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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 2009

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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 at ICES Headquarters, Copenhagen, during May 5-11 2009. There were 19 stocks in its remit, including *Nephrops* Functional Units (FUs), 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 excluding the Gulf of Cádiz), 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 *L. whiffiagonis* and *L. boscii* in Divisions VIIIc and IXa), 1 of sole in Divisions VIIIa,b (Bay of Biscay), 2 FUs of *Nephrops* in Divisions VIIIa,b, 2 in Division VIIIc and 5 in Division IXa. There were 16 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 assessments and providing catch forecasts and a first draft of advice for 2010 for all stocks except *Nephrops*. For *Nephrops*, catch data and series of abundance indices were updated. Analytical assessments using age-structured models were conducted for the hake stocks, the southern stocks of megrim and the Bay of Biscale sole. A surplus-production model, without age or length structuring, was used to assess the southern stocks of anglerfish. The state of stocks for which no analytical assessment could be performed (northern anglerfish, due to ageing problems and increasing discards, and northern megrim, due to data deficiencies) was inferred from examination of commercial catch and effort data and from survey information.

A benchmark assessment is scheduled for the two stocks of hake for the beginning of 2010. WGHMM members prepared a plan establishing priorities for preparatory work (report Annex N). Main, albeit not the only, issues with the hake assessments are ageing problems and a need to account for discards in a coherent way. The assessment scientists would like ICES and national institutes to be aware that they will need to be allowed time to work on these issues during the forthcoming months in order to have a realistic chance of a successful benchmark workshop. WGHMM has also addressed recommendations to develop these lines of work to the ICES Methods Working Group (report Annex O).

Several stock coordinators participated in an InterCatch workshop organised by ICES on the day before the start of the WGHMM meeting. Most of them would like to use InterCatch next year, but this depends on national data submitters uploading the data. For some stocks the facility to store age-length keys in InterCatch and to be able to use them singly or combined according to some weighing scheme is necessary for InterCatch to become an efficient tool.

Section 1 of the report presents a synthesis by stock and discusses general issues, whereas Section 2 provides a description of relevant fishing fleets. The ensuing sections contain the stock assessments. Several annexes follow, including stock annexes. Titles and abstracts of working documents presented to the meeting are in Annex B. WGHMM recommendations are in Annex O.

1 Introduction

1.1 Terms of Reference

2008/2/ACOM08 The **Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim** [WGHMM] (Chair: Carmen Fernández, Spain*) will meet at ICES HQ, 5–11 May 2009 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 2009 for the attention of ACOM.

Fish Stock	Stock Name	Stocks Co-ordinator	Assess. Coord. 1	Assess. Coord. 2	Advice
ang-78ab	Anglerfish (*Lophius budegassa* and *L. piscatorius*) in Divisions VIIb-k and VIIIa,b	Spain/France	Spain/France	France/Spain	Advice
ang-8c9a	Anglerfish (*Lophius budegassa* and *L. piscatorius*) in Divisions VIIIc and IXa	Spain	Spain	Portugal	Advice
hke-nrtn	Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock);	France	France	Spain	Advice
hke-soth	Hake in Division VIIIc and IXa (Southern stock);	Spain	Spain	Portugal	Advice
mgb-8c9a	Megrim (*Lepidorhombus boscii*) in Divisions VIIIc and IXa	Spain	Spain		Advice
mgw-8c9a	Megrim (*Lepidorhombus whiffiagonis*) in Divisions VIIIc and IXa	Spain	Spain	France	Advice
mgw-78	Megrim (*L. whiffiagonis*) in Subarea VII & Divisions VIIIa,b,d,e	Spain	Spain	France	Advice
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	Portugal	No advice
nep-9a	*Nephrops* in Division IXa (FU 26-30)	Portugal	Portugal	Spain	No advice

Note: *Nephrops* in FU16 and FU17 moved to WGCSE

1.2 Stock Synthesis

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. Landings in 2008 were 47 800 t, below the TAC of 54 000 t.

The Northern hake emergency plan (EC 1162/2001, EC 2602/2001 and EC 494/2002) has been 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%. According to ICES, the northern hake stock has met the SSB target in the recovery plan for two consecutive years (2006 and 2007). Article 3 of 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.

An age-based assessment (XSA) was performed using 4 commercial CPUE series and 4 surveys. Discards were not included in the assessment, as data are missing for several fleets and many past years.

SSB and fishing mortality estimates from the assessment indicate that the stock can be considered to be at full reproductive capacity and harvested sustainably. SSB is estimated to be slightly above B_{pa} in 2009, and F has been around F_{pa} since 2001. Recruitment has been relatively stable over the last decade. There are large uncertainties associated with the most recent recruitments, which are only estimated by a single survey. In the absence of reliable 2007 and 2008 recruitment estimates, a geometric mean based on past recruitment values has been used. Applying a fishing mortality of F = 0.25 (F_{pa}) as defined in Article 5.2 of the recovery plan is expected to lead to an SSB of 171 200 t in 2011, with estimated landings of 55 200 t in 2010.

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

Hake in Divisions VIIIc and IXa excluding the Gulf of Cádiz (Southern stock)

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 2008, including the Gulf of Cádiz, were estimated to be 16 740 t, larger than twice the TAC (7 047 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}), and to drive fishing mortality to 0.27. This is to be achieved by applying a fishing mortality rate reduction of 10% every year, with a constraint of 15% maximum change in TAC between any two consecutive years. The regulation also includes effort management measures. The recovery plan has not been evaluated by ICES.

An age-based assessment with a Bayesian statistical catch-at-age separable model (with 2 separability periods) was conducted, based on landings, three commercial lpue and two survey series. Discards were not included in the assessment, due to the lack of data for many earlier years.

SSB and F estimates from the assessment indicate that the stock is at reduced reproductive capacity and at increased risk of being harvested unsustainably. Fishing mortality has been increasing in recent years and is currently close to F_{lim}, well above F_{max} and the target F established in the recovery plan. SSB has been increasing since 2004, but there is still 57% probability that it is below B_{lim} in 2009. Recruitment was high in the mid-1980s and at much lower levels during the 1990s and early 2000s. Recruitment increased every year from 2002 to 2007, with the latter year corresponding to the largest recruitment value in the entire series. There are indications, however, that the 2008 recruitment value is very low.

A 10% reduction in F in 2010 with respect to F_{2008} would lead to landings of 14 980 t (adjusting for Cádiz inclusion, which is done by multiplying yield by 1.0425) and an SSB median value of 24 400 t in 2011. If a 10% F reduction had taken place yearly from the start of the recovery plan in 2006, F should be able to attain the 0.27 target value by 2010. F=0.27 in 2010 corresponds to 9 530 t of landings (including Cádiz) and median SSB in 2011 equal to 30 000 t. The TAC in 2009 was 8 104 t, so both values of landings in 2010 are more than 15% above the 2009 TAC. In order for median SSB to reach 35 000 t (B_{pa}) in 2011, F should be equal to 0.13 in 2010, corresponding to 4 860 t of landings (including Cádiz).

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

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 landings. Anglerfish is an important component of mixed fisheries taking hake, megrim, sole, cod, plaice and *Nephrops*. Landings of both species combined in 2008 were 32 200 t, below the TAC of 36 000 t, which is set for both species combined.

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. There are indications of a good incoming recruitment in 2008.

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. There are indications of another strong incoming recruitment in 2008.

In view of the available data, the WG concluded that continuing fishing at present levels should not harm any of the two stocks. 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 2008 were 3 288 t, 68% above the TAC of 1 955 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.

Biomass of *L. piscatorius* has decreased strongly 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 three consecutive years now, but it is still well above F_{MSY}. Fishing mortality equal to 0 from 2010 onwards is not expected to bring the stock to B_{MSY} until 2013.

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} at present. Biomass was close to B_{MSY} at the beginning of the time series, 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 2009. Keeping the fishing mortality at the current level is expected to bring the stock back to B_{MSY} by 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 of the report.

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. Landings in 2008 were 11 273 t, well below the TAC of 20 425 t (although this includes also Division VIIa and a small contribution for *L.boscii*), and correspond to the lowest value in the entire series. 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. The data situation has improved this year, although a number of important issues still remain. The present assessment is based on examining commercial cpue and data from several surveys.

None of the data examined appeared to indicate the presence of either a strong incoming recruitment or a strong decreasing trend in biomass. In view of the available data, the working group 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 2008 were 1 110 t (of which 84% 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 years starting from 2004 correspond to the lowest SSB estimates. Recruitment has been continuously at low levels for about one decade, with the 2008 estimate being the second lowest in the series. F has been variable over time, although with generally lower values after the mid 1990s.

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, with the three most recent year classes being below average.

Fishing at F *status quo* (taken as the average F of 2006-2008) is assumed for 2009. Fishing also at F *status quo* in 2010 is expected to lead to a slight increase in SSB for *L. whiffiagonis*, whereas SSB would decrease slightly for *L. boscii*, in relation to the 2009 values. For SSB of *L. whiffiagonis* to return to pre-2004 levels by 2011, a 30% reduction with respect to F *status quo* would be necessary in 2010.

The differences in SSB and recruitment trends in the last years make it difficult to give combined advice for the two stocks. There are no defined precautionary limit points. F_{max} is not well defined for any of the two stocks, whereas $F_{0.1}$ is 30% below F *status quo* for the two of them. Mixed fishery considerations should be taken into account when providing management advice.

Details of the assessments are presented in Section 9 of the report.

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 2008 were 4 300 t, whereas the TAC was 4 582 t (4 170 t increased by 412 t due to underutilisation of the 2007 French quota).

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 % yearly reduction), while constraining the TAC change to a maximum of 15% between consecutive years. Once the SSB target is estimated to have been met, the Council should decide on a long-term fishing mortality target and the rate of reduction to be applied in order to reach it.

An updated age-based assessment (XSA) was performed this year, using landings and 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. No recruitment indices are available for this stock.

According to the assessment performed this year, SSB has been increasing since 2004, being above 13 000 t (B_{pa}) in 2008 and 2009. F has been stable at lower levels since 2003 and is presently just under F_{pa}. Hence, the stock is classified as being at full reproductive capacity and harvested suistainably in relation to precautionary limit points. Current F is, nonetheless, well above F_{max} and $F_{0.1}$. 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.

Since SSB is presently above B_{pa}, according to the multiannual plan, the EC must establish a long-term fishing mortality target and a rate of reduction in order to achieve it. Until this is done, the plan offers no practial guidance for managing the fishery. If F in 2010 is 10% below F *status quo* (taken as the average F of 2006-2008), as established in the management plan applied in the last few years, landings are expected to be 4 490 t with SSB reaching 15 170 t by 2011. On the other hand, fishing at F_{pa} in 2010 would correspond to landings of 5 190 t with an SSB value of 14 370 t in 2011.

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 3 years, with landings being 3 030 t in 2008, the lowest recorded value, and below the TAC (4 320 t).

Minimum landing size increased in 2006 as a consequence of a French regulation and several effort and gear selectivity regulations have also been put in place in very 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 considerably higher than those 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.

The stock was assessed in 2008 using XSA. ICES concluded that SSB was relatively stable and advised to maintain current landings. This year, no assessment has been carried out and only an update of data has been done. Considerable effort is being put in the development of a probabilistic method to fill in the many gaps in the series of discards estimates.

Details can be found in Section 10 and Annex J of the report.

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 2008 from the two FUs combined were 58 t, below the TAC of 124 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 2008 were 39 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 2008.

FU 31 (Cantabrian Sea): Landings reported by Spain (the only participant in the fishery) are available for the period 1983-2008. 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. No lpue data were available for 2008.

Both FUs were assessed in 2008, with the conclusion that they were at very low levels and ICES advised zero catch. No assessments have been conducted this year.

Additional details are provided in Section 11 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 2008 from the 5 FUs combined were 323 t, below the TAC of 415 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. *Nephrops* represents a minor percentage in the composition of total trawl landings but is a very valuable species for the profitability of these fleets. 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.

The stock was assessed in 2008 and found to be at an extremely low level. ICES advised zero catch. No assessment has been conducted this year.

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, namely the trawl fleet fishing for fish and the trawl fleet fishing for crustaceans. The trawl fleet fishing for fish operates along the entire coast while the trawl fleet directed to crustaceans operates mainly in the Southwest and South Portugal, 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.

Until 1992 landings fluctuated around 480 t, subsequently falling drastically and reaching an all time low of 132 t in 1996. Landings increased after that again substantially until 2004, at which point a new decreasing trend started. Landings were 208 t in 2008.

In 2008, an assessment was carried out, using XSA separately for males and females. The asessment was accepted for trends only. ICES concluded that the stock had recovered from its low mid-1990s level and advised that landings should not exceed those seen during the period when the stock was recovering (around 200 t). No assessment has been conducted this year.

FU 30 (Gulf of Cádiz): *Nephrops* in the Gulf of Cádiz is caught in a mixed fishery by the trawl fleet. Landings are markedly seasonal with high values from April to September. Landings were reported by Spain and minor quantities by Portugal. 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, when landings were just 80 t. Estimated directed effort at *Nephrops* has decreased very substantially since 2006, probably as a consequence of several effort regulation measures established in very recent years and other factors such as bad weather conditions and an industry strike in 2008. Landings of rose shrimp increased in 2008, indicating a possible change in the objectives of the fishery.

The stock was assessed in 2008 and found to be relatively stable. ICES advised that landings should not exceed the recent average level of 200 t. No assessment has been conducted this year.

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 28-30) 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 of the report.

1.3 Data available

As in previous years, data for 2009 were prepared in advance of the meeting, and all revisions to data are referred to in the appropriate stock sections.

Several stocks assessed by the Group are managed by means of TACs that apply to areas different from those corresponding to individual stocks, notably in Subarea 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. 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. Any other deficiencies in the landings data are discussed in each stock section.

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

1.4 Issues that arose during the WGHMM meeting

See also the Recommendations from WGHMM presented in Annex O.

1.4.1 Use of InterCatch by WGHMM

A generic ToR this year for WGHMM was the use of the database InterCatch (IC) for all stocks. This could not be achieved as the national data were not uploaded in the IC database. Nevertheless, an IC workshop focusing on the needs of WGHMM stock coordinators was organised at ICES HQ on the day just before the start of the WGHMM meeting, with participation of several stock coordinators.

The stock coordinators present at the workshop concluded that IC would be a useful tool for them to prepare input files to run assessments, although it is recognised that certain aspects (chiefly, the incorporation of Age-Length keys in IC) important for several of the WGHMM stocks were not yet implemented in IC. It is important to realise that for some stocks several ALKs are used in a given year (e.g. ALKs by semester or by country) and sometimes several ALKs are combined to produce one to be applied to a part or the whole of the stock. Hence, it is important that the facility to store several ALKs for a given stock and year and to use them singly or combined according to some weights decided by the stock coordinator be incorporated in IC. A recommendation for the incorporation of this facility in IC is made in the Recommendations Annex O.

It is also understood that some national institutes are making an effort to prepare their systems so as to be able to provide data files in IC format. Most WGHMM stock coordinators expect to be able to use IC next year, but this will be dependent on the national data being uploaded into the IC database.

1.4.2 Stock annexes

A considerable effort was made this year to provide stock annexes for as many stocks as possible. For some of the stocks, it was impossible to do this, due to a shortage of manpower. It is the intention of WGHMM to have the remaining stock annexes ready before next year's meeting (with the possible exception of those for the two southern megrim stocks, for which there is no stock coordinator at present). WG members have concerns about the contents of the stock annexes. In particular, they feel that a historical perspective of the stock assessment should be included in the stock annex, as this would be in line with quality assurance.

1.4.3 Developments of stock assessments outside benchmarks

Even though stock assessments can only be modified at benchmark workshops, it is the view of the current WGHMM members that effort must continue at all times to improve stock assessments, both in terms of input data and the methods applied. In this respect, WGHMM members intend to operate by presenting WDs with developments and improvements to stock assessments at their yearly meetings. An annex in the WGHMM report will compile titles and abstracts of all WDs presented, and these will be referred to in the body of the report whenever relevant. Hence, stock assessment developments will continue and it is expected that some of these developments will be incorporated when benchmark workshops take place. The WG recommends that ICES Secretariat takes measures to ensure WDs are not lost (see recommendation in Annex O).

1.4.4 Advice drafting in WGHMM meeting

The WGHMM meeting tried to produce a first draft of the advice, as requested in the ToRs. Trying to follow ICES guidelines for advice was found to be difficult, as there were several instances in which stocks did not appear to fit well in any of the categories defined for advice purposes. Nevertheless, a serious attempt was made to fulfill this task. In doing so, a number of difficulties arose, particularly as the stocks considered in the group are caught in mixed fisheries. The issue was particularly problematic for the two southern megrims and the two southern anglerfishes, as there is a single TAC for both species of megrim and the same happens for both species of anglerfish. One of the species of megrim is estimated to be at very low levels, whereas the other one is at levels much closer to average. A similar situation happened for the anglerfishes. In these cases, the group did not propose any particular advice, but merely stated the situation and the consequences of managing the stocks one way or the other.

The WG reiterates the importance of evaluating recovery and management plans (such as those currently in place for hakes), so that, if found to be precautionary, advice can be delivered in accordance with them. By not evaluating them, ICES advice may not be relevant, when the rules applied to provide advice are very different from those in the management plans.

1.4.5 Problems with SharePoint

WG members encountered many problems with the SharePoint (which they had planned to use extensively). There were quite a few problems in the process of checking in and out documents and with usernames to which checked-out documents were allocated. The problems with the SharePoint sometimes meant that work done on files was lost. Some file extensions were found not to be allowed in the SharePoint. In particular, files from the software R, extensively used in the WG, were not allowed. A feature to synchronise folders in PCs and SharePoint should be developed (see recommendation in Annex O).

1.4.6 Section with surveys description to be included in 2010 WGHMM report

The WG decided that it would be desirable to have a section in the report providing a brief summary description (with appropriate reference to DATRAS website), as well as established acronyms, for all surveys used in the WG report. These are currently described in various sections corresponding to different stocks and are not always referred to consistently. This will be implemented in the 2010 WGHMM report.

Table 1.3 **Biological sampling levels by stock and country. Number of fish measured and aged from landings in 2008**

		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								771
	No. ages								410
	No. samples**								4
E & W (UK)	No. lengths	8768		1173		8879			
	No. ages	239		46		1184			
	No. samples*	85		59		115			
France	No. lengths					12353			30248
	No. ages					865			1823
	No. samples*					57			233
Portugal	No. lengths		2691		3255		0	10313	
	No. ages***		0		0		0	0	
	No. samples*		570		539		0	170	
Republic of	No. lengths	8884		2609		17072			
Ireland	No. ages	1389		588		1585			
	No. samples**	257		135		147			
Spain	No. lengths		7121		4306	15510	3637	18492	
	No. ages		0		0	1926	823	703	
	No. samples		207		212	123	138	158	
Total	**No. lengths**	**17652**	**9812**	**3782**	**7561**	**53814**	**3637**	**28805**	**31019**
	No. ages	**1628**	**0**	**634**	**0**	**5560**	**823**	**703**	**2233**
Total No. in international landings (thousands)		**10244**	**540**	**6775**	**503**	**59148**	**1212**	**8447**	**15208**
No. Measured as % of annual number caught		**0.2**	**1.8**	**0.1**	**1.5**	**0.1**	**0.3**	**0.3**	**0.2**

* Vessels
** Categories
*** Ages, surveys
****Boxes/hauls (for sampling onboard)
*****Otoliths collected and prepared but not read

Table 1.3 (continued)

		Hake		Nephrops		
		IIIa, IV, VI, VII & VIIIa,b	VIIIc & IXa	VIIIab FU 23-24	VIIIc FU 25-31	IXa FU 26-30
Scotland (UK)	No. lengths	5825				
	No. ages					
	No. samples*	132				
E & W (UK)	No. lengths	9274				
	No. ages	446				
	No. samples*	107				
France	No. lengths	19800		28622		
	No. Ages*****	2762				
	No. samples***	270		534		
Portugal	No. lengths		105392			9462
	No. ages***		1255			
	No. samples*		786			43
Republic of Ireland	No. lengths	10791				
	No. ages*****	1514				
	No. samples*	235				
Spain	No. lengths	63618	66447		5553	3947
	No. ages	3296	2672			
	No. samples*	246	500		64	68
Total	**No. lengths**	**109308**	**171839**	**28622**	**5553**	**13409**
	No. ages	**8018**	**3927**	**0**	**0**	**0**
Total No. in international landings (thousands)		**57387**	**39571**	**313305**	**787**	**8599**
No. Measured as % of annual number caught		**0.2**	**0.4**	**0.01**	**0.71**	**0.2**

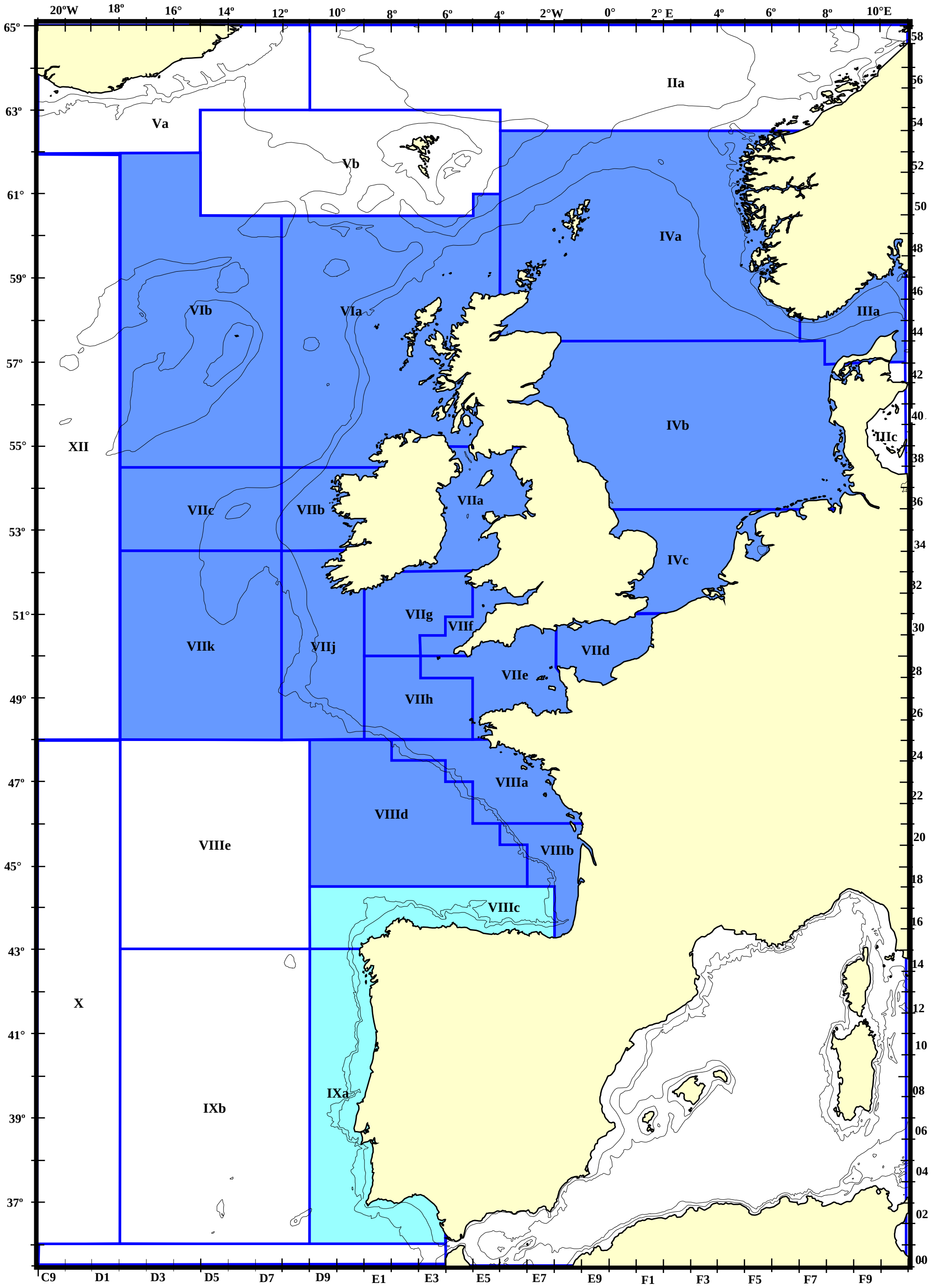


Figure 1.1. Map of ICES Divisions. Northern (IIIa, IV, VI, VII and VIIIabd) and Southern (VIIIc and IXa) Divisions with different shading.

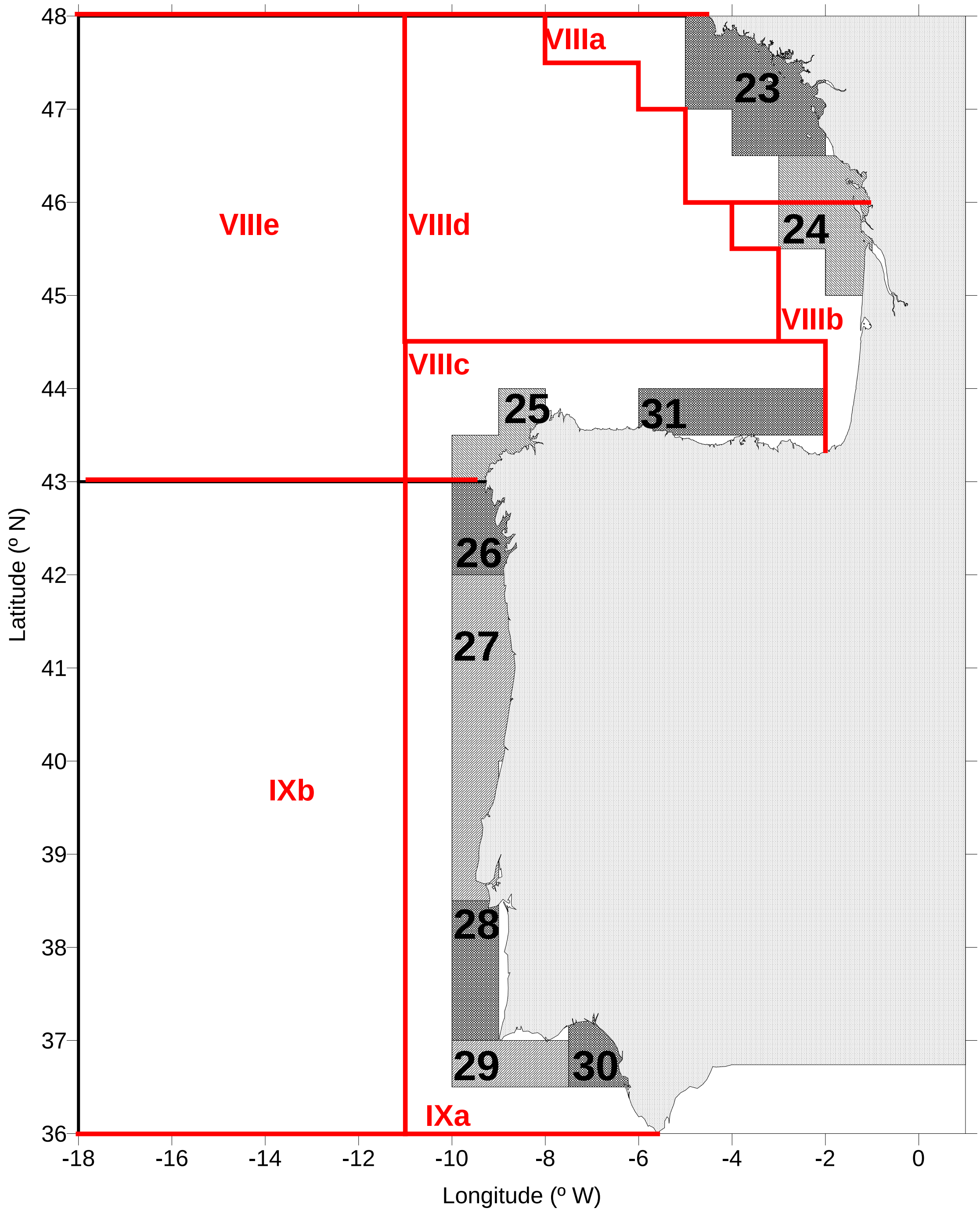


Figure 1.2. ICES Subarea VIII and Division IXa. Nephrops Functional Units

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

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

2 Fisheries description

2.1 Celtic – Biscay Shelf (Subarea VII and Divisions VIIIa,b,d).

2.1.1 Current fishery units.

The fleets operating in the ICES Subarea VII and Divisions VIIIabd are used in the WGHMM 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.

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

2.2.1 Current fishery units.

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), which have been used in this WG as follows:

COUNTRY	FISHERY UNIT	DESCRIPTION
Spain	**Small Gillnet**	Gillnet fleet using "*beta*" gear (60 mm mesh size) for targeting hake in Divisions 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 Section 2 of the 2007 WGHMM report (ICES, 2007).

2.2.2 Proposal of fleet segmentation for commercial data compilation.

WG members noted that some parts of the Iberian fleet segmentation presented in the 2007 WG report with regards to mixed-fisheries could be applied in order to improve the fleet structure used to report landings in WGHMM reports. The WG agreed on the following proposal for presentation of southern stocks landings as of next year, with extension to geographical sub-segmentation when required. It is noted, however, that the proposal (and acronyms to be used) will have to be checked with national laboratories in charge of data compilation, before it can be considered as final.

COUNTRY	FISHERY UNIT	DESCRIPTION	ACRONYM PROPOSED	CURRENT GEOGRAPHIC AREAS OF OPERATION	FISHERY UNIT BY MANAGEMENT AREA
Spain	**Gillnet *"volanta"***	Spanish gillnet fleet using *"volanta"* gear (90 mm mesh size) for targeting hake	SP-GNSV	Division VIIIc	---
Spain	**Gillnet *"rasco"***	Spanish Gillnet fleet using *"rasco"* gear (280 mm mesh size) for targeting anglerfish	SP-GNSR	Division VIIIc	---
Spain	**Long line**	Spanish long line fleet targeting a variety of species (hake, great fork beard, conger)	SP-LLS	Division VIIIc	---
Spain	**Artisanal**	Spanish miscellaneous fleet exploiting a variety of species	SP-ART	1. Division VIIIc 2. Division IXa excluding Gulf of Cádiz 3. Gulf of Cádiz	SP-ARTN-8c SP-ARTN-9a SP-ARTS
Spain	**Pair Bottom Trawl**	Spanish pair bottom trawl targeting blue whiting and hake using a gear of 55 mm mesh size	SP-PTB	1. Division VIIIc 2. Division IXa excluding Gulf of Cádiz	SP-PTB -8c SP-PTB-9a
Spain	**Northern Bottom Otter Trawl**	Spanish bottom otter trawl targeting horse mackerel, mackerel, hake, anglerfish, megrim, and Nephrops using a gear of 70 mm mesh size	SP-OTBN	1. Division VIIIc 2. Division IXa excluding Gulf of Cádiz	SP-OTBN-8c SP-OTBN-9a
Spain	**Southern Bottom Otter Trawl**	Spanish bottom otter trawl (40 mm mesh size)	SP-OTBS	Gulf of Cádiz	---
Portugal	**Artisanal small scale**	Portuguese artisanal small scale fleet	PT-ART	Division IXa	---
Portugal	**Gillnet**	Portuguese gillnet fleet	PT-GNS	Division IXa	---

	Long line	Portuguese long line fleet	PT-LLS	Division IXa	---
	Trawl crustaceans	Portuguese trawl fleet targeting crustaceans	PT-OTBC	Division IXa	---
	Trawl fish	Portuguese trawl fleet targeting fish	PT-OTBF	Division IXa	---

Regarding the gillnet fleet, a clear distinction between "*volanta*" and "*rasco*" is proposed in order to avoid confusion. Until now, hake landings, which correspond to "*volanta*" gear, and anglerfish landings, which correspond to "*rasco*" gear, have been reported under the same generic fleet denomination of "gillnet". On the other hand, changes in the Spanish sampling programme will make it impossible to register the landings of the Spanish small gillnet fleet as it has been done until now, so these landings will be included in the gillnet "*volanta*" fleet in the future.

The Spanish fleet reported until now as Northern trawl fleet will be split between pair trawlers and otter trawlers, because this disaggregation is possible under the current Spanish data base system. A more detailed disaggregation of the otter trawl fleet into its two main components, one targeting demersal species and another one targeting pelagic species, will not be possible in the near future since the two gears involved, "*baca*" and "*jurelera*" (the latter also referred to as "HVO", high vertical opening, gear) respectively, can be carried on board and used during the same trip. The otter trawlers operating in the Gulf of Cádiz (Map 2.2.1) are considered separately, because they use a different codend mesh size and the area is under specific local management measures.

The Portuguese fleet traditionally reported as "Artisanal" will be split into three different components: small scale artisanal fleet, gillnetters and long liners. Gillnet and long line landings can be extracted from vessels (larger than 10m) logbooks. The remaining landings will correspond to the small scale artisanal fleet.

The Portuguese trawl fleet will be split into its two main components, trawler targeting crustaceans and trawlers targeting fish.

Map 2.2.1. Geographical distribution of the Spanish local management areas within ICES Division IXa. The ecological and fishery differences found in the Gulf of Cádiz makes it more practical to distinguish between this area and the rest of Spanish waters in Division IXa.

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

Type of assessment: update, stock on observation list.

Data revisions: Landings for years 2007 for Ireland and Denmark. They lead to minor revisions in the total landings and the catch at age table.

Review Group issues: no outstanding issues.

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.

In 2008, the main part of the fishery (close to 90% of the total landings) was conducted in six Fishery Units, three of them from Subarea VII: FU 1 (Long-line in medium to deep water in Subarea VII), FU 3 (Gill nets in Subarea VII) and FU 4 (Non-*Nephrops* trawling in medium to deep water in Subarea VII), two from Subarea VIII: FU 13 (Gill nets in shallow to medium water) and FU 14 (Trawling in medium to deep water in Subarea VIII) and one in Subareas IIIa, IV, V and VI, representing respectively 20%, 9%, 15%, 10%, 13 % and 22% of the total in 2008.

Spain accounts for the main part of the landings with 53% of the total. France is taking 30% of the total, UK(E+W) 1%, UK(Scot.) 6%, Denmark 3%, Ireland 3% and other countries (Norway, Belgium, Netherlands, Germany, and Sweden) contributing small amounts.

3.1.3 Summary of ICES advice for 2009 and management for 2008 and 2009

ICES advice for 2009

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 of 156 700 t in 2010, with estimated landings in 2009 of 51 500 t. This would imply a decrease in TAC of 5%. ICES also indicates that the current fishing mortality, estimated at 0.25, 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)	2003	2004	2005	2006	2007	2008	2009
IIIa, IIIb,c,d (EC Zone)	904	1178	1284	1323	1588	1627	1552
IIa (EC Zone), IV	1053	1373	1496	1541	1850	1896	1808
Vb (EC Zone), VI, VII, XII, XIV	16823	21926	23888	24617	29541	30281	28879
VIIIa,b,d,e	11220	14623	15932	16412	19701	20196	19261
Total Northern Stock [IIa-VIIIabd]	30000	39100	42600	43893	52680	54000	51500

Management for 2008 and 2009

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 stock has met the SSB target in the recovery plan of 140 000 t for two years (2006 and 2007). Article 3 of the recovery plan indicates that, in such a situation, a management plan should be implemented. 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 1961-2008 as used by the WG are given in Table 3.1. They include landings from Divisions IIIa and IVa,c, 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.

Data revisions have been carried out this year on the Irish and Danish landings from 2007. They lead to minor revisions in total landings and in the catch-at-age matrix presented below.

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. In 2004 and 2005, an important increase in landings has been observed with 46 416 t and 46 550 t of hake landed respectively. In 2006, the total landings decreased to 41 469 t. They increased again in 2007 at 45 093 t and in 2008 at 47 822 t.

Over the period 1995 to 2001, the decrease in landings was mainly observed in Subarea VIII from 28 100 t in 1995 to 9 200 t in 2001. At the same time, landings in Subarea VII fluctuated around 20 000 t (23 100 t in 2001). In Subareas IVa-VI, a decrease in landings is observed from 1995 to 1998 (5 300 t and 3 200 t respectively). In Subarea VIII, after an increase in the landings of more than 6 000 t in 2002 , there has been a stabilization in 2003 and 2004 at 15 300 and 15 500 t respectively. The observed increase in landings between 2003 and 2004 is mainly located in Subarea VII and in Subareas IVa-VI where landings have increased by 1 660 t and 3 470 t respectively. In 2006, landings have decreased in both Subarea VII and VIII. The increase in landings observed between 2006 and 2007 is mainly due to an increase in landings from area VII. From 2007 to 2008, landings increased in Subarea VIII and Subareas IVa-VI and decreased in Subarea VII.

A presentation of the discard data sampling and data availability is presented in the Stock Annex. Table 3.2 presents discard data available to the group from 1999 to 2008. It should be noted that this year, an important increase in discards from the Spanish trawl fleets operating in the ICES Subarea VII (FU4) has been observed.

All information available suggest that discards rate could be high in some years, area and for some fleets. Improvement in discard data availability (number of fleets sampled and area coverage) has been observed in recent years. However, sampling do not cover all fleets contributing to hake catches, discards rates of several fleets are simply not known and when data are available, it is not possible to incorporate them in a consistent way. Furthermore, reconstructing an historical series is still problematic. As last year, the Group therefore decided not to include discard estimates into the full time series of catch at age data.

3.2.2 Biological sampling

The sampling level is given in Table 1.3.

Length compositions of the 2008 landings by Fishery Unit and quarter were provided by France, Ireland, Spain, Scotland, UK(E&W) and Denmark (annual), which together contribute the majority of the catches. Annual catch figures were provided by other countries and, in most instances, were taken from the official statistics. Length compositions samples are not available for each FU of each country in which landings are observed. It is therefore necessary to calculate the length compositions of catches or landings of some countries using samples from other FU and/or countries (see Stock Annex). The length distribution substitutions are outlined in Table 3.3. The international length compositions for 2008 by fishery units are given in Table 3.4. The length distribution of landings over the period 1978-2008 is given in Figure 3.1.

Since 1998, the number of fish from 15 cm to 25 cm in length have decreased in the landings, and then the mean length in landings and catches over the period 1998-2007 have higher values in the series (more than 35 cm) (Figure 3.2).

2008 quarterly ALKs were available from two institutes in Spain : From the AZTI Institute where sampling was conducted on the Basque fleet fishing mainly in Subarea

VIII and partly in Subarea VII, and from the IEO Institute where sampling was conducted on the Spanish fleet fishing in Subarea VII.

After examination of all ALK available, it was decided to use, as in previous years, an annual ALK obtained by summing the number of otoliths read at age. The resulting ALK was applied to the annual length composition of the international landings, in order to estimate the landing-at-age composition and mean weights at age.

The landing-at-age matrices input to XSA is given in Table 3.5. The corresponding mean weights at age in the landings (also used as mean weights in the stock) are given in Table 3.6. Abundance of age groups 0 and 1 in the landings have been much lower since 1998.

See the stock annex for the history of the derivation of the ALKs and on ageing problems for hake.

The landing-at-age and effort data available for XSA tuning are given in Table 3.7.

The natural mortality is assumed to be constant at age (0.2) for all runs.

The maturity ogive, for both sexes combined is:

Age	0	1	2	3	4	5	6+
	0.0	0.0	0.0	0.2	0.6	0.9	1.0

(Martin, 1991; ICES CM 1993/Assess: 3)

The SSB is calculated at the 1st January.

3.2.3 Abundance indices from surveys

The FR-RESSGASCS surveys was conducted in the Bay of Biscay from 1978 to 2002, the FR-EVHOES survey conducted in the Bay of Biscay and in Celtic Sea with a new design since 1997, the UK-WCGFS survey conducted in Celtic Sea from 1988 to 2004 when it stopped, and the SP-PGFS survey conducted on the Porcupine bank since 2001. Table 3.7, and Figure 3.3a and b show the abundance indices (only for ages 0, 1 and 2 for the three first) obtained from these surveys. A description of each survey is given in the stock annex.

Since 1987, the recruitment index from FR-RESSGASCS has been following a slight decreasing trend. For age 1 and 2, the index has fluctuated without trend.

After two consecutive years of increases, the abundance index provided by FR-EVHOES for age 0 dropped in 2003, showed a sharp increase in 2004 and dropped again in 2005. The index has increased again in 2006, 2007 and 2008 to reach the highest value of the series. Abundance indices for ages 1 and 2 are variable with no marked trend.

Indices at age 1 and 2 from UK-WGCFS show high variability and no trends.

For the SP-PGFS survey conducted on Porcupine's Bank since 2001, abundance index from younger ages (Age 0, 1 and 2) followed an increasing trends since 2003 while decreasing trends are observed on age 5 and 6. It must be noted that in spite of using the same gear design as in previous years, some differences in the mean vertical and door spread of the gear were observed during the 2008 survey together with a longer mean time to make ground contact. This may have produced a decrease in the abundance indices of several species (including hake), which was however not possible quantify. It was noted as last year that this survey may provide indices of abundances mainly on older ages.

Spatial distribution of FR-EVHOES age 0 index are given in Figure 3.4. 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).

Index of abundance from an Irish Groundfish Surveys has been provided to the group (IGFS from 2003 to 2008). This survey is conducted west of Ireland and the Celtic sea. The data series may be considered for inclusion in the next benchmark assessment.

3.2.4 Commercial catch-effort data

A description of the commercial tuning fleet is given in the stock annex .

Commercial fleets used in the assessment to tune the model

Effort and LPUE data for the period 1982-2008 are given in Table 3.8a and Figure 3.5a

Since 1985, the LPUE of A Coruña trawlers has fluctuated, with an increasing trend reaching its maximum value in 2000. Over the same period, LPUE from Vigo trawlers followed a slight decreasing trend, becoming less variable during the last 15 years.

LPUE from Ondarroa and Pasajes pair trawlers have followed similar trends and have been quite variable. Two peak values have been observed in 1995 and 2002. For Ondaroa, a very large increase in LPUE has been observed in 2008. In 2005, both fleets have experienced a decrease in effort (expressed in number of days) which correspond 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 its operations in 2008. A removal of this fleet from the tuning could be envisaged in the future.

Commercial fleets not used in the assessment to tune the model

Effort and LPUE data for some other Spanish fleets fishing in Subarea VI, VII and Divisions VIIIa,b,d and from French fleets fishing in Divisions VIIIa,b,d provided to the Working Group are given in Table 3.8b and Figure 3.5b.

For the fleets for which a long enough series of LPUE is available (i.e., Ondarroa “Baka” trawlers fishing in Subarea VI, VII and Div. VIIIa,b,d, Pasajes “Bou” trawlers fishing in Subarea VIII, longliners from A Coruña, Celeiro and Burela in VII, longliners from Avilés in VIIIa,b,d and 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 Ondaroa trawl in VI which shows a increasing trend after 2003.

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 3.8b and presented in Figure 3.5b 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

The run is an update.

3.3.1 Input data

Discards have been removed from the whole series (see section 3.2.1).

The Group did not have confidence in the estimate of age 0 in the landings because of inconsistencies in the data for this age group in recent years. Therefore, age 0 was removed from the catch at age matrix (replaced with 0 landings) and from the commercial fleet data. However, age 0 is still used in the assessment because indices for age 0 are available from surveys.

Large numbers of individuals are present in the 8-plus group of landings data mainly before 1992 (Table 3.5).

3.3.2 Model

As in previous years, the model chosen by the Group to assess the history of the stock dynamics was XSA using the VPA suite.

Final run

The same settings as in 2008 were retained for the final runs. They are presented below:

Fleets	WG 2008		WG 2009	
SP-CORUTR7	85-07	3-7	85-08	3-7
SP-VIGOTR7	82-07	2-7	82-08	2-7
SP-PAIRT_ON8	94-07	2-6	94-08	2-6
SP-PAIRT_PA8	94-07	3-6	94-07	3-6
FR-RESSGASCS	87-01	0-5	87-01	0-5
FR-EVHOES	97-07	0-5	97-08	0-5
UK-WCGFS	88-04	1-2	88-04	1-2
SP-PGFS	01-07	2-7	01-08	2-7
Taper		Yes (3 over 20)		Yes (3 over 20)
Tuning range		Full		Full
Ages catch dep. stock size		No		No
q plateau		6		6
F shrinkage se		1.0		1.0
year range		5		5
age range		4		4

3.3.3 Assessment results

The diagnostics from the final XSA for this run is given in Table 3.9.

Survivors at age 0 and 1 (year class 2007 and 2008) are only estimated by the FR-EVHOES indices. For age 2, four fleets contribute to the estimation of survivors : SP-VIGOTR7, SP-PAIRT-ON8, FR-EVHOES and SP-PGFS surveys and their estimates are not very consistent. FR-EVHOE contributes the most with 69% of the weight. For the older ages there is a reasonable consistency in the estimates of survivors between indices.

Log-catchability residuals resulting from XSA for each fleet and selected ages are presented in Figures 3.6.a to c. Some trends in catchabilities are apparent on SP-CORUTR7 even though these trends were not apparent in single fleet runs.

Due to the short period covered by SP-PGFS survey, the retrospective analysis was carried out without this fleet. (Figure 3.7). It showed a tendency to under-estimate F and over-estimate SSB slightly in recent years. Furthermore, SSBs are revised upwards for the earlier part of the series as more years are used in the analysis. In that case, the earlier years of the SP-VIGOTR7 and SP-CORUTR7 tuning series are not used in the assessment and only the F shrinkage remains. Recruitments tend to be poorly estimated. Low values are revised upward and high values downwards when new years are added to the data series.

Mean F2008 was estimated at 0.24 and SSB at 136 588 t.

Summary results from the final XSA are given in Tables 3.10 to 3.12 and Figure 3.8.

3.3.4 Year class strength and recruitment estimations

The 2006 year class is estimated at 228 million. This estimate, higher than the GM90-06 (184 million), is mainly determined by the FR-EVHOES surveys (with a weight of 69%). The Working Group noted that this year class was estimated to be close to that of last year's fit (226 million).

Due to the end of UK-WCGFS (stopped in 2004), the recruitment in 2007 is only estimated by FR-EVHOES (with a weight of 86%). This recruitment (335 million) is 82% higher than GM90-06. The 2008 year class is estimated at 502 million, 173% over GM90-06. As, each year, there are large uncertainties associated with the level of the most recent recruitments which are only estimated by FR-EVHOES (this year, the 2007 and 2008 recruitments), until this is confirmed, it was decided to replace 2007 and 2008 recruitments by GM90-06 (184 million).

3.3.5 Historic trends in biomass, fishing mortality and recruitment

No major trends are observed in mean F over the period covered by the assessment. In recent years, a decreasing trend is observed from 1995 to 2008.

After a plateau at high level before 1986, SSB has decreased sharply to a low level in the mid 90s and stayed at that low level until 1998. Since that year, SSB has been steadily increasing.

After showing a slight decline in the 90s, the recruitment has been increasing since 2001.

3.4 Catch options and prognosis

The group noted that due to the impossibility to account, in a satisfactory manner, for discards into the assessment, fishing mortalities on young ages used in the predictions are under-estimated. This would lead to over-optimistic projections at status quo but could also reduce the impact of a decrease in F or an effective improvement in fishing pattern.

3.4.1 Short – Term projection

Input data for the catch predictions are given in Table 3.13. They correspond to the options indicated in the Stock Annex.

Landings and SSB predicted for various levels of fishing mortality in 2010 are given in Table 3.14 and Figures 3.9. The detailed output of predictions for 2009-2011 under status quo F is given in Table 3.15. The contribution of different year classes to predicted landings in 2010 and SSB in 2011 is summarised in Table 3.16. The estimates of year classes for which GM90-06 recruitment has been assumed will contribute to 15% of landings in 2010 and 18% to SSB in 2011.

Maintaining status quo F is expected to result in increase in landings in 2010 and 2011 above the 2009 TAC (51,500 t). SSB is also expected to increase.

3.4.2 Yield and biomass per recruit analysis

Results of equilibrium landings and SSB per recruit based on the status quo exploitation pattern are presented in Tables 3.17 and Figure 3.9. Considering the yield curve, F_{max} and $F_{0.1}$ are respectively estimated to be 73% and 41% of reference F. The maximum yield is less than 3% above the current yield.

3.5 Biological reference points

In 2003, ACFM updated precautionary reference points following a revision of the assessment model and input data in recent years. The new points are presented in the table below together with previous values.

	WG 1998	ACFM 1998	ACFM 2003
$\mathbf{F}_{lim}$	No proposal	0.28 (= $\mathbf{F}_{loss}$ WG 98)	0.35(= $\mathbf{F}_{loss}$ WG 03)
$\mathbf{F}_{pa}$	No proposal	0.20 (= $\mathbf{F}_{lim}$*$e^{-1.645*0.2}$)	0.25(= $\mathbf{F}_{lim}$*$e^{-1.645*0.2}$)
$\mathbf{B}_{lim}$	No proposal	120 000 t (~ $\mathbf{B}_{loss}$= B_{94})	100 000t(~ $\mathbf{B}_{loss}$= B_{94})
$\mathbf{B}_{pa}$	119 000 t (=$\mathbf{B}_{loss}$= B_{94})	165 000 t (= $\mathbf{B}_{lim}$*$e^{1.645*0.2}$)	140 000t(= $\mathbf{B}_{lim}$*$e^{1.645*0.2}$)

Due to the uncertainty associated with the perception of the current stock history, it is neither possible to assess the validity of the current precautionary reference points nor possible to propose any revisions.

3.6 Comments on the assessment

As in last year, discards were removed from the whole catch-at-age matrix and it was decided to exclude the age 0 in the international catch at age matrix.

Several sources of uncertainties remain for this stock:

- CPUE indices from commercial fleets.
- Non validated ageing criteria and possibility of bias in ageing as shown by several tagging experiments.
- Decrease in the precision of age estimation in recent years.
- Substantial uncertainty associated with total catches, particularly on small ages (discards).
- Estimation of recruitment in recent years due mainly to inconsistencies in younger age indices from the FR-EVHOES survey.

Several of these sources of uncertainties will be investigated in a dedicated benchmark workshops planned for the beginning of 2010.

The assessment is consistent with last year in terms of F and SSB (Figure 3.10). High variability in the most recent recruitment estimates is moderated as more data are available for those year classes.

To validate age determination the Working Group participants support the project of conducting a large scale tagging experiment.

3.7 Management considerations

The main concern regarding this stock was the low levels of SSB since 1992. As in last year, there are indications of an increase in SSB in recent years.

FR-EVHOES survey index indicates an increase in recent recruitments (2006 to 2008) 2008 recruitment index is the highest values in the series.

Short-term forecasts of SSB and yield are influenced by several strong year classes estimated in recent years. It should be noted however that year class strengths are poorly estimated as shown by the retrospective analysis.

The Group is concerned by the under-estimation of F on young ages, as it introduces bias in projections.

Table 3.1. Northern Hake. Estimates of catches ('000 t) by area for 1961-2008 (revisions in bold).

	Landings (1)					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	-2.2	50.6	2.4	52.9
1979	8.7	17.6	27.2	-2.4	51.1	2.7	53.8
1980	9.7	22.0	28.4	-2.8	57.3	3.2	60.5
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	-4.2	59.9	1.5	61.4
1991	8.3	21.5	31.6	-3.9	57.6	1.7	59.3
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

(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.
(*) Year for which no discards estimates is available

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
Spanish Trawl in VII	FU 4	**612**	**137**	**245**	NA	**1254**	**1089**	**1099**	**965**	**718**	**2141**
		4124	*1175*	*2354*	NA	*16143*	*10654*	*13376*	*5786*	*5554*	*25059*
French Nephrops trawl in VIIIabd	FU9	**565**	**341**	**417**	**172**	**1035**	**1359**	**1597**	**532**	**767**	**858**
		9139	*7421*	*6407*	*2992*	*23676*	*39550*	*37740*	*18031*	*24277*	*18245*
French trawl in VIIIabd	FU10	**211**	**169**	**100**	**142**	NA	NA	NA	NA	NA	NA
		3053	*3013*	*1439*	*2253*	NA	NA	NA	NA	NA	NA
Spanish trawl in VIIIabd	FU14	NA	NA	NA	NA	NA	**30**	**489**	**206**	**471**	**352**
		NA	NA	NA	NA	NA	*451*	*8475*	*3397*	*10002*	*7153*
Irish trawl and seine in VII	FU15	**190**	**650**	**194**	NA	NA	**32**	**94**	*	*	*
		1868	*892*	*1046*	NA	NA	282	*629*	*	*	*
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**
		NA	NA	NA	NA	NA	NA	NA	NA	NA	*11*
Danish trawl and seine	FU16	**42**	**21**	**142**	**354**	**242**	**206**	**814**	**610**	**255**	**190**
		29	*38*	*483*	*691*	*479*	*775*	NA	NA	*849*	*642*
Total Weight from sampled fleet (t)		**1620**	**1319**	**1098**	**668**	**2531**	**2716**	**3278**	**1702**	**1957**	**3547**
Total Number from sampled fleets ('000)		*18213*	*12539*	*11730*	*5935*	*40299*	*51712*	*60220*	*27215*	*39833*	*51110*

* sampled but not raised

Table 3.3. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Derivation of quarterly length compositions by country and fishery unit for 2008

Country								
Unit	Quarter	France	Ireland	Spain	UK(E+W)	Scotland	Denmark	Others
1	1			SP1.Q1.08	SP1.Q1.08			
	2			2	2			
	3			3	3			
	4			4	4			
2	1	SP1.Q1.08			SP1.Q1.08			
	2	2			2			
	3	3			3			
	4	4			4			
3	1	FR3.Q1.08		SP3.Q1.08	EW3.Q1.08			
	2	2		2	2			
	3	3		3	3			
	4	4		4	4			
4	1	SP4.Q1.08		SP4.Q1.08	EW4.Q1.08			
	2	2		2	2			
	3	3		3	3			
	4	4		4	4			
5	1	FR5.Q1.08			EW5.Q1.08			
	2	2			2			
	3	3			3			
	4	4			4			
6	1				EW6.Q1.08			
	2				2			
	3				3			
	4				4			
8	1	Raised to ALL						
	2							
	3							
	4							
9	1	FR9.Q1.08						
	2	2						
	3	3						
	4	4						
10	1	FR10.Q1.08						
	2	2						
	3	3						
	4	4						
12	1	FR12.Q1.08		SP12.Q1.08				
	2	2		2				
	3	3		3				
	4	4		4				
13	1	FR13.Q1.08		SP13.Q1.08				
	2	2		2				
	3	3		3				
	4	4		4				
14	1			SP14.Q1.08				
	2			2				
	3			3				
	4			4				
15	1		IR15.Q1.08					IR.15.Annual
	2		2					
	3		3					
	4		4					
16	1	SP.16.+DK.16Annual	SP.16.+DK.16Annual	SP16.Q1.08	SP.16.+DK.16Annual	SC16.Q1.08	DK16.Annual	SP.16.+DK.16Annual
	2			2		2		
	3			3		3		
	4			4		4		
00	1	Raised to All						
	2							
	3							
	4							
ALK	1	Annual (SP)						
	2							
	3							
	4							

Table 3.4. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Annual length compositions of landings, discards and catches by fishery unit for 2008

	UNIT															Landings	Discards			Catches
Length	1	2	3	4	5	6	8	9	10	12	13	14	15	16	00	All	9	10	All	All
5																				
6																				
7																				
8																				
9																				
10													0			0				0
11																				
12																				
13																				
14																				
15																				
16																				
17																				
18																				
19																				
20																				
21									4							4				4
22																				
23													0			0				0
24								0	7				1			8				8
25				3				5	22			2	2			34				34
26				14				26	73			61	2			176				176
27				50				115	94			263	4			528				528
28				102				225	146			710	4			1192				1192
29				192	5			273	242		0	1256	8			1983				1983
30			0	286	5			331	242		0	1506	15			2393				2393
31			0	250	28	0		336	371		1	1226	23			2243				2243
32			2	350	33	0		303	368		5	1259	28	0		2356				2356
33	0	0	1	451	52	1		285	262		5	1429	34	2		2530				2530
34	0	0	3	383	38	1		218	280	0	13	1097	42	2		2084				2084
35	2	0	6	397	31	1		179	254	0	17	1025	40	2		1962				1962
36	9	1	3	375	58	2		138	346	0	29	1069	51	3		2091				2091
37	14	1	5	397	19	2		118	312	1	32	933	54	9		1901				1901
38	24	1	13	512	40	2		101	244	1	39	1058	56	22		2120				2120
39	32	2	17	443	49	2		89	290	2	55	766	60	31		1844				1844
40	62	4	23	563	29	2		77	242	4	55	702	52	65		1886				1886
41	70	4	26	497	23	2		66	134	3	60	499	47	70		1506				1506
42	62	4	43	503	36	1		55	147	6	59	341	38	84		1384				1384
43	79	5	25	445	33	1		38	66	10	50	372	35	83		1247				1247
44	93	6	34	448	6	1		33	70	11	61	254	28	99		1147				1147
45	105	7	52	441	10	1		24	55	6	49	218	24	109		1104				1104
46	108	7	49	441	1	1		19	34	10	46	185	21	139		1064				1064
47	129	8	54	374	4	1		18	31	10	42	147	20	110		950				950
48	182	11	44	337	6	0		16	21	14	43	120	20	169		988				988
49	185	12	73	301	2	0		10	16	14	45	100	18	167		947				947
50	230	14	80	279		0		12	26	13	51	85	18	203		1014				1014
51	193	12	101	225	0	0		6	30	11	53	73	16	179		902				902
52	237	15	93	209	2	0		6	11	12	59	52	14	144		858				858
53	226	14	101	175	2	0		5	27	13	61	41	14	286		971				971
54	231	14	84	149	3	0		3	21	17	73	39	16	321		977				977
55	238	15	126	174	3	0		3	22	13	96	51	12	220		977				977
56	248	16	104	132	5	0		2	11	13	107	35	15	370		1061				1061
57	243	15	87	117	2	0		2	17	16	132	40	16	229		919				919
58	220	14	68	119	6			2	7	15	138	27	13	300		932				932
59	237	15	80	95	4	0		1	10	13	156	26	21	375		1037				1037
60	259	16	67	88	1	0		1	3	14	142	31	16	439		1078				1078
61	220	14	75	79	1	0		1	2	14	131	22	18	340		919				919
62	188	12	69	61	1	0		1	2	11	153	22	15	242		780				780
63	197	12	113	63	2	0		1	2	16	130	22	15	275		851				851
64	175	11	72	58	5	0		1	2	12	127	24	14	227		731				731
65	154	10	78	56	1	0		1	2	10	115	22	19	153		624				624
66	139	9	99	48	5	0		0	6	9	112	20	17	163		629				629
67	158	10	68	53	2	0		1	5	9	92	17	15	160		593				593
68	131	8	64	35	5	0		0	7	8	90	14	13	138		516				516
69	119	7	77	27	5	0		1	3	6	75	16	13	95		445				445
70	119	7	78	23	0	0		1	3	6	68	12	11	120		449				449
71	93	6	42	26	2	0		1	2	5	41	10	15	94		338				338
72	83	5	40	14	2	0		1	2	5	42	7	13	75		290				290
73	73	5	50	15	1	0		1	4	3	43	6	9	72		284				284
74	74	5	52	9	2	0		0	0	4	41	8	10	59		265				265
75	74	5	19	9	1	0		0	2	4	29	6	9	62		219				219
76	52	3	27	6	1	0		0	0	3	25	3	9	60		192				192
77	52	3	21	6				1	0	3	23	3	6	36		155				155
78	46	3	22	3		0		0	0	2	17	2	5	32		134				134
79	44	3	13	3		0		0		2	15	2	4	22		109				109
80	39	2	8	2		0		0	0	2	5	1	4	19		82				82
81	29	2	7	2		0		0	0	1	3	0	3	23		71				71
82	22	1	6	1		0		0	0	1	4	1	2	27		66				66
83	12	1	4	1		0		0	0	1	4	1	2	24		50				50
84	14	1	3	1				0	0	1	2	0	1	15		37				37
85	10	1	4	0	2	0		0		1	4	0	1	8		31				31
86	6	0	5	0		0			0	0	3	0	1	16		32				32
87	4	0	2	0		0		0		0	1	0	1	5		14				14
88	2	0	2	0					0	0	0	0	2	9		16				16
89	1	0	1	0				0	0	0	0	0	1	3		8				8
90	1	0	2	0						0	0	0	2	1		7				7
91	1	0	1	0						0	0	0	0	4		7				7
92	1	0	1	0						0	0	0	0	1		4				4
93	1	0	1	1				0		0	0	0	0	1		4				4
94	0	0	1	0				0		0	0	0	0	3		5				5
95	0	0	1	0		0					0	0	0	4		5				5
96	0	0	0							0	0	0	1	2		3				3
97	0	0	0	0						0	0	0	0	1		1				1
98	0	0	0							0	0	0	0	3		3				3
99	0	0	0	0									0	7		8				8
100	0	0	1	1		0		0			0		1	9		13				13
Total N '1000	6052	379	2595	10924	572	26		3156	4604	383	3166	17341	1152	6844		57387				57387
Catch tons	9345	586	4140	7141	316	16	131	926	1704	563	4815	6297	1159	10654	29	47822				47822

Table 3.5. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Age composition of the landings

At 23/04/2009 10:49

Table 1 Landings numbers at age Numbers*10**-3

YEAR	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
AGE													
0	1067	515	2208	3525	3471	2242	3734	24126	246	3476	26810	4103	37196
1	35743	27147	29306	40909	33962	34497	16515	12457	23312	9204	14233	16352	20701
2	31482	30751	27015	30497	68206	27618	13470	8401	19799	19362	14461	23560	35202
3	16385	13221	15264	14689	14057	23042	14941	10841	19791	13048	22351	21195	15736
4	8279	7125	12592	10060	10031	15823	18113	5943	7815	16132	10515	14153	13500
5	8402	6765	9150	8705	5634	7574	9158	4969	4676	9187	9515	9556	7614
6	5297	4984	4208	4173	4264	5083	7799	5597	3832	5807	7883	6837	6870
7	2310	3642	3114	3896	2648	2891	3993	4151	2704	3421	6498	3914	4961
+gp	4344	5954	6355	6592	5813	6085	7356	10946	9499	8897	8006	9295	8075
TOTALNUM	113308	100104	109212	123047	148085	124855	95080	87431	91673	88534	120272	108964	149854
TONSLAND	49521	50637	56473	53920	54996	57508	63288	56100	57093	63368	64824	66472	64288
SOPCOF %	103	103	103	96	102	99	100	100	100	100	100	99	102

YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AGE													
0	20445	8101	30789	1586	4091	5948	3650	115	52	89	0	0	1
1	43381	20969	36349	35225	22032	12345	27534	2078	1018	744	198	318	716
2	16801	17759	17726	36775	31317	10827	27875	14771	12624	10125	6068	14648	7254
3	16370	19512	16506	22515	28102	15789	14693	16229	20546	19738	11142	18532	15249
4	11857	16907	9132	13459	13787	8563	7153	8556	11012	13100	7223	6808	10671
5	6356	10272	5588	7459	9869	7573	4489	6778	6821	7416	6054	4332	8035
6	4749	6461	5763	4639	5384	8026	4373	3382	4742	5695	5294	5022	6116
7	4506	4215	6012	4616	3380	4305	3513	2087	2834	2754	3601	3396	3065
+gp	6616	6560	6097	4156	4588	4837	5548	3820	2542	3305	3725	4784	2791
TOTALNUM	131082	110757	133961	130429	122549	78212	98829	57815	62191	62965	43305	57840	53896
TONSLAND	52373	56618	52146	51259	57619	47213	42600	35010	39814	42022	36675	40105	43162
SOPCOF %	99	100	100	100	100	100	100	100	100	100	100	100	100

YEAR	2004	2005	2006	2007	2008
AGE					
0	14	213	0	0	0
1	1524	1821	446	1002	459
2	10723	11770	10822	11962	9740
3	14699	13483	16376	14760	17590
4	7548	7421	8164	8910	9496
5	7795	7157	5871	7974	7501
6	6039	6267	4564	6324	6271
7	4013	4125	2552	3040	3751
+gp	4231	3819	4357	3283	2578
TOTALNUM	56587	56076	53151	57255	57387
TONSLAN	46416	46550	41469	45093	47822
SOPCOF	100	100	100	100	100

Table 3.6. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Mean weight at age in the Landings

At 23/04/2009 10:49

Table 2 Landings weights at age (kg)

YEAR	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE														
0	0.021	0.023	0.021	0.015	0.013	0.014	0.013	0.028	0.015	0.014	0.020	0.014	0.013	0.019
1	0.067	0.071	0.083	0.068	0.058	0.065	0.070	0.077	0.086	0.058	0.070	0.091	0.065	0.063
2	0.177	0.179	0.179	0.173	0.154	0.169	0.183	0.199	0.199	0.195	0.177	0.196	0.178	0.202
3	0.357	0.354	0.357	0.358	0.360	0.340	0.337	0.363	0.346	0.353	0.337	0.347	0.356	0.343
4	0.570	0.570	0.570	0.570	0.560	0.562	0.566	0.562	0.565	0.565	0.564	0.567	0.564	0.574
5	0.836	0.834	0.830	0.829	0.840	0.838	0.843	0.835	0.837	0.836	0.835	0.839	0.841	0.833
6	1.153	1.153	1.156	1.155	1.149	1.152	1.149	1.146	1.155	1.155	1.156	1.152	1.156	1.163
7	1.513	1.517	1.516	1.519	1.517	1.514	1.516	1.514	1.510	1.512	1.512	1.519	1.504	1.490
+gp	2.979	2.735	2.815	2.925	2.899	2.935	2.894	2.620	2.895	2.926	2.562	2.557	2.464	2.459
0 SOPCOF	1.029	1.025	1.027	0.957	1.024	0.990	1.005	1.000	0.999	0.995	0.998	0.990	1.020	0.993

Table 2 Landing weights at age (kg)

YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE														
0	0.032	0.024	0.025	0.038	0.024	0.040	0.057	0.028	0.019	0.000	0.034	0.075	0.059	0.032
1	0.051	0.059	0.054	0.082	0.051	0.065	0.092	0.099	0.093	0.106	0.125	0.146	0.123	0.114
2	0.155	0.146	0.141	0.190	0.180	0.154	0.179	0.192	0.187	0.180	0.200	0.219	0.222	0.21
3	0.303	0.332	0.305	0.354	0.347	0.302	0.322	0.310	0.318	0.311	0.301	0.345	0.342	0.317
4	0.524	0.570	0.547	0.552	0.533	0.463	0.484	0.534	0.551	0.605	0.548	0.596	0.621	0.587
5	0.797	0.869	0.812	0.837	0.822	0.794	0.790	0.949	0.882	1.057	0.938	0.965	0.981	1.002
6	1.150	1.127	1.183	1.209	1.183	1.212	1.198	1.439	1.265	1.287	1.409	1.404	1.387	1.518
7	1.519	1.595	1.658	1.708	1.610	1.683	1.613	1.770	1.669	1.591	1.696	1.965	1.775	1.943
+gp	2.359	2.479	2.574	2.528	2.441	2.494	2.637	2.644	2.484	2.361	2.269	2.674	2.594	2.752
0 SOPCOF	1.005	0.999	1.000	1.000	1.000	1.000	0.999	1.000	1.000	1.000	1.002	1.001	1.0003	1.0005

Table 2 Landing weights at age (kg)

YEAR	2006	2007	2008
AGE			
0	0.085	0.07	0.007
1	0.141	0.149	0.154
2	0.222	0.235	0.217
3	0.345	0.364	0.345
4	0.607	0.645	0.647
5	0.971	1.013	1.155
6	1.407	1.437	1.594
7	1.769	1.766	2.081
+gp	2.698	2.583	2.697
0 SOPCOF	1.0002	1	1.0001

Table 3.7. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Commercial fleets and Surveys tuning data

SP-CORUTR7

1985	2008								
1	1	0	1						
2	7								EFF.
10000	63	269	579	561	622	473	347	1985	14268
10000	1132	2052	639	374	290	187	173	1986	11604
10000	927	2057	3180	1684	751	264	160	1987	12444
10000	426	1250	1160	1191	860	508	239	1988	12852
10000	128	926	1228	1152	824	370	268	1989	12420
10000	141	641	1186	827	647	322	201	1990	11328
10000	258	1239	1212	699	373	236	132	1991	9852
10000	99	1958	3248	1774	556	216	133	1992	6828
10000	102	1289	1355	1025	967	528	167	1993	5748
10000	72	1483	2789	1767	636	428	123	1994	5736
10000	1223	5363	3775	2399	830	270	189	1995	4812
10000	112	1257	1646	2003	1533	564	420	1996	4116
10000	375	1104	1024	1037	852	466	442	1997	4044
10000	113	2094	2445	2506	876	332	289	1998	3924
10000	558	3219	4385	2280	767	309	130	1999	3732
10000	523	5843	7176	3675	1735	427	279	2000	2868
10000	44	1732	3049	2705	1879	943	561	2001	2640
10000	399	2384	1988	1136	848	467	512	2002	2556
10000	509	4566	5501	3001	1310	397	227	2003	3084
10000	383	2855	4033	2943	1417	748	519	2004	2820
10000	821	2154	3013	2815	1591	765	430	2005	2748
10000	340	2785	3802	2644	1266	545	406	2006	2688
10000	217	1301	3607	2551	1448	674	410	2007	2772
10000	206	1856	3364	2660	1481	755	445	2008	1872

SP-VIGOTR7

1982	2008									
1	1	0	1							
1	7									EFF.
10000	51	389	142	96	34	12	4	2	1982	75194
10000	188	638	455	142	34	16	8	4	1983	75233
10000	5	147	231	248	81	30	10	4	1984	76448
10000	15	85	70	45	40	41	23	16	1985	71241
10000	102	151	132	79	45	20	11	11	1986	68747
10000	14	229	135	163	70	37	16	9	1987	66616
10000	24	284	505	168	120	61	28	10	1988	65466
10000	104	168	144	57	23	10	5	5	1989	75853
10000	22	326	169	96	27	13	6	4	1990	80207
10000	42	279	242	80	32	15	8	3	1991	78218
10000	15	304	404	167	38	7	3	1	1992	63398
10000	4	83	200	82	27	18	7	3	1993	59879
10000	3	241	382	131	55	15	8	3	1994	56546
10000	19	172	260	117	62	18	5	3	1995	50697
10000	0	59	183	90	61	40	12	9	1996	54162
10000	2	100	148	77	41	27	13	11	1997	50576
10000	0	110	198	97	50	18	8	7	1998	53596
10000	0	114	330	167	59	21	8	3	1999	50842
10000	3	144	304	120	38	24	8	5	2000	55185
10000	0	58	162	66	39	24	10	6	2001	56776
10000	2	151	228	69	27	20	11	12	2002	50410
10000	23	239	292	90	43	21	7	4	2003	54369
10000	21	184	251	113	50	25	14	10	2004	53472
10000	23	217	130	62	49	28	13	8	2005	52455
10000	9	116	253	85	45	23	11	10	2006	53924
10000	6	119	192	97	46	25	11	8	2007	59213
10000	4	82	158	78	36	18	10	7	2008	58396

SP-PAIRT-ON8

1994	2008									
1	1	0	1							
1	7									EFF.
1000	14	450	2396	1503	199	76	12	1	1994	362
1000	111	2816	4639	2008	249	35	3	0	1995	959
1000	230	1046	1887	1154	245	99	23	4	1996	1332
1000	249	2153	2964	995	217	74	44	3	1997	1290
1000	144	1840	2152	534	45	16	2	0	1998	1482
1000	14	792	2628	747	118	20	3	0	1999	1787
1000	44	1328	3336	994	148	51	6	1	2000	1214
1000	0	1095	3358	969	135	20	4	0	2001	1153
1000	0	2494	8446	1264	173	24	2	0	2002	1281
1000	0	358	3404	2044	242	117	20	0	2003	1436
1000	15	1083	4007	1015	406	146	15	1	2004	1288
1000	324	3303	3677	1097	259	202	76	5	2005	1107
1000	42	2130	6346	1945	271	114	33	3	2006	1236
1000	21	2386	5955	2197	303	28	4	1	2007	1034
1000	126	5007	10931	3996	640	102	17	3	2008	791

Table 3.7.(cont.) **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**
Commercial fleets and Surveys tuning data

SP-PAIRT-PA8

1994	2007									
1	1	0	1							
1	7									EFF.
1000	0	37	1050	834	181	106	10	1	1994	423
1000	122	2578	4228	1615	227	46	3	1	1995	746
1000	35	803	1811	1035	303	140	36	6	1996	1367
1000	231	1930	2602	854	195	69	41	2	1997	1752
1000	1	1267	2172	651	113	61	11	1	1998	1462
1000	0	403	2730	1520	300	96	22	3	1999	1180
1000	2	235	2751	1066	236	154	35	13	2000	1233
1000	0	230	2602	979	209	67	9	1	2001	587
1000	0	1552	4357	1953	585	249	27	3	2002	720
1000	0	277	3121	1430	548	274	25	2	2003	754
1000	198	1261	3231	1047	460	217	35	2	2004	733
1000	170	1912	2552	1369	402	173	59	0	2005	252
1000	56	1641	4484	1527	211	90	27	3	2006	182
1000	0	1377	4221	1685	287	27	5	1	2007	105

FR-RESSGASCS

1987	2002										
1	1	0	1								
0	7										EFF.
1000	26289	46857	16060	2981	1227	438	255	140	287	1987	319
1000	23567	33399	12807	7885	1675	576	271	230	198	1988	321
1000	6125	67091	20389	6907	1887	793	445	239	304	1989	289
1000	13369	35760	35099	6829	1502	701	374	291	486	1990	313
1000	10089	39926	9309	5897	792	311	173	94	213	1991	338
1000	8822	26680	12912	4685	1506	341	134	89	256	1992	317
1000	11288	24745	31522	6187	766	198	98	100	168	1993	340
1000	12019	37975	42109	8908	1301	311	106	102	102	1994	274
1000	11717	47214	23658	6935	1231	723	317	183	122	1995	272
1000	17003	23658	11805	2665	428	194	144	90	170	1996	270
1000	5006	24399	33165	5300	788	204	83	58	117	1997	304
1000	3820	12034	14509	2947	776	341	72	41	79	1998	158
1000	8935	20366	13514	3182	636	135	58	132	129	1999	160
1000	6966	16022	14354	5583	745	134	123	79	204	2000	116
1000	13390	33552	29293	5354	904	160	45	41	71	2001	161
1000	6807	6898	20653	18303	1463	429	270	171	89	2002*	113

FR-EVHOES Total

										* not used
1997	2008									
1	1	0.83	0.92							
0	7									
1000	40354	6473	8164	1828	300	106	11	4	43	1997
1000	36875	5177	3630	1826	481	72	15	38	46	1998
1000	28205	13404	9071	2342	393	98	87	34	76	1999
1000	32233	2197	3881	1630	616	94	44	4	14	2000
1000	56465	8493	4523	2194	554	103	47	20	51	2001
1000	103477	8355	6202	3615	339	108	34	0	38	2002
1000	28742	8557	4965	1170	199	64	62	14	56	2003
1000	146235	14469	3934	1266	205	48	20	40	91	2004
1000	38937	16480	8718	1736	245	56	34	11	18	2005
1000	65410	4556	5111	1318	462	135	43	31	5	2006
1000	117061	11973	8688	5547	366	58	39	22	29	2007
1000	153393	23667	8958	3479	859	245	118	45	25	2008

UK-WCGFS

1988	2004		
1	1	0.17	0.25
1	2		
1000	415421	153500	1988
1000	627974	343607	1989
1000	484365	563599	1990
1000	2442891	353970	1991
1000	442857	441300	1992
1000	2363194	210976	1993
1000	1975125	449223	1994
1000	1227609	450588	1995
1000	634164	235538	1996
1000	1064510	263486	1997
1000	781341	218355	1998
1000	1953670	455483	1999
1000	483676	360107	2000
1000	203427	72974	2001
1000	1172148	236674	2002
1000	1837968	319931	2003
1000	845976	301246	2004

SP-PGFS

2001	2008									
1	1	0.67	0.75							
0	7									
1000	310	95	341	975	1114	1964	2917	2143	1509	2001
1000	64	115	1498	2438	971	1709	1343	885	2068	2002
1000	554	409	422	1968	3066	6715	4287	1367	666	2003
1000	2392	1671	520	656	1752	4039	3225	2622	2503	2004
1000	2323	3317	5734	3222	3306	2190	1693	867	550	2005
1000	16091	379	337	1743	4726	2563	1462	772	439	2006
1000	5500	6516	3971	2266	2709	3335	2095	1167	966	2007
1000	5268	11364	6324	2287	3385	3070	1151	741	459	2008

Table 3.8.a. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Effective effort indices and LPUE values of commercial fleets used in the assessment to tune the mode

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

* 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			

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

Table 3.8.b. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Effective effort indices and LPUE values of commercial fleets not used in the assessment to tune the model.

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

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

* 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/day)	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

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/day)	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

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

** (1 day = 20 fishing hours)　　** (1 day = 9 fishing hours)

Table 3.9. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) XSA tuning Diagnostics**

Lowestoft VPA Version 3.1 Extended Survivors Analysis
6/05/2009 14:01
Hake Northern stock (WGHMM 2009) Update
CPUE data from file nhake-update.cpu

Catch data for 31 years. 1978 to 2008. Ages 0 to 8.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-CORUTR	1985	2008	3	7	0	1
SP-VIGOTR7	1982	2008	2	7	0	1
SP-PAIRT-O	1994	2008	2	6	0	1
SP-PAIRT-P/	1994	2008	3	6	0	1
FR-RESSGA	1987	2008	0	5	0	1
FR-EVHOES	1997	2008	0	5	0.83	0.92
UK-WCGFSI	1988	2008	1	2	0.17	0.25
SP-PGFS□	2001	2008	2	7	0.67	0.75

Time series weights : Tapered time weighting applied
Power = 3 over 20 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 4 oldest ages.
S.E. of the mean to which the estimates are shrunk = 1.000

Minimum standard error for population
estimates derived from each fleet = .300
Prior weighting not applied

Tuning converged after 58 iterations

Regression weights

0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0	0	0	0	0	0	0	0	0	0
1	0.009	0.006	0.002	0.003	0.007	0.011	0.013	0.003	0.006	0.002
2	0.144	0.122	0.066	0.175	0.091	0.127	0.115	0.097	0.109	0.074
3	0.353	0.35	0.192	0.293	0.279	0.269	0.234	0.232	0.186	0.231
4	0.301	0.399	0.207	0.172	0.274	0.217	0.211	0.217	0.191	0.175
5	0.293	0.341	0.324	0.185	0.315	0.33	0.329	0.258	0.34	0.244
6	0.518	0.426	0.438	0.492	0.431	0.416	0.485	0.362	0.489	0.493
7	0.637	0.656	0.529	0.562	0.641	0.566	0.562	0.372	0.438	0.609

XSA population numbers (Thousands)

YEAR \ AGE	0	1	2	3	4	5	6	7
1999	1.58E+05	1.20E+05	1.04E+05	7.64E+04	4.68E+04	2.97E+04	1.30E+04	6.65E+03
2000	1.50E+05	1.29E+05	9.73E+04	7.39E+04	4.40E+04	2.84E+04	1.81E+04	6.33E+03
2001	1.38E+05	1.23E+05	1.05E+05	7.05E+04	4.26E+04	2.41E+04	1.65E+04	9.69E+03
2002	1.49E+05	1.13E+05	1.01E+05	8.06E+04	4.76E+04	2.84E+04	1.43E+04	8.73E+03
2003	1.81E+05	1.22E+05	9.22E+04	6.91E+04	4.92E+04	3.28E+04	1.93E+04	7.16E+03
2004	1.95E+05	1.48E+05	9.92E+04	6.89E+04	4.28E+04	3.06E+04	1.96E+04	1.03E+04
2005	1.92E+05	1.60E+05	1.20E+05	7.15E+04	4.31E+04	2.82E+04	1.80E+04	1.06E+04
2006	2.28E+05	1.57E+05	1.29E+05	8.73E+04	4.63E+04	2.86E+04	1.66E+04	9.09E+03
2007	3.35E+05	1.86E+05	1.28E+05	9.61E+04	5.67E+04	3.06E+04	1.81E+04	9.47E+03
2008	5.02E+05	2.74E+05	1.52E+05	9.41E+04	6.53E+04	3.83E+04	1.78E+04	9.09E+03

Estimated population abundance at 1st Jan 2009

0.00E+00	4.11E+05	2.24E+05	1.15E+05	6.11E+04	4.49E+04	2.46E+04	8.90E+03

Taper weighted geometric mean of the VPA populations:

2.01E+05	1.51E+05	1.13E+05	7.72E+04	4.68E+04	2.87E+04	1.66E+04	8.55E+03

Standard error of the weighted Log(VPA populations) :

0.3749	0.2463	0.1471	0.1264	0.1608	0.1654	0.1637	0.1819

Table 3.9. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**
(Cont.) **XSA tuning Diagnostics**

Log catchability residuals.
Fleet : SP-CORUTR7

Age	1982	1983	1984	1985	1986	1987	1988
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
4	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
6	99.99	99.99	99.99	99.99	99.99	99.99	99.99
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
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	-1.06	-1.37	-0.58	-0.14	-0.77	-0.45	1.03	-0.38	-0.69	-0.09
4	-0.9	-1.1	-1.08	0.18	-0.82	-0.35	0.27	-0.29	-0.89	-0.26
5	-0.93	-0.9	-1.33	-0.34	-0.52	-0.26	-0.17	0.05	-0.43	0.31
6	-0.86	-0.88	-1.04	-1	-0.26	-0.34	-0.39	0.06	-0.14	-0.03
7	-1.06	-1.2	-1.18	-0.71	-0.19	-0.25	-0.29	0.02	-0.38	-0.45

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
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	0.36	0.99	-0.25	-0.02	0.78	0.31	-0.03	0.03	-0.85	-0.45
4	0.33	0.93	0.02	-0.53	0.5	0.3	0	0.16	-0.1	-0.32
5	-0.06	0.48	0.33	-0.76	0.12	0.18	0.21	0.11	0.04	-0.19
6	-0.19	0.25	0.43	-0.2	-0.09	-0.04	0.2	-0.01	0.1	0.14
7	-0.38	0	0.31	-0.27	-0.2	0.04	0.03	-0.24	-0.04	0.19

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

Age	3	4	5	6	7
Mean Log q	-12.4774	-11.6725	-11.4766	-11.5104	-11.5104
S.E(Log q)	0.5667	0.4623	0.3497	0.2453	0.2761

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	-0.82	-1.813	10.26	0.09	20	0.42	-12.48
4	1.15	-0.148	11.81	0.08	20	0.56	-11.67
5	1.09	-0.121	11.58	0.16	20	0.4	-11.48
6	0.69	0.979	10.96	0.5	20	0.17	-11.51
7	0.66	1.282	10.75	0.59	20	0.16	-11.63

Fleet : SP-VIGOTR7

Age	1982	1983	1984	1985	1986	1987	1988
0	No data for this fleet at this age						
1	No data for this fleet at this age						
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	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
5	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
7	99.99	99.99	99.99	99.99	99.99	99.99	99.99

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	0.2	0.9	0.8	0.73	-0.47	0.61	0.42	-0.66	-0.27	-0.12
3	-0.53	-0.32	0.18	0.66	-0.25	0.58	0.4	0.08	-0.32	-0.06
4	-0.4	-0.04	-0.22	0.78	-0.06	0.16	0.36	0.38	0.09	0.08
5	-0.86	-0.34	-0.45	-0.2	-0.18	0.26	0.15	0.54	0.33	0.38
6	-1.3	-0.82	-0.26	-1.35	-0.23	-0.08	-0.22	0.41	0.41	0.06
7	-1.36	-1.15	-0.6	-1.16	-0.47	-0.22	-0.21	0.13	0.06	-0.14

Table 3.9. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**
(Cont.) **XSA tuning Diagnostics**

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	-0.04	0.25	-0.76	0.29	0.8	0.48	0.45	-0.27	-0.23	-0.78
3	0.47	0.42	-0.23	0.02	0.42	0.26	-0.45	0.02	-0.38	-0.53
4	0.63	0.41	-0.25	-0.33	-0.05	0.29	-0.32	-0.07	-0.16	-0.52
5	0.26	-0.11	0.07	-0.54	-0.14	0.07	0.14	0.02	0	-0.5
6	0.2	-0.04	0.06	0.08	-0.24	-0.08	0.15	0.01	0.04	-0.25
7	-0.02	0.03	-0.23	-0.01	-0.22	0.07	-0.01	-0.17	-0.16	-0.17

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	-15.8177	-14.8626	-15.2398	-15.4567	-15.5099	-15.5099
S.E(Log q)	0.5195	0.3683	0.3408	0.2983	0.2394	0.2106

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	-1.2	-1.926	6.6	0.07	20	0.56	-15.82
3	-3.14	-1.61	-0.08	0.01	20	1.08	-14.86
4	187.87	-1.686	853.57	0	20	59.28	-15.24
5	-55.22	-2.17	******	0	20	14.26	-15.46
6	2.12	-1.231	22.02	0.11	20	0.5	-15.51
7	0.99	0.047	15.52	0.52	20	0.18	-15.62
1							

Fleet : SP-PAIRT-ON8

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	99.99	99.99	99.99	99.99	99.99	-1.29	0.69	-0.32	0.28	0.17
3	99.99	99.99	99.99	99.99	99.99	-0.56	0.3	-0.56	-0.3	-0.65
4	99.99	99.99	99.99	99.99	99.99	-0.11	0.5	0.22	-0.06	-0.92
5	99.99	99.99	99.99	99.99	99.99	-0.08	-0.08	0.31	0.37	-1.34
6	99.99	99.99	99.99	99.99	99.99	0.58	-0.51	0.37	0.45	-1.02
7	No data for this fleet at this age									

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	-0.63	-0.05	-0.35	0.57	-1.33	-0.28	0.65	0.12	0.25	0.81
3	-0.43	-0.16	-0.18	0.66	-0.11	0.05	-0.08	0.26	0.08	0.73
4	-0.57	-0.18	-0.26	-0.13	0.37	-0.22	-0.15	0.35	0.26	0.71
5	-0.66	-0.37	-0.3	-0.29	-0.03	0.56	0.19	0.19	0.27	0.75
6	-0.82	-0.23	-1.09	-0.72	0.54	0.73	1.17	0.62	-0.81	0.5
7	No data for this fleet at this age									

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

Age	2	3	4	5	6
Mean Log q	-10.9908	-9.5819	-10.2306	-11.5363	-12.247
S.E(Log q)	0.639	0.4133	0.4257	0.5254	0.7852

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	0.28	2.26	11.45	0.51	15	0.15	-10.99
3	0.35	2.205	10.67	0.54	15	0.12	-9.58
4	0.46	1.576	10.51	0.47	15	0.18	-10.23
5	0.43	1.375	10.82	0.38	15	0.22	-11.54
6	0.3	1.703	10.48	0.38	15	0.22	-12.25

Table 3.9. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**
(Cont.) **XSA tuning Diagnostics**

Fleet : SP-PAIRT-PA8

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
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	-1.07	0.52	-0.29	-0.11	-0.32
4	99.99	99.99	99.99	99.99	99.99	-0.64	0.33	0.16	-0.16	-0.67
5	99.99	99.99	99.99	99.99	99.99	-0.5	-0.49	0.2	-0.06	-0.74
6	99.99	99.99	99.99	99.99	99.99	0.27	-0.88	0.07	-0.25	-0.3
7	No data for this fleet at this age									

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
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	-0.08	-0.04	-0.12	0.31	0.12	0.16	-0.13	0.23	0.05	99.99
4	0.19	-0.06	-0.2	0.36	0.07	-0.13	0.12	0.16	0.05	99.99
5	-0.05	-0.23	-0.19	0.61	0.46	0.36	0.31	-0.38	-0.11	99.99
6	0.13	0.23	-0.51	0.98	0.75	0.49	0.38	-0.25	-1.49	99.99
7	No data for this fleet at this age									

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

Age	3	4	5	6
Mean Log q	-9.8998	-10.2835	-11.2118	-11.6099
S.E(Log q)	0.2812	0.276	0.4003	0.7021

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	0.69	0.547	10.31	0.27	14	0.2	-9.9
4	1	-0.005	10.28	0.18	14	0.29	-10.28
5	0.55	0.872	10.78	0.31	14	0.22	-11.21
6	0.89	0.091	11.4	0.07	14	0.66	-11.61

Fleet : FR-RESSGASCS

Age	1982	1983	1984	1985	1986	1987	1988
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	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
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	No data for this fleet at this age						
7	No data for this fleet at this age						

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	-0.52	0	-0.06	-0.36	0.01	0.24	0.11	0.47	-0.51	-0.71
1	0.86	0.34	0.24	0	-0.2	0.36	0.72	-0.13	-0.05	-0.61
2	-0.08	0.5	-0.77	-0.6	0.4	0.69	0.27	-0.45	0.46	-0.32
3	0.21	0.26	0.25	-0.01	0.06	0.6	0.55	-0.36	0.14	-0.48
4	0.83	0.44	-0.2	0.72	-0.09	0.19	0.45	-0.33	0.15	-0.1
5	0.99	1.23	0.15	0.3	0.12	0.3	0.92	0.01	0.24	0.61
6	No data for this fleet at this age									
7	No data for this fleet at this age									

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0.07	-0.13	0.61	99.99	99.99	99.99	99.99	99.99	99.99	99.99
1	-0.01	-0.32	0.46	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	-0.34	-0.23	0.38	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	-0.39	0.21	0.14	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	-0.29	-0.03	0.11	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	-0.6	-0.54	-0.21	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	No data for this fleet at this age									
7	No data for this fleet at this age									

Table 3.9. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**
(Cont.) **XSA tuning Diagnostics**

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

Age	0	1	2	3	4	5
Mean Log q	-9.7505	-8.5712	-8.4382	-9.4369	-10.6729	-11.4638
S.E(Log q)	0.4794	0.4284	0.4403	0.383	0.2683	0.5369

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	0.84	0.119	10.11	0.14	13	0.46	-9.75
1	0.88	0.092	8.95	0.16	13	0.43	-8.57
2	0.28	1.187	10.71	0.46	13	0.12	-8.44
3	0.61	0.248	10.13	0.11	13	0.26	-9.44
4	0.74	0.348	10.67	0.36	13	0.22	-10.67
5	1.42	-0.181	12.01	0.05	13	0.87	-11.46

Fleet : FR-EVHOES Total

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.18	-0.19
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.27	-0.42
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.37	-0.44
3	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	-0.06	-0.09
4	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.04	0.27
5	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	0.56	0.07
6	No data for this fleet at this age									
7	No data for this fleet at this age									

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	-0.54	-0.36	0.29	0.82	-0.65	0.9	-0.41	-0.06	0.13	0
1	0.6	-1.28	0.12	0.19	0.14	0.47	0.53	-0.75	0.05	0.34
2	0.51	-0.29	-0.26	0.19	-0.01	-0.29	0.31	-0.32	0.23	0.06
3	0.21	-0.12	0.08	0.54	-0.45	-0.37	-0.13	-0.6	0.7	0.29
4	0.11	0.7	0.46	-0.17	-0.65	-0.53	-0.36	0.2	-0.25	0.44
5	0.06	0.1	0.34	0.1	-0.45	-0.66	-0.42	0.38	-0.46	0.67
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age	0	1	2	3	4	5
Mean Log q	-7.9177	-9.5209	-9.5596	-10.1195	-11.3546	-12.2456
S.E(Log q)	0.5055	0.5619	0.3078	0.4104	0.4328	0.4471

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
0	0.97	0.071	8.04	0.4	12	0.52	-7.92
1	0.77	0.412	10.08	0.27	12	0.45	-9.52
2	0.72	0.579	10.14	0.33	12	0.23	-9.56
3	0.36	1.831	10.85	0.49	12	0.13	-10.12
4	0.79	0.268	11.23	0.16	12	0.36	-11.35
5	1.85	-0.495	13.92	0.04	12	0.86	-12.25

Fleet : UK-WCGFS

Age	1982	1983	1984	1985	1986	1987	1988
0	No data for this fleet at this age						
1	99.99	99.99	99.99	99.99	99.99	99.99	99.99
2	99.99	99.99	99.99	99.99	99.99	99.99	99.99
3	No data for this fleet at this age						
4	No data for this fleet at this age						
5	No data for this fleet at this age						
6	No data for this fleet at this age						
7	No data for this fleet at this age						

Table 3.9. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**
(Cont.) **XSA tuning Diagnostics**

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	No data for this fleet at this age									
1	-0.6	-0.76	0.63	-0.89	0.63	0.59	0.26	-0.52	0.01	-0.1
2	0.09	0.6	0.23	0.3	-0.34	0.38	0.53	-0.08	-0.13	-0.24
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	No data for this fleet at this age									
1	0.89	-0.58	-1.4	0.44	0.81	-0.15	99.99	99.99	99.99	99.99
2	0.55	0.37	-1.31	-0.07	0.3	0.18	99.99	99.99	99.99	99.99
3	No data for this fleet at this age									
4	No data for this fleet at this age									
5	No data for this fleet at this age									
6	No data for this fleet at this age									
7	No data for this fleet at this age									

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

Age	1	2
Mean Log q	-4.9664	-5.9062
S.E(Log q)	0.7407	0.5583

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	1.66	-0.206	0.48	0.02	16	1.32	-4.97
2	9.49	-0.376	-42.05	0	16	5.65	-5.91

Fleet : SP-PGFS

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	99.99	99.99	-1.25	0.35	-0.89	-0.73	1.47	-1.45	1.03	1.3
3	99.99	99.99	-0.51	0.34	0.27	-0.83	0.7	-0.11	0.02	0.08
4	99.99	99.99	-0.62	-0.89	0.3	-0.16	0.46	0.75	-0.02	0.05
5	99.99	99.99	-0.16	-0.56	0.76	0.33	-0.2	-0.11	0.15	-0.23
6	99.99	99.99	0.4	-0.19	0.63	0.32	-0.2	-0.35	0.02	-0.56
7	99.99	99.99	0.69	-0.06	0.63	0.86	-0.28	-0.38	0.04	-0.25

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	-11.195	-10.3999	-9.647	-8.8863	-8.5918	-8.5918
S.E(Log q)	1.2073	0.486	0.5391	0.4023	0.4091	0.5185

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	0.22	1.434	11.55	0.37	8	0.24	-11.2
3	0.66	0.368	10.7	0.17	8	0.34	-10.4
4	0.84	0.129	9.83	0.1	8	0.49	-9.65
5	0.56	0.654	9.52	0.28	8	0.23	-8.89
6	0.38	1.06	9.33	0.34	8	0.15	-8.59
7	2.26	-0.328	7.59	0.01	8	1.2	-8.45

Terminal year survivor and F summaries :

Table 3.9. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**
(Cont.) **XSA tuning Diagnostics**

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

Year class = 2008

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR	1	0	0	0	0	0	0
SP-VIGOTR7	1	0	0	0	0	0	0
SP-PAIRT-O	1	0	0	0	0	0	0
SP-PAIRT-P.	1	0	0	0	0	0	0
FR-RESSGA	1	0	0	0	0	0	0
FR-EVHOES	410745	0.529	0	0	1	1	0
UK-WCGFSI	1	0	0	0	0	0	0
SP-PGFS□	1	0	0	0	0	0	0
F shrinkage	0	1				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
410745	0.53	0	1	0	0

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

Year class = 2007

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR	1	0	0	0	0	0	0
SP-VIGOTR7	1	0	0	0	0	0	0
SP-PAIRT-O	1	0	0	0	0	0	0
SP-PAIRT-P.	1	0	0	0	0	0	0
FR-RESSGA	1	0	0	0	0	0	0
FR-EVHOES	280913	0.393	0.103	0.26	2	0.866	0.001
UK-WCGFSI	1	0	0	0	0	0	0
SP-PGFS□	1	0	0	0	0	0	0
F shrinkage	51987	1				0.134	0.008

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
224013	0.37	0.44	3	1.208	0.002

1

Age 2 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-CORUTR	1	0	0	0	0	0	0
SP-VIGOTR7	52778	0.541	0	0	1	0.146	0.154
SP-PAIRT-O	258296	0.666	0	0	1	0.096	0.034
SP-PAIRT-P.	1	0	0	0	0	0	0
FR-RESSGA	1	0	0	0	0	0	0
FR-EVHOES	119143	0.249	0.036	0.14	3	0.686	0.071
UK-WCGFSI	1	0	0	0	0	0	0
SP-PGFS□	425086	1.283	0	0	1	0.026	0.021
F shrinkage	77117	1				0.046	0.108

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
115456	0.21	0.19	7	0.897	0.074

Table 3.9. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) (Cont.) XSA tuning Diagnostics

Age 3 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-CORUTR	38935	0.59	0	0	1	0.063	0.343
SP-VIGOTR7	39555	0.313	0.141	0.45	2	0.217	0.338
SP-PAIRT-O	111227	0.362	0.214	0.59	2	0.163	0.134
SP-PAIRT-P.	1	0	0	0	0	0	0
FR-RESSGA	1	0	0	0	0	0	0
FR-EVHOES	62210	0.216	0.221	1.02	4	0.435	0.228
UK-WCGFSI	1	0	0	0	0	0	0
SP-PGFS□	74801	0.479	0.317	0.66	2	0.094	0.193
F shrinkage	58319	1				0.028	0.241

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
61124	0.15	0.14	12	0.93	0.231

1

Age 4 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-CORUTR	26965	0.374	0.252	0.67	2	0.093	0.277
SP-VIGOTR7	29248	0.236	0.067	0.28	3	0.223	0.258
SP-PAIRT-O	65043	0.282	0.218	0.77	3	0.155	0.124
SP-PAIRT-P.	47354	0.3	0	0	1	0.127	0.167
FR-RESSGA	1	0	0	0	0	0	0
FR-EVHOES	60677	0.196	0.233	1.18	5	0.294	0.132
UK-WCGFSI	1	0	0	0	0	0	0
SP-PGFS□	41836	0.37	0.266	0.72	3	0.091	0.187
F shrinkage	34407	1				0.016	0.223

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
44870	0.11	0.11	18	1.021	0.175

Age 5 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
SP-CORUTR	21529	0.263	0.054	0.2	3	0.131	0.274
SP-VIGOTR7	19617	0.191	0.168	0.88	4	0.235	0.297
SP-PAIRT-O	37951	0.254	0.129	0.51	4	0.124	0.165
SP-PAIRT-P.	28009	0.214	0.09	0.42	2	0.165	0.217
FR-RESSGA	1	0	0	0	0	0	0
FR-EVHOES	25929	0.185	0.223	1.2	6	0.214	0.233
UK-WCGFSI	21116	0.795	0	0	1	0.009	0.279
SP-PGFS□	22235	0.284	0.174	0.61	4	0.108	0.266
F shrinkage	18242	1				0.013	0.316

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
24594	0.09	0.07	25	0.829	0.244

Table 3.9. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) (Cont.)** **XSA tuning Diagnostics**

1

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

Year class = 2002

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR	9895	0.203	0.033	0.16	4	0.195	0.453
SP-VIGOTR7	7745	0.167	0.099	0.6	5	0.264	0.55
SP-PAIRT-O	10834	0.249	0.123	0.49	5	0.097	0.421
SP-PAIRT-P.	8872	0.193	0.099	0.52	3	0.148	0.494
FR-RESSGA	1	0	0	0	0	0	0
FR-EVHOES	8261	0.187	0.164	0.88	6	0.141	0.523
UK-WCGFSI	13338	0.48	0.305	0.63	2	0.017	0.354
SP-PGFS□	8839	0.245	0.268	1.09	5	0.123	0.496
F shrinkage	10278	1				0.016	0.44

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
8902	0.08	0.05	31	0.666	0.493

Age 7 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
SP-CORUTR	4665	0.176	0.032	0.18	5	0.251	0.547
SP-VIGOTR7	3866	0.154	0.094	0.61	6	0.301	0.63
SP-PAIRT-O	3260	0.249	0.232	0.93	5	0.069	0.714
SP-PAIRT-P.	3474	0.189	0.289	1.53	4	0.118	0.682
FR-RESSGA	7435	0.559	0	0	1	0.009	0.376
FR-EVHOES	4007	0.189	0.135	0.72	6	0.1	0.614
UK-WCGFSI	5754	0.487	0.066	0.13	2	0.012	0.464
SP-PGFS□	3540	0.235	0.141	0.6	6	0.121	0.672
F shrinkage	10190	1				0.019	0.287

Weighted prediction :

Survivors at end of yea	Int s.e	Ext s.e	N	Var Ratio	F
4045	0.08	0.06	36	0.712	0.609

Table 3.10. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Estimates of fishing mortality at age

At 23/04/2009 11:21

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR / AGE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
0	0	0	0	0	0	0	0	0	0	0	0
1	0.1963	0.1253	0.1506	0.1668	0.1814	0.2341	0.1027	0.0876	0.1593	0.0646	0.0975
2	0.2752	0.2586	0.1771	0.2313	0.4616	0.22	0.1344	0.0695	0.1957	0.1926	0.1371
3	0.215	0.1773	0.1971	0.1377	0.1584	0.2771	0.1775	0.1525	0.2322	0.1912	0.356
4	0.1431	0.1362	0.2557	0.1929	0.1314	0.2692	0.3662	0.0991	0.1567	0.3014	0.2324
5	0.2471	0.1667	0.26	0.2824	0.1573	0.1387	0.2464	0.1604	0.1055	0.2791	0.2923
6	0.1771	0.227	0.1483	0.1808	0.2173	0.2079	0.2072	0.234	0.1789	0.1848	0.4117
7	0.1964	0.1776	0.2163	0.1994	0.1668	0.2243	0.2506	0.1621	0.169	0.2404	0.325
+gp	0.1964	0.1776	0.2163	0.1994	0.1668	0.2243	0.2506	0.1621	0.169	0.2404	0.325
FBAR 2- 6	0.2115	0.1932	0.2077	0.205	0.2252	0.2226	0.2263	0.1431	0.1738	0.2298	0.2859

YEAR / AGE	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0	0	0	0	0	0	0	0	0	0	0
1	0.1093	0.1547	0.2645	0.1496	0.2285	0.254	0.1818	0.0872	0.2047	0.0179	0.0094
2	0.232	0.3621	0.1814	0.1642	0.1823	0.3816	0.3769	0.1275	0.2895	0.1612	0.1438
3	0.3052	0.2395	0.2848	0.3315	0.2263	0.3714	0.5685	0.3311	0.2553	0.2729	0.3526
4	0.4015	0.3253	0.2864	0.5372	0.2545	0.2916	0.4101	0.3354	0.2448	0.2318	0.3011
5	0.343	0.3925	0.2499	0.4322	0.3384	0.3413	0.3613	0.4157	0.2946	0.3872	0.293
6	0.3537	0.4453	0.456	0.4345	0.4629	0.5248	0.444	0.5662	0.4519	0.3786	0.5177
7	0.3694	0.4718	0.5966	0.9845	0.9635	0.8575	0.9522	0.7893	0.5228	0.4049	0.637
+gp	0.3694	0.4718	0.5966	0.9845	0.9635	0.8575	0.9522	0.7893	0.5228	0.4049	0.637
FBAR 2- 6	0.3271	0.3529	0.2917	0.3799	0.2929	0.3821	0.4322	0.3552	0.3072	0.2863	0.3216

YEAR / AGE	2000	2001	2002	2003	2004	2005	2006	2007	2008	FBAR **-**
0	0	0	0	0	0	0	0	0	0	0
1	0.0064	0.0018	0.0031	0.0065	0.0115	0.0127	0.0031	0.006	(0.0019)*	0.0036
2	0.1222	0.0659	0.1754	0.091	0.1272	0.1151	0.0971	0.1089	0.0736	0.0932
3	0.35	0.192	0.2933	0.2795	0.2689	0.2337	0.2323	0.1861	0.2314	0.2166
4	0.3994	0.2074	0.1719	0.274	0.2169	0.211	0.2165	0.1909	0.1752	0.1942
5	0.3411	0.3245	0.1849	0.3152	0.3303	0.3291	0.2575	0.3402	0.2437	0.2805
6	0.4264	0.4376	0.4916	0.4313	0.4157	0.4849	0.3618	0.4885	0.4931	0.4478
7	0.6558	0.5288	0.5622	0.641	0.5659	0.5623	0.3716	0.4379	0.6093	0.4729
+gp	0.6558	0.5288	0.5622	0.641	0.5659	0.5623	0.3716	0.4379	0.6093	
FBAR 2- 6	0.3278	0.2455	0.2634	0.2782	0.2718	0.2748	0.233	0.2629	0.2434	

*replaced by AM06-07 0.0046

Table 3.11 Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Estimates of stock number at age (start of year) (*000)

1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
311103	283028	359376	276389	223138	228462	200454	213670	198521	206841	213135
221659	254710	231724	294232	226288	182690	187049	164118	174938	162535	169347
144642	149137	183975	163202	203881	154539	118359	138199	123097	122134	124745
93613	89937	94278	126182	106023	105209	101537	84716	105546	82869	82475
68626	61818	61671	63378	90018	74086	65289	69612	59550	68507	56041
42411	48695	44166	39098	42787	64624	46339	37064	51616	41684	41492
36069	27121	33747	27881	24134	29933	46056	29653	25850	38028	25815
14312	24738	17695	23822	19051	15901	19908	30650	19213	17697	25881
26784	40263	35915	40108	41640	33290	36459	80472	67203	45761	31661
959218	979447	1062547	1054292	976960	888733	821450	848155	825535	786056	770591

1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
194902	251946	203666	240205	211993	178905	199482	200753	158209	146531	157838
174500	159572	206276	166747	196664	173565	146475	163322	164363	129531	119970
125771	128073	111916	129632	117548	128124	110230	99989	122546	109655	104171
89048	81654	73005	76427	90065	80201	71624	61912	72067	75110	76413
47301	53728	52615	44959	44917	58804	45290	33213	36402	45708	46810
36368	25921	31774	32348	21511	28513	35967	24606	19444	23332	29681
25361	21129	14333	20263	17190	12556	16595	20517	13294	11857	12969
14003	14577	11083	7438	10743	8859	6082	8715	9536	6927	6648
32999	23504	16087	11372	10707	7852	8115	9651	14906	12575	5891
740252	760105	720754	729391	721338	677380	639861	622678	610767	561226	560390

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	GMST 78-**	AMST 78-**
150357	137925	148937	180544	195344	191776	227781	(334801)*	(501677)*	(0)*	204759	210042
129226	123102	112924	121940	147817	159934	157013	186491	(274112)*	(410745)*	168644	173180
97302	105129	100608	92166	99188	119643	129295	128148	151780	(224013)*	123854	126100
73865	70503	80582	69117	68896	71506	87306	96066	94095	115456	83092	84196
43971	42616	47641	49206	42791	43107	46344	56662	65297	61124	52583	53932
28361	24147	28355	32846	30631	28204	28578	30556	38329	44870	33501	34847
18129	16510	14292	19295	19622	18025	16615	18086	17803	24594	21122	22512
6328	9690	8726	7157	10263	10601	9087	9474	9085	8902	12229	13632
7501	9920	12161	6439	10702	9706	15392	10141	6172	6792		
555039	539540	554226	578710	625254	652502	717411	870427	1158350	896496		

Age 0 in 2007 replaced by:	184281
Age 0 in 2008 replaced by:	184281
Age 0 in 2009 replaced by:	184281
Age 1 in 2008 replaced by:	150876
Age 1 in 2009 replaced by:	150876
Age 2 in 2009 replaced by:	122966

**Table 3.12 Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Summary of catches and XSA results**

	RECRUITS Age 0	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2- 6
1978	311103	298008	206097	49521	0.2403	0.2115
1979	283028	337893	243932	50637	0.2076	0.1932
1980	359376	332116	228762	56473	0.2469	0.2077
1981	276389	351803	246941	53920	0.2184	0.2050
1982	223138	349288	248717	54996	0.2211	0.2252
1983	228462	329014	238210	57508	0.2414	0.2226
1984	200454	336205	253811	63288	0.2494	0.2263
1985	213670	438169	349625	56100	0.1605	0.1431
1986	198521	409306	320889	57093	0.1779	0.1738
1987	206841	343522	265891	63368	0.2383	0.2298
1988	213135	282333	206628	64824	0.3137	0.2859
1989	194902	266356	185525	66472	0.3583	0.3271
1990	251946	221879	148751	64288	0.4322	0.3529
1991	203666	193922	120441	52373	0.4348	0.2917
1992	240205	170207	104091	56618	0.5439	0.3799
1993	211993	171101	102113	52146	0.5107	0.2929
1994	178905	161444	95516	51259	0.5367	0.3821
1995	199482	171962	98893	57619	0.5826	0.4322
1996	200753	152419	95627	47213	0.4937	0.3552
1997	158209	159277	98349	42600	0.4332	0.3072
1998	146531	163175	93963	35010	0.3726	0.2863
1999	157838	159154	91801	39814	0.4337	0.3216
2000	150357	157928	94578	42022	0.4443	0.3278
2001	137925	165289	103569	36675	0.3541	0.2455
2002	148937	178790	107710	40105	0.3723	0.2634
2003	180544	194769	109979	43162	0.3925	0.2782
2004	195344	205105	121601	46416	0.3817	0.2718
2005	191776	200396	120501	46550	0.3863	0.2748
2006	227781	237184	129760	41469	0.3196	0.2330
2007*	(334801)	252722	126744	45093	0.3558	0.2629
2008*	(501677)	261571	136588	47822	0.3501	0.2434
Arith. Mean	223474	246849	164374	51047	0.355	0.2727
Units	(Thousand	(Tonnes)	(Tonnes)	(Tonnes)		

* Replaced by GM90-06 184281

Table 3.13. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Prediction with management option table: Input data

2009	Landings							
Age	Exploitation pattern	Weight in catch	Stock size	Natural Mortality	Maturity ogive	Prop. of F bef. spaw.	Prop. of M bef. spaw.	Weight in stock
0	0.0000	0.054	184281	0.2	0.00	0	0	0.054
1	0.0046	0.148	150876	0.2	0.00	0	0	0.148
2	0.0932	0.225	122966	0.2	0.00	0	0	0.225
3	0.2166	0.351	115456	0.2	0.23	0	0	0.351
4	0.1942	0.633	61124	0.2	0.60	0	0	0.633
5	0.2805	1.046	44870	0.2	0.90	0	0	1.046
6	0.4478	1.479	24594	0.2	1.00	0	0	1.479
7	0.4729	1.872	8902	0.2	1.00	0	0	1.872
8+	0.4729	2.659	6792	0.2	1.00	0	0	2.659
Unit	-	Kilograms	Thousands	-	-	-	-	Kilograms

2010	Landings							
Age	Exploitation pattern	Weight in catch	Stock size	Natural Mortality	Maturity ogive	Prop. of F bef. spaw.	Prop. of M bef. spaw.	Weight in stock
0	0.0000	0.054	184281	0.2	0.00	0	0	0.054
1	0.0046	0.148		0.2	0.00	0	0	0.148
2	0.0932	0.225		0.2	0.00	0	0	0.225
3	0.2166	0.351		0.2	0.23	0	0	0.351
4	0.1942	0.633		0.2	0.60	0	0	0.633
5	0.2805	1.046		0.2	0.90	0	0	1.046
6	0.4478	1.479		0.2	1.00	0	0	1.479
7	0.4729	1.872		0.2	1.00	0	0	1.872
8+	0.4729	2.659		0.2	1.00	0	0	2.659
Unit	-	Kilograms	Thousands	-	-	-	-	Kilograms

2011	Landings							
Age	Exploitation pattern	Weight in catch	Stock size	Natural Mortality	Maturity ogive	Prop. of F bef. spaw.	Prop. of M bef. spaw.	Weight in stock
0	0.0000	0.054	184281	0.2	0.00	0	0	0.054
1	0.0046	0.148		0.2	0.00	0	0	0.148
2	0.0932	0.225		0.2	0.00	0	0	0.225
3	0.2166	0.351		0.2	0.23	0	0	0.351
4	0.1942	0.633		0.2	0.60	0	0	0.633
5	0.2805	1.046		0.2	0.90	0	0	1.046
6	0.4478	1.479		0.2	1.00	0	0	1.479
7	0.4729	1.872		0.2	1.00	0	0	1.872
8+	0.4729	2.659		0.2	1.00	0	0	2.659
Unit	-	Kilograms	Thousands	-	-	-	-	Kilograms

Table 3.14. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Catch predictions with management option table

Year: 2009				
Landings				
F Factor	Reference F	Catch in weight	Stock Biomass	Sp. Stock Biomass
1.0	0.2465	50120	257221	145908

Year: 2010					Year: 2011	
Landings						
F Factor	Reference F	Catch in weight	Stock Biomass	Sp. Stock Biomass	Stock Biomass	Sp. Stock Biomass
0.0	0.0000	0	269869	161566	346043	233240
0.1	0.0247	6321			338087	226082
0.2	0.0493	12429			330396	219177
0.3	0.0740	18331			322962	212513
0.4	0.0986	24036			315773	206083
0.5	0.1233	29552			308821	199877
0.6	0.1479	34884			302097	193886
0.7	0.1726	40040			295593	188102
0.8	0.1972	45028			289299	182518
0.9	0.2219	49853			283209	177125
1.0	0.2465	54521			277314	171916
1.1	0.2712	59038			271608	166884
1.2	0.2958	63410			266084	162023
1.3	0.3205	67643			260735	157325
1.4	0.3451	71741			255554	152786
1.5	0.3698	75709			250536	148398
1.6	0.3944	79553			245674	144157
1.7	0.4191	83276			240963	140056
1.8	0.4437	86884			236398	136091
1.9	0.4684	90380			231972	132256
2.0	0.4930	93768			227682	128547

Table 3.15. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Detailed tables

MFDP version 1a
Run: Hake2009
Time and date: 16:56 06/05/2009
Fbar age range: 2-6

Year: 2009 F multiplier: 1 Fbar: 0.2465

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.0000	0	0	184281	9951	0	0	0	0
1	0.0046	623	92	150876	22330	0	0	0	0
2	0.0932	9933	2232	122966	27626	0	0	0	0
3	0.2166	20453	7186	115456	40564	26555	9330	26555	9330
4	0.1942	9810	6210	61124	38691	36674	23215	36674	23215
5	0.2805	9993	10455	44870	46949	40383	42254	40383	42254
6	0.4478	8106	11992	24594	36383	24594	36383	24594	36383
7	0.4729	3064	5736	8902	16665	8902	16665	8902	16665
8	0.4729	2338	6217	6792	18062	6792	18062	6792	18062
Total		64320	50120	719861	257221	143900	145908	143900	145908

Year: 2010 F multiplier: 1 Fbar: 0.2465

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.0000	0	0	184281	9951	0	0	0	0
1	0.0046	623	92	150877	22330	0	0	0	0
2	0.0932	9933	2232	122964	27626	0	0	0	0
3	0.2166	16247	5708	91717	32223	21095	7411	21095	7411
4	0.1942	12217	7733	76118	48183	45671	28910	45671	28910
5	0.2805	9178	9603	41211	43120	37090	38808	37090	38808
6	0.4478	9147	13531	27752	41054	27752	41054	27752	41054
7	0.4729	4429	8292	12867	24088	12867	24088	12867	24088
8	0.4729	2756	7330	8007	21294	8007	21294	8007	21294
Total		64530	54521	715794	269869	152482	161566	152482	161566

Year: 2011 F multiplier: 1 Fbar: 0.2465

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.0000	0	0	184281	9951	0	0	0	0
1	0.0046	623	92	150877	22330	0	0	0	0
2	0.0932	9933	2232	122964	27626	0	0	0	0
3	0.2166	16247	5708	91716	32223	21095	7411	21095	7411
4	0.1942	9705	6143	60468	38276	36281	22966	36281	22966
5	0.2805	11429	11959	51320	53698	46188	48328	46188	48328
6	0.4478	8401	12428	25489	37706	25489	37706	25489	37706
7	0.4729	4998	9356	14520	27181	14520	27181	14520	27181
8	0.4729	3666	9749	10650	28323	10650	28323	10650	28323
Total		65002	57667	712284	277314	154222	171916	154222	171916

Input units are thousands and kg - output in tonnes

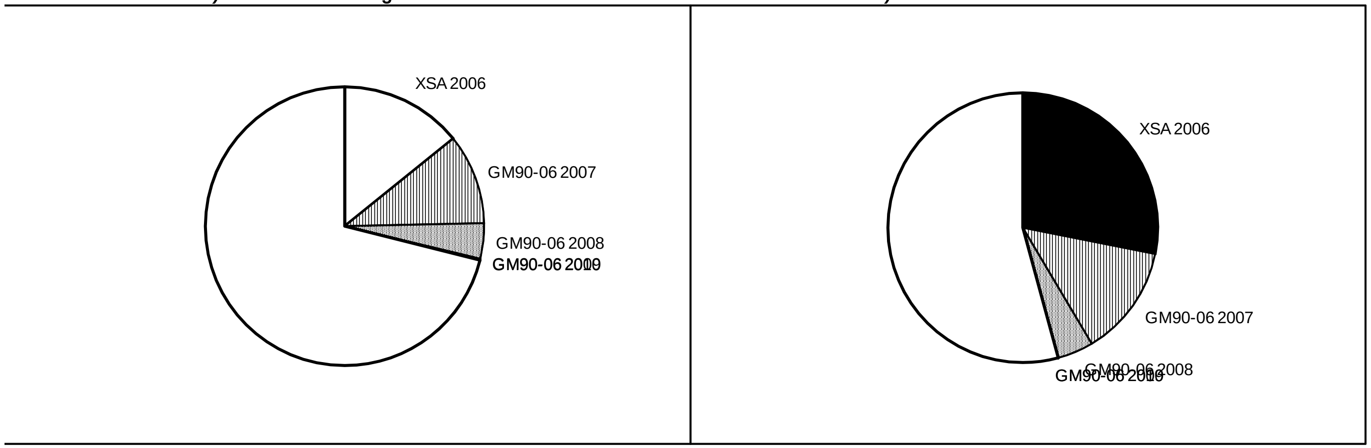
Table 3.16 **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2006	2007	2008	2009	2010
Stock No. (thousands) of 0 year-olds	227781	184281	184281	184281	184281
Source	XSA	GM90-06	GM90-06	GM90-06	GM90-06
Status Quo F:					
% in 2009 landings	14.3	4.5	0.2	0.0	-
% in 2010	14.2	10.5	4.1	0.2	0.0
% in 2009 SSB	6.4	0.0	0.0	0.0	-
% in 2010 SSB	17.9	4.6	0.0	0.0	0.0
% in 2011 SSB	28.1	13.4	4.3	0.0	0.0

GM : geometric mean recruitment

Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) : Year-class % contribution to

a) 2010 landings **b) 2011 SSB**



XSA 2006 GM90-06 2007 GM90-06 2008 GM90-06 2009 GM90-06 2010

This table has been corrected by ICES Secretariat. The correct table has been provided by the WGHMM. Due to a formatting problem the first version was incorrect.

Table 3.17. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Yield per recruit summary table

MFYPR version 2a
Run: hake2009
Time and date: 18:21 06/05/2009
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	5.5167	5.0571	2.3885	4.4306	2.3885	4.4306
0.1	0.0246	0.0856	0.139	5.0902	4.0433	1.9739	3.4237	1.9739	3.4237
0.2	0.0493	0.1454	0.2179	4.7927	3.3653	1.6879	2.7524	1.6879	2.7524
0.3	0.0739	0.1901	0.2639	4.5711	2.8824	1.4775	2.2761	1.4775	2.2761
0.4	0.0986	0.225	0.2907	4.3981	2.5227	1.3153	1.9227	1.3153	1.9227
0.5	0.1232	0.2532	0.3057	4.2581	2.2453	1.186	1.6514	1.186	1.6514
0.6	0.1479	0.2767	0.3132	4.1417	2.0256	1.08	1.4376	1.08	1.4376
0.7	0.1725	0.2968	0.3159	4.0429	1.8477	0.9913	1.2655	0.9913	1.2655
0.8	0.1972	0.3141	0.3156	3.9574	1.7009	0.9158	1.1243	0.9158	1.1243
0.9	0.2218	0.3293	0.3132	3.8825	1.5781	0.8505	1.0069	0.8505	1.0069
1	0.2465	0.3428	0.3096	3.816	1.4739	0.7934	0.9079	0.7934	0.9079
1.1	0.2711	0.3549	0.3052	3.7564	1.3844	0.743	0.8235	0.743	0.8235
1.2	0.2957	0.3659	0.3003	3.7026	1.3068	0.6982	0.7509	0.6982	0.7509
1.3	0.3204	0.3759	0.2951	3.6535	1.239	0.6579	0.6879	0.6579	0.6879
1.4	0.345	0.3851	0.2899	3.6086	1.1792	0.6215	0.6327	0.6215	0.6327
1.5	0.3697	0.3935	0.2847	3.5672	1.1261	0.5885	0.5842	0.5885	0.5842
1.6	0.3943	0.4014	0.2796	3.5288	1.0786	0.5583	0.5411	0.5583	0.5411
1.7	0.419	0.4087	0.2746	3.4932	1.0359	0.5306	0.5027	0.5306	0.5027
1.8	0.4436	0.4155	0.2698	3.46	0.9974	0.5052	0.4683	0.5052	0.4683
1.9	0.4683	0.4219	0.2651	3.4288	0.9624	0.4817	0.4374	0.4817	0.4374
2	0.4929	0.4279	0.2606	3.3996	0.9305	0.4599	0.4094	0.4599	0.4094

Reference p	F multiplier	Absolute F
Fbar(2-6)	1	0.2465
FMax	0.7343	0.1810
F0.1	0.4131	0.1018
F35%SPR	0.5443	0.1341

Weights in kilograms

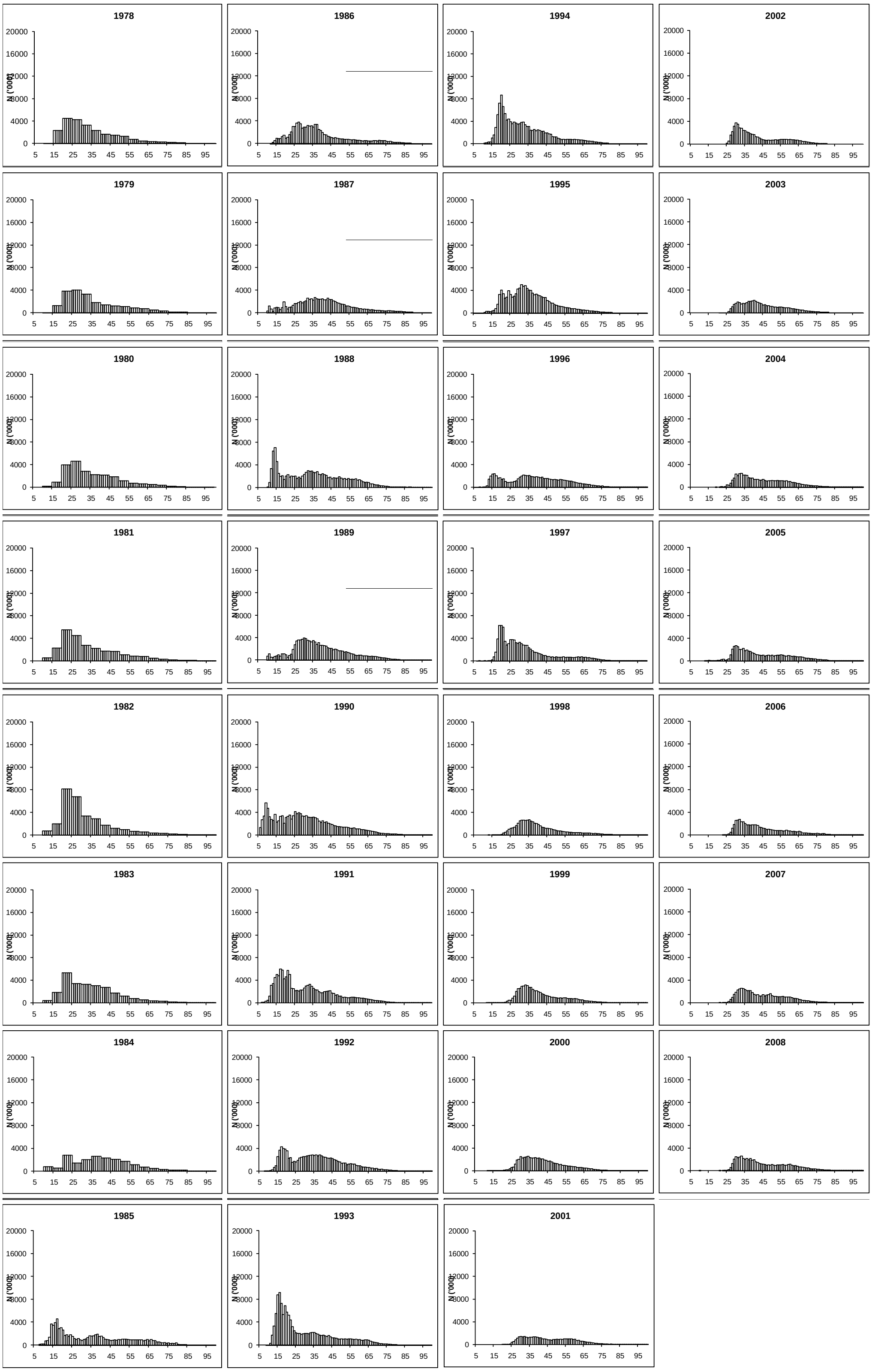


Figure 3.1. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Landings length distributions in 1978-2008.

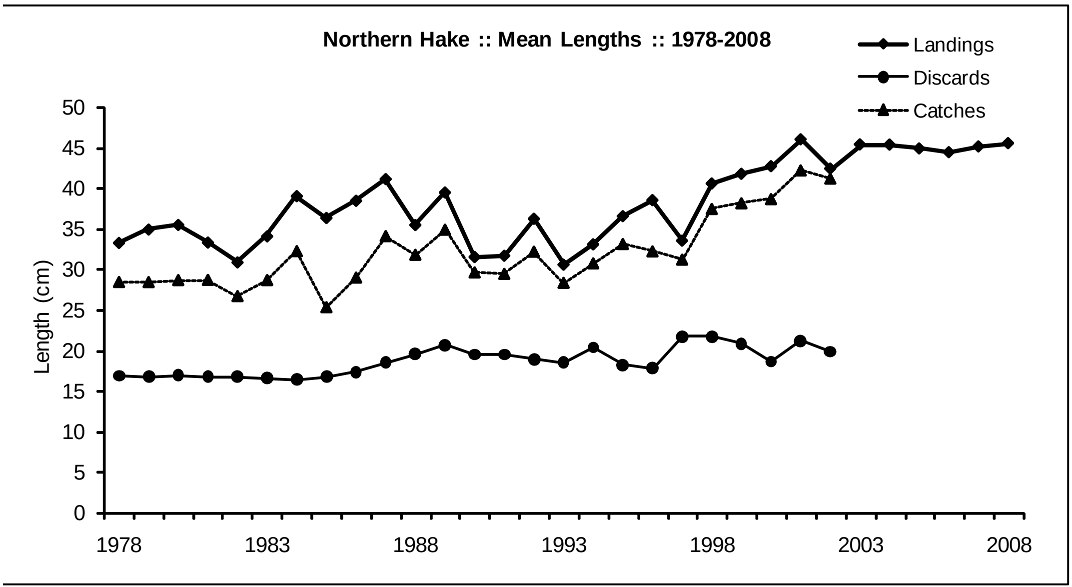


Figure 3.2. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Mean length of landings, discards and catches

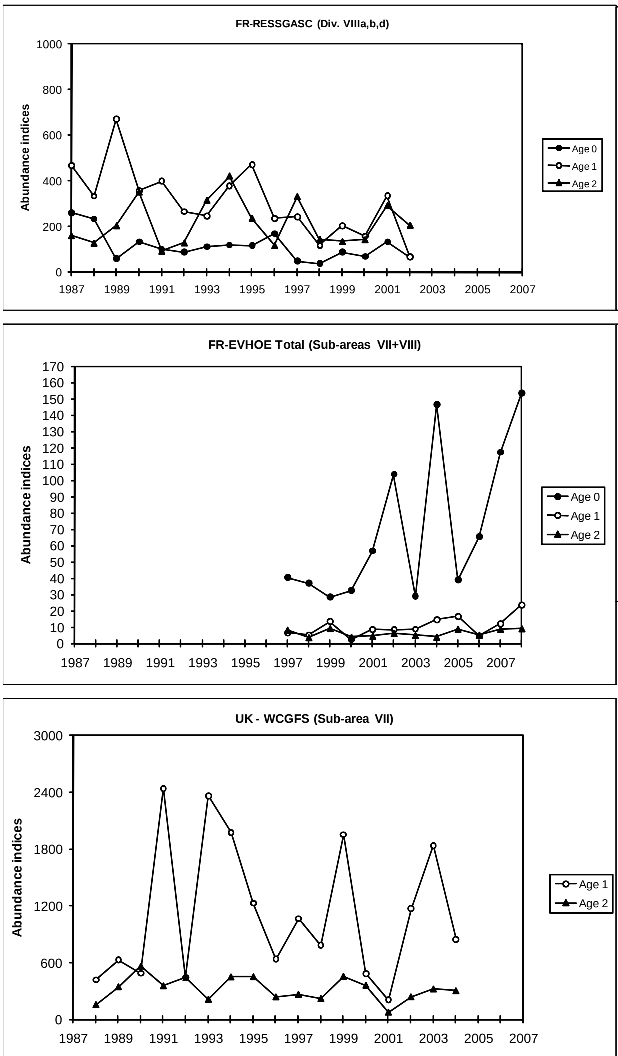


Figure 3.3a Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Abundance indices at age from surveys

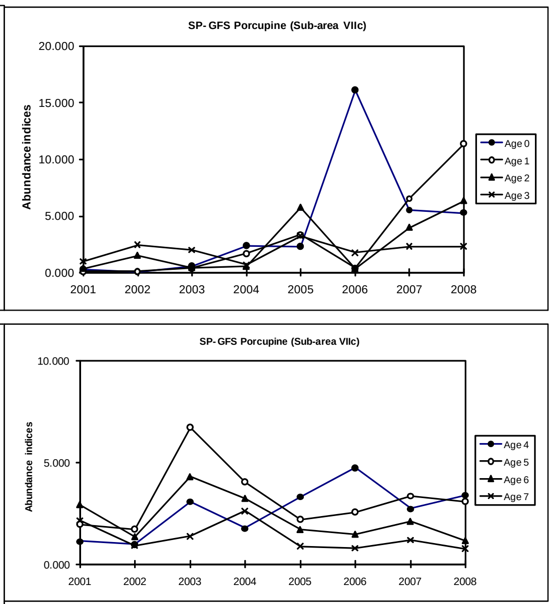


Figure 3.3b Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Abundance indices at age from surveys

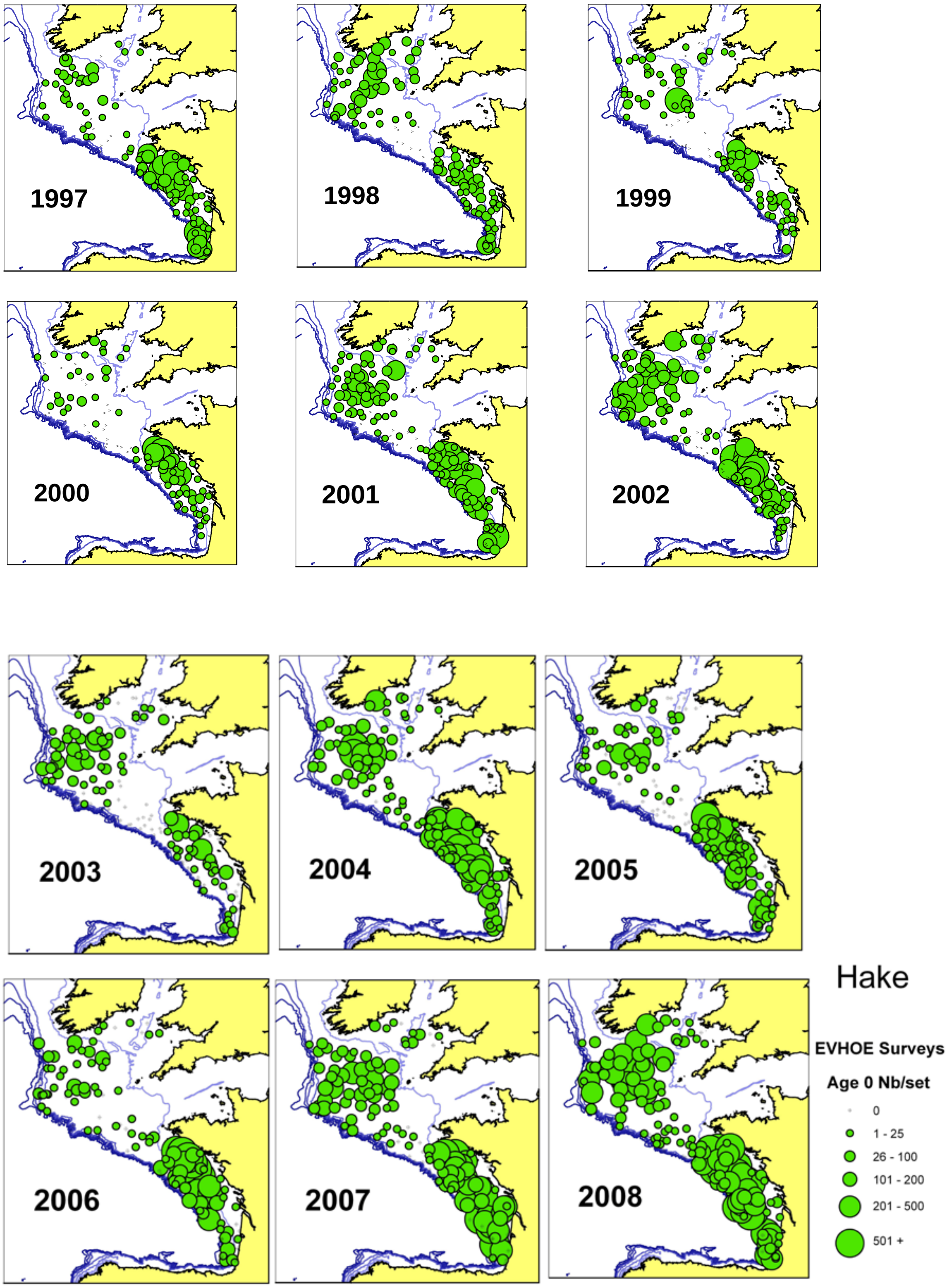


Figure 3.4 . Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock). Spatial distribution of Age 0 indices from FR-EVHOES survey from 1997 to 2006

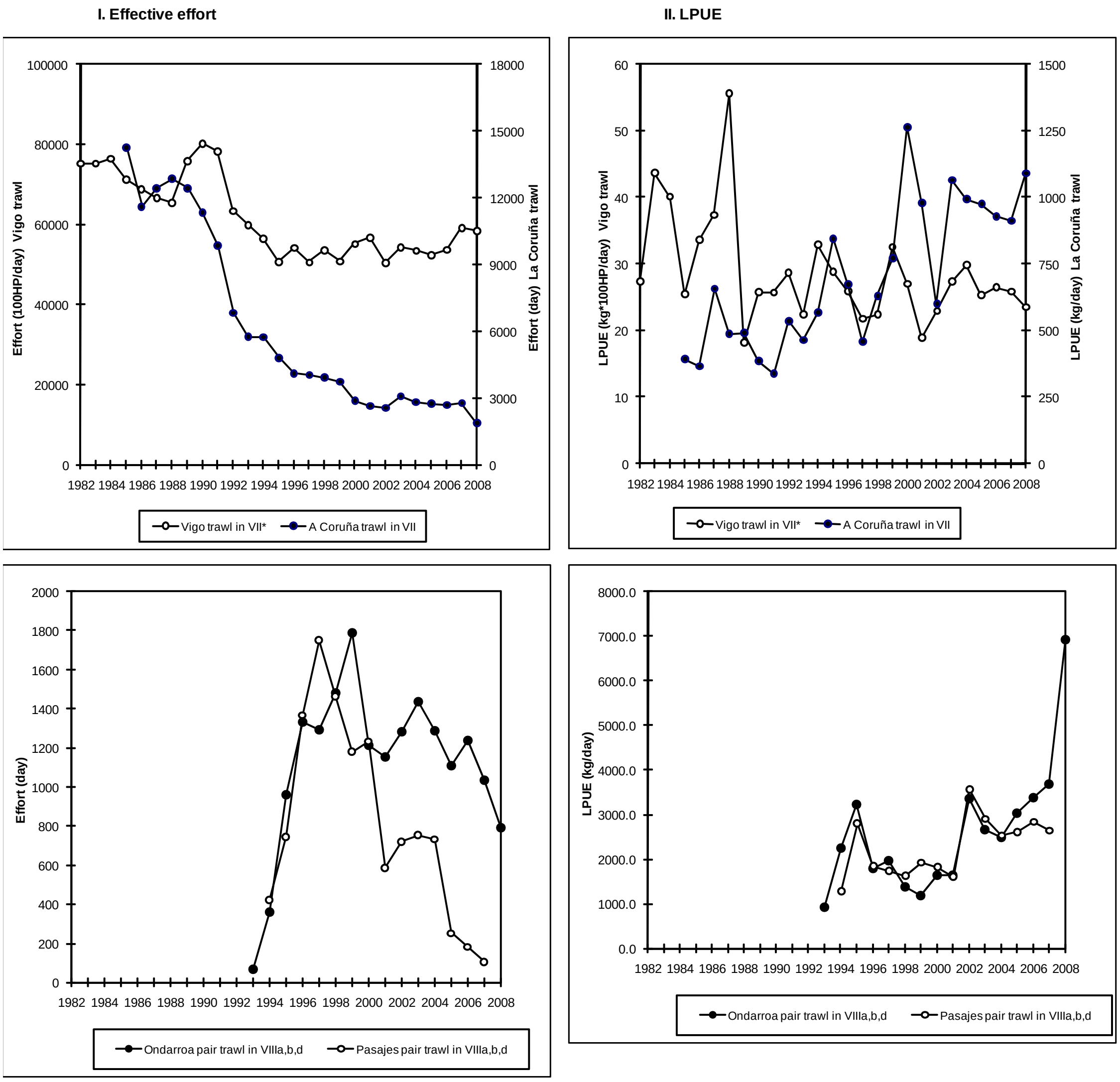


Figure 3.5.a. NORTHERN HAKE. Effective effort indices and LPUE values of commercial fleets used in the assessment to tune the model.

