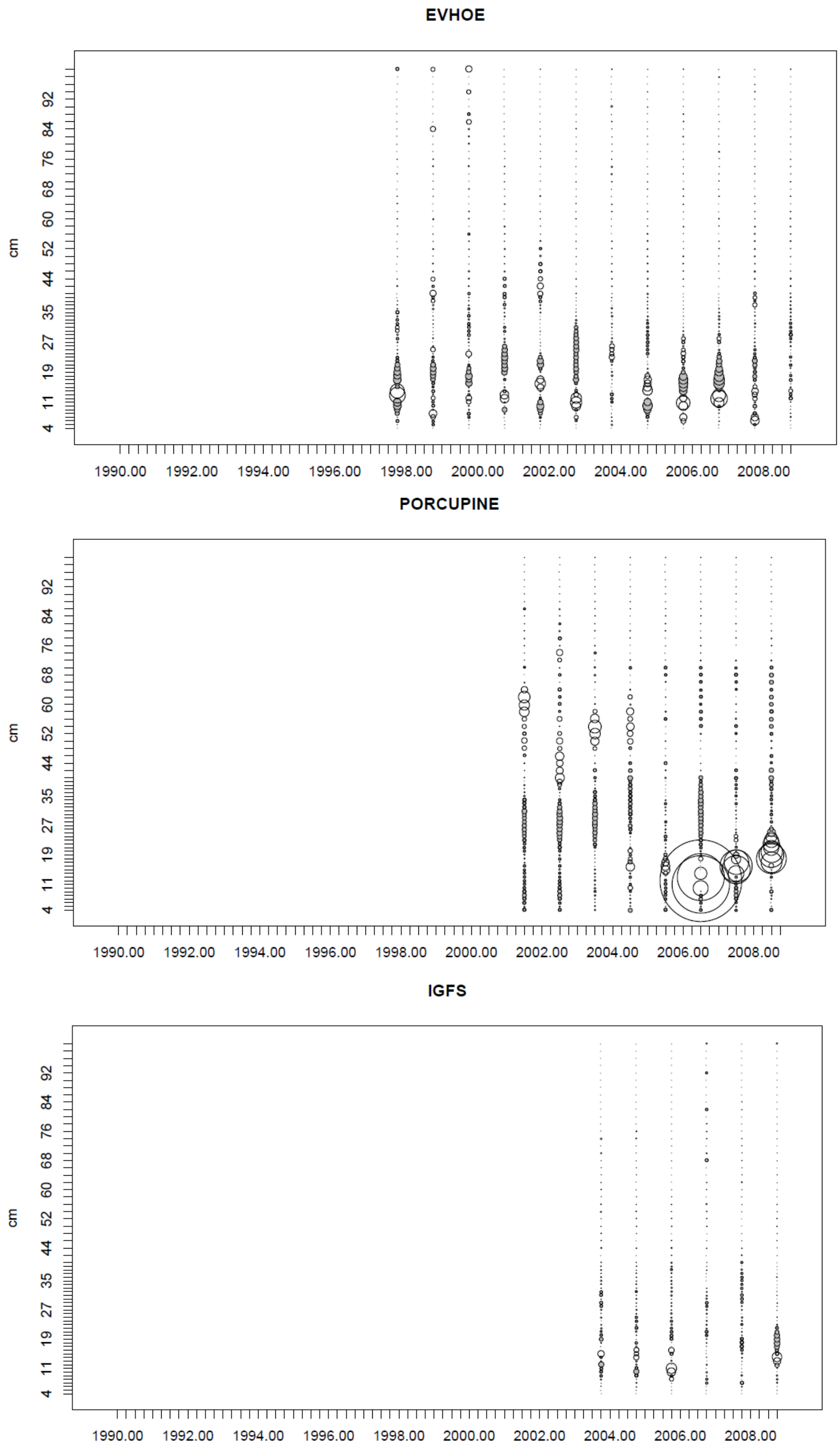


Figure 3.5. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)

Residuals plot of the fit to the length distributions of the surveys abundance indices.

For RESSGASC, fits are by quarter.

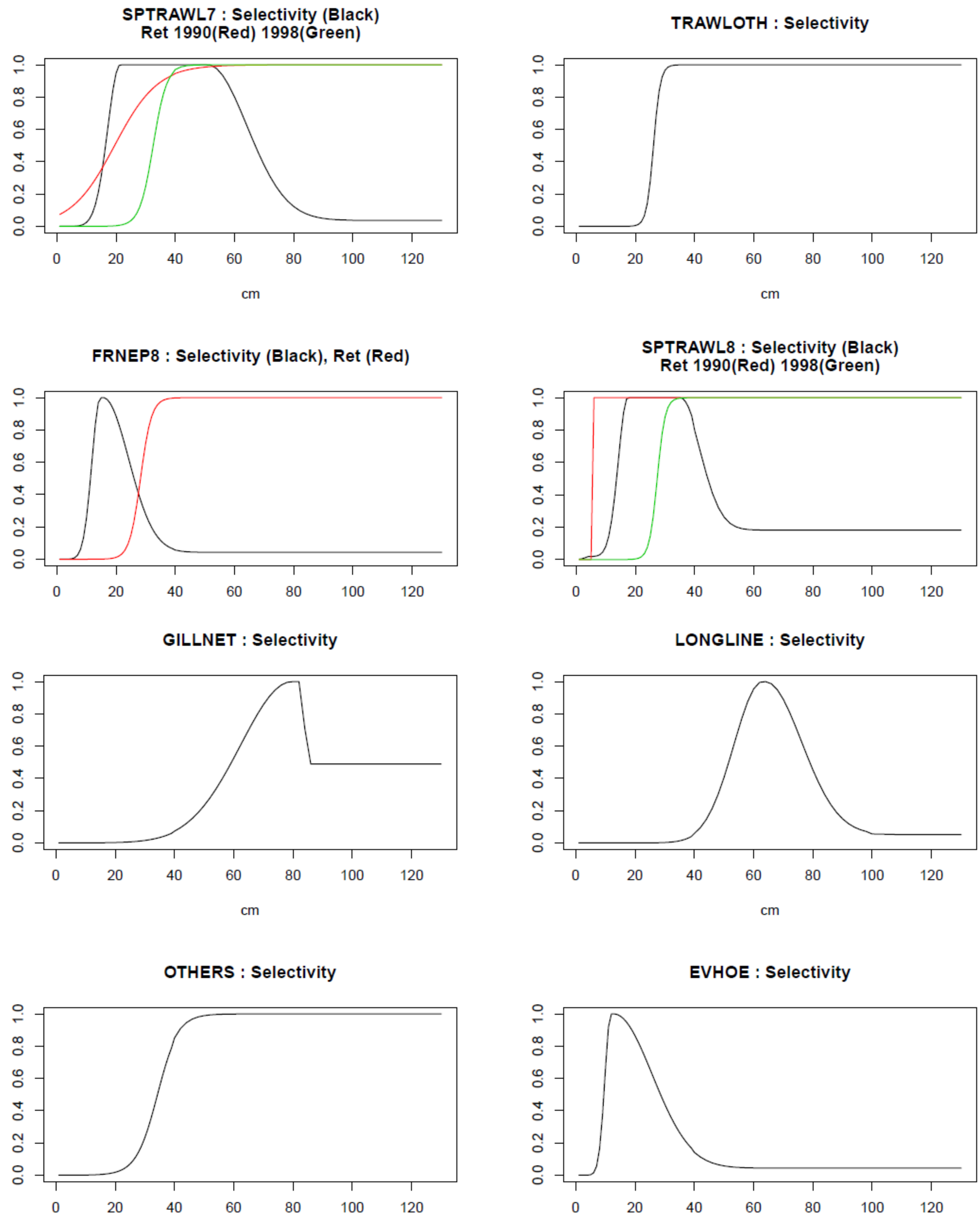


Figure 3.6. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)

Selectivity and retention functions by fleet estimated by SS3

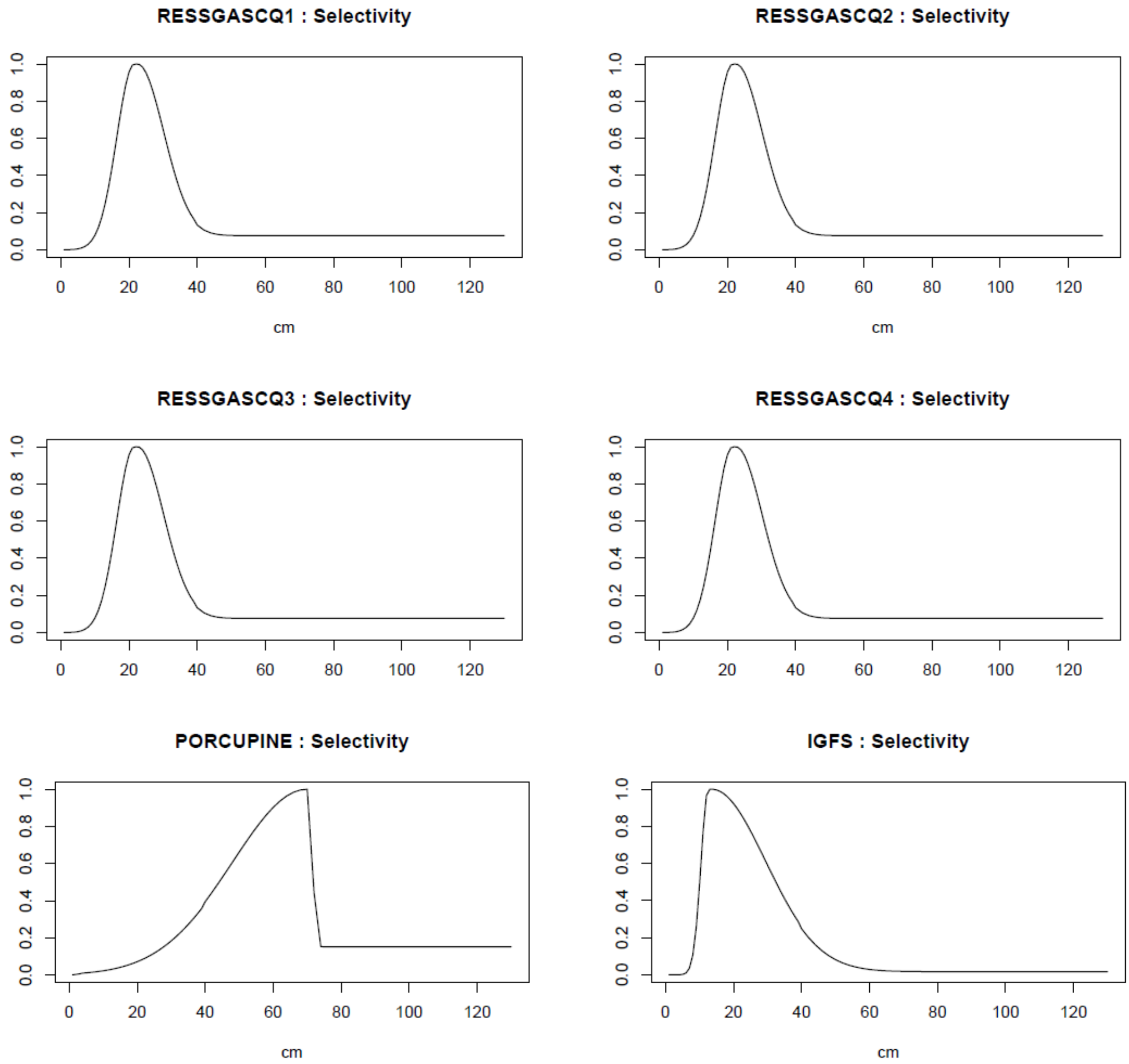


Figure 3.6. (continued) Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Selectivity and retention functions estimated by SS3.

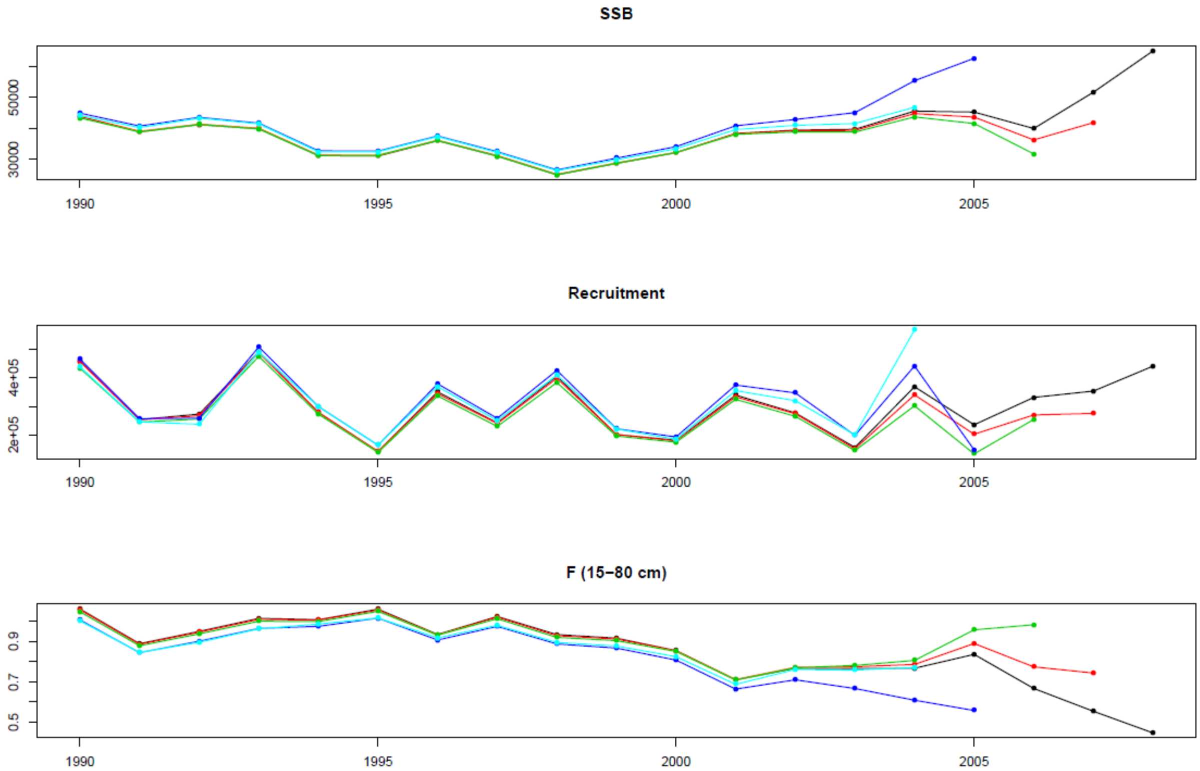


Figure 3.7. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)

Retrospective plot from SS3

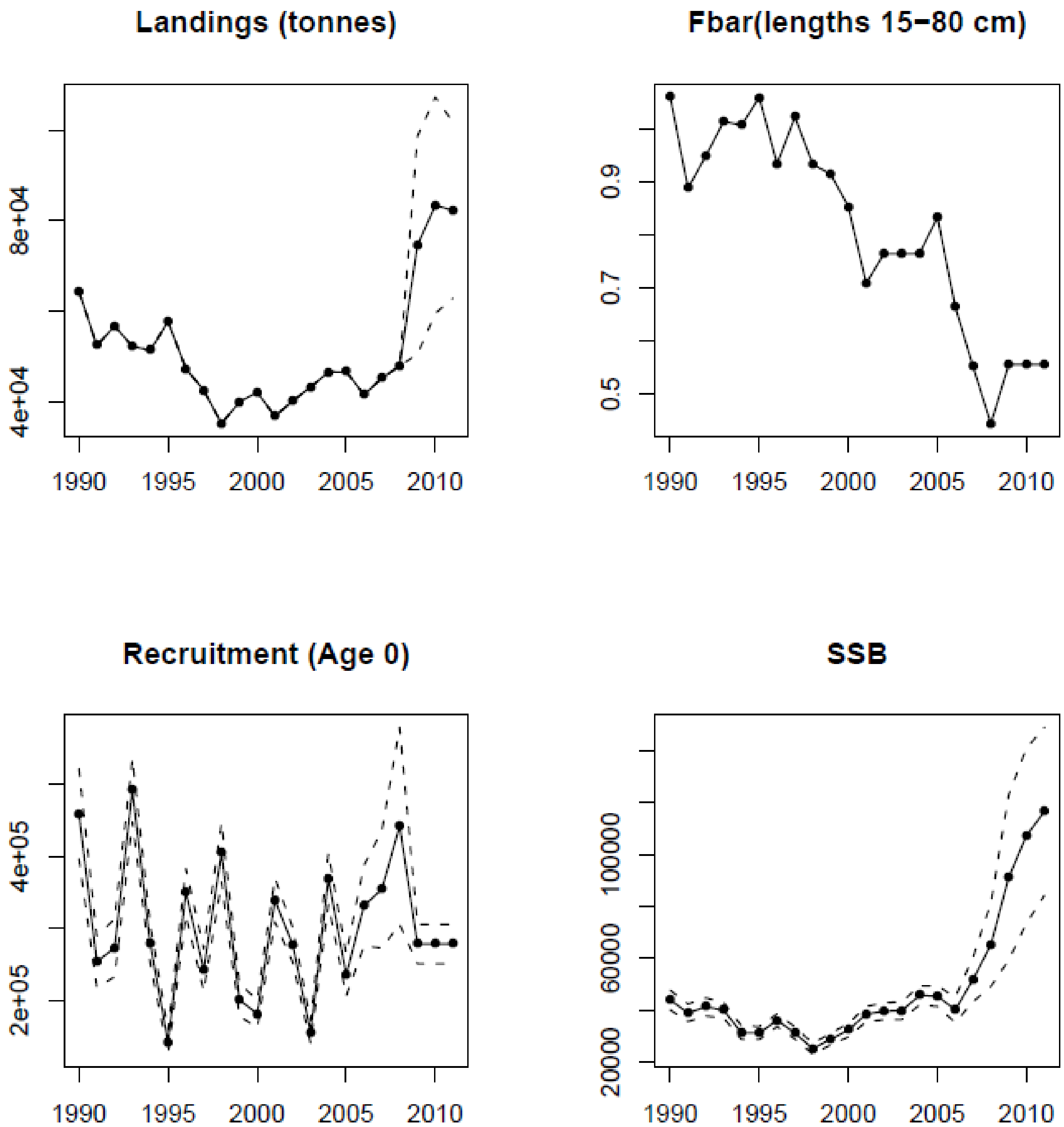


Figure 3.8. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)

Summary plot with stock trends and 3 years projections using 3-year average F and

recruitment equal to geometric mean of estimated recruitment from 1990 to 2006.

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

Long term predictions

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

There was no accepted assessment for either *Lophius piscatorius* or *Lophius budegassa* in 2007. The Working Group found that the input data showed deficiencies especially as discard was known to be increasing and that ageing problem had become more obvious.

L. piscatorius and L. budegassa:

Type of assessment in 2010: Same Advice as Last Year (SALY).

Data revisions this year: Irish 2008 landings

Review Group issues:

Comments by the previous year's Review Group indicate that there is a problem with ageing these species. Problems with ageing need to be resolved to move forward with an analytical assessment for this stock. Reference points should be defined for this stock.

This stock is targeted as part of a mixed fishery (hake, megrim, sole, cod, plaice, and Nephrops), however, this was not noted in the 2009 report. Ecosystem information was not considered in examination of stock trends. Discards have not been reported for this stock; however, preliminary information indicates an increasing proportion of small fish of both species are discarded in the fishery. There is a plan to evaluate the methodology of discard estimation as it is thought to overestimating discard levels (problems with raising procedure).

Overall, LPUE and survey data indicate that biomass has increased since 2000 for both species, with a continued increase for *L. budegassa* and stable biomass for *L. piscatorius* in recent years. Length distribution data confirm that peaks in survey abundance are attributable to strong year classes. Recent commercial landings appear to be at or below the current TAC, however discards have not been included in the catch data.

The benchmark assessment is now tentatively scheduled for 2012.

4.1 General

4.1.1 Summary of ICES advice for 2010 and management for 2009 and 2010

ICES advice for 2010

Effort in fisheries that catch anglerfish should not increase.

Management applicable for 2009 and 2010

The TAC applied to both species and including Division VIIa was set at 36 000 t for 2009 and at 41 400 t for 2010

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

4.1.2 Landings

There has been a small revision of the Irish landings for 2008 that had however little influence on the total international landings data.

French data providers have not been able to produce reliable landing estimates for 2009 (Total or by FU). In case of Spanish data, landings by FU were available but were considered preliminary due to possible problems with raising procedure from the new concurrent sampling and the splitting of both anglerfish species in Spanish total landings, so SP-VIGO7 and SP-CORUTR7 tunning fleets were not used for analysis. Since French and Spanish landings are historically about the 80% of anglerfish landings no reliable landing figures were produced for 2009.

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.

4.1.3 Discards

Estimation of discards has been carried by some countries. This information shows that an increasing proportion of small fish of both species are caught and discarded. However last year the WG noted that the raising procedure to be used must be given high attention as some estimates seemed unrealistically high. The WG recommended that prior to the next benchmark assessment raising methodology be provided and discussed prior to incorporation in the catch data.

Table 4.1-1 Anglerfish in Divisions VIIb-k and VIIIa,b,d -Total landings from 1984 to 2009 – 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	24731	5276	30007
1990	23434	5950	29384
1991	20385	4684	25069
1992	17554	3530	21084
1993	16633	3507	20140
1994	18093	3841	21934
1995	21922	4862	26784
1996	24132	6102	30233
1997	23928	5846	29774
1998	23295	4876	28171
1999	21845	3143	24989
2000	18129	2456	20585
2001	19729	2875	22604
2002	22848	3571	26419
2003	28551	4681	33232
2004	29510	5639	35149
2005	27520	5237	32757
2006	26340	4822	31162
2007	30874	5213	36087
2008*	27153	5032	32185
2009**	13448	667	14115

* revised

** preliminar (Spain) and partial (no French 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.

The landings have declined steadily from 23 700 t in 1986 to 12 800 t in 1992, then increased to 22 100 t in 1996 and declined to 14 000 t in 2000. The landings have increased since then reaching the maximum of the time series in 2007 (29 600 t). The 2008 value show a 17% drop at 24 600t.

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

No reliable data is presented for 2009 since French data was not available and Spanish data was considered preliminary. No length distribution was computed due to such problems.

4.2.1.2 Commercial LPUE

Effort for three Spanish fleets and English FU6 and LPUE data for Spanish "Baka" trawlers and English FU6 were available in 2009 (Table 4.2-2 and Figure 4.2-1.. Fishing effort for most fleets show a decrease until the mid 1990's. Effort remained relatively stable thereafter.

All the commercial LPUE series decreased steadily until 1992. Since then, they all have increased up to 2007 except for the 2 BAKA fleet in the most recent years. Most showed a decline in 2008. In 2009 the only two available LPUEs show an increase.

4.2.1.3 Surveys data

4.2.1.3.1 The French EVHOE 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 and the length distributions in Figure 4.2-3**Error! Reference source not found.Error! Reference source not found.**..

The weight indices show a continuous increase from 2000 to 2007 and a decrease till then to 2005 level but with very high variability. Abundance in numbers shows four peaks in 2001, 2002, 2004 and to a lower extent in 2008, numbers in 2009 are very similar to precedent year.

The length distribution shows that these peaks 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 and 2004), 25 – 45 for the second (2002, 2003 and 2005) and 45-55 for the third (2003, 2004 and 2006) although the later 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 indicates a good incoming recruitment at the level of 2008, although not as strong as in 2001, 2002 and 2004.

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.

4.2.1.3.2 The Spanish Porcupine Groundfish Survey (SP-PGFS)

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 2002-2004.

In 2008 however unsolved problems with the gear affected its geometry. It is very difficult to asses 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 last four years since 2005. For 2009 results are very similar to the ones from 2008 for all the parameters studied.

4.2.1.3.3 The Irish Groundfish Survey (IR-IGFS)

Abundance indices in Nb/sqKm from this survey are given in Table 4.2-3. They show the same drop than the EVHOE and the SP-PGFS after the peak in 2004. In 2009 shows a recovery in abundance but not recovering to 2005 levels. 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 covered Areas VIIe and VIIf and 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 more evidently tracked in 2005 with a mode at 25-45 cm and in 2006 with a mode at 45-60 cm as in the EVHOE survey. The pulse of recruitment observed in the EVHOE survey in 2008 was also present in the EW-FSP survey. For 2009 the highest value of the series for recruitment has been recorded by the survey and the good recruitment for 2008 can be tracked too.

4.2.2 Conclusion

LPUE's, survey data (biomass and abundance indices, length distribution) 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 are evidences of good recruitment in 2008 and 2009.

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 the good incoming recruitment.

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	2342	754		673	444	1772		20474
1990	1021	8787	3950	1736	880		410	391	2578		19753
1991	1752	7565	2806	1196	752		284	218	1657		16229
1992	1773	6254	1489	1052	887		254	166	942		12818
1993	1742	5776	2125	1281	969		360	278	950		13481
1994	1377	7344	2595	1523	1236		261	198	1586		16120
1995	1915	8461	3195	1805	1242		501	429	1954	228	19730
1996	2244	9796	2637	2189	1149	138	441	379	2229	938	22141
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	8419	2369	1407	780	19	98	116	1259	0	17630
2000	2034	7076	1642	1457	726	5	91	77	863	0	13972
2001	2002	8040	2293	1982	886	17	146	76	1402	0	16845
2002	2719	9626	2609	1836	915	5	247	96	1908	0	19961
2003	3498	12324	2786	1978	974	81	470	168	2575	0	24853
2004	5004	12738	2642	2454	852	14	457	216	3296	0	27675
2005	5154	11224	2400	2385	594	7	342	165	2936	58	25265
2006	3741	12983	2216	2418	700	3	429	217	2758	2	25469
2007	4595	15589	2382	2836	660	11	286	244	3015	0	29617
2008*	5107	11983	1885	2007	491	10	227	325	2573	1	24609
2009**	444	5679	358	2019	0	16	0	0	374	0	8888

* revised

** preliminary (Spain) and partial (no French data)

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

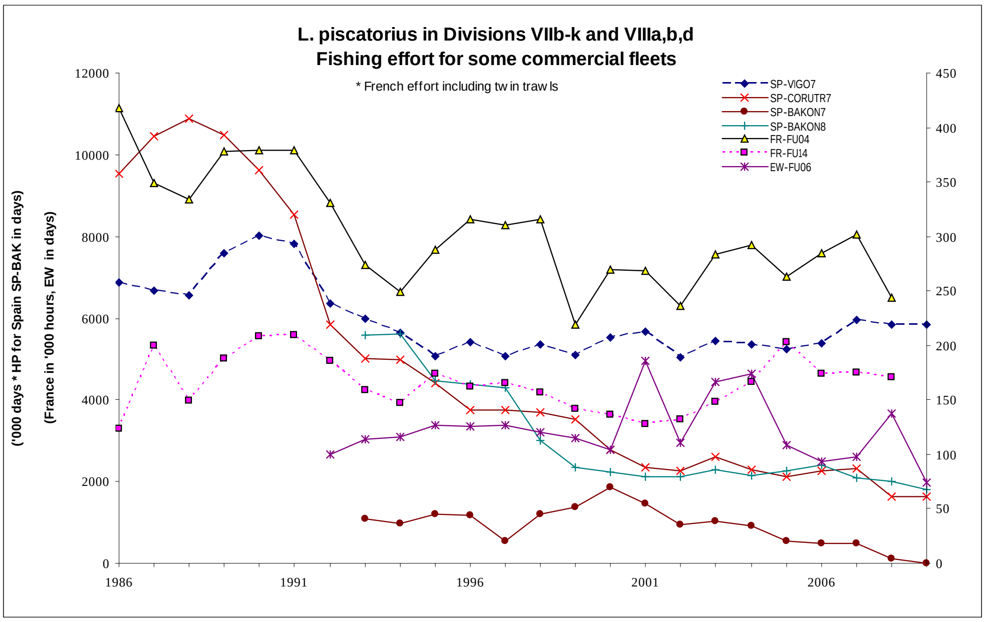
EFFORT	SP-VIGO7 in Sub-Area VII ('000 days*HP)	SP-CORUTR7 in Sub-Area VII ('000 days*HP)	French Benthic trawlers* Celtic Sea FU04 ('000 hrs)	French Benthic Twin Trawls Celtic Sea ('000 hrs)	French Benthic trawlers* Bay of Biscay FU14 ('000 hrs)	French Benthic Twin Trawls Bay of Biscay ('000 hrs)	EW FU06 Beam trawlers in VII ('00 days)	SP-BAKON7 (days)	SP-BAKON8 (days)
1986	6875	9527	418	N/A	123	N/A	N/A	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	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	5952	2323	149	152	48	127	97	476	2098
2008	5840	1640	118	126	58	113	138	105	2017
2009**	5852	1626	NA	NA	NA	NA	75	0	1807

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	N/A	131	N/A	N/A	N/A	N/A
1987	235	326	142	N/A	119	N/A	N/A	N/A	N/A
1988	182	272	132	N/A	110	N/A	N/A	N/A	N/A
1989	210	236	102	N/A	61	N/A	N/A	N/A	N/A
1990	206	228	104	N/A	85	N/A	N/A	N/A	N/A
1991	184	234	82	N/A	55	N/A	N/A	N/A	N/A
1992	188	200	56	N/A	35	N/A	94	N/A	N/A
1993	268	172	60	N/A	42	N/A	93	60	23
1994	289	187	111	N/A	75	N/A	81	73	44
1995	410	131	131	N/A	84	N/A	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	627	409	233	214	118	151	202	261	71
2008	465	542	214	190	97	122	106	171	101
2009**	N/A	N/A	N/A	N/A	N/A	N/A	198	N/A	144

* 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 2009 from the IR-IGFS.

Year	2003	2004	2005	2006	2007	2008	2009
Nb/sqKm	68.7	91.8	64.0	32.1	21.1	18.7	44.6



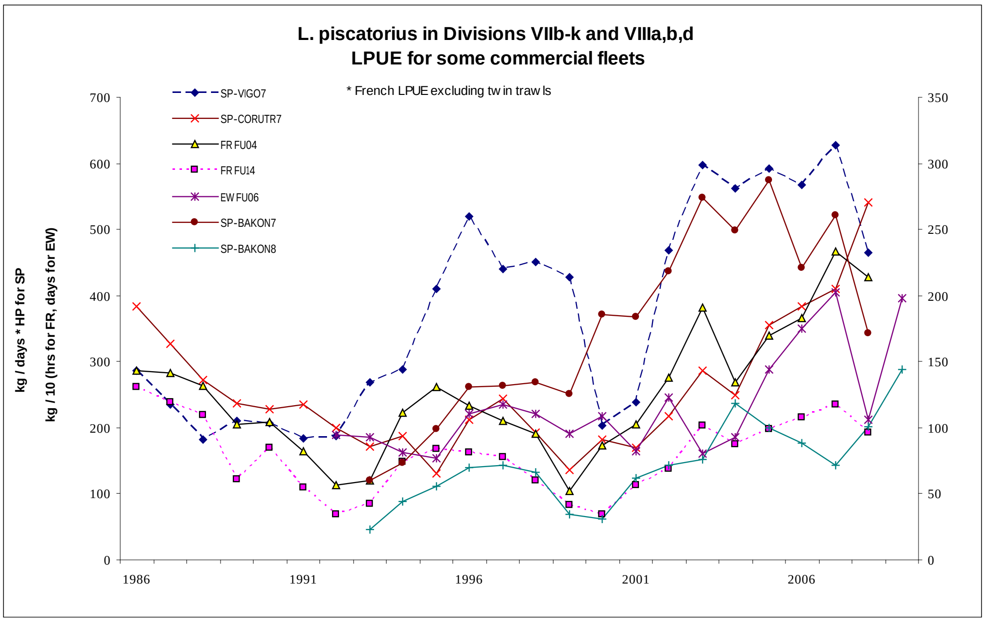


Figure 4.2-1 L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data

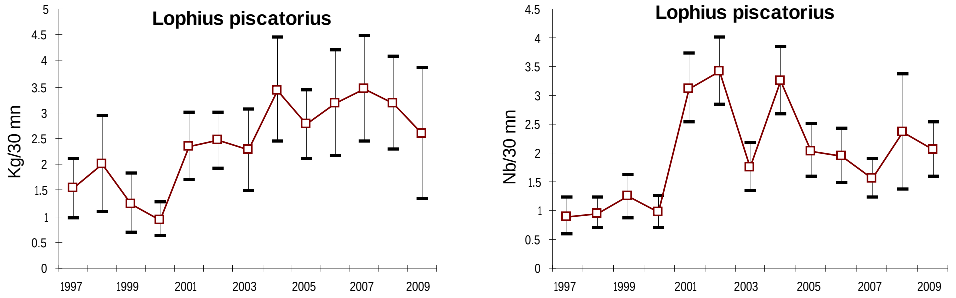


Figure 4.2-2 L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Evolution of the EVHOE survey's indices Kg (left) and Nb (right) per 30 minutes tow from 1997 to 2009

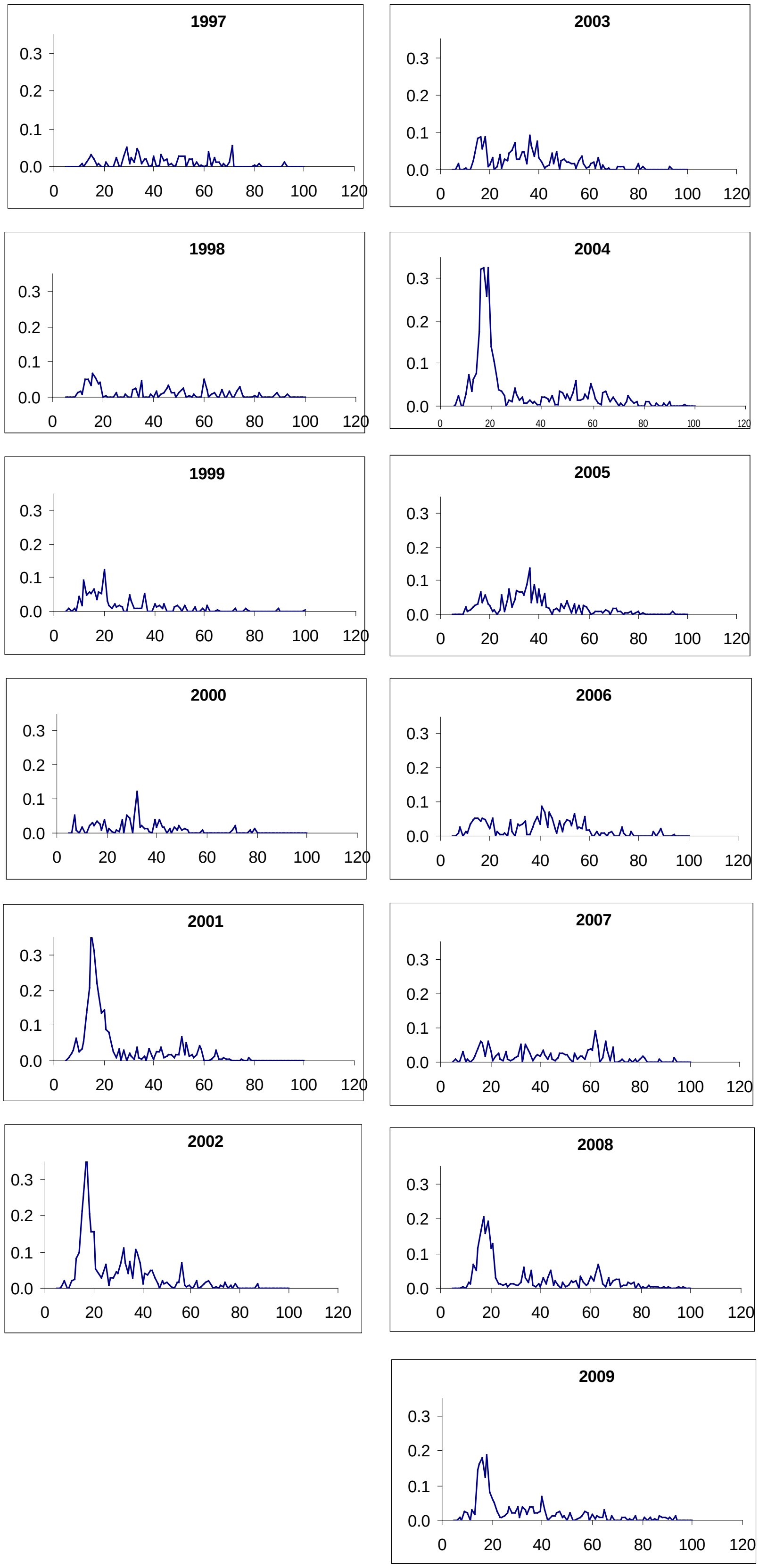


Figure 4.2-3 - L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Evolution of the EVHOE Length distributions in Nb per 30 minutes tow from 1997 to 2009

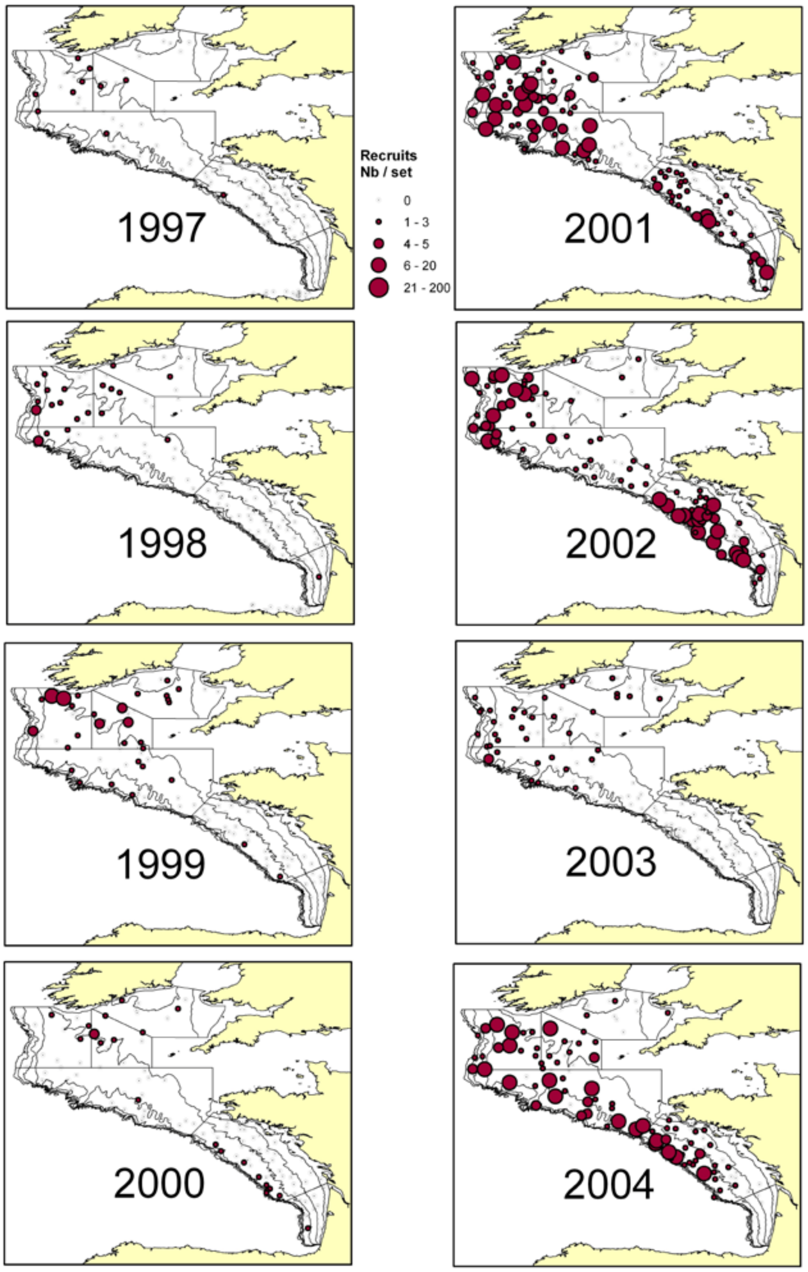


Figure 4.2-4 – L. piscatorius in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the EVHOE surveys from 1997 to 2004.

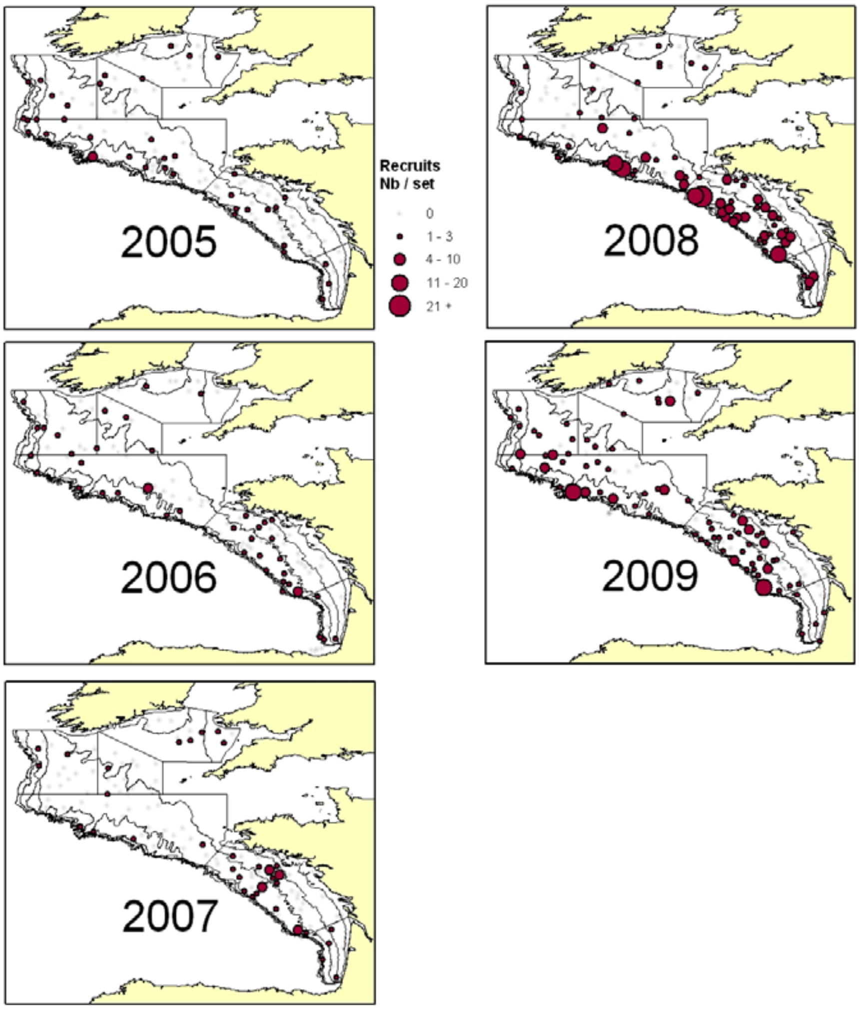


Figure 4.2-5 – L. piscatorius in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the EVHOE surveys from 2005 to 2009.

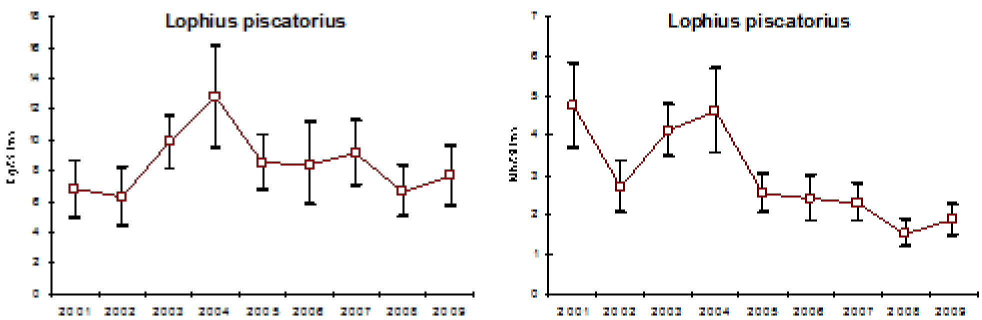


Figure 4.2-6 - L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Evolution of the SP-PGFS survey's indices Kg (left) and Nb (right) per 30 minutes tow from 2001 to 2009.

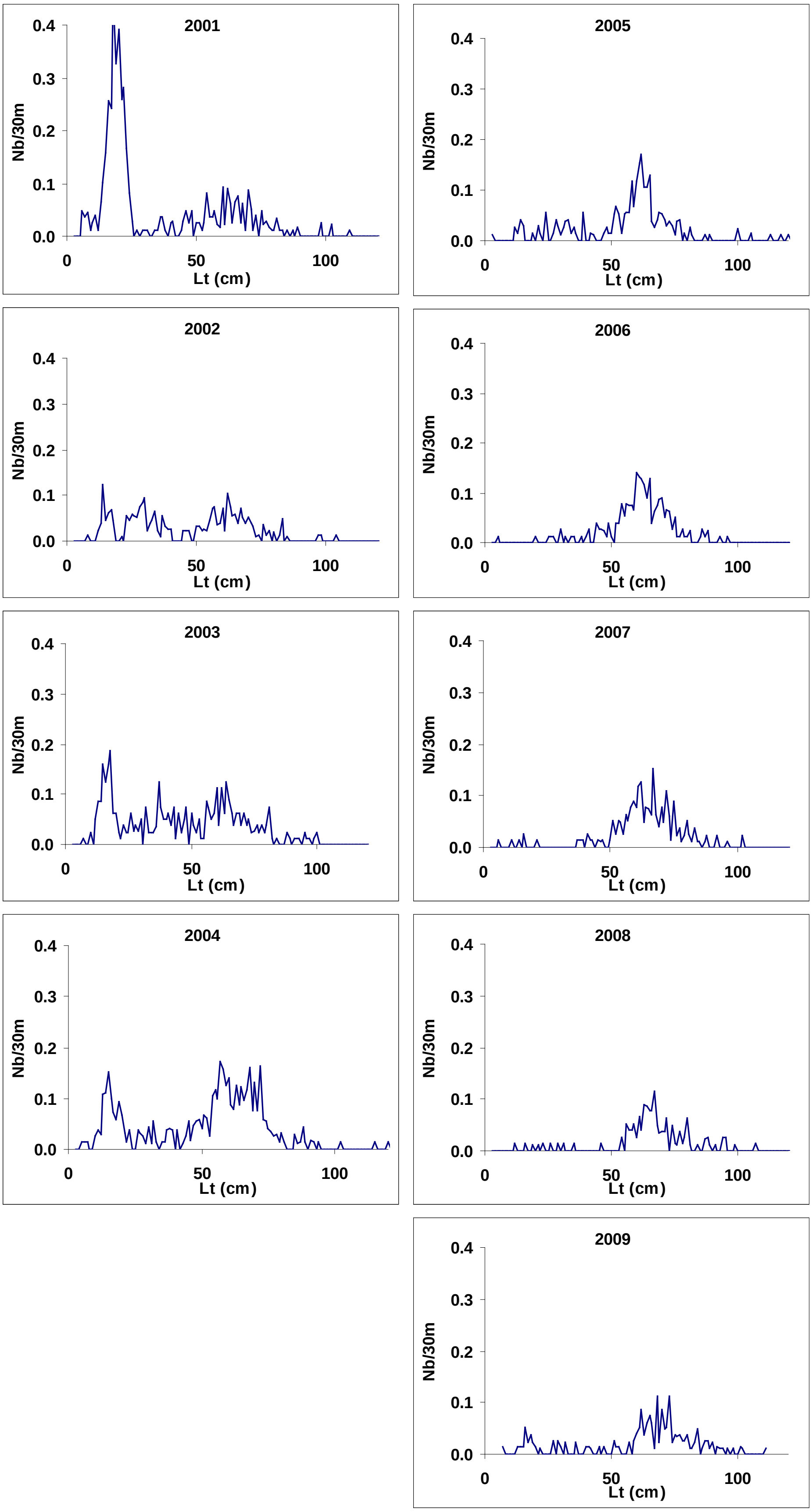


Figure 4.2-7 - L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Evolution of the SP-PGFS Length distributions in Nb per 30 minutes tow from 2001 to 2009

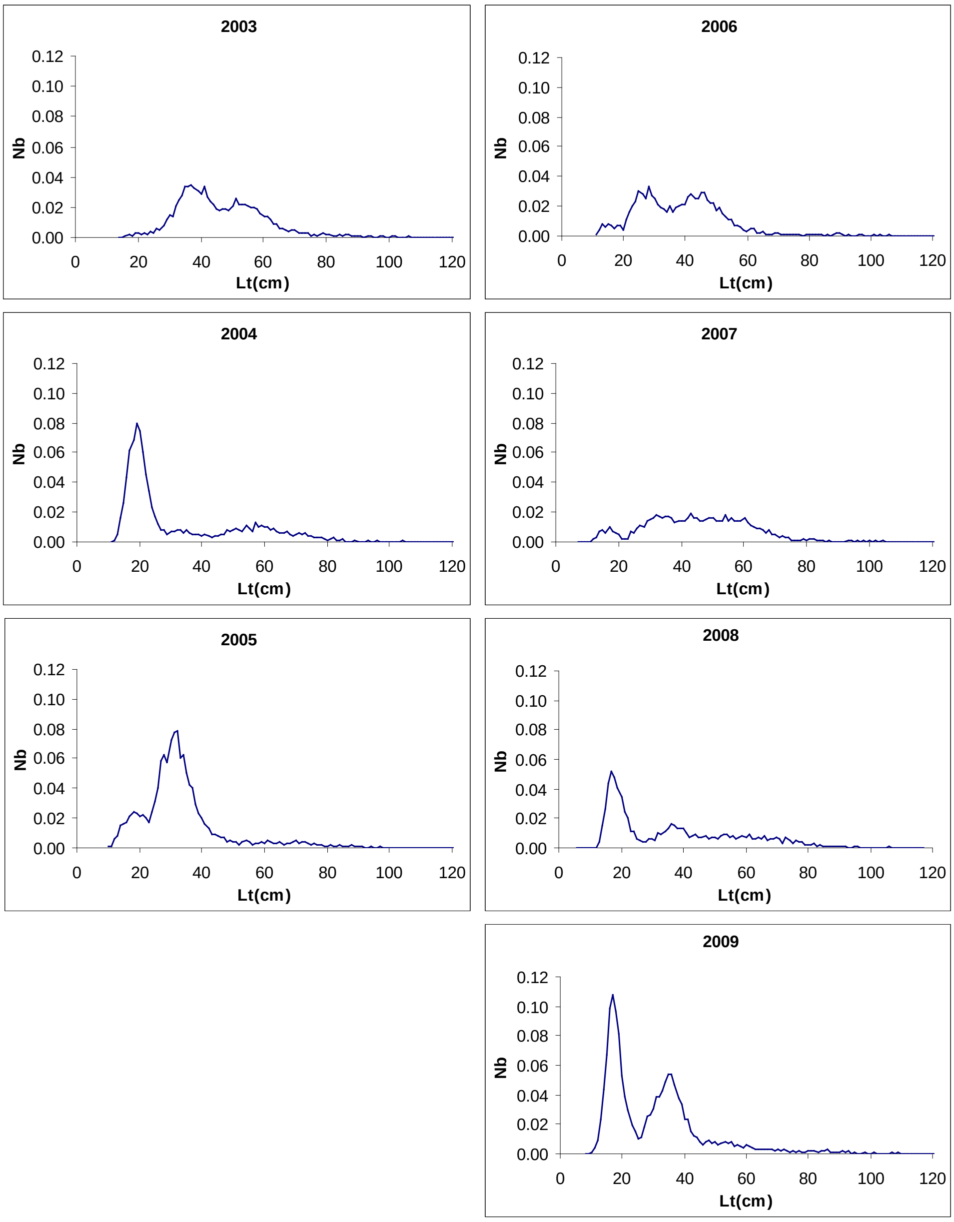


Figure 4.2-8 - L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Evolution of the EW-FSP Length distributions in Nb per meter beam per hour tow from 2003 to 2009

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

4.3.1 Data

4.3.1.1 Commercial Catch

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

The landings have fluctuated all over the studied period between 5 700 t to 9 600 t with a succession of high (1989-1992, 1998 and 2003) and low values (1987, 1994 and 2001). The total estimated landings have dropped from 2003 to 2006 then rose again to 7 574 t in 2008.

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

No reliable data is presented for 2009 since French data was not available and Spanish data was considered preliminary. No length distribution was computed due to such problems.

Commercial LPUE

Effort and LPUE data were available in 2009 for one Spanish fleet (SP-BAKON8) 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 mid 1990's. Effort remained relatively stable thereafter unless SP-BAKON7 that disappeared last year.

LPUEs from SP-VIGOTR7 an SP-BAKON7 show the same increasing trend from 1993 to 2000. Since then LPUE s have fluctuated with some conflicting trends for some fleets in the most recent period. In last year both available LPUEs show a increase of similar slope.

4.3.1.2 Surveys data

4.3.1.2.1 The French EVHOE 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, but a recent and continuous increase since 2005 to its maximum value in 2008. The abundance index shows a similar pattern to reach its highest values in the time series in 2008. For 2009 the indexes returned to 2005 levels.

The length distributions (Figure 4.3-3) show that this corresponds to strong incoming year classes from 2004 till 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 (2004, 2005 and 2006) and 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 for recruitment nor the signal from 2008 strong recruitment can be followed.

The localisation of juveniles (individuals smaller than 16 cm) caught during the survey from 1997 to 2008 show two nursery areas one in the western Celtic Sea and another in the north-western area of the Bay of Biscay Figure 4.3-4 and Figure 4.3-5. However, in 2008, juveniles are also found in more southern area of the Bay of Biscay in deeper waters. In 2009 against the normal pattern was found again.

4.3.1.2.2 The English Fisheries Science Partnership survey.

This survey covered Areas VIIe & VIIf. Trends in biomass and abundance are not presented as more detailed analysis of trends in abundance and biomass will be prepared in time for the next benchmark assessment, when factors such as size class and substrate type will be investigated.

Length distribution of *L. budegassa* catches are available and presented in Figure 4.3-6. The survey covers a restricted area of the species distribution but the pulses of recruitment observed in the EVHOE surveys are also present in the EW-FSP survey.

For 2009 the English survey has recorded its historical maximum for recruitment and the good recruitment from 2008 can be followed very well.

4.3.1.2.3 Other surveys

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

4.3.2 Conclusion

Survey data give indication that the biomass has shown a continuous increase since the mid 2000's as a consequence of several good incoming recruitments. There is good evidence of a strong incoming recruitment from 2008 data and contradictory signals for 2009 recruitment from the two available surveys.

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 even be easier than for *L. piscatorius* given the length distribution observed in recent years in the EVHOE survey and the last two years in English Fisheries Science Partnership.

	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	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	1217	515	0	446	112	1829	0	9533
1990	53	4818	631	905	653	0	550	156	1865	0	9632
1991	88	4414	921	384	507	0	475	117	1933	0	8840
1992	90	4808	301	305	594	0	459	191	1518	0	8266
1993	93	3415	429	405	399	0	433	101	1385	0	6659
1994	70	2935	265	209	540	0	232	49	1515	0	5814
1995	110	3963	455	159	617	0	312	62	1286	90	7053
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	4928	119	285	338	0	144	76	1450	0	7359
2000	57	4480	161	261	228	0	124	31	1270	0	6613
2001	41	3796	107	260	306	0	121	29	1100	0	5759
2002	30	4327	147	251	382	0	112	14	1195	0	6458
2003	92	5754	337	346	376	5	195	26	1248	0	8379
2004	122	4716	242	349	376	0	254	9	1407	0	7474
2005	73	4780	162	411	329	0	235	56	1431	14	7492
2006	9	3630	145	276	218	0	286	1	1128	1	5693
2007	93	3987	168	305	250	0	243	0	1424	0	6470
2008*	21	4833	187	375	254	0	235	0	1669	0	7576
2009**	0	4608	24	302	0	0	0	0	293	0	5227

* revised

** preliminary and partial (no French data)

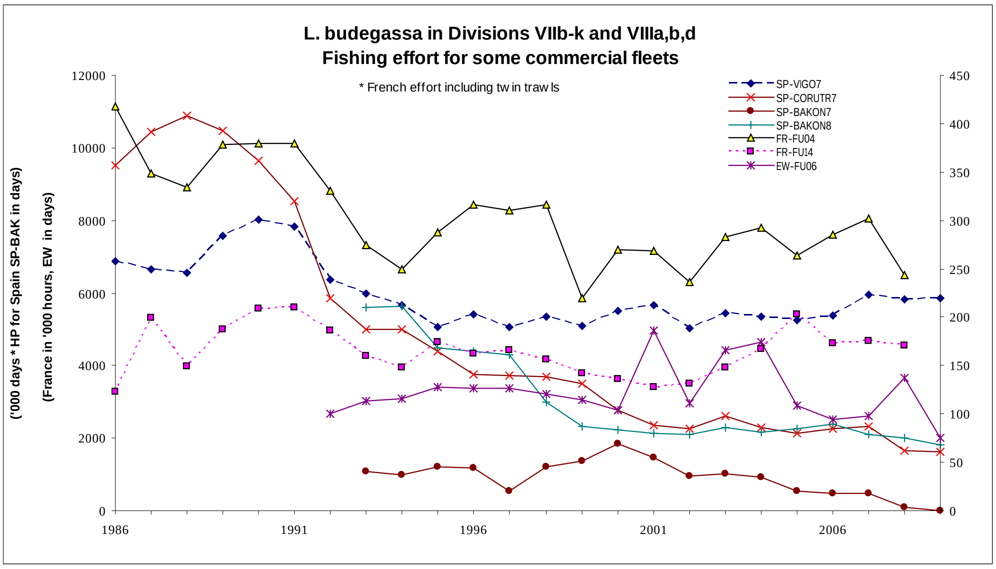
Table 4.3-1 Lophius budegassa in Divisions VIIb-k and VIIIa,b,d - Landings in tonnes by Fishery Unit

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	NA	NA	NA	NA	75	0	1807

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	NA	51	NA	NA	NA	NA
1987	294	16	25	NA	48	NA	NA	NA	NA
1988	265	42	39	NA	53	NA	NA	NA	NA
1989	272	25	47	NA	65	NA	NA	NA	NA
1990	250	29	52	NA	62	NA	NA	NA	NA
1991	231	30	44	NA	54	NA	NA	NA	NA
1992	248	14	48	NA	53	NA	28	NA	NA
1993	194	15	43	NA	50	NA	30	51	55
1994	203	20	44	NA	60	NA	11	108	61
1995	286	8	51	NA	47	NA	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	403	11	31	28	50	64	10	256	70
2008	545	5	48	43	68	86	16	248	74
2009**	NA	NA	NA	NA	NA	NA	30		118

* Identified twin trawls excluded
** Preliminary



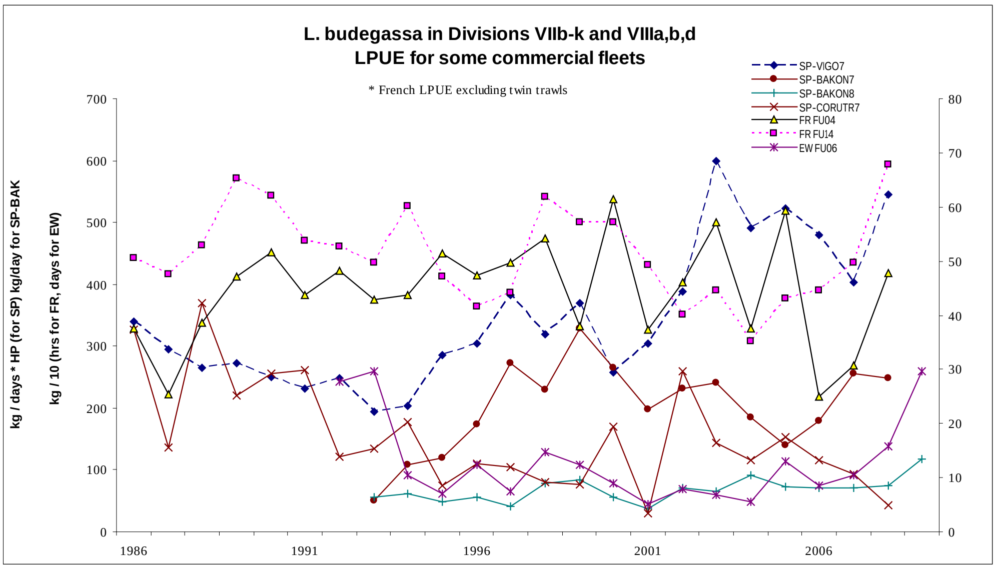


Figure 4.3-1 L. budegassa in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data

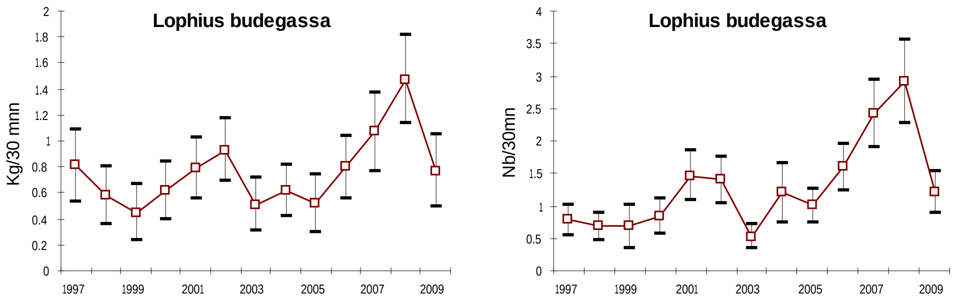


Figure 4.3-2 L. budegassa in Divisions VIIb-k and VIIIa,b,d- Evolution of the EVHOE survey's indices Kg (left) and Nb (right) per 30 minutes tow from 1997 to 2009

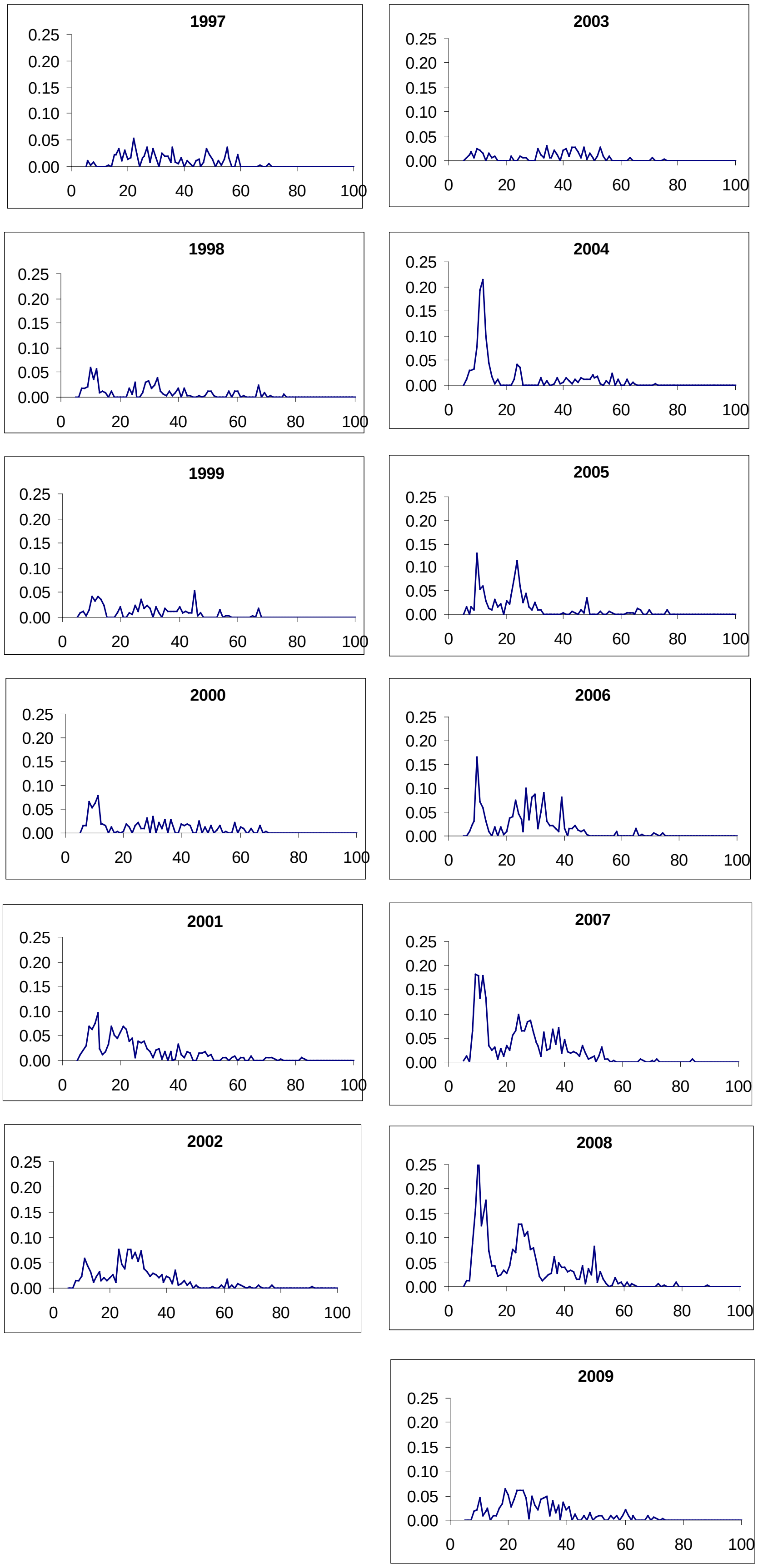


Figure 4.3-3 - L. budegassa in Divisions VIIb-k and VIIIa,b,d- Evolution of the EVHOE Length distributions in Nb per 30 minutes tow from 1997 to 2009.

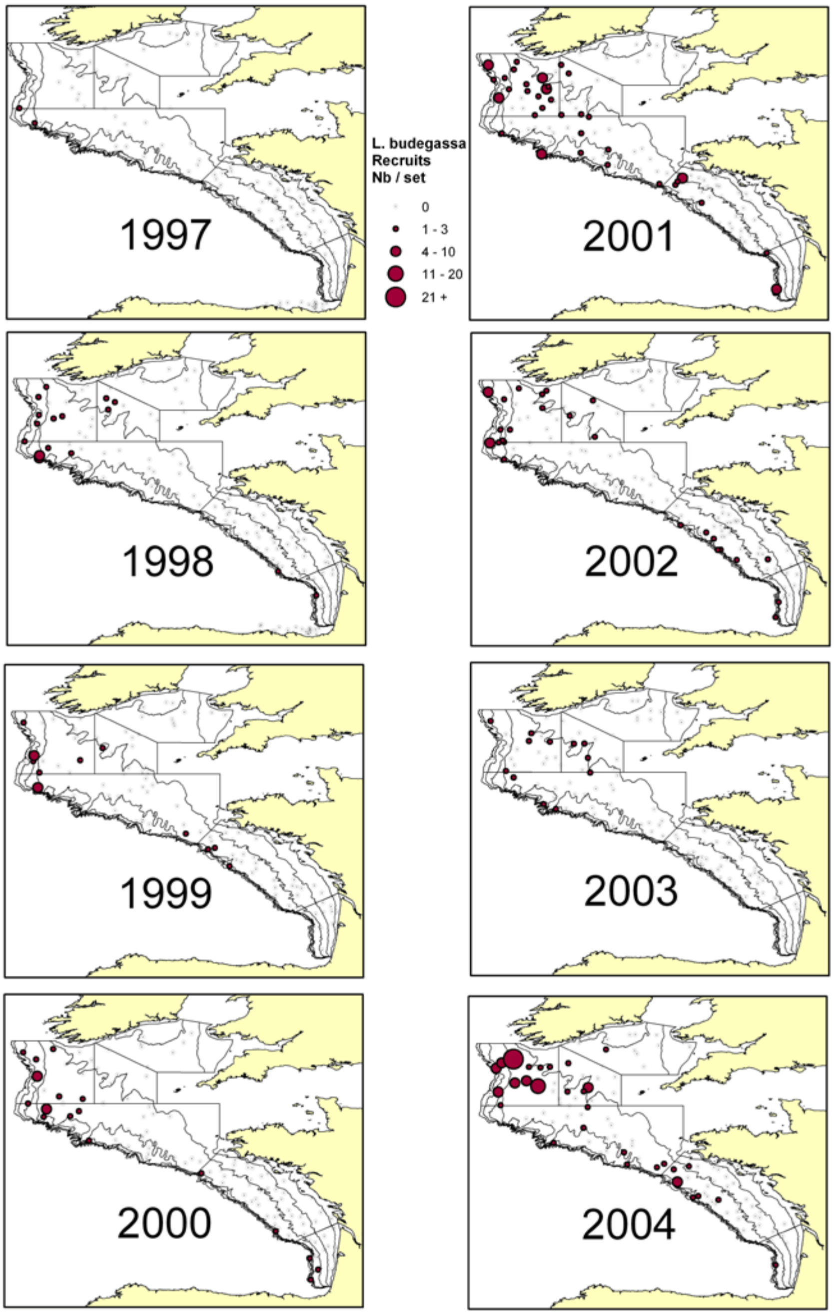


Figure 4.3-4 – L. budegassa in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 16 cm) in Nb per 30m observed in the EVHOE surveys from 1997 to 2004.

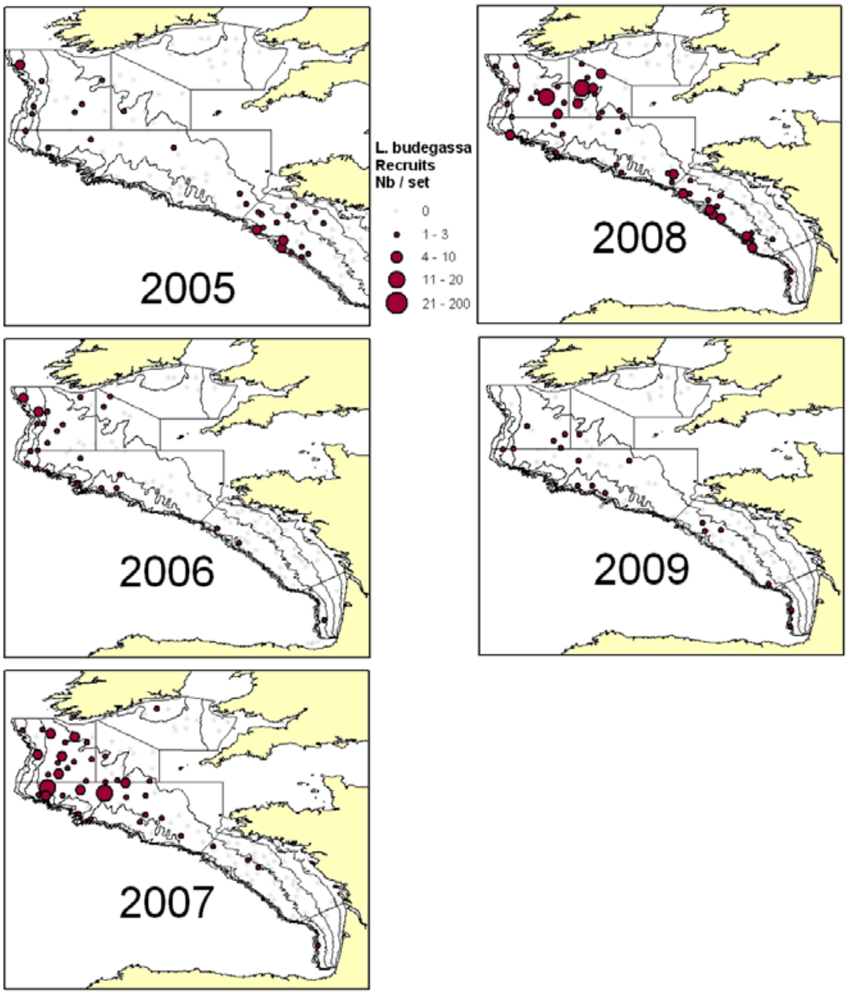


Figure 4.3-5 – L. budegassa in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 16 cm) in Nb per 30m observed in the EVHOE surveys from 2005 to 2009.

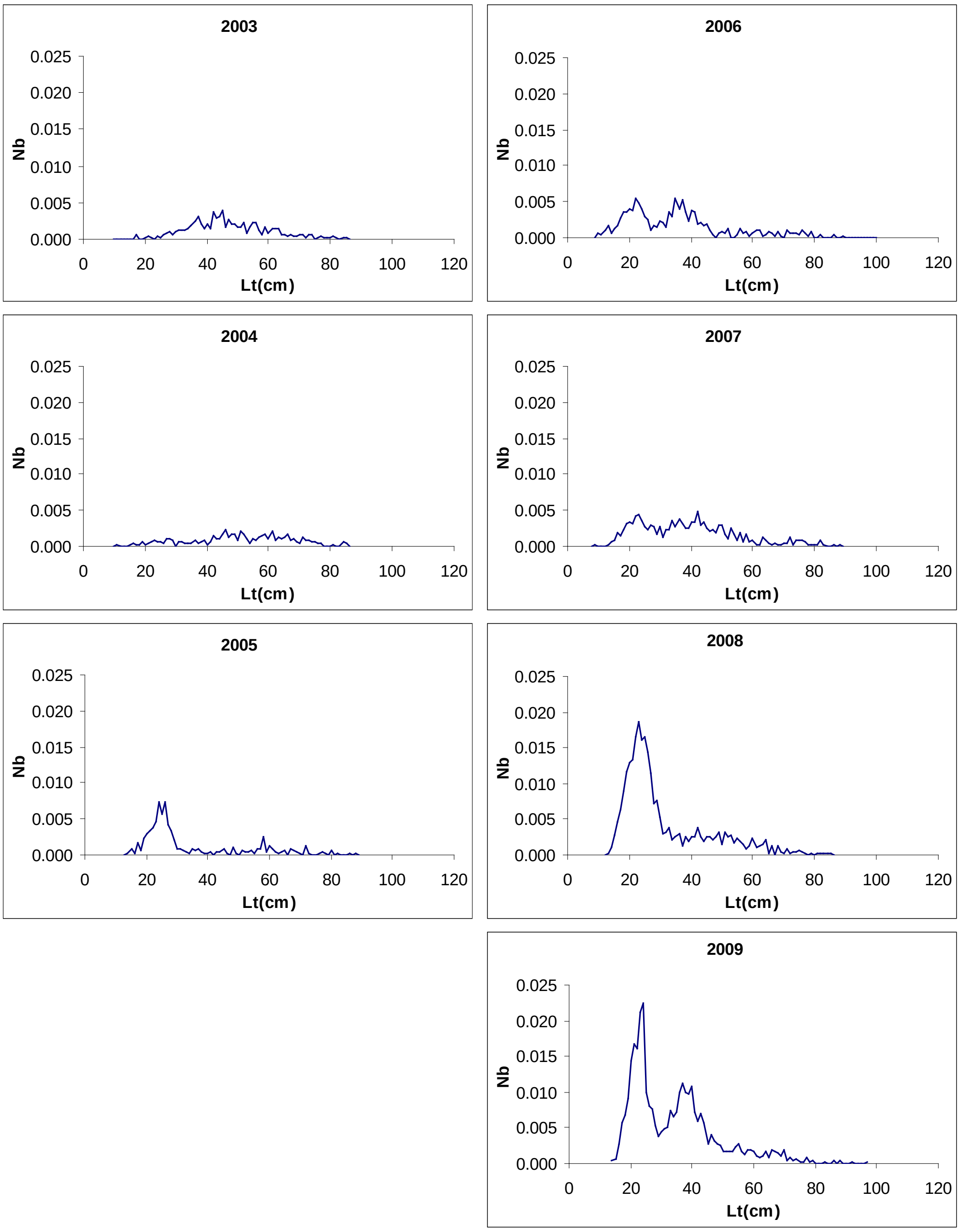


Figure 4.3-6 - L. budegassa in Divisions VIIb-k and VIIIa,b,d- Evolution of the EW-FSP Length distributions in Nb per 30 minutes tow from 2003 to 2009.

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

Assessment type: SALY. No analytical assessment is available for this stock.

Data revisions this year: minor revisions to catches in 2008.

Review Group comments: these were in relation to:

- "Severe deficiencies in the data" for this stock. There appears to be an on-going 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.

Reply to Review Group:

Improvement in the quality of the input data has not occurred since last year. In 2010, quality has even decreased, as explained:

No estimation for catches for this stock are delivered this year as France has not provided these 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 data series 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 this year. The Irish Otter trawl LPUEs series has not been revised for the time of this meeting.

No segmentation of the main commercial fleets used in the assessment has been carried out.

Mixed fisheries considerations and ecosystem information is included in Annex E (Stock annex, Sections A2 and A3).

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 and French vessels. In 2008, both countries together have reported more than 70 % of the total landings, the rest of the catches are reported by Irish and UK demersal trawlers. See more detailed description of the fishery in Annex E (Stock annex, Section A2).

Estimates of total landings (including unreported or miss-reported landings) and catches (landings + discards) as used by the Working Group up to 2008 are shown in Table 5.1.

5.1.2 Summary of ICES Advice for 2010 and Management applicable for 2009 and 2010

ICES advice for 2010

ICES advised on the basis of exploitation boundaries in relation to precautionary considerations that there should be no increase in effort of fisheries that catch *L. whiffiagonis* in 2010

Management applicable for 2009 & 2010

The 2009 and 2010 TACs were set at 20 425 t, including a 5% contribution of *L. boscii* in the landings for which stock there is no assessment.

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

5.2 Data

5.2.1 Commercial catches and discards

Landings in 2009, are expected to be considerably higher than in 2008 (11 282 t) as even with no French data, landings reached up to 12 790 t

Discard data available by country and the procedure to derive them are summarised in Table 5.2a. The discards decrease in 2000 and 2001 (Table 5.1) can be partly explained by the reduction in the minimum landing size. 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. In 2006 discards increased again around 30 %, especially in ages 3 & 4, while a decrease occurred till 2008. In 2009, discards increased close to levels of 2007.

Since 1999, only Spanish discard data are used, applied only to Spanish fleets. This has led to an artificial decrease in the amount of total discards, since no estimates for French fleets were available. The group states strongly the importance of incorporating 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.

Preliminary discards estimates from United Kingdom were available to the group at sampling level. Ireland presented raised discard data. Data series available for discards are detailed in the Annex E-Stock annex- Section B2.

In the following table the discard ratio in weight of the most recent years is presented. Length distribution of 2002 has been derived from 2001 estimates.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Discard ratio (%)	19	7	7	8	17	24	13	17	14	11	na

5.2.2 Biological sampling

Age and Length distribution provided by countries are explained in Annex E-Stock annex- Section B3. Derivations of length compositions and ALK's used for 2008 data are presented in Table 5.2b. In 2009, no derivations were feasible to be carried out as no total catch was provided to the group due to lack of French landings.

Table 5.3 shows the available original length composition of landings by Fishing Unit in 2009.

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 5.1) due to the change in MLS. Up to 2008, mean lengths stay relatively stable in the recent years with a marked decrease in length of discards.

Age distribution for landings and discards from 1987 to 2008 are presented in Figure 5.2.

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) results for the period 1997–2009 are summarised in Table 5.4a.

EVHOE 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 in 2009 to medium levels of the series.

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 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 from 2001 to 2009, and from IGFS from 2003-2009.

When comparing Spanish, French and Irish biomass indices some contradictory signals are detected (Figure 5.3). The EVHOE index decreased from 2001 until 2005 and since then has increased. The Spanish Porcupine Survey 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.

Irish Ground Fish Survey gives the highest estimates in 2005 with a decrease in trend to 2007 and increasing again till 2009 in agreement with EVHOE.

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 and the southern coverage of IGFS, whereas the eastern boundary of SP-PGFS essentially coincides with the western one of IGFS (See surveys map distribution in Section 2.2).

5.2.4 Commercial catch-effort data

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 1984–2009. From 1985 to 2008, LPUEs from four French trawling fleets: FR-FU04, Benthic Bay of Biscay, Gadoids Western Approaches and *Nephrops* Western Approaches are available. No update of these last data series has been provided to the WG (Table 5.4b and Figure 5.4).

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 maintained till 2009. SP-CANTAB7 remains quite stable since 1991 and decreased slightly since 2000. In 2009, no effort has been deployed by this fleet. The effort of the French benthic trawlers fleet in the Celtic Sea decreased from 1991 to 1994, then increased in 1995-1996 and remained relatively stable until 2007, when it decreased again (Figure 5.4a). 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 5.4b). 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 again in 2006 and 2007. The CPUE of SP-VIGOTR7, as for SP-CORUTR7, has had a sharp increase in 2009. SP-CANTAB7 has been fluctuating up to 1999 and then a general increasing trend is observed. No CPUE value is available for this fleet in 2009, as it deployed no effort.

The LPUE of all French bottom trawlers fleets decreased from 1988 to 1991 and remained relatively stable until 1994 (Figure 5.4c). 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 was provided for French fleets.

5.2.5 Conclusions

Precise estimates of recent development of the stock population structure and SSB are not available. Spanish commercial CPUEs series give congruous trends and survey biomass indices also show an increase in 2009. 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 problems and deficiencies of this assessment 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 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.

Table 5.1 Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d.
Nominal landings and catches (t) provided by the Working Group.
Revised values in bold.

	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	14371	3284	17655	18100
1991	15094	3282	18376	18100
1992	15600	2988	18588	18100
1993	14929	3108	18037	21460
1994	13685	2700	16385	20330
1995	15862	3206	19068	22590
1996	15109	3026	18135	21200
1997	14230	3066	17296	25000
1998	14345	5371	19716	25000
1999	13715	3135	16850	20000
2000	14485	1033	15517	20000
2001	15806	1275	17081	16800
2002	15988	1466	17454	14900
2003	15414	3147	18561	16000
2004	14300	4511	18811	20200
2005	12712	1831	14542	21500
2006	12015	2468	14483	20425
2007	13330	2238	15568	20425
2008*	**11282**	1442	12724	20425
2009	na	2028	na	20425

*: Irish landings reviewed from 1514 to 1523 tn
na: in 2009 no landing statistics from France are available

(1) for both megrim species and VIIa included

Table 5.2a 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)	-	-
1996	(FR91)	(SP94)	-	-
1997	(FR91)	(SP94)	-	-
1998	(FR91)	(SP94)	-	-
1999	-	**SP99**	-	-
2000	-	**SP00**	-	-
2001	-	**SP01**	-	-
2002	-	(SP01)	-	-
2003	-	**SP03**	**IR***	***UK****
2004	-	**SP04**	**IR***	-
2005	-	**SP05**	**IR***	-
2006	-	**SP06**	**IR***	***UK****
2007	-	**SP07**	**IR***	***UK****
2008	-	**SP08**	**IR***	***UK****
2009	-	**SP09**	**IR***	***UK****

- In bold: years where discards sampling programs provided information
- In bold and * (italics): years where discards sampling programs provided information, just at sampling level, but are not used in the derivation
- In bold and *: years where discards sampling programs provided information but are not used in the derivation
- In (): years for which the length distribution of discards has been derived

Table 5.2b Megrim (*L.whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d.
Derivations of length compositions and ALK's used for 2008. No 2009 data is derived due to lack of catches

2008					
Unit	**Data**	**France**	**Ireland**	**Spain**	**UK**
3	Landings	-			EW.03.08Q
	Discards	-			-
	ALK	-			EW.ALL FU.08Q
4	Landings	FR.04.08Y		SP.04.08Q	EW.04.08Q
	Discards	-		SP.ALL FU.08Y	-
	ALK	-		SP.04.08Y	EW.ALL FU.08Q
5	Landings	FR.05.08Y			EW.05.08Q
	Discards	-			-
	ALK	-			EW.ALL FU.08Q
6	Landings	-			EW.06.08Q
	Discards	-			-
	ALK	-			EW.ALL FU.08Q
8	Landings	FR.08.08Y			
	Discards	-			
	ALK	-			
9	Landings	-			
	Discards	-			
	ALK	-			
10	Landings	-			
	Discards	-			
	ALK	-			
14	Landings	FR.14.08Y		SP.14.08Q	
	Discards	-		-	
	ALK	-		-	
All fisheries Units	Landings	-	IR.ALL FU.08Q		
	Discards	-	-		
	ALK	-	IR.ALL FU.08Q		
No of samples		57	147	123	115
No of fishes measured		12353	17072	15510	8879
No of fish aged		-	1585	1926	1184

(-) : no discards assumed or available
ALL FU : all fishery units combined
Q : quarterly data
Sm : semestrial data
Y : annual data
S : by sex

Table 5.3 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.

Length	FRANCE	SPAIN		IRELAND	UNITED KINGDOM			
class (cm)	ALL FISHING U	FU04:Otter trawl-me	FU14:Otter trawl-med&	ALL FISHING U	FU03:Fixed net	FU 04: Otte	FU05:Otter t	FU06:Beam trawl-all de
10		0	0	0	0	0	0	0
11		0	0	0	0,000	0	0	0
12		0	0	0	0,000	0	0	0
13		0	0	0	0,000	0	0	0
14		0	0	1	0,000	0	0	0
15		0	0	1	0,000	0	0	0
16		0	0	6	0,000	0	0	0
17		0	0	14	0,000	0	0	0
18		0	0	27	0,000	0	0	0
19		22	6	84	0,000	0	0	0
20		258	21	219	0,000	0	0	0
21		1574	41	304	0,000	0	0	0
22		3052	85	439	0,000	0	0	0
23		5601	203	544	0,000	0	0	0
24		7217	201	634	0,000	0	0	11
25		7156	315	705	0,000	0	1	25
26		6195	284	687	0,000	0	1	42
27		5885	306	655	0,304	0	3	94
28		5289	275	529	0,261	0	9	97
29		3700	250	396	0,335	0	17	142
30		2762	203	337	0,474	0	24	171
31		1880	171	320	0,528	0	28	159
32		1706	106	228	0,817	0	34	148
33		1230	63	196	0,922	0	43	128
34		968	53	145	0,745	0	40	126
35		695	36	104	1,015	0	46	101
36		376	25	80	1,000	0	35	85
37		311	13	83	0,742	0	29	78
38		255	9	41	0,770	0	21	76
39		202	11	45	0,383	0	16	56
40		207	7	35	0,369	0	17	49
41		117	7	23	0,248	0	13	32
42		119	7	19	0,214	0	8	29
43		71	6	20	0,117	0	9	26
44		82	3	13	0,098	0	7	18
45		62	4	6	0,119	0	7	19
46		49	3	6	0,030	0	3	18
47		32	1	3	0,022	0	2	17
48		30	1	1	0,000	0	2	13
49		17	1	1	0,011	0	0	12
50		19	1	0	0,022	0	1	11
51		16	1	0	0,000	0	0	7
52		4	0	0	0,000	0	0	7
53		1	0	0	0,000	0	0	5
54		4	0	0	0,000	0	0	4
55		0	0	0	0,000	0	0	4
56		0	0	0	0,000	0	0	2
57		3	0	0	0,000	0	0	1
58		0	0	0	0,000	0	0	1
59		0	0	0	0,000	0	0	0
60		0	0	0	0,000	0	0	0
61		0	0	0	0,000	0	0	0
62		0	0	0	0,000	0	0	0
63		0	0	0	0,000	0	0	0
64		0	0	0	0,000	0	0	0
65		0	0	0	0,000	0	0	0
66		0		0	0,000	0	0	0
67		0		0	0,000	0	0	0
68		0		0	0,000	0	0	0
69		0		0	0,000	0	0	0
70		0		0	0,000	0	0	0
TOTAL	0	57167	2720	6952	10	0	419	1815

Table 5.4a 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	0.47	3.85	2.71	1.55	1.40	1.11	0.62	0.35	0.18
1998	100	1.62	0.65	4.35	3.06	1.49	0.98	0.78	0.40	0.13
1999	100	0.53	3.35	0.68	2.06	3.30	1.61	0.67	0.29	0.25
2000	100	1.38	2.62	2.52	1.36	1.20	0.73	0.41	0.28	0.14
2001	100	0.93	5.07	1.87	2.36	2.72	1.87	1.40	0.37	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	2.51	0.86	0.36	0.38	0.21	0.07
2007	100	4.04	3.91	1.63	1.38	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	

Table 5.4a(cont)

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

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

Table 5.4a' EVHOE 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	2,48	14,71

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

IGFS Abundance Indices by numbers by 10 square kilometers

2003	1227
2004	1926
2005	2254
2006	2039
2007	725
2008	1247
2009	1850

Table 5.4b 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))		
	Benthic Bay of Bisca	Benthic Western Approac	Gadoids Western Approac	Nephrops Western Approac	A Coruña -VII	Cantábrico- VII	Vigo-VII
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
1996	2.5	5.7	1.4	3.5	3.9	58.4	79.3
1997	2.8	6.7	1.2	3.0	3.0	46.9	96.0
1998	2.4	8.2	1.5	3.7	2.4	35.7	82.4
1999	3.4	6.8	0.8	3.4	1.1	32.5	137.0
2000	3.1	8.0	0.6	3.9	5.5	45.0	128.9
2001	2.1	9.6	0.7	3.9	1.3	75.6	131.2
2002	2.3	8.1	0.5	3.1	1.3	76.4	185.3
2003	1.8	6.7	0.5	3.0	11.2	54.0	192.1
2004	1.7	4.9	0.4	3.3	3.3	60.0	211.0
2005	1.9	6.3	0.4	3.4	1.7	58.46	135.3
2006	2.3	6.6	0.3	3.0	1.4	76.42	146.1
2007	2.4	6.4	0.3	2.5	2.4	87.86	147.7
2008	2.3	6.5	0.4	2.5	3.0	37.58	114.8
2009	NA	NA	NA	NA	8.3	0.00	168.8

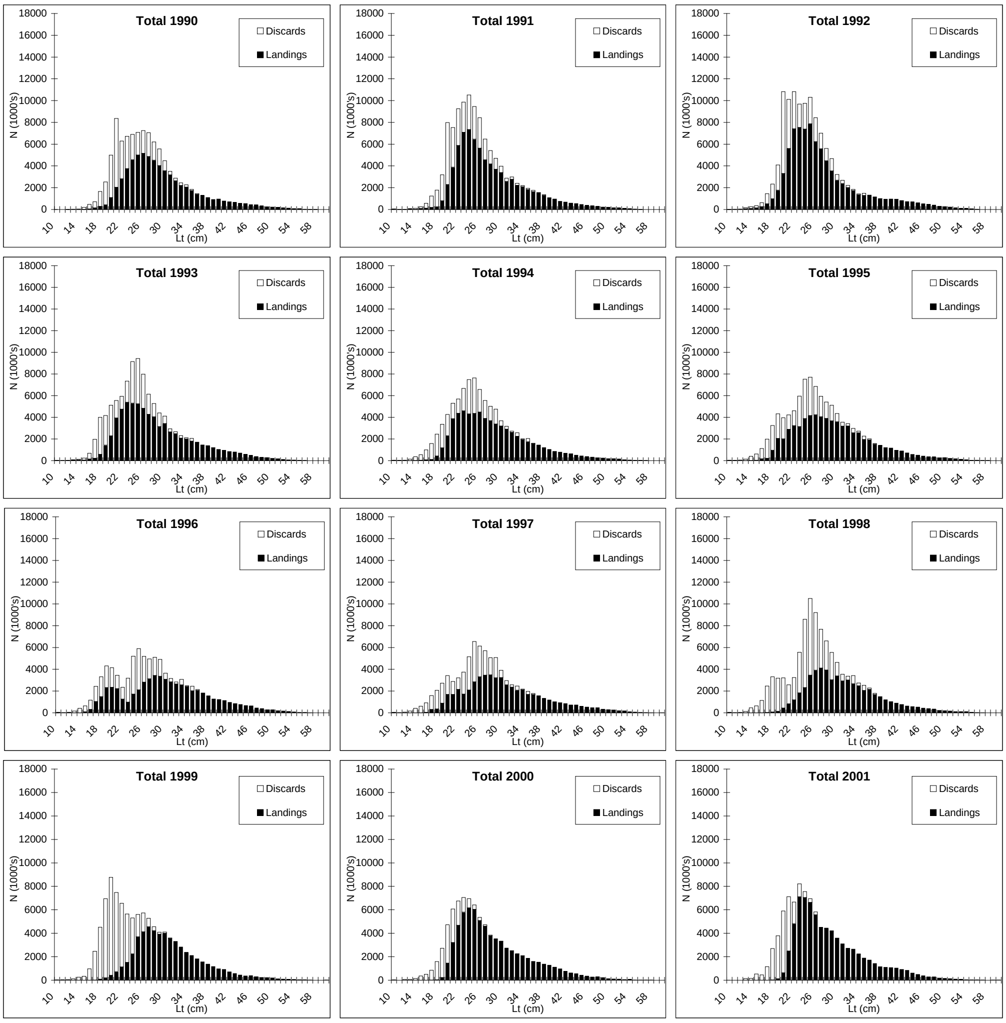


Figure 5.1 - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Length composition of catches for the years 1990 to 2008. 2009 international length distribution has not been derived due to lack of total catch data.

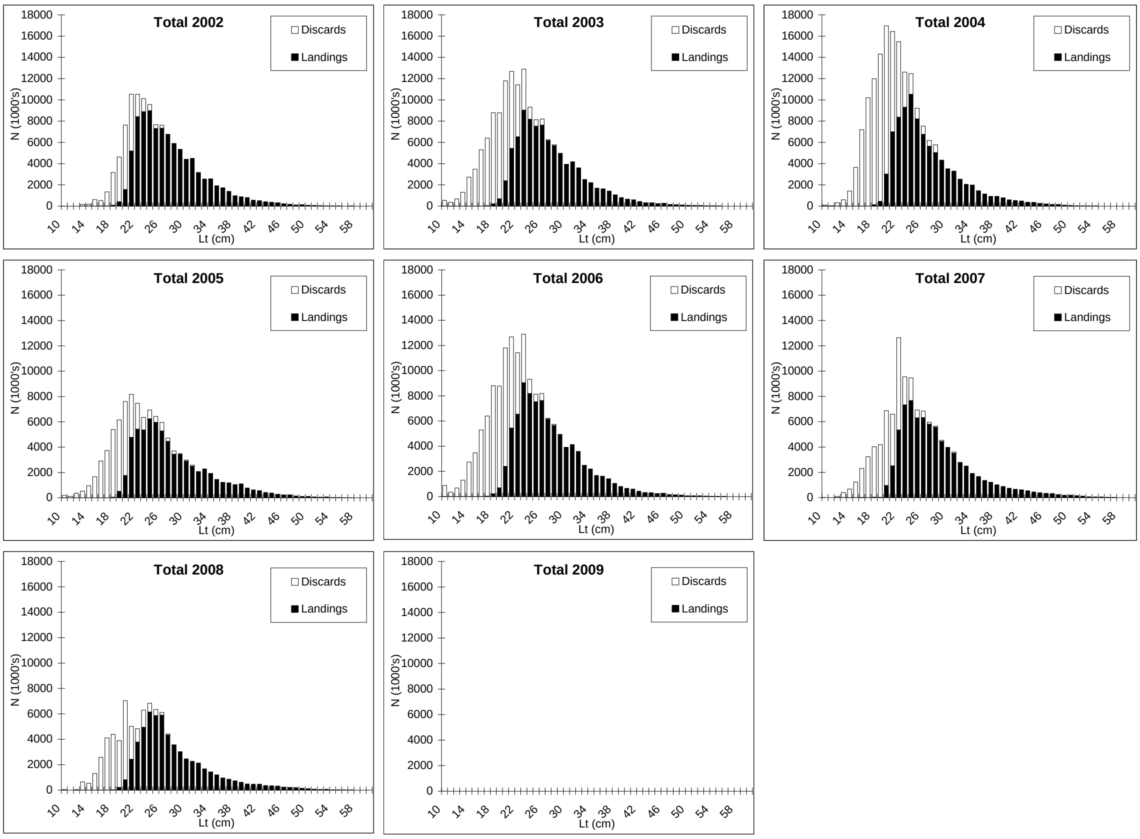


Figure 5.1 - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Length composition of catches for the years 1990 to 2008. 2009 international length distribution has not been derived due to lack of total catch data.

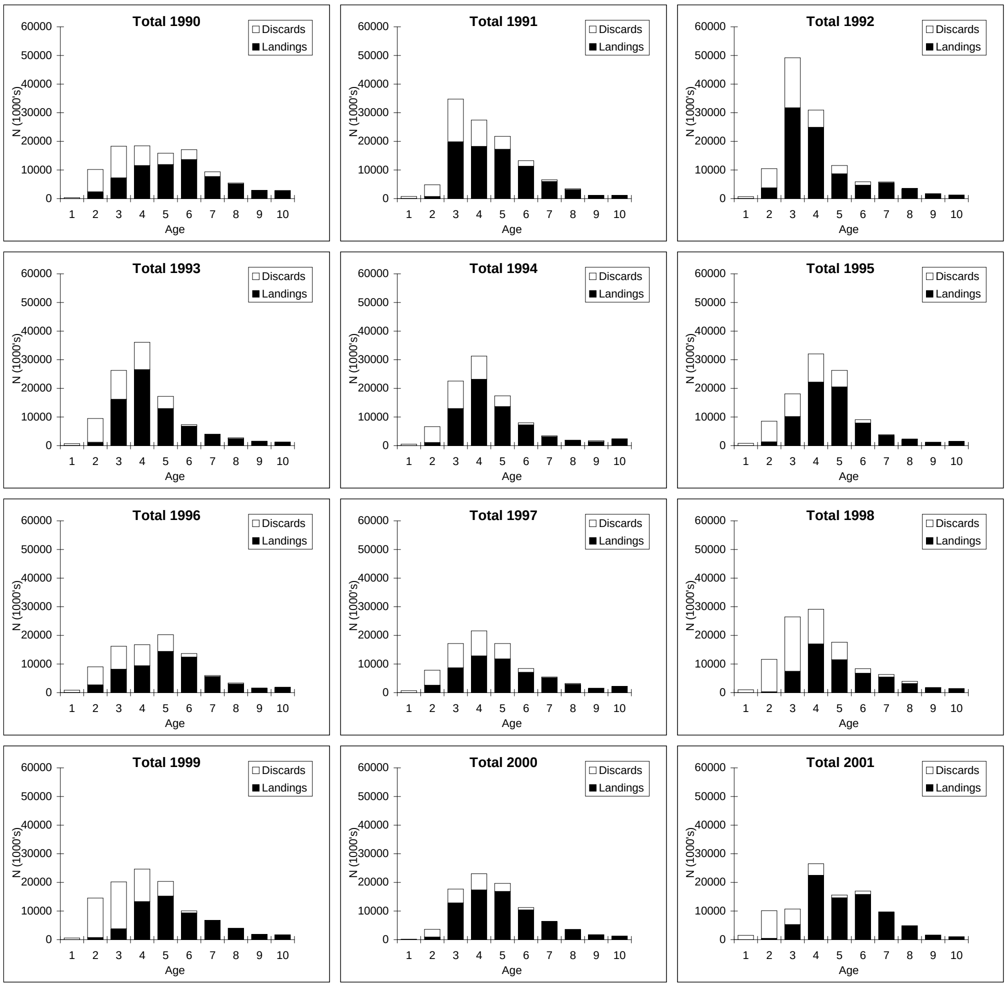


Figure 5.2. - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Age composition of catches for the years 1990 to 2009. 2009 international age composition has not been derived due to lack of total catch data.

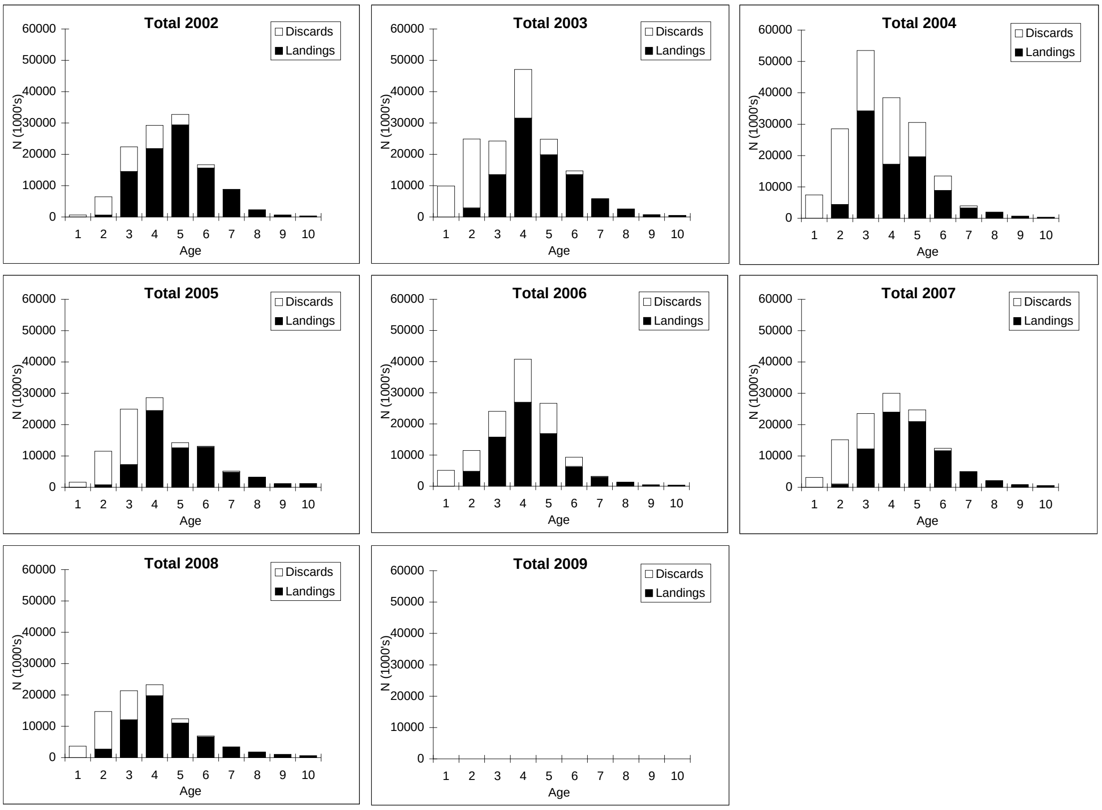


Figure 5.2. - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Age composition of catches for the years 1990 to 2009. 2009 international age composition has not been derived due to lack of total catch data.

Figure 5.3 Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Scaled Biomass Indices for EVHOE, SP-PGFS and IGFS

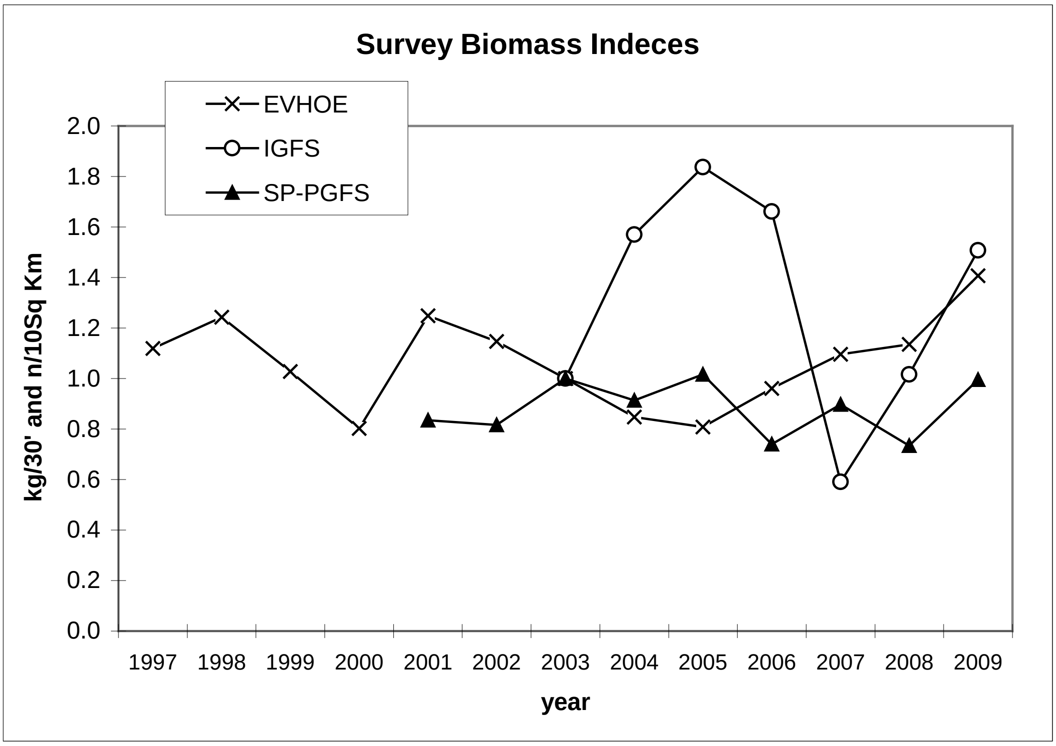


Figure 5.4a Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Evolution of effort for different bottom trawler fleets.

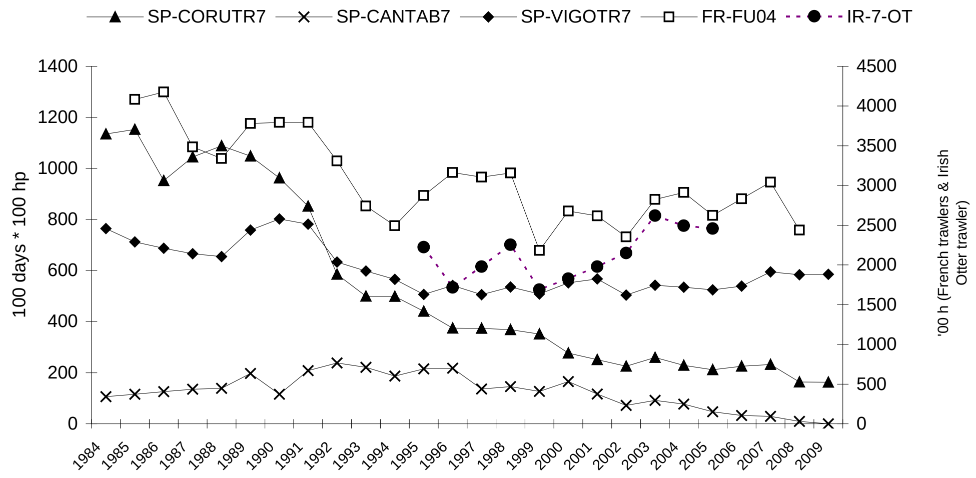


Figure 5.4b Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d. Spanish CPUE for different bottom trawler fleets.

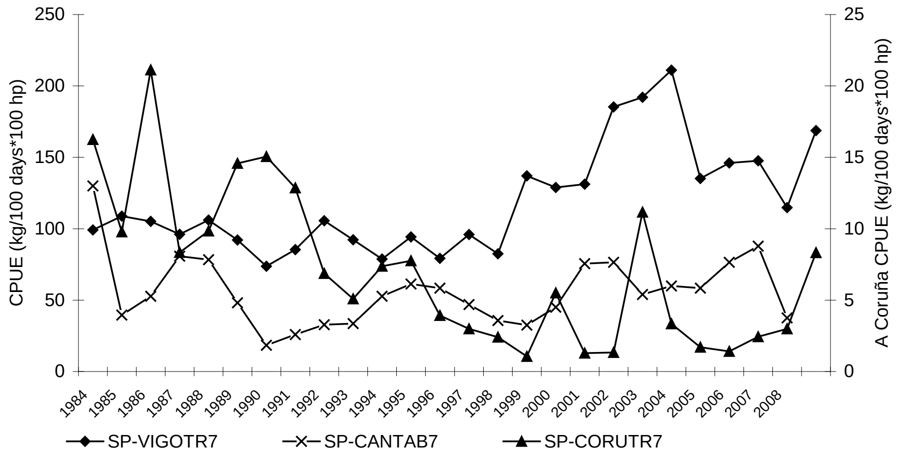
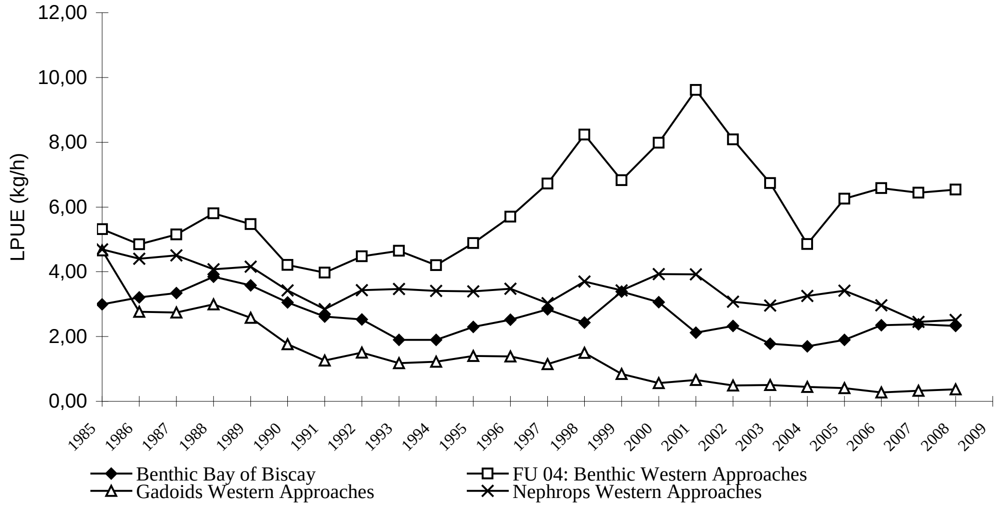


Figure 5.4c Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d. French LPUE for different bottom trawler fleet.



6 Bay of Biscay Sole

Type of assessment in 2010: update.

Data revisions this year: Compared to last year assessment, there is only very limited change in data due to small revisions of 2008 landings and of 2008 commercial LPUE.

Review Group issues:

- To avoid the repetitions between the report and the Stock annex, the ecosystem aspect, the fishery description and the input date (sections 6.1.1, 6.1.2 and 6.3.1) are completely transferred to the Stock annex.
- The RG question "Is the certainty of the catch time series the same for each year of the time series?" is addressed in the first paragraph of the section 6.2.1.
- The need to make clearer the explanation of the mean weight calculations is addressed in the Stock annex.

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 2010 and management applicable to 2009 and 2010

ICES advice for 2010:

ICES advises on the basis of exploitation boundaries in relation to precautionary considerations that landings for 2010 should not exceed 4 900 t.

Management applicable to 2009 and 2010

The sole landings in the Bay of Biscay are subject to a TAC regulation. The 2009 TAC was set at 4390 t. The 2010 TAC is set at 4829 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, to answer to the RG question about the certainty of these data

The 2008 landings estimate was revised 0.02% lower to 4299 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 3600t in 2009. According to the fishing industry, this marked decrease is due in 2009 to a change in target species of the fleet (growing interest for squids and cuttle fish) and to unfavourable meteorological and hydrodynamic conditions in the first quarter of the year.

The 2009 figure is 26 % below the landings predicted by the 2009 WG at status quo mortality (4867 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, they show that discards of offshore trawlers at age 2 and above are likely low in recent years.

Available discards estimates for a limited number of trips have shown that discards of beam trawlers and gillnetters are generally low but they show also that the inshore trawlers fleet may have occasionally high discards of sole (mainly at age 1).

6.2.2 Biological sampling

Length compositions are available on a quarterly basis from 1984 for the French fleets and from 1994 for the Belgian beam trawlers. The 2009 sampling level is given in table 1.3. The French length distributions are shown on Figures 6.2 a, b & c from 1984 onwards. The relative length distribution of landings in 2009 is shown by country in Table 6.3.

The quarterly French sampling for length compositions is by gear (trawl or fixed net) and 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 2008 split was slightly revised because of small correction in the database (Table 6.1 b).

The age distribution of catches was revised from 2005 onwards because the change in the age reading method in France. This latter was formerly carried out on burning otolith sections and it is now performed on otolith slices as in Belgium. This change causes only small differences in the total age distribution (Working document in ICES files). The discrepancy between French and Belgian mean weight at age, noticed by preceding WG, was thus only slightly reduced. A better agreement between French and Belgian age readers would certainly reduce this gap a bit more (about 80% of agreement for a reading comparison carried out in 2006 on a set of otoliths). However, a likely effect of the weight at age samples process may also be presumed (weight-length relationship in France and straight estimate) and should be investigated.

International age compositions are estimated using the same procedure as in previous years, as described in Stock Annex (Table 6.4 and Figures 6.3 a & b).

International mean weights at age of the catch are French-Belgian quarterly weighted mean weights (Table 6.5).

6.2.3 Abundance indices from surveys

Two CPUE RESSGASC surveys are available for the tuning process from 1987, but they are both terminated after 2002. Indices of abundance, measured in number per 100 hours, are presented in Table 6.6.

Since 2007, a new beam trawl survey is carried out by France to provide a sole abundance index in the Bay of Biscay. This survey is coordinated by the ICES WGBEAM. During its three first years, a particular attention has been paid to the effect of luminosity on the CPUE to check the need to work at night as underlined by the industry.

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.

A third French commercial fleet LPUE series was added in 2005. It is formed by offshore trawlers landing sole in other harbours than Les Sables and La Rochelle fleets. It was not updated for 2009 because some errors were found in the record of daily fishing effort in the data file and it was not possible to correct them before the WG meeting (contrary to La Rochelle and Les Sables trawler LPUE series which have been checked using copies of logbook provided by the producer organisations).

For the same reason, the estimate of the total effort of French offshore trawlers (using LPUE calculated for the whole trawler fleet) is not available in 2009 (Table 6.2a and Figure 6.1a). Up to 2008, this index shows that, after a decrease until 1999, the effort of this French trawler fleet has been stable in recent years. The effort time series of the Belgian beam trawl fleet does not show also any trend in recent years but some large variations.

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 (Figure 6.1b). 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. The "other French trawlers" series has remained relatively stable.

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 (Table 6.2b). Later on, its trend is flat.

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 1984-2009.

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.

Three commercial fleets (FR-SABLES, FR-ROCHELLE French offshore trawlers and BEL-BT Belgian beam trawlers) and two quarterly FR-RESSGASC-S survey CPUE series (from 1987 to 2002) are available for tuning (Table 6.7). 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 %
Offshore beam trawlers	BEL-BT	1997 – 2009	1 – 8	7 %

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 FR-SABLES and FR-ROCHELLE.

The Belgian beam trawlers fleet presents high residuals in comparison with the French commercial fleets and was excluded because of the discrepancy in age reading between France and Belgium, as in preceding years.

Exploratory run

The two RESSGASC fleets have no effect on recent years trends but, as noticed by the previous WG, they increase the fishing mortalities before 1992 and, inversely, lower the SSB (Figure 6.9). In order to limit change in historical trends and to have some coherence with preceding assessments, two series are kept in the tuning files, as agreed by the 2008 RG. The management plan in force for this stock, which includes a biomass target largely based on the SSB trend, reinforces particularly the need to be consistent in that case on choices which affect long term trend of the SSB.

Final XSA run

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

			2009 XSA			2010 XSA
Catch data range			84-08			84-09
Catch age range			2-8+			2-8+
Fleets	FR – SABLES	91-07	2-7	FR – SABLES	91-**09**	2-7
	FR – ROCHELLE	91-07	2-7	FR – ROCHELLE	91-**09**	2-7
	FR – RESSGASC2	87-02	2-7	FR – RESSGASC2	87-02	2-7
	FR – RESSGASC4	87-02	2-7	FR – RESSGASC4	87-02	2-7
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 6.8. The log-catchability residuals are shown in Figure 6.4 a & b and retrospective results in Figure 6.5. As in last year assessment, the retrospective patterns shows some diverging trends prior to 1991. This lack of convergence is reduced by the removal of the RESSGASC survey series. Differences in lengths of commercial series and in those of survey series and in their trend are likely to be the cause of this problem.

The two commercial fleets drive almost entirely the estimates of survivors. The FR-RESSGASC-S surveys have no weight at any age and the F shrinkage receives less than 2 % throughout. Commercial fleet estimates are close at ages 3 to 7 but at age 2, Les Sables estimate is 61% above La Rochelle estimate. However, they receive a close weight at all ages.

Fishing mortalities and stock numbers at age are given in Tables 6.9 and 6.10 respectively. The results are summarised in Table 6.11. Trends in yield, F, SSB and recruitments are plotted in Figure 6.6. Fishing mortality in 2009 is estimated by XSA to have been at 0.33. Fishing mortality in 2008 is now estimated at 0.39, a bit higher than last year WG report (0.38).

6.3.3 Assessment results

6.3.3.1 Estimating year class abundance

The 2006 year class is estimated to be 21.3 million 2 year olds by XSA. Last year's WG XSA estimate (21.2 million) was not accepted by the WG which preferred to overwrite this year class with the $GM_{93\text{-}07}$ (23.2 million) because the lack of reliability of the XSA estimates that shows the retrospective analysis. The present value indicates that this year class strength is below the average.

The 2007 year class is estimated to be at 19.9 million 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 $GM_{93\text{-}07}$, as in previous WG assessment. The estimates provided by each tuning fleet are largely different and, furthermore, the new ORHAGO survey indices tend to confirm the low precision of the XSA estimate of the recruitment in terminal year. Indeed, this survey indicates that the 2007 year class might be above recent year classes (Figure 6.7).

The XSA estimate was consequently overwritten by a short series $GM_{93\text{-}07}$ from 1993 up to two years before the terminal years (2007), as in preceding assessments, since there is observed fall in stock numbers at age 2 after 1993. This $GM_{93\text{-}07}$ is also used to estimate subsequent recruitments.

Recruitment at age 2

YEAR CLASS	THOUSANDS	BASIS	SURVEYS	COMMERCIAL	SHRINKAGE
2006	21299	XSA	0 %	98 %	2 %
2007	22809	GM(93-07)			
2008 & subsequent	22809	GM(93-07)			

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 6.11 and illustrated in Figure 6.6.

Since 1984, fishing mortality gradually has increased, peaked in 2002 and decreased substantially the following two years. It increased in 2005 and, later on, a decreasing trend is observed again, fishing mortality being 0.45 in 2005 and 0.39 in 2008 and 0.33 in 2009.

SSB trend in earlier years increases from 10600 t in 1984 to 16 600 t in 1993, afterwards it shows a continuous decrease to 9 800 t in 2003. After a 24 % increase between 2003 and 2006, the SSB remains close to 13000 t. It is estimated to be 12800 t in 2009, 3% lower than 2008.

The recruitment values are lower since 1993. Afterwards, the series is relatively stable, but few values below the average are worth noting since 2001.

6.3.4 Catch options and prognosis

The exploitation pattern is the scaled mean over the period 2007-2009 (over 2007-2008 at age 2), considering the decreasing trend in F in the last three years of the assessment and the information given by the industry on low catch in the beginning of the year (fixed net best fishing season) in 2010 because unfavourable meteorological and hydrodynamic conditions. This *status quo* F is estimated at 0.33.

The recruits at age 2 from 2010 to 2012 are assumed equal to $GM_{93\text{-}07}$. Stock number at age 3 in 2010 is derived from $GM_{93\text{-}07}$ reduced by total estimated mortality. Stock numbers at ages 4 and above in 2009 are the XSA estimates.

Weights at age in the landings are the 2007-2009 unweighted 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 2007-2009 unweighted means using the old fresh/gutted transformation coefficient of French landing (1.11). The predicted spawning biomass are 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 6.12.

The landings forecasts is 4142 t in 2010 (TAC is set at 4829 t), 13 % higher than the 2009 landings.

Assuming recruitment at GM_{93-07}, the SSB is predicted to increase to 14100 t in 2010 and to 14900 t in 2011, at *status quo* F. It will continue to grow at *status quo* F, to reach 15500t in 2012 (Tables 6.13 and 6.14).

The proportional contributions of recent year classes to the landings in 2011 and to the SSB in 2012 are given in Table 6.15. Year classes for which GM_{93-07} recruitment has been assumed (2007 to 2010) contribute 58 % of the 2011 landings and 68 % of the 2012 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 6.16 and in Figure 6.8. The $\mathbf{F}_{sq}$ (0.33) is 27 % above $\mathbf{F}_{max}$ (= 0.26) and 3 times $\mathbf{F}_{0.1}$ (=0.11). Long-term equilibrium landings and SSB (at F *status quo* and assuming GM recruitment) are estimated to be 4900 t and 16900 t respectively.

6.3.5 Biological reference points

The WG 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 Approach	MSY $B_{trigger}$	13000 t	Bpa
	F_{MSY}	0.26	Fmax because no stock-recruitment relationship, limited variations of recruitment, Fishing mortality pattern known with a low uncertainty
Precautionary Approach	B_{lim}	Not defined	
	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.
	F_{lim}	0.58	Based on the historical response of the stock.
	F_{pa}	0.42	F_{lim} * 0.72

Bpa is proposed as MSY $B_{trigger}$ in a first approach but it could be revised at the forthcoming benchmark (planned for this stock in early 2011).

Fmax is proposed as F_{MSY}. This proposal is supported by the absence of stock-recruitment relationship and the limited variations of recruitment, even at an exploitation rate largely above Fmax. This Fmax is relatively stable, the present value being equal to the mean of the value of Fmax estimated by the three last WGHMM for this stock. The fishing mortality pattern is known with a low uncertainty because of the limited discards and the satisfactory sampling level of the catches.

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 the 2007 year class at age 2 but this series must be continued to allow a better estimate of the incoming recruitment.

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 (otoliths exchange and analysis of weight at age estimate process).

Discarding

Available data on discards have shown that discards may be important at age 1 but they are likely low at age 2 and above in recent years. The limited available discards sampling does not allow to have an estimate of these discards.

Consistency

The RESSGASC series has been kept in the tuning series in view to have consistency in historical trends in F and SSB (Figure 6.9). Even if they do not contribute to terminal year estimates, the removal of these series changes rather substantially the earlier part of the trends. The WG preferred consequently to keep them in the tuning file to be consistent with preceding WGs. The implementation on a management plan aiming at a SSB target reinforces this need of consistency in trend on which are based reference points.

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 assessment. This GM estimate has a very large contribution in predicted landings and SSB. Furthermore, it is worth noting that variability of recruit series has increased since 2001 and that, in recent period, the use of GM estimate has lead several times to forecast an increase in SSB which was superior to the observed one in following years.

The retrospective pattern in F is worth noting up to 2007 but it is low in 2008 (Figure 6.5).

The definition of reference groups of vessels and the use of thresholds on species percentage to build the French series of commercial fishing effort data and LPUE indices is considered to provide representative LPUE of change in stock abundance by limiting the effect of long term change in fishing power (technological creep) and of change in fishing practices in the sole fishery.

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.

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 2010 WGHMM to assess the state of the Bay of Biscay sole stock. The participants did not express reservations on these data. An explanation of the catch decrease in 2009 was provided and it was indicated that the catch in the beginning of 2010 are also lower than before 2009. A working plan was adopted to be able to present new tuning fleets at the next benchmark with the cooperation of the industry.

6.3.6 Management considerations

The assessment indicates that SSB has decreased continuously to 9800 t in 2003, since a peak in 1993 (16 600 t), has increased to 12900t in 2006 but it remains close to 13000 t thereafter. It is forecast to be 14100t in 2010 at *status quo* F and assuming GM recruitment.

The management plan agreed in 2006 for this stock aims to bring the SSB at 13000 t in 2008 in a first step. According to the last forecast and the previous one carried out by the 2009 WGHHM, this aim has been reached and the plan should enter in its second step, with a decision on the long term target as well as on the rules to reach it.

Table **6.1 a** : Bay of Biscay sole (Division VIIIa,b). Internationnal 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		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	363	na					3600		

[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	2009
Shrimp trawlers	1	0	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	6
Offshore otter trawlers	29	26	26	30	30	24	21	24	18	24	23	21	19	21	19	18
Offshore beam trawlers	6	9	8	7	8	10	8	8	6	7	8	8	9	9	7	10
Fixed nets	52	53	54	52	52	61	63	59	70	60	60	63	64	61	69	66

Table **6.2 a** : Bay of Biscay sole LPUE and indices of fishing effort for French offshore trawlers.

Year	CPUE RESSGASC survey (kg/H) term		LPUE La Rochelle offshore trawlers of French sole fishery	LPUE Les Sables offshore trawlers of French sole fishery	LPUE Other harbours * offshore trawlers of French sole fishery	LPUE All offshore trawlers of French sole fishery	effort index All offshore trawlers of French sole fishery
	2	4	(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	0.7	1.1	6.6	5.9	4.6	5.4	816
1988	1.6	0.7	6.4	6.7	4.1	5.1	944
1989	1.2	0.9	5.5	6.1	4.5	5.1	996
1990	1.0	1.6	7.1	6.3	4.9	5.7	975
1991	1.1	2.2	6.5	6.5	4.7	5.4	954
1992	0.8	2.1	5.4	5.6	4.9	5.1	884
1993	1.0	1.5	4.6	6.4	4.9	5.2	791
1994	1.0	1.8	5.0	6.6	5.8	5.6	944
1995	1.0	1.8	4.6	5.4	5.0	5.2	742
1996	1.8	2.1	4.9	6.0	5.0	5.4	628
1997	1.2	1.4	4.1	5.3	4.6	4.7	774
1998	1.9	2.2	4.2	5.3	4.2	4.2	834
1999	1.1	0.9	3.7	5.9	4.2	4.5	524
2000	0.9	0.7	4.0	5.7	4.7	4.7	577
2001	1.0	1.0	3.4	4.0	5.2	4.7	454
2002	0.8	1.2	4.4	5.0	4.6	4.6	430
2003	-	-	4.1	3.9	4.8	4.6	447
2004	-	-	4.0	4.1	4.7	4.4	448
2005	-	-	3.9	5.2	4.2	4.2	495
2006	-	-	3.4	5.4	4.5	4.5	465
2007	-	-	3.5	5.3	4.6	4.5	440
2008	-	-	4.1	5.6	4.6	4.5	468
2009	-	-	3.3	5.2	na	na	na

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

Table **6.2 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

Table 6.3 : Bay of Biscay Sole - 2009
French and Belgian relative length distribution of landings

Length(cm)	France	Belgium
13	0.01	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	0.01	0.00
22	0.23	0.24
23	2.48	2.02
24	6.40	6.24
25	7.91	10.33
26	7.07	10.32
27	7.64	13.10
28	8.71	16.69
29	9.07	10.57
30	10.09	7.59
31	9.19	5.45
32	6.87	4.69
33	5.53	3.99
34	3.97	2.17
35	2.99	2.22
36	2.37	1.50
37	1.96	1.09
38	1.58	0.74
39	1.48	0.44
40	1.03	0.38
41	0.79	0.10
42	0.72	0.08
43	0.59	0.04
44	0.44	0.01
45	0.26	0.01
46	0.21	0.00
47	0.15	0.00
48	0.12	0.00
49	0.07	0.00
50	0.03	0.00
51	0.02	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

Table 6.4 : Bay of Biscay Sole, Catch number at age (in thousands)

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Age													
2	5901	8493	6126	3794	4962	4918	7122	4562	4640	1897	2603	3249	3027
3	3164	4606	4208	5634	5928	6551	6312	6302	7279	7816	5502	5663	5180
4	2786	2479	2673	3578	4191	3802	4423	4512	4920	6879	8803	6356	5409
5	2034	1962	2301	2005	2293	3147	2833	2083	2991	3661	5040	3644	2343
6	1164	906	1512	1482	1388	2046	972	1113	2236	1625	1968	1795	1697
7	880	708	1044	690	874	967	1018	1063	1124	566	970	843	1366
+gp	1181	729	1235	714	766	499	870	981	951	708	696	986	1319
TOTALNUM	17110	19883	19099	17897	20402	21930	23550	20616	24141	23152	25582	22536	20341
TONSLAND	4038	4251	4805	5086	5382	5845	5916	5569	6550	6420	7229	6205	5854
SOPCOF %	107	103	102	102	101	101	100	102	100	100	100	100	100

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	3801	4096	2851	5677	3004	5192	4213	3396	3973	3574	3821	3172	2432
3	9079	5550	5113	7015	6447	4770	6315	5391	3467	4443	5175	4782	3894
4	5380	6351	4870	5143	4942	4945	2246	3300	3743	2746	2617	2882	2259
5	3063	2306	2764	2542	1807	3095	1225	920	2307	2009	1422	1352	1545
6	1578	1237	1314	955	929	1261	730	662	988	1029	1264	939	974
7	692	785	902	421	522	613	377	272	460	529	687	893	567
+gp	877	1188	977	444	489	437	251	333	509	1531	949	1195	991
TOTALNUM	24470	21513	18791	22197	18140	20313	15357	14274	15447	15861	15935	15215	12662
TONSLAND	6259	6027	5249	5760	4836	5486	4108	4002	4539	4793	4363	4299	3600
SOPCOF %	100	101	100	101	101	101	101	101	102	101	100	100	100

Table 6.5 : Bay of Biscay Sole, Catch weight at age (in kg)

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Age													
2	0.121	0.106	0.102	0.141	0.134	0.136	0.131	0.143	0.146	0.145	0.147	0.16	0.159
3	0.168	0.174	0.173	0.201	0.19	0.188	0.179	0.192	0.196	0.197	0.195	0.206	0.204
4	0.213	0.252	0.245	0.285	0.272	0.258	0.241	0.26	0.262	0.267	0.251	0.252	0.268
5	0.269	0.313	0.328	0.376	0.357	0.354	0.348	0.325	0.341	0.341	0.324	0.308	0.319
6	0.329	0.39	0.409	0.467	0.495	0.437	0.436	0.437	0.404	0.439	0.421	0.403	0.399
7	0.368	0.457	0.498	0.497	0.503	0.543	0.601	0.535	0.49	0.569	0.569	0.484	0.453
+gp	0.573	0.698	0.657	0.682	0.604	0.799	0.854	0.715	0.715	0.677	0.774	0.658	0.625
SOPCOFAC	1.0712	1.0302	1.0197	1.0248	1.008	1.0055	1.0039	1.0183	1.0004	1.0008	1.0016	1.0023	0.9998

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*	2008*	2009*
Age													
2	0.142	0.161	0.177	0.171	0.153	0.171	0.18	0.19	0.189	0.194	0.176	0.174	0.173
3	0.193	0.212	0.219	0.207	0.22	0.209	0.226	0.228	0.226	0.242	0.226	0.229	0.217
4	0.256	0.257	0.246	0.276	0.266	0.263	0.307	0.291	0.298	0.282	0.299	0.287	0.277
5	0.319	0.335	0.305	0.343	0.344	0.319	0.362	0.391	0.367	0.347	0.327	0.352	0.32
6	0.406	0.41	0.404	0.452	0.429	0.465	0.487	0.493	0.43	0.42	0.388	0.392	0.363
7	0.502	0.501	0.533	0.573	0.52	0.592	0.657	0.643	0.468	0.455	0.42	0.402	0.453
+gp	0.678	0.7	0.582	0.755	0.62	0.686	0.643	0.81	0.658	0.531	0.513	0.52	0.601
SOPCOFAC	1.0048	1.0091	1.0006	1.0066	1.0102	1.0119	1.0061	1.0092	1.0151	1.0142	1.0018	1.0001	1.0023

(*) In 2007, 2008 and 2009, French catch weight at age computed using the new fresh/gutted transformation coefficient (1.04)
Before 2007, the French fresh/gutted transformation coefficient is 1.11
The Belgian fresh/gutted transformation coefficient is 1.05

Table 6.6 : Ressgasc indices of sole VIIIa,b abundance (No/100h)

FR - RESSGASC 2

Year \ Age	1	2	3	4	5	6	7	8
1987	9	106	85	51	18	15	3	15
1988	215	557	228	95	47	17	4	2
1989	21	279	200	64	32	14	12	6
1990	7	441	129	73	34	4	6	2
1991	7	189	181	128	45	19	7	13
1992	0	78	139	116	42	19	3	13
1993	0	43	150	146	97	28	15	13
1994	3	218	166	133	38	10	8	5
1995	30	155	165	80	44	28	23	10
1996	18	359	504	266	53	30	12	11
1997	24	180	385	130	41	16	9	13
1998	1	375	338	311	82	31	18	4
1999	5	220	226	94	41	30	9	2
2000	2	153	156	126	48	13	7	6
2001	11	179	181	106	34	25	13	5
2002	4	132	140	62	35	10	7	3

FR - RESSGASC 4

Year \ Age	1	2	3	4	5	6	7	8
1987	503	160	109	54	24	10	3	3
1988	212	152	79	25	14	11	6	1
1989	87	137	93	48	35	29	8	5
1990	67	390	203	77	49	10	10	10
1991	397	553	298	88	20	9	4	3
1992	107	860	283	65	25	9	3	4
1993	87	218	234	111	46	24	1	0
1994	99	333	272	128	44	6	5	12
1995	201	463	230	105	47	12	4	4
1996	323	513	221	96	27	8	11	11
1997	76	177	272	103	44	19	12	13
1998	75	371	396	224	33	18	9	6
1999	15	174	114	88	21	14	8	2
2000	23	74	79	66	36	7	4	3
2001	26	132	143	92	33	11	2	2
2002	54	164	146	51	36	19	5	3

Table 6.7 : Sole 8ab, available tuning data (landings)

SOLE VIIIa,b commercial landings (N in 10**-3) and survey catch - Fishing effort in hours

Series, year and range used in tuning are shown in bold type

FR - SABLES

Year	Fishing effort	1	**2**	**3**	**4**	**5**	**6**	**7**	8
1991	33763	30.5	**242.1**	**332.8**	**194.7**	**73.8**	**32.4**	**23.6**	19.5
1992	30445	3.7	**236.8**	**285.8**	**130.2**	**59.5**	**32.1**	**15.0**	11.9
1993	34273	3.7	**152.0**	**441.3**	**224.0**	**75.7**	**27.0**	**8.0**	10.9
1994	20997	1.2	**94.1**	**157.4**	**184.3**	**77.3**	**24.2**	**13.4**	10.8
1995	31759	7.3	**173.4**	**228.1**	**177.1**	**69.1**	**34.1**	**15.9**	19.5
1996	31518	13.0	**193.0**	**222.6**	**169.8**	**55.6**	**37.8**	**29.4**	23.2
1997	27040	5.0	**140.9**	**290.9**	**114.2**	**49.0**	**26.7**	**10.6**	11.4
1998	16260	0.8	**86.9**	**112.1**	**113.6**	**31.4**	**13.8**	**8.1**	7.7
1999	12528	0.0	**64.9**	**53.2**	**39.7**	**26.8**	**15.0**	**15.2**	17.6
2000	11271	3.4	**81.3**	**121.3**	**45.0**	**15.7**	**8.4**	**4.7**	4.7
2001	9459	2.4	**35.2**	**67.8**	**35.8**	**8.7**	**5.1**	**2.9**	2.0
2002	10344	7.2	**76.9**	**60.5**	**37.7**	**19.4**	**8.3**	**3.8**	1.7
2003	7354	1.5	**39.1**	**49.3**	**14.3**	**7.8**	**4.0**	**1.7**	0.6
2004	6909	2.7	**38.7**	**36.4**	**23.0**	**5.7**	**3.9**	**1.7**	1.8
2005	6571	6.6	**46.3**	**26.0**	**24.8**	**15.4**	**6.5**	**3.3**	3.3
2006	6223	7.6	**62.5**	**29.6**	**11.9**	**6.6**	**3.7**	**2.4**	6.3
2007	5954	1.0	**31.5**	**28.4**	**18.2**	**12.5**	**10.7**	**6.6**	8.2
2008	4321	0.0	**22.8**	**23.0**	**16.7**	**8.1**	**5.3**	**4.9**	7.7
2009	3577	0.7	**23.0**	**22.6**	**9.9**	**7.1**	**4.2**	**2.4**	5.6

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	3.6	**63.3**	**45.1**	**19.3**	**6.5**	**2.7**	**1.4**	2.6
2001	7074	2.1	**22.4**	**38.1**	**23.9**	**6.2**	**3.8**	**2.0**	1.9
2002	6957	9.1	**90.1**	**36.2**	**11.8**	**5.4**	**2.3**	**1.2**	0.4
2003	5028	2.2	**37.4**	**40.0**	**9.1**	**3.7**	**1.8**	**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	**17.5**	**10.6**	**8.8**	**5.3**	**2.4**	**1.1**	1.3
2006	2304	1.5	**10.8**	**8.2**	**3.8**	**2.4**	**1.3**	**0.6**	1.9
2007	2553	0.2	**12.3**	**21.4**	**4.5**	**1.9**	**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	**4.9**	**7.1**	**2.3**	**1.3**	**0.7**	**0.4**	0.6

FR - RESSGASC 2

Year	Fishing effort	1	2	3	4	5	6	7	8
1987	80	7.0	84.9	67.7	40.9	14.1	11.8	2.0	11.7
1988	85	182.9	473.2	193.6	81.1	39.9	14.5	3.8	2.0
1989	82	17.3	228.9	163.6	52.8	26.6	11.3	9.5	5.0
1990	85	6.2	375.2	110.0	61.7	29.0	3.8	5.0	2.0
1991	87	6.0	164.2	157.1	111.7	39.3	16.5	6.2	11.0
1992	85	0.0	66.5	118.1	98.6	35.6	16.5	2.7	11.0
1993	76	0.0	32.7	113.6	111.3	73.9	21.4	11.5	9.5
1994	79	2.7	172.4	130.9	104.7	30.3	8.0	6.0	4.0
1995	82	24.3	126.8	135.3	65.7	35.8	22.7	19.0	8.4
1996	74	13.0	265.9	372.7	196.6	39.0	22.4	8.9	8.5
1997	98	23.4	176.4	377.7	127.7	40.4	15.6	8.8	13.0
1998	85	0.6	318.5	287.2	264.4	69.8	26.3	15.6	3.6
1999	82	4.0	180.3	185.5	77.4	33.2	24.3	7.2	2.0
2000	78	1.4	119.4	121.4	98.3	37.7	10.3	5.4	5.0
2001	84	9.4	150.2	152.2	89.4	28.5	21.1	11.0	4.2
2002	47	2.0	61.9	66.0	29.2	16.4	4.8	3.2	1.5

FR - RESSGASC 4

Year	Fishing effort	1	2	3	4	5	6	7	8
1987	79	397.7	126.7	86.1	42.4	18.8	7.8	2.5	2.0
1988	93	197.6	141.2	73.7	23.3	13.4	10.0	5.6	1.2
1989	65	56.5	89.1	60.2	31.5	22.5	18.8	5.5	3.0
1990	72	48.5	280.9	146.1	55.6	35.5	7.5	7.5	7.5
1991	74	293.5	409.1	220.2	64.8	14.6	6.6	2.7	2.5
1992	72	76.7	619.4	203.8	46.5	17.9	6.2	2.5	3.0
1993	71	62.1	155.1	166.2	79.1	32.5	17.0	1.0	0.0
1994	60	59.2	199.9	162.9	76.8	26.4	3.8	3.0	7.0
1995	90	180.8	416.7	206.9	94.3	42.0	11.2	3.9	3.3
1996	61	196.8	312.8	135.1	58.6	16.6	5.0	6.5	6.5
1997	67	50.8	118.7	182.5	69.3	29.7	13.0	8.1	8.8
1998	73	55.0	270.7	288.7	163.7	24.1	12.9	6.3	4.6
1999	78	12.0	135.8	88.6	68.3	16.5	10.9	6.3	1.5
2000	38	8.6	28.0	30.2	25.2	13.6	2.8	1.6	1.0
2001	77	20.0	101.3	109.8	70.6	25.3	8.4	1.7	1.8
2002	68	36.4	111.7	99.4	34.5	24.6	12.9	3.6	1.7

BEL-BT

Year	Fishing effort	1	2	3	4	5	6	7	8
1997	10740		179.5	390.3	192.1	148.7	61.5	49.0	83.3
1998	11162		48.3	176.1	216.1	99.1	91.6	59.8	196.8
1999	14668		19.0	367.4	420.6	293.2	159.0	118.2	316.0
2000	11566		433.3	656.7	208.8	68.8	25.2	15.3	21.2
2001	13278		144.7	313.3	298.6	184.8	77.7	57.7	81.7
2002	12851		0.0	85.8	309.0	272.0	131.3	56.9	137.4
2003	11198		113.3	599.1	183.0	78.3	44.0	29.7	106.8
2004	12175		393.1	801.0	190.5	67.4	46.9	17.3	42.6
2005	15017		336.5	565.7	318.2	145.3	90.3	31.3	70.0
2006	16699		141.0	605.6	385.0	255.4	127.3	71.4	69.0
2007	16270		554.1	691.6	335.6	151.9	71.6	37.5	113.6
2008	12946		402.8	794.0	140.9	61.8	50.7	20.3	28.2
2009	16159		99.7	692.5	357.8	187.0	99.6	86.9	123.3

Table 6.8

```
Lowestoft VPA Version 3.1

   6/05/2010  11:23

Extended Survivors Analysis

SOLE VIIIa,b

CPUE data from file tunfilt.dat

Catch data for  26 years. 1984 to 2009. Ages  2 to   8.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                   ,    year, year,  age ,  age
FR-SABLES           ,   1991, 2009,   2,     7,   .000,  1.000
FR-ROCHELLE         ,   1991, 2009,   2,     7,   .000,  1.000
FR-RESSGASC-2       ,   1987, 2009,   2,     7,   .270,   .500
FR-RESSGASC-4       ,   1987, 2009,   2,     7,   .830,   .960


Time series weights :

     Tapered time weighting not applied


Catchability analysis :

     Catchability independent of stock size for all ages

     Catchability independent of age for ages >=    6


Terminal population estimation :

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

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

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

     Prior weighting not applied


Tuning had not converged after   30 iterations


Total absolute residual between iterations
29 and  30 =     .00034

Final year F values
Age         ,      2,      3,      4,      5,      6,      7
Iteration 29,  .1376,  .2902,  .3427,  .3047,  .3775,  .4018
Iteration 30,  .1376,  .2901,  .3426,  .3047,  .3774,  .4017



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,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009

     2,  .272,  .209,  .245,  .198,  .227,  .241,  .189,  .230,  .170,  .138
     3,  .476,  .499,  .524,  .466,  .370,  .339,  .412,  .405,  .442,  .290
     4,  .760,  .645,  .796,  .444,  .420,  .421,  .435,  .403,  .367,  .343
     5,  .710,  .584,  .985,  .405,  .291,  .515,  .372,  .374,  .333,  .305
     6,  .502,  .541,  .946,  .575,  .354,  .514,  .404,  .375,  .403,  .377
     7,  .416,  .501,  .742,  .735,  .386,  .395,  .506,  .458,  .440,  .402
```

Table 6.8 (cont'd)

XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7
2000	2.50E+04	1.95E+04	1.02E+04	5.25E+03	2.54E+03	1.30E+03
2001	1.67E+04	1.72E+04	1.09E+04	4.30E+03	2.34E+03	1.39E+03
2002	2.52E+04	1.23E+04	9.47E+03	5.19E+03	2.17E+03	1.23E+03
2003	2.47E+04	1.78E+04	6.59E+03	3.87E+03	1.75E+03	7.62E+02
2004	1.76E+04	1.83E+04	1.01E+04	3.82E+03	2.33E+03	8.93E+02
2005	1.95E+04	1.27E+04	1.15E+04	6.02E+03	2.59E+03	1.48E+03
2006	2.18E+04	1.38E+04	8.18E+03	6.80E+03	3.25E+03	1.40E+03
2007	1.96E+04	1.63E+04	8.30E+03	4.79E+03	4.24E+03	1.97E+03
2008	2.13E+04	1.41E+04	9.86E+03	5.02E+03	2.98E+03	2.64E+03
2009	1.99E+04	1.63E+04	8.19E+03	6.18E+03	3.26E+03	1.80E+03

Estimated population abundance at 1st Jan 2010

	0.00E+00	1.57E+04	1.10E+04	5.26E+03	4.13E+03	2.02E+03

Taper weighted geometric mean of the VPA populations:

	2.45E+04	1.81E+04	1.10E+04	6.00E+03	3.19E+03	1.66E+03

Standard error of the weighted Log(VPA populations) :

	.1911	.2148	.2393	.2264	.2295	.3299

1

Log catchability residuals.