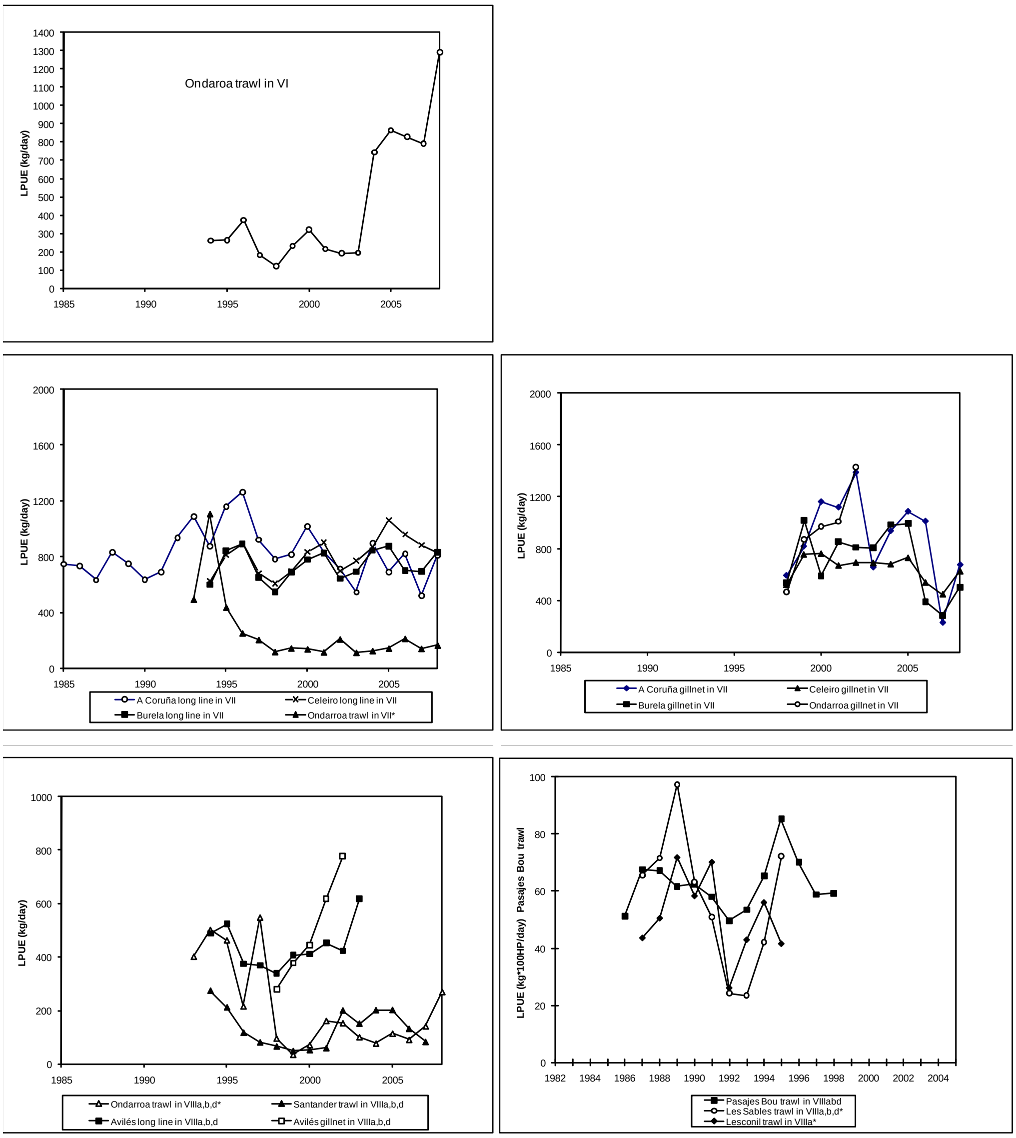


Figure 3.5b. NORTHERN HAKE. LPUE values of commercial fleets not used in the assessment to tune the model

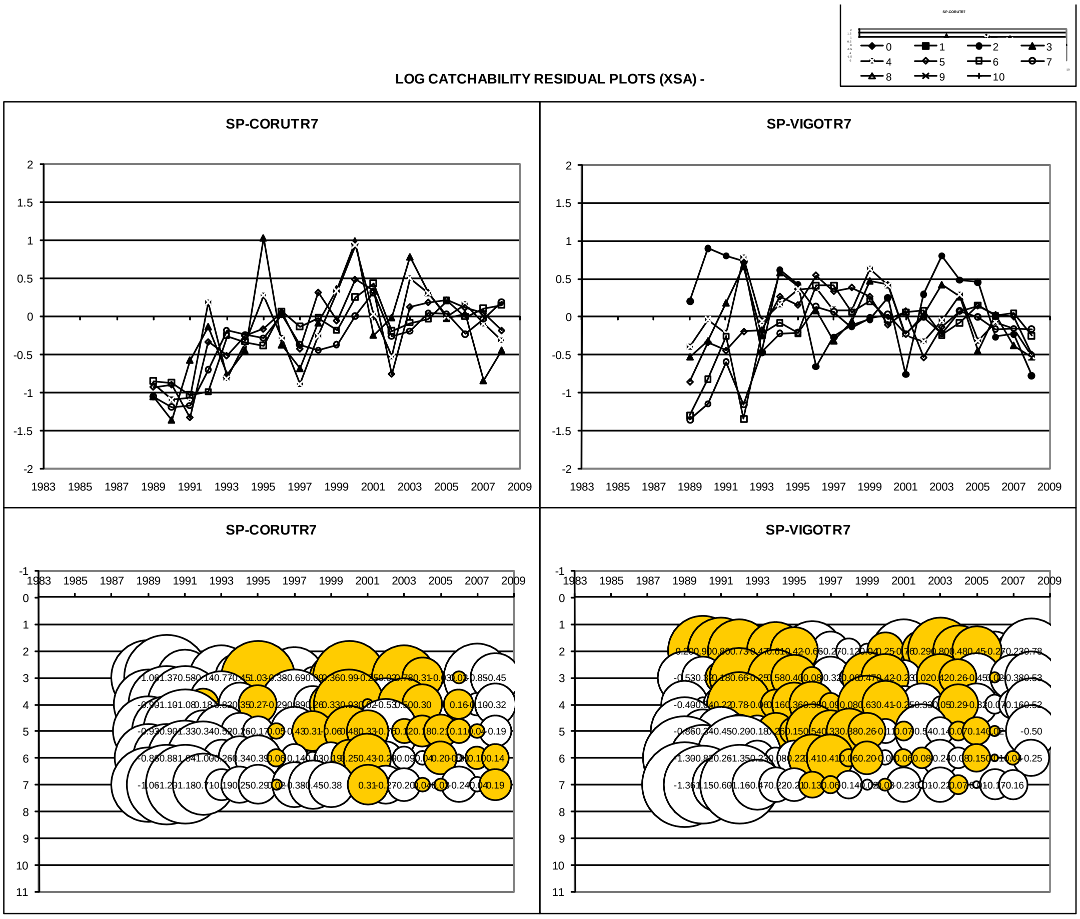
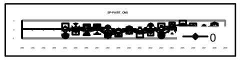


Figure 3.6.a. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)



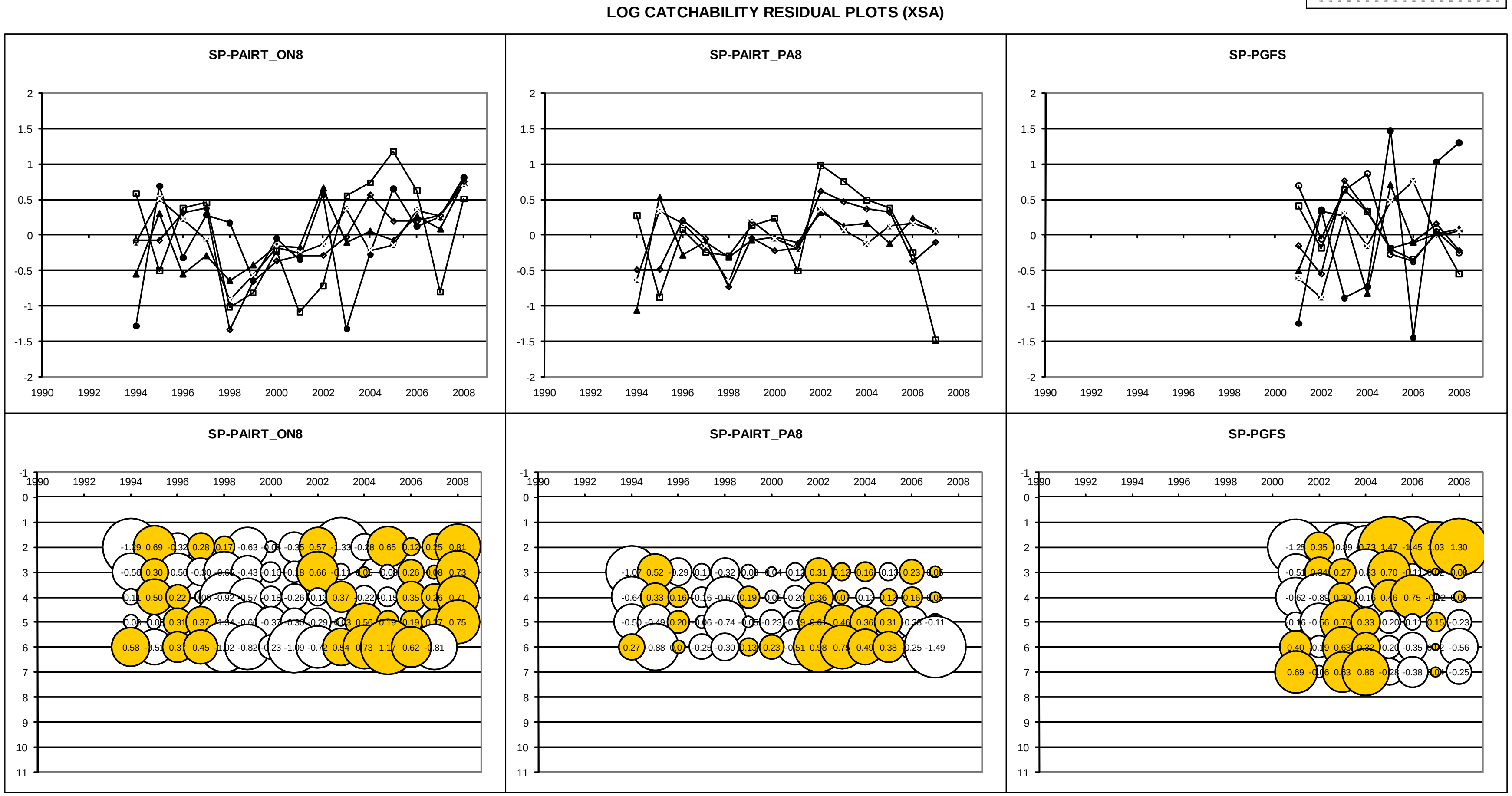


Fig 3.6b **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**

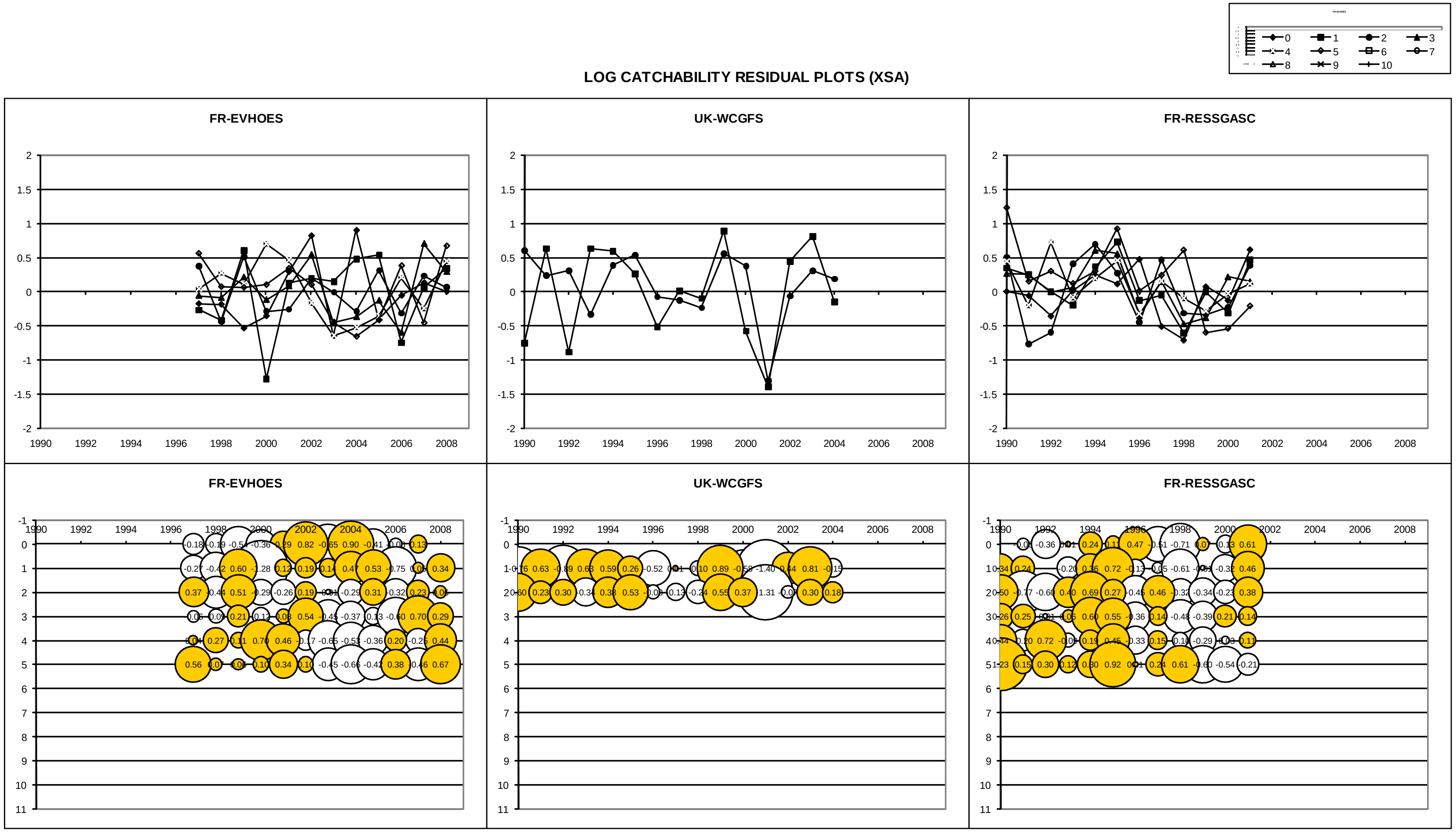


Fig 3.6c **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)**

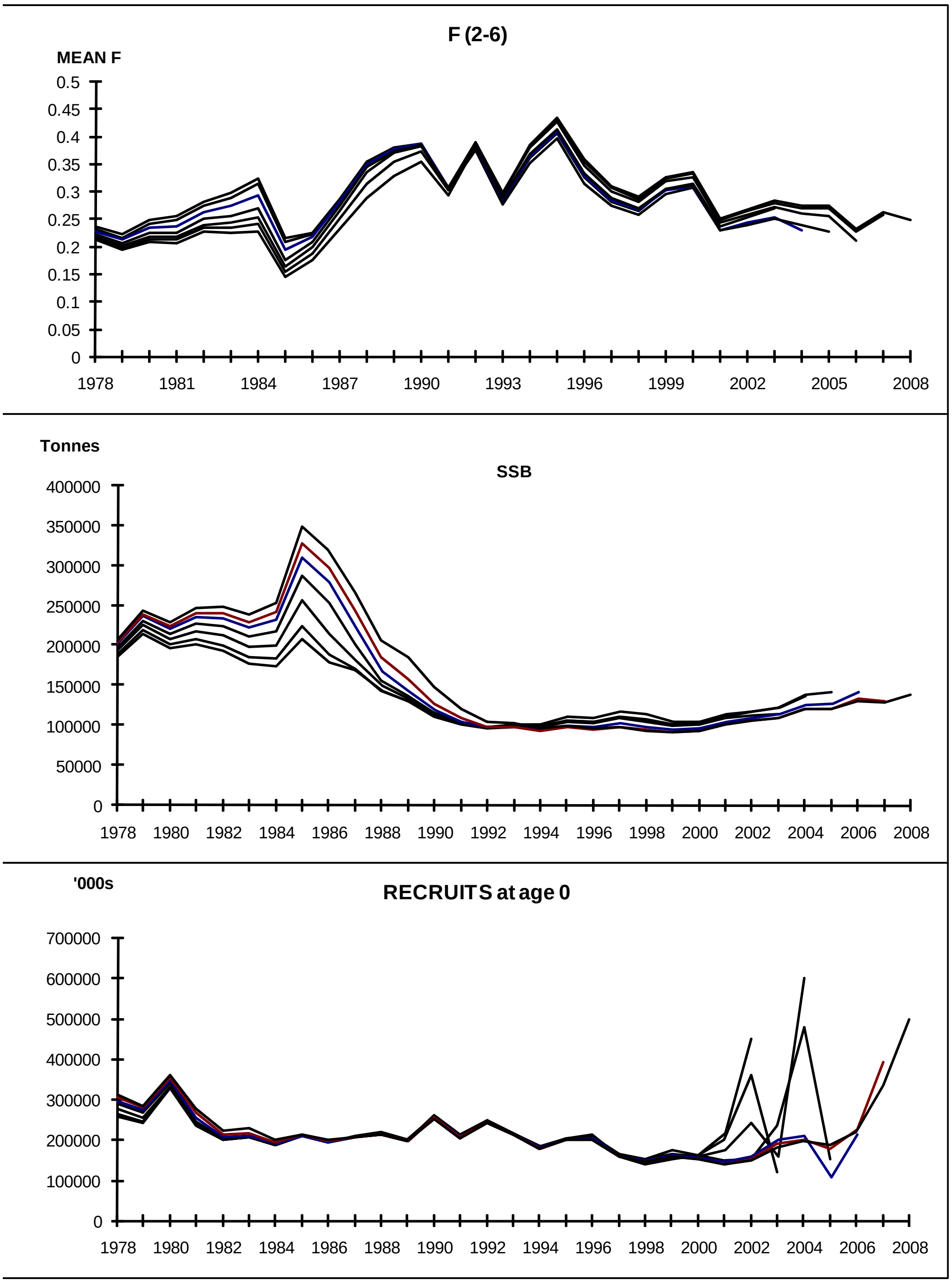


Figure 3.7. **Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Retrospective XSA**

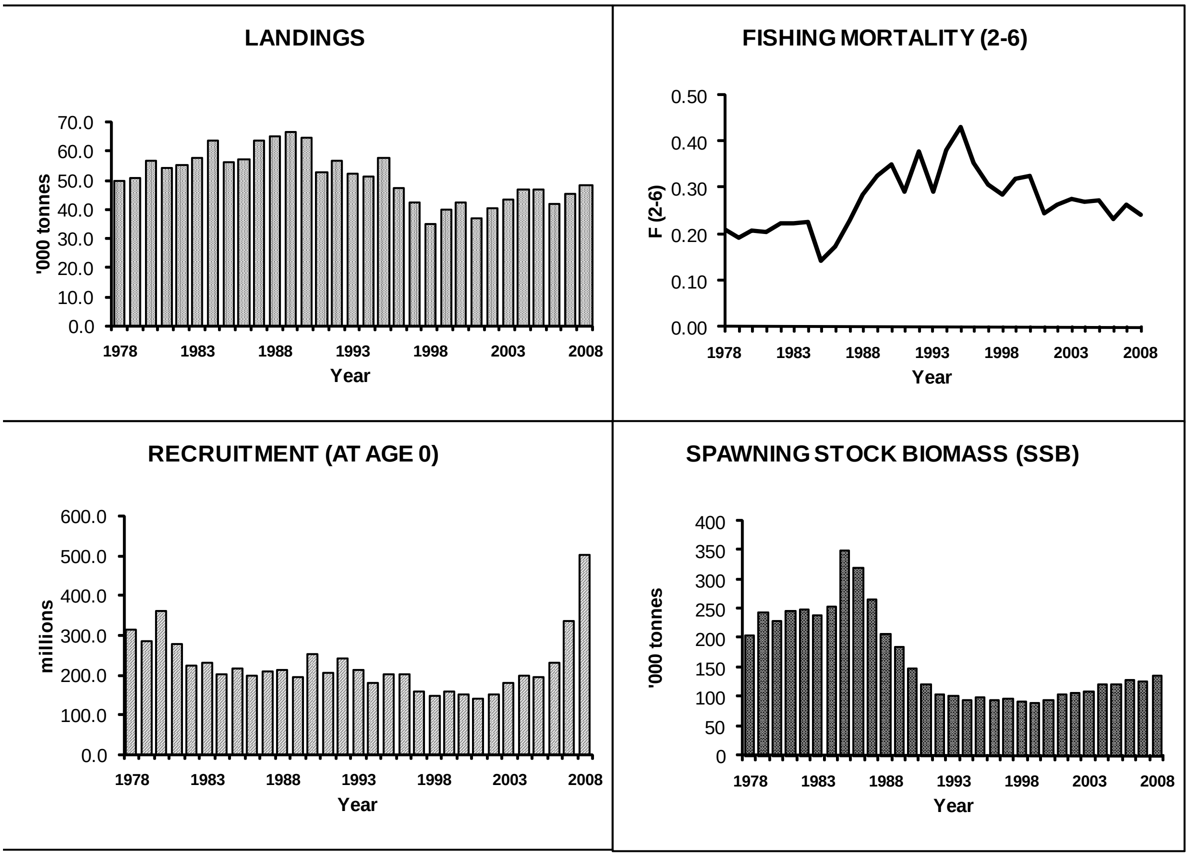
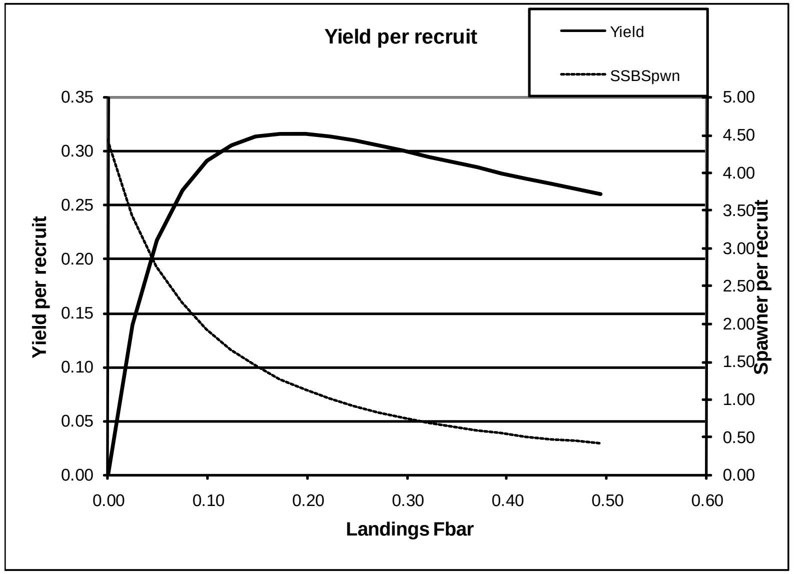
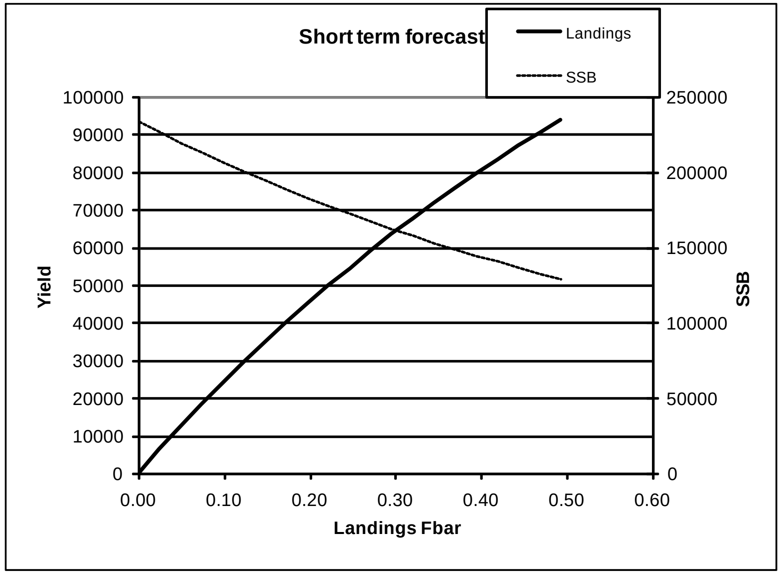


Figure 3.8. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Summary Plot (No Age 0)





MFYPR version 2a
Run: hake2009
Time and date: 18:21 06/05/2009

Reference point	F multiplier	Absolute F
Fbar(2-6)	1.0000	0.2465
FMax	0.7343	0.1810
F0.1	0.4131	0.1018
F35%SPR	0.5443	0.1341

Weights in kilograms

MFDP version 1a
Run: Hake2009
Hake Northern stock (WGHMM 2009) Update WGHMM2008
Time and date: 16:56 06/05/2009
Fbar age range: 2-6

Input units are thousands and kg - output in tonnes

Figure 3.9 : Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
Short term and long term predictions

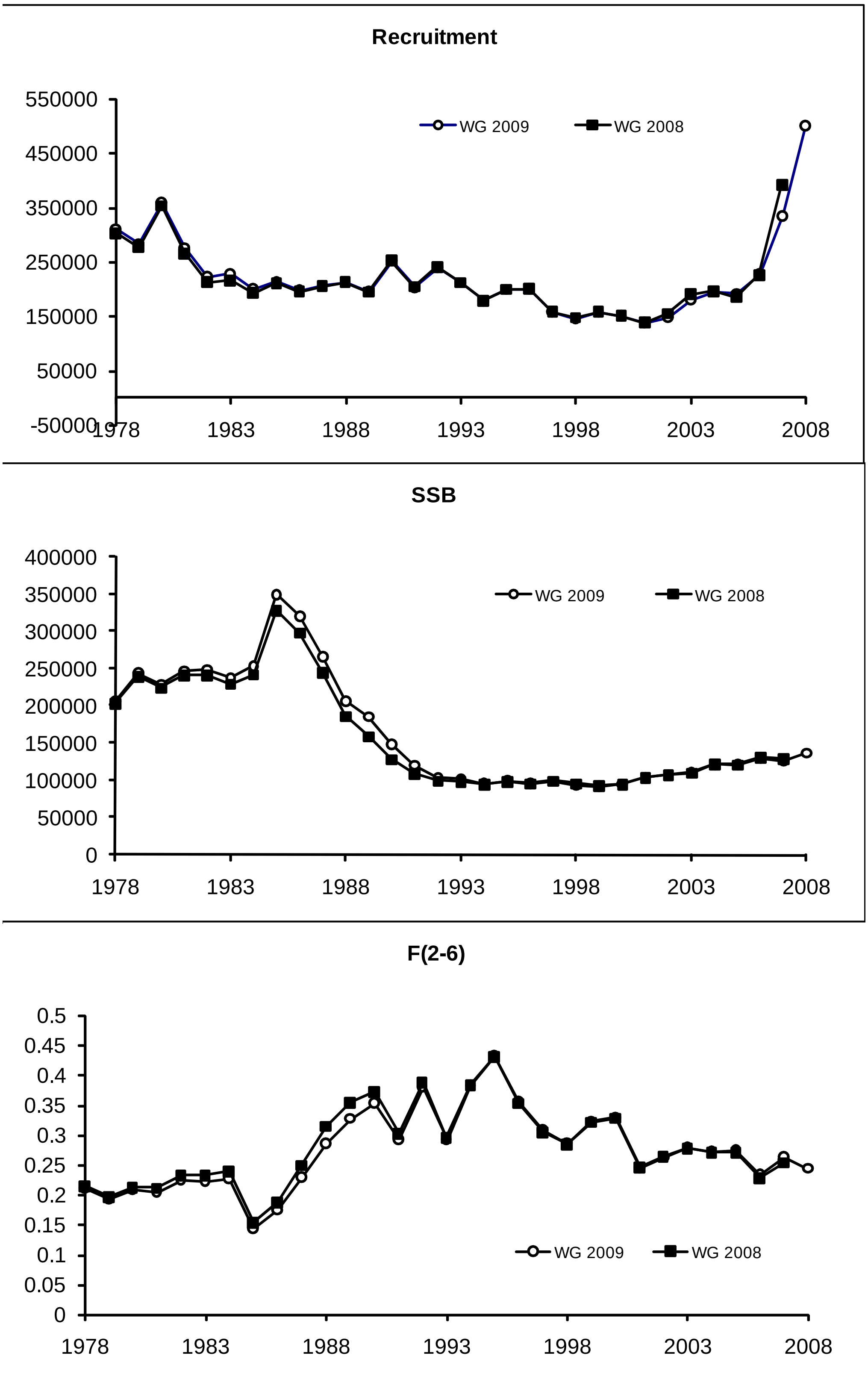


Figure 3.10. Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock) Comparative Runs for Updates

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 2009: update

Data revisions this year: Irish 2007 landings

Review Group issues: RG in 2008 made the following comments for both assessments: "The assessment is clearly influenced by the anticipation of the benchmark assessment in 2009 and updates of time series are presented without much comment. Solving the ageing problem should have first priority."

The benchmark assessment is now tentatively scheduled for 2012.

4.1 General

4.1.1 Summary of ICES advice for 2009 and management for 2008 and 2009

ICES advice for 2009

The current fishing mortality is uncertain and cannot be evaluated with respect to long-term yield and low risk to SSB.

ICES advice for 2009 : Same advice as for 2008

Management applicable for 2008 and 2009

The TAC applied to both species and including Division VIIa was set at 36 000 t for 2008 and for 2009

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 2007 that had however little influence on the total international landings data.

Landings have increased since 2000 and have fluctuated around 33 000 t since 2003. The landings of both species combined are estimated at 32 174 t in 2008.

Table 4.1-1 Anglerfish in Divisions VIIb-k and VIIIa,b,d -Total landings from 1984 to 2008 – 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**	27142	5032	32174

* revised
** preliminary

4.1.3 Discards

Estimation of discards has been carried by some countries and preliminary data presented to the WG (WD 1, PC). This information shows that an increasing proportion of small fish of both species are caught and discarded. However 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.

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.

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	11974	1885	2007	491	10	227	325	2573	1	24601

* revised
** preliminary

Figure 4.2-1 shows the evolution of the length composition of landings over the period 1993 to 2008.

The length composition of landings has showed a shift towards smaller individuals in 2002 and 2003, similar to that observed in 1993 and 1994, these individuals are reaching larger lengths in 2004 and 2005 landings. Small individuals again show up in the 2005 landings with a mode at around 25-30 cm that can be tracked down to 2008 at 60-65 cm. The 2008 landings show a drop in the landings the mid size fish (35-65 cm) and a truncated distribution at small lengths. The drop could be related to weaker year-classes following the good recruitments observed in the early 2000's.The truncated distribution could be explained by increased discarding as indicated by the preliminary data presented.

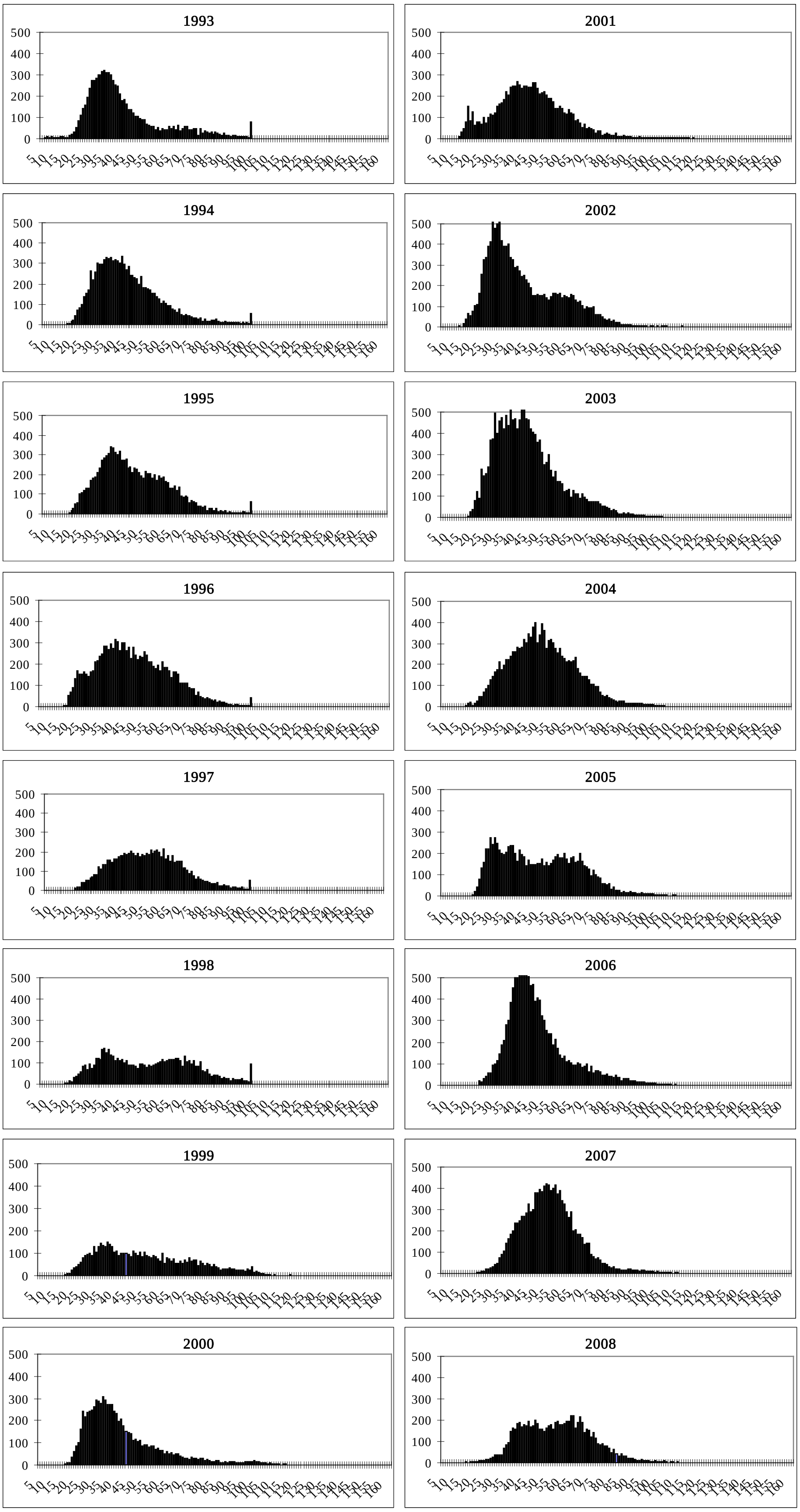


Figure 4.2-1 Anglerfish (Lophius piscatorius) in Divisions VIIb-k and VIIIa,b -Length distributions of landings from 1993 to 2008

4.2.1.2 Commercial LPUE

Effort and LPUE data were available in 2008 for four Spanish fleets and for the French FR-FU04 and FR-FU14 (Table 4.2-2 and Figure 4.2-2). Fishing effort for most fleet 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 show a decline in 2008. This decline may not reflect a decrease in biomass but could be explained by an avoidance of grounds with high abundance of small individuals of the species that have to be discarded.

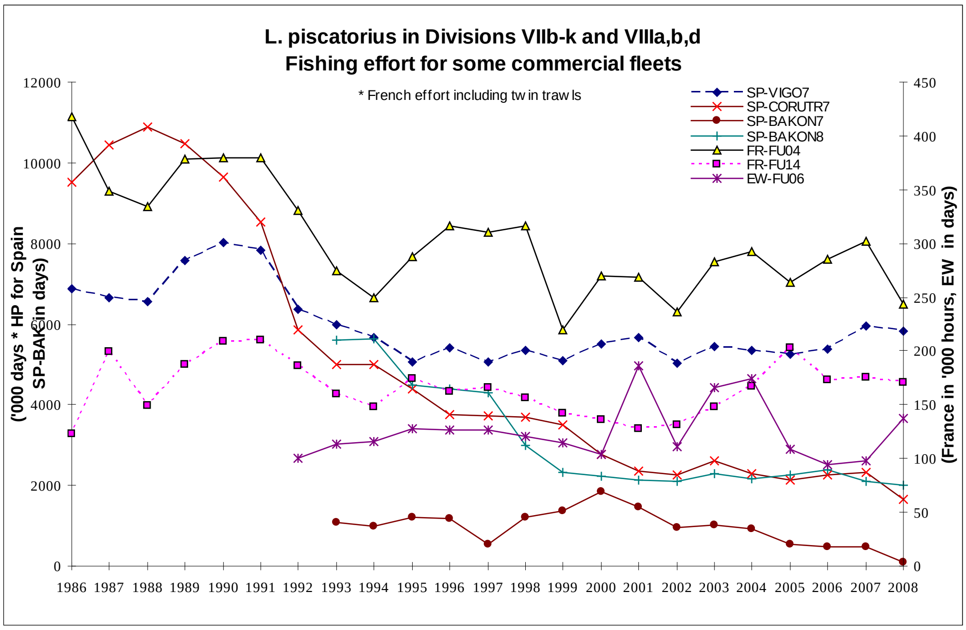
Table 4.2-2 L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data

EFFORT	SP-VIGO7 in Sub-Area VII ('000 days*HP)	SP-CORUTR7 in Sub-Area VII ('000 days*HP)	French Benthic trawlers* Celtic Sea FU04 ('000 hrs)	French Benthic Twin Trawls Celtic Sea ('000 hrs)	French Benthic trawlers* Bay of Biscay FU14 ('000 hrs)	French Benthic Twin Trawls Bay of Biscay ('000 hrs)	EW FU06 Beam trawlers in VII ('00 days)	SP-BAKON7 (days)	SP-BAKON8 (days)
1986	6875	9527	418	N/A	123	N/A	N/A		
1987	6662	10453	349	N/A	199	N/A	N/A		
1988	6547	10886	334	N/A	150	N/A	N/A		
1989	7585	10483	378	N/A	187	N/A	N/A		
1990	8021	9630	380	N/A	208	N/A	N/A		
1991	7822	8522	380	N/A	210	N/A	N/A		
1992	6370	5852	331	N/A	186	N/A	100		
1993	5988	5001	274	N/A	159	N/A	114	1094	5590
1994	5655	4990	249	N/A	148	N/A	116	980	5619
1995	5070	4403	287	N/A	174	N/A	127	1214	4474
1996	5416	3746	196	121	144	19	126	1170	4378
1997	5058	3738	178	133	133	33	126	540	4286
1998	5360	3684	182	134	117	40	121	1196	3002
1999	5084	3512	110	110	83	59	115	1384	2337
2000	5519	2773	165	104	87	49	104	1850	2227
2001	5678	2356	135	133	61	66	186	1451	2118
2002	5041	2258	116	120	57	75	111	949	2107
2003	5437	2597	147	136	68	81	166	1022	2296
2004	5347	2292	160	133	78	89	174	910	2159
2005	5246	2120	127	137	83	121	109	544	2263
2006	5392	2257	140	145	72	101	94	487	2398
2007	5952	2323	149	152	48	127	97	476	2098
2008**	5840	1640	118	126	58	113	138	105	2017

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	285.9	383.0	142.9		130.8				
1987	235.2	326.1	141.5		118.9				
1988	182.2	272.4	131.8		109.7				
1989	210.3	236.3	102.4		60.9				
1990	206.5	227.5	104.0		85.2				
1991	183.6	234.5	81.8		54.8				
1992	188.0	199.5	56.2		34.7		94.2		
1993	268.1	172.3	60.0		42.1		93.2	59.8	23.0
1994	288.8	186.6	111.3		74.6		81.2	73.3	44.1
1995	409.7	130.5	130.8		84.2		76.6	98.6	55.8
1996	520.0	212.1	116.6	159.1	81.1	113.5	110.2	130.4	69.6
1997	439.7	244.5	105.4	133.0	77.6	83.8	117.3	131.5	71.3
1998	450.7	192.7	95.5	113.1	60.3	66.4	110.9	133.9	66.3
1999	428.2	136.4	52.0	75.6	41.9	44.2	95.5	125.2	34.1
2000	202.9	182.1	86.7	72.8	34.0	45.3	109.0	185.5	31.2
2001	238.6	169.8	102.5	119.3	56.3	85.5	82.5	184.1	61.4
2002	468.8	218.1	138.3	151.8	69.0	120.5	123.0	218.3	71.7
2003	598.0	286.2	191.2	185.6	101.7	153.9	80.3	273.7	76.3
2004	562.9	249.3	133.9	187.7	87.1	172.1	92.6	249.0	118.7
2005	591.5	356.0	169.7	146.1	98.7	133.2	143.9	287.4	99.7
2006	568.2	382.9	183.1	196.3	107.7	136.6	175.4	221.1	88.7
2007	627.4	409.4	233.3	213.7	117.5	150.8	202.4	260.5	71.5
2008**	464.8	541.6	213.7	190.1	96.8	122.1	105.8	171.4	100.6

* Identified twin trawls excluded

**Preliminary



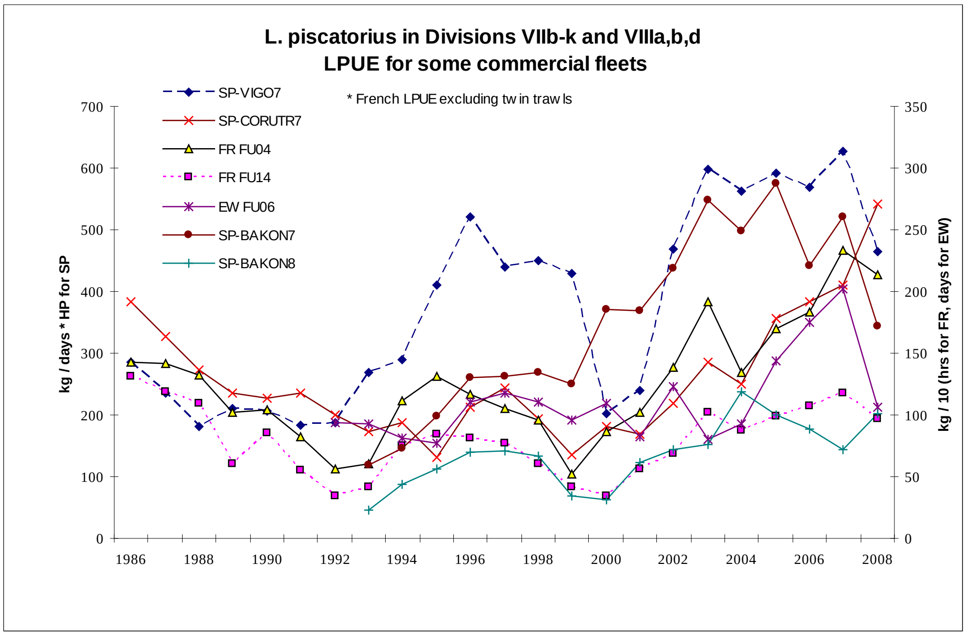


Figure 4.2-2 L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data

4.2.1.3 Surveys data

4.2.1.3.1 The French FR-EVHOE survey

This survey covers the highest proportion of the area of stock distribution. Standardised biomass, and abundance indices are given in Figure 4.2-3 and the length distributions in Figure 4.2-4.

The weight indices show a continuous increase from 2000 to 2007 and the numbers four peaks in 2001, 2002, 2004 and to a lower extent in 2008.

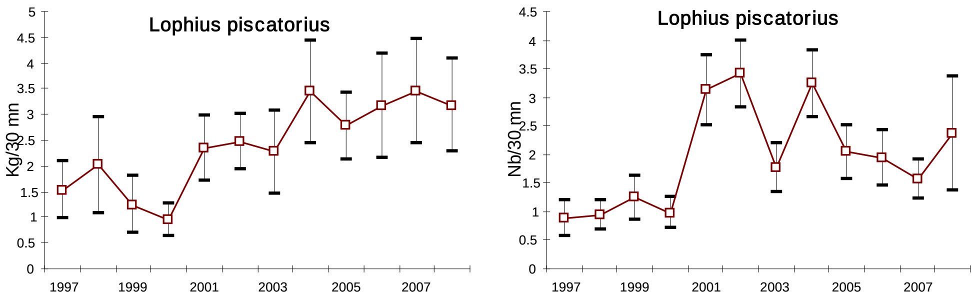


Figure 4.2-3 L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Evolution of the FR-EVHOE survey's indices Kg (left) and Nb (right) per 30 minutes tow from 1997 to 2008

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 2008 indicates a good incoming recruitment, although not as strong as in 2001, 2002 and 2004.

In Figure 4.2-5 and Figure 4.2-6, 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.

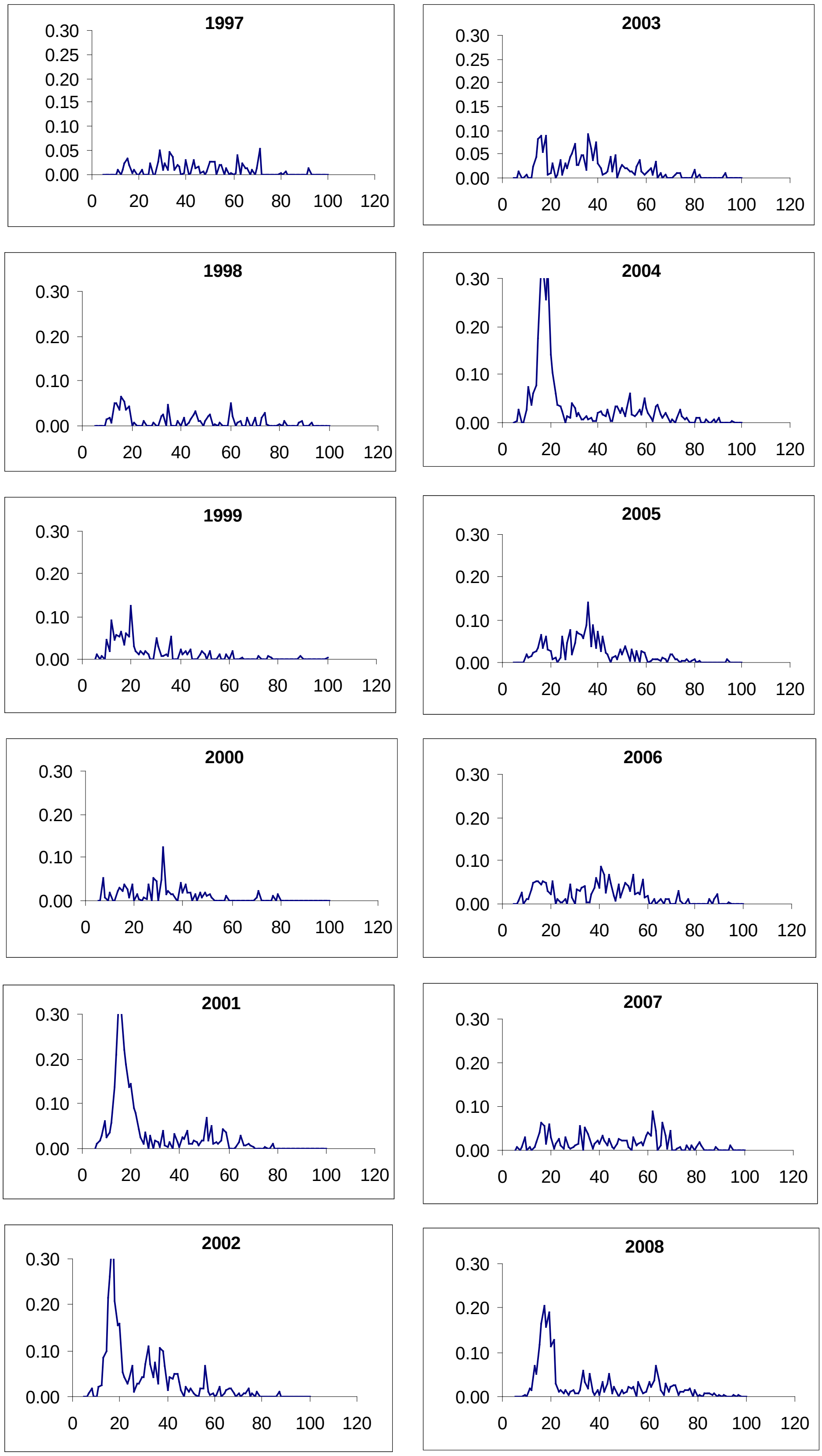


Figure 4.2-4 - L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Evolution of the FR-EVHOE Length distributions in Nb per 30 minutes tow from 1997 to 2008

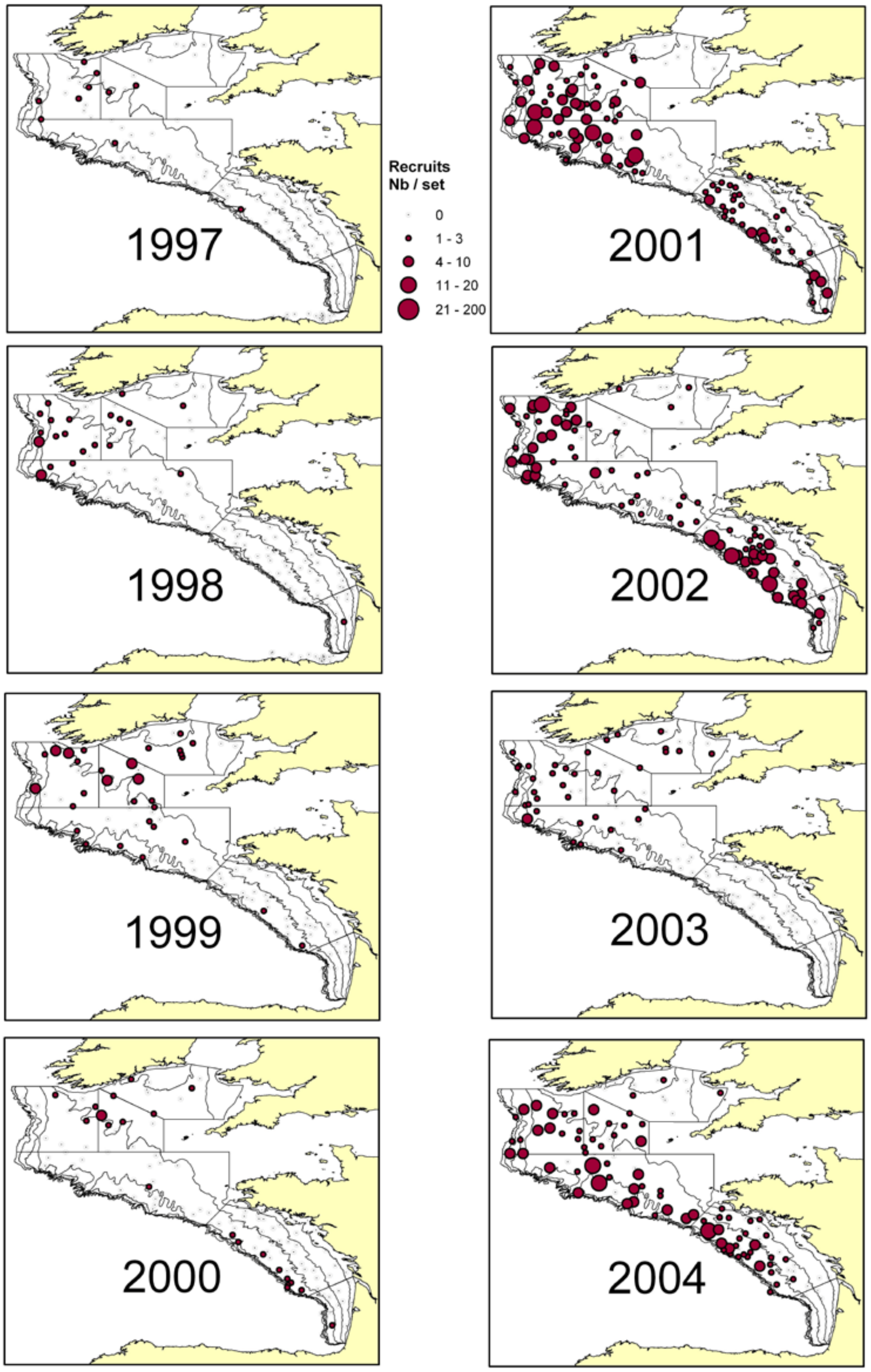


Figure 4.2-5 – L. piscatorius in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the FR-EVHOE surveys from 1997 to 2004.

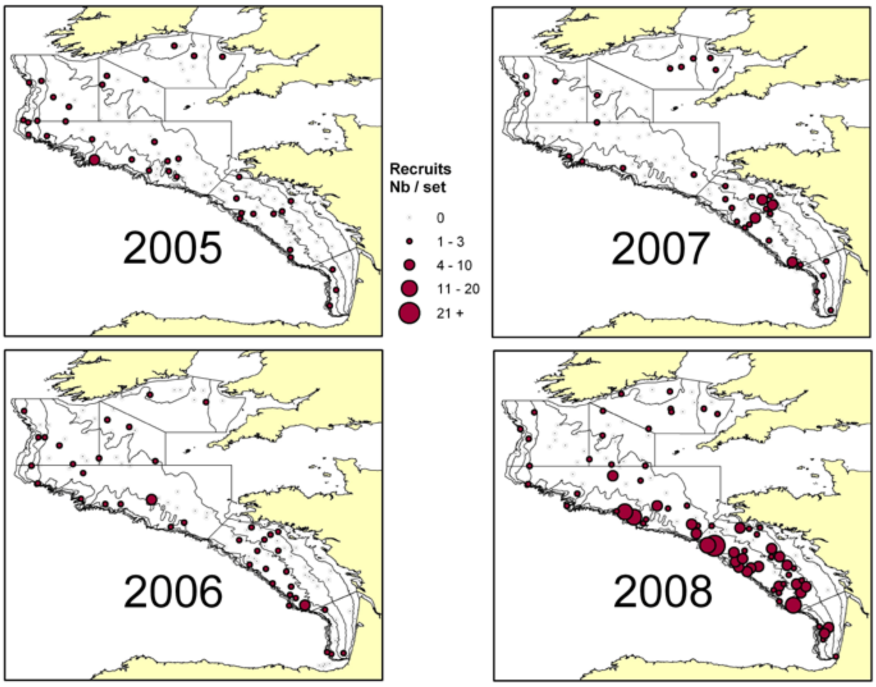


Figure 4.2-6 – L. piscatorius in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 23 cm) in Nb per 30m observed in the FR-EVHOE surveys from 2005 to 2008.

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 4.2-7 and the length distributions in Figure 4.2-8. 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.

Figure 4.2-7 - 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 2008

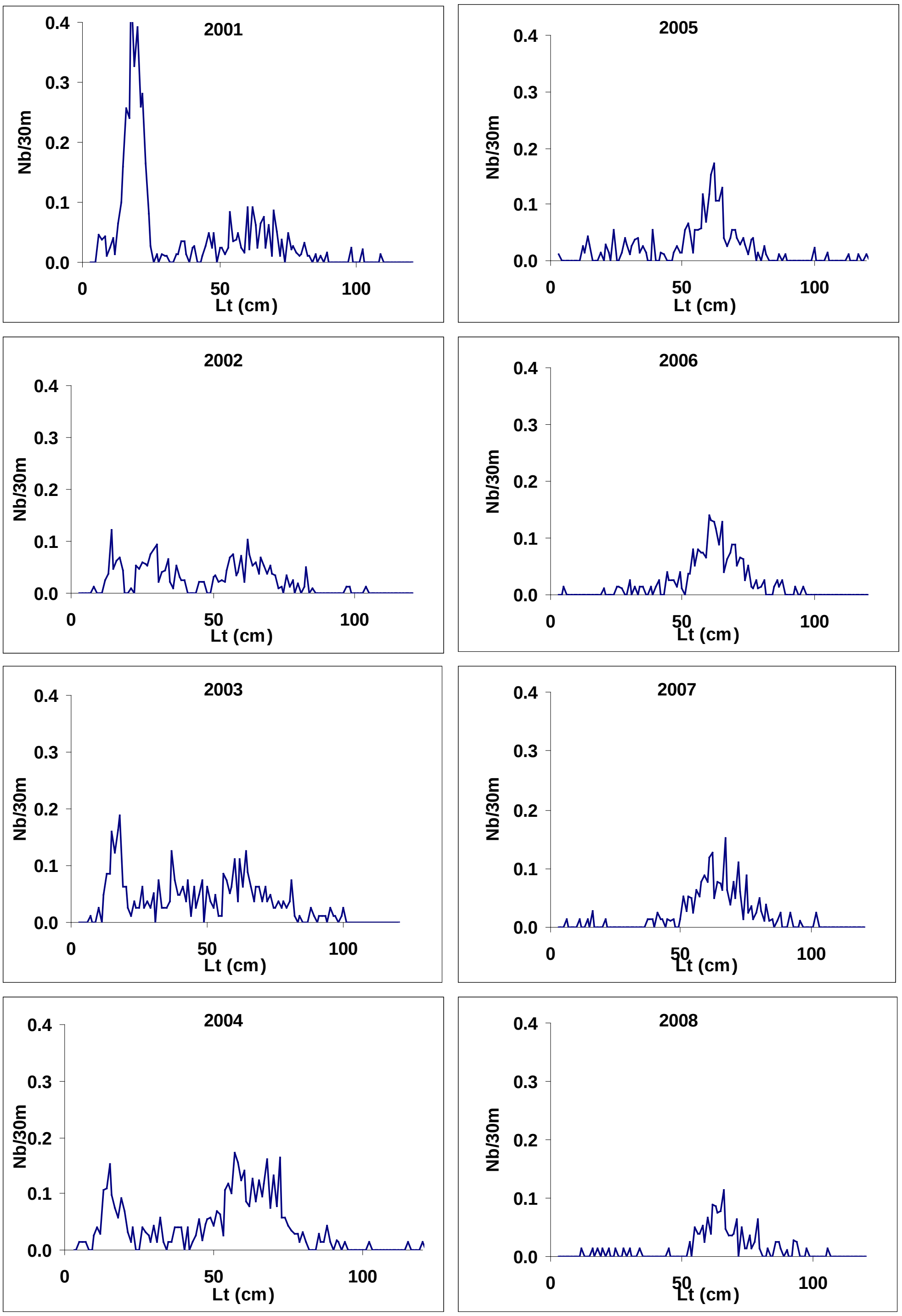


Figure 4.2-8 - L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Evolution of the SP-PGFS Length distributions in Nb per 30 minutes tow from 2001 to 2008

4.2.1.3.3 The Irish Groundfish Survey (IR-IGFS)

Abundance indices in Nb/sqKm from this survey are given in table Table 4.2-3. They show the same drop than the FR-EVHOE and the SP-PGFS after the peak in 2004. However the index in 2008 has continued to decrease while the EVHOE index shows an increase due to incoming recruitment. This can be explained by the more southern distribution on recruits observed in 2008 in areas not covered by the IR-IGFS. Due to the overall low number caught in some years the length distributions are not presented.

Table 4.2-3 - L. piscatorius in Divisions VIIb-k and VIIIa,b,d– Abundance indices in Nb/sq Km from 2003 to 2008 from the IR-IGFS.

Year	2003	2004	2005	2006	2007	2008
Nb/sqKm	68.9	91.5	63.5	32.3	21.3	19.7

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 4.2-1. 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 FR-EVHOE survey in 2008 is also present in the EW-FSP survey.

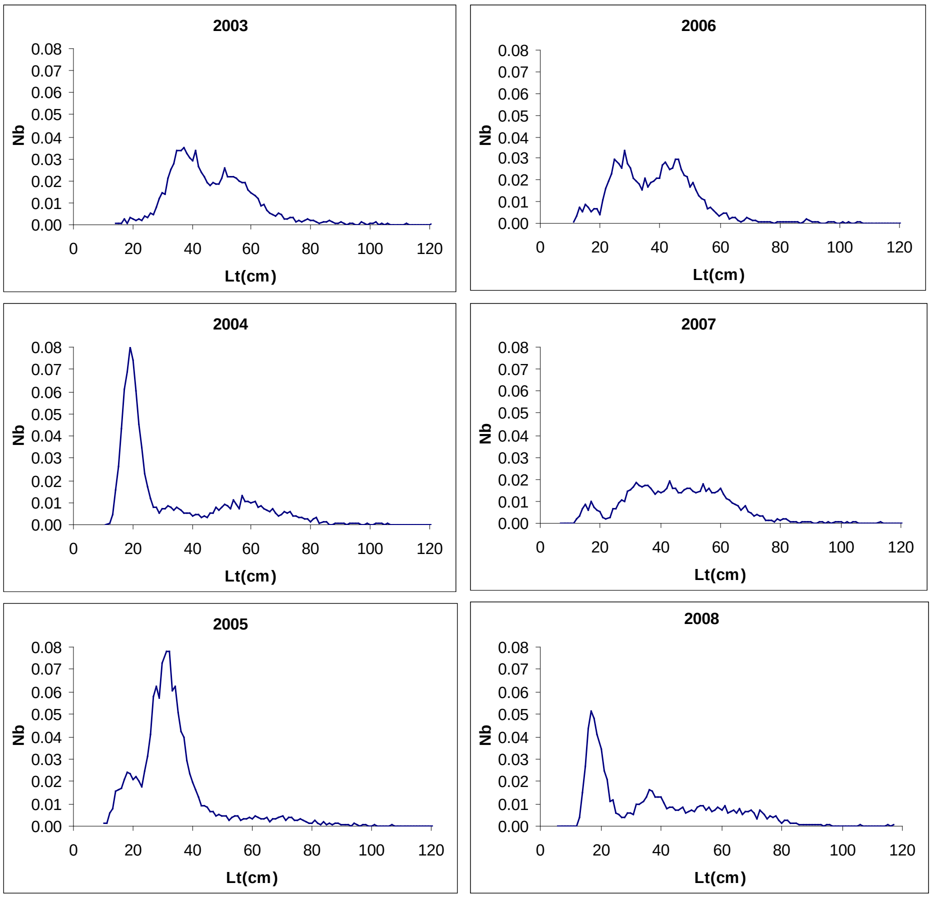


Figure 4.2-9 - L. piscatorius in Divisions VIIb-k and VIIIa,b,d- Evolution of the EW-FSP Length distributions in Nb per meter beam per hour tow from 2003 to 2008

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.

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 show 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.

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 4.2-1

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.

	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	4831	187	375	254	0	235	0	1669	0	7574

* revised
** preliminary

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

Figure 4.3-1 shows the evolution of the length composition of landings over the period 1993 to 2008.

In 2001, length compositions of landings showed an important component of the landings comprised of small individuals (20-30cm).

In 2002 and 2003, this mode could be followed by an increase in the catches of individuals of 30-40 cm.

In 2004, the amount of fish greater than 45 cm in the landings is however only slightly higher than those observed in previous years. Furthermore, the international length distribution shows a lack of fish of 25-30 cm. This could be caused by a low sampling level or by discarding practices of small fish (less than 500g, ie less than 30 cm by French and Spanish fishermen to avoid quota closure and for market reasons (high-grading) – as reported by the industry.

The length composition in 2006 shows that a high proportion of the landings is comprised of small individuals of a modal length of 30cm. This mode can be tracked in the 2007 length distribution of landings available for several countries. They provide indication that discards could be high in some cases. The length distribution of landings in 2008 shows again a shift towards smaller individuals and a truncated distribution at 28 cm. This could reflect a strong incoming year class not landed by some fleets as indicated by the partial information on discards.

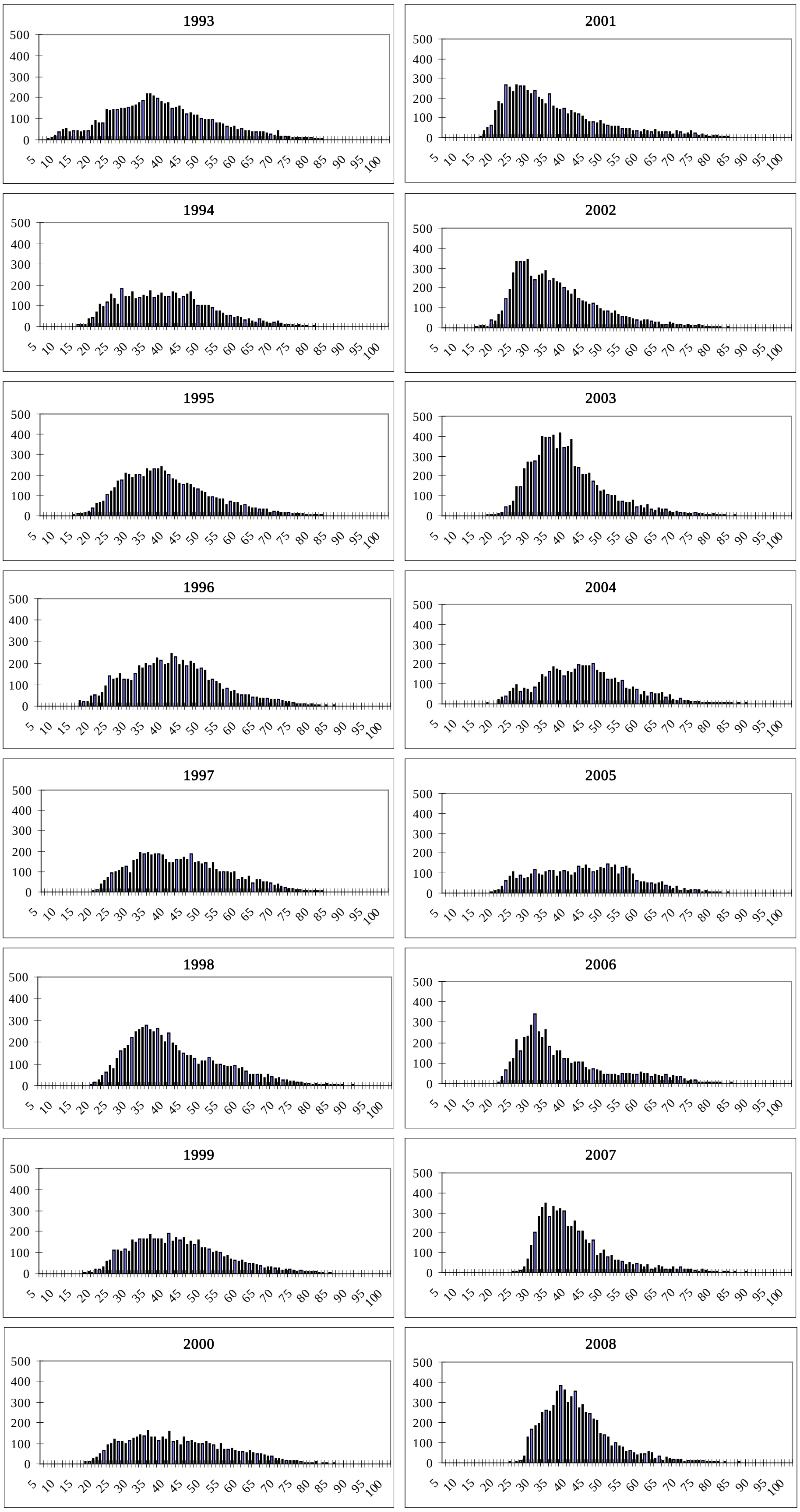


Figure 4.3-1 Anglerfish (Lophius budegassa) in Divisions VIIb-k and VIIIa,b -Length distributions of landings from 1993 to 2008

Commercial LPUE

Effort and LPUE data were available in 2008 for four Spanish fleets and for the French FR-FU04 and FR-FU14 (Table 4.3-2 and Figure 4.3-2). Fishing effort for most fleets shows a decrease until the mid 1990's. Effort remained relatively stable thereafter.

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.

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		
1987	6662	10453	349	N/A	199	N/A	N/A		
1988	6547	10886	334	N/A	150	N/A	N/A		
1989	7585	10483	378	N/A	187	N/A	N/A		
1990	8021	9630	380	N/A	208	N/A	N/A		
1991	7822	8522	380	N/A	210	N/A	N/A		
1992	6370	5852	331	N/A	186	N/A	100		
1993	5988	5001	274	N/A	159	N/A	114	1094	5590
1994	5655	4990	249	N/A	148	N/A	116	980	5619
1995	5070	4403	287	N/A	174	N/A	127	1214	4474
1996	5416	3746	196	121	144	19	126	1170	4378
1997	5058	3738	178	133	133	33	126	540	4286
1998	5360	3684	182	134	117	40	121	1196	3002
1999	5084	3512	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

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	339.3	37.4	37.6		50.6				
1987	294.3	15.6	25.4		47.6				
1988	264.9	42.2	38.7		52.8				
1989	272.0	25.1	47.2		65.2				
1990	250.4	29.2	51.6		62.0				
1991	231.2	29.9	43.7		53.8				
1992	248.1	13.9	48.2		52.8		27.6		
1993	194.4	15.4	42.9		49.7		29.7	51.0	55.3
1994	202.9	20.2	43.7		60.2		10.5	107.7	61.2
1995	285.9	8.4	51.3		47.1		7.1	120.0	48.7
1996	303.5	12.5	47.5	64.7	41.5	58.0	12.3	173.4	56.9
1997	383.4	12.0	49.8	62.8	44.2	47.7	7.4	272.9	41.9
1998	319.0	9.2	54.3	64.3	61.8	68.1	14.7	229.3	77.8
1999	369.4	8.8	37.9	55.4	57.2	63.4	12.3	329.0	84.6
2000	257.1	19.5	61.4	49.5	57.2	73.0	9.0	265.5	56.4
2001	304.3	3.4	37.4	40.7	49.3	71.0	5.2	198.2	37.2
2002	388.9	29.6	46.0	47.9	40.1	65.5	7.9	231.6	70.6
2003	599.6	16.4	57.2	53.4	44.5	63.9	6.9	241.7	64.9
2004	490.2	13.2	**37.6**	**45.7**	**35.1**	**55.2**	**5.6**	185.5	91.5
2005	522.5	17.6	**59.2**	**55.6**	**43.1**	**57.6**	**13.1**	139.6	72.0
2006	479.4	13.3	25.0	26.7	44.5	56.4	8.5	179.2	70.4
2007	402.7	10.8	30.6	28.1	49.8	63.9	10.5	256.3	70.1
2008**	545.2	4.9	47.8	42.5	67.9	85.7	15.8	247.6	74.4

* Identified twin trawls excluded
** Preliminary

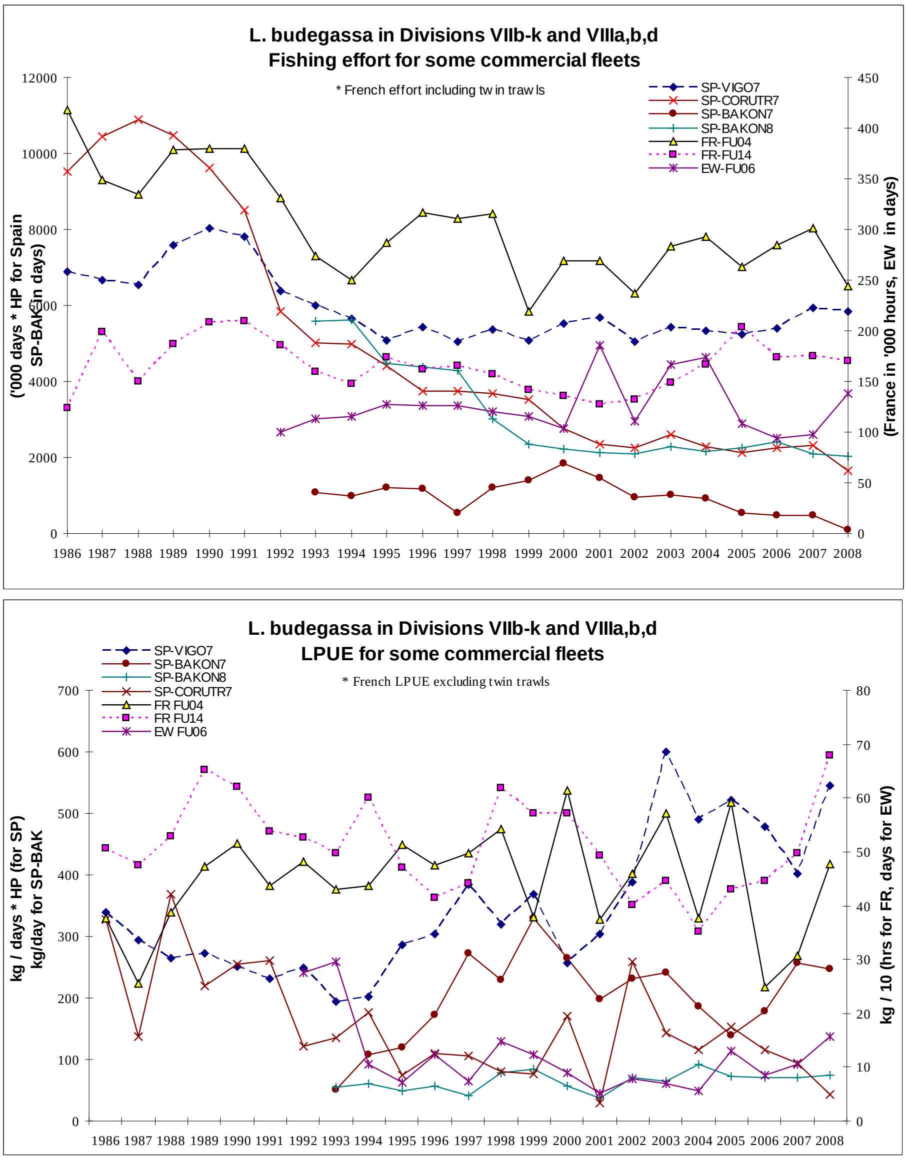


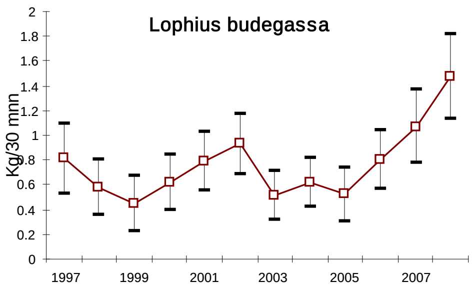
Figure 4.3-2 L. budegassa in Divisions VIIb-k and VIIIa,b,d- Effort and LPUE data

4.3.1.2 Surveys data

4.3.1.2.1 The French FR-EVHOE survey

This survey covers the highest proportion of the area of stock distribution. Standardised biomass, and abundance indices are given in Figure 4.3-3 .

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.



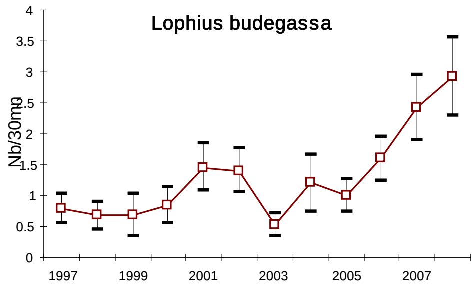


Figure 4.3-3 L. budegassa in Divisions VIIb-k and VIIIa,b,d- Evolution of the FR-EVHOE survey's indices Kg (left) and Nb (right) per 30 minutes tow from 1997 to 2007

The length distributions (Figure 4.3-4.) show that this corresponds to strong incoming year-classes since 2004 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).

The continuous incoming of strong year classes since 2004 accounts for an increase in the biomass index.

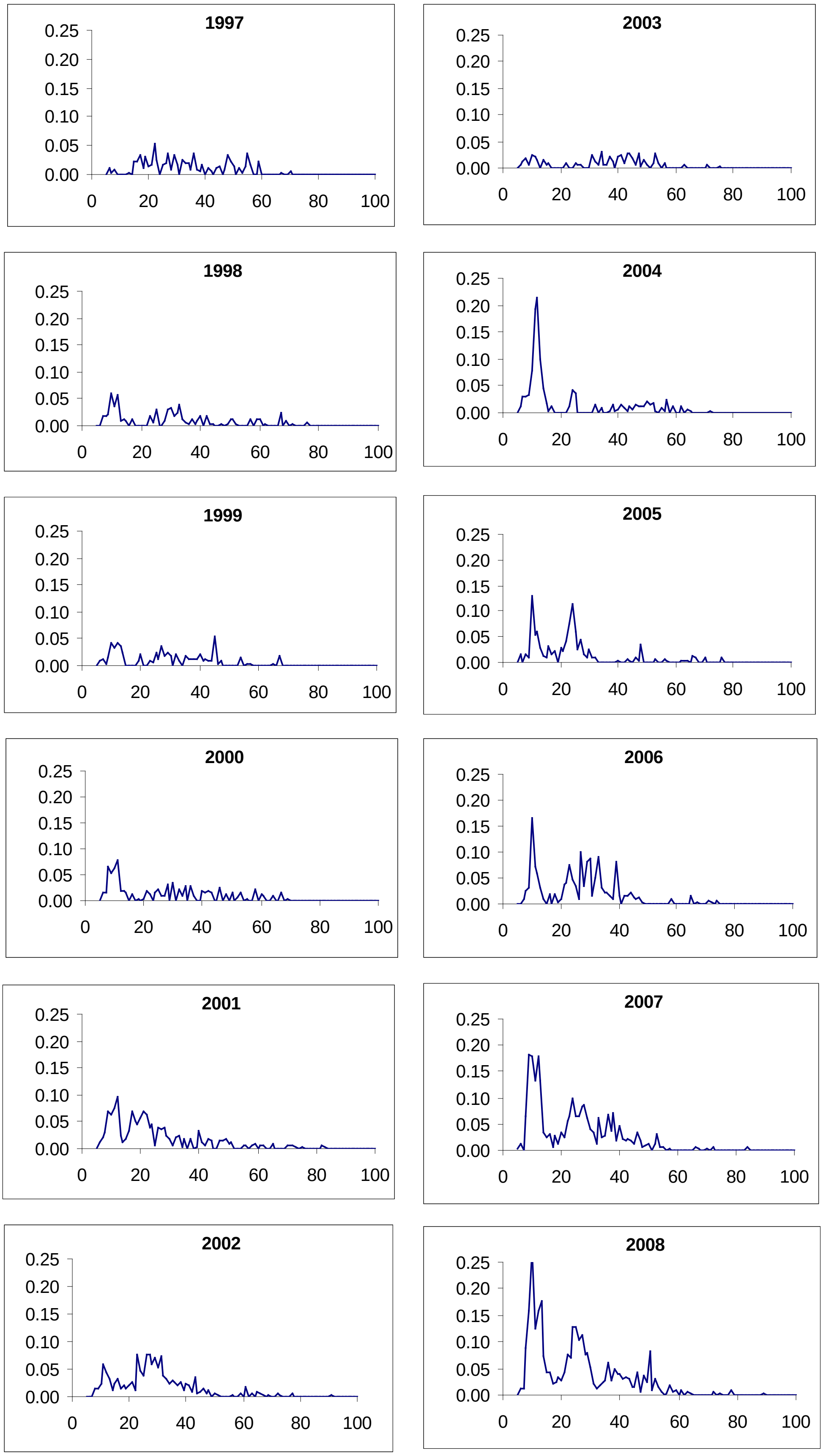


Figure 4.3-4 - L. budegassa in Divisions VIIb-k and VIIIa,b,d- Evolution of the FR-EVHOE Length distributions in Nb per 30 minutes tow from 1997 to 2008.

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 4.3-5 and Figure 4.3-6). However, in 2008, juveniles are also found in more southern area of the Bay of Biscay in deeper waters.

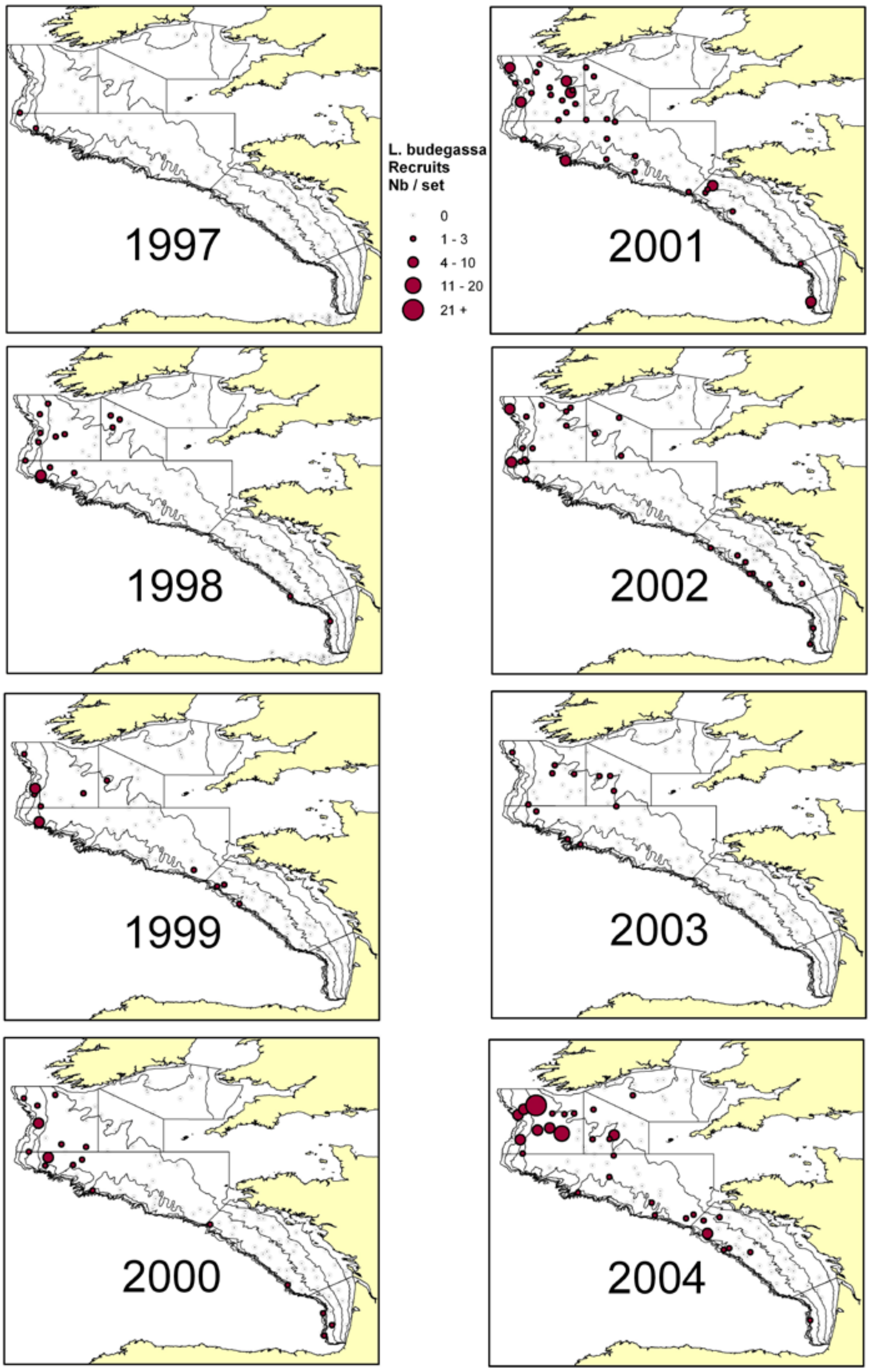


Figure 4.3-5 – L. budegassa in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 16 cm) in Nb per 30m observed in the FR-EVHOE surveys from 1997 to 2004.

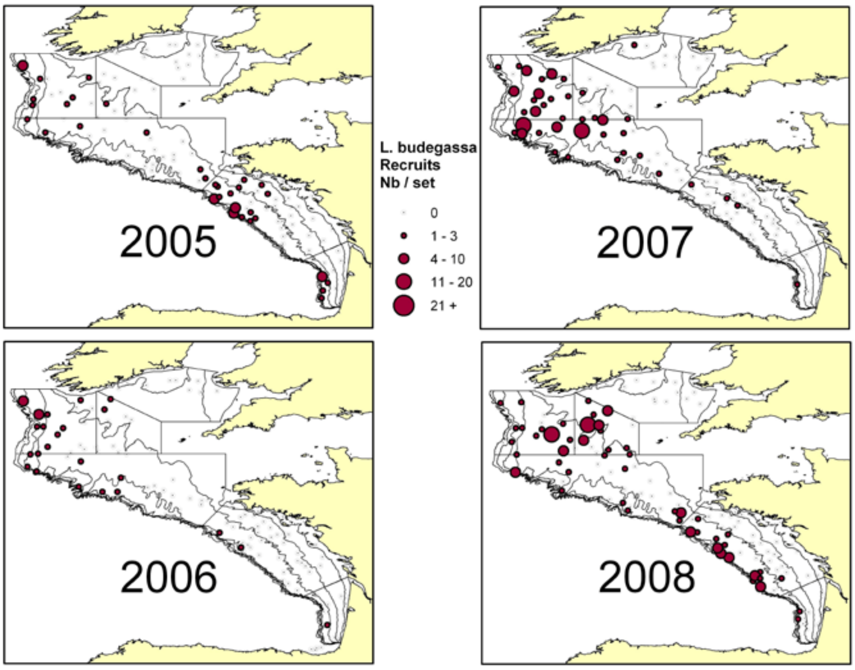


Figure 4.3-6 – L. budegassa in Divisions VIIb-k and VIIIa,b,d, distribution of recruits (lt < 16 cm) in Nb per 30m observed in the FR-EVHOE surveys from 2005 to 2008.

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 4.3-7. The survey covers a restricted area of the species distribution but the pulses of recruitment observed in the FR-EVHOE surveys are also present in the EW-FSP survey.

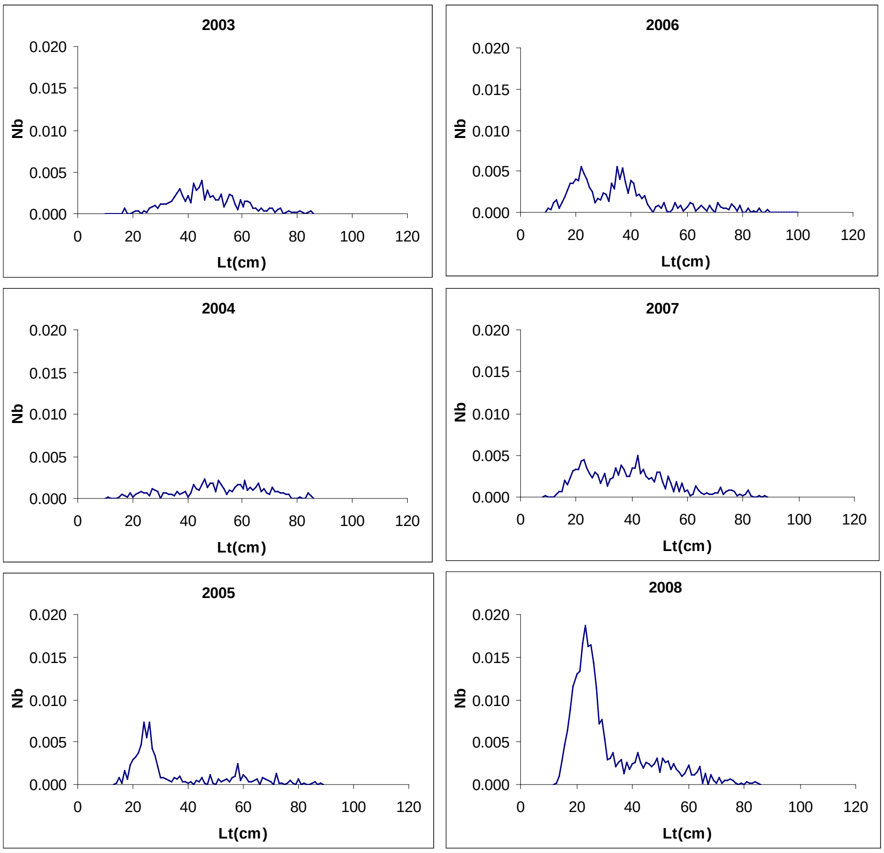


Figure 4.3-7 - L. budegassa in Divisions VIIb-k and VIIIa,b,d- Evolution of the EW-FSP Length distributions in Nb per 30 minutes tow from 2003 to 2008.

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.

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 show 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.

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

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

Data revisions this year: minor revisions to catches in 2007.

Review Group comments: these were in relation to 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 were 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.

Improvement in the quality of the input data has occurred since last year, however major data issues remain, as explained next:

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.

The Irish Ground Fish Survey and the Spanish Porcupine Ground fish survey were updated. Survey information on numbers at age have been updated and completed for FR-EVHOES index. The SP-PGFS was not examined as questions in relation to behavior of the gear used in 2008 were raised.

Commercial tuning data for four French fleets have been revised and 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.

Concerns about data remain in relation to the underestimation of the international catch matrix 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 CPUEs are still important to be delivered to the group.

5.1 General

5.1.1 Fishery description

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 70 % of the total landings, and 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 are shown in Table 5.1.

5.1.2 Summary of ICES Advice for 2009 and Management applicable for 2008 and 2009

No new advice was delivered in 2008. The advice given by ICES in 2007 for 2008 was also applicable for 2009.

The 2007, 2008 and 2009 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 2008 (11 273 t) are slightly lower than that observed in 2007 (13 330 t) being the lowest in the data series (Table 5.1)

Discard data available by country and the procedure to derive them are summarised in Table 5.2a. The discards decrease in 2000 and 2001 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 in 2007 and 2008 (Figure 5.1).

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
Discard ratio (%)	19	7	7	8	17	24	13	17	14	11

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 2007 and 2008 data are presented in Table 5.2b.

Table 5.3a and Table 5.3b show the international length composition of landings and discards of 2008 and the available original length composition of landings by Fishing Unit in 2008.

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. Mean lengths stay relatively stable in the recent years with a marked decrease in 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 (FR-EVHOES) results for the period 1997–2008 are summarised in Table 5.4a.

FR-EVHOES indices for age 1 showed high values in years 2002 and 2003. In 2004 and 2005 indices show lower values increasing again in 2006 and 2007 but decreasing sharply in 2008. No general trend was evident.

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 FR-EVHOES 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 2008, and from IR-GFS from 2003-2008.

When comparing Spanish, French and Irish biomass indices some contradictory signals are detected (Figure 5.3). The FR-EVHOES 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 2001-2007 attained in 2006. In 2008, concerns about the good performance of the gear used in this survey were raised by the IBTS WG, thus SP-PGFS estimates can not be considered to be entirely reliable.

Irish Ground Fish Survey gives the highest estimates in 2005 with a decrease in trend to 2007, increasing again in 2008 in agreement with FR-EVHOES.

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 FR-EVHOES and the southern coverage of IR-GFS, whereas the eastern boundary of SP-PGFS essentially coincides with the western one of IR-GFS.

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 1984–2008. 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. (Table 5.4b and Figure 5.4).

The general level of effort in SP-CORUTR7 and SP-VIGOTR7 has decreased since 1991, estabilising the last years of the series. SP-VIGOTR7 showed a slight increase in 2007 maintained in 2008. SP-CANTAB7 remains quite stable since 1991 and decreased slightly since 2000. 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 the last two years of the series (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 but in 2006 and 2007 CPUE increased. In 2008, Vigo CPUE decreased again. SP-

CANTAB7 has been fluctuating up to 1999 and then a general increasing trend is observed. This series shows a strong drop in 2008.

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.

5.2.5 Conclusions

Precise estimates of recent development of the stock population structure and SSB are not available. Commercial CPUEs series still give conflicting trends. However, 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.

The Group concludes that in view of the available data, the stock appears stable at the present level of fishing.

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.

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	11273	1442	12715	20425

(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****

- 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 2007 and 2008 data

2007					
Unit	**Data**	**France**	**Ireland**	**Spain**	**UK**
3	Landings	-			EW.03.07Q
	Discards	-			-
	ALK	-			EW.ALL FU.07Q
4	Landings	-		SP.04.07Q	EW.04.07Q
	Discards	-		SP.ALL FU.07Y	-
	ALK	-		SP.04.07Y	EW.ALL FU.07Q
5	Landings	-			EW.05.07Q
	Discards	-			-
	ALK	-			EW.ALL FU.07Q
6	Landings	-			EW.06.07Q
	Discards	-			-
	ALK	-			EW.ALL FU.07Q
8	Landings	-			
	Discards	-			
	ALK	-			
9	Landings	-			
	Discards	-			
	ALK	-			
10	Landings	-			
	Discards	-			
	ALK	-			
14	Landings	-		SP.14.07Q	
	Discards	-		-	
	ALK	-		-	
All fisheries	Landings	FR.S.FU.07Y	IR.ALL FU.07Q		
Units	Discards	-	-		
	ALK	-	IR.ALL FU.07Q		
No of samples		-	17	76	73
No of fishes measured		-	2396	11657	13123
No of fish aged		-	673	1026	1407

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

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	Landings	-	IR.ALL FU.08Q		
Units	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 5.3a - Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. International length composition for 2008. Numbers in thousands.

		2008	
Lt	Landings	Discards	**Catches**
10	0	35	**35**
11	0	0	**0**
12	0	38	**38**
13	0	651	**651**
14	0	539	**539**
15	0	1306	**1307**
16	2	2576	**2578**
17	5	4110	**4115**
18	24	4377	**4401**
19	214	3681	**3895**
20	831	6209	**7041**
21	2439	2580	**5018**
22	3789	1042	**4831**
23	4953	1352	**6305**
24	6155	687	**6842**
25	5873	463	**6335**
26	5911	201	**6112**
27	4338	80	**4419**
28	3554	7	**3561**
29	3018	4	**3023**
30	2461	2	**2463**
31	2269	2	**2271**
32	2129	0	**2129**
33	1681	0	**1681**
34	1434	1	**1435**
35	1202	0	**1202**
36	966	0	**966**
37	867	0	**867**
38	733	0	**733**
39	619	0	**619**
40	490	0	**490**
41	473	0	**473**
42	467	0	**467**
43	364	0	**364**
44	354	0	**354**
45	319	0	**319**
46	243	0	**243**
47	212	0	**212**
48	199	0	**199**
49	143	0	**143**
50	124	0	**124**
51	84	0	**84**
52	56	0	**56**
53	68	0	**68**
54	32	0	**32**
55	27	0	**27**
56	11	0	**11**
57	11	0	**11**
58	6	0	**6**
59	0	0	**0**
60	0	0	**0**
Total	59148	29945	**89093**
Wt	11273	1442	**12715**
Mean L	**27**	20	**24**
%<25cm	***31***	***96***	***53***
%<20cm	***0***	*41*	***14***

Table 5.3b Megrim (*L.whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Original Length composition by fleet (thousands). No raised to the total landings has been deployed
No length frequencies for Belgium are available.

Length	FRANCE	SPAIN		IRELAND	UNITED KINGDOM			
class (cm)	ALL FISHING UNITS	FU04:Otter trawl-med&deep	FU14:Otter trawl-med&deep VII	ALL FISHING UNITS	FU03:Fixed net	FU 04: Otter trawl-med&	FU05:Otter trawl-sh	FU06:Beam trawl-all depths
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0.000	0	0	0
12	0	0	0	0	0.000	0	0	0
13	0	0	0	0	0.000	0	0	0
14	0	0	0	0	0.000	0	0	0
15	0	0	0	0	0.000	0	0	0
16	0	0	0	2	0.000	0	0	0
17	0	0	0	5	0.000	0	0	0
18	0	9	0	13	0.000	0	0	0
19	0	173	0	34	0.000	0	0	0
20	0	740	17	50	0.000	0	0	0
21	0	2257	28	86	0.000	0	0	0
22	0	3490	57	136	0.000	0	0	0
23	1	4426	135	247	0.000	0	0	1
24	12	5354	162	431	0.000	0	2	2
25	35	4944	141	538	0.000	0	2	18
26	74	4934	112	554	0.010	0	5	23
27	156	3117	222	538	0.044	0	12	70
28	181	2308	163	540	0.057	0	20	95
29	235	1824	105	463	0.078	0	28	79
30	285	1271	123	390	0.096	0	28	84
31	321	1187	57	328	0.125	0	30	62
32	413	1018	49	279	0.266	0	30	67
33	440	678	18	213	0.332	0	26	59
34	418	547	12	172	0.290	0	24	45
35	350	428	11	162	0.496	0	21	36
36	350	264	9	108	0.624	0	20	36
37	273	281	8	84	0.692	0	20	39
38	194	253	6	66	0.611	0	18	37
39	164	204	9	58	0.583	0	17	28
40	189	126	9	37	0.561	0	10	32
41	183	124	5	38	0.344	0	11	29
42	213	111	4	21	0.338	0	10	28
43	170	82	4	14	0.250	0	7	23
44	177	94	2	15	0.071	0	4	27
45	173	73	2	13	0.081	0	4	19
46	161	31	1	9	0.019	0	2	19
47	131	35	1	5	0.103	0	2	19
48	141	16	1	4	0.034	0	2	19
49	83	25	1	5	0.010	0	1	10
50	88	8	0	1	0.009	0	1	17
51	60	6	0	0	0.000	0	1	10
52	39	3	0	2	0.000	0	0	10
53	53	3	0	0	0.000	0	0	7
54	26	1	0	0	0.000	0	0	4
55	21	0	0	1	0.000	0	0	5
56	8	1	0	0	0.000	0	0	2
57	10	0	0	0	0.000	0	0	1
58	5	0	0	0	0.000	0	0	1
59	0	0	0	0	0.000	0	0	0
60	0	0	0	0	0.000	0	0	0
61	0	0	0	0	0.000	0	0	0
62	0	0	0	0	0.000	0	0	0
63	0	0	0	0	0.000	0	0	0
64	0	0	0	0	0.000	0	0	0
65	0	0	0	0	0.000	0	0	0
66	0	0	0	0	0.000	0	0	0
67	0	0	0	0	0.000	0	0	0
68	0	0	0	0	0.000	0	0	0
69	0	0	0	0	0.000	0	0	0
70	0	0	0	0	0.000	0	0	0
TOTAL	5833	40444	1475	5665	6		358	1066

Table 5.4a **Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d.**
Abundance Indices for UK-WCGFS-D, UK-WCGFS-S, IR-GFS, SP-PGFS and EVHOES

UK-WCGFS-D — **Effort in hours**

	Effort	**Age 1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1987	100		863	5758	0	0	0	95	1753	151
1988	100	8	256	59	49	0	228	1008	1262	632
1989	100		70	188	471	2540	788	3067	680	1060
1990	100	8	526	1745	553	2584	1985	974	1154	974
1991	100		415	1375	1250	989	912	1677	593	731
1992	100	7	28	425	414	349	189	206	132	121
1993	100		122	382	1758	1505	728	739	666	718
1994	100		69	1593	1542	2663	1325	1278	825	595
1995	100	47	582	747	1755	1686	1303	548	281	421
1996	100	15	69	475	549	1580	1231	870	327	117
1997	100		329	751	1702	1518	541	149	47	17
1998	100		120	797	1432	1134	866	242	246	13
1999	100		237	270	734	760	302	94	33	17
2000	100		143	1004	619	681	395	67	35	13
2001	100	20	384	690	1426	581	460	376	226	45
2002	100		162	2680	1915	1349	761	690	315	104
2003	100		330	1705	3149	2662	1451	676	417	179
2004	100	168	1001	1382	1069	897	628	208	47	

UK-WCGFS-S — **Effort in hours**

	Effort	**Age 1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1987	100		499	3082	641	891	180	794	264	587
1988	100		47	55	585	95	367	0	50	93
1989	100		616	574	547	1540	576	361	297	198
1990	100		375	1057	816	661	1220	195	454	176
1991	100	2	373	829	822	394	460	550	178	293
1992	100		149	278	323	193	109	164	93	36
1993	100		470	877	1140	601	327	321	143	233
1994	100		74	1000	1301	998	521	374	185	153
1995	100	28	435	878	1167	1054	805	488	359	130
1996	100	2	64	401	389	823	592	372	152	43
1997	100	3	284	1028	550	540	289	202	75	29
1998	100	4	30	438	665	381	209	97	48	21
1999	100		69	82	222	214	103	53	41	20
2000	100		72	377	249	313	169	81	52	20
2001	100	2	131	297	594	104	145	122	80	37
2002	100		134	808	506	757	339	326	181	82
2003	100	5	184	289	639	416	328	113	102	36
2004	100	50	343	467	270	394	303	124	49	21

FR-EVHOES

	Effort	**Age 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

IR-7-GFS

	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

SP-GFS

	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

Table 5.4a (Cont'd)

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

SP-GFS 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

IR-GFS Abundance Indices by numbers by 10 square kilometers

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

Table 5.4.b

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

French and Spanish CPUEs for different bottom trawler fleets.

French (single and twin bottom trawls combined) CPUE (kg/h)				Spanish CPUE (kg/(100day*100 hp))			Irish LPUE ('000 h)
Benthic Bay of Biscay	Benthic Western Approaches	Gadoids Western Approaches	Nephrops Western Approaches	A Coruña -VII	Cantábrico- VII	Vigo-VII	Otter trawlers
				16.3	130.1	99.1	-
3.0	5.3	4.7	4.7	9.8	39.5	108.9	-
3.2	4.8	2.8	4.4	21.1	52.8	105.1	-
3.3	5.1	2.7	4.5	8.3	80.7	96.2	-
3.8	5.8	3.0	4.1	9.8	78.3	106.1	-
3.6	5.5	2.6	4.2	14.6	48.1	92.1	-
3.1	4.2	1.8	3.4	15.1	18.4	73.8	-
2.6	4.0	1.3	2.8	12.9	25.9	85.4	-
2.5	4.5	1.5	3.4	6.9	32.8	105.6	-
1.9	4.6	1.2	3.5	5.1	33.5	92.3	-
1.9	4.2	1.2	3.4	7.4	52.7	78.7	-
2.3	4.9	1.4	3.4	7.8	61.3	94.3	8.4
2.5	5.7	1.4	3.5	3.9	58.4	79.3	9.2
2.8	6.7	1.2	3.0	3.0	46.9	96.0	7.0
2.4	8.2	1.5	3.7	2.4	35.7	82.4	6.4
3.4	6.8	0.8	3.4	1.1	32.5	137.0	5.9
3.1	8.0	0.6	3.9	5.5	45.0	128.9	5.8
2.1	9.6	0.7	3.9	1.3	75.6	131.2	7.1
2.3	8.1	0.5	3.1	1.3	76.4	185.3	6.7
1.8	6.7	0.5	3.0	11.2	54.0	192.1	5.3
1.7	4.9	0.4	3.3	3.3	60.0	211.0	4.7
1.9	6.3	0.4	3.4	1.7	58.46	135.3	4.3
2.3	6.6	0.3	3.0	1.4	76.42	146.1	-
2.4	6.4	0.3	2.5	2.4	87.86	147.7	-
2.3	6.5	0.4	2.5	3.0	37.58	114.8	-

Figure 5.1. - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Length composition of catches for the years 1990 to 2008.

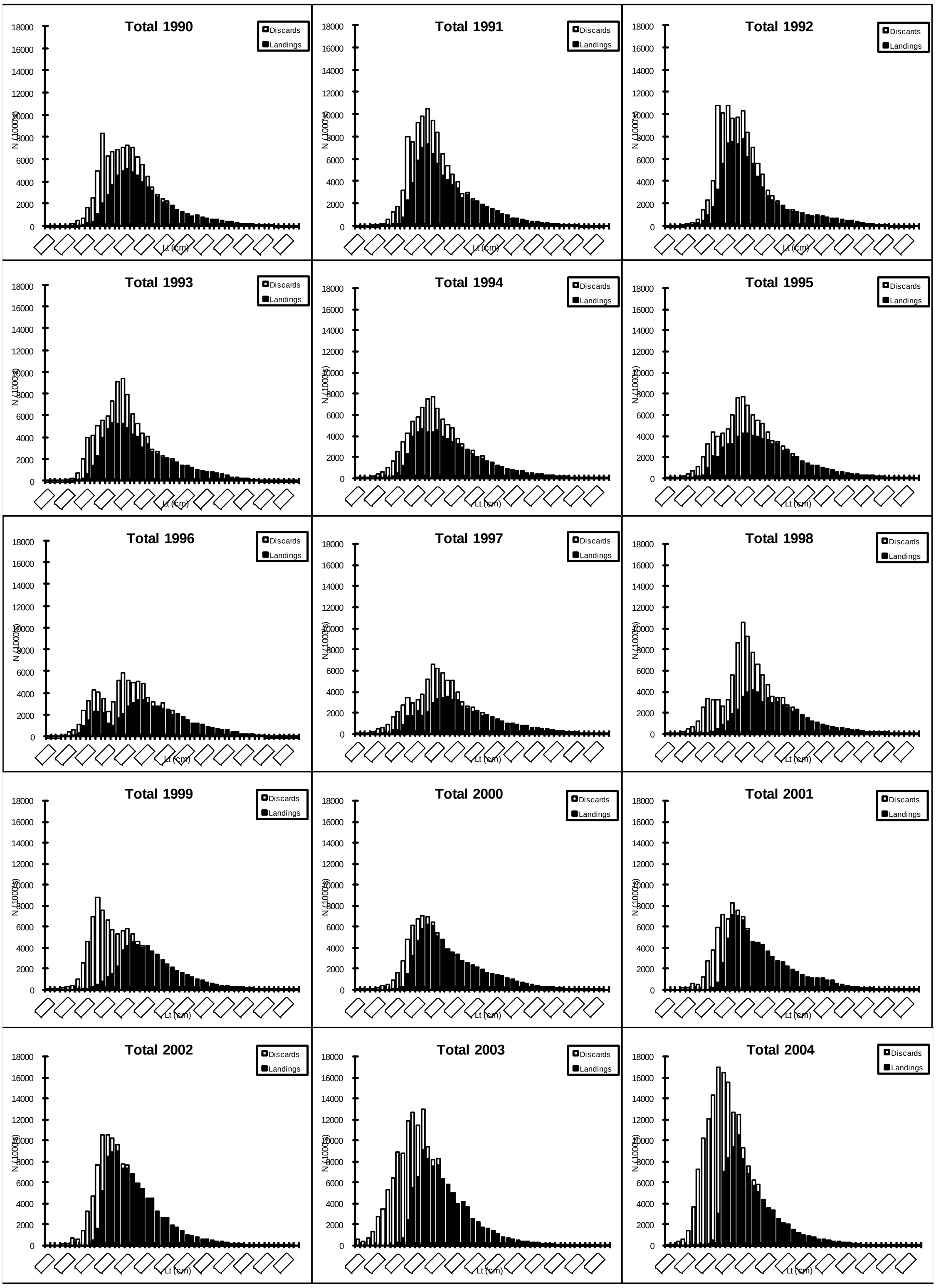


Figure 5.1.cont. - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Length composition of catches for the years 1990 to 2008.

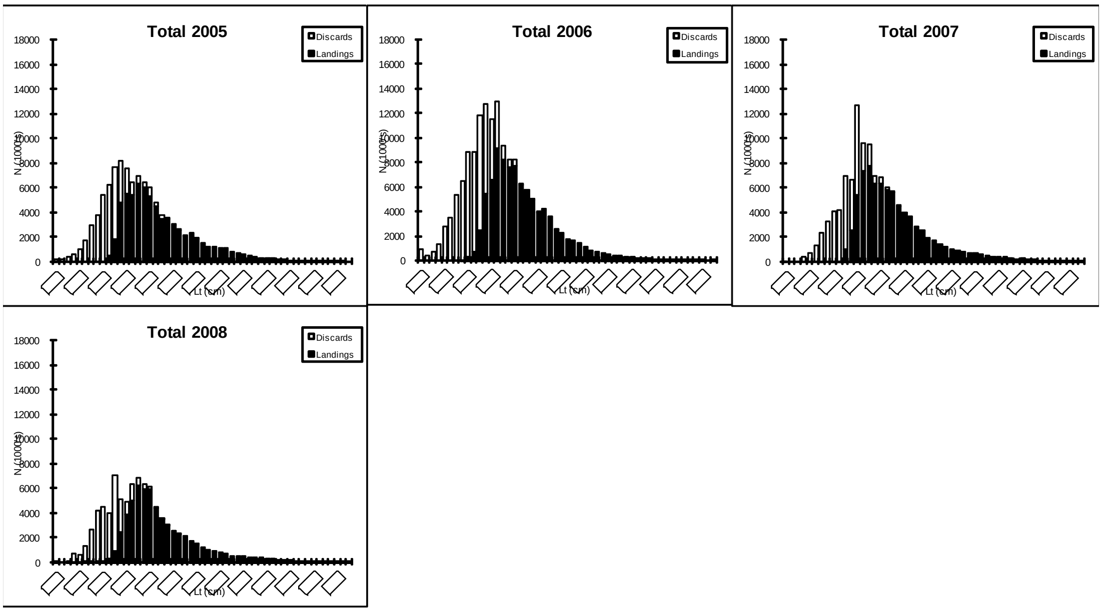


Figure 5.2. - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Age composition of catches for the years 1990 to 2008.

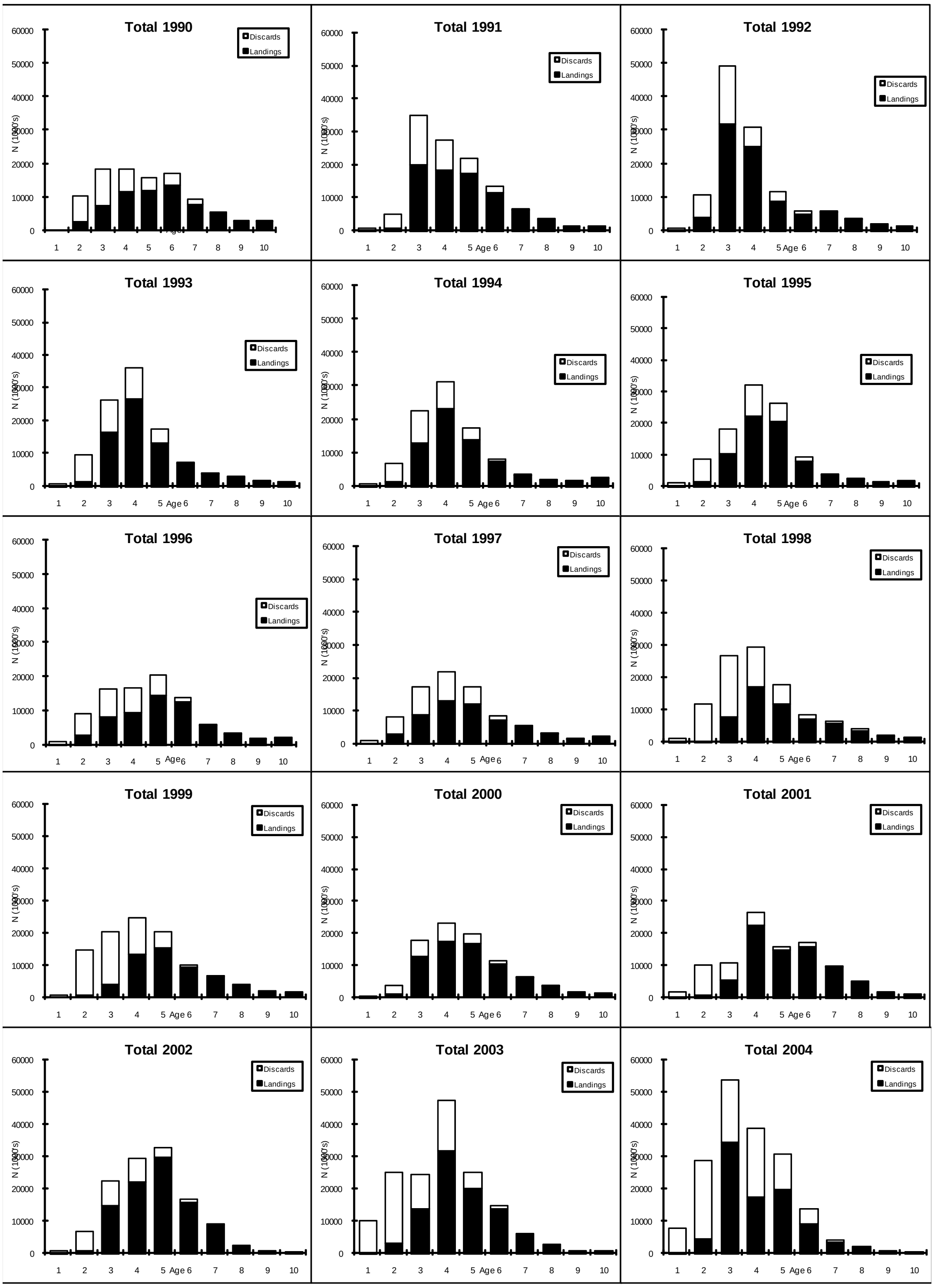
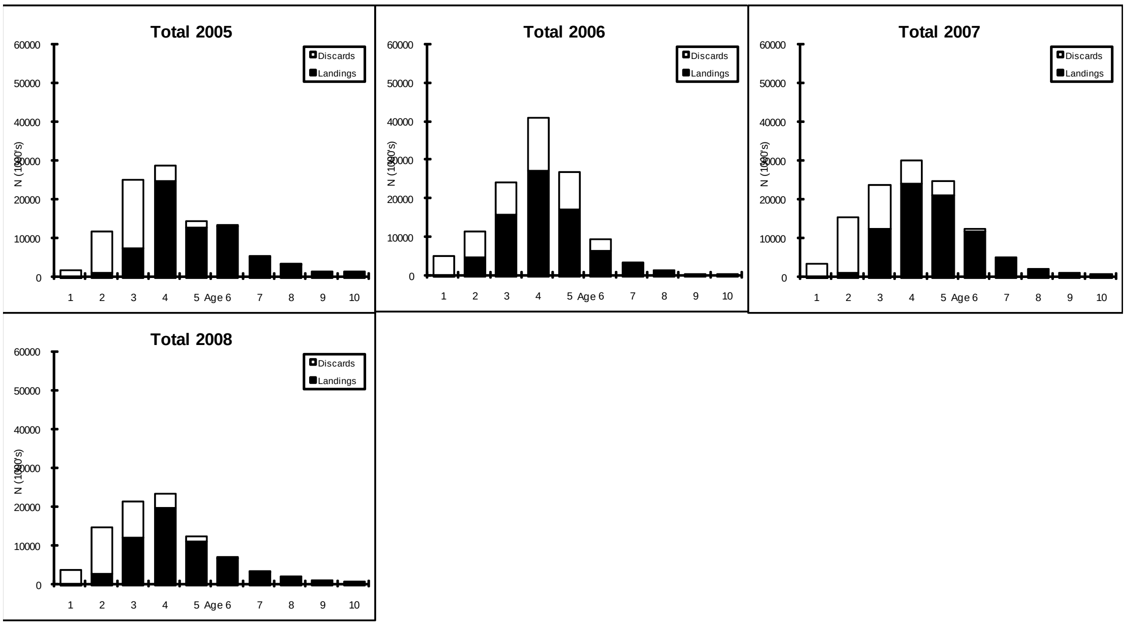


Figure 5.2. cont - Megrim (L.whiffiagonis) in Divisions VIIb-k and VIIIa,b,d. Age composition of catches for the years 1990 to 2008.



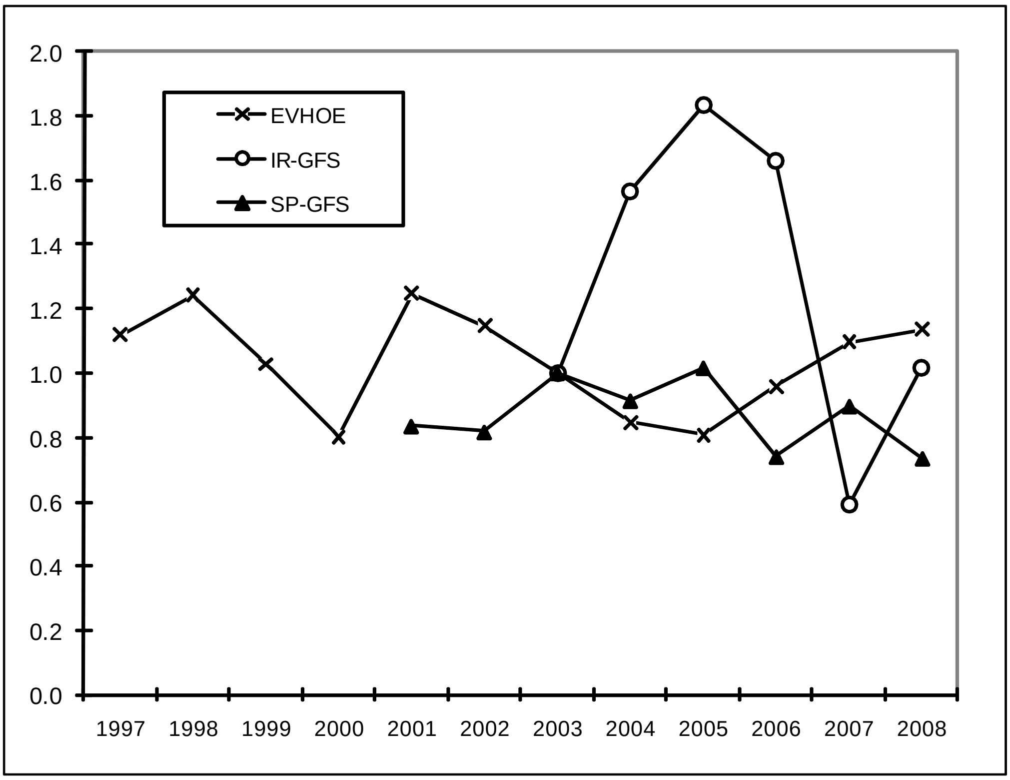


Figure 5.3 Megrim (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b,d. Scaled Biomass Indices for FR-EVHOES, SP-PGFS and IR-GFS

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

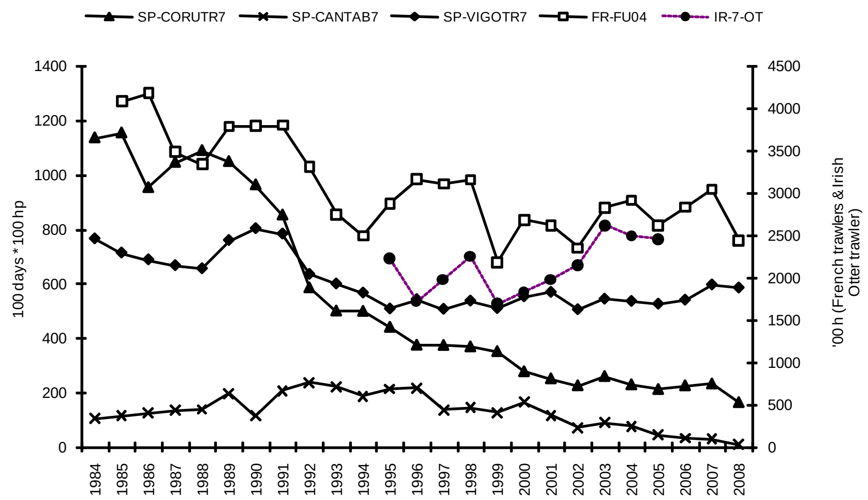


Figure 5.4b Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d.
Spanish CPUE for different bottom trawler fleets.

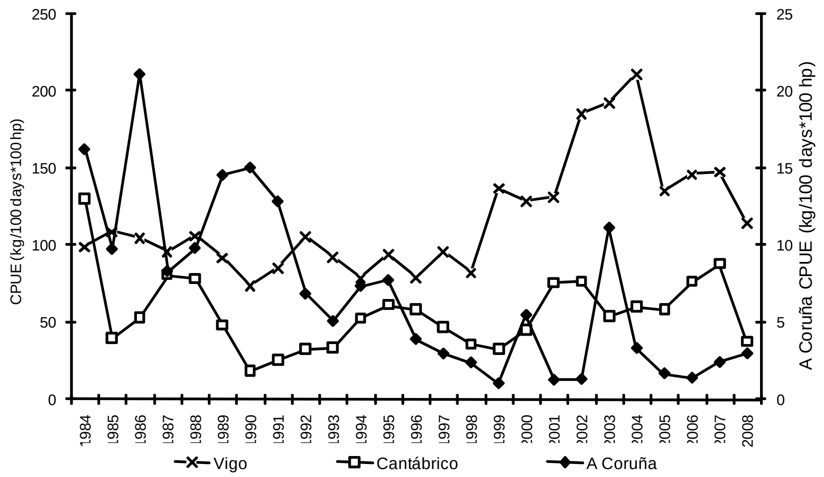
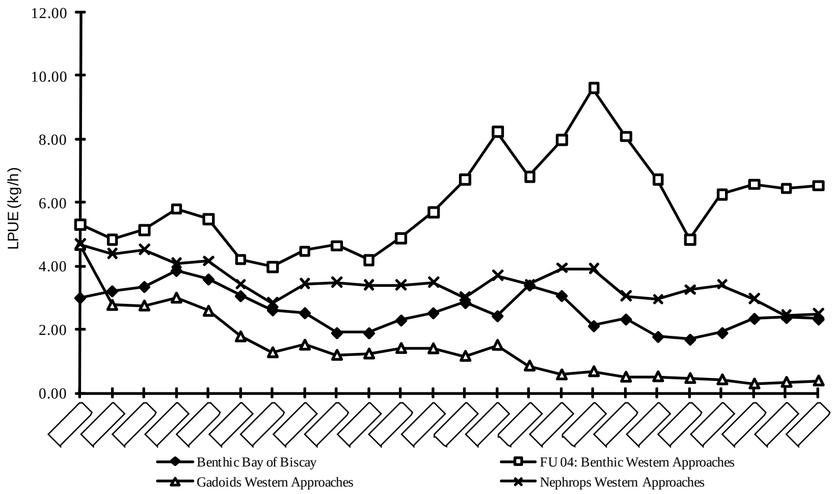


Figure 5.4c Megrim (*L. whiffiagonis*) in Divisions VIIb,c,e-k and VIIIa,b,d.
French LPUE for different bottom trawler fleet.



6 Bay of Biscay Sole

Type of assessment in 2009: update.

Data revisions this year: Compared to last year assessment, there is only very limited change in data due to small revisions of 2007 landings and of 2007 commercial LPUE.

Review Group issues:

RG comments on the 2008 assessment have already been addressed in the minutes. RG agreed two WG options which were discussed by 2008 WG:

- the continued use of the RESSGASC surveys in order to ensure historic results that are in line with the basis for the agreed reference points,
- the use of a GM from 1993 to antepenultimate year in the assessment to replace the last estimate of the youngest age group because this latter is always uncertain.

6.1 General

6.1.1 Ecosystem aspects

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. Spawning grounds spread at depth from 30 to 100 m. Nursery grounds are located in the coastal waters, in bays and estuaries (map in Stock Annex in annex F).

Studies in Vilaine Bay (South Brittany) showed a significant positive relationship between the flow of Vilaine River in winter-spring and the size of the sole nursery in this area. This result led the WGSSDS (former WG "parent " of this stock) to investigate if a relationship could be found between the river flows and the sole recruitment in the Bay of Biscay at its 2006 meeting, but without any success. The environmental effect on the sole recruitment is likely to be more complex at the Bay of Biscay scale. Its knowledge is the aim of two surveys series which are planned in 2007-2009 in the Charente sounds (La Rochelle area) and in the Loire estuary.

6.1.2 Fishery description

The Bay of Biscay sole fishery (a more detailed description is provided in the Stock Annex) has two main components: the major one is a French gill net fishery directed at sole (about two third of total catches) and the other one is a French and Belgian trawl fishery (French otter or twin trawlers and Belgian beam trawlers). The otter and twin trawlers have more mixed species catches than beam trawlers which are directed at sole. The French coastal boats of these two fisheries have a larger proportion of young fish in their catch than offshore boats.

6.1.3 Summary of ICES advice for 2009 and management applicable to 2008 and 2009

ICES advice for 2009:

ICES recommends that the landings in 2009 should not exceed 4430 t; this is in accordance with the precautionary approach.

Management applicable to 2008 and 2009

The sole landings in the Bay of Biscay are subject to a TAC regulation. The 2008 TAC was set at 4582 t (4170 t increased by 412t in 2008 due to underutilisation of 2007 French quota). The 2009 TAC is set at 4390 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 is 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 should 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 close to the SSB target in 2008, the long-term target fishing mortality rate and the associated rate of reduction has not yet been set. The management plan established in 2006 has not been evaluated by ICES.

6.2 Data

6.2.1 Commercial catches and discards

The WG estimates of landings and catches are shown in Table 6.1a with official landings. 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. They can be largely different from the official landings in some years, for instance when official figures are still provisional or when the TAC is largely overshot (year 2002).

The 2007 landings estimate was revised 2% higher to 4363 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. The 2008 figure is 10 % below the landings predicted by the 2008 WG at *status quo* mortality (4754 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 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 French length distributions are shown on Figures 6.2 a, b & c from 1984 onwards. The relative length distribution of landings in 2008 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 12m long). The split of the French landings in these components is made as described in Stock Annex. The 2007 split was slightly revised because some late recording of logbooks in the database in 2007 (Table 6.1 b).

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). In 2007 and 2008, the estimate is calculated using the new fresh/gutted transformation coefficient of the French landing which was changed from 1.11 to 1.04 in 2007.

The discrepancy between French and Belgian mean weight at age still exists (ICES files). An investigation of this problem was carried out in 2005-2006. It has shown that the discrepancy results from differences in age reading due to the reading methods (on burning sections in France and on slices in Belgium) and, to a lesser extend, to the age readers (about 80% of agreement on a set of otoliths). The reading is now carried out in France using the two methods, to be able to a have a new homogeneous international series in the future.

6.2.3 Abundance indices from surveys

Two CPUE FR-RESSGASC-S 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.

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 adds information on LPUE 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.

These three series were revised because some 2007 logbooks were not available at the time of the 2008 WG meeting. An estimate of the total effort of French offshore trawlers (using LPUE calculated for the whole trawler fleet) shows that, after a decrease until 1999, the effort of this fleet is stable in recent years (Table 6.2a and Figure 6.1a). After a low in 2003-2004, the effort of the Belgian beam trawl fleet has returned to its previous 2001-2002 level, but it has decreased again in 2008.

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 an increasing trend but this latter is moderate since 2005. 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

Stock weights are set to the catch weights, using the same fresh/gutted transformation coefficient for the French landings in 2007 and 2008 than the preceding years (1.11).

As in previous assessments, natural mortality is assumed to be 0.1 for all age groups and all years.

The following observed maturity ogive (estimation described in Stock Annex) is used in all years:

AGE	≤ 1	2	3	4	≥ 5
Mature	0	0.32	0.83	0.97	1

Proportions of F and M before spawning were set to zero, as in previous years, to reflect SSB at 1st January.

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 1984-2008.

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 – 2008	0 – 8	<1 %
Offshore otter trawlers	FR-ROCHELLE	1991 – 2008	0 – 8	<1 %
Offshore beam trawlers	BEL-BT	1997 – 2008	0 – 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 notice by the previous WG, they increase the fishing mortalities before 1992 and, inversely, lower the SSB. 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.

			2008 XSA			2009 XSA
Catch data range			84-07			84-08
Catch age range			2-8+			2-8+
Fleets	FR – SABLES	91-07	2-7	FR – SABLES	91-**08**	2-7
	FR – ROCHELLE	91-07	2-7	FR – ROCHELLE	91-**08**	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 all ages and also 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 2008 is estimated by XSA to have been at 0.38. Fishing mortality in 2007 is now estimated at 0.38, lower than in last year WG report (0.45).

6.3.3 Assessment results

6.3.3.1 Estimating year class abundance

The 2005 year class is estimated to be 23.1 million 2 year olds by XSA. Last year's WG XSA estimate (21.5 million) was not accepted by the WG which preferred to overwrite this year class with the GM (22.9 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 close to the average.

The 2006 year class is estimated to be at 21.3 million 2 year olds by XSA. The WG considered that this XSA recruitment estimate in terminal year could not be accepted because it is no more reliable than in the preceding year. It was overwritten by a short series GM from 1993 as in preceding assessments since there is observed fall in stock numbers at age 2 after 1993. As in last year assessment, a mean from 1993 up to two years before the terminal years (2006) was preferred to a mean to one year before the terminal year (2007) because the retrospective pattern shows that convergence may not be before two years when terminal year estimate differs largely from posterior annual estimate. The GM $_{93\text{-}06}$ is also used to estimate subsequent recruitments.

Recruitment at age 2

YEAR CLASS	THOUSANDS	BASIS	SURVEYS	COMMERCIAL	SHRINKAGE
2005	23068	XSA	0 %	99 %	1 %
2006	23191	GM(93-06)			
2007 & subsequent	23191	GM(93-06)			

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. Later on, the trend is much more flat, fishing mortality ranging between 0.43 in 2005 and 0.38 in 2007 and 2008.

SSB trend in earlier years increases from 10600 t in 1984 to 16 600 t in 1993, afterwards it shows a continuous decrease to 9 700 t in 2003. After a 18 % increase in 2004, a lower but continuous increase is observed from 2004 onwards. It leads to an SSB estimate of 13700 t in 2008.

The recruitment values are lower since 1993. Afterwards, the series is relatively stable, but three low values are worth noting in 2001, 2004 and 2005.

6.3.4 Catch options and prognosis

The exploitation pattern is the unscaled mean over the period 2006-2008 (over 2006-2007 at age 2), considering there is no trend in F in the last three years of the assessment. This *status quo* F is estimated at 0.39.

The recruits at age 2 from 2009 to 2011 are assumed equal to GM $_{93\text{-}06}$. Stock number at age 3 in 2009 is derived from GM $_{93\text{-}06}$ reduced by total estimated mortality. Stock numbers at ages 4 and above in 2008 are the XSA estimates.

Weights at age in the landings are the 2006-2008 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 2006-2008 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 4867 t in 2009 (TAC is set at 4390 t), 13 % higher than the 2008 landings.

Assuming recruitment at GM $_{93\text{-}06,}$ the SSB is predicted to increase slowly to 14500 t in 2009 and to 14600 t in 2010, at *status quo* F. It will keep the same low growth at *status quo* F, to reach 14700t in 2011 (Tables 6.13 and 6.14).

The proportional contributions of recent year classes to the landings in 2010 and to the SSB in 2011 are given in Table 6.15. Year classes for which GM recruitment has been assumed (2006 to 2008) contribute 57 % of the 2010 landings and 70 % of the 2011 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 6.7. The landings $\mathbf{F}_{sq}$ (0.39) is 62 % above $\mathbf{F}_{max}$ (= 0.24) and 4 times $\mathbf{F}_{0.1}$ (=0.10). Long-term equilibrium landings and SSB (at F *status quo* and assuming GM recruitment) are estimated to be 5000 t and 14900t respectively.

6.3.5 Biological reference points

The values and the basis of present and past reference points and the conclusion of 2004 WGSSDS examination are given below :

	ACFM 1998	ACFM 1999	WG & ACFM	WG 2004	ACFM 2006
			Change in maturity ogive	Change in recruitment age and in Fbar age range	Change in Fbar age range
$\mathbf{F}_{lim}$	Not defined	Not defined	0.5 (potential collapse)	Not defined	$\mathbf{F}_{lim}$=0.58 (potential collapse)
$\mathbf{F}_{pa}$	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 to promote SSB increase in the short- to medium-term	$\mathbf{F}_{pa} = \mathbf{F}_{lim}\ e^{(-1.645 * .2)} = 0.42$
$\mathbf{B}_{lim}$	Not defined	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	13 000t

6.3.6 Comments on the assessment

Sampling

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

The Working Group considers that the lack of survey index, especially for estimating the incoming recruitment, is an important deficiency in this assessment.

An age reading discrepancy causes a gap between the French and Belgian numbers at age distribution and the weights at age.

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. 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.

A retrospective pattern in F is also worth noting. It leads to a downward revision of F in 2007, which is now estimated to be below F_{pa}.

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 taking into account long term change in fishing power and 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 recent 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 2009 WG to assess the Bay of Biscay sole stock. The participants did not express reservations on these data.

6.3.7 Management considerations

The assessment indicates that SSB has decreased continuously to 9700 t in 2003, since a peak in 1993 (16 600 t), has increased to 11500t in 2004 but more slowly since then to reach 13700 t in 2008. The SSB is forecast to be 14500t in 2009 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, this aim has been reached and the plan should enter in its second step, with a new agreement on 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						Unallocated	WG	Discards [2]	WG
Years	Belgium	France[1]	Nether.	Spain	Others	Total	landings	landings		catches
1979	0	2376		62*		2443	176	2619	-	-
1980	33*	2549		107*		2689	297	2986	-	-
1981	4*	2581*	13*	96*		2694	242	2936	-	-
1982	19*	1618*	52*	57*		1746	2067	3813	-	-
1983	9*	2590	32*	38*		2669	959	3628	-	-
1984		2968	175*	40*		3183	855	4038	99	4137
1985	25*	3424	169*	308*		3925	326	4251	64	4315
1986	52*	4228	213*	75*		4567	238	4805	27	4832
1987	124*	4009	145*	101*		4379	707	5086	198	5284
1988	135*	4308		0		4443	939	5382	254	5636
1989	311*	5471		0		5782	63	5845	356	6201
1990	301*	5231		0		5532	384	5916	303	6219
1991	389*	4315		3		4707	862	5569	198	5767
1992	440*	5928		0		6359	191	6550	123	6673
1993	400*	6096		13		6496	-76	6420	104	6524
1994	466*	6627		2***		7095	134	7229	184	7413
1995	546*	5326		0		5872	333	6205	130	6335
1996	460*	3842		0		4302	1552	5854	142	5996
1997	435*	4526		0		4961	1298	6259	118	6377
1998	469*	3821	44	0		4334	1693	6027	127	6154
1999	504	3280		0		3784	1465	5249	110	5359
2000	451	5293		5***		5749	11	5760	51	5811
2001	361	4350	201	0		4912	-76	4836	39	4875
2002	303	3680		2***		3985	1501	5486	21	5507
2003	296	3805		4***		4105	3	4108	20	4128
2004	324	3739		9***		4072	-70	4002	-	-
2005	358	4003		10		4371	168	4539	-	-
2006	393	4030		9		4432	361	4793	-	-
2007	401	3707		9		4117	246	4363	-	-
2008	305	2514**			2*	2821	1479	4300		

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

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

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

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

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

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

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

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

Table 6.3 : Bay of Biscay Sole - 2008
French and Belgian relative length distribution of landings

Length(cm)	France	Belgium
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	0.00	0.00
22	0.23	0.25
23	1.37	3.25
24	5.02	9.21
25	6.72	11.61
26	7.55	9.72
27	7.75	17.07
28	9.61	13.49
29	11.00	11.69
30	11.04	7.90
31	8.97	4.90
32	7.25	4.13
33	5.20	2.39
34	4.34	1.67
35	3.01	0.96
36	2.24	0.72
37	1.90	0.48
38	1.46	0.28
39	1.16	0.17
40	1.06	0.08
41	0.87	0.01
42	0.63	0.01
43	0.43	0.01
44	0.38	0.00
45	0.26	0.00
46	0.20	0.00
47	0.10	0.00
48	0.11	0.00
49	0.05	0.00
50	0.04	0.00
51	0.02	0.00
52	0.01	0.00
53	0.02	0.00
54	0.01	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	
Age													
2	5901	8493	6126	3794	4962	4918	7122	4562	4640	1897	2603	3249	
3	3164	4606	4208	5634	5928	6551	6312	6302	7279	7816	5502	5663	
4	2786	2479	2673	3578	4191	3802	4423	4512	4920	6879	8803	6356	
5	2034	1962	2301	2005	2293	3147	2833	2083	2991	3661	5040	3644	
6	1164	906	1512	1482	1388	2046	972	1113	2236	1625	1968	1795	
7	880	708	1044	690	874	967	1018	1063	1124	566	970	843	
+gp	1181	729	1235	714	766	499	870	981	951	708	696	986	
TOTALNUM	17110	19883	19099	17897	20402	21930	23550	20616	24141	23152	25582	22536	
TONSLAND	4038	4251	4805	5086	5382	5845	5916	5569	6550	6420	7229	6205	
SOPCOF %	107	103	102	102	101	101	100	102	100	100	100	100	
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Age													
2	3027	3801	4096	2851	5677	3004	5192	4213	3396	4114	3421	3952	3154
3	5180	9079	5550	5113	7015	6447	4770	6315	5391	3428	4081	5006	4710
4	5409	5380	6351	4870	5143	4942	4945	2246	3300	3604	3673	2574	2931
5	2343	3063	2306	2764	2542	1807	3095	1225	920	2224	1960	1652	1363
6	1697	1578	1237	1314	955	929	1261	730	662	922	993	1179	1227
7	1366	692	785	902	421	522	613	377	272	487	612	640	916
+gp	1319	877	1188	977	444	489	437	251	333	503	1081	905	907
TOTALNUM	20341	24470	21513	18791	22197	18140	20313	15357	14274	15282	15821	15908	15208
TONSLAND	5854	6259	6027	5249	5760	4836	5486	4108	4002	4539	4793	4363	4300
SOPCOF %	100	100	101	100	101	101	101	101	101	102	102	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	
Age													
2	0.121	0.106	0.102	0.141	0.134	0.136	0.131	0.143	0.146	0.145	0.147	0.16	
3	0.168	0.174	0.173	0.201	0.19	0.188	0.179	0.192	0.196	0.197	0.195	0.206	
4	0.213	0.252	0.245	0.285	0.272	0.258	0.241	0.26	0.262	0.267	0.251	0.252	
5	0.269	0.313	0.328	0.376	0.357	0.354	0.348	0.325	0.341	0.341	0.324	0.308	
6	0.329	0.39	0.409	0.467	0.495	0.437	0.436	0.437	0.404	0.439	0.421	0.403	
7	0.368	0.457	0.498	0.497	0.503	0.543	0.601	0.535	0.49	0.569	0.569	0.484	
+gp	0.573	0.698	0.657	0.682	0.604	0.799	0.854	0.715	0.715	0.677	0.774	0.658	
SOPCOFAC	1.0712	1.0302	1.0197	1.0248	1.008	1.0055	1.0039	1.0183	1.0004	1.0008	1.0016	1.0023	
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007*	2008*
Age													
2	0.159	0.142	0.161	0.177	0.171	0.153	0.171	0.18	0.19	0.191	0.196	0.174	0.176
3	0.204	0.193	0.212	0.219	0.207	0.22	0.209	0.226	0.228	0.231	0.241	0.229	0.228
4	0.268	0.256	0.257	0.246	0.276	0.266	0.263	0.307	0.291	0.301	0.275	0.294	0.286
5	0.319	0.319	0.335	0.305	0.343	0.344	0.319	0.362	0.391	0.369	0.344	0.317	0.353
6	0.399	0.406	0.41	0.404	0.452	0.429	0.465	0.487	0.493	0.428	0.448	0.397	0.375
7	0.453	0.502	0.501	0.533	0.573	0.52	0.592	0.657	0.643	0.468	0.441	0.463	0.388
+gp	0.625	0.678	0.7	0.582	0.755	0.62	0.686	0.643	0.81	0.677	0.617	0.521	0.586
SOPCOFAC	0.9998	1.0048	1.0091	1.0006	1.0066	1.0102	1.0119	1.0061	1.0092	1.0209	1.0154	1.0029	1.0011

(*) In 2007 and 2008, 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

	Age							
Year	**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

	Age							
Year	**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	11.2	**46.4**	**23.5**	**23.4**	**14.8**	**6.4**	**3.5**	3.2
2006	6223	8.6	**61.4**	**31.0**	**14.4**	**5.8**	**3.3**	**2.2**	3.9
2007	5954	1.1	**32.2**	**26.4**	**18.3**	**15.4**	**9.9**	**6.0**	7.8
2008	4321	0.0	**22.0**	**23.2**	**16.5**	**8.4**	**7.0**	**5.0**	5.8

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	2.5	**18.2**	**10.5**	**8.5**	**5.0**	**2.2**	**1.2**	1.3
2006	2304	1.6	**10.5**	**7.8**	**5.6**	**2.3**	**1.1**	**0.6**	1.2
2007	2553	0.4	**14.3**	**19.9**	**3.6**	**2.3**	**1.5**	**0.6**	1.0
2008	1887	0.3	**10.9**	**14.4**	**5.9**	**2.1**	**1.5**	**1.1**	1.0

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

Table 6.8

```
Lowestoft VPA Version 3.1

  21/04/2009  19:50

Extended Survivors Analysis

SOLE VIIIa,b

CPUE data from file tunfilt.dat

Catch data for  25 years. 1984 to 2008. Ages  2 to   8.

     Fleet,            First, Last, First, Last, Alpha,  Beta
                   ,    year, year,  age ,  age
FR-SABLES           ,   1991, 2008,   2,     7,   .000,  1.000
FR-ROCHELLE         ,   1991, 2008,   2,     7,   .000,  1.000
FR-RESSGASC-2       ,   1987, 2008,   2,     7,   .270,   .500
FR-RESSGASC-4       ,   1987, 2008,   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 =     .00019

Final year F values
Age         ,      2,      3,      4,      5,      6,      7
Iteration 29,  .1696,  .3416,  .3394,  .3490,  .4726,  .4568
Iteration 30,  .1696,  .3416,  .3394,  .3490,  .4726,  .4567


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,  1999,  2000,  2001,  2002,  2003,  2004,  2005,  2006,  2007,  2008

     2,  .131,  .271,  .210,  .251,  .201,  .200,  .259,  .174,  .199,  .170
     3,  .391,  .477,  .495,  .528,  .483,  .379,  .283,  .392,  .368,  .342
     4,  .632,  .760,  .645,  .782,  .449,  .444,  .416,  .490,  .408,  .339
     5,  .708,  .710,  .584,  .987,  .392,  .297,  .538,  .372,  .378,  .349
     6,  .679,  .500,  .541,  .946,  .578,  .338,  .482,  .434,  .356,  .473
     7,  .515,  .421,  .498,  .741,  .735,  .389,  .396,  .606,  .489,  .457
```

Table 6.8 (Cont'd)
1
XSA population numbers (Thousands)

YEAR	AGE 2	3	4	5	6	7
1999	2.45E+04	1.66E+04	1.09E+04	5.72E+03	2.80E+03	2.36E+03
2000	2.52E+04	1.95E+04	1.02E+04	5.26E+03	2.55E+03	1.29E+03
2001	1.67E+04	1.74E+04	1.09E+04	4.29E+03	2.34E+03	1.40E+03
2002	2.46E+04	1.22E+04	9.59E+03	5.19E+03	2.17E+03	1.23E+03
2003	2.43E+04	1.73E+04	6.53E+03	3.97E+03	1.75E+03	7.61E+02
2004	1.97E+04	1.80E+04	9.68E+03	3.77E+03	2.43E+03	8.88E+02
2005	1.89E+04	1.46E+04	1.11E+04	5.62E+03	2.53E+03	1.57E+03
2006	2.25E+04	1.32E+04	9.96E+03	6.64E+03	2.97E+03	1.42E+03
2007	2.31E+04	1.71E+04	8.08E+03	5.52E+03	4.14E+03	1.74E+03
2008	2.13E+04	1.71E+04	1.07E+04	4.86E+03	3.43E+03	2.63E+03

Estimated population abundance at 1st Jan 2009

, 0.00E+00, 1.62E+04, 1.10E+04, 6.90E+03, 3.10E+03, 1.93E+03,

Taper weighted geometric mean of the VPA populations:

, 2.50E+04, 1.83E+04, 1.12E+04, 6.00E+03, 3.19E+03, 1.65E+03,

Standard error of the weighted Log(VPA populations) :

, .1781, .2062, .2307, .2272, .2326, .3344,
1

Log catchability residuals.