Fleet : FR-SABLES

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	99.99	-.23	-.14	-.39	-.41	-.09	-.21	-.12	-.04	-.18
3	99.99	.14	-.15	.19	-.08	-.14	.00	.24	.03	-.38
4	99.99	.17	-.23	-.05	.40	.17	.05	.04	.48	-.18
5	99.99	.14	-.10	-.06	.28	.03	-.08	-.19	.18	.31
6	99.99	-.08	.21	-.36	.05	-.22	.23	-.02	-.38	.41
7	99.99	.20	.00	-.25	.19	.05	.45	-.09	.04	.54

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	.19	-.10	.21	-.13	.27	.41	.62	.11	-.01	.24
3	.43	.15	.30	.04	-.27	-.21	-.08	-.24	.03	-.01
4	.18	.00	.17	-.25	-.15	-.15	-.48	-.04	.00	-.16
5	-.03	-.30	.39	-.13	-.43	.27	-.71	.32	.14	-.02
6	-.04	-.26	.39	.05	-.30	.23	-.56	.27	.26	.11
7	.01	-.33	.09	.10	-.15	.06	-.10	.60	.32	.16

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	-15.0731	-14.5622	-14.5298	-14.7331	-14.7185	-14.7185
S.E(Log q)	.2693	.2097	.2321	.2828	.2807	.2675

Regression statistics :

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

Table 6.8 (cont'd)

```
 Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q


  2,    3.03,   -2.423,     25.20,     .08,     19,     .72,  -15.07,
  3,     .89,     .592,     14.03,     .62,     19,     .19,  -14.56,
  4,     .70,    2.402,     12.95,     .79,     19,     .14,  -14.53,
  5,     .89,     .488,     14.04,     .52,     19,     .26,  -14.73,
  6,    1.23,    -.700,     16.25,     .36,     19,     .35,  -14.72,
  7,     .67,    3.448,     12.26,     .87,     19,     .13,  -14.62,
1

 Fleet : FR-ROCHELLE

  Age  ,  1990,  1991,  1992,  1993,  1994,  1995,  1996,  1997,  1998,  1999
     2 , 99.99,  -.08,  -.18,  -.46,  -.39,  -.04,   .33,  -.05,   .20,  -.02
     3 , 99.99,   .23,   .00,   .03,  -.18,  -.07,   .09,   .15,  -.06,  -.44
     4 , 99.99,   .49,   .17,  -.17,   .34,   .34,  -.10,  -.04,   .51,  -.20
     5 , 99.99,   .51,   .22,  -.04,   .23,   .24,  -.33,  -.32,   .03,   .21
     6 , 99.99,   .21,   .37,  -.23,   .13,  -.34,  -.13,  -.02,  -.52,   .49
     7 , 99.99,   .27,   .22,  -.02,  -.01,  -.09,  -.13,  -.20,  -.05,   .21


  Age  ,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008,  2009
     2 ,   .19,  -.32,   .70,   .14,   .34,   .07,  -.20,  -.04,   .06,  -.25
     3 ,  -.21,  -.09,   .23,   .26,  -.06,  -.37,  -.32,   .37,   .45,  -.01
     4 ,  -.06,   .20,  -.28,  -.01,  -.21,  -.18,  -.32,  -.29,   .01,  -.20
     5 ,  -.15,   .11,  -.03,  -.04,  -.41,   .35,  -.27,  -.25,   .08,  -.15
     6 ,  -.34,   .26,   .03,   .16,  -.20,   .46,  -.08,  -.25,   .04,  -.04
     7 ,  -.37,   .12,  -.14,  -.22,  -.07,   .18,   .04,  -.27,   .18,   .00



 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,  -15.0142,  -14.6086,  -14.8365,  -15.1952,  -15.2464,  -15.2464,
 S.E(Log q),     .2820,     .2446,     .2660,     .2554,     .2821,     .1814,


 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,    1.00,     .001,     15.01,     .34,     19,     .29,  -15.01,
  3,     .94,     .271,     14.30,     .52,     19,     .24,  -14.61,
  4,     .67,    2.310,     13.04,     .75,     19,     .16,  -14.84,
  5,     .79,    1.156,     13.82,     .64,     19,     .20,  -15.20,
  6,    1.72,   -1.663,     20.42,     .24,     19,     .46,  -15.25,
  7,     .81,    1.992,     13.74,     .86,     19,     .13,  -15.26,
1

 Fleet : FR-RESSGASC-2

  Age  ,  1987,  1988,  1989
     2 ,  -.53,  1.07,   .32
     3 ,  -.79,   .24,   .08
     4 ,  -.75,  -.16,  -.49
     5 ,  -.84,  -.05,  -.34
     6 ,  -.14,  -.07,  -.41
     7 ,  -.67,  -.48,   .33
```

Table 6.8 (cont'd)

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	.67	-.34	-1.21	-1.48	.10	-.12	.49	.04	.84	.19
3	-.44	-.19	-.69	-.59	-.22	-.24	1.03	.57	.68	.35
4	-.35	.08	-.13	-.14	-.10	-.37	.75	.26	1.06	.00
5	-.25	.05	-.17	.59	-.52	-.11	.19	-.20	.80	.11
6	-1.46	.01	.21	.32	-.68	.13	.55	-.15	.33	.71
7	-.36	-.39	-1.06	1.01	-.24	.97	.09	.14	.74	-.38

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	-.14	.40	-.30	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	-.15	.13	.23	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	.42	.13	-.21	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	.38	.18	.17	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	-.06	.68	.01	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	-.06	.53	.10	99.99	99.99	99.99	99.99	99.99	99.99	99.99

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

Age	2	3	4	5	6	7
Mean Log q	-9.4234	-9.0650	-9.0801	-9.3593	-9.5768	-9.5768
S.E(Log q)	.6828	.5111	.4558	.4065	.5402	.5916

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	5.84	-.860	5.78	.00	16	4.02	-9.42
3	-4.24	-2.061	13.45	.01	16	1.96	-9.06
4	.87	.218	9.13	.18	16	.41	-9.08
5	3.08	-1.394	10.57	.03	16	1.21	-9.36
6	2.76	-.935	12.17	.02	16	1.50	-9.58
7	2.87	-1.033	13.61	.02	16	1.70	-9.56

1

Fleet : FR-RESSGASC-4

Age	1987	1988	1989
2	-.38	-.47	-.64
3	-.48	-.74	-.59
4	-.47	-1.24	-.53
5	-.33	-1.02	.04
6	-.18	-.22	.72
7	.13	.30	.48

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	.33	.46	.91	-.17	.23	.70	.55	-.23	.58	-.33
3	.08	.36	.05	-.09	.31	.13	.26	.35	.91	-.26
4	.01	-.05	-.46	-.14	.27	.26	.02	.39	1.12	.28
5	.41	-.56	-.42	.15	-.02	.30	-.23	.15	.17	-.18
6	-.41	-.50	-.03	.48	-.76	-.37	-.37	.40	.00	.33
7	.69	-.65	-.46	-.95	-.25	-.32	.48	.79	.35	-.17

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	-1.08	-.16	-.31	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	-.70	.02	.41	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	.19	.33	.02	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	.43	.43	.69	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	-.36	.15	1.14	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	-.33	-.97	.25	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Table 6.8 (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,	-9.0202,	-8.8853,	-9.0533,	-9.2955,	-9.5465,	-9.5465,
S.E(Log q),	.5533,	.4575,	.5199,	.4406,	.5046,	.5566,

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,	.48,	1.452,	9.62,	.36,	16,	.26,	-9.02,
3,	1.11,	-.160,	8.78,	.13,	16,	.52,	-8.89,
4,	.95,	.065,	9.07,	.12,	16,	.51,	-9.05,
5,	2.29,	-1.045,	9.96,	.04,	16,	1.01,	-9.30,
6,	5.21,	-1.302,	15.61,	.01,	16,	2.57,	-9.55,
7,	.74,	.586,	9.01,	.26,	16,	.42,	-9.59,

Terminal year survivor and F summaries :

Age 2 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 ,	20034.,	.276,	.000,	.00,	1,	.513,	.109
FR-ROCHELLE ,	12240.,	.289,	.000,	.00,	1,	.467,	.173
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	9803.,	1.50,,,,				.020,	.212

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
15687.,	.20,	.18,	3,	.903,	.138

Age 3 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 ,	10914.,	.170,	.002,	.01,	2,	.552,	.292
FR-ROCHELLE ,	11213.,	.190,	.034,	.18,	2,	.438,	.285
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	7656.,	1.50,,,,				.010,	.395

Table 6.8 (cont'd)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
11005.,	.13,	.02,	5,	.179,	.290

Age 4 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
FR-SABLES ,	5046.,	.143,	.078,	.54,	3,	.557,	.355
FR-ROCHELLE ,	5571.,	.162,	.206,	1.28,	3,	.434,	.326
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	4235.,	1.50,,,,				.009,	.410

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
5259.,	.11,	.09,	7,	.823,	.343

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

Year class = 2004

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FR-SABLES ,	4173.,	.133,	.147,	1.11,	4,	.518,	.302
FR-ROCHELLE ,	4095.,	.143,	.117,	.82,	4,	.474,	.307
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000

F shrinkage mean , 3197., 1.50,,,, .008,
.378

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
4127.,	.10,	.08,	9,	.844,	.305

1

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

Year class = 2003

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
FR-SABLES ,	2181.,	.128,	.066,	.52,	5,	.511,	.354
FR-ROCHELLE ,	1868.,	.135,	.079,	.59,	5,	.481,	.403
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	1821.,	1.50,,,,				.008,	.411

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
2021.,	.09,	.05,	11,	.558,	.377

Table 6.8 (cont'd)

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

Year class = 2002

Fleet,		Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,		Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
FR-SABLES	,	1179.,	.126,	.119,	.94,	6,	.439,	.377
FR-ROCHELLE	,	1024.,	.122,	.074,	.61,	6,	.554,	.423
FR-RESSGASC-2	,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4	,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean	,	1320.,	1.50,,,,				.008,	.342

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
1091.,	.09,	.07,	13,	.746,	.402

1
1

Table 6.9 : Bay of Biscay Sole, Fishing mortality (F) at age

Terminal Fs derived using XSA (With F shrinkage)

YEAR		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE														
	2	0.3162	0.3869	0.2633	0.1758	0.2165	0.202	0.2641	0.1433	0.1474	0.0827	0.1094	0.1548	0.1137
	3	0.2815	0.3869	0.2993	0.3655	0.4034	0.435	0.3819	0.3504	0.3169	0.3506	0.3233	0.3256	0.3495
	4	0.414	0.3306	0.3609	0.3973	0.4506	0.4343	0.5219	0.458	0.4496	0.4935	0.7396	0.6682	0.5213
	5	0.4172	0.5094	0.514	0.4467	0.4238	0.6394	0.5939	0.441	0.5544	0.6289	0.7269	0.6951	0.4899
	6	0.3849	0.2942	0.8341	0.6508	0.5637	0.7349	0.3648	0.4341	1.0716	0.5886	0.7342	0.5458	0.7272
	7	0.4066	0.3792	0.5719	1.0701	0.9105	0.8746	0.9082	0.7593	0.9333	0.7703	0.7522	0.7197	0.943
+gp		0.4066	0.3792	0.5719	1.0701	0.9105	0.8746	0.9082	0.7593	0.9333	0.7703	0.7522	0.7197	0.943
0 FBAR 3- 6		0.3744	0.3803	0.5021	0.4651	0.4604	0.5609	0.4656	0.4209	0.5981	0.5154	0.631	0.5587	0.522

YEAR		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR **-**
AGE														
	2	0.2109	0.1305	0.2724	0.209	0.2445	0.1978	0.2269	0.2414	0.189	0.2297	0.1703	0.1376	0.1792
	3	0.3942	0.3914	0.4764	0.4992	0.524	0.4658	0.37	0.3388	0.4115	0.4048	0.4419	0.2901	0.379
	4	0.7211	0.6321	0.7603	0.6447	0.796	0.4438	0.4195	0.4209	0.4355	0.4026	0.3669	0.3426	0.3707
	5	0.5754	0.7097	0.7104	0.5839	0.9852	0.4051	0.2915	0.5154	0.3717	0.3744	0.3328	0.3047	0.3373
	6	0.4069	0.6731	0.5019	0.5412	0.9457	0.5754	0.3542	0.5136	0.404	0.3755	0.4026	0.3774	0.3851
	7	0.6708	0.5186	0.4155	0.5005	0.7417	0.7346	0.3861	0.3952	0.5062	0.4578	0.4397	0.4017	0.4331
+gp		0.6708	0.5186	0.4155	0.5005	0.7417	0.7346	0.3861	0.3952	0.5062	0.4578	0.4397	0.4017	
0 FBAR 3- 6		0.5244	0.6016	0.6123	0.5673	0.8127	0.4725	0.3588	0.4472	0.4057	0.3893	0.386	0.3287	

Table 6.10 : 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	1994	1995	1996
AGE														
	2	22884	27831	27821	24734	26796	28270	32256	35931	35584	25132	26411	23821	29603
	3	13557	15093	17104	19346	18772	19526	20902	22412	28172	27784	20936	21422	18464
	4	8640	9258	9276	11473	12146	11346	11436	12909	14284	18567	17705	13710	13997
	5	6269	5168	6018	5850	6978	7003	6650	6141	7388	8245	10257	7646	6359
	6	3830	3737	2810	3257	3386	4133	3343	3322	3575	3840	3978	4486	3453
	7	2769	2359	2520	1104	1537	1744	1793	2101	1947	1108	1929	1727	2352
+gp		3702	2420	2965	1132	1337	893	1521	1926	1634	1376	1375	2007	2253
0 TOTAL		61651	65865	68514	66897	70952	72916	77901	84740	92585	86052	82590	74820	76480

YEAR		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AGE														
	2	22648	24502	25027	16747	25161	24682	17585	19477	21818	19571	21299	19893	0
	3	17911	16597	19458	17245	12296	17828	18326	12682	13844	16342	14074	16255	15687
	4	12995	10927	10154	10934	9472	6588	10125	11454	8177	8301	9865	8186	11005
	5	5541	5717	5255	4295	5192	3866	3825	6022	6803	4787	5021	6184	5259
	6	3890	2820	2544	2337	2168	1754	2333	2586	3255	4245	2978	3257	4127
	7	1689	2343	1302	1394	1231	762	893	1481	1400	1966	2639	1802	2021
+gp		2540	2526	1368	1299	872	504	1089	1633	4033	2704	3517	3137	2991
0 TOTAL		67214	65432	65107	54251	56391	55985	54176	55335	59330	57916	59393	58715	41090

( ) age 2 replaced by GM 93-2007 = 22809
( ) age 3 replaced by GM e-(F07-08+M) = 16897

Table 6.11 : 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	22884	12974	10648	4038	0.3792	0.3744
1985	27831	13751	11229	4251	0.3786	0.3803
1986	27821	14396	11895	4805	0.404	0.5021
1987	24734	15687	12557	5086	0.405	0.4651
1988	26796	16209	13062	5382	0.412	0.4604
1989	28270	16389	13062	5845	0.4475	0.5609
1990	32256	16871	13279	5916	0.4455	0.4656
1991	35931	18746	14419	5569	0.3862	0.4209
1992	35584	20546	15962	6550	0.4103	0.5981
1993	25132	20134	16577	6420	0.3873	0.5154
1994	26411	19568	16101	7229	0.449	0.631
1995	23821	17999	14554	6205	0.4264	0.5587
1996	29603	18104	14151	5854	0.4137	0.522
1997	23790	16885	13713	6259	0.4564	0.5897
1998	22648	16859	13634	6027	0.4421	0.5244
1999	24502	16262	12614	5249	0.4161	0.6016
2000	25027	15840	12162	5760	0.4736	0.6123
2001	16747	13275	10800	4836	0.4478	0.5673
2002	25161	13354	9917	5486	0.5532	0.8127
2003	24682	13573	9806	4108	0.4189	0.4725
2004	17585	14568	11497	4002	0.3481	0.3588
2005	19477	15050	11958	4539	0.3796	0.4472
2006	21818	16395	12878	4793	0.3722	0.4057
2007	19571	15944	12726	4363	0.3428	0.3893
2008	21299	16546	13212	4299	0.3254	0.386
2009	(19893)	16011	12817	3600	0.2809	0.3287
Arith. Mean	24972	16228	12893	5249	0.4078	0.4981
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

GM 93-2007 = 22809

Table 6.12 **Multifleet prediction input data**

Sole in Bay of Biscay
Multi fleet input data

MFDP version 1a
Run: BBSole_wg10
Time and date: 18:41 06/05/2010
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input Fs are 2007-2008 means at age 2
Input Fs are 2007-2009 means at age 3 to 8
Catch and stock wts are 2007-2009 means
Recruits are 1993-2007 GM
scale F

2010

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	22809	0.1	0.32	0	0	0.185	0.1786	0.174
3	16897	0.1	0.83	0	0	0.237	0.3384	0.224
4	11005	0.1	0.97	0	0	0.305	0.3311	0.288
5	5259	0.1	1	0	0	0.354	0.3013	0.333
6	4127	0.1	1	0	0	0.405	0.3440	0.381
7	2021	0.1	1	0	0	0.452	0.3868	0.425
8	2991	0.1	1	0	0	0.579	0.3868	0.545

2011

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	22809	0.1	0.32	0	0	0.185	0.1786	0.174
3		0.1	0.83	0	0	0.237	0.3384	0.224
4		0.1	0.97	0	0	0.305	0.3311	0.288
5		0.1	1	0	0	0.354	0.3013	0.333
6		0.1	1	0	0	0.405	0.3440	0.381
7		0.1	1	0	0	0.452	0.3868	0.425
8		0.1	1	0	0	0.579	0.3868	0.545

2012

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	22809	0.1	0.32	0	0	0.185	0.1786	0.174
3		0.1	0.83	0	0	0.237	0.3384	0.224
4		0.1	0.97	0	0	0.305	0.3311	0.288
5		0.1	1	0	0	0.354	0.3013	0.333
6		0.1	1	0	0	0.405	0.3440	0.381
7		0.1	1	0	0	0.452	0.3868	0.425
8		0.1	1	0	0	0.579	0.3868	0.545

Table 6.13 : Bay of Biscay Sole Multifleet prediction, management option table

MFDP version 1a
Run: BBSole_wg10
Time and date: 18:41 06/05/2010
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Basis
F(2010) = Fsq = mean F(07–09) scaled to F 2009 = 0.33
R10–11 = GM(93–07) = 22.8 million

2010

Biomass	SSB	Landings FMult	Landings FBar	Yield
17751	14106	1.0000	0.3287	4142

2011

Biomass	SSB	Landings FMult	Landings FBar	Landing Yield	2012 Biomass	SSB
18564	14906	0.0000	0.0000	0	24421	20583
.	14906	0.1000	0.0329	498	23822	20003
.	14906	0.2000	0.0657	981	23241	19442
.	14906	0.3000	0.0986	1449	22679	18898
.	14906	0.4000	0.1315	1903	22134	18372
.	14906	0.5000	0.1644	2342	21606	17862
.	14906	0.6000	0.1972	2768	21095	17368
.	14906	0.7000	0.2301	3181	20600	16890
.	14906	0.8000	0.2630	3581	20120	16427
.	14906	0.9000	0.2958	3969	19655	15978
.	14906	1.0000	0.3287	4345	19204	15544
.	14906	1.1000	0.3616	4709	18768	15123
.	14906	1.2000	0.3944	5062	18345	14715
.	14906	1.3000	0.4273	5405	17935	14320
.	14906	1.4000	0.4602	5737	17537	13938
.	14906	1.5000	0.4931	6059	17152	13567
.	14906	1.6000	0.5259	6371	16779	13208
.	14906	1.7000	0.5588	6674	16417	12860
.	14906	1.8000	0.5917	6967	16067	12523
.	14906	1.9000	0.6245	7252	15727	12196
.	14906	2.0000	0.6574	7528	15397	11880

Bpa = 13000 t
Fpa = 0.42

Input units are thousands and kg - output in tonnes

Table 6.14 : Bay of Biscay sole Detailed predictions

MFDP version 1a
Run: BBSole_wg10
Time and date: 18:41 06/05/2010
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Year: 2010 F multiplier: 1 Fleet1 HCFba 0.3287

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1786	3556	620	22809	4212	7299	1348	7299	1348
3	0.3384	4630	1037	16897	3999	14025	3319	14025	3319
4	0.3311	2960	851	11005	3360	10675	3259	10675	3259
5	0.3013	1305	435	5259	1862	5259	1862	5259	1862
6	0.344	1146	437	4127	1673	4127	1673	4127	1673
7	0.3868	619	263	2021	913	2021	913	2021	913
8	0.3868	916	499	2991	1733	2991	1733	2991	1733
Total		15132	4142	65109	17751	46396	14106	46396	14106

Year: 2011 F multiplier: 1 Fleet1 HCFba 0.3287

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1786	3556	620	22809	4212	7299	1348	7299	1348
3	0.3384	4730	1059	17262	4085	14328	3391	14328	3391
4	0.3311	2931	843	10899	3328	10572	3228	10572	3228
5	0.3013	1775	591	7151	2531	7151	2531	7151	2531
6	0.344	978	373	3521	1427	3521	1427	3521	1427
7	0.3868	811	345	2647	1196	2647	1196	2647	1196
8	0.3868	943	514	3080	1785	3080	1785	3080	1785
Total		15724	4345	67370	18564	48598	14906	48598	14906

Year: 2012 F multiplier: 1 Fleet1 HCFba 0.3287

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1786	3556	620	22809	4212	7299	1348	7299	1348
3	0.3384	4730	1059	17262	4085	14328	3391	14328	3391
4	0.3311	2995	862	11135	3400	10801	3298	10801	3298
5	0.3013	1757	585	7082	2507	7082	2507	7082	2507
6	0.344	1330	507	4787	1941	4787	1941	4787	1941
7	0.3868	692	294	2258	1020	2258	1020	2258	1020
8	0.3868	1078	587	3520	2039	3520	2039	3520	2039
Total		16138	4514	68855	19204	50076	15544	50076	15544

Input units are thousands and kg - output in tonnes

Table 6.15 Sole in VIIIa,b

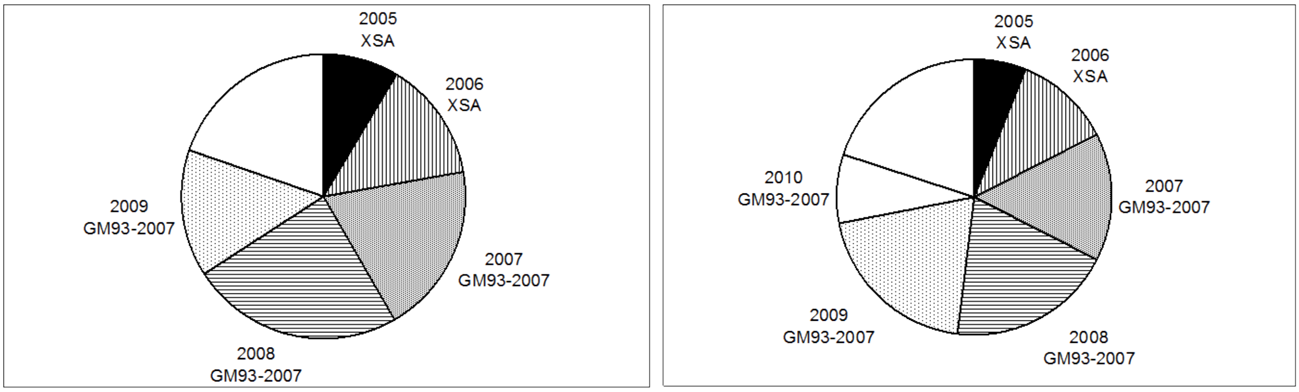
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2005	2006	2007	2008	2009	2010
Stock No. (thousands) of 2 year-olds	19571	21299	22809	22809	22809	22809
Source	XSA	XSA	GM93-2007	GM93-2007	GM93-2007	GM93-2007
Status Quo F:						
% in 2010 landings	10.5	20.5	25.0	15.0	-	-
% in 2011	8.6	13.6	19.4	24.4	14.3	-
% in 2010 SSB	13.2	23.1	23.5	9.6	-	-
% in 2011 SSB	9.6	17.0	21.7	22.7	9.0	-
% in 2012 SSB	6.6	12.5	16.1	21.2	21.8	8.7

GM : geometric mean recruitment

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

a) 2011 landings **b) 2012 SSB**



XSA	XSA	GM93-2007	GM93-2007	GM93-2007	GM93-2007
2005	2006	2007	2008	2009	2010

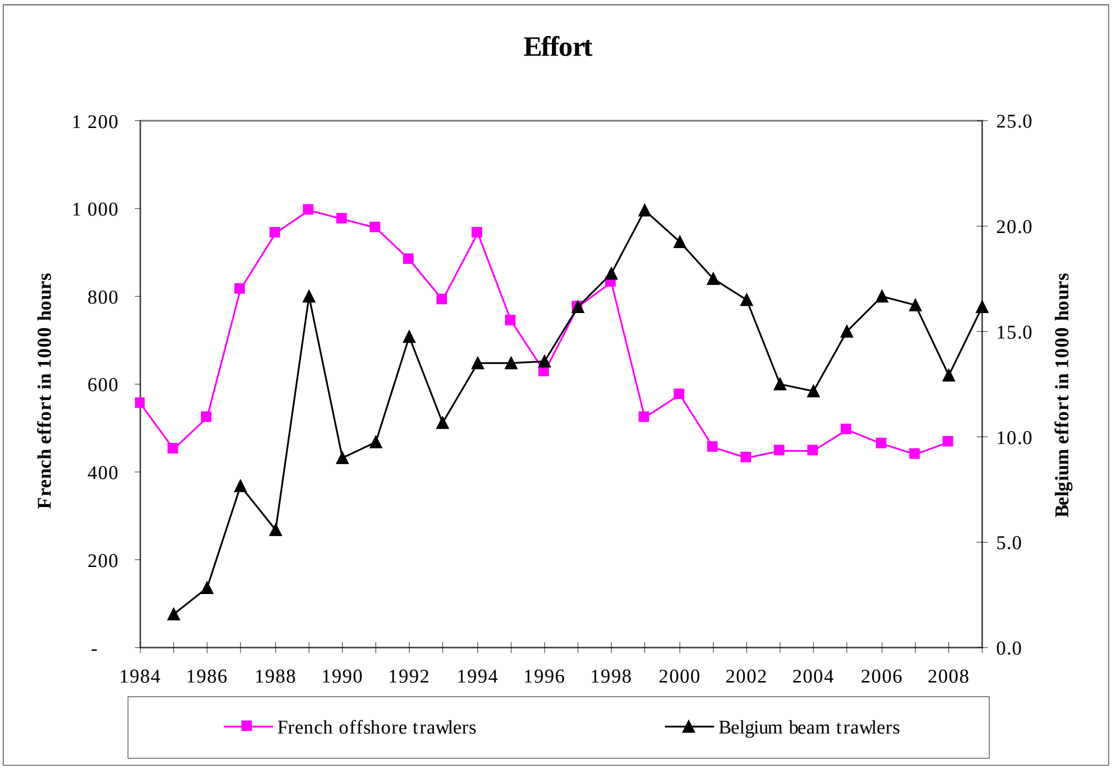
Table 6.16 : Bay of Biscay Sole Multifleet Yield per recruit

MFYPR version 2a
Run: BBSole_WG10
Time and date: 18:46 06/05/2010
Yield per results

Landings FMult	Landings Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0000	0.0000	0.0000	0.0000	10.5083	4.7978	9.6499	4.6283	9.6499	4.6283
0.1000	0.0329	0.2533	0.1070	7.9785	3.3859	7.1241	3.2175	7.1241	3.2175
0.2000	0.0657	0.3976	0.1585	6.5377	2.6003	5.6871	2.4329	5.6871	2.4329
0.3000	0.0986	0.4914	0.1856	5.6023	2.1035	4.7555	1.9370	4.7555	1.9370
0.4000	0.1315	0.5576	0.2006	4.9434	1.7629	4.1002	1.5974	4.1002	1.5974
0.5000	0.1644	0.6069	0.2087	4.4523	1.5163	3.6126	1.3517	3.6126	1.3517
0.6000	0.1972	0.6453	0.2130	4.0711	1.3303	3.2349	1.1665	3.2349	1.1665
0.7000	0.2301	0.6761	0.2149	3.7658	1.1856	2.9330	1.0227	2.9330	1.0227
0.8000	0.2630	0.7013	0.2154	3.5154	1.0702	2.6859	0.9081	2.6859	0.9081
0.9000	0.2958	0.7225	0.2150	3.3060	0.9763	2.4796	0.8150	2.4796	0.8150
1.0000	0.3287	0.7405	0.2141	3.1281	0.8986	2.3048	0.7381	2.3048	0.7381
1.1000	0.3616	0.7561	0.2128	2.9748	0.8334	2.1545	0.6736	2.1545	0.6736
1.2000	0.3944	0.7696	0.2114	2.8413	0.7780	2.0240	0.6190	2.0240	0.6190
1.3000	0.4273	0.7816	0.2099	2.7240	0.7304	1.9095	0.5721	1.9095	0.5721
1.4000	0.4602	0.7922	0.2084	2.6200	0.6891	1.8083	0.5316	1.8083	0.5316
1.5000	0.4931	0.8017	0.2069	2.5271	0.6531	1.7181	0.4962	1.7181	0.4962
1.6000	0.5259	0.8103	0.2055	2.4436	0.6213	1.6373	0.4651	1.6373	0.4651
1.7000	0.5588	0.8180	0.2040	2.3681	0.5932	1.5644	0.4376	1.5644	0.4376
1.8000	0.5917	0.8251	0.2027	2.2996	0.5680	1.4984	0.4131	1.4984	0.4131
1.9000	0.6245	0.8315	0.2014	2.2370	0.5455	1.4383	0.3912	1.4383	0.3912
2.0000	0.6574	0.8374	0.2002	2.1797	0.5252	1.3834	0.3715	1.3834	0.3715

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.3287
FMax	0.7971	0.2620
F0.1	0.3383	0.1112
F35%SPR	0.3922	0.1289

Weights in kilograms



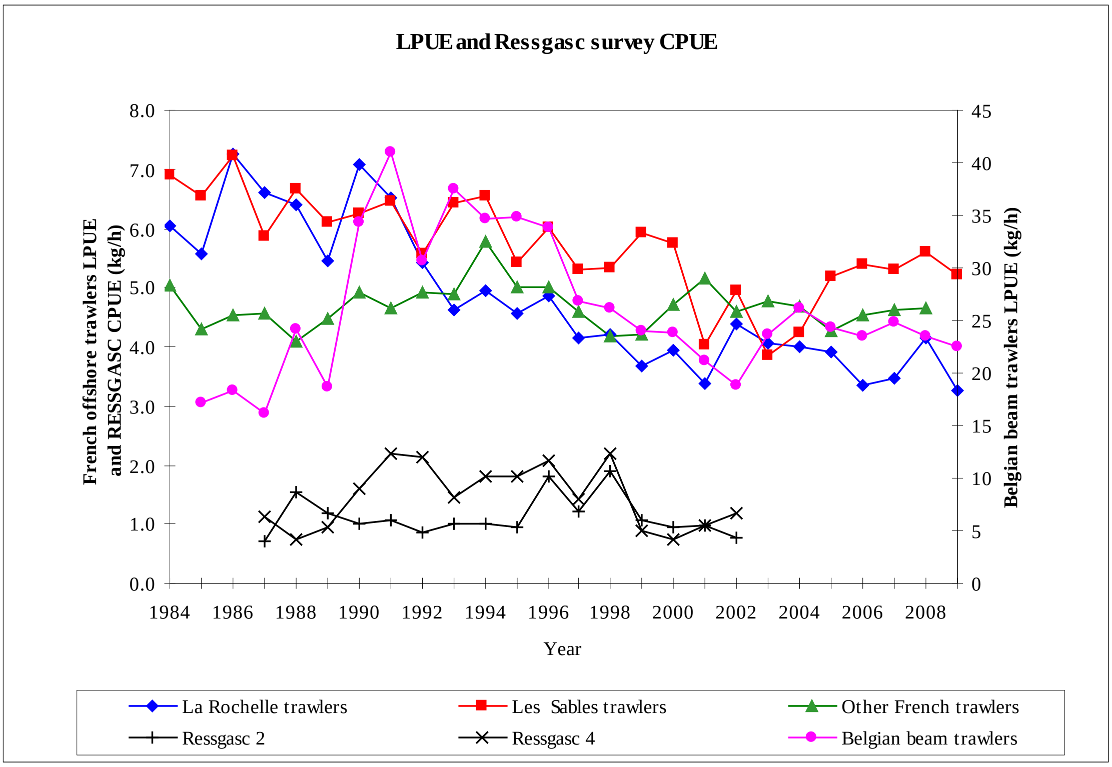


Figure 6.1 : Bay of Biscay sole (Division VIIIa,b)

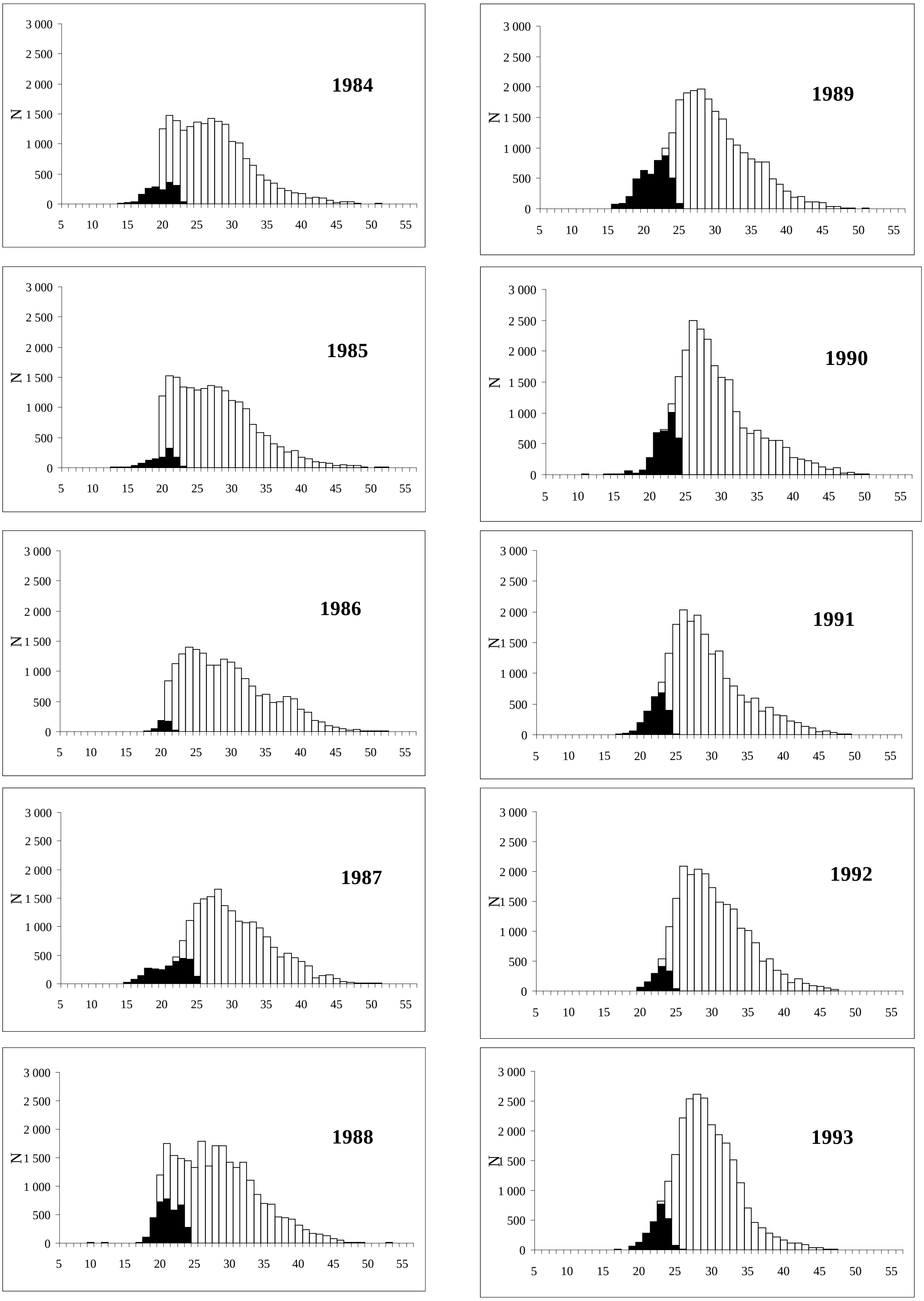


Figure 6.2 a : **Bay of Biscay sole French length distribution from 1984 to 1993**

Total French landings

Discard estimates of the French offshore trawlers fleet

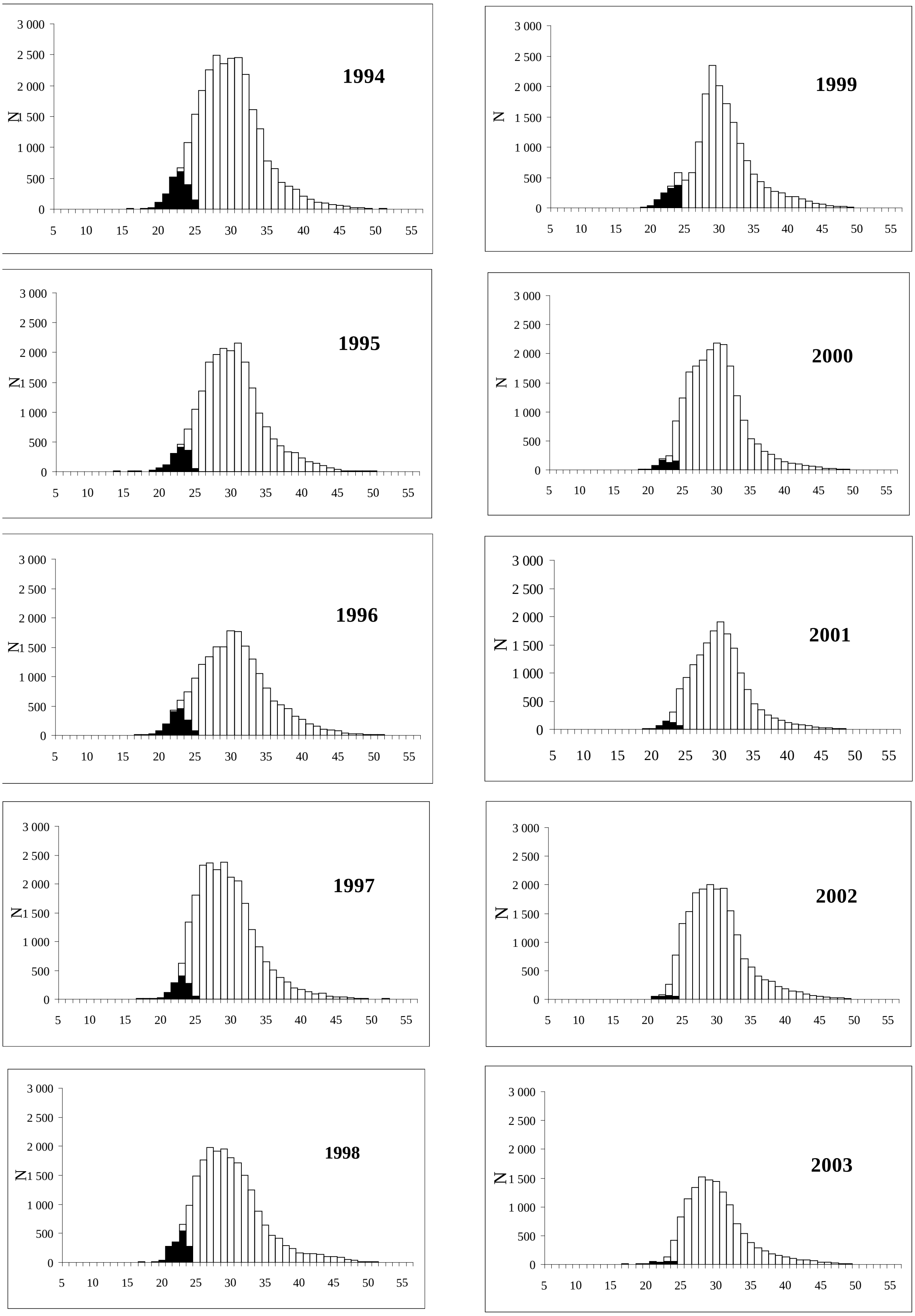


Figure 6.2 b : **Bay of Biscay sole French length distribution from 1994 to 2003**

Total French landings

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

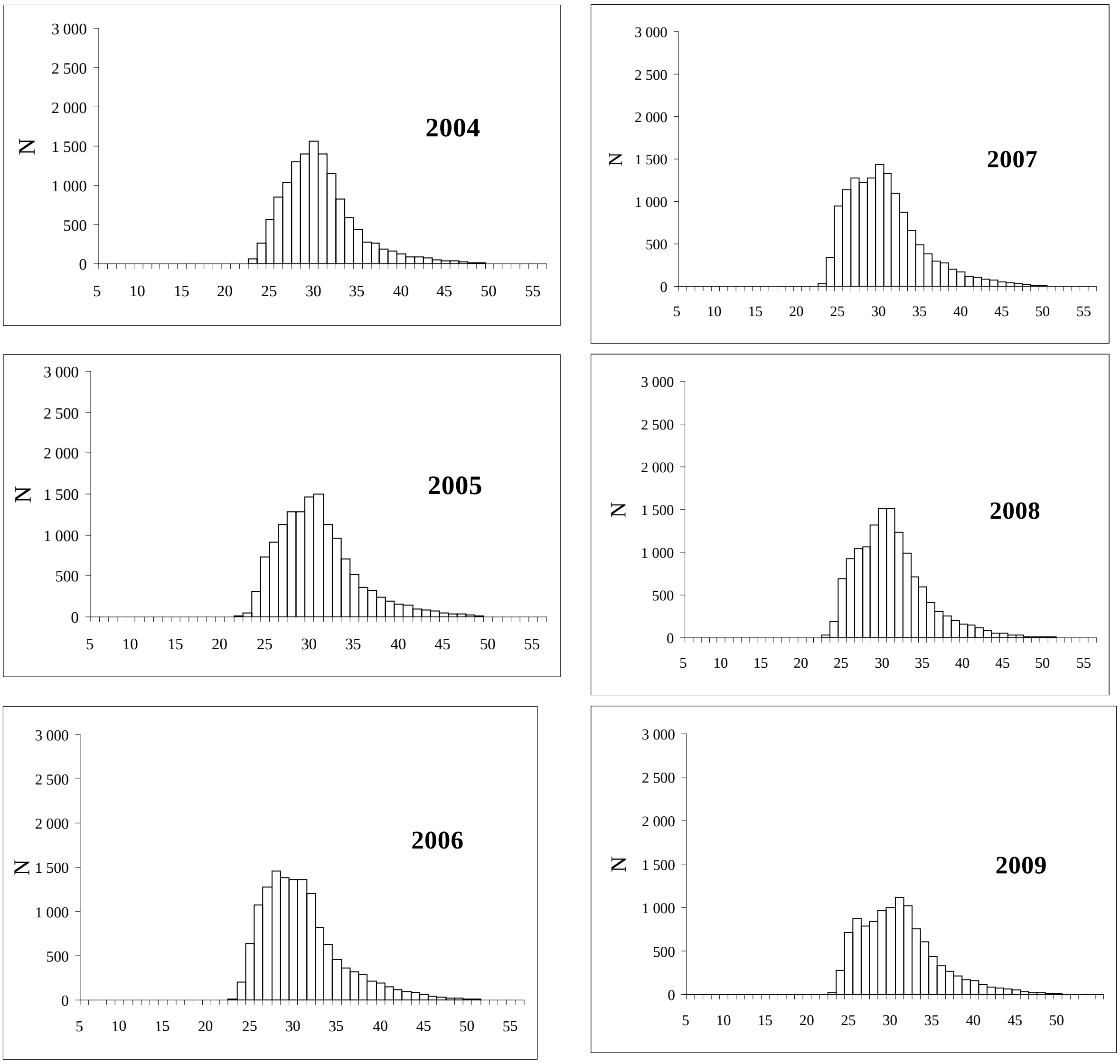
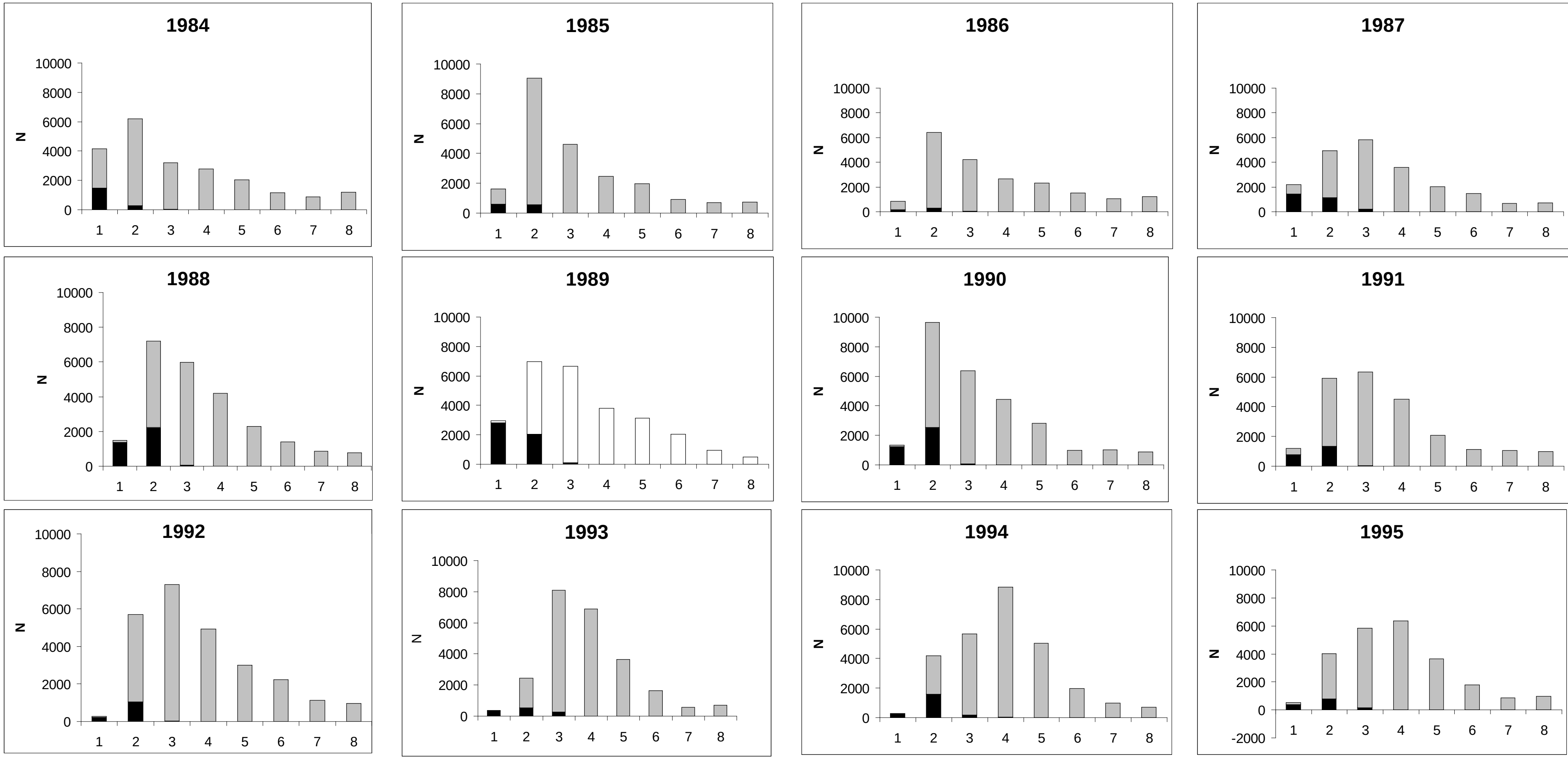


Figure 6.2 c : Bay of Biscay sole French length distribution from 2004 to 2009


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

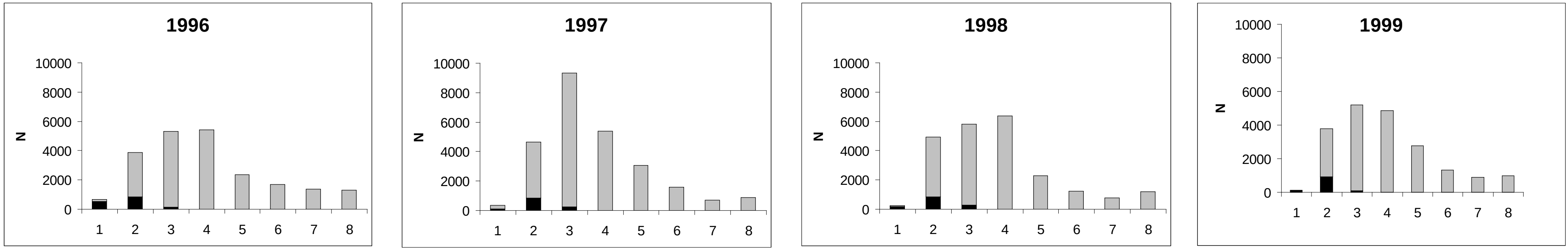


Figure 6.3 a : Bay of Biscay sole landings and discards age distributions from 1984 to 1999 (numbers in thousands)

Total landings
Discard estimates of the French offshore trawlers fleet

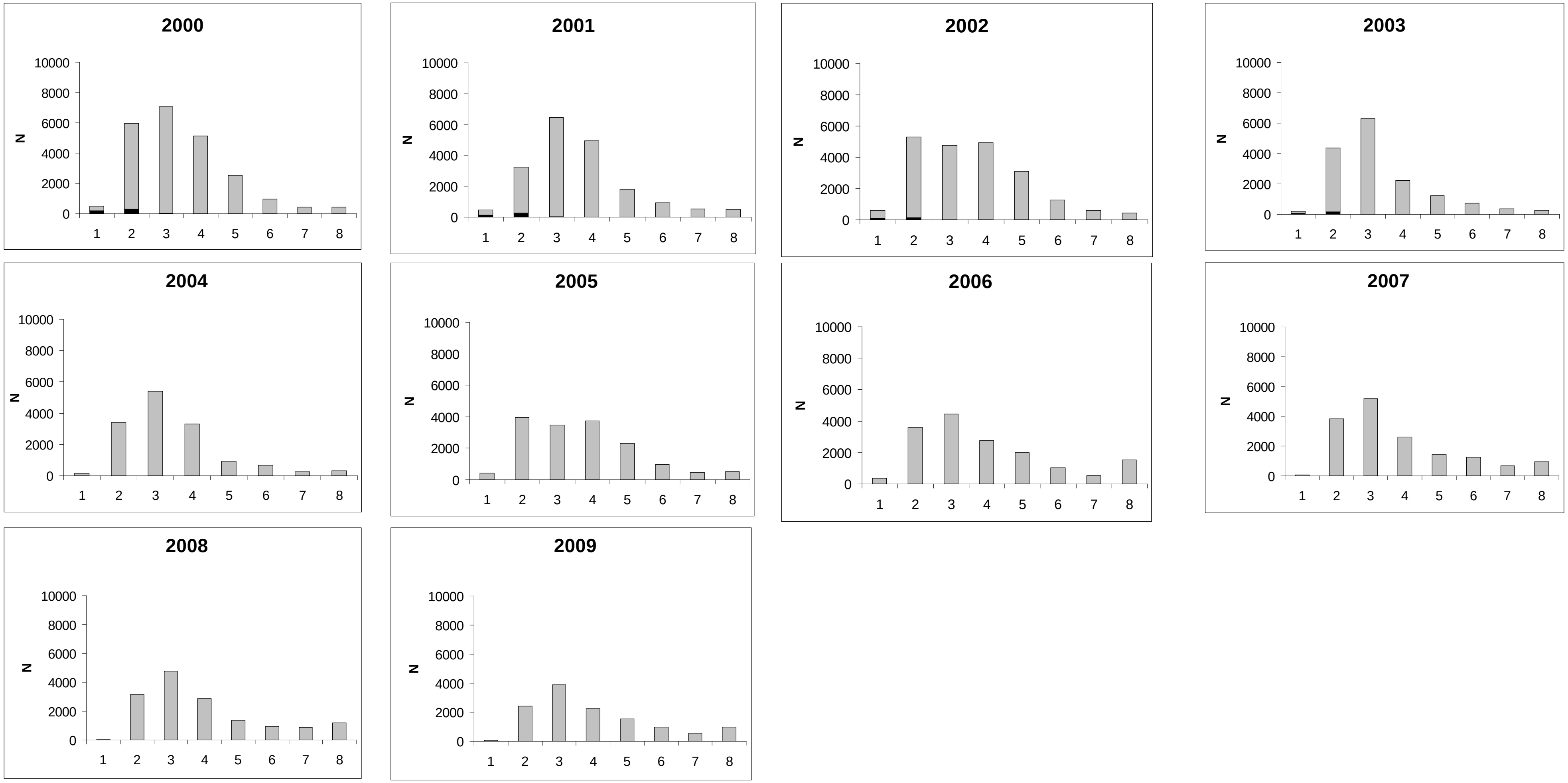


Figure 6.3 b : Bay of Biscay sole landings and discards age distributions from 2000 to 2004 landings age distribtion since 2004 (numbers in thousands)

LOG CATCHABILITY RESIDUAL PLOTS (XSA)

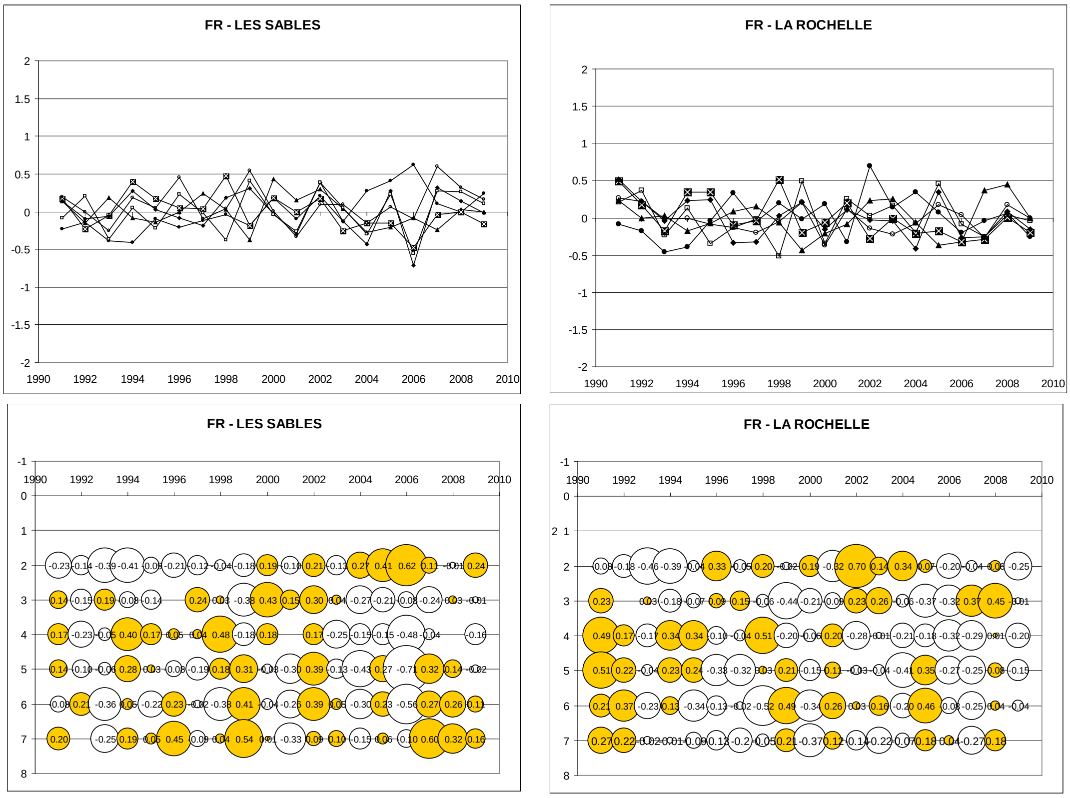
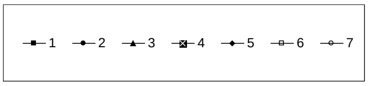


Figure 6.4 a : Bay of Biscay sole (Division VIIIa,b)



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

LOG CATCHABILITY RESIDUAL PLOTS (XSA)

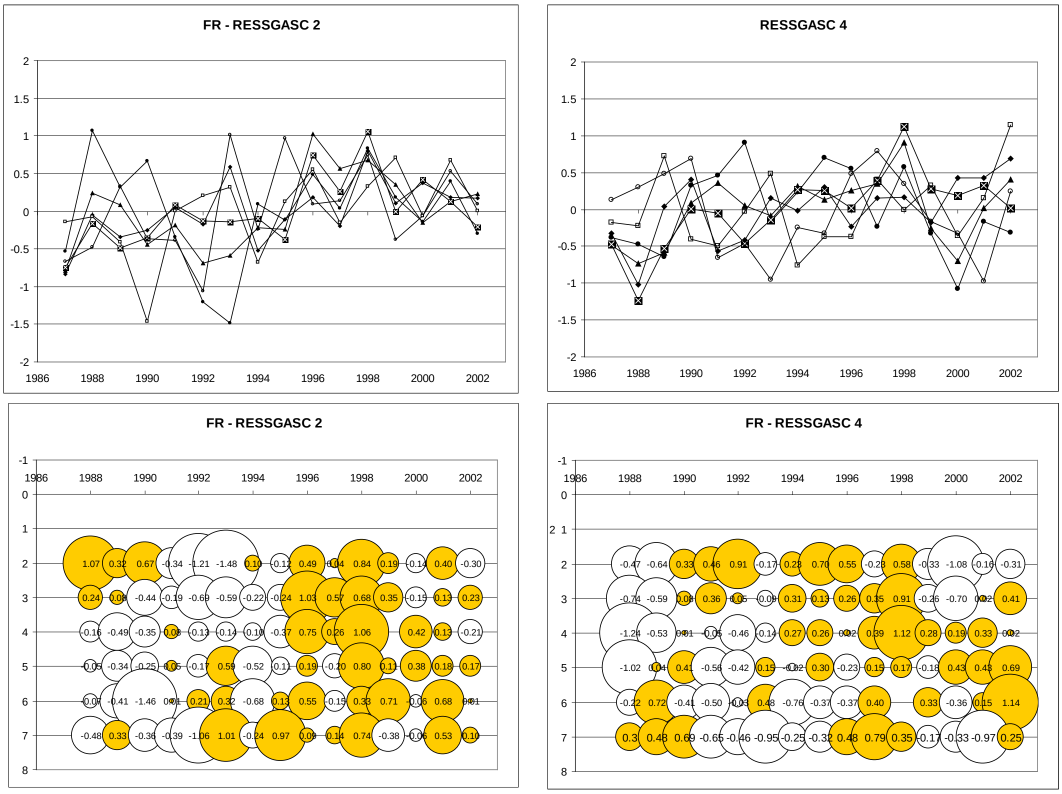
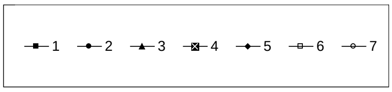


Figure 6.4 b : Bay of Biscay sole (Division VIIIa,b)

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



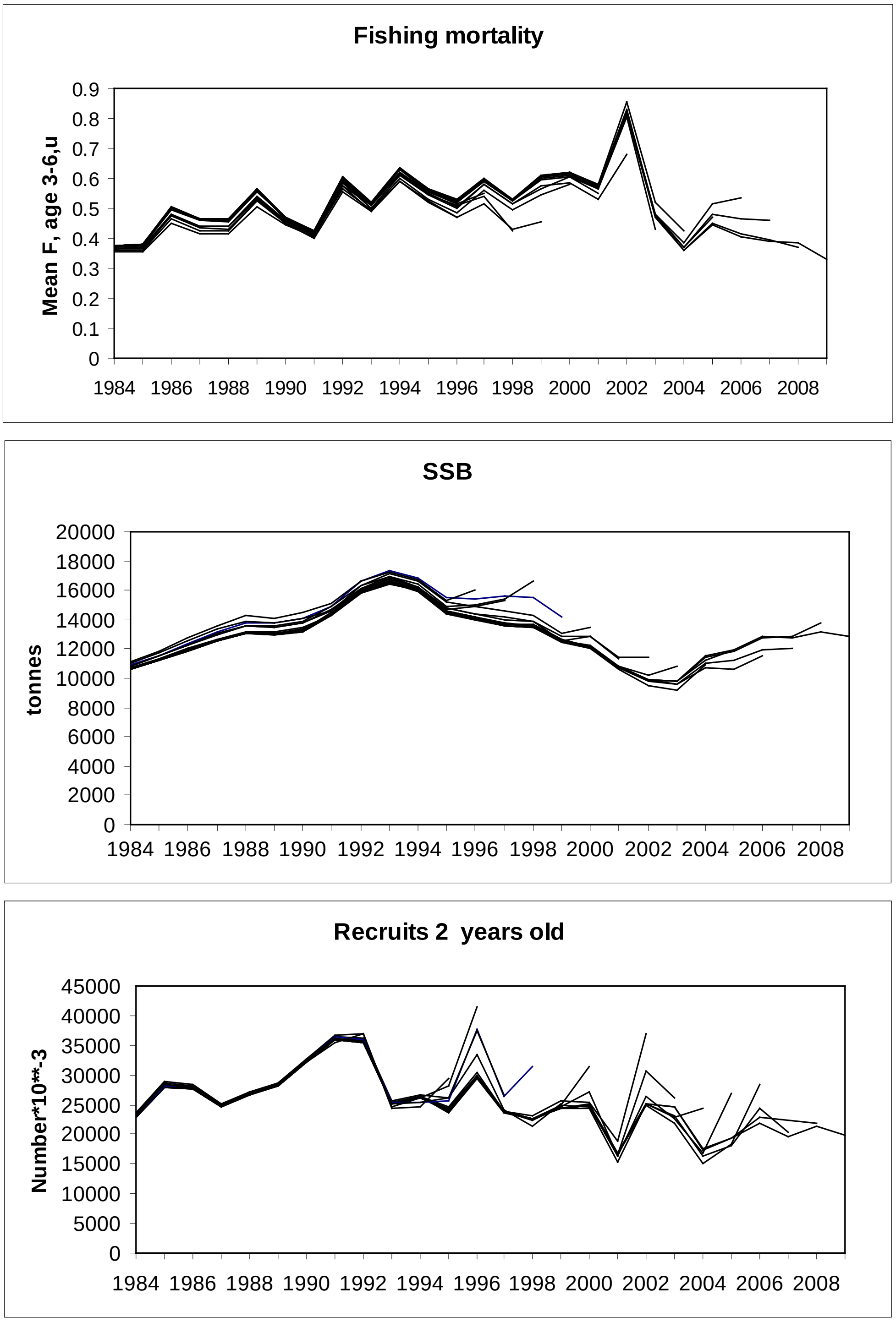
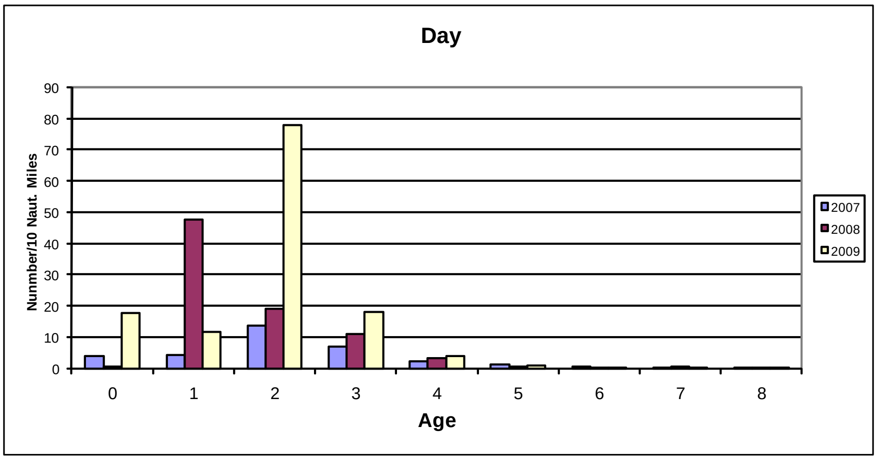


Figure 6.5 : Bay of Biscay sole (Division VIIIa,b) - Retrospective results
(No taper, q indep. stock size all ages, q indep. of age>=6, shr.=1.5)

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



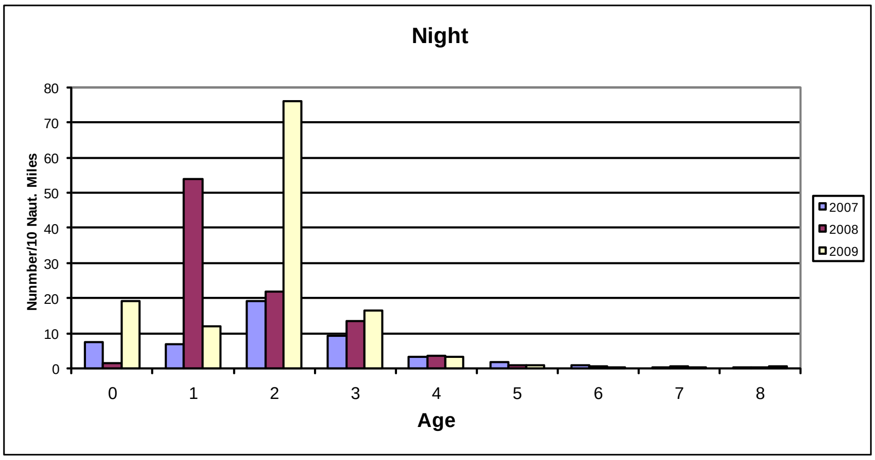
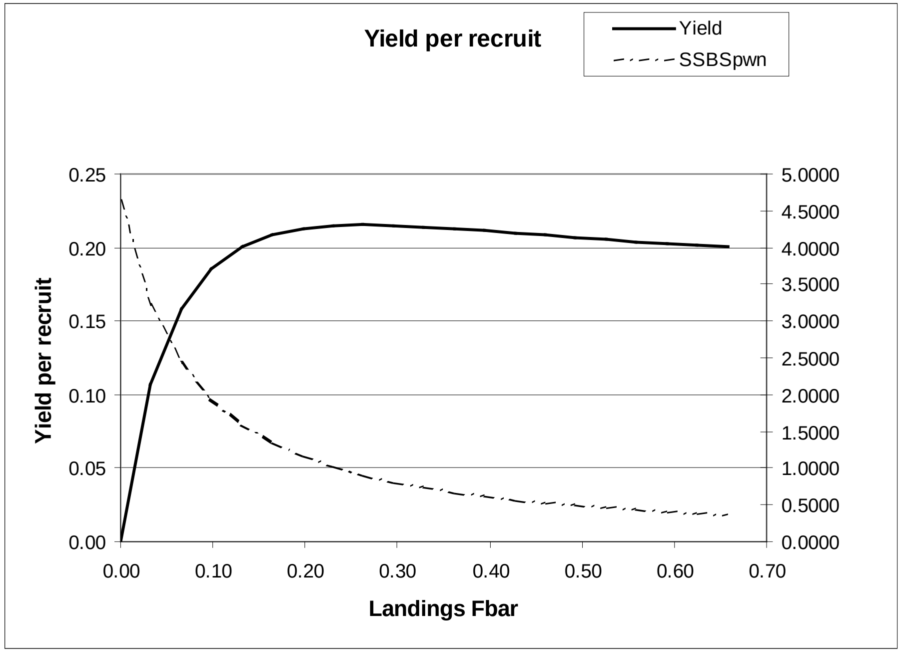
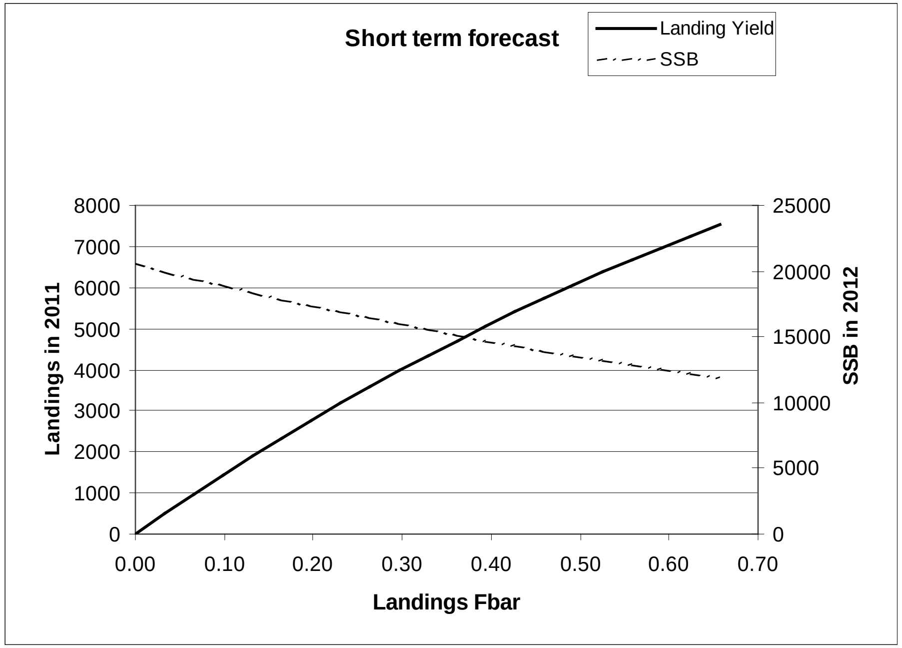


Figure 6.7 : Bay of Biscay sole (Division VIIIa,b) - 2007-2009 ORHAGO Indices
(Numbers/10 nautical miles by daylight and at night)





MFYPR version 2a
Run: BBSole_WG10
Time and date: 18:46 06/05/2010

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.3287
FMax	0.7971	0.2620
F0.1	0.3383	0.1112
F35%SPR	0.3922	0.1289

Weights in kilograms

MFDP version 1a
Run: BBSole_wg10
Time and date: 18:41 06/05/2010
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input units are thousands and kg - output in tonnes

Figure 6.8 : Bay of Biscay sole

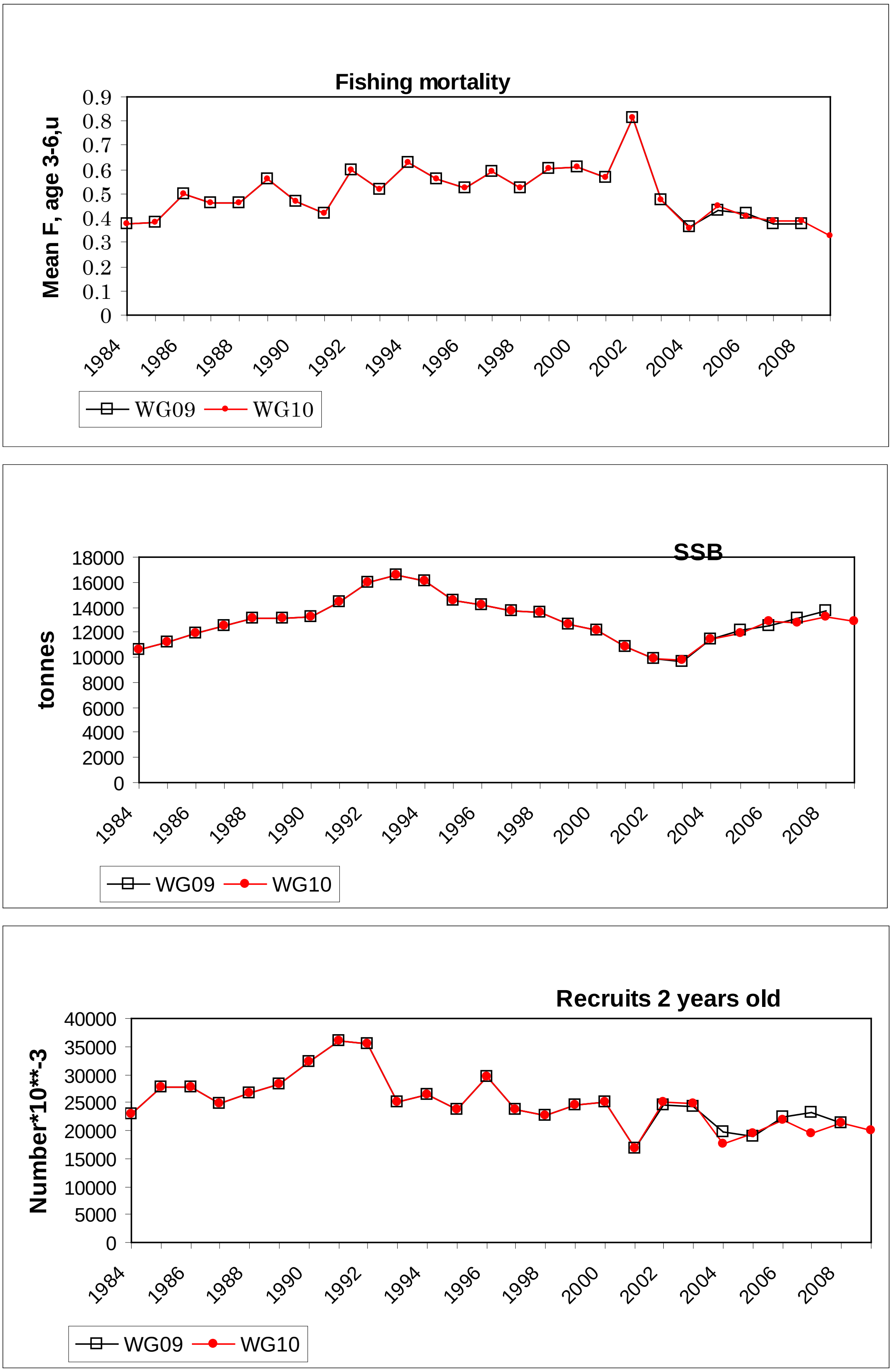


Figure 6.9 : Bay of Biscay sole (Division VIIIa,b) - WG10 / WG09 comparison

7 Southern Stock of Hake

The update and corrected version of Southern Hake section is available in Annex V.

7.1 General

Type of assessment is "update" based on benchmark assessment (WKROUND, 2010).

Discards data series from Portugal were reviewed.

Review group based most of their recommendations on past statistical catch-at-age assessment. This assessment was replaced during past WKROUND benchmark (WKROUND, 2010) and most of the last Review group suggestions no longer apply. The only one is the use of a constant length – weight relationship. This was not addressed in the benchmark although WGHMM recognized the interest of analysing it properly in the future.

Southern hake assessment was reviewed last January (WKROUND, 2010). Three important modifications were incorporated: Cadiz data was included; discards data were reviewed an included and an age-length assessment model with fast growth was approved to be used as a basis for advice.

7.1.1 Fishery description

Moved to South hake annex G.

7.1.2 ICES advice and Management applicable to 2009 and 2010

ICES Advice for 2010

ICES advised on the basis of the exploitation boundaries in relation to precautionary limits that landings for 2010 should not exceed 4 900 t.

Management Applicable

Hake is managed by TAC, effort control and technical measures. The agreed TAC for Southern Hake, including Cadiz, in 2009 was 8 104 t and in 2010 was 9 300 t. Catches in 2009 were estimated to be 22 400 t. Landings were 19 200 t, more than 2 times above Southern hake TAC; and discards were 3200 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) and F target (0.27) are not considered suitable under new model. This regulation also includes effort management in addition to TAC measures. An evaluation of the recovery plan is under ICES discussion.

Since 2006 an annual reduction of 10% fishing days at sea was applied to all fleets providing they fish more that 50 tonnes at year. In Gulf of Cádiz area, that has particular effort reduction regulations.

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.

7.2 Data

Data Revisions

Portuguese discards data have been revised (WD 3).

7.2.1 Commercial Catch: landings and discards

Catches: landings and discards

Southern Hake catches by country and gear for the period 1972-2009, as estimated by the WG, are given in Table 7.1. In 2009, the total catches estimate were 22.400 t, following the continued increasing trend since 2004 (8 000 t) when the historical minimum was achieved. 2009 landings were 16% higher than those of 2008. Landings were 19 200 t (86%) and discards 3 200 t (14%). Spanish catches were 16 800 t (75%) and Portuguese were 2 400 t (25%). Trawl landings were 11 400 t (60%) and artisanal landings (mainly long liners and gill-netters) was 7 800 t, (40%).

7.2.2 Biological Sampling

The sampling levels in 2009 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 2009. Figure 7.1 shows the length distributions of landings and discards for 1982-2009. Whereas the mode of the landings remains about 30 cm, in recent years an increase in mean length from 33 cm in 2006 to 35-36 cm in 2007-2009 was observed. This was mainly caused by an increase of catches in larger fish mainly coming from long liners and gill-netters.

Growth, Length–weight relationship and M

An international length-weight relationship for the whole period has been used since 1999 (see Stock Annex). The assessment model follows a constant von Bertalanffy model with fixed Linf = 130 cm, t0=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. No important differences are shown in recent years.

7.2.3 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 (P-GFS-oct) has shown variable abundance indices with a minimum in 1987. Biomass and recruitment (<20 cm) in 2009 are the highest in the series continuing the recent increasing trend.

The Spanish groundfish survey (Sp-GFS) shows low values for biomass and abundance in early 2000s, but abundance and biomass increases since 2004, being in 2009 at the historical maximum. The recruitment index (<20 cm) is well above the historical highest value.

The recruitment indices of the Spanish (Sp-GFS and SP-GFS-caut) and Portuguese autumn surveys (Figure 7.3) were relatively inconsistent in the past. However the three 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.

The Spanish (SP-GFS and SP-GFS-caut) and the Portuguese (P-GFS-oct) surveys are used to tune model, fitting the length proportions and the survey trends. Observed length proportions are presented together with model fits in figure 7.6 (panels f, g, h) and will be commented in model diagnostics

Commercial catch–effort data

Effort series is 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), Cadiz Trawl (SP-CTR) and Portuguese trawl (P-TR) fleets. These data are given in Table 7.5 and shown in Figure 7.4. Just SP-CORUTRP, and P-TR are used in the assessment.

Effort has been relatively stable since 2004 for SP-CORUTR, SP-CORUTRP and SP-VIMATR meanwhile P-TR and SP-CTR show a decreasing trend. This recent patter is also applicable to 2009 with the exception of SP-CTR, this is caused by the inclusion of effort from a new harbour (Ayamonte) in 2009, that was not considered before since was not important in the past. A review of this figures will be provided next year..

LPUEs in table 7.5 show a recent increasing trend reaching an historical maximum for all fleets except SP-CTR, although this LPUE are not realistic.. LPUEs show a clear increase in 2009 compared with 2008 for all trawl fleets.

7.3 Assessment

This year an update (from the benchmark conducted in WKROUND, 2010) assessment was performed. The procedure followed is described in the Stock Annex (Annex G) and applied in the GADGET environment. The main changes with respect to last year are the use of only length based information and quarterly structure. No age data are used.

7.3.1 Model diagnostics

First, convergence is examined (Figure 7.5). Convergence diagnostics are presented as likelihood profiles for every estimated parameter, where the values on the horizontal axes of the plots represent multiplicative factors with respect to the estimated parameter value. Convergence is not guaranteed if the minimum likelihood value does not correspond to the estimated parameter value (i.e. the multiplier 1). Changing this multiplier up to plus/minus 50% shows how the likelihood changes. This change 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. To facilitate interpreting the plots, they are presented scaled and unscaled. From Figure 7.5, all parameter estimates correspond to the minimum of the likelihood.

Residuals for surveys and commercial CPUE indices are presented (Fig 7.6a). These are grouped in 15 cm classes (from 4 to 49 in surveys and 25 to 70 cm in CPUEs). The spread of residuals ranges between -1 and 1, or less in some cases. Trends are observed in SP-GFS (4-19 cm) and in Pt-CPUE (25-40 cm) residuals after year 2002. With these exceptions, the fits are quite consistent.

Proportions at length (observed and expected) are presented in figure 7.6 (b-h). These proportions are grouped by 2 cm classes for all "fleets" used in the model calibration. These "fleets" are described in the Stock Annex (Annex G). 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. In general, the fit to landings proportions at length (for years 1994-2009) are good and for discards (1992-2009) worse, which is not strange considering the high errors in discards sampling. The model takes into account the data quality when weighting the individual likelihood components (defined in Stock Annex), so discards have less impact on the overall model fit.

Sensitivity to the 2009 datasets is presented in the next table. The analysis was performed comparing the results (in terms of recruitment in 2008 and 2009; F 2009 and SSB 2009) obtained when excluding one dataset from 2009 with those from the final run (which includes all data sets). The most sensitive parameter is recruitment in 2009, and the dataset with highest impact corresponds to 2009 SP-GFS, driving the stock to higher recruitment and SSB and lower F in 2009.

Relative change (no 2009 Data Run / Final Run)

	final	no landings	no discards	no SP-CPUE	no PT-CPUE	no PT-GFS	no SP-GFS	no SP-GFS-caut
rec08	1	0.95	0.98	1.00	**1.42**	0.96	**0.70**	0.99
rec09	1	1.07	**1.05**	1.00	**0.88**	**1.50**	**0.48**	1.00
F09	1	1.00	0.99	0.99	1.01	0.99	**1.16**	0.99
SSB09	1	1.01	1.01	1.01	**0.90**	1.00	**0.94**	1.00

Robustness to some model assumptions was checked by fitting the same data with different model assumptions, such as different M (0.2 and 0.3) and different Linf (115 and 100 cm) values; a comparison with the final run (M=0.4 and Linf=130) is presented in Figure 7.6(i). Results show high sensitivity to initial conditions showing the difficulties to estimate properly the SSB at the beginning of the time series. Other parameters are consistent. F shows different levels but trends are similar

7.3.2 Assessment results

Estimated parameters

The model estimates selection parameters for each "fleet" for which length proportions are fitted and the growth parameter k (von Bertalanffy). Results are presented in figure 7.7. The selection patterns of different "fleets" of catches (catches in 1982-93; landings in 1994-2009; discards 1992-2009 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 (1994-2009) selection patterns are used for projections.

Survey selection patterns are presented in the lower selection pattern panel. The Portuguese survey P-GFS-oct catches relatively larger fish than the Spanish surveys (SP-GFS and SP-GFS-caut). Both Spanish surveys show a similar pattern, they are both are performed in the Autumn, with the same vessel and gear.

The von Bertalanffy k parameter was estimated as 0.165, which is in agreement with the assumed faster growth. The sensitivity analysis performed shows that the k estimate is dependent on the assumed Linf (130 cm) and natural mortality (0.4) values. These two parameters were fixed at the values decided during WKROUND (2010)

Historic trends in biomass, fishing mortality, yield and recruitment

Model estimated abundance at length is presented in Figure 7.1, together with observed landings and discards length frequency distributions. This abundance is at the beginning of the 4th quarter. In this way we can show the impact of recruitment, which has happened in the 1st and 2nd quarters. The figure shows a general increase of small fish after 2004 that contributes to an increase of large fish in more recent years.

Summary results (Table 7.6 and figure 7.8) present estimated annual values for fishing mortality (averaged over ages 1-3), recruitment (age 0) and SSB, as well as landings and discards.

Recruitment in 2009 is huge (more than 10 times the historical mean) and needs to be confirmed in the future. Nevertheless, all the surveys showed high recruitment values in 2009 and, in general, recruitment has been increasing strongly after 2004. Catches (landings and discards) also have increases in recent years (from 8 Kt in 2004 to 22.4 in 2009). F of total catches shows relatively stable values since year 2000, with a minimum in 2004 (0.68), a maximum of 0.81 in 2007 and with a value 0.74 in 2009. SSB have also increased continuously since 1998 (6.4 Kt) reaching 20.1 Kt in 2009.

Retrospective pattern for SSB, fishing mortality, yield and recruitment

Figure 7.9 presents the results from assessment performed with data until 2009, 2008, 2007, 2006, 2005 and 2004. SSB shows a trend to be underestimated in the recent past. F presents an opposite trend, i.e. it was overestimated in recent years. Estimated recruits in 2009 correct upwards those estimated in previous years.

This retrospective pattern is similar to those obtained in previous assessments (using a Statistical catch at age method), which did not include discards and assumed slower growth, showing that these are not the main causes of this pattern. However the bias with the new model is lower.

This pattern has consequences for projections and advice. Regarding the expected yield in 2010 and 2011 based on a reference F, this is difficult to predict since the underestimation of SSB may be compensated by the overestimation of F. However, if this pattern remains, SSB in 2012 may be higher than projected by the model if SSB now is higher than assumed.

7.4 Catch options and prognosis

7.4.1 Short-term projections

The methodology used is the one developed in the benchmark (WKROUND, 2010) and described in the Stock Annex (Annex G).

Management options are presented in table 7.7 and figure 7.10. Assuming a recruitment of 58.9 mill (geo mean 1989-2008) during 2009-11, the expected yield (landings) in 2010 will be 15.5 kt and SSB in 2011 21.1 kt.

Different F multipliers applied in 2011 provide management alternatives according to different schemes. Under Fsq (=F(2009)=0.74), yield (landings) in 2011 will be 13.9 kt and SSB in 2012 18.5 kt. Decreasing F by 10% (=0.67), yield will be 12.8 and SSB 20 kt. Applying the Fmsy (=0.26) candidate in 2011 results in 5.8 kt of yield and 30.1 kt of SSB in 2012. Under the EC / ICES transition scheme (F=0.64), yield equals 12.5 and SSB 20.5 kt. Keeping the same TAC in 2011 as in 2010 (9.3 kt), F in 2011 will be 0.44 and SSB in 2012 25 kt.

7.4.2 Yield and biomass per recruit analysis

F producing maximum landings per recruit was estimated following the Stock Annex (Annex G). This results in Fmax = 0.26 and F0.1=0.19 (figure 7.11)

7.5 Biological reference points

Previous PA values are not relevant with new assessment model. WGHMM proposes Fmax (F=0.26) as a proxy for Fmsy.

SSB against recruitment at age 0 are presented in figure 7.12. Different candidates for Fmsy are over plotted as replacement lines sorted from F40%<F0.1<F35%<F30%<Fmax. It is not possible to know the level of recruitment under the equilibrium SSBs provided at these F levels. However, within the range of observed SSBs [7, 20 Kt] there are not signals of change in production.

7.5.1 Stochastic simulations to test robustness of MSY candidates

The objective of this analysis is to test the robustness of several Fmsy candidates, computed from the updated assessment approved by the benchmark (ICES, 2010), to uncertainty in the stock dynamics, in particular to the assumptions about natural mortality, Linf of the von Bertalanffy growth curve and the stock-recruitment dynamics.

Two values of natural mortality, 0.2 and 0.4, and two values of Linf, 100cm and 130cm, were considered. Four assessments were run under these assumptions and, for each assessment, three stock-recruitment relationships, Beverton and Holt (B&H), Ricker and geometric mean, were fit to the SSB and recruitment estimates from the assessment. The combination of these results generated 12 distinct stock dynamics, which will be referred to as "operating models". It must be noted that S/R models are not well fitted to this stock due to the narrow range of SSBs observed. However, for the sake of completeness, it was considered relevant for this exercise to include S/R models.

Four MSY candidates were computed from the approved assessment (which assumes 0.4 for natural mortality and 130cm for Linf), using the S/R relationships referred to above. The candidates are: Fmax (0.25), F0.1 (0.17), Ricker's Fmsy (0.56), and B&H's Fmsy (0.23). The Fmax and F0.1 reference points are slightly different from the assessment values because they were computed using year/age dynamics instead of the quarter/length dynamics.

The Fmsy candidate values were applied to the different operating models, producing 4*12=48 scenarios, and stochastically projecting forward 40 years, in order to drive the stocks to equilibrium. Variability in the assessment results, which Gadget does not provide, was included by inserting multivariate lognormal errors on numbers-at-age and catch-at-age. Fishing mortality was computed to assure catches would match abundance. Recruitment was computed at the start of the year, 1st of Janurary, which is a departure from the original model where recruitment events occur 50% in quarter 1 and 50% in quarter 2. Future recruitments were generated from the S/R model, adding lognormal error with standard deviation computed from the residuals of the S/R fit.

The results were summarised with the median of the ratio between landings and MSY (L/MSY), median of the ratio between SSB and BMSY (SSB/BMSY) and the median percentage of the virgin spawning per recruit (%SPR). In these statistics, the numerators correspond to using the Fmsy candidate values obtained from the approved assessment model, whereas the denominators were computed considering the operating models' own biological reference points. The rationale is to test how the long term yield and biomass would react to a sub-optimal fishing level. In sub-optimal situations our analysis looks for candidates that provide the highest L/MSY, to maximise yield in the long term. However, to take into account the risk to SSB one also looks for the lowest number of SSB/BMSY<1 occurrences and a %SPR between 30% and 40%, as advised by WKFRAME (ICES, 2010).

Regarding long term yield (Figure 7.13, left column), fishing at F0.1 gives the best results for the B&H dynamics and geomean recruitment, but if reality corresponds to a Ricker S/R it shows the worst results among all Fmsy candidates considered. Fishing at Ricker's Fmsy gives the worst results, except if a Ricker drives the S/R dynamics. However, in all cases the results obtained are the most variable. Fishing at Fmax or B&H's Fmsy, which are similar levels, gives results in the middle of the two extremes F0.1 and Ricker's Fmsy, with an overall level that is always above 70% of MSY. Note that there are values of L/MSY above 1, which is counterintuitive as one should not be able to catch more that MSY for a certain dynamics. These are due to the levels of recruitment produced by the lognormal distribution, which are above the equilibrium recruitment assumed by the S/R, giving rise to higher population sizes than expected and producing catches above MSY.

Considering the relative levels of SSB (Figure 7.13, middle column), the candidates Fmax and B&H's Fmsy produce values close to one, with the exception of two operating models with M=0.2/Linf=130cm and S/R B&H or geomean. In these cases the ratio drops to 0.5, which may represent some risk, in particular taking into account the %SPR produced, between 15% and 20% (Figure 7.13, right panel). Ricker's Fmsy produce SSB/BMSY below 0.5 in all cases except in the operating model M=0.4/Linf=130cm and S/R Ricker, which is expected. The %SPR of this scenario is below 15%. F0.1 produces higher SSB, most of the times above 1.5 and 40% %SPR. The operating model with M=0.2/Linf=130cm and S/R B&H or geomean also produces SSB/BMSY below 1, with %SPR around 30%.

The conclusion is that within the range of fishing mortalities tested, Fmax is the level that is more robust to departures from the assumed underlying dynamics, regarding the production of long term yield and avoiding risk to SSB. M seems to be the assumption with more impact on the results.

7.6 Comments on the assessment

This year's assessment uses a new model, GADGET, that is based on length frequency quarterly data and a von Bertalanffy growth model. The assessment was approved in WKROUND (ICES, 2010a) and updated by this WG with 2009 data.

Following the benchmark recommendations, the group explored some alternative model configurations to test the robustness of the assessment. More details about the possible subjects for research are included in WKROUND (ICES, 2010a). As stated by WKROUND, the current model configuration should be open to some adjustment in subsequent assessment updates.

The growth parameter k is estimated by the model and reflects a faster growth than before. Consistently, natural mortality was set at 0.4, twice the previous natural mortality.

New datasets were included in the assessment, in particular discards of the trawl fleets and information from the Gulf of Cadiz.

The current assessment shows a retrospective pattern with a tendency to overestimate F and underestimate SSB.

The table below summarises the consistency with last (WKROUND, 2010) assessment.

BRP	Year	WKROUND10	WGHMM10	% change	Comments
Fbar	2008	0.91	0.75	-21%	
SSB	2008	12.5	16.0	22%	
R	2008	61.7	72.3	15%	

In spite of these changes the relative perspective about stock status and exploitation is similar to previous years. An increase in stock size is observed, mainly due to high recruitments and stable F. There has also been an increase in landings.

The likelihood scores of the Gadget model have changed from those obtained in WKROUND (ICES, 2010a), in particular the balance between the contribution of catch data and abundance indices to the model fit changed from 40/60 to 30/70, respectively.

The Spanish groundfish survey index for 2009 has a large impact on the estimation of 2009 recruitment and, to a lesser extent, on fishing mortality and SSB. Nevertheless, all datasets indicate an increase in recent recruitment.

Gadget uses forward projection to fit the model parameters and is sensitive to initial values (1982), consequently the starting years may have convergence problems and assessment results for those years should be considered with caution.

7.7 Management considerations

There are indications of high recruitments in recent years.

The previous PA reference points are not relevant in the face of the new assessment.

Fmax is considered a good proxy for Fmsy and tests ran during this WG showed that it is robust to uncertainty in the assumed stock dynamics, although the tests were constrained to a limited number of alternative scenarios.

Considering Fmax as a target for this fishery, the current exploitation level is still high.

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 (WGSAM, 2008, 2009).

Table 7.1 HAKE SOUTHERN STOCK. Catch estimates (´000 t) by country and gear, 1972-2009

	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			**0.1**	**8.7**	3.77	1.33	**0.3**	**5.1**	-	**0.5**	**13.8**	**14.3**
1993	0.37	1.26	2.74	0.54	2.67			**0.2**	**7.6**	3.04	0.87	**0.4**	**3.9**	-	**0.7**	**11.5**	**12.2**
1994	0.37	1.90	1.47	0.32		0.82	1.90	**0.3**	**6.8**	2.30	0.79	**0.7**	**3.1**	-	**1.0**	**9.9**	**10.9**
1995	0.37	1.59	0.96	0.46		2.34	2.94	**0.9**	**8.6**	2.56	1.03	**1.2**	**3.6**	-	**2.1**	**12.2**	**14.3**
1996	0.23	1.15	0.98	0.98		1.46	2.17	**0.9**	**7.0**	2.01	0.76	**1.0**	**2.8**	-	**1.9**	**9.7**	**11.6**
1997	0.30	1.04	0.76	0.88		1.32	1.78	**1.1**	**6.1**	1.52	0.90	**1.2**	**2.4**	-	**2.3**	**8.5**	**10.8**
1998	0.32	0.75	0.62	0.53		0.88	1.95	**0.6**	**5.0**	1.67	0.97	**1.1**	**2.6**	-	**1.7**	**7.7**	**9.4**
1999	0.33	0.60	0.00	0.57		0.87	1.59	**0.4**	**4.0**	2.12	1.09	**1.2**	**3.2**	-	**1.5**	**7.2**	**8.7**
2000	0.26	0.85	0.15	0.58		0.83	1.98	**0.6**	**4.7**	2.09	1.16	**1.2**	**3.3**	-	**1.8**	**7.9**	**9.7**
2001	0.32	0.55	0.11	1.20		1.06	1.12	**0.4**	**4.4**	2.02	1.20	**1.3**	**3.2**	-	**1.7**	**7.6**	**9.2**
2002	0.22	0.58	0.12	0.88		1.37	0.75	**0.4**	**3.9**	1.81	0.97	**1.1**	**2.8**	-	**1.5**	**6.7**	**8.2**
2003	0.37	0.43	0.17	1.25		1.36	1.07	**0.3**	**4.7**	1.13	0.96	**1.0**	**2.1**	-	**1.4**	**6.7**	**8.1**
2004	0.45	0.42	0.13	1.06		1.66	1.13	**0.2**	**4.8**	1.27	0.80	**0.9**	**2.1**	-	**1.1**	**6.9**	**8.0**
2005	0.72	0.63	0.09	0.88		2.77	1.14	**0.6**	**6.2**	1.10	0.96	**1.4**	**2.1**	-	**2.0**	**8.3**	**10.3**
2006	0.48	0.71	0.35	0.63		4.70	1.81	**2.5**	**8.7**	1.22	0.91	**0.7**	**2.1**	-	**3.2**	**10.8**	**14.0**
2007	0.83	1.80	0.89	0.50		6.71	2.07	**1.3**	**12.8**	1.41	0.72	**1.7**	**2.1**	-	**3.0**	**14.9**	**17.9**
2008	1.12	2.64	1.51	0.53		6.32	2.44	**1.4**	**14.6**	1.27	0.94	**1.0**	**2.2**	-	**2.4**	**16.8**	**19.2**
2009	1.36	2.92	2.10	0.55		7.37	2.54	**1.9**	**16.8**	1.39	0.96	**1.3**	**2.4**	-	**3.2**	**19.2**	**22.4**

Table 7.2 HAKE SOUTHERN STOCK - length compositions (thousands) by gear in 2009

Length (cm)	PORTUGAL			SPAIN					STOCK		
	Trawl	Art	Disc	Art	Trawl	Longline	Gillnets	Disc	Land	Disc	Catch
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	2	0	2	2
6	0	0	86	0	0	0	0	0	0	86	86
7	0	0	133	0	0	0	0	3	0	136	136
8	0	0	312	0	2	0	0	11	2	323	325
9	0	0	566	0	28	0	0	17	28	583	611
10	0	0	677	0	68	0	0	181	68	858	926
11	0	0	399	0	163	0	0	72	163	471	633
12	0	0	423	0	336	0	0	231	336	654	990
13	0	0	697	0	429	0	0	280	429	978	1407
14	0	0	833	0	549	0	0	406	549	1239	1788
15	0	0	1250	0	510	0	0	510	510	1760	2269
16	0	0	1322	0	386	0	0	644	386	1966	2352
17	0	0	1335	0	244	0	0	501	244	1835	2079
18	0	0	1612	0	213	0	0	590	214	2202	2416
19	0	2	2179	0	223	0	0	551	225	2731	2956
20	0	1	1966	0	217	0	0	496	219	2462	2680
21	0	1	2167	0	227	0	0	1025	228	3192	3420
22	0	5	1678	0	239	0	0	1628	244	3306	3550
23	0	4	1023	0	247	0	0	2235	251	3257	3508
24	2	4	1090	2	211	0	0	3415	219	4506	4724
25	17	14	786	0	301	0	1	2982	333	3768	4101
26	77	39	666	10	541	0	1	2192	669	2857	3526
27	119	51	188	267	783	0	1	1244	1221	1433	2653
28	225	64	216	338	904	0	1	605	1532	821	2353
29	344	69	158	316	1159	0	2	273	1891	431	2322
30	487	87	153	401	1162	0	10	101	2147	254	2400
31	235	111	141	371	1303	0	17	33	2037	174	2210
32	155	154	71	487	1497	0	29	17	2323	88	2411
33	111	178	80	403	1352	2	37	13	2083	93	2176
34	80	128	5	468	1341	3	53	26	2073	31	2104
35	88	164	7	414	1195	3	61	21	1923	28	1951
36	94	147	4	325	1152	12	44	2	1773	6	1780
37	67	88	28	261	1040	22	50	0	1528	28	1556
38	58	98	4	233	860	16	48	0	1313	4	1317
39	33	69	0	175	657	37	41	0	1012	0	1012
40	33	85	0	119	540	39	46	0	863	0	863
41	28	74	0	100	569	59	41	1	870	1	872
42	33	77	0	79	426	82	50	2	746	2	748
43	27	95	0	35	408	79	58	0	701	0	702
44	33	76	4	21	488	91	73	1	782	5	787
45	36	78	0	12	472	106	80	1	784	1	785
46	30	78	13	20	443	96	84	0	753	13	766
47	20	72	4	4	511	96	79	0	782	4	786
48	34	90	0	6	460	121	105	0	818	0	818
49	41	74	0	5	415	101	103	0	740	0	740
50	24	48	0	4	374	131	114	0	695	0	695
51	16	59	0	4	328	115	141	6	663	6	669
52	9	41	0	3	300	105	141	0	598	0	598
53	15	35	0	0	272	74	133	0	530	0	530
54	11	43	0	0	238	121	131	0	545	0	545
55	11	39	0	0	195	59	122	0	427	0	427
56	9	31	0	0	187	69	121	0	417	0	417
57	7	19	0	0	125	51	108	0	309	0	309
58	3	17	0	0	120	62	101	0	303	0	303
59	5	12	0	0	77	30	94	0	219	0	219
60	7	15	0	0	85	28	66	0	201	0	201
61	5	7	0	0	56	19	62	0	148	0	148
62	3	6	0	0	51	16	56	0	133	0	133
63	7	13	0	0	44	26	47	0	136	0	136
64	2	9	0	0	33	18	38	0	100	0	100
65	1	10	0	0	22	11	28	0	71	0	71
66	0	3	0	0	23	18	28	0	73	0	73
67	1	2	0	0	17	8	24	0	53	0	53
68	1	2	0	0	14	13	15	0	44	0	44
69	1	1	0	0	10	17	16	0	44	0	44
70	1	1	0	0	7	8	11	0	28	0	28
71	0	0	0	0	5	15	13	0	33	0	33
72	0	1	0	0	6	1	7	0	15	0	15
73	0	0	0	0	4	2	4	0	10	0	10
74	0	5	0	0	2	1	5	0	13	0	13
75	0	0	0	0	3	16	2	0	22	0	22
76	0	0	0	0	3	1	4	0	8	0	8
77	1	0	0	0	3	1	4	0	10	0	10
78	0	0	0	0	2	1	2	0	4	0	4
79	0	0	0	0	1	12	2	0	15	0	15
80	0	0	0	0	0	1	2	0	4	0	4
81	0	0	0	0	1	12	1	0	14	0	14
82	0	0	0	0	0	1	0	0	1	0	1
83	0	0	0	0	0	0	1	0	1	0	1
84	0	0	0	0	0	0	0	0	1	0	1
85	0	0	0	0	1	0	1	0	2	0	2
86	0	0	0	0	1	0	0	0	1	0	1
87	0	0	0	0	0	0	1	0	1	0	1
88	0	0	0	0	0	0	0	0	1	0	1
89	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	2	0	3	0	3
TOTAL	2651	2698	22276	4883	26880	2025	2766	20319	41902	42595	84497
Nominal Weight (tons)	0.96	1.39	1.27	1.36	10.46	2.10	2.92	1.92	19.19	3.19	22.38
SOP	0.88	1.45	1.36	1.40	10.41	2.10	2.92	1.92	19.15	3.28	22.43
SOP / NW	1.10	0.96	0.93	0.97	1.01	1.00	1.00	1.00	1.00	0.97	1.00
Mean length (cm)	34.3	40.4	19.3	34.0	34.7	51.4	51.4	23.2	36.9	21.2	28.9

Table 7.3 HAKE SOUTHERN STOCK - Portuguese groundfish surveys; biomass, abundance and recruitment indices

Year	PESCADA-BD					P-GFS-jul (Summer)					P-GFS-oct (Autumn)					
	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	no survey since 2002					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	No survey										37.5	4.4	476.4	75.9	318.6	93

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						0								
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

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

YEAR	A Coruña Trawl			A Coruña Pair Trawl			Vigo and Marín trawl [1]			Santander trawl			Cadiz trawl			Portugal trawl		
	Landings	lpue *	Effort	Landings	lpue *	Effort	Landings	lpue *	Effort	Landings	lpue *	Effort	Landings	lpue ***	Effort	Landings	lpue **	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				1714		
1989	715	16	44440	480	31	15240				245	13.9	17607				1847	39.2	47072
1990	749	17	44430	429	24	18250	438	17.5	25063	392	19.2	20469				1138	33.9	33535
1991	501	12	40440	609	20	30530	368	12.6	29260	340	15.2	22391				1245	38.2	32574
1992	589	15	38910	730	27	26670	666	21.4	31146	311	13.6	22833				1325	34.4	38522
1993	514	12	44504	350	16	21349	290	13.1	22198	390	18.2	21370				871	31.6	27585
1994	473	12	39589	319	15	20732	556	21.3	26115	296	13.0	22772	326	11.7	27823	789	31.6	24980
1995	831	20	41452	691	24	28988	1018	35.5	28677	336	23.9	14046	458	14.2	32194	1026	38.9	26350
1996	722	20	35728	249	14	17555	647	21.9	29480	274	22.7	12071	975	30.5	31951	894	34.7	25788
1997	732	21	35211	295	18	16307	347	9.2	37578	127	10.8	11776	880	27.0	32573	906	38.5	23511
1998	895	27	32563	198	12	16966	284	6.7	42371	122	11.4	10646	523	15.9	32824	913	35.5	25749
1999	691	23	30232	139	15	9322	402	10.1	39738	92	8.9	10349	570	17.4	32731	1092	40.8	26771
2000	590	20	30102	92	29	3190	371	11.0	33771	52	5.9	8779	584	19.5	29875	1162	32.5	35723
2001	597	20	29923	91	19	4873	293	8.7	33802	47	15.5	3053	1203	39.6	30416	1210	37.2	32550
2002	232	11	21823	266	37	7147	256	10.6	24288	30	7.6	3975	883	28.9	30526	970	36.5	26593
2003	274	15	18493	121	30	3988	397	17	23151	22	5.8	3837	1251	39.5	31643	962	36.4	26420
2004	259	12	21112	249	29	8582	259	23	11139	17	4.6	3776	1062	35.4	30029	800	35.6	22464
2005	330	16	20663	428	47	9025	286	29	9981	7	4.9	1404	885	27.3	32419	965	37.7	25576
2006	518	27	19264	489	78	6245	360	32	11128	24	9.0	2718	634	24.1	26248	908	36.3	25021
2007	621	29	21201	788	58	13471	375	34	11062	64	14.8	4334	505	20.7	24398	724	36.0	20110
2008	762	38	20212	631	70	8964	454	41	11034	64			529	27.7	19135	936	42.6	21981
2009	640	40	16162	886	112	7944	400	42	9468	31	28	1125	550	25.9	21218	964	42.9	22478

* - Kg/fishind day x100 HP

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

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

***- Kg/fishing day

Portugal trawl series standarized in 2010

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

Table 7.6. Southern Hake Stock Assessment summary

Year	Fbar(1-3)	R (thousands)	SSB (tonnes)	Landings (tonnes)	Discards (tonnes)
1982	0.36	73.1	40.7	17.6	
1983	0.44	61.0	44.6	22.9	
1984	0.45	51.6	41.6	22.2	
1985	0.42	33.6	41.9	18.9	
1986	0.44	30.7	39.0	17.2	
1987	0.50	37.4	36.2	16.2	
1988	0.64	50.7	26.6	16.7	
1989	0.65	58.4	19.7	13.8	
1990	0.69	61.8	15.8	13.2	
1991	0.68	52.4	16.0	12.8	
1992	0.82	38.5	15.3	13.8	*0.5* *
1993	0.86	46.0	12.9	11.5	*0.7* *
1994	0.85	86.6	9.4	9.9	*1.0* *
1995	1.14	39.1	7.7	12.2	*2.1* *
1996	1.10	79.5	9.0	9.7	*1.9* *
1997	1.10	57.3	7.0	8.5	*2.3* *
1998	0.87	45.2	6.4	7.7	*1.7* *
1999	0.73	49.0	8.3	7.2	*1.5* *
2000	0.80	52.1	9.8	7.9	*1.8* *
2001	0.79	37.8	10.1	7.6	*1.7* *
2002	0.75	51.7	10.5	6.7	*1.5* *
2003	0.75	48.7	10.4	6.7	*1.4* *
2004	0.68	58.7	10.5	6.9	1.1
2005	0.69	94.8	11.1	8.3	2.0
2006	0.78	75.6	12.7	10.8	3.2
2007	0.81	146.8	15.2	14.9	3.0
2008	0.75	72.3	16.0	16.8	2.4
2009	0.74	675.1	20.1	19.2	3.2

* estimated from survey abundance and discards/landings rate

Recruitment = 58.909 mill (geo mean 1989-08)

Table 7.9. Catch Options Table.

	SSB 2010	BIO 2010	F 2010 = F09	Yield 2010	Catch 2010	SSB 2011	BIO 2011
number	22126	29259	0.74	15519	18653	21065	26650

Fmult	F 2011	Yield 2011	Catch 2011	SSB 2012	
0.0	0.00	18	22	38166	
0.1	0.07	1786	2115	35726	
0.2	0.15	3474	4117	33379	
0.3	0.22	5069	6011	31149	
0.35	0.26	5832	6918	30076	*Fmax (F msy proxi)*
0.4	0.30	6573	7799	29031	
0.49	0.36	7851	9321	27218	*-15% 09 TAC (7905)*
0.5	0.37	7989	9486	27022	
0.6	0.44	9321	11075	25117	*2010 TAC (9300)*
0.7	0.52	10572	12570	23314	
0.71	0.53	10693	12714	23139	*+15% 09 TAC (10695)*
0.8	0.59	11745	13974	21608	
0.87	0.64	12521	14905	20470	*ICES / EC transition scheme (F=0.64)*
0.9	0.67	12843	15292	19996	*-10% F (RP proposal)*
1	0.74	13869	16525	18475	
1.1	0.81	14826	17679	17041	
1.2	0.89	15716	18755	15690	
1.3	0.96	16543	19757	14421	
1.4	1.04	17310	20689	13229	
1.5	1.11	18019	21553	12111	
1.6	1.18	18672	22352	11064	
1.7	1.26	19272	23090	10086	
1.8	1.33	19822	23769	9172	
1.9	1.41	20325	24392	8322	
2	1.48	20782	24961	7530	

There is a EC Recovery Plan (-10% annual F redution; +-15% TAC constrain)
Fmsy proxi = Fmax (0.26)
No B trigger decided
No other Biological Reference Points (old BRP's no valid under new model)
TAC 2010 = 9100 (-+15% [7735-10465])
F transition (0.8*Fsq+0.2*Fmax) =0.64
Recruitment = 58.909 mill (geo mean 1989-08)

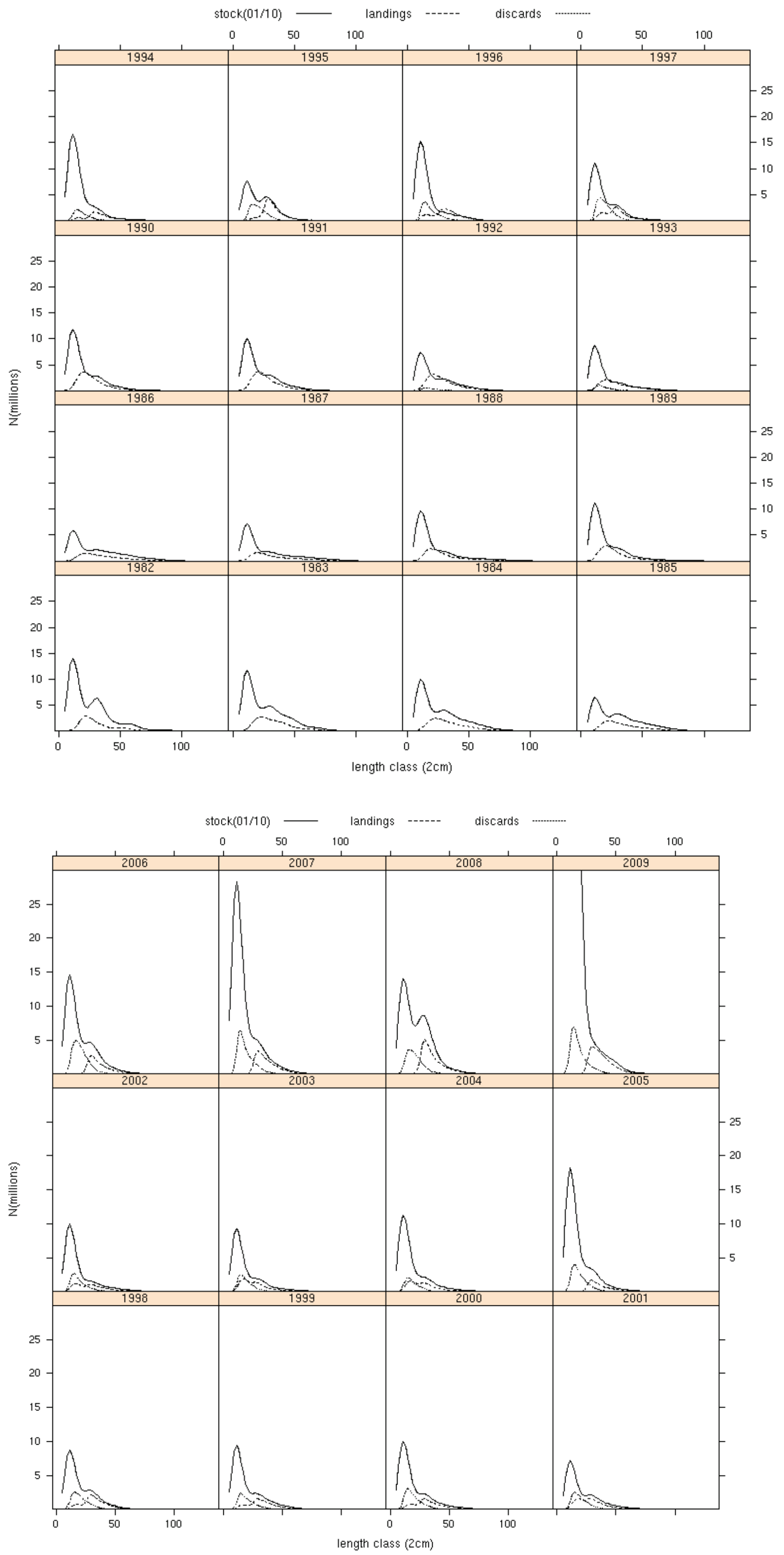


Figure 1. Length distribution of catches (landings and discards) and model abundance in first of 3rd quarter. Recruitment happens at the end of first and second quarter. Abundance is plotted at 3rd quarter to show recruits.

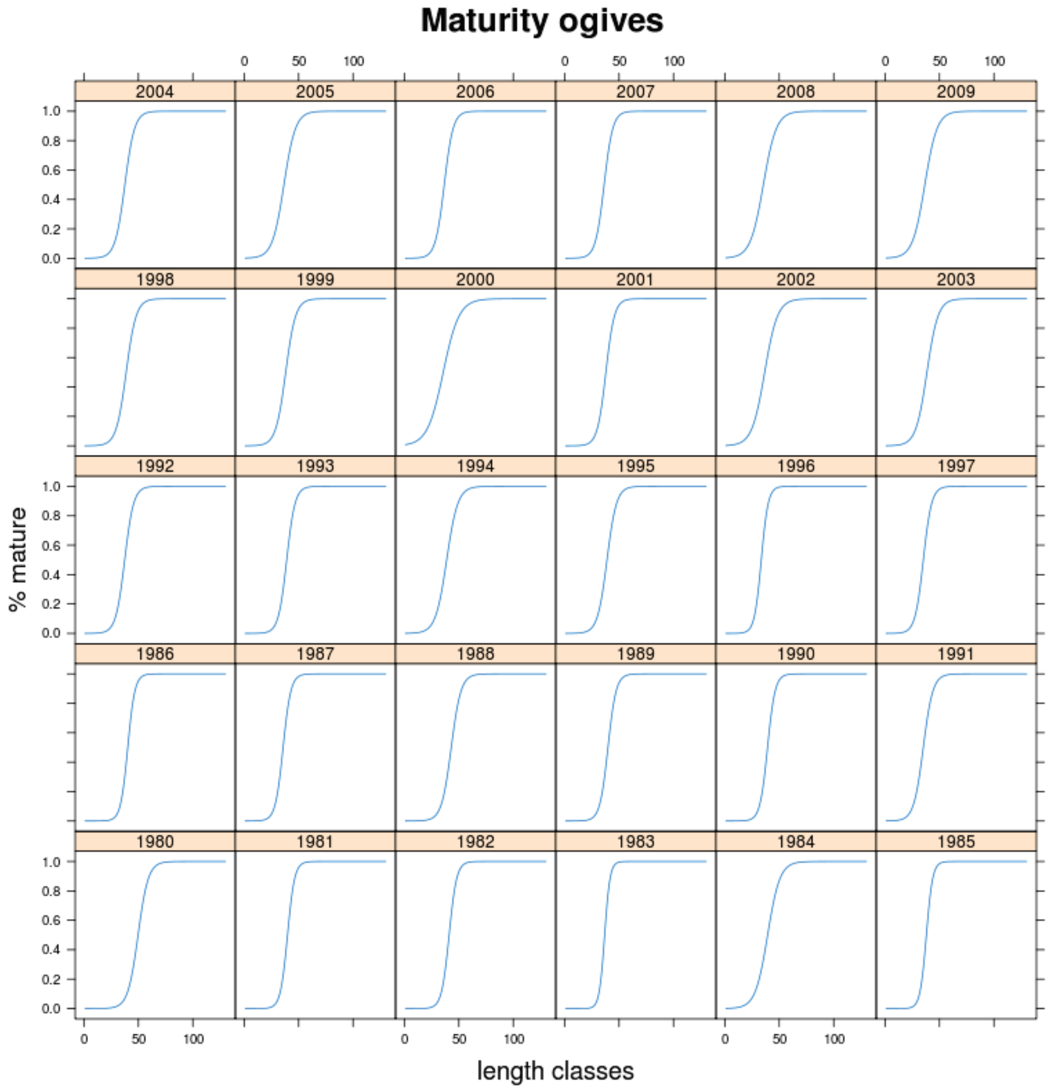


Figure 7.2 Maturity ogive

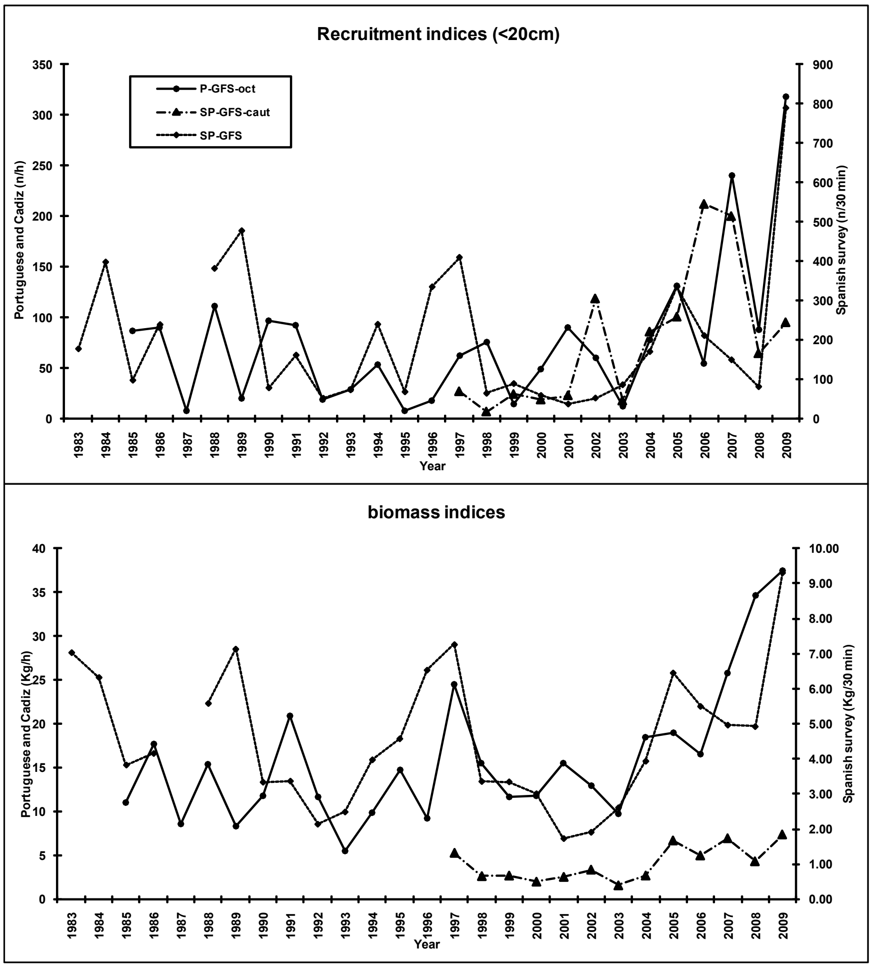


FIGURE 7.3 HAKE SOUTHERN STOCK - Recruitment and biomass Indices from groundfish surveys

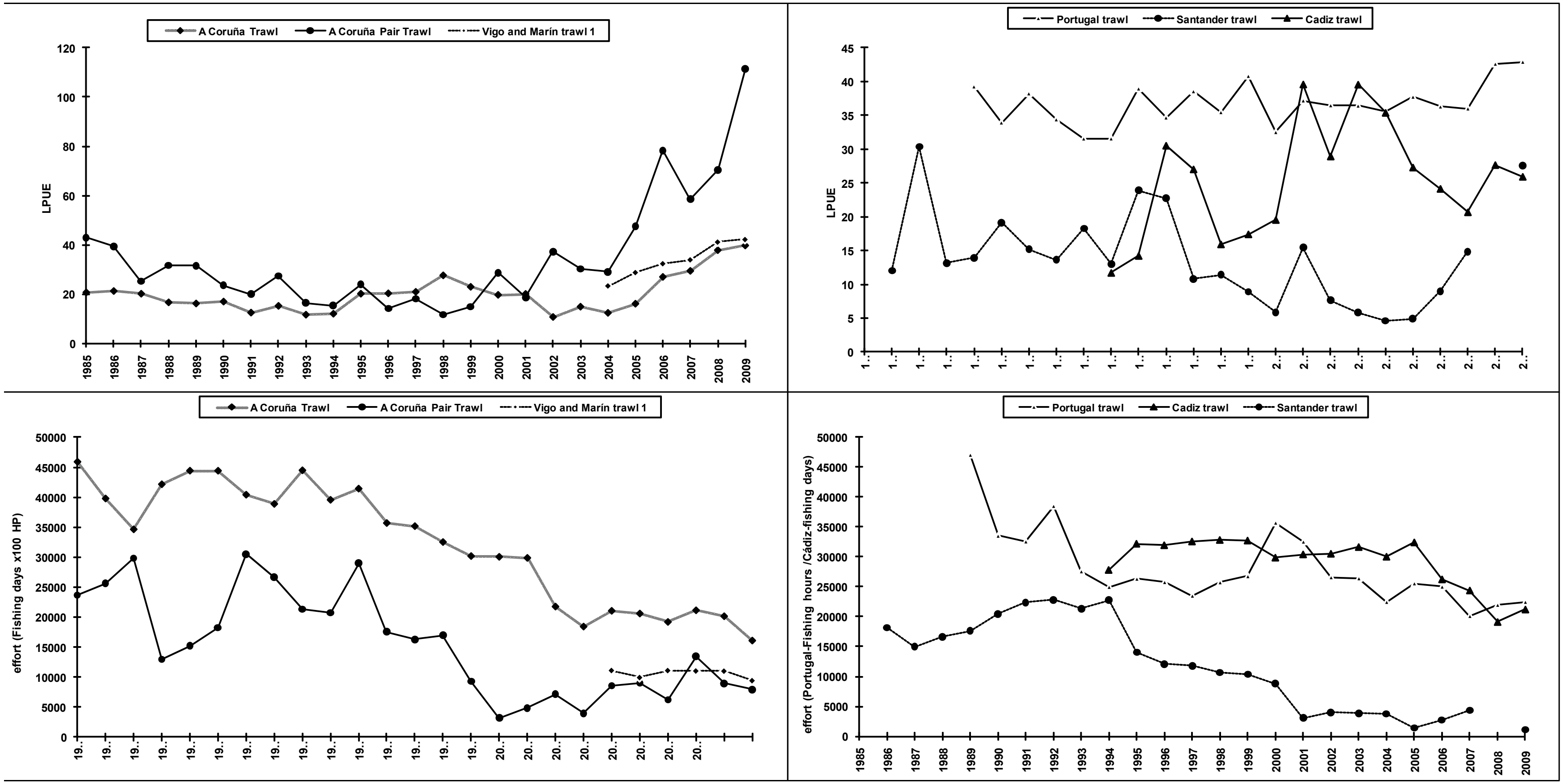


FIGURE 7.4 HAKE SOUTHERN STOCK - LPUE and fishing effort trends for trawl fleets

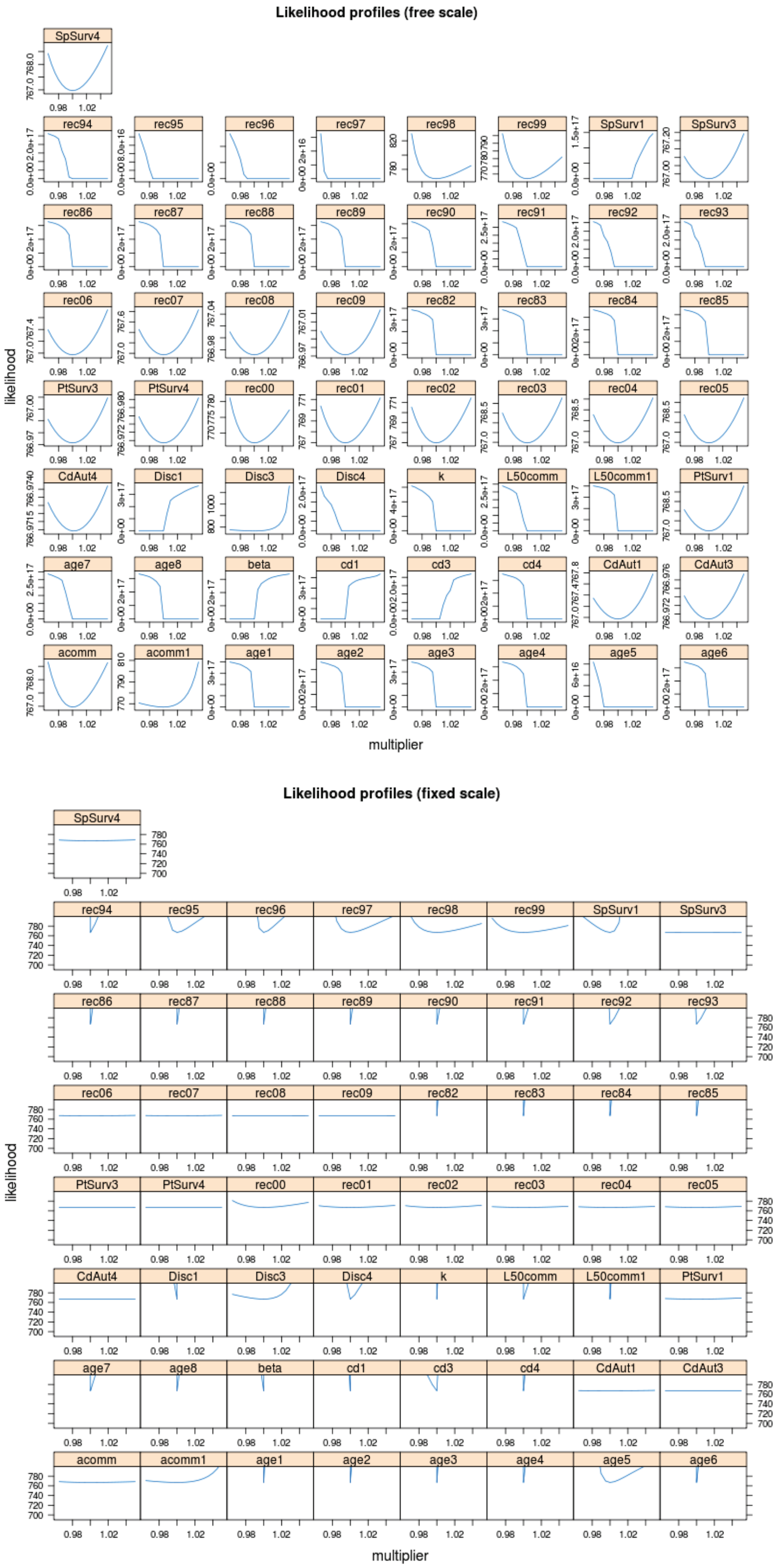
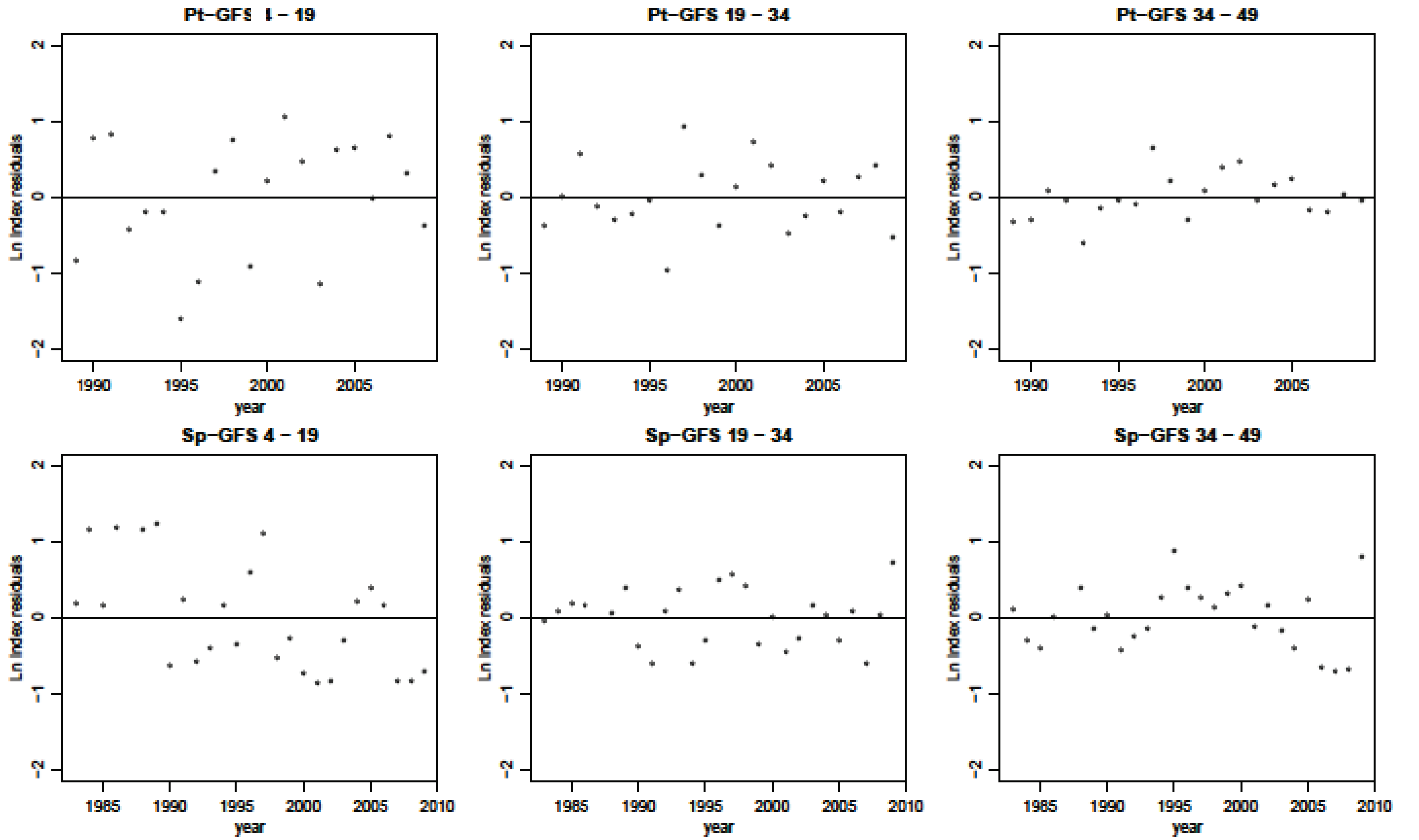
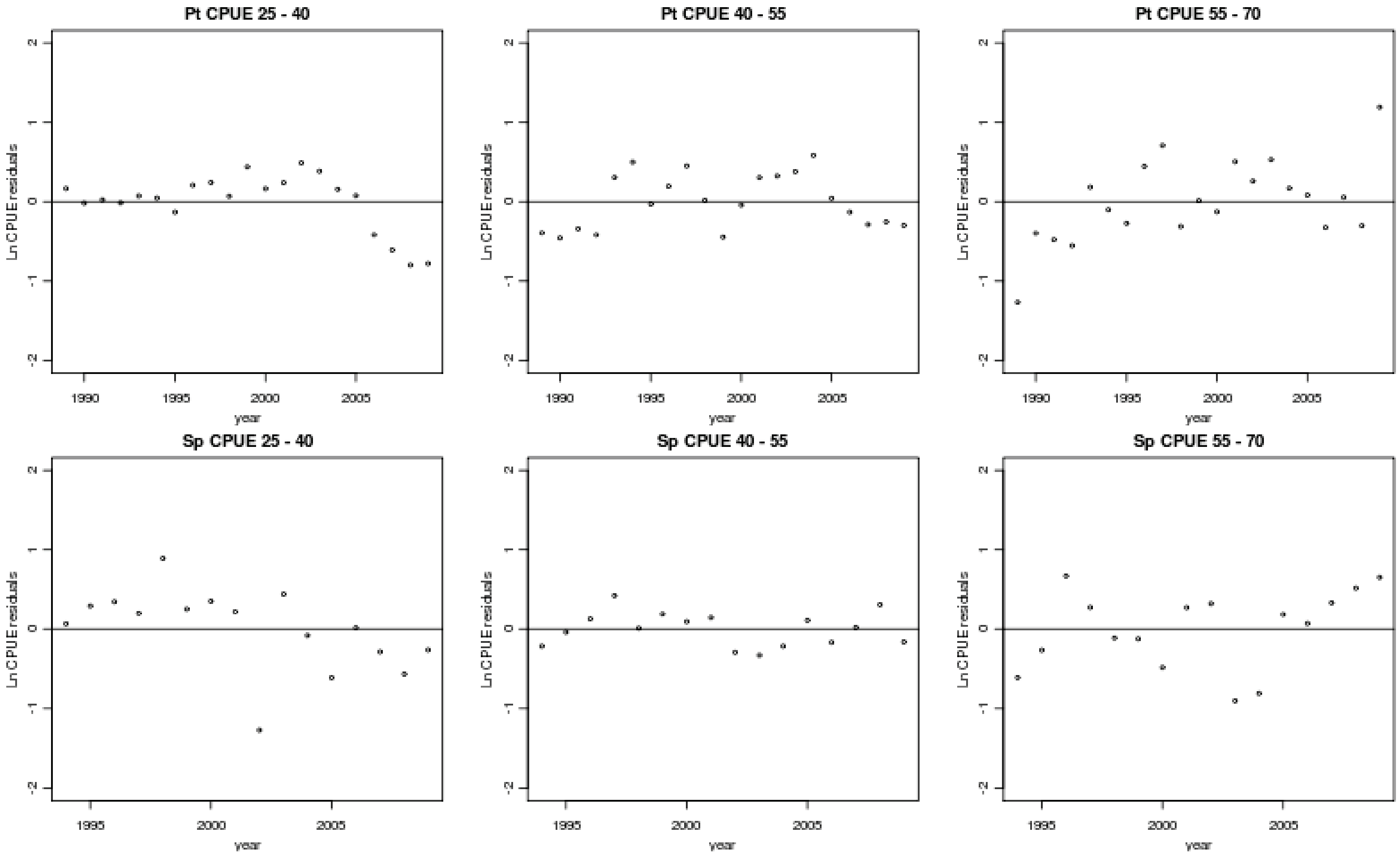


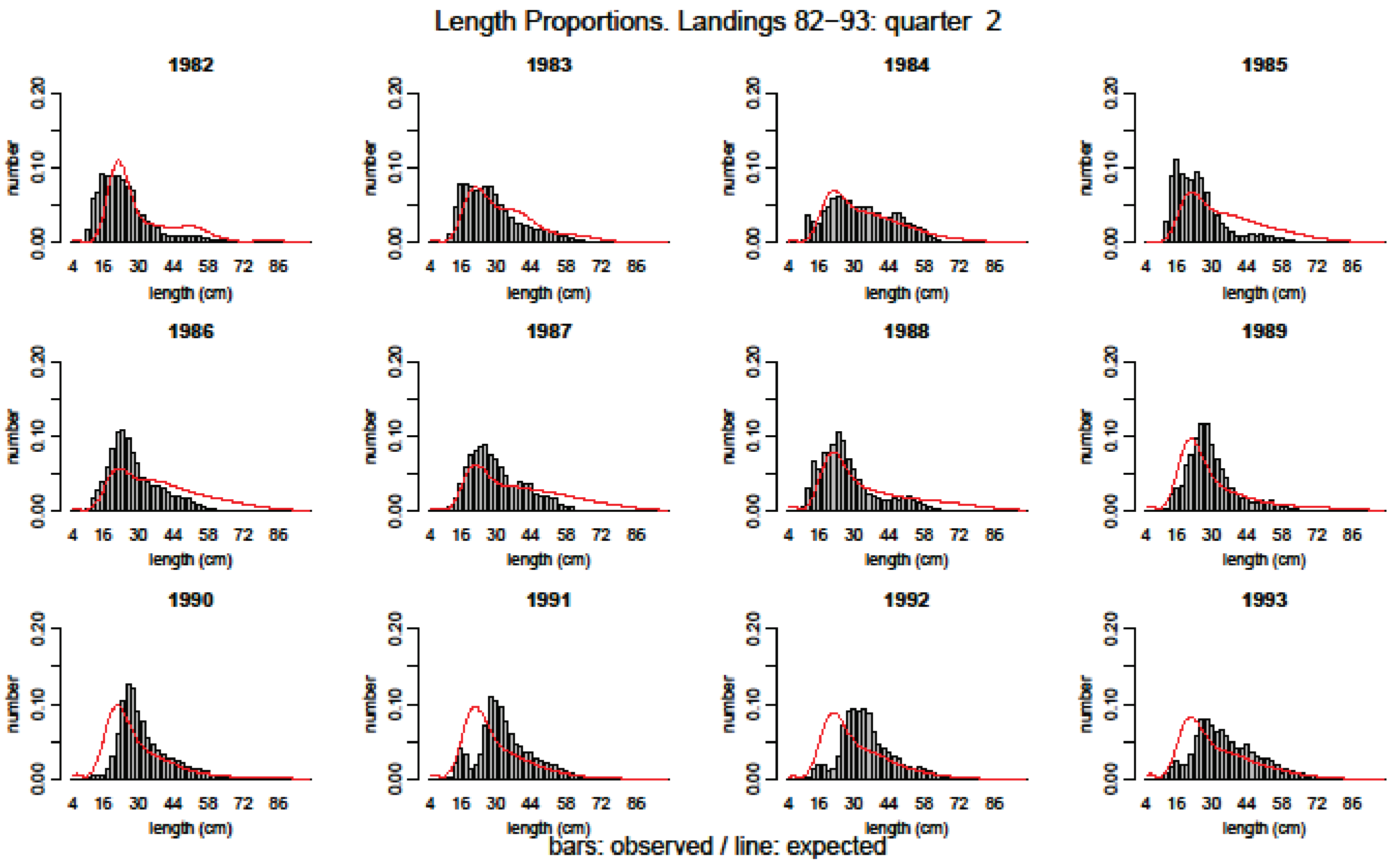
Figure 7.5. Gadget convergence with likelihood profiles. Scaled (upper panel) and unscaled (lower panel)



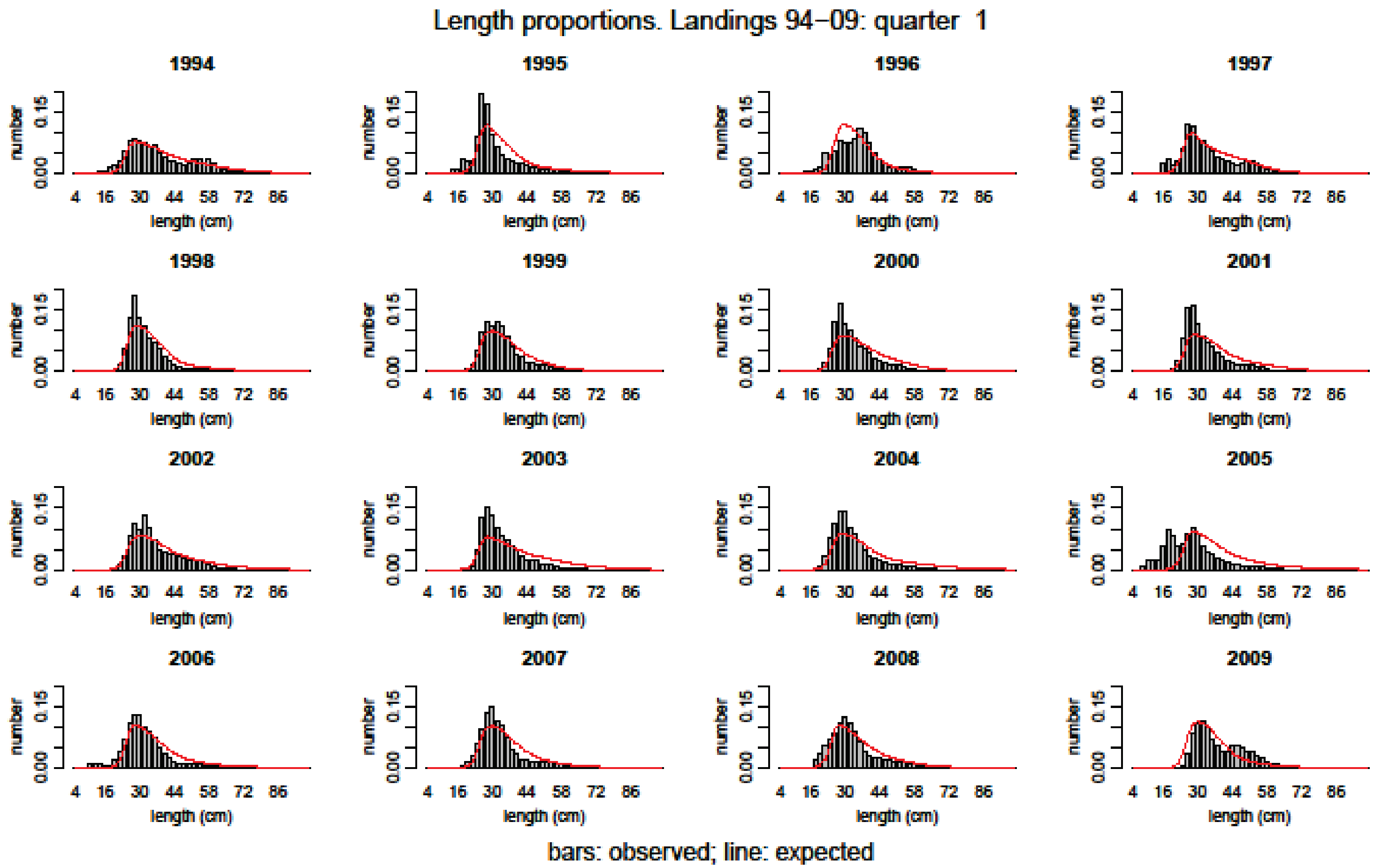
(a) Survey residuals



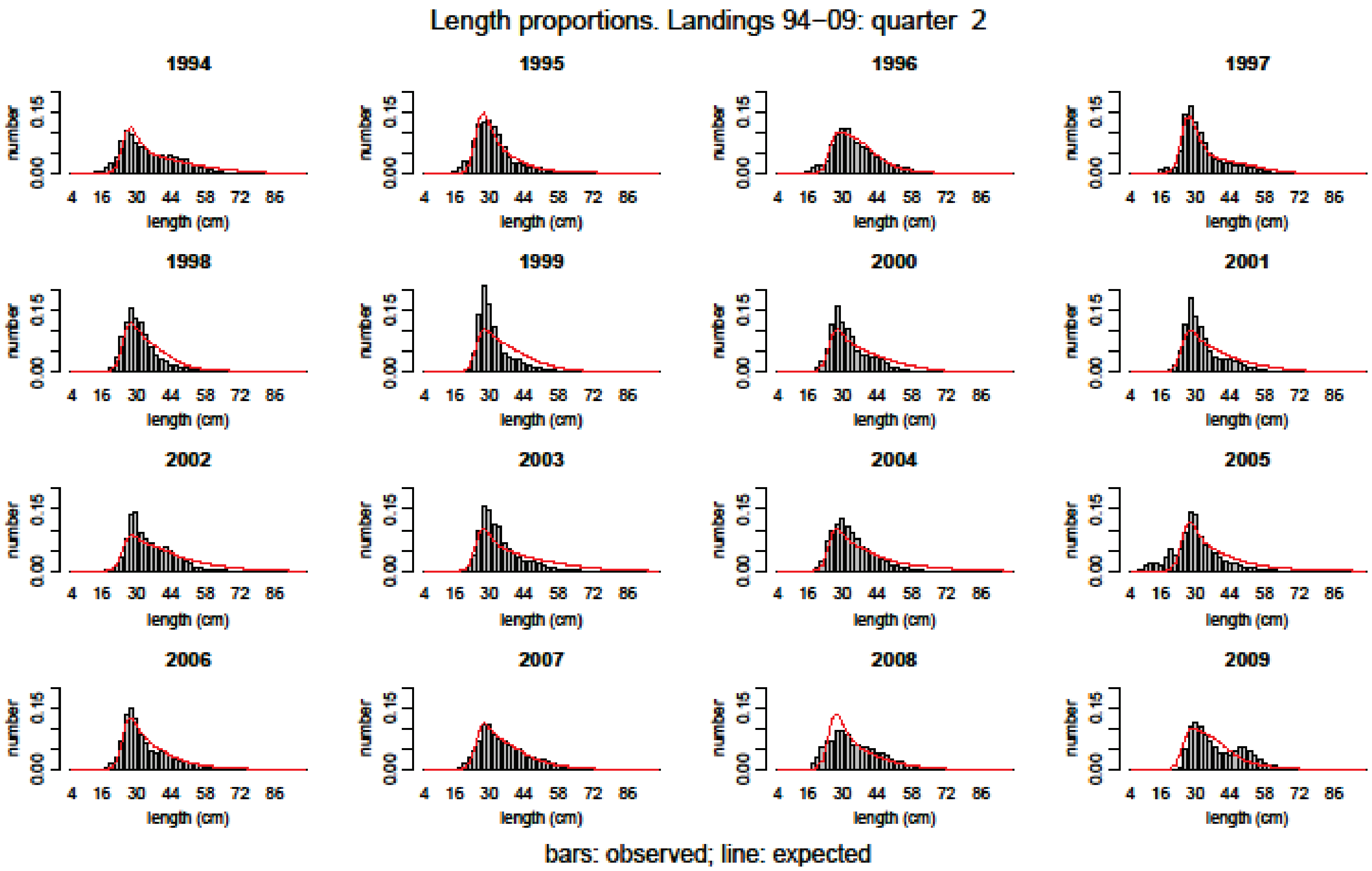
(a) CPUE residuals


Length Proportions. Landings 82−93: quarter 2
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
number
0.00
0.10
0.20
4 16 30 44 58 72 86
length (cm)
bars: observed / line: expected

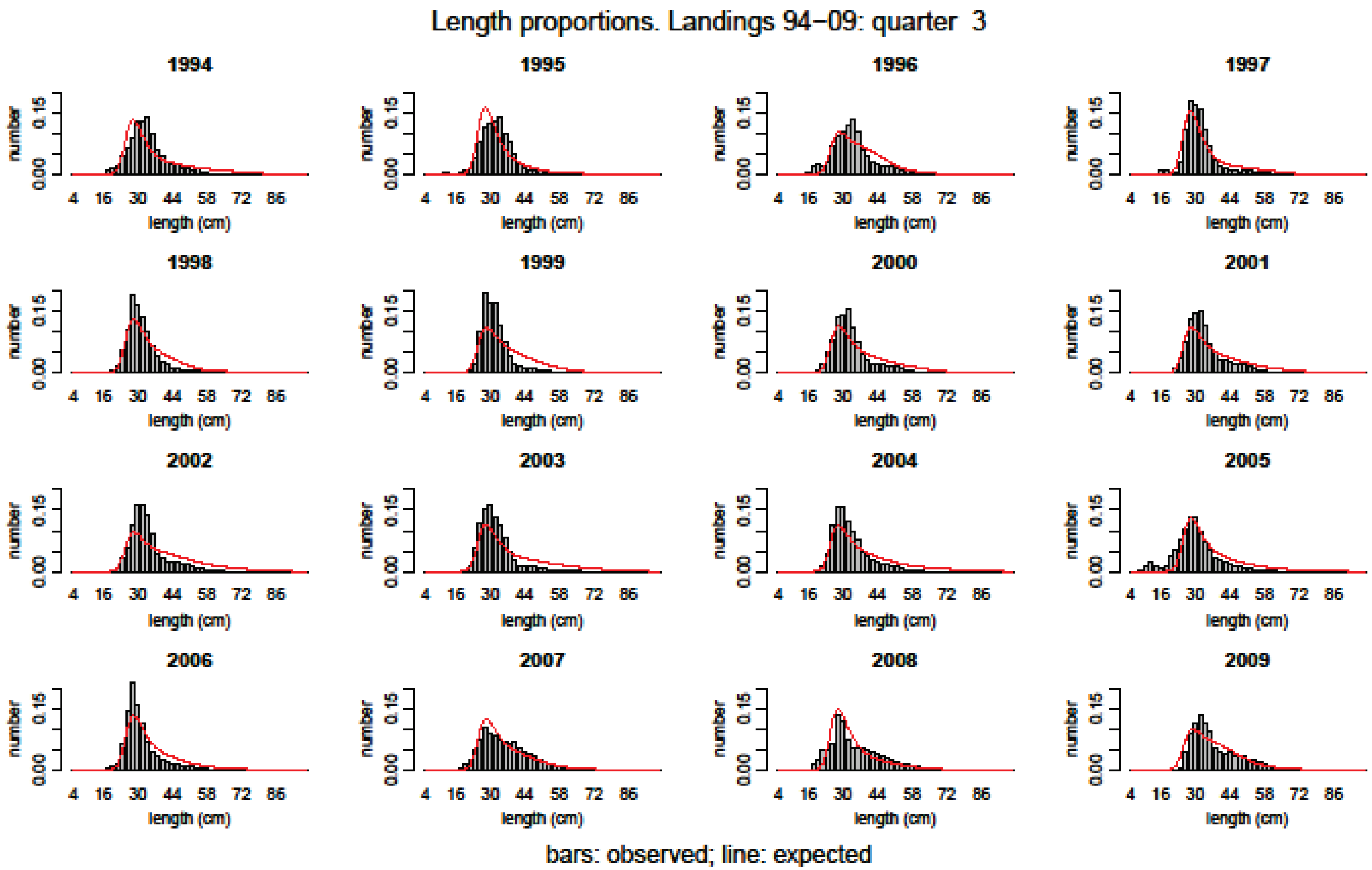
(b)


Length proportions. Landings 94−09: quarter 1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
number
0.00 0.15
4 16 30 44 58 72 86
length (cm)
bars: observed; line: expected

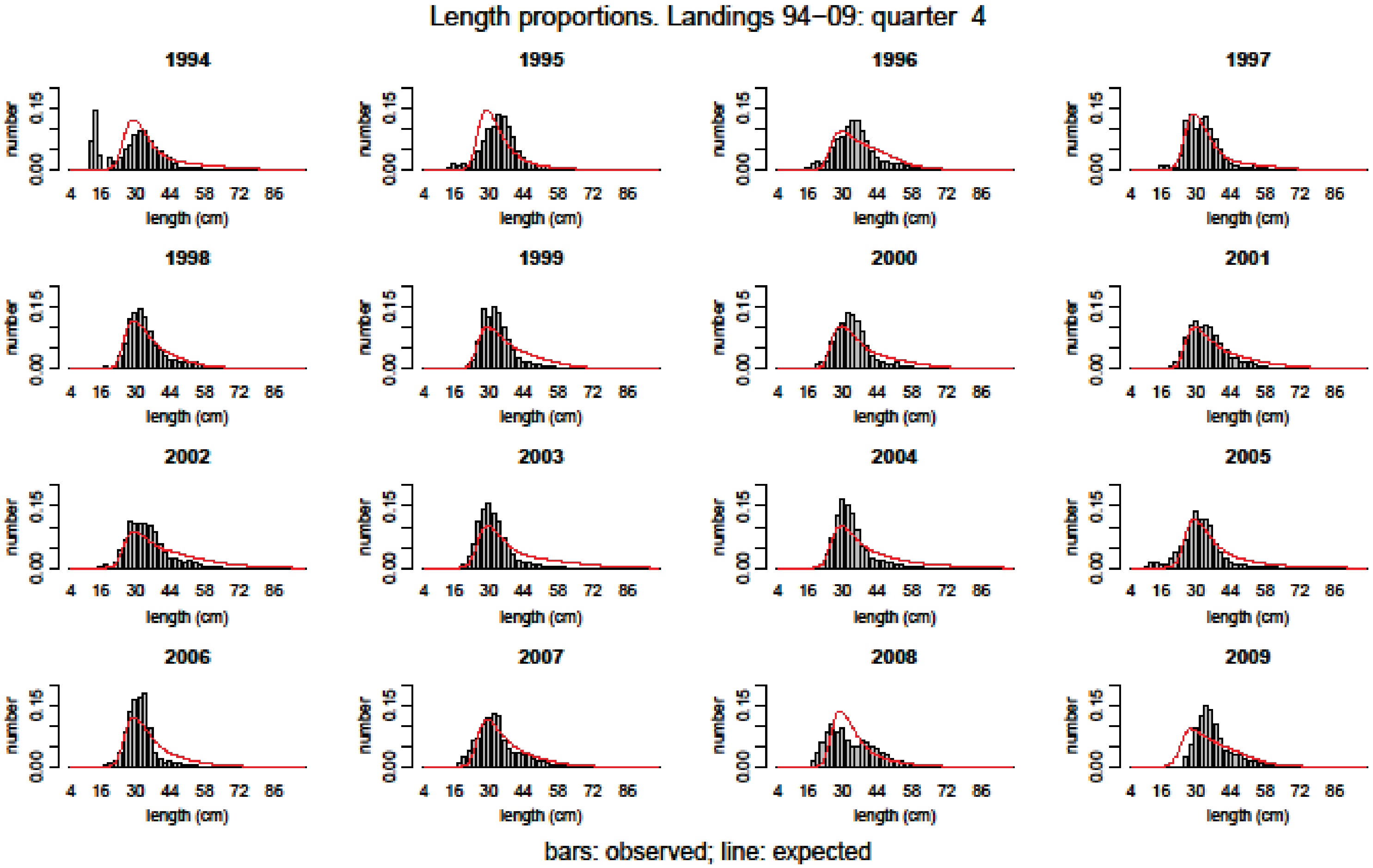
(c1)


Length proportions. Landings 94−09: quarter 2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
number
0.00 0.15
4 16 30 44 58 72 86
length (cm)
bars: observed; line: expected

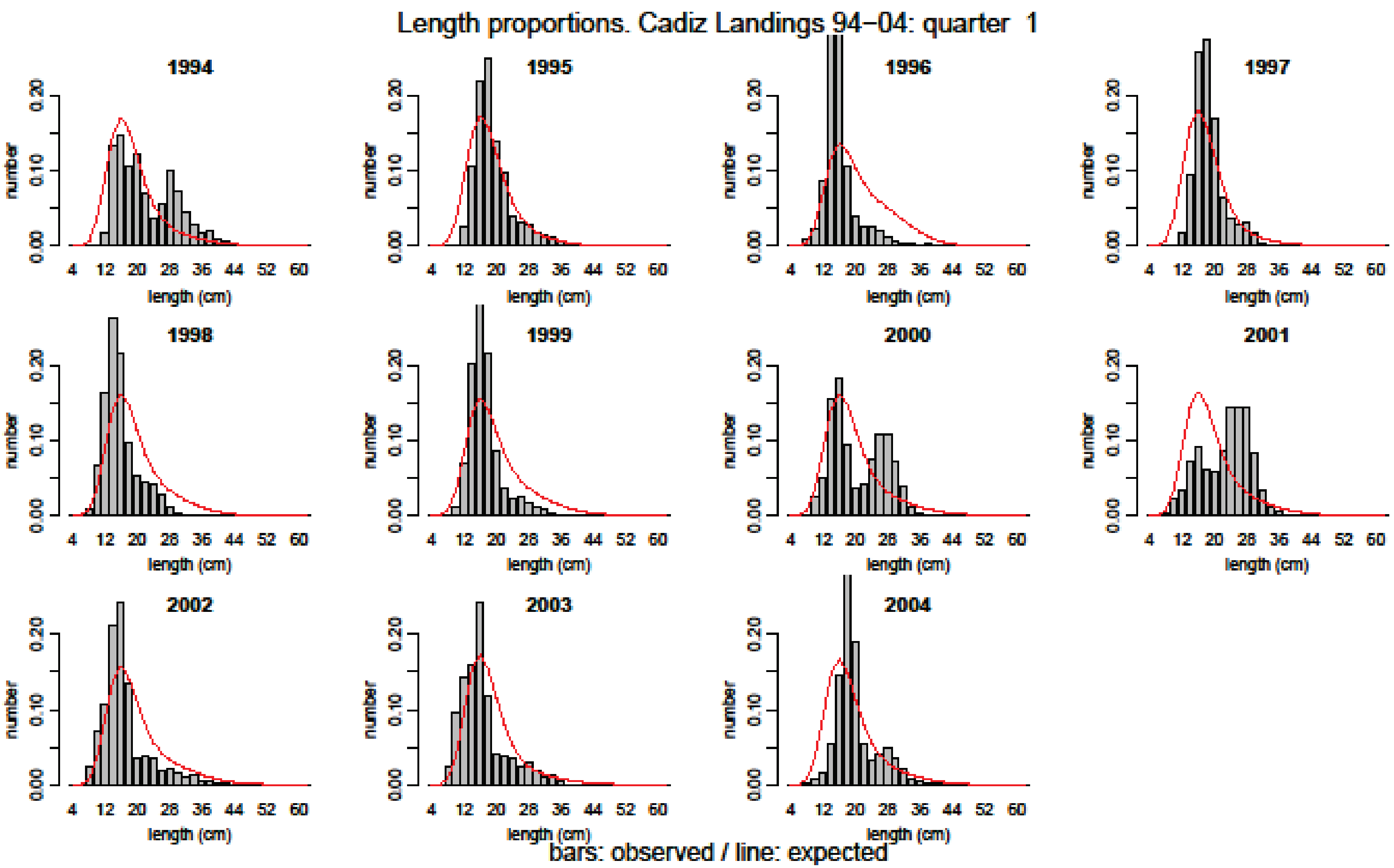
(c2)


Length proportions. Landings 94−09: quarter 3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
number
0.00 0.15
4 16 30 44 58 72 86
length (cm)
bars: observed; line: expected

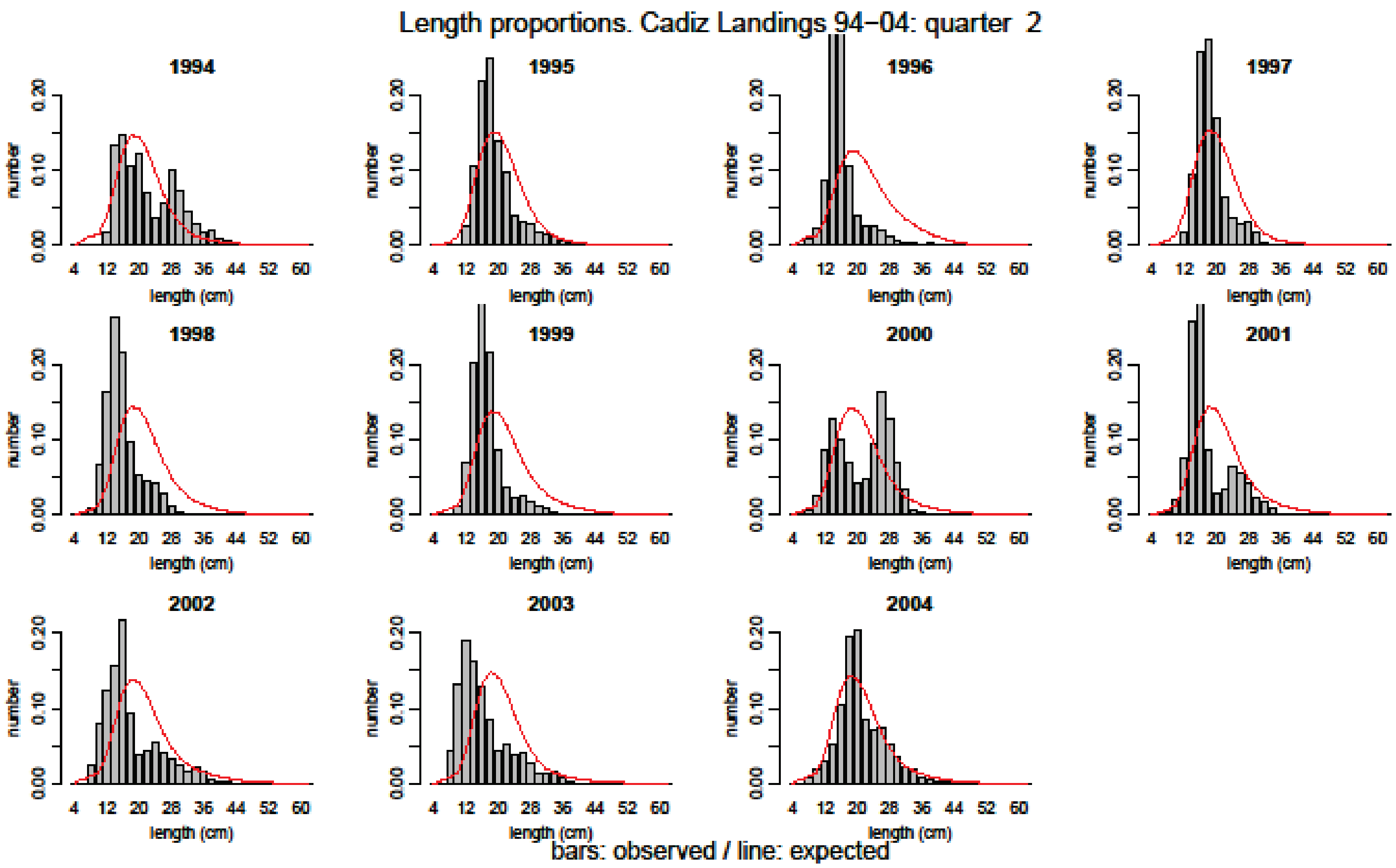
(c3)


Length proportions. Landings 94−09: quarter 4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
number
0.00
0.15
4
16
30
44
58
72
86
length (cm)
bars: observed; line: expected

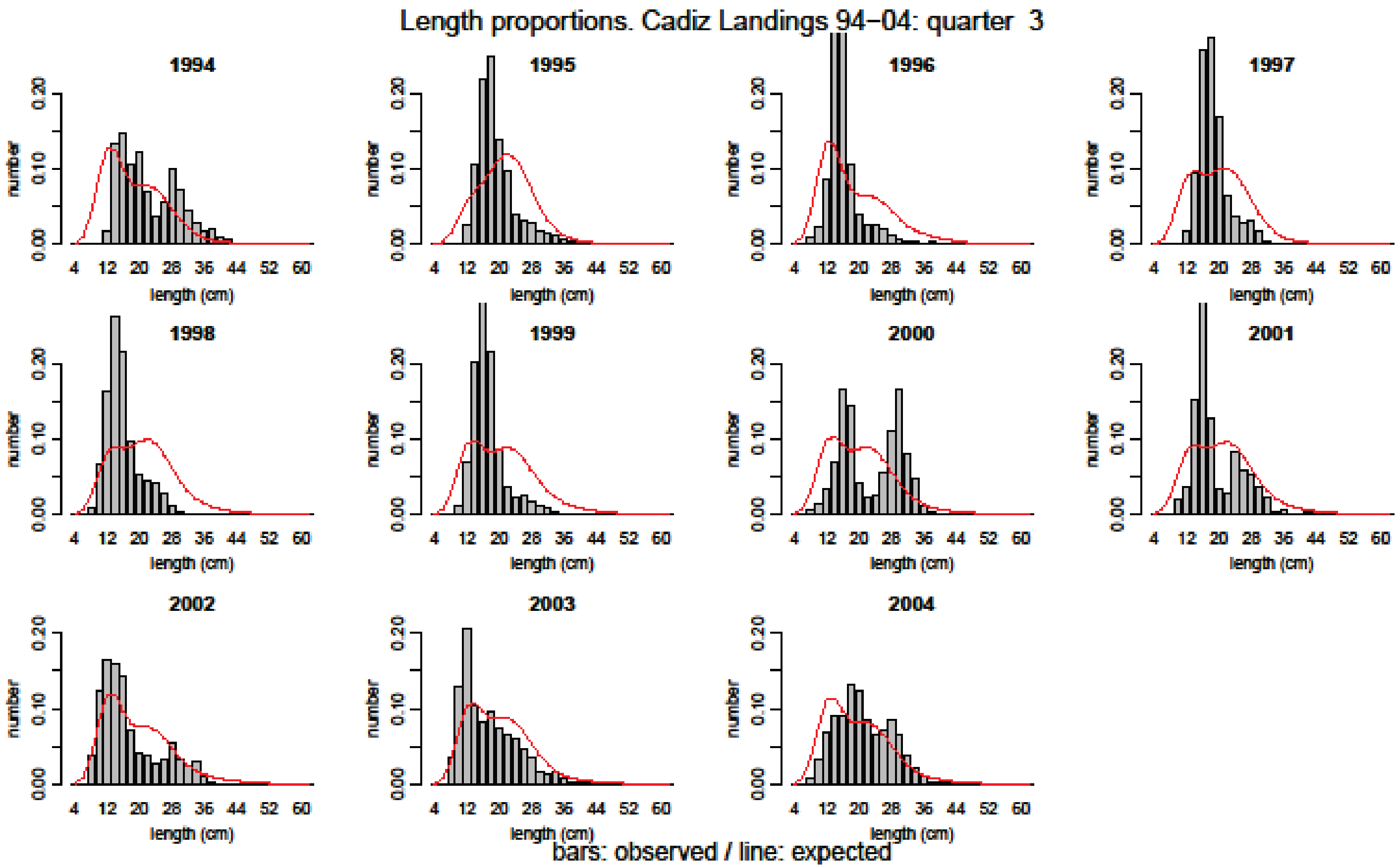
(c4)


Length proportions. Cadiz Landings 94−04: quarter 1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
number
length (cm)
bars: observed / line: expected

(d1)

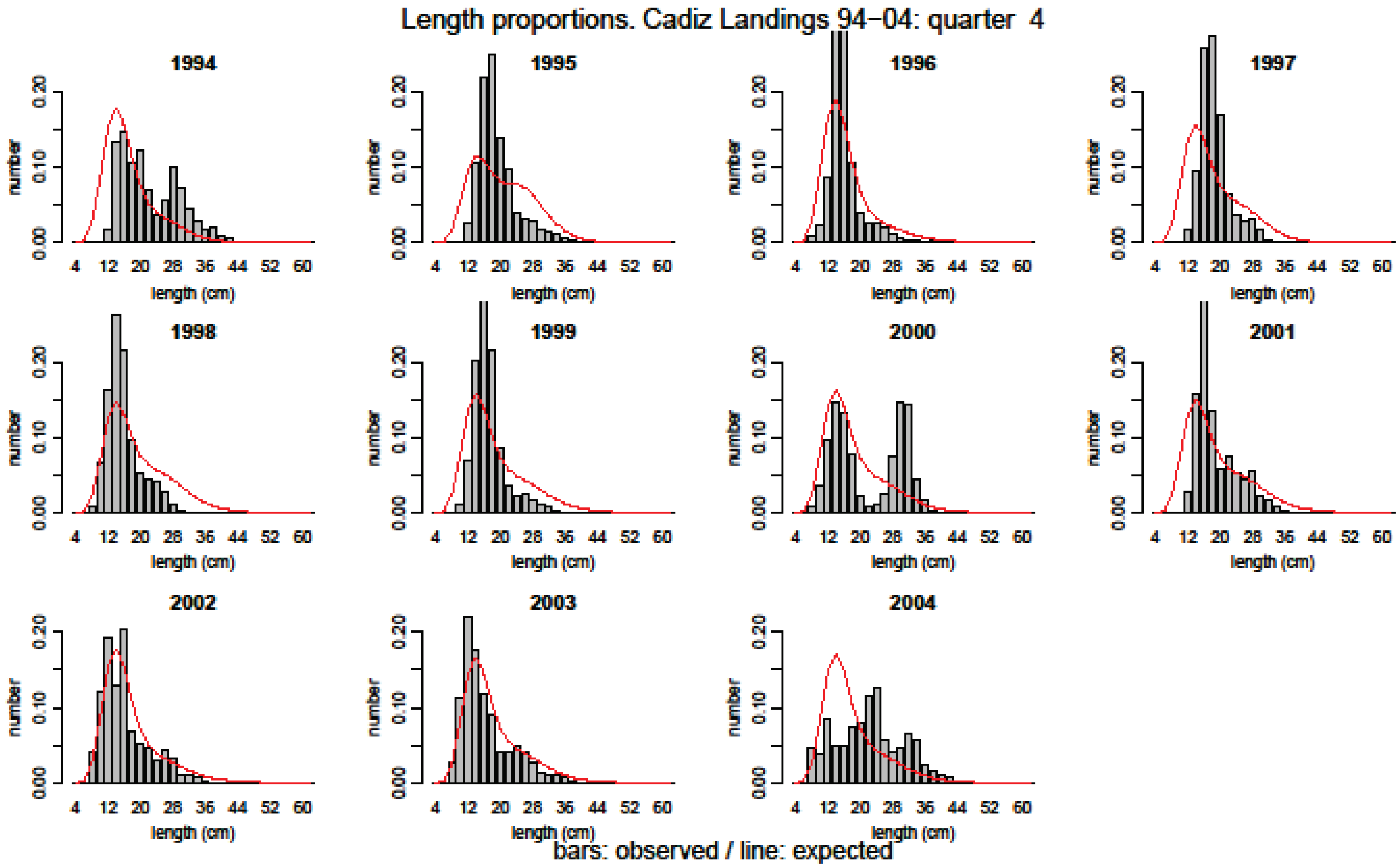

Length proportions. Cadiz Landings 94−04: quarter 2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
number
length (cm)
bars: observed / line: expected

(d2)

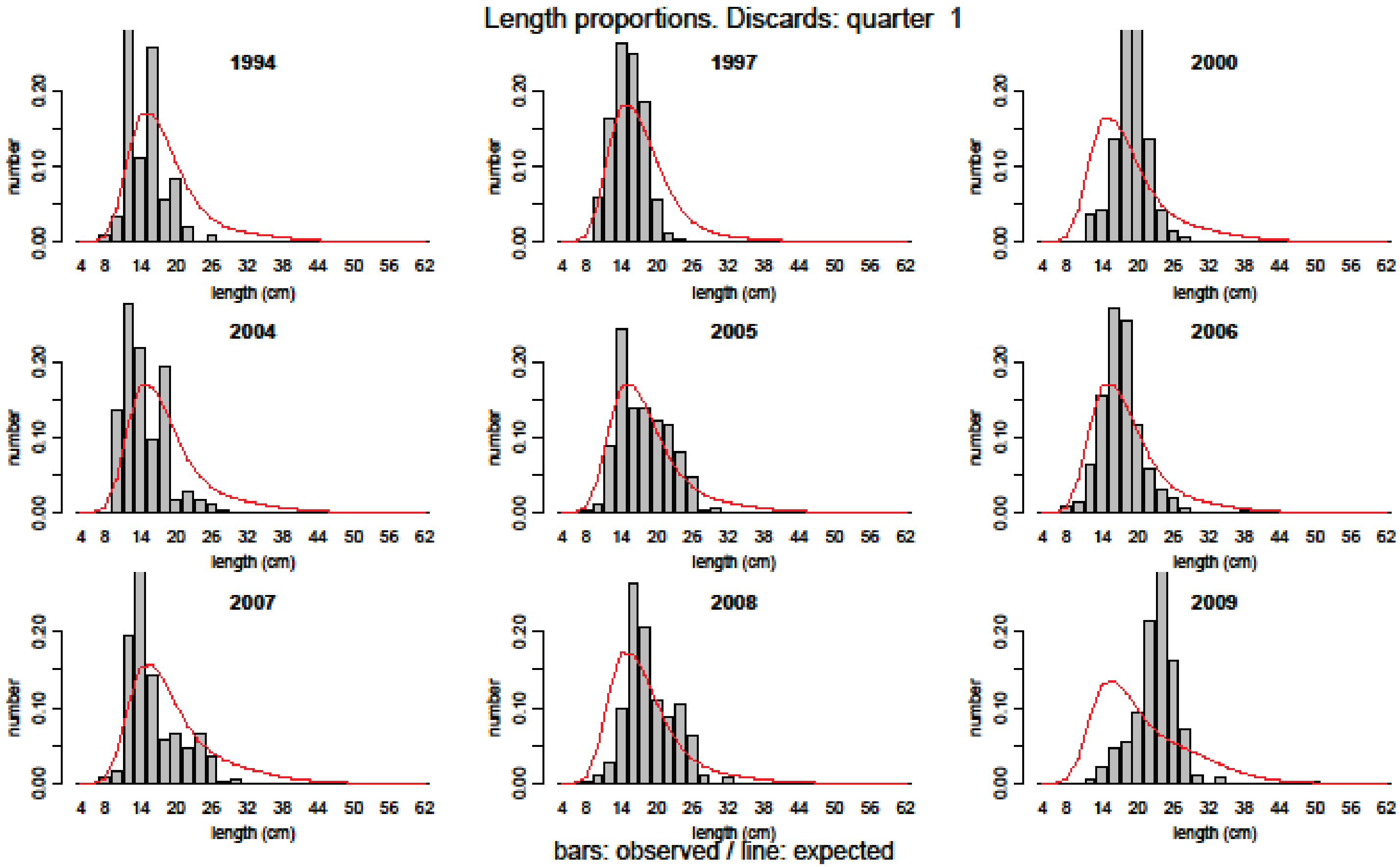


Length proportions. Cadiz Landings 94−04: quarter 3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
number
0.00
0.10
0.20
4 12 20 28 36 44 52 60
length (cm)
bars: observed / line: expected

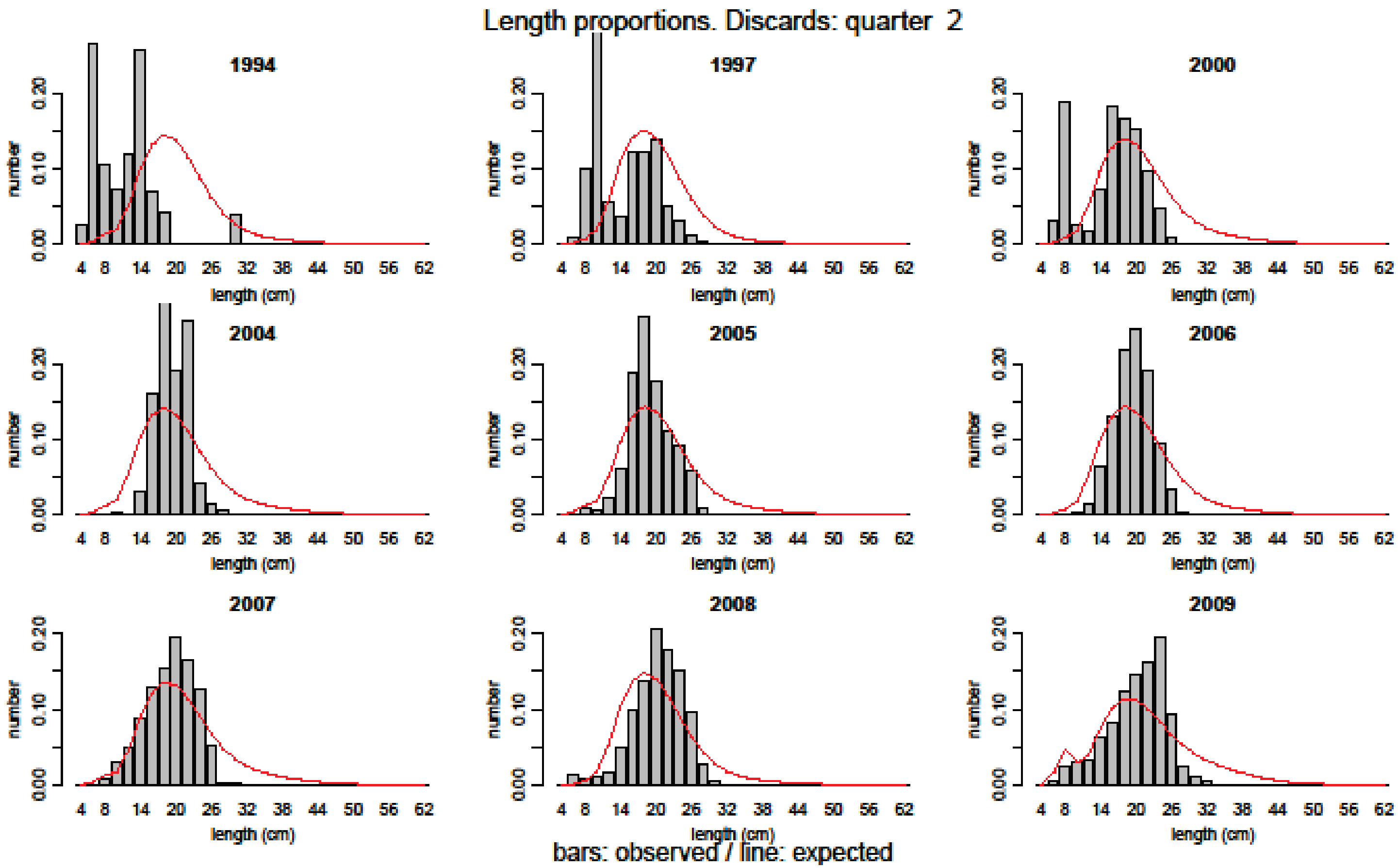
(d3)


Length proportions. Cadiz Landings 94−04: quarter 4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
number
length (cm)
bars: observed / line: expected

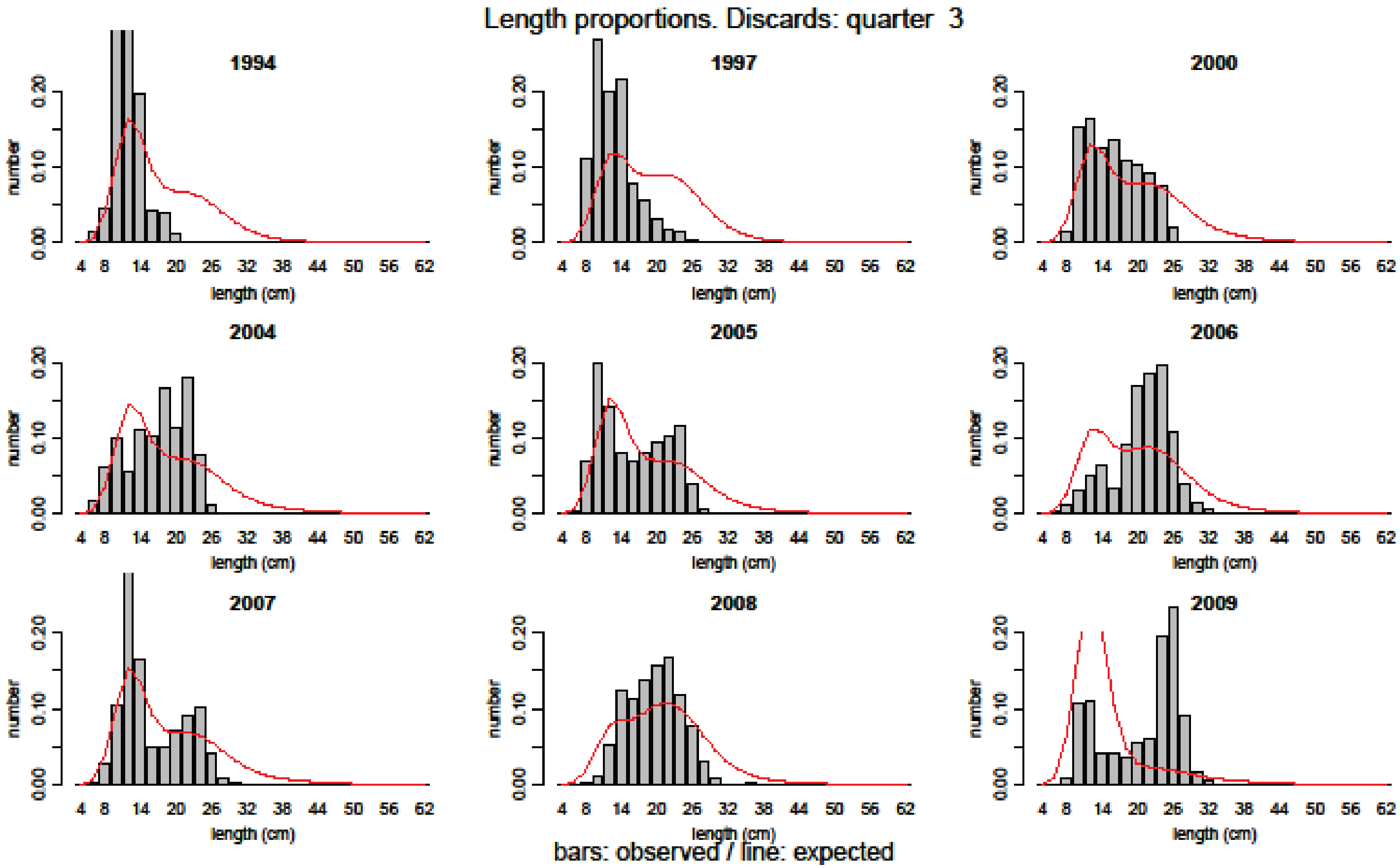
(d4)


Length proportions. Discards: quarter 1
1994
1997
2000
2004
2005
2006
2007
2008
2009
number
0.00
0.10
0.20
4 8 14 20 26 32 38 44 50 56 62
length (cm)
bars: observed / line: expected

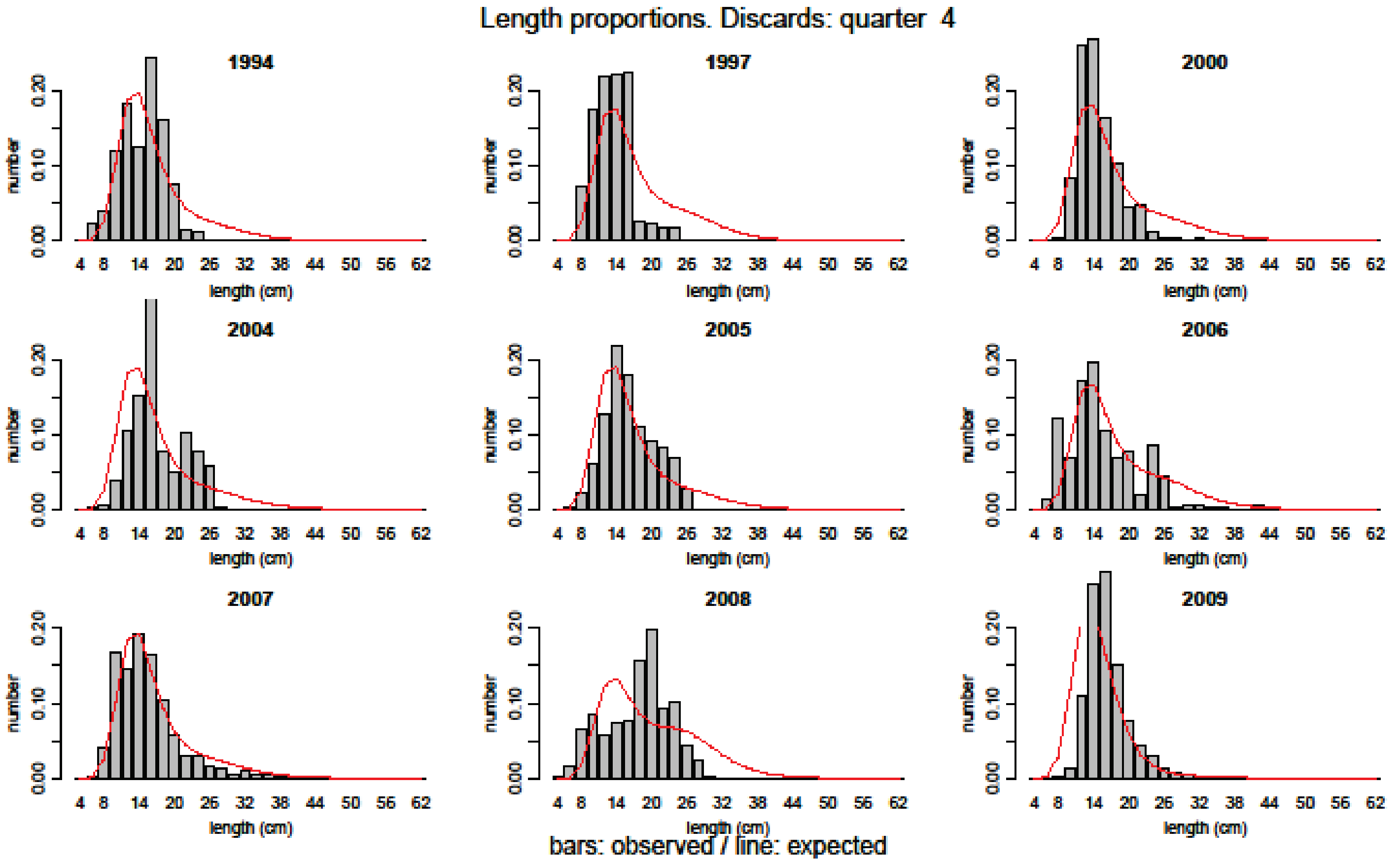
(e1)


Length proportions. Discards: quarter 2
1994
1997
2000
2004
2005
2006
2007
2008
2009
number
0.00
0.10
0.20
4 8 14 20 26 32 38 44 50 56 62
length (cm)
bars: observed / line: expected

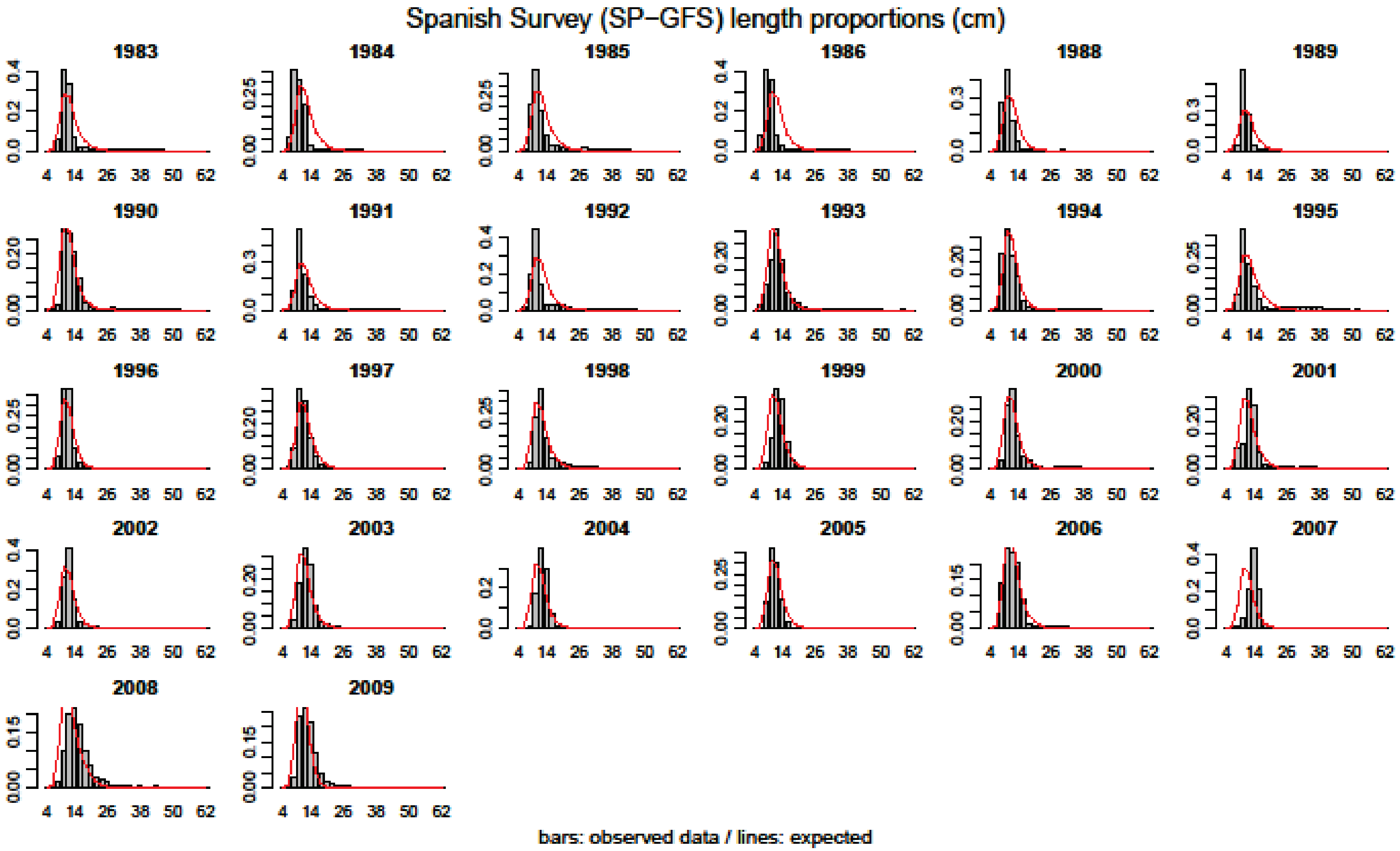
(e2)


Length proportions. Discards: quarter 3
1994
1997
2000
2004
2005
2006
2007
2008
2009
number
length (cm)
bars: observed / line: expected

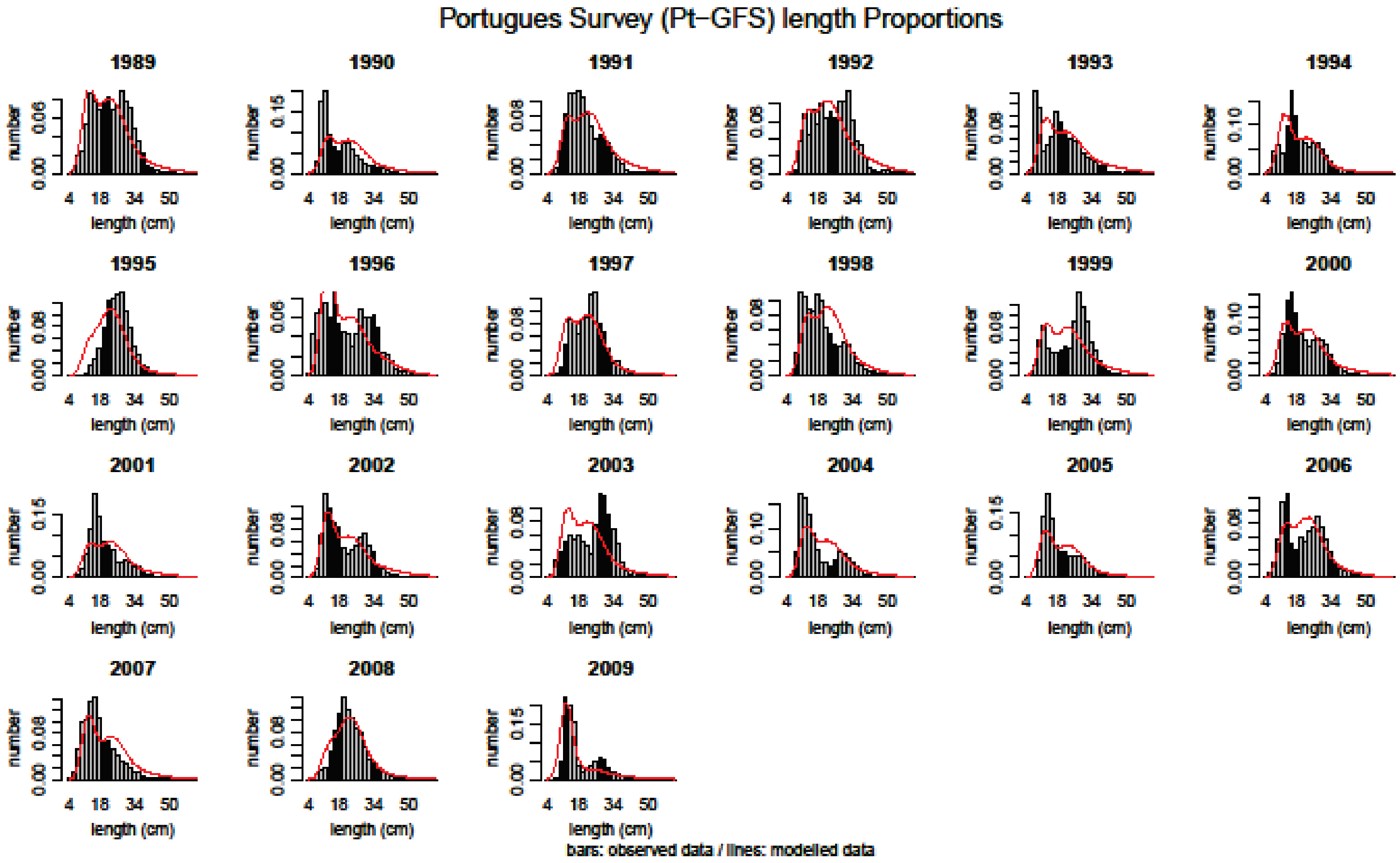
(e3)


Length proportions. Discards: quarter 4
1994
1997
2000
2004
2005
2006
2007
2008
2009
number
length (cm)
bars: observed / line: expected

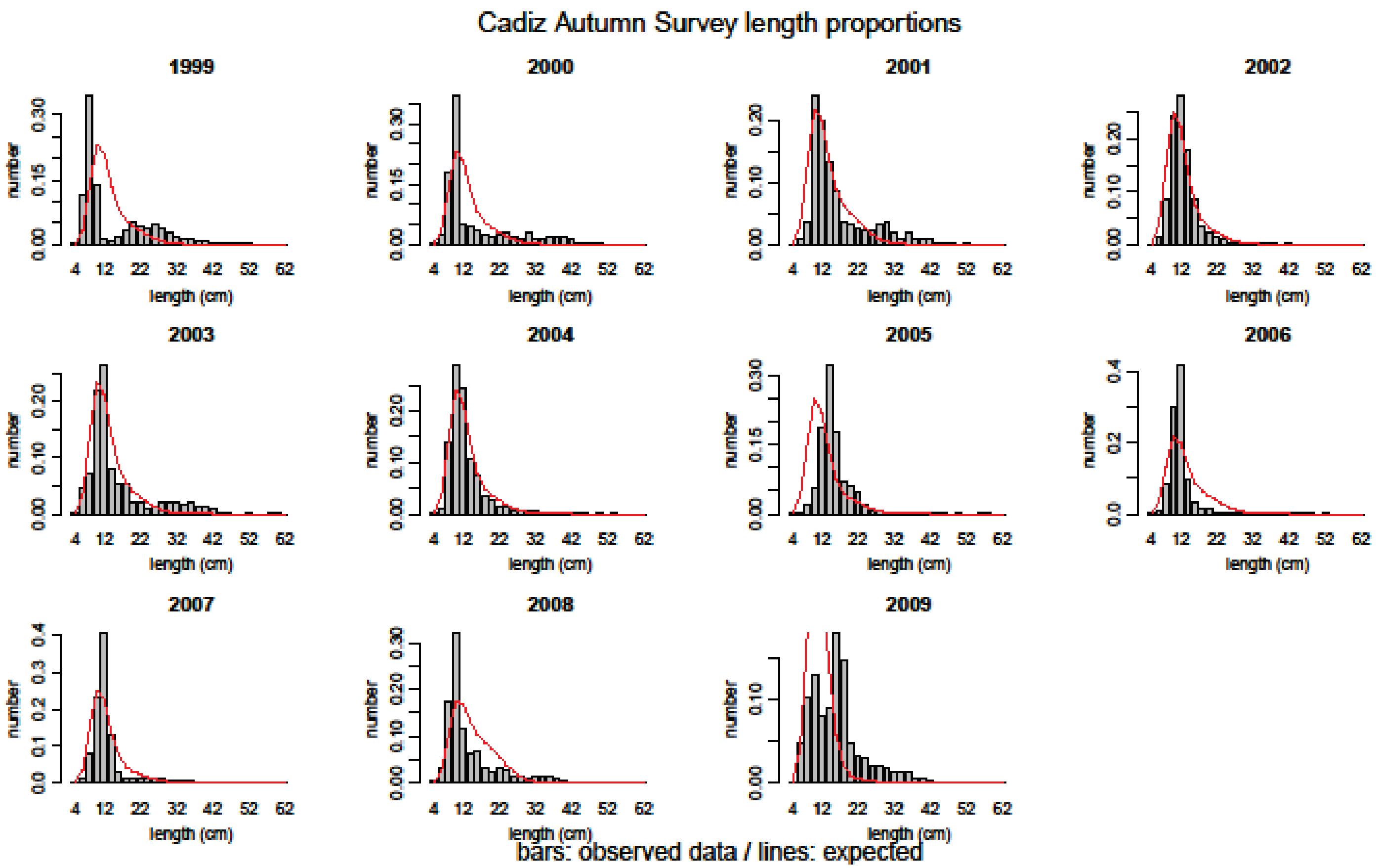
(e4)


Spanish Survey (SP−GFS) length proportions (cm)
1983
1984
1985
1986
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
4 14 26 38 50 62
bars: observed data / lines: expected

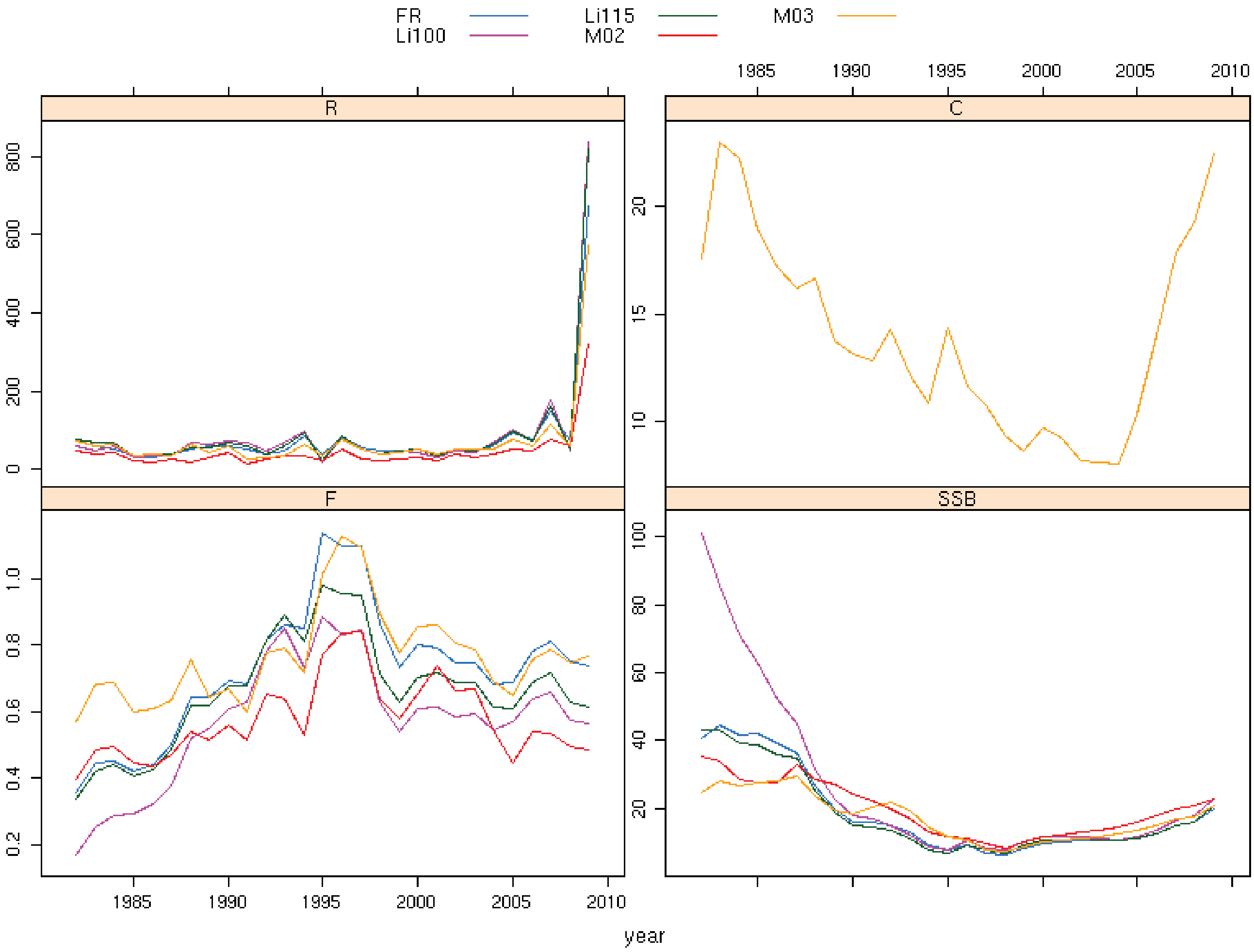
(f)


Portugues Survey (Pt-GFS) length Proportions
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
number
length (cm)
4 18 34 50
bars: observed data / lines: modelled data

(g)


Cadiz Autumn Survey length proportions
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
number
length (cm)
bars: observed data / lines: expected

(h)



(i) robustness to alternative model assumptions (FR-Final Run with Linf=130 and M=0.4; colors indicate the parameter changed)

Figure 7.6 Diagnostics Residuals (a); observed vs. expected length proportions (b-h); and robustness to alternative model assumptions (i)

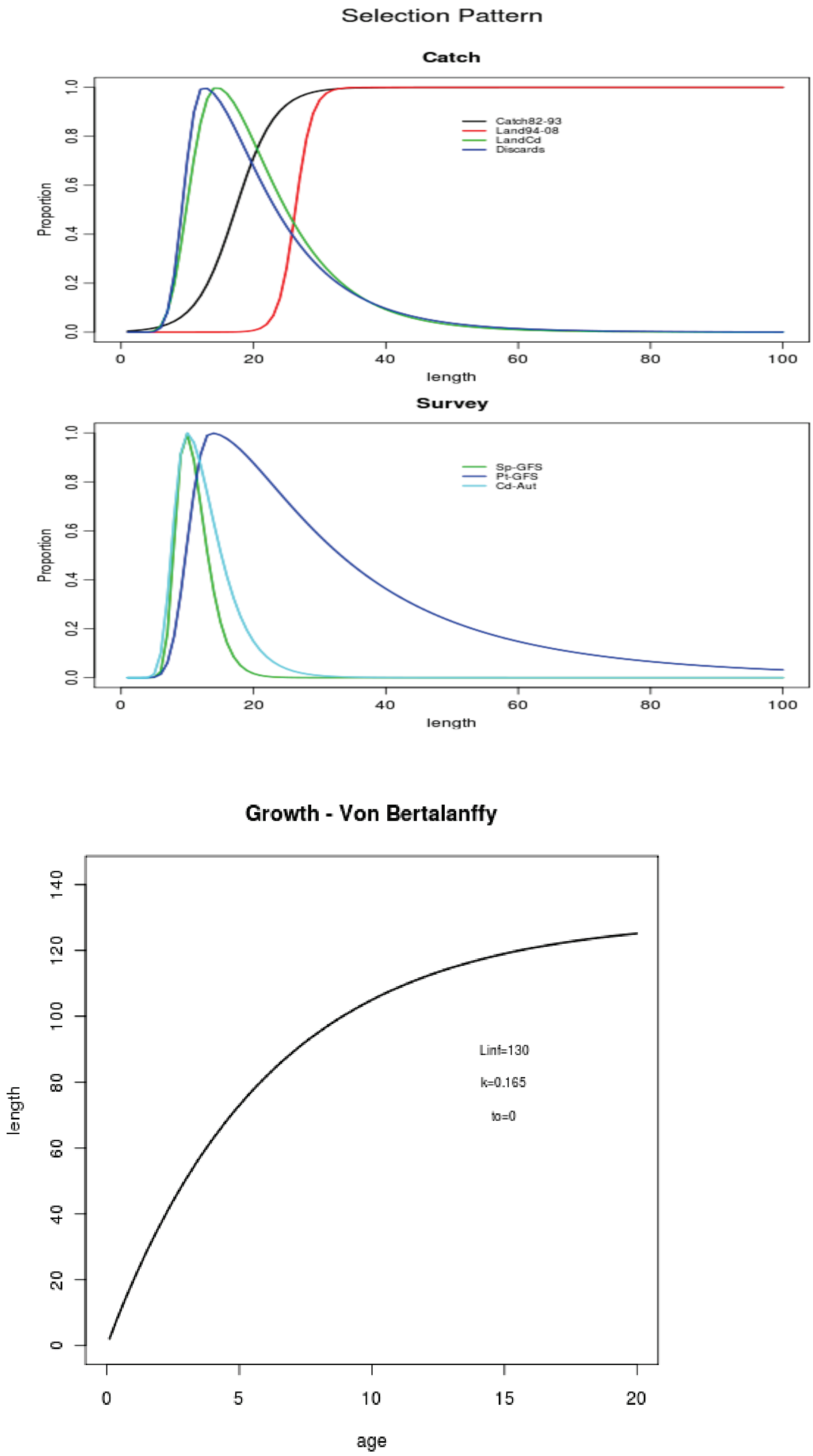


Figure 7.7. Selection pattern (upper panel) and and von Bertalanffy growth with k parameter estimated by the model (lower panel)

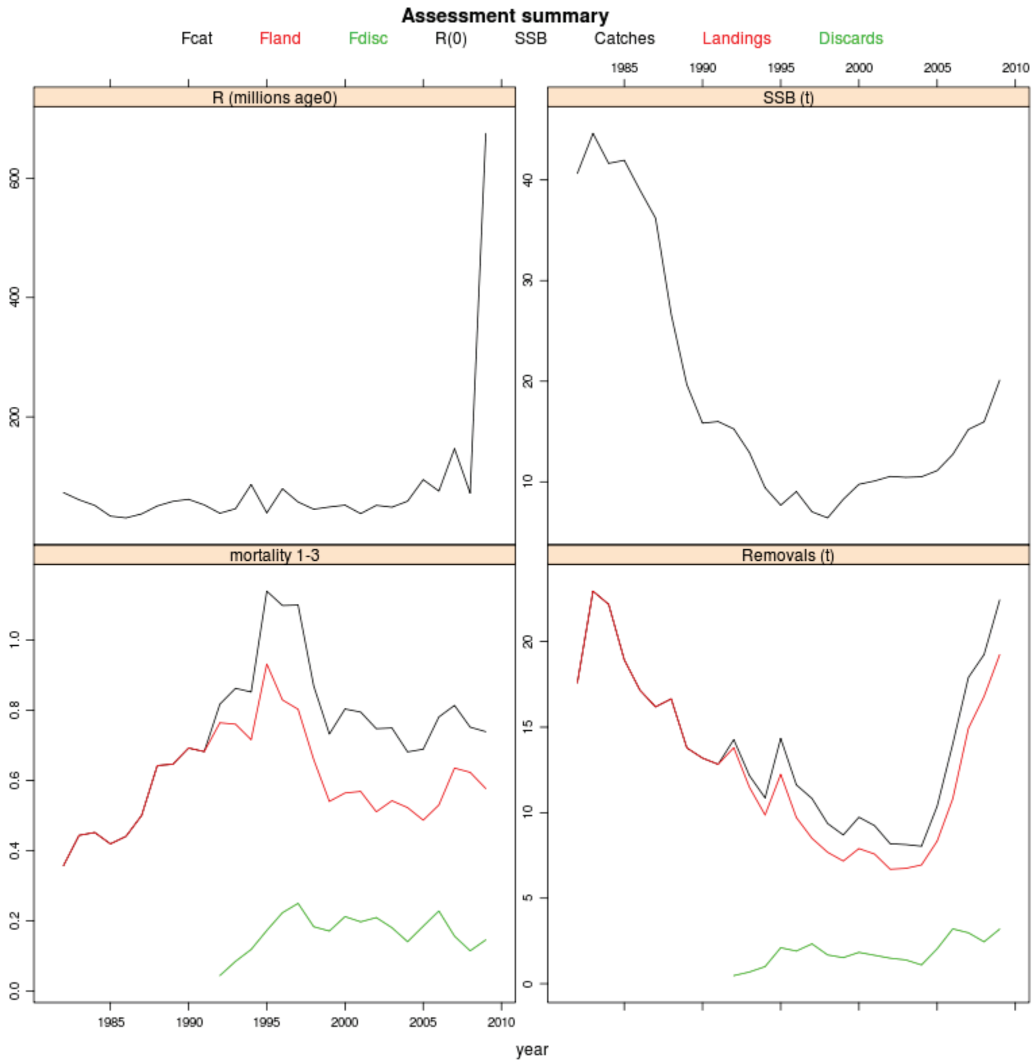


Figure 7.8. Summary plot

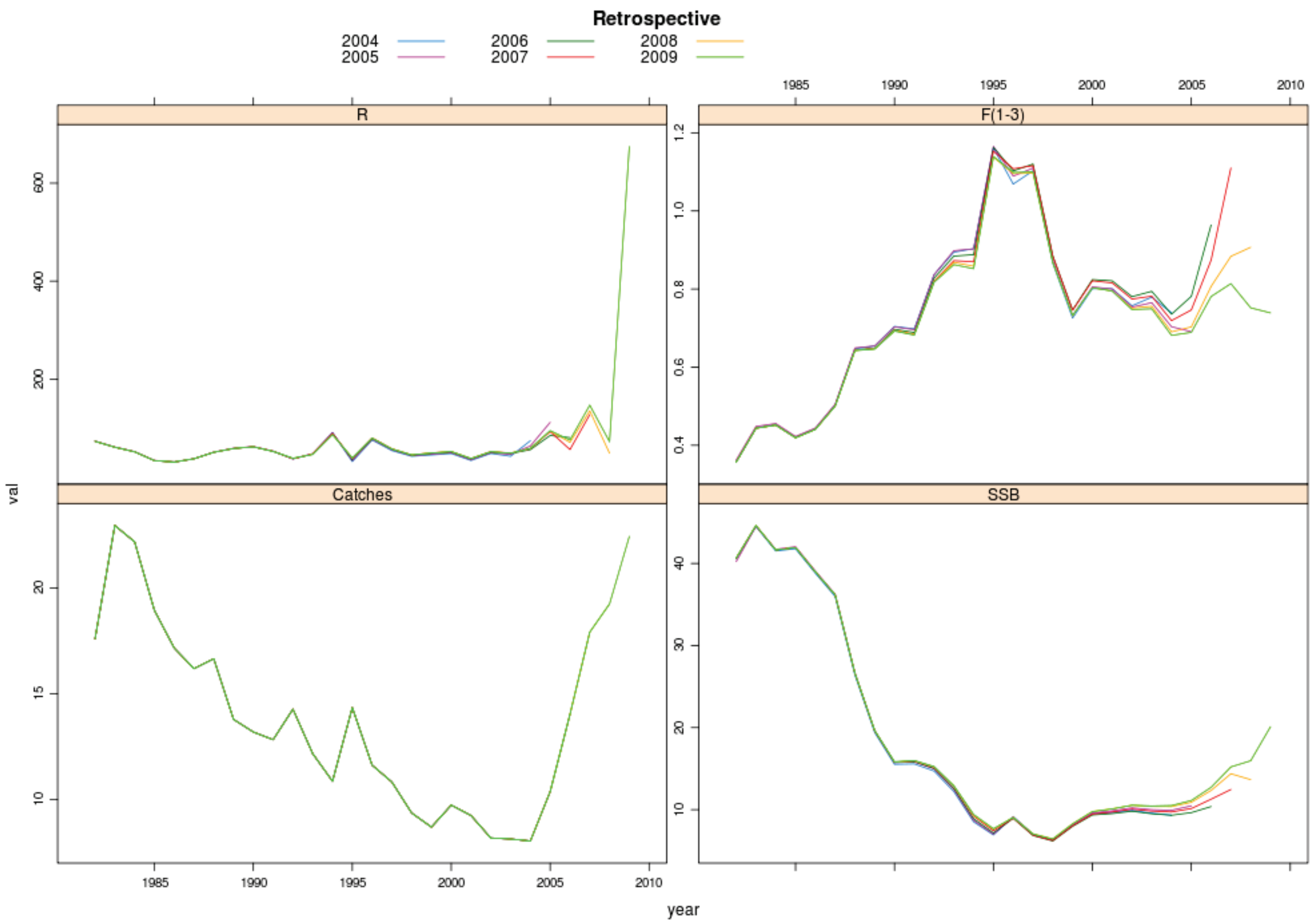


Figure 7.9. Retrospective plot

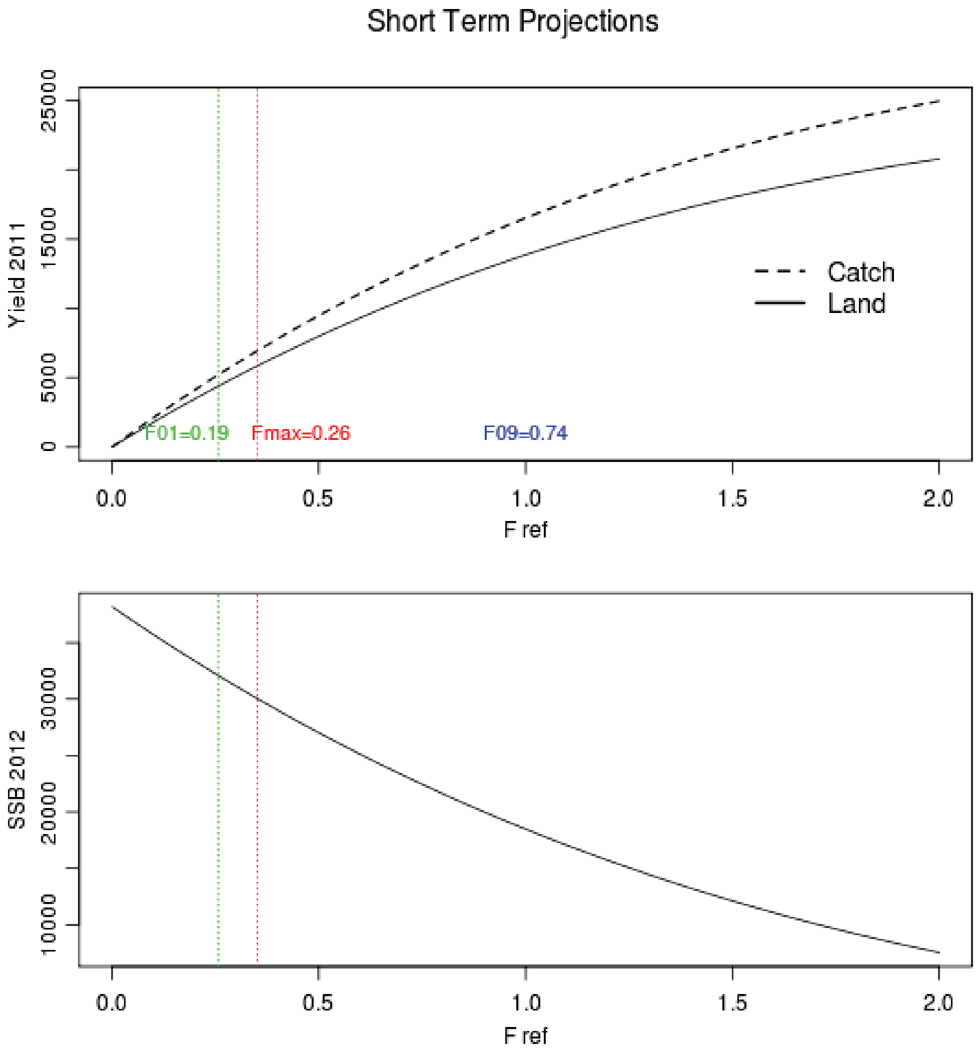


Figure 7.10. Short term advice

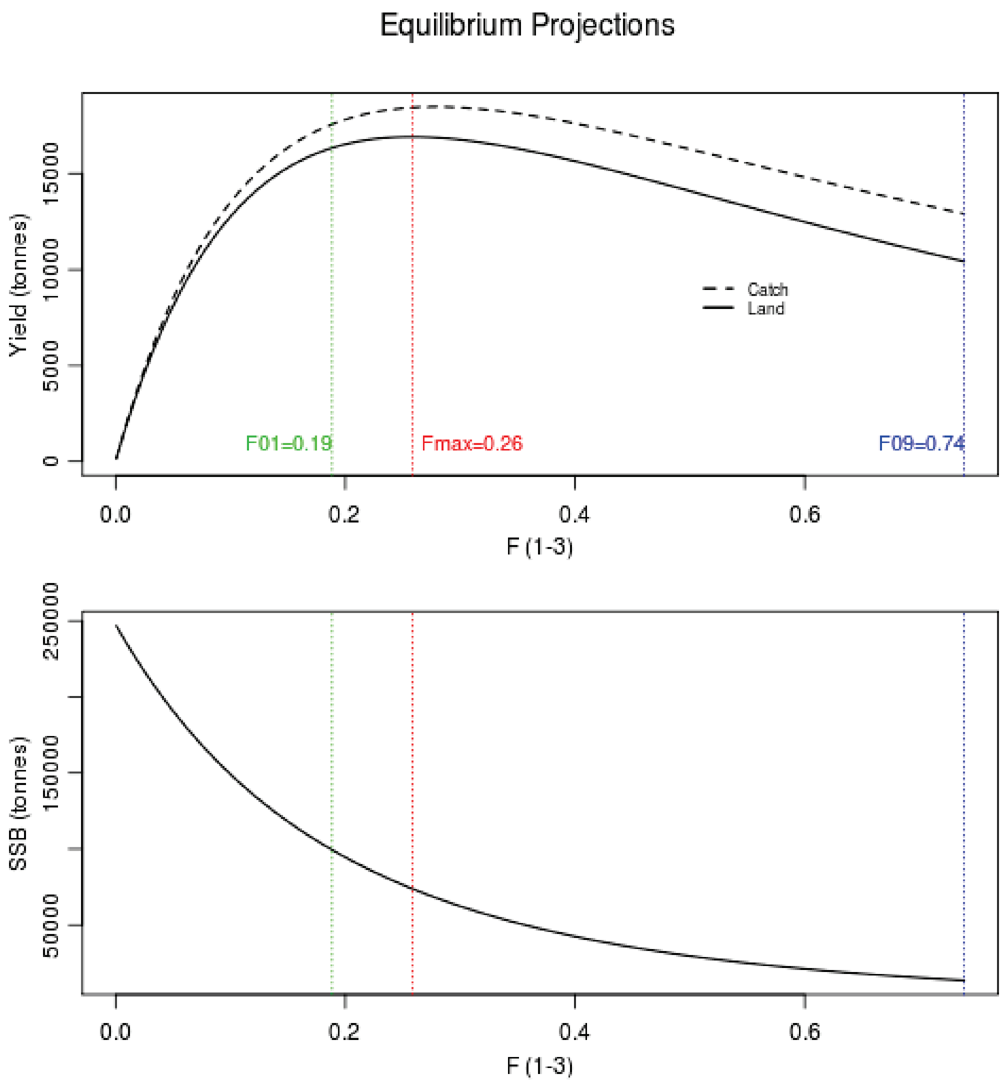


Figure 7.11. Long term yield and SSB (with recruitement = geometric mean of 1989-008 = 58.9 mill)

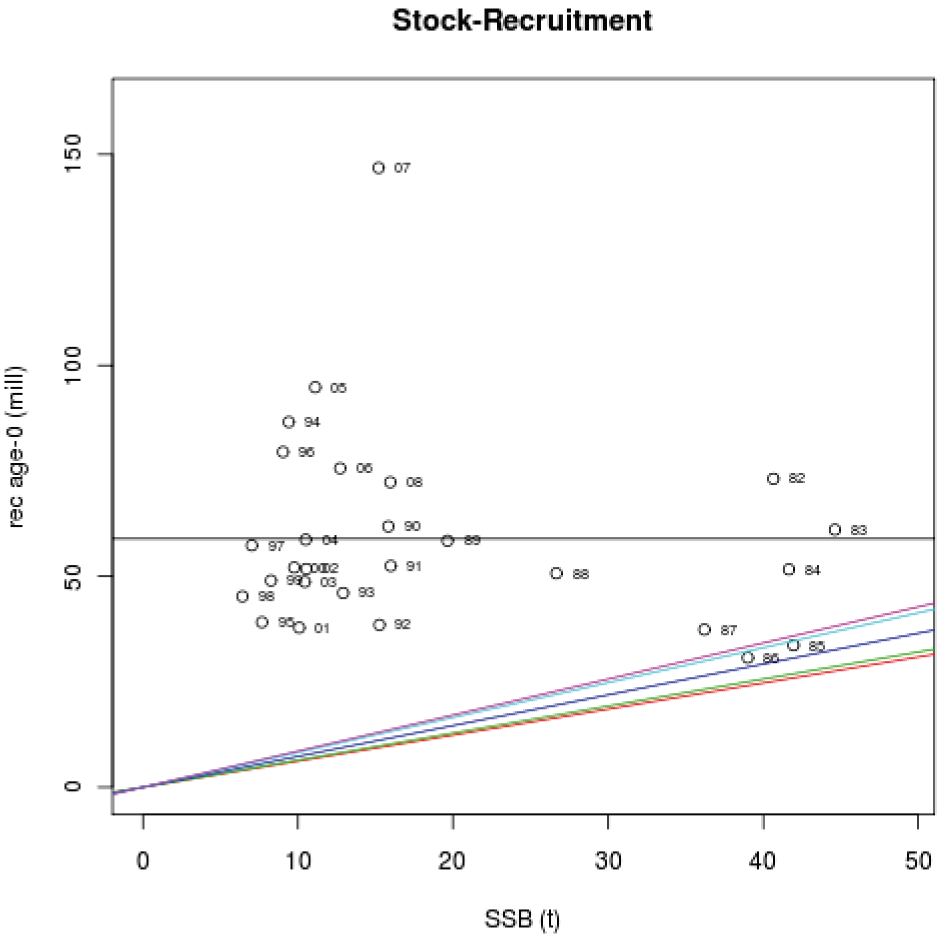


Figure 7.12 Stock-Recruitmen Relationship with replacement lines (F40<F0.1<F35<F030<Fmax). Horizontal line is the geometric mean = 58.9 mill

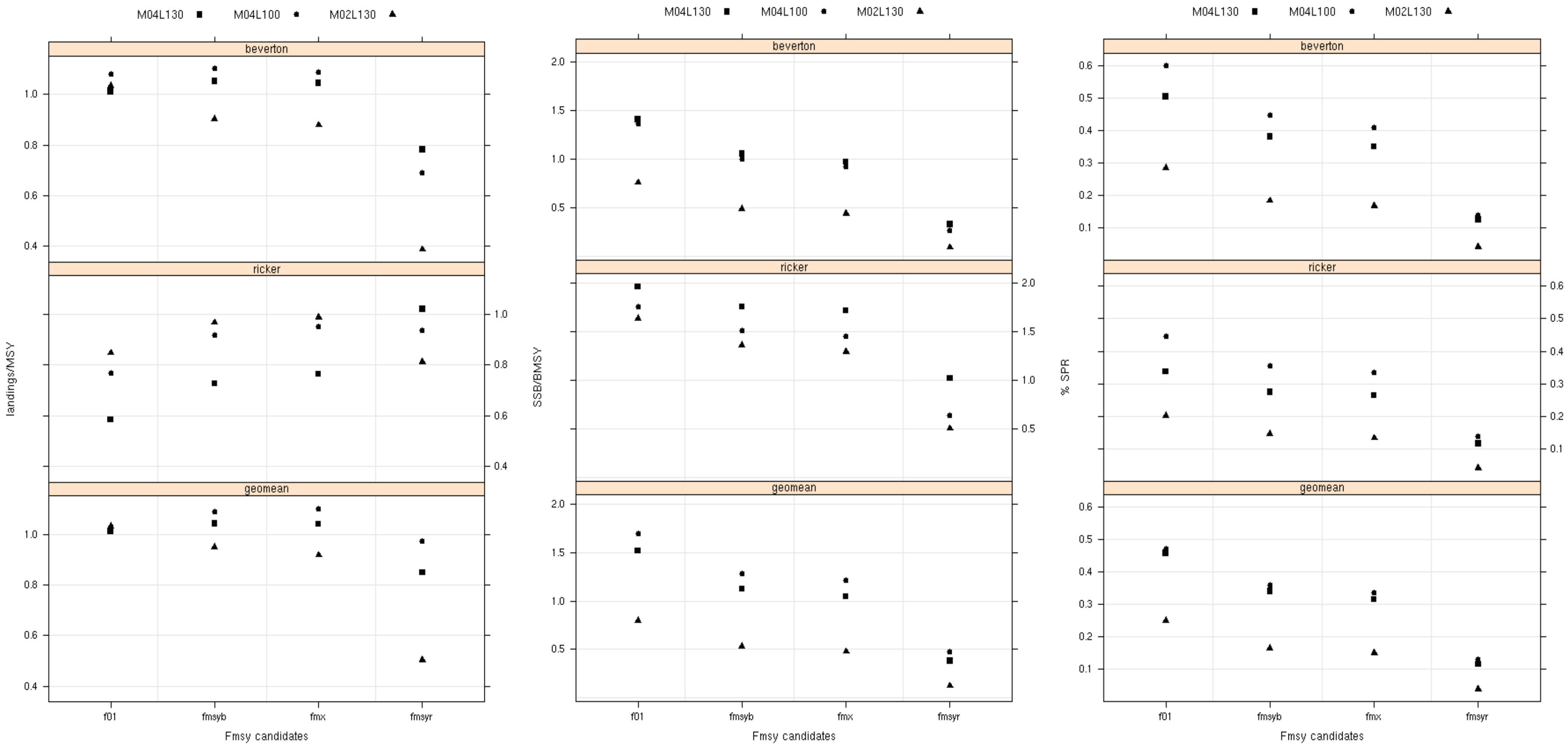


Figure 7.13. Management Strategy Evaluation. Effect of Fmsy candidates on different operative models

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

L. piscatorius and L. budegassa

Type of assessment in 2010: update (of the WGHMM-2009 assessment)

Software used: ASPIC (separately for each of the species)

Data revisions this year: Portuguese crustacean and fish trawl 2007 and 2008 landings, effort and LPUE values.

RG2009 comments:

1. *There is no justification in the assessment for the choice of LPUE indices used in the ASPIC models for each species. This information could be included in the stock annex.*

   The geographic distribution of the species (*L. piscatorius* mainly in the north and *L. budegassa* mainly in the south) is one of the reasons to choose the LPUE series employed in the assessment of anglerfish.

   The LPUE series used for the *L. piscatorius* assessment are A Coruña Trawl Fleet (SP-CORUTR8c) in VIIIc and Cedeira Gillnet (SP-CEDGNS8c) in VIIIc, these are the most representative fisheries of this stock in terms of landings.

   The LPUE series used for the *L. budegassa* assessment are the Portuguese trawl targeting fish (PT-TRF9a) in IXa and the Portuguese trawl targeting crustacean (PT-TRC9a) in IXa, these are the ones that are more characteristic of the distribution of the stock area, although they are not the most representative in terms of landings.

   This explanation was included in the Stock annex.

2. *The allowable ranges of K and MSY for L. piscatorius and q for L. budegassa could be extended based on the number of bootstrap trials replaced due to values of these going out of bounds.*

   In the case of *L. piscatorius* the upper bound of K was increased from 100 000 to 112 000 and the upper bound of MSY was increased from 10 000 to 11 500. With this change the number of replaced trials decreased to minimum proportions. Although it is thought that those changes have improved the model fit, it must be taken into account that they are the reason for the discrepancies detected in F/F_{MSY} and B/B_{MSY} trends and the parameter estimates in the comparison of the results from WGHMM2009 and this WG assessment.

   In the case of *L. budegassa* some trials were attempted changing the starting estimate of *q* but most of them didn't converge, and the ones that had converged increased the number of bootstrap trials replaced due to values of *q, K* and *MSY* going beyond the bounds.

3. *The number of bootstrap trials could be increased from 500 to 1000 to determine 95 % rather than 80 % confidence levels. It may also be useful to present figures of the range of parameter estimates from the bootstrap runs (B and F in particular) in the final year of the assessment, either as cumulative distribution functions (CDFs) or probability density functions (PDFs).*

   The number of bootstrap trials was increased to 1000 to estimate the 95% bias corrected confidence intervals for the parameters estimates. Histograms for bootstrap estimates of relative Biomass and Fishery mortality in the last year with their empirical cumulative distribution functions are also included in the report.

4. *Analysis of length compositions in catches should be considered in order to improve knowledge of growth. Some trends in the catch compositions indicate that cohorts might be tracked.*

   It was not possible to carry out and present this type of analysis till now. Efforts will be made to present it in the next benchmark assessment scheduled for 2012.

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.

A benchmark assessment of anglerfish in Divisions VIIIc and IXa was carried out in 2007. Due to the inconsistencies found in catch-at-age data, the Working Group did not accept the age-structured assessment and an ASPIC model was applied for each species separately.

The inconsistencies observed in the catch-at-age data are probably related to ageing estimation problems. Recent studies indicate that growth was underestimated (Azevedo *et al*., 2008; Landa *et al*., 2008) and new methods and analysis to validate the age information were recommended (see WGHMM2008 report).

Summary of ICES advice for 2010 and management for 2009 and 2010

ICES advice for 2010:

ICES advises on the basis of exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects that in order to reach B_{MSY} the 2010 catches should be zero or a management plan should be developed. The advice accounts for the poor condition of the *L. piscatorius* stock.

Management applicable for 2009 and 2010:

The two species are managed under a common TAC that was set at 1 760 t for 2009 and 1496 t for 2010.

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 2000, the Spanish landings were on average 47% from the trawl fleet (mean lengths in 2009 of 61 cm and 50 cm in Divisions VIIIc and IXa, respectively) and 53% from the gillnet fishery (mean length of 76 cm in Division VIIIc in 2009). Since 2000, Portuguese landings were on average 8% from bottom trawlers (mean length of 58 cm in 2009) and 92% from the artisanal fleet (mean length of 69 cm in 2009).

8.1.2 Data

8.1.2.1 Commercial catches and discards

Total landings of *L. piscatorius* by country and gear for the period 1978–2009, as estimated by the Working Group, are given in Table 8.1.1. See historical landings analysis in Annex H. The landings in 2009 of only *L. piscatorius* are higher than the combined species 2009 TAC of 1760 t.

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.

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

8.1.2.2 Biological sampling

The sampling levels for 2009 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 in 2009 are similar to previous years but an important reduction of Portuguese sampling levels was observed in 2009. Data for 2009 are viewed as provisional.

Length composition

Table 8.1.3 gives the annual length compositions by country and gear for 2009. The annual length compositions for all fleets combined for the period 1986–2009 are presented in Figure 8.1.1.

Landings in number, the mean length and mean weight in the landings between 1986 and 2009 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 2003. The 2003-2005 values remained at around the same level. Mean lengths and mean weights in the landings have 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 64 cm in 2009.

8.1.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2009 are summarized in Table 8.1.5. (See stock annex for background information).

8.1.2.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 8.1.6 and Figure 8.1.2 for Spanish trawlers (Division VIIIc) from the ports of Santander, Avilés and A Coruña since 1986 and for the Portuguese trawlers (Division IXa) since 1989. 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 standardized LPUE series was updated this year with a new year of information by applying the same model used in 2007 and 2009 (Costas *et al.*, 2007). The new LPUE estimates from 1999 to 2009 have changed slightly in relation to the previous standardization estimates. A comparison of the standardized LPUEs series is shown in Figure 8.1.3. Standardized effort provided for A Coruña fleet (1994-2006) and for Portuguese trawl fleets (1989-2008) and their corresponding LPUEs are also given in Table 8.1.4, but not represented in Figure 8.1.2.

All fleets show a general decrease in landings during the late 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. Proportion in total landings is higher for the Cedeira and A Coruña fleets. The A Coruña fleet decreased its importance since 1991.

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 A Coruña, Santander 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.

Since 2005 a decreasing trend is observed for Cedeira and Santander fleets. Last year an important increase of Cedeira LPUE was observed.

8.1.3 Assessment

In WGHMM2009 the assessment of the status of each anglerfish species was carried out separately based on ASPIC (Prager, 1994; Prager, 2004). This year an update of that assessment was carried out.

8.1.3.1 Input data

The input data comprising the LPUEs for the Spanish trawl fleet of A Coruña (SP-CORUTR8c) and the Spanish gillnet fleet of Cedeira (SP-CEDGNS8c) fleet, and the landings are presented in Table 8.1.7.

8.1.3.2 Model

The ASPIC (version 5.34) model (implements the Schaeffer population growth model) was used for the assessment. Run was performed conditioning on yield rather than on effort. The model options, the starting guesses and the minimum and maximum constraints of each parameter are indicated in Table 8.1.7. Some changes were made in the input settings in relation to the ones used in previous assessment. In order to estimate the 95% confidence intervals of the parameter estimates the number of required bootstrap trials was increased to 1000. The allowed upper bounds for MSY and K were increased to avoid the high proportion of replaced bootstrap trials that was observed in last year assessment.

8.1.3.3 Assessment results

Figure 8.1.4 plots the model generated and the observed values for both fleets. The r square between observed and fitted CPUE values are respectively 0.548 and 0.149 for the A Coruña and the Cedeira fleet (see Annex M). The correlation coefficient between input fleets was 0.696.

Table 8.1.8 contains the results of the parameter estimates, including the point estimates and the Bootstrap results (the relative bias in percentage and bias-corrected confidence intervals for 80% and 95%). Bias and precision of parameter estimates vary depending on the parameter. The F_{2009}/F_{MSY} and B_{2010}/B_{MSY} ratios show respectively 9.98% and 15.35% of bias and 41.10% and 45.40% values of inter-quartile range. The total biomass at the beginning of 2010 is estimated to be at 22% of B_{MSY} with the 80% bias-corrected confidence interval between 13% and 33%. F_{2009}/F_{MSY} is estimated to be 1.46 with the 80% bias-corrected confidence interval between 1.05 and 2.24. Fishing mortality in 2009 is therefore estimated to be over F_{MSY} and total biomass in 2010 is estimated to be under B_{MSY}. MSY is estimated to be 7096 t with 80% CI from 6851 t to 7290 t.

Figure 8.1.5 shows the trends of the F and B-ratios. The trends show that fishing mortality has been over F_{MSY} along the time series except in 2001 and 2002. The biomass shows a decreasing trend since the beginning of the time series being relatively stable at low levels through the last 10-15 years. During the last 5 years the biomass is estimated to be around 30% of B_{MSY}. The 80% confidence intervals in Figure 8.1.6 also indicate that fishing mortality has been above F_{MSY} for the total period (except 2001 and 2002) and that biomass has never been above B_{MSY}.

Figure 8.1.6 shows the values of F_{2009}/F_{MSY} and B_{2010}/B_{MSY} for the 1000 bootstrap replicates and their cumulative distribution function. Only the 0.4% of the bootstrap estimates of current biomass were greater than or equal to B_{MSY}, while 11% of bootstrap estimates of current fishing mortality were less than F_{MSY}.

Figure 8.1.7 shows the F and B ratio trends for last assessment and this year assessment. At the beginning of the time series high differences in relative values of biomass and fishing mortality are observed between the two assessments. A different run of the model with the same last year input settings was performed, concluding that the increase in upper bounds of MSY and K was causing this effect. A comparison of parameter estimates from the 2009 and 2010 assessments is shown in the Table 8.1.9.

8.1.4 Projections

Projections were performed based on ASPIC estimates. The projected B/B_{MSY} and yield are presented in Table 8.1.10, with each column of the table corresponding to a fishing mortality scenario. Projections were performed for F *status quo* (assumed as F_{2009}), for reductions in F in the first projection year from 10% to 50% and for F_{MSY} level and for F equal to zero. A new set of projections were performed with the necessary F reductions to obtain a yield (adding to *L. budegassa* yield) corresponding to the 2010 TAC and +/-15% 2010 TAC. The biomass is expected to increase under all scenarios. F *status quo* is expected to bring biomass to 39% of B_{MSY} in next ten years. Reductions of more than 50% and the scenario under zero catches the biomass is expected to achieve B_{MSY} the next ten years. Even with zero catches in 2011, biomass will not reach B_{MSY} until 2015.

8.1.5 Biological Reference Points

Comments on the biological reference points are in section 8.3.

8.1.6 Comments on the assessment

Comments on the assessment are in section 8.3.

8.1.7 Management considerations

Management considerations are in section 8.3.

Table 8.1.1. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Tonnes landed by the main fishing fleets for 1978-2009 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	545	1013	1558	79	9	285	374	1932
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	1262	1269	2531	264	27	335	626	3157
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

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	71.3	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	1.8

n/a: not available
CV: coefficient of variation

Table 8.1.3. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Length composition by fleet for landings in 2009 (thousands).

	Div. VIIIc			Div. IXa				Div. VIIIc+IXa
	SPAIN			SPAIN	PORTUGAL			
Length (cm)	Trawl	Gillnet	TOTAL	Trawl	Trawl	Artisanal	TOTAL	TOTAL
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.084	0.000	0.084	0.000	0.000	0.000	0.000	0.084
25	0.249	0.000	0.249	0.000	0.000	0.000	0.000	0.249
26	0.393	0.000	0.393	0.158	0.000	0.000	0.158	0.551
27	0.125	0.000	0.125	0.076	0.000	0.000	0.076	0.201
28	0.279	0.000	0.279	0.246	0.000	0.000	0.246	0.525
29	0.411	0.000	0.411	0.169	0.000	0.000	0.169	0.580
30	0.999	0.000	0.999	0.220	0.000	0.000	0.220	1.219
31	1.305	0.000	1.305	0.298	0.000	0.000	0.298	1.603
32	0.687	0.000	0.687	0.269	0.038	0.000	0.307	0.994
33	2.380	0.000	2.380	0.333	0.000	0.000	0.333	2.713
34	2.384	0.000	2.384	0.339	0.000	0.000	0.339	2.723
35	3.303	0.000	3.303	4.585	0.012	0.000	4.597	7.900
36	4.782	0.000	4.782	0.870	0.000	0.000	0.870	5.652
37	3.368	0.000	3.368	0.700	0.038	0.000	0.739	4.107
38	4.060	0.000	4.060	5.358	0.000	0.000	5.358	9.418
39	4.148	0.000	4.148	4.497	0.044	0.000	4.541	8.689
40	3.543	0.092	3.635	5.467	0.032	0.000	5.499	9.134
41	4.470	0.000	4.470	5.403	0.190	0.000	5.593	10.063
42	3.734	0.092	3.826	1.420	0.009	0.000	1.429	5.255
43	3.026	0.136	3.162	14.099	0.000	0.048	14.147	17.309
44	4.919	0.043	4.962	1.414	0.296	0.327	2.037	6.999
45	3.677	0.043	3.720	0.493	0.024	0.053	0.571	4.291
46	2.971	0.113	3.084	5.323	0.000	0.079	5.402	8.486
47	3.316	0.064	3.380	0.863	0.201	0.131	1.195	4.575
48	1.637	0.000	1.637	4.967	0.201	1.103	6.271	7.908
49	2.430	0.043	2.473	4.927	0.000	0.052	4.979	7.452
50	3.408	0.430	3.838	0.827	0.000	1.206	2.033	5.871
51	3.096	0.399	3.495	0.503	0.000	0.129	0.632	4.127
52	3.408	1.230	4.638	1.332	0.000	1.256	2.589	7.227
53	3.148	1.400	4.548	0.190	0.018	0.124	0.332	4.880
54	3.421	0.845	4.266	0.768	0.016	0.197	0.981	5.247
55	3.082	0.558	3.640	0.688	0.073	1.294	2.054	5.694
56	4.096	1.214	5.310	1.443	0.000	0.880	2.323	7.633
57	5.120	0.887	6.007	0.479	0.113	1.639	2.231	8.238
58	5.194	2.223	7.417	0.891	0.000	0.420	1.311	8.728
59	3.335	2.406	5.741	0.340	0.000	0.432	0.772	6.513
60	3.735	3.200	6.935	0.787	0.000	1.191	1.978	8.913
61	4.447	2.653	7.100	0.487	0.000	0.738	1.225	8.325
62	4.373	3.225	7.598	1.826	0.000	0.403	2.229	9.827
63	5.457	3.893	9.350	0.473	0.000	0.526	0.999	10.349
64	4.204	3.290	7.494	1.286	0.000	0.790	2.076	9.570
65	3.965	2.957	6.922	0.086	0.000	0.582	0.667	7.589
66	5.652	5.605	11.257	1.222	0.000	1.347	2.569	13.826
67	4.340	4.695	9.035	0.506	0.000	0.630	1.136	10.171
68	4.400	4.932	9.332	0.119	0.130	0.505	0.754	10.086
69	4.606	5.109	9.715	0.010	0.000	0.509	0.518	10.233
70	4.290	6.729	11.019	0.328	0.038	0.518	0.884	11.903
71	3.528	5.814	9.342	0.536	0.000	0.540	1.075	10.417
72	2.273	5.131	7.404	0.324	0.000	0.696	1.020	8.424
73	2.615	6.004	8.619	1.028	0.000	0.403	1.431	10.050
74	2.845	5.607	8.452	0.067	0.062	0.484	0.612	9.064
75	2.547	6.901	9.448	0.067	0.018	0.473	0.558	10.006
76	3.941	4.663	8.604	0.618	0.038	0.612	1.269	9.873
77	2.906	3.650	6.556	0.185	0.032	0.288	0.505	7.061
78	2.287	3.236	5.523	0.302	0.004	0.413	0.719	6.242
79	2.726	3.955	6.681	0.000	0.000	0.730	0.730	7.411
80	3.181	3.720	6.901	0.000	0.012	0.458	0.469	7.370
81	1.959	3.029	4.988	1.142	0.000	0.097	1.239	6.227
82	2.400	2.990	5.390	0.662	0.004	0.253	0.919	6.309
83	2.567	3.127	5.694	0.306	0.000	0.181	0.487	6.181
84	2.572	2.939	5.511	0.668	0.004	0.281	0.954	6.465
85	2.264	4.007	6.271	0.000	0.000	0.657	0.657	6.928
86	2.694	3.548	6.242	1.838	0.004	0.471	2.314	8.556
87	2.178	2.264	4.442	0.055	0.067	0.291	0.413	4.855
88	2.074	3.216	5.290	1.351	0.000	0.489	1.840	7.130
89	1.444	2.089	3.533	0.662	0.000	0.022	0.684	4.217
90	2.533	3.271	5.804	0.000	0.038	0.336	0.374	6.178
91	1.644	2.222	3.866	0.302	0.024	1.109	1.435	5.301
92	0.823	2.122	2.945	0.000	0.000	0.077	0.077	3.022
93	1.355	2.292	3.647	0.000	0.028	0.028	0.056	3.703
94	0.373	2.367	2.740	0.000	0.000	0.187	0.187	2.927
95	1.141	1.776	2.917	0.152	0.000	0.044	0.196	3.113
96	1.103	1.279	2.382	0.000	0.000	0.470	0.470	2.852
97	0.695	1.256	1.951	0.000	0.000	0.214	0.214	2.165
98	0.764	0.541	1.305	0.607	0.028	0.022	0.658	1.963
99	0.431	0.815	1.246	0.278	0.000	0.011	0.290	1.536
100+	3.303	8.270	11.573	0.487	0.132	1.214	1.833	13.406
TOTAL	213	161	373	89	2	29	119	493
Tonnes	850	1058	1909	213	10	148	371	2280
Mean Weight (g)	3998	6590	5114	2405	4889	5177	3112	4629
Mean length (cm)	61.1	75.8	67.5	50.2	58.3	68.7	54.8	64.4
Measured weight (t)	8.7	19	27.3	1.6	0.2	2.3	4.1	31.4

Table 8.1.4. ANGLERFISH (*L. piscatorius*). Divisions VIIIc and IXa.
Numbers, mean weight and mean length of landings between 1986 and 2009.

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	289	6682	72
2000	190	6885	72
2001	127	6189	64
2002	381	2766	50
2003	784	2907	54
2004	793	3881	61
2005	856	4259	63
2006	923	3211	58
2007	553	4251	62
2008	540	4327	63
2009	493	4629	64

Table 8.1.5. ANGLERFISH (*L. piscatorius*). Divisions VIIIc and IXa.
Abundance indices from Spanish and Portuguese surveys.

	Spanish Survey					Portuguese Survey		
	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	115	1.07	0.17	1.91	0.17	92	+	+

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

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	%	Cedeira	%	Portugal Crustacean	%	Portugal Fish	%
1986	500	7	516	8	1070	16						
1987	500	10	529	10	949	18						
1988	401	6	387	6	1565	25						
1989	214	4	305	6	961	19			85	2	175	3
1990	260	7	278	7	781	21			106	3	219	6
1991	245	7	281	8	865	24			73	2	151	4
1992	198	6	222	7	694	21			25	1	51	2
1993	76	3	186	8	386	17			36	2	75	3
1994	116	6	188	9	245	12			23	1	47	2
1995	192	10	186	10	260	14			22	1	45	2
1996	322	11	270	9	413	14			45	2	88	3
1997	345	9	381	10	411	11			51	1	59	2
1998	286	10	316	11	138	5			11	<1	17	1
1999	108	6	182	9	162	8	342	18	3	<1	6	<1
2000	28	2	75	6	85	7	140	11	2	<1	2	<1
2001	23	3	54	7	84	11	87	11	9	1	7	1
2002	75	7	57	6	130	13	130	13	18	2	11	1
2003	111	5	85	4	228	10	159	7	13	1	16	1
2004	216	7	106	3	279	9	382	12	12	<1	14	<1
2005	278	8	59	2	391	11	434	12	12	<1	17	<1
2006	148	5	89	3	242	8	415	14	13	<1	16	1
2007	101	4	103	4	222	9	233	10	7	<1	6	<1
2008	99	4	n/a	n/a	273	12	228	10	6	<1	5	<1
2009	69	3.02	35	2	165	7.2	183	8	5	<1	5	<1

Fishing effort

	Div. VIIIc						Div. IXa			
Year	[1] Avilés	[1] Santander	[1] A Coruña	[2] A Coruña standardized	[3] Cedeira standardized 2009	[3] Cedeira standardized 2008	[4] Portugal Crustacean	[5] Portugal Crustacean standardized	[4] Portugal Fish	[5] Portugal Fish standardized
1986	10845	18153	39810							
1987	8309	14995	34680							
1988	9047	16660	42180							
1989	8063	17607	44440				76	23	52	18
1990	8497	20469	44430				90	20	61	17
1991	7681	22391	40440				83	17	57	15
1992	n/a	22833	38910				71	15	49	14
1993	7635	21370	44504				75	13	56	13
1994	9620	22772	39589	4738			41	8	36	10
1995	6146	14046	41452	5298			38	8	41	9
1996	4525	12071	35728	5084			64	14	54	12
1997	5061	11776	35211	4801			43	11	27	9
1998	5929	10646	32563	3668			48	11	35	10
1999	6829	10349	30232	6424	4895	4939	24	8	18	6
2000	4453	8779	30072	5125	3768	3813	42	10	19	6
2001	1838	3053	29923	6103	2197	2221	85	18	19	5
2002	2748	3975	21823	2581	2491	2520	62	10	14	4
2003	2526	3837	18493	2515	2792	2822	42	10	17	6
2004	n/a	3776	21112	5056	5748	5806	21	7	14	4
2005	n/a	1404	20663	5161	3511	3546	20	5	13	4
2006	n/a	2718	19264	3949	4464	4511	22	5	12	4
2007	n/a	4334	21201	n/a	4648	4691	22	6	8	3
2008	n/a	n/a	20212	n/a	5233	5285	14	4	5	2
2009	n/a	1125	16163	n/a	2324	n/a	15	n/a	6	n/a

[1] Fishing days per 100 HP
[2] Fishing days
[3] Soaking days
[4] 1000 Hours trawling with occurrence of anglerfish
[5] 1000 Hauls
n/a - not available

LPUE

	Div. VIIIc						Div. IXa			
Year	[1] Avilés	[1] Santander	[1] A Coruña	[2] A Coruña standardized	[3] Cedeira standardized 2009	[3] Cedeira standardized 2008	[4] Portugal Crustacean	[5] Portugal Crustacean standardized	[4] Portugal Fish	[5] Portugal Fish standardized
1986	46.1	28.4	26.9							
1987	60.2	35.3	27.4							
1988	44.3	23.3	37.1							
1989	26.5	17.3	21.6				1.1	3.7	3.3	9.9
1990	30.6	13.6	17.6				1.2	5.2	3.6	12.8
1991	31.9	12.6	21.4				0.9	4.4	2.6	9.8
1992	n/a	9.7	17.8				0.3	1.6	1.0	3.7
1993	9.9	8.7	8.7				0.5	2.7	1.3	5.7
1994	12.0	8.2	6.2	49.5			0.6	3.0	1.3	4.9
1995	31.2	13.2	6.3	44.3			0.6	2.8	1.1	4.9
1996	71.1	22.4	11.6	77.2			0.7	3.1	1.6	7.1
1997	68.1	32.3	11.7	81.3			1.2	4.5	2.2	6.7
1998	48.3	29.7	4.2	32.0			0.2	1.0	0.5	1.8
1999	15.8	17.6	5.4	24.8	69.8	69.2	0.1	0.4	0.3	1.0
2000	6.3	8.6	2.8	16.1	37.0	36.6	0.0	0.2	0.1	0.4
2001	12.5	17.6	2.8	12.2	39.4	39.0	0.1	0.5	0.4	1.4
2002	27.5	14.3	6.0	46.9	52.3	51.7	0.3	1.9	0.8	2.4
2003	44.0	22.1	12.3	83.4	57.1	56.5	0.3	1.3	0.9	2.8
2004	n/a	28.1	13.2	55.1	66.4	65.7	0.6	1.9	1.0	3.3
2005	n/a	41.9	18.9	75.6	123.5	122.3	0.6	2.2	1.3	4.7
2006	n/a	32.7	12.6	60.9	93.0	92.0	0.6	2.4	1.3	4.2
2007	n/a	23.8	10.5	n/a	50.1	49.7	0.3	1.1	0.8	2.1
2008	n/a	n/a	13.5	n/a	43.5	43.1	0.4	1.5	1.0	2.9
2009	n/a	31.3	10.2	n/a	78.7	n/a	0.3	n/a	0.8	n/a

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

Table 8.1.7. ANGLERFISH (*L. piscatorius*) - Division VIIIc and IXa.

ASPIC input settings and data

Input	**Value**
Error type	YLD - Condition on yield
Number of bootstrap trials	1000
Maximum F when estimating effort	8.0d0 (y-1)
Statistical weight for B1 > K	1
Statistical weights for fisheries	F1: 1, F2: 1
B1-ratio (starting guess)	0.5
MSY (starting guess)	5 000 (t)
K (starting guess)	50 000 (t)
q (starting guess)	F1: 1d-5, F2: 1d-6
Estimated parameters	All: B1-Ratio, MSY, K, qF1, qF2
Min and max allowable MSY	2 000 (t) - 11 500 (t)
Min and max K	5 000 (t) - 112 000 (t)
Random number seed	1964185

F1:	SP-CORUTR8c	
Type:	CC (CPUE and Catch)	
Year	CPUE (t/effort)	Catch (t)
1980	-1	4816
1981	-1	5568
1982	-1	5782
1983	-1	6114
1984	-1	6032
1985	-1	6139
1986	0.0269	6870
1987	0.0274	5141
1988	0.0371	6321
1989	0.0216	4996
1990	0.0176	3790
1991	0.0214	3640
1992	0.0178	3381
1993	0.0087	2329
1994	0.0062	2007
1995	0.0063	1834
1996	0.0116	2955
1997	0.0117	3715
1998	0.0042	2981
1999	0.0054	1932
2000	0.0028	1259
2001	0.0028	788
2002	0.0060	1032
2003	0.0123	2278
2004	0.0132	3157
2005	0.0189	3644
2006	0.0126	2963
2007	0.0105	2350
2008	0.0135	2337
2009	0.0102	2280

F2:	SP-CEDGNS8c
Type:	I1 (Index of biomass – annual average)
Year	CPUE (t/effort)
1980	-1
1981	-1
1982	-1
1983	-1
1984	-1
1985	-1
1986	-1
1987	-1
1988	-1
1989	-1
1990	-1
1991	-1
1992	-1
1993	-1
1994	-1
1995	-1
1996	-1
1997	-1
1998	-1
1999	0.0698
2000	0.0370
2001	0.0394
2002	0.0523
2003	0.0571
2004	0.0664
2005	0.1235
2006	0.0930
2007	0.0501
2008	0.0435
2009	0.0787

Table 8.1.8. ANGLERFISH (*L. piscatorius*) - 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(2010): equilibrium yield available in 2010; Y(Fmsy): yield availabe at Fmsy in 2010; Ye2010/MSY: equilibrium yield available in 2010 as proportion of MSY;fmsy (1): fishing effort rate at MSY for SP-CORUTR8c; fmsy (2): fishing effort rate at MSY for SP-CEDGNS8c.

	WG2010								
			Bias Corrected Bootstrap Confidence Interval						
Parameter	Point estimates	Relative bias	80% lower CL	80% upper CL	95% lower CL	95% upper CL		IQ-Range	Relative IQ-Range
B1/K	0.26	14.20%	0.25	0.28	0.23	1.01		0.01	3.30%
K	54350	-1.01%	48820	60960	41490	71400		2717	5.00%
q(1)	1.91E-06	-2.25%	1.55E-06	2.17E-06	9.56E-07	2.33E-06		2.88E-07	15.10%
q(2)	1.20E-05	-1.41%	9.43E-06	1.51E-05	5.82E-06	1.68E-05		2.62E-06	21.80%
MSY	7096	-2.58%	6851	7290	3822	7729		146	2.10%
Ye(2010)	2825	2.58%	1796	3785	1351	4406		1079	38.20%
Y (Fmsy)	2419	-1.62%	2080	2633	1821	2717		295	12.20%
Bmsy	27180	-1.01%	24410	30480	20740	35700		1359	5.00%
Fmsy	0.261	0.02%	0.221	0.273	0.149	0.303		0.012	4.50%
fmsy(1)	136500	5.12%	120300	157100	113700	172600		17940	13.10%
fmsy(2)	21720	6.55%	17470	26480	15530	30290		4451	20.50%
B_{2010}/Bmsy	0.22	15.35%	0.13	0.33	0.09	0.47		0.10	45.40%
F_{2009}/Fmsy	1.46	9.98%	1.05	2.24	0.88	2.79		0.60	41.10%
Ye_{2010}/MSY	0.40	8.08%	0.24	0.55	0.17	0.72		0.16	40.10%
q2/q1	6.28	1.16%	5.16	7.87	4.64	8.86		1.37	21.80%

Table 8.1.9. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Comparison of parameter estimates between 2009 an 2010 assesments.

Parameter	Assessment	
Point estimates	2009	2010
B1/K	0.41	0.26
K	32260	54350
MSY	5668	7096
Y(Fmsy)	1531	2419
Bmsy	16330	27180
Fmsy	0.347	0.261
B./Bmsy	0.27	0.22
F./Fmsy	1.57	1.46
q(1)	2.44E-06	1.91E-06
q(2)	1.52E-05	1.20E-05
q2/q1	6.2	6.3

B./Bmsy: B_{2009}/Bmsy for 2009; B_{2010}/Bmsy for 2010.
F./Fmsy: F_{2008}/Fmsy for 2009; F_{2009}/Fmsy for 2010.
Y(Fmsy): yield fishing at Fmsy for the next year of the assessment.

Table 8.1.10. ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Point estimates of B/B_{MSY}(from 2010 to 2019) and Yield (from 2010 to 2019) for projections with F status quo (Fsq), F_{MSY}, zero catches and first year reduction in F of 10, 20, 30, 40 and 50%. Reductions to obtain yields equal to 2010 TAC and +/- 15% of 2010 TAC are also presented. The value of F_{2010}/F_{MSY} is equal to Fsq in all scenarios proposed. Values for F/F_{MSY} are also given.

Fishing mortality trends in relation to F_{MSY}

			Decrease in first year						-15% TAC (1 496 t)	TAC (1 496 t)	+15% TAC (1 496 t)
year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %	reduction 71.1 %	reduction 65.7 %	reduction 60.2 %
2010	1.46	1.46	146	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46
2011	1.46	1	0	0.73	0.88	1.02	1.17	1.31	0.44	0.50	0.58
2012	1.46	1	0	0.73	0.88	1.02	1.17	1.31	0.44	0.50	0.58
2013	1.46	1	0	0.73	0.88	1.02	1.17	1.31	0.44	0.50	0.58
2014	1.46	1	0	0.73	0.88	1.02	1.17	1.31	0.44	0.50	0.58
2015	1.46	1	0	0.73	0.88	1.02	1.17	1.31	0.44	0.50	0.58
2016	1.46	1	0	0.73	0.88	1.02	1.17	1.31	0.44	0.50	0.58
2017	1.46	1	0	0.73	0.88	1.02	1.17	1.31	0.44	0.50	0.58
2018	1.46	1	0	0.73	0.88	1.02	1.17	1.31	0.44	0.50	0.58
2019	1.46	1	0	0.73	0.88	1.02	1.17	1.31	0.44	0.50	0.58

Biomass trends in relation to B_{MSY}

year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %	reduction 71.1 %	reduction 65.7 %	reduction 60.2 %
2010	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
2011	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
2012	0.26	0.29	0.38	0.31	0.30	0.29	0.28	0.27	0.34	0.33	0.33
2013	0.28	0.35	0.56	0.40	0.37	0.35	0.32	0.30	0.46	0.45	0.43
2014	0.30	0.41	0.80	0.50	0.45	0.41	0.37	0.33	0.61	0.58	0.55
2015	0.32	0.48	1.06	0.60	0.53	0.47	0.41	0.36	0.77	0.72	0.68
2016	0.34	0.55	1.31	0.70	0.61	0.53	0.46	0.39	0.93	0.87	0.81
2017	0.35	0.61	1.52	0.80	0.69	0.59	0.50	0.42	1.08	1.00	0.93
2018	0.37	0.67	1.69	0.90	0.77	0.65	0.54	0.45	1.21	1.12	1.04
2019	0.39	0.73	1.80	0.98	0.83	0.70	0.58	0.48	1.31	1.22	1.14

Yield

year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %	reduction 71.1 %	reduction 65.7 %	reduction 60.2 %
2010	2419	2419	2419	2419	2419	2419	2419	2419	2419	2419	2419
2011	2614	1889	0	1438	1693	1937	2172	2398	866	1017	1168
2012	2811	2275	0	1844	2096	2316	2507	2671	1195	1378	1552
2013	3007	2698	0	2314	2550	2730	2863	2953	1597	1812	2007
2014	3202	3149	0	2830	3040	3169	3231	3239	2056	2303	2518
2015	3393	3613	0	3371	3549	3620	3605	3524	2538	2820	3056
2016	3577	4075	0	3908	4056	4068	3975	3803	3007	3326	3585
2017	3755	4519	0	4413	4539	4500	4333	4074	3427	3786	4072
2018	3925	4933	0	4864	4982	4903	4671	4332	3776	4176	4494
2019	4085	5306	0	5250	5374	5269	4985	4573	4051	4490	4841

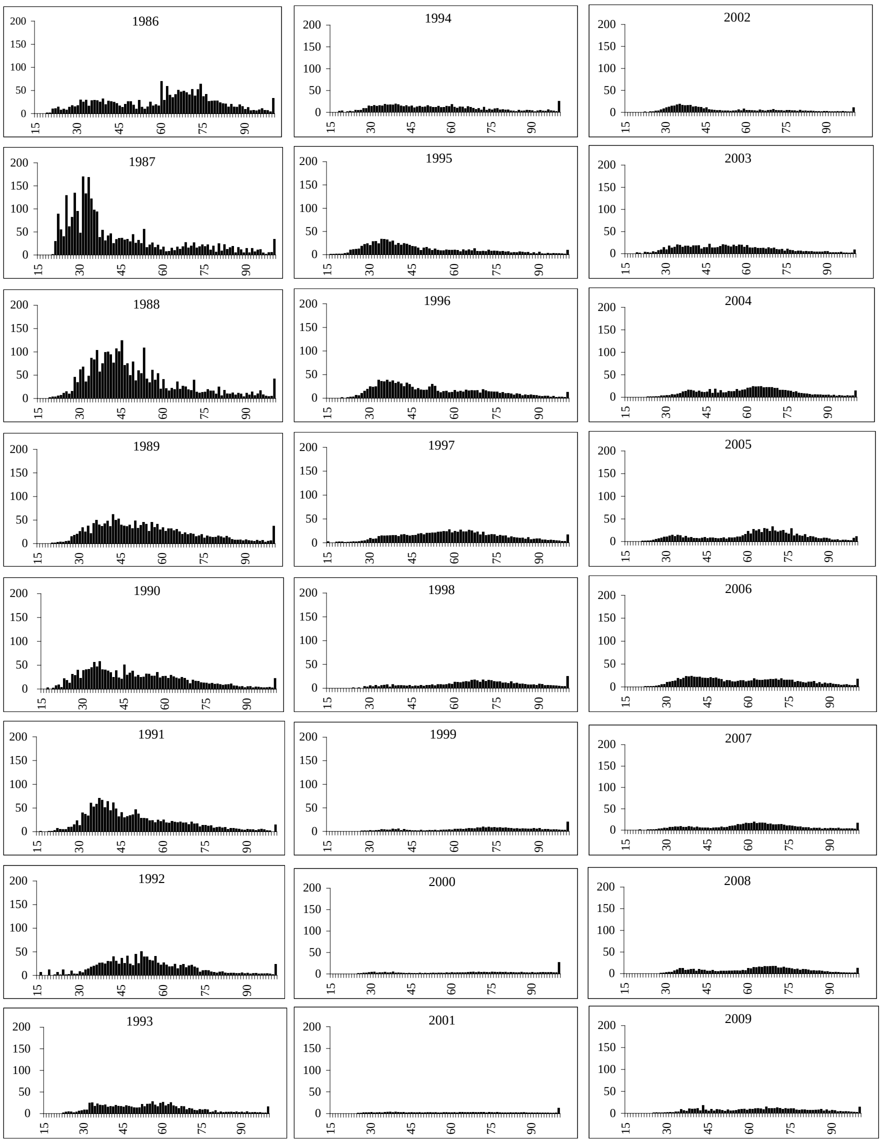


Figure 8.1.1 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Length distributions of landings (thousands for 1986 to 2009).

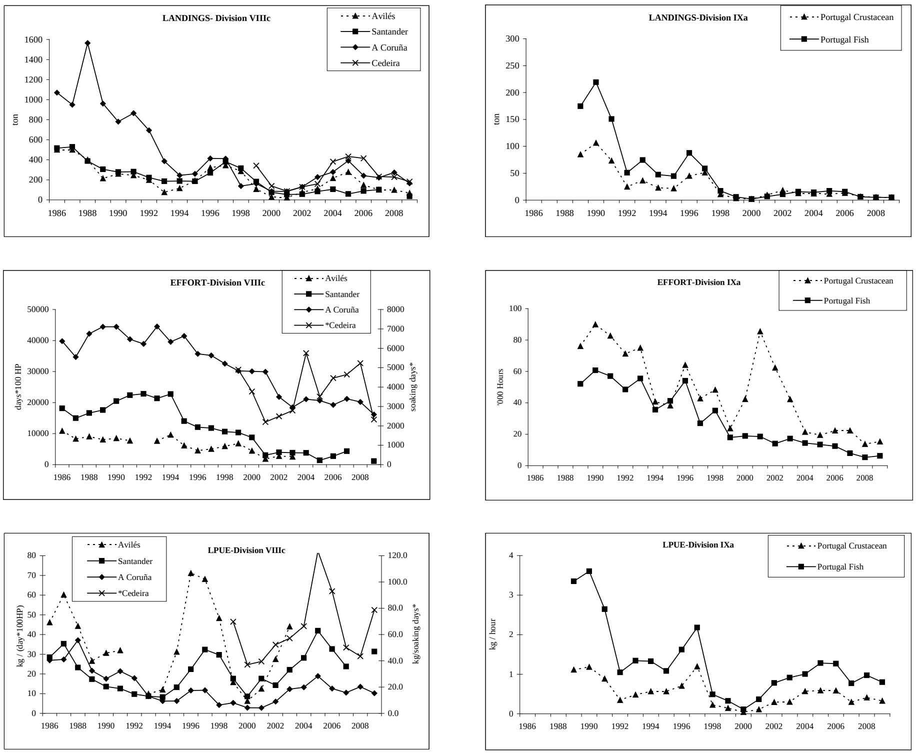


Figure 8.1.2 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Trawl and gillnet landings, effort and LPUE data between 1986-2009.

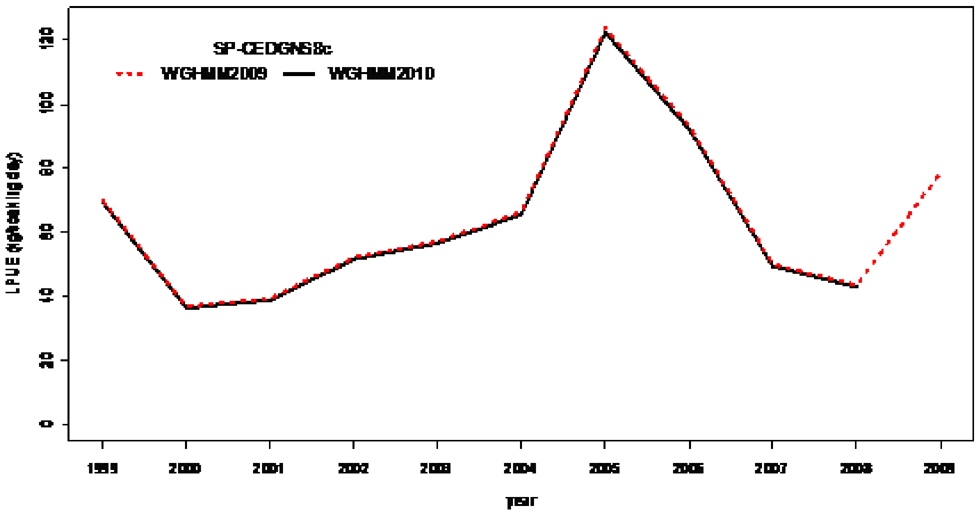


Figure 8.1.3 **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Comparison of LPUE estimates of Cedeira fleet from the 2009 and 2010 standardization runs.

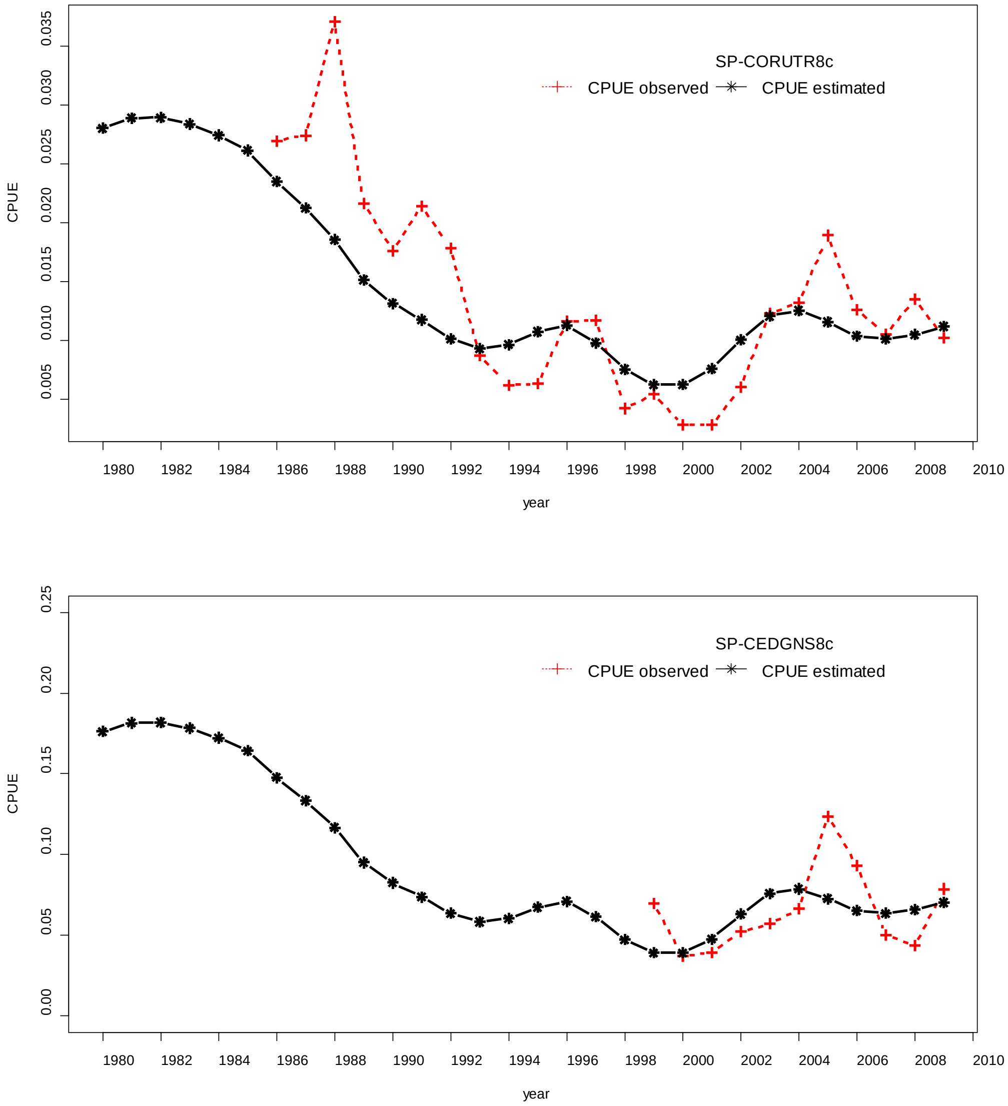


Figure 8.1.4 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.

Observed CPUE for the two commercial fleets and estimated values by the model.

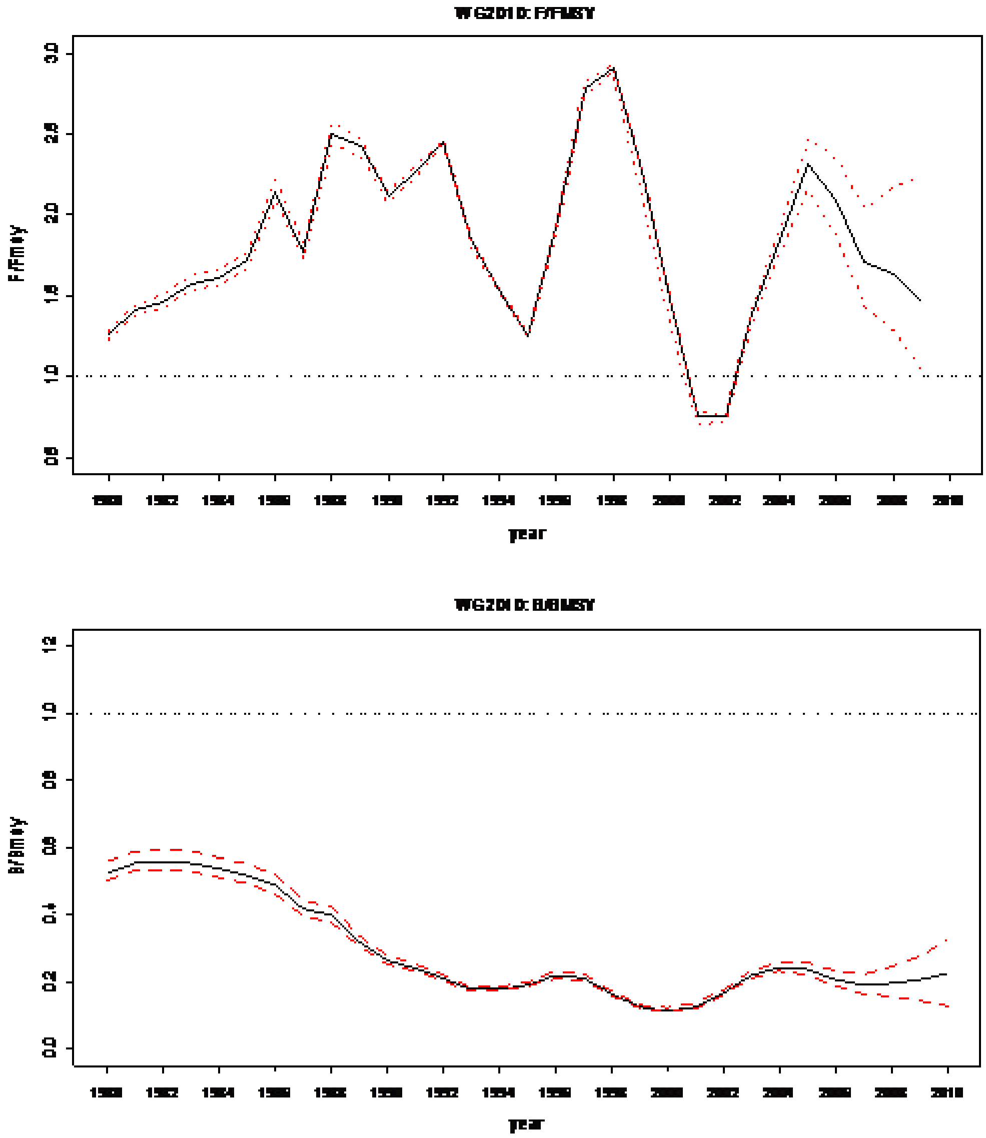
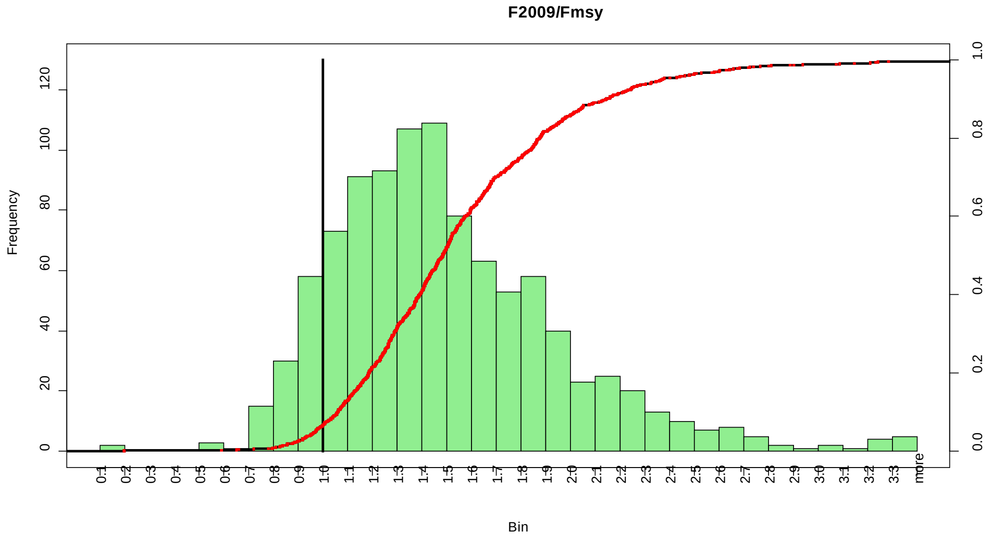


Figure 8.1.5 **ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.**

Confidence intervals (80%) of the F/F_{MSY} and B/B_{MSY} ratios.



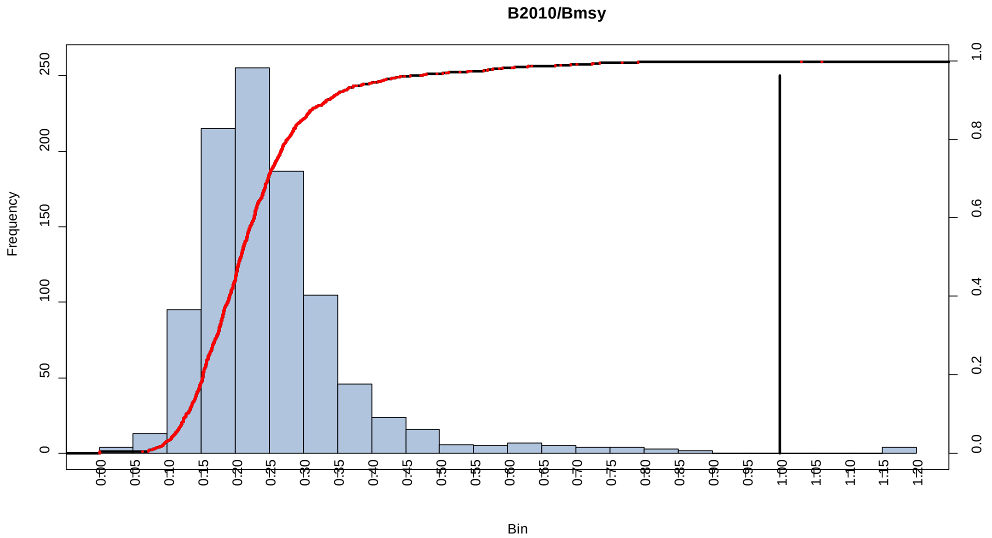
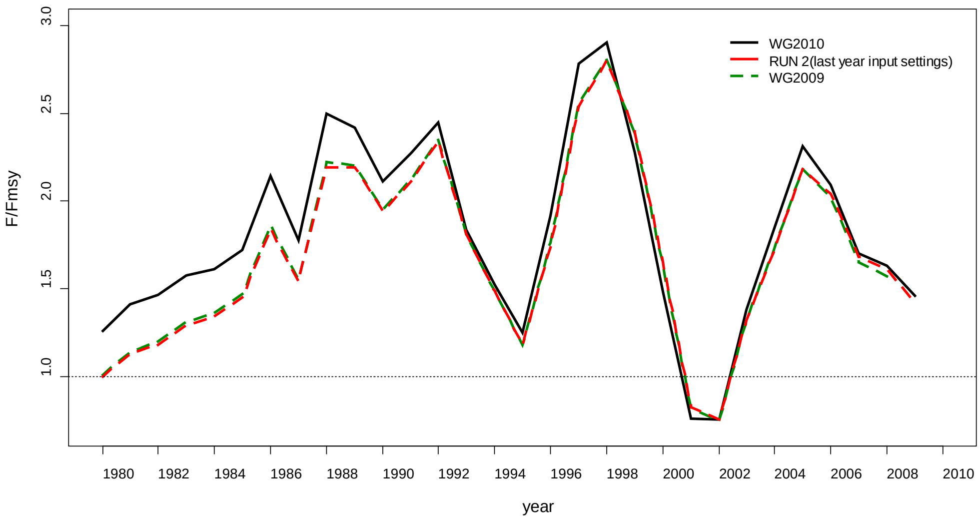


Figure 8.1.6 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.

Histograms and cumulative frequency distributions of estimated values of F2009/ F_{MSY} and B2010/ B_{MSY} by bootstrap (1000 replicates). The black line shows the estimate at reference point of one (F_{MSY}, B_{MSY}).



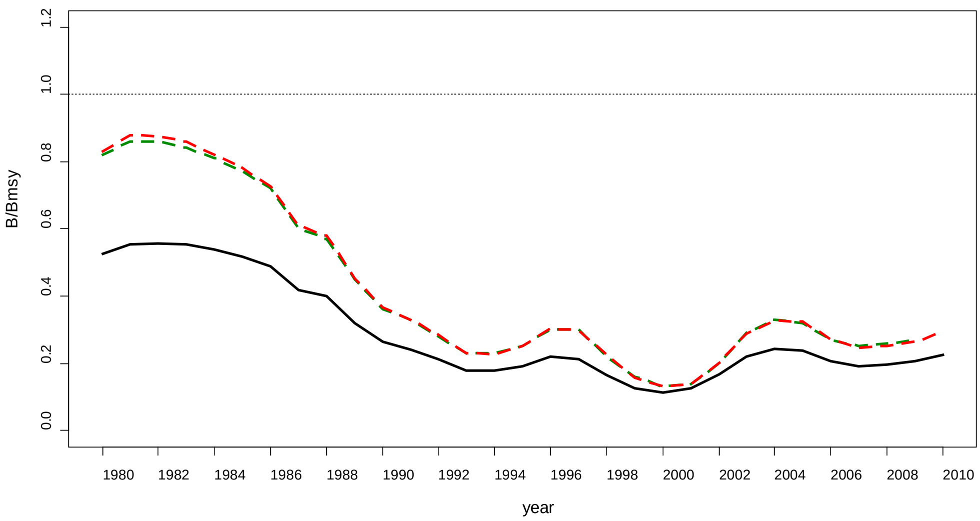


Figure 8.1.7 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.

Ratio trends of F/F$_{MSY}$ and B/B$_{MSY}$ estimated by ASPIC for the period 1980-2009 for WG2010, WG2009 and a RUN performed in 2010 with the same input settings as last year.

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 (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 2000, the Spanish landings were on average split 74% from the trawl fleet (mean lengths in 2009 of 49 cm and 44 cm for Divisions VIIIc and IXa, respectively) and 26% from the artisanal fleet (mean length of 62 cm in 2009 in Division VIIIc). Portuguese landings were on average for the same period split, 24 % from the trawl fleet (mean length of 49cm in 2009) and 76% from the artisanal fleet (mean length of 58cm in 2009).

8.2.2 Data

8.2.2.1 Commercial catches and discards

Total landings of *L. budegassa* by country and gear for the period 1978–2009, as estimated by the Working Group, are given in Table 8.2.1 (Annex H). From 2002 to 2007 landings increased to 1 301 t, decreasing afterwards to a minimum in 2009 of 769 t.

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 in 2004, 2005 and, particularly, 2006 in relation to previous years. The maximum value, by far, of the time series occurred in 2006 with 92 t. The coefficient of variation for weight data varied from 24% to 99%.

8.2.2.2 Biological sampling

The procedure for sampling of this species is the same as for *L. piscatorius* (Annex H). The sampling levels for 2009 are shown in Table 1.3. The metier sampling adopted in Spain and Portugal in 2009, following the requirement of EU Data Collection Framework, can have an effect on the provided data. Spanish sampling levels in 2009 are similar to previous years but an important reduction of Portuguese sampling levels was observed in 2009. Data for 2009 are viewed as provisional.

Length composition

Table 8.2.3 gives the length compositions by country and gear for 2009. The annual length compositions between 1986 and 2009 are presented 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. In 2008 and 2009 these small fish were not 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 landings observed was low, being 9% of the maximum value (year 1987). In 2006 and 2007 the number of landings more than doubled the 2005 number, since then the number of landings decreased to a minimum in 2009 at the same time that mean weight and length increased giving the maximum level of the series.

8.2.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2009 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 1996 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.

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. From then onwards a slight increase was observed in the majority of fleets. The LPUEs of the two Portuguese fleets has increased considerably till 2007, especially the PT-TRF9a fleet, regardless of the decrease in the last two years the LPUEs stayed relative high.

8.2.3 Assessment

In WGHMM2009 the assessment of the status of each anglerfish species was carried out separately based on ASPIC (Prager, 1994; Prager, 2004). This year an update of that assessment was carried out.

8.2.3.1 Input data

The input data, comprising the LPUEs for the Portuguese trawl crustacean fleet (PT-TRC9a), the LPUEs for the Portuguese trawl fish fleet (PT-TRF9a) and the landings, are presented in Table 8.2.7. As in the last assessment the LPUE series of PT-TRC9a was introduced as CC and the PT-TRF9a as a biomass index.

8.2.3.2 Model

The ASPIC (version 5.34) model (which implements the Schaeffer population growth model) was used for the 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). They are the same ones used in the 2007 and 2009 assessments.

8.2.3.3 Assessment results

The correlation coefficient between input fleets is very high (0.903) but the r square between observed and fitted CPUE values are negative, -0.589 for PT-TRC9a and -0.259 for PT-TRF9a (Annex M). Point estimates and bias-corrected bootstrap confidence intervals for parameters are presented in table 8.2.8, whereas Figure 8.3 plots observed and estimated CPUEs for each of the series used in the model. B_{2010}/B_{MSY} and F_{2009}/F_{MSY} have respectively -1.34% and 5.82% of bias and both have around 28% relative inter-quartile ranges. Biomass in 2010 is estimated to be 80% of B_{MSY} with 95% bias-corrected confidence interval between 51% and 115%. Fishing mortality in 2009 is estimated to be 0.45 times F_{MSY} with 95% bias-corrected confidence interval between 0.30 and 0.71 times F_{MSY}. MSY is estimated to be 2 515 t with 95% CI from 2 510 t to 2 526 t. This parameter shows no bias and a negligible inter-quartile range. More detailed results can be found in Annex M.

Trends in relative biomass (Figure 8.2.4) indicate a decrease since the late eighties with a slight recovery in the late nineties and in recent years. Fishing mortality remained at high levels between late eighties and late nineties, dropping after that. In 2009, biomass is estimated to be below B_{MSY} and fishing mortality is estimated to be below F_{MSY}.

Figure 8.2.5 shows the values of F_{2009}/F_{MSY} and B_{2010}/B_{MSY} for the 1000 bootstrap replicates and their cumulative distribution function. Only the 11.4% of the bootstrap estimates of current biomass were greater than or equal to B_{MSY}, while 99.8% of bootstrap estimates of current fishing mortality were less than F_{MSY}.

Comparison between the 2009 and 2010 assessments show that both assessments are very consistent for the common period (Table 8.2.9 and Figure 8.2.6).

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 F_{2009}), F_{MSY}, with zero catches and for reductions in F in the first projection year from 10% to 50% of F *status quo*. A new set of projections were performed with the necessary F reductions to obtain a yield (adding to *L. piscatorius*) corresponding to the 2010 TAC and +/-15% 2010 TAC.

The biomass is expected to increase under all fishing mortality scenarios examined. Fishing mortality equal to F *status quo* in 2011 is expected to bring the stock back to B_{MSY} in 2012 (Table 8.2.10).

8.2.5 Biological Reference Points

Comments on the biological reference points are in section 8.3.

8.2.6 Comments on the assessment

Comments on the assessment are in section 8.3.

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 1978-2009 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	2163
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	913	104	1017	615	68	131	814	1831
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	571	127	698	671	110	406	1187	1885
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	251	120	371	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

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

n/a: not available

CV: coefficient of variation

Table 8.2.3 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
Length composition by fleet for landings in 2009 (thousands).

	Div. VIIIc			Div. IXa				Div. VIIIc+IXa
	SPAIN			SPAIN	PORTUGAL			
Length (cm)	Trawl	Gillnet	TOTAL	Trawl	Trawl	Artisanal	TOTAL	TOTAL
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.146	0.000	0.146	0.092	0.000	0.000	0.092	0.238
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.260	0.000	0.000	0.260	0.260
25	0.000	0.000	0.000	0.253	0.000	0.000	0.253	0.253
26	0.000	0.000	0.000	0.260	0.000	0.000	0.260	0.260
27	0.266	0.000	0.266	0.155	0.000	0.000	0.155	0.421
28	0.364	0.000	0.364	1.505	0.000	0.000	1.505	1.869
29	0.132	0.000	0.132	2.662	0.000	0.000	2.662	2.794
30	0.115	0.000	0.115	1.581	0.000	0.000	1.581	1.696
31	0.654	0.000	0.654	3.853	0.000	0.000	3.853	4.507
32	0.805	0.000	0.805	3.930	0.093	0.000	4.023	4.828
33	2.622	0.000	2.622	2.504	0.000	0.000	2.504	5.126
34	3.652	0.000	3.652	7.361	1.272	0.000	8.633	12.285
35	2.588	0.000	2.588	1.325	0.774	0.000	2.099	4.687
36	4.911	0.000	4.911	2.353	0.518	0.000	2.871	7.782
37	2.879	0.000	2.879	7.530	0.000	0.000	7.530	10.409
38	3.941	0.000	3.941	1.242	0.591	0.000	1.833	5.774
39	4.482	0.000	4.482	1.454	0.000	0.584	2.038	6.520
40	7.956	0.000	7.956	1.074	0.000	0.354	1.428	9.384
41	5.749	0.000	5.749	0.458	0.000	0.573	1.031	6.780
42	6.227	0.321	6.548	1.293	0.000	0.354	1.647	8.195
43	6.015	0.222	6.237	1.442	0.000	0.927	2.369	8.606
44	5.146	0.048	5.194	0.952	0.093	0.948	1.993	7.187
45	4.261	0.000	4.261	1.416	0.000	0.120	1.537	5.798
46	3.287	0.232	3.519	1.619	0.591	3.784	5.994	9.513
47	2.712	0.222	2.934	0.373	0.000	4.636	5.008	7.942
48	4.411	0.560	4.971	0.000	0.076	0.851	0.927	5.898
49	3.031	0.161	3.192	0.172	0.000	0.249	0.420	3.612
50	2.166	0.853	3.019	0.640	0.000	0.086	0.727	3.746
51	2.384	0.974	3.358	0.200	0.000	0.865	1.064	4.422
52	2.742	0.464	3.206	1.481	0.591	0.153	2.225	5.431
53	3.564	1.138	4.702	1.784	0.151	0.086	2.022	6.724
54	2.926	0.727	3.653	1.490	0.518	0.469	2.477	6.130
55	2.924	0.782	3.706	3.412	0.000	0.059	3.471	7.177
56	3.017	1.401	4.418	4.097	0.000	0.200	4.297	8.715
57	2.598	1.220	3.818	2.234	0.591	0.564	3.390	7.208
58	4.887	1.507	6.394	2.457	0.000	0.494	2.951	9.345
59	3.985	1.986	5.971	2.611	0.591	0.745	3.947	9.918
60	5.545	3.060	8.605	0.574	0.000	1.208	1.782	10.387
61	5.418	2.518	7.936	1.617	0.000	0.580	2.197	10.133
62	3.264	1.896	5.160	0.086	0.000	0.457	0.543	5.703
63	3.719	2.629	6.348	0.455	0.000	0.901	1.356	7.704
64	3.118	1.700	4.818	0.321	0.000	0.734	1.055	5.873
65	3.174	1.258	4.432	0.715	0.000	0.564	1.279	5.711
66	1.754	1.775	3.529	1.053	0.000	0.556	1.609	5.138
67	1.085	1.091	2.176	0.403	0.000	0.693	1.096	3.272
68	1.557	0.826	2.383	0.041	0.000	0.583	0.624	3.007
69	0.885	1.560	2.445	0.143	0.518	0.714	1.374	3.819
70	0.447	0.843	1.290	0.169	0.684	0.230	1.083	2.373
71	0.549	0.812	1.361	0.000	0.093	0.351	0.444	1.805
72	0.336	1.066	1.402	0.000	0.000	0.384	0.384	1.786
73	0.541	0.581	1.122	1.297	0.000	0.252	1.549	2.671
74	0.344	0.978	1.322	1.053	0.000	0.517	1.570	2.892
75	0.131	0.374	0.505	0.000	0.076	0.034	0.110	0.615
76	0.005	0.289	0.294	0.000	0.000	0.562	0.562	0.856
77	0.048	0.055	0.103	0.000	0.000	0.034	0.034	0.137
78	0.000	0.321	0.321	0.000	0.007	0.378	0.385	0.706
79	0.163	0.269	0.432	0.175	0.021	0.177	0.372	0.804
80	0.096	0.207	0.303	0.000	0.000	0.213	0.213	0.516
81	0.000	0.200	0.200	0.078	0.000	0.416	0.495	0.695
82	0.000	0.118	0.118	0.000	0.007	0.184	0.191	0.309
83	0.085	0.139	0.224	0.000	0.000	1.019	1.019	1.243
84	0.108	0.000	0.108	0.000	0.000	0.512	0.512	0.620
85	0.000	0.000	0.000	0.000	0.000	0.136	0.136	0.136
86	0.000	0.000	0.000	0.000	0.000	0.079	0.079	0.079
87	0.000	0.000	0.000	0.000	0.000	0.022	0.022	0.022
88	0.000	0.000	0.000	0.000	0.007	0.153	0.160	0.160
89	0.000	0.089	0.089	0.000	0.000	0.622	0.622	0.711
90	0.000	0.000	0.000	0.099	0.000	0.034	0.134	0.134
91	0.000	0.000	0.000	0.000	0.000	0.367	0.367	0.367
92	0.000	0.089	0.089	0.000	0.000	0.000	0.000	0.089
93	0.000	0.000	0.000	0.000	0.000	0.011	0.011	0.011
94	0.000	0.000	0.000	0.000	0.076	0.000	0.076	0.076
95	0.000	0.000	0.000	0.000	0.000	0.011	0.011	0.011
96	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
97	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
98	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
99	0.000	0.089	0.089	0.000	0.000	0.000	0.000	0.089
100+	0.000	0.000	0.000	0.000	0.000	0.093	0.093	0.093
TOTAL	140	38	178	76	8	31	115	292
Tonnes	301	148	449	172	34	114	320	769
Mean Weight (g)	2151	3942	2530	2273	4253	3688	2791	2633
Mean Length	49.3	62.3	52.1	44.3	49.3	58.6	48.5	50.7
Measured weight (t)	2.6	1.8	4.4	3.2	0.1	1.5	1.6	6.0

Table 8.2.4 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
Number, mean weight and mean length of landings between 1986 and 2009.

	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	292	2633	51

Table 8.2.5 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
Abundance indices from Spanish and Portuguese surveys.

	Spanish surveys					Portuguese Surveys		
	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	0.04	0.23
2009	115	0.30	0.08	0.35	0.08	92	0.02	0.00

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

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	%	Cedeira	%	Portugal Crustacean	%	Portugal Fish	%
1986	64	3	21	1	353	14						
1987	85	2	16	0	636	17						
1988	125	3	30	1	435	12						
1989	119	5	32	1	280	11			89	3	183	7
1990	58	2	40	2	258	11			127	5	261	11
1991	52	2	62	3	182	8			101	5	208	10
1992	33	2	107	5	180	9			94	4	193	9
1993	53	2	143	6	201	9			64	3	132	6
1994	65	4	196	12	166	11			26	2	53	3
1995	141	8	126	7	341	19			22	1	46	3
1996	162	10	89	5	334	21			45	3	88	5
1997	143	8	122	7	298	16			38	2	43	2
1998	91	4	114	5	323	15			70	3	111	5
1999	41	2	67	4	380	20	14	1	41	2	69	4
2000	23	2	44	3	287	21	4	<1	66	5	76	6
2001	12	1	28	3	281	28	6	1	59	6	42	4
2002	11	1	16	2	76	10	7	1	47	6	28	4
2003	9	1	15	2	85	9	3	<1	30	3	38	4
2004	32	3	23	2	68	7	5	1	23	2	27	3
2005	54	6	7	1	54	6	2	<1	12	1	19	2
2006	16	1	18	2	70	6	4	<1	18	2	22	2
2007	11	1	19	1	109	8	2	<1	34	3	31	2
2008	10	1	n/a	n/a	163	17	0.4	<1	21	2	19	2
2009	5	1	8	1	80	10	3.9	1	18	2	16	2

Fishing effort

	Div. VIIIc						Div. IXa			
Year	[1]Avilés	[1]Santander	[1]A Coruña	[2]A Coruña standardized	[3]Cedeira standardized 2008	[3]Cedeira standardized 2008	Portugal [4]Crustacean	Portugal [5]Crustacean standardized	Portugal [4]Fish	Portugal [5]Fish standardized
1986	10845	18153	39810							
1987	8309	14995	34680							
1988	9047	16660	42180							
1989	8063	17607	44440				76	23	52	18
1990	8497	20469	44430				90	20	61	17
1991	7681	22391	40440				83	17	57	15
1992	n/a	22833	38910				71	15	49	14
1993	7635	21370	44504				75	13	56	13
1994	9620	22772	39589	4738			41	8	36	10
1995	6146	14046	41452	5298			38	8	41	9
1996	4525	12071	35728	5084			64	14	54	12
1997	5061	11776	35211	4801			43	11	27	9
1998	5929	10646	32563	3668			48	11	35	10
1999	6829	10349	30232	6424	4895	4939	24	8	18	6
2000	4453	8779	30073	5125	3768	3813	42	10	19	6
2001	1838	3053	29923	6103	2197	2221	85	18	19	5
2002	2748	3975	21823	2581	2491	2520	62	10	14	4
2003	2526	3837	18493	2515	2792	2822	42	10	17	6
2004	n/a	3776	21112	5056	5748	5806	21	7	14	4
2005	n/a	1404	20663	5161	3511	3546	20	5	13	4
2006	n/a	2718	19264	3949	4464	4511	22	5	12	4
2007	n/a	4334	21202	n/a	4648	4691	22	6	8	3
2008	n/a	n/a	20212	n/a	5233	5285	14	4	5	2
2009	n/a	1125	16163	n/a	2324		15	n/a	6	n/a

[1] Fishing days per 100 HP [4] 1000 Hours trawling with occurrence of anglerfish
[2] Fishing days [5] 1000 Hauls
[3] Soaking days n/a - not available

LPUE

	Div. VIIIc						Div. IXa			
Year	[1]Avilés	[1]Santander	[1]A Coruña	[2]A Coruña standardized	[3]Cedeira standardized 2009	[3]Cedeira standardized 2008	Portugal [4]Crustacean	Portugal [5]Crustacean standardized	Portugal [4]Fish	Portugal [5]Fish standardized
1986	5.9	1.1	8.9							
1987	10.3	1.1	18.3							
1988	13.9	1.8	10.3							
1989	14.7	1.8	6.3				1.2	3.9	3.5	10.4
1990	6.8	1.9	5.8				1.4	6.2	4.3	15.2
1991	6.7	2.8	4.5				1.2	6.1	3.6	13.5
1992	n/a	4.7	4.6				1.3	6.2	4.0	14.1
1993	7.0	6.7	4.5				0.9	4.8	2.4	10.1
1994	6.7	8.6	4.2	37.4			0.6	3.4	1.5	5.5
1995	23.0	9.0	8.2	69.1			0.6	2.8	1.1	5.0
1996	35.8	7.4	9.4	69.9			0.7	3.1	1.6	7.1
1997	28.3	10.4	8.5	66.4			0.9	3.3	1.6	4.9
1998	15.3	10.7	9.9	93.7			1.5	6.3	3.2	11.5
1999	5.9	6.5	12.6	59.6	2.8	2.7	1.7	5.0	3.9	12.2
2000	5.1	5.0	9.6	56.6	1.1	1.0	1.6	6.5	4.0	12.6
2001	6.7	9.3	9.4	47.7	2.6	2.6	0.7	3.2	2.3	8.5
2002	4.1	4.1	3.5	33.0	2.9	2.8	0.8	4.8	2.0	6.2
2003	3.6	4.0	4.6	40.8	0.9	0.9	0.7	3.1	2.2	6.7
2004	n/a	6.0	3.2	13.5	0.9	0.9	1.1	3.5	1.9	6.2
2005	n/a	4.9	2.6	10.6	0.6	0.6	0.6	2.4	1.4	5.0
2006	n/a	6.8	3.6	18.2	0.9	0.9	0.8	3.3	1.7	5.6
2007	n/a	4.5	5.2	n/a	0.5	0.5	1.5	5.6	4.0	10.5
2008	n/a	n/a	8.1	n/a	0.1	0.1	1.5	5.4	3.6	10.6
2009	n/a	6.8	5.0	n/a	1.7		1.1	n/a	2.6	n/a

[1] kg/days*100HP [4] kg/hour trawl
[2] kg/day [5] kg/haul
[3] kg/soaking day

Table 8.2.7 ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa.

ASPIC input settings and data.

Input	Value
Error type	YLD – Condition on yield
Number of bootstrap trials	1000
Maximum F when estimating effort	8.0d0 (y^{-1})
Statistical weight for B1 > K	1
Statistical weights for fisheries	F1: 1, F2: 1
B1-ratio (starting guess)	0.5
MSY (starting guess)	3000 (t)
K (starting guess)	20000 (t)
q (starting guess)	F1: 1d-5, F2: 1d-4
Estimated parameters	All: B1-Ratio, MSY, K, qF1, qF2
Min and max allowable MSY	2 000 (t) – 10 000 (t)
Min and max K	5000 (t) – 100 000 (t)
Random number seed	1964185

F1:	P-TRC			F2:	P-TRF
Type:	CC (CPUE and Catch)			Type:	I1 (Index of biomass – annual average)
Year	CPUE (t/effort)	Catch (t)		Year	CPUE (t/effort)
1980	-1	2110		1980	-1
1981	-1	2300		1981	-1
1982	-1	2369		1982	-1
1983	-1	2379		1983	-1
1984	-1	1929		1984	-1
1985	-1	1833		1985	-1
1986	-1	2563		1986	-1
1987	-1	3832		1987	-1
1988	-1	3700		1988	-1
1989	0.00117	2578		1989	0.00351
1990	0.00141	2334		1990	0.00429
1991	0.00122	2163		1991	0.00365
1992	0.00132	2111		1992	0.00397
1993	0.00085	2227		1993	0.00237
1994	0.00064	1580		1994	0.00150
1995	0.00058	1831		1995	0.00111
1996	0.00070	1629		1996	0.00162
1997	0.00088	1813		1997	0.00160
1998	0.00145	2089		1998	0.00316
1999	0.00172	1885		1999	0.00385
2000	0.00156	1369		2000	0.00404
2001	0.00069	1013		2001	0.00227
2002	0.00075	770		2002	0.00200
2003	0.00071	926		2003	0.00217
2004	0.00107	973		2004	0.00190
2005	0.00063	897		2005	0.00138
2006	0.00080	1148		2006	0.00173
2007	0.00153	1301		2007	0.00398
2008	0.00150	951		2008	0.00356
2009	0.00114	769		2009	0.00258

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(2010): equilibrium yield available in 2010; Y(Fmsy): yield availabe at Fmsy in 2010; Ye2010/MSY: equilibrium yield available in 2010 as proportion of MSY;fmsy (1): fishing effort rate at MSY for P-TRC; fmsy (2): fishing effort rate at MSY for P-TRF.

	WG2010								
			Bootstrap Confidence Interval						
Parameter	Point estimates	Relative bias	Lower 80%	Higher 80%	Lower 95%	Higher 95%	IQ-Range	Relative IQ-Range
B1/K	0.40	-0.06%	0.40	0.40	0.40	0.40	0.00	0.10%
K	11480	-0.33%	11360	11590	11090	11810	53	0.50%
q(1)	4.60E-07	1.01%	3.99E-07	5.33E-07	3.65E-07	5.79E-07	6.82E-08	14.80%
q(2)	1.13E-06	3.79%	1.03E-06	1.27E-06	1.01E-06	1.36E-06	1.29E-07	11.40%
MSY	2515	0.03%	2513	2519	2510	2526	1	0.00%
Ye(2010)	2419	-3.17%	2160	2513	1935	2518	190	7.90%
Y.@Fmsy	1062	-0.50%	1009	1082	975	1084	39	3.70%
Bmsy	5740	-0.33%	5680	5796	5545	5904	26.29	0.50%
Fmsy	0.438	0.39%	0.434	0.444	0.425	0.456	0.002	0.50%
fmsy(1)	953200	0.69%	819000	1093000	749500	1191000	141600	14.90%
fmsy(2)	387000	-2.50%	345200	427600	318500	433800	44390	11.50%
B./Bmsy	0.80	-1.34%	0.61	1.04	0.51	1.15	0.22	27.70%
F./Fmsy	0.45	5.82%	0.34	0.60	0.30	0.71	0.13	28.70%
Ye./MSY	0.96	-3.20%	0.86	1.00	0.77	1.00	0.07	7.80%
q2/q1	2.5	4.01%	1.99	2.85	1.83	3.14	0.44	17.80%

Table 8.2.9 ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa
Comparasion of parameter estimates between 2009 and 2010 assessments

Parameter	Assessment year	
point estimates	2009	2010
B1/K	0.39	0.40
K	11630	11480
MSY	2536	2515
Y.@Fmsy	1827	1062
Bmsy	5813	5740
Fmsy	0.436	0.438
B./Bmsy	0.72	0.80
F./Fmsy	0.61	0.45
q(1)	4.48E-07	4.60E-07
q(2)	1.11E-06	1.13E-06
q2/q1	2.5	2.5

B./Bmsy: B_{2009}/Bmsy for 2009; B_{2010}/Bmsy for 2010.

F. ./Fmsy: F_{2008}/Fmsy for 2009; F_{2009}/Fmsy for 2010.

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 2010 to 2019) and Yield (from 2010 to 2019) for projections with F status quo (Fsq), FMSY, zero catches and first year reduction in F of 10, 20, 30, 40 and 50%. Reductions to obtain yields equal to 2010 TAC, and +/- 15% 2010 TAC are also presented. The value of F2010/FMSY is equal to Fsq in all scenarios proposed. Values for F/FMSY are also given.