Fleet : FR-SABLES

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	99.99	99.99	-.20	-.11	-.36	-.38	-.06	-.18	-.09	-.01
3	99.99	99.99	.17	-.12	.22	-.05	-.11	.03	.26	.06
4	99.99	99.99	.17	-.24	-.05	.40	.17	.05	.04	.47
5	99.99	99.99	.14	-.11	-.06	.27	.03	-.09	-.20	.18
6	99.99	99.99	-.08	.22	-.35	.06	-.22	.24	-.02	-.38
7	99.99	99.99	.21	.00	-.25	.20	.05	.46	-.08	.04

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2	-.15	.22	-.06	.26	-.08	.17	.48	.60	-.02	-.01
3	-.35	.46	.17	.33	.10	-.22	-.45	.03	-.35	-.17
4	-.19	.17	.00	.15	-.24	-.10	-.18	-.47	-.02	-.11
5	.31	-.04	-.31	.39	-.17	-.41	.30	-.82	.38	.21
6	.42	-.04	-.26	.39	.06	-.34	.23	-.56	.21	.43
7	.53	.03	-.33	.09	.10	-.14	.07	-.15	.64	.35

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	-15.1030	-14.5892	-14.5230	-14.7282	-14.7219	-14.7219
S.E(Log q)	.2589	.2511	.2326	.3158	.3009	.2829

Regression statistics :

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

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	2.40	-1.922	22.13	.11	18	.58	-15.10
3	.84	.682	13.84	.54	18	.21	-14.59
4	.73	1.783	13.13	.73	18	.16	-14.52
5	.87	.485	13.96	.48	18	.28	-14.73
6	1.15	-.457	15.74	.36	18	.36	-14.72
7	.68	2.969	12.30	.84	18	.15	-14.62

Table 6.8 (Cont'd)

Fleet : FR-ROCHELLE

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	99.99	99.99	-.09	-.18	-.46	-.40	-.05	.32	-.06	.19
3	99.99	99.99	.26	.03	.06	-.15	-.04	.12	.18	-.03
4	99.99	99.99	.48	.16	-.18	.32	.33	-.12	-.05	.50
5	99.99	99.99	.50	.21	-.05	.22	.23	-.34	-.33	.02
6	99.99	99.99	.21	.37	-.23	.13	-.34	-.13	-.02	-.53
7	99.99	99.99	.27	.22	-.02	-.01	-.08	-.13	-.19	-.05

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2	-.03	.17	-.32	.72	.16	.21	.14	-.27	-.08	.02
3	-.42	-.18	-.07	.26	.32	-.01	-.52	-.30	.26	.23
4	-.21	-.07	.18	-.32	-.01	-.16	-.21	-.12	-.50	-.01
5	.19	-.16	.10	-.04	-.08	-.41	.36	-.30	-.22	.11
6	.50	-.35	.26	.03	.16	-.24	.37	-.14	-.30	.24
7	.21	-.36	.12	-.14	-.22	-.06	.21	.07	-.29	.19

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	-15.0081	-14.6371	-14.8222	-15.1825	-15.2458	-15.2458
S.E(Log q)	.2850	.2434	.2744	.2604	.2969	.1892

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	1.04	-.100	15.20	.30	18	.30	-15.01
3	.81	.893	13.72	.58	18	.20	-14.64
4	.67	2.030	13.04	.71	18	.17	-14.82
5	.81	.942	13.97	.61	18	.21	-15.18
6	1.66	-1.465	19.98	.24	18	.48	-15.25
7	.79	2.136	13.60	.87	18	.14	-15.26

1

Fleet : FR-RESSGASC-2

Age	1987	1988
2	-.53	1.06
3	-.79	.24
4	-.75	-.16
5	-.84	-.05
6	-.14	-.07
7	-.67	-.48

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2	.31	.67	-.34	-1.21	-1.48	.10	-.12	.49	.04	.83
3	.08	-.44	-.19	-.69	-.59	-.22	-.24	1.03	.57	.68
4	-.49	-.34	.08	-.13	-.14	-.10	-.37	.75	.26	1.06
5	-.34	-.25	.05	-.17	.59	-.52	-.11	.19	-.20	.81
6	-.41	-1.46	.01	.21	.32	-.68	.13	.55	-.15	.33
7	.33	-.36	-.38	-1.06	1.01	-.24	.98	.09	.14	.74

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2	.19	-.14	.40	-.28	99.99	99.99	99.99	99.99	99.99	99.99
3	.35	-.15	.12	.23	99.99	99.99	99.99	99.99	99.99	99.99
4	.01	.42	.13	-.23	99.99	99.99	99.99	99.99	99.99	99.99
5	.11	.38	.18	.17	99.99	99.99	99.99	99.99	99.99	99.99
6	.72	-.06	.68	.01	99.99	99.99	99.99	99.99	99.99	99.99
7	-.39	-.05	.53	.10	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,	-9.4219,	-9.0650,	-9.0811,	-9.3590,	-9.5764,	-9.5764,
S.E(Log q),	.6824,	.5112,	.4561,	.4070,	.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,	5.50,	-.854,	6.04,	.00,	16,	3.79,	-9.42,
3,	-4.28,	-2.064,	13.48,	.01,	16,	1.98,	-9.07,
4,	.87,	.229,	9.13,	.18,	16,	.41,	-9.08,
5,	3.11,	-1.403,	10.59,	.03,	16,	1.23,	-9.36,
6,	2.75,	-.934,	12.16,	.02,	16,	1.49,	-9.58,
7,	2.87,	-1.036,	13.60,	.02,	16,	1.69,	-9.56,

1

Fleet : FR-RESSGASC-4

Age ,	1987,	1988
2 ,	-.38,	-.48
3 ,	-.48,	-.74
4 ,	-.47,	-1.24
5 ,	-.33,	-1.02
6 ,	-.18,	-.22
7 ,	.13,	.30

Age ,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	1996,	1997,	1998
2 ,	-.65,	.32,	.46,	.91,	-.17,	.23,	.70,	.55,	-.23,	.58
3 ,	-.59,	.08,	.36,	.05,	-.09,	.31,	.12,	.26,	.35,	.91
4 ,	-.53,	.01,	-.04,	-.46,	-.14,	.27,	.26,	.02,	.39,	1.12
5 ,	.04,	.41,	-.56,	-.42,	.15,	-.02,	.30,	-.23,	.14,	.18
6 ,	.72,	-.41,	-.50,	-.03,	.48,	-.75,	-.37,	-.37,	.39,	-.01
7 ,	.48,	.69,	-.64,	-.46,	-.95,	-.25,	-.32,	.48,	.80,	.35

Age ,	1999,	2000,	2001,	2002,	2003,	2004,	2005,	2006,	2007,	2008
2 ,	-.33,	-1.09,	-.15,	-.28,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
3 ,	-.26,	-.70,	.01,	.42,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
4 ,	.28,	.19,	.34,	.00,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
5 ,	-.19,	.43,	.43,	.70,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
6 ,	.34,	-.37,	.15,	1.14,	99.99,	99.99,	99.99,	99.99,	99.99,	99.99
7 ,	-.18,	-.32,	-.98,	.24,	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,	-9.0185,	-8.8853,	-9.0547,	-9.2950,	-9.5460,	-9.5460,
S.E(Log q),	.5533,	.4579,	.5196,	.4412,	.5045,	.5564,

Table 6.8 (Cont'd)

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,	1.433,	9.61,	.36,	16,	.26,	-9.02,
3,	1.12,	-.172,	8.77,	.13,	16,	.53,	-8.89,
4,	.94,	.086,	9.08,	.12,	16,	.50,	-9.05,
5,	2.31,	-1.051,	9.97,	.04,	16,	1.01,	-9.30,
6,	5.20,	-1.302,	15.59,	.01,	16,	2.56,	-9.55,
7,	.74,	.579,	9.02,	.26,	16,	.42,	-9.58,

1

Terminal year survivor and F summaries :

Age 2 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 ,	16074.,	.266,	.000,	.00,	1,	.537,	.171
FR-ROCHELLE ,	16586.,	.293,	.000,	.00,	1,	.443,	.166
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	13043.,	1.50,,,,				.020,	.207

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
16231.,	.20,	.02,	3,	.127,	.170

Age 3 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 ,	9906.,	.186,	.077,	.41,	2,	.504,	.373
FR-ROCHELLE ,	12320.,	.191,	.147,	.77,	2,	.484,	.310
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	9625.,	1.50,,,,				.012,	.382

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
11005.,	.13,	.08,	5,	.600,	.342

Age 4 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 ,	6768.,	.150,	.247,	1.65,	3,	.538,	.345
FR-ROCHELLE ,	7108.,	.162,	.142,	.88,	3,	.453,	.331
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	5003.,	1.50,,,,				.009,	.443

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
6900.,	.11,	.12,	7,	1.086,	.339

Age 5 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 ,	3548.,	.143,	.099,	.69,	4,	.490,	.311
FR-ROCHELLE ,	2733.,	.146,	.155,	1.06,	4,	.501,	.388
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	2665.,	1.50,,,,				.009,	.396

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3105.,	.10,	.09,	9,	.897,	.349

1

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

Year class = 2002

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FR-SABLES ,	2056.,	.138,	.204,	1.48,	5,	.488,	.450
FR-ROCHELLE ,	1815.,	.139,	.136,	.98,	5,	.502,	.497
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	2119.,	1.50,,,,				.011,	.439

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1932.,	.10,	.11,	11,	1.128,	.473

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

Year class = 2001

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
FR-SABLES ,	1504.,	.134,	.173,	1.30,	6,	.415,	.457
FR-ROCHELLE ,	1502.,	.123,	.100,	.81,	6,	.577,	.457
FR-RESSGASC-2 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
FR-RESSGASC-4 ,	1.,	.000,	.000,	.00,	0,	.000,	.000
F shrinkage mean ,	1837.,	1.50,,,,				.008,	.388

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
1506.,	.09,	.09,	13,	.961,	.457

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	1997
AGE															
	2	0.3162	0.3868	0.2634	0.1759	0.2165	0.202	0.2642	0.1433	0.1475	0.0827	0.1093	0.1549	0.1137	0.1839
	3	0.2815	0.3869	0.2993	0.3657	0.4035	0.435	0.3819	0.3506	0.317	0.3507	0.3233	0.3252	0.35	0.5093
	4	0.414	0.3306	0.3609	0.3972	0.451	0.4343	0.5219	0.4579	0.4498	0.4937	0.7398	0.6679	0.5204	0.6557
	5	0.4172	0.5094	0.5141	0.4467	0.4238	0.6405	0.594	0.4411	0.5542	0.6295	0.7275	0.6955	0.4896	0.5574
	6	0.3849	0.2942	0.8341	0.6508	0.5636	0.7348	0.3658	0.4342	1.0721	0.5882	0.7357	0.5467	0.728	0.6351
	7	0.4066	0.3792	0.5719	1.0702	0.9107	0.8744	0.9079	0.7631	0.9337	0.7712	0.7513	0.7226	0.9464	0.659
+gp		0.4066	0.3792	0.5719	1.0702	0.9107	0.8744	0.9079	0.7631	0.9337	0.7712	0.7513	0.7226	0.9464	0.659
0 FBAR 3- 6		0.3744	0.3803	0.5021	0.4651	0.4605	0.5611	0.4659	0.421	0.5983	0.5155	0.6316	0.5588	0.522	0.5894

YEAR		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	FBAR **-**
AGE													
	2	0.2109	0.1305	0.2707	0.21	0.2507	0.2014	0.1997	0.2593	0.1742	0.1986	0.1696	0.1808
	3	0.3941	0.3914	0.4767	0.4945	0.5279	0.4829	0.3791	0.2831	0.3923	0.3679	0.3416	0.3673
	4	0.7205	0.632	0.7604	0.6452	0.7816	0.4491	0.4439	0.4164	0.4902	0.4077	0.3394	0.4124
	5	0.5779	0.7085	0.7102	0.584	0.9872	0.3921	0.2966	0.5382	0.3716	0.3776	0.349	0.3661
	6	0.405	0.6785	0.5003	0.541	0.946	0.5778	0.338	0.482	0.4336	0.3556	0.4726	0.4206
	7	0.6691	0.5147	0.4213	0.4979	0.741	0.7351	0.3887	0.3959	0.6057	0.4888	0.4567	0.517
+gp		0.6691	0.5147	0.4213	0.4979	0.741	0.7351	0.3887	0.3959	0.6057	0.4888	0.4567	
0 FBAR 3- 6		0.5244	0.6026	0.6119	0.5662	0.8107	0.4755	0.3644	0.4299	0.4219	0.3772	0.3756	
	1												

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	1997
AGE															
	2	22885	27832	27809	24733	26794	28273	32248	35923	35580	25137	26434	23797	29612	23792
	3	13557	15094	17104	19336	18771	19525	20904	22404	28165	27780	20940	21442	18442	23915
	4	8640	9257	9276	11474	12136	11346	11435	12911	14278	18560	17702	13714	14015	11760
	5	6269	5168	6018	5851	6979	6995	6649	6140	7390	8239	10251	7643	6363	7536
	6	3830	3737	2810	3257	3387	4133	3336	3322	3574	3842	3972	4481	3450	3529
	7	2769	2359	2520	1104	1537	1744	1794	2094	1947	1107	1930	1722	2347	1507
+gp		3702	2420	2965	1132	1337	893	1521	1919	1634	1375	1376	2002	2248	1899
0 TOTAL		61651	65866	68502	66886	70940	72908	77887	84712	92567	86040	82605	74802	76477	73937

YEAR		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	GMST 84-**	AMST 84-**
AGE															
	2	22647	24494	25167	16670	24615	24281	19723	18937	22490	23068	(21253)	0	25246	25647
	3	17912	16596	19451	17372	12227	17334	17963	14616	13221	17096	17113	(16231)	18461	18873
	4	13003	10928	10153	10927	9586	6526	9677	11125	9964	8081	10707	11005	11376	11669
	5	5523	5724	5256	4295	5186	3970	3768	5617	6638	5522	4864	6900	6081	6238
	6	3905	2804	2550	2337	2167	1749	2427	2534	2967	4142	3425	3105	3142	3222
	7	1692	2357	1287	1399	1231	761	888	1566	1416	1740	2627	1932	1615	1699
+gp		2545	2541	1352	1305	872	504	1083	1612	2488	2450	2590	2990		
0 TOTAL		67227	65444	65216	54305	55884	55124	55529	56007	59186	62099	62579	42162		

( ) age 2 replaced by GM 93-2006 = 23191
( ) age 3 replaced by GM e-(F06-07+M) = 17416

Table 6.11 : Bay of Biscay Sole, Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUIT: Age 2	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSE	FBAR 3- 6
1984	22885	12974	10648	4038	0.3792	0.3744
1985	27832	13751	11229	4251	0.3786	0.3803
1986	27809	14394	11894	4805	0.404	0.5021
1987	24733	15685	12555	5086	0.4051	0.4651
1988	26794	16206	13059	5382	0.4121	0.4605
1989	28273	16386	13059	5845	0.4476	0.5611
1990	32248	16867	13276	5916	0.4456	0.4659
1991	35923	18735	14410	5569	0.3865	0.421
1992	35580	20542	15959	6550	0.4104	0.5983
1993	25137	20130	16572	6420	0.3874	0.5155
1994	26434	19569	16099	7229	0.449	0.6316
1995	23797	17991	14548	6205	0.4265	0.5588
1996	29612	18101	14147	5854	0.4138	0.522
1997	23792	16885	13713	6259	0.4564	0.5894
1998	22647	16866	13641	6027	0.4418	0.5244
1999	24494	16272	12625	5249	0.4157	0.6026
2000	25167	15846	12151	5760	0.474	0.6119
2001	16670	13296	10824	4836	0.4468	0.5662
2002	24615	13275	9903	5486	0.554	0.8107
2003	24281	13404	9706	4108	0.4232	0.4755
2004	19723	14777	11448	4002	0.3496	0.3644
2005	18937	15323	12190	4539	0.3724	0.4299
2006	22490	16107	12486	4793	0.3839	0.4219
2007	23068	16750	13069	4363	0.3338	0.3772
2008	(21253)	17237	13750	4300	0.3127	0.3756
Arith. Mean	25368	16295	12918	5315	0.4124	0.5043
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

1

GM 93-2006 = 23191

Table 6.12 Multifleet prediction input data

Sole in Bay of Biscay
Multi fleet input data

MFDP version 1a
Run: BBsole-WG09
Time and date: 13:33 08/05/2009
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input Fs are 2006-2007 means at age 2
Input Fs are 2006-2008 means at age 3 to 8
Catch and stock wts are 2006-2008 means
Recruits are 1993-2006 GM

2009

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	23191	0.1	0.32	0	0	0.189	0.1864	0.178
3	17416	0.1	0.83	0	0	0.241	0.3673	0.228
4	11005	0.1	0.97	0	0	0.297	0.4124	0.280
5	6900	0.1	1	0	0	0.352	0.3661	0.332
6	3105	0.1	1	0	0	0.423	0.4206	0.398
7	1932	0.1	1	0	0	0.449	0.5171	0.422
8	2990	0.1	1	0	0	0.599	0.5171	0.562

2010

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	23191	0.1	0.32	0	0	0.189	0.1864	0.178
3		0.1	0.83	0	0	0.241	0.3673	0.228
4		0.1	0.97	0	0	0.297	0.4124	0.280
5		0.1	1	0	0	0.352	0.3661	0.332
6		0.1	1	0	0	0.423	0.4206	0.398
7		0.1	1	0	0	0.449	0.5171	0.422
8		0.1	1	0	0	0.599	0.5171	0.562

2011

Age	N	M	Mat	PF	PM	Stock Wt	F Landings	Landing WT
2	23191	0.1	0.32	0	0	0.189	0.1864	0.178
3		0.1	0.83	0	0	0.241	0.3673	0.228
4		0.1	0.97	0	0	0.297	0.4124	0.280
5		0.1	1	0	0	0.352	0.3661	0.332
6		0.1	1	0	0	0.423	0.4206	0.398
7		0.1	1	0	0	0.449	0.5171	0.422
8		0.1	1	0	0	0.599	0.5171	0.562

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

MFDP version 1a
Run: BBsole-WG09
Time and date: 13:33 08/05/2009
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Basis
F(2009) = Fsq = mean F(06-–08) = 0.39
R09–10 = GM(93–06) = 23.2 million

2009

Biomass	SSB	Landings FMult	Landings FBar	Yield
18258	14465	1.0000	0.3916	4867

2010

Biomass	SSB	Landings FMult	Landings FBar	Landing Yield	2011 Biomass	SSB
18402	14610	0.0000	0.0000	0	24330	20349
.	14610	0.1000	0.0392	578	23641	19681
.	14610	0.2000	0.0783	1134	22978	19038
.	14610	0.3000	0.1175	1669	22340	18420
.	14610	0.4000	0.1566	2185	21726	17825
.	14610	0.5000	0.1958	2681	21135	17253
.	14610	0.6000	0.2350	3159	20565	16702
.	14610	0.7000	0.2741	3620	20017	16173
.	14610	0.8000	0.3133	4063	19490	15663
.	14610	0.9000	0.3524	4490	18981	15172
.	14610	1.0000	0.3916	4902	18492	14700
.	14610	1.1000	0.4308	5298	18021	14245
.	14610	1.2000	0.4699	5680	17567	13807
.	14610	1.3000	0.5091	6049	17129	13386
.	14610	1.4000	0.5482	6403	16708	12980
.	14610	1.5000	0.5874	6746	16302	12589
.	14610	1.6000	0.6265	7075	15910	12213
.	14610	1.7000	0.6657	7393	15533	11850
.	14610	1.8000	0.7049	7700	15170	11501
.	14610	1.9000	0.7440	7995	14819	11165
.	14610	2.0000	0.7832	8280	14482	10841

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-WG09
Time and date: 13:33 08/05/2009
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Year: 2009 F multiplier: 1 Fleet1 HCFba 0.3916

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1864	3759	669	23191	4383	7421	1403	7421	1403
3	0.3673	5110	1167	17416	4203	14455	3489	14455	3489
4	0.4124	3551	993	11005	3268	10675	3170	10675	3170
5	0.3661	2019	670	6900	2431	6900	2431	6900	2431
6	0.4206	1018	405	3105	1314	3105	1314	3105	1314
7	0.5171	745	315	1932	868	1932	868	1932	868
8	0.5171	1154	648	2990	1790	2990	1790	2990	1790
Total		17356	4867	66539	18258	47478	14465	47478	14465

Year: 2010 F multiplier: 1 Fleet1 HCFba 0.3916

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1864	3759	669	23191	4383	7421	1403	7421	1403
3	0.3673	5110	1167	17416	4203	14455	3488	14455	3488
4	0.4124	3522	985	10915	3242	10587	3144	10587	3144
5	0.3661	1929	640	6592	2323	6592	2323	6592	2323
6	0.4206	1420	565	4330	1833	4330	1833	4330	1833
7	0.5171	712	300	1845	829	1845	829	1845	829
8	0.5171	1025	576	2656	1590	2656	1590	2656	1590
Total		17476	4902	66944	18402	47886	14610	47886	14610

Year: 2011 F multiplier: 1 Fleet1 HCFba 0.3916

Age	Landings F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
2	0.1864	3759	669	23191	4383	7421	1403	7421	1403
3	0.3673	5110	1167	17416	4203	14455	3488	14455	3488
4	0.4124	3522	985	10915	3242	10587	3144	10587	3144
5	0.3661	1913	635	6538	2304	6538	2304	6538	2304
6	0.4206	1356	540	4136	1751	4136	1751	4136	1751
7	0.5171	993	419	2572	1156	2572	1156	2572	1156
8	0.5171	937	527	2428	1454	2428	1454	2428	1454
Total		17590	4941	67197	18492	48139	14700	48139	14700

Input units are thousands and kg - output in tonnes

Table 6.15 Sole in VIIIa,b

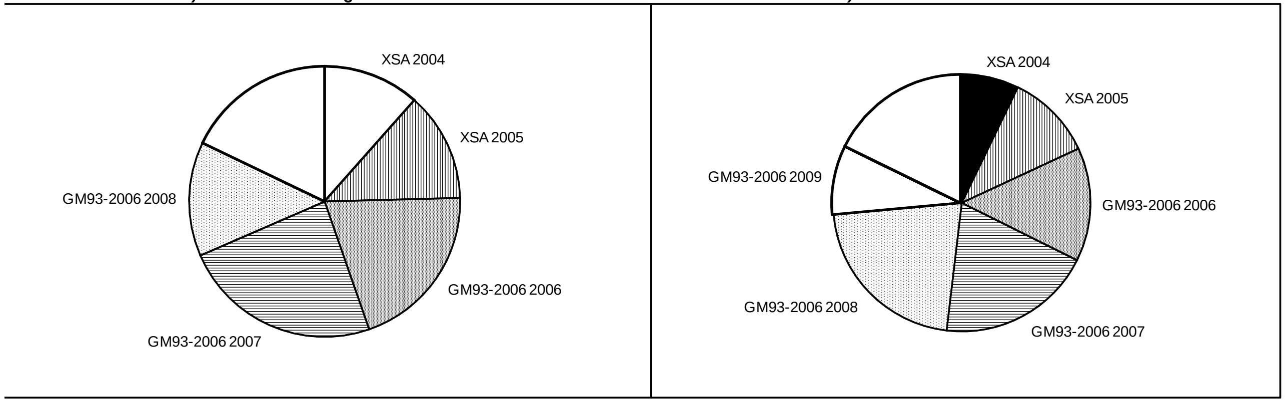
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class		2004	2005	2006	2007	2008	2009
Stock No. (thousands) of 2 year-olds		22490	23068	23191	23191	23191	23191
Source		XSA	XSA	GM93-2006	GM93-2006	GM93-2006	GM93-2006
Status Quo F:							
% in 2009	landings	13.8	20.4	24.0	13.7	-	-
% in 2010		11.5	13.1	20.1	23.8	13.6	-
% in 2009	SSB	16.8	21.9	24.1	9.7	-	-
% in 2010	SSB	12.5	15.9	21.5	23.9	9.6	-
% in 2011	SSB	7.9	11.9	15.7	21.4	23.7	9.5

GM : geometric mean recruitment

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

a) 2010 landings b) 2011 SSB



XSA	XSA	GM93-2006	GM93-2006	GM93-2006	GM93-2006
2004	2005	2006	2007	2008	2009

Table 6.16 : Bay of Biscay Sole Multifleet Yield per recruit

MFYPR version 2a
Run: BBsole-WG09
Time and date: 13:42 08/05/2009
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	4.9204	9.6499	4.7475	9.6499	4.7475
0.1000	0.0392	0.2974	0.1293	7.5383	3.2076	6.6841	3.0358	6.6841	3.0358
0.2000	0.0783	0.4466	0.1809	6.0497	2.3752	5.1995	2.2044	5.1995	2.2044
0.3000	0.1175	0.5373	0.2042	5.1450	1.8867	4.2988	1.7169	4.2988	1.7169
0.4000	0.1566	0.5990	0.2150	4.5314	1.5672	3.6889	1.3984	3.6889	1.3984
0.5000	0.1958	0.6440	0.2196	4.0844	1.3431	3.2457	1.1752	3.2457	1.1752
0.6000	0.2350	0.6785	0.2210	3.7424	1.1778	2.9073	1.0109	2.9073	1.0109
0.7000	0.2741	0.7059	0.2207	3.4710	1.0513	2.6394	0.8853	2.6394	0.8853
0.8000	0.3133	0.7283	0.2195	3.2497	0.9517	2.4214	0.7865	2.4214	0.7865
0.9000	0.3524	0.7470	0.2178	3.0652	0.8713	2.2402	0.7069	2.2402	0.7069
1.0000	0.3916	0.7629	0.2159	2.9087	0.8052	2.0869	0.6417	2.0869	0.6417
1.1000	0.4308	0.7766	0.2140	2.7741	0.7500	1.9554	0.5873	1.9554	0.5873
1.2000	0.4699	0.7885	0.2120	2.6569	0.7032	1.8412	0.5413	1.8412	0.5413
1.3000	0.5091	0.7991	0.2102	2.5538	0.6632	1.7411	0.5020	1.7411	0.5020
1.4000	0.5482	0.8084	0.2085	2.4624	0.6285	1.6526	0.4680	1.6526	0.4680
1.5000	0.5874	0.8168	0.2068	2.3808	0.5982	1.5738	0.4384	1.5738	0.4384
1.6000	0.6265	0.8244	0.2053	2.3073	0.5715	1.5030	0.4124	1.5030	0.4124
1.7000	0.6657	0.8312	0.2038	2.2409	0.5479	1.4392	0.3895	1.4392	0.3895
1.8000	0.7049	0.8375	0.2025	2.1805	0.5267	1.3814	0.3690	1.3814	0.3690
1.9000	0.7440	0.8432	0.2012	2.1253	0.5078	1.3287	0.3507	1.3287	0.3507
2.0000	0.7832	0.8485	0.2001	2.0746	0.4907	1.2806	0.3342	1.2806	0.3342

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.3916
FMax	0.6238	0.2443
F0.1	0.2601	0.1019
F35%SPR	0.3148	0.1233

Weights in kilograms

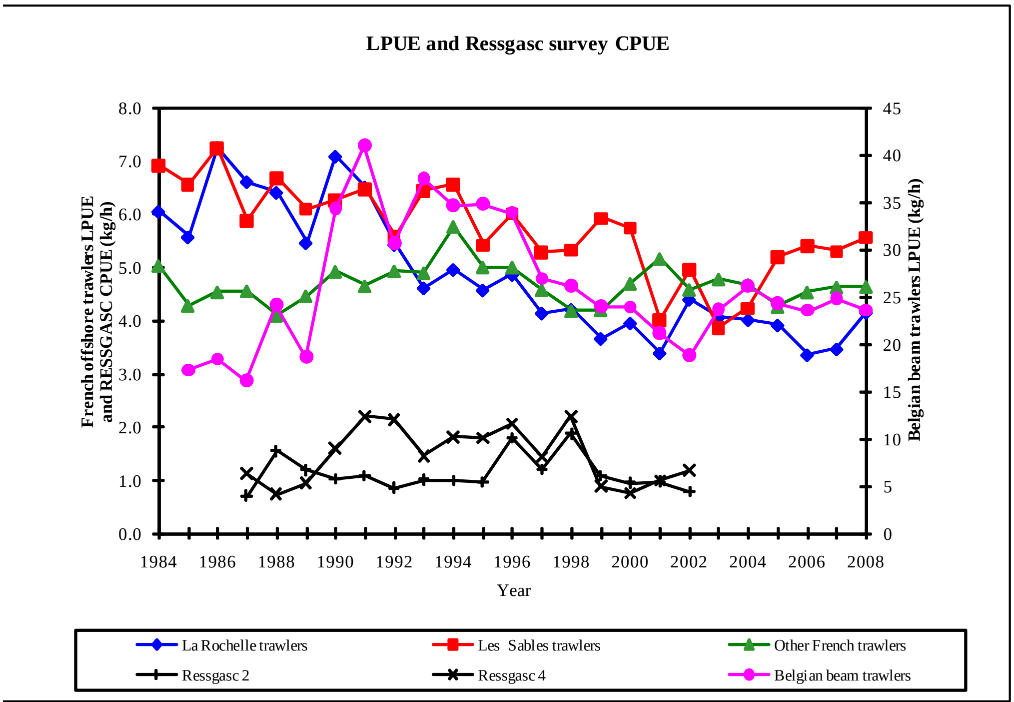


Figure 6.1 : Bay of Biscay sole (Division VIIIa,b)

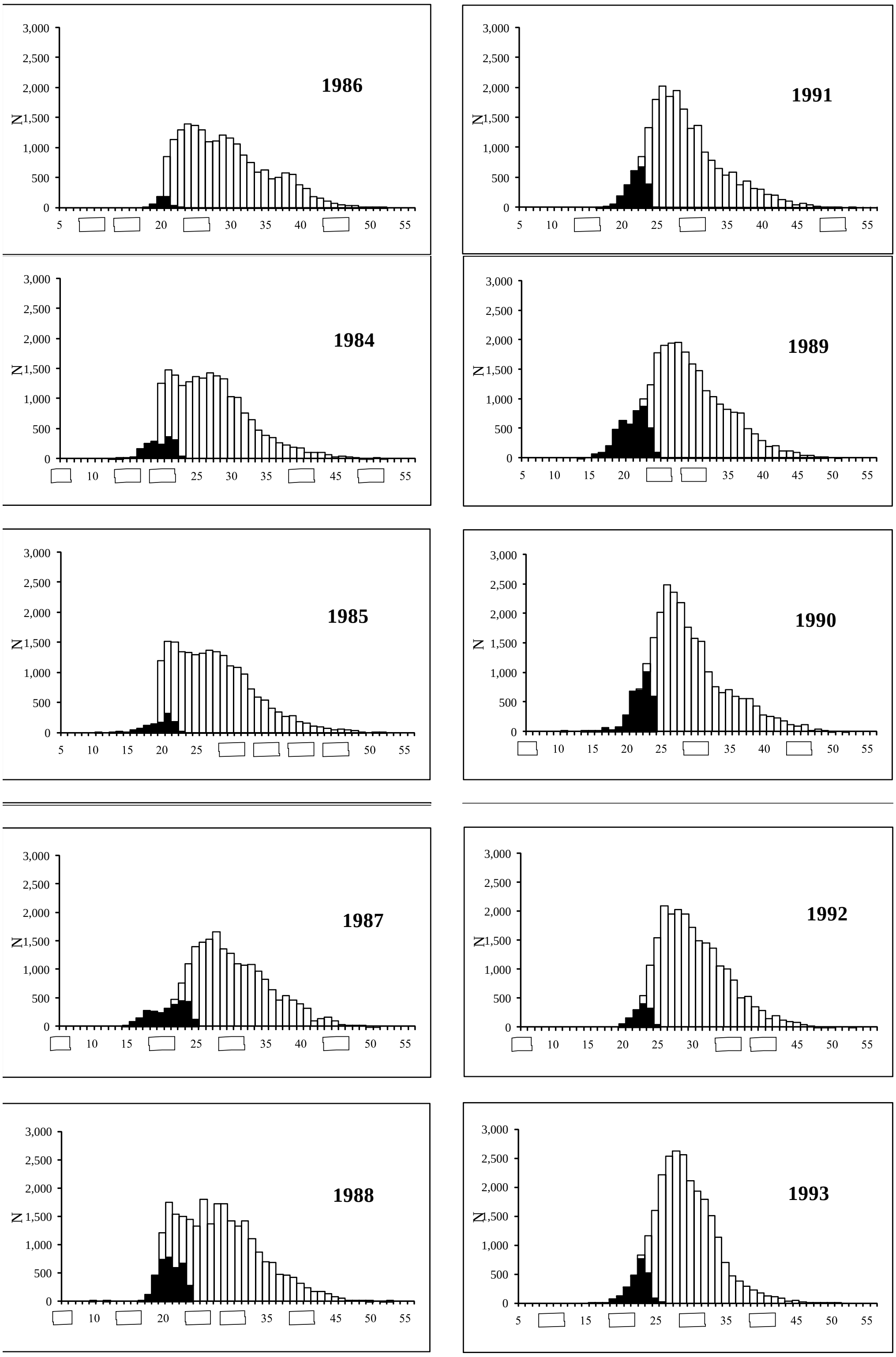
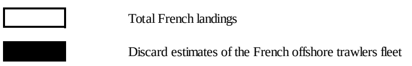


Figure 6.2 a : Bay of Biscay sole French length distribution from 1984 to 1993



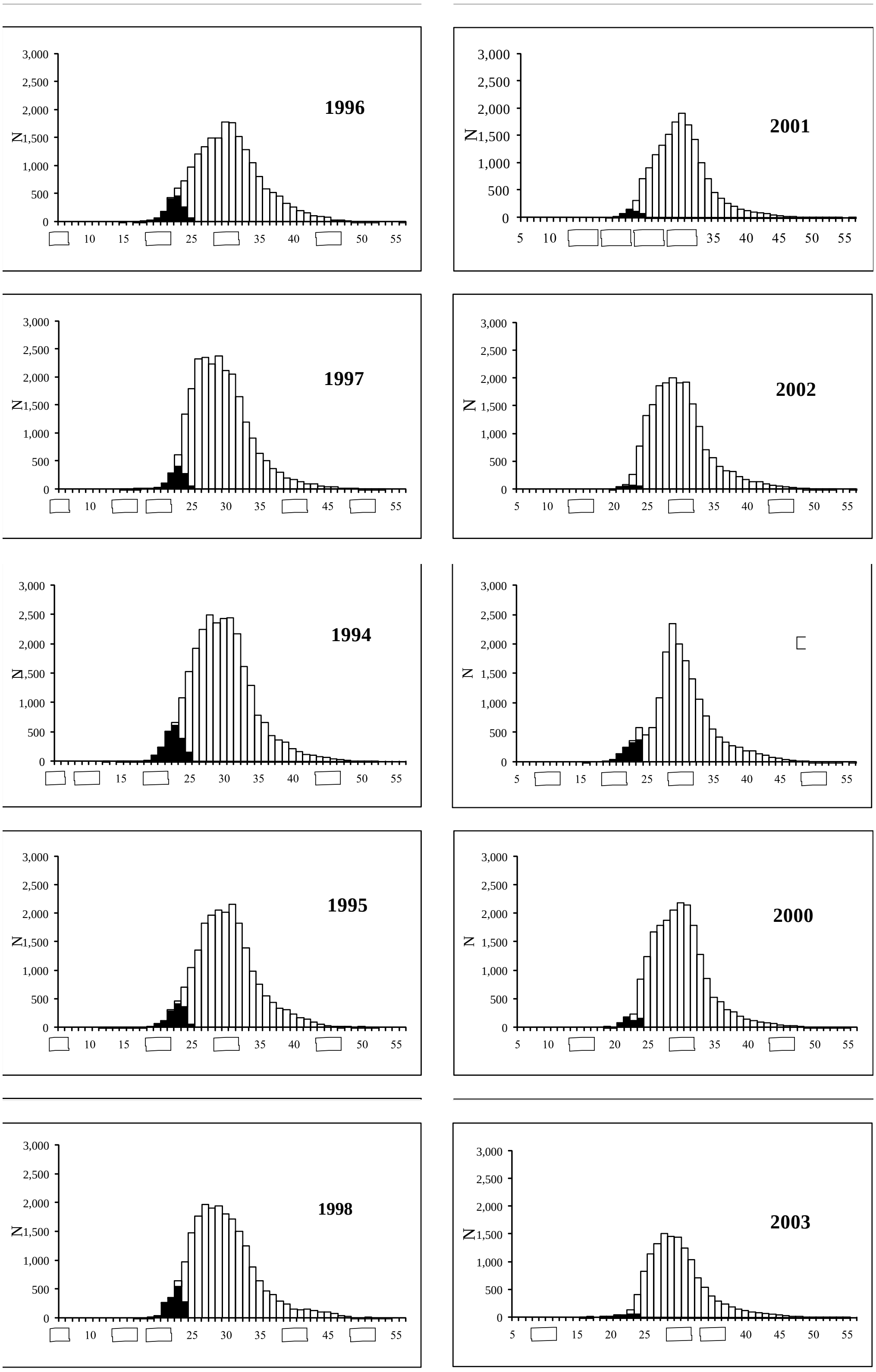


Figure 6.2 b : Bay of Biscay sole French length distribution from 1994 to 2003

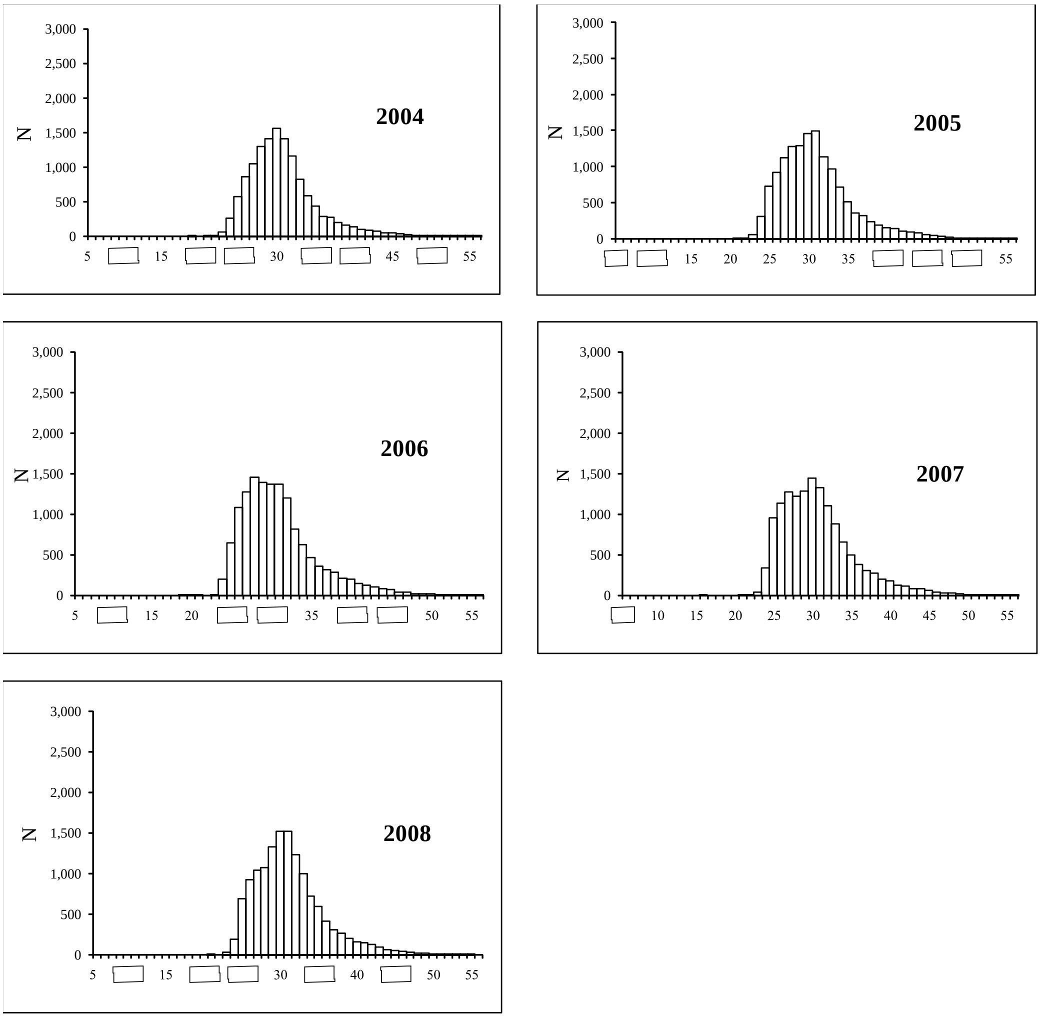


Figure 6.2 c : **Bay of Biscay sole French length distribution from 2004 to 2008**

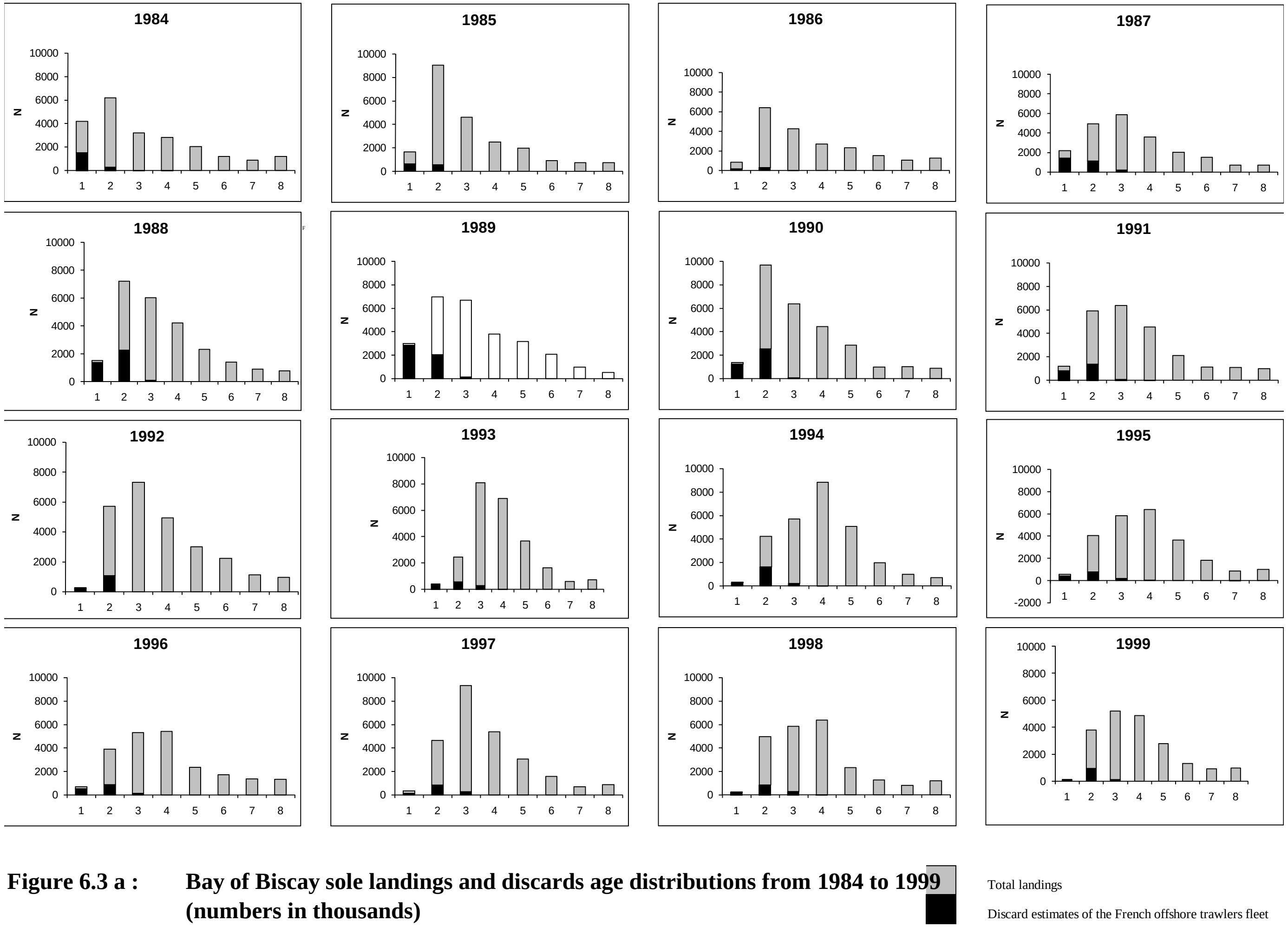


Figure 6.3 a : Bay of Biscay sole landings and discards age distributions from 1984 to 1999 (numbers in thousands)

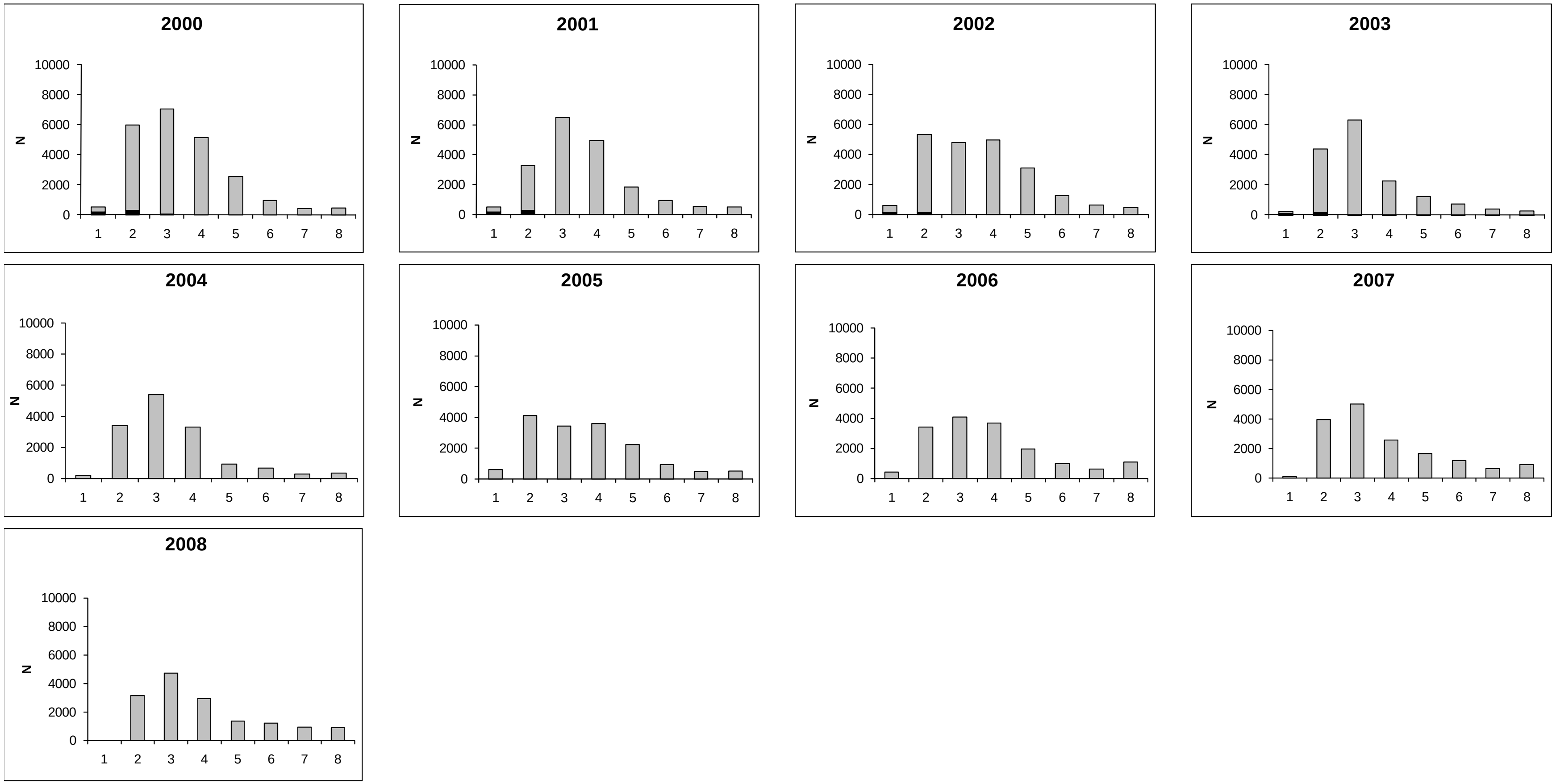


Figure 6.3 b : **Bay of Biscay sole landings and discards age distributions from 2000 to 2004 ; landings age distribtion since 2004 (numbers in thousands)**

Total landings

Discard estimates of the French offshore trawlers fleet

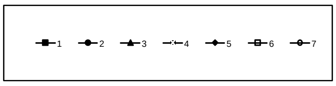
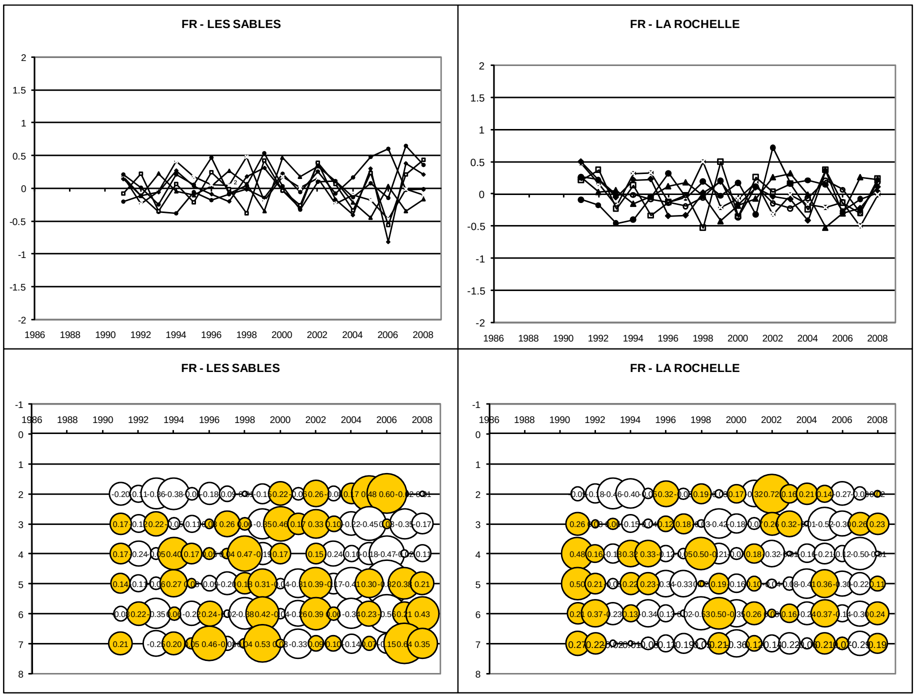


Figure 6.4 a : Bay of Biscay sole (Division VIIIa,b) - XSA (No Taper, mean q, s.e. shrink = 1.5, s.e. min =

LOG CATCHABILITY RESIDUAL PLOTS (XSA)



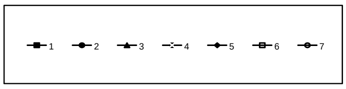
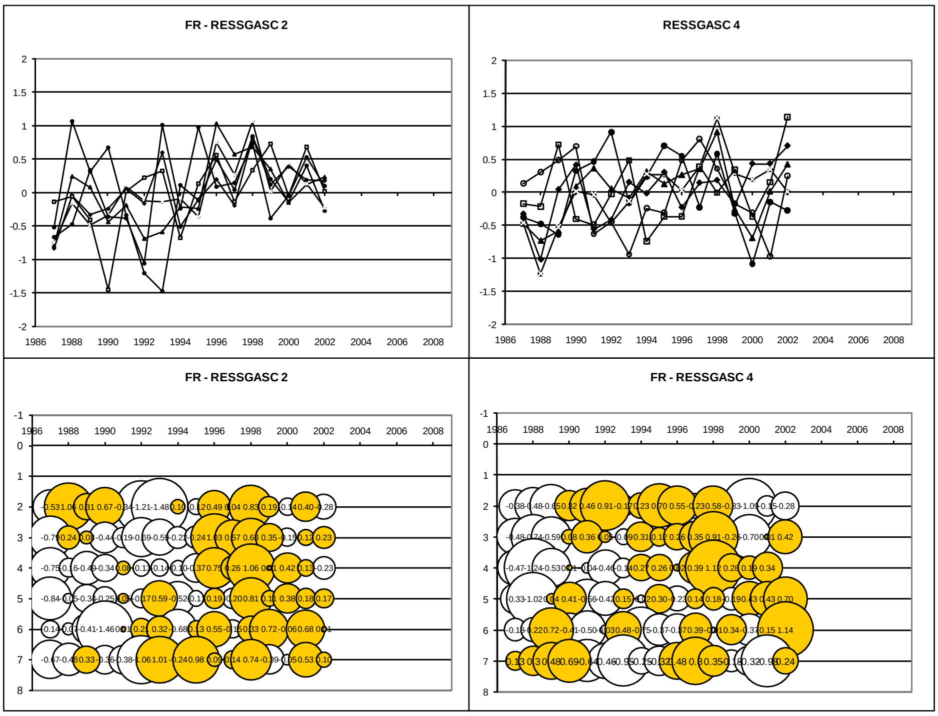


Figure 6.4 b : Bay of Biscay sole (Division VIIIa,b) - XSA (No Taper, mean q, s.e. shrink = 1.5, s.e. min

LOG CATCHABILITY RESIDUAL PLOTS (XSA)



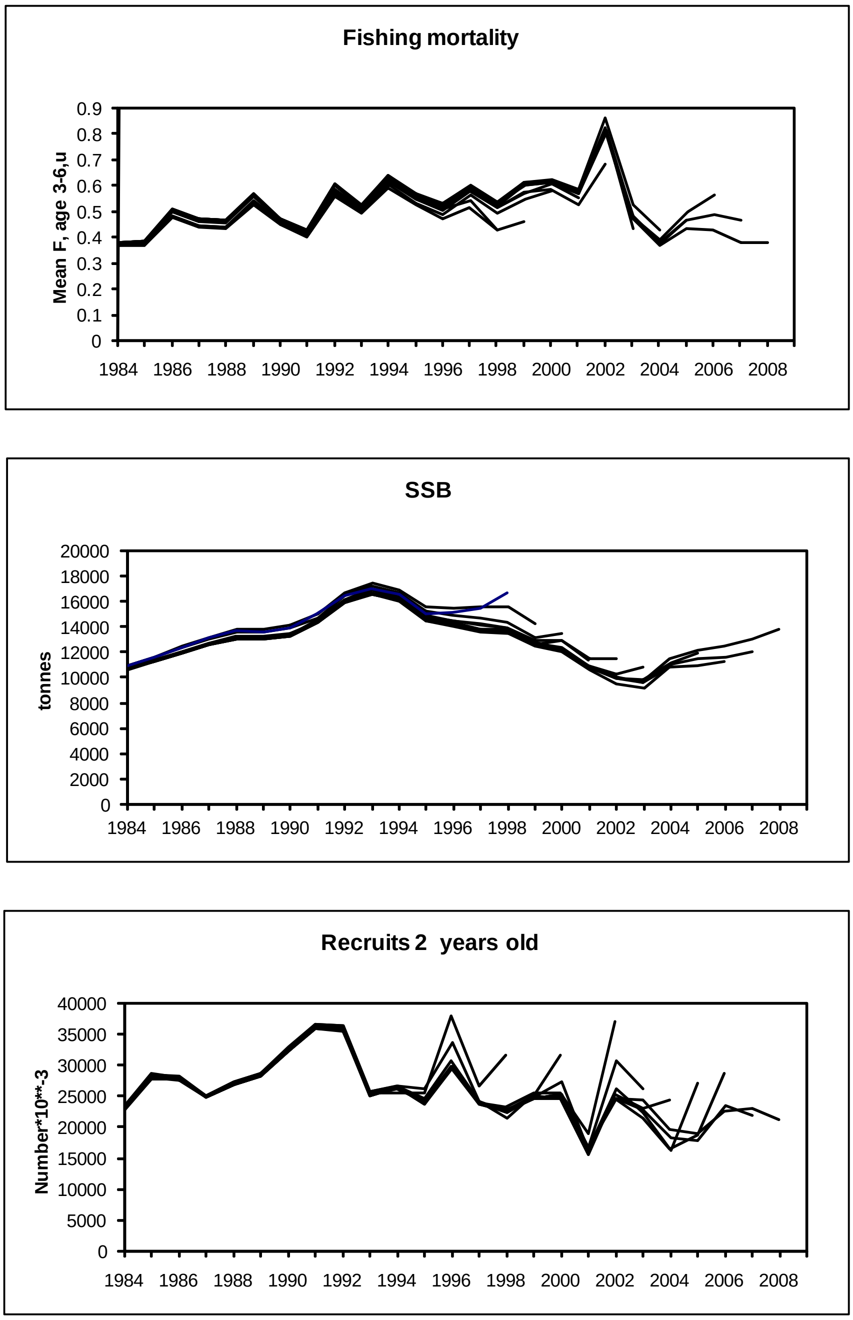


Figure 6.5 : Bay of Biscay sole (Division VIIIa,b) - Retrospective results
(No taper, q indep. stock size all ages, q indep. of age>=6, shr.=1.5)

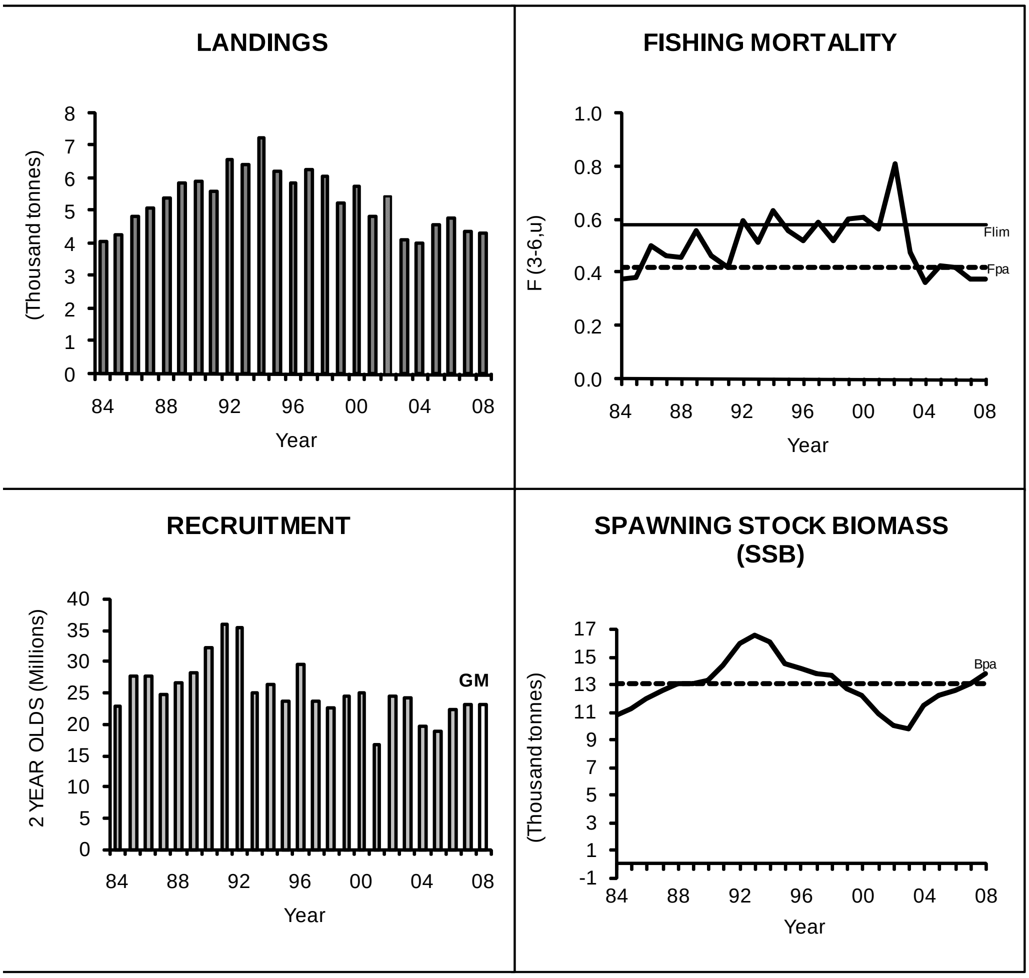
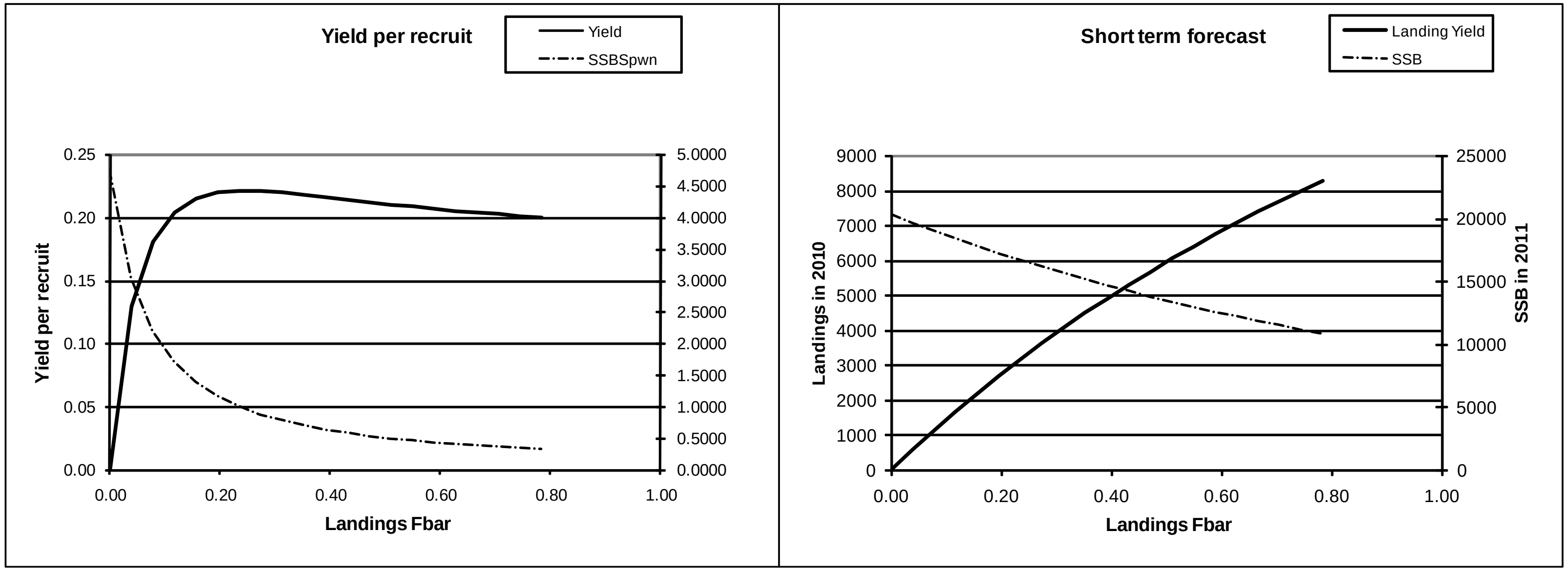


Figure 6.6 Sole in Division VIIIa,b (Bay of Biscay)



MFYPR version 2a
Run: BBsole-WG09
Time and date: 13:42 08/05/2009

Reference point	F multiplier	Absolute F
Fleet1 Landings Fbar(3-6)	1.0000	0.3916
FMax	0.6238	0.2443
F0.1	0.2601	0.1019
F35%SPR	0.3148	0.1233

Weights in kilograms

MFDP version 1a
Run: BBsole-WG09
Time and date: 13:33 08/05/2009
Fbar age range (Total) : 3-6
Fbar age range Fleet 1 : 3-6

Input units are thousands and kg - output in tonnes

Figure 6.7 : Bay of Biscay sole

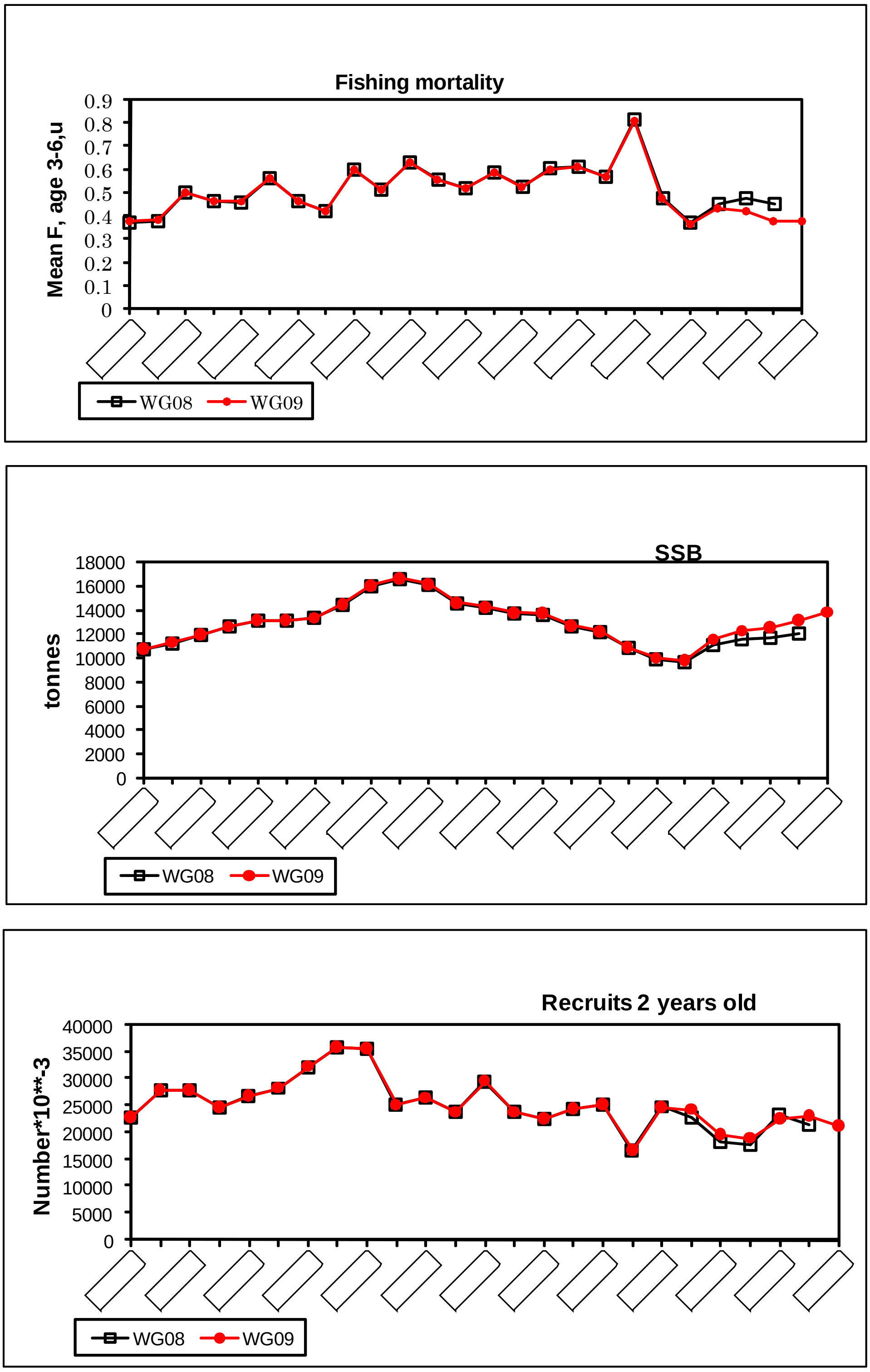


Figure 6.8 : Bay of Biscay sole (Division VIIIa,b) - WG09 / WG08 comparison

7 Southern Stock of Hake

7.1 General

Type of assessment is "update".

Data revisions this year: Discards data series from Portugal were reviewed. Assessment do not use discards.

Review group issues:

The model performance expressed as a retrospective analysis should be conducted by the WG.

The review group asked that a plot with survey result indices is to be included in the next WGHMM report, in order to assess the single indices.

Axis values in some figures are unreadable (i.e. Figure 7.3)

The 3 issues were addressed and solved.

7.1.1 Fishery description

Moved to South hake annex G

7.1.2 ICES advice and Management applicable to 2008 and 2009

ICES Advice for 2009

Zero catches or a recovery plan.

Management Applicable to 2008 and 2009

Hake is managed by TAC, effort control and technical measures. The agreed TAC for Southern Hake, including Cadiz, in 2008 was 7 047 t and in 2009 was 8 104t. Landings in 2008 including Cadiz were estimated to be 16 740 t, more than 2 times above the TAC for Southern Stock.

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, i.e. 35 000 t of spawning stock biomass, driving fishing mortality towards 0.27. This regulation also includes effort management in addition to TAC measures. Recovery Plan has not been evaluated by ICES.

Since 2006 an annual reduction of 10% fishing days at sea was applied to all fleets except in Gulf of Cádiz area, that has particular regulations. See Annex M - Cádiz Hake for details.

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 due to an observed duplication of effort data (WD 9). The number of trips provided for OTB_DEF included also the number of trips performed by the OTB_CRU. For that reason, previous OTB_DEF discards estimates for the 2004-2007 periods were overestimated. Discards are not used in the assessment model.

7.2.1 Commercial Catch and discards

Landings

Total landings from the Southern Hake Stock (with and without the Gulf of Cadiz) by country and gear for the period 1972-2008, as estimated by the WG, are given in Table 7.1.

In 2008, the total landings estimates, including the Gulf of Cadiz were 16 740, following the continued increasing trend since 2002 (6 720t) when the historical minimum was achieved. 2008 landings were 12% higher than those of 2007. Spanish landings were 14.5 Kt, representing 86% of total stock landings, and Portuguese landings were 2.24 Kt being a 14% of total landings.

Trawl landings were 10.23 kt, similar to 2007, meanwhile artisanal fleet landings, targeting fish larger in size, was 6.51 kt, 31% higher than the 4.96 kt landed in 2007 .

Discards

A Spanish Discard Sampling Programme is being carried out in Divisions VIIIc and IXa North since 1993 for years 1994, 1997, 1999-2000 and continuously after 2003. The Portuguese Discard Sampling Programme started in 2003 (second semester). Both samplings schemes cover the trawl fishery where discards comprise mainly young ages.

Table below shows the discards weight trends by country

	Portugal		Spain		Total	
	weight(t)	CV	weight(t)	CV	weight(t)	CV
1994			287	0.36		
1997			1129	0.24		
1999			358	0.25		
2000			622	0.21		
2003			342	0.64		
2004	898	0.23	243	0.22	1141	0.18
2005	1444	0.18	319	0.18	1763	0.15
2006	821	0.26	2647	0.24	3468	0.19
2007	1651	0.19	868	0.2	2519	0.14
2008	1159	0.28	1562	0.13	2721	0.14

Since 2004 total discards oscillate between 1.1 Kt in 2004 and 3.5 Kt in 2006. In 2008 total discards were 2.7 Kt.

7.2.2 Biological Sampling

The sampling levels in 2008 are summarized in Table 1.3.

Length Composition

Table 7.2 presents the length compositions of landings by country and gear and mean length for 2008.

Figure 7.1 shows the length distributions of landings for 1982-2008 with a vertical line to mark the minimum landing size (27 cm). Whereas the mode remains about 30 cm, in recent years an increase in mean length from 33 cm in 2006 to 35 cm in 2007 and 36 cm in 2008 was observed. This was mainly caused by an increase of catches in fish larger than 40 cm (WD 8)

Age composition

Table 7.3 summarises the ALKs used for landings, surveys and CPUEs. An annual Iberian ALK has been used since 2001 combining IEO, AZTI and IPIMAR age readings.

Length-weight relationship, weights-at-age and M

An international length-weight relationship for the whole period has been used since 1999 (see stock Annex G)

Landed numbers and weights at age for 1982-2008 are given in Tables 7.4 and 7.5, respectively. Weights at age in the catch have been used as stock weights. A small decrease in mean weight for all ages was observed in 2008 compared with 2007.

Natural mortality was assumed to be 0.2 year^{-1} for all age groups in all years.

Maturity ogive

The stock is assessed with annual maturity ogives. The maturity proportion in this year's assessment are shown in Table 7.6. With regards to last year estimates, some ages show high maturity proportions while others show lower proportions, but differences are not relevant.

7.2.3 Abundance indices from surveys

Biomass, abundance and recruitment indices for the Portuguese and Spanish surveys respectively are presented in Table 7.7 and Table 7.8 and figure 7.2.

Since 1989 the Portuguese Autumn survey has shown variable abundance indices with a minimum in 1987. Biomass in 2008 is the highest in the series but recruitment at age dropped to 23 individuals/hour, the minimum since 1995.

The Spanish survey (Sp-GFS) shows low values for biomass and abundance in early 2000s' but abundance and biomass increases since 2004, being in 2008 above the historic mean. Recruitment at age 0 has dropped since the good 2005 figure (325 individuals/30 min) to current 74 ind/30min close to the lowest of the time series.

The recruitment index of the Spanish (Sp-GFS and SP-GFS-caut) and Portuguese autumn surveys (Figure 7.2) 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 and a strong drop in 2008.

The Spanish and the Portuguese October groundfish surveys are used to tune model. Abundance at age are shown in table 7.10. In general, abundance at age increases, compared with last year for all ages except ages 0 in both surveys and age 1 in the Portuguese survey.

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. Effort for Santander trawl (SP-SANTR) was not available in 2008. These data are given in Table 7.9 and shown in Figure 7.3. Table below summarizes the acronyms for the fleets available were just SP-CORUTR, 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 pattern is also applicable to 2008.

LPUEs in table 7.9 show a recent increasing trend reaching an historical maximum for all fleets except Cádiz trawl, that being high is not the maximum (SP-SANTR effort was not available in 2008). LPUEs show a clear increase in 2008 compared with 2007 for all trawl fleets. This increase ranges from a 20% in SP-CORUTRP or SP-VIMATR to a 60% for P-TR.

7.3 Assessment

This year an update of 2008 assessment was performed

7.3.1 Input data for assessment

As in previous years, age plus was set at 8 and the data for age 0 in the catch at age matrix was replaced by zeroes due to the low landings in this age for recent years after implementation of MLS. The catch at age matrix is presented in Table 7.4. Table 7.10 presents the tuning information available.

The table below summarizes the available information from tuning fleets:

FLEET	ACRONYMS	PERIOD	AGE RANGE
Portuguese Trawl	P-TR-89	1989 – 1994	0 – 8+
	P-TR-95	1995 – 2008	0 – 8+
Spanish A Coruña Trawl VIIIc	SP-CORUTR8c-85	1985 – 1993	0 – 8+
	SP-CORUTR8c-94	1994 – 2008	0 – 8+
Spanish A Coruña Pair Trawl VIIIc	SP-CORUTRP8c-85	1985 – 1993	0 – 8+
	SP-CORUTRP8c-94	1994 – 2008	0 – 8+
Santander Trawl	SP-SANTR	1986 – 2007	0 – 8+
Vigo/Marin Trawl	SP-VIMATR	1990 – 2008	0 – 8+
Spanish GFS	SP-GFS	1983 – 2008	0 – 8+
Portuguese GFS July	P-GFS-jul	1989 – 2001	0 – 8+
Portuguese GFS October	P-GFS-oct	1989 – 2008	0 – 8+
Cadiz GFS - Autumn	SP-GFS- caut	2000-2008	0 – 8+

7.3.2 Model

Model Description

The assessment was conducted using a Bayesian statistical-catch-at-age model. A detailed description of the model is presented in South hake Annex G.

This year 60 000 iterations of the computational MCMC algorithm were performed, a burn-in period of 10000 iterations was used and 1 every 10 iterations were kept, generating 5000 draws for analysis.. All posterior summaries presented are based on the 5000 kept draws. The run took about 6 hours in a standard desktop PC.

The prior distributions used are presented in the table below (log-normal distributions are parameterised with median and CV).

Priors table

prior	distribution
N1982,0, ..., N2008,0	log-Normal (40000,1.5)
N1982,1	log-Normal (32749,2)
N1983,2	log-Normal (21952,2)
N1983,3	log-Normal (10901,2)
N1982,4	log-Normal (5413,2)
N1983,5	log-Normal (2688,2)
N1982,6,	log-Normal (1335,2)
N1982,7	log-Normal (663,2)
N1982,8+	log-Normal (654,2)
f year (1982-2008)	log-Normal (0.6,1)
r (a,1) [ages 1 to 8+]	Unif (0,2)
r (a,2) [ages 1 to 8+]	Unif (0,2)
(r (6,)=1)	
q (a), all fleets and ages	log-Normal (exp(-7), 12)
Ψf(a), all fleets and ages	gamma (4, 0.345)
Ψc(a), all fleets and ages	gamma (4, 0.345)

Final Run

Final settings used this year and last year's configuration is detailed below:

parameters		2008 WG		2009 WG	
Fleets	P-TR-95	95-07	2-8+	95-08	2-8+
	SP-CORUTR8c-85	85-93	2-8+	85-93	2-8+
	SP-CORUTR8c-94	94-07	3-8+	94-08	3-8+
	SP-GFS	83-07	0-4	83-08*	0-4
	P-GFS-oct	89-07	0-4	89-08*	0-4
Age recruitment		0		0	
Catch data		Age 0 = 0		Age 0 = 0	
		Year 1982-07		Year 1982-08	
q plateau age		6		6	
Separability Period		1982-94 / 1995-07		1982-94 / 1995-08	

***: some age/years not included on the assessment (see above)**

7.3.3 Model diagnostics

Preliminary analysis of the MCMC chain and autocorrelation plots did not show any worrying features. For the set of kept draws autocorrelation was negligible

Prior-posterior plots for each of the model parameters have been examined (Figure 7.4). In most cases, the posterior distribution is much more concentrated than the prior and is often centred at a different place. This indicates that the model has been able to extract information from the data in order to revise (substantially in many cases) the prior distribution. In other words, the results are mostly driven by the data rather than by the prior.

Time series of residuals were plotted for each of the tuning indices and ages and for landed numbers-at-age (Figure 7.5). The residuals are plotted in logarithmic scale and are not standardised. Plot shows median and CI (0.05-0.95).

Landings at-age residuals shows a good random behaviour for ages 0 to 4 but an upwards trend may be observed in last 6 years for older ages (5-8+) driven to a model underestimation of catches for these ages in 2008 (Fig 7.5 a). Similar trends regarding abundance are observed in Spanish Coruña trawl (Fig 7.5 e) and Portuguese trawl LPUEs (Fig 7.5 f).

7.3.4 Assessment results

Historic trends in biomass, fishing mortality, yield and recruitment

Table 7.11 show median F and abundance at age results.

Table 7.12 shows median, CI (0.05-0.95) and CV for F bar (2-5), recruitment, SSB and yield. Fig 7.6 shows the corresponding plots.

Recruitment (age 0) declined continuously between 1984 (median=85 millions) and 2001 (median=36 millions). From 2002 onwards the recruitment has increased, being good from 2004 to 2007, with values well over the mean of the time series. Model results shows a poor recruitment in 2008, the lowest in the historic series, which is in agreement with the 3 autumn surveys (that provide information about recruitment).

The median SSB values are above 20 thousand t before 1984 and since then never got again these figures. The weak median was 7 thousand t in 1998 and 8 thousand t in 2003 and since then increases until the present 23 thousand t; with CI 0.05-0.95 equal to 20-25 thousand t, i.e with low probability of being above Blim (25 thousand t).

Fishing mortality reached peaks in 1995 (median = 0.63 year^{-1}) and 2002 (median = 0.64) and has subsequently declined until 2004 (0.37 year^{-1}). Since then the F have been increasing being the median value in 2008 of 0.52 year^{-1}, with CI 0.05-0.95 equal to 0.42-0.65.

Landings were high in the beginning of the series (median above 20 thousand t) and since then they decreased continuously getting the lower figure with median of 5.7 thousand t in 2004. After that the yield increases reaching 14 Kt in 2008 with CI 0.05-0.95 in 12-17 Kt. Model underestimates the total landings since 2005, being the estimate in 2008 of 14.3 Kt whereas the observed value is 16.2 Kt. The model underestimation of landings may have arisen from underestimation of F or of N or a combination of both which at the moment cannot be assessed. This feature was already present in last year assessment but at a lower rate without significant impact on the stock perspective. The problem will be addressed in the 2010 bechmark assessment .

The yield and SSB have increased in recent years sustained by recent good recruitments observed between 2004 and 2007 but the poor recruitment in 2008, if is confirmed, may change this trend.

Retrospective pattern for SSB, fishing mortality, yield and recruitment

Figure 7.7 presents the different estimations for assessment performed with data until 2008, 2007, 2006, 2005 and 2004. Median values were plotted for all assessments and 90% credibility intervals just for current assessment. SSB shows a trend to be underestimated in the recent past, with medians estimated in 2007 or 2006 outside of 2008 credibility interval. F and landings present an opposite trend, i.e. they were overestimated in recent years. Notice that 2007 Fbar estimated in last year assessment was 0.69, that was corrected to 0.44 in the present assessment. Retrospective pattern for recruits is less predictable, with up and downward estimation.

This pattern may be explained by high abundance and catches in ages older than 4, when recruitment was low in the corresponding cohorts, and also by the underestimation of landings. Regarding the former there are 3 possible explanations: (1) change in selection pattern, that can explain an increase in catches but not in abundance, and there is not information suggesting this change (2) fish coming from another place, but there is not any external information suggesting such a strong movement and (3) faster growth, so that fish aged as 4 and older are younger coming from good recruitments in 2004-07. There are tagging experiences confirming this underestimation of individual growth rate when reading ages from otoliths and that suggest that growth could be up to two times faster. In addition, the model underestimation of landings may also have an impact on retrospective pattern, which is however not possible to assess at the moment.

The consequences of this retrospective pattern in projections are difficult to predict.

7.4 Catch options and prognosis

7.4.1 Short-term projections

The methodology used is the same as last year and considers variability in population size, selection pattern and recruitment. The variability in F and N is given by the 5000 values drawn from the posterior distribution from the Bayesian model. M, weight and maturity-at-age variability was not considered.

Median values of the input data for predictions are given in Table 7.13. Table 7.14 shows the median and 90% credibility intervals for stock size in 2008 and the exploitation pattern. Catch and stock weights, and proportion mature at age were set as the mean for the period 2006-2008.

Statistics to be used as risk indicators are the probability of SSB being below Blim (P[SSB<Blim (25000 t)]), the probability of F being above the recovery plan F target (P[Fbar>0.27]), the probability of landings decreasing or increasing above or below 15% of the 2009 TAC (P[Y<>15%TAC2009]) and the probability of SSB decreases (P[SSB2011<SSB2008]). These estimations are presented in Figure 7.9.

The 2008 recruitment distribution was accepted for projections since its uncertainty is already captured by the high variability of the estimate. Figure 7.6 clearly shows this and in Table 7.12 one can confirm the CV of 0.51, much higher than in previous years. Recruitments in 2009 to 2011 were obtained by resampling from historical recruitments (1989-2008) within each iteration. The median values and 90% credibility intervals can be consulted in Table 7.16. The median of the recruitment distributions used for projections were 49.5 (CV=0.40) millions in 2009-11 (Table 7.15)

STF are based on status quo F (Fsq=F2008=0.52) for the following reasons: (i) landings have increased in 2008 and are above the TAC; (ii) fishing mortality shows an increasing trend.

The STF results at Fsq are presented in Figure 7.8 and Table 7.15. Median of expected yield increases from 14.3 kt in 2008 to 16.5 kt in 2009 dropping to 15.6 kt in 2010 (CV=0.13). Median SSB remains quite stable moving from 24.6kt in 2009 to 24.7 in 2010 and 23.1 Kt in 2011 (CV=0.21).

Table 7.16 present the Single option prediction detailed tables, with median values at age.

Table 7.17 presents the Management option table with Bayesian prediction including the risk indicators mentioned before. Figure 7.9 presents two plots, the upper one shows the stochastic expected yield in 2010 and the expected SSB in 2011 under different levels of F multipliers (from 0 to 2). The lower plot shows the risk indicators for the same different levels of F. With F=0.52 in 2010, median expected yield is 15.5 Kt, with a 100% of probability of being out of the 15% range of departure from the 2009 TAC. The median SSB in 2011 is 23.1 Kt and the probability of being below Blim is 65%. For median SSB to reach Bpa (35 Kt) in 2011, medians F in 2010 should be 0.13 and the corresponding median yield is 4 659 t. (without Gulf of Cadiz). In this situation the probability that SSB in 2011 is below Blim (25 Kt) is a 3%

7.4.2 Yield and biomass per recruit analysis

YPR estimation performed during 2007 assessment, based in XSA results, shows Fmax equal to 0.23 and F0.1 equal to 0.14. Stochastic yield per recruit and SSB per recruit analysis were performed this year with means of last 3 years for maturity, weight and selection pattern, this last was drawn from the 5000 MCMC samples. No variability was considered for maturity, weight or M. Results and confidence intervals are presented in Fig 7.11. Median maximum yield per recruit is 0.24 Kg corresponding with Fmax equal to 0.18 (CI 95% 0.15-0.21). Median F0.1 is 0.10 (CI 95% 0.8-0.12) with a corresponding median yield per recruit of 0.21 Kg.

7.5 Biological reference points

The present reference points are presented in the Table below together with the previous ones:

BRPs	ACFM 2000	ACFM 2003	ACFM 2004
Flim	0.45 = Floss	Not defined	0.55 = Floss
Fpa	0.27 = Flim*e(-1.645*0.3)	Not defined	0.40 = Flim*0.72
Blim	20 500 t = Bloss	25 000 t (level impaired recruitment)	Not changed
Bpa	33 600 t = Blim*e(1.645*0.3)	35000 t = Bpa ~ Blim * 1.4.	Not changed

Figure 7.10 clearly shows a different perspective of the stock history regarding to the actual BRP. SSB plot in Fig 7.6 shows that Bpa=35 000 t was just observed in 1983, second year of the series.

7.6 Comments on the assessment

The Gulf of Cadiz landings are not included in the assessment. In 2008 Gulf of Cádiz landings were 0.56 Kt, 3.3% of total landings, these represent an important part of the landings by number, specially at young ages. (Annex M - Cádiz Hake).

Discards were not considered due to the short and discontinuous time series available. However the discard rate is considered to be high particularly in ages 0, 1 and 2. WD 10 shows that not considering discards provides a more pessimistic view for recovery prospects under a scenario of reducing F, like those expected with effort reduction regulations.

There is a serious concern about European hake growth. Tagging experiences show that growth rate could be two times higher than expected, although the true value is uncertain. Otoliths reading continue with the same historical basis until an alternative ALK can be developed.

Notice that landings are estimated by the model. The model has underestimated total landings since 2005. In 2008 the estimated landings were 14.3 Kt whereas the observed value was 16.2 Kt. This model feature will be reviewed in 2010 benchmark assessment.

Current assessment shows a high retrospective pattern with a trend to overestimate F and landings and underestimate SSB. For instance, F in 2007 estimated in past assessment was 0.69, that was estimated this year as 0.44. Underestimation of growth might explain this particular pattern, although other factors also may be causing this behaviour.

A comparison between the 2008 and 2009 assessments is shown on the text table below.

BRP	YEAR	WG08	WG09	% CHANGE	COMMENTS
Fbar	2007	0.69	0.44	-36%	Median of stochastic estimates
	2008		0.52		
SSB	2007	18.2	21.5	20%	Median of stochastic estimates
	2008		22.7		
Land	2007	14.3	12.0	-19%	Median of stochastic stimates
	2008		14.3		
R	2007	79.5	117.0	46%	Median of stochastic estimates
	2008		35.2		

7.7 Evaluation of the recovery plan

The analysis of the recovery plan was not carried out yet.

7.8 Management considerations

Current assessment shows two main problems, high retrospective pattern and underestimation of landings in recent years. The confounding of these two factors makes it difficult to predict their impact on our perspective of the stock at the moment.

There is an increasing trend in fishing mortality, a high overshoot of the TAC and high discard rates, showing that the implementation of the recovery plan was not effective.

Recent increases in SSB and Yield were due to good recruitment levels in previous years, particularly 2004-2007, nevertheless there are signs of poor recruitment in 2008, so if the fishery continues such a high F the stock may not be able to reach the levels set in the recovery plan (Bpa=SSB=35 000 t).

Table 7.1 HAKE SOUTHERN STOCK - Landings estimates (´000 t) by country and gear, 1972-2008

	Spain										Portugal			France	Total	TOTAL
YEAR	Gillnet	Small Gillnet	Longline	Artisanal Unallocated	Artisanal Cadiz	Total Artisanal	Trawl North	Trawl Cadiz	Total Trawl	Total	Artisanal	Trawl	Total		Stock Without Cadiz	STOCK
1972	-	-	-	-	-	7.10	10.20	-	10.20	17.30	4.70	4.10	8.80		26.10	26.10
1973	-	-	-	-	-	8.50	12.30	-	12.30	20.80	6.50	7.30	13.80	0.20	34.80	34.80
1974	2.60	1.00	2.20	-	-	5.80	8.30	-	8.30	14.10	5.10	3.50	8.60	0.10	22.80	22.80
1975	3.50	1.30	3.00	-	-	7.80	11.20	-	11.20	19.00	6.10	4.30	10.40	0.10	29.50	29.50
1976	3.10	1.20	2.60	-	-	6.90	10.00	-	10.00	16.90	6.00	3.10	9.10	0.10	26.10	26.10
1977	1.50	0.60	1.30	-	-	3.40	5.80	-	5.80	9.20	4.50	1.60	6.10	0.20	15.50	15.50
1978	1.40	0.10	2.10	-	-	3.60	4.90	-	4.90	8.50	3.40	1.40	4.80	0.10	13.40	13.40
1979	1.70	0.20	2.10	-	-	4.00	7.20	-	7.20	11.20	3.90	1.90	5.80		17.00	17.00
1980	2.20	0.20	5.00	-	-	7.40	5.30	-	5.30	12.70	4.50	2.30	6.80		19.50	19.50
1981	1.50	0.30	4.60	-	-	6.40	4.10	-	4.10	10.50	4.10	1.90	6.00		16.50	16.50
1982	1.25	0.27	4.18	-	-	5.69	3.92	0.49	4.41	10.10	5.01	2.49	7.49		17.11	17.59
1983	2.10	0.37	6.57	-	-	9.04	5.29	0.57	5.87	14.91	5.19	2.86	8.04		22.38	22.95
1984	2.27	0.33	7.52	-	-	10.13	5.84	0.69	6.54	16.66	4.30	1.22	5.52		21.49	22.18
1985	1.81	0.77	4.42	-	-	7.00	5.33	0.79	6.12	13.12	3.77	2.05	5.82		18.15	18.94
1986	2.07	0.83	3.46	-	-	6.37	4.86	0.98	5.84	12.21	3.16	1.79	4.95	0.01	16.19	17.16
1987	1.97	0.53	4.41	-	-	6.91	3.50	0.95	4.45	11.36	3.47	1.33	4.80	0.03	15.23	16.19
1988	1.99	0.70	2.97	-	-	5.65	3.98	0.99	4.96	10.61	4.30	1.71	6.02	0.02	15.67	16.65
1989	1.86	0.56	1.95	-	-	4.37	3.92	0.90	4.82	9.19	2.74	1.85	4.58	0.02	12.89	13.79
1990	1.72	0.59	2.13	-	-	4.44	4.13	1.20	5.33	9.77	2.26	1.14	3.40	0.03	11.99	13.19
1991	1.41	0.42	2.20	-	-	4.02	3.63	1.21	4.84	8.87	2.71	1.25	3.96	0.01	11.62	12.83
1992	1.48	0.40	2.05	-	-	3.94	3.79	0.98	4.76	8.70	3.77	1.33	5.10		12.82	13.80
1993	1.26	0.36	2.74	-	0.01	4.37	2.67	0.54	3.21	7.58	3.04	0.87	3.91		10.94	11.49
1994	1.90	0.37	1.47	-	0.00	3.74	2.72	0.33	3.04	6.79	2.30	0.79	3.09		9.54	9.87
1995	1.59	0.37	0.96	-	0.00	2.92	5.27	0.46	5.73	8.65	2.57	1.03	3.59		11.78	12.24
1996	1.15	0.21	0.98	-	0.03	2.37	3.64	0.98	4.61	6.98	2.01	0.89	2.90		8.87	9.88
1997	1.04	0.30	0.77	-	0.04	2.15	3.10	0.88	3.98	6.13	1.51	0.91	2.42		7.62	8.54
1998	0.75	0.32	0.63	-	0.04	1.73	2.83	0.52	3.35	5.09	1.67	0.91	2.58		7.10	7.67
1999	0.60	0.17	0.25	0.22	0.02	1.27	2.45	0.57	3.02	4.29	2.12	1.09	3.21		6.91	7.50
2000	0.85	0.13	0.15	0.13	0.01	1.27	2.81	0.58	3.39	4.66	2.09	1.16	3.25		7.32	7.91
2001	0.58	0.18	0.11	0.14	0.04	1.04	2.18	1.20	3.38	4.42	2.00	1.20	3.20		6.38	7.62
2002	0.60	0.12	0.14	0.05	0.02	0.94	2.13	0.88	3.01	3.95	1.80	0.97	2.77		5.82	6.72
2003	0.43	0.25	0.17	0.23	0.02	1.10	2.43	1.25	3.68	4.78	1.15	0.96	2.11		5.62	6.89
2004	0.42	0.25	0.13	0.19	0.03	1.03	2.79	1.06	3.85	4.88	1.31	0.80	2.11		5.89	6.98
2005	0.63	0.17	0.23	0.40	0.02	1.46	3.91	0.89	4.80	6.26	1.12	0.96	2.09		7.44	8.35
2006	0.71	0.27	0.35	0.20	0.02	1.55	6.51	0.63	7.14	8.69	1.14	0.91	2.04		10.07	10.73
2007	1.80	0.41	0.89	0.41	0.01	3.52	8.78	0.50	9.28	12.80	1.44	0.72	2.16		14.45	14.96
2008	2.64	0.49	1.51	0.54	0.03	5.21	8.76	0.53	9.29	14.50	1.30	0.94	2.24		16.18	16.74

Table 7.2 HAKE SOUTHERN STOCK - length compositions (thousands) by gear in 2008 (without Cadiz)

Length class (cm)	PORTUGAL		SPAIN					STOCK TOTAL
	Trawl	Hooks gillnets	Trawl	Small gillnets	Gillnets	Artisanal	Longline	
10								
11								
12								
13								
14								
15								
16								
17								
18			23	70		101		193
19			40	136		204		381
20	0	0	66	176		265		507
21	0	0	88	216		324		628
22	3	0	119	288		427		837
23	6	0	146	347		518		1017
24	18	4	196	362		534		1113
25	33	21	393	298		422		1167
26	66	79	666	174		245		1230
27	108	178	1023	91		115		1515
28	134	322	1205	89		88		1838
29	149	567	1335	133		117		2302
30	149	616	1172	185	1	154		2277
31	127	342	1314	140	2	115	0	2039
32	100	243	1331	128	2	106	1	1909
33	107	214	889	116	1	95	2	1423
34	120	139	888	100	2	83	5	1336
35	102	175	865	72	9	58	10	1290
36	92	143	873	48	11	40	15	1223
37	80	114	869	32	10	26	28	1159
38	72	68	812	27	10	23	41	1054
39	77	35	896	24	20	21	55	1129
40	78	39	740	21	38	17	72	1005
41	79	39	743	13	49	10	77	1009
42	67	34	596	10	57	8	95	868
43	70	23	601	3	63	2	101	864
44	75	20	450	2	71	1	107	726
45	71	26	589	3	70	2	97	857
46	78	28	457	2	74	2	100	741
47	76	21	375	0	82	0	92	647
48	60	16	380	2	82	1	95	635
49	66	11	304	1	96	1	93	572
50	55	7	243		111		90	505
51	45	6	196		109		82	439
52	48	5	145		115		74	386
53	40	4	153		119		68	384
54	33	3	121		135		56	348
55	26	2	107	0	120	0	48	303
56	25	2	94		114		42	277
57	19	2	52		112		32	217
58	18	2	56	0	100	0	29	205
59	9	1	49		83		22	164
60	10	1	44	0	68	0	22	146
61	7	1	31		64		14	117
62	6	1	26		55		14	101
63	10	0	23		46		9	89
64	9	0	26		30		8	74
65	3	0	15		34		8	59
66	3	0	9		31		5	49
67	3	0	15		19		6	43
68	2	0	16		11		4	34
69	1	0	10		11		4	27
70	1	0	5		9		3	18
71	1	0	5		11		4	21
72	1	0	5		7		3	15
73	0	0	2		6		2	11
74	0	0	0		6		2	9
75	0	0	4		4		2	10
76	0	0	0		1		1	3
77	0		1		3		1	6
78	0	0	0		4		1	5
79	0	0	2		1		1	4
80	0	0	1		1		1	3
81	0		0		1		1	1
82	0	0	0		0		0	1
83	0				1		0	1
84		0	0		0		0	1
85	0		1		0		0	1
86			1		1		0	2
87	0		0		0		0	1
88			0				0	0
89			1				0	1
90	1						0	1
TOTAL	2636	3558	21901	3308	2297	4125	1746	39571
Nominal Weight (tons)	1.30	0.94	8.76	0.49	2.64	0.54	1.51	16.18
SOP	1.30	0.94	8.76	0.50	2.64	0.54	1.51	16.18
SOP / NW	1.00	1.00	1.00	0.99	1.00	1.01	1.00	1.00
Mean length (cm)	39.0	32.6	36.5	26.7	53.4	25.5	48.6	35.9

Table 7.3 HAKE SOUTHERN STOCK - ALKs used in the assessment

<table>
<tr><th rowspan="2">Year</th><th>Landings + Commercial</th><th colspan="2">Portuguese surveys</th><th>7.8.1 Spanish surveys</th></tr>
<tr><th>tuning fleets</th><th>July</th><th>October</th><th>September</th></tr>
<tr><td>1982</td><td rowspan="5">Combined IEO 1994-98</td><td rowspan="7"></td><td rowspan="3"></td><td></td></tr>
<tr><td>1983</td><td rowspan="4">Combined September IEO 1994-98</td></tr>
<tr><td>1984</td></tr>
<tr><td>1985</td><td rowspan="8">Combined IPIMAR 93-98</td></tr>
<tr><td>1986</td></tr>
<tr><td>1987</td><td rowspan="3">Combined AZTI 87-89</td><td>no survey</td></tr>
<tr><td>1988</td><td rowspan="6">Combined September IEO 1994-98</td></tr>
<tr><td>1989</td><td rowspan="4">Combined IPIMAR 93+95+97+98</td></tr>
<tr><td>1990</td><td rowspan="3">Combined IEO 1994-98</td></tr>
<tr><td>1991</td></tr>
<tr><td>1992</td></tr>
<tr><td>1993</td><td>Annual IEO 93*</td><td>July IPIMAR 93</td><td>October IPIMAR 93</td></tr>
<tr><td>1994</td><td>Annual IEO 94</td><td>no survey</td><td>October IPIMAR 94</td><td>September IEO 94</td></tr>
<tr><td>1995</td><td>Annual IEO 95</td><td>July IPIMAR 95</td><td>October IPIMAR 95</td><td>September IEO 95</td></tr>
<tr><td>1996</td><td>Annual IEO 96</td><td>no survey</td><td>October IPIMAR 96</td><td>September IEO 96</td></tr>
<tr><td>1997</td><td>Annual IEO 97</td><td>July IPIMAR 97</td><td>October IPIMAR 97</td><td>September IEO 97</td></tr>
<tr><td>1998</td><td>Annual IEO 98</td><td>July IPIMAR 98</td><td>October IPIMAR 98</td><td>September IEO 98</td></tr>
<tr><td>1999</td><td>Annual IEO +AZTI 99</td><td>July IPIMAR 99</td><td>October IPIMAR 99</td><td>September IEO 99</td></tr>
<tr><td>2000</td><td>Annual IEO +AZTI 00</td><td>July IPIMAR 00</td><td>October IPIMAR 00</td><td>September IEO 00</td></tr>
</table>

2001	Annual Iberian 01	July IPIMAR 01	October IPIMAR 01	September IEO 01
2002	Annual Iberian 02	No survey	October IPIMAR 02	September IEO 02
2003	Annual Iberian 03	No survey	October IPIMAR 03	September IEO 03
2004	Annual Iberian** 04	No survey	October IPIMAR 04	September IEO 04
2005	Annual Iberian 05	No survey	October IPIMAR 05	September IEO 05
2006	Annual Iberian 06	No survey	October IPIMAR 06	September IEO 06
2007	Annual Iberian 07	No survey	October IPIMAR 07	September IEO 07
2008	Annual Iberian 08	No survey	October IPIMAR 08	September IEO 08

* - Just one reader

** - IEO and IPIMAR

Table 7.4. Southern Hake Stock. Landings numbers at age (thousands)

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	18606	9701	4831	18292	5334	1075	4295	1057	699
1	24786	19257	8220	26321	16520	8307	14353	6333	5114
2	22533	21902	11851	24904	21128	16544	20965	18223	14988
3	7541	9753	7273	7214	7957	9996	8547	10984	6326
4	3299	5523	5885	3231	4968	5098	3274	2721	3294
5	2193	3694	4576	2423	2940	3123	2837	1848	1959
6	1831	2825	3362	2098	1740	1611	1817	1115	1353
7	1249	1873	2080	1421	885	807	1023	648	832
8+	990	1384	1437	902	408	421	657	507	557

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	1675	944.4	1297.7	2060.3	326.4	776.9	299	21.2	0.9
1	3058	2061	3319	2935	2019	1162	1291	2862	1242
2	9816	8875	6759	6414	15968	8074	11020	12048	6421
3	6671	7422	3614	4191	9493	6444	6941	5172	9604
4	3536	3808	2476	3578	4208	2882	1434	1707	2736
5	2031	2028	1882	1980	1901	1061	1091	705	891
6	1400	1357	1685	990	1062	907	757	463	425
7	860	909	998	630	698	525	411	266	209
8+	587	810	963	681	416	386	211	179	89

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	15.4	0.0	9.3	0.0	0.1	0.2	12.2	11.4	0
1	1492	657	407	1401	1857	743	3042	2774	3135
2	6500	7224	3933	7871	8286	7422	13608	12899	13220
3	8440	6983	6896	5976	4571	10185	11072	11241	11976
4	3045	2060	1953	1749	1777	2741	2575	3988	5121
5	1295	1055	917	695	870	962	1185	2109	2715
6	364	568	583	300	364	541	582	1298	1682
7	208	340	207	106	134	186	225	660	947
8+	136	152	141	73	55	115	136	365	775

Tables 7.5. Southern Hake Stock. Landinds mean weight at age (kilograms)

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	0.026	0.031	0.024	0.029	0.029	0.027	0.023	0.026	0.028
1	0.071	0.072	0.078	0.07	0.079	0.06	0.054	0.063	0.1
2	0.156	0.167	0.171	0.154	0.157	0.133	0.127	0.14	0.168
3	0.306	0.313	0.334	0.3	0.32	0.296	0.283	0.284	0.31
4	0.552	0.565	0.584	0.566	0.558	0.604	0.634	0.598	0.556
5	0.84	0.82	0.826	0.847	0.788	0.858	0.949	0.917	0.8
6	1.117	1.098	1.084	1.12	1.019	1.054	1.131	1.13	1.083
7	1.332	1.322	1.298	1.312	1.21	1.206	1.267	1.31	1.302
8+	1.93	1.906	1.931	1.804	1.817	1.894	1.916	1.954	1.856

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.031	0.029	0.033	0.026	0.03	0.031	0.038	0.034	0.039
1	0.088	0.1	0.105	0.129	0.066	0.068	0.074	0.127	0.125
2	0.193	0.197	0.209	0.205	0.169	0.195	0.184	0.202	0.179
3	0.315	0.325	0.344	0.317	0.293	0.358	0.304	0.33	0.268
4	0.553	0.543	0.59	0.506	0.501	0.59	0.567	0.544	0.494
5	0.798	0.789	0.815	0.774	0.734	0.815	0.858	0.79	0.86
6	1.077	1.099	1.035	1.091	1.007	1.068	1.075	1.096	1.071
7	1.299	1.364	1.287	1.303	1.281	1.266	1.287	1.276	1.294
8+	1.885	1.955	1.944	1.895	1.868	2.006	2.095	1.905	1.98

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0.033	0.037	0.039	0.044	0.046	0.016	0.053	0.044	0.044
1	0.128	0.103	0.12	0.122	0.127	0.104	0.135	0.113	0.084
2	0.18	0.17	0.184	0.188	0.205	0.185	0.191	0.207	0.176
3	0.266	0.277	0.292	0.303	0.33	0.27	0.303	0.348	0.321
4	0.54	0.5	0.569	0.55	0.58	0.515	0.594	0.629	0.592
5	0.87	0.828	0.846	0.826	0.841	0.861	0.865	0.887	0.837
6	1.131	1.012	1.077	1.069	1.102	1.069	1.215	1.174	1.045
7	1.387	1.227	1.3	1.486	1.294	1.372	1.276	1.334	1.308
8+	1.776	1.644	1.793	1.981	2.09	1.887	1.932	2.052	1.865

Table 7.6. Southern Hake Stock. Prop. of mature at age (combined sexes).

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.02
2	0.02	0.02	0.09	0.02	0.02	0.02	0.02	0.03	0.05
3	0.13	0.28	0.31	0.21	0.17	0.16	0.12	0.18	0.24
4	0.62	0.90	0.68	0.83	0.67	0.59	0.54	0.67	0.66
5	0.87	0.97	0.83	0.96	0.86	0.79	0.78	0.88	0.87
6	0.95	0.99	0.90	0.99	0.94	0.90	0.88	0.95	0.96
7	0.97	1.00	0.93	0.99	0.97	0.94	0.92	0.97	0.99
8+	1.00	1.00	0.98	1.00	1.00	0.99	0.98	1.00	1.00

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.06	0.04	0.02	0.08	0.02	0.02	0.03	0.04	0.21
2	0.23	0.17	0.13	0.17	0.14	0.26	0.18	0.09	0.28
3	0.48	0.40	0.33	0.33	0.35	0.68	0.45	0.21	0.39
4	0.80	0.71	0.72	0.57	0.68	0.94	0.86	0.46	0.60
5	0.92	0.88	0.88	0.79	0.85	0.98	0.95	0.69	0.80
6	0.97	0.96	0.93	0.92	0.94	0.99	0.98	0.84	0.86
7	0.99	0.98	0.97	0.96	0.97	1.00	0.99	0.90	0.91
8+	1.00	1.00	1.00	0.99	0.99	1.00	1.00	0.97	0.96

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.20	0.03	0.13	0.07	0.08	0.08	0.12	0.05	0.12
2	0.28	0.09	0.22	0.15	0.22	0.26	0.24	0.28	0.25
3	0.41	0.26	0.39	0.32	0.43	0.41	0.44	0.53	0.47
4	0.69	0.64	0.70	0.63	0.65	0.56	0.67	0.72	0.76
5	0.85	0.90	0.86	0.83	0.80	0.76	0.85	0.85	0.88
6	0.90	0.95	0.92	0.90	0.88	0.86	0.96	0.95	0.93
7	0.95	0.98	0.95	0.97	0.92	0.94	0.98	0.98	0.96
8+	0.96	0.99	0.97	0.99	0.99	0.99	1.00	1.00	0.99

Table 7.7 HAKE SOUTHERN STOCK - Portuguese groundfish surveys; biomass, abundance and recruitment indices

Year	Spring					Summer					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.	Age 0 - n/hour	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	60.1	150
1986						27.4	1.8	249.4	15.1	118	17.7	1.2	165.6	28.4	73.0	117
1987											8.6	0.9	37.4	3.7	3.1	81
1988											15.3	1.7	177.8	30.8	77.7	98
1989						11.9	0.9	80.8	8.6	114	8.4	0.5	59.6	4.6	12.9	130
1990						9.8	1.0	95.6	13.5	98	11.8	1.0	157.2	26.3	82.0	107
1991						14.2	1.2	104.2	11.3	119	20.9	4.3	195.3	41.5	56.6	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	12.1	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	23.2	58
1994											9.9	1.0	98.9	12.1	18.3	77
1995						15.0	1.4	129.3	16.3	81	14.8	1.7	85.8	10.7	2.1	80
1996***											9.2	1.1	109.9	17.8	56.4	63
1997						19.0	1.4	206.5	16.9	86	24.6	9.3	208.0	92.5	40.4	51
1998						10.5	0.8	71.6	8.6	87	15.6	2.0	140.6	21.7	54.0	64
1999***						11.8	0.7	116.2	10.1	65	11.6	1.5	118.3	17.1	43.2	71
2000						16.4	1.6	123.0	15.2	88	11.8	1.8	102.7	19.9	29.9	66
2001						16.6	1.7	132.5	14.2	83	15.6	2.8	164.2	38.5	50.9	58
2002											13.0	2.1	117.6	26.9	43.5	66
2003 ***											9.8	1.0	94.2	8.0	30.7	71
2004 ***											18.4	3.3	402.3	85.2	250.2	79
2005	17.7	2.6	384.0	53.8	68	**no survey since 2002**					19.0	1.9	214.2	23.5	105.8	87
2006	16.0	2.0	377.5	55.4	66						16.5	1.8	126.2	11.0	44.7	88
2007	22.4	3.4	609.1	114.1	63						25.8	2.8	370.2	46.7	127.5	96
2008	31.1	4.8	700.6	170.8	67						34.6	4.3	293.6	33.9	23	87

all data concerns 20 mm cod end mesh size except data marked with * which concerns 40 mm
(**) 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 7.8 HAKE SOUTHERN STOCK - Spanish groundfish surveys; abundances and recruitment indices for total area (Mino - Bidasoa). Biomass for Cadiz surveys.

	Spanish Survey (Sp-GFS)						Cadiz Survey (Sp-GFS-caut)				Cadiz Survey (Sp-GFS-cspr)			
	Biomass index (Kg/30min)		Abundance Index (nº/30min)			Age 0 (n/30 min)	Biomass index (Kg/h)		n/h		Biomass index (Kg/h)		n/h	
Year	Mean	s.e.	Hauls	Mean	s.e.	Mean	Mean	s.e.	hauls	age 0	Mean	s.e.	hauls	age 0
1983	7.04	0.65	107	192.4	25.0	172.6								
1984	6.33	0.60	94	410.4	53.5	394.8								
1985	3.83	0.39	97	108.5	14.0	93.6								
1986	4.16	0.50	92	247.8	46.5	236.2								
1987														
1988	5.59	0.69	101	390.0	67.4	378.4								
1989	7.14	0.75	91	487.9	73.1	469.9								
1990	3.34	0.32	120	85.9	9.1	72.4								
1991	3.37	0.39	107	166.8	15.8	157.4								
1992	2.14	0.19	116	59.3	5.4	49.8								
1993	2.49	0.21	109	80.0	8.0	67.4					3.04	0.53	30	
1994	3.98	0.33	118	245.0	24.9	233.8					2.68	0.33	30	
1995	4.58	0.44	116	80.9	8.4	66.6					4.66	1.28	30	
1996	6.54	0.59	114	345.2	40.5	329.4					7.66	1.14	31	
1997	7.27	0.78	119	421.4	56.5	398.1	5.28	2.77	27		3.34	0.52	30	
1998	3.36	0.28	114	75.9	8.7	60.3	2.66	0.42	34		2.93	0.67	31	
1999	3.35	0.25	116	95.3	10.6	75.9	2.71	0.44	38		3.03	0.37	38	
2000	3.01	0.43	113	66.9	7.4	56.6	2.03	0.61	30	17.8	3.02	0.47	41	NA
2001	1.73	0.29	113	42.0	7.6	35.7	2.57	0.45	39	22.5	6.01	0.79	40	NA
2002	1.91	0.23	110	57.1	8.8	50.9	3.39	0.78	39	116.2	2.74	0.25	41	NA
2003	2.61	0.27	112	92.8	11.6	80.3	1.61	0.28	41	15.8				
2004	3.94	0.40	114	177.0	23.5	156.6	2.72	0.69	40	83.6	3.65	0.47	40	NA
2005	6.46	0.53	116	344.8	32.2	325.2	6.68	1.29	42	88.7	10.77	5.65	40	NA
2006	5.50	0.39	115	224.5	21.9	209.7	4.99	2.00	41	210.0	2.15	0.40	41	NA
2007	4.97	0.43	117	158.2	15.0	143.4	6.92	1.43	37	197.7	3.22	0.68	41	NA
2008	4.93	0.46	115	99.3	11.55	74.23	4.33	0.60	41	61.0	3.48	0.67	41	NA

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

Table 7.9 HAKE SOUTHERN STOCK. Landings (tonnes), Catch per unit effort and effort for trawl fleets

	A Coruña Trawl			A Coruña Pair Trawl			Vigo and Marín trawl [1]			Santander trawl			Cadiz trawl			Portugal trawl		
YEAR	Landings	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	9.8	187553
1990	749	17	44430	429	24	18250	438	17.5	25063	392	19.2	20469				1138	11.2	101552
1991	501	12	40440	609	20	30530	368	12.6	29260	340	15.2	22391				1245	9.4	132126
1992	589	15	38910	730	27	26670	666	21.4	31146	311	13.6	22833				1325	8.1	163825
1993	514	12	44504	350	16	21349	290	13.1	22198	390	18.2	21370				871	6.8	128011
1994	473	12	39589	319	15	20732	556	21.3	26115	296	13.0	22772	326	11.7	27823	789	6.2	128033
1995	831	20	41452	691	24	28988	1018	35.5	28677	336	23.9	14046	458	14.2	32194	1026	12.4	82450
1996	722	20	35728	249	14	17555	647	21.9	29480	274	22.7	12071	975	30.5	31951	894	7.6	118257
1997	732	21	35211	295	18	16307	347	9.2	37578	127	10.8	11776	880	27.0	32573	906	8.0	112583
1998	895	27	32563	198	12	16966	284	6.7	42371	122	11.4	10646	523	15.9	32824	913	8.9	102919
1999	691	23	30232	139	15	9322	402	10.1	39738	92	8.9	10349	570	17.4	32731	1092	11.3	97000
2000	590	20	30102	92	29	3190	371	11.0	33771	52	5.9	8779	584	19.5	29875	1162	8.6	134681
2001	597	20	29923	91	19	4873	293	8.7	33802	47	15.5	3053	1203	39.6	30416	1210	9.6	126478
2002	232	11	21823	266	37	7147	256	10.6	24288	30	7.6	3975	883	28.9	30526	970	12.2	79443
2003	274	15	18493	121	30	3988	397	17	23151	22	5.8	3837	1251	39.5	31643	962	8.0	120419
2004	259	12	21112	249	29	8582	259	23	11139	17	4.6	3776	1062	35.4	30029	728	10.3	71013
2005	330	16	20663	428	47	9025	286	29	9981	7	4.9	1404	885	27.3	32419	965	10.0	96849
2006	518	27	19264	489	78	6245	360	32	11128	24	9.0	2718	634	24.1	26248	908	10.2	88788
2007	621	29	21201	788	58	13471	375	34	11062	64	14.8	4334	505	20.7	24398	724	9.9	72920
2008	762	38	20212	631	70	8964	454	41	11034	64			529	27.7	19135	936	15.9	58915

* - Kg/fishind day x100 HP

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

** - Kg/hour (new lpue serie)

***- Kg/fishing day

2003 - Pt lpue - revised

Trawl cadiz effort revised in 2007 WG

Table 7.10. Tunning information available in "Lowestoft" format

SOUTHERN HAKE. TUNNING FLEETS. WG2009.

112										
P-Tr-89										
1989	1994									
1	1	0	1							
0	8									
187.55	1022.1	4347.2	5302.4	1857.3	363.8	73.6	13.3	5.4	1.9	1989
101.55	63.3	1009.9	3169.4	1183.3	244.8	57	21.5	9.6	2.1	1990
132.13	2.7	302.3	2788.8	1583	331.9	61.5	18	8.9	3.8	1991
163.82	0	234.8	2509.1	1673.6	365.3	75.4	24.7	11.6	4.7	1992
128.01	0.3	199.8	1460.7	805.3	224.7	77.4	49.4	18.5	6.9	1993
128.03	3.2	400.1	1279	800.7	358	84.6	17.4	6.4	4	1994
P-Tr-95										
1995	2008									
1	1	0	1							
0	8									
82.45	0.9	38	2947.3	1297.6	215.2	51.2	14.1	5.6	2	1995
118.26	0.1	31.3	1998.5	1023.4	188	50.5	26.1	9.9	3.8	1996
112.58	1	35.4	2667.6	1103.6	116.6	56.2	28.7	11.3	3	1997
102.92	7.6	348.7	2229.9	827.9	165.4	41.3	15.1	6.3	1.9	1998
97	0	323.8	2171.7	2027.8	262.7	41.9	18.5	8	1.5	1999
134.68	0	332.7	1700.7	2143.1	344.1	73	17.7	7.8	3.8	2000
126.48	0	93	2044.1	1953.4	348.8	107.9	47	24.7	8.8	2001
79.44	0	93.9	1307.8	1863.5	244.6	66.4	33	10	5.4	2002
120.42	0	195.1	1944	1210.3	220.3	75.7	30.4	8.3	4.6	2003
78.11	0	176.78	1573.87	728.33	203.18	81.76	25.54	7.99	2.31	2004
96.85	0	39.8	1698.5	1955.2	233.3	57.9	25.3	6.8	3.3	2005
88.79	1.4	286.4	1643.4	1311.1	189.4	55	15.5	4.9	2.3	2006
72.92	0	129.81	1343.87	920.27	135.01	48.55	20.03	8.05	2.09	2007
58.92	0	62.70	1712.48	1479.53	200.98	63.01	25.34	8.72	4.84	2008
SP-CORUTR8c-85										
1985	1993									
1	1	0	1							
0	8									
45.92	0.85	380.13	1763.25	662.97	229.86	90.33	51.64	27	10.32	1985
39.81	12.72	768.48	1397.08	473.85	234.57	111.45	53.02	24.53	10.67	1986
34.68	5.12	451.14	1322.29	366.79	181.08	87.46	41.62	21.6	8.75	1987
42.18	4.38	382.37	1172.86	411.59	183.65	96.79	47.03	25.05	9.01	1988
44.44	0.42	152.99	1117.28	607.24	209.69	81.32	31.58	14.26	6.4	1989
44.43	0.02	146.53	1108.8	539.9	249.17	95.34	38.07	16.08	7.24	1990
40.44	0	47.32	466.25	308.83	186.11	85.06	41.39	19.44	8.81	1991
38.91	0	105.08	845.37	372.64	161.88	77.18	42.5	22.05	11.52	1992
44.5	0.4	135.05	610.06	277.18	136.24	64.8	43.62	19.22	13.07	1993
SP-CORUTR8c-94										
1994	2008									
1	1	0	1							
0	8									
39.59	0	257.27	736.18	461.95	269.04	89.86	25.25	13.06	8.94	1994
41.45	0	23.6	2591.82	900.05	355.13	100.04	29.46	14.85	8.19	1995
35.73	0.06	99.76	860.43	719.62	272.42	66.94	47.8	25.31	11.73	1996
35.21	0.5	60.17	935.31	725.25	175.18	101.99	57.25	25.36	4.3	1997
32.56	0	289.5	1867.37	849.8	228.46	58.49	25.79	12.4	6.38	1998
30.23	0	63.8	305.7	889.8	457.2	95.3	35.3	14.9	5.5	1999

30.1	0	48.21	392.5	818.52	317.31	92.4	19.98	9.06	5.11	2000
29.92	0	6.34	388.37	673.8	256.99	98.7	47.38	29.58	16.7	2001
21.82	0	0.9	24.47	122.36	77.16	44.12	31.85	15.28	18.61	2002
18.49	0	49.26	351.68	351.31	96.97	27.52	10.41	2.78	1.37	2003
21.11	0.01	40.63	302.72	231.05	94.75	38.47	13.57	4.44	1.77	2004
20.66	0	5.22	129.07	325.33	163.18	63.15	33.14	10.12	5.03	2005
19.26	0	48.1	457.2	704.4	159.2	53.5	23.3	8.6	4.7	2006
21.2	0	54.01	500.66	588.56	205.3	86.42	41.48	19.4	10.16	2007
20.21	0.00	10.31	421.39	764.79	305.00	122.68	64.31	31.15	20.27	2008

SP-CORUTRP8c-85

1985 1993

1 1 0 1

0 8

23.7	0.06	89.96	748.56	635.32	323.14	152.46	97.69	59.24	30.57	1985
25.63	1.76	208.07	965.55	597	392.64	187.16	83.61	34.66	11.02	1986
29.82	0.24	58.67	362.43	383.26	379.21	167.81	62.63	27.32	11.13	1987
12.98	0.14	41.62	363.9	286.74	161.39	71.65	29.74	13.24	4.17	1988
15.24	0	23.22	255.19	296.21	222.66	99.19	37.1	15.43	6.76	1989
18.25	0.01	33.17	339.82	333.73	175.58	68.38	28.41	12.28	4.75	1990
30.53	0	13.97	243	355.97	283.67	129.68	56.31	23.98	9.94	1991
26.67	0	24.23	366.44	513.92	285.78	138.82	66.42	29.75	11.1	1992
21.35	0	8.32	99.1	123.47	110.4	70.9	51.55	25.63	17.34	1993

SP-CORUTRP8c-94

1994 2008

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0 8

20.73	0	42.7	207.28	227.93	188.59	68.1	23.25	12.25	7.61	1994
28.99	0	5.17	868.23	847.01	358.32	105.6	31.38	12.64	4.9	1995
17.56	0	1.23	279.99	265.15	112.16	25.22	12.21	4.04	1.26	1996
16.31	0	3.88	352.23	362.18	68.32	45.54	25.74	10.53	2.06	1997
16.97	0	31.02	329.18	207.05	60.63	16.21	6.67	3.11	1.47	1998
9.32	0	8.9	92.8	215.2	80.4	17.7	5.8	1.9	0.5	1999
3.19	0	9.63	86.44	161.64	40.11	8.61	1.96	0.99	0.66	2000
4.87	0	0.81	75.78	156.51	41.39	7.58	3.16	1.19	0.35	2001
7.15	0	1.14	87.24	395.65	107.57	33.48	17.72	5.17	4.74	2002
3.99	0	9.73	124.7	181.04	47.32	9.36	3.13	0.77	0.42	2003
8.58	0	65.57	490.06	268.47	59.35	14.6	4.98	1.8	0.79	2004
9.03	0	5.61	183.17	445.29	230.45	74.06	35.49	10.87	7.05	2005
6.25	0	24.6	138.3	220.9	176.7	120.1	64.9	25.1	14.4	2006
13.47	0	3.72	61.3	215.35	267.22	191.66	125.05	63.07	36.67	2007
8.96	0.00	0.13	7.80	99.25	254.85	182.96	106.34	52.68	42.27	2008

SP-SANTR

1986 2008

1 1 0 1

0 8

18.15	0	0.37	10	70.04	114.58	58.99	26.2	11.09	5.76	1986
15	0	0.91	21.25	75.3	183.42	141.44	67.42	29.36	12.1	1987
16.66	0	0.07	3.54	33.46	98.88	64.47	31.69	14.48	6.17	1988
17.61	0	0.48	12.53	70.98	135.76	69.99	28	10.84	4.44	1989
20.47	0	0.34	26.22	151.74	231.1	107.86	41.4	15.21	5.56	1990
22.39	0	0.2	8.28	55.73	162.81	104.93	51.52	22	8.77	1991
22.83	0	0.04	6.08	70.84	168.82	88.11	38.11	16.97	10.02	1992
21.37	0	0.21	42.43	93.52	140.92	100.99	69.64	31.83	14.92	1993
22.77	0	4.12	51.05	113.85	195.38	112.17	31.78	12.05	5.92	1994

14.05	0	0	39.58	161.63	280.32	122.89	37.65	11.62	2.49	1995
12.07	0	0	25.88	204.82	187.26	51.38	25.64	8.04	2.63	1996
11.78	0	0	12.03	84.29	77.11	34.63	15.01	4.85	1.78	1997
10.65	0	0.55	27.73	75	83.25	29.26	10.87	4.51	1.84	1998
10.35	0	0.1	6.2	57.8	85.9	21.3	6	1.7	0.6	1999
8.78	0	0.72	7.34	29.13	50.78	13.35	2.03	0.48	0.25	2000
3.05	0	0.06	11.05	43.28	33.81	10.41	3.14	1.29	0.43	2001
3.98	0	0.28	12.34	48.28	15.44	3.49	1.17	0.26	0.08	2002
3.84	0	0.02	4.97	23.41	15.89	4.04	1.04	0.07	0.01	2003
3.78	0	0.05	7.77	20.16	10.11	2.13	0.41	0.09	0.01	2004
1.4	0	0	1.16	6.26	5.17	1.35	0.47	0.07	0.01	2005
2.72	0	0	4.2	23.5	15.6	4.6	0.8	0.2	0	2006
4.33	0	0.17	16.36	62.49	35.95	10.82	2.65	0.81	0.18	2007
NA	0.00	0.01	5.86	50.63	41.70	14.43	5.40	1.45	0.51	2008
SP-VIMATR										
1990	2008									
1	1	0	1							
0	8									
25.06	2.1	107.3	540.2	322.2	133.7	56.8	30.8	15.1	4.9	1990
29.26	0	40.1	415.3	325.7	116.3	39.9	18.7	9.2	5.6	1991
31.15	0.6	63.5	461.2	728.7	398	119.7	44.2	19.7	6.5	1992
22.2	0.9	121.9	452.6	219.4	78.5	30.6	25.6	10.9	5.4	1993
26.12	0	141.8	607.1	467.3	294.7	84.3	30.3	18	7.6	1994
28.68	0	72.7	2352.3	1079.3	340.1	111.9	55.7	29.4	6.9	1995
29.48	0.8	75.1	875	753.6	201.9	43.6	35.9	19.2	4.5	1996
37.58	0.1	84	768.4	426.8	69.2	28.9	14.3	6.3	1.2	1997
42.37	0	123.51	697.31	250.53	49.44	15.81	8.59	4.42	1.29	1998
39.74	0	78.5	495.9	871.9	134	17.3	6.8	2.4	0.1	1999
33.77	0.12	136.19	593.68	625.64	139.89	32.06	6.19	2.19	1.21	2000
33.8	0	56.22	585.77	449.21	89.31	19.61	7.92	4.83	2.44	2001
24.29	0.09	65.77	413.91	413.6	80.25	22.31	9.3	2.62	1.18	2002
23.15	0	191.25	973.19	462.56	79.14	27.27	9.44	1.9	0.84	2003
11.14	0.01	256.82	589.77	192.24	59.93	22.9	7.48	2.55	0.91	2004
9.98	0	57.33	498.38	466.33	72.19	23.35	14.11	4.85	3.2	2005
11.13	0	157.4	786.1	533.3	50.1	12.7	4.5	1.8	1.3	2006
11.06	0	61.48	537.01	428.17	98.4	36.35	14.19	6.13	2.3	2007
11.03	0.00	43.33	682.77	490.82	155.70	56.76	25.03	10.60	7.06	2008
SP-GFS										
1983	2008									
1	1	0.75	0.83							
0	8									
1	172.63	7.34	6.34	2.63	1.96	0.94	0.28	0.13	0.12	1983
1	394.75	6.13	5.55	1.78	1.12	0.7	0.24	0.08	0.03	1984
1	93.56	6.79	5.47	1.78	0.84	0.34	0.1	0.03	0.01	1985
1	236.24	4.65	3.59	1.81	0.83	0.44	0.16	0.04	0.02	1986
0	0	0	0	0	0	0	0	0	0	1987
1	378.42	4.98	3.57	1.52	0.89	0.39	0.13	0.08	0.03	1988
1	469.86	11.01	4.89	1.22	0.5	0.28	0.13	0.05	0.03	1989
1	72.37	7.56	3.23	1.46	0.8	0.34	0.1	0.04	0.04	1990
1	157.44	5.47	1.97	0.95	0.58	0.32	0.11	0.05	0.02	1991
1	49.78	4.47	3.1	1.29	0.44	0.15	0.06	0.03	0.03	1992
1	67.38	8.69	2.31	0.86	0.42	0.18	0.08	0.05	0.03	1993
1	233.83	7.12	2.06	1.04	0.79	0.17	0.05	0.06	0.01	1994
1	66.57	2.71	6.21	3.7	1.06	0.45	0.1	0.04	0.02	1995

	1	329.39	10.11	2.85	1.47	0.86	0.27	0.13	0.1	0.03	1996
	1	398.15	17.44	3.46	1.82	0.46	0.12	0.03	0.01	0	1997
	1	60.31	9.28	4.33	1.17	0.6	0.27	0.03	0	0	1998
	1	75.86	15.07	1.17	2.19	0.51	0.29	0.05	0.01	0	1999
	1	56.55	5.26	3.11	1.02	0.48	0.26	0.1	0.05	0.03	2000
	1	35.72	3.01	1.56	1.03	0.51	0.1	0.05	0.04	0.02	2001
	1	50.87	3.37	1.14	1.09	0.35	0.19	0.11	0.03	0.01	2002
	1	80.28	9.41	1.93	0.59	0.33	0.15	0.05	0.03	0.03	2003
	1	156.65	17.65	1.76	0.62	0.21	0.12	0.03	0.01	0.02	2004
	1	325.17	13.94	2.99	1.84	0.71	0.13	0.02	0.03	0	2005
	1	209.67	4.31	8.06	1.73	0.37	0.21	0.06	0.05	0.01	2006
	1	143.39	9.17	3.64	1.09	0.48	0.32	0.09	0	0	2007
	1	74.23	17.45	4.69	1.54	0.81	0.36	0.13	0.07	0.04	2008
P-GFS-jul											
1989		2001									
	1	1	0.58	0.67							
	0	8									
	1	1.32	41.43	30.02	10.69	2.45	1	0.41	0.21	0.03	1989
	1	5.33	66.06	13.49	7.84	2.23	1.01	0.42	0.27	0.08	1990
	1	3.61	58.23	27.08	9.4	2.77	1.6	0.9	0.58	0.07	1991
	1	1.4	34.95	23.93	9.16	2.34	1.19	0.65	0.35	0.03	1992
	1	4.24	76.33	11.97	6.71	2.48	1.94	0.84	0.45	0.25	1993
	0	0	0	0	0	0	0	0	0	0	1994
	1	1.7	63.1	50.69	9.63	2.47	1.25	0.27	0.12	0.01	1995
	0	0	0	0	0	0	0	0	0	0	1996
	1	0.51	169.17	27.65	4.83	2.78	0.91	0.39	0.28	0.02	1997
	1	3.09	38.59	15.09	9.9	2.81	1.43	0.44	0.14	0.07	1998
	1	10.7	62.36	37.29	4.25	1.43	0.72	0.24	0.11	0.13	1999
	1	5.26	73.89	25.48	10.68	4.52	1.87	0.75	0.26	0.17	2000
	1	13.08	67.72	30.42	15.45	4.07	0.78	0.54	0.28	0.15	2001
P-GFS-oct											
1989		2008									
	1	1	0.83	0.92							
	0	8									
	1	12.89	20.12	16.89	7.39	1.53	0.37	0.16	0.05	0.04	1989
	1	82.01	45.38	19.31	7.41	2.36	0.41	0.11	0.08	0.08	1990
	1	56.6	82.4	36.69	14.6	3.13	0.65	0.31	0.17	0.19	1991
	1	12.09	20.17	19.11	10.18	2.65	0.61	0.42	0.2	0.13	1992
	1	23.24	17.13	8.56	3.56	1.35	0.27	0.26	0.11	0.08	1993
	1	18.28	50.94	18.26	5.88	1.52	0.31	0.08	0.05	0.11	1994
	1	2.1	34.58	37.15	8.12	2.88	0.39	0.3	0.15	0.08	1995
	1	NA	NA	10.07	6.91	1.94	0.85	0.28	0.11	0.02	1996
	1	40.4	70.39	83.74	8.74	2.34	1.6	0.61	0.01	0	1997
	1	54.02	46.52	22.75	12.33	3.01	1.14	0.56	0.17	0.09	1998
	1	NA	NA	21.21	7.82	2.03	0.39	0.15	0.05	0.07	1999
	1	29.9	39.32	21.41	8.88	1.71	1.01	0.29	0.09	0.05	2000
	1	50.9	73.92	22.21	14.26	2.12	0.62	0.13	0.02	0.02	2001
	1	43.54	37.13	26.78	7.52	2.11	0.41	0.12	0.01	0	2002
	1	NA	NA	10.93	6.1	1.28	0.25	0.11	0.03	0	2003
	1	NA	NA	22.81	7.94	1.71	0.79	0.17	0.15	0.01	2004
	1	105.68	67.42	30.1	7.68	1.99	0.68	0.1	0.09	0	2005
	1	44.69	35.41	32.58	10.03	2.53	0.62	0.32	0.02	0.03	2006
	1	127.52	168.51	48.79	19.75	3.34	1.13	0.74	0.3	0.12	2007
	1	23.26	146.34	87.77	32.32	6.25	2.03	1.30	0.49	0.26	2008

SP-GFS-caut

2000	2008									
0	1	0.83	0.875							
0	5									
1	17.77	2.26	1.86	1.26	1.41	0.33	0.19	0.07	0.00	2000
1	22.50	2.85	3.30	1.12	0.58	0.18	0.08	0.11	0.02	2001
1	116.24	7.16	2.68	0.65	0.32	0.18	0.12	0.08	0.08	2002
1	15.78	2.60	1.39	1.14	0.68	0.21	0.20	0.00	0.07	2003
1	83.60	7.31	2.41	0.99	0.19	0.06	0.00	0.00	0.00	2004
1	88.66	27.38	2.42	1.13	0.29	0.08	0.04	0.00	0.00	2005
1	209.97	6.97	3.15	1.37	0.58	0.23	0.00	0.00	0.00	2006
1	197.66	12.95	6.87	2.25	1.01	0.13	0.08	0.00	0.03	2007
1	60.98	10.64	5.34	1.68	0.60	0.23	0.04	0.02	0.00	2008

Table 7.11 Abundance and F at age

Fig 11 (a) median N-at-age and CV in braquets

N age	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	96761 (0.09)	88433 (0.09)	85819 (0.09)	81634 (0.09)	83283 (0.09)	68186 (0.09)	54721 (0.09)	47572 (0.09)	49021 (0.09)
1	79221 (0.1)	79221 (0.09)	72403 (0.09)	70263 (0.09)	66836 (0.09)	68186 (0.09)	55826 (0.09)	44802 (0.09)	38949 (0.09)
2	53637 (0.1)	57403 (0.1)	54437 (0.09)	48885 (0.09)	48637 (0.09)	46110 (0.09)	46888 (0.09)	37265 (0.09)	30905 (0.09)
3	30946 (0.1)	31392 (0.1)	28873 (0.09)	25705 (0.08)	25156 (0.08)	24707 (0.09)	22980 (0.09)	21923 (0.08)	19271 (0.08)
4	16967 (0.12)	18217 (0.11)	15824 (0.1)	13612 (0.09)	13254 (0.09)	12794 (0.09)	12313 (0.09)	10765 (0.08)	11336 (0.08)
5	9293 (0.17)	10170 (0.13)	9470 (0.11)	7748 (0.1)	7241 (0.09)	6965 (0.09)	6601 (0.09)	6002 (0.09)	5746 (0.09)
6	5756 (0.23)	5314 (0.18)	4915 (0.14)	4264 (0.12)	3825 (0.11)	3542 (0.11)	3328 (0.11)	2948 (0.11)	2982 (0.1)
7	2824 (0.35)	3045 (0.24)	2260 (0.19)	1928 (0.15)	1873 (0.13)	1656 (0.13)	1493 (0.13)	1287 (0.13)	1306 (0.12)
8	1848 (0.45)	2053 (0.27)	1615 (0.21)	1071 (0.18)	989 (0.15)	931 (0.15)	811 (0.15)	639 (0.16)	649 (0.15)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	47099 (0.09)	61698 (0.1)	52575 (0.09)	46166 (0.09)	51021 (0.09)	53104 (0.09)	44356 (0.09)	41357 (0.09)	41773 (0.09)
1	40135 (0.09)	38561 (0.09)	50514 (0.1)	43045 (0.09)	37798 (0.09)	41773 (0.09)	43478 (0.09)	36316 (0.09)	33860 (0.09)
2	27498 (0.09)	28445 (0.09)	26498 (0.09)	34428 (0.1)	29817 (0.09)	29571 (0.09)	32738 (0.09)	34101 (0.09)	28734 (0.09)
3	16723 (0.08)	14947 (0.08)	14264 (0.08)	13135 (0.08)	17606 (0.09)	15399 (0.09)	15327 (0.09)	17717 (0.09)	19441 (0.09)
4	10420 (0.08)	9124 (0.08)	7514 (0.08)	7083 (0.08)	6711 (0.08)	6362 (0.09)	5606 (0.09)	6009 (0.09)	7625 (0.09)
5	6307 (0.09)	5841 (0.08)	4728 (0.09)	3857 (0.09)	3742 (0.08)	2912 (0.09)	2776 (0.09)	2589 (0.09)	2984 (0.09)
6	2996 (0.1)	3326 (0.1)	2809 (0.1)	2248 (0.1)	1889 (0.1)	1638 (0.1)	1279 (0.11)	1290 (0.11)	1294 (0.1)
7	1399 (0.12)	1425 (0.12)	1414 (0.12)	1175 (0.12)	979 (0.12)	739 (0.12)	642 (0.13)	537 (0.13)	591 (0.13)
8	716 (0.15)	789 (0.15)	701 (0.15)	657 (0.15)	599 (0.15)	444 (0.16)	334 (0.17)	305 (0.17)	298 (0.17)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	37798 (0.09)	37798 (0.08)	47099 (0.09)	55826 (0.09)	67508 (0.1)	71682 (0.12)	90219 (0.16)	117008 (0.26)	35242 (0.51)
1	34201 (0.09)	30946 (0.09)	30946 (0.08)	38561 (0.09)	45707 (0.09)	55271 (0.1)	58689 (0.12)	73865 (0.16)	95798 (0.26)
2	26650 (0.09)	26897 (0.09)	24384 (0.09)	24051 (0.08)	30311 (0.09)	36468 (0.09)	43821 (0.1)	46818 (0.12)	58392 (0.16)
3	15803 (0.09)	14630 (0.09)	14644 (0.1)	12479 (0.09)	13785 (0.08)	18875 (0.09)	22107 (0.09)	27055 (0.1)	27849 (0.12)
4	7878 (0.09)	6382 (0.09)	5803 (0.09)	5202 (0.09)	5425 (0.08)	6971 (0.08)	9081 (0.09)	10978 (0.09)	12565 (0.11)
5	3609 (0.09)	3718 (0.09)	2971 (0.1)	2487 (0.1)	2613 (0.09)	3049 (0.08)	3779 (0.09)	5049 (0.09)	5797 (0.1)
6	1427 (0.11)	1719 (0.11)	1741 (0.11)	1282 (0.12)	1253 (0.11)	1477 (0.1)	1665 (0.1)	2114 (0.1)	2683 (0.1)
7	560 (0.12)	617 (0.13)	729 (0.14)	669 (0.15)	592 (0.13)	663 (0.12)	748 (0.12)	864 (0.11)	1035 (0.12)
8	291 (0.17)	278 (0.16)	286 (0.17)	283 (0.19)	344 (0.18)	407 (0.17)	435 (0.16)	503 (0.16)	535 (0.16)

Fig 11 (b) median F-at-age and CV in braquets

	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
1	0.12 (0.19)	0.17 (0.18)	0.2 (0.18)	0.17 (0.18)	0.17 (0.18)	0.18 (0.18)	0.2 (0.17)	0.16 (0.18)	0.15 (0.18)
2	0.33 (0.14)	0.48 (0.13)	0.55 (0.12)	0.46 (0.13)	0.47 (0.13)	0.49 (0.12)	0.56 (0.12)	0.46 (0.13)	0.41 (0.13)
3	0.33 (0.13)	0.49 (0.12)	0.55 (0.12)	0.46 (0.12)	0.47 (0.11)	0.49 (0.12)	0.56 (0.11)	0.46 (0.11)	0.41 (0.12)
4	0.31 (0.13)	0.45 (0.12)	0.51 (0.12)	0.43 (0.12)	0.44 (0.11)	0.46 (0.12)	0.52 (0.11)	0.43 (0.12)	0.38 (0.12)
5	0.36 (0.14)	0.53 (0.12)	0.59 (0.12)	0.5 (0.12)	0.51 (0.12)	0.54 (0.12)	0.6 (0.12)	0.5 (0.12)	0.45 (0.12)
6	0.44 (0.14)	0.65 (0.12)	0.73 (0.12)	0.62 (0.12)	0.63 (0.12)	0.66 (0.12)	0.74 (0.12)	0.61 (0.12)	0.55 (0.12)
7	0.58 (0.15)	0.85 (0.15)	0.96 (0.15)	0.81 (0.14)	0.83 (0.14)	0.87 (0.14)	0.98 (0.14)	0.8 (0.14)	0.73 (0.14)
8	0.78 (0.15)	1.14 (0.14)	1.29 (0.14)	1.09 (0.14)	1.12 (0.14)	1.16 (0.13)	1.31 (0.13)	1.08 (0.14)	0.97 (0.14)

	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
1	0.15 (0.18)	0.17 (0.18)	0.18 (0.18)	0.17 (0.18)	0.05 (0.18)	0.05 (0.18)	0.04 (0.19)	0.04 (0.19)	0.04 (0.19)
2	0.4 (0.13)	0.49 (0.13)	0.5 (0.12)	0.47 (0.13)	0.46 (0.12)	0.45 (0.12)	0.41 (0.13)	0.36 (0.13)	0.39 (0.13)
3	0.41 (0.12)	0.49 (0.11)	0.5 (0.12)	0.47 (0.12)	0.82 (0.1)	0.81 (0.11)	0.73 (0.1)	0.64 (0.12)	0.7 (0.12)
4	0.38 (0.12)	0.45 (0.12)	0.47 (0.12)	0.44 (0.12)	0.63 (0.11)	0.63 (0.11)	0.57 (0.12)	0.5 (0.12)	0.54 (0.11)
5	0.44 (0.12)	0.53 (0.12)	0.54 (0.12)	0.51 (0.12)	0.62 (0.11)	0.62 (0.11)	0.56 (0.12)	0.49 (0.13)	0.54 (0.12)
6	0.54 (0.12)	0.65 (0.12)	0.67 (0.12)	0.63 (0.12)	0.73 (0.11)	0.73 (0.12)	0.66 (0.12)	0.58 (0.13)	0.63 (0.12)
7	0.71 (0.14)	0.86 (0.14)	0.88 (0.15)	0.83 (0.15)	1 (0.14)	1 (0.14)	0.9 (0.15)	0.79 (0.15)	0.86 (0.15)
8	0.95 (0.14)	1.15 (0.14)	1.18 (0.14)	1.11 (0.14)	1.19 (0.16)	1.18 (0.16)	1.07 (0.17)	0.93 (0.17)	1.02 (0.17)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
1	0.04 (0.19)	0.04 (0.19)	0.05 (0.19)	0.04 (0.19)	0.03 (0.19)	0.03 (0.19)	0.03 (0.19)	0.03 (0.19)	0.04 (0.21)
2	0.4 (0.13)	0.41 (0.13)	0.47 (0.13)	0.35 (0.13)	0.27 (0.13)	0.3 (0.13)	0.28 (0.13)	0.32 (0.13)	0.38 (0.15)
3	0.71 (0.11)	0.72 (0.12)	0.83 (0.11)	0.63 (0.12)	0.48 (0.12)	0.53 (0.12)	0.5 (0.12)	0.56 (0.11)	0.67 (0.14)
4	0.55 (0.12)	0.56 (0.12)	0.64 (0.13)	0.49 (0.12)	0.37 (0.12)	0.41 (0.12)	0.39 (0.12)	0.44 (0.12)	0.52 (0.14)
5	0.54 (0.12)	0.55 (0.13)	0.64 (0.13)	0.48 (0.13)	0.37 (0.12)	0.4 (0.12)	0.38 (0.12)	0.43 (0.12)	0.51 (0.15)
6	0.64 (0.12)	0.65 (0.13)	0.75 (0.14)	0.57 (0.13)	0.43 (0.13)	0.48 (0.13)	0.45 (0.13)	0.51 (0.12)	0.61 (0.15)
7	0.87 (0.15)	0.89 (0.15)	1.03 (0.16)	0.78 (0.17)	0.59 (0.16)	0.65 (0.16)	0.61 (0.16)	0.69 (0.15)	0.83 (0.17)
8	1.03 (0.17)	1.05 (0.17)	1.21 (0.18)	0.92 (0.18)	0.7 (0.18)	0.77 (0.18)	0.73 (0.18)	0.82 (0.17)	0.98 (0.19)

Table 7.12. Southern Hake Stock. Bayesian estimates and uncertainty

	Fbar(2-5)				R (thousands)				SSB (tonnes)				Yield (tonnes)			
Year	**P 5%**	**median**	**P 95%**	**CV**	**P 5%**	**median**	**P 95%**	**CV**	**P 5%**	**median**	**P 95%**	**CV**	**P 5%**	**median**	**P 95%**	**CV**
1982	0.27	0.33	0.40	0.12	83283	96761	113550	0.09	23912	27933	32765	0.10	12502	15178	18591	0.12
1983	0.41	0.49	0.58	0.11	76880	88433	103777	0.09	30163	34321	39160	0.08	17787	21476	25813	0.11
1984	0.46	0.55	0.65	0.10	73865	85819	99708	0.09	24242	27454	31070	0.07	17494	21231	25626	0.12
1985	0.39	0.46	0.55	0.10	70263	81634	94845	0.09	21186	23717	26512	0.07	12755	15224	18249	0.11
1986	0.40	0.47	0.56	0.10	71682	83283	97734	0.09	17036	19045	21225	0.07	12363	14622	17317	0.10
1987	0.42	0.50	0.58	0.10	59278	68186	78433	0.09	15751	17641	19634	0.07	12000	14145	16606	0.10
1988	0.48	0.56	0.65	0.10	47099	54721	62944	0.09	14854	16688	18659	0.07	12437	14834	17592	0.10
1989	0.39	0.46	0.54	0.10	41357	47572	54721	0.09	14809	16586	18496	0.07	9467	11272	13316	0.10
1990	0.35	0.41	0.49	0.10	42617	49021	56954	0.09	14356	15982	17720	0.06	8502	10082	11910	0.10
1991	0.34	0.41	0.48	0.10	40538	47099	54721	0.09	17734	19539	21459	0.06	8279	9827	11494	0.10
1992	0.41	0.49	0.58	0.10	52575	61698	71718	0.10	15917	17624	19384	0.06	9506	11261	13271	0.10
1993	0.42	0.50	0.59	0.10	45707	52575	61698	0.09	13478	14882	16470	0.06	8931	10709	12786	0.11
1994	0.40	0.47	0.56	0.10	40135	46166	53637	0.09	11209	12400	13651	0.06	7929	9519	11302	0.11
1995	0.55	0.63	0.73	0.09	44356	51021	59278	0.09	10216	11327	12533	0.06	7984	9433	11055	0.10
1996	0.54	0.63	0.73	0.09	46166	53104	61084	0.09	13417	14719	16300	0.06	7964	9411	11191	0.10
1997	0.48	0.57	0.67	0.10	38561	44356	51534	0.09	10183	11203	12350	0.06	6657	7904	9417	0.10
1998	0.41	0.50	0.59	0.11	35954	41357	48050	0.09	6604	7288	8124	0.06	6392	7721	9333	0.12
1999	0.46	0.54	0.64	0.10	36316	41773	48533	0.09	10165	11154	12289	0.06	6544	7877	9467	0.11
2000	0.46	0.55	0.65	0.10	32860	37798	43915	0.09	11230	12272	13511	0.06	6571	7828	9335	0.11
2001	0.46	0.56	0.67	0.11	33190	37798	43478	0.08	8338	9262	10325	0.07	6129	7341	8797	0.11
2002	0.54	0.64	0.77	0.11	40538	47099	53637	0.09	9733	10805	12072	0.07	6814	8252	9965	0.12
2003	0.41	0.49	0.58	0.11	48050	55826	64861	0.09	7644	8541	9625	0.07	5024	6100	7431	0.12
2004	0.31	0.37	0.44	0.11	57526	67508	78433	0.10	9366	10254	11297	0.06	4740	5689	6808	0.11
2005	0.35	0.41	0.48	0.10	59278	71682	86682	0.12	10321	11323	12433	0.06	5735	6898	8265	0.11
2006	0.32	0.39	0.46	0.11	69564	90219	117008	0.16	14748	16109	17590	0.05	7099	8482	10109	0.11
2007	0.37	0.44	0.52	0.10	76880	117008	179872	0.26	19589	21454	23612	0.06	10115	12018	14091	0.10
2008	0.42	0.52	0.65	0.13	15994	35242	75358	0.51	20436	22689	25249	0.07	11981	14302	16952	0.11

Table 7.13 - Hake Southern Stock - Single option prediction input data
(short term forecast was performed based on bayesian posterior distribution)

Year: 2009								
Age	Stock size*	Natural mortality	Maturity ogive	Prop. of F bef. spaw.	Prop. of M bef. spaw.	Weight in stock	Exploit. pattern*	Weight in catch
0	49513.47	0.2	0.00	0	0	0.05	0.00	0.05
1	28853.89	0.2	0.09	0	0	0.11	0.04	0.11
2	75521.88	0.2	0.26	0	0	0.19	0.38	0.19
3	32622.56	0.2	0.48	0	0	0.32	0.67	0.32
4	11636.1	0.2	0.72	0	0	0.61	0.52	0.61
5	6093.071	0.2	0.86	0	0	0.86	0.51	0.86
6	2830.977	0.2	0.94	0	0	1.14	0.61	1.14
7	1193.817	0.2	0.97	0	0	1.31	0.83	1.31
8+	535.729	0.2	0.99	0	0	1.95	0.98	1.95
Units	thousands					kg		kg

Year: 2010								
Age	Recruit.* (age 0)	Natural mortality	Maturity ogive	Prop. of F bef. spaw.	Prop. of M bef. spaw.	Weight in stock	Exploit. pattern*	Weight in catch
0	49513	0.2	0.00	0	0	0.05	0.00	0.05
1	-	0.2	0.09	0	0	0.11	0.04	0.11
2	-	0.2	0.26	0	0	0.19	0.38	0.19
3	-	0.2	0.48	0	0	0.32	0.67	0.32
4	-	0.2	0.72	0	0	0.61	0.52	0.61
5	-	0.2	0.86	0	0	0.86	0.51	0.86
6	-	0.2	0.94	0	0	1.14	0.61	1.14
7	-	0.2	0.97	0	0	1.31	0.83	1.31
8+	-	0.2	0.99	0	0	1.95	0.98	1.95
Units	thousands					kg		kg

Year: 2011								
Age	Recruit.* (age 0)	Natural mortality	Maturity ogive	Prop. of F bef. spaw.	Prop. of M bef. spaw.	Weight in stock	Exploit. pattern*	Weight in catch
0	49513.47	0.2	0.00	0	0	0.05	0.00	0.05
1	-	0.2	0.09	0	0	0.11	0.04	0.11
2	-	0.2	0.26	0	0	0.19	0.38	0.19
3	-	0.2	0.48	0	0	0.32	0.67	0.32
4	-	0.2	0.72	0	0	0.61	0.52	0.61
5	-	0.2	0.86	0	0	0.86	0.51	0.86
6	-	0.2	0.94	0	0	1.14	0.61	1.14
7	-	0.2	0.97	0	0	1.31	0.83	1.31
8+	-	0.2	0.99	0	0	1.95	0.98	1.95
Units	thousands					kg		kg

Input units are thousands and kg - output in tonnes

bayesian model
* median values from bayesian posterior
Fbar age range: 2-5

Table 7.14. Input data for stochastic prediction.

Age	selection pattern			Stock size in 2008		
	5%	50%	95%	5%	50%	95%
0	0.00	0.00	0.00	15994	35242	75358
1	0.03	0.04	0.05	62944	95798	147267
2	0.29	0.38	0.48	45010	58392	75736
3	0.53	0.67	0.84	22900	27849	33937
4	0.41	0.52	0.66	10602	12565	15017
5	0.40	0.51	0.65	4952	5797	6828
6	0.48	0.61	0.77	2247	2683	3191
7	0.62	0.83	1.09	851	1035	1263
8	0.71	0.98	1.31	417	535	698
Units				thousands		

Table 7.15. Southern Hake Stock. Bayesian predictions and uncertainty

	Fbar(2-5)				R (thousands)				SSB (tonnes)				Yield (tonnes)			
Year	P 5%	median	P 95%	CV	P 5%	median	P 95%	CV	P 5%	median	P 95%	CV	P 5%	median	P 95%	CV
2008	0.42	0.52	0.65	0.13	15994	35242	75358	0.51	20436	22689	25249	0.07	11981	14302	16952	0.11
2009	0.42	0.52	0.65	0.13	35596	49513	98716	0.40	20652	24601	29134	0.11	14064	16459	19416	0.10
2010	0.42	0.52	0.65	0.13	35596	49513	98716	0.40	18815	24648	31940	0.16	12784	15552	19413	0.13
2001	0.42	0.52	0.65	0.13	35596	49513	98716	0.40	16224	23121	32475	0.21	10466	13133	16980	0.15

Table 7.16 - Hake Southern Stock

Single option prediction detailed tables (median values)

Year: 2009		F multiplier: 1		Fbar: 0.52		1 January	
Age	Absolut F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp. Stock size	Sp. Stock biomass
0	0.00	0	0	49513	2327	56	3
1	0.04	992	110	28854	3193	2654	294
2	0.38	21610	4135	75522	14450	19526	3736
3	0.67	14543	4712	32623	10570	15696	5086
4	0.52	4290	2595	11636	7040	8335	5043
5	0.51	2225	1920	6093	5258	5247	4528
6	0.61	1172	1341	2831	3241	2675	3062
7	0.83	613	801	1194	1559	1162	1518
8+	0.98	303	592	536	1044	532	1038
Total			16459				24600
Unit		thousands	tonnes	thousands	tonnes	thousands	tonnes

Year: 2010		F multiplier: 1		Fbar: 0.52		1 January	
9	Absolut F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp. Stock size	Sp. Stock biomass
0	0.00	0	0	49513	2327	56	3
1	0.04	1430	158	40538	4486	3729	413
2	0.38	6449	1234	22563	4317	5834	1116
3	0.67	18896	6122	42282	13699	20344	6591
4	0.52	5034	3046	13575	8213	9724	5883
5	0.51	2060	1778	5677	4899	4888	4219
6	0.61	1234	1412	2969	3398	2806	3212
7	0.83	644	842	1261	1647	1228	1604
8+	0.98	336	656	591	1153	587	1145
Total			15562				24647
Unit		thousands	tonnes	thousands	tonnes	thousands	tonnes

Year: 2011		F multiplier: 1		Fbar: 0.52		1 January	
Age	Absolut F	Catch in numbers	Catch in weight	Stock size	Stock biomass	Sp. Stock size	Sp. Stock biomass
0	0.00	0	0	49513	2327	56	3
1	0.04	1430	158	40538	4486	3729	413
2	0.38	9184	1757	31846	6093	8234	1575
3	0.67	5627	1823	12598	4082	6062	1964
4	0.52	6509	3938	17702	10710	12681	7672
5	0.51	2415	2084	6613	5707	5694	4914
6	0.61	1148	1314	2771	3172	2619	2997
7	0.83	678	886	1326	1731	1291	1686
8+	0.98	362	705	638	1243	633	1235
Total			13196				23152
Unit		thousands	tonnes	thousands	tonnes	thousands	tonnes

median figures from bayesian posterior.
Notice sum of medians does not equal medians of sums
Input units are thousands and kg - output in tonnes
Fbar age range: 2-5

Table 7.17 - Hake Southern Stock - Management option table with Bayesian prediction.

2009

biomass*	ssb*	fmult	fbar*	yield*	P[SSB<Blim]	P[Fbar>0.27]
49814	24601	1.00	0.52	16459	0.57	1.00

2010

biomass*	ssb*	fmult	fbar*	P[Fbar>0.27]	yield*	P[Y<>15%TAC2009]
45608	24648	0	0.00	0.00	0	1.00
45608	24648	0.1	0.05	0.00	1999	1.00
45608	24648	0.2	0.10	0.00	3881	1.00
45608	24648	0.24	0.13	0.00	4659	1.00
45608	24648	0.3	0.16	0.00	5654	0.93
45608	24648	0.4	0.21	0.02	7328	0.34
45608	24648	0.50	0.26	0.39	8903	0.38
45608	24648	0.60	0.31	0.87	10394	0.82
45608	24648	0.70	0.37	0.99	11798	0.98
45608	24648	0.80	0.42	1.00	13119	1.00
45608	24648	0.90	0.47	1.00	14373	1.00
45608	24648	1.00	0.52	1.00	15552	1.00
45608	24648	1.10	0.57	1.00	16672	1.00
45608	24648	1.20	0.63	1.00	17727	1.00
45608	24648	1.30	0.68	1.00	18722	1.00
45608	24648	1.40	0.73	1.00	19674	1.00
45608	24648	1.50	0.78	1.00	20573	1.00
45608	24648	1.60	0.84	1.00	21424	1.00
45608	24648	1.70	0.89	1.00	22225	1.00
45608	24648	1.80	0.94	1.00	22974	1.00
45608	24648	1.90	0.99	1.00	23691	1.00
45608	24648	2.00	1.04	1.00	24389	1.00

2011

biomass*	ssb*	P[SSB<Blim]	P[SSB<SSB2008]
63337	40253	0.00	0.00
60421	38004	0.01	0.00
57780	35868	0.02	0.00
56717	35003	0.03	0.00
55220	33906	0.04	0.01
52795	32057	0.09	0.02
50584	30321	0.15	0.04
48415	28692	0.23	0.09
46383	27175	0.33	0.15
44503	25748	0.44	0.24
42728	24386	0.55	0.35
41048	23109	0.65	0.45
39462	21900	0.73	0.57
37993	20763	0.80	0.67
36562	19708	0.86	0.75
35230	18716	0.90	0.82
34012	17775	0.93	0.88
32813	16887	0.95	0.91
31725	16038	0.97	0.94
30670	15245	0.98	0.97
29700	14501	0.99	0.98
28786	13808	0.99	0.99

Blim 25 000 t
Btrg=Bpa 35 000 t recovery plan target
Ftrg 0.27 recovery plan target
* median values

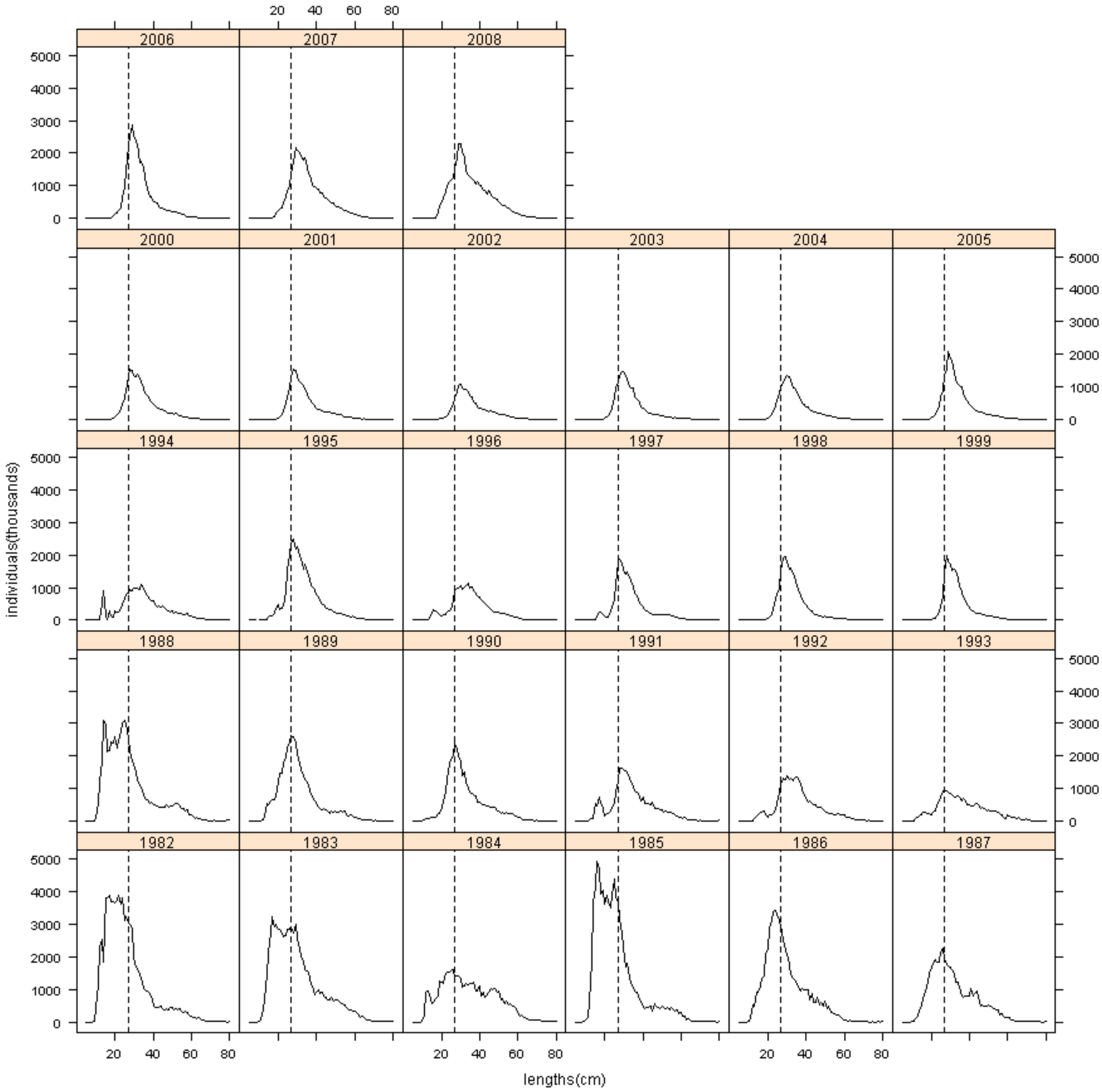
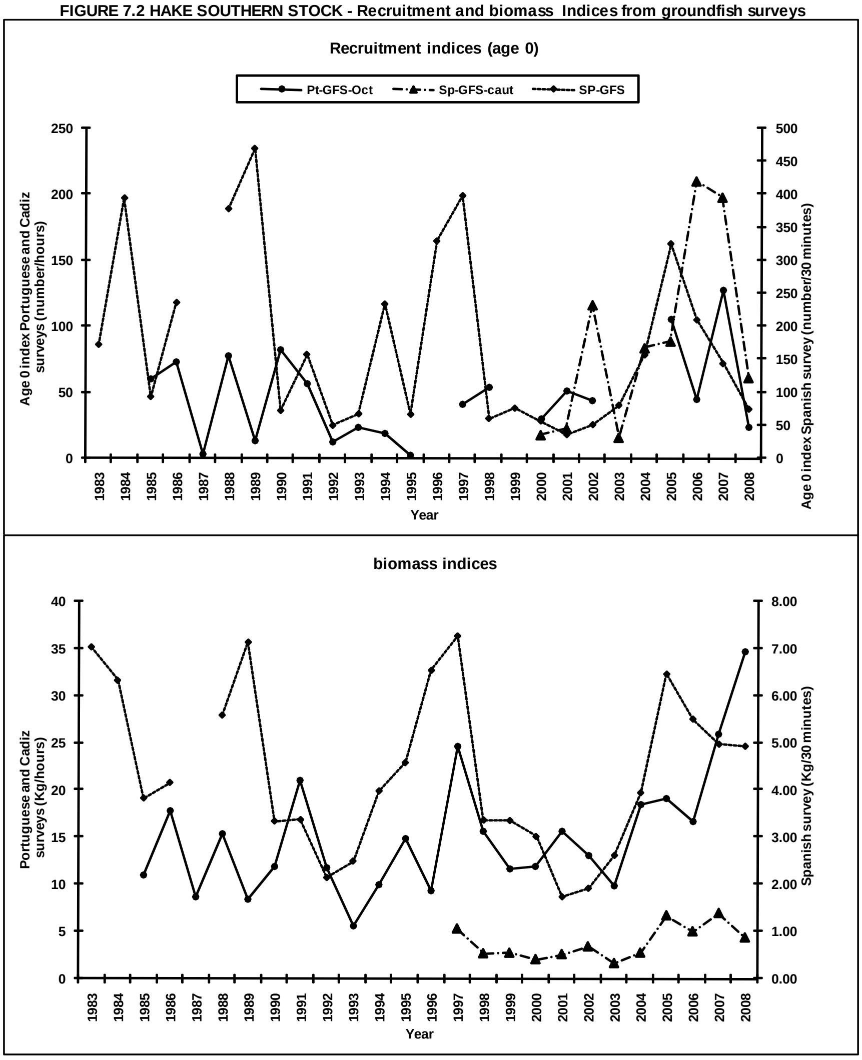


Figure 7.1. Southern Hake Stock. Length distribution of landings from 1982 to 2008(without Gulf of Cádiz)

FIGURE 7.2 HAKE SOUTHERN STOCK - Recruitment and biomass Indices from groundfish surveys



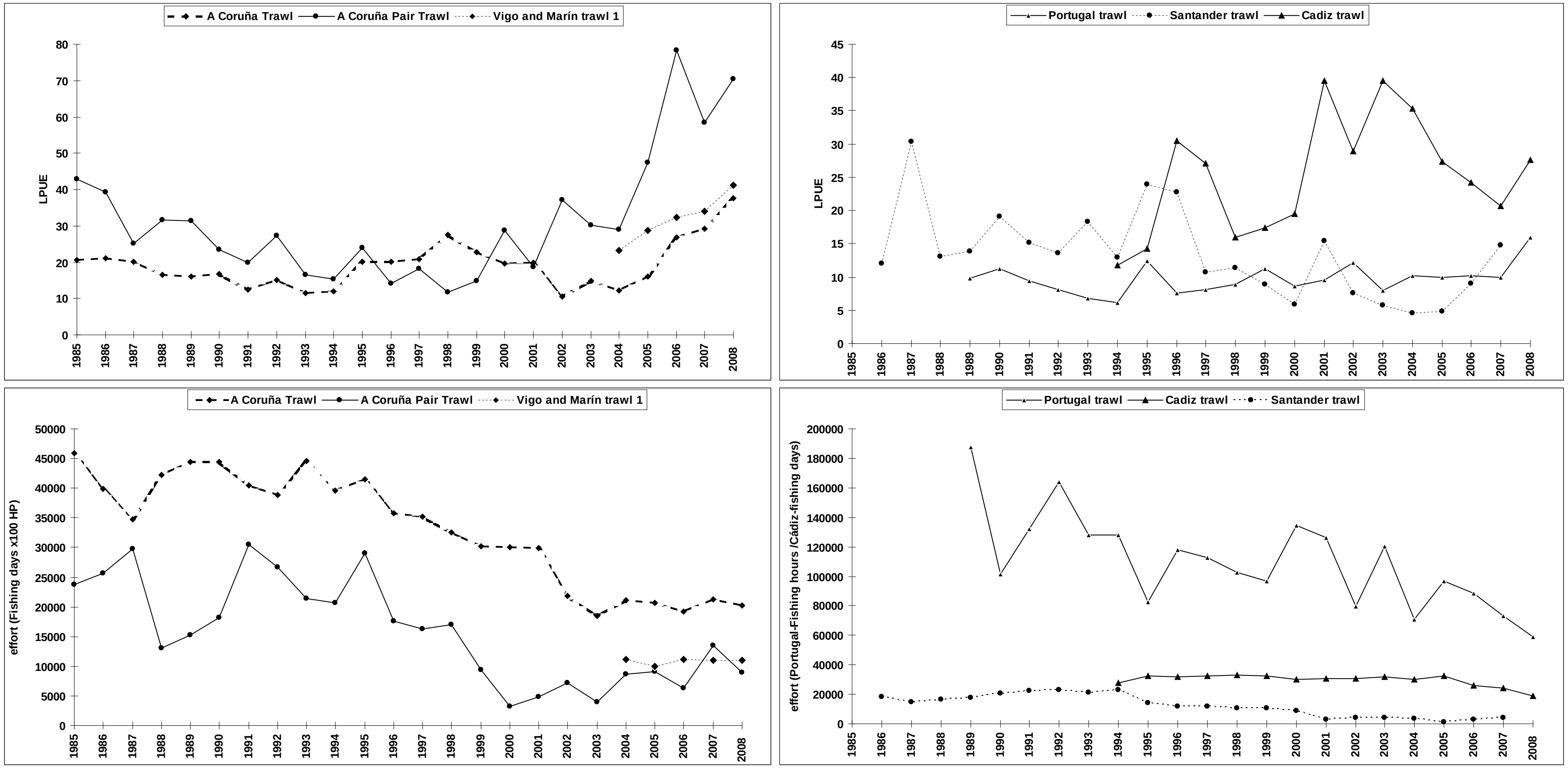
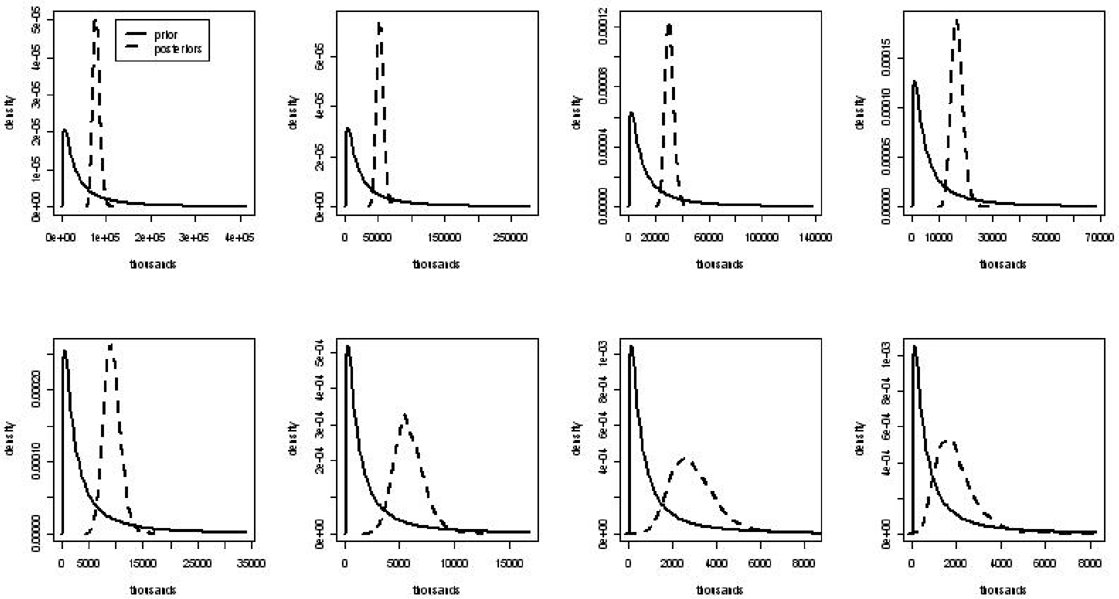
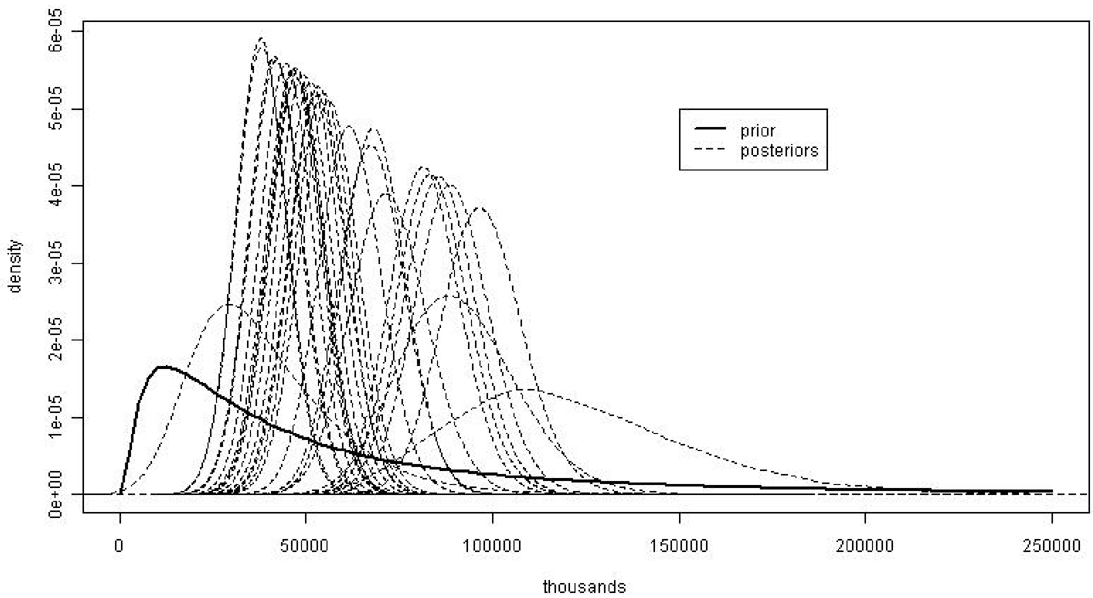


Figure 7.3 HAKE SOUTHERN STOCK - LPUE and fishing effort trends for trawl fleets

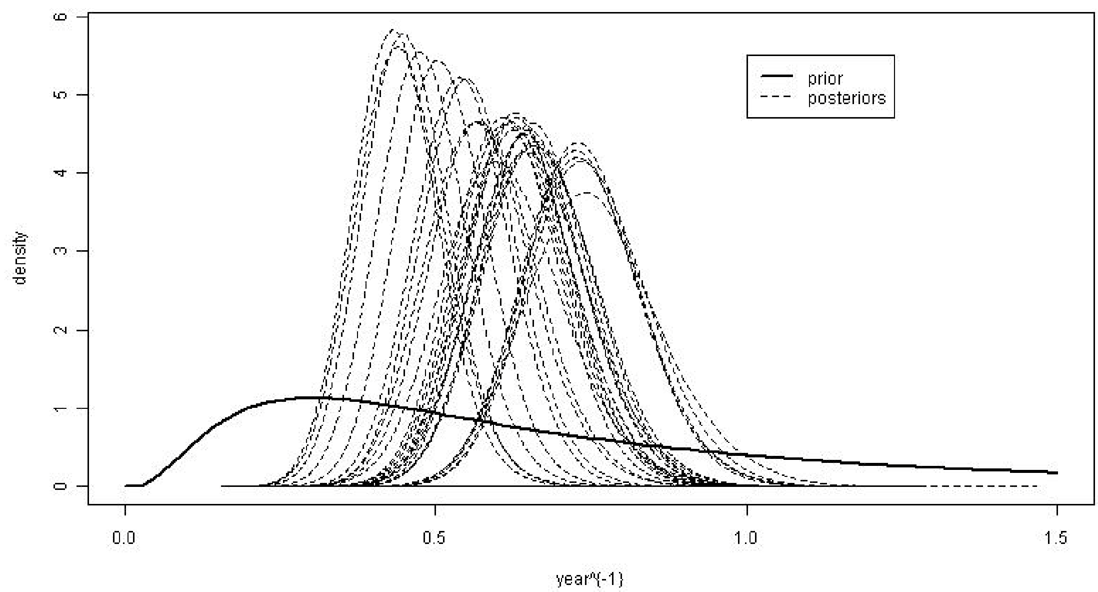
Figure 7.4. Priors and posteriors for: (a) Abundance at age (1-8+) in first year; (b) Abundance at age 0; (c) f at year; (d) selection at age in first separable period; (e) selection at age in second separable period; (f) Spanish autumn demersal survey (SP-GFS) log catchability; (g) Portuguese autumn demersal survey (P-GFS-oct) log catchability ; (h) Coruña trawl LPUE (1985-1993) log catchability; (i) Coruña trawl LPUE (1994-2008) log catchability; (j) Portuguese trawl LPUE (1995-2008) log catchability .



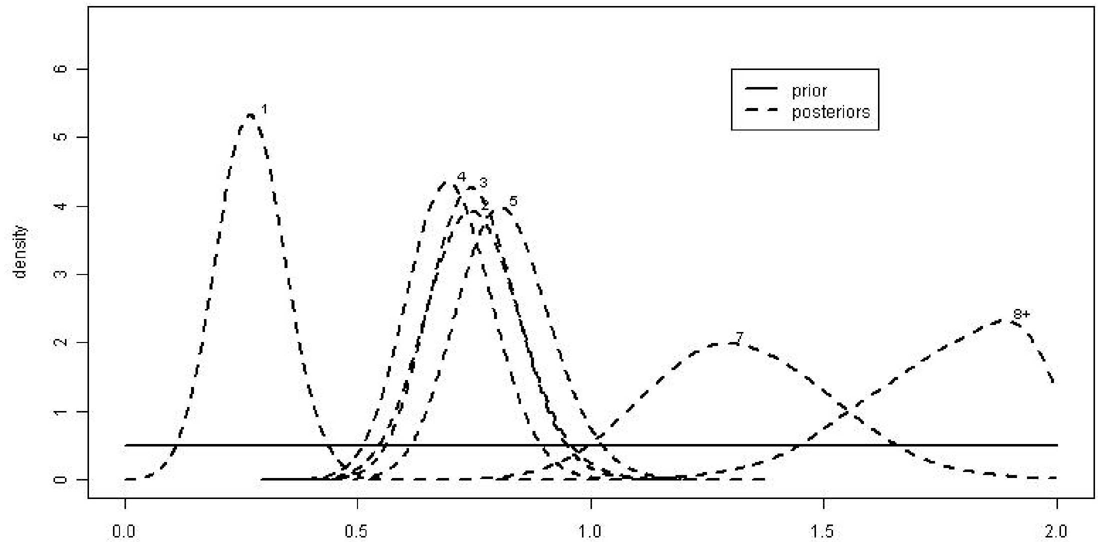
7.4(a). Abundance at age (1-8+) in first year (1982)



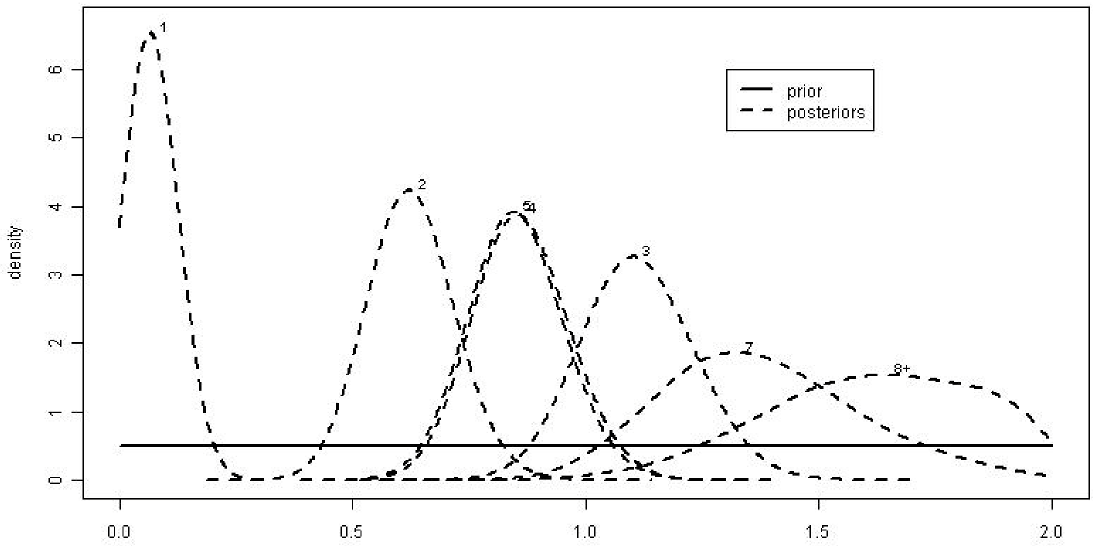
7.4(b). Abundance at age 0 (recruitments). Common prior and posteriors for each year (1982-2008).



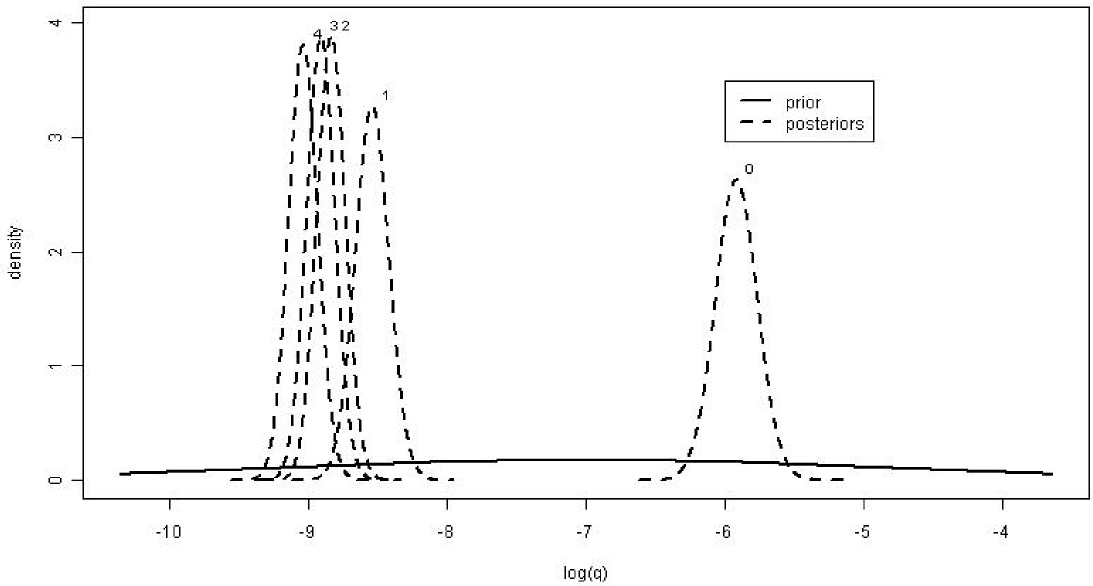
7.4 (c) f at year (separable F). Common prior and posteriors for each year (1982-2008)



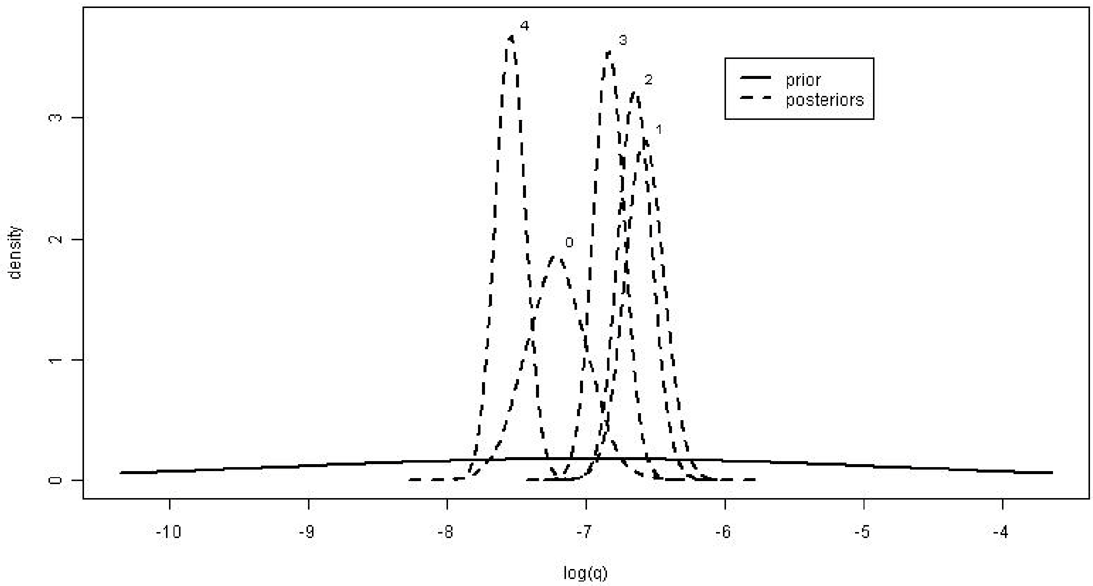
7.4 (d) selection at age in first separable period (1982-1994). Common prior and posteriors for each age (1–8+)



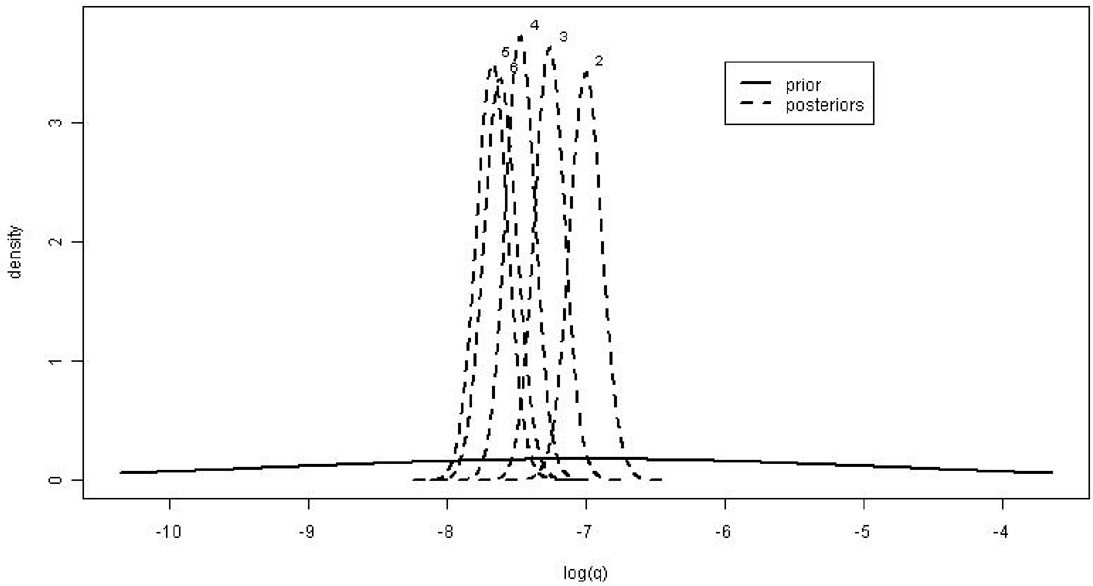
7.4 (e) selection at age in second separable period (1995-2008). Common prior and posteriors for each age (1–8+)



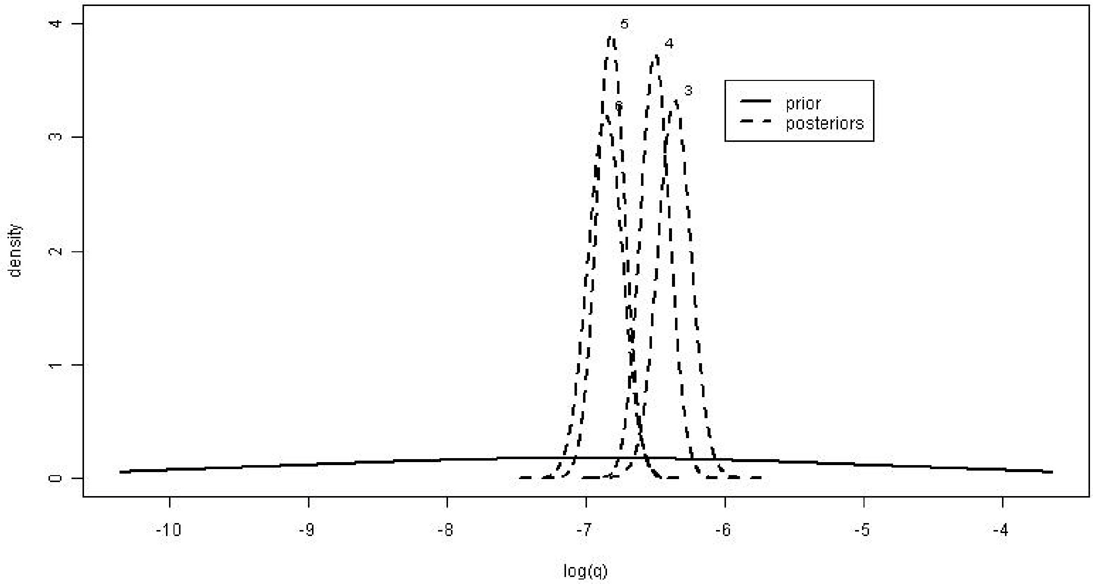
7.4 (f) Spanish autumn demersal survey (SP-GFS) log catchability



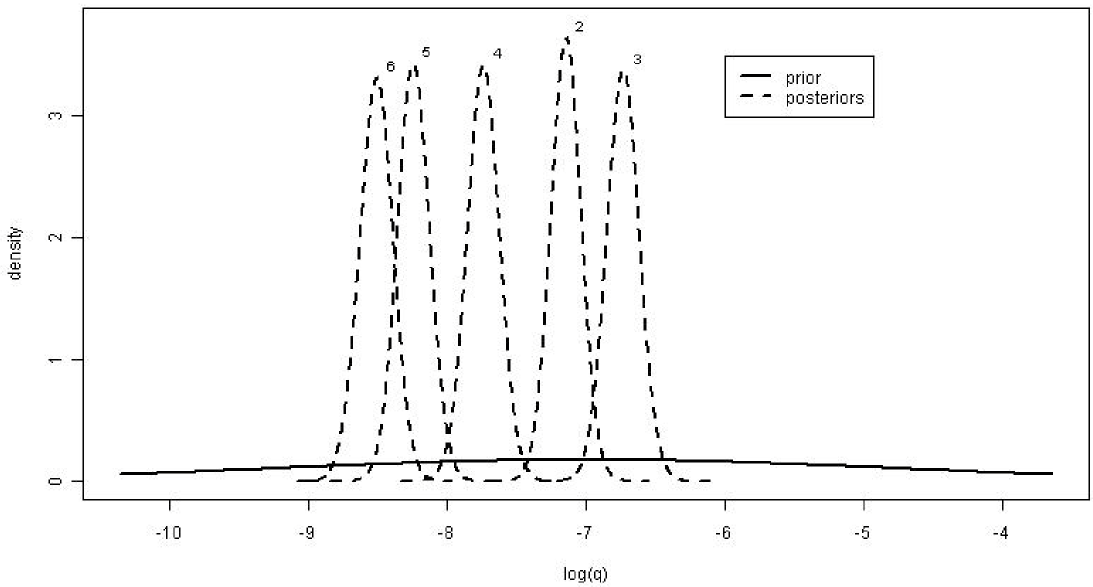
7.4 (g) Portuguese autumn demersal survey (PT-GFS) log catchability



7.4 (h) Coruña trawl LPUE (1985-1993) log catchability

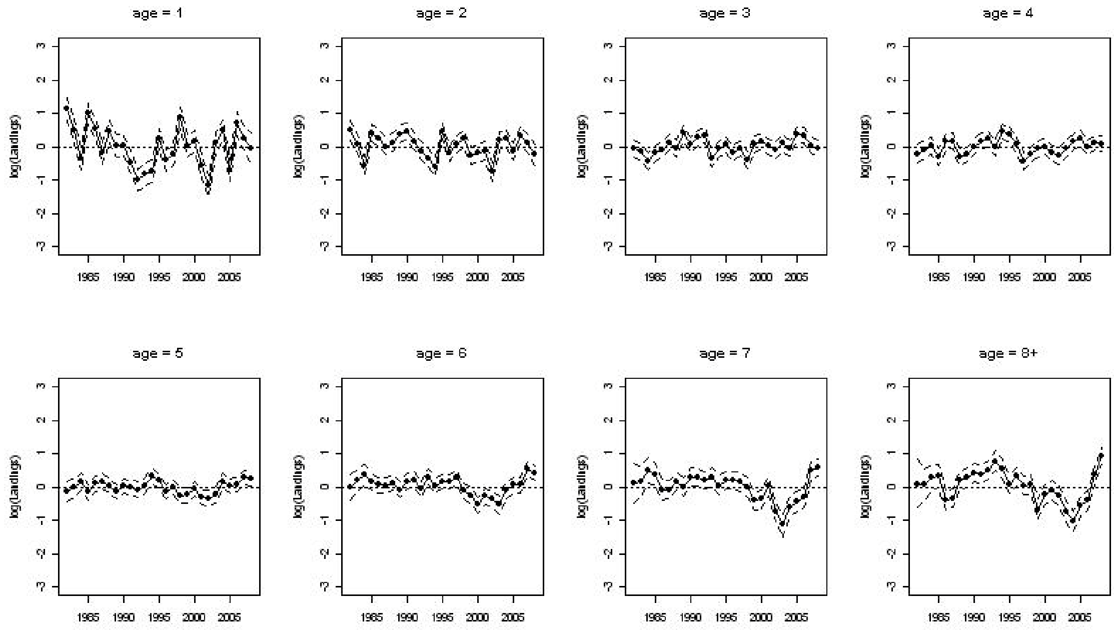


7.4 (i) Coruña trawl LPUE (1994-2008) log catchability

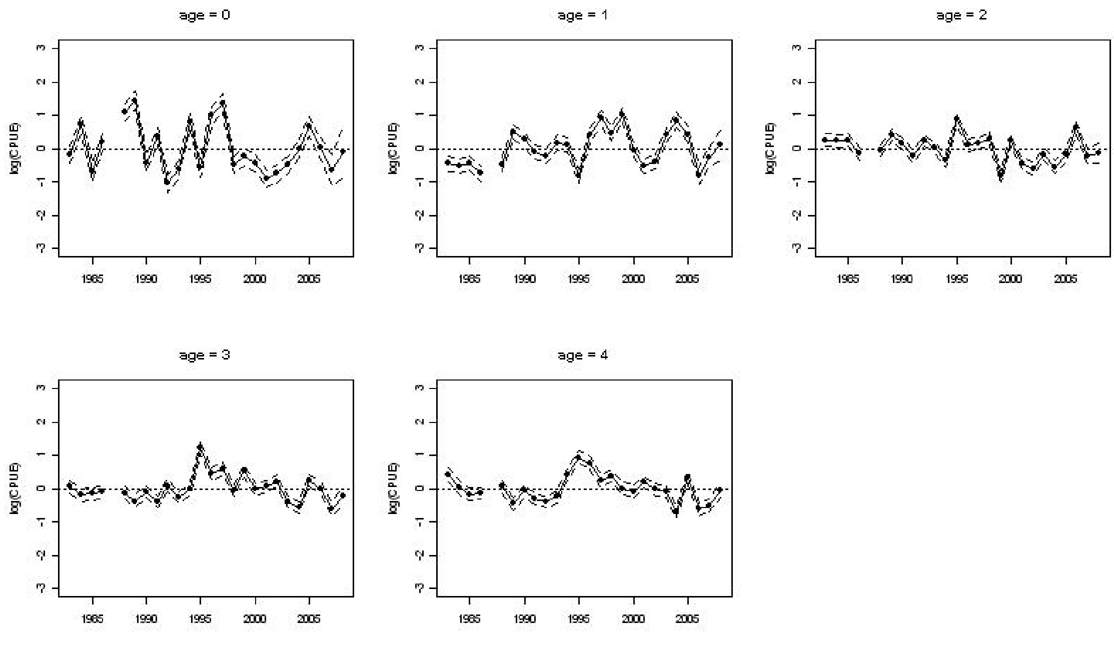


7.4 (j) Portuguese trawl CPUE (1995-2008) log catchability

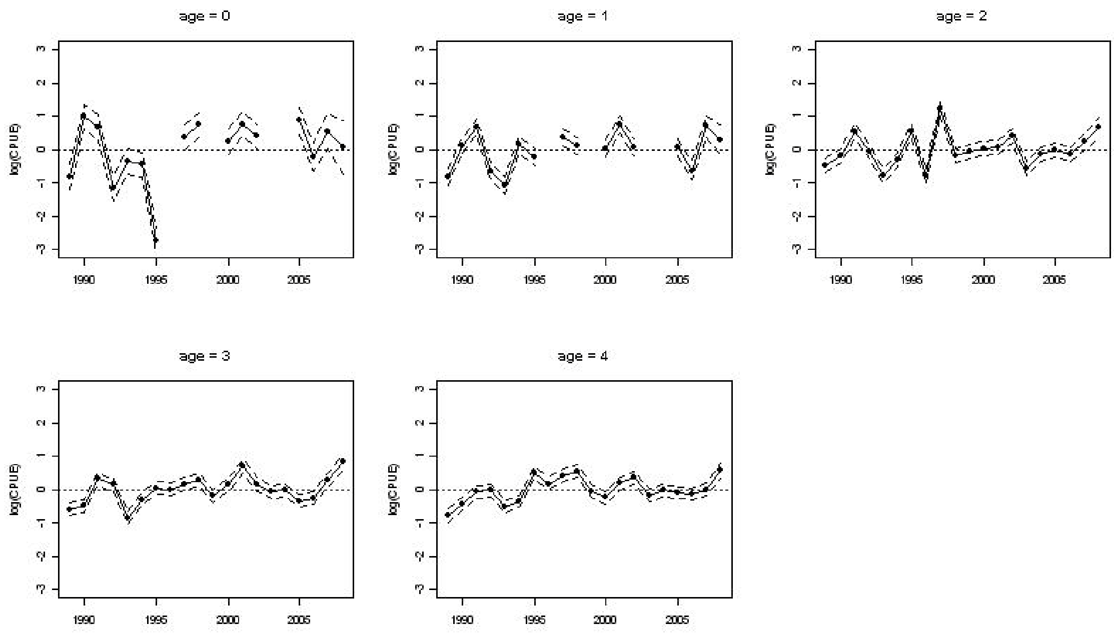
Figure 7.5. Bayesian stochastic residuals at age for: (a) Catch; (b) Spanish autumn survey; (c) Portuguese autumn survey; (d) Coruña trawl LPUE (1985-1993); (e) Coruña trawl LPUE (1994-2008); (f) Portuguese trawl LPUE (1995-2008). CI [0.05-0.95]



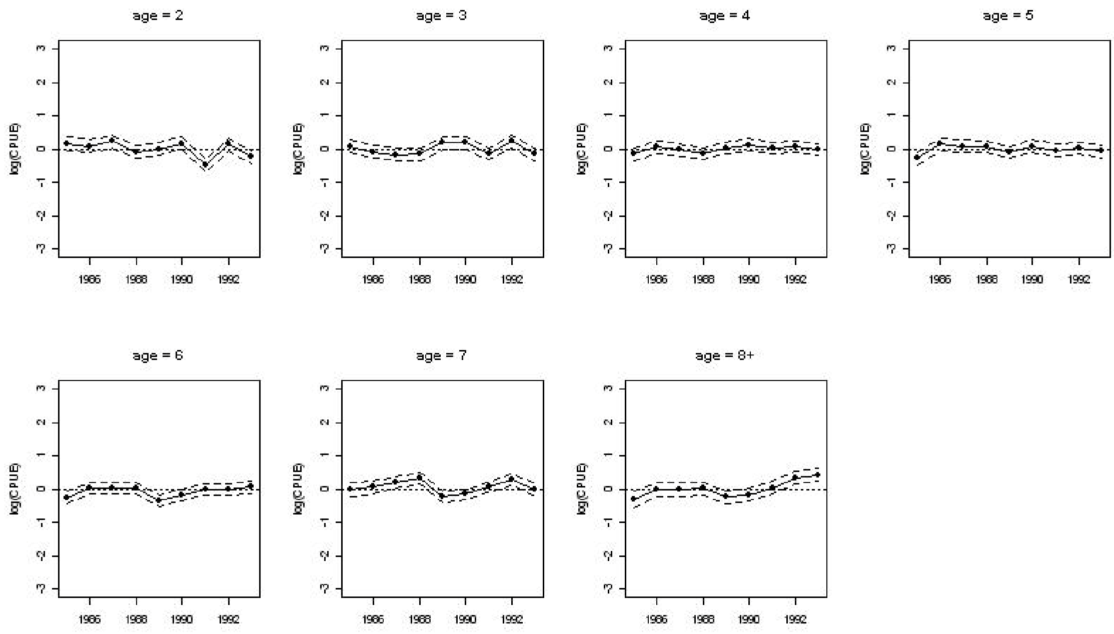
7.5 (a) Catch at age residuals



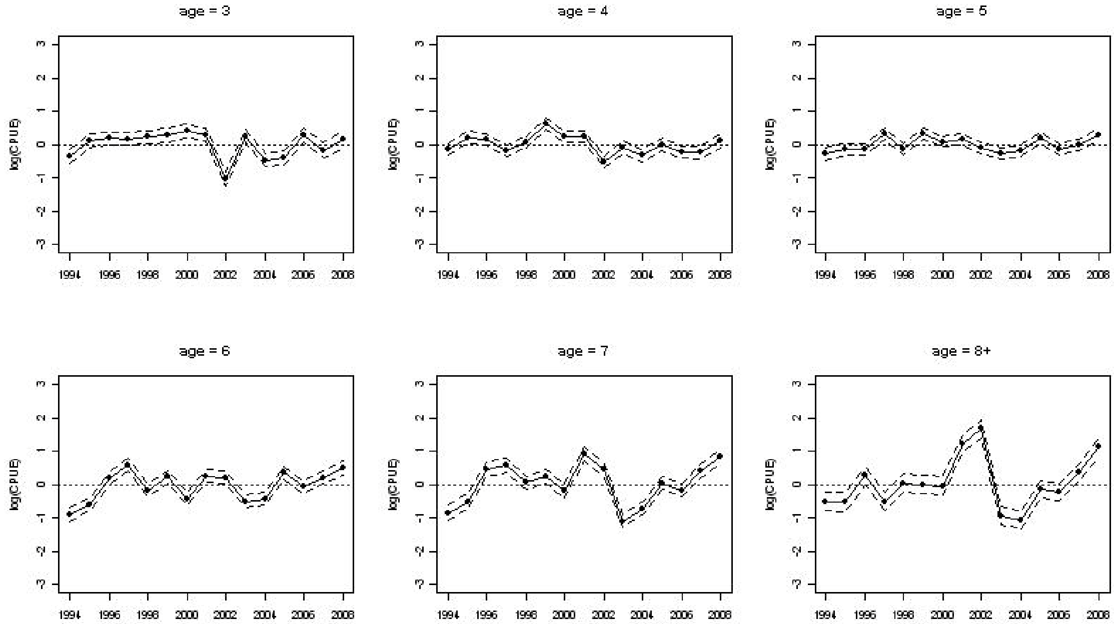
7.5 (b) Spanish autumn survey (SP-GFS) residuals at age



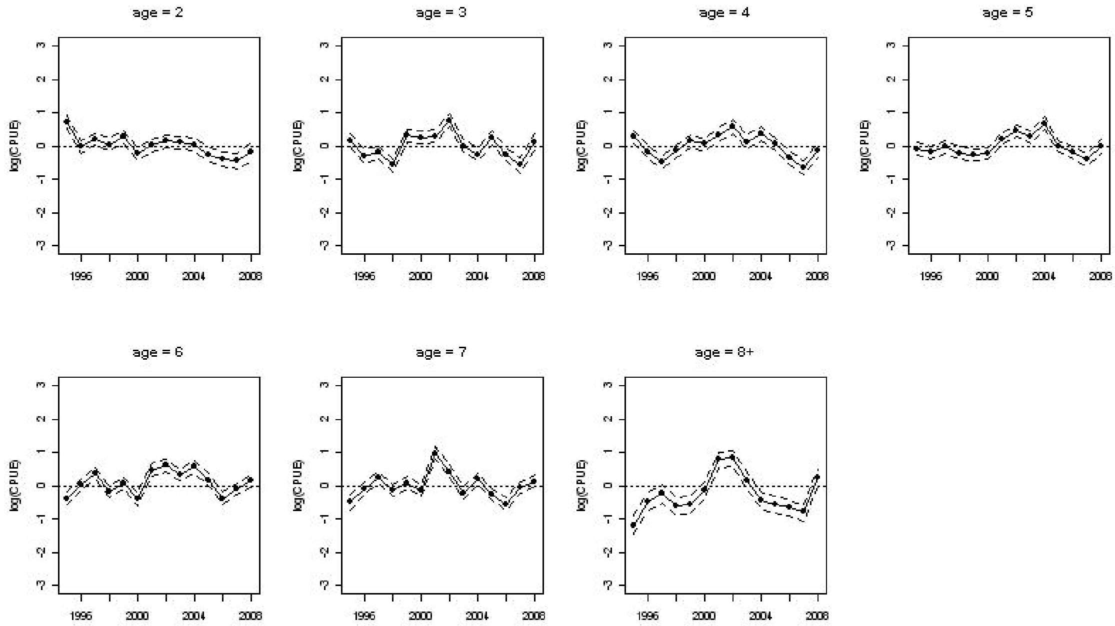
7.5 (c) Portuguese autumn survey (P-GFS-oct) residuals at age



7.5 (d) Coruña trawl LPUE (1985-1993) residuals at age



7.5 (e) Coruña trawl LPUE (1994-2008) residuals at age



7.5 (f) Portuguese trawl LPUE (1995-2008) residuals at age

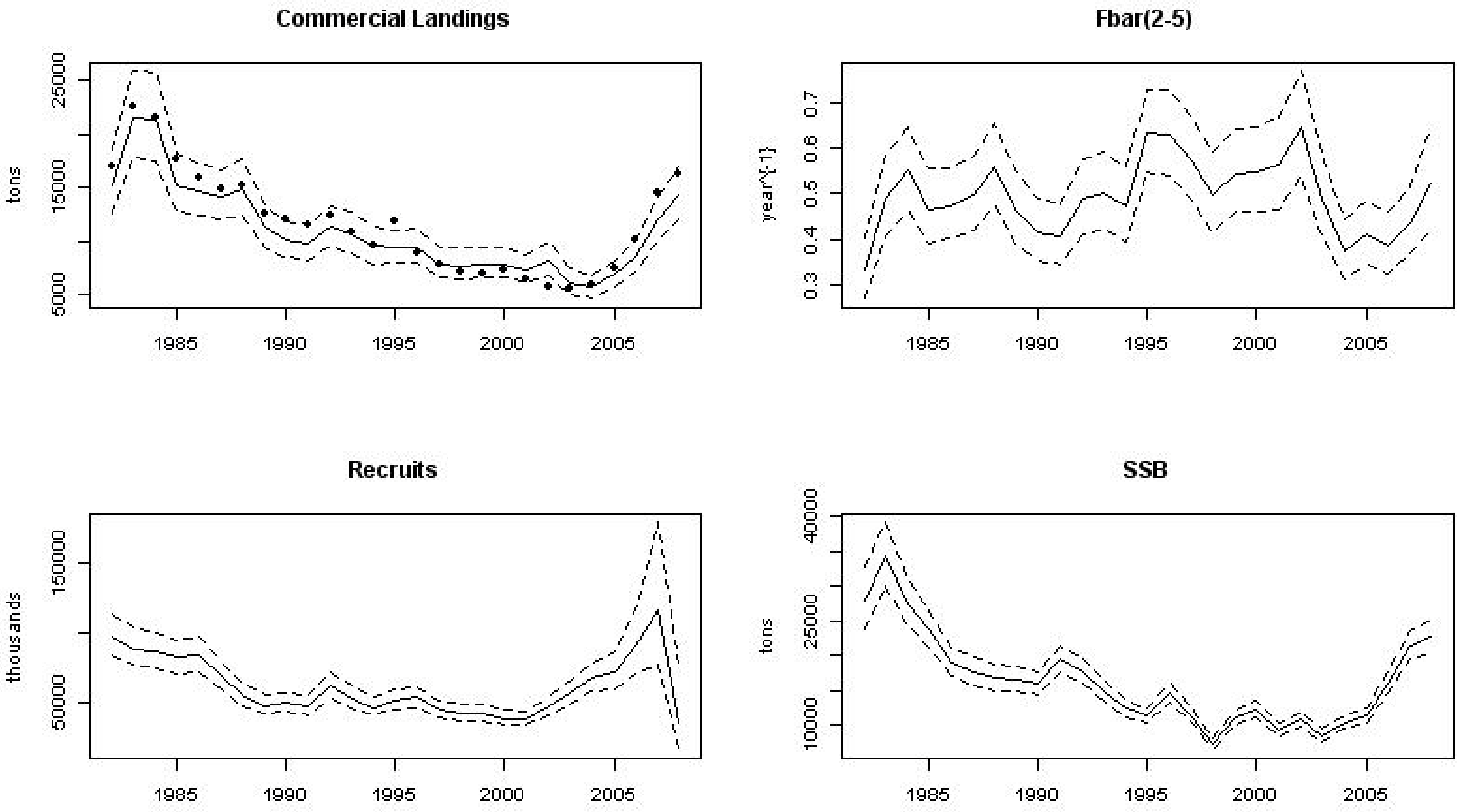


Figure 7.6. South hake summary plot. Catch (modelled and reported); F bar; recruitment at age 0 and SSB. Credibility intervals [0.05-0.95].

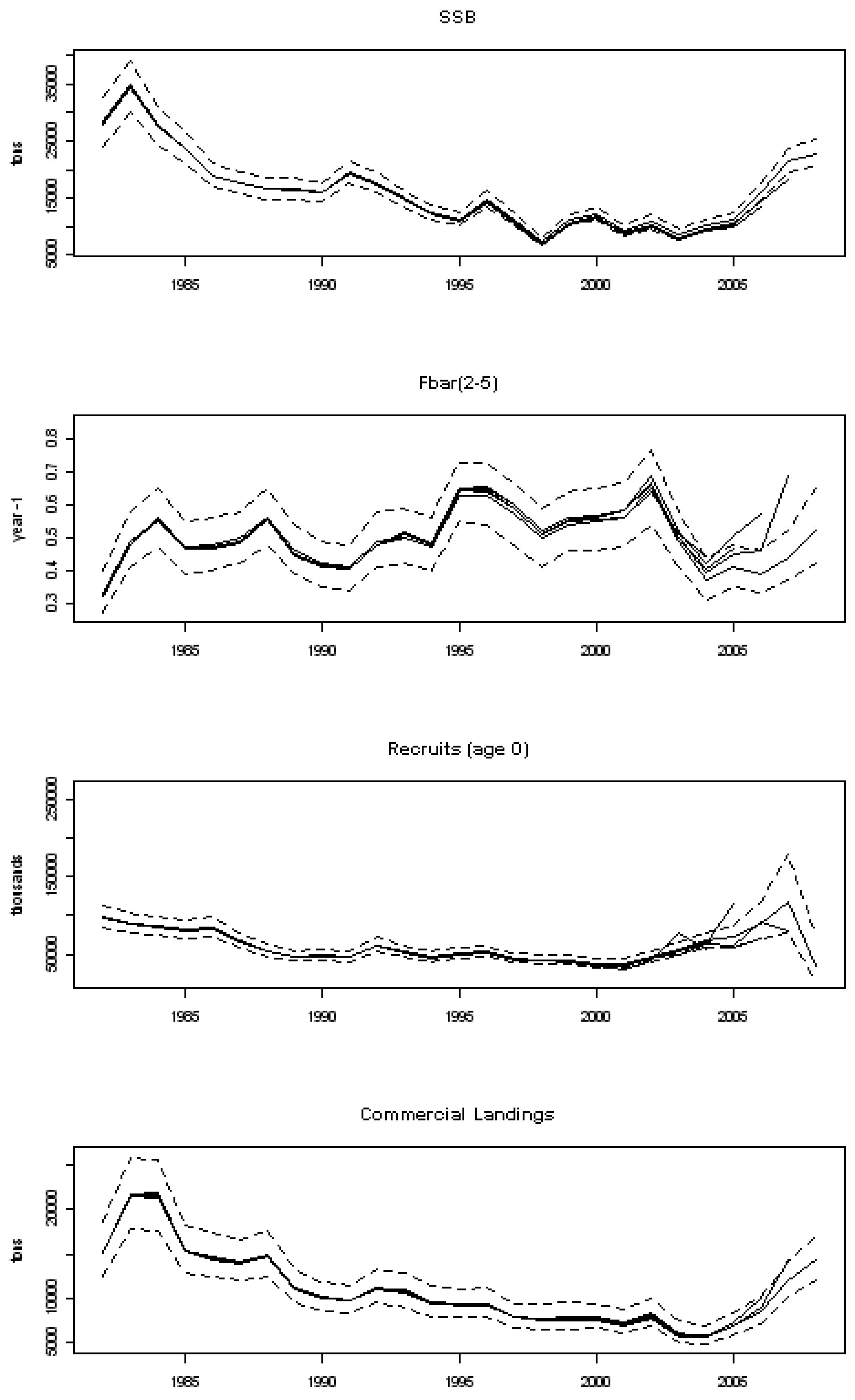


Figure 7.7. Retrospective trends for SSB, Fbar, recruits and landings estimated with data until 2008, 2007, 2006, 2005 and 2004.

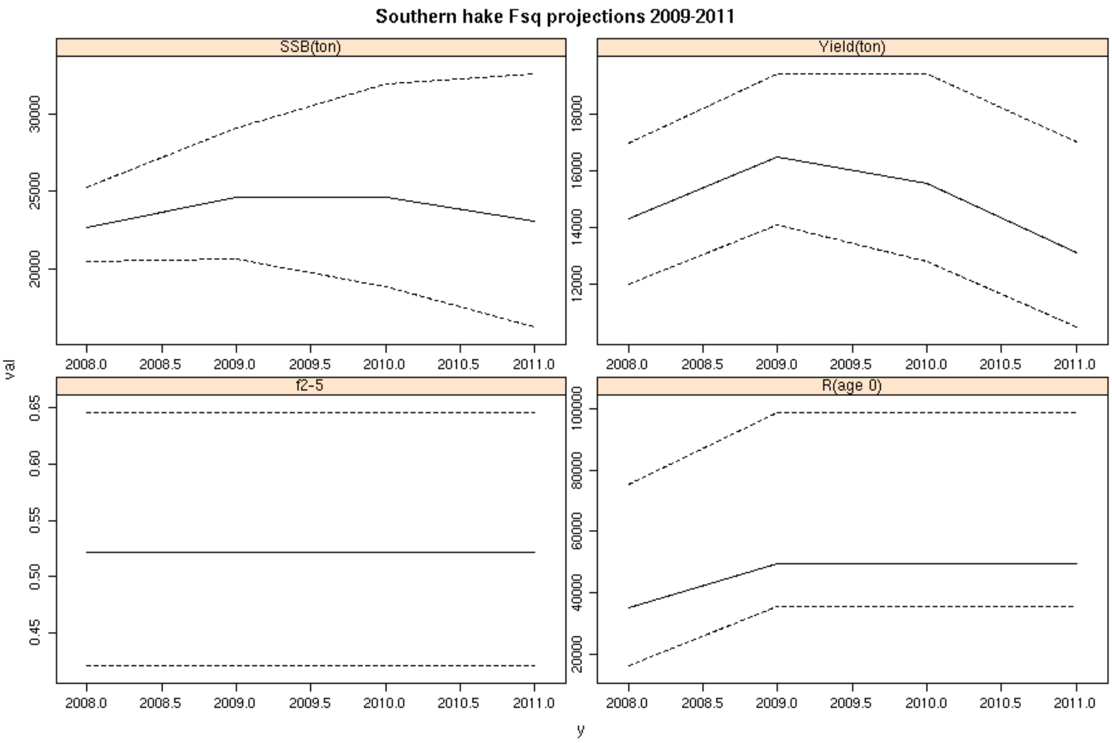
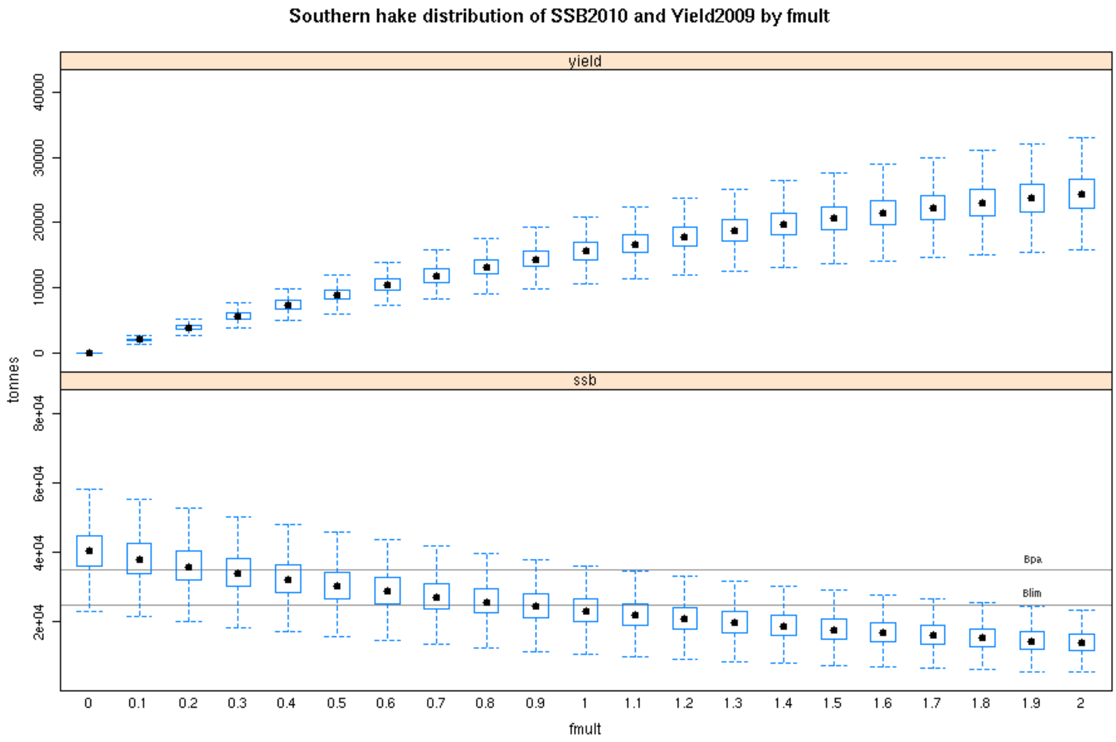
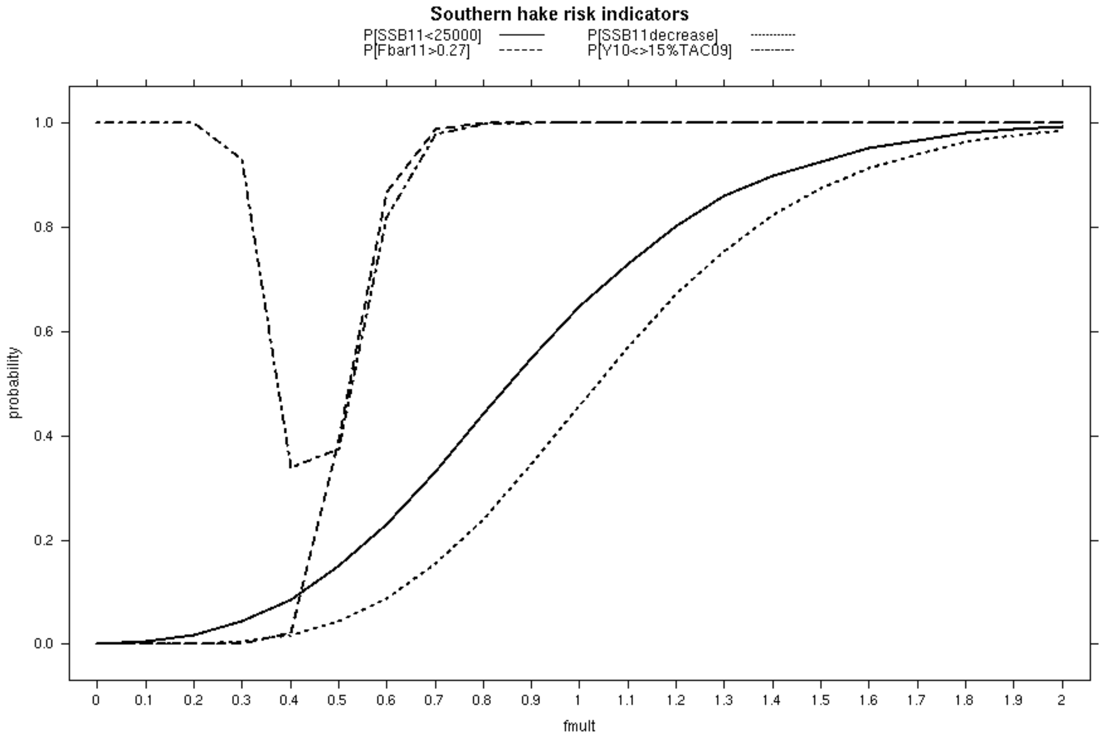


Figure 7.8. South hake stochastic projections for SSB, yield, Fbar (2-5) and recruitment at age 0. Median Fsq=0.52 and median recruitment for 2009,10,11 = 49 513th.). CI[0.05,0.95]. Notice Blim=25 000 t.



Expected yield in 2010 and SSB in 2011 under different F levels.



b) Risk indicators. Prob[SSB 2011 < 25 Kt]; Prob [Fbar 2010 > 0.27 (Rec. Plan Target)]; Prob [SSB 2011 < SSB 2008]; Prob[Yield in 2010 <> 15% TAC 2009]

Figure 7.9. Southern hake. Risk management options.

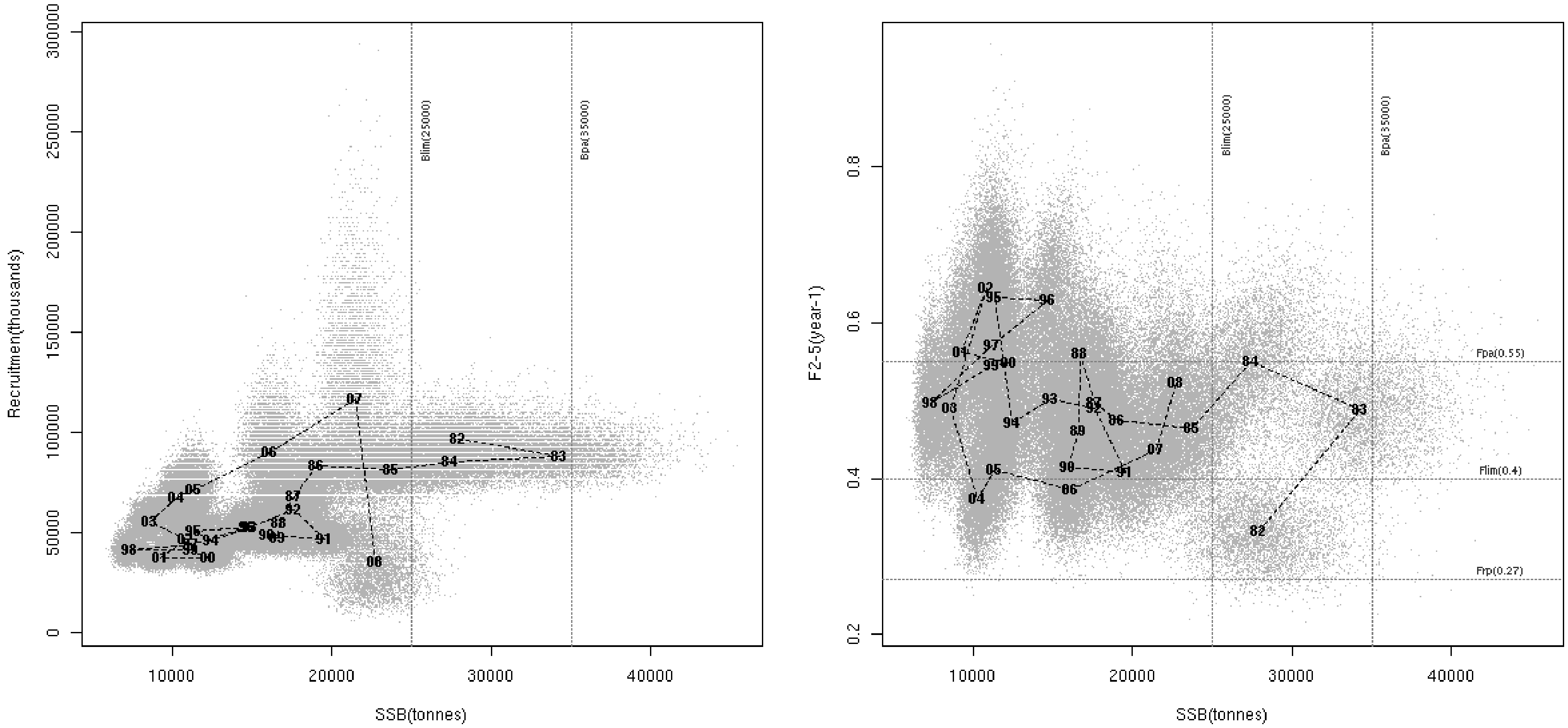
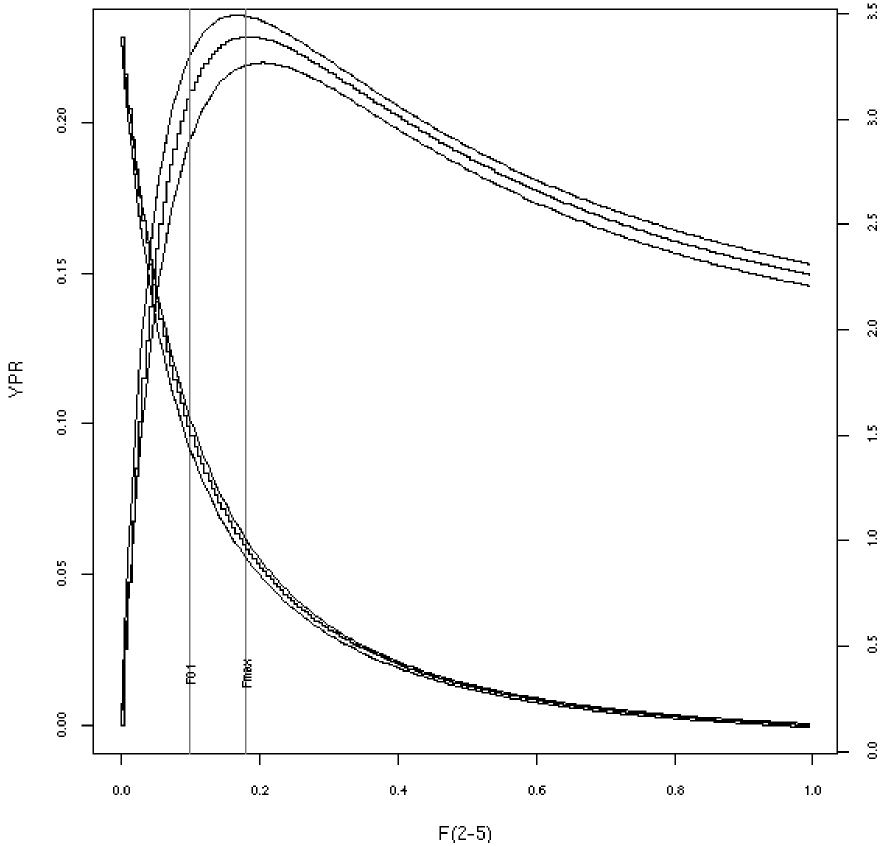


Figure 7.10. Southern Hake Stock. Stock recruitment relationship SSB – F trajectory



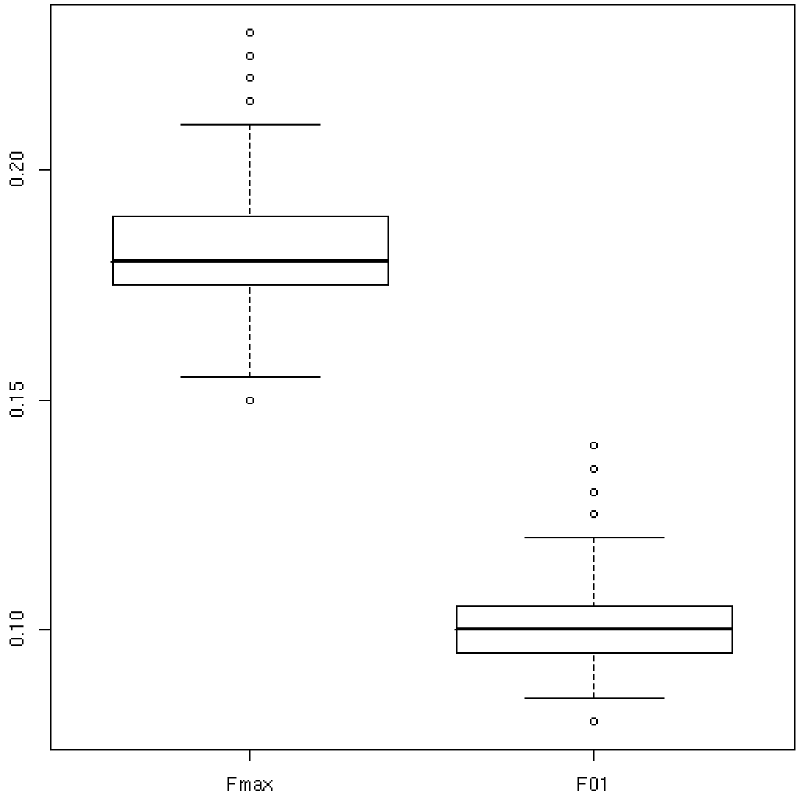


Figure 7.11. Yield and SSB per recruit (left panel). Fmax and F0.1 distribution (right panel)

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

L. piscatorius and L. budegassa

Type of assessment in 2009: update (of the WGHMM-2007 assessment)

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

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

RG2007 and RG2008 comments:

1. *It is unclear why fleet standardization only involved the gillnet fleet; the remaining trawl fleets should also be considered.*
   In WGHMM2008 standardized LPUE series for both Portuguese trawl fleets and for A Coruña trawl fleet were presented. This year an update of the standardization of Portuguese trawl fleet was also presented to the WG (WD11). The standardized series will be considered for inclusion in the assessment when there is a benchmark.

2. *Catch at age bubble plots do not track the yc very well; they might suggest ageing problems, i.e. growth is faster than aged. Also weight at age seem amazingly stable over the years, suggesting that ageing is too "consistent".*
   Severe ageing problems for anglerfish species were detected in the WGHMM2007 exploratory analysis. Scientific problems are still unsolved and no age information was provided to the WG after 2007.

3. *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.*
   There was not time to carry out this analysis in the WGHMM2009. It will be presented in WGHMM2010.

4. *In order to improve the stock production model the WG is encouraged to access more historical data as input for the model, i.e. pre 1980 catches.*
   In recent years a revision of historical anglerfish data on catch and effort has been carried out. Some Portuguese and Spanish catch information for 1978 and 1979 is available for Division IXa but data from Division VIIIc are currently impossible to recover.

5. *The effort fluctuated slightly for the trawl fleets and undergone a high drop for the artisanal fleet of Cedeira. LPUE decreased for all trawl commercial fleets and increased for the artisanal fleet.*
   By mistake, the 2007 values presented for the Cedeira series in WGHMM2008 had not been standardized, so they were not comparable to the rest of the series. An update of the standardized LPUE series of Cedeira was carried out this year (see Table 8.1.4 and 8.2.4). In the last three years the effort has remained at high levels and a decreasing trend in LPUE for both stocks was observed.

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 being 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 2009 and management for 2008 and 2009

ICES advice for 2009:

The new information available this year was not expected to result in any significant change in the perception of the stocks status. The advice on this stock for the fishery in 2009 is therefore the same as the advice given in 2007 for the 2008 fishery: There are no indications that the stock has improved since last year. Fishing mortality equal to zero is not expected to bring the stock back to Bmsy in 2010. ICES therefore reiterates its previous advice to close the fishery and develop a recovery plan that will ensure rapid and safe recovery towards Bmsy.

Management applicable for 2008 and 2009:

The two species are managed under a common TAC that was set at 1 955 t for 2008 and 1760 t for 2009.

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 year 2000.

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

8.1.1 General

8.1.1.1 Ecosystem aspects

L. 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). The Southern stock comprises ICES divisions VIIIc and IXa and its boundaries were not based on biological criteria.

The spawning of *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 and Quincoces, 2002). This particular spawning leads to highly clumped distributions of eggs and newly emerged larvae (Hislop *et al*., 2001) and favorable or unfavorable ecosystem conditions can have therefore important impacts in the recruitment.

Due to the particular reproduction aspects (that shows a high parental investment in the offspring), and suspected slow growth and late maturation, the population dynamics of this species is expected to be highly sensitive to external biological/ecosystem factors. From what is known of the life history of this species, it is a typical K strategist, and therefore adapted for long-term population sustainability in predictable long-lasting environments and is unlikely to persist in unstable environments.

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. In the Portuguese trawl fleet, the combined weight of both *Lophius* species represented less than 1% of the total landings in weight and in the artisanal fleet this value reached 2% between 2000 and 2002. Since 1997 Spanish landings represented on average 84% of the total *L. piscatorius* stock landings.

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 1997, the Spanish landings were on average 46% from the trawl fleet (mean lengths in 2008 of 57 cm and 55 cm in Divisions VIIIc and IXa, respectively) and 54% from the gillnet fishery (mean length of 74 cm in Division VIIIc in 2008). Since 1997, Portuguese landings were on average 8% from bottom trawlers (mean length of 47 cm in 2008) and 92% from the artisanal fleet (mean length of 62 cm in 2008).

For the Spanish trawl fleets is necessary to take into account that 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 with very few anglerfish catches.

8.1.2 Data

8.1.2.1 Commercial catches and discards

Total landings of *L. piscatorius* by country and gear for the period 1978–2008, as estimated by the Working Group, are given in Table 8.1.1. There were unrecorded landings in Division VIIIc between 1978 and 1979, and it is not possible to obtain the total landings in those years. The maximum landing of the available series was recorded in 1986 with 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 decreased to 2 337 t in 2008.

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. The landings in 2008 of only *L. piscatorius* are higher than the combined species 2008 TAC of 1955 t.

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 2008. The raising procedure used to estimate discards was based on effort. Discards estimates of *L. piscatorius* in weight and associated coefficient of variation (CV) are shown in the table below:

Year	Weight (t)	CV
1994	20.9	34.05
1995	n/a	n/a
1996	n/a	n/a
1997	5.4	68.13
1998	n/a	n/a
1999	0.8	71.30
2000	5.7	33.64
2001	n/a	n/a
2002	n/a	n/a
2003	25.1	54.42
2004	48.2	32.53
2005	44.1	30.97
2006	43.7	48.33
2007	17.1	28.44
2008	4.9	56.47

n/a: not available

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. 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.

8.1.2.2 Biological sampling

Both Spain and Portugal carry out biological sampling at markets. 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. Although all the fish of each sampled boat are measured, it is difficult to cover the whole length range in the landings.

The sampling levels for 2008 are shown in Table 1.3. Spanish and Portuguese market sampling effort has increased considerably since 1995 and is expected to be maintained in the future.

Length composition

The sampled length compositions were raised for each country and SOP corrected to total landings on a quarterly or yearly basis (when the sampling levels by quarter were low) by using an international length-weight relationship:

$$Wt\ (kg) = 0.000027 * Lt\ (cm)^{2.839} \qquad \text{(BIOSDEF, 1998)}$$

Table 8.1.2 gives the annual length compositions by country and gear for 2008. The average lengths of trawl caught anglerfish are lower compared to the artisanal fleets. The annual length compositions for all fleets combined for the period 1986–2008 are presented in Figure 8.1.1. Landings in number, the mean length and mean weight in the landings between 1986 and 2008 are in the following table:

	1986	1987	1988	1989	1990	1991	1992	1993
Total (thousands)	1872	2806	2853	1821	1677	1657	1256	857
Mean Weight (g)	3670	1832	2216	2744	2261	2197	2692	2719
Mean Length (cm)	61	44	50	54	49	50	54	54

	1994	1995	1996	1997	1998	1999	2000	2001
Total (thousands)	704	876	1153	1043	583	289	190	127
Mean Weight (g)	2850	2093	2564	3560	5113	6682	6885	6189
Mean Length (cm)	54	48	52	60	68	72	72	64

	2002	2003	2004	2005	2006	2007	2008
Total (thousands)	381	784	793	856	923	553	540
Mean Weight (g)	2766	2907	3881	4259	3211	4251	4327
Mean Length (cm)	50	54	61	63	58	62	63

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 63 cm in 2005 and again in 2008.

8.1.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2008 are summarized in Table 8.1.3. Considering the very small amount of anglerfish caught in the two surveys, these indices were not considered to reflect the change in the abundance of this species.

8.1.2.4 Commercial catch-effort data

Landings, effort and LPUE data are given in Table 8.1.4 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 the two new years of information by applying the same model used in 2007 (Costas *et al.*, 2007). The new LPUE estimates from 1999 to 2006 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) provided by Cardador (WD11) 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. 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.

8.1.3 Assessment

In WGHMM2007 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 8.1.5. As in the last assessment, LPUE series of SP-CORUTR8c was introduced as CC (CPUE and total catch) and the SP-CEDGNS8c as index of biomass.

8.1.3.2 Model

The ASPIC (version 5.16) 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 8.1.5. They are the same ones used in the 2007 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 0.62 and 0.12 for the A Coruña and the Cedeira fleet (see Annex H). The correlation coefficient between input fleets was 0.704.

Table 8.1.6 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). Bias and precision of parameter estimates vary depending on the parameter. The F_{2008}/F_{MSY} and B_{2009}/B_{MSY} ratios show respectively 23% and 1% of bias and 49% and 43% values of inter-quartile range. The total biomass at the beginning of 2009 is estimated to be at 27% of B_{MSY} with the 80% bias-corrected confidence interval between 13% and 36%. F_{2008}/F_{MSY} is estimated to be 1.57 with the 80% bias-corrected confidence interval between 1.18 and 2.57. Fishing mortality in 2008 is therefore estimated to be over F_{MSY} and total biomass in 2009 is estimated to be under B_{MSY}. The MSY estimate is 5 668 t with -7% of bias and 6% relative inter-quartile range.

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 8.1.5 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 that the F and B ratio trends are similar between last assessment and this year assessment with a slight down shift in F for the present assessment. A comparison of parameter estimates from the 2007 and 2009 assessments is shown in the table below:

Parameter	Assessment	
point estimates	2007	2009
B1/K	0.49	0.41
K	25520	32260
MSY	5402	5668
Y(Fmsy)	1962	1531
Bmsy	12760	16330
Fmsy	0.423	0.347
B./Bmsy	0.36	0.27
F./Fmsy	1.55	1.57
q(1)	2.80E-6	2.44E-6
q(2)	2.00E-5	1.52E-5
q2/q1	7.1	6.2

B./Bmsy: B_{2007}/Bmsy for 2007; B_{2009}/Bmsy for 2009.
F./Fmsy: F_{2006}/Fmsy for 2007; F_{2008}/Fmsy for 2009.
Y(Fmsy): yield fishing at Fmsy for the next year of the assessment.

8.1.4 Projections

Projections were performed based on ASPIC estimates. The projected B/B_{MSY} and yield are presented in Table 8.1.7, with each column of the table corresponding to a fishing mortality scenario. Projections were performed for F *status quo* (assumed as F_{2008}), for reductions in F in the first projection year from 10% to 50% and for F_{MSY} level and for F equal to zero. The biomass is expected to increase under all scenarios. F *status quo* is expected to bring biomass to 37% of B_{MSY} in next ten years. Reducing F by 50% or under zero catches the biomass is expected to achieve B_{MSY} the next ten years. Even with zero catches in 2010, biomass will not reach B_{MSY} in 2011.

8.1.5 Biological Reference Points

There are no biological reference points defined for this stock.

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 1978-2008 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

n/a: not available

Table 8.1.2 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Length composition by fleet for landings in 2008 (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	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.006	0.000	0.006	0.006
27	0.000	0.000	0.000	0.023	0.009	0.000	0.032	0.032
28	0.369	0.000	0.369	0.000	0.015	0.000	0.015	0.384
29	0.605	0.000	0.605	0.092	0.006	0.000	0.098	0.703
30	1.203	0.000	1.203	0.500	0.009	0.000	0.509	1.712
31	1.666	0.000	1.666	0.672	0.106	0.007	0.785	2.451
32	1.326	0.000	1.326	1.040	0.092	0.000	1.131	2.458
33	4.495	0.000	4.495	1.221	0.085	0.015	1.321	5.815
34	6.536	0.000	6.536	1.506	0.160	0.042	1.708	8.244
35	9.772	0.000	9.772	1.555	0.094	0.008	1.657	11.429
36	9.593	0.000	9.593	1.556	0.217	0.025	1.797	11.391
37	5.428	0.000	5.428	1.427	0.220	0.004	1.651	7.079
38	5.979	0.000	5.979	1.420	0.284	0.032	1.736	7.715
39	7.235	0.000	7.235	1.647	0.192	0.007	1.846	9.081
40	7.503	0.000	7.503	1.526	0.376	0.074	1.976	9.479
41	3.459	0.000	3.459	1.408	0.206	0.263	1.877	5.336
42	8.616	0.000	8.616	0.352	0.183	0.137	0.672	9.287
43	6.024	0.025	6.049	0.560	0.345	0.282	1.186	7.236
44	6.354	0.000	6.354	0.493	0.150	0.239	0.881	7.235
45	4.043	0.000	4.043	0.683	0.174	0.442	1.299	5.342
46	3.985	0.064	4.049	0.670	0.180	0.442	1.292	5.341
47	5.075	0.000	5.075	0.950	0.256	0.641	1.846	6.921
48	3.236	0.193	3.429	0.432	0.179	0.399	1.011	4.439
49	2.863	0.203	3.067	0.321	0.097	0.606	1.024	4.091
50	3.066	0.160	3.226	0.515	0.071	1.200	1.786	5.012
51	2.454	0.644	3.098	0.678	0.135	1.373	2.186	5.284
52	2.290	0.370	2.661	0.463	0.216	1.776	2.456	5.116
53	2.233	1.013	3.246	0.681	0.066	1.378	2.125	5.371
54	2.333	1.006	3.339	1.017	0.093	1.261	2.370	5.709
55	3.083	0.944	4.027	0.471	0.081	1.220	1.771	5.798
56	2.892	0.861	3.753	0.365	0.146	1.659	2.170	5.924
57	2.102	1.458	3.560	0.722	0.104	1.127	1.952	5.512
58	4.082	1.378	5.460	0.564	0.091	0.786	1.441	6.901
59	3.374	1.497	4.871	0.331	0.152	0.979	1.462	6.333
60	6.864	3.023	9.888	0.274	0.000	1.279	1.553	11.440
61	4.322	4.468	8.789	0.878	0.197	0.716	1.791	10.581
62	7.514	4.575	12.088	0.800	0.022	0.710	1.532	13.620
63	5.102	6.975	12.078	0.490	0.056	0.802	1.348	13.426
64	6.307	6.756	13.063	0.807	0.021	0.717	1.545	14.607
65	5.087	7.549	12.636	0.819	0.041	0.733	1.594	14.230
66	4.951	9.435	14.386	0.864	0.000	0.470	1.334	15.720
67	6.728	7.823	14.551	0.486	0.009	0.395	0.890	15.441
68	6.084	8.639	14.723	0.440	0.092	0.475	1.007	15.731
69	7.063	7.697	14.759	1.070	0.018	0.445	1.533	16.292
70	5.933	9.034	14.967	1.118	0.015	0.286	1.419	16.386
71	3.718	8.147	11.865	0.433	0.008	0.289	0.729	12.594
72	4.467	6.408	10.875	1.190	0.000	0.423	1.613	12.488
73	4.524	8.789	13.313	0.955	0.000	0.266	1.221	14.534
74	3.671	7.451	11.122	0.767	0.013	0.381	1.161	12.283
75	3.683	7.218	10.900	0.674	0.000	0.249	0.923	11.824
76	3.423	6.509	9.932	0.632	0.000	0.267	0.899	10.831
77	3.502	4.390	7.892	0.787	0.042	0.224	1.053	8.946
78	3.279	5.678	8.957	0.639	0.009	0.322	0.971	9.928
79	2.924	3.679	6.602	0.456	0.000	0.200	0.656	7.258
80	3.245	5.321	8.566	0.577	0.006	0.271	0.854	9.420
81	4.497	3.901	8.398	0.101	0.020	0.325	0.447	8.845
82	2.962	4.502	7.464	0.152	0.000	0.280	0.432	7.896
83	2.397	3.214	5.610	0.248	0.000	0.233	0.481	6.091
84	1.872	4.301	6.172	0.059	0.009	0.158	0.226	6.398
85	2.183	2.630	4.814	0.388	0.000	0.325	0.713	5.527
86	1.494	3.803	5.297	0.221	0.013	0.238	0.472	5.768
87	1.879	2.917	4.797	0.194	0.012	0.118	0.324	5.121
88	1.464	1.870	3.334	0.155	0.003	0.207	0.365	3.699
89	1.151	2.495	3.647	0.345	0.000	0.124	0.469	4.115
90	0.821	1.269	2.090	0.145	0.000	0.242	0.387	2.477
91	0.728	1.314	2.042	0.209	0.004	0.146	0.360	2.402
92	0.286	1.984	2.270	0.000	0.009	0.151	0.160	2.430
93	1.036	1.038	2.074	0.000	0.000	0.308	0.308	2.382
94	0.243	1.101	1.344	0.043	0.000	0.129	0.172	1.515
95	0.264	1.021	1.286	0.000	0.000	0.116	0.116	1.402
96	0.127	0.814	0.941	0.000	0.000	0.086	0.086	1.026
97	0.288	0.806	1.094	0.066	0.000	0.080	0.146	1.240
98	0.367	0.314	0.680	0.077	0.000	0.068	0.145	0.825
99	0.480	0.532	1.011	0.043	0.000	0.101	0.144	1.155
100+	2.759	7.495	10.254	0.732	0.071	0.941	1.743	11.997
TOTAL	263	197	460	44	5	31	80	540
Tonnes	894	1168	2062	138	11	127	275	2337
Mean Weight (g)	3399	5939	4486	3114	1971	4119	3420	4327
Mean length (cm)	57.5	73.8	64.4	55.0	47.3	62.5	57.3	63.4
Measured weight (t)	13.2	18.0	31.2	1.8	0.7	12.5	15.1	46.3

Table 8.1.3 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		N/30 min		Hauls	N/60 min	kg/60 min
		Yst	Sst	Yst	Sst			
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	0.07	0.09
1990	120	1.19	0.22	1.20	0.22	123	0.05	0.46
1991	107	0.71	0.22	0.50	0.09	99	+	+
1992	116	0.76	0.15	1.18	0.16	59	0.01	0.09
1993	109	0.88	0.16	1.20	0.14	65	0.01	0.08
1994	118	1.66	0.62	3.70	0.49	94	0.02	+
1995	116	2.19	0.32	5.70	0.69	88	0.03	0.05
1996*	114	1.54	0.26	1.40	0.16	71	0.18	0.27
1997	116	1.69	0.39	0.67	0.11	58	0.03	0.49
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	0.04	0.06
2003*	112	1.67	0.40	1.41	0.16	80	0.15	0.29
2004*	114	2.09	0.32	2.71	0.32	79	0.12	0.16
2005	116	3.05	0.54	2.04	0.19	87	0.04	0.12
2006	115	1.88	0.40	2.86	0.30	88	0	0
2007	117	1.65	0.25	2.56	0.25	96	+	+
2008	115	1.85	0.37	1.96	0.35	89	0	0

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 8.1.4 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

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 2006	[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	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	25	6	17	3
2008	n/a	n/a	20212	n/a	5285	n/a	18	4	13	2

[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 2008	[3] Cedeira standardized 2006	[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	69.2	74.1	0.1	0.4	0.3	1.0
2000	6.3	8.6	2.8	16.1	36.6	41.5	0.0	0.2	0.1	0.4
2001	12.5	17.6	2.8	12.2	39.0	38.9	0.1	0.5	0.4	1.4
2002	27.5	14.3	6.0	46.9	51.7	50.0	0.3	1.9	0.8	2.4
2003	44.0	22.1	12.3	83.4	56.5	61.9	0.3	1.3	0.9	2.8
2004	n/a	28.1	13.2	55.1	65.7	75.0	0.6	1.9	1.0	3.3
2005	n/a	41.9	18.9	75.6	122.3	107.5	0.6	2.2	1.3	4.7
2006	n/a	32.7	12.6	60.9	92.0	90.6	0.6	2.4	1.3	4.2
2007	n/a	23.8	10.5	n/a	49.7	n/a	0.3	1.1	0.4	2.1
2008	n/a	n/a	13.5	n/a	43.1	n/a	0.3	1.5	0.4	2.9

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

Table 8.1.5. ANGLERFISH (*L. piscatorius*) - Division VIIIc and IXa.

ASPIC input settings and data

Input	Value
Error type	YLD - Condition on yield
Number of bootstrap trials	500
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) - 10 000 (t)
Min and max K	5 000 (t) - 100 000 (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

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	0.0692
2000	0.0366
2001	0.0390
2002	0.0517
2003	0.0565
2004	0.0657
2005	0.1223
2006	0.0920
2007	0.0497
2008	0.0431

Table 8.1.6. 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(2009): equilibrium yield available in 2009; Y(Fmsy): yield availabe at Fmsy in 2009; Ye2009/MSY: equilibrium yield available in 2009 as proportion of MSY;fmsy (1): fishing effort rate at MSY for SP-CORUTR8c; fmsy (2): fishing effort rate at MSY for SP-CEDGNS8c.

	WG2009								
			Bias Corrected Bootstrap Confidence Interval						
Parameter	Point estimates	Relative bias	80% lower CL	80% upper CL	50% lower CL	50% upper CL		IQ-Range	Relative IQ-Range
B1/K	0.41	36.21%	0.25	0.42	0.34	0.41		0.07	17.60%
K	32660	2.12%	29130	42400	31930	35990		4061	12.40%
q(1)	2.44E-06	-11.01%	2.21E-06	2.79E-06	2.41E-06	2.71E-06		3.05E-07	12.50%
q(2)	1.52E-05	-7.88%	1.33E-05	2.98E-05	1.51E-05	1.90E-05		3.91E-06	25.70%
MSY	5668	-7.07%	5543	7023	5668	6016		348	6.10%
Ye(2009)	2648	4.89%	1551	3432	2058	3053		995	37.60%
Y(Fmsy)	1531	11.75%	807	2129	1086	1783		696	45.50%
Bmsy	16330	2.12%	14560	21200	15960	17990		2031	12.40%
Fmsy	0.3471	-7.06%	0.303	0.393	0.338	0.366		0.028	7.90%
fmsy(1)	142400	6.64%	125400	158300	132800	148000		15170	10.70%
fmsy(2)	22820	5.59%	16430	26500	19950	23940		3986	17.50%
B_{2009}/Bmsy	0.27	22.78%	0.13	0.36	0.17	0.30		0.13	49.20%
F_{2008}/Fmsy	1.57	1.17%	1.18	2.57	1.38	2.06		0.68	43.50%
Ye_{2009}/MSY	0.47	14.60%	0.23	0.60	0.30	0.51		0.20	43.70%
q2/q1	6.24	5.52%	5.24	8.09	5.75	7.10		1.35	21.70%

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

Point estimates of B/B_{MSY}(from 2009 to 2018) and Yield (from 2009 to 2018) for projections with F status quo (Fsq), F_{MSY}, zero catches and first year reduction in F of 10, 20, 30, 40 and 50%. The value of F_{2009}/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					
year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %
2009	1.57	1.57	1.57	1.57	1.57	1.57	1.57	1.57
2010	1.57	1	0	0.79	0.94	1.10	1.26	1.41
2011	1.57	1	0	0.79	0.94	1.10	1.26	1.41
2012	1.57	1	0	0.79	0.94	1.10	1.26	1.41
2013	1.57	1	0	0.79	0.94	1.10	1.26	1.41
2014	1.57	1	0	0.79	0.94	1.10	1.26	1.41
2015	1.57	1	0	0.79	0.94	1.10	1.26	1.41
2016	1.57	1	0	0.79	0.94	1.10	1.26	1.41
2017	1.57	1	0	0.79	0.94	1.10	1.26	1.41
2018	1.57	1	0	0.79	0.94	1.10	1.26	1.41

Biomass trends in relation to B_{MSY}

year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %
2009	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
2010	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
2011	0.30	0.36	0.50	0.39	0.37	0.35	0.33	0.31
2012	0.31	0.44	0.80	0.50	0.46	0.42	0.38	0.34
2013	0.32	0.53	1.14	0.63	0.56	0.49	0.43	0.37
2014	0.34	0.61	1.46	0.76	0.65	0.56	0.47	0.40
2015	0.35	0.69	1.68	0.87	0.74	0.62	0.52	0.42
2016	0.36	0.76	1.83	0.96	0.81	0.68	0.55	0.45
2017	0.36	0.81	1.91	1.04	0.88	0.72	0.59	0.47
2018	0.37	0.86	1.95	1.09	0.92	0.76	0.62	0.49

Yield

year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %
2009	2470	2470	2470	2470	2470	2470	2470	2470
2010	2597	1831	0	1487	1736	1970	2192	2400
2011	2718	2281	0	1979	2204	2385	2528	2638
2012	2831	2762	0	2529	2710	2820	2869	2869
2013	2936	3247	0	3094	3225	3253	3202	3091
2014	3033	3709	0	3626	3713	3666	3518	3299
2015	3123	4124	0	4088	4149	4042	3809	3490
2016	3204	4480	0	4461	4517	4370	4068	3663
2017	3277	4771	0	4746	4813	4645	4294	3818
2018	3343	5002	0	4954	5042	4870	4487	3955

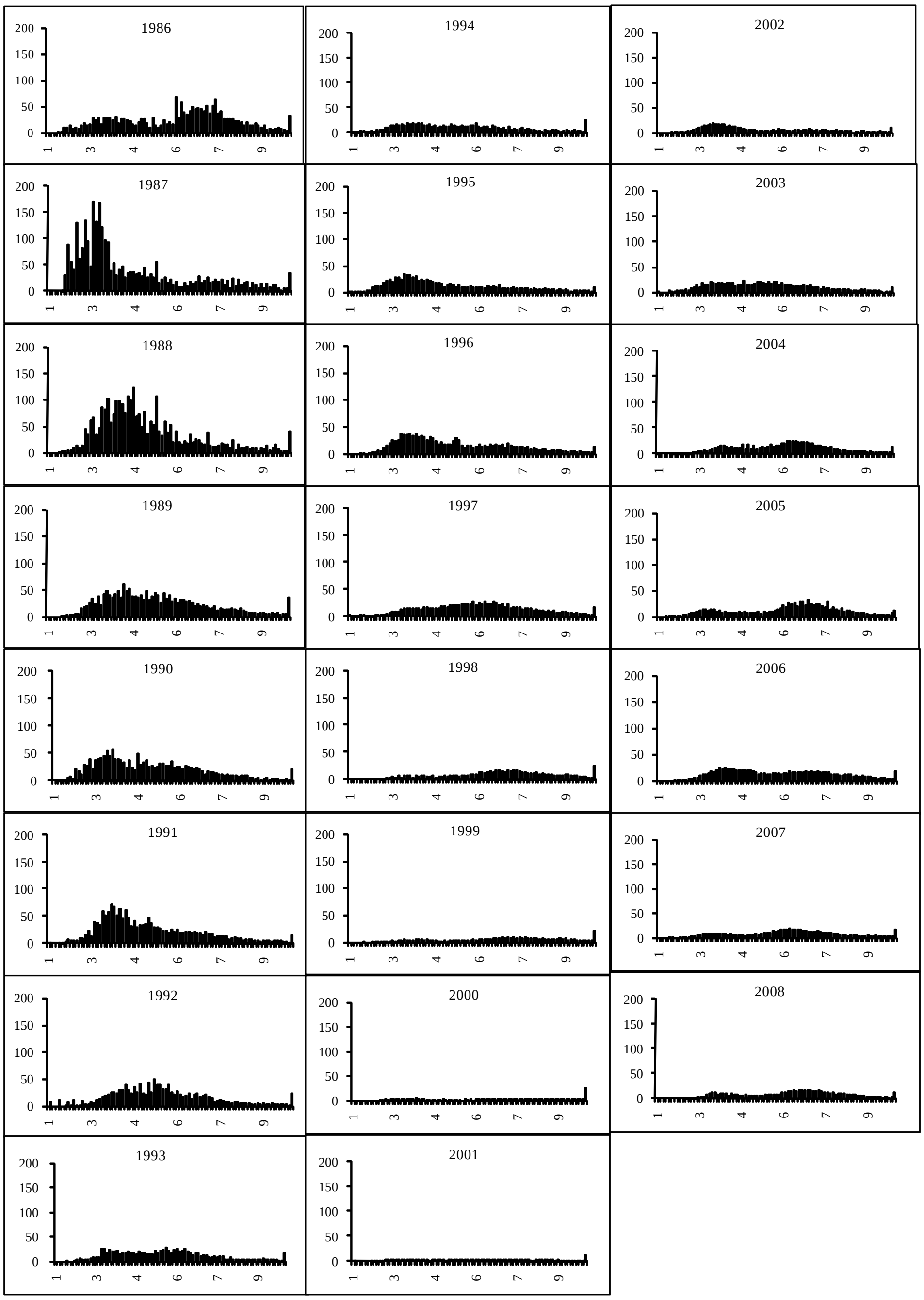


Figure 8.1.1 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Length distributions of landings (thousands for 1986 to 2008).

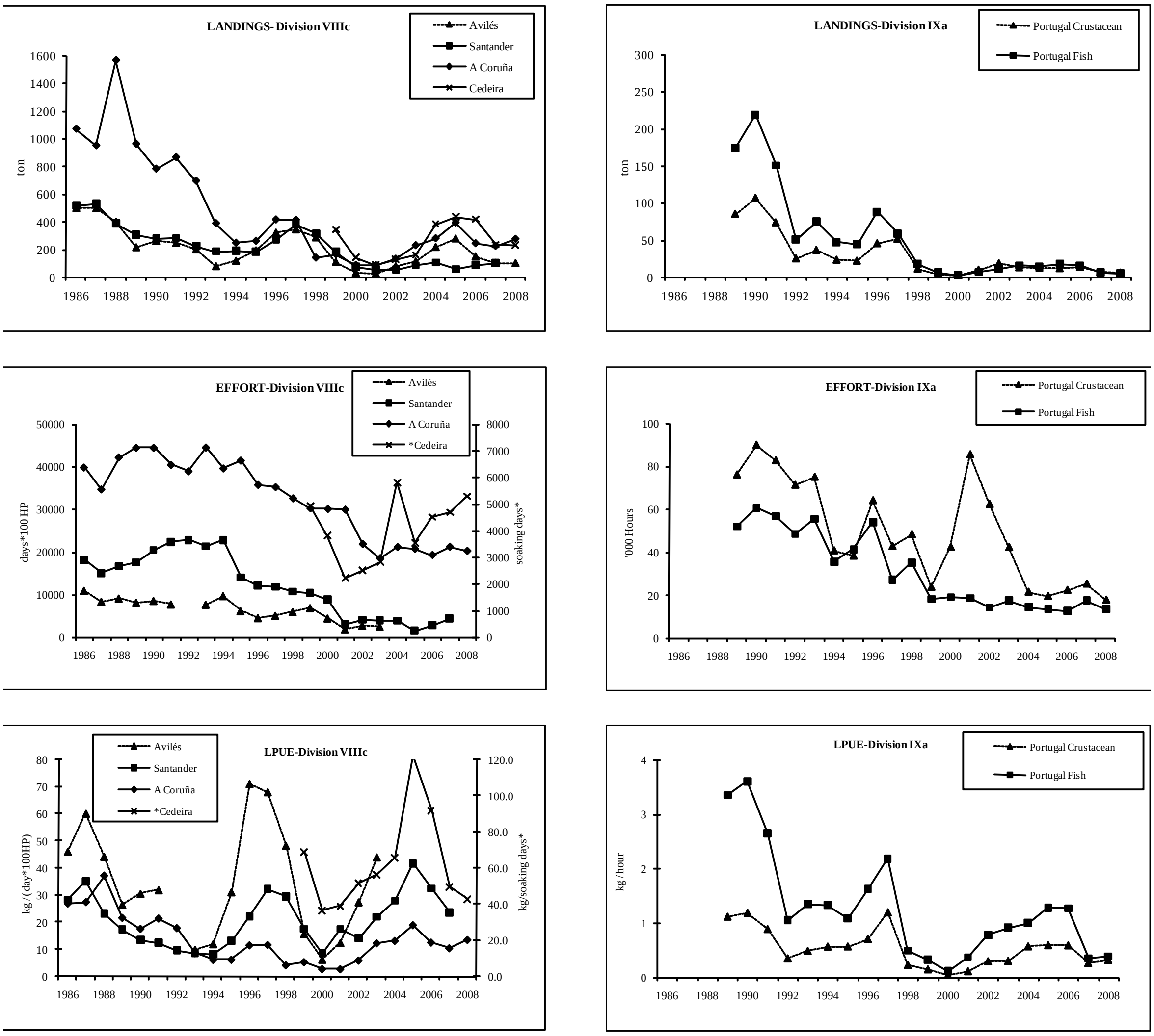
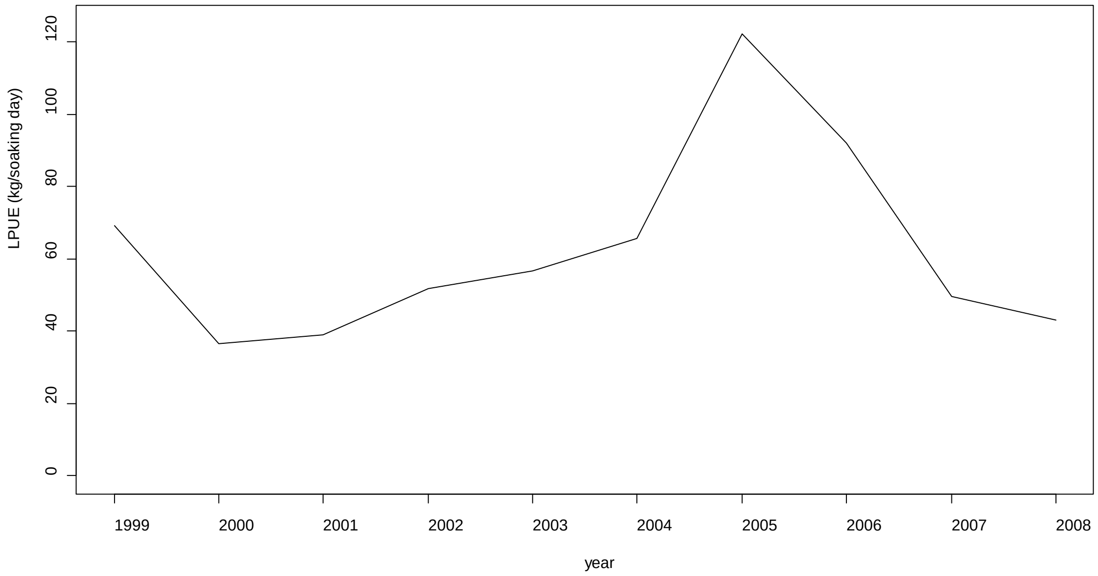
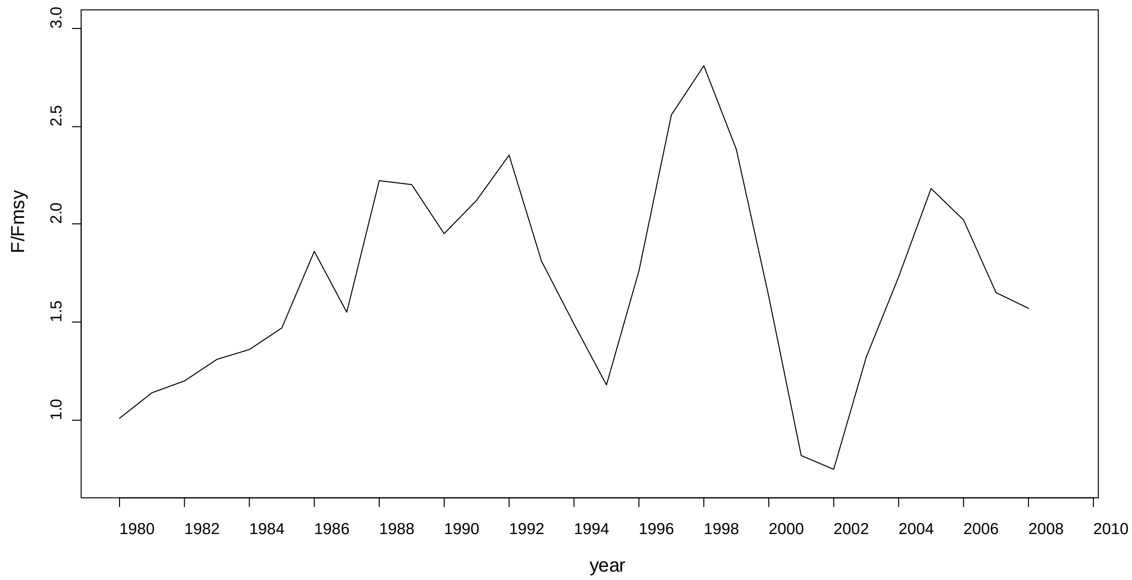
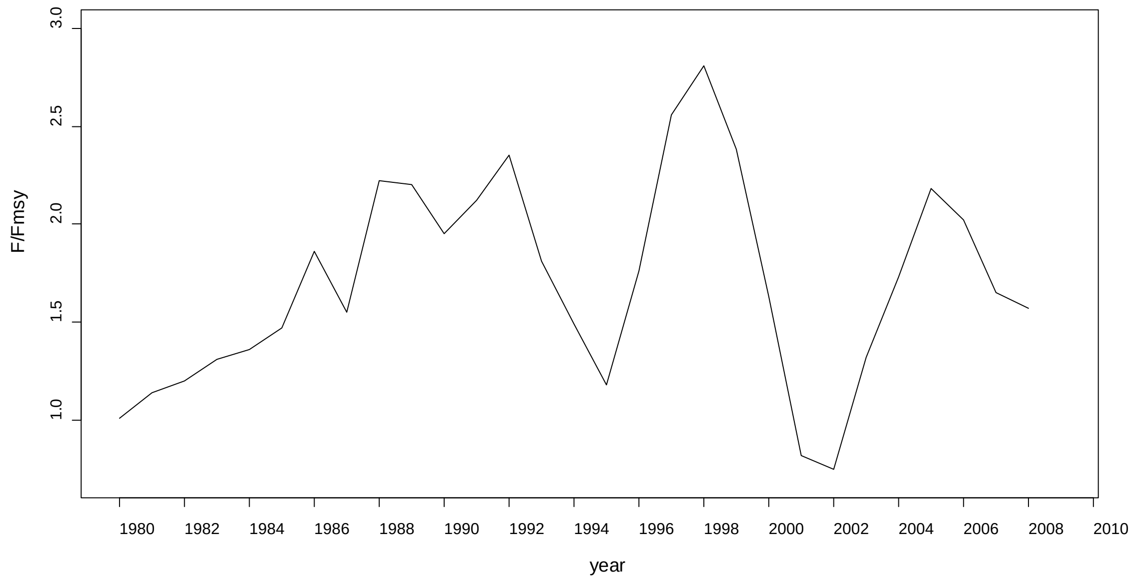


Figure 8.1.2 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa.
Trawl and gillnet landings, effort and LPUE data between 1986-2008.


LPUE (kg/soaking day)
0
20
40
60
80
100
120
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
year



F/Fmsy
1.0
1.5
2.0
2.5
3.0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
year



F/Fmsy
3.0
2.5
2.0
1.5
1.0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
year

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

8.2.1 General

8.2.1.1 Ecosystem aspects

L. budegassa is a North Eastern Atlantic species, with a distribution area from the British Isles to Senegal (including the Mediterranean and the Black Sea). The Southern stock comprises ICES divisions VIIIc and IXa and its boundaries were not based on biological criteria. Biological/ecosystem aspects are common with *L. piscatorius* (section 8.1.1.1).

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. The importance of *Lophius* species in the fisheries is referred to in section 8.1.1.2. Since 1997 Spanish landings represented on average 74% of the total *L. budegassa* stock landings.

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 1997, the Spanish landings were on average 89% from the trawl fleet (mean lengths in 2008 of 48 cm and 46 cm for Divisions VIIIc and IXa, respectively) and 11% from the artisanal fleet (mean length of 67 cm in 2008 in Division VIIIc). Portuguese landings were on average for the same period, 25 % from the trawl fleet (mean length of 48cm in 2008) and 75% from the artisanal fleet (mean length of 55cm in 2008).

For the Spanish trawl fleets it is necessary to take into account that 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 with very few anglerfish catches.

8.2.2 Data

8.2.2.1 Commercial catches and discards

Total landings of *L. budegassa* by country and gear for the period 1978–2008, as estimated by the Working Group, are given in Table 8.2.1. There were unrecorded landings in Division VIIIc between 1978 and 1979, and it is not possible to obtain the total landings in those years. After 1980, landings increased and reached a peak of 3 832 t in 1987. Since then, landings decreased and reached a minimum in 2002 with 770 t. From 2002 to 2007 landings increased to 1300t and in 2008 declined again to 951t. This decrease was observed in Division IXa mainly in the Spanish trawl fleet.

Since 2005, Portuguese combined species landings were TAC constrained and very low landings were registered during the 4th quarter since then.

Since 1994 a Spanish Discard Sampling Programme has been 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 2008. Discards estimates of *L. budegassa* in weight and associated coefficient of variation (CV) are shown in the table below:

Year	Weight (t)	CV
1994	6.1	24.39
1995	n/a	n/a
1996	n/a	n/a
1997	21.3	35.22
1998	n/a	n/a
1999	19.7	43.69
2000	8.7	35.11
2001	n/a	n/a
2002	n/a	n/a
2003	1.1	53.64
2004	8.1	70.22
2005	13.6	45.61
2006	92.0	56.79
2007	0.3	98.77
2008	1.9	59.45

n/a: not available

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%. Discard data were not included in the assessment, given that sampling does not cover all fleets contributing to anglerfish catches and the lack of data in many years of the series.

8.2.2.2 Biological sampling

The procedure for sampling of this species is the same as for *L. piscatorius*. The sampling levels for 2008 are shown in Table 1.3. Spanish and Portuguese market sampling effort has increased since 1995 and is expected to be maintained in future.

Length composition

The sampled length compositions were raised for each country and SOP corrected to total landings on a quarterly basis or yearly basis (when the sampling levels by quarter were low) by using an international length-weight relationship:

$$Wt\ (kg) = 0.0000211 * Lt\ (cm)^{2.9198} \quad \text{(BIOSDEF, 1998)}$$

Table 8.2.2 gives the length compositions by country and gear for 2008.

The annual length compositions between 1986 and 2008 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 that was confirmed by the lowest annual mean lengths (37 and 39 cm) observed since 1986. In 2008 these small fish were not observed. The total annual landings in numbers and the annual mean length and mean weight are in the following table:

	1986	1987	1988	1989	1990	1991	1992	1993	1994
Total (thousands)	1704	4673	2653	1815	1590	1672	1497	1238	1063
Mean Weight (g)	1504	820	1395	1420	1468	1294	1410	1799	1486
Mean Length (cm)	43	34	43	44	44	42	45	48	44

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total (thousands)	1583	1146	1452	1554	1268	680	435	514	507
Mean Weight (g)	1157	1422	1248	1380	1487	2010	2329	1497	1826
Mean Length (cm)	40	44	41	42	42	47	49	41	46

	2004	2005	2006	2007	2008
Total (thousands)	468	408	1030	1036	503
Mean Weight (g)	1974	2198	1115	1255	1889
Mean Length (cm)	47	49	37	39	48

In 2005 the lowest total number in landings was observed, being 9 % of the maximum value (year 1987). In 2006 and 2007 the number in landings more than doubled the 2005 number, but in 2008 the number in landings, mean weight and length are at the level of 2005 again.

8.2.2.3 Abundance indices from surveys

Spanish and Portuguese survey results for the period 1983–2008 are summarized in Table 8.2.3. 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 8.2.4 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. As explained in Section 8.1.2.4, the Portuguese fleet was split into fish trawlers and crustacean trawlers and a Spanish artisanal fleet was available for the port of Cedeira in Division VIIIc.

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 2005.

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 majority of fleets. In the last two years the LPUEs of the two Portuguese fleets has increased considerably, especially the P-TRF fleet.

8.2.3 Assessment

In WGHMM2007 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 (P-TRC), the LPUEs for the Portuguese trawl fish fleet (P-TRF) and the landings, are presented in Table 8.2.5. As in the last assessment the LPUE series of P-TRC was introduced as CC and the P-TRF as biomass index.

8.2.3.2 Model

The ASPIC (version 5.24) model (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 guesses and the minimum and maximum constraints of each parameter are indicated in the input file (Table 8.2.5). They are the same ones used in the 2007 assessment.

8.2.3.3 Assessment results

The correlation coefficient between input fleets is very high (0.907). Point estimates and bias-corrected bootstrap confidence intervals for parameters are presented in table 8.2.6, whereas Figure 8.3 plots observed and estimated CPUEs for each of the series used in the model. B_{2009}/B_{MSY} and F_{2008}/F_{MSY} have respectively -2.51% and 7.87% of bias and both have 28% relative inter-quartile ranges. Biomass in 2009 is estimated to be 72% of B_{MSY} with 80% bias-corrected confidence interval between 52% and 95%. Fishing mortality in 2008 is estimated to be 0.6 times F_{MSY} with 80% bias-corrected confidence interval between 0.46 and 0.83 times F_{MSY}. MSY is estimated to be 2536 t with 80% CI from 2594 t to 2539 t. This parameter shows no bias and a negligible inter-quartile range. More detailed results can be found in Annex H.

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 2008, biomass is estimated to be below B_{MSY} and fishing mortality is estimated to be below F_{MSY}.

Comparison between the 2007 and 2009 assessments show that both assessments are very consistent for the common period (Figure 8.2.5).

Parameter	Assessment year	
point estimates	2007	2009
B1/K	0.4167	0.3874
K	11370	11630
MSY	2499	2536
Y (Fmsy)	879.3	1827
Bmsy	5687	5813
Fmsy	0.4394	0.4363
B./Bmsy	0.3519	0.7203
F./Fmsy	1.386	0.6089
q(1)	4.60E-07	4.48E-07
q(2)	1.13E-06	1.11E-06
q2/q1	2.458	2.482

B./Bmsy: B_{2007}/Bmsy for 2007; B_{2009}/Bmsy for 2009.
F./Fmsy: F_{2006}/Fmsy for 2007; F_{2008}/Fmsy for 2009.
Y(Fmsy): yield fishing at Fmsy for the next year of the assessment.

8.2.4 Projections

Projections were performed based on the ASPIC estimates. The projected B/B_{MSY} and yield are presented in Table 8.2.5, where each column corresponds to a fishing mortality scenario. Projections were performed for F *status quo* (assumed as F_{2008}), F_{MSY}, with zero catches and for reductions in F in the first projection year from 10% to 50% of F *status quo*.

The biomass is expected to increase under all fishing mortality scenarios examined. Fishing mortality equal to F status quo in 2010 is expected to bring the stock back to Bmsy in 2011 (Table 8.2.7).

8.2.5 Biological Reference Points

There are no biological reference points defined for this stock.

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 1978-2008 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	n/a	n/a
1979	n/a	n/a	n/a	306	n/a	210	n/a	n/a
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

n/a: not available

Table 8.2.2 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa.
Length composition by fleet for landings in 2008 (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	0.000	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	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.189	0.189	0.189
27	0.045	0.000	0.045	0.100	0.004	0.379	0.483	0.528
28	0.000	0.000	0.000	0.137	0.000	0.401	0.538	0.538
29	0.000	0.000	0.000	0.173	0.096	0.242	0.512	0.512
30	0.977	0.000	0.977	0.547	0.192	0.417	1.156	2.133
31	1.524	0.000	1.524	0.616	0.100	0.455	1.171	2.695
32	2.583	0.000	2.583	1.511	0.093	0.287	1.891	4.474
33	3.988	0.000	3.988	3.546	0.293	0.044	3.882	7.870
34	6.008	0.000	6.008	3.741	0.095	0.088	3.924	9.932
35	9.460	0.000	9.460	7.276	0.287	0.215	7.778	17.238
36	7.866	0.000	7.866	10.806	0.399	0.118	11.323	19.189
37	9.522	0.000	9.522	12.006	0.553	0.082	12.641	22.163
38	9.840	0.000	9.840	14.157	0.695	0.156	15.008	24.848
39	10.798	0.000	10.798	14.380	0.932	0.135	15.447	26.245
40	13.707	0.000	13.707	10.314	0.667	0.476	11.457	25.164
41	9.377	0.000	9.377	7.502	0.939	0.539	8.980	18.357
42	9.929	0.000	9.929	9.895	1.194	1.015	12.104	22.033
43	9.292	0.000	9.292	5.103	1.552	1.067	7.722	17.014
44	9.110	0.000	9.110	5.788	1.325	1.035	8.148	17.258
45	7.376	0.125	7.501	5.078	1.213	0.614	6.905	14.406
46	6.007	0.218	6.225	4.421	0.946	0.893	6.259	12.484
47	6.037	0.211	6.248	6.378	0.847	0.982	8.207	14.455
48	4.024	0.303	4.327	4.656	0.441	0.920	6.017	10.345
49	5.799	0.028	5.827	6.407	0.381	0.863	7.651	13.478
50	4.468	0.737	5.205	5.911	0.350	1.792	8.053	13.258
51	6.317	0.742	7.059	6.261	0.146	1.066	7.473	14.532
52	4.138	0.352	4.490	6.566	0.291	1.412	8.269	12.759
53	6.291	1.024	7.315	6.574	0.266	1.384	8.224	15.539
54	5.925	1.116	7.041	6.475	0.419	2.051	8.945	15.986
55	4.974	0.329	5.303	4.802	0.357	2.247	7.406	12.709
56	6.626	0.487	7.113	3.343	0.401	1.506	5.250	12.364
57	5.038	1.056	6.094	5.313	0.350	2.352	8.015	14.109
58	3.857	0.542	4.399	2.276	0.258	2.295	4.829	9.228
59	4.085	0.468	4.553	2.369	0.117	2.145	4.631	9.185
60	3.906	1.302	5.208	2.987	0.375	1.657	5.019	10.227
61	2.682	0.569	3.251	2.011	0.122	1.253	3.386	6.637
62	1.711	0.819	2.530	1.466	0.370	1.032	2.868	5.398
63	2.133	1.172	3.305	1.542	0.146	0.870	2.559	5.864
64	0.778	0.356	1.134	0.891	0.198	0.573	1.662	2.796
65	1.424	0.422	1.846	0.684	0.200	1.021	1.905	3.751
66	0.910	1.156	2.066	0.736	0.018	0.433	1.187	3.253
67	0.569	0.474	1.043	0.584	0.111	0.438	1.133	2.176
68	0.801	0.701	1.502	0.484	0.127	0.134	0.746	2.248
69	0.972	0.469	1.441	0.345	0.015	0.254	0.614	2.054
70	0.969	0.702	1.671	0.145	0.028	0.180	0.353	2.024
71	0.455	0.297	0.752	0.245	0.079	0.240	0.564	1.316
72	0.565	0.548	1.113	0.387	0.066	0.181	0.635	1.747
73	0.536	0.387	0.923	0.314	0.104	0.078	0.495	1.419
74	0.293	0.323	0.616	0.690	0.000	0.127	0.817	1.433
75	0.423	0.300	0.723	0.026	0.012	0.307	0.346	1.069
76	0.452	0.203	0.655	0.000	0.030	0.134	0.164	0.819
77	0.148	0.071	0.219	0.086	0.099	0.131	0.316	0.535
78	0.315	0.127	0.442	0.233	0.039	0.163	0.436	0.878
79	0.270	0.000	0.270	0.131	0.085	0.309	0.525	0.795
80	0.184	0.272	0.456	0.000	0.067	0.237	0.304	0.760
81	0.280	0.000	0.280	0.142	0.104	0.192	0.438	0.718
82	0.057	0.065	0.122	0.046	0.063	0.291	0.400	0.522
83	0.172	0.000	0.172	0.397	0.084	0.195	0.676	0.848
84	0.000	0.039	0.039	0.000	0.014	0.147	0.161	0.200
85	0.216	0.000	0.216	0.170	0.075	0.157	0.402	0.618
86	0.216	0.000	0.216	0.000	0.042	0.185	0.227	0.443
87	0.000	0.000	0.000	0.000	0.029	0.116	0.145	0.145
88	0.000	0.000	0.000	0.000	0.000	0.042	0.042	0.042
89	0.000	0.000	0.000	0.038	0.007	0.034	0.079	0.079
90	0.000	0.000	0.000	0.000	0.028	0.032	0.060	0.060
91	0.000	0.000	0.000	0.038	0.053	0.050	0.140	0.140
92	0.000	0.000	0.000	0.000	0.027	0.010	0.036	0.036
93	0.000	0.000	0.000	0.000	0.018	0.022	0.040	0.040
94	0.000	0.000	0.000	0.000	0.029	0.005	0.034	0.034
95	0.000	0.000	0.000	0.000	0.000	0.030	0.030	0.030
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	0.029	0.029	0.029
98	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
99	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100+	5.551	3.335	8.886	0.000	0.000	0.000	0.000	8.886
TOTAL	222	22	244	199	19	41	259	503
Tonnes	386	70	456	336	40	119	495	951
Mean Weight (g)	1739	3190	1869	1685	2076	2903	1907	1889
Mean Length	47.6	67.2	49.3	45.5	48.0	54.7	47.1	48.2
Measured weight (t)	4.0	1.2	5.2	3.4	1.3	7.3	8.6	13.7

Table 8.2.3 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	0.05	0.26

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

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 2006	Portugal [4]Crustacean	Portugal [5]Crustacean standardized	Portugal [4]Fish
1986	10845	18153	39810						
1987	8309	14995	34680						
1988	9047	16660	42180						
1989	8063	17607	44440				76	23	52
1990	8497	20469	44430				90	20	61
1991	7681	22391	40440				83	17	57
1992	n/a	22833	38910				71	15	49
1993	7635	21370	44504				75	13	56
1994	9620	22772	39589	4738			41	8	36
1995	6146	14046	41452	5298			38	8	41
1996	4525	12071	35728	5084			64	14	54
1997	5061	11776	35211	4801			43	11	27
1998	5929	10646	32563	3668			48	11	35
1999	6829	10349	30232	6424	4939	4607	24	8	18
2000	4453	8779	30073	5125	3813	3361	42	10	19
2001	1838	3053	29923	6103	2221	2226	85	18	19
2002	2748	3975	21823	2581	2520	2605	62	10	14
2003	2526	3837	18493	2515	2822	2576	42	10	17
2004	n/a	3776	21112	5056	5806	5086	21	7	14
2005	n/a	1404	20663	5161	3546	4032	20	5	13
2006	n/a	2718	19264	3949	4511	4584	22	5	12
2007	n/a	4334	21202	n/a	4691		22	6	8
2008	n/a	n/a	20212	n/a	5285		14	4	5

[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 2008	[3]Cedeira standardized 2006	Portugal [4]Crustacean	Portugal [5]Crustacean standardized	Portugal [4]Fish
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
1990	6.8	1.9	5.8				1.4	6.2	4.3
1991	6.7	2.8	4.5				1.2	6.1	3.6
1992	n/a	4.7	4.6				1.3	6.2	4.0
1993	7.0	6.7	4.5				0.9	4.8	2.4
1994	6.7	8.6	4.2	37.4			0.6	3.4	1.5
1995	23.0	9.0	8.2	69.1			0.6	2.8	1.1
1996	35.8	7.4	9.4	69.9			0.7	3.1	1.6
1997	28.3	10.4	8.5	66.4			0.9	3.3	1.6
1998	15.3	10.7	9.9	93.7			1.5	6.3	3.2
1999	5.9	6.5	12.6	59.6	2.7	2.9	1.7	5.0	3.9
2000	5.1	5.0	9.6	56.6	1.0	1.2	1.6	6.5	4.0
2001	6.7	9.3	9.4	47.7	2.6	2.6	0.7	3.2	2.3
2002	4.1	4.1	3.5	33.0	2.8	2.7	0.8	4.8	2.0
2003	3.6	4.0	4.6	40.8	0.9	1.0	0.7	3.1	2.2
2004	n/a	6.0	3.2	13.5	0.9	1.0	1.1	3.5	1.9
2005	n/a	4.9	2.6	10.6	0.6	0.6	0.6	2.4	1.4
2006	n/a	6.8	3.6	18.2	0.9	0.9	0.8	3.3	1.7
2007	n/a	4.5	5.2	n/a	0.5		1.5	5.6	4.0
2008	n/a	n/a	8.1	n/a	0.1		1.5	5.4	3.6

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

Table 8.2.5 Anglerfish (*L. budegassa*) – Divisions VIIIc and IXa.

ASPIC input settings and data.

Input	Value
Error type	YLD – Condition on yield
Number of bootstrap trials	500
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	
Type:	CC (CPUE and Catch)	
Year	CPUE (t/effort)	Catch (t)
1980	-1	2110
1981	-1	2300
1982	-1	2369
1983	-1	2379
1984	-1	1929
1985	-1	1833
1986	-1	2563
1987	-1	3832
1988	-1	3700
1989	0.00117	2578
1990	0.00141	2334
1991	0.00122	2163
1992	0.00132	2111
1993	0.00085	2227
1994	0.00064	1580
1995	0.00058	1831
1996	0.00070	1629
1997	0.00088	1813
1998	0.00145	2089
1999	0.00172	1885
2000	0.00156	1369
2001	0.00069	1013
2002	0.00075	770
2003	0.00071	926
2004	0.00107	973
2005	0.00063	897
2006	0.00080	1148
2007	0.00153	1301
2008	0.00148	951

F2:	P-TRF
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	0.00351
1990	0.00429
1991	0.00365
1992	0.00397
1993	0.00237
1994	0.00150
1995	0.00111
1996	0.00162
1997	0.00160
1998	0.00316
1999	0.00385
2000	0.00404
2001	0.00227
2002	0.00200
2003	0.00217
2004	0.00190
2005	0.00138
2006	0.00173
2007	0.00398
2008	0.00361

Table 8.2.6 ANGLERFISH (L. budegassa) – Divisions VIIIc and IXa. ASPIC results: parameter estimates, bootstrap relative bias and confidence interval, and interquartil (IQ) range.