Fishing mortality trends in relation to F_{MSY}

			Decrease in first year						-15% TAC (1496)	TAC=1496	+15% TAC (1496)
year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %	reduction 71.1 %	reduction 65.7 %	reduction 60.2 %
2010	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
2011	0.45	1	0.00	0.23	0.27	0.32	0.36	0.41	0.13	0.16	0.18
2012	0.45	1	0.00	0.23	0.27	0.32	0.36	0.41	0.13	0.16	0.18
2013	0.45	1	0.00	0.23	0.27	0.32	0.36	0.41	0.13	0.16	0.18
2014	0.45	1	0.00	0.23	0.27	0.32	0.36	0.41	0.13	0.16	0.18
2015	0.45	1	0.00	0.23	0.27	0.32	0.36	0.41	0.13	0.16	0.18
2016	0.45	1	0.00	0.23	0.27	0.32	0.36	0.41	0.13	0.16	0.18
2017	0.45	1	0.00	0.23	0.27	0.32	0.36	0.41	0.13	0.16	0.18
2018	0.45	1	0.00	0.23	0.27	0.32	0.36	0.41	0.13	0.16	0.18
2019	0.45	1	0.00	0.23	0.27	0.32	0.36	0.41	0.13	0.16	0.18

Biomass trends in relation to B_{MSY}

year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %	reduction 71.1 %	reduction 65.7 %	reduction 60.2 %
2010	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
2011	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
2012	1.25	1.03	1.46	1.35	1.33	1.31	1.29	1.27	1.39	1.38	1.37
2013	1.38	1.02	1.73	1.55	1.52	1.48	1.45	1.41	1.63	1.61	1.59
2014	1.46	1.01	1.88	1.66	1.62	1.58	1.54	1.50	1.75	1.73	1.71
2015	1.50	1.01	1.95	1.72	1.68	1.63	1.59	1.54	1.82	1.79	1.77
2016	1.52	1.01	1.98	1.75	1.70	1.66	1.61	1.57	1.85	1.82	1.80
2017	1.54	1.00	1.99	1.76	1.72	1.67	1.63	1.58	1.86	1.83	1.81
2018	1.54	1.00	2.00	1.77	1.72	1.68	1.63	1.59	1.86	1.84	1.82
2019	1.54	1.00	2.00	1.77	1.73	1.68	1.64	1.59	1.87	1.84	1.82

Yield

year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %	reduction 71.1 %	reduction 65.7 %	reduction 60.2 %
2010	1062	1062	1062	1062	1062	1062	1062	1062	1062	1062	1062
2011	1318	2623	0	688	819	947	1073	1197	405	479	553
2012	1504	2584	0	830	977	1118	1252	1381	500	587	674
2013	1621	2559	0	918	1076	1224	1364	1497	558	654	749
2014	1687	2543	0	966	1129	1283	1427	1562	589	689	789
2015	1724	2533	0	989	1156	1313	1460	1597	603	707	808
2016	1742	2527	0	1000	1169	1328	1476	1614	610	714	818
2017	1752	2523	0	1006	1176	1335	1485	1624	613	718	822
2018	1757	2520	0	1008	1179	1339	1489	1628	614	720	824
2019	1760	2518	0	1009	1180	1341	1491	1630	615	720	824

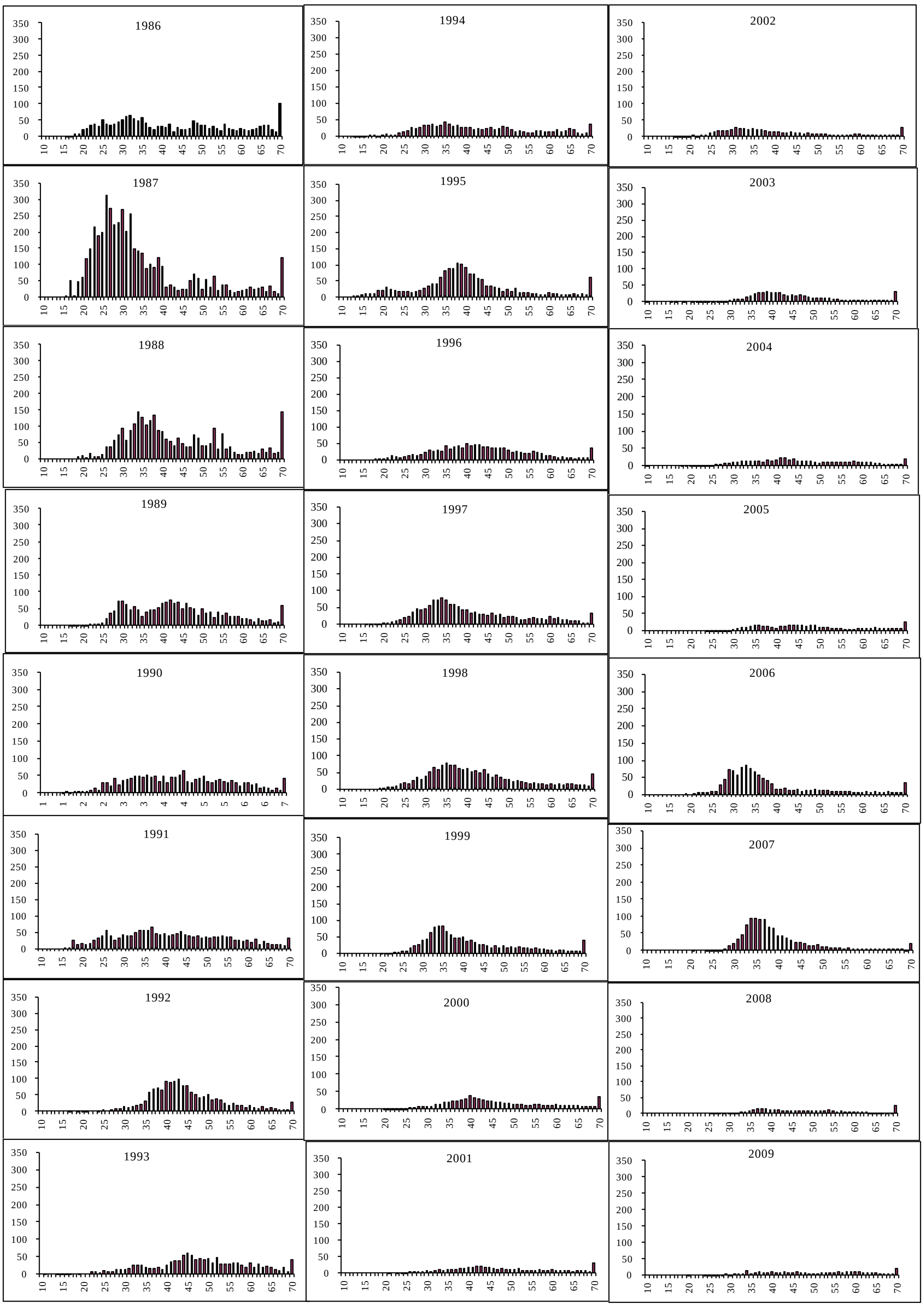


Figure 8.2.1 **ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa. Length distributions of landings (thousands for 1986 to 2009).**

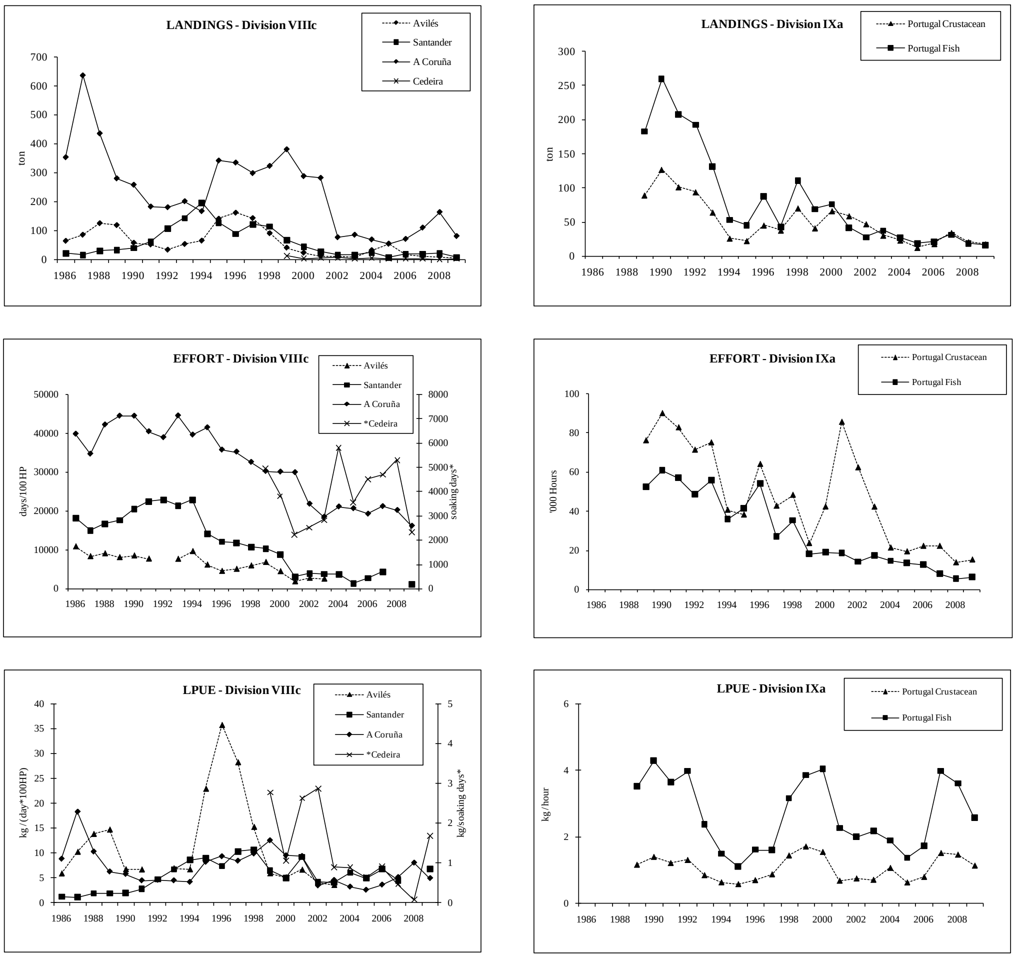
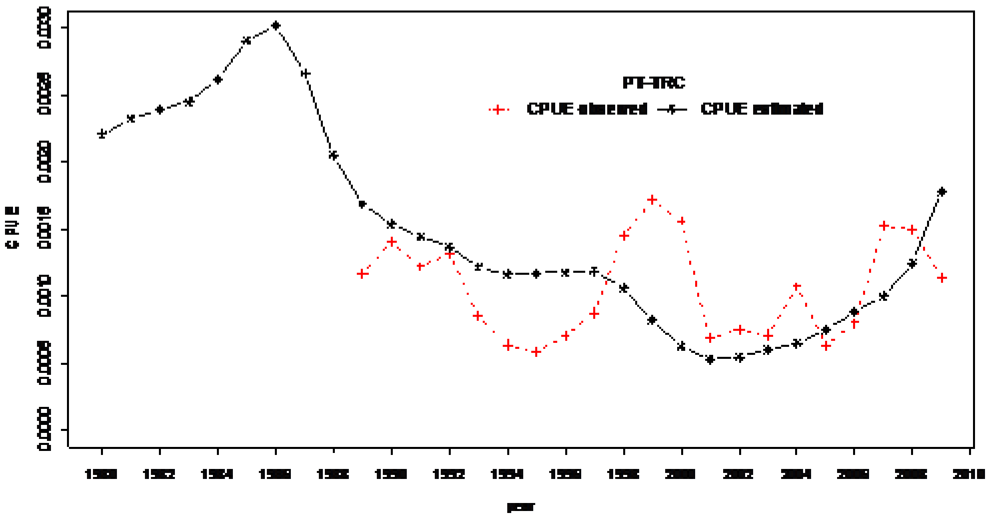


Figure 8.2.2 **ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.**
Trawl and gillnet landings, effort and LPUE data between 1986-2009.



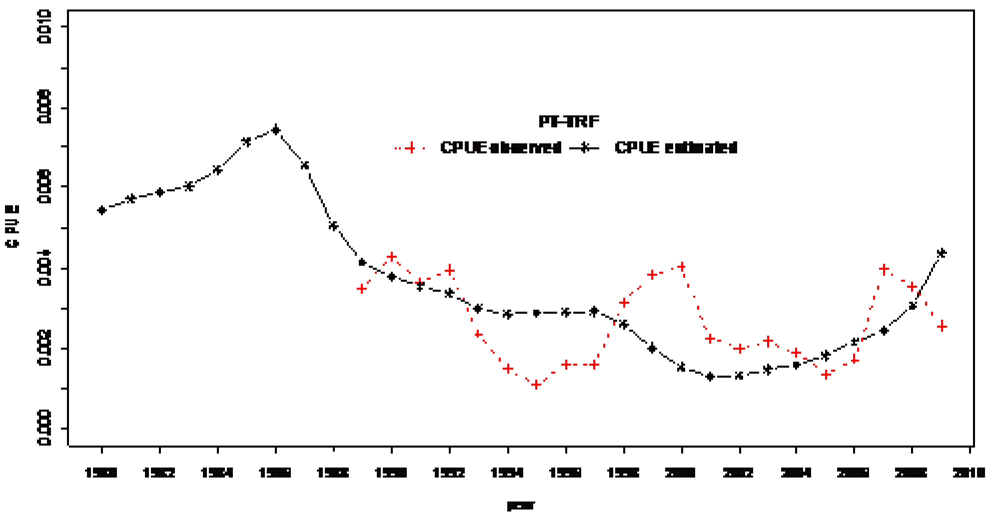
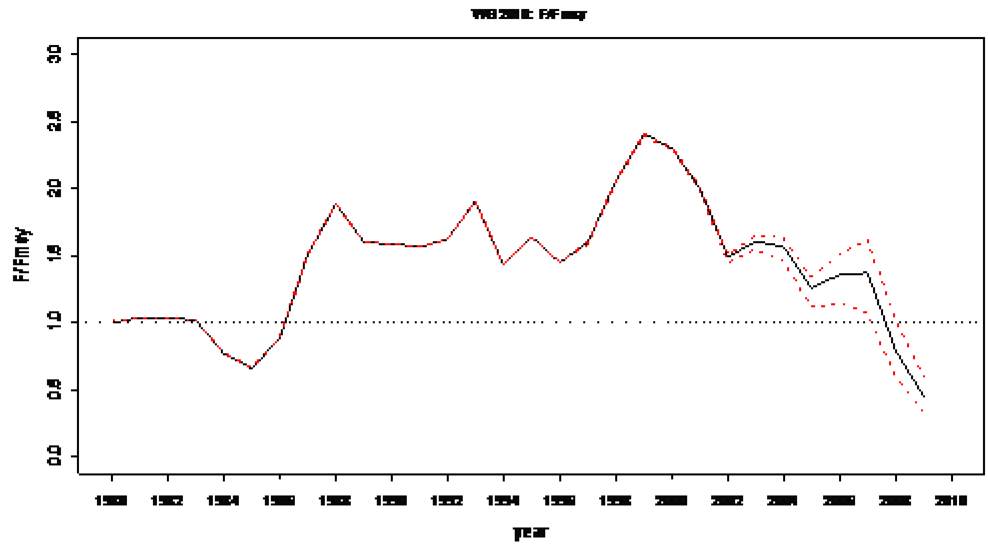


Figure 8.2.3. ANGLERFISH (*L. budegassa*)– Divisions VIIIc and IXa. Observed CPUE for the two commercial fleets and estimated values by the model.



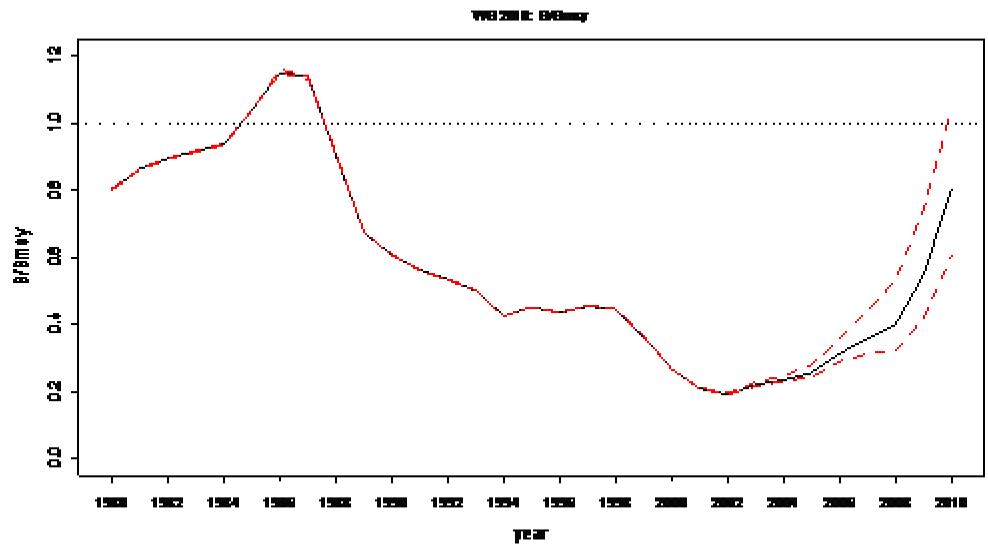


Figure 8.2.4. ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa. Confidence intervals (80%) of the F/FMSY and B/BMSY ratios.

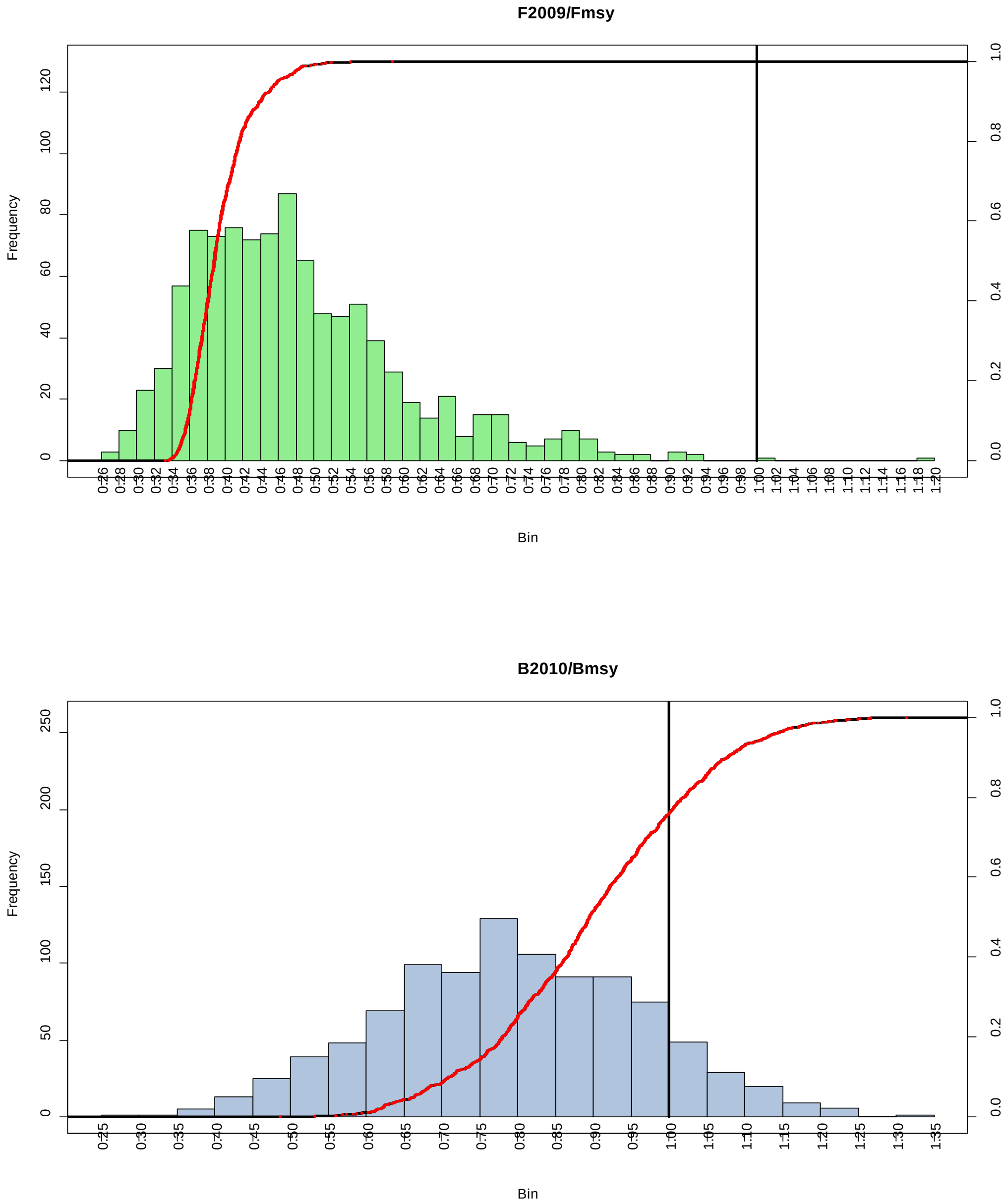


Figure 8.2.5. ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa. Histograms and cumulative frequency distributions of estimated valuesof F2009/Fmsy and B2010/Bmsy by bootstrap (1000 replicates). The black line shows the estimate at reference point of one (Fmsy,Bmsy)

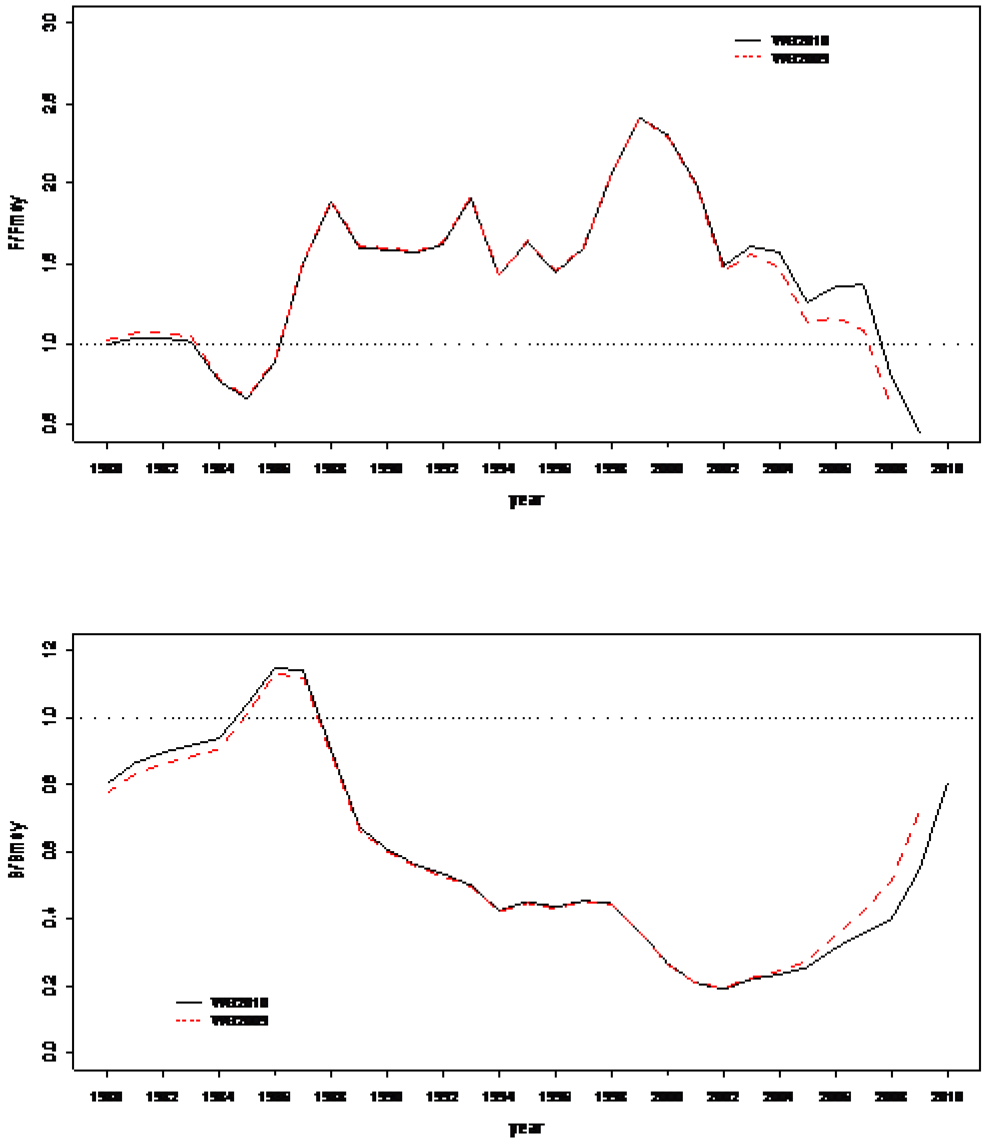


Figure 8.2.6. ANGLERFISH (*L. budegassa*) – Divisions VIIIc and IXa. Trends of the F/FMSY and B/BMSY ratios from the 2009 and 2010 assessments.

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. During the last three years, landings decreased to 3 049 t (2 280 t *L. piscatorius* and 769 t *L. budegassa*) in 2009.

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 75% of the 2009 landings.

The TAC (1 760 t in 2009 and 1496 t in 2010) is set for both species of anglerfish combined. Landings in 2009 were 1.73 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 2002 for the A Coruña fleet and in 2003 for the Portuguese fleets. Both Portuguese trawl fleets show afterwards an increasing trend till 2006 but since then a declined in LPUE was observed, while the data available for the Spanish fleets indicates stability or an increasing trend.

8.3.1 Assessment

Working Group has performed assessments for each species separated (sections 8.1 and 8.2).

8.3.2 Comments on the assessment

In the update of the last assessment, changes in input settings have been made for *L. piscatorius*. These changes led to a significant difference in relation to previous assessments especially at the beginning of the time series and also in the K and B_{MSY} estimates. For *L. budegassa* the correlation coefficient between input fleets is very high but the r square between observed and fitted CPUE values are negative, what is a matter of concern.

8.3.3 Biological Reference Points

The output F_{MSY} from the assessments is propose for a reference point but biomass reference point Btrigger is not possible to define at this point due to the concerns explained in point 8.3.2.

8.3.4 Management considerations

Lophius piscatorius and *L. budegassa* are subject to a common TAC (1 760 t in 2009 and 1 496 t in 2010), so the joint status of these species should be taken into account when formulating management advice. Combined landings in 2009 (3 049 t) were 1.73 times the TAC. Both species of anglerfish are reported together because of their similarity but are assessed separately.

Biomass in 2010 of *L. piscatorius* is estimated to be below B_{MSY} and, despite the decrease in fishing mortality since 2005, F in 2009 is still above F_{MSY}. Fishing mortality equal to zero is not expected to bring the stock back to B_{MSY} before 2015.

Fishing mortality for *L. budegassa* shows a decreasing trend since 1999 and in 2009 is below F_{MSY}. This has led to an increase in biomass but it is still below B_{MSY}. Fishing mortality equal to F *status quo* is expected to bring the stock back to B_{MSY} in 2011.

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 1978-2009 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	0	222	728	
1979	n/a	n/a	n/a	625	0	435	1060	
1980	4008	1477	5485	786	0	654	1440	6926
1981	3909	2240	6149	1040	0	679	1719	7867
1982	2742	3095	5837	1716	0	598	2314	8151
1983	4269	1911	6180	1426	0	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	6125
1991	1993	854	2847	878	533	1545	2956	5803
1992	1668	1068	2736	786	363	1610	2758	5494
1993	1360	959	2319	699	306	1231	2237	4556
1994	1232	1028	2260	629	149	549	1327	3587
1995	1743	677	2420	814	134	297	1245	3665
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	1513	1389	2901	549	77	602	1229	4130
2005	1651	1719	3370	653	60	458	1171	4541
2006	1489	1371	2860	801	68	381	1250	4111
2007	1327	1076	2404	866	78	303	1247	3651
2008	1280	1238	2518	474	51	246	770	3288
2009	1151	1207	2358	386	43	262	691	3049

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	%	Cedeira	%	Portugal Crustacean	%	Portugal Fish	%
1986	564	6	537	6	1423	15						
1987	585	7	545	6	1585	18						
1988	526	5	418	4	2000	20						
1989	333	4	338	4	1241	16			174	2	358	5
1990	317	5	318	5	1038	17			233	4	480	8
1991	297	5	344	6	1047	18			174	3	359	6
1992	232	4	329	6	874	16			118	2	244	4
1993	129	3	329	7	587	13			100	2	206	5
1994	181	5	384	11	412	11			49	1	101	3
1995	333	9	312	9	601	16			44	1	90	2
1996	484	11	359	8	748	16			90	2	175	4
1997	488	9	503	9	709	13			89	2	102	2
1998	377	7	430	8	461	9			81	2	128	3
1999	148	4	249	7	542	14	355	9	44	1	75	2
2000	51	2	119	5	373	14	143	5	68	3	78	3
2001	35	2	82	5	366	20	92	5	68	4	49	3
2002	87	5	73	4	206	11	137	8	65	4	39	2
2003	120	4	100	3	312	10	162	5	43	1	53	2
2004	248	6	129	3	347	8	387	9	35	1	42	1
2005	332	7	66	1	445	10	436	10	24	1	36	1
2006	164	4	107	3	312	8	419	10	31	1	37	1
2007	113	3	123	3	332	9	235	6	47	1	38	1
2008	109	3	n/a	n/a	436	13	228	7	26	1	24	1
2009	74	2	42.9	1	245	8	193	6	23	1	21	1

Fishing effort

	Div. VIIIc						Div. IXa			
Year	[1] Avilés	[1] Santander	[1] A Coruña	A Coruña standardize	Cedeira standardized	Cedeira standardiz	Portugal Crustacean	Portugal Crustacean	[4] Portugal Fish	Portugal Fish
1986	10845	18153	39810							
1987	8309	14995	34680							
1988	9047	16660	42180							
1989	8063	17607	44440				76	23	52	18
1990	8497	20469	44430				90	20	61	17
1991	7681	22391	40440				83	17	57	15
1992	n/a	22833	38910				71	15	49	14
1993	7635	21370	44504				75	13	56	13
1994	9620	22772	39589	4738			41	8	36	10
1995	6146	14046	41452	5298			38	8	41	9
1996	4525	12071	35728	5084			64	14	54	12
1997	5061	11776	35211	4801			43	11	27	9
1998	5929	10646	32563	3668			48	11	35	10
1999	6829	10349	30232	6424	4939	4607	24	8	18	6
2000	4453	8779	30072	5125	3813	3361	42	10	19	6
2001	1838	3053	29923	6103	2221	2226	85	18	19	5
2002	2748	3975	21823	2581	2520	2605	62	10	14	4
2003	2526	3837	18493	2515	2822	2576	42	10	17	6
2004	n/a	3776	21112	5056	5806	5086	21	7	14	4
2005	n/a	1404	20663	5161	3546	4032	20	5	13	4
2006	n/a	2718	19264	3949	4511	4584	22	5	12	4
2007	n/a	4334	21201	n/a	4691	n/a	22	6	8	3
2008	n/a	n/a	20212	n/a	5285	n/a	14	4	5	2
2009	n/a	1125	16163	n/a	2324	n/a	15	n/a	6	n/a

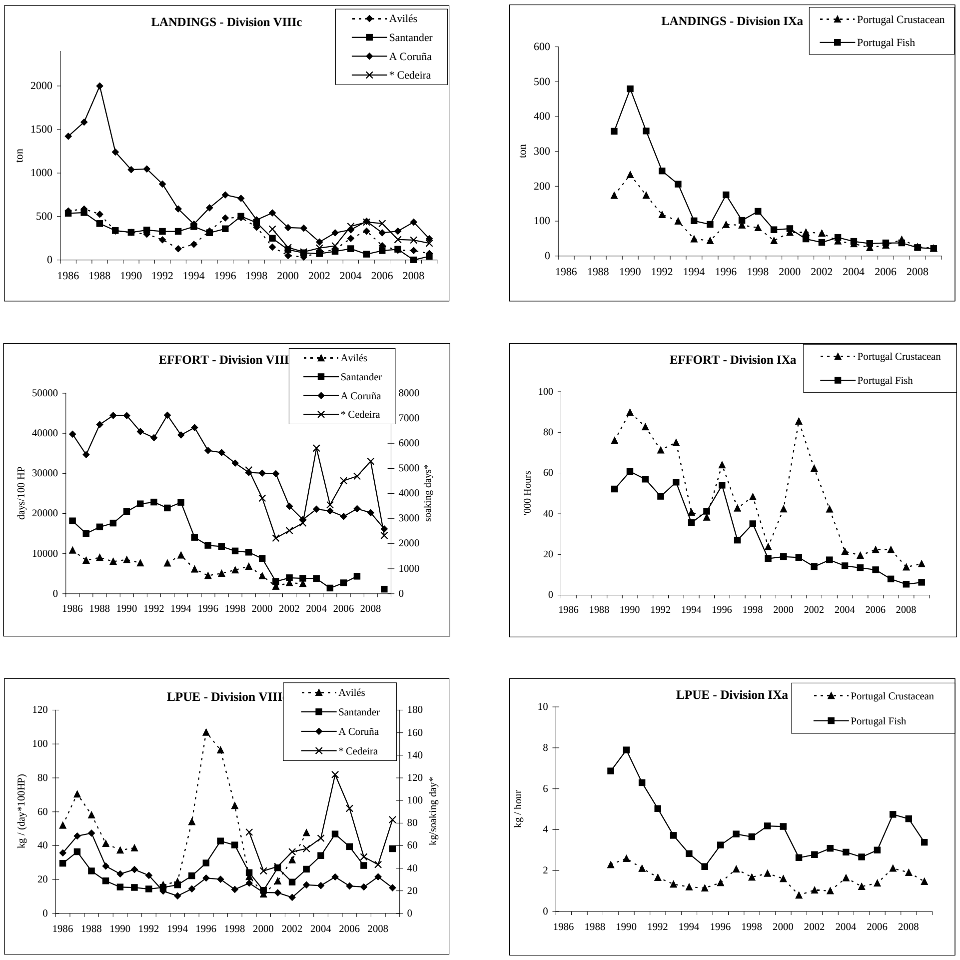


Figure 8.3.1 ANGLERFISH (*L. budegassa and L. piscatorius*) - Divisions VIIIc and IXa.
Trawl and gillnet landings, effort and LPUE data between 1986-2009.

9 Megrims in Divisions VIIIc and IXa

L. whiffiagonis:

Type of assessment in 2010: update (advice for this stock was last given in 2009)

Software used: Lowestoft suite for XSA assessment, MFDP and MFYPR for short term deterministic projections and equilibrium per recruit analysis.

Data revisions this year: Landings and length distributions for year 2008 Spanish data. Portuguese trawl 2007 and 2008 effort and LPUE values.

Review Group issues for *L.whiffiagonis*: Following recommendations from RG in 2009, the following actions were taken:

1. An explanation about the exclusion of age 1 of commercial fleets used for tuning the XSA, has been added in the text for data input.
2. A stock annex will be presented next year for this stock.

L. boscii:

Type of assessment in 2010: update (advice for this stock was last given in 2009)

Software used: Lowestoft suite for XSA assessment, MFDP and MFYPR for short term deterministic projections and equilibrium per recruit analysis.

Data revisions this year: Landings and length distributions for year 2008 Spanish data. Portuguese trawl 2007 and 2008 effort and LPUE values.

Review Group issues for *L. Boscii*: According RG in 2009 recommendations, next issues were made:

1. An annotation about the exclusion of 2003 data of the SP-GFS used as input in the assessment has been added in figure 9.2.6.
2. A stock annex will be presented next year for this stock.

Review Group general issues affecting both species:

Following recommendations from RG in 2009, the following actions were taken:

Tables with discards estimates and biological parameters, previously included in the text, have been moved to proper tables.

The section on ecosystem aspects has been reduced and simplified.

Descriptions of surveys have been removed from the fishery description.

General

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. The region is characterized by a large number of commercial and non-commercial fish species caught for human consumption.

The genus *Lepidorhombus* is represented in eastern Atlantic waters by two species, Megrim (*L. whiffiagonis*) and four-spot megrim (*L. boscii*). Megrim (*L. whiffiagonis*) is distributed in shallow waters of 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) (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. whiffiagoni*s of 50 to 300 m (Sanchez et al, 1998). 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). 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).

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, 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 decrease to 12 years in Divisions VIIIc and IXa (BIOSDEF, 1998; Landa et. al, 2000). The maximum age for four-spot in Divisions VIIIc and IXa is 11 years (Landa et al, 2002, Landa, pers. com.).

Fishery description

Management of megrim is both by TAC and technical measures. The minimum mesh size for towed gears ranges between 40 and 90 mm, depending on catch species composition. Minimum landing size is 20 cm.

Two species of megrim are included in the landings from ICES Divisions VIIIc and IXa: megrim and four-spot megrim. 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.

Total estimated international landings for both species combined in 2009 were 1218 t, which is below the TAC (1430 t). No landings data are available for these stocks before 1986, although some Spanish harbours have longer landings series. Total 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 (see Figure 9.1.1). There has been some increase in landings since that year.

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 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. This gear, named High Vertical Opening (HVO) 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 HVO (for which around 77% of the total catch is horse mackerel) that do not catch megrim has reduced the effort on these species in recent years.

The *Prestige* oil spill in the northwest Spanish coast (November 2002) prompted a re-distribution 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.

Atlantic mackerel, anglerfish, blue whiting, horse mackerel, hake, different cephalopods and *Nephrops* account for a high percentage (around 70%) of all retained species in this multispecies trawl fishery. A great number of species are caught as by-catch. Discards are important, particularly for younger ages of both megrim species. Around 30-60% of the individuals caught are discarded by trawlers. 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.

Summary of ICES advice for 2010 and management for 2009 and 2010

ICES advice for 2010 (as extracted from ICES Advice 2009, Book 7):

In the absence of defined precautionary reference points, the state of the two stocks cannot be evaluated with regard to these. SSB of both species has decreased since the late 1980s. However, SSB for L. boscii shows a slightly upwards trend after reaching a minimum in 2001. For both species fishing mortality has decreased since the late 1990s. Recent recruitment for L. boscii has been below average. For L. whiffiagonis recruitment has been low in the last decade There are no explicit management objectives for these stocks. ICES advises on the basis of exploitation boundaries in relation to high-long term yield and low risk of depletion of the production potential that combined catches of L. whiffiagonis and L. boscii should not exceed 900 t.

Management applicable for 2009 and 2010:

The agreed combined TAC for megrim and four-spot megrim in ICES Divisions VIIIc and IXa was 1430 t in 2009 and 1287 t in 2010.

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

9.1.1 General

See general section for both species.

9.1.2 Data

9.1.2.1 Commercial catches and discards

Working Group estimates of landings for the period 1986 to 2009 are given in Table 9.1.1(a). The total estimated international landings in Divisions VIIIc and IXa for 2009 was 84 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 2009 represent the lowest value of the entire series.

Discards data are available for Spanish trawlers in the years displayed in Table 9.1.1(b). Annual discards of megrim are estimated to be around 5 t to 70 t along the whole series. Discards in number represent between 15-45% 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 showed in the previously mentioned table.

9.1.2.2 Biological sampling

Annual length compositions of total landings are displayed in Figure 9.1.2 for the period 1986 – 2009. Length distributions were available for 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. There has been a strong decrease in landings of fish under 15 cm in length since 1994 and under 20 cm in recent years. This change probably results from stricter enforcement of the minimum landing size (20 cm) and a mesh size increase. The bulk of the landings in numbers in recent years corresponds to fish of 20-30 cm in length. Table 9.1.2(a) shows the total length distribution by ICES division for 2009. Figure 9.1.2 indicates that the length distribution of landings in 2009 presents a decrease in number in sizes between 22 and 28 cm compared to previous years.

Sampling levels for both species are given in Table 1.3.

Mean lengths and mean weights in landings since 1990 are shown in Table 9.1.2(b). The mean length and mean weight values in 2009 are the highest in the historic series.

Age compositions of landings (Table 9.1.3) are based on annual Spanish ALKs for 1990 - 2009, whereas a survey ALK from 1986 combined with an annual ALK from 1990 was applied to years 1986-1989. Catch weights-at-age of landings (Table 9.1.4) were also used as the weights-at-age in the stock. The following parameter values were used in the length-weight relationship: a=0.006488 and b=3.0114.

Natural mortality was set to 0.2 and assumed constant over all ages and years, as previously. This is the same value used for *L. whiffiagonis* in Subareas VII and Divisions VIIIab. The sex combined maturity ogive (BIOSDEF, 1998) was the same used in previous assessments, and is as follows:

Age	0	1	2	3 and older
Prop. mature	0	0.34	0.90	1.00

9.1.2.3 Abundance indices from surveys

Two Portuguese (P-GFS-oct, also called "October" survey, and P-CTS, also called "Crustacean" survey) and one Spanish (SP-GFS) survey indices are summarised in Table 9.1.5.

Portuguese surveys indicate low abundance and recruitment indices for the whole period except for the initial year of the Crustacean survey (1997). 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. Indices from these surveys are not considered to be representative of megrim abundance, due to the very low catch rates.

The Spanish survey (SP-GFS) 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 (Figure 9.1.3(a), bottom right panel). The abundance index in 2009 is the lowest in the series and the biomass index is the second lowest.

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 recruitment 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.

Catch numbers-at-age per unit effort and effort values for the Spanish survey are given in Table 9.1.6. 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 reasonably good at tracking cohorts through time and highlights the weakness of the last few cohorts.

9.1.2.4 Commercial catch-effort data

Fishing effort and LPUE data were available for the period 1986 - 2009 for one fleet of Spanish trawlers from A Coruña (SP-CORUTR8c) fishing in Division VIIIc, and for Portuguese trawlers fishing in Division IXa for the period 1988 – 2009 (Table 9.1.7 and Figure 9.1.3(a)). Effort from the Portuguese fleet is estimated from a sample of logbooks from sea trips where megrim occurred in the catch. No 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. A local minimum was reached in 2003, in which restrictions imposed on fishing activity due to the Prestige oil spill had an influence on effort. The 2009 effort value is the lowest in the series. A Coruña LPUE (SP-CORUTR8c) shows relatively high stable values for 1986 – 1992. Since 1998 LPUE has declined.

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 9.1.6.

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 9.1.7 and Figure 9.1.3(a)).. Portuguese 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.

9.1.3 Assessment

An update assessment was conducted, using the same settings and specifications as in last year.

9.1.3.1 Input data

The age range considered in the assessment was 1 to 7+. Due to the low and fluctuating catches of age 0, data from this age were not included, though they are presented in Table 9.1.3. Landed numbers-at-age and effort data for two commercial Spanish fleets, A Coruña (SP-CORUTR8c) for the period 1990 – 2009 and Avilés (SP-AVILESTR) for 1990-2003, and the indices from the Spanish survey (SP-GFS) in Divisions VIIIc and IXa (1990-2009) were used for tuning (see Table 9.1.6). Age 1 indices from the commercial fleets were not used for tuning.

9.1.3.2 Model

Data screening

The top panel of Figure 9.1.4 shows catch 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.

Visual inspection of Figures 9.1.3(b) and 9.1.3(c) indicates that all series are good up to age 5 in relation to the internal consistency of each abundance at age data series. 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 indices.

Final run

Settings used for this year are the same used last year and are detailed below:

		2009 WG		2010 WG	
Fleets	SP-CORUTR8c	90-08	2-6	90-09	2-6
	SP-AVILESTR	90-03	2-6	90-03	2-6
	SP-GFS survey	90-08	1-6	90-09	1-6
Taper			No		No
Tuning range			19		20
Ages catch dep. Stock size			1-4		1-4
q plateau			5		5
F shrinkage s.e.			1.5		1.5
year range			5		5
age range			3		3

The retrospective analysis shows trends 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, with results varying appreciably depending on the number of iterations used. The diagnostics (and all subsequent calculations) presented in this report correspond to a run of 200 iterations performed with the Lowestoft suite and were stable in the sense that increasing the number of iterations no longer altered them.

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 (with the exception of those corresponding to 2008 and 2009). Almost all residuals are negative in 2009 for the two tuning indices. 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, after the local peak reached in 2006, which may be explained by the relatively high landings in that year. The SSB values in 2007-2009 are the three lowest in the series. Recruitment in 2009 is the second lowest in the series, after that of 1994.

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 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.

9.1.3.4 Year class strength and recruitment estimations

The 2007 year class is estimated to have 1.8 million individuals at 1 year of age based on the information from the Spanish survey (SP-GFS) (55% of weight) and one commercial fleet (SP-CORUTR8c) (23% of weight). P-shrinkage and F-shrinkage contributed 20% and 2% of the weight, respectively. The estimate from the update run in the 2009 Working Group was 1.7 million at one year of age.

The 2008 year class is estimated to have 1.6 million fish at 1 year of age, based on the Spanish survey (SP-GFS) (65% of weight), P-shrinkage (29% of the weight) and F shrinkage (5%).

In accordance with the procedure agreed at the 2009 WG, GM is computed over years 1998-2007, as it is felt to be more realistic for conducting short term forecasts. 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
2006	3015	XSA	41%	43%	16%
2007	1787	XSA	55%	23%	22%
2008	1587	XSA	65%		35%
2009	2729	GM $_{(98-07)}$			

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 2658 t in 1990 to 968 t in 1995. From 1996 to 2003, it remained relatively stable at low levels with an average value of around 1200 t. Starting from 2004, SSB is estimated to have been even lower, below 1000 t in every year. The values for 2004-2009 are the lowest in the series, with SSB in 2008 and 2009 (both 728 t) corresponding to the lowest value.

F has declined in recent years from the high levels observed prior to 1995 (Fbar, for ages 2-4, in the range of 0.29-0.44 before 1995) and the high value reached in 1998 (0.36).. Fbar increased every year between 2003 and 2006 (Fbar=0.34 in 2006), but has decreased in 2007 (Fbar=0.26) and 2008 (Fbar=0.21), reaching in 2009 the lowest value of the series with 0.10.

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.

9.1.3.6 Catch Options and prognosis

Population numbers for the catch forecast were taken from the final XSA outputs. Stock size at age 1 in the years 2009 to 2011 was assumed to be GM_{98-07} (2.7 million). The exploitation pattern used was the unscaled average of 2007-2009 (corresponding to Fbar = 0.19, F *status quo*). Mean weights in the catch and in the stock were computed as averages over 2007-2009.

9.1.3.7 Short-term projections

The input data for deterministic short-term predictions are shown in Table 9.1.13. 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 2010-2012 is given in Table 9.1.15.

Under *status quo* F, landings in 2010 and 2011 are predicted to be 143 t and 149 t respectively. SSB would increase from the 781 t estimated for 2010 to 840 t in 2011 and 909 t in 2021. Despite these increases, SSB in 2012 would still be below all values estimated for SSB up until 2003.

The contributions of recent year classes to the predicted landings in 2011 and SSB in 2012, assuming GM_{98-07} recruitment, are presented in Table 9.1.16. The assumed GM_{98-07} age 1 recruitment in 2010 and 2011 contributes 14% to landings in 2011 and 41% to the predicted SSB at the beginning of 2012. Megrim starts to contribute strongly to SSB at 2 years of age.

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 s*tatus quo* exploitation (Fbar = 0.19), and assuming GM_{98-07} for recruitment, the equilibrium yield would be around 197 t with an SSB of 1100 t. Fishing at $F_{0.1}$ (= 0.14) leads to an equilibrium yield of 185 t <u>and</u> an SSB of 1310 t. F_{max} is not well defined for this stock.

It should be taken into account that natural mortality (0.2) is similar to the value of *status quo* F and this has an effect on the yield and SSB per recruit results.

9.1.4 Biological reference points

The stock-recruitment series is plotted in Figure 9.1.9(a). 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.

The table below shows a summary of the reference points proposed in the past. In 2000, there was a re-evaluation of historical data, but reference points were not well defined.

	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

Possible Reference Points for the MSY Approach to advice:

Possible proxies to be considered for Fmsy are in the range of Fmax, F0.1 and F35percent. Fmax is not well defined for this stock, as the yield-per-recruit curve generally shows a very flat top. The following table shows the values estimated for these 3 possible proxies in the last 6 WGs:

	WG2005	WG2006	WG2007	WG2008	WG2009	WG2010
FMax	0.35	0.36	0.38	0.39	0.37	0.32
F0.1	0.15	0.16	0.16	0.18	0.17	0.14
F35percent	0.21	0.22	0.22	0.23	0.22	0.21

There has been some variability in these values throughout the years, with a non-negligible decrease in Fmax and F0.1 this year. The assessment of this stock and yield-per-recruit calculation ignore the fact that discards exist, hence, Fmax and F0.1 are likely to be overestimated. A rough sensitivity exercise was conducted in this WG, whereby yield-per-recruit was computed based on landings assuming the following proportion of individuals landed at age: (0.1,0.4,0.8,1,1,1,1) for ages 1 to 7+, respectively, and dividing the exploitation pattern-at-age by these proportions, thus increasing the fishing mortality of the younger ages. The following table compares the results obtained from the original analysis (ignoring discards, left side of the table) and from the sensitivity exercise (with the 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
F35percent	0.21	0.07	0.38	0.19	0.05	0.38
F40percent	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, F35percent and F40percent values are affected to a much lesser extent.

Additionally, Figure 9.1.9(b) displays the estimated SSB and recruitment from XSA together with the replacement lines corresponding to Fmax, F0.1, F35percent and F40percent from the original analysis. Focusing mostly on the SSB and recruitment values of the last 15 years, the slope of the Fmax replacement line appears to be too high, whereas F35percent, F40percent and F0.1 lead to replacement lines that cross the cloud of observed points.

At this stage, F40percent=0.17 is proposed as an Fmsy proxy. This proposal should be considered as preliminary and may be revised as further work continues on this assessment.

9.1.5 Comments on the 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 15-45% 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 in order to get a larger number of years which could then be included in the assessment.

The behaviour of commercial fleets with regards to landings of age 1 individuals appears to have changed in time. Hence, data from commercial fleets used for tuning is only taken for ages 2 and older. However, the Spanish survey (SP-GFS) 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 low levels since 1991, with a slow but gradually declining trend since 1997. The last six years (2004-2009) correspond to the lowest SSB estimates. Both high and low recruitments have been observed during the period of low SSB (recruitments since 1992), although all recruitments since 1998 have been low. The 2009 recruitment estimate is the second lowest in the series.

Megrim starts to contribute strongly to SSB at 2 years of age. Around 40% of the predicted SSB in 2012 relies on year classes for which recruitment has been assumed to be GM_{98-07}.

Recent F is estimated to be similar to the assumed natural mortality, which should be kept in mind when interpreting yield per recruit results.

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(a) 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

* Data revised in WG2010 from original value presented

Table. 9.1.1(b) Megrim (*L. whiffiagonis*) in Divisions VIIIc, IXa. Discard/Total Catch ratio and estimated CV for Spanish trawlers

Year	1994	1997	1999	2000	2001	2003	2004	2005	2006	2007	2008*	2009
Weight Ratio	0.06	0.17	0.17	0.13	0.01	0.11	0.07	0.14	0.08	0.004	0.06	0.13
CV	50.2	24	21.9	41.4	57.6	19.6	27.3	48.2	29	46.8	58.4	53.7
Number Ratio	0.42	0.38	0.42	0.45		0.26	0.16	0.3	0.21	0.02	0.16	0.36

* Modified in WG2010 due to revision in landings data

Table 9.1.2 Megrim (*L. whiffiagonis*) Divisions VIIIc and IXa.
Annual length compositions of landings (´000 fish) in 2009

Length (cm)	Div. VIIIc	Div. IXa	Total
10			
11			
12			
13			
14			
15			
16			
17	0.9	0.1	0.9
18			
19	2.4	0.2	2.6
20	9.8	0.9	10.7
21	15.4	2.0	17.4
22	21.0	2.0	23.1
23	49.4	4.6	54.0
24	41.8	6.1	47.9
25	34.7	4.6	39.2
26	34.3	3.8	38.1
27	36.7	3.7	40.4
28	34.5	4.1	38.7
29	40.9	5.5	46.4
30	36.1	5.4	41.5
31	20.6	3.3	23.9
32	13.9	3.1	17.0
33	15.1	1.7	16.7
34	9.1	1.2	10.2
35	11.9	1.3	13.2
36	8.5	0.8	9.3
37	4.4	0.4	4.8
38	3.6	0.5	4.1
39	2.4	0.2	2.7
40	5.0	0.5	5.5
41	1.1	0.1	1.2
42	0.7	0.1	0.8
43	1.0	0.1	1.1
44	0.7	0.1	0.7
45	1.2	0.1	1.3
46	0.5	0.0	0.6
47	0.1	0.0	0.1
48	0.2	0.0	0.2
49	0.3	0.0	0.3
50+			
Total	458	56	515

Table 9.1.2 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
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
Mean weight (g)	105	108	129	108	124	121	120	118	119	127	134	124	137	134	137	127	137	148	147	163

Table 9.1.3 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Catch numbers at age.

Catch numbers at age Numbers*10**-3

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	*2008	2009
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)
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
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
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
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
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
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
+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
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
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
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

(*) Age 0 was not used in the assessment.

* Data revised in WG2010 from original value presented

Table 9.1.4 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Catch weights at age (kg).

Mean weight at age

YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	*2008	2009
AGE																								
1	0.045	0.049	0.045	0.051	0.041	0.039	0.034	0.036	0.046	0.060	0.054	0.056	0.046	0.056	0.056	0.058	0.058	0.056	0.062	0.061	0.063	0.065	0.059	0.065
2	0.102	0.084	0.090	0.102	0.098	0.091	0.095	0.080	0.069	0.071	0.088	0.083	0.070	0.070	0.072	0.085	0.082	0.089	0.085	0.080	0.092	0.088	0.092	0.091
3	0.121	0.092	0.103	0.122	0.129	0.108	0.125	0.117	0.100	0.102	0.121	0.102	0.099	0.089	0.094	0.088	0.115	0.116	0.109	0.111	0.123	0.110	0.119	0.135
4	0.164	0.143	0.150	0.164	0.166	0.146	0.155	0.147	0.130	0.127	0.128	0.126	0.130	0.119	0.121	0.118	0.119	0.150	0.130	0.143	0.159	0.144	0.147	0.160
5	0.216	0.176	0.191	0.224	0.207	0.173	0.209	0.195	0.150	0.165	0.164	0.141	0.155	0.160	0.161	0.148	0.162	0.194	0.157	0.165	0.182	0.197	0.188	0.188
6	0.316	0.314	0.290	0.293	0.241	0.252	0.321	0.237	0.190	0.212	0.211	0.199	0.189	0.216	0.215	0.172	0.206	0.252	0.204	0.199	0.228	0.236	0.247	0.249
+gp	0.477	0.415	0.424	0.520	0.369	0.420	0.534	0.538	0.344	0.340	0.354	0.341	0.324	0.296	0.296	0.256	0.388	0.382	0.320	0.380	0.393	0.366	0.409	0.408
SOPCOFAC	0.949	0.950	0.949	0.994	0.986	1.002	1.000	1.003	1.001	1.006	1.020	0.998	1.008	1.007	1.010	1.007	1.001	1.0059	1.0018	0.9837	0.9999	0.9991	0.9996	1.0009

* Data revised in WG2010 from original value presented

Table 9.1.5 Megrim (*L. whiffiagonis*) Divisions VIIIc, IXa.

Abundance and Recruitment indices from Portuguese and Spanish surveys.

Biomass Index

	Portugal (k/h)			Spain (k/30 min)	
	October	Crustaceans	s.e	Mean	s.e.
1983				0.96	0.14
1984				1.92	0.34
1985				0.89	0.15
1986				1.65	0.20
1987				ns	
1988				3.52	0.64
1989				3.13	0.53
1990	0.08			3.08	0.86
1991	0.11			1.22	0.17
1992	0.11			1.39	0.20
1993	0.04			1.46	0.24
1994	0.05			1.02	0.20
1995	0.01			1.03	0.16
A,1996	+			1.64	0.22
1997	+	1.41	1.04	1.79	0.25
1998	0.01	0.20	0.09	1.47	0.23
A,B,1999	+	0.11	0.11	1.59	0.29
2000	+	0.06	0.05	1.80	0.35
2001	0	0.04	0.03	1.45	0.28
2002	0.04	0.07	0.04	1.26	0.24
A,2003	0.01	0.07	0.05	0.82	0.16
A,2004	0.01	ns		1.08	0.20
2005	0.01	0.37	0.20	1.29	0.21
2006	0.02	0.29	0.18	1.03	0.18
2007	0.00	0.15	0.09	1.13	0.24
2008	0.00	0.25	0.11	0.68	0.15
2009	0.00	0.03	0.01	0.80	0.12

Abundance index

	Portugal (n/h)		Spain (n/30 min)	
	Crustaceans	s.e.	Mean	s.e.
1983			14.00	2.45
1984			28.00	4.57
1985			9.00	1.34
1986			33.00	6.22
1987			ns	
1988			43.00	8.82
1989			42.00	7.04
1990			28.00	5.50
1991			10.00	1.67
1992			18.00	3.35
1993			15.00	3.23
1994			8.00	1.87
1995			11.00	1.86
A,1996			21.00	3.60
1997	7.22	4.82	20.00	3.26
1998	1.09	0.51	14.80	2.64
A,B,1999	0.57	0.53	15.50	3.05
2000	0.27	0.17	19.40	4.46
2001	0.07	0.04	12.80	2.77
2002	0.21	0.10	12.10	2.65
A,2003	0.16	0.08	7.20	1.26
A,2004	ns		8.44	1.39
2005	0.71	0.35	9.76	1.73
2006	0.43	0.24	6.38	1.16
2007	0.49	0.37	6.87	1.52
2008	1.49	0.71	4.33	1.07
2009	0.10	0.05	4.17	0.59

Recruitment index

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

+	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)

Table 9.1.6 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Tuning data.

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

1986	2009								
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

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: SP-GFS (n/30 min)

1988	2009								
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

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

Table 9.1.7 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	na		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	na		3.4	35.4	0.10
2005	18	20.7	0.88	35	na		19.0	42.6	0.45
2006	18	19.3	0.94	29	na		26.3	40.3	0.65
2007**	23	21.2	1.10	12	na		10.5	43.8	0.24
2008**	17	20.2	0.82	11	na		14.4	38.4	0.37
2009	12	16.2	0.76	12	na		6.0	49.3	0.12

[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

22/04/2010 10:12

Extended Survivors Analysis

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

CPUE data from file fleetw.txt

Catch data for 24 years. 1986 to 2009. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-CORUTR8c	1990	2009	2	6	0	1
SP-AVILESTR	1990	2009	2	6	0	1
SP-GFS	1990	2009	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 200 iterations

Total absolute residual between iterations
199 and 200 = .00408

Final year F values

Age	1	2	3	4	5	6
Iteration **	0.0197	0.0709	0.0981	0.1253	0.2254	0.2558
Iteration **	0.0197	0.0707	0.098	0.1249	0.2239	0.254

Regression weights

	1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.003	0.015	0.014	0.053	0.018	0.062	0.045	0.029	0.004	0.02
2	0.088	0.144	0.071	0.142	0.129	0.108	0.306	0.105	0.14	0.071
3	0.321	0.323	0.214	0.172	0.172	0.336	0.361	0.278	0.19	0.098
4	0.329	0.209	0.143	0.18	0.235	0.198	0.36	0.412	0.287	0.125
5	0.343	0.232	0.212	0.193	0.291	0.228	0.334	0.361	0.428	0.224
6	0.175	0.25	0.123	0.1	0.392	0.215	0.246	0.262	0.255	0.254

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
2000	3.08E+03	1.60E+03	2.41E+03	2.00E+03	1.37E+03	5.72E+02
2001	3.01E+03	2.51E+03	1.20E+03	1.43E+03	1.18E+03	7.98E+02
2002	2.50E+03	2.43E+03	1.78E+03	7.11E+02	9.48E+02	7.63E+02
2003	2.77E+03	2.01E+03	1.85E+03	1.18E+03	5.05E+02	6.28E+02
2004	2.88E+03	2.15E+03	1.43E+03	1.28E+03	8.04E+02	3.41E+02
2005	2.28E+03	2.32E+03	1.55E+03	9.86E+02	8.25E+02	4.92E+02
2006	2.29E+03	1.75E+03	1.70E+03	9.06E+02	6.62E+02	5.38E+02
2007	3.02E+03	1.79E+03	1.06E+03	9.71E+02	5.17E+02	3.88E+02
2008	1.79E+03	2.40E+03	1.32E+03	6.55E+02	5.27E+02	2.95E+02
2009	1.59E+03	1.46E+03	1.71E+03	8.94E+02	4.02E+02	2.81E+02

Estimated population abundance at 1st Jan 2010

0.00E+00	1.28E+03	1.11E+03	1.27E+03	6.48E+02	2.65E+02

Taper weighted geometric mean of the VPA populations:

4.24E+03	3.41E+03	2.33E+03	1.49E+03	8.81E+02	4.53E+02

Standard error of the weighted Log(VPA populations) :

0.7149	0.6403	0.5111	0.4684	0.3945	0.4155

Log catchability residuals.

Fleet : SP-CORUTR8c

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	0.39	0.79	0.28	-0.16	-1.1	-0.13	0.31	-0.24	-0.58	-0.61
3	0.06	-0.1	0.45	-0.1	-0.08	-0.3	-0.62	-0.08	-0.24	-0.06
4	0.15	0.1	0.47	0.15	0.12	-0.23	-0.21	-0.08	-0.09	-0.25
5	0.37	0.9	1.33	0.38	0.8	-0.37	0.25	0.06	0.39	0.15
6	0.28	0.21	0.08	-0.04	1.18	-0.67	0.3	0.83	1.46	1.11

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	No data for this fleet at this age									
2	-0.18	0.27	-0.13	0.34	-0.24	-0.24	0.35	0.26	0.12	0.48
3	0.23	0.43	0.48	-0.17	-0.35	0.19	0	0.31	0.05	-0.11
4	0.04	-0.1	0.16	-0.09	-0.27	-0.24	0.04	0.19	0.26	-0.14
5	0.24	-0.37	-0.03	-0.46	-0.64	-0.98	-0.76	-0.33	-0.29	-0.65
6	-0.33	-0.18	-0.5	-0.92	-0.03	-0.95	-0.93	-0.61	-0.88	-0.68

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	-5.6282	-5.6282
S.E(Log q)	0.6011	0.7513

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	0.73	1.539	7.53	0.64	20	0.46	-7.36
3	0.71	2.171	6.91	0.76	20	0.29	-6.61
4	0.53	4.622	6.64	0.84	20	0.21	-6.12

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	0.56	2.378	6.1	0.62	20	0.3	-5.63
6	1.19	-0.399	5.62	0.19	20	0.91	-5.69

Fleet : SP-AVILESTR

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	No data for this fleet at this age									
2	-0.07	0.08	99.99	-0.19	0.09	-0.61	-0.07	0	-0.14	-0.15
3	-0.21	-0.31	99.99	-0.65	0.14	-0.75	-0.41	0.3	0.07	0.22
4	-0.09	-0.4	99.99	-0.75	0.26	-0.19	0.03	-0.12	0.37	0.28
5	-0.74	-0.15	99.99	-1.26	0.59	-0.02	0.71	0.55	0.53	0.41
6	-0.79	-1.17	99.99	-1.07	0.36	-0.02	0.81	1.21	1.16	1.21

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	No data for this fleet at this age									
2	0.22	0.44	0.22	0.2	99.99	99.99	99.99	99.99	99.99	99.99
3	0.21	0.97	0.47	-0.04	99.99	99.99	99.99	99.99	99.99	99.99
4	0.27	0.31	0.19	-0.17	99.99	99.99	99.99	99.99	99.99	99.99
5	-0.02	0.16	-0.19	-0.59	99.99	99.99	99.99	99.99	99.99	99.99
6	-0.63	0.24	-0.56	-1.11	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	-4.4014	-4.4014
S.E(Log q)	0.5906	0.9214

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	4.965	6.92	0.86	13	0.27	-5.06
3	0.61	1.479	6	0.56	13	0.49	-4.83
4	0.81	0.862	5.25	0.65	13	0.34	-4.75

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	0.89	0.248	4.68	0.3	13	0.55	-4.4
6	4.85	-1.593	-2.23	0.02	13	4.21	-4.43
1							

Fleet : SP-GFS

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	-0.27	-0.4	-0.1	0.03	-0.9	-0.21	0.06	-0.06	0	0.33
2	0.08	-0.28	-0.49	0.06	-0.81	-0.58	-0.03	0.06	-0.11	0.35
3	0.05	-0.75	-0.37	-0.88	0.26	-1.05	-0.87	0.02	0.2	0.41
4	0.28	-0.14	0	-0.07	0.05	-0.26	-0.33	-0.14	-0.15	-0.1
5	0.22	-0.05	0.26	-0.26	0.15	-0.06	-0.14	0	0.05	0.14
6	0.16	-0.84	-0.87	-0.97	-0.05	-0.52	0.07	0.11	1.15	1.48

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.77	0.14	0.46	0.22	0.15	0.5	0.02	0.12	-0.45	-0.4
2	0.65	0.64	0.39	0.09	0.22	0	0.3	-0.09	-0.04	-0.4
3	0.37	0.26	0.84	0.06	0.1	0.53	0.22	0.45	0.14	0.01
4	0.31	0.28	-0.31	-0.07	-0.02	0.28	0.05	0.32	0.04	0
5	0.23	-0.01	0.06	-0.3	-0.26	0.34	0.06	0.07	-0.18	-0.32
6	-0.15	-0.56	-0.79	-1.29	0.48	-0.12	-0.17	-0.15	-0.78	-0.22

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	-6.2632	-6.2632
S.E(Log q)	0.195	0.7181

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	0.52	3.446	7.71	0.74	20	0.39	-7.29
2	0.66	2.239	7.28	0.71	20	0.39	-6.92
3	0.89	0.467	6.87	0.49	20	0.53	-6.77
4	0.75	2.418	6.67	0.84	20	0.21	-6.49

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	0.82	1.941	6.34	0.87	20	0.15	-6.26
6	1.93	-1.363	6.82	0.11	20	1.3	-6.46
1							

Terminal year survivor and F summaries :

Age 1 Catchability dependent on age and year class strength

Year class = 2008

Fleet	E S	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
SP-GFS□	853	0.426	0	0	1	0.652	0.029
P shrinkage mea	3410	0.64				0.294	0.007
F shrinkage mea	787	1.5				0.054	0.032

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1276	0.34	0.53	3	1.541	0.02

1

Age 2 Catchability dependent on age and year class strength

Year class = 2007

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	1791	0.47	0	0	1	0.225	0.044
SP-AVILESTR	1	0	0	0	0	0	0
SP-GFS□	724	0.3	0.025	0.08	2	0.548	0.107
P shrinkage mea	2326	0.51				0.203	0.034
F shrinkage mea	475	1.5				0.024	0.158

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1114	0.22	0.28	5	1.238	0.071

Age 3 Catchability dependent on age and year class strength

Year class = 2006

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	1211	0.254	0.102	0.4	2	0.434	0.102
SP-AVILESTR	1	0	0	0	0	0	0
SP-GFS□	1308	0.253	0.049	0.2	3	0.406	0.095
P shrinkage mea	1486	0.47				0.146	0.084
F shrinkage mea	422	1.5				0.014	0.269

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1268	0.17	0.07	7	0.415	0.098

Age 4 Catchability dependent on age and year class strength

Year class = 2005

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	616	0.166	0.094	0.56	3	0.454	0.131
SP-AVILESTR	1	0	0	0	0	0	0
SP-GFS□	646	0.168	0.03	0.18	4	0.44	0.125
P shrinkage mea	881	0.39				0.099	0.093
F shrinkage mea	245	1.5				0.007	0.3

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
648	0.11	0.06	9	0.512	0.125

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

Year class = 2004

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	318	0.162	0.161	0.99	4	0.362	0.189
SP-AVILESTR	1	0	0	0	0	0	0
SP-GFS□	240	0.134	0.133	1	5	0.63	0.244
F shrinkage mea	169	1.5				0.007	0.331

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
265	0.1	0.1	10	0.983	0.224

1
Age 6 Catchability constant w.r.t. time and age (fixed at the value for age) 5

Year class = 2003

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	178	0.164	0.139	0.85	5	0.352	0.255
SP-AVILESTR	1	0	0	0	0	0	0
SP-GFS□	179	0.132	0.102	0.77	6	0.636	0.253
F shrinkage mea	320	1.5				0.011	0.15

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
180	0.1	0.08	12	0.738	0.254

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 22/04/2010 10:14

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR		1986	1987	1988	1989
AGE					
	1	0.1289	0.2018	0.3562	0.0923
	2	0.3259	0.4811	0.6017	0.4067
	3	0.2436	0.2	0.4157	0.2286
	4	0.4444	0.2215	0.3084	0.4824
	5	0.786	0.3698	0.5233	0.356
	6	0.4952	0.2652	0.4189	0.3582
+gp		0.4952	0.2652	0.4189	0.3582
FBAR 2- 4		0.338	0.3009	0.4419	0.3725

Table 8 Fishing mortality (F) at age

YEAR		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE											
	1	0.4827	0.2683	0.1213	0.1455	0.035	0.0672	0.0274	0.014	0.0215	0.0112
	2	0.403	0.5471	0.1564	0.291	0.1734	0.04	0.285	0.201	0.2054	0.0864
	3	0.2871	0.258	0.2957	0.1798	0.5659	0.1462	0.0525	0.3203	0.3689	0.3613
	4	0.5135	0.4489	0.6987	0.3954	0.5503	0.3902	0.2372	0.1454	0.5139	0.376
	5	0.5022	0.9345	0.8985	0.5003	1.2128	0.4999	0.6386	0.5519	0.7728	0.5304
	6	0.4975	0.4177	0.2563	0.3666	1.3207	0.3844	0.6601	1.0885	1.6881	1.1996
+gp		0.4975	0.4177	0.2563	0.3666	1.3207	0.3844	0.6601	1.0885	1.6881	1.1996
FBAR 2- 4		0.4012	0.418	0.3836	0.2887	0.4299	0.1921	0.1916	0.2222	0.3627	0.2746

Table 8 Fishing mortality (F) at age

YEAR		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR 07-09
AGE												
	1	0.0032	0.0148	0.0138	0.0528	0.0178	0.0616	0.045	0.0294	0.0043	0.0197	0.0178
	2	0.088	0.1442	0.0712	0.1424	0.1292	0.1082	0.3061	0.1046	0.1403	0.0707	0.1052
	3	0.3213	0.3232	0.2139	0.1723	0.1724	0.3361	0.3612	0.2781	0.1902	0.098	0.1888
	4	0.3295	0.2093	0.1434	0.1797	0.2354	0.1977	0.3603	0.4124	0.2874	0.1249	0.2749
	5	0.343	0.2317	0.2121	0.1926	0.2915	0.2277	0.3336	0.3615	0.4284	0.2239	0.3379
	6	0.1749	0.2504	0.1231	0.0998	0.392	0.2146	0.2456	0.262	0.2545	0.254	0.2568
+gp		0.1749	0.2504	0.1231	0.0998	0.392	0.2146	0.2456	0.262	0.2545	0.254	
FBAR 2- 4		0.2462	0.2256	0.1429	0.1648	0.179	0.214	0.3425	0.265	0.206	0.0979	

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 22/04/2010 10:14

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
AGE					
	1	9260	12217	10978	9528
	2	7757	6665	8174	6294
	3	3415	4585	3373	3667
	4	1968	2191	3073	1822
	5	1017	1033	1438	1849
	6	569	379	584	697
+gp		544	335	416	922
TOTAL		24530	27405	28037	24780

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

YEAR		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE											
	1	12209	4781	10278	4237	1285	8650	8092	6501	3997	1978
	2	7113	6169	2993	7454	2999	1016	6622	6446	5249	3203
	3	3432	3892	2922	2096	4562	2064	799	4077	4317	3499
	4	2389	2108	2462	1780	1434	2121	1460	621	2423	2444
	5	921	1170	1102	1002	981	677	1176	943	439	1187
	6	1060	456	376	367	498	239	336	508	445	166
+gp		1558	189	330	129	175	247	183	190	196	321
TOTAL		28682	18766	20464	17065	11934	15015	18668	19286	17066	12797

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

YEAR		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	GM 98-07
AGE													
	1	3075	3008	2495	2771	2881	2276	2288	3015	1787	1587	0	2729
	2	1601	2510	2427	2015	2152	2317	1752	1791	2397	1457	1276	
	3	2405	1200	1779	1850	1431	1549	1703	1056	1321	1706	1114	
	4	1996	1428	711	1176	1275	986	906	971	655	894	1268	
	5	1374	1176	948	505	804	825	662	517	527	402	648	
	6	572	798	763	628	341	492	538	388	295	281	265	
+gp		1104	585	352	556	240	233	182	267	171	137	267	
TOTAL		12127	10706	9476	9501	9124	8678	8030	8006	7152	6464	4837	

Table 9.1.12 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Summary of catches and XSA results.

Run title : Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa

At 22/04/2010 10:14

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	9260	2603	2249	659	0.2931	0.338
1987	12217	2334	1883	497	0.264	0.3009
1988	10978	2659	2259	817	0.3617	0.4419
1989	9528	2972	2587	714	0.276	0.3725
1990	12209	3058	2658	977	0.3676	0.4012
1991	4781	1873	1694	614	0.3625	0.418
1992	10278	1908	1649	516	0.3129	0.3836
1993	4237	1607	1447	383	0.2647	0.2887
1994	1285	1211	1151	479	0.4162	0.4299
1995	8650	1318	968	218	0.2253	0.1921
1996	8092	1632	1285	329	0.256	0.1916
1997	6501	1692	1398	356	0.2546	0.2222
1998	3997	1509	1351	446	0.33	0.3627
1999	1978	1258	1162	343	0.2951	0.2746
2000	3075	1426	1301	253	0.1945	0.2462
2001	3008	1123	987	175	0.1774	0.2256
2002	2495	1080	965	117	0.1213	0.1429
2003	2771	1194	1074	134	0.1248	0.1648
2004	2881	956	820	149	0.1818	0.179
2005	2276	958	848	147	0.1734	0.214
2006	2288	973	861	210	0.2439	0.3425
2007	3015	902	756	155	0.205	0.265
2008	1787	819	728	133	0.1827	0.206
2009	1587	809	728	84	0.1154	0.0979
Arith. Mean	5382	1578	1367	371	0.25	0.2792
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 9.1.13. Megrim (*L. whiffiagonis*) in Division VIIIc, IXa. Prediction with management option table: Input data

MFDP version 1a
Run: MEG
Time and date: 09:07 26/04/2010
Fbar age range: 2-4

Age	2010 Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt
1	2729	0.2	0.34	0	0	0.063	0.018	0.063
2	1276	0.2	0.9	0	0	0.090	0.105	0.090
3	1114	0.2	1	0	0	0.121	0.189	0.121
4	1268	0.2	1	0	0	0.150	0.275	0.150
5	648	0.2	1	0	0	0.191	0.338	0.191
6	265	0.2	1	0	0	0.244	0.257	0.244
7	267	0.2	1	0	0	0.394	0.257	0.394

Age	2011 Stock size	Natural mortality	Maturity ogive	Prop. of F bef. Spaw.	Prop. of M bef. Spaw.	Weight in Stock	Exploit pattern	Weight CWt
1	2729	0.2	0.34	0	0	0.063	0.018	0.063
2	.	0.2	0.9	0	0	0.090	0.105	0.090
3	.	0.2	1	0	0	0.121	0.189	0.121
4	.	0.2	1	0	0	0.150	0.275	0.150
5	.	0.2	1	0	0	0.191	0.338	0.191
6	.	0.2	1	0	0	0.244	0.257	0.244
7	.	0.2	1	0	0	0.394	0.257	0.394

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	2729	0.2	0.34	0	0	0.063	0.018	0.063
2	.	0.2	0.9	0	0	0.090	0.105	0.090
3	.	0.2	1	0	0	0.121	0.189	0.121
4	.	0.2	1	0	0	0.150	0.275	0.150
5	.	0.2	1	0	0	0.191	0.338	0.191
6	.	0.2	1	0	0	0.244	0.257	0.244
7	.	0.2	1	0	0	0.394	0.257	0.394

Input units are thousands and kg - output in tonnes

Table 9.1.14. Megrim (*L. whiffiagonis*) in Div. VIIIc and IXa catch forecast : management option table

MFDP version 1a
Run: MEG
Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa
Time and date: 09:07 26/04/2010
Fbar age range: 2-4

2010				
Biomass	SSB	FMult	FBar	Landings
906	781	1	0.1896	143

2011					2012	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
973	840	0	0	0	1213	1079
.	840	0.1	0.019	17	1194	1060
.	840	0.2	0.0379	33	1175	1042
.	840	0.3	0.0569	49	1157	1024
.	840	0.4	0.0758	64	1139	1006
.	840	0.5	0.0948	79	1122	989
.	840	0.6	0.1138	94	1105	972
.	840	0.7	0.1327	108	1089	956
.	840	0.8	0.1517	122	1073	940
.	840	0.9	0.1707	136	1057	924
.	840	1	0.1896	149	1042	909
.	840	1.1	0.2086	162	1027	894
.	840	1.2	0.2275	175	1012	879
.	840	1.3	0.2465	187	998	865
.	840	1.4	0.2655	199	984	851
.	840	1.5	0.2844	211	971	838
.	840	1.6	0.3034	223	958	825
.	840	1.7	0.3224	234	945	812
.	840	1.8	0.3413	245	932	799
.	840	1.9	0.3603	256	920	787
.	840	2	0.3792	267	908	775

Input units are thousands and kg - output in tonnes

Table 9.1.15. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Single option prediction: Detail Tables.

MFDP version 1a
Run: MEG
Time and date: 09:07 26/04/2010
Fbar age range: 2-4

Year:	2010	F multiplier:	1	Fbar:	0.1896				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0178	44	3	2729	172	928	58	928	58
2	0.1052	116	10	1276	115	1148	104	1148	104
3	0.1888	174	21	1114	135	1114	135	1114	135
4	0.2749	277	42	1268	191	1268	191	1268	191
5	0.3379	169	32	648	124	648	124	648	124
6	0.2568	55	13	265	65	265	65	265	65
7	0.2568	55	22	267	105	267	105	267	105
Total		890	143	7567	906	5638	781	5638	781

Year:	2011	F multiplier:	1	Fbar:	0.1896				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0178	44	3	2729	172	928	58	928	58
2	0.1052	199	18	2195	198	1975	178	1975	178
3	0.1888	147	18	940	114	940	114	940	114
4	0.2749	165	25	755	114	755	114	755	114
5	0.3379	206	39	789	151	789	151	789	151
6	0.2568	78	19	378	92	378	92	378	92
7	0.2568	69	27	337	133	337	133	337	133
Total		909	149	8123	973	6103	840	6103	840

Year:	2012	F multiplier:	1	Fbar:	0.1896				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0178	44	3	2729	172	928	58	928	58
2	0.1052	199	18	2195	198	1975	178	1975	178
3	0.1888	253	31	1618	196	1618	196	1618	196
4	0.2749	140	21	637	96	637	96	637	96
5	0.3379	123	23	470	90	470	90	470	90
6	0.2568	95	23	461	112	461	112	461	112
7	0.2568	93	37	453	179	453	179	453	179
Total		946	156	8562	1042	6542	909	6542	909

Input units are thousands and kg - output in tonnes

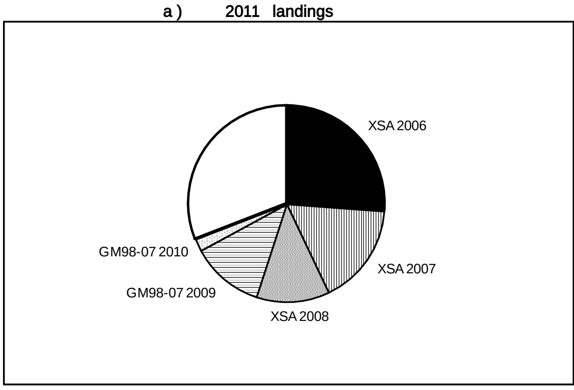
Table 9.1.16 **Megrim (L. whiffiagonis) in Divisions VIIIc and IXa**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2006	2007	2008	2009	2010
Stock No. (thousands) of 1 year-olds	3015	1787	1587	2729	2729
Source	XSA	XSA	XSA	GM98-07	GM98-07
Status Quo F:					
% in 2010 landings	29.4	14.7	7.0	2.1	-
% in 2011	26.2	16.8	12.1	12.1	2.0
% in 2010 SSB	24.4	17.3	13.3	7.4	-
% in 2011 SSB	18.0	13.6	13.6	21.2	6.9
% in 2012 SSB	12.3	9.9	10.6	21.6	19.6

GM : geometric mean recruitment

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

a) 2011 landings



b) 2012 SSB

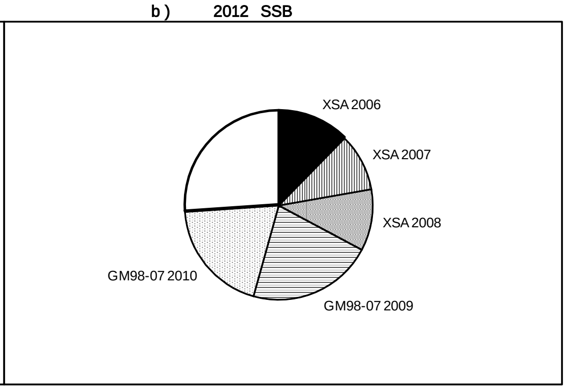


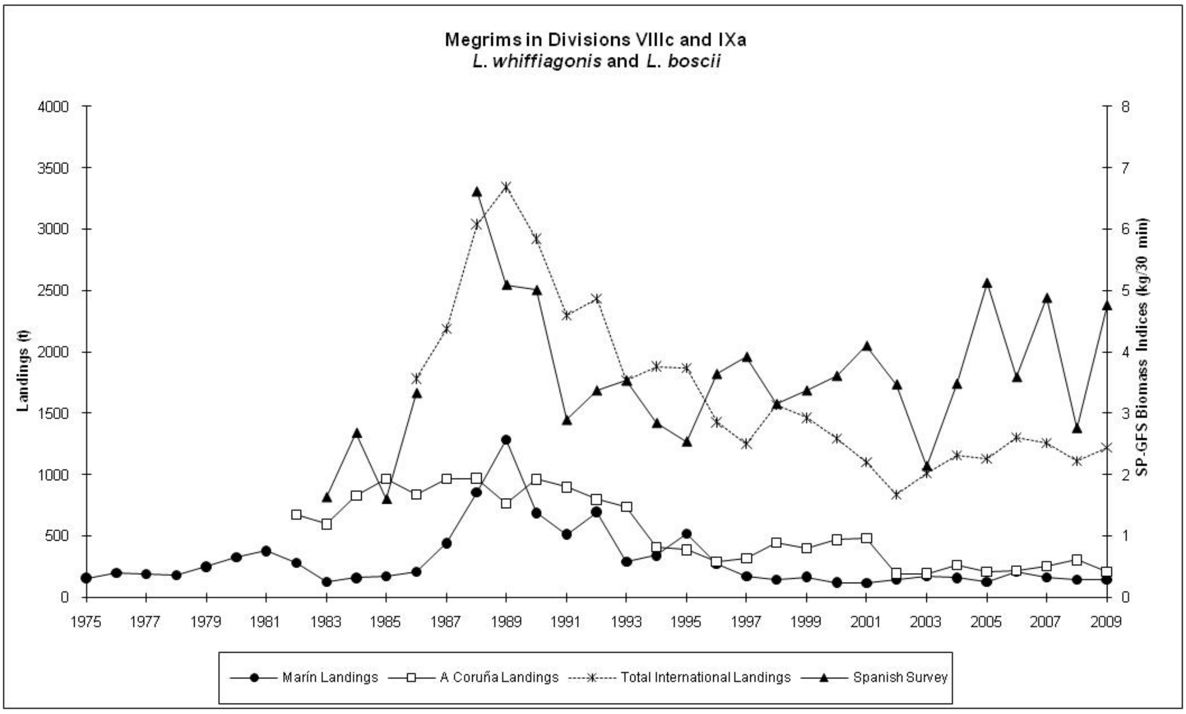
Table 9.1.17. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa, yield per recruit results.

MFYPR version 2a
Run: MEG
Time and date: 10:33 26/04/2010
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0	0.0000	0.0000	0.0000	5.5167	1.1310	4.7748	1.0821	4.7748	1.0821
0.1	0.0190	0.0846	0.0205	5.0952	0.9817	4.3535	0.9329	4.3535	0.9329
0.2	0.0379	0.1518	0.0351	4.7608	0.8659	4.0192	0.8170	4.0192	0.8170
0.3	0.0569	0.2065	0.0457	4.4890	0.7739	3.7476	0.7251	3.7476	0.7251
0.4	0.0758	0.2518	0.0535	4.2639	0.6995	3.5226	0.6507	3.5226	0.6507
0.5	0.0948	0.2900	0.0593	4.0742	0.6385	3.3331	0.5896	3.3331	0.5896
0.6	0.1138	0.3227	0.0636	3.9122	0.5876	3.1712	0.5388	3.1712	0.5388
0.7	0.1327	0.3510	0.0669	3.7723	0.5448	3.0314	0.4960	3.0314	0.4960
0.8	0.1517	0.3757	0.0692	3.6501	0.5084	2.9094	0.4597	2.9094	0.4597
0.9	0.1707	0.3975	0.0710	3.5424	0.4772	2.8018	0.4285	2.8018	0.4285
1.0	0.1896	0.4169	0.0723	3.4467	0.4503	2.7063	0.4015	2.7063	0.4015
1.1	0.2086	0.4343	0.0733	3.3611	0.4268	2.6208	0.3780	2.6208	0.3780
1.2	0.2275	0.4500	0.0739	3.2840	0.4061	2.5438	0.3574	2.5438	0.3574
1.3	0.2465	0.4642	0.0744	3.2141	0.3880	2.4741	0.3393	2.4741	0.3393
1.4	0.2655	0.4772	0.0747	3.1505	0.3719	2.4106	0.3231	2.4106	0.3231
1.5	0.2844	0.4891	0.0749	3.0922	0.3575	2.3525	0.3088	2.3525	0.3088
1.6	0.3034	0.5000	0.0750	3.0386	0.3446	2.2991	0.2959	2.2991	0.2959
1.7	0.3224	0.5101	0.0750	2.9892	0.3330	2.2497	0.2844	2.2497	0.2844
1.8	0.3413	0.5195	0.0750	2.9433	0.3226	2.2040	0.2739	2.2040	0.2739
1.9	0.3603	0.5283	0.0749	2.9007	0.3130	2.1615	0.2644	2.1615	0.2644
2.0	0.3792	0.5364	0.0748	2.8609	0.3044	2.1219	0.2557	2.1219	0.2557

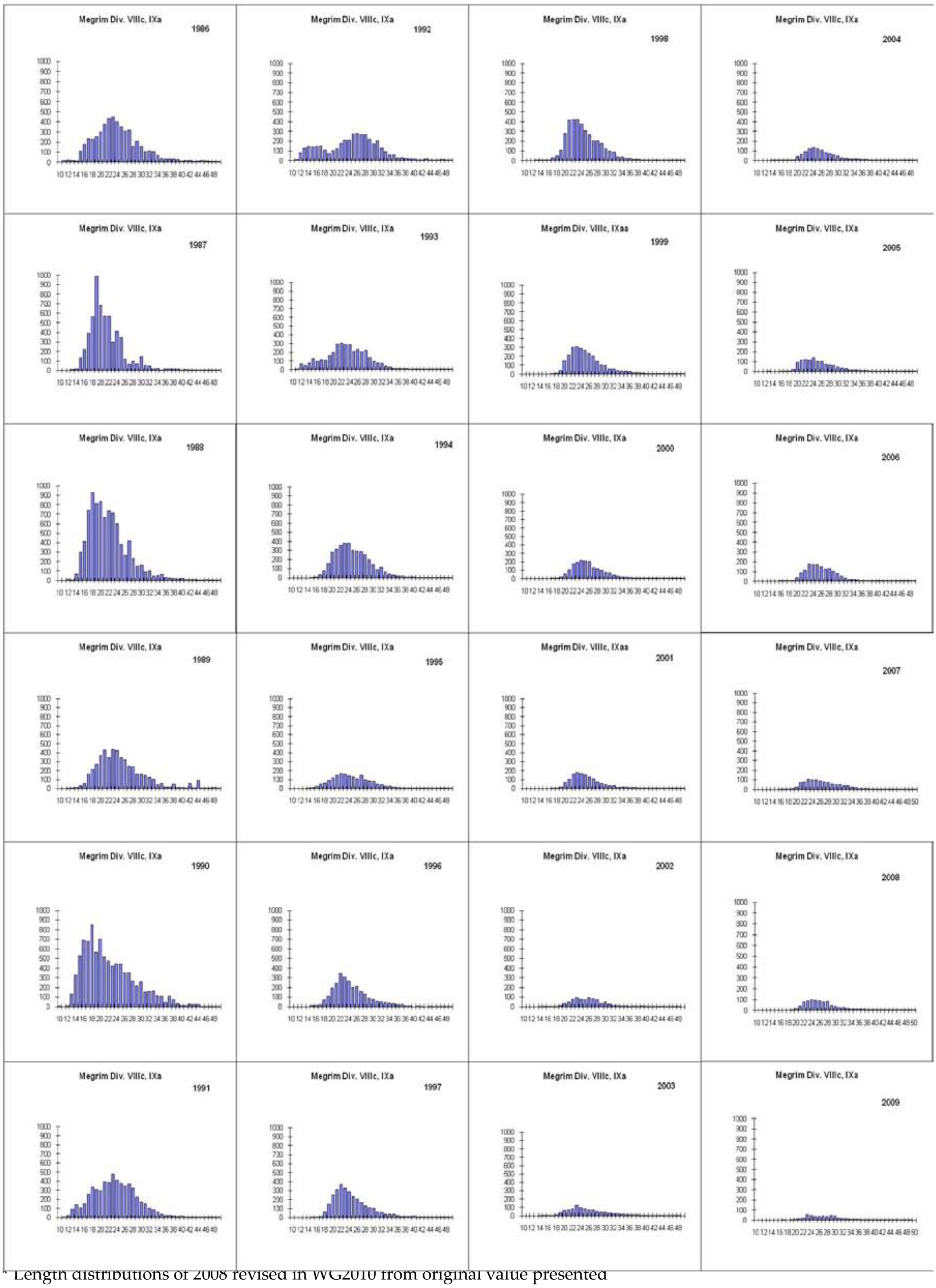
Reference point	F multiplier	Absolute F
Fbar(2-4)	1	0.1896
FMax	1.6778	0.3182
F0.1	0.7446	0.1412
F35%SPR	1.0966	0.2079
Flow	0.6050	0.1147
Fmed	1.1852	0.2247
Fhigh	4.0998	0.7774

Weights in kilograms



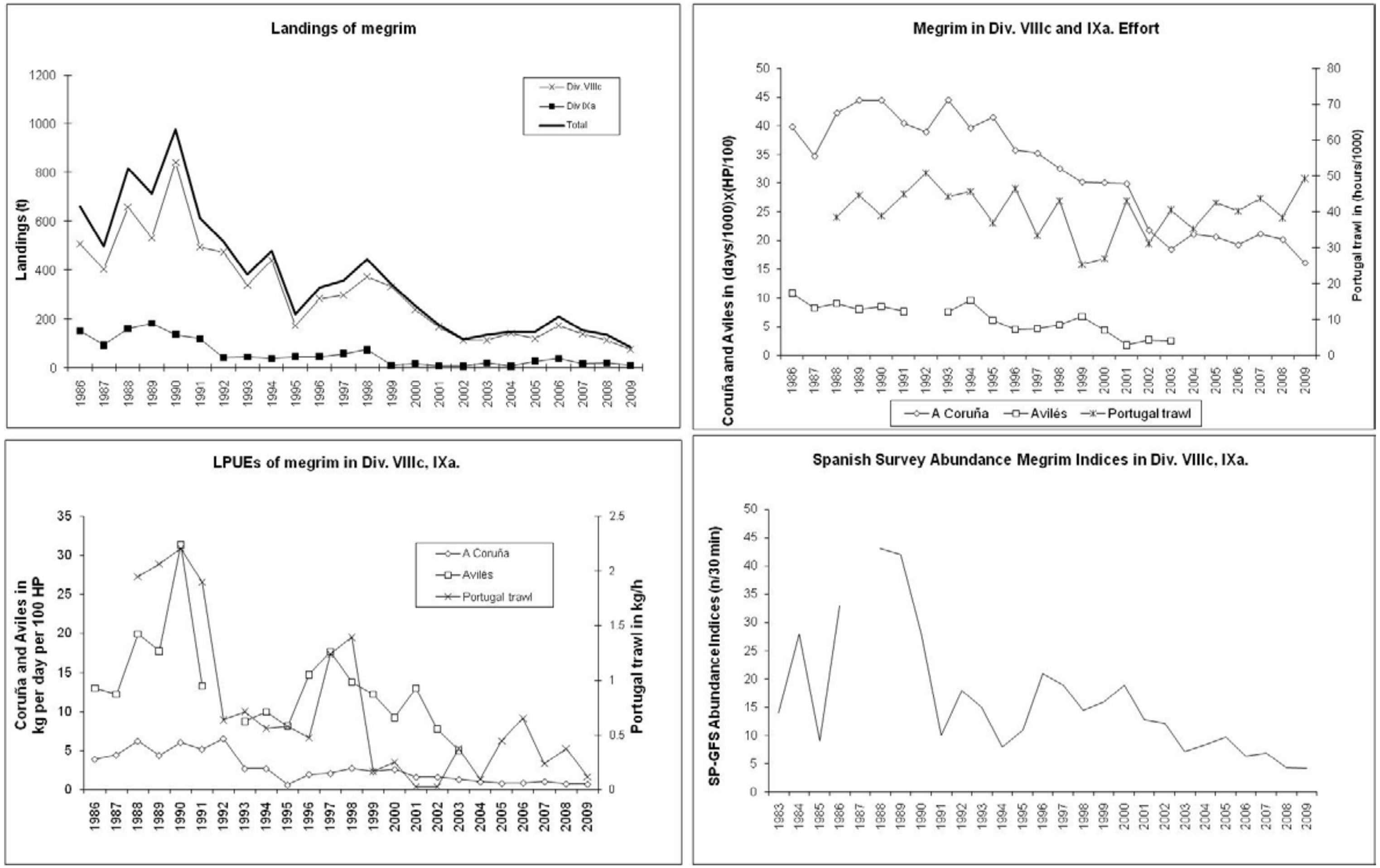
* Spanish Landings of 2008 revised in WG2010 from original value presented

Figure 9.1.1 Historical landings and biomass indices of Spanish survey of megrims (both species combined).



* Length distributions of 2008 revised in WG2010 from original value presented

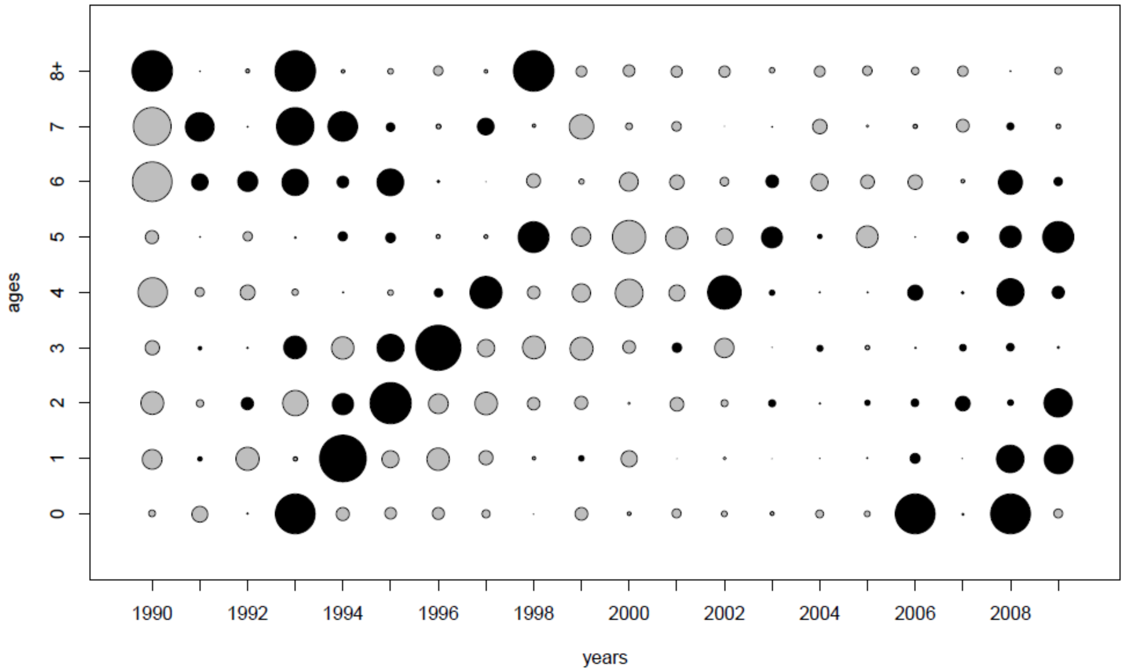
Figure 9.1.2 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Annual length compositions of landings ('000)



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

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

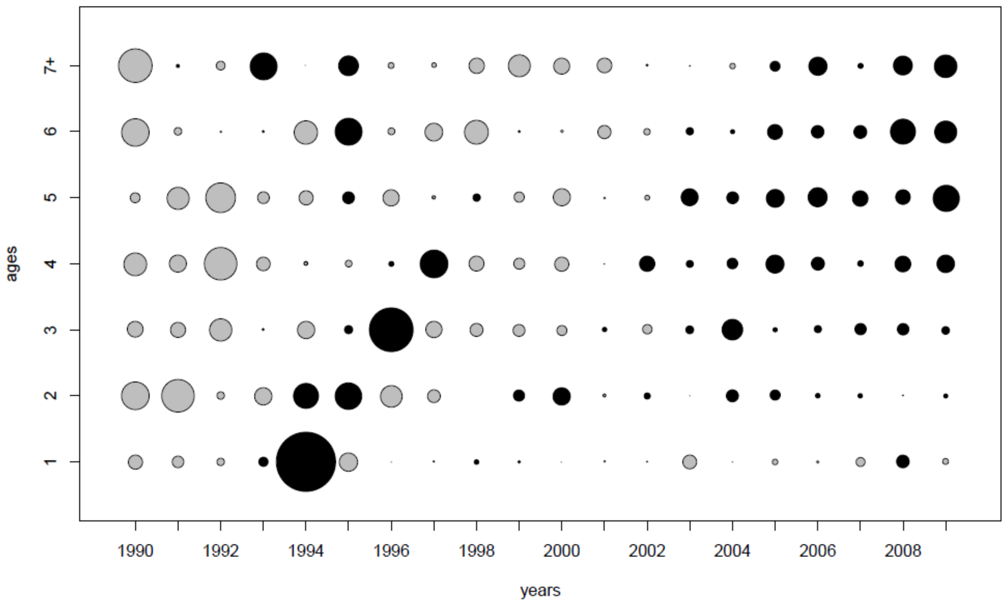
Figure 9.1.3(a) Megrim (*L.whiffiagonis*) in Divisions VIIIc, IXa. Landings (t), Efforts, LPUEs and Abundance Indices



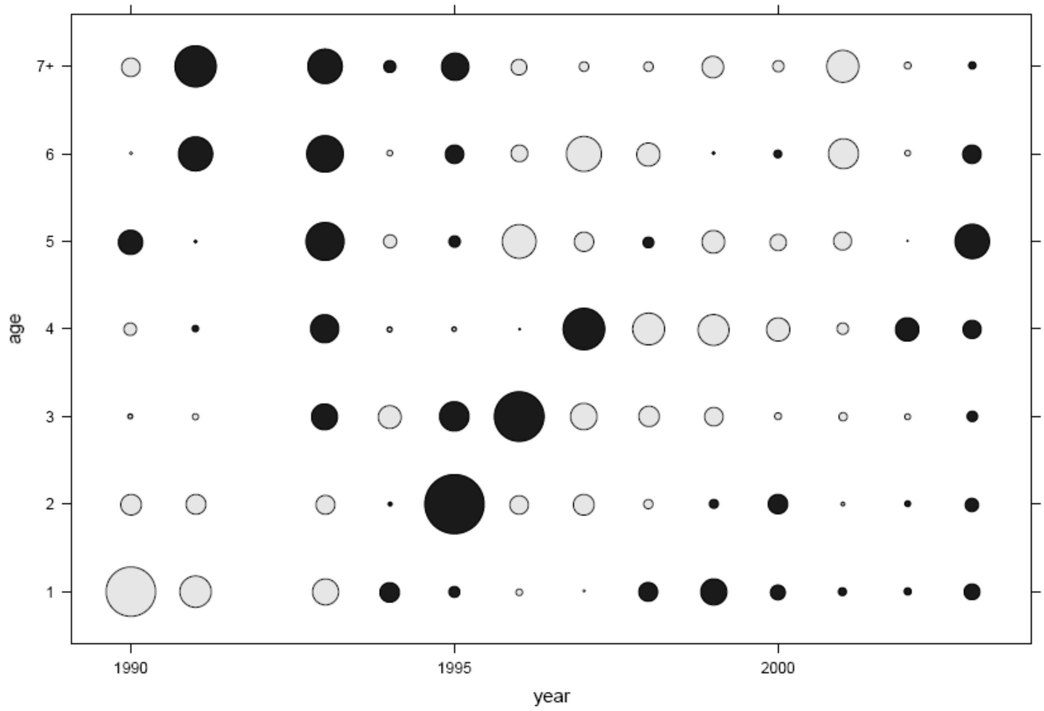
Standardized log(abundance index at age) from survey SP-GFS

(black bubbles means <0)

Figure 9.1.3(b): Megrim (L. Whiffiagonis) in Divisions VIIIc&IXa



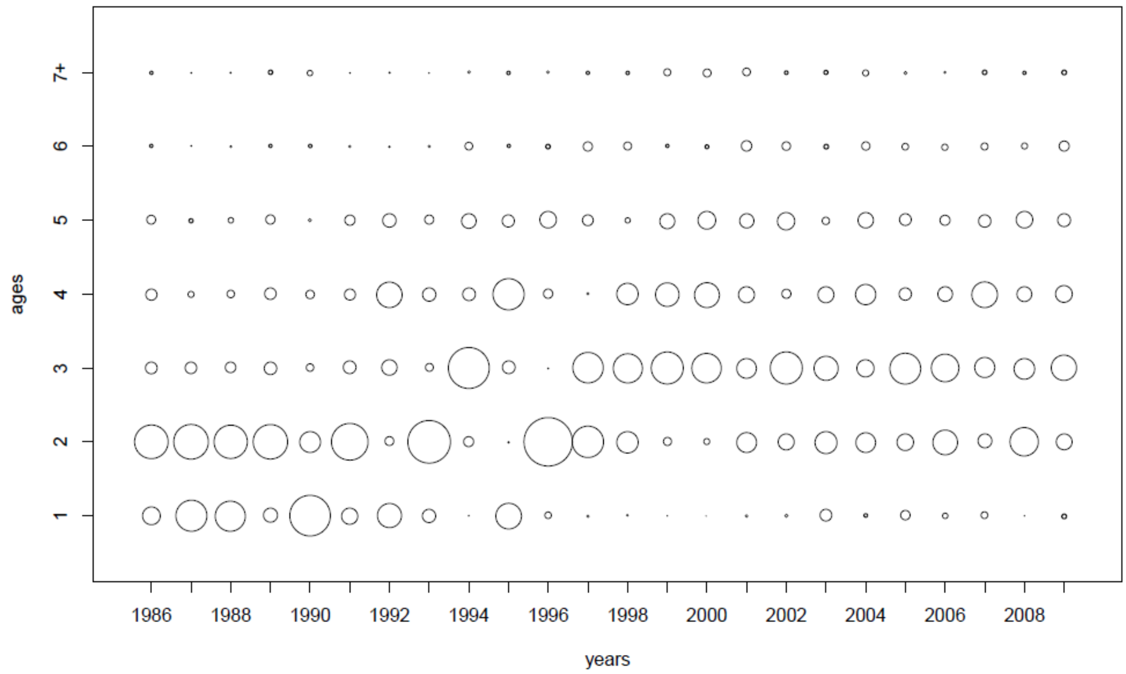
Standardized log(abundance index at age) from A Coruña VIIIc trawl fleet (black bubble means < 0)



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

Catch proportions at age



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

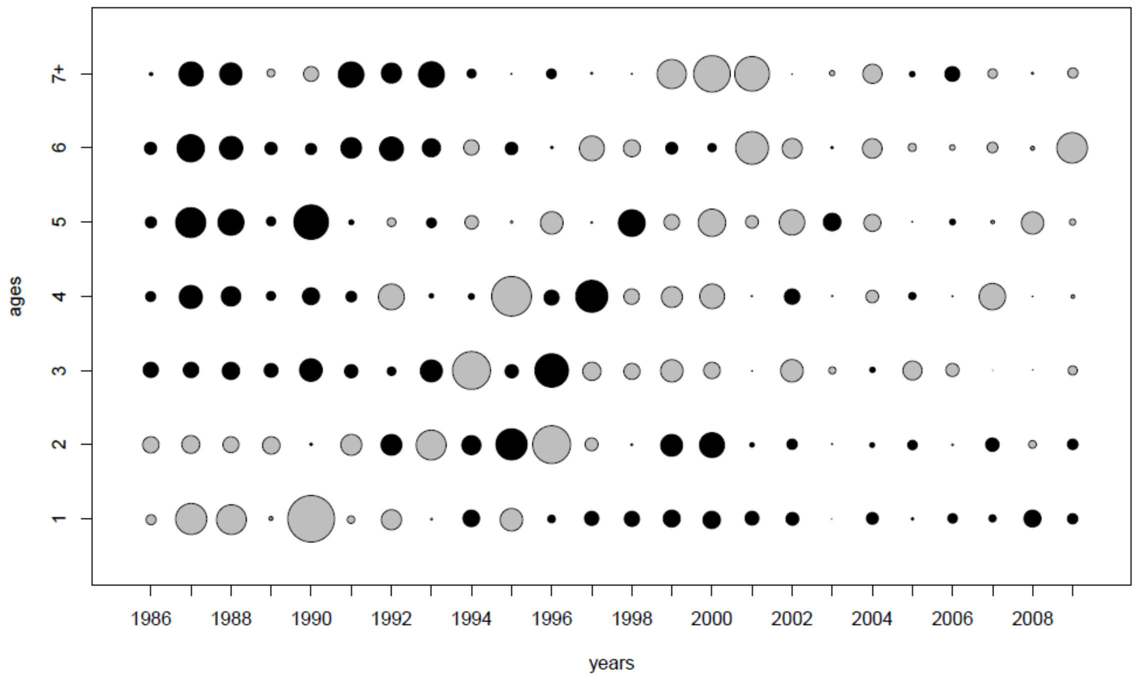


Figure 9.1.4. Megrim (L. Whiffiagonis) in Divisions VIIIc & IXa.

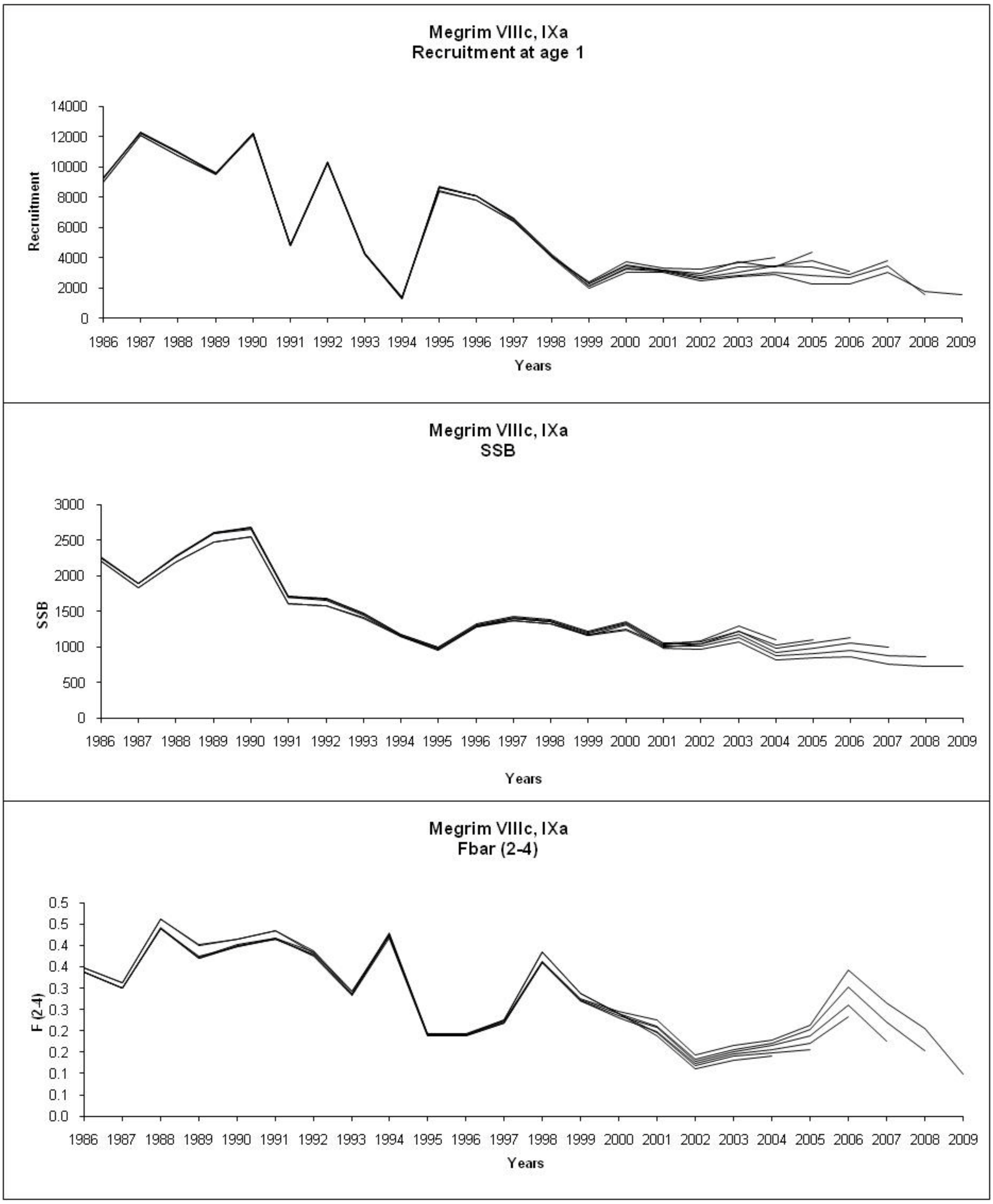


Figure 9.1.5. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Retrospective XSA

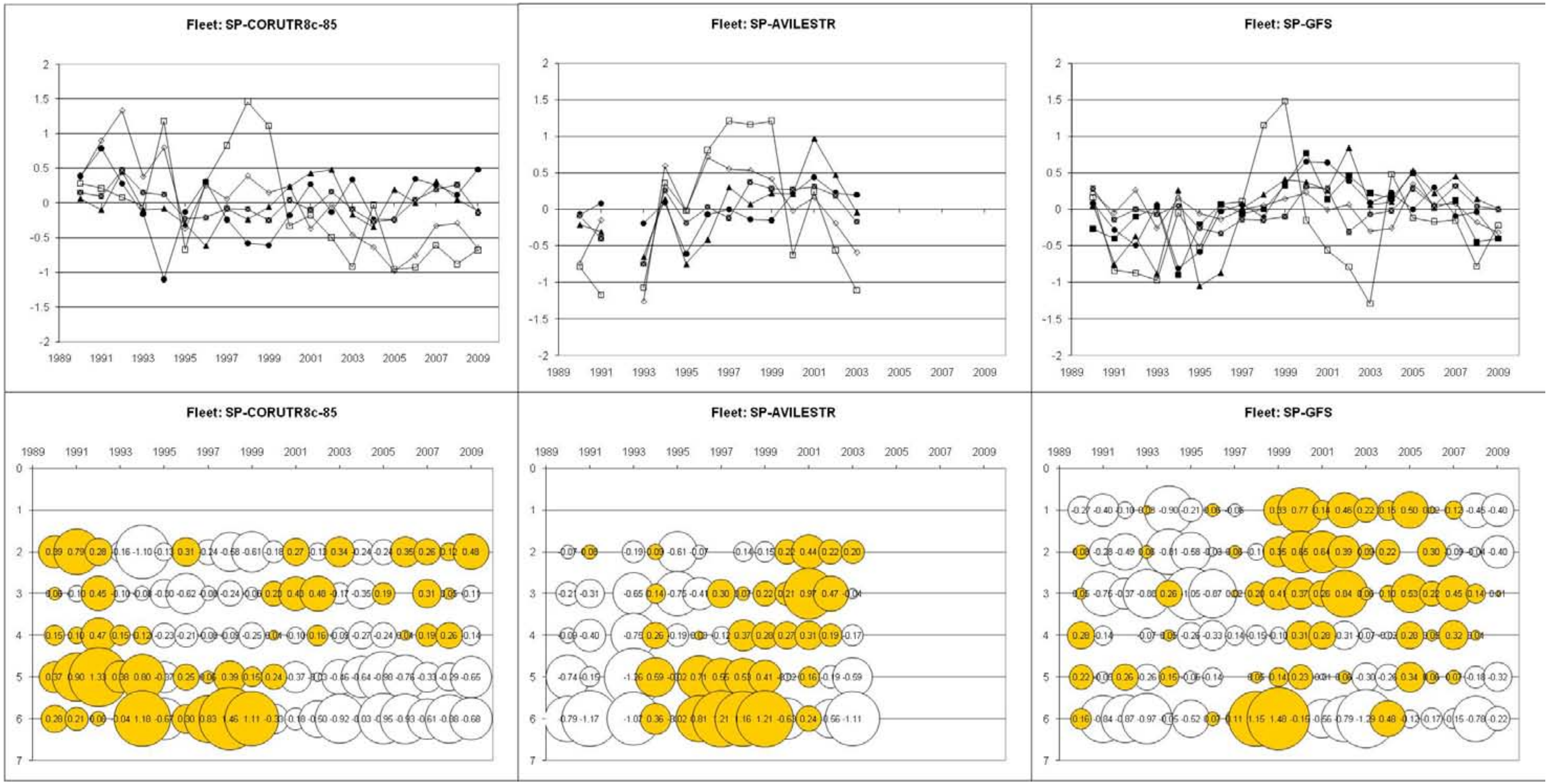


Figure 9.1.6. Megrim in Divisions VIIIc and IXa. LOG CATCHABILITY RESIDUAL PLOTS (XSA)

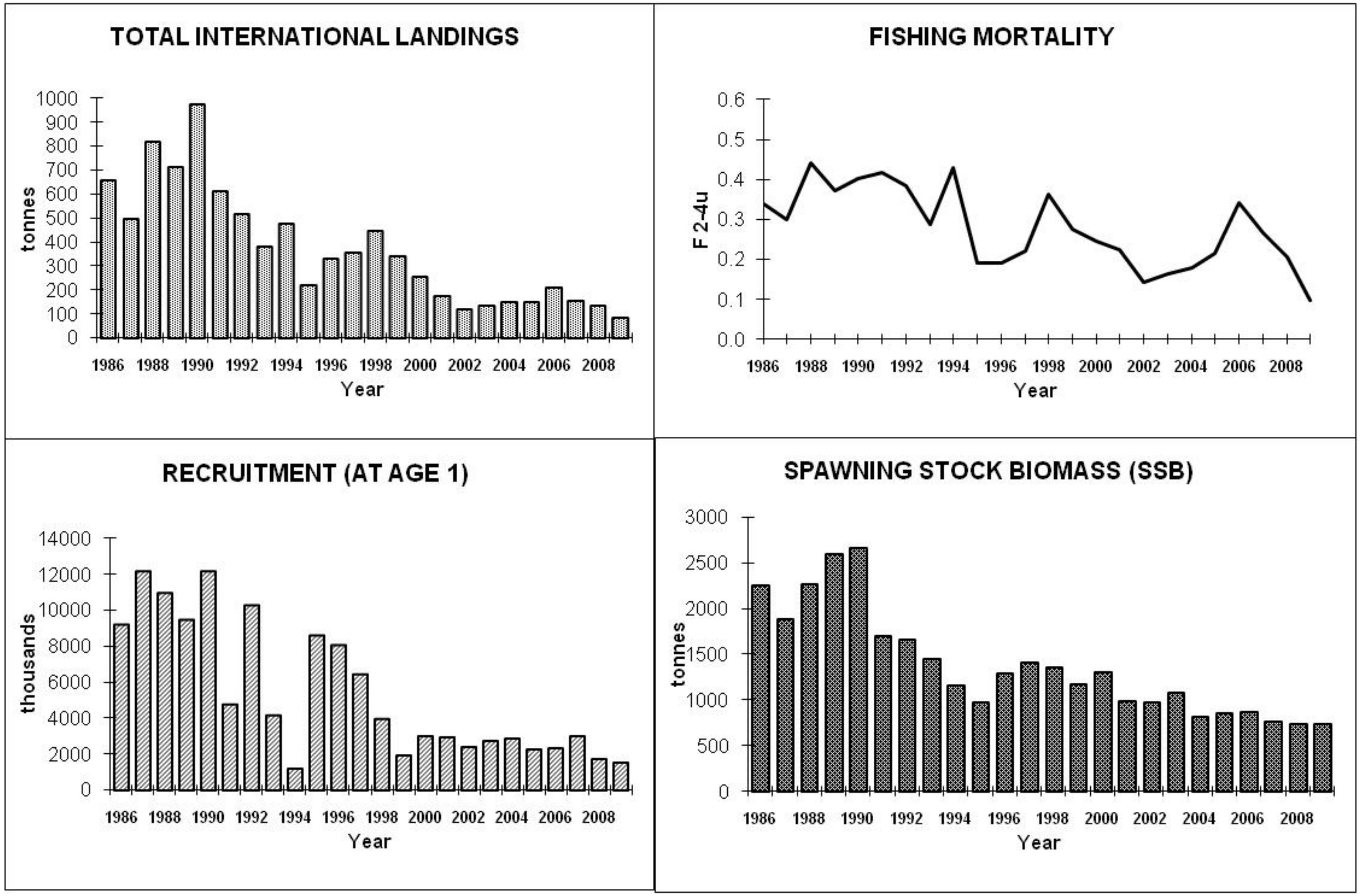
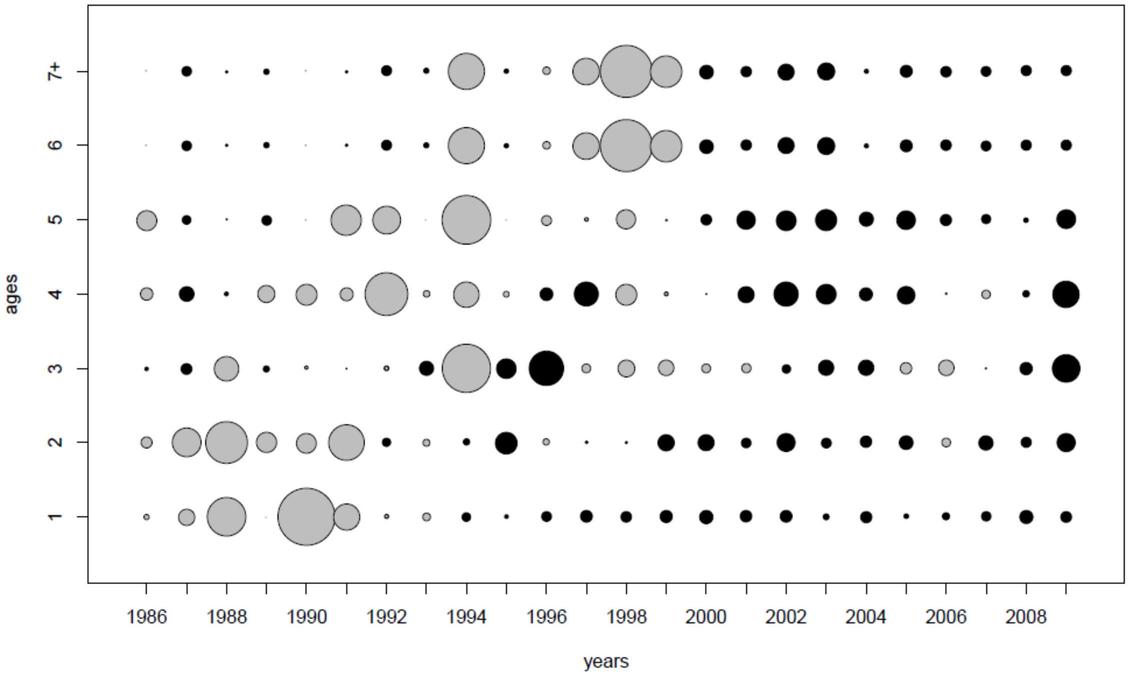


Figure 9.1.7(a) Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Stock Summary

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



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

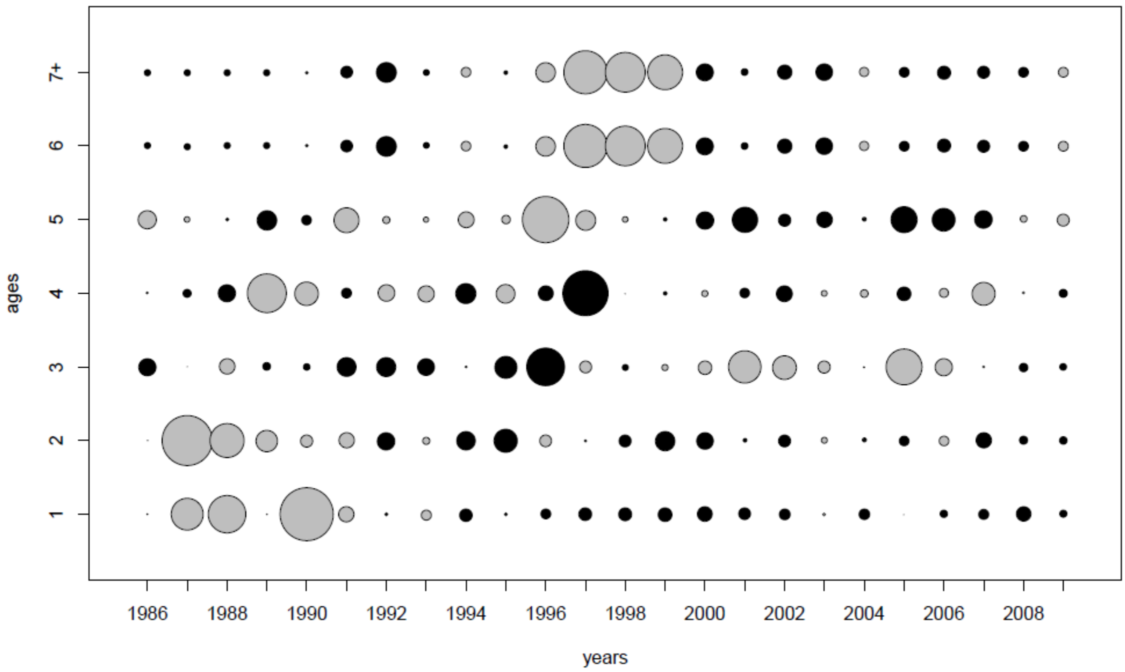
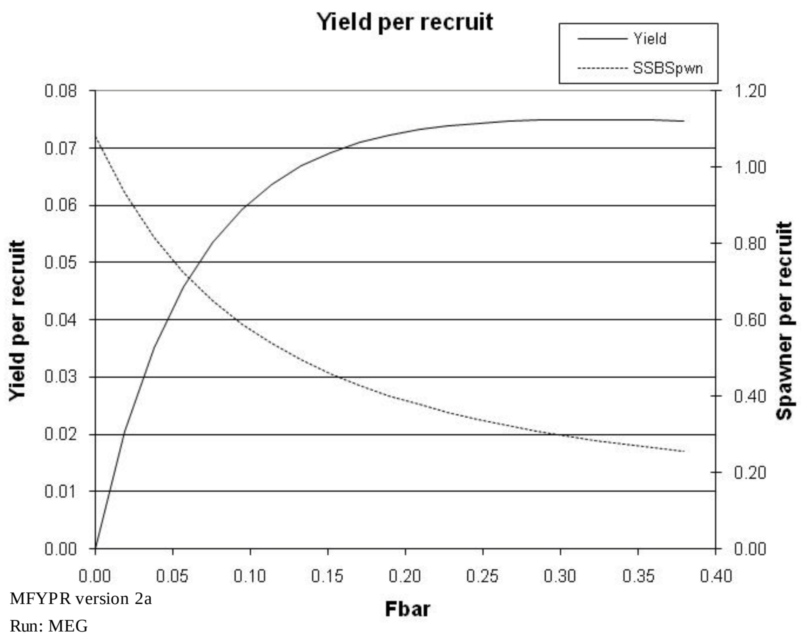
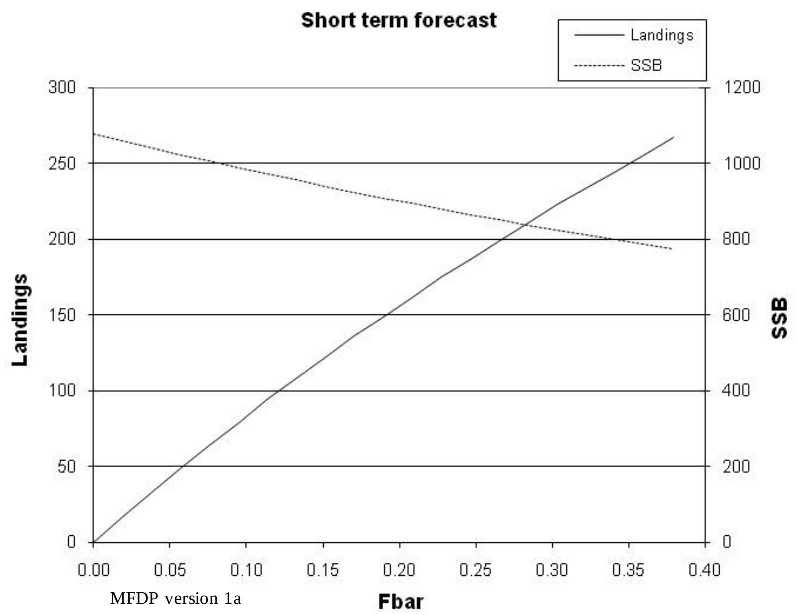


Figure 9.1.7(b): Megrim (L. Whiffiagonis) in Divisions VIIIc&IXa



MFYPR version 2a
Run: MEG
Time and date: 10:33 26/04/2010



MFDP version 1a
Run: MEG
Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa
Time and date: 09:07 26/04/2010
Fbar age range: 2-4

Input units are thousands and kg - output in tonnes

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.1896
FMax	1.6778	0.3182
F0.1	0.7446	0.1412
F35%SPR	1.0966	0.2079
Flow	0.6050	0.1147
Fmed	1.1852	0.2247
Fhigh	4.0998	0.7774

Weights in kilograms

Figure 9.1.8. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa, forecast summary

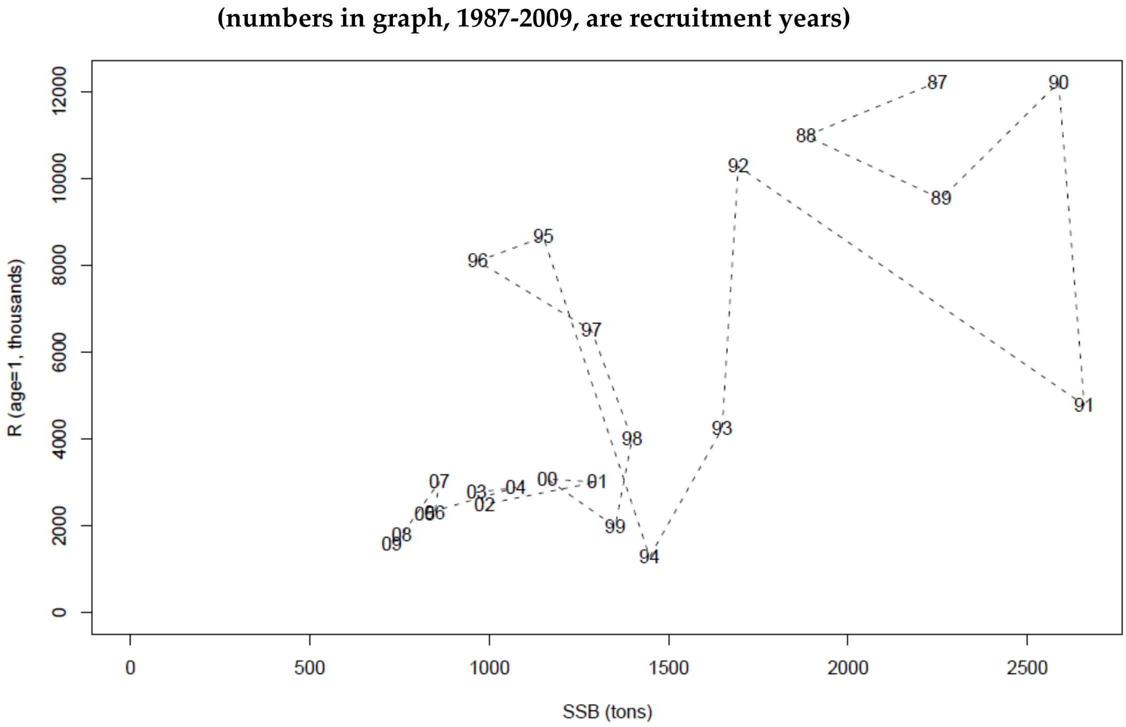


Figure 9.1.9(b). Megrim (*L.whiffiagonis*) in Divisions VIIIc and IXa. SSB-Recruitment plot.

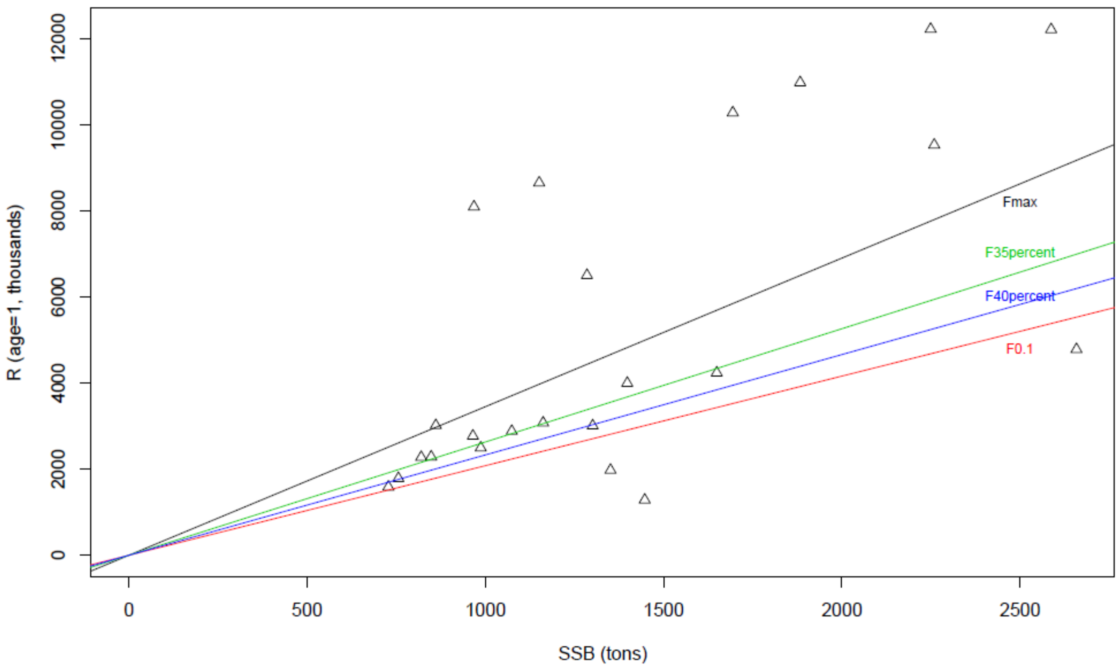


Figure 9.1.9(b). Megrim (*L.whiffiagonis*) in Divisions VIIIc and IXa. SSB-Recruitment plot and replacement lines corresponding to Fmax, F0.1, F35percent and F40percent

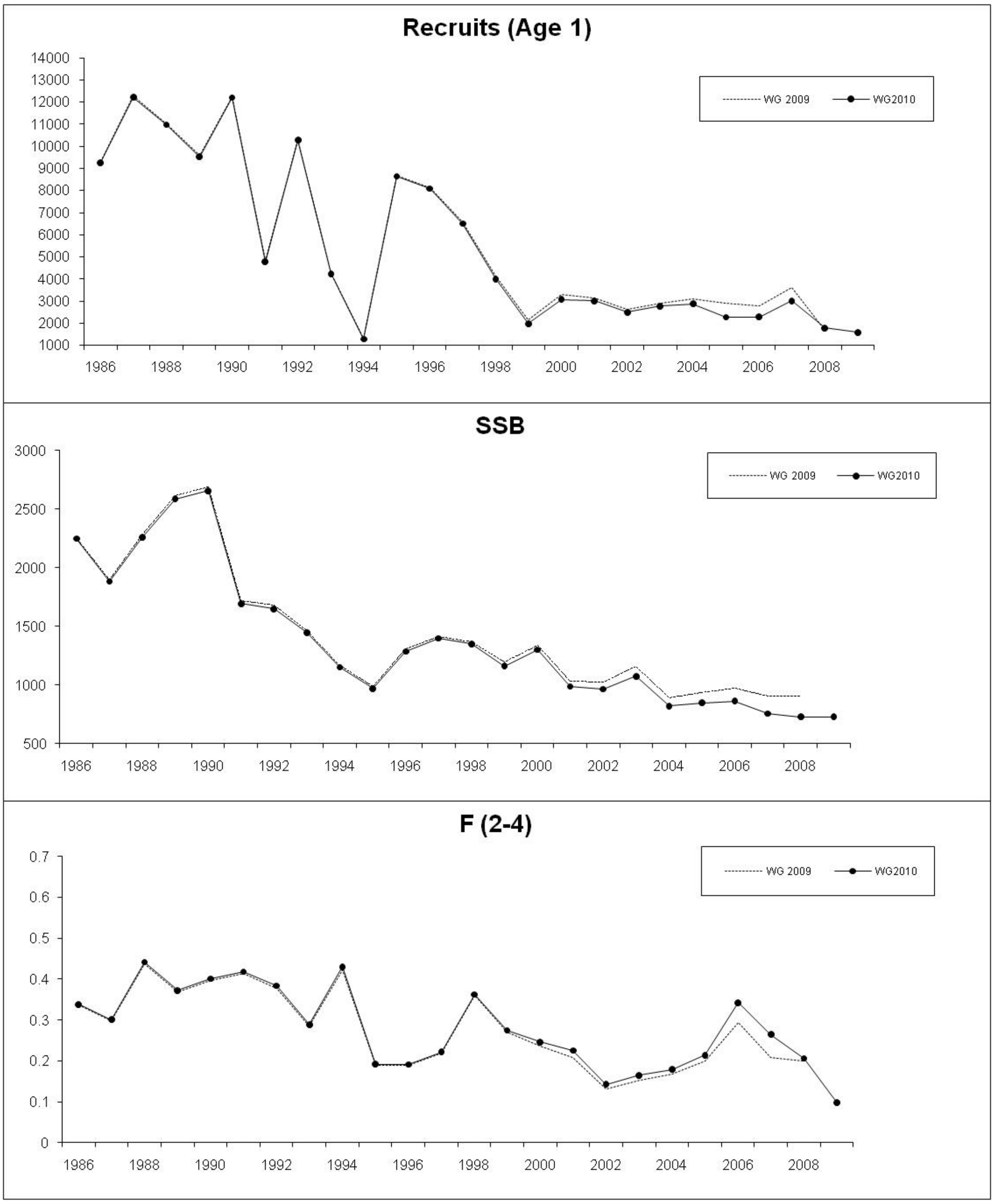


Figure 9.1.10. Megrim (*L. whiffiagonis*) in Div. VIIIc, IXa. Recruits, SSB and F estimates from WG09 and WG10

9.2 Four-spot megrim (*Lepidorhombus boscii*)

9.2.1 General

See general section for both species.

9.2.2 Data

9.2.2.1 Commercial catches and discards

The estimates of four-spot megrim international landings for the period 1986 to 2009 used by the WG are given in Table 9.2.1(a). As in previous years, Portuguese and Spanish landings of four-spot megrim were estimated using the relative abundances of the two species of megrim in the sampled landings.

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 2009 are 1134 t.

Discards data are available for Spanish trawlers in some years. Annual discards of four-spot megrim are estimated to be from around 140 t to 520 t along the whole time series. Discards in number represent between 40-62% of the total catch. Discards data are not used in this assessment due to the lack of data in some years of the series. Discard / Total Catch ratio and CV are showed in Table 9.2.1(b):

9.2.2.2 Biological sampling

Annual length compositions of total landings are given in Figure 9.2.1 for the period 1986-2009. Length distributions were available for Spanish and Portuguese landings since 1986 and 1998, respectively. There has been a decrease of small fish (under 15 cm) landed since 1994. This is considered to have resulted from stricter enforcement of the minimum landing size (20 cm), as well as a mesh size increase regulation in year 2000. Table 9.2.2(a) shows the length distribution by fleet and country for 2009.

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 9.2.2(b).

Age compositions for 1990–2009 were based on Spanish annual ALKs. Age compositions for 1986–1989 were based on a survey ALK for 1986 combined with an annual ALK for 1990.

Due to very low landings in the age 0 group over the whole period (see Table 9.2.3), the values of these landings were replaced by zeros in the assessment.

Weights-at-age of landings (given in Table 9.2.4) were also used as weights-at-age in the stock. The parameter values of the length-weight relationship used in the computation are a=0.00431, b=3.1904. There is some variability in the weights-at-age through the historical time series.

The natural mortality rate was set to 0.2, as it is usually done, and was assumed to be constant over all ages and years. This is the same value used for *L. whiffiagonis* in Subarea VII and Divisions VIIIabd, VIIIc and IXa. The same sex-combined maturity ogive (BIOSDEF, 1998) as used last year for the whole assessment period is again used this year:

Age	0	1	2	3	4	5+
Prop. mature	0.0	0.55	0.86	0.97	0.99	1

9.2.2.3 Abundance indices from surveys

Portuguese and Spanish survey indices are summarised in Table 9.2.5.

Two Portuguese surveys, named ``Crustacean´´ (P-CTS) and ``October´´ (P-GFS-oct), provide indices for 2009. It is difficult to draw meaningful conclusions from the high P-GFS-oct indices found in 2003 and 2004, as the survey was conducted with a different vessel and gear on those years. Excluding those two years, the biomass index from the October survey in 2007 was the highest observed since 1994, whereas the value in 2009 is the second lowest in the series. The Crustacean survey had many operational problems in 2004 so its indices for that year cannot be used. In 2009, both the biomass and abundance indices from the Crustacean survey are also the second lowest in the time series.

Total biomass, abundance and recruitment indices from the Spanish Ground-Fish Survey (SP-GFS) are also presented in Table 9.2.5. Total biomass indices from this survey had generally remained stable after a maximum level in 1988. A very low value was obtained in 2003 (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 high value in 2004 and an even higher one (the highest in the series) in 2005. The very high index in 2005 applies to all ages and not just the recruitment ages (see Table 9.2.6, 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 2009, the total biomass and abundance index values are above time series averages. Only the age 1 index is 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

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 1986-2009) and Avilés (SP-AVILESTR, for years 1986–2003), fishing in ICES Division VIIIc (see Table 9.2.6). 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 9.2.7 displays landings (in tonnes), fishing effort and LPUE for the two Spanish trawl fleets just mentioned as well as for the Portuguese trawl fleet fishing in Division IXa for the period 1988–2009 (see also Figure 9.2.3). The fishing effort of the Portuguese fleet was estimated from a sample of logbooks from sea trips where megrim was present in the landings. The LPUE series of the two Spanish fleets show conflicting trends until 1998, after which they show more agreement.

Commercial fleets used in the assessment to tune the model

A Coruña trawl fleet (SP-CORUTR8c) was used for tuning. The effort of this fleet had been generally stable until year 1993, after which a steady declined started. The lowest effort value was reached in 2003, when restrictions imposed on fishing activity due to the Prestige oil spill influenced effort. Figure 9.2.3 depicts the time series of effort and LPUE values for this fleet. Due to the increased use of HVO gear (which catches very little megrim) by this fleet in recent years, estimated effort values for recent years are not directly comparable with those from earlier years. Hence, as done in the last few years, only catch and effort data up to year 1999 from this tuning fleet are presently used in the assessment.

Commercial fleets not used in the assessment to tune the model

The effort of the Avilés trawl fleet (SP-AVILESTR) has been decreasing along the whole period, reaching very low levels in recent years.

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

The assessment is an update of the one performed last year.

9.2.3.1 Input data

The age range considered was 0 to 7+. 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 9.2.3) were replaced by zeros.

Two fleets were used for tuning: the commercial A Coruña fleet SP-CORUTR8c for ages older than 2 and years 1986-1999 and the Spanish survey (SP-GFS) for all ages and years 1988-2009, with the exception of 2003.

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 2009 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 (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:

		2009 WG		2010 WG	
Tuning fleets	SP-CORUTR8c	Years: 86-99	Ages: 3-6	Years: 86-99	Ages: 3-6
	SP-GFS	Years: 88-08 (2003 not included)	Ages: 0-6	Years: 88-09 (2003 not included)	Ages: 0-6
Taper			3 over 20		3 over 20
Tuning range			23		24
Ages catch dep. Stock size			0-1-2		0-1-2
Q plateau			5		5
F shrinkage s.e.			1.5		1.5
year range for F shrinkage			5		5
age range for F shrinkage			3		3

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 (20 years), tuning (and, therefore, residuals) starts in year 1990. 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 almost all ages in 2001, 2005 and 2007, 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, whereas in 2009 the majority are positive. 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 2009. 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_{2-4}) is estimated to be 0.27 in 2009, entirely in line with the stable 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 2007 year class estimate is 20 million individuals, obtained by averaging estimates coming from the Spanish survey tuning data (80% of weight), P-shrinkage (19% weight) and F-shrinkage (1% weight).

The 2008 year class estimate is 16 million individuals, estimated from the Spanish survey (67% of weight), P-shrinkage (31% weight) and F-shrinkage (2% weight).

The 2009 year class estimate is 31 million individuals, obtained by averaging a higher value coming from the Spanish survey (52% weight) and a lower one from P-shrinkage (48% weight).

Following the usual procedure applied to this stock, the geometric mean of estimated recruitment over the years 1990-2007 ($GM_{90\text{-}07}$ = 25 million individuals) has been used for computation of 2010 and subsequent year classes, for prediction purposes. Estimates of recruitment for years 1986 to 1989 were excluded because age compositions on those years were based on combined ALKs. Excluding the last two assessment years from the GM computation is standard practice. Working Group estimates of year-class strength used for prediction are:

Recruitment at age 0:

Year class	Thousand	Basis	Survey	Commercial	Shrinkage
2007	20369	XSA	80%	-	20%
2008	16072	XSA	67%	-	33%
2009	31088	XSA	52%	-	48%
2010	24726	$GM_{90\text{-}07}$			

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 7900 t in 1988 to 3500 t in 2001, the lowest value in the series, and has since experienced some increase. The 2008 SSB is estimated to be 5326 t, the highest value after 1994. SSB is a bit lower in 2009, with an estimated value of 4717 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 and 2005, recruitment has been above this average level..Although it is estimated to have dropped in the period 2006-2008 (23, 20 and 16 million), an increase has occurred in 2009, with a value of 31 million individuals.

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 1996 and 1997, a second period stabilised at a lower level.

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

For the catch forecast, population numbers in 2010 for ages 1 and older were taken from the XSA output. Stock size at age 0 in years 2010-2012 was assumed to be $GM_{90\text{-}07}$ (24.7 million). The exploitation pattern used (F *status quo*) was the unscaled average of 2007-2009, which gives an Fbar value of 0.25. Mean weights in the catch and in the stock were computed as averages of 2007-2009.

9.2.4.1 Short-term projections

The input data for deterministic short-term projections are given in Table 9.2.13.

Table 9.2.14 gives the management options for 2011, 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 2010-2012, is given in Table 9.2.15. Under this scenario, projected landings for 2010 and 2011 are 1133 and 1033 t, respectively. Landings in 2009 were 1134 t.

Under F *status quo* for 2010 and 2011, projected SSB values for 2011 and 2012 are about 4800 t in 2011 and 4900 t in 2012. Hence, SSB in 2011 and 2012 would increase slightly from the 4700 t value estimated for 2010.

The contributions of recent year classes to the projected landings and SSB are presented in Table 9.2.16 (under F *status quo*). The three year classes 2007-2009 constitute 55% and 49% of the predicted SSB for 2011 and 2012, respectively. The year classes for which GM_{90-07} recruitment is assumed contribute less than 1% to landings in 2011 and 29% to SSB in 2012.

9.2.4.2 Yield and biomass per recruit analysis

The input data for this analysis are given in Table 9.2.13. Results are in Table 9.2.17. The left panel of Figure 9.2.8 plots yield-per-recruit and SSB-per-recruit versus Fbar.

Under F s*tatus quo* (Fbar=0.25), yield-per-recruit is 0.044 kg and SSB-per-recruit is 0.199 kg. Assuming GM_{90-07} recruitment of 24.7 million, the equilibrium yield would be around 1090 t with an SSB value of 4900 t.

F_{max} is not well defined for this stock. Assuming GM_{90-07} recruitment and $F_{0.1}$(=0.14), equilibrium yield would be around 990 t and SSB 6700 t.

9.2.4.3 Biological reference points

There are no biological reference points for this stock. The table below summarises the history of limit point considerations for this stock.

	ACFM 1998	WG-1999	WG-2000	ACFM 2000	WG-2002	ACFM 2003	WG-2003
F_{lim}	0.25 (**F_{loss}** WG98)	No proposal	0.40 (**F_{loss}**)		Not defined		
F_{pa}	0.20 (**F_{lim}** $e^{-1.645*\sigma}$)	No proposal	0.30 (**F_{lim}** $e^{-1.645*\sigma}$)	Not adopted	0.31 (**F_{med}**)	Not adopted	No proposal
B_{lim}	3 400 t (**B_{loss}**,=B_{96} WG98)	4 700 t (**B_{loss}**=B_{96} WG99) *			Not defined		
B_{pa}	5 000 t (B_{lim} × 1.4)	6 500 t	4 700 t (**B_{loss}**,=B_{95})	Not adopted	5 000 t (**B_{loss}**=B_{95})	Not adopted	No proposal

*** A new maturity ogive was used.**

Stock-recruitment data from before 1990 are not considered reliable. For the remaining years there is no evidence of reduced recruitment at the lower stock levels observed (Figure 9.2.9.(a)).

At present, there is no new information to define biomass reference points B_{lim} and B_{pa} for this stock. B_{loss} is now estimated at 3500 t (2001 SSB).

Possible Reference Points for the MSY Approach to advice:

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 (see Figure 9.2.7(b)). Nonetheless, an attempt has been made this year to examine possible Fmsy candidates.

Possible proxies considered for Fmsy are in the range of Fmax, F0.1 and F35%. Fmax is not well defined for this stock, as the yield-per-recruit curve generally shows a very flat top. The following table shows the values estimated for these 3 possible proxies in the last 6 WGs:

	WG2005	WG2006	WG2007	WG2008	WG2009	WG2010
Fmax	0.63	0.48	0.55	0.57	0.62	0.39
F0.1	0.27	0.17	0.18	0.14	0.18	0.14
F35percent	0.31	0.26	0.27	0.25	0.28	0.24

There has been some variability in these values throughout the years, with a non-negligible decrease this year. The assessment of this stock and yield-per-recruit calculation ignore the fact that discards exist, hence, Fmax and F0.1 are likely to be overestimated. A rough sensitivity exercise was conducted in this Working Group, where yield-per-recruit was computed based on landings assuming the following proportion of individuals landed at age: (0.01,0.01,0.4,0.8,1,1,1,1) for ages 0 to 7+, respectively, and dividing the exploitation pattern-at-age by these proportions, thus increasing the fishing mortality of the younger ages. The following table displays the results from the original analysis (ignoring discards, left side of the table) and the sensitivity exercise (with the assumed landed proportions, 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	0.39	0.05	0.16	0.21	0.03	0.21
F01	0.14	0.04	0.27	0.13	0.03	0.28
F35percent	0.24	0.04	0.21	0.21	0.03	0.21
F40percent	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, F35percent and F40percent values are much less affected.

Additionally, Figure 9.2.9(b) displays the estimated SSB and recruitment from XSA together with the replacement lines corresponding to Fmax, F0.1, F35percent and F40percent from the original analysis. All these replacement lines cross through the cloud of points. F40percent=0.18 is proposed as Fmsy proxy, consistently with the choice made for *L.whiffiagonis*. This proposal should be considered as preliminary and may be revised as further work continues on this assessment.

9.2.5 Comments on the assessment

One commercial fleet (SP-CORUTR8c) and the Spanish survey (SP-GFS) 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 29% of the predicted SSB in 2012 relying on year classes with recruitment assumed to be given by GM_{90-07}. The GM recruitment assumed for the predictions is taken over the period 1990-2007, to avoid using data from years based on a combined ALK.

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 40-62% of the total catch. Including discards would produce a more real picture of fishing exploitation and stock dynamics. The most important effect of discards inclusion would probably be possible shifts in 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. Fishing at *status quo* F (Fbar=0.25) during 2010 and 2011 would result in some biomass increase from the 2009 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. The estimated Fbar values for the two species display a correlation of only 0.33 over the 24 years in the assessment.

Table 9.2.1(a) 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

* Data revised in WG2010 from original value presented

Table. 9.2.1(b) Megrim (*L. boscii*) in Divisions VIIIc, IXa. Discard/Total Catch ratio and estimated CV for Spanish trawlers

Year	1993	1994	1997	1999	2000	2001	2003	2004	2005	2006	2007	2008**	2009
Weight Ratio	0.27	0.3	0.28	0.24	0.33	0.13	0.21	0.3	0.3	0.27	0.21	0.20	0.23
CV	42.5	23.2	11.2	14.4	16.5	12.6	10.2	23.1	24	48.4	18.3	22.6	21.1
Number Ratio	0.61	0.6	0.62	0.59	0.6	0.4	0.49	0.56 *	0.56	0.42	0.46	0.41	0.39

* Modified in 2005 due to revision in the length data

** Modified in 2009 due to revision in landings data

Table 9.2.2(a) Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Length compositions of landings in 2009 ('000 fish)

	Spain		Portugal		Total		
Length (cm)	**Div. VIIIc**	**Div. IXa**	**Trawler**	**Artisanal**	**Spain**	**Portugal**	**Total**
10							
11							
12		0.296			0.296		0.296
13							
14							
15		0.569			0.569		0.569
16	47.594	0.819	3.934		48.413	3.934	52.347
17	26.485	14.142	8.993		40.627	8.993	49.620
18	105.200	63.663	24.154	0.331	168.862	24.485	193.347
19	316.305	185.775	44.795	9.231	502.079	54.026	556.105
20	539.447	359.739	119.096	9.927	899.186	129.023	1028.210
21	695.024	485.469	221.896	25.352	1180.493	247.248	1427.741
22	721.204	450.646	265.339	37.811	1171.850	303.149	1474.999
23	695.932	423.198	243.590	37.877	1119.130	281.467	1400.597
24	528.765	350.606	165.930	37.319	879.370	203.250	1082.620
25	433.895	280.955	145.876	18.961	714.850	164.838	879.688
26	368.377	212.764	100.397	17.236	581.141	117.633	698.774
27	212.188	134.772	90.891	22.557	346.960	113.448	460.408
28	177.665	79.199	68.344	9.663	256.864	78.007	334.871
29	114.980	52.635	37.047	4.870	167.615	41.917	209.532
30	95.034	32.534	6.931	12.594	127.568	19.525	147.093
31	42.231	22.774	4.062	4.003	65.005	8.065	73.070
32	27.049	15.287	9.398	1.656	42.335	11.054	53.389
33	24.414	10.506	1.048	0.204	34.920	1.253	36.173
34	12.133	7.465	0.985	0.013	19.598	0.998	20.597
35	4.113	5.235	0.031	0.204	9.348	0.235	9.583
36	8.407	0.917			9.323		9.323
37	0.937	0.520			1.457		1.457
38	0.075				0.075		0.075
39	0.114				0.114		0.114
40	0.262				0.262		0.262
41		0.070			0.070		0.070
42	0.075	8.500			8.575		8.575
43							
44							
45	0.302				0.302		0.302
46							
47							
48	0.302				0.302		0.302
49							
50+							
Total	5199	3199	1563	250	8398	1813	10210

Table 9.2.2(b) Megrim (*L. boscii*) Divisions VIIIc and IXa.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
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
Mean weight (g)	116	118	122	128	111	96	107	112	109	113	121	114	105	101	98	97	99	109	110	111

Table 9.2.3 Four-spot megrim (*L. boscii*) in Divisions VIIIc, IXa. 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
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)
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
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
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
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
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
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
+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
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
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
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

(*) Age 0 was not used in the assessment.

* Data revised in WG2010 from original value presented

Table 9.2.4 Four-spot megrim (*L. boscii*) in Divisions VIIIc, IXa. Catch weights at age (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
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
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
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
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
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
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
+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
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

* Data revised in WG2010 from original value presented

Table 9.2.5 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	0.82	0.35	3.96	0.32

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	6.68	3.15	52.83	3.97

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

+ 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)

Table 9.2.6 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Tuning data

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

1986	2009									
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

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: SP-GFS (n/30 min)

1988	2009									
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

* SP-AVILESTR fleet excluded from the assessment.