	WG2009							
			Bootstrap Confidence Interval					
Parameter	Point estimates	Relative bias	Lower 80%	Higher 80%	Lower 50%	Higher 50%	IQ-Range	Relative IQ-Range
B1/K	0.39	0.02%	0.39	0.39	0.39	0.39	0.00	0.10%
K	11630	0.06%	11500	12070	11620	11710	96	0.80%
q(1)	4.48E-07	0.43%	3.86E-07	5.23E-07	4.14E-07	4.87E-07	7.28E-08	16.30%
q(2)	1.11E-06	3.87%	1.02E-06	1.21E-06	1.05E-06	1.15E-06	1.07E-07	9.60%
MSY	2536	-0.01%	2529	2539	2535	2537	1	0.00%
Ye(2009)	2338	-3.94%	1956	2524	2202	2468	267	11.40%
Y.@Fmsy	1827	-2.52%	1323	2396	1615	2127	512	28.00%
Bmsy	5813	0.06%	5751	6034	5808	5856	47.92	0.80%
Fmsy	0.436	-0.04%	0.419	0.442	0.433	0.437	0.004	0.90%
fmsy(1)	975000	0.86%	842100	1132000	899100	1061000	161600	16.60%
fmsy(2)	392900	-3.09%	358900	428800	380500	418000	37470	9.50%
B./Bmsy	0.72	-2.51%	0.52	0.95	0.64	0.84	0.20	28.10%
F./Fmsy	0.61	7.87%	0.46	0.83	0.52	0.69	0.17	27.70%
Ye./MSY	0.92	-3.94%	0.77	1.00	0.87	0.97	0.11	11.40%
q2/q1	2.5	4.82%	1.97	2.83	2.16	2.62	0.47	18.80%

Table 8.2.7. Anglerfish (*L. budegassa*) – Divisions VIIIc and IXa. Point estimates of B/B_{MSY}(from 2009 to 2018) and Yield (from 2007 to 2016) for projections with F status quo (Fsq), F_{MSY}, zero catches and first year reduction in F of 10, 20, 30, 40 and 50% of B_{MSY}. Values for F/F_{MSY} are also given.

Fishing mortality trends in relation to F_{MSY}

			Decrease in first year					
year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %
2009	0.6089	0.61	0.61	0.61	0.61	0.61	0.61	0.61
2010	0.6089	1	0.00	0.30	0.37	0.43	0.49	0.55
2011	0.6089	1	0.00	0.30	0.37	0.43	0.49	0.55
2012	0.6089	1	0.00	0.30	0.37	0.43	0.49	0.55
2013	0.6089	1	0.00	0.30	0.37	0.43	0.49	0.55
2014	0.6089	1	0.00	0.30	0.37	0.43	0.49	0.55
2015	0.6089	1	0.00	0.30	0.37	0.43	0.49	0.55
2016	0.6089	1	0.00	0.30	0.37	0.43	0.49	0.55
2017	0.6089	1	0.00	0.30	0.37	0.43	0.49	0.55
2018	0.6089	1	0.00	0.30	0.37	0.43	0.49	0.55

Biomass trends in relation to B_{MSY}

year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %
2009	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
2010	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2011	1.09	0.95	1.34	1.21	1.19	1.16	1.14	1.11
2012	1.21	0.97	1.66	1.42	1.38	1.34	1.29	1.25
2013	1.29	0.98	1.84	1.55	1.50	1.44	1.39	1.34
2014	1.33	0.99	1.93	1.63	1.57	1.51	1.45	1.39
2015	1.36	0.99	1.97	1.66	1.60	1.54	1.48	1.42
2016	1.37	0.99	1.99	1.68	1.62	1.56	1.50	1.43
2017	1.38	1.00	2.00	1.69	1.63	1.57	1.50	1.44
2018	1.39	1.00	2.00	1.69	1.63	1.57	1.51	1.45

Yield

year	Fsq	F_{MSY}	zero catches	reduction 50 %	reduction 40 %	reduction 30 %	reduction 20 %	reduction 10 %
2009	1272	1272	1272	1272	1272	1272	1272	1272
2010	1560	2375	0	828	981	1131	1278	1421
2011	1781	2430	0	1023	1195	1356	1507	1649
2012	1931	2466	0	1155	1338	1507	1662	1803
2013	2024	2491	0	1230	1423	1598	1756	1898
2014	2079	2507	0	1270	1468	1648	1809	1953
2015	2110	2517	0	1291	1492	1674	1838	1983
2016	2127	2524	0	1300	1503	1687	1853	1999
2017	2137	2528	0	1305	1509	1694	1861	2008
2018	2142	2531	0	1307	1512	1698	1865	2013

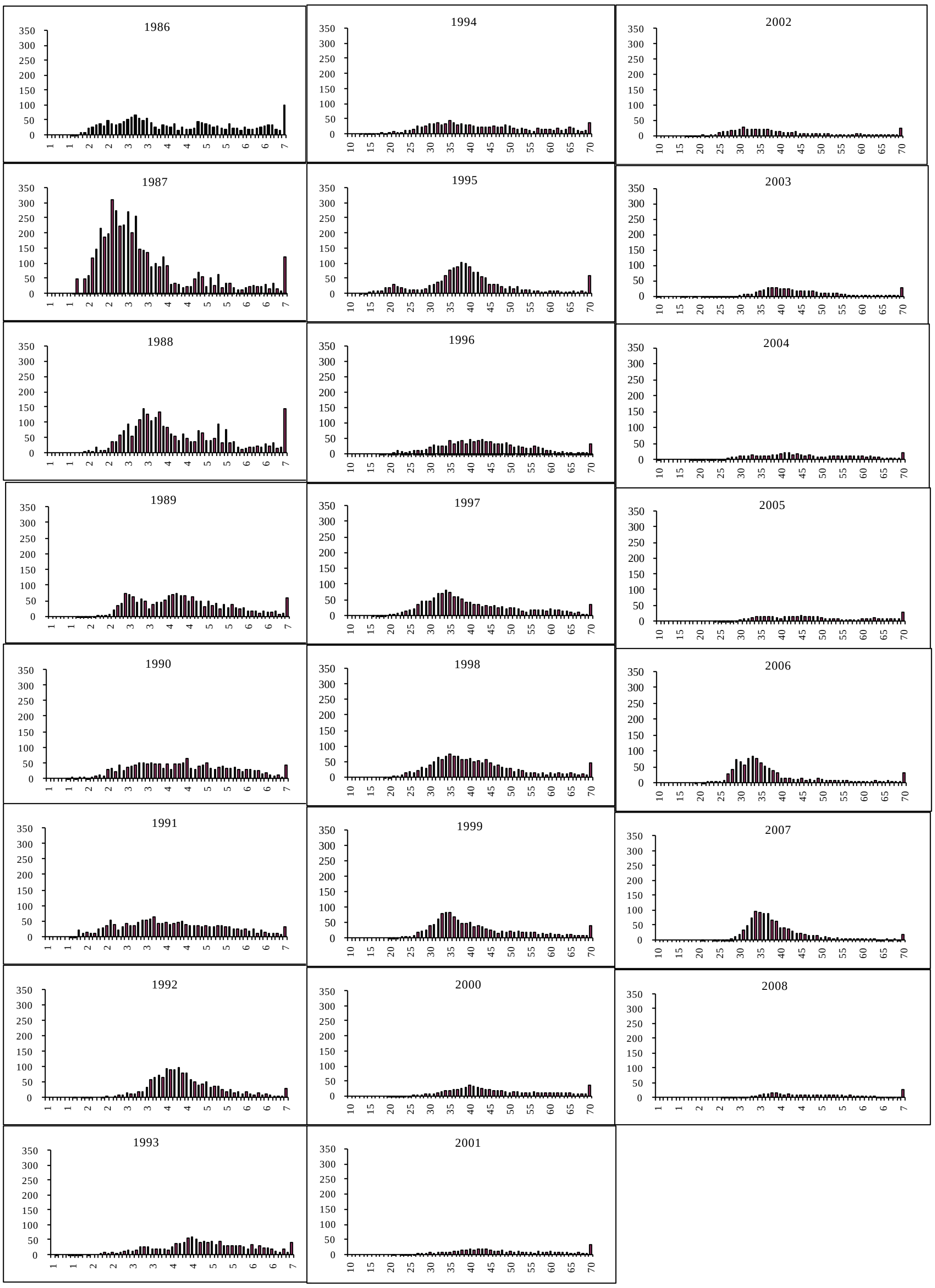


Figure 8.2.1 **ANGLERFISH (L. budegassa) - Divisions VIIIc and IXa.**
Length distributions of landings (thousands for 1986 to 2008).

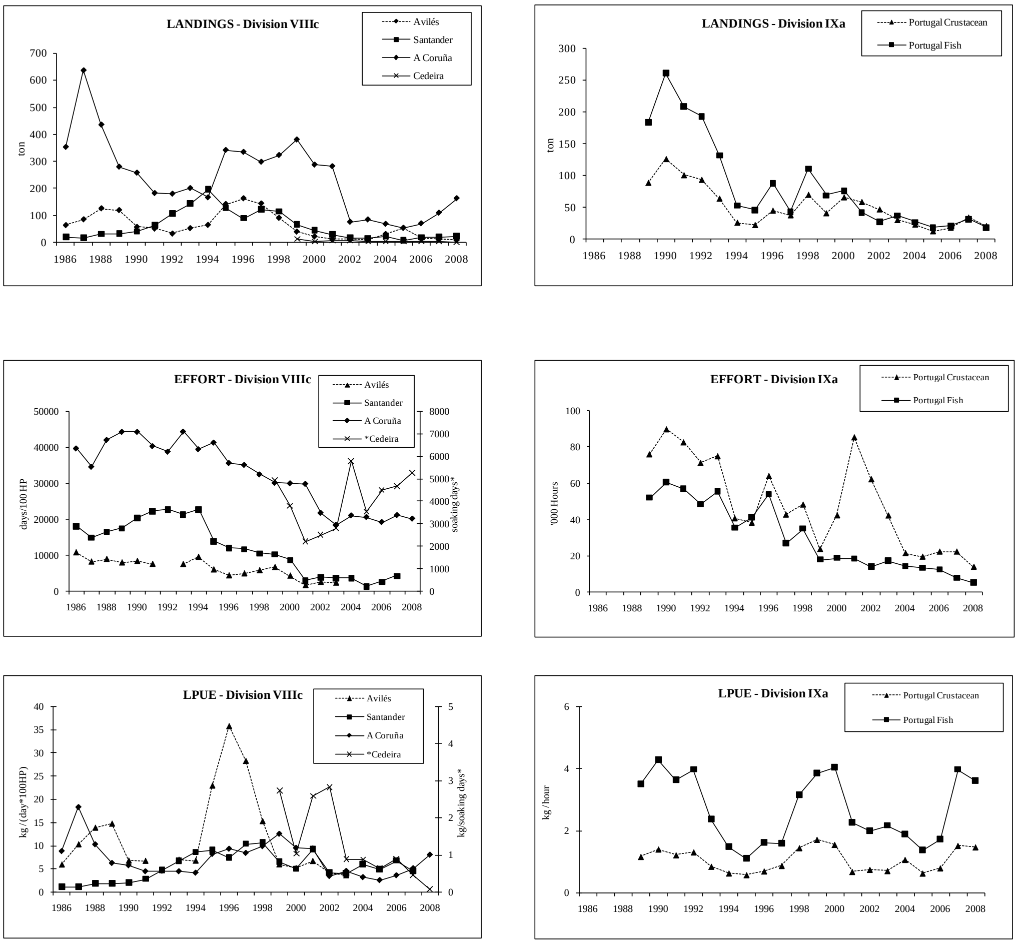
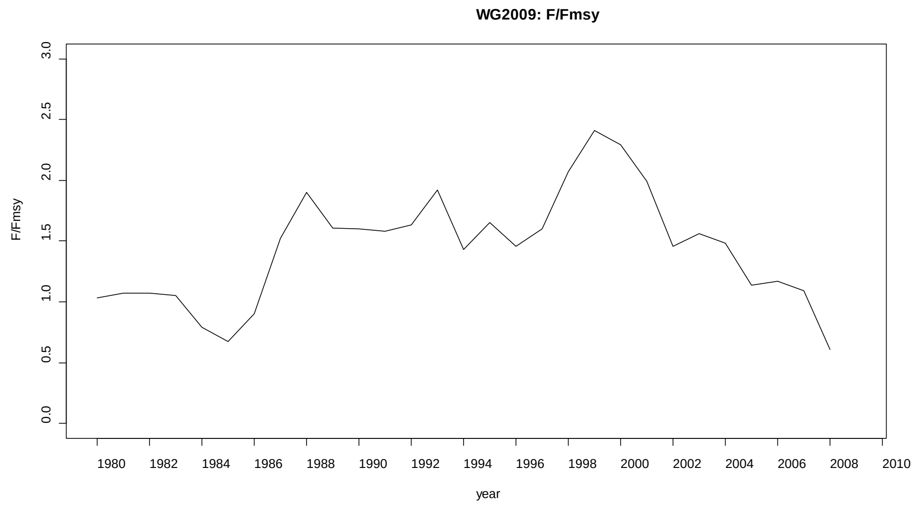


Figure 8.2.2 **ANGLERFISH (L. budegassa) - Divisions VIIIc and IXa.**
Trawl and gillnet landings, effort and LPUE data between 1986-2008.


WG2009: F/Fmsy
F/Fmsy
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
year


F/Fmsy
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
year

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 3 288 t (2 337 t *L. piscatorius* and 951 t *L. budegassa*) in 2008.

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 71% of the 2008 landings.

The TAC (1 955 t in 2008 and 1 760 t in 2009) is set for both species of anglerfish combined. Landings in 2008 were 1.68 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 an increasing trend from 2006 onwards, while the data available for the Spanish fleets indicates stability or a decreasing 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

- Update of the last assessment, no changes have been made.

8.3.3 Management considerations

Lophius piscatorius and *L. budegassa* are subject to a common TAC (1 955 t in 2008 and 1 760 t in 2009), so the joint status of these species should be taken into account when formulating management advice. Combined landings in 2008 (3 288 t) were 1.68 times the TAC. Both species of anglerfish are reported together because of their similarity but are assessed separately.

Biomass in 2009 of *L. piscatorius* is estimated to be below Bmsy and, despite the decrease in fishing mortality since 2005, F in 2008 is still above Fmsy. Fishing mortality equal to zero is not expected to bring the stock back to Bmsy before 2013.

Fishing mortality for *L. budegassa* shows a decreasing trend since 1999 and in 2008 is below Fmsy. This has led to an increase in biomass but it is still below Bmsy. Fishing mortality equal to F *status quo* is expected to bring the stock back to Bmsy 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 1978-2008 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

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	41	1	38	1
2008	99	3	n/a	n/a	436	13	228	7	26	1	24	1

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 2006	[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	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	25	6	17	3
2008	n/a	n/a	20212	n/a	5285	n/a	18	4	13	2

[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	[3] Cedeira standardize	[4] Portugal Crustacean	[5] Portugal Crustacean	[4] Portugal Fish	[5] Portugal Fish
1986	52.0	29.6	35.7							
1987	70.4	36.3	45.7							
1988	58.1	25.1	47.4							
1989	41.3	19.2	27.9				2.3	7.7	6.9	20.3
1990	37.4	15.5	23.4				2.6	11.4	7.9	28.0
1991	38.6	15.3	25.9				2.1	10.4	6.3	23.3
1992	n/a	14.4	22.5				1.7	7.8	5.0	17.8
1993	16.9	15.4	13.2				1.3	7.5	3.7	15.8
1994	18.8	16.8	10.4	86.9			1.2	6.4	2.8	10.5
1995	54.1	22.2	14.5	113.4			1.1	5.6	2.2	9.9
1996	106.9	29.7	20.9	147.1			1.4	6.2	3.2	14.3
1997	96.4	42.7	20.1	147.7			2.1	7.8	3.8	11.6
1998	63.6	40.4	14.2	125.7			1.7	7.3	3.6	13.3
1999	21.7	24.1	17.9	84.4	71.9	77.1	1.9	5.4	4.2	13.2
2000	11.4	13.6	12.4	72.7	37.6	42.7	1.6	6.7	4.2	12.9
2001	19.1	26.9	12.2	59.9	41.6	41.5	0.8	3.7	2.6	9.8
2002	31.6	18.4	9.4	79.9	54.5	52.7	1.0	6.7	2.8	8.7
2003	47.6	26.1	16.9	124.2	57.4	62.9	1.0	4.4	3.1	9.5
2004	n/a	34.1	16.4	68.6	66.6	76.0	1.6	5.4	2.9	9.5
2005	n/a	46.9	21.5	86.2	122.9	108.1	1.2	4.7	2.7	9.7
2006	n/a	39.4	16.2	79.1	92.9	91.5	1.4	5.8	3.0	9.9
2007	n/a	28.3	15.7	n/a	50.1	n/a	1.6	6.9	2.2	12.9
2008	n/a	n/a	21.6	n/a	43.1	n/a	1.5	6.9	1.8	13.6

[1] kg/day*100HP [4] kg/hour trawl
[2] kg/day [5] kg/haul
[3] kg/soaking day n/a - not available

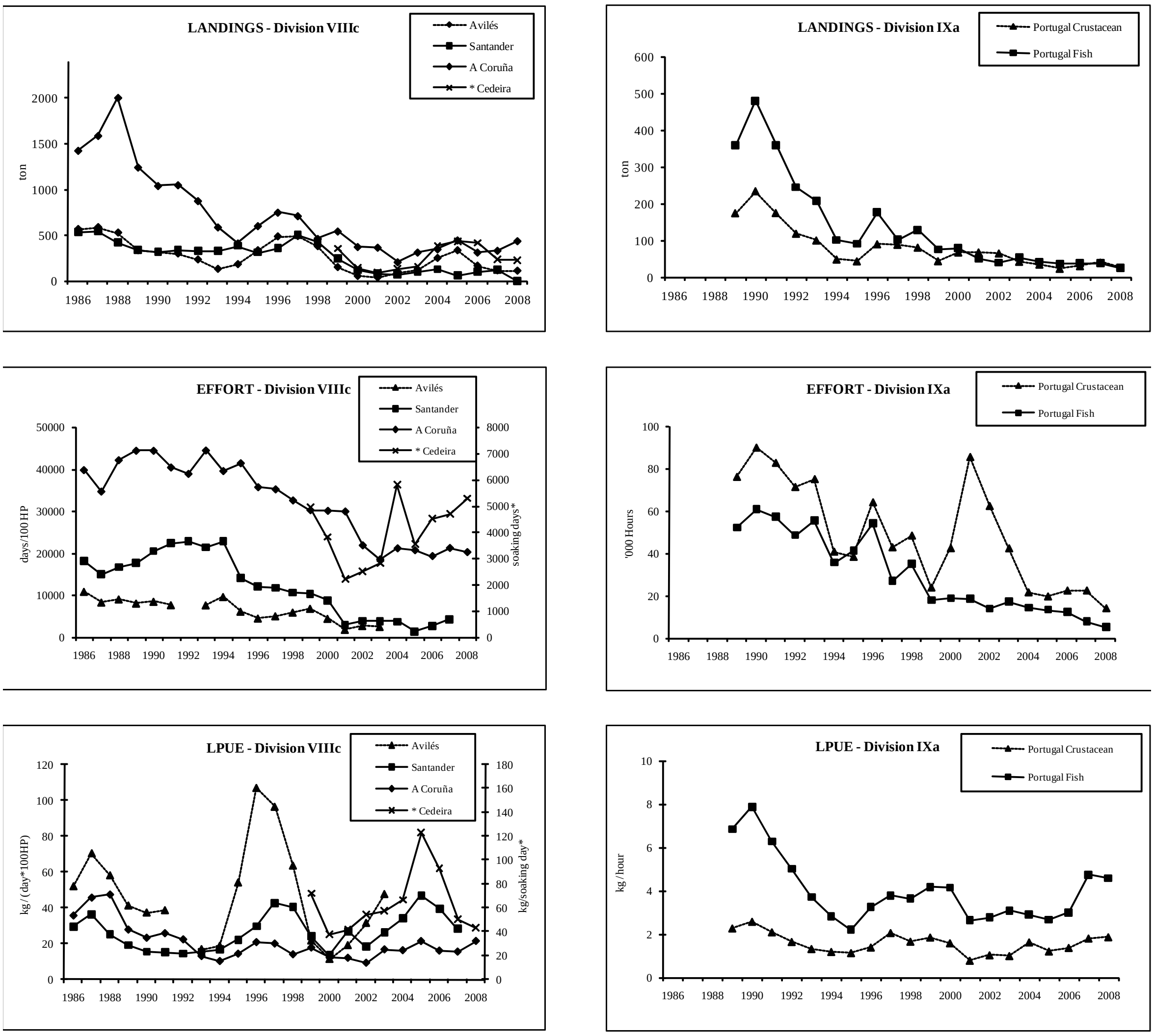


Figure 8.3.1 ANGLERFISH (*L. budegassa and L. piscatorius*) - Divisions VIIIc and IXa. Trawl and gillnet landings, effort and LPUE data between 1986-2008.

9 Megrims in Divisions VIIIc and IXa

L. *whiffiagonis:*

Type of assessment in 2009: update (advice for this stock was last given in 2007)

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

Data revisions this year: Portuguese trawl 2007 effort and LPUE value.

Review Group issues: RG in 2007 and RG 2008 made the following comments:

1) to look more into the exploitation pattern (F matrix), as there seems to be a shift in exploitation pattern around 1995 to older age groups ==> F matrix has been examined (last paragraph of Section 9.1.3.3)

2) not enough tuning diagnostics as a consequence of having run XSA with FLR ==> XSA has been run with the Lowestoft suite this year

3) Spanish survey data based on very scarce catches, less than 1 fish per 30 minute haul ==> There was an error in the label of the bottom right panel of Figure 9.1.3(a) and in the units indicated for the recruitment ages in Table 9.1.5, which may have been causing the confusion. Average catch per 30 minute haul is 13 individuals over the time series. As also noted by the RG, the survey has satisfactory internal consistency (see new Figure 9.1.3(b)).

4) Recruitment for short term prognosis is GM(92-04) (referring to the 2007 assessment), that includes the strong 1991 yc ==> This year GM(98-06) was used in the short term predictions of this stock (details in Section 9.1.3.4)

5) RG encourage the WG in the task of developing an assessment incorporating uncertainty ==> It has been impossible to do this year, due to a shortage of manpower. But the WG will continue to try to develop this.

L. *boscii*:

Type of assessment in 2009: update (advice for this stock was last given in 2007)

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

Data revisions this year: Portuguese trawl 2007 effort and LPUE value.

Review Group issues: RG in 2007 suggested that reference points should be proposed ==> To be considered when a benchmark is conducted

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*). Some general ecosystem studies on megrim have been carried out in the distribution area of these stocks (Rodriguez-Marín and Olaso, 1993; Sánchez and Gil, 1995; Sanchez et al, 1998 and 2001 and Rodriguez-Marín, 2002).

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). Both species of megrim disappear at the mouth of the most important rivers, probably associated with the occurrence of continental run-off, which acts mainly by modifying the composition of the grounds on which megrim depend for food, and creating grounds which are more appropriate for other flatfish, such as sole, plaice or thickback sole (*Dicologoglossa cuneata)*, adapted to estuarine conditions (Sánchez et al., 2001).

The dependence on sediment is probably related both to the distribution of suitable prey and to the ability of flatfish to bury themselves. Burying provides some protection from predators and reduces the use of energy. The juvenile habitat is often a small and generally shallower part of the total habitat occupied by the species. For certain species nursery areas play an important role, whereas for other species no specific nursery areas are known. In general for North Atlantic flatfish the magnitude of recruitment is mainly an effect of transport to and quality of areas for larval development (van der Veer *et al*., 1990, 2000, Beverton and Iles 1992; Bailey 1994; Wennhage and Pihl 2001).

Many flatfish species show a gradual offshore movement of juveniles as they grow. This might indicate that habitat quality for flatfish is size-dependent. Another common pattern is the annual micro- and macroscale movements and migrations between spawning, feeding and wintering areas (e.g., Molander 1925; Gibson 1994).

Most flatfishes are associated with finer sediments, rather than with hard substrata. The structure of the sea bed is an important factor controlling their distribution and there is increasing evidence that flatfish species can distinguish between and select sediments on the basis of their grain size (Gibson, 1994).

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).

Juveniles of these species feed mostly on detritivore crustaceans inhabiting deep-lying muddy bottoms. Adult *L. boscii* feeds mainly on crustaceans inhabiting muddy surfaces (Rodriguez-Marín and Olaso, 1993; Rodriguez-Marín, 2002) as opposed to *L. whiffiagonis*, which are more ichthyophagous and where rates of crustacean in diet decrease with fish size (Rodriguez-Marín, 2002). Such seabed occurs in the Cantabrian Sea at a greater depth than in the Mediterranean, since the internal Cantabrian continental shelf has a rocky structure. However, recent data show a greater presence of *L. boscii*, suggesting that this species is predominant on all soft bottoms of the continental shelf. Segregation of and competition between species may be the result of several niche aspects (depth, distribution, diet, etc). None of the two species represent an important part of the diet for the main fish predators in this 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 megrim 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 decreases to 9 years in Divisions VIIIc and IXa (BIOSDEF, 1998; Landa et. al, 1996).

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 2008 were 1110 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.

The Spanish survey (SP-GFS) has provided biomass indices since 1983 (Figure 9.1.1). The survey indicates erratic trends, with a sharp increase in 1988 followed by a strong decrease. Since 1988, the lowest value of the series was found in 2003. Values have been quite variable in recent years: after 2003, the index increased significantly in 2004 and again in 2005, followed by a decrease in 2006, an increase in 2007 and a decrease again in 2008. The index value in 2008 is below the historic average.

The *Prestige* oil spill in the northwest Spanish coast (November 2002) prompted a redistribution of fishing effort, particularly in the Galician area. Some regulation measures, such as spatial and seasonal closures, were adopted in order to minimise the oil spill impact on fisheries. Some trawl fleets display lower effort in 2003 in relation to later years.

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 or ``*jurelera*'', affects catches of *L. boscii* more than those of *L. whiffiagonis,* because it operates mainly in the distribution area of the former species, which is different from that of the latter 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.

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 2009 and management for 2008 and 2009

ICES advice for 2009 (as extracted from ICES Advice 2008, Book 7):

These stocks and fishery have been rather stable for the last decade, so the new information available this year was not expected to result in any significant change in the perception of the stocks status. The advice on these stocks for the fishery in 2009 is therefore the same as the advice given in 2007 for the 2008 fishery: At recent levels of fishing mortality for both species, SSB has been stable for *L. whiffiagonis* and showing some signs of increase for *L. boscii*. Fishing mortality should not be allowed to increase. This level of exploitation would correspond to landings of around 230 t for *L. whiffiagonis* and around 1200 t for *L. boscii.* The combined landings at the current exploitation level would be around 1430 t.

Management applicable for 2008 and 2009:

The agreed combined TAC for megrim and four-spot megrim in ICES Divisions VIIIc and IXa for 2008 and 2009 was 1430 t in both years.

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 2008 are given in Table 9.1.1. The total estimated international landings in Divisions VIIIc and IXa for 2008 was 178 t. Landings reached a peak of 977 t in 1990, followed by a steady decline to their lowest level of 117 t in 2002. Some increase in landings has been observed since then, with landings in 2008 corresponding to the second highest value of this most recent period.

Discards data are available for Spanish trawlers in the years displayed in the table below. 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 last two years 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 table below:

Spanish Discard/Total Catch ratio											
Year	1994	1997	1999	2000	2001	2003	2004	2005	2006	2007	2008
Weight Ratio	0.06	0.17	0.17	0.13	0.01	0.11	0.07	0.14	0.08	0.004	0.03
CV	50.2	24.0	21.9	41.4	57.6	19.6	27.3	48.2	29.0	46.8	40.7
Number Ratio	0.42	0.38	0.42	0.45		0.26	0.16	0.30	0.21	0.02	0.06

9.1.2.2 Biological sampling

Annual length compositions of total landings are displayed in Figure 9.1.2 for the period 1986 – 2008. 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) in Divisions VIIIc and IXa 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 shows the total length distribution by ICES division for 2008. Figure 9.1.2 indicates that the length distribution of landings in 2008 is fairly typical of what has been seen in recent years.

Sampling levels for both species are given in Table 1.3.

Mean lengths and mean weights in landings since 1990 are shown in the table below. The mean length and mean weight values in 2008 are the highest and second highest in the historic series, respectively.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
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	26.0	25.7	26.1	25.3	26.2	26.7	27.1
Mean weight (g)	105	108	129	108	124	121	120	118	119	127	134	124	137	134	137	127	137	148	147

Age compositions of landings (Table 9.1.3) are based on annual Spanish ALKs for 1990 - 2008, 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 (PT-GFS, also called "October" survey, and PT-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 2006-2008 being the three lowest in the historic series (Figure 9.1.3(a), bottom right panel). Both the abundance and biomass index values in 2008 are the lowest in the historic series.

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. Age 0 is not used in the assessment due to the severe scarcity of commercial landings of this age. The age 1 abundance index in 2008 is 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 - 2008 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 – 2008 (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. The lowest value was reached in 2003, in which restrictions imposed on fishing activity due to the Prestige oil spill had an influence on effort. 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)). This year there has been a small revision of the 2007 effort (and, hence, LPUE) value. 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 the last assessment (2007 WG, although the 2008 WG also performed an update run for consistency checking).

9.1.3.1 Input data

The age range considered 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 – 2008 and Avilés (SP-AVILESTR) for 1990-2003, and the indices from the Spanish survey (SP-GFS) in Divisions VIIIc and IXa (1990-2008) were used for tuning (see Table 9.1.6).

9.1.3.2 Model

Data screening

The FLEDA package of FLR was used to explore the quality of the input data. 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.

The internal consistency of each abundance at age data series used to tune the assessment model was examined by checking correlations between ages following cohorts, for the ages and years used for tuning. The results, displayed in Table 9.1.8, indicate that all series are good up to age 5. Age 6 is harder to track along cohorts, particularly for the Spanish survey and the A Coruña trawl fleet. The same conclusion can be reached by visual inspection of Figures 9.1.3(b) and 9.1.3(c). These figures also indicate a certain degree of agreement between the three indices.

Final run

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

		2007 WG		2009 WG	
Fleets	SP-CORUTR8c	90-06	2-6	90-08	2-6
	SP-AVILESTR	90-03	2-6	90-03	2-6
	SP-GFS survey	90-06	1-6	90-08	1-6
Taper			No		No
Tuning range			17		19
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 slight overestimation of recruitment and SSB and underestimation of F in recent years (Figure 9.1.5).

9.1.3.3 Assessment results

There were convergence problems with the XSA run, with results varying appreciably depending on the number of iterations used. This happened both when running XSA with the Lowestoft suite and with FLR. Results from the Lowestoft suite and FLR also differed. 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 (with the Lowestoft suite) 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). Almost all residuals are negative in 2008 for the two tuning indices (survey and Coruña trawl). 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 decreased slightly in 2008, after the local peak reached in 2006, which may be explained by the relatively higher landings in that year. SSB in 2008 is estimated to be the second lowest in the series, after the value estimated for SSB in 2004. Recruitment in 2008 is also estimated to be the second lowest in the series, after that of 1994.

The RG indicated that the F matrix should be examined, as there appeared to be a shift in the exploitation pattern around 1995 to older age groups. 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 2006 year class is estimated to have 3.6 million individuals at 1 year of age based on the information from the Spanish survey (SP-GFS) (54% of weight) and one commercial fleet (SP-CORUTR8c) (25% of weight). P-shrinkage and F-shrinkage contributed 19% and 2% of the weight, respectively. The estimate from the update run in the 2008 Working Group was close to 3.8 million at one year of age.

The 2007 year class is estimated to have 1.7 million fish at 1 year of age, based on the Spanish survey (SP-GFS) (67% of weight), P-shrinkage (29% of the weight) and F shrinkage (4%).

Estimates of recruitment for the years 1986 to 1989, for which age compositions were based on combined ALKs, were excluded from the estimation of recruitment to be used in short-term projections. Age 1 recruitments corresponding to year classes from the period of low SSB (so age 1 recruitment starting from 1992), and excluding the recruitment estimates of the final two assessment years, were used to estimate recruitment at age 1 as a geometric mean (GM) in previous Working Groups. This procedure would correspond to computing GM over the (age 1) recruitment estimates for years 1992-2006. However, taking into account a RG comment that suggested that recruitment in 1992 should be excluded from the GM computation and noticing that recruitment has been consistently at low levels since 1998, this year it has been decided to take GM over years 1998-2006, 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
2005	2801	XSA	38%	46%	16%
2006	3628	XSA	54%	25%	21%
2007	1666	XSA	67%		33%
2008	2964	GM $_{(98\text{-}06)}$			

9.1.3.5 Historic trends in biomass, fishing mortality and recruitment

Table 9.1.12 and Figure 9.1.7(a) indicate that SSB decreased from 2690 t in 1990 to 990 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 below 1000 t in every year. The values for 2004-2008 are the five lowest in the series.

F has declined in recent years from the high levels observed prior to 1995 (Fbar, for ages 2-4, in the range of 0.28-0.44 before 1995) and the high value reached in 1998 (0.36). The lowest value in the time series was reached in 2002 (Fbar = 0.13). Fbar increased every year between 2003 and 2006 (Fbar=0.29 in 2006), but has decreased in 2007 (Fbar=0.21) and 2008 (Fbar=0.20).

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 2008 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_{98-06} (3.0 million). The exploitation pattern used was the unscaled average of 2006-2008 (corresponding to Fbar = 0.23, F *status quo*). Mean weights in the catch and in the stock were computed as averages over 2006-2008.

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 2009-2011 is given in Table 9.1.15.

Under *status quo* F, landings in 2009 and 2010 are predicted to be 182 t and 187 t respectively. SSB would increase from the 906 t estimated for 2009 to 939 t in 2010 and 975 t in 2011. Despite these increases, SSB in 2011 would still be below all values estimated for SSB up until 2003.

The contributions of recent year classes to the predicted landings in 2010 and SSB in 2011, assuming GM_{98-06} recruitment, are presented in Table 9.1.16. The assumed GM_{98-06} age 1 recruitment in 2009 and 2010 contributes 17% to landings in 2010 and 40% to the predicted SSB at the beginning of 2011. 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 analysis 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 = 0.23), and assuming GM_{98-06} for recruitment, the equilibrium yield would be around 210 t with an SSB of 1070 t. Fishing at $F_{0.1}$ (= 0.17) leads to an equilibrium yield of 196 t and an SSB of 1340 t. F_{max} is not well defined for this stock .

It should be taken into account that natural mortality (0.2) is almost as high as 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. Most of the high recruitment values are at the beginning of the series, and the first four values 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
F_{lim}	Not defined	Not defined	Not defined	Not defined	Not defined
F_{pa}	No proposal	No proposal	Not adopted	No proposal	Not adopted
B_{lim}	900 t (B_{loss},=B95 WG98)		Not defined		
B_{pa}	1 500 t (B_{lim} × 1.64)	900 t (B_{loss},=B_{95} WG98)	Not adopted	1 500 t (stock history)	Not adopted

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 and 2008, for which discard estimates are much lower, 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 last one performed (in 2007 WG) 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 five years (2004-2008) 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 2008 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 2011 relies on year classes for which recruitment has been assumed to be GM_{98-06}.

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 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	159	2	161	17	178

**Table 9.1.2 Megrim (*L. whiffiagonis*) Divisions VIIIc and IXa.
Annual length compositions of landings (´000 fish) in 2008**

Length (cm)	Div. VIIIc	Div. IXa	Total
10			
11			
12			
13			
14			
15			
16			
17			
18			
19	3.3	0.3	3.6
20	20.0	2.1	22.1
21	56.3	5.9	62.3
22	98.6	10.7	109.3
23	107.1	11.9	119.0
24	118.8	12.8	131.6
25	114.5	12.5	127.0
26	104.0	13.0	117.0
27	88.1	14.1	102.2
28	89.9	13.8	103.8
29	56.1	8.0	64.1
30	43.6	6.5	50.1
31	32.0	4.5	36.5
32	34.7	3.7	38.4
33	21.8	2.3	24.1
34	16.2	1.7	17.9
35	15.4	1.6	17.0
36	13.5	1.4	14.9
37	14.1	1.5	15.6
38	9.1	1.0	10.0
39	5.8	0.6	6.4
40	4.4	0.5	4.8
41	3.0	0.3	3.4
42	2.7	0.3	3.0
43	2.2	0.2	2.4
44	1.2	0.1	1.4
45	1.0	0.1	1.2
46	1.2	0.1	1.3
47	0.9	0.1	1.0
48	0.4	0.0	0.5
49	0.5	0.1	0.6
50+	0.1	0.0	0.1
Total	1081	132	1212

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
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)
1	1013	2020	2977	760	4230	1018	1062	519	40	509	198	82	77	20	9	40	31	129	46	123	91	79	10
2	1952	2303	3344	1903	2135	2352	392	1703	432	36	1486	1062	882	240	122	305	151	242	236	215	418	161	383
3	668	752	1038	678	775	801	677	312	1784	254	37	1011	1205	960	598	300	310	265	205	401	467	232	274
4	639	394	738	631	868	690	1120	526	549	620	279	76	881	693	507	244	86	175	242	160	248	297	196
5	501	289	530	501	329	643	591	357	624	241	502	362	214	442	361	220	164	80	184	152	170	142	222
6	201	80	181	190	376	141	77	102	330	69	147	305	328	105	83	160	80	54	100	86	106	81	80
+gp	194	71	130	253	558	59	68	36	119	72	81	116	149	207	161	118	37	48	71	41	36	56	47
TOTALNUM	5168	5909	8938	4916	9271	5704	3987	3555	3878	1801	2733	3014	3735	2667	1841	1387	860	993	1084	1177	1536	1048	1212
TONSLAND	659	497	817	714	977	614	516	383	479	218	329	356	446	343	253	175	117	134	149	147	210	155	178
SOPCOF %	95	95	95	99	99	100	100	100	100	101	102	100	101	101	101	101	100	101	100	98	100	100	100

* Age 0 was not used in the assessment.

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
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
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	0.091
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
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
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	0.190
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	0.248
+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	0.407
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	1.0011

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	+	1.4	1.0	1.79	0.25
1998	0.01	0.2	0.1	1.47	0.23
A,B,1999	+	0.1	0.1	1.59	0.29
2000	+	0.1	0.0	1.80	0.35
2001	0	0.0	0.0	1.45	0.28
2002	0.04	0.1	0.0	1.26	0.24
A,2003	0.01	0.1	0.1	0.82	0.16
A,2004	0.01	ns		1.08	0.20
2005	0.01	0.4	0.2	1.29	0.21
2006	0.02	0.3	0.2	1.03	0.18
2007	0.00	0.1	0.1	1.13	0.24
2008	0.00	0.2	0.1	0.68	0.15

	Abundance index			
	Portugal (n/h)		Spain (n/30 min)	
	Crustaceans	s.e.	Mean	s.e.
1983			14.0	2.45
1984			28.0	4.57
1985			9.0	1.34
1986			33.0	6.22
1987			ns	
1988			43.0	8.82
1989			42.0	7.04
1990			28.0	5.50
1991			10.0	1.67
1992			18.0	3.35
1993			15.0	3.23
1994			8.0	1.87
1995			11.0	1.86
A,1996			21.0	3.60
1997	7.2	4.8	20.0	3.26
1998	1.1	0.5	14.8	2.64
A,B,1999	0.6	0.5	15.5	3.05
2000	0.3	0.2	19.4	4.46
2001	0.1	0.0	12.8	2.77
2002	0.2	0.1	12.1	2.65
A,2003	0.2	0.1	7.2	1.26
A,2004	ns		8.4	1.39
2005	0.7	0.4	9.8	1.73
2006	0.4	0.2	6.4	1.16
2007	0.5	0.4	6.9	1.52
2008	1.5	0.7	4.3	1.07

	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

+ 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	2007								
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

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	2008								
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

*** 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	43.3	0.24
2008	17	20.2	0.82	11	na		14.4	37.9	0.38

[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

Table 9.1.8. Megrim (L.Whiffiagonis) in Divisions VIIIc & IXa. Correlation between different ages following cohorts.

"SP_CORUTR8c"

age	2	3	4	5	6
2	1.00	NA	NA	NA	NA
3	0.82	1.00	NA	NA	NA
4	0.71	0.63	1.00	NA	NA
5	0.71	0.68	0.58	1.00	NA
6	0.14	0.15	0.49	0.22	1.00

"SP_AVILESTR"

age	2	3	4	5	6
2	1.00	NA	NA	NA	NA
3	0.73	1.00	NA	NA	NA
4	0.53	0.74	1.00	NA	NA
5	0.38	0.63	0.46	1.00	NA
6	0.28	0.25	0.25	0.58	1.00

"SP_GFS"

age	1	2	3	4	5	6
1	1.00	NA	NA	NA	NA	NA
2	0.88	1.00	NA	NA	NA	NA
3	0.78	0.77	1.00	NA	NA	NA
4	0.55	0.63	0.68	1.00	NA	NA
5	0.49	0.55	0.66	0.57	1.00	NA
6	0.05	0.05	0.12	-0.23	0.29	1.0

Table 9.1.9. Megrim (L. whiffiagonis) in Divisions VIIIc and IXa. Tuning diagnostic.

Lowestoft VPA Version 3.1

9/04/2009 11:57

Extended Survivors Analysis

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

CPUE data from file fleetw.txt

Catch data for 23 years. 1986 to 2008. Ages 1 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-CORUTR	1990	2008	2	6	0	1
SP-AVILEST	1990	2008	2	6	0	1
SP-GFS	1990	2008	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 = .00859

Final year F values

Age	1	2	3	4	5	6
Iteration **	0.0067	0.1581	0.2014	0.2431	0.497	0.3018
Iteration **	0.0067	0.1578	0.2008	0.2419	0.4933	0.299

Regression weights

1	1	1	1	1	1	1	1	1	1

Fishing mortalities

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0.01	0.003	0.014	0.013	0.05	0.016	0.048	0.037	0.024	0.007
2	0.083	0.081	0.134	0.068	0.134	0.123	0.1	0.227	0.084	0.158
3	0.354	0.307	0.292	0.197	0.164	0.161	0.315	0.326	0.189	0.201
4	0.373	0.32	0.197	0.127	0.163	0.222	0.182	0.33	0.355	0.242
5	0.521	0.34	0.223	0.198	0.167	0.257	0.211	0.3	0.319	0.493
6	1.022	0.17	0.247	0.117	0.092	0.324	0.183	0.224	0.227	0.299

XSA population numbers (Thousands)

YEAR	AGE 1	2	3	4	5	6
1999	2.14E+03	3.32E+03	3.56E+03	2.46E+03	1.20E+03	1.81E+02
2000	3.28E+03	1.73E+03	2.50E+03	2.05E+03	1.39E+03	5.85E+02
2001	3.13E+03	2.68E+03	1.31E+03	1.50E+03	1.22E+03	8.07E+02
2002	2.64E+03	2.53E+03	1.92E+03	7.99E+02	1.01E+03	7.98E+02
2003	2.90E+03	2.13E+03	1.93E+03	1.29E+03	5.76E+02	6.80E+02
2004	3.11E+03	2.26E+03	1.52E+03	1.34E+03	8.97E+02	3.99E+02
2005	2.92E+03	2.51E+03	1.63E+03	1.06E+03	8.82E+02	5.68E+02
2006	2.80E+03	2.28E+03	1.86E+03	9.76E+02	7.25E+02	5.84E+02
2007	3.63E+03	2.21E+03	1.49E+03	1.10E+03	5.75E+02	4.40E+02
2008	1.67E+03	2.90E+03	1.66E+03	1.01E+03	6.30E+02	3.42E+02

Estimated population abundance at 1st Jan 2009

0.00E+00	1.36E+03	2.03E+03	1.12E+03	6.51E+02	3.18E+02

Taper weighted geometric mean of the VPA populations:

4.63E+03	3.73E+03	2.48E+03	1.60E+03	9.54E+02	4.89E+02

Standard error of the weighted Log(VPA populations) :

0.6694	0.5871	0.4714	0.413	0.3322	0.3911

1

Log catchability residuals.

Fleet : SP-CORUTR8c

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age								
2	0.3	0.66	0.31	-0.18	-0.87	0.09	0.24	-0.23	-0.51
3	0.06	-0.1	0.41	-0.05	-0.1	-0.21	-0.42	-0.09	-0.23
4	0.12	0.09	0.39	0.15	0.13	-0.2	-0.14	0.05	-0.1
5	0.37	0.89	1.34	0.38	0.79	-0.4	0.26	0.07	0.36
6	0.28	0.19	0.05	-0.05	1.14	-0.73	0.23	0.82	1.43

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	No data for this fleet at this age									
2	-0.49	-0.06	0.27	-0.04	0.38	-0.12	-0.16	0.18	0.17	0.04
3	-0.07	0.21	0.41	0.43	-0.12	-0.27	0.2	-0.01	0.04	-0.07
4	-0.23	0.02	-0.09	0.16	-0.1	-0.22	-0.19	0.06	0.14	-0.06
5	0.15	0.26	-0.38	-0.07	-0.57	-0.73	-1.03	-0.84	-0.43	-0.41
6	0.98	-0.33	-0.17	-0.52	-0.97	-0.19	-1.08	-0.99	-0.72	-0.98

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	-5.6551	-5.6551
S.E(Log q)	0.6274	0.7713

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	0.63	2.325	7.68	0.7	19	0.37	-7.45
3	0.63	2.992	7.05	0.8	19	0.24	-6.66
4	0.47	5.448	6.77	0.86	19	0.17	-6.16

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	0.54	1.903	6.18	0.5	19	0.32	-5.66
6	1.46	-0.714	5.54	0.12	19	1.13	-5.74

Fleet : SP-AVILESTR

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	No data for this fleet at this age								
2	-0.07	0.07	99.99	-0.18	0.11	-0.55	-0.07	0	-0.14
3	-0.19	-0.3	99.99	-0.59	0.12	-0.67	-0.32	0.27	0.05
4	-0.09	-0.37	99.99	-0.69	0.26	-0.17	0.06	-0.06	0.34
5	-0.72	-0.14	99.99	-1.25	0.59	-0.03	0.74	0.58	0.51
6	-0.78	-1.17	99.99	-1.06	0.33	-0.06	0.76	1.22	1.15

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	No data for this fleet at this age									
2	-0.15	0.19	0.39	0.21	0.18	99.99	99.99	99.99	99.99	99.99
3	0.19	0.18	0.89	0.41	-0.04	99.99	99.99	99.99	99.99	99.99
4	0.26	0.25	0.27	0.14	-0.21	99.99	99.99	99.99	99.99	99.99
5	0.44	0.01	0.17	-0.22	-0.69	99.99	99.99	99.99	99.99	99.99
6	1.09	-0.61	0.27	-0.57	-1.15	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	-4.4445	-4.4445
S.E(Log q)	0.6012	0.9066

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	0.39	5.402	6.99	0.88	13	0.25	-5.08
3	0.57	1.74	6.14	0.6	13	0.44	-4.86
4	0.76	1.116	5.41	0.66	13	0.32	-4.78

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	0.86	0.288	4.78	0.28	13	0.54	-4.44
6	4.51	-1.523	-1.52	0.02	13	3.88	-4.49

Fleet : SP-GFS

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	-0.26	-0.38	-0.09	0.05	-0.86	-0.19	0.08	-0.05	0
2	0.08	-0.26	-0.45	0.07	-0.75	-0.51	-0.02	0.07	-0.09
3	0.04	-0.67	-0.3	-0.71	0.17	-0.84	-0.57	-0.02	0.13
4	0.23	-0.11	-0.02	-0.04	0.07	-0.22	-0.24	0.01	-0.14
5	0.24	-0.04	0.28	-0.24	0.14	-0.07	-0.11	0.03	0.03
6	0.18	-0.84	-0.88	-0.96	-0.11	-0.57	0.01	0.11	1.1

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	0.29	0.73	0.14	0.44	0.21	0.11	0.28	-0.14	-0.03	-0.32
2	0.34	0.61	0.6	0.38	0.09	0.22	-0.03	0.05	-0.25	-0.16
3	0.32	0.32	0.27	0.73	0.09	0.14	0.5	0.18	0.16	0.03
4	-0.09	0.27	0.25	-0.24	-0.07	0	0.28	0.07	0.24	-0.25
5	0.17	0.27	0	0.03	-0.41	-0.35	0.31	-0.01	-0.02	-0.26
6	1.3	-0.12	-0.52	-0.79	-1.32	0.32	-0.24	-0.22	-0.26	-0.84

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	-6.3142	-6.3142
S.E(Log q)	0.2083	0.7198

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	0.51	3.597	7.76	0.76	19	0.35	-7.26
2	0.64	2.306	7.35	0.71	19	0.36	-6.94
3	0.76	1.105	7.05	0.55	19	0.44	-6.84
4	0.66	3.156	6.81	0.83	19	0.19	-6.55

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	0.79	1.782	6.42	0.81	19	0.16	-6.31
6	1.86	-1.226	6.9	0.11	19	1.24	-6.56

Terminal year survivor and F summaries :

Age 1 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-CORUTR	1	0	0	0	0	0	0
SP-AVILEST	1	0	0	0	0	0	0
SP-GFS	979	0.386	0	0	1	0.665	0.009
P shrinkage	3725	0.59				0.29	0.002
F shrinkage	253	1.5				0.044	0.035

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1359	0.32	0.55	3	1.735	0.007

Age 2 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-CORUTR	2111	0.382	0	0	1	0.252	0.152
SP-AVILEST	1	0	0	0	0	0	0
SP-GFS	1843	0.26	0.066	0.26	2	0.536	0.172
P shrinkage	2481	0.47				0.193	0.131
F shrinkage	2419	1.5				0.019	0.134

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
2030	0.19	0.07	5	0.354	0.158

Age 3 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-CORUTR	1114	0.212	0.109	0.51	2	0.46	0.201
SP-AVILEST	1	0	0	0	0	0	0
SP-GFS	978	0.228	0.077	0.34	3	0.377	0.226
P shrinkage	1602	0.41				0.152	0.144
F shrinkage	949	1.5				0.011	0.232

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1118	0.15	0.08	7	0.566	0.201

Age 4 Catchability dependent on age and year class strength

Year class = 2004

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR	646	0.147	0.055	0.37	3	0.461	0.243
SP-AVILEST	1	0	0	0	0	0	0
SP-GFS	585	0.154	0.122	0.79	4	0.407	0.265
P shrinkage	954	0.33				0.126	0.171
F shrinkage	620	1.5				0.006	0.252

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
651	0.1	0.08	9	0.752	0.242

Age 5 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
SP-CORUTR	324	0.145	0.093	0.64	4	0.386	0.483
SP-AVILEST	1	0	0	0	0	0	0
SP-GFS	311	0.128	0.115	0.9	5	0.605	0.499
F shrinkage	701	1.5				0.009	0.252

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
318	0.1	0.07	10	0.762	0.493

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

Year class = 2002

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR	203	0.145	0.148	1.02	5	0.393	0.305
SP-AVILEST	1	0	0	0	0	0	0
SP-GFS	214	0.126	0.104	0.82	6	0.597	0.291
F shrinkage	196	1.5				0.01	0.314

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
210	0.1	0.08	12	0.82	0.299

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 9/04/2009 12:00

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR		1986	1987	1988
AGE				
	1	0.1282	0.2008	0.3549
	2	0.3235	0.4778	0.5972
	3	0.2422	0.1981	0.4113
	4	0.442	0.2199	0.3047
	5	0.7819	0.3668	0.5176
	6	0.4925	0.263	0.4139
+gp		0.4925	0.263	0.4139
FBAR 2- 4		0.3359	0.2986	0.4377

Table 8 Fishing mortality (F) at age

YEAR		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE											
	1	0.0918	0.4802	0.2642	0.1209	0.1444	0.0339	0.0669	0.0273	0.0138	0.0208
	2	0.4045	0.4003	0.5424	0.1534	0.2899	0.1719	0.0387	0.2835	0.2003	0.2022
	3	0.2261	0.285	0.2556	0.2919	0.1758	0.5628	0.1447	0.0507	0.318	0.3672
	4	0.4744	0.5053	0.4441	0.6879	0.3882	0.5328	0.3867	0.2343	0.1399	0.5082
	5	0.3501	0.4887	0.9036	0.8791	0.4866	1.1622	0.4737	0.629	0.5421	0.7267
	6	0.3522	0.4849	0.4003	0.2418	0.3524	1.2297	0.352	0.6005	1.0494	1.5918
+gp		0.3522	0.4849	0.4003	0.2418	0.3524	1.2297	0.352	0.6005	1.0494	1.5918
FBAR 2- 4		0.3683	0.3968	0.414	0.3778	0.2846	0.4225	0.19	0.1895	0.2194	0.3592

Table 8 Fishing mortality (F) at age

YEAR		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	FBAR 06-08
AGE												
	1	0.0104	0.003	0.0142	0.0131	0.0504	0.0165	0.0477	0.0366	0.0244	0.0067	0.0225
	2	0.0833	0.0811	0.1345	0.0682	0.1342	0.1228	0.0996	0.2265	0.0839	0.1578	0.1561
	3	0.3537	0.3072	0.2925	0.1969	0.1641	0.1609	0.3154	0.3256	0.1892	0.2008	0.2385
	4	0.3734	0.3198	0.1975	0.1267	0.1626	0.2218	0.182	0.3296	0.3552	0.2419	0.3089
	5	0.5206	0.3397	0.2228	0.1975	0.1666	0.2571	0.2114	0.2998	0.3189	0.4933	0.3707
	6	1.0221	0.1704	0.2472	0.1175	0.0919	0.3239	0.1831	0.2238	0.2275	0.299	0.2501
+gp		1.0221	0.1704	0.2472	0.1175	0.0919	0.3239	0.1831	0.2238	0.2275	0.299	
FBAR 2- 4		0.2701	0.236	0.2082	0.1306	0.1536	0.1685	0.199	0.2939	0.2094	0.2002	

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 9/04/2009 12:00

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR		1986	1987	1988
AGE				
	1	9304	12271	11012
	2	7805	6701	8219
	3	3433	4624	3402
	4	1977	2206	3105
	5	1021	1040	1450
	6	571	382	590
+gp		546	337	420
TOTAL		24656	27561	28198

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

YEAR		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE											
	1	9577	12259	4845	10307	4265	1326	8688	8117	6594	4137
	2	6322	7153	6209	3046	7478	3022	1049	6653	6467	5325
	3	3703	3454	3925	2955	2139	4581	2083	827	4102	4334
	4	1846	2418	2127	2489	1807	1469	2137	1476	643	2444
	5	1875	941	1195	1117	1024	1004	706	1188	956	458
	6	707	1081	472	396	380	515	257	360	519	455
+gp		935	1589	196	348	133	182	266	196	194	201
TOTAL		24965	28896	18968	20658	17225	12099	15187	18817	19475	17353

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

YEAR		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	GM 98-06
AGE													
	1	2137	3282	3134	2635	2899	3111	2920	2801	3628	1666	0	2964
	2	3317	1732	2679	2530	2129	2257	2506	2279	2211	2899	1359	
	3	3562	2499	1307	1917	1935	1524	1634	1857	1488	1665	2030	
	4	2458	2047	1505	799	1289	1344	1063	976	1098	1008	1118	
	5	1204	1385	1217	1011	576	897	882	725	575	630	651	
	6	181	585	807	798	680	399	568	584	440	342	318	
+gp		351	1131	592	368	602	282	269	197	303	200	331	
TOTAL		13210	12661	11242	10058	10111	9815	9842	9420	9742	8409	5808	

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 9/04/2009 12:00

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	9304	2616	2260	659	0.2916	0.3359
1987	12271	2348	1895	497	0.2623	0.2986
1988	11012	2678	2277	817	0.3589	0.4377
1989	9577	3001	2614	714	0.2731	0.3683
1990	12259	3092	2691	977	0.3631	0.3968
1991	4845	1896	1715	614	0.358	0.414
1992	10307	1941	1681	516	0.3069	0.3778
1993	4265	1629	1468	383	0.261	0.2846
1994	1326	1230	1169	479	0.4099	0.4225
1995	8688	1341	990	218	0.2203	0.19
1996	8117	1653	1305	329	0.2521	0.1895
1997	6594	1710	1412	356	0.2521	0.2194
1998	4137	1532	1369	446	0.3258	0.3592
1999	2137	1297	1195	343	0.2871	0.2701
2000	3282	1475	1341	253	0.1887	0.236
2001	3134	1173	1030	175	0.1699	0.2082
2002	2635	1147	1025	117	0.1141	0.1306
2003	2899	1283	1157	134	0.1159	0.1536
2004	3111	1038	892	149	0.1671	0.1685
2005	2920	1071	934	147	0.1575	0.199
2006	2801	1112	974	210	0.2156	0.2939
2007	3628	1081	905	155	0.1713	0.2094
2008	1666	993	902	178	0.1973	0.2002
Arith. Mean	5692	1667	1443	385	0.2487	0.2767
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: MEG89
Time and date: 13:03 11/04/2009
Fbar age range: 2-4

2009	Stock	Natural	Maturity	Prop. of F	Prop. of M	Weight	Exploit	Weight
Age	size	mortality	ogive	bef. Spaw.	bef. Spaw.	in Stock	pattern	CWt
1	2964	0.2	0.34	0	0	0.062	0.023	0.062
2	1359	0.2	0.9	0	0	0.090	0.156	0.090
3	2030	0.2	1	0	0	0.117	0.239	0.117
4	1118	0.2	1	0	0	0.150	0.309	0.150
5	651	0.2	1	0	0	0.189	0.371	0.189
6	318	0.2	1	0	0	0.237	0.250	0.237
7	331	0.2	1	0	0	0.389	0.250	0.389

2010	Stock	Natural	Maturity	Prop. of F	Prop. of M	Weight	Exploit	Weight
Age	size	mortality	ogive	bef. Spaw.	bef. Spaw.	in Stock	pattern	CWt
1	2964	0.2	0.34	0	0	0.062	0.023	0.062
2	.	0.2	0.9	0	0	0.090	0.156	0.090
3	.	0.2	1	0	0	0.117	0.239	0.117
4	.	0.2	1	0	0	0.150	0.309	0.150
5	.	0.2	1	0	0	0.189	0.371	0.189
6	.	0.2	1	0	0	0.237	0.250	0.237
7	.	0.2	1	0	0	0.389	0.250	0.389

2011	Stock	Natural	Maturity	Prop. of F	Prop. of M	Weight	Exploit	Weight
Age	size	mortality	ogive	bef. Spaw.	bef. Spaw.	in Stock	pattern	CWt
1	2964	0.2	0.34	0	0	0.062	0.023	0.062
2	.	0.2	0.9	0	0	0.090	0.156	0.090
3	.	0.2	1	0	0	0.117	0.239	0.117
4	.	0.2	1	0	0	0.150	0.309	0.150
5	.	0.2	1	0	0	0.189	0.371	0.189
6	.	0.2	1	0	0	0.237	0.250	0.237
7	.	0.2	1	0	0	0.389	0.250	0.389

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: MEG89
Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa
Time and date: 13:03 11/04/2009
Fbar age range: 2-4

2009				
Biomass	SSB	FMult	FBar	Landings
1040	906	1	0.2345	182

2010					2011	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
1083	939	0	0	0	1331	1187
.	939	0.1	0.0235	21	1307	1163
.	939	0.2	0.0469	41	1284	1140
.	939	0.3	0.0704	61	1261	1117
.	939	0.4	0.0938	81	1239	1095
.	939	0.5	0.1173	99	1218	1074
.	939	0.6	0.1407	118	1197	1053
.	939	0.7	0.1642	136	1177	1033
.	939	0.8	0.1876	153	1157	1013
.	939	0.9	0.2111	170	1138	994
.	939	1	0.2345	187	1119	975
.	939	1.1	0.258	203	1101	957
.	939	1.2	0.2814	219	1083	939
.	939	1.3	0.3049	234	1065	922
.	939	1.4	0.3283	249	1049	905
.	939	1.5	0.3518	264	1032	889
.	939	1.6	0.3752	278	1016	873
.	939	1.7	0.3987	292	1000	857
.	939	1.8	0.4221	306	985	842
.	939	1.9	0.4456	319	970	827
.	939	2	0.469	332	956	813

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: MEG89
Time and date: 13:03 11/04/2009
Fbar age range: 2-4

Year:	2009	F multiplier:	1	Fbar:	0.2345				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0226	60	4	2964	185	1008	63	1008	63
2	0.1561	178	16	1359	123	1223	111	1223	111
3	0.2385	392	46	2030	237	2030	237	2030	237
4	0.3089	271	41	1118	168	1118	168	1118	168
5	0.3707	184	35	651	123	651	123	651	123
6	0.2501	64	15	318	75	318	75	318	75
7	0.2501	67	26	331	129	331	129	331	129
Total		1216	182	8771	1040	6679	906	6679	906

Year:	2010	F multiplier:	1	Fbar:	0.2345				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0226	60	4	2964	185	1008	63	1008	63
2	0.1561	312	28	2373	214	2135	193	2135	193
3	0.2385	184	21	952	111	952	111	952	111
4	0.3089	317	48	1309	196	1309	196	1309	196
5	0.3707	190	36	672	127	672	127	672	127
6	0.2501	74	18	368	87	368	87	368	87
7	0.2501	83	32	414	161	414	161	414	161
Total		1220	187	9052	1083	6858	939	6858	939

Year:	2011	F multiplier:	1	Fbar:	0.2345				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0226	60	4	2964	185	1008	63	1008	63
2	0.1561	312	28	2373	214	2135	193	2135	193
3	0.2385	321	38	1662	194	1662	194	1662	194
4	0.3089	149	22	614	92	614	92	614	92
5	0.3707	222	42	787	149	787	149	787	149
6	0.2501	76	18	380	90	380	90	380	90
7	0.2501	100	39	498	194	498	194	498	194
Total		1240	191	9278	1119	7084	975	7084	975

Input units are thousands and kg - output in tonnes

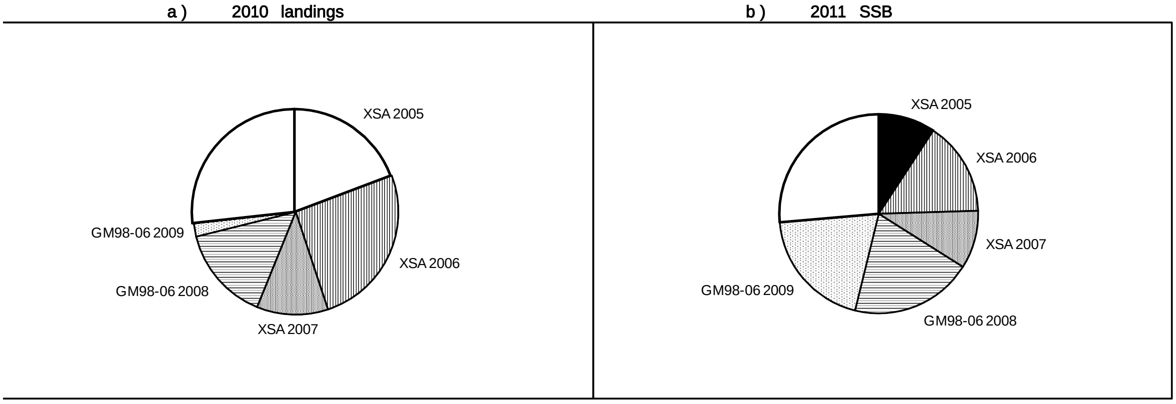
Table 9.1.16 **Megrim (L. whiffiagonis) in Divisions VIIIc and IXa**
Stock numbers of recruits and their source for recent year classes used in predictions, and the relative (%) contributions to landings and SSB (by weight) of these year classes

Year-class	2005	2006	2007	2008	2009
Stock No. (thousands) of 1 year-olds	2801	3628	1666	2964	2964
Source	XSA	XSA	XSA	GM98-06	GM98-06
Status Quo F:					
% in 2009 landings	22.4	25.1	8.7	2.2	-
% in 2010	19.3	25.7	11.2	15.0	2.1
% in 2009 SSB	18.5	26.2	12.3	7.0	-
% in 2010 SSB	13.5	20.9	11.8	20.6	6.7
% in 2011 SSB	9.2	15.3	9.4	19.9	19.8

GM : geometric mean recruitment

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

a) 2010 landings **b) 2011 SSB**



XSA 2005	XSA 2006	XSA 2007	GM98-06 2008	GM98-06 2009

Table 9.1.17. Megrim (L. whiffiagonis) in Divisions VIIIc and IXa, yield per recruit results.

MFYPR version 2a
Run: MEG89
Time and date: 13:04 11/04/2009
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0.0	0.0000	0.0000	0.0000	5.5167	1.1156	4.7748	1.0670	4.7748	1.0670
0.1	0.0235	0.0925	0.0207	5.0557	0.9575	4.3140	0.9090	4.3140	0.9090
0.2	0.0469	0.1659	0.0354	4.6908	0.8355	3.9493	0.7870	3.9493	0.7870
0.3	0.0704	0.2253	0.0459	4.3952	0.7393	3.6539	0.6907	3.6539	0.6907
0.4	0.0938	0.2745	0.0535	4.1512	0.6620	3.4101	0.6134	3.4101	0.6134
0.5	0.1173	0.3157	0.0591	3.9467	0.5989	3.2057	0.5504	3.2057	0.5504
0.6	0.1407	0.3508	0.0632	3.7729	0.5469	3.0321	0.4984	3.0321	0.4984
0.7	0.1642	0.3810	0.0661	3.6234	0.5035	2.8828	0.4550	2.8828	0.4550
0.8	0.1876	0.4073	0.0683	3.4936	0.4668	2.7532	0.4184	2.7532	0.4184
0.9	0.2111	0.4304	0.0699	3.3797	0.4357	2.6395	0.3872	2.6395	0.3872
1.0	0.2345	0.4508	0.0710	3.2791	0.4089	2.5391	0.3605	2.5391	0.3605
1.1	0.2580	0.4690	0.0718	3.1895	0.3858	2.4497	0.3374	2.4497	0.3374
1.2	0.2814	0.4854	0.0723	3.1092	0.3657	2.3695	0.3173	2.3695	0.3173
1.3	0.3049	0.5002	0.0726	3.0368	0.3481	2.2973	0.2998	2.2973	0.2998
1.4	0.3283	0.5136	0.0728	2.9711	0.3327	2.2318	0.2843	2.2318	0.2843
1.5	0.3518	0.5258	0.0729	2.9113	0.3189	2.1722	0.2706	2.1722	0.2706
1.6	0.3752	0.5371	0.0730	2.8565	0.3067	2.1176	0.2584	2.1176	0.2584
1.7	0.3987	0.5474	0.0729	2.8061	0.2958	2.0674	0.2475	2.0674	0.2475
1.8	0.4221	0.5570	0.0728	2.7596	0.2860	2.0210	0.2377	2.0210	0.2377
1.9	0.4456	0.5658	0.0727	2.7165	0.2771	1.9781	0.2289	1.9781	0.2289
2.0	0.4690	0.5741	0.0726	2.6765	0.2691	1.9382	0.2209	1.9382	0.2209

Reference point	F multiplier	Absolute F
Fbar(2-4)	1	0.2345
FMax	1.5778	0.37
F0.1	0.7079	0.166
F35%SPR	0.9497	0.2227
Flow	0.4938	0.1158
Fmed	1.1020	0.2584
Fhigh	3.0621	0.7181

Weights in kilograms

Figure 9.1.1 Historical landings and biomass indices of Spanish survey of megrims (both species combined).

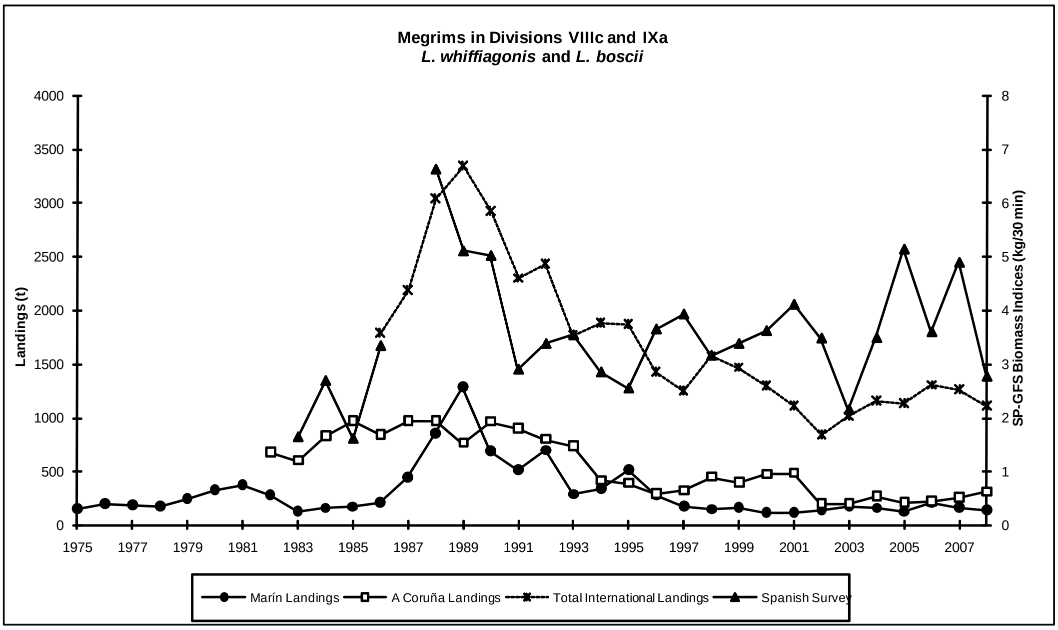
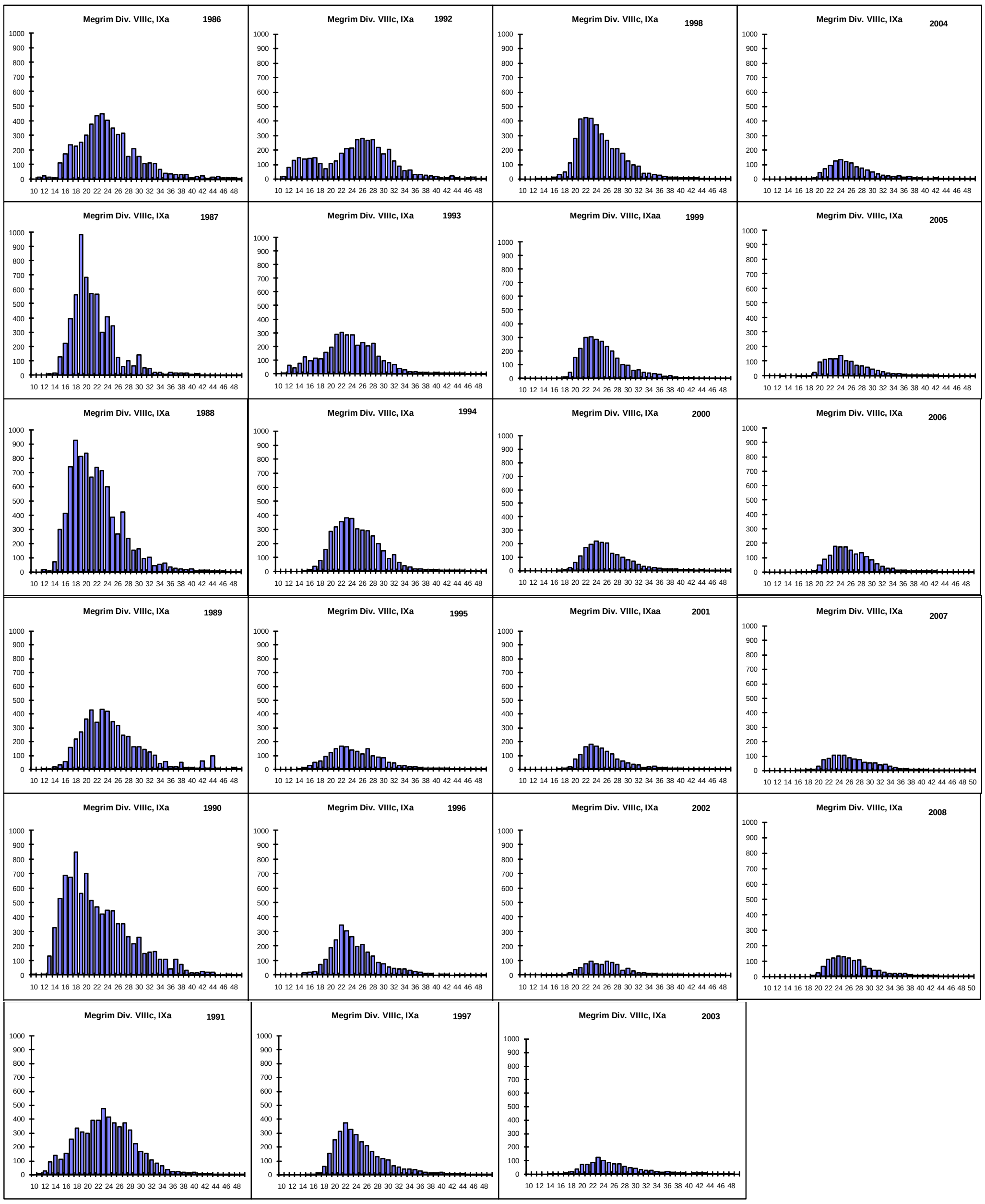


Figure 9.1.2 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa, Annual length compositions of landings ('000)



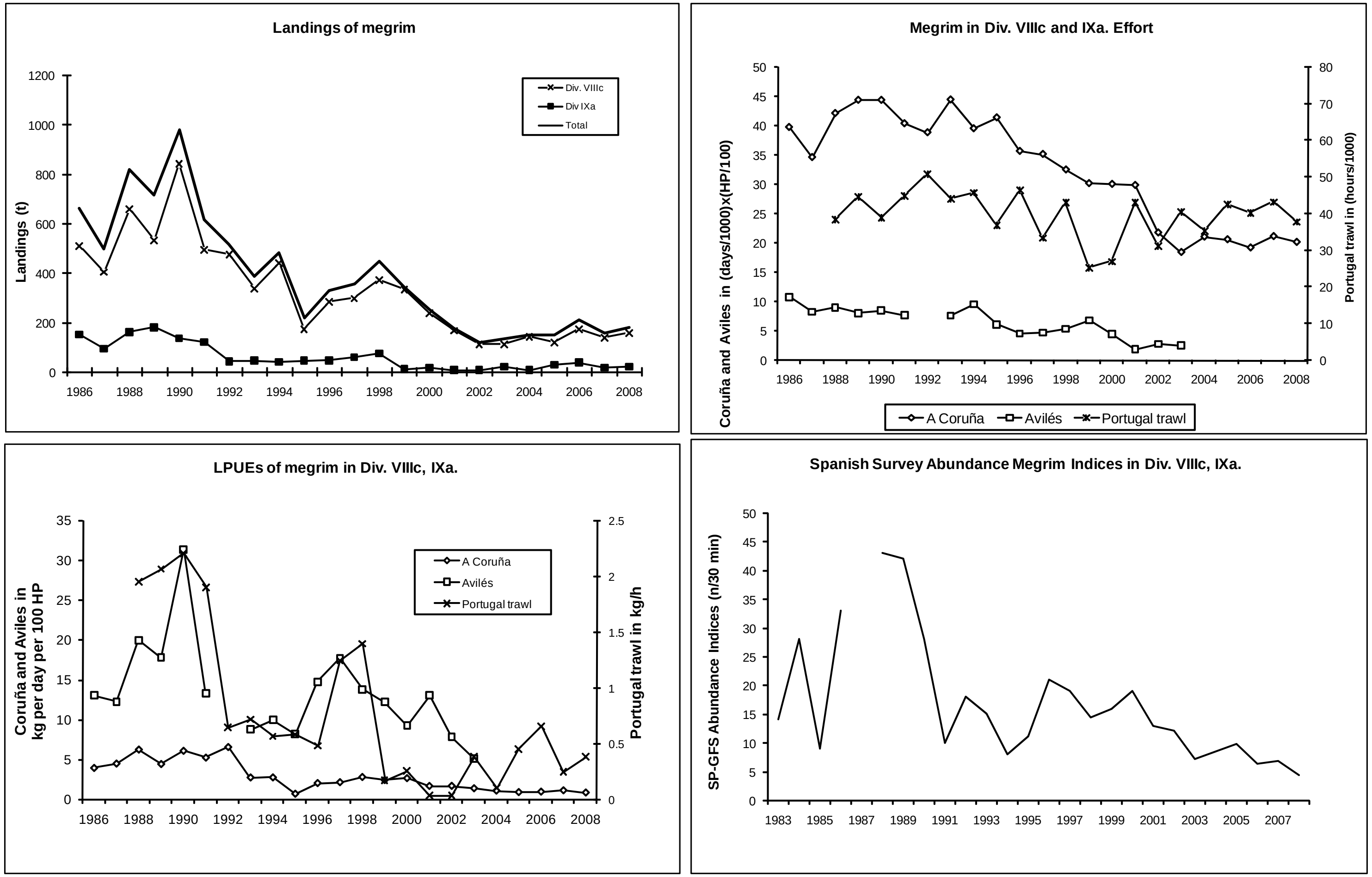


Figure 9.1.3(a) Megrim (*L.whiffiagonis*) in Divisions VIIIc, IXa. Landings (t), Efforts, LPUEs and Abundance Indices.

Standardized log(abundance index at age) from survey SP-GFS (black bubbles means <0)

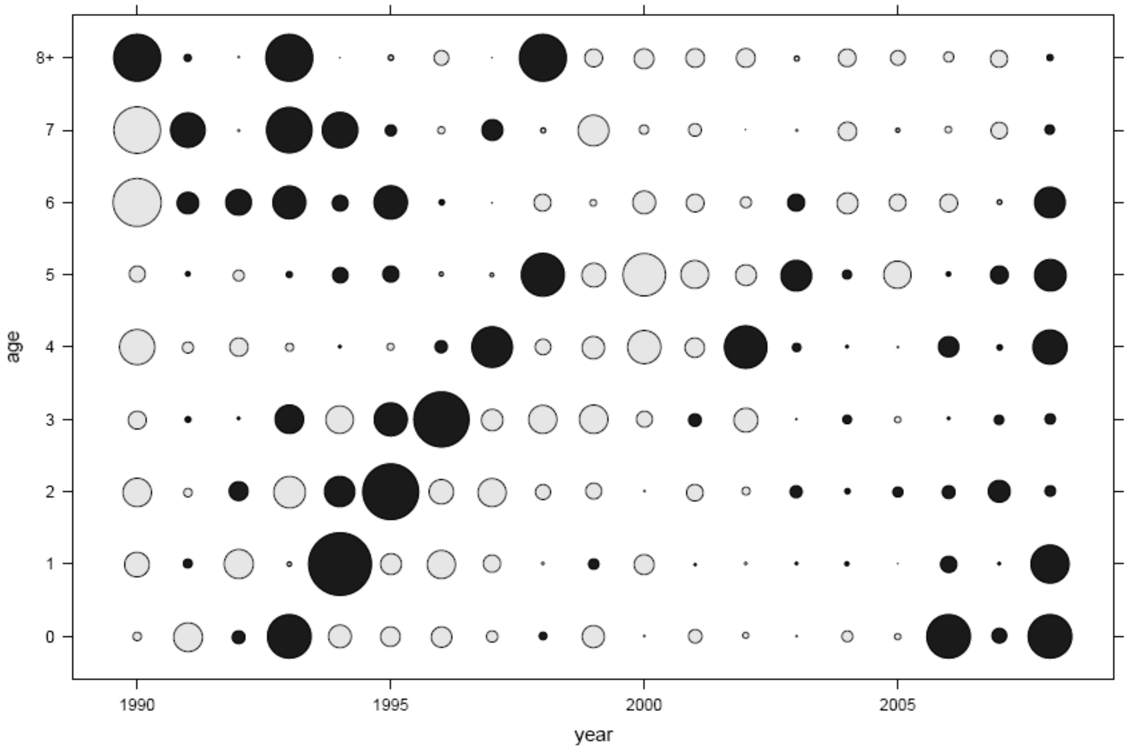
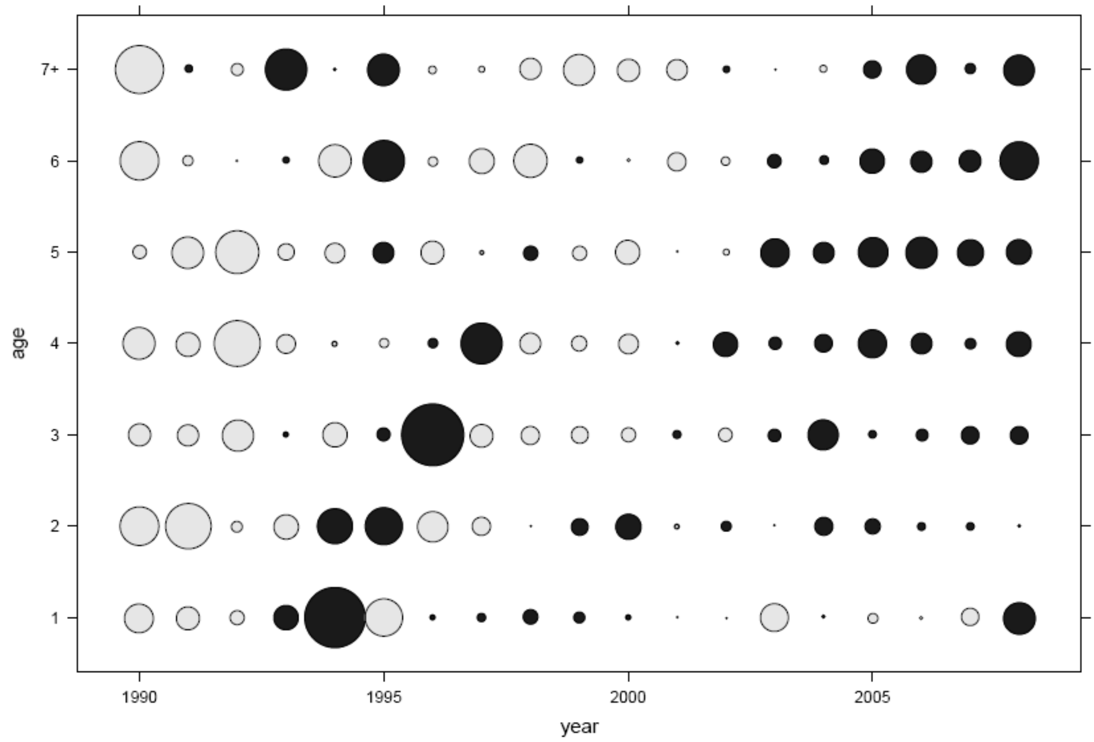


Figure 9.1.3(b): Megrim (L. Whiffiagonis) in Divisions VIIIc&IXa

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)

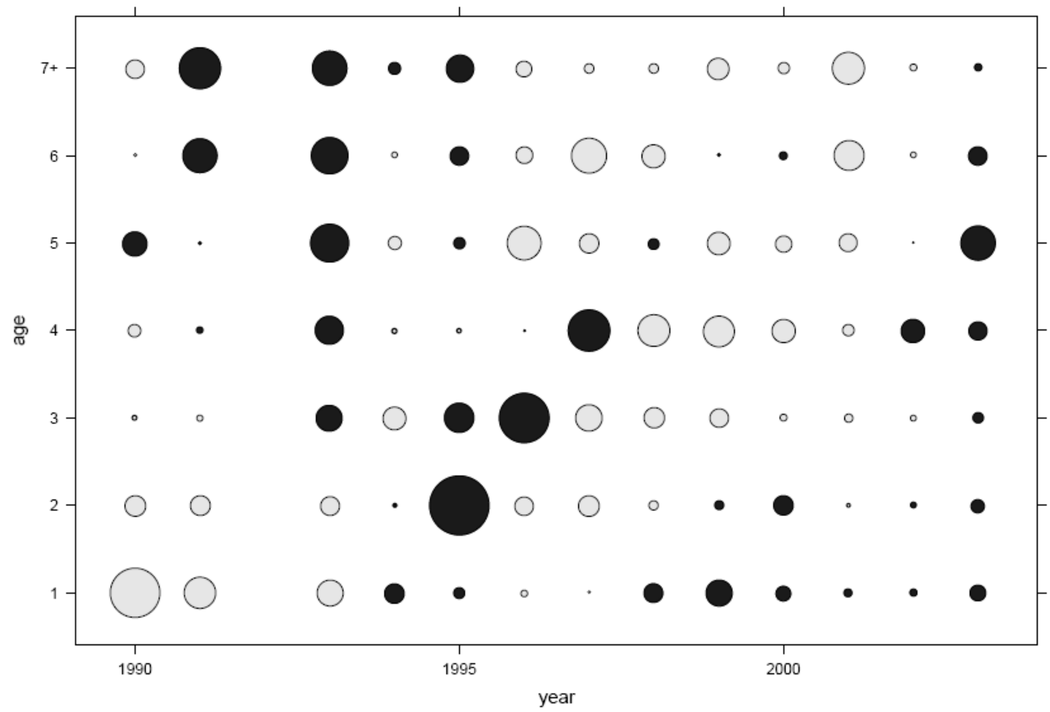
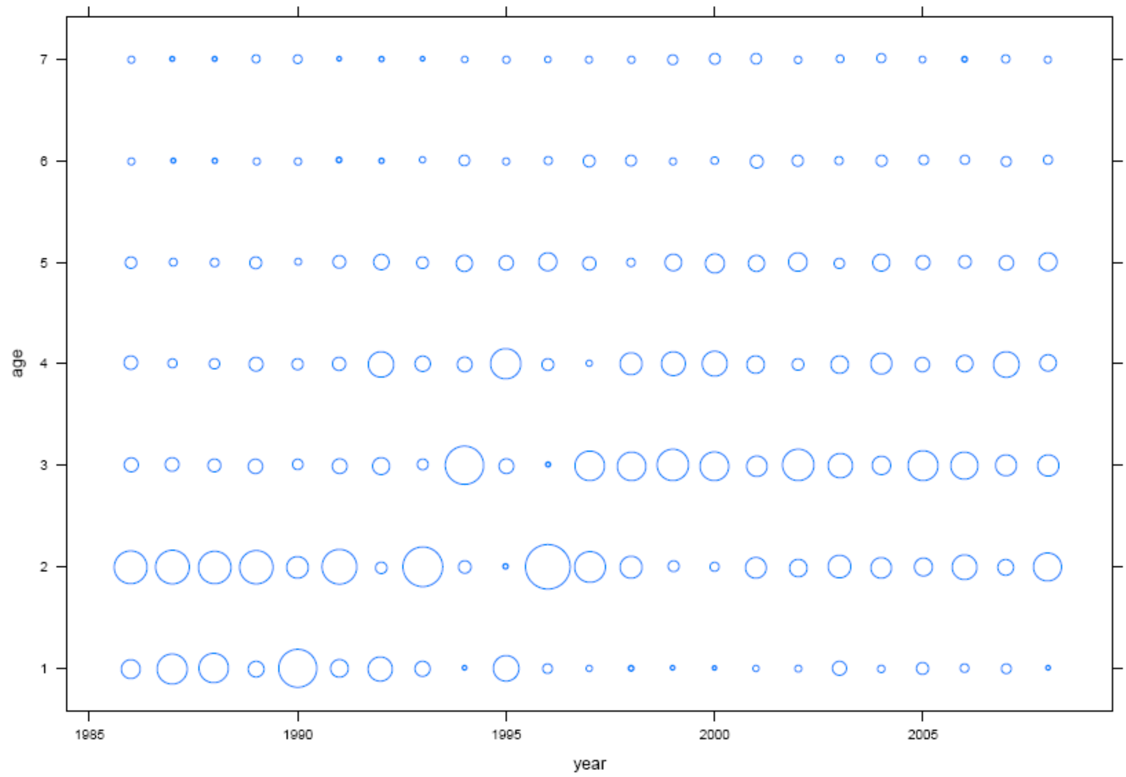


Figure 9.1.3(c): Megrim (L. Whiffiagonis) in Divisions VIIIc&IXa

Catch proportions at age using FLEDA



Standardized catch proportions at age using FLEDA (black bubble means < 0)

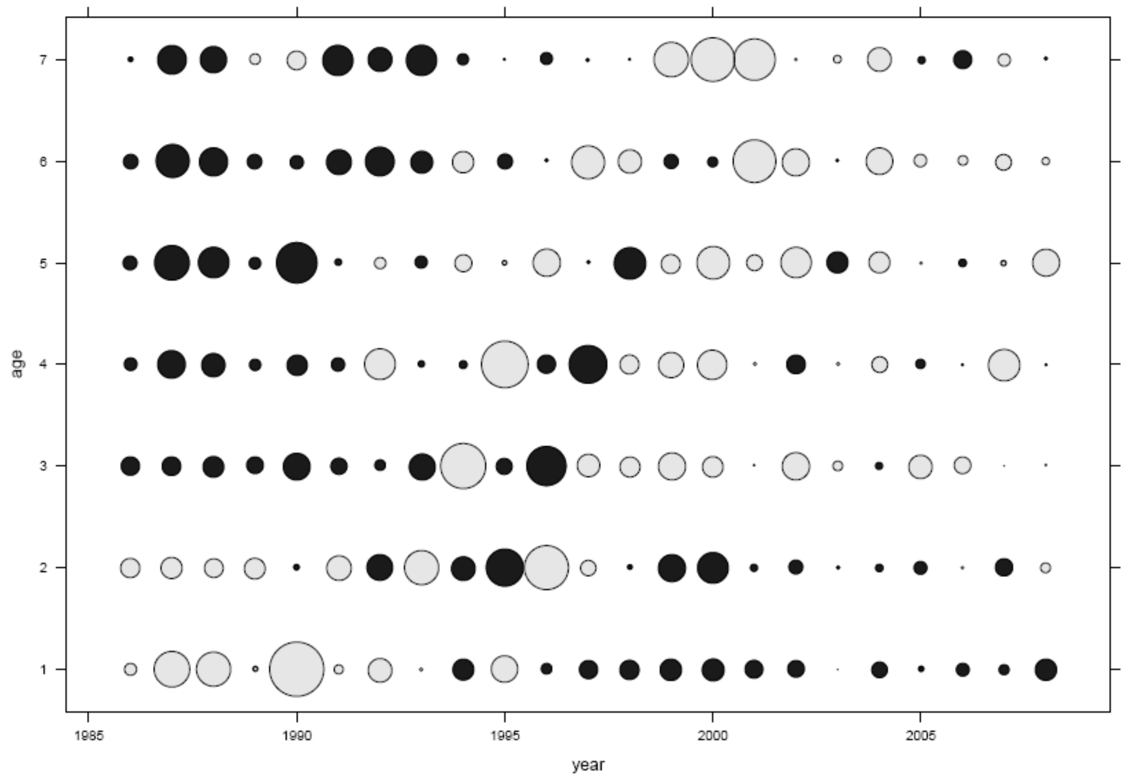


Figure 9.1.4. Megrim (L. Whiffiagonis) in Divisions VIIIc & IXa.

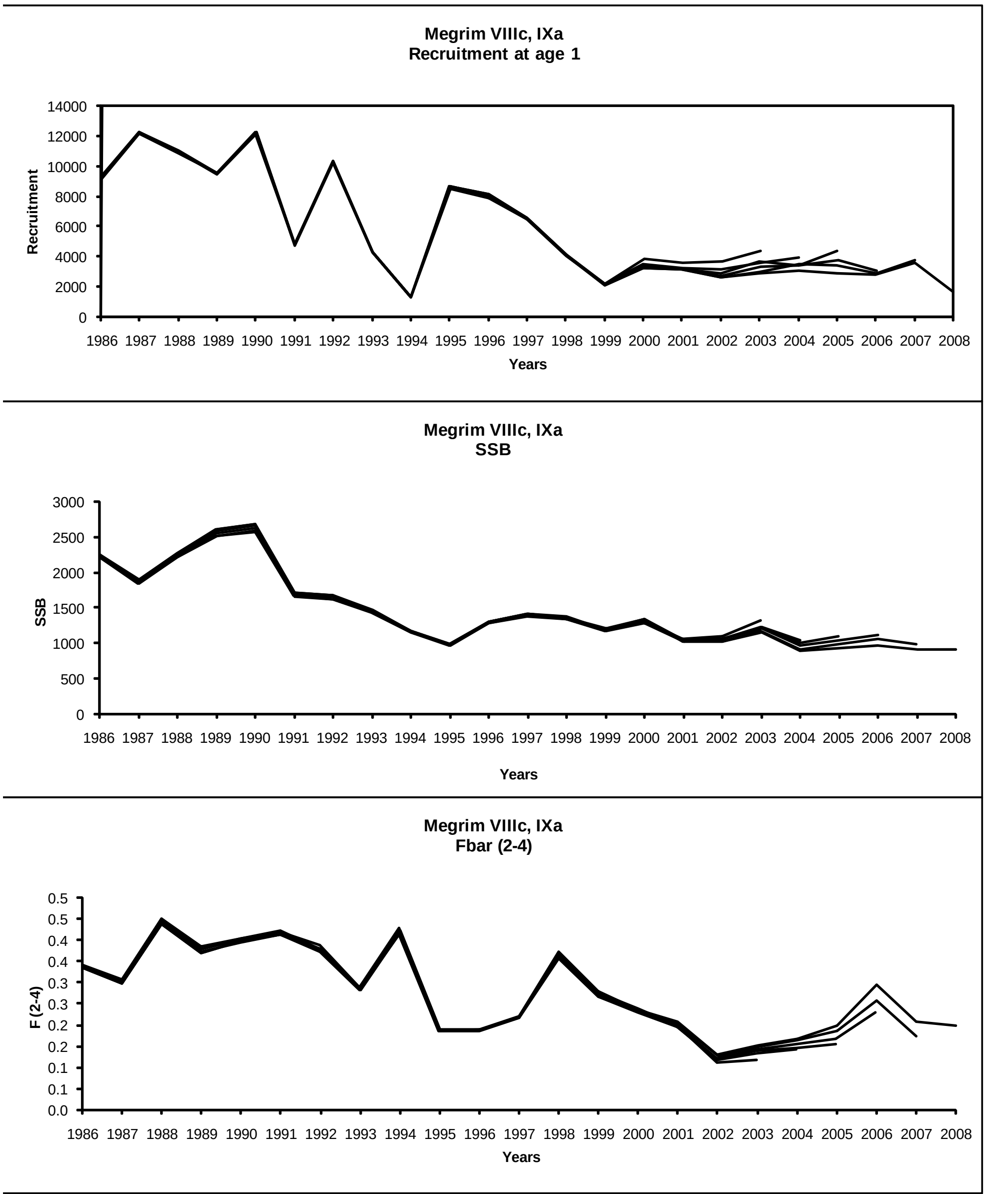
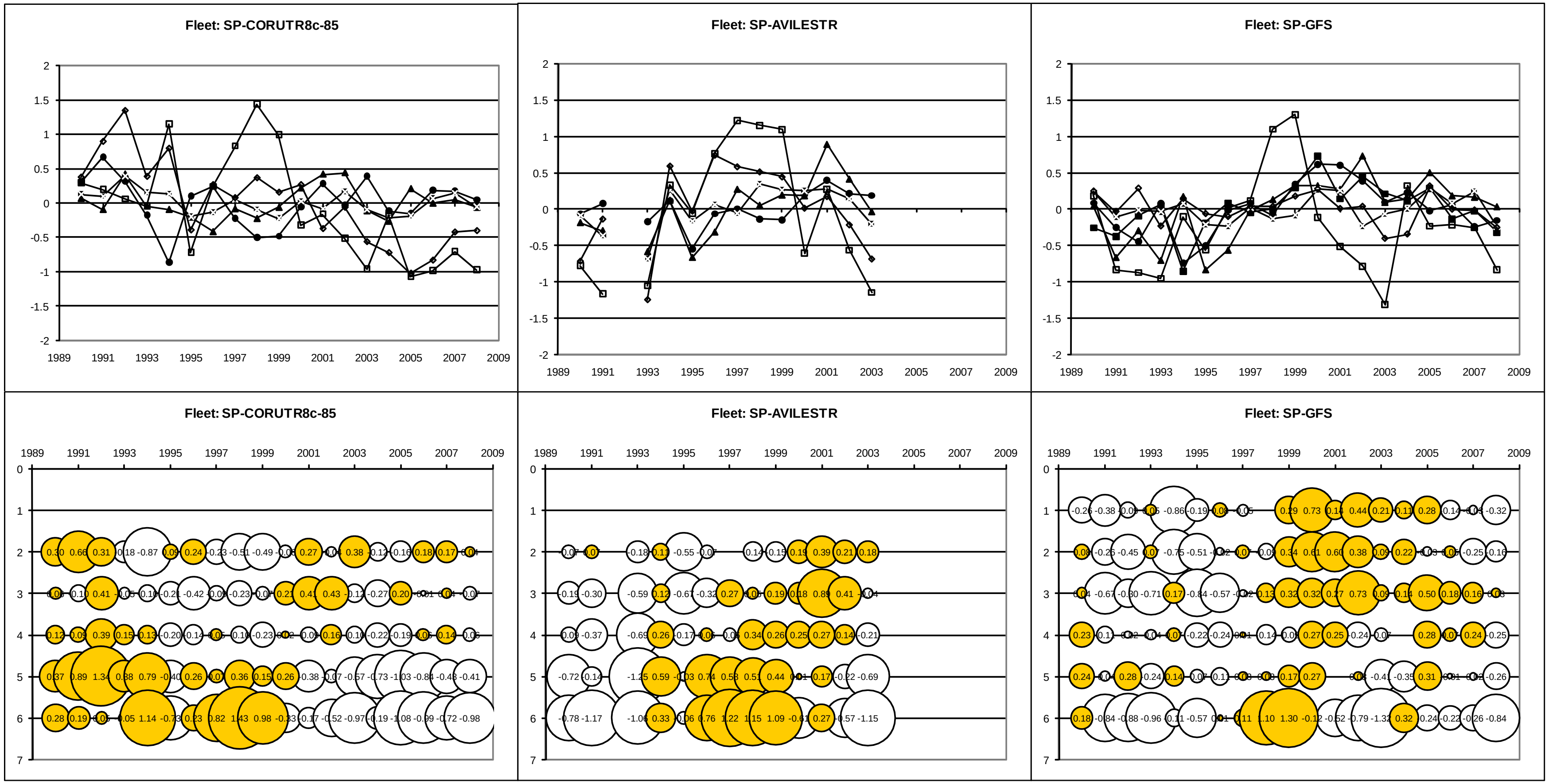


Figure 9.1.5. Megrim (L. whiffiagonis) in Divisions VIIIc and IXa. Retrospective XSA

Figure 9.1.6. **Megrim in Divisions VIIIc and IXa.** **LOG CATCHABILITY RESIDUAL PLOTS (XSA)**



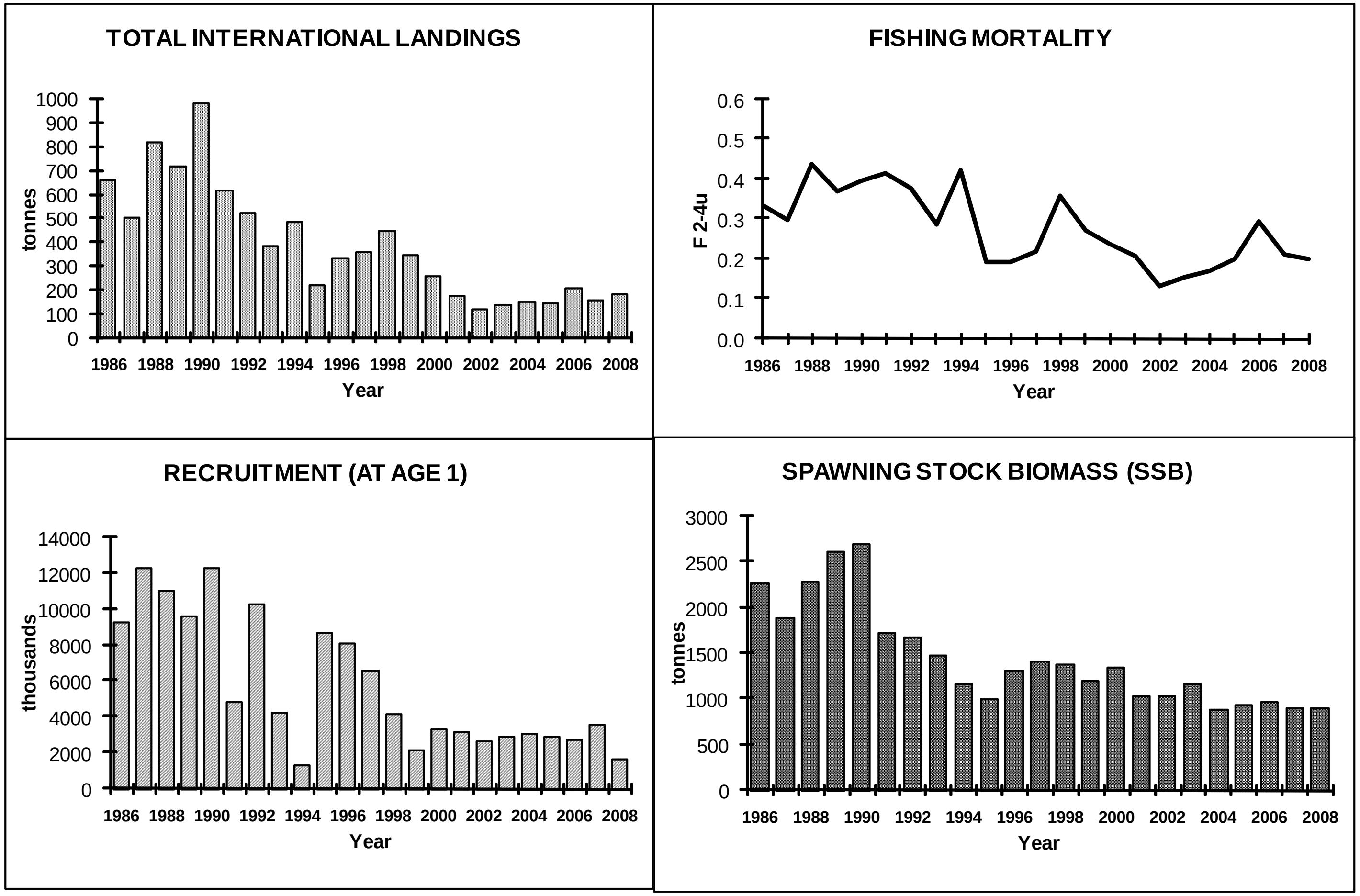
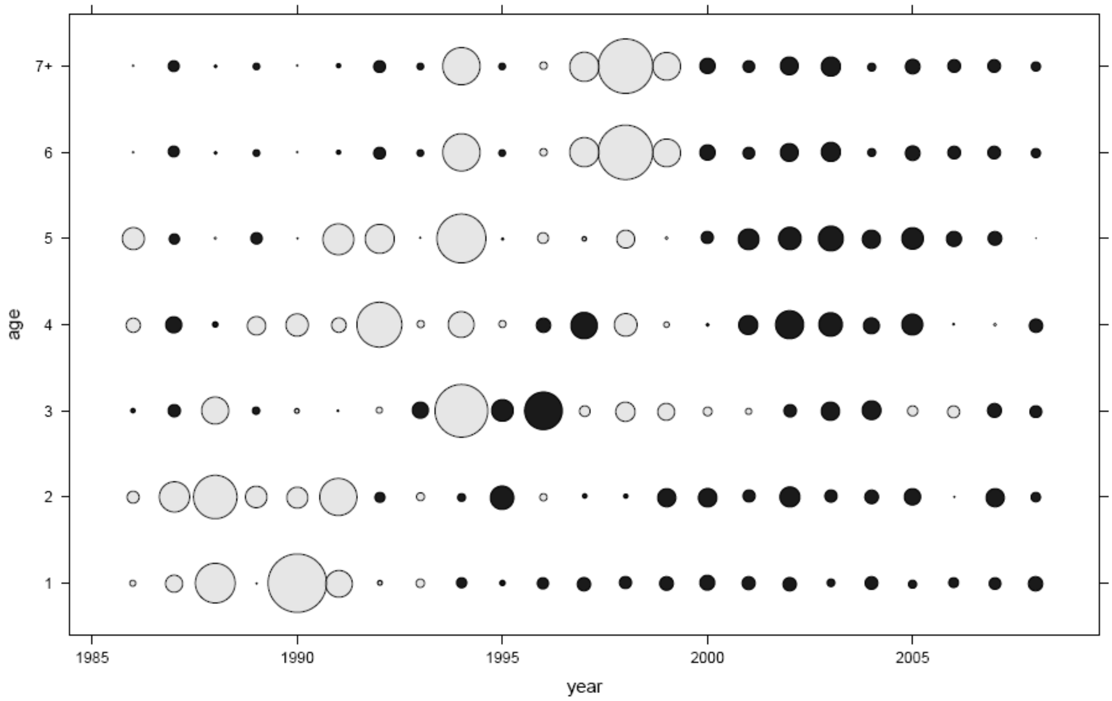


Figure 9.1.7(a) Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Stock Summary

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



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

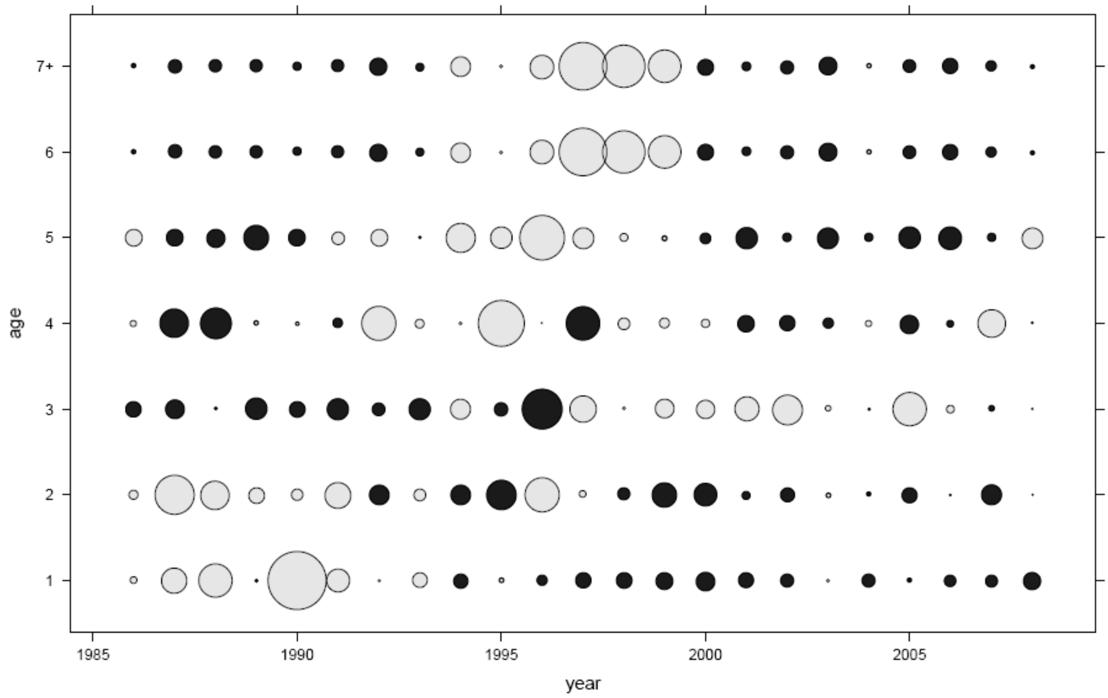
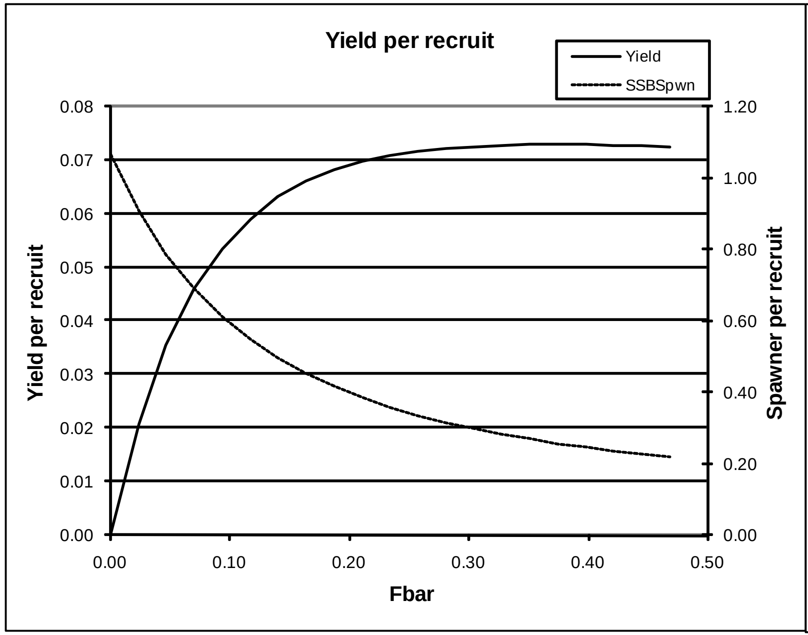
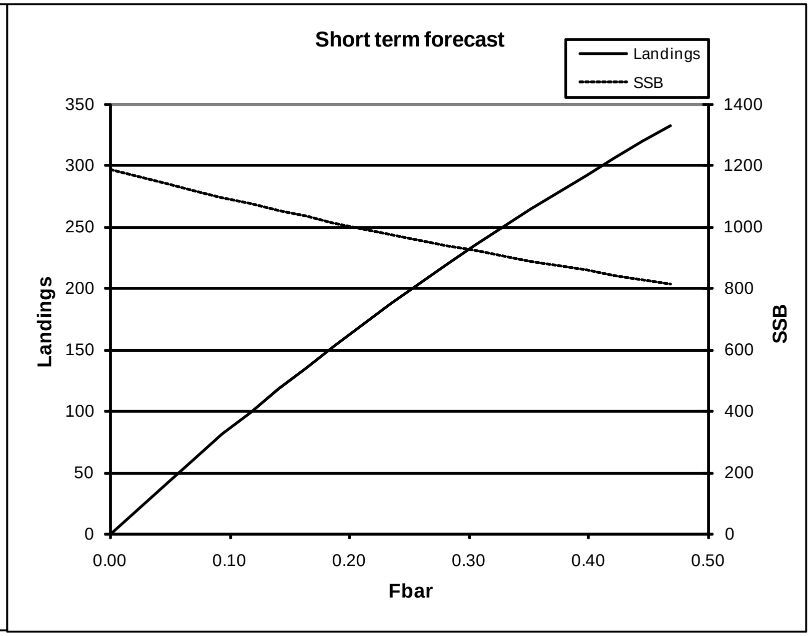


Figure 9.1.7(b): Megrim (L. Whiffiagonis) in Divisions VIIIc&IXa

Figure 9.1.8. Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa, forecast summary





MFYPR version 2a
Run: MEG89
Time and date: 13:04 11/04/2009

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.2345
FMax	1.5778	0.3700
F0.1	0.7079	0.1660
F35%SPR	0.9497	0.2227
Flow	0.4938	0.1158
Fmed	1.1020	0.2584
Fhigh	3.0621	0.7181

Weights in kilograms

MFDP version 1a
Run: MEG89
Megrim (L. whiffiagonis.) in Divisions VIIIc and IXa
Time and date: 13:03 11/04/2009
Fbar age range: 2-4

Input units are thousands and kg - output in tonnes

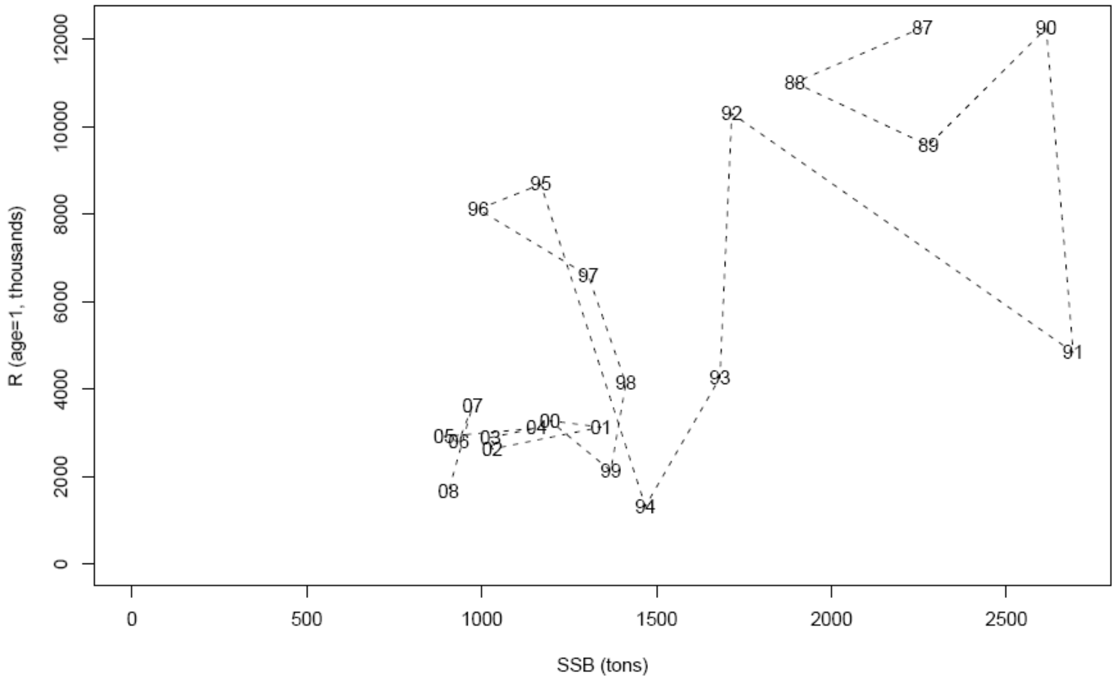


Figure 9.1.9. Megrim (L.whiffiagonis) in Divisions VIIIc and IXa. SSB-Recruitment plot. (numbers in graph, 1987-2008, are recruitment years)

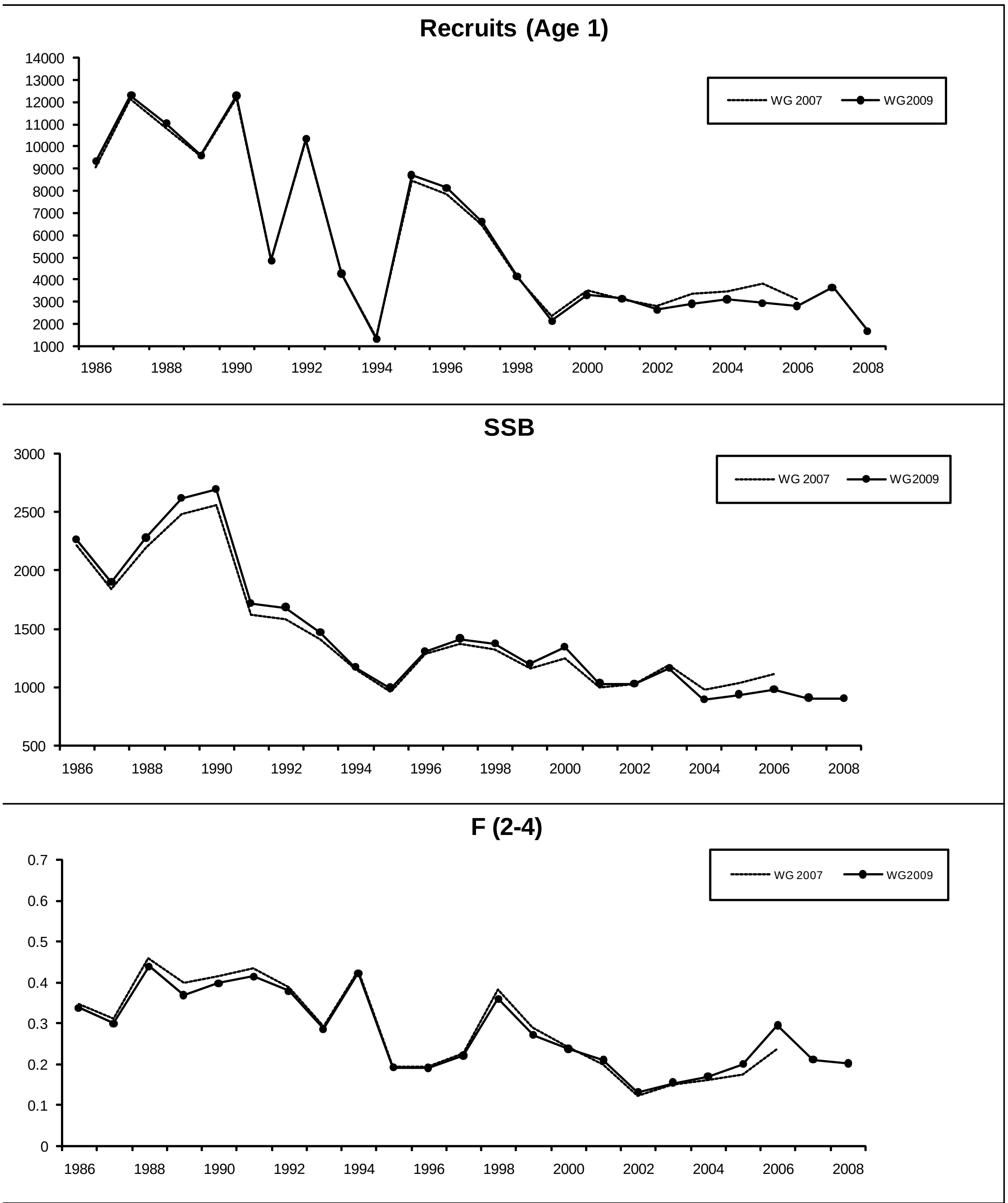


Figure 9.1.10. Megrim (*L. whiffiagonis*) in Div. VIIIc, IXa. Recruits, SSB and F estimates from WG07 and WG09

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 2008 used by the WG are given in Table 9.2.1. 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, with landings of 1092 t in 2006 and 1104 t in 2007. Landings in 2008 are a bit lower, at 933 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 the table below:

Spanish Discard/Total Catch ratio												
Year	1993	1994	1997	1999	2000	2001	2003	2004	2005	2006	2007	2008
Weight Ratio	0.27	0.3	0.28	0.24	0.33	0.13	0.21	0.3	0.3	0.27	0.21	0.17
CV	42.5	23.2	11.2	14.4	16.5	12.6	10.2	23.1	24.0	48.4	18.3	16.0
Number Ratio	0.61	0.60	0.62	0.59	0.60	0.40	0.49	0.56 *	0.56	0.42	0.46	0.43

* Modified in 2005 due to revision in the length data

9.2.2.2 Biological sampling

Annual length compositions of total landings are given in Figure 9.2.1 for the period 1986-2008. 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 shows the length distribution by fleet and country for 2008.

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 below.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
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
Mean weight (g)	116	118	122	128	111	96	107	112	109	113	121	114	105	101	98	97	99	109	110

Age compositions for 1990–2008 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´´ (PT-CTS) and ``October´´ (PT-GFS), provide indices for 2008. It is difficult to draw meaningful conclusions from the high PT-GFS 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 2008 is a bit below average. The Crustacean survey had many operational problems in 2004 so its indices for that year can not be used. In 2008, both the biomass and abundance indices from the Crustacean survey are close to the historical average values.

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 2008, the total biomass and abundance index values are a bit above and below time series averages, respectively. Both the age 0 and age 1 indices are very low in 2008, in particular the value for age 0 is close to the historical minimum.

It can be appreciated from Figure 9.2.2 that the index values corresponding to the three most recent cohorts (year classes 2006-2008) are below average. From this same figure, 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 1986-2008) 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 1988–2008 (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 presented in this report is an update of the last one, performed in the 2007 WG using XSA (in the 2008 WG an update run was conducted for consistency checking, but without presenting diagnostics or discussing results).

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 1988-2008, with the exception of 2003.

Model

Data screening

The FLEDA package of FLR was used to explore the quality of the input data. 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 2008 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).

The internal consistency of each abundance index used to tune the assessment model was examined by checking correlations between ages following cohorts. The results, displayed in Table 9.2.8, indicate that both indices are reasonably good in this respect, although the correlations between age 0 and older ages in the cohort is low and sometimes even negative. A similar impression is obtained from visual inspection of Figure 9.2.2 (both panels), bearing in mind that survey year 2003 and A Coruña ages younger than 3 are not used to tune the XSA.

Final XSA run

Settings for this year's assessment were the same ones used in the previous (2007 WG) assessment. Details are in the table:

		2007 WG		2009 WG	
Tuning fleets	SP-CORUTR8c	Years: 86-99	Ages: 3-6	Years: 86-99	Ages: 3-6
	SP-GFS	Years: 88-06 (2003 not included)	Ages: 0-6	Years: 88-08 (2003 not included)	Ages: 0-6
Taper			3 over 20		3 over 20
Tuning range			21		23
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 reveals some underestimation of F and overestimation of SSB, although results corresponding to the three most recent years are very consistent with each other (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 1989. 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. 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 2008. Hence, survivor estimates are given by the survey and P-shrinkage for ages 0 to 2, and only by the survey for ages 3 to 6. F-shrinkage gets very low weight, due to the large s.e. value set for it (1.5).

Table 9.2.10 presents the fishing mortality-at-age estimates. Fbar (=$F_{2\text{-}4}$) is estimated to be 0.23 in 2007 and 2008, corresponding to the second lowest value in the entire time series. Whereas F is estimated to be rather high in 2007 for ages 5 and 6 (there were higher landings than usual for those ages in 2007), F for ages 5 and 6 is close to Fbar in 2008 (F=0.21 for age 5 and F=0.26 for age 6).

Population numbers-at-age estimates are presented in Table 9.2.11.

9.2.3.3 Year class strength and recruitment estimations

The 2006 year class estimate is 22 million individuals, obtained by averaging estimates coming from the Spanish survey tuning data (79% of weight), P-shrinkage (20% weight) and F-shrinkage (1% weight).

The 2007 year class estimate is 19 million individuals, estimated from the Spanish survey (69% of weight), P-shrinkage (30% weight) and F-shrinkage (2% weight).

The 2008 year class estimate is 19 million individuals, obtained by averaging a lower value coming from the Spanish survey (45% weight) and a higher one from P-shrinkage (55% weight).

Following the usual procedure applied to this stock, the geometric mean of estimated recruitment over the years 1990-2006 ($GM_{90\text{-}06}$ = 25 million individuals) has been used for computation of 2009 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 compuation is standard practice. Working Group estimates of year-class strength used for prediction can be summarised as follows:

Recruitment at age 0:

YEAR CLASS	THOUSAND	BASIS	SURVEY	COMMERCIAL	SHRINKAGE
2006	21 796	XSA	79%	-	21%
2007	19 130	XSA	69%	-	32%
2008	18 914	XSA	45%	-	55%
2009	25 491	$GM_{90\text{-}06}$			

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 3800 t in 2001, the lowest value in the series, and has since experienced some increase. The 2008 SSB is estimated to be 5230 t, the highest value after 1994.

Recruitment has fluctuated around 28 million fish from 1990 to 2002, with the exception of the very weak 1993 and 1998 year classes (with 13 and 10 million individuals, respectively). In 2003 and 2005, recruitment has been above this average level, but it is estimated to have dropped to lower values in the last 3 years (22, 19 and 19 million recruits in 2006-2008).

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 higher and lower relative exploitation pattern on the older ages.

9.2.4 Catch options and prognosis

For the catch forecast, population numbers in 2009 for ages 1 and older were taken from the XSA output. Stock size at age 0 in years 2009-2011 was assumed to be GM_{90-06} (25 million). The exploitation pattern used (F *status quo*) was the unscaled average of 2006-2008, which gives an Fbar value of 0.26. Mean weights in the catch and in the stock were computed as averages of 2006-2008.

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 2010, 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 2009-2011, is given in Table 9.2.15. Under this scenario, projected landings for 2009 and 2010 are 1119 and 1049 t, respectively. Landings in 2008 were 933 t.

Under F *status quo* for 2009 and 2010, projected SSB values for 2010 and 2011 are about 4800 t in both years. Hence, SSB in 2010 and 2011 would decrease from the 5000 t value estimated for 2009.

The contributions of recent year classes to the projected landings and SSB are presented in Table 9.2.16 (under F *status quo*). The year classes for which GM_{90-06} recruitment is assumed contribute less than 1% to landings in 2010 and 31% to SSB in 2011.

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=0.26), yield-per-recruit is 0.043 kg and SSB-per-recruit is 0.205 kg. Assuming GM_{90-06} recruitment of 25.5 million, the equilibrium yield would be around 1100 t with an SSB value of 5200 t. Fishing at $F_{0.1}$(=0.18) equilibrium yield would be around 1020 t and SSB 6300 t. F_{max} is not well defined for this stock.

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
$\mathbf{F}_{lim}$	0.25 ($\mathbf{F}_{loss}$ WG98)	No proposal	0.40 ($\mathbf{F}_{loss}$)		Not defined		
$\mathbf{F}_{pa}$	0.20 ($\mathbf{F}_{lim}\,e^{-1.645*\sigma}$)	No proposal	0.30 ($\mathbf{F}_{lim}\,e^{-1.645*\sigma}$)	Not adopted	0.31 ($\mathbf{F}_{med}$)	Not adopted	No proposal
$\mathbf{B}_{lim}$	3 400 t ($\mathbf{B}_{loss}$,=B_{96} WG98)	4 700 t ($\mathbf{B}_{loss}$=B_{96} WG99) *			Not defined		
$\mathbf{B}_{pa}$	5 000 t (B_{lim} × 1.4)	6 500 t	4 700 t ($\mathbf{B}_{loss}$,=B_{95})	Not adopted	5 000 t ($\mathbf{B}_{loss}$=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)..

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 3800 t (2001 SSB). Given the interannual variability detected in the relative exploitation pattern at age (F-at-age/Fbar, see Figure 9.2.7(b)), the Working Group considers that fishing mortality reference points should not be proposed until a stabilisation of the exploitation pattern is clearly perceived. The issue of defining possible reference points will be considered when a benchmark assessment for this stock takes place.

9.2.5 Comments on the assessment

As this was an update assessment, everything has been performed using the same settings and specifications as in the last assessment (at the 2007 Working Group). Details are summarised in the following.

One commercial fleet (SP-CORUTR8c) and the Spanish survey (SP-GFS) were used for tuning. The SP-CORUTR8c fleet data used for tuning corresponds to ages 3 and older, which are not well represented in the survey. Only SP-CORUTR8c 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 appears to provide good estimates for young and middle ages and covers a large part of the distribution area of the stock. The indices for 2003 were not used for tuning due to the unusually low values obtained in that year, which are not in agreement with the high catches obtained by commercial fleets. Moreover, the high indices obtained by the Spanish survey in 2004 and 2005, are in contradiction with those low values detected in 2003. The 2006 indices from this survey are much closer to the historic average, while the 2007 values are again high. The 2008 index values are around average (a bit above average for biomass and a bit below for abundance). The Spanish survey SP-GFS gets a strong weight in the estimates for this stock.

Comparison of this assessment with the last one performed shows similar trends, with only small revisions for the common time period (Figure 9.2.10).

Four-spot megrim starts to contribute strongly to SSB at 2 years of age, with 31% of the predicted SSB in 2011 relying on year classes with recruitment assumed to be given by GM_{90-06}. The GM recruitment assumed for the predictions is taken over the period 1990-2006, 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 obviously 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 slight increasing trend between 2001 and 2008. Fishing at *status quo* F (Fbar=0.26) during 2009 and 2010 would result in some biomass decrease from the 2008 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 essentially 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 0.38 over the 23 years in the assessment.

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 2009 (average of estimated F over 2006-2008, corresponding to Fbar=0.23 for *L. whiffiagonis* and Fbar=0.26 for *L. boscii*), Figure 9.3.2 gives the combined predicted landings for 2010 and individual SSB for 2011, 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 2006-2008) for both species in 2010, predicted combined landings in 2010 are 1236 t and individual SSBs in 2011 are 975 t for *L. whiffiagonis* and 4846 t for *L. boscii*. The equilibrium combined yield at *status quo* F level for both species, would be around 1310 t with a combined SSB of 6300 t.

It should be kept in mind in the management of these stocks that *L. whiffiagonis* is estimated to be at very low levels, whereas SSB for *L. boscii* has had a slight upwards trend starting from 2002. The three most recent recruitments for *L. boscii* are a bit below average. The different current status of the two stocks makes it difficult to give combined advice for the two of them.

It should also be kept in mind that combined landings have been below the TAC in 2007 and 2008, as follows:

Landings(2007) = 1259 t < TAC(2007) = 1440 t

Landings(2008) = 1111 t < TAC(2008) = 1430 t (=TAC(2009))

As there are no precautionary limit points defined for these stocks, it is not possible to provide advice in relation to them. F_{max} is not well defined for any of the two stocks and $F_{0.1}$ (equal to 0.17 for *L. whiffiagonis* and 0.18 for *L. boscii*) corresponds to a reduction of 30% over F *status quo* for the two stocks.

Table 9.2.1. Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Total landings (t).

	Spain			Portugal	Total
Year	VIIIc	IXa	Total	IXa	VIIIc IXa
1986	799	197	996	128	1124
1987	995	586	1581	107	1688
1988	917	1099	2016	207	2223
1989	805	1548	2353	276	2629
1990	927	798	1725	220	1945
1991	841	634	1475	207	1682
1992	654	938	1592	324	1916
1993	744	419	1163	221	1384
1994	665	561	1227	176	1403
1995	685	826	1512	141	1652
1996	480	448	928	170	1098
1997	505	289	794	101	896
1998	725	284	1010	113	1123
1999	713	298	1011	114	1125
2000	674	225	899	142	1041
2001	629	177	807	124	931
2002	343	247	590	130	720
2003	393	314	707	169	876
2004	534	295	829	177	1006
2005	473	321	794	189	983
2006	542	348	891	201	1092
2007	591	295	886	218	1104
2008	500	262	761	172	933

Table 9.2.2. Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa, Length compositions of landings in 2008 ('000 fish)

	Spain		Portugal		Total		
Length (cm)	Div. VIIIc	Div. IXa	Trawler	Artisanal	Spain	Portugal	Total
10							
11							
12							
13							
14			0.058			0.058	0.058
15		0.379	0.073		0.379	0.073	0.452
16	3.168	3.830	0.391		6.998	0.391	7.390
17	15.032	28.461	1.453	0.097	43.493	1.550	45.043
18	91.309	132.636	5.203	0.485	223.945	5.688	229.633
19	190.663	300.040	37.529	3.643	490.703	41.172	531.875
20	377.718	354.051	187.103	10.553	731.769	197.656	929.425
21	615.961	386.444	297.485	4.691	1002.405	302.176	1304.58
22	681.608	299.949	251.280	31.441	981.557	282.721	1264.27
23	567.434	259.956	103.171	33.811	827.390	136.982	964.372
24	445.674	251.396	46.887	39.512	697.070	86.399	783.469
25	340.013	189.337	62.219	17.331	529.350	79.549	608.900
26	272.711	144.538	89.523	19.708	417.244	109.231	526.475
27	212.372	103.277	86.901	15.956	315.649	102.857	418.50
28	174.488	71.675	65.177	4.865	246.163	70.042	316.20
29	98.763	43.874	27.683	2.659	142.637	30.343	172.98
30	93.025	25.926	11.578	1.364	118.951	12.942	131.89
31	72.247	13.160	5.821	4.845	85.407	10.666	96.073
32	40.807	5.376	0.560	0.113	46.183	0.673	46.856
33	22.625	7.820	5.360	0.226	30.445	5.586	36.03
34	6.860	0.979	5.023		7.839	5.023	12.86
35	4.814	1.587	0.205	4.160	6.401	4.365	10.76
36	3.360	1.139	0.087		4.499	0.087	4.586
37	0.282	0.087			0.369		0.369
38	2.829	0.098			2.927		2.927
39	0.286		0.004		0.286	0.004	0.290
40	0.498				0.498		0.498
41	0.486				0.486		0.486
42							
43							
44							
45							
46							
47							
48							
49							
50+							
Total	4335	2626	1291	195	6961	1486	8447

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
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)
1	110	2283	1525	733	1444	1160	846	546	83	1421	397	35	45	38	45	167	190	367	392	123	34	9	15
2	3475	11580	10092	7140	5184	3679	2667	2334	2915	2205	2136	1244	1204	1161	655	1138	2389	2802	2515	2522	2735	1606	1498
3	3690	5073	5455	5392	1885	3328	4000	2096	4515	6138	1267	2870	4236	2781	1645	1251	2361	2873	3084	2995	4506	2633	3327
4	3940	3593	4779	5909	3829	1911	5179	3799	2268	5596	3814	744	2940	3908	2782	2393	743	1476	2439	1841	2153	2600	2037
5	1132	1344	2366	3479	2311	2650	2200	1151	1612	1056	1896	1624	698	1402	1849	1870	387	499	1128	1370	988	1865	944
6	849	569	1161	1778	1383	1028	738	635	839	582	204	1066	829	235	785	937	236	447	279	779	252	848	339
+gp	229	141	463	630	803	479	67	278	446	280	551	443	349	488	838	357	359	142	337	393	219	460	286
TOTALNUM	13425	24583	25841	25061	16839	14235	15694	10839	12678	17278	10265	8026	10301	10013	8599	8149	6665	8606	10174	10023	10887	10021	8446
TONSLAND	1124	1688	2223	2629	1945	1682	1916	1384	1403	1652	1098	896	1123	1125	1041	931	720	876	1006	983	1092	1104	933
SOPCOF %	100	100	100	100	100	99	103	99	100	97	100	102	100	101	101	101	100	101	101	101	101	101	101

* Age 0 was not used in the assessment

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
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
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
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
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
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	0.152
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	0.202
+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	0.236
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	1.0066

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	3.0	1.3	2.17	0.22
1998	0.04	2.7	0.9	1.80	0.20
A,B,1999	+	0.0	0.0	1.93	0.24
2000	0.08	2.2	0.8	1.89	0.28
2001	0.09	1.7	0.7	2.65	0.25
2002	0.02	2.8	1.0	2.21	0.22
A,2003	1.36	3.7	1.2	1.32	0.16
A,2004	1.27	ns		2.40	0.24
2005	0.05	2.6	0.8	3.84	0.41
2006	0.10	1.6	0.6	2.56	0.24
2007	0.14	2.2	0.7	3.75	0.35
2008	0.07	2.5	0.9	2.08	0.22

	Abundance index			
	Portugal (n/h)		Spain (n/30 min)	
	Crustacean	SE	Mean	SE
1983			11.8	1.8
1984			15.8	2.0
1985			14.0	1.7
1986			32.6	3.8
1987			ns	-
1988			59.2	6.5
1989			40.7	6.2
1990			40.3	3.0
1991			27.7	2.6
1992			49.1	5.2
1993			43.3	5.4
1994			26.9	3.6
1995			32.3	2.8
1996			44.8	4.1
1997	31.6	15.5	43.5	3.8
1998	26.5	10.7	34.3	4.5
B,1999	1.2	1.1	29.3	3.2
2000	20.6	8.5	33.0	4.6
2001	17.2	7.1	42.7	3.4
2002	40.6	13.7	34.6	3.3
2003	60.8	21.0	16.9	1.5
2004	ns		43.9	3.7
2005	34.5	12.0	62.9	6.2
2006	19.9	6.5	41.5	3.0
2007	32.3	11.3	51.1	4.3
2008	26.3	9.6	32.2	3.0

	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,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

+ 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	2006									
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

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	2008									
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

* 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	43.3	3.8
2008	288	20.2	14.3	15	na		146	37.9	3.8

[1] LPUE as catch (kg) per fishing day per 100 HP

[2] LPUE as catch (kg) per hour.

* Portuguese trawl effort revised from originally submitted value

Table 9.2.8. Four spot megrim (L.Boscii) in Divisions VIIIc & IXa. Correlation between different ages following cohorts.

"SP_CORUTR8c"

age	3	4	5	6
3	1.00	NA	NA	NA
4	0.66	1.00	NA	NA
5	0.35	0.38	1.00	NA
6	0.72	0.47	0.48	1.00

"SP_GFS"

age	0	1	2	3	4	5	6
0	1.00	NA	NA	NA	NA	NA	NA
1	0.38	1.00	NA	NA	NA	NA	NA
2	0.34	0.56	1.00	NA	NA	NA	NA
3	-0.02	0.31	0.51	1.00	NA	NA	NA
4	0.07	0.18	0.71	0.51	1.00	NA	NA
5	-0.01	0.54	0.24	0.40	0.26	1.00	NA
6	-0.10	0.61	0.60	0.49	0.47	0.45	1.00

Table 9.2.9. Four-spot megrim (L.boscii) in Divisions VIIIc and IXa. Tuning diagnostic.

Lowestoft VPA Version 3.1

11/04/2009 20:24

Extended Survivors Analysis

Four spot megrim (L. boscii) Division VIIIc and IXa

CPUE data from file fleetb.txt

Catch data for 23 years. 1986 to 2008. Ages 0 to 7.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
SP-CORUTR	1986	2008	3	6	0	1
SP-GFS	1988	2008	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 = .00045

Final year F values

Age	0	1	2	3	4	5	6
Iteration 39	0	0.0011	0.1204	0.2376	0.3334	0.2147	0.2624
Iteration 40	0	0.0011	0.1203	0.2375	0.3334	0.2145	0.2622

1

Regression weights

0.751	0.82	0.877	0.921	0.954	0.976	0.99	0.997	1	1

Fishing mortalities

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0	0	0	0	0	0	0	0	0	0
1	0.005	0.003	0.009	0.01	0.019	0.015	0.006	0.001	0.001	0.001
2	0.094	0.11	0.091	0.168	0.192	0.17	0.129	0.179	0.08	0.12
3	0.289	0.188	0.316	0.275	0.314	0.334	0.315	0.358	0.262	0.238
4	0.478	0.527	0.458	0.315	0.277	0.482	0.341	0.393	0.361	0.333
5	0.432	0.437	0.844	0.122	0.361	0.354	0.552	0.31	0.712	0.214
6	0.468	0.461	0.414	0.229	0.202	0.353	0.443	0.181	0.479	0.262

XSA population numbers (Thousands)

YEAR	AGE 0	1	2	3	4	5	6
1999	2.17E+04	8.53E+03	1.42E+04	1.22E+04	1.14E+04	4.42E+03	6.95E+02
2000	2.56E+04	1.78E+04	6.95E+03	1.06E+04	7.50E+03	5.77E+03	2.35E+03
2001	2.68E+04	2.10E+04	1.45E+04	5.10E+03	7.20E+03	3.63E+03	3.05E+03
2002	2.70E+04	2.19E+04	1.70E+04	1.08E+04	3.04E+03	3.73E+03	1.28E+03
2003	3.48E+04	2.21E+04	1.78E+04	1.18E+04	6.74E+03	1.82E+03	2.70E+03
2004	2.76E+04	2.85E+04	1.77E+04	1.20E+04	7.05E+03	4.19E+03	1.04E+03
2005	3.44E+04	2.26E+04	2.30E+04	1.23E+04	7.04E+03	3.57E+03	2.41E+03
2006	2.18E+04	2.82E+04	1.84E+04	1.66E+04	7.32E+03	4.10E+03	1.68E+03
2007	1.91E+04	1.78E+04	2.30E+04	1.26E+04	9.48E+03	4.04E+03	2.46E+03
2008	1.89E+04	1.57E+04	1.46E+04	1.74E+04	7.94E+03	5.41E+03	1.62E+03

Estimated population abundance at 1st Jan 2009

0.00E+00	1.55E+04	1.28E+04	1.06E+04	1.12E+04	4.66E+03	3.57E+03

Taper weighted geometric mean of the VPA populations:

2.41E+04	2.02E+04	1.67E+04	1.21E+04	7.09E+03	3.72E+03	1.78E+03

Standard error of the weighted Log(VPA populations) :

0.3184	0.3331	0.3437	0.3868	0.395	0.3814	0.4774

1

Log catchability residuals.

Fleet : SP-CORUTR8c

Age	1986	1987	1988
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
4	99.99	99.99	99.99
5	99.99	99.99	99.99
6	99.99	99.99	99.99

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-0.09	-0.18	0.3	0.22	0.55	-0.49	0.18	-0.61	-0.49	0.41
4	-0.09	0.3	-0.17	0.51	0.79	0.16	-0.14	-0.18	-0.68	0.27
5	-0.35	0.09	0.75	0.41	0.1	0.12	0.26	-0.59	-0.29	0.35
6	-0.24	0.01	0.56	0.23	0.27	0.03	0.18	-0.33	0.04	0.12

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	0.31	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
4	0.14	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
5	-0.04	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99	99.99
6	0.21	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	-6.5387	-5.7439	-5.3426	-5.3426
S.E(Log q)	0.5094	0.4517	0.3904	0.2382

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	0.73	0.539	7.34	0.71	11	0.44	-6.54
4	0.69	0.917	6.73	0.85	11	0.32	-5.74
5	2.19	-1.471	2.02	0.5	11	0.71	-5.34
6	0.93	0.295	5.4	0.93	11	0.25	-5.26
1							

Fleet : SP-GFS

Age	1986	1987	1988
0	99.99	99.99	99.99
1	99.99	99.99	99.99
2	99.99	99.99	99.99
3	99.99	99.99	99.99
4	99.99	99.99	99.99
5	99.99	99.99	99.99
6	99.99	99.99	99.99

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	0.66	-0.34	-0.19	-0.14	-0.01	0.33	-0.15	0.57	0.7	0.12
1	-0.2	0.07	-0.12	0.39	-0.01	-0.74	0.22	0.05	0.03	-0.15
2	-0.37	-0.25	-0.44	-0.64	-0.26	-0.53	-0.59	0.03	-0.28	-0.17
3	-0.97	-1.1	-0.9	-0.58	-0.67	-0.63	-0.75	-0.57	0.13	-0.1
4	-0.73	-0.33	-0.72	-0.33	-0.51	-0.08	-0.35	-0.66	-0.05	0.07
5	-0.72	0.15	-0.04	-0.02	-0.65	0.02	-0.14	0.37	0.12	0.57
6	-1.23	-0.37	-1.04	-0.18	-0.25	0.01	-0.2	0.35	0.16	0.2

Age	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0.01	-0.09	-0.43	-0.15	99.99	-0.11	0.36	-0.23	0.11	-0.32
1	0.33	0.19	0.21	-0.34	99.99	0.12	0.18	-0.22	-0.02	-0.2
2	0.04	0.14	0.16	0.06	99.99	-0.09	0.24	0.03	0.16	0.1
3	-0.12	-0.19	0.53	0.21	99.99	-0.03	0.53	-0.04	0.37	-0.23
4	-0.4	0.41	0.31	0.32	99.99	0	0.29	-0.18	0.21	-0.29
5	-0.28	0.04	1.1	-0.69	99.99	-0.43	0.54	-0.27	0.43	-0.89
6	-0.12	-0.05	0.16	-0.2	99.99	-0.36	-0.09	-0.08	0.11	-0.03

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	-7.1239	-7.3331	-7.6665	-7.6665
S.E(Log q)	0.3844	0.3192	0.5855	0.2038

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	0.5	1.494	9.95	0.5	19	0.33	-9.84
1	0.95	0.2	7.31	0.67	19	0.26	-7.18
2	0.9	0.492	7.25	0.72	19	0.23	-6.98

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	1.38	-0.907	6.27	0.39	19	0.53	-7.12
4	1.45	-1.317	6.65	0.49	19	0.45	-7.33
5	2.38	-1.033	6.82	0.06	19	1.39	-7.67
6	0.88	1.077	7.67	0.89	19	0.17	-7.71

Terminal year survivor and F summaries :

Age 0 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-CORUTR	1	0	0	0	0	0	0
SP-GFS	11270	0.366	0	0	1	0.453	0
P shrinkage	20155	0.33				0.547	0
F shrinkage	0	1.5				0	0

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
15487	0.25	0.43	2	1.745	0

Age 1 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-CORUTR	1	0	0	0	0	0	0
SP-GFS	11973	0.226	0.151	0.67	2	0.686	0.001
P shrinkage	16701	0.34				0.298	0.001
F shrinkage	1615	1.5				0.016	0.008

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
12814	0.19	0.19	4	1.028	0.001

Age 2 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-CORUTR	1	0	0	0	0	0	0
SP-GFS	10310	0.182	0.092	0.5	3	0.79	0.124
P shrinkage	12053	0.39				0.197	0.107
F shrinkage	8334	1.5				0.013	0.151

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
10602	0.16	0.07	5	0.418	0.12

Age 3 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-CORUTR	1	0	0	0	0	0	0
SP-GFS	11298	0.169	0.138	0.82	4	0.983	0.236
F shrinkage	8027	1.5				0.017	0.318

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
11233	0.17	0.12	5	0.719	0.238

Age 4 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-CORUTR	1	0	0	0	0	0	0
SP-GFS	4670	0.151	0.113	0.75	5	0.982	0.333
F shrinkage	4074	1.5				0.018	0.373

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
4658	0.15	0.1	6	0.666	0.333

Age 5 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
SP-CORUTR	1	0	0	0	0	0	0
SP-GFS	3659	0.166	0.179	1.08	5	0.975	0.21
F shrinkage	1457	1.5				0.025	0.461

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
3574	0.17	0.17	6	1.03	0.214

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

Year class = 2002

Fleet	E S	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
SP-CORUTR	1	0	0	0	0	0	0
SP-GFS	1024	0.18	0.089	0.49	6	0.973	0.262
F shrinkage	1019	1.5				0.027	0.263

Weighted prediction :

Survivors at end of year	Int s.e	Ext s.e	N	Var Ratio	F
1024	0.18	0.08	7	0.445	0.262

Table 9.2.10 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Estimates of fisihing mortality at age.

Run title : Four spot megrim (L. boscii) Division VIIIc and IXa

At 11/04/2009 20:26

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1986	1987	1988
AGE			
0	0	0	0
1	0.0025	0.0586	0.0611
2	0.1186	0.3858	0.3946
3	0.2161	0.2543	0.316
4	0.4363	0.3381	0.4051
5	0.3395	0.2586	0.391
6	0.3327	0.2853	0.3731
+gp	0.3327	0.2853	0.3731
FBAR 2- 4	0.257	0.3261	0.3719

Table 8 Fishing mortality (F) at age

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	0.0259	0.0585	0.077	0.0265	0.0184	0.009	0.065	0.0148	0.0019	0.0029
2	0.4472	0.2568	0.2076	0.2545	0.0949	0.1294	0.3463	0.1317	0.0589	0.0853
3	0.3794	0.2007	0.2608	0.3659	0.3259	0.2682	0.4391	0.3431	0.2626	0.2905
4	0.6765	0.5111	0.3218	0.8353	0.7184	0.7119	0.6267	0.542	0.3475	0.4713
5	0.5873	0.6198	0.8299	0.7632	0.4375	0.7869	0.8921	0.4473	0.4687	0.6464
6	0.5782	0.491	0.6282	0.5796	0.517	0.6708	0.7501	0.4153	0.49	0.4665
+gp	0.5782	0.491	0.6282	0.5796	0.517	0.6708	0.7501	0.4153	0.49	0.4665
FBAR 2- 4	0.501	0.3228	0.2634	0.4852	0.3797	0.3698	0.4707	0.3389	0.223	0.2824

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	FBAR 06-08
AGE											
0	0	0	0	0	0	0	0	0	0	0	0
1	0.0049	0.0028	0.0088	0.0096	0.0185	0.0153	0.006	0.0013	0.0006	0.0011	0.001
2	0.0944	0.11	0.0907	0.1684	0.1916	0.1704	0.1292	0.1792	0.0802	0.1203	0.1266
3	0.2892	0.188	0.3163	0.2752	0.3138	0.3339	0.315	0.3579	0.2624	0.2375	0.2859
4	0.4778	0.5272	0.4581	0.3146	0.2769	0.4816	0.3411	0.3931	0.3613	0.3334	0.3626
5	0.4318	0.437	0.8439	0.1219	0.3614	0.3535	0.5523	0.3098	0.7124	0.2145	0.4122
6	0.4679	0.461	0.4143	0.2285	0.202	0.3528	0.4428	0.1811	0.4793	0.2622	0.3075
+gp	0.4679	0.461	0.4143	0.2285	0.202	0.3528	0.4428	0.1811	0.4793	0.2622	
FBAR 2- 4	0.2872	0.2751	0.2884	0.2527	0.2608	0.3286	0.2617	0.3101	0.2347	0.2304	

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 11/04/2009 20:26

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR	1986	1987	1988
AGE			
0	54114	34707	38734
1	48951	44305	28416
2	34341	39978	34208
3	20983	24972	22254
4	12315	13841	15855
5	4346	6518	8081
6	3316	2534	4120
+gp	888	624	1630
TOTAL	179253	167478	153297

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

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
0	34304	21137	43639	40323	12533	30461	36420	24332	21304	10421
1	31713	28086	17306	35729	33013	10262	24939	29819	19921	17442
2	21885	25301	21688	13119	28487	26535	8326	19133	24054	16278
3	18875	11457	16024	14428	8328	21211	19087	4822	13732	18568
4	13284	10575	7675	10108	8193	4922	13281	10074	2801	8646
5	8657	5529	5193	4555	3590	3270	1977	5810	4796	1620
6	4475	3940	2436	1854	1738	1897	1219	663	3041	2458
+gp	1568	2265	1121	166	753	996	578	1777	1252	1025
TOTAL	134760	108290	115082	120281	96636	99554	105829	96429	90902	76458

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

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	GM 90-06
AGE												
0	21701	25647	26755	26964	34848	27648	34384	21796	19130	18914	0	25491
1	8532	17767	20998	21905	22076	28532	22637	28151	17845	15662	15487	
2	14240	6951	14506	17040	17762	17742	23005	18422	23018	14602	12814	
3	12238	10608	5098	10847	11790	12007	12251	16553	12608	17392	10602	
4	11370	7503	7197	3042	6744	7053	7040	7320	9475	7940	11233	
5	4418	5772	3626	3727	1818	4186	3568	4098	4045	5405	4658	
6	695	2349	3053	1277	2701	1037	2407	1681	2461	1624	3574	
+gp	1430	2484	1153	1932	854	1243	1203	1454	1322	1362	1882	
TOTAL	74623	79082	82385	86733	98594	99449	106494	99476	89904	82902	60250	

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 11/04/2009 20:26

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	54114	6692	5771	1124	0.1948	0.257
1987	34707	8256	7071	1688	0.2387	0.3261
1988	38734	8855	7898	2223	0.2815	0.3719
1989	34304	8533	7548	2629	0.3483	0.501
1990	21137	7385	6707	1945	0.29	0.3228
1991	43639	6743	6067	1682	0.2772	0.2634
1992	40323	6285	5455	1916	0.3512	0.4852
1993	12533	6292	5589	1384	0.2476	0.3797
1994	30461	5896	5331	1403	0.2632	0.3698
1995	36420	5458	4723	1652	0.3498	0.4707
1996	24332	5203	4456	1098	0.2464	0.3389
1997	21304	4886	4311	896	0.2078	0.223
1998	10421	5171	4680	1123	0.24	0.2824
1999	21701	4810	4401	1125	0.2556	0.2872
2000	25647	4671	4176	1041	0.2493	0.2751
2001	26755	4437	3798	931	0.2451	0.2884
2002	26964	5123	4394	720	0.1638	0.2527
2003	34848	5313	4528	876	0.1935	0.2608
2004	27648	5209	4438	1006	0.2267	0.3286
2005	34384	5437	4602	983	0.2136	0.2617
2006	21796	5839	5130	1092	0.2129	0.3101
2007	19130	5680	5033	1104	0.2194	0.2347
2008	18914	5807	5228	933	0.1785	0.2304
Arith. Mean	28705	5999	5275	1329	0.2476	0.3183
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: 10:53 12/04/2009
Fbar age range: 2-4

2009 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	25491	0.2	0	0	0	0.003	0.000	0.003
1	15487	0.2	0.55	0	0	0.040	0.001	0.040
2	12814	0.2	0.86	0	0	0.071	0.127	0.071
3	10602	0.2	0.97	0	0	0.091	0.286	0.091
4	11233	0.2	0.99	0	0	0.112	0.363	0.112
5	4658	0.2	1	0	0	0.138	0.412	0.138
6	3574	0.2	1	0	0	0.178	0.308	0.178
7	1882	0.2	1	0	0	0.223	0.308	0.223

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	25491	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	0.071	0.127	0.071
3	.	0.2	0.97	0	0	0.091	0.286	0.091
4	.	0.2	0.99	0	0	0.112	0.363	0.112
5	.	0.2	1	0	0	0.138	0.412	0.138
6	.	0.2	1	0	0	0.178	0.308	0.178
7	.	0.2	1	0	0	0.223	0.308	0.223

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	25491	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	0.071	0.127	0.071
3	.	0.2	0.97	0	0	0.091	0.286	0.091
4	.	0.2	0.99	0	0	0.112	0.363	0.112
5	.	0.2	1	0	0	0.138	0.412	0.138
6	.	0.2	1	0	0	0.178	0.308	0.178
7	.	0.2	1	0	0	0.223	0.308	0.223

Input units are thousands and kg - output in tonnes

Table 9.2.14 Four-spot megrim (*L. boscii*) in Divisions 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: 10:53 12/04/2009
Fbar age range: 2-4

2009				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
5514	5001	1	0.2584	1119

2010					2011	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
5433	4834	0	0	0	6632	5985
.	4834	0.1	0.0258	120	6500	5854
.	4834	0.2	0.0517	237	6373	5727
.	4834	0.3	0.0775	350	6249	5604
.	4834	0.4	0.1033	459	6129	5485
.	4834	0.5	0.1292	565	6014	5369
.	4834	0.6	0.155	668	5901	5258
.	4834	0.7	0.1809	768	5793	5150
.	4834	0.8	0.2067	864	5688	5045
.	4834	0.9	0.2325	958	5586	4944
.	4834	1	0.2584	1049	5488	4846
.	4834	1.1	0.2842	1137	5392	4751
.	4834	1.2	0.31	1222	5300	4659
.	4834	1.3	0.3359	1305	5210	4570
.	4834	1.4	0.3617	1385	5124	4484
.	4834	1.5	0.3876	1463	5040	4401
.	4834	1.6	0.4134	1538	4958	4320
.	4834	1.7	0.4392	1612	4880	4242
.	4834	1.8	0.4651	1683	4803	4166
.	4834	1.9	0.4909	1752	4729	4092
.	4834	2	0.5167	1819	4658	4021

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: 10:53 12/04/2009
Fbar age range: 2-4

Year:	2009	F multiplier:	1	Fbar:	0.2584				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	25491	68	0	0	0	0
1	0.001	14	1	15487	614	8518	338	8518	338
2	0.1266	1384	98	12814	910	11020	782	11020	782
3	0.2859	2401	218	10602	965	10284	936	10284	936
4	0.3626	3115	349	11233	1258	11121	1246	11121	1246
5	0.4122	1436	198	4658	643	4658	643	4658	643
6	0.3075	862	153	3574	636	3574	636	3574	636
7	0.3075	454	101	1882	420	1882	420	1882	420
Total		9666	1119	85741	5514	51057	5001	51057	5001

Year:	2010	F multiplier:	1	Fbar:	0.2584				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	25491	68	0	0	0	0
1	0.001	19	1	20870	828	11479	455	11479	455
2	0.1266	1368	97	12667	899	10894	773	10894	773
3	0.2859	2093	191	9244	841	8967	816	8967	816
4	0.3626	1809	203	6522	730	6456	723	6456	723
5	0.4122	1973	272	6400	883	6400	883	6400	883
6	0.3075	609	108	2525	450	2525	450	2525	450
7	0.3075	792	177	3284	734	3284	734	3284	734
Total		8663	1049	87003	5433	50005	4834	50005	4834

Year:	2011	F multiplier:	1	Fbar:	0.2584				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0	0	0	25491	68	0	0	0	0
1	0.001	19	1	20870	828	11479	455	11479	455
2	0.1266	1843	131	17070	1212	14680	1042	14680	1042
3	0.2859	2069	188	9138	832	8864	807	8864	807
4	0.3626	1577	177	5686	637	5629	630	5629	630
5	0.4122	1145	158	3715	513	3715	513	3715	513
6	0.3075	837	149	3470	618	3470	618	3470	618
7	0.3075	843	188	3497	781	3497	781	3497	781
Total		8334	992	88938	5488	51334	4846	51334	4846

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			2006	2007	2008	2009	2010
Stock No. (thousands)			21796	19130	18914	25491	25491
of	0 year-olds						
Source			XSA	XSA	XSA	GM90-06	GM90-06
Status Quo F:							
% in	2009	landings	19.5	8.8	0.1	0.0	-
% in	2010		19.4	18.2	9.2	0.1	0.0
% in	2009	SSB	18.7	15.6	6.8	0.0	-
% in	2010	SSB	15.0	16.9	16.0	9.4	0.0
% in	2011	SSB	10.6	13.0	16.7	21.5	9.4

GM : geometric mean recruitment

Four-spot megrim (L. boscii) in Divisions VIIIc and IXa : Year-class % contribution to

a) 2010 landings **b) 2011 SSB**

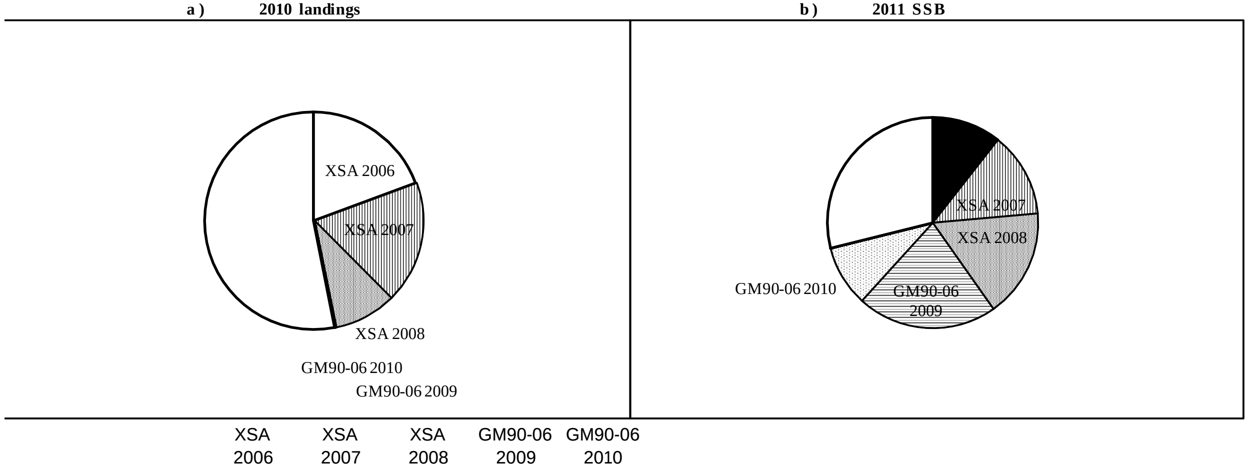


Table 9.2.17 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Yield per recruit results.

MFYPR version 2a
Run: LDB
Time and date: 10:54 12/04/2009
Yield per results

FMult	Fbar	CatchNos	Yield	StockNos	Biomass	SpwnNosJan	SSBJan	SpwnNosSpwn	SSBSpwn
0	0	0	0	5.5167	0.5912	4.0334	0.5653	4.0334	0.5653
0.1	0.0258	0.0836	0.0127	5.1003	0.505	3.6174	0.4791	3.6174	0.4791
0.2	0.0517	0.1471	0.0215	4.7846	0.4409	3.3022	0.4151	3.3022	0.4151
0.3	0.0775	0.1968	0.0277	4.5375	0.3917	3.0555	0.3659	3.0555	0.3659
0.4	0.1033	0.2368	0.0322	4.3392	0.3531	2.8575	0.3273	2.8575	0.3273
0.5	0.1292	0.2696	0.0355	4.1766	0.322	2.6953	0.2963	2.6953	0.2963
0.6	0.155	0.297	0.0379	4.041	0.2967	2.5601	0.271	2.5601	0.271
0.7	0.1809	0.3202	0.0398	3.9263	0.2758	2.4457	0.2501	2.4457	0.2501
0.8	0.2067	0.3402	0.0411	3.8281	0.2582	2.3478	0.2325	2.3478	0.2325
0.9	0.2325	0.3575	0.0422	3.743	0.2433	2.263	0.2177	2.263	0.2177
1	0.2584	0.3727	0.043	3.6685	0.2306	2.1889	0.205	2.1889	0.205
1.1	0.2842	0.3861	0.0436	3.6028	0.2197	2.1235	0.1941	2.1235	0.1941
1.2	0.31	0.398	0.044	3.5445	0.2101	2.0654	0.1846	2.0654	0.1846
1.3	0.3359	0.4087	0.0444	3.4922	0.2018	2.0135	0.1763	2.0135	0.1763
1.4	0.3617	0.4184	0.0446	3.4451	0.1944	1.9667	0.169	1.9667	0.169
1.5	0.3876	0.4272	0.0448	3.4025	0.1879	1.9244	0.1625	1.9244	0.1625
1.6	0.4134	0.4352	0.045	3.3637	0.1821	1.8858	0.1567	1.8858	0.1567
1.7	0.4392	0.4425	0.0451	3.3282	0.1769	1.8506	0.1515	1.8506	0.1515
1.8	0.4651	0.4493	0.0452	3.2955	0.1722	1.8182	0.1468	1.8182	0.1468
1.9	0.4909	0.4556	0.0452	3.2654	0.1679	1.7884	0.1426	1.7884	0.1426
2	0.5167	0.4614	0.0453	3.2375	0.164	1.7607	0.1387	1.7607	0.1387

Reference point	F multiplier	Absolute F
Fbar(2-4)	1	0.2584
FMax	2.4021	0.6206
F0.1	0.7093	0.1833
F35%SPR	1.0643	0.275
Flow	0.4563	0.1179
Fmed	1.2184	0.3148
Fhigh	2.2327	0.5768

Weights in kilograms

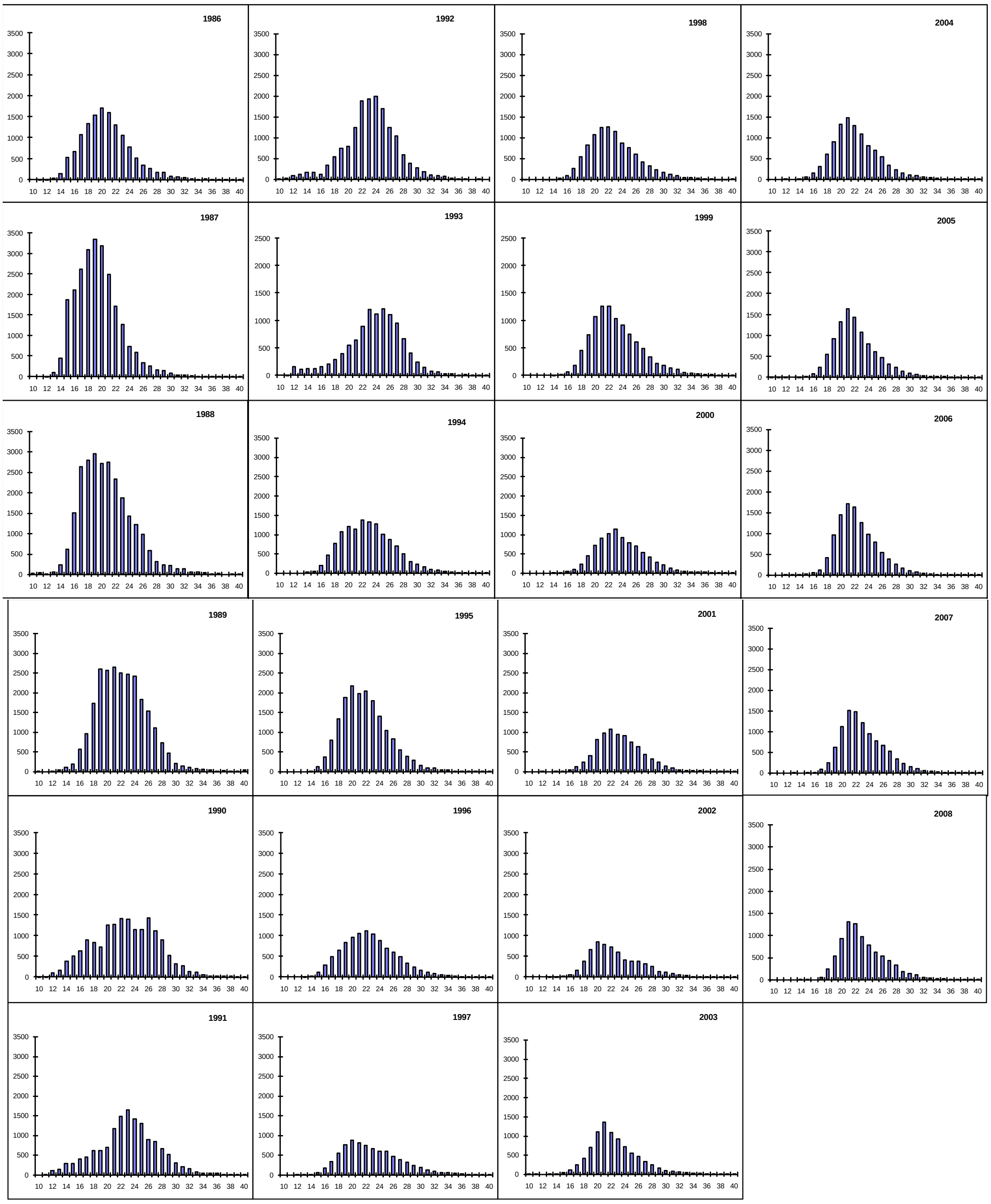
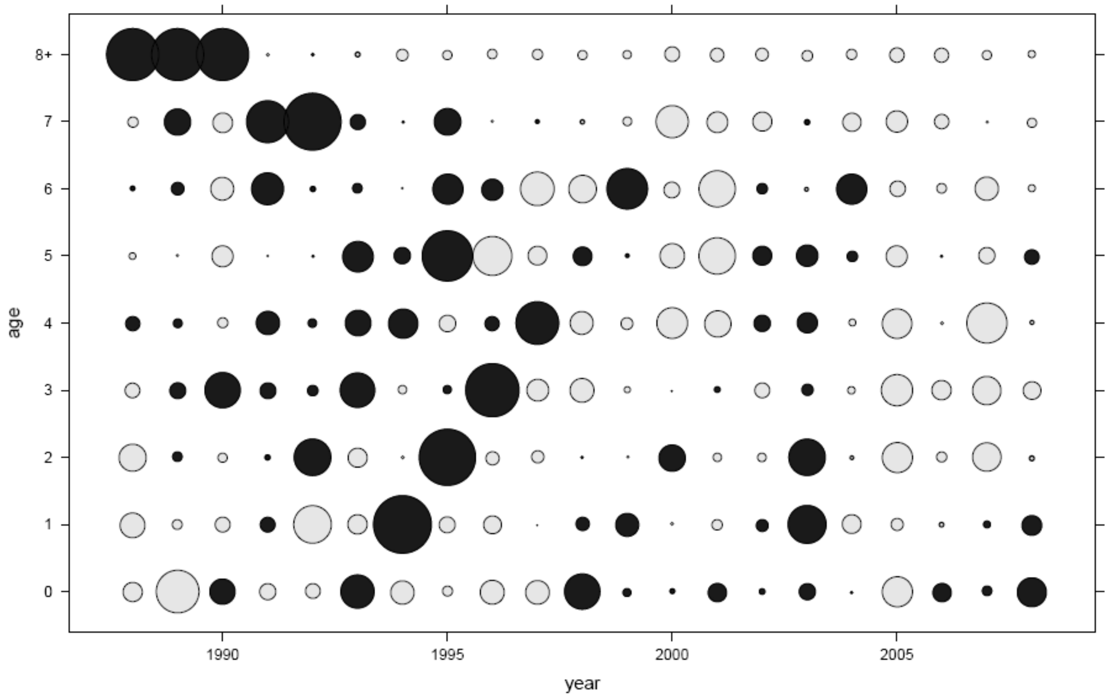


Figure 9.2.1 Four-spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Annual length compositions of landings ('000)

Standardized log(abundance index at age) from SP GFS

(black bubble means < 0)



Standardized log(abundance index at age) from A Coruña VIIIc trawl fleet

(black bubble means < 0)

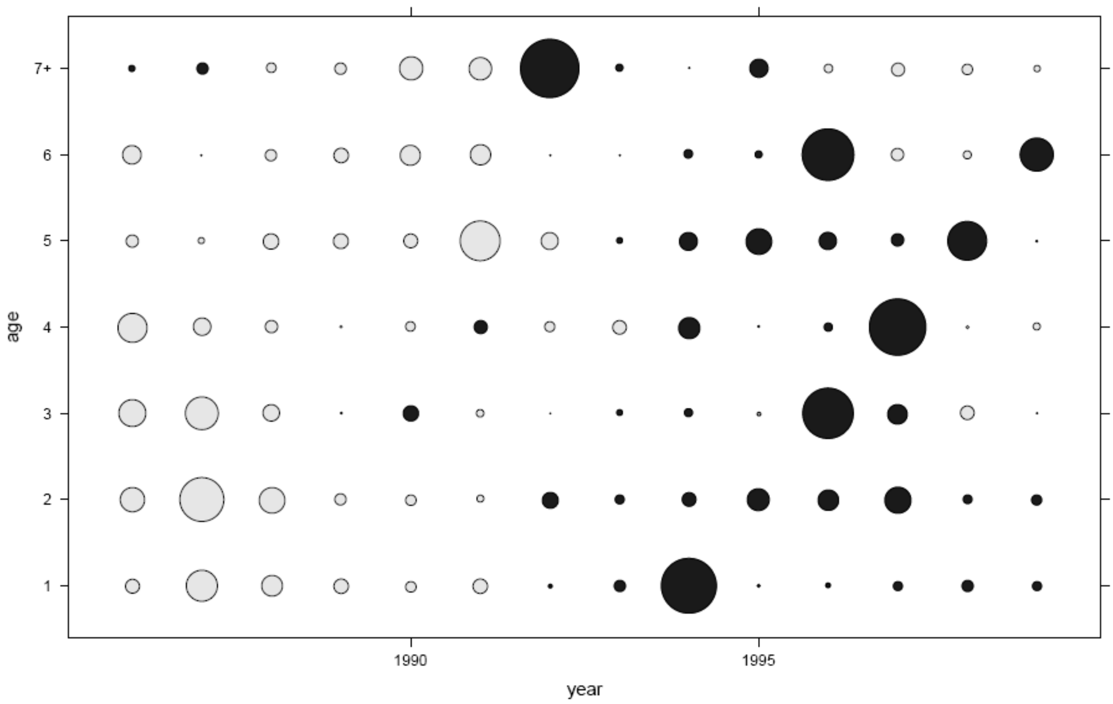
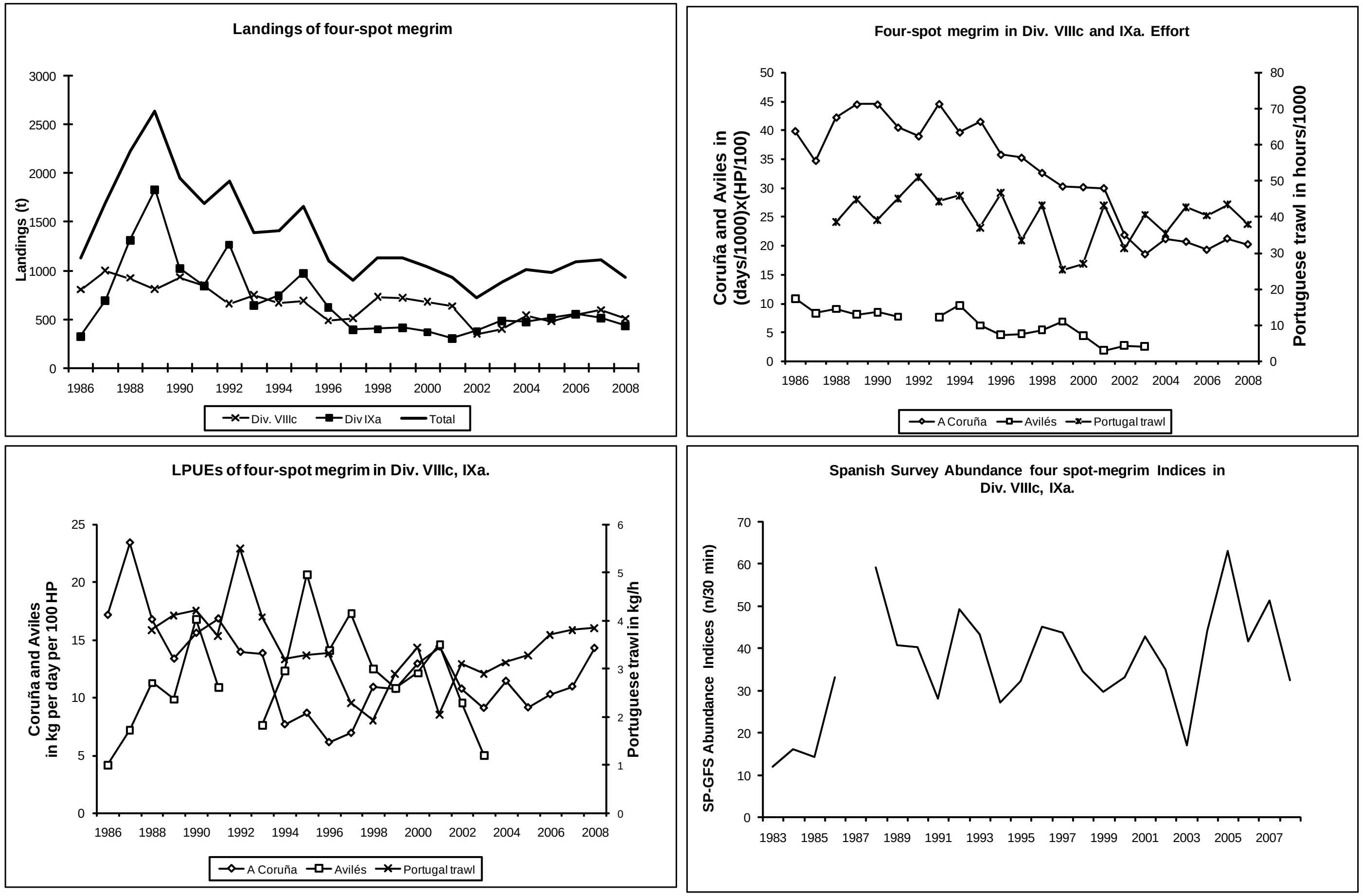
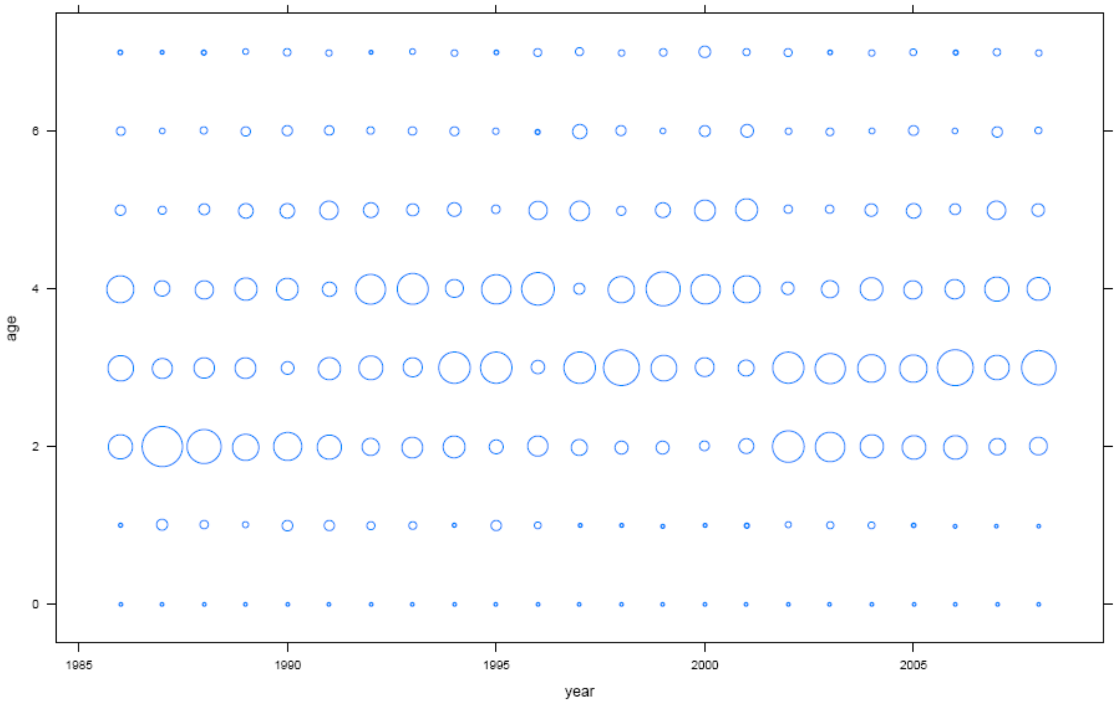


Figure 9.2.2: Four-spot megrim (L. Boscii) in Divisions VIIIc&IXa

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 using FLEDA



Standardized catch proportions at age using FLEDA (black bubble means < 0)

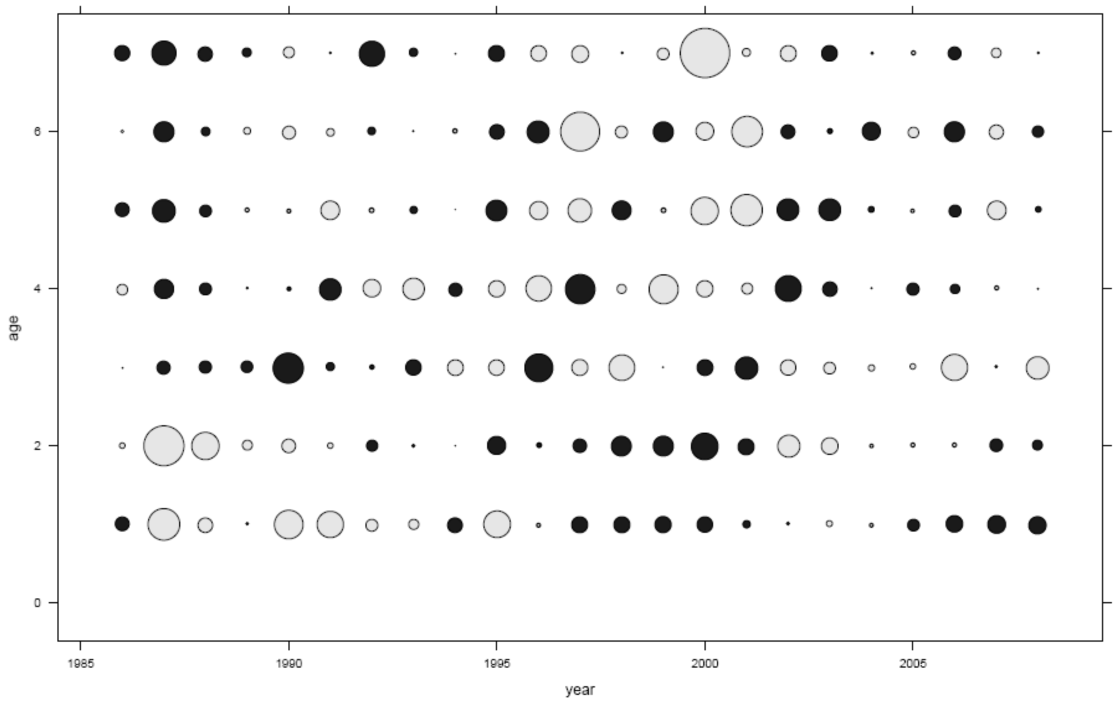


Figure 9.2.4. Four-spot megrim (L. Boscii) in Divisions VIIIc & IXa.

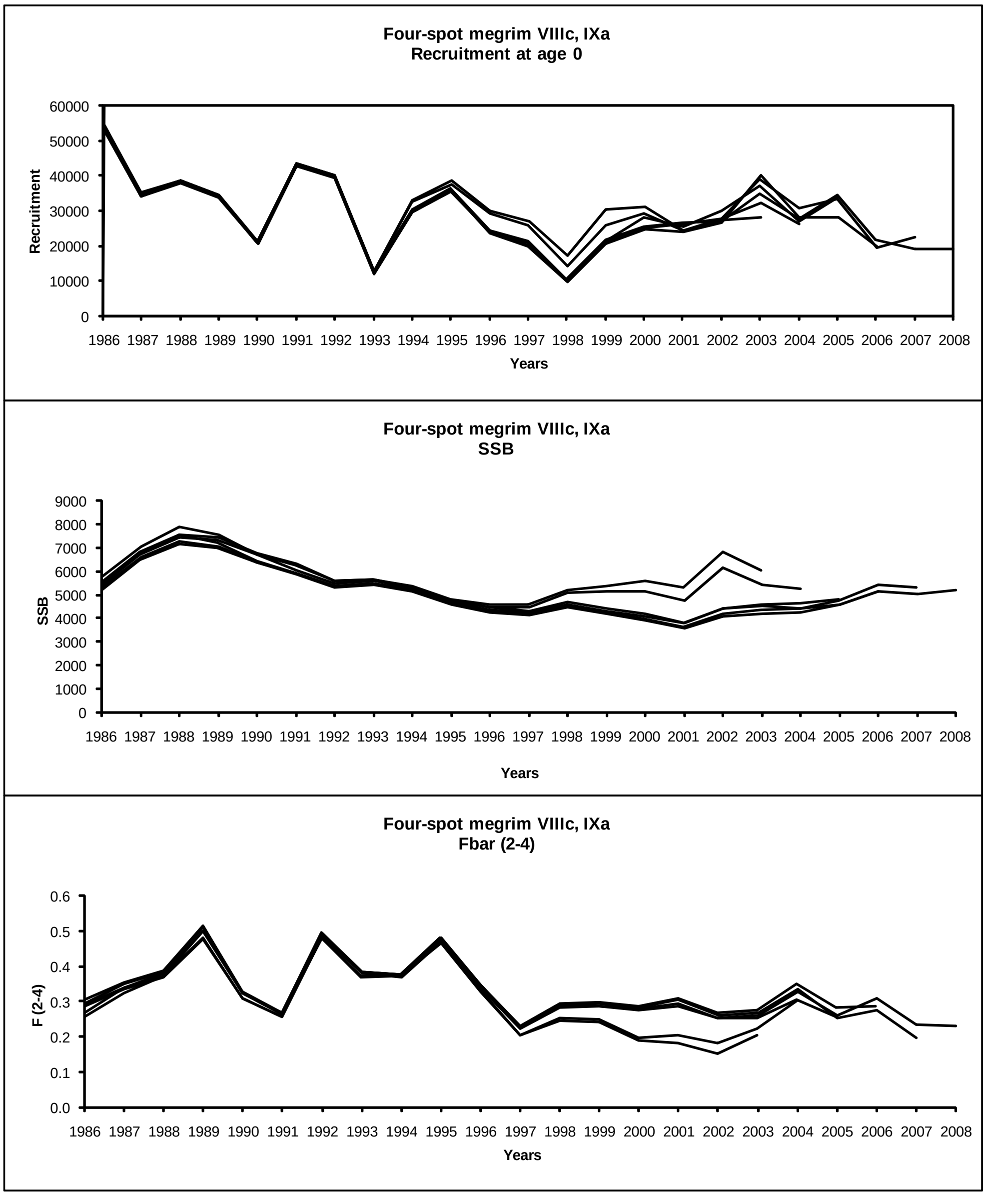
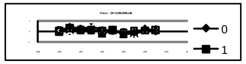
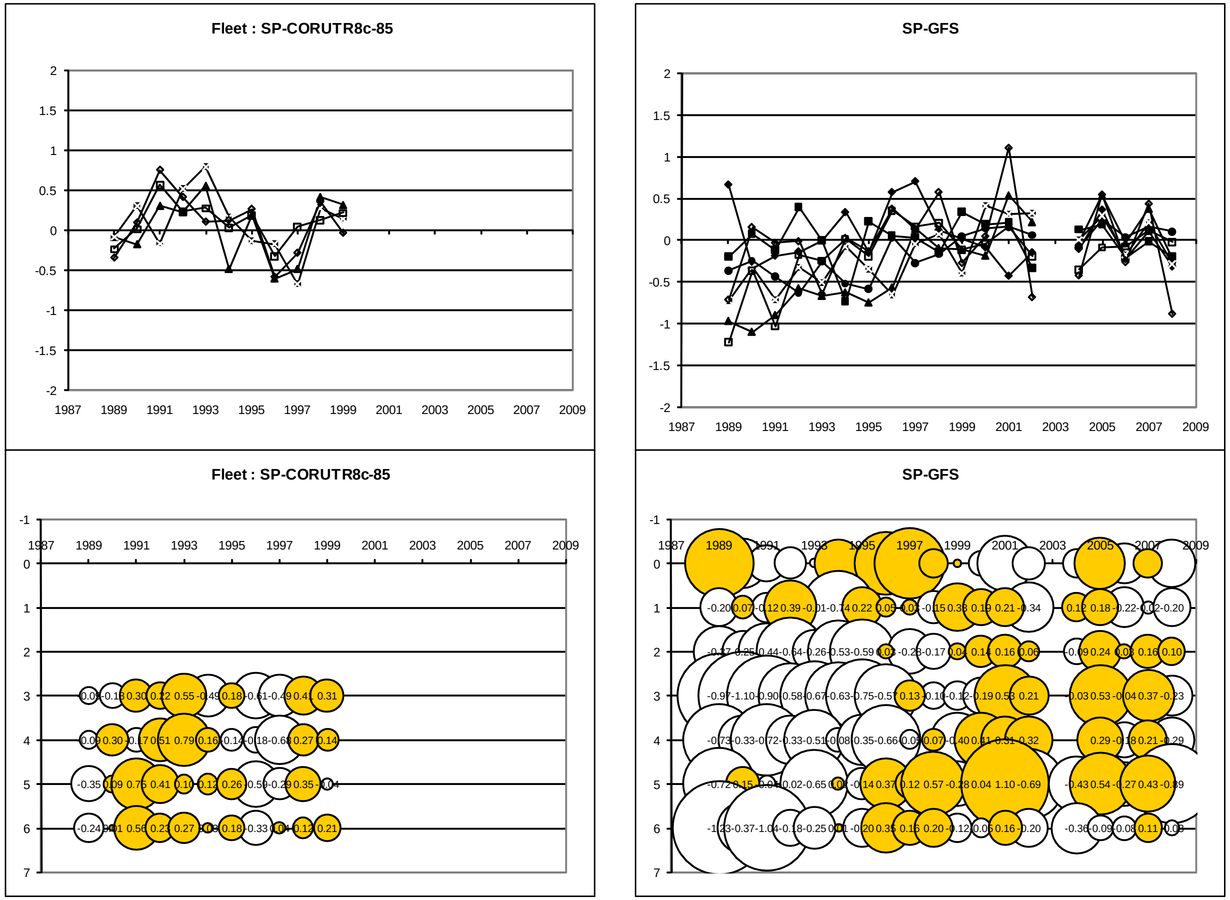


Figure 9.2.5. Four-spot megrim (L. Boscii) in Divisions VIIIc and IXa. Retrospective XSA

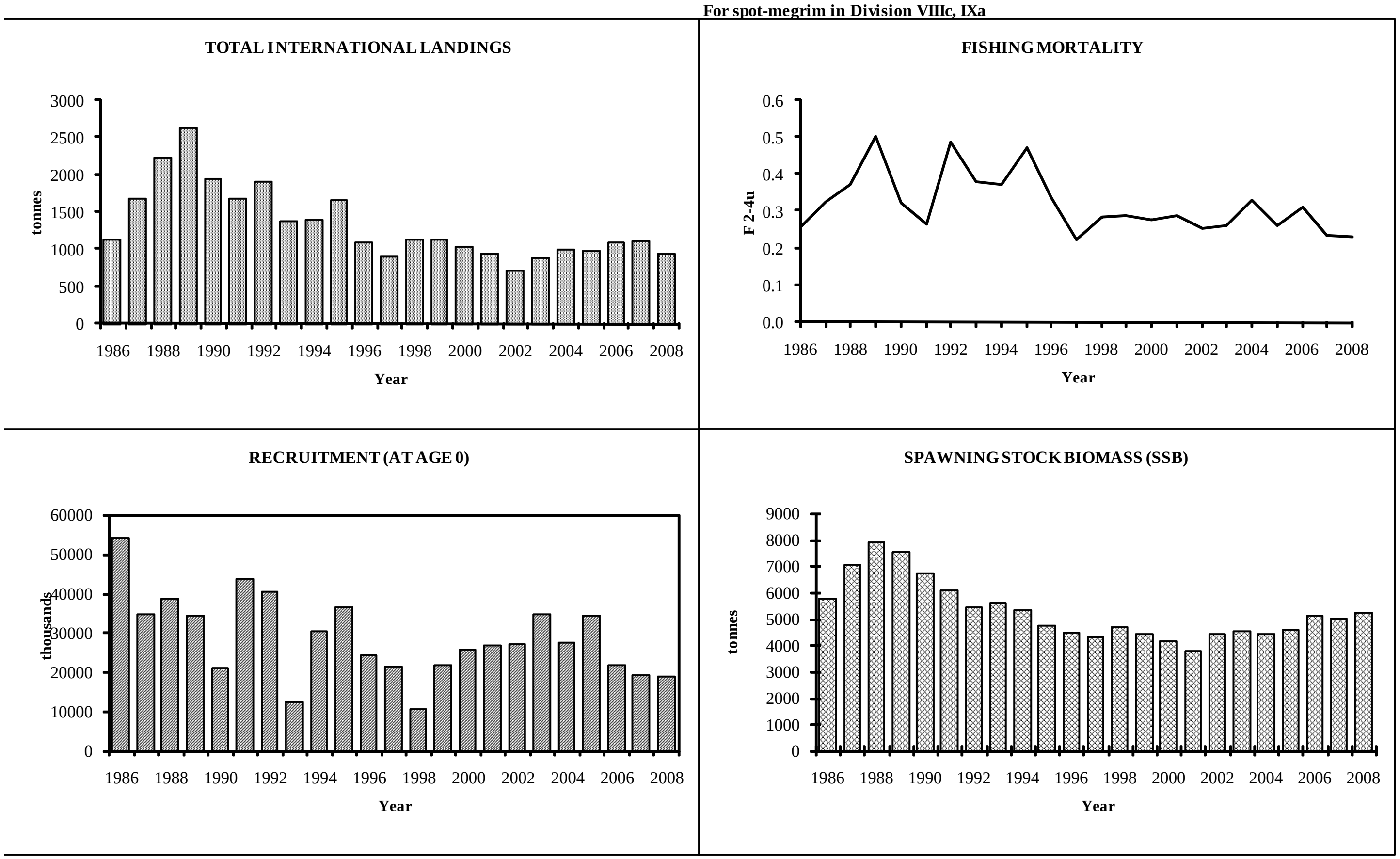
Figure 9.2.6. Four spot megrim (*L. boscii*) in Divisions VIIIc and IXa



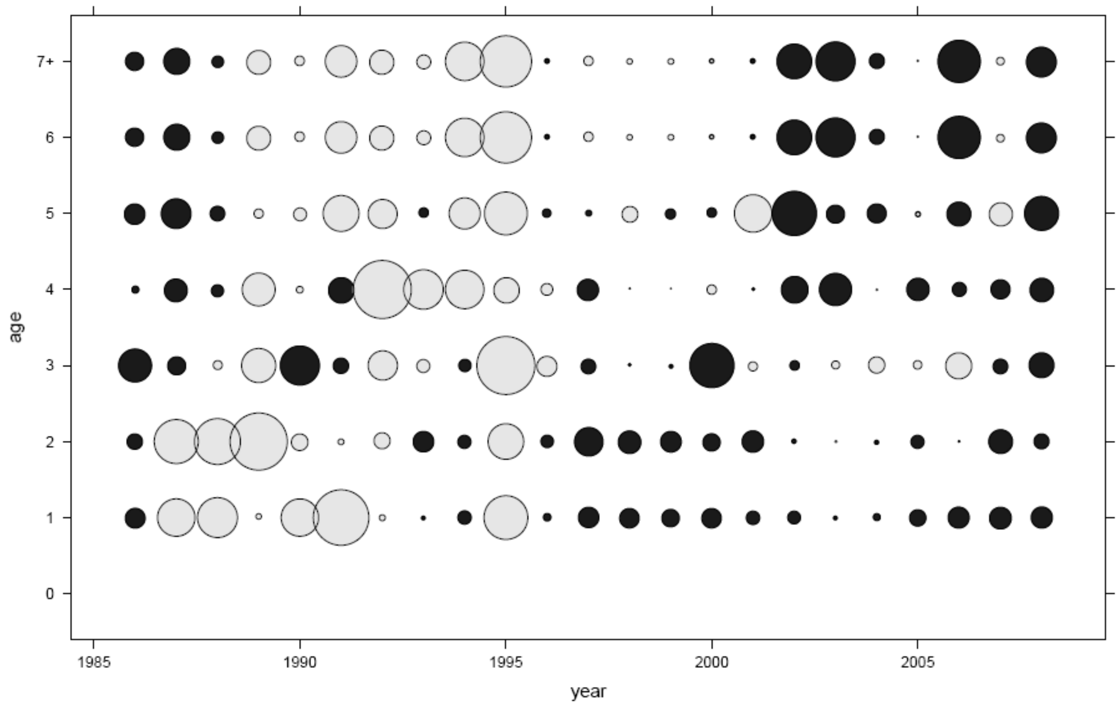
LOG CATCHABILITY RESIDUAL PLOTS (XSA)



Figurre 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)

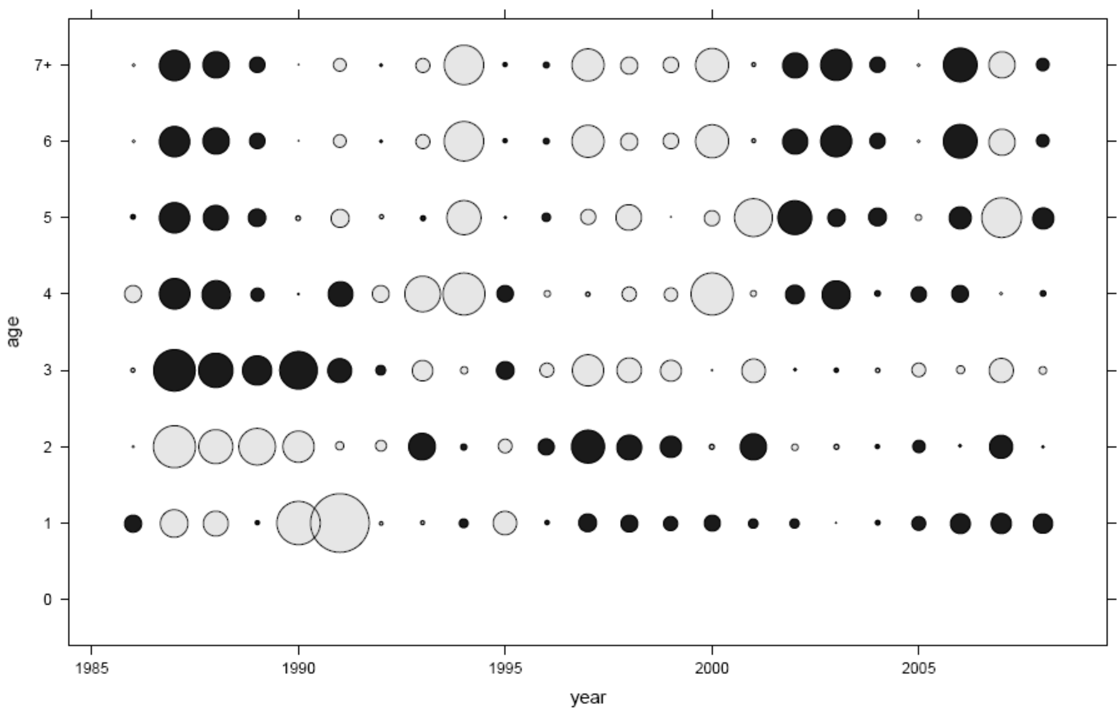
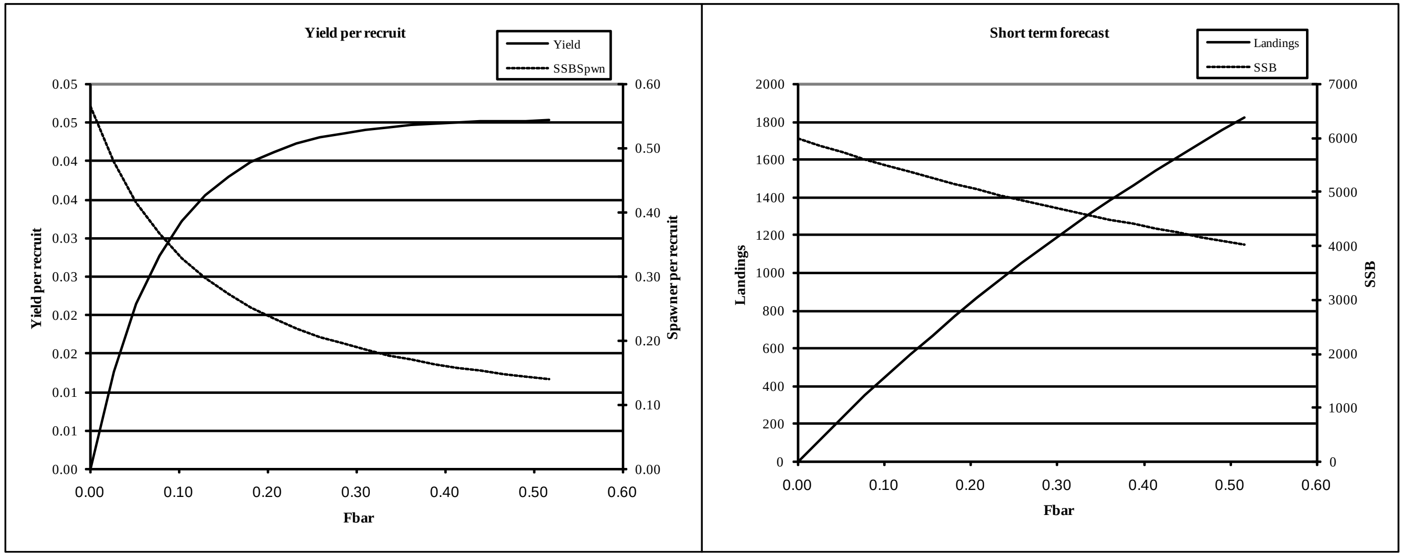


Figure 9.2.7(b): Four-spot megrim (L. Boscii) in Divisions VIIIc&IXa

Figure 9.2.8. Four-spot megrim (L. boscii) in Divisions VIIIc and IXa. Forecast summary



MFYPR version 2a
Run: LDB
Time and date: 10:54 12/04/2009

Reference point	F multiplier	Absolute F
Fbar(2-4)	1.0000	0.2584
FMax	2.4021	0.6206
F0.1	0.7093	0.1833
F35%SPR	1.0643	0.2750
Flow	0.4563	0.1179
Fmed	1.2184	0.3148
Fhigh	2.2327	0.5768

Weights in kilograms

MFDP version 1a
Run: LDB
Four spot megrim (L. boscii) Division VIIIc and IXa
Time and date: 10:53 12/04/2009
Fbar age range: 2-4

Input units are thousands and kg - output in tonnes

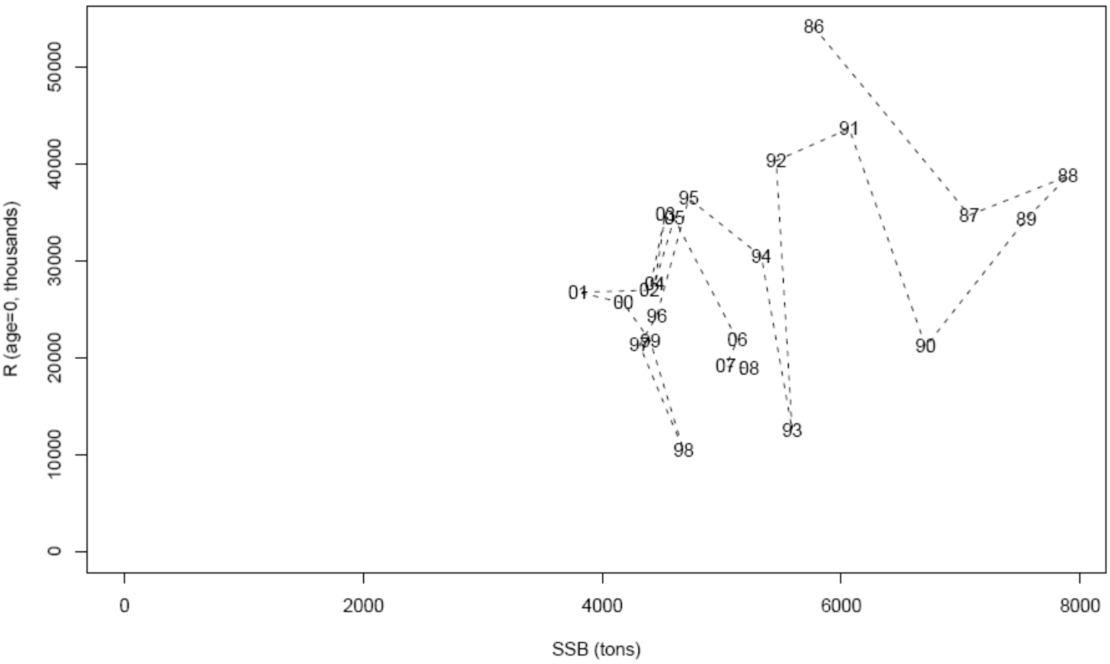


Figure 9.2.9. Four spot megrim (L.boscii) in Divisions VIIIc and IXa. SSB-Recruitment plot.

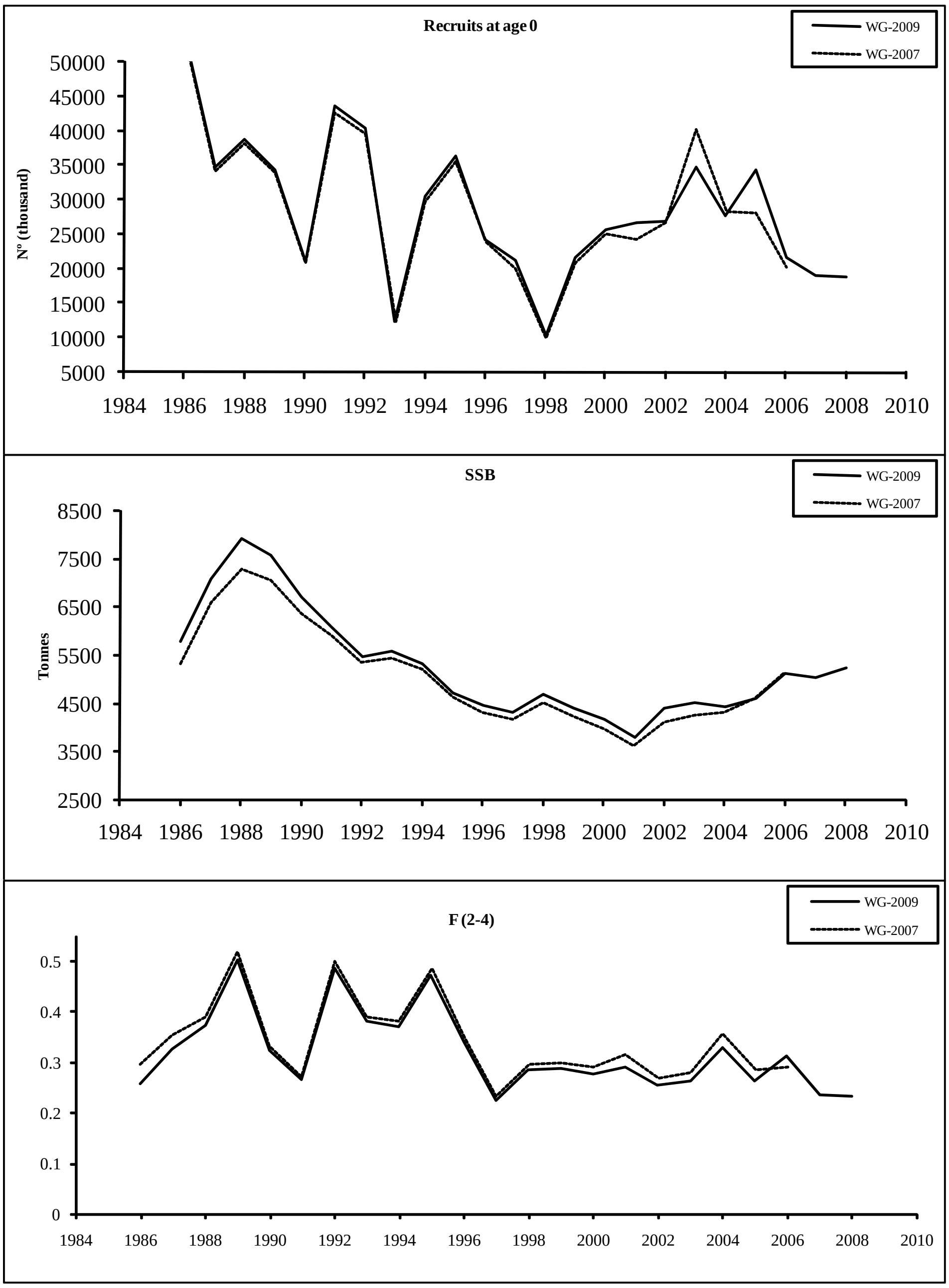


Figure 9.2.10. Four-spot megrim (L. boscii) Recruits, SSB and Fs from WG07 and WG09

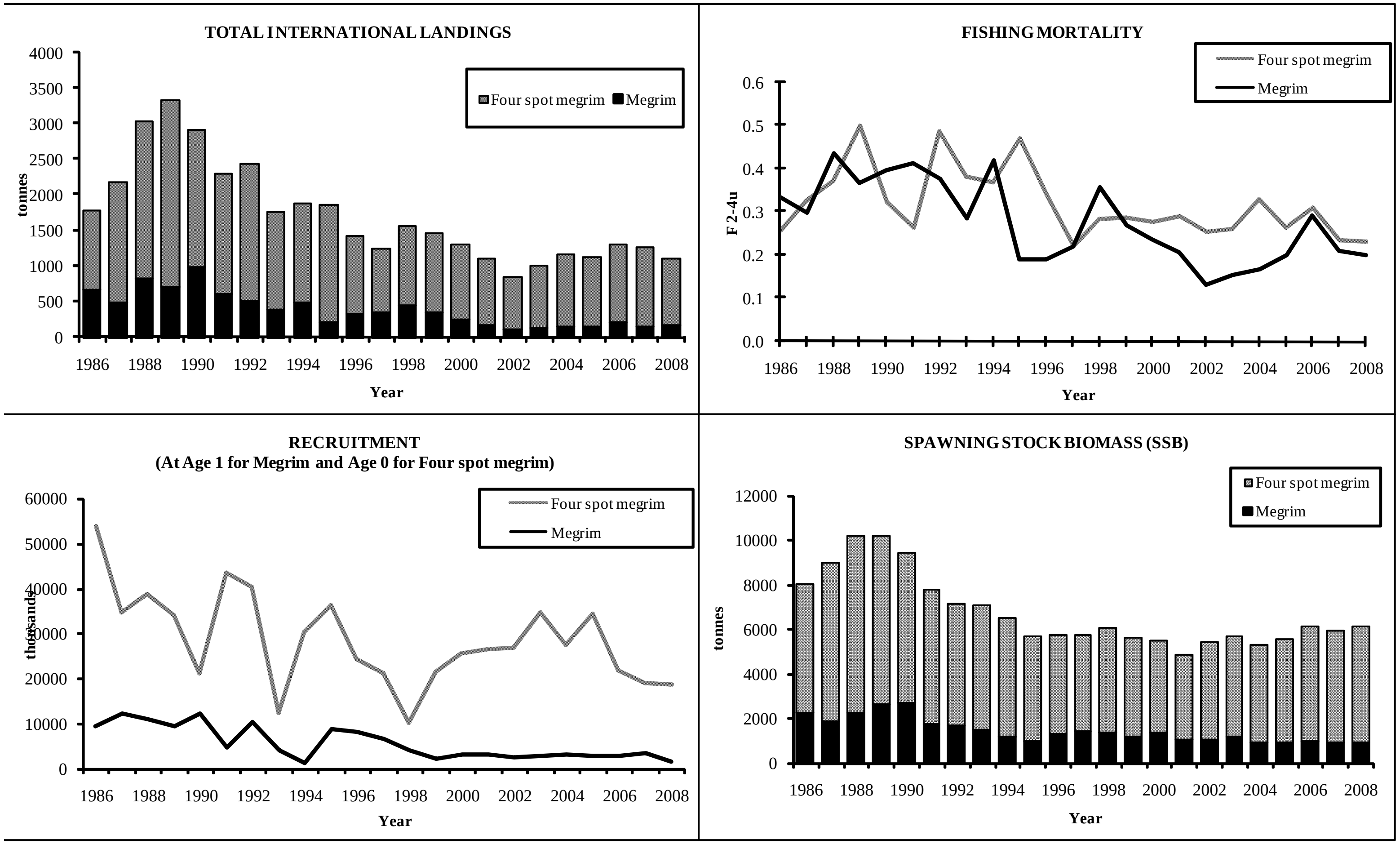
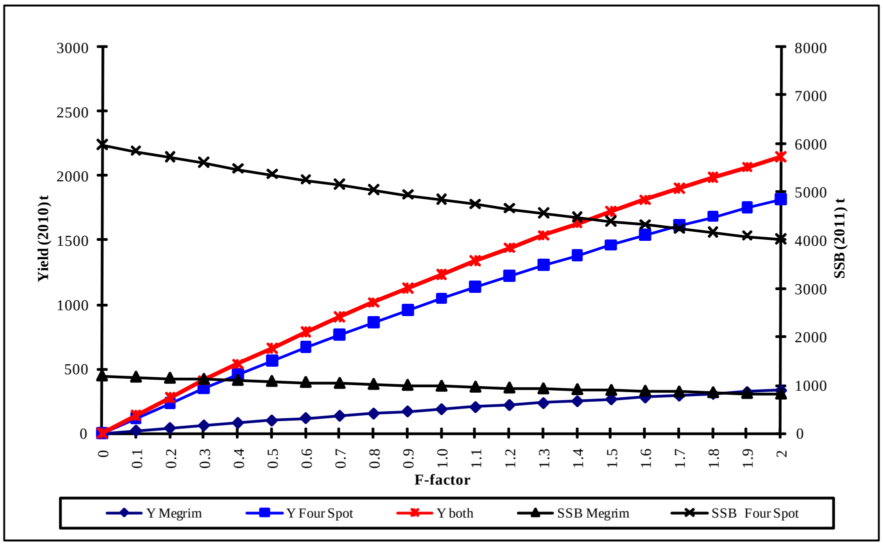


Figure 9.3.1. Stock trends for both stocks. Megrin and Four-spot megrim in Divisions VIIIc and IXa.

**Figure 9.3.2. Megrims (*L. whiffiagonis and L. boscii*) in Divisions VIIIc and IXa.
Combined Short Term Forecasts assuming status quo in 2009**



10 Nephrops (Divisions VIII ab, FU 23-24)

Type of assessment in 2009:	no assessment
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 2009

Exploitation boundaries in relation to precautionary considerations: "Since the SSB has been relative stable, the current landings can be maintained. ICES recommends not to increase land-ings in 2009 over the recent level of 3400 t (2005–2007 average)."

10.1.4 Management applicable for 2008 and 2009

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 2009 was 4104 t (4320 t for 2008) whereas the ICES recommendation was 3400 t (averaged landings for 2005-2007). In 2008, total nominal landings reached 3030 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 the 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 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 2008). 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 1960-2008 are given in Table 10.1.

Throughout the mid-60's, the French landings gradually increased to a peak value of 7000 t in 1973-1974, then fluctuated between 4500 and 6000 t during the 80's and the mid-90's. An increase has been noticeable during the early 2000's. A slight decrease occurred in 2008 (3030 t compared to 3173 in 2007, 3430 t in 2006 and 3689 t in 2005). The landings for 2008 were reached under the new selectivity regulations. Under the assumption that the adopted selectivity device is uniformly 80 mm of codend mesh size for the whole fishery, it is possible to calculate the total landings under the former regulation (see selectivity parameters for *Nephrops* trawlers in Stock Annex): 3430 t would be landed in 2008 against the actual 3030 t.

Males usually predominate in the landings (sex ratio defined as number of females divided by total fluctuating between 0.31 and 0.46 for the overall period 1987-2008). 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 1480 t whereas discard estimates of the recent sampled years (2003-2008) reached a higher level of 2610 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 2008, 198 million individuals were estimated to have been discarded (2120 t); under the former selectivity parameters (70 mm of codend mesh size), this amount would be 245 million individuals (2600 t).

10.2.2 Biological sampling

Discard data by sampling on board are available for 1987, 1991, 1998 and since 2003. For the intermediate years up to 2002, numbers discarded at length were derived by the "proportional method" (Table 10.2) described in 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 catches programme on board *Nephrops* trawlers (229 trips and 580 hauls have been sampled over six 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%), 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 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 WG in methodological analysis (see ICES files; WGHMM 2008). This method looked promising, but, it has been considered premature to switch to a new discard derivation method until there is a benchmark assessment.

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 sexes 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 cannot be available for the WG of the same year, but can provide useful additional information before reviewing stock status in autumn. In medium-term, tuning data currently based on commercial catch-effort set (see Section 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 10.4; Figure 10.3). Effort increased from 1987 to 1992, but there has been a decreasing trend since then. In 2008, 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 10.3), 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, increase of LPUE was larger (15.1 kg/hour *i.e.* +10%).

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.

10.3 Assessment

No assessment was carried out in 2009.

10.4 Catch options and prognosis

No catch option and prognosis is provided in 2009.

10.5 Biological reference points

No reference point is defined for this stock.

10.6 Comments on the assessment

The continuation of the French *Nephrops* trawlers sampling programme onboard will avoid the use of "derived" data for missing years. 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. The additional exploratory runs based on discard derivation by applying probability concepts as performed by WGHMM 2007 and 2008 (detailed in 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.

In 2009 there was no assessment, but it was attempted to compare consistency of predictions provided by WG 2008 with the actual status 2008.

scenario for discards on missing years	landings (t)	discards (t)	removals (t)
status quo (proportional)	4872	2204	6415
proba+data for 2006	4237	2295	5844
proba+simulation for 2006	4186	2122	5671
actual status 2008	3428	2599	5247

Note: actual status is based on values which should be provided if the selectivity parameters remained unchanged in 2008 (see above: estimated actual landings and discards of 3030 t and 2123 t respectively replaced by 3428 t and 2599 t respectively if no change on trawl device was carried out).

Even if the comparison should be done under *status quo* on fishing effort (reduction of –7% between 2007 and 2008 for the tuning commercial fleet), it is obvious that the explorations based on probabilistic derivation for discards (mainly if discards for 2006 are simulated) provide closer results to the actual values than the status quo derivation retained by ICES. This should be taken into consideration for the future assessment of the stock.

Information from the fishing industry

The French fishing industry and scientists have met to discuss information which could be used in the assessments. The industry has not provided any additional quantitative information, but they supported information on landings and fishing effort compiled by WG. The partnership commented on the application of one tuning series involving 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 increase of LPUE in the area VIIIb compared with the stability in VIIIa,; in 2007 and 2008, relevant decrease of LPUE in VIIIb against stability even slight increase 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.

10.7 Management considerations

There is no proposal for precautionary reference points for this stock. Recruitment level in the early 2000's (2004 and 2005) was probably higher than historical average values, but it remains uncertain and contributes significantly to uncertainty of catches in the short-term.

The use of selective devices for *Nephrops* since 2008 resulted in –19% for discards (in number) compared to the amount which should be theoretically obtained under the former regulation. There was also –12% for landings (in weight), thus, the regulation effect on discard rate seems to be slight due to the gradual s-shaped profile of selectivity curves for *Nephrops*. 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 1960-2008.

Year	Landings (1)					Total Discards		Catches
	FU 23-24 (2)	FU 23	FU 24	Unallocated (M A N)(3)	Total VIIIa,b	FU 23-24		Total
	VIIIa,b	VIIIa	VIIIb		used by WG	VIIIa,b		VIIIa,b
1960	3524	-	-	-	3524	-		3524
1961	3607	-	-	-	3607	-		3607
1962	3042	-	-	-	3042	-		3042
1963	4040	-	-	-	4040	-		4040
1964	4596	-	-	-	4596	-		4596
1965	3441	-	-	-	3441	-		3441
1966	3857	-	-	-	3857	-		3857
1967	3245	-	-	-	3245	-		3245
1968	3859	-	-	-	3859	-		3859
1969	4810	-	-	-	4810	-		4810
1970	5454	-	-	-	5454	-		5454
1971	3990	-	-	-	3990	-		3990
1972	5525	-	-	-	5525	-		5525
1973	7040	-	-	-	7040	-		7040
1974	7100	-	-	-	7100	-		7100
1975	-	6460	322	-	6782	-		6782
1976	-	6012	300	-	6312	-		6312
1977	-	5069	222	-	5291	-		5291
1978	-	4554	162	-	4716	-		4716
1979	-	4758	36	-	4794	-		4794
1980	-	6036	71	-	6107	-		6107
1981	-	5908	182	-	6090	-		6090
1982	-	4392	298	-	4690	-		4690
1983	-	5566	342	-	5908	-		5908
1984	-	4485	198	-	4683	-		4683
1985	-	4281	312	-	4593	-		4593
1986	-	3968	367	99	4335	-		4335
1987	-	4937	460	64	5397	1767	*	7164
1988	-	5281	594	69	5875	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

(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*

* methodology explained in the Working Document proposed in the WGHMM 2005; stock annex J

Table 10.3.a Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) landings length distributions in 1987-2008.

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
10	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
12	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
14	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
16	0	158	59	0	0	0	0	0	0	0	14	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
18	331	553	131	64	30	0	0	31	20	0	0	0	0	14	13	0	13	0	23	5	4	12
19	1296	1886	901	48	79	138	0	72	61	0	0	0	0	11	38	0	0	15	24	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
21	6476	8882	7039	1947	1572	1595	1285	482	1573	414	1313	288	219	433	643	925	241	224	250	69	14	191
22	13501	16050	12971	5913	4733	3948	3878	2824	2395	1311	2799	985	849	1015	2116	1122	578	825	718	130	18	208
23	21337	25374	18073	10910	7854	9701	7398	5366	5523	2799	4638	3171	1888	2531	6261	5513	1387	2002	2404	226	48	322
24	24339	33950	21960	13293	15521	20948	11949	9650	8731	6071	10005	6484	4032	5462	8915	10061	3450	5157	6013	816	188	721
25	32476	36294	25650	16440	19747	27876	21011	15079	14348	13239	19837	13980	10717	11357	17106	12951	7275	9987	12573	2821	1201	2742
26	29670	29808	22747	18205	22106	26617	23732	18312	19769	16779	19380	13535	10590	10212	13745	21403	11881	12797	16423	6327	5684	6319
27	28086	28380	22091	16109	21900	28410	26044	21181	25126	18384	22823	16602	12724	11528	17098	19433	15915	14422	20320	11915	9439	10891
28	24925	26017	19087	19595	21214	32091	27580	20488	20914	15744	19466	14432	12058	12639	15835	22074	16896	13964	20240	14531	13248	12640
29	18703	20920	14227	16250	17138	24760	20627	16527	15909	16332	20878	11832	9448	11473	13779	16559	15343	13221	16684	14478	12516	12890
30	18407	17862	13688	12055	14762	19828	21414	15903	19164	20214	21487	16335	16187	13888	16168	18105	15840	12552	14416	13587	12219	10726
31	11419	13156	9037	11088	12408	14281	13452	11207	13333	14009	9791	8539	9209	9828	11316	9989	12217	10635	11675	11728	10698	9772
32	10185	12822	8410	8540	8635	12786	12711	11490	13667	14392	9622	9237	9745	8936	11335	10284	10349	8973	9181	9626	9274	8845
33	8528	8848	7127	10649	7273	9297	11369	7022	7117	8576	6334	5947	6000	6333	8250	7813	7575	7321	7206	8367	7859	7436
34	5926	7812	6967	10543	7987	7318	7355	6684	7584	6524	4816	6619	5910	5225	6185	5308	5847	5530	6045	7068	6539	6425
35	5763	5935	6214	7637	5425	5928	6307	5646	4677	6578	4737	6700	5267	4895	5213	4309	4493	4213	4721	5108	6529	5366
36	4033	5064	4532	6274	4979	4998	4608	4337	3709	4133	2568	5308	4291	3242	4037	3157	3821	3092	3115	4085	4735	3867
37	4024	3754	3545	4841	4541	4195	4089	3752	3496	4226	2135	4722	3230	2946	2901	2049	3185	2708	2392	3182	3839	3121
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3527	2588	2687	2369	2224	2816	2026	2193	2652	2639	2398
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2169	2186	2027	2297	1559	2316	1645	1525	1946	2245	2043
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3084	2353	1862	1908	1398	2135	1523	1519	1595	1711	1633
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1362	1020	941	764	1553	1167	1078	1167	1227	1190
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797	863	632	1576	875	898	989	1111	1015
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1049	761	534	530	640	1156	743	798	739	710	805
44	965	704	1192	1401	1089	1050	745	500	915	414	219	748	708	413	383	432	876	690	612	634	746	706
45	641	581	1194	955	1058	766	684	550	700	464	253	902	429	421	523	416	882	603	571	597	518	536
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248	294	328	596	485	396	479	373	405
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213	368	241	506	379	327	442	311	361
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205	188	188	378	321	304	384	257	294
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177	183	79	227	332	263	320	237	262
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154	160	115	283	328	250	287	190	228
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109	135	73	192	221	157	247	163	201
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85	102	46	171	155	166	201	138	116
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133	82	51	134	131	129	137	140	121
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63	40	20	89	100	92	157	115	95
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75	53	30	63	57	96	138	79	73
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18	24	13	26	95	61	118	60	67
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20	46	6	52	60	51	134	70	41
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16	29	6	22	36	39	135	45	40
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7	26	3	12	42	38	86	33	19
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2	21	11	9	17	17	115	33	23
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8	7	0	6	9	26	41	23	7
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1	2	0	5	3	14	21	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
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4	0	0	0	7	7	19	10	6
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1	0	1	0	1	12	12	9	1
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0	0	0	2	1	6	10	1	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0	0	0	0	1	4	9	1	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	4	8	3	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	2	0	1	6	2	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	2	5	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
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	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
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	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
Total	**288974**	**324498**	**244875**	**213779**	**217338**	**274286**	**240638**	**188879**	**202294**	**182041**	**188694**	**161549**	**135304**	**133383**	**172819**	**180442**	**152485**	**139753**	**166167**	**127942**	**117273**	**115274**
Weights	**5397**	**5875**	**4835**	**4972**	**4754**	**5681**	**5109**	**4092**	**4452**	**4118**	**3610**	**3865**	**3209**	**3069**	**3730**	**3679**	**3742**	**3285**	**3689**	**3430**	**3176**	**3030**

Table 10.3.b Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) discards length distributions in 1987-2008.

Total Discards

CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	22	0
11	0	0	0	0	114	167	143	109	148	128	92	85	59	74	75	94	0	0	94	0	171	38
12	0	0	0	0	0	0	0	0	0	0	0	128	89	110	113	141	70	363	413	70	202	98
13	0	0	0	0	93	147	139	84	56	65	76	162	138	143	191	217	294	1722	1085	234	122	235
14	78	97	76	59	258	384	337	245	301	268	210	660	507	564	684	822	636	3152	3190	1138	900	389
15	2074	2174	1821	1673	1249	1895	1728	1148	1073	1058	1028	1741	1370	1462	1861	2186	1198	5548	7287	3102	1288	189
16	3974	4053	3469	3140	2240	3339	3073	2019	1736	1786	1884	1861	1474	1554	2010	2349	3386	6784	13528	7810	2959	1027
17	13577	14887	10425	8655	4638	6824	6302	4133	3347	3497	3914	3527	2744	2957	3624	4197	5927	8836	15094	11655	3636	1832
18	29288	32816	23482	19987	10619	14908	13531	9408	8483	8297	8987	5003	4016	4207	5254	5880	8078	10161	19795	16139	4590	2626
19	28370	31363	23215	19980	12852	17524	15718	11346	10790	10148	10853	5991	4770	5041	6271	7098	11506	17361	19522	25891	5244	6473
20	60253	63749	49546	43147	22797	30242	26971	19970	19533	18146	19453	12091	9630	10098	12509	13968	12142	19250	22265	39742	8735	11444
21	45446	48597	37609	33037	18043	24296	21757	15876	15497	14594	15429	9973	7931	8238	10357	11586	18597	25898	32409	54220	11585	15630
22	51268	55078	42614	37864	24289	32524	29063	21354	21039	19695	20776	23278	18405	19216	23711	26333	21416	25210	35523	69870	17930	24730
23	23074	24630	19336	17235	15611	20115	17713	13687	14986	13676	13624	21641	17276	17526	22103	23990	28429	26756	40041	70094	24086	27560
24	7213	8375	6179	5468	13741	17107	15018	11903	13375	12258	12285	19750	15994	16182	20628	22367	26501	21343	36279	55408	30615	29638
25	2686	2850	2369	2172	14722	17933	15639	12662	14027	12581	13036	20487	16780	16884	21505	22987	23211	20085	30222	52660	32917	28007
26	672	806	485	391	7131	8990	7917	6166	6350	5744	6176	10676	8631	8817	10928	11696	17357	12006	19003	38812	27376	23127
27	270	350	255	242	1711	2447	2217	1532	1395	1348	1424	7502	5870	6421	7474	8420	9680	6436	8498	20124	20567	10129
28	0	0	0	0	999	1258	1098	867	890	777	844	3019	2394	2647	3034	3394	6187	3487	4603	10263	10365	5893
29	0	0	0	0	138	168	146	118	118	102	117	1357	1133	1241	1443	1573	2537	2115	1201	4188	4464	3225
30	0	0	0	0	291	344	296	248	256	216	247	686	613	608	778	782	1605	1901	1600	2578	2868	1923
31	0	0	0	0	97	115	99	83	85	72	82	129	135	123	173	155	1326	1115	1417	1109	1316	925
32	0	0	0	0	0	0	0	0	0	0	0	481	433	426	549	548	574	735	526	592	737	454
33	0	0	0	0	0	0	0	0	0	0	0	231	195	214	249	271	313	503	296	544	484	421
34	0	0	0	0	0	0	0	0	0	0	0	151	150	135	190	174	261	385	553	411	537	1025
35	0	0	0	0	0	0	0	0	0	0	0	88	92	93	119	114	176	424	260	230	265	206
36	0	0	0	0	0	0	0	0	0	0	0	48	61	57	80	68	113	108	46	73	336	78
37	0	0	0	0	0	0	0	0	0	0	0	74	95	89	124	106	83	74	246	25	299	153
38	0	0	0	0	0	0	0	0	0	0	0	44	56	53	73	63	93	31	116	99	40	93
39	0	0	0	0	0	0	0	0	0	0	0	36	46	43	61	52	15	139	147	0	3	369
40	0	0	0	0	0	0	0	0	0	0	0	57	73	68	95	81	37	73	37	169	47	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	60	20	0	40	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	12	31	0	20	53
43	0	0	0	0	0	0	0	0	0	0	0	6	7	7	9	8	14	13	0	0	11	0
44	0	0	0	0	0	0	0	0	0	0	0	30	39	36	50	43	0	13	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	2	3	3	4	4	13	0	0	36	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
47	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
49	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
51	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
53	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
55	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
57	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
59	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
61	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
63	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
65	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
67	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
69	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
71	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
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	0
Total	**268244**	**289827**	**220879**	**193050**	**151634**	**200725**	**178905**	**132957**	**133485**	**124457**	**130538**	**150995**	**121209**	**125340**	**156331**	**171768**	**201841**	**222102**	**315346**	**487288**	**214788**	**198031**
Weights	**1767**	**1909**	**1459**	**1280**	**1213**	**1583**	**1406**	**1060**	**1086**	**1005**	**1049**	**1453**	**1177**	**1213**	**1512**	**1645**	**1977**	**1932**	**2698**	**4544**	**2411**	**2123**

Table 10.3.c Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) catches length distributions in 1987-2008.

Total catches

CL mm/Y	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	22	0
11	0	0	0	0	114	167	143	109	148	128	92	85	59	74	75	94	0	0	94	0	171	38
12	0	0	0	0	0	0	0	0	0	0	0	128	89	110	113	141	70	363	413	70	202	98
13	0	0	0	0	93	147	139	84	56	65	76	162	138	143	191	217	294	1722	1085	234	122	235
14	78	97	76	59	258	384	337	245	301	268	210	660	507	564	684	822	636	3152	3190	1138	900	389
15	2074	2174	1821	1673	1249	1895	1728	1148	1073	1058	1042	1741	1370	1462	1861	2186	1198	5548	7287	3102	1289	189
16	3974	4210	3528	3140	2240	3339	3073	2019	1736	1786	1897	1861	1474	1554	2010	2349	3386	6784	13528	7810	2959	1027
17	13727	15117	10502	8667	4673	6886	6302	4133	3347	3497	3914	3527	2744	2957	3624	4197	5946	8842	15094	11655	3636	1832
18	29620	33369	23613	20052	10649	14908	13531	9439	8503	8297	8987	5003	4016	4222	5267	5880	8092	10161	19819	16144	4593	2638
19	29666	33249	24116	20028	12931	17662	15718	11418	10850	10148	10853	5991	4770	5052	6309	7098	11506	17377	19547	25891	5244	6473
20	63382	67976	52337	43676	23271	30692	27435	20176	19874	18194	19901	12116	9701	10214	12793	14075	12215	19302	22342	39747	8738	11521
21	51922	57479	44647	34984	19615	25891	23042	16358	17070	15008	16741	10260	8150	8671	11000	12511	18838	26122	32659	54289	11598	15820
22	64770	71128	55584	43777	29023	36472	32941	24178	23435	21006	23575	24263	19254	20231	25827	27455	21994	26035	36241	70000	17948	24938
23	44411	50004	37409	28145	23464	29817	25111	19053	20509	16475	18261	24812	19164	20057	28364	29503	29815	28758	42445	70320	24134	27882
24	31551	42325	28138	18762	29262	38055	26967	21554	22106	18329	22290	26235	20026	21643	29544	32428	29951	26500	42292	56224	30803	30359
25	35162	39143	28020	18612	34469	45809	36650	27741	28375	25820	32874	34467	27497	28240	38612	35939	30486	30072	42795	55482	34119	30750
26	30342	30615	23232	18596	29237	35607	31650	24478	26119	22524	25556	24211	19222	19030	24673	33099	29238	24803	35426	45140	33060	29446
27	28357	28730	22346	16351	23611	30858	28261	22713	26521	19733	24247	24104	18594	17949	24573	27852	25595	20858	28818	32039	30006	21020
28	24925	26017	19087	19595	22213	33349	28678	21355	21804	16521	20310	17450	14453	15286	18869	25468	23082	17451	24843	24794	23613	18533
29	18703	20920	14227	16250	17276	24927	20773	16645	16027	16434	20995	13189	10581	12714	15223	18132	17880	15336	17885	18666	16980	16115
30	18407	17862	13688	12055	15053	20173	21710	16151	19420	20430	21735	17021	16800	14496	16946	18886	17445	14453	16016	16165	15087	12649
31	11419	13156	9037	11088	12505	14396	13551	11289	13419	14081	9874	8668	9344	9951	11489	10144	13544	11751	13092	12836	12014	10697
32	10185	12822	8410	8540	8635	12786	12711	11490	13667	14392	9622	9718	10178	9362	11884	10832	10923	9709	9707	10218	10011	9299
33	8528	8848	7127	10649	7273	9297	11369	7022	7117	8576	6334	6178	6196	6547	8499	8083	7888	7824	7502	8911	8343	7857
34	5926	7812	6967	10543	7987	7318	7355	6684	7584	6524	4816	6770	6060	5360	6375	5482	6108	5916	6598	7479	7076	7449
35	5763	5935	6214	7637	5425	5928	6307	5646	4677	6578	4737	6787	5359	4988	5332	4423	4669	4637	4981	5339	6793	5573
36	4033	5064	4532	6274	4979	4998	4608	4337	3709	4133	2568	5356	4352	3299	4116	3225	3934	3200	3161	4158	5071	3945
37	4024	3754	3545	4841	4541	4195	4089	3752	3496	4226	2135	4796	3325	3034	3025	2155	3268	2782	2638	3207	4138	3273
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3571	2645	2740	2443	2287	2908	2057	2309	2751	2679	2491
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2205	2232	2070	2358	1611	2331	1784	1672	1946	2247	2412
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3140	2425	1930	2002	1480	2172	1596	1556	1764	1758	1633
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1362	1020	941	764	1588	1227	1098	1167	1267	1190
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797	863	632	1580	887	929	989	1130	1069
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1055	769	541	540	649	1170	755	798	739	722	805
44	965	704	1192	1401	1089	1050	745	500	915	414	219	778	747	449	433	476	876	703	612	634	746	706
45	641	581	1194	955	1058	766	684	550	700	464	253	904	432	424	527	419	895	603	571	633	518	536
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248	294	328	596	485	396	479	373	405
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213	368	241	506	379	327	442	311	361
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205	188	188	378	321	304	384	257	294
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177	183	79	227	332	263	320	237	262
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154	160	115	283	328	250	287	201	228
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109	135	73	192	221	157	247	163	201
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85	102	46	171	155	166	201	138	116
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133	82	51	134	131	129	137	140	121
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63	40	20	89	100	92	157	115	95
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75	53	30	63	57	96	138	79	73
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18	24	13	26	95	61	118	60	67
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20	46	6	52	60	51	134	70	41
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16	29	6	22	36	39	135	45	80
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7	26	3	12	42	38	86	33	19
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2	21	11	9	17	17	115	33	23
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8	7	0	6	9	26	41	23	7
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1	2	0	5	3	14	21	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
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4	0	0	0	7	7	19	10	6
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1	0	1	0	1	12	12	9	1
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0	0	0	2	1	6	10	1	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0	0	0	0	1	4	9	1	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	4	8	3	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	2	0	1	6	2	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	2	5	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
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	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
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	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
Total	**557218**	**614325**	**465754**	**406829**	**368972**	**475011**	**419544**	**321836**	**335779**	**306498**	**319232**	**312544**	**256513**	**258723**	**329150**	**352210**	**354326**	**361855**	**481512**	**615230**	**332060**	**313305**
Weights	**7164**	**7784**	**6295**	**6252**	**5967**	**7264**	**6515**	**5152**	**5539**	**5123**	**4658**	**5318**	**4386**	**4282**	**5242**	**5324**	**5719**	**5216**	**6387**	**7974**	**5587**	**5154**

Table 10.3.d Nephrops in FUs 23-24 Bay of Biscay (VIIIa,b) removals length distributions in 1987-2008.

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
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0	16	0
11	0	0	0	0	80	117	100	76	104	89	65	60	42	52	53	66	0	0	66	0	119	27
12	0	0	0	0	0	0	0	0	0	0	0	90	62	77	79	99	49	254	289	49	142	69
13	0	0	0	0	65	103	97	59	39	45	54	114	97	100	134	152	206	1205	760	164	85	164
14	55	68	53	41	181	269	236	171	210	188	147	462	355	395	479	575	445	2206	2233	797	630	272
15	1452	1522	1274	1171	875	1327	1209	803	751	741	734	1219	959	1024	1303	1530	839	3883	5101	2171	902	132
16	2782	2995	2488	2198	1568	2337	2151	1413	1215	1250	1332	1302	1032	1088	1407	1644	2370	4749	9469	5467	2072	719
17	9654	10651	7375	6070	3282	4839	4411	2893	2343	2448	2740	2469	1921	2070	2537	2938	4168	6192	10565	8158	2545	1282
18	20833	23524	16568	14055	7464	10435	9472	6617	5958	5808	6291	3502	2811	2959	3691	4116	5668	7112	13880	11302	3216	1851
19	21155	23840	17151	14034	9075	12405	11003	8014	7613	7104	7597	4194	3339	3540	4428	4968	8055	12168	13690	18124	3671	4531
20	45306	48851	37473	30732	16432	21619	19344	14185	14014	12750	14065	8489	6812	7185	9040	9884	8572	13527	15662	27825	6118	8087
21	38288	42900	33365	25073	14202	18602	16515	11595	12421	10630	12113	7269	5771	6200	7893	9036	13259	18353	22936	38023	8123	11131
22	49389	54605	42800	32418	21736	26715	24222	17772	17123	15097	17342	17280	13732	14466	18714	19555	15569	18472	25584	49039	12569	17519
23	37489	42615	31609	22974	18781	23782	19797	14947	16013	12372	14174	18320	13981	14800	21733	22306	21287	20731	30433	49292	16909	19614
24	29387	39813	26285	17121	25139	32923	22461	17983	18093	14652	18604	20310	15228	16789	23355	25717	22001	20097	31408	39602	21619	21468
25	34356	38288	27309	17960	30052	40429	31958	23943	24167	22046	28963	28321	22463	23175	32160	29042	23523	24046	33728	39684	24243	22348
26	30141	30373	23087	18479	27098	32910	29275	22628	24214	20800	23703	21008	16632	16384	21394	29590	24031	21202	29725	33496	24847	22508
27	28276	28625	22270	16278	23098	30124	27596	22253	26102	19328	23820	21853	16833	16023	22330	25327	22691	18927	26269	26002	23835	17982
28	24925	26017	19087	19595	21914	32972	28349	21095	21537	16288	20057	16545	13735	14492	17959	24450	21226	16405	23462	21715	20503	16765
29	18703	20920	14227	16250	17235	24877	20729	16609	15992	16403	20960	12782	10241	12342	14790	17660	17119	14701	17525	17409	15641	15148
30	18407	17862	13688	12055	14965	20069	21621	16077	19343	20366	21661	16815	16616	14314	16713	18652	16963	13883	15536	15391	14227	12072
31	11419	13156	9037	11088	12476	14362	13521	11265	13393	14059	9849	8629	9304	9914	11437	10097	13146	11416	12667	12504	11619	10419
32	10185	12822	8410	8540	8635	12786	12711	11490	13667	14392	9622	9574	10048	9234	11719	10667	10751	9488	9549	10041	9790	9163
33	8528	8848	7127	10649	7273	9297	11369	7022	7117	8576	6334	6109	6137	6483	8424	8002	7794	7673	7413	8748	8197	7731
34	5926	7812	6967	10543	7987	7318	7355	6684	7584	6524	4816	6725	6015	5320	6318	5430	6030	5800	6432	7356	6915	7142
35	5763	5935	6214	7637	5425	5928	6307	5646	4677	6578	4737	6761	5332	4960	5296	4389	4616	4510	4903	5269	6714	5511
36	4033	5064	4532	6274	4979	4998	4608	4337	3709	4133	2568	5341	4333	3282	4093	3205	3900	3168	3147	4136	4971	3921
37	4024	3754	3545	4841	4541	4195	4089	3752	3496	4226	2135	4774	3296	3008	2988	2123	3243	2760	2564	3199	4048	3228
38	3131	3106	3193	4966	2993	3933	2991	2771	2879	2788	1142	3558	2628	2724	2421	2268	2881	2048	2274	2721	2667	2463
39	2151	2778	2154	3339	2869	2987	2290	1841	1746	1596	927	2195	2218	2057	2340	1596	2327	1742	1628	1946	2246	2301
40	2425	2159	2175	2766	2414	2574	2206	1738	2015	1956	982	3123	2403	1910	1974	1455	2161	1574	1545	1713	1744	1633
41	1375	1753	1461	1951	2076	1546	1452	1150	1123	1250	520	1558	1362	1020	941	764	1577	1209	1092	1167	1255	1190
42	1350	1542	1130	1668	1662	1599	1111	1118	1558	1142	508	1490	1124	797	863	632	1579	883	920	989	1125	1053
43	1150	1209	1087	1908	1495	1348	1069	687	1039	610	370	1053	767	539	537	646	1166	752	798	739	718	805
44	965	704	1192	1401	1089	1050	745	500	915	414	219	769	735	438	418	463	876	699	612	634	746	706
45	641	581	1194	955	1058	766	684	550	700	464	253	904	431	423	526	418	891	603	571	622	518	536
46	645	689	669	713	666	734	584	353	460	374	135	525	424	248	294	328	596	485	396	479	373	405
47	509	391	641	715	431	567	417	407	437	397	140	327	276	213	368	241	506	379	327	442	311	361
48	343	333	526	863	636	588	456	270	494	264	92	382	104	205	188	188	378	321	304	384	257	294
49	290	254	378	470	377	263	145	178	254	205	57	132	151	177	183	79	227	332	263	320	237	262
50	319	216	351	230	263	256	238	273	255	179	76	154	159	154	160	115	283	328	250	287	198	228
51	135	241	240	181	210	107	126	156	214	123	38	191	58	109	135	73	192	221	157	247	163	201
52	192	48	180	335	180	159	202	107	175	77	30	115	93	85	102	46	171	155	166	201	138	116
53	137	70	150	121	124	111	55	136	91	84	26	156	23	133	82	51	134	131	129	137	140	121
54	111	112	218	99	189	94	120	77	55	75	11	93	11	63	40	20	89	100	92	157	115	95
55	76	85	187	53	63	61	128	66	91	53	9	114	16	75	53	30	63	57	96	138	79	73
56	111	41	123	26	28	66	50	49	47	62	12	7	5	18	24	13	26	95	61	118	60	67
57	74	39	116	43	34	61	72	36	77	48	8	31	14	20	46	6	52	60	51	134	70	41
58	39	65	70	2	11	68	58	47	88	48	9	14	5	16	29	6	22	36	39	135	45	68
59	32	60	36	13	17	28	13	31	36	30	8	10	2	7	26	3	12	42	38	86	33	19
60	21	7	30	5	24	7	54	26	32	9	5	8	4	2	21	11	9	17	17	115	33	23
61	21	15	15	4	11	0	25	12	4	4	0	0	3	8	7	0	6	9	26	41	23	7
62	0	0	21	10	0	44	3	8	0	9	1	10	0	1	2	0	5	3	14	21	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
64	0	7	0	0	0	14	7	10	0	0	0	0	0	4	0	0	0	7	7	19	10	6
65	8	0	4	0	0	0	30	16	4	0	0	4	2	1	0	1	0	1	12	12	9	1
66	0	0	0	0	0	0	7	0	20	2	4	0	0	0	0	0	2	1	6	10	1	0
67	0	0	0	0	0	0	18	3	0	0	0	0	0	0	0	0	0	1	4	9	1	0
68	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	2	4	8	3	0
69	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	2	0	1	6	2	0
70	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	2	5	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
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	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
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	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
Total	**476745**	**527377**	**399490**	**348914**	**323482**	**414794**	**365872**	**281949**	**295733**	**269161**	**280070**	**267245**	**220150**	**221121**	**282250**	**300679**	**293774**	**295224**	**386908**	**469044**	**267624**	**253896**
Weights	**6634**	**7211**	**5857**	**5868**	**5603**	**6789**	**6093**	**4834**	**5213**	**4822**	**4344**	**4882**	**4033**	**3918**	**4788**	**4831**	**5126**	**4637**	**5578**	**6611**	**4864**	**4517**

Table 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.
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

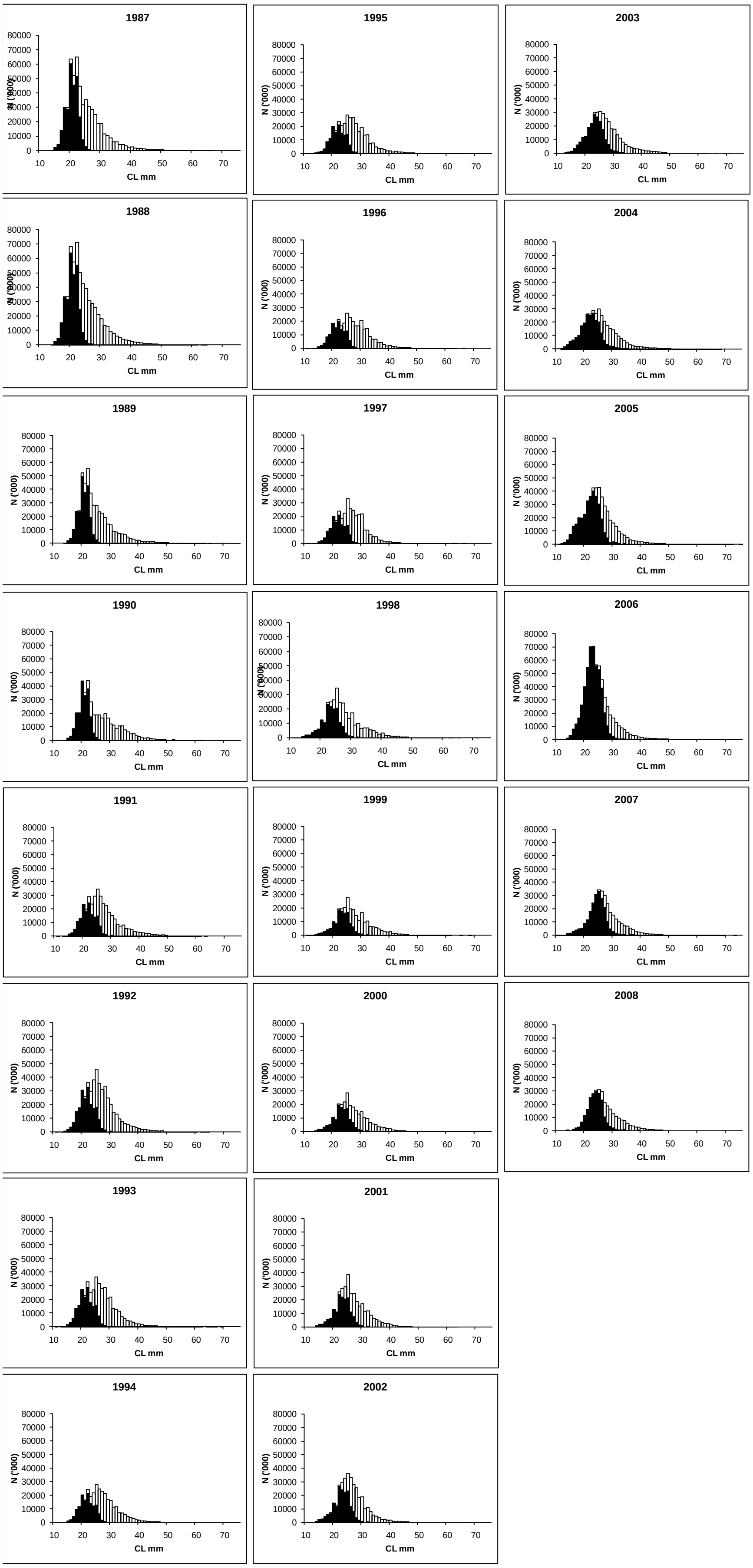


Figure 10.1. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) catches (landings in white and discards in black) length distributions in 1987-2008.

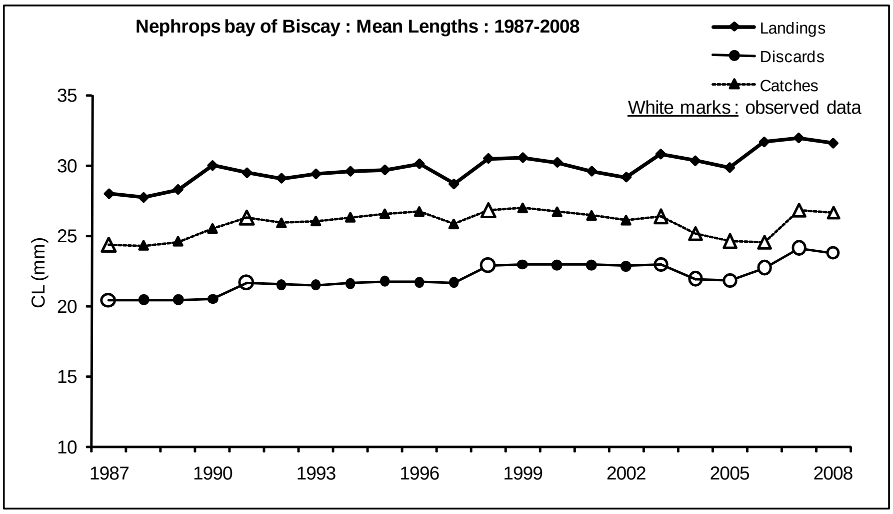
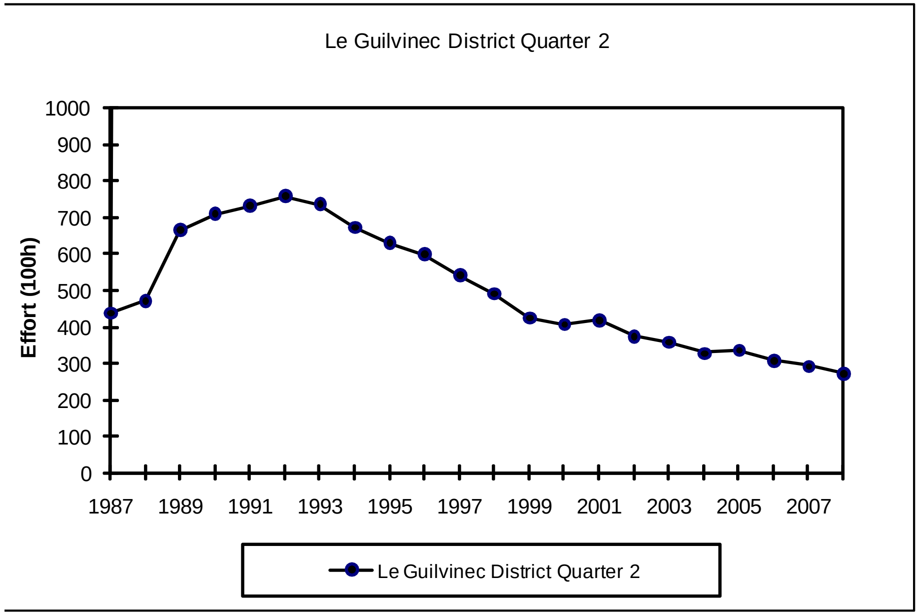


Figure 10.2. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - mean length of landings, discards and catches

I. Effort



II. LPUE

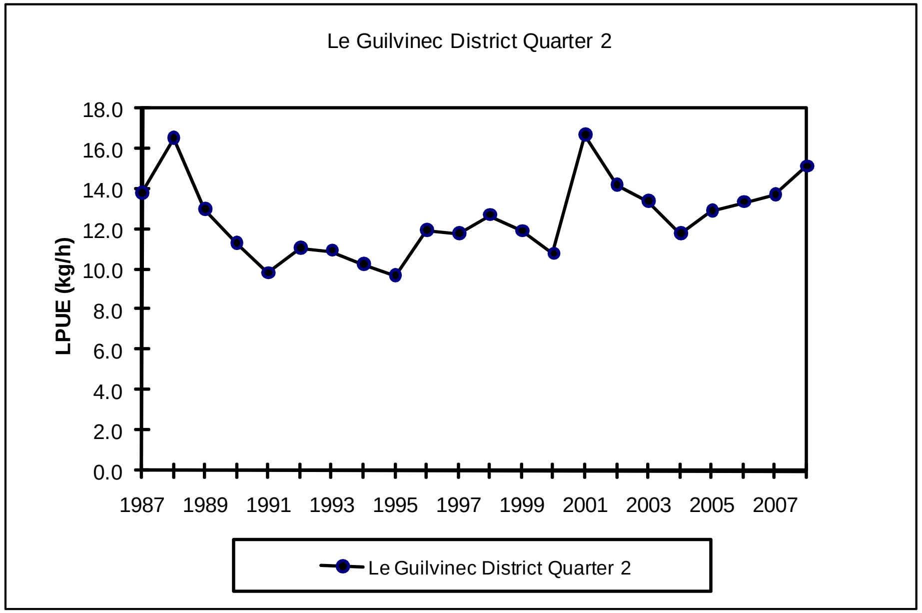


Figure 10.3. Nephrops in FUs 23-24 bay of Biscay (VIIIa,b) - Effort and LPUE values of commercial fleets used in the assessment to tune the model.

11 *Nephrops* in Division VIIIc

11.1 *Nephrops* FU 25 (North Galicia)

11.1.1 General

11.1.1.1 Ecosystem aspects

Two Functional Units are comprised in Division VIIIc: FU 25 (North Galicia) and FU 31 (Cantabrian Sea).

In this geographical area, characterized by episodic upwelling of North Atlantic Central Water during summer, various coastal fisheries fish for pelagic and bottom resources. Annual catches of *Nephrops* are relatively small compared with other Atlantic *Nephrops* stocks, but this species gives one of the most valuable revenues for the trawl fleet.

Nephrops is a burrowing species and occurs on muddy sea bed on the continental shelves and upper slopes. The distribution of *Nephrops* in this area is limited to depths ranging from 90-600 m in a patchwork configuration where the substrate is suitable.

The life history of *Nephrops* consists of a pelagic larval phase and sedentary non-migratory juvenile and adult stages. After reaching sexual maturity, the male moults more frequently than the female, consequently growing faster. The emergence patterns of the *Nephrops* females during the incubation period results in a different exploitation pattern for males and females. There are no reports on *Nephrops*' predators in the area.

11.1.1.2 Fishery description

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. Since the decline of the main target species in the area, 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, each targeting a different species. Only the baca trawl catches *Nephrops*. An extended description of these fisheries was given in STECF (2003). Trawl vessels can change the gear from year to year and consequently the target species and the 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 measures to minimize the impact on the fisheries, such as spatial and seasonal closures for fishing fleets. This caused a reduction in fishing effort of the trawl fleet from November 2002 to June 2003.

Nephrops is managed in the area by an annual TAC and technical measures. The European Union regulations establish 20 mm carapace length (CL) as a minimum landing size for *Nephrops* in the area. Few animals are caught under size. Generally, only soft and damaged individuals are discarded (Pérez et al., 1996). Although *Nephrops* represents around only 1% of the total weight landed by the bottom trawl fishery, the species is a very valuable component of the landings. The species have been regularly assessed since 1990 (ICES, 1990). A recovery plan for southern hake and Atlantic Iberian *Nephrops* stocks was implemented and enforced since 2006.

11.1.1.3 Summary of ICES Advice for 2009 and management applicable to 2008 and 2009

ICES advice 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 2008 and 2009

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 124 and 112 t were set for the whole of Division VIIIc for 2008 and 2009, 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 2008 were 39 t, the lowest value recorded during the time series. The time series of the commercial landings (Figure 11.1.1) gives a clear decline trend, with actual 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 1982-2008 (see also Figure 11.1.2). Mean sizes in the landings in the last decade, 1999-2008, varied between 37.3 and 43.7 mm CL for the males, and between 36.8 and 40.4 mm CL for the females. The mean size time series show 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.

Fishery statistics are believed to be reliable. However, during the periods 1998-2001 and 2004-2008 the usual information sources failed and landings data were obtained from sampling program, not directly from the sale sheets as in the rest of the series, which makes the quality of estimates more questionable. The fishing effort corresponds to the bottom trawl fleet that fish in a mixed fishery for a demersal species (not directed at *Nephrops*) depending on market forces. Fishing effort and LPUE data for 1999-2008 do not include the trips of the HVO trawl directed at mackerel or horse mackerel (instead of targeting mixed bottom species). The overall trend in fishing effort is decreasing, with current effort being approximately half the level in 1999. 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. 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 overall fishery landings.

LPUE shows an overall decreasing trend (Figure 11.1.1). After a period with quite variable LPUE until 1993, LPUE remained relatively stable at around 40 kg/trip between 1993 and 1997. Since then LPUE fluctuated at low level and declined in 2008 to 9.9 kg/trip, the lowest recorded value in the time series.

11.1.3 Assessment

No assessment was carried out in this working group.

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 7% 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 2008 was 124 t. Landings of *Nephrops* from Division VIIIc (FU 25 and FU 31) in 2008 were estimated to be 58 t, just under half 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 rebuilding the stock within the 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 (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).

11.2 *Nephrops* FU 31 (Cantabrian Sea)

11.2.1 General

11.2.1.1 Ecosystem aspects

Description made in previous section of this report (see Section 11.1.1.1) corresponds also to this area.

11.2.1.2 Fishery description

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 fleets components operating in the Cantabrian Sea (namely HVO trawl and pair trawl) do not catch *Nephrops*.

11.2.1.3 Summary of ICES Advice for 2009 and management applicable to 2008 and 2009

ICES advice 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 2008 and 2009

TACs of 124 and 112 t were set for the whole of Division VIIIc for 2008 and 2009, 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 1983-2008. The highest landings were recorded in 1989 and 1990. Since 1996 landings have declined sharply from 129 t to less than 20 t in recent years.

11.2.2.2 Biological sampling

Length frequencies by sex of *Nephrops* landings were collected by the sampling program. The sampling levels are shown in Table 1.3.

Mean size of males and females in the landings fluctuated during 1988-2008, but shows a general increasing trend for both sexes (Figure 11.2.1).

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 2004-2007 due to the lack of information from Avilés. In 2008, fishing effort data are not available neither for the fleets of Santander or Aviles. 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) show fluctuations around the general downward trend. In recent years the LPUE has remained at low levels (Figure 11.2.1) with a recent decreasing trend.

11.2.3 Assessment

No assessment was carried out in this working group.

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).

11.3 Summary for Division VIIIc

Nephrops in Division VIIIc includes two FUs (North Galicia, FU 25 and Cantabrian Sea, FU 31). Table 11.2.2 gives the landings in Division VIIIc. Landings from both FUs have declined dramatically in recent years. The agreed *Nephrops* TAC for Division VIIIc in 2008 was 124 t. Landings in Division VIIIc were always below the TAC, and therefore the TAC has not been restrictive.

The very low levels of landings from FU 25 and FU 31, 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 (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). ICES has not evaluated the recovery plan.

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

* estimated landings from sampling program
+ preliminar

Table 11.1.2 *Nephrops* FU 25, North Galicia.
Length compositions of landings, mean weight (kg) and mean length (CL, mm), 1982-2008.

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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	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
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
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
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
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

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

*Preliminar

Table 11.2.1 *Nephrops* FU 31, Cantabrian Sea.
Landings in tonnes.

Year	Trawl	Creel	Total
1980			
1981			
1982			
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

*preliminar

Table 11.2.2 *Nephrops* Division VIIIc.
Landings in tonnes by FU and Division VIIIc.

Year	FU 25	FU 31	DIVISION VIIIc
1975	731		731
1976	559		559
1977	667		667
1978	690		690
1979	475		475
1980	412		412
1981	318		318
1982	431		431
1983	433	63	496
1984	515	100	615
1985	477	128	605
1986	364	127	491
1987	412	118	530
1988	445	151	596
1989	376	177	553
1990	285	174	459
1991	453	109	562
1992	428	94	522
1993	274	101	375
1994	245	148	393
1995	273	94	367
1996	209	129	338
1997	219	98	317
1998	103	72	175
1999	124	48	172
2000	81	34	115
2001	147	27	174
2002	143	26	169
2003	89	22	111
2004	75	17	92
2005	63	14	77
2006	62	15	77
2007	67	19	86
2008*	39	19	58

*Preliminar

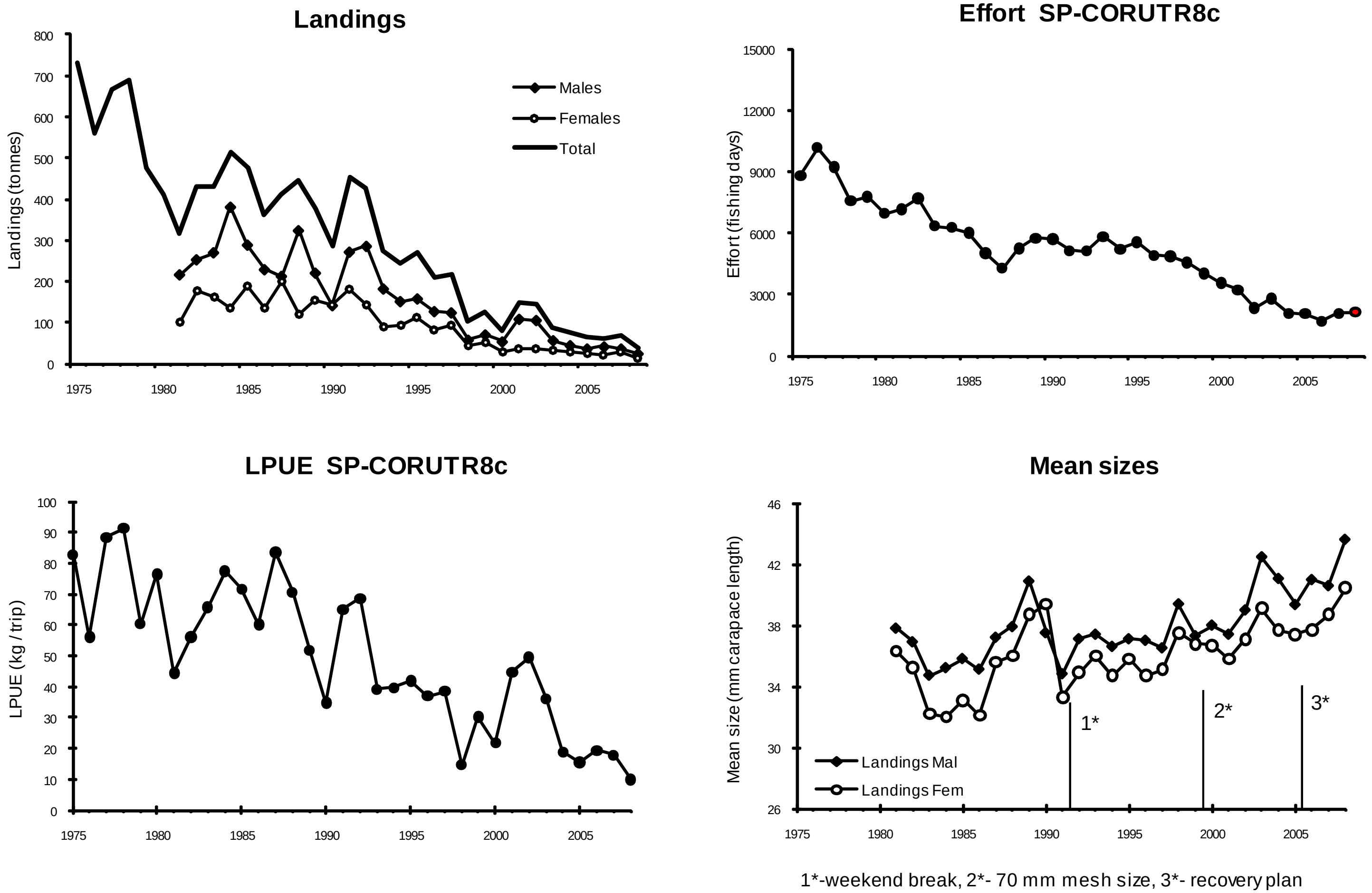


Figure 11.1.1 *Nephrops* FU 25, North Galicia: Long-term trends in landings, effort, LPUE, and mean sizes.

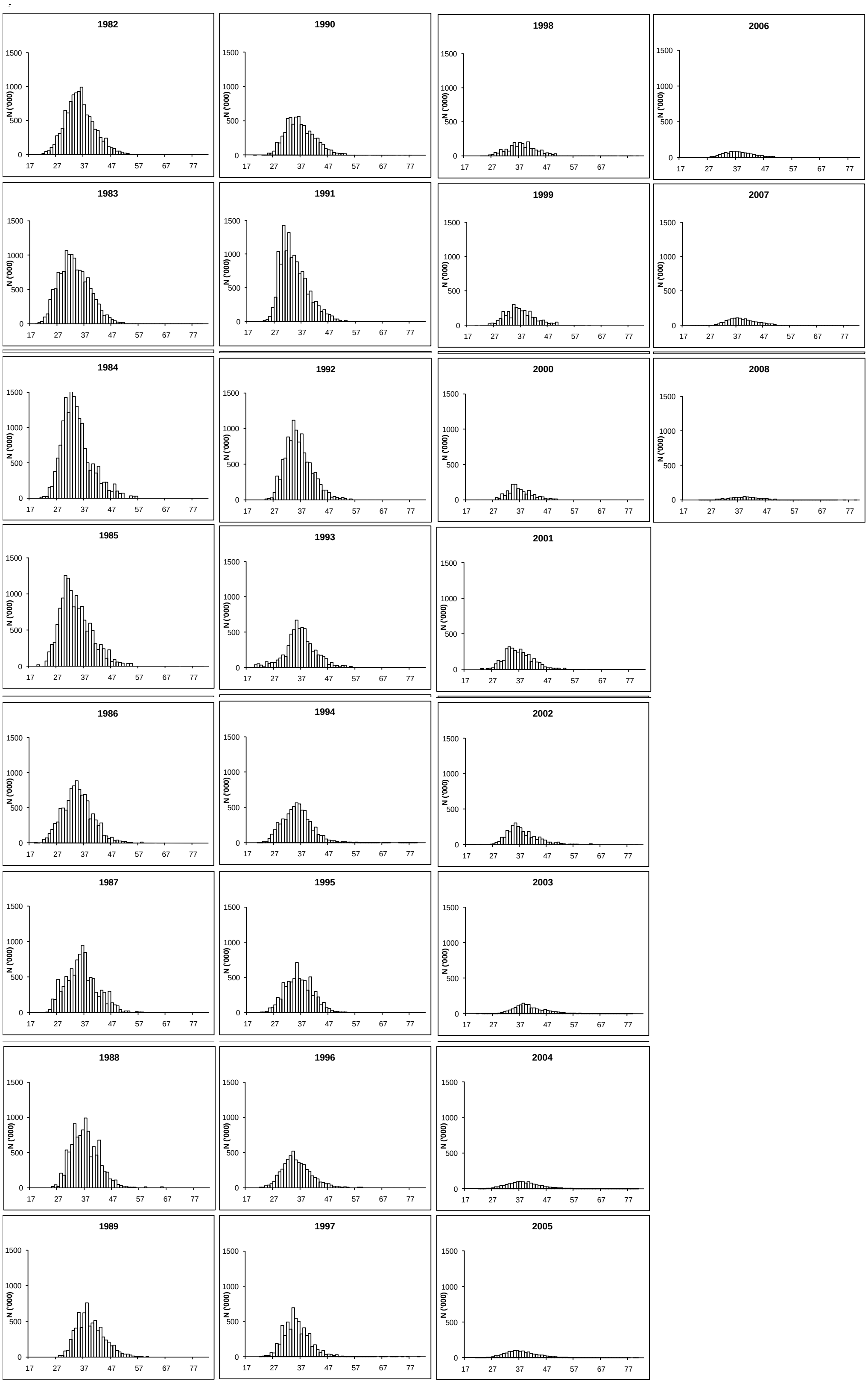


Figure 11.1.2 *Nephrops* FU 25, North Galicia: length distributions in landings, 1982-2008.

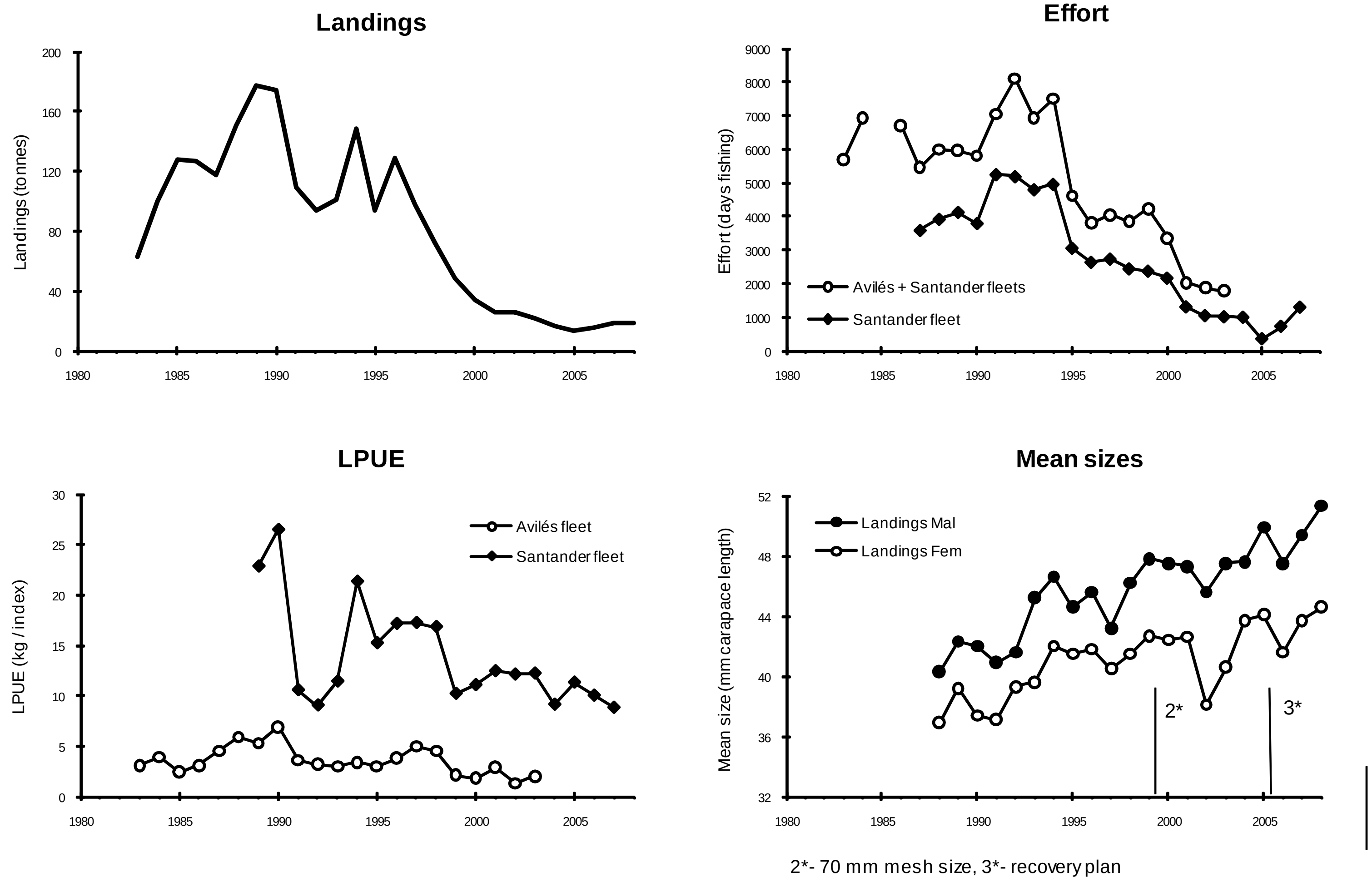


Figure 11.2.1 *Nephrops* FU 31, Cantabrian Sea: Long-term trends in landings, effort, LPUE, and mean sizes.

12 *Nephrops* in Division IXa

The ICES Division IXa has five *Nephrops* Functional Units: FU 26, West Galicia; FU 27 North Portugal; FU 28, Alentejo, Southwest Portugal; FU 29, Algarve, South Portugal and FU 30, Gulf of Cádiz.

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		247	247	693
2003	39	7		7	26	33	72			35	327	362	362	4	281	285	718
2004	38	8	0	8	24	32	70			31	415	445	445	4	130	135	650
2005	16	10	0	10	16	26	42			31	382	413	413	3	232	235	690
2006	15	12	0	12	17	29	44			17	233	249	249	4	224	228	521
2007	20	8	0	9	17	26	46			18	218	236	236	4	177	181	462
2008**	17	7	0	7	12	19	36			35	173	208	208	3	77	80	323

* Prior 1996, landings of Spain recorded in FU 26 include catches in FU 27

** Preliminary values

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	650
2005	540	690
2006	486	521
2007	437	462
2008	415	323
2009	374	

12.1 Nephrops FU 26-27, West Galicia and North Portugal (Division IXa)

12.1.1 General

12.1.1.1 Ecosystem aspects

In the northern part of the Division IXa two Functional Units are considered: FU 26 (West Galicia) and FU 27 (North Portugal).

In this geographical area, characterized by episodic upwelling of North Atlantic Central Water during summer, various coastal fisheries fish for pelagic and bottom resources. Annual catches of *Nephrops* are relatively small compared with other Atlantic *Nephrops* stocks, but this species gives one of the most valuable revenues for the trawl fleet.

The distribution of *Nephrops* in this area is limited to depths ranging from 90-500 m. Patch pattern is clearly identified in shallower waters (80-140 m) in the west coast of Galicia. The life history of *Nephrops* consists of a pelagic larval phase and sedentary non-migratory juvenile and adult stages. After reaching sexual maturity, the male moults more frequently than the female, consequently growing faster. Berried females tend to remain inside their burrows during the incubation period (from August to February) remaining less available to fishing gear. The emergence patterns of the *Nephrops* females during the incubation period result in a different exploitation pattern for males and females. There are no reports on relevant *Nephrops*' predators in the area.

12.1.1.2 Fishery description

Nephrops is caught as a by-catch in the mixed bottom trawl fishery in the North and Northwest Iberian Atlantic. The commercial species of the fishery are hake, anglerfish, megrim, blue whiting, mackerel, horse mackerel and a set of other fish and cephalopods. The fishery takes place throughout the year, with the highest yields of *Nephrops* in spring and summer. The overall decline of some bottom commercial species in the area (mainly hake in the last decade) has influenced the fishing strategies of the trawl fleets in terms of gear modalities and target species.

At present, the trawl fleet fishing in the area comprises three components: baca bottom trawl, high vertical opening trawl (HVO) and bottom pair trawl, each targeting a different species. Only the baca bottom trawl catches *Nephrops*. Trawl vessels can change the gear from year to year and consequently the target species and the 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) determined the adoption of several temporary measures to minimize the impact on the fisheries, such as spatial and seasonal closures for fishing fleets. This caused a reduction in fishing effort of the trawl fleet from November 2002 to June 2003.

Generally, only soft and damaged *Nephrops* individuals are discarded in the fishery (Pérez *et al.*, 1996). Currently, *Nephrops* represents around 1% of the total weight landed by the bottom trawl fishery, but the species is a very valuable component of the landings. The species has been regularly assessed since 1990.

Nephrops is managed in the whole Division by an annual TAC, together with several technical measures. The Council Regulation (CE) No. 850/98 establishes 20 mm carapace length (CL) as the minimum landing size for *Nephrops* in the area. Few animals are caught under size. A recovery plan for southern hake and Atlantic Iberian *Nephrops* stocks was implemented and enforced since 2006.

12.1.2 Summary of ICES Advice for 2009 and management applicable to 2008 and 2009

ICES 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 2008 and 2009

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 415 and 374 t for 2008 and 2009, respectively, and the maximum number of fishing days per vessel was fixed at 194 and 175 days for these two years (Annex IIb of Council Regulations nos. 40/2008 and 43/2009). 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 1975-2008 (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 (36 t in 2008), representing less than 10 % 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 since 1989, from about 90 t to the recent 7 t.

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 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 1988-2008 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 1994-2008 (Table 12.1.3). The overall trend for the LPUE of SP-MATR is decreasing. In 2008, this fleet accounted by 47 % of the landings from these FUs.

Time series of fishing effort and LPUE of the bottom trawl fleets with the home ports 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

No assessment was carried out in this working group.

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 8% of the average landings in the early period of the time series (1975-1992). Fishing effort indices for FU26-27 have decreased in 2008.

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 closed area (June-August) for *Nephrops* in 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

*Prior 1996 landings of Spain from FU 26 include catches in FU 27
**preliminar

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, 1988-2008.

Size, CL/Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10																					
11																					
12	0	0	6	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	
14	0	69	27	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	
16	0	191	289	13	0	0	0	0	0	0	0	0	3	17	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	
18	0	683	898	25	0	0	2	1	0	0	0	0	16	19	0	4	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	
20	27	1057	2044	97	6	5	10	7	25	3	0	0	86	151	3	29	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
22	39	1657	2642	398	48	99	84	47	202	12	1	0	129	348	11	11	1	0	1	0	0
23	109	1901	3063	568	103	99	77	151	373	26	6	0	127	518	16	31	0	0	0	0	1
24	198	1626	2736	1216	284	222	169	338	550	46	7	3	93	466	22	17	1	2	1	0	2
25	290	2212	1802	1477	541	381	199	672	906	113	45	15	134	441	35	28	1	2	1	0	3
26	574	1675	1451	1516	829	542	289	709	960	184	40	43	145	365	56	22	7	2	2	1	2
27	854	1878	1333	1351	926	904	409	933	746	306	80	68	129	419	106	40	18	8	5	2	3
28	1272	1560	1319	1940	1079	1017	524	1298	842	402	138	109	123	274	74	46	23	12	8	6	9
29	1487	1716	913	1797	1023	987	613	1223	706	489	191	134	143	266	86	60	20	15	13	7	7
30	1615	1510	845	1501	1069	1140	767	1371	792	681	295	195	172	252	118	90	31	25	20	12	13
31	1960	1106	632	1450	1180	890	802	1378	609	719	359	239	182	209	105	102	27	21	21	13	16
32	1951	1472	772	1484	1197	912	847	1491	601	888	411	292	285	220	160	95	49	29	35	23	27
33	2288	1313	601	1126	1378	878	898	1444	517	780	525	377	176	201	167	84	56	26	40	47	23
34	1581	1299	572	1160	1001	849	853	1255	542	745	551	376	192	156	131	83	56	31	51	43	37
35	1487	952	518	1044	915	855	745	963	506	637	569	432	200	148	96	91	53	26	48	46	25
36	1161	634	407	879	776	901	611	744	433	527	484	360	176	120	110	85	56	21	42	36	22
37	838	545	284	651	627	736	546	580	348	484	417	321	175	143	106	111	70	31	51	49	31
38	1196	608	294	616	545	682	621	542	346	534	425	308	128	110	76	72	86	35	61	38	28
39	837	451	226	600	505	510	475	425	285	406	292	240	128	85	95	79	65	27	43	36	21
40	501	325	199	450	666	573	412	455	284	466	393	218	115	65	76	60	90	24	55	39	32
41	428	288	165	375	431	385	321	321	213	399	312	182	112	58	88	48	60	21	40	32	23
42	367	287	144	220	362	375	314	214	182	360	249	210	66	57	81	54	101	22	47	43	26
43	433	296	156	203	425	307	293	188	165	325	292	219	64	36	76	47	73	25	38	49	25
44	164	277	87	136	301	251	200	152	127	290	207	193	61	44	52	33	62	20	32	38	36
45	165	286	58	110	303	219	178	125	118	218	196	162	58	42	44	34	56	17	18	29	17
46	96	135	23	90	350	153	129	116	94	191	178	152	40	28	49	26	29	20	18	24	18
47	94	117	45	82	228	104	92	84	56	123	120	84	38	47	42	31	38	26	18	28	17
48	71	100	25	49	222	58	96	55	70	117	147	96	23	18	22	13	28	18	12	15	16
49	73	76	29	42	148	84	71	46	23	60	105	64	21	16	15	16	18	13	11	14	9
50	83	127	14	46	63	81	69	29	31	81	95	54	17	12	12	15	16	15	13	14	9
51	15	48	9	14	71	27	59	13	21	43	59	21	17	6	7	15	7	15	7	7	9
52	20	75	14	33	71	21	59	18	22	43	55	30	18	6	7	10	12	10	8	10	9
53	23	34	13	26	34	20	28	6	13	30	37	33	5	5	6	10	5	7	6	8	4
54	14	10	11	23	23	14	12	6	15	42	28	27	8	3	2	8	4	11	10	6	7
55	6	27	1	6	13	17	12	1	9	25	26	12	6	7	3	4	5	8	3	6	6
56	6	9	1	5	5	10	5	1	9	14	14	14	7	4	3	5	3	4	2	3	6
57	10	5	1	2	6	5	10	0	4	8	12	6	5	3	3	2	2	3	2	4	5
58	11	5	1	4	6	5	14	0	3	6	11	5	4	5	4	3	3	4	4	4	5
59	7	0	4	0	7	2	7	0	0	2	1	5	3	3	0	1	4	3	1	3	2
60	2	0	2	0	4	3	3	0	0	1	2	3	2	2	2	2	7	4	2	1	3
61	4	0	1	0	3	2	12	0	0	0	2	0	3	2	0	2	1	14	1	2	1
62	2	0	1	0	1	0	7	0	0	0	0	0	1	5	0	2	2	4	2	1	3
63	1	0	1	0	3	0	5	0	0	1	0	0	3	3	0	2	1	2	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
65	2	0	1	0	1	0	2	0	0	0	0	0	1	1	1	1	2	2	1	1	1
66	3	0	1	0	1	0	2	0	0	0	1	0	2	2	0	1	0	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
68	2	11	1	0	2	2	6	0	0	0	0	0	2	1	0	2	1	1	2	2	2
69	1	4	1	0	1	1	0	0	0	0	0	0	2	1	0	1	1	1	2	1	1
70	12	25	1	2	12	6	8	0	1	0	3	0	11	1	1	5	4	8	1	1	4
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
mber (thousand)	22409	31275	29319	23087	17811	15360	12003	17411	11828	10827	7383	5302	3822	5712	2169	1666	1257	638	800	752	569
Total weight (t)	727	708	450	603	636	522	448	511	331	432	344	246	132	132	87	72	70	42	44	46	36
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
ean 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

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

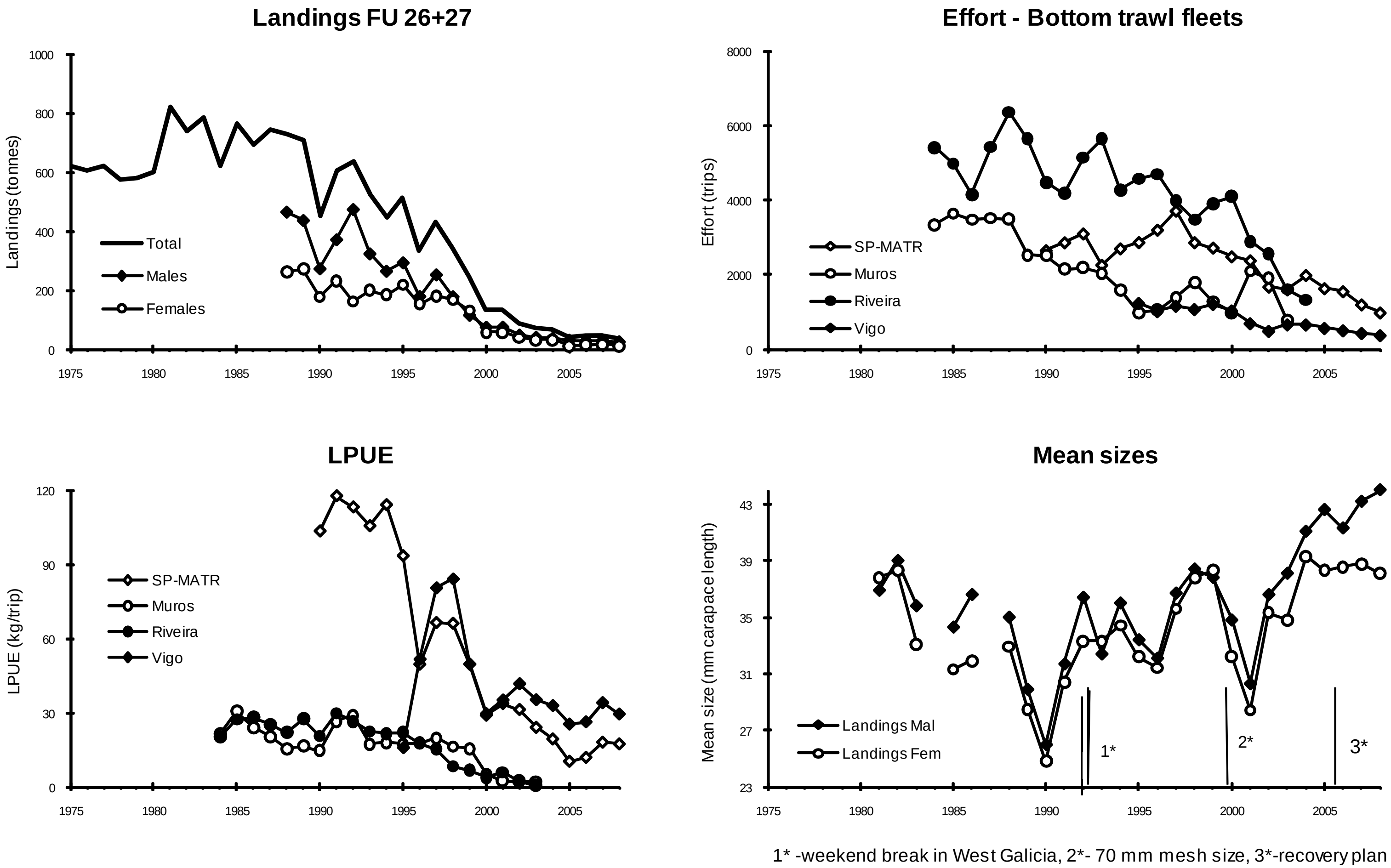


Figure 12.1.1 *Nephrops* FU 26+27, West Galicia and North Portugal: Long-term trends in landings, effort, LPUE and mean sizes.