Table 9.2.7 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	na		111	35.4	3.1
2005	189	20.7	9.1	48	na		140	42.6	3.3
2006	198	19.3	10.3	35	na		149	40.3	3.7
2007*	232	21.2	10.9	22	na		165	43.8	3.8
2008*	288	20.2	14.3	15	na		146	38.4	3.8
2009	195	16.2	12.1	44	na		183	49.3	3.7

[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

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Extended Survivors Analysis

Four spot megrim (L. boscii) Division VIIIc and IXa

CPUE data from file fleetb.txt

Catch data for 24 years. 1986 to 2009. Ages 0 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-CORUTR8c	1986	2009	3	6	0	1
SP-GFS□	1988	2009	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 = .00093

Final year F values

Age	0	1	2	3	4	5	6
Iteration 39	0	0.0018	0.0538	0.3361	0.4265	0.4713	0.2861
Iteration 40	0	0.0018	0.0538	0.3362	0.4262	0.4718	0.286

Regression weights

	0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	0	0	0	0	0	0	0	0	0	0
1	0.003	0.009	0.01	0.019	0.016	0.006	0.001	0.001	0.001	0.002
2	0.118	0.096	0.176	0.201	0.177	0.139	0.176	0.07	0.118	0.054
3	0.205	0.347	0.294	0.331	0.355	0.33	0.395	0.256	0.214	0.336
4	0.563	0.519	0.358	0.302	0.523	0.372	0.42	0.418	0.345	0.426
5	0.485	0.968	0.144	0.435	0.399	0.637	0.351	0.805	0.277	0.472
6	0.553	0.488	0.29	0.247	0.466	0.535	0.223	0.58	0.335	0.286

XSA population numbers (Thousands)

	AGE						
YEAR	0	1	2	3	4	5	6
2000	2.47E+04	1.69E+04	6.48E+03	9.80E+03	7.15E+03	5.32E+03	2.04E+03
2001	2.57E+04	2.02E+04	1.38E+04	4.72E+03	6.54E+03	3.33E+03	2.68E+03
2002	2.61E+04	2.10E+04	1.64E+04	1.02E+04	2.73E+03	3.19E+03	1.04E+03
2003	3.25E+04	2.14E+04	1.70E+04	1.13E+04	6.26E+03	1.56E+03	2.26E+03
2004	2.81E+04	2.66E+04	1.72E+04	1.14E+04	6.62E+03	3.79E+03	8.28E+02
2005	3.92E+04	2.30E+04	2.14E+04	1.18E+04	6.55E+03	3.21E+03	2.08E+03
2006	2.32E+04	3.21E+04	1.88E+04	1.53E+04	6.93E+03	3.69E+03	1.39E+03
2007	2.04E+04	1.90E+04	2.63E+04	1.29E+04	8.41E+03	3.73E+03	2.13E+03
2008	1.61E+04	1.67E+04	1.55E+04	2.00E+04	8.16E+03	4.53E+03	1.36E+03
2009	3.11E+04	1.32E+04	1.36E+04	1.13E+04	1.32E+04	4.73E+03	2.81E+03

Estimated population abundance at 1st Jan 2010

0.00E+00	2.55E+04	1.08E+04	1.06E+04	6.60E+03	7.09E+03	2.42E+03

Taper weighted geometric mean of the VPA populations:

2.42E+04	1.93E+04	1.62E+04	1.17E+04	7.04E+03	3.46E+03	1.62E+03

Standard error of the weighted Log(VPA populations) :

0.3343	0.3474	0.3466	0.3873	0.4279	0.3737	0.4906

Log catchability residuals.

Fleet : SP-CORUTR8c

Age	1986	1987	1988	1989
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
4	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.2	0.28	0.2	0.53	-0.51	0.16	-0.63	-0.48	0.41	0.32
4	0.3	-0.18	0.5	0.78	0.15	-0.14	-0.18	-0.68	0.31	0.17
5	0.01	0.75	0.39	0.1	0.11	0.26	-0.59	-0.29	0.36	0.02
6	-0.11	0.45	0.3	0.3	0.06	0.22	-0.27	0.08	0.15	0.27

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
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	-6.4991	-5.7102	-5.2854	-5.2854
S.E(Log q)	0.54	0.4743	0.4049	0.2668

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	0.7	0.435	7.37	0.73	10	0.51	-6.5
4	0.68	0.731	6.73	0.87	10	0.38	-5.71
5	2.34	-1.295	1.55	0.54	10	0.81	-5.29
6	0.96	0.124	5.24	0.93	10	0.32	-5.16
1							

Fleet : SP-GFS

Age	1986	1987	1988	1989
0	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99
3	99.99	99.99	99.99	99.99
4	99.99	99.99	99.99	99.99
5	99.99	99.99	99.99	99.99
6	99.99	99.99	99.99	99.99

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	-0.35	-0.21	-0.16	-0.01	0.33	-0.15	0.56	0.73	0.17	0.04
1	0.14	-0.13	0.53	0.08	-0.88	0.32	0.15	0.08	-0.1	0.35
2	-0.28	-0.5	-0.78	-0.27	-0.58	-0.76	0.03	-0.29	-0.21	0.05
3	-1.22	-1.02	-0.71	-0.79	-0.74	-0.86	-0.68	0.04	-0.19	-0.21
4	-0.44	-0.84	-0.44	-0.63	-0.19	-0.45	-0.76	-0.15	0.01	-0.47
5	-0.08	-0.16	-0.16	-0.8	-0.12	-0.26	0.24	-0.01	0.45	-0.35
6	-0.64	-1.3	-0.24	-0.35	-0.09	-0.27	0.27	0.07	0.11	-0.19

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	-0.08	-0.41	-0.15	99.99	-0.16	0.19	-0.31	0.02	-0.17	0.26
1	0.26	0.3	-0.31	99.99	0.26	0.21	-0.32	-0.08	-0.3	-0.16
2	0.09	0.16	0.06	99.99	-0.11	0.32	-0.04	0.01	-0.02	0.21
3	-0.24	0.5	0.14	99.99	-0.1	0.44	-0.07	0.21	-0.53	0.73
4	0.34	0.3	0.32	99.99	-0.05	0.24	-0.25	0.23	-0.45	0.45
5	-0.04	1.08	-0.72	99.99	-0.5	0.51	-0.34	0.38	-0.87	0.67
6	-0.04	0.14	-0.14	99.99	-0.24	-0.07	-0.06	0.13	-0.01	-0.04

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	-6.9867	-7.1868	-7.4634	-7.4634
S.E(Log q)	0.4419	0.3641	0.6017	0.1582

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	0.49	1.801	9.92	0.58	19	0.3	-9.77
1	1.07	-0.25	7.02	0.61	19	0.3	-7.19
2	0.99	0.026	6.93	0.71	19	0.24	-6.92

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	1.64	-1.153	5.47	0.26	19	0.71	-6.99
4	1.16	-0.515	6.92	0.53	19	0.44	-7.19
5	1.39	-0.428	7.17	0.12	19	0.87	-7.46
6	0.89	1.393	7.49	0.94	19	0.13	-7.5

Terminal year survivor and F summaries :

Age 0 Catchability dependent on age and year class strength

Year class = 2009

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	1	0	0	0	0	0	0
SP-GFS□	32873	0.335	0	0	1	0.518	0
P shrinkage m	19350	0.35				0.482	0
F shrinkage m	0	1.5				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
25458	0.24	0.37	2	1.525	0

Age 1 Catchability dependent on age and year class strength

Year class = 2008

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	1	0	0	0	0	0	0
SP-GFS□	9102	0.238	0.006	0.03	2	0.668	0.002
P shrinkage m	16205	0.35				0.315	0.001
F shrinkage m	3779	1.5				0.017	0.005

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
10755	0.19	0.2	4	1.019	0.002

Age 2 Catchability dependent on age and year class strength

Year class = 2007

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	1	0	0	0	0	0	0
SP-GFS□	10499	0.182	0.149	0.82	3	0.801	0.054
P shrinkage m	11697	0.39				0.186	0.049
F shrinkage m	3998	1.5				0.012	0.136

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
10584	0.16	0.11	5	0.679	0.054

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

Year class = 2006

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	1	0	0	0	0	0	0
SP-GFS□	6591	0.169	0.187	1.11	4	0.981	0.337
F shrinkage m	7210	1.5				0.019	0.312

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
6603	0.17	0.16	5	0.956	0.336

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

Year class = 2005

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	1	0	0	0	0	0	0
SP-GFS	7084	0.158	0.163	1.03	5	0.979	0.426
F shrinkage m	7241	1.5				0.021	0.419

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
7087	0.16	0.14	6	0.913	0.426

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

Year class = 2004

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	1	0	0	0	0	0	0
SP-GFS	2421	0.156	0.146	0.94	6	0.971	0.471
F shrinkage m	2260	1.5				0.029	0.498

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2416	0.16	0.13	7	0.833	0.472

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

Year class = 2003

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR8c	1	0	0	0	0	0	0
SP-GFS	1750	0.172	0.135	0.78	6	0.976	0.283
F shrinkage m	1116	1.5				0.024	0.414

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1731	0.17	0.12	7	0.727	0.286

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

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Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1986	1987	1988	1989
AGE				
0	0	0	0	0
1	0.0025	0.0592	0.0618	0.0261
2	0.117	0.3835	0.3996	0.4538
3	0.2118	0.2501	0.3133	0.3866
4	0.4309	0.3294	0.3959	0.6669
5	0.3344	0.2541	0.3765	0.5654
6	0.3277	0.2794	0.3642	0.5441
+gp	0.3277	0.2794	0.3642	0.5441
FBAR 2- 4	0.2532	0.321	0.3696	0.5024

Table 8 Fishing mortality (F) at age

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	0.059	0.0777	0.027	0.0187	0.0091	0.0674	0.0153	0.002	0.0031	0.0053
2	0.2597	0.2095	0.2573	0.0966	0.1315	0.3531	0.1369	0.061	0.0883	0.1018
3	0.2048	0.2646	0.3704	0.3308	0.274	0.4486	0.3527	0.2754	0.3033	0.3017
4	0.5265	0.3304	0.8576	0.7339	0.7301	0.6485	0.5616	0.3614	0.5054	0.5096
5	0.6033	0.8813	0.7998	0.4596	0.8242	0.9456	0.4743	0.4974	0.691	0.483
6	0.4606	0.5976	0.6558	0.5655	0.7329	0.8312	0.4644	0.5392	0.5138	0.5267
+gp	0.4606	0.5976	0.6558	0.5655	0.7329	0.8312	0.4644	0.5392	0.5138	0.5267
FBAR 2- 4	0.3303	0.2682	0.4951	0.3871	0.3786	0.4834	0.3504	0.2326	0.299	0.3044

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR 07-09
AGE											
0	0	0	0	0	0	0	0	0	0	0	0
1	0.003	0.0092	0.01	0.0192	0.0164	0.0059	0.0012	0.0005	0.001	0.0018	0.0011
2	0.1184	0.0957	0.1756	0.2008	0.1767	0.1394	0.1758	0.07	0.1179	0.0538	0.0805
3	0.2052	0.3469	0.2938	0.3313	0.3551	0.33	0.3953	0.2562	0.2141	0.3362	0.2688
4	0.5626	0.5187	0.3578	0.3021	0.5229	0.3723	0.4205	0.4181	0.3445	0.4262	0.3963
5	0.4846	0.9678	0.1442	0.4353	0.3994	0.6373	0.3505	0.8052	0.2772	0.4718	0.5181
6	0.5527	0.4876	0.2898	0.2469	0.4659	0.5346	0.2235	0.58	0.3346	0.286	0.4002
+gp	0.5527	0.4876	0.2898	0.2469	0.4659	0.5346	0.2235	0.58	0.3346	0.286	
FBAR 2- 4	0.2954	0.3204	0.2757	0.2781	0.3516	0.2806	0.3305	0.2481	0.2255	0.2721	

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 28/04/2010 13:35

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
AGE				
0	53588	34330	38360	34040
1	49195	43874	28107	31407
2	34790	40178	33855	21632
3	21361	25339	22417	18587
4	12439	14150	16156	13417
5	4402	6619	8334	8903
6	3358	2580	4203	4683
+gp	899	635	1663	1642
TOTAL	180032	167705	153096	134310

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

YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
AGE										
0	20950	42927	39734	12332	29446	35193	23535	19832	9726	20613
1	27869	17152	35145	32532	10096	24108	28814	19269	16237	7963
2	25051	21511	12993	28009	26141	8191	18452	23231	15744	13253
3	11251	15819	14283	8225	20820	18765	4711	13175	17895	11801
4	10339	7506	9940	8074	4837	12961	9809	2711	8190	10818
5	5638	5000	4416	3452	3173	1908	5548	4580	1546	4045
6	4141	2525	1696	1625	1785	1140	607	2827	2280	634
+gp	2382	1163	152	704	936	540	1624	1162	950	1304
TOTAL	107620	113603	118360	94952	97235	102805	93100	86786	72568	70430

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

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	GM 90-07
AGE												
0	24682	25653	26100	32477	28138	39216	23158	20369	16072	31088	0	24726
1	16877	20208	21003	21369	26590	23038	32108	18960	16677	13159	25458	
2	6485	13777	16394	17024	17163	21415	18750	26257	15515	13640	10755	
3	9800	4717	10250	11260	11403	11776	15251	12877	20044	11290	10584	
4	7145	6535	2730	6255	6620	6545	6932	8409	8160	13248	6603	
5	5321	3333	3185	1563	3786	3213	3693	3727	4532	4734	7087	
6	2043	2683	1037	2258	828	2079	1391	2130	1364	2812	2416	
+gp	2158	1012	1567	713	991	1038	1202	1142	1138	980	2333	
TOTAL	74511	77918	82265	92919	95518	108321	102485	93871	83503	90951	65236	

Table 9.2.12 Four-spot megrim (L. boscii) in Divisions VIIIc and IXa. Summary of catches and XSA results.

Run title : Four spot megrim (L. boscii) Division VIIIc and IXa

At 28/04/2010 13:35

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	53588	6770	5845	1124	0.1923	0.2532
1987	34330	8328	7148	1688	0.2361	0.321
1988	38360	8924	7976	2223	0.2787	0.3696
1989	34040	8582	7607	2629	0.3456	0.5024
1990	20950	7393	6721	1945	0.2894	0.3303
1991	42927	6674	6005	1682	0.2801	0.2682
1992	39734	6155	5337	1916	0.359	0.4951
1993	12332	6152	5459	1384	0.2535	0.3871
1994	29446	5764	5210	1403	0.2693	0.3786
1995	35193	5315	4602	1652	0.359	0.4834
1996	23535	4999	4278	1098	0.2567	0.3504
1997	19832	4673	4119	896	0.2175	0.2326
1998	9726	4922	4458	1123	0.2519	0.299
1999	20613	4520	4136	1125	0.272	0.3044
2000	24682	4307	3838	1041	0.2713	0.2954
2001	25653	4112	3500	931	0.266	0.3204
2002	26100	4702	4002	720	0.1799	0.2757
2003	32477	4950	4198	876	0.2087	0.2781
2004	28138	4845	4115	1006	0.2445	0.3516
2005	39216	5160	4316	983	0.2277	0.2806
2006	23158	5668	4896	1092	0.223	0.3305
2007	20369	5721	5020	1104	0.2199	0.2481
2008	16072	5933	5326	980	0.184	0.2255
2009	31088	5138	4717	1134	0.2404	0.2721
Arith. Mean	28398	5821	5118	1323	0.2553	0.3272
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

MFDP version 1a
Run: LDB
Time and date: 17:59 28/04/2010
Fbar age range: 2-4

2010 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	24726	0.2	0	0	0	0.003	0.000	0.003
1	25458	0.2	0.55	0	0	0.040	0.001	0.040
2	10755	0.2	0.86	0	0	0.068	0.081	0.068
3	10584	0.2	0.97	0	0	0.087	0.269	0.087
4	6603	0.2	0.99	0	0	0.112	0.396	0.112
5	7087	0.2	1	0	0	0.139	0.518	0.139
6	2416	0.2	1	0	0	0.176	0.400	0.176
7	2333	0.2	1	0	0	0.240	0.400	0.240

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	24726	0.2	0	0	0	0.003	0.000	0.003
1	.	0.2	0.55	0	0	0.040	0.001	0.040
2	.	0.2	0.86	0	0	0.068	0.081	0.068
3	.	0.2	0.97	0	0	0.087	0.269	0.087
4	.	0.2	0.99	0	0	0.112	0.396	0.112
5	.	0.2	1	0	0	0.139	0.518	0.139
6	.	0.2	1	0	0	0.176	0.400	0.176
7	.	0.2	1	0	0	0.240	0.400	0.240

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	24726	0.2	0	0	0	0.003	0.000	0.003
1	.	0.2	0.55	0	0	0.040	0.001	0.040
2	.	0.2	0.86	0	0	0.068	0.081	0.068
3	.	0.2	0.97	0	0	0.087	0.269	0.087
4	.	0.2	0.99	0	0	0.112	0.396	0.112
5	.	0.2	1	0	0	0.139	0.518	0.139
6	.	0.2	1	0	0	0.176	0.400	0.176
7	.	0.2	1	0	0	0.240	0.400	0.240

Input units are thousands and kg - output in tonnes

Table 9.2.14. Megrim (*L. boscii*) in Div. VIIIc and IXa catch forecast : management option table

MFDP version 1a
Run: LDB
Four spot megrim (L. boscii) Division VIIIc and IXa
Time and date: 17:59 28/04/2010
Fbar age range: 2-4

2010				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
5440	4783	1	0.2486	1133

2011					2012	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
5475	4821	0	0	0	6694	6057
.	4821	0.1	0.0249	121	6559	5923
.	4821	0.2	0.0497	237	6430	5794
.	4821	0.3	0.0746	349	6305	5670
.	4821	0.4	0.0994	458	6185	5550
.	4821	0.5	0.1243	562	6069	5435
.	4821	0.6	0.1491	663	5957	5324
.	4821	0.7	0.174	760	5850	5217
.	4821	0.8	0.1988	854	5746	5113
.	4821	0.9	0.2237	945	5646	5014
.	4821	1	0.2486	1033	5549	4918
.	4821	1.1	0.2734	1117	5456	4825
.	4821	1.2	0.2983	1199	5366	4736
.	4821	1.3	0.3231	1278	5280	4650
.	4821	1.4	0.348	1354	5196	4567
.	4821	1.5	0.3728	1428	5115	4486
.	4821	1.6	0.3977	1499	5037	4409
.	4821	1.7	0.4225	1568	4962	4334
.	4821	1.8	0.4474	1634	4889	4262
.	4821	1.9	0.4723	1699	4819	4192
.	4821	2	0.4971	1761	4752	4125

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.

MFDP version 1a
Run: LDB
Time and date: 17:59 28/04/2010
Fbar age range: 2-4

Year: 2010 F multiplier: 1 Fbar: 0.2486

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	24726	66	0	0	0	0
1	0.0011	25	1	25458	1010	14002	555	14002	555
2	0.0806	756	51	10755	731	9249	629	9249	629
3	0.2688	2271	197	10584	917	10266	890	10266	890
4	0.3963	1971	221	6603	742	6537	734	6537	734
5	0.5181	2619	365	7087	987	7087	987	7087	987
6	0.4002	727	128	2416	426	2416	426	2416	426
7	0.4002	702	169	2333	561	2333	561	2333	561
Total		9072	1133	89962	5440	51891	4783	51891	4783

Year: 2011 F multiplier: 1 Fbar: 0.2486

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	24726	66	0	0	0	0
1	0.0011	20	1	20244	803	11134	442	11134	442
2	0.0806	1463	99	20820	1416	17905	1218	17905	1218
3	0.2688	1743	151	8124	704	7880	683	7880	683
4	0.3963	1977	222	6623	744	6557	737	6557	737
5	0.5181	1344	187	3637	507	3637	507	3637	507
6	0.4002	1040	183	3456	609	3456	609	3456	609
7	0.4002	784	188	2606	626	2606	626	2606	626
Total		8372	1033	90236	5475	53176	4821	53176	4821

Year: 2012 F multiplier: 1 Fbar: 0.2486

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	24726	66	0	0	0	0
1	0.0011	20	1	20244	803	11134	442	11134	442
2	0.0806	1163	79	16556	1126	14238	968	14238	968
3	0.2688	3375	293	15727	1363	15255	1322	15255	1322
4	0.3963	1517	170	5083	571	5033	565	5033	565
5	0.5181	1348	188	3648	508	3648	508	3648	508
6	0.4002	534	94	1774	313	1774	313	1774	313
7	0.4002	1001	241	3326	799	3326	799	3326	799
Total		8959	1065	91085	5549	54408	4918	54408	4918

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	2007	2008	2009	2010	2011
Stock No. (thousands) of 0 year-olds	20369	16072	31088	24726	24726
Source	XSA	XSA	XSA	GM90-07	GM90-07
Status Quo F:					
% in 2010 landings	17.4	4.5	0.1	0.0	-
% in 2011	21.5	14.6	9.6	0.1	0.0
% in 2010 SSB	18.6	13.2	11.6	0.0	-
% in 2011 SSB	15.3	14.2	25.3	9.2	0.0
% in 2012 SSB	10.3	11.5	26.9	19.7	9.0

GM : geometric mean recruitment

Four-spot megrim (L. boscii) in Divisions VIIIc and IXa : Year-class % contribution to

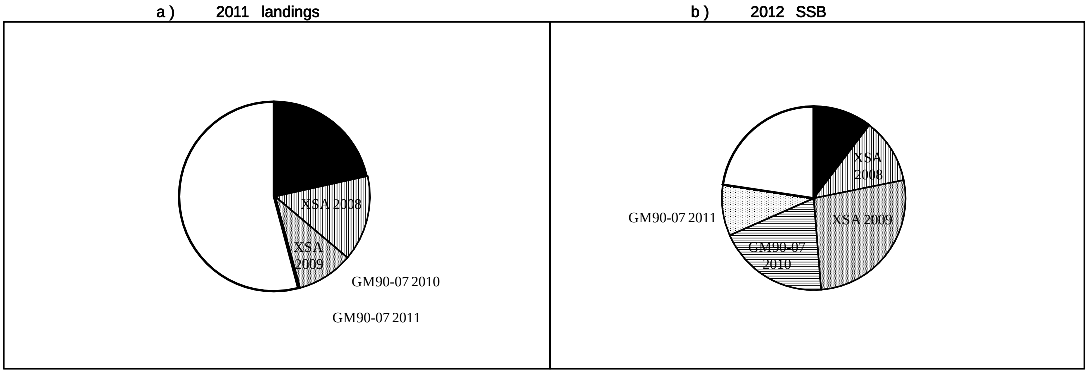


Table 9.2.17 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Yield per recruit results.

MFYPR version 2a
Run: LDB
Time and date: 09:20 29/04/2010
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	5.5167	0.6101	4.0334	0.5845	4.0334	0.5845
0.1	0.0249	0.0932	0.0154	5.0524	0.5061	3.5694	0.4806	3.5694	0.4806
0.2	0.0497	0.1596	0.0251	4.7221	0.4339	3.2395	0.4083	3.2395	0.4083
0.3	0.0746	0.2094	0.0315	4.4753	0.3812	2.993	0.3557	2.993	0.3557
0.4	0.0994	0.248	0.0357	4.2839	0.3413	2.8019	0.3159	2.8019	0.3159
0.5	0.1243	0.2789	0.0387	4.1312	0.3104	2.6494	0.2849	2.6494	0.2849
0.6	0.1491	0.3042	0.0407	4.0064	0.2858	2.5248	0.2604	2.5248	0.2604
0.7	0.174	0.3253	0.0421	3.9024	0.2659	2.4211	0.2405	2.4211	0.2405
0.8	0.1988	0.3432	0.0431	3.8144	0.2495	2.3334	0.2241	2.3334	0.2241
0.9	0.2237	0.3586	0.0437	3.7389	0.2358	2.2581	0.2104	2.2581	0.2104
1	0.2486	0.372	0.0442	3.6733	0.2242	2.1928	0.1989	2.1928	0.1989
1.1	0.2734	0.3838	0.0445	3.6157	0.2143	2.1355	0.189	2.1355	0.189
1.2	0.2983	0.3943	0.0447	3.5647	0.2058	2.0847	0.1805	2.0847	0.1805
1.3	0.3231	0.4036	0.0449	3.5192	0.1984	2.0394	0.1731	2.0394	0.1731
1.4	0.348	0.4121	0.0449	3.4782	0.1919	1.9986	0.1666	1.9986	0.1666
1.5	0.3728	0.4198	0.045	3.4411	0.1861	1.9618	0.1609	1.9618	0.1609
1.6	0.3977	0.4268	0.045	3.4073	0.181	1.9282	0.1558	1.9282	0.1558
1.7	0.4225	0.4332	0.045	3.3764	0.1764	1.8975	0.1512	1.8975	0.1512
1.8	0.4474	0.4391	0.0449	3.3479	0.1723	1.8692	0.1471	1.8692	0.1471
1.9	0.4723	0.4446	0.0449	3.3216	0.1686	1.8431	0.1434	1.8431	0.1434
2	0.4971	0.4497	0.0448	3.2972	0.1652	1.8189	0.14	1.8189	0.14

Reference point	F multiplier	Absolute F
Fbar(2-4)	1	0.2486
FMax	1.5665	0.3894
F0.1	0.5581	0.1387
F35%SPR	0.9485	0.2358
Flow	0.3661	0.091
Fmed	1.214	0.3018
Fhigh	2.3748	0.5903

Weights in kilograms

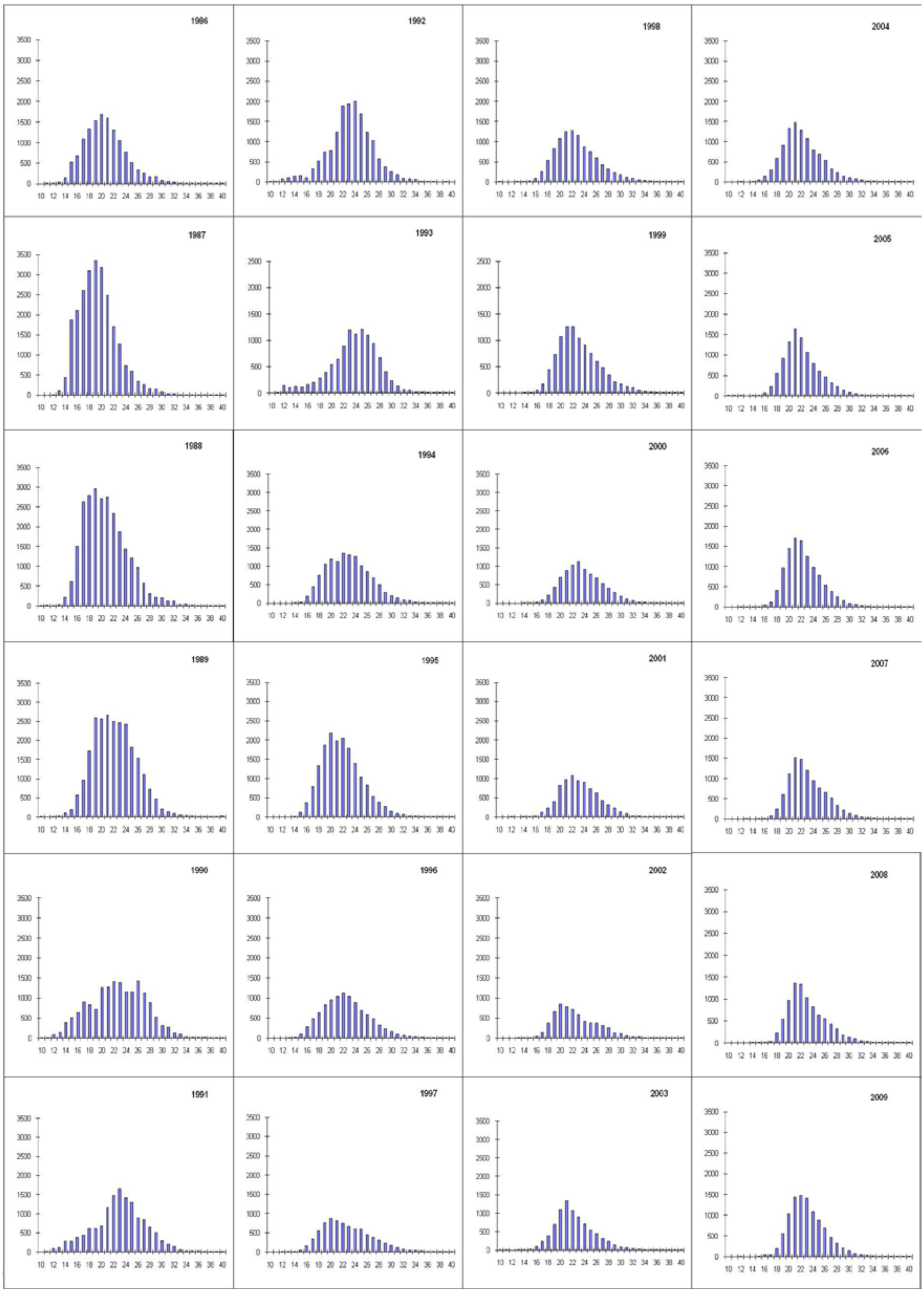


Figure 9.2.1 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Annual length compositions of landings ('000)

Standardized log(abundance index at age) from SP GFS

(black bubble means < 0)

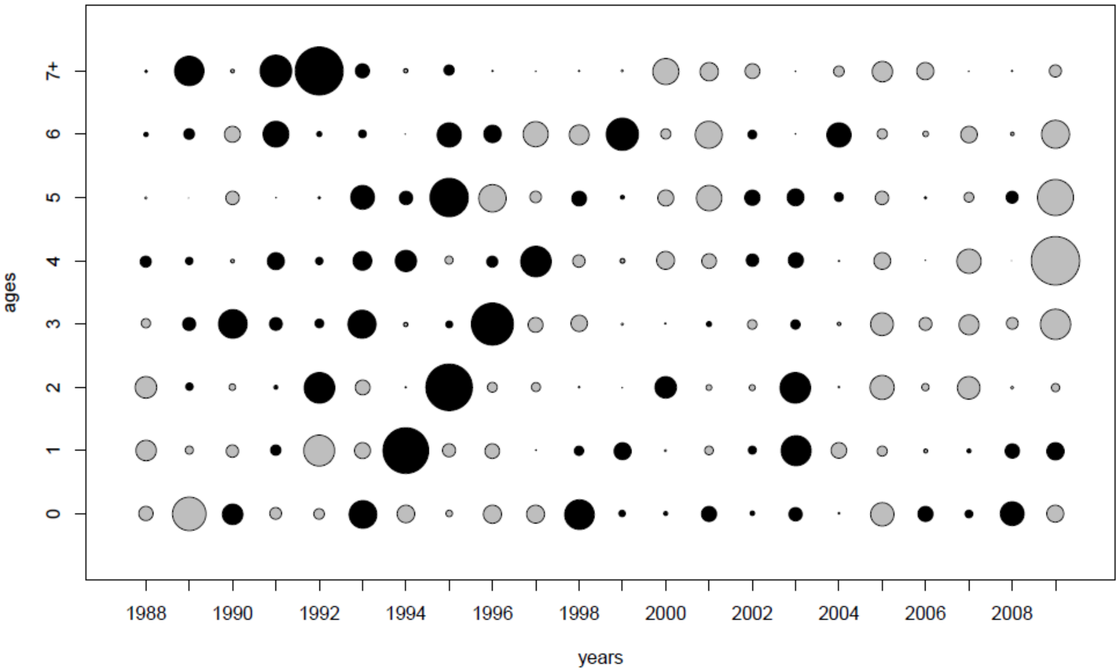
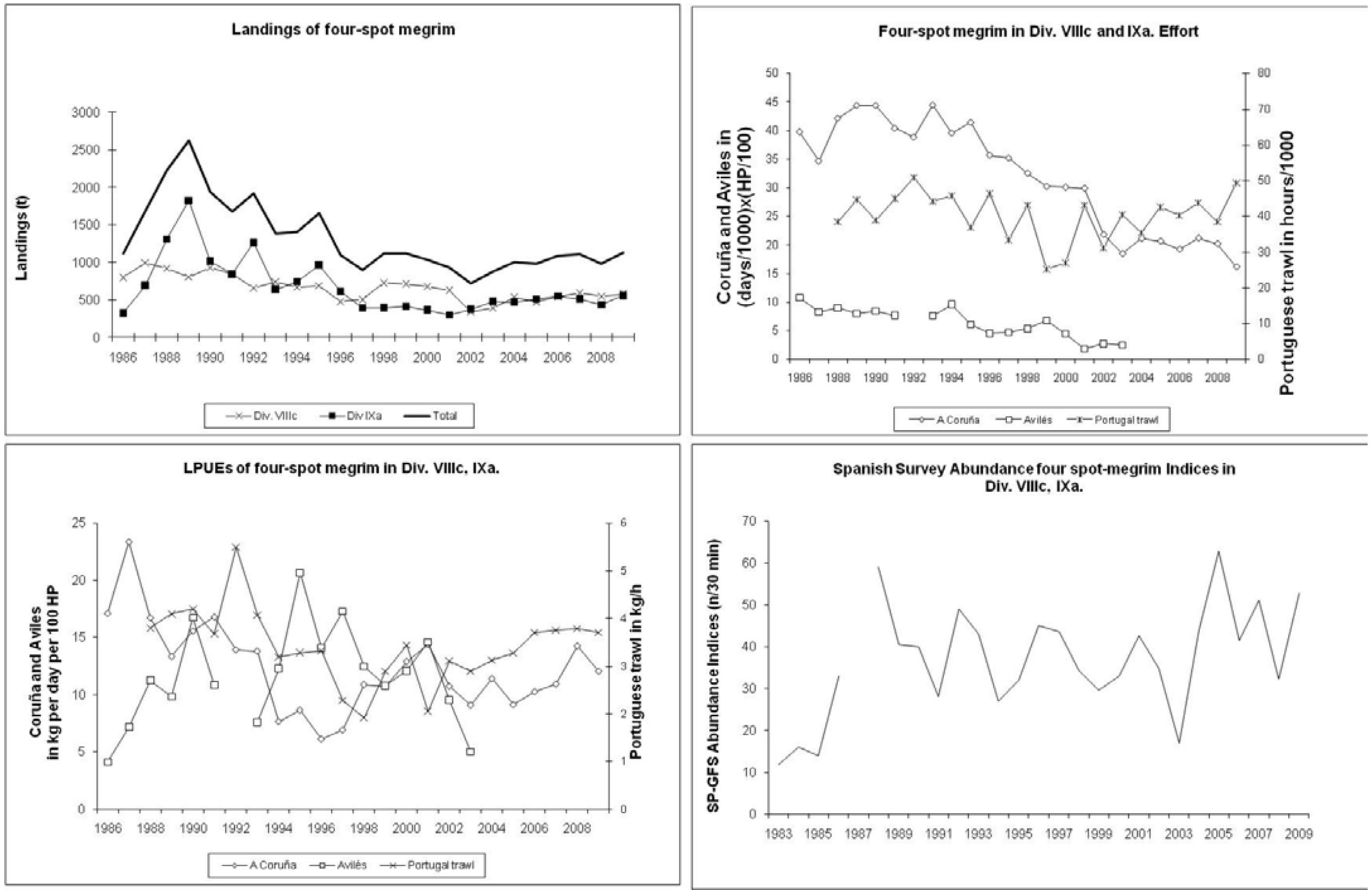


Figure 9.2.2: Four-spot megrim (*L. boscii*) in Divisions VIIIc&IXa

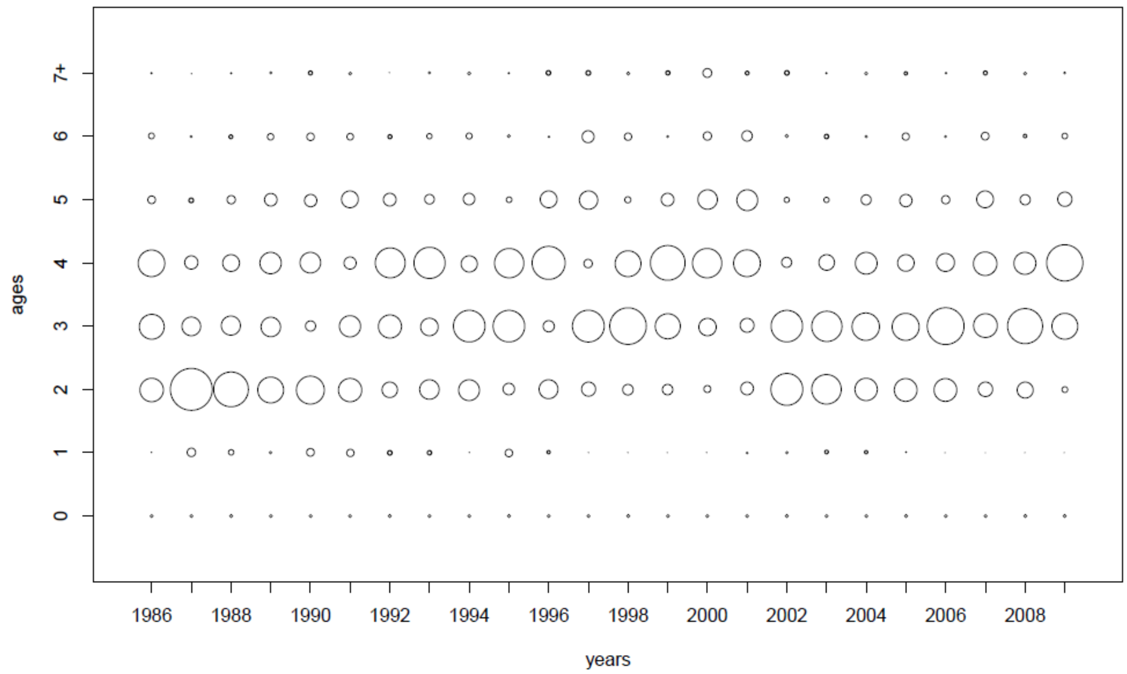


* Spanish Landings of 2008 revised in WG2010 from original value presented

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

Figure 9.2.3 Four-spot megrim (*L.boscii*) in Divisions VIIIc and IXa. Landings (t), Efforts, LPUEs and Abundance Indices.

Catch proportions at age



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

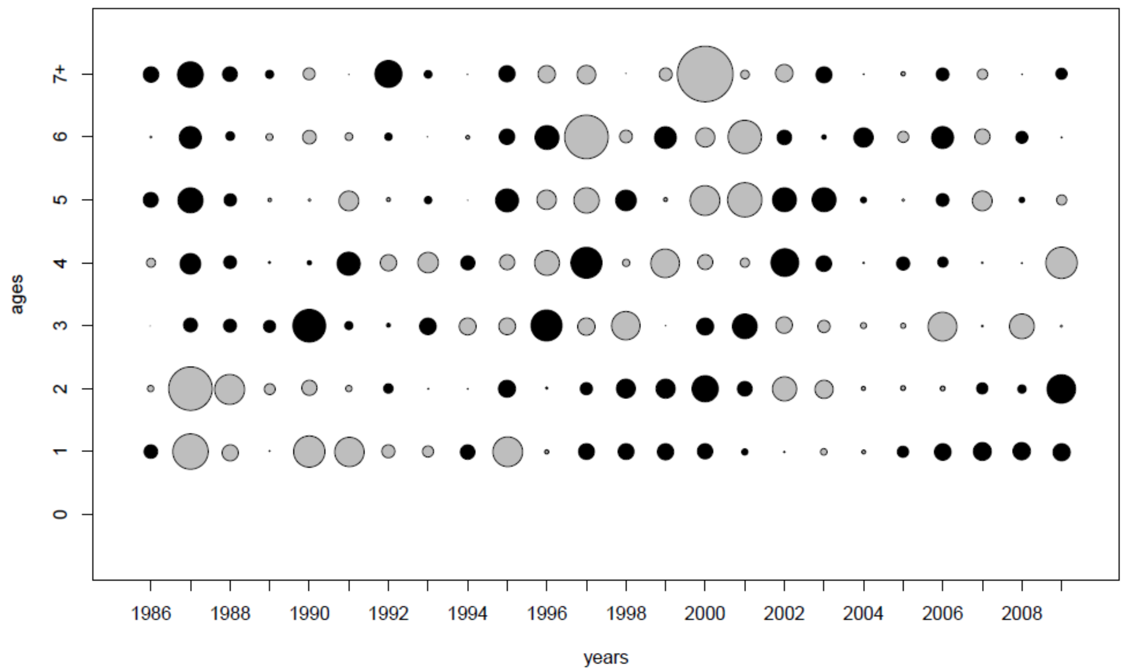


Figure 9.2.4. Four-spot megrim (*L. boscii*) in Divisions VIIIc & IXa.

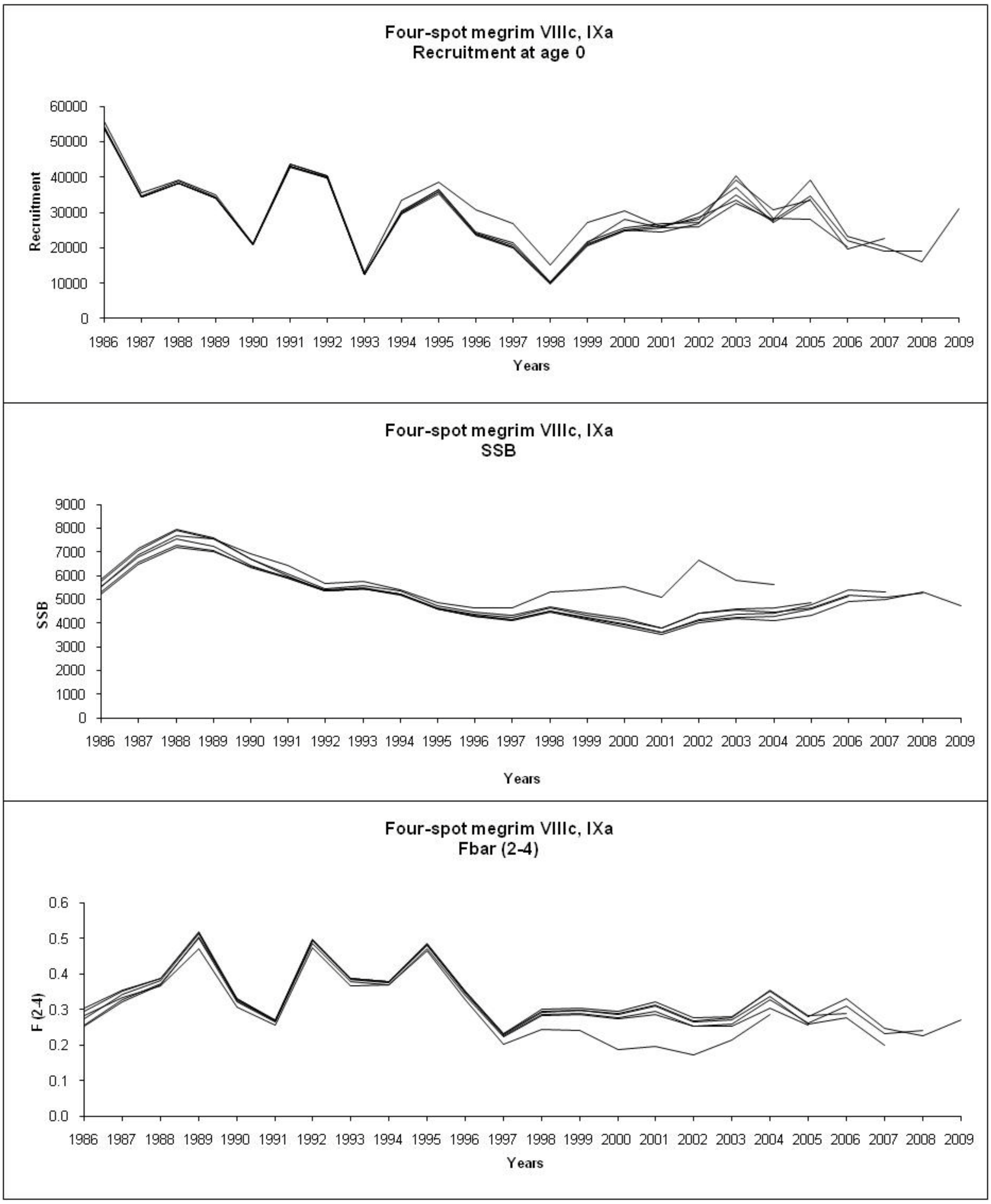


Figure 9.2.5. Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Retrospective XSA

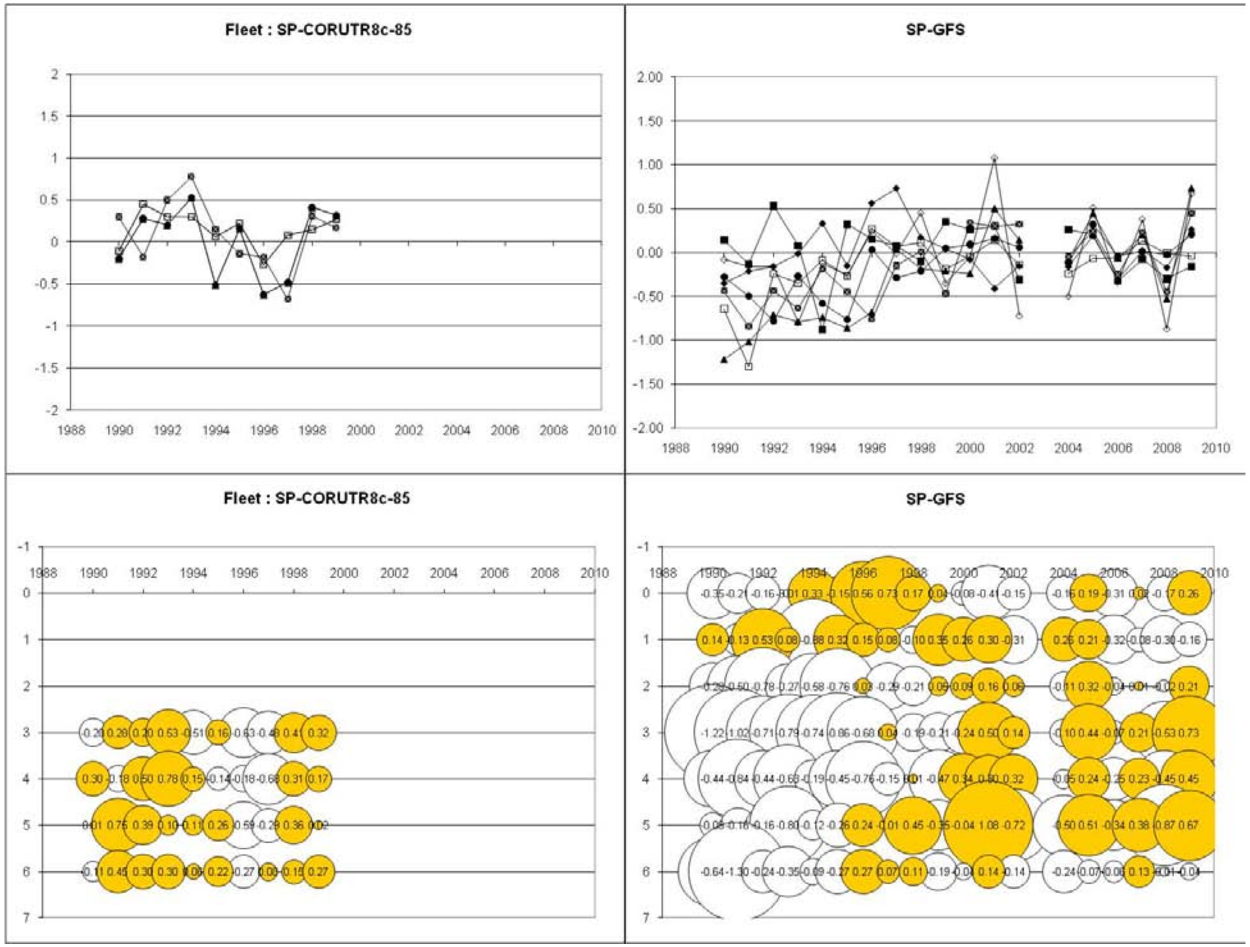
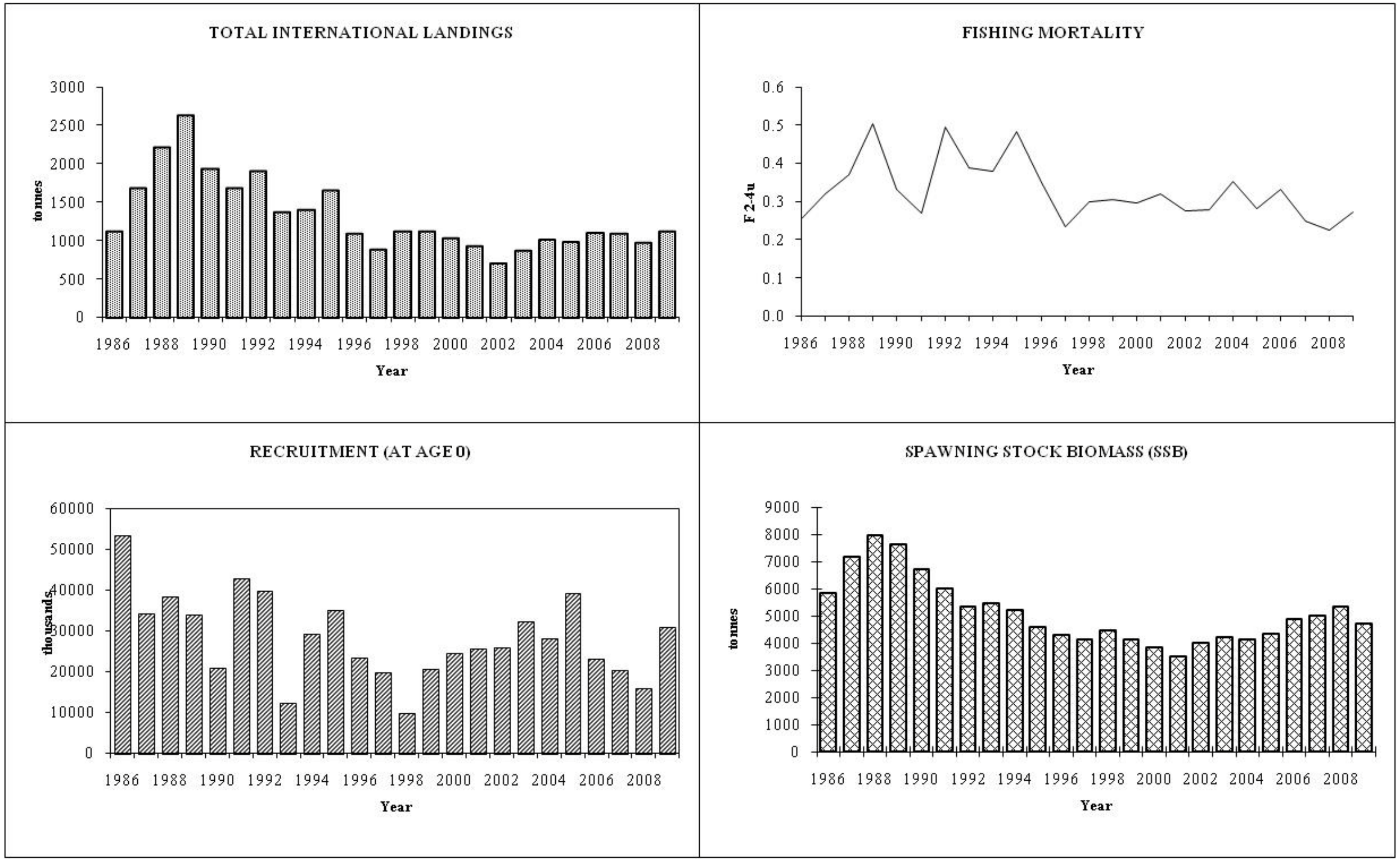


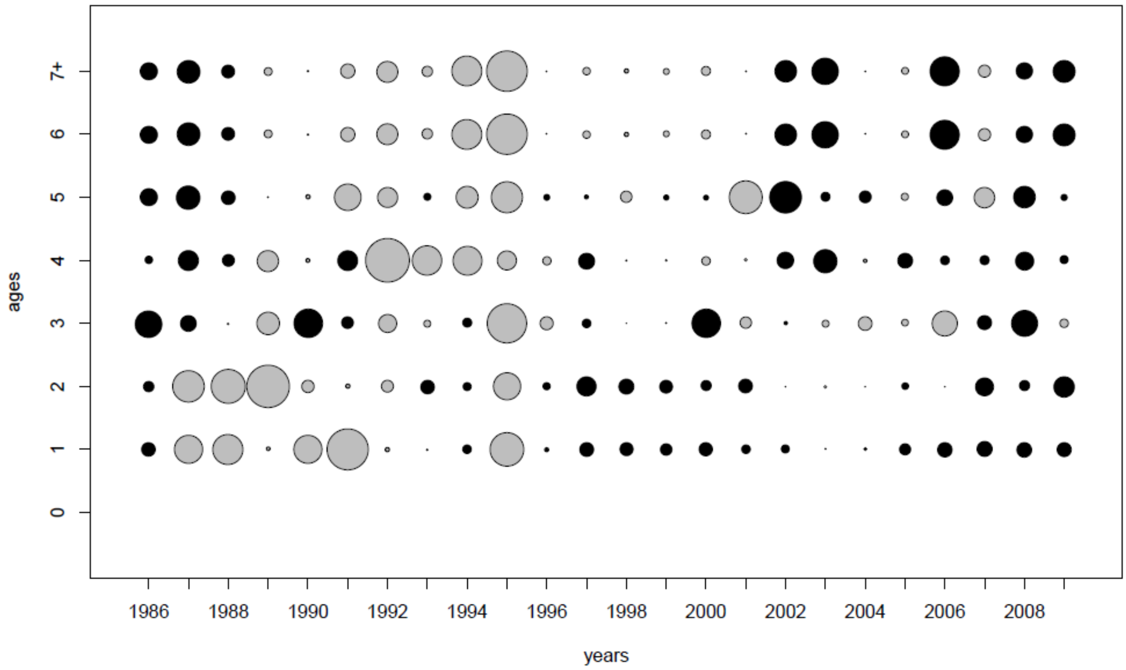
Figure 9.2.6. Four spot megrim (*L. boscii*) in Divisions VIIIc and IXa. LOG CATCHABILITY RESIDUAL PLOTS (XSA)



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

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)

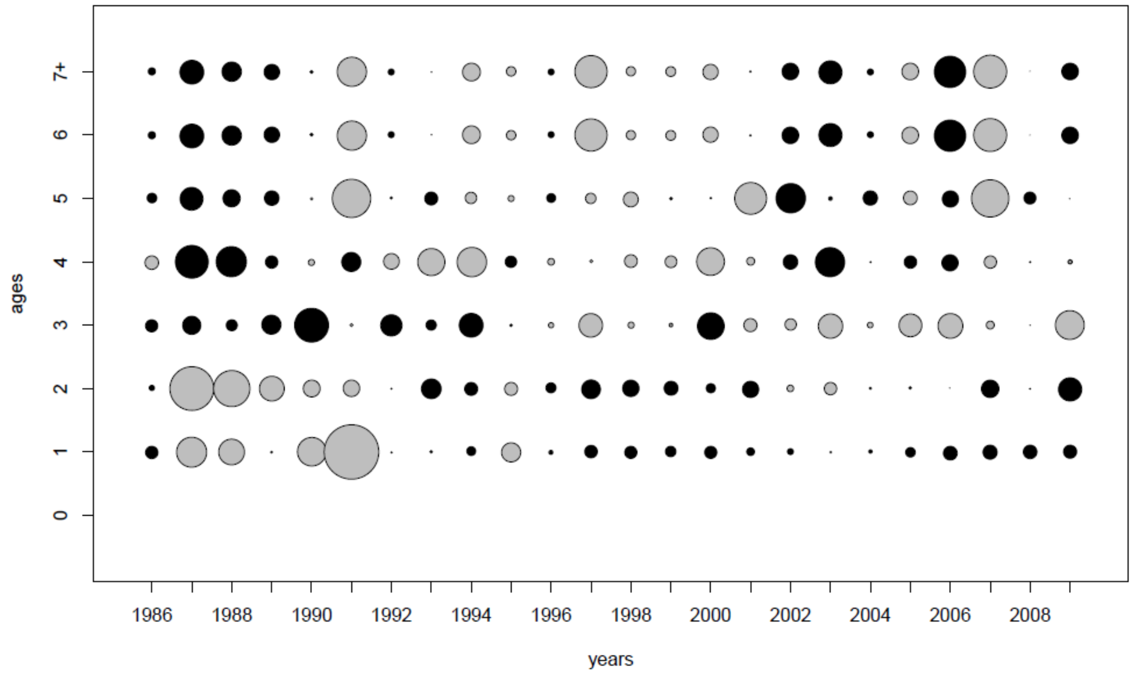
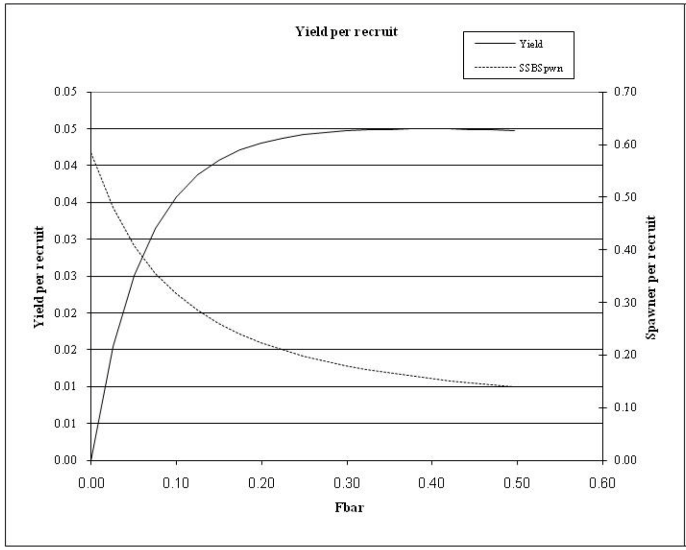
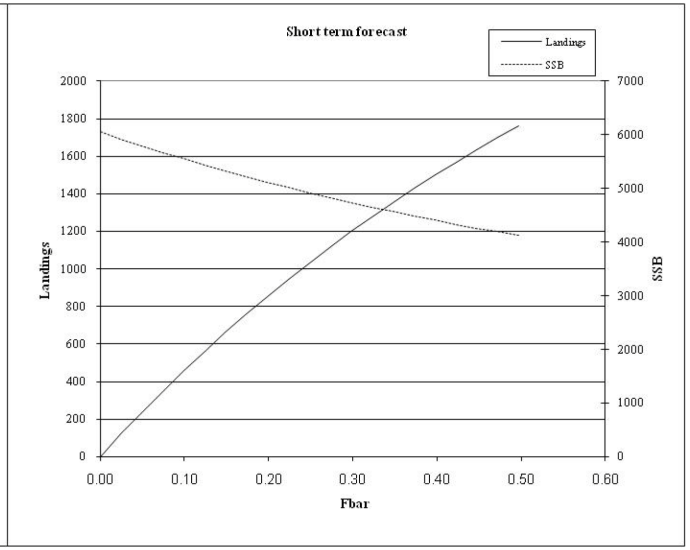


Figure 9.2.7(b): Four-spot megrim (L. Boscii) in Divisions VIIIc&IXa





MFYPR version 2a
Run: LDB
Time and date: 09:20 29/04/2010

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.2486
FMax	1.5665	0.3894
F0.1	0.5581	0.1387
F35%SPR	0.9485	0.2358
Flow	0.3661	0.0910
Fmed	1.2140	0.3018
Fhigh	2.3748	0.5903

Weights in kilograms

MFDP version 1a
Run: LDB
Four spot megrim (L. boscii) Division VIIIc and IXa
Time and date: 17:59 28/04/2010
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

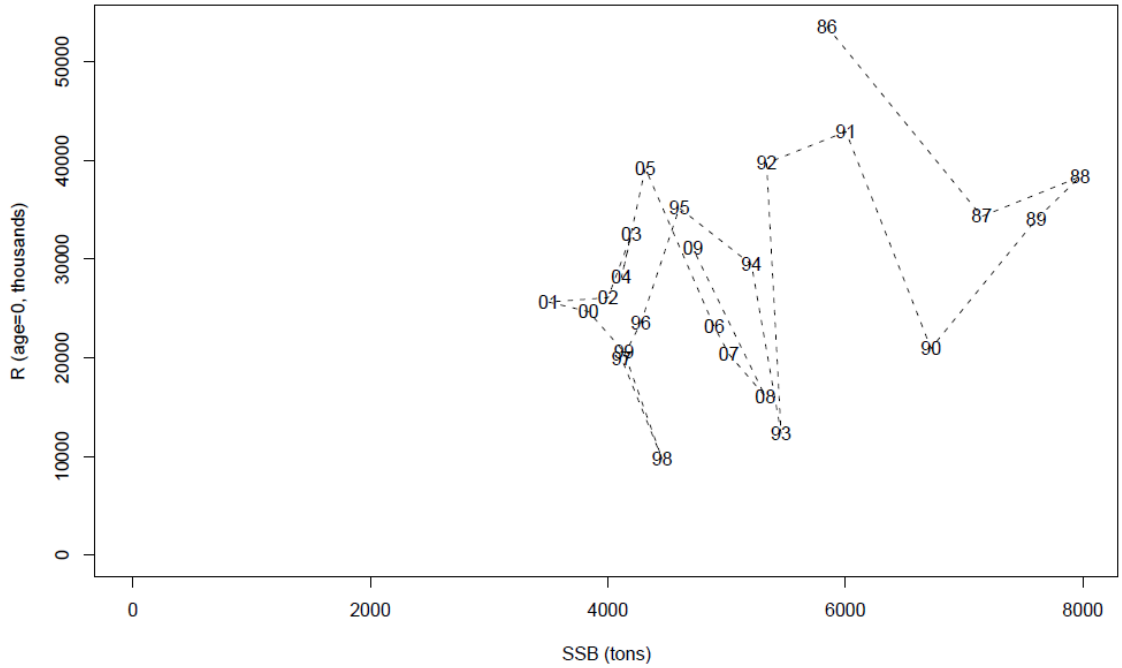


Figure 9.2.9(a). Four spot megrim (*L.boscii*) in Divisions VIIIc and IXa. SSB-Recruitment plot.

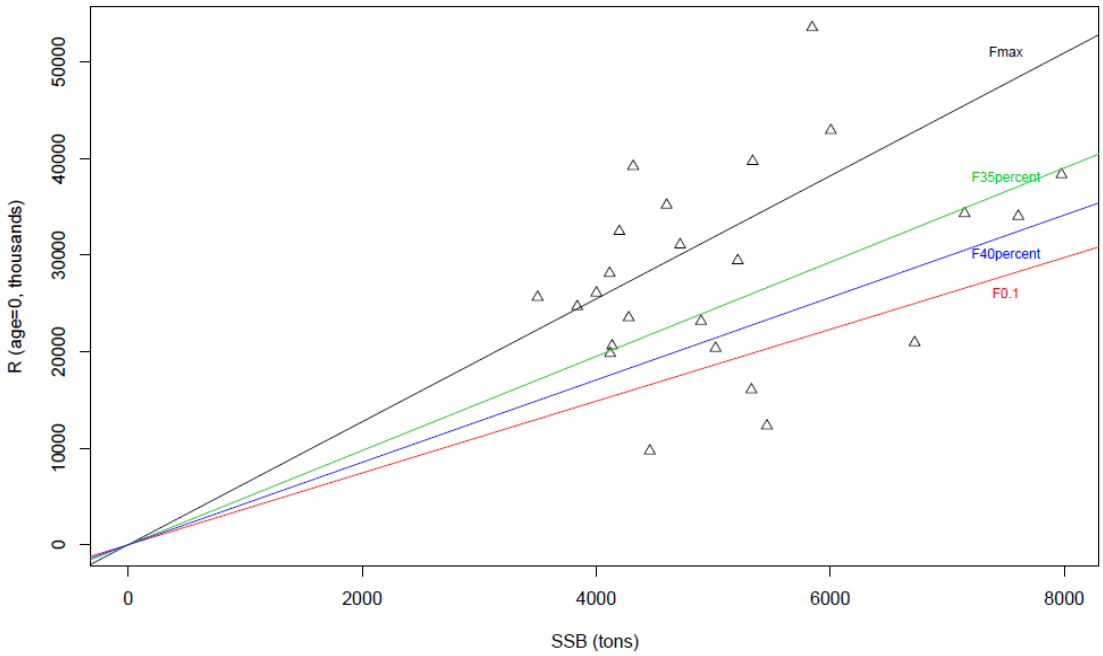


Figure 9.2.9(b). Megrim (*L.boscii)* in Divisions VIIIc and IXa. SSB-Recruitment plot and replacement lines corresponding to Fmax, F0.1, F35percent and F40percent

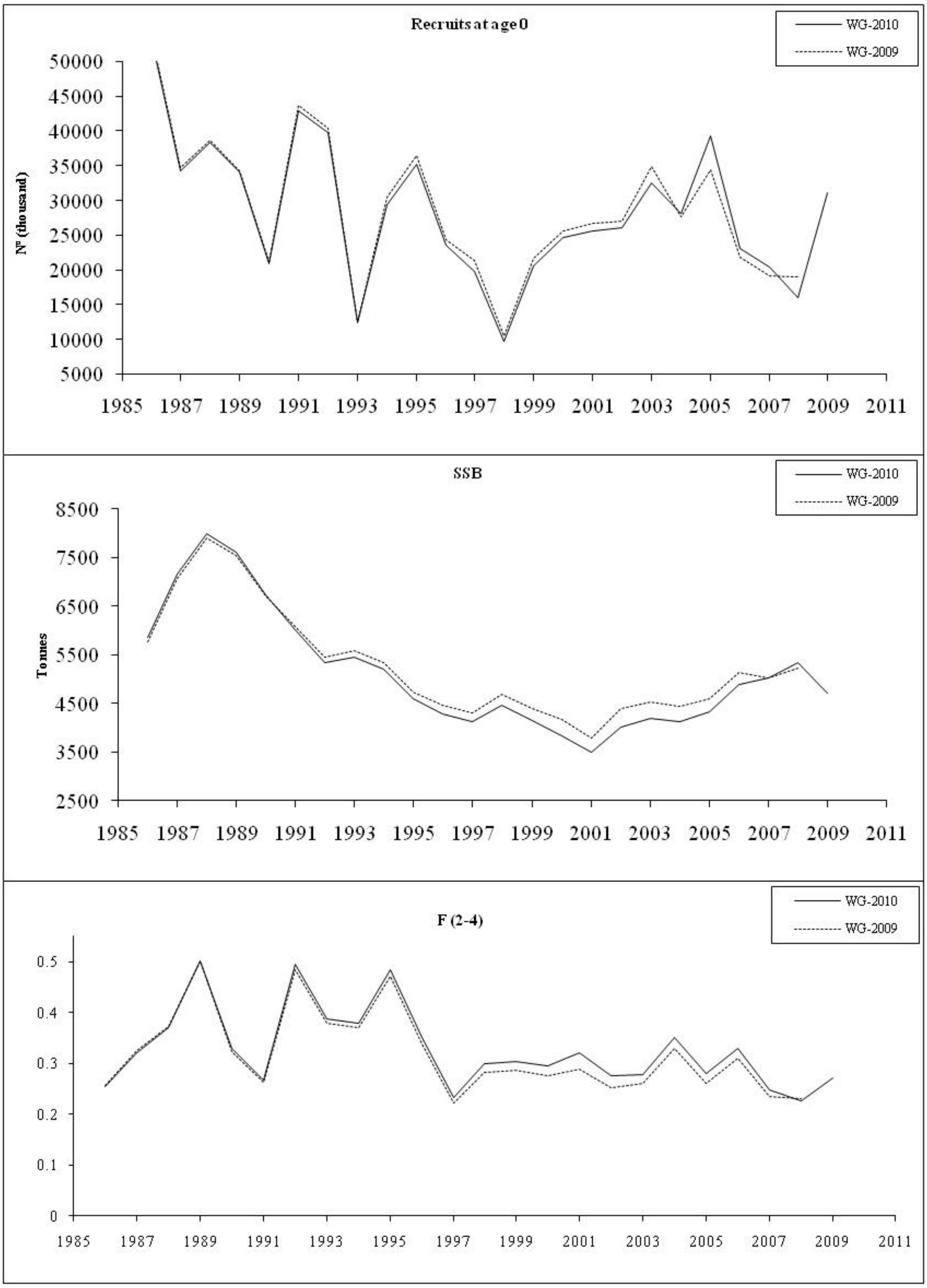


Figure 9.2.10. Four-spot megrim (*L. boscii*) Recruits, SSB and Fs from WG09 and WG10

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 2010 (average of estimated F over 2007-2009, corresponding to Fbar=0.19 for *L. whiffiagonis* and Fbar=0.25 for *L. boscii*), Figure 9.3.2 gives the combined predicted landings for 2011 and individual SSB for 2012, 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 2007-2009) for both species in 2011, predicted combined landings in 2011 are 1182 t and individual SSBs in 2012 are 909 t for *L. whiffiagonis* and 4918 t for *L. boscii*. The equilibrium combined yield at status quo F level for both species, would be around 1287 t with a combined SSB 6000 t.

As there are no precautionary limit points defined for these stocks, it is not possible to provide catch options in relation to them.

Fishing at F40percent for both in 2011 would correspond to landings of 918 t in 2011 (29% decrease with respect to 2010 TAC) for both species combined, leading to an SSB in 2012 of 920 t for *L. whiffiagonis* and 5190 t for *L. boscii*.

It should be noted that landings have been below the TAC since 2007, as follows:

Landings(2007) = 1259 t < TAC(2007) = 1440 t

Landings(2008) = 1113 t < TAC(2008) = 1430 t

Landings(2009) = 1218 t < TAC(2009) = 1430 t

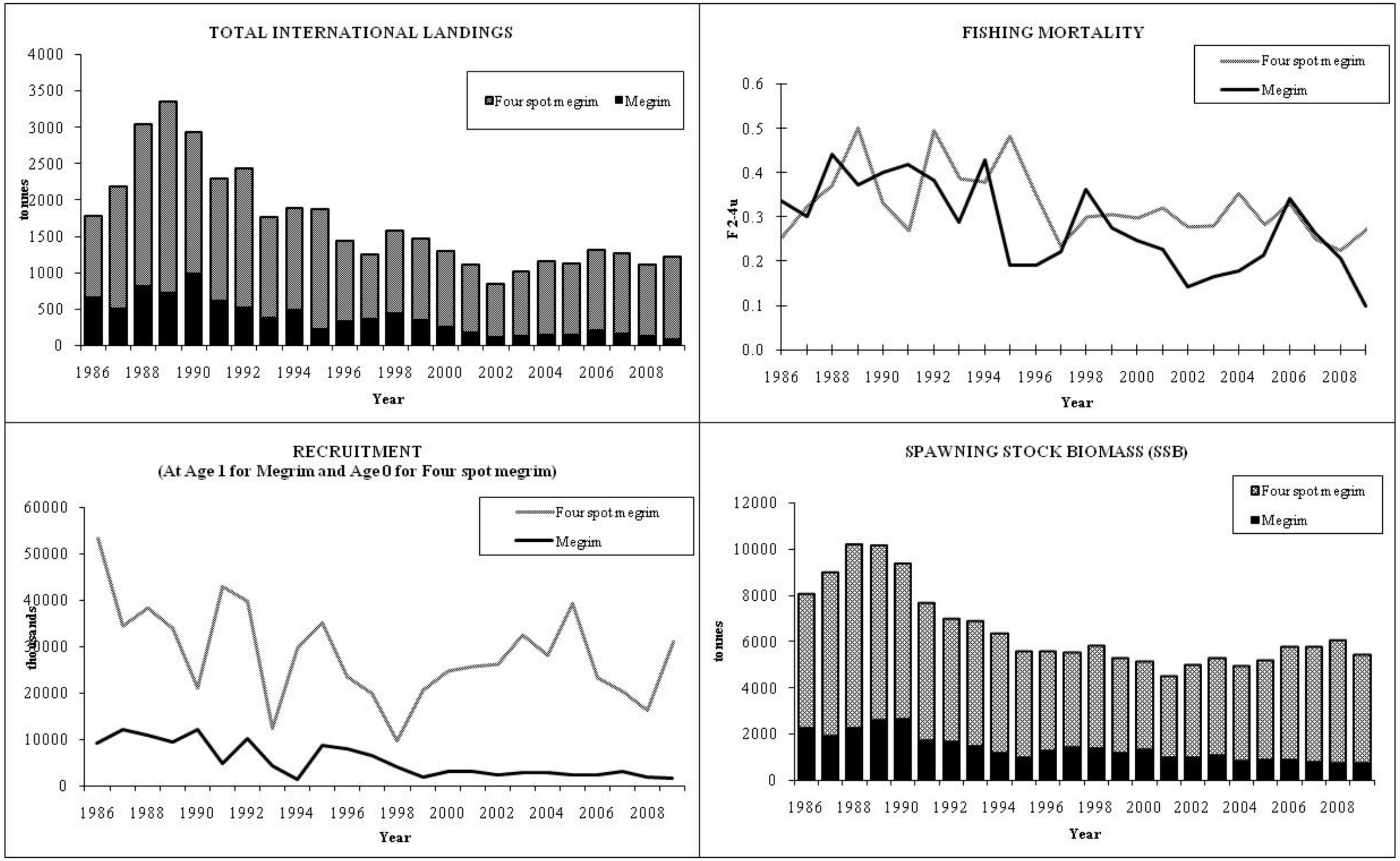


Figure 9.3.1. Stock trends for both stocks. Megrin and Four-spot megrim in Divisions VIIIc and IXa.

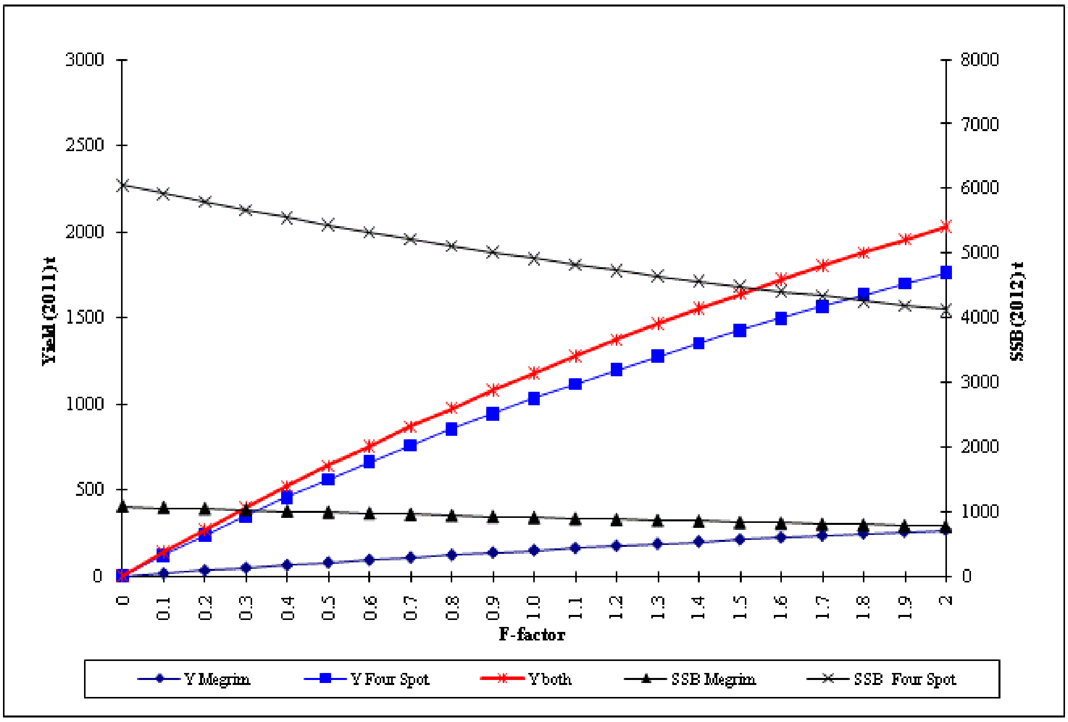


Figure 9.3.2. Megrims (*L. whiffiagonis and L. boscii*) in Divisions VIIIc and IXa. Combined Short Term Forecasts (landings in 2011 and SSB at the start of 2012) assuming status quo F in 2010

10 Nephrops (Divisions VIII ab, FU 23-24)

Type of assessment	update assessment
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 2010

Exploitation boundaries in relation to precautionary considerations: As the stock was not assessed in 2009, the ICES advice for 2010 is the same as for 2009. "Since the SSB has been relatively stable, the current landings can be maintained. ICES recommends not to increase landings in 2010 over the recent level of 3 400 t (2005–2007 average)."

10.1.4 Management applicable for 2009 and 2010

Espèce:	Langoustine *Nephrops norvegicus*	Zone:	VIII a, VIII b, VIII d et VIII e (NEP/8ABDE.)
Espagne	234		
France	3 665		
UE	3 899		
TAC	3 899		TAC analytique

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 2010 was 3 899 t (4 104 t for 2009) whereas the ICES recommendation was 3 400 t (averaged landings for 2005-2007). In 2009, total nominal landings reached 3 030 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, it should be noted that *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 (230 in 2009). 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 1960-2009 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). The landings for 2008 and 2009 were 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 1987-2009). 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). 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.

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 late 90's (not routinely sampled) is about 1 480 t whereas discard estimates of the recent sampled years (2003-2009) reached a higher level of 2 500 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 2009, 174 million individuals were estimated to have been discarded (1 830 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, numbers discarded at length were derived by the "proportional method" (Table 10.2) described in the Stock Annex. The derivation method uses ratios at each length between discards and total numbers landed for sexes combined by quarter.

Since 2003, discards have been estimated from sampling catch programmes on board *Nephrops* trawlers (269 trips and 725 hauls have been sampled over seven 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: 69% and increased in 2009: 79%), 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), thus, the poor set of available data cannot yet be used by the WG.

The derivation effect for the discards as explained above is shown in Figure 10.2. Derived discards mean length are obviously the same, however, change was observed when a new discard sampling programme was conducted.

These variations in discard mean lengths reflect the annual variability influence of recruitment on the discard rate which is related to regulations on MLS and codend mesh size. 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 the WG in methodological analysis (see ICES files). This method looked promising and should be examined when a benchmark assessment is organised for the stock.

The length distribution of landings, discards, catches and removals are presented in Tables 10.3.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

Currently, abundance indices are not available for this stock. This situation will be improved in the future once a data time series has been collected. A survey specifically designed to evaluate abundance indices of *Nephrops* commenced in 2006 (with the most appropriate season: 2nd quarter, hours of trawling: around dawn and dusk and fishing gear: twin trawl). This survey (called LANGOLF; see Stock Annex) occurs once a year in May. Therefore, its results for abundance indices are not available for the WG of the same year, but can provide useful additional information before reviewing stock status in autumn. In the short-term (2012), tuning data currently based on commercial catch-effort set (see §10.2.4) should be extended by using LANGOLF data.

10.2.4 Commercial catch-effort data.

Commercial fleets used in the assessment to tune the model

Up to 1998, the majority of the vessels were not obliged to keep logbooks because of their size and fishing forms were established by inquiries. Since 1999, logbooks became compulsory for all vessels longer than 10 m. The available log-book data cannot be currently considered as representative for the fishing effort of the whole fishery during the overall time series. Hence, since 2004, it was attempted to define a better effort index.

Effort data indices, landings and LPUE for the "Le Guilvinec District" *Nephrops* trawlers in the 2nd quarter are available for the overall time series (Table 10.7; Figure 10.4). Effort increased from 1987 to 1992, but there has been a decreasing trend since then. In 2007, the lowest fishing effort for the whole period was observed. The downwards trend in effort can be explained by the decrease in the number of fishing vessels following the decommissioning schemes implemented by the EU. The LPUEs of the "Le Guilvinec district" 2nd Quarter *Nephrops* fleet are reasonably stable, fluctuating around a long-term average of 12.5 kg/hour (Figure 10.4), with a maximum in the series of 16.5 kg/hour occurring in 1988 and 2001. LPUE almost remained stable between 2005 and 2007 (12.9 to 13.4 kg/hour, then 13.8 kg/hour *i.e.* +3% per year) despite increase of MLS at the end of 2005. In 2008, LPUE increased was larger (15.1 kg/hour), but decreased in 2009 (14.0 kg/h *i.e.* –8%).

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) 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 10.7) were obtained by using the ratios of Quarter 2-fleet-landings to Total-Quarter 2-landings.

10.3 Assessment

Biological parameters used in this year's assessment (growth parameters, length-weight relationships, natural mortality rates, discard survival rates, etc.) are provided in Table 10.4.

The male and female removal length distributions for the time series 1987-2009 were split into 9 'age groups' (the oldest age group being a plus group). The removals-at-age for each sex were summed and are presented in Table 10.5 and Figure 10.3.

Removal weights-at-age are averages weighted by numbers-at-age for each sex (Table 10.6).

10.3.1 Model

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 10.8). The results show that the residuals are generally low and do not follow any systematic pattern.

Since 2005, removals at age per unit effort for "Le Guilvinec district 2nd Quarter" have been used to tune the VPA. In the WGNEPH 2004, the tuning data were associated with a second tuning fleet covering the other harbours and districts of the Bay of Biscay for the same reference period (trip duration of this second fleet longer than one day). In 2005, the 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.

Exploratory runs

Even if the assessment in 2010 is an update one, WG investigated additional exploratory runs based on different approaches to the derivation of discards for missing years (see Stock Annex).

Files created from these calculations, tables and figures are available in the ICES files.

Final run

The same settings as in 2008 were used for the final run (Stock Annex). Tuning data are in Table 10.9.

10.3.2 Assessment results

The diagnostics from the final XSA are given in Table 10.10.

Log-catchability residuals resulting from XSA for the tuning fleet are presented in Figure 10.5. They are quite high from 1987 to 1990 for age groups 1 and 2. The high residuals for age 1 at the start of the series can be explained by the limited number of samples available to estimate the discards in 1987, which are used to derive estimates for 1988-1990. From 1991 onwards the residuals are lower, but some year effects appear around 2001 and 2006.

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 not well estimated around 2000-2001, but in the middle of 2000's the retrospective pattern is more satisfactory.

In the 2008 assessment, $Fbar_{2007\ (ages\ 2\text{-}5)}$ was estimated at 0.36 whereas this value is notably revised upwards (0.50) by the 2010 WGHMM. The SSB value for 2007 was estimated at 12 510 t by the 2008 WG, but the current estimation of the SSB_{2007} is 9 350 t.

10.3.3 Year-class strength and recruitment estimations

- The 2005 year class is now estimated at 647 million compared to an estimate of 756 million from the 2008 assessment (WGHMM 2008 replaced this value by $GM_{87\text{-}05}$=683 million).
- The 2006 year class is now estimated at 673 million compared to an estimate of 383 million from the 2008 assessment (WGHMM 2008 replaced this value by $GM_{87\text{-}05}$=683 million).

- The 2007 and 2008 year classes were estimated to be 520 and 722 million respectively.

YEAR CLASS (RECRUITMENT AT AGE 1)	MILLION	BASIS
2005	647	XSA
2006	673	XSA
2007	520	XSA
2008	722	XSA

10.3.4 Historic trends in biomass, fishing mortality and recruitment

A full summary of the XSA estimated series is presented in Table 10.13 and Figure 10.7.

F_{bar} has declined gradually to 0.38 in 2009 with some fluctuations in the beginning of the 90's. The reduction of the fishing effort since 2005 (-13% for the tuning time series; Table 10.7, 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 (1987-2009) is 0.57.

SSB decreased by 20% in the 90's, 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 (953 million) to 1998 (485 million). An increase was observed during the early 2000's with an average (GM) recruitment value of 691 million for the years 2000-2005 which is higher than the average values (658 million) of the overall time series. This is due to the year classes 2003 and 2004 which are estimated as high consistently with last year's assessment.

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 10.14.

The exploitation patterns for the projection are based on the unscaled average Fs-at-age in the years 2007-2009 ($F_{2\text{-}5}$=0.43). GM over 1987-2008 (659 million) was used for age 1 from 2010 onwards. Mean weights-at-age for dead discards and landings were taken as the discard and landing averages for 2007-2009 respectively.

Table 10.15 and Figure 10.8 give the short-term yield and SSB forecasts.

Assuming *status quo* F, landings are predicted to increase from 3 030 t in 2009 to 3 610 t in 2010 and to 3 690 t in 2011. SSB is predicted to be equal to 11 390 t in 2010 and to slightly increase in 2011 (11 790 t) and 2012 (12 160 t). All these values are higher than the long-term arithmetic mean of the time series (8 910 t). The year classes for which recruitments were assumed using GM have marginal contribution in the landings for 2011, but 28% in the SSB for 2012 (Table 10.17).

It should be pointed out that the predicted landings under *status quo* F for 2010 (3 610 t) are lower than the 3 899 t TAC 2010 for FU23-24.

10.4.2 Yield and biomass per recruit analysis

Results of equilibrium landings and SSB/R are given in Table 10.18 and Figure 10.8. In the Y/R curve based on landings only, F_{max} (0.17) is estimated to be at 56% of the reference F (it is noticeable that the F multiplier was estimated at 45% by WGHMM 2008). $F_{0.1}$ and $F_{35\%SPR}$ also calculated on landings only are estimated to be 0.11 and 0.14 respectively (36% 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 more than 10% and SSB per recruit would increase up to 84% whereas a reduction of F to $F_{35\%SPR}$ would produce an increase of Y/R up to 9.5% and of SSB/R of 109%.

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. In 2009, there was a substantial improvement of the sampling design as many trips were sampled in the Southern part of the fishery. Applying discard data from 'sampled' to 'non-sampled' years bears the risk of inconsistency between the different data sets because it introduces an inter-dependency between years and also prevents detection of any signal on recruitment strength. The additional exploratory runs based on discard derivation by applying probability concepts as performed by WGHMM since 2007 (Stock Annex) result in more contrast in recruitment, more regular residuals of Log catchabilities and better consistency in retrospective pattern for recruitment, especially the exploratory run with simulated discards for 2006.

10.7 Information from the fishing industry

There was no meeting between the French fishing industry and scientists prior to the WG. 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 (in 2006, strong increases of LPUE in the area VIIIb compared with the stability in VIIIa; in 2007 and 2008, relevant decreases of LPUE in VIIIb against stability even slight increases in VIIIa). Thus, they emphasized the necessity of applying additional tuning 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 (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 yet 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 1960-2009

Year	Landings (1) FU 23-24 (2) VIIIa,b	FU 23 VIIIa	FU 24 VIIIb	Unallocated (M A N)(3)	Total VIIIa,b used by WG	Total Discards FU 23-24 VIIIa,b		Catches Total VIIIa,b
1960	3524	-	-	-	3524	-		3524
1961	3607	-	-	-	3607	-		3607
1962	3042	-	-	-	3042	-		3042
1963	4040	-	-	-	4040	-		4040
1964	4596	-	-	-	4596	-		4596
1965	3441	-	-	-	3441	-		3441
1966	3857	-	-	-	3857	-		3857
1967	3245	-	-	-	3245	-		3245
1968	3859	-	-	-	3859	-		3859
1969	4810	-	-	-	4810	-		4810
1970	5454	-	-	-	5454	-		5454
1971	3990	-	-	-	3990	-		3990
1972	5525	-	-	-	5525	-		5525
1973	7040	-	-	-	7040	-		7040
1974	7100	-	-	-	7100	-		7100
1975	-	6460	322	-	6782	-		6782
1976	-	6012	300	-	6312	-		6312
1977	-	5069	222	-	5291	-		5291
1978	-	4554	162	-	4716	-		4716
1979	-	4758	36	-	4794	-		4794
1980	-	6036	71	-	6107	-		6107
1981	-	5908	182	-	6090	-		6090
1982	-	4392	298	-	4690	-		4690
1983	-	5566	342	-	5908	-		5908
1984	-	4485	198	-	4683	-		4683
1985	-	4281	312	-	4593	-		4593
1986	-	3968	367	99	4335	-		4335
1987	-	4937	460	64	5397	1767	*	7164
1988	-	5281	594	69	5875	1909		7784
1989	-	4253	582	77	4835	1459		6295
1990	1	4613	359	87	4972	1280		6252
1991	1	4353	401	55	4754	1213	*	5967
1992	0	5123	558	47	5681	1583		7264
1993	0	4577	532	49	5109	1406		6515
1994	0	3721	371	27	4092	1060		5152
1995	0	4073	380	14	4452	1086		5539
1996	0	4034	84	15	4118	1005		5123
1997	2	3450	147	41	3610	1049		4658
1998	2	3565	300	40	3865	1453	*	5318
1999	2	2873	337	26	3209	1177		4386
2000	0	2848	221	36	3069	1213		4282
2001	1	3421	309	22	3730	1512		5242
2002	2	3323	356	36	3679	1645		5324
2003	1	3399	343	49	3742	1977	*	5719
2004	na	2970	315	5	3285	1932	*	5216
2005	na	3306	383	na	3689	2698	*	6387
2006	na	3000	430	na	3430	4544	*	7974
2007	na	2881	292	na	3176	2411	*	5587
2008	na	2774	256	na	3030	2123	*	5154
2009	na	2816	212	na	3029	1833	*	4862

(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	derived from 1987
1989	derived from 1987
1990	derived from 1987
1991	sampled
1992	derived from 1991
1993	derived from 1991
1994	derived from 1991
1995	derived from 1991
1996	derived from 1991
1997	derived from 1991
1998	sampled
1999	derived from 1998
2000	derived from 1998
2001	derived from 1998
2002	derived from 1998
2003	sampled
2004	sampled
2005	sampled
2006	sampled
2007	sampled
2008	sampled
2009	sampled

Table 10.3.a Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 1987-2009.

Landings CL mm/	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
10	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
12	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
14	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
16	0	158	59	0	0	0	0	0	0	0	14	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	19	6	0	0	0	0	0
18	331	553	131	64	30	0	0	31	20	0	0	0	0	14	13	0	13	0	23	5	4	12	0
19	1296	1886	901	48	79	138	0	72	61	0	0	0	0	11	38	0	0	15	24	0	0	0	0
20	3129	4227	2791	529	474	450	464	206	341	48	448	25	72	116	284	107	73	52	77	5	4	77	37
21	6476	8882	7039	1947	1572	1595	1285	482	1573	414	1313	288	219	433	643	925	241	224	250	69	14	191	73
22	13501	16050	12971	5913	4733	3948	3878	2824	2395	1311	2799	985	849	1015	2116	1122	578	825	718	130	18	208	290
23	21337	25374	18073	10910	7854	9701	7398	5366	5523	2799	4638	3171	1888	2531	6261	5513	1387	2002	2404	226	48	322	478
24	24339	33950	21960	13293	15521	20948	11949	9650	8731	6071	10005	6484	4032	5462	8915	10061	3450	5157	6013	816	188	721	1961
25	32476	36294	25650	16440	19747	27876	21011	15079	14348	13239	19837	13980	10717	11357	17106	12951	7275	9987	12573	2821	1201	2742	3722
26	29670	29808	22747	18205	22106	26617	23732	18312	19769	16779	19380	13535	10590	10212	13745	21403	11881	12797	16423	6327	5684	6319	8398
27	28086	28380	22091	16109	21900	28410	26044	21181	25126	18384	22823	16602	12724	11528	17098	19433	15915	14422	20320	11915	9439	10891	12992
28	24925	26017	19087	19595	21214	32091	27580	20488	20914	15744	19466	14432	12058	12639	15835	22074	16896	13964	20240	14531	13248	12640	16005
29	18703	20920	14227	16250	17138	24760	20627	16527	15909	16332	20878	11832	9448	11473	13779	16559	15343	13221	16684	14478	12516	12890	13748
30	18407	17862	13688	12055	14762	19828	21414	15903	19164	20214	21487	16335	16187	13888	16168	18105	15840	12552	14416	13587	12219	10726	13497
31	11419	13156	9037	11088	12408	14281	13452	11207	13333	14009	9791	8539	9209	9828	11316	9989	12217	10635	11675	11728	10698	9772	11025
32	10185	12822	8410	8540	8635	12786	12711	11490	13667	14392	9622	9237	9745	8936	11335	10284	10349	8973	9181	9626	9274	8845	9456
33	8528	8848	7127	10649	7273	9297	11369	7022	7117	8576	6334	5947	6000	6333	8250	7813	7575	7321	7206	8367	7859	7436	7199
34	5926	7812	6967	10543	7987	7318	7355	6684	7584	6524	4816	6619	5910	5225	6185	5308	5847	5530	6045	7068	6539	6425	6080
35	5763	5935	6214	7637	5425	5928	6307	5646	4677	6578	4737	6700	5267	4895	5213	4309	4493	4213	4721	5108	6529	5366	4639
36	4033	5064	4532	6274	4979	4998	4608	4337	3709	4133	2568	5308	4291	3242	4037	3157	3821	3092	3115	4085	4735	3867	3748
37	4024	3754	3545	4841	4541	4195	4089	3752	3496	4226	2135	4722	3230	2946	2901	2049	3185	2708	2392	3182	3839	3121	2604
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3527	2588	2687	2369	2224	2816	2026	2193	2652	2639	2398	1897
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2169	2186	2027	2297	1559	2316	1645	1525	1946	2245	2043	1512
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3084	2353	1862	1908	1398	2135	1523	1519	1595	1711	1633	1205
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1362	1020	941	764	1553	1167	1078	1167	1227	1190	883
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797	863	632	1576	875	898	989	1111	1015	744
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1049	761	534	530	640	1156	743	798	739	710	805	542
44	965	704	1192	1401	1089	1050	745	500	915	414	219	748	708	413	383	432	876	690	612	634	746	706	473
45	641	581	1194	955	1058	766	684	550	700	464	253	902	429	421	523	416	882	603	571	597	518	536	394
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248	294	328	596	485	396	479	373	405	304
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213	368	241	506	379	327	442	311	361	259
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205	188	188	378	321	304	384	257	294	243
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177	183	79	227	332	263	320	237	262	195
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154	160	115	283	328	250	287	190	228	154
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109	135	73	192	221	157	247	163	201	114
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85	102	46	171	155	166	201	138	116	111
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133	82	51	134	131	129	137	140	121	98
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63	40	20	89	100	92	157	115	95	63
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75	53	30	63	57	96	138	79	73	76
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18	24	13	26	95	61	118	60	67	54
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20	46	6	52	60	51	134	70	41	32
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16	29	6	22	36	39	135	45	40	48
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7	26	3	12	42	38	86	33	19	23
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2	21	11	9	17	17	115	33	23	14
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8	7	0	6	9	26	41	23	7	9
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1	2	0	5	3	14	21	9	9	9
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0	5	1	1	5	8	19	9	7	10
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4	0	0	0	7	7	19	10	6	3
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1	0	1	0	1	12	12	9	1	4
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0	0	0	2	1	6	10	1	0	2
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0	0	0	0	1	4	9	1	0	2
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	4	8	3	0	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	2	0	1	6	2	0	1
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	2	5	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	1	5	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	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
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0
Total	**288974**	**324498**	**244875**	**213779**	**217338**	**274286**	**240638**	**188879**	**202294**	**182041**	**188694**	**161549**	**135304**	**133383**	**172819**	**180442**	**152485**	**139753**	**166167**	**127942**	**117273**	**115274**	**125433**
Weights	**5397**	**5875**	**4835**	**4972**	**4754**	**5681**	**5109**	**4092**	**4452**	**4118**	**3610**	**3865**	**3209**	**3069**	**3730**	**3679**	**3742**	**3285**	**3689**	**3430**	**3176**	**3030**	**3029**

Table 10.3.b Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 1987-2009.

Table 10.3.b Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 1987-2009.

Total Discards

CL mm/	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	22	0	82
11	0	0	0	0	114	167	143	109	148	128	92	85	59	74	75	94	0	0	94	0	171	38	135
12	0	0	0	0	0	0	0	0	0	0	0	128	89	110	113	141	70	363	413	70	202	98	79
13	0	0	0	0	93	147	139	84	56	65	76	162	138	143	191	217	294	1722	1085	234	122	235	177
14	78	97	76	59	258	384	337	245	301	268	210	660	507	564	684	822	636	3152	3190	1138	900	389	291
15	2074	2174	1821	1673	1249	1895	1728	1148	1073	1058	1028	1741	1370	1462	1861	2186	1198	5548	7287	3102	1288	189	1157
16	3974	4053	3469	3140	2240	3339	3073	2019	1736	1786	1884	1861	1474	1554	2010	2349	3386	6784	13528	7810	2959	1027	2315
17	13577	14887	10425	8655	4638	6824	6302	4133	3347	3497	3914	3527	2744	2957	3624	4197	5927	8836	15094	11655	3636	1832	3059
18	29288	32816	23482	19987	10619	14908	13531	9408	8483	8297	8987	5003	4016	4207	5254	5880	8078	10161	19795	16139	4590	2626	4843
19	28370	31363	23215	19980	12852	17524	15718	11346	10790	10148	10853	5991	4770	5041	6271	7098	11506	17361	19522	25891	5244	6473	6485
20	60253	63749	49546	43147	22797	30242	26971	19970	19533	18146	19453	12091	9630	10098	12509	13968	12142	19250	22265	39742	8735	11444	12766
21	45446	48597	37609	33037	18043	24296	21757	15876	15497	14594	15429	9973	7931	8238	10357	11586	18597	25898	32409	54220	11585	15630	16772
22	51268	55078	42614	37864	24289	32524	29063	21354	21039	19695	20776	23278	18405	19216	23711	26333	21416	25210	35523	69870	17930	24730	18701
23	23074	24630	19336	17235	15611	20115	17713	13687	14986	13676	13624	21641	17276	17526	22103	23990	28429	26756	40041	70094	24086	27560	21693
24	7213	8375	6179	5468	13741	17107	15018	11903	13375	12258	12285	19750	15994	16182	20628	22367	26501	21343	36279	55408	30615	29638	24105
25	2686	2850	2369	2172	14722	17933	15639	12662	14027	12581	13036	20487	16780	16884	21505	22987	23211	20085	30222	52660	32917	28007	20736
26	672	806	485	391	7131	8990	7917	6166	6350	5744	6176	10676	8631	8817	10928	11696	17357	12006	19003	38812	27376	23127	14205
27	270	350	255	242	1711	2447	2217	1532	1395	1348	1424	7502	5870	6421	7474	8420	9680	6436	8498	20124	20567	10129	9188
28	0	0	0	0	999	1258	1098	867	890	777	844	3019	2394	2647	3034	3394	6187	3487	4603	10263	10365	5893	5927
29	0	0	0	0	138	168	146	118	118	102	117	1357	1133	1241	1443	1573	2537	2115	1201	4188	4464	3225	3163
30	0	0	0	0	291	344	296	248	256	216	247	686	613	608	778	782	1605	1901	1600	2578	2868	1923	3261
31	0	0	0	0	97	115	99	83	85	72	82	129	135	123	173	155	1326	1115	1417	1109	1316	925	1824
32	0	0	0	0	0	0	0	0	0	0	0	481	433	426	549	548	574	735	526	592	737	454	839
33	0	0	0	0	0	0	0	0	0	0	0	231	195	214	249	271	313	503	296	544	484	421	671
34	0	0	0	0	0	0	0	0	0	0	0	151	150	135	190	174	261	385	553	411	537	1025	830
35	0	0	0	0	0	0	0	0	0	0	0	88	92	93	119	114	176	424	260	230	265	206	332
36	0	0	0	0	0	0	0	0	0	0	0	48	61	57	80	68	113	108	46	73	336	78	197
37	0	0	0	0	0	0	0	0	0	0	0	74	95	89	124	106	83	74	246	25	299	153	188
38	0	0	0	0	0	0	0	0	0	0	0	44	56	53	73	63	93	31	116	99	40	93	269
39	0	0	0	0	0	0	0	0	0	0	0	36	46	43	61	52	15	139	147	0	3	369	55
40	0	0	0	0	0	0	0	0	0	0	0	57	73	68	95	81	37	73	37	169	47	0	66
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	60	20	0	40	0	8
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	12	31	0	20	53	0
43	0	0	0	0	0	0	0	0	0	0	0	6	7	7	9	8	14	13	0	0	11	0	38
44	0	0	0	0	0	0	0	0	0	0	0	30	39	36	50	43	0	13	0	0	0	0	14
45	0	0	0	0	0	0	0	0	0	0	0	2	3	3	4	4	13	0	0	36	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
49	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
51	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
53	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
55	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
57	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
59	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
61	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
63	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
65	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
67	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
69	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
71	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
73	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
75	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**	**289827**	**220879**	**193050**	**151634**	**200725**	**178905**	**132957**	**133485**	**124457**	**130538**	**150995**	**121209**	**125340**	**156331**	**171768**	**201841**	**222102**	**315346**	**487288**	**214788**	**198031**	**174480**
Weights	**1767**	**1909**	**1459**	**1280**	**1213**	**1583**	**1406**	**1060**	**1086**	**1005**	**1049**	**1453**	**1177**	**1213**	**1512**	**1645**	**1977**	**1932**	**2698**	**4544**	**2411**	**2123**	**1833**

Table 10.3.c Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 1987-2009.

Total catches

CL mm/	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	22	0	82
11	0	0	0	0	114	167	143	109	148	128	92	85	59	74	75	94	0	0	94	0	171	38	135
12	0	0	0	0	0	0	0	0	0	0	0	128	89	110	113	141	70	363	413	70	202	98	79
13	0	0	0	0	93	147	139	84	56	65	76	162	138	143	191	217	294	1722	1085	234	122	235	177
14	78	97	76	59	258	384	337	245	301	268	210	660	507	564	684	822	636	3152	3190	1138	900	389	291
15	2074	2174	1821	1673	1249	1895	1728	1148	1073	1058	1042	1741	1370	1462	1861	2186	1198	5548	7287	3102	1289	189	1157
16	3974	4210	3528	3140	2240	3339	3073	2019	1736	1786	1897	1861	1474	1554	2010	2349	3386	6784	13528	7810	2959	1027	2315
17	13727	15117	10502	8667	4673	6886	6302	4133	3347	3497	3914	3527	2744	2957	3624	4197	5946	8842	15094	11655	3636	1832	3059
18	29620	33369	23613	20052	10649	14908	13531	9439	8503	8297	8987	5003	4016	4222	5267	5880	8092	10161	19819	16144	4593	2638	4843
19	29666	33249	24116	20028	12931	17662	15718	11418	10850	10148	10853	5991	4770	5052	6309	7098	11506	17377	19547	25891	5244	6473	6485
20	63382	67976	52337	43676	23271	30692	27435	20176	19874	18194	19901	12116	9701	10214	12793	14075	12215	19302	22342	39747	8738	11521	12803
21	51922	57479	44647	34984	19615	25891	23042	16358	17070	15008	16741	10260	8150	8671	11000	12511	18838	26122	32659	54289	11598	15820	16845
22	64770	71128	55584	43777	29023	36472	32941	24178	23435	21006	23575	24263	19254	20231	25827	27455	21994	26035	36241	70000	17948	24938	18991
23	44411	50004	37409	28145	23464	29817	25111	19053	20509	16475	18261	24812	19164	20057	28364	29503	29815	28758	42445	70320	24134	27882	22172
24	31551	42325	28138	18762	29262	38055	26967	21554	22106	18329	22290	26235	20026	21643	29544	32428	29951	26500	42292	56224	30803	30359	26066
25	35162	39143	28020	18612	34469	45809	36650	27741	28375	25820	32874	34467	27497	28240	38612	35939	30486	30072	42795	55482	34119	30750	24458
26	30342	30615	23232	18596	29237	35607	31650	24478	26119	22524	25556	24211	19222	19030	24673	33099	29238	24803	35426	45140	33060	29446	22603
27	28357	28730	22346	16351	23611	30858	28261	22713	26521	19733	24247	24104	18594	17949	24573	27852	25595	20858	28818	32039	30006	21020	22181
28	24925	26017	19087	19595	22213	33349	28678	21355	21804	16521	20310	17450	14453	15286	18869	25468	23082	17451	24843	24794	23613	18533	21932
29	18703	20920	14227	16250	17276	24927	20773	16645	16027	16434	20995	13189	10581	12714	15223	18132	17880	15336	17885	18666	16980	16115	16911
30	18407	17862	13688	12055	15053	20173	21710	16151	19420	20430	21735	17021	16800	14496	16946	18886	17445	14453	16016	16165	15087	12649	16757
31	11419	13156	9037	11088	12505	14396	13551	11289	13419	14081	9874	8668	9344	9951	11489	10144	13544	11751	13092	12836	12014	10697	12849
32	10185	12822	8410	8540	8635	12786	12711	11490	13667	14392	9622	9718	10178	9362	11884	10832	10923	9709	9707	10218	10011	9299	10295
33	8528	8848	7127	10649	7273	9297	11369	7022	7117	8576	6334	6178	6196	6547	8499	8083	7888	7824	7502	8911	8343	7857	7870
34	5926	7812	6967	10543	7987	7318	7355	6684	7584	6524	4816	6770	6060	5360	6375	5482	6108	5916	6598	7479	7076	7449	6910
35	5763	5935	6214	7637	5425	5928	6307	5646	4677	6578	4737	6787	5359	4988	5332	4423	4669	4637	4981	5339	6793	5573	4972
36	4033	5064	4532	6274	4979	4998	4608	4337	3709	4133	2568	5356	4352	3299	4116	3225	3934	3200	3161	4158	5071	3945	3945
37	4024	3754	3545	4841	4541	4195	4089	3752	3496	4226	2135	4796	3325	3034	3025	2155	3268	2782	2638	3207	4138	3273	2792
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3571	2645	2740	2443	2287	2908	2057	2309	2751	2679	2491	2166
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2205	2232	2070	2358	1611	2331	1784	1672	1946	2247	2412	1566
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3140	2425	1930	2002	1480	2172	1596	1556	1764	1758	1633	1272
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1362	1020	941	764	1588	1227	1098	1167	1267	1190	892
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797	863	632	1580	887	929	989	1130	1069	744
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1055	769	541	540	649	1170	755	798	739	722	805	580
44	965	704	1192	1401	1089	1050	745	500	915	414	219	778	747	449	433	476	876	703	612	634	746	706	487
45	641	581	1194	955	1058	766	684	550	700	464	253	904	432	424	527	419	895	603	571	633	518	536	394
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248	294	328	596	485	396	479	373	405	304
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213	368	241	506	379	327	442	311	361	259
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205	188	188	378	321	304	384	257	294	252
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177	183	79	227	332	263	320	237	262	195
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154	160	115	283	328	250	287	201	228	154
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109	135	73	192	221	157	247	163	201	114
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85	102	46	171	155	166	201	138	116	111
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133	82	51	134	131	129	137	140	121	98
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63	40	20	89	100	92	157	115	95	63
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75	53	30	63	57	96	138	79	73	76
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18	24	13	26	95	61	118	60	67	54
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20	46	6	52	60	51	134	70	41	32
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16	29	6	22	36	39	135	45	80	48
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7	26	3	12	42	38	86	33	19	23
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2	21	11	9	17	17	115	33	23	14
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8	7	0	6	9	26	41	23	7	9
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1	2	0	5	3	14	21	9	9	9
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0	5	1	1	5	8	19	9	7	10
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4	0	0	0	7	7	19	10	6	3
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1	0	1	0	1	12	12	9	1	4
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0	0	0	2	1	6	10	1	0	2
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0	0	0	0	1	4	9	1	0	2
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	4	8	3	0	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	2	0	1	6	2	0	1
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	2	5	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	1	5	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	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
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0
Total	**557218**	**614325**	**465754**	**406829**	**368972**	**475011**	**419544**	**321836**	**335779**	**306498**	**319232**	**312544**	**256513**	**258723**	**329150**	**352210**	**354326**	**361855**	**481512**	**615230**	**332060**	**313305**	**299913**
Weights	**7164**	**7784**	**6295**	**6252**	**5967**	**7264**	**6515**	**5152**	**5539**	**5123**	**4658**	**5318**	**4386**	**4282**	**5242**	**5324**	**5719**	**5216**	**6387**	**7974**	**5587**	**5154**	**4862**

Table 10.3.d Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 1987-2009.

Removals=Landings+dead catches (discard survival rate : 30%)

CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0	16	0	58
11	0	0	0	0	80	117	100	76	104	89	65	60	42	52	53	66	0	0	66	0	119	27	94
12	0	0	0	0	0	0	0	0	0	0	0	90	62	77	79	99	49	254	289	49	142	69	56
13	0	0	0	0	65	103	97	59	39	45	54	114	97	100	134	152	206	1205	760	164	85	164	124
14	55	68	53	41	181	269	236	171	210	188	147	462	355	395	479	575	445	2206	2233	797	630	272	204
15	1452	1522	1274	1171	875	1327	1209	803	751	741	734	1219	959	1024	1303	1530	839	3883	5101	2171	902	132	810
16	2782	2995	2488	2198	1568	2337	2151	1413	1215	1250	1332	1302	1032	1088	1407	1644	2370	4749	9469	5467	2072	719	1621
17	9654	10651	7375	6070	3282	4839	4411	2893	2343	2448	2740	2469	1921	2070	2537	2938	4168	6192	10565	8158	2545	1282	2141
18	20833	23524	16568	14055	7464	10435	9472	6617	5958	5808	6291	3502	2811	2959	3691	4116	5668	7112	13880	11302	3216	1851	3390
19	21155	23840	17151	14034	9075	12405	11003	8014	7613	7104	7597	4194	3339	3540	4428	4968	8055	12168	13690	18124	3671	4531	4540
20	45306	48851	37473	30732	16432	21619	19344	14185	14014	12750	14065	8489	6812	7185	9040	9884	8572	13527	15662	27825	6118	8087	8974
21	38288	42900	33365	25073	14202	18602	16515	11595	12421	10630	12113	7269	5771	6200	7893	9036	13259	18353	22936	38023	8123	11131	11813
22	49389	54605	42800	32418	21736	26715	24222	17772	17123	15097	17342	17280	13732	14466	18714	19555	15569	18472	25584	49039	12569	17519	13381
23	37489	42615	31609	22974	18781	23782	19797	14947	16013	12372	14174	18320	13981	14800	21733	22306	21287	20731	30433	49292	16909	19614	15664
24	29387	39813	26285	17121	25139	32923	22461	17983	18093	14652	18604	20310	15228	16789	23355	25717	22001	20097	31408	39602	21619	21468	18835
25	34356	38288	27309	17960	30052	40429	31958	23943	24167	22046	28963	28321	22463	23175	32160	29042	23523	24046	33728	39684	24243	22348	18237
26	30141	30373	23087	18479	27098	32910	29275	22628	24214	20800	23703	21008	16632	16384	21394	29590	24031	21202	29725	33496	24847	22508	18342
27	28276	28625	22270	16278	23098	30124	27596	22253	26102	19328	23820	21853	16833	16023	22330	25327	22691	18927	26269	26002	23835	17982	19424
28	24925	26017	19087	19595	21914	32972	28349	21095	21537	16288	20057	16545	13735	14492	17959	24450	21226	16405	23462	21715	20503	16765	20154
29	18703	20920	14227	16250	17235	24877	20729	16609	15992	16403	20960	12782	10241	12342	14790	17660	17119	14701	17525	17409	15641	15148	15962
30	18407	17862	13688	12055	14965	20069	21621	16077	19343	20366	21661	16815	16616	14314	16713	18652	16963	13883	15536	15391	14227	12072	15779
31	11419	13156	9037	11088	12476	14362	13521	11265	13393	14059	9849	8629	9304	9914	11437	10097	13146	11416	12667	12504	11619	10419	12302
32	10185	12822	8410	8540	8635	12786	12711	11490	13667	14392	9622	9574	10048	9234	11719	10667	10751	9488	9549	10041	9790	9163	10043
33	8528	8848	7127	10649	7273	9297	11369	7022	7117	8576	6334	6109	6137	6483	8424	8002	7794	7673	7413	8748	8197	7731	7668
34	5926	7812	6967	10543	7987	7318	7355	6684	7584	6524	4816	6725	6015	5320	6318	5430	6030	5800	6432	7356	6915	7142	6661
35	5763	5935	6214	7637	5425	5928	6307	5646	4677	6578	4737	6761	5332	4960	5296	4389	4616	4510	4903	5269	6714	5511	4872
36	4033	5064	4532	6274	4979	4998	4608	4337	3709	4133	2568	5341	4333	3282	4093	3205	3900	3168	3147	4136	4971	3921	3886
37	4024	3754	3545	4841	4541	4195	4089	3752	3496	4226	2135	4774	3296	3008	2988	2123	3243	2760	2564	3199	4048	3228	2736
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3558	2628	2724	2421	2268	2881	2048	2274	2721	2667	2463	2085
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2195	2218	2057	2340	1596	2327	1742	1628	1946	2246	2301	1550
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3123	2403	1910	1974	1455	2161	1574	1545	1713	1744	1633	1252
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1362	1020	941	764	1577	1209	1092	1167	1255	1190	889
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797	863	632	1579	883	920	989	1125	1053	744
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1053	767	539	537	646	1166	752	798	739	718	805	568
44	965	704	1192	1401	1089	1050	745	500	915	414	219	769	735	438	418	463	876	699	612	634	746	706	482
45	641	581	1194	955	1058	766	684	550	700	464	253	904	431	423	526	418	891	603	571	622	518	536	394
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248	294	328	596	485	396	479	373	405	304
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213	368	241	506	379	327	442	311	361	259
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205	188	188	378	321	304	384	257	294	249
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177	183	79	227	332	263	320	237	262	195
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154	160	115	283	328	250	287	198	228	154
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109	135	73	192	221	157	247	163	201	114
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85	102	46	171	155	166	201	138	116	111
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133	82	51	134	131	129	137	140	121	98
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63	40	20	89	100	92	157	115	95	63
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75	53	30	63	57	96	138	79	73	76
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18	24	13	26	95	61	118	60	67	54
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20	46	6	52	60	51	134	70	41	32
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16	29	6	22	36	39	135	45	68	48
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7	26	3	12	42	38	86	33	19	23
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2	21	11	9	17	17	115	33	23	14
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8	7	0	6	9	26	41	23	7	9
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1	2	0	5	3	14	21	9	9	9
63	19	13	10	0	3	28	0	5	20	4	5	4	0	0	5	1	1	5	8	19	9	7	10
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4	0	0	0	7	7	19	10	6	3
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1	0	1	0	1	12	12	9	1	4
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0	0	0	2	1	6	10	1	0	2
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0	0	0	0	1	4	9	1	0	2
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	4	8	3	0	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	2	0	1	6	2	0	1
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	2	5	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	1	0	1	5	0	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	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
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0
Total	**476745**	**527377**	**399490**	**348914**	**323482**	**414794**	**365872**	**281949**	**295733**	**269161**	**280070**	**267245**	**220150**	**221121**	**282250**	**300679**	**293774**	**295224**	**386908**	**469044**	**267624**	**253896**	**247569**
Weights	**6634**	**7211**	**5857**	**5868**	**5603**	**6789**	**6093**	**4834**	**5213**	**4822**	**4344**	**4882**	**4033**	**3918**	**4788**	**4831**	**5126**	**4637**	**5578**	**6611**	**4864**	**4517**	**4312**

Table 10.4. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Input data and parameters.

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	0.30	Gueguen and Charuau, 1975
MALES		
Growth - K	0.140	after Conan and Morizur, 1979 ; plus unpublished data
Growth - L(inf)	76	"
Natural mortality - M	0.3	Morizur, 1982
Size at maturity (knife-edged)	26.3 mm CL	unpublished data (WKNEPH 2006)
Length/weight - a	0.00039	Conan, 1978
Length/weight - b	3.180	"
FEMALES		
Immature Growth		
Growth - K	0.140	after Conan and Morizur, 1979 ;Verdois et al., 2001
Growth - L(inf)	76	"
Natural mortality - M	0.3	Morizur, 1982
Size at maturity	25 mm CL	Morizur, 1982
Mature Growth		
Growth - K	0.110	after Conan and Morizur, 1979 ;Verdois et al., 2001
Growth - L(inf)	56	"
Natural mortality - M	0.2	based on Morizur, 1982 ; assuming lower rate for mature females
Length/weight - a	0.00081	Conan, 1978
Length/weight - b	2.970	"

Table 10.5. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Age composition of the Removals

	Table 1	Catch numbers at age			Numbers*10**-3								
	YEA	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
	TONS	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
	YEA	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
	AGE												
	1	6036	6458	8051	9303	11261	22460	36232	23117	8306	3699	7000	
	2	77413	82164	111944	115574	109582	125230	172918	258597	87844	99973	88860	
	3	74298	73448	95922	118923	98869	83829	116587	122019	102757	84444	88629	
	4	35997	35006	37879	38594	44283	35293	36234	40279	44633	40961	41386	
	5	15463	13786	15550	10841	17614	15606	13218	13009	13150	14108	12866	
	6	5392	5291	6545	4100	5991	6290	6073	5273	5302	5836	4882	
	7	2665	2306	2900	1400	2584	2899	2550	2771	2444	2221	1870	
	8	1266	1192	1824	953	1516	1390	1244	1492	1241	1245	915	
	+gp	1621	1470	1636	993	2076	2227	1853	2487	1948	1410	1161	
0	TOTA	220150	221121	282251	300679	293774	295224	386908	469044	267624	253896	247569	
	TONS	4033	3918	4788	4831	5126	4637	5578	6611	4864	4517	4312	
	SOPC	101	100	101	101	99	100	100	100	100	100	100	
	1												

Table 10.6. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Removals weight at age

Table 2 Catch weights at age (kg)

YEAI	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE												
1	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.0036
2	0.008	0.008	0.008	0.008	0.009	0.009	0.0086	0.009	0.009	0.009	0.009	0.009
3	0.0162	0.0169	0.0161	0.017	0.0163	0.0169	0.0164	0.017	0.0171	0.0168	0.0163	0.0165
4	0.0279	0.0267	0.028	0.0282	0.0268	0.0256	0.0251	0.0267	0.0261	0.0266	0.0241	0.027
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
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
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
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
+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 SOPC	1.0098	1.0033	1.0052	0.9939	0.996	0.9874	1.0008	0.9873	0.988	0.9969	0.9945	1.0038

YEAI	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE											
1	0.0036	0.0036	0.0036	0.0036	0.0036	0.003	0.0036	0.0035	0.0035	0.0036	0.0035
2	0.009	0.009	0.009	0.009	0.009	0.0085	0.009	0.0085	0.0095	0.009	0.009
3	0.0165	0.0165	0.0166	0.0165	0.0169	0.0165	0.016	0.0165	0.0163	0.0163	0.017
4	0.0267	0.0263	0.0259	0.0257	0.0259	0.0252	0.0258	0.0269	0.027	0.0268	0.0259
5	0.0362	0.0356	0.0337	0.0358	0.036	0.0332	0.035	0.0368	0.0379	0.037	0.0342
6	0.0454	0.0417	0.041	0.0464	0.0517	0.0435	0.0447	0.0476	0.0461	0.0453	0.0436
7	0.0483	0.0503	0.0497	0.0538	0.0594	0.0575	0.057	0.0592	0.0534	0.0607	0.0564
8	0.0534	0.0594	0.0527	0.0533	0.0645	0.0653	0.0663	0.0705	0.0667	0.0676	0.0684
+gp	0.0607	0.0719	0.0736	0.0696	0.0712	0.0782	0.0827	0.1028	0.083	0.0859	0.0874
0 SOPC	1.0071	1.0048	1.0053	1.0061	0.9882	1.002	0.9957	0.9971	1.0006	1.0006	0.9969
1											

Table 10.7. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b). Effort and LPUE values of commercial fleets used in the assessment to tune the model.

Sub-area VIII a,b

	Le Guilvinec District Quarter 2		
Year	Landings(t)	Effort(100h)	LPUE(Kg/h)
1987	603	437	13.8
1988	777	471	16.5
1989	862	664	13.0
1990	801	708	11.3
1991	717	728	9.8
1992	841	757	11.1
1993	805	735	11.0
1994	690	671	10.3
1995	609	627	9.7
1996	715	598	12.0
1997	638	539	11.8
1998	622	489	12.7
1999	505	423	11.9
2000	438	405	10.8
2001	697	417	16.7
2002	527	371	14.2
2003	480	357	13.4
2004	387	327	11.8
2005	433	335	12.9
2006	409	306	13.4
2007	401	291	13.8
2008	410	271	15.1
2009	390	279	14.0

Table 10.8. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Separable analysis

At 4/05/2010 19:55

Separable analysis
from 1987 to 2009 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 231.542 and
final sum of squared residuals is 10.410 after 75 iterations

Matrix of Residuals

Years / Ages	1987/88	1988/89
1/ 2	-0.177	0.094
2/ 3	0.433	0.738
3/ 4	0.085	0.233
4/ 5	-0.044	0.121
5/ 6	0.026	-0.124
6/ 7	-0.106	-0.484
7/ 8	-0.131	-0.455
TOT	0.001	0.001
WTS	0.001	0.001

Years	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99
1/ 2	0.356	0.151	-0.456	0.09	-0.121	-0.104	-0.166	-0.597	0.034	-0.131
2/ 3	0.898	0.124	-0.184	0.186	-0.239	-0.148	-0.108	-0.541	0.208	-0.039
3/ 4	-0.036	-0.386	-0.138	0.152	-0.291	0.074	0.017	-0.294	0.331	-0.021
4/ 5	-0.18	-0.034	-0.062	0.033	-0.077	0.034	-0.103	0.04	0.254	-0.173
5/ 6	-0.224	0.014	0.148	0.049	0.235	-0.023	0.145	0.224	-0.112	0.092
6/ 7	-0.103	0.156	0.287	-0.245	0.103	-0.16	-0.028	0.274	-0.416	0.087
7/ 8	0.199	0.225	0.184	-0.325	0.282	0.244	0.195	0.364	-0.618	0.339
TOT	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
WTS	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Years	1999/**	2000/**	2001/**	2002/**	2003/**	2004/**	2005/**	2006/**	2007/**	2008/**	TOT	WTS
1/ 2	-0.361	-0.354	-0.618	0.016	-0.147	0.228	0.287	0.772	-0.265	-1.02	0	0.268
2/ 3	-0.18	-0.155	-0.533	0.145	-0.005	-0.196	0.063	0.513	-0.212	-0.168	0	0.281
3/ 4	-0.074	0.072	-0.186	0.388	0.135	-0.05	0.153	-0.025	0.077	-0.155	0	0.52
4/ 5	-0.046	0.051	-0.029	0.013	-0.027	-0.081	-0.06	-0.092	0.128	0.106	0	1
5/ 6	0.222	0.14	0.219	-0.023	0.126	0.047	0.002	-0.149	-0.058	0.157	0	0.774
6/ 7	0.031	0.03	0.464	-0.122	-0.14	0.044	-0.095	-0.242	0.032	0.263	0	0.447
7/ 8	0.13	-0.199	0.181	-0.525	-0.105	0.128	-0.203	-0.063	-0.02	0.158	0	0.357
TOT	0.001	0	0	0	0	0	0	0	0	0	-1.309	
WTS	0.001	0.001	0.001	0.001	0.001	1	1	1	1	1		

Fishing Mortalities (F)

	1987	1988	1989
F-values	0.6034	0.6074	0.5202

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
F-values	0.6173	0.5694	0.6454	0.7527	0.5424	0.6001	0.619	0.4717	0.5798	0.5206

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
F-values	0.4967	0.6318	0.4925	0.6132	0.6139	0.6206	0.6156	0.5128	0.473	0.4

Selection-at-age (S)

	1	2	3	4	5	6	7	8
S-values	0.0415	0.6547	1.1079	1.1621	1	0.9464	0.9017	1

Table 10.9. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Tune data

bay	of	biscay	TUNE	DATA	:	EFFORT	100HRS		
101									
FLEET	QGV	Q2							
1987	2009								
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	2695.2	29783.6	17583.8	7337.2	2397.9	884.8	379.7	199.9	292.7
663.5	2648.0	29789.8	14875.8	6866.0	2901.9	1656.7	840.3	352.5	789.3
707.8	2088.7	19070.8	11166.9	8860.4	3778.1	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	746.4	19581.8	17246.3	9023.5	3920.1	1446.4	491.5	189.3	242.4
734.7	642.0	15853.5	14705.2	7927.1	3733.1	1966.0	959.4	422.7	653.8
670.6	573.8	13077.7	15461.9	8340.0	2378.7	940.9	429.6	233.5	445.1
626.9	495.9	11677.5	13228.4	5969.2	2784.4	1123.2	459.7	160.7	292.5
597.9	533.1	10521.1	12661.4	8264.6	3959.6	1550.5	743.8	307.4	371.3
539.0	590.9	13531.3	15653.4	8438.8	2863.2	1140.7	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	305.0	9210.1	10053.8	6013.5	2828.6	985.2	546.9	250.7	253.2
405.2	271.6	8914.2	8186.3	5408.1	2461.7	1002.3	381.9	231.9	255.5
417.1	430.1	13370.9	13968.6	8169.1	3850.7	1731.9	716.9	399.1	294.8
371.3	379.1	12992.1	15801.6	5399.0	1904.3	714.2	249.9	217.3	181.6
357.0	310.4	8195.0	10153.6	6228.1	2708.0	908.4	444.4	256.5	361.9
327.1	1154.3	10057.4	7886.9	4891.8	2536.2	1033.7	473.0	211.2	284.8
334.6	1409.8	14030.9	10522.3	4993.1	2127.6	1062.8	439.2	186.8	280.2
306.3	1394.2	20254.7	13349.6	5258.6	1967.3	811.8	428.9	239.7	366.9
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
278.7	477.5	6737.3	10032.2	6092.9	2121.2	817.6	304.6	147.6	177.1

Table 10.10. Nephrops in Fus 23-24 Bay of Biscay (VIIIa,b) - XSA tuning diagnostics

4/05/2010 19:56

Extended Survivors Analysis

bay of biscay M+F WG 2006 t0=0 9+

CPUE data from file tuneff.DAT

Catch data for 23 years. 1987 to 2009. Ages 1 to 9.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
FLEETQGV(	1987	2009	1	8	0.25	0.5

Time series weights :

Tapered time weighting applied
Power = 3 over 23 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 = 1.500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning converged after 29 iterations

1

Regression weights

0.831	0.879	0.918	0.948	0.969	0.984	0.993	0.998	1	1

Fishing mortalities

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0.011	0.016	0.02	0.02	0.033	0.046	0.042	0.014	0.008	0.011
2	0.262	0.311	0.371	0.381	0.357	0.432	0.61	0.251	0.27	0.315
3	0.558	0.615	0.712	0.704	0.628	0.748	0.697	0.579	0.449	0.449
4	0.612	0.683	0.578	0.686	0.631	0.664	0.68	0.641	0.513	0.441
5	0.57	0.656	0.447	0.614	0.59	0.55	0.57	0.525	0.453	0.315
6	0.453	0.632	0.377	0.51	0.492	0.514	0.471	0.514	0.5	0.294
7	0.378	0.516	0.277	0.462	0.534	0.401	0.5	0.443	0.449	0.311
8	0.479	0.629	0.335	0.588	0.52	0.492	0.464	0.467	0.453	0.356

1
XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6	7	8
2000	665000	415000	195000	86700	35900	16500	8300	3550
2001	595000	487000	237000	86700	36600	15800	8150	4430
2002	554000	434000	265000	99600	34100	14800	6550	3790
2003	667000	402000	222000	101000	43500	17000	7910	3860
2004	799000	484000	204000	85500	39700	18300	7940	3880
2005	930000	573000	251000	84600	35400	17100	8740	3630
2006	647000	658000	276000	92500	33900	15900	7980	4550
2007	673000	459000	265000	107000	36500	14900	7740	3770
2008	520000	491000	264000	116000	43900	16800	6960	3870
2009	722000	382000	278000	131000	53900	21700	7940	3460

Estimated population abundance at 1st Jan 2010

0.00E+00	5.29E+05	2.06E+05	1.38E+05	6.59E+04	3.06E+04	1.26E+04	4.53E+03

Taper weighted geometric mean of the VPA populations:

6.37E+05	4.58E+05	2.40E+05	9.82E+04	3.90E+04	1.67E+04	7.56E+03	3.54E+03

Standard error of the weighted Log(VPA populations) :

1.74E-01	1.68E-01	1.23E-01	1.29E-01	1.26E-01	1.07E-01	1.27E-01	2.12E-01

1

Log catchability residuals.

Fleet : FLEETQGVQ2

Age	1987	1988	1989
1	0.9	1.28	0.97
2	0.34	0.53	0.34
3	-0.1	0.15	-0.34
4	-0.24	-0.02	-0.49
5	-0.33	-0.23	-0.36
6	-0.42	-0.33	-0.06
7	-0.23	-0.38	0.03
8	-0.12	0.03	-0.06

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	0.67	-0.66	-0.34	-0.38	-0.35	-0.39	-0.26	0.04	-0.29	-0.46
2	-0.19	-0.52	-0.25	-0.33	-0.39	-0.38	-0.42	-0.02	-0.03	-0.02
3	-0.62	-0.57	-0.38	-0.45	-0.26	-0.35	-0.3	0.02	-0.1	-0.03
4	-0.34	-0.41	-0.36	-0.37	-0.27	-0.55	-0.11	0	-0.13	0
5	-0.29	-0.39	-0.23	-0.13	-0.48	-0.38	0.01	-0.17	-0.09	0.05
6	0.04	-0.41	-0.34	0.23	-0.38	-0.28	0.02	-0.27	0.06	-0.16
7	0.03	-0.3	-0.59	0.23	-0.11	-0.25	0.24	-0.42	0.18	0.07
8	0.01	-0.19	-0.19	0.24	-0.02	-0.03	0.25	0.04	0.34	0.04

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	-0.69	-0.15	-0.09	-0.43	0.79	0.82	1.26	-0.65	0.01	0.16
2	-0.19	0.05	0.27	-0.07	0.03	0.2	0.58	-0.27	0.2	0.01
3	-0.19	0.14	0.3	0.07	-0.03	0.07	0.28	0.13	0.12	-0.01
4	-0.07	0.34	-0.13	0.08	0.07	0.09	0.15	0.17	0.18	-0.05
5	0.02	0.45	-0.14	0.07	0.17	0.07	0.13	0	0.21	-0.26
6	-0.08	0.55	-0.25	-0.06	0.07	0.15	0.03	0.08	0.36	-0.24
7	-0.39	0.28	-0.52	-0.03	0.14	-0.1	0.09	-0.12	0.05	-0.22
8	0	0.35	-0.1	0.19	0.05	-0.04	0.06	-0.15	0.03	-0.1

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	-12.9972	-9.4489	-8.68	-8.392	-8.3989	-8.4628	-8.4628	-8.4628
S.E(Log q)	0.5937	0.2672	0.2103	0.2025	0.2153	0.2469	0.2587	0.1623

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	0.4	1.704	13.22	0.4	23	0.22	-13
2	0.56	1.969	11.03	0.63	23	0.13	-9.45
3	0.66	1.097	9.95	0.47	23	0.14	-8.68
4	1.48	-0.718	6.91	0.16	23	0.3	-8.39
5	1.5	-0.682	7.31	0.14	23	0.33	-8.4
6	1.16	-0.201	8.27	0.12	23	0.3	-8.46
7	0.66	0.941	8.67	0.39	23	0.16	-8.53
8	0.83	1.035	8.37	0.75	23	0.13	-8.41
1							

Terminal year survivor and F summaries :

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

Year class = 2008

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEETQGV(	622017	0.615	0	0	1	0.855	0.01
F shrinkage	204299	1.5				0.145	0.029

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
529149	0.57	0.42	2	0.746	0.011

1

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

Year class = 2007

Fleet	ES	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEETQGV(	208655	0.27	0	0	2	0.958	0.312

F shrinkage	161168	1.5				0.042	0.388

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of yea	s.e	s.e		Ratio	
206379	0.27	0.04	3	0.142	0.315

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

Year class = 2006

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEETQGV(	140075	0.202	0.166	0.82	3	0.969	0.444
F shrinkage	89635	1.5				0.031	0.627

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of y	s.e	s.e		Ratio	
138134	0.2	0.14	4	0.7	0.449

1

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

Year class = 2005

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEETQGV(	66718	0.174	0.184	1.05	4	0.973	0.437
F shrinkage	41345	1.5				0.027	0.633

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of yea	s.e	s.e		Ratio	
65863	0.17	0.16	5	0.926	0.441

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

Year class = 2004

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEETQGV(	31138	0.171	0.144	0.84	5	0.975	0.311
F shrinkage	15733	1.5				0.025	0.543

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of yea	s.e	s.e		Ratio	
30614	0.17	0.14	6	0.796	0.315

1

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

Year class = 2003

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEETQGV(	12807	0.165	0.107	0.65	6	0.977	0.29
F shrinkage	6587	1.5				0.023	0.503

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of yea	s.e	s.e		Ratio	
12612	0.17	0.11	7	0.636	0.294

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

Year class = 2002

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEETQGV(	4583	0.162	0.098	0.61	7	0.977	0.308
F shrinkage	2752	1.5				0.023	0.47

Weighted prediction :

Survivors	Int	Ext	N	Var	F
at end of yea	s.e	s.e		Ratio	
4530	0.16	0.09	8	0.582	0.311

1

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 6

Year class = 2001

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
FLEETQGV(	1890	0.156	0.033	0.21	8	0.977	0.356
F shrinkage	1832	1.5				0.023	0.365

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
1889	0.16	0.03	9	0.195	0.356

1

FLEETQGVQ2

CPUE adjusted to start of year

	AGE							
YEAR	1	2	3	4	5	6	7	8
1987	5.284203	74.45168	42.52367	17.57055	5.692216	1.984926	0.9379748	0.4482809
1988	6.509582	91.74657	54.43445	22.76108	6.968567	2.443429	1.034221	0.5836653
1989	4.51868	62.65804	30.39809	13.97001	5.815585	3.36336	1.732678	0.7290926
1990	3.335004	35.37746	21.02882	18.06357	7.544248	3.812823	1.655245	0.7334533
1991	0.9004927	25.56307	25.16144	16.10354	6.354009	2.480736	0.9576597	0.4705066
1992	1.114189	34.20907	33.46851	17.72785	7.522298	2.61128	0.8660783	0.4008646
1993	0.9868084	28.16658	28.59008	16.21498	7.68064	4.12812	2.009656	0.9191069
1994	0.9636589	24.54691	31.87656	17.565	4.789978	1.84535	0.9108142	0.4877551
1995	0.890354	23.61839	29.83042	13.39418	6.221779	2.470152	1.009808	0.3829498
1996	1.003678	21.97516	29.25008	19.93493	9.268915	3.512594	1.748396	0.7022605
1997	1.235414	32.22605	40.67627	22.06433	6.925356	2.665401	1.003723	0.5730847
1998	0.8202992	28.99779	32.81733	18.76231	8.042953	4.039678	2.273735	1.251735
1999	0.8106373	27.19188	32.19344	19.76322	9.194374	3.028603	1.716192	0.7883044
2000	0.7531434	27.13488	27.3106	18.40237	8.249462	3.215376	1.191632	0.7513286
2001	1.160642	40.26893	46.23802	27.73253	12.94038	5.769685	2.287236	1.327763
2002	1.150628	44.93742	60.88855	19.79858	6.65099	2.430208	0.8195425	0.7281479
2003	0.9799137	29.59095	40.56813	24.71908	10.46568	3.378492	1.623533	0.9819132
2004	3.997873	39.30447	33.45219	20.77045	10.6064	4.168416	1.937202	0.8607466
2005	4.795892	55.09582	45.59866	20.97551	8.567966	4.223096	1.673916	0.7363126
2006	5.174352	92.8272	62.01972	24.28293	8.720492	3.468398	1.852559	1.021567
2007	0.7935668	27.5131	51.4752	28.81783	8.194924	3.424134	1.45046	0.6844386
2008	1.190189	47.36898	50.51128	31.37561	12.19989	5.08219	1.550853	0.8427132
2009	1.924784	30.41398	46.71388	28.29213	9.400019	3.594177	1.347449	0.6640007

1

Table 10.11. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b). Estimates of Fishimg mortality at age

Run title : bay of biscay M+F WG 2010 t0=0 9+

At 4/05/2010 19:56

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
AGE												
1	0.0317	0.0423	0.0319	0.027	0.0156	0.0253	0.025	0.0177	0.0161	0.0164	0.0193	0.0186
2	0.593	0.6971	0.5944	0.4299	0.3347	0.4478	0.4141	0.3162	0.3359	0.295	0.3691	0.3617
3	0.7391	0.7605	0.5664	0.5204	0.5914	0.7816	0.7072	0.619	0.6792	0.6165	0.6541	0.6485
4	0.6696	0.7661	0.5548	0.7346	0.683	0.8149	0.8446	0.6767	0.6658	0.7331	0.6708	0.6449
5	0.5353	0.5897	0.5139	0.6786	0.6221	0.7512	0.8603	0.5555	0.6545	0.6522	0.4607	0.5923
6	0.4437	0.4522	0.5488	0.7887	0.6284	0.5864	0.9155	0.4844	0.6115	0.5638	0.3678	0.6151
7	0.4882	0.4151	0.5907	0.7868	0.7323	0.521	0.909	0.6946	0.6084	0.6634	0.2874	0.6703
8	0.583	0.6024	0.5991	0.7127	0.8137	1.0181	1.0102	0.6545	0.8285	0.5864	0.3982	0.7217
+gp	0.583	0.6024	0.5991	0.7127	0.8137	1.0181	1.0102	0.6545	0.8285	0.5864	0.3982	0.7217
0 FBAR 2- 5	0.6343	0.7034	0.5574	0.5909	0.5578	0.6989	0.7066	0.5419	0.5838	0.5742	0.5387	0.5619

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	FBAR **
AGE												
1	0.0124	0.0113	0.0159	0.0197	0.0198	0.0332	0.0463	0.0424	0.0145	0.0083	0.0113	0.0114
2	0.2945	0.2615	0.3105	0.3706	0.3806	0.3574	0.4319	0.6099	0.2514	0.2698	0.3152	0.2788
3	0.5632	0.5582	0.6151	0.7119	0.7036	0.6282	0.7479	0.6967	0.5791	0.4491	0.4487	0.4923
4	0.6333	0.6116	0.6833	0.5781	0.6856	0.631	0.6639	0.6803	0.6406	0.5133	0.4412	0.5317
5	0.6036	0.5703	0.6559	0.4467	0.6137	0.59	0.5498	0.5699	0.5251	0.453	0.3155	0.4312
6	0.4532	0.4527	0.6324	0.3765	0.5102	0.4919	0.5138	0.4707	0.5141	0.5002	0.2939	0.436
7	0.5087	0.3781	0.5158	0.2774	0.4621	0.5337	0.4015	0.5001	0.4427	0.4486	0.3107	0.4007
8	0.5141	0.4793	0.6287	0.3353	0.588	0.5205	0.4921	0.464	0.4669	0.4529	0.3559	0.4253
+gp	0.5141	0.4793	0.6287	0.3353	0.588	0.5205	0.4921	0.464	0.4669	0.4529	0.3559	
0 FBAR 2- 5	0.5237	0.5004	0.5662	0.5268	0.5959	0.5517	0.5984	0.6392	0.4991	0.4213	0.3801	
1												

Table 10.12. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Estimates of stocks number at age

Run title : bay of biscay M+F WG 2010 t0=0 9+

At 4/05/2010 19:56

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	952533	795860	755567	756376	766903	689955	635315	603371	581174	572006	521500	484821	566972
2	674915	683643	565170	542145	545423	559343	498378	459039	439147	423669	416863	378949	352563
3	275992	276322	252228	231083	261293	289134	264796	244026	247872	232521	233683	213514	195520
4	98142	102643	100593	111489	106954	112646	103056	101673	102337	97879	97754	94618	86939
5	35315	39127	37157	44984	41650	42073	38836	34490	40250	40955	36620	38927	38664
6	14318	16104	16896	17309	17774	17412	15460	12794	15412	16291	16615	17991	16767
7	5597	7155	7979	7601	6126	7384	7544	4820	6139	6512	7220	8958	7574
8	2401	2675	3679	3442	2695	2294	3415	2367	1874	2602	2612	4218	3569
+gp	3774	3769	7302	3309	3216	3539	4799	4127	2953	3462	2731	5525	4509
0 TOTAL	2062985	1927297	1746573	1717739	1752034	1723781	1571599	1466709	1437157	1395897	1335599	1247522	1273076

YEAR	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	GMST 87-**	AMST 8
AGE													
1	665204	594698	553753	666568	799382	930303	646559	672616	519703	722406	0	666231	676735
2	414828	487237	433633	402223	484113	572865	658000	459086	491137	381822	529149	489240	497678
3	194555	236593	264603	221768	203657	250854	275556	264882	264491	277796	206379	242781	244307
4	86703	86702	99607	101124	85462	84629	92478	106922	115608	131464	138134	97765	98112
5	35941	36632	34096	43516	39676	35412	33933	36475	43882	53888	65863	38201	38320
6	16466	15824	14806	16987	18346	17128	15914	14946	16802	21725	30614	16210	16265
7	8300	8155	6548	7913	7943	8736	7980	7741	6961	7935	12612	7253	7330
8	3547	4429	3792	3864	3882	3627	4554	3769	3872	3462	4530	3210	3300
+gp	4320	3910	3911	5213	6137	5332	7498	5844	4333	4349	4262		
0 TOTAL	1429863	1474179	1414749	1469176	1648598	1908887	1742472	1572281	1466790	1604847	991542		
1													

Table 10.13.Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b). Summary of Catches and XSA results

Run title : bay of biscay M+F WG 2010 t0=0 9+

Table 16 Summary (without SOP correction)

	RECI Age 1	TOTALBIO	TOTSPBIC	REMOVALS	LANDINGS	DISCARDS	YIELD/SSI	FBAR 2- 5
1987	952533	19654	9327	6634	5397	1767	0.7113	0.6343
1988	795860	19416	9596	7211	5875	1909	0.7515	0.7034
1989	755567	18133	9574	5857	4835	1460	0.6117	0.5574
1990	756376	18128	9783	5868	4972	1281	0.5998	0.5909
1991	766903	18506	9465	5603	4754	1213	0.5920	0.5578
1992	689955	18923	9907	6789	5681	1584	0.6852	0.6989
1993	635315	16671	8758	6093	5109	1405	0.6957	0.7066
1994	603371	16084	8502	4834	4092	1060	0.5686	0.5419
1995	581174	16193	8856	5213	4452	1087	0.5886	0.5838
1996	572006	15511	8433	4822	4118	1005	0.5717	0.5742
1997	521500	14425	7635	4344	3610	1049	0.5690	0.5387
1998	484821	14593	8557	4882	3865	1453	0.5705	0.5619
1999	566972	13752	7732	4033	3209	1177	0.5217	0.5237
2000	665204	14523	7593	3918	3069	1213	0.5160	0.5004
2001	594698	15509	8001	4788	3730	1512	0.5984	0.5662
2002	553753	15556	8569	4831	3679	1646	0.5637	0.5268
2003	666568	15922	8965	5126	3742	1977	0.5718	0.5959
2004	799382	15333	7979	4637	3285	1931	0.5811	0.5517
2005	930303	17886	8378	5578	3689	2698	0.6658	0.5984
2006	646559	18461	9468	6611	3430	4544	0.6982	0.6392
2007	672616	17141	9346	4864	3176	2411	0.5204	0.4991
2008	519703	17142	9773	4517	3030	2124	0.4621	0.4213
2009	722406	17947	10801	4312	3029	1833	0.3992	0.3801
Arith. Mean	671893	16757	8913	5277	4080	1710	0.5919	0.5675
Units	(Thousands	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 10.14 Nephrops in Fus 23-24 bay of Biscay (VIIIa,b) Prediction with management option table: Input data

2010	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	0.003	0.0114	0.003	658752	0.30	0	0	0	0.004
2	0.0114	0.011	0.2674	0.009	529149	0.30	0	0	0	0.009
3	0.2937	0.018	0.1986	0.015	206379	0.25	0.75	0	0	0.017
4	0.4763	0.027	0.0554	0.022	138134	0.25	1	0	0	0.027
5	0.4128	0.037	0.0184	0.035	65863	0.25	1	0	0	0.036
6	0.4180	0.046	0.0180	0.030	30614	0.25	1	0	0	0.045
7	0.3958	0.057	0.0049	0.078	12612	0.25	1	0	0	0.057
8	0.4061	0.069	0.0191	0.044	4530	0.25	1	0	0	0.068
9+	0.4202	0.085	0.0051	0.101	4262	0.25	1	0	0	0.085
Unit	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

2011	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	0.003	0.0114	0.003	658752	0.30	0	0	0	0.004
2	0.0114	0.011	0.2674	0.009		0.30	0	0	0	0.009
3	0.2937	0.018	0.1986	0.015		0.25	0.75	0	0	0.017
4	0.4763	0.027	0.0554	0.022		0.25	1	0	0	0.027
5	0.4128	0.037	0.0184	0.035		0.25	1	0	0	0.036
6	0.4180	0.046	0.0180	0.030		0.25	1	0	0	0.045
7	0.3958	0.057	0.0049	0.078		0.25	1	0	0	0.057
8	0.4061	0.069	0.0191	0.044		0.25	1	0	0	0.068
9+	0.4202	0.085	0.0051	0.101		0.25	1	0	0	0.085
Unit	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

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	0.003	0.0114	0.003	658752	0.30	0	0	0	0.004
2	0.0114	0.011	0.2674	0.009		0.30	0	0	0	0.009
3	0.2937	0.018	0.1986	0.015		0.25	0.75	0	0	0.017
4	0.4763	0.027	0.0554	0.022		0.25	1	0	0	0.027
5	0.4128	0.037	0.0184	0.035		0.25	1	0	0	0.036
6	0.4180	0.046	0.0180	0.030		0.25	1	0	0	0.045
7	0.3958	0.057	0.0049	0.078		0.25	1	0	0	0.057
8	0.4061	0.069	0.0191	0.044		0.25	1	0	0	0.068
9+	0.4202	0.085	0.0051	0.101		0.25	1	0	0	0.085
Unit	-	Kilograms	-	Kilograms	Thousands	-	-	-	-	Kilograms

Table 10.15 Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - Catch predictions with management option table

Year:	2010					
	Landings		Dead Discards			
F Factor	Reference F	Landings in weight	Reference F	Discards in weight	Stock Biomass	Sp. Stock Biomass
1.0	0.2986	3610	0.1349	1582	19420	11389

Year:	2011						Year: 2012	
	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	19766	11790	26868	18589
0.1	0.0299	448	0.0135	193			26042	17810
0.2	0.0597	875	0.0270	378			25252	17064
0.3	0.0896	1285	0.0405	558			24496	16351
0.4	0.1194	1676	0.0540	731			23771	15669
0.5	0.1493	2050	0.0675	897			23078	15017
0.6	0.1792	2407	0.0809	1059			22414	14393
0.7	0.2090	2749	0.0944	1214			21778	13797
0.8	0.2389	3076	0.1079	1364			21169	13226
0.9	0.2687	3389	0.1214	1509			20585	12680
1.0	0.2986	3688	0.1349	1650			20026	12157
1.1	0.3285	3974	0.1484	1785			19490	11658
1.2	0.3583	4248	0.1619	1916			18977	11179
1.3	0.3882	4510	0.1754	2042			18485	10721
1.4	0.4180	4761	0.1889	2164			18014	10283
1.5	0.4479	5000	0.2024	2282			17562	9864
1.6	0.4778	5230	0.2158	2397			17129	9463
1.7	0.5076	5450	0.2293	2507			16714	9079
1.8	0.5375	5660	0.2428	2614			16316	8711
1.9	0.5673	5861	0.2563	2717			15934	8359
2.0	0.5972	6054	0.2698	2817			15568	8022

Table 10.16 Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - Detailed tables

MFDP version 1a
Run: lang
Time and date: 17:41 06/05/2010
Fbar age range (Total) : 2-5
Fbar age range Fleet 1 : 2-5

Year: 2010 F multiplier: 1 Fleet1 HCFbar: 0.2986 Fleet1 DFbar: 0.1349

Age	Total F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0	4	0	0.0114	6431	21	658752	2328	0	0	0	0
2	0.0114	4579	50	0.2674	107425	967	529149	4851	0	0	0	0
3	0.2937	42788	770	0.1986	28931	424	206379	3412	154784	2559	154784	2559
4	0.4763	45653	1233	0.0554	5306	119	138134	3670	138134	3670	138134	3670
5	0.4128	19717	723	0.0184	878	31	65863	2395	65863	2395	65863	2395
6	0.418	9261	423	0.018	399	12	30614	1378	30614	1378	30614	1378
7	0.3958	3669	208	0.0049	45	4	12612	717	12612	717	12612	717
8	0.4061	1338	92	0.0191	63	3	4530	306	4530	306	4530	306
9	0.4202	1302	111	0.0051	16	2	4262	364	4262	364	4262	364
Total		128310	3610		149494	1582	1650295	19420	410799	11389	410799	11389

Year: 2011 F multiplier: 1 Fleet1 HCFbar: 0.2986 Fleet1 DFbar: 0.1349

Age	Total F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0	4	0	0.0114	6431	21	658752	2328	0	0	0	0
2	0.0114	4175	46	0.2674	97954	882	482500	4423	0	0	0	0
3	0.2937	61498	1107	0.1986	41582	610	296625	4904	222469	3678	222469	3678
4	0.4763	32468	877	0.0554	3774	84	98240	2610	98240	2610	98240	2610
5	0.4128	18924	694	0.0184	843	30	63214	2299	63214	2299	63214	2299
6	0.418	10082	460	0.018	435	13	33327	1500	33327	1500	33327	1500
7	0.3958	4485	254	0.0049	55	4	15416	876	15416	876	15416	876
8	0.4061	1943	133	0.0191	91	4	6580	445	6580	445	6580	445
9	0.4202	1367	117	0.0051	16	2	4475	382	4475	382	4475	382
Total		134946	3688		151181	1650	1659130	19766	443721	11790	443721	11790

Year: 2012 F multiplier: 1 Fleet1 HCFbar: 0.2986 Fleet1 DFbar: 0.1349

Age	Total F	CatchNos	Yield	DF	DCatchNos	DYield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0	4	0	0.0114	6431	21	658752	2328	0	0	0	0
2	0.0114	4175	46	0.2674	97954	882	482500	4423	0	0	0	0
3	0.2937	56077	1009	0.1986	37916	556	270475	4472	202857	3354	202857	3354
4	0.4763	46666	1260	0.0554	5424	121	141199	3751	141199	3751	141199	3751
5	0.4128	13459	493	0.0184	599	21	44957	1635	44957	1635	44957	1635
6	0.418	9676	442	0.018	417	12	31987	1439	31987	1439	31987	1439
7	0.3958	4882	277	0.0049	60	5	16782	954	16782	954	16782	954
8	0.4061	2375	163	0.0191	112	5	8042	543	8042	543	8042	543
9	0.4202	1719	147	0.0051	21	2	5627	481	5627	481	5627	481
Total		139033	3837		148934	1625	1660323	20026	451452	12157	451452	12157

Input units are thousands and kg - output in tonnes

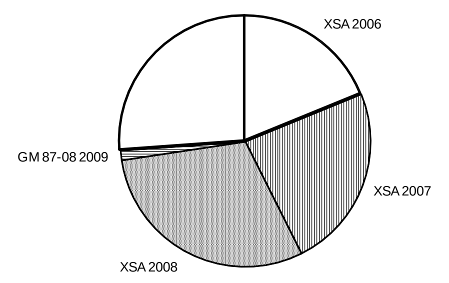
Table 10. 17 **Nephrops in FUs 23-24 bay of Biscay males and females combined**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class			2006	2007	2008	2009	2010
Stock No. (thousands) of		1 year-olds	672616	519703	722406	658752	658752
Source			XSA	XSA	XSA	GM 87-08	GM 87-08
Status Quo F:							
% in	2010	landings	34.2	21.3	1.4	0.0	-
% in	2011		18.8	23.8	30.0	1.2	0.0
% in	2010	SSB	32.2	22.5	0.0	0.0	-
% in	2011	SSB	19.5	22.1	31.2	0.0	0.0
% in	2012	SSB	11.8	13.4	30.9	27.6	0.0

GM : geometric mean recruitment

Nephrops in FUs 23-24 bay of Biscay males and females combined : Year-class % contribution to

a) 2011 landings



b) 2012 SSB

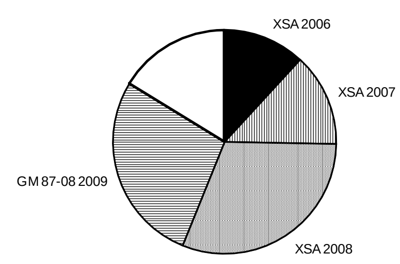


Table 10.18 Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) : Yield per recruit summary table

MFYPR version 2a
Run: LANG
Time and date: 17:44 06/05/2010
Yield per results

	Landings			DeadDiscards								
FMult	LandingsFbar	LandingsNos	LandingsYield	DeadDiscardsFbar	DeadDiscardsNos	DeadDiscardsYield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	4.2219	0.1239	2.3439	0.1113	2.3439	0.1113
0.1	0.0299	0.0717	0.0032	0.0135	0.0300	0.0004	3.8191	0.0980	1.9459	0.0855	1.9459	0.0855
0.2	0.0597	0.1194	0.0049	0.0270	0.0578	0.0007	3.5213	0.0800	1.6527	0.0676	1.6527	0.0676
0.3	0.0896	0.1518	0.0058	0.0405	0.0837	0.0010	3.2927	0.0670	1.4286	0.0546	1.4286	0.0546
0.4	0.1194	0.1739	0.0063	0.0540	0.1079	0.0013	3.1120	0.0574	1.2524	0.0451	1.2524	0.0451
0.5	0.1493	0.1889	0.0065	0.0675	0.1306	0.0015	2.9658	0.0500	1.1105	0.0378	1.1105	0.0378
0.6	0.1791	0.1988	0.0065	0.0810	0.1519	0.0017	2.8452	0.0443	0.9941	0.0321	0.9941	0.0321
0.7	0.2090	0.2051	0.0064	0.0945	0.1719	0.0019	2.7441	0.0398	0.8972	0.0276	0.8972	0.0276
0.8	0.2389	0.2087	0.0063	0.1079	0.1908	0.0021	2.6582	0.0361	0.8153	0.0241	0.8153	0.0241
0.9	0.2687	0.2103	0.0061	0.1214	0.2087	0.0023	2.5844	0.0331	0.7454	0.0211	0.7454	0.0211
1.0	0.2986	0.2104	0.0059	0.1349	0.2256	0.0025	2.5202	0.0307	0.6851	0.0187	0.6851	0.0187
1.1	0.3284	0.2094	0.0057	0.1484	0.2416	0.0026	2.4639	0.0286	0.6326	0.0167	0.6326	0.0167
1.2	0.3583	0.2076	0.0055	0.1619	0.2569	0.0027	2.4141	0.0269	0.5865	0.0150	0.5865	0.0150
1.3	0.3881	0.2051	0.0053	0.1754	0.2713	0.0029	2.3697	0.0254	0.5457	0.0136	0.5457	0.0136
1.4	0.4180	0.2022	0.0051	0.1889	0.2851	0.0030	2.3300	0.0241	0.5094	0.0124	0.5094	0.0124
1.5	0.4478	0.1989	0.0049	0.2024	0.2983	0.0031	2.2941	0.0230	0.4770	0.0113	0.4770	0.0113
1.6	0.4777	0.1954	0.0047	0.2159	0.3108	0.0032	2.2615	0.0220	0.4478	0.0104	0.4478	0.0104
1.7	0.5076	0.1916	0.0045	0.2294	0.3228	0.0033	2.2318	0.0211	0.4214	0.0096	0.4214	0.0096
1.8	0.5374	0.1878	0.0043	0.2429	0.3343	0.0034	2.2047	0.0204	0.3975	0.0089	0.3975	0.0089
1.9	0.5673	0.1839	0.0042	0.2564	0.3453	0.0035	2.1797	0.0197	0.3756	0.0082	0.3756	0.0082
2.0	0.5971	0.1800	0.0040	0.2699	0.3558	0.0036	2.1566	0.0191	0.3556	0.0077	0.3556	0.0077

Reference point	F multiplier	Absolute F
Fleet1 Landings Fb	1.0000	0.2986
FMax	0.5602	0.1673
F0.1	0.3629	0.1084
F35%SPR	0.4817	0.1438

Weights in kilograms
* based on landings

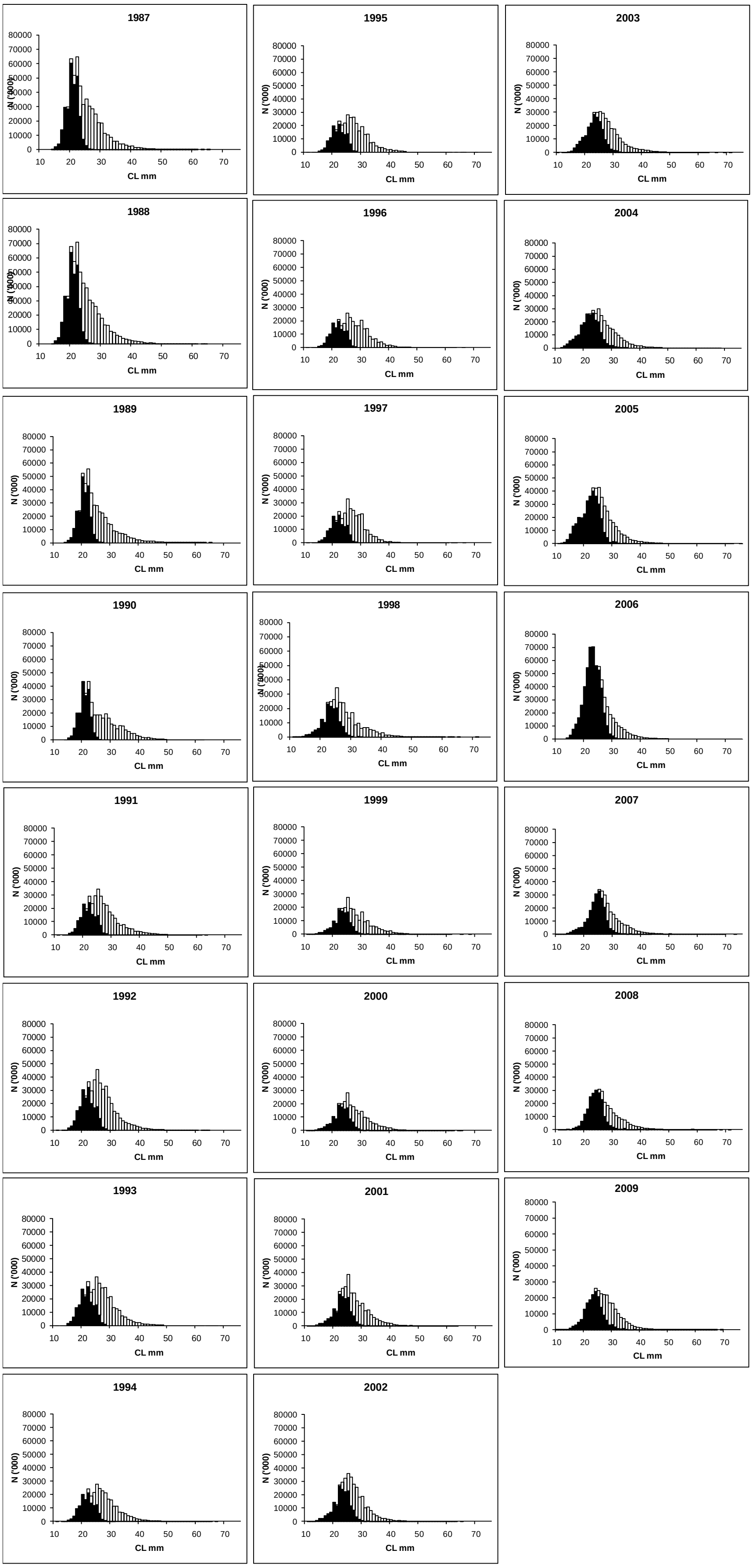


Figure 10.1. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) catches (landings in white and discards in black) length distributions in 1987-2009.