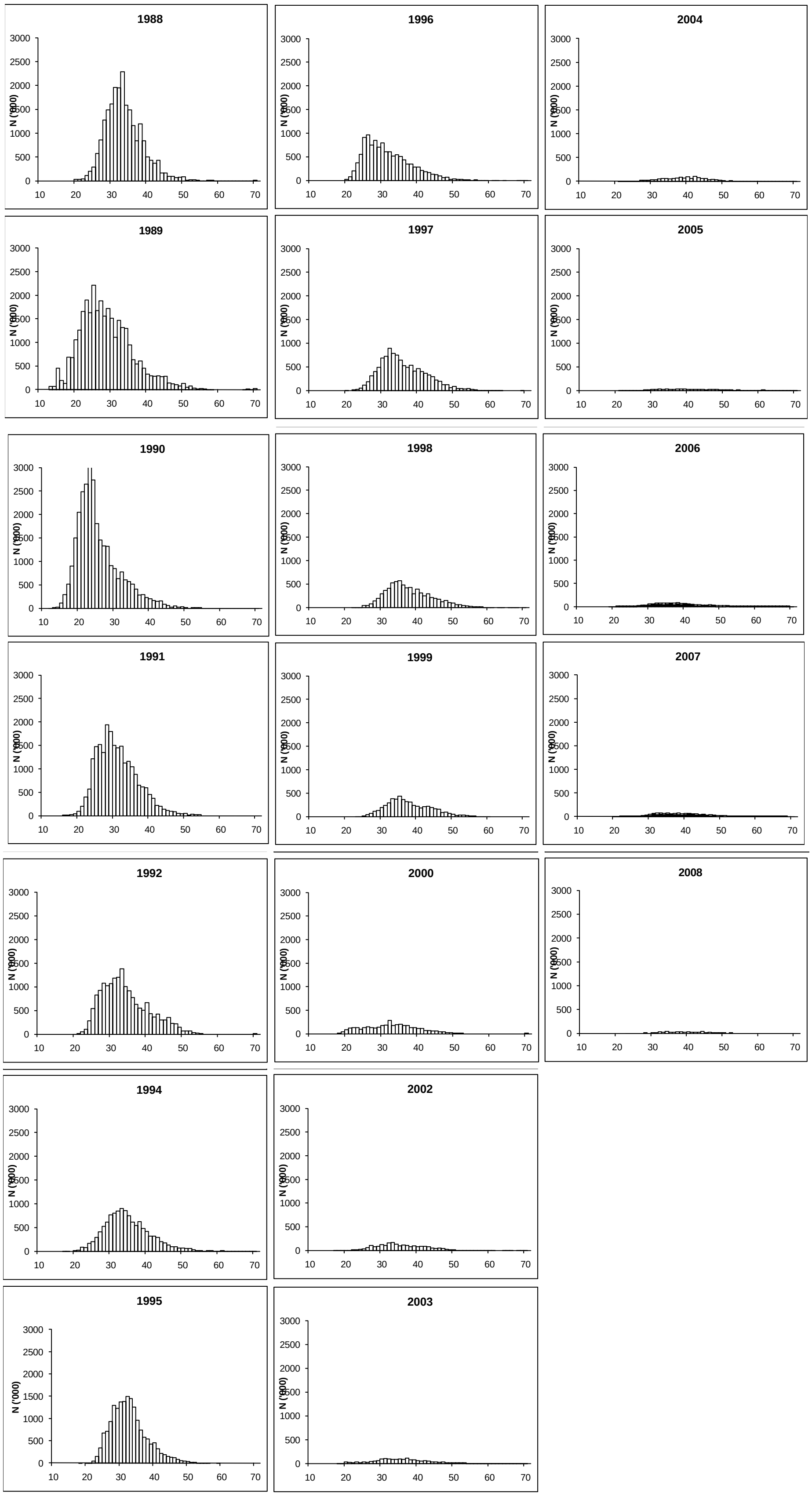


Figure 12.1.2 Nephrops FU 26-27, West Galicia and North Portugal: length distributions in landings, 1988-2008.

12.2 FU 28 – 29 (SW and S Portugal)

12.2.1 General

12.2.1.1 Ecosystem aspects

See Annex L.

12.2.1.2 Fishery description

See Annex L.

12.2.1.3 ICES Advice for 2009 and Management applicable for 2008 and 2009

ICES Advice for 2009

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 2008 and 2009

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 415 and 374 t for 2008 and 2009, respectively, and the maximum number of fishing days per vessel was fixed at 194 and 175 days for these two years (Annex IIb of Council Regulations nos. 40/2008 and 43/2009). The reduction of fishing days included in these regulations is not applicable to the Gulf of Cadiz (FU 30).

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. In the period 1990–1996, the landings fell drastically, to an all time low of 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 2008 was 208 t.

Males are the dominant component in all landings with exception for 1995 and 1996 when total female landings exceeded male landings (ICES, 2006). For the last seven years male to female sex-ratio has been close to 1.5:1.

Information on the discard sampling program onboard the Portuguese crustacean trawlers was provided to the Working Group. The weight of *Nephrops* discarded in 2006-2008 was very low with high CVs. The table below shows the summary of the discards sampling program for the period 2004-2008.

	Crustacean Trawl Fishery				
	2004	**2005**	**2006**	**2007**	**2008**
No of trips sampled	17	15	7	12	12
No of hauls sampled	111	74	30	72	66
Total estimated discards (t)	15.9	43.9	7.0	0.8	4.3
CV (%)	18.5	35.5	62.5	41.7	62.5

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 2008 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.

Information on discards was not taken into account in the estimation of the total catch length distributions due to the low level of discards, the high CVs 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 (Figure 12.2.3).

12.2.2.3 Abundance indices from surveys

Over the past decade, several groundfish and crustacean trawl surveys 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 juveniles 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, the crustacean trawl survey conducted in the 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 a MD4000 high resolution colour camera, a 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.

Abundance indices from trawl, sediment composition and video images 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 1994-2008 (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 variabilility, 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 low 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 and the differences from the 2008 standardization are in a file kept at the WGHMM 2009 SharePoint (more details will be presented in a WD to WGHMM 2010). 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 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 accordingly fixed to 240 days for the year 2006 (Council Regulation (EC) No 51/2006), 216 days for the year 2007 (Council Regulation (EC) No 41/2007) and 194 days for 2008 (Council Regulation (EC) No 40/2008). 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 2008 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 40 kg/day in the period 1995-2003 (Figure 12.2.1). This seems to be mostly the result of a decrease in male CPUE. Female CPUE was more or less stable throughout the whole period, with exception of a peak in 1995 (ICES, 2006). The total CPUE shows an increase in 2003-2005, declining again in 2006-2008.

The opposite trends shown by the commercial fleet and survey CPUE series in the last two years 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 needs further development and will be approached in more detail in next WG. Crustacean vessels are targeting two main species, Norway lobster and rose shrimp, which have different market value. Depending on their abundance/availability, the effort is directed at one species or the other. In 2007-2008, the landings of rose shrimp increased showing a change in the objectives of the fishery (Figure 12.2.4). The effort is estimated using the CPUE of the fleet. If the CPUE of *Nephrops* decreased due to a change in target species (and consequently, fishing grounds), the effort might be overestimated.

12.2.3 Assessment

No assessment was carried out in this WG.

12.2.4 Biological reference points

There are no biological reference points defined for this stock.

12.2.5 Management considerations

Nephrops is taken by a multi-species and mixed bottom trawl fishery.

A recovery plan for southern hake and Iberian *Nephrops* stocks was approved in December 2005 and in action since the end of January 2006. This recovery plan includes a reduction of 10% in 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 and 40/2008).

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 (1984-2008)

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**
17																									
18																									
19					4	21					0									0				1	0
20			0	16	4			6	4							4				0		4		2	1
21		17	9			84		16	37	9						3	3	0	2	0	0	33		4	0
22	7	5	14	15		97	9	29	96	38	9				2	0	16	1	2	13	5	51	9	16	7
23	24	7	7	8		143	5	19	55	34			8	4		5	8	3	1	3	19	32	20	26	9
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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	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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
58	13	14	8	14	11	17	14		11	4	6		5	3	5	4	13	23	26	20	15	10	5	5	18
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
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
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
62	3	1	2	1	2	3		1	7	5	1		2	7	1	3	6	10	11	15	19	8	7	3	14
63	1	1		1	1	4		5	0	1	0		2	3	0	2	1	4	11	11	9	7	6	1	7
64		2	0	2	1			1	3	1	2		0	4	0	1	1	9	11	8	11	10	6	1	10
65	0	0		2	2				3	1	1		0	4		0	4	6	5	4	4	9	6	0	9
66	0			0	1					1			0	4	0		1	5	8	3	8	3	4	1	11
67	0			0	0	0			6	5				6	0			4	3	5	2	2	5	1	6
68					0	2				0	1			0	0			1	6	6	2	3	3	0	7
69				0										0	0		0	3	3	2	3	2	3	1	4
70	0			1		0				2				0	0		0	6	2	4	3	4	4	0	3
71										0					0			2	2	4	1	1	2	0	2
72				0		0				1					0			2	2	4	2	3	3	0	3
73														0			0	0	1	1	1	2	2		1
74	0									1								0	1	1	1	3	1		1
75																		0	1	0	0	1	1		1
76																		0	0	0	0	0	1		1
77																			0	0	0	0	1		1
78		0			0																0	1			0
79																			0		0	1	0		0
80									0													0			0
81																							0		0
82																			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**
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**

Table 12.2.1.b. FU 28-29 - Length Composition of Nephrops Females (1984-2008)

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**
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
22	8	21	30	78		88	19	11	102	63			0	13	2	5	18	0		3	12	86	12	20	10
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
51	0	0	3	4	3	7	2	4	4	5	0			1	2	2	10	9	22	13	15	17	8	4	9
52	1			5	5	8	1		5	6	1	1	0	1	1	3	16	6	19	20	16	17	6	2	6
53	2			2	3	1			9	6	0			0	0		6	6	10	12	9	10	1	0	7
54				4	1	1			1	1			1	0	1		5	2	2	14	9	6	7	0	7
55				0	1	1			6	2							1	2	3	9	4	5	1	1	3
56				3	0	2		5	14	5					0		3	1	3	7	7	2	1	0	2
57				0	0	1			4	1			0		0		1	0	2	4	2	3	0		1
58				0		0			4	1								1	1	1	2	0	0	0	1
59				1	0	0											0	1	0	0	1	1	1		
60					0				1	0								0		0		2			1
61						1											3	1		0	1				
62																			0	0	0	1	0		
63									4	1								0	0			0			
64																					1	0		0	0
65																					0	0			
66																	0	0				0			
67																									
68									4	1															
69																									
70																					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**
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**

Table 12.2.2. - SW and S Portugal (FUs 28-29): Effort and CPUE of Portuguese trawlers, 1994-2008 (standardized/revised).

Year	No. of trawlers	CPUE (t/boat)	Estimated days	CPUE (kg/day)
1994	31	7.6	4237	56
1995	30	9.1	4773	57
1996	25	5.3	3711	36
1997	25	5.5	3261	42
1998	25	6.4	5768	28
1999	29	7.3	9801	22
2000	33	6.1	7847	26
2001**	33	8.2	8531	32
2002	34	10.5	9214	39
2003	35	9.3	7113	46
2004	33	12.6	7064	59
2005	32	11.9	6055	63
2006	30	7.7	4040	57
2007	30	7.3	4241	51
2008*	30	5.8	4257	41
* 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, 1994-2008.

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
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, 1994-2008.

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
na = not available ns = no survey										

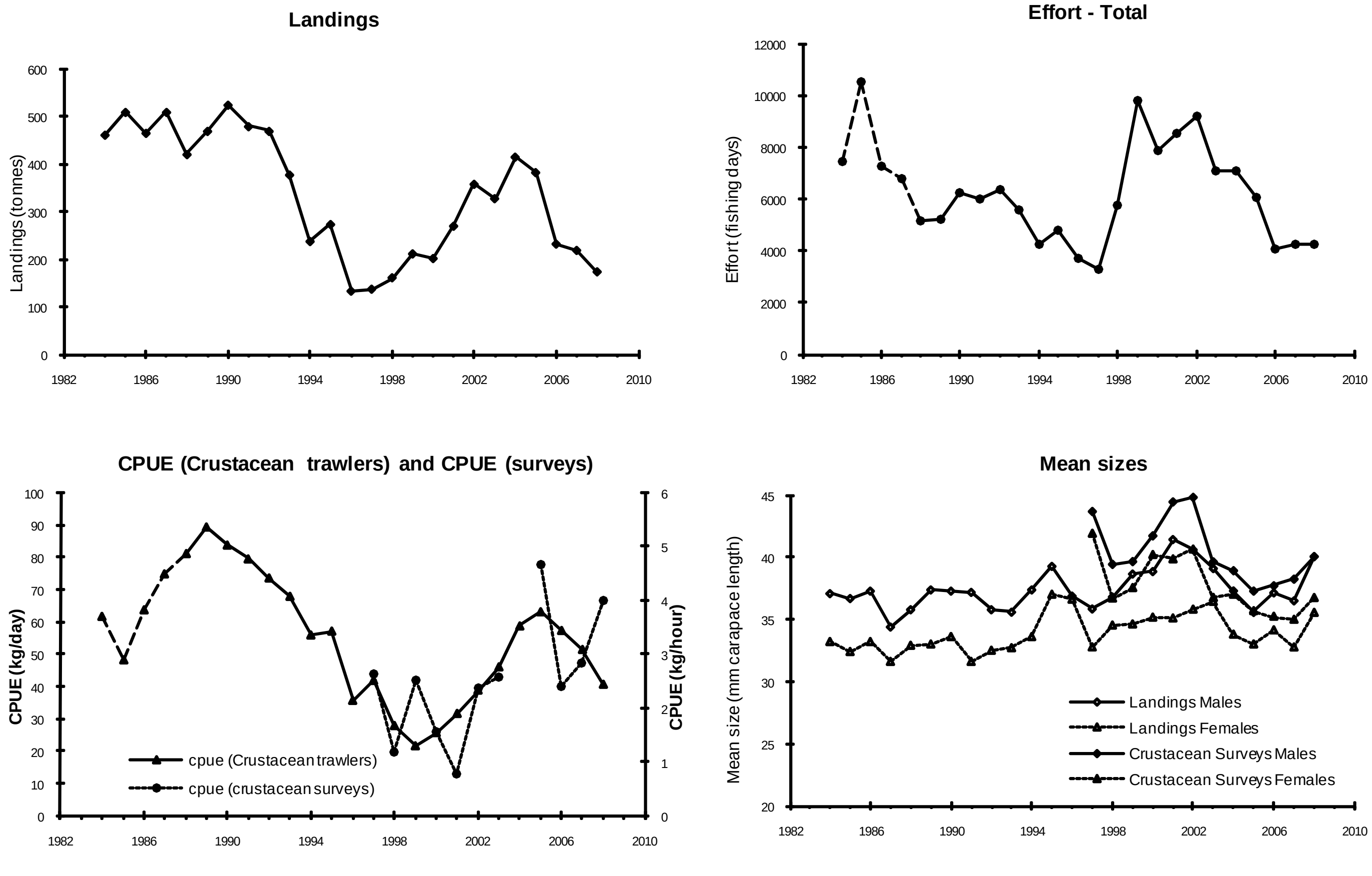


Figure 12.2.1. SW and S Portugal (FU 28+29): landings, effort, biomass indices and mean sizes of *Nephrops* in landings and landings. Note: Values of LPUEs and effort before 1988 are less reliable.

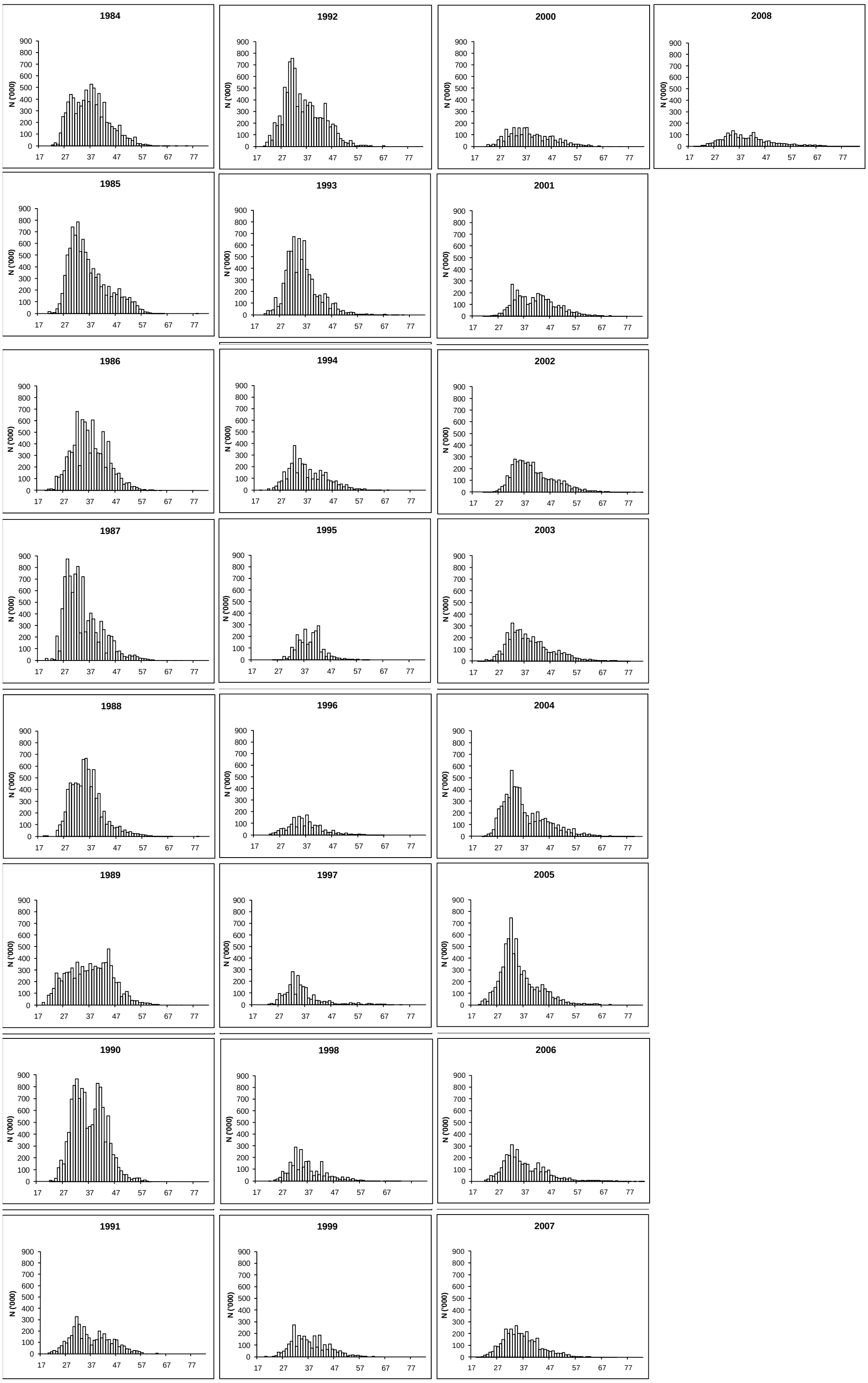


Figure 12.2.2.a. SW and S Portugal (FU 28-29) male length distributions for the period 1984-2008.

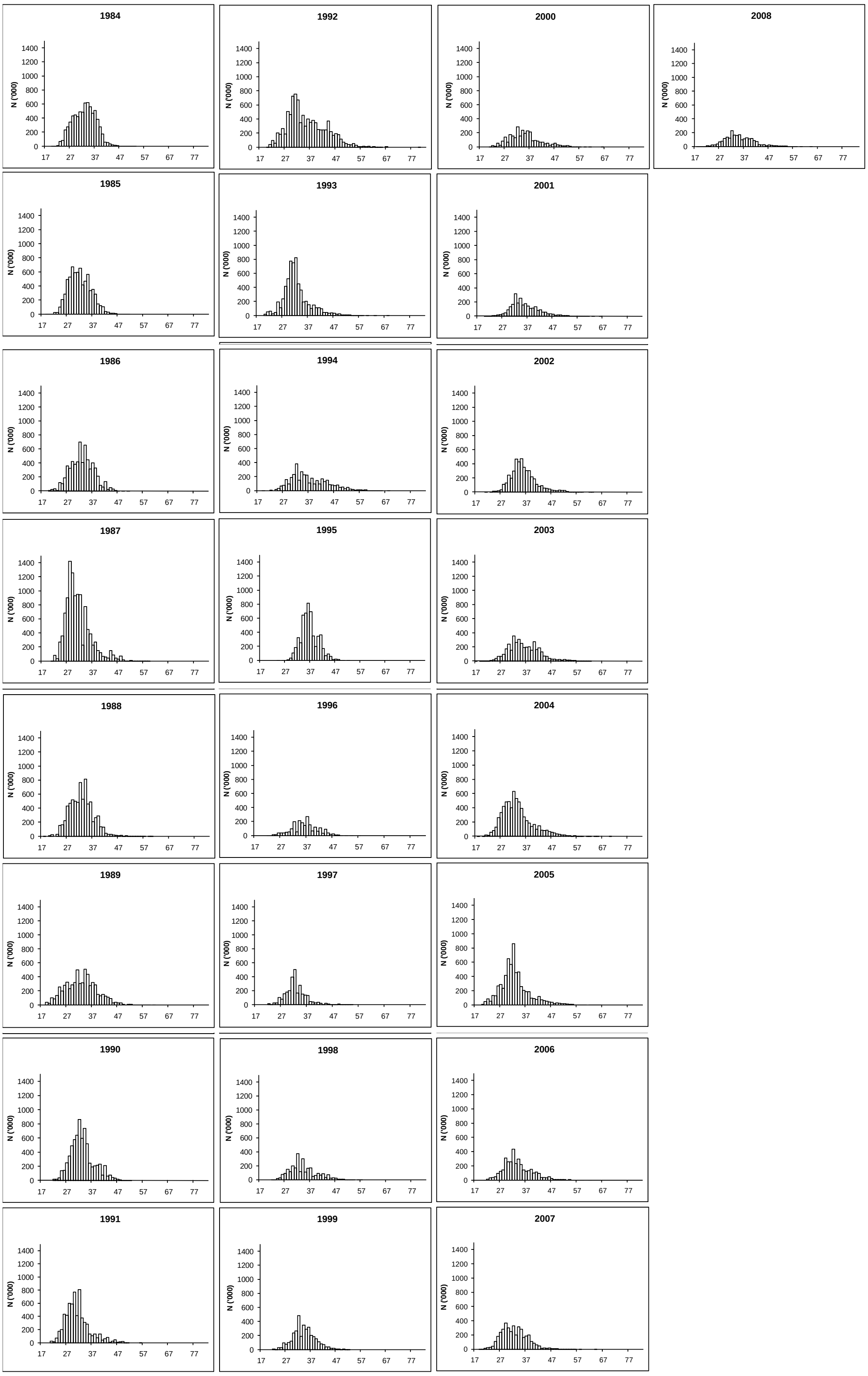


Figure 12.2.2.b. SW and S Portugal (FU 28-29) female length distributions for the period 1984-2008.

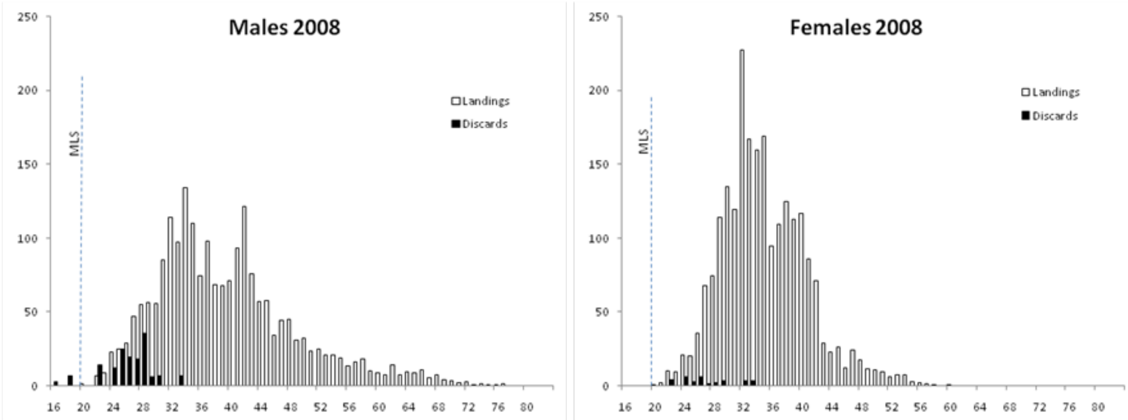


Figure 12.2.3. Landings and Discards length distributions in 2008.

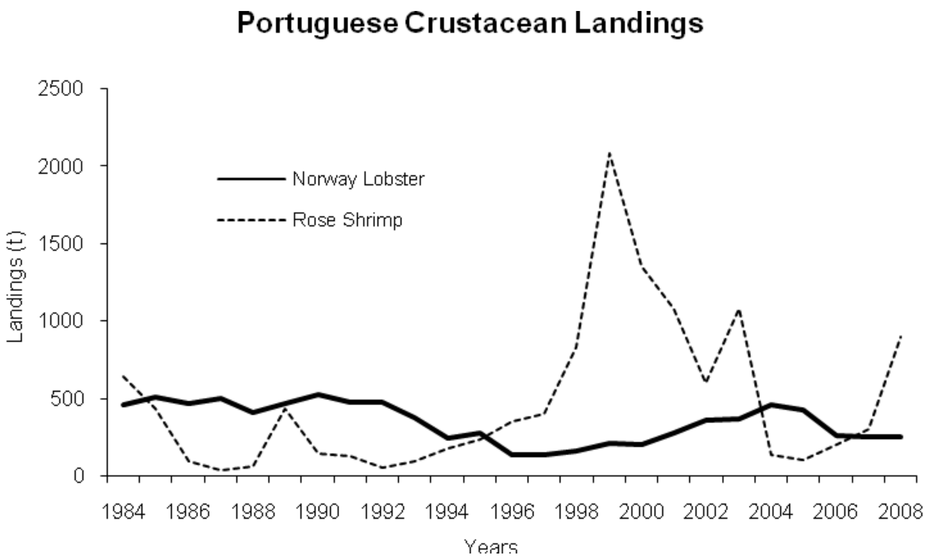


Figure 12.2.4 FUs 28-29: Portuguese Crustacean Landings in the period 1984-2008.

12.3 *Nephrops* in FU 30 (Gulf of Cadiz)

12.3.1 General

12.3.1.1 Ecosystem aspects

The main *Nephrops* fishing grounds in FU 30 (Gulf of Cádiz) are located at between 300 and 700 meters of depth (Ramos *et al*., 1997). On the east, the Gibraltar Strait splits the Gulf of Cadiz from the Mediterranean sea and is considered a natural border. On the west, the Guadiana River does not seem to be a real boundary for splitting possibly different populations (ie FU 29 and FU 30). The separation could be based on practical and management considerations.

The life history of *Nephrops* consists of a pelagic larval phase and sedentary non-migratory juvenile and adult stages. After reaching sexual maturity, males moult more frequently than females, consequently growing faster. Berried females tend to remain inside their burrows during the incubation period (from August to February) remaining less available to fishing gear.

12.3.1.2 Fishery description

Nephrops in the Gulf of Cádiz are caught in a mixed fishery targeted by the trawl fleet. Landings are clearly seasonal with high values from April to September (Jiménez, 2002). The species represents 1.5% of the total trawl landings from the area. The main landing ports are Huelva, Isla Cristina, Puerto de Santa María and Sanlúcar de Barrameda. Huelva was the most important *Nephrops* landing port five years ago, nevertheless, landings from Isla Cristina and Puerto de Santa María overcame Huelva landings in recents years. At the moment, FU 30 provides the biggest Spanish *Nephrops* landings in the Iberian area. The bottom trawl fleet has been recently modernized (2000), becoming easier for it now to access the more remote and deeper fishing grounds.

Bottom trawl fishing fleet segmentation was performed using logbooks information in 2007. The results showed a highly multispecific fishery carried out by this fleet.

12.3.1.3 ICES Advice for 2009 and Management applicable for 2008 and 2009

ICES Advice 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 2008 and 2009

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). This has been set up in order to improve the yields of the target demersal species, including *Nephrops*, without increasing 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, de 20 de Febrero, B.O.E nº 48)

The TAC set for the whole Division IXa was 415 t for 2008 and 374 t for 2009.

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.

Along the time series, 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 285 t in 2003, and stabilizing around 230 t during 2005-2006, except in 2004 when a decrease of more than 50% was observed. Since 2006 landings have declined to 80 t in 2008.

Since 2005 an annual discarding program is carried out during the *Nephrops* fishing season (summer). The discarding rate of *Nephrops* in this fishery fluctuated annually but was always low, ranging between 0.5% and 5.5%. In 2008, the percentage of discarded *Nephrops* by weight was 2.5% (Table 12.3.2). Figure 12.3.1 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

The sampling of commercial landings followed a multistage stratified random scheme by month in the Port of Huelva until 2005. Since 2006 a new sampling scheme has been designed, which includes sampling in other fishing ports (Isla Cristina, El Puerto de Santa María and Sanlúcar de Barrameda) and excludes the Port of Huelva because the landings in this port have decreased.

Figure 12.3.3 gives the annual landings length composition for males, females and both sexes combined during the period 2001-2008. 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. Mean size of males, females and sexes combined of *Nephrops* landings from 2001 to 2008 are shown in Figure 12.3.2.

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) carried out from 1993 to 2009 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 12.3.4). 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 12.3.4).

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) during the period 2001-2009 are presented in Figure 12.3.5. The time series of *Nephrops* mean sizes for males, females and combined sexes obtained in these surveys are shown in Figure 12.3.6. 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

The estimate of the *Nephrops* directed effort in the Gulf of Cádiz has been obtained from daily fishing trips landings with at least 10% *Nephrops* in weight of the total landings. Figure 12.3.2 shows total bottom trawl fishing effort and directed effort estimates. LPUE series are shown in Figure 12.3.2 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. 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. Since then LPUE slightly increases remaining stable in recent years at around 60 Kg/day (Figure 12.3.2).

The overall LPUE trend is quite similar to the abundance survey index in the stratum of 200-700 m (Figure 12.3.4). The lowest values were detected in 2004 in both series. In 2008, the abundance survey index was well above the commercial LPUE, however, the abundance index in 2009 dropped (just below the previous 2008 commercial LPUE), which 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, 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.

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). This has been set up in order to improve the yields of the target demersal species, including *Nephrops*, without increasing fishing effort.

In order to further reduce the fishing effort, a new fishing closure period of 30 days (16 January – 15February) was established this year (ORDEN ARM/401/2009, de 20 de Febrero, B.O.E nº 48)

Table 12.3.1 *Nephrops* FU 30, Gulf of Cádiz.
Landings in tonnes by Functional Unit

	FU 30		
	Spain	Portugal	Total
Year	Trawl	All gears	
1994	108		108
1995	131		131
1996	49		49
1997	97		97
1998	85		85
1999	120		120
2000	129		129
2001	178		178
2002	247		247
2003	281	4	285
2004	130	4	135
2005	232	3	235
2006	225	4	229
2007	177	4	181
2008*	77	3	80

* Preliminar

Table 12.3.2. *Nephrops* FU 30, Gulf of Cadiz.
Mean carapace length of the discarded and retained fraction of *Nephrops*, and % of discarded (2005-2008) 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

Table 12.3.3 *Nephrops* FU 30, Gulf of Cádiz.
Abundance index from Spanish bottom trawl spring surveys (SPS-GFS)

	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	0.40	8	0.76	18
1995	0.67	10			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

ns = no survey

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	107.6	90.2	98.6	915
1995	130.6	107.2	99.4	1079
1996	48.5	40.4	88.2	458
1997	97.1	74.7	79.2	943
1998	85.3	50.5	62.2	811
1999	120.2	83.3	66.1	1259
2000	128.9	89.9	60.6	1484
2001	178.4	130.2	67.7	1924
2002	246.6	182.4	74	2466
2003	280.6	193.3	78.4	2467
2004	130.4	86.2	42.5	2029
2005	232	217.7	52.7	4134
2006	225	211	63.5	3327
2007	176.8	165.6	58.8	2824
2008**	80	50.2	58.2	861

*Landings, LPUE and fishing effort from fishing trips with at least 10% Nephrops.
** Preliminar

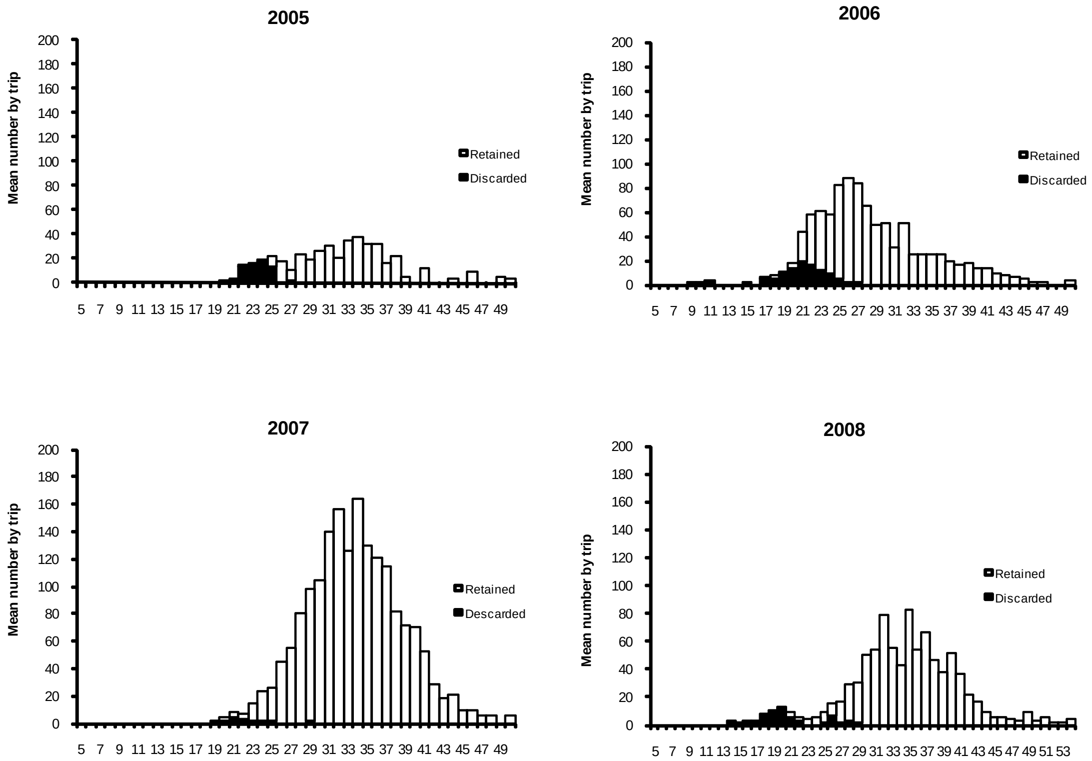


Figure 12.3.1. *Nephrops* FU 30: Gulf of Cadiz.
Length distribution of retained and discarded fractions Nephrops from discards program during 2005-2008 period.

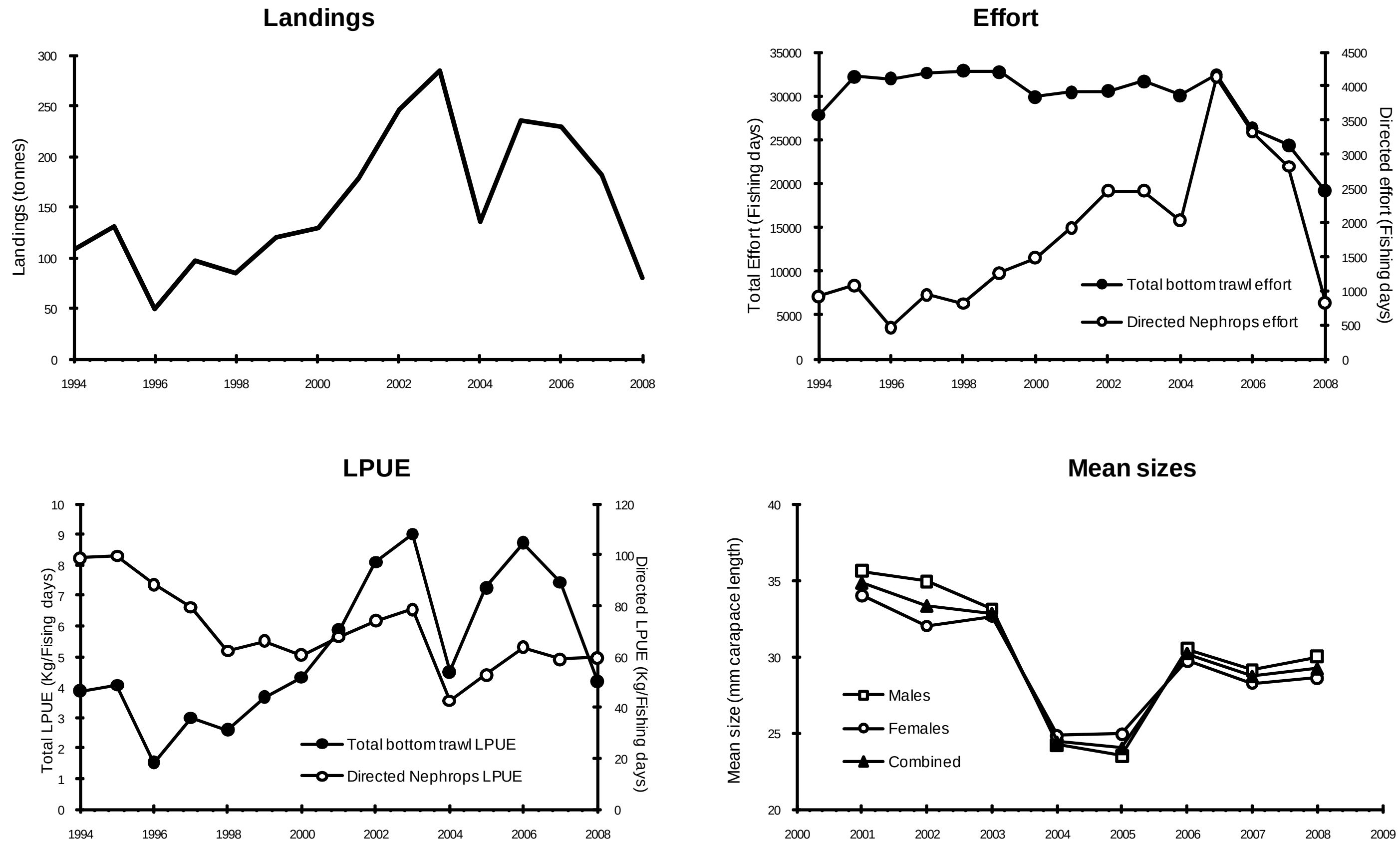


Figure 12.3.2. *Nephrops* FU 30, Gulf of Cadiz: Long-term trends in landings, effort, LPUE and mean sizes.

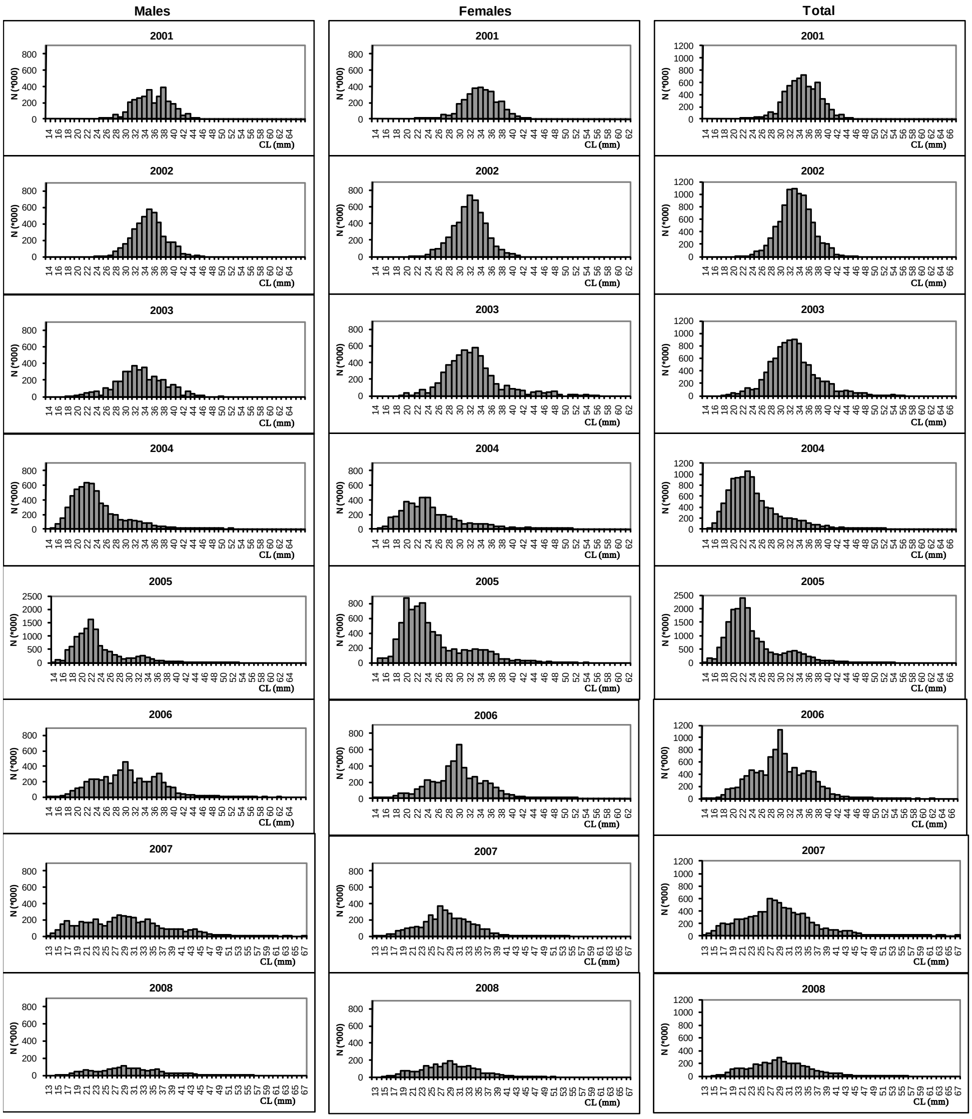


Figure 12.3.3. *Nephrops* FU 30: Gulf of Cadiz. Lenght distributions of landings from 2001 to 2008.

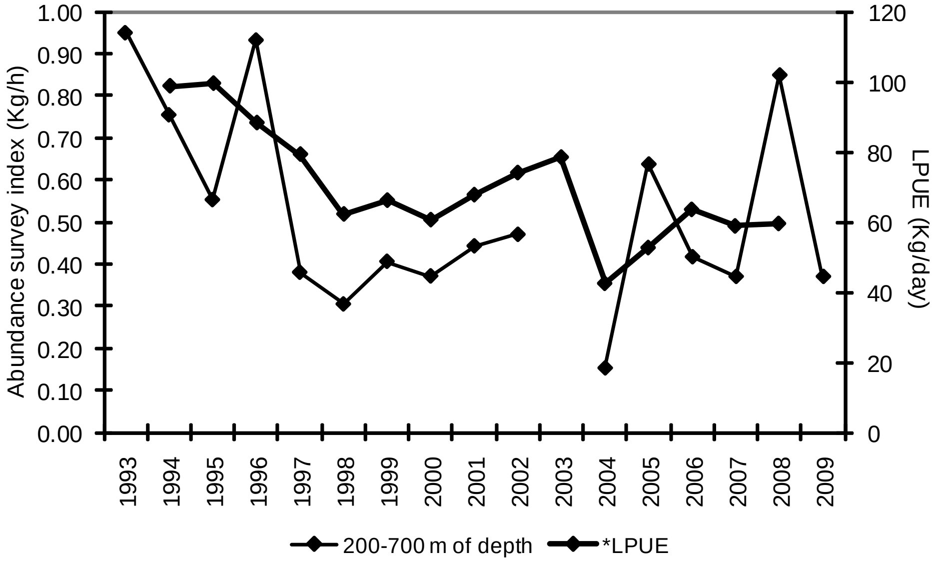


Figure 12.3.4 *Nephrops* FU 30: Gulf of Cádiz. Abundance index from Spanish bottom trawl spring surveys (SPS-GFS) and commercial *LPUE from bottom trawl fleet.

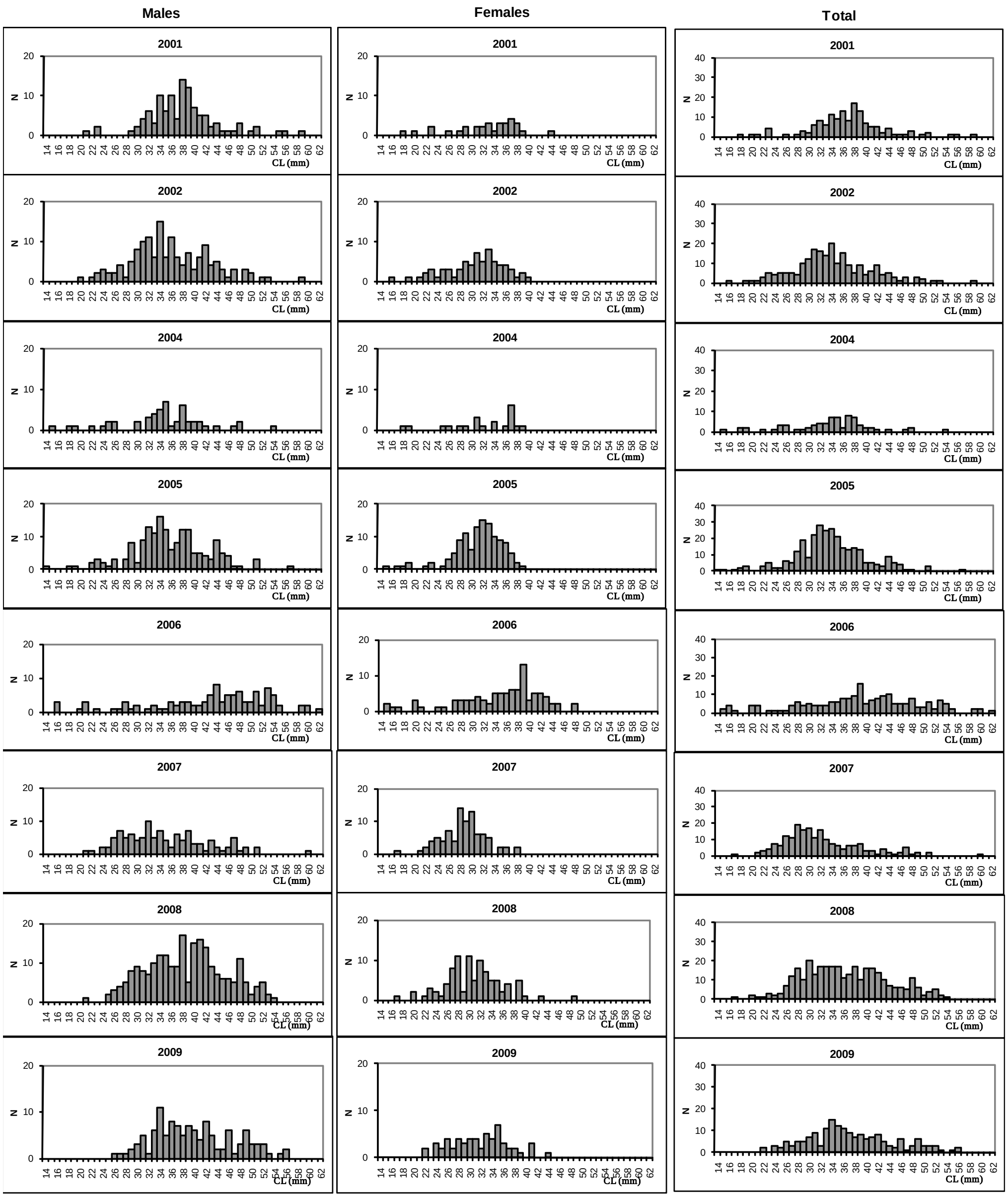


Figure 12.3.5. *Nephrops* FU 30, Gulf of Cadiz.
Spanish bottom trawl spring surveys (SPS-GFS) length distributions : 2002-2009

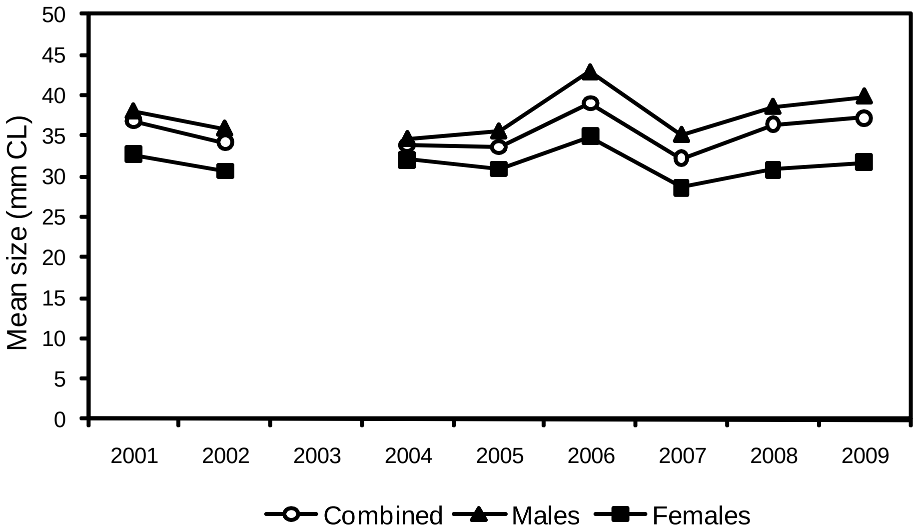


Figure 12.3.6. *Nephrops* FU 30, Gulf of Cadiz:
Mean size in spring botom trawl survey from 2001 to 2009.

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, for the first time after 5 years, the landings were below the TAC (-22%).

The northernmost stocks (FUs 26-27) continue to present a declining trend. The southern stocks (FUs 28-30) 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. In addition to this, landings have been in excess of the TAC for some recent years and the TAC has not constrained the fishing mortality. Therefore, 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 28–30 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 fishing effort.

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Annex B Working Documents presented to the WGHMM 2009 meeting.

WD 1

Walmsley, S. 2009. Estimates of northern monk and northern megrim discarding by the UK (England and Wales) beam trawl and otter trawl fleets.

This document examines the UK (England and Wales) discard data collected for northern monkfish and northern megrim between 2003 and 2007. It compares three methods of raising the data to the fleet level in order to supply discard estimates that are comparable with the landed numbers at length that have already been supplied to the WGHMM. Comparisons with known landings indicated that raising using the number of hours fished consistently overestimated the numbers of fish retained, whilst raising using the number of days fished or the landed weight provided estimates of landed numbers at length that were more similar to known landings. Discard data showed the strong 2004 monkfish year class that was heavily discarded in 2004 & 2005.

WD 2

Walmsley, S., Ashworth, J. & Forster, R. 2009. Western Anglerfish 2003-2008. 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 2008. Indices of *L. piscatorius* and *L. budegassa* abundance and biomass were calculated. The indices indicated that *L. piscatorius* abundance has declined slightly during the survey series but biomass has remained relatively stable. In contrast, *L. budegassa* abundance and biomass have both increased since 2005. There also appear to be strong incoming year classes for both species.

WD 3

Corina Chaves, Fátima Cardador, Ernesto Jardim. 2009. How are the Portuguese Winter Groundfish Survey Indices Related with the Southern Stock of Hake Assessment?

This working document aimed to analyze if the abundance indices of hake estimated from the Winter survey data were related with the results from 2008 assessment and if there was any effect in including the survey abundance indices at age in the assessment of Southern Hake.

The Portuguese Winter Groundfish Surveys (W-PGFS) restarted in 2005 and were carried out in February/March until 2008. In 2009 it was not performed because its removal from funding in the Data Collection Regulation.

Data from these surveys have been used to map the geographical distribution of mature hake, estimate the maturity ogive and to monitor the total abundance and the abundance of spawning biomass. These surveys also provide an important input to the assessment of the Southern hake as a tuning fleet and also for the assessment of southern anglerfish and megrims, horse mackerel, mackerel and blue whiting. It is also the most suitable survey to provide data for ecosystem indicators in Portuguese continental waters. The suppression of this survey for funding in spawning season will not allow collecting the maturity data required by DCR.

The data used refer to the Portuguese winter surveys performed in 1992-1993 and in 2005-2008.

Length and age distributions of hake from these surveys show that catches are mainly focuses on fish below 20 cm and on fish with 1-year-old. Several indicators of hake abundance in surveys were explored and the mean total number per hour was the one that better relates with the Southern Hake population estimates with a regression coefficient estimated of 0.78.

The XSA assessment was performed using the same data and options than the updated 2009 XSA but including the winter surveys (2005-2008) catch rates for ages 1-7, as a tuning fleet. The assessment estimate very small log catchability residuals for the winter survey and a strong influence of these fleet indices in the estimates of the survivors in the terminal year. For the year classes 2007-2004 the contribution of this fleet is higher then the contributions of the other fleets. The inclusion of this survey in the assessment does not remove the bias in the retrospective pattern, resulting overestimation of fishing mortality and underestimation of spawning stock biomass.

The abundance indices of hake provided by the winter survey series seem to follow the same trend as the population estimated from the last year assessment. The reinstall of the Portuguese winter survey in DCR will contribute to an improvement in the assessment of hake and will allow to obtain maturity data need for assessment and biological data for the ecosystem analysis.

WD 4

Piñeiro C. and H. De Pontual, 2009. *Current status of Hake Otolith Exchange 2009 and WKAEH2009*

The PGCCDBS recommended conducting a Workshop on Age Estimation of European Hake (WKAEH) in 2009, with a previous otolith exchange among laboratories involved in the assessment of the hake stocks in order to identify the current ageing problems between readers and the state of art of age estimation after validation studies conducted so far. This document report on the work carried out so far on the otolith exchange and presents the Workshop including some recommendations.

WD 5

L. Silva, S. Cerviño, C. Farias, C, M. Sainza and Y. Vila. 2009. An update of Gulf of Cadiz hake.

Hake from the Gulf of Cadiz is considered part of the Southern stock of hake. Nevertheless, quality of data does not let us to incorporate it in the modelling part of the assessment. In this work we update the relevant information about the fishery and the population. In general we can see that there are not mayor differences regarding last. Landings remains stable and they are about a 4% of stock catches, trawl LPUEs increase and there are surveys signals of bad recruitment.

WD 6

S. Cerviño, S. Mehault, C. Fernández, E. Jardim and F. Saborido, 2000. Sensitivity of South hake Biological Reference Points to Stock-Recruitment uncertainty".

Stock-recruitment relationship is one of the main sources of uncertainty for fisheries management. This uncertainty compromises our capacity to predict the future and to set precise management references points. Nevertheless management relays in the knowledge about this relationship; when it sets limits to avoid and targets to go to. Current South hake management reference points were set in 2003 under different model and state and claim for review. Here we analyze the effects of stock-recruitment uncertainty on biological reference points for South hake management. These uncertainty sources are: different explanatory variables (SSB, female SSB and egg production); alternative structural models; considering depensation or not; and variability in stock-recruitment parameters that was estimated through Bayesian fit. This variability was incorporated into Biological Reference Points (BRPs) estimation (MSY, Fmsy, Fcrash, etc). A Comparative analysis of main factors affecting BRPs suggest that alternative management reference points (limits and targets) may be more useful to drive stock to recovery.

WD 7

S. Cerviño, F. Cardador, D. Howell, E. Jardim, I. Olaso, A. Punzón, I, Preciado, and F. Velasco, 2009. An age-length cannibal model for South hake with GADGET.

Available stomach data suggests that cannibalism in Southern hake averages 5% of the diet. This, combined with the hake's high energetic requirements, make cannibalism a significant source of mortality on younger fish. It is therefore important that the impact of cannibalism on the outcome of current management plans be evaluated. This study presents an analysis of a Southern hake "Gadget" model with cannibalism. Southern hake is a depleted stock which has been managed with a recovery plan since 2006. The plan implements an annual 10% F reduction aiming to get 35 000 tonnes of SSB by 2015. This work aims to understand how the inclusion of cannibalism into the model changes our perception about the consequences of different management options. Uncertainty about hake growth is also taken into account. An initial model without cannibalism was developed for comparative purposes. This was extended to incorporate cannibalism and was fit estimating abundances and mortalities able to satisfy hake predation requirements. Model results show that cannibalism is an important source of natural mortality for young age classes (ages 0 and 1). Total hake consumed varies during the model time series (1990-2007) representing an important proportion of total catches. The incorporation of cannibalism into the assessment model gives a more pessimistic view about the SSB recovery possibilities and future yield of Southern hake in the medium and long term

WD 8

Cerviño, S. and E. Jardim, 2009. South hake assessment.

An update of Southern hake stock was performed. An extensive data analysis are presented. There are a big amount of catches and an increase in abundance indices for ages older than 4, coming from cohorts than were not supposed to be good. The

Bayesian statistical catch-at-age was performed and shows a two main problems: an underestimation of catches in recent years and a strong retrospective pattern.

WD 9

Ana Cláudia Fernandes, Dina Silva, Elisabete Henriques and Graça Pestana, 2009. Hake discards in Portuguese trawl fleets for 2004-2008 periods

Hake discards estimates from Portuguese Discard Sampling Programme presented this year have a correction of 2004-2007 periods' results (presented in previous meetings). They had to be corrected due to an observed duplication of effort data. This resulted in an overestimation of OTB_DEF discards estimates. Analysis of hake catch shows big fluctuations between years of discarded hake and with higher values when compared to landings. An exception was observed for 2006 where landings "dominated" total catch with 53% (910t landed vs. 821t discarded). Comparing discards estimates between OTB_DEF and OTB_CRU fleets, results show that this last fleet discards fewer amounts of hake in relation to OTB_DEF. This pattern seems to be changing from last year's results and in 2008 OTB_CRU reached 40% of total discarded with 465t. Graphics presented for hake discards length composition show differences between 2004-2006 and 2007-2008 periods: in the first period, OTB_DEF presented higher discards in numbers when compared with OTB_CRU but with similar length compositions and, for the last period, the difference of numbers discarded was not so pronounced but some differences in length compositions were observed.

WD 10

C. Fernández, S. Cerviño, N. Pérez and E. Jardim, 2009. Stock assessment and projections incorporating discards estimates in some years: An application to the hake stock in ICES divisions VIIIc and IXa.

A Bayesian age-structured stock assessment model is developed that takes into account the information available about discards and is able to handle gaps in the time series of discards estimates. The model incorporates a term reflecting mortality due to discarding and appropriate assumptions about how this mortality may change over time are made. The result is a stock assessment that takes due account of the available information on discards while, at the same time, producing a complete time series of discards estimates. The method is applied to the hake stock in ICES divisions VIIIc and IXa, which experiences very high discarding on the younger ages. The stock is fished by Spain and Portugal and for each country there are only discards estimates for recent years. Furthermore, the years for which Portuguese estimates are available are only a subset of the years with Spanish estimates. Two runs of the model are performed, one assuming zero discards and another one incorporating discards. Assessment results and projections of future stock trajectories are compared and discussed and implications for management commented on. Results show that not taking discards into account in the assessment process may drive predictions far away from reality.

WD 11

Cardador, F. 2009. Update Portuguese Trawl CPUE standardization for Anglerfish (ICES IXa).

Results of the Portuguese commercial trawl CPUE by each fleet component Crustacean (PTC) and Fish (PTF) are presented for 1989-2008. Data used were provided by the Portuguese Fisheries Administration (DGPA) and comprised the trawl logbooks for 1989-2008 with catches of anglerfish (both species combined) and vessel identification and type (Crustacean and Fish trawler).

Generalized linear models (GLM) were applied to the catch rates in kg/haul. The modelling approach consisted of adopting the gamma distribution with log link and a stepwise procedure that started by testing the significance of explanatory variables (factors). The factors retained for the final model were those with more than 1% contribution to the overall variance.

The results indicate that for the Portuguese Crustacean trawl the model fitted explains 18% of the overall variability of the catch rates and for the Portuguese Fish Trawl the model explains 27%. In both fleets the variance explained by the vessel category factor (7% for PTC and 16% for PTF) are higher than that explained by the year and quarter factors, indicating that vessel strategy has a major effect on CPUE.

The standardized CPUEs for 1989-2006 are very similar to the values estimated in 2008 with the same GLM procedure. The results for 2007-2008 show an increase in the catch rates of anglerfish for both fleet components when compared with 2006 estimates.

WD 12

Iñaki Quincoces, Marina Santurtún & Dorleta García 2009. Accounting for the influence of the biological parameters uncertainty in the perception of the Northern Hake stock status and management

The introduction of biological variability in forecasts of nothern hake stock recovery in the Bay of Biscay and the Celtic Sea is studied by modelling the possible error in ageing. Uncertainty in the catch at age associated to the ageing process is modelled assuming that the assignation of a wrong age to a certain age follows a multinomial distribution.

Annex C: Northern Stock of Hake

Quality Handbook **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:	7 May 2009
Revised by	

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 shown 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 70s 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

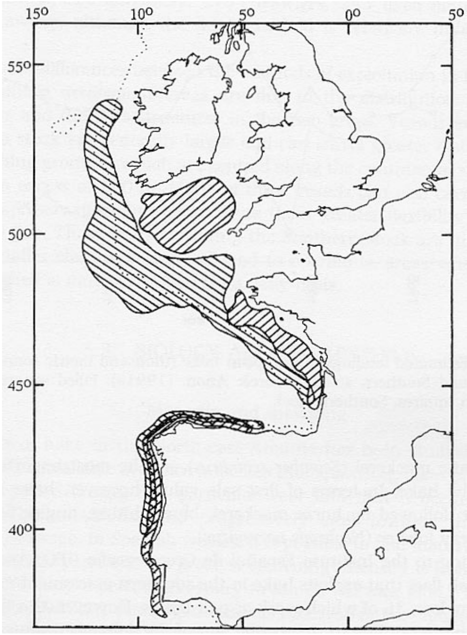

Figure 1. Main spawning and nursery areas. Spawning areas sloping downwards from left to right; Nursery areas sloping downwards from right to left. (from Casey and Pereiro 1995)

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 in 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, long line, and gill net). 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	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	

The main part of the fishery is currently conducted in six Fishery Units, three of them from Sub-area VII: FU 4, FU 1 and FU 3, two from Sub-area 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 Sub areas IV-VI-VII and VIII is set at 27 cm total length (30cm 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 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.
- 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.

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 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 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 Sub area 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 200m 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, seabass, 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 fishes. 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

Length compositions of the landings are not available for all Fishery Units, quarters and countries. Only the main FUs/Countries are sampled. For those not sampled, substitution of length distributions is conducted. Table 1 presents, as an example, the substitution carried out on 2008 data.

Table 1. Derivation of quarterly length compositions by country and fishery unit for 2008

Country		France	Ireland	Spain	UK(E+W)	Scotland	Denmark	Others
Unit	Quarter							
1	1			SP1.Q1.08	SP1.Q1.08			
	2			2	2			
	3			3	3			
	4			4	4			
2	1	SP1.Q1.08			SP1.Q1.08			
	2	2			2			
	3	3			3			
	4	4			4			
3	1	FR3.Q1.08		SP3.Q1.08	EW3.Q1.08			
	2	2		2	2			
	3	3		3	3			
	4	4		4	4			
4	1	SP4.Q1.08		SP4.Q1.08	EW4.Q1.08			
	2	2		2	2			
	3	3		3	3			
	4	4		4	4			
5	1	FR5.Q1.08			EW5.Q1.08			
	2	2			2			
	3	3			3			
	4	4			4			
6	1				EW6.Q1.08			
	2				2			
	3				3			
	4				4			
8	1	Raised to ALL						
	2							
	3							
	4							
9	1	FR9.Q1.08						
	2	2						
	3	3						
	4	4						
10	1	FR10.Q1.08						
	2	2						
	3	3						
	4	4						
12	1	FR12.Q1.08		SP12.Q1.08				
	2	2		2				
	3	3		3				
	4	4		4				
13	1	FR13.Q1.08		SP13.Q1.08				
	2	2		2				
	3	3		3				
	4	4		4				
14	1			SP14.Q1.08				
	2			2				
	3			3				
	4			4				
15	1		IR15.Q1.08					IR.15.Annual
	2		2					
	3		3					
	4		4					
16	1	SP.16.+DK.16Annual	SP.16.+DK.16Annual	SP16.Q1.08	SP.16.+DK.16Annual	SC16.Q1.08	DK16.Annual	SP.16.+DK.16Annual
	2			2		2		
	3			3		3		
	4			4		4		
00	1	Raised to All						
	2							
	3							
	4							
ALK	1	Annual (SP)						
	2							
	3							
	4							

B.1.2 Discards

Until 2002, the only discards series available to 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 program of discards in the French Nephrops trawlers fishery of the Bay of Biscay started in June 2002. Estimates obtained by this program (see Table 2 below) were significantly different (by a factor 2 to 10) from previous estimates for that fishery (estimates are from 532t in 2006 to 1597t in 2005). Such discrepancies could be explained by changes in the sampling, changes in the discarding practices, variations in the abundance of small fishes 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 gill-netters from 1995 to 2008. Their values are quite variable from year to year from 100 to 800t.

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 to previous years. Discards were estimated to vary from very small amounts to more than 1000t in 2003-2005 and over 2000t in 2008. CVs were highly variable from 20% to more than 100%. The current raising procedure based on landings is not considered satisfactory and will be revised in the near future. This may lead to important revision in discards estimates for those fleets. 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 2. 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
Spanish Trawl in VII	FU 4	**612**	**137**	**245**	NA	**1254**	**1089**	**1099**	**965**	**718**	**2141**
		4124	*1175*	*2354*	NA	*16143*	*10654*	*13376*	*5786*	*5554*	*25059*
French Nephrops trawl in VIIIabd	FU9	**565**	**341**	**417**	**172**	**1035**	**1359**	**1597**	**532**	**767**	**858**
		9139	*7421*	*6407*	*2992*	*23676*	*39550*	*37740*	*18031*	*24277*	*18245*
French trawl in VIIIabd	FU10	**211**	**169**	**100**	**142**	NA	NA	NA	NA	NA	NA
		3053	*3013*	*1439*	*2253*	NA	NA	NA	NA	NA	NA
Spanish trawl in VIIIabd	FU14	NA	NA	NA	NA	NA	**30**	**489**	**206**	**471**	**352**
		NA	NA	NA	NA	NA	*451*	*8475*	*3397*	*10002*	*7153*
Irish trawl and seine in VII	FU15	**190**	**650**	**194**	NA	NA	**32**	**94**	*	*	*
		1868	*892*	*1046*	NA	NA	282	*629*	*	*	*
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**
		NA	NA	NA	NA	NA	NA	NA	NA	NA	*11*
Danish trawl and seine	FU16	**42**	**21**	**142**	**354**	**242**	**206**	**814**	**610**	**255**	**190**
		29	*38*	*483*	*691*	*479*	*775*	NA	NA	*849*	*642*
Total Weight from sampled fleet (t)		**1620**	**1319**	**1098**	**668**	**2531**	**2716**	**3278**	**1702**	**1957**	**3547**
Total Number from sampled fleets ('000)		*18213*	*12539*	*11730*	*5935*	*40299*	*51712*	*60220*	*27215*	*39833*	*51110*

* sampled but not raised

Although some improvement in discard data availability has recently been observed (number of fleets sampled and area coverage), sampling does not cover all fleets contributing to hake catches, discard rates of several fleets are simply not known and when data are available, it is not possible to incorporate them in a consistent way. Furthermore, reconstructing an historical series is problematic. Since the 2003 Working Group, discard estimates have been removed from the full time series of catch data. The assessment is thus conducted on landings only.

Conversion from length to age is carried out with an age-length key (ALK). ALKs based on otolith (sagitta) reading for northern hake are used since 1992 (Table 3.) ; prior to that, age composition of the catches was estimated using a numerical method. When several ALKs are combined, the annual ALK is obtained by summing the number of otolith read at age.

Table 3. History of the ALK used for Northern hake assessment.

ALK	Before 1992	1992 - 1998	1999	2000 - 2002	2003 - 2004	2005 - 2007	2008
Numerical	X						
French		X	X	X	X	X	
Spanish-AZTI			X	X	X	X	X
Spanish-IEO			X	X	X	X	X
Irish					X		

There is a low confidence in the estimate of age 0 in the landings because of inconsistencies in the data for this age group in recent years. Therefore, age 0 has been removed from the catch at age matrix (replaced with 0 landings) and from the commercial fleet tuning indices since the 2003 WG. However, age 0 is still included in the assessment because indices for age 0 are available from surveys.

B.2. Biological

Mean weight at age are estimated from a fixed length-weight relationship (W(g)= 0.00513*L(cm)^3.074; ICES, 1991b)

In the absence of a direct estimate of natural mortality, a constant value of 0.2 was assumed for all age classes and years.

The time invariant maturity ogive, for both sexes combined is (Martin, 1991; ICES, 1993):

Age	0	1	2	3	4	5	6+
Proportion mature	0.0	0.0	0.0	0.2	0.6	0.9	1.0

There is concern over age estimation (loss in precision in recent years and non validated ageing criteria). Some preliminary results on growth and accuracy of age determination from otolith reading were obtained from a tagging study conducted in 2002 in the Bay of Biscay (de Pontual et al. 2003., de Pontual, pers. comm.). They show under-estimation of growth and inaccuracy in the current ageing criteria used by hake otolith readers.

Proportion of F and M prior to spawning are specified as zero to give estimates of spawning stock biomass referred to January 1. In the absence of independent estimates, the mean weights at age in the total catch are assumed to represent the mean weights in the stock.

B.3. Surveys

Abundance indices are available from the following research-vessel surveys:

French Evhoe groundfish survey (FR-EVHOES): years 1997 – present. The survey occurs in autumn. The α and β of the tuning series in the XSA assessment were set to account for the timing of this survey within the year. The survey uses a GOV trawl with a 20mm cod-end liner. It covers the shelf of both the Bay of Biscay and the Celtic Sea (Figure 2). Numbers at age for this abundance index are estimated from otoliths collected during the survey.

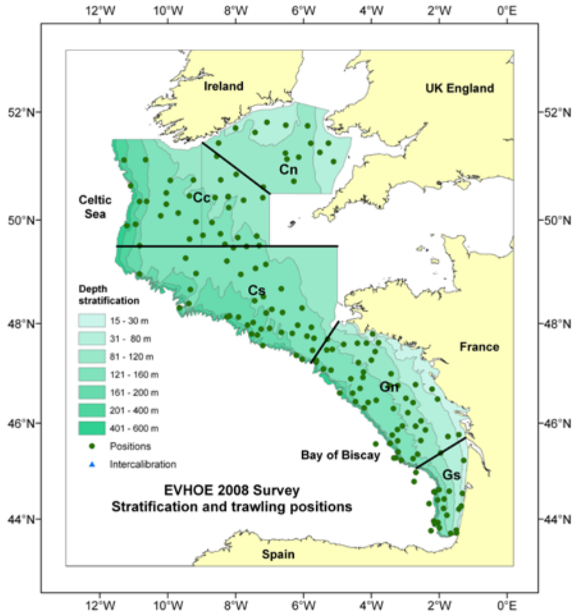

Figure 2. Map of Evhoe stratification and trawling positions

French Ressgasc groundfish survey (FR-RESSGASCS): years 1978 to 2002. Over the years 1978-1997 the FR-RESSGASCS 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, since there was a change of vessel at that time. Weather conditions encountered by FR-RESSGASCS in 2002 gives to this index a poor reliability and it was decided not to use it. The survey uses a 25m "Vendéen type" bottom trawl. It covers the Bay of Biscay. Numbers at age for this abundance index are estimated from otoliths collected during the survey. The survey ended in 2002.

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.

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.

B.4. Commercial CPUE

Landings-per-unit-effort time series are available from the following fleets:

Commercial fleets used in recent assessments to tune the XSA model

Data from several Spanish fleets have been used for tuning the XSA, namely trawlers from A Coruña and Vigo fishing in Sub-area VII (SP-CORUTR7 and SP-VIGOTR7), pair trawlers 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 Div. VIIb-c, j-k, while the trawler fleet from Vigo, targeting megrim, works in shallower waters in Div. VIIj-h and catch hake as by-catch. Both pair trawler fleets from Ondarroa and Pasajes are targeting hake in the Bay of Biscay.

The Spanish landings data used in the Northern Hake assessment are based on sales notes and Owners Associations data compiled by IEO; and Basque Country sales notes and Ship Owners data compiled by AZTI.

Other available commercial fleets not used in recent assessments to tune the XSA model.

Effort and LPUE data for some other Spanish fleets fishing in Subarea VI, VII and Divisions VIIIa,b,d have been provided to the Working Group.

They are Ondarroa "Baka" trawlers fishing in Subareas VI, VII and Div. VIIIa,b,d, Pasajes "Bou" trawlers fishing in Sub-area 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 gill-netters 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 gill-netters and long liners, 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 log-book 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: XSA.

Software used: VPA v. 3.1 (Darby and Flatman, 1994).

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 data series. 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, whilst 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.

Only update runs have been performed since 2008. These runs use catch at age estimated with an ALK based on otolith readings and no further sensitivity analyses have been conducted.

Model Options chosen:

Working Groups	1999		2000		2001		2002		2003		2004	
SP-CORUTR7	86-98	2-8	86-99	5-8	85-00	3-8	85-01	3-7	85-02	3-7	85-03	3-7
SP-VIGOTR7					82-00	3-8	82-01	2-7	82-02	2-7	82-03	2-7
SP-PASAJES8	86-98	2-8	-	-	-	-	-	-	-	-	-	-
SP-BOU_PA8	-	-	-	-	-	-	86-98	3-7	86-98	3-7	-	-
SP-PAIRT_ON8	-	-	-	-	94-00	2-6	94-01	2-6	94-02	2-6	94-03	2-6
SP-PAIRT_PA8	-	-	-	-	94-00	3-6	94-01	3-6	94-02	3-6	94-03	3-6
FR-LESCONIL	87-98	0-5	87-98	0-5	87-00	0-5	87-01	1-5	87-02	1-5	-	-
FR-LESSABLES	87-98	0-5	87-98	1-5	87-00	1-5	87-01	1-5	87-02	1-5	-	-
FR-RESSGASCS	87-98	0-5	87-99	0-5	87-00	0-5	87-01	0-5	87-02	0-5	87-01	0-5
FR-EVHOES	-	-	-	-	97-00	0-5	97-01	0-5	97-02	0-5	97-03	0-5
UK-WCGFS	88-98	1-2		-	88-00	1-2	88-01	1-2	88-02	1-2	88-03	1-2
Taper	No		No		Yes[1]		Yes[1]		Yes[1]		Yes[1]	
Tuning range	13		14		Full		Full		Full		Full	
Ages catch dep. stock size	No		No		No		No		No		No	
q plateau	6		6		6		6		6		6	
F shrinkage se	1.0		1.0		1.0		1.0		1.0		1.0	
year range	5		5		5		5		5		5	
age range	4		4		4		4		4		4	

[1] : tri-cubic over 20 years

Working Groups	**2005 to 2007** Update		**2005 to 2007** Simulated ALK		**2008 to present** Update	
SP-CORUTR7	85-final year	3-7	-	-	85-final year	3-7
SP-VIGOTR7	82-final year	2-7	82-05	1-5	82-final year	2-7
SP-PAIRT_ON8	94-Final year	2-6	94-05	1-3	94-final year	2-6
SP-PAIRT_PA8	94-final year	3-6	94-05	1-3	94-final year	3-6
FR-RESSGASCS	87-01	0-5	87-01	0-5	87-01	0-5
FR-EVHOES	97-final year	0-5	97-05	0-4	97-final year	0-5
UK-WCGFS	88-fianl year	1-2	88-04	1-2	88-04	1-2
SP-PGFS	01-final year	2-7	01-05	0-7	01-final year	2-7
Taper		Yes[1]		Yes[1]		Yes[1]
Tuning range		Full		Full		Full
Ages catch dep. stock size		No		No		No
q plateau		6		6		6
F shrinkage se		1.0		1.0		1.0
year range		5		5		5
age range		4		4		4

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1978-2008	0-8+	Yes
Canum	Catch at age in numbers	1978-2008	0-8+	Yes
Weca	Weight at age in the commercial catch	1978-2008	0-8+	Yes
West	Weight at age of the spawning stock at spawning time.	1978-2008	0-8+	Yes
Mprop	Proportion of natural mortality before spawning	1978-2008		No
Fprop	Proportion of fishing mortality before spawning	1978-2008		No
Matprop	Proportion mature at age	1978-2008	0-8+	No
Natmor	Natural mortality	1978-2008	0-8+	No

Tuning data:

Type	Name	Year range	Age range
Commercial	SP-CORUTR7	85-final year	3-7
Commercial	SP-VIGOTR7	82-final year	2-7
Commercial	SP-PAIRT_ON8	94-final year	2-6
Commercial	SP-PAIRT_PA8	94-07	3-6
Survey	FR-RESSGASCS	87-01	0-5
Survey	FR-EVHOES	97-final year	0-5
Survey	UK-WCGFS	88-04	1-2
Survey	SP-PGFS	01-final year	2-7

D. Short-Term Projection

- Model used: Age structured
- Software used: MFDP prediction with management option table and yield per recruit routines.
- Initial stock size. Taken from the XSA survivors. The recruitment at age 0 in the final 2 assessment years is estimated as a short-term GM (1990 until final assessment year minus 2).
- 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.
- 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: Unscaled mean F from the final 3 assessment years (to reflect recent selection patterns).
- Intermediate year assumptions: status quo F
- Stock recruitment model used: None, the short-term geometric mean (1990 until final assessment year minus 2) recruitment at age 0 is used.

E. Medium-Term Projections

No medium term projections are done for this stock

F. Long-Term Projections

- Model used: yield and biomass per recruit over a range of F values.
- Software used: MFYPR
- Selectivity pattern: unscaled mean F from the final 3 assessment years (to reflect recent selection patterns).
- Stock and catch weights-at-age: mean of last three years.
- 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. The new points are presented in the table below together with previous values.

	WG 1998	ACFM 1998	ACFM 2003
$\mathbf{F}_{lim}$	No proposal	0.28 (= $\mathbf{F}_{loss}$ WG 98)	0.35(= $\mathbf{F}_{loss}$ WG 03)
$\mathbf{F}_{pa}$	No proposal	0.20 (= $\mathbf{F}_{lim}$*$e^{-1.645*0.2}$)	0.25(= $\mathbf{F}_{lim}$*$e^{-1.645*0.2}$)
$\mathbf{B}_{lim}$	No proposal	120 000 t (~ $\mathbf{B}_{loss}$= B_{94})	100 000t(~ $\mathbf{B}_{loss}$= B_{94})
$\mathbf{B}_{pa}$	119 000 t (=$\mathbf{B}_{loss}$= B_{94})	165 000 t (= $\mathbf{B}_{lim}$*$e^{1.645*0.2}$)	140 000t(= $\mathbf{B}_{lim}$*$e^{1.645*0.2}$)

H. Other Issues

None

I. References

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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 As sessment 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
	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
VIIb-k	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
	FU 9 Nephrops	FR	Q	FR.09.08
VIIIa,b	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

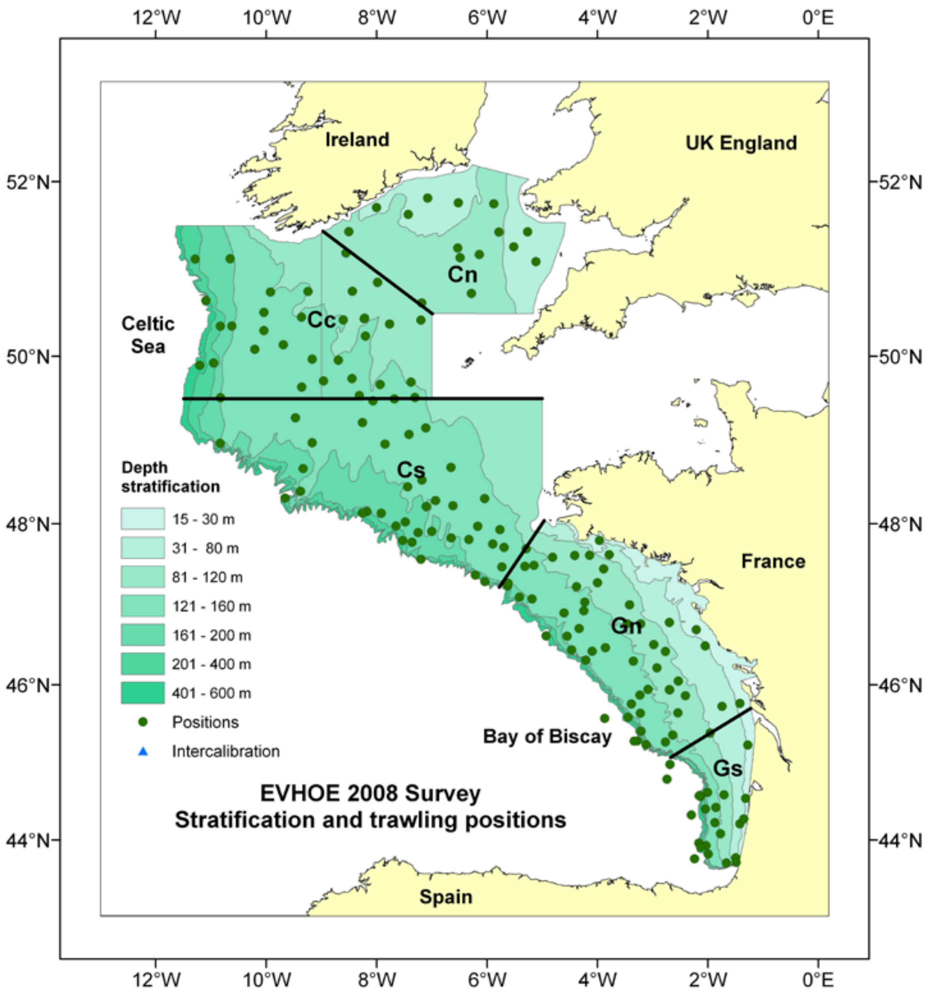
In 2007, WGHMM rejected the XSA age based assessments of both species because of data quality (increased discards not incorporated) and ageing problems clearly identified. Therefore there is no age based data used to assess the stocks. Only length distributions of landings and survey indices are used.

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

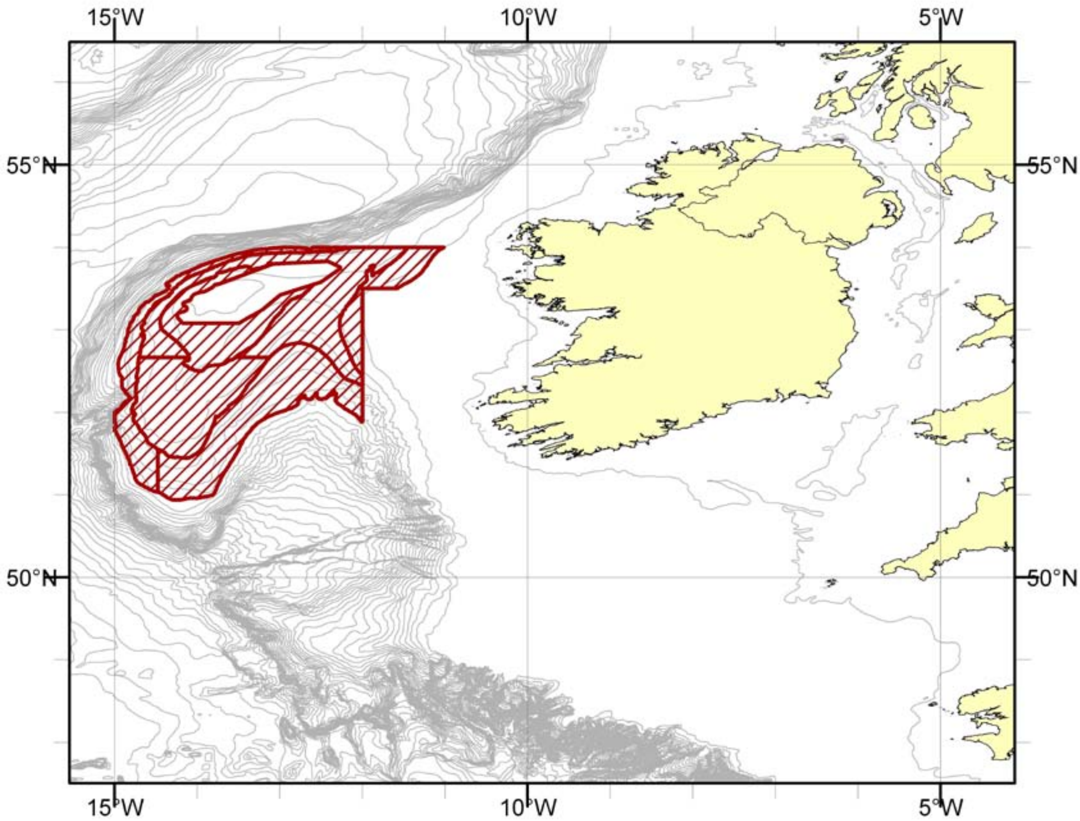
This survey covers the largest proportion of the area of stock distribution. It started in 1997.



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 in Divisions VIIb-k and VIIIa,b,d

Quality Handbook	**ANNEX E: Megrim in Divisions VIIb-k and VIIIa,b,d**

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Megrim (*Lepidorhombus whiffiagonis*) in Divi sions 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
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 Sub-area 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 Sub-area 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****

-In bold: years where discards sampling programs provided information

-In bold and *: years where discards sampling programs provided information but are not used in the derivation

- In bold and * (italics): years where discards sampling programs provided information, just at sampling level, 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.

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

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 1997–2008 are available.

An abundance index was provided for the Spanish Porcupine Ground Fish Survey from 2001 to 2008. 2008 data has not been incorporated in this update assessment as commented in the general introduction.

Irish Ground Fish Survey is also from 2003 to 2008.

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	1997-2008	1-9
Spanish Porcupine Ground Fish Survey	SP-PGFS	2001-2008	0-10+
Irish Ground Fish Survey	IR-GFS	2003-2008	0-10+

Surveys used in the update assessment:

Type	Name	Year range	Age range
French EVHOE Survey	FR – EVHOES	1997-2008	1-9
Spanish Porcupine Ground Fish Survey	SP-PGFS	2001-2007	0-10+
Irish Ground Fish Survey	IR-GFS	2003-2008	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 2008, and Vigo (SP-VIGOTR7) 1984–2008. 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. 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 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 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.

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Annex F: Bay of Biscay Sole

Quality Handbook **ANNEX: D – Bay of Biscay Sole**

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 2009 (G. Biais)

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 150m, 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).

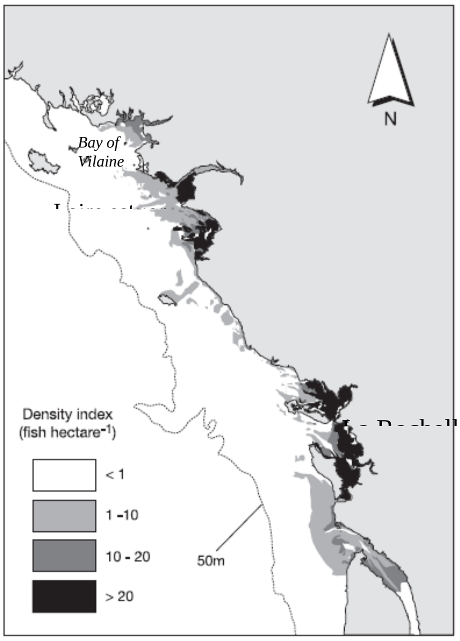


Figure 1 : Fitted 0-group sole density (number of fish per hectare) in the Bay of Biscay (Le Pape *et al.*, 2003a).

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.

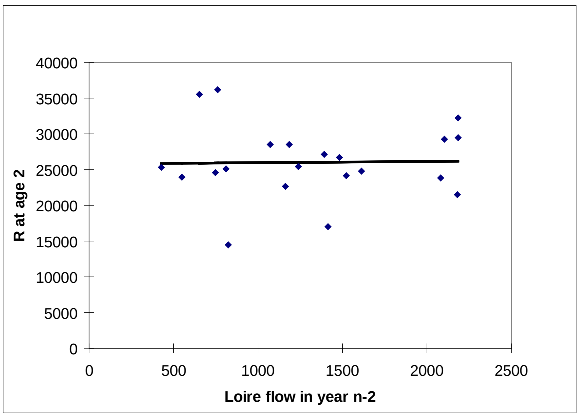
Catches have increased continuously since the beginning of the 1980s, until a maximum was reached in 1994 (7 400 t). They have decreased afterwards to 4000-4800t in 2003-2008.

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 12m 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

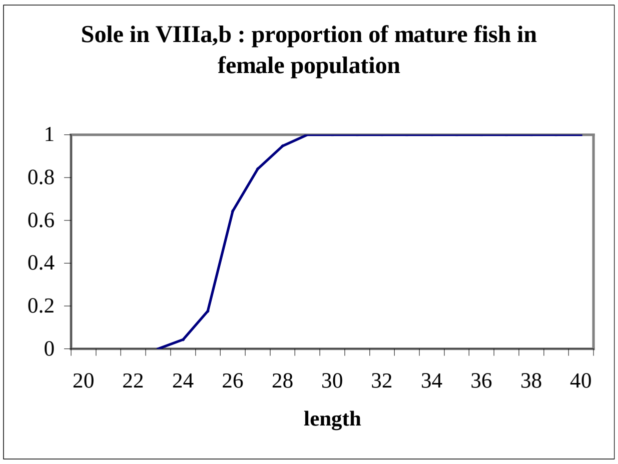
<u>Weights at Age</u>

French mean weights at age are estimated using quarterly length-weight relationships. Belgian mean weight 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.

<u>Maturity ogive</u>

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.

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
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
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+
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
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
FR – ROCHEL1	Not used	Not used	Not used	Not used	Not used	84-92 2-7	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
FR – OTHER	Not used	Not used	Not used	Not used	Not used	Not used	95-04 2-7	Removed	**REMOVED**	**REMOVED**	**REMOVED**
FR – RESSGASC-S	88-97 1-7	89-98 1-7	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
FR – RESSGASC-S 3	Not used	Not used	87-97 2-6	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
Taper	No	No	Yes	Yes	**YES**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Tuning range	10	10	17	18	**19**	**20**	**18**	19	20	21	22
Ages catch dep. Stock size	No	No	No	No	No	No	No	No	No	No	No
Q plateau	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
Year range	5	5	5	5	5	5	5	5	5	5	5
age range	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
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

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	
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	GM	GM	GM	GM	
Age 3	Derived from GM	Derived from GM	Derived from GM	Derived from GM	Derived from GM	
Age>3	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	
Weight at age	Unweighted 02-04	Unweighted 03-05	Unweighted 04-06	Unweighted 05-07	Unweighted 06-08	

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 2009: recruitment is at age 2. XSA last year numbers are considered poorly estimated and are overwritten using a geometric mean of past recruitment values.

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.

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	ACFM 2006
			Change in maturity ogive	Change in recruitment age and in FBar age range	Change in Fbar age range
$\mathbf{F}_{lim}$	Not defined	Not defined	0.5 (potential collapse)	Not defined	$\mathbf{F}_{lim}$=0.58 (potential collapse)
$\mathbf{F}_{pa}$	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	$\mathbf{F}_{pa} = \mathbf{F}_{lim}\ e^{(-1.645 * .2)}$ = 0.42
$\mathbf{B}_{lim}$	Not defined	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	13 000t

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
Date:	May 2009
Revised by	Santiago Cerviño and Ernesto Jardim

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*". Castillo *et al.* (2005) also identified a more complex genetic structure where Cádiz hake was found genetically closer to Atlantic hake than Mediterranean Hake.

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. SSB and F bar trends are quite similar compared with model without cannibalism, Recruitment are higher. 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.

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.

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 total number of trips, performed by each fleet is used to estimate discards. This seems to be the best sampling variable to use, as there is no correlation between landings and discards.

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 and ALK since 2000.

The length composition sampling design follows a multistage stratified random scheme by quarter, harbour and gear. The age sampling scheme follows a stratified random sampling design by length class of 1 cm.

An international length-weight relationship for the whole period has been used since 1999 (a=0.00000659, b=3.01721).

An annual Iberian ALK for landings has been used since 2001 combining IEO, AZTI and IPIMAR age readings. Commercial and survey ALKs are available from 1993, with the exception of the Spanish survey which has ALKs from 1994. Catches at age for the years without ALK were estimated using combined ALKs from nearby years .

Mean weights at age in the stock are estimated from the mean weights at age in the catch.

Natural mortality was assumed to be 0.2 year^{-1} for all age groups in all years.

Maturity proportions-at-age was estimated with sexes combined from IEO sampling. Proportion mature at age are estimated by fitting a GAM to the weighted mean of proportion of males and proportion of females by the sex ratio. Data available from IPIMAR and AZTI since 2004 were not considered since they produce bias in the temporal series.

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)** survey has used a fixed sampling design since 1989, covering the whole Portuguese continental shelf. Since 2002 haul duration has been 30 minutes. Prior to this, haul duration was 1 hour. In 1996, 1999, 2003 and 2004 the R/V *Capricórnio* with a CAR gear was used instead of the R/V *Noruega* with a NCT gear. Recent work on calibration of these vessels showed a higher catchability of *Capricórnio*, in particular at lower sizes. Ages 0 and 1 for these years were excluded in the calibration procedure.

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

B.5. Other relevant data

[NA]

C. Historical Stock Development

2009 Assessment:

Model used: Bayesian statistical catch-at-age (since 2008. XSA before 2008)

Software used: Ad-hoc R script available in the Sharepoint. To run it is needed R, FLCORE, WinBUGS and R2WinBugs, availables in “software” folder. Assessment control is exerted from R script “test_bayFunc.R”.

Model Description:

The dynamics of the stock are modelled forwards in time. Starting from yearly recruitments and numbers-at-age in the first year, the entire matrix of numbers-at-age is obtained applying to them the natural mortality (assumed to be M=0.2) and fishing mortality rates. Fishing mortality at age is assumed to be separable, with an overall yearly fishing level f(y) and a selection pattern at age constant over a period of time. Two periods of separability are considered: there is a selection pattern r(a,1) covering all years until 1994 and another selection pattern r(a,2) starting from 1995. For identifiably of these parameters, the selection pattern at age a=6 is taken equal to 1, so the yearly fishing level f(y) corresponds to fishing mortality at age 6.

The data to fit the model consist of estimated landed numbers at age and abundance indices at age. There are 5 tuning fleets (Spanish survey, Portuguese survey, Coruña commercial trawl until 1993, Coruña commercial trawl from 1994 and Portuguese commercial trawl from 1995) that provide abundance indices and a log-normal error structure is assumed. Each age and index has its own catchability parameter, assumed constant over time. Catchability values for ages 6 and older are taken to be the same (q plateau at age 6). Commercial catch according to the model is given by the usual Baranov catch equation and the observed (i.e. estimated) landed numbers at age relate to the latter via a log-normal error distribution.

All prior distributions are centred at values considered reasonable, but were given high dispersion (large variance or coefficient of variation) to reflect the idea of "little prior knowledge". In this way, the results from the model fit should be driven mainly by the information contained in the data (international catch matrix and tuning indices) and not by the prior.

Model equations

Let N(y, a) denote the number of individuals of age *a* = 0,…,A in year *y* = 1,…, Y. Age *a* = 0 corresponds to the recruits and A = 8+ to a plus group. Year *y* = 1 corresponds to 1982 and y = Y to final assessment year.

1 - POPULATION EQUATIONS AND PRIOR:

The model considers forward dynamics. Starting from recruits each year and from individuals aged 1 and older in the first year, the dynamics of the population are modelled forwards in time, taking into account natural and fishing mortality.

• RECRUITS EACH YEAR: For y = 1,…, Y we take the prior distribution

$$\log(N(y,0)) \sim N[\log(medrec), \mathrm{var} = \log(1 + cvrec^2)]$$

where *medrec* and *cvrec* are some suitably chosen values.

When considering recruitment in the original (non-logged) scale, *medrec* and *cvrec* respectively correspond to the median value and coefficient of variation of the prior distribution.

• NUMBERS-AT-AGE IN INITIAL YEAR: For a = 1,…,A in year y = 1 we take the

prior distribution

$$\log(N(1,a)) \sim N[logmedyear1(a), \mathrm{var} = \log(1 + cvyear1^2)]$$

where *logmedyear1*(a) and *cvyear1* are suitably chosen values. In original (non-logged) scale, exp(*logmedyear1*(a)) and *cvyear1* correspond to the median and coefficient of variation of the prior distribution of numbers aged a in the first year.

For *a = 1,…,A − 1*, we have taken:

$$\text{(1)} \quad logmedyear1(a) = \log(medrec) - aM - \sum_{j=0}^{a-1} medFyear1(j)$$

For *a* = *A*, the plus group, we have taken:

(2)

$$logmedyear1(A) = \log(medrec) - AM - \sum_{j=0}^{A-1} medFyear1(j) - \log\left[1 - \exp\{-M - medFyear1(A)\}\right.$$

where *medrec* is the prior median value of recruitment, *M* = 0.2 is the assumed natural mortality rate and *medFyear1*(a) is a prior guess regarding fishing mortality at age *a* in the first year.

• POPULATION DYNAMICS: For years y = 2,…, Y we assume deterministic population dynamics as follows

For ages $a = 1, \ldots, A - 1$:

$$N(y,a) = N(y-1,a-1)\exp(-Z(y-1,a-1))$$

For age $a = A$ (plus group):

$$N(y,A) = N(y-1,A-1)\exp(-Z(y-1,A-1)) + N(y-1,A)\exp(-Z(y-1,A))$$

for all y and a:

$$Z(y,a) = M + F(y,a)$$

where the total mortality rate $Z(y, a)$ is the sum of the natural mortality rate M) and the fishing mortality rate $F(y, a)$.

• SEPARABLE FISHING MORTALITY: We assume a separable model for $F(y, a)$, with two time periods for separability with cut point in some year $Yc < Y$ (Yc = 1994). Hence, there is a first period covering $y = 1, \ldots, Yc$ and a second period covering $y = 1+Yc, \ldots, Y$, and we assume:

$$F(y, a) = f(y)\, r(a, 1), \text{ if } y \leq Yc;$$

$$F(y, a) = f(y)\, r(a, 2), \text{ if } y > Yc.$$

Not all parameters intervening in $F(y, a)$ are separately identified. For each of the two periods of separability, multiplying all $f(y)$ in that period by a constant c while dividing the exploitation pattern at age for that period by the same constant c would leave $F(y, a)$ unchanged. A way to identify the model parameters is by fixing one value of the exploitation pattern at age in each of the two separability periods. For both periods k = 1, 2, we have taken

$$r(a=6,k)=1$$

(i.e. exploitation pattern at age a = 6 equal to 1). Note that this implies $f(y) = F(y, 6)$, i.e. $f(y)$ corresponds to fishing mortality at age 6. We have further assumed

$$r(a=0,k)=0$$

for both time periods (implying no fishing mortality at age 0), since commercial catches of age 0 are recorded as zeroes. For ages different than 0 or 6, we have assumed independent prior distributions

$$r(a,k) \sim Uniform(0, r\max)$$

for both time periods, where $rmax$ is a positive value.

For $y = 1, \ldots, Y$, we take the prior

$$\log(f(y)) \sim N(\log(medf), var = \log(1 + cvf^2))$$

for some suitably chosen values of $medf$ and cvf. These values correspond to the median and coefficient of variation of the prior distribution of f(y) in original (non-logged) scale.

2 - OBSERVATION EQUATIONS AND PRIORS:

Two types of observations provide information about the population parameters and population numbers at age: commercial landings and abundance indices, with the latter coming both from surveys and LPUEs of commercial fleets.

ABUNDANCE INDICES: We have f = 1,…, 5 tuning fleets (a Spanish survey, a Portuguese survey, the Coruña trawl commercial fleet separated in two different periods and the Portuguese trawl fleet) that provide abundance indices in the form of numbers caught (or landed, in the case of commercial fleets) per unit effort, for each of the ages and years (there are some missing ages and years; this causes no difficulty to the fitting methodology).

Let $I_f(y, a)$ denote the observed abundance index from fleet f for age a in year y, and let (α_f , α_f) be the portion of the year over which that fleet operates. We assume a log-Normal observation equation for the fleet index as follows:

$$\log(I_f(y,a)) \sim N(\log(\mu_f(y,a), \mathrm{var} = 1/\psi_f(a))$$

Where:

$$\mu_f(y,a) = q_f(a)N(y,a)\frac{\exp(-\alpha_f Z(y,a)) - \exp(-\beta_f Z(y,a))}{(\beta_f - \alpha_f)Z(y,a)}$$

For the fleets' catchabilities, we have assumed $q_f(a) = q_f(6)$ for all $a > 6$ and for each $a \leq 6$ we have taken the prior

$$\log(q_f(a)) \approx N(\mu(\log(q_f)), \mathrm{var} = \sigma^2(\log(q_f)))$$

for some chosen values $\mu(\log(q_f))$ and σ^2 $(\log(q_f))$.

For the precision (inverse of variance) of the fleet index, we have taken for each age a in the fleet the prior

$$\psi_f(a) \sim Gamma(shape = s1_f, rate = s2_f)$$

COMMERCIAL CATCH: From Baranov catch equation, catch numbers of age a in year y are

$$C_{\mathrm{mod}}(y,a) = N(y,a)\{1 - \exp(-Z(y,a))\}\frac{F(y,a)}{Z(y,a)}$$

and assuming a log-Normal observation error for observed (i.e. estimated) catch, we obtain the observation equation:

$$\log(C_{obs}(y,a)) \approx N(\log(C_{\mathrm{mod}}(y,a)), \mathrm{var} = 1/\psi_C(a))$$

For the precision of this observation equation, we have taken the following prior distribution for each age

$$\psi_C(a) \approx Gamma(shape = s1_C, rate = s2_C)$$

The Bayesian model was fitted using a Markov chain Monte Carlo (MCMC) computational algorithm. The model was programmed in the software WinBUGS and run from R using the package R2WinBUGS. MCMC is a very powerful simulation methodology, capable of simulating high-dimensional distributions, but subsequent draws ("iterations") are correlated.

Model Options chosen:

The prior distributions used are presented in the table below. The log-Normal distributions have been parameterised with the median and coefficient of variation, and the Gamma distributions with the standard shape and rate parameters. The prior median values for numbers-at-age in the first year were derived by considering reasonable values for recruitment and fishing mortality at age and applying the latter until reaching each of the ages (see equations 1 and 2). As for all other priors, a large coefficient of variation was assumed. The catchabilities of the different tuning fleets and ages were assigned the same log-Normal prior distribution. As indicated already, log-Normal errors were assumed for the abundance indices and commercial landings at age estimates. In logarithmic scale, the precisions (inverse of variances) of the corresponding Normal distributions were assigned a Gamma (s1,s2) prior distribution, with s1= 4, s2=0.345 for all ages in the 5 tuning fleets and commercial catch-at-age estimates. In the original (non-logarithmic) scale this gives a prior median value for the coefficient of variation of 30%, with (20%, 61%) as 95% prior credible interval.

Priors table

prior	distribution
N1982,0, ..., N2008,0	log-Normal (40000,1.5)
N1982,1	log-Normal (32749,2)
N1983,2	log-Normal (21952,2)
N1983,3	log-Normal (10901,2)
N1982,4	log-Normal (5413,2)
N1983,5	log-Normal (2688,2)
N1982,6,	log-Normal (1335,2)
N1982,7	log-Normal (663,2)
N1982,8	log-Normal (654,2)
f year (1982-2008)	log-Normal (0.6,1)
r (a,1) [ages 1 to 8+]	Unif (0,2)
r (a,2) [ages 1 to 8+]	Unif (0,2)
(r (6,)=1)	
q (a), all fleets and ages	log-Normal (exp(-7), 12)
Ψf(a), all fleets and ages	gamma (4, 0.345)
Ψc(a), all fleets and ages	gamma (4, 0.345)

The fleets used for tuning the assessment model are presented below:

Type	Name	Comments
Portuguese Trawl	P-TR-89	Not used
	P-TR-95	used
Spanish A Coruña Trawl VIIIc	SP-CORUTR8c-85	Used
	SP-CORUTR8c-94	used
Spanish A Coruña Pair Trawl VIIIc	SP-CORUTRP8c-85	Not used
	SP-CORUTRP8c-94	Not Used
Santander Trawl	SP-SANTR	Not Used
Vigo/Marin Trawl	SP-VIMATR	Not used
Spanish GFS	SP-GFS	Used
Portuguese GFS July	P-GFS-jul	Not used
Portuguese GFS October	P-GFS-oct	Used
Cadiz GFS - Autumn	SP-GFS- caut	Not used

D. Short-Term Projection

Model used: Stochastic age structured forward projection

Software used: R script with FLR libraries (\Data\hke-south\Final Runs\ Forecast\ stochproj.R)

Initial stock size: 5000 iterations of abundance-at-age in last year. Age 0 included.

Maturity: arithmetic mean of last 3 years

F and M before spawning: 0

Weight at age in the stock: arithmetic mean of last 3 years

Weight at age in the catch: arithmetic mean of last 3 years

Exploitation pattern: F arithmetic mean of last 3 years

Intermediate year assumptions: F = last assessment year F

Stock recruitment model used: resampling historical estimates since 1989 until the last assessment year.

Procedures used for splitting projected catches: NA

E. Medium-Term Projections

NA

F. Long-Term Projections

Model used: YPR and BPR

Software used: Ad-hoc R script (\Data\hke-south\Final Runs\ Forecast\test_BRP.R)

Maturity: arithmetic mean of last 3 years

F and M before spawning: NA

Weight at age in the stock: arithmetic mean of last 3 years

Weight at age in the catch: arithmetic mean of last 3 years

Exploitation pattern: arithmetic mean of last 3 years

Procedures used for splitting projected catches: NA

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

NA

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Annex H: ANGLERFISH – L. Piscatorius and L. Budegassa

H1 - *L. piscatorius* Aspic bootstrp output

```
Southern Anglerfish - L.piscatorius-2009 - RUN 1                                                        Page 1
                                                                        Wednesday, 29 Apr 2009 at 14:54:21
ASPIC -- A Surplus-Production Model Including Covariates (Ver. 5.16)
                                                                                           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:\documents and settings\paz\escritorio\aspic suite 5.0\asp
-----------------------------------------------------------------------------------------------------------------------
Operation of ASPIC:  Fit logistic (Schaefer) model by direct optimization with bootstrap.
Number of years analyzed:                      29          Number of bootstrap trials:                        500
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  Coruna                             |   1.000
                                       |      23
                                       |
 2  Cedeira                            |   0.704   1.000
                                       |      10      10
                                       -------------------------------------------------
                                              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                               3.816E+00     23   1.817E-01    1.000E+00    9.446E-01        0.619
Loss(2)   Cedeira                              1.218E+00     10   1.523E-01    1.000E+00    1.127E+00        0.123
.....................................................................................
TOTAL OBJECTIVE FUNCTION, MSE, RMSE:      5.03394897E+00          1.798E-01    4.240E-01
Estimated contrast index (ideal = 1.0):           0.3642          C* = (Bmax-Bmin)/K
Estimated nearness index (ideal = 1.0):           0.9296          N* = 1 - |min(B-Bmsy)|/K




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MODEL PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
-----------------------------------------------------------------------------------------------------------------------
Parameter                                       Estimate     User/pgm guess    2nd guess     Estimated   User guess

B1/K      Starting relative biomass (in 1980)   4.080E-01         5.000E-01    7.075E-01             1            1
MSY       Maximum sustainable yield             5.668E+03         5.000E+03    3.111E+03             1            1
K         Maximum population size               3.266E+04         5.000E+04    1.867E+04             1            1
phi       Shape of production curve (Bmsy/K)    0.5000            0.5000            ----             0            1

--------- Catchability Coefficients by Data Series ---------------
q(1)      Coruna                                2.437E-06         1.000E-05    9.500E-04             1            1
q(2)      Cedeira                               1.521E-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             5.668E+03                           ----                     ----
Bmsy      Stock biomass giving MSY              1.633E+04                            K/2          K*n**(1/(1-n))
Fmsy      Fishing mortality rate at MSY         3.471E-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(2009)/Bmsy                   2.701E-01                           ----                     ----
F./Fmsy   Ratio: F(2008)/Fmsy                   1.571E+00                           ----                     ----
Fmsy/F.   Ratio: Fmsy/F(2008)                   6.367E-01                           ----                     ----

Y.(Fmsy)  Approx. yield available at Fmsy in 2009  1.531E+03                    MSY*B./Bmsy              MSY*B./Bmsy
          ...as proportion of MSY               2.701E-01                           ----                     ----
Ye.       Equilibrium yield available in 2009   2.648E+03            4*MSY*(B/K-(B/K)**2)     g*MSY*(B/K-(B/K)**n)
          ...as proportion of MSY               4.672E-01                           ----                     ----

--------- Fishing effort rate at MSY in units of each CE or CC series ---------
fmsy(1)   Coruna                                1.424E+05                    Fmsy/q( 1)               Fmsy/q( 1)
```

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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	0.352	1.333E+04	1.369E+04	4.816E+03	4.816E+03	5.519E+03	1.013E+00	8.161E-01
2	1981	0.397	1.403E+04	1.402E+04	5.568E+03	5.568E+03	5.555E+03	1.144E+00	8.591E-01
3	1982	0.416	1.402E+04	1.389E+04	5.782E+03	5.782E+03	5.541E+03	1.199E+00	8.583E-01
4	1983	0.455	1.378E+04	1.345E+04	6.114E+03	6.114E+03	5.491E+03	1.310E+00	8.436E-01
5	1984	0.470	1.315E+04	1.282E+04	6.032E+03	6.032E+03	5.406E+03	1.355E+00	8.054E-01
6	1985	0.508	1.253E+04	1.207E+04	6.139E+03	6.139E+03	5.282E+03	1.465E+00	7.670E-01
7	1986	0.645	1.167E+04	1.066E+04	6.870E+03	6.870E+03	4.978E+03	1.857E+00	7.145E-01
8	1987	0.539	9.776E+03	9.540E+03	5.141E+03	5.141E+03	4.688E+03	1.553E+00	5.987E-01
9	1988	0.769	9.323E+03	8.222E+03	6.321E+03	6.321E+03	4.263E+03	2.215E+00	5.709E-01
10	1989	0.764	7.265E+03	6.542E+03	4.996E+03	4.996E+03	3.628E+03	2.200E+00	4.449E-01
11	1990	0.676	5.897E+03	5.603E+03	3.790E+03	3.790E+03	3.222E+03	1.949E+00	3.611E-01
12	1991	0.735	5.329E+03	4.952E+03	3.640E+03	3.640E+03	2.915E+03	2.118E+00	3.263E-01
13	1992	0.815	4.604E+03	4.149E+03	3.381E+03	3.381E+03	2.513E+03	2.348E+00	2.820E-01
14	1993	0.627	3.736E+03	3.714E+03	2.329E+03	2.329E+03	2.285E+03	1.807E+00	2.288E-01
15	1994	0.518	3.692E+03	3.873E+03	2.007E+03	2.007E+03	2.369E+03	1.493E+00	2.261E-01
16	1995	0.410	4.054E+03	4.469E+03	1.834E+03	1.834E+03	2.676E+03	1.182E+00	2.483E-01
17	1996	0.609	4.896E+03	4.852E+03	2.955E+03	2.955E+03	2.868E+03	1.755E+00	2.998E-01
18	1997	0.889	4.809E+03	4.178E+03	3.715E+03	3.715E+03	2.527E+03	2.562E+00	2.945E-01
19	1998	0.976	3.621E+03	3.054E+03	2.981E+03	2.981E+03	1.920E+03	2.812E+00	2.217E-01
20	1999	0.826	2.560E+03	2.339E+03	1.932E+03	1.932E+03	1.507E+03	2.380E+00	1.568E-01
21	2000	0.566	2.135E+03	2.224E+03	1.259E+03	1.259E+03	1.439E+03	1.631E+00	1.307E-01
22	2001	0.284	2.315E+03	2.779E+03	7.880E+02	7.880E+02	1.763E+03	8.171E-01	1.418E-01
23	2002	0.262	3.290E+03	3.946E+03	1.032E+03	1.032E+03	2.405E+03	7.535E-01	2.015E-01
24	2003	0.457	4.663E+03	4.989E+03	2.278E+03	2.278E+03	2.933E+03	1.316E+00	2.855E-01
25	2004	0.599	5.318E+03	5.274E+03	3.157E+03	3.157E+03	3.070E+03	1.725E+00	3.257E-01
26	2005	0.757	5.231E+03	4.816E+03	3.644E+03	3.644E+03	2.849E+03	2.180E+00	3.203E-01
27	2006	0.701	4.436E+03	4.225E+03	2.963E+03	2.963E+03	2.553E+03	2.021E+00	2.716E-01
28	2007	0.574	4.026E+03	4.095E+03	2.350E+03	2.350E+03	2.486E+03	1.654E+00	2.465E-01
29	2008	0.545	4.162E+03	4.287E+03	2.337E+03	2.337E+03	2.585E+03	1.571E+00	2.549E-01
30	2009		4.410E+03						2.701E-01

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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	*	3.337E-02	0.3517	4.816E+03	4.816E+03	0.00000	1.000E+00
2	1981	*	3.417E-02	0.3971	5.568E+03	5.568E+03	0.00000	1.000E+00
3	1982	*	3.385E-02	0.4163	5.782E+03	5.782E+03	0.00000	1.000E+00
4	1983	*	3.277E-02	0.4547	6.114E+03	6.114E+03	0.00000	1.000E+00
5	1984	*	3.125E-02	0.4704	6.032E+03	6.032E+03	0.00000	1.000E+00
6	1985	*	2.942E-02	0.5085	6.139E+03	6.139E+03	0.00000	1.000E+00
7	1986	2.690E-02	2.598E-02	0.6445	6.870E+03	6.870E+03	-0.03492	1.000E+00
8	1987	2.740E-02	2.325E-02	0.5389	5.141E+03	5.141E+03	-0.16421	1.000E+00
9	1988	3.710E-02	2.004E-02	0.7688	6.321E+03	6.321E+03	-0.61604	1.000E+00
10	1989	2.160E-02	1.594E-02	0.7637	4.996E+03	4.996E+03	-0.30367	1.000E+00
11	1990	1.760E-02	1.365E-02	0.6764	3.790E+03	3.790E+03	-0.25381	1.000E+00
12	1991	2.140E-02	1.207E-02	0.7351	3.640E+03	3.640E+03	-0.57287	1.000E+00
13	1992	1.780E-02	1.011E-02	0.8149	3.381E+03	3.381E+03	-0.56557	1.000E+00
14	1993	8.700E-03	9.050E-03	0.6272	2.329E+03	2.329E+03	0.03948	1.000E+00
15	1994	6.200E-03	9.438E-03	0.5183	2.007E+03	2.007E+03	0.42019	1.000E+00
16	1995	6.300E-03	1.089E-02	0.4104	1.834E+03	1.834E+03	0.54735	1.000E+00
17	1996	1.160E-02	1.182E-02	0.6091	2.955E+03	2.955E+03	0.01914	1.000E+00
18	1997	1.170E-02	1.018E-02	0.8891	3.715E+03	3.715E+03	-0.13886	1.000E+00
19	1998	4.200E-03	7.443E-03	0.9761	2.981E+03	2.981E+03	0.57217	1.000E+00
20	1999	5.400E-03	5.701E-03	0.8259	1.932E+03	1.932E+03	0.05419	1.000E+00
21	2000	2.800E-03	5.421E-03	0.5660	1.259E+03	1.259E+03	0.66064	1.000E+00
22	2001	2.800E-03	6.772E-03	0.2836	7.880E+02	7.880E+02	0.88312	1.000E+00
23	2002	6.000E-03	9.617E-03	0.2615	1.032E+03	1.032E+03	0.47175	1.000E+00
24	2003	1.230E-02	1.216E-02	0.4566	2.278E+03	2.278E+03	-0.01153	1.000E+00
25	2004	1.320E-02	1.285E-02	0.5986	3.157E+03	3.157E+03	-0.02667	1.000E+00
26	2005	1.890E-02	1.174E-02	0.7567	3.644E+03	3.644E+03	-0.47644	1.000E+00
27	2006	1.260E-02	1.030E-02	0.7014	2.963E+03	2.963E+03	-0.20194	1.000E+00
28	2007	1.050E-02	9.979E-03	0.5739	2.350E+03	2.350E+03	-0.05087	1.000E+00
29	2008	1.350E-02	1.045E-02	0.5452	2.337E+03	2.337E+03	-0.25632	1.000E+00

* Asterisk indicates missing value(s).

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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	--	*	2.083E-01	0.00000	1.000E+00
2	1981	0.000E+00	0.000E+00	--	*	2.133E-01	0.00000	1.000E+00
3	1982	0.000E+00	0.000E+00	--	*	2.113E-01	0.00000	1.000E+00
4	1983	0.000E+00	0.000E+00	--	*	2.046E-01	0.00000	1.000E+00
5	1984	0.000E+00	0.000E+00	--	*	1.951E-01	0.00000	1.000E+00
6	1985	0.000E+00	0.000E+00	--	*	1.837E-01	0.00000	1.000E+00
7	1986	0.000E+00	0.000E+00	--	*	1.622E-01	0.00000	1.000E+00
8	1987	0.000E+00	0.000E+00	--	*	1.451E-01	0.00000	1.000E+00
9	1988	0.000E+00	0.000E+00	--	*	1.251E-01	0.00000	1.000E+00
10	1989	0.000E+00	0.000E+00	--	*	9.952E-02	0.00000	1.000E+00
11	1990	0.000E+00	0.000E+00	--	*	8.524E-02	0.00000	1.000E+00
12	1991	0.000E+00	0.000E+00	--	*	7.533E-02	0.00000	1.000E+00
13	1992	0.000E+00	0.000E+00	--	*	6.312E-02	0.00000	1.000E+00
14	1993	0.000E+00	0.000E+00	--	*	5.649E-02	0.00000	1.000E+00
15	1994	0.000E+00	0.000E+00	--	*	5.891E-02	0.00000	1.000E+00
16	1995	0.000E+00	0.000E+00	--	*	6.798E-02	0.00000	1.000E+00
17	1996	0.000E+00	0.000E+00	--	*	7.381E-02	0.00000	1.000E+00
18	1997	0.000E+00	0.000E+00	--	*	6.357E-02	0.00000	1.000E+00
19	1998	0.000E+00	0.000E+00	--	*	4.646E-02	0.00000	1.000E+00
20	1999	1.000E+00	1.000E+00	--	6.920E-02	3.558E-02	0.66508	1.000E+00
21	2000	1.000E+00	1.000E+00	--	3.660E-02	3.384E-02	0.07845	1.000E+00
22	2001	1.000E+00	1.000E+00	--	3.900E-02	4.227E-02	-0.08051	1.000E+00
23	2002	1.000E+00	1.000E+00	--	5.170E-02	6.003E-02	-0.14939	1.000E+00
24	2003	1.000E+00	1.000E+00	--	5.650E-02	7.590E-02	-0.29516	1.000E+00
25	2004	1.000E+00	1.000E+00	--	6.570E-02	8.023E-02	-0.19978	1.000E+00
26	2005	1.000E+00	1.000E+00	--	1.223E-01	7.326E-02	0.51241	1.000E+00
27	2006	1.000E+00	1.000E+00	--	9.200E-02	6.427E-02	0.35870	1.000E+00
28	2007	1.000E+00	1.000E+00	--	4.970E-02	6.229E-02	-0.22584	1.000E+00
29	2008	1.000E+00	1.000E+00	--	4.310E-02	6.522E-02	-0.41418	1.000E+00

* Asterisk indicates missing value(s).

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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	50% lower	50% upper	Inter-quartile range	Relative IQ range
B1/K	4.080E-01	1.478E-01	36.21%	2.535E-01	4.235E-01	3.361E-01	4.081E-01	7.193E-02	0.176
K	3.266E+04	6.908E+02	2.12%	2.913E+04	4.240E+04	3.193E+04	3.599E+04	4.061E+03	0.124
q(1)	2.437E-06	-2.683E-07	-11.01%	2.209E-06	2.789E-06	2.409E-06	2.713E-06	3.045E-07	0.125
q(2)	1.521E-05	-1.199E-06	-7.88%	1.331E-05	2.977E-05	1.511E-05	1.902E-05	3.913E-06	0.257
MSY	5.668E+03	-4.006E+02	-7.07%	5.543E+03	7.023E+03	5.668E+03	6.016E+03	3.480E+02	0.061
Ye(2009)	2.648E+03	1.296E+02	4.89%	1.551E+03	3.432E+03	2.058E+03	3.053E+03	9.953E+02	0.376
Y.@Fmsy	1.531E+03	1.799E+02	11.75%	8.066E+02	2.129E+03	1.086E+03	1.783E+03	6.964E+02	0.455
Bmsy	1.633E+04	3.454E+02	2.12%	1.456E+04	2.120E+04	1.596E+04	1.799E+04	2.031E+03	0.124
Fmsy	3.471E-01	-2.451E-02	-7.06%	3.025E-01	3.930E-01	3.384E-01	3.660E-01	2.755E-02	0.079
fmsy(1)	1.424E+05	9.460E+03	6.64%	1.254E+05	1.583E+05	1.328E+05	1.480E+05	1.517E+04	0.107
fmsy(2)	2.282E+04	1.274E+03	5.59%	1.643E+04	2.650E+04	1.995E+04	2.394E+04	3.986E+03	0.175
B./Bmsy	2.701E-01	6.151E-02	22.78%	1.250E-01	3.642E-01	1.655E-01	2.983E-01	1.328E-01	0.492
F./Fmsy	1.571E+00	1.832E-02	1.17%	1.178E+00	2.572E+00	1.380E+00	2.063E+00	6.835E-01	0.435
Ye./MSY	4.672E-01	6.823E-02	14.60%	2.343E-01	5.958E-01	3.036E-01	5.077E-01	2.040E-01	0.437
q2/q1	6.242E+00	3.443E-01	5.52%	5.239E+00	8.092E+00	5.748E+00	7.100E+00	1.352E+00	0.217

INFORMATION FOR REPAST (Prager, Porch, Shertzer, & Caddy. 2003. NAJFM 23: 349-361)

Unitless limit reference point in F (Fmsy/F.): 0.6367
CV of above (from bootstrap distribution): 0.3440

NOTES ON BOOTSTRAPPED ESTIMATES:

- Bootstrap results were computed from 500 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:	101
Trials replaced for q out-of-bounds:	3		
Trials replaced for K out-of-bounds:	198	Residual-adjustment factor:	1.0856

Elapsed time: 0 hours, 21 minutes, 43 seconds.