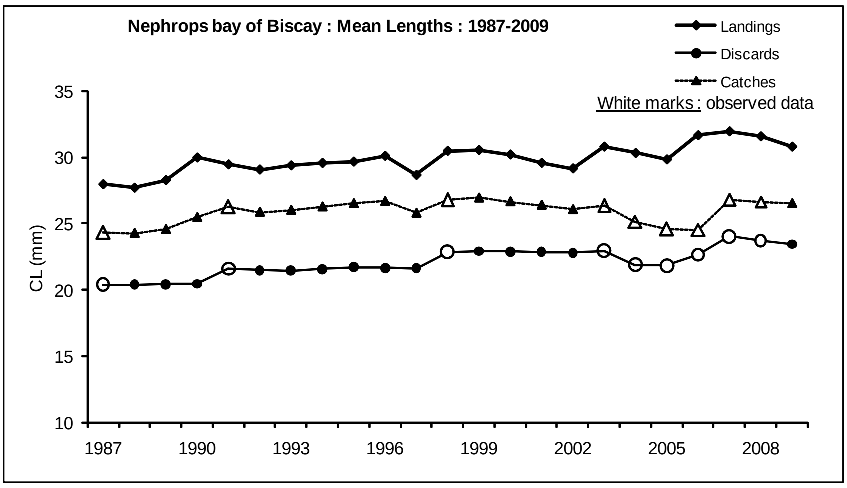


Figure 10.2. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - mean length of landings, discards and catches

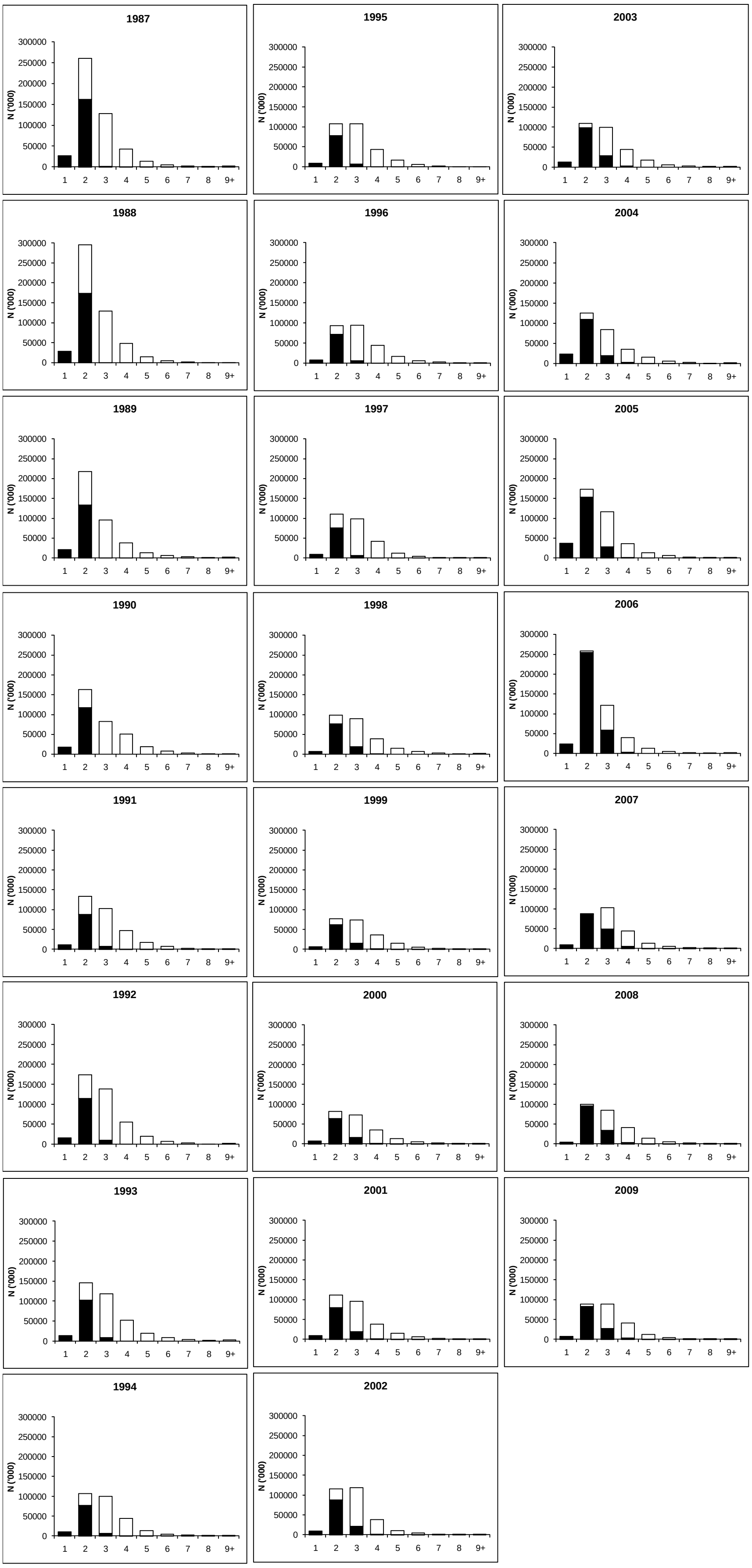
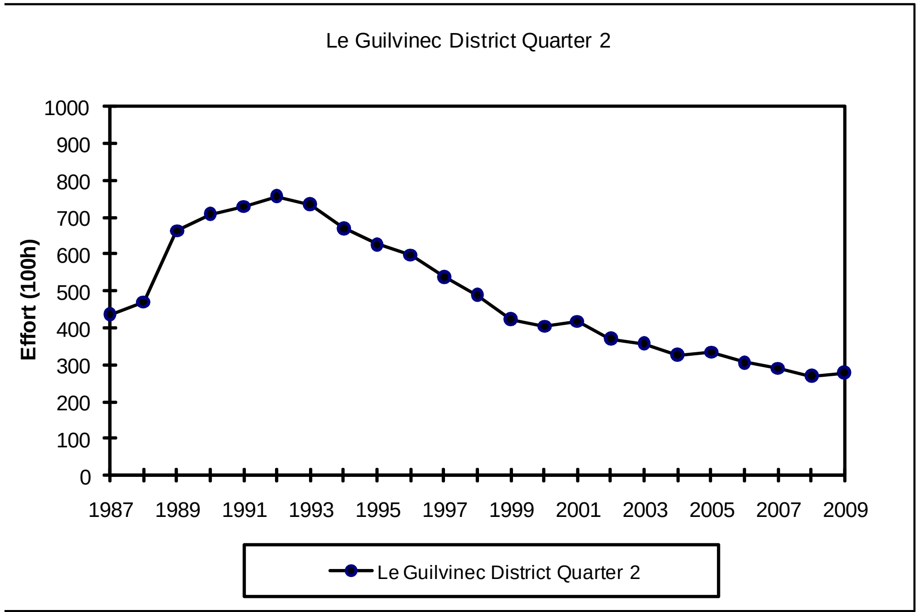


Figure 10.3 Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) catches (landings in white and dead discards in black; mortality of discards equal to .70) age distributions in 1987-2009.

I. Effort



II. LPUE

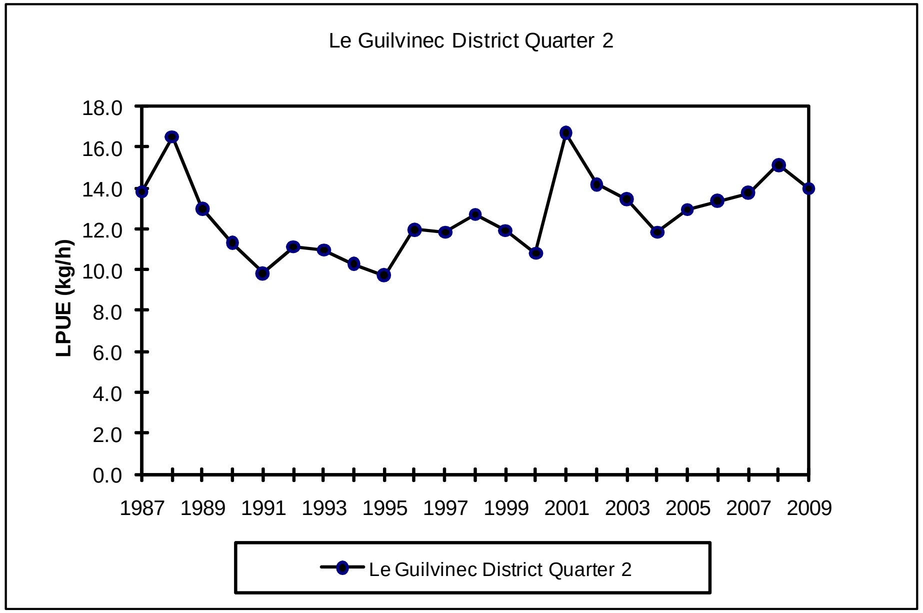
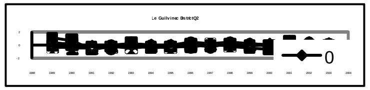
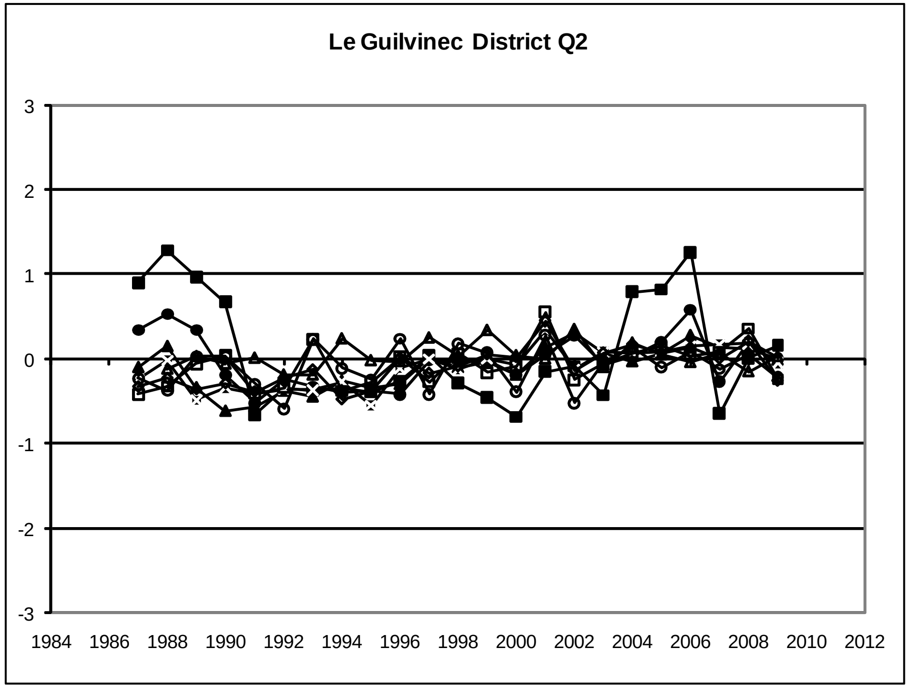


Figure 10.4. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - Effort and LPUE values of commercial fleets used in the assessment to tune the model.



LOG CATCHABILITY RESIDUAL PLOTS (XSA)



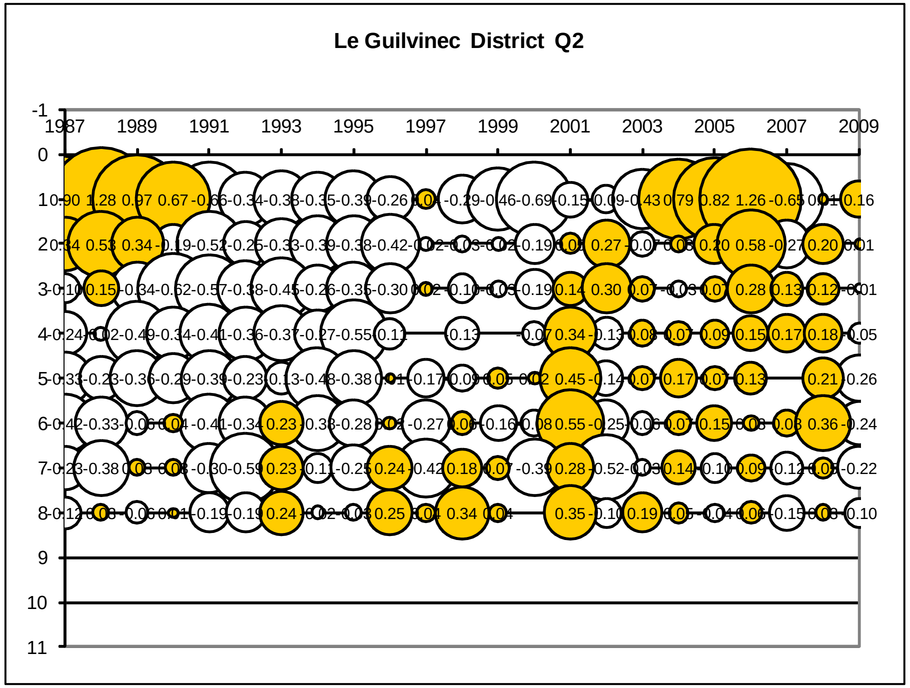


Figure 10.5 Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b)

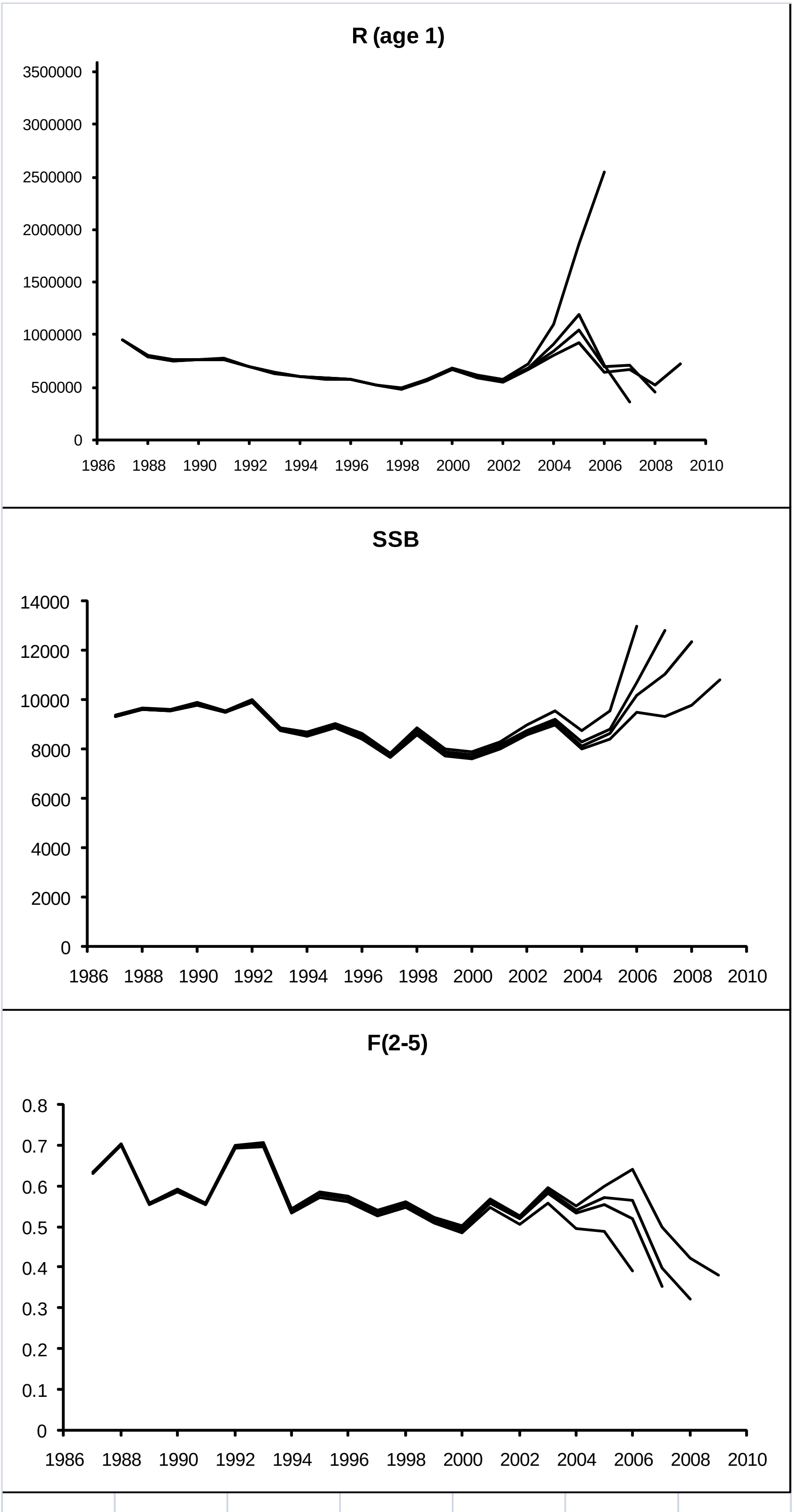


Figure 10.6 Retrospective Analysis (Nephrops Bay of Biscay(FU 23-24)

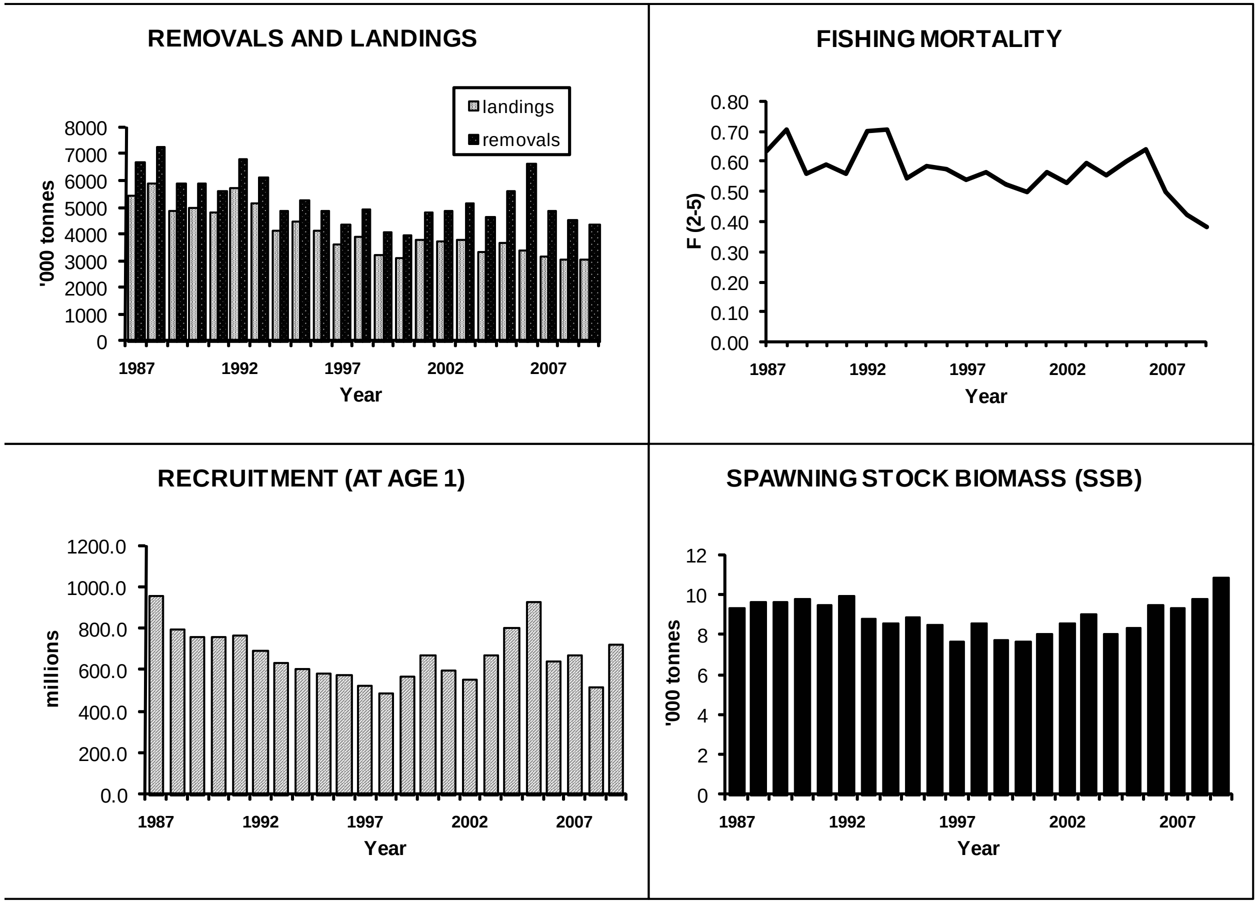
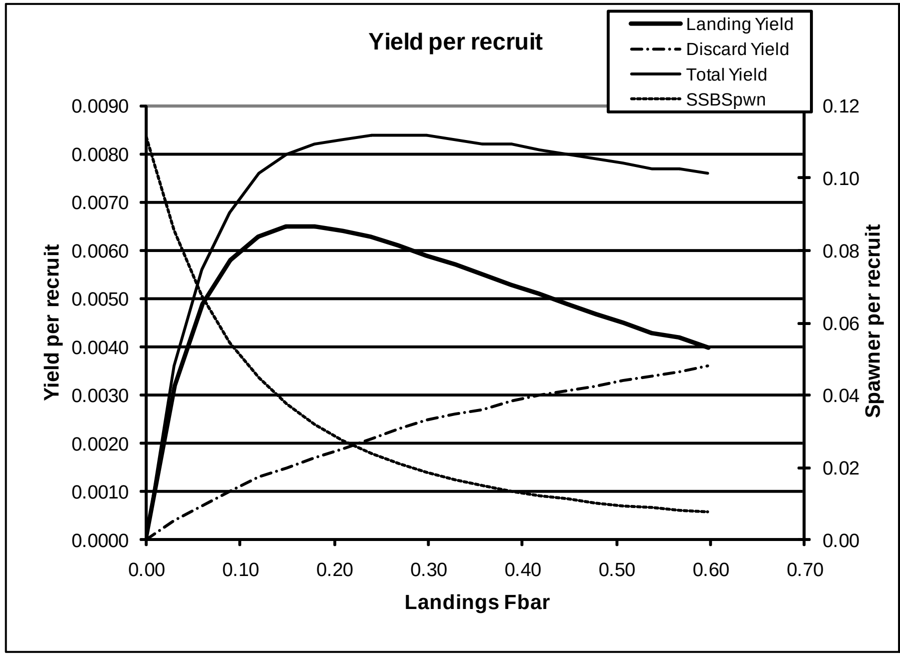


Figure 10.7. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Historical trends in biomass, fishing mortality and recruitment



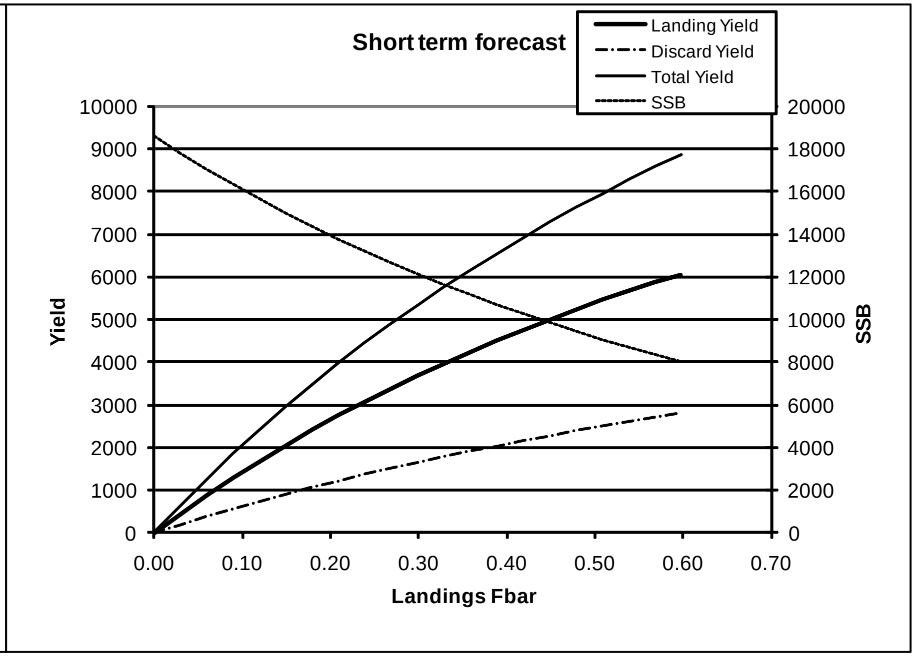


Figure 10.8. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Short term and long term predictions

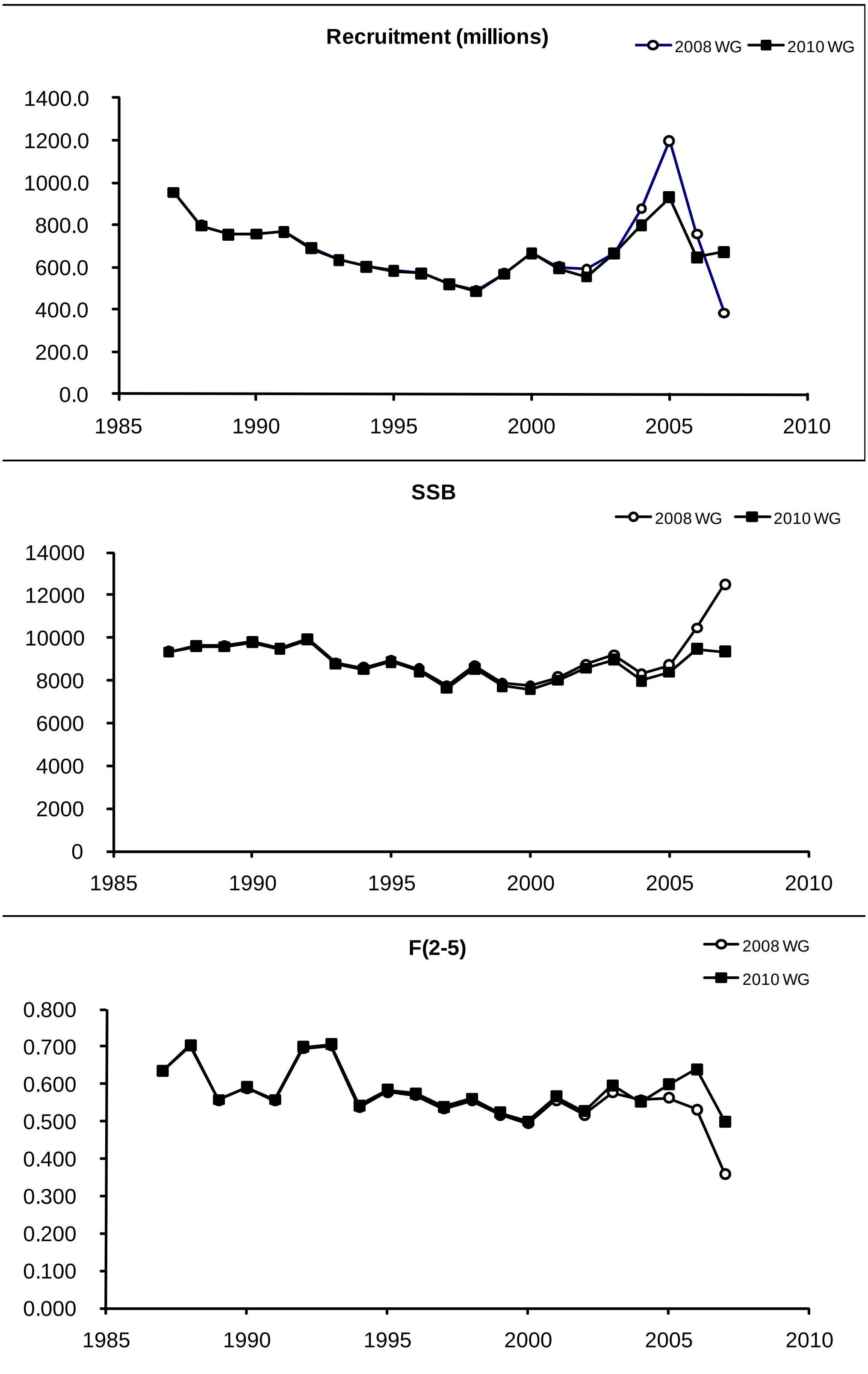


Figure 10.9. Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) - Comparative Final Runs

11 *Nephrops* in Division VIIIc

11.1 *Nephrops* FU 25 (North Galicia)

11.1.1 General

11.1.1.1 Ecosystem aspects

Sea Annex K

11.1.1.2 Fishery description

Sea Annex K

11.1.1.3 Summary of ICES Advice for 2010 and management applicable to 2009 and 2010

ICES advice for2010

Since ICES advice on *Nephrops* is biennial, the advice for 2010 was the same as for 2009:

Available information indicates that the stock is at a very low abundance level. The stock assessments are only indicative of stock trends. In the absence of defined reference points, the state of the stocks cannot be evaluated in this regard. No new analytical assessment of this FU was conducted in 2008. The perception of the state of the stock and the advice remains unchanged to that previously expressed by ICES. However, the stock suffers severe recruitment failure.

FU 25 (North Galicia): Landings and LPUE have fluctuated along a marked downward trend and are currently very low. Mean sizes have shown an increasing trend over the time-series. This may reflect poor recruitment. The fishing effort has been reduced in recent years, but increased slightly in 2007. This information indicates that the stock is at a very low abundance level.

Given the very low state of the stock, ICES repeats its advice of a zero catch for the stock in FU 25.

Management applicable to 2009 and 2010

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 112 and 101 t were set for the whole of Division VIIIc for 2009 and 2010, respectively.

11.1.2 Data

11.1.2.1 Commercial catches and discards

Landings were reported only by Spain (Table 11.1.1). Since the early 90s landings declined from about 400 t to less than 50 t. 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. The time series of the commercial landings (Figure 11.1.1) shows a clear declining trend, with present figures representing less than 10% of the landings in the 70s.

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 1982-2009 (see also Figure 11.1.2). Mean sizes in the landings in the last decade, 1999-2009, varied between 37.3 and 48.5 mm CL for the males, and between 36.8 and 45.5 mm CL for the females. The mean size time series shows an increasing trend (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 suggest that the increasing trend of mean sizes can reflect a continuous low level of recruitment during the last period of the series.

11.1.2.3 Commercial catch-effort data

Fishing effort and LPUE data were available for the A Coruña trawl fleet (SP-CORUTR8c) (Table 11.1.3 and Figure 11.1.1). This fleet accounted for more than 80% of the *Nephrops* landings from FU 25 up to 2003, diminishing afterwards and currently accounting for approximately 50% of the landings.

The overall trend in fishing effort is decreasing, with current effort being approximately half the level in 2000. The long time series of effort (Figure 11.1.1) shows a marked decrease between 1976 and 1987, 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, the fishing effort reached the lowest value of the series with 1552 fishing trips. 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 in 2009 to 7.3 kg/trip, the lowest recorded value in the time series.

11.1.3 Assessment

This FU 25 is assessed by examining the LPUE series trend, as was done in 2008. The trend indicates that the stock is at a minimum historical level.

11.1.4 Biological reference points

There are no reference points defined for this stock.

11.1.5 Management Considerations

Nephrops is taken as by catch in the mixed bottom fishery. The overall trend in landings of *Nephrops* from the North Galicia FU 25 is of a strong decline. Landings have dramatically decreased since 1992. Current landings represent about 4% of the mean landings in the early period of the time series (1975-1980).

Nephrops is managed by TAC and technical measures. The TAC for the whole of Division VIIIc in 2009 was 112 t. Landings of *Nephrops* from Division VIIIc (FU 25 and FU 31) in 2009 were estimated to be 27 t, around 25% 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* FU 25, 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

* estimated landings from sampling program

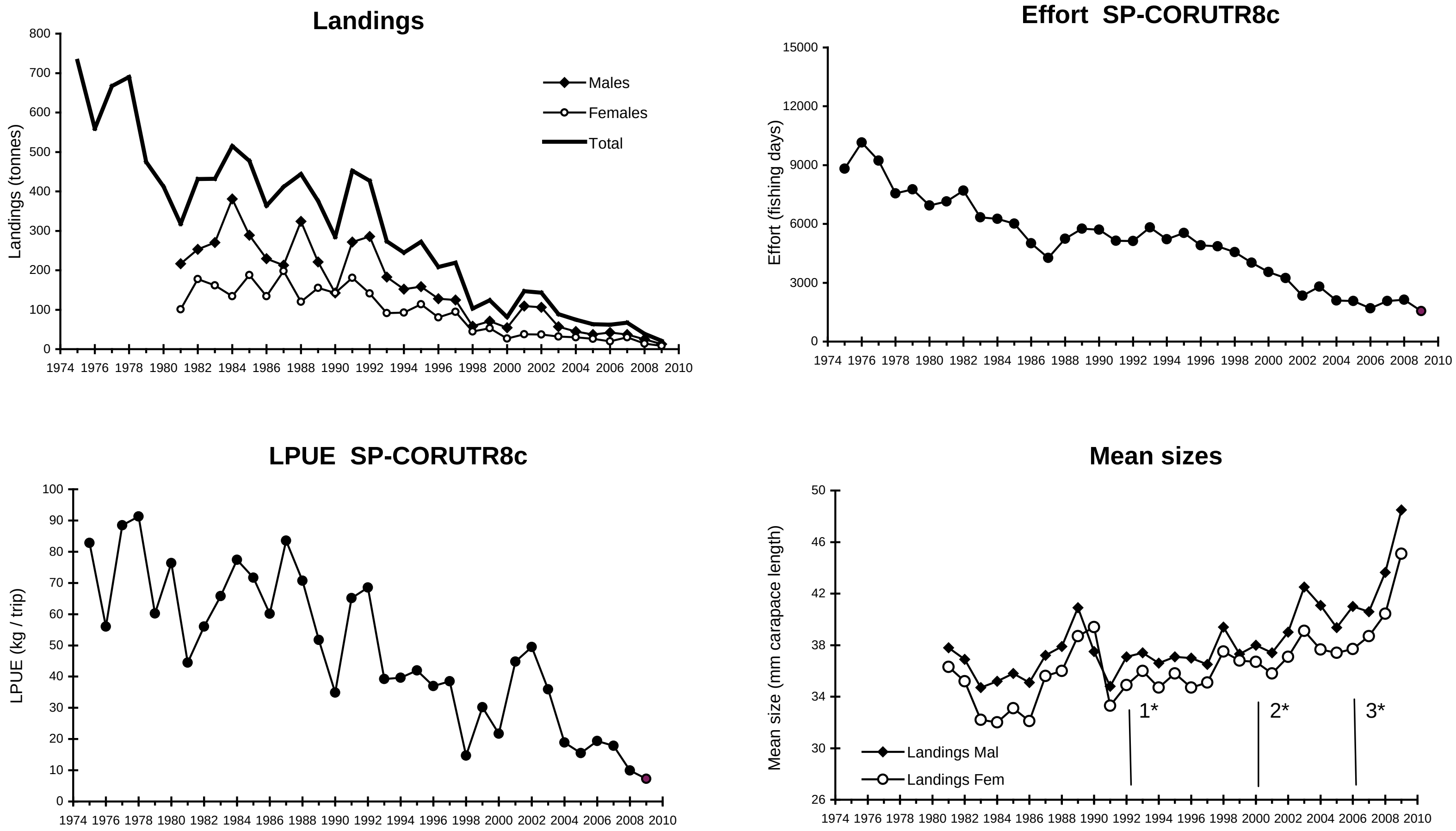
Table 11.1.2 *Nephrops* FU 25, North Galicia.

Length compositions of landings, mean weight (kg) and mean length (CL, mm), 1982-2009.

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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
86																												
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
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
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
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

Table 11.1.3 *Nephrops* FU 25, 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



1*-weekend break, 2*- 70 mm mesh size, 3*- recovery plan

Figure 11.1.1 *Nephrops* FU 25, North Galicia: Long-term trends in landings, effort, LPUE, and mean sizes.

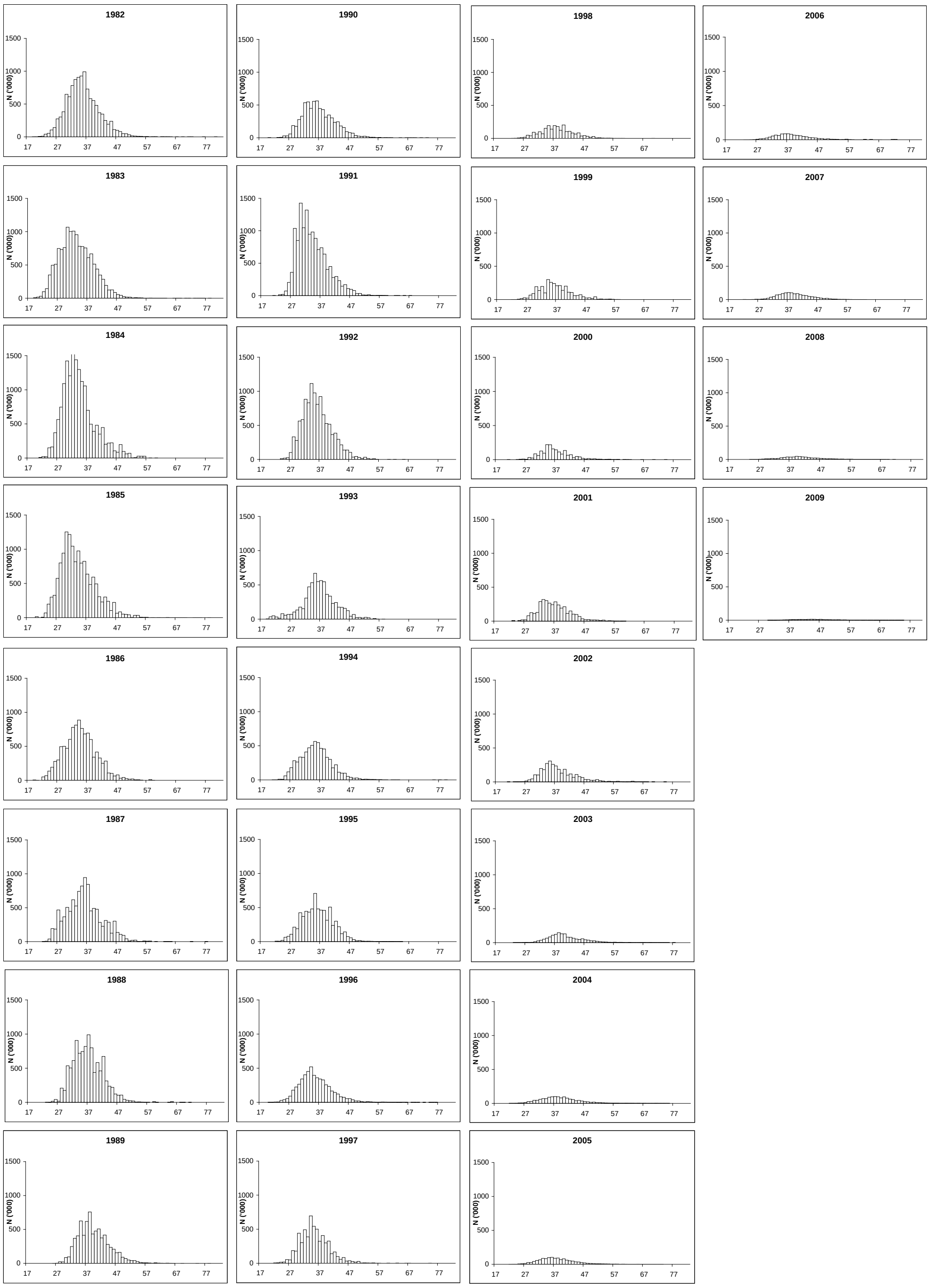


Figure 11.1.2 *Nephrops* FU 25, North Galicia: length distributions in landings, 1982-2009.

11.2 *Nephrops* FU 31 (Cantabrian Sea)

11.2.1 General

11.2.1.1 Ecosystem aspects

Sea Annex K

11.2.1.2 Fishery description

Sea Annex K

11.2.1.3 Summary of ICES Advice for 2010 and management applicable to 2009 and 2010

ICES advice for 2010

Since ICES advice on *Nephrops* is biennial, the advice for 2010 was the same as for 2009:

Available information indicates that the state of the stock is poor. In the absence of defined reference points, the state of the stocks cannot be evaluated in this regard.

FU 31 (Cantabrian Sea): Landings are currently very low. LPUE values are at the lowest levels on record. Mean sizes fluctuated with a clear upward trend. This may reflect poor recruitment. Fishing effort has increased slightly since 2005. This information indicates that the state of the stock is poor.

Given the very low state of the stock, ICES repeats its advice of a zero catch for the stock in FU 31

Management applicable to 2009 and 2010

TACs of 112 and 101 t were set for the whole of Division VIIIc for 2009 and 2010, 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

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 1983-2009. The highest landings were recorded in 1989 and 1990, with 177 and 174 tonnes, respectively. Since 1996 landings have declined sharply from 129 t to less than 20 t in recent years, with a minimum value in 2009 of 6 tonnes.

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 1988-2009, but shows a general increasing trend for both sexes (Figure 11.2.1), with the highest values in 2009 (males with 55.8 mm and females with 45.9 mm CL).

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 ports in Avilés and Santander. Total effort is not available for the period 2004-2009 due to the lack of information from Avilés. In 2008, fishing effort information was not available for the fleet of Santander either. 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). The increased use of other gears (HVO and pair trawl in recent years) has resulted in the reduction in effort by the baca trawl fleet, the only gear fishing for *Nephrops*.

The LPUE data series (no data available in 2008) shows fluctuations around the general downward trend. In recent years the LPUE has been at low levels (Figure 11.2.1), with a recent decreasing trend, reaching the lowest value of the time series in 2009.

11.2.3 Assessment

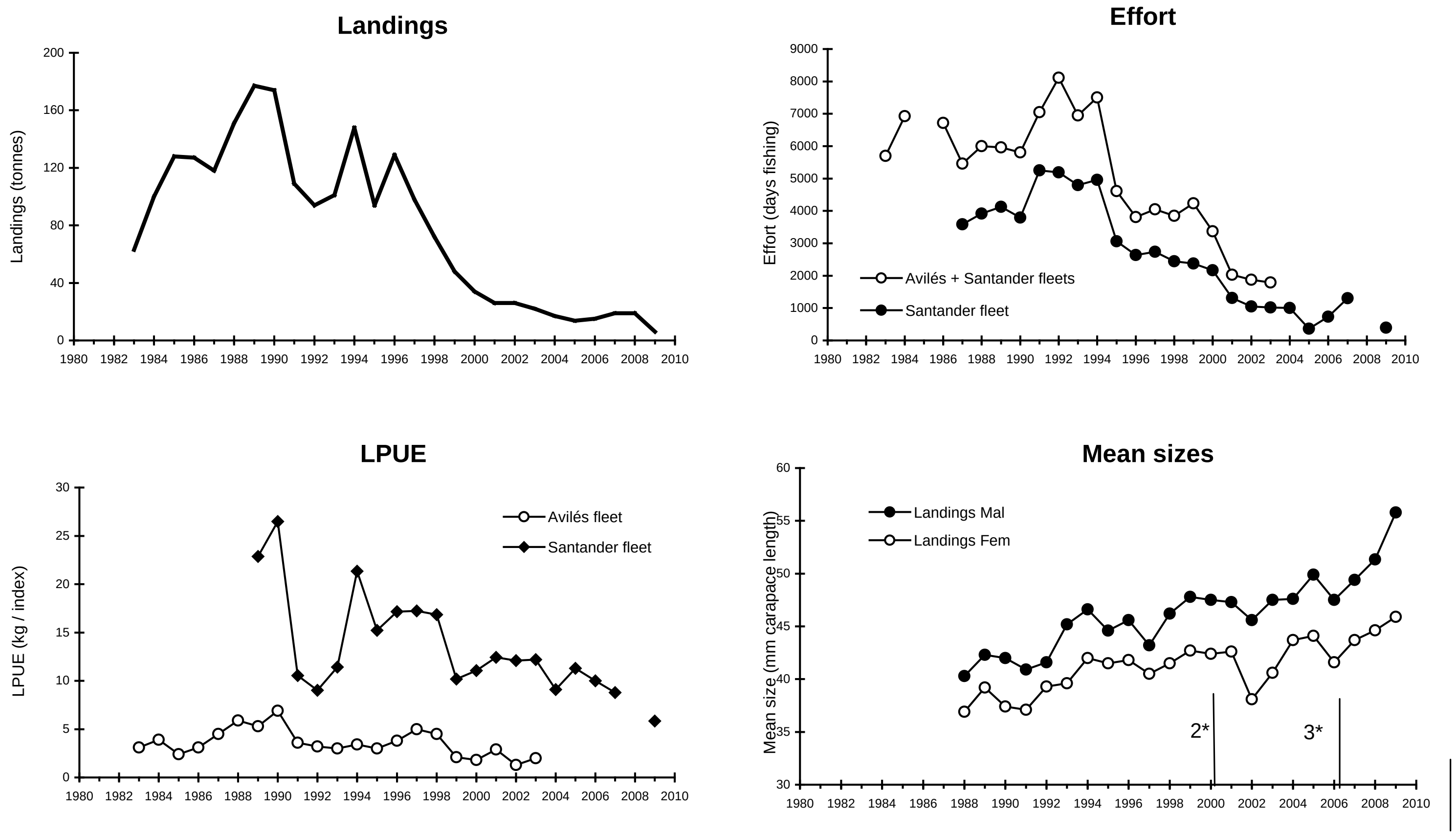
This FU 31 is assessed by examining the landings and LPUE series trends, as was done in 2008. This leads to the conclusion that the population is at minimum historical levels.

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.

Table 11.2.1 *Nephrops* FU 31, 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



2*- 70 mm mesh size, 3*- recovery plan

Figure 11.2.1 *Nephrops* FU 31, 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. Landings from both FUs have declined dramatically in recent years. The agreed *Nephrops* TAC for the whole of Division VIIIc in 2009 was 112 t. Landings in Division VIIIc were always below the TAC, and therefore the TAC has not been restrictive. In 2009, landings were only 27 t, corresponding to the lowest value of the time series.

The very low levels of landings from FU 25 and FU 31 and the decreasing LPUE trends indicate that both stocks are in very poor condition.

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* SubDivision VIIIc.
Landings in tonnes by FU and SubDivision 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

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.

Tables 12.1 and 12.2 show the time series of recorded landings and TAC for the Division IXa.

Table 12.1. Total recorded landings in Division IXa (Management Area Q)

	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	
	Spain	Portugal			Spain	Total		Spain	Spain	Portugal				Portugal	Spain		
Year	Trawl	Artisanal	Trawl	Total	Trawl			Trawl	Trawl	Artisanal	Trawl	Total		Unalloc	Trawl		
1975	622						622	137	1510		34	34	1681				2303
1976	603						603	132	1752		30	30	1914				2517
1977	620						620	95	1764		15	15	1874				2494
1978	575						575	120	1979		45	45	2144				2719
1979	580						580	96	1532		102	102	1730				2310
1980	599						599	193	1300		147	147	1640				2239
1981	823						823	270	1033		128	128	1431				2254
1982	736						736	130	1177		86	86	1393				2129
1983	786						786				244	244	244				1030
1984	604		14	14		14	618				461	461	461				1079
1985	750	4	11	15		15	765				509	509	509		257	257	1531
1986	657	9	28	37		37	694				465	465	465		221	221	1380
1987	671	19	52	71		71	742			11	498	509	509		302	302	1553
1988	631	41	55	96		96	727			15	405	420	420		139	139	1286
1989	620	22	66	88		88	708			6	463	469	469		174	174	1351
1990	401	17	31	48		48	449			4	520	524	524		220	220	1193
1991	549	14	40	54		54	603			5	473	478	478		226	226	1307
1992	584	15	37	52		52	636			1	469	470	470		243	243	1349
1993	472	14	36	50		50	522			1	376	377	377		160	160	1059
1994	426	8	14	22		22	448				237	237	237		108	108	793
1995	501	1	9	10		10	511			1	272	273	273		131	131	915
1996	264		17	17	50	67	331			4	128	132	132		49	49	512
1997	359		6	6	68	74	433			2	134	136	136		97	97	666
1998	295		8	8	42	50	345			2	159	161	161		85	85	591
1999	194	5	0	6	48	54	248			5	206	211	211		120	120	578
2000	102	8	1	9	21	30	132			4	197	201	201		129	129	462
2001	105	4	2	6	21	27	132			2	269	271	271		178	178	582
2002	59	4	0	4	24	28	87			1	358	359	359		262	262	708
2003	39	7		7	26	33	72			35	327	362	362	4	303	307	740
2004	38	8	0	8	24	32	70			31	415	445	445	4	143	148	663
2005	16	10	0	10	16	26	42			31	382	413	413	3	243	246	701
2006	15	12	0	12	17	29	44			17	233	249	249	4	241	245	538
2007	20	8	0	9	17	26	46			18	218	236	236	4	211	215	496
2008	17	7	0	7	12	19	36			35	173	208	208	3	117	120	363
2009	16	4	0	4	5	9	25			17	105	122	122	2	117	119	267

* Prior 1996, landings of Spain recorded in FU 26 include catches in FU 27

Table 12.2. Management Area Q. 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	663
2005	540	690
2006	486	538
2007	437	496
2008	415	363
2009	374	267
2010	337	

12.1 Nephrops FU 26–27, West Galicia and North Portugal (Division IXa)

12.1.1 General

12.1.1.1 Ecosystem aspects

Sea Annex L

12.1.1.2 Fishery description

Sea Annex L

12.1.2 Summary of ICES Advice for 2010 and management applicable to 2009 and 2010

ICES advice for 2010

As ICES advice for Nephrops is biennial, the advice given for 2010 was the same as the advice for 2009:

Available information indicates that state of the stock is poor. The stock assessments are only indicative of stock trends. In the absence of defined reference points, the state of the stocks cannot be evaluated in this regard.

FU 26+FU 27 West Galicia and North Portugal: Landings have gradually declined since the 1980s, and are now very low. LPUE levels are low, but increased slightly in 2007. Mean sizes have increased in recent years and this may reflect continuing poor recruitment as indicated in the previous assessment. Available information indicates that the stocks are at a very low level of abundance.

The stocks in FUs 26–27 are at an extremely low level. Mean sizes and previous assessment (2006) indicated that the stocks suffer a progressive recruitment failure. ICES advises no fishing on *Nephrops* until there is evidence of stock improvement.

Management applicable to 2009 and 2010

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 374 and 337 t for 2009 and 2010, respectively, and the maximum number of fishing days per vessel was fixed at 175 and 158 days for these two years (Annex IIb of Council Regulations nos. 43/2009 and 23/2010). The reduction of fishing days included in these regulations is not applicable to the Gulf of Cadiz (FU 30).

12.1.3 Data

12.1.3.1 Commercial catches and discards

Landings are reported by Spain and minor quantities by Portugal (Table 12.1.1). 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 artisanal 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. 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 1975-2009 (Figure 12.1.1). During 1975-1989, landings fluctuated between 600 and 800 t. From 1990 onwards there has been a marked downward trend in landings. Since 2005 landings were below 50 t (25 t in 2009), representing less than 5 % of the landings realized prior to 1990. Fishery statistics are considered to be reliable since the landings data are 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 2009.

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 Marín 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 1988-2009 are given in Table 12.1.2 and Figure 12.1.2.

12.1.3.3 Commercial catch-effort data

Fishing effort and LPUE data are available for Marín trawl fleet (SP-MATR) for the period 1994-2009 (Table 12.1.3). The overall trend for the LPUE of SP-MATR is decreasing, with some stability in the three last years. In 2009, this fleet accounted for 60 % of the landings from these FUs.

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) are also available. These data are plotted in Figure 12.1.1 for complementary information.

12.1.4 Assessment

These FU 26-27 are assessed by the analysis of the LPUE series trend, as was done in 2008. Results from earlier analytical assessments were only taken as indicative of trends. Results this year continue to indicate a very low abundance level.

12.1.5 Biological reference points

There are no reference points defined for this stock

12.1.6 Management Considerations

Nephrops is taken as by catch in a mixed bottom trawl fishery. Landings of *Nephrops* have substantially declined since 1995. Current landings represent 6% of the average landings in the early period of the time series (1975-1992). Fishing effort indices for FU26-27 have 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.

Table 12.1.1 *Nephrops* FU 26-27, West Galicia and North Portugal.
Landings in tonnes.

	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	7	72
2004	38	24	8	70
2005	16	16	10	42
2006	15	17	12	44
2007	20	17	9	46
2008	17	12	7	36
2009	16	5	4	25

*Prior 1996 landings of Spain from FU 26 include catches in FU 27

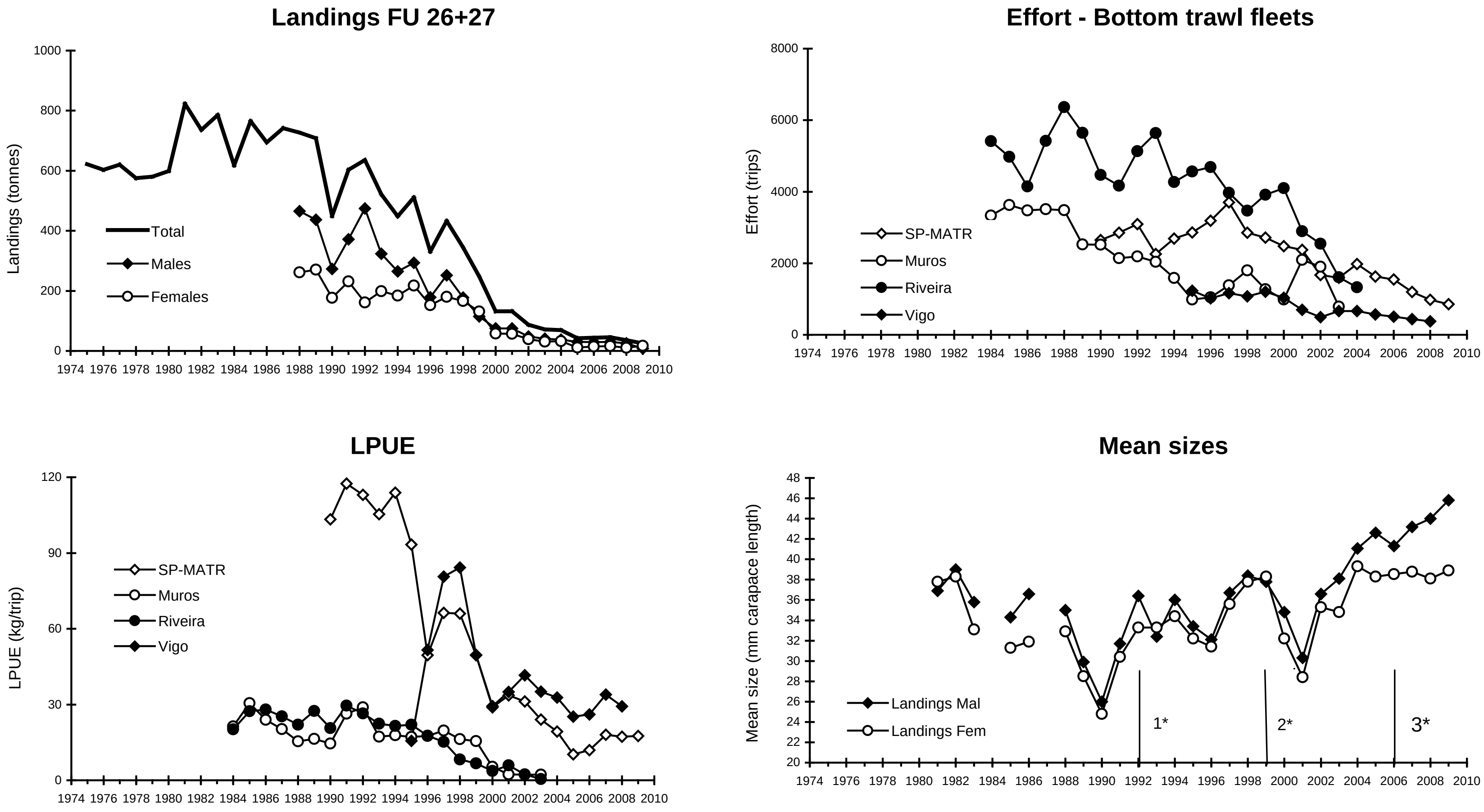
Table 12.1.2 Nephrops FU 26-27, West Galicia and North Portugal.

Length compositions, mean weight (kg) and mean size (CL, mm) in landings, 1988-2009.

Size, CL/Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
12	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	71	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	69	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	451	110	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	191	289	13	0	0	0	0	0	0	0	0	3	17	0	0	0	0	0	0	0	0
17	0	128	518	17	0	0	7	0	0	0	0	0	3	11	0	0	0	0	0	0	0	0
18	0	683	898	25	0	0	2	1	0	0	0	0	16	19	0	4	0	0	0	0	0	0
19	0	679	1502	38	0	0	0	0	0	0	0	0	38	52	0	4	0	0	0	0	0	0
20	27	1057	2044	97	6	5	10	7	25	3	0	0	86	151	3	29	0	0	0	0	0	0
21	27	1260	2489	199	12	24	19	8	78	0	0	0	119	236	3	27	0	0	1	0	0	0
22	39	1657	2642	398	48	99	84	47	202	12	1	0	129	348	11	11	1	0	1	0	0	0
23	109	1901	3063	568	103	99	77	151	373	26	6	0	127	518	16	31	0	0	0	0	1	0
24	198	1626	2736	1216	284	222	169	338	550	46	7	3	93	466	22	17	1	2	1	0	2	0
25	290	2212	1802	1477	541	381	199	672	906	113	45	15	134	441	35	28	1	2	1	0	3	1
26	574	1675	1451	1516	829	542	289	709	960	184	40	43	145	365	56	22	7	2	2	1	2	1
27	854	1878	1333	1351	926	904	409	933	746	306	80	68	129	419	106	40	18	8	5	2	3	1
28	1272	1560	1319	1940	1079	1017	524	1298	842	402	138	109	123	274	74	46	23	12	8	6	9	4
29	1487	1716	913	1797	1023	987	613	1223	706	489	191	134	143	266	86	60	20	15	13	7	7	9
30	1615	1510	845	1501	1069	1140	767	1371	792	681	295	195	172	252	118	90	31	25	20	12	13	11
31	1960	1106	632	1450	1180	890	802	1378	609	719	359	239	182	209	105	102	27	21	21	13	16	9
32	1951	1472	772	1484	1197	912	847	1491	601	888	411	292	285	220	160	95	49	29	35	23	27	11
33	2288	1313	601	1126	1378	878	898	1444	517	780	525	377	176	201	167	84	56	26	40	47	23	11
34	1581	1299	572	1160	1001	849	853	1255	542	745	551	376	192	156	131	83	56	31	51	43	37	22
35	1487	952	518	1044	915	855	745	963	506	637	569	432	200	148	96	91	53	26	48	46	25	18
36	1161	634	407	879	776	901	611	744	433	527	484	360	176	120	110	85	56	21	42	36	22	15
37	838	545	284	651	627	736	546	580	348	484	417	321	175	143	106	111	70	31	51	49	31	17
38	1196	608	294	616	545	682	621	542	346	534	425	308	128	110	76	72	86	35	61	38	28	20
39	837	451	226	600	505	510	475	425	285	406	292	240	128	85	95	79	65	27	43	36	21	14
40	501	325	199	450	666	573	412	455	284	466	393	218	115	65	76	60	90	24	55	39	32	21
41	428	288	165	375	431	385	321	321	213	399	312	182	112	58	88	48	60	21	40	32	23	16
42	367	287	144	220	362	375	314	214	182	360	249	210	66	57	81	54	101	22	47	43	26	14
43	433	296	156	203	425	307	293	188	165	325	292	219	64	36	76	47	73	25	38	49	25	13
44	164	277	87	136	301	251	200	152	127	290	207	193	61	44	52	33	62	20	32	38	36	13
45	165	286	58	110	303	219	178	125	118	218	196	162	58	42	44	34	56	17	18	29	17	12
46	96	135	23	90	350	153	129	116	94	191	178	152	40	28	49	26	29	20	18	24	18	8
47	94	117	45	82	228	104	92	84	56	123	120	84	38	47	42	31	38	26	18	28	17	8
48	71	100	25	49	222	58	96	55	70	117	147	96	23	18	22	13	28	18	12	15	16	7
49	73	76	29	42	148	84	71	46	23	60	105	64	21	16	15	16	18	13	11	14	9	5
50	83	127	14	46	63	81	69	29	31	81	95	54	17	12	12	15	16	15	13	14	9	9
51	15	48	9	14	71	27	59	13	21	43	59	21	17	6	7	15	7	15	7	7	9	6
52	20	75	14	33	71	21	59	18	22	43	55	30	18	6	7	10	12	10	8	10	9	6
53	23	34	13	26	34	20	28	6	13	30	37	33	5	5	6	10	5	7	6	8	4	6
54	14	10	11	23	23	14	12	6	15	42	28	27	8	3	2	8	4	11	10	6	7	4
55	6	27	1	6	13	17	12	1	9	25	26	12	6	7	3	4	5	8	3	6	6	5
56	6	9	1	5	5	10	5	1	9	14	14	14	7	4	3	5	3	4	2	3	6	6
57	10	5	1	2	6	5	10	0	4	8	12	6	5	3	3	2	2	3	2	4	5	5
58	11	5	1	4	6	5	14	0	3	6	11	5	4	5	4	3	3	4	4	4	5	5
59	7	0	4	0	7	2	7	0	0	2	1	5	3	3	0	1	4	3	1	3	2	2
60	2	0	2	0	4	3	3	0	0	1	2	3	2	2	2	2	7	4	2	1	3	3
61	4	0	1	0	3	2	12	0	0	0	2	0	3	2	0	2	1	14	1	2	1	1
62	2	0	1	0	1	0	7	0	0	0	0	0	1	5	0	2	2	4	2	1	3	2
63	1	0	1	0	3	0	5	0	0	1	0	0	3	3	0	2	1	2	1	1	1	1
64	2	0	1	0	3	1	4	0	0	0	1	0	2	2	0	2	1	1	1	1	2	3
65	2	0	1	0	1	0	2	0	0	0	0	0	1	1	1	1	2	2	1	1	1	2
66	3	0	1	0	1	0	2	0	0	0	1	0	2	2	0	1	0	1	1	1	1	1
67	2	4	1	0	1	1	1	0	0	0	1	0	3	1	0	2	1	2	1	1	1	1
68	2	11	1	0	2	2	6	0	0	0	0	0	2	1	0	2	1	1	2	2	2	1
69	1	4	1	0	1	1	0	0	0	0	0	0	2	1	0	1	1	1	2	1	1	1
70	12	25	1	2	12	6	8	0	1	0	3	0	11	1	1	5	4	8	1	1	4	1
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	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
73	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
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
umber (thousand)	22409	31275	29319	23087	17811	15360	12003	17411	11828	10827	7383	5302	3822	5712	2169	1666	1257	638	800	752	569	355
Total weight (t)	727	708	450	603	636	522	448	511	331	432	344	246	132	132	87	72	70	42	44	46	36	25
Mean weight (kg)	0.032	0.023	0.015	0.026	0.036	0.034	0.037	0.029	0.028	0.040	0.047	0.046	0.035	0.023	0.040	0.043	0.056	0.066	0.057	0.061	0.063	0.071
lean length (mm)	34.0	29.1	25.9	31.4	34.5	34.3	35.2	32.9	31.9	36.2	38.1	38.1	33.5	29.5	36.0	36.2	40.2	42.0	40.0	41.3	41.5	42.6

Table 12.1.3 *Nephrops* FU 26-27, 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



1* -weekend break in West Galicia, 2*- 70 mm mesh size, 3*-recovery plan

Figure 12.1.1 *Nephrops* FU 26+27, West Galicia and North Portugal: Long-term trends in landings, effort, LPUE and mean sizes.

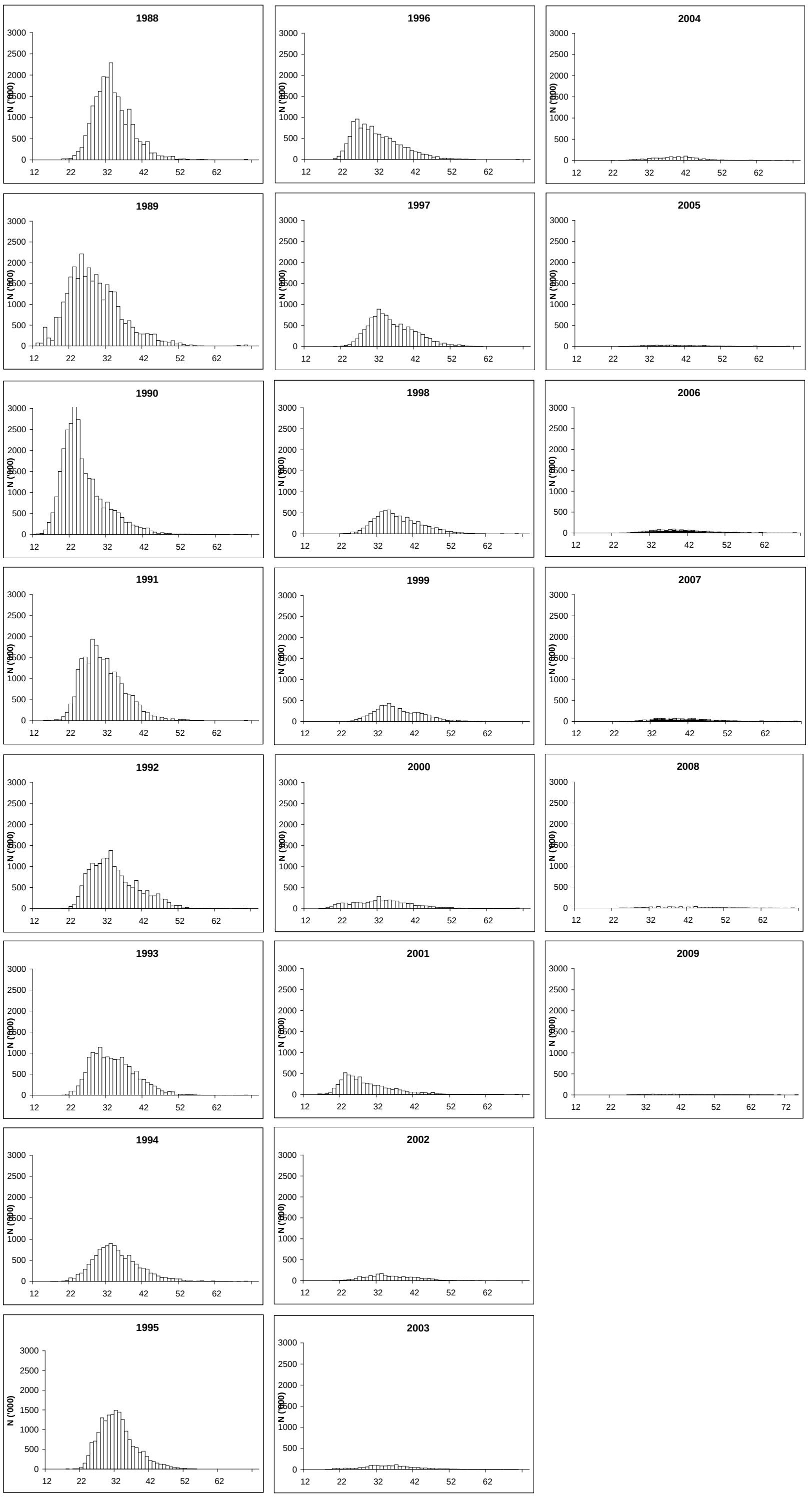


Figure 12.1.2 Nephrops FU 26-27, West Galicia and North Portugal: length distributions in landings, 1988-2009.

12.2 FU 28 – 29 (SW and S Portugal)

Type of assessment in 2010: update (from assessment conducted in 2008).

12.2.1 General

12.2.1.1 Ecosystem aspects

See the Stock Annex (in Annex L of WG report)

12.2.1.2 Fishery description

See the Stock Annex (in Annex L of WG report)

12.2.1.3 ICES Advice for 2010 and Management applicable for 2009 and 2010

ICES Advice for 2010

The advice for these stocks is biennial and valid for 2009 and 2010 (ICES, 2008)

In the absence of defined reference points, the state of the stocks cannot be evaluated in this regard.

The stock assessments are only indicative of stock trends. Recruitment and SSB were sharply reduced in the early 1990s. After the lowest value in 1996, SSB has shown an increasing trend until 2001 and remained around the same level in the following years. Fishing mortality showed the same decline to the mid-1990s and subsequently increased for the males, but appears to be stable for the females. In the last three years, fishing mortality has decreased for both sexes. Recruitment was stable at a low level in the period 1996–2002, but has increased again in the last four years. The mean sizes of males and females have fluctuated with no apparent trend, unlike other *Nephrops* stocks where an increasing trend in mean size may be indicative of recruitment failure.

In FUs 28–29, the stock appears to have recovered from its low level in 1996 to almost the level of the mid-1980s by 2002 and has been relatively stable since then. The average landings during the period when the stock was recovering (1996–2002) was about 200 t. Therefore, ICES advises that landings in 2009 should not exceed 200 t.

Management applicable for 2009 and 2010

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 374 and 337 t for 2009 and 2010, respectively, and the maximum number of fishing days per vessel was fixed at 175 and 158 days for these two years (Annex IIb of Council Regulations nos. 43/2009 and 53/2010). The reduction of fishing days included in these regulations is not applicable to the Gulf of Cadiz (FU 30), which has a different regime.

12.2.2 Data

12.2.2.1 Commercial catches and discards

Table 12.1 and Figure 12.2.1 show the landings data series for these Functional Units (FUs). Up to 1992 the estimated landings from FUs 28 and 29 have fluctuated between 450 and 530 t, with a long-term average of about 480 t, 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 total landings in 2009 was 122 t, the lowest value observed in the series.

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.

Discards are negligible in this fishery.

12.2.2.2 Biological sampling

Length distributions for both males and females for the Portuguese trawl landings are obtained from samples taken weekly at the main auction port, Vila Real de Sto. António. Sampling frequency in 2009 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 is presented in Table 1.3.

12.2.2.3 Abundance indices from surveys

Over the past decade, several groundfish (P-GFS-Oct) and crustacean trawl surveys (P-CTS) 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. In 2007-2008, the CPUE from the crustacean survey increased again.

In 2008 and 2009, the crustacean trawl survey conducted in the Functional Units 28 and 29, was combined with an experimental video sampling. The collection of images covered the whole area in 2009. The methodology is described in the Stock Annex.

Abundance indices from trawl, sediment composition and video images from the 2008 survey were available for FU 28 and looked in more detail. Higher abundances of *Nephrops* were found in muddy and sandy mud sediments. Images from hauls showing different levels of density and different mean individual sizes were visualized. These images contribute to the characterization of the burrow systems in deep waters (presentation to SGNEPS2009).

12.2.2.4 Mean sizes

Mean carapace length (CL) data for males and females in the landings and surveys are presented for the period 1994-2009 (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.

12.2.2.5 Commercial catch-effort data

A standardization of the CPUE series was presented to WGHMM in 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.

The CPUE standardization was reviewed based on the larger variability of the GLM estimates in the first four years of the series and the differences to the observed average CPUEs in the same period, which could probably be explained by the lower number of records in this period.

The grouping of the vessels in categories used in 2008 was looked into more detail and, although the vessel used as standard had a larger number of years with logbook records, after the grouping, its resulting category had no records for the first three years.

A new trial was performed taking as standard the second more represented vessel in the period, but with a larger number of records. Within the resulting classification, the category of the standard vessel has records over the whole time series. A new GLM was built with the new categories in 2009. The two models are very similar in the total explained variance and by factor, the CPUE trends are the same, but the new model shows a better fit to the observed data. The same model updated with the 2008-2009 data was used in this working group.

The data on effort were updated using the standardized CPUE of Crustacean trawlers estimated from the revised model. As a result, there was a slight increase in all values of the effort series in relation to the estimated values in 2008, keeping the same trend. Due to low number of records, the effort estimated for the year 2001 was replaced by the average of the years 2000 and 2002. The CPUE series used in Working Groups prior to 2008 was estimated based on all trawl vessels (fish and crustacean vessels).

Total fishing effort decreased from a peak in 1985 to much lower values in the early 1990s. In the period 1999-2002, fishing effort increased substantially (Table 12.2.2 and Figure 12.2.1).

The effort in 2003-2004 corresponds to only eleven months 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 days in 2007, 194 days in 2008 and 175 days in 2009 (Council Regulations (EC) No 51/2006, 41/2007, 40/2008, 43/2009). 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). 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 effort in 2006 to 2009 corresponds to 11 months each year but it was not possible to evaluate if the effort applied previously in the box in FU 28 was transferred to other areas in FU 28 and 29.

Since 1989, CPUE has declined considerably, from almost 100 kg/day in 1989 to an average of about 25 kg/day in the period 1999-2001 (Figure 12.2.1). The total CPUE shows an increase in 2003-2005, declining again in 2006-2009.

The opposite trends shown by the commercial fleet and survey CPUE series in 2007-2008 raised concerns on the data and method used for the estimation of the fleet CPUE.

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 WD5 and during this working group. 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 12.2.3).

The effort is estimated using the CPUE of the fleet. If the CPUE of *Nephrops* decreased due to a change in target species (and consequently, fishing grounds), the effort might be overestimated.

Different approaches have been tried as alternatives to the standardization previously used: (*a*) the incorporation of rose shrimp daily catch and its proportion in relation to the total daily catch of the two target species as two additional explanatory variables and (*b*) the use of the cpue based only in target trips, considering these as the daily records with 60% or more of *Nephrops*.

The model including the two new variables (alternative *a*) explains 73% of the variability against the 19% of the previous model updated. The 60% rule (alternative *b*) reduces very much the number of records in some years, when the fleet is targeting rose shrimp. Figure 12.2.4 shows the comparison among the different options of CPUE.

The group considered that an important progress was made in the standardization of *Nephrops* CPUE and encouraged to continue the work in this line. For use in the next assessment, a specific proposal of standardization must be presented well in advance to the working group meeting.

12.2.3 Assessment

In 2008, the assessment results have only been taken as indicative of trends. The assessment for *Nephrops* stocks is biennial, so no analytical assessment for this stock was performed in 2009.

Updated assessments were carried out for males and females separately.

The assessments were performed with XSA in R 2.8.1 with FLR, using FLCore version 2.2, FLAssess version 2.0, FLXSA version 2.0 and FLBRP version 0.7.0.

12.2.3.1 Input data

The length composition of the landings (Tables 12.2.1.a-b and Figures 12.2.2.a-b) was converted to age composition using the slicing procedure. The input parameters and the software used are mentioned in the Stock Annex.

Age frequency distributions and weight-at-age for males and females are shown in Tables 12.2.5.a-b and 12.2.6.1-b.

12.2.3.2 Model and assessment results

See Stock Annex for Male and Female model settings. The effort of the trawl fleet tuning series (P-TR) was derived using the standard CPUE estimated as in previous assessment (GLM model with factors year, month and vessel category). Tuning data are presented in Table 12.2.7.

Males

The analysis of log catchability residuals has shown pronounced year effects in surveys but not particular high values.

The pattern of the commercial fleet log catchability (with positive or negative values for all ages over a period of years) might be explained by the behaviour of the crustacean fleet. This fleet is not targeting only *Nephrops* but also the deepwater rose shrimp (*Parapenaeus longirostris*) and, to a lesser extent, the red shrimp (*Aristeus antennatus*). Figure 12.2.3 shows the total catches of Norway lobster and rose shrimp in these FUs. In the periods 1998-2003 and 2006-2009, due to the high abundance of rose shrimp and its market value (higher than the *Nephrops* value), the crustacean fleet shifted its effort to target shrimp, catching less *Nephrops* in all ages. As the fishery data is based on the crustacean fleet, it is not possible to obtain a different residuals pattern, unless the influence of rose shrimp in the fleet behaviour is removed.

The log catchability residuals for the male assessment are shown in Figure 12.2.5. Table 12.2.8 presents the diagnostics from the model application. Fishing mortality and population numbers are given in Tables 12.2.9 and 12.2.10 and the summary results are presented in Table 12.2.11. F_{2009} was estimated at 0.14.

The retrospective analysis was performed showing a strong retrospective pattern (Figure 12.2.6). In the last years of the assessment period, there is an overestimation of Recruitment and SSB and an underestimation of F.

Females

The log catchability residuals show the same pattern as for males, with year effects in the survey data and the overall trend in the catchability residuals of the commercial fleet shifting from positive values in the period 1988-95 to negative from 1996 onwards, in all ages (Figure 12.2.7).

Table 12.2.12 presents the diagnostics from the model application. Fishing mortality and population numbers are given in Tables 12.2.13 and 12.2.14 and the summary results are presented in Table 12.2.15. F_{2009} was estimated at 0.06.

As for males, the retrospective analysis (Figure 12.2.8) indicates an overestimation of Recruitment and SSB and an underestimation of F in recent years.

12.2.3.3 Historic trends in biomass, fishing mortality and recruitment

Trends in the estimates of yield, F_{bar}, SSB and recruitment are shown in Tables 12.2.11

and 12.2.15 and Figures 12.2.9 and 12.2.10.

Fishing mortality for both males and females has decreased since 2005. Regarding the male population, after a declining trend in the period 1989-95, SSB increased in 1996-2001, fluctuating around the average since then. Male recruitment is at a low level after the decline observed in the period 2004-2008. Females SSB and recruitment have been stable over the entire period.

12.2.4 Short-term Projections

Taking into consideration the retrospective pattern, the results of the assessment were only accepted as indicative of trends. Hence, no projections were performed.

12.2.5 Biological reference points

No reference points were previously defined for this stock.

Biological reference points were estimated on the basis of the Yield per Recruit curve. Considering the retrospective pattern, the biological reference points were estimated based on the convergent part of the XSA. The selection pattern and weights-at-age used were the average of the years 2002-2004.

The following table summarizes the BRPs for these FUs, for males and females. F_{max} is not well defined.

	Males		Females	
BRP	**F**	**%SPR**	**F**	**%SPR**
$F_{0.1}$	0.20	45%	0.20	42%
$F_{35\%SPR}$	0.30	35%	0.28	35%

As the values of the assessment were not accepted, status of the stock cannot be evaluated in relation to the reference points.

$F_{0.1}$ might be considered as a potential F_{msy} proxy. However, since the extent to which the fishery targets *Nephrops* depends on rose shrimp abundance, and this might potentially impact on the relative exploitation pattern-at-age, the WG decided that a sensitivity analysis of any potential F_{msy} proxy should be conducted before a value could be proposed.

12.2.6 Comments on the assessment

As stated in previous WG reports (see e.g. ICES, 1999a), the growth parameters and the value of M are important sources of uncertainty in the assessment.

Figures 12.2.11 and 12.2.12 show the comparison between the assessment results in 2008 an 2010. The $Fbar_{2007}$ estimated in 2008 was revised upwards by the 2010 WGHMM. The SSB and Recruitment values estimated for 2007 were revised downwards.

Taking into consideration the retrospective pattern, the results of the assessment were only accepted as indicative of trends, but not for projections.

12.2.7 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 effort reductions in number of fishing days are included in each year regulations (Council Regulations (EC) Nos. 51/2006, 41/2007, 40/2008 and 43/2009).

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).

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).

Table 12.2.1.a. FU 28-29 - Length Composition of Nephrops Males (1984-2009)

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
17																										
18																										
19					4	21					0									0				1	0	
20			0	16	4			6	4							4				0		4		2	1	0
21		17	9			84		16	37	9						3	3	0	2	0	0	33		4	0	0
22	7	5	14	15		97	9	29	96	38	9				2	0	16	1	2	13	5	51	9	16	7	1
23	24	7	7	8		143	5	19	55	34			8	4		5	8	3	1	3	19	32	20	26	9	3
24	14	40	121	209	51	272	27	53	202	42	18		17	9	8	9	20	5	2	11	26	106	49	43	23	23
25	109	83	115	81	97	229	116	69	181	149	34	3	23	6	16	39	13	6	3	39	57	117	42	49	25	24
26	250	170	137	446	128	205	182	111	263	72	68	0	36	43	32	33	58	8	11	56	155	150	64	95	29	31
27	282	326	170	718	208	269	149	94	185	95	77	0	54	95	81	49	85	24	24	87	233	202	77	89	47	51
28	374	500	289	871	399	280	337	139	506	272	157	0	56	78	65	68	44	24	48	60	257	280	114	113	55	72
29	439	559	341	727	456	283	415	159	462	382	95	28	38	88	65	109	148	53	60	145	297	326	173	150	57	68
30	412	742	328	584	442	317	695	239	725	548	187	11	68	104	160	133	87	74	139	244	361	522	225	240	55	106
31	277	670	389	742	457	230	813	325	755	548	231	24	92	172	129	272	111	92	123	186	329	565	220	201	85	95
32	373	784	680	806	446	367	866	260	670	674	383	108	151	283	289	88	161	274	233	325	563	744	310	240	114	111
33	339	531	213	236	428	265	702	133	345	365	149	83	70	90	95	182	92	139	281	245	424	439	206	192	97	66
34	389	635	609	721	656	328	785	239	451	655	270	215	159	251	269	152	160	224	257	263	421	566	268	267	134	79
35	478	525	590	245	664	291	755	171	296	475	224	169	147	169	118	175	100	173	274	270	416	330	171	200	110	63
36	378	463	519	342	572	295	449	138	399	639	221	147	78	154	166	143	158	163	265	193	271	262	146	202	75	47
37	528	346	322	406	424	356	465	77	351	391	107	262	172	149	167	128	162	167	247	231	202	293	152	177	98	46
38	496	383	606	355	571	302	479	120	378	344	179	134	113	58	85	75	106	99	254	193	176	228	143	216	69	48
39	353	309	361	240	326	332	611	126	348	306	95	151	62	46	47	180	81	109	229	169	110	176	85	138	68	51
40	447	337	323	156	366	316	829	200	248	174	144	232	83	82	83	83	96	159	254	209	197	152	86	147	71	52
41	247	230	316	335	164	314	797	141	243	158	93	247	78	37	53	184	102	130	163	158	128	129	106	131	93	42
42	371	246	507	264	215	360	628	174	246	170	168	293	85	33	167	58	91	195	163	164	209	152	156	162	122	83
43	199	156	198	62	102	364	335	121	242	107	127	65	31	21	43	102	47	181	167	168	132	119	80	66	76	31
44	194	233	422	215	128	481	553	125	371	179	150	88	42	28	69	63	86	173	122	119	145	174	120	70	57	40
45	165	144	233	206	93	339	324	90	220	150	87	27	22	21	34	111	61	140	113	101	153	140	79	66	58	21
46	148	178	189	170	72	231	228	128	167	55	79	58	21	33	38	67	85	144	106	75	123	116	96	56	34	20
47	129	161	140	74	76	191	202	122	191	96	68	31	38	20	34	59	88	120	111	74	116	113	51	48	44	21
48	176	212	149	79	85	193	121	62	178	102	78	25	15	9	24	40	55	80	104	81	108	64	46	53	45	19
49	89	138	104	58	43	73	92	78	111	47	47	16	20	4	13	50	37	79	86	58	71	53	35	30	31	20
50	91	142	50	34	53	94	58	67	69	30	50	12	9	3	33	32	65	93	103	92	99	70	24	34	32	16
51	66	120	63	27	34	114	59	44	50	38	29	4	6	7	14	32	34	71	72	63	50	41	26	30	24	14
52	64	135	66	44	38	77	33	40	35	15	46	11	16	7	31	8	53	88	94	72	78	46	32	39	25	25
53	45	99	32	37	23	40	19	16	29	18	22	5	6	6	11	13	18	41	69	57	37	23	18	17	21	11
54	73	101	35	45	22	35	27	29	50	23	18	5	8	16	19	15	31	54	53	56	59	25	29	22	21	15
55	20	67	25	31	22	37	30	26	29	19	9	3	4	10	8	9	19	34	28	45	31	12	12	8	19	10
56	20	35	14	20	16	20	30	19	5	5	11	2	4	3	6	13	19	29	43	29	66	15	9	7	14	10
57	10	33	5	15	12	22	7	10	6	5	11	3	7	16	8	8	19	37	37	24	19	9	5	5	16	9
58	13	14	8	14	11	17	14		11	4	6		5	3	5	4	13	23	26	20	15	10	5	5	18	6
59	7	10	3	9	4	16	5	2	9	3	10	0	5	2	3	4	10	15	16	13	18	8	8	4	10	3
60	3	6	3	4	3	13	2		10	8	1	1	1	4	1	1	8	15	25	16	28	13	5	2	9	6
61	3	1	4	4	1	5		1	3	2	1	0	1	9	1	2	14	9	11	8	13	9	6	3	7	3
62	3	1	2	1	2	3		1	7	5	1		2	7	1	3	6	10	11	15	19	8	7	3	14	7
63	1	1		1	1	4		5	0	1	0		2	3	0	2	1	4	11	11	9	7	6	1	7	3
64		2	0	2	1			1	3	1	2		0	4	0	1	1	9	11	8	11	10	6	1	10	5
65	0	0		2	2				3	1	1		0	4		0	4	6	5	4	4	9	6	0	9	1
66	0			0	1					1			0	4	0		1	5	8	3	8	3	4	1	11	1
67	0			0	0	0			6	5				6	0			4	3	5	2	2	5	1	6	1
68					0	2				0	1			0	0			1	6	6	2	3	3	0	7	0
69				0										0	0		0	3	3	2	3	2	3	1	4	1
70	0			1		0				2				0	0		0	6	2	4	3	4	4	0	3	1
71										0					0			2	2	4	1	1	2	0	2	0
72				0		0				1					0			2	2	4	2	3	3	0	3	1
73														0			0	0	1	1	1	2	2		1	0
74	0									1								0	1	1	1	3	1		1	1
75																		0	1	0	0	1	1		1	1
76																		0	0	0	0	0	1		1	0
77																			0	0	0	0	1		1	0
78		0			0																0	1			0	
79																			0		0	1	0		0	0
80									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	4503	6286	6977	3563	3680	2088	1487
Landings (t)	292	353	315	277	249	318	351	345	304	232	139	98	65	74	88	116	117	190	222	201	245	230	136	128	105	60

Table 12.2.1.b. FU 28-29 - Length Composition of Nephrops Females (1984-2009)

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
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	15	47	3	12	2	1
22	8	21	30	78		88	19	11	102	63			0	13	2	5	18	0		3	12	86	12	20	10	1
23	66	21	7	31	28	135	15	69	38	21	2		0	0	4	4	6	7	0	9	54	53	33	28	10	3
24	79	102	118	270	153	258	38	173	164	41	22	2	11	20	15	25	49	7	10	19	80	133	39	40	21	17
25	228	205	104	357	163	197	138	198	203	191	73		13	20	25	27	24	15	11	36	126	125	48	108	20	18
26	272	284	186	684	220	282	140	436	361	111	92	1	35	102	74	94	81	24	15	66	261	266	94	182	36	65
27	345	491	359	902	429	326	247	418	448	235	134	0	37	77	91	76	139	34	34	66	332	285	123	238	67	111
28	431	523	322	1421	471	231	345	598	597	413	170	6	36	152	148	100	64	44	107	96	422	234	144	279	75	135
29	443	672	419	1253	516	285	491	590	514	523	269	31	45	178	114	121	171	90	127	171	481	416	310	365	114	122
30	422	588	381	928	499	317	575	771	599	775	326	104	50	199	199	236	152	131	237	238	488	649	256	298	135	168
31	487	593	418	948	482	501	639	414	736	752	427	182	95	394	168	263	131	167	195	150	400	567	255	245	119	107
32	485	653	700	946	766	306	859	807	617	824	558	322	198	502	376	485	283	316	296	355	629	860	433	330	227	171
33	613	415	406	227	527	314	596	375	430	449	283	251	53	163	116	187	153	184	467	265	530	454	235	197	167	90
34	618	467	654	774	813	511	734	310	369	359	353	641	209	278	298	346	235	252	429	307	481	463	296	314	159	101
35	562	563	447	447	460	435	519	284	287	194	246	674	184	150	112	287	193	158	470	248	391	258	221	280	169	83
36	469	329	316	386	489	274	243	130	267	203	237	811	142	135	166	317	225	174	351	188	272	206	141	164	94	66
37	505	353	400	223	206	318	189	108	333	154	147	692	267	129	171	201	213	144	302	198	218	186	126	185	110	73
38	383	284	330	269	265	285	207	135	251	100	128	348	151	39	48	184	85	108	300	199	183	184	133	199	125	68
39	274	142	211	146	288	148	216	74	176	150	66	194	67	35	59	151	92	112	213	153	137	92	150	106	112	70
40	171	119	80	119	132	131	230	131	147	110	114	344	120	21	89	111	79	133	186	273	163	87	98	84	116	50
41	58	106	55	65	128	149	73	39	68	108	77	361	63	31	64	81	66	79	110	163	99	75	113	60	86	66
42	50	36	133	54	43	127	210	62	69	95	73	165	111	18	84	73	67	91	80	184	149	119	95	46	71	74
43	30	27	21	40	28	109	58	82	26	43	23	64	29	2	34	38	41	55	87	127	85	72	36	13	29	20
44	17	13	47	147	27	91	77	6	46	42	43	88	90	18	71	34	49	56	57	72	81	62	38	18	23	34
45	14	11	27	84	19	27	41	21	40	34	13	54	36	8	22	18	23	29	51	65	82	52	29	14	26	13
46	7	6	5	40	14	38	31	45	25	37	11	13	15	4	28	18	38	33	40	36	63	40	45	15	12	17
47	5	3	3	26	9	24	16	7	12	29	7	18	23	3	23	7	52	26	25	24	55	35	20	7	24	13
48	4	1		71	11	29	7	15	18	15	4	15	8	2	6	9	25	12	24	27	46	19	9	6	18	6
49	1	0	3	17	4	9	1	17	17	23	4	1	6	7	6	4	21	15	19	18	29	25	6	5	12	5
50	1	0		2	6	3	1	2	32	8	17	1	2	1	6	5	10	15	26	24	24	24	6	2	11	6
51	0	0	3	4	3	7	2	4	4	5	0			1	2	2	10	9	22	13	15	17	8	4	9	2
52	1			5	5	8	1		5	6	1	1	0	1	1	3	16	6	19	20	16	17	6	2	6	3
53	2			2	3	1			9	6	0			0	0		6	6	10	12	9	10	1	0	7	2
54				4	1	1			1	1			1	0	1		5	2	2	14	9	6	7	0	7	1
55				0	1	1			6	2							1	2	3	9	4	5	1	1	3	3
56				3	0	2		5	14	5					0		3	1	3	7	7	2	1	0	2	0
57				0	0	1			4	1			0		0		1	0	2	4	2	3	0		1	0
58				0		0			4	1								1	1	1	2	0	0	0	1	1
59				1	0	0											0	1	0	0	1	1	1			0
60					0				1	0								0		0		2			1	
61						1											3	1		0	1					0
62																			0	0	0	1	0			
63									4	1								0	0			0				0
64																					1	0		0	0	0
65																					0	0				
66																	0	0				0				
67																										
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	3866	6458	6247	3573	3871	2240	1788
Landings (t)	169	156	150	232	171	151	174	134	165	145	97	174	67	62	72	95	84	79	135	126	170	152	95	90	67	48

Table 12.2.2. - SW and S Portugal (FUs 28-29): Effort and CPUE of Portuguese trawlers, 1994-2009 (standardized/revised).

Year	No. of trawlers	CPUE (t/boat)	Estimated days	CPUE (kg/day)
1994	31	7.6	4456	53
1995	30	9.1	4926	55
1996	25	5.3	3677	36
1997	25	5.5	3396	40
1998	25	6.4	5756	28
1999	29	7.3	10012	21
2000	33	6.1	7761	26
2001**	33	8.2	8769	31
2002	34	10.5	9776	37
2003	35	9.3	7511	44
2004	33	12.6	7242	57
2005	32	11.9	6330	60
2006	30	7.7	4123	56
2007	30	7.3	4439	49
2008	30	5.8	4589	38
2009*	30	3.6	4208	26

* provisional; ** effort = average of years 2000 and 2002

Table 12.2.3. - SW and S Portugal (FUs 28-29): *Nephrops* CPUEs (kg/hour) in research trawl surveys, 1994-2009.

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

ns = no survey nr = not reliable

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, 1994-2009.

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

na = not available ns = no survey

Table 12.2.5.a. FUs 28-29. Nephrops males. Landing numbers at age (Numbers x 10^3)

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE													
2	2069	2837	1752	4102	2057	2307	1931	2543	3139	1952	778	57	352
3	2870	3773	3425	3260	3692	2163	3709	2780	3033	3616	1549	1067	877
4	1892	1511	2086	1272	1465	1942	2851	1930	1591	1116	745	1071	401
5	750	852	1017	686	414	1301	1030	1118	1020	530	419	206	126
6	309	517	278	158	165	353	196	509	271	134	167	43	48
7	153	295	107	121	74	128	64	177	114	62	61	16	22
+gp	61	111	42	78	58	108	50	96	67	47	46	6	27
0 TOTALNUM	8104	9895	8707	9677	7925	8303	9830	9153	9234	7457	3765	2466	1853
TONSLAND	292	353	315	277	249	318	350	344	305	232	139	98	64
SOPCOF %	99	99	99	99	99	99	100	100	100	100	99	99	98

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE													
2	534	510	395	545	251	362	765	1601	2142	897	942	356	436
3	1219	1218	1139	937	1232	1746	1709	2531	2996	1423	1481	701	479
4	257	453	663	487	862	1121	985	893	875	607	760	474	291
5	104	182	372	349	607	518	415	601	560	358	272	221	109
6	20	86	151	179	314	339	273	286	202	112	128	109	69
7	33	45	43	80	148	172	171	144	70	66	57	65	41
+gp	70	27	49	101	187	229	183	230	124	98	37	160	62
0 TOTALNUM	2236	2521	2811	2678	3602	4486	4502	6284	6968	3561	3677	2087	1487
TONSLAND	74	88	116	117	190	222	201	245	230	136	128	105	60
SOPCOF %	101	100	100	100	102	102	101	100	103	102	101	104	103

Table 12.2.5.b. FUs 28-29. Nephrops females. Landing numbers at age (Numbers x 10^3)

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE													
2	2059	2584	1743	5411	2234	2073	1693	2856	2695	2004	908	87	201
3	1022	1324	1065	2049	1235	866	1492	1342	1451	1693	955	441	246
4	1204	969	1102	1094	1353	767	1404	883	905	995	725	797	265
5	1038	909	848	928	1013	763	905	463	564	431	500	1353	335
6	844	597	655	486	511	538	368	213	538	277	295	1165	382
7	526	329	426	323	463	335	357	165	343	218	153	431	168
8	199	179	110	154	205	216	265	149	182	171	156	550	153
9	75	80	157	83	95	194	244	84	98	141	105	313	138
10	35	31	41	104	38	142	89	78	45	59	41	99	68
11	19	15	46	143	29	70	72	19	55	48	33	88	76
12	10	8	12	59	18	43	40	49	34	44	14	26	23
+gp	14	5	10	136	45	89	30	50	137	107	36	36	39
0 TOTALNUM	7046	7029	6212	10970	7238	6097	6960	6350	7047	6186	3920	5385	2095
TONSLAND	169	156	150	232	171	151	174	134	165	145	97	174	67
SOPCOF %	101	100	99	100	100	101	100	100	103	102	100	101	100

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE													
2	663	568	558	621	281	412	577	2000	1932	917	1406	416	549
3	831	518	696	392	437	510	503	1060	1461	667	615	336	306
4	544	460	597	415	469	862	601	1084	1082	593	528	358	220
5	326	311	585	400	342	815	459	708	531	401	479	277	155
6	204	262	403	339	257	561	350	401	341	234	327	195	126
7	61	95	273	149	187	412	292	260	214	240	237	197	116
8	40	126	156	116	175	245	361	217	129	162	116	164	88
9	31	113	108	96	126	131	259	194	154	143	71	107	101
10	10	64	50	60	76	106	150	115	94	51	20	37	34
11	16	56	32	44	52	69	88	105	73	42	20	32	29
12	6	33	22	42	39	51	51	81	51	51	18	18	20
+gp	15	47	30	154	98	157	176	225	172	69	29	103	44
0 TOTALNUM	2746	2653	3508	2827	2539	4332	3865	6451	6232	3569	3866	2238	1788
TONSLAND	62	72	95	84	79	135	126	170	152	95	90	67	48
SOPCOF %	99	99	100	101	100	100	102	101	101	100	99	101	100

Table 12.2.6.a. FUs 28-29. Nephrops males. Landing weights at age (kg)

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE													
2	0.014	0.015	0.014	0.014	0.015	0.012	0.015	0.014	0.014	0.015	0.015	0.016	0.014
3	0.028	0.026	0.027	0.026	0.027	0.027	0.026	0.025	0.026	0.026	0.026	0.028	0.027
4	0.044	0.044	0.045	0.045	0.043	0.046	0.045	0.046	0.045	0.044	0.046	0.045	0.045
5	0.066	0.067	0.064	0.064	0.066	0.065	0.064	0.066	0.065	0.065	0.065	0.065	0.066
6	0.087	0.088	0.087	0.087	0.088	0.088	0.086	0.087	0.086	0.086	0.088	0.087	0.087
7	0.108	0.108	0.106	0.109	0.108	0.108	0.11	0.109	0.109	0.11	0.106	0.107	0.107
+gp	0.135	0.132	0.135	0.137	0.136	0.139	0.131	0.132	0.144	0.145	0.137	0.133	0.139
0 SOPCOFAC	0.9942	0.9910	0.9927	0.9861	0.9910	0.9940	1.0000	1.0003	0.9968	0.9999	0.9866	0.9935	0.9813
	100												

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE													
2	0.015	0.015	0.015	0.014	0.016	0.016	0.015	0.015	0.014	0.015	0.014	0.014	0.014
3	0.026	0.026	0.027	0.027	0.026	0.027	0.027	0.026	0.025	0.026	0.027	0.027	0.026
4	0.044	0.046	0.045	0.045	0.047	0.045	0.045	0.046	0.045	0.046	0.044	0.046	0.046
5	0.065	0.065	0.066	0.066	0.065	0.066	0.066	0.066	0.065	0.065	0.066	0.066	0.065
6	0.09	0.089	0.088	0.089	0.089	0.088	0.089	0.088	0.088	0.088	0.089	0.088	0.089
7	0.11	0.108	0.109	0.108	0.108	0.107	0.108	0.108	0.107	0.108	0.107	0.109	0.108
+gp	0.146	0.136	0.138	0.141	0.142	0.142	0.143	0.142	0.147	0.148	0.142	0.147	0.144
0 SOPCOFAC	1.0089	0.9987	1.0025	1.0030	1.0187	1.0172	1.0139	1.0050	1.0264	1.0216	1.0059	1.0443	1.0254

Table 12.2.6.b. FUs 28-29. Nephrops females. Landing weights at age (kg)

YEAR	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
AGE													
2	0.013	0.014	0.014	0.014	0.014	0.012	0.014	0.014	0.013	0.014	0.014	0.016	0.014
3	0.019	0.019	0.02	0.019	0.02	0.019	0.02	0.019	0.019	0.019	0.02	0.02	0.02
4	0.024	0.023	0.024	0.024	0.024	0.024	0.024	0.023	0.023	0.023	0.023	0.024	0.024
5	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
6	0.033	0.033	0.033	0.032	0.032	0.033	0.033	0.033	0.033	0.032	0.032	0.032	0.033
7	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.038	0.037	0.037	0.037
8	0.042	0.043	0.042	0.042	0.043	0.043	0.042	0.042	0.042	0.043	0.042	0.043	0.042
9	0.047	0.046	0.047	0.047	0.046	0.047	0.048	0.048	0.047	0.047	0.047	0.046	0.047
10	0.052	0.052	0.053	0.054	0.053	0.052	0.053	0.052	0.053	0.053	0.053	0.053	0.054
11	0.057	0.057	0.057	0.057	0.057	0.056	0.057	0.056	0.057	0.057	0.056	0.057	0.056
12	0.062	0.062	0.061	0.061	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.061	0.061
+gp	0.072	0.069	0.073	0.072	0.073	0.072	0.07	0.073	0.075	0.073	0.073	0.07	0.07
0 SOPCOFAC	1.0064	1.0025	0.9908	1.0001	0.9971	1.0061	0.9987	1.0000	1.0324	1.0164	1.0046	1.0066	0.9958

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
AGE													
2	0.014	0.014	0.014	0.014	0.015	0.015	0.014	0.014	0.013	0.014	0.014	0.014	0.014
3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.019
4	0.023	0.024	0.024	0.024	0.024	0.024	0.024	0.023	0.023	0.023	0.024	0.023	0.023
5	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
6	0.032	0.032	0.032	0.032	0.032	0.033	0.033	0.032	0.033	0.033	0.033	0.033	0.033
7	0.037	0.038	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037
8	0.043	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.043	0.043	0.042	0.042	0.043
9	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
10	0.054	0.053	0.053	0.053	0.053	0.052	0.052	0.053	0.052	0.053	0.053	0.052	0.053
11	0.057	0.056	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.056
12	0.061	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.061	0.062
+gp	0.074	0.071	0.072	0.072	0.073	0.074	0.074	0.073	0.074	0.073	0.073	0.073	0.073
0 SOPCOFAC	0.9936	0.9923	1.0000	1.0148	1.0031	1.0044	1.0161	1.0106	1.0072	1.0044	0.9862	1.0076	1.0046

Table 12.2.7.a. FUs 28-29. Nephrops males. Tuning fleets.

NEP MALE(000) PORTUG TUNE DATA

102								
P-TR								
1988	2009							
1	1	0	1					
2	8							
6554.8	2056.5	3691.8	1464.8	414.3	165.1	74.3	57.7	1988
6629.4	2307.3	2163.2	1941.8	1301.1	353.4	127.6	108.3	1989
6927.9	1930.7	3709.4	2851	1029.5	195.7	64.1	49.8	1990
5595.9	2543	2780.4	1929.9	1118	508.5	176.7	96.3	1991
6563.4	3139.4	3033.1	1590.6	1019.9	271.1	113.6	66.6	1992
5648.7	1951.9	3615.7	1116.3	530.1	134.2	61.9	47	1993
4455.7	778.3	1549.2	745.1	418.9	166.6	60.6	46.3	1994
4925.8	57	1067.3	1070.7	205.8	42.9	16	6.3	1995
3677.4	352.4	876.9	401.3	125.9	48.2	22.1	26.5	1996
3395.6	533.7	1219.4	256.5	103.9	20.1	32.7	69.8	1997
5756.3	510	1218.2	453.4	181.9	85.7	45.1	26.6	1998
10011.8	395.1	1138.5	662.5	371.9	151.3	42.5	48.8	1999
7760.9	544.6	937.1	487.1	349.2	179.1	79.8	100.7	2000
16628.7	251.3	1232.4	862.4	607.1	314.1	147.7	186.9	2001
9776.3	362.3	1745.5	1120.7	517.8	339.2	171.6	228.9	2002
7511.5	765.3	1709.4	985.2	414.9	273.4	170.8	182.6	2003
7242.1	1600.7	2530.8	892.9	601.3	285.5	143.6	229.5	2004
6329.9	2141.6	2996.1	874.9	559.9	201.9	70.2	123.5	2005
4122.8	897.2	1422.6	607.4	358	112.3	66.3	97.5	2006
4439.3	941.7	1480.9	760.4	272.4	127.7	56.8	36.6	2007
4588.7	356.3	701.2	474.4	220.9	109.3	65.1	159.9	2008
4207.9	435.5	478.6	291.4	109.1	69.4	40.9	61.7	2009
P-CTS								
1997	2009							
1	1	0.41	0.47					
2	8							
1	1.4	3.3	4.5	3.7	1.7	0.8	1.8	1997
1	2	4.7	2.9	1.4	0.9	0.4	0.6	1998
0	0	0	0	0	0	0	0	1999
1	1.2	3.5	4.4	2.1	1.4	0.3	0.6	2000
1	0.8	1.3	1.8	1.6	0.9	0.4	0.6	2001
1	1	4.9	6.6	3.3	1.6	1.2	1.6	2002
1	5.5	6	5.5	2.9	1.7	1	1.6	2003
0	0	0	0	0	0	0	0	2004
1	1.8	0.6	0.8	0.4	0.2	0.1	0.3	2005
1	6	10.6	7.7	3.7	1.5	0.7	0.8	2006
1	6.8	12.5	8.6	3.1	1.8	0.6	1.4	2007
1	5.9	17.5	11.9	7.6	3.8	1.5	1.6	2008
1	3.6	5.1	4	2.5	2.3	1.2	1.6	2009

Table 12.2.7.b. FUs 28-29. Nephrops females. Tuning fleets.

NEP FEMALE(000) PORT TUNE DATA													
102													
P-TR													
1988	2009												
1	1	0	1										
2	13												
6554.8	2234.3	1234.8	1352.6	1013.4	510.7	463.1	204.5	95.4	38	28.5	18.1	44.8	1988
6629.4	2073.4	866.1	766.7	762.9	537.8	335.1	216.4	194.1	141.9	70	43.3	89.3	1989
6927.9	1692.7	1492.3	1403.9	805.4	367.7	357.4	265.4	243.9	88.5	72.4	40	30.3	1990
5595.9	2855.5	1342.3	882.5	463	212.8	165.2	148.9	84.1	77.8	19.2	48.5	50.3	1991
6563.4	2695.4	1450.7	905.3	564.1	537.8	342.6	182.1	97.7	45.4	55.2	33.8	137.1	1992
5648.7	2003.5	1692.8	994.9	431.1	276.8	218.1	170.7	140.6	58.6	48.4	44.1	106.8	1993
4455.7	907.9	854.5	725.3	500.4	294.9	153	155.8	105.4	40.7	32.9	13.6	35.9	1994
4925.8	87.3	440.5	796.9	1353.3	1164.9	430.5	549.8	312.6	98.8	88.2	26.3	36.2	1995
3677.4	200.8	246.4	265.2	335.4	382.1	168.1	152.7	138.2	67.9	75.5	23.1	39.2	1996
3395.6	662.6	831	543.8	326	204	61.4	39.6	30.7	10.4	15.9	5.6	15.1	1997
5756.3	568.3	518.1	460.2	310.9	261.9	94.5	125.7	112.7	64	55.8	33.4	47.3	1998
10011.8	557.5	695.8	597.3	584.6	402.6	273.3	155.6	107.6	50.1	31.7	21.6	30.4	1999
7760.9	620.5	391.5	414.8	400.3	339.4	149.3	116.2	95.8	59.8	43.5	42.4	153.5	2000
16628.7	280.5	437.1	469	342.4	257.1	186.7	175.3	126.3	75.7	52.2	39	97.6	2001
9776.3	411.8	510	862	814.9	561	411.9	245.3	130.9	106.3	69.4	51.3	157.4	2002
7511.5	576.7	502.5	601.3	459.1	350	291.6	361	258.5	149.8	87.9	50.8	175.6	2003
7242.1	1999.7	1060.4	1084.2	708.1	400.8	260.2	216.6	194.3	115.4	105.4	81.3	224.7	2004
6329.9	1931.9	1460.6	1082.1	531.1	340.5	213.6	128.9	154.2	94.1	72.6	51.1	171.5	2005
4122.8	917.2	666.5	593.4	401.4	233.8	239.5	162	142.5	50.7	42.3	51	68.9	2006
4439.3	1406.3	614.8	528.4	479.4	327.1	236.5	116.4	70.6	19.9	19.8	18	29	2007
4588.7	415.5	335.5	357.6	276.8	194.9	196.8	164.1	107.4	36.8	31.8	18.3	102.7	2008
4207.9	549	305.7	220.3	154.9	126	115.7	88.1	101.4	34.3	28.5	20.1	44.2	2009
P-CTS													
1997	2009												
1	1	0.41	0.47										
2	13												
1	1.2	0.7	1.4	1.5	2	2.5	2.5	3.5	4	2.7	2.4	6.7	1997
1	2.1	1.9	2	1.9	1.2	1.1	1.2	1	0.6	0.6	0.3	1.1	1998
0	0	0	0	0	0	0	0	0	0	0	0	0	1999
1	0.8	0.9	0.9	2.5	3	2.5	1.9	2	1.4	1.1	0.9	1.8	2000
1	0.7	0.4	0.5	0.7	0.5	0.5	0.8	0.7	0.6	0.3	0.2	0.8	2001
1	0.9	1.4	1.7	3	3.5	2.8	2.7	2.3	1.8	1.4	1.3	2.4	2002
1	7.3	2.6	3.3	3.6	3.7	3.3	2.4	1.9	1.8	1	0.9	3.3	2003
0	0	0	0	0	0	0	0	0	0	0	0	0	2004
1	3.1	0.2	0.2	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	1.5	2005
1	7.8	4.3	5.8	5.4	4.8	4.2	2.5	1.9	1.1	0.9	0.6	1.1	2006
1	11.1	5.8	3.9	4	4.6	4.7	4.1	2.7	0.8	1.2	0.2	1.7	2007
1	8.4	6.6	7.2	7.9	7.2	6.3	5.5	3.6	3.1	1.6	1	2.8	2008
1	5.6	2.4	3.4	3.6	4.2	3.3	2.5	1.2	1	1	0.8	2.7	2009

Table 12.2.8. Nephrops FU 28-29. XSA diagnostics. Males

FLR XSA Diagnostics 2010-05-06 14:09:24

CPUE data from ind0

Catch data for 26 years. 1984 to 2009. Ages 2 to 8.

	fleet	first age	last age	first year	last year	alpha	beta
1	P-TR	2	7	1988	2009	0	1
2	P-CTS	2	7	1997	2009	0.41	0.47

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of 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 = 1.5

Minimum standard error for population
estimates derived from each fleet = 0.3

prior weighting not applied

Regression weights

	year									
age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
all	0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

	year									
age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.079	0.032	0.051	0.092	0.194	0.318	0.161	0.184	0.084	0.075
3	0.207	0.29	0.367	0.404	0.564	0.776	0.41	0.494	0.227	0.173
4	0.18	0.337	0.533	0.413	0.433	0.436	0.387	0.455	0.324	0.154
5	0.279	0.402	0.393	0.433	0.546	0.614	0.359	0.337	0.256	0.126
6	0.413	0.494	0.467	0.421	0.701	0.399	0.261	0.233	0.245	0.132
7	0.463	0.842	0.638	0.518	0.464	0.411	0.245	0.227	0.199	0.151
8	0.463	0.842	0.638	0.518	0.464	0.411	0.245	0.227	0.199	0.151

XSA population number (Thousand)

year \ age	2	3	4	5	6	7	8
2000	8310	5812	3444	1669	615	250	311
2001	9199	5687	3499	2132	936	301	372
2002	8480	6598	3153	1850	1057	423	553
2003	10102	5970	3386	1371	925	491	516
2004	10563	6825	2952	1660	658	450	708
2005	9126	6448	2878	1418	712	242	420
2006	6998	4917	2198	1379	569	354	516
2007	6517	4412	2418	1105	713	325	207
2008	5145	4017	1994	1137	584	418	1019
2009	7024	3505	2373	1069	652	339	507

Estimated population abundance at 1st Jan 2010

year \ age	2	3	4	5	6	7	8
2010	0	4831	2186	1508	699	424	216

Fleet: P-TR

Log catchability residuals.

age \ year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.382	0.487	0.596	1.157	1.177	1.283	1.109	-1.581	0.14	0.411	-0.24
3	0.147	-0.387	0.23	0.519	0.641	1.061	0.688	0.688	0.627	0.662	-0.122
4	0.073	0.292	0.652	0.68	0.801	0.871	0.866	1.269	0.873	0.124	-0.195
5	0.173	0.858	0.48	1.067	0.967	1.023	1.26	0.286	0.449	0.299	-0.206
6	0.235	1.083	-0.019	1.135	0.729	0.212	1.431	-0.113	-0.208	-0.697	0.293
7	0.234	0.866	0.482	0.906	0.565	0.276	0.293	-0.042	0.029	-0.056	0.079

age \ year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	-1.015	-0.429	-2.088	-1.101	-0.246	0.531	1.16	0.913	0.969	0.154	0.125
3	-0.847	-0.78	-1.209	-0.444	-0.084	0.28	0.73	0.528	0.64	-0.166	-0.35
4	-0.662	-0.898	-1.033	-0.05	-0.039	0.046	0.186	0.498	0.583	0.213	-0.439
5	-0.309	-0.459	-0.858	-0.348	0.011	0.276	0.526	0.425	0.289	-0.019	-0.635
6	-0.218	0.022	-0.562	-0.088	0.073	0.613	0.193	0.198	0.014	0.029	-0.5
7	-0.26	0.135	-0.037	0.22	0.278	0.205	0.221	0.138	-0.012	-0.176	-0.365

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

	2	3	4	5	6	7
Mean_Log	-11.0692	-9.7588	-9.7847	-9.7863	-9.8773	-9.8773
S.E_Logq	0.9432	0.6111	0.6065	0.5734	0.5422	0.3176

Fleet: P-CTS

Log catchability residuals.

age	year 1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	-0.72	-0.441	NA	-0.908	-1.436	-1.123	0.425	NA	-0.491	0.909	1.116	1.166	0.357
3	-0.208	-0.109	NA	-0.5	-1.432	-0.22	0.099	NA	-2.117	0.864	1.175	1.487	0.367
4	0.5	-0.301	NA	-0.358	-1.198	0.291	-0.015	NA	-1.771	0.742	0.786	1.247	-0.092
5	1.289	-0.22	NA	-0.421	-0.884	-0.022	0.166	NA	-1.77	0.371	0.406	1.238	0.131
6	0.979	0.406	NA	0.139	-0.687	-0.245	-0.071	NA	-1.96	0.219	0.163	1.114	0.453
7	0.378	0.023	NA	-0.48	-0.212	0.458	0.074	NA	-1.569	-0.076	-0.151	0.499	0.465

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

	2	3	4	5	6	7
Mean_Log	-7.768	-6.692	-6.0936	-6.002	-5.9104	-5.9104
S.E_Logq	0.9339	1.0648	0.8862	0.8761	0.8379	0.5965

Terminal year survivor and F summaries:

Age 2 Year class =2007

source	scaledWts	survivors	yrcls
P-TR	0.405	5474	2007
P-CTS	0.4	6898	2007
fshk	0.195	1795	2007

Age 3 Year class =2006

source	scaledWts	survivors	yrcls
P-TR	0.649	1540	2006
P-CTS	0.201	3154	2006
fshk	0.151	634	2006

Age 4 Year class =2005

source	scaledWts	survivors	yrcls
P-TR	0.64	972	2005
P-CTS	0.24	1374	2005
fshk	0.12	493	2005

Age 5 Year class =2004

source

	scaledWts	survivors	yrcls
P-TR	0.701	370	2004
P-CTS	0.208	796	2004
fshk	0.09	176	2004

Age 6 Year class =2003

source

	scaledWts	survivors	yrcls
P-TR	0.773	257	2003
P-CTS	0.16	666	2003
fshk	0.067	133	2003

Age 7 Year class =2002

source

	scaledWts	survivors	yrcls
P-TR	0.8	150	2002
P-CTS	0.162	344	2002
fshk	0.037	237	2002

Table 12.2.9. Nephrops FU 28-29. Males Fs-at-age

age	year 1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	0.1573	0.2546	0.1317	0.2591	0.1509	0.1694	0.1976	0.2804	0.3360	0.3214	0.2125	0.0159	0.0663
3	0.4547	0.5437	0.6400	0.4360	0.4454	0.2629	0.5120	0.5527	0.7362	0.9696	0.5210	0.5766	0.4034
4	0.5971	0.5260	0.7745	0.5968	0.4026	0.5081	0.7658	0.6340	0.8438	0.7777	0.6076	1.0157	0.5040
5	0.5374	0.6857	0.9913	0.7317	0.4445	0.9024	0.6422	0.9394	0.9982	0.9067	0.9061	0.3735	0.3279
6	0.3503	1.0872	0.5683	0.4399	0.4317	1.0341	0.3532	0.9175	0.7136	0.3629	0.9840	0.2280	0.1545
7	0.5012	0.7785	0.7905	0.5977	0.4313	0.8283	0.5866	0.7261	0.6037	0.3871	0.3102	0.2448	0.1961
8	0.5012	0.7785	0.7905	0.5977	0.4313	0.8283	0.5866	0.7261	0.6037	0.3871	0.3102	0.2448	0.1961

age	year 1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.0803	0.0709	0.0569	0.0792	0.0323	0.0509	0.0921	0.1937	0.3183	0.1613	0.1838	0.0839	0.0748
3	0.3856	0.2978	0.2504	0.2074	0.2900	0.3672	0.4044	0.5636	0.7763	0.4096	0.4942	0.2266	0.1727
4	0.2184	0.2694	0.2940	0.1795	0.3374	0.5328	0.4126	0.4330	0.4358	0.3873	0.4546	0.3235	0.1540
5	0.2601	0.2661	0.4191	0.2786	0.4018	0.3933	0.4333	0.5461	0.6138	0.3591	0.3373	0.2558	0.1262
6	0.0873	0.4016	0.4190	0.4131	0.4944	0.4667	0.4208	0.7007	0.3994	0.2606	0.2332	0.2450	0.1319
7	0.1661	0.3235	0.4017	0.4628	0.8425	0.6378	0.5178	0.4635	0.4109	0.2454	0.2273	0.1993	0.1511
8	0.1661	0.3235	0.4017	0.4628	0.8425	0.6378	0.5178	0.4635	0.4109	0.2454	0.2273	0.1993	0.1511

Table 12.2.10. Nephrops FU 28-29. Males. Population numbers at age.

age	year 1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	16513	14660	16506	20875	17062	17199	12512	12083	12782	8251	4724
3	9126	10452	8419	10719	11934	10870	10756	7607	6763	6767	4433
4	4889	4291	4496	3289	5135	5663	6191	4775	3243	2399	1901
5	2095	1994	1878	1535	1341	2543	2524	2132	1876	1033	817
6	1213	907	744	516	547	637	764	984	617	512	309
7	452	633	226	312	246	263	168	398	291	224	264
8	178	234	88	197	189	218	128	212	168	168	199

age	year 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2	4209	6386	8037	8653	8305	8310	9199	8480	10102	10563	9126
3	2830	3069	4428	5495	5971	5812	5687	6598	5970	6825	6448
4	1950	1178	1519	2231	3022	3444	3499	3153	3386	2952	2878
5	767	523	527	905	1262	1669	2132	1850	1371	1660	1418
6	244	391	279	301	514	615	936	1057	925	658	712
7	86	144	248	190	149	250	301	423	491	450	242
8	33	171	526	111	169	311	372	553	516	708	420

age	year 2006	2007	2008	2009	2010
2	6998	6517	5145	7024	0
3	4917	4412	4017	3505	4831
4	2198	2418	1994	2373	2186
5	1379	1105	1137	1069	1508
6	569	713	584	652	699
7	354	325	418	339	424
8	516	207	1019	507	216

Table 12.2.11. Nephrops FU 28-29. Male XSA summary results

Year	R (thousands)	SSB (tonnes)	Yield (Yield)	Fbar (2-7)
1984	16513	845	292	0.4330
1985	14660	828	353	0.6460
1986	16506	709	315	0.6494
1987	20875	704	277	0.5102
1988	17062	796	249	0.3844
1989	17199	886	318	0.6175
1990	12512	868	350	0.5096
1991	12083	750	344	0.6750
1992	12782	597	305	0.7053
1993	8251	473	232	0.6209
1994	4724	356	139	0.5902
1995	4209	269	98	0.4091
1996	6386	266	64	0.2753
1997	8037	376	74	0.1996
1998	8653	399	88	0.2716
1999	8305	496	116	0.3068
2000	8310	577	117	0.2701
2001	9199	656	190	0.3997
2002	8480	693	222	0.4081
2003	10102	651	201	0.3802
2004	10563	669	245	0.4834
2005	9126	565	230	0.4924
2006	6998	509	136	0.3039
2007	6517	449	128	0.3217
2008	5145	540	105	0.2224
2009	7024	462	60	0.1351

Table 12.2.12. Nephrops FU 28-29. XSA diagnostics. Females

FLR XSA Diagnostics 2010-05-06 15:33:52

CPUE data from ind0

Catch data for 26 years. 1984 to 2009. Ages 2 to 13.

	fleet	first age	last age	first year	last year	alpha	beta
1	P-TR	2	12	1988	2009	0	1
2	P-CTS	2	5	1997	2009	0.41	0.47

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability independent of size for all ages

Catchability independent of age for ages > 11

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 = 1.5

Minimum standard error for population
estimates derived from each fleet = 0.3

prior weighting not applied

Regression weights

	year									
age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
all	0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

year										
age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.086	0.038	0.049	0.057	0.174	0.186	0.101	0.169	0.053	0.056
3	0.074	0.081	0.09	0.078	0.14	0.185	0.09	0.091	0.055	0.05
4	0.105	0.119	0.226	0.145	0.239	0.208	0.106	0.096	0.07	0.047
5	0.119	0.118	0.311	0.181	0.254	0.176	0.111	0.118	0.066	0.039
6	0.117	0.104	0.289	0.212	0.237	0.186	0.109	0.124	0.064	0.039
7	0.085	0.087	0.243	0.239	0.242	0.191	0.193	0.154	0.102	0.049
8	0.092	0.136	0.158	0.348	0.281	0.181	0.217	0.135	0.152	0.06
9	0.151	0.137	0.143	0.249	0.32	0.331	0.312	0.138	0.178	0.132
10	0.161	0.171	0.164	0.242	0.167	0.252	0.171	0.064	0.099	0.079
11	0.263	0.205	0.235	0.198	0.268	0.151	0.171	0.093	0.139	0.104

XSA population number (Thousand)

year \ age	2	3	4	5	6	7	8	9	10	11	12	13
2000	8293	6093	4610	3942	3393	2020	1460	755	446	208	225	811
2001	8348	6228	4634	3399	2866	2471	1519	1090	531	311	131	324
2002	9543	6581	4704	3370	2473	2114	1854	1085	778	367	207	631
2003	11577	7441	4926	3071	2021	1517	1358	1296	770	541	237	815
2004	13867	8956	5637	3489	2099	1338	978	785	827	495	363	997
2005	12590	9544	6373	3634	2216	1356	860	605	467	573	310	1035
2006	10601	8559	6493	4239	2495	1506	917	588	356	297	403	543
2007	10000	7849	6405	4779	3107	1831	1017	604	352	245	205	329
2008	8854	6915	5870	4766	3479	2248	1285	727	431	270	183	1024
2009	11076	6873	5358	4483	3651	2672	1662	904	498	319	193	422

Estimated population abundance at 1st Jan 2010

year \ age	2	3	4	5	6	7	8	9	10	11	12	13
2010	0	8589	5362	4197	3539	2884	2090	1287	651	379	237	140

Fleet: P-TR

Log catchability residuals.

age \ year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	0.915	0.934	0.757	1.341	1.103	1.264	0.743	-1.685	-0.806	0.617	0.062
3	0.745	0.18	0.844	1.001	0.808	1.096	1.04	0.077	-0.27	0.818	-0.017
4	0.794	0.367	0.726	0.672	0.59	0.716	0.607	0.88	-0.152	0.595	-0.286
5	0.846	0.592	0.863	0.156	0.387	0.31	0.577	1.555	0.61	0.328	-0.271
6	0.658	0.66	0.194	0.029	0.485	0.157	0.483	1.894	1.121	0.48	-0.161
7	0.533	0.698	0.687	-0.053	0.742	0.109	0.117	1.201	0.932	-0.284	-0.532
8	0.26	0.015	0.807	0.322	0.072	0.514	0.188	1.722	0.791	-0.254	0.048
9	-0.738	0.46	0.314	0.179	-0.072	0.148	0.499	1.059	1.205	-0.607	0.421
10	-0.319	0.338	0.469	0.156	0.136	0.29	-0.165	1.168	0.689	-0.531	0.248
11	-0.425	0.495	-0.174	-0.658	-0.181	0.589	0.123	0.697	1.649	-0.554	0.833
12	-0.125	0.372	0.388	-0.002	0.086	0.109	-0.034	0.148	0.048	-0.35	-0.037

age \ year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	-0.462	-0.126	-1.712	-0.925	-0.514	0.641	0.843	0.659	1.103	-0.083	0.06
3	-0.128	-0.425	-1.095	-0.461	-0.34	0.287	0.7	0.408	0.34	-0.189	-0.191
4	-0.408	-0.357	-0.994	0.181	0	0.535	0.531	0.292	0.111	-0.238	-0.555
5	-0.373	-0.315	-1.085	0.412	0.134	0.51	0.28	0.244	0.231	-0.373	-0.819
6	-0.283	-0.375	-1.252	0.293	0.251	0.397	0.29	0.188	0.238	-0.455	-0.865
7	-0.355	-0.707	-1.446	0.106	0.353	0.403	0.304	0.743	0.442	-0.004	-0.647
8	-0.428	-0.791	-1.161	-0.483	0.566	0.389	0.087	0.697	0.151	0.235	-0.601
9	-0.498	-0.511	-1.37	-0.796	0.019	0.304	0.473	0.844	-0.041	0.179	-0.031
10	-0.163	-0.115	-0.813	-0.327	0.327	-0.004	0.538	0.582	-0.467	-0.07	-0.209
11	-0.848	0.192	-0.818	-0.154	-0.06	0.279	-0.16	0.395	-0.284	0.082	-0.125
12	-0.159	0.071	-0.154	0.154	0.248	0.336	0.127	0.266	-0.195	-0.091	0.041

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

	2	3	4	5	6	7	8	9	10	11	12
Mean_Log	-11.2837	-11.1434	-10.8599	-10.7743	-10.7297	-10.7156	-10.5536	-10.3398	-10.675	-10.4884	-10.4884
S.E_Logq	0.9093	0.5934	0.5158	0.5856	0.6485	0.6273	0.6223	0.6277	0.4599	0.5883	0.194

Fleet: P-CTS

Log catchability residuals.

	year												
age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	-0.977	-0.29	NA	-1.233	-1.394	-1.272	0.631	NA	-0.252	0.805	1.246	1.038	0.41
3	-1.033	0.132	NA	-0.444	-1.274	-0.072	0.419	NA	-2.348	0.787	1.173	1.414	0.406
4	-0.294	-0.123	NA	-0.59	-1.177	0.079	0.661	NA	-2.373	0.932	0.543	1.232	0.563
5	-0.466	-0.252	NA	0.023	-1.102	0.447	0.665	NA	-1.99	0.717	0.3	0.961	0.224

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

	2	3	4	5
Mean_Log	-7.8874	-8.2559	-7.8172	-7.2463
S.E_Logq	0.994	1.1266	1.043	0.8751

Terminal year survivor and F summaries:

Age 2 Year class =2007

source			
	scaledWts	survivors	yrcls
P-TR	0.487	9102	2007
P-CTS	0.336	12921	2007
fshk	0.177	3385	2007

Age 3 Year class =2006

source			
	scaledWts	survivors	yrcls
P-TR	0.748	4418	2006
P-CTS	0.147	8032	2006
fshk	0.106	2321	2006

Age 4 Year class =2005

source			
	scaledWts	survivors	yrcls
P-TR	0.762	2403	2005
P-CTS	0.146	7354	2005
fshk	0.092	1285	2005

Age 5 Year class =2004

source

	scaledWts	survivors	yrcls
P-TR	0.654	1557	2004
P-CTS	0.241	4418	2004
fshk	0.105	895	2004

Age 6 Year class =2003

source

	scaledWts	survivors	yrcls
P-TR	0.83	1211	2003
fshk	0.17	733	2003

Age 7 Year class =2002

source

	scaledWts	survivors	yrcls
P-TR	0.824	1091	2002
fshk	0.176	540	2002

Age 8 Year class =2001

source

	scaledWts	survivors	yrcls
P-TR	0.83	702	2001
fshk	0.17	372	2001

Age 9 Year class =2000

source

	scaledWts	survivors	yrcls
P-TR	0.811	629	2000
fshk	0.189	313	2000

Age 10 Year class =1999

source

	scaledWts	survivors	yrcls
P-TR	0.898	306	1999
fshk	0.102	190	1999

Age 11 Year class =1998

source

	scaledWts	survivors	yrcls
P-TR	0.866	208	1998
fshk	0.134	143	1998

Age 12 Year class =1997

source

	scaledWts	survivors	yrcls
P-TR	0.957	145	1997

Table 12.2.13. Nephrops FU 28-29. Females Fs-at-age

age	year 1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
2	0.1939	0.2374	0.1502	0.5026	0.2069	0.2132	0.1867	0.2706	0.2502	0.2529	0.1182	0.0115	0.0207
3	0.1202	0.1839	0.1449	0.2648	0.2009	0.1152	0.2344	0.2216	0.2142	0.2459	0.1832	0.0772	0.0407
4	0.2176	0.1600	0.2297	0.2177	0.2803	0.1848	0.2768	0.2117	0.2286	0.2232	0.1577	0.2295	0.0609
5	0.2392	0.2538	0.2052	0.3088	0.3218	0.2522	0.3464	0.1375	0.2034	0.1618	0.1668	0.4932	0.1423
6	0.4406	0.2103	0.2932	0.1736	0.2787	0.2825	0.1849	0.1265	0.2346	0.1452	0.1587	0.7261	0.2483
7	0.3626	0.3055	0.2282	0.2299	0.2495	0.2978	0.3078	0.1182	0.3082	0.1404	0.1115	0.3663	0.2083
8	0.2541	0.1999	0.1586	0.1198	0.2230	0.1764	0.4088	0.2026	0.1850	0.2480	0.1410	0.7295	0.2128
9	0.1340	0.1535	0.2705	0.1706	0.1016	0.3419	0.3087	0.2175	0.1985	0.2128	0.2386	0.4636	0.4001
10	0.2482	0.0745	0.1078	0.2915	0.1105	0.2160	0.2574	0.1518	0.1746	0.1753	0.0876	0.3689	0.1702
11	0.2722	0.1645	0.1518	0.6778	0.1199	0.3052	0.1628	0.0810	0.1533	0.2855	0.1409	0.2774	0.5386
12	0.2558	0.1806	0.1845	0.3002	0.1619	0.2696	0.2864	0.1563	0.2002	0.1763	0.1204	0.1599	0.1079
13	0.2558	0.1806	0.1845	0.3002	0.1619	0.2696	0.2864	0.1563	0.2002	0.1763	0.1204	0.1599	0.1079

age	year 1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	0.0793	0.0773	0.0795	0.0863	0.0378	0.0489	0.0566	0.1736	0.1858	0.1005	0.1689	0.0533	0.0563
3	0.1117	0.0821	0.1280	0.0737	0.0807	0.0895	0.0776	0.1402	0.1853	0.0900	0.0905	0.0551	0.0504
4	0.1187	0.0834	0.1285	0.1047	0.1186	0.2263	0.1449	0.2390	0.2078	0.1065	0.0956	0.0697	0.0465
5	0.0990	0.0922	0.1449	0.1190	0.1180	0.3110	0.1806	0.2540	0.1761	0.1105	0.1175	0.0663	0.0389
6	0.1206	0.1077	0.1658	0.1171	0.1044	0.2886	0.2124	0.2370	0.1861	0.1093	0.1237	0.0639	0.0389
7	0.0569	0.0753	0.1565	0.0852	0.0872	0.2426	0.2388	0.2419	0.1913	0.1932	0.1540	0.1018	0.0490
8	0.0690	0.1583	0.1710	0.0921	0.1364	0.1581	0.3479	0.2806	0.1810	0.2172	0.1353	0.1521	0.0604
9	0.0600	0.2853	0.1976	0.1511	0.1371	0.1431	0.2490	0.3196	0.3308	0.3119	0.1383	0.1783	0.1324
10	0.0463	0.1713	0.1975	0.1606	0.1713	0.1637	0.2421	0.1674	0.2520	0.1713	0.0645	0.0992	0.0792
11	0.0545	0.3716	0.1199	0.2634	0.2054	0.2347	0.1980	0.2684	0.1509	0.1712	0.0934	0.1392	0.1038
12	0.0668	0.1552	0.2392	0.2334	0.4005	0.3198	0.2699	0.2842	0.2013	0.1505	0.1021	0.1171	0.1226
13	0.0668	0.1552	0.2392	0.2334	0.4005	0.3198	0.2699	0.2842	0.2013	0.1505	0.1021	0.1171	0.1226

Table 12.2.14. Nephrops FU 28-29. Females. Population numbers at age.

age	year 1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
2	12913	13513	13814	15138	13212	11933	10986	13313	13459	9910	9003
3	9973	8708	8725	9733	7498	8795	7894	7463	8316	8581	6301
4	6804	7240	5932	6180	6115	5022	6417	5113	4895	5496	5494
5	5393	4481	5051	3860	4070	3783	3418	3984	3387	3189	3599
6	2618	3476	2846	3368	2321	2415	2407	1979	2843	2263	2221
7	1911	1379	2306	1738	2318	1438	1491	1638	1428	1841	1602
8	982	1089	832	1503	1131	1479	874	897	1191	859	1310
9	660	624	730	581	1091	741	1015	476	600	811	549
10	174	473	438	456	401	807	431	610	313	403	537
11	89	111	359	322	279	294	533	273	429	215	277
12	49	56	77	253	134	203	178	371	206	302	133
13	70	35	62	577	330	415	134	383	831	727	349

age	year 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2	8434	10831	9600	8445	8058	8293	8348	9543	11577	13867	12590
3	6549	6826	8686	7260	6400	6093	6228	6581	7441	8956	9544
4	4295	4963	5366	6360	5475	4610	4634	4704	4926	5637	6373
5	3841	2795	3824	3901	4791	3942	3399	3370	3071	3489	3634
6	2494	1921	1985	2836	2913	3393	2866	2473	2021	2099	2216
7	1551	988	1227	1441	2085	2020	2471	2114	1517	1338	1356
8	1173	881	657	949	1094	1460	1519	1854	1358	978	860
9	931	463	583	502	663	755	1090	1085	1296	785	605
10	354	480	254	449	309	446	531	778	770	827	467
11	402	200	331	199	310	208	311	367	541	495	573
12	197	250	96	257	112	225	131	207	237	363	310
13	270	422	257	362	157	811	324	631	815	997	1035

age	year 2006	2007	2008	2009
2	10601	10000	8854	11076
3	8559	7849	6915	6873
4	6493	6405	5870	5358
5	4239	4779	4766	4483
6	2495	3107	3479	3651
7	1506	1831	2248	2672
8	917	1017	1285	1662
9	588	604	727	904
10	356	352	431	498
11	297	245	270	319
12	403	205	183	193
13	543	329	1024	422

Table 12.2.15. Nephrops FU 28-29. Female XSA summary results

Year	R (thousands)	SSB (tonnes)	Yield (Yield)	Fbar (4-10)
1984	12913	797	169	0.2709
1985	13513	783	156	0.1939
1986	13814	808	150	0.2133
1987	15138	857	232	0.2160
1988	13212	785	171	0.2236
1989	11933	762	151	0.2502
1990	10986	740	174	0.2987
1991	13313	702	134	0.1665
1992	13459	750	165	0.2190
1993	9910	736	145	0.1867
1994	9003	673	97	0.1517
1995	8434	678	174	0.4824
1996	10831	612	67	0.2061
1997	9600	660	62	0.0815
1998	8445	722	72	0.1390
1999	8058	722	95	0.1660
2000	8293	760	84	0.1186
2001	8348	738	79	0.1247
2002	9543	784	135	0.2190
2003	11577	780	126	0.2308
2004	13867	817	170	0.2485
2005	12590	822	152	0.2179
2006	10601	782	95	0.1743
2007	10000	790	90	0.1184
2008	8854	848	67	0.1045
2009	11076	838	48	0.0636

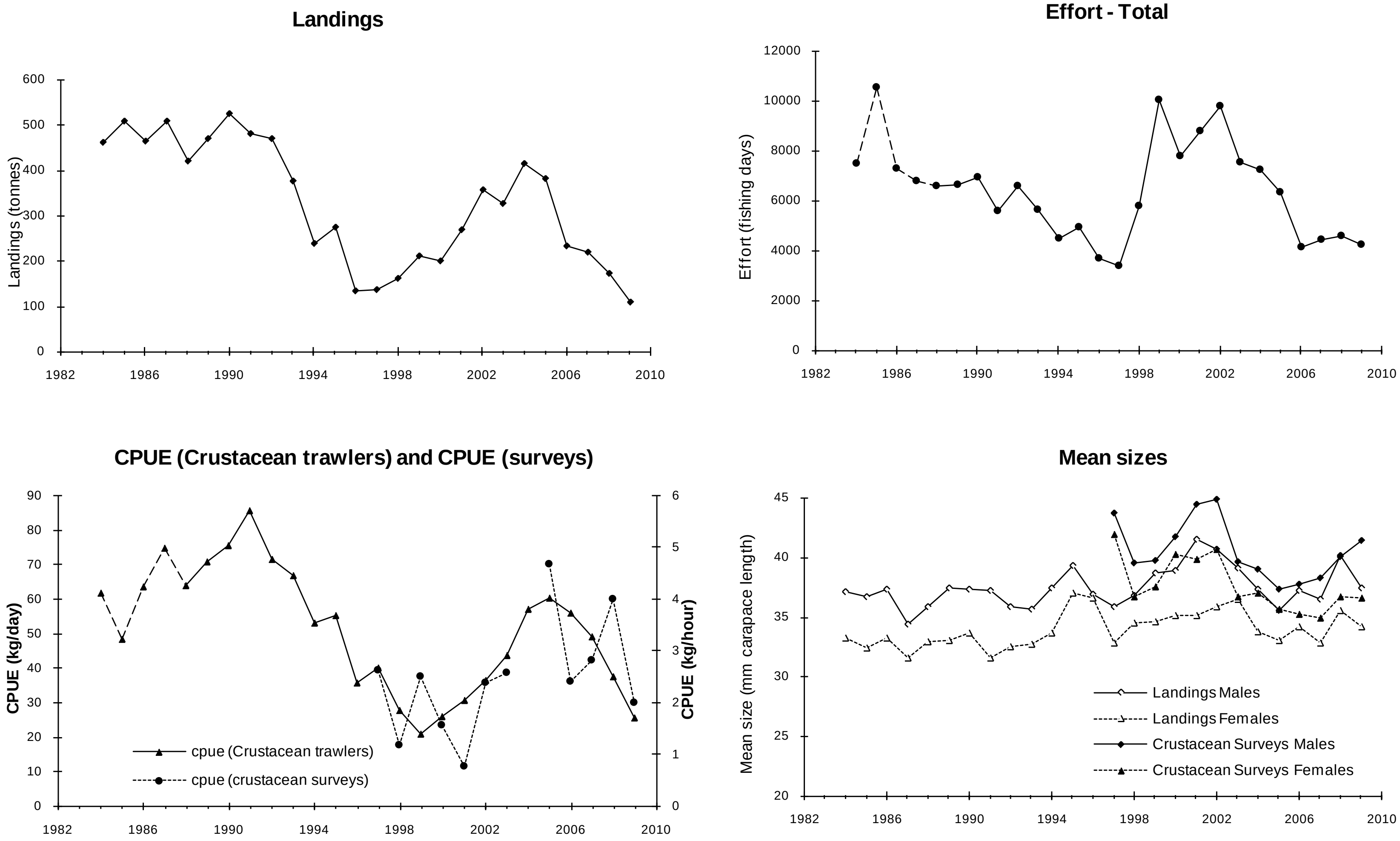


Figure 12.2.1. SW and S Portugal (FU 28+29): Landings, effort, biomass indices and mean sizes of *Nephrops* in landings and surveys. Note: Values of Crustacean trawlers CPUE and effort before 1988 are less reliable.

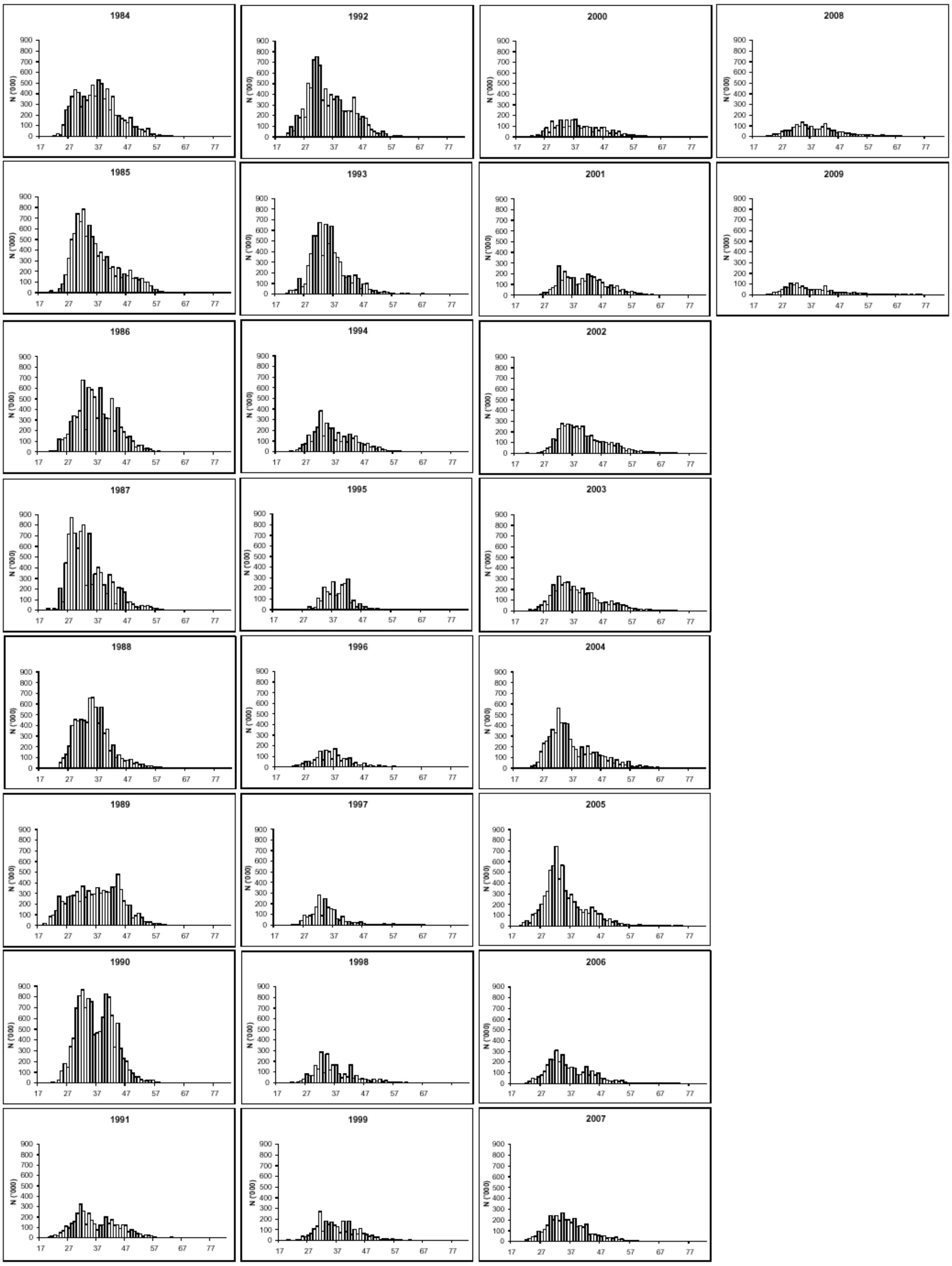


Figure 12.2.a. SW and S Portugal (FU 28-29) male length distributions for the period 1984-2009.