H2 - *L. budegassa* Aspic bootstrp output

```
Southern Anglerfish - ank                                                                          Page 1
                                                                          Tuesday, 05 May 2009 at 14:58:07
ASPIC -- A Surplus-Production Model Including Covariates (Ver. 5.24)
                                                                                          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: aspic.inp
------------------------------------------------------------------------------------------------------------------------
Operation of ASPIC:  Fit logistic (Schaefer) model by direct optimization with bootstrap.
Number of years analyzed:                    29          Number of bootstrap trials:                          500
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
                                      |      20
                                      |
 2  PT.fish.tr                        |   0.907   1.000
                                      |      20      20
                                       --------------------------------------------------
                                             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                            3.507E+00    20    1.949E-01    1.000E+00     1.120E+00       -0.330
Loss(2)   PT.fish.tr                             4.462E+00    20    2.479E-01    1.000E+00     8.802E-01       -0.048
........................................................................................................
TOTAL OBJECTIVE FUNCTION, MSE, RMSE:        7.96914959E+00          2.277E-01    4.772E-01
Estimated contrast index (ideal = 1.0):             0.4671          C* = (Bmax-Bmin)/K
Estimated nearness index (ideal = 1.0):             1.0000          N* = 1 - |min(B-Bmsy)|/K


Southern Anglerfish - ank                                                                         Page 2

MODEL PARAMETER ESTIMATES (NON-BOOTSTRAPPED)
------------------------------------------------------------------------------------------------------------------------
Parameter                                         Estimate     User/pgm guess    2nd guess    Estimated   User guess

B1/K      Starting relative biomass (in 1980)    3.874E-01          5.000E-01    6.758E-01            1            1
MSY       Maximum sustainable yield              2.536E+03          3.000E+03    3.600E+03            1            1
K         Maximum population size                1.163E+04          2.000E+04    9.603E+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                            4.475E-07          1.000E-05    9.500E-04            1            1
q(2)      PT.fish.tr                             1.111E-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              2.536E+03                          ----                     ----
Bmsy      Stock biomass giving MSY               5.813E+03                           K/2           K*n**(1/(1-n))
Fmsy      Fishing mortality rate at MSY          4.363E-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(2009)/Bmsy                    7.203E-01                          ----                     ----
F./Fmsy   Ratio: F(2008)/Fmsy                    6.089E-01                          ----                     ----
Fmsy/F.   Ratio: Fmsy/F(2008)                    1.642E+00                          ----                     ----

Y.(Fmsy)  Approx. yield available at Fmsy in 2009  1.827E+03                 MSY*B./Bmsy              MSY*B./Bmsy
          ...as proportion of MSY                7.203E-01                          ----                     ----
Ye.       Equilibrium yield available in 2009    2.338E+03          4*MSY*(B/K-(B/K)**2)      g*MSY*(B/K-(B/K)**n)
          ...as proportion of MSY                9.218E-01                          ----                     ----

--------- Fishing effort rate at MSY in units of each CE or CC series ---------
fmsy(1)   PT.crust.tr                            9.750E+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	0.451	4.504E+03	4.676E+03	2.110E+03	2.110E+03	2.439E+03	1.034E+00	7.747E-01
2	1981	0.467	4.833E+03	4.926E+03	2.300E+03	2.300E+03	2.477E+03	1.070E+00	8.313E-01
3	1982	0.467	5.010E+03	5.077E+03	2.369E+03	2.369E+03	2.496E+03	1.070E+00	8.618E-01
4	1983	0.457	5.136E+03	5.205E+03	2.379E+03	2.379E+03	2.509E+03	1.048E+00	8.835E-01
5	1984	0.346	5.266E+03	5.582E+03	1.929E+03	1.929E+03	2.530E+03	7.920E-01	9.058E-01
6	1985	0.294	5.867E+03	6.231E+03	1.833E+03	1.833E+03	2.520E+03	6.742E-01	1.009E+00
7	1986	0.393	6.554E+03	6.520E+03	2.563E+03	2.563E+03	2.499E+03	9.010E-01	1.127E+00
8	1987	0.665	6.490E+03	5.766E+03	3.832E+03	3.832E+03	2.526E+03	1.523E+00	1.116E+00
9	1988	0.830	5.184E+03	4.460E+03	3.700E+03	3.700E+03	2.388E+03	1.901E+00	8.918E-01
10	1989	0.703	3.873E+03	3.666E+03	2.578E+03	2.578E+03	2.189E+03	1.612E+00	6.662E-01
11	1990	0.697	3.484E+03	3.351E+03	2.334E+03	2.334E+03	2.081E+03	1.597E+00	5.993E-01
12	1991	0.687	3.231E+03	3.147E+03	2.163E+03	2.163E+03	2.003E+03	1.575E+00	5.558E-01
13	1992	0.709	3.071E+03	2.977E+03	2.111E+03	2.111E+03	1.932E+03	1.625E+00	5.282E-01
14	1993	0.837	2.892E+03	2.659E+03	2.227E+03	2.227E+03	1.789E+03	1.919E+00	4.974E-01
15	1994	0.625	2.453E+03	2.528E+03	1.580E+03	1.580E+03	1.726E+03	1.432E+00	4.220E-01
16	1995	0.718	2.600E+03	2.551E+03	1.831E+03	1.831E+03	1.738E+03	1.645E+00	4.472E-01
17	1996	0.635	2.507E+03	2.566E+03	1.629E+03	1.629E+03	1.745E+03	1.455E+00	4.312E-01
18	1997	0.699	2.622E+03	2.594E+03	1.813E+03	1.813E+03	1.759E+03	1.602E+00	4.511E-01
19	1998	0.901	2.568E+03	2.318E+03	2.089E+03	2.089E+03	1.618E+03	2.066E+00	4.418E-01
20	1999	1.050	2.097E+03	1.795E+03	1.885E+03	1.885E+03	1.323E+03	2.407E+00	3.607E-01
21	2000	1.001	1.535E+03	1.368E+03	1.369E+03	1.369E+03	1.053E+03	2.294E+00	2.640E-01
22	2001	0.866	1.219E+03	1.170E+03	1.013E+03	1.013E+03	9.181E+02	1.985E+00	2.096E-01
23	2002	0.636	1.124E+03	1.211E+03	7.700E+02	7.700E+02	9.466E+02	1.457E+00	1.933E-01
24	2003	0.680	1.300E+03	1.362E+03	9.260E+02	9.260E+02	1.049E+03	1.558E+00	2.237E-01
25	2004	0.644	1.423E+03	1.510E+03	9.730E+02	9.730E+02	1.146E+03	1.477E+00	2.449E-01
26	2005	0.495	1.597E+03	1.811E+03	8.970E+02	8.970E+02	1.333E+03	1.135E+00	2.747E-01
27	2006	0.510	2.033E+03	2.249E+03	1.148E+03	1.148E+03	1.582E+03	1.170E+00	3.497E-01
28	2007	0.477	2.467E+03	2.727E+03	1.301E+03	1.301E+03	1.820E+03	1.094E+00	4.243E-01
29	2008	0.266	2.986E+03	3.579E+03	9.510E+02	9.510E+02	2.153E+03	6.089E-01	5.136E-01
30	2009		4.187E+03						7.203E-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	*	2.092E-03	0.4513	2.110E+03	2.110E+03	0.00000	1.000E+00
2	1981	*	2.204E-03	0.4669	2.300E+03	2.300E+03	0.00000	1.000E+00
3	1982	*	2.272E-03	0.4666	2.369E+03	2.369E+03	0.00000	1.000E+00
4	1983	*	2.329E-03	0.4571	2.379E+03	2.379E+03	0.00000	1.000E+00
5	1984	*	2.498E-03	0.3456	1.929E+03	1.929E+03	0.00000	1.000E+00
6	1985	*	2.788E-03	0.2942	1.833E+03	1.833E+03	0.00000	1.000E+00
7	1986	*	2.918E-03	0.3931	2.563E+03	2.563E+03	0.00000	1.000E+00
8	1987	*	2.580E-03	0.6646	3.832E+03	3.832E+03	0.00000	1.000E+00
9	1988	*	1.996E-03	0.8295	3.700E+03	3.700E+03	0.00000	1.000E+00
10	1989	1.170E-03	1.641E-03	0.7032	2.578E+03	2.578E+03	0.33799	1.000E+00
11	1990	1.409E-03	1.499E-03	0.6966	2.334E+03	2.334E+03	0.06240	1.000E+00
12	1991	1.222E-03	1.408E-03	0.6874	2.163E+03	2.163E+03	0.14180	1.000E+00
13	1992	1.315E-03	1.332E-03	0.7091	2.111E+03	2.111E+03	0.01291	1.000E+00
14	1993	8.535E-04	1.190E-03	0.8374	2.227E+03	2.227E+03	0.33245	1.000E+00
15	1994	6.372E-04	1.131E-03	0.6249	1.580E+03	1.580E+03	0.57409	1.000E+00
16	1995	5.824E-04	1.142E-03	0.7176	1.831E+03	1.831E+03	0.67313	1.000E+00
17	1996	7.027E-04	1.148E-03	0.6349	1.629E+03	1.629E+03	0.49108	1.000E+00
18	1997	8.791E-04	1.161E-03	0.6989	1.813E+03	1.813E+03	0.27804	1.000E+00
19	1998	1.450E-03	1.037E-03	0.9012	2.089E+03	2.089E+03	-0.33503	1.000E+00
20	1999	1.721E-03	8.034E-04	1.0500	1.885E+03	1.885E+03	-0.76211	1.000E+00
21	2000	1.559E-03	6.122E-04	1.0007	1.369E+03	1.369E+03	-0.93467	1.000E+00
22	2001	6.861E-04	5.235E-04	0.8659	1.013E+03	1.013E+03	-0.27053	1.000E+00
23	2002	7.539E-04	5.420E-04	0.6357	7.700E+02	7.700E+02	-0.32995	1.000E+00
24	2003	7.135E-04	6.095E-04	0.6799	9.260E+02	9.260E+02	-0.15756	1.000E+00
25	2004	1.074E-03	6.758E-04	0.6443	9.730E+02	9.730E+02	-0.46332	1.000E+00
26	2005	6.336E-04	8.105E-04	0.4953	8.970E+02	8.970E+02	0.24620	1.000E+00
27	2006	8.014E-04	1.006E-03	0.5105	1.148E+03	1.148E+03	0.22787	1.000E+00
28	2007	1.526E-03	1.220E-03	0.4771	1.301E+03	1.301E+03	-0.22340	1.000E+00
29	2008	1.477E-03	1.602E-03	0.2657	9.510E+02	9.510E+02	0.08126	1.000E+00

* Asterisk indicates missing value(s).

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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	--	*	5.193E-03	0.00000	1.000E+00
2	1981	0.000E+00	0.000E+00	--	*	5.471E-03	0.00000	1.000E+00
3	1982	0.000E+00	0.000E+00	--	*	5.638E-03	0.00000	1.000E+00
4	1983	0.000E+00	0.000E+00	--	*	5.781E-03	0.00000	1.000E+00
5	1984	0.000E+00	0.000E+00	--	*	6.199E-03	0.00000	1.000E+00
6	1985	0.000E+00	0.000E+00	--	*	6.920E-03	0.00000	1.000E+00
7	1986	0.000E+00	0.000E+00	--	*	7.241E-03	0.00000	1.000E+00
8	1987	0.000E+00	0.000E+00	--	*	6.404E-03	0.00000	1.000E+00
9	1988	0.000E+00	0.000E+00	--	*	4.954E-03	0.00000	1.000E+00
10	1989	1.000E+00	1.000E+00	--	3.514E-03	4.071E-03	-0.14726	1.000E+00
11	1990	1.000E+00	1.000E+00	--	4.288E-03	3.721E-03	0.14187	1.000E+00
12	1991	1.000E+00	1.000E+00	--	3.648E-03	3.495E-03	0.04278	1.000E+00
13	1992	1.000E+00	1.000E+00	--	3.975E-03	3.306E-03	0.18418	1.000E+00
14	1993	1.000E+00	1.000E+00	--	2.372E-03	2.953E-03	-0.21905	1.000E+00
15	1994	1.000E+00	1.000E+00	--	1.498E-03	2.808E-03	-0.62816	1.000E+00
16	1995	1.000E+00	1.000E+00	--	1.112E-03	2.834E-03	-0.93515	1.000E+00
17	1996	1.000E+00	1.000E+00	--	1.621E-03	2.850E-03	-0.56428	1.000E+00
18	1997	1.000E+00	1.000E+00	--	1.604E-03	2.881E-03	-0.58585	1.000E+00
19	1998	1.000E+00	1.000E+00	--	3.158E-03	2.574E-03	0.20430	1.000E+00
20	1999	1.000E+00	1.000E+00	--	3.853E-03	1.994E-03	0.65875	1.000E+00
21	2000	1.000E+00	1.000E+00	--	4.038E-03	1.519E-03	0.97760	1.000E+00
22	2001	1.000E+00	1.000E+00	--	2.267E-03	1.299E-03	0.55680	1.000E+00
23	2002	1.000E+00	1.000E+00	--	2.000E-03	1.345E-03	0.39650	1.000E+00
24	2003	1.000E+00	1.000E+00	--	2.174E-03	1.513E-03	0.36293	1.000E+00
25	2004	1.000E+00	1.000E+00	--	1.897E-03	1.677E-03	0.12298	1.000E+00
26	2005	1.000E+00	1.000E+00	--	1.378E-03	2.011E-03	-0.37810	1.000E+00
27	2006	1.000E+00	1.000E+00	--	1.733E-03	2.498E-03	-0.36539	1.000E+00
28	2007	1.000E+00	1.000E+00	--	3.976E-03	3.028E-03	0.27222	1.000E+00
29	2008	1.000E+00	1.000E+00	--	3.606E-03	3.975E-03	-0.09741	1.000E+00

* Asterisk indicates missing value(s).

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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	50% lower	50% upper	Inter-quartile range	Relative IQ range
B1/K	3.874E-01	9.149E-05	0.02%	3.864E-01	3.894E-01	3.872E-01	3.877E-01	4.656E-04	0.001
K	1.163E+04	7.386E+00	0.06%	1.150E+04	1.207E+04	1.162E+04	1.171E+04	9.583E+01	0.008
q(1)	4.475E-07	1.947E-09	0.43%	3.856E-07	5.231E-07	4.139E-07	4.867E-07	7.279E-08	0.163
q(2)	1.111E-06	4.301E-08	3.87%	1.023E-06	1.214E-06	1.045E-06	1.151E-06	1.065E-07	0.096
MSY	2.536E+03	-1.993E-01	-0.01%	2.529E+03	2.539E+03	2.535E+03	2.537E+03	1.196E+00	0.000
Ye(2009)	2.338E+03	-9.222E+01	-3.94%	1.956E+03	2.524E+03	2.202E+03	2.468E+03	2.667E+02	0.114
Y.@Fmsy	1.827E+03	-4.603E+01	-2.52%	1.323E+03	2.396E+03	1.615E+03	2.127E+03	5.123E+02	0.280
Bmsy	5.813E+03	3.693E+00	0.06%	5.751E+03	6.034E+03	5.808E+03	5.856E+03	4.792E+01	0.008
Fmsy	4.363E-01	-1.781E-04	-0.04%	4.193E-01	4.415E-01	4.330E-01	4.368E-01	3.780E-03	0.009
fmsy(1)	9.750E+05	8.420E+03	0.86%	8.421E+05	1.132E+06	8.991E+05	1.061E+06	1.616E+05	0.166
fmsy(2)	3.929E+05	-1.214E+04	-3.09%	3.589E+05	4.288E+05	3.805E+05	4.180E+05	3.747E+04	0.095
B./Bmsy	7.203E-01	-1.810E-02	-2.51%	5.217E-01	9.464E-01	6.366E-01	8.392E-01	2.027E-01	0.281
F./Fmsy	6.089E-01	4.794E-02	7.87%	4.586E-01	8.326E-01	5.214E-01	6.901E-01	1.687E-01	0.277
Ye./MSY	9.218E-01	-3.629E-02	-3.94%	7.712E-01	9.954E-01	8.679E-01	9.733E-01	1.053E-01	0.114
q2/q1	2.482E+00	1.196E-01	4.82%	1.968E+00	2.825E+00	2.158E+00	2.624E+00	4.662E-01	0.188

INFORMATION FOR REPAST (Prager, Porch, Shertzer, & Caddy. 2003. NAJFM 23: 349-361)

Unitless limit reference point in F (Fmsy/F.): 1.642
CV of above (from bootstrap distribution): 0.2253

NOTES ON BOOTSTRAPPED ESTIMATES:

- Bootstrap results were computed from 500 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: 163
Trials replaced for K out-of-bounds: 0
Trials replaced for MSY out of bounds: 0
Residual-adjustment factor: 1.0690

Elapsed time: 0 hours, 7 minutes, 9 seconds.

Annex J: Nephrops (Division VIIIa,b FU 23-24 Management Area N

Quality Handbook **ANNEX: J – Nephrops Management Area N**

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 2009

A. General

A.1. Stock definition

Nephrops are distributed in North East Atlantic, from Iceland to South Portugal, in the North Sea and also in the Mediterranean sea, particularly in the western part. *Nephrops* live on 15–800m deep grounds, on muddy substrata. The distribution of this species is more determined by ground type and sea temperature than depth. *Nephrops* live in burrows dug in the mud. It leaves this burrow during low light periods (at dawn and dusk) to look for food. It can be caught in high quantities during this active time. *Nephrops* are sedentary. However they can move short distances if adverse factors modify its habitat, like mud disturbance by storms or other mechanical action on the sea bottom.

In the Bay of Biscay, *Nephrops* grounds correspond to muddy areas: the first one, which is the largest one, is in Division VIIIa and is called "la grande vasière", the second one in Division VIIIb is called "vasière de la Gironde". The overall area extends for around 12000 km² of surface.

A.2. Fishery

Nephrops in FUs 23-24 are almost exclusively exploited by French trawlers which have decreased notably throughout the recent fifteen years after conflicts of 1993-1994 and according to different decommissioning schemes.

The general features of the *Nephrops* fishery, as described in the 2003 *Nephrops* Working Group report (ICES, 2003) are still valid, but some can now be updated thanks to more precise information collected on vessel activity and economic results. These showed that:

- about 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.

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

Length frequency data of the landings are available by sex on a monthly basis. They have been sampled since 1984, but for reasons of lack of confidence in the older data sets, the data for 1984-86 were omitted from the assessments. Discard data are available for 1987, 1991, 1998, 2003 and 2004 only. Intermediate years up to 2002 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)

B.2.3.1. Introduction

Nephrops discards are commonly high (*e.g.* 43% in weight of the total catches of *Nephrops* in the North Sea stock: Catchpole *et al.*, 2005; 70% of the total caught number in the Portuguese crustecean-trawl fishery: Fonseca *et al.*, 2005). Furthermore, discards of other fishes are also generated by trawlers targeting *Nephrops*: by-catch of teleostei in Southern Portugal (Monteiro *et al.*, 2001); small demersal fishes particularly whiting in the West of Scotland (Stratoudakis *et al.*, 2001); discarded crustaceans and echinoderms in the UK waters (Bergmann, 2001; Bergmann *et al.*, 2002a,b); impact on demersal communities of the northern Tyrrhenian Sea: Sartor *et al.*, 2001; discards of North Sea cod, haddock and whiting: Catchpole *et al.*, 2005, Catchpole *et al.*, 2007; hake of the Bay of Biscay: Talidec *et al.*, 2005). For the *Nephrops* fishery of the Bay of Biscay sampling onboard carried out in several years of the whole time series 1987-2007 allowed of estimating discarded amounts. Hence, the discard rate fluctuated in the range 41-65% (in number of individuals) for the period 1987-2005 (anon, 2006) before fishing pattern modification (minimum legal size, MLS increase at the end of 2005). Focusing on years 2003, 2004 and 2005, the discarded *Nephrops* were respectively equal to 57%, 61% and 65% of the total annual catches (Talidec *et al.*, 2005; anon, 2006). The discarded percentage moved upwards to 79% in 2006 after the increase of the MLS (anon, 2007), but was reduced in 2007 near previous level (65%; anon, 2008).

Advices for *Nephrops* stocks management have therefore to include the additional fishing mortality by discarding in stock assessment (anon, 2004) and technical measures for selectivity improvements can be proposed in order to reduce discard rate (Campos *et al.*, 2002; Catchpole and Revill, 2008). Thus, usual methods of assessment have to tackle sampling problems for data collected onboard commercial vessels. Many references analysed the discard sampling plan and tested underlying assumptions at the aim of predicting the discarding behaviour (Pope *et al.*, 1991; anon, 2002; Rochet *et al.*, 2002; Trenkeland Rochet, 2002; Rochet and Trenkel, 2005; Fifas *et al.*, 2006).

B.2.3.2. Material

B.2.3.2.1. Data from biological sampling

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 (209 trips and 529 hauls have been sampled over period 2003-2007). 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.

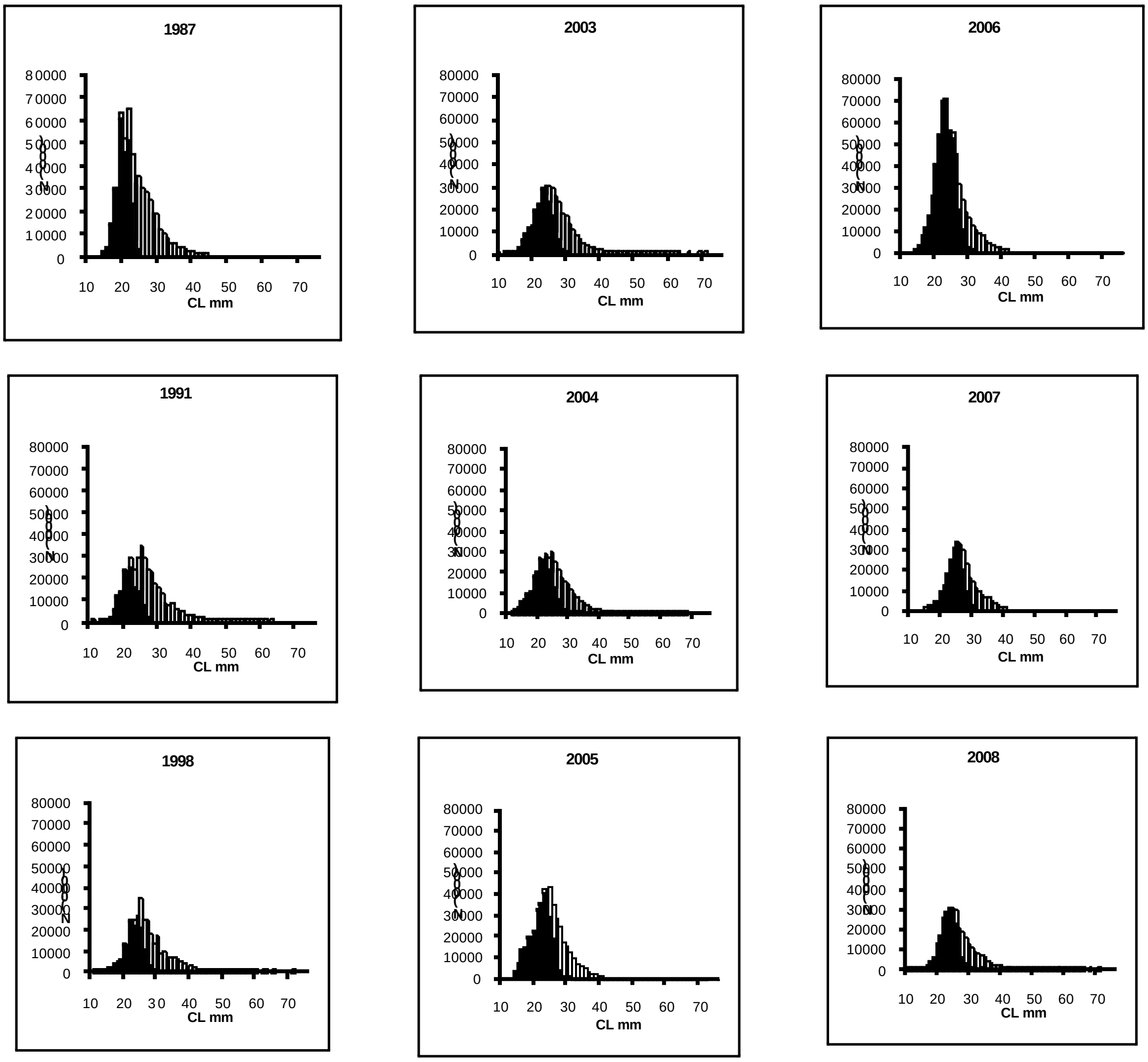

Figure 1. **Length (carapace length, CL in mm) distribution of frequencies for catches (landings in white, discards in dark). Years with sampling onboard. Data from years until 2005 (*i.e.* before MLS change) are used for discard derivation as explained below.**

B.2.3.3. Method

B.2.3.3.1. Sampled years

Notations

Indices:*g*=segment [g=1, 2, …, G]; *m=métier* [*m*=1, 2, …, *M*]; *i*=fishing trip[*i*=1, 2, …, *n* for the sample, *N* for the population]; *j*=haul [*j*=1, 2, …, *h* ou *H*]; *s*=sex [*s*=1, 2]; *k*=commercial category [*k*=1, 2, …, *K*]; *l*=length class [*l*=1, 2, …, *L*]

Variables (numbers or weights or volumes):A=total landings; a=sampled landings; D=total discards; d=sampled discards; C=total catch (C=A+D); c=sampled catch.

We want to estimate the total number/weight discarded by species and segment: D_{gs} for *Nephrops*, the length distribution of discards by sex and segment: D_{gsl}

Sampling strategy

The overall programme is based on a stratified random sampling. Two strategies are possible depending on the way catch is handled onboard:

Strategy 1: *sampling is carried out before the catch is sorted*. A sample of the catch is taken and then sorted by the crew. The sampling ratio is known *f=c/C*. In some cases (*e.g.* Lorient fishing harbour), it is not possible to estimate the total catch and an estimate of the sampled fraction is given by *f=a/A*.

Strategy 2: *sampling is carried out after the catch is sorted*. The crew sorts the catch, then samples of discards and landings are collected. The sampled fraction is then *f=d/D*.

For this method, 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

(1) By haul:

$$\hat{D}_{gijsl}=\frac{X_{gij}}{x_{gij}}.d_{gijsl} \qquad [1]$$

$$Var\left(\hat{D}_{gijsl}\right)=\left(\sum_{s}\sum_{l}\hat{D}_{gijsl}-\sum_{s}\sum_{l}d_{gijsl}\right)\sum_{s}\sum_{l}d_{gijsl}\,\hat{p}_{gijsl}(1-\hat{p}_{gijsl})/\left(\sum_{s}\sum_{l}\hat{D}_{gijsl}-1\right) \quad \text{with:}$$

$$\hat{p}_{gijsl}=\frac{d_{gijsl}}{\sum_{s}\sum_{l}d_{gijsl}} \qquad [2]$$

Note: X_{gij} and x_{gij} are respectively the total reference and sampled weights (or volumes) for haul j of trip I and segment g; X=C or A (x=c or a) of strategy 1; otherwise, X=D (x=d) if strategy 2.

(2) By trip:

$$\hat{D}_{gisl}=\sum_{j=1}^{h_{gi}}\hat{D}_{gijsl}\frac{H_{gi}}{h_{gi}}$$

[3]

$$Var\left(\hat{D}_{gisl}\right)=\frac{H_{gi}^{2}}{h_{gi}}\left(1-\frac{h_{gi}}{H_{gi}}\right)\frac{\sum_{j=1}^{h_{gi}}\left(\hat{D}_{gijsl}-\frac{\hat{D}_{gisl}}{H_{gi}}\right)^{2}}{h_{gi}-1}+\frac{H_{gi}}{h_{gi}}\sum_{j=1}^{h_{gi}}\frac{1-\hat{f}_{gij}}{\hat{f}_{gij}^{2}}Var\left(\hat{D}_{gijsl}\right) \quad \text{with:} \quad \hat{f}_{gij}=\frac{x_{gij}}{X_{gij}}$$

[4]

Note: H_{gi} and h_{gi} are respectively the total and the sampled numbers of hauls for trip I and segment g.

(3) <u>By segment</u>:

$$\hat{D}_{gsl}=\sum_{i=1}^{n_g}\hat{D}_{gisl}\frac{\hat{N}_g}{n_g}$$

[5]

$$Var\left(\hat{D}_{gsl}\right)=\frac{\hat{N}_g^{2}\left(1-f_g\right)}{n_g}\frac{\sum_{i=1}^{n_g}\left(\hat{D}_{gisl}-\frac{\hat{D}_{gsl}}{\hat{N}_g}\right)^{2}}{n_g-1}+\frac{\hat{N}_g}{n_g}\sum_{i=1}^{n_g}Var\left(\hat{D}_{gisl}\right) \quad \text{with:} \quad f_g=\frac{n_g}{\hat{N}_g}$$

[6]

Note: $\hat{N}_g$ and n_g are respectively the total and sampled number of trips for segment g.

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 (Cochran, 1977).

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.2.3.3.2. 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; Table 1). 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).

Table 1. Investigations on relationship (log-log transformation: $L_{disc}=\gamma.L_{land}^{\alpha}$) of mean sizes of landings and discards. Combined sexes and whole year data.

Year	E[Ll]	E[Ld]	X=ln(E[Ll])	Y=ln(E[Ld])	expected E[Ld]
1987	27.973	20.414	3.331	3.016	20.324
1991	29.463	21.606	3.383	3.073	21.752
1998	30.489	22.863	3.417	3.130	22.746
2003	30.801	22.956	3.428	3.134	23.052
2004	30.320	22.897	3.412	3.131	22.582
2005	29.838	21.840	3.396	3.084	22.114

N=6; R^2=0.9579; α(slope)=1.3073; β(intercept)=-1.3431;
γ(exp(β))=0.2610; E[X]=3.3945; σ^2=0.0001137

Note: E[Ll]= mean size of landings; E[Ld]=mean size of discards (CL expressed in mm)

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).

Let j be a year with no dataset on discards. By quarter k, the number of discarded individuals by sex (m or f) and by size L, ND_{jklm} (or ND_{jklf}), *vs.* size is expressed by:

$$ND_{jklm} = NL_{jklm}.\exp(-\alpha_k.(L-L50_k)) \quad \text{or} \quad ND_{jklf} = NL_{jklf}.\exp(-\alpha_k.(L-L50_k)) \qquad [7]$$

α_k and $L50_k$ are the parameters of the s-shaped curve (logistic model) fitted by quarter k describing the commercial *Nephrops* hand-sorting onboard on both sexes combined.

(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 (Table 1) is also included in the final fitting. The assumed distribution of discards is given by:

$$\varphi(L) = \frac{\alpha}{1+\exp(\beta.(L-Lm))} \quad \text{for} \quad L>Lm$$

$$\varphi(L) = \frac{\alpha}{1+\exp(-\beta.(L-Lm))} \quad \text{for} \quad L\leq Lm \qquad [8]$$

where α, β, Lm are coefficients of the distribution (ϕ(L)=α/2 when L=Lm).

The final run is performed on the whole distribution for sampled years whereas it involves only in the descending part for missing years. It includes constraints as:

(1)The sum of frequencies for descending part of distribution is equal to that calculated by the descending part of the equation [8] *i.e.* the retained values of the 2nd stage of calculation described previously are assumed to be reliable.

(2)The coefficient of determination of the relationship of the mean sizes of landings vs. discards for missing years (after calculation of the increasing part of the whole distribution: equation [8]) has to be not significantly lower than the coefficient provided for sampled years (Table 1).

(3)The parameter Lm is assumed to be included in the confidence interval of the observed mean sizes of discards against mean sizes of landings (for *a priori* confidence level 1-α).

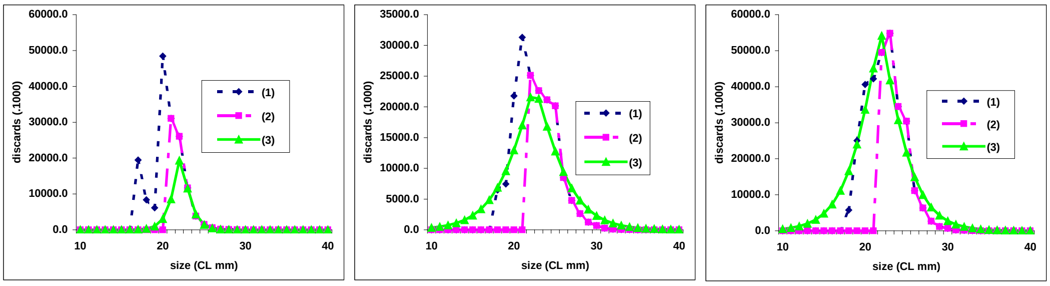

Figure 2. **The three stages for calculation of discards. Example of simulation for years 1990, 2000, 2001 (1): s-shaped hand-sorting; (2): erasing unlikely values; (3): density of probability.**

B.2.3.3.3. Validation

The generated by simulation values are tested against discards estimated by sampling. This validation involves in three main stages:

(1) Examination of the total amount of discards calculated by simulation that should not be significantly different from that obtained by sampling.

(2) Test by linear regression performed on simulated numbers vs. size as dependent variable against sampled numbers as independent one. The slope of this relationship should not be significantly different from 1 (bisecting line) and the intercept should not be significantly different from 0.

(3) Test of cumulative frequencies of the sets, sampled and simulated, using non parametric approaches such as Kolmogorov-Smirnov.

B.2.3.4. Results

B.2.3.4.1. Sampled years

Total catches, landings and discards, of *Nephrops* in Bay of Biscay for the period 1987-2007 are given in Table 2. The French landings 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. A slight decrease has occurred since 2005.

The average weight of discards per year in the period 1987-2007 is about 2 280 t whereas discard estimates of the recent sampled years (2003-2007) reached a higher level of 2 760 t. Discards represent most of the catches of the smallest individuals as indicated by the available data (Fig. 1).

The Table 3 presents the CV of discards estimates at each sampling level for years 2003 and 2004. CV varies from 30% in the range 20-30 mm to 100% for extreme length intervals. The Figure 3 provides DLF of *Nephrops* discards by sex for years 2003-2007.

Discards reached the highest level in 2006 due to the MLS change (Dec. 05) and, moreover, because of more drastic measures as daily quotas were adopted on purpose of avoiding TAC overshot of preceding years.

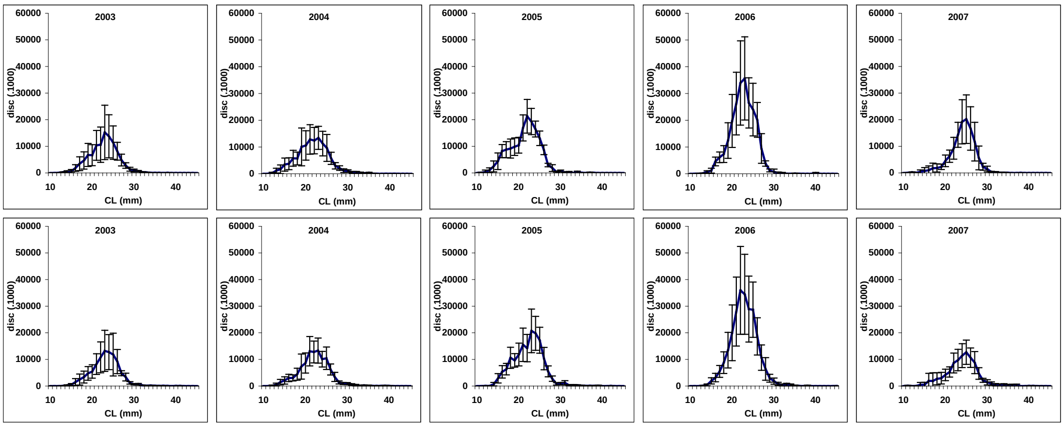

Figure 3. **Distribution of length frequencies (CL in mm) and confidence intervals (confidence level 1-α=0.95) for discards estimated by sampling onboard under DCR. Data by sex (females above, males below).**

Table 2. *Nephrops* in the Bay of Biscay (VIIIa,b) - Estimates of catches, landings and discards (numbers in 10^3 individuals), for 1987-2007 (data used for stock assessment by ICES).

Year	Landings		Discards		Year	Landings		Discards	
	t	number	t	number		t	number	t	number
1987	5 461	288 974	1 767	268 244	1998	3 907	161 549	1 453	150 995
1988	5 944				1999	3 238			
1989	4 912				2000	3 105			
1990	5 060				2001	3 753			
1991	4 810	217 338	1 213	151 634	2002	3 717			
1992	5 728				2003	3 792	152 485	1 977	201 841
1993	5 158				2004	3 290	139 753	2 193	222 089
1994	4 119				2005	3 689	166 165	2 698	315 346
1995	4 467				2006	3 430	127 942	4 544	487 288
1996	4 133				2007	3 173	117 273	2 411	214 788
1997	3 640								

Table 3. CV of discards estimates at each sampling level. Years 2003 and 2004.

	female		male	
	weight	number	weight	number
Discards 2003				
by tow	0.076	0.016	0.075	0.016
by trip	0.255	0.199	0.244	0.200
by the fleet	0.255	0.268	0.257	0.258
Discards 2004				
by tow	0.030	0.010	0.040	0.010
by trip	0.191	0.165	0.169	0.137
by the fleet	0.146	0.178	0.157	0.169

B.2.3.4.2. Missing years

B.2.3.4.2.1. Hand-sorting s-shaped curves

The parameters α and L50 of the hand-sorting logistic curves by quarter estimated on sampled years and used for the discard derivation on missing years are provided below (Table 4). The values show that the hand-sorting behaviour has gradually changed during the whole period (increase of L50 by 2.4-3.5 mm CL *i.e.* by 8-11.5 mm of total size).This significant modification may be explained by the change of the implemented mesh size.

Table 4. Summary of parameters of s-shaped hand-sorting curves.

quarter	1987's data (applied on 1988-1990)		1991's data (applied on 1992-1997)		1998's data (applied on 1999-2002)	
	α (mm^{-1})	L50 (CL mm)	α (mm^{-1})	L50 (CL mm)	α (mm^{-1})	L50 (CL mm)
Q1	1.013	21.849	0.743	23.880	1.036	25.302
Q2	1.009	23.145	0.689	23.878	0.898	25.572
Q3	1.512	23.214	0.749	24.397	0.573	26.203
Q4	1.270	22.812	0.838	23.887	0.788	25.752

B.2.3.4.2.2. Estimates of discards

Total number of discarded individuals (10^3 individuals), estimated by the sampling plan under previous MLS regulation (*i.e.* six years; disc obs) and by the probabilistic simulation (overall time series; disc exp) are given by Table 5. This Table also provides estimates of parameters α, β, γ and Lm and corresponding coefficients of variation (CV %). Accordingly to the relationship of mean sizes of landed vs. discarded individuals by year for the sampled series, the same relationship on overall time series used as constraint for fitting model is illustrated (Fig. 4). Figure 5 presents discard rate by sex and combined for the whole time series 1987-2005.

Table 5. Estimates of discards: disc obs (calculated by sampling), disc exp (provided by the probabilistic derivation). Parameters (Lm, α, β) of the density of probability of simulated discards [in bold: sampled years; discards are expressed in thousands and CV in%]. Fitting is carried out on the whole DLF for sampled years, only on the descending part retained after the 2[nd] stage of simulation for missing years.

year	Lm	CV(Lm)	α	CV(α)	β	CV(β)	disc obs	disc exp
1987	**20.472**	**0.892**	**122654**	**10.424**	**0.618**	**13.949**	**268 244**	**273 137**
1988	20.390	0.168	367535	2.023	0.999	0.549		503 246
1989	20.614	5.092	204629	51.622	0.881	17.756		318 732
1990	22.163	2.065	42775	35.253	1.190	6.559		50 218
1991	**21.751**	**0.901**	**50726**	**7.969**	**0.456**	**10.680**	**151 634**	**153 750**
1992	21.378	23.165	44129	96.972	0.349	33.591		173 099
1993	21.677	7.358	37779	36.264	0.415	13.682		125 506
1994	21.851	6.641	29128	33.979	0.434	13.622		92 793
1995	21.948	9.976	25072	48.685	0.416	20.100		83 582
1996	22.370	13.322	18104	72.458	0.431	24.528		57 959
1997	20.985	18.720	32076	78.808	0.347	24.400		126 897
1998	**22.746**	**0.650**	**48703**	**5.858**	**0.445**	**7.800**	**150 995**	**151 189**
1999	22.799	12.864	39679	68.940	0.434	27.142		126 533
2000	22.474	15.541	47599	77.446	0.397	27.367		164 996
2001	21.862	9.792	111786	52.172	0.453	21.049		341 887
2002	21.283	26.240	94729	116.689	0.369	39.088		352 273
2003	**23.052**	**0.438**	**59005**	**3.544**	**0.405**	**4.713**	**201 841**	**202 317**
2004	**22.582**	**0.708**	**55660**	**4.869**	**0.339**	**6.622**	**222 089**	**225 545**
2005	**22.114**	**0.823**	**82229**	**5.726**	**0.358**	**7.671**	**315 346**	**316 565**
Averaged discards (only sampled years)							*218 358*	*220 417*

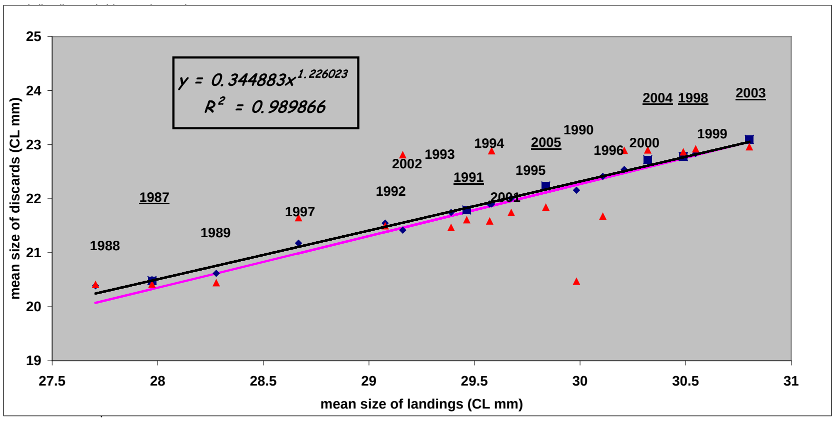

Figure 4. Final results of probabilistic derivation of discards. Relationship mean sizes of landings vs. discards. The triangular fonts represent the results of the "proportional" derivation. The underlined years correspond to the available dataset of sampling onboard. The rhombus fonts involve in the probabilistic derivation. The dark curve is provided by the final fitting on the whole time series 1987-2005. The bright curve is the result of the fitting on the years with available data (underlined years; see also Table 1).

Comparison of sampled and simulated discards for the available dataset on six years shows an overall good adequacy: average values are respectively 218 and 220 million individuals, moreover, difference by year does not exceed 2%; however, this difference is wherever positive i.e. the density of probability model induces a slight overestimation of discarded numbers. Fitting provides accurate estimates for Lm, α, β on sampled years (CV< 1%, 3-11% and 4-14% respectively for the three model parameters). Nevertheless, the model parameters' CV do not reflect the actual uncertainty (Fig. 3) because of complex organisation of samples (sub-sampling stratified plan applied onboard).

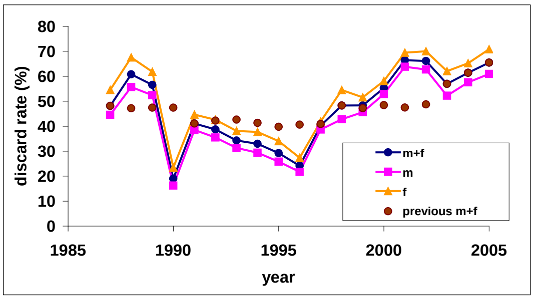

Figure 5. Comparison between discard rates obtained by previous (proportional) derivation and by probabilistic derivation. Combined (m+f) or separated sexes.

Figure 6 presents DLF obtained by sampling and by simulation for the six sampled years associated to uncertainty of the model vs. size (Taylor's polynomials). Both DLF by year are close, but the results involving in the ascending part of distributions appear more consistent. For many years, the descending part provided by the model evolves more gradually vs. size than the actual given by sampling.

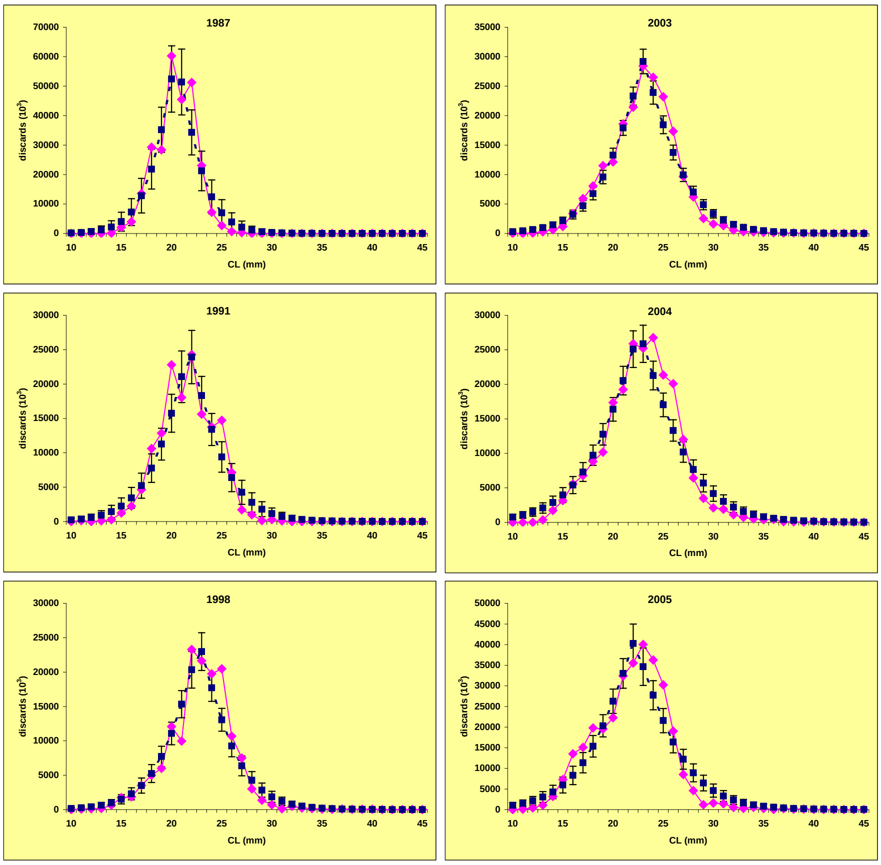

Figure 6. **Comparison between distributions of length frequencies (carapace length, CL in mm) of discards obtained by sampling and by simulation (broken lines). Simulated DLFs are provided with confidence interval by size performed by using Taylor's polynomial (confidence level=1-α=.95).**

On years with no sampling onboard, fitting is performed only on the descending part of DLF, hence, CV remain high mainly for parameter α (not bounded while the ascending part of density of probability is not included for fitting). In accordance with that, if the fitting on the six sampled years is carried out only on the descending part of DLF (as for simulated years), CV increase considerably, but only slight differences are revealed for values of Lm, α, β. Otherwise, difference by year between sampling and simulation remains low (1-8%).

Results of linear regressions performed on simulated vs. sampled discards by size are shown in Figure 7. Regressions with constant term (intercept) seem to be pertinent as the coefficient of determination (R^2) is always higher than 0.9. Nevertheless, the slope (α) by year is invariably lower than 1 (around 0.9); the null hypothesis (α=1) is always rejected for confidence level 95%. Intercept (β) is generally non significantly different from 0. If linear regression by year is undertaken under constraint β=0, the coefficient of determination (ϱ^2) decreases moderately and the slope increases slightly.

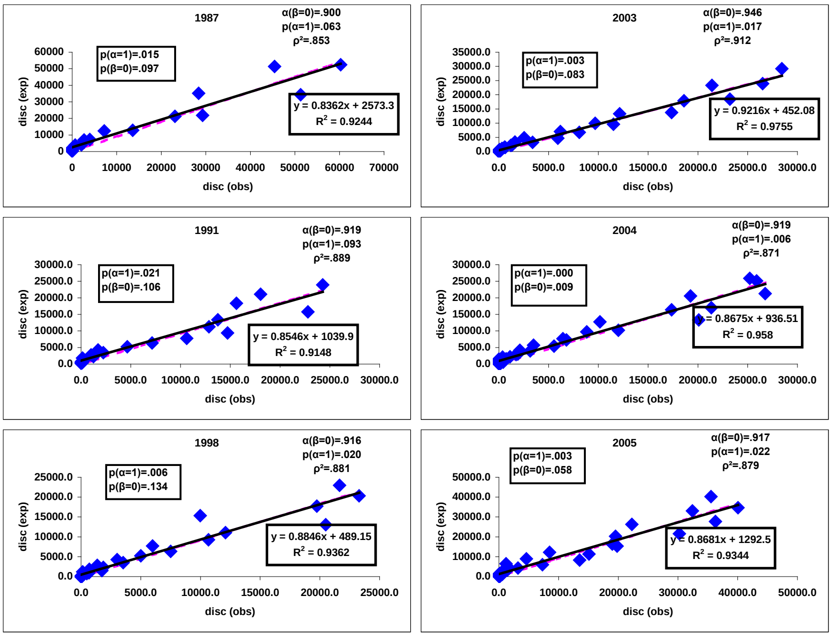

Figure 7. **Comparison between numbers of discarded individuals obtained by simulation (Y axis) and by sampling (X axis). Statistical tests by year for linear regressions of Y vs. X with intercept (Y=αX+β; framed area) or not (Y=αX). Probabilities [p(α=1), p(β=0)] are expressed using two-sided t-student.**

The Kolmogorov-Smirnov test carried out on cumulated frequencies of sampled against simulated discards is given in Figure 8. In every case, the critical test value (Dobs) is non significant for confidence level 95%. It should be interesting to note that Dobs are more often located at sizes larger than the parameter Lm of density of probability *i.e.* at the descending part of distribution which is denoted by a bit less consistent result of simulation compared to sampling.

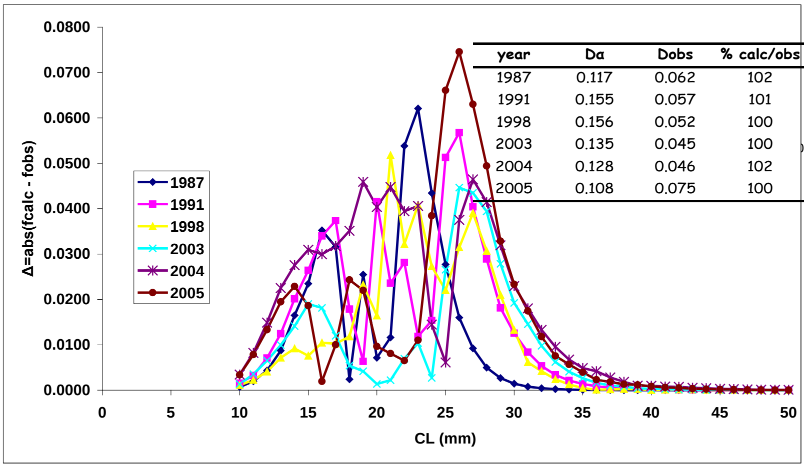

Figure 8. **Statistical test (Kolmogorov-Smirnov) between cumulated frequencies of sampled and simulated discards by year (1-α=.95).**

B.2.3.5. Discussion and conclusion

Discarding practices under the dominant exploitation pattern of the Bay of Biscay *Nephrops* stock induce damages for both ecosystem and market aspects. With the aim of reducing these effects, alternative fishing gears or improvement of the trawl selectivity were investigated (Revill *et al.*, 2007; Macher *et al.*, 2008). Because of the preponderance of the discarding component in the whole fishing mortality for *Nephrops* fisheries, it should not be pertinent to exclude discarded amounts from total catches for the ICES stock assessment. In this concern, the discards sampling program was occasionally applied since the late 80's and has been routinely implemented since 2003. It allows the estimation of discards from direct observation conducted onboard fishing vessels (Talidec *et al.*, 2005; anon, 2006). Reliability of assessment can be affected by methods used for discard extrapolation on years with no sampling onboard. The "proportional" calculation of discards performed previously by ICES is suspected to smooth inter-annual variability of the recruitment due to common DLF datasets applied over many years. The change in the amount of discards could be due to the restriction of individual quotas, 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.

This paper attempts an alternative approach for discard calculation based on three main assumptions (1) stability of s-shaped hand-sorting curves of retained proportion vs. size within quarter under a given exploitation pattern *i.e.* for unchanged mesh size and MLS (therefore, years after recent MLS change, 2006 and 2007, were excluded from further analysis); (2) strong relationship between mean sizes of discarded *Nephrops* vs. landed as statistically argued on sampled years and (3) symmetry of density of probability for discards.

Fifas *et al.* (2006) compiled generalised linear model for L50 of hand-sorting s-shaped curves against several independent variables. The model was processed only on data 2003-2005; previous data (1987, 1991, 1998) were omitted because information by sampled trip were unavailable on standardised computing support. Time components such as year (because of the annual variability of the recruitment strength) and season (because of differences of accessibility mainly between sexes) have relevant effect. Seasonal (quarterly) effect seems to be more significant: L50 is rather stronger throughout 2nd and 3rd quarters than in autumn and winter months during female burrowing. Yearly effect is also significant, but to a lesser extent, moreover no trend can be explored over only three years.

The relationship between mean sizes of discards and landings for sampled years is statistically robust, but not easily interpretable. Fifas *et al.* (2006) considered the effect of percentiles L0.05 and L0.95 of total catches on the L50 of hand-sorting onboard. The fact that the L0.95 effect on L50 is stronger than the L0.05 one emphasizes two points: (1) the sparse effect of L0.05 reduces reliability of the sampling of landings at auction for accurate assessment of the annual recruitment whether no sampling on-board is carried out and (2) several market and regulation aspects could explain the stronger effect of L0.95 (individual daily quotas etc.). Nevertheless, compilation proceeded on aggregated quarterly data provides the strongest effect by using the percentile L0.50.

The model based on symmetrical density of probability gives generally adequate results on six years of the onboard sampling dataset. However, the complex organization of the samples and the not well balanced current sampling plan between harbours and districts (dominance of the Northern part of the fishery mainly "Le Guilvinec" district) may prevent further investigations on parameters' uncertainty. The confidence intervals for discards by size are narrow (Fig. 6): compared with Table 3, on years 2003 and 2004, they are compatible with values of CV on tow level (1-2% by sex for discarded numbers, 3-8% for discarded weights), but they do not agree with uncertainties by the fleet (CV by sex of 17-27% and 15-26% for numbers and weights respectively).

The continuation of the French *Nephrops* trawlers onboard sampling programme will avoid the use of “derived” data for missing years. As pointed out by ICES (anon, 2008), the exploratory runs based on discard derivation by applying probability concepts results in more contrast in recruitment, more regular residuals of Log catchabilities and better consistency in retrospective pattern for recruitment. Moreover, the probabilistic approach gives more consistent results when compared with LPUE time series of the tuning fleet used for the ICES assessment ("Le Guilvinec" district; 2nd quarter) whereas the "proportional" derivation provides more sparse relationship with LPUE's indices (Fig. 9). The maximum LPUE of the time series occurring in 1988 and 2001 coincides with high discard "probabilistic" rates although "proportional" calculation provided less contrasted results. It is noticeable that no constraint was set for back-calculations on the relationship between discard rate and LPUE.

The projections performed by ICES under the *status quo* fishing mortality manifest stronger reactivity of the stock when the discards are back-calculated by the method employed by this paper. The agreed TAC (accorded by applying the "proportional" method) compared with probabilistic results seems to be under-estimated in the early 2000's (high signal of recruitment occurring during the same period) whereas an over-estimation is outlined for the more recent years. This should be taken into consideration when formulating a new methodology for discard estimates of the stock.

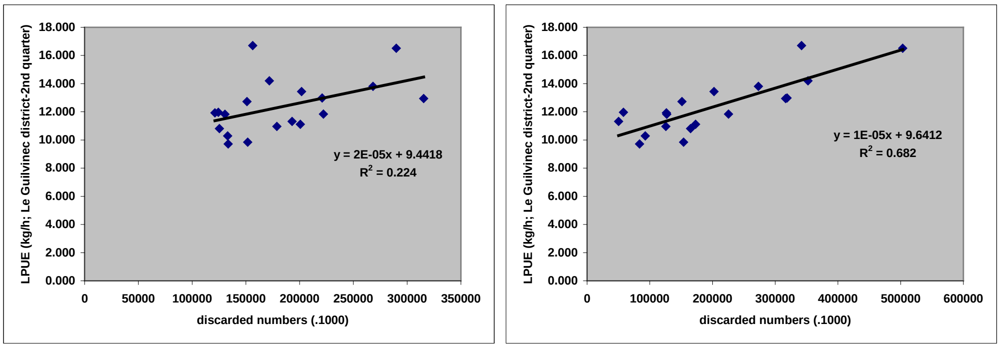

Figure 9. **Correlations between discarded numbers (left: "proportional" derivation, right: probabilistic derivation) and the LPUE indices (tuning fleet used for ICES assessment; "Le Guilvinec" district-2nd quarter). Years 1987-2005.**

B.3. Surveys

B.3.1. Generalities.

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 successive years (2006 and 2007) in order to examine recruitment levels for 2005 and 2006.

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 10). The five strata are defined as:

(1) 25% mud and silt stratum (abbreviation VV)

(2) 75% mud and silt stratum (abbreviation VS)

(3) Lithoclastic mud<25% stratum (abbreviation LI)

(4) Carbonated mud<25% stratum (abbreviation CB)

(5) Calcareous mud<25% stratum (abbreviation 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 7). The provided values are averaged on years 2003-2005.

Table 7. 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

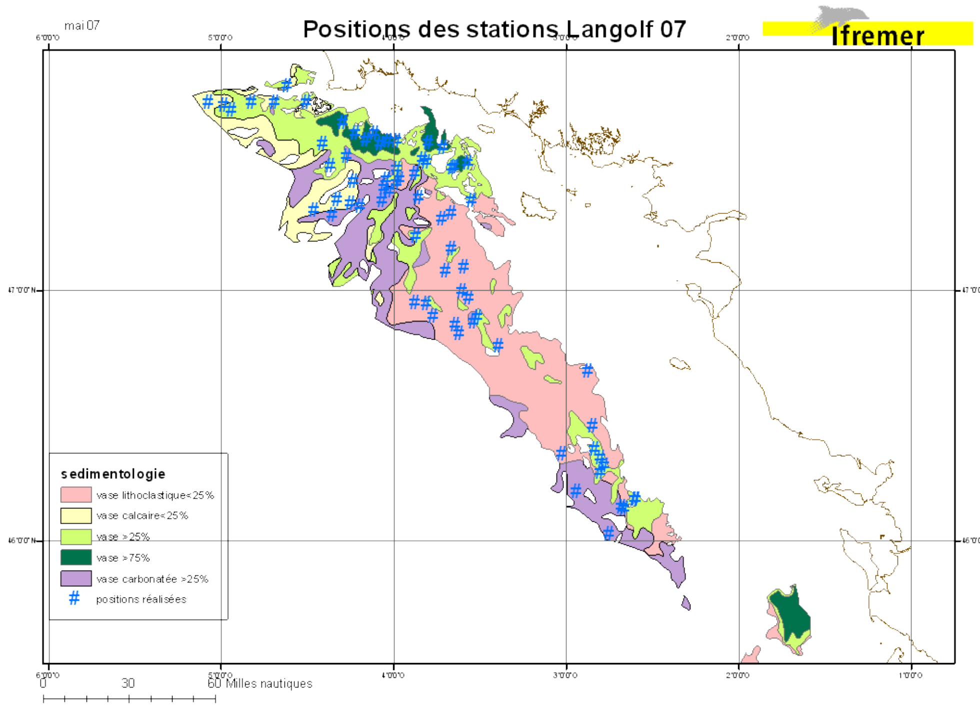

Figure 10. ***Nephrops*** **of the Bay of Biscay (FU 23-24). The Central Mud Bank, the five spatial strata and the distribution of sampling units for 2007's survey.**

The Table 8 gives details for sampling allocation which is based on combined ratio of surface and of fishing effort by stratum.

Table 8. Surfaces (km²) of the five sedimentary strata of the Central Mud Bank. Allocation of the sampling effort vs. surface (W_surf) and vs. distribution of the fishing effort (W_eff) as pointed in Table 7. Number of sampling units (N) by stratum (71 hauls as realized during the 2006's survey are considered for allocation).

strate	surface	W_surf	W_eff	W_comb	N
VS	633.10	0.054	0.121	0.088	6
VV	2691.51	0.231	0.541	0.386	27
CL	1152.86	0.099	0.091	0.095	7
LI	4663.64	0.399	0.198	0.299	21
CB	2535.61	0.217	0.049	0.133	10

B.3.2. Comparison of numbers by sex and stratum.

The Table 9 provides comparative standardized (raised to 40000 m² of sampled surface by haul) results of numbers of harvested individuals by year and by sex for each stratum.

Table 9. Number of caught individuals by year survey, sex and stratum.

	females					*Males*				
stratum	*CB*	*CL*	*LI*	*VS*	*VV*	*CB*	*CL*	*LI*	*VS*	*VV*
2006	4128	6544	11285	3185	6805	4362	5907	10464	2942	6957
2007	21149	8542	31910	1317	19387	17770	4780	26244	1455	18682
2008	16075	5901	24968	4641	17465	10569	3958	17671	3572	14015
ratio 07/06	5.12	1.31	2.83	0.41	2.85	4.07	0.81	2.51	0.49	2.69
ratio 08/07	0.76	0.69	0.78	3.52	0.90	0.59	0.83	0.67	2.46	0.75

The first relevant result is the significantly higher numbers of *Nephrops* during the 2007's and 2008's survey. In spite of bad meteorological conditions mainly for 2007 which may affect trawling efficiency, the difference can be explained by the survey's period (May instead of April since 2007; higher catchability for females which gradually leave burrows). Some strata present stronger differences among the three years (mainly stratum CB which corresponds to 22% of the total Mud Bank surface and secondarily strata LI and VV respectively 40% and 23% of the total harvested area). The other two strata (CL and VS; respectively 10% and 5% of the total surface) provide more ambiguous results[1].

The second relevant result involves in 2008's values which are lower than for 2007 apart from stratum VS. That may be due to lower recruitment indices for 2008 as the ICES Working Group stated.

In the case of females, a higher difference between the two years was expected because the 2007's survey occurred later (May instead of April). In fact, for each stratum the ratio between caught individuals in 2007 and 2006 is systematically stronger for females than for males. The influence on the ratio variability of the bad meteorological conditions in 2007 remains unknown[2].

B.3.3. Comparison of numbers by "age".

The L2AGE slicing program was used by former WGNEPH and by WGHMM for the Bay of Biscay at the aim of performing XSA. This procedure allocates length classes into age groups by assuming Von Bertalanffy model of individual growth by sex ($L\infty$=76; K=.14 for males and immature females moulting twice by year whereas $L\infty$=56; K=.11 for mature females moulting once by year).

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[1] The three strata (CB, LI and VV) with the strongest inter-annual difference were sampled with slightly modified fishing gear's design between the two surveys: in 2007, 100% of the hauls were realized using rock hopper on twin trawls whereas in 2006 the percentage of rock hopper was for 10-70% of the total sampling units for the three strata CB, LI and VV. As these strata cover 85% of the total harvested area, that may explain a part of the difference. Hence, a part of the difference may be due to an artifact.

[2] The determinism of the behaviour of females which gradually leave their burrows during the 2nd quarter remains unknown. It is not obvious that this behaviour is affected either by the photoperiod (there is no evidence in 80-120 m of depth) or by other factors such as turbidity, sea-water temperature etc.

As commented by WGHMM 2007 and 2008, the slicing process is often disapproved because it may induce lack of contrast between years (input set of common parameters for individual growth). Moreover, the Von Bertalanffy's equation is often invalidated for crustaceans. As it would not be reasonable to expect that methods of direct age determination for *Nephrops* will be routinely available in the foreseeable future, alternative methods as CSA have to be investigated. The current use of the slicing conversion is just an indication in order to discern overall recruitment trends for comparison between recruitment of 2004 and 2005. The slicing program converted size composition of experimental catches to "age groups" by year and sex for the overall harvested area (Table 10).

Table 10. relative % by "age" and sex (slicing application).

year	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*mean age*
	females									
2006	2.1	30.1	34.8	18.0	7.6	3.7	1.7	0.9	1.1	3.28
2007	0.3	25.5	35.9	21.1	9.9	3.8	1.6	0.9	1.1	3.43
2008	3.2	25.7	24.1	20.6	12.0	7.1	4.0	2.1	1.2	3.68
	males									
2006	2.3	30.3	41.9	16.3	5.5	2.5	0.9	0.1	0.1	3.05
2007	0.3	20.1	46.2	23.4	6.9	2.1	0.8	0.1	0.0	3.27
2008	2.9	29.0	28.8	21.7	11.4	4.5	1.5	0.2	0.0	3.30

This table shows the dominance of the "age-groups" 2 and 3 for both sexes and years (with a strong percentage of males for "age group" 3). The table also indicates that the mean age between 2006 and 2008 increased. For the last year's survey this result is expected because several indications show low recruitment index 2006, but there is some contradictions for 2007's results: many indications provided by commercial VPA argue for strong recruitment 2005 whereas survey's results do not give the same trend. Thus, there is a no evidence for demonstration of the strength of the recruitment 2005 compared to the 2004's one which was the highest of the whole time series used by ICES for the stock assessment. On the other hand, it seems that the recruitment 2005 is stronger than the 2006's one (see percentages for "age group" 2), but there is no further possibility by this way to validate the assumption of high abundance as stated by WG.

B.3.4. Comparison of mean sizes by sex.

The Table 11 provides mean sizes by year, sex and stratum (expressed by carapace length, CL, in mm; conversion of CL to TS is done by multiplying by 3.3).

Table 11. Mean sizes (CL, in mm) by year, sex and stratum.

Females						Males						
CB	CL	LI	VS	VV	TOT	CB	CL	LI	VS	VV	TOT	year
27.2	26.7	27.5	25.5	26.9	27.0	29.7	27.4	30.0	26.0	29.3	28.9	2006
27.0	28.1	28.0	25.1	27.4	27.5	30.7	30.9	30.2	27.8	30.0	30.3	2007
31.1	28.3	26.6	24.3	27.3	27.8	34.7	31.7	28.5	24.6	30.1	30.2	2008

Mean sizes increase steeply between 2006 and 2007 in the stratum CL for both sexes and mainly for males whereas for the other strata the difference between years is less obvious. In 2008, for the stratum CB mean sizes grow up strongly for both sexes. Moreover, the curves of cumulative frequencies of experimental catches vs. size by year and by sex are proposed for each stratum (Fig. 11).

Comparison of cumulative frequencies for the stratum VS provided not pertinent results maybe because of low number of sampling units. However, the number of samples in the stratum CL is also low. For further comparative exploration, results for females is not retained because of the difference of date (April 2006 and May 2007) for surveys perhaps affecting female catchability. In the case of males, the size corresponding to the maximum difference between yearly cumulative frequencies is around 23-27 mm (*i.e.* 2.5-3 years old individuals under assumptions involving in growth parameters for slicing; see above). The cumulative frequencies are systematically stronger in 2006 and the highest difference is observed in the stratum CL (Diff=.278 for males Diff=.181 for females; according to the mean sizes given in Table 11).

As for slicing output, this result is also noisy compared to conclusions given by discard rates comparison as presented during the WG. It is not currently possible by the exploration of the survey's data to deduce if the R2005 is at least as abundant as the R2004. Neither *Nephrops* mean sizes seem to become smaller nor mean ages seem to decrease. Nevertheless, in the stratum VV (23% of the whole area, 54% of the fishing effort averaged on years 2003-2005, but more than 65% in 2006), the differences between cumulative frequencies between 2006 and 2007 is the weakest (see values of Diff_max: Fig. 11). It means that in this stratum the R2005 should be at least comparable with the estimate of the R2004, but the increase of the local exploitation rate gives noisy results.

Four different interpretations should be given for results of the comparison between surveys 2006 and 2007:

(1) *Spatial variability of the recruitment*: the R2005 maybe stronger on the sea bottom with more compact mud composition (strata VV and VS). There is no possibility to test this point.

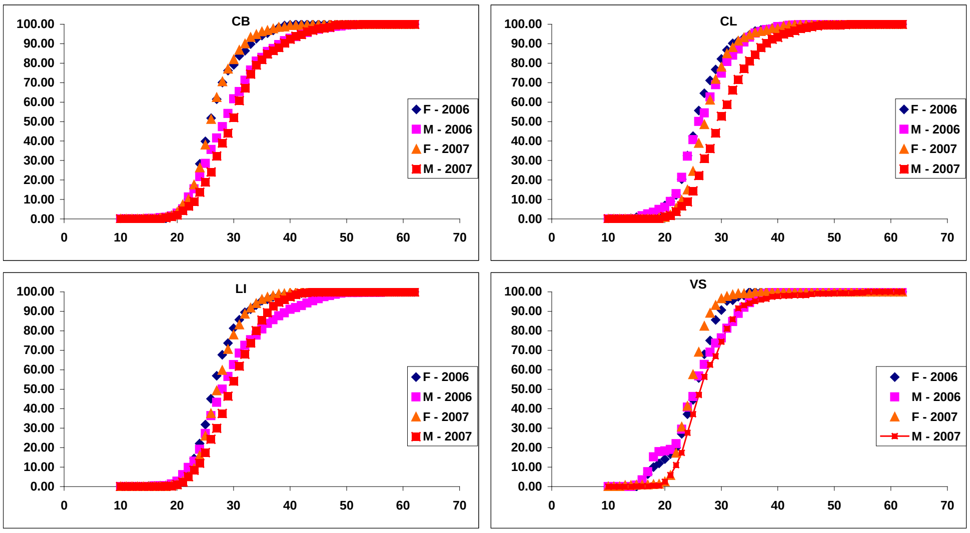
(2) *Different fishing pressure according to areas*: the fishing vessels could be less concentrated on the stratum CL located in the periphery of the overall area (see Fig. 10: light yellow area) perhaps because of increase of fuel prices constraining trip duration. In this case, there should be some benefits for mean sizes of *Nephrops*.

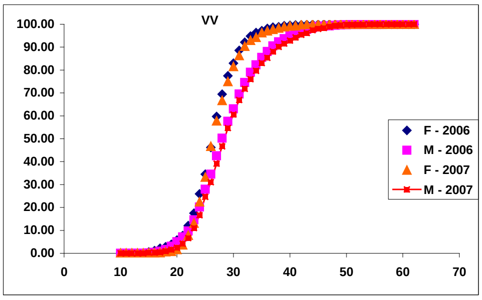
(3) *Inter-annual variability of the growth*: As slicing is based on fixed growth parameters from year to year, there should be a bias. There is no possibility to test this point.

(4) *Global deficiency of the R2005 compared to the R2004*: in this case, use of the R2004 level for R2005 as performed by WGHMM should be not valid. However, all other indices (see WD 1) argue for a high level for the R2005.

B.3.5. Comparison of 2007's survey with DCR sampling result (2nd quarter; Q2).

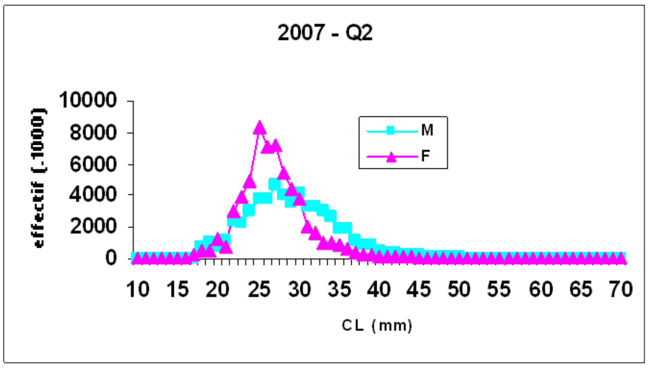
For the 2007 surveys, statistical comparisons were performed by sex between DCR onboard commercial sampling results (program OBSMER, 2nd quarter) and survey's data. DLFs by sex seem to be very close (Fig. 12); the Kolmogorov-Smirnov test on cumulative frequencies showed no significant differences. This result looks promising and demonstrates that the chosen period for survey should be adequate for reliable estimates of abundance indices by sex.

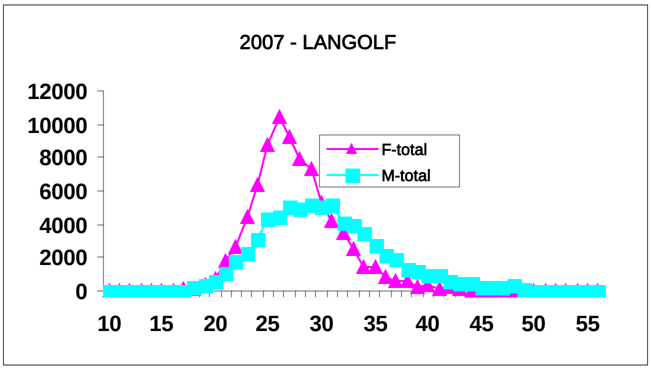




strate	femelles		mâles	
	Diff_max	L	Diff_max	L
CB	0.036	32	0.116	26
CL	0.181	25	0.278	26
LI	0.079	28	0.134	27
VS	0.145	27	0.173	19
VV	0.044	23	0.036	23

Figure 11. *Nephrops* of the Bay of Biscay (FU 23-24). Comparisons by stratum and sex of cumulative frequencies of experimental survey catches between 2006 and 2007 (Diff_max=maximum observed difference between years; L=corresponding size).





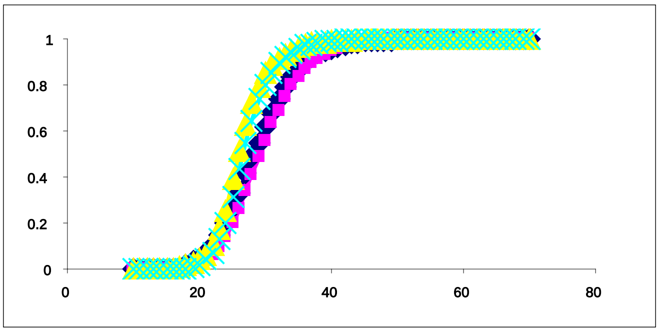


Figure 12. *Nephrops* of the Bay of Biscay (FU 23-24). Comparison by sex of DLF provided by DCR commercial sampling onboard (for 2nd quarter; Q2) and 2007's survey data. Kolmogorov-Smirnov test on cumulative frequencies.

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 up to last year were no longer used this year (as they take into account trips with more than 10% of *Nephrops* in value). The attempt made in 2004 to define a better effort index was eventually chosen for this year's assessment and is described 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[3]. 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.

$$L50 = 28.12 + 0.447 * MS - 4.87 * Ts - 0.095 * MR \qquad [9]$$

and

[3] 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.

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 12) [all polyethylene material; SF=selection factor=L50/MS]:

Table 12. 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 13. Usual input parameters (maturity, growth rate, natural mortality) for performing XSA on FU23-24 *Nephrops* stock.

Males and immature females: L∞=76, K=0.14; mature females: L∞=56, K=0.11

age		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9+*
Size	*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 20)		Yes (3 over 20)		Yes (3 over 21)	
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	

D. Short-Term Projection

This section is detailed in the Working group reports 2005-2008.

E. Medium-Term Projections

No analysis was carried out.

F. Long-Term Projections

This section is detailed in the Working group reports 2005-2008.

G. 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.

H. Other Issues

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Annex L: Nephrops FU 28-29

Quality Handbook **ANNEX: L Nephrops FU28-29**

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 2009
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 2006-2007.

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 cara-pace length (CL).

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 an all time low of 132 t. From 1997 to 2005 landings have increased to levels observed during the early 1990s but decreased again in 2006 and 2007. The value of total landings in 2007 was 236 t.

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 seven 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.

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.

The collection of video footage in each trawl station will be routinely carried out from 2009 onwards. These data will allow estimating absolute biomass, 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 Norway lobster and rose shrimp. 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 slicing: L2AGE4.exe
- XSA: Lowestoft VPA Suite (VPA95.exe), Retvpa02.exe, FLR package

Males	2006 WGHMM		2008 WGHMM	
Tuning Fleets used (First - Last year ; Ages used)	Period	Ages	Period	Ages
P-TR: Crustacean Trawl Fleet	1988-2005	2 - 7	1988-2007	2 - 7
P-CTS: Crustacean Trawl Survey	1997-2005	2 - 7	1997-2007	2 - 7
First age for normal catchability independent	All ages independent		All ages independent	
First age at which q is considered independent of	6		6	
Taper time weight applied?	Tricube over 20 yrs		Tricube over 20 yrs	
F shrinkage (SE for mean F)	1.5		1.5	
F Shrinkage	Final 5	3 oldest	Final 5	3 oldest
Minimum Log SE for terminal population estimates	0.3		0.3	
Fbar (age)	2 - 7		2 - 7	
Recruitment Age	2		2	

Females	2006 WGHMM		2008 WGHMM	
Tuning Fleets used (First - Last year ; Ages used)	Period	Ages	Period	Ages
P-TR: Crustacean Trawl Fleet	1988-2005	2 – 12	1988-2007	2 – 12
P-CTS: Crustacean Trawl Survey	1997-2005	2 – 5	1997-2007	2 – 5
First age for normal catchability independent analysis	All ages independent		All ages independent	
First age at which q is considered independent of age	11		11	
Taper time weight applied?	Tricube over 20 yrs		Tricube over 20 yrs	
F shrinkage (SE for mean F)	1.5		1.5	
F Shrinkage	Final 5 yrs	5 oldest	Final 5 yrs	5 oldest
Minimum Log SE for terminal population estimates	0.3		0.3	
Fbar (age)	4 – 10		4 – 10	
Recruitment Age	2		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 M. – Southern Hake Cadiz

1.1 Introduction

1.1.1 Ecosystem aspects

Considerations on the stock relationships for Gulf of Cadiz Hake

Hake from the Gulf of Cadiz has generally been considered part of the Southern stock of hake. Nevertheless, there are serious concerns with this definition due to differences between the length distribution of catches in this area and those corresponding to other distribution areas of the stock. In addition, the large amounts of small individuals indicated by catches in this area cannot be tracked down in other areas when becoming older. Because of these concerns, hake from the Gulf of Cadiz was removed from the assessment of the Southern Stock of Hake in 2003. The geographical area excluded corresponds to the Gulf of Cadiz from the Portuguese border at the Guadiana river to the Gibraltar strait. There is no reason to support the premise that the Guadiana river is a real boundary separating two possibly different populations. This division arises mainly from practical and management considerations, since the stated large amounts of small fish are fished within this area by Spanish trawlers. To the east, Gibraltar Strait separates the Gulf of Cadiz from the Mediterranean sea and it is considered a natural border due to the differences observed in the species biology in the two areas. In this respect, Silva *et al.* (2005, WD 16) have studied the spawning season and size at first maturity of hake in the Gulf of Cadiz concluding that the results obtained are more similar to those of the Southern Stock than of Mediterranean hake. This similarity is larger regarding size at first maturity, which is much smaller in the Mediterranean, while in the Gulf of Cadiz is even slightly larger than in the northern part of the Iberian Peninsula. Castillo *et al*. (2005) also have identified a complex genetic structure for the Southern stock where Cádiz hake was found to be genetically closer to Atlantic hake than to Mediterranean hake. Nevertheless, the similarities with the population on the northern African shelf, and the exchange rates across the Gibraltar Strait, and with the Northern African and Portuguese shelves still need to be investigated.

1.1.2 Fishery description

Hake in the Gulf of Cadiz is caught in a mixed fishery mainly by Spanish trawlers, but also by artisanal fleets. For the trawl fleet, this area is considered a zone of exception with regards to the rest of the statistical subdivision in the North eastern Atlantic, due to the derogation for the use of a smaller minimum mesh size of 40 mm. The trawl fleet is quite homogenous, operating mainly from four coastal localities: Isla Cristina, Sanlucar de Barrameda, Puerto de Santa María and Huelva. Two main groups can be distinguished among the larger trawlers. 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. Hake makes up around 7-8% of the total landings of the trawl fleet in this area; the rest of the landings are very heterogeneous and include more than 30 different species (several fish species, shrimps and cephalopods are also important target species). Currently, hake and the others target species from Gulf of

Cádiz bottom trawl fleet are landed by an unique and highly multispecific *metier* (see WGHMM 2007 report Section 2).

The artisanal fleet, consisting of small vessels with a mean length of 7.7 m, varies seasonally in terms of gears used as well as targeted species. Hake is mainly caught by gillnets with 80 mm mesh size. This fleet targets the adult portion of the hake population in the area, which gathers near the coast during the winter. Information regarding length distribution of these landings was not available in previous years, but it is available since 2004.

The trawl landings represent on average 97% of the total hake catch, while the artisanal landings constitute the remaining 3%. Hake artisanal catches occur mainly between October and March, while trawl landings are more abundant between March and August.

Management applicable to 2008 and 2009

Southern Hake is under a Recovery Plan managed by TAC, effort reduction and technical measures. The Gulf of Cadiz hake are managed under different measures than the rest of the Southern stock like 10% effort reduction and minimum mesh sizes. The agreed TAC for the whole Southern stock in 2008 was 7700 and 8104 in 2009. Cadiz landings in 2008 was 562 t.

Technical measures applied to Gulf of Cadiz hake are: (i) minimum landing size of 27 cm, as for the rest of the stock, (ii) trawl fishing banned at less than 6 miles from the coast or in waters shallower than 50 m, and (iii) minimum mesh size of 40 mm for the trawl fleet, smaller than in the rest of the stock area. Currently, a Fishing Plan is being followed by the entire trawl fleet in Division IXa South, Gulf of Cádiz, (ORDEN APA/2801/2007, 27 of September, B.O.E nº 234), which will be applied until September 2009 and consequently affects hake. This Plan restricts daily fishing hours and establishes two days a week of no fishing. Furthermore, the plan establishes a fishing closure period of 60 days, which took place last year between September 24th and November 22th . In order to reduce more the fishing effort, a new fishing closure period of 30 days (16 January – 15February) was establishes this year (ORDEN ARM/401/2009, de 20 de febrero, B.O.E nº 48)

Recently, a new regulation was established on February 2008 by regional administration with the aim to distribute the fishing effort (nº hours per day) during the year (Resolution 13th February, BOJA nº 40). This one has been set up in order to improve the yields of the target demersal species, including Hake, without increasing the fishing effort.

There is a Recovery Plan for the Iberian stock of hake (EC, 2166/2005). Effort measures implemented in this Plan trough annex IIb (EC, 43/2009 and previous similar regulations) do not affect Cádiz fleet. Cadíz catch are not used in the present assessment models for south hake; the Recovery Plan establishes that TAC for non assessed areas, like Cádiz will be proportional to the mean catch relationship during the last 3 years.

1.2 Data

1.2.1 Commercial catches and discards

Landings

The landings data used in Gulf of Cadiz are based on Spanish sales notes and Owners Associations data compiled by IEO.

Total landings from the Gulf of Cadiz Hake by gear for the period 1982-2008, as estimated by the WG, are given in Table 1. Landings from the trawl fleet are available since 1982, while landings from the artisanal fleet are only available from 1993.

Total landings range between 400 and 1200 t. Landings show two ascending periods, from 1982 to 1991 and from 1994 to 2001, with a drop in the landings from 1992 to 1994, the minimum of the series. Since 2003 with a peak on 1200 t, the landings fell during the last 5 years until a minimum of 518 t in 2007. Both trawl and artisanal landings have increased in 2008 with 529 and 33 tonnes, respectively. In addition, two factors contributed to the drop in the numbers of fishing trips carried out during 2008: on one hand, the fishing sector was inactive in June as they were on strike during some weeks. On the other hand, the bad meteorological conditions did not allow the fleet to operate during several weeks.

Discards

A pilot discard survey with observers on board was carried out since 2005 under the EU DCR programme. Results indicated a discarding rate of Hake of about 10% in weight, corresponding to 88 tonnes (Table 1). In 2008 the discarding rate was less than in 2005 with 3% in weight, corresponding to 16 tonnes, similar to than those in 2006 and 2007. Figure 1 shows the catch length composition including discards. The proportion of discards in numbers in 2008 was about 20 %.

1.2.2 Biological Sampling

Sampling of commercial landings is carried out by IEO. The length composition sampling design follows a multistage stratified random scheme by month and harbour for the trawl fleet. Sampling from the artisanal fishery started in 2004. Age sampling started in 2000 and follows a stratified random sampling design by quarter and length class (of 1 cm) as part of the Southern Stock sampling scheme.

Length Composition

Table 2 presents the length composition by gear in 2008, including discards. Length distribution usually shows two modes Length compositions of the trawl landings are available since 1994. The trawl fleet landings length composition has a mode around 14-28 cm depending on the year, with an increase to 19 cm in 2004, 20 cm in 2005, 26 cm in 2006 and 2007. In 2008 was similar to previous years, with 25 cm of mode. As stated above, the artisanal fleet targets a different component of the stock. In 2008 the mean length was 37 cm slightly higher than previous.

Figure 2 shows the length distributions of trawl landings and annual mean length for the time series available for this fleet. Length composition in recent years has changed, with an increase from 18 cm in 2002 to 28 in 2007 and 2008. The increase of mean size in landing in mainly due to an high control implementation. Before 2004, length distributions had remained quite stable since 1996, with mean varying between 16 and 20 cm depending on the year. Length compositions in 1994 and 1995 were very different from the rest of the series, which may be partly due to the fact that the sampling programme began in 1994.

Age Composition

Otoliths from commercial landings and surveys have been collected since 2000. Catch at age for 2005, 2006, 2007 and 2008 were derived using the Cadiz ALK from this year, whereas earlier catches at age were derived using a yearly ALK from the entire southern stock.

In a preliminary assessment carried out in 2003 (Velasco et al., 2003b), the same ALKs as for the rest of the stock were used (see Table 6.3 in the report) and the same procedure has been used for 2004. In 2005 the ALK from Gulf of Cádiz hake was used. Table 3 shows the catch at age matrix for the Gulf of Cadiz hake landings. Landings are composed mainly of fish of ages 0 and 1, which constitute between 60% and 95% in the numbers of landings for all years. In recent years this percentage has been decreasing, with the lowest proportion observed in 2006 and 2007 (~35%). In 2008 was observed a similar value than previus years (38%) This was mainly due to an increase in landings control.

Length-weight relationship, weights-at-age and M

In the preliminary assessment carried out in 2003 the length weight parameters for the whole stock were applied (Table 4).. Length-weight relationships for males, females and both sexes combined was presented for first time in 2004 and was updated since then.

Maturity

Maturity ogives separated for both sexes as well as combined have been estimated in the area during 2004 (Silva *et al.*, 2005, WD 16). The L_{50} for females was larger than in the northern part of the Iberian Peninsula, while the males fall within the range of values found in the rest of the stock. Sampling for maturity have continued since then and data from 2004 to 2007 are available. However, after to apply the maturation criteria established in the Workshop on Sexual Maturty Staging of Hake and Monk (ICES WKMSHM, 2007) help in Lisbon, L_{50} decrease until to 43 cm, as much 2004 as 2007 (Silva et al., 2007, WD 10). These values are similar to the estimates obtained in the north and west populations of the Iberian Peninsula.

In whole year, mature females has been found, although with highest values in summer (May– September) and winter (December – February). These reproduction periods are different to those found in the north and west populations of the Iberian Peninsula, where this one occur between February and May.

1.2.3 Surveys

Two groundfish surveys are carried out annually in the Gulf of Cadiz in March (since 1994, but not in 2003) and November (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 towing hauls (ICES, 2002d).

Survey total abundance indices in weight and number are presented in Table 5, and Figure 3. The November survey in 2004 indicated a high abundance of small individuals, and this good signal has been corroborated by the 2005 March survey, which had the highest abundance in number of the whole series. In 2006, the March survey abundance index showed a hard decrease while November survey showed the highest value in the time series. Biomass indices from both surveys show similar trends since 2004 but different trends when compared with the LPUE series from the trawl fishery in recent years, although in the past the trends were similar.

Otoliths for hake ALKs for these surveys are collected from year 2000 and the age distribution was calculated since 1994 (general alk before 2000). Table 6 shows abundance-at-age for the Autumn survey (ALK for spring survey are not available due to ageing problems for age 0 fish). Autumn survey shows the higher values in recent years, with the highest time series value in 2005 and 2007. In 2008 the value decrease to the observed in 2006.

Survey abundance at age in each year and survey (Autumn and Spring surveys) were calculated on the basis of the ALK from the corresponding survey.

1.2.4 Commercial CPUE

Effort series from the Gulf of Cadiz trawl fleet is collected from sale notes and Owners Associations data and compiled by IEO.

Landings, LPUE and effort data are available only for the trawl fleet. These data are given in Table 7 and shown in Figure 4. The effort from the trawl fleet remains quite constant before 2006, around 30000 fishing days during the time series available, with a small peak in 1998 with 32824. In the last 4 years the effort have decreased until 19125 days in 2008. This fact could be partially due to the fishing plans set up by Spanish administration which include a close season of 45 days (2004 – 2006) and 60 days in 2007 and 2008. Besides close season, the decrease of 20% in 2008 could be related with both the fisherman strike and the bad weather conditions. (see 1.2.1)

The trawl fleet LPUE series shows a fluctuating pattern, with an increase in the last four years. Effort unit (fishing days) is a measure of global effort rather than of the real effort on hake, since this fleet targets up to 30 different species and the behaviour of the fleet varies depending on the market and the relative abundance of several species. The downwards trend in LPUEs from 2004 to 2007 was broken this year with an increase of 30% regarding 2007

1.3 Assessment

Although there is good information from this area, with the currently available methods, it is not possible at present to include the Gulf of Cadiz to be assessed with the rest of the Southern Stock. However, in the future, assessment models incorporating migration patterns should be explored.

1.4 References

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Table 1.- GULF OF CADIZ HAKE: Landings and Catch estimates (tonnes) by gear,1982-08

Year	Trawl	Artisanal	Total Landings	Discards	Total Catch
1982	485		485		
1983	574		574		
1984	694		694		
1985	789		789		
1986	976		976		
1987	952		952		
1988	986		986		
1989	899		899		
1990	1196		1196		
1991	1210		1210		
1992	975		975		
1993	541	5	546		
1994	326	5	331		
1995	458	4	462		
1996	975	32	1007		
1997	880	43	923		
1998	523	44	567		
1999	570	24	595		
2000	584	14	598		
2001	1203	38	1242		
2002	883	21	904		
2003	1251	19	1270		
2004	1062	33	1095		
2005	885	24	909	88	996
2006	634	25	659	12.5	671
2007	505	14	518	11	529
2008	529	33	562	16	578

Table 2 GULF OF CADIZ HAKE - trawl catches length compositions (thousands) in 2008

Length	Landings			Discards	Catch
class (cm)	Trawl	Artisanal	Total		Total
5				11,7	11,7
6				19,6	19,6
7				44,3	44,3
8				58,4	58,4
9				37,6	37,6
10				125,2	125,2
11				84,3	84,3
12				171,4	171,4
13				45,5	45,5
14	2,3		2,3	48,2	50,5
15	9,5		9,5	60,1	69,6
16	7,4		7,4	12,5	19,9
17	9,9		9,9	3,2	13,1
18	21,1		21,1	20,3	41,4
19	44,0		44,0	3,2	47,2
20	60,9		60,9	3,2	64,1
21	95,8		95,8	6,4	102,1
22	174,5		174,5	3,2	177,7
23	226,9		226,9		226,9
24	251,4		251,4		251,4
25	315,6		315,6		315,6
26	300,9		300,9		300,9
27	295,3	1,4	296,7		296,7
28	258,0	1,6	259,6		259,6
29	150,5	0,3	150,7		150,7
30	167,0	2,2	169,2		169,2
31	105,6	3,2	108,8		108,8
32	88,0	3,4	91,5		91,5
33	60,7	7,7	68,5		68,5
34	56,1	5,3	61,5		61,5
35	39,2	7,1	46,3		46,3
36	25,3	8,7	34,0		34,0
37	34,2	7,0	41,2		41,2
38	24,5	8,8	33,3		33,3
39	17,5	7,4	24,9		24,9
40	18,7	6,4	25,0		25,0
41	17,9	2,8	20,7		20,7
42	11,4	2,0	13,4		13,4
43	10,9	3,8	14,7		14,7
44	7,6	0,2	7,9		7,9
45	5,8	0,2	6,0		6,0
46	5,6	0,4	6,0		6,0

47	3,7	0,2	3,9		3,9
48	2,8		2,8		2,8
49	2,3		2,3		2,3
50	2,7		2,7		2,7
51	1,9		1,9		1,9
52	0,7		0,7		0,7
53	0,6		0,6		0,6
54	0,4		0,4		0,4
55					
56					
57					
58	0,0		0,0		0,0
59					
60					
TOTAL N.	**2935**	**80**	**3015**	**758**	**3773**
Nominal weight	529	33	562	16	578
SOP	513	31	544	11	555
SOP factor	1,03	1,04	1,03	1,53	1,04
Mean length (cm)	27,6	36,8	27,8	11,9	24,6

Table 3. GULF OF CADIZ HAKE. Catch in numbers by age

Catch numbers at age Numbers*10**-3

	YEAR														
AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	975	1622	15036	4990	8518	4979	6750	3678	5438	10321	1400	2089	205	6	27
1	819	3524	4772	8179	3753	5733	4621	8188	6155	8959	6872	3974	1091	702	1174
2	543	1086	1703	1818	976	657	1108	3842	2046	2643	2538	2614	1724	1449	1399
3	259	235	256	205	43	328	448	1182	1084	812	526	782	250	280	314
4	93	42	83	2	3	12	9	59	80	78	93	117	85	83	75
5	19	5	9	0	0	0	0	10	7	8	27	30	22	40	22
6	4	0	2	0	0	0	0	2	2	2	8	11	12	11	4
7	2	0	0	0	0	0	0	0	0	0	2	1	0	3	1
+gp	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALNUM	2715	6513	21861	15196	13293	11709	12936	16961	14813	22821	11467	9619	3388	2573	3015
TONSLAND	331	462	1007	926	567	595	598	1242	904	1270	1095	909	659	518	562
SOP %	100	100	100	101	101	100	100	100	100	100	102	100	100	103	104

Table 4. Cadiz hake, mean weight in stock.

	YEAR														
AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.05	0,04
1	0.09	0.05	0.05	0.06	0.06	0.05	0.04	0.04	0.04	0.05	0.06	0.07	0.12	0.11	0,11
2	0.18	0.13	0.14	0.15	0.14	0.15	0.12	0.14	0.13	0.15	0.16	0.12	0.19	0.17	0,17
3	0.26	0.28	0.35	0.22	0.27	0.22	0.22	0.22	0.24	0.28	0.29	0.25	0.37	0.31	0,32
4	0.41	0.44	0.54	0.53	0.47	0.37	0.42	0.40	0.41	0.42	0.52	0.43	0.59	0.61	0,58
5	0.63	0.52	0.60	0.58	0.58	0.68	0.72	0.67	0.66	0.58	0.76	0.71	0.80	0.85	0,79
6	0.94	0.70	0.78	0.66	0.78	0.74	0.73	0.76	0.76	0.63	0.96	0.74	1.06	1.03	0,88
7	1.34	0.76	1.19	0.91	0.86	0.91	1.08	0.82	0.79	0.85	1.17	0.89		1.20	1,03
+gp	1.78		1.22				1.08	0.76	0.76	2003	1.66	0.00			

Table 5 GULF OF CADIZ HAKE - November and march groundfish surveys; abundances indices for total Gulf of Cadiz area.

	Spring survey					Autum survey				
Year	Hauls	Biomass (kg/h)	s.e.	Abundance (nº/h)	s.e.	Hauls	Biomass (kg/h)	s.e.	Abundance (nº/h)	s.e.
1993	30	3.04	0.53	32	6.2					
1994	30	2.68	0.33	34	4.8					
1995	30	4.66	1.28	87	36.7					
1996	31	7.66	1.14	103	21.8					
1997	30	3.34	0.52	83	19.5	27	5.28	2.77	52	17.2
1998	31	2.93	0.67	30	12.4	34	2.66	0.42	18	3.5
1999	38	3.03	0.37	54	11.4	38	2.71	0.44	35	11.1
2000	41	3.02	0.47	51	14.9	30	2.03	0.61	25	4.8
2001	40	6.01	0.79	106	25.3	39	2.57	0.45	31	5.2
2002	41	2.74	0.25	35	3.6	39	3.39	0.78	127	37.8
2003						41	1.61	0.28	22	4.6
2004	40	3.65	0.47	104	19.7	40	2.72	0.69	94	39.1
2005	40	10.77	5.65	226	145.4	42	6.68	1.29	120	31.3
2006	41	2.15	0.40	17	3.3	41	4.99	2.00	224	157.1
2007	41	3.22	0.68	64	13.0	37	6.92	1.43	221	89.0
2008	41	3,48	0,67	63	25,0	41	4,33	0,60	78	22,0

Table 6. Abundance at age in Cádiz Autum survey

Autum Survey	0	1	2	3	4	5	6	7	8
2000	17.77	2.26	1.86	1.26	1.41	0.33	0.19	0.07	0.00
2001	22.50	2.85	3.30	1.12	0.58	0.18	0.08	0.11	0.02
2002	116.24	7.16	2.68	0.65	0.32	0.18	0.12	0.08	0.08
2003	15.78	2.60	1.39	1.14	0.68	0.21	0.20	0.00	0.07
2004	83.60	7.31	2.41	0.99	0.19	0.06	0.00	0.00	0.00
2005	88.66	27.38	2.42	1.13	0.29	0.08	0.04	0.00	0.00
2006	209.97	6.97	3.15	1.37	0.58	0.23	0.00	0.00	0.00
2007	197.66	12.95	6.87	2.25	1.01	0.13	0.08	0.00	0.03
2008	60,98	10,64	5,34	1,68	0,60	0,23	0,04	0,02	0,00

Table 7. GULF OF CADIZ HAKE. Landings (tonnes), Catch per unit effort and effort (fishing days) for the trawl fleet

Gulf of Cadiz Trawl			
Year	Landings (tonnes)	lpue (Kg/fishing day)	Effort
1993	541	17.9	30199
1994	326	11.7	27823
1995	458	14.2	32194
1996	975	30.5	31951
1997	880	27.0	32573
1998	523	15.9	32824
1999	570	17.4	32731
2000	584	19.5	29875
2001	1203	39.6	30416
2002	883	28.9	30526
2003	1251	39.5	31643
2004	1062	35.4	30029
2005	885	27.3	32419
2006	634	24.2	26248
2007	505	20.7	24398
2008	529	27,6	19135

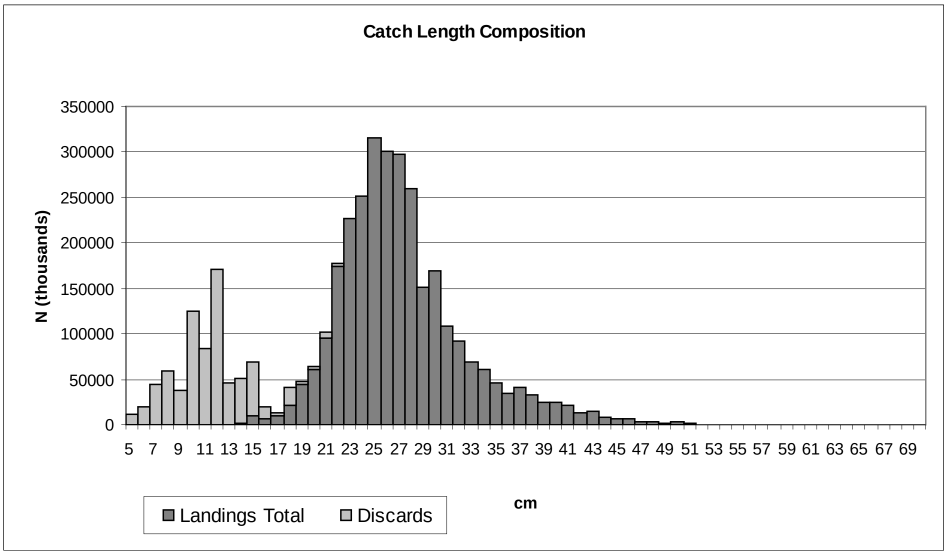

Figure 1 Landings and discards size distribution in 2008

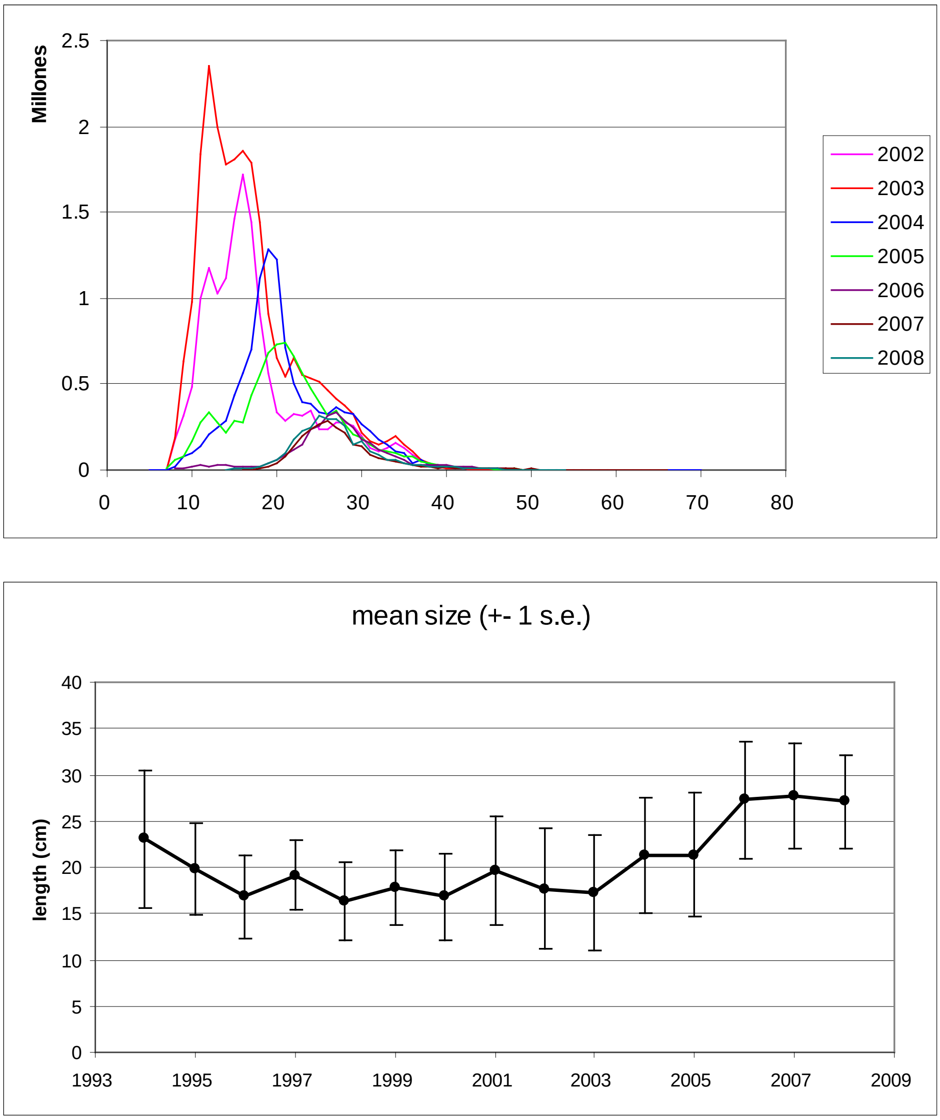

Figure 2 Cádiz hake landings size distribution (numbers in thousands)

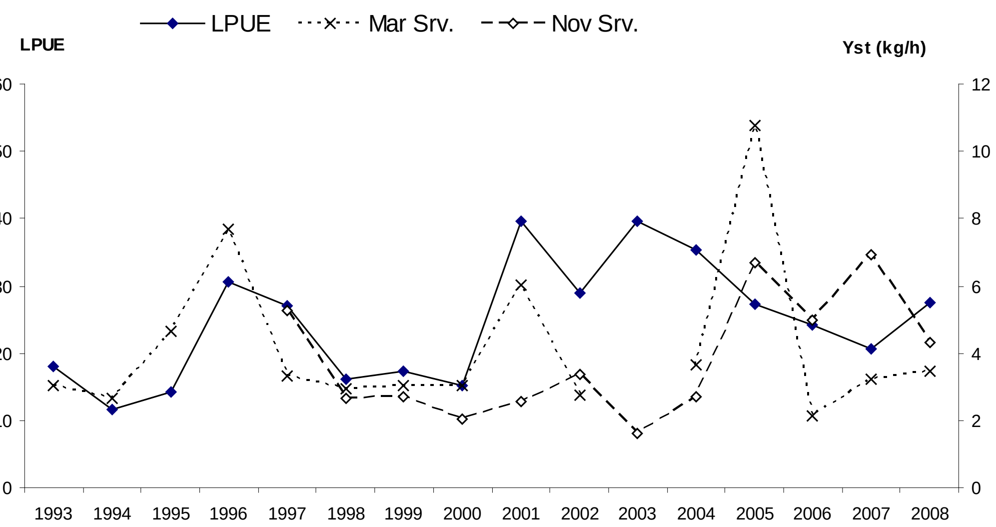

Figure 3. GULF OF CADIZ HAKE - Trawl LPUE and survey abundance indices (kg / 1 h. haul)

Figure 4 GULF OF CADIZ HAKE - Fishing effort and LPUE trends for the trawl fleet from 1993 to 2008

Annex N - Hakes benchmark planning

A subgroup of WGHMM met at various times during the meeting to organise priorities and tasks in view of the benchmark assessments for the two stocks of hake due to take place at the beginning of 2010. A summary of their conclusions and workplan for the forthcoming months follows. First, the reasoning behind the request for a benchmark workshop for hakes made by the 2008 WGHMM is presented. This has been extracted from Section 1 of the 2008 WGHMM report.

Request from 2008 WGHMM meeting for a benchmark workshop for hakes

Several sources of uncertainties require investigation for both hake stocks (northern and southern). The working group is of the opinion that, due to the volume of investigation needed to address these issues, the common subjects and the need to investigate relations between the two stocks, a dedicated benchmark workshop for hakes should be scheduled for 2009.

Common subjects that should be addressed are:

- Ageing problem: as little progress has been made on this issue and no alternative and validated ageing criteria can be foreseen for the near future, the use of alternative stock assessment methods less dependent on the estimation of age (Length based and/or surplus production model) should be considered.

- Discards: Since 2003, improvements in discard data collection from observer programs provides useful information which can potentially be used for the reconstruction of historical data series of discards which could be incorporated into the assessment.

- Migrations/stock structure: the recent high recruitments and increasing trend in biomass estimated for southern hake when the stock was at a poor state may reflect the migration of individuals from the northern stock. Such issue needs to be explored and ways of including it on the assessment/advice must be considered.

- Assessment model: Recent developments on Bayesian analysis of fisheries data created the opportunity to use models that consider uncertainty on the input parameters and produce results with uncertainty bounds. This situation requires previous practices to be developed in agreement, like forecasts, biological reference points, advice, etc.

Furthermore, for the **northern stock** of hake the following issues should also be addressed:

- CPUE series: A thorough analysis of the usefulness of some of the commercial CPUE series currently used in the assessment needs to be carried out together with the standardization of those selected to be used as index of abundance.

- Maturity ogive: the maturity ogive currently used in the assessment is based on 80's samplings of individuals from Subarea VIII (Divisions VIIIab and VIIIc, with different stocks). In order to obtain an updated and more representative maturity ogive, all related works made since then need to be compiled and, in the case of nothing relevant were found, a deeper study about this issue must be requested by the WG.

For the **southern stock** of hake the following issues should be addressed in priority:

- Cadiz data: The information collected on the Gulf of Cadiz must be included on the assessment. The biggest problem with such subject is the reconstruction of the historical series of landings at age which starts in 1994 while the catch matrix starts in 1982.

- Maturity ogive: At the moment a sex combined maturity ogive is used computed with IEO data although IPIMAR and AZTI also collect such information. Previous data analysis suggest different reproduction pattern along the Iberian coast. On the other hand, the reproductive potential of the stock may not be reflected by maturity ogives and recent projects.

Planning for the 2010 hakes benchmark

The following aspects were discussed and agreed. For each of them, there was at least one scientist that expressed a commitment to work in its direction.

DATA ISSUES:

Maturity: It will be necessary to use different sources of information, such as other studies, sampling from different areas, etc

Discards: There is a reasonable amount of data from different areas/fleets since 2003. When considering the historical period and all fleets and areas, there are many gaps in the series of discard estimates. Hence, there is a need to reconstruct discards to fill in the gaps. Two approaches will be considered: (1) development of population dynamics models that jointly estimate discards and population abundances, (2) GLM approach to estimate discards prior to their incorporation in assessment models.

Tunning series: Several tuning series will be considered for revision (Portuguese trawl, A Coruña trawl in VIIIc, Portuguese "October" GFS,...). Additionally, some new series will be tried in the assessment (Spanish Cádiz GFS, Portuguese GFS-fev, Irish GFS). An attempt will be made to combine Spanish and Portuguese surveys to obtain a single index covering the whole of the distribution area of the southern hake stock.

In order to make it possible to use the data sets efficiently, the information must be stored consistently and using the same aggregation level. The group agreed on using time series of landings and discards in weigth and length (when available) as well as tunning series at the level of ICES Division/Fishery Unit/Institute/Quarter. For southern hake smaller divisions identifying the northern part of Spain in IXa and the Gulf of Cádiz will be used. Biological parameters like maturity, weight, length, sex and age shall be stored at the individual level using the BIOSDEF database. Survey data shall be used by haul/age. Whenever available, the information will be extracted from the DATRAS database.

AGEING PROBLEM:

The issue of what use could be made of the WKAEH (Workshop on Age Estimation of Hake, to be held in November 2009) was discussed. There are about 1200 recovered individuals from tagging experiments that should be available to this WK, together with other information such as otolith shapes, otolith weight and daily growth. This information must be used to compute new growth parameters, which relies on the participation of scientists in the WK with a background on modelling in order to do this. The idea would then be to construct synthetic ALKs on the basis of the growth parameter estimates provided by the WK. This could be used to condition an Operating Model, with the purpose of evaluating the implications that using a wrong growth pattern may have on management. To be able to do this, datasets must have been organised by length by the time of the WK.

Another approach would be to use models that do not rely on age readings to do the assessment, such as Gadget, length based models or global production models.

STOCK IDENTITY:

The group considers it impossible to look at distinctions between the north and south stocks properly in the time available. However it is important to have a preliminary analysis of this issue to have an idea about the magnitude of the problem. It could be the case that the split between the Bay of Biscay and the Celtic sea is clearer than between northern and southern stocks.

A primary objective for the southern stock is the inclusion of the Gulf of Cádiz data in the assessment.

ASSESSMENT MODEL:

The group decided to test different assessment models in the search for alternatives to age based models as well as in an effort to improve the models used at present. It was planned to try the following models:

Age based models - improvements over the Bayesian model currently used for southern hake (e.g. force the model to follow landings) and XSA

Length based models - Multifan-CL, Stock Synthesis and Gadget will be explored.

Global production model - CSA.

It was decided to use MSE analysis for testing different hypotheses about the stocks and the fisheries. Two approaches are available at the moment and will be considered, a model that includes assessment (full feedback loop) in the projection phase and another one that uses simple projections.

MANAGEMENT:

Biological Reference Points must be revised and, if possible, change the currently used SSB to more appropriate reproductive potential indicators.

The group realises that evaluation of recovery and long term management plans is outside the scope of the benchmark workshop, but reiterates the urgency to evaluate the southern hake recovery plan. This should be done on the basis of the assessments approved by the benchmark.

DEADLINES:

The following deadlines were defined taking into account the large amount of work required to prepare the workshop and the overload of the scientists involved:

Data ready in the agreed format (including data from stakeholders): **end of October.**

Assessment models explored (studied and/or developed) and ready to be run: **mid December.**

MSEs implemented: **mid December**

A coordination meeting is proposed during the WKAEH (November).

REQUEST FOR BENCHMARK WORKSHOP DATE:

Given that WKAEH, considered to be important for this benchmark, is taking place during November 2009 and that the scientists involved in this group are very busy with other aspects of work during the month of January, it is requested that the benchmark workshop for hakes takes place in late February. **The third week of February 2010 is proposed for the benchmark workshop.**

EXTERNAL EXPERTISE DESIRABLE:

Two main areas of external expertise have so far been identified as being very important for the success of these benchmark assessments: (1) expertise in length-based statistical assessment models (such as Multifan-CL, Stock Synthesis and Gadget), (2) expertise in growth models and their incorporation in assessment. The scientists involved in the planning of this work will be happy to suggest some possible names of experts, if so requested.

NOTE ON ASSESSMENT SCIENTISTS INVOLVEMENT:

The assessment scientists involved in these benchmark assessments would like ICES and national institutes to be aware that they will need to be allowed time to work on these issues during the forthcoming months in order to have a realistic chance of a successful benchmark workshop.

Annex O - Recommendations

Continuation of Portuguese winter survey

A Portuguese winter survey was established in 2005 but, due to a lack of funding, it was discontinued in 2009. The survey was carried out along the entire Portuguese coast to coincide with the spawning season of hake. Hence, it was able to provide information on spawning ages of hake, which are not well represented in the Spanish and Portuguese autumn surveys. The WG considers the continuation of this survey important for the assessment of the southern stock of hake and recommends that it is restarted again. Ideally, the survey should be coordinated with some (new) surveys from Spain in order to cover the entire distribution area of the southern stock during the spawning season.

Survey for sole in Divisions VIIIa,b (Bay of Biscay)

No recent survey indices are available for this stock. As a consequence, no information is available on incoming recruitments. Recruitment values used for predictions are based on a geometric mean which may contribute up to 60% of the predicted landings in the TAC year and 70% of SSB in the following year. The WG considers that the lack of fishery independent data is an important deficiency of the Bay of Biscay sole assessment. The WG reiterates its previously expressed strong interest in the new survey ORHAGO, launched in 2007, which aims to provide an abundance index series for the Bay of Biscay sole and it considers that the survey is a priority need for the sole assessment.

Tagging experiments for age validation

The WG recommends that large scale tagging experiments be conducted for the purpose of age validation of hake and anglerfish.

Storage and availability of Working Documents

WG members were concerned about the volume of work presented at ICES WGs (not only WGHMM) that is not easily available and that may be lost after some time passes. WG members request that ICES provides a repository with search facilities for working documents or that an alternative system is established for numbering, keeping and making available working documents presented to ICES WGs.

Inclusion of Age-Length Keys in InterCatch

Several stocks assessed in WGHMM require the incorporation of Age-Length keys in InterCatch in order to make efficient use of this tool. Some stocks use several ALKs for a same given year (e.g. ALKs by semerster or by country) and sometimes several ALKs are combined into one that is applied to a part or the whole of the stock. Hence, it is important that InterCatch develops a facility to import and store several ALKs for a given stock and year and to use them singly or combined according to some weights.

SharePoint

The SharePoint should allow for synchronisation of local PC folders with SharePoint folders.

Requests to ICES Methods WG for methodology needed for 2010 benchmark assessments for hakes

Three major topics have been identified, on which WGHMM members would like to request support from the Methods WG. The first two topics arise as a consequence of the age determination problems from otolith reading for hake (otolith age reading method has not been validated and information coming from tagging experiments indicates that growth is being underestimated). The third topic relates to the need to account for discards (thought to be very substantial on young individuals) in the assessment. A brief description of these topics follows:

1. Development of or guidance with assessment methodologies that are not reliant on age-length keys. Models and methodologies on which WGHMM is seeking expertise include, but need not be limited to, Multifan-CL, Stock Synthesis, Gadget or global production models.

2. Ways of handling implications for assessment of revisions in growth parameters (as this may be an outcome of the WKAEH, to be held in November 2009) when there is no alternative way of ageing fish.

3. Methods for reconstruction of historical series of discards estimates or alternative ways of accounting coherently for discards in assessments when there are many gaps in the series of estimates.

Discards data with information about quality

The WGHMM received several data sets of discards data regarding hake, monkfish, megrim, sole and nephrops. Most of these data are not used in the assessments due to the short time series. However, the group would like to have more information about the discard data provided in order to better assess their quality. WGHMM requests that discards data be accompanied with information about the number of trips, number of hauls, raising factor and coefficient of variation. WGHMM acknowledges that most data sets provide some information about precision but none provided all the information required. Additionally the WG would like to have information about outliers analyses, if any were conducted. Due to the large variability found in some of the data sets, it is very important to have information about how outliers were treated in order to take decisions about the inclusion of discards data in the assessments.

RECOMMENDATION	FOR FOLLOW UP BY:
1. Continuation of Portuguese winter survey	
2. Continuation of ORHAGO survey	
3. Tagging experiments for age validation of hake and anglerfish	
4. Repository or some other way to store and make Working Documents available	ICES Secretariat
5. Age-Length keys (several per stock and year) to be incorporated in InterCatch, with the facility to use them singly or combined according to some weights	ICES Secretariat
6. SharePoint to allow for synchronisation of local PC folders with SharePoint folders	ICES Secretariat
7. Development/application of assessment methodologies not reliant on age-length keys (Multifan-CL, Stock Synthesis, Gadget, global production models...)	Methods WG

8. Accounting for revisions in growth parameters in assessments when there is no alternative way of ageing fish	Methods WG
9. Methods for reconstructing historical series of discards or alternative ways of coherently accounting for discards in assessments when there are many gaps in the series of estimates	Methods WG
10. Discards data to be provided with information on number of trips and number of hauls sampled, raising factor, coefficient of variation and any analyses conducted to handle the presence of outliers.	

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.***
	(e.g. Discarding is poorly documented)	*(e.g. Most countries supply discard data to the WG but sampling levels are low and variable for the main fleets catching this species. Discard rates are also highly variable and changing in response to recruitment and management.)* *(e.g. There may be scope to develop co-operative projects with industry on self sampling, reference fleets etc.)*	*(e.g. RCM and PGCCDBS)*
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*
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*
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*
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*
Mgw-8c9a	*The following data, which would be useful for the assessment, are missing from Portugal: all data relating to discards, length distributions of landings, ALKs*	*Request the appropriate data from Portugal, with indicators of quality*	

Stock	Data Problem	How to be addressed in DCR	By who
Mgw-8c9a	*The following data, which are relevant for the assessment, are missing from Spain: length or age distributions of discards*	*Request the appropriate data from Spain, with indicators of quality*	
Mgb-8c9a	*The following data, which are relevant for the assessment, are missing from Portugal: all data relating to discards, ALKs, abundance indices-at-age suitable to be used as tuning fleets*	*Request the appropriate data from Portugal, with indicators of quality*	
Mgb-8c9a	*The following data, which are relevant for the assessment, are missing from Spain: length or age distributions of discards*	*Request the appropriate data from Spain, with indicators of quality*	
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*
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*
Neph-8ab	*(1) Many years with no sampling onboard throughout the time series (13 years on 22).* *(2)Discards sampling routinely carried out since 2003, but the sampling plan is not well balanced (no sampling onboard in 8b apart from year 2005; 8b involves in 10-15% of annual landings).*	*(1)Validation of investigations for discard derivation (methods group, papers …).* *(2)Change of the sampling allocation (sub-contractors for 8b?)*	
Generic	*The WGHMM received several data sets of discards data regarding hake, monkfish, megrim, sole and nephrops. Most of these data are not used in the assessments due to the short time series. However, the group would like to have more information about the discard data provided in order to better assess their quality. WGHMM requests that discards data be accompanied with information about the number of trips, number of hauls, raising factor and coefficient of variation. WGHMM acknowledges that most data sets provide some information about precision but none provided all the information required. Additionally the WG would like to have information about outliers analyses, if any. Due to the large variability found in some of the data sets, it is very important to have information about how outliers were treated in order to take decisions about the inclusion of discards data in the assessment.*		*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 Bilbao (Spain), 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.

WGHMM will report by xx May 2010 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		Advice
nep-8c	*Nephrops* in Division VIIIc (FU 25, 31)	Spain	Spain		Advice
nep-9a	*Nephrops* in Division IXa (FU 26-30)	Spain/Portugal	Spain/Portugal	Portugal/Spain	Advice

Annex R - Review of ICES Hake Monk and Megrim Report 2009

Review Group Technical Minutes

Review of ICES Hake Monk and Megrim Report 2009. *25-29 May 2009*

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 well written and easy to follow. All of the assessments were considered updates. The introductory paragraphs were useful, clear and appropriate.

The Review Group considered the following stocks:

- Anglerfish (Lophius piscatorius and L. budegassa) in Divisions VIIIc and IXa
- Hake in Division IIIa, Subareas IV, VI and VII and Divisions VIIIa,b,d (Northern stock)
- Hake in Division VIIIc and IXa (Southern stock)
- Megrim (Lepidorhombus boscii and L. whiffiagonis) in Divisions VIIIc and IXa
- Sole in Divisions VIIIa,b (Bay of Biscay)

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.

The review was hampered by the lack of stock annexes for two of the chapters. Some other stock annexes needed further work. Repetition between the chapters and the annexes should be avoided. Also the use of “FLR” language should be discouraged as most of the terms developed for the FLR community have little context to others in the fisheries world (e.g. what is FLEDA?).

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 upcoming benchmark assessments. The review was surprised that megrim (both species) was not “ear marked” for a benchmark in the near future. The RG felt that of all the stock assessments in the report, the megrim should be considered the highest priority for the benchmark process. The RG agreed with the WGs approach to the hake benchmark assessment. Although the utility and relevance of continuing to try to assess the 0 groups should be tested and explained (the RG was not convinced that it was of value).

The use of the ecosystem information was generally poor, and for some stocks, too long and not relevant to the advice, but this is usual for almost all ICES assessment working groups. The use of fixed length to weight relationships for the entire time series was anachronistic and also suggested that the WG has not readily adapted to the ecosystem approach. Addressing between year variability in maturity may be relevant to increasing our understanding of stock dynamics in the ecosystem (as carried out for some stocks and proposed by the WG for others in the future) but not, if used in isolation, without considering the variability in stock weight introduced through interannual changes in fish condition. The ecosystem information should provide useful information for advice on the stock, fishery or ecosystem. Just dumping everything that is known about a fish and its ecology is not useful.

As no new management plans were submitted for evaluation, none were addressed by the WG. It should be noted that the northern hake has not reached over 140 Kt for at least two years in a row following the current assessment.

Although the organization of the report by stock suggests a bias towards single species approaches, the sections on fisheries highlighted that all of these stock are caught in mixed fisheries and this factor must be accounted for when considering exploitation and management. As pointed out in many chapters, the setting of stock specific TACs for fish caught in mixed fisheries is not a successful management technique. There was little evidence of developing a mixed fishery approach, other than considering the anglerfish and megrim species together. The WG is aware of this and are waiting for a workshop to be developed to help build mixed fishery integrated advice.

Considering that many of the fleets used for the LPUE series are common to different stocks, the RG considered that dealing with LPUE in a separate chapter, which could be referred to in the following stock sections, would aid understanding of the dynamics and issues of the fleets. The was also not mention of accounting for "technological creep" when applying LPUE series, which has been estimated as 2% per year in other European mixed fisheries (see Rijnsdorp et al., 2006).

Also new techniques to account for and to use discard information are becoming available and some were discussed at the WG. Statements such as "sampling is patchy" and "the discarding rate is variable" are now not strong enough excuses, not to take discarding into account in a stock assessment, especially when discarding is high or shows a trend (see Aarts & Poos, 2009; Dickey-Collas et al., 2007). The WG has the in-house ability to develop custom statistical catch at age and Bayesian stock assessment models and have shown that they are aware of potential solutions to these issues (see WD 10 of HMMWG).

Overall, the RG found the WG 2009 report of high quality and a suitable basis for providing advice.

References

Aarts, G., and Poos, J. J. 2009. Comprehensive discard reconstruction and abundance estimation using flexible selectivity functions. – ICES Journal of Marine Science, 66: 763–771.

Dickey-Collas, M., Pastoors, M. A, and van Keeken, O. A. 2007. Precisely wrong or vaguely right: simulations of noisy discard data and trends in fishing effort being included in the stock assessment of North Sea plaice. – ICES Journal of Marine Science, 64: 1641–1649.

Rijnsdorp, A. D., Daan, N., and Dekker, W. 2006. Partial fishing mortality per fishing trip: a useful indicator of effective fishing effort in mixed demersal fisheries. – ICES Journal of Marine Science, 63: 556–566.

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

1) **Assessment type:** update (stock on observation list)
2) **Assessment**: analytical
3) **Forecast**: Short-term (age-structured with management option table and yield per recruit routines for a range of *F* values) and long-term (yield and biomass per recruit over a range of *F* values)
4) **Assessment model**: XSA – tuning by 4 commercial catch at age series (only three active in 2008) + 4 research surveys (but 3 since 2001, and 2 since 2004).
5) **Consistency**: Update of 2008 assessment. Consistent model formulation and data inputs.
6) **Stock status**: $B_{lim}<B<B_{pa}$ since 2001 and increasing each year. $F<F_{lim}$ since 1997 and $F<F_{pa}$ (just) in 2008. Recruitment uncertain for recent year classes but seems to be high recent years.
7) **Man. Plan.**: Recovery plan initiated in 2001 with a recommended *F* (=0.25) and limits on TAC fluctuations (<15%). Deemed successful in 2007 (mature stock >140 000t for two consecutive years, 2006 and 2007). Now a management plan is under development by the EC (no specific management rules yet).

General comments

The assessment is an update of the 2008 assessment, performed using identical settings and updated (one extra year) data. The assessment is carried out according to the prescribed practices in the stock annex. The assessment is well documented and presented providing clear results of the analyses completed. The forecast methods and results are very good, giving a clear indication of likely short-term outcomes and probable long term equilibria for a broad range of *F*. Adequate results are presented for the formulating of advice.

Some tables are included in the text without proper headings or numbers. These should be formally included as proper tables.

Ecological factors or environmental conditions impacting on hake population dynamics are not taken into account at present in the assessment or in the management.

Discard estimates since 2002 are highly variable by year, fleet and estimation method. In addition discard information is not available for all fleets and the current raising procedure may not be satisfactory. Revising this method could lead to a notable revision in discards estimates for those fleets. Discard estimates in recent years are around the level of 2-3 thousand tons annually, roughly 5% of the TAC. If these numbers are revised up it may no longer be reasonable to excluded discard information from the assessment.

Technical comments

The input data and historical model development are well documented in the stock annex. Some sections of text and tables/figures from the annex are repeated (unnecessarily) in the assessment.

The maturity ogive value for age 3 should be 0.23 not 0.2 in both the stock annex and the assessment (tables within the text give only one decimal place). A value of 0.23 is used in stock projections (and presumably the calculation of SSB from the assessment as well, but this is not specified). p. 24

Is it necessary to estimate numbers at age 0? The assessment model predicts numbers for the start of the year (Jan 1), and specifies that no mortality occurs prior to spawning. This means that the number of age 0 fish for each year is the total reproductive output of the stock. There is only one index (FR-EVHOES) for age 0 since the UK-WCGFS survey ended and it is noted in the assessment that: "Recruitments tend to be poorly estimated. Low values are revised upward and high values downwards when new years are added to the data series." Yet even these revisions are unlikely to be producing more accurate estimates. There is no estimate of *F* for age 0 (assumed to be 0) in recent years and there is likely to be substantial variation in *M* at this age (probably due to density dependent factors (e.g. predation, cannibalism etc.) and environmental conditions). Hence using a fixed value of M=0.2 to back calculate numbers at age from older ages is unlikely to result in meaningful estimates of the size of this age class. While historically age 0 fish have been present in the landings, for the last ten years numbers of age 0 fish in the landings have been negligible, with fish only starting to recruit to the fishery at age 1. Presenting results for recruitment at age 1 may be more meaningful in the current and future assessments, especially considering that geometric mean (1990-2006) values are used for the recruitment in 2007-2009 due to the unreliability of estimates. It is uncertain how removing age 0 estimates would affect the model fit.

Table 3.1 states that years 2003-2008 have NO discards estimates available then Table 3.2 details the discard data for years 1999-2008. Reasons are given in the text as to why these discard data are assumed to be inadequate (too few fleets, difficult to construct historical time series etc.). Perhaps Table 3.1 should be altered to say 'inadequate discard estimates'.

"In the absence of independent estimates, the mean weights at age in the total catch (Table 3.6) are assumed to represent the mean weights in the stock." If the stock assessment is considered a relative index, this approach is adequate, however if the stock assessment is consider absolute or feeds into multispecies analyses this approach biases the SSB. Stock numbers are estimated for Jan 1 so the estimated weights should be for this time too. Landings occur throughout the year (according to alpha and beta) so on average should be half a year's growth heavier for each age. This could be leading to an over-estimate of SSB and total biomass. In the absence of independent estimates of stock weight, growth models could be used to back-calculate weights at Jan 1.

Table 3.7 (commercial fleets and survey tuning data) is confusing. The data is presented in Lowestoft format, which specifies effort in the first column. These values are set as 1 000 (for all years) for all indices except the SP-CORUT R7 and SP-VIGOT R7, which are set at 10 000. Two columns are added to the end of the matrix for year and effort (values varying by year), however there are no effort estimates for the last three indices (FR-EVHOES, UK-WCGFS and SP-PGFS). Presumably effort by year is constant in these surveys. The way these input data are derived is unclear.

No accounting for technological creep in the LPUE time series.

There are some year effects in the log catchability residuals of a couple of the surveys but these still appear to be reasonable.

It is good that *F*-shrinkage rarely accounts for very much of the weighting in year-class estimates, although this would be expected given that there are 4 surveys and 4 commercial CPUE indices.

The WG note in the text that recent recruitment estimates are unreliable (recruitment values for the last two years are replaced by geometric means) but this should also be noted in Fig 3.8 as it is done in Table 3.11. Otherwise this figure gives a false impression of very strong recruitment in recent years. Likewise, in the Management considerations section the authors say: "FR-EVHOES survey index indicates an increase in recent recruitments (2006 to 2008) 2008 recruitment index is the highest values in the series." Again, this is misleading for management purposes.

There is very good agreement with the 2008 assessment results (no major changes in the update).

Figure b) in Table 3.16 is very unclear. Only two shadings are visible. Although the GM90-06 estimates are said in the text to account for 18% of the catch in 2011, this can not be seen in the figure.

In both the stock annex and the assessment it is claimed that "According to ICES, the northern hake stock has met the SSB target in the recovery plan of 140 000 t for two years (2006 and 2007)." No reference is provided for this and according to the current assessment and the 2008 assessment this is not the case (2006= 129 760t; 2007=126 744t). In fact 2008 (136 588t) is the first time the SSB has been above 130 000t since 1990.

p. 23 §2, line 6-8: According to table 3.1, the increase between 2003 and 2004 should be 1100 t (IVa+VI) and 2100 t (VII), not 3470 t and 1660 t as written in text.

p. 24 §1 in 3.2.3: It says that "The FR-RESSGASCS surveys was conducted in the bay of Biscay from 1978 to 2002, …". In the data table (Table 3.7), only data for 1987 to 2002 is given. Is 1978 a typing error, or is only parts of the survey series used. If the latter is true, then why?

Table 3.7: It would be nice if the table legend told us what the different numbers used as tuning data where (CPUE, landings, indexes etc), as well as the denominators.

Table 3.16: The figure of 2011 SSB doesn't seem to match the numbers in the table … And is also difficult to read.

Table 3.17: The column headings (or the table legend) should be improved (e.g. SSBjan really is SSB/R …)

STOCK ANNEX:

p. 398 Table 2: When comparing the table and the text (p. 397 §3) the RG got confused. WG say that "A new sampling program of discards in the French *Nephrops* trawlers fishery of the Bay of Biscay started in June 2002." Still there are numbers for French *nephrops* also in 1999-2001. Why?

p. 399: The maturity ogive table should be given with two decimal numbers (according to input data age 3 should be 0.23, age 4: 0.60, age 5: 0.90 and age 6+: 1.00.

p. 402 §3: Report says that "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." According to the table on p. 403, this happened already in WGHMM2005.

Conclusions

The assessment has been performed correctly according to prescribed procedures in the stock annex. The results and their implications are well explained. When caution is required, the authors have noted it e.g. lack of discards in the assessment potentially leading to underestimate of F in lower ages. The main uncertainties of the assessment are clearly identified and recommendations are made for the 2010 benchmark assessment.

Presenting results for recruitment at age 1 rather than age 0 may be more meaningful in the current fishery and these estimates would be less prone to error given the current assessment setup.

Estimates of stock weights at age at Jan 1 should be different (lower) from estimates of landings weights at age taken throughout the year. Modelling work or independent estimates could be used to determine these values. The impact of accounting for interannual variation in condition (annual estimates of the length weight relationship) should be addressed.

The recovery plan for this stock has been deemed successful although the results of this assessment indicate that the target has not yet been attained.

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

1) **Assessment type:** update (of the WGHMM-2007 assessment)
2) **Assessment**: analytical
3) **Forecast**: presented (8 scenarios, 10 years)
4) **Assessment model**: ASPIC production model (one for each species) – tuning by 1 commercial CC (CPUE and total catch) series + 1 standardised index of biomass (LPUE series) for each assessment (different fleets used for each species, Spanish (Div. VIIIc) for *L. piscatorius* and Portuguese (Div. IXa) for *L. budegassa*).
5) **Consistency**: **No Stock Annex**. Update of 2007 assessment. Consistent model formulation and data inputs.
6) **Stock status**: No reference points for the stocks. *L. piscatorius*: fluctuating around 25% of B_{MSY} for the last 15 years, *F* well above F_{MSY}. *L. budegassa*: *B* increasing and *F* decreasing steadily over last 8 years. In 2008 *F* dropped below F_{MSY} and *B* at almost 75% of B_{MSY}.
7) **Man. Plan.**: None (but caught in mixed fisheries and recovery plans are in place for hake and *Nephrops* in the same area).

General comments

The assessments are updated of the 2007 assessments, performed using identical settings and updated (two extra years) data. There is no stock annex for these stocks so it is impossible to review the presented assessments in terms of prescribed practices. However, the assessment is well documented and presented providing clear, succinct results of the analyses completed. Adequate results are presented for the formulating of advice.

Some tables are included in the text without proper headings or numbers (e.g. discard estimations and parameter comparisons between 2007 and 2009). These should be formally included as proper tables.

In section 8.1.3.1, the input data for the *L. piscatorius* assessment is said to be in Table 8.1.5 while it is actually in Table 8.1.4.

Table 8.2.4 (landings section) does not contain a column for the % of the annual stock landings for the Portugal Fish fleet.

Table 8.1.3. Keep column order the same : Kg and then N for both series.

In section 8.2.4, incorrect table specified

These stocks are not biologically defined and the species distributions extend beyond the boundaries of the assessment (*L. piscatorius* mainly to the north and *L. budegassa* mainly to the south). The surveys/LPUEs used in the assessments of each species come from different ICES areas (*L. piscatorius* Div. VIIIc to the north and *L. budegassa* Div. IXa to the south). The stocks also have differing current status. It is not ideal to manage these stocks with a single TAC but this is necessary given that these species are reported together. However, the status of both stocks should be taken into account when providing advice to ensure precautionary management, i.e. considering the stock in poorer condition. For both species the stock size is predicted to increase at current *F*.

Limited ecosystem information has been provided, especially considering that this stock is part of a large mixed fishery.

Technical comments

Input data broadly appear to be correct and suitable.

There is no justification in the assessment for the choice of LPUE indices used in the ASPIC models for each species. They are seemingly chosen because of the locations in relation to the distribution of the species in the management areas or because of larger contribution to annual landings. Support for the choice of LPUE series could be included in a stock annex.

The data on estimated discards indicates a large CV on most estimates. However, given the short time series of data for these and that the data are only limited to a few of the fleets it seems justifiable to omit this data at this stage. The current estimates represent a very small percentage of the total landings (~2-3%). It would be worthwhile to continue presenting this data to assess trends in discard abundance.

The model parameters used in both assessments seem reasonable. However, 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 (Annex H) due to values of these going out of bounds (ranging from 20 to 40% of the trials). A large proportion of trials replaced could bias the estimates coming out of the bootstrap analysis if the same bound (upper or lower) is being exceeded each time.

The number of bootstrap trials could be increased from 500 to 1000 to determine 95% rather than 80% confidence levels (perhaps more statistically meaningful). 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 bootstrap biases are larger for *L. piscatorius* than *L. budegassa*, but are not unacceptable.

The restrospective differences between the 2009 and 2007 assessments are greater for *L. piscatorius* than *L. budegassa* and in opposite directions. A substantial decrease (~25%) in the estimated q values for *L. piscatorius* has resulted in higher F and lower B estimates for the period 2003-2007 than the previous assessment indicated. The WG describe a "slight downshift in F from the 2007 estimate". This should be clarified in light of this retrospective change: F is estimated to be higher in 2007 than initially thought, but F in 2009 is slightly lower what it was originally estimated to be in 2007. The current assessment of *L. budegassa* estimates F to be slightly lower and B to be slightly higher from 2003-2007 than originally estimated in the 2007 assessment.

The Portugal Crustacean and Fish indices used in the *L. budegassa* assessment show sharp increases in LPUE over the last two years (Fig. 8.2.2). This change is not seen in the Spain fleets, which do not match the Portugal indices over the duration of the time series. These data points are likely the reason for the slight retrospective pattern in this assessment and lead to the current stock status to be reasonably healthy. Should these points turn out to be anomalous it is likely that the stock status view will be revised downwards (less healthy) in later assessments.

No accounting for technological creep in the LPUE time series.

Conclusions

A stock annex is necessary for this stock and it could be used to clarify certain aspects of the formulation of the stock assessments. However, it seems that the assessment for the most part has been performed correctly.

Some slight changes may be useful such as increasing the number of bootstrap runs, changing some of the allowable ranges for parameter estimates and the presentation of risk profile plots for *B* and *F* estimates in the final year.

Stock Hake in Division VIIIc and IXa (Southern stock)

1) **Assessment type:** update
2) **Assessment**: analytical
3) **Forecast**: presented
4) **Assessment model**: Bayesian statistical catch at age model (3 LPUE fleets and 2 surveys)
5) **Consistency**: same as last year
6) **Stock status**: B = 22.7 kt < Blim = 25.0 kt, B increasing in recent years, F= 0.52 > Fpa = 0.40, R uncertain.
7) **Man. Plan.**: Recovery plan agreed in 2005: not evaluated by ICES. SSB above 35.0 kt in 2015 and reduce F to 0.27 year^{-1}.

General comments

As this was a update assessment, the RG felt it was not that appropriate to extensively review the choice of assessment model, especially as none of the group were experts in Bayesian modelling. The WG also explained the model well in the report and discussed many of the issues associated with the assessment in a clear and considered manner. The issues of the underestimation of the catch in recent years is worrying and the fact that the credibility intervals (CI) are much smaller than the between year retrospective change needs to be further address. The WG must state clearly what the credibility intervals are, and the text must clearly state that the CI does not reflect all of the variability in the assessment approach.

The use of interannually variable maturity ogive is sensible, but why is the length at age relationship assumed to be static over the whole time series (see comments in general section above).

At p. 149 §5: "As in previous years, age plus was set at 8 and the data for age 0 in the catch at age matrix was replaced by zeroes due to the low landings in this age for recent years after implementation of MLS. The catch at age matrix is presented in Table 7.4. Table 7.10 presents the tuning information available." What's the effect of this? Why is this done? See RG comments on age 0 in the Northern Hake section above.

Technical comments

The order of the figures doesn't correspond exactly to the order of appearance in the text.

Much repetition between stock annex and report chapter.

Over confident precision given in the text (are the landings really that well estimated to be confident to estimate to 2 decimal places?).

As in last years report some of the text on the figures was too small to read (e.g. Figure 7.4)

p. 150 Priors table (also p. 447 in stock annex): some of the N priors (age 2, 3 and 5) are marked with 1983 instead of 1982. Is this correct?

p. 150 below the 2nd table: it is said that "some age/years not included on the assessment (see above)". Where is the years not included mentioned?

p. 151 §6: "Fishing mortality reached peaks in 1995 (median = 0.63 year-1) and 2002 (median = 0.64)…". Also 1996 had a median F = 0.63 year-1 (Table 7.12).

p. 152 §6: "The median values and 90% credibility intervals can be consulted in Table 7.16." The reference should be to table 7.15.

p. 152 section 7.4.1 paragraphs in strange order

Table 7.3.1 – should go in the annex

Table 7.17: column fmult – should have two decimal numbers for all the rows.

Figure 7.4a. The figure legend is not good. This information should be included in the table legend instead. The figures should be marked with age.

Figure 7.5c. The very negative log residual for age=0 in 1995 is not commented in the text describing the residuals (p. 151 §1).

Figure 7.10 explain what the grey dots (areas) are.

Figure 7.11 strange sub-labelling of figures

Table 7.12 show age of recruits on table

Stock annex:

p. 449 Table of Biological reference points: For Blim, some of the text under "Technical basis" is missing.

Conclusions

As this was an update, the RG found that the assessment was carried out appropriately, and described in a clear manner. It is clear that the WG are aware of the major issues in the assessment. This assessment does provide the basis for advice.

Stock: Megrim (Lepidorhombus boscii and L. whiffiagonis) in Divisions VIIIc and IXa

1) **Assessment type:** update (advice for these stocks was last given in 2007)
2) **Assessment**: analytical and exploratory
3) **Forecast**: presented
4) **Assessment model**: XSA (one for each species) – tuning by 2 commercial LPUE indices + 1 survey
5) **Consistency**: **No Stock Annex.** Same settings and specifications as in the last assessment (2007 WG, although the 2008 WG also performed an update run for consistency checking).
6) **Stock status**: No reference points. SSB at consistently low levels for the last 15 years. *F* is also near the lowest of the time series.
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

The assessments are updates of the 2007 assessments (although the 2008 WG also performed an update run for consistency checking), performed using identical settings and updated (two extra years) data. There is no stock annex for these stocks so it is impossible to review the presented assessments in terms of prescribed practices. While, the assessment is well documented and presented, there are numerous issues related to this assessment that could limit its usefulness for providing management advice and these issues are clearly presented in the assessment.

Some tables are included in the text without proper headings or numbers (e.g. discard estimations and parameter comparisons between 2007 and 2009). These should be formally included as proper tables.

Megrim (*L. whiffagonis*): Previous RG recommendations have been addressed (except investigating an assessment method incorporating uncertainty due to lack of manpower – no stock co-ordinator for these stocks).

Four-spot Megrim (*L. boscii*): Have not addressed previous RGs recommendation to establish reference points for the stock (this will be done when a benchmark assessment is conducted).

The ecosystem aspects where long, poorly organised, repetitive and speculative. They are not useful for the provision of advice. Descriptions of surveys are included in the fishery description.

Technical comments

Megrim (*L. whiffagonis*)

Discards in number represent between 15-45% of the total catch. This is a high proportion and it seems unreasonable to simply ignore this source of mortality. See general comments and references on discarding above.

The input data is clearly explained. Initially surveys seemed to pick up cohorts, but since 2000 no trends are distinguishable. Indices are low for all ages without any notable cohort structure.

In the absence of independent estimates of stock weight, growth models could be used to back-calculate weights at Jan 1 instead of using landings weights..

The note under figure 9.1.6 says age 1 was excluded from the LPUE indices (and this is also explained later in section 9.1.5) but the text for data input in the assessment (9.1.3.1) says only age 0 was removed.

Retrospective analysis seems out of place (results mentioned before the assessment results). The retrospective pattern is unidirectional (consistently raising *F* and lowering *B*), could be indicative of a poor fit in recent years.

Figure 9.1.1 is not referred to in the text.

Very strange that the Lowestoft Suite and FLR XSAs produced different results. This should not happen. It is necessary to know how the results differed and if the WG have any ideas as to why this may be the case.

The non-convergence of the XSA is worrying. Also, 200 is a lot of iterations to carry out yet still present a non-converged model. In some cases the number of iterations could have a notable effect on the model results – it may be better to have a smaller number (40-60). Were there convergence problems in the previous assessments as well? This is probably an indication of the lack of signal in the data.

Shrinkage often results in over conservative assessments. The model has a medium *F* shrinkage s.e. (1.5). However, it appears there is no reason to assume that *F* levels have changed sharply from year to year for some time (~15 years) so increasing the level of *F* shrinkage should be acceptable. Given that there is no clear signal in last few years (since 2000), perhaps increasing the amount of shrinkage (decrease *F* shrinkage s.e. to ~0.5-1) would assist in the convergence of the XSA. This would of course shift higher emphasis to landings estimates in recent times (and this could be problematic as well since the majority of the fishing pressure presently seems to be on one or two cohorts).

The survey residuals are poor. Years of most being negative or most being positive are common.

Proportion F and M before spawning could be set to 0.15 given that Spawning is claimed to occur mainly in March.

Is XSA really a suitable model for this stock assessment, as the fishery in recent years seems to be on a single cohort and the tuning information has very little information?

The great degree of work and the accompanying WG explanations on the recruitment used in the projections seems disproportionate to the certainty of the stock assessment. Do we really know what the dynamics of the stock are. Why has recruitment decline in a linear manner with SSB, when F is low?

Four spot (*L. boscii*)

Discards in number represent between 40-62% of the total catch. This is a very high proportion and it is unreasonable to simply ignore this source of mortality (see comments above in general section on discards).

The input data for this assessment are limited. Also, the internal consistency of the indices does not appear to be very good. There is only one index of population abundance from 2000 onwards. This could be problematic e.g. the data for this survey in 2003 was considered problematic leaving only catch data for 2003. This is probably the reason for the strange retrospective pattern where the 2003 and 2004 lines are very different from the rest (otherwise retrospective pattern for this stock is better than that of Megrim).

It should be mentioned in table 9.2.6 that 2003 is excluded from the SP-GFS input data for the assessment.

This XSA also doesn't converge, but this issue is not described in the text as it was for Megrim. There is also no explanation as to why the number of iterations for this assessment is limited to 40 compared to 200 for megrim. The RG felt that this approach, of limiting iterations was appropriate.

Residual patterns for surveys have strong year class effects.

Conclusions

A stock annex is necessary for these fish. The assessment has been implemented in a consistent way compared to previous assessments, however it seems that the current model used may not be suitable. There are poor residual patterns and the model does not converge. There are also input data issues associated with these stocks, specifically assumed high discard rates but inconsistent data to effectively incorporate this in the assessment, and a lack of any clear signals of cohort abundance in recent years in the indices. It is clear that the WG are aware of these issues.

The assessments show both populations to be very stable, if low, for the last few years. However this may be a result of the poor signal in the survey indices, and could potentially be providing poor reflection of current stock status. This would make the results from these models not ideal for the provision of management advice. It is also difficult to provide advice when there are no management objectives, as is the case for these fisheries.

While the assessment has been properly implemented and well documented, there is a need to improve upon the current methods used. There are also no reference points available for these stocks. A benchmark assessment is required. It is worrying that there is no stock co-coordinator or stock annex for this stock.

The WG developed a statistical catch at age model for megrim to begin to address these problems and the RG recommends that this work be continued and encouraged.

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 LPUE fleets (1991-2008) + 2 surveys (1987-2002)
5) **Consistency**: Consistent with last year
6) **Stock status**: B = 13.75 kt > Bpa = 13.0 kt, F= 0.38 < Fpa = 0.42, Recruitment poorly estimated and low compared to the rest of the time series
7) **Man. Plan.**: Agreed 2006: not evaluated by ICES. SSB above 13 000 t by 2008. As this has been reached a further plan should be developed with longer term targets.

General comments

This was generally easy to follow and clearly described. However there was much repetition between the report chapter and the annex. The issue of discards and use of CPUE (or LPUE) has been discussed above. Describing how the catch time series has been put together is useful, but it leads to the question: is the certainty the same for each year of the time series. The current model will assume it is. The RG found no errors in the application of the stock annex.

Technical comments

Some tables and figures not referred to in the main text. The order of the figures doesn't correspond exactly to the order of appearance in the text.

p. 112 §4: The description is not clear (also applies to p. 113 §3). This is more clearly explained at the paragraph starting at the bottom of page 115. This also means that there is a difference in catch and stock weight at age for the years 2006-2008. This is not mentioned in the stock annex (which on p. 432 says "stock weights are set to the catch weights"). However, in the input data (sol8lsw, sol8lcw), RG can only find a difference in the years 2007-2008. In 2006, the weights at age are equal.

p. 117 §4: Include a reference to Figure 6.5 and 6.8.

Table 6.1a: Should the TAC also be given here?

Stock annex:

p. 431: The . is used as a multiplication sign here. Wouldn't it be clearer to use e.g. *? RG would also use brackets around "D/RGT" in the last equation.

Conclusions

The assessment has been performed correctly and the RG views it appropriate for the provision of advice.

Annex S - Technical Minutes of the Celtic Sea Review Group (RGCS) 2009 – Anglerfish and Megrim stocks

26 May – 4 June 2009, Fairhaven Massachusetts, USA

Reviewers: Steve Cadrin (chair), Adam Barkley, Greg DeCelles, Dan Goethel, Nikki Jacobson, Lisa Kerr, Dave Martins, Cate O'Keefe, Sally Roman, Tony Wood

Working Groups:

- Working Group on Celtic Seas Ecoregion (WGCSE, Colm Lordan chair)
- Herring Assessment Working Group (HAWG, Maurice Clarke chair)
- Working Group on the Assessment of Hake Monk and Megrim (WGHMM, Carmen Fernandez, chair)

Secretariat: Barbara Schoute

Process - The ICES advisory service quality assurance program requested that a team of graduate and post-doctoral students and their professor serve as a review group. The group initially met on 26 May to review the ICES advisory process, RG guidelines and to assign several WG report sections to each reviewer. A second meeting was held on 27 May to review standard ICES assessment models (XSA, ICA, SURBA, TSA and BADAPT). Members reviewed WG report sections independently, then presented their summaries and reviews to the group in a series of meetings during 1-3 June to discuss reviewers' proposals and form RG conclusions.

General - Stock assessment reports for 32 stocks were reviewed (Table1). The WG reports were generally informative, and WG decisions about data, model choice and specification and interpretations were clearly explained and justified. The RG concludes that the reports are technically correct, and the RG agrees with WG recommendations, with few exceptions. In nearly all cases, the assessments appropriately applied the procedures specified in the stock annexes. Some general issues were raised for many stocks related to discards, definition of assessment and management units and standardized methods. These general observations should be considered for the next benchmark reviews of these stocks.

Table 1. Stocks reviewed ordered by working group (WG), terms of reference (ToR), type of assessment and assessment method.

WG	Stock	Name	ToR	type	method
wgcse	cod-7e-k	Cod in Divisions VIIe-k (Celtic Sea Cod)	Update	no method	Benchmarked
wgcse	cod-iris	Cod in Division VIIa (Irish Sea)	Update	assess	BADAPT
wgcse	cod-rock	Cod in Division VIb (Rockall)	No assessment	no advice	
wgcse	cod-scow	Cod in Division VIa (West of Scotland)	Update	assess trends	TSA
wgcse	had-7b-k	Haddock in Divisions VIIb-k	Update	assess trends	XSA
wgcse	had-iris	Haddock in Division VIIa (Irish Sea)	Update	assess trends	SURBA
wgcse	had-rock	Haddock in Division VIb (Rockall)	Update	assess	XSA
wgcse	had-scow	Haddock in Division VIa (West of Scotland)	Update	assess	TSA
wgcse	whg-7e-k	Whiting in Divisions VIIe-k	Same Advice	assess trends	XSA
wgcse	whg-iris	Whiting in Division VIIa (Irish Sea)	Same Advice	assess trends	SURBA
wgcse	whg-scow	Whiting in Division VIa (West of Scotland)	Update	assess	SURBA
wgcse	ple-7h-k	Plaice in Divisions VIIh-k (Southwest of Ireland)	Same Advice	catch trends	-
wgcse	ple-celt	Plaice in Divisions VIIf,g (Celtic Sea)	Update	assess	XSA
wgcse	ple-echw	Plaice in Division VIIe (Western Channel)	Update	catch trends	XSA
wgcse	ple-iris	Plaice in Division VIIa (Irish Sea)	Update	assess	ICA
wgcse	sol-celt	Sole in Divisions VIIf, g (Celtic Sea)	Update	assess	XSA
wgcse	sol-echw	Sole in Division VIIe (Western Channel)	Update	survey trends	Benchmarked
wgcse	sol-iris	Sole in Division VIIa (Irish Sea)	Update	assess	XSA
wgcse	nep-11	Nephrops in Division VIa (North Minch, FU 11)	Update	assess trends	Benchmarked
wgcse	nep-12	Nephrops in Division VIa (South Minch, FU 12)	Update	assess trends	Benchmarked
wgcse	nep-13	Nephrops in Division VIa (Firth of Clyde, FU 13)	Update	assess trends	Benchmarked
wgcse	nep-14	Nephrops in Division VIIa (Irish Sea East, FU 14)	No assessment	assess trends	
wgcse	nep-15	Nephrops in Division VIIa (Irish Sea West, FU 15)	Update	assess trends	Benchmarked
wgcse	nep-17	Nephrops in Division VIIb (Aran Grounds, FU 17)	Update	assess trends	Benchmarked
wgcse	nep-19	Nephrops in Division VIIa,g,j (South East & West of IRL, FU 19)	No assessment	assess trends	
wgcse	nep-2022	Nephrops in Division VIIf,g,h (Celtic Sea, FU 20-22)	No assessment	assess trends	
wgcse	nep-7bcj	Nephrops in Division VIIb,c,j,k (Porcupine Bank, FU 16)	No assessment	assess	Status changed
wgcse	ang-ivvi	Anglerfish in Division IIa, IIIa, Subarea IV and VI	Update	assess trends	-
wgcse	meg-scrk	Megrim in Subarea VI (West of Scotland and Rockall)	Update	catch trends	-
wghmm	ang-78ab	Anglerfish in Divisions VIIb-k and VIIIa,b,d	Update	assess trends	-
wghmm	mgw-78	Megrim in Divisions VIIb-k and VIIIa,b,d	Update	survey & cpue trends	-
hawg	her-irls	Herring in Division VIIa South VIIg,h,j,k (Celtic Sea & S. Ireland)	Benchmark	assess trends	ICA
hawg	her-irlw	Herring in Divisions VIa (South) and VIIb,c	Same Advice	assess trends	ICA
hawg	her-nirs	Herring in Division VIIa North of 52° 30' N (Irish Sea)	Same Advice	assess trends	-
hawg	her-vian	Herring in Division VIa (North)	Update	assess	ICA

Most of the stocks that were reviewed are caught in mixed-stock fisheries. Many assessments include mixed-stock considerations, estimate discards, and include them in the stock assessment. However, the treatment of discards varies widely among assessments. The RG recommends that all information on discarded catch should be reported, the magnitude of discards should be estimated or approximated for all fleets, and if the proportion of discards is substantial, discards should be included as a component of catch for the entire assessment series for exploratory analyses and possibly as the basis for fishery management advice. The RG recognizes that estimates of discards for some fleets and in historical periods will be highly uncertain. However, many of the stocks in this group have substantial discards, and retrospective patterns suggest under-reported catch. The RG concludes that including discard approximations may improve the accuracy and consistency of assessments.

The definition of assessment units and management units do not correspond for many stocks in this group. Many management areas include multiple assessment units, such that catch of each assessment unit is not directly managed, because TACs can be taken from any component stock. Assessment and management unit definitions should be re-evaluated to improve the effectiveness of management. Furthermore, stock units should reflect biological stocks within the practical constraints of fishery monitoring and resource surveys for stocks that overlap. Many of the data-poor assessments in this group may benefit from aggregation of management units.

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

Assessment Type: Update

Assessment: Trends

Forecast: Not presented

Assessment method: L. piscatorius and L. budegassa are assessed separately, but advised as a single stock. Currently, there is no accepted analytical assessment for either species in this stock. Assessment of the two species is based on LPUE, survey indices, and length distributions. A benchmark assessment is scheduled for 2012.

Consistency: Stock status is considered to be the same as last year.

Stock Status: Indicators point to the stock being stable. Current stock size (B) and fishing mortality (F), as well as reference points (Blim, Bpa, Flim, and Fpa), were not defined.

Management Plan: There is no explicit management plan in place for this stock. The combined TAC for L. picatorisus and L. budegassa in 2009 is 36,000 t. The ban on gillnets, in place since 2006, continues (at depths > 200m) within subareas VIa,b and VIIb,c,j,k.

General Comments:

- 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. .

Technical Comments:

- The available commercial landings and survey data have been used as specified in the annex. As recommended, no age-based data is used in assessing the stock as there is uncertainty concerning ageing of these species.
- Improvements in the presentation of the data would make the report more easily interpretable. For example: 1) the x-axis of figure 4.2-1 should be revised for clarity and a label indicating units of length measures should be included, 2) the font in Table 4.2-1 and 4.2-2 t should be increased, 3) the y-

axes of figures 4.2-2 and 4.2-3 should be fixed so that they can be clearly read. In Figure 4.2-4 the 1998 graph should be fixed, as well as other annual graphs in which data appears to be cut off due to scaling of the y-axis.

-

Conclusions:

- The LPUE and survey data indicate that biomass of the two species in this stock has been increasing or stable since 2000. The WG concludes that continued fishing at present levels is acceptable. The previous year's RG indicated that they thought the assessment was influenced by the anticipation of a benchmark review (i.e., there was not much comment made on updates of data, due to the expectation that a benchmark review would be performed in the near future). We agree with the previous year's RG comment that a priority should be placed on obtaining accurate age and growth information for these species. Additionally, we recommend that and effort is made to quantify discards, as indicators suggest that discard levels are increasing. Given the uncertainty in basic life history of these species we recommend that a precautionary approach be used in the management of this stock, ICES may want to consider setting TAC at a more conservative level until a benchmark review is completed.
- The ICES advice for anglerfish in Divisions IIa, IIIa and Subareas IV, VI should be considered for this stock. ICES have advised a two-stage approach in order to facilitate future management of this fishery. This approach was a direct result of quality and quantity issues with the available data. The first stage was a data collection stage, designed to improve the data collected by the fishery without increasing exploitation of the stock. The second stage will then use this data to pursue a management plan.

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

Assessment Type: Update.

Assessment: Survey and CPUE trends

Forecast: Presented (forecasts were based on the analytical model in use until 2006, but this is currently not accepted as a valid assessment for this stock).

Assessment method: Currently, there is no accepted analytical assessment for this stock. Assessment of the stock is based on discard data, catch-at-age data, survey indices, and commercial CPUE and LPUE. A benchmark workshop is planned for 2011.

Consistency: Same as last year.

Stock Status: Indicators point to the stock being stable; however some indices give conflicting trends in stock biomass. Current stock size (B) and fishing mortality (F) were not defined. Currently, Flim is 0.44 and Blim Bpa and Fpa are not defined. ICES proposes that Bpa be set to 55 000 t (lowest observed SSB) and Fpa be set at 0.3.

Management Plan: There is no new management advice for this stock in 2009. The TAC for this stock in 2009 is 20,425 t (TAC includes a 5% contribution of L. boscii for which there is no assessment). The minimum landing size of megrim remains at 20 cm (min. size was reduced from 25 to 20 cm in 2000).

General Comments:

- The previous year's RG indicated their concern about "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. The discard ratio (in weight) in this fishery has ranged from 24 to 7% since 1999 and was estimated to be 11% in 2008.
- 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. The French and Spanish surveys are more closely matched, although they diverge in the most recent years. The Spanish survey, however, is not considered a reliable index of abundance due to concerns over performance of gear. The surveys do not overlap, and may reflect spatial heterogeneity in the distribution of megrim within this management unit. 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. In the Biological sampling section there is an ambiguous statement "Mean lengths stay relatively stable in the recent years with a marked decrease in

discards", clarify that there is a marked decrease in the length of discard rather than amount.

Technical Comments:

- The data available on megrim in Divisions VIIb-k and VIIIa,b,d were used as specified in the stock annex. In 2007, the prior analytical assessment (XSA) was found to be unacceptable and the current assessment relies on commercial and survey data. Commercial and survey data present conflicting views on recent trends in biomass, however, because discard data and survey indices do not indicate the presence of strong incoming recruitments or strong decreasing biomass, the WG concludes that the stock appears stable at the present level of fishing.
- An effort should be made to ensure tables and figures are easily interpretable. In general the font in tables and figures should be increased and figure axes should be readable.
- The current assessment does not give a strong basis for issuing advice. More effort is needed in the assessment of trends in biomass for this stock.

Conclusions:

The WG concludes that the stock is stable and continued fishing at present levels is acceptable. The RG contends that this statement should be considered with caution and in the context of the current problems and deficiencies of this assessment. The fact that survey indices and commercial CPUE data are not congruous is worrisome and should be evaluated further. We agree with the WG's stated need for annual estimates of discards. A priority should be placed on obtaining discard data from the French fleet, which in combination with the Spanish fleet report 70% of landings.