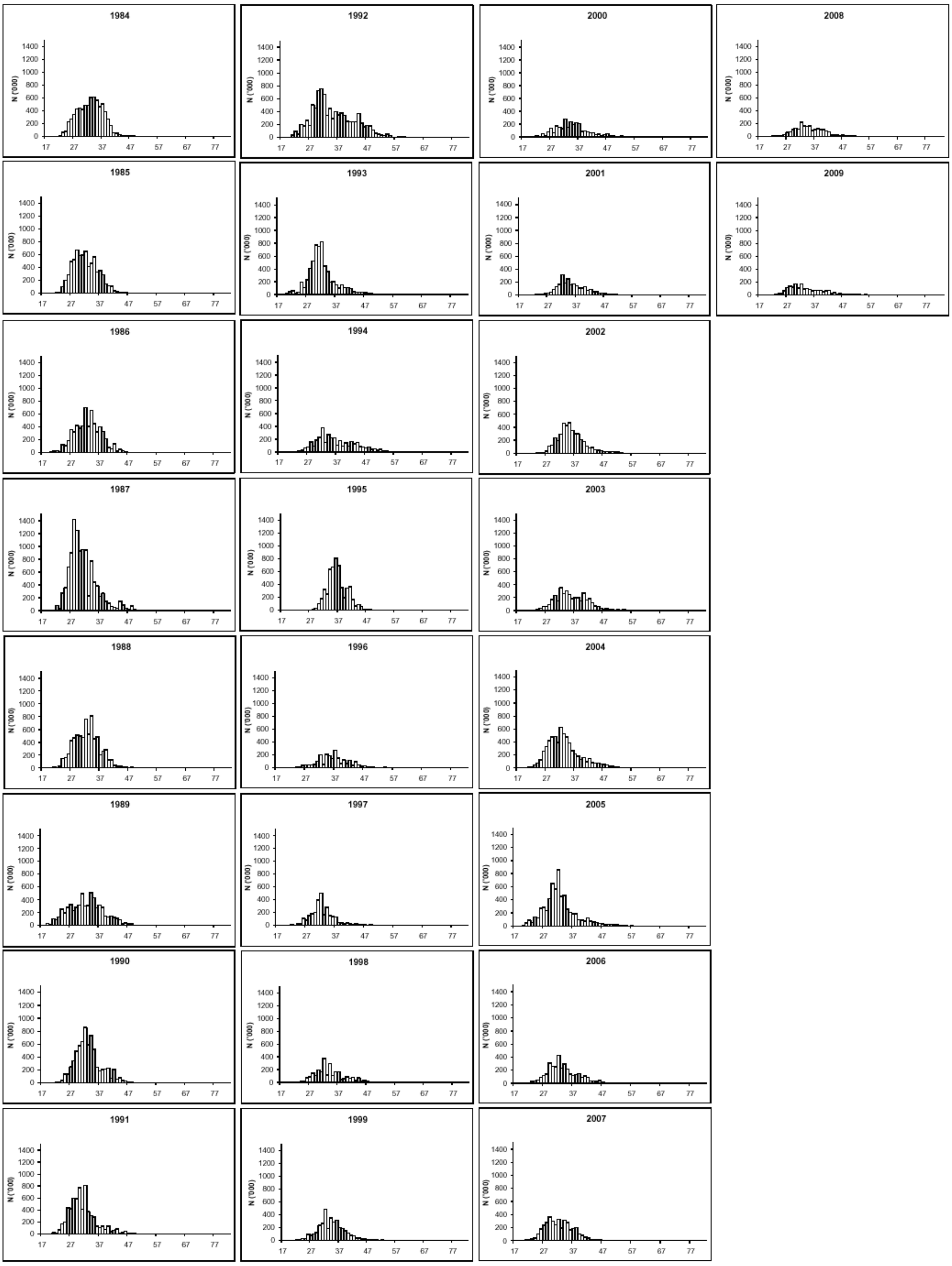


Figure 12.2.b. SW and S Portugal (FU 28-29) female length distributions for the period 1984-2009.

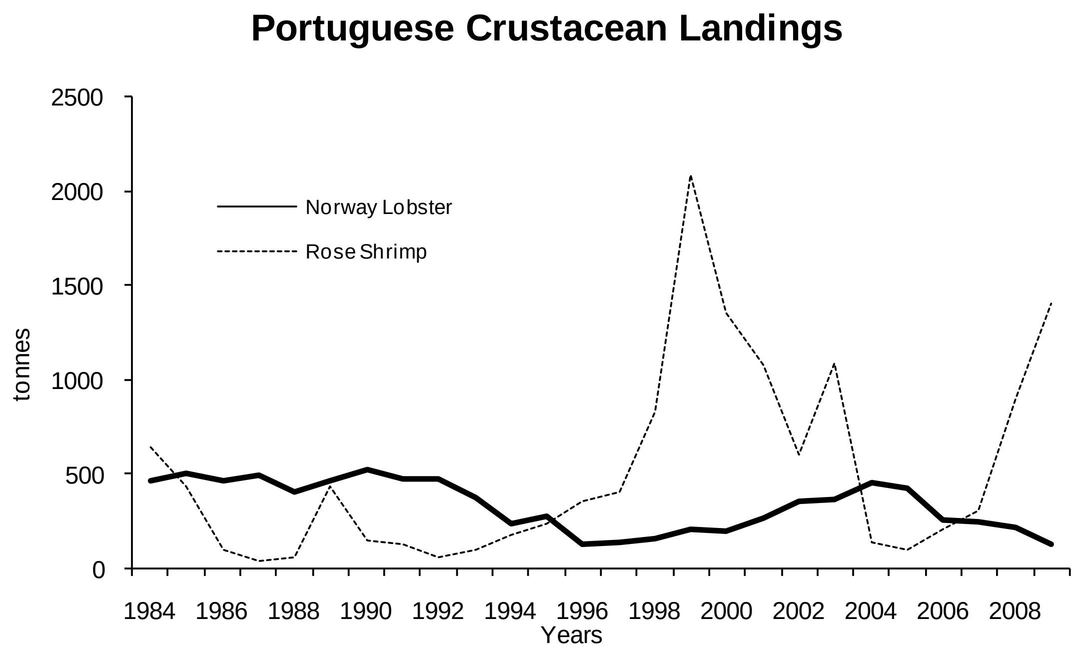


Figure 12.2.3 FUs 28-29: Portuguese Crustacean Landings in the period 1984-2009.

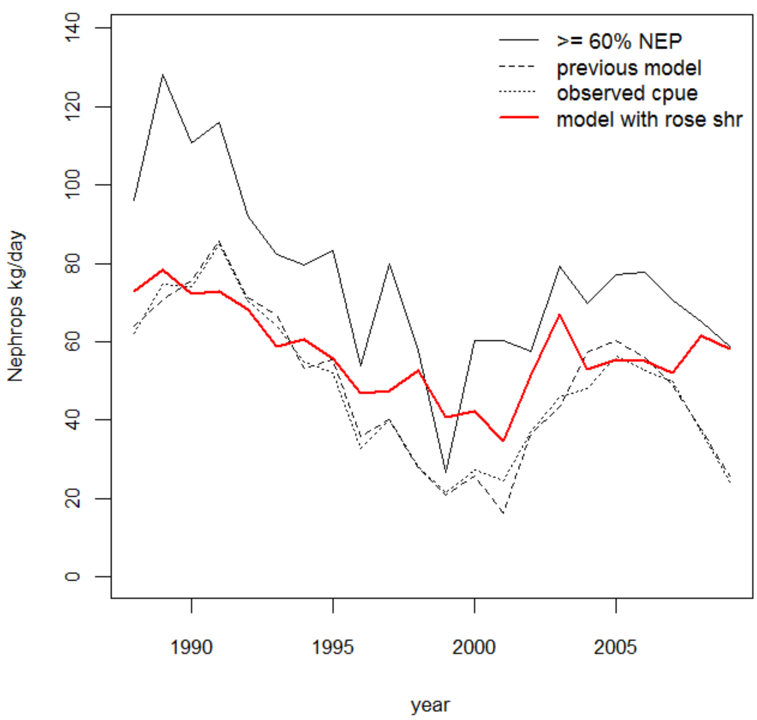


Figure 12.2.4. Comparison of *Nephrops* CPUE, estimated with different standardization methods and the observed CPUE.

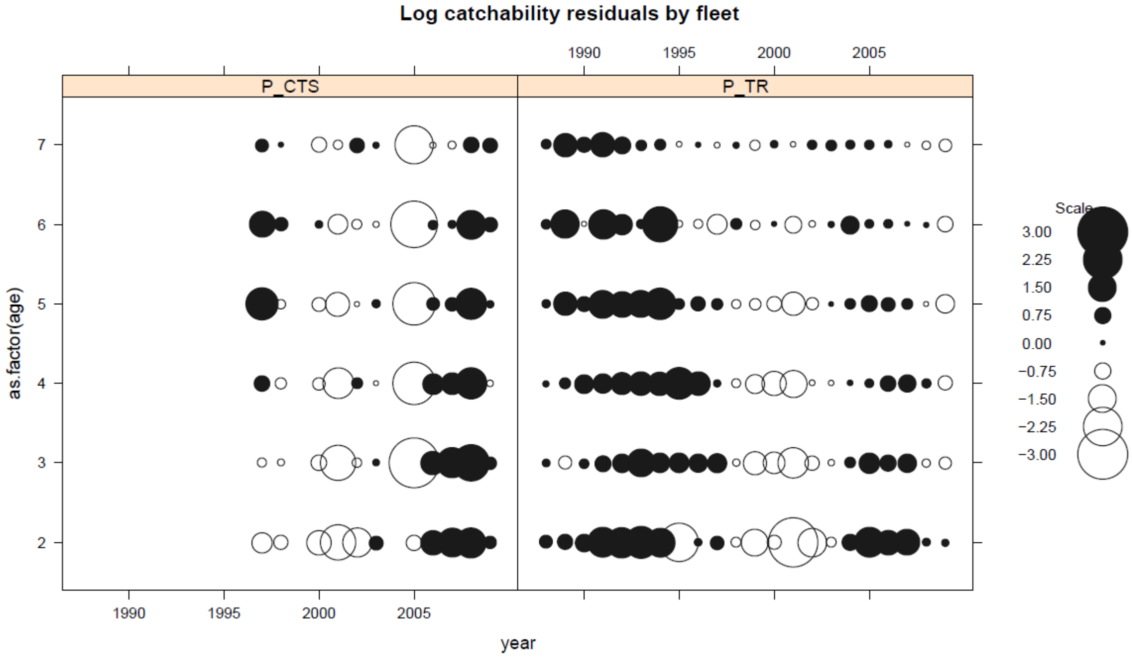


Figure 12.2.5. FUs 28-29. *Nephrops* Males. Log catchability residuals by fleet.

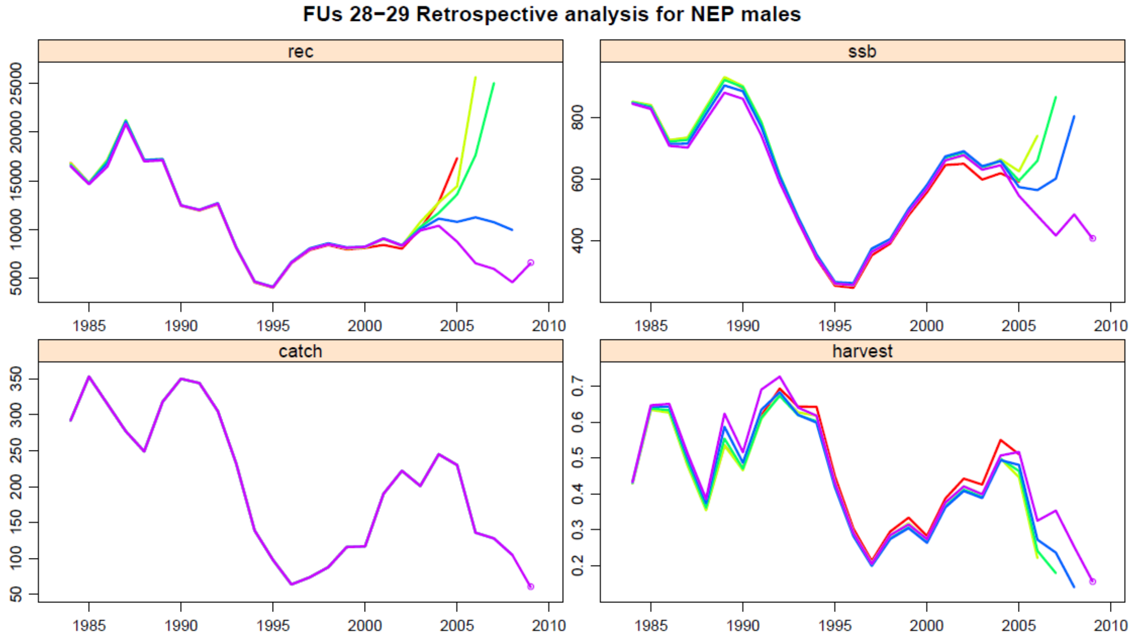


Figure 12.2.6. FUs 28-29. *Nephrops* Males. Retrospective analysis

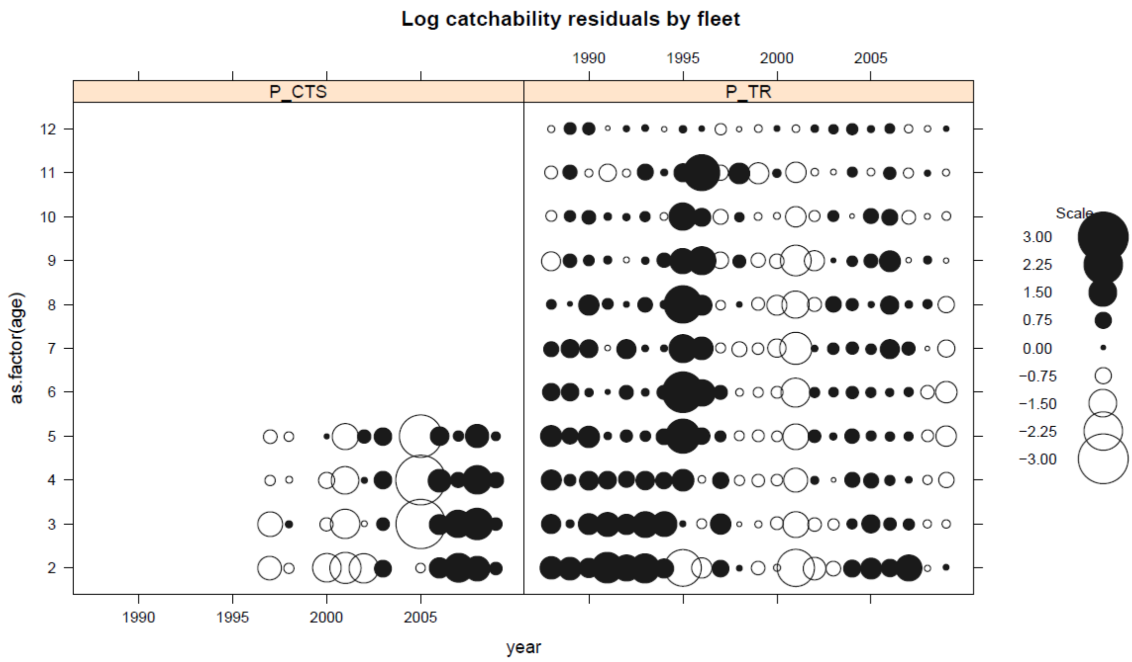


Figure 12.2.7. FUs 28-29. *Nephrops* Females. Log catchability residuals by fleet.

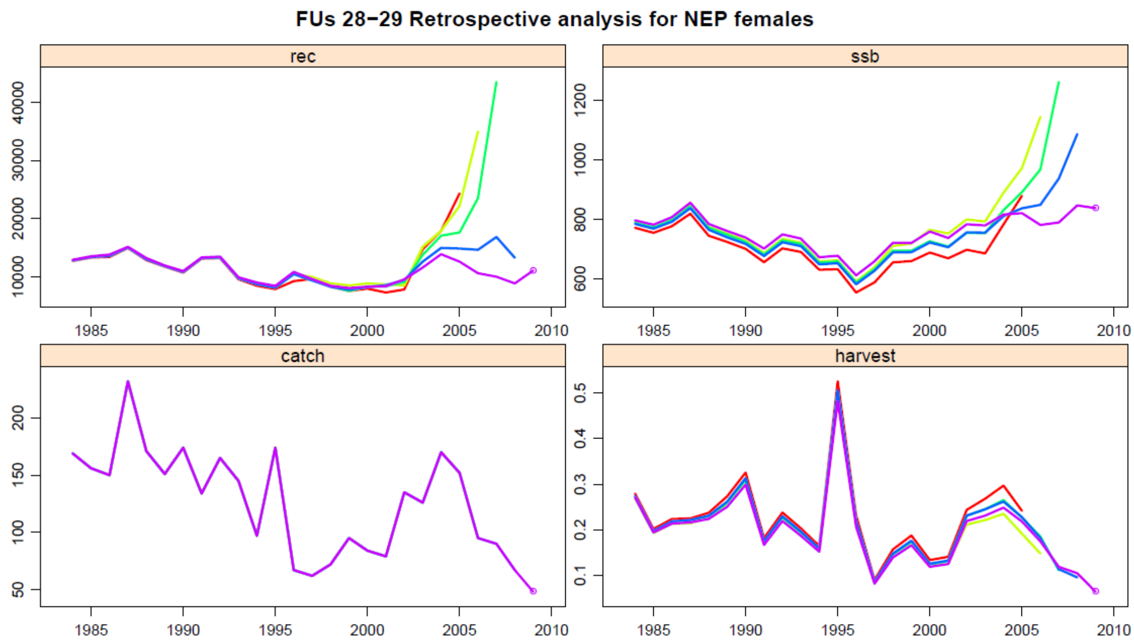


Figure 12.2.8. FUs 28-29. *Nephrops* Females. Retrospective analysis

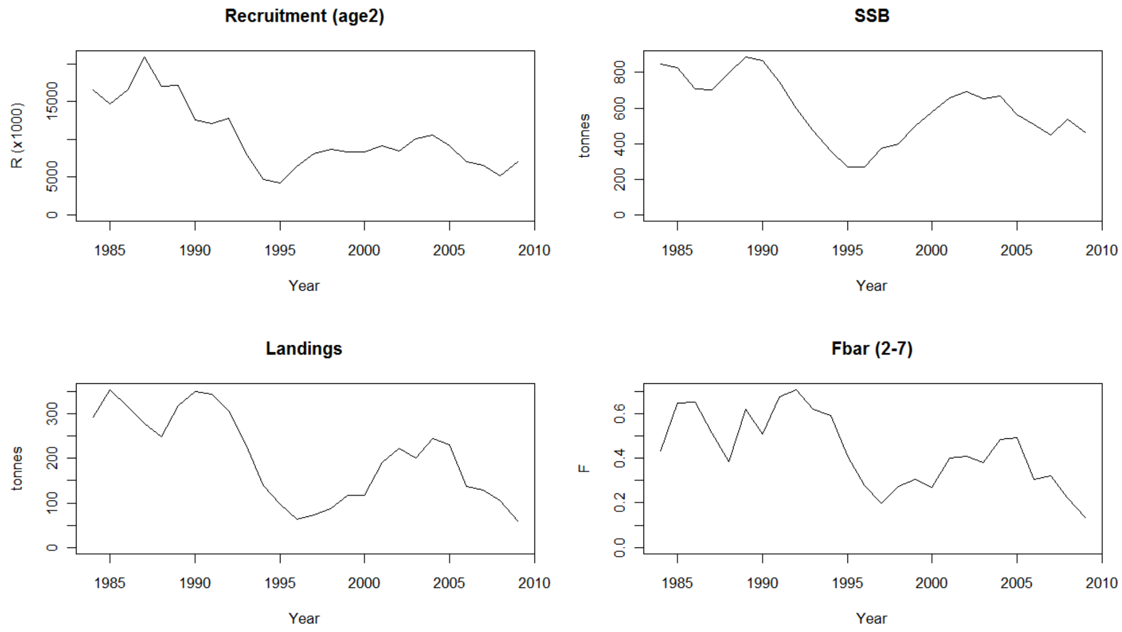


Figure 12.2.9. FUs 28-29. Output VPA males: Trends in Spawning Stock Biomass, Landings, Fbar and Recruitment.

Figure 12.2.10. FUs 28-29. Output VPA females: Trends in Spawning Stock Biomass, Landings, Fbar and Recruitment.

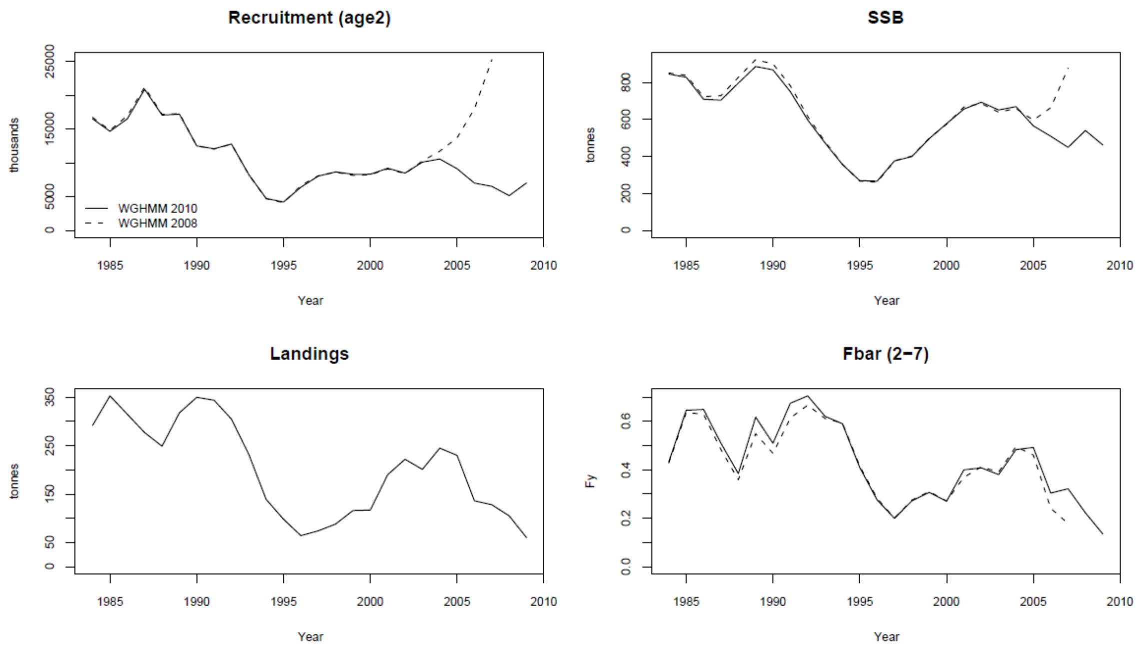


Figure 12.2.11. FU 28-29, *Nephrops* Males: Comparison between 2008 and 2010 assessments.

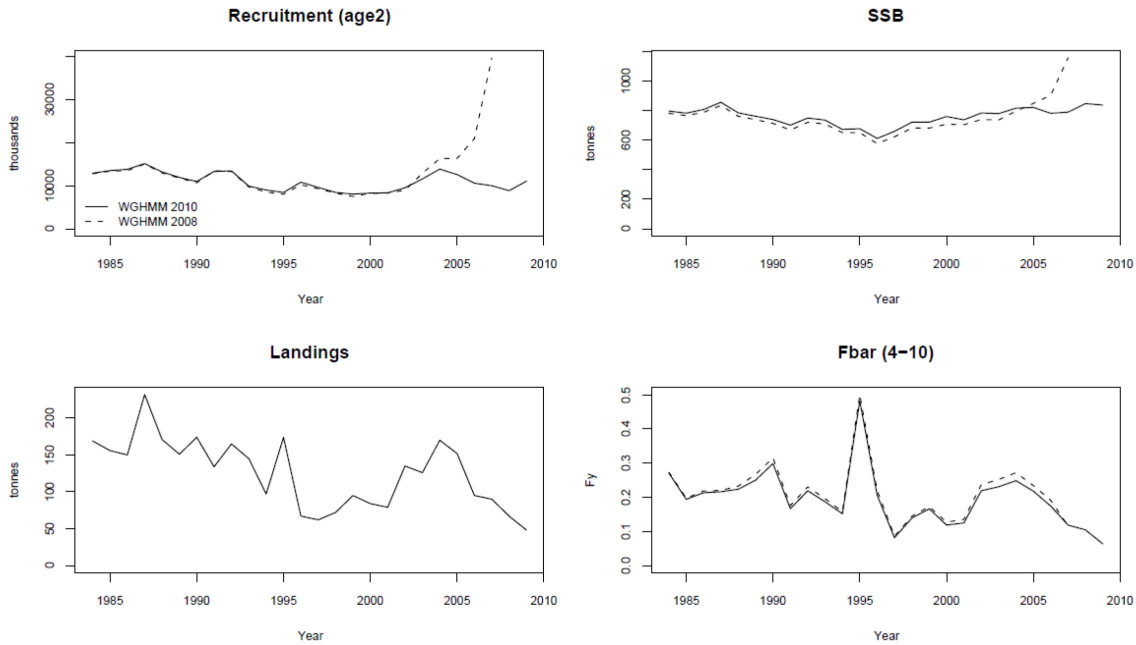


Figure 12.2.12. FU 28-29, *Nephrops* Females: Comparison between 2008 and 2010 assessments.

12.3 *Nephrops* in FU 30 (Gulf of Cadiz)

12.3.1 General

12.3.1.1 Ecosystem aspects

See Annex L

12.3.1.2 Fishery description

See Annex L

12.3.1.3 ICES Advice for 2010 and Management applicable for 2009 and 2010

ICES Advice for 2010

As ICES advice for *Nephrops* is biennial, the advice for 2010 is the same as that given for 2009:

In the absence of defined reference points, the state of the stock cannot be evaluated in this regard.

The stock appears to be relatively stable based on survey and LPUE data, but the stock status is unknown in relation to its long-term potential. The mean sizes have fluctuated along the period with no apparent trend, unlike other *Nephrops* stocks where an increasing trend in mean size may be indicative of recruitment failure. Landings have shown an increasing trend since 1996 to levels observed in the 1980s. Landings were around 230 t in 2005 and 2006, but a 21% decrease was observed in 2007.

As the state of the stock is unknown but abundance has been stable in recent years, ICES advises that the landings in 2009 should not exceed the recent average level of 200 t (2005–2007).

Management applicable for 2009 and 2010

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).

A closed season of 60 days was established in 2007 for the Gulf of Cadiz bottom trawl fleet by Spanish Administration in order to reduce the fishing effort.

In February 2008, a new regulation was established by the regional administration with the aim of distributing the fishing effort (number of hours per day) throughout the year (Resolution 13th February, BOJA nº 40) and it was modified in 2009 (Resolution 26th Janaury, BOJA nº 36 and Resolution 23th November, BOJA nº 235). This Resolution and their modifications have been set up in order to improve the yields of the target demersal species, including *Nephrops*, without increasing total fishing effort

In order to further reduce the fishing effort, a new fishing closure period of 30 days (16 January – 15 February) was established in 2009 (ORDEN ARM/401/2009, 20 th February, B.O.E nº 48). An increase of mesh size was established since September of 2009 (Orden ARM/2515/2009) for the bottom trawl fleet, including a closed season of 60 days in autumn. In 2010, a new regulation increased the closed season 21 days (16-22 January and 1-14 February).

The TAC set for the whole Division IXa was 374 t for 2009 and 337 t for 2010.

12.3.2 Data

The sampling level for the species is given in Table 1.3.

12.3.2.1 Commercial catch and discard

The Working Group estimates of landings for FU 30 are given in Table 12.3.1. Landings were reported by Spain and also minor quantities by Portugal. Spanish data come from different sources. Data used in the Gulf of Cadiz are based on Spanish sales notes, Fishermen Brotherhoods and Owners Associations.

Since 2007 a significant increase in *Nephrops* landings has been observed in Ayamonte port, which is located in the mouth of the Guadiana River. Landings from this port have not been taken into account in earlier Working Groups. However, this port accounted for more than 30% of the total FU30 landings in 2008 and 2009, becoming the most important *Nephrops* landing port of the Gulf of Cádiz, followed by Isla Cristina port. Previously, the landings in Ayamonte port were minimal, with the fleet landing in nearby ports. Due to this recent importance of this port, their landings have now been incorporated to the Gulf of Cadiz time series of landings, 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 in two last years (Figure 12.3.1). 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, and stabilizing around 246 t during 2005-2006, except in 2004 when a decrease of more than 50% was observed. Since 2006 landings have declined to 120 t and 119 t in 2008 and 2009, respectively.

Since 2005 an annual discarding sampling programme is carried out during the *Nephrops* fishing season (summer). The discarding rate of *Nephrops* in this fishery fluctuates annually but is always low, ranging between 0.5% and 5.2% in weight. In 2009, the percentage of discarded *Nephrops* by weight was 2.7%, similar to previous year (Table 12.3.2). Figure 12.3.2 shows the estimated length frequency distributions of the discarded and retained *Nephrops* by trip in these surveys. The mean carapace length has fluctuated along the period with no apparent trend (Table 12.3.2).

12.3.2.2 Biological sampling

Figure 12.3.3 gives the annual landings length composition for males, females and both sexes combined during the period 2001-2009. The length composition of landings in 2004 and 2005 shows a shift to smaller sizes in relation to previous years. Length compositions from 2001-2003 may be biased, as samples did not cover all the commercial categories. During 2004 and 2005, all the commercial categories were sampled. The smallest category (CL 14 - 27 mm) accounted for 40-50 % of landings in 2004 and 2005. A new sampling scheme was set up in 2006 in order to cover a wider geographical area and all the commercial landings categories of the species. The number of samples and ports covered suggests more reliable information. The mean sizes for both sexes remained relatively stable after the sampling scheme was changed., but with a slight increase in 2009 from 29.2 mm to 31.6 mm Mean size of males, females and sexes combined of *Nephrops* landings from 2001 to 2009 are shown in Figure 12.3.4.

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 (SPS-GFS-cspr) carried out from 1993 to 2010 are shown in Table 12.3.3. The 2004 survey values are the lowest in the time series and this has also been detected in the commercial LPUE for 2004 (Figure 12.3.5). 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 (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). Its value is similar to the previous year. This survey is not specifically directed to *Nephrops* and the information needs to be considered with caution, as the survey is not carried out during the main *Nephrops* fishing season.

The length distributions of *Nephrops* obtained in the Spanish bottom trawl Spring surveys (SPS-GFS-cspr) during the period 2001-2010 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 42.9 to 34.6 mm CL for males and between 34.9 to 30.6 mm CL for females.

12.3.2.4 Commercial LPUE

Figure 12.3.1 shows total bottom trawl fishing effort and LPUE modified after the incorporation of the Ayamonte information from 2002. Directed effort estimates and LPUE series are shown in Figure 12.3.1 and Table 12.3.4.

The directed fishing effort trend is clearly increasing from 1994 to 2005, and after that the trend is declining. The maximum of the series was reached in 2005. In 2009, directed effort increased by more than 500 fishing days with respect to the previous year. LPUE obtained from the directed effort shows a gradual decrease from 1994 to 1998. After 1998, the trend slightly increases until 2003. In 2004, the LPUE decreases to the minimum value recorded. LPUE then increased until 2008, declining again in 2009. The incorporation of the Ayamonte data caused an increase of the directed LPUE in 2007 and 2008 (Figure 12.3.1). In 2009, the LPUE declined a 32% in relation to the previous year.

The overall LPUE trend is quite similar to the abundance survey index in the stratum of 200-700 m (Figure 12.3.5). 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 indicate the variability of survey data.

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. These inconsistencies are because during this period, the sampling of landings was not stratified by commercial categories and the resulting length frequencies showed a bias. Since 2006, a new sampling scheme was applied and the information is more reliable. Based on the DCR, the sampling scheme changed again in 2009, when concurrent sampling onboard was introduced.

As was done in 2008, the assessment this year is based on examination of LPUE, survey and the directed effort trends. The LPUE shows a general decreasing trend from 1994 to 2004 and has remained stable in last four years. The survey trend is stable since 1997, albeit with large variability. Directed effort shows a strong decrease since 2005. Hence, the state of stock appears to be stable at recent levels of fishing.

12.3.4 Biological reference points

There are no reference points 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 to 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. However, the Gulf of Cadiz is excluded from the effort related management.

An annual Fishing Plan started in 2004 and it is still in force. Currently, a Fishing Plan is being followed by the trawl fleet in Division IXa South, Gulf of Cádiz, (ORDEN APA/2801/2007, 27 of September, B.O.E nº 234), which is being applied from September 2007 to September 2009, and affects *Nephrops*. The plan restricts the daily fishing hours, establishes two days per week of no fishing and a single landing event per vessel per day. The reduction of the daily fishing hours per day has a direct effect on the reduction of *Nephrops* directed effort because the trawl fleet does not have enough time to access *Nephrops* fishing grounds which are located far away from the fishing port. Furthermore, the plan establishes a fishing closed season of 60 days, which took place last year between September 24th and November 22th. This new Fishing Plan increased the closed season by 15 days compared to the previous Fishing Plans (ORDEN APA/2883/2006, 19 of September, B.O.E. nº 225).

The effects of the closed season on *Nephrops* 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. A 20% and 15% decrease in directed effort were observed in 2006 and 2007, respectively. Preliminary fishing data of the year 2008, indicate a reduction of about 70% of fishing effort directed to *Nephrops*. In 2008, the landings of rose shrimp (*Parapenaeus longirostris*) have increased showing a change in the objetives of the fishery. Additionally, a reduction in the number of vessels was observed in last year due decommissioning. Bad weather conditions and fishermen strike during 2008 probably also had an influence in this reduction.

In February 2008, a new regulation was established by the regional administration with the aim of distributing the fishing effort (number of hours per day) throughout the year (Resolution 13th February, BOJA nº 40), and it was modified in 2009 (Resolution 26th Janaury, BOJA nº 36 and Resolution 23th November, BOJA nº 235). This regulation established a continued fishing time from 00:00 h on Monday to 21:00 h on Thursday during summer, which is the main *Nephrops* fishing period. This fact may have favoured that the fleets of ports nearest to *Nephrops* grounds as Ayamonte or Isla Cristina targeted the fishing effort to this species. This has been set up in order to improve the yields of the target demersal species, including *Nephrops*, without increasing the total fishing effort. In terms of the effort directed to *Nephrops*, the effect of these regulations has been an increase in the last year.

In order to further reduce the fishing effort, a new fishing closure period of 30 days (16 January – 15February) was established in 2009 (ORDEN ARM/401/2009, de 20 de Febrero, B.O.E nº 48). An increase of mesh size was establish since September of 2009 (Orden ARM/2515/2009) for the bottom trawl fleet, including a closed season of 60 days in autumn. In 2010, a new regulation increased the closed season 21 days (16-22 January and 1-14 February) (ARM/58/2010, 21th January).

Table 12.3.1 *Nephrops* FU 30, Gulf of Cádiz:
Landings in tonnes by Functional Unit

	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

Table 12.3.2. *Nephrops* FU 30, Gulf of Cadiz:
Mean carapace length of the discarded and retained fraction of *Nephrops*, and % of discarded (2005-2009) 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

Table 12.3.3 ***Nephrops*** **FU 30, Gulf of Cádiz:**
Abundance index from Spanish bottom trawl spring surveys (SP-GFS-cspr)

	Spanish bottom trawl spring surveys					
	200-500 meters		500-700 meters		200-700 meters	
Year	Kg/60'	Nb/60'	Kg/60'	Nb/60'	Kg/60'	Nb/60'
1993	0.77	19	1.16	34	0.95	26
1994	1.23	31	0.60	8	0.94	21
1995	0.55	8	**	**		
1996	0.56	10	1.33	29	0.93	19
1997	0.08	2	0.70	23	0.38	12
1998	0.40	16	0.23	7	0.30	11
1999	0.50	15	0.28	7	0.41	12
2000	0.22	7	0.57	15	0.37	10
2001	0.32	8	0.61	14	0.44	11
2002	0.49	17	0.45	11	0.47	14
2003	ns	ns	ns	ns	ns	ns
2004	0.15	5	0.15	4	0.15	5
2005	0.54	18	0.76	25	0.64	21
2006	0.24	6	0.66	20	0.42	12
2007	0.44	16	0.23	9	0.35	13
2008	0.88	26	0.81	14	0.85	20
2009	0.64	18	0.3	4	0.37	9
2010	0.63	20	**	**		

ns = no survey

**= no sampled

Table 12.3.4 ***Nephrops*** **FU 30, Gulf of Cádiz:**
Total landings and landings, LPUE and effort at the bottom trawl fleet making fishing trips with at least 10% *Nephrops* catches.

Year	Total landings (t)	*Landings (t)	*LPUE (kg/day)	*Effort (Fishing days)
1994	108	90	98,6	915
1995	131	107	99,4	1079
1996	49	40	88,2	458
1997	97	75	79,2	943
1998	85	51	62,3	811
1999	120	83	66,2	1259
2000	129	90	60,6	1484
2001	178	130	67,7	1924
2002	262	196	69,4	2827
2003	307	214	75,4	2840
2004	147	98	44,3	2206
2005	246	228	52,7	4336
2006	246	227	64,0	3555
2007	215	198	63,7	3105
2008	120	84	72,9	1150
2009	119	83	50,0	1653

*Landings, LPUE and fishing effort from fishing trips with at least 10% *Nephrops*.

** Ayamonte landings are included since 2002

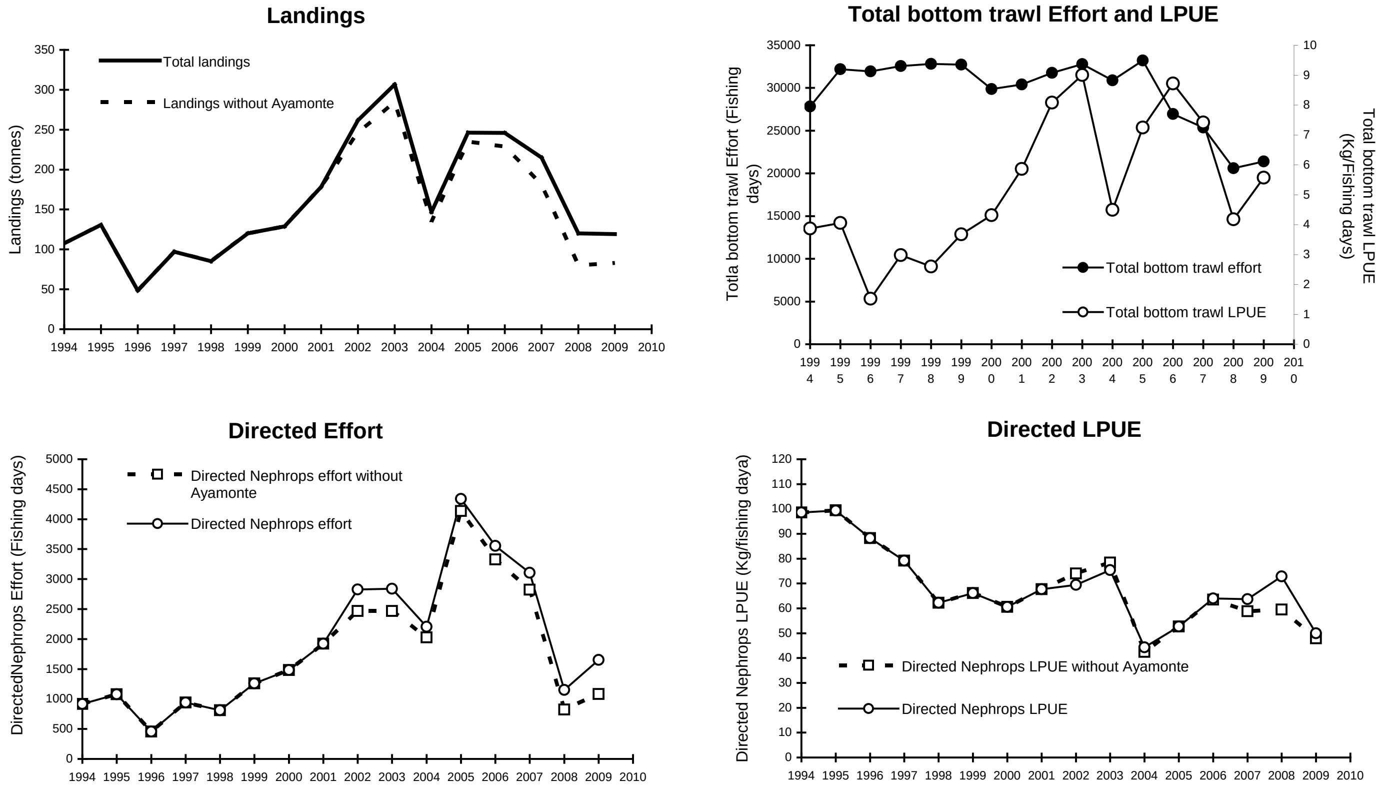


Figure 12.3.1. *Nephrops* FU 30, Gulf of Cadiz: Long-term trends in landings, effort and LPUE.

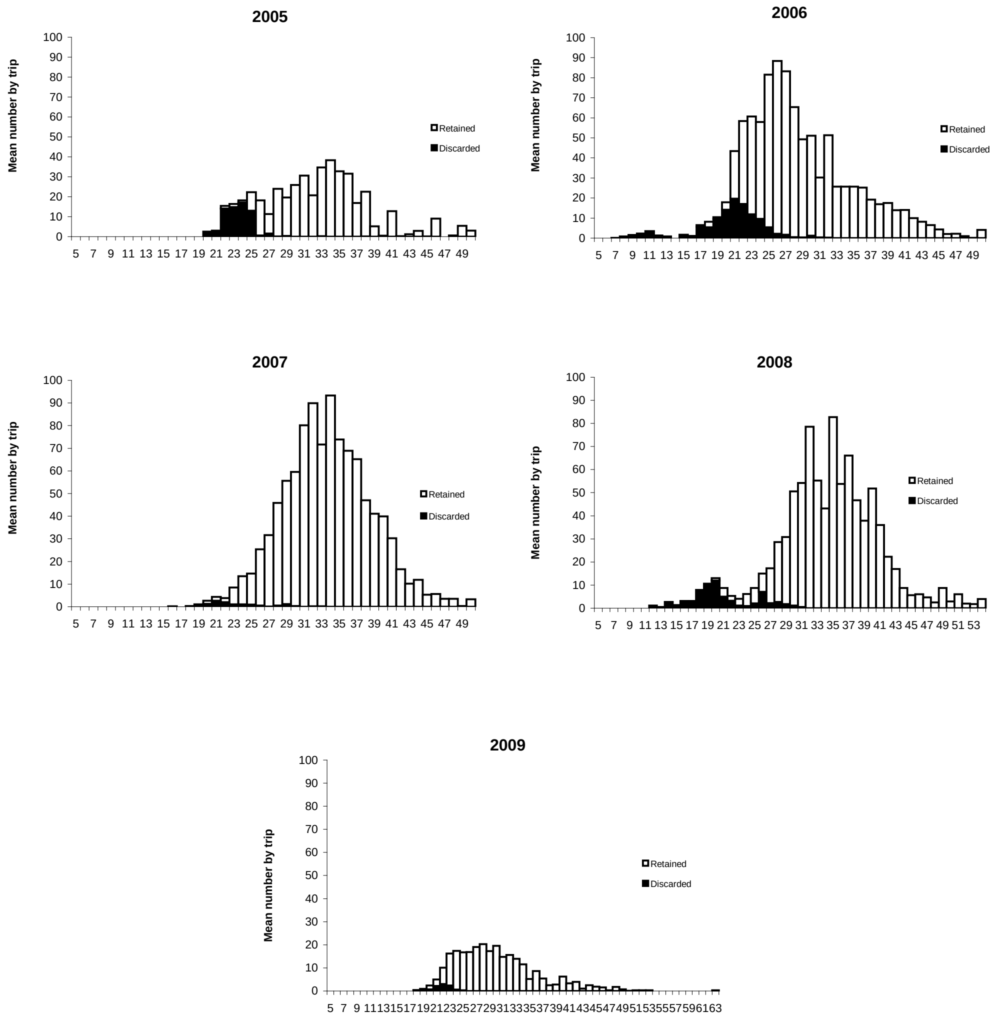


Figure 12.3.2. *Nephrops* FU 30, Gulf of Cadiz:
Length distribution of retained and discarded fractions Nephrops from discards program 2005-2009 period.

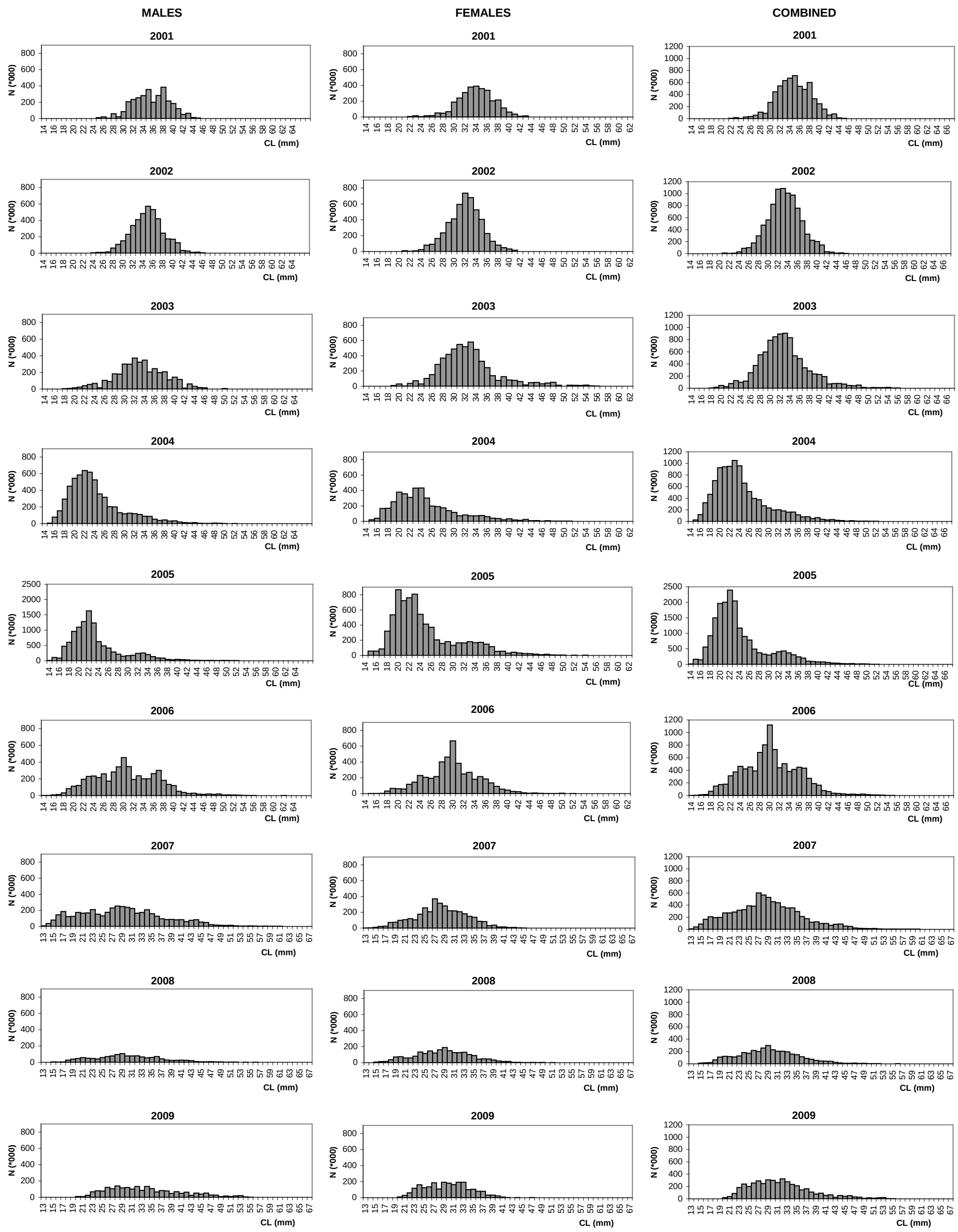


Figure 12.3.3. *Nephrops* FU 30, Gulf of Cadiz: Lenght distributions of landings from 2001 to 2009.

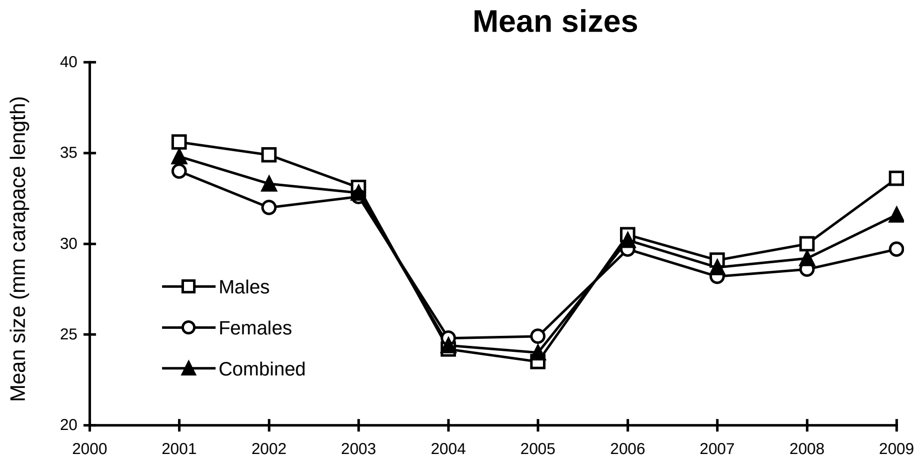


Figure 12.3.4. Nephrops FU 30, Gulf of Cadiz: Commercial mean size trend of males, females and combined for the period 2001-2009.

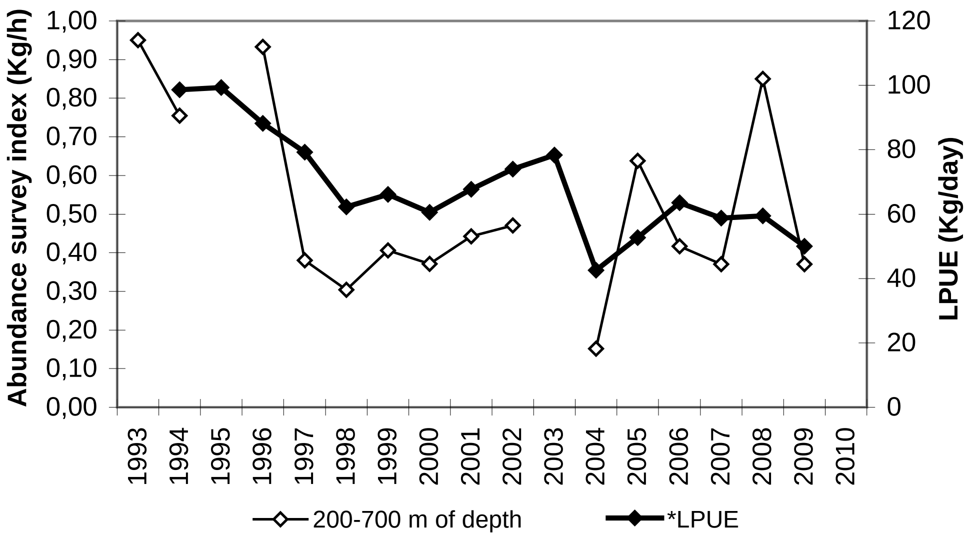


Figure 12.3.5 *Nephrops* in FU 30, Gulf of Cádiz:
Abundance index from Spanish bottom trawl spring surveys (SP-GFS-cspr) and commercial *LPUE from bottom trawl fleet.

* 1995 and 2010: strata 500-700 m no sampled

** 2003: no survey

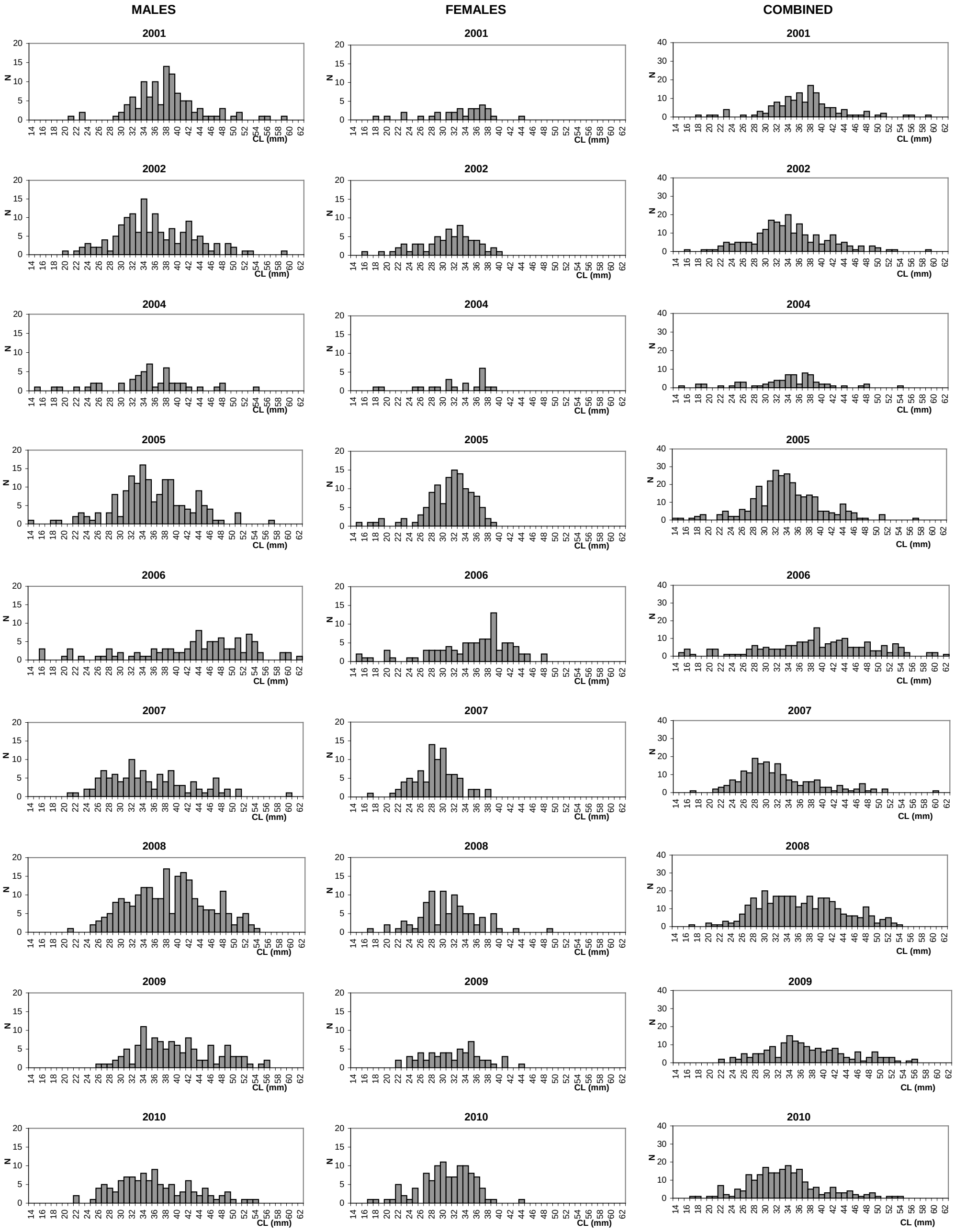


Figure 12.3.6. *Nephrops* FU 30, Gulf of Cadiz:
Spanish bottom trawl spring surveys (SP-GFS-cspr) length distributions from 2001 to 2010.

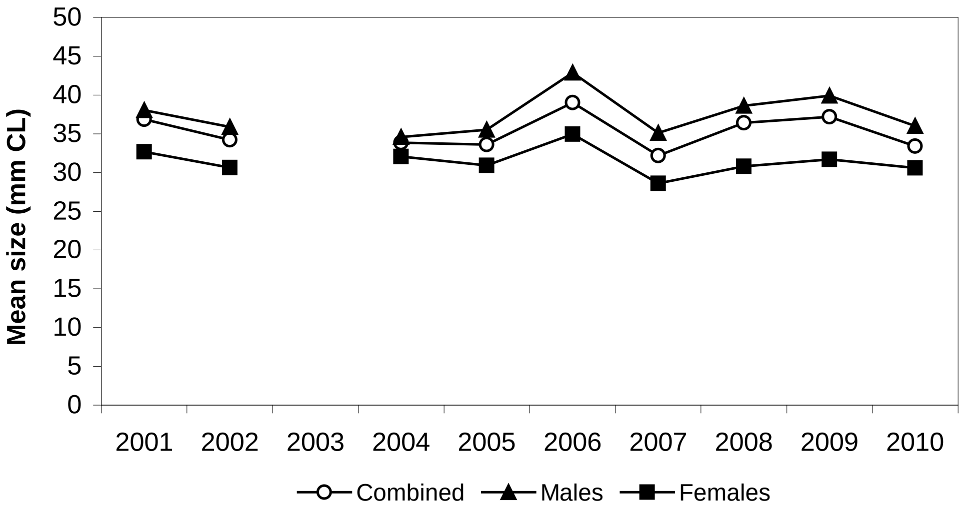


Figure 12.3.7. *Nephrops* FU 30, Gulf of Cadiz:
Mean size in spring botom trawl survey (SP-GFS-cspr) from 2001 to 2010.

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 and 2009, the landings were below the TAC (-12% and -29%, respectively, see Tables 12.1 and 12.2).

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 recent years. 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).

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, in peak of the fishing season (May-August) (Council Regulation (EC) No 2166/2005).

A Portuguese regulation (Portaria no. 43, 12th January 2006) closes the crustacean fishery in FUs 28-29 in January every year. Also, a closed season of 60 days was established in 2007 for the Gulf of Cadiz (FU 30) bottom trawl fleet by Spanish Administration (ORDEN APA/2801/2007, 27 of September, B.O.E nº 234) in order to reduce the fishing effort. This closure takes place between September and November and covers the period 2007-2009.

No evaluation of the impact of these closures on the *Nephrops* stocks in FUs 28–29 and FU 30 has been carried out.

In February 2008, a new regulation was established by the Spanish regional administration with the aim of distributing the fishing effort (nº hours per day) throughout the year in the Gulf of Cadiz (Resolution 13th February, BOJA nº 40). This has been set up in order to improve the yields of the target demersal species, including *Nephrops*, without increasing total fishing effort.

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Annex A - List of participants

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5 – 11 May 2010

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Annex B Working documents presented to the WGHMM meeting

WD 1

C. Piñeiro, M. Saínza, Ana Leal, Antonio Gómez and Cristina Gonzalez. 2010. An Attempt of age estimation based on fast growth model hypothesis for European Hake: preliminary results.

This document presents the preliminary results of an age estimation study of hake otoliths from 2006 (N:1071), based on the fast growth hypothesis and the comparative analysis of this age estimation exercise with those obtained previously in 2006 for annual ALK (WGHMM,ICES C.M. 2007/ACFM:21) using the slow growth model. Furthermore, the supervised exercise 2 undertaken at WKAEH 2009 by the same reader was used to intercalibrate the size of the rings considered for first three ages. The main goal is to produce a new age interpretation criteria following the guidelines for hake age estimation developed at the above mentioned workshop. According to the recommendations of the WKAEH, we consider very interesting that other assessment readers participate in a future calibration exercise using the new software available in the WebGR website (http://webgr.azti.es) that could lead to standardization of methodologies for age estimation of hake based on fast growth hypothesis. The data thus generated could be used to investigate the possibilities of providing a transition matrix from the old to the new ALKs. However, the complexity of age estimation of European hake still remains and further research is needed to develop a new ageing criteria based on tagging and recapture material.

WD 2

Biais G., Lissardy M. & Leroy A.: The effect of a change in age reading method for the French age length key of the Bay of Biscay sole

Since the beginning of the catch and weight at age time series used for the Bay of Biscay sole assessments, the ages in the French landings have been determined by reading otoliths which have been burnt and manually cut. From 2005 onwards, the ages in French landings are also determined by reading the age of sampled fishes on thin slices obtained by sectionning the second otholith of this fishes. A second catch and weight at age time series can thus be used to carry out an assessment. A comparison of this assessment with the 2009 WGHMM assessment shows only limited differences in the outputs. Consequently the adoption of the data time series resulting from the change in French age reading method is proposed for the assessment carried out in 2010 by the WGHMM. This change makes easier the comparison between French and Belgian age readings and thus should help in reducing the discrepancy observed between French and Belgian weight at age series.

WD 3

Ana Cláudia Fernandes, Ernesto Jardim, Graça Pestana. 2010. Discards estimates of hake (Merluccius merluccius) for Portuguese.

This document presents Portuguese discards estimates for hake in 2009. Data used in the estimation comes from onboard sampling programme for crustacean (OTB_CRU) and fish (OTB_DEF) trawl fleets. The information of effort in hours and in days for both fleets is also used in the discards estimation and was provided by Portuguese Administration (DGPA). The procedure used to raise discards was the one presented by Fernandes et al. (2010). A recalculation of discards estimates for 2004-2008 periods presented in Fernandes et al. (2010) was also performed for this document because there was a problem with effort data provided at that time.

WD 4

Corina Chaves, Fátima Cardador and Ernesto Jardim. 2010. Changes in the spatial distribution and abundance of Hake in Portuguese continental waters (ICES, Div. IXa) in 1985-2009 Portuguese groundfish surveys.

This working document aimed at analyzing trends in the abundance and geographical distribution of the biomass indices of hake during 1985-2009. Data used in this work refer to Portuguese autumn surveys performed in 1985-2009 and are presented as biomass indices computed for juveniles (<20 cm) and adults (>= 20 cm) and its geographical distribution and the ratio of biomass index of juveniles and adults (weight of juveniles per one kg of adults). Similar trends were estimated both for juveniles and adults with two tendencies: one during 1985-2005 when the biomass index fluctuated around the series average and another with an increase in the last years (2006 onwards). The ratio juveniles/adults shows an overall mean similar in the North and Southwest zones (around 0.15) but presented very high values in 2005 and 2009 in the North zone (0.48 and 0.38). Changes in distribution are mostly affected by biomass, e.g, when biomass was higher the distribution was wider. Since 2007, the adult hake distribution has spread through the entire Portuguese waters and expanding to the Northern, while juveniles started to have a wider distribution since 2004.

WD 5

Cristina Silva. 2010. Portuguese deepwater crustacean trawl fishery: the estimation of a target CPUE in a multi-specific fishery

There are two main target species in the Portuguese crustacean trawl fishery, which are the deepwater rose shrimp (Parapenaeus longirostris) and the Norway lobster (Nephrops norvegicus). These two species have a different but overlapping depth distribution. Rose shrimp occurs from 100 to 350 meters of depth whereas Norway lobster is distributed from 200 to 800 meters. 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 *Nephrops*, having a higher revenue with lower production costs.

In the last two working groups, a trial to standardize the CPUE was carried out using GLMs, 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, two new variables were incorporated: the daily catches of this species and its proportion in relation to *Nephrops*.

WD 6

Santurtún M., Landa J., Iriondo A., Quincoces I. & Garcia D., 2010: brief note on biological parameter used in northern megrim assessment. Is there any need of review? A comparison between age length key for the northern stock of megrim for 2007, 2008 & 2009 & consideration of the maturity ogive being currently used.

During the PGCCDBS (Planning Group on Collection of Catch and Discard Biological Sampling) 2009 meeting concluded under ToR F: 1.9.7 PGCCDBS recommends a small-scale otolith exchange for megrim (*Lepidorhombus whiffiagonis*) in 2011. In that sense PGCCDBS wanted to know the "WGHMM opinion" as to the desirability/need/urgency for Otolith Workshop at soonest in 2011 and the need of the maturity key revision. The importance of ALKs is based on the use of these combined ALKs to be applied for certain years, to the length distributions for those countries not providing megrim otolith readings or numbers at age. For comparison, semestral and annual ALKs from Spain and United Kingdom from the last 3 years (2007 – 2009) were used. Proportions of lengths by age were compared between comparable ages and countries. Also mean length by age was analysed.. In general terms, UK asigns larger proportion of bigger individuals by age than Spain. This, results in the mean length at all ages obtained by UK are consistently higher than Spanish ones. Reasons for this could be the different precedence of the samples between both countries with different growth patters or real differences in the ageing criteria. To clarify the cause, the Group firmly supports the Otolith Exchange and Workshop foreseen.

WD 7

Roa-Ureta R. & Quincoces I. 2010. A preliminary assessment of monkfish (Lophius piscatorius) in ICES divisions VIIb-k and VIIIa,b,d

A production model of Graham-Schaefer form was coded in AD Model Builder and fit to data of monkfish, updated to 2008. The process model consisted of the non-equilibrium difference formulation with initial biomass fixed at various levels in relation to equilibrium biomass, K. The observations consisted of two scientific survey series (FR-EVHOE and SP-PGFS) of 8 years long each. The FR-EVHOE series yielded a signal of juveniles so to fit the model to contemporaneous biomass and catch a two-year lag was set for this index. Each index at each annual value provided its estimate and it estimation standard error and with these a marginal likelihood model was set for the observation process. The 16 indices were considered as independent so the total likelihood was the unweighted product of the 16 indices probabilities assumed normally distributed. The catch series was suspected to be censored due to regulations introduced in 2005 that banned the landings of fish less than 500 gr. Thus a model was built to predict the catch of fish less than 500 g from 2005 to 2008. The corrected catch series was used to fit the production model. Results of this preliminary setup of the production model considering the initial biomass that maximized the loglikelihood of the data shows that the stock has an equilibrium biomass at around 113 thousand tonnes, with a intrinsic rate of growth close to 3 per year. Surveys catchabilities were estimated at 1.8e-5 for FR-EVHOE and 8.8e-5 for SP-PGFS. Generally standard errors of the estimates were relatively low. Further development of the model would consider three aspects. First, to update the catch information to 2009; second, the include series of commercial indices of abundance; and third, to let initial biomass be a free parameter in the model.

WD 8

Jardim E., 2010: Historical (1938-1957) landings of hake of the Portuguese trawl fleet.

Historical data about landings and effort of the trawl fleet operating in the continental shelf of Portugal between 1938 and 1957 were compiled from the Portuguese Navy fishery statistics. The data refers to monthly catches of Hake in three distinct length groups, small (pescadinha), medium (pescada) and large (marmota) caught by vessels of less than 150 TaB or above 150 TaB. For these vessel groups it was compiled the number of vessels and several measures of effort, number of hours fishing, number of days at sea, number of hauls and number of trips. Based on the information available the CPUE was computed. All information was plotted and a lowess smoother was adjusted to better visualise the trends. Some interesting information can be extracted, in particular with the effect of the second world war, it can be seen how the fishery evolved showing a high peak in late fourties and a decrease in the late fifties. CPUE shows a decrease in the fourties with an incerase in the fifties. Conclusions about CPUE and it's link to abundance will have to be further explored as the catchability is likely to have increased very much in this period, as well as the composition of the fleet regarding the ratio between steam vessels and internal combustion powered vessels.

WD 9

Walmsley, S., Forster, R., & Armstrong , S. 2010. Western Anglerfish 2003-2009. Fisheries Science Partnership Programme Report:

This report presents the results of the FSP survey carried out on the anglerfish fishing grounds off the SW coast of England during September and October 2009. Indices of *L. piscatorius* and *L. budegassa* abundance and biomass were calculated. The indices indicated that *L. piscatorius* abundance increased slightly in 2009 and that biomass has remained relatively stable. In contrast, *L. budegassa* abundance and biomass have both increased since 2005. As with 2008, strong incoming year classes were observed in 2009 for both species. Data also show a shift in the numbers of stations in which *L. budegassa* were observed. At the start of the time series, *L. budegassa* were absent from majority of stations and if the species was present, only 1-5 fish were observed. In 2009, *L. budegassa* were observed in almost all stations and for some stations, more than 20 fish were present. This shift in distribution may have affected the indices of abundance and biomass for this species in 2009.

WD 10

Quincoces, I. & Mahè J.C. 2010. Update of Northern Anglerfish assessment.

The updated data of both anglerfishes is presented in the present working document. The only available data from 2009 are in case of fisheries CPUEs from England and Basque Country (Spain) and the landings from countries that historically landed less than the 50% of the total landings. From surveys data a new strong recruitment is detected for L. piscatorius in almost all surveys and for L. budegassa contradictory recruitment signals between French EVHOE and English FSP has been recorded.

WD 11:

Gerritsen H. 2010. Are age-length-keys appropriate for estimating numbers-at-age of megrim?

(Introduction, no abstract provided)

Megrim have a relatively broad age distribution (fish up to 11 years are regularly encountered in the catches) and each age class tends to have a broad size distribution (many age classes span 30cm or more). This has led to concern about the use of Age-Length-Keys (ALKs) to estimate the age distribution because a fish at a given length can be any of a large number of ages. For example, a 30cm fish could be aged 2, 3, 4,5, 6 or 7.

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:	15 February 2010
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.

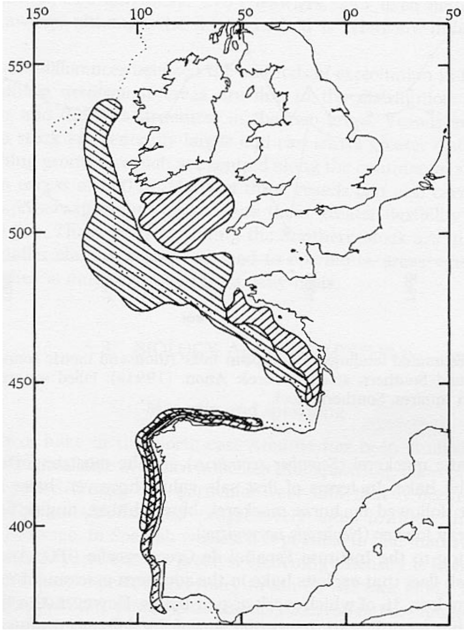

Figure 1. Main spawning and nursery areas. Spawning areas sloping downwards from left to right; Nursery areas sloping downwards from right to left. (from Casey and Pereiro, 1995)

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 + SUBAREA 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).

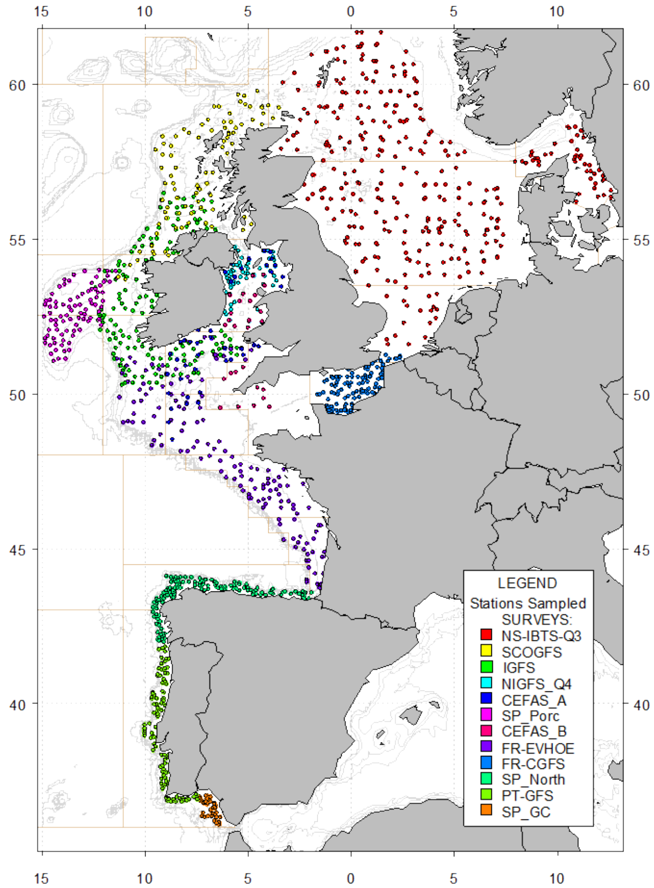

Figure 2. Map of East Atlantic groundfish surveys: stratification and trawling positions.

Abundance indices are available from the following research-vessel surveys:

Abundance indices used in the SS3 assessment:

French Evhoe groundfish survey (EVHOE): 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 (SP-PGFS): 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): 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 tri-cubic 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 SP-PGFS 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.

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	1990–2008 (LFD + Weight)	1994, 1999, 2000, 2003–2008 (LFD + Weight)
FRNEP8	French trawl targeting *Nephrops* in VIII	09	1990–2008 (LFD + Weight)	2003–2008 (LFD + Weight)
SPTRAWL8	Spanish trawl in VIII	14	1990–2008 (LFD + Weight)	2005–2008 (LFD + Weight)
TRAWLOTH	All other trawl	05 + 06 + 08 + 10	1990–2008 (LFD + Weight)	
GILLNET	Gillnet all countries	03 + 13	1990–2008 (LFD + Weight)	
LONGLINE	Longline all countries	01 + 02 + 12	1990–2008 (LFD + Weight)	
OTHERS	Everything else all countries	15 + 16 + 00	1990–2008 (LFD + Weight)	

*** 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	Bay of Biscay and Celtic Sea	1997–2008	4
RESSGASC	Bay of Biscay	1990–1997 1998–2001	1, 2 ,3 and 4 2 and 4
SP-PGFS	Porcupine Bank	2001–2008	3
IGFS	North, West and South of Ireland	2003–2008	4

No commercial fleet tuning data are used.

SS3 settings (input data and control files):

Years: 1990 to 2008, 1 area, 4 seasons, both sexes combined

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. Surveys' CV were increased by 0.1 (EVHOE), 0.2 (RESSGASC, IGFS), 0.3 (SP-PGFS).

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:

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:

Landings and discards: 0.5 for all fleets, except LONGLINE to which a factor of 1 was applied

Surveys: 1 (EVHOE), 0.525 (RESSGASC, IGFS), 0.35 (SP-PGFS)

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=0.7, 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.

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.

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 weightsat-length: Same length–weight relationship as in the assessment model
- Maturity: Fixed maturity ogive as used in assessment

G. Biological reference points

In 2003, ACFM updated precautionary reference points following a revision of the assessment model and input data in recent years. These values all should be re-evaluated based on results from WKROUND 2010.

	WG 1998	ACFM 1998	ACFM 2003
Flim	No proposal	0.28 (= Floss WG 98)	0.35 (= Floss WG 03)
Fpa	No proposal	0.20 (= Flim*e-1.645*0.2)	0.25 (= Flim*e-1.645*0.2)
Blim	No proposal	120 000 t (~ Bloss= B94)	100 000 t (~ Bloss= B94)
Bpa	119 000 t (=Bloss= B94)	165 000 t (= Blim*e1.645*0.2)	140 000 t (= Blim*e1.645*0.2)

H. Other issues

None.

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Annex D: Anglerfish in Divisions VIIb-k and VIIIa,b,d

Quality Handbook **ANNEX: D - Anglerfish**

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:	6 May 2009
Revised by	Jean-Claude Mahé

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 - 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 90's 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 North Eastern 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 2000’s 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 data series 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 2008 length compositions, by fishery unit for L. piscatorius and L. budegassa, in Divisions VIIb-k and in VIIIa,b,d.

ICES Division	Fishery unit	Country		2008
VIIb-k	FU 3 Fixed nets	FR	Q	FR.03.08
		EW	Y	total International length distribution species ratio available
	FU 4 Medium and deep waters non-Nephrops	IR	Q	IR.04.08
		FR	Q	FR.04.08
		SP	Q	SP.04.08
		EW	Q	total International LD
	FU 5 gadoid fleets	EW	Q	EW.05.08
		FR	Q	FR.05.08
	FU 6 beam-trawl	BEL	Q	total International LD
		EW	Q	EW.06.08
	FU 8 Nephrops	FR	Q	FR.08.08
VIIIa,b	FU 9 Nephrops	FR	Q	FR.09.08
	FU 10 artisanal bottom trawl	FR	Q	FR.10.08
	FU 14 medium and deep waters non Nephrops	FR	Q	FR.14.08
		SP	Q	SP.14.08

No discards assumed

Discards: preliminary information is available but not used due to uncertainties in adequacy of raising methodologies used.

B.2. Biological

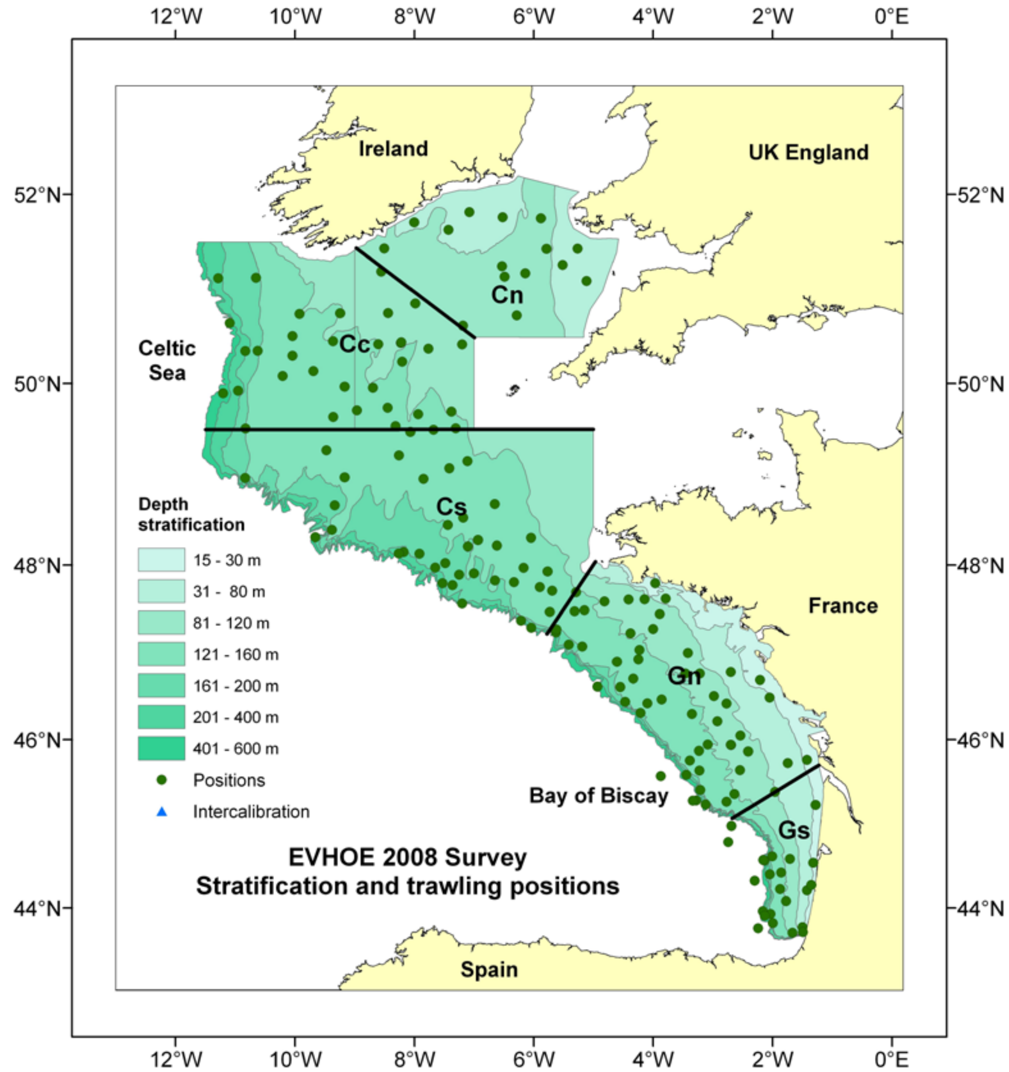
In 2007, WGHMM rejected the XSA age based assessments of both species because of data quality (increased discards not incorporated) and ageing problems clearly identified. Therefore there is no age based data used to assess the stocks. Only length distributions of landings and survey indices are used.

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

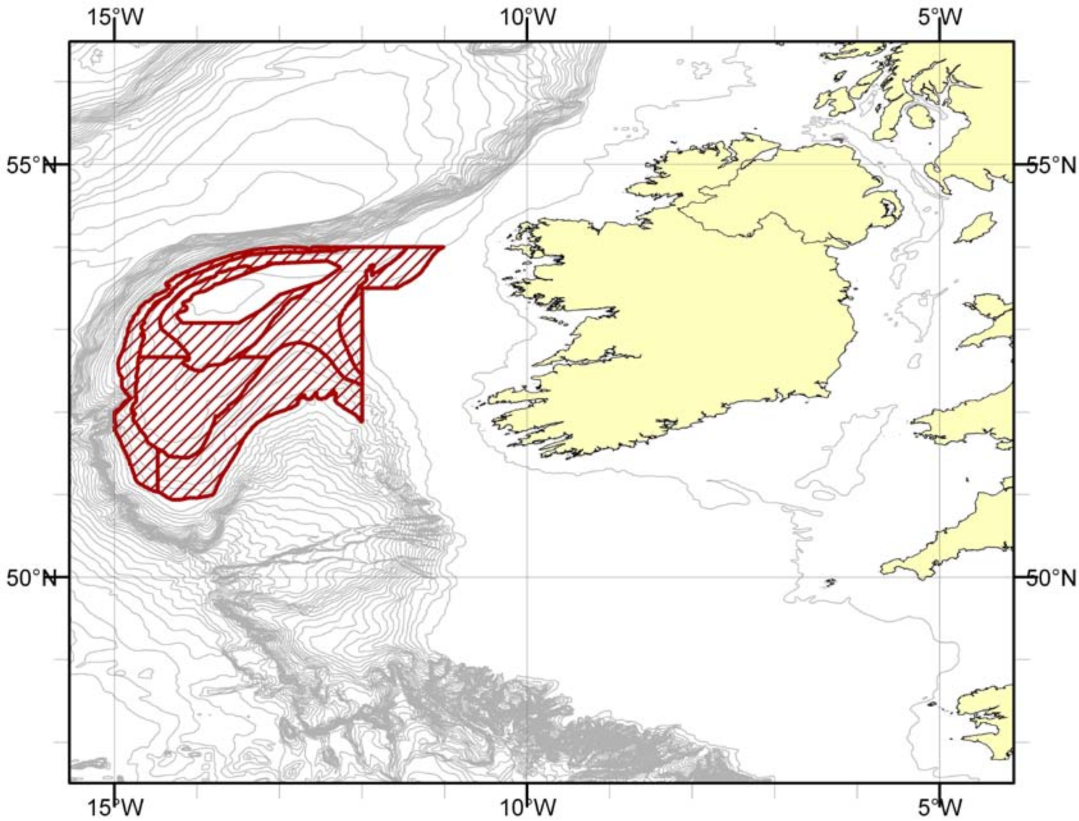
This survey covers the largest proportion of the area of stock distribution. It started in 1997.



Map of Survey Stations completed by the EVHOE Survey in 2008.

The Spanish Porcupine Groundfish Survey (SP-PGFS)

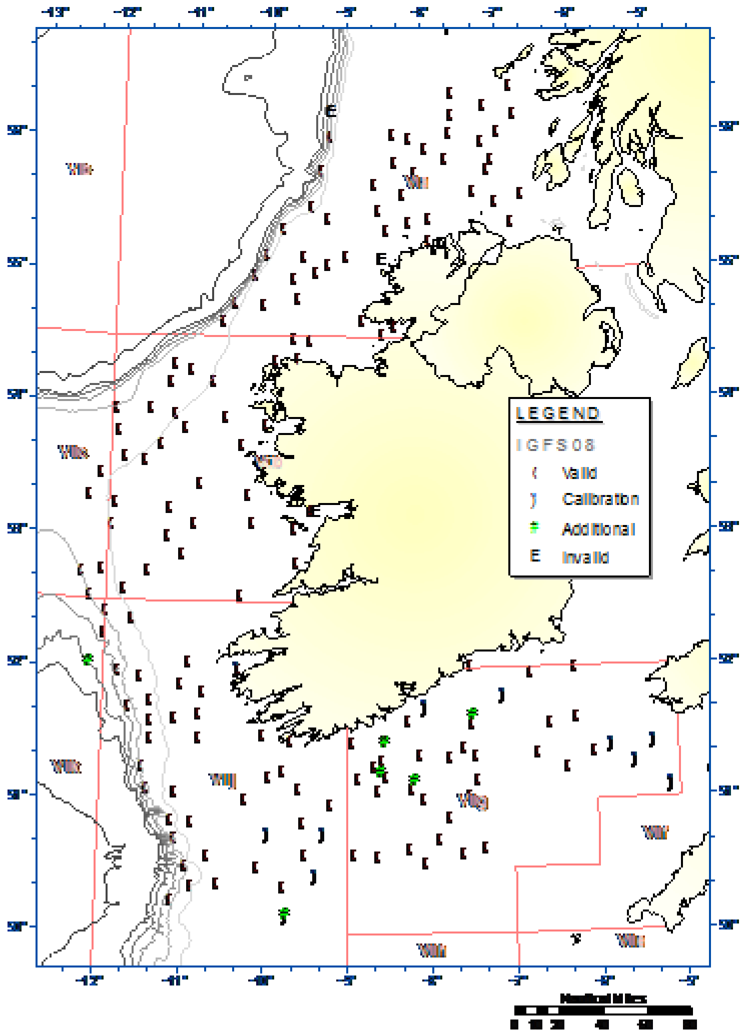
This survey was initiated in 2001 and covers the Porcupine Bank.



Map of area covered by the Porcupine Groundfish Survey.

The Irish Groundfish Survey (IR-IGFS)

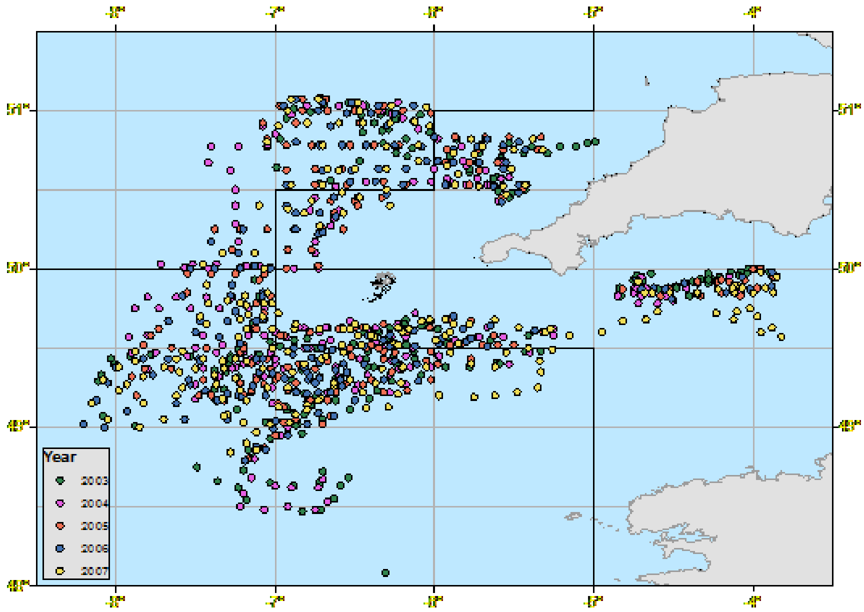
This survey was initiated in 2003 and covers areas around Ireland.



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 covers Areas VIIe and VIIf and started in 2003.



Map of Survey Stations completed by the EW-FSP Survey in 2003 - 2007.

A full description of the survey can be found in Section 1.4 of the WGHMM2008 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. Historical Stock Development

In 2007, the Working Group found that the input data showed deficiencies especially as discards were known to be increasing and that ageing problem had become more obvious, consequently the WG rejected an analytical assessment. The assessments of the two species (WG 2009) are based on the analysis of LPUEs, surveys indices and length distributions.

Indicators point to the stocks being stable.

D. Short-Term Projection: NOT USED

E. Medium-Term Projections: NOT USED

F. Long-Term Projections: NOT USED

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

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 for 2009.

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

Quality Handbook **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 Me grim from the Southern Waters)
Date:	30 April 2009 (Reviewed 11 May 2010)
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 by-catch.

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	Fisheries
Spain	Divisions VIIb,c,e–k and VIIIa,b,d	52%	Otter trawls targeting mixed groups of species (hake, anglerfish, *Nephrops* and other). Netters targeting also mixed species (anglerfish, hake and megrim)
France	Subarea VII	21 %	Benthic trawlers targeting benthic and demersal species
Ireland	Divisions VIIb,c,g	13%	Multipurpose vessels targeting gadoids, plaice, sole and anglerfish
UK	ICES Divisions VIIe,f,g,h	12%	Beam trawlers
Belgium	Divisions VIIb,c,e–k and VIIIa,b,d	1%	Beam 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 Faeroe Islands to Mauritania (from 70ºN to 26ºN) 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 Faeroe Islands (63ºN) 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 north-east 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 (BIOS-DEF, 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 food web 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, sand eels, 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 & 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 on 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 is explained and incorporated into the historical data series 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 co-operation 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 Sub-areas VI and VII was firstly target. During 1994, discard sampling was undertaken for other fleets (long liner (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.

Some preliminary discards estimates from Ireland and United Kingdom were available to the group at the fleet and sampling level, respectively.

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)	-	-
1996	(FR91)	(SP94)	-	-
1997	(FR91)	(SP94)	-	-
1998	(FR91)	(SP94)	-	-
1999	-	**SP99**	-	-
2000	-	**SP00**	-	-
2001	-	**SP01**	-	-
2002	-	(SP01)	-	-
2003	-	**SP03**	**IR***	***UK****
2004	-	**SP04**	**IR***	-
2005	-	**SP05**	**IR***	-
2006	-	**SP06**	**IR***	***UK****
2007	-	**SP07**	**IR***	***UK****
2008	-	**SP08**	**IR***	***UK****
2009	-	**SP09**	**IR***	***UK****

- In bold: years where discards sampling programs provided information

- In bold and * (italics): years where discards sampling programs provided information, just at sampling level, but are not used in the derivation

- In bold and *: years where discards sampling programs provided information but are not used in the derivation

- 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 was provided to the group.

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. 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
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	NA	NA	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 (FR-EVHOES) results for the period 1997–2009 are available.

An abundance index was provided for the Spanish Porcupine Ground Fish Survey from 2001 to 2009. 2009 data has been incorporated in this update assessment.

Irish Ground Fish Survey is also from 2003 to 2009.

Surveys available for the assessment:

Type	Name	Year range	Age range
UK Survey Deep Water	UK-WCGFS-D	1987-2004	1-10+
UK Survey Shallow Water	UK-WCGFS-S	1987-2004	1-10+
French EVHOE Survey	FR – EVHOES	1997-2009	1-9
Spanish Porcupine Ground Fish Survey	SP-PGFS	2001-2009	0-10+
Irish Ground Fish Survey	IR-GFS	2003-2009	0-10+

Surveys used in the update assessment:

Type	Name	Year range	Age range
French EVHOE Survey	FR – EVHOES	1997-2009	1-9
Spanish Porcupine Ground Fish Survey	SP-PGFS	2001-2009	0-10+
Irish Ground Fish Survey	IR-GFS	2003-2009	0-10+

It must be noted that area covered by the three surveys does not overlap, just the northern component of FR-EVHOES and the southern coverage of IR-GFS. (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. No update for the French LPUEs series has been provided to the group. Data for the Irish fleet (IR-7-OT) from 1995 to 2005 is not presented as it was removed in 2007 because of LPUE patterns in different areas and major changes in the fleet structure over time.

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 detect possible recruitment processes that are not completely registered in the catch at age matrix and LPUE.

C. Historical Stock Development

Starting from 2007, no analytical assessment has been carried out. Assessment is based on discard data (Spanish data series and "preliminary" discard data from UK, and IR), catch at age data, survey indices and commercial CPUEs and LPUEs data series 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

D. Short-term projection (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.

E. Medium-Term Projections: NOT USED

F. Long-Term Projections (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 3 years of assessment (to reflect recent selection patterns).

Procedures used for splitting projected catches: Catches are not split

G. Biological Reference Points

	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:

$\mathbf{B_{lim}}$ = Not defined.	$\mathbf{B_{pa}} = \mathbf{B_{loss}}$. There is no evidence of reduced recruitment at the lowest biomass observed and $\mathbf{B_{pa}}$ was therefore set equal to the lowest observed SSB.
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$.	$\mathbf{F_{pa}} = \mathbf{F_{med}}$; this implies a less than 45% probability that ($SSB_{MT} < \mathbf{B_{pa}}$).

H. Other Issues

Starting from 2007, no analytical assessment has been conducted. A benchmark workshop on this stock is planned for first quarter of 2011.

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, little 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 is 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 is still not available. UK "preliminary" unraised data was 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 data series 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 yeas 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 data series have been provided for the assessment. Only sampling data from United Kingdom were available.
- Commercial tuning data for four French fleets have not been 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 success benchmark planned in the 1st quarter of 2010.

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Annex F: Bay of Biscay Sole

Quality Handbook Stock Annex: Sole in Division VIIIab

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Sole (Division VIIIab)
Working Group:	Assessment of Hake, Monk and Megrim Stocks
Date:	July 2004 (G. Biais)
Last updated:	May 2010 (G. Biais and 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 Britanny.

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).

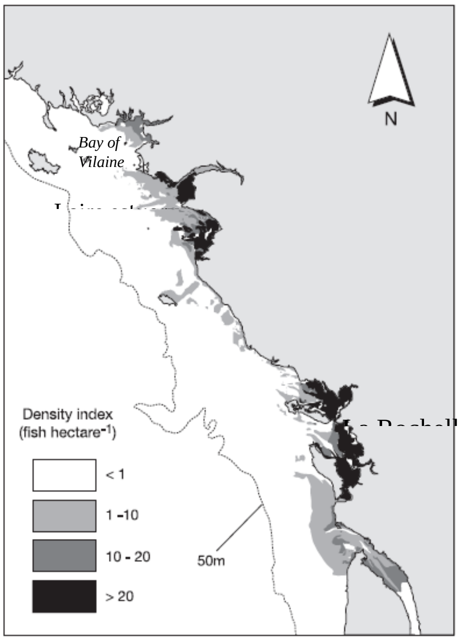


Figure 1 : Fitted 0-group sole density (number of fish per hectare) in the Bay of Biscay (Le Pape et *al.*, 2003a).

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. On the opposite, the otter trawl effort shows a decreasing trend until 1999 but it is stable since then.

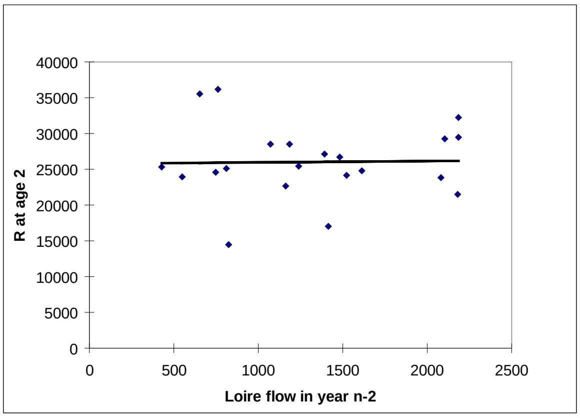
Catches have increased continuously since the beginning of the 1980s, until a maximum was reached in 1994 (7 400 t). They have decreased afterwards to 3600-4800t in 2003-2009, the last year is the lower.

A.3 Ecosystem aspects

The quality and the extend 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 of the French offshore trawlers

Discards estimates are available for the French offshore trawlers from 1984 to 2003. They were provided by the French trawl surveys FR-RESSGASC-S from 1984 to 2002. This surveys were carried out each quarter until 1997, but only in the second and last quarter since 1998. Consequently, discards in the first and third quarter have been estimated using respectively the last quarter survey of the preceding year and the second quarter survey from 1998 onwards.

In 2002, this survey was discontinued because the discards estimates that it provides were estimated to depend on some questionable assumptions (see below). They are no longer used in the assessment since 2005.

In 2004 assessment, commercial trawler sample trips were used to estimate 2003 discards, doing the same assumptions and using the same estimation method than previously for the FR-RESSGASC-S estimates.

Discards estimates when using RESSGASC surveys (Gwen Drez R/S using 55mm Vendéen trawl)

Assumptions :

Between length T1 and T2, defined for being :

- T1 = Length above which discards are assumed to be low
- T2 = Length above which catch are low

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)

If so, RESSGASC length distribution is representative of total catch distribution between T1 and T2, and

discard estimate = (RGL . OTT/RGT) – OTL

with

RGL = Catch number at length L during a RESGASC survey

RGT = Total catch number from T1 = 21 cm to T2 = 35 cm during a RESSGASC survey

OTL = Total catch number at length L of the offshore trawlers in the quarter (or the half-year since 1998) of the survey

OTT = Total catch number from T1 = 21 cm to T2 = 35 cm of the offshore trawlers in the quarter (or the half-year since 1998) of the survey

OTT/RGT = proportionality factor between offshore trawler fleet catch and RESSGASC catch in number

(Guichet R. et *al.*, 1998.)

Discards estimate when using catch sampling at sea on offshore trawlers in 2003

Assumptions 1) is still valid if the trawls used during the sampled trips are the same than in the fleet (probably more likely than for the RESSGASC survey in recent years)

Assumptions 2) is valid if trawl hauls were sampled in the main fishing areas and if there is only a small effect of fishing area on the length composition of the offshore trawlers fleet (likely in offshore waters)

Note : if T1 chosen to be lower than the size at which discards are negligible, the discards are underestimated.

Demonstration :

K = OTT/RGT for T1 < T1′ with T1′ true length above which discard are negligible

RGT = RGT′′ + RGT′

With RGT′′= Total catch number from T1 to T1′ during a RESSGASC survey

RGT′ = Total catch number from T1′ to T2 during a RESSGASC survey

OTT = OTT′′ + OTT′

With OTT′′ = Total catch number from T1 to T1′ of the offshore trawler fleet

OTT′ = Total catch number from T1′ to T2 of the offshore trawler fleet

K′ = OTT′/RGT′ "true" proportionality factor

Then

OTT′ = K′ . RGT′

Furthermore, if D are the discards between T1 and T1′

Then D = RGT′′. K′ - OTT′′

And OTT′′ = RGT′′. K′ - D

K = OTT/RGT

K . RGT = OTT′′ + OTT′ = (K′ . RGT′′ – D) + K′ . RGT′ = K′ . (RGT′′ + RGT′) – D

K . RGT = K′. RGT -D

K′ = K + (D/ RGT)

Then K′>K and discards are underestimated when using K

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 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) provides 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.

French offshore trawlers discards are estimated to have represented about 1 to 3 % of the total catches in recent years (1991-2003) and less than 0.5% since in 2002 and 2003. Given their low contribution to the total catch and the questionable assumptions on which they are based, their monitoring was not continued in 2004 and they have been no longer used in the assessment, as recommended by ACFM, since 2005. Available discards estimates for a limited number of trips shows that discards of beam trawlers and gillnetters are also generally low. They can be occasionally high in the inshore trawlers fleet. However, this fleet only account for 12% of the total French landing and therefore discards estimates are not considered to be a priority for this stock given their likely low contribution to the total catch.

B.2 Biological

Weights at Age

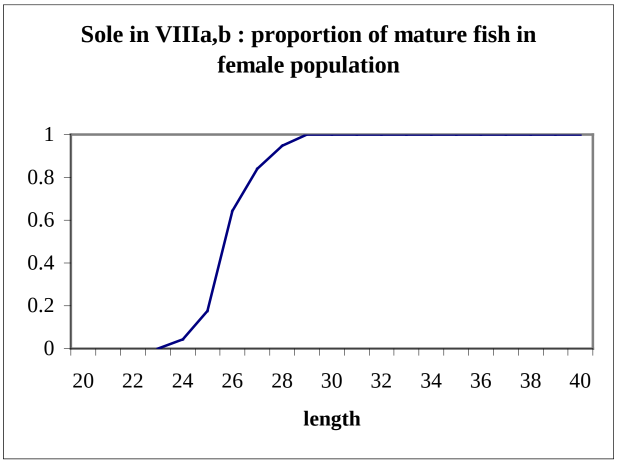
French mean weights at age are estimated using quarterly length-weight relationships in which weight are gutted weight multiplicated by the fresh/gutted transformation coefficient of French landing. This latter was changed from 1.11 to 1.04 in 2007. The French mean weights at age in catches are consequently 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 survey series are available but it worth noting that these surveys were carried out to provide hake discard estimates and consequently not well designed for providing 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.

Consequently, the abundance indices provided by these surveys are closed of commercial CPUE with the advantage to guarantee that no change occurred in fishing gear but the disadvantage to provide a CPUE based on a limited number of hours.

Because the change from a quarterly to an half yearly planning of this survey in 1998, the annual FR-RESSGASC-S CPUE series was turn to four quarterly ones at the 2001 WG. An attempt to use the series in the first and the third quarters (which end in 1997) was made, but the quality was too poor to retain them at following WG. Therefore, only the second and fourth quarters series have been used in the tuning process since 2002.

B.4 Commercial CPUE

Four series of commercial fishing effort data and LPUE indices are available : La Rochelle offshore trawlers (FR-ROCHEL), Les Sables d'Olonne offshore trawlers (FR-SABLES), trawlers landing sole in other harbours than La Rochelle and Les Sables

(FR-OTHER) and a Belgian beam trawlers series, this two latter being presented for the first time respectively at the 2005 WG and at the 2004 WG.

The effort of the French commercial fleets was revised in 2002. Some corrections were made when the data base was checked to be stored in a new data management system (mean difference over years 3%, maximum 12%). The unit of effort was changed from hours corrected for horse power (H x 100 kW) to hours because this correction was considered introducing more noise, because of the quality of its measurement, than any improvement in this rather homogeneous fleet.

French commercial LPUE in the tuning files came from the fraction of catches for which gear and fishing effort data are available. As a consequence, the tuning effort series were partial and no estimate of effort can be provided by fleet but only for the total effort of French offshore trawlers (revised in 2004 using LPUE calculated for the whole trawler fleet).

Up to 2004 WG, the French commercial LPUE were calculated using all the available effort data. At 2005 WG, the French series of commercial fishing effort data and LPUE indices were revised to take into account changes in fishing areas due to change in targeting species in recent years and the decreasing number of offshore trawlers which land sole in La Rochelle and Les Sables. A minimum 10% 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. 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. To limit the effect of change in fishing power of the fleets throughout the tuning period and particularly the effect of the decreasing number of La Rochelle trawlers, a minimum number of years (10 from 1984 or 7 in the last 10 years) with sole landings was added to include boats in a fleet. 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 series of LPUE of trawlers landing sole in other harbours than La Rochelle and Les Sables (FR-OTHER) was presented at 2005 WG for the first time. This additional information was estimated to be helpful to compensate for the lack of La Rochelle LPUE in 2004 which results from the combination of the decrease of number of boats in this fleet and from a delay in recording its 2004 logbooks. The same threshold in landing percentage was used to calculate this new LPUE series but neither the criterion of a minimum duration of participation in the fishery nor the skipper survey on target species were used. This LPUE series adds information on LPUE trend in the northern part of the Bay of Biscay, but the quality is lower because it was not possible to carry out the same selection process of vessels than for the two other fleets. Consequently, this fleet have not been used since the 2005 WG.

C. Historical stock development : Assessment Methods and Settings

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
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
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+
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
FR – ROCHEL	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
FR – ROCHEL1	Not used	Not used	Not used	Not used	Not used	84-92 2-7	Removed	Removed	Removed	Removed	Removed	Removed
FR – ROCHEL2	Not used	Not used	Not used	Not used	Not used	93-03 2-7	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**
FR – RESSGASC-S	88-97 1-7	89-98 1-7	remove d	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
FR – RESSGASC-S 3	Not used	Not used	87-97 2-6	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
Taper	No	No	Yes	Yes	**YES**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Tuning range	10	10	17	18	**19**	**20**	**14**	15	16	17	18	19
Ages catch dep. Stock size	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
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
Year range	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
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
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

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 catch 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.

D. Short term projection

Inputs

WG Year	1998	1999	2000	2001	2002	2003	2004
Recruitment	Age 1 GM 84-95	Age 1 GM 84-96	Age 1 GM 92-96	Age 1 GM 92-99	Age 1 GM 92-00	Age 1 GM 92-01	Age 2 GM 93-02
Age 2	XSA	derived from GM	derived from GM	derived from GM	Derived from GM	Derived from GM	XSA
Age 3	XSA	derived from GM	derived from GM	derived from GM	Derived from GM	Derived from GM	XSA + Derived from GM
Age>3	XSA	XSA	XSA	XSA	XSA	XSA	XSA
F	Unscaled 95-97	Unscaled 96-98	- Unscaled 96-97 at age 1 - Unscaled 96-98 at age>1	- Unscaled 98-99 at age 1 - Unscaled 98-00 at age>1	- Unscaled 99-00 at age 1 - Unscaled 99-01 at age>1	- Unscaled 00-01 at age 1 - Unscaled 00-02 at age>1	Scaled 01-03
Weight at age	Unweighted 95-97	Unweighted 96-98	Unweighted 96-98	Unweighted 96-98	Unweighted 99-01	Unweighted 00-02	Unweighted 01-03

WG Year	2005	2006	2007	2008	2009	2010
Recruitment	Age 2 GM 93-03	Age 2 GM 93-04	Age 2 GM 93-05	Age 2 GM 93-05	Age 2 GM 93-06	Age 2 GM 93-07
Age 2	GM	GM	GM	GM	GM	GM
Age 3	Derived from GM	Derived from GM	Derived from GM	Derived from GM	Derived from GM	Derived from GM
Age>3	XSA	XSA	XSA	XSA	XSA	XSA
F	- Unscaled 03-04 in 2005 - Unscaled 00-04 in 2006-07	- Unscaled 03-04 at age 2 - Unscaled 03-05 at age>2	- Unscaled 04-05 at age 2 - Unscaled 04-06 at age>2	- Unscaled 05-06 at age 2 - Unscaled 05-07 at age>2	- Unscaled 06-07 at age 2 - Unscaled 06-08 at age>2	- Scaled 07-09 at age >= 2
Weight at age	Unweighted 02-04	Unweighted 03-05	Unweighted 04-06	Unweighted 05-07	Unweighted 06-08	Unweighted 07-09

Up to 2003: recruitment is at age 1. XSA last year numbers are considered poorly estimated and are overwritten using a geometric mean of past recruitment values.

In 2004: recruitment is at age 2. XSA last year numbers are used.

From 2005 to 2010: recruitment is at age 2. XSA last year numbers are considered poorly estimated and are overwritten using a geometric mean of past recruitment values. A mean from 1993 up to two years before the terminal years is preferred to a mean to one year before the terminal year because the retrospective pattern shows that convergence may not be before two years when terminal year estimate differs largely from posterior annual estimate.

Recruitments is observed to be at a lower level after 92 (after 93 at age 2). Consequently a short term geometric mean is used.

The exploitation pattern is generally an un-scaled 3 year arithmetic mean (2 years at first age when recruitment is overwritten by GM).

A scaled mean was used in 2004 to take in account the 2002 fixed net catchability increase and available information on landings in the first part of 2004.

An un-scaled 5 year arithmetic mean (4 years at age 2 when recruitment is overwritten by GM) was used in 2005 for the same reason.

A scaled mean was used in 2010 because the decreasing trend in F.

Catch and stock weights at age are taken as the mean of the last 3 years. Since 2007, weight in catches were corrected for a change in transformation coefficient for the French landing.

Maturity ogive and natural mortality estimates are those indicated previously.

E. Medium term projections

Medium term projection are carried out using the following inputs :

- last year deleted when recruitment is overwritten by GM (in SUM file)
- short series of same length than adopted GM for recruitment estimate (in SUM file)
- TAC year population number and fishing mortality (=WG year + 1) to be consistent with the short term forecast (in SEN file).

Several stock recruit relationships have been used used since 1997. The Shepherd model was used in 1997, the Ricker model in 1998-2000, the Beverton-Holt model in 2001. The fit is very poor with all of them and a ramdom bootstrap has been was preferred since 2002.

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

The following biological reference points were proposed for this stock since 1998 :

	ACFM 1998	ACFM 1999	WG & ACFM 2001	WG 2004
			Change in maturity ogive	Change in recruitment age and in FBar age range
$\mathbf{F}_{lim}$	Not defined	Not defined	0.5 (potential collapse)	Not defined
$\mathbf{F}_{pa}$	0.40 (*prob (SSB*$_{MT}$*<*$\mathbf{B}_{pa}$*)<.1*)	0.45 (*prob (SSB*$_{MT}$*<*$\mathbf{B}_{pa}$*)<.05*)	$\mathbf{F}_{pa} = \mathbf{F}_{lim}\ e^{(-1.645 * .2)} =$ 0.36.	F proposal
$\mathbf{B}_{lim}$	Not defined	Not defined	Not defined	Not defined
$\mathbf{B}_{pa}$	11 300 t ($\mathbf{B}_{loss}$)	11 300 t ($\mathbf{B}_{loss}$)	13 000 t	Not relevant

H. Other Issues

None

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Annex G: 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 (WKROUND)
Date:	February 2010
Revised by Daniel Howell	Santiago Cerviño, Ernesto Jardim and

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 is used. The growth parameters were decided based on (i) tagging data collected for the north stock, 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 for years 1982 to 2008 (Southern hake WD 3).

B.3. Surveys

The **Spanish October** groundfish (SP-GFS) 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 (SP-GFS-caut)**, 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 and ALKs are available since then.

The **Portuguese October groundfish (P-GFS-oct)** 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**, 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 β, which is estimated within the model. In addition to the spread of growth from the beta-binomial distribution, there is a minimum to this spread due by discretisation of the length distribution.

Catches

All catches within the model are calculated on length, with the fleets having size-based catchability. This imposes a size-based mortality, which can affect mean weight and length at age in the population (Kvamme 2005). A fleet (or other 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	1994-2008	YES	Iberia	Land1.ldist
Length distribution of landings	1982-1993	NO	Iberia	Land.ldist
Length distribution of landings in Cadiz	1994-2008	YES	Gulf of Cadiz	cdLand.ldist
Length distribution of Spanish GFS	1982-2008	-	North Spain	SpDem.ldist
Length distribution of Spanish GFS	1989-2008	-	Portugal	PtDem.ldist
Length distribution of Spanish GFS in Cadiz	1990-2008	-	Gulf of Cadiz	CdAut.ldist
Length distribution of discards	1994, 1998, 1999, 2004-2008	YES	Iberia	Disc.ldist
Abundace index of Spanish GFS of 4-19 cm individuals	1982-2008	-	North Spain	SpIndex15cm.1
Abundace index of Spanish GFS of 20-35 cm individuals	1982-2008	-	North Spain	SpIndex15cm.2
Abundace index of Spanish GFS of 36-51 cm individuals	1982-2008	-	North Spain	SpIndex15cm.3
Abundace index of Portuguese GFS of 4-19 cm individuals	1989-2008	-	Portugal	PtIndex15cm.1
Abundace index of Portuguese GFS of 20-35 cm individuals	1989-2008	-	Portugal	PtIndex15cm.2
Abundace index of Portuguese GFS of 36-51 cm individuals	1989-2008	-	Portugal	PtIndex15cm.3
Abundace index of Spanish	1994-2008	YES	North Spain	SpCPUE15cm.1

trawlers from A Coruña of 4-19 cm individuals				
Abundace index of Spanish trawlers from A Coruña of 20-35 cm individuals	1994-2008	YES	North Spain	SpCPUE15cm.2
Abundace index of Spanish trawlers from A Coruña of 36-51 cm individuals	1994-2008	YES	North Spain	SpCPUE15cm.3
Standardized abundace index of Portuguese trawlers of 4-19 cm individuals	1989-2008	YES	Portugal	PtCPUE15cm.1
Standardized index of Portuguese trawlers of 20-35 cm individuals	1989-2008	YES	Portugal	PtCPUE15cm.2
Standardized index of Portuguese trawlers of 36-51 cm individuals	1989-2008	YES	Portugal	PtCPUE15cm.3

Description of the likelihood components weighting procedure and % of contribution to the final total likelihood:

Likelihood component	**var**	**quarters**	**quality**	**area**	**Multiplicative Weight**	**%**
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 2008). 27 params
- The growth rate (k) of the von Bertalanffy growth model.
- Parameter β 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 (1994-2008) . 2 params
  - Cadiz landings (1982-2004) . 3 params
  - Discards (1992-08) . 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

69 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: abundance at age and mean length for ages 0 to 15+

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.

Intermediate year assumptions: F = last assessment year F

Stock recruitment model used: geometric mean of years 89-07

Procedures used for splitting projected catches: driven by selection functions and provide by GADGET.

E. Medium-Term Projections

NA

F. Long-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 89-07

Procedures used for splitting projected catches: driven by selection functions.

G. Biological Reference Points

Unchanged since 2004

	Type	Value	Technical basis
Precautionary approach	B_{lim}	25 000 t	The level below which there are indications of impaired
	B_{pa}	35 000 t	~ B_{lim} *1.4
	F_{lim}	0.55	F_{loss}
	F_{pa}	0.40	~ F_{lim} * 0.72
Targets	F_y	0.27	EC Recovery plan.

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. The two new models are considered to be an improvement on the previous method given the problems related to age data described below. 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

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Annex H: Southern Anglerfish (Divisions VIIIc, IXa)

Quality Handbook	**Annex H: Southern anglerfish (*L. piscato rius* and *L. budegassa*)**

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Southern anglerfish (Divisions VIIIc, IXa)
Working Group:	Working Group on the Assessment of Southern Shelf of Hake, Monk and Megrim Stocks (WGHMM)
Last Update:	WGHMM2010

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 *L. budegassa* has a more southerly distribution. *L. piscatorius* is distributed from Norway (Barents Sea) to the Straits of Gibraltar (and including the Mediterranean and the Black Sea) and *L. budegassa* 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 three anglerfish 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 two stocks on the Southern Shelf area, the Northern stock in Divisions VIIb-k and VIIIa,b and d and the Southern stock in Divisions VIIIc and IXa. The stock under this Annex is called Southern Anglerfish and is defined as anglerfish in Divisions VIIIc and IXa. The boundaries of Northern and Southern Anglerfish stocks were establish 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, *L. piscatorius* and *L. Budegassa* are caught and landed together, due to that, the advice is given for the combined stock. 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, the Spanish recent landings being around 90 % 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 2003-2009 period the catches were between 3 000 t and 4 500 t. Both species are caught on the same grounds by the same fleets and are marked together.

L. piscatorius and *L. budegassa* 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 HVO (High Vertical Opening) has taken place in higher proportion relative to previous years. This gear targets horse mackerel and mackerel with very few anglerfish catches. Since 1997, the Spanish landings were on average 51 % from the trawl fleet and 49 % 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 2000, 24 % from trawlers and 76% 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 these stocks is considered very low, estimated data for Spanish trawl fleet (WGHMM2010).

Each year, the European Union Administration sets a combined TAC and quota for *L. piscatorius* and *L. budegassa*. 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

Both anglerfish are benthic species that occur on muddy to gravelly bottoms. White anglerfish attains a maximum size of around 163 cm corresponding to a weight of approximately 51 kg, and black anglerfish attains a maximum size of around 93 cm corresponding to a weight of approximately 12 kg. Historically *Lophius piscatorius* and *L. budegassa* has been considered slow growing species, with a late maturation (Duarte *et al*., 2001). Nevertheless, new evidences from mar-recapture experiments indicate that the anglerfish growth could be faster.

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-Diaz 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 *L. piscatorius* from the seabed to the near surface have been recorded in the Northeast Atlantic (Hislop *et al.*, 2001) and is 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 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 of *L. piscatorius* and *L. budegassa* 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. For *L. piscatorius* the maximum landing of the available series was recorded in 1986 at 6 870 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 3 644 t. Since 2005 landings have slowly decreased to 2 280 t in 2009.

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 2008.

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 2009 of 769 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 started in mid 2003, with hake as the main target species, due to that the anglerfish data are not yet processed.

Discard data are not included in the input data for analytical assessment because sampling does not cover all fleets contributing to anglerfish catches and the lack of data in many years of the series.

B.2 Biological

Landing numbers at length

The quarterly Spanish and Portuguese sampling for length compositions is by port, gear (trawl or gillnet) and ICES Divisions. Length data from sampled vessels are summed and the resulting length composition is applied to the quarterly landings of the corresponding port, gear and ICES Divisions. 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). Spanish and Portuguese market sampling effort increased considerably from 1995 to 2008. 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. In WHMM2007, 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 biological data that are provided to the WG are the mean weight and mean length by gear, country and ICES Division. A yearly length-weight relationship, common for Spain and Portugal, are applied by species:

L. piscatorius: $W=0.0000270*L^{2.8390}$ (BIOSDEF, 1998)

L. budegassa: $W=0.0000211*L^{2.9198}$ (BIOSDEF, 1998)

Trial assessment of these stocks 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 for these stocks.

B.3 Surveys

The **Spanish Groundfish Survey (SP-GFS)** and the **Portuguese October Groundfish Survey (P-GFS-oct)** series for the two anglerfish species are available from 1983, except 1987 for SP-GFS. Due to the low level of anglerfish caught in the two surveys, these indices are not considered to reflect the change in the abundance of this species and are not employed in the stock assessment.

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) according to the fleet segmentation proposed by the IBERMIX project (WD06, Castro *et al*., 2007). Due to the different distribution of the species, more southerly in the case of *L. budegassa*, the fleets employed to tune the stock assessment are different by species.

Commercial fleets used in recent assessments of L. piscatorius to tune the ASPIC model

- Coruña trawlers (SP-CORUTR8c): years 1986-2009. Data provided for 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 *L. piscatorius* and 13% of *L. budegassa* 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.

- Cedeira gillnet (SP-CEDGNS8c): years 1999-2009. Data provided for Cedeira gillnets comprise annual standardized effort (in soaking days), landings and length composition of landings. This fleet represents an average of 10% of international catches of *L. piscatorius* and 5% of *L. budegassa* since 1999.

Commercial fleets used in recent assessments of L. budegassa to tune the ASPIC model

- Portuguese trawlers targeting fish (PT-TRF9a): years 1989-2009. 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 *L. piscatorius* and 3 % of *L. budegassa* 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.

- Portuguese trawlers targeting crustacean (PT-TRC9a): years 1989-2009. 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 *L. piscatorius* and 3% of *L. budegassa* 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.

Other available commercial series of LPUEs that have never been employed in the analysis are:

- Avilés trawlers (SP-AVTR8c): 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 *L. piscatorius* and 3% of *L. budegassa* along the time series. This commercial series has never been used as a tuning fleet in the WG. The effort series was interrupted in 2003.
- Santander trawlers (SP-SANTR8c): years 1986-2009. 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 *L. piscatorius* and 3% of *L. budegassa* along the time series. Effort data for 2008 was not provided to the WG. This commercial series has never been used as a tuning fleet in the WG.

C. Historical stock development: Assessment Methods and Settings

These 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 last accepted assessment was carried out in the 2010 WG. Model input settings and data used in last assessments are summarised in the next table:

WG	2005	2006	2007		2008	2009		2010	
Assessment Model	Non-equilibrium Surplus production model (Prager, 1994a)	Non-equilibrium Surplus production model (Prager, 1994a)	Non-equilibrium Surplus production model (Prager, 1994a)		No updated	Non-equilibrium Surplus production model (Prager, 1994a)		Non-equilibrium Surplus production model (Prager, 1994a)	
Software	ASPIC (v. na)	ASPIC (v. 5.05)	ASPIC (v. 5.16)		No updated	ASPIC (v. 5.16)	ASPIC (v. 5.24)	ASPIC (v. 5.34)	ASPIC (v. 5.34)
Stock	Combined	Combined	L.piscatorius	L.budegassa		L.piscatorius	L.budegassa	L.piscatorius	L.budegassa
Catch data range	1986-2004	1980-2005	1980-2006	1980-2006		1980-2008	1980-2008	1980-2009	1980-2009
CPUE Series 1 (years)	SP-CORUTR8c (1986-2004)	SP-CORUTR8c (1986-2005)	SP-CORUTR8c (1986-2006)	PT-TRF9a (1989-2006)		SP-CORUTR8c (1986-2008)	PT-TRF9a (1989-2008)	SP-CORUTR8c (1986-2009)	PT-TRF9a (1989-2009)
CPUE Series 2 (years)									
Index of Biomass (years)	PT-TR9a (1989-2004)	PT-TR9a (1989-2005)	SP-CEDGNS8c (1999-2006)	PT-TRC9a (1989-2006)		SP-CEDGNS8c (1999-2008)	PT-TRC9a (1989-2008)	SP-CEDGNS8c (1999-2009)	PT-TRC9a (1989-2009)
Error Type	Condition on yield	Condition on yield	Condition on yield	Condition on yield		Condition on yield	Condition on yield	Condition on yield	Condition on yield
Number of bootstrap	500	500	500	500		500	500	1000	1000
Maximum F	8.0 (y-1)	8.0 (y-1)	8.0 (y-1)	8.0 (y-1)		8.0 (y-1)	8.0 (y-1)	8.0 (y-1)	8.0 (y-1)
Statistical weight B1/K	1	1	1	1		1	1	1	1
Statistical weight for fisheries	1,1	1,1	1,1	1,1		1,1	1,1	1,1	1,1
B1-ratio (starting guess)	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5
MSY (starting guess)	5000 t	5000 t	5000 t	3000 t		5000 t	3000 t	5000 t	3000 t
K (starting guess)	100 000 t	100 000 t	50 000 t	20 000 t		50 000 t	20 000 t	50 000 t	20 000 t
q1 (starting guess)	1d-5	1d-5	1d-5	1d-5		1d-5	1d-5	1d-5	1d-5
q2 (starting guess)	1d-6	1d-6	1d-6	1d-4		1d-6	1d-4	1d-6	1d-4
Estimated parameter	All	All	All	All		All	All	All	All
Min and Max allowable MSY	2000 (t) -20000 (t)	2000 (t) -10000 (t)	2000 (t) -10000 (t)	2000 (t) -10000 (t)		2000 (t) -10000 (t)	2000 (t) -10000 (t)	2000 (t) -11500 (t)	2000 (t) -10000 (t)
Min and Max K	50000 (t) -500000 (t)	50000 (t) -500000 (t)	5000 (t) - 500000 (t)	5000 (t) -500000 (t)		5000 (t) - 100000 (t)	5000 (t) -100000 (t)	5000 (t) - 112000 (t)	5000 (t) -100000 (t)
Random Number Seed	1964185	1964185	1964185	1964185		1964185	1964185	1964185	1964185

*** na: not available**

D. Short term projection

See Medium term projections

E. Medium term projections

Model: ASPIC projections (Prager, 1994).

Software: ASPICP

It was assumed Fsq for the intermediate year.

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.

F. Yield and biomass per recruit / long term projections

None

G. Biological reference points

No biological reference points are defined for this stock.

H. Other Issues

None

I. References

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Annex J: Bay of Biscay Nephrops (FU 23–24)

Quality Handbook **Annex J: Bay of Biscay *Nephrops* (FU 23-24)**

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
Created:	August 2005
Last update:	May 2010

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 km^2 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 230 boats are currently involved in the Bay of Biscay *Nephrops* fishery spending an average of 193 days at sea in 2003,
- 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 and 2008's data). 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 very 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.

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. 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 show that since 1997 the proportion of females in the landings has slightly increased, reaching nearly 45% of the total. Changes in sex ratio can be related to discards sampling.

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 for 2003 and 2004 have been estimated by a sample mean estimator from on board sampling programme.

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 1987-2004 (with derivation biases already stated) is about 1 500 tonnes.

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 (269 trips and 725 hauls have been sampled over period 2003-2009). 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

(based on paper submitted to *ICES Journal of Marine Science*: S. Fifas, M.-J. Rochet, M. Salaün, O. Gaudou, C. Talidec in 2009; in revision and correction)

Overall scheme of this methodology is provided below. At present, this methodology is used only for exploratory runs, with the intention of using it for the main assessment after it has been tested in a benchmark.

B.2.3.1. Sampled years

The overall programme is based on a stratified random sampling. Discards are estimated for each sampled fishing trip and raised by multiplying by the total number of fishing trip in the stratum. The total number of trips is usually not known, its estimate can be done using the number of auction hall sales in the case of trips of short duration (1 day); that is the case for "Le Guilvinec" district, but not for the Southern part of the fishery. Estimates and variances are provided by haul, trip or segment (i.e. fleet or district). As there is only one sample collected during each fishing operation, the within-FO variance is estimated by assuming a fixed total sample size, only the species composition and the length frequency being variable. The variance of the observed quantity in each category is estimated by assuming a hyper-geometric distribution.

The ratio between discards and an auxiliary variable was afterwards estimated. The ratio-estimate is more accurate than the simple estimate only if the correlation of discards with the auxiliary variable is larger than half the ratio of the coefficients of variation: ϱ>CV(auxiliary var.)/(2*CV(discards)) (Cochran, 1977). Total landings were taken into account as auxiliary variable. The ratio of discards over landings by trip is calculated and is then raised using total landings.

B.2.3.2. Missing years

The integration of a set of independent variables (recruitment strength, density of probability of discards, regulations, market considerations) to extrapolate reliable discard rate from sampled to missing years was already considered by ICES. Indeed, the available common dataset (six years while the years after the MLS change *i.e.* 2006 and 2007 are excluded) reveals strong correlation for the relationship mean size of discards *vs.* mean size of landings (after log-log transformation) either on quarterly data (mainly for 2nd and 3rd quarters representing the major part of catches) or on the whole year datasets (R^2=0.96). This conclusion is valid on both separated sexes or on combined data. Even if year 1987 is removed from the regression, the R^2 remains high (0.90).

A new approach based on probabilistic concepts and on relationships between mean sizes of landings and of discards was performed by ICES. The main concepts of the derivation (back-calculation) are summarized as (Fig. 2):

1) The first step involves applying hand-sorting selection of retained catches which is explained by s-shaped (logistic) function *vs.* size. As statistically tested (Fifas *et al.*, 2006), the hand-sorting function is stable within-quarter for given parameters of the exploitation pattern (if mesh size and MLS remain constant within period). The overall time series was divided into three periods (years 1987-1990, 1988-1990 and 1992-1997).

2) The second step consists in removing undersized individuals unusual in landings which can generate unreliably extreme values of discards due to sampling problems (very high CV of landings for the extreme size classes). Hence, size classes less than a tested threshold (1% of cumulative landings) were eliminated. This calculation process retains only a part of the initial hand-sorting generated distributions of discards mainly the decreasing part of discarded individuals.

3) The third step allows the generation of missing size classes by applying a probability density function which can be symmetrical in regards to the overall symmetry of DLF of discards (Fig. 1). 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.

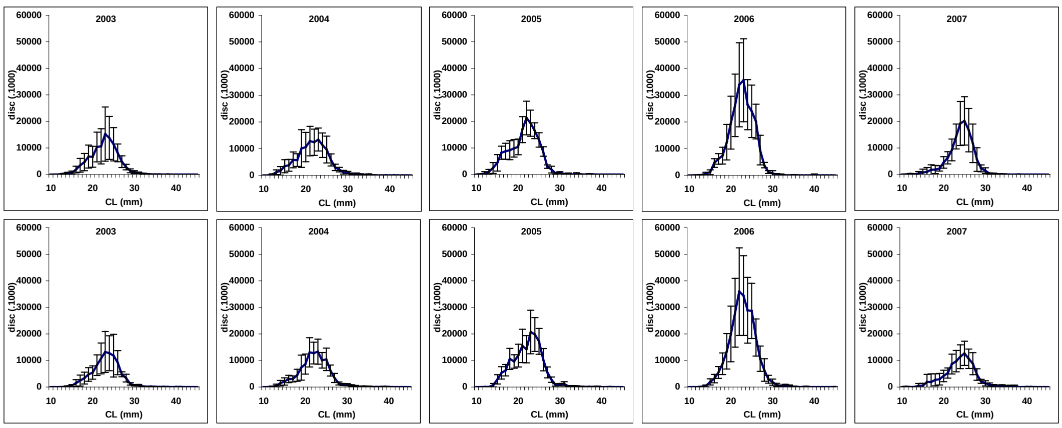

Figure 1. Years 2003-2007. Distribution of length frequencies (CL in mm) and confidence intervals (confidence level 1-α=0.95) for discards estimated by sampling. Data by sex (females above, males below).

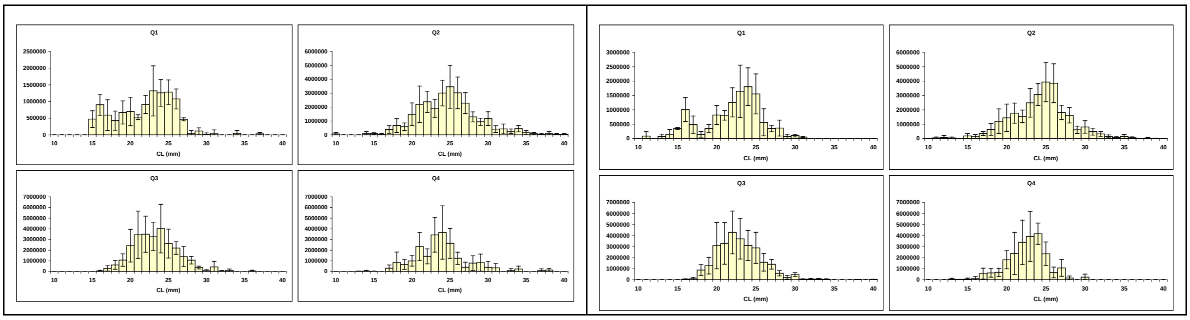

Figure 2. Distribution of length frequencies (CL in mm) for discards 2009 and confidence intervals (confidence level 1-α=0.95). Data by sex (males left, females right).

B.3. Surveys

A survey 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). In the future, this survey should provide an independent tuning dataset. These data can not currently be included as indices for the stock assessment. Nevertheless, some preliminary comparisons can be undertaken between data provided by the first four successive years (2006-2009) in order to examine recent recruitment levels.

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

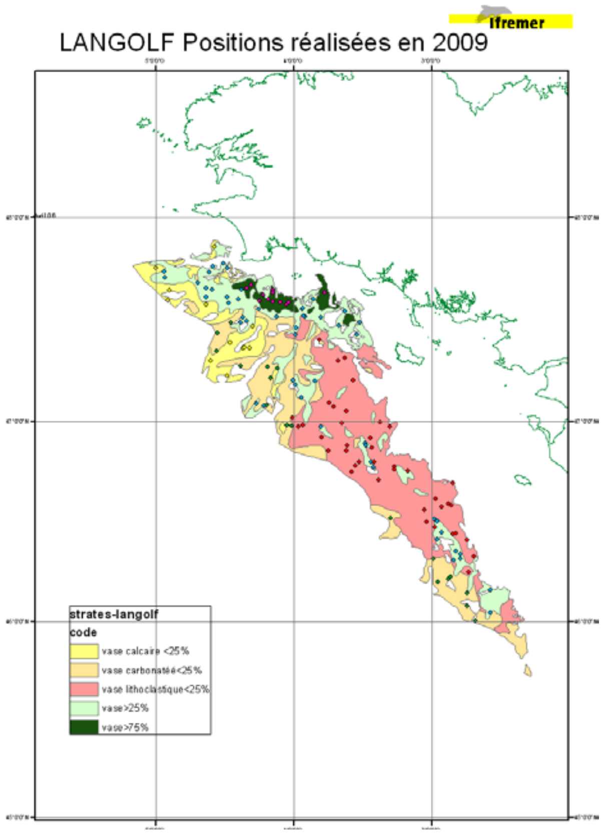

Figure 3. ***Nephrops*** **of the Bay of Biscay (FU 23-24). The Central Mud Bank, the five spatial strata and the distribution of sampling units for 2009's survey.**

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

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]:

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[1] A fraction of Le Guilvinec trawlers (mainly located at the harbour of Loctudy) correspond to a different profile of exploitation from that of traditional vessels which can be used to tune XSA. The typical daily trip for this category consists on longer fishing time than the traditional one. The daily catchability for *Nephrops* is maximised around dawn and dusk. Then, this fraction of trawlers was removed from the tuning fleet.

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

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	males	10	19	26	33	38	43	48	51	54
(CL mm)	females	10	19	26	29	32	34	36	38	40
M	Males	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	females	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	combined	0.3	0.3	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Maturity	Males	0	0	1	1	1	1	1	1	1
	females	0	0	0.5	1	1	1	1	1	1
	combined	0	0	0.75	1	1	1	1	1	1

Recruitment is assumed to occur at the 1st January and SSB is calculated at this date.

For the 2004 assessment as explained above a new tuning series was built (a) by choosing another reference fleet (the "Le Guilvinec district") and another reference period (the second quarter, which is much more indicative of the actual directedness of the fleet towards *Nephrops*) and (b) by adding a second tuning fleet covering the other ports of the Bay of Biscay, with selected *Nephrops* directed trips in the second quarter too.

This second tuning fleet has not been included since WGHMM 2005, because it is based on log book data whose quality is poor for this fishery.

So only the tuning fleet of "Le Guilvinec District" was kept to carry out the assessment. Annual age compositions were obtained by using the ratios of Quarter 2-fleet-landings to Total-quarter 2-landings.

Recent input data types and model options chosen are detailed in the following table:

Fleets	2006 XSA		2007 XSA		2008 XSA	
FR -Q2 -QGV	1987-2005	Ages 1-9+	1987-2006	Ages 1-9+	1987-2007	Ages 1-9+
Taper	Yes (3 over whole time series)		Yes (3 over whole time series)		Yes (3 over whole time series)	
Tuning range	Full		Full		Full	
Age catchability dependent of stock size	No		No		No	
Q plateau	6		6		6	
F shrinkage se	1.5		1.5		1.5	
Year range of shrinkage	5		5		5	
Age range of shrinkage	5		5		5	

Note: no assessment was performed in 2009.

D. Short-Term Projections

Short-term projections are performed using MFDP and MFYPR procedures. In the particular case of the Bay of Biscay *Nephrops*, it is necessary to prepare data prior to the execution of the modules. Matrix containing numbers of removals by year and by age is computed using MFREP executable (available in ICES libraries) aiming to split into two matrices involving in landings and discards and the same procedure is carried out on matrix of F at age.

Apart from 2009 when no assessment was performed on the stock, short-term projections were provided on annual basis since the incorporation of the stock in the WGHMM (2005). Input for projections carried out for the five last years are commented below.

2006: In the assessment, recruitment 2005 was replaced by GM(87-04)=679 million. This GM value was input in projections for recruitments from 2006 onwards. Unscaled Fbar was calculated on years 2003-2005 (F=0.49).

2007: In the assessment, recruitment for 2005 was replaced by R2004 (=1006 million) because the WG adopted arguments for strong recruitment value for this year, but rejected the extremely high value provided by XSA. Two additional runs were also carried out with R2005 replaced either by GM(87-04)=672 million or by 90th percentile of the series 1987-2004 *i.e.* 860 million. Recruitment 2006 was replaced by GM(87-04) which was also used in projections for recruitments from 2007 onwards. The exploitation patterns for the projection are based on the unscaled average Fs-at-age in the years 2004-2006 (F_{2-5}=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.

H. References

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Annex K – Stock Annex – Nephrops in VIIIc F 25-31

Quality Handbook **ANNEX:_Nephrops in VIIIc**
FU 25

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 SP-CORUTR-8c	Assessment Years 1982-2005	Assessment Ages 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.

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

Morizur, Y., 1982. Estimation de la mortalité pour quelques stocks de langoustine, *Nephrops norvegicus*. ICES C.M. 1982/K:10

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 – Nephrops in VIIIc FU 25- 31

Quality Handbook **ANNEX:_Nephrops in VIIIc_**

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 – Nephrops in Division IXa

Quality Handbook **ANNEX:_Nephrops in FU 26-27**

Stock specific documentation of standard assessment procedures used by ICES.

Stock	West Galician and North Portugal (Division IXa, FU 26-27).
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 SP-MATR	Assessment Years 1994-2005	Assessment Ages 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.

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.

Fernández, A., Fariña, A.C. and Penas, E., 1986. Efectos de un cambio de malla en la pesquería de cigala (Nephrops norvegicus L.) de Galicia. Bol. Esp. Oceanogr., 3: 57-74.

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

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.

Annex L – Stock Annex – Nephrops in Division IXa

Quality Handbook ANNEX:_Nephrops in FU 28-29

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Southwest and South Portugal (Division IXa, FUs 28-29)
Working Group:	WGHMM
Date:	07 May 2010 (updated)
Revised by	Cristina Silva

A. General

A.1. Stock definition

The Norway lobster (*Nephrops norvegicus*) is distributed along the continental slope off the southwest and south Portuguese coast, at depths ranging from 200 to 800 m. Its distribution is limited to muddy sediments, and requires sediment with a silt and clay content of between 10–100% to excavate its burrows, and this means that the distribution of suitable sediment defines the species distribution. Although FUs 28 and 29 are different stocklets, landings records are not differentiated and they are assessed together.

A.2. Fishery

The fishery in FUs 28 and 29 is mainly conducted by Portugal. For the last 25 years, this species has been a very important resource for the demersal trawl fisheries operating in the region. With exception of the years when the abundance of pink shrimp (*Parapenaeus longirostris*) is extremely high, *Nephrops* constitutes the main target species of the majority of the crustacean trawl fleet, and is not generally caught as by-catch of other fleets.

The Portuguese trawl fleet comprises two components, namely the trawl fleet fishing for fish and the trawl fleet fishing for crustaceans. The trawl fleet fishing for fish operates off the entire coast while the trawl fleet directed to crustaceans operates mainly in the Southwest and South Portugal, in deep waters, where crustaceans are more abundant. The fish trawlers are licensed to use a mesh size >= 65 mm and the crustacean trawlers are licensed for two different mesh sizes, 55 mm for catching shrimp and >= 70 mm for Norway lobster. Demersal fish trawlers that regularly land *Nephrops*, do in fact target this resource, which in terms of overall profit, represents a significant additional income.

The number of trawlers targeting crustaceans has been fixed at 35 since the early 1990s. However, since the late 1990s, some vessels have been replaced by new ones, better equipped and with a more powerful engine. In 2008, the number of licensed fish trawlers was 69 with an average of 645 HP, 182 GRT and 26 m of overall length, whereas the number of crustacean trawlers was 30, with an average of 562 HP, 177 GRT and 25 m of overall length.

There are two main target species in the crustacean fishery, which are the Norway lobster and the deepwater rose shrimp. These two species have a different but overlapping depth distribution. Rose shrimp occurs from 100 to 350 meters of depth whereas Norway lobster is distributed from 200 to 800 meters. The number of fishing trips directed to one species or to the other depends on the abundance of these species each year. The number of fishing trips directed to *Nephrops* increased in 2004-2005, dropping again in 2006-2009.

The fishery takes place throughout the year, with the highest landings usually being made in the spring and summer.

A Recovery Plan for the southern hake and Iberian *Nephrops* stocks has been in force since the end of January 2006 (Council Regulation (EC) No. 2166/2005). The aim of the recovery plan is to rebuild the stocks within 10 years, with a reduction of 10% in F relative to the previous year and the TAC set accordingly. In order to reduce fishing mortality on *Nephrops* stocks in this area even further, the Recovery Plan introduced a seasonal ban in the trawl and creel fishery in a box, located in FU 28, for four months in the peak of the *Nephrops* fishing season (May – August).

Every year, the TAC and the number of fishing days per vessel is regulated.

A Portuguese national regulation (Portaria no. 1142/2004, 13th September 2004) enforced a complete closure of the deepwater crustacean trawl fishery in January–February 2005 and established a ban on *Nephrops* fishing from 15 September to 15 October. The ban in September–October was already implemented in 2004. This regulation was revoked in January 2006 after the implementation of the Recovery Plan, keeping only one month of closure of the crustacean fishery in January (Portaria no. 43/2006, 12th January 2006). Although these periods do not correspond to the main fishing season for Nephrops, these measures resulted in a reduction of effort.

The minimum landing size (MLS) for *Nephrops norvegicus* is 20 mm of carapace length (CL) or 70 mm of total length (TL). Discards are negligible and are mainly related to quality (broken or soft shells).

The main by-catch species are blue whiting, hake and anglerfish.

A.3. Ecosystem aspects

The Norway lobster (*Nephrops norvegicus*) is distributed along the southwest and south Portuguese coast, at depths ranging from 200 to 800 m. Its distribution along the continental slope is patchy and high abundance areas have been clearly identified.

Differences in the length composition of catches originating from FU28 (SW Portugal) and those originating from FU29 (S Portugal) were observed during the surveys. At present there is no scientific evidence to separate these stocks and consider them two sub-populations. Further work in this area is needed to improve our knowledge about this stock.

Another topic that should be further investigated, is the possible interaction between the stocks found in FU29 and FU30 (Cadiz). Exchanges between the two populations are likely to occur since there are no known physical/geographical constraints limiting this exchange. Aiming for a better understanding of the *Nephrops* population dynamics, tagging experiments and genetic studies would provide valuable information, which would help to support the issues dealt with during the assessment working groups.

Norway lobster is a benthic species that attains a maximum size of around 80mm (CL) corresponding to a weight of approximately 400g. Lobsters spawn from August through to November off the shelf edge in deep waters. After spawning, females carry the eggs for a 3 to 4 month period after which the larvae hatch and become pelagic free swimmers. Larvae move freely in the water column for a short time period before settling into the mud grounds. Females reach the first maturity at 30 mm and males around 28 mm of carapace length (CL) (ICES, 2006).

A comprehensive study into the role of Norway lobsters in the ecosystem has not yet been carried out. It would be particularly useful to have such information, as *Nephrops* is known to be part of an extended and dynamic community of highly valuable commercial species.

B. Data

B.1. Commercial catch

Up to 1992 the estimated landings from FUs 28 and 29 have fluctuated between 450 and 530 t, with a long-term average of about 480 t. Between 1990 and 1996, the landings fell drastically to 132 t. From 1997 to 2005 landings have increased to levels observed during the early 1990s but decreased again in recent years. The value of total landings in 2009 was 122 t, the lowest value of the series.

Males are the dominant component in all landings with exception of 1995 and 1996 when total female landings exceeded male landings (ICES, 2006a). For the last eight years male to female sex-ratio has been close to 1.5:1.

A discard sampling program onboard the Portuguese crustacean trawlers started in 2004. The weight of *Nephrops* discarded in 2006-2008 was very low with high CVs. No discards were recorded in 2009.

B.2. Biological

Length distributions for both males and females for the Portuguese trawl landings are obtained from samples taken weekly at the main auction port, Vila Real de Sto. António. The sampling data are raised to the total landings by market category, vessel and month. Information on discards is not taken into account in the estimation of the total catch length distributions due to the low level of discards and the lack of defined raising procedures. However, the length distribution of discards confirms the idea that *Nephrops* is not rejected because of its MLS (20 mm of CL) but mainly due to quality problems.

Mean weights-at-age for this stock are estimated from fixed weight-length.

A natural mortality rate of 0.3 was assumed for all age classes and years for males and immature females, with a value of 0.2 for mature females based in Morizur (1982). The lower value for mature females reflects the reduced burrow emergence while ovigerous and hence an assumed reduction in predation.

The size at maturity for females was recalculated at ICES-WKNEPH 2006 to be 30 mm being the same as used in assessments prior to 2008 (ICES, 2006). An asymmetrical log-log relationship was used to estimate the maturity ogive and L_{50}.

A segmented regression was used to estimate the size at maturity for males as the breakpoint in the growth relationship between the appendix masculina and the carapace length. The value estimated for FU 29 was 28.4 mm of CL (ICES, 2006).

Growth parameters were estimated using the Bhattacharya method and tagging experiments (Figueiredo, 1989).

Several factors were considered to potentially affect survival, including duration of the tow and season, and biological characteristics of the individuals (e.g. size, sex and ovigerous condition). Survival was only affected by season (increased mortality in warm months). A global estimate of survival of released lobsters, taking into consideration survival and proportion of the catches for each season, was 35% (Castro *et al.*, 2003)

Summary:

INPUT PARAMETERS		
Parameter	Value	Source
Discard Survival	0.35	
MALES		
Growth - K	0.200	Portuguese data (Bhattacharya method) ; tagging (ICES, 1990a)
Growth - L(inf)	70	"
Natural mortality - M	0.3	Figueiredo (1989)
Size at maturity (mm CL)	28.4	ICES (2006)
Length/weight - a	0.00028	Figueiredo (pers. comm., 1986)
Length/weight - b	3.2229	"
FEMALES		
Immature Growth		
Growth - K	0.200	Portuguese data (Bhattacharya method) ; tagging (ICES, 1990a)
Growth - L(inf)	70	"
Natural mortality - M	0.3	Figueiredo (1989)
Size at maturity (mm CL)	30	ICES (1994)
Mature Growth		
Growth - K	0.065	Portuguese data (Bhattacharya method) ; tagging (ICES, 1990a)
Growth - L(inf)	65	"
Natural mortality - M	0.2	Figueiredo (1989)
Length/weight - a	0.00056	Figueiredo (pers. comm., 1986)
Length/weight - b	3.0288	"

B.3. Surveys

The Portuguese crustacean surveys started in 1981. The surveys were carried out with the research vessels «Mestre Costeiro» and «Noruega» and the main areas covered were the southwest coast (Alentejo or FU 28) and the south coast (Algarve or FU 29). The main objectives were to estimate the abundance, to study the distribution and the biological characteristics of the main crustacean species, namely *Nephrops norvegicus* (Norway lobster), *Parapenaeus longirostris* (rose shrimp) and *Aristeus antennatus* (red shrimp).

In 1997, a stratified sampling design was adopted, based on the design for the demersal resources. The sectors and depth strata were the same used for the groundfish surveys, from 200 to 750 meters in the southwest coast and from 100 to 750 meters in the south coast. The number of hauls in each stratum was dependent on *Nephrops* and rose shrimp abundance variance, with a minimum of 2 stations per stratum. The average total number of stations in the period 1997-2004 was 60. These surveys were carried out in May-July and had a total duration of 20 days.

Since 2005, sampling was based on a regular grid superimposed on the area of *Nephrops* distribution. This sampling procedure allows a more powerful use of data, especially considering the use of geostatistical tools. The total duration of the survey was the same (20 days) and the haul duration had to be reduced from 60 to 30 minutes in order to cover all the rectangles (77) of the grid.

Sediment samples have been collected since 2005 with the aim to study the characteristics of the *Nephrops* fishing grounds.

In 2008, the crustacean trawl survey conducted in Functional Units 28 and 29, was combined with an experimental video sampling. The collection of images was limited to 10 stations in FU 28.

A SeaCorder, composed of an MD4000 high resolution colour camera, an MP4 video recorder and a 30 Gb hard drive, was hung at the central point of the headline, pointing forward onto the sea floor with an angle of 45 degrees, approximately (ICES, 2007). A 2-beam laser pointer is attached to the SeaCorder, for measuring purposes (estimation of the width of view and *Nephrops* and burrows sizes).

The collection of video footage was routinely carried out in each trawl station was routinely carried in 2009. This methodology is being evaluated to see if the data can be used for biomass estimation, length distribution and *Nephrops* catchability by the trawl gear (ICES, 2009).

B.4. Commercial CPUE

A standardization of the CPUE series was presented to WGHMM in 2008 (Silva, C. – WD 25) and reviewed in 2009, applying the generalized linear models (GLMs). The data used for this standardization were the crustacean logbooks for the period 1988-2008. The factors retained for the final model (year, month and vessel category) were those which contribute more than 1% to the overall variance. The model explains 17% to 19% of the variabilility, when using the CPUE in kg/day or kg/haul respectively. The CPUE series was standardised and the effort estimated correspondingly.

However some concerns related to the characteristics of the fishery remain. The main target species of this fleet are rose shrimp and Norway lobster. The vessels change their fishing objective according to the abundance of these species, which can affect the target CPUE estimation and consequently the derived effort. Further work has to be done on this subject, using only *Nephrops* targeting trips.

B.5. Other relevant data

C. Historical Stock Development

In the past, LCA assessments were carried out for males and females separately over a 3-year reference period, in which the stock was considered to be in a steady state. The steady state assumption was questioned due to the decrease of the stock and this method was abandoned (ICES, 2002).

Software used: Lba99g.exe

Age structured XSA assessments have been carried out recently for *Nephrops*, males and females separately (ICES, 2008), with two tuning fleets: the crustacean fleet and the crustacean survey. The results were considered unreliable for several reasons most importantly, growth and natural mortality assumptions and the use of age-converted groups by slicing. However, the results have been taken as indicative of stock trends.

Software used:

- For conversion of the length compositions in ages with slicing: L2AGE4.exe
- XSA: Lowestoft VPA Suite (VPA95.exe), Retvpa02.exe, FLR package

Males	2006 – 2010 WGHMM	
Tuning Fleets used (First - Last year ; Ages used)	Period	Ages
P-TR: Crustacean Trawl Fleet	1988-2005	2 - 7
P-CTS: Crustacean Trawl Survey	1997-2005	2 - 7
First age for normal catchability independent	All ages independent	
First age at which q is considered independent of	6	
Taper time weight applied?	Tricube over 20 yrs	
F shrinkage (SE for mean F)	1.5	
F Shrinkage	Final 5	3 oldest
Minimum Log SE for terminal population estimates	0.3	
Fbar (age)	2 - 7	
Recruitment Age	2	

Females	2006 – 2010 WGHMM	
Tuning Fleets used (First - Last year ; Ages used)	Period	Ages
P-TR: Crustacean Trawl Fleet	1988-2005	2 – 12
P-CTS: Crustacean Trawl Survey	1997-2005	2 – 5
First age for normal catchability independent	All ages independent	
First age at which q is considered independent of age	11	
Taper time weight applied?	Tricube over 20 yrs	
F shrinkage (SE for mean F)	1.5	
F Shrinkage	Final 5 yrs	5 oldest
Minimum Log SE for terminal population estimates	0.3	
Fbar (age)	4 – 10	
Recruitment Age	2	

Other indicators, such as CPUE from the fleet, abundance index from crustacean trawl survey and mean sizes in landings and in surveys have also been used when analysing trends.

D. Short-Term Projection

Not used

E. Medium-Term Projections

Not used

F. Long-Term Projections

Not used

G. Biological Reference Points

There are no biological reference points defined for this stock.

H. Other Issues

I. References

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Annex L – Stock Annex – Nephrops in Division IXa

Quality Handbook **ANNEX:_Nephrops in FU 30**

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

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Annex M: ASPIC results for southern anglerfish in VIIIc and IXa

M1 – *L. piscatorius* Aspic bootstrap output

```
Southern Anglerfish - mon2010                                                                                    Page 1
                                                                                        Thursday, 06 May 2010 at 22:00:55
ASPIC -- A Surplus-Production Model Including Covariates (Ver. 5.34)
                                                                                                       BOT program mode
Author:     Michael H. Prager; NOAA Center for Coastal Fisheries and Habitat Research             LOGISTIC model mode
            101 Pivers Island Road; Beaufort, North Carolina  28516  USA                             YLD conditioning
            Mike.Prager@noaa.gov                                                                     SSE optimization

Reference:  Prager, M. H. 1994. A suite of extensions to a nonequilibrium            ASPIC User's Manual is available
            surplus-production model.  Fishery Bulletin 92: 374-389.                         gratis from the author.

CONTROL PARAMETERS (FROM INPUT FILE)             Input file: c:\archivos de programa\kk\aspic534\aspicmon2010_bot6.inp
------------------------------------------------------------------------------------------------------------------------
Operation of ASPIC:  Fit logistic (Schaefer) model by direct optimization with bootstrap.
Number of years analyzed:                      30           Number of bootstrap trials:                         1000
Number of data series:                          2           Bounds on MSY (min, max):      2.000E+03     1.150E+04
Objective function:                 Least squares           Bounds on K (min, max):        5.000E+03     1.120E+05
Relative conv. criterion (simplex):     1.000E-10           Monte Carlo search mode, trials:       1         10000
Relative conv. criterion (restart):     3.000E-08           Random number seed:                              1964185
Relative conv. criterion (effort):      1.000E-04           Identical convergences required in fitting:           10
Maximum F allowed in fitting:               8.000

PROGRAM STATUS INFORMATION (NON-BOOTSTRAPPED ANALYSIS)                                                  error code   0
------------------------------------------------------------------------------------------------------------------------
Normal convergence

CORRELATION AMONG INPUT SERIES EXPRESSED AS CPUE (NUMBER OF PAIRWISE OBSERVATIONS BELOW)
------------------------------------------------------------------------------------------------------------------------
                                       |
 1  Coruna                             |   1.000
                                       |      24
                                       |
 2  Cedeira                            |   0.696   1.000
                                       |      11      11
                                       --------------------------------------------------
                                               1       2

GOODNESS-OF-FIT AND WEIGHTING (NON-BOOTSTRAPPED ANALYSIS)
------------------------------------------------------------------------------------------------------------------------
                                                   Weighted            Weighted      Current     Inv. var.    R-squared
Loss component number and title                         SSE       N         MSE       weight        weight      in CPUE

Loss(-1)  SSE in yield                            0.000E+00
Loss(0)   Penalty for B1 > K                      0.000E+00       1         N/A    1.000E+00           N/A
Loss(1)   Coruna                                  4.577E+00      24   2.080E-01    1.000E+00     8.416E-01        0.548
Loss(2)   Cedeira                                 1.171E+00      11   1.301E-01    1.000E+00     1.346E+00        0.149
................................................................................................
TOTAL OBJECTIVE FUNCTION, MSE, RMSE:         5.74777137E+00          1.916E-01   4.377E-01
Estimated contrast index (ideal = 1.0):              0.2222          C* = (Bmax-Bmin)/K
Estimated nearness index (ideal = 1.0):              0.7790          N* = 1 - |min(B-Bmsy)|/K


MODEL PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
------------------------------------------------------------------------------------------------------------------------
Parameter                                          Estimate     User/pgm guess    2nd guess    Estimated   User guess

B1/K      Starting relative biomass (in 1980)     2.624E-01          5.000E-01    7.075E-01            1            1
MSY       Maximum sustainable yield               7.096E+03          5.000E+03    3.071E+03            1            1
K         Maximum population size                 5.435E+04          5.000E+04    1.842E+04            1            1
phi       Shape of production curve (Bmsy/K)      0.5000             0.5000            ----            0            1

--------- Catchability Coefficients by Data Series ---------------
q(1)      Coruna                                  1.913E-06          1.000E-05    9.500E-04            1            1
q(2)      Cedeira                                 1.202E-05          1.000E-06    9.500E-05            1            1

MANAGEMENT and DERIVED PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
------------------------------------------------------------------------------------------------------------------------
Parameter                                          Estimate               Logistic formula          General formula

MSY       Maximum sustainable yield               7.096E+03                          ----                     ----
Bmsy      Stock biomass giving MSY                2.718E+04                           K/2           K*n**(1/(1-n))
Fmsy      Fishing mortality rate at MSY           2.611E-01                      MSY/Bmsy                 MSY/Bmsy

n         Exponent in production function         2.0000                             ----                     ----
g         Fletcher's gamma                        4.000E+00                          ----      [n**(n/(n-1))]/[n-1]

B./Bmsy   Ratio: B(2010)/Bmsy                     2.242E-01                          ----                     ----
F./Fmsy   Ratio: F(2009)/Fmsy                     1.460E+00                          ----                     ----
Fmsy/F.   Ratio: Fmsy/F(2009)                     6.848E-01                          ----                     ----

Y.(Fmsy)  Approx. yield available at Fmsy in 2010  1.760E+03                  MSY*B./Bmsy              MSY*B./Bmsy
          ...as proportion of MSY                 2.480E-01                          ----                     ----
Ye.       Equilibrium yield available in 2010     2.825E+03         4*MSY*(B/K-(B/K)**2)     g*MSY*(B/K-(B/K)**n)
          ...as proportion of MSY                 3.981E-01                          ----                     ----

--------- Fishing effort rate at MSY in units of each CE or CC series ---------
fmsy(1)   Coruna                                  1.365E+05                   Fmsy/q( 1)               Fmsy/q( 1)
```

ESTIMATED POPULATION TRAJECTORY (NON-BOOTSTRAPPED)

Obs	Year or ID	Estimated total F mort	Estimated starting biomass	Estimated average biomass	Observed total yield	Model total yield	Estimated surplus production	Ratio of F mort to Fmsy	Ratio of biomass to Bmsy
1	1980	0.329	1.426E+04	1.466E+04	4.816E+03	4.816E+03	5.589E+03	1.259E+00	5.248E-01
2	1981	0.369	1.504E+04	1.510E+04	5.568E+03	5.568E+03	5.695E+03	1.412E+00	5.533E-01
3	1982	0.382	1.516E+04	1.512E+04	5.782E+03	5.782E+03	5.699E+03	1.465E+00	5.579E-01
4	1983	0.412	1.508E+04	1.483E+04	6.114E+03	6.114E+03	5.631E+03	1.579E+00	5.549E-01
5	1984	0.421	1.460E+04	1.433E+04	6.032E+03	6.032E+03	5.510E+03	1.612E+00	5.371E-01
6	1985	0.449	1.408E+04	1.366E+04	6.139E+03	6.139E+03	5.341E+03	1.721E+00	5.179E-01
7	1986	0.559	1.328E+04	1.228E+04	6.870E+03	6.870E+03	4.961E+03	2.143E+00	4.885E-01
8	1987	0.463	1.137E+04	1.110E+04	5.141E+03	5.141E+03	4.611E+03	1.775E+00	4.183E-01
9	1988	0.652	1.084E+04	9.699E+03	6.321E+03	6.321E+03	4.157E+03	2.496E+00	3.988E-01
10	1989	0.632	8.674E+03	7.908E+03	4.996E+03	4.996E+03	3.527E+03	2.420E+00	3.192E-01
11	1990	0.552	7.205E+03	6.868E+03	3.790E+03	3.790E+03	3.133E+03	2.114E+00	2.651E-01
12	1991	0.593	6.548E+03	6.137E+03	3.640E+03	3.640E+03	2.842E+03	2.272E+00	2.409E-01
13	1992	0.639	5.750E+03	5.290E+03	3.381E+03	3.381E+03	2.493E+03	2.448E+00	2.116E-01
14	1993	0.480	4.862E+03	4.851E+03	2.329E+03	2.329E+03	2.307E+03	1.839E+00	1.789E-01
15	1994	0.399	4.840E+03	5.026E+03	2.007E+03	2.007E+03	2.382E+03	1.529E+00	1.781E-01
16	1995	0.327	5.215E+03	5.604E+03	1.834E+03	1.834E+03	2.624E+03	1.253E+00	1.919E-01
17	1996	0.501	6.005E+03	5.899E+03	2.955E+03	2.955E+03	2.746E+03	1.919E+00	2.209E-01
18	1997	0.726	5.796E+03	5.115E+03	3.715E+03	3.715E+03	2.418E+03	2.782E+00	2.133E-01
19	1998	0.758	4.499E+03	3.932E+03	2.981E+03	2.981E+03	1.904E+03	2.904E+00	1.655E-01
20	1999	0.595	3.421E+03	3.249E+03	1.932E+03	1.932E+03	1.595E+03	2.277E+00	1.259E-01
21	2000	0.387	3.084E+03	3.251E+03	1.259E+03	1.259E+03	1.596E+03	1.483E+00	1.135E-01
22	2001	0.199	3.421E+03	3.963E+03	7.880E+02	7.880E+02	1.917E+03	7.616E-01	1.259E-01
23	2002	0.197	4.551E+03	5.244E+03	1.032E+03	1.032E+03	2.473E+03	7.537E-01	1.675E-01
24	2003	0.361	5.991E+03	6.306E+03	2.278E+03	2.278E+03	2.910E+03	1.384E+00	2.205E-01
25	2004	0.482	6.624E+03	6.548E+03	3.157E+03	3.157E+03	3.007E+03	1.847E+00	2.437E-01
26	2005	0.603	6.474E+03	6.040E+03	3.644E+03	3.644E+03	2.803E+03	2.311E+00	2.382E-01
27	2006	0.547	5.633E+03	5.421E+03	2.963E+03	2.963E+03	2.548E+03	2.093E+00	2.073E-01
28	2007	0.444	5.218E+03	5.290E+03	2.350E+03	2.350E+03	2.494E+03	1.701E+00	1.920E-01
29	2008	0.426	5.362E+03	5.480E+03	2.337E+03	2.337E+03	2.573E+03	1.633E+00	1.973E-01
30	2009	0.381	5.597E+03	5.844E+03	2.228E+03	2.228E+03	2.723E+03	1.460E+00	2.060E-01
31	2010		6.093E+03						2.242E-01

RESULTS FOR DATA SERIES # 1 (NON-BOOTSTRAPPED) Coruna

Data type CC: CPUE-catch series Series weight: 1.000

Obs	Year	Observed CPUE	Estimated CPUE	Estim F	Observed yield	Model yield	Resid in log scale	Statist weight
1	1980	*	2.803E-02	0.3286	4.816E+03	4.816E+03	0.00000	1.000E+00
2	1981	*	2.888E-02	0.3687	5.568E+03	5.568E+03	0.00000	1.000E+00
3	1982	*	2.892E-02	0.3824	5.782E+03	5.782E+03	0.00000	1.000E+00
4	1983	*	2.837E-02	0.4122	6.114E+03	6.114E+03	0.00000	1.000E+00
5	1984	*	2.741E-02	0.4210	6.032E+03	6.032E+03	0.00000	1.000E+00
6	1985	*	2.614E-02	0.4493	6.139E+03	6.139E+03	0.00000	1.000E+00
7	1986	2.690E-02	2.349E-02	0.5595	6.870E+03	6.870E+03	-0.13569	1.000E+00
8	1987	2.740E-02	2.122E-02	0.4633	5.141E+03	5.141E+03	-0.25540	1.000E+00
9	1988	3.710E-02	1.855E-02	0.6517	6.321E+03	6.321E+03	-0.69301	1.000E+00
10	1989	2.160E-02	1.513E-02	0.6318	4.996E+03	4.996E+03	-0.35630	1.000E+00
11	1990	1.760E-02	1.314E-02	0.5519	3.790E+03	3.790E+03	-0.29251	1.000E+00
12	1991	2.140E-02	1.174E-02	0.5932	3.640E+03	3.640E+03	-0.60059	1.000E+00
13	1992	1.780E-02	1.012E-02	0.6391	3.381E+03	3.381E+03	-0.56486	1.000E+00
14	1993	8.700E-03	9.278E-03	0.4801	2.329E+03	2.329E+03	0.06434	1.000E+00
15	1994	6.200E-03	9.614E-03	0.3993	2.007E+03	2.007E+03	0.43869	1.000E+00
16	1995	6.300E-03	1.072E-02	0.3273	1.834E+03	1.834E+03	0.53145	1.000E+00
17	1996	1.160E-02	1.128E-02	0.5010	2.955E+03	2.955E+03	-0.02775	1.000E+00
18	1997	1.170E-02	9.783E-03	0.7264	3.715E+03	3.715E+03	-0.17896	1.000E+00
19	1998	4.200E-03	7.521E-03	0.7581	2.981E+03	2.981E+03	0.58260	1.000E+00
20	1999	5.400E-03	6.215E-03	0.5946	1.932E+03	1.932E+03	0.14051	1.000E+00
21	2000	2.800E-03	6.218E-03	0.3873	1.259E+03	1.259E+03	0.79784	1.000E+00
22	2001	2.800E-03	7.580E-03	0.1988	7.880E+02	7.880E+02	0.99589	1.000E+00
23	2002	6.000E-03	1.003E-02	0.1968	1.032E+03	1.032E+03	0.51389	1.000E+00
24	2003	1.230E-02	1.206E-02	0.3613	2.278E+03	2.278E+03	-0.01963	1.000E+00
25	2004	1.320E-02	1.252E-02	0.4821	3.157E+03	3.157E+03	-0.05255	1.000E+00
26	2005	1.890E-02	1.155E-02	0.6034	3.644E+03	3.644E+03	-0.49228	1.000E+00
27	2006	1.260E-02	1.037E-02	0.5466	2.963E+03	2.963E+03	-0.19488	1.000E+00
28	2007	1.050E-02	1.012E-02	0.4442	2.350E+03	2.350E+03	-0.03699	1.000E+00
29	2008	1.350E-02	1.048E-02	0.4265	2.337E+03	2.337E+03	-0.25308	1.000E+00
30	2009	1.020E-02	1.118E-02	0.3813	2.228E+03	2.228E+03	0.09156	1.000E+00

* Asterisk indicates missing value(s).

RESULTS FOR DATA SERIES # 2 (NON-BOOTSTRAPPED) Cedeira

Data type I1: Abundance index (annual average) Series weight: 1.000

Obs	Year	Observed effort	Estimated effort	Estim F	Observed index	Model index	Resid in log index	Statist weight
1	1980	0.000E+00	0.000E+00	--	*	1.762E-01	0.00000	1.000E+00
2	1981	0.000E+00	0.000E+00	--	*	1.815E-01	0.00000	1.000E+00
3	1982	0.000E+00	0.000E+00	--	*	1.818E-01	0.00000	1.000E+00
4	1983	0.000E+00	0.000E+00	--	*	1.783E-01	0.00000	1.000E+00
5	1984	0.000E+00	0.000E+00	--	*	1.722E-01	0.00000	1.000E+00
6	1985	0.000E+00	0.000E+00	--	*	1.642E-01	0.00000	1.000E+00
7	1986	0.000E+00	0.000E+00	--	*	1.476E-01	0.00000	1.000E+00
8	1987	0.000E+00	0.000E+00	--	*	1.334E-01	0.00000	1.000E+00
9	1988	0.000E+00	0.000E+00	--	*	1.166E-01	0.00000	1.000E+00
10	1989	0.000E+00	0.000E+00	--	*	9.505E-02	0.00000	1.000E+00
11	1990	0.000E+00	0.000E+00	--	*	8.255E-02	0.00000	1.000E+00
12	1991	0.000E+00	0.000E+00	--	*	7.376E-02	0.00000	1.000E+00
13	1992	0.000E+00	0.000E+00	--	*	6.358E-02	0.00000	1.000E+00
14	1993	0.000E+00	0.000E+00	--	*	5.830E-02	0.00000	1.000E+00
15	1994	0.000E+00	0.000E+00	--	*	6.042E-02	0.00000	1.000E+00
16	1995	0.000E+00	0.000E+00	--	*	6.736E-02	0.00000	1.000E+00
17	1996	0.000E+00	0.000E+00	--	*	7.090E-02	0.00000	1.000E+00
18	1997	0.000E+00	0.000E+00	--	*	6.148E-02	0.00000	1.000E+00
19	1998	0.000E+00	0.000E+00	--	*	4.726E-02	0.00000	1.000E+00
20	1999	1.000E+00	1.000E+00	--	6.980E-02	3.905E-02	0.58070	1.000E+00
21	2000	1.000E+00	1.000E+00	--	3.700E-02	3.907E-02	-0.05456	1.000E+00
22	2001	1.000E+00	1.000E+00	--	3.940E-02	4.763E-02	-0.18977	1.000E+00
23	2002	1.000E+00	1.000E+00	--	5.230E-02	6.303E-02	-0.18668	1.000E+00
24	2003	1.000E+00	1.000E+00	--	5.710E-02	7.579E-02	-0.28319	1.000E+00
25	2004	1.000E+00	1.000E+00	--	6.640E-02	7.870E-02	-0.17000	1.000E+00
26	2005	1.000E+00	1.000E+00	--	1.235E-01	7.260E-02	0.53134	1.000E+00
27	2006	1.000E+00	1.000E+00	--	9.300E-02	6.516E-02	0.35576	1.000E+00
28	2007	1.000E+00	1.000E+00	--	5.010E-02	6.359E-02	-0.23839	1.000E+00
29	2008	1.000E+00	1.000E+00	--	4.350E-02	6.587E-02	-0.41487	1.000E+00
30	2009	1.000E+00	1.000E+00	--	7.870E-02	7.024E-02	0.11368	1.000E+00

* Asterisk indicates missing value(s).

ESTIMATES FROM BOOTSTRAPPED ANALYSIS

Param name	Point estimate	Estimated bias in pt estimate	Estimated relative bias	Bias-corrected approximate confidence limits 80% lower	80% upper	95% lower	95% upper	Inter-quartile range	Relative IQ range
B1/K	2.624E-01	3.726E-02	14.20%	2.522E-01	2.793E-01	2.326E-01	1.013E+00	8.600E-03	0.033
K	5.435E+04	-5.476E+02	-1.01%	4.882E+04	6.096E+04	4.149E+04	7.140E+04	2.717E+03	0.050
q(1)	1.913E-06	-4.308E-08	-2.25%	1.550E-06	2.173E-06	9.564E-07	2.332E-06	2.883E-07	0.151
q(2)	1.202E-05	-1.697E-07	-1.41%	9.430E-06	1.510E-05	5.817E-06	1.682E-05	2.617E-06	0.218
MSY	7.096E+03	-1.831E+02	-2.58%	6.851E+03	7.290E+03	3.822E+03	7.729E+03	1.462E+02	0.021
Ye(2010)	2.825E+03	7.285E+01	2.58%	1.796E+03	3.785E+03	1.351E+03	4.406E+03	1.079E+03	0.382
Y.(Fmsy)	2.419E+03	-3.926E+01	-1.62%	2.080E+03	2.633E+03	1.821E+03	2.717E+03	2.946E+02	0.122
Bmsy	2.718E+04	-2.738E+02	-1.01%	2.441E+04	3.048E+04	2.074E+04	3.570E+04	1.359E+03	0.050
Fmsy	2.611E-01	5.279E-05	0.02%	2.213E-01	2.727E-01	1.493E-01	3.030E-01	1.174E-02	0.045
fmsy(1)	1.365E+05	6.983E+03	5.12%	1.203E+05	1.571E+05	1.137E+05	1.726E+05	1.794E+04	0.131
fmsy(2)	2.172E+04	1.422E+03	6.55%	1.747E+04	2.648E+04	1.553E+04	3.029E+04	4.451E+03	0.205
B./Bmsy	2.242E-01	3.441E-02	15.35%	1.292E-01	3.265E-01	8.843E-02	4.715E-01	1.018E-01	0.454
F./Fmsy	1.460E+00	1.457E-01	9.98%	1.045E+00	2.237E+00	8.751E-01	2.792E+00	5.995E-01	0.411
Ye./MSY	3.981E-01	3.217E-02	8.08%	2.417E-01	5.470E-01	1.690E-01	7.199E-01	1.597E-01	0.401
q2/q1	6.284E+00	7.300E-02	1.16%	5.156E+00	7.871E+00	4.641E+00	8.859E+00	1.370E+00	0.218

INFORMATION FOR REPAST (Prager, Porch, Shertzer, & Caddy. 2003. NAJFM 23: 349-361)

Unitless limit reference point in F (Fmsy/F.): 0.6848
CV of above (from bootstrap distribution): 0.6721

NOTES ON BOOTSTRAPPED ESTIMATES:

- Bootstrap results were computed from 1000 trials.
- Results are conditional on bounds set on MSY and K in the input file.
- All bootstrapped intervals are approximate. The statistical literature recommends using at least 1000 trials for accurate 95% intervals. The default 80% intervals used by ASPIC should require fewer trials for equivalent accuracy. Using at least 500 trials is recommended.
- Bias estimates are typically of high variance and therefore may be misleading.

Trials replaced for lack of convergence: 0
Trials replaced for q out-of-bounds: 4
Trials replaced for K out-of-bounds: 39
Trials replaced for MSY out of bounds: 14
Residual-adjustment factor: 1.0801

Elapsed time: 0 hours, 44 minutes, 30 seconds.

M2 - *L. budegassa* Aspic bootstrap output

```
Southern Anglerfish - ank                                                                              Page 1
                                                                          Saturday, 08 May 2010 at 23:57:26
ASPIC -- A Surplus-Production Model Including Covariates (Ver. 5.34)
                                                                                           BOT program mode
Author:    Michael H. Prager; NOAA Center for Coastal Fisheries and Habitat Research    LOGISTIC model mode
           101 Pivers Island Road; Beaufort, North Carolina  28516  USA                    YLD conditioning
           Mike.Prager@noaa.gov                                                            SSE optimization

Reference:  Prager, M. H. 1994. A suite of extensions to a nonequilibrium        ASPIC User's Manual is available
           surplus-production model.  Fishery Bulletin 92: 374-389.                    gratis from the author.

CONTROL PARAMETERS (FROM INPUT FILE)                      Input file: c:\users\ralpoim\documents\aspic534\aspic.inp
-------------------------------------------------------------------------------------------------------------------
Operation of ASPIC:  Fit logistic (Schaefer) model by direct optimization with bootstrap.
Number of years analyzed:                    30            Number of bootstrap trials:                        1000
Number of data series:                        2            Bounds on MSY (min, max):       2.000E+03    1.000E+04
Objective function:                Least squares           Bounds on K (min, max):         5.000E+03    1.000E+05
Relative conv. criterion (simplex):     1.000E-08          Monte Carlo search mode, trials:        1       10000
Relative conv. criterion (restart):     3.000E-08          Random number seed:                             1964185
Relative conv. criterion (effort):      1.000E-04          Identical convergences required in fitting:           6
Maximum F allowed in fitting:              8.000

PROGRAM STATUS INFORMATION (NON-BOOTSTRAPPED ANALYSIS)                                           error code   0
-------------------------------------------------------------------------------------------------------------------
Normal convergence

CORRELATION AMONG INPUT SERIES EXPRESSED AS CPUE (NUMBER OF PAIRWISE OBSERVATIONS BELOW)
-------------------------------------------------------------------------------------------------------------------
                                      |
 1  PT.crust.tr                       |   1.000
                                      |      21
                                      |
 2  PT.fish.tr                        |   0.903   1.000
                                      |      21      21
                                       ------------------------------------------------
                                             1       2

GOODNESS-OF-FIT AND WEIGHTING (NON-BOOTSTRAPPED ANALYSIS)
-------------------------------------------------------------------------------------------------------------------
                                                Weighted            Weighted      Current    Inv. var.   R-squared
Loss component number and title                      SSE     N           MSE       weight       weight     in CPUE

Loss(-1)  SSE in yield                         0.000E+00
Loss(0)   Penalty for B1 > K                   0.000E+00     1           N/A    1.000E+00          N/A
Loss(1)   PT.crust.tr                          3.889E+00    21     2.047E-01    1.000E+00    1.110E+00      -0.589
Loss(2)   PT.fish.tr                           4.848E+00    21     2.551E-01    1.000E+00    8.902E-01      -0.259
.........................................................................................
TOTAL OBJECTIVE FUNCTION, MSE, RMSE:       8.73646303E+00          2.361E-01    4.859E-01
Estimated contrast index (ideal = 1.0):           0.4808          C* = (Bmax-Bmin)/K
Estimated nearness index (ideal = 1.0):           1.0000          N* = 1 - |min(B-Bmsy)|/K


MODEL PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
-------------------------------------------------------------------------------------------------------------------
Parameter                                       Estimate     User/pgm guess    2nd guess    Estimated   User guess

B1/K      Starting relative biomass (in 1980)  4.027E-01          5.000E-01    6.758E-01            1            1
MSY       Maximum sustainable yield            2.515E+03          3.000E+03    3.600E+03            1            1
K         Maximum population size              1.148E+04          2.000E+04    9.413E+03            1            1
phi       Shape of production curve (Bmsy/K)   0.5000             0.5000            ----            0            1

--------- Catchability Coefficients by Data Series --------------
q(1)      PT.crust.tr                          4.597E-07          1.000E-05    9.500E-04            1            1
q(2)      PT.fish.tr                           1.132E-06          1.000E-04    9.500E-03            1            1

MANAGEMENT and DERIVED PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
-------------------------------------------------------------------------------------------------------------------
Parameter                                       Estimate              Logistic formula           General formula

MSY       Maximum sustainable yield            2.515E+03                          ----                      ----
Bmsy      Stock biomass giving MSY             5.740E+03                           K/2          K*n**(1/(1-n))
Fmsy      Fishing mortality rate at MSY        4.382E-01                      MSY/Bmsy                  MSY/Bmsy

n         Exponent in production function      2.0000                             ----                      ----
g         Fletcher's gamma                     4.000E+00                          ----      [n**(n/(n-1))]/[n-1]

B./Bmsy   Ratio: B(2010)/Bmsy                  8.046E-01                          ----                      ----
F./Fmsy   Ratio: F(2009)/Fmsy                  4.529E-01                          ----                      ----
Fmsy/F.   Ratio: Fmsy/F(2009)                  2.208E+00                          ----                      ----

Y.(Fmsy)  Approx. yield available at Fmsy in 2010  2.103E+03                MSY*B./Bmsy               MSY*B./Bmsy
          ...as proportion of MSY              8.361E-01                          ----                      ----
Ye.       Equilibrium yield available in 2010  2.419E+03          4*MSY*(B/K-(B/K)**2)      g*MSY*(B/K-(B/K)**n)
          ...as proportion of MSY              9.618E-01                          ----                      ----

--------- Fishing effort rate at MSY in units of each CE or CC series ---------
fmsy(1)   PT.crust.tr                          9.532E+05                     Fmsy/q( 1)                Fmsy/q( 1)
```

ESTIMATED POPULATION TRAJECTORY (NON-BOOTSTRAPPED)

Obs	Year or ID	Estimated total F mort	Estimated starting biomass	Estimated average biomass	Observed total yield	Model total yield	Estimated surplus production	Ratio of F mort to Fmsy	Ratio of biomass to Bmsy
1	1980	0.440	4.623E+03	4.800E+03	2.110E+03	2.110E+03	2.447E+03	1.003E+00	8.053E-01
2	1981	0.455	4.960E+03	5.055E+03	2.300E+03	2.300E+03	2.479E+03	1.038E+00	8.640E-01
3	1982	0.455	5.139E+03	5.205E+03	2.369E+03	2.369E+03	2.493E+03	1.039E+00	8.952E-01
4	1983	0.446	5.263E+03	5.329E+03	2.379E+03	2.379E+03	2.502E+03	1.019E+00	9.169E-01
5	1984	0.339	5.386E+03	5.694E+03	1.929E+03	1.929E+03	2.513E+03	7.731E-01	9.384E-01
6	1985	0.290	5.970E+03	6.318E+03	1.833E+03	1.833E+03	2.487E+03	6.621E-01	1.040E+00
7	1986	0.390	6.624E+03	6.570E+03	2.563E+03	2.563E+03	2.463E+03	8.903E-01	1.154E+00
8	1987	0.662	6.524E+03	5.787E+03	3.832E+03	3.832E+03	2.504E+03	1.511E+00	1.137E+00
9	1988	0.828	5.196E+03	4.467E+03	3.700E+03	3.700E+03	2.381E+03	1.890E+00	9.052E-01
10	1989	0.703	3.877E+03	3.669E+03	2.578E+03	2.578E+03	2.187E+03	1.604E+00	6.754E-01
11	1990	0.696	3.486E+03	3.351E+03	2.334E+03	2.334E+03	2.079E+03	1.589E+00	6.072E-01
12	1991	0.688	3.231E+03	3.146E+03	2.163E+03	2.163E+03	2.001E+03	1.569E+00	5.628E-01
13	1992	0.710	3.069E+03	2.975E+03	2.111E+03	2.111E+03	1.931E+03	1.619E+00	5.347E-01
14	1993	0.838	2.890E+03	2.657E+03	2.227E+03	2.227E+03	1.788E+03	1.913E+00	5.034E-01
15	1994	0.626	2.451E+03	2.525E+03	1.580E+03	1.580E+03	1.726E+03	1.428E+00	4.269E-01
16	1995	0.719	2.597E+03	2.548E+03	1.831E+03	1.831E+03	1.737E+03	1.640E+00	4.524E-01
17	1996	0.636	2.503E+03	2.562E+03	1.629E+03	1.629E+03	1.744E+03	1.451E+00	4.361E-01
18	1997	0.700	2.619E+03	2.590E+03	1.813E+03	1.813E+03	1.758E+03	1.598E+00	4.562E-01
19	1998	0.903	2.563E+03	2.312E+03	2.089E+03	2.089E+03	1.617E+03	2.062E+00	4.466E-01
20	1999	1.054	2.091E+03	1.788E+03	1.885E+03	1.885E+03	1.321E+03	2.406E+00	3.643E-01
21	2000	1.008	1.527E+03	1.358E+03	1.369E+03	1.369E+03	1.049E+03	2.300E+00	2.661E-01
22	2001	0.878	1.207E+03	1.154E+03	1.013E+03	1.013E+03	9.098E+02	2.003E+00	2.103E-01
23	2002	0.650	1.104E+03	1.184E+03	7.700E+02	7.700E+02	9.303E+02	1.485E+00	1.924E-01
24	2003	0.707	1.264E+03	1.310E+03	9.260E+02	9.260E+02	1.017E+03	1.613E+00	2.203E-01
25	2004	0.689	1.356E+03	1.412E+03	9.730E+02	9.730E+02	1.085E+03	1.573E+00	2.362E-01
26	2005	0.551	1.468E+03	1.629E+03	8.970E+02	8.970E+02	1.225E+03	1.256E+00	2.557E-01
27	2006	0.597	1.795E+03	1.923E+03	1.148E+03	1.148E+03	1.402E+03	1.363E+00	3.128E-01
28	2007	0.599	2.050E+03	2.172E+03	1.301E+03	1.301E+03	1.543E+03	1.367E+00	3.571E-01
29	2008	0.350	2.292E+03	2.714E+03	9.510E+02	9.510E+02	1.811E+03	7.997E-01	3.992E-01
30	2009	0.198	3.152E+03	3.875E+03	7.690E+02	7.690E+02	2.236E+03	4.529E-01	5.491E-01
31	2010		4.619E+03						8.046E-01

RESULTS FOR DATA SERIES # 1 (NON-BOOTSTRAPPED) PT.crust.tr

Data type CC: CPUE-catch series Series weight: 1.000

Obs	Year	Observed CPUE	Estimated CPUE	Estim F	Observed yield	Model yield	Resid in log scale	Statist weight
1	1980	*	2.206E-03	0.4396	2.110E+03	2.110E+03	0.00000	1.000E+00
2	1981	*	2.323E-03	0.4550	2.300E+03	2.300E+03	0.00000	1.000E+00
3	1982	*	2.393E-03	0.4552	2.369E+03	2.369E+03	0.00000	1.000E+00
4	1983	*	2.449E-03	0.4465	2.379E+03	2.379E+03	0.00000	1.000E+00
5	1984	*	2.618E-03	0.3387	1.929E+03	1.929E+03	0.00000	1.000E+00
6	1985	*	2.904E-03	0.2901	1.833E+03	1.833E+03	0.00000	1.000E+00
7	1986	*	3.020E-03	0.3901	2.563E+03	2.563E+03	0.00000	1.000E+00
8	1987	*	2.660E-03	0.6622	3.832E+03	3.832E+03	0.00000	1.000E+00
9	1988	*	2.053E-03	0.8282	3.700E+03	3.700E+03	0.00000	1.000E+00
10	1989	1.170E-03	1.686E-03	0.7027	2.578E+03	2.578E+03	0.36555	1.000E+00
11	1990	1.409E-03	1.540E-03	0.6965	2.334E+03	2.334E+03	0.08939	1.000E+00
12	1991	1.222E-03	1.446E-03	0.6875	2.163E+03	2.163E+03	0.16837	1.000E+00
13	1992	1.315E-03	1.368E-03	0.7096	2.111E+03	2.111E+03	0.03911	1.000E+00
14	1993	8.535E-04	1.221E-03	0.8383	2.227E+03	2.227E+03	0.35825	1.000E+00
15	1994	6.372E-04	1.161E-03	0.6256	1.580E+03	1.580E+03	0.59980	1.000E+00
16	1995	5.824E-04	1.171E-03	0.7185	1.831E+03	1.831E+03	0.69873	1.000E+00
17	1996	7.027E-04	1.178E-03	0.6357	1.629E+03	1.629E+03	0.51654	1.000E+00
18	1997	8.791E-04	1.191E-03	0.7000	1.813E+03	1.813E+03	0.30322	1.000E+00
19	1998	1.450E-03	1.063E-03	0.9034	2.089E+03	2.089E+03	-0.31058	1.000E+00
20	1999	1.721E-03	8.220E-04	1.0541	1.885E+03	1.885E+03	-0.73916	1.000E+00
21	2000	1.559E-03	6.244E-04	1.0078	1.369E+03	1.369E+03	-0.91489	1.000E+00
22	2001	6.861E-04	5.306E-04	0.8776	1.013E+03	1.013E+03	-0.25708	1.000E+00
23	2002	7.539E-04	5.441E-04	0.6505	7.700E+02	7.700E+02	-0.32605	1.000E+00
24	2003	7.135E-04	6.023E-04	0.7067	9.260E+02	9.260E+02	-0.16946	1.000E+00
25	2004	1.074E-03	6.490E-04	0.6891	9.730E+02	9.730E+02	-0.50379	1.000E+00
26	2005	6.336E-04	7.490E-04	0.5505	8.970E+02	8.970E+02	0.16726	1.000E+00
27	2006	8.014E-04	8.839E-04	0.5970	1.148E+03	1.148E+03	0.09800	1.000E+00
28	2007	1.526E-03	9.983E-04	0.5990	1.301E+03	1.301E+03	-0.42415	1.000E+00
29	2008	1.498E-03	1.247E-03	0.3504	9.510E+02	9.510E+02	-0.18298	1.000E+00
30	2009	1.143E-03	1.781E-03	0.1985	7.690E+02	7.690E+02	0.44325	1.000E+00

* Asterisk indicates missing value(s).

RESULTS FOR DATA SERIES # 2 (NON-BOOTSTRAPPED) PT.fish.tr

Data type I1: Abundance index (annual average) Series weight: 1.000

Obs	Year	Observed effort	Estimated effort	Estim F	Observed index	Model index	Resid in log index	Statist weight
1	1980	0.000E+00	0.000E+00	--	*	5.434E-03	0.00000	1.000E+00
2	1981	0.000E+00	0.000E+00	--	*	5.723E-03	0.00000	1.000E+00
3	1982	0.000E+00	0.000E+00	--	*	5.893E-03	0.00000	1.000E+00
4	1983	0.000E+00	0.000E+00	--	*	6.033E-03	0.00000	1.000E+00
5	1984	0.000E+00	0.000E+00	--	*	6.447E-03	0.00000	1.000E+00
6	1985	0.000E+00	0.000E+00	--	*	7.153E-03	0.00000	1.000E+00
7	1986	0.000E+00	0.000E+00	--	*	7.438E-03	0.00000	1.000E+00
8	1987	0.000E+00	0.000E+00	--	*	6.551E-03	0.00000	1.000E+00
9	1988	0.000E+00	0.000E+00	--	*	5.058E-03	0.00000	1.000E+00
10	1989	1.000E+00	1.000E+00	--	3.514E-03	4.154E-03	-0.16725	1.000E+00
11	1990	1.000E+00	1.000E+00	--	4.288E-03	3.794E-03	0.12245	1.000E+00
12	1991	1.000E+00	1.000E+00	--	3.648E-03	3.562E-03	0.02379	1.000E+00
13	1992	1.000E+00	1.000E+00	--	3.975E-03	3.368E-03	0.16556	1.000E+00
14	1993	1.000E+00	1.000E+00	--	2.372E-03	3.008E-03	-0.23728	1.000E+00
15	1994	1.000E+00	1.000E+00	--	1.498E-03	2.859E-03	-0.64629	1.000E+00
16	1995	1.000E+00	1.000E+00	--	1.112E-03	2.885E-03	-0.95318	1.000E+00
17	1996	1.000E+00	1.000E+00	--	1.621E-03	2.901E-03	-0.58217	1.000E+00
18	1997	1.000E+00	1.000E+00	--	1.604E-03	2.932E-03	-0.60346	1.000E+00
19	1998	1.000E+00	1.000E+00	--	3.158E-03	2.618E-03	0.18741	1.000E+00
20	1999	1.000E+00	1.000E+00	--	3.853E-03	2.025E-03	0.64336	1.000E+00
21	2000	1.000E+00	1.000E+00	--	4.038E-03	1.538E-03	0.96540	1.000E+00
22	2001	1.000E+00	1.000E+00	--	2.267E-03	1.307E-03	0.55092	1.000E+00
23	2002	1.000E+00	1.000E+00	--	2.000E-03	1.340E-03	0.40017	1.000E+00
24	2003	1.000E+00	1.000E+00	--	2.174E-03	1.483E-03	0.38240	1.000E+00
25	2004	1.000E+00	1.000E+00	--	1.897E-03	1.599E-03	0.17102	1.000E+00
26	2005	1.000E+00	1.000E+00	--	1.378E-03	1.845E-03	-0.29159	1.000E+00
27	2006	1.000E+00	1.000E+00	--	1.733E-03	2.177E-03	-0.22795	1.000E+00
28	2007	1.000E+00	1.000E+00	--	3.976E-03	2.459E-03	0.48054	1.000E+00
29	2008	1.000E+00	1.000E+00	--	3.560E-03	3.073E-03	0.14718	1.000E+00
30	2009	1.000E+00	1.000E+00	--	2.581E-03	4.387E-03	-0.53046	1.000E+00

* Asterisk indicates missing value(s).

ESTIMATES FROM BOOTSTRAPPED ANALYSIS

Param name	Point estimate	Estimated bias in pt estimate	Estimated relative bias	Bias-corrected approximate confidence limits 80% lower	80% upper	95% lower	95% upper	Inter-quartile range	Relative IQ range
B1/K	4.027E-01	-2.268E-04	-0.06%	4.016E-01	4.036E-01	3.985E-01	4.048E-01	4.057E-04	0.001
K	1.148E+04	-3.781E+01	-0.33%	1.136E+04	1.159E+04	1.109E+04	1.181E+04	5.258E+01	0.005
q(1)	4.597E-07	4.636E-09	1.01%	3.989E-07	5.334E-07	3.649E-07	5.791E-07	6.819E-08	0.148
q(2)	1.132E-06	4.287E-08	3.79%	1.027E-06	1.268E-06	1.014E-06	1.361E-06	1.288E-07	0.114
MSY	2.515E+03	8.489E-01	0.03%	2.513E+03	2.519E+03	2.510E+03	2.526E+03	9.566E-01	0.000
Ye(2010)	2.419E+03	-7.666E+01	-3.17%	2.160E+03	2.513E+03	1.935E+03	2.518E+03	1.904E+02	0.079
Y.(Fmsy)	1.062E+03	-5.314E+00	-0.50%	1.009E+03	1.082E+03	9.749E+02	1.084E+03	3.889E+01	0.037
Bmsy	5.740E+03	-1.891E+01	-0.33%	5.680E+03	5.796E+03	5.545E+03	5.904E+03	2.629E+01	0.005
Fmsy	4.382E-01	1.697E-03	0.39%	4.337E-01	4.435E-01	4.248E-01	4.557E-01	2.139E-03	0.005
fmsy(1)	9.532E+05	6.588E+03	0.69%	8.190E+05	1.093E+06	7.495E+05	1.191E+06	1.416E+05	0.149
fmsy(2)	3.870E+05	-9.665E+03	-2.50%	3.452E+05	4.276E+05	3.185E+05	4.338E+05	4.439E+04	0.115
B./Bmsy	8.046E-01	-1.076E-02	-1.34%	6.099E-01	1.040E+00	5.146E-01	1.153E+00	2.228E-01	0.277
F./Fmsy	4.529E-01	2.634E-02	5.82%	3.416E-01	5.950E-01	3.023E-01	7.050E-01	1.301E-01	0.287
Ye./MSY	9.618E-01	-3.080E-02	-3.20%	8.562E-01	9.984E-01	7.692E-01	9.999E-01	7.493E-02	0.078
q2/q1	2.463E+00	9.870E-02	4.01%	1.994E+00	2.850E+00	1.830E+00	3.141E+00	4.391E-01	0.178

INFORMATION FOR REPAST (Prager, Porch, Shertzer, & Caddy. 2003. NAJFM 23: 349-361)

Unitless limit reference point in F (Fmsy/F.): 2.208
CV of above (from bootstrap distribution): 0.2147

NOTES ON BOOTSTRAPPED ESTIMATES:

- Bootstrap results were computed from 1000 trials.
- Results are conditional on bounds set on MSY and K in the input file.
- All bootstrapped intervals are approximate. The statistical literature recommends using at least 1000 trials for accurate 95% intervals. The default 80% intervals used by ASPIC should require fewer trials for equivalent accuracy. Using at least 500 trials is recommended.
- Bias estimates are typically of high variance and therefore may be misleading.

Trials replaced for lack of convergence:	0	Trials replaced for MSY out of bounds:	0
Trials replaced for q out-of-bounds:	204		
Trials replaced for K out-of-bounds:	0	Residual-adjustment factor:	1.0654

Elapsed time: 0 hours, 11 minutes, 27 seconds.

Annex N - Benchmark Planning for northern megrim and Bay of Biscay sole

Benchmark for Megrim in VIIb-k AND VIIIabd:

WGHMM attempted to organise priorities and tasks in view of the benchmark assessment for the northern stock of megrim originally scheduled to take place at the beginning of 2011. A summary of the conclusions on the discussion about the date and contents of a benchmark follows.

Reasons for a benchmark workshop:

Since 2007, severe deficiencies in the data led to serious shortage of basic information for this stock, precluding analytical assessment. There is a need for a dedicated time for mending and working out missing data in order to improve its assessment.

Major data issues are listed below

- *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 data series have been provided for the assessment. From United Kingdom only sampling data were available. Underestimation of the international catch matrix occurs as some main countries 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 providing discard data since 1999.

- Revisions of some commercial CPUEs series should be conducted.
- No segmentation of the main commercial fleets used in the assessment has been carried out.

WGHMM09 identified some data problems related to the Data Collection Regulation to be recommended for the attention of PGCCDBS (see ICES, 2009 WGHMM Report-Annex P). This list of data deficiencies was also delivered to the Regional Coordination meeting (RCM) of the Northeast Atlantic, which took place at the end of September 2009. At that meeting, Ireland and United Kingdom were recommended to contact directly the stock coordinator to clarify the data improvements required for LPUEs and discard data series, respectively. At that time, France made the compromise to make available to the WGHMM landings and weights at age of the whole data series of megrim.

Up to date, none of the actions above, identified to give answer to the requests of the assessment group, have been carried out (May 2010). The consequences of that resulted in a continuous shortage of data for the WGHMM in 2010 and raised real doubts about the feasibility of getting any improvement whatsoever of data to be provided to the group.

Planning for the megrim benchmark

Based on the high implication needed from the main countries deploying the megrim fishery, the discussion of the group were initiated by evaluating the real possibility of having data delivered with enough time to carry out a successful benchmark.

It is considered that a main problem with megrim assessment is the lack of discard data and, if this is not provided to the group, then experts on megrim should look for other solutions to overcome data deficiencies.

During the meeting, some information was received from French colleagues about the above issue.

France reached compromise was:

- 2009 landings: the official deadline for availability of statistical catch data is October 2010.
- Discard data: there may be some estimate for 2009, but not for the previous years as there is no reliable discard sampling data for previous years.
- The FU04 series will be updated to include 2009 but not to the level 6. This data has not been validated, if available, for previous years in the database. The detailed segmentation is theoretically available for 2009 but reliability has to be checked.

The French compromise of delivering data to the group, just for the 2009 data, exceeds any possible date planned to carry out a successful benchmark. Also no assurance of getting the complete discard data series was commented.

On the light of the above, WGHMM identified that efforts should be directed to search for alternative ways to handle the lack of discard information as well as to think about a stable future solution to avoid future possible problems with the discard data to be annually delivered to the group.

Thus, if discard data are not provided, there is a need to reconstruct discards data series to fill the gaps. The solutions considered were:

- *Age based models* – XSA after reconstructing the discard data series using selectivity functions applied to the catches distribution.

- *Age based models that allow for some missing discards data* - evaluate whether to shift into *e.g.* SS3 (Stock Synthesis) model would be useful. 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.

However, the success of this plan would require an important human workforce from June to December 2010 in order to reach the benchmark with a complete developed and conditioned model. Time remaining to accomplish this titanic task, from this working group (May 2010) to the benchmark proposed date (January 2011), appears to be clearly insufficient to complete this goal.

Conclusions:

On the view of the above, the group proposes to postpone the megrim benchmark to 2012, hoping that during this time, the work on the new models can be developed. The group commented on the importance of checking the progress on data availability and more importantly, model development during the next WGHMM 2011, to confirm or even delay the newly proposed benchmark date.

Benchmark for Sole in Bay of Biscay:

WGHMM proposed in 2009 that a benchmark assessment will be planned for the Bay of Biscay sole stock in 2011. The more appropriate period should March 2011 to be able to prepare the data requested by a Benchmark WG.

Reasons for a benchmark workshop

The decreasing number of boats in the two commercial tuning fleets was already a problem in 2009. The priority given to the vessels fishing Bay of Biscay sole in the French decommissioning plan has decreased even further this number and it is already know that if should be impossible to tune the XSA one year more using the same tuning fleets.

Major data issues are listed below:

- Landings: check of the French data base
- Discards: analysis of available data
- Biological sampling: revision of the weights at age (landings and stock) and of the maturity ogive
- Commercial LPUEs series: proposal of a new trawler tuning series, examination of the possibility to use LPUE of fixed netters, calculation of a standardized index.
- Surveys: inclusion of the ORHAGO survey in the tuning data and exclusion of the RESSGASC series.

Annex O – Recommendations

RECOMMENDATION	FOR FOLLOW UP BY:
1. Research on hake growth should continue. Otoliths should continue to be collected, as age reading methods could soon be available.	PGCCDBS
2. Otolith exchange for Bay of Biscay sole, to be coordinated by Gérard Biais	PGCCDBS
3. WGHMM does not perceive a necessity for a maturity staging workhop for megrim (see WD 6)	PGCCDBS
4. As Nephrops and sole are also assessed in this WG, the name WGHMM does not seem appropriate. It is proposed that the group be renamed "Working Group on the Assessment of Southern Shelf Demersal Stocks" (WGSSD)	ICES Secretariat
5. A benchmark for Nephrops FU 23-24 should be preliminarily scheduled for the beginning of 2012. Progress towards this benchmark will be re-assessed at WGHMM in 2011, when a definite recommendation will be given.	ICES Secretaria / ACOM
6. Benchmark for northern megrim should be delayed until 2012 (see details in Annex N), and progress on required data and methods to be developed for this benchmark will be re-assessed by WGHMM in 2011.	ICES Secretariat / ACOM
7. ToR list increasing year by year on issues not strictly related to assessment (for example, producing various tables, graphs, additional MSY work this year, etc). This leads to a very high work load, impacting negatively on the quality of the work produced by the WG. Recommendation: not to increase work load any further	ACOM leadership
8. Closer tracking of the recommendations made by the group to PGCCDBS and resolutions concerning them in RCM meetings.	ICES Secretariat
9. The WG requests that RCM-NA addresses the issues identified by WGHMM in 2009 in relation to Mgw-78, as well as those raised in 2010.	RCM-NA

Annex P - Stock Data Problems Relevant to Data Collection WGHMM

Stock	Data Problem	How to be addressed in DCR	By who
Stock name	**Data problem identification**	**Description of data problem and recommend solution**	**Who should take care of the recommended solution and who should be notified on this data issue.**
Mgw-78	Ireland: Revised tunning fleet catches not provided since 2007	LPUE data series stopped in 2006 because of patterns in different areas and major changes in the fleet structure over time.	Ireland and ICES delegate & PGCCDBS & RCM-NA & SGRN
Mgw-78	France: No LANDINGS are provided to the group.	STRONG request for providing these data to Member State.	France and ICES delegate & PGCCDBS RCM-NA & SGRN
Mgw-78	France: No update of CPUEs data series are provided to the group.	STRONG request for providing these data to Member State.	France and ICES delegate & PGCCDBS RCM-NA & SGRN
Mgw-78	France: No discard data (biomass, length distributions and age composition) is delivered to the WGHMM since 1998.	STRONG request for providing these data to Member State.	France and ICES delegate & PGCCDBS RCM-NA & SGRN
Mgw-78	France: No ALK and consequently age composition of landing sand weigth at age is provided to the WGHMM routinely.	Strong request for providing these data to Member State.	France and Ices delegate & PGCCDBS RCM-NA & SGRN
Mgw-78	United Kingdome: Discards provided to WGHMM but not used because of bad quality of the data. (Actually data is not raised).	Application of recommendations of WS Discards (Charlotte Lund, 2003) and future WS on discards (2009)	UK and PGCCDBS RCM-NA & SGRN
Mgb-8c9a	The following data, which are relevant for the assessment, are missing from Portugal: discards (total and length composition), abundance indices-at-length or age suitable to be used as tuning fleets	Request the appropriate data from Portugal, with indicators of quality	Portugal and PGCCDBS RCM-NA & SGRN
Ang-78	United Kingdom, Spain and Ireland: Discards provided to WGHMM but not used because of bad quality of the data. (Doubts about the adequacy of raising methodology used).	Application of recommendations of WS Discards (Charlotte Lund, 2003) and future WS on discards (2009)	UK, IRL, SP and PGCCDBS RCM-NA & SGRN

Stock	Data Problem	How to be addressed in DCR	By who
Ang-78	France: Neither landings nor length distribution data is delivered to the WGHMM.	Strong request for providing these data to Member State.	France and Ices delegate & PGCCDBS RCM-NA & SGRN
Ang-78	France: No discard data is delivered to the WGHMM.	Strong request for providing these data to Member State.	France and Ices delegate & PGCCDBS RCM-NA & SGRN
Ang-78	The precise methodology used for splitting catches between both Lophius species is not available to the WGHMM and no precision estimates are delivered	Strong request for providing these data to Member States.	PGCCDBS RCM-NA & SGRN
Ang-78	Available maturity data recorded under DCF is not being delivered to WGHMM	Strong request for providing these data to Member States.	PGCCDBS RCM-NA & SGRN
Ang-78	Sex-ratio data recorded under DCF is not being delivered to WGHMM	Strong request for providing these data to Member States.	PGCCDBS RCM-NA & SGRN
Ang-78	Growth at length data recorded under DCF is not being delivered to WGHMM	Strong request for providing these data to Member States.	PGCCDBS RCM-NA & SGRN
Ang-89	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. Problems with the splitting of the two species have been detected. Inconsistencies in length composition of landings. An important reduction of Portuguese sampling levels was observed in 2009.	Revision of 2009 Spanish landings data. Revision of 2009 Spanish length samplings.	Spain, Portugal and PGCCDBS RCM-NA & SGRN
Northern Hake	France: very poor quality 2009 landing and discard data provided this year which lead the Working group not to update the assessment	Request to France to provide a revision of the data	France and Ices delegate & PGCCDBS RCM-NA & SGRN
BB sole	Need to find out the cause of the discrepancy between French and Belgian weights at age.	Otolith exchange	France, Belgium and PGCCDBS

Annex Q – WGHMM Proposed ToRs for next meeting

The **Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim** [WGHMM] (Chair: Carmen Fernández, Spain) will meet in ICES HQ, 5-11 May 2011 to:

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

The assessments will be carried out on the basis of the stock annex in National Laboratories, prior to the meeting. This will be coordinated as indicated in the table below.

WGHMM will report by 18 May 2011 for the attention of ACOM.

Fish Stock	Stock Name	Stocks 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	SALY
ang-8c9a	Anglerfish (*Lophius budegassa* and *L. piscatorius*) in Divisions VIIIc and IXa	Spain/Portugal	Spain/Portugal	Portugal/Spain	SALY
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		SALY
mgw-8c9a	Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIIc and IXa	Spain	Spain		SALY
mgw-78	Megrim (*L. whiffiagonis*) in Subarea VII & Divisions VIIIa,b,d,e	Spain	Spain		SALY
sol-bisc	Bay of Biscay sole	France	France		Advice
nep-8ab	*Nephrops* in Divisions VIIIa,b (Bay of Biscay, FU 23, 24)	France	France		No advice
nep-8c	*Nephrops* in Division VIIIc (FU 25, 31)	Spain	Spain		No advice
nep-9a	*Nephrops* in Division IXa (FU 26-30)	Spain/Portugal	Spain/Portugal	Portugal/Spain	No advice

Annex R - Review Group Technical Minutes

Review of ICES Hake Monk and Megrim/ Bay of Biscay Advice 2010

Review of ICES Hake Monk and Megrim Report 2010 - 25-31 May 2010

Reviewers:	Mark Dickey-Collas	Netherlands (chair)
	Cecilie Kvamme	Norway
	David Miller	Netherlands
Chair WG:	Carmen Fernandez	Spain
Secretariat:	Cristina Morgado	ICES

General

The RG acknowledged the intense effort expended by the working group to produce the report. The report was generally well written and easy to follow. Most assessments were considered updates but some had changed as a result of benchmark studies. The introductory paragraphs were useful, clear and appropriate.

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*) in Divisions VIIIc and IXa
- Megrim (*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)

Plus:

- Request on FMSY targets for Northern hake

The WG had addressed their terms of reference. The report was succinct and well organised. The information used in the projections generally appeared appropriate and correct. Almost all stocks had a stock annex.

As all of the stock assessments were updates it was not the role of the RG to question the methods used. No major faults were found in the update assessments. The review below is meant to stimulate and encourage thinking for up coming benchmark assessments.

There was still a paucity of relevant ecosystem information. Many of the comments from last year's review (use of fixed length to weight relationships, fixed maturity ogives etc) are still relevant.

Some of these assessments (sole, *nephrops*) improve their LPUE / CPUE series by e.g. using 10% limit on the species percentage (e.g. 10% for *nephrops*) to ensure that only trips which target the species of interest are included in the LPUE for this species. If the stock biomass of the target species in reality is decreasing, whereas other stocks taken in the same fishery are more stable, could you, by only including trips with more than e.g. 10% *nephrops* choose only the trips with extremely good catches of *nephrops* (that doesn't reflect the real situation in the area) out of the trips that actually target *nephrops*? If so, this would create artificially high LPUEs, and underestimate the decrease in stock abundance.

As pointed out in many chapters, the setting of stock specific TACs for fish caught in mixed fisheries is not a successful management technique. Overall, the RG found the WG 2010 report of high quality.

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

1) **Assessment type:** Benchmark (stock on observation list) but not agreed by WG
2) **Assessment**: analytical (but not carried out in 2010), "only for broad trends"
3) **Forecast**: None
4) **Assessment model**: Stock synthesis 3, SS3 (Methot, 2005), length based – tuning by 4 surveys (EVHOE, RESSGASC, SP-GFS, IGFS). No data from 2009 included in the assessment.
5) **Consistency**: First application of benchmark model – assessment rejected based on poor data so previous years assessment used. Still doubts remain over this assessment, even in its ability to predict trends.
6) **Stock status**: Unknown as recent trends are not accepted by WG and no new PA reference points are given. Assessment only indicative of broad trends. No PA points defined.
7) **Man. Plan.**: agreed by EU in 2004. ICES did not evaluate the plan. The current assessment has only been accepted as indicative of trends and no recovery plan based TAC can be advised A proposal for a long-term plan has been put forward by the EU (2009), with the aim of reaching MSY.

General comments

Due to suspected poor quality of French landings data for 2009, this assessment was not updated from that of the benchmark in 2010. The working group did consider replacing this data with a 'guestimate' but this approach was rejected. This was not mentioned in the report and may be worth reporting. It is disappointing that a flexible model such as SS3 is unable to handle poor data from a source which only represents less than a quarter of the total annual landings on average.

The assessment was also rejected by the WG because the recent trends in F and SSB were thought to be too strong and not indicative of the other available trends. It was suggested that this large increase/decrease was partly caused by a lack of tuning series for larger fish. The review group could not comment on this reasoning but they agreed with the WG that the assessment as it was could not provide information for projections or the stock status.

Fmsy

Range of candidate Fmsy values presented on the basis of SPR analysis. The report voices concern over Fmax (F24%) being too high to act as a proxy for Fmsy for this stock. However this value is lower (substantially) than any F observed for this stock the entire modeled period. The assessment (not agreed) suggests that F is currently almost 50% higher than this now and the stock is rebuilding (rapidly). This highlights the problem of the timeframe being modeled by the newly accepted method (starts after the stock reduced significantly due to data unavailability before this period). Nevertheless this could also suggest that F35% may be too low for an Fmsy proxy and perhaps a range from F30%-Fmax would be more reasonable.

F35% SPR given as 0.2 in the definition of Fmsy ranges, but 0.21 in YPR reference points table.

Technical comments

Input data broadly appear to be correct and suitable.

Stock annex:

Reference Hewitt and Hoenig 2005 is missing in the reference list

On page 441, §1 it is said that "For the two Spanish trawl fisheries, it is thought that discarding became much more substantial from 1998." Why?

The description of how the stock synthesis model is used is a bit too short to be easy to follow – thus it is too difficult to understand what really has been done.

It is mentioned that "a workshop has shown that the previously internationally agreed ageing method is neither accurate nor precise and provides overestimation of age." There is still no new replacement ageing method. It was therefore decided to use a length-based stock assessment model. Still, age is mentioned several times in the description of the used stock assessment method (e.g. p. 440. This is rather confusing. E.g. I don't understand how southern hake data can be fitted to a von Bertalanffy growth curve without age data …)

On page 442 the phrasing "according to how representative each survey was felt to be of stock abundance" or similar was used twice in lines 1-5. This should be rephrased and elaborated on, as this judgment probably is more than a mere feeling.

WG Report chapter

Some repetitions from the stock annex (p 26-27).

Page 27, §5: Elaborate on why the French data is of poor quality. **This is very important, as it forms part of the substantive reason for rejecting the assessment using the new benchmark method.**

Page 29, §4: assessment not updated due to the lack of reliable French landings. The review group was told that an exploratory run including 2009 data were done, but not accepted by the WG due to strange results. It would be very useful if this exploratory run had been presented shortly in the report (what was used for replacing French landings, results, ideas about the reason for the strange results).

Figure 3.1. In the SS3 model, the RESSGASC survey is split by quarter, so it would be nice to present this survey by quarter also in this figure.

Some problems in the residuals and the retrospective pattern.

Don't like the y-axes on figure 3.7 – makes it difficult to get a proper feel for the extent of the retro problem. As it is displayed, it appears quite severe.

Conclusions

The report states that recent trends are very uncertain for various reasons then goes on to recommend its use as a trend-based assessment.

Ideally the benchmark should have recommended a 'back up' model to run in parallel with the SS3 given the notable concerns over the contrasts in the data over the modelled period causing the model to be unable to accurately predict important population indicators.

A lot of important information about this stock on its historical development is lost when the modelled period is reduced to the time when data by quarter etc. is available. This removes contrasts in the time series and makes it difficult to properly analyse trends and define potential Fmsy values. It is strongly recommended that the time period modelled is extended back further in time as it seems that the data that is available for early years is now no longer of any value given the current modelling framework.

SS3 is supposed to be a very flexible model, capable of using all available data to full effect while estimating many parameters. It does not seem reasonable for such a model to collapse in the face of some missing catch data from a not so important FU of the fishery and a paucity of tuning information for larger fish.

The review group agrees with the working group that the current assessment does not provide information for the provision of advice and suggests further that due to the restricted stock dynamics over this new shorter period there is little information for determining MSY targets.

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

1) **Assessment type:** update
2) **Assessment**: analytical
3) **Forecast**: Medium term forecast presented (11 scenarios, 10 years)
4) **Assessment model**: ASPIC surplus production model (one for each species) – tuning by landings and 2 commercial fleet indices (LPUE) for each assessment (different fleets used for each species, Spanish (Div. VIIIc) for L. piscatorius and Portuguese (Div. IXa) for L. budegassa).
5) **Consistency**: Update of 2009 assessment, done according to stock annex. Consistent model formulation and data inputs.
6) **Stock status**: No PA reference points for the stocks. L. piscatorius: below BMSY for the last 15 years (around 25%), F well above FMSY despite decrease in recent years. L. budegassa: B increasing and F decreasing steadily over last 8 years. In 2008 F dropped below FMSY and has remained below it, B increasing but not yet above BMSY.
7) **Man. Plan.**: None (but caught in mixed fisheries and recovery plans are in place for hake and *Nephrops* in the same area). A proposal for a management plan for the Iberian mixes fisheries of hake, anglerfish and *Nephrops* is being considered by EC.

General comments

The assessments are updated of the 2009 assessments, performed using identical settings and updated (two extra years) data. The assessment is well documented and presented providing clear, succinct results of the analyses completed. Adequate results are presented for the formulating of advice.

Generally clearly presented and easy to follow despite two separate assessments being run.

Fmsy

The ASPIC model is well suited for providing advice according to Fmsy framework (i.e. Fmsy can be directly estimated, with uncertainty bounds, from the parameters).

Fmsy from the model outputs is proposed as a reference point but concerns over the estimation of the biomass parameters means no Btrigger has been defined.

Should the projection scenarios should also include a ICES Fmsy transition scheme line? (at least in the advice).

Advice sheet

Still rough – some of the template guidelines (blue text) needs to be removed.

The 'Environmental influence on the stock' section just repeats most of the 'biology' section and then says, "recruitment is sensitive to the environment". Not very useful.

Figure 7.4.4.2 *L budegassa* – incorrect legend in figure (2007 and 2009 swapped).

Outlook for 2011 table a bit messy, difficult to read.

Rationale for the three rows below Fmsy should be -15%, 0% and +15% change in TAC, not in terms of percentage change in F.

MSY approach description not clear. Says “F should be reduce to…” but then gives the multiplication factor to get to whatever F should be, not the value itself.

Should also be noted that this is based on the stock in poorest condition (L. pisc.).

Says this year that advice is based on transition scheme in ICES Fmsy framework, but advice given is just 0t.

Technical comments

Input data broadly appear to be correct and suitable.

L. piscatorius

Number of bootstrap runs has been increased from 500 to 1000 following review of the 2009 assessment. This change allows for a better understanding of the uncertainty in the assessment outputs without compromising the methodology (i.e. can still be considered an update assessment despite the change).

However, they still talk about 80% CIs (instead of 95% CIS that can be reasonably estimated with the increased number of runs) when describing the results and in plots (e.g. Figure 8.1.5).

In comparison with the previous assessment, there is a large increase in the estimated values of K and Bmsy, complemented with decrease in estimate of Fmsy, and B1 stays similar (Table 8.1.9). This is thought to be because of changes made to the min and max allowable ranges for MSY and K (expanded to decrease the number of replaced bootstrap trials). However the trend remains the same with only relative differences in B and F (in historic period up to 1992 for F and the whole time series for B).

L. budegassa

Parameter estimates very similar from 2009 to 2010. Good.

Increased number of bootstrap runs and describes 95% confidence intervals in the text, but still plots 80% CIs.

Estimates of B are down and F up for most recent years (retro) but trend consistent.

Both assessments have very low R-squared values for observed vs fitted CPUE values of the two series used (even negative – possible? – for L bud). What are the implications of this? Is the model still acceptable? The implications of this are not discussed too much despite saying: “The assessments are completely dependent on commercial LPUE data which may be biased due to targeting, local depletions, and changes in efficiency.”

Figure 8.1.3. legend is incorrect (wrong lines for the two assessments).

Pg 5, ln 41 should read Figure 8.1.5 not 8.1.6

Conclusions

The assessment for the most part has been performed correctly according to the stock annex. However there are some concerns over the fit of the model to the CPUE series. This does provide information for the provision of advice.

Stock Hake in Division VIIIc and IXa (Southern stock)

1) **Assessment type**: update from bench mark in 2010
2) **Assessment**: analytical
3) **Forecast**: presented
4) **Assessment model**: Gadget (Age-length based) – tuning by 2 comm (SP-CORUTR, P-TR) + 3 surveys (SP-GFS, SP-GFS-caut, P-GFS-aut)
5) **Consistency**: : First application of this model for advice.
6) **Stock status**: 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) for the last three years. Suggested Fmsy-candidate = Fmax = 0.26
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

This assessment is clearly presented and well explained. The stock was benchmarked very recently and the benchmark assessment has been updated with the latest available data according to the stock annex for the stock.

This was a well documented, well ordered and considered section. It was easy to follow and interpret. Chapter 7.5.1 "Stochastic simulations to test robustness of MSY candidates" gives a thorough and interesting testing of different candidates. Although it is said that 4*12 scenarios were run. In Figure 7.13 only 4*9 scenarios are presented, as the combination M02L100 is missing. Was this combination also run?

The discard is quite high, about the same size as the landings when looking at numbers in 2009 (in weight, 14%).

Concerning the EC recovery plan – when there is a conflict between the ±15% in TAC and the 10% reduction in F, what should the advice be?

The recruitment in 2009 is estimated to be very high in the model, but as it is replaced by a GM in the short-term projections, it looks OK. Figure 7.6 – Recruitment scale could be better. Why large increase in last year? Can't clearly see patterns in Recruitment because hugging the x-axis. Ten times higher than historical mean in 2009.

The stock has a history of Catches > TAC > ICES advice.

Fmsy

A thorough stochastic evaluation of potential Fmsy candidates was preformed and Fmax was recommended as a robust reference point for this stock.

Technical comments

Input data broadly appear to be correct and suitable.

Stock annex:

P. 482, §8: The growth function is estimated by using tagging data for the north stock, i.e. the Northern hake (?). Is the growth of these two stocks similar?

P. 482, §10: Maturity at length – please give the parameters of this logistic maturity curve. Was it estimated within Gadget, or externally?

P. 486-487: In the table “Data used for the assessment …”: shouldn’t 2009 also be included in the time period?

P. 487: In the table “Description of the likelihood components …”: Is it really % in the rightmost column? Or rather relative contributions?

P. 488: How do you give starting values for numbers at age (as well as limits for these values) in the first year, when there is no good method for ageing?

P. 490: Are the biological reference points still valid with the use of a new assessment model? The growth rate and natural mortality has increased, and likely other characteristics of the stock with them.

P. 490: Under “H. Other issues …” it is said that (line 2) “The two new models are considered to be an improvement …”. As far as I can see, only one new model is presented for this stock. Are you talking about both hake stocks?

Reference Hewitt and Hoenig 2005 is missing in the reference list

Report Stock section:

P. 144, §4: It is said that “Previous PA values are not relevant with new assessment model.” This should be mentioned in the stock annex also.

P. 154: Should be marked as Figure 7.1.

Figure 7.4 – the years on two of the x-axes are not complete.

P. 159-176 – mark these figures as Figure 7.6 a) etc., instead of only a) etc.

Figure 7.7, upper panel = Catch, explanation of colours: should it be Land94-09 (instead of 94-08)? And Discards94-09?

Conclusions

This is a clear, well described and accepted stock assessment. The RG feels it is a good basis for the provision of advice.

Stock: Megrim (Lepidorhombus boscii and L. whiffiagonis) in Divisions VIIIc and IXa

1) **Assessment type:** update
2) **Assessment**: analytical
3) **Forecast**: presented
4) **Assessment model**: XSA (one for each species) – tuning by 1 comm LPUE series (SP-CORUTR8c) + 1 survey (SP-GFS)
5) **Consistency**: same as last year but no stock annex
6) **Stock status**: No PA reference points. L. boscii above proposed Fmsy value, L. whiffiagonis below proposed Fmsy in the last year (2009).
7) **Managament Plan.**: None (but caught in mixed fisheries and recovery plans are in place for hake and *Nephrops* in the same area).

General comments

This section was well documented, well ordered, transparent and considered. It was easy to follow and interpret. There is currently no stock annex for these stocks, these are proposed to be presented next year. However, the assessments are clearly described.

Updated assessments were performed for this stock even though advice will be the same as last year. This was done to attempt to provide candidate reference points for the Fmsy approach to management based on the latest available data and model fits.

High discards – around 40-62% of ind caught by trawl discarded. Discards are NOT included in the assessment, due to lack proper sampling. The simple exercise trying to show the importance of the discards concerning estimation of Fmsy-candidates is very illustrative (see below).

The bubble plots showing standardized values (Figure 9.13b-c, 9.1.4) are very illustrative.

Some problems with patterns in the residuals of the fleets used for tuning (year effects).

Fmsy

It is acknowledged that the exclusion of discards from the assessment is likely to affect the estimation of Fmax and F0.1 (potential proxies for Fmsy). A small sensitivity to discards is performed to test the likely effect of this on potential Fmsy proxies and it is concluded that while Fmax may be affected, F40% seems more robust. Given that the YPR curve is also flat-topped making Fmax poorly defined, F40% is proposed as a potential Fmsy proxy. No Btrigger value is proposed.

Technical comments

Input data broadly appear to be correct and suitable.

L. whiffiagonis:

Concern about failure to converge (doesn’t after 200 runs). See Methods WG report 2009. Strong retrospective pattern is also of concern.

There is no Table 9.2.8 (Tables goes from 9.2.7 to 9.2.9).

Table 9.2.17. The column headings Yield and SSBJan should be changed into Yield/R and SSBJan/R.

Conclusions

While there are some concerns with the assessments performed, these have no impact on the advice for this year. The updates have been used to provide a defendable Fmsy proxy.

Stock: Sole in Divisions VIIIa,b (Bay of Biscay):

1) **Assessment type:** update
2) **Assessment**: analytical
3) **Forecast**: presented
4) **Assessment model**: XSA – tuning by 2 CPUE fleets ((FR-SABLES, FR-ROCHEL) and 2(RESSGASC Q2 + Q4), 2 of which have data series up to 2002 only (i.e. discontinued).
5) **Consistency**: Consistent with last year
6) **Stock status**: Biomass fluctuating around Bpa (=MSY Btrigger) for last 5 years, currently slightly above it. F has been slightly below Fpa for the last 4 years. Recruitment for this stock is uncertain but thought to be slightly below the geometric mean of the historic period.
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 has been reached. Plan is **not** evaluated by ICES. First phase biomass target for 2008 has been reached and the plan should enter in 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.

The practice of using different fresh / gutted transformation coefficients for catch and stock to be able to compare with the estimated PA values for SSB seems a bit odd, as I guess it would be possible to estimate new PA reference points for SSB.

The only tuning fleets that influence the results in the last years of the assessment are the two commercial fleets. These fleets each contributes with less than 1% of the catches of sole (page 97). Can we trust that these fleets are representative for the entire fleet, and not too much influenced by technical creep, and thus representative of the stock abundance?

Some pattern in the residuals (year effects). Very little trend in the CPUE series – stable stock or poor indicators?

Discards assumed to be low in recent years for the most important fleets. This needs more justification.

Apparent problems with ageing and weight-at-age – differences between France and Belgium.

The recruitment of the year classes 2007-2010 are all estimated by GM93-2007 and the influence of this estimate on landings and SSB in the short-term projection is very high (58% of the 2011 landings, 68% of the 2012 SSB). However, according to the XSA results, the recruitment has been fairly stable throughout the time series 93-07, so this is probably not a problem.

Table numbering system different to other sections of the report (i.e. 6.x, instead of 6.section.x). Also, Table 6.2 comes up in the text after Table 6.3.

Final XSA settings in 2009 column show first two fleets were only used up to 2007. Assume this was meant to be 2008 as the data appears to be available.

Fmsy

Fmsy chosen as Fmax – reasonable given the (lack of) stock recruit pattern and lack of faith in recruitment estimates. MSY Btrigger chosen as default fallback value = Bpa.

Advice sheet

Good. All necessary information included and clearly presented according to the ICES template.

Except:

Stock status table – for Bpa/Btrigger should be above, below, above.

Table 7.4.12.1 – not completed for 2011.

Technical comments

Input data broadly appear to be correct and suitable.

Stock annex:

The table at p. 478 gives the impression that PA reference points are not defined for this stock. According to the table in the advice sheet, reference points are defined.

Report Stock section:

The tables and figures come in a strange order, not chronologically according to where they are mentioned in the text.

XSA didn't converge. Have any runs been done to test the sensitivity to the number of iterations run? The total absolute residual between the last two iterations seems small enough though. **Please look at the methods working group 2009 report, where they discuss convergence in XSA.**

Limited discussion on management plan. First phase complete, what now? Recommend moving to an F-based target (Fmsy)?

Conclusions

Good assessment. Done as laid out in the annex. Clearly explained and presented.

This stock shows only small fluctuations over time, not surprising given the lack of contrast in the CPUE series that it is fitted to.

Management plan moving to an F-based target is a positive development.

Fmsy reference points acceptable given the data.

Stock: *Nephrops* in Divisions VIIIa,b (Bay of Biscay, FU 23, 24):

1) **Assessment type:** update
2) **Assessment**: analytical
3) **Forecast**: presented
4) **Assessment model**: XSA with slicing of length distributions of catch (combined sexes including discards) + tuning by 1 LPUE fleet
5) **Consistency**: no advice or assessment last year, same approach as 2 years ago.
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). The fishing mortality (0.4) is probably well above candidate FMSY of 0.17. Large retrospective pattern.
7) **Man. Plan.**: No specific management objectives are known to ICES. TAC does not limit the fishery. In light of the EU policy paper on fisheries management (12 May 2009, COM(2009) 224) this stock is classified under category 6. As the TAC was not constraining for landings over the years 2006-2009, that implies a TAC in 2011 based on reduction up to 15% of the averaged landings over recent years in order to reach Fmax proxy up to 2015.

General comments

This was generally easy to follow and clearly described. The RG found no errors in the application of the stock annex.

The large retrospective pattern in both F and SSB (only information prior to 2004 appeared consistent) suggests that the information base about the current status of the stock is weak.

Technical comments

Quite a lot of repetitions from the stock annex (p. 312-316). Should refer to the stock annex instead.

Table 10.4-10.6 not mentioned in the text.

The tables and figures come in a strange order, not chronologically according to where they are mentioned in the text.

The strong year effects in the residuals of the tuning fleet are not clearly stated in the text. In Figure 10.5 there is clearly a dominance of negative residuals from 1987-1996, relatively small residuals from 1997-2000, and positive residuals from 2001-2009.

Table 10.9 would be easier to read and understand if column headings and row names (year) were added.

What is the incubation time of the *nephrops* eggs? In page 502 (Annex J – Bay of Biscay *Nephrops*) it is said that it takes 7 months, whereas in Annex L p. 527 it is said that "After spawning, females carry the eggs for a 3 to 4 month period after which the larvae hatch …".

Conclusions

The assessment has been performed correctly and the RG views it appropriate for broad advice but information on the recent years is poor and therefore the provision of short term projections is not appropriate.

Stock: *Nephrops* in Division VIIIc (FU 25, 31)

1) **Assessment type:** update
2) **Assessment**: stock trends
3) **Forecast**: none
4) **Assessment model**: Analysis of trends in LPUE
5) **Consistency**: no advice or assessment last year, same approach as 2 years ago
6) **Stock status**: two function units (25 and 31) both at SSBs at historic lows.
7) **Man. Plan.**: TAC does not limit the fishery. 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

This report is clear and documents well the fisheries and attempts to assess the exploited stocks. The weakness of the assessment is correctly noted. The LPUE series are the most appropriate technique to assess the stock and the conclusions are justified.

Technical comments

No mention of why discards considered very low in these fisheries.

Otherwise no other technical issues.

Conclusions

The assessment has been performed correctly and the RG views it appropriate for broad advice.

Stock: *Nephrops* in Division IXa (FU 26-30):

1) **Assessment type:** update
2) **Assessment**: Varies dependent on FU, all denote trends only
3) **Forecast**: none
4) **Assessment model**: **FU 26 and 27**: analysis of LPUE trends (no discard estimates). **FU 28 and 29**: XSA with slicing of length distributions of landings (separate sexes, no discards as negligible) + tuning by 1 LPUE fleet and 1 survey fleet. **FU 30**: trends in LPUE and survey.
5) **Consistency**: no advice or assessment last year, same approach as 2 years ago.
6) **Stock status**: No agreed biological reference points. FU 26 and 27 stocks are at an extremely low level. Increase in mean sizes and previous assessment (2006) indicate that the stocks suffer a progressive recruitment failure. FU 28 and 29 large retrospective pattern makes comment on current state of stock biomass and recruitment difficult but F appears more robust and suggests a decline in fishing mortality over the last 5 years. FU 30 – the trends in the time series are difficult to interpret and the review group find it difficult to justify the statement of stock stability in recent years.
7) **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

This was generally easy to follow and clearly described. The RG found no errors in the application of the stock annex.

FU 28 & 29: The large retrospective pattern in both F and SSB (only information prior to 2004 appeared consistent) suggests that the information base about the current status of the stock is weak.

The claim of stability in biomass of FU30, was considered unjustified by the review group. The evidence held in the report suggests either “no information to provide advice” or a decline.

Technical comments

FU 28 & 29: The year effects in the residuals of the XSA are quite high, for both males and females. And the retrospective pattern is also quite strong. Is it sensible to split the *nephrops* by sex even when defining BRP’s for this stock? As shown by the table at page 378, the differences between males and females concerning estimated BRPs are negligible.

Is it sensible to split by sex in the XSA? The results show e.g. decrease in the R of males, whereas the recruitment of females is quite stable. Is this reasonable? Recruitment to the fishery at a quite early age, probably before being mature, and then the natural and the fishing mortality should be similar for males and females, shouldn’t it? The SSB results are similar – males decreasing and females more or less stable – but this may be more reasonable – given the lower mortality for mature females hiding in their burrows.

Conclusions

Other than for FU30, the reported analysis provides a good basis for the advice.

Annex S - Celtic Sea Technical Minutes

Review of ICES **Working Group on the Assessment of Southern Shelf Stocks of Hake Monk and Mergrim [WGHMM] Report 2010**

4–11 May 2010

Reviewers:	Mike Armstrong (chair), Marie Storr-Paulsen, Jens Floeter, Yvonne Walther
Chair WG:	Carmen Fernandez, Spain
Secretariat:	Cristina Morgado

Review process

The Review Group considered the following stocks:

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

- Megrim (L. whiffiagonis) in Subarea VII & Divisions VIIIa,b,d,e

These were reviewed along with all the ICES WGCSE stocks and four stocks from ICES HAWG. The Review Group conducted its work by correspondence and through Webex conference facilities organised by ICES. The reviews have been carried out according the Guidelines provided by ICES, particularly focusing on the need to Quality Assure the assessment results supporting the provision of fishery management advice by ICES in the annual ACOM advice sheets. All stocks were reviewed by at least two reviewers. This involved:

- Checking that update assessments have been correctly implemented using the methods described in the Stock Annexes;
- Checking that the assessments have been implemented correctly, which could involve re-running the assessments to ensure the results in the WG report can be replicated exactly;
- Ensuring the assessment results and forecast results are carried over correctly to the advice sheets and advising ICES of any errors detected;
- Evaluating the ability of the stock assessments for providing credible management advice, and suggesting alternative advice where assessments do not appear appropriate;
- Providing recommendations to the Working Group to help with future development of the assessments through benchmarking.

Anglerfish (Lophius budegassa and L. piscatorius) in Divisions VIIb-k and VIIIa,b (report section 4)

1) **Assessment type:** (SALY).
2) **Assessment:** no -assessment has been accepted in recent years
3) **Forecast:** None
4) **Assessment model:** catch data; fishery and survey CPUE trends
5) **Consistency:** no reliable fishery landings data for 2009
6) **Stock status:** indication of a series of moderate and good year classes
7) **Man. Plan.:** none

General comments

The WG addressed the TORs relevant to providing "same advice as last year".

An age based assessment was rejected by the WG in 2007, due to problems in age reading. The assessment is currently based only on fishery LPUE and survey trends.

The WG report and Stock Annex do not provide ecosystem information relevant to anglerfish populations and their fisheries. Some basic biology is provided in the Stock Annex under "ecosystem aspects"..

The data provided by the WG are purely single-species and the WG does not provide mixed fishery data and evaluations to support development of management advice.

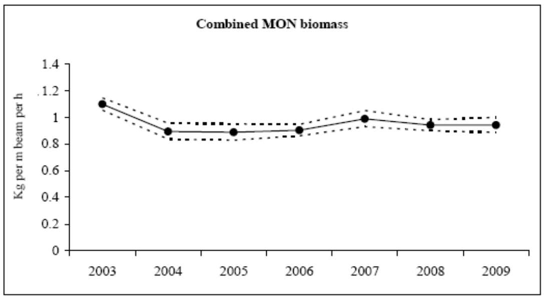
There is no management plan for these stocks.

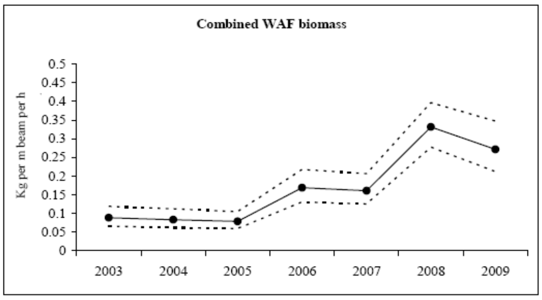
In 2009 there were large problems with landing data as roughly 80% of anglerfish landings are from France and Spain, and these countries were not able to provide final or reliable data to the WG. Therefore no reliable landings and length frequency data have been produced for 2009. In 2008 the catches of both species were estimated at 32 200 t.

Estimation of discards shows that an increasing proportion of small fish of both species are discarded. This must be a consequence of improved recruitment in the 2000s and highlights a need for measures to reduce the catch and discarding of juveniles. The WGHMM provides survey data plots for recruits that show a widespread distribution when recruitment is strong, meaning that it would be difficult for the anglerfish fisheries to avoid areas with small anglerfish. The WGHMM recommends that prior to the next benchmark assessment, the raising methodology for discards be provided and discussed.

Four surveys are conducted in the relevant area and used for providing abundance trends. The fishery LPUE's and the Evhoe survey (biomass and abundance indices, length distribution) give indication that the biomass of L. piscatorius 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 recruitment in 2008 and 2009. The Spanish Porcupine Bank survey gives a different trend, indicating a relatively stable CPUE in terms of biomass and a declining CPUE in terms of numbers. The WG presented length compositions but not the CPUE trends from the UK Fisheries Science partnership survey in VIIe and VIIf . Figures available on the Cefas web site show a stable CPUE in terms of weight, for L. piscatorius but an increasing abundance of L. budegassa (see figures below).

UK FSP survey indices (kg per metre beam per h) for Lophius piscatorius (MON) and Lophius budegassa (WAF)





The fishery LPUE for L budegassa show a range of different trends depending on fleet. The Evhoe survey shows a sharp increase in biomass and numbers from 2005 – 2008 followed by a sharp drop. This is also apparent in the UK-FSP survey (trends not plotted in the WG report but shown above). The surveys show evidence of relatively strong recruitment in the 2000s.

Technical comments

1. The WG should ensure consistent use of survey names in text and figures/ tables.
2. When the WG states in the report that “there was no accepted assessment for either L piscatorius or L budegassa in 2007” it should be made clear that it was a “rejection of an age based assessment due to age reading problems”.
3. A number of the figures do not indicate the units on the axes.
4. The WG should ensure that the compilation of discards data for the next benchmark takes notice of the ICES advice on discard raising procedures given in the Workshop on Discard Raising procedures (WKDRP) and that the bias and precision of the data are evaluated, for example using the COST tools, to meet the requirements of the ICES Quality Assurance Framework.
5. The four surveys should be examined in more detail to find reasons for conflicting information in some years, which may be due to difference in spatial coverage.

Conclusions

The RG considers that the surveys provide a reasonably coherent picture of trends in abundance of the two anglerfish species, indicating an increasing or stable biomass and abundance. A suitable assessment framework is needed to allow allow an integrated analysis of the fishery and survey information. The RG agrees with the WG that the recent increase in recruitment, clearly defined as modes in the length compositions, provides an opportunity for validating ages. It will also allow an evaluation of statistical assessment methods that can handle length data.

However, the RG is concerned about the decreased quality of fishery data and emphasizes the need for adequate sampling data..

Mergrim (L. whiffiagonis) in Subarea VII & Divisions VIIIa,b,d,e (report section

1) **Assessment type:** SALY
2) **Assessment:** No analytical assessment is available for this stock since 2007
3) **Forecast:** none
4) **Assessment model:** CPUE trends. Biomass indices from three surveys (EVHOE, SP-PGFS, and IGFS). CPUEs trends from 3 Spanish fleets. LPUEs for 4 French commercial fleets till 2008.
5) **Consistency:** No fishery data are available for 2009 due non-availability of French landings figures (major part of the landings)
6) **Stock status:** stable, however, very uncertain
7) **Man. Plan.:** none

General comments

The WG addressed address the TORs relevant to providing "Same advice as last year"..

The WG provided an update of data available for assessment, including survey trends. A major problem for this (and many other stocks) is the absence of official French landings data in 2009, which has precluded the compilation of commercial landings and length/age composition data for 2009.

Some ecosystem information relevant to megrim and its fisheries is provided in the Stock Annex along with basic information on biology.

The data provided by the WG are purely single-species and the WG does not provide mixed fishery data and evaluations to support development of management advice.

There is no management plan for this stock.

Last year the RG raised some problems concerning quality of discard data and conflicting survey indices. However, the quality of the input data has decreased since last year and no inter-sessional work to improve data quality has appeared. Although this species is targeted in a mixed fishery the TAC is relatively high and this can cause some concern as long as the data quality is at the present poor level.

The RG agrees with the WG and highly recommends member states to deliver catch data and the necessary sampling data for landings and discards to allow improvement of the assessment , as the stock is planned to be benchmarked in 2011. As with many stocks, a major issue is the apparent inability of some countries to provide adequate, quality assured and appropriately raised discards data to Working Groups, despite Data Collection Framework requirements to estimate discards to specified precision levels.

Technical comments

1. In section 5.2. The change in MLS seems to be used to explain both increase and decrease in discard levels.

2. The way discard numbers are provided by countries is very inconsistent. If it is not possible to raise discard numbers to total fleet with acceptable precision and accuracy, discard data should not be accepted. Currently discards are only estimated for the Spanish fleet. There are no explanations in the text why the Irish and UK discard numbers have not been supplied in raised form and why France does not supply discards data.
3. A table with landings in tonnes by country could be useful.
4. The WG does not provide any evaluation of the relative quality of the different tuning fleets, for example in terms of internal consistency of age compositions or presence of year effects, and if differences in trends are related to different spatio-temporal patterns across the range of the stock as opposed to accuracy problems in the surveys. Screening of such data using models such as SURBA is common in other Working groups. SURBA would also provide recruitment series that could be compared across surveys.

Conclusions

The RG agrees with the WG that the stock appears stable at the present level of fishing.

However, the landings are expected to be considerably higher in 2009 than in 2008 as they have exceeded the 2008 level without the French data (20% of the landings in the stock annex). The RG are concerned about the increasing landings coincident with the decreasing quality of input data. This is an important issue for ICES to deal with urgently, as neither the stock assessment Expert Groups, the PGCCDBS or the Regional Coordination Meetings appear to have success in ensuring the delivery of the necessary fishery sampling data in the required form in all cases. This is probably an issue for the European Commission in relation to DCF requirements.

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

Important preliminary remark: Due to the lack of reliable French landings for 2009 the Working Group decided, during its May 2010 meeting, not to update the assessment and to base its advice on the last available assessment (WKROUND, 2010). The French data were made available during fall 2010 and the assessment was updated by the WG in October 2010. The following report is an edited version of the initial WGHMM 2010 report.

Type of assessment: update (stock benchmarked in 2010), stock on observation list.

Data revisions: Discard data for Spanish trawl in VII have been revised, as errors found in the effort data used to raise trip estimates to fleet level were corrected.

Review Group issues: This year, the assessment model has changed and almost all issues raised by the review group are not valid anymore. All other issues (Comment on discard in table 3.1, comment on discard sampling program in the Stock Annex) have been addressed in the current version of the report

1.1 General

1.1.1 Stock definition and ecosystem aspects

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

1.1.2 Fishery description

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

1.1.3 Summary of ICES advice for 2010 and management for 2009 and 2010

ICES advice for 2010

Applying a fishing mortality of F = 0.25 as indicated in Article 5.2 of the agreed recovery plan is expected to lead to an SSB 171,200 t in 2011 (the highest SSB since 1989), with estimated landings in 2010 of 55 200 t. This implies an increase in TAC of 7%. ICES also indicates that the fishing mortality in 2008, estimated at 0.24, is above fishing mortalities that are expected to lead to high long-term yields and low risk of stock depletion (F0.1 = 0.10 and Fmax = 0.18). This indicates that long-term yield is expected to increase at fishing mortalities well below the historic values. Fishing at such a lower mortality is expected to lead to higher SSB and therefore lower the risk of observing the stock to be outside precautionary limits.

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)	2004	2005	2006	2007	2008	2009	2010
IIIa, IIIb,c,d (EC Zone)	1178	1284	1323	1588	1627	1552	1661
IIa (EC Zone), IV	1373	1496	1541	1850	1896	1808	1935
Vb (EC Zone), VI, VII, XII, XIV	21926	23888	24617	29541	30281	28879	30900
VIIIa,b,d,e	14623	15932	16412	19701	20196	19261	20609
Total Northern Stock [IIa-VIIIabd]	39100	42600	43893	52680	54000	51500	55105

Management for 2009 and 2010

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, the northern hake SSB for 2009 is estimated to be above the recovery plan target (140 000 t). Article 3 of the recovery plan prescribes that a management plan should be implemented when the target is reached in two consecutive years and ICES considers that SSB has been approximately 140 000 t in the last two years. Such a plan is under development by the EC.

1.2 Data

1.2.1 Commercial catches and discards

Total landings from the Northern stock of hake by area for the period 1961-2009 as used by the WG are given in Table 3.1(Annex T). 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.

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 47 822 t in 2008. This tendency continued in 2009 with a 23% increase from 2008 to 58 977 t).

The discard data sampling and data availability are presented in the Stock Annex. Table 3.2(Annex T) presents discard data available to the group from 1999 to 2009. Discards estimates from Spanish Trawl in VII have been revised: fishing effort values used in the raising have been corrected as they were over-estimated leading to an overestimation of discards.

1.2.2 Biological sampling

The sampling level is given in Table 1.3.

Length compositions of the 2009 landings by Fishery Unit and quarter were provided by Ireland, Spain, France, Scotland, UK(E&W) and Denmark (annual).

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 (Annex T)).

1.2.3 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 survey conducted in the Bay of Biscay and in Celtic Sea with a new design since 1997, the SP-PGFS survey conducted on the Porcupine Bank since 2001, and the Irish Groundfish Survey (IGFS) 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 3.1 (Annex T) presents 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.

After two consecutive years of increases in 2001 and 2002, the abundance index provided by EVHOE 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 to a level close to the 2005 and 2006 levels.

The abundance index provided by IGFS follows a similar trend to EVHOE in recent years with a sharp decrease from 2008 to 2009.

For the SP-PGFS survey conducted on Porcupine's Bank since 2001, the abundance index follows an increasing trend since 2003, reaching its highest value in 2009.

The spatial distribution of the EVHOE index for hakes from 0 to 20cm is given in Figure 3.2 (Annex T). In 1999, the Erika shipwreck limited the spatial coverage of this survey in the Bay of Biscay. It is apparent from this figure that inter-annual variations in abundance are different between areas (VII and VIII).

1.2.4 Commercial catch-effort data

A description of the commercial LPUE indices available to the group is given in the Stock Annex.

They are not used in the assessment model.

Effort and LPUE data for the period 1982-2009 are given in Table 3.4ab(Annex T) and Figure 3.3ab (Annex T).

Since 1985, the LPUE of A Coruña trawlers operating in Subarea VII has fluctuated, with an increasing trend reaching its maximum value in 2009. 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. In 2005, both fleets have 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, the longliners from A Coruña, Celeiro and Burela in VII, the longliners from Avilés in VIIIa,b,d 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 (Annex T) and presented in Figure 3.3b (Annex T) only for the period 1987-1995.

LPUE values of Spanish gill-netters that started to fish hake in Subareas VII and VIII in 1998 present in general an increasing trend in both sea areas until 2002. 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 gill-netters and long liners, LPUEs expressed in kg/day may not be the most appropriate.

1.3 Assessment

This is an updated assessment from the Benchmark workshop WKROUND (ICES, 2010).

1.3.1 Input data

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

1.3.2 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). The value of the input parameter "sigma_R" has been revised from 0.7 to 0.4 as it was found to be more appropriate. This change has been documented in the Stock Annex.

1.3.3 Assessment results

Fits to the surveys abundance indices are presented in Figure 3.4. The upward trend in relative abundance observed in all three contemporary trawl surveys (EVHOE, SP-PGFS and IGFS) has been captured by the model. Residuals of their length frequency distributions show a "fairly random" behavior with no particular trend or lack of fit (Figure 3.5, where open and shaded circles denote positive and negative residuals, respectively). Residuals of the length frequency distributions of commercial fleets (not presented in this report) show some patterns, as mentioned in the benchmark report (ICES, 2010a).

The assessment model includes estimation of size-based selectivity functions which partition the total catch into discarded and retained portions. Figure 3.6 (Annex T) presents selectivity (for the total catch) and retention functions by fleet estimated by the model.

The retrospective analysis (Figure 3.7(Annex T)) shows that the model results are sensitive to the exclusion of recent data. This is expected because of the relatively short survey tuning index timeseries, th e recent increases in the survey indices and the small number of ages in the stock. The patterns observed indicate that current estimates have some uncertainty and, with the exception of 2008, a tendency to underestimate SSB and over-estimate F in the most recent years.

F2009 (average of F-at-length over lengths 15-80 cm) was estimated at 0.39 and SSB at 93 084 t.

Summary results from SS3 are given in Table 3.5 (Annex T) and Figure 3.8 (Annex T).

1.3.4 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 419 million in 2007 (estimated to be among the highest of the series), the recruitment has decreased sharply to 146 million in 2009 (one of the lowest values of the series).

The level of spawning-stock biomass averaged 3 8 000 t during 1990–2006, then increased to 93 000 t in 2009 in line with the good recruitments of recent years.

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 averaged near 1.0 during the 1990s and declined sharply afterwards to 0.39 in 2009.

Because spawning biomass during 1990–2009 varied over a narrow and low range, it is not feasible to observe a relationship between recruitment and spawning biomass.

1.4 Catch options and prognosis

1.4.1 Short – Term projection

Because of:

a) the important uncertainties associated with this assessment (see Section 1.6 of this Annex) and, in particular, with the strength of recent trends (rates of SSB increase and F decrease in the final assessment years). See Figure 3.8 (Annex T).

b) the clearly unrealistic rate of SSB increase obtained from the short term projections under status-quo F conducted by WKROUND (ICES, 2010a).

The Working Group decided not to conduct short term projections.

1.4.2 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 based are presented in Table 3.6 (Annex T) and Figure 3.9 (Annex T). The F-multiplier in Table 3.6 is with respect to the average F in the final 3 assessment years (2007-2009).

1.5 Biological reference points

This assessment represents 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.

The time-series of spawning biomass and recruitment does not have sufficient contrast to allow direct estimation of Fmsy. Reference points of F0.1, F35%, F30% and Fmax were calculated within the SS3 assessment model to provide a range of potential proxies for Fmsy. Fx% is the fishing rate that would reduce spawning biomass per recruit to x% of its unfished level.

Fmax (=0.29) would be a potential candidate for Fmsy, as the yield-per-recruit curve has a well-defined maximum and discards are incorporated in the assessment and taken into account in the yield-per-recruit computation. Moreover, SSB during the historic period has been capable of increasing under high fishing pressure, suggesting a productive stock. However, an F value of 0.29 corresponds approximately to F24%, whereas the guidelines provided by WKFRAME (ICES, 2010b) suggest that F values larger than F30% might lead to recruitment overfishing. WKFRAME further indicated that values around F35% should be robust Fmsy proxies against stock-recruitment functions and recruitment variability. Taking all this into account and the specific aspects of the northern hake stock, this Working Group has suggested that a fishing mortality in the range F35% - Fmax (i.e. 0.21 – 0.29) should be selected as Fmsy. If a single value is to be chosen within that range, F30%=0.24 could be a suitable candidate.

	Type	Value	Technical basis
MSY Approach	MSY $B_{trigger}$	Not defined	
	F_{MSY}	0.21-0.29 or 0.24	Between F35% and Fmax or F30%
Precautionary Approach	B_{lim}	Not defined	
	B_{pa}	Not defined	
	F_{lim}	Not defined	
	F_{pa}	Not defined	

1.6 Comments on the assessment

The northern hake assessment has been completely revised during the WKROUND benchmark workshop (ICES, 2010a). The new assessment has shifted to 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. No age data are used in the new assessment.

Due to the poor quality of the French data for 2009 (landings and discards in weight), no update assessment was carried out by the WG during its May meeting. French landing data for 2009 were made available during fall 2010 leading the WG to update the assessment conducted by the benchmark workshop WKROUND (ICES, 2010).

The assessment is found to be limited in its ability to precisely estimate current stock abundance and mortality because the modelled time period, 1990–2009, does not exhibit strong contrasts in the available data. Furthermore, over that period, little information is available on large fish as a very small proportion of fish larger than 60 cm is observed in the data since 1990 (landings and surveys). All this leads to large uncertainties associated with the main population parameters (SSB, F and recruitment), particularly in the most recent years, which propagate into the short-term forecast as shown in the stock trends presented during WKROUND.

The recent increasing trends in recruitment and SSB and the decreasing trend in F estimated by SS3 are considered to be representative of recent development of the stock in overall terms. These trends are consistent with increasing landings (Table 3.1 (Annex T)) and increasing LPUEs and decreasing effort of some of the main fleets catching hake (Table 3.3 (Annex T)). The Working Group considered, however, that the rate of increase and decrease of those trends remains uncertain.

As a consequence, the Working Group accepted the assessment as only indicative of trends (with the concern stated above that the rates of increase and decrease remain uncertain) and decided not to carry out short term projection.

Future work should attempt to extend the modelled time period back to about 1960 to improve the model's ability to determine the degree to which historical levels of fishing reduced hake abundance. The downward trend during the 1980s in the catch of larger hake should provide information regarding the level of fishing mortality that caused this decline. Incorporating tuning information about large fish would help stabilize the SSB estimates.

1.7 Management considerations

The change of assessment model has modified the historical perspective of the stock. The modeled time-period now starts in 1990, at the end of the sharp decrease in SSB estimated in previous assessments.

As in previous years, there are strong indications of an increase in SSB and decrease in fishing mortality, although the rates of increase and decrease are uncertain.

Table 3.1 (Annex T). Northern hake estimated of catches ('000 t) by area for 1961-2009.

[redacted]

Table 3.2 (Annex T). 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)).

[redacted]

Table 3.3 (Annex T). 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 2009.

[redacted]

Table 3.4.a (Annex T). 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

* Before 1988 landings and effort refer to Vigo trawl fleet only, from 1988 to 2002 to combined Vigo+Marín trawl fleet
** Effort in days/100HP; LPUE in kg/(day/100HP)

Sub-area VIII

	Ondarroa pair trawl in 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	10611			

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

Table 3.4.b (Annex T). 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			

* 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

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

* 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 (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Summary of catches and SS3 results.

Year	Recruit Age 0	Total Biomass	Total SSB	Landings	Yield/SSB	F (15-80 cm)
1990	425841	73155	45084	64287	1.43	1.02
1991	234245	65979	39815	52375	1.32	0.86
1992	254205	68973	42264	56617	1.34	0.92
1993	468990	60961	40820	52144	1.28	0.98
1994	269017	55030	31982	51259	1.6	0.98
1995	138351	61418	31936	57621	1.8	1.03
1996	337173	56453	36622	47210	1.29	0.91
1997	229784	48137	31655	42465	1.34	1
1998	387233	45676	25534	35060	1.37	0.91
1999	191602	50535	29210	39814	1.36	0.89
2000	177356	56971	32841	42026	1.28	0.83
2001	331323	57383	39276	36675	0.93	0.69
2002	269771	60352	40376	40107	0.99	0.75
2003	152629	65821	40668	43162	1.06	0.75
2004	355501	69039	46443	46417	1	0.75
2005	233125	66209	45978	46550	1.01	0.83
2006	329089	66562	40328	41467	1.03	0.66
2007	418973	78604	51450	45098	0.88	0.55
2008	354777	100986	64455	47823	0.74	0.44
2009	146257	140190	93084	58975	0.63	0.39
Arith. Mean	285262	67422	42491	47358		
Units	Thousands	Tonnes	Tonnes	Tonnes		

Table 3.6 (Annex T). 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
0.771	0.1	0.05	0.111	0.11	2.406
0.604	0.2	0.09	0.181	0.178	1.885
0.48	0.3	0.14	0.223	0.219	1.499
0.387	0.4	0.18	0.247	0.243	1.209
0.316	0.5	0.23	0.26	0.255	0.988
0.262	0.6	0.28	0.266	0.259	0.816
0.219	0.7	0.32	0.266	0.259	0.682
0.184	0.8	0.37	0.264	0.255	0.576
0.157	0.9	0.41	0.259	0.25	0.491
0.135	1	0.46	0.253	0.243	0.421
0.117	1.1	0.51	0.246	0.235	0.365
0.102	1.2	0.55	0.239	0.227	0.318
0.089	1.3	0.6	0.232	0.219	0.279
0.079	1.4	0.65	0.225	0.211	0.246
0.07	1.5	0.69	0.217	0.203	0.218
0.062	1.6	0.74	0.21	0.196	0.195
0.056	1.7	0.78	0.203	0.188	0.174
0.05	1.8	0.83	0.197	0.181	0.156
0.045	1.9	0.88	0.19	0.174	0.141
0.041	2	0.92	0.184	0.167	0.128

	SPR level	Fmult	F(15-80 cm)
Fmax	0.24	0.64	0.29
F0.1	0.36	0.44	0.2
F35%	0.35	0.45	0.21

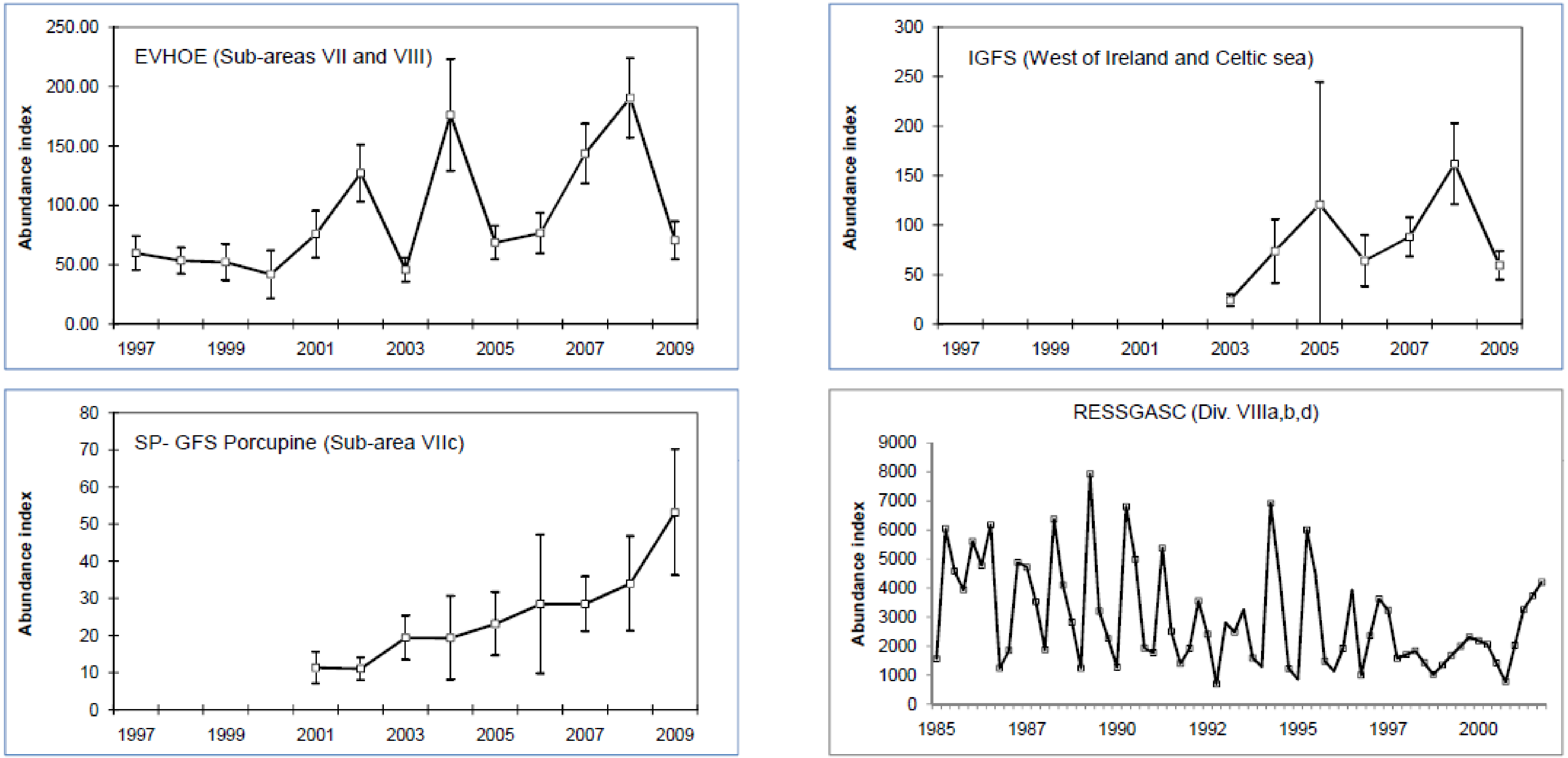


Figure 3.1 (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Abundance indices from surveys.

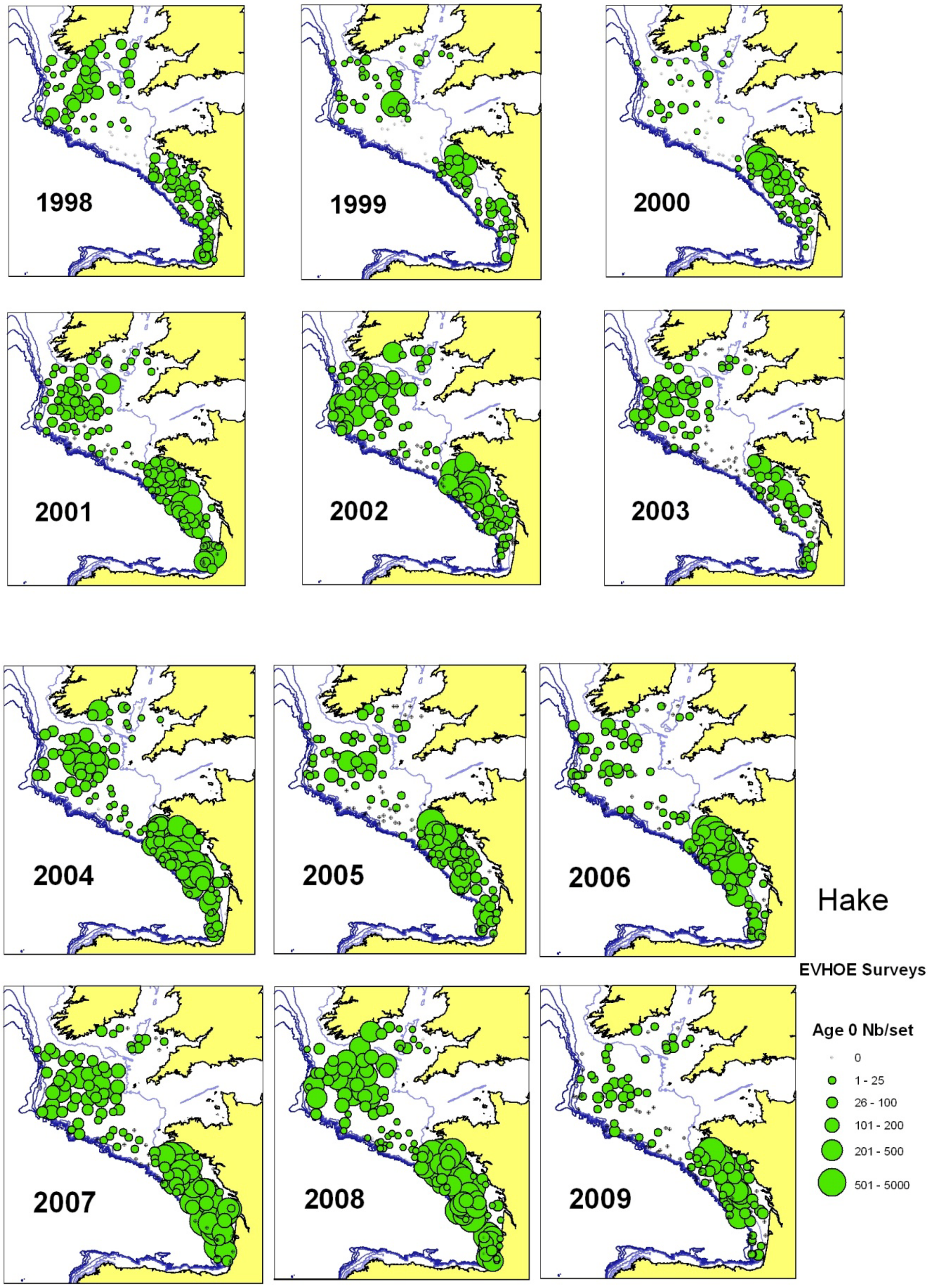


Figure 3.2 (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Spatial distribution of hake (0-20 cm) indices from FR-EVHOES survey from 1998 to 2009.

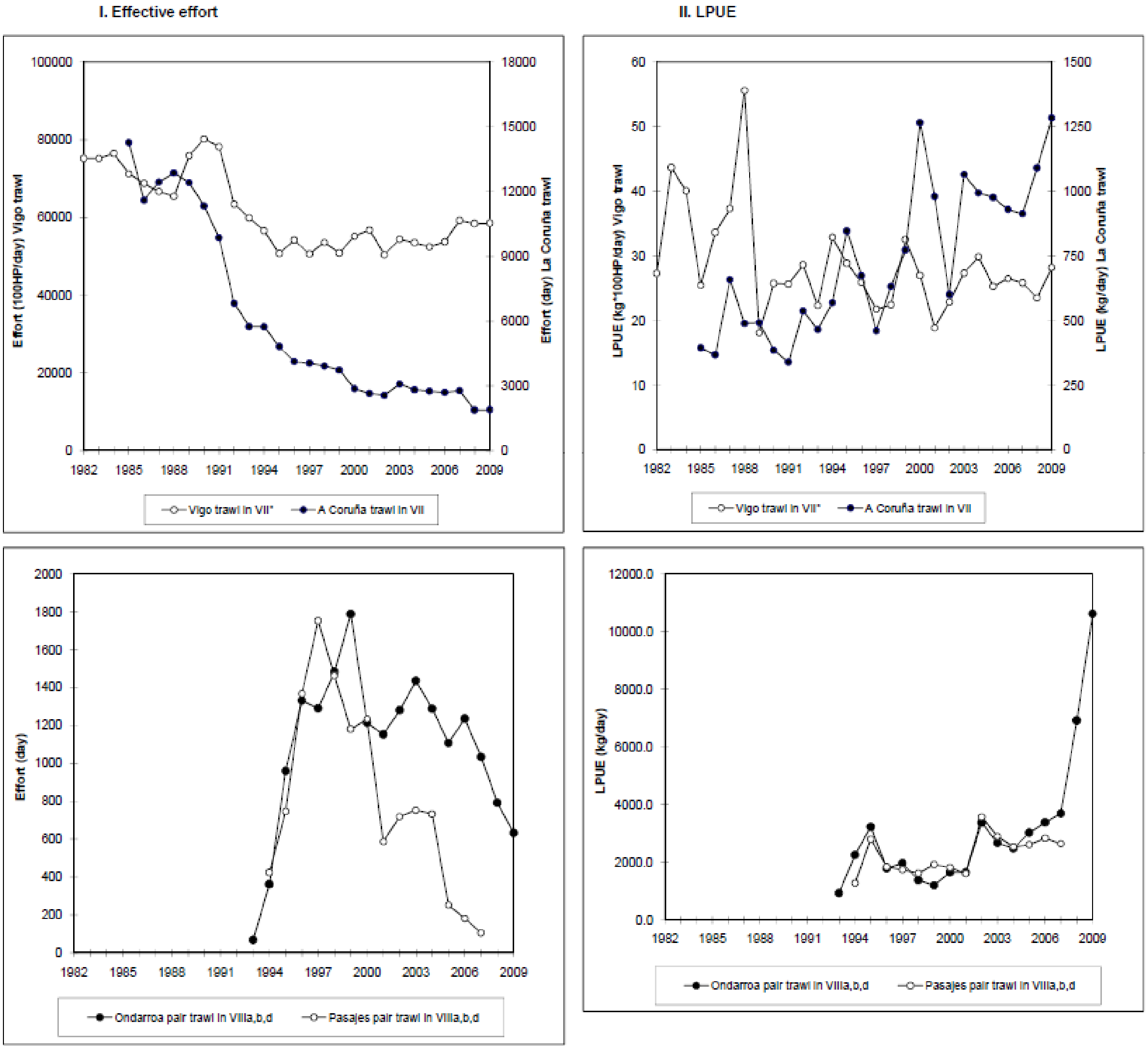


Figure 3.3a (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock).

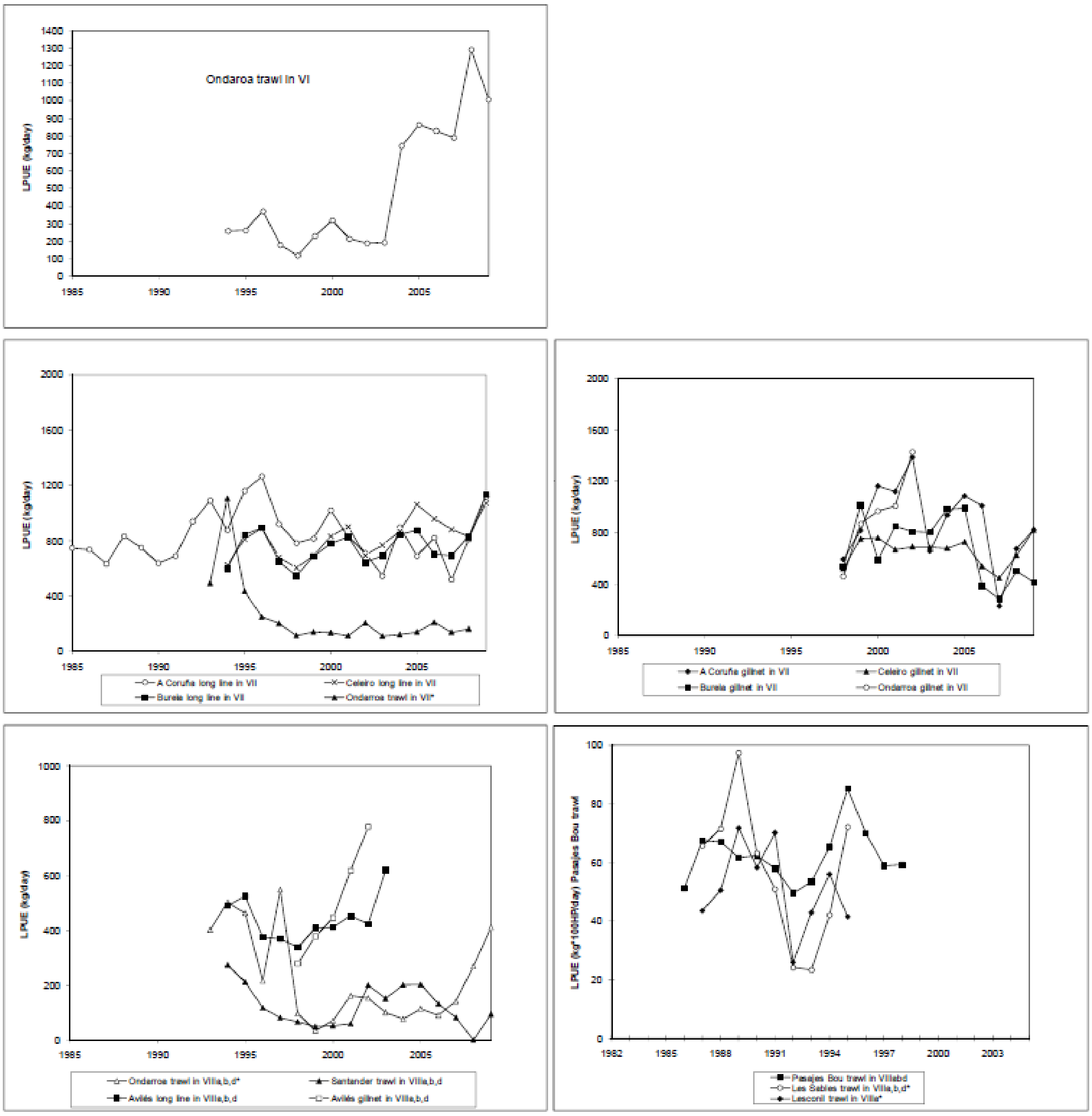


Figure 3.3b (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock).

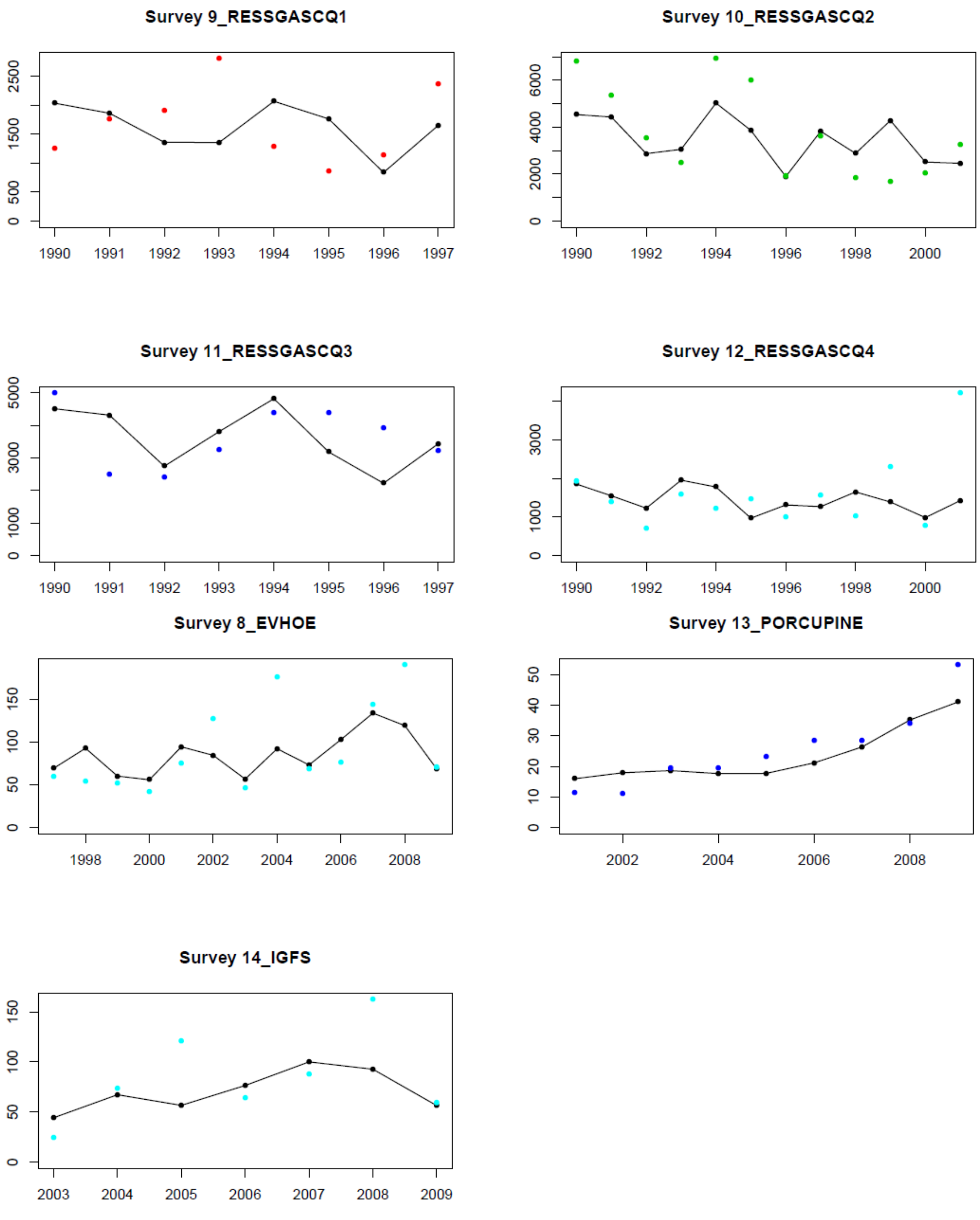
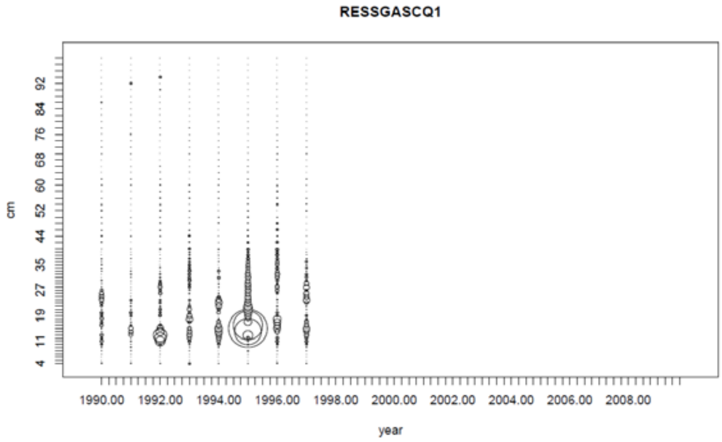
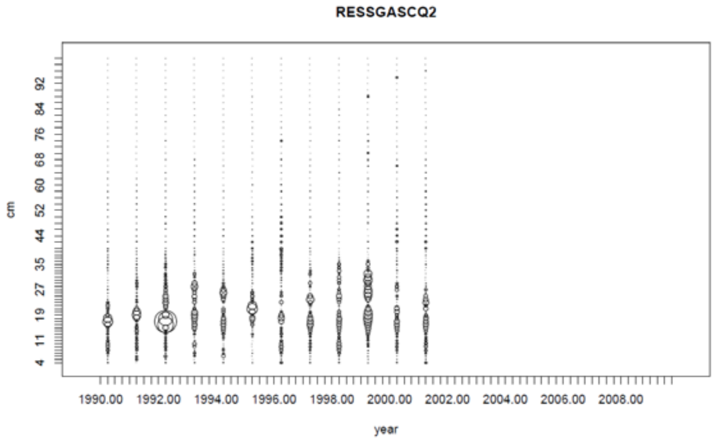


Figure 3.4 (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Fits to the surveys abundance indices, for RESSGASC, fits are by quarter.


RESSGASCQ1
cm
4
11
19
27
35
44
52
60
68
76
84
92
1990.00 1992.00 1994.00 1996.00 1998.00 2000.00 2002.00 2004.00 2006.00 2008.00
year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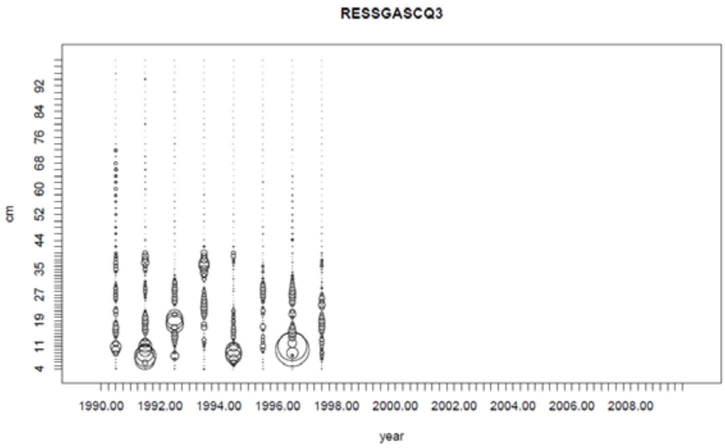
cm
4
11
19
27
35
44
52
60
68
76
84
92
1990.00 1992.00 1994.00 1996.00 1998.00 2000.00 2002.00 2004.00 2006.00 2008.00
year


RESSGASCQ3
cm
4
11
19
27
35
44
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60
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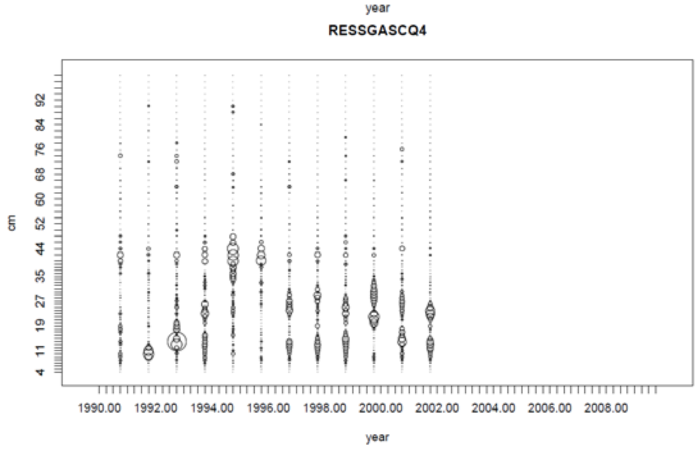
76
84
92
1990.00 1992.00 1994.00 1996.00 1998.00 2000.00 2002.00 2004.00 2006.00 2008.00
year


RESSGASCQ4
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4
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1990.00 1992.00 1994.00 1996.00 1998.00 2000.00 2002.00 2004.00 2006.00 2008.00
year

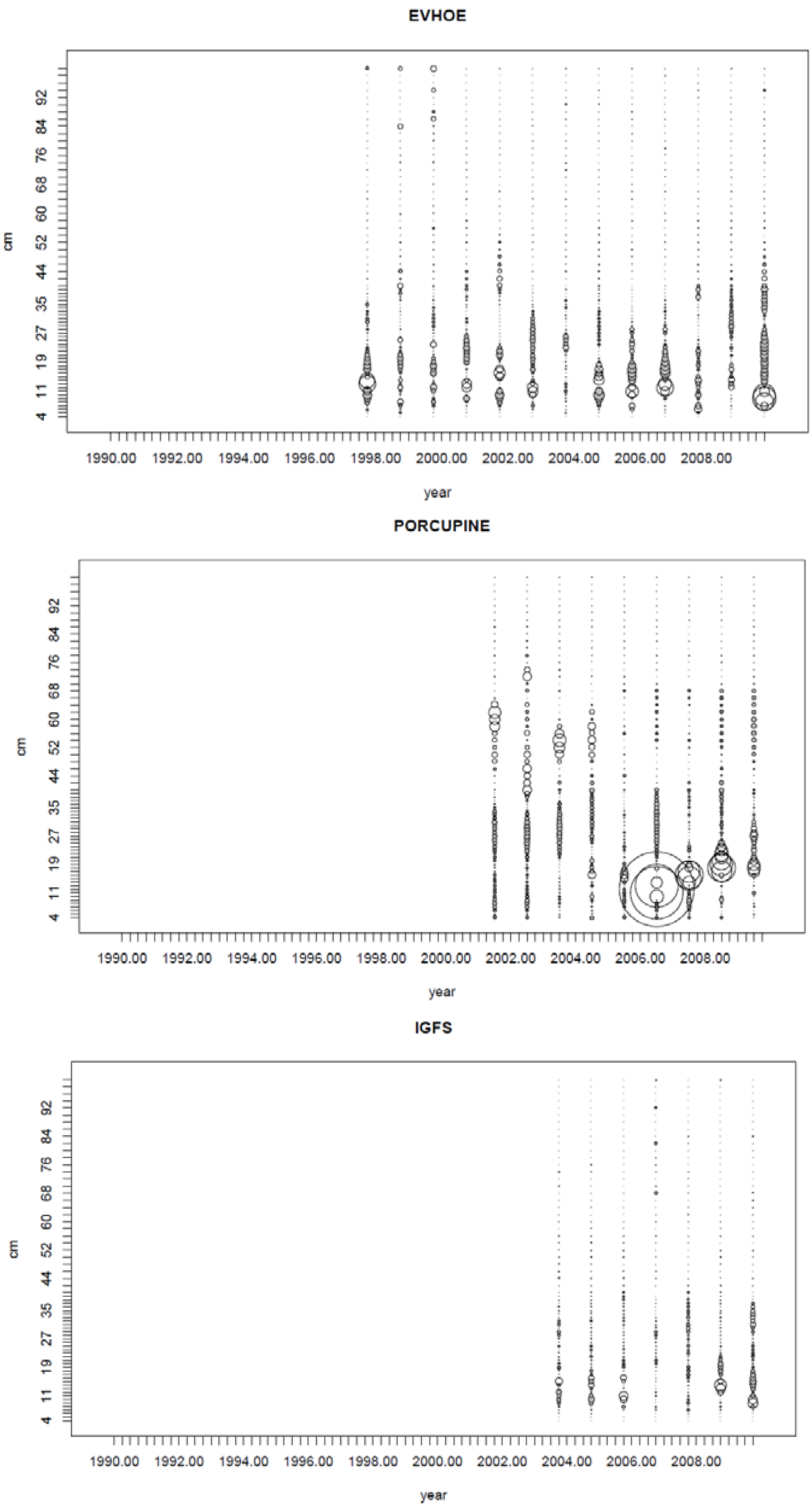

Figure 3.5 (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Residuals plot of the fit to the length distributions of the surveys abundance indices. For RESSGASC, fits are by quarter.

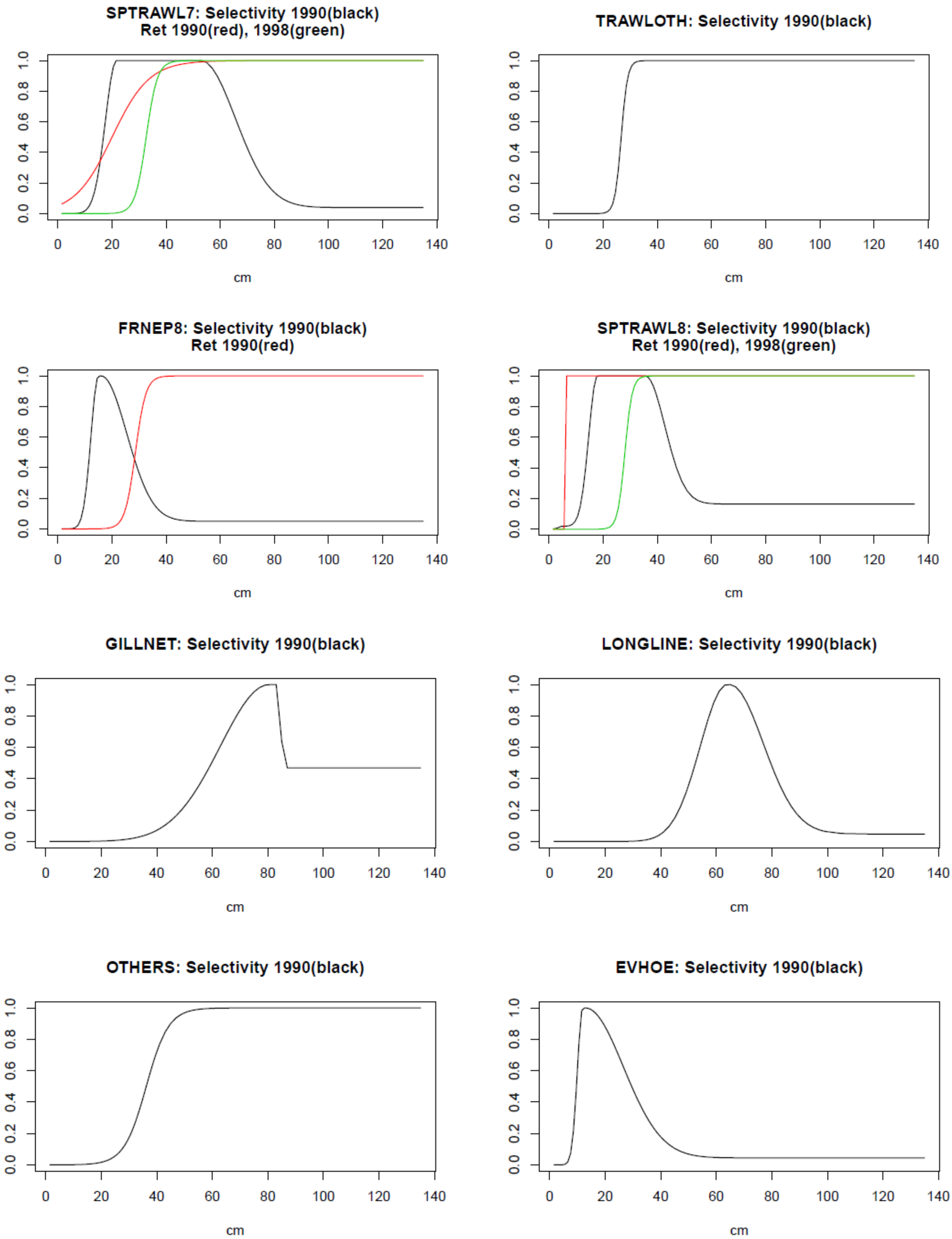

Figure 3.6 (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Selectivity and retention functions by fleet estimated by SS3

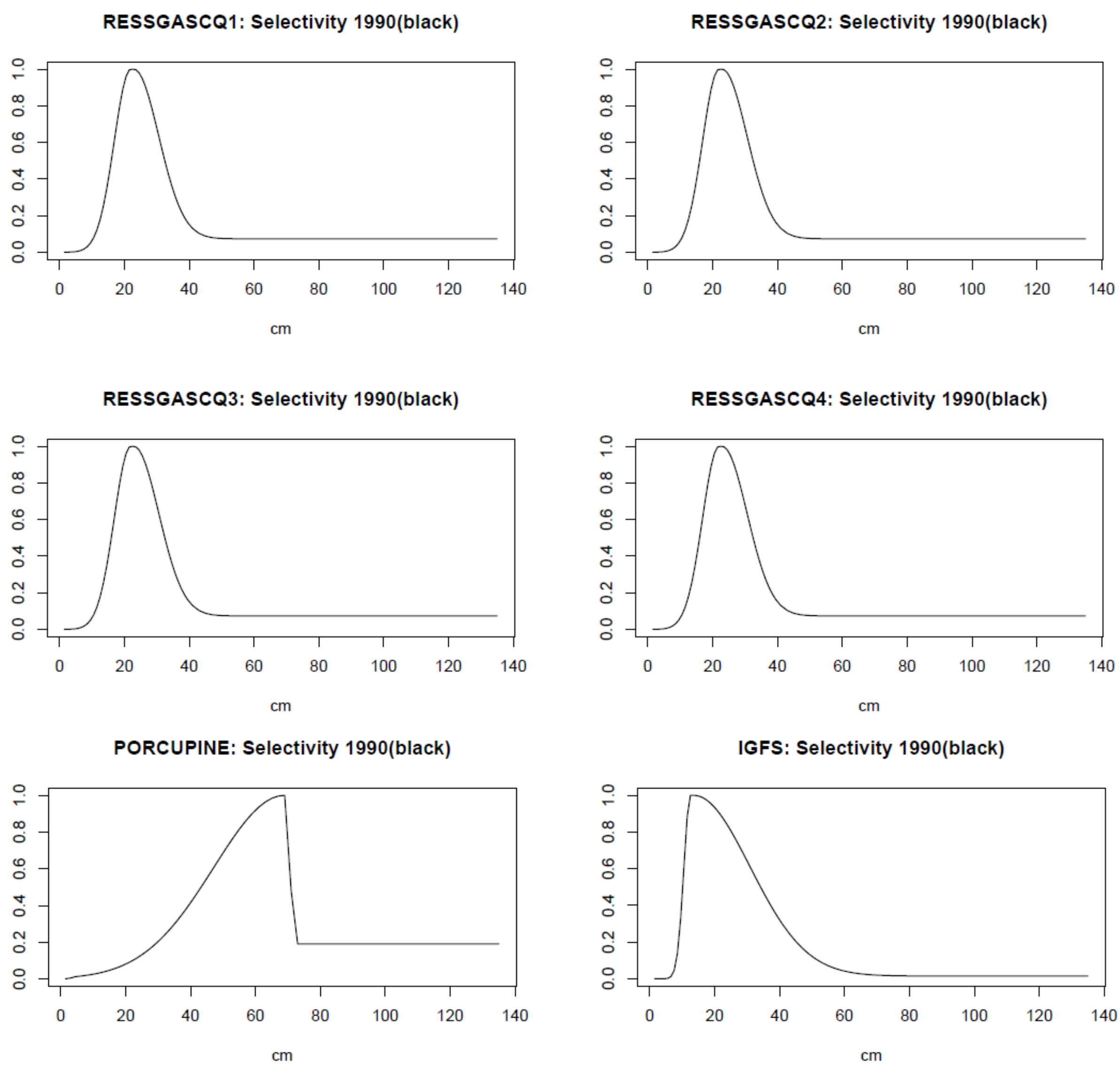

Figure 3.6 (Annex T) (continued). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Selectivity and retention functions estimated by SS3.

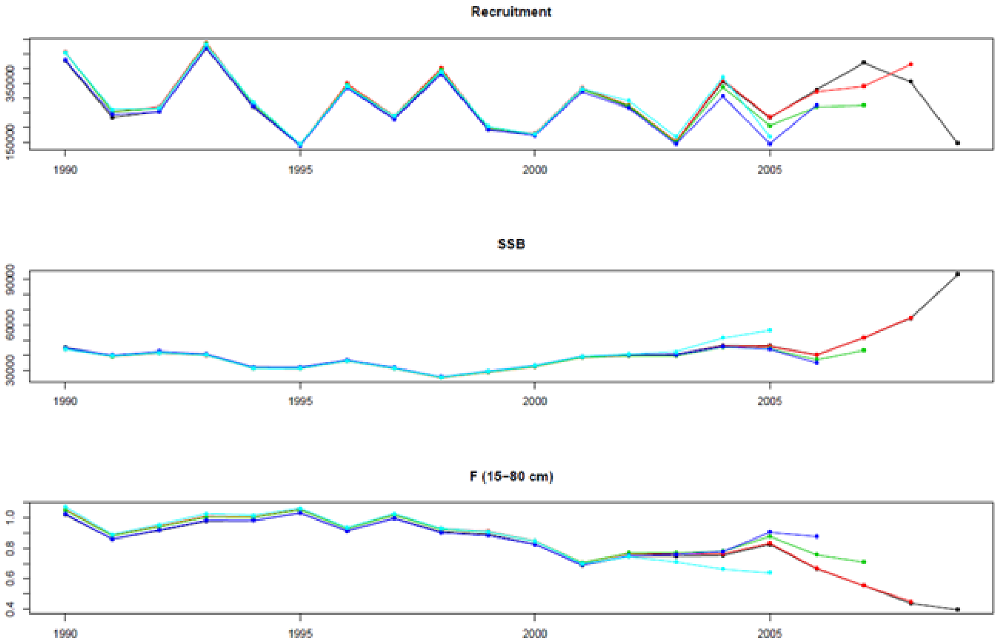

Figure 3.7 (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Retrospective plot from SS3

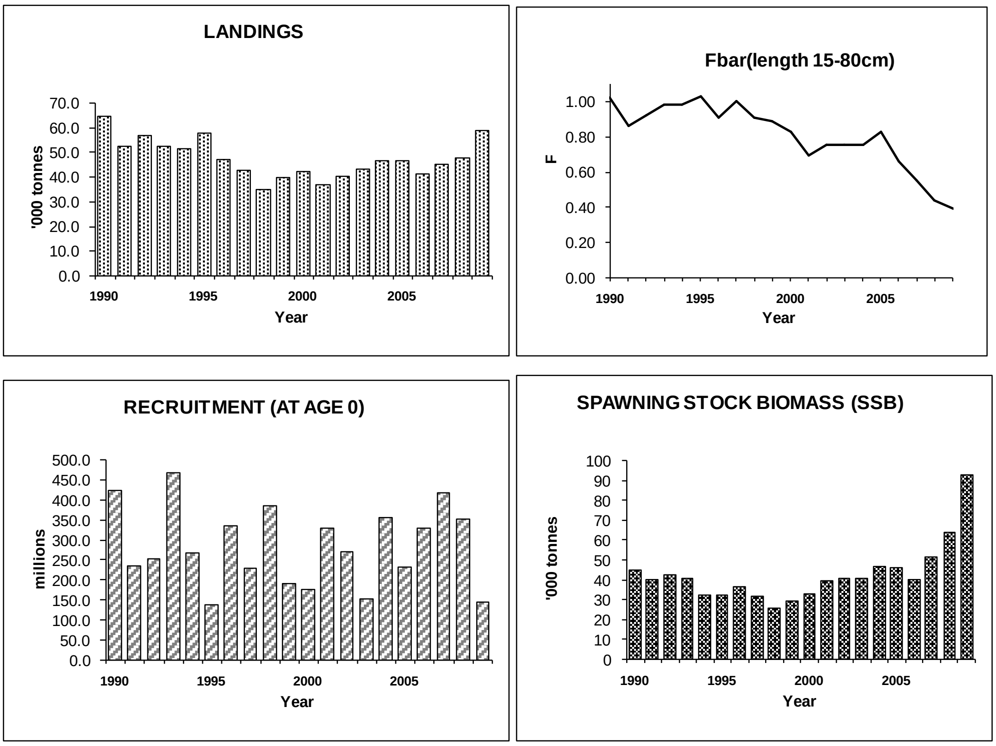

Figure 3.8 (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)Summary plot with stock trends

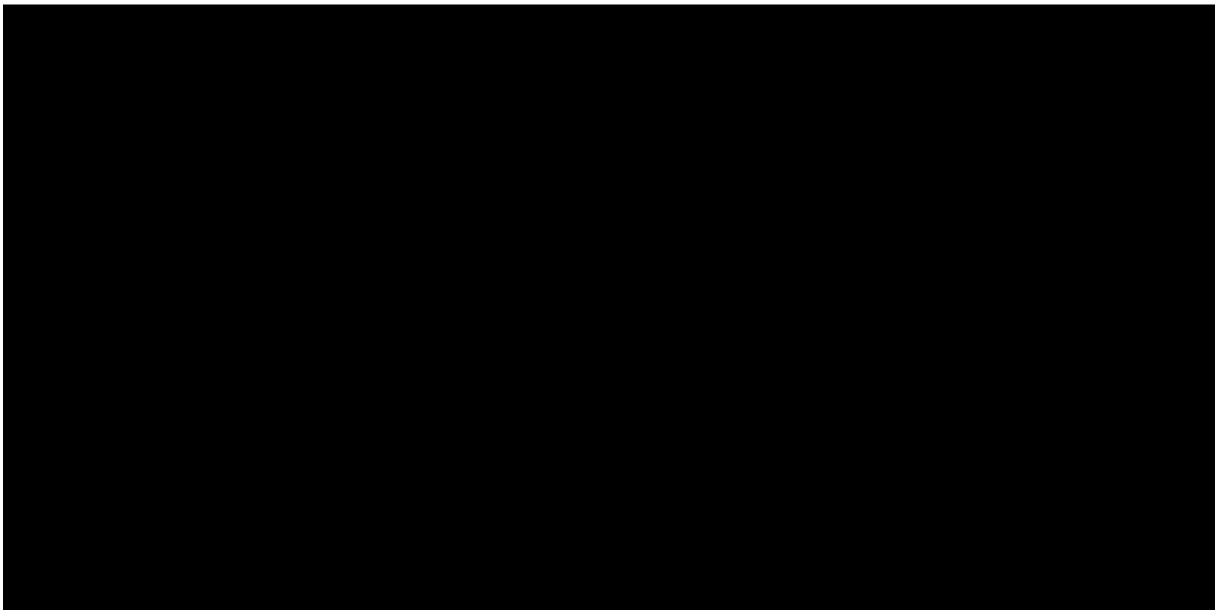

Figure 3.9 (Annex T). Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Long term predictions

Annex U Technical Minutes: Northern hake update assessment in October

Review of ICES WGHMM 2010 update (Northern Hake stock) *20/Oct/2010*

Reviewer: David Charles Moorcroft Miller The Netherlands

Chair WG: Carmen Fernandez Spain

Secretariat: Cristina Morgado ICES

General

The Review Group considered the following stocks:

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

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

1) **Assessment type:** update (of 2010 Benchmark)
2) **Assessment**: trends
3) **Forecast**: presented / not presented
4) **Assessment model**: SS3 length-based model, 4 survey indices.
5) **Consistency**: First application of benchmark model
6) **Stock status**: Unknown (trends only). SSB has been increasing and F decreasing in recent years.
7) **Man. Plan.**: Recovery plan agreed by EU in 2004, though ICES did not evaluate the plan. The targets of this plan have been met. A new management plan was proposed in 2009 aiming to achieve MSY, but ICES has evaluated the target F_{MSY} value and found it to be inappropriate.

General comments

There are some minor suggestions to Annex T and the draft advice for northern hake[1]. The changes made to the report document since the previous review appears to be acceptable and accurate.

The stock annex for this stock is very well prepared, clear to read and contains just the right amount of information. It makes describes the assessment procedure concisely. It is just a pity that the first application of this assessment following the benchmark has failed to produce a useable assessment beyond one indicative of trends. The reasons for this have been explained in section 3.6 of the report, but it worries me a little bit that perhaps the assessment would have been accepted were it not for the steepness of the stock recovery in recent years. However, I agree with the concerns and accept how this assessment has been used to provide advice.

[1] Those changes were incorporated in the respective documents.

The assessment was carried out according to the stock annex. One setting was changed, but I agree with the thoughts of the assessors and the benchmark chair that this revision is acceptable. Now that the French data for 2009 is available, the data used correspond to the specifications of the stock annex.

No short term forecast has been conducted this year due to concerns over the absolute values produce by the model.

Technical comments

Although changes to the assessment methodology are not possible, a few comments:

- Certain technical restrictions were brought in for some fleet segments in certain areas in 2001 (e.g. mesh size limits), yet selectivity of each fleet is assumed to be unchanged over the whole period. Is this likely to have any impact?

- What was the basis for the value of 0.2 for M initially used in assessments of this stock? To me it sounds like the standard guess. If so, now that growth is assumed to be faster than previously thought this is does not mean that you should start applying mathematics to a guess. If in fact the M was based to some degree on the growth parameters from the stock I think it is better to say “the estimated growth parameters suggest a value of M around 0.4” rather than “we now think the stock grows twice as fast, so we doubled our previous estimate of M”.

- It is not clear to me from the stock annex whether the parameters used in the conversion from length to weight for some of the outputs from the SS3 are the same ones as previously used (ICES 1991b).

I would prefer it if the y-axes in the retrospective plots (Figure 3.7 (Annex T)) had a minimum of 0, especially given the concerns that this assessment does not have enough contrast in the data. Just showing the range over which the fluctuations occur can make the retrospective problem appear more severe, as it is difficult to get a proper feel for the extent of the retro problem.

A range of candidate F_{MSY} values is presented on the basis of SPR analysis. The report voices concern over Fmax (F24%) being too high to act as a proxy for F_{MSY} for this stock. However, the proposed value is well below the assumed M for the stock. Also, this value is lower (substantially) than any F observed for this stock the entire modelled period. F is currently almost 50% higher than this now and the stock is rebuilding (rapidly). This highlights the problem of the timeframe being modelled by the newly accepted method (starts after the stock reduced significantly due to data unavailability before this period). Nevertheless this could also suggest that F35% may be too low for an F_{MSY} proxy and perhaps a range from F30%-Fmax would be more reasonable.

The annex still says that the (precautionary) reference points for this stock will be recalculated following the benchmark, but this has not been done for reasons explained in the report.

I notice that there are still lots of values talked about, plotted and tabled in the report even though it is only accepted as a trend based assessment. I assume that it is just the advice sheet that needs values removed. In which case, the average F values in the YPR table should be removed.

Section 1.3.1 of Annex T (Input data) says “See stock annex”. In the stock annex it says that surveys and catches only up to 2008 are used. There should either be a table in the report showing the actual year ranges, or the annex should read *y-1* (where *y* is the assessment year).

The '*' on Table 3.1 (Annex T) and in the advice sheet (Table 9.4.1.2) (*=inadequate discards estimates) confuses me. Does this imply the discards estimates from 1971 to 2002 were perfectly adequate? I know over this period the working group chose not to use them in the assessments but does this still apply for 2009 as well?

Conclusions

I think it is acceptable to use the results of this assessment as indicative of trends and to provide advice on this basis.

A lot of important information about this stock on its historical development is lost when the modelled period is reduced to the time when data by quarter etc. is available. This removes contrasts in the time series and makes it difficult to properly analyse trends and define potential F_{MSY} values. It is strongly recommended that the time period modelled is extended back further in time, even with courser resolution over this period, as it seems that the data that is available for early years is now no longer of any value given the current modelling framework